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Ham Radio Above 50 MHz

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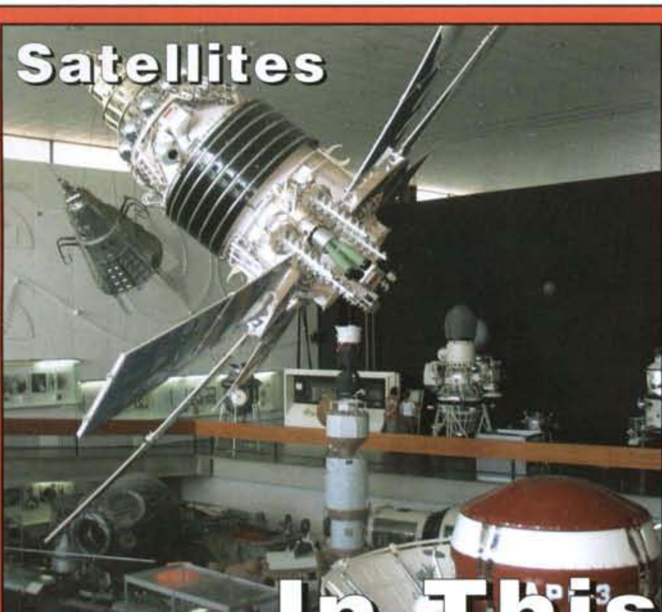

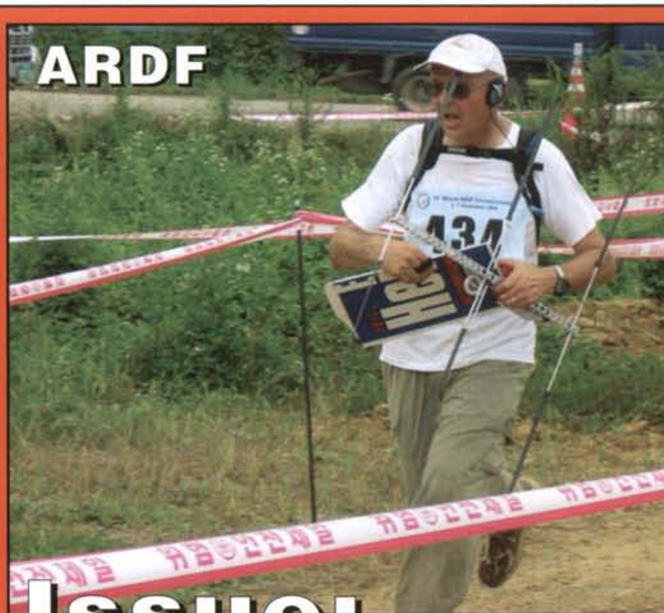

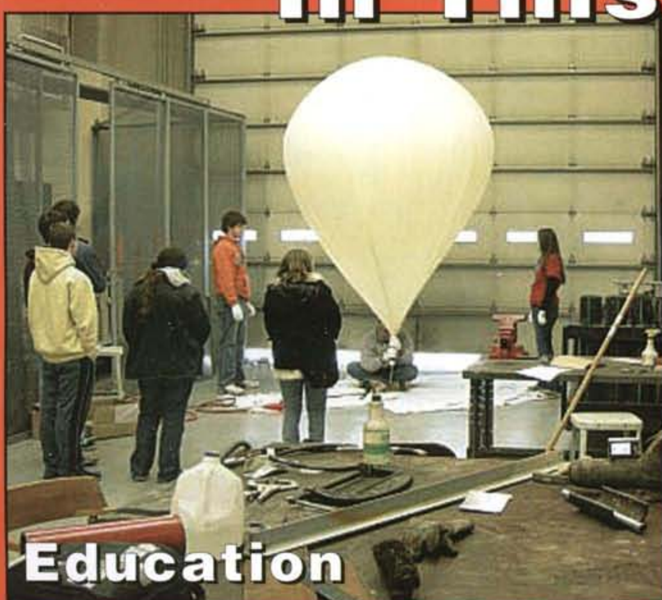

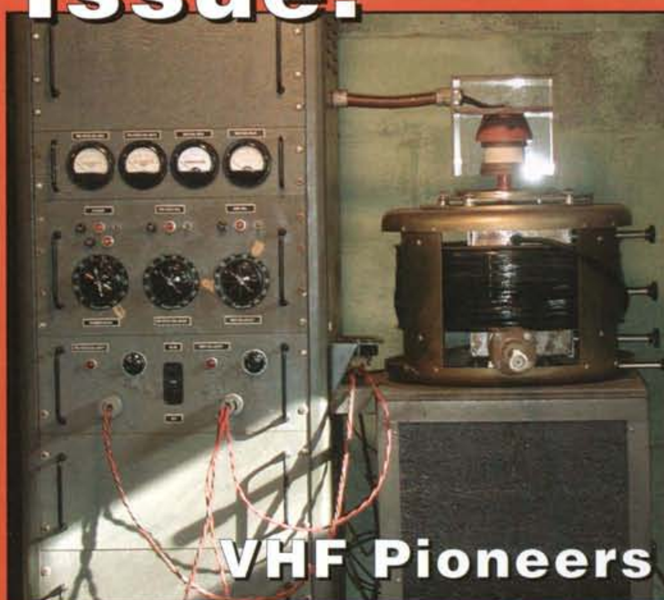

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contents

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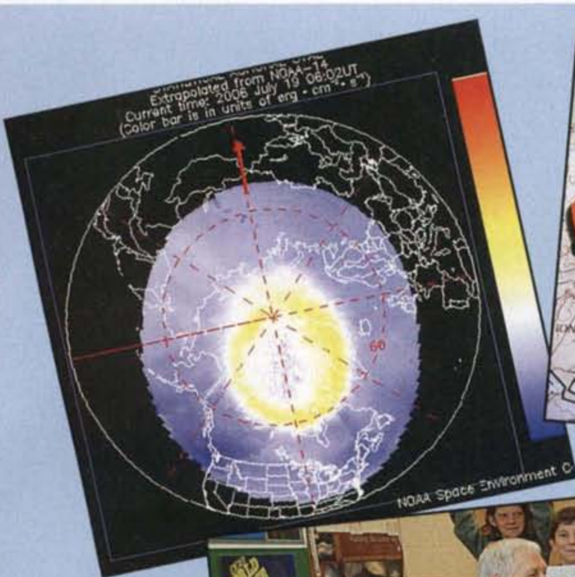
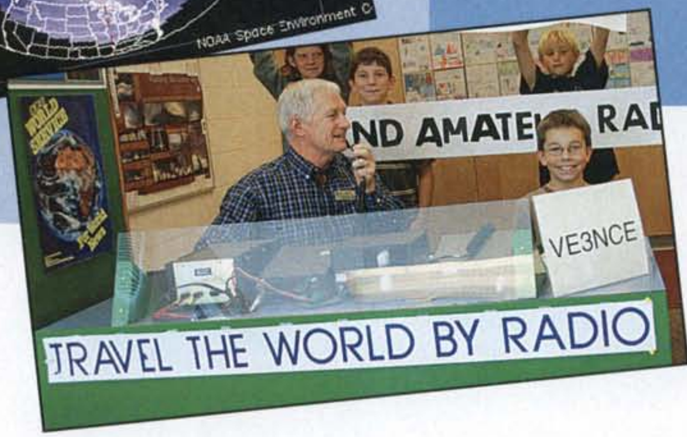
FEATURES





COLUMNS

DEPARTMENTS

On The Cover: For details see the following columns and articles in this issue. Top left, "Satellites" by W5IU, p. 64; top right "Homing In" by KØOV, p. 54; bottom left, "Tulsa (OK) Technology Center . . ." by KE5URH, p. 32; bottom right, The Basement Lab Group, Part 2" by WA2VVA, p. 18.

CQ VHF Ham Radio Above 50 MHz

LINE OF SIGHT

A Message from the Editor

The 2008 TAPR/DCC Conference

In all my years of attending conferences, I have never seen such a well-organized event as this year's TAPR/DCC conference. Three factors contributed to the success of the conference. First was the leadership provided by TAPR president David Toth, VE3GYQ, and TAPR vice-president Steve Bible, N7HPR. They saw to it that all of the oversight details were handled well.

Next was the on-the-ground leadership of Kermit Carlson, W9XA, and Mark Thompson, WB9QZB. Kermit and his crew were responsible for making sure everything worked properly at the venue, the Chicago Holiday Inn hotel. Among their responsibilities were making arrangements at the hotel, setting up and operating the audio/visual equipment. The A/V equipment was provided by Ron Steinberg, K9IKZ, of RC Communications (more about his part appears below). Mark was responsible for working with local clubs and the local publicity for the conference. Both Kermit and Mark were recognized for their hard work during the banquet (see photo).

Finally, as mentioned above, Ron Steinberg, K9IKZ, was responsible for the A/V—and superb is the best way to describe his setup. Two large screens with flame-thrower projectors were positioned on opposite sides of the stage area in the main ballroom. In addition, two remote, large-screen LCD monitors and speakers were installed in the hallway and the demo room, which allowed participants in those areas to keep track of presentations.

As part of the A/V presentation, during breaks a rotating PowerPoint slide presentation was projected and featured each of the significant supporters of the conference. Because *CQ VHF* was a sponsor, I was quite pleased to see our logo as part of that rotation.

All of this superb organization provided the setting for the excellent presentations that were made throughout the weekend. Thanks to Gary Pearce, KN4AQ, a DVD of each of the presentations will be available for purchase in about three months. Watch for an announcement of its availability in my "VHF Plus" column in *CQ* magazine.

On a personal note, I would like to say thank you to all concerned for their very gracious hosting of my wife, Carol, W6CL, and me during our all-too-brief stay at the conference. Because of my church commitment on Sunday morning, we had to fly back on Saturday evening. Even so, the hospitality shown by all to us during our stay was deeply appreciated.

Next Year's Conference

The leadership has agreed to hold the conference in Chicago at the same hotel in 2009.

The TAPR/DCC banquet recognized some of those who contributed to the success of the event (left W9XA, right WB9QZB).

A strong factor in this decision was the use of the excellent A/V equipment this year, which Ron agreed to make available again next year. What helped make it possible to use the A/V equipment for the TAPR/DCC conference was that it had been used for the W9DXCC convention the prior week. In discussing the A/V availability with me, Ron commented that it made economic sense to keep everything in place for both events.

A New Way of Hosting Ham Radio Events?

Ron added that what would make even more economic sense in these times of belt-tightening was for ham radio organizations to plan back-to-back-to-back events. He suggested that next year the W9DXCC convention could be followed by a midweek event organized by an antique radio organization, which would then be followed by the weekend TAPR/DCC event. The benefits could be a possible hotel package for some who would want to take in all three events, plus some sort of discount price that could be negotiated for all three events. Also, having the same A/V equipment in place for the whole week would be much less costly than installing and then tearing down after each event. A final benefit would be the cross-pollination of the hams attending each others' events. Hams attending one event could learn about what other hams are doing and maybe get some new ideas for their own niches in the hobby.

Ron concluded his conversation with me by suggesting that I consider promoting his idea of multiple events being held consecutively during a particular week. Perhaps other organizers could follow Ron's suggestion in other parts of the country. For example, a QCWA chapter could piggy-back on a regional hamfest to draw hams to both events.

Growing Use of Technology

Certainly, the A/V equipment used by both the W9DXCC and TAPR/DCC organizations raised the bar for future events. Several of the attendees with whom I spoke at the TAPR/DCC said that they had never experienced such quality in A/V production. With the bar set so high, what could be next?

In a conversation I had with Kermit Carlson, W9XA, about that subject, he informed me that as the president of the Central States VHF Society, he hopes to be able to present online video streaming of the conference at next year's event, which will also be held at the Chicago Holiday Inn. By making the video streaming available, he plans to also offer online registration for the event so that hams who are not able to travel to Chicago will also be able to participate in the conference. He added that the online arrangements would include a talkback feature so that online participants would be able to ask questions of the presenters.

In making next year's CSVHFS conference available online, Kermit is borrowing from the growing interest in online and distance education. For a variety of reasons, people are not able to travel to central locations to take courses. The answer to this dilemma is the use of the evolving internet technology to make it possible for students to receive comparable education at their distant locations.

A collateral benefit for what Gary Pearce, KN4AQ, and Kermit are doing (Gary with his DVDs and Kermit with his online access) is the archiving of the presentations that were made at the events. By way of Gary's DVDs and the subsequent downloading of the videos from the CSVHFS conference, hams will have access to technical presentation in ways that never before have been available. Both local hams and hams in far-away DX locations will be able to gain knowledge and insight from the presentations made during what had previously been isolated conferences.

It could very well be that along with setting the bar for future A/V commitment to a conference, the TAPR/DCC conference may have also provided the germination point for the future of knowledge transfer and cross-pollination for the Amateur Radio Service.

Until the next issue... 73 de Joe, N6CL

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Long-Range Summer 6-Meter Paths Between The U.S. and Japan

The "Magic Band" is full of mysterious propagation modes. Here WB2AMU comments on the Short-path Summer Solstice Propagation (SSSP) theory put forth by JE1BMJ.

By Ken Neubeck,* WB2AMU

During this past summer there were a number of interesting occurrences on 6 meters, particularly in the area of long-distance contacts being made, not only with the East Coast of the U.S. into Europe, but also to Japan into various parts of the U.S. during the months of June and July! This latter path has been the topic of intense discussion by many 6-meter operators regarding what the actual propagation modes are that cause dthis to occur.

In my previous article entitled "Observing the Double-Hop Sporadic-*E* Phenomenon on 6 meters," which was published in the Summer 2008 issue of *CQ VHF*, I discussed the occurrence of double-hop sporadic-*E* during the summer months. Typically, the presence of certain multiple-hop sporadic-*E* paths has allowed for the eastern part of the U.S. to work into western Europe (e.g., Spain, Portugal, and the Azores). This path was observed regularly this past summer.

Also during this summer there were several days when high-power stations in Japan were able to work many stations in the U.S. running high and sometimes moderate power. A number of 6-meter aficionados have started using the phrase Short-path Summer Solstice Propagation (SSSP) to describe this path in lieu of the traditional multiple-hop Sporadic-E model. (For more information on SSSP, see the article by Han Higasa, JE1BMJ, elsewhere in this issue.) The introduction of this model has created a bit of controversy and a lot of thought-provoking ideas. However, because of the near-regular occurrences of the U.S. to Japan path on 50 MHz this summer, something besides the traditional multiple-hop sporadic-*E* model may be needed to explain what has been happening.

This article will examine both the SSSP model, the traditional multiple-hop model, and the feasibility of each. As this is a phenomenon that is relatively new, there has been a lot of speculation involving initial observations, and hopefully through careful study this subject can be addressed properly.

History of Japan to U.S. 50-MHz QSOs

Over the years there have been a number of contacts between Japan and the West Coast of the U.S. that have been recorded on 6 meters, both via the *F2* mode during the high solar activity years and via multiple sporadic-*E* hops during the summer months. However, contacts between Japan and non-West Coast parts of the U.S. during the summer have been happening more often on 6 meters because of increased activity on the band, particularly with the appearance of high-power Japanese 6-meter stations.

