W6OTX W6ARA

PAARA NEWSLETTER
VOLUME 72, NUMBER 5, May 2021

K6OTA K6YQT

PAARAgraphs

The Official Newsletter of the
Palo Alto Amateur Radio Association, Inc.
Celebrating 84 years as an *active* amateur radio club—*Since 1937*

Radio Waves in Planetary Research

Radio technology has played a major role in astronomy ever since 1933, when Karl Jansky accidentally discovered that the center of our galaxy emits broad-spectrum radio noise. In a similar fashion, Arno Penzias and Robert Wilson accidentally discovered the Cosmic Microwave Background (proof of the Big Bang) in 1965 while working for Bell Labs. But did you know that radio is also used extensively in planetary research within our own solar system? Jupiter and Saturn emit their own radio signatures, some of which can be detected by amateurs here on Earth. Large radio observatories like Arecibo (RIP) and Goldstone have used RADAR to observe every planet from Mercury to Saturn (along with hundreds of asteroids), often in incredible detail. Spacecraft like Voyager 1 and 2, Cassini, and Juno contain high-precision oscillators that enable

(Speaker — Continued on page 6)

This meeting will be conducted with Zoom

Time: May 7, 2021 07:00 PM Pacific Time

https://us02web.zoom.us/j/86521162525

Login ID: First name and Call Sign

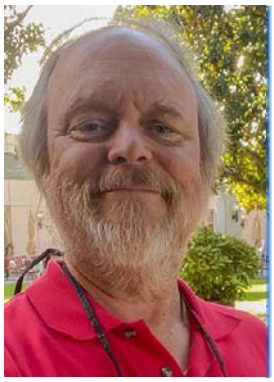
Meeting ID: 865 2116 2525

Upcoming Events

May 7 June 4 July 2	PAARA General Meeting, 7:00 PM Zoom Meeting
May 19 June 16 July 21	Board Meeting, 7:00 PM. Everyone welcome! Zoom Meeting, eMail President for details!
May	Electronic Flea Market Cancelled

President's Corner

May 2021



Summer is fast approaching and Solar Cycle 25 seems to be ramping up! What's of more interest in your book, summer, or the ramp-up in solar activity? In my book, both are exciting events though summer will come long before the peak of Cycle 25. However, any increase in sunspots and solar activity bodes well for a bit more HF fun during the summer than in past years. I don't know about you but I'm looking forward to working 10M again!

As I draft this column, I noticed registration has opened for "Virtual Visalia 2021", the DX Convention at:

(President — Continued on page 5)

EVOLUTION OF A DOPPLER RDF NETWORK FOR THE SAN FRANCISCO BAY AREA

Andy Korsak KR6DD, with assistance of Shri KA6Q, Henry W6REK, Alessio AJ6RQ, and Bill AI6LL

The project began April 2019 when I decided to utilize a Raspberry Pi 2B (aka Rpi2B, RPi, Rpi) donated by Stephen Wendl K9WS several years earlier, which I finally got around to try out by hooking up its GPIO pins to ribbon cable connections I had soldered at antenna switching points of a Ramsey Electronics DDF-1 Doppler direction finder. Also needed was one more connection at the strobe circuit point which defines which one of 16 LED's lights up for bearing indication, and also a DDF-1 circuit ground reference. Then I began writing Gforth code on the Rpi2B to grab 4-bit nibble data representing the DDF-1 LED selected by the strobe line at about 600 times per second and watched data scroll fast on the TV monitor hooked to the RPi via HDMI cable.

It took a lot of programming the RPi up to Aug 2020 to analyze streams of time & date stamped 4-bit nibbles at a rate of around 500 per second, figure out how to process them, and acquire a bearing angle. I wrote software to filter noisy data and do averaging, store stable estimated bearings, then provide for data transfer to a data storage center at Shri's private IP domain. Once a basic RDF node network is up and running we will work on software for crossing bearing lines on a map to estimate signal source locations.

