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CQ Communications, Inc.
25 Newbridge Road
Hicksville, NY 11801 USA

CQ VHF (ISSN 1085-0708), Vol. 16, No. 3. Periodical Postage Paid at Hicksville, NY and additional offices. Offices: 25 Newbridge Road, Hicksville, New York 11801. Telephone: (516) 681-2922. Statement of Ownership, Management & Circulation, October 11, 2012. *CQ VHF*, 25 Newbridge Road, Hicksville, NY 11801 Publication #1085-0708. Issued quarterly (4-times a year), subscription price $28.00 per year (4 issues). Publisher: Richard A. Ross; Editor: Joe Lynch: Owned by CQ Communications, Inc. Stockholders: Richard A. Ross. Circulation (Average of Preceding 12 months): Net Press Run 3,601, Mail Subscriptions 2,293. Sales Through Dealers and News Agents 529, Total Paid 2,822, Free Distribution 120, Total Distribution 2,942, Copies Not Distributed 659, Total 3,601. Circulation (single issue nearest filing date); 3,359, Mail Subscriptions 2,218 Sales Through Dealers and News Agents 795, Other, Total Paid 3,013, Free Distribution 118, Total Distribution 3,131, Copies Not Distributed 228, Total 3,359 s/DorothyKehrwieder, Business Manager.

Printed in the United States of America.
Postmaster: Please send change of address to *CQ VHF*, 25 Newbridge Road, Hicksville, NY 11801.

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FALL 2012
Vol. 16 No. 3

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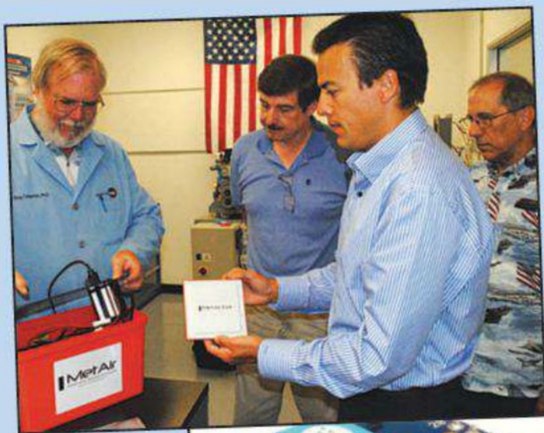
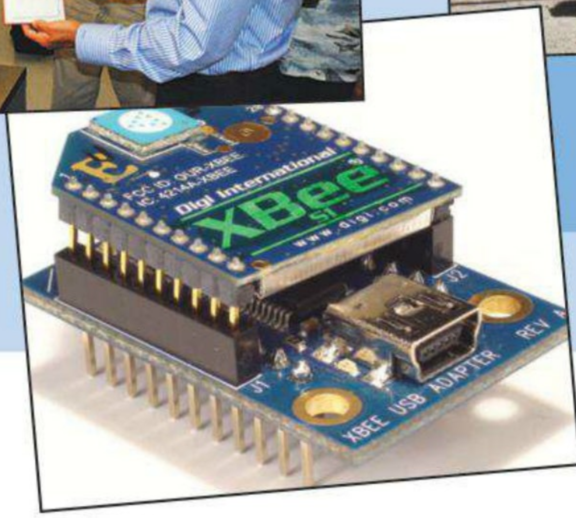




COLUMNS

DEPARTMENTS

On The Cover: Main photo—A ballon launch from the Indiana University – Purdue University Columbus campus; for details see "Up in the Air" by WB8ELK, p. 61. **Insets:** Top left—General plot of the path between the Pacific Northwest and Europe on June 29; "Summer 2012 VHF Report" by WB2AMU, p. 10. Middle—Side view of the 6-meter antenna tuner; "Six-Meter Antenna Coupler" by K8VBL, p. 18. Top right—A student-built BalloonSat; "Amateur Radio as a Tool for Changing Students' Attitudes Toward Science" by KD4STH, p. 42.

CQ VHF Ham Radio Above 50 MHz

Jim Kennedy, KH6/K6MIO and Jay Liebmann, K5JL Honored

Jim Kennedy, KH6/K6MIO, and Jay Liebmann, K5JL, were honored at this year's Central States VHF Society conference. Kennedy received the Chambers and Liebmann received the Wilson award.

Chambers Award: The John T. Chambers Award was instituted in 1970 on the suggestion of Bill Smith, KØCER. The award honors John Chambers, W6NLZ, for his many contributions to VHF, most notably his work with Ralph "Tommy" Thomas, KH6UK, proving the existence of the West Coast to Hawaii duct.

Kennedy was honored for his many contributions in advancing the studies of propagation. Along with his coauthor, Gene Zimmerman, W3ZZ (SK), he has published several articles on propagation in the society's *Proceedings*, as well as in this magazine.

Jim Kennedy, KH6/K6MIO, receives the Chambers Award from Kent Britain, WA5VJB, at this year's Central States VHF Society conference.

After receiving the award, Jim shared with me that he was surprised and honored to be this year's recipient. He added that it is especially humbling to follow in the footsteps of John Chambers, one of his heroes. He stated that he used to hang out with John to learn from him as John set about to perform his experiments in the attempt to make contact with Tommy over the now famous California to Hawaii tropo duct.

Wilson Award: The Wilson Award was instituted in 1982 in memory of long-time society member Melvin S. Wilson, W2BOC. It is given for outstanding and continuing service to the society or to VHF/UHF in general.

Liebmann was honored for his many years of service to the society and amateur radio . I remember one contribution in which heretofore Jay has received almost no recognition—the K5JL repeater in Oklahoma City.

As the ARRL Oklahoma Section Manager, I was responsible for the amateur radio operators who responded to the Murrah building terrorist bombing disaster. Without a doubt, the backbone of communications for the amateur radio operators was the K5JL repeater. Its reliability despite more than a week of continuous day and night operation is a testament to Jay's commitment to excellence in his station and to serving his community. Furthermore, throughout the years of Jay's activities from Piedmont, Oklahoma, he has been active on the VHF and microwave bands, giving many operators their first DX QSO.

In this Issue

Despite the lack of VHF propagation this past summer, Ken Neubeck, WB2AMU, noted four significant events. He reports on them beginning on page 10.

Rex Moncur, VK7MO, and Dave Smith, VK3HZ, have been doing experimental work in bouncing signals off commercial airplanes. They document one of their long-range QSOs beginning on page 22.

Jon Titus, KZ1G, recently published *The Hands-on XBee Lab Manual* (Newnes, 2012). By way of introducing us to XBee devices, he authored "Getting Started with XBee Transceiver Modules" (beginning on page 26).

As a testament to the popularity of Bob Bruninga, WB4APR's Automatic Packet Reporting System (APRS), amateur radio operators have been developing secondary usage projects. Two such projects are featured in this issue: "Public Service Event APRS Web Mapping for Wireless Devices" by Ted Jacobson, W8KVK, and Rob Jacobson, KB9AFT, (beginning on page 32), and "APRS and the Android Smartphone" by Sagar Gupta, KC2VSG (beginning on page 38).

Paul Verhage, KD4STH, recently earned his Ph.D. from the University of Kansas, studying student involvement with BalloonSats. Excerpts of his dissertation begin on page 42.

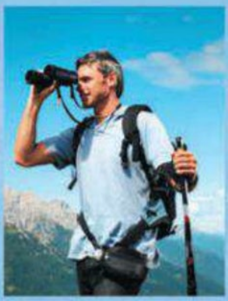
And Finally . . .

With each issue of *CQ VHF* magazine we are attempting to increase the technical competence level. We hope that you like and appreciate our efforts.

If you have comments about our efforts, or an interesting project for this, your niche of the Amateur Radio Service, please contact me at n6cl@sbcglobal.net.

Until next time . . .

73 de Joe, N6CL



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One Reader's Opinion

The Decline and Fall of 2 Meters FM

By John W. Thompson MD (ret),* K3MD

Many newspapers around the U.S. print a page entitled "Op-Ed." This usually runs opposite the editorial page; hence its name. Sometimes the name takes on a double meaning, when the author has a viewpoint opposite to the editor's. Its purpose is to give a writer an opportunity to express a view or propose an idea for discussion in a longer format than what is normally found in a letter to the editor. There are many views and ideas floating around in the world of VHF that are worth considering and discussing. Please note that the views expressed herein are those of the author and do not reflect the views of CQ VHF *or its editorial staff.* —N6CL

When this article was first presented in the 1970s, 2 meters FM was one of the most advanced forms of electronic communications available. FM itself was fairly new then, and narrow-band FM was very advanced. The initial available equipment primarily was converted aircraft and maritime equipment. Many have spent their last dollar, or close to it, to acquire a new FM rig. In my own case, I got a Sonar, but wanted a Genave™. The Sonar was a crudely converted maritime-mobile FM rig with persistently intermittent audio on transmit. When phone patching became available, this was the craze. Many were impressed by the ability of amateur radio operators to call from their cars with their radios.

In the current world, many young adults will spend their last dollar on a new smart phone for just the same reason. The smart phone allows games, texting, the web, movies, etc., wirelessly. The current generation of non-electrical engineer users could care less about whether the device uses UHF, VHF, or microwave to interface to a hotspot in order to achieve its uses. AT&T and other providers are clamoring for reassignment (at price) of TV broadcast frequencies in order to relieve congestion on the lightning-fast growth of the smartphone and wireless data.

The primary benefit of 2 meters FM was that it encouraged the local fraternity of hams to know one another and to get together on the air and in person. It still serves this purpose. However, its utility is being reduced by the cell phone and the smart phone. The overall utilization of the very impressive array of VHF, UHF, and microwave repeaters nationally, digital and analog, is being reduced. This is somewhat counteracted by D-STAR™ and GPS-position reporting (APRS) devices which buck the national trend by advancing the radio art with computer-aided enhancements that attract the technically competent arm of amateur radio. The ability of a ham operator to impress the general public with his/her technical competence with APRS 2-meter gear is limited by the easy availability of very inexpensive navigational devices with map readouts (Tom-Tom, etc.) to the general public. The local radio club and the regional radio club and hamfests still serve the purpose of encouraging interaction of like-minded amateur radio operators.

The encouragement of computer-enhanced and digitally-enhanced radio operations may spell the future of the amateur radio hobby. Unfortunately, one of the basic tenets of amateur radio, the ability to perform emergency communications, has been supplanted to some degree by the digitally enhanced emergency-response industry and police and fire calling radios. Many competent amateur radio emergency teams are now relegated a back seat in emergency planning activities. This is despite countless volunteer hours by ARES, RACES, and Red Cross members in many SETs. This varies widely by geographic area, as some ARES groups have many volunteers and are very well organized. This is very unfortunate and may have grave consequences in the case of a national disaster caused by conflict or weather. The probability of weather disaster seems to be increasing, although the consensus on this is not total. Those who deny the existence of global warning are becoming fewer and fewer even among the most conservative circles.

Very recently in *CQ VHF* magazine there was on op-ed stating that 2 meters SSB was becoming close to extinct. Of course this is not the case, as on the East Coast of the U.S. 2 meters SSB seems to be having a great resurgence in activity largely due to the work of one man—Stan Hilinski, KA1ZE/3. He uses a unique combination of daily nets, remote control, and chat networks that are best explained by reading his QRZ.com page. The summer tropo propagation has been excellent during 2012 with the high-temperature weather we experienced on the East Coast. We must not dismiss the tireless efforts of the Mt. Airy VHF Club in Philadelphia to increase VHF activity.

I have heard that in larger cities the 2-meter FM repeaters are very busy with new hams. The availability of inexpensive high-tech equipment is beyond anything available 30 years ago. A fully-equipped duobander can be purchased for $119 (AES, Wouxun™ KG-UV3D), which is an unbelievable price! The Japanese 2-meter FM radios, often engineered in Japan and manufactured elsewhere in Asia, are works of art with very easy-to-use interfaces and features that only 15 years ago would be incorporated into the most expensive available equipment.

Predicting the future is fraught with difficulty and uncertainty, but this does not preclude the media from doing it every day with an air of certainty. It often is interesting to observe the first-licensed year statistics that are readily available while operating ARRL Sweepstakes. CW

(Continued on page 82)

*e-mail: <k3md@arrl.net>

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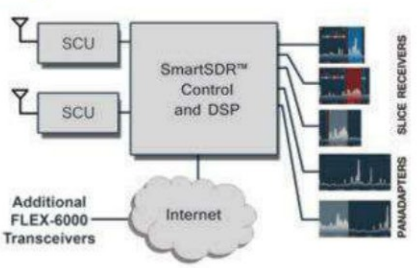

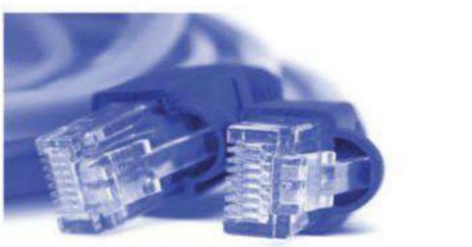

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Current Contests

January: The ARRL VHF Sweepstakes is scheduled for the weekend of January 19–21, 2013. For ARRL contest rules, see the issue of *QST* prior to the month of the contest or the URL: <http://www.arrl.org>.

Current Meteor Showers

November: The *Leonids* is predicted to peak around 0930 UTC on November 17. As with last year's shower, this year's peak may go largely unnoticed.

December: Two showers occur this month. The first, the *Geminids*, is predicted to peak around 1330 UTC on December 13. The actual peak can occur 2.5 hours before or after the predicted peak. It has a broad peak and is a good north-south shower producing an average of 60 meteors per hour at its peak.

The second, the *Ursids*, is predicted to peak around 0800 UTC on December 22. It is an east-west shower, producing an average of no greater than 10 meteors per hour, with the very rare possibility of upwards of 90 meteors at its peak.

January: The *Quadrantids,* or *Quads*, is a brief but very active meteor shower. The expected peak is around 1325 UTC on January 3, with up to 40 meteors per hour at its peak. The actual peak can occur three hours before or after the predicted peak. The best paths are north-south. Long-duration meteors can be expected about one hour after the predicted peak.

For more information on the above meteor shower predictions see Tomas Hood, NW7US's "VHF Propagation" column. Also visit the International Meteor Organization's website: <http://www.imo.net>.

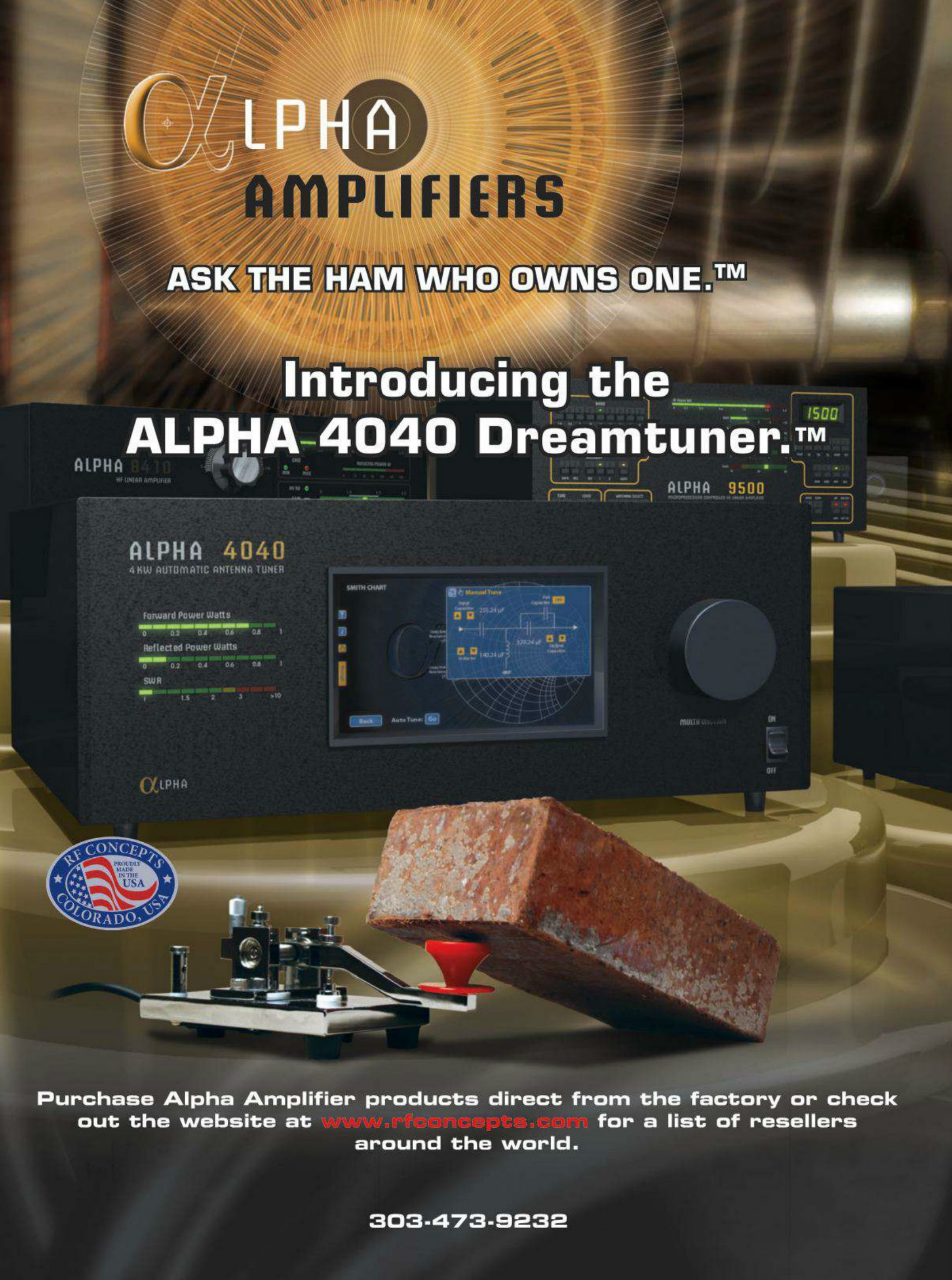
Calls for Papers

Calls for papers are issued in advance of forthcoming conferences either for presenters to be speakers, or for papers to be published in the conferences' *Proceedings*, or both. For more information, questions about format, media, hardcopy, e-mail, etc., please contact the person listed with the announcement. The following organization has announced a call for papers for its forthcoming conference:

The **Society of Amateur Radio Astronomers** (SARA) solicits papers for presentation at its 2013 Western Regional Conference, to be held February 9 through February 10, 2013, at Best Western Socorro Hotel & Suites, Socorro, New Mexico. Papers on radio-astronomy hardware, software, education, research strategies, observations, and philosophy are welcomed. SARA members or supporters wishing to present a paper should e-mail a letter of intent, including a proposed title and informal abstract or outline, to <westernconference@radio-astronomy.org> no later than December 1, 2012 (please let them know if you require more time). Be sure to include your full name, affiliation, postal address, and e-mail address, and indicate your willingness to attend the conference to present your paper. Submitters will receive an e-mail response, typically within one week. Formal printed *Proceedings* will be published for this conference and all presentations will made available on CD.

Quarterly Calendar

Nov. 1, 2012	Moon apogee
Nov. 7, 2012	Last quarter Moon
Nov. 13, 2012	New Moon
Nov. 13, 2012	Solar eclipse
Nov. 14, 2012	Moon perigee
Nov. 17, 2011	*Leonids* meteor shower
Nov. 20, 2012	First quarter Moon
Nov. 28, 2012	Full Moon
Nov. 28, 2012	Moon apogee
Nov. 28, 2012	Lunar eclipse
Dec. 6, 2012	Last quarter Moon
Dec. 12, 2012	Moon perigee
Dec. 13, 2012	New Moon
Dec. 13, 2011	*Geminids* meteor shower
Dec. 20, 2012	First quarter Moon
Dec. 22, 2011	*Ursids* meteor shower
Dec. 25, 2012	Moon apogee
Dec. 28, 2012	Full Moon
Jan. 4, 2012	*Quadrantids* meteor shower
Jan. 5, 2013	Last quarter Moon
Jan. 10, 2013	Moon apogee
Jan. 11, 2013	New Moon
Jan. 18, 2013	First quarter Moon
Jan. 22, 2013	Moon perigee
Jan. 27, 2013	Full Moon
Feb. 3, 2013	Last quarter Moon
Feb. 7, 2013	Moon apogee
Feb. 10, 2013	New Moon
Feb. 17, 2013	First quarter Moon
Feb. 19, 2013	Moon perigee
Feb. 25, 2013	Full Moon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Summer 2012 VHF Report: Unique *E*-Region VHF Propagation Events

Despite this past summer's overall dismal VHF propagation, there were some unique highlights. WB2AMU reports on four of them and summarizes their respective effects.

By Ken Neubeck,* WB2AMU

For many VHF operators located in North America, the summer of 2012 was not an exceptionally good one in comparison to previous summer seasons. For some areas of North America there did not seem to be as many sporadic-*E* openings present and only a handful of transatlantic openings occurred. In fact, for many located in the southeast U.S., it seemed to be a bad summer overall for 6-meter sporadic-*E* activity.

As mentioned in my last article published in the Summer 2012 issue of *CQ VHF* magazine, the June ARRL VHF contest had significant 6-meter sporadic-*E* activity that was observed in many areas of North America on both days of the contest. However, sporadic-*E* activity for the balance of June and July seemed to be uneven at best.

With regard to 6-meter transatlantic openings from my location on Long Island, New York (Grid FN30), I observed a few days of 6-meter activity into Europe during the summer. Early in the season, on June 8th, I worked CU1JT at 1410 UTC off the back of the beam on CW. This opening followed an evening of heavy activity from my QTH into the Midwest, along with some double-hop into Arizona and New Mexico.

My most significant opening into Europe occurred on the evening of June 22, when at 2315 UTC, from my home station, I worked MMØAMW on CW, followed by several more UK and western European stations worked on CW over the next 90 minutes: G4RRA, EI4DQ, G4RGK, G4IGO, G3WZT, and F6KHM. My final opening to Europe occurred while I was at work during the morning of July 3 using my portable setup from my car, 50 watts and a mag mount vertical. I worked GØTSM and G4BUE at 10:35 a.m. local time.

However, in general, for most 6-meter stations located in the Northeast, the number of transatlantic openings seemed to be somewhat fewer compared to the summer of 2011. For many stations in the U.S. it appeared that there were less sporadic-*E* openings overall, but there were a few very good ones in terms of quality, such as the major June 6-meter opening between the Pacific Northwest and Europe, along with a significant 2-meter July opening in the eastern U.S. These would be joined by other *E*-layer events

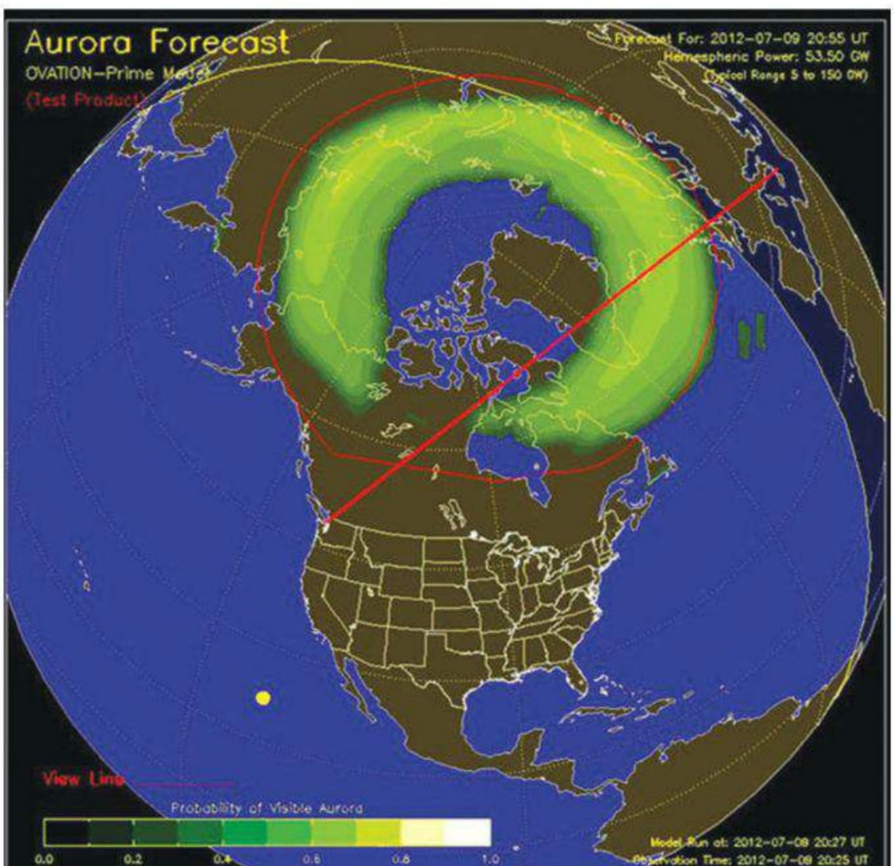

Figure 1. This is a general plot of the path between the Pacific Northwest and Europe on June 29. (NOAA ovation plot modified by Steve McDonald, VE7SL to show path).

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such as aurora and combination modes that are discussed in detail in the following sections of this article.

Event 1: 6-meter Sporadic-*E* opening between the Pacific Northwest into Europe

A major event occurred on June 24 with a multiple-hop sporadic-*E* opening between the Pacific Northwest (PNW) and Europe. This report comes primarily by way of Steve McDonald, VE7SL, in British Columbia, who was one of the more active stations during the opening and was kind enough to provide me with details of his observations, along with reports from others in his area.

On the morning of June 24, Steve checked the ON4KST spotting site (http://www.on4kst.com) for possible 6-meter activity when he saw that W7FI, also from the Pacific Northwest area, worked CT1HZE on CW on 6 meters. Steve quickly went into his shack, heard and then worked Joe, CT1HZE, on CW. After working Joe, Steve was hearing other weak CW signals, all at less than 559 signal strength and not lasting for more than 30 to 60 seconds before fading. Propagation continued in this manner with signals coming and going in waves, as it was either feast or famine. Steve noted that during the entire four-hour opening no European TV video signals in the 40-MHz range were heard. However, all three VE4 beacons and station VA5MG were loud and fluttery throughout. At times VE6TA (very rarely even heard at his QTH) was as strong as local VE7XF. Steve's contacts are provided in Table 1 with the new 6-meter DXCC countries for him shown in bold. Figure 1 shows the general path as plotted by Steve from the PNW into Europe.

In addition to Steve, several other stations from the PNW did well, also with QSOs into Europe. Stations such as N7DB, W7EW, VE7AG, K7RWT, and VE7XF worked some of the stations that Steve worked, particularly the UK and Scotland, with both W7EW and K7RWT managing to work SV1DH. All of these stations noted that many of the signals from Europe were weak and these stations found CW as the best way to go.

Steve also managed to score another new country on 6 meters, a QSO with 4Z4UF on July 13 at 1440 UTC, which is early in the day (7:40 a.m. PDT). Steve noted that overall the sporadic-*E* season for the summer of 2012 in his area was the worst in many years in terms of "hours of *Es*" but was the best in his 40+ years on 6 meters in terms of the quality of openings, leading to a very odd summer indeed.

This opening is of special importance to the PNW stations because a multiple-hop sporadic-*E* event in the right direction is pretty much the only propagation mode that would allow them to work Europe on 6 meters. *F2* openings on 6 meters typically are one-hop paths when running the east-west direction, covering about 3000 miles in one hop, so that method is not too promising. Thus, this was a major event for the PNW stations in working new DXCC countries on 6 meters!

QSOs made by VE7SL (CN88) June 29, 2012

Time (UTC)	Callsign	Frequency (MHz)	Mode
1321	CT1HZE	50.0	CW
1341	DJ6YX	50.0	CW
1347	CT1HZE	50.1	SSB
1350	**SP3RNZ**	50.0	CW
1355	SP2DDX	50.0	CW
1411	DL7CM	50.0	CW
1414	DL9USA	50.0	CW
1415	**F8DZY**	50.0	CW
1418	F8GGD	50.0	CW
1421	DK3WG	50.0	CW
1436	CT1FJC	50.0	CW
1439	ON4AXU	50.0	CW
1452	**GM3YTS**	50.0	CW
1508	IT9TYR	50.0	CW
1509	GM4WJA	50.0	CW
1510	**LZ2WO**	50.0	CW
1517	SP3AGE	50.0	CW
1524	LZ2CC	50.0	CW
1525	F5BZB	50.0	CW
1605	**SV1DH**	50.0	CW
1610	**LY2IJ**	50.0	CW
1630	**EI4KF**	50.0	CW
1638	G4RGK	50.0	CW
1640	G4WJS	50.0	CW
1649	G4FUF	50.0	CW
1651	S57RR	50.0	CW
1655	S57A	50.0	CW
1658	IK5MEJ	50.0	CW
1706	EA8CQS	50.0	CW
1706	MMØAMW	50.0	CW
1724	ON4IQ	50.0	CW

Table 1. Stations VE7SL worked on June 29, 2012. Note: New DXCC countries on 6 meters for VE7SL are shown in bold.

Event 2: 6-meter Aurora Opening on July 15, 2012

Through tracking of solar activity during the second week of July, it could be seen that there was the possibility of Earth-directed solar events from active sunspot regions of the Sun. Indeed, the warnings were sounded with the *Kp* index reaching 6 on Sunday, July 15. VHF operators in North America stood by patiently to see when the aurora borealis would extend into the lower latitudes in order to reflect radio signals.

It appears that the approximate time this occurred was 1900 UTC, or 3 p.m. EDT (1900 UTC). At that point I was hearing a number of Canadian stations from Ontario such as VE3KU, VE3EN, VE3FGU, and VE3NG. Their signals were readable but unfortunately not to the point where they could hear my sig-

Two-meter QSOs made by WB2AMU (FN30) on July 24, 2012
Station Setup: Mobile, 40 Watts, 3-element Yagi @ 12 feet

Time (UTC)	Callsign	Grid	Frequency (MHz)	Mode
2217	K8TQK	EM89	144.195	SSB
2220	KØWYN	EM48	144.190	SSB
2221	KF4WE	EM56	144.200	SSB
2251	KB5MR	EM25	144.190	SSB
2256	KØCIY	EM25	144.210	SSB
2300	K5SW	EM25	144.170	SSB
2304	WØBLD	EM37	144.225	SSB

Table 2. Two-meter QSOs made by WB2AMU (FN30) on July 24, 2012.

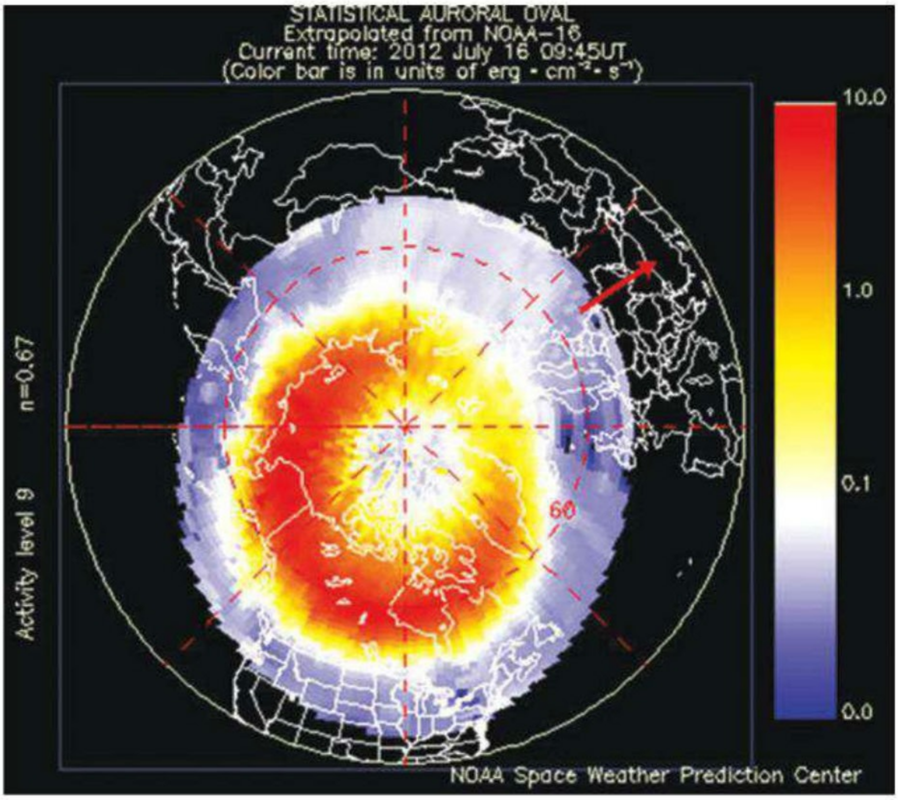


Figure 2. This is a plot of the aurora the day after the moderate aurora opening on Six Meters of July 15th in the Northern Hemisphere. (Plot courtesy of NOAA).

nals. I did manage to work K2AXX in FN12 from my home in FN30 and then I had to leave for a family function. During the next few hours, I was able to hear a few signals from the Midwest US from my mobile setup from the event. When I got home at around 8 p.m. EDT (0000 UTC), I managed to work K2MUB in FN21 and then the band faded. Figure 2 shows the extended aurora plot by NOAA for early July 16.

It is interesting to see that a fairly significant event took place during July from solar impact. During the early spring of 2012, there were a number of potential events from direct hits on the earth's magnetic field from solar events, yet only a few high-latitude aurora events were observed in North America.

This event may be a potential predictor of upcoming solar events for the fall of 2012 in North America. For the most part, the sunspot count has been averaging around 100 during the summer months, with the solar flux approaching 130. Early geomagnetic activity indicators fseem to indicate that more aurora events are likely during the fall of 2012, and hopefully this will translate into some *F*-layer related events, both in the form of *F2* and TEP (transequatorial propagation).

The problem with Cycle 24 so far is that the solar activity does not appear to be sustainable. There have been some good periods of solar activity building up during the past year, but then it seems to lose steam and drop into a weak period of low sunspot counts and solar flux. The experts have already predicted that Cycle 24 probably will be a less-than-average solar cycle, and there are signs so far that seem to support this. Figure 2 is a plot of the aurora the day after the moderate aurora opening on 6 meters of July 15 in the Northern Hemisphere (plot courtesy of NOAA).

Event 3: Two-meter Sporadic-*E* Opening on July 24, 2012

At 5:30 p.m. EDT (2130 UTC) from home on Long Island (FN30), I observed that there were many strong signals on 6 meters that were coming from a fairly short distance away. Over the next 30 minutes I worked KB8ZMJ (EM99), K8BEG (EN80), K8VBL (EN62), W8IDM (EN61), and W9FR (EM69). I even found double-hop sporadic-*E* on 6 meters and had a QSO with K7JE from DM33 in AZ. By 2200 UTC I went to my car to listen on 2 meters using a magmount vertical. (I do not have a permanent 2-meter setup in my house.) I started hearing some weak SSB.

I then set up my three-element 2-meter Yagi on the rooftop of my car, with 40 watts from my FT-857, while the car was in the driveway and found rising and fading signals coming in from the west. After I worked three stations using this setup, I then moved to a parking field (see photo 1) about a mile away to work four more stations. I missed a couple of W4 stations in grids that I needed on 2 meters, but all in all it was a good effort. K5SW had the best and most consistent signal for the duration of the one-hour opening. Please see Table 2 for contacts that I made. All of the contacts were made using SSB. By 2315 UTC, all skip signals had faded for me on 2 meters. At that point, the rain came for a few minutes and I then was treated to a rainbow—a lucky sporadic-*E* rainbow? (See photo 2)

After the 2-meter sporadic-*E* opening subsided, there were still a lot of signals coming in on 6 meters, including those coming in via double-hop sporadic-*E*. I worked some new grids during the opening as well. Beginning at 2354 UTC, I worked KEØUI (DM78), KØYW (EM67) and K5ZG (DM88), all on CW.

Two-meter sporadic-*E* openings are pretty rare in some parts of the U.S. and they typically last for less than an hour. The last 2-meter sporadic-*E* opening for me was on July 6, 2004, with an opening that began at 2200 UTC, and it lasted for an hour. That was almost eight years ago!

I then collected observations from other stations that participated in the opening using different sources, including direct contact via e-mail. Station log data came from Ron, WZ1V (FN31), Chris, W3CMP (FN10), and Chad, NØYK (DM98) with their contact data shown in Tables 3A, B, C, and Tables 4 and 5. It is observed that all of these QSOs were SSB only. It would seem that during the riding of the signals going up and down, SSB seemed to be the best way to go, rather than CW, because of the "shout quickly" factor. Also, I was able to collect log information from Sam, K5SW. Sam initially was mobile when he worked W3CMP at around 2230 UTC and then got home quickly to work over 40 stations in a 10-grid group beginning at 2252 UTC as shown in Table 6. Clearly, K5SW was the station that cleaned up the most during this opening!