Some of the contacts made between the U.S. and Japan on 6 meters during the latter part of the last century were documented in a paper by Jon Jones, NØJK, entitled "Multi-hop 50 MHz Sporadic-*E* Transpacific Propagation" which was presented in the *Proceedings* of the 27th Conference of the Central States VHF Society (1993).

In his paper, Jon discusses a contact that was made by WBØ-DRL in Kansas with JR3HED during the June 1992 ARRL

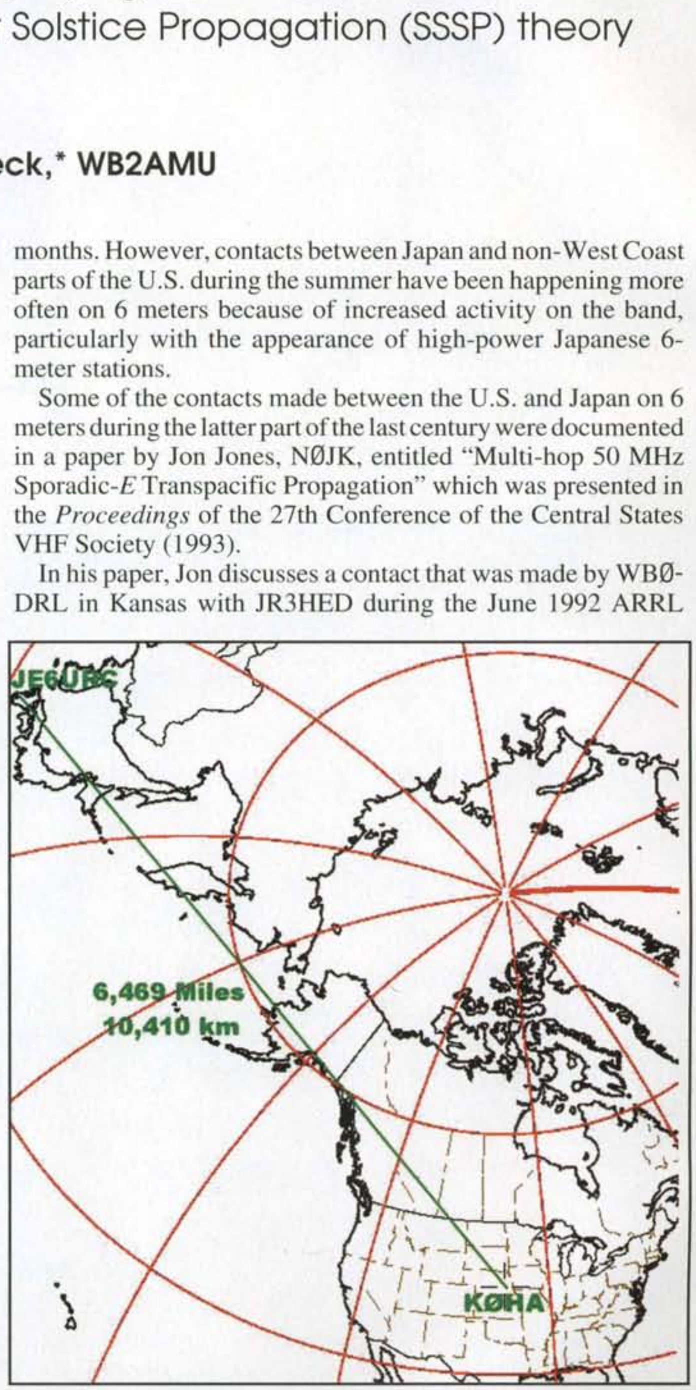

Figure 1. Plot of 50-MHz QSO between KØHA in Kansas and JE6URG in Japan. (Graph courtesy of Bill Hohnstein, KØHA.) The plot, constructed by Bill Hohnstein, KØHA, is of the 6-meter path between his QTH in Kansas and JA6URG, located in southern Japan, during the summer of 2008.

*CQ VHF Features Editor, 1 Valley Road, Patchogue, NY 11772
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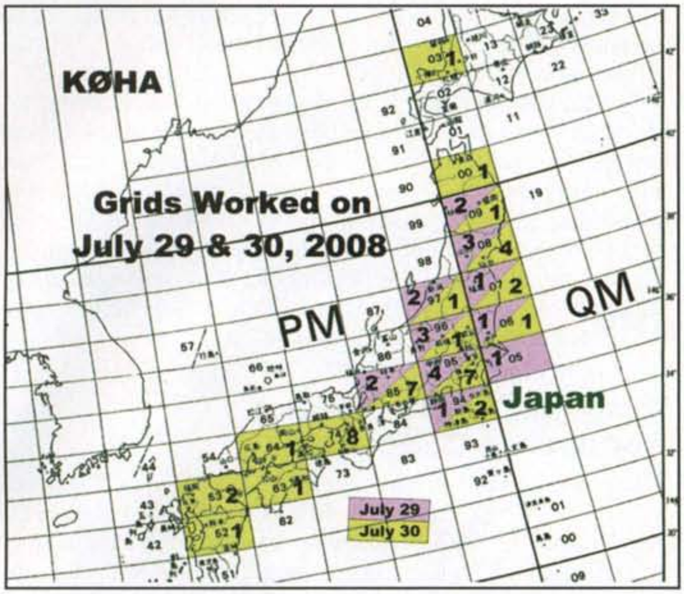


*Figure 2. Grids worked by KØHA on July 29 and July 30, 2008. (Graph courtesy of Bill Hohnstein, KØHA.) The figure shows a total of 17 different grids worked by KØHA over a two-day period. The timing of this opening would seem to fall out of the time frame of an SSSP-based propagation model and would seem to reflect a multiple-hop sporadic-*E *formation.*

VHF Contest at 0600 UTC on the Saturday of the contest. It took many calls and repeats for the contact to be completed. It was speculated that this was at least a five-hop sporadic-*E* event using a conventional model to explain this path. Jon also notes in his article that there were previous events that had been observed some years before 1993 during the summer months that involved other stations in the Midwest and Japan!

This path was experienced many times during the summer of 2008. One station that had excellent success is that of Bill Hohnstein, KØHA, with a typical 6-meter QSO taking the path that is shown in figure 1. Bill also worked many different grids in Japan during the two-day period of July 29th and 30th, as shown in figure 2.

The conditions for such a path to occur would require the station in Kansas or a surrounding area to point its directional antenna towards the northwest (roughly in the 300- to 320-degree direction from Kansas), while the Japanese station would point northeast (at 120 to 130 degrees). Signals for this path would generally be weak. Therefore, multi-element arrays of five or more elements seem to be the rule and usually with significant levels of power. It would seem that a different path was observed between California and Japan, as there would be a more pronounced polar crossing involved based on the direction of the antennas.

Multiple-Hop Sporadic-*E* Model

One point concerning the feasibility of a five-hop sporadic-*E* event occurring on 6 meters centers on the statistical probability of such an event. Figure 3 shows what this basic multiple-hop sporadic-*E* model for a contact between Kansas and Japan would look like. It is noted that two- and three-hop events are occasionally observed on 6 meters during the peak of the sporadic-*E* season, which usually occurs during June and July for many stations in the U.S. These peak months often favor directions such as the East Coast U.S. and parts of Europe.

However, while two- or three-hop propagation occasionally is observed, rarely have four-hop or five-hop events. Thus, it is safe to say that those events are rare, especially on a daily basis between the East Coast into areas past western Europe, such as eastern Europe and the Middle East.

Examining the geometry involved for stations in Florida to work into Japan by multiple-hop sporadic-*E* on 6 meters sug-

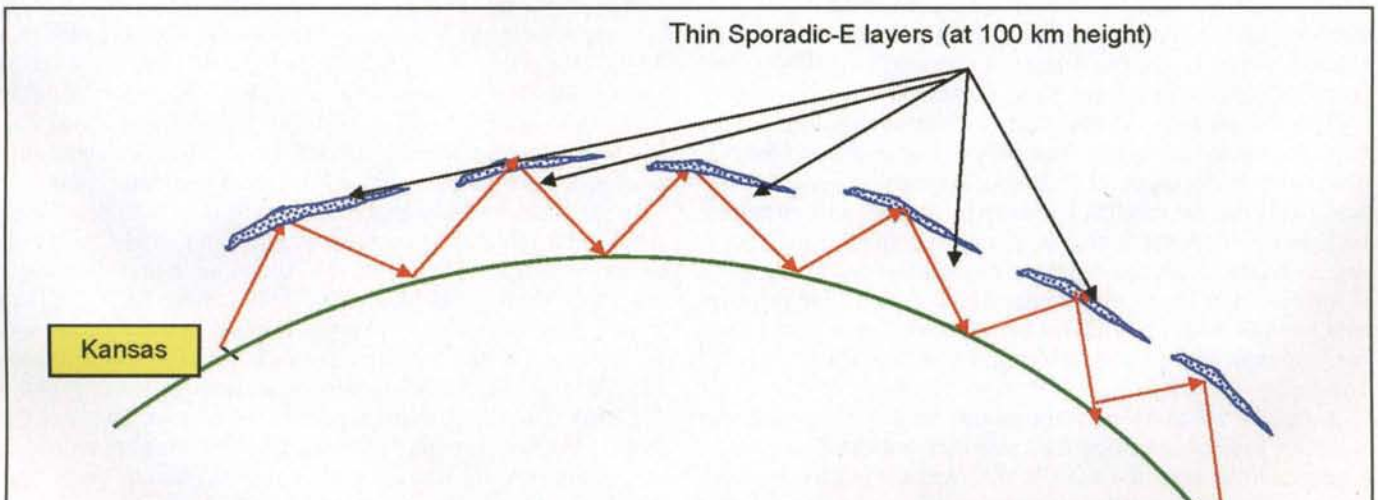


*Figure 3. Multiple-hop sporadic-*E *model for a 50-MHz QSO between Kansas and Japan.*

gests a minimum of six sporadic-*E* formations be involved using a conventional model as shown in figure 3. However, based on many years of observations, it seems odd that there would be several days of multiple-hop sporadic-*E* on the same path and not anywhere else. For example, it is hard to find multiple-hop sporadic-*E* events of long distance between the U.S. and other faraway locations in the Northern Hemisphere during the summer months, let alone observe them for a few days in a row! Thus, it would appear on the surface that there is something unique about the 50-MHz path between the U.S. and Japan that does not seem to be replicated anywhere else.

There are some favorable factors involved in the possibility of a consistent multi-hop sporadic-*E* path between Japan and the U.S. Measured as early as the International Geophysical Year (IGY) 1957–1958, Japan and the surrounding areas in Asia have been observed to have the highest incidence of sporadic-*E* of any location on the planet during the summer. Therefore, it is reasonable to conclude that multi-hop sporadic-*E* between Japan and other areas such as the U.S. has a realistic chance of occurring, in part because of the high amount of sporadic-*E* activity in the vicinity of Japan.

Now fast forward to the year 2008. This summer there were a significant number of observations on 6 meters between Japan and the U.S., particularly during the days before, on, and after the Summer Solstice. These events usually occurred around the same time period of 0000 to 0200 UTC, where it is the early evening hours in the eastern U.S. and early morning in Japan. One example is provided by the log of Dick Peacock, W2GFF, which shows a number of QSOs during this time between his station in southern Alabama and Japan. Using CW, he worked JE1BMJ on July 9, JHØRNN and JA7QVI on July 10, and JE1BMJ again on July 12. RST signal reports on his end ranged from 539 to 579. It seems truly amazing that this path occurred for three days in a four-day period in early July!

Incidentally, Bob Mobile, K1SIX, has collected several JA to U.S. observations from different stations during 2008 into one database at this internet location: <http://k1six.com/SSSP%20EVENTS%202008.pdf>. In reviewing his data, one can see a period of eight days in June and July when Japan was either heard or worked by stations located in the Midwest and southern U.S. (in particular, Florida, Alabama. and Texas).

With these many days of occurrences between stations in the U.S. and Japan during this time period, and based on observations in other directions, there is speculation that it seems highly unlikely that the mechanism was purely sporadic-*E* in nature, particularly since the path was going over the northern polar region. Indeed, past observations involving auroral-*E*, or Au*Es*, show that those long-range contacts can occur during the summer months, and it would not be impossible that this type of phenomenon could be involved in the path between the U.S. and Japan.

It appears that there are some unique long-distance paths on 6 meters that are repeated each summer season. The transatlantic path between the eastern U.S. and the coastal areas of western Europe generally can show up as a regular double-hop sporadic-*E* path that takes place between May and August, as discussed in my above-mentioned article in the Summer 2008 issue of *CQ VHF*.

This year I observed approximately ten such openings between May and August, with the grand finale for this path occurring on August 1, when I was able to work six different countries in the same general area of southern Europe and northern Africa on 6 meters CW during the early evening hours: the Azores, Spain, Portugal, Madeira Island, Balearic Islands, and Morocco.

Double-hop sporadic-*E* paths can occur longer than two hours. However, it would seem that triple-hop and quadruple-hop openings generally would be of shorter duration. Therefore, imagine the idea of a five-hop or six-hop sporadic-*E* path being the primary model as shown in figure 3 between the U.S. and Japan lasting for an hour or more! Could there be a geophysical phenomenon that is unique for the days surrounding the Summer Solstice that could bepart of the reason for this path. If so, what phenomenon could this be?