Fig. 1 — DDF-1 and Rpi2B Combo

Then in Aug 2020 as I began looking for more Ramsey Electronics DDF-1's to start installing RDF nodes at cooperating ham's homes at high elevations circling the bay area, it turned out that the DDF-1 became “unobtainium”!!! Recently some Dutch hams came out with Doppler RDF kits for about 200 EUROs but I chose to go a different route: I thought of checking into the possibility of doing the whole job with an Rpi, except that it has no analog I/O at all except for an audio sound output jack, so a sound card would have to be added.

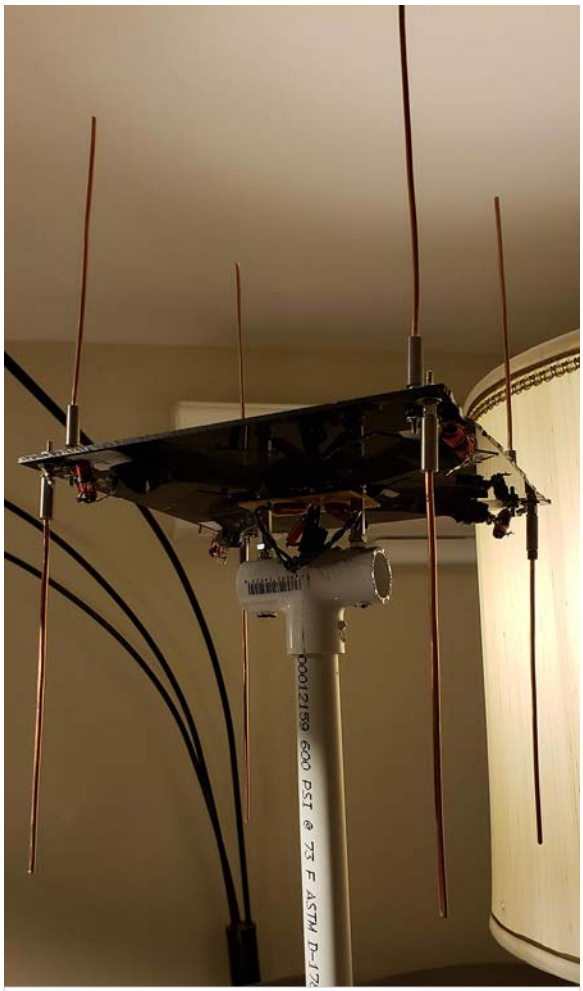


Fig. 2 — 4-Dipole UHF Doppler Array

(RDF Network — Continued on page 3)

(RDF Network — Continued from page 2)

We may actually be able to integrate our bearings data flow with the mapping package that is available for the DDF2020T which already comes with software for networking. http://ns1.holidays.net/store/Radio-Direction-Finder-RDF-KN2C-DDF2020T-Doppler-DFer-With-GPS-Receiver_180835160568.html but those units cost $400 and our RPi based DF nodes will be much cheaper.

Fig. 1 shows the DDF-1 and Rpi2B combo I was ready to present for copying and installing by participating hams living at high elevations around the greater bay area:

For developing the Gforth SW for capturing and acquiring bearings I used a 4-dipole UHF Doppler array sitting on my grand piano at the apartment I rented. I walked around it keying up on 446.000 using a dummy load connected to an HT. (See Fig. 2)

The new "all RPi DDF" (except for adding a sound card and a few R's and C's)

Henry W6REK recently donated to me an RPi3B to replace my dead DELL 630 laptop (which was running my Echolink node and xcorder.exe 24/7 apps) along with two USB sound cards and an adequate 5V wall wart. The intent was to put my Echolink node on the RPi3B, but I set that task aside in order to start working on SW for an Rpi3B version of what the DDF-1 does. The latest Rpi's are at least twice as fast as the Rpi2B which has just under 1GHz CPU cycle speed. That may be fast enough to handle all the tasks of antenna switching, bearings acquisition, and RDF network data reporting with very little additional hardware. The square wave corners of antenna switching on/off pulses at each antenna need rounding off to avoid switching diodes acting as RF mixers bringing in undesired nearby frequencies within the receiver's IF pass band. The easiest way is RC filtering, but the Dutch hams who recently posted their modified version of the DDF-1 concept improved up on it by adding smooth linear ramp up and down of two antennas' series diode currents as one gets turned off while the next one gets turned on, so that there is nearly perfect "hand off" from one antenna to the other.

https://radiodirectionfinding.wordpress.com/

https://radiodirectionfinding.wordpress.com/rdf41/

So I put off changing my PC based Echolink node to one like Henry's on an Rpi3B and began writing Gforth code for an all Rpi (plus sound card and a few R's and C's) SW/HW DDF package.