Note the different setups that were used by these stations regarding antennas and power. Power was not necessarily a lim-

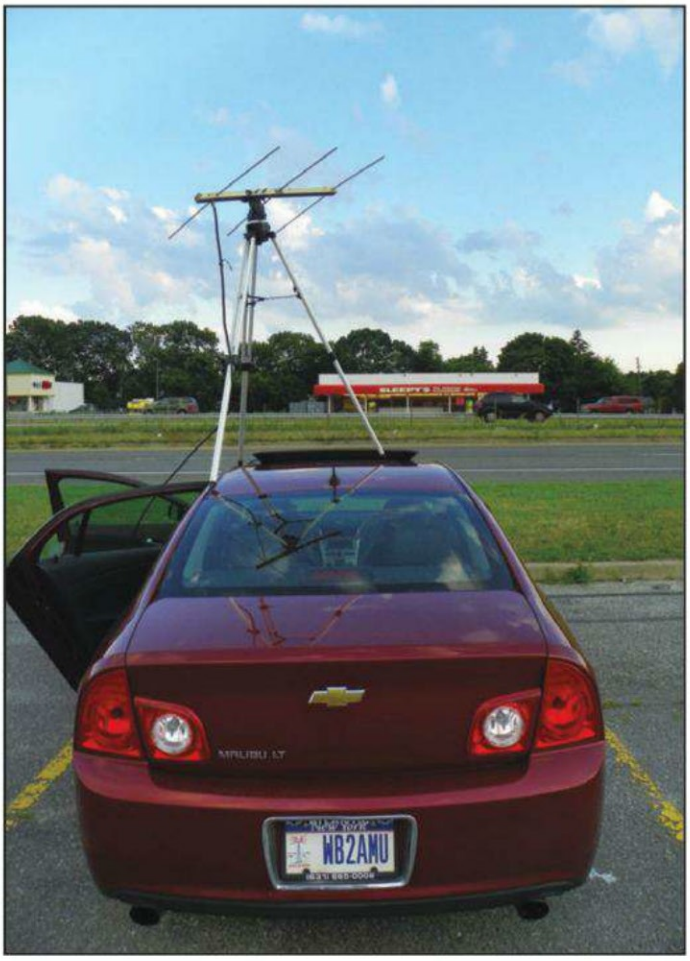


Photo 1. This is the author's portable setup at a park and ride parking lot located in Patchogue, Long Island (Grid FN30) in which he set up a three-element Yagi positioned on the roof of his car pointed southwest. (Photo by Ken Neubeck, WB2AMU)

Two-meter QSOs made by WZ1V (FN31) on July 24, 2012
Station Setup: Home, 250 watts, 6-element Yagi @ 42 feet

Time (UTC)	Callsign	Grid	Frequency (MHz)	Mode
2146	KA9CFD	EN40	144.205	SSB
2155	WØFY	EM48	144.205	SSB
2202	WØSRB	EM48	144.205	SSB
2206	W8WN	EM77	144.205	SSB
2208	K8TQK	EM89	144.205	SSB
2209	K9KUF	EM58	144.205	SSB
2216	KF4WE	EM56	144.205	SSB
2225	W4AW	EM55	144.205	SSB
2233	AG4V	EM55	144.205	SSB
2236	KØDOK	EM48	144.205	SSB
2241	KØAZ	EN37	144.205	SSB
2245	KØCIY	EM25	144.205	SSB
2246	W7QJQ	EM25	144.205	SSB
2251	K5SW	EM25	144.205	SSB
2256	K5KDX	EM35	144.205	SSB
2306	W5MRB	EM35	144.205	SSB

Table 3. Two-meter QSOs made by WZ1V (FN31) on July 24, 2012.

iting factor as evidenced by Chad, NØYK, who used a transverter setup that puts out 8 watts. Directional antennas, particularly those with more elements and decent height, were important. Figures 3A through 3C show some interesting grid-square plots based on QSOs made by WB2AMU, WZ1V, and K5SW, revealing the tight area of coverage that was worked during the one-hour opening.

A number of interesting things can be gleaned from looking at these tables and figures. It is most likely that at the point when K8TQK was worked by East Coast stations—2208 UTC for WZ1V (FN31) and 2217 UTC for WB2AMU (FN30) on 2 meters—probably was when 222 MHz was open. This is suspected because EM89 to FN30 and FN31 is a fairly short distance that is representative of the "shortening" of the skip (or increased sporadic-*E* formation density that can reflect higher frequency radio waves). There were a few reports of 222-MHz

Two-meter QSOs made by W3CMP (FN10) on July 24, 2012
Station Setup: Home, 1500 Watts, 18-element Yagi @ 45 feet

Time (UTC)	Call sign	Grid	Frequency (MHz)	Mode
2221	KF4WE	EM55	144.2	SSB
2229	KB5MR	EM25	144.2	SSB
2230	W5KI	EM36	144.2	SSB
2232	KØAZ	EM37	144.2	SSB
2233	K5SW/M	EM25	144.2	SSB
2238	K5YY	EM26	144.2	SSB
2242	KØDOK	EM48	144.2	SSB
2243	WAØCNS	EM48	144.2	SSB
2243	W7QJQ	EM25	144.2	SSB
2243	KØCIY	EM25	144.2	SSB
2247	WØFY	EM48	144.2	SSB
2251	KD5OLB	EM25	144.2	SSB
2255	K5KDX	EM25	144.2	SSB
2259	WØBLD	EM37	144.2	SSB
2303	K5KDX	EM25	144.2	SSB
2309	N5UWY	EM15	144.2	SSB
2316	AF5CC	EM04	144.2	SSB
2324	N5IZ	EM04	144.2	SSB
2328	NØYK	DM98	144.2	SSB
2334	KD5ZVE	EM26	144.2	SSB
2352	WB5AFY	EM04	144.2	SSB

Table 4. Two-meter QSOs made by W3CMP (FN10) on July 24, 2012.

Two-meter QSOs made by NØYK (DM98) on July 24, 2012
Station setup: Home, 8 Watts, 12-element Yagi @ 20 feet

Time (UTC)	Callsign	Grid	Frequency (MHz)	Mode
2319	K4SAN	FM05	144.2	SSB
2320	K4TRT	EM97	144.2	SSB
2320	K4QI	FM06	144.2	SSB
2323	KX4DX	EM96	144.2	SSB
2328	W3CMP	FN10	144.2	SSB
2344	W4RVZ	FM16	144.2	SSB

Table 5. Two-meter QSOs made by NØYK (DM98) on July 24, 2012.

signals being heard by some stations in this trajectory via sporadic-*E* during the opening. Keep in mind that sporadic-*E* formations are not necessarily uniform in terms of density throughout the entire formation, where some parts of the formation may be very dense in order to reflect higher frequency radio waves, which apparently is the case when parts of the formation are dense enough to reflect 6-meter signals, a subset of that able to reflect 2-meter signals and a much smaller portion that could reflect 222-MHz signals.

Overall, it was a very good day for both 2 and 6 meters. With the MUF (maximum usable frequency) going up and many formations around, it becomes very hard for a VHF operator to

DN92	EN02	EN12	EN22	EN32	EN42	EN52	EN62	EN72	EN82	EN92	FN02	FN12	FN22	FN32
DN91	EN01	EN11	EN21	EN31	EN41	EN51	EN61	EN71	EN81	EN91	FN01	FN11	FN21	FN31
DN90	EN00	EN10	EN20	EN30	EN40	EN50	EN60	EN70	EN80	EN90	FN00	FN10	FN20	**FN30**
DM99	EM09	EM19	EM29	EM39	EM49	EM59	EM69	EM79	EM89	EM99	FM09	FM19	FM29	------
DM98	EM08	EM18	EM28	EM38	EM48	EM58	EM68	EM78	EM88	EM98	FM08	FM18	FM28	------
DM97	EM07	EM17	EM27	EM37	EM47	EM57	EM67	EM77	EM87	EM97	FM07	FM17	FM27	------
DM96	EM06	EM16	EM26	EM36	EM46	EM56	EM66	EM76	EM86	EM96	FM06	FM16	FM26	------
DM95	EM05	EM15	EM25	EM35	EM45	EM55	EM65	EM75	EM85	EM95	FM05	FM15	FM25	------
DM94	EM04	EM14	EM24	EM34	EM44	EM54	EM64	EM74	EM84	EM94	FM04	FM14	FM24	------
DM93	EM03	EM13	EM23	EM33	EM43	EM53	EM63	EM73	EM83	EM93	FM03	FM13	------	------
DM92	EM02	EM12	EM22	EM32	EM42	EM52	EM62	EM72	EM82	EM92	FM02	------	------	------
DM91	EM01	EM11	EM21	EM31	EM41	EM51	EM61	EM71	EM81	EM91	------	------	------	------
DM90	EM00	EM10	EM20	EM30	EM40	EM50	EM60	EM70	EM80	EM90	------	------	------	------
DL99	EL09	EL19	EL29	EL39	EL49	EL59	------	EL79	EL89	EL99	------	------	------	------

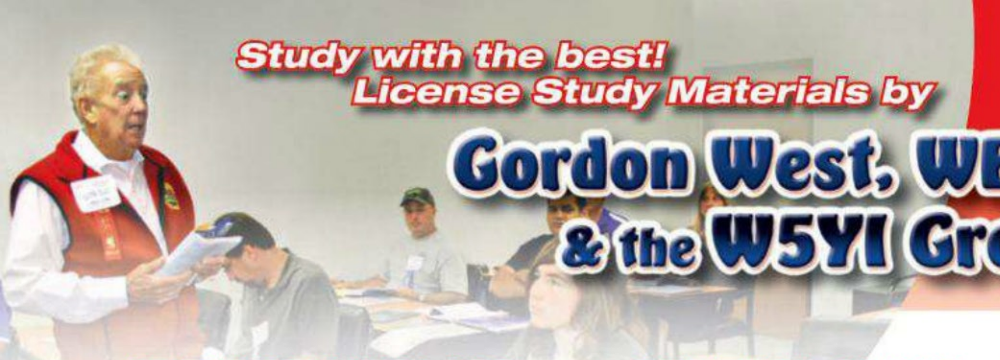
Figure 3A. Plot of grids worked by WB2AMU (FN30) on 2 meters. Blue indicates QTH. Yellow indicates worked grids.

DN92	EN02	EN12	EN22	EN32	EN42	EN52	EN62	EN72	EN82	EN92	FN02	FN12	FN22	FN32
DN91	EN01	EN11	EN21	EN31	EN41	EN51	EN61	EN71	EN81	EN91	FN01	FN11	FN21	**FN31**
DN90	EN00	EN10	EN20	EN30	EN40	EN50	EN60	EN70	EN80	EN90	FN00	FN10	FN20	FN30
DM99	EM09	EM19	EM29	EM39	EM49	EM59	EM69	EM79	EM89	EM99	FM09	FM19	FM29	------
DM98	EM08	EM18	EM28	EM38	EM48	EM58	EM68	EM78	EM88	EM98	FM08	FM18	FM28	------
DM97	EM07	EM17	EM27	EM37	EM47	EM57	EM67	EM77	EM87	EM97	FM07	FM17	FM27	------
DM96	EM06	EM16	EM26	EM36	EM46	EM56	EM66	EM76	EM86	EM96	FM06	FM16	FM26	------
DM95	EM05	EM15	EM25	EM35	EM45	EM55	EM65	EM75	EM85	EM95	FM05	FM15	FM25	------
DM94	EM04	EM14	EM24	EM34	EM44	EM54	EM64	EM74	EM84	EM94	FM04	FM14	FM24	------
DM93	EM03	EM13	EM23	EM33	EM43	EM53	EM63	EM73	EM83	EM93	FM03	FM13	------	------
DM92	EM02	EM12	EM22	EM32	EM42	EM52	EM62	EM72	EM82	EM92	FM02	------	------	------
DM91	EM01	EM11	EM21	EM31	EM41	EM51	EM61	EM71	EM81	EM91	------	------	------	------
DM90	EM00	EM10	EM20	EM30	EM40	EM50	EM60	EM70	EM80	EM90	------	------	------	------
DL99	EL09	EL19	EL29	EL39	EL49	EL59	------	EL79	EL89	EL99	------	------	------	------

Figure 3B. Plot of grids worked by WZ1V (FN31) on 2 meters. Blue indicates QTH. Yellow indicates worked grids.

DN92	EN02	EN12	EN22	EN32	EN42	EN52	EN62	EN72	EN82	EN92	FN02	FN12	FN22	FN32
DN91	EN01	EN11	EN21	EN31	EN41	EN51	EN61	EN71	EN81	EN91	FN01	FN11	FN21	FN31
DN90	EN00	EN10	EN20	EN30	EN40	EN50	EN60	EN70	EN80	EN90	FN00	FN10	FN20	FN30
DM99	EM09	EM19	EM29	EM39	EM49	EM59	EM69	EM79	EM89	EM99	FM09	FM19	FM29	------
DM98	EM08	EM18	EM28	EM38	EM48	EM58	EM68	EM78	EM88	EM98	FM08	FM18	FM28	------
DM97	EM07	EM17	EM27	EM37	EM47	EM57	EM67	EM77	EM87	EM97	FM07	FM17	FM27	------
DM96	EM06	EM16	EM26	EM36	EM46	EM56	EM66	EM76	EM86	EM96	FM06	FM16	FM26	------
DM95	EM05	EM15	**EM25**	EM35	EM45	EM55	EM65	EM75	EM85	EM95	FM05	FM15	FM25	------
DM94	EM04	EM14	EM24	EM34	EM44	EM54	EM64	EM74	EM84	EM94	FM04	FM14	FM24	------
DM93	EM03	EM13	EM23	EM33	EM43	EM53	EM63	EM73	EM83	EM93	FM03	FM13	------	------
DM92	EM02	EM12	EM22	EM32	EM42	EM52	EM62	EM72	EM82	EM92	FM02	------	------	------
DM91	EM01	EM11	EM21	EM31	EM41	EM51	EM61	EM71	EM81	EM91	------	------	------	------
DM90	EM00	EM10	EM20	EM30	EM40	EM50	EM60	EM70	EM80	EM90	------	------	------	------
DL99	EL09	EL19	EL29	EL39	EL49	EL59	------	EL79	EL89	EL99	------	------	------	------

Figure 3C. Plot of grids worked by K5SW (EM25) on 2 meters. Blue indicates QTH. Yellow indicates worked grids.



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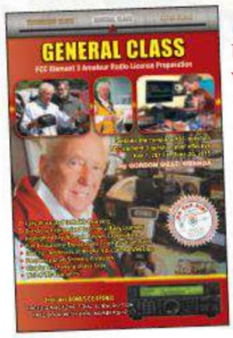

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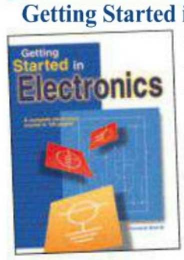

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pick the band on which to focus (double-hop going on 6 meters and sporadic-*E* on 2 meters!).

In figures 3A and 3B it can be seen that the QSOs made by WB2AMU and WZ1V with K8TQK in EM89 stood out, as it was clearly the shortest path of the grids worked and probably at that specific time (around 2208 to 2217 UTC) it was indicative of a 222-MHz opening in that general trajectory based on the MUF distance formula. In Figure 3C, K5SW worked all of his QSOs in a tight 10-grid grouping, indicating a well-defined cloud formation and somewhat stable MUF value at just above 144 MHz.

Event 4: Early September Sporadic-*E* openings, and TEP plus Sporadic-*E* Paths on 6 meters

During the early part of September there were a number of solar impacts that glanced by the Earth and created geomagnetic activity such that the *Kp* index reached 6 for a few days. This created some aurora events in Europe and some in high latitudes in North America. It stirred up some TEP activity on 6 meters between South America and the southern U.S. During this time, the solar flux index was in the 130 to 140 range, which is generally sufficient for TEP to occur during the equinox periods.

On September 5, at around 2100 UTC, a number of stations in the Ohio area were hearing the LU6EE beacon on 6 meters. At the same time stations in Florida were being heard and worked. I worked K4LO in EM60 at 2109 UTC, meaning that a potential sporadic-*E* link was present to connect to the TEP that was also present at that time. At 2150 UTC I heard CE4WJK on SSB on 50.130 MHz from my QTH on Long Island off and on for about 15 minutes but was not able to get him. However, several New England stations managed to work him and hopefully this fall I will have an opportunity to finally work Chile for a new country on 6 meters.

The following day, September 6, saw a very similar opening. I was able to work

Summary of Grids worked by K5SW (EM25) on July 24, 2012 (SSB unless indicated)
Home station setup: 240 Watts, 18-element Yagi @ 72 feet

Grid	Number	Callsigns
FM08	1	K4RTS
FM09	2	N4MM, K3JYD
FM18	4	K1HTV, KE2N, W4CLJ, K1RA/M (CW)
FM19	4	N3ALN, W3BNN, K8GU, K3ARN
FM29	1	K3GNC
FN10	4	W3CMP, NZ3M, K3TUF, KB3TNZ
FN20	14	K2TXB, N2NT, K2RMX, W2QEG, WB2CUT, K3EMG, WA2ONK, N2LT, W2BVH, KA3KDL, K2DZM, N3TVV (CW), WØRSJ, K2KV
FN21	1	WA2FGK
FN30	5	W2MGF, KC2JRQ, N2YBB, WB2AMU, AA2DR
FN31	4	WB2SIH, W1COT, K1TEO (CW), K1PXE (CW)

Table 6. Summary of grids worked by K5SW (EM25) on July 24, 2012 (SSB unless indicated).

Photo 2. Shortly after the great sporadic-E opening ended, there was a brief period of rain, followed by a "lucky" rainbow that was seen to the east of the author's portable setup. (Photo by WB2AMU)

LU7YS at 2211 UTC, shortly after he worked NY2NY, who is 30 miles to the east of me on Long Island. LU7YS's signal was not too strong and there was QSB. He was the only station I was able to hear. While I did not hear any stations via the sporadic-*E* link, stations in the Texas area (where the sporadic-*E* link would have started) were working LU7YS.

What was great about these openings is that a rare September sporadic-*E* opening was present and connected to the TEP path, allowing many stations in the northeastern U.S. and Canada to work Chile and Argentina. Because of the time of year and consistent nature of the openings, there may be some question as to whether the sporadic-*E* link is a conventional sporadic-*E* link or some kind of forward *E*-layer scatter.

There is some indication that there is an unusual pattern of sporadic-*E* openings for September of 2012. This year's ARRL September VHF contest was held on September 8 and 9, and on both days sporadic-*E* was observed on 6 meters. On Saturday evening there was opening from the northeast into the south on 6 meters and I managed to work N4NH in North Carolina and heard a few others. On Sunday morning around 9:45 a.m. EDT (1345 UTC), I finally worked W4AS (EL95) and N4BP (EL96) after several tries on 6 meters. These stations were using SSB and were in for several minutes, but the signals were not super strong like a typical summertime sporadic-*E* opening and I had to resort to using CW from my QRP setup to work both of these stations. Later on Sunday evening the band was open for several hours after 8 p.m. EDT (0000 UTC) from the northeast into Florida and I managed to get KN4Y (EM70) and N3LL (EL86). Again, the opening was modest in strength, but the duration was very long for a September sporadic-*E* opening! This was the first time I have ever observed sporadic-*E* for during all three ARRL VHF contests in one year and on both days of the contest!

Later I learned that on both days during the contest weekend New England stations were able to work into Brazil, indicating the presence of a sporadic-*E* link to the evening TEP path on 6 meters. Stations such as Lefty, K1TOL, and others in Maine were able to work CX9AU and CX8DS during Saturday evening, along with LU and PY stations. This may be the first time ever that so many stations in the September VHF contest were able to work DX stations via the TEP mode for points! In any event, this unusual propagation will put a lot of stations on alert for the next 60 days or so, up to the beginning of November to listen around 2100 UTC for more potential sporadic-*E* plus TEP paths. These unusual happenings will warrant further investigation, and I will be collecting data with the possibility of a future article that further examines this.

Summary

While it is expected that the solar activity is enough to create occasional TEP events on 6 meters, it will be a very interesting effort to try to predict what type of *F2* activity may occur on the band as well. The solar activity for Cycle 24 has been increasing in general, but it will be hard to state that activity levels similar to Cycle 23 will be reached on the HF bands as well as 6 meters. It seems that every time the Sun seems to be pushing in a positive direction, there are periods of interruption where low sunspot counts are observed. All that can be stated is that regular listening on the band and monitoring of Internet spotting sites should reward those who are patient in the quest to catch that occasional opening.

I want to thank several stations for providing input to the this article: Chris, W3CMP, Steve VE7SL, Ron, WZ1V, Chris, W3CMP, Sam, K5SW, and Chad, NØYK. Their reports helped captured these interesting events and allowed for better definition of the unique *E*-layer events that occurred during the summer of 2012.

Six-Meter Antenna Coupler

Most of us who operate on the Magic Band use Yagi antennas. Occasionally, some of us want to experiment with more unusual antennas for 6-meter operation. Here K8VBL describes a simple antenna tuner that makes these antennas work more efficiently.

By Thomas M. Turner,* K8VBL (ex-VP2VEL)

The use of coax-cable-fed Yagi antennas has become nearly universal among 6-meter enthusiasts. However, use of an antenna coupler to match the nominal 50-ohm output of a transceiver to a balanced high-impedance two-wire feedline will open many new possibilities for antenna experimentation. For instance, the following driven arrays have reactive high-impedance feed points. These interesting bi-directional wire-type antennas, as described in most of the older *ARRL Antenna Handbooks*, are conveniently fed via low-loss balanced feedlines such as 300-ohm "window line" or 450-ohm ladder line. An antenna coupler has the capability to "tune out" the reactance at the feedline input and transform the relatively high impedance to 50 ohms.

Sterba curtain array: gain 6 to 8 dBd
Lazy H: gain 6 dBd
Horizontal V-beam (one-half of a rhombic antenna) Eight wavelengths at 6 meters is only 156 feet of wire on each leg of the "V." With an angle of 35 degrees between the legs, a low-radiation angle gain of 9 dBd is realized.

A universal 1/2-wavelength open-wire stub plus 1/2-wave coaxial balun can be used to match the above antennas to a 50-ohm coaxial line. However, this is a relatively narrow-band matching system and cannot accommodate excursions in the 4-MHz-wide 6-meter band without excessive standing-wave ratio. Use of a balanced antenna coupler allows SWR adjustments to quickly be made with one tuning control in the shack.

The following antenna coupler design is adapted from the "Bandmaster Z-Match" which was manufactured by Harvey-Wells Electronics, Southbridge, Massachusetts, popular in the 1950s. It is described as a "multi-band 80–10 meter coupler" in the *RSGB Amateur Radio Handbook*, Third Edition, 1963, p. 370, and in the *ARRL Antenna Handbook*, Tenth Edition, 1964, p. 98. A design that employs a toroidal transformer is shown in the *ARRL Handbook for Radio Communications*, 2011 Edition, p. 24.1. Advantages of this design over the typical two-circuit type that employs a difficult to find split-stator capacitor and tapped secondary coil are: A common single-section variable capacitor is used and the tuned circuit is not tapped. The tapped coil introduces losses due to circulating current.

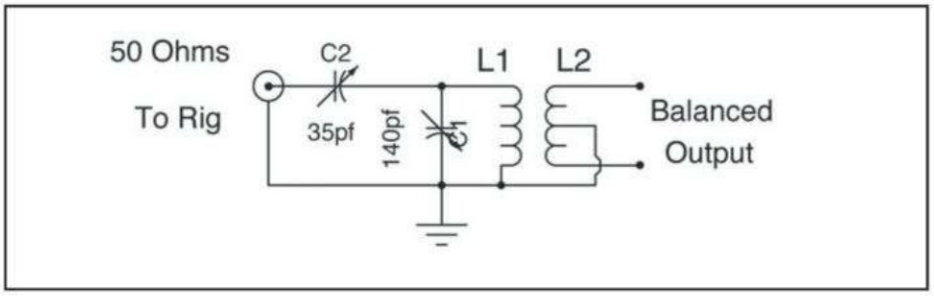

Fig. 1– Schematic diagram of the tuner.

Referring to the circuit diagram, fig.1, capacitor C1 and primary coil L1 form a tuned circuit that resonates at the operating frequency. Secondary coil L2, connected to the balanced feedline, couples any reactance that may exist at the feedline input, either capacitive or inductive, into L1. C1 is then adjusted to tune out the reactance so that the impedance at the "hot" (ungrounded) end of L1–C1 is purely resistive. Then, capacitor C2 is adjusted to provide an impedance match between the 50-ohm coaxial input and the tuned circuit. Each capacitor is adjusted

Photo 1– Front view of the tuner. (Photos by the author)

*Apple Hill Farm, 8530 N. Branch Rd., Watervliet, MI 49098


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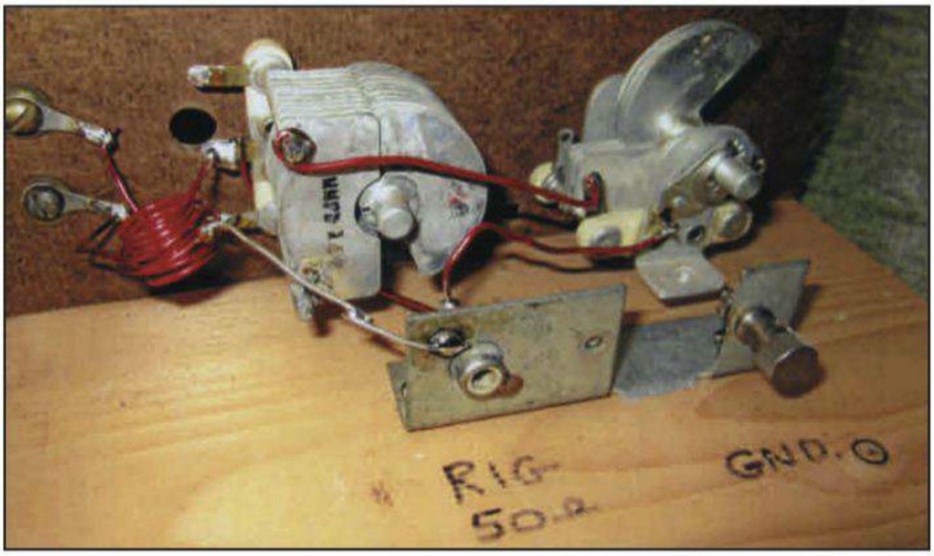

Photo 2– Interior view.

a little at a time until the SWR indicator shows zero reflected power. When so tuned, only C1 requires readjustment over a 2-MHz band excursion.

The coils each consist of approximately two turns of #16 AWG enameled copper wire. The exact number of turns is not critical, as C1, 140 pF, has sufficient range to resonate L1. The inside diameter of L1 is 1/2 inch, and may conveniently be wound in the threads of a 1/2-13 bolt and then unscrewed from the bolt. Coil L2, centered over L1, has an inside diameter of about 5/8 inch and is center tapped. The grounded center tap ensures that the output voltage and current will truly be balanced.

Photos 1 and 2 show the prototype coupler, built on a wood chassis with junk parts, the binding posts having been salvaged from an old telegraph relay and the dials from a non-descript old battery set. Two problems were noted with the prototype:

First, because of capacitor C2 floating above ground, excessive "hand capacitance" existed when the capacitor was being adjusted. This was entirely overcome in the final coupler, photo 2, left, and photos 3, 4, and 5, by using a RadioShack project box shielded enclosure plus an insulating shaft coupling on C2. An insulated mount for C2 was made by sawing an "L" bracket out of a comer of a plastic box.

The coaxial input connector is an RCA phono jack. These inexpensive connectors feature simple single-hole mounting and low-loss ceramic insulation. They cause a minimal impedance "bump" at 50 MHz. Measurement of the coupler output showed that the voltages were not balanced to ground. Rearrangement of the coils to center L1 within L2 and bring L2's center tap directly to chassis ground resulted in good voltage balance at the coupler's output. If feedline current is not the same in each wire, radiation from the feedline will reduce the antenna system's efficiency.

Over the years, I have used a number of home-brew antenna couplers, both HF and VHF, of various designs, and wondered about their efficiency. How much energy, both transmitting and receiving, was lost in these handy devices?

To determine efficiency, a 300-ohm nonreactive 2-watt resistor was connected across the coupler's antenna terminals, and a few watts of power were fed into the 50-ohm input. The capacitors were adjusted to provide an input SWR of 1:1. A VTVM and RF probe were used to measure the voltage at the input, and the sum of the voltages to ground from each side of the 300-ohm load resistor. Squaring these voltage indications and dividing by respective resistances gave a power transfer efficiency of only 55! In an attempt to improve efficiency by reducing leakage reactance of the coils, new coils were made that increased the L/C ratio. Efficiency was practically unchanged! I then checked the efficiency of another 6-meter coupler that utilized the classic ARRL design as shown in most of its VHF handbooks.

Calculated efficiency of this coupler was about 63 percent. Some may question the accuracy of using an RF probe and a 60-year-old Heathkit VTVM, and then squaring the voltage indication. While the VTVM and probe accuracy are certainly doubtful, repeatability of the measurements was good. The same VTVM range was used for all measurements. It occurred to me that the 50-MHz signal at the coupler's input may contain harmonic energy which was filtered out by the tuned circuits, thus accounting for the lower energy at the output.

A 100-MHz scope showed both input and output wave shapes were good sinusoids. This was substantiated by the fact that the SWR on the coax feedline to the coupler could be reduced to 1:1. Any significant amount of harmonic energy would have shown up as reflected power such that the coupler could not have been

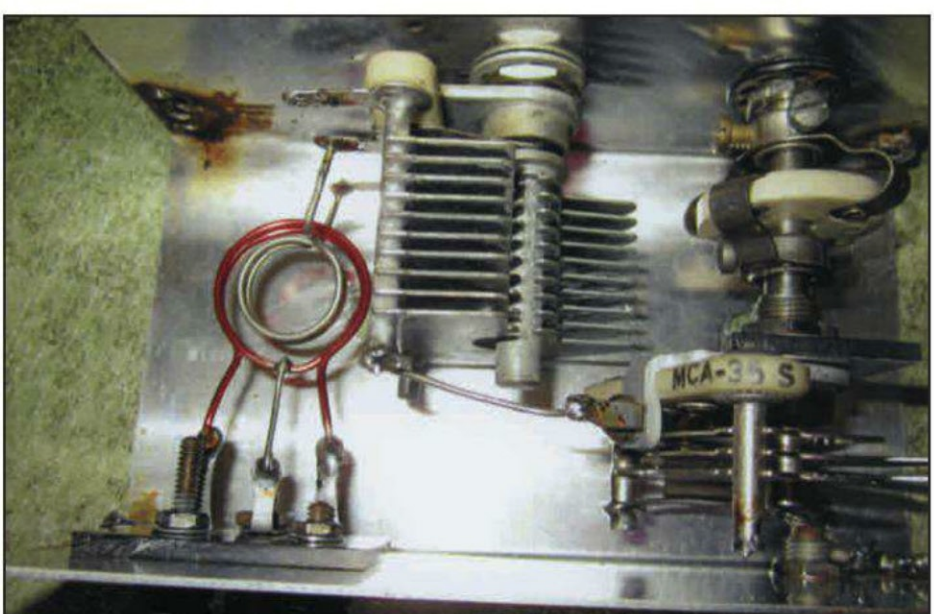

Photo 3– Top view.

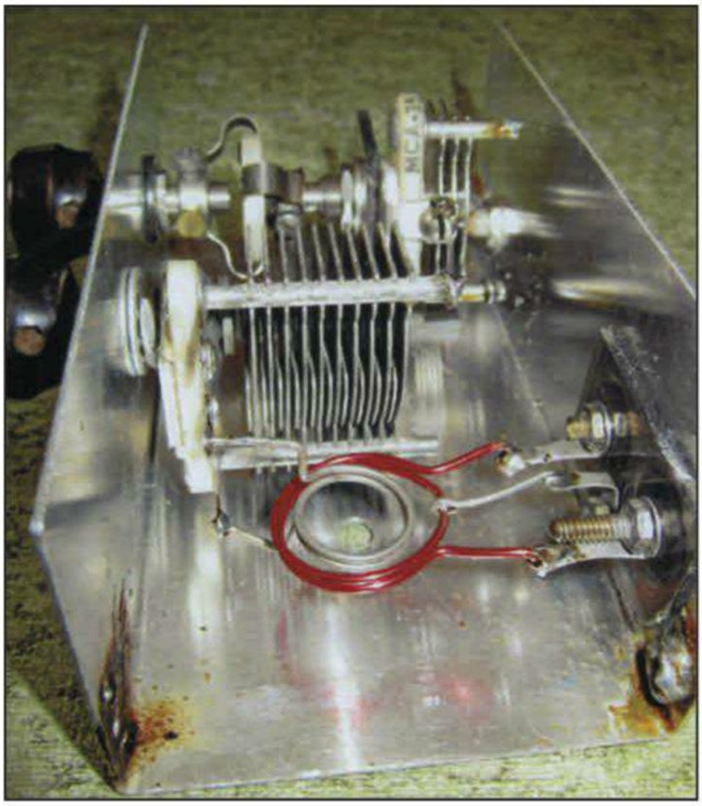

Photo 4– Right-side view.

adjusted to provide a 1:1 SWR. Efficiency could probably be improved by winding the coils on a powdered-iron toroidal core.

Although the antenna coupler "tunes out" reactance on the balanced feedline to present a resistive load to the transceiver, standing waves do exist on the balanced line. In effect, the line and coupler become a tuned circuit with circulating current. Antenna system losses remain low because loss at 50 MHz in a properly balanced line is approximately half of that in a similar length of the average coaxial cable. Further advantages of balanced line are that it is about half the cost of coax and much lighter in weight.

Therefore, what is the standing-wave ratio on your balanced line? An easy way to find out is to connect a non-inductive (carbon) resistor equal to the feedline surge impedance (300 or 450 ohms) to the coupler's output in place of the feedline. Use an antenna analyzer (or apply 1 or 2 watts of power from a transceiver) and adjust the coupler for a 1:1 SWR indication on the coax. Now remove the resistor and reconnect the feedline. The SWR indication will be that of the balanced feedline. Modern 2-watt deposited-film resistors seem to have a reactive component, but the older Allen-Bradley and IRC carbon resistors give nearly a pure resistance at 50 MHz.

Selecting Coaxial Cable

Is that weather-beaten coil of coax for sale at the local hamfest really a bargain? To find out, connect your antenna analyzer to one end (leave the other end open-circuited) and tune the analyzer to about 3.6 MHz. The SWR indication should be infinite, because all of the energy put into the cable should be reflected back from the open end. Of course, a shorted cable will give the same indication. Now set the analyzer to a very high frequency (most analyzers will go to about 170 MHz). If the cable is shorted, the SWR will remain infinite, but if the cable is simply lossy at VHF, as most used coax is, indication will be something less than infinite. A SWR indication close to 1:1 shows that most of the energy put into the cable has been absorbed in the trip down and back, and the cable would not be suitable for use at VHF.

Photo 5– Rear-panel view.

462-km 24-GHz Aircraft Scatter QSO

At the website listed below* the authors described the completion of a 255-km 24-GHz aircraft scatter QSO using JT65c on the Hobart–Melbourne, Australia flight path with small domestic aircraft such as 737s.

By Rex Moncur,† VK7MO, and Dave Smith, VK3HZ

This article covers extension of the distance from 255 km to 462 km using the same equipment that was used on the Hobart–Melbourne flight path and now on the Sydney–Melbourne flight path. The latter path has the benefit of much more frequent aircraft traffic, with some being larger international aircraft such as 747s. Even so, many aircraft did not produce useful decodes and it took some five hours and many aircraft to complete the QSO.

*See: <http://www.vk3hz.net/microwave/Aircraft_Scatter_Contact_24_GHz.pdf>

†e-mail: <moncur@bigpond.net.au>

Path of Propagation

Figure 1 has a red line which shows the path of propagation between VK3HZ and the QTH of VK1DO, where VK7MO operated. The pink lines are standard aircraft flight paths. The red line crosses a pink line near the mid-point of the path. This is the Sydney–Melbourne flight path along which several aircraft typically traverse every hour. VK1DO's location is at 800

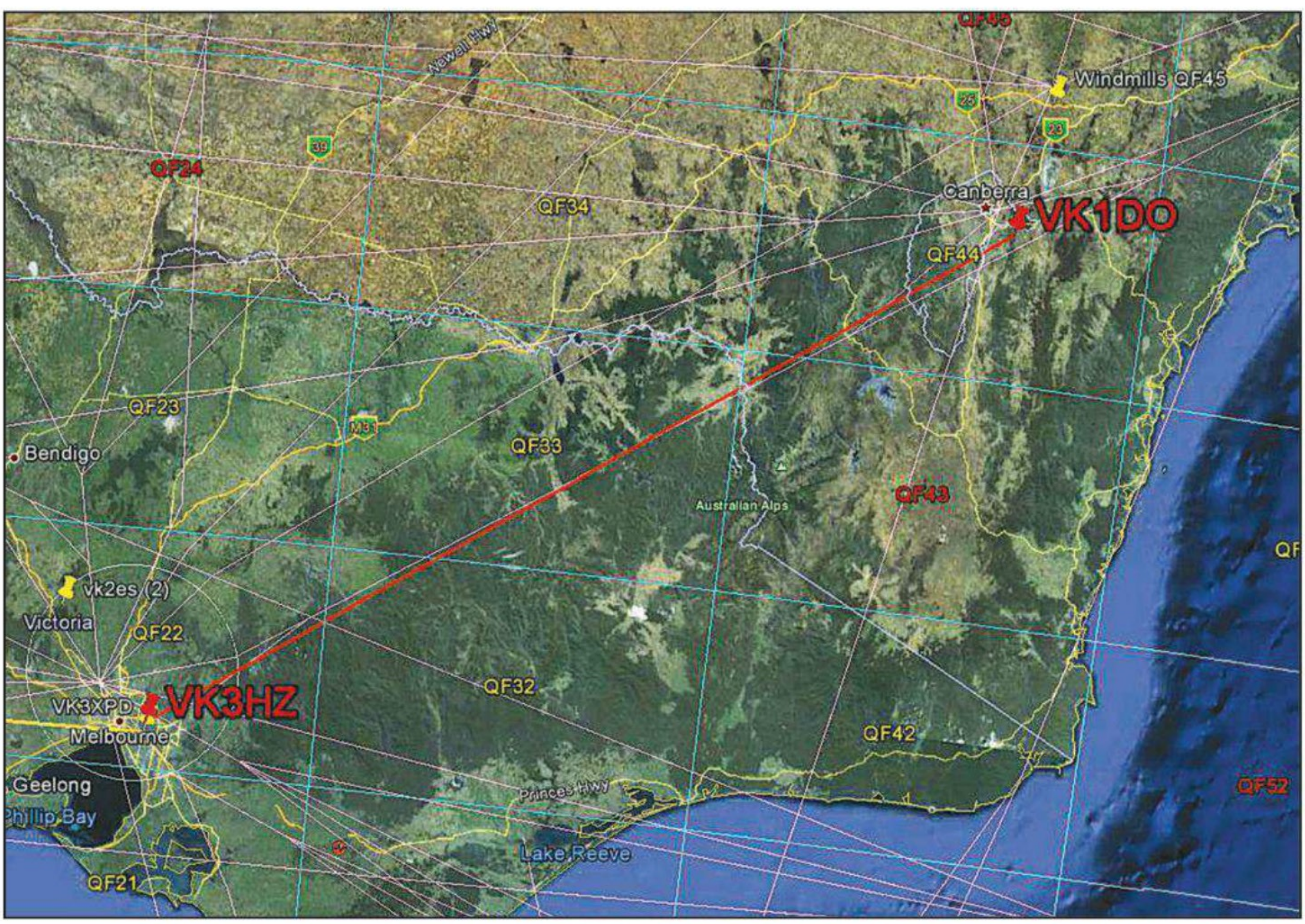

Figure 1. Path of propagation and aircraft flight paths.