Short-Path Summer Solstice Propagation (SSSP) Model

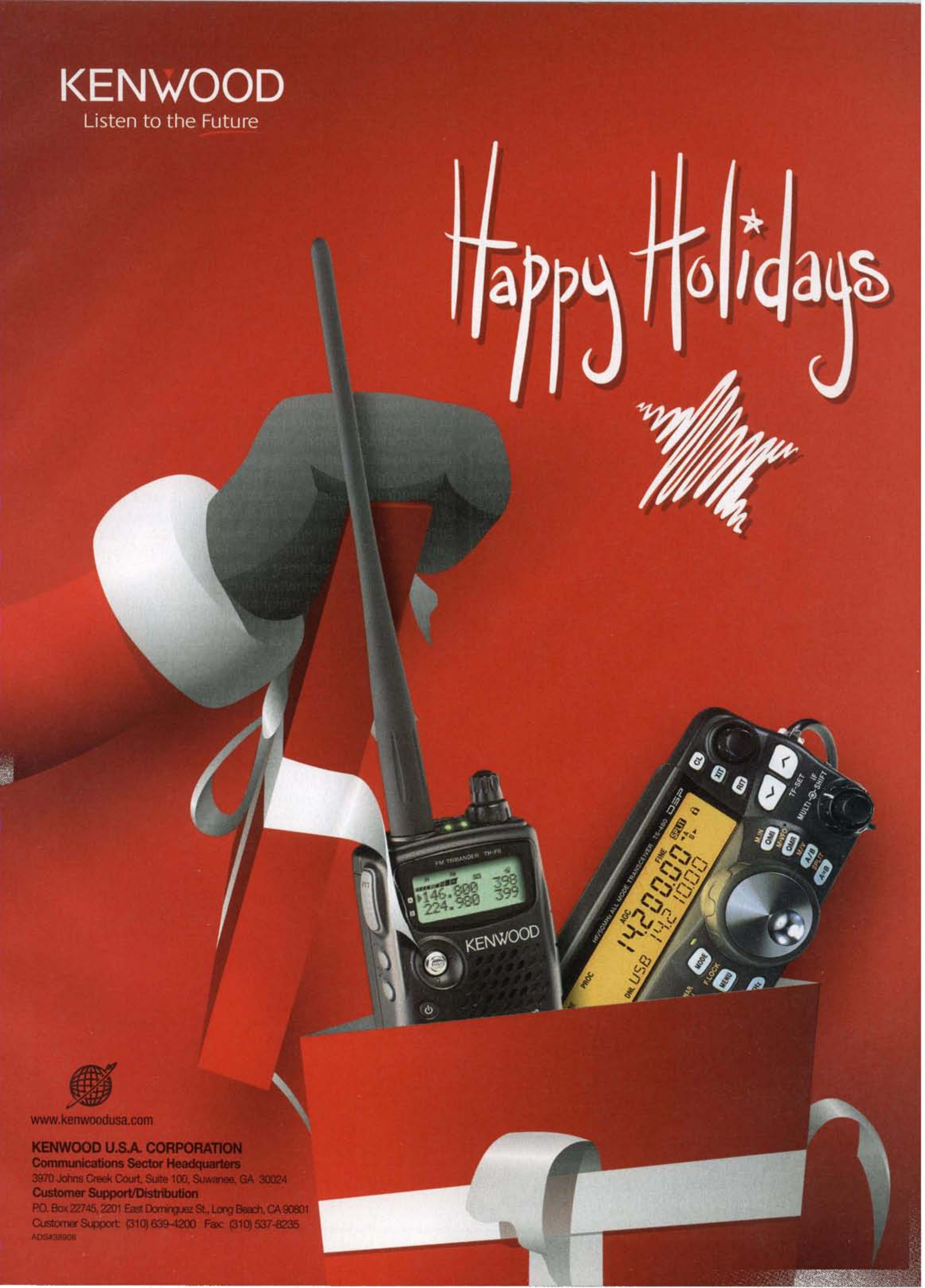
This unique path has had its share of observations. The paper "SSSP: Short-path Summer Solstice Propagation," written by Han Higasa, JE1BMJ, which was published in the September 2006 issue of the Japanese magazine *CQ Ham Radio,* and subsequently translated by Chris Gare, G3WOS, looks at another model besides the multi-hop sporadic-*E* model. This paper, which appears elsewhere in this issue of *CQ VHF* magazine, discusses the traditional multiple-hop sporadic-*E* model and then proposes a model that states that the 6-meter signal comes off at an appropriate takeoff angle into the ionosphere and never touches down in between. Typically, the stations from Japan who are worked via SSSP are running high power at 1 KW, and the signals are usually very weak, like EME signals.

This mode has been called the *whispering mode* in the past. Han suggests that the phenomenon Polar Mesosphere Summer Echo (PMSE)[1], which is characterized as a strong radar echo phenomenon that occurs in the polar regions at 80 to 90 km above the ground, may be involved. PMSE has been observed between 150 and 210 days a year between the end of May and the end of July, which matches the time frame for the Japan to North America events on 6 meters.

Han also states that the reason why this path seems to only happen on 6 meters is because: "The PMSE region refracts our 50-MHz signals especially efficiently, and I believe this to be one of the main reasons why SSSP has been reported on 50 MHz and not on 28 or 144 MHz for many years." Also Han states that it is hard to make definitive conclusions without supporting scientific observations by rockets and other means.

It has been observed that the Japan to U.S. path is not confined to only high-power stations. Jon Jones, NØJK, was able to complete a QSO with JA7QVI using his indoor 2-element Yagi and 100 watts in June 2006. He noted that JA7QVI had a solid signal that was easy to copy, in contrast to SSSP whisper weak signals noted by other stations. He also noted that on August 1, 2008, K7BG in Montana used 50 watts to work JL8GFB. Therefore, there appear to be two variations to the path, one where signals are strong (multiple-hop sporadic-*E*?) and one where signals are very week and require very high power (SSSP?).

The key component of the SSSP model is the fact that the signals would never touch the ground in between the stations, behaving in similar fashion to a chordal-hop *F2* skip that is observed during 6-meter long-path propagation. Thus, a purely SSSP-based model without any sporadic-*E* hops would be something like that depicted in figure 4. However, through examination of existing scientific literature such as the paper "Polar mesosphere



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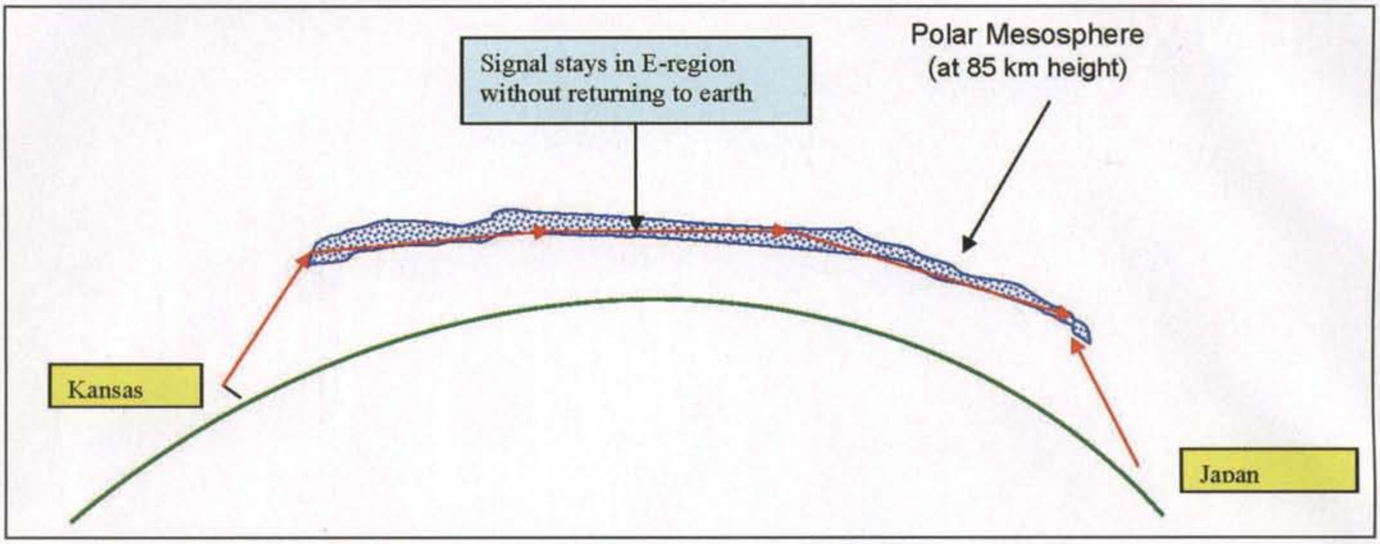

Figure 4. Theoretical SSSP model for a 50-MHz QSO between Kansas and Japan and no combinations.

summer echoes (PMSE): review of observations and current understanding" by Rapp and Lubken (Atmospheric Chemistry and Physics, 4, 2601– 2633, 2004) one sees a number of observations that would make the model that is depicted in figure 4 highly unlikely.

For one thing, this paper notes that the lowest latitude (farthest south) PMSE has been observed is at 52 to 55 degrees N and as far north as 75 to 78 degrees N. Strong electron density of 5000 charged particles per cubic centimeter has been observed in the PMSE at 85 to 90 km above Earth. This is a slightly lower height than sporadic-*E* formations, which fall in the 90- to 105-km range. Thus, based on the height of this PMSE formation and the actual coverage of the formation, it seems highly unlikely that the formation alone is capable of sustaining signals in a chordal-hop fashion for such a long distance from the middle of the U.S. into Japan. In fact, based on the geometry, a PMSE formation may only cover the distance covered by two sporadic-*E* hops. Therefore, I believe that a more likely explanation that embraces both models is a combination of both sporadic-*E* propagation and a PMSE-based propagation mode. However, more data from the scientific side would be needed in order to support this theory.

It appears that stations located in southern Florida, southern Alabama, or southern Texas would have to be linked towards the northern U.S. via a sporadic-*E* link based on the fact that often the southern US stations can hear stations in the Michigan and Minnesota areas during the path into Japan. This would suggest at least one sporadic-*E* link based on the distance between the southern and northern U.S. Most likely, there would have to be a second sporadic-*E* path as well that goes from the northern sta-

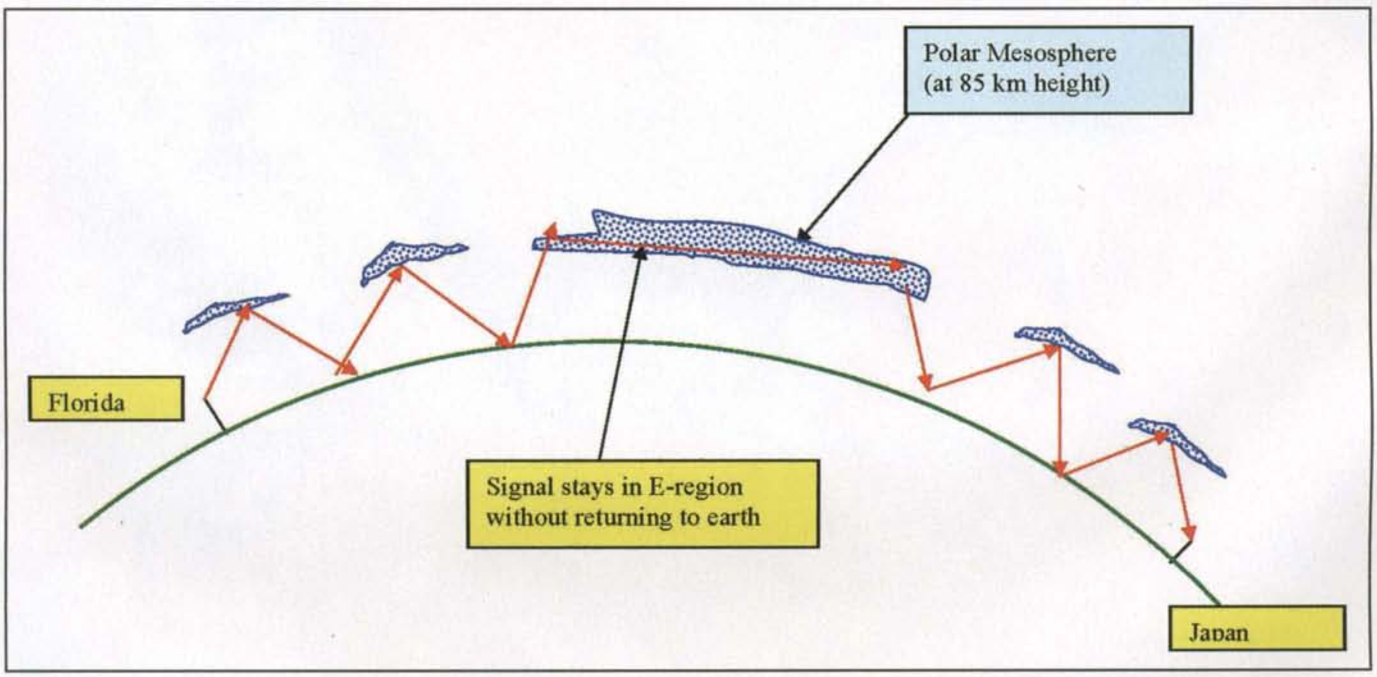

*Figure 5. Combined SSSP and sporadic-*E *model for a 50-MHz QSO between Florida and Japan.*

tions into the lower part of the Arctic region. Also with Japan having the highest incidence of sporadic-*E* in the world, there is most likely at least one, and perhaps two, sporadic-*E* formation that links the Japanese stations into the lower Arctic region from their end as well. Thus, a possible combination model using PMSE would look like figure 5, where there are sporadic-*E* formations that link into the PMSE formation, followed by additional sporadic-*E* formations.

Could there be a similar PMSE-type situation for the southern polar area on 50 MHz? The answer is possibly yes, but because of the small number of stations that are located in the southern latitudes—primarily Australia, Argentina, and South Africa—such a path would inherently be harder to detect. Also, it must be considered that the incidence of sporadic-*E* is not at the same level in this area of the world as it is in the area of Japan. Therefore, this reduced level of sporadic-*E* may be a factor as to whether such a path could appear in the Southern Hemisphere. (It is noted that the area of South Africa has the lowest incidence of sporadic-*E* during the year of anyplace in the world.)

Therefore, it now appears that the summer months' Japan to U.S. path is a unique path on 6 meters that does not seem to have any counterpart path in the Southern Hemisphere. The Northern Hemisphere path benefits from the large number of Japanese and North American operators on 6 meters, with many of them having excellent antenna setups and high-power capability.

In addition, besides this large number of hams on 6 meters, the active use of spotting sites on the internet has been a major factor in collecting data. One such site is run by ON4KST: <http://www.on4kst.info>. It saw a lot of international activity at key times during the day when Japanese stations were able to announce their operating frequency for U.S. stations to listen for them.

Now,what about events that occur outside the PMSE phenomenon window of the solstice period—i.e., openings that occur during the month of May or during the latter part of July? This may suggest that the multi-hop sporadic-*E* model would probably be more applicable and valid than the SSSP model. Indeed, this would leave us with two basic models, both of which are valid, with stipulations, as follows:

1. Multiple-hop sporadic-*E*—during May, June and July.

2. Sporadic-*E* hops plus PMSE—during Summer Solstice, around 0000 UTC.

Summary

There is still not enough information at this time to make any kind of conclusive statement regarding the probable propagation modes involved in a path between Japan and parts of the U.S. during the summertime sporadic-*E* season on 6 meters. There is no doubt that sporadic-*E* activity is at least a part of this path, regardless of which model is used.

The increase in observations has highlighted some characteristics of such a path, and observations of other long-range paths have provided some additional information with regard to the likelihood of several sporadic-*E* hops occurring at the same time for an extended period.

It would be great if there were ongoing scientific programs that could collect relevant data that would help determine what the geophysical phenomenon is that is involved in these unique 6-meter contacts. However, the sad truth is that there are currently a limited number of these programs and thoughtful speculation is all that can be done at this point. Eventually, science may catch up with ham radio observations, just as happened in the 1930s when the sporadic-*E* phenomenon and the aurora phenomenon both were discovered as a radio propagation mode on the amateur radio 5-meter band by U.S. hams.

Therefore, it is important that hams be encouraged to continue to collect such observations to make temporary models until the opportunity to improve upon these models can occur. The observations presented in this article are only a starting point, and more will be needed in order to better characterize the phenomena involved in this unique path. This will be a challenging area for 6-meter operators in the future!

Note

1. For further reading on PMSEs see: "Observation of polar mesosphere summer echoes with calibrated VHF radars at 69 degrees in the Northern and Southern Hemispheres," by R. Latteck, W. Singer, R. J. Morris, D. A. Holdsworth, and D. J. Murphy, *Geophysical Research letters,* Vol. 34, L14805, 2007.

Acknowledgements

I want to thank Jon Jones, NØJK; Bob Mobile, K1SIX; Dick Peacock, W2GFF; and Bill Holstein, KØHA for the data they collected and was used in this article. ■

SSSP: Short-path Summer Solstice Propagation

Two years ago, JE1BMJ developed a theory to explain long-distance propagation on 6 meters. While his theory has become somewhat dated and even he is re-examining parts of it, it is still considered a viable theory to at least partially explain the long-distance propagation. It is presented here as a means of comparision with WB2AMU's article, which begins on page 6.

By Han Higasa,* JE1BMJ

For many years DXers on 50 MHz have been surprised by the unexpected and excellent short-path propagation from Japan to Europe and North America. In 2006, short-path QSOs from W to EU and KL7 to EU were also reported. This propagation, which occurs around the Summer Solstice of June 21st, has generally been described as "multi-hop sporadic-*E*" and has been reported from the 1970s onward. I would like to ask: "Who undertook the surveys or deep studies on this type of propagation?" and "Why has it been assumed to be multi-hop sporadic-*E*?"

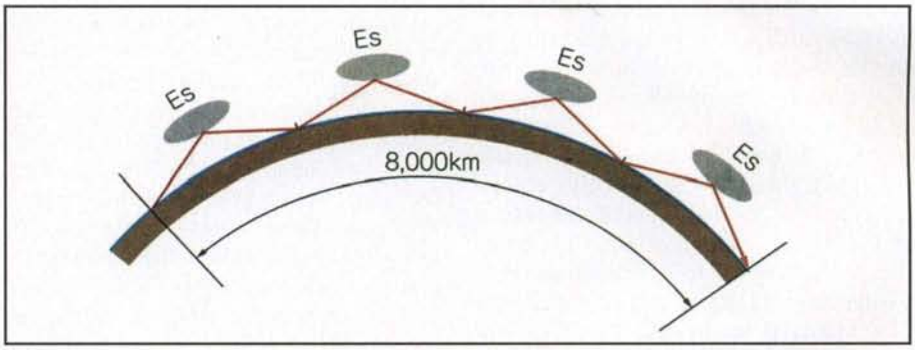

Figure 1. A model of "Multi-hop Es.*" We need to ask ourselves whether this is really correct.*

SSSP, or S3P, is an acronym for Short-path Summer Solstice Propagation, a name that Chris, G3WOS, and I have called this type of propagation and that I believe *not* to be based on multiple hops. SSSP has been discovered in the Northern Hemisphere, but symmetrically there should also be similar propagation at the December Solstice in the Southern Hemisphere. Because the December Solstice is called the Winter Solstice in the Northern Hemisphere, one might want to call it SWSP (Short-path Winter Solstice Propagation), but in this article I will refer to both SSSP and SWSP simply as SSSP to avoid any confusion.

Here I define SSSP as the short-path propagation around the June Solstice in the Northern Hemisphere and the similar propagation around the December Solstice in the Southern Hemisphere.

In June 1999, I first found SSSP through a 50-MHz CW QSO with Toivo, OH7PI, and up to the year 2006 I continued running propagation tests called "The Six Metre Propagation Test Campaign around the Summer Solstice." Although the amount of collected data is small and the exact mechanism is yet unknown, here I will introduce and hypothesize about the cause and nature of this type of propagation.

Why Has It Been Called "Multi-hop Sporadic-E"?

Figure 1 shows the usual model of multi-hop sporadic-*E*. In this model 50-MHz signals are refracted by *E*-layer clouds and reflected or bounced from the surface of the Earth several times between the transmitter and receiver—often described as one-hop or two-hop sporadic-*E*. However, I believe that assuming this mode of propagation stretches credibility when talking about summer short-path propagation between Japan and Europe.

Assuming the height of the *E*-cloud to be about 90 to 100 km, the maximum one-hop distance will be around 2,000 km. The distance of JA–EU propagation is between 10,000 and 12,000 km. Thus, the number of hops via classic multi-hop sporadic-*E* needs to be five, six, or even more. With JA–NA paths, we have a large area of sea on the path, but on the JA–EU path there is only the Eurasian continent and no water. Thus, the 50-MHz signal will be scattered and/or absorbed by the inefficient ground surface.

The short-path JA–EU QSOs seen this year are strong at the peak and the tone of CW signal is pure with little or no distortion—i.e., they do not appear to have been dispersed or scattered from, as would be expected, a signal that has been exposed to multiple reflections from the Earth's uneven ground. Such distortion can easily be observed on EME signals. Because of this issue, I am confident that the multi-hop sporadic-*E* model is not adequate to explain the propagation we have experienced this summer and for which I have adopted the term SSSP.

The Discovery of SSSP

In the spring of 1999 I acquired a special station license of 1 KW output for 1.8 MHz to 50 MHz. As in many countries, in Japan we need an explanatory document for the application of a 1-KW out-

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This article was originally published in the September 2006 issue of the Japanese magazine CQ Ham Radio. *English translation was assisted by Chris Gare, G3WOS. Reprinted here with permission from JE1BMJ.*

put license for 50 MHz. In my application I wrote that I wanted to study FAI (Field-Aligned Irregularities) in the *E*-region, as this was a newly found and currently unexplained phenomenon on the amateur bands. After the initial inspection of the KW station resulted in approval, I was praised by the inspection officer for the document explaining my requirement for high power on 50 MHz.

After a just a few months, on the evening of June 23, 1999, I found that the 48.25-MHz TV carrier from Europe was strong and I called CQ on 50.105 MHz. Almost immediately Toivo, OH7PI, called me. The QSO was the first QSO between JA and OH in Cycle 23. Toivo's CW signal was a pure tone with slow QSB of around 10–30 seconds. From that day, I called CQ every day on 50 MHz, and many stations in a wide variety of European countries (including SM, OH, G, GD, DL, SP, OZ, YO, F, PA) gave me received reports of my signal via the internet.

Furthermore, on July 10, a very strong opening started between JA and SM7FJE and around 35 JAs were lucky enough to have made QSOs to Europe. In addition, I completed a QSO with YO4AUL. This QSO has been recognized as the first YO–JA 50-MHz QSO following YO stations obtaining permission to operate on 50 MHz.

From 1999 to 2006 I have been running "The Six Metre Propagation Test Campaign" around the Summer Solstice and have called CQ on 50 MHz for many days every single season. I have often posted messages to the UKSMG announcement page regarding the campaign and discussed the nature of this propagation

However, reception of my views was not always particularly good. Almost all the contributors over the years thought that the widely accepted mechanism of multi-hop sporadic-*E* was the simplest explanation. Nevertheless, now I am happy to report that many other 50 MHz operators are open to the idea that this propagation is actually caused by a different mechanism, one that I have called SSSP.

A turning point was the unprecedented and totally unpredicted almost daily occurrence of strong JA–EU propagation during the summer of 2006 extending as far as the UK on several days. Table 1 shows a summary of JA–NA and JA–EU SSSP openings from 1990 to 2006. It is clear that the same kind of propagation occurs almost every year and is seemingly not influenced by solar activity; the peak of Cycle 22 was 1989 –1991 and the peak of Cycle 23 was 1999–2001. The year 2006 was the bottom of Cycle 23's solar activity. Please note "none" in Table 1 means no data was obtained. There is a possibility that propagation occurred. However, if it did it was not noted.

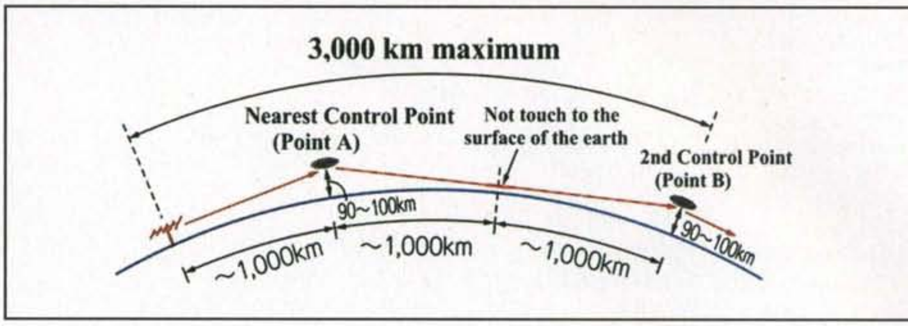

Figure 2. A model of the nearest control point of SSSP.

Characteristics of SSSP Propagation

The following is a summary of the characteristics of SSSP propagation obtained through my activity and tests:

1. Band: 50 MHz.

2. Period of occurrence: End of May through end of July every year (Northern Hemisphere) and around the December Solstice (Southern Hemisphere, extrapolated).

3. Time of propagation: JA–NA, 2100–0200 UTC, morning in JA, evening/night in USA; 0400–0900 UTC afternoon in JA, night/morning in USA; JA–EU, 0400–1000 UTC, afternoon in JA, morning in Europe.

4. Antenna direction: On or near short-path azimuth.

5. Paths: Mainly JA–NA, JA–EU. However, West Coast W–EU and KL7–EU have also been reported. Almost all paths are in the daylight area of the Earth and all are in the same hemisphere. (Note: To date, SSSP has been seen in the Northern Hemisphere only, but there is a possibility in the Southern Hemisphere.)

6. On JA–EU opening: 5Bs have frequently been reported (4X and ZC also but less frequcntly).

7. Length of openings: Open areas are "spotty" on both sides and move on a day-by-day basis.

8. Signal strength: Generally signals are weak with slow 10–30-second QSB and without any flutter. This is one of the features of the propagation that provides evidence that the signal path of SSSP never touches the surface of the Earth. More on this later.

9. Power: A high transmitter ERP is needed. Stations with 100 or 200 watts and a single Yagi are possible, but the crest time or usable time is short.

Possible Mechanism for SSSP Propagation

I will attempt to explain the core mechanism behind SSSP. Many of you know that I am just one of the many radio amateurs around the world who operate on 50 MHz and I myself have no way of directly measuring electron density in situ or by rocket-based observation. Even so, I am confident that SSSP has a different propagation mechanism from that assumed for multi-hop sporadic-*E*, the usual model accepted for this type of propagation.

Figure 2 shows the first control point (Point A) at which the 50-MHz signal is bent. I assume that point A could be located in either the *E*-layer or the higher *F1*-layer. If it lies in the *E*-layer, the height of Point A is around 90–100 km with a maximum one-hop distance of about 2,000 km. If the control point lies in the *F1*-layer, the height would be around 200 km and the maximum hop distance would be 3,000 km.

Please note that in the SSSP model the path never actually touches the ground. When it is assumed that Point A lies in the *E*-layer, the second control point (Point B) is a maximum of 3,000 km away from a station. If Point A is assumed to be located in the *F1*-layer, Point B is a maximum of 4,500 km away.

It is often said [Ref. 1] that the *F1*-layer is likely to occur in the daylight time of a summer season and constantly has an MUF of 4 to 5 MHz which is nearly independent of solar activity. When assuming *F1*-layer as the first control point of a 50-MHz signal, the incident angle should be less than five degrees by the secant law.

In the actual SSSP openings I have experienced, I have had to set my stacked Yagis

1990: June KL7
1991: May KL7
1992: June W6, W7; July YU, OK, OH, OE, DL
1993: none
1994: none
1995: July W6, W7, VE7
1996: July KL7
1997: none
1998: May W6; July W5, W6, W7
1999: June OH, SM, YO, W; July W5, W7
2000: June W5, W6, W7, W8, W9, WØ, KL7; July W5, W6, W7, W9, WØ, VE
2001: June W6, W7, KL7, SP, S5, 9A, OK, OZ, PA, HB9, OE, OH, DL, 5B, JY; July W6, W7, KL7
2002: June W6
2003: June W6, W7, VE, 5B; July W5, W6, W7, UXØ, Z3, 9H, LZ, 9A, SP, YU
2004: June I, SP, OH, ES, 9H, UT, 5B, W6
2005: June W7, 9H, G, SV8, LY, OH, YU, YO, I, 5B; July W6, W7, KL7, I, 5B
2006: May, June, July, many W and EU!

Table 1. SSSP openings from JA to NA and EU, 1990–2006

to an elevation angle of around 15 degrees compared to normal *F2* propagation when it is usually set to near zero degrees. Therefore, it is likely that Point A is nearer than the model shown in figure 2.

At the present time I believe that the *E*-layer is a more likely contender for the first control point at both the JA and EU ends of the path. I assume that the 50-MHz signal in Japan is bent at the first control point (Point A) above the Japan Sea and reaches the second control point (Point B) at around 55 degrees N, which is located near the Lake Baikal in eastern Siberia. From Point B the 50-MHz signal is carried by the region of "Polar Mesosphere Summer Echo" (PMSE). PMSE is a strong radar echo phenomenon obtained by radar observations at both north and south polar regions at around 80–90 km above the ground.

It is reported [Ref 2] that PMSE has been observed between 150 to 210 days of the year. PMSE also exactly matches the time period when we see SSSP propagation, between the end of May and the end of July. It is also reported that PMSE occurs at 52–78 degrees N in the Northern Hemisphere and has a Bragg Scale of three meters.

In regard to the explanation of PMSE and the Bragg Scale, I would recommend that you search the internet for further information, as there are many papers and articles on this subject. The paper entitled "Polar Mesosphere Summer Echo (PMSE): review of observations and current understanding" by M. Rapp and E. J. Lubken, 2004, can be obtained directly from <http://www.copernicus.org/EGU/acp/acp/4/2601/acp-4-2601.pdf> [Ref 2]. I believe this is the best paper for radio amateurs.

In this article I simply mention that the Bragg Scale of three meters can be translated to the frequency of 50 MHz. The PMSE region refracts our 50-MHz signals especially efficiently, and I believe this to be one of the main reasons why SSSP has been reported on 50 MHz and not on 28 or 144 MHz for many years.

The average height of the PMSE region is 88 km above the ground, which is by coincidence very near to the height of the *E*-layer. The PMSE region consists of suspended ice particles that are caused by the very low temperature of around 150°K at that height. Multiple studies regarding the polar mesosphere have reported that such a low temperatures are a result of the greenhouse warming effect that we are familiar with these days.

I would now like to attempt to explain the complete mechanism of SSSP (see figure 3). The *E*- (or *F1*-) layer provides the nearest control point for the stations at both ends of the link and the PMSE region connects the two control points over the polar region. The 50-MHz signal will be bent at the nearest control point and will propagate through the PMSE region covering the Arctic pole without ever touching the surface of the Earth. I believe this to be the core proposed mechanism of SSSP and provides a good explanation for the lack of distortion and the strength of signals I have observed in my study.

If SSSP does use the PMSE region as a type of chordal propagation, we can say that SSSP is a completely new type of propagation caused directly by the effect of greenhouse warming due to the activities of humans. For all of us, SSSP is a newly discovered propagation on our amateur bands. If so, that's really exciting!

We can monitor the electron density of the auroral oval in the Arctic polar area on a nearly real-time basis by looking at <http://www.sec.noaa.gov/pmap/pmapN.html>. On this page we can imagine how 50-MHz signals could propagate over the polar region.

Figure 4 shows the image of the auroral oval of the Arctic pole at 0600 UTC on July 19, 2006. This was one of the excellent days when I made many QSOs with European stations via SSSP. The map shows how a high electron density area covers the JA–EU path.

In the Southern Hemisphere, SSSP should also occur around the December Solstice. Operators on 50 MHz in ZS, VK, ZL PY, LU, CE, and other areas in the Southern Hemisphere are requested to look for this "*au natural*" gift as Christmas comes near!

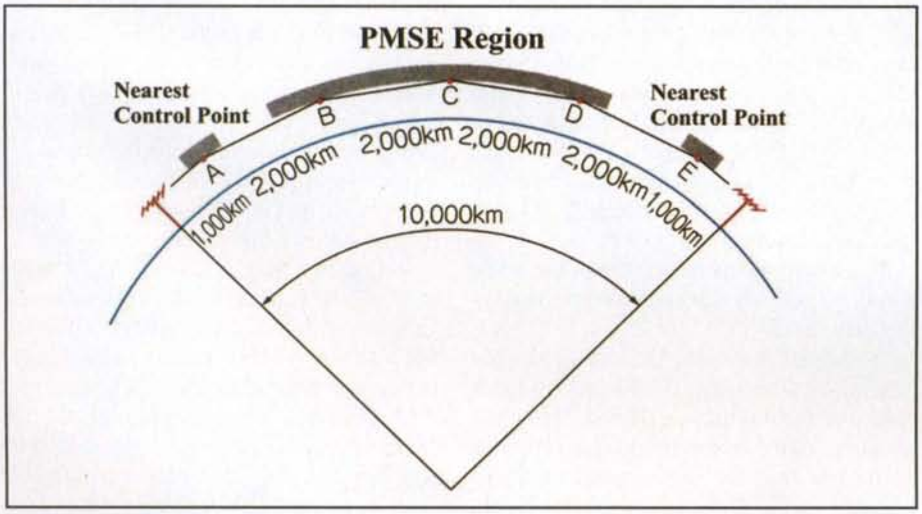

Figure 3. A model of end-to-end SSSP.

Author Sidebar

While this article was written in 2006, I would like to point out that my opinions concerning my findings remain flexible. For example, I worked about 450 QSOs with North American stations—including KL7s, XEs, and HI3TEJ—in this 2008 season, and have reached the conclusion that we might need some other propagation model to explain the SSSP.

This model is much affected by geomagnetic activity; when the *K*-index is high, the auroral oval around the north pole turns to red (ref: POES-N graph page, meaning higher electron density) and the SSSP likely disturbed; when the color of the auroral oval is yellow to orange and has a thick area in the direction of the sun and the part comes to the midpoint of the two stations, the propagation will likely occur.

In this SSSP article I mentioned a connection to the PMSE and that the propagation will last until around the end of July. However, we experienced the opening toward EU and NA until the middle of August.

At least we can say that the path does not touch the Earth—meaning that it is a chordal hop—and as the path run through or near the auroral oval, it may be much affected by auroral activities.

Although the content of this original SSSP article is older than current knowledge, I think it is worth reading and considering as an introduction to the mystery of the natural phenomena, as well as what we need to address in the future.

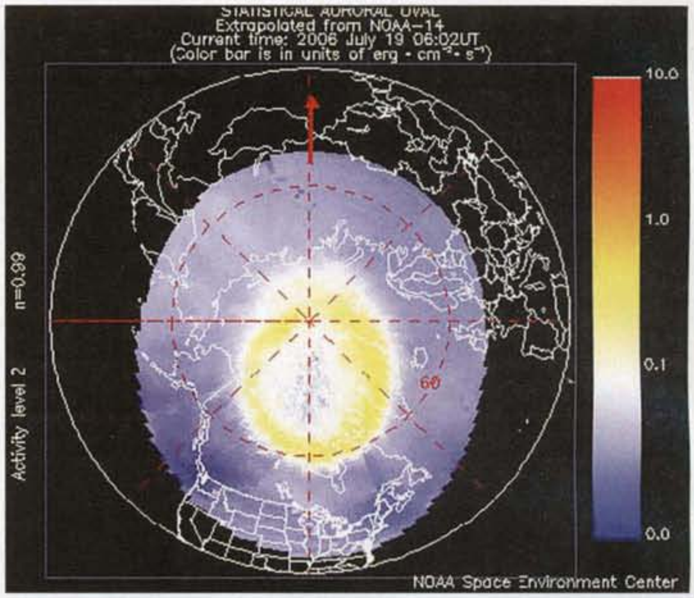

Figure 4. Map showing the electron density in the auroral oval at 0600 UTC on July 19, 2006.

One other point I need to mention in regard to SSSP is concerned with the elevation angle of my antenna. Figure 5 shows my current antenna system with 10 degrees of elevation angle. I am using two 10.7-meter boom, 8-element Yagis with an elevation mechanism. The stacking distance is 7.7 meters and the average height is 30 meters AGL.

I am using 35 meters of RG17A/U coax cable. The Yagis are based on the CL6DXZ from the Create Design company, optimized using the YO and AO software by K6STI. This horizontally polarized, vertically stacked pair of Yagis exhibits very high SNR (signal to noise ratio) on 50 MHz compared to a single Yagi configuration because of the sharp and clean radiation pattern in the vertical plane.

Additionally I am using a TS-940 and FT-1000MP with a homebrew transverter and a 1-KW output linear amplifier. The receiving converter consists of a 2SK571 VHF FET and a double balanced mixer. This converter exhibits a low noise figure and high gain, which is good enough for my DXing activities. My S-meter always reads S1 to S2 because of the high gain of the converter and because of artificial noise from the residential area surrounding my shack. However, I need high sensitivity, especially on 50 MHz.

The high dynamic range and noise blanker of the legendary HF band flagship transceivers address these challenging operating conditions. In the Japanese market these old transceivers can be obtained at affordable prices, and they are very well suited for combining with 50-MHz transverters.

To buy one of these inexpensive transceivers second hand and use a tall tower with large or stacked antennas and low-loss large diameter coax for 50 MHz is the best way. Through understanding and realizing the law and the rules (yes, Zen and the Art!), building an excellent system is not difficult today.

When I increase the elevation angle of my Yagis (for instance from 0 to 10 degrees), the level of incoming noise decreases substantially, by up to 6–10 dB. This is because of the elimination of nearby noise interference received on the underside of the main lobe. When further increasing the elevation angle, I frequently observe that the DX signal can be heard clearly, whereas the level of interference rapidly decreases. As a result, the SNR of DX signals is much improved and this is very helpful when copying weak signals buried in the buzz when using SSSP.

In this year's sporadic-*E* season, from the end of May to the end of July 2006, I made some 180 QSOs with EU stations, including HVØ, and 80 QSOs with NA stations, including W, VE, and KL7. For almost all of these SSSP QSOs I found that the optimal elevation angle was in the range of 10–15 degrees, although this maybe a particular result of my own location, system, and the antenna. As the exact propagation characteristics of SSSP propagation are still unknown, the general access angle of elevation is also unknown. I heard stations using a single Yagi without elevation and they were making SSSP QSOs quite easily. They had a broad main lobe and could attain literally a wide range of propagation.

Stations with stacked Yagis should have a high SNR and a low elevation angle, but without an elevation mechanism they will ultimately suffer poorer SNR because of the weak DX signal from higher elevation angle and the loud TV buzz being simultaneously received. I recommend a single long-boom (1.5–2.5 WL) Yagi with or without an elevation rotator, or vertically stacked Yagis with an elevation rotator for SSSP. Although a single Yagi has a broad main lobe and can easily adapt to any of the types of propagation encountered on 50 MHz, the elevation mechanism will also make sense in improving the SNR of weak DX signals.

The Great Days of SSSP

Figure 6 shows the GoogleEarth propagation map (http://www.dxers.info/ google/earth/index.php) that Chris, G3WOS, downloaded on June 14, 2006. The paths—including JA–EU, JA–5B, and JA–5T are indicated on it.

On that day I had QSOs with G4IGO, G3WOS, G4FVP, SV1LK, SV1SB, 9A6R, G4RGK, and some Italian stations. Amazingly, Nicolas, 5T5SN, gave me a report from Africa, about 13,500 km away!

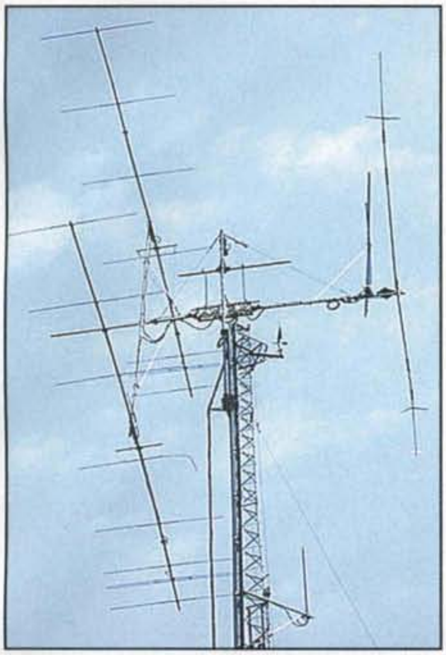

Figure 5. JE1BMJ's 10.7-meter boom, 8-element Yagis stacked 7.7 meters apart with an elevation rotation mechanism.

On July 19 (see again figure 4) I completed QSOs with the following stations: NL7Z, DK1MAX, I5IAR, ON7GB, DL7QY, OH2BC, I5TAT, DJ3TF, LY3UM, LY3DA, DL3BUE, SM3GSK, OH2BP, ON7BJ, DL7CM, DL2OE, F8ZW, OH2MA, DK3WG, DM2AYO, ON4AOI, PA3GND, DJ2BW, and others.

Conclusions

Although there are still many unresolved or unknown phenomena in relation to SSSP propagation at the present time, I hope many 50-MHz enthusiasts will continue to survey, research, and exploit SSSP. For reasons outlined in this article, this newly discovered mode of propagation provides QSO opportunities across great distances that were either unattainable or unnoticed in the past.

Our primary goal should be to take advantage of this opportunity which provides considerable excitement equivalent to that experienced at the peak of the solar cycle using *F2* propagation. SSSP even occurs in the dip of a solar cycle. I look forward to having an SSSP QSO with many of you on 50 MHz in the near future!

Acknowledgements

Thanks to all the 50-MHz DXers who are using SSSP every season. And my special thanks to Chris Gare, G3WOS, who assisted in the naming of this propagation, producing the GoogleEarth map, and editing English for this article. ■

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5. "SSSP: a newly discovered propagation on 50 MHz," Han Higasa, JE1BMJ, *CQ Ham Radio* September 2006, CQ pubs, Japan.

6. For more information and a different viewpoint of the same phenomenon described by JE1BMJ, see the article "Whispering Gallery Propagation" by JA1ELY and TZ6JA in the June 2007 issue of *CQ* magazine.

The Basement Laboratory Group: A Pioneering VHF Club

Part 2 – Walt Morrison, W2CXY

This second installment of WA2VVA's look back at our pioneers focuses on someone dear to him, his father.

By Mark Morrison,* WA2VVA

The factory in Newark, New Jersey is now silent. No longer do the dynamos run there, singing their distant song. No longer does the arc light cast its brilliance upon the ground below, nor do the cobblestone streets surrounding this place give any clue as to what happened there so many years ago.

However, in the not-so-distant past, this place was a beacon for industry and technology. It was here that the standards for measuring electricity were first established, born of necessity in the developing years of the second industrial age. Thomas Edison lived nearby, as did the captains of industry.

Yet for one inventor, a chemist by trade, work was a passion and this place was home. This was the Weston Electric Light Company, founded by Dr. Edward Weston, holder of over 300 patents and contemporary, nay competitor, of Thomas Edison. Weston's factory in Newark was the first of its kind, dedicated to the production of finely crafted carbon arc lamps and the dynamos needed to run them.

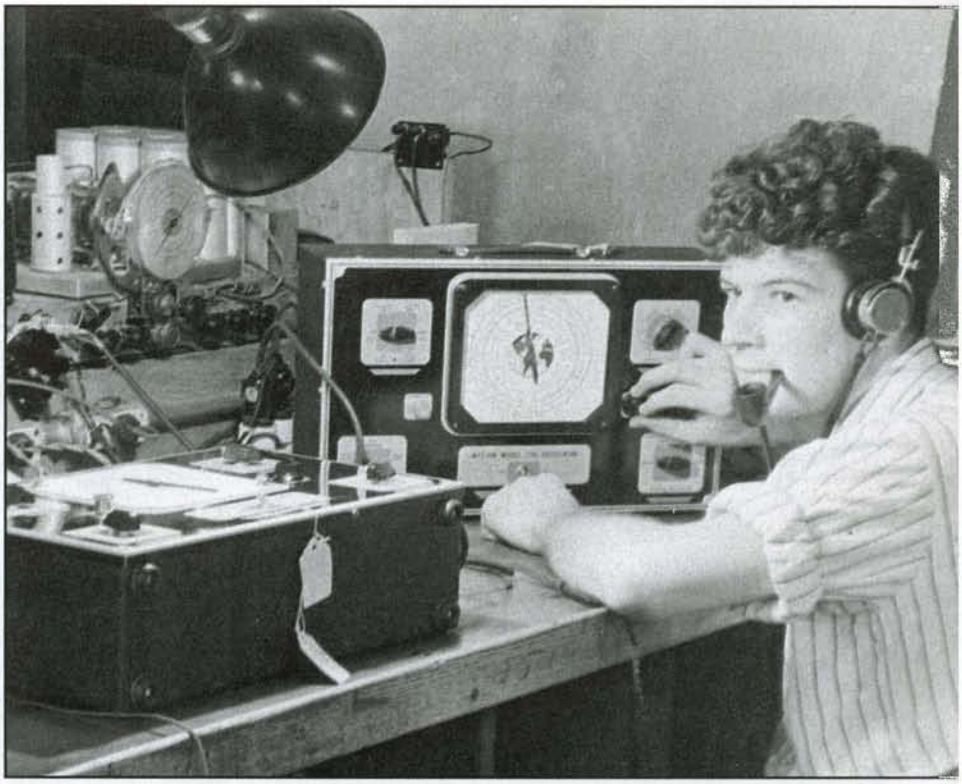

Figure 1. Photo of a Weston Electric Light Company employee in 1938.

Weston equipment was used in some of the earliest examples of public lighting, first in Newark and then in major post offices and parks across America. In 1883, Weston equipment was even used to illuminate the Brooklyn Bridge. In 1887, Weston invented the first truly permanent magnet that would become the backbone of electrical measuring apparatus for decades to come.

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Weston also invented a photo-electric cell that was used in photographic exposure meters popular at the time. Weston's greatest achievement, however, may have been his founding of the Newark Technical School, now the New Jersey Institute of Technology, where many a young man got his start in the age of power and lighting.

One such man was Walter Morrison, who as a young man in the 1930s worked at Weston by day and attended Newark Technical School by night. This was a good fit, as Weston made instruments for photography as well as radio, both avid interests of Walt's. On at least one occasion, Walt brought his camera to the Weston Instrument facility on Frelinghuysen Avenue for a behind-the-scenes look at the place. The photograph in figure 1 from 1938 shows one of Walt's co-workers at the controls of a Model 766

Figure 2. Pins from 1932 ARRL Hudson Division Convention.

Figure 3. QSL card of Gerald Jeapes, G2XV.

direct-reading oscillator, part of a trio of products marketed for the new field of FM radio, the latest invention of radio pioneer Major Edwin Armstrong.

Completing the trio were the Model 772 Super-sensitive analyzer and the Model 787 UHF oscillator, the latter tunable from 22 MHz all the way up to 150 MHz. Weston advertised that such a wide frequency range "safeguards against obsolescence in the event of changes in assigned frequencies." Those familiar with the tragic story of FM radio can appreciate that statement.

In 1931, at the age of 17, Walt received his first and only call, W2CXY. Almost immediately Walt showed an interest in VHF communications, as illustrated by the pins shown in figure 2 from the 7th Annual ARRL Hudson Division Convention held in Newark the following year.

While Walt may have been "listening" on VHF, he was "talking" on the HF bands, as illustrated by the QSL card shown in figure 3 from July 1938. Note what appears to be a large Weston meter on the left of the picture.

Later that same year the CBS Radio Network aired Orson Welles' historic "War of the Worlds" program, creating panic among the listening public and traffic jams as many sought the safety of the surrounding hills. Whether Walt was among them is unknown, but the photo

Figure 4. Photo of Walt Morrison and Edna Carhart in Long Valley, New Jersey.

Figure 5. Photo of the VHF antenna collection near Newark, New Jersey.

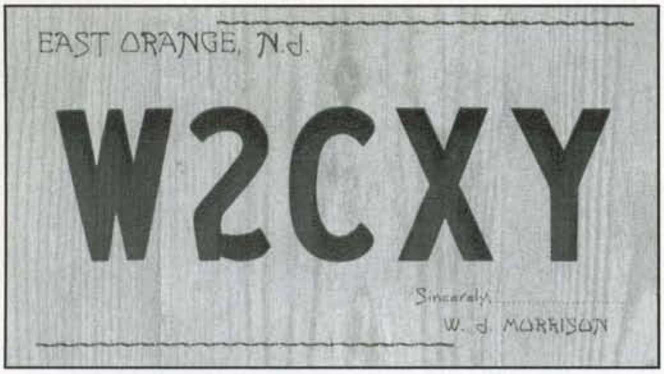


Figure 6. QSL card of Walt Morrison, W2CXY.

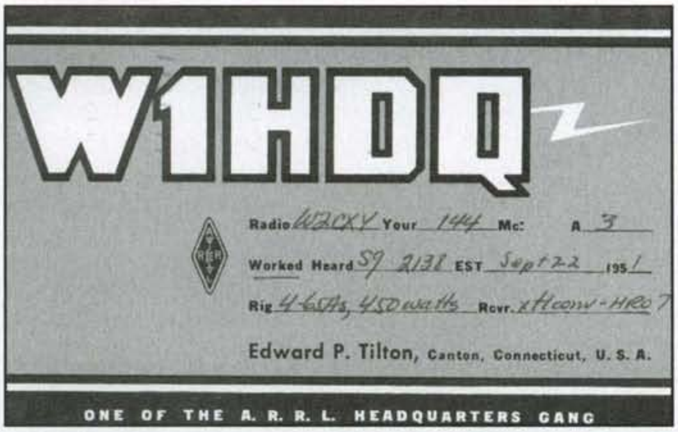


Figure 7. QSL card of Ed Tilton, W1HDQ.

in figure 4 suggests he would have been well-prepared. It shows Walt and another Weston employee, his future wife Edna Carhart, resting beside his 1936 Ford in Long Valley, New Jersey. Note the vertically polarized Yagi antenna supported by bamboo poles. The Yagi was only introduced to the U.S. in 1932, so this is arguably one of the earliest uses of such an antenna for mobile/portable use. The 2-meter band was not allocated to amateurs until 1945, so this may be a $2^1/_2$-meter antenna.

In 1940 Walt left Weston to work for the Prudential Insurance Company, one of the greatest friends that Newark has ever known, and full of opportunity for young engineers interested in the growing field of power and lighting. Walt worked in the Architecture and Engineering Division, where he designed power and lighting systems for the many buildings that "the Pru" would construct for itself and others. Walt worked there for 40 years before retiring in 1982.

The tightly spaced houses in the suburbs of Newark made it challenging to erect serious VHF antennas, but Walt and his friends were up to the task. This picture, figure 5, shows how far serious hams were willing to go back then. The tower as shown and the many VHF beams belonged to one of Walt's friends.

In the 1940s Walt and his family moved to the town remembered in the "I Love Lucy" television series when Lucille remarked, "The traffic was backed up all the way to East Orange, New Jersey!" Figure 6 is Walt's QSL card from the era. Walt and his family lived on North Grove Street.

Walt's logbooks are very detailed from the 1940s into the 1950s. The earliest entries reveal names that would become lasting friendships, including one QSO dated April 7, 1951 with BLG founder Carl Scheideler, W2AZL. On subsequent pages we see other familiar names, including East Coast VHF legends such as Tommy Thomas, W2UK, and Ed Tilton, W1HDQ. The QSL in figure 7 confirms a QSO between W2CXY and Ed, also in 1951.

In 1953, when W2UK and Paul Wilson, W4HHK, first experimented with meteor scatter on 144 MHz, it was Ed Tilton who established the requirements for a valid contact. When Tommy and Paul finally met those requirements in 1954, they were credited with the very first meteor-scatter QSO ever made on 2 meters, something for which they received the ARRL Merit Award.

The "Basement Laboratory Sessions" were held most Thursday evenings at the QTH of Carl Scheideler, W2AZL. This informal gathering of "underground engineers," as W2UK would refer to them, provided an opportunity for VHF operators to meet and discuss various VHF projects. One such project even got the attention of the U.S. Army as illustrated by a curious letter Walt received from the U.S. Army Map Service in May of 1955. This letter was in response to Walt's proposition to use the moon as a reflector of coherent light waves for communications purposes.

Walt may have gotten the idea from the Century of Progress Exposition years earlier when Dr. Weston's innovative photoelectric cell was used to detect light from the star Arcturus and then trigger the huge arc light that symbolized the beginning of that great event. Included in the Army response was a three-page letter from Mr. John O'Keefe, the man later credited with the discovery of the Earth's pear shape and a champion of the laser reflectors left on the moon by Apollo astronauts.

Unfortunately, the response was not encouraging, as a suitable source of coherent light had not yet been invented. However, when the laser was invented some years later, MIT scientists proved that it could be done. It is interesting to note that Mr. O'Keefe's letter suggested a potential mode of VHF communications that to my knowledge has not yet been exploited. Details will be revealed in a future article.

Many antenna parties brought people together for the express purpose of getting someone on the air. Figure 8 is Walt's array in 1956, shortly after it was erected by "the basement engineers" at Walt's new QTH in Chatham, New Jersey. The tower was 70 feet tall.

Walt's station included an AN/ARC-1 military transceiver for local 2-meter work, and a modified SCR-522 driving 150 watts into a pair of 4-125As for DX work. On the receiving side, the classic W2AZL crystal-controlled converter provided IF output to a Collins 75A-4 receiver. Accessories included an audio filter salvaged from a surplus RAK-7, a Lamb Noise Silencer, and a "Panadaptor," the latter used for watching and chasing meteor-scatter "pings" in real time. A Collins KWS-1K (identical to the KWS-1 but without the matching power supply) was used for HF liaison work setting up schedules and assisting with VHF contacts.

Many amateurs collaborated on building projects, often following plans written by amateurs and published in *QST*, *CQ*, *73* and *ham radio* magazines. Carl Scheideler's 417A crystal-controlled converter became a classic after its appearance in *QST*. Carl and Walt spent hours building these converters and either giving them away or selling them to others. In the 1990s

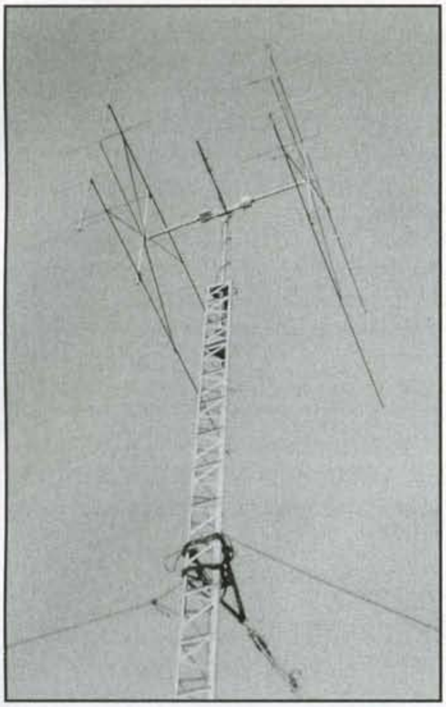


Figure 8. The 2-meter array of W2CXY in Chatham, New Jersey circa 1956.

Walt found one at a local ham flea market and recognized it as one that he had constructed. It was easy to tell from the trademark thumb screws that he used on such projects.

Some of the hams in the W2CXY logbook became well known in VHF circles years later. The QSL card in figure 9 is from 14-year-old Joe Taylor, now recognized as the Noble Prize winning Princeton physicist who recently revolutionized meteor-scatter communication with his WSJT signal-processing software. This software makes it possible to complete meteor-scatter contacts practically any time of the year.

In the 1950s flexible-film tape recorders became popular, and many amateurs used them to record and share their work with others. Although nothing could replace a good ear for making contacts, audio recordings provided objective evidence that such contacts had been made. W2CXY recorded the signals of many others during VHF contests and schedules. Some of his more memorable recordings are those of WØIFS, KØEMC, W5RCI, W5AJG, W4LTU, and W5FAG, all with ranges greater than 1000 miles at a time when 500 miles was something to brag about.

Just as important as tape recordings were the written listening reports, as these could indicate potential DX paths. One example, figure 10, is a report from Bob Turk, W7LEE, in Parker, Arizona, who reported hearing W2CXY on 2 meters in 1956, representing an amazing 2100 miles! Note that the record-breaking contact between BLG associate Tommy Thomas, KH6UK, and John Chambers, W6NLZ, was still a year away, so this was big news to the amateur radio community. Those familiar with the *Perseids* meteor shower should recognize the date on this card.

In 1956, Walt organized a large group of hams for a Christmas audio tape to be sent to Tommy Thomas, KH6UK, and his wife Helene in Hawaii. Walt documented the voices of many old timers and VHF pioneers, including Carl Scheideler, W2AZL, Paul Wilson, W4HHK, Walt Bain, W4LTU, Frank Lester, W2AMJ, Tony Shepard, VE3DIR, and others. Many of them described their accomplishments for 1956 and what they hoped to accomplish in 1957.

One of the hams Walt recorded on his Christmas tape was Paul Wilson, W4HHK, the person credited with making the first meteor-scatter contact on 2 meters with Tommy Thomas, W2UK. The card in figure 11 documents what Paul believed to be the first New Jersey to Tennessee aurora contact on 144 MHz.

In 1957, Walt assembled this "stovepipe final" VHF amplifier with input and output cavities tunable from 60 MHz to 450 MHz (see figure 12). He adapted it to use Eimac's new 4CX1000A, which Walt received from Eimac for evaluation.

Representatives from Eimac showed quite a bit of interest in this device. One demonstration for a top Eimac rep involved a pencil being stuck into an access hole, which promptly lit the pencil on fire! This part of the station is now on Long Island, New York.

In 1957, the official beginning of the International Geophysical Year (IGY) provided an opportunity for VHF enthusiasts to contribute toward the understanding of the world around them. The ARRL published a special newsletter for the purpose of documenting the events and calls of those participating. The Propagation Research Project, as it was called, allowed amateurs around the world to coordinate their activities and share findings with other "observers." This was also the dawn of the space age, and for the VHF enthusiast, an opportunity to explore and document the unknown.

The IGY got off to a big start when the Russians launched Sputnik in October 1957. The logbook of W2CXY shows that

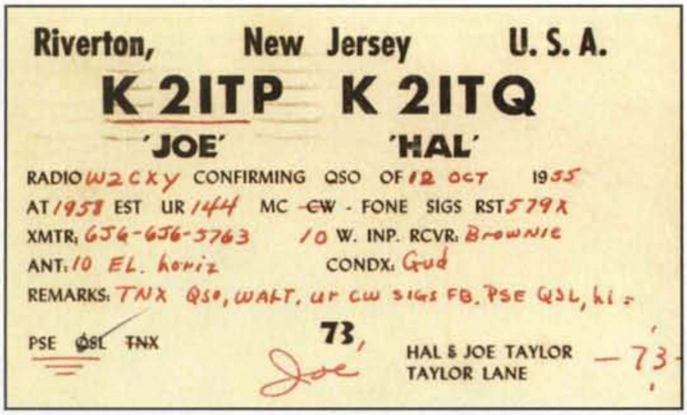


Figure 9. QSL card of Joe Taylor, K2ITP, circa 1955.

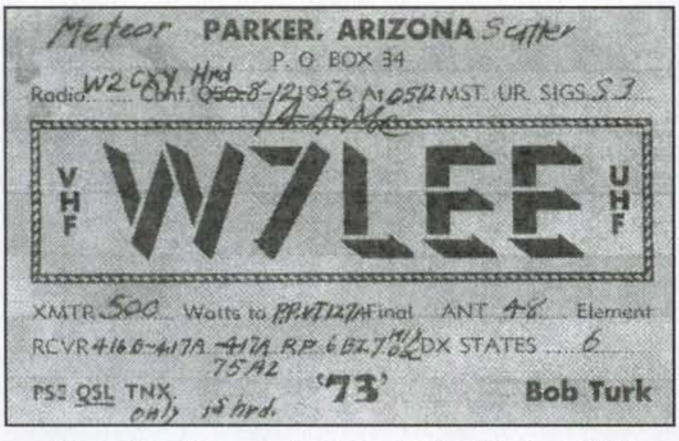


Figure 10. QSL card of Bob Turk, W7LEE, circa 1956.

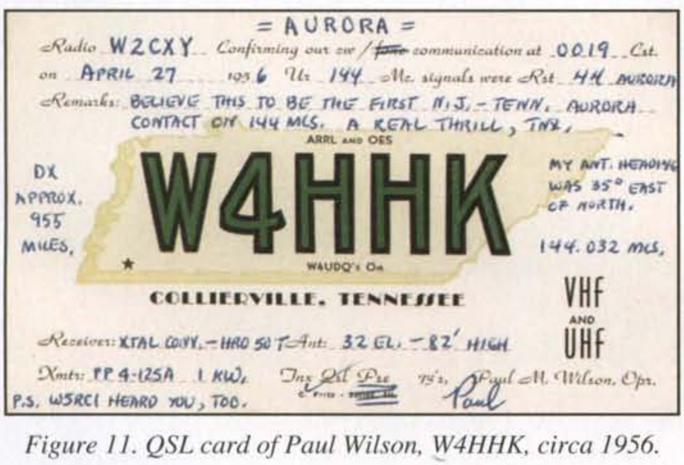
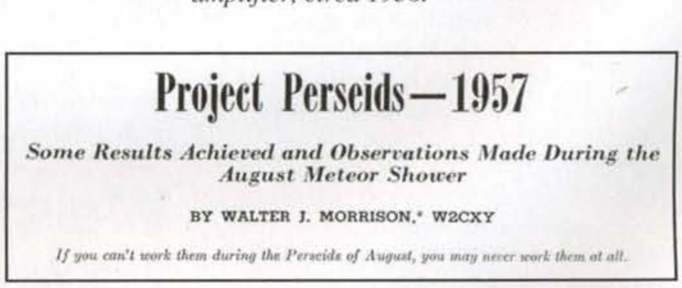


Figure 11. QSL card of Paul Wilson, W4HHK, circa 1956.


Figure 12. Photo of W2CXY with the "stovepipe final" VHF amplifier, circa 1956.


Project Perseids—1957

Some Results Achieved and Observations Made During the August Meteor Shower

BY WALTER J. MORRISON,* W2CXY

If you can't work them during the Perseids of August, you may never work them at all.

Figure 13. Article by W2CXY from QST, *November 1957.*

he monitored the Russian satellite in the first few days after its launch. Something else the logbook shows are the numerous 2-meter contacts Walt made that year, including those needed to win the ARRL VHF contest for top one-band score. Walt described meteor-scatter operations in the November 1957 issue of *QST* (see figure 13).

Ever vigilant in his quest to expand the 2-meter horizon, in 1958 Walt coordinated transatlantic tests with amateurs in Holland (see figure 14). Although success eluded them, this was one of the earliest coordinated 2-meter tests across the Atlantic and possibly the only one conducted as part of the IGY.

144-Mc. Transatlantic Tests

The information for this item came to us the long way 'round; PRP observer Walt Morrison, W2CXY, came up with the idea, sent it off to the Radio Society of Great Britain, and we read about it in the March, 1958 RSGB Bulletin. Walt feels that neither meteor nor auroral propagation look too good for accomplishing that dream of two-meter operators, a transatlantic contact. He believes that three possibilities remain -- ionospheric scatter under conditions of intense F2 layer ionization, moon bounce or tropospheric propagation. Whatever the mode of propagation, then, the signals, if there at all, will be extremely weak. Obviously an emulation of the W6NLZ-KH6UK effort is called for, making use of the best possible equipment.

W2CXY will operate on 14.095 Mc. and 144.01 Mc. simultaneously transmitting "IGY TEST IGY-TEST IGY TEST DUAL 14095/144010 DE W2CXY" at about 20 w.p.m. for five minutes commencing at 1330, 1900 and 0300 GMT (0830, 1400 and 2200 EST) on Saturdays and Sundays and at 2330 GMT (1830 EST) Mondays to Fridays. The five-minute transmission period will alternate with similar listening periods on both bands.

Equipment to be used by W2CXY includes a Collins KWS-1K running 1 kw. to a ground plane on 14 Mc. For 144 Mc., the transmitter comprises a modified SCR522 driving push-pull 4-125As also running 1 kw. input and feeding a 40-element array consisting of four 16 ft. long yagis spaced 12 ft. by 12 ft. on a 70-ft. tower. A new coaxial final using an Eimac 4CX1000A tunable from 60 to 450 Mc. will be completed soon. The station is 350 ft. above sea level with a relatively clear path to the Atlantic 20 miles north-east of Chatham, New Jersey. Best of luck Walt!

Figure 14. From PRP News.

In April of 1958, Walt wrote an article for *CQ* magazine entitled "Modern Dilemma—144 Megacycle Style" in which he described a real-life situation involving late-night VHF openings into rare DX territory. The dilemma was whether or not to alert his meteor-scatter partner Carl, W2AZL, to a rare opening with Ruddy Ellis, W4LNG, at the risk of disturbing Carl's family.

During the summer of 1958, Walt took best DX by working the *Perseids* meteor shower and rose to the top of the 2-meter standings. The "2-meter standings," published monthly in *QST*, was the "Who's Who" of VHF operators. This single achievement ensured Walt a spot in the column for the next 16 years.

Operation Shotput provided a unique opportunity for VHF enthusiasts to extend the reach of their signals. In October of

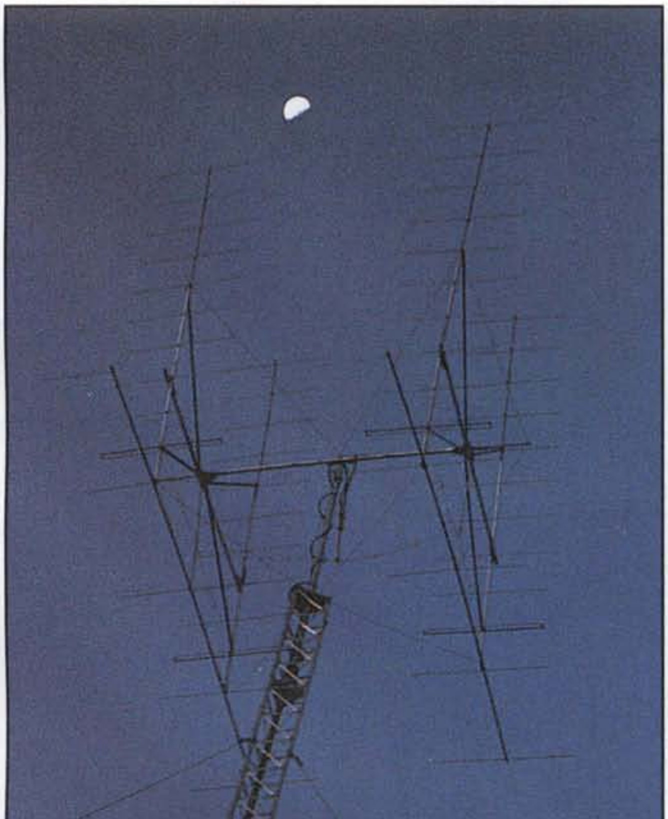


Figure 15. W2CXY 2-meter array positioned for a moonbounce attempt.

Figure 16. The W2CXY Klystron and magnet power supplies, circa 1959.

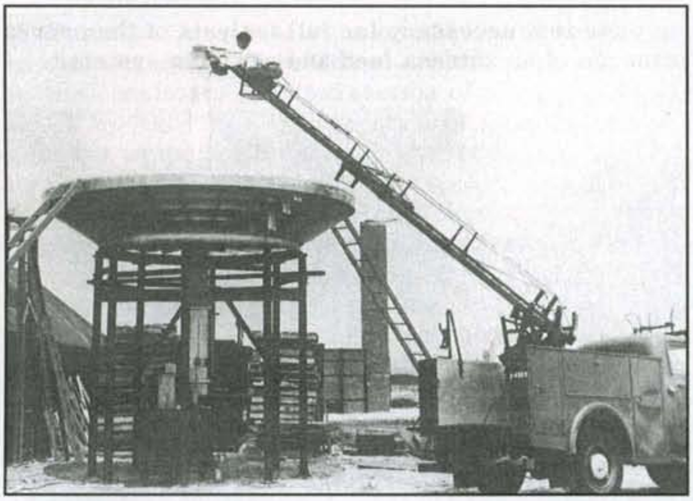


Figure 17. General bronze dish, from Scatter Propagation Theory and Practice, *published by Howard W. Sams in 1956.*

1959, an aluminized Mylar balloon was launched from Wallops Island, Virginia. This was the first (vertical) launch of the ECHO satellite series, something that allowed testing to be performed prior to putting an actual satellite into orbit. Although the balloon ruptured into thousands of pieces that resulted in a spectacular sight visible all the way to Canada, it provided a once-in-a-lifetime opportunity for the few amateurs who participated, including W2CXY. Signals from all along the East Coast could be heard from W2CXY and others as they successfully bounced their 2-meter signals off the surface of this artificial satellite.

Because the balloon was only at altitude for about 12 minutes, those who participated had to scramble to get on board. What is significant is how Walt and the others used this balloon for communications purposes a full eight months before Bell Labs did the same thing with the orbiting version of ECHO1. I often wonder if Carl Scheideler, who worked for Bell Labs at the time, might have given Walt and other East Coast VHF enthusiasts advance notice of this rare opportunity. This is believed to be the first time any kind of manmade space reflector was used for amateur communications.

Early moonbounce work was attempted by many amateurs already established with high-power 144-MHz stations. First attempts usually involved pointing the beam toward the moon, with no particular method of tracking its motion. This was easiest to do when the Moon was on the horizon. Many discovered the ground gain that could be achieved in this manner. Although the legal limit for 144 MHz was 1 KW at the time, it was generally believed that sufficient antenna gain was needed on both ends of the circuit in order to be successful. Most considered 19 dB the minimum gain required. This meant stacked Yagis and high power. Figure 15 shows Walt's array positioned for an early 144-MHz moonbounce test.

Some experimented with extra-long Yagis, referred to as "Long Johns," while others thought collinear arrays provided more directivity. In the end, while many amateurs reported hearing their own echoes, especially when the Moon was low on the horizon, the size of the array, the height of the tower, the requirement to track changes in altitude and azimuth, and everything else needed to make it work were big challenges.

More attractive in some ways was the parabolic dish, available as military surplus, which offered high gain in a compact size. Of course that meant moving from 144 MHz to the higher bands, such as 432 MHz or 1296 MHz, and for many a VHF station, this was akin to starting over. A 432-MHz station could be assembled using components similar to those used for 144 MHz, but since the legal power limit was only 500 watts, 432 MHz was not favored for moonbounce. The next logical choice was 1296 MHz, where the legal limit was 1000 watts.

Figure 18. W2CXY dish, Chatham, New Jersey, circa 1962.

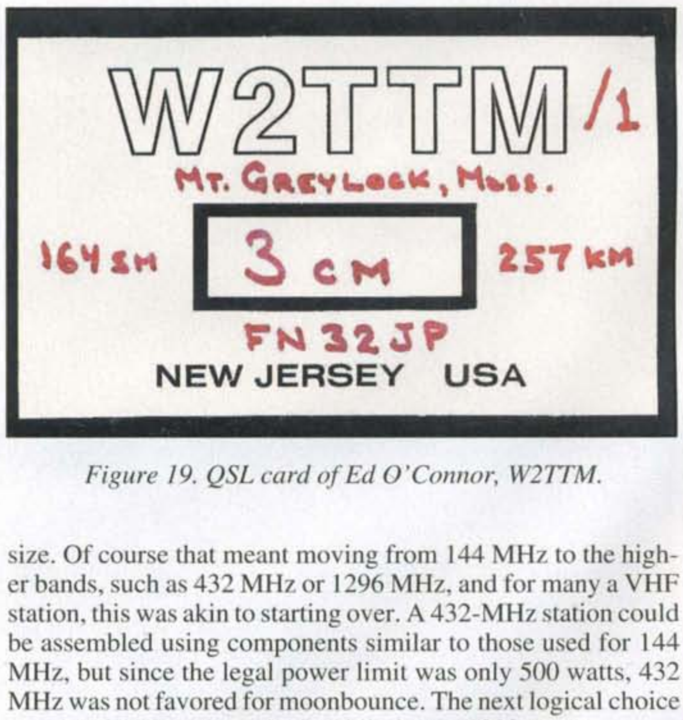


Figure 19. QSL card of Ed O'Connor, W2TTM.

The prospect of doing serious moonbounce work posed something of a dilemma for Walt. Not being able to support simultaneous 144 MHz and 1296 MHz setups, he apparently dropped out of 144 MHz to dedicate his time and resources to building the first amateur UHF moonbounce station in the State of New Jersey, and one of only three in the United States (the others being W6HB and W1FZJ at the time).

In 1959, Walt contacted the Eitel-McCullough Company (Eimac) to express interest in constructing an amateur 1296-

MHz moonbounce station, if only the necessary Klystron components could be obtained. As a result of his efforts, not only did Eimac provide such equipment at no cost, but later followed up with perhaps a dozen such devices for others, including Tommy Thomas, KH6UK, and John Chambers, W6NLZ.

The picture in figure 16 shows the Eimac Klystron (right) and the rack-mounted magnet power supplies built by W2CXY (left) prior to being relocated to Infoage in Wall, New Jersey.

While Carl Scheideler, W2AZL, and Bill Ashby, K2TKN, provided assistance on the receiving side of the W2CXY moonbounce station, Ed O'Connor, W2TTM, helped locate and transport a 15-foot parabolic dish from Long Island, New York to Chatham, New Jersey. The dish was a "precision parabola" constructed by the General Bronze Company (well known for its radio telescope work at Arecibo) and specifically designed for SWR test purposes. The picture in figure 17 shows Walt's dish, or one identical to it, being used for feedhorn testing at the General Bronze facility in the 1950s.

The year 1960 was the year that radio amateurs first bounced radio signals off the moon for a valid QSO. Although Walt did not participate in that historic QSO, he was part of the chain of events that helped make it happen. Hank Brown, W6HB, of Eimac later credited Walt as being part of the motivation for making it all happen. Here's what Hank had to say in his September 1960 *QST* article:

> The project received a tremendous boost when Walt Morrison, W2CXY, contacted Hank and told him of East Coast interest in the undertaking. Accordingly, several Eimac u.h.f. transmitting klystrons were modified to reach a frequency of 1296 MHz and one was shipped to Walt, and another to Sam Harris, W1FZJ.

The Chatham location was really flat, with space for working outside on beams and towers. In 1961, Walt turned attention to getting his dish up and running. At the peak of the space race, a parabolic dish in the backyard (see figure 18) was something unusual. People would often slow down as they drove down the street and a few of the more curious actually got out of their cars to take a closer look. Walt's dish was last owned by Ed O'Connor, W2TTM.

On the evening of March 15, 1962, Walt's team—which included Ed O'Connor, W2TTM, Carl Scheideler, W2AZL, Bill Ashby, K2TKN, and a few others—succeeded in bouncing a 1296-MHz signal off the moon into the dish of W1BU in Medfield, Massachusetts. Sam Harris, W1FZJ, had this to say in the May 1962 issue of *QST*:

> W2CXY and his group of basement engineers, which includes such notables as W2AZL, K2TKN, K2GQI, W2HAC [s/b K2HAC] and others too numerous to mention, are also on the air both transmitting and receiving. As a matter of interest I did receive a short transmission from them by way to the moon on the night of March 15—the first moonbounce signal we have heard at W1BU since August of 1960.

Considering that Walt's signal was the first to be heard by Sam since 1960, W2CXY appears to be the third amateur station to ever reflect a 1296-MHz signal off the moon to be heard by another station.

In the 1970s, Walt kept a low profile on the VHF bands, but did maintain a presence on 2 meters by installing a Drake TR-72 in his Ford Pinto and traveling around the country. Walt attended many of the Central States VHF Society Conferences with his good friend Carl, W2AZL, finding particular enjoyment in the VHF preamplifier noise-figure contests.

In the 1980s, Walt rediscovered the thrill of making contacts in the "World Above 50 MHz," only this time on 10 GHz. BLG member Ed O'Connor, W2TTM, and others had been active on this band for some time and encouraged Walt to get back into the action. Walt took up the challenge in typical fashion: Build it yourself and build it big! While most of his friends chose the ubiquitous RCA satellite TV dish and gunplexer setup, Walt went with a 4-foot spun-aluminum dish and the less common Traveling Wave Tube (TWT) amplifier. Here was all the thrill of making your own equipment, setting it up on mountaintops, and working schedules again. Some of the hams Walt worked on 2 meters in the 1950s were worked again on 10 GHz. The QSL card in figure 19 documents just such a contact between Walt and Ed O'Connor, W2TTM, in August 1990. The inscription on the back reads:

> Walter,
>
> Happy to be your first Mass. contact & your best 10 GHz to date. This is like reliving the old days on 2 mtrs.
>
> 73, Ed

For 10-GHz operations Walt and his friends seemed to favor the historic Twin Lights Lighthouse overlooking Sandy Hook, New Jersey. Once the home of a great arc light, this place provides a spectacular view of the Atlantic Ocean and New York City. Marconi chose this site for radio tests some 100 years earlier (in 1899) and later established the first wireless telegraph station in the U.S. that was capable of both transmitting and receiving on a regular basis. It was also from this site that Walt completed his final QSO.

The Twin Lights Lighthouse once had its own power house, complete with dynamos and steam engines that powered the great light until 1917, when it was deemed too expensive to keep operating. However, now the lighthouse is silent. No longer do the dynamos run there, singing their distant song. No longer does the arc light cast its brilliance upon the ground below, nor do the cobblestone streets surrounding this place give any clue as to what happened there so many years ago. However, in the not-so-distant past, this place was a beacon of industry and technology.

VHF-Plus Contesting on a Shoestring

Many of us hope that our progeny consider taking up our wonderful hobby. Here K7SZ describes his initial successes with his grandson Llyam.

By Rich Arland,* K7SZ

Occasionally something happens that makes me think our ham radio hobby has an actual chance of enduring into the foreseeable future. Ergo, my 11-year-old grandson, Llyam. A couple of years ago, while working on the ARRL's QRP book, Llyam approached me about possibly building one of the small QRP kits that I had managed to amass over the last couple of years.

Wow! A chance to win a newcomer to the ranks of amateur radio! Why not? That started what has become in recent months Llyam's quest to become a ham radio operator. This is a good thing. I remember becoming interested in radio at around his age, shortly after my dad's console radio shocked the heck out of me. (Mom would say, "He's never been the same since.") That experience whetted my appetite and I just had to learn more about what "bit" me! Fifty-plus years later I am still learning, and it has been one heck of a ride. For Llyam to express interest in learning about radio and wanting to obtain his ham ticket is a real treat. A few more Llyams and I think our hobby has a chance to survive quite well!

Together we built one of Rex Harper, W1REX's "Tuna-Tin-II" transmitters for 40 meters. Llyam learned how to solder properly (he now corrects me when he sees me trying to cut corners with a soldering iron), how to read a basic schematic, how to understand resistor and capacitor codes, how to use a VOM's basic functions, how to wire a circuit, and how to perform the all-important "smoke test." It should be noted here that Llyam's first kit went together without a hitch (not counting putting the label on the tuna tin upside down, but that's a whole other story) and the "smoke test" went flawlessly. Listening to the milliwatt transmitter in a monitor receiver tuned to 40 meters (7040 kHz, to be exact) really excited him.

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My 11-year-old grandson, Llyam, operating my Yaesu FT-726.

This was fully documented by my daughter, Maja, who took a ton of pictures, some of which ended up in the QRP book. Llyam, now world famous, is still full of questions and eager to learn more. A trip last year to the Military Radio Collector's Association (MRCA) meet at the West End Fairgrounds near Gilbert, PA, provided a chance for him to widen his radio horizons by being introduced to a different facet of the radio hobby: collecting, restoring, and using military electronics (primarily HF and VHF radio gear). The 30-plus attendees treated Llyam like royalty, and K1BOX gave him a PRC-10 (low-band VHF/FM man-pack radio set) to restore! Of course the real reason I brought him along was to crank the hand generator for the GRC-9! Nothing like a 10-year-old with lots of energy!

By now I suppose you are wondering what all this has to do with VHF-plus. In his quest for his license, Llyam has dutifully been studying the question pool, using his flash cards, asking endless questions, and having very little fun in the process. Unfortunately, today's kids need a lot of instantaneous feedback to maintain their interest in a project. It is

Llyam on the roof holding on to the mast that supports the loop antennas.

the same with Llyam. He needs some "hands-on" to keep his interests kindled and burning brightly. Enter the September VHF QSO Party the weekend of the 13–14, 2008.

In the early 1990s I purchased a Yaesu FT-726 tri-band VHF/UHF transceiver from Rick Rinehimer, K3TOW. I used this radio quite successfully for some terrestrial weak-signal work along with some Low Earth Orbit (LEO) Mode-A satellite work. Mode-A, for those who don't remember, entailed transmitting uplink to the satellite on 2 meters and receiving the downlink on 10 meters. It is sort of a flying cross-band repeater system. Unfortunately, I had to sell that rig (something about a house payment, or food, or bills, or some other such nonsense) about 1996, and I have regretted that decision ever since.

About two months ago I found another FT-726 on eBay for a reasonable price, so I jumped at the chance to procure this radio set. It came with only the 2-meter and 70-cm modules included, but that was enough for the present. Llyam, of course, noted a new piece of gear in the shack about 3.2 microseconds after he arrived, so we had to give a demonstration.

Living inside the city limits of Wilkes-Barre, Pennsylvania, which is down in a valley (the Wyoming Valley, actually), is a severe drawback when it comes to VHF-plus operating. Aside from the obvious problems with line of sight (LOS) transmission and reception paths, running some medium to high power on the high bands can quickly bring your station to the attention of your neighbors. Having been in our present home for 20 years, my neighbors pretty well knew that I was crazy, putting up all sorts of antennas during various times of the year. Running QRP on HF kept me out of their TVs, stereos, toasters, and electric toothbrushes. However, a QRP power level of 5 watts output on VHF plus without some serious effort to erect some killer antennas is really counterproductive. While the LEO satellites were great fun, serious terrestrial weak-signal work was very limited at my present location.

Enter "Mr. Enthusiasm," aka Llyam! To an 11-year-old aspiring radio amateur nothing—and I do mean nothing—seems impossible. It's so nice to be young! I let slip the information about the September VHF QSO Party in a couple of days and Llyam jumped at the idea of "working the contest." I tried to explain that while we had the transceiver to do the job, antennas were critical and I really didn't have anything up for the VHF bands except for the Diamond discone that was shared between my 2-meter FM rig and my scanner. Not to be daunted, Llyam reminded me of the three halo antennas I had sitting on the porch that were supposed to be going up at our new home in Dacula, Georgia.

OK, we'll see what we can kluge up in a couple of hours. The halos were the work of Phil Brazzlle at the KU4AB antenna lab in Collierville, Tennessee (http://ku4ab.com/). I had read the e-ham reviews of these inexpensive halo designs along with testing and gain results at the Central States VHF Society's website (http://www.csvhfs.org/). I ordered one halo for each of my favorite VHF-plus bands—6 meters, 2 meters, and 70 cm—with the idea that I would add a second halo for each of the three bands, along with the phasing kits after settling in at our new place in Georgia.

Halos in hand, Llyam and I found a 10-foot piece of steel mast to support the three antennas along with three runs of RG-213 coaxial cable, complete with connectors installed. Hey, this would be a quick and dirty antenna installation that couldn't get much easier, could it? (I know what you're thinking: I have just violated the prime rule of amateur radio antenna parties, thereby upsetting Edsel Murphy!)

Up on our flat roof above our dining room, Llyam and I took down the old, trusty Diamond discone that had been up there for about six years. Although I had used that antenna for 6- and 2-meter activity, it was low to the ground and I wanted to get these new antennas a bit higher for possibly better results.

We positioned the antennas on the 10-foot steel pole starting with the 70-cm halo at the very top. Coming down about 24 inches, we placed the 2-meter halo, and coming farther down the mast about 60 inches, we placed the 6-meter halo. We had sort of a weird-looking VHF-plus Christmas tree made from halo antennas and a steel mast! Who says life doesn't imitate art?

Llyam helped me install the RG-213 coaxial cable on each antenna, tape the connectors, and then tape the coax down to the mast to provide a neat installation. Once we had everything put together and tied down, I placed the "short stack" on the mast that originally held the discone and we were done, except for running the coaxial cable into the shack. We exited the roof, assembled in the make-shift shack (the main shack was completely torn down pending our move) consisting of a computer table and a FT-726 transceiver. After retrieving the coax and running them to the radios, we then set about checking out things using my MFJ Model 269 Antenna Analyzer. Now for those of you who don't have one, my best advice is to get one—*now*! Seriously, this analyzer can be the best, most relied upon piece of antenna test gear you will ever own. The 269 covers from the lower HF bands up through 70 cm. It's a really nice piece of test gear that once you have one, you'll wonder how you ever got along with out one! (No, I don't have an affiliation with the company, just a very satisfied user).

While the 6-meter and the 70-cm halos performed as advertised with their center frequencies almost spot on according to the factory numbers, the 2-meter halo had some "issues." It seems that either there was a problem with the coaxial cable, one of the end connectors (although we had ohmed them out prior to installing them), or the antenna itself, as I could not get it to resonate anywhere near the 2-meter band! Edsel? Oh, there you are! Well, nothing to do but hit the roof again.

Back on the roof, Llyam and I pulled down the "short stack" and removed the tape around the connector. About that time Llyam ask me about the funny little wire sticking up in the air at the feedpoint of the antenna. Hmmm . . . it looked like possibly a cold solder joint at the factory. The center conductor connection from the SO-239 coaxial connector to the antenna had popped loose and was hanging in mid-air. No wonder I couldn't get a proper reading on the analyzer. We quickly took off the 2-meter halo, returned to the house, re-soldered the errant wire, and proceeded to put the antenna back on the mast and replace the mast on the roof. All of this totaled about 30 minutes work. Now 2 meters worked fine. Unfortunately, though, Murphy wasn't quite through with us yet!

We fired up the FT-817 on 6 meters and worked a couple of locals calling "CQ Contest." It was Llyam's first attempt at contesting, so we had to coach him a bit, but he soon became quite adept at calling stations and giving the exchange. Going to 2 meters on the FT-726 yielded a few more stations, including several we had worked on 6 meters. Again Llyam was eager to get into the fray. Finally, migrating up to 70 cm we found another problem. The connector on the 70-cm antenna had a bad PL-259 on the shack end, which initially we had neglected to spot. Out came the 100W iron, solder, X-Acto™ knives, and the small pipe tubing cutter, and I showed Llyam how to properly install a PL-259 on a piece of coaxial cable.

Once we had replaced the connector we were good to go on 70 cm. There we worked only a couple of stations, but nonetheless, Llyam was intrigued by the magic of ham radio.

How did we do in the contest? Probably dead last, but who cares? This wasn't a serious contesting effort, but it was a serious attempt to give a fledgling radio amateur some insight into a different facet of the hobby. Since Llyam's first license will be Technician Class, knowing that lots of fun can be had on the VHF/UHF bands without a major outlay of money will keep him interested. Not only did Llyam get a chance to rub elbows with some of the local "big gun" contesters in this area, he got a feel for contesting without all the hype and craziness associated with a major contest effort. Additionally, we had some valuable lessons in troubleshooting, learning how to install connectors, proper use of a VOM and an antenna analyzer, and some critical thinking skills used in troubleshooting. These are the kind of things that the books and flash cards can't teach a person. It takes some one-on-one a lot of times to get through some of the theory of radio.

How is Llyam after his first contesting effort? Back in school, doing homework, and studying his ham test questions. He'll be ready for the test. Then he'll have bragging rights at school. After all, how many fifth graders can talk about satellites, work the world, or build a radio? Not too many, and I am positive of that! ■

CQ's 6 Meter WAZ Awards

(As of October 1, 2008)

By Floyd Gerald,* N5FG, CQ WAZ Award Manager

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	KØFF	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	1,2,3,6,7,12,18,19,22,23,25,28,30,31,32
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	K0SQ	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	17,18,19,22,23,26,34,37,38
80	JH1HHC	2,5,7,9,18,34,35,37,40.
81	PY2RO	1,2,17,18,19,21,22,23,26,28,29,30,38,39,40
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	1,2,12,18,19,32
85	K4PI	17,18,19,21,22,23,24,26,28,29,30,34,37,38,39

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Radio Life Insurance with "SPOT"

Your spouse tracks your 10-GHz rover operation on the internet, and as you step back to admire your massive mountaintop X-band system a diamondback rattler sinks its fangs into your left ankle. No cell phone coverage, so you push the SPOT satellite transponder "911" button and the rescue begins.

By Gordon West,* WB6NOA

If you are into VHF/UHF and microwave roving, there is a new, inexpensive satellite transponder system that might save your life. It will also keep your XYL back at home taking part in your adventure. She can track your progress going up the hills with Google Maps® showing your precise location. I wish this was on ham radio APRS, but no such luck. Nor is this commercial system an EPIRB (Emergency Position Indicating Radio Beacon) or a (PLB) Personal Locator Beacon.

This small satellite transponder, called "SPOT," is a product of Globalstar USA, a Vodaphone Airtouch Pic company best known for those classic-looking satellite phones that many ham radio emergency responders used during the Katrina crisis along with the reliable ham radio communications gear.

This small orange transponder has plenty going for your safety when you head out on your next VHF/UHF rover expedition. The SPOT device itself sells for under $150, plus there is a basic service charge for a one-year contract that is $99 per year. Add $7.95 to include $100,000 last-resort evacuation service, and add $50 if you regularly go hiking and you want your SPOT unit to *automatically* update your position every few minutes or miles, independent of cell-phone coverage.

The seven-ounce SPOT portable position sender contains a built-in GPS receiver tied into the L-band transmitter, tuned to commercial Globalstar LEO satellites, 1611 MHz to 1618 MHz, digital code division multiple access (CDMA), running about a quarter watt out. Two lithium-ion AA batteries could allow for 1900 uplinks, or when key-entered into the automatic tracking mode, 14 days of continuous operation.

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An Emergency Position Indicating Radio Beacon (EPIRB), left, and the orange SPOT distress signaling device side by side on a marine chart. (Photo by Julian Frost)

The orange SPOT satellite transponder floats in water, is waterproof up to 1 meter down for 30 minutes, carries military standard 810 E method 507.3, withstanding 100% condensation, and is shock resistant.

To conserve battery life, the GPS receiver built into the SPOT unit only powers on to retrieve a current position fix needed for a manual or automatic uplink to the chain of 48 LEO (Low Earth Orbit) