W7DTA Amateur Radio Club
Rogue Valley
Since 1936
Medford, Oregon

The Repeater

Next Club Meeting
Thursday,
February 4, 2016, 7:00 PM

Red Cross Building,
60 Hawthorne St., Medford, OR
Across from Hawthorne Park

Program:
1. **Beginner: Design and Construct a Low Cost 2M Antenna**
2. **Advanced: Basics of Ethernet.**

Volume 2016, Issue 2 **February 2016**

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President's Report

My apologies to everyone who showed up for the planned January meeting. The building entrance code had been changed, but due to a miscommunication we did not learn about the new code the evening of the meeting.

The attendance looked good, but it was a bit too cold and dark to hold the meeting outdoors!

We've since gotten the new code, and all should be set for the February meeting. We will plan to have the same two program topics by Allan and Tom that were originally slotted for January.

Scott, NA7OM

The Repeater is the official newsletter of the Rogue Valley Amateur Radio Club, Inc. It is published 10 times a year—once per month excluding July and August.

Secretary's Report

We were locked out of the Red Cross meeting room and not able to hold the January meeting as scheduled.

Hopefully the issue has been addressed.

The programs originally scheduled for January will instead be presented at the February meeting.

There are no meeting minutes for January.

This Month's Programs

1. Beginner: How to Design and Construct a Low-Cost 2 Meter Antenna.

Program: This will be a discussion and tutorial on the Design, debugging, and construction of a very cheap but functional 2m antenna. 2 Meters antenna are widely discussed in various articles, but there are some basic problems with many of those designs that prevent them from working to their full potential. Allan will go through the process from start to finish.

Biography: Allan Taylor, K7GT, is our club Vice President for 2016, and has been club President several terms in the past. He brings a lot of experience in designing and building antennas, and has a good antenna farm to attest.

2. Advanced: Basics of Ethernet

Program: Ethernet has changed a lot since it's beginnings in the early 1980s. Many hams haven't had the time to keep up with the large number of improvements and enhancements in Ethernet over the years. It's now full-duplex, and collisions are a thing of the past. This presentation will cover some practical things you need to know about Ethernet such as:

- Cat 5, Cat5E and Cat6 : what's the difference and when do I need which kind?
- What's the difference between regular, riser, plenum, and shielded cable?
- What's the color code?
- What's Power-over-Ethernet?
- What's a cross-over cable? Do I need one?
- What is an Ethernet switch, when do I need one?

Biography: Tom McDermott, N5EG, is the RVARC newsletter editor. He is involved in the drafting of some new and recent Ethernet 802.3 standards. He is a member of the IEEE Standards Association and a voting member of the IEEE Ethernet 802.3 Working Group.

Does anyone know what time it is?

One of the things with which we amateurs are occasionally concerned is the accuracy of our transmit frequency. Normally we reach for a frequency counter to measure our transmitter (first setting the transmitter into a continuous carrier mode, such as CW with the key down, or unmodulated RTTY).

This works well enough for low frequencies, but as we transmit at higher frequencies, the accuracy of our frequency counter can be quite significant. Consider for example, operation at 10.100 MHz. That's right on the band edge. If our frequency counter has an error of 1 PPM (one part per million, or 1E-6), that's a possible error of 10.1 Hertz. So we might be out of band. We would need to operate at 10.1000101 MHz to make sure we're in-band.

The problem becomes more severe at VHF and UHF. For example, at 448 MHz, a 1 PPM error is 448 Hertz. At 10 GHz, a 1 PPM error is 10 KHz. Normally crystal oscillators are nowhere as good as 1 PPM unless they are temperature compensated or temperature controlled (such as in an oven). My ovenized frequency counter ages more than 5 PPM between alignments (about a year apart).

Crystals not only are temperature sensitive, they are sensitive to power supply voltage, and the quartz crystal itself ages over time. All of these lead to inaccuracies in the oscillator frequency.

I recently assembled a homebrew 160-6m all-mode transceiver. It is frequently used for experiments of all sorts, and knowing the precise frequency of the radio is one of the variables in some of the experiments. Fortunately the unit is capable of being locked to an external 10 MHz reference frequency, and I have two Stratum-I clocks available. One is a double-oven (oven within oven) crystal oscillator that is locked to the GPS satellite constellation. The other is a Rubidium oscillator that is locked to the local CDMA cell site towers in the Medford area. Stratum-I refers to the telecom designation of a frequency source that is locked to a traceable reference, and that can holdover on its own for 24 hours if the master reference is lost temporarily. At one time the telephone companies distributed master time and frequency to all central offices using wireline equipment, but more often now they use GPS to acquire the reference.

The idea behind locking an oscillator to a known reference actually occurs in the time domain, rather than the frequency domain. The phase of the 10 MHz clock is compared to some other reference.

In the case of GPS, the unit first must be told the exact location on earth of its antenna. (It can learn this by itself in about 24 hours). From then on it can determine time from the constellation of satellites. The unit measures the deviation of it's own time (divided down from 10 MHz) compared to the time synthesized from measuring the visible GPS satellites. There is a digital low pass filter with time constants of many hours that smooth any sudden variation. Once a day or two, the satellites will align in an unfavorable geometry, and there will be some drift of the computed phase. The idea is that over the long-term, GPS is very precise (being itself locked to Cesium standards on the ground). A crystal can be very stable in the short term, and by combining the two, the results should be stable over a wide range of times from short to long.

Similarly, the Rubidium unit measures it's time compared to time derived from the RF and pilot carrier frequency and phase of the CDMA2000 signals transmitted by CDMA cell towers. The Rubidium oscillator has excellent short term stability, and achieves long-term accuracy externally.

The question then arises: how stable are these two Stratum-I clocks? One way to measure them is to compared the sine wave rising-zero-crossing edge of one oscillator agianst the other. If the two oscillators are perfectly stable, then the time-interval between the two zero crossings will be constant over a long period of time.

A measure of error is then how that time interval changes. The measure would be the RMS error of the change of the time interval. Although this sounds like a good technique, it turns out to have some mathematical problems, one being that it doesn't converge over long periods.

To solve that problem, Dr. David Allan of the (then) National Bureau of Standards (now NIST) devised a stability definition that has better statistical properties. The measurement is called the Allan Deviation (ADEV) of the measurement. We really don't care about the absolute phase offset between two oscillators, and in fact we don't really care about the absolute frequency difference. What we care about is how stable over time the oscillator is. If the frequency drifts (changes) over time, then it is not stable. But if the frequency error never changes, the oscillator is in fact perfectly stable (but just off-frequency). We can compensate for a frequency error if we know what it is. We can't compensate for random frequency instability.

The measurement goes like this:

A. The time interval difference between two oscillator is measured.
B. One second later, the TI difference is again measured.
C. One second later (two seconds total) the TI difference is again measured.

If (B-A) = (C-B) then the rate of change of the time difference is constant. So to measure the instability, we just look at (C-B)-(B-A) which is = C-2B+A. We measure this for a time difference of once second, and compute the RMS (root-mean-square) error. That the ADEV value at a measuring interval of one second. Similarly we can measure C,B, and A at 10-second intervals rather than one second intervals. Then the RMS of those measurements is the ADEV value at a 10 second interval. Similarly we measure and compute the time-interval differences up to perhaps 100,000 seconds (a day and a quarter).

By plotting the value of ADEV against the value of the measurement time interval (referred to as tau), and plotting on a log-log chart, we get a plot of the Allan Deviation of oscillator 1 compared to oscillator 2. The shape of this curve in fact tells a lot about the behavior and stability of the frequency sources.

Interestingly, one can convert mathematically from oscillator phase noise to Allan Deviation, but not the other direction.

I wrote Gnuradio drivers for my homebrew radio which makes it quick and easy to setup experiments, take and record data, and vary the tests. Over the holidays the setup was used to find the background noise of the test setup (by measuring an oscillator against itself), and comparing the Crystal-GPS-locked oscillator to the Rubidium oscillator, both when it was and when it was not locked to the CDMA call system.

I learned much about my radio in the process. The internal TCXO crystal oscillator has terrible ADEV performance. I suspect that the Phase Noise of that oscillator is probably bad as well. The external clock reference had some buffering problems, and I ended up modifying the reference circuit that drives the radio electronics. With these modifications I was able to achieve mediocre-to-poor ADEV measurement performance (compared to precision test equipment).

I was able to measure the stability of the unlocked Rubidium oscillator with reasonable resolution. Its really pretty good, achieving about 1E-12 accuracy and 1E-11 stability.

I was hoping to find a way to easily characterize the phase noise of radio without an expensive test equipment setup. It looks like that is mathematically intractable.

I did find a reference to one paper on how to estimate Phase Noise from ADEV, but the content is locked up behind an academic paywall. The abstract presumes that one can estimate oscillator frequency error physics, bound them, and then make an estimate for each error source and fit it to the measured ADEV value. That seems a bit out of reach for measuring ham rigs (where various PLL and oscillator schemes would probably invalidate the error models).

While the project seems to have reached a dead end, it was in fact quite educational. I learned for example that single-precision floating point math is not good enough for computing Allan Deviation at long time intervals, and devised a measurement setup that used integers throughout.

I also learned that the Rubidium oscillator is quite accurate in frequency and moderately stable when unlocked to an external reference.

One thing to remember is that any measurement is always one oscillator compared to another. We cannot know the exact Allan Deviation unless we have a perfect reference to measure against. The best of those clocks are Cesium or a Hydrogen Maser, neither of which are easy (or cheap) to find.

There is a mathematical technique where if we have 3 oscillators, we can measure each against the other (three total measurements) and then isolate much of the error to each one. This lets us improve our characterization of each oscillator by an order-of-magnitude or so. My current setup is I think not good enough for that yet.

Many microwave amateur beacons have now adopted the use of surplus Stratum-I clocks to set the frequency of the beacon transmitter. This is necessary because otherwise the beacon could be way-off frequency and it might be difficult to find, especially if the receiver bandwidth is narrow to permit hearing a weak beacon.

A number of relatively inexpensive telecom grade clocks came on the market starting about 1995, as phone cell sites needed highly precise time and frequency references, and those sites started getting far away from the central office. Those have been released as surplus in many cases, and some of them are good bargains for ham experimenters.

I picked up both of my units on the surplus market, and have been fortunate to have had good results. Both units are configured using a serial RS232 interface, and a standard protocol called TL1 (Transaction Language 1) which is a most unfriendly but theoretically human-readable interface. In reality the equipment suppliers define proprietary commands, so it's difficult to know what they are. One of the units came with a program to configure the unit with drop-down Windows commands. The Rubidium unit has such software, but it's no longer available. Fortunately it seems to initialize correctly without any commands.

The GPS-DO (GPS Disciplined Oscillator) has the 1024 GPS rollover problem, but the firmware allowed me to tell it which 19-year epoch we are now living in. The original GPS satellites apparently never planned to live more than 19 years.

UTC time includes the effect of leap-seconds which occur occasionally when the earth's rotation drifts out of sync with precise time by about a second. GPS does not adjust for leap seconds, so UTC and GPS time now differ by 17 seconds (the accumulated leap second adjustments since the start of GPS time).

— Tom, N5EG

ARRL Board Elects Rick Roderick, K5UR, President

The ARRL Board of Directors has elected ARRL First Vice President Rick Roderick, K5UR, of Little Rock, Arkansas, as the League's next president. The Board took the action as it convened for its 2016 Annual Meeting in Windsor, Connecticut. Roderick, 63, will officially assume office for a 2 year term at the conclusion of the Annual Meeting, which wraps up on January 16. He will become ARRL's 16th president, succeeding Kay Craigie, N3KN, of Blacksburg, Virginia, who is completing her third term as the League's president.

The Board also chose other officers, electing Dakota Division Director Greg Widin, K0GW, of Stillwater, Minnesota, as First Vice President, succeeding Roderick, and Rocky Mountain Division Director Brian Mileshosky, N5ZGT, of Albuquerque, New Mexico, as Second Vice President, succeeding Jim Fenstermaker, K9JF.

(Courtesy ARRL News).

ARRL President-Elect Rick Roderick, K5UR. [Rick Lindquist, WW1ME, photo]

February 2016

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2 • Women Hams Net	3	4 • **RVARC Meeting** • Women Hams Net • ARES Net	5	6
7	8	9 • Women Hams Net	10	11 • Women Hams Net • ARES Net.	12	13 • CQ WW WPX RTTY
14 • CQ WW WPX RTTY	15	16 • Women Hams Net	17	18 • **RVARC Newsletter Deadline** • Women Hams Net • ARES Net.	19	20 • ARRL DX CW
21 • ARRL DX CW	22	23 • Women Hams Net	24	25 • Women Hams Net • ARES Net.	26 • CQ 160 Phone	27 • CQ 160 Phone
28	29					

Events

- Thursday February 4th - 7:00 PM RVARC Club Meeting
- Tuesdays & Thursdays 7:00 PM—Women Hams Net K7RVM Repeater 147.000 (+) [PL 123.0]
- Thursdays 7:30 PM - ARES Net. K7RVM repeater 147.000 (+) [PL 123.0]
- Next Newsletter: March Issue. Deadline for input: February 18th.
- Feb 13-14: CQ World Wide WPX Contest RTTY http://www.cqwpxrtty.com/rules.htm
- Feb 20-21: ARRL DX Contest CW. http://www.arrl.org/arrl-dx
- Feb 26-28: CQ 160 Meter Contest, Phone http://www.cq160.com/rules.htm

RVARC Membership

RVARC membership dues run from January 1 through December 31. Please bring cash or a check payable to RVARC to a club meeting, or mail (checks only) to:

RVARC Membership
c/o 1058 Linda Ave.
Ashland OR 97520

Regular Member:	$20.00
Senior Member (62 and over):	$15.00
Family Member:	$20.00
Student Member:	$10.00

For Sale

2016 Amateur Radio Examinations

In the Rogue Valley, amateur radio exams are provided by the RVARC and the SOARC. New exam participants need to provide identification, while upgrading amateurs need to **provide a copy of their current license** as well as show identification. The exam fee for 2015 remains $15.00. All license candidates must provide a picture ID. Upgrading amateurs must also provide a photocopy of their current license to send in with their application. To search for other exam locations, see:

http://www.arrl.org/arrlvec/examsearch.phtml or our club webpage: http://w7dta.org

Medford—Phoenix, OR

Time: Saturdays, Registration 8:30 AM. Exam session at 9:00 AM. Walk-ins welcome.
Location: Fire District 5 HQ. 5811 South Pacific Highway, Phoenix, Oregon 97535
Dates 2016: Feb 27 Jun 18 Oct 29
Contact: Don Bennett, Email: kg7bp@rfwarrior.com Phone: (541) 973-3625

Grants Pass

Time: Fridays Registration 6:00 PM. Exam session at 6:30 PM. Walk-ins welcome.
Location: Fruitdale Grange. 1440 Parkdale Dr., Grants Pass OR 97527-5288
Dates 2016: Feb 19 May 20 Aug 19 Nov 18
Contact: John Stubbe, K7VSU, email: jstubbe7@gmail.com Phone: (541) 218-2244

Roseburg, Bend, Redding, Brookings, Crescent City — Please see our club webpage, http://w7dta.org for updates as we receive schedules for these cities.

Next Club Meeting

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