Instead of mimicking the switched capacitor synchronous filter in the DDF-1 I chose to use a digital finite impulse response (FIR) filter implemented in software on the Rpi. Shri pointed me to a website where you can design filters for free:

http://t-filter.engineerjs.com/

Here are some examples of my evaluation of such a filter. At first I used a 600rps antenna rotation rate leading to a 600Hz "doppler tone", then Shri suggested using 1.6kHz because speech has typically less energy around that frequency, so there is better chance of picking out the tone there in the spectrum.

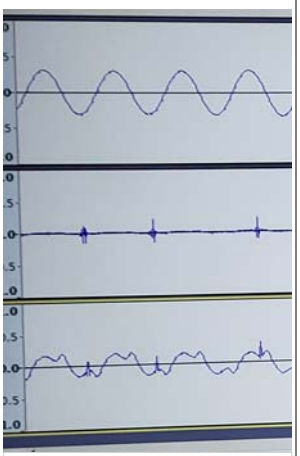


Fig. 3 — 1.6kHz

The synch spikes seen in the lower audacity tracks arise from injection of a single 21us pulse mixed into the audio coming from the sound card using a couple of resistors. This pulse is emitted from an RPi GPIO pin concurrently with turning on Ant1 while turning off Ant4, providing a time reference when computing the time to the next positive going zero crossing of the FIR filtered Doppler

(RDF Network — Continued on page 4)

(RDF Network — Continued from page 3)

tone seen in the 3rd audacity track. The 2nd track was made using audacity's excellent equalizer capability configured to filter out all but a narrow spectral segment around 23.95kHz (the recordings were made using 48kbps). In the bearings processing program I will measure time from the spike to the zero crossing to get a phase angle value, then convert that to a bearing angle in degrees taking into account a calibration term.

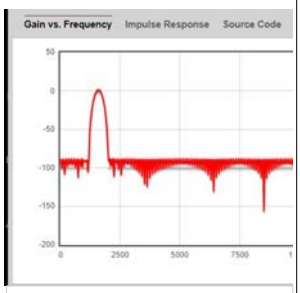


Fig. 4 — Spectrum

My Gforth FIR filter implementation runs about 10 times too slowly to permit continuous tone filtering within one of the four RPi CPU cores while other cores do bearing acquisition and data transfer, but this would be only a data slowdown, not a total roadblock, i.e. during a kerchunk, for example, I would collect enough bearing samples in several short bursts of FIR updates within its 50-100ms duration.

Shri warned me about trying to write assembler code segments using the Gforth capability to do that. Apparently the tricks we Forth programmers used back in the old days to speed up slow parts of our code don't work well, in not at all, anymore. Modern CPU's like the ARM processors are so darn complicated and sophisticated optimizations are required. It's much better nowadays to utilize fancy optimizing C compilers that are designed by large teams of programmers at great cost to software development corporations. So, instead of trying to speed up my code by writing ARM assembler code to replace the Gforth 437 multiplications of FIR filter coefficients and accumulations, Henry W6REK wrote a Python program that that he calls a Gforth-transpiler (a play on the words translator and compiler) which converts my Gforth code to a C program, then compiles it into highly optimized run-time code using “gcc” or “clang” (Linux compiling tools).

The bottom line: now my Rpi3B “transpiled” program for FIR filtering runs fast enough to occupy only 70-90% of the 625us antenna rotation period for the 1.6kHz Doppler tone phase that modulates signals arriving at the UHF DDF antennas shown above during RPi3B SW development, but soon I will be testing with live signals using a 2m 4-dipole DDF array now hanging high on a tightrope between tall trees at my new rented home.

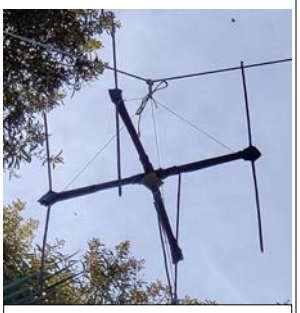


Fig 5. — DDF Array

Figure 6 is of the current status of the RPi-DDF HW prototype – an RPi3B switches four antennas on for ¼ of an antenna rotation cycle and grabs audio via a sound card to pick off two things:

(a) the resulting Doppler tone caused by antenna rotation phase modulating the audio from a receiver

(b) a synch pulse emitted by a GPIO pin each time Ant1 is turned on.

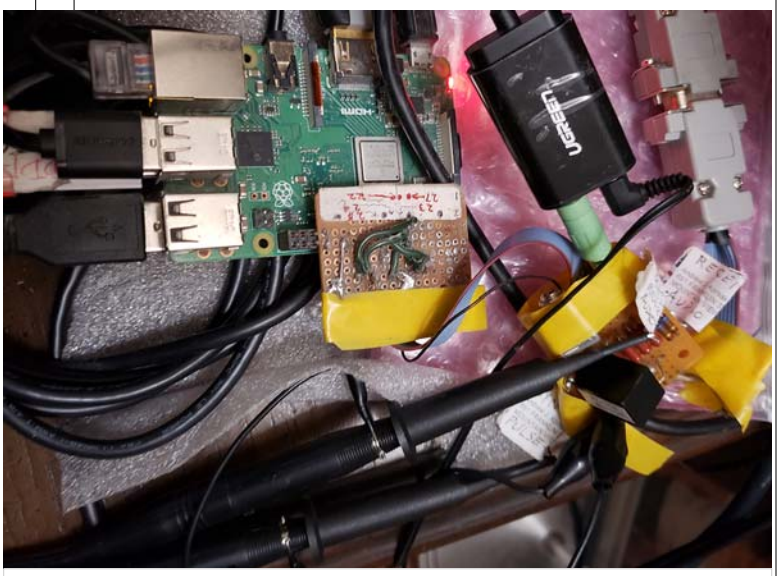


Fig. 6 — Current Status of RPi-DDF HW Prototype

(President — Continued from page 1)

dxconvention.com/pages/registration.html

Advanced registration is required to win one of the door prizes. The best part, registration is free. Pre-registration ends on May 15th just as the "doors" open at 7 AM. The schedule currently shows DX related seminars on May 15th and manufacture related seminars on May 16th. All seminars will be recorded and posted on the NCDXC website at a later date. It's good to see they were able to put something together this year after last year's COVID canceled event.

If you're a member of the ARRL and haven't checked out the "Learning Network Webinars" may I suggest that you do so? There are quite a few interesting presentations there such as, "HF, VHF, and UHF antennas for SOTA", "Emergency Communications", "Ultra-Portable operations", "Digital modes", and "Arduino's", to name a few. The link to view the recorded or upcoming presentations can be found at the bottom of this page:

arrl.org/arrl-learning-network-webinars.

I guess the offenders aren't paying any attention to the FCC. I think I mentioned back in January when the FCC issued their first Enforcement Advisory regarding using any amateur or personal radio services radio for unlawful activities, such as coordination of unlawful protests or whatever, that I speculated the offenders wouldn't be "listening" to the FCC and keep it up. As they have again issued the warning with a bit stronger language, one can only assume it's still going on. For the good of us all, if you happen to learn of someone misusing radios in violation of our use privileges, they are asking for our help to advise the authorities of any illegal activity we may notice. If it happens to be someone you know, you might want to give them a heads up otherwise stay safe and let the authorities handle it. Here's a link to the notice:

arrl.org/news/fcc-issues-enforcement-advisory-radio-users-again-reminded-not-to-use-radios-in-crimes.

If you've followed the board minutes and this column in the last couple of months, you know we conducted a Field Day questionnaire. Considering the club has ~150 members, a response of 21 members is far less than hoped. The board discussed the responses to the pole and asked Doug, KG6LWE, our Field Day chair to contact the City of Menlo Park to see if they are issuing permits for Bidwell Bayfront Park. The City's response was not until maybe July 1st. Thus, our usual site will not be available. That leaves Doug's QTH in San Martin as the only possible site should we move forward with a club-sponsored station. The board agrees that if we move forward, we'll operate in the 2A class. If you're interested in participating and didn't respond to the questionnaire, please let a board member or Doug know before the end of the May 7th meeting. We need more than the 18 people indicating they might work the event to make even operating 2A successful.

Rob Fenn, KC6TYD, VP, and Education Chair, gave the board an introductory presentation on the status of our new education program. There is more work to be done before getting the program going but it's moving forward. So, I ask, what have you done lately to help a new ham or someone interested in amateur radio? I have been meeting and emailing a new technician who is writing her 2nd book. I'm

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(Continued from page 1)

extremely sensitive Doppler shift measurements from Earth, allowing the characterization of planetary gravitational fields. Finally, radio waves passing through planetary atmospheres and ring systems allow us to determine their internal structure and even, potentially, the age of Saturn's rings. In this talk we will give an overview of some of the more fascinating uses for radio waves in planetary research and discuss the dramatic results that could not have been found any other way.

Rob French (AC6GO) is a planetary researcher at the SETI Institute in Mountain View, CA. He uses images from Voyager, Cassini, and the Hubble Space Telescope to investigate the origin and evolution of the rings and moons of the outer planets. He recently co-authored a book chapter on Saturn's dusty F ring and was the co-discoverer of Hippocamp, a small moon of Neptune. Rob is also deeply involved with NASA's Planetary Data System, which is tasked with archiving all science data from NASA space missions for use by future generations. He lives in Sunnyvale, CA with his wife and three cats (one of which is named for a moon of Jupiter), has been a licensed amateur radio operator for nearly 30 years, and is an avid pilot.

April 21, 2021 Board Meeting Minutes

The April board meeting was held on Zoom. The meeting was called to order at 7:10 p.m. Attending were Jim Thielemann K6SV, President; Rob Fenn KC6TYD, Vice President; Ric Hulett N6AJS, Secretary; Bob Korte KD6KYT, Treasurer; Doug Teter KG6LWE, Darryl Presley KI6LDM, Joel KD6W, Directors; and Clark Martin KK6ISP, ASVARO representative. A quorum was present.

President's Report: The ARRL has established "The ARRL Learning Network":

http://www.arrl.org/arrl-learning-network.

It's a collection of informative webinars on many ham radio topics. There are many useful webinars for ARRL members. Check it out!

Quiz: What are the three most common sources of RFI? 1) power lines 2) LED lighting, dimmers and grow lights 3) Solar power inverters. These represent 90% of the reported RFI cases.

Darryl has been working with PG&E to find and resolve some micro-arcing issues. If you have interference, do your own investigation to pinpoint the source before involving the power company. This will help them and they will be more responsive.

Secretary's Report: We received several renewals over the last month, bringing our membership to 154. We welcome a new member, Eric Meltzer KI6PQR – thanks for joining PAARA!

Treasurer's Report: PAARA's insurance has been updated. We paid the cost of electricity to our landlord at the W6OTX repeater site. Most income has been from member renewals.

VP / Program Chair Report: Our guest speaker for the May meeting will be Marty French AC6GO. He will be presenting on "radio waves and planetary research". Thanks to Marty W6NEV for finding this topic and presenter.

Old Business

The board discussed the 'breakout rooms' from the recent online club meetings. The consensus is that the meetings are a good addition to the meeting. In the future we will poll the attendees for their input.

We continue to need articles for PAARAgraphs: It's the members' contributions that make our newsletter special! Please put together an article, even a short one, for an upcoming issue.

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(Minutes — Continued from page 6)

Field Day Poll:

We had 21 responses to the Field Day poll. Here are some results:

18 people indicated they "would" or "might" operate FD 2021.

More than half of respondents would be interested to operate from either Bedwell Bayfront Park in Menlo Park (11/21), or at the alternate site in San Martin (14/21).

Bedwell Bayfront was the first choice for most. (9/20)

More than half (12/21) of respondents would participate in one or more antenna workdays.

SSB was the preferred operating mode (12/21), followed by FT8 or Digital (4/21). Where are all the CW operators?

We will scale our effort back to class 2A this year. This will require 2 work days for antenna work.

UPDATE: Doug KG6LWE has found that Bedwell Bayfront park will NOT be available for Field Day 2021. Our probable alternate site is at Doug's property in San Martin.

Education Committee: Rob Fenn KC6TYD gave a presentation describing how we might set up programs to help out new hams. There was some discussion about 1:1 vs group meeting vs: video presentation formats. Joel proposed a syllabus with dates of trainings.

Clark, KK6ISP provided the ASVARO update: We have no updated status on the future of the Electronic Flea Market.

900 MHz repeater status: The 900 MHz repeater is on the air. Activity on the repeater to date is very low. Check the back of this newsletter for the frequency information.

We will be videoconferencing the next club meeting on May 7th.

The meeting was adjourned at 8:28 pm.

Respectfully submitted,
Ric Hulett N6AJS

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not at liberty to disclose the topic of the book but amateur radio is playing an important part in her storyline. Much of our conversations have been somewhat of a crash course in HF radio. At our last meeting in my shack, she got to spin the dial to see what it's like to try and operate a radio she knew next to nothing about. For me, it's been an interesting and fun adventure to help her understand the limits and capabilities of operating HF. I was quite pleased when she announced "that's it, I'm going to start studying for my general license"! Previously she'd told me she's energized her husband and daughter into getting their technician licenses.

73, Jim K6SV
Get on the air to keep the airwaves alive!

Rick's Ice Cream shop

I know this isn't related to ham radio, but Rick's Ice Cream shop is near and dear to the brick and mortar PAARA meetings all of us miss so dearly, and a tradition for many of us in combination with our monthly Palo Alto meeting "fix". Another small business fighting to survive the pandemic, Rick's had been pulling through with support from the community, but at the end of March lost thousands of dollars during a night time burglary. Perhaps you could stop by for an ice cream cup or order a milk shake through GrubHub to show them support?

https://patch.com/california/paloalto/peninsula-ice-cream-shop-robbed-manager-worries-safety

Rick's Ice Cream (aka Rather Rich Ice Cream)
3946 Middlefield Rd
Palo Alto, CA 94303
https://www.ricksicecream.com/
(in the small shopping plaza right next to Cubberly, the PAARA meeting location, and Piazza's)

Joanna K6YL

Palo Alto Amateur Radio Association, Inc.

PO Box 911 Menlo Park, CA 94026

Officers

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Director ('21)	Doug Teter, KG6LWE dteter@wcwi.com	650-367-6200
Director ('21)	Darryl Presley, KI6LDM ki6ldm@arrl.net	650 255-2454

Appointed Positions

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Chaplain	Rick Melrose K6RDM K6RDM@yahoo.com	408-341-9070
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Station Trustee	K6YQT .. Doug Teter, KG6LWE	650-367-6200
Station Trustee	K6OTA ... Ron Chester, W6AZ	
Property Manager	Gerry Tucker, N6NV	
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Speaker Coordinator	Rob Fenn, kc6tyd	650-888-9060

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Photographer	*Position Vacant*	

VE Exams

Redwood City Main Library, Community Conference Room, 4th Saturday 10:30 am each month and De Anza Park, Sunnyvale, 2nd Saturday 10:30 am each month except November and December. See website for details and exceptions: http://amateur-radio.org or Contact Al, WB6IMX@att.net

Electronics Flea Market

Sponsorship by **A.S.V.A.R.O. — A**ssociation of **S**ilicon **V**alley **A**mateur **R**adio **O**rganizations
Second Saturday of month, March-September, 6am–12 noon
Contact: http://www.electronicsfleamarket.com/

PAARA — Palo Alto Amateur Radio Association

Meets 1st Friday 7:00pm each month at Room H-6, Cubberley Community Center; Net 145.230 - PL 100Hz Mondays at 8:30. See our website at http://www.paara.org for more information or contact: Joel Wilhite KD6W, KD6W@ARRL.NET, 650-325-8239

FARS — Foothills Amateur Radio Society

Meets 4th Friday each month at 7:30pm
Contact: http://www.fars.k6ya.org

NCDXC — Northern California DX Club

Meets 3rd Thursday 7:30pm each month,
Repeater for member info 147.360, Thursday 8:00PM
Contact: http://ncdxc.org or Mike Gavin W6WZ, (650) 851 8699

50 MHz & Up Group

Meets 1st Thursday each month at 7pm in the Summit Room at the Sunnyvale Sports Basement, 1177 Kern Ave, Sunnyvale
Contact: http://50MhzandUp.org

SPECS

Southern Peninsula Emergency Communication System

Meets each Monday 8:00pm on Net 145.27, 440.80 MHz
Contact: http://specsnet.org or Tom Cascone, KF6LWZ, 650-688-0441

SCARES

South County Amateur Radio Emergency Service

Meets 3rd Thursday 7:30pm each month, Belmont EOC, Belmont City Hall, One Twin Pines Lane, Belmont CA 94002. Net is on 146.445 [PL 114.8] & 444.50 (PL-100) 7:30 Monday evenings. Contact: President Gary D. Aden, K6GDA 650-743-1265 (D), 650- 595-5590 (N)
Web: http://k6mpn.org E-mail: pres@k6mpn.org

SCCARA

Santa Clara County Amateur Radio Association

Operates W6UU & W6UU/R, repeater 146.985-pl
Nets: 2m, 7:30pm Mon; 70cm, 10M (28.385) 8PM Thur.
Meets 2nd Mon each month @ 7:30 PM.
ARRL/VEC license testing contact 408-507-4698

SVECS — Silicon Valley Emergency Communications

Operates AA6BT repeater (146.115 MHz+)
contact: http://www.svecs.net or Lou Stierer WA6QYS 408 241 7999

TEARS — The Elmer Amateur Radio Society

Dedicated to operational training, knowledge building & FCC exam testing.
KV6R repeater under construction.
Contact: AA6T@ARRL.NET
Most members are Extra Class or VE's. See QRZ dot com/kv6r for class info

WVARA — West Valley Amateur Radio Association

W6PIY six-meter repeater on 52.58mHz. Normally, six-meters is linked with 147 and 223, while 441 and 1286 repeaters are linked.

VHF:	52.58	(-500) 151.4 ctcss	UHF:		
	147.39	(+600) 151.4 ctcss		441.35 (+5.0)	88.5 ctcss
	223.96	(+1.6) 156.7 ctcss		1286.20 (-12m)	100.0 ctcss

Meetings are 2nd Wednesday of every month except July, August and December.
Contact: http://wvara.org, Bill Ashby N6FFC, 408-267-3118, president@wvara.org

American Red Cross,

Santa Clara Valley Chapter

Contact: http://santaclaravalley.redcross.org or Scott Hensley KB6UOO, (408) 967 7924 fshensley@Novell.com

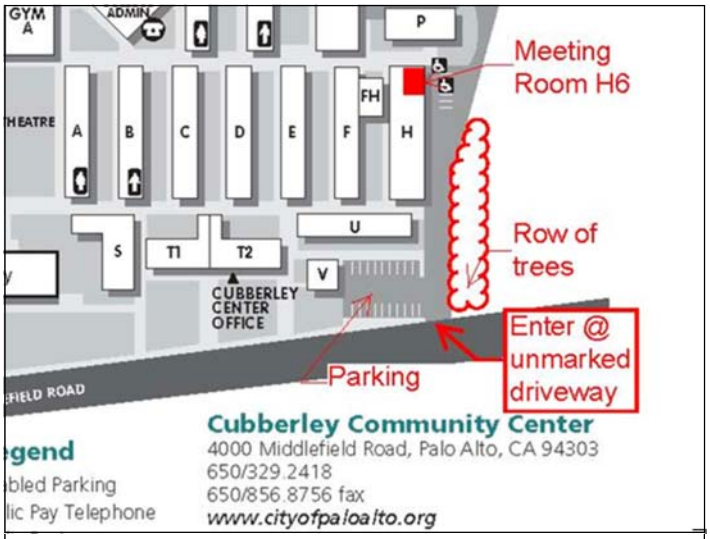
(**Please** send changes to PAARA*graphs* editor)

PAARA Weekly Radio Net

Info and Swap Session
every Monday evening at 8:30pm
on the N6NFI 145.230 MHz repeater

Week	Control Operator
1st	Joel - KD6W
2nd	John - W6JMK
3rd	Ric - N6AJS
4th	Rob - KC6TYD
5th	Rob - KC6TYD

If you're interested in trying out at Net Control, Contact Doug, KG6LWE. It's good practice, and lots o' fun! Give it a try.



Meeting Location — Middlefield Road between San Antonio and Charleston in Palo Alto. 4000 Middlefield Road

Palo Alto Amateur Radio Association
P.O. Box 911, Menlo Park
California 94026-0911

Club meetings are on the first Friday of each month, 7:00pm at the Room H-6, Cubberley Community Center.

Radio NET & Swap Session every Monday evening, at 8:30pm, on the 145.230 −600 MHz repeater, PL 100Hz.

Membership in PAARA is $25.00 per calendar year, which includes one subscription to PAARAgraphs
$6 for each additional family member (no newsletter).
Make payment to the
Palo Alto Amateur Radio Association,
P.O. Box 911, Menlo Park, CA 94026-0911

ARV'S, WA6UUT (SK)
WEDNESDAY
HAM RADIO LUNCHEON
Our 11th year!
- Since May 2, 2007 –
BLACK BEAR DINER
Sunnyvale, California
415 East El Camino Real
(Just "North" of South Fair Oaks Avenue on El Camino Real)
11:30 AM ~ 3:00 PM
Website:www.blackbeardiner.com

Many food choices available from the breakfast, lunch or dinner menus. Ample parking is available. Walk in & "bear" left for our location in the restaurant!

NOT A CLUB, CLOSED GROUP OR CLIQUE; AMATEUR RADIO OPERATORS AND FRIENDLY PEOPLE ARE ENCOURAGED TO ATTEND!

Submit items to **PAARA*graphs*** by the 3rd Wed to:
rrvt@swde.com
Text: .doc, .rtf, or .txt
Photos: jpg, png or tiff

Subscription Problems?
Contact Database Manager:
Ric Hulett, N6AJS
408-332-4593
energyconserved@sbcglobal.net

PAARA W6OTX DMR Repeater Frequencies

144 – 144.9625 up 2.5 MHz	DMR—NOR CAL Brandmeister
440 – 444.475 up 5 MHz	DMR
900 – 927.225 down 25 Mhz	On Line

PAARA Badges

In the absence of in person meetings, you can still order a badge from the Club's website, PAARA.org. Go to the bottom of the membership page to order. Badges will be mailed to purchasers, at an additional cost of $4.95 until we can meet face to face again.

PAARA*graphs* Ad Rates

PAARA*graphs* accepts paid advertisements from non-members. (short personal ads remain free for members in good standing). **All ad rates listed are per issue**.
1. Not-for-profit ads by association members for ham-related items and wants. No cost for business card–size ads (additional space at $2.50 per business card size per issue).
2. For Profit organizations and/or individuals: $5-business card size, $14.00-quarter page, $25-half page, $50 full page or back cover per issue.

These fees may be reduced or waived in exchange for a valuable consideration that is given to the Association or its general membership. Such consideration must be in addition to any existing arrangements with the association. The PAARAgraphs editors reserve the right to reject any ad deemed to be not in the best interest of the Association.
All fees payable in advance by the year with "scanner-ready" copy or text-only ads. **Give payment and copy to Walt Gyger, K6WGY.**

PAARA*graphs* — May 2021

Accept no substitutes. Produced and printed in California USA

STAMP

Palo Alto Amateur Radio Association, Inc.
PAARA*graphs* Newsletter
P.O. Box 911
Menlo Park, California 94026

FIRST CLASS MAIL

Address Service Requested