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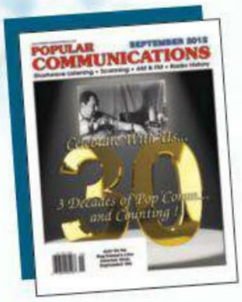

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meters and has a clear take-off toward VK3HZ. VK3HZ operated from his roof at around 110 meters, which also gave a clear take-off.

The path of propagation was deliberately chosen to be closely aligned with an aircraft flight path so as to minimize the amount of Doppler shift. In this case the angle between the path of propagation and the flight path is around 1.5 degrees, and below this produced a Doppler shift of less than 10 Hz over the 48-second JT65c transmission. This is well within the limits of WSJT's AFC system to follow. WSJT's AFC should be capable of following aircraft with crossing angles of up to 5 degrees at 24 GHz.

Photo 1. Rex, VK7MO, all set for low absorption losses (low temperature) with 24-GHz system.

For the typical heights of aircraft at 36,000 feet on this 462-km path it was necessary to beam upwards in elevation at around two degrees as calculated with the spreadsheet: <http://www.vk3hz.net/microwave/aircraft_elevation.xls>.

Water Vapor Losses

A key issue at 24 GHz is to minimize water-vapor losses. On a surface path of this length, such losses can be of the order of 100 dB. The advantage of aircraft scatter propagation is that much of the path is at high altitude, where there is much less water vapor due to lower air density and lower temperatures. Water vapor losses at each end can be further reduced by choosing locations with high elevations, and VK1DO's home QTH at 800 meters elevation thus was an advantage. Cooler temperatures also decrease the amount of water vapor that the air can hold and therefore the test was undertaken in winter with a morning temperature at VK1DO's location of zero degrees Celsium. It is possible to estimate the water-vapor losses using precipitable water data available at the University of Wyoming for sites near the operating locations. (See:<http://weather.uwyo.edu/upperair/sounding.html>.)

For the day in question the data gives 9 mm of precipitable water at Melbourne and 13 mm at Wagga Wagga—say 11 mm average.

While further work needs to be done to define the relationship between precipitable water and absorption losses, as a rough estimate the total absorption losses in dB on a typical aircraft scatter path are given by: Losses (dB) = 0.0025 × PW (mm) × distance (km).

In this case, with PW = 11 mm and distance = 462 km, the absorption loss is around 12 dB. While 12 dB does not seem like a lot, there is little in reserve on aircraft scatter propagation, so keeping the water-vapor loss to a minimum is critical.

Equipment

All systems are GPS locked and use the digital mode JT65c. VK3HZ: Thales module and 38-cm dish (37 dBi)—estimated 1.5 watts TX and 1.6 dB sun noise. VK7MO: DB6NT transverter, pre-amp,

VK3HZ Extract of ALL.TXT file	VK7MO Extract of ALL.TXT file
221100 Transmitting: JT65C VK7MO VK3HZ QF22	213400 Transmitting: JT65C VK3HZ VK7MO QF44
223800 0 -27 0.1 118 10 *	
231000 0 -31 0.0 -30 26 *	
231200 0 -28 0.9 3 6 *	
231200 1 3/18 VK3HZ VK7MO QF44 ? 0 2	
231517 Transmitting: JT65C VK7MO VK3HZ -30	
231600 0 -32 0.5 -19 42 * VK3HZ VK7MO QF44 ? 0 1	231700 0 -31 5.5 24 6 #
231600 1 4/20 VK3HZ VK7MO QF44 0 6	
233400 0 -26 0.1 -30 4 * VK3HZ VK7MO QF44 0 10	003100 0 -31 -0.9 11 5 *
001200 1 -25 0.2 -32 4 * VK3HZ VK7MO QF44 0 10	010300 1 -26 -0.6 -30 5 * VK7MO VK3HZ -30 0 10
	010408 Transmitting: JT65C VK3HZ VK7MO R-26
010400 1 -29 -0.1 -32 5 *	
011600 0 -27 0.2 5 43 * VK3HZ VK7MO R-26 0 8	030100 0 -33 0.8 -32 29 (RRR see below)
011701 Transmitting: JT65C RRR	030240 Transmitting: JT65C VK3HZ VK7MO 73

Table 1. QSO with yellow highlights indicates individual decodes, and blue highlights show average decodes. The data that did not contribute to the QSO have been deleted for brevity.

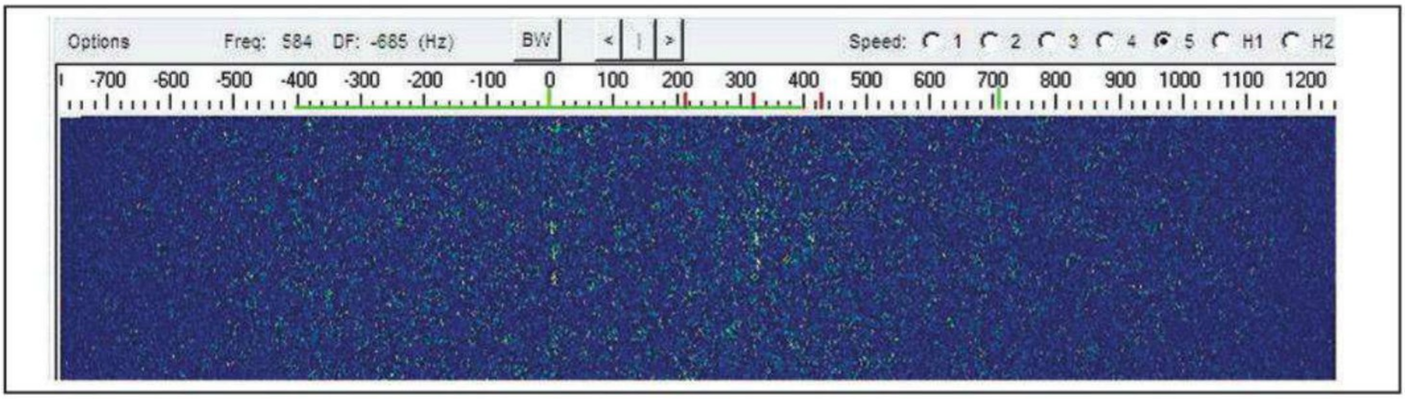

Figure 2. Spec JT display at VK7MO shows a glint of a few seconds of RRR at 0301.

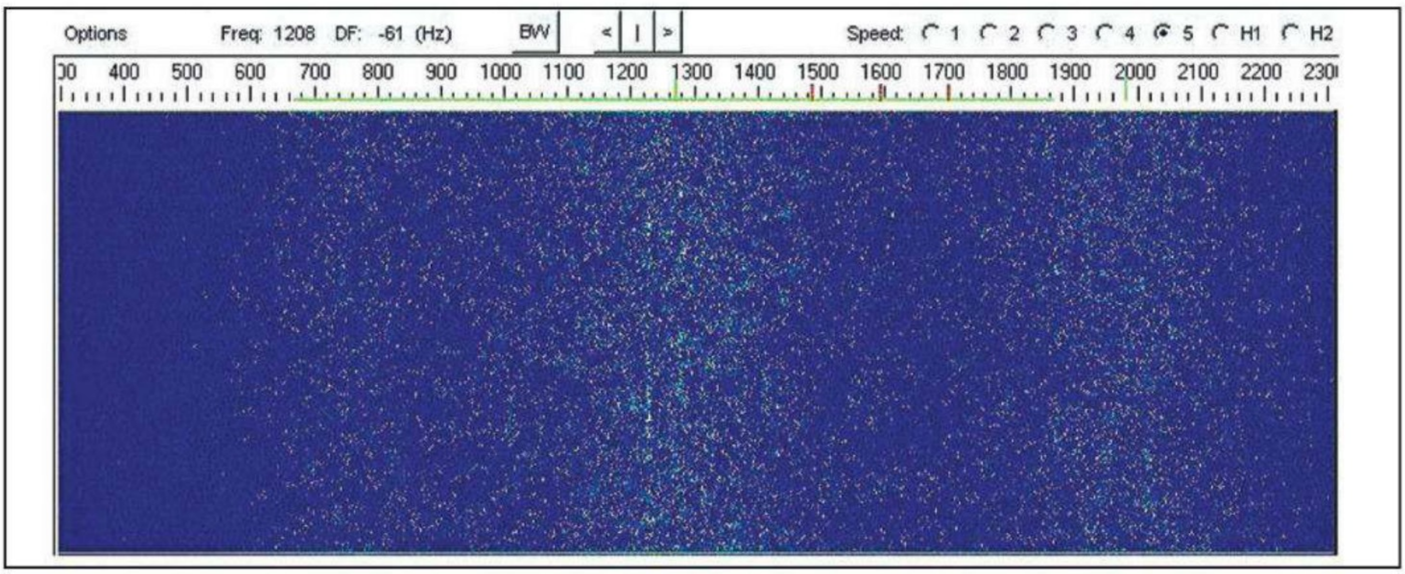

Figure 3. Spec JT display at VK3HZ shows the best signal at 0012.

and 3-watt PA to 47-cm (39-dBi) offset dish—estimated output 3 watts to feed and 3.8-dB sun noise on RX.

QSO

Table 1 is the extract of the ALL.TXT files at each end based only on the data that contributed to the QSO. The blue highlights relate to data derived from the Deep Search average, and the yellow highlights show decodes achieved without averaging. Figure 2 shows how RRR was decoded by eye on the waterfall display to complete the QSO. It was noted that at the VK7MO end only one full text decode was achieved and that this was based on a large 747 aircraft. Even the RRR received by VK7MO required a 747. At the VK3HZ end a total of four full decodes were achieved without averaging and one with averaging. Figure 3 shows the best signal received by VK3HZ at 0012. This difference in decodes between the two stations might be explained by the 3 dB higher power being transmitted by VK7MO.

It is noted that full decodes were achieved on only five of perhaps 30 aircraft that crossed the path during the time the QSO was undertaken. This appears to be explained by the fact that in general smaller aircraft such as 737s rarely produce a sufficiently strong signal to achieve a decode.

As shown in figure 3, the signal came in bursts of just a few seconds with no significant signal at all between. This is typical of the signal variation on all received signals, and while generally similar in character to 10-GHz aircraft scatter signals, it appears that bursts are shorter at the higher frequency. While on the surface this suggests that a mode such as ISCAT-A, which is designed to cope with short bursts, might be more effective, ISCAT-A is significantly less sensitive, and based on our experience on 10 GHz we doubt that ISCAT-A would cope with the significantly weaker signals we experience on 24 GHz. Nevertheless, it would be worth testing ISCAT-A, as it can cope with much greater Doppler shift, as would be encountered where the aircraft crosses at an angle greater than about 5 degrees, which we think is the limit for JT65c.

Conclusion

While this is a limited test, it does indicate that with large aircraft such as a 747 and by planning the QSO at a time of low absorption losses, it is possible to complete an aircraft scatter QSO up to 450 km with stations of 1.5 to 3 watts output.

Acknowledgement

Thanks go to Chris Davis, VK1DO, for making his QTH available.

Get Started with XBee Transceiver Modules

XBee is the brand name from Digi International for a family of form factor compatible radio modules. KZ1G has done extensive research into these modules and their applications to communicationns. Here he gives an introductory look into the transceiver modules, focusing on the 2.4-GHz point-to-point module.

By Jon Titus,* KZ1G

The inexpensive XBee Series-1 transceiver modules from Digi International™ offer hams, experimenters, and engineers an inexpensive way to communicate digital, analog, and serial information over short distances; about 100 feet (30 meters) indoors and up to 300 feet (91 meters) line-of-sight outdoors. The interchangeable XBee PRO modules have longer ranges and require more power. The small modules operate in the 2.4-GHz unlicensed instrumentation, scientific, and medical (ISM) band available worldwide and use the IEEE 802.15.4 communication protocol. You can use XBee modules for point-to-point or many-point-to-coordinator communications. Applications include monitoring remote conditions, low-power serial-communication links, remote controls, and so on. Before you jump in, download a copy of the "XBee/XBee-PRO RF Modules Product Manual" from Digi at <http://tinyurl.com/cudrpka>. XBee modules have agency approvals in the USA, Canada, Europe, Japan, and Australia.

Like most two-way radios, XBee modules can transmit and receive, but not simultaneously. You do not have separate XBee receivers and transmitters.

The 3.3-volt modules come with either a "chip" or wire antenna installed, or with an SMA connector so you can use an antenna of your choice. Each module, such as the XB24-AWI-001, provides six digital I/O pins that also can act as analog inputs, two pulse-width modulator (PWM) outputs, a serial I/O port (UART), and several control signals (figure 1). To work with XBee modules in solderless breadboards, you'll need adapter boards that route XBee signals to pins on 0.1-inch centers. The module pins have a 2-mm pitch. I have used the Parallax 32403 (figure 2) and the SparkFun BOB-08276 adapters.

Digi supplies free module-configuration software called X-CTU which runs under Windows® and communicates with modules via their serial port. I used the Parallax 32400 USB adapter board which connects an XBee module to a PC through a USB cable. Sparkfun has a similar adapter, WRL-08687. The X-CTU software provides four tabbed windows (figure 3) that let you: (1) select and configure the USB COM port, (2) open a terminal window to communicate with a module via its UART, (3) check and set module registers, and (4) perform a range test. By default, XBee modules have UART settings of 9600 bits/sec, no flow control, eight data bits, no parity, and one stop bit (8N1). Download the X-CTU software at <http://www.digi.com/support/productdetail?pid=3352>. Look under "Diagnostics, Utilities and MIBs."

To begin, you attach an XBee module to your PC via a USB adapter and start the X-CTU software. The PC Settings window lets you choose the USB Serial Port connected to your PC—COM7 on my computer. Then you can test serial communications. Results show the type of module attached, its firmware version, and serial number. If the test fails, check the PC serial-port settings in the X-CTU Com Port Setup area to ensure they match those given above. Problems often stem from either an incorrect Flow Control

**e-mail: <jontitus@comcast.net>*
KZ1G writes about microcontrollers and electronics. His latest book, The Hands-On XBee Lab Manual, includes 22 experiments, 10 appendices, and links for code downloads.

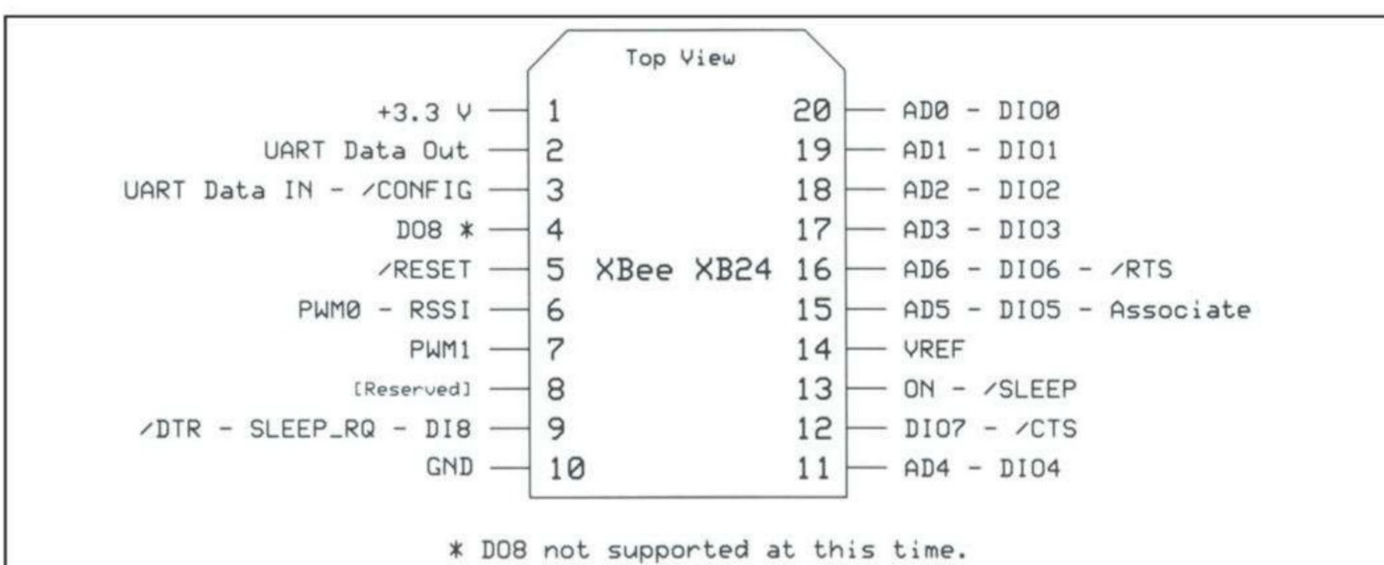

Figure 1. Pinouts for an XBee Series-1 module, top view.

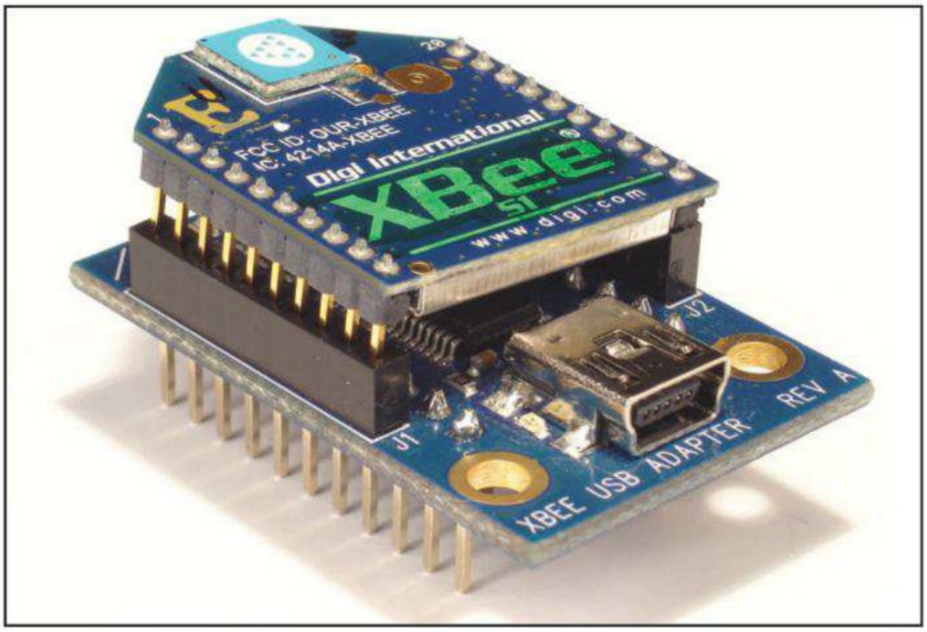

Figure 2. An adapter board connects a module with pins on 2-mm centers with a breadboard that places receptacles on 0.1-in. (2.54-mm) centers.

choice or bit rate, or from selection of the wrong virtual serial USB port.

After an XBee module passes the basic communication test, you can use modem-like AT commands in the X-CTU Terminal window to communicate with it. Open the Terminal window and type only +++ into the large open terminal area. Do not press the Enter key. The three plus signs put the module in a mode to accept commands as ASCII character codes. When ready, the module should respond with "OK." Then you can type in a command such as ATSH[Enter]. The module will respond with the most significant bytes of its serial number. If you type ATSL[Enter], the terminal should display the least-significant four bytes of the serial number (figure 4). Each module has a unique 64-bit address, although a response to an ATSH command will not display leading zeros. My module has a hex address of: 0013A2004049E1E6.

After you see "OK," or after you type your last AT command, an XBee module remains in the AT-command mode for 10 seconds, a default value. You can change this time with a CT command, but 10 seconds should suffice. You can always type +++ again to re-enter the AT-command mode. The manual noted previously lists and describes 68 commands used to configure a local module and to communicate with remote modules. Most operations require a small subset of these commands.

Remote Digital Monitoring and Control

To monitor a remote on-or-off condition, I labeled my remote module XMTR and a second module RCVR. The latter

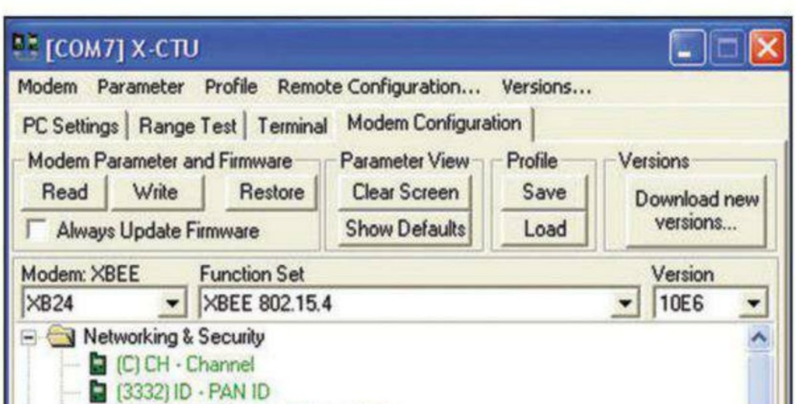

Figure 3. The X-CTU software configures, tests, and communicates with XBee modules attached through a USB port.

XMTR		RCVR	
Parameter	**Value**	**Parameter**	**Value**
DL	FE54	DL	12AB
MY	12AB	MY	FE54
IA	FFFF	IA	FFFF
DIO0	3 - DI	DIO0	5 - DO HIGH
IR	3E8	—	—
IT	2	—	—

Table 1. Parameter changes for my remote (XMTR) and local (RCVR) modules for digital I/O.

module will indicate the remote on-or-off condition. To communicate and show this information, each module must know: (1) each other's address, (2) what action (if any) to perform, and (3) how to configure digital I/O lines. (You can label modules as you wish, and the NI command lets you name a module with as many as 20 ASCII characters.)

My settings, shown in Table 1, establish a destination address low (DL) and a source address (MY) for each module. I chose values at random. These values can range from 0000 to FFFE. Do not use FFFF, which has a special function. Note the relationship between the MY information in one module and the DL information in the other. I left the destination address high (DH) at zero, the default value. The XMTR module requires a pin set for digital input (pin 20, AD0-DIO0), and the RCVR module needs its corresponding pin (pin 20, AD0-DIO0) set for a digital output. The DO-HIGH setting simply specifies the initial state of the DIO0 pin on my RCVR when I apply power. I could have chosen instead DIO0 LOW.

Both modules require an IA setting of FFFF, which lets received information change the state of I/O pins. The XMTR module requires two other settings: IR - Sample Rate and IT - Samples before TX. The IR setting needs a hexadecimal value that equals a period in milliseconds. In this case, 3E8 creates a 1000 msec, or one second, delay period. The IT setting tells the XMTR module to take two (2) samples from all active input pins—one second apart (as set by IR)—and then transmit that data to the RCVR module. All other settings in the X-CTU Modem Configuration window remain unchanged.

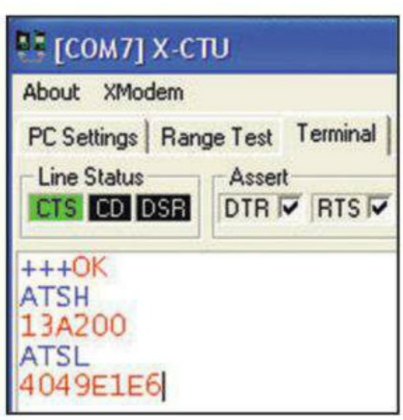

Figure 4. The typed +++ puts an XBee module in AT command mode. The ATSH and ATSL commands fetch the module's serial number.

To make the parameter changes, I put each module in the USB adapter in turn and used the Modem Configuration window in the X-CTU software to configure it. Just click on a parameter to change it or to key in a new value. Changed values appear in blue to make them easy to find.

After changing the parameters for an attached module, a click on the Write button saves them. It can't get much easier. You can check the settings in an XBee module plugged into the USB adapter by opening the Modem Configuration window and clicking on Read. If necessary, a click on the Restore button resets the attached XBee module back to its factory-default state.

After configuring the XMTR and RCVR modules, electrical connections shown in figure 5 let me change the logic state at the AD0-DIO0 pin on the XMTR module and see the logic level changes on the LED connected to the RCVR's AD0-DIO0 pin. In this setup it can take as many as two seconds to see the LED change state, because the XMTR module must take two samples one second apart before it transmits data to the RCVR module. For a faster response, I reconfigured the XMTR with an IR value of 64 hex for a 100-msec period, and IT for only one sample. To change settings, you must first Read the current settings in a module, change them, and then Write the results. This example illustrates how you can use XBee modules to monitor remote switches, perhaps attached to windows and doors. You could reverse this setup and use an XBee to remotely control on-off devices.

By the way, you can change configurations with AT commands sent through the X-CTU Terminal window to an XBee module connected to your PC. A command such as ATD0 3 would set the AD0-DIO0 pin at a digital input. However, this approach takes extra time and typing errors can creep in. I prefer to use the X-CTU Modem Configuration window. You can save parameter settings for modules in files on your PC.

Transfer Analog Information, Too

Each XBee module includes a 10-bit analog-to-digital converter (ADC) that will digitize a voltage applied to an I/O pin, AD0-DIO0 through AD5-DIO5, set as an analog input. The X-CTU Modem Configuration information includes an ADC setting for these pins. The 10-bit results get transmitted much like digital-input information, but only the AD0 and AD1 inputs produce an analog output at a receiving module. I'll tackle the AD2-to-AD5 ADC data shortly.

When set as analog inputs, the analog inputs AD0 and AD1 at a transmitter correspond to the pulse-width modulated outputs PWM0/RSSI (pin 6) and PWM1 (pin 7), respectively, at a receiving module. To set the XMTR to accept an analog input at its AD1-DIO1 pin and the RCVR to produce a PWM output at its PWM1 pin, I used the configurations in Table 2 after restoring the modules to the factory defaults.

XMTR		RCVR	
Parameter	**Value**	**Parameter**	**Value**
DL	FE54	DL	12AB
MY	12AB	MY	FE54
IA	FFFF	IA	FFFF
DIO1	2 - ADC	P1	2 - PWM OUTPUT
IR	3E8	—	—
IT	2	—	—

Table 2. Parameter changes for the remote (XMTR) and local (RCVR) modules for analog input and PWM output.

The circuit in figure 6 shows the needed connections. A

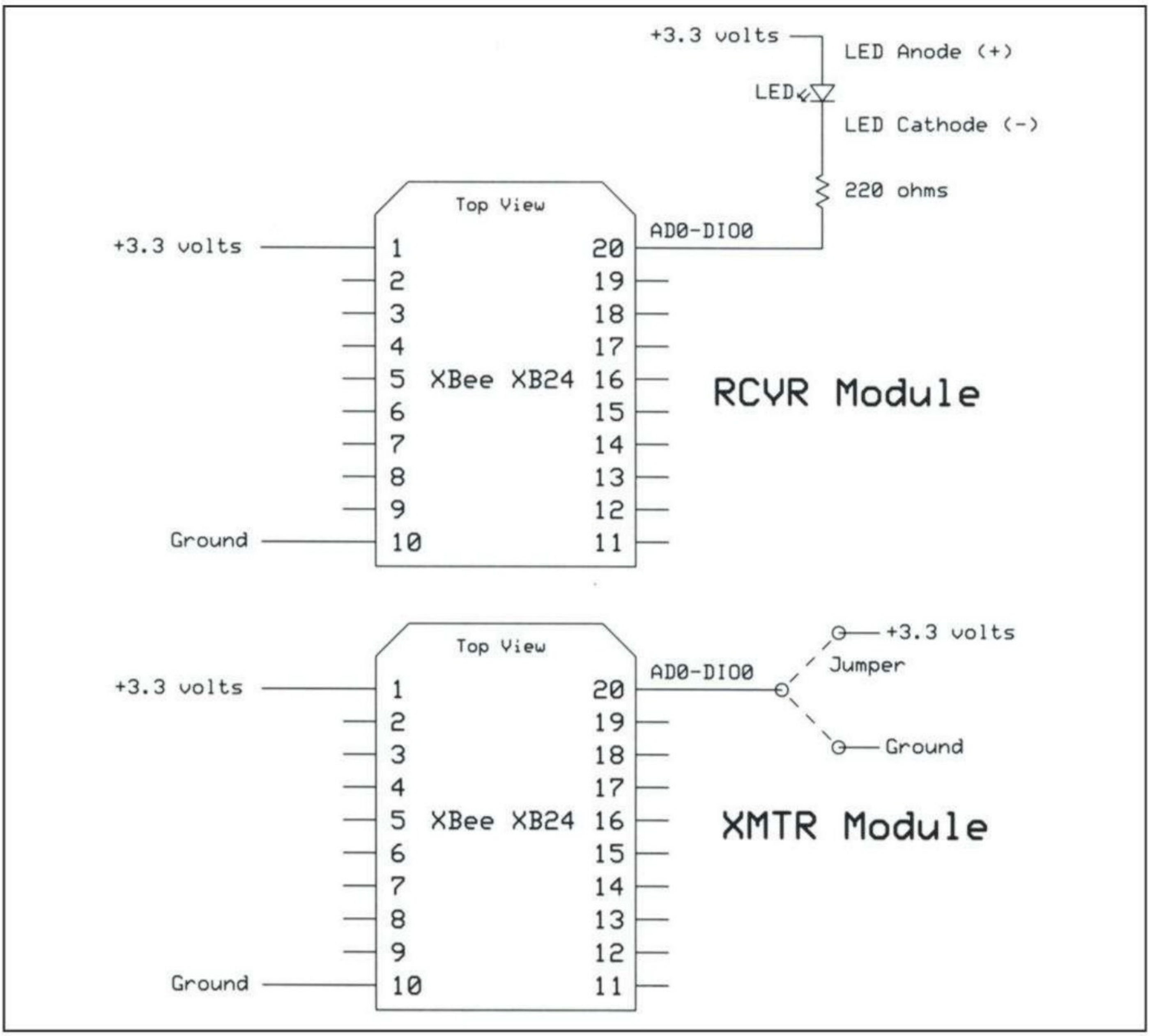

Figure 5. Connections to XBee modules for communication of a digital on-off signal.

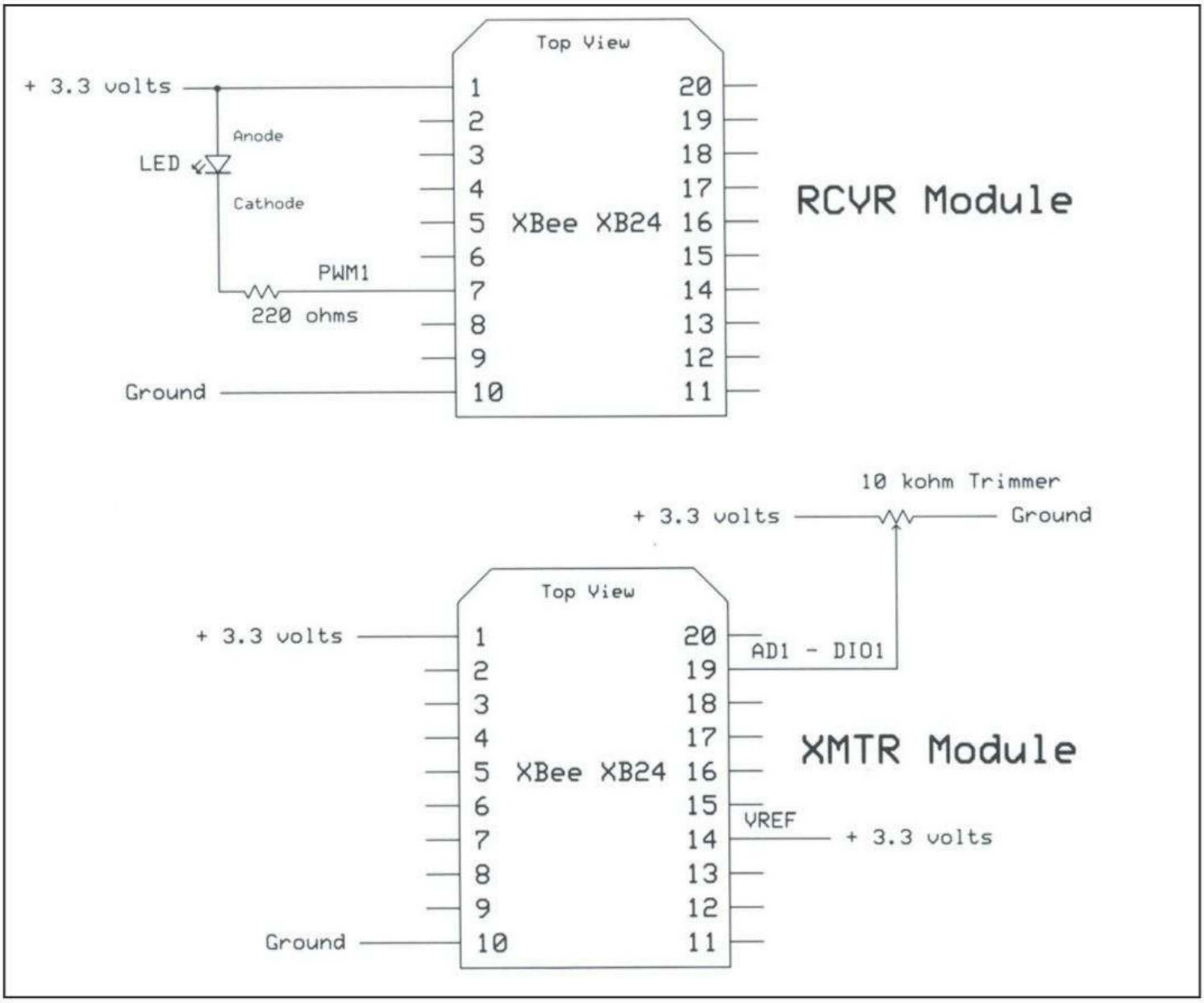

Figure 6. Connections so the XMTR module can send analog information to the RCVR module with a PWM output enabled.

potentiometer at the XMTR module provides a way to vary the voltage at the AD1-DIO1 pin set for an analog input. The LED at the PWM1 output (pin 7) on the RCVR module lets you observe the PWM signal indirectly as LED brightness. Remember, the intensity will change only after the XMTR takes two ADC samples one second apart. You could connect a scope to the PWM1 pin to see the signal.

Note the ADC requires a reference voltage at the VREF (pin 14). I used the 3.3-volt power rail as a reference, but in practice you probably want a more stable reference such as an LM336Z-2.5 which produces a 2.5-volt signal. The reference establishes the upper limit for the ADC input. With a 3.3-volt reference input each increment of the ADC output represents a 3.3 volts/210(superscript me), or a 3.2-millivolt step. With a 2.5-volt reference the ADC still has 1024 steps, but the input can only go from 0 to 2.5 volts, which results in 2.4-mV steps.

The XMTR module will sample the AD1 input and convert the input voltage to a 10-bit value every second and then transmit two successive values. The corresponding PWM output will vary from 100-percent off to 100-percent on in 1024 steps, but your eye can detect only large changes in LED brightness. The PWM output has a constant frequency of 15.6 kHz. Only the duty cycle changes.

Unfortunately, the PWM0/RSSI and PWM1 outputs have some quirks that require a lengthy explanation, so I recommend against using them unless you plan to sample the AD0-DIO0 or AD1-DIO1 analog inputs regularly and often. You can get the 10-bit ADC information in other ways.

How to Decode Analog and Digital Information

As you've seen, received analog and digital information can control output pins on an XBee module. The I/O-pin information also appears in packets at the receiver's UART Data Out pin (pin 2). I removed the RCVR module from the breadboard and placed it in the USB adapter and switched to the X-CTU Terminal window to see the raw data. The Terminal window provides a Show Hex option that helps make the received information easier to decode. Figure 7 shows a packet as received from the XMTR module when I ran the PWM tests. It might look like a jumble of bytes, but XBee packets have a standard

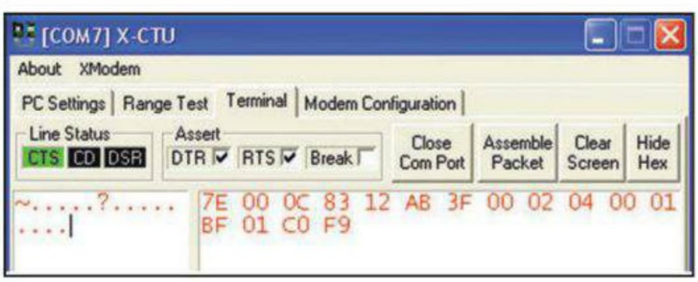

Figure 7. Raw data displayed for two ADC samples taken at the AD1-DIO1 input on the XMTR module.

format as shown in Table 3. This format simplifies decoding of packets by people and microcontrollers.

The number of bytes in a message includes only those lightly shaded. The active-signal bytes indicate the active analog and digital inputs, and here the single logic-1 bit in 0400 signifies only input AD1-DIO1 active as an analog input. The XBee manual shows the format for the other bits in an active-signal byte. The next two values, 01BF and 01C0, represent the 10-bit values for the two measurements of the AD1-DIO1 voltage signal.

If you had enabled digital inputs, too, you would see corresponding bits sent in the active-signal byte and two bytes of data per sample from the nine digital pins, AD0-DIO0 through AD6-DIO6, DIO7, and DI8.

Each packet sent or received includes a checksum that helps the receiving module detect transmission errors. A transmitter calculates a checksum and appends it to the end of a packet. A receiver will also calculate a checksum as it receives a packet and will compare it with the one in the received packet. If an error occurs, the packet sent out the receiver's serial port indicates an error condition in the status byte. The checksum calculation includes only the information in the gray boxes in Table 3.

When you send a packet to a remote XBee module, you must calculate the checksum and place it at the end of the packet. Suppose you have a short packet such as: 0F, AB, 00, 00, 12, 49.

Add these hexadecimal bytes—a hex calculator will help—and get a sum: hex 115. Use only the least-significant two hex values: 15 (??JOE) and subtract them from FF. The result forms the checksum byte: EA.

The XBee modules have many other capabilities which include going into sleep modes (saving battery life), transmitting data on command, setting up networks of modules, determining the number of modules in a network, transmitting command packets to remote modules, and so on. The best way to learn more? Buy two or three XBee Series-1 modules and start to experiment.

7E	Start-of-transmission byte
000C	Number of bytes in packet = 12
83	Code for 16-bit module addressing
12AB	Sending-module address
3F	Signal strength
00	Status byte = OK
02	Number of samples from XMTR
0400	Active-signal bytes
01BF	First ADC value
01C0	Second ADC value
F9	Checksum

Table 3. Format for XBee packets with I/O samples.

Public Service Event
APRS Web Mapping for Wireless Devices

This article originally appeared as a paper in the TAPR and ARRL 30th Digital Communications Conference 2011 Proceedings.

By Ted Jacobson,* W8KVK, and Rob Jacobson, KB9AFT

This article is a case study describing real-time APRS web-mapping support for Lead and Last runner tracking during the 2011 Athens Ohio Marathon. Objectives were: (a) to provide real-time web-based runner location maps for race officials, emergency services, and spectators without the use of JAVA or Flash; (b) to support a wide range of web-capable wireless devices; and (c) to optimize display speeds while reducing bandwidth demands.

Introduction

The Athens Ohio Marathon[1] is a 44-year-old, 26-plus-mile running event in the Appalachian hill country of southeast Ohio. Much of the route is along a heavily forested, terrain-obstructed rail-trail. Amateur radio has supported this event for decades, with limited Automatic Packet Reporting System (APRS) support introduced over the past few years. For the 2011 event, the APRS support team embarked on a service upgrade designed to provide real-time web-based Lead and Last runner location mapping for event officials, emergency services, and the general public. This experimental approach may also have value for other APRS field operations such as search and rescue, damage assessment, etc.

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Designing & Implementing the RF network

Significant terrain challenges made it desirable to do some preliminary Google Earth terrain-obstruction signal-contour "pseudo ray tracing" analyses[2] described by Bob Bruninga, WB4APR,

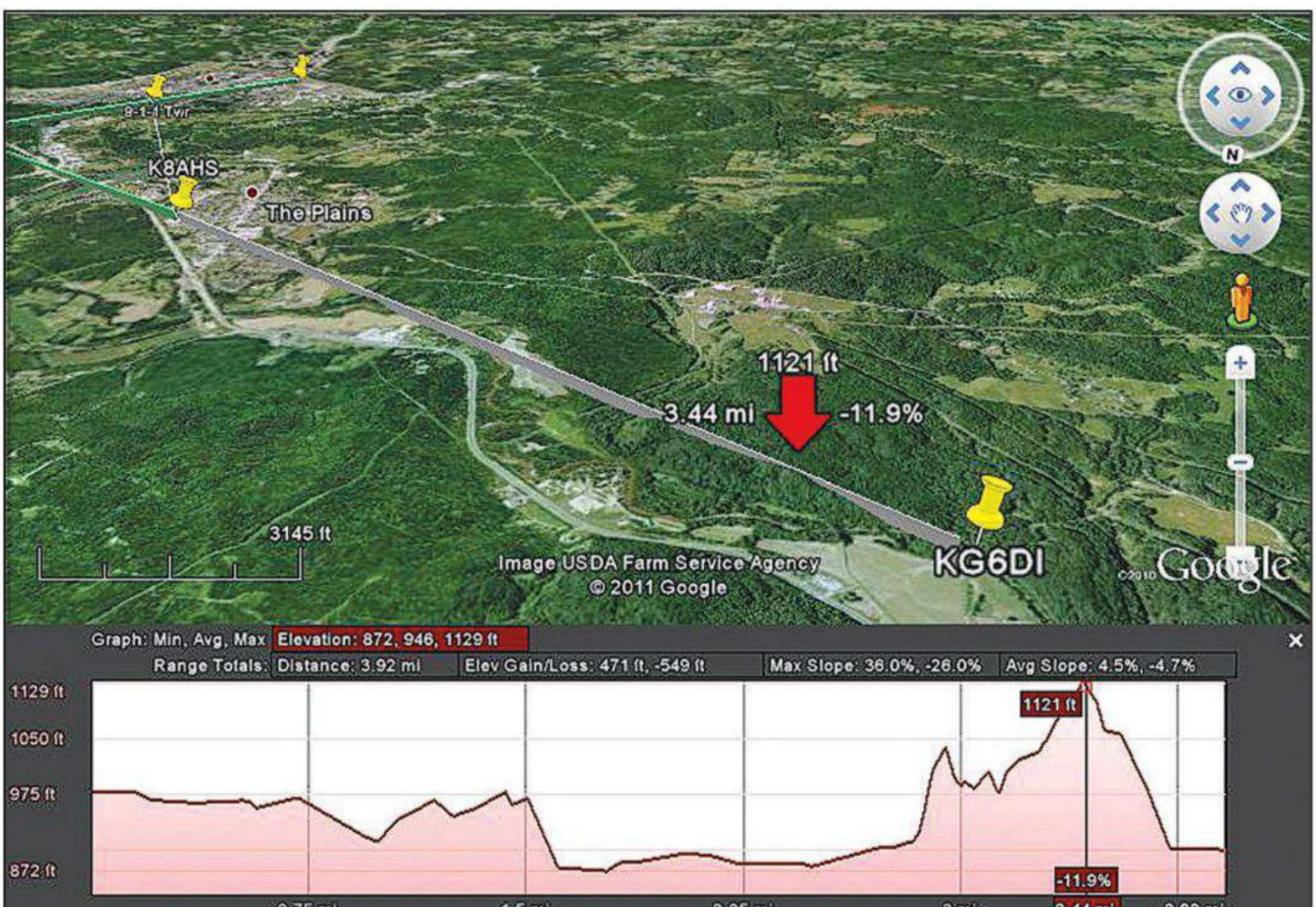

Figure 1. Google Earth "Ray Tracing" Analysis for the 2011 Athens OH Marathon route.

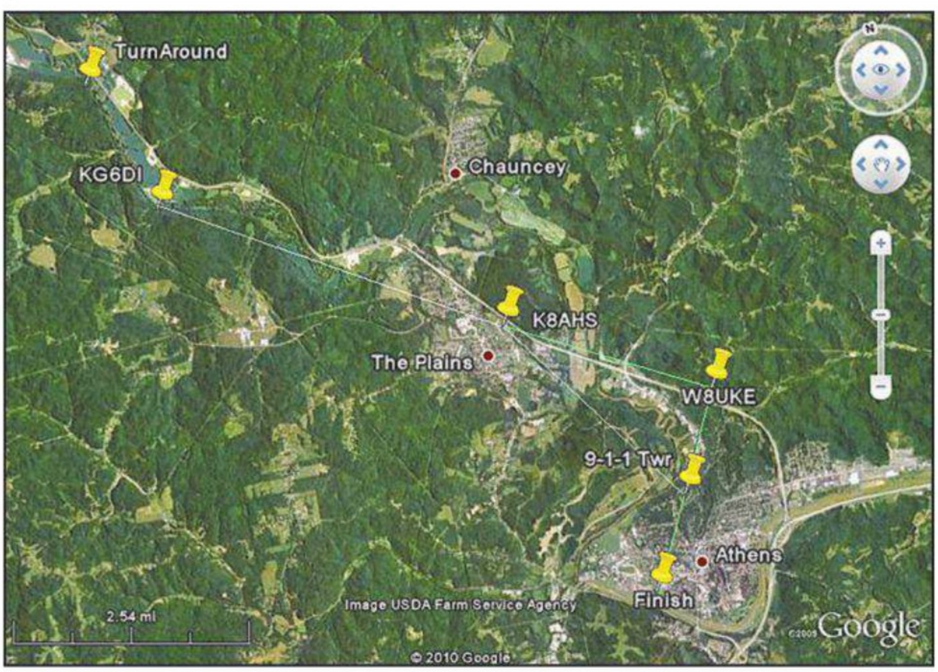

Figure 2. Final APRS Network Architecture, 2011 Athens Ohio Marathon.

as part of the annual Appalachian Trail Golden Packet Event [3]. These analyses provided useful approximations of where relay and fill-in digipeaters might be needed. Figure 1 is an example of this type of analysis, clearly showing a major terrain obstruction approaching the KG6DI mobile digipeater location[4].

The final network design incorporated the fixed digipeaters at W8UKE and K8AHS, with temporary mobile and portable digipeaters deployed elsewhere as needed. Figure 2 shows the final network.

The Lead and Last runner trackers were bicycle-mobile stations using Byonics™ Micro-Trak™ "All-in-One" (AIO) units[5]. Pictures and narrative covering the Lead runner bicycle mobile station are available online[6] courtesy of WD8RIF. Final design of the RF network needed to take into consideration the low power and modest antennas of these trackers.

In addition to the two bicycle-mobile stations, an APRS-equipped golf cart was on the route for runner health-and-welfare coverage and supplies delivery. An over-the-air APRS display was provided at the finish line press box for use by event officials and the public-address announcer.

The bicycle-mobile stations transmitted beacons at 35-second intervals with different time-slotting values to prevent data collisions. The 35-second value was selected in order (a) to provide higher map plot resolutions, (b) to provide faster replacement of lost packets, and (c) to provide more precise position reporting for emergency services in the event of

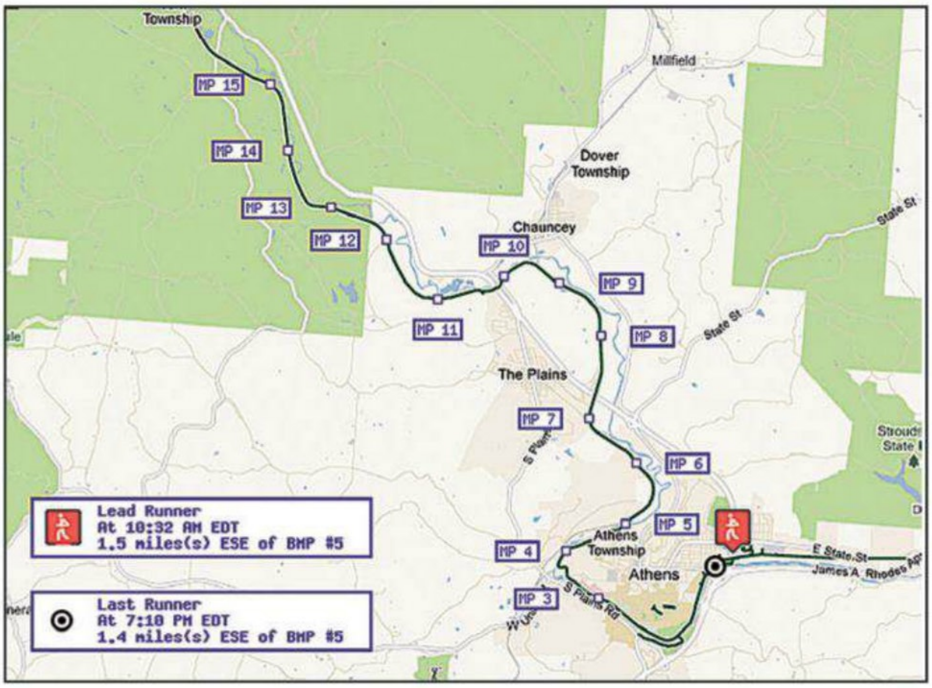

Figure 3. Final online map as the end user received it.

injury or other emergency. Much of this route is in deep forest not easily accessible from the public-roads network.

The reason for the 35-second beacon interval (versus a 30-second interval) is that our local WIDEn-N configurations treat beacons generated at intervals 30 seconds or less as "dupes," and thus discard such beacons.

WIDEn-N protocols[7] were used to ensure that individual packets would reach the over-the-air APRS display at the finish-line press box, regardless of which part of the network first received each packet.

The APRS Data to Web Mapping Interface

The individual position-reporting packets were received and ported to the Internet via an internet-gateway (I-Gate) running UI-View32 software. The Application Programming Interface (API)[8] at APRS.fi[9] was chosen for the front-end data processing due to its robust performance and Extensible Markup Language (XML) generating capabilities. The APRS.fi API (properly) has strict limits on the number of queries it will accept from the same source within a specified time period. Abusing the API every 35 seconds for two bicycle mobiles (plus the golf cart) was avoided by (a) combining all three mobiles into a single XML query and (b) adding additional query repeat protection within the mapping interface itself.

The Real-Time Web Maps

Because of the popularity and familiarity of Google Maps™ , a base map was created using Google Map API services.[10] This provided a "static" base map that could be presented to the end user from a local server, instead of repeatedly downloading the same map from Google. As with the APRS.fi API, Google has limits on how frequently each unique user may download the same map from its server.

Once created, this static base map was augmented with rail-trail Milepost (MP) numbers and time-stamp text boxes for runner icons. Large-format runner icons and map references were employed to enhance viewing on small screens. The dark highlighting of the rail-trail itself was provided by Google in partnership with the Rails-to-Trails Conservancy[11]. Similar nationwide rail-trail and bicycle route map features are available on many Google Maps by selecting the "bicycle" overlay.

The final online map as displayed to users is shown in Figure 3.

The wide range of web-enabled wireless device makes, models, vintages, and operating systems in use today made it advisable to avoid JAVA or Flash in executing the final map display. The resulting final map, therefore, was executed in pure HTML.

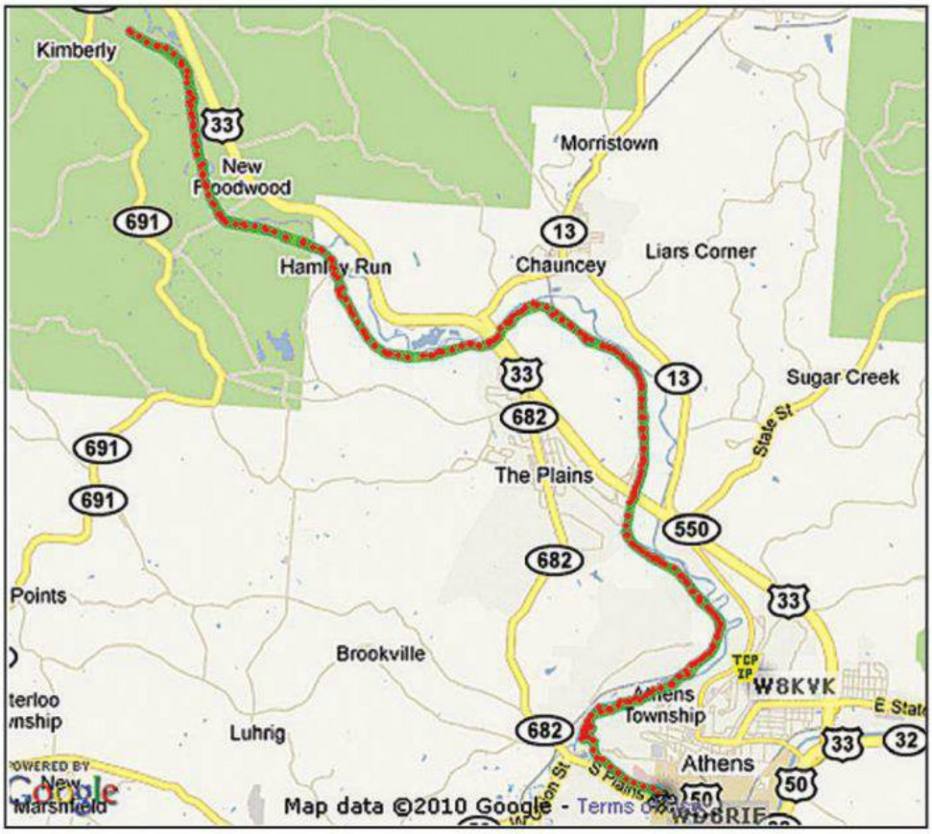

Figure 4. Actual valid packets received and plotted. (Courtesy APRS.fi).

The actual APRS position data were extracted from the XML queries to the APRS.fi API, and then overlaid on the base map using PHP (a popular open-source web scripting language). In the process, the icon placements were updated, as were the text references to distance to the nearest rail-trail Milepost. Since these steps are all "server side" services, the end user's device did not have to perform any of the processing, thus significantly increasing map download speeds while reducing bandwidth demands. As more and more cellular carriers discontinue unlimited data plans, this bandwidth conservation feature will become more and more important.

For many (but not all) web-enabled wireless devices, the map was "refreshed" via HTML every 60 seconds. The timestamps for each bicycle mobile were also updated if/as new data became available.

It should be noted that other types of (non-Google) maps could be used in a project of this kind, but any such map would have to be "geo-referenceable"—i.e., one must be able to determine the exact latitude/longitude value for each pixel on the map.

Project Evaluation and Lessons Learned

The RF network seemed to perform well. It may have been over-engineered, but it was helpful to have some redundancy and coverage overlap in case of one or more site failures. A plot of all valid runner location beacons actually processed appears in figure 4, courtesy of APRS.fi. Top to bottom distance of this route is 13-plus miles.

The web mapping applications and user interfaces also performed well, although being our first year of publicized service, the number of simultaneous web users over the six-hour event was moderate.

The various servers involved had no problem carrying the loads.

Some makes/models of web-capable wireless devices did not process the HTML refresh scheme correctly. It appeared that some wireless carriers were prohibiting these refreshes as a bandwidth restriction measure. As more and more cellular carriers discontinue unlimited data plans, we may want to review the whole concept of automatic map refreshes in the future, and turn the associated decisions over to the individual end user, or perhaps provide one map version with automatic refresh and another with only user-initiated manual refresh.

One advantage of the static base map design is that it is unlikely to change over the next few years. There may be slight changes in the various overlays, but these likely would be minimal. If this project is continued, future development and software-coding workload should be modest.

Notes

1. Athens Ohio Marathon Home page: <http://athensmarathon.org/>

2. Bob Bruninga's (WB4APR) tutorial on "ray tracing" in Google Earth: <http://aprs.org/hamtrails/aprsGoogleEarth.txt>

3. Appalachian Trail Golden Packet Event (courtesy WB4APR): <http://aprs.org/at-golden-packet.html>

4. KG6DI high-profile on-route digipeater (pictures and narrative): <http://w8kvk.com/KG6DI>

5. Byonics Micro-Trak "All-in-one" trackers used for this event: <http://www.byonics.com/microtrak/mtaio.php>

6. The lead runner bicycle mobile tracking station (courtesy WD8RIF): <http://home.frognet.net/~mcfadden/wd8rif/bicycle-mobile.htm>

7. WIDEn-N APRS Network Protocol (courtesy WB4APR): <http://aprs.org/fix14439.html>

8. Using the APRS.fi Application Programming Interface (API):<http://aprs.fi/page/api>

9. APRS.fi is an APRS Mapping and Data internet service in Helsinki, Finland: <http://www.aprs.fi/>

10. Using the Google Maps Application Programming Interface (API): <http://code.google.com/apis/maps/index.html>

11. Rails-to-Trails Conservancy Teams with Google for Bikeway Directions and Mapping: <http://www.railstotrails.org/news/newsroom/pressReleases/archives/20100310_DC_RTC_Google_Bike_Directions.html>

APRS and the Android Smartphone

The following article originally appeared as a paper in the TAPR and ARRL 30th Digital Communications Conference 2011 Proceedings. Because of the increased interest in APRS and cell phone usage, KC2VSG has developed a way to adapt the Android Smartphone for use in APRS tracking.

By Sagar Gupta,* KC2VSG

This article discusses a means of using the Android smartphone as a Global Positioning System (GPS) receiver unit to provide serial location data to an APRS beacon transmitter. Using an application I developed, an Android smartphone with a GPS receiver sends its location to a laptop computer via Bluetooth. Through a program written for the laptop the position data is sent to a serial port in NEMA-0183 format. This serial data can then be sent to a TNC/radio to transmit an APRS beacon with location information. After appropriate digipeating, the beacon information reaches an I-gate station and appears on the APRS Internet system. Although an APRS app is available for Android smartphones, which puts the location information directly on the Internet, that application is not useful when there is no cellphone coverage, Wi-Fi access, or one does not want to pay for the Android data plan.

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Background

Most Android phones are equipped with GPS receivers, but that only provides one-way communication and

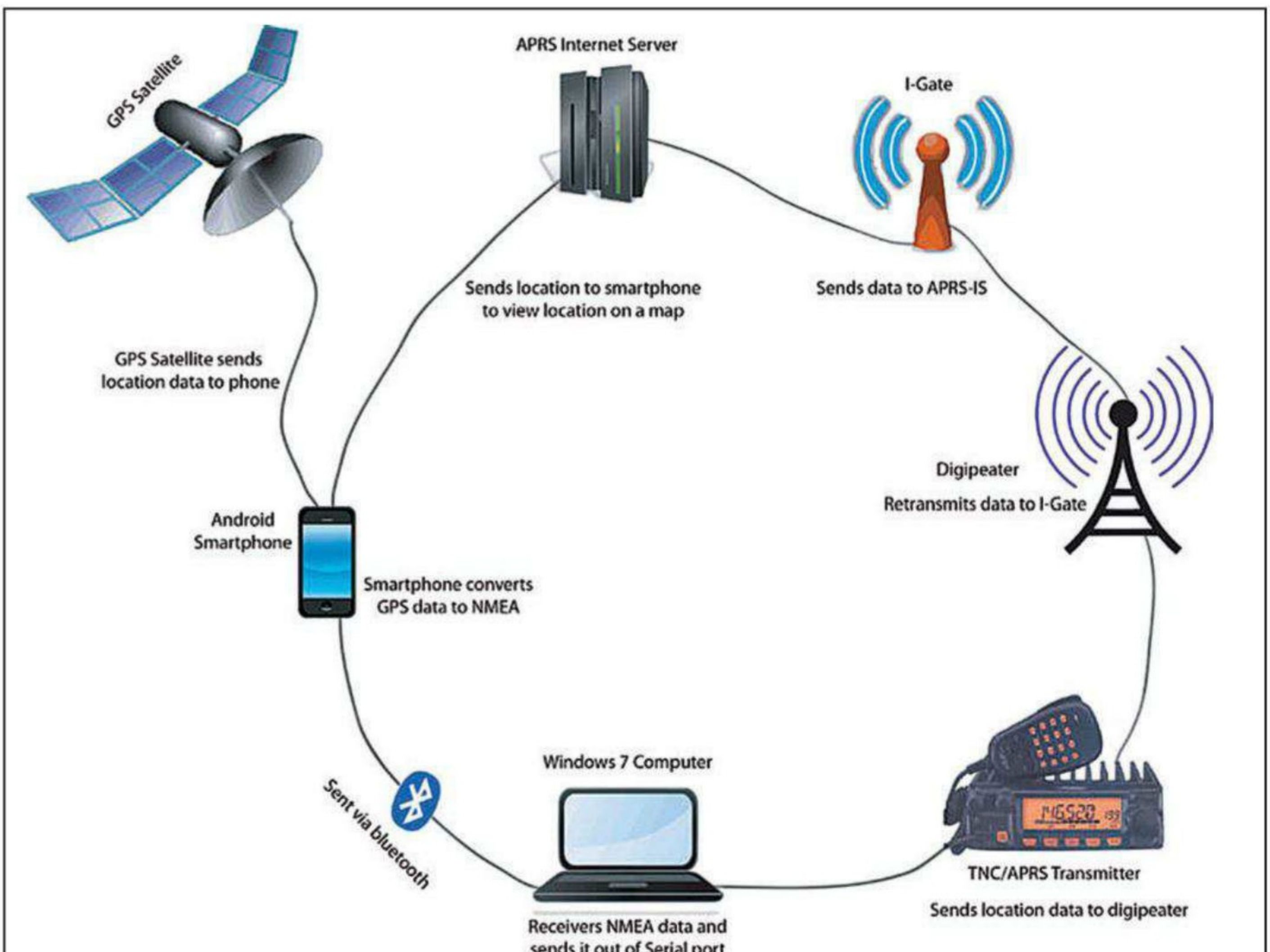

Figure 1. This image demonstrates the interrelationship among the various elements that make it possible for an Android Smartphone to be able to track APRS beacon transmitters.

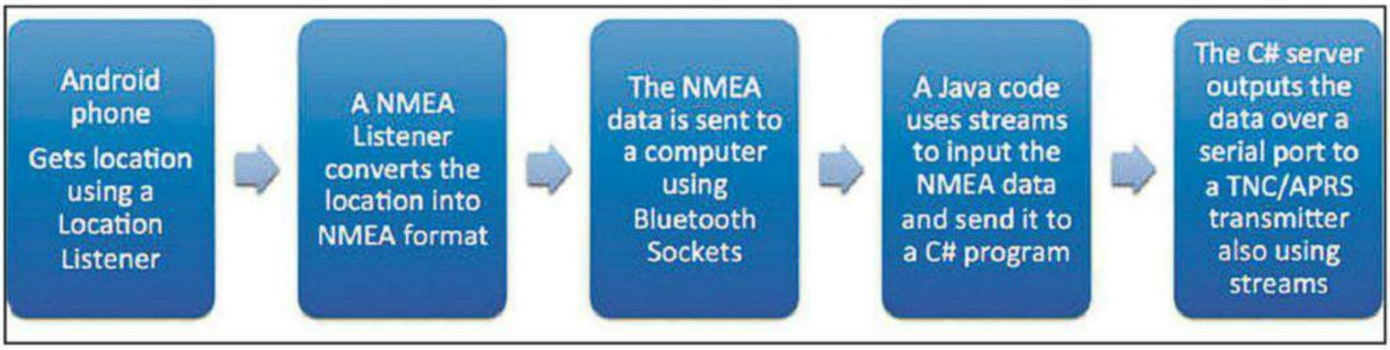

Figure 2. The software's basic sequence of events.

informs you of your location. Knowing exactly where you are is not always useful, but informing others of your location can be. An Android APRS app is currently available to amateurs who use the APRS Internet server to inform others of your location. But what if you were in a location without cellular service or Internet access? I have now created another method to put your location on the Internet using APRS using an Android application to be described. The Android phone will receive the user's location from its built in GPS receiver and then output the location via Bluetooth in an NMEA (National Marine Electronics Association) format to a laptop computer. The computer takes the data received and sends it out through a serial port to an APRS TNC/transmitter, which will send the location by radio to the APRS Internet Gateway known as an I-Gate. The I-Gate will then upload the location information into an APRS Intern Server. Once your location is in the server database users can track their location or the location of others on a map built in to the APRS application. The following diagram illustrates the process.

APRS

APRS has been around since 1984 when Bob Bruninga, WB4APR, developed it; in fact the acronym APRS was derived from the last few characters of his callsign. Bruninga still maintains the APRS website and APRS is still an excellent service available to amateur radio operators. The technology of APRS is still excellent and it provides many useful services for the amateur radio community.

The Automatic Packet Reporting System is a digital communication protocol designed for the purpose of sending real time location data of any object or person into the APRS-Internet System (APRS-IS) using the local RF-network. The location data sent to the APRS-IS will be stored in a server and can be retrieved by a variety of APRS software that is accessible to everybody. The software will take the location data from the server and display it on a map, providing a simple user interface. Additional significant features provided by the APRS software includes signal bearing discovery, search and rescue, data collection from weather stations, and the use of alerts and objects. All these amazing features have their roots in packet communications, a method of broadcasting data via radio signals between two amateur radio operators, but APRS is a little different.

APRS varies from original packet communications because data is no longer sent just between two points but instead becomes public to everyone. APRS works off packet repeaters known as digipeaters, which collect and retransmit data to other digipeaters in similar fashion that repeaters retransmit radio waves. Each time it goes through a digipeater it leaves some information behind for others to access and retransmit. Through this method the data can travel great distances and eventually they will reach an I-Gate where everyone on the Internet has access to the data that has been traveling around the digipeaters. Because the data being sent is often repeated multiple times the information is generally never lost; in fact there are excess copies of the same information that the I-Gate has to delete before putting the data in the database. APRS is a strong and secure network for informing others of your location; it is a shame that more people do not use this magnificent technology.

The Android Platform

Android phones are extremely popular today and are the most popular type of smartphones available. Google has developed an extensive platform using Java that is easy to use and free to develop on. This has led to the creation of an immense application market with over 250,000 apps. The operating system (OS) is used in nearly every type of product. In products such as TVs, netbooks, tablets, phones, printers, and even washing machines and driers are starting to incorporate the Android OS. It is an ever expanding OS and it possibilities are limitless. While it may seem like fairly new technology, it has taken a while to develop.

The Android OS initiated development in 2003 when Rich Miner, Chris White, Andy Ruben, and Nick Sears in Palo Alto, California founded the company, Android Incorporated. The group created a strong foundation for the mobile platform using Linux as a base, and after two years they caught the eye of Google Inc. In 2005 Google acquired Android Inc. and started expanding on the work that the founders had started. With Google's vast amount of resources and technology geniuses they were able to complete the first version of the OS in just three years. On October 22, 2008, HTC, a large company that produces mobile phones, released the first Android phone, the HTC Dream, and from there onward the Android platform has taken off and matured into an incredible operating system.

Combining the APRS and Android Phones

At the moment APRS transmitters can send location information based on the location data received from a GPS receiver unit or manual input, but I take out the need for the GPS unit and replace it with a more common item—the Android smartphone. The way my Android application currently functions is by getting the user's location from a GPS receiver built into the Android phone, converting the location data into an NMEA format, and outputting the data over Bluetooth to a server code written on a Windows® 7 laptop computer. A server code written in Java on my PC accepts the Bluetooth connection and then sends the NMEA data received from the Android phone to a C# program which sends the data to a serial port on the computer. If the computer does not have a serial port (as most newer computers do not), a USB to serial adapter cable may be used. The APRS TNC/ transmitter is connected to the serial port directly or via a 9-pin to a small stereo plug converter cable. Once the location is inputted to the APRS transmitter it will then beacon its location to an I-Gate, and once the location is available at the I-Gate the APRS app will get the location from the server and display it on a map built into the app. There is a lot of movement of data from one format to another right now, but I am working on simplifying the process by writing the server code entirely in C#.

In the Android code the two main classes, the LocationListener class and LocationManager, are used to receive the location data using the GPS receiver built in the phone. Once the location data is received, an NmeaListener class object converts the location into an NMEA format. By using the BluetoothSocket class the NMEA data is sent over Bluetooth to a computer running Windows 7 with Bluetooth capabilities. On the computer is a server code written in Java that uses and InputStream class object to read the NMEA data and an OutputStream class object to send the data to a C# server. The C# server also uses InputStreams and OutputStreams to read the NMEA data and send out of a serial port into the TNC/APRS transmitter. Once the location is in the transmitter, it can be sent out to an APRS-IS and the location data is accessible to everyone. Included is a small chart showing the basics of how the software works.

Currently in the Android app store there is an APRS app which uploads the user's current location to the APRS-IS via the cellular data network Wi-Fi connection. The app is good but it does not make use of a radio transmitter. What I have done is transform an Android smartphone into a GPS receiver and use it to send location to a beaconing APRS TNC/transceiver that will then upload the user's location to an I- Gate using RF bands. It is a simple deviation from the app but it fulfills a few new purposes. For one, if someone is currently in a location without access to Wi-Fi or does not have cell phone service, this app along with a laptop and APRS TNC/transmitter can be used to inform others of his or her location for safety purposes. For example, if one were to go on an expedition somewhere deep in the Appalachian Mountains where there would be no service, one could use the Android app to inform others of his location in case of an emergency. Another plus to this app is that it is free. One does not need any data plan to use this service, just a functioning Android phone, a laptop and an APRS TNC/transmitter.

Future Possibilities

This app is still under development and has many possibilities for additional features. One additional capability that could be added is the use of software TNCs instead of hardware ones. Software TNCs are becoming more common and making this app compatible could drastically reduce the amount of hardware necessary. Instead of having a physical TNC or an APRS transmitter, a sound card inputted in the headphone jack and the microphone jack of a computer will suffice. This would make the app less hardware dependent and that would mean fewer things needed to make this app work.

Another way to decrease the amount of supplies to make this app functioning could be by removing the laptop from this process. Currently the laptop is needed, because as of now there is no way to output data from an Android phone other than Bluetooth, and currently APRS TNCs cannot accept data over Bluetooth so a laptop had to be used as a middle man to get the data from the Android phone to the APRS TNC/transmitter.

APRS TNC/transmitter. According to Internet rumors, Google will release a new version of its Android OS in November of this year and with that update will come the ability to send data over the micro-USB to USB cable that comes with all Android phones. Hopefully once that happens the laptop could be taken out of the process and the Android phone can send data directly to the APRS transmitter with a few cables. However, until then there is no way I found to get data to an APRS transmitter without the use of a computer.

A third feature this application could boast is to send location data to an APRS-IS using Wi-Fi or a cellular network just like the other APRS app currently works. By adding this feature to the app it would reduce the need of having two apps for a similar function. Also this app could have the ability to switch between a Wi-Fi mode and TNC/APRS transmitter based on the availability of theses services. For example, if one was in an area without Wi-Fi or access to a cellular network the app could automatically switch to the TNC/APRS transmitter mode and once the phone had cellular service it could switch back to Wi-Fi mode. Overall this application has not yet reached its full potential and can still become more phenomenal.

Conclusion

Android phones have been designed to include several devices in one compact product, including phones, cameras, camcorders, browsers, and much more. Now I have added one more function to Android phones as a GPS transmitter. The Android phone can replace a large, bulky GPS receiver unit and be used to output the same NMEA data. Using that data the user's location can be sent to an I-Gate using an APRS TNC/transmitter, and the data can be received on the same standard APRS. The application has a lot of potential for future improvement as well by removing the amount of additional hardware and software needed to operate this application. This application makes it easier to let others be aware of your location in places without service, providing a good safety measure in areas where being safe can become a challenge.

References

http://luugiathuy.com/2011/02/android-java-bluetooth/http://developer.android.com/resources/samples/BluetoothChat/index.html

Acknowledgements

Thanks to my father's knowledge in computer sciences I was able to manage the difficult programming required for this application. Also his enthusiasm for amateur radio served as a strong source of motivation for me to complete this app.

Bob Buus, W2OD: Thanks to Bob's assistance and expertise with technology, the seemingly complex hardware behind amateur radio became much simpler. Without his assistance the hardware aspect of this project would have been much more challenging.

The Holmdel RACES Organization: Thanks to The Holmdel RACES I was able to test my application to see if it worked in reality and not just theory. They loaned me an APRS transmitter with which I was able to test my application to see if it was actually functional.

Amateur Radio as a Tool for Changing Students' Attitudes Toward Science

This past August KD4STH graduated from the University of Kansas with a Ph.D. in science education. His dissertation centered on student involvement with BalloonSats. Here is a summary of that dissertation.

By Paul Verhage,* KD4STH

Doctoral programs typically end in a dissertation that demonstrates that the graduate student can design, carry out, and complete the analysis of a program of research. My program was no different. I wanted to discover how BalloonSats, which are functional models of satellites, can betools for change, specifically in students' attitudes toward science. In order to launch, track, and recover the student BalloonSats in my study, I had to use amateur radio, specifically APRS.

Now that I have graduated and published my dissertation, I would like to acquaint *CQ VHF* magazine readers with the design and results of my study. In my study, students had a brief period of time to design a BalloonSat from a kit of parts. I chose this task because it is similar to the US FIRST (http://www.usfirst.org) robotics challenge.

For readers not familiar with FIRST, it's a competition for high-school-age students. They and their mentors turn a 140-pound kit of parts into a competition robot within a six-week time frame. I chose this design for my study because I used to be a FIRST coach and because a previous study by Dr. A. G. Welch (2007) found that FIRST robotics was effective in changing some students' attitudes toward science.

Student involvement in the science of near space goes back a long way. After Bill Brown, WB8ELK, started the modern amateur near-space exploration movement, amateur radio groups such as Windtrax in Indiana, EOSS in Colorado, and Bill's own group in Ohio involved a small number of students in the launching and tracking of payloads through the use of amateur radio and weather balloons. These groups even helped a number of these students develop and fly science experiments on their high-altitude trackers. The number of students remained small, because it is difficult for students to integrate experiments into the complex APRS trackers used to follow and recover the near-space payloads.

That changed starting in 2001 with the creation of the BalloonSat concept. Chris Koehler's BalloonSats are self-contained science experiments that replicate satellites. Without being concerned about APRS trackers and amateur radio licenses, students can focus on designing their experiments. This is similar to designing a satellite for NASA. You design a satellite to meet NASA's minimum requirements; however, you aren't concerned about the rocket, astronauts, or tracking station involved in the launch.

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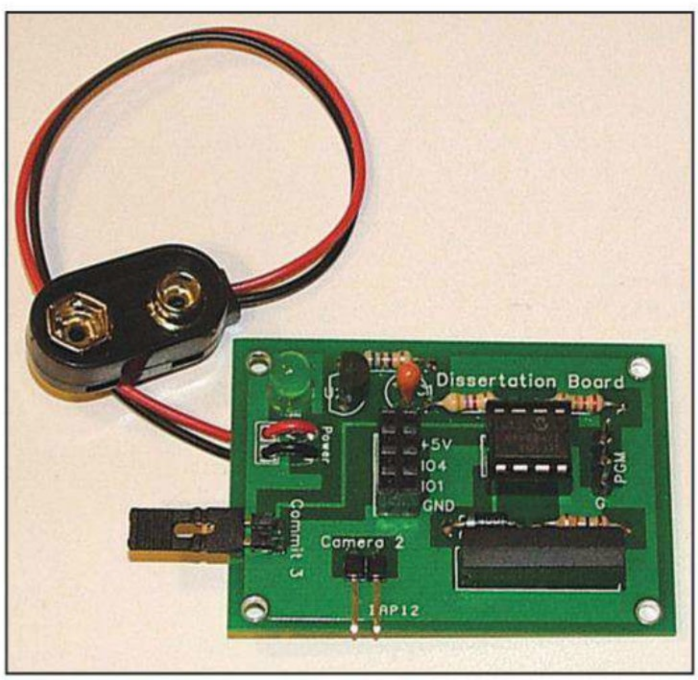
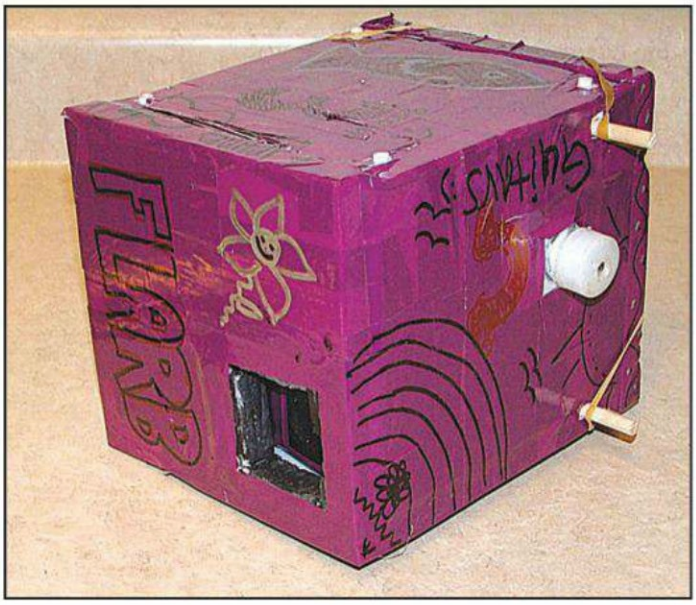
A review of the literature completed prior to initiating my study found that there is not a lot written about BalloonSats (compared to other forms of science education methods). What material has been published is mostly descriptive in nature. Thus, for example, many publications describe how schools create and maintain their programs. Other articles describe the state educational standards that BalloonSats meet. Finally I found several articles in which the authors reported that their students enjoyed the BalloonSat activity and that they were excited by the prospect of sending an experiment into a space-like environment.

I did, however, manage to find a single published study in which BalloonSats were investigated for their effects toward several science and engineering areas. These included intrinsic motivation, application knowledge, content knowledge, and cognitive skills. This study was performed with undergraduate students at Taylor University during the 2007– 2008 academic year by Dr. Snyder and Dr. Voss.

The newness of BalloonSats means there is limited research regarding them. This is excellent, since my study to investigate



This is the flight computer that students learned to solder and program. It can collect 256 sensor readings and trigger a digital camera to record images.



Here is one of the student BalloonSats. It is a 6-inch Styrofoam cube with a temperature sensor inside the airframe and a second one beneath the plastic cap on the right. The camera is looking through the window at the bottom left.

their effectiveness at changing students' attitudes toward science would be novel. The students I chose for this study were in grades seven through ten, and my survey, the Test of Science Related Attitudes (TOSRA), has been found to be reliable and valid for this age group.

TOSRA was designed to measure the following seven students' attitudes toward science:

1. The social implications of science
2. The normality of scientists
3. Attitude toward scientific inquiry
4. The adoption of scientific attitudes
5. The enjoyment of science lessons
6. Leisure interest in science
7. Career interest in science

Once I had identified the subject of the study and its assessment, I had to meet the following four milestones:

1. Design a BalloonSat kit in time to be mailed out by mid-December.
2. Find as many teachers as possible to volunteer their classrooms to participate in the study.
3. Have students complete the TOSRA pre-survey and their BalloonSats in time for me to launch the BalloonSats.
4. Have students download the data and pictures from their BalloonSat and complete the TOSRA post-survey in time for me to analyze the results.

Nineteen teachers in six states and two Canadian provinces initially volunteered over 300 students for the study. However, the study ended collecting data from 183 students in the pre-survey and 138 students in the post-survey.

Each classroom received a BalloonSat kit in late December. Each kit contained the following items:

- A programmable flight computer kit
- A sensor kit
- A modified digital camera
- A selection of Styrofoam squares, six inches on a side with various thicknesses
- A square of Correplast
- Five plastic tubes
- A plastic lid
- A set of theater gels to create an infrared filter
- A roll of thin colored tape
- A programming cable

For this study the students were allowed to select if they wanted to join the treatment group that built a BalloonSat or join the control group that didn't build a BalloonSat. As you can imagine, students who wanted to build the BalloonSat had on average a more positive attitude toward science compared to students who chose not to build one. Therefore, I had to perform an analysis of covariance, or ANCOVA, in order to find a difference between the two groups.

An analysis performed at the end of the study found no significant difference between the BalloonSat and control groups in any of the attitudes toward science, except for one leisure interest in science. This indicates that after building a BalloonSat, having it launched, and getting back the data, students were more interested in taking up science activities as a hobby outside of school. In addition, a search for interaction showed that both male and female students responded the same way to BalloonSats. This is good, since girls are under-represented in science, technology, engineering, and mathematics (STEM) careers. The BalloonSat is helpful for both boys and girls.

A day or two prior to launch each BalloonSat was tethered to one another and then to the GPS tracking modules. The BalloonSats were tethered together using four thin strings that pass through the plastic tubes that students glued to the inside edges of their BalloonSat.

For readers who are math geeks, the F-ratio for two groups of 138 samples in the post-survey is as follows.

$F(1,135) = 3.91$, $p = 0.05$, and partial $\eta 2 = 0.03$

This ratio tells us that there is only a five-percent chance that the difference between the pre and pos tmean scores of the treatment and control group was due to random error. In addition, the BalloonSat only accounted for three percent of variance (difference in scores) between groups. This implies that a BalloonSat project like this has a small to moderate effect on students' attitudes toward their leisure interest in science.

What is next for me and the investigation of the effectiveness of BalloonSats? First, I want to repeat the study in order to test the effectiveness of a second BalloonSat project on students' attitudes toward science. According to a second study recently performed at Taylor University, a student may need to experience projects such as the BalloonSat three or more times in order to develop stronger interests in science.

Second, I need to expand the number of students in my investigation. Increasing the number of subjects in a future study can detect the BalloonSat's smaller effects. Perhaps other attitudes are impacted by BalloonSats, but they were too small for my study to detect statistically.

Third, a BalloonSat study needs to expand its timeframe and encompass an entire school year. One reason this is necessary is because both students and teachers mentioned that they did not have enough time to complete the project. Giving students more time to complete the BalloonSat project probably will increase the student success level and that may increase students' attitudes toward science even further.

Fourth, the delivery of the assembly, testing, and use directions need to be improved. I felt that the materials provided were adequate, but too many students asked questions that were answered in the online directions. I believe making more of the materials available in multimedia format might help these students.

Fifth, too many of the teachers were unable to give their students sufficient help. Some teachers responded by finding outside help. For example, one middle school in Washington got outside help from Space Shuttle astronaut Pinky Nelson, and I secretly helped a second school. I found that schools that couldn't get outside help were more likely to drop out of the study. I therefore see a need to provide teacher training online or in a workshop before beginning a year-long study.

Finally, I suspect that observing the launch of students' BalloonSats will create a greater impact on students than just receiving their BalloonSat after its recovery. If increasing a student's involvement with the BalloonSat project increases the power of the BalloonSat program, then watching the launch of one BalloonSat may increase students' attitudes toward science as effectively as building two BalloonSats.

Summary

That's my study. In preparation, I spent over two years in a graduate program at the University of Kansas. I enjoyed implementing the study and its results. While not as strong as I had hoped, it at least gave me more ideas worth researching. Thus, if you are a teacher interested in testing STEM education projects, or know of a teacher who might be, please contact me via e-mail at <nearsys@gmail.com>. You can find more information about the BalloonSat project by reading the documentation I provided; look at my website, <nearsys.com> and click on the Dissertation link. You can also read a copy of my dissertation on my website under the Publications link.

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Welch, A. G. (2007). The effects of the FIRST robotics competition on high school students' attitudes toward science (doctoral dissertation). Retrieved from UMI (ProQuest Dissertation Publishing: <http://www.proquest.com, 3283939>.

Lightweight Zinc-Air Batteries for Mountaintopping

The need to power emergency communications always is challenging. Here WB6NOA reports on one potential solution, Zinc-Air batteries, commenting on both their advantages and disadvantages as a power source for EmComm.

By Gordon West,* WB6NOA

Leave the Jet Ski sealed lead-acid battery at home. Get twice the capacity with half the weight with new Zinc-Air battery packs.

The battery technology called zinc-air has been around for decades, but rarely found in the size and shape that can fit into a backpack and deliver 12 volts, up to 12 amps, for an entire weekend of VHF/UHF microwave mountaintop operating.

"My sealed lead acid is heavy, plus I need to bring along a solar panel to keep my 10-GHz microwave power source at a steady 12 volts DC," comments Julian Frost, N3JF. Ten-GHz transverters are frequency sensitive to a LO that changes frequency slightly as the solar panel changes charging current in the hot sunlight, or drops current dramatically as soon as a cloud floats by.

The sealed lead acid battery also needs periodic charging and conditioning before the big mountaintop expedition.

This same lead acid battery may also double as part of the emergency responders' "grab-and-go" kit power system, but again, it needs periodic "exercise" to keep its 12.8 volts DC "fresh" for an unanticipated widespread emergency response.

I recently tested some old technology with new packaging technology from Quantum Sphere (QSI), a leading provider of advanced portable power systems utilizing Zinc-air battery technology. The non-rechargeable zinc-air battery pack was about the same size as an automobile lead acid battery but only half the weight, and ten times the equivalent energy per kilogram. Also, don't let the non-rechargeable aspect of this technology turn you off, as the internal zinc-air power cartridge is field replaceable.

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This orange box contains the zinc-air battery ready for deployment simply by pulling the protective shield, letting in air!

"Our zinc-air portable power system is aboard Arctic Row, a 1,100-mile expedition across the Arctic Ocean from Canada to Russia," comments Michele Kinman of Quantum Sphere.

"We are the backup power system to recharge portable electronic devices and the boat's lithium battery, which is connected to a radio, GPS nav system, and the onboard desalination water system," adds Kinman. It was the water purification system that was most critical for zinc-air battery backup in case wind and weather conditions could not sustain conventional charging techniques.

The one-time-use zinc-air power source was chosen because of its compact size for a four-person rowing boat, high power output, light weight, and portability.

"For ham radio operators and first responders power-critical mission applications may need 72 hours of battery run time, with no need for regular battery maintenance before an unexpected event, and a long five-years-plus shelf life that guarantees readiness in emergency situations," comments Tracy Lenocker, WA6ERA, Mountain Division Chief, Office of Emergency Services, San Bernardino County Fire Department.

Old OMs, like me, are quite familiar with zinc-air batteries found in the majority of hearing aids. They are lightweight, run multiple days longer than heavy rechargeable hearing-aid batteries, and you know you have brand-new power as soon as you peel off the air-blocking tab.

Best of all is the eco-friendly aspect: Zinc oxide and good ol' air is all you throw away, non-toxic!

For our 10-GHz San Bernardino Microwave Society "Tune Up" we used the Quantum Sphere MetAir™ Ranger primary (non-rechargeable) power source. Everyone wanted to see what was in the orange box.

What we unveiled were zinc-air battery "plates" where the positive terminals act as the nano-enabled cathode, providing high power, and the negative terminal anode utilizes recycled zinc "waste" as clean fuel. The fuel for the cathode is simply oxygen form the air we breathe. Fuel for the anode is zinc metal powder, a refined byproduct from the steel industry! These zinc particles form a porous anode, which is saturated with an electrolyte paste to make it electrically conductive. Oxygen causes a reaction and forms hydroxyl ions. This forms zincate, thereby releasing electrons to travel to the cathode.

I was told that Quantum Sphere's patented nano-technology production processes create the high surface area advanced catalysts that facilitate this electro-chemical reaction with greater efficiency resulting in higher energy density within the zinc-air battery.

As a result, the MetAir™ Ranger PPS has higher energy capacity to volume and weight ratio than any other commercially available battery.

For our ham radio tests, the factory provided cells that were combined in various form factors with series and parallel connections leading to 12 volts DC output, 12 continuous amp-capable output, 275 amp hours of stored capacity, all in a 28-pound portable system with Anderson connectors output.

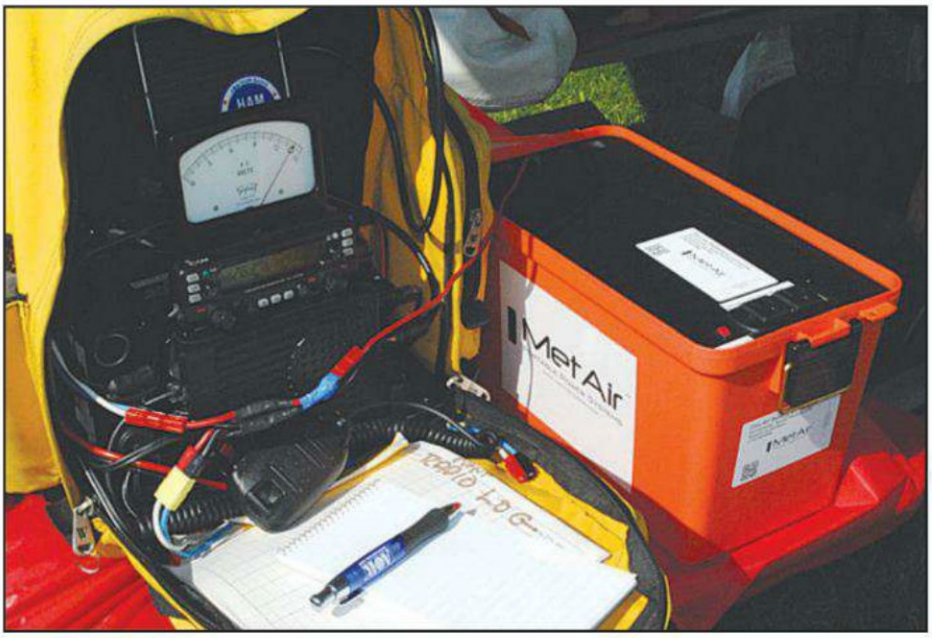
For the ham radio microwave application our system could give us 12 amps continuous and 15 amps intermittent. This would be plenty of current to handle my 2-watt, 10-GHz transverter driven by the 100-milliwatt Kenwood 2-meter LO transceiver.

To activate this portable battery system, I simply pulled the tab affixed to the air-blocking membrane covering the large holes within the battery system. Within about 5 seconds, 12.5 volts DC came up on my DVM and I was ready to draw some current. When I switched on the LO 2-meter transceiver, then added the 2-meter transverter, the voltage barely dipped. A small fan came on, sensing current draw, blowing into the cathode for oxygen that acts as the fuel for the anode zinc metal powder/paste, spread on a thin porous screen.

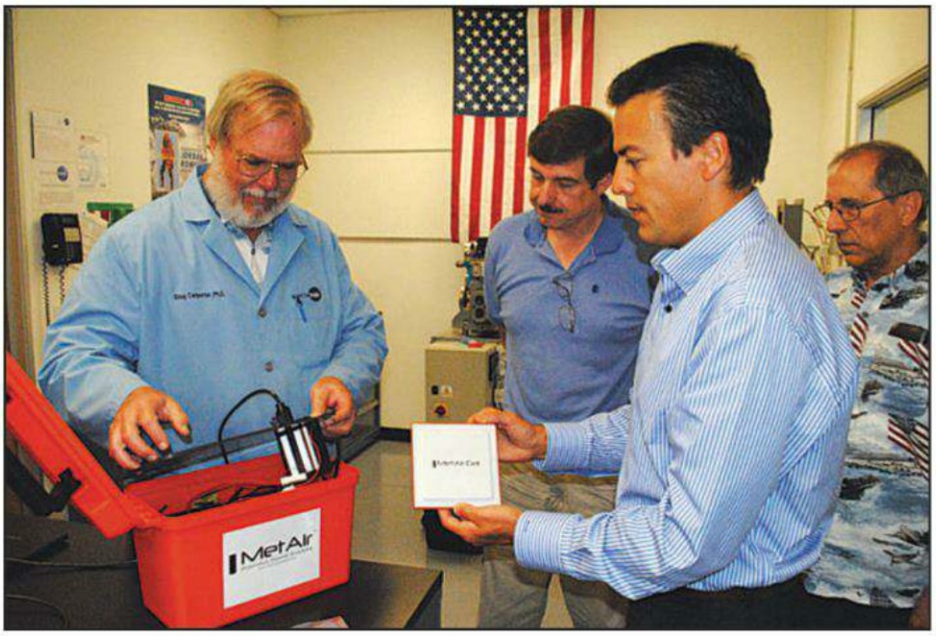
On transmit, using SSB as well as CW, and even FM, the voltage remained nearly constant with no sign of FMing of my signal. We even added some external loads to see if the voltage would drop down, but again, no voltage drop nor noticeable FMing of my transmit signal.

Computer plots of the output voltage over time and load, show little decay of voltage or current output until the very last few minutes of battery life. It takes an immediate nose-dive at the end, so you do need to keep track of the amount of average current you are pulling.

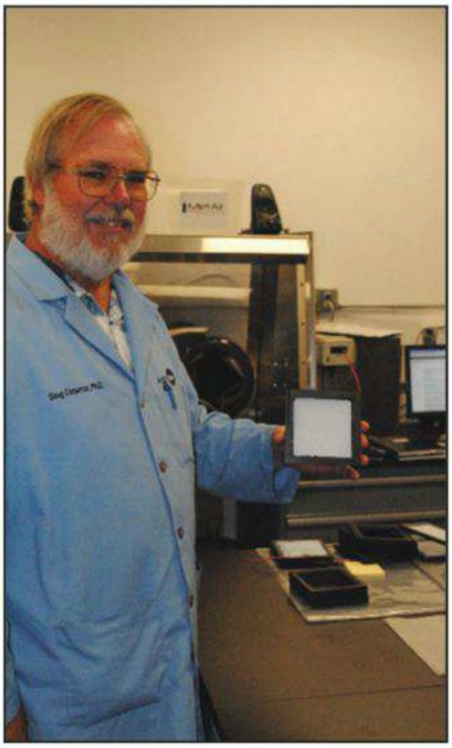
Most amazing was the run time—multiple days of additional testing, well beyond a single day of operation with a



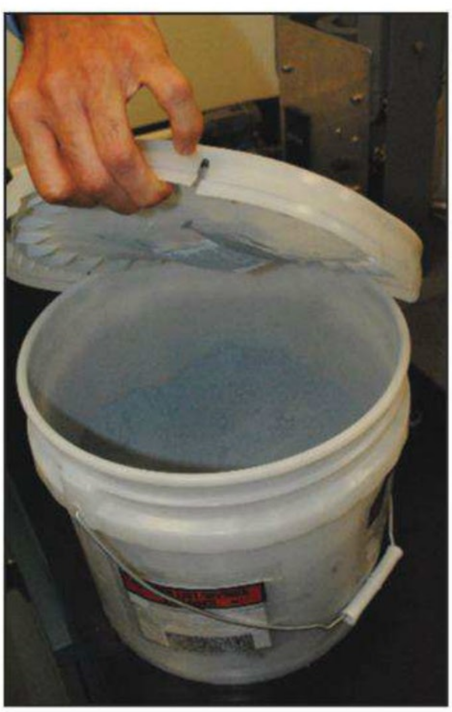
Once we pulled the protective air-tight cover off the battery pack and closed up the box, we had 13 volts at about 5 amps to power this grab-and-go emergency pack for several days of operation! On FM, the pack worked fine.



Here is an individual zinc-air battery cell,ready for the zinc to be applied in an argon chamber, and then sealed to prevent air from activating the battery action until needed.



During out tests on SSB to power up the transverter on 10 GHz we needed the larger cell system with larger battery plates to keep the LO from FMing due to voltage excursions on transmit from 13 volts down to 11 volts. On FM, no problem, but on SSB, not acceptable on the smaller cell system without a voltage regulator.



Zinc powder, filtered to a fine mix, ready to be painted on the battery plates in the argon chamber.

sealed lead acid battery at twice the weight!

For a mountain-topping ham radio DXpedition, where battery run time must be absolutely dependable, series in-line "counters" can give you accurate indications of how much energy remains as soon as you pull the air-blocking shield. Once the shield is pulled, even under no load, the zinc-air reaction is taking place, slowly dissipating capacity over a two-week period.

So don't pull the tab until you need to! Once the reaction begins, you can't turn it off.

Pricing for the MetAir™ Ranger system providing 275 amp hours at 12 volts, 28 pounds, is still to be determined as of this writing. Pricing for the replacement cartridge has not yet been set.

However, think about the five-year shelf-life emergency applications:

1. Fresh back-up power to run *or charge* consumer electronic devices (after their internal batteries go dead)
2. Dependable power for nighttime use of CPAP breathing devices
3. Dependable power in a maritime or aeronautical ditch bag
4. Dependable power for emergency medical life-saving equipment

You get the idea. . . . With a five-year shelf life you have a portable power system with an optional 110-VAC inverter that needs absolutely *zero* maintenance when stored in an emergency locker or the orange "grab-and-go" kit. Unlike traditional sealed lead acid, nickel cadmium or nickel metal hydride, plus dangerous lithium applications, absolutely *no* monthly battery charging maintenance is required. You have five years of fresh energy as soon as you pull the tab for five years.

To learn more, visit <http://www.QSINANO.com>, and with specific ham radio application questions, you may e-mail <mkinman@qsinano.com>, or phone (714) 545-6266, ext. 104.

Ten-GHz rig testing: Testing at the recent San Bernardino Microwave Society annual tune-up party revealed that the zinc-air prototype battery did support FM gear. However, it did not offer the necessary DC regulation needed by microwave transverter systems.

The larger zinc-air battery, with built-in voltage regulator and buffer capacitors, which I satisfactorily tested at the factory, will be necessary to keep this sensitive amateur radio gear on frequency without transmit warble.

It's lots of dollars, but for a DXpedition that may need a reliable source of DC, or AC from the inverter, this gear may be just the answer—long five-year life with almost no decay, non-toxic nor flammable, half the weight of a regular wet cell battery, with eight times the run time over that same-size wet cell . Yes, the downside is cost, and no capabilities for high-current output, such as starting an electric generator,starting a car, or running a KW amp!

On the other hand, for no-EMI noise running a laptop via a USB charge, or the inverter (noise) to run power cubes, for a very long(er) time, this would be good!

Holiday Gift Ideas

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by Franz Langner, DJ9ZB

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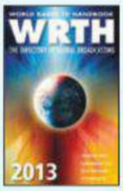

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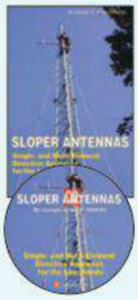

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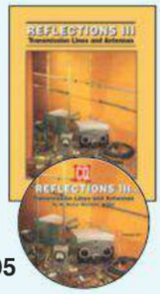

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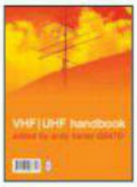

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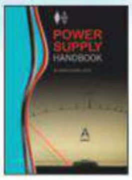

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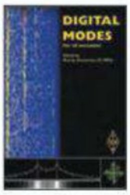

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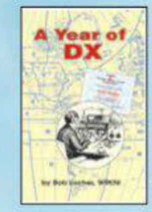

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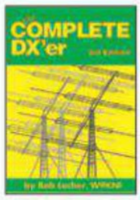

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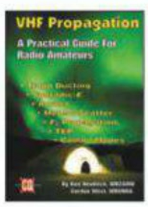

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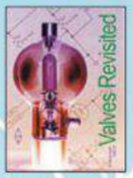

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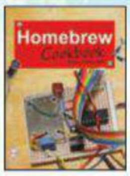

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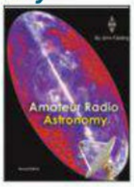

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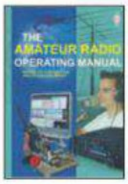

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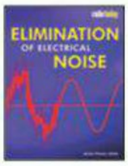

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There's a "Secret Service" in Memphis on the 222 Ham Band

The 222-MHz amateur radio band is way underutilized. WV5J reports on a local solution to occupying the band in hopes of inspiring others to do the same in their respective communities.

By John Wood,* WV5J

Want to know where the ham action is in Memphis, Tennessee? I'll tell you, but you'll have to keep it a secret, because it's more than just a secret; it's a secret service. It has taken root and grown surprisingly large in the fertile soil of the slim 222-MHz ham band.

That's 222–225 MHz—or more specifically, 224.78 MHz—the frequency for the repeater that has recently been acting like a ham magnet and attracting so much amateur radio attention in the mid-south of the U.S. that it has reached phenomenon status.

Why are they so drawn to 222? Perhaps it's because when you tell someone it's a secret, they just can't help but be curious. Or maybe it's that like you, they are looking for the action.

Whatever the reason, though, local hams have been turning out in relatively large numbers to be a part of this new, ham-radio version of the "Secret Service" on the 222–225 MHz band in Memphis.

They seem to come from all points of the compass to join the VHF fun, accessing the Memphis-based repeater from as far away as Bolivar and as close as Germantown, Bartlett, and Collierville; these all are Tennessee cities and Memphis suburbs for you non-local hams.

Local hams have also checked in on the 224.78-MHz repeater from nearby Arkansas and Mississippi, relatively VHF DX considering line-of-sight limitations of 222–225-MHz signals.

The membership requirements to be a part of the action are few: All it takes is an 222-MHz FM radio, a current FCC amateur radio operator's license, and a desire to make new friends.

The response has been impressive, but the effort did not start out that way. In the beginning, back in early 2008, there were only three local hams active on the 222-MHz band—three hams who thought it would be helpful to utilize this underused band as a kind of an intercom for chasing 6-meter DX grid squares during the summer band openings in that year. Back then, the best common denominator on the band was the 224.42-MHz repeater, which all three operators – Rick Tillman, WA4NVM, Lance Morris, N4GMT, and Damon Runyon, WA4HFN—could access, but hitting it was a strain for some other area hams.

One other machine on 224.12 MHz was also operational but sometimes even tougher to hit than the 42 machine, so it was used even less.

The status quo changed dramatically when the Tri-State Repeater Association, which operates and maintains most of the ham repeaters in Memphis, opted to move its 224.78 MHz machine from a tall building in downtown Memphis to the top of a 400-foot building in east Memphis that was more centrally located to most of the active hams. Suddenly a Monday-night net that began with only three hams grew weekly to six check-ins, then eight, and actually surpassed ten after the third month, to the surprise of all.

To keep the membership growing and to enhance the fun, those who checked into the net and in doing so proved their operating prowess on 224 were granted Secret Service assigned numbers of the double "0" variety, ala James Bond. Lance, N4GMT, earned the coveted "double 0 one" honors, followed by Rick at 002 and Damon at 003. Yes, it was a small start but a start nonetheless.

As Net Control Station Lance, N4GMT, recites every week when he reads the net preamble, the 222 (MHz) Roundup Net, as it is called, "was started to promote the use of the 222 band and for those who have equipment a reason to use it."

They've even added a touch of innovation with N4LI, Peter, designated as double 0 seven, serving each net night as the 222-MHz eBay reporter giving net check-ins an update on any 222-MHz ham gear that's up for sale on the Internet auction service, eBay.

And now . . . my how things have changed! At the last count, membership in this Secret Service totals more than 65 area amateurs and more seem to be coming online each week, partly due to the daily nets called at 6:30 every morning on the 224.78 repeater, commonly referred to as "muster." In a more practical sense, it's the active ham's way to say "Good morning, Memphis." Participation is not required and no early morning nets are called on weekends, so Secret Service members can rest up for those early weekday 6:30 AM check-ins.

"You can't run with the pack if you're still in the rack," Rick Tillman, WA4NVM, tells the sleepy hams most every morning, then feigns a threat of putting non-present hams on KP duty for missing muster. Sure it has military overtones, but it's all in fun, and that's why Memphis area hams have turned out in droves for the local version of the Secret Service.

Net leaders add to the enjoyment of Secret Service membership by holding bi-monthly breakfast sessions at a centrally located restaurant, and on various occasions toss in a brunch meeting at a different restaurant just to keep the scenery from getting stale. Those who show up for the meetings include Secret Service agents with assigned numbers and others who are itching to join. Their membership status is not important, since all are welcomed.

Thus, if you're a ham living in the Memphis area, grab a piece of 222 FM gear and join the fun, or if you're just traveling through Memphis and you have a 222 mobile in the vehicle, tune to 224.78 MHz (narrow, minus offset) and transmit your callsign. You may be surprised at the response you receive. However, don't expect me to tell you precisely how much VHF ham fun you can have when you ID, because, after all, it is a *secret*!

**e-mail: wv5j@netscape.net*

By Joe Moell,* KØOV

HOMING IN

Radio Direction Finding for Fun and Public Service

Most Medals Ever for Team USA at the 2012 ARDF World Championships

It has medieval castles, monasteries, and natural hot springs. The forests are full of pines, firs, oaks, and Balkan beech. In those trees are Scops Owls, Red-tailed Shrikes, and Wood Larks. This is Kopaonik (pronounced "kuh-POH-nik"), a mountain range in central Serbia, just north of Kosovo. For 160 days a year snow covers these mountains and attracts visitors from all over Europe and the UK to its two dozen ski lifts, as well as sleigh rides, Ski-Doos, and ice skating. However, in September 2012, Kopaonik hosted hundreds of fans of on-foot hidden transmitter hunting, also called foxtailing, radio-orienteering, and ARDF.

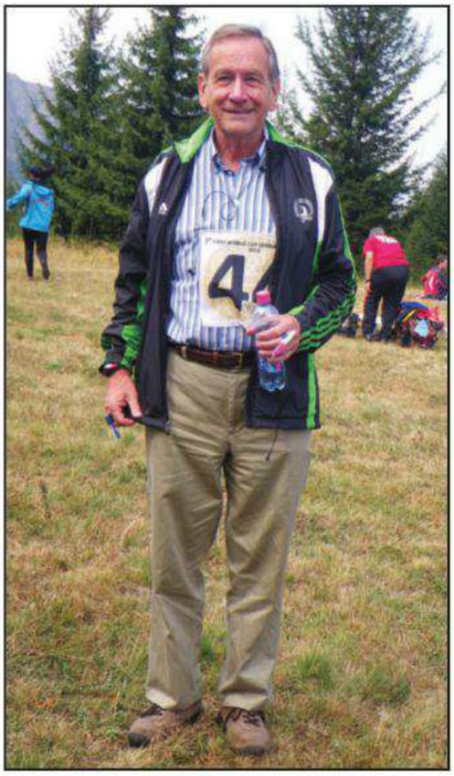
*P.O. Box 2508, Fullerton, CA 92837
e-mail: <k0ov@homingin.com>

Every even-numbered year, radio-orienteers of the world gather to learn from each other and see who is best at the sport. Fifteen countries have hosted the World Championships since the first one in 1980. This was the first time for the Amateur Radio Union of Serbia (SRS) to host, and everyone agreed that it had never been done better.

Jay Hennigan, WB6RDV, of Goleta, CA told me, "It was extremely well organized and executed. I had more fun than at any World Championships before." This was Jay's fifth World Championships. His passport has stamps from trips to championships in Croatia, Korea, Bulgaria, and the Czech Republic. He earned his position on ARDF Team USA 2012 by capturing three gold medals and one silver medal in the 2011 and 2012 USA ARDF Championships.

Regulations of the International Amateur Radio Union (IARU) allow only three competitors per nation in each age/gender category, of which there are six for males and five for females. After

Twelve members of USA's delegation to the Sixteenth ARDF World Championships. Left to right are Ruth Bromer, WB4QZG; Lori Huberman; Joseph Huberman, K5JGH; Nicolai Mejevoi; William Smathers, KG6HXX; Scott Moore, KF6IKO; Alla Mezhevaya; Jay Hennigan, WB6RDV; George Neal, KF6YKN; Vadim Afonkin, KB1RLK; Harley Leach, KI7XF and Karla Leach, KC7BLA. Not shown are Bob Cooley, KF6VSE; and Marvin Johnston, KE6HTS, who was a member of the international jury. (Photo by Jay Hennigan, WB6RDV)



When doing ARDF, Jay Hennigan, WB6RDV usually wears a cool and comfortable running suit. However, on the first day of the World Cup he had to hunt transmitters in street clothes with a borrowed antenna because his luggage was lost. Nevertheless, he found all of his required transmitters. (Photo by Joseph Huberman, K5JGH)

the 2012 USA championships at Mt. Laguna, California,[1] invitations were given to 22 foxtailers to represent USA and ARRL in Serbia at their own expense. Because of scheduling conflicts, medical issues and financial difficulties, only 13 accepted.

These nine men and four women ranged in age from 27 to 71. They flew to Belgrade, where most were met by the Serbian organizers and taken by bus to Kopaonik, 180 miles to the south. They enjoyed fine cuisine and stayed in resort hotels that were built to host European royalty. According to Marvin Johnston, KE6HTS, of Santa Barbara, CA, "The food was excellent. Each meal was wonderful!"

A Training Camp with Medals

Eight members of Team USA arrived early for a new event, the ARDF World Cup. Recent world championships have included up to four days of optional training just before the main ARDF competitions. The Serbs improved on this concept by providing four full-scale ARDF events, two on 2 meters and two on 80 meters that were good training plus an opportunity to win medals.

The World Cup was for individuals, not national teams, so there was no limit to the number of persons from each country. The Chinese Radio Sports Association alone sent 120 people, mostly teenagers. WB6RDV says the hotel Wi-Fi became very slow in the evenings, probably because these Chinese youth were enjoying the uncensored Internet.

World Cup courses were in newly mapped terrain and were in full accordance with IARU rules for ARDF.[2] Those rules call for five transmitters in rural and wooded terrain, typically 1000 acres or more. Contestants set out from the start as Fox #1 came on the air and tried to be the fastest to "punch in" at all required transmitters and then get to the finish line in another part of the forest.

A typical start-to-finish route for all five foxes is 6 to 10 kilometers. All of them transmit on the same frequency. Each is on for 60 seconds at a time in rotating and repeating sequence. Hunters must seek three, four, or all five, depending on their age and gender. There is a continuous transmitter on another frequency at the finish corridor to help competitors find their way home.

The Serbs created a point system to combine the results of each competitor's four days. In each age/gender category, the winner each day earned 100 points and the rest were allocated a lesser number based on their times and positions relative to the category winner. Five of the eight USA participants in the World Cup were in the top three of their categories

Yagis everywhere! These 2-meter ARDF receiver/antenna sets are in impound before the of start competition day two. Competitors retrieve their receivers just before they go out on the course so they aren't tempted to take bearings while they wait. (Photo by Jay Hennigan, WB6RDV)

Joseph Huberman, K5JGH, "punches in" at the spectator control in the middle of the ARDF Sprint competition. He found his seven required fox transmitters in less than 30 minutes. (Photo by Marvin Johnston, KE6HTS)

on at least one day. Others built up their point scores by consistent performance. Final scores were not published before the medal ceremony, so it was a very pleasant surprise when five of our team members got to stand on the podium.

Bob Cooley, KF6VSE, of Pleasanton, CA received the World Cup overall gold medal for men over age 70. Bob also earned a gold medal for 80 meters and bronze for 2 meters. He attributes his success to regular participation in classic orienteering meets, where he is the leader in his age/gender category in sprint and medium-distance events.

In the M40 category, USA's Team Captain Vadim Afonkin, KB1RLI, of Newton, MA, captured overall World Cup silver and 2-meter silver. He had excellent times each day, but was always a few minutes slower than Baktybek Sharshenov of Russia. WB6RDV captured silver on 80 meters in the M60 category. Winning World Cup bronze medals for their 80-meter runs were Alla Mezhevaya of Loves Park, IL in W35 category and Ruth Bromer, WB4QZG, of Raleigh, NC in W60.

WB6RDV's medal was the result of consistent performances all four days, despite some adverse circumstances. "I was scheduled to fly from Los Angeles to Cincinnati, to Paris, and then to Belgrade," he recounted. "The overseas flight was delayed, so they rescheduled me on a regional airline. While I was waiting at the airport, I used my laptop to e-mail the organizers to tell them what flight I would be on and when I would arrive, about two in the afternoon. All the others arriving that day came in during the morning and the bus set out for Kopaonik before I got there.

"I called the organizers on arrival and they arranged for a ham in Belgrade to pick me up and take me to the bus terminal. I caught a city bus that got me to a little town about 25 miles from Kopaonik at 1 AM. The head of the organizers, Dusan Ceha, YU1EA, met me there in his personal car and drove me to the hotel. By then it was 2 AM and I had to compete the next morning. I almost overslept but managed to get on the bus to the first ARDF course with a few seconds to spare.

"Because of the flight delay, my bags were lost. Fortunately I had packed my spare receiver in my backpack and KF6VSE had a spare Yagi I could use. I had to run in slacks and button-down shirt. Then to top it off, the start triangle was mismarked on the map, so I spent 50 minutes off the map to the west because the trails didn't make sense. Once I figured this out and found my first transmitter, I did pretty well."

More Gold for the USA

The remainder of our team arrived Monday, September 10. By the end of the day, over 330 foxtailers were there to represent 33 nations. On Tuesday was the Model Event for equipment testing prior to the first ARDF event of the championships on Wednesday.

There were ten transmitters on Wednesday's course, five on each band. Six of the eleven age/gender categories hunted the 2-meter foxes, and the remaining five categories searched for the 80-meter ones. Everyone walked about a kilometer to the starting area. The finish was very close to the main hotel.

This was the day that "The Star-Spangled Banner" would be heard at the medal ceremony for the first time at an ARDF World Championships, and it would be heard twice. KB1RLI found his four required 80-meter transmitters and sprinted to the finish in just under 50 minutes. He was about a minute faster than second-place finisher Bengt Evertsson, SM4VMU, of Sweden. This was Vadim's fifth consecutive trip to the World Championships and his first medal on USA's team. He learned the sport as a youth in his native Russia.

KF6VSE picked up his third Serbian gold medal that day. Bob was in the category for men over age 70, which required finding three two-meter foxes. He did it in 1:32:42, which was almost four minutes faster than second-place finisher Viktor Baranovskyi of Ukraine.

Team USA's two gold medalists were Bob Cooley, KF6VSE (left), and Vadim Afonkin, KB1RLI. Bob won the 2-meter ARDF competition in M70 category as well as two gold and one bronze medals in the ARDF World Cup. Vadim, our Team Captain, won the M40 age category on 80 meters as well as a bronze medal in the Sprint competition. (Photo by Ruth Bromer, WB4QZG)

Karla Leach, KC7BLA, and Ruth Bromer, WB4QZG, received congratulations from members of the Czech ARDF team. They were on the podium to receive bronze medals for their team third place in the W60 category on 80 meters. They also medaled in the same event two years ago in Croatia. (Photo by Joseph Huberman, K5JGH)

According to KF6VSE, "The start was at a fairly high place on one side of the map and I got some useful bearings there. But then to get to my transmitters, I had to cross a deep valley where reflections turned my bearings into total nonsense. It wasn't until 25 minutes later when I got to the other side and started climbing some hills that bearings became useful again. My required transmitters were all on that far edge of the map, kind of in a line."

Thursday, September 13 was the day of the Sprint competition. The Sprint is a new short course that is intended to be a demonstration of radio-orienteering to the public. Competitors start at two-minute intervals to seek up to five 80-meter transmitters that cycle at five times the rate of classic ARDF transmitters. Once they find the first set, they run through a corridor in front of the cheering spectators to a second five-fox fast-cycle course on a different 80-meter frequency. They find their required foxes and rush to the finish.

"The most fun of all was the sprint," WB6RDV told me. "It was fast-paced because of the 12-second transmissions. You never had to worry about waiting around a non-transmitting fox for three-and-a-half minutes looking for flags. I had to find seven transmitters plus the spectator and finish controls. I ran so fast that I went right past one of my four on the first half. I realized the error, went back and got it, and punched the spectator control a second time. I found out later that once the spectator control is punched, any punches afterward on first-course controls don't count. That cost me about two minutes and five or six places."

Team USA has had only one opportunity to practice the Sprint. The first sprint course on North American soil was June 1, 2012 at the USA Championships at Mt. Laguna. KB1RLI won that event by almost thirteen minutes. He proved his skill again in Serbia, completing this Sprint course in just 17:25 to earn a bronze medal in M40. He was less than two minutes behind Sergiy Goncharuk of Ukraine, who won gold in that category.

The second day of full-course ARDF competition was Friday, September 14, when everyone competed on the band that they didn't run on two days before. According to KE6HTS, "A thunderstorm soaked the forest before the event, but the weather cleared nicely by start time."

Two stateside hams medaled that day as the team of Ruth Bromer, WB4QZG, of Raleigh, NC and Karla Leach, KC7BLA, of Bozeman, MT took bronze in the category for women over age 60. Team members aren't allowed to help or even to communicate with one another in the forest, but their individual scores are aggregated to determine the national

team standings. Although Ruth and Karla did not medal individually, their combined score made them the third best team in W60 on 80 meters.

KF6VSE says that the 2-meter course was easier on the second day. "Everyone started behind a big hill and had to climb to the top, but once they got there, bearings were excellent. There was no need to pass through a deep bowl that day."

"I spent ten minutes before I could get my first set of bearings," reported Joseph Huberman, K5JGH, of Raleigh, NC. "It took five minutes to get to the top of the hill and it was such a super spot that I just stayed there for a full cycle of transmitters and got bearings on all of them."

At one of the ARDF awards ceremonies are USA team members Scott Moore, KF6IKO; Bob Cooley, KF6VSE; Harley Leach, KI7XF; and Karla Leach, KC7BLA. Peeking out from behind them are team members Vadim Afonkin, KB1RLI; George Neal, KF6YKN; and Lori Huberman. (Photo by Ruth Bromer, WB4QZG)

A Short Time Limit for Foxoring

The last event in Serbia was Foxoring on September 15. Competitors received a map marked with ten small circles in the field. They used their orienteering skills to navigate to the circle locations. In or near to each was a very low power 80-meter transmitter for them to locate using their direction finders. As in regular ARDF, scoring was first by the number of foxes found and second by elapsed time.

To get the Foxoring concluded in time for some participants to get to their early flights for home, the Serbian organizers imposed a time limit of 100 minutes. That forced many competitors to go to the finish line before they found all required foxes. USA did not medal in Foxoring, but WB4QZG finished fourth in her category and WB6RDV was seventh in his.

WB6RDV commented, "Foxoring is a very good combination of radio-orienteering and regular orienteering. I liked it even though I didn't do very well. The total course length for my category was about six kilometers. If I'd had the full 150 minutes, I would have been able to get all my transmitters. But there were lots of very speedy competitors there. Some of those people ran those courses faster than I can run on a track."

Championship event organizers are sticklers for following and enforcing the IARU rules of the sport. Besides certifying the results and ruling on protests, members of the international jury act as observers out on the courses. KE6HTS, who represented IARU Region 2 on the jury, patrolled between 2-meter fox #3 and 80-meter fox #5 on the first competition day. "I was in the field and a new European competitor came up and asked where we were on the map," Marvin recalls. "I said that I could tell him but then he would be disqualified for getting help. He lost interest in asking after that."

Serbia

Serbia is a peaceful country today, but often gets reminders of its history of conflicts. Just over one month before the World Cup began, two Serbian soldiers were killed by a bomblet in a field near the Mt. Kopaonik military barracks, about three miles from the event hotel. Much unexploded ordinance (UXO) remains in southern Serbia from the bombings carried out from NATO-occupied Kosovo in April 1999. Cluster bombs that missed their intended targets fell into a cushion of deep snow, which kept many from detonating. As the snow melted, they sank into the leaves and dirt where they were often missed by the first demining crews.

The Serbian military launched a full investigation right away. Kopaonik National Park officials and the championships organizers hastened to assure participants and visitors that all competition locations were outside the areas where cluster bombs were known to have fallen. These areas had also been thoroughly swept prior to the skiing and orienteering events that have taken place in recent years.

There were no UXO incidents in the ARDF championships venues. However, on the day of the Sprint event another demining contractor lost his life to one of these antipersonnel weapons while working south of the competition sites near the border with Kosovo.

Summary

Congratulations to every member of Team USA for making our country a serious contender at international-rules radio-orienteering. For more about the team and the 16th World Championships, including the roster, photos and links to the full results, go to my "Homing In" website.[3] Lots of information about IARU rules and RDF equipment for ARDF is also there.

Plans are now being made for next year's USA and IARU Region 2 ARDF Championships, which are open to all and will help determine the members of Team USA who will travel to Kazakhstan for the Seventeenth World Championships in 2014. Is there a future champion in your ham club? Start planning now for ARDF practices and training sessions when the weather warms up next spring. Consider teaming up with your local orienteering club to include ARDF in their classic orienteering sessions.

I hope to see you at next year's national championships!

73, Joe, KØOV

Notes

1. Details of the 2012 USA Championships are in "Homing In" for the CQ VHF Summer 2012 issue.

2. <http://www.homingin.com/intlfox.html#rules>

3. http://www.homingin.com

By Bill Brown,* WB8ELK

New Heights for Amateur Radio

Space Day Event

On September 29, Spaceport Indiana, in Columbus, Indiana, hosted an event to introduce students to a wide range of space- and science-related activities. Over 60 students ranging from 7th grade to college level attended along with parents, volunteers, and guest speakers.

Throughout the day various sessions were held in the classrooms and auditorium of the IUPUC (Indiana University – Purdue University Columbus) campus. The students learned about space flight, rocketry, astronomy, amateur radio, and high-altitude ballooning. They even had an inflatable planetarium dome inside one of the classrooms that nearly filled the room and a star party at the end of the day.

Club members from the South Central Indiana Communications Support Group, Inc. (http://www.scicsg.org/) set up a tent outside the building with a complete ham radio station, which was quite popular with the students. The station was in a 10 by 10 ft. canopy and included an HF voice station, an HF digital station, and an APRS station, plus several RDF (radio direction finding) and portable satellite antennas. This station drew a good bit of attention from students, parents, and volunteers throughout the day. Many of the students had never heard about amateur radio. I suspect there will be some new hams if the interest level of both the parents and students are any indication. The students particularly enjoyed the digital modes that were demonstrated throughout the day.

Up and Away

During the lunch hour everyone gathered at the commons area behind the building to participate in a high-altitude balloon launch. The payloads consisted of two APRS trackers using the Doppler DF Instruments MicroBeacon board and high-altitude GPS units. In addition, we flew an Elktronics MMT transmitter on 144.36 MHz sending position reports via DominoEX, RTTY, and CW. This board also controlled an Iridium modem module that sends a GPS position message directly through the Iridium satellite network.

Dr. Peter Schubert and a group of students from the IUPUI (Indiana University

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e-mail: <wb8elk@aol.com>

Photo 1. Balloon launch from the IUPUC campus.

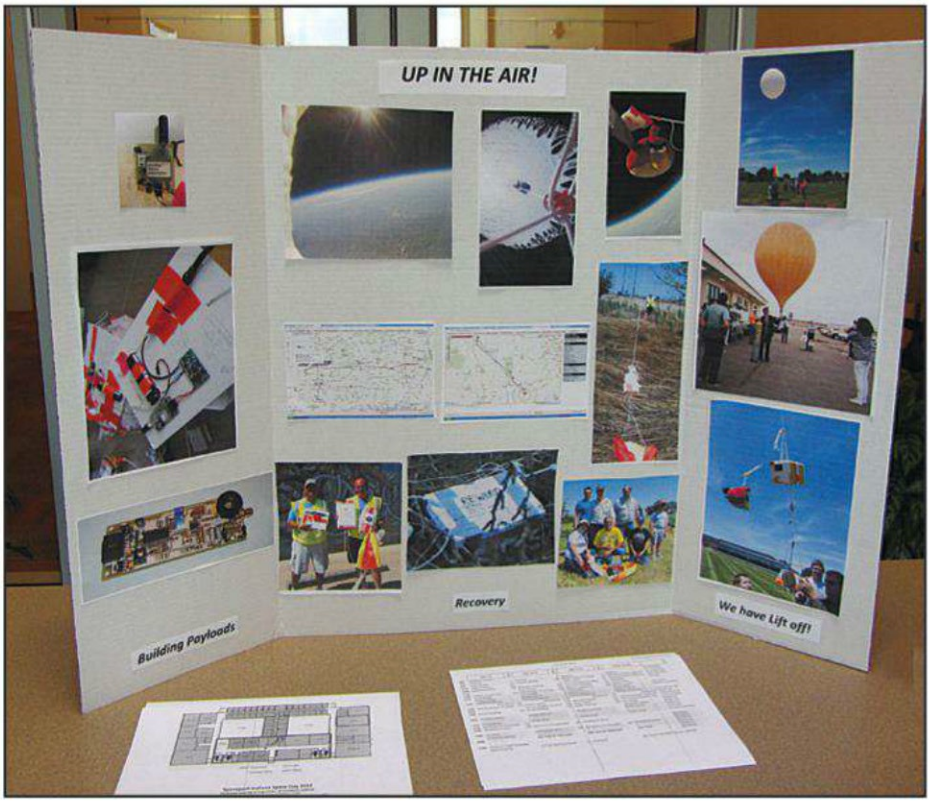

Photo 2. Amateur radio balloon display at the entrance of the Space Day event.

- Purdue University Indianapolis) SEDS group (Students for the Exploration and Development of Space) brought along an intriguing experiment. Their goal was to determine the altitude in near space where you can no longer hear a scream. Their Space Scream! project consisted of two GMRS radios and an audio recorder inside their payload box. The transmitter was VOX-activated to relay whatever was heard on the receive unit. Although they had desense problems with their experiment, it was interesting to see the reaction of people walking by when the students screamed loudly into their ground-station radio.

The balloon took off over the campus while the SEDS students and the amateur radio demonstration station listened and decoded the telemetry from the payloads with Space Day students crowded about.

All of the trackers were working perfectly as the balloon burst at 79,000 feet and started the parachute descent back to Earth. We had APRS tracking displays on wide-screen monitors in the classrooms so that the students could track the entire flight.

Photo 3. Amateur radio demonstration tent operated by members of SCICSG, Inc.

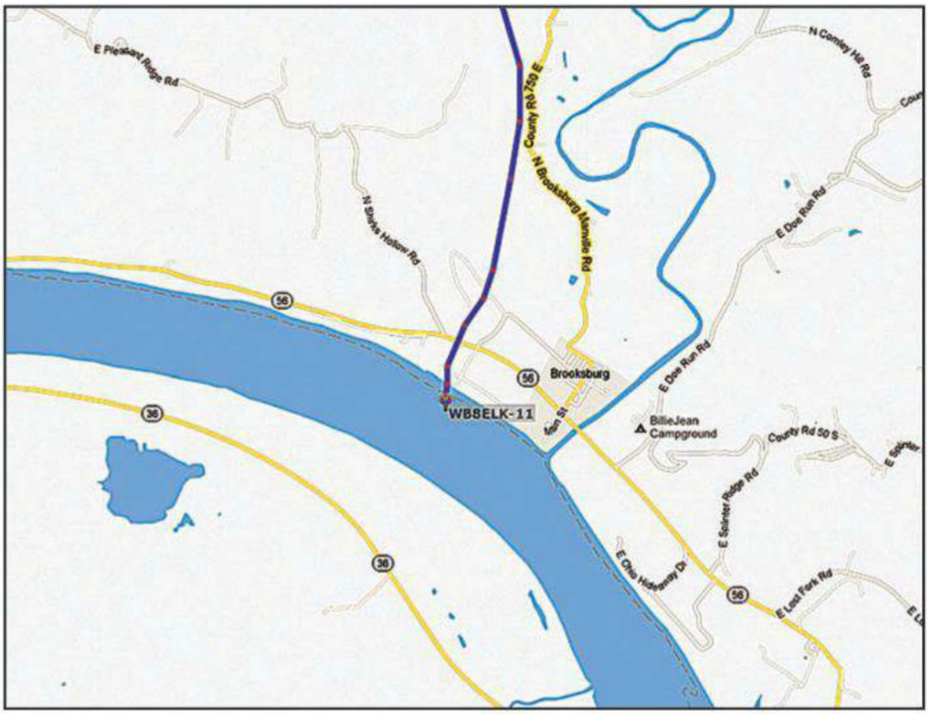

Photo 4. Splashdown in the Ohio River.

I was walking by one of the rooms and heard a collective shout of "Uh, Oh!" I looked inside at the APRS tracking screen and it showed that the last position just before landing was right over the Ohio River. The river is a half-mile wide at that point, and yes, indeed, we landed right smack dab in the middle of the river.

Houseboat Chase Vehicle

You might think that would have been the end of our payloads as they drifted slowly away. After about four hours in the water, however, I got a phone call from a fellow named Tim Marsh who asked, "Is this Bill?" He then said that he was on a houseboat with some friends in the middle of the Ohio River and had seen some boxes with orange duct tape floating on the river. When he pulled in the parachute they were at first worried that there might be a skydiver under the water but were relieved to see only experiments. My "Backup Recovery System" had worked—a large "Reward" sign with my phone number.

A few days later we drove to Tim's

Photo 5. Bev Teter retrieves the payloads from the back of Tim Marsh's truck.

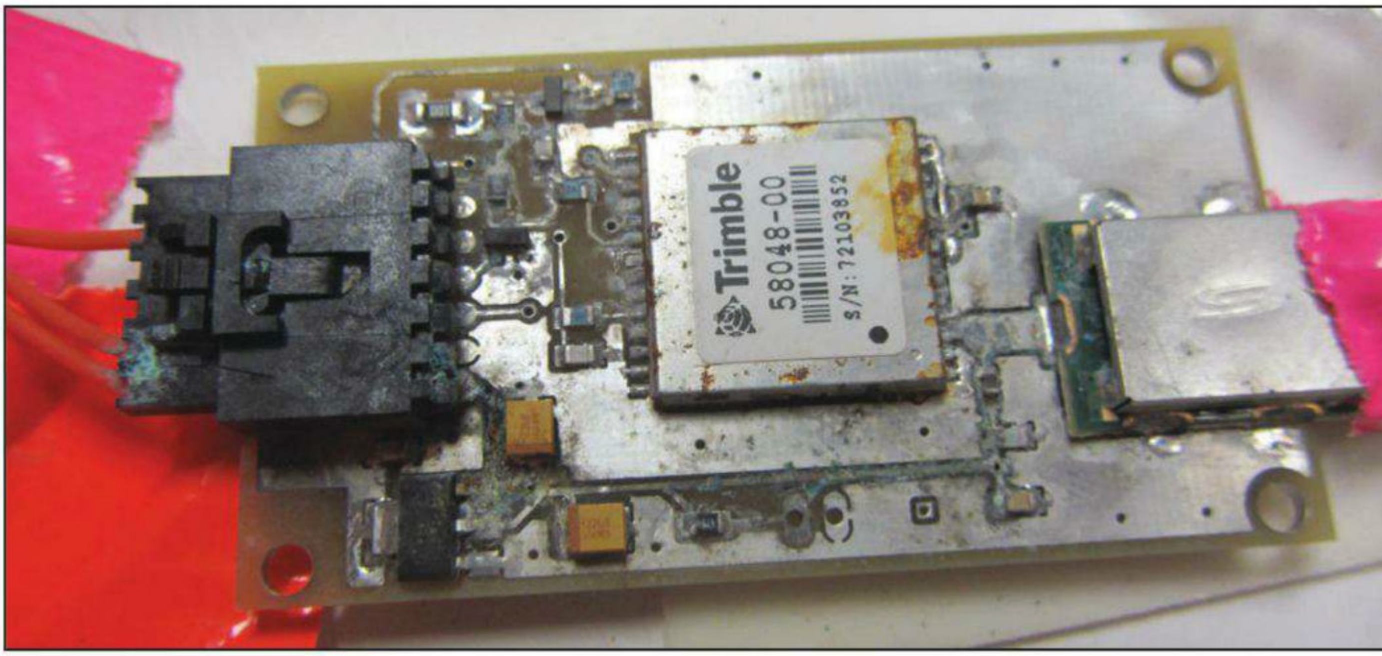

Photo 6. River water and electronics do not mix.

house in Rabbit Hash, Kentucky to retrieve the payloads. After a long night's drive down a gravel road that seemed more like a dry river bed, we finally arrived at Tim's house and pulled our payloads out of the back of his pickup truck. It was interesting to note that the mayor of Rabbit Hash is a dog (http:// www.rabbithashusa.com/). I guess they figured that a dog could do a better job of running the town.

After spending four hours submerged in the Ohio River and four days in the back of Tim's pickup truck exposed to the rain, the payload electronics were not in the best of shape. As you can see in a photo, my GPS receiver is quite green and corroded. Fortunately, the SEDS Space Scream recorder was well-protected, so hopefully we'll find out if someone can hear you scream in Near Space.

73, Bill, WB8ELK

By James Duffy,* KK6MC

How to Work a VHF/UHF Contest

Beginning with the January 2013 ARRL VHF Contest there will be two new contest categories of interest to those who want to get their start in VHF/UHF contesting. You don't need to be a weak-signal operator to participate in these new categories; one is for FM only. These two new categories of interest to beginners are the Single-Op FM-Only category and a Three-Band Single-Op (3BSO) category. The Single-Op FM-Only category covers four bands: 50 MHz, 144 MHz, 222 MHz, and 440 MHz with a maximum power output limitation of 100 watts. The Three-Band Single-Op category covers three bands: 50 MHz, 144 MHz, and 432 MHz with maximum power output limitations of 100 watts on 50 MHz and 144 MHz, and 50 watts on 432 MHz. As I am writing this in early October, the contest rules for January have not been released, so be sure to check the ARRL website for any final rule changes prior to participating in the contest. These categories will apply to the January, June, and September contests beginning with the 2013 January VHF Sweepstakes. These contests are envisioned as a way to bring more newcomers to VHF contesting. If you have never contested on VHF/UHF, take advantage of these categories to get your feet wet.

I thought that with the implementation of these new categories aimed at the beginner, a column on how to get started in VHF/UHF contesting is in order. In particular, the 3BSO category aligns nicely with those who own one of the DC-to-Daylight rigs so popular with newcomers to ham radio in recent years. If you own a Kenwood TS-2000, an Icom IC7000 or IC706, or a Yaesu FT897, FT857, FT847, or FT100, this category was designed for you. You don't need one of these rigs to participate, though, and you don't need to have capability on all the bands. Use what you have. You don't need to compete in one of the new categories either, but they are tailor-made for the newcomer to have fun and be competitive with the equipment he or she has.

Why Contest?

Contesting is a test of your capabilities and your station capabilities. It satisfies your competitive instincts. It gives you motivation to improve your station. It improves your operating skills. Contest exchanges, fast and efficient, are good practice for emergency traffic handling. If you are chasing grids for an award, it provides a readily available supply of grids, many rare, to work. It introduces you to other VHF/UHF operators in the area, always a good thing, particularly if you need help with your station or antennas. With lots of stations on the air during the contest weekend, it gives you a good idea of the potential that the VHF bands offer.

Grid Squares

If you contest, you will need to know your grid square. For VHF activity purposes, the world is marked off in 1-degree latitude by 2-degree longitude grid squares. The exchange in VHF/UHF contests is your grid square. There are several ways to determine your grid square; the easiest way is to use the F6FVY Google map app <http://f6fvy.free.fr/qthLocator/fullScreen.php>. Just click on your QTH on the map and you will get a six-digit grid square. You only need to send the first four digits in the contest, but some contesters exchange all six. You can also get your grid square from your QRZ.com listing. The QRZ.com grid square is tied to your post office and Zip code, so it is occasionally off. If you get your grid square from this source and you live near a grid boundary, check it.

You can usually get a free grid square map from ICOM™ at most hamfests. Download a free one from ICOM at <http://www.icomamerica.com/en/downloads/DownloadDetails.aspx?Document=415>, or purchase a nice graphic one from the ARRL. Many operators color in grids on the map as they work them in a contest, and this gives a good idea of what grids you need to pursue, as well as what you have accomplished. Use one map per band.

What to Expect

You turn on the radio at the beginning of the contest. What do you expect to encounter?

More than nearly any other ham radio activity, the complexion of VHF contesting depends greatly on what part of the country you live in. If you are in a densely populated region such as the northeast corridor, you will hear lots of activity on nearly all the bands for much of the contest. If you live in a sparsely populated area, such as the desert southwest, activity will be harder to come by, particularly as the contest draws on.

Activity will be highest at the beginning of the contest and then will taper off as stations work everyone available. There is usually another peak of activity on Saturday evening and on Sunday morning. The last hour of the contest is either "boom or bust." Stations are either tired of the contest and have gone QRT, so that there is little activity, or they are frantically trying to boost their score and you will hear lots of stations. It is important to be on at the beginning of a contest. If you don't want to spend the whole weekend in front of the radio, and in many locations you won't have activity to support it, a good strategy is to get on at the beginning of the contest, when you will be able to work the strong stations. Stay on and tune around to pick up the weaker stations that are a bit farther out. After a couple of hours, you may well have exhausted the readily available stations. You probably want to do something else at that point. Set your radio to the calling frequency, or scan the available FM simplex channels, lightly squelched if the white noise bothers you, and do something else around the shack or house while monitoring for contest activity in the background. Return to the radio every hour or half hour to give a short call to pick up anyone who may have started the contest late.

For CW and SSB, you will find activity is in the lower part of the band, usually starting at the calling frequency and mov-

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Band	SSB/CW Calling Frequency	FM National Simplex Frequency
50 MHz	50.125 MHz	52.525 MHz
144 MHz	144.2 MHz	Do not use 146.52, the national calling frequency; try 146.415, 146.445, 146.475, 146.490, 146.505, 146.535, 146.550 , 146.565, and 146.580 instead, but check for other local use
222 MHz	222.1 MHz	222.350 MHz
432 MHz	432.1 MHz	446.0 MHz

Table 1. Calling frequencies and simplex frequencies.

ing up. For FM, activity will center on the simplex channels. Contacts cannot be made on the national 2-meter FM calling frequency, 146.52 MHz, so that stations not in the contest can still make contacts. Don't just monitor the calling frequencies; tune around. FM simplex frequencies vary from one part of the country to another, so check around before the contest to see which, other than 146.52 MHz, are most commonly used.

If you don't hear activity, call "CQ Contest." Don't be timid.

Calling Frequency and DX Window

Each band has calling frequencies, listed in Table 1. It is important not to abuse the calling frequency. The calling frequency is intended as a VHF watering hole where you are most likely to find a contact without tuning all over the band. If there is little or no activity, it is OK to call an occasional CQ on the calling frequency. If you work more than a couple of stations after a CQ on the calling frequency, it is usually best to move up the band and then call CQ. If the band isn't crowded, you don't have to move very far; if it is crowded, you probably don't need to use the calling frequency. The calling frequency is a shared resource, so don't monopolize it. Even if you can't hear anyone on the frequency, there may be someone who can hear you and you may be interfering with his QSO. It is also common practice to announce your presence on the calling frequency and then give a frequency up the band on which you will be calling CQ.

Each band has FM simplex channels. You can use the national calling frequency on 50 MHz, 222 MHz, and 440 MHz, but not on 146.52 MHz. There are a limited number of FM simplex channels, so these are a shared resource as well. FM is pretty much limited to one station on a frequency at a time, so if one simplex frequency is being used, move to another. If you are on a simplex frequency calling CQ, give long pauses to let others use the frequency. If you are calling CQ and no one answers after a reasonable time, move to another band or frequency and let others use the frequency. It doesn't hurt to ask if anyone else wants to use the frequency if you are not getting answers to your CQs.

It has been a long time since FM was promoted as a contest activity, so this new contesting season will be an experiment and an interesting one to watch.

Logging

Your log should record the date and time of the contact, on which band the contact was made, your exchange (for most contests this is your grid square), the station you worked, and his exchange. If you contest on the HF bands and use a logging program, chances are that logging program will support VHF contests. In that case, you are all set and don't need a new program. If you are in need of a logging program, there are several that support VHF contests and are free. VHF LOG is one that is free and pretty easy to use. I use N1MM for my fixed operations and RoverLog™ for my roving operations.

Paper logging is fine, especially for the casual contester, but becomes cumbersome for large logs (and for most contests a computer log is much preferred, while some require it for large scores). In addition to a log, you should keep a dupe sheet of calls by band you have worked. The computer-based logging programs do this automatically, but with paper logging you will need to keep track manually. Some operators can do this in their head, without a dupe sheet, but I find it difficult once a page in the log has been turned. You can dupe after the contest, and need to for paper logs greater than 100 QSOs. You can also enter your paper log to a web-based entry after the contest, see the "Send In Your Log" section below. This is probably the easiest way to do it if you have a small operation, as it will generate the log in the proper Cabrillo format and generate a proper header, often the hardest part of generating a Cabrillo-format log.

However you log your contacts, be sure to submit your log to the contest sponsor. This is important, no matter how few contacts you make. You may win a category, and log submittals indicate interest in the contest and can also indicate to contest sponsors how to improve the contest.

Sample QSO

There are two contest operating strategies: calling CQ on a frequency, often referred to as running; and search-and-pounce—that is, tuning the band for stations calling CQ, then answering them. You should use both techniques, although most stations find running more productive when the band is open. The newcomer tends to be timid about CQing and focuses on search-and-pounce. Be bold! Successful contesting requires the use of both techniques. CQing is not just the purview of the big guns.

Here is how the typical VHF contest QSO goes:

The CQing station calls:
CQ Contest Kilo Kilo Six Mike Charlie
The calling station replies with his call:
November Five Juliet Echo Hotel
The CQing station then replies to the calling station:
November Five Juliet Echo Hotel copy Delta Mike Six Five
The calling station replies:
Roger Kilo Kilo Six Mike Charlie copy Delta Mike Six Five
The CQing station then replies:
Roger, Kilo Kilo Six Mike Charlie QRZ contest?

This is a good, clean QSO. However, the experienced contester knows that there are more points to be had if he can work other bands with the same station, so the opportunist contester will reply:

Roger, any other bands?

By asking for other bands, the CQing station will increase his QSO total and perhaps pick up a new band multiplier. The calling station will also benefit. You will hear this a lot in contesting and it is a good strategy and habit to pick up.

Thus, N5JEH replies:
Yes, 6 meters, 432, and 1296

The CQing station says something like:
OK, let's QSY to 432 but before we go is there anyone else on frequency?

This gives others a quick chance to work the CQing station before he QSYs. He should also ask:
Does anyone else want to go with us?

He may or may not get a reply, but then he will announce the QSY:
Kilo Kilo Six Mike Charlie QSY to 432.105

Once there he will call the station that QSYs with him. Then they run through the exchanges again. Note that he specifies a frequency close to, but not on the calling frequency. That is to avoid landing on potential QSOs in progress on the calling frequency. He also specifies going to 432 first rather than 50 MHz. This is because the 432 points are worth more than 50-MHz QSO points, and if one loses contact with the station when QSYing, it is better to do it after a 4-point QSO on 432 than after a 2-point one on 50 MHz. The next logical progression is to 1296. Signals are likely be weaker on 1296 than on 432, so the chance of a QSO may be lower. If contact is lost, rejoining on the original frequency that the QSO started is the generally accepted practice. If you can't regain contact there, try later in the contest.

Notice in the above exchanges phonetics were used exclusively. This is to avoid confusion and to get the calls right. It is possible to mistake a B for a D or an N for an M, and so on, even if signals are loud. Get in the practice of using phonetics all the time. Also use single digits rather than the compound numbers for the grid square exchange. So say Delta Mike Six Five rather than Delta Mike Sixty Five. Sixty Five sounds a lot like Fifty Five, but it is much easier to distinguish Six Five from Five Five. There are other combinations that are easily confused if individual numbers are not used; Fifty and Fifteen, Sixty and Sixteen are two obvious examples, but there are others. Use phonetics. Don't hesitate to ask for fills if you miss something. Most stations are happy to provide the fill. Remember, you both must get everything right for the contact to count.

Club Competition

In addition to the individual station competitions, the VHF contests (and others as well) have a club competition. You submit your score as affiliated with a club. Check to see if the local club to which you belong is compiling such an entry. If so, participate. It is a good motivator.

Many specialty VHF/UHF clubs, contest clubs, or DX clubs submit club entries to the VHF/UHF contests. Check these clubs in your area to see if they do. You may want to join and submit a log for them. Most of these clubs are competitive and eager to have new members submit logs with the contest name to help the score. Plus you will get contesting tips and encouragement, and some local clubs sponsor activity hours within the contest to ensure that everyone in the club works everyone else in the club on all the bands they have. This will increase your score.

Strategy

With a modest station, say 100 watts to a one- or two-wavelength-long Yagi on the bands above 2 meters, and little or no propagation enhancement, you should be able to work your grid square and the grids touching your grid square, if there is activity in those grids. If there is some enhancement, you can work farther. Sometimes lots farther.

You will hear several different types of stations. The strongest and most persistent signals on the band are likely to be from the multi-operator and single-operator high-power stations. These stations usually are well equipped and you will be able to work them easily from a modest station. Because they have high power and high antennas, you can hear them, sometimes much louder than they can hear you. This can lead to situations in which you call the station and he does not come back. Don't be discouraged. He wants to work you. There are several reasons why he might not come back to you: He may not have his antenna pointed exactly in your direction, there may be louder local stations calling, and/or you may be below his noise floor. In situations like this, go to CW and call. CW can often be heard when SSB cannot. If that doesn't help, note the frequency and come back to it later. The big stations tend to hang out on a single frequency and spend a lot of time swinging the beam after the initial surge of activity early in the contest. Also, there is significant QSB on long-haul signals, so the chances are that when you return to the frequency he may have swung his beam in your direction, he has worked the local stations, your signal may have picked up, and you will be able to pick him up. Once you make contact with one of these well-equipped stations, he is likely to ask you if you have any other bands, and if so, to make QSOs on those bands. If you can go to another band, do so. This is a good way for both of you to increase your score. QSYing from one band to another is a fundamental strategy of VHF/UHF contesting.

You will hear a lot of stations like yourself with modest capabilities. It may take some persistence to work these stations if they are located at long distances away, but it is worth it. It helps to know where they are located so you can point in their direction. You will also hear these stations working the stronger stations when the stronger stations are running. While it is usually considered bad form to work the calling station on the running station's frequency, a simple and quick request for the calling station to QSY up 5 or 10 kHz is usually acceptable. A simple "KK6MC (or whatever station you want to work) up 5?" will usually do the job and not upset the running station, particularly if you do not do it too often. Search-and-pouncers usually tune up the band, so if you hear a station working someone else and you want to work him, move up the band a bit, say 5 kHz, and call CQ, or call the station you want to work. It won't work every time, but it often will be enough so that it is worth trying, particularly if you need the grid.

You will also hear Rover stations. Rovers are a uniquely VHF/UHF contest phenomenon. The Rovers are mobile self-contained VHF/UHF stations. They rove from one grid square to another, activating the grid square, and then moving on to the next grid square. These Rovers give you an opportunity to work a station in grid squares where there may be no activity, and also to work more QSOs, as you can work the Rovers more than once as they rove from grid to grid. Rovers run the gamut from low-power stations with omnidirectional loops to high-power stations with long Yagis up high. The typical Rover, if there is such a thing, usually runs modest power, 100 watts or less, to moderate-length Yagis up 10 to 15 feet. They often can set up in optimal operating sites, such as mountaintops, so they have good signals. The key to working Rovers is to know where they are and when they are there. Many Rovers post an itinerary before a contest. When you work a Rover, you can ask what other grids he will be visiting and when he will be there. The window to work them in a grid square is usually pretty short, so you need to pay attention to where they are and when.

It is tempting to sit on the calling frequency and work the new stations as they show up, and you can accumulate a decent score this way, but unless you tune the band you are likely to miss some of the stations that are on. This is especially true on 6 meters, where there is often CW activity from 50.80 MHz to 50.1 MHz that never shows up on the calling frequency. It is also often true on 432 MHz, where in some locales birdies from local UHF TV stations can render the calling frequency almost useless.

Much of the contesting activity originates with contacts on 2 meters and then migrates to the other bands, so it is tempting to sit on the 2-meter calling frequency waiting for activity to show up and then QSY to other bands. If you do this, make sure that you occasionally also go down to 6 meters and call CQ, even if 6 is dead. There are often short sporadic-E openings on 6 meters, particularly in the January contest, and a short CQ on 6 every so often will help you pick these up.

One key to success in VHF/UHF contesting is to be loud on 2 meters. Many QSOs with other stations start on 2 and then move to other bands. If you want to improve your VHF/UHF station for contesting, start with improving your 2-meter station. If you are running a loop or vertical, replace it with a small beam. If you are using RG58 or other high-loss coaxial feedline, replace it with RG213 or better. If you are running less than 100 watts, try to borrow or buy a "brick" linear amplifier to boost your signal to the 100-watt limit allowed in the three-band category.

Send in Your Log

Again, please send in your log no matter how few QSOs you have made or how low your score is. It is estimated that as many as two thirds of participants in contests don't submit logs. Don't be one of them.

You can submit paper logs, and if you don't have an alternate, it is OK to do so. These days, all paper logs are entered electronically by volunteers, so if you can transcribe your paper log to an electronic form, please do so. The easiest way to do this is online at <http://www.b4h.net/cabforms/>. Logs should be submitted in Cabrillo format. If you use a logging program or the b4h net page, it generates a Cabrillo format automatically. You can also use a spreadsheet to generate a Cabrillo log, the formats are on the ARRL website <http://www.arrl.org/files/file/SubmittingAnElectronicContestLog.pdf>.

Before the Contest

Find out what grid you are in. Make up a small sign with your exchange on it, like this:

(HIS CALL) COPY Delta Mike Six Five QSL?

Put it where you can see it easily from your operating position. It is easy to get flustered in the heat of the contest, or late at night, so referring to this card will help you get the exchange right.

Make sure that you know the rules and how to comply with them. Decide what category you are going to enter. It is considered bad form in many circles to decide the category to enter after the contest is over. Make sure your station operates on all the bands you are going to operate in the contest. Check out your logging program so that you know it is interfaced properly to your station.

A good way to check your station's performance and to gauge its performance with respect to others in the contest is to participate in the various band activity nights that are held in your area. This will not only give you an idea of how your station performs, but also gives you a chance to let others know that you will be on for the contest. That will give them some incentive to look for you. You will also find out who will be on and you can look for them.

Don't Be Timid

Don't be shy about participating in a contest as a first timer. I will admit it can be intimidating at first, but contesting is a social activity and the more people who participate, the more everyone in the contest benefits. Therefore, most operators will greet you with open arms, as you are providing them with new QSOs and perhaps a new grid or a new multiplier.

If you are unsure of yourself, listen to the activity first to get an idea of how the exchanges go, but don't wait too long to make your first contact. Stations come and go quickly in a contest and you need to be on when they are to work them. Don't listen exclusively. While calling CQ is often thought of as being the purview of the big guns, you should call CQ some, even if you are a small station. It is very productive and you may catch someone, like yourself, who was just listening, waiting for someone to make a call.

Don't worry about fumbling your first few QSOs or making a mistake. Most operators will be very understanding, and they will help you correct your mistakes if they recognize them.

The CQ WW VHF Contest

CQ sponsors a VHF contest in July every year. It has a different flavor than the ARRL contests, but the skills mentioned above still apply. The CQ WW VHF contest consists of only two bands, 6 and 2 meters, so there is not as much QSYing as with multiple bands. With only two bands to pay attention to, it is easier to be in the right place at the right time to catch activity. Plus, you can operate and enter as single-band in the CQ WW VHF Contest, so you can concentrate on optimizing your station on one band. There is usually sporadic-E skip during the contest and one can focus on that propagation mode without worrying about missing too much activity on 2 meters. There is a Hilltopper category especially for the QRP operator, with operating times limited to six hours, so if your available time for contests is limited and you enjoy QRP, this is an ideal category for you. By the time the CQ WW VHF Contest occurs in July, you should have had the experience in the January and June ARRL contests to be comfortable operating in the CQ WW contest.

Summary

Begin planning now to enter these contests. Contesting will sharpen your operating skills and give you an idea of what the VHF/UHF bands are capable. With the new categories that the ARRL offers, getting into VHF/UHF contesting is easier than ever!

73, James, KK6MC

By Bob Witte,* KØNR

FM

FM/Repeaters—Inside Amateur Radio's "Utility" Mode

Your First VHF/UHF Station

Many Technician licensees start out with a handheld transceiver, often a dualband 2-meter/70-cm radio. There is a lot to like about such a radio, since in one package a new ham can get on the air with the two most popular VHF/UHF ham bands. This quickly gets them on the air and operating with their new Technician privileges. Of course, however, this pipsqueak of a radio can only do so much.

The next step in radio equipment depends on where you want to go with your ham radio activity. One option is getting an HF station established so that you can enjoy longer distance radio activity. Another avenue is to establish a more capable VHF/UHF FM station (the "Utility Mode") at home. While we don't normally work DX with this mode, a lot of fun and useful ham radio activity gets done this way. While a handheld transceiver might be a good start, a new Tech can work a lot farther with a good FM station at home. Such a station will have ten times the transmit power and a much better antenna system. Working through repeaters helps handheld and fixed stations extend their range, but it is also important to have useful simplex coverage. Think in terms of a worst-case scenario, with all repeaters off the air due to severe weather or some other emergency situation. How far can you communicate with your station? The self-sufficient approach is to make sure you have maximum FM VHF range without the need for repeaters.

Operating FM simplex can be a lot of fun. Many radio hams like the idea of not being dependent on "the box on the hill" and enjoy putting together a solid station for simplex activity. The Summits On The Air (SOTA) program is seeing a growth in activity here in North America, both on HF and VHF. Most of the VHF activity is on 2 meters FM, so having a capable station will help you work more of those summits.

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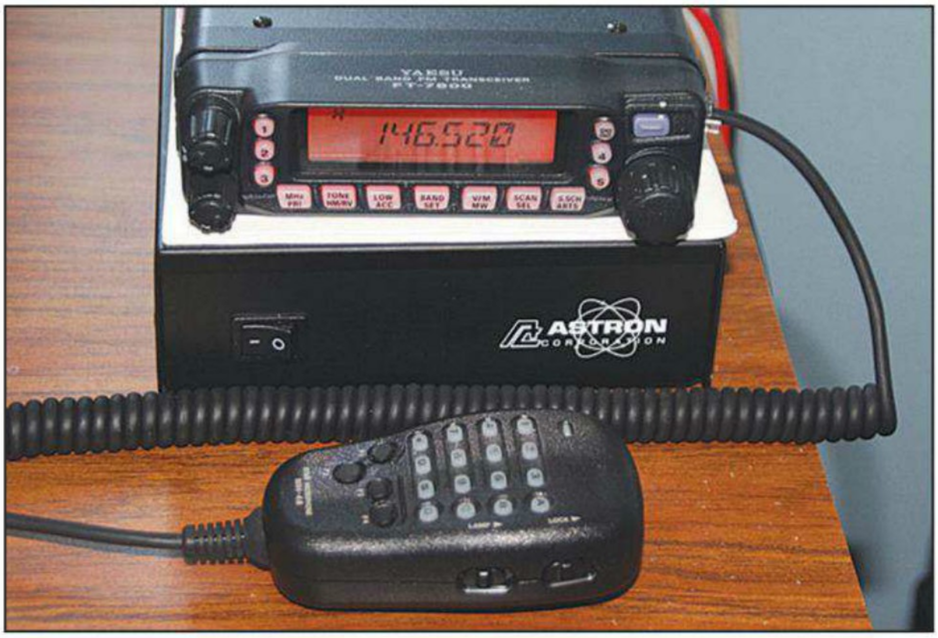

Photo 1. This dualband 2M/70cm transceiver is sitting on top of the DC power supply that powers it.

When establishing a home FM station, I encourage people to get a dualband radio that covers both 2 meters (146 MHz) and 70 cm (440 MHz).

Some people will argue for just getting a single-band radio for 2 meters. This is a less expensive way to go, and if your radio budget is tight, it certainly is a reasonable choice. I have found that adding the second band opens up a lot more radio operating including a whole bunch of additional repeaters and the chance to work crossband FM satellites. For this column we'll assume a dualband station, but the same basic approach and principles apply for a single band station.

A VHF/UHF home radio installation consists of:

- **VHF/UHF FM Transceiver:** A dualband mobile transceiver that covers the 2-meter and 70-cm bands (photo 1)
- **DC Power Supply:** A power supply to power the transceiver
- **Coaxial cable and connectors:** These connect the transceiver to the antenna
- **VHF/UHF vertical antenna:** An antenna that covers the desired ham bands.

VHF/UHF FM Transceiver

The main piece of equipment for your FM station is the transceiver. In most

Cable Type	Diameter	Cable Loss (100 Feet)		
		100 MHz	200 MHz	400 MHz
RG-58	0.193 in	4.6 dB	5.6 dB	8.4 dB
RG-8X	0.242 in	3.1 dB	4.5 dB	6.6 dB
RG-8 Style	0.405 in	1.9 dB	2.8 dB	4.2 dB
RG-8 Style Low loss	0.405 in	1.3 dB	1.8 dB	2.5 dB

Table 1. Typical specifications for some common coaxial cable types used in amateur radio. Check the manufacturer's data sheet since cable loss depends on the materials and construction techniques.

Photo 2. The coaxial cable on the left is the larger and lower loss RG-8 type cable. The cable on the right is RG-8X. Both cables are shown with PL-259 connectors installed.

Photo 3. This dualband 2M/70 cm antenna is installed on top of the house, sharing the same mast as a TV antenna.

cases, this will be a mobile transceiver that we set up to use indoors. These radios have 50 watts or so of transmit power and a range of features. The biggest variation in transceivers is whether they have one receiver or two. Radios that have one receiver can cover both 2 meters and 70 cm, but they operate on only one frequency at a time. These radios are easily spotted because they only have one frequency displayed.

A more expensive but more versatile option is to get a two-receiver radio, which can monitor both 2 meters and 70 cm simultaneously. Sometimes these radios are called "true dualband" or similar. These radios are very much like getting two radios in one, since you can monitor two frequencies at once. Most of these radios will also let you put both receivers on the same band. This is handy for monitoring, say, the 146.52 MHz calling frequency while also listening to your local 2-meter repeater.

There are some other features that may interest you. Some radios from ICOM offer the D-STAR mode, the most popular digital voice format for amateur radio. Other radios offer Automatic Packet Reporting System (APRS), EchoLink functions, and crossband repeat.

DC Power Supply

Since these mobile radios are set up to be powered by a vehicle's 12-volt power system, you'll need a DC power supply. A car battery is nominally 12 volts, so we often think of this as a 12-volt system, but the vehicle electrical system delivers more like 13.8 volts. Thus, you will see these DC power supplies rated and adjusted for 13.8 volts.

The two main types of power supplies are *linear* and *switching*. The linear supplies have a large transformer that makes them large and heavy. The switching supplies are much lighter and more compact. There used to be a problem with radio interference generated from switching supplies, but this issue has disappeared for quality power supplies intended for use with radio gear. Be careful before buying a switching power supply that was not intended for radio applications.

Basic power supplies are pretty plain with just an ON/OFF switch and a power indicator. Some supplies have voltage and current meters to give you more information on the status of the power supply. This is a nice upgrade but certainly not required. Make sure the power supply can deliver the required current for your transceiver (typically, 9 to 13 amps). You might want to get a power supply with extra current capacity to be ready for future use (in the range of 18 to 20 amps). This sets you up for powering a second radio or using it with a higher power transceiver in the future.

Coaxial Cable

You will need a length of 50-ohm coaxial cable to connect the transceiver to the antenna. At VHF and UHF, we need to be concerned about signal attenuation or loss through the cable. Cable loss increases with frequency and is normally specified as dB loss per 100 feet. Larger diameter cable generally has lower loss but the loss also depends on the materials used in the cable.

Table 1 shows the typical specifications of some common cable types. The actual cable performance may vary with the manufacturer, so this is a general guide. The smallest cable listed is RG-58, which is commonly used for mobile installations. For home VHF/UHF installations, we'll try to avoid this cable, except for use in short jumpers. The RG-8X cable (sometimes called "mini-8") is somewhat larger in diameter than RG-58, but with lower loss. The RG-8 style cable is about 0.4 inches in diameter and is commonly used in HF installations. For VHF/UHF, we'll tend to use the low-loss variations on the RG-8 cable that have the same diameter but use a lower loss dielectric inside. These cables go by a variety of names, such as 9913, LMR 400, etc. with somewhat different construction.

Since the dualband station will operate on the 440 MHz band, we'll use the 400-MHz column to estimate the cable loss. Clearly, the loss on 146 MHz will always be lower, so we won't focus on that. Since 440 MHz is larger than 400 MHz, the actual loss will be slightly larger than indicated by the table.

Suppose our cable length is 100 feet long. The signal loss at 400 MHz using lowloss RG-8 cable is roughly 2.5 dB. Recall that a 3 dB loss means that we lose *half of the power* due to cable attenuation, so 2.5 dB represents a substantial loss. Now suppose that we try to use a smaller cable, RG-8X. The loss at 100 feet is a whopping 6.6 dB! A 6-dB loss means that we only have 25% of the transmit power making it to the antenna, so 6.6 dB is even worse than that. Clearly, we need to pay attention to these numbers.

Let's take a shorter example: a cable run of only 25 feet. The loss at 400 MHz through the low-loss RG-8 drops to 25/100 × 2.5 dB = 0.625 dB. Not bad at all. How about using the smaller RG-8X cable? The loss at 400 MHz is 25/100 × 6.6 dB = 1.65 dB. That means one dB of additional signal loss but with a much smaller and easier-to-route cable. That might be a good choice for some situations.

You'll want to take a careful look at the transceiver and antenna locations, and how much coaxial cable you'll need to connect them. In many cases the coax run will be long enough (50 feet or more) that you should buy the best lowloss cable you can afford. In other cases, you can do the calculation to figure out the best compromise.

Connectors

Coaxial cables are useless until you put a connector on the end of them. For most FM transceivers in the U.S. the transceiver will require a PL-259 connector on the cable (photo 2). The connector on the transceiver is called an SO-239. Actually, the PL-259/SO-239 combination is not that great for 440 MHz, but it is commonly used anyway.

If you haven't soldered (or crimped) PL-259 connectors on before, you should definitely do some research on how to do it. Better yet, get some help from one of your local radio hams. You may be able to buy preassembled cables, but it is much easier to route the cable through holes and tight spots without the big old PL-259 on the end. This is a skill that you should develop. I've listed some YouTube resources in the references. (I will warn you that there any many different methods out there with some very opinionated people promoting each one of them.)

Antenna

You will need an antenna that covers the 2-meter and 70-cm bands. I'd recommend a modest-size vertical antenna to get started. There are a number of useful vertical antennas that are about 4 to 6 feet in height, such as the Comet GP-3 (http://www.universal-radio.com/catalog/hamants/3901.html), Cushcraft AR-270 (http://www.universal-radio.com/catalog/hamants/0583.html), and Diamond X-50A (http://www.universalradio.com/catalog/hamants/2553.html). This type of antenna is omnidirectional and vertically polarized, a good way to go for general-purpose FM operating. Of course, you can put up a larger antenna and get more gain. Another option is to put up a directional antenna such as a Yagi design. However, this approach requires an antenna rotor, which complicates the installation.

The coaxial cable will be connected to these antennas using, you guessed it, a PL-259 connector. A good place to install the antenna is up high on your house. These antennas are small enough such that you can use a regular TV mast and mounting brackets (photo 3). Check out what's available at your local hardware store, home improvement store, or RadioShack™ .

In the era of restrictive covenants and homeowners association rules, you may not have the option of an external antenna. An attic installation is a compromise, but it can be made to work. The main concern is to keep the attic antenna away from metal objects that can interfere with the performance of the antenna. Keep the antenna away from metal ducts, electrical wires, and metal pipes. A metal roof is a real problem and likely removes the option of an attic antenna.

Safety Warning: Keep away from power lines during antenna installation.

Getting the antenna up high really helps its performance on VHF/UHF, but it also makes it an attractive target for lightning strikes. Your antenna system should be grounded for lightning protection. This usually means installing a ground rod into the ground and running a thick ground wire from the ground rod to the antenna. This way the energy of a lightning strike will tend to be directed to ground instead of into your ham shack and the rest of your house. I say "tend to be directed" since it is difficult to contain the incredible energy of a direct lightning hit. It is also a good idea to install a lightning arrestor (surge suppressor) in the coax. Antenna grounding is a complex subject, which I won't address in this short article. A helpful and practical source of information on grounding is Chapter 28 (Safety) in the *2012 ARRL Handbook for Radio Communications*.

VHF/UHF FM Simplex Frequencies

The FM portions of the VHF and UHF ham bands are channelized, with specific frequencies identified for simplex operation. The National Simplex Calling Frequencies are:

2 meter Band: 146.52 MHz
70 cm Band: 446.00 MHz

These two frequencies are consistently applied across North America. Other simplex frequencies depend on local usage so you'll need to consult your local VHF or UHF band plan.

In particular, on 2 meters, some areas use a 15-kHz channel spacing while others use a 20-kHz spacing. For the 15-kHz spacing areas, the simplex frequencies adjacent to 146.52 MHz are 146.490, 146.505, 146.535, 146.550, 146.565, 146.580 MHz, etc. If the 20-kHz spacing is used, then the adjacent simplex frequencies are 146.480, 146.500, 146.540, 146.560, 146.580 MHz, etc.

The situation is more consistent on 70 cm, with most areas using a 25-kHz channel spacing, resulting in simplex channels at 446.025, 446.050, 446.075, 446.100 MHz, etc.

Putting It All Together

Putting up a basic FM VHF/UHF station is not that complicated but does require some planning to make it go right. In particular, thinking through where the antenna will be mounted and how the coax will be routed can save trouble later.

Once the antenna is in place, you'll need to check the SWR on both bands using an SWR meter or antenna analyzer. We should measure an SWR of less than 2, and probably more like 1.5 or better. SWR measurements are best made right at the antenna, but we'll also check the SWR at the transceiver. This gives us confidence that the entire antenna system, including the coaxial cable and its connectors, is installed correctly.

Thanks es 73

Thanks for taking the time to read another one of my columns on the "Utility Mode." I always enjoy hearing from readers, so stop by my blog at <http://www.k0nr.com/blog> or drop me an e-mail.

73, Bob KØNR

References

1. Coaxial cable loss calculator: <http://www.timesmicrowave.com/cgi-bin/calculate.pl>.

2. YouTube video of PL-259 Installation on RG-8: <http://www.youtube.com/watch?v=n1nabA6yMoI>.

3. YouTube video of PL-259 Installation on RG-8X: <http://www.youtube.com/watch?v=PzXXjzmA-IE>.

4. North America Summits On the Air: <http://na-sota.org/>.

By Kent Britain,* WA5VJB

What to Look for in Antenna Performance

It sure seems to come in cycles. Back in the 1960s and 1970s advertising claims for antennas got so bad that most magazines stopped allowing manufactures to include claims of the gain of their antennas in their advertising. The worst cases I saw were a 17-dB gain, 5/8th-wave vertical and a 37-dB gain, 3-element Yagi. They were from the same company, by the way!

The exaggerated claims of performance are working their way back into advertising, especially when you visit websites. Here are but a few of the things you need to look out for in the data sheets on the websites.

Computer Models of the Patterns

In Figure 1 I have a NEC model of a 10-element Cheap Yagi that's been floating around for 18 years. Many, many of them have been built and dozens have been tested on antenna ranges, so we have a pretty good idea of their actual performance. Note that the left/right side lobes are not identical. Most Yagis have driven elements that are not perfectly symmetrical—i.e., more metal, or more current on one side or the other. This results in some squint in pattern and some extra bumps in the side lobes.

The new computer programs make some very nice plots, but rarely are accurate. That good old computer phrase GIGO (Garbage In equals Garbage Out) applies to antennas as well.

I like to use the example of the guy who is very proud of his gas mileage. He drives 400 miles, gets 7 gallons of gas, and proudly announces his 57.142857143 miles per gallon. Of course, the gas pump has nowhere near 12-place accuracy, and just a few psi of tire pressure change will change the odometer reading. The antenna simulation programs are much like this—rows of digits that are far beyond their accuracy.

A truly accurate model of an antenna is a heck of a lot of work, and many of the secondary effects of block insulators, mounting brackets, stubs, and even the routing of the coax are not included in most models. Furthermore, I won't even start on some of the pitfalls when it comes to close spaced parallel wires such as you find in most driven elements.

At this last Dayton Hamvention® I spoke at length with a new antenna company about its plots. The left and right sides of the plot were perfectly symmetrical (mirror image) but the driven element was not symmetrical. I pointed out that his computer model was not of the antenna he was selling. His antenna had a stub on one side of the driven element, yet his computer-generated patterns were perfectly symmetrical. His reply was that since the current in the 1/4-wave stub was zero, he didn't have to include it in the model! Well, if the current is zero, then you don't need it, take it off, and save the metal! But it then will have a poor SWR!

In short, there will be current in that shorted stub, and it will radiate. It is so easy to play with the dimensions and make an antenna that is very pretty on the computer, but it's not fair to use this tweaked computer plot in the advertising and sell something different.

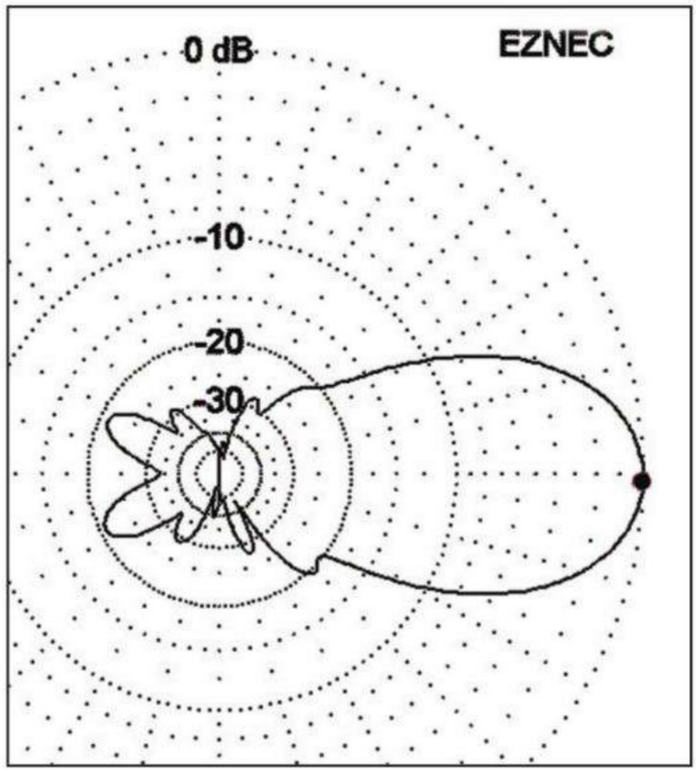

Figure 1. 1 Azimuth plot. Note left and right sides are not identical.

Claimed Accuracy of the Gain

Several years ago I was in one of the NIST (National Institute of Standards and Technology) Anechoic Chambers in Boulder, Colorado. They had spent over a week working with one horn antenna to get the gain to within 0.1 dB. Now you would think that you just set the source and test antenna a few feet apart, set the marker on the HP 8510 network analyzer, and it gives to dB to 0.001 dB.

You do have a power reading to the nearest 0.001 dB, but exactly how far apart were the antennas? I'm not talking about a tape measure between the antennas, either, but the distance between the phase center of the antennas. For a horn antenna, that phase center is inside the horn and its exact position depends on a lot of factors.

Now I get to have a little fun with you. If you are going to set up some Yagis for these tests, where do you think the phase center of a Yagi is? For example, if you have a big dish that is fairly flat, what part of the 10-element Yagi would you place at the focal point? It's a bit of a teaser.

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The short answer is no one on this planet can accurately measure antenna gain to 0.01 dB. If a company claims gain to that accuracy, it is a guess from a computer, not an actual measurement.

Resistance Losses in the Elements

Material losses in Yagi elements are quite small. You can run several hundred watts into a Yagi then go feel all the elements. They still will be pretty much at the same temperature as when you started. If there were any losses, the elements would have gotten hot, or at least warm. With a high-Q antenna there are more circulating currents than in a low-Q antenna, and we are looking at typical element diameters—that is, no elements made out of 36-gauge wire. Therefore, for a typical Yagi the difference among copper, aluminum, and super conductor at 0-ohm elements is about 1/20th of a dB. No big deal really.

100-Acre Sheet of Optically-Flat Room-Temperature Super Conductor

Here we go back to that 10-element Yagi in figure 1. It is the pattern of a 10-element, 902-MHz Cheap Yagi we have measured many times at antenna parties. Depending on how closely the dimensions were followed, how long their coax jumper was, and construction technique, we see about a 13- to 13.5-dBi gain. NEC predicts 14.62 dBi. Okay, down a dB or so, not bad really wood and clothesline wire.

Next in figure 2 I show the pattern in an elevation plot. Manufacturers rarely show free-space elevation plots, as the antennas tend to have more side lobes and the plots don't look as pretty. For several reasons the outer ring of the graph is set at 20 dBi. NEC again shows 14.62 dBi gain.

Now let's mount that same Yagi over a perfect ground plane. One-hundred acres of perfectly flat sheet copper would come close, but you really need 100 acres of a sheet material that is a super conductor (0 ohms resistance) at room temperature. In figure 3 gain is now 20.18 dBi. That little Yagi, plugged into a computer the right way, is now a 20.18-dBi antenna. The lobe is 7 degrees above the horizon. It might be good for a moonrise EME QSO, but it is a bummer if you are trying to hit a repeater.

Back to that guy at Dayton . . . He was claiming 27 dBi gain for a 33-element Yagi. The best I have ever done is 23 dBi gain and that took 80 elements on a very long loop Yagi. He was claiming the extra 6 dBi gain by putting his NEC antenna over 100 acres of optically flat room-temperature super conductor.

The technique for measuring gain in the above NIST example is called the Absolute, or Friis, method. The Friis method is taking two identical antennas and placing them a fixed distance apart. Next you calculate the free-space path loss. If the path loss is, say, –60 dB, and your test equipment measures –40 dB, then each antenna has 10 dB of gain. While test equipment can easily measure the loss to 0.001 dB, you can't get that kind of accuracy for the distance between two phase centers. It is sort of like measuring the precise distance between two clouds. NIST was taking loss-measuring data at hundreds of different distance points and plotting curves to better under-

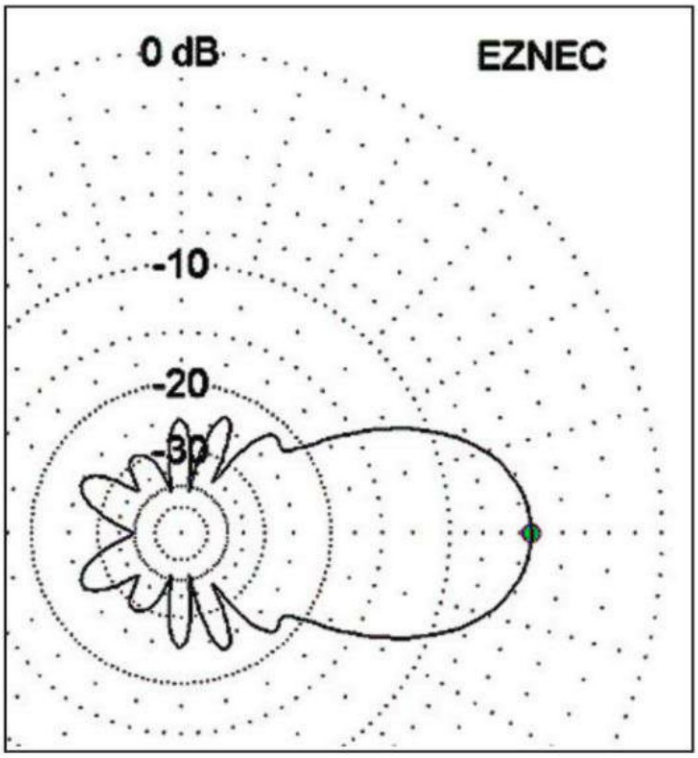

Figure 2. Elevation plot of the same 10-element Yagi.

stand the position of the antenna phase centers to reduce uncertainty to .1 dB..

Decibels or dBs

A decibel, or a dB, is a ratio. It was named after Dr. Bell, so it is dB, not db. Boy, that's my first clue that an antenna company is clueless when it uses "db" in its advertising. The term dB is a way of expressing a ratio in a logarithmic scale.

Let's say my car has 100 horsepower and your car has 200 horsepower. Then your car has 3 dB more horse power than mine. Or house A has 1000 square feet of floor space, and house B has 4000 square feet of floor space, then house B has 6 dB more floor space. I guess we could call these 3 dBHP and 6 dBFS.

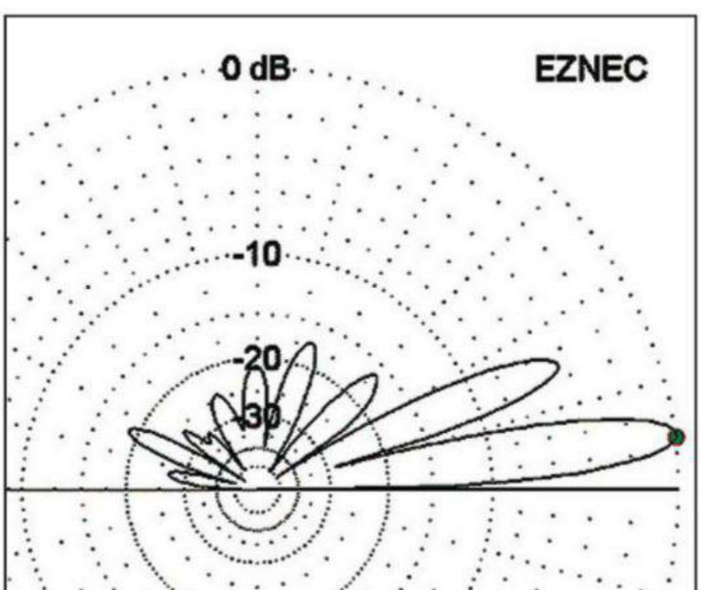

Figure 3. Elevation plot over perfect ground plane.

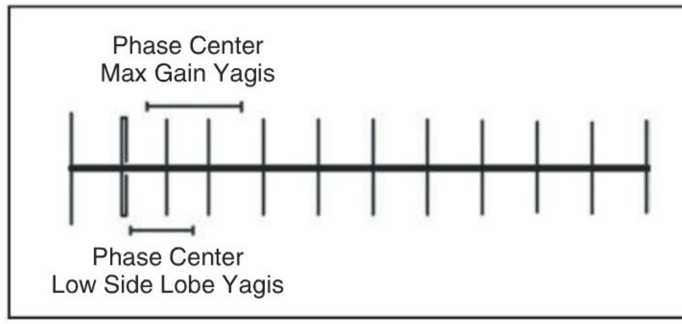

Figure 4. Phase center of a Yagi.

With antennas we typically see dBi for dB above an isotropic source, one that radiates equally in all directions. A 100-watt light bulb is a pretty good isotropic source. Furthermore, dBd is dB above a simple dipole. Remember, dB is just ratio. We could use a length of wet string as our reference, so it becomes dBws, or the more classic Wet Noodle, dBwn.

In the case of the antenna company that said its 5/8th monopoles had 17 dB of gain, it never said dBi, dBd, or even dBwn . . . just db. Thus, the term is meaningless.

So what do you look for?

- Gain in dB (not dBi or dBd).
- Gain shown to .01 or even .001 dB: The real world can't do that.
- Symmetrical polar plots: This shows a simplified model of the driven element and it never happens at an outdoor antenna range.
- More gain than is theoretically possible for a Yagi that size (sounds like another column).

Therefore, if you want to measure the absolute gain of two identical Yagis by the Friis method, how far apart do you place them? Is that distance measured between the ends of the antennas—i.e., the closest directors? Between the reflectors? Between the driven elements? Here is where we run into another one of those real-world uncertainties.

For a 2- or 3-element Yagi the phase center is basically the driven element. As you make the Yagi longer and longer, the phase center moves slightly down the director string . How far it moves depends on the current distribution in the directors. In figure 4 you can see that a Yagi designed for a very clean pattern has its phase center closer to the driven element than a Yagi designed for maximum gain. We're back to the fact that you have to measure it!

As always, I welcome antenna questions and column suggestions from readers. Many a column topic has been suggest by you. An e-mail to <wa5vjb@cq-vhf.com> or <wa5vjb@amsat.org> will work. Also, for several dozen other antenna projects you are welcome to visit <http://www.wa5vjb.com> and look in the Reference section.

73, Kent, WA5VJB

By Tomas Hood,* NW7US

An Ongoing Challenge

At a recent local amateur radio club meeting, your columnist had the opportunity to discuss with members the idea that the progress of this hobby continues because of the desire to learn, discover, and accomplish new things. A radio amateur not only can participate in emergency service, join in weekly on-the-air nets, participate in DXing and contests, etc., but can build new things, applying the latest in electronics, and can even be part of scientific discovery. Yes, the radio amateur is poised to discover more about the natural world with each passing day, season, and solar cycle.

Here is a question: Is it possible to predict propagation conditions and DX openings on the frequencies above 30 MHz? Are there reliable models that enable us to forecast sporadic-*E*, aurora, troposcatter, and other known propagation modes? Using models, can we program our alarm clocks and set a schedule so that we can communicate by some mode with reliability and predictability on VHF and above?

In the last ten years, a significant amount of new information and some stunning discoveries have been made by radio amateurs who dedicated themselves to the scientific method while operating on these higher frequencies. Some of these discoveries have been detailed on the pages of this magazine in previous issues.

After many decades of on-the-air experience, the amateur and scientific communities are still struggling to find a practical understanding of the complex modes of propagation unique to VHF and above. While decades of weak-signal and long-range (DX) operation on VHF exist, most of this historical information is contained in contest and special-event logs.

More significantly, most of this historical data is sparse and the number of operators limited. There is no historical, worldwide data simply because the population of VHF operators active in weak-signal, long-distance DXing or other facets of our hobby has been sparse, though growing.

The research done by the scientific community is helpful, but also limited to very specific research. There is a great opportunity for us amateur radio scientists to unlock the secrets of propagation on these higher frequencies. The encouraging fact is that the ranks of operators (scientific explorers!) are growing each year. More than ever, affordable radios have become available and inquisitive amateurs are becoming active. It is not just local FM repeaters; more and more amateurs are getting into the exotic areas of radio operation.

True worldwide exploration of propagation on the amateur bands above 30 MHz only recently has become a reality. The number of active, on-the-air amateurs is enough to support true research of regional, national, and worldwide VHF/UHF DX. What is missing?

We still need a coordinated effort to record daily activity worldwide. I'm not talking about the routine check-in on the local repeater net. We need more accurate DX clusters where grid-square information is recorded for both ends of the QSO, e-mail reflectors, Twitter groups, on-line real-time discussion of current conditions, and repositories of logs. These are all ways we can create leverage to increase our knowledge. With more detailed information, we can continue to reveal what we never knew about the natural world. It has been through these activities that some of the recent, amazing discoveries have been made and written about in this magazine.

Now, in this new sunspot Cycle 24, we have more accurate information and more volume of detailed geomagnetic and solar data, weather information, and other points of data than ever before. All of this is at our disposal through the Internet, and we have the affordable equipment with which we can explore it.

More people on the air. More data. Better equipment. Better software and modes. Now is the time to get serious about moving our hobby forward into new territory. That's been the hallmark of the amateur radio hobby since its inception. We lead the way in scientific discovery as well as the application of our knowledge and skills. It is a very large venue to explore and of which to be a part.

That's why the "new" Makers movement is so hot. People are building, experimenting, and pushing the envelope of what is possible. Thus, let's add science to our daily activity on the VHF-and-above spectrum. Are you already doing this? If not, are you willing? Are you ready?

I would like to hear from you. Write to me and tell me your thoughts on this matter. If you have any story about your experimentation, discovery, or how you are going about a scientific inquiry into our world of radio, please share your experience with me. Let me know if I can share it with the rest of the readers of this column.

Are you active in online discussion groups? Share what your group is doing. If you have ideas on how we can coordinate better, let's hear about it. I will include your ideas and stories in this column.

Join the community of modern amateur scientists working toward unlocking the secrets of propagation on the bands above 30 MHz. We need as many on-the-air operators, using as many modes of propagation, on as many VHF and UHF bands as possible. I await your correspondence.

Meteors

Speaking of trying new things, there are a number of opportunities in meteor-scatter propagation during this period to try your skills and employ your equipment. One of the largest yearly meteor showers occurs during November. Check out the Summer 2012 edition of *CQ VHF*, this column, for more information on how to work meteor showers.

For the 2012 *Leonids* shower, meteors will appear to radiate out of the constellation Leo from the second week of November, peaking around the middle of the month, and then tapering off

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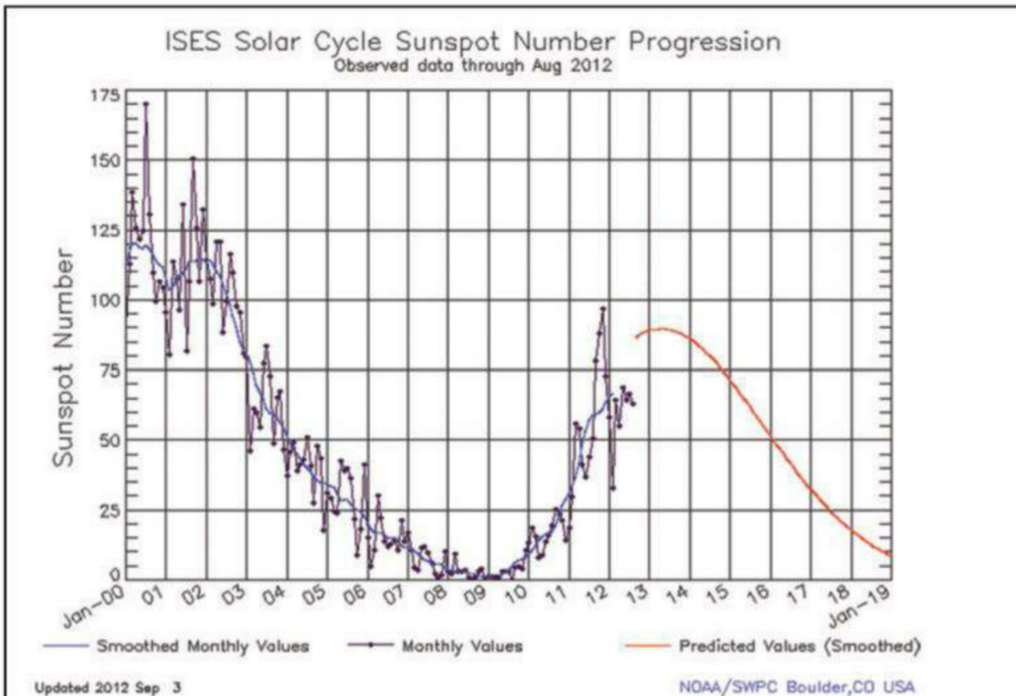
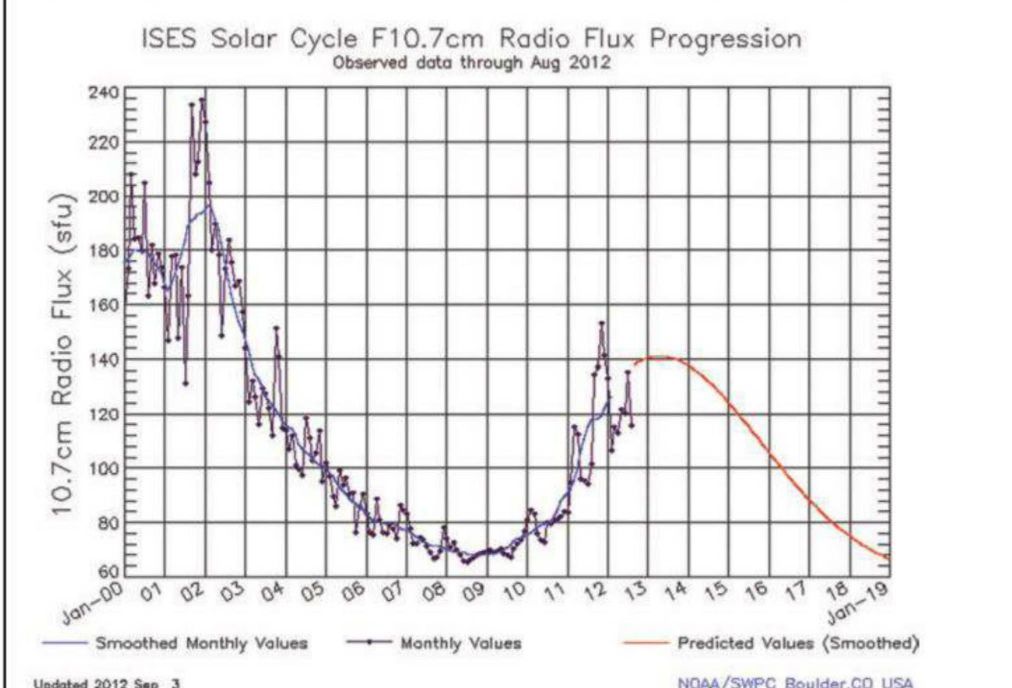
through to the end of November. We hope each year for a storm event, with more than 200 meteors per hour.

This year might produce enhanced rates, but only from the perspective of radio systems; the size of the comet dust is on the order of 10 to 100 microns and thus might not produce many visual meteor trails. However, remember that with a high hourly rate, even tiny patches of ionized *E*-region meteor trail in sufficient quantity could support VHF propagation. Because of the latest advances in our equipment, including very powerful soundcards and computer hardware, married with the right software, you have an excellent opportunity to work this shower.

This year the best window to start trying meteor-scatter mode is early evening. Then the shower should pick up as midnight rolls by, peak around 2 AM local time, and then taper off as morning arrives. Any night between the 14 and the 22 of November might be good, with the peak expected on the 17th at 0930 UTC.

Watch out for the *alpha-Monocerotids* from November 15–20, with a maximum





meteor count on November 21 at 0955 UTC. The hourly rate is about five meteors, which is not exciting. However, last year there was a 30-minute storm burst with a rate of approximately 420 visible meteors per hour in Europe. Forecasters modeling this shower think that this year will be dismal, if the shower even occurs. That's because the Earth's path will be farther away from the dust trail. They think the big peak will come in 2017. However: no one can know for sure, so be ready to fire up the meteor-scatter software and get those radios dialed in.

Watch for the *Ursids* from December 17 through 26 with a maximum on December 22 peaking at 2208 UTC. Most people miss this, but it could have an hourly rate as high as 50. In 2008, it reportedly had two peaks with an hourly rate of 30 to 35. The *Ursid* radiant is circumpolar from most northern locations and culminates after daybreak, while it is highest in the sky later in the night. This one could be a good VHF player.

The *Geminids* are possibly the most reliable of the annual showers. While the duration of this meteor shower is shorter than that of others, there's a definite plateau of maximum activity. The *Geminids* begin to peak during predawn on December 13, with a quick climb to its maximum rate of around 120 per hour, according to forecasts. Its window is from December 4 through 17. In North America and Canada, VHF enthusiasts will have the best opportunity to work meteor-scatter propagation from December 12 through the wee hours on the 14th, but as *Geminids* are a "long tail" event, expect continual opportunity, although less often, several days or nights after the peak.

Don't forget to send me your stories and reports of your experience with meteor scatter. Other readers and I would love to hear about it!

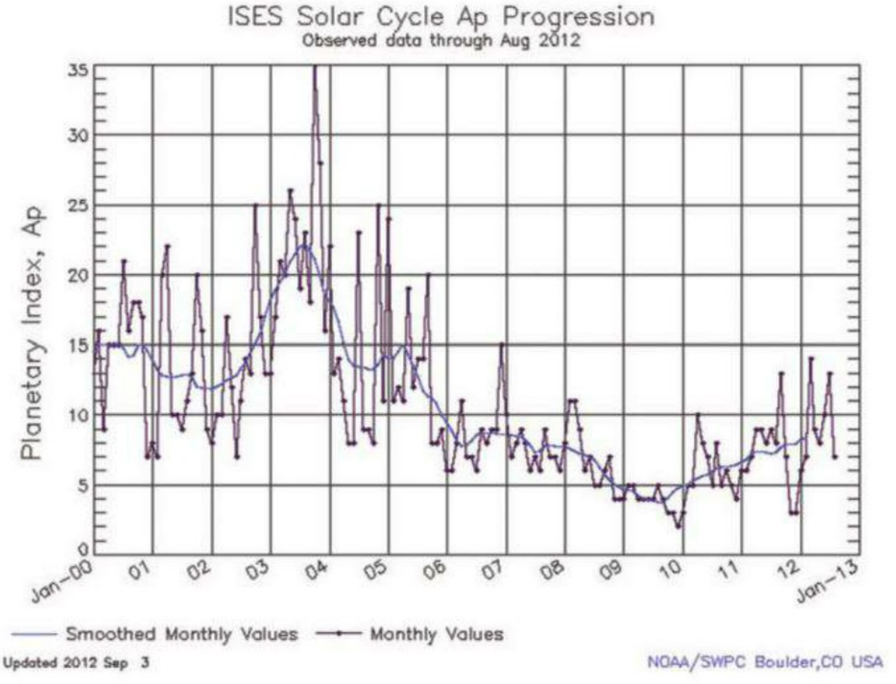


Figure 1. Some space-weather observers are speculating that we've already seen the peak of sunspot Cycle 24. Looking at these graphs of monthly sunspot counts and the monthly 10.7-cm radio flux lends itself to such speculation. However, caution is advised, as the Sun is unpredictable (no matter what researchers have come up with in their modeling of the data) and may well surprise us. Remember that the recent sunspot-cycle minimum defied all prediction. In the meantime, though, it is true that solar activity has been rather mild, as we see in the Ap *graph of monthly geomagnetic activity. The VHF DXer might see this as a double negative; low activity equates to an ionosphere that won't support worldwide DX on VHF, and moderate at best geomagnetic activity results in few aurora events, leaving the DXer hungry for action. As we move through the next three months, we may see a change in activity. Time will tell. (Credit: NOAA [National Oceanic and Atmospheric Administration]/SWPC [Space Weather Prediction Center])*

The Solar Cycle Pulse

The (preliminary) observed sunspot numbers from June through August 2012 are 64.5, 66.5, and 63.1. The smoothed sunspot counts for December 2011 through February 2012 are 63.4, 65.5, and 66.9.

The monthly 10.7-cm (preliminary) numbers from June through August 2012 are 120.5, 135.6, and 115.7. These numbers are slightly higher than one year ago. The cycle seems to be increasing in strength, but somewhat slowly. The smoothed 10.7-cm radio flux numbers for December 2011 through February 2012 are 121.6, 124.4, and 126.7. The activity level is now high enough to support 10-meter propagation and some limited 6-meter propagation over many paths via the *F2*-region.

The smoothed planetary *A*-index (*Ap*) numbers from December 2011 through February 2012 are 8.0, 8.3, and 8.4. The monthly readings from June through August 2012 are 10, 13, and 7.

The monthly sunspot numbers forecast for November 2012 through January 2013 are 82, 84, and 86, while the monthly 10.7-cm flux forecast numbers are 135, 137, and 138 for the same period. Give or take about eight points for all predictions.

(Note that these are preliminary figures. Solar scientists make minor adjustments after publishing, by careful review.)

Feedback, Comments, Observations Solicited!

I am looking forward to hearing from you about your observations of VHF and UHF propagation. Please send your

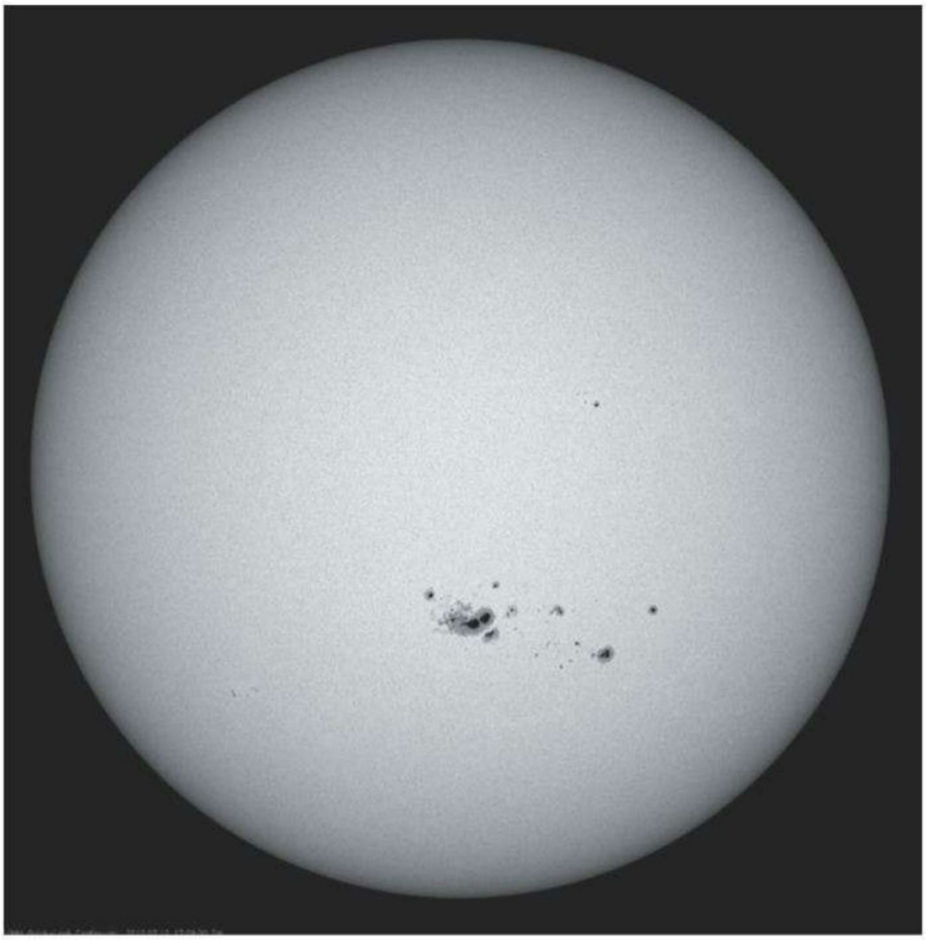


Figure 2. VHF DXers are anxious to see more of this: large, active sunspot regions peppering the solar surface. This image, captured by the HMI instruments aboard the SDO spacescraft, shows the cooler active sunspot region contrasted against a hotter solar disc on July 12, 2012. (Credit: SDO [Solar Dynamics Observatory]/HMI (Heliospheric and Magnetic Imager])

reports to me via e-mail, or drop me a letter about your VHF/UHF experiences. I'll create summaries and share them with the readership. I look forward to hearing from you. Up-to-date propagation information can be found at my propagation center at <http://sunspotwatch.com/>. If you are using Twitter, follow @ hfradiospacewx for space weather and propagation alerts, and follow @NW7US to hear from me about various space weather and amateur radio news. Facebook members should check out the CQ VHF Magazine Fan Page at <http://www.facebook. com/CQVHF>, and the Space Weather and Radio Propagation Group at <http:// www. facebook.com/spacewx.hfradio>.

Until the next issue, happy weak-signal DXing! 73 de Tomas, NW7US

CQ's 6 Meter and Satellite WAZ Awards

(As of October 1, 2012)

By Floyd Gerald,* N5FG, CQ WAZ Award Manager

6 Meter Worked All Zones

No.	Callsign	Zones needed to have all 40 confirmed
1	N4CH	16,17,18,19,20,21,22,23,24,25,26,28,29,34,39
2	N4MM	17,18,19,21,22,23,24,26.28.29,34
3	JI1CQA	2,18,34,40
4	K5UR	2,16,17,18,19,21,22,23,24,26,27,28,29,34,39
5	EH7KW	1,2,6,18,19,23
6	K6EID	17,18,19,21,22,23,24,26,28,29,34,39
7	K0FF	16,17,18,19,20,21,22,23,24,26,27,28,29,34
8	JF1IRW	2,40
9	K2ZD	2,16,17,18,19,21,22,23,24,26, 28,29,34
10	W4VHF	16,17,18,19,21,22,23,24,25,26,28,29,34,39
11	GØLCS	1,6,7,12,18,19,22,23,28,31
12	JR2AUE	2,18,34,40
13	K2MUB	16,17,18,19,21,22,23,24,26,28,29,34
14	AE4RO	16,17,18,19,21,22,23,24,26,28,29,34,37
15	DL3DXX	18,19,23,31,32
16	W5OZI	2,16,17,18,19,20,21,22,23,24,26,28,34,39,40
17	WA6PEV	3,4,16,17,18,19,20,21,22,23,24,26,29,34,39
18	9A8A	1,2,3,6,7,10,12,18,19,23,31
19	9A3JI	1,2,3,4,6,7,10,12,18,19,23,26,29,31,32
20	SP5EWY	1,2,3,4,6,9,10,12,18,19,23,26,31,32
21	W8PAT	16,17,18,19,20,21,22,23,24,26,28,29,30,34,39
22	K4CKS	16,17,18,19,21,22,23,24,26,28,29,34,36,39
23	HB9RUZ	1,2,3,6,7,9,10,18,19,23,31,32
24	JA3IW	2,5,18,34,40
25	IK1GPG	1,2,3,6,10,12,18,19,23,32
26	W1AIM	16,17,18,19,20,21,22,23,24,26,28,29,30,34
27	K1LPS	16,17,18,19,21,22,23,24,26,27,28,29,30,34,37
28	W3NZL	17,18,19,21,22,23,24,26,27,28,29,34
29	K1AE	2,16,17,18,19,21,22,23,24,25,26,28,29,30,34,36
30	IW9CER	1,2,6,18,19,23,26,29,32
31	IT9IPQ	1,2,3,6,18,19,23,26,29,32
32	G4BWP	1,2,3,6,12,18,19,22,23,24,30,31,32
33	LZ2CC	1
34	K6MIO/KH6	16,17,18,19,23,26,34,35,37,40
35	K3KYR	17,18,19,21,22,23,24,25,26,28,29,30,34
36	YV1DIG	1,2,17,18,19,21,23,24,26,27,29,34,40
37	KØAZ	16,17,18,19,21,22,23,24,26,28,29,34,39
38	WB8XX	17,18,19,21,22,23,24,26,28,29,34,37,39
39	K1MS	2,17,18,19,21,22,23,24,25,26,28,29,30,34
40	ES2RJ	1,2,3,10,12,13,19,23,32,39
41	NW5E	17,18,19,21,22,23,24,26,27,28,29,30,34,37,39
42	ON4AOI	1,18,19,23,32
43	N3DB	17,18,19,21,22,23,24,25,26,27,28,29,30,34,36
44	K4ZOO	2,16,17,18,19,21,22,23,24,25,26,27,28,29,34
45	G3VOF	1,3,12,18,19,23,28,29,31,32
46	ES2WX	1,2,3,10,12,13,19,31,32,39
47	IW2CAM	1,2,3,6,9,10,12,18,19,22,23,27,28,29,32
48	OE4WHG	1,2,3,6,7,10,12,13,18,19,23,28,32,40
49	TI5KD	2,17,18,19,21,22,23,26,27,34,35,37,38,39
50	W9RPM	2,17,18,19,21,22,23,24,26,29,34,37
51	N8KOL	17,18,19,21,22,23,24,26,28,29,30,34,35,39
52	K2YOF	17,18,19,21,22,23,24,25,26,28,29,30,32,34
53	WA1ECF	17,18,19,21,23,24,25,26,27,28,29,30,34,36
54	W4TJ	17,18,19,21,22,23,24,25,26,27,28,29,34,39
55	JM1SZY	2,18,34,40
56	SM6FHZ	1,2,3,6,12,18,19,23,31,32
57	N6KK	15,16,17,18,19,20,21,22,23,24,34,35,37,38,40
58	NH7RO	1,2,17,18,19,21,22,23,28,34,35,37,38,39,40
59	OK1MP	1,2,3,10,13,18,19,23,28,32
60	W9JUV	2,17,18,19,21,22,23,24,26,28,29,30,34
61	K9AB	2,16,17,18,19,21,22,23,24,26,28,29,30,34
62	W2MPK	2,12,17,18,19,21,22,23,24,26,28,29,30,34,36
63	K3XA	17,18,19,21,22,23,24,25,26,27,28,29,30,34,36
64	KB4CRT	2,17,18,19,21,22,23,24,26,28,29,34,36,37,39
65	JH7IFR	2,5,9,10,18,23,34,36,38,40
66	KØSQ	16,17,18,19,20,21,22,23,24,26,28,29,34
67	W3TC	17,18,19,21,22,23,24,26,28,29,30,34
68	IKØPEA	1,2,3,6,7,10,18,19,22,23,26,28,29,31,32
69	W4UDH	16,17,18,19,21,22,23,24,26,27,28,29,30,34,39
70	VR2XMT	2,5,6,9,18,23,40
71	EH9IB	1,2,3,6,10,17,18,19,23,27,28
72	K4MQG	17,18,19,21,22,23,24,25,26,28,29,30,34,39
73	JF6EZY	2,4,5,6,9,19,34,35,36,40
74	VE1YX	17,18,19,23,24,26,28,29,30,34
75	OK1VBN	1,2,3,6,7,10,12,18,19,22,23,24,32,34
76	UT7QF	1,2,3,6,10,12,13,19,24,26,30,31
77	K5NA	16,17,18,19,21,22,23,24,26,28,29,33,37,39
78	I4EAT	1,2,6,10,18,19,23,32
79	W3BTX	17,18,19,22,23,26,34,38
80	JH1HHC	2,5,7,9,18,34,35,37,40.
81	PY2RO	1,2,17,184OM,19,21,22,23,26,28,29,30,38,39,40
82	W4UM	18,19,21,22,23,24,26,27,28,29,34,37,39
83	I5KG	1,2,3,6,10,18,19,23,27,29,32.
84	DF3CB	1,18,19,32
85	K4PI	17,18,19,21,22,23,24,26,28,29,30,34,37,38,39.
86	WB8TGY	16,17,18,19,21,22,23,24,26,28.29,30,34,36,39
87	MU0FAL	1,2,12,18,19,22,23,24,26,27,28,29,30,31,32
88	PY2BW	1,2,17,18,19,22,23,26,28,29,30,38,39,40.
89	K4OM	17,18,19,21,22,23,24,26,28,29,32,34,36,38,39.
90	JH0BBE	2,33,34,40
91	K6QXY	17,18,19,21,22,23,34,37,39
92	JA8ISU	2,7,8,9,19,33,34,36,37,38,39,40
93	YO9HP	1,2,6,7,11,12,13,18,19,23,28,29,30,31,40
94	SV8CS	1,2,18,19,29
95	SM3NRY	1,6,10,12,13,19,23,25,26,29,30,31,32,39
96	VK3OT	2,10,11,12,16,34,35,37,39,40
97	UY1HY	1,2,3,6,7,9,12,18,19,23,26.28,31,32,36
98	JA7QVI	2,40
99	K1HTV	17,18,19,21,22,23,24,26,28,29,34
100	OK1RD	2,6,7,8,9,11,12,13,18,19,21,22,28,39,40
101	S51DI	1,2,6,18,19
102	S59Z	1,2,6,7,10,12,17,18,19,22,23,24,26,31,32
103	UY5ZZ	1,2,3,6,7,10,11,12,13,18,19,29,31,32,39
104	UX0FF	1,2,6,7,10,12,13,18,19,22,28,29,31,32
105	EI3IO	1,3,12,18,19,23,29,30,31,32
106	JJ2BLV	2,4,5,7,8,9,16,18,19,34,35,36,37,38,40
107	EA6SX	1,2,10,12,18,19,22,26,27,28,29,30,31,32.
108	PE5T	1,2,3,6,12,18,19,22,27,29,30,31,32,39
109	SP3RNZ	1,2,3,6,7,13,18,19,23,24,26,28,31,32
110	W9VHF	17,18,19,21,22,23,24,26,28,29,30,34,36,39
111	UT5URW	1,2,3,4,6,7,10,11,12,18,19,29,30,31,32

Satellite Worked All Zones

No.	Callsign	Issue date	Zones Needed to have all 40 confirmed
1	KL7GRF	8 Mar. 93	None
2	VE6LQ	31 Mar. 93	None
3	KD6PY	1 June 93	None
4	OH5LK	23 June 93	None
5	AA6PJ	21 July 93	None
6	K7HDK	9 Sept. 93	None
7	W1NU	13 Oct. 93	None
8	DC8TS	29 Oct. 93	None
9	DG2SBW	12 Jan. 94	None
10	N4SU	20 Jan. 94	None
11	PAØAND	17 Feb. 94	None
12	VE3NPC	16 Mar. 94	None
13	WB4MLE	31 Mar. 94	None
14	OE3JIS	28 Feb. 95	None
15	JA1BLC	10 Apr. 97	None
16	F5ETM	30 Oct. 97	None
17	KE4SCY	15 Apr. 01	10,18,19,22,23, 24,26,27,28, 29,34,35,37,39
18	N6KK	15 Dec. 02	None
19	DL2AYK	7 May 03	2,10,19,29,34
20	N1HOQ	31 Jan. 04	10,13,18,19,23, 24,26,27,28,29, 33,34,36,37,39
21	AA6NP	12 Feb. 04	None
22	9V1XE	14 Aug. 04	2,5,7,8,9,10,12,13, 23,34,35,36,37,40
23	VR2XMT	01 May 06	2,5,8,9,10,11,12,13,23,34,40
24	XE1MEX	19 Mar. 09	2,17,18,21,22,23,26,34,37,40
25	KCØTO	17 Mar. 11	None
26	TI5RLI	10 July 12	2, 16, 19, 22, 23, 24, 26. 34

CQ offers the Satellite Work All Zones award for stations who confirm a minimum of 25 zones worked via amateur radio satellite. In 2001 we "lowered the bar" from the original 40 zone requirement to encourage participation in this very difficult award. A Satellite WAZ certificate will indicate the number of zones that are confirmed when the applicant first applies for the award.

Endorsement stickers are not offered for this award. However, an embossed, gold seal will be issued to you when you finally confirm that last zone.

Rules and applications for the WAZ program may be obtained by sending a large SAE with two units of postage or an address label and $1.00 to the WAZ Award Manager: Floyd Gerald, N5FG, P.O. Box 449, Wiggins, MS 39577-0449. The processing fee for all CQ awards is $6.00 for subscribers (please include your most recent *CQ* or *CQ VHF* mailing label or a copy) and $12.00 for nonsubscribers. Please make all checks payable to Floyd Gerald. Applicants sending QSL cards to a CQ Checkpoint or the Award Manager must include return postage. N5FG may also be reached via e-mail: <n5fg@cq-amateur-radio.com>.

**P.O. Box 449, Wiggins, MS 39577-0449; e-mail: <n5fg@cq-amateur-radio.com>*

By Keith Pugh,* W5IU

Working Satellites Through the Decline of Active "Birds"

I have been "under the weather" for the last couple of months with a broken right shoulder. Consequently, I have missed some planned activities and have had difficulty typing single-handed with my left hand. For this issue I am offering the following update to an old topic. I should be back up to full speed for the next issue with a complete report of the 2012 AMSAT Space Symposium.

Within the past few days we have apparently lost an old friend, AO-27. This old "bird" has been with us since September of 1993 and was one of the first FM satellites. It certainly was the most popular and longest lived FM bird. The command station hasn't given up on it yet, but its days are certainly numbered. The rest of our fleet is aging. Meanwhile, the CubeSats are multiplying—at least ten new ones in the last month (this column was written in early October)—and doing great, but they aren't as satisfying for the average ham as the older, larger birds.

What do we still have to work with? What can we do to keep active through the decline? What are the prospects for the future?

What Do We Still Have to Work With?

At the moment we are down to one FM Satellite, SO-50; three linear transponder satellites, AO-07, FO-29, and VO-52; the International Space Station (ISS); and the CubeSats. We have at least four new birds sitting on the shelf awaiting affordable launches. One of these, Phase 3E, is planned for the much sought after High Earth Orbit (more about this later).

I mentioned before that the fleet is aging. Not counting the CubeSats, the newest one of these satellites is VO-52 and it is seven years old. The oldest, AO-07, was launched in 1974, died in 1981, and returned from the dead in 2001; it's doing great while in sunlight, but I guess you could say that it's living on borrowed time. AO-27, launched in 1993, may be gone, but in any case has operational restrictions. It was our most active FM bird. SO-50 continues to work okay, but it's relatively low-powered down link coupled with some control restrictions make it less popular than AO-27.

The CubeSats, while numerous, in general do not have active transponders and at best have telemetry beacons. Most of them have digital downlinks. A few take pictures. Most of them were built and are controlled by schools around the world. When their original scientific experiments are completed, many of them die or remain relatively idle. A few have had ongoing experiments that are of interest to amateur radio operators, but many have not. In spite of all of this negativity, the CubeSats are probably the immediate future of amateur radio satellites.

For a complete history of the amateur radio satellites refer to: <http://www.amsat.org/amsat-new/satellites/history.php>.

What Can We Do to Keep Active Through the Decline?

First and foremost, don't give up hope! There are groups still actively developing new satellites that need everyone's help. You don't have to be a rocket scientist to help develop satellites. Yes, we do need some rocket scientists, but one of the greatest needs is for folks who are good at fund raising. Launch and development costs are skyrocketing, and we need new and innovative ways of financing our new birds.

One of the best ways we have found so far is to market our potential for promoting science, technology, engineering, and mathematics (STEM) education. You can help us get our feet in the doors of schools and other organizations to expose our youth to the positive effects of amateur radio satellites and amateur radio in general. Keep your eyes and ears open for new opportunities.

Next, use but don't abuse the birds that are still active. We only have one FM bird at the moment. Spread out the usage and don't "hog the air" on our remaining birds. SO-50 goes unused much of the time. Make a conscious effort to work SO-50 more, even though SO-50 requires some extra effort to use. Become familiar with its characteristics and use it!

Make more use of the linear transponder birds. Using these satellites requires a little more investment in equipment and refinement of technique, but the benefits are longer and more meaningful QSOs. First, you will need equipment capable of SSB or CW, and you will need full duplex capability. There are many ways to achieve this.

First, there are satellite radios that offer this capability all in one box in both the new and used markets. Next, many single-band, multi-mode radios are available that can be utilized in pairs to equip your station. With the help of available computer controls, operation can be greatly simplified. Even without the computer controls, the techniques are not difficult but can be a little challenging, requiring some practice. Last, your HF equipment, with the addition of converters and/or transverters, can become all or part of your satellite station.

Last, support the worldwide organizations that are building and launching amateur radio satellites. These are usually the AMSAT groups, but can include other organizations such as schools and space agencies, as well. Volunteer your time, effort, and assets to teach and demonstrate our capabilities at schools, hamfests, radio club meetings, and before officials who can help our cause. This kind of activity can be just as personally rewarding as working that new state, country, or grid square on the birds

Amateur Radio on the International Space Station (ARISS) is always looking for help with its efforts to promote STEM education in the schools. Become an ARISS mentor or part of a local ARISS Contact Ground Station Support Group. Be a part of an ARISS contact or at least

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e-mail: <w5iu@swbell.net>

listen to one to experience the satisfaction of observing the reactions of the kids.

What are the Prospects for the Future?

ARISSat: At the time ARISSat-1 was built, three more copies of the satellite were constructed. One was sent to Russia as a flight spare and is complete except for solar arrays. We would like to get it back from Russia to be made available for the next launch opportunity. The other two are also short solar arrays and a few other parts that were used during the testing and qualification of the flight units. All three of these could be made ready in fairly short order if an affordable launch became available. A wealth of data is available from ARISSat-1 to be used by educators, students, and interested hams to further satellite studies and other projects. This data is currently being cataloged, processed, and stored in forms accessible to everyone.

Project Fox: AMSAT-NA development efforts have now returned to Project Fox. This effort was approved by the BoD a couple of years ago but had been overtaken by the ARISSat-1 effort. It has now been split into a two-phase program, FOX-1 and FOX-2. FOX-1 will be a CubeSat replacement for the FM transponders on AO-27 and AO-51 done quickly due to the current urgency. FOX-2 will include a software defined linear transponder and other features. Development of FOX-2 will lag FOX-1 due to limited assets. Further details are available at: <http://www.amsat.org/amsat-new/fox/>. An updated report of all aspects of Project Fox will be presented at the 2012 AMSAT Symposium.

On November 15, 2011, AMSAT submitted a proposal to NASA for its CubeSat Launch Initiative, also known as the "Educational Launch of NanoSat" (ELaNa) program. NASA selects projects that it deems to have merit in support of its strategic and educational goals. Projects that are selected will be able to enter into a collaboration agreement in which NASA will cover the integration and launch costs of the satellite. FOX-1 is one of the winners announced in February 2012. AMSAT is now working with NASA to define the launch and other details. The launch is targeted for 2013.

FunCube: AMSAT-UK embarked on this project several years ago and it is about to come to fruition. It is a CubeSat that is aimed at STEM education, but it does include a linear transponder and other features. Launch is now planned for 2013. A related project, UKube, is also off and running. Launches for both of these are being defined, with recent announcements favoring a Russian Soyuz in early 2013.

As part of this effort a ground station element was developed including the FunCube Dongle as an affordable receiver for use in the schools. The FunCube Dongle project has developed a life of its own, and hundreds of these SDR receivers have already been marketed worldwide. An improved version—the FunCube Dongle Pro+—recently has been announced.

KIWIsat: A project of AMSAT-ZL, this one is nearing completion and looking for a launch opportunity.

Phase 3E: A project of AMSAT-DL, Phase 3E basically is sitting on the shelf in Germany awaiting a launch opportunity. This project is part of the Phase 5 project in Germany that would ultimately produce a lunar orbiter. At least partial funding of a launch was to have come from the German government via the Phase 5 effort, but things have slowed down due to world economic problems. Recent announcements indicate that support of the German government has disappeared. AMSAT-DL continues to look for an affordable launch, but prospects are not good. Some of the newer launch agencies are being pursued.

CubeSats: Many of these continue to be developed by schools and other groups. One of AMSAT-NA's goals for Project Fox is to provide a readily available "RF Bus Design" for the other CubeSat groups to utilize for their own goals while providing a simultaneous amateur radio transponder capability.

I'm sure there are other projects out there but these are the major ones of which I am aware.

Summary

Use our remaining amateur radio satellites wisely and expand your own use of the linear transponder birds if you haven't already done so.

Continue the amateur radio satellites in education theme with Project Fox. It is a natural carry-on to ARISSat-1 and will be AMSAT-NA's next satellite. FOX-1 will replace the void left by the demise of AO-27 and AO-51. AMSAT is now working with NASA to define the FOX-1 Launch.

Support FUNCube, a similar AMSAT-UK satellite that may launch before Project Fox, and don't forget KIWIsat from "down under."

Just before my accident in July, I represented AMSAT and ARISS at a function called "Moon Day" at The Frontiers in Flight Museum in Dallas, Texas. This is an annual affair commemorating the first visit to the moon in 1969. We got our feet in the door and should have an expanded presence there next year—a great opportunity!

Please continue to support AMSAT's plans for the future of amateur radio satellites. Refer to the AMSAT web page at <http://www.amsat.org> for details. Satellite details are updated regularly at <http://www.amsat.org/amsat-new/satellites/status.php>. Follow the projects and progress of AMSAT-UK at <http://www.uk.amsat.org/>.

'Til next time! 73 de Keith, W5IU

old Berkeley friends, colleagues, and classmates).

I guess I got carried away, because I found myself spouting SETI for the better part of an hour. Then Richard dropped his bombshell: "I've just set up a private SETI research organization. How'd you like to run it?"

A fascinating opportunity, I told Richard, when finally it sunk in that the hour just passed had actually been a job interview. There was just one complication: I was teaching electronics engineering at a Pennsylvania college, and winter classes were about to start right after the holidays.

"No problem," effused Richard. "Just quit your teaching job and come to work for The SETI League."

"Let me get this straight," I responded. "You're asking me to give up a tenured full professorship, a job for life backed by the taxing authority of the state, to do fringe science on soft money? How can I possibly pass up a deal like that?"

My sarcasm was not lost on Richard. We ended the conversation with my promise to fly my Beechcraft the short distance to northern New Jersey the following week so that he could try to twist my arm.

That meeting was pivotal. Richard's vision for his newly founded nonprofit paralleled my own concept of privatized science. We both disparaged the multi-million-dollar government approach to SETI and felt there had to be a better way. Why not, we both reasoned, tap into a resource that NASA never contemplated—the world's thousands of amateur astronomers and moonbounce hams and microwave experimenters? With their help we could launch a search that not only would eclipse any previous SETI effort, but that would be immune to any congressional budget-slashing efforts.

In the end, I agreed to help out on a consulting basis throughout the upcoming semester, while seeking a leave of absence for the following academic year.

That leave was ultimately granted and was to become a sabbatical from which I would never return. It's a tale that has been told incrementally in this column over the past dozen years. The sequel to the story is that, for extraordinary (though unwitting) service to The SETI League, the organization's board of trustees in 2012 bestowed upon W2QOV its annual Orville Greene Service Award.

And where was "Larry the Dad" while Richard and I were plotting our little SETI insurrection? Why, just down the road in Hoboken, New Jersey, as it turned out, doing something even more amazing than what Richard and I were attempting. He was going back to school.

Larry, it happens, had been a graduate student decades back at Stevens Institute of Technology. The degree he had sought was a PhD. The one he actually earned was ABD (All But Dissertation). Having completed all his coursework and concluding his research, he was penning his doctoral thesis when somebody else pre-published his most important, original breakthrough idea.

Pick another topic and start again, his advisor told him. However, that was not an option for Larry, who by then had acquired a job, and a family, and a mortgage. Therefore, he went back to IBM, ultimately to manage a whole department of PhDs, his being the only one on the team without a doctorate to call his own.

Wearing his "Captain of Industry" cap, Larry found himself back on the Stevens campus in the early 1990s, attending an engineering conference. He chanced to run into his old advisor (by now a very long-time full professor), who asked, "So, did you ever finish that doctorate?"

When Larry answered in the negative, his old professor asked, "Why not come back here and do it now?"

Of course, the statute of limitations on Larry's prior coursework had long expired. The school offered to waive it. All he needed to do was complete a suitable research project, write a dissertation, and march in cap and gown and hood.

That is exactly what "Larry the Dad" did, well into his sixties, afterward retiring from IBM as *Doctor* "Larry the Dad." This was almost as improbable an accomplishment as the one Richard Factor and I were (and are still) attempting.

73, Paul, N6TX

OP ED *(from page 6)*

operators are becoming a rare breed, indeed. Some of the younger hams are interested in CW, but the gap between high-speed CW operators and the beginners is increasing, not decreasing, despite the efforts of the FISTS organization.

Although difficult at best, this essay has attempted to address the current problem of inactivity on 2 meter FM, once the glory-spot of amateur radio. A solution to the problem is uncertain, as the one thing that is certain is change. What the actual solution is I do not know.

The ARRL is in a very precarious position with regard to 2-meters FM. The manufacturers of 2-meter FM gear, of course, want 2-meter FM portrayed in a positive manner, but at the same time, the board of directors of the ARRL are very aware of the current lack of activity on 2 meters FM. More and more innovative and inexpensive designs of 2-meter equipment are available, and still demand is not that great.

Overall the status of 2-meter (and the same goes for other bands) FM activity and quality of operating is still quite a lot better than the cronyism and clannish activity currently seen on the 75-meter SSB band.

So that this article is not misconstrued, the main point is that the use of conventional and data cellphones and tablets constitutes a real and current danger to VHF repeater and weak-signal operation, much greater than any other, including broadband via power lines (BPL). There are many birdies interfering with weak-signal operation. Commercial pressures for spectrum may eliminate any amateur VHF allocations.

Other than to encourage weak-signal and repeater operation rather than smart phone use for VHF operators, I do not have a solution for the problem. When I observe hams using their smartphones at hamfests and amateur gatherings, the Pogo quote "we have found the enemy and it is us" comes to mind. For the good of ham radio, get on your local 2-meter repeater and check into the club or ARES net! Monitor your local repeater. Call CQ on 144.200 MHz. We need our VHF frequencies.

Thanks go to Rick Rosen, K1DS, for editorial assistance.

(Disclaimer: This piece in no way reflects the position of the Susquehanna Valley ARC, Frankford Radio Club, Mt. Airy VHF Radio Club, ARRL, CQ Communications and its subsidiaries, or CW ops, QCWA, OOTC, QRP ARCI, SWOT, CFO, or the other clubs to which I belong!

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By Dr. H. Paul Shuch,* N6TX

DR. SETI'S STARSHIP

Searching For The Ultimate DX

"Larry the Dad"

Although he has never been a SETI League member, Larry Spector, W2QOV, is largely responsible for its very existence, for it was "Larry the Dad" who first introduced me to Richard Factor, WA2IKL.

Larry Spector, W2QOV, with the Schweitzer glider he currently flies. Larry is indirectly responsible for The SETI League's very existence. Three decades ago he introduced two of his ham radio buddies to each other. Richard Factor, WA2IKL, went on to found The SETI League, and H. Paul Shuch, N6TX, became its founding Executive Director.

Let's go back to the beginning. In the early 1980s, I used to chat with Larry on a local 220-MHz repeater while commuting back and forth to the California college at which I then taught electronics and aeronautics. He was a fellow pilot and flight instructor, and onetime owner of a pristine Piper J3 Cub. By the time I met him and his wife Libby, they were flying a Beech Bonanza, fast cousin to my old Beech Sierra. Larry, a Bell Labs alumnus and longtime IBM employee, was then managing a cutting-edge engineering research department staffed by distinguished PhDs, so we frequently talked airplanes, and ham radio, and engineering. Not necessarily in that order.

At the time, when not teaching my classes, I was running a Silicon Valley startup and hip deep in the development of BiDCAS, an airborne anti-collision radar system. Once the prototype was tested and the patent filed, I told Larry about my project and lamented the challenges of putting my promising design into commercial production. That's when Larry mentioned his friend Richard.

Richard, I was told, owned a successful electronics company in New Jersey. He was a friend of Larry's daughter Claire (hence the nickname bestowed on Larry), a fellow ham, and pilot, and was in the process of introducing some rather innovative avionics products. My BiDCAS radar design might yet find a home. Would I be interested in meeting him, Larry wondered.

Indeed, I would. Larry made the introduction. Richard's company sent mine a retainer check, we each signed a non-disclosure agreement, and I sent along photocopies of my lab notebooks for his patent attorney to peruse. At first it appeared that we might be able to do a profitable business together. For reasons beyond the scope of this story, that never panned out — but this was (as Rick Blaine said to Louie at the end of *Casablanca*) the beginning of a beautiful friendship.

It was beautiful, though admittedly intermittent. For the next decade, as life and geography precluded closer contact, Richard and I crossed paths about once a year. Usually we'd play telephone catch-up around the December holidays. Our conversations became formulaic: "Anything exciting going on in your life," each of us would ask the other. "Any new jobs, cars, ham gear, wives?" ("I never made the same mistake twice," Richard would always answer to that last query.) "Any new research interests?" "Airplanes?" "Exciting travels?" We'd fill in the blanks, wish each other a happy new year, and then not talk again until another twelve months had passed.

The December 1994 call from Richard brought with it a new question: "Do you know anything about SETI?" he inquired.

It was a reasonable question. I had gone to grad school at the University of California, Berkeley, a hotbed of SETI activity. As it happened, I knew most of the key players in SETI science, and, as a microwave circuit engineer, was relatively well versed in the technologies being harnessed to ferret out RF evidence of our cosmic companions.

I proceeded to brief my ham friend on the termination, the year prior, of the modestly funded NASA SETI office. I apprised him of efforts to privatize that research, including the upcoming launch of Project Phoenix, a continuation of NASA's targeted search under the aegis of the nonprofit SETI Institute (staffed largely by a regrouped aggregation of former NASA employees, many of them my

(Continued on page 82)

*Executive Director Emeritus, The SETI League, Inc., <www.setileague.org>
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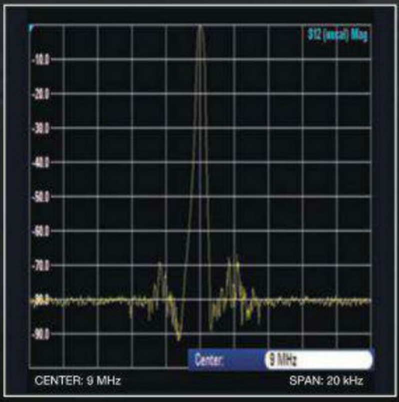

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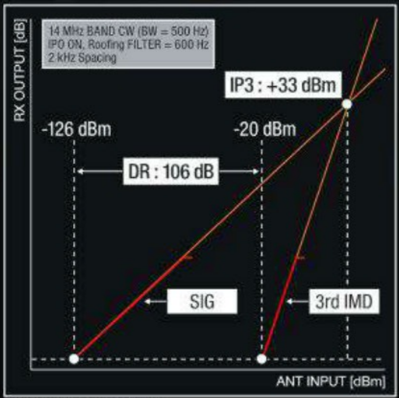

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