ARROWHEAD RADIO AMATEUR CLUB, INC. • DULUTH, MINNESOTA • WØGKP 1929

The RELAY

June 2023

The Official Publication of the Arrowhead Radio Amateur Club
A.R.A.C. Inc. P.O. Box 7164 Duluth MN 55807-7164 http://www.thearac.org Dues: Member $20/Family $25

INDEX

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Summer 2023

Join us on Facebook!

Artificial Intelligence:

Machine Learning & Ham Radio

Artificial Intelligence has been around a long time, assisting us in the form of communications and navigation for the past couple of decades. GPS navigation with interactive speech; ride-hailing apps on your phone; digital assistants Siri, Alexa, or Cortana; autocorrect and auto complete via text or emails; voice recognition and face detection for security, to name just a few.

Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition and machine vision.

IBM puts it this way:
"At its simplest form, artificial intelligence is a field, which combines computer science and robust datasets, to enable problem-solving. It also encompasses sub-fields of machine learning and deep learning, which are frequently mentioned in conjunction with artificial intelligence. These disciplines are comprised of AI algorithms which seek to create expert systems which make predictions or classifications based on input data.

"Over the years, artificial intelligence has gone through many cycles of hype, but even to skeptics, the release of OpenAI's ChatGPT seems to mark a turning point. The last time generative AI loomed this large, the breakthroughs were in computer vision, but now the leap forward is in natural language processing. And it's not just language: Generative models can also learn the grammar of software code, molecules, natural images,

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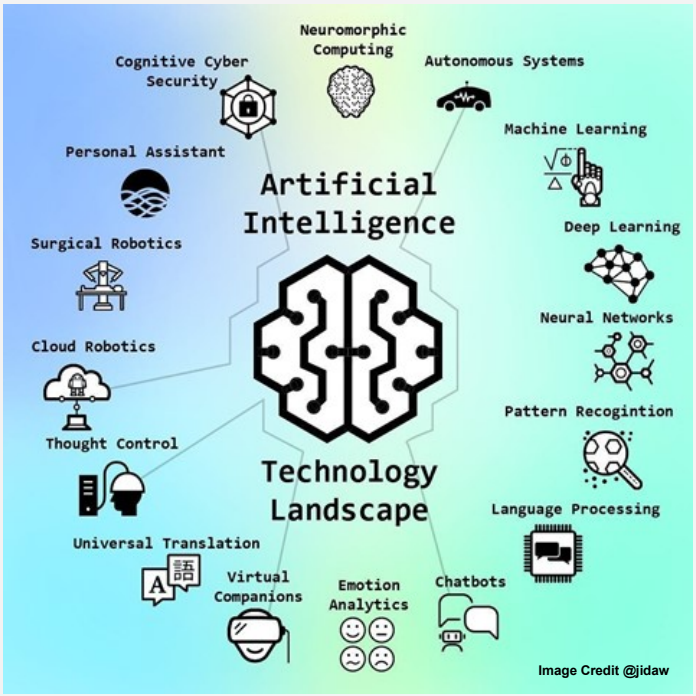


Jide Awe @jidaw posted this AI diagram on Twitter awhile back. All of the AI components illustrated are actively being pursued in R&D or are currently implemented.

Image Credit: LinkedIn.com

ARAC Board Meeting - May 2, 2023

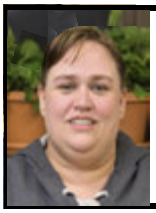
PRESIDENT

NØVRM
Gene Ellefsen
371Ø Chambersburg Ave
Duluth, MN 55811
218-39Ø-3272
lspitech@mail.com

VICE PRESIDENT

KØDJP
David Pyrlik
david.pyrlik@gmail.com

SECRETARY



KFØGJW
Melinda Nelson

TREASURER

KEØYTM
Sam Frey
ke0ytm@gmail.com

3RD YEAR BOARD

AAØAC
Dave Davis
218-348-6649
aaøac@outlook.com

2ND YEAR BOARD

AAØAW
Doug Nelson
aaøaw@arrl.net

1ST YEAR BOARD

WØDIO
Denny Anderson

Present:

Board Members

Gene Ellefsen – N0VRM, Dave Pyrlik – K0DJP, Sam Frey – KC0YTM, Melinda Nelson – KF0GJW, Dave Davis – AA0AC, Doug Nelson - AA0AW

Board Advisors (Non-Board Members)

Randy Wabik –KR0B, Grant Forsyth – KC0WUP, Bob Schulz – KC0NFB

Guest: Jon Nelson – N0UOZ, Robin Davis, Rochelle Nelson

Meeting called to order by President Gene – N0VRM at 18:27 (6:27 pm)

Minutes:

Minutes were sent via email. Motion to approve Doug Nelson – AA0AW. Seconded by Dave Davis – AA0AC, motion passed.

Treasurer's Report:

Checking: $1,476.37
Savings: $1,775.68
Repeater: $3,118.54
Subtotal Cash $6,370.59

Winter CD: $1,736.49
Summer CD: $ 0.00
Subtotal CD: $1,736.49

Assets Subtotal: $7,507.08

Minus Checks Outstanding
1586 $600.00
Checks Subtotal: - $600.00
Grand Total $8,107.08

Motion to approve by Doug Nelson – AA0AW, seconded by Melinda Nelson – KF0GJW, motion passed.

Continued on Page 3

ARAC Board Meeting continued

Testing:
We have 4 preregistered for the HamFest testing session. The new General Testing Pool is out and will go into effect on July 1st. As always if you are looking to test or upgrade, or know of anyone that is interested in testing please contact Doug Nelson at AA0AW@arrl.net

Repeater:
Randy Wabik – KR0B, going to try and get down to Mahtowa to set up the new system and get it on the air. Need to start looking at the 94-site. Noticing that when the wind picks up it is hard to transmit. Get a diagnosis of what is going on with the 94-site. Looking for an estimate to have someone to climb and look at the antenna and the antenna feed line.

HamFest:
- We are up to 58 tables, another 2 tables today.
- Emailed the building management, waiting for the meeting to get the key and give the deposit check.
- Signs to bring in.
- PA System
- Will have white boards and markers, as well as tumble wheels.
- Wrist bands and large ticket for hourly tickets (Will be in multiple colors as we are trying to get rid of the stuff that we already have.)
- Menus printed up.
- Went over the prizes that were donated for the drawings.

New Business:
- Grandma's Marathon – Make sure to sign up or let Doug know if you are not going to be at your spot this year.

Motion to adjourn by Melinda Nelson – KF0GJW, seconded by Sam Frey – KC0YTM, motion passed at 19:11 (7:11 pm)

May 11th, 2023

Present:
President: Gene Ellefsen – N0VRM
Vice President: Dave Pyrlik – K0DJP
Treasurer/Membership: Sam Frey – KE0YTM
Secretary: Melinda Nelson – KF0GJW
First Year Board: Dennis Anderson – W0DIO
Second Year Board: Doug Nelson – AA0AW
Third Year Board: Dave Davis – AA0AC
Special Events: Open/Gene Ellefsen – N0VRM (acting)
Parliamentarian: Grant Forsyth – KC0WUP
Repeater: Dave Pyrlik – K0DJP
Testing: Doug Nelson – AA0AW
Repeater: Randy Wabik – KR0B
Property/Picnic: Scott Ahlgren – N0VYU
HamFest/Education: Bob Schulz – KC0NFB

Absent:
Third Year Board: Dave Davis – AA0AC
Chaplin:
Web Site: Thomas Dorr – KE0RHA
Newsletter/Historian: Kim Waller – KE0NQS
Newsletter/Historian: Steve Waller – KE0NQT

Meeting called to order at 19:03 (7:03 PM) by President Gene Ellefsen – N0VRM. Thirty-eight (38) members in attendance.

Minutes:
Minutes are posted on the website and in the newsletter. Motion to accept by Jon Nelson – N0UOZ. Motion Passed.

Treasurer's Report:
Checking: $1,476.37
Savings: $1,775.68
Repeater: $3,118.54
Subtotal Cash $6,370.59

Winter CD: $1,736.49
Summer CD: $0.00
Subtotal CD: $1,736.49

Assets Subtotal: $8,410.24

Minus Checks Outstanding
1586 $600.00
Checks Subtotal: - $600.00
Grand Total $7,507.08

Motion to accept as presented by Doug Nelson – AA0AW, seconded by Jon Nelson – N0UOZ, motion passed.

Donation to WDSE for $1,200.00. Motion to accept made by Doug Nelson – AA0AW, seconded by Jon Nelson – N0UOZ. Motion passed.

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Grandma's Marathon
Doug Nelson – AA0AW, 5 weeks away. Will be getting ahold of you via phone or email to ensure that you are still able to hold your spot. The password to get signed-up is Ham2023. This will take you to the place you need to sign up for Grandma's Marathon. The meeting on June 8th is about Grandma's Marathon. Will be passing out all information and shirts out at this time as well. Please make sure to be there to get your items.

Testing:
Doug Nelson – AA0AW, if anyone needs testing contact Doug Nelson at AA0AW@ARRL.net and they will test individually. **Do not forget to get your FRN number prior to testing.** You can go to FCC.gov/uls and register. You will also need an email address going forward.

Repeater:
Randy Wabik – KR0B and Dave Pyrlik – K0DJP are going to go up to Channel 8 tomorrow and get things set up so that we can get the 94-site tested to see what is going on with it. A tentative date is set for June 3rd to go to Mahtowa to work on getting the rest of the repeater up on the air and clean the shack up.

New Business:
June Meeting will be about Grandma's Marathon.
Grandma's Marathon password this year is Ham23.

Silent Key: (Please keep their family in your thoughts)

Door Prize was won by Mark Soder – KI0DB, returned to the club.

Motion to adjourn by Bob Schulz – KC0NFB, seconded by Jon Nelson – N0UOZ, motion passed at 19:17 (7:17 PM).

Motion to adjourn by Robin Davis, seconded by Dave Davis – AA0AC, motion passed at 19:30 (7:30 PM).

CLUB REPEATER
WØGKP
146.94 (-)
CTCSS TONE
103.5

Prez Sez ...

Hi Everyone,

June is going to be a very busy Month for the ARAC Club, starting with the Club meeting on Thursday, June 8 - 7:00 pm at the Coppertop Church. The Program for the meeting is Grandma's Marathon. If you are volunteering for the Marathon, please make every effort to attend the meeting as the info packets will be distributed then. The Marathon is on Saturday June 17.

Saturday June 24 and Sunday June 25 is Summer Field Day at Spirit Mountain Parking Lot C. This is the first Parking Lot you come to on your left. Set up will be about 9:30am on Saturday. This happens to also be the Club Breakfast Saturday, so some people might be a little later. We could use set help Saturday morning and the actual event runs from 1:00 pm Saturday to 2:00 pm Sunday. This is a good event to get some HF operating experience for you Hams that have not been able to operate HF. We plan on 4 Stations operating different modes, so that you can see what is out there, and everyone is welcome and operate.

The Club will furnish brats and bottled water, and if you would like to bring a dish to share that would be greatly appreciated. We also need help Sunday for the take down. This is a fun event, so I hope to see a lot of you there!!

73,
Gene Ellefsen NØVRM

LOOKING for an Amateur Radio License TESTING SESSION?

Schedule your own Testing Session TODAY!

Contact Doug Nelson-AA0AW at aa0aw@arrl.net or 218-391-5874

All Exam Candidates are REQUIRED to have an FCC Registration Number (FRN) before exam day, which will require your email address.

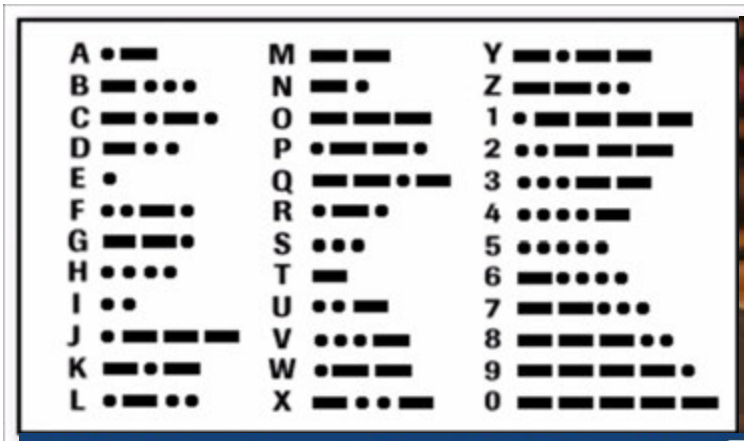
Not Currently Licensed? For New License Candidate FRN registration, go to:
www.fcc.gov/new-users-guide-getting-started-universal-licensing-system-uls

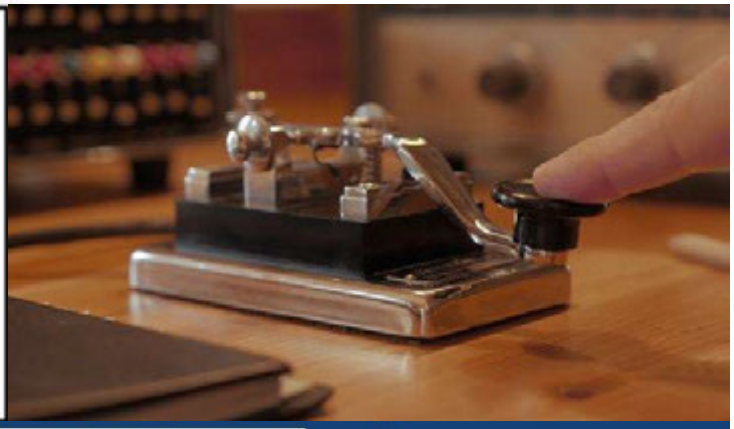
Upgrading to General or Expert Class & not sure you have an FRN number? go to
https://wireless2.fcc.gov/UlsApp/UlsSearch/searchLicense.jsp

UPGRADE CANDIDATES:
Please bring a copy of your current license to the exam session.

CW Abbreviations

AR End of Message	AS Pse QRX	BK Back to You	SK End of Contact
TU Thank You	PSE Please	K Invite to Transmit	
QST Calling all Amateurs	QRL Are You Busy?	QRU Have anything for me	
QRV Are You Ready?	QRX Standby	QRS Transit Slower	





US Amateur Radio Bands

US AMATEUR POWER LIMITS

FCC 97.313 An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.

Effective Date for 2,200 and 630 Meters to be announced

ARRL The national association for AMATEUR RADIO®

On March 28, 2017, the Federal Communications Commission adopted rules that will allow Amateur Radio access to 472-479 kHz (630 meters) and to 135.7-137.8 kHz (2,200 meters). However, amateurs cannot use these frequencies until 30 days after the Report and Order is published in the Federal Register and the final procedures for registering stations with the Utilities Telecoms Council (UTC) have been approved and announced. At the time this chart was created, the Report and Order had not been published and the UTC online registration site is not yet available. Follow ARRL news for further information. New charts will be published at www.arrl.org/graphical-frequency-allocations when the bands are fully available for use.

2,200 Meters (135 kHz)

135.7 kHz — 1 W EIRP maximum — 137.8 kHz; E,A,G

630 Meters (472 kHz)

472 kHz — 479 kHz; E,A,G

5 W EIRP maximum, except in Alaska within 496 miles of Russia where the power limit is 1 W EIRP.

160 Meters (1.8 MHz)

Avoid interference to radiolocation operations from 1.900 to 2.000 MHz

1.800 — 1.900 — 2.000 MHz; E,A,G

80 Meters (3.5 MHz)

3.500 — 3.600 — 3.700 — 4.000 MHz; E, A, G; N,T (200 W); 3.800; 3.525 — 3.600

60 Meters (5.3 MHz)

CW, Dig, USB: 5330.5 — 5332 — 5346.5 — 5348 — 5357.0 — 5358 — 5371.5 — 5373 — 5403.5 — 5405 kHz; 2.8 kHz; E,A,G (100 W)

General, Advanced, and Amateur Extra licensees may operate on these five channels on a secondary basis with a maximum effective radiated power (ERP) of 100 W PEP relative to a half-wave dipole. Permitted operating modes include upper sideband voice (USB), CW, RTTY, PSK31 and other digital modes such as PACTOR III. Only one signal at a time is permitted on any channel.

40 Meters (7 MHz)

7.000 — 7.075 — 7.100 — 7.300 MHz; ITU 1,3 and FCC region 2 west of 130° west or below 20° north; E, A, G; N,T (200 W); 7.175; N,T outside region 2; 7.025 — 7.125

See Sections 97.305(c), 97.307(f)(11) and 97.301(e). These exemptions do not apply to stations in the continental US.

30 Meters (10.1 MHz)

Avoid interference to fixed services outside the US.

200 Watts PEP; E,A,G; 10.100 — 10.150 MHz

20 Meters (14 MHz)

14.000 — 14.150 — 14.350 MHz; E, A, G; 14.175; 14.025 — 14.150 — 14.225

17 Meters (18 MHz)

E,A,G; 18.068 — 18.110 — 18.168 MHz

15 Meters (21 MHz)

21.000 — 21.200 — 21.450 MHz; E, A, G; N,T (200 W); 21.225; 21.025 — 21.275 — 21.200

12 Meters (24 MHz)

E,A,G; 24.890 — 24.930 — 24.990 MHz

10 Meters (28 MHz)

28.000 — 28.300 — 29.700 MHz; E,A,G; N,T (200 W); 28.000 — 28.500

6 Meters (50 MHz)

50.1; E,A,G,T; 50.0 — 54.0 MHz

2 Meters (144 MHz)

144.1; E,A,G,T; 144.0 — 148.0 MHz

1.25 Meters (222 MHz)

E,A,G,T; N (25 W); 219.0 — 220.0 — 222.0 — 225.0 MHz

*Geographical and power restrictions may apply to all bands above 420 MHz. See *The ARRL Operating Manual* for information about your area.

70 cm (420 MHz)*

E,A,G,T; 420.0 — 450.0 MHz

33 cm (902 MHz)*

E,A,G,T; 902.0 — 928.0 MHz

23 cm (1240 MHz)*

1240 — 1300 MHz; E,A,G,T; N (5 W); 1270 — 1295

All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz ‡	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

‡ No pulse emissions

KEY

Note:

CW operation is permitted throughout all amateur bands.

MCW is authorized above 50.1 MHz, except for 144.0-144.1 and 219-220 MHz.

Test transmissions are authorized above 51 MHz, except for 219-220 MHz

= RTTY and data
= phone and image
= CW *only*
= SSB phone
= USB phone, CW, RTTY, and data
= Fixed digital message forwarding systems *only*

E = Amateur Extra
A = Advanced
G = General
T = Technician
N = Novice

See *ARRLWeb* at www.arrl.org for detailed band plans.

ARRL
We're At Your Service

ARRL Headquarters:
860-594-0200 (Fax 860-594-0259)
email: hq@arrl.org

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email: orders@arrl.org

Membership/Circulation Desk:
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email: membership@arrl.org

Getting Started in Amateur Radio:
Toll-Free 1-800-326-3942 (860-594-0355)
email: newham@arrl.org

Exams: 860-594-0300 email: vec@arrl.org

NETS

Have a favorite HF/6m/2m/1.25m/7Øcm net that you check into or listen in on? Also, please send corrections and we will add it to the list below - Kim KEØNQS at my email KEØNQS.mn@gmail.com.

- **Northland Weather Group Net:** Mondays 2ØØØ on the ARAC repeater (146.940 MHz with a tone of 103.5 and standard offset).
- **Minnesota D-Star Net:** Sundays at 19:3Ø on Reflector 53A
- **Minnesota Section Net** 12ØØ and 173Ø on 3.86Ø [Net Manager: NØYR] http://www.mn-section.org/dept_stm.html
- The non-non-net: Evenings 2ØØØ 144.2ØØ USB except for Sunday evenings.
- Badger WX Net: Ø5ØØ-Ø715 on 3.985. Give 24 hour high/low/current temperature, precipitation and snowfall.
- **PICONET**: 3.925 from Ø9ØØ-11ØØ CT Mon-Sat and 16ØØ-17ØØ CT Mon-Fri. Info at: http://www.piconet3925.com
- Michigan Upper Peninsula Net: 16ØØ (CST) on 3.921 MHz Sun-Sat and 12ØØ Sun. Info: http://www.michupnet.com
- Great Lakes Marine/Maritime Mobile Net: Morning Ø7:3Ø - 3.932; Ø8:15 - 7.261 MHz and evening 18:3Ø - 3.173Ø927; 19:15 - 7.268 MHz. Weekend extra net: 1Ø:ØØ - 7.261/7.268 MHz. All CST, LSB and +/- QRM. See: http://www.sailblogs.com/member/glmmnet/
- MIDCARS: Ø7:3Ø-13:ØØ - 7.258 MHz. See: http://www.midcars.net
- Iowa snowbird net on 14.257MHz, M-W-F at 1Ø:ØØ am Local Time. This is an open net.
- Spider Web Net (Marco Island FL) on 14.347 every morning at Ø73Ø CST/CDT: http://www.spiderwebnet.net
- Maritime Mobile Service Network: Daily at 11ØØ—21ØØ Central on 14.3ØØ. http://mmsn.org and http://www.143ØØ.net
- RV Radio Network: Every day at 19ØØ Central on 7.265 MHz. Web site: http://www.rvradionetwork.com
- Upper Midwest Ten Meter Net: Every Thursday Evening @ 8 PM – 28.48Ø MHz USB
- Wisconsin Sideband Net: Daily @ 5:15 PM – 3985 [or 3982.5] KHz LSB
- Hobby Helpers Net - Tuesday @ 8 PM – 28.33Ø MHz USB (Isanti MN) LSB [Net Manager: WOØA].
- Northstar Trader Net: 3.9Ø8 +/- at Ø83Ø CST Sundays
- WARFA: 3.9Ø8 +/- Sun/Tue/Thu nights at 22ØØ CST, http://warfa.org/
- Youth Net: 14.32Ø-1433Ø Sundays 18ØØ-19ØØ UTC, Net Control: AC8PI
- YACHT: Saturdays 19ØØ CST on EchoLink #481872, http://yachthams.webstarts.com
- Northwestern Ontario ARES Net: Evenings at 2Ø:15 (Central) on +/- 3.75ØMhz
- The Iron Range Net: Saturdays at Ø8ØØ Central time on or near 3.919 Mhz. Look them up on Facebook!
- FORX Net: Mondays at 19ØØ Central at 3.941 Mhz +/- QRM. WAØJXT — Grand Forks, North Dakota
- HF CW: Fridays Ø8:ØØ CST, 7.112 MHz. Informal slow speed CW Net. W8IRT NCS. Email: w8irt@aol.com
- Minnesota ARES Digital Net: Thursdays at 2ØØØ CST, 3.5835 MHz USB +/- QRM, Mode: Olivia 8/5ØØ.
- SARA Digital Net: Sundays at 19ØØ Local, 3.582.15Ø MHz USB +/- QRM, Mode: BPSK31/BPSK63
- Spider Web Net (Marco Island FL): 14.347 every morning at Ø73Ø CST/CDT: http://www.spiderwebnet.net
- Broadcaster Net: 7.231 or 3.855 M/W/F @ 15ØØ UTC. 14.255 M-F @ 213Ø UTC. http://www.cbsretirees.com/ham.htm
- Old Military Radio Net: 7.268 +/- nightly at Ø2ØØz. Other times/Frequencies too. See: http://www.mrca.ar88.net/
- Rag Chew Crew/Tailgaters/Freewheelers Nets: 3.916 +/- nightly at 19ØØ CST, http://www.tailgatersnet.com
- North South Net: 7.214.6 +/- at Ø7ØØ CST, Monday-Saturday

DULUTH AREA REPEATERS

ARAC System WØGKP

Frequency	Offset	Tone	Location
146.940	minus	103.5	Duluth
146.940	minus	107.2	Lakeside (recv)
146.940	minus	151.4	Two Harbors (recv)
146.940	minus	100.0	Gary-New Duluth (recv)
146.940	minus	110.9	Cloquet (recv)
147.000	minus	103.5	Mahtowa
444.100	plus	103.5	Duluth UHF Link

N9MMU/N9QWH System (WI)

145.310	minus	110.9	Duluth
145.490	minus	110.9	Solon Springs
147.255	plus	110.9	Hayward
145.110	minus	110.9	Rice Lake
147.345	minus	136.5	Holcombe
145.230	minus	110.9	Eau Claire

WECOMM – WI Statewide Linked System WE9COM

147.075	plus	110.9	Meteor Hill (closest repeater to Duluth)

LSAC System # 1

147.330	plus	151.4	Proctor
147.330	plus	103.5	Duluth (recv for Proctor)
147.270	plus	114.8	Two Harbors
147.270	plus	103.5	Wales
147.090	plus	114.8	Silver Bay
145.410	minus	114.8	Finland
147.300	plus	114.8	Isabella
145.150	minus	103.5	Washburn, WI
146.700	minus	103.5	Bayfield, WI
443.850	+5.00	none	Bayfield, WI
147.165	plus	110.9	Hurley, WI
146.640	minus	151.4	Ely
443.500	+5.00	141.3	Gilbert
147.060	plus	103.5	Virginia
147.360	plus	162.2	Cook
147.165	plus	114.8	Coleraine
443.925	+5.00	110.9	Brainerd
443.200	+5.00	114.8	Tamarack
147.360	plus	203.5	Aitkin
146.865	minus	146.2	Giese
147.570	simplex	146.2	Hinckley
444.575	+5.00	146.2	Hinckley
443.325	+5.00	146.2	Isanti

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DULUTH AREA REPEATERS, continued

NARC System NAØRC

147.135 plus 103.5 Knife River
145.450 minus 114.8 Park Point (rcv)
147.135 plus 114.8 Knife River - Park Point (rcv)

Stand Alone Repeaters

145.210 minus 110.9 Clam Lake, WI
146.880 minus 123.0 Grand Rapids, MN
146.910 minus 146.2 Duxbury, MN
146.955 minus 146.2 Askov, MN
147.105 plus 110.9 Chaffey, WI
444.850 +5.00 141.3 Cloquet, MN

Fusion

Fusion **(**Analog has tone and C4FM digital with no tone)

147.150 plus 151.4 NTØB Gilbert. MN Fusion Repeater
145.170 minus 110.9 WA9KLM Superior, WI – Douglas County RACES/ARES Fusion Repeater (Digital only) Fusion Room 28373

145.250 minus 103.5 KBØYHX Cloquet, MN – Carlton County RACES/ARES Fusion Repeater

444.300 +5.00 103.5 NØEO Duluth, MN – Spirit Valley Amateurs Fusion Repeater WIRES-X NØEO (Analog only) Fusion Room 40494

444.400 +5.00 103.5 NAØRC Knife River, MN – Wires X Connected to NØEO Room 40494
444.500 +5.00 103.5 NØLCR Two Harbors, MN – Wires X Connected to NØEO Room 40494
444.600 +5.00 103.5 NØLCR Silver Bay, MN – Wires X Connected to NØEO Room 40494
444.800 +5.00 103.5 NØLCR Grand Marais, MN – Wires X Connected to NØEO Room 40494

D-Star

147.375 plus NØEO D Star
442.200 plus NØEO D Star

Rev. KCØWDQ as of 10/1/22 For ARAC Newsletter

Elmers

El-mer / ɛl-mər/ [el-mer]
1. a male given name: from Old English words meaning “noble” and “famous.”
2. an adhesive used to bond like or unlike materials
3. An experienced ham radio operator who mentors new and prospective hams.

Name	Call Sign	Expertise
Jeff Nast	KCØMKS	APRS, EchoLink, WinLink, Fusion, Contesting
Bob Schulz	KCØNFB	Contesting
Jim Anderson	NØJWA	QsoNet
Doug Nelson	AAØAW	HF, VHF/UHF, Contesting, Packet, APRS, Morse Code, VE testing, Echolink, Allstar, EmCom…

UPCOMING EVENTS

Next ARAC Board Meeting

Tuesday, June 6, 2Ø23
@ 6:30 p.m.
Sammy's Pizza - Spirit Valley

Next ARAC Club Meeting

Thursday, June 8th
7 p.m.
Coppertop Church!

Program:
All the latest key updates on Grandma's Marathon

Doug Nelson
AA0AW

A Must-See Program for All Grandma's Marathon Volunteers!

ARRL FIELD DAY

ARRL Field Day is the most popular on-the-air event held annually in the US and Canada. On the fourth weekend of June, more than 35,000 radio amateurs gather with their clubs, groups or simply with friends to operate from remote locations.

ARAC FIELD DAY Details

BEGINS:
Saturday, JUNE 24 at 1 pm

ENDS:
Sunday, JUNE 25 at 2 pm

- **We need set-up help on Saturday at 9:30 am!**
- **Tear-down help on Sunday is appreciated!**
- **Brats and bottled water provided by the Club.**
- **Grateful to all who can also bring a dish to share :)**

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Members, please check your name and email address for accuracy. If you are not on this list and want to be on the list, contact us with your info. If you need to make a change, please let us know at KEØNQS.mn@gmail.com OR KEØNQT@gmail.com

SUNDAY NIGHT NETS
193Ø - **CW - 28.125 MHz USB-CW**
2ØØØ -**USB 28.45Ø MHz**
21ØØ - **Southern St. Louis County Emergency Services Net**
MONDAY NIGHT NETS
2ØØØ- **Northland WX Net -** ARAC Repeater

JUNE
CLUB EVENTS

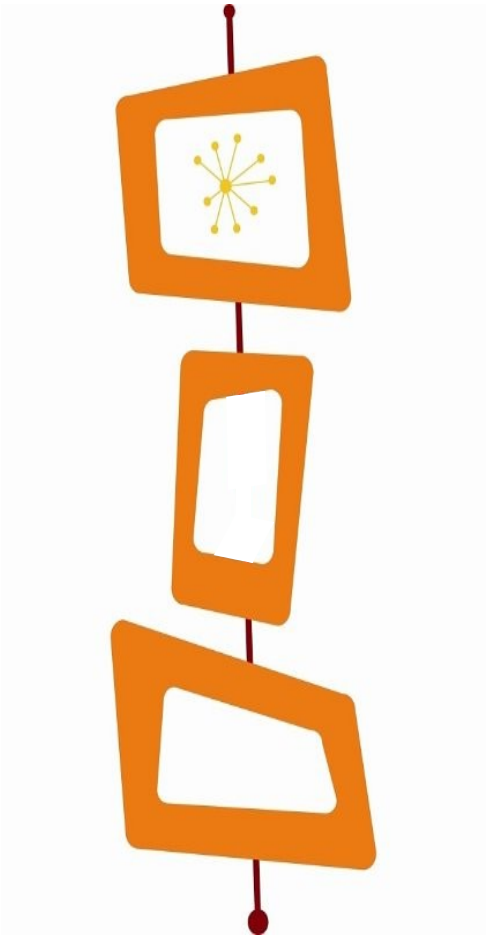
TUESDAY NIGHT NETS
2ØØØ -**Douglas Cty 145.49Ø MHz**
2Ø3Ø -**Central Carlton County**
WEDNESDAY NIGHT NETS
19ØØ -**Lake County - LSAC1**
2nd & 4th Wednesdays
21ØØ -**BWAR**

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4 CW 1930 NØPDG USB 2000 NØPDG ES 2100 KCØWDQ	5 WX 2000 KCØMKS	6 ARAC BOARD MEETING Sammy's Pizza 6:30 pm DC Net 2000 CC Net 2030	7 21ØØ -**BWAR**	8 ARAC Club Meeting Coppertop Church 7:00 PM	9	10
11 CW 1930 AAØAW USB 2000 AAØAW ES 2100 WØNWO	12 DC ARES/ RACES Mtg 1900 DC EOC WX 2000 KCØMKS	13 DC Net 2000 CC Net 2030	14 Lake County ARES/RACES Meeting 1800 Lake County Net 1900 21ØØ -**BWAR**	15	16	17 Grandma's Marathon
18 Happy Father's Day! CW 1930 NØPDG USB 2000 KB9WLB ES 2100 NØVRM	19 WX 2000 KCØMKS	20 DC Net 2000 CC Net 2030	21 St Louis County ARES/RACES Meeting 1800 21ØØ -**BWAR**	22 Carlton County ARES/RACES Meeting 1900 CC EOC	23	24 ARAC Club Breakfast 8 AM Field Day 1 PM Spirit Mtn Lot C
25 Field Day Ends at 2 PM Spirit Mtn Lot C CW 1930 AAØAW USB 2000 K9KDK ES 2100 KEØYTM	26 WX 2000 KCØMKS	27 DC Net 2000 CC Net 2030	28 Lake County Net 1900 21ØØ -**BWAR**	29	30	

Get this newsletter *faster* via email!
Email Doug AAØAW at
aaØaw@arrl.net

Next Club Meeting:
Thursday,
June 8th, 2023 - 7 pm
at the Coppertop Church!

ARAC Committee Chairs



Club License Trustee:
Ray Barnes KEØZN

Control Operators:
AAØAW - NØKXT - KCØNFB

Newsletter/Historian:
Kim KEØNQS & Steve KEØNQT Waller

Education Chair:
Bob Schulz KCØNFB

Hamfest Chair:
Bob Schulz KCØNFB

Chaplain:
Rollie Bockbader KBØCK

Visiting Chaplain:

Parliamentarian:
Grant Forsyth KCØWUP

Website:
Thomas Dorr KEØRHA

Membership:
Sam Frey KEØYTM

Property Chair:
Scott Ahlgren NØVYU

Testing:
Doug Nelson AAØAW

Field Day:

Picnic Chair:
Scott Ahlgren, NØVYU

Repeater Chairs:
Randy Haglin NØBZZ
Randy Wabik KAØJZV

Contest Calendar at www.contestcalendar.com

National Contest Journal at www.ncjweb.com

QSO Party Note: State/Province/National QSO Parties are abbreviated with the 2 or 3 letter abbreviation for the state/province/national designation followed by QP for QSO Party:

Examples: Minnesota QSO Party is MNQP
British Columbia QSO Party = BCQP

QRZ web site at www.qrz.com
VHF Propagation site at www.aprs.mountainlake.k12.mn.us

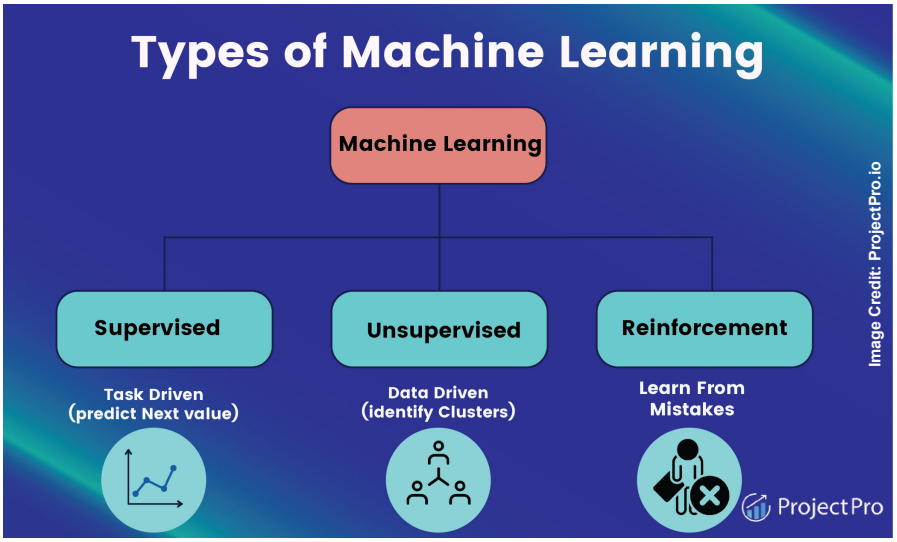
Reminder: The Contest Corral monthly listing of contests can be found in each issue of QST. ARRL sponsored contests can be found in Contest Corral, highlighted, or on the ARRL's web site at arrl.org.

and a variety of other data types."

So what is Machine Learning? MIT Sloan School of Management explains:
"Machine learning is behind chatbots and predictive text, language translation apps, the shows Netflix suggests to you, and how your social media feeds are presented. It powers autonomous vehicles and machines that can diagnose medical conditions based on images.

"When companies today deploy artificial intelligence programs, they are most likely using machine learning — so much so that the terms are often used interchangeably, and sometimes ambiguously. Machine learning is a subfield of artificial intelligence that gives computers the ability to learn without explicitly being programmed.

"In just the last five or 10 years, machine learning has become a critical way, arguably the most important way, most parts of AI are done," said MIT Sloan professor Thomas W. Malone, the founding director of the MIT Center for Collective Intelligence. "So that's why some people use the terms AI and machine learning almost as synonymous … most of the current advances in AI have involved machine learning."



Project Pro is a company that makes AI project templates for software developers, whether they're experts or beginners. Pictured here is a basic diagram of machine learning types. They say, "We are building the world's largest end-to-end software projects platform with 100,000 project solutions. We help you get your work done faster and get practical experience by providing verified, reusable, project templates from industry experts"

So how does Artificial Intelligence Machine Learning (AIML) affect ham radio now and in the future? First of all, the quality of noise reduction AND enhancing the sound of human voice transmissions for human ears. Many people in the amateur radio community, especially younger hams, see this technological progress in ham radio equipment as helpful —and necessary—to the hobby. Several technologies exist to this end, and they will continue to become more cost efficient for companies to build into moderate-priced radios.

In a recent post to **KB6NU's Ham Radio Blog**, **Dave New N8SBE** speaks to AI technology originally developed for military becoming cost effective for ham radio equipment:

"There have been adaptive receiver systems, that figure out what modulation is being transmitted, and automatically adopt to it. It's been widely used in pricey military monitoring systems, but as the price of the required computation comes down, it will eventually end up in commercial and then amateur systems."

KB6NU's Ham Radio Blog is posted by **Dan Romanchik KB6NU** of Ann Arbor MI, and always has interesting content. Last December, Dan mentioned that he had read an article called "***Bleeding Edge Tech-Filtering with Neural Networks*".** The article asked "Can the noise of received HF transmissions be removed using AI?" Romanchik reported that **Kurt Zoglmann AD0WE** of **Morse Code Ninja** commented, saying, "Yes! The amateur radio community could create a version of DeepFilterNet that is user-friendly for amateur radio operators and has all the knobs to tweak its performance in real-time. It requires modest hardware for real-time filtering."

Hams are also getting creative with current AI applications used in "home-grown" ham radio experiments.

A few months ago, a young ham named **Billy Penley KN4MKB** wrote about a project he did on his website **TheModernHam.com**. Also a YouTuber (**Modern Ham** is his handle), Penley shares his full project in a video for those interested at https://www.youtube.com/watch?v=E7AAhJtk-o

Penley writes, "Noise Suppression AI and Ham Radio. A Perfect Mix? I was tweaking some setting with my microphone and had a crazy thought. Why don't we use the same software used in content production to reduce noise on amateur radio? Sure, modern radios come with some built in digital noise reduction, but nothing compares to what is on the market for PCs these days. So I sought out to combine Noise Suppression AI and ham radio to see how much sound quality can be had."

In the overview of how it was done, Penley says, "We must first pipe our radio audio into our computer. This ob-

Continued on Page 16

viously varies between each radio on how it can be done, but the simplest method is connecting a wire between your radio speaker out, and computer microphone in. Special care must be taken not to overload your computers **sound-card.** Turn your radio audio way down before connecting the two if you proceed with this manner. After this, its just a matter of enabling "Listen Mode" on the audio device on Windows."

Be sure to watch Penley's YouTube video for all the details. He concludes, "There's nothing that can replace the human ear when it comes to digging sounds out of static (at this point anyways). What this technology can do however, is make the listening experience much more enjoyable for those stations with decent signals. What I would love to see in the future is this technology being incorporated into modern radios. The biggest limitation at this point is the lack of processing power in the radios themselves. But maybe in the future (probably the distant one) we can see some partnership between these companies to bring tailored noise reduction to amateur radio."

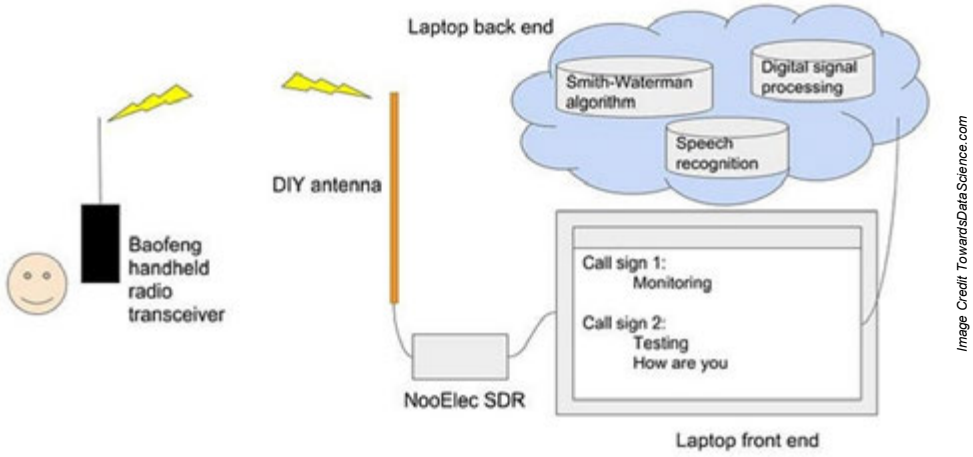
Here's another interesting approach, demonstrating that simple projects like this reflect how current and next generation hams will evolve the hobby, rather than having it become obsolete, as many fear:

Chris at **TowardsDataScience.com** did a project on building a speech recognition system for amateur radio communication. You can read the full article here:
https://towardsdatascience.com/make-amateur-radio-cool-again-said-mr-artificial-intelligence-36cb32978fb2

Chris says, "I speak to a Baofeng handheld radio transceiver, the DIY antenna picks up the radio wave, SDR demodulates the radio signal to standard audio signal, Google speech-to-text performs the speech recognition, Smith-Waterman algorithm performs sequence alignment to find the most probable call sign in a database and AJAX is used in a local httpserver to output the text. The system diagram is shown below:"

Chris reported that this basic project successfully finds the most probable call sign from a database and captures the message "monitoring".

He ends his project report with these comments: "…people say that amateur radio is a dying hobby…there are many interesting things one can do with it, especially when it is combined with more recent technology (like Artificial Intelligence). So, I decided to work on this project and share it with you all. I hope you find it fun."



System diagram for the voice recognition system for amateur radio communication

Hams are also talking about "cognitive radio" and the fact that Machine Learning will inevitably influence the way we utilize bands. Last Fall **Michelle Thompson W5NYV** gave an in-depth presentation at **QSO Today Virtual Ham Expo**. View the full presentation on YouTube video at https://youtu.be/-ojTlFECrSY , but here's an excerpt:

"What does the future of amateur radio look like when radios use Machine Learning to operate? How does our relationship to the bands change with cognitive radio? Where are we in this transformation? And what will happen next?

"First, the fun part:

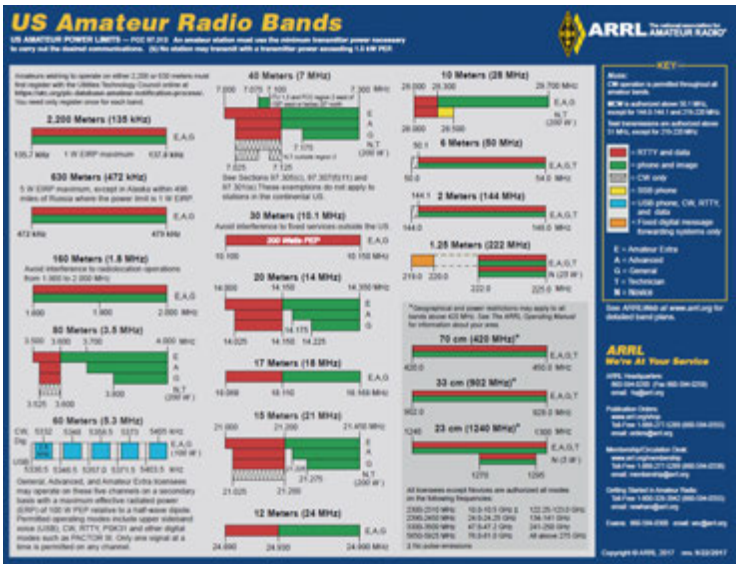
Machine Learning lets us identify the signals on the air nearly instantaneously. We can monitor all the bands, all the time. We can know when our friends are online, what's hot for a contest, or spot rare DX, the instant the call sign is transmitted. We can build a database of contacts and analyze who talks to who, and when. We can predict with a very high degree of accuracy, who is going to be on a satellite pass or who is available during an opening. We can use machine learning to figure out if that tropospheric duct during the summer is likely or not on a particular Saturday. We can analyze log books and get a lot of insight into how to win the next CQ worldwide. Being able to know things that we didn't know before is a hallmark of Machine Learning. Artificial Intelligence Machine Learning doesn't create information. It reveals what the information might be able to tell us, much faster than a human could...It is also something that any competent radio operator in the future needs to know about. We are accustomed to a world where frequency privileges

Continued on Page 17

for the various radio services are coordinated like real estate. We are given permission to build our systems on stretches of bandwidth. Once we are there, we usually end up with something that looks a lot like land ownership. The property limits are set down and our access is described, with a set of rules that cover things like channelization, power limits, interference, constraints, and so on.

"When you look at a frequency allocation chart, it looks very much like a densely packed urban landscape With lots of mixed use development. but bandwidth is not dirt. The systems that we built aren't permanent in terms of the radio frequencies at all. The capital expenditures for towers, and base stations and receiver handsets, and radios etc., are certainly expensive and quite often involve actual real estate investment, sometimes very contentiously, if you have ever been involved with a dispute over tower placement. But the signals broadcast over the airwaves are completely ephemeral. With reconfigurable or adaptive radios, we can break free of the rigidly restrictive planned nature of spectrum management. The benefits of being able to re-deploy entire wireless communication systems dynamically it improves the use of spectrum and dramatically increase his revenue. And something specifically important to the FCC, it contributes toward US competitiveness.

"So let's pretend spectrum was handled exactly like real estate. Let's say we own a restaurant. Our restaurant is open during the day and closed at night. What if that restaurant could be turned into a completely different business, overnight, on demand, like extra housing when there's a concert or game in town. What if, instead of being a restaurant every day, it could be an urgent care clinic on days of high demand for healthcare.



"While we can't do a trick like this for brick and mortar buildings, we are at a point where we are starting to be able to do this for wireless communication systems. Artificial intelligence Machine Learning is central in adaptive communications. AIML will be at least as eruptive a technology as the transistor. It is here to stay and amateur radio will be affected. There will be positive affects, and negative affects. To get more of the former, and less of the latter, it's up to us and how we respond to this very large technological change.

"So what is this adaptive radio frequency technology all about?

"The biggest bang for the buck is being able to break free from the band with constraints. This means for many communications systems, transmissions will not be associated strictly with a band. The ***function*** of the communication will drive the form much more than it does today.

"Band width is the frequency or span of frequencies used for a particular communication's function. Bandwidth is also widely used to mean the ***rate of data delivered through a system***. Data rate or throughput is closely related to—and limited by—the occupied frequency range of the channel, service or transmission. But these two terms are not really synonymous. So when we talk about the frequency range occupied by a signal, we should use **bandwidth**. And when we talk about the amount of data used by a signal per unit of time, we should probably use **throughput**. Bandwith, along with the signal-to-noise ratio, determines how close we are to achieving something called **channel capacity**.

"AIML serves a big role in optimizing forward error correction codes. The channel capacity limits our ability to detect and correct errors in digital signals. It's a limitation that is related to the physics of entropy. Due to decades of productive work, there are a variety of error-correcting codes that produce spectral efficiencies—and therefore throughput—very close to the channel capacity limit. Two examples of very high performance codes are polar codes, used terrestrially in 5G, and LDPC codes used in space within DBBS2 and S2x Protocols.

"One vision of cognitive radio is that radios will understand the environment dynamically and automatically change their parameters. They will learn from that experience. And the radio will experiment with new configurations. This is supposed to help the humans that use the radio. Dynamic spectrum allocation and high performance cognitive radio have a desired destination. Reconfigurable radios that perfectly fill in a sea of noise floor with efficient and coordinated digital signals. To do this we need to be able to sense the spectrum. And it is believed that we will need to have access to some sort of spectrum or operator database. Spectrum sharing increases utility and usability. A future amateur operator may not think of operation in terms of which band they're on at all. Spectrum access would be whatever is currently available, with the radio coordinating access and picking a frequency without any traditional band limitations, or identity. Instead of a waterfall and spectrum display, the ideal user interface of the future may be a set of channel metrics, or a network graph for who you can reach. [In that scenario, AIML would be] a fundamental part of the cognitive radio future."

Very interesting comments from **Michelle Thompson W5NYV**, though understandably off-putting to some hams. She's quite right that the future of cognitive ham radio is up to the amateur radio community. It is very important that we listen, ask questions and understand the technological horizon that affects our hobby and discuss it with each other. We need to hear input from younger hams and keep them engaged by sharing our insights and opinions, while listening and respecting their perspectives. Actually, our hobby was born out of young people assembling their own radio sets on the cutting edge of what technology could do at the time. And through the last 100+ years, each generation of amateur radio operators has adapted and adjusted to utilize new technologies as they arose. We can have confidence that moving forward, the hobby of ham radio may look different than when we began, but the future of amateur radio is still very bright indeed.★

Contest Calendar - June 2023

+ Walk for the Bacon QRP Contest	0000Z-0100Z, Jun 1 and 0200Z-0300Z, Jun 2
+ CWops Test	0300Z-0400Z, Jun 1
+ CWops Test	0700Z-0800Z, Jun 1
+ NRAU 10m Activity Contest	1700Z-1800Z, Jun 1 (CW) and 1800Z-1900Z, Jun 1 (SSB) and 1900Z-2000Z, Jun 1 (FM) and 2000Z-2100Z, Jun 1 (Dig)
+ SKCC Sprint Europe	2000Z-2200Z, Jun 1
+ PODXS 070 Club Three Day Weekend Contest	0000Z, Jun 2 to 2359Z, Jun 4
+ NCCC FT4 Sprint	0100Z-0130Z, Jun 2
+ NCCC RTTY Sprint	0145Z-0215Z, Jun 2
+ NCCC Sprint	0230Z-0300Z, Jun 2
+ HA3NS Sprint Memorial Contest	1900Z-1929Z, Jun 2 (40m) and 1930Z-1959Z, Jun 2 (80m)
+ K1USN Slow Speed Test	2000Z-2100Z, Jun 2
+ 10-10 Int. Open Season PSK Contest	0000Z, Jun 3 to 2400Z, Jun 4
+ PVRC Reunion	0000Z-0159Z, Jun 3 and 0000Z-0159Z, Jun 4
+ Tisza Cup CW Contest	0200Z-1459Z, Jun 3
+ KANHAM Contest	0600Z, Jun 3 to 0600Z, Jun 4
+ Wake-Up! QRP Sprint	0600Z-0629Z, Jun 3 and 0630Z-0659Z, Jun 3 and 0700Z-0729Z, Jun 3 and 0730Z-0800Z, Jun 3
+ Kentucky QSO Party	1300Z, June 3 to 0100Z, Jun 4
+ UKSMG Summer Contest	1300Z, Jun 3 to 1300Z, Jun 4
+ RSGB National Field Day	1500Z, Jun 3 to 1500Z, Jun 4
+ IARU Region 1 Field Day, CW	1500Z, Jun 3 to 1459Z, Jun 4
+ ARRL Inter. Digital Contest	1800Z, Jun 3 to 2400Z, Jun 4
+ K1USN Slow Speed Test	0000Z-0100Z, Jun 5
+ ICWC Medium Speed Test	1300Z-1400Z, Jun 5

Continued on Page 19

Contest Calendar - June 2023

+ OK1WC Memorial	1630Z-1729Z, Jun 5
+ ICWC Medium Speed Test	1900Z-2000Z, Jun 5
+ RSGB 80m Club Championship, Data	1900Z-2030Z, Jun 5
+ Worldwide Sideband Activity Contest	0100Z-0159Z, Jun 6
+ ARS Spartan Sprint	0100Z-0300Z, Jun 6
+ ICWC Medium Speed Test	0300Z-0400Z, Jun 6
+ Phone Weekly Test	0230Z-0300Z, Jun 7
+ A1Club AWT	1200Z-1300Z, Jun 7
+ CWops Test	1300Z-1400Z, Jun 7
+ Mini-Test 40	1700Z-1759Z, Jun 7
+ VHF-UHF FT8 Activity Contest	1700Z-2100Z, Jun 7
+ Mini-Test 80	1800Z-1859Z, Jun 7
+ CWops Test	1900Z-2000Z, Jun 7
+ CWops Test	0300Z-0400Z, Jun 8
+ CWops Test	0700Z-0800Z, Jun 8
+ EACW Meeting	1900Z-2000Z, Jun 8
+ NCCC FT4 Sprint	0100Z-0130Z, Jun 9
+ NCCC RTTY Sprint	0145Z-0215Z, Jun 9
+ NCCC Sprint	0230Z-0300Z, Jun 9
+ K1USN Slow Speed Test	2000Z-2100Z, Jun 9
+ VK Shires Contest	0000Z-2359Z, Jun 10
+ Asia-Pacific Sprint, SSB	1100Z-1300Z, Jun 10
+ Portugal Day Contest	1200Z, Jun 10 to 1200Z, Jun 11
+ SKCC Weekend Sprintathon	1200Z, Jun 10 to 2400Z, Jun 11
+ AGCW VHF/UHF Contest	1400Z-1700Z, Jun 10 (144) and 1700Z-1800Z, Jun 10 (432)
+ GACW WWSA CW DX Contest	1500Z, Jun 10 to 1500Z, Jun 11
+ REF DDFM 6m Contest	1600Z, Jun 10 to 1600Z, Jun 11
+ ARRL June VHF Contest	1800Z, Jun 10 to 0259Z, Jun 12
+ Cookie Crumble QRP Contest	1700Z-2200Z, Jun 11
+ K1USN Slow Speed Test	0000Z-0100Z, Jun 12
+ 4 States QRP Group Second Sunday Sprint	0000Z-0200Z, Jun 12

Continued on Page 20

Contest Calendar - June 2023

+ ICWC Medium Speed Test	1300Z-1400Z, Jun 12
+ OK1WC Memorial	1630Z-1729Z, Jun 12
+ ICWC Medium Speed Test	1900Z-2000Z, Jun 12
+ Worldwide Sideband Activity Contest	0100Z-0159Z, Jun 13
+ ICWC Medium Speed Test	0300Z-0400Z, Jun 13
+ NAQCC CW Sprint	0030Z-0230Z, Jun 14
+ Phone Weekly Test	0230Z-0300Z, Jun 14
+ A1Club AWT	1200Z-1300Z, Jun 14
+ CWops Test	1300Z-1400Z, Jun 14
+ Mini-Test 40	1700Z-1759Z, Jun 14
+ VHF-UHF FT8 Activity Contest	1700Z-2100Z, Jun 14
+ Mini-Test 80	1800Z-1859Z, Jun 14
+ CWops Test	1900Z-2000Z, Jun 14
+ RSGB 80m Club Championship, CW	1900Z-2030Z, Jun 14
+ Walk for the Bacon QRP Contest	0000Z-0100Z, Jun 15 and 0200Z-0300Z, Jun 16
+ CWops Test	0300Z-0400Z, Jun 15
+ CWops Test	0700Z-0800Z, Jun 15
+ NTC QSO Party	1900Z-2000Z, Jun 15
+ NCCC FT4 Sprint	0100Z-0130Z, Jun 16
+ NCCC RTTY Sprint	0145Z-0215Z, Jun 16
+ NCCC Sprint	0230Z-0300Z, Jun 16
+ SARL Youth QSO Party	1200Z-1300Z, Jun 16
+ K1USN Slow Speed Test	2000Z-2100Z, Jun 16
+ SMIRK Contest	0000Z, Jun 17 to 2400Z, Jun 18
+ Pajajaran Bogor DX Contest	0000Z-2359Z, Jun 17
+ All Asian DX Contest, CW	0000Z, Jun 17 to 2400Z, Jun 18
+ IARU Region 1 50 MHz Contest	1400Z, Jun 17 to 1400Z, Jun 18
+ Stew Perry Topband Challenge	1500Z, Jun 17 to 1500Z, Jun 18
+ West Virginia QSO Party	1600Z, Jun 17 to 0400Z, Jun 18
+ ARRL Kids Day	1800Z-2359Z, Jun 17
+ Feld Hell Sprint	1800Z-1959Z, Jun 17

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+ WAB 50 MHz Phone	0800Z-1400Z, Jun 18
+ Run for the Bacon QRP Contest	2300Z, Jun 18 to 0100Z, Jun 19
+ K1USN Slow Speed Test	0000Z-0100Z, Jun 19
+ ICWC Medium Speed Test	1300Z-1400Z, Jun 19
+ OK1WC Memorial	1630Z-1729Z, Jun 19
+ ICWC Medium Speed Test	1900Z-2000Z, Jun 19
+ Worldwide Sideband Activity Contest	0100Z-0159Z, Jun 20
+ ICWC Medium Speed Test	0300Z-0400Z, Jun 20
+ NAQCC CW Sprint	0030Z-0230Z, Jun 21
+ Phone Weekly Test	0230Z-0300Z, Jun 21
+ A1Club AWT	1200Z-1300Z, Jun 21
+ CWops Test	1300Z-1400Z, Jun 21
+ VHF-UHF FT8 Activity Contest	1700Z-2100Z, Jun 21
+ Mini-Test 40	1700Z-1759Z, Jun 21
+ Mini-Test 80	1800Z-1859Z, Jun 21
+ CWops Test	1900Z-2000Z, Jun 21
+ CWops Test	0300Z-0400Z, Jun 22
+ CWops Test	0700Z-0800Z, Jun 22
+ RSGB 80m Club Championship, SSB	1900Z-2030Z, Jun 22
+ NCCC FT4 Sprint	0100Z-0130Z, Jun 23
+ NCCC RTTY Sprint	0145Z-0215Z, Jun 23
+ NCCC Sprint	0230Z-0300Z, Jun 23
+ K1USN Slow Speed Test	2000Z-2100Z, Jun 23
+ UFT QRP Contest	0600Z-0900Z, Jun 24 and 1400Z-1700Z, Jun 24
+ Ukrainian DX DIGI Contest	1200Z, Jun 24 to 1200Z, Jun 25
+ His Maj. King of Spain Contest, SSB	1200Z, Jun 24 to 1200Z, Jun 25
+ ARRL Field Day	1800Z, Jun 24 to 2100Z, Jun 25
+ K1USN Slow Speed Test	0000Z-0100Z, Jun 26
+ ICWC Medium Speed Test	1300Z-1400Z, Jun 26
+ QCX Challenge	1300Z-1400Z, Jun 26
+ OK1WC Memorial	1630Z-1729Z, Jun 26

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+ ICWC Medium Speed Test	1900Z-2000Z, Jun 26
+ QCX Challenge	1900Z-2000Z, Jun 26
+ RSGB FT4 Contest	1900Z-2030Z, Jun 26
+ Worldwide Sideband Activity Contest	0100Z-0159Z, Jun 27
+ ICWC Medium Speed Test	0300Z-0400Z, Jun 27
+ QCX Challenge	0300Z-0400Z, Jun 27
+ SKCC Sprint	0000Z-0200Z, Jun 28
+ Phone Weekly Test	0230Z-0300Z, Jun 28
+ A1Club AWT	1200Z-1300Z, Jun 28
+ CWops Test	1300Z-1400Z, Jun 28
+ Mini-Test 40	1700Z-1759Z, Jun 28
+ Mini-Test 80	1800Z-1859Z, Jun 28
+ CWops Test	1900Z-2000Z, Jun 28
+ QRP Fox Hunt	0100Z-0230Z, Jun 29
+ CWops Test	0300Z-0400Z, Jun 29
+ CWops Test	0700Z-0800Z, Jun 29
+ NCCC FT4 Sprint	0100Z-0130Z, Jun 30
+ NCCC RTTY Sprint	0145Z-0215Z, Jun 30
+ NCCC Sprint	0230Z-0300Z, Jun 30
+ K1USN Slow Speed Test	2000Z-2100Z, Jun 30

Our thanks to Bruce Horn, WA7BNM for use of this calendar!

Visit Bruce at www.contestcalendar.com/contestcal.html

The ARAC RELAY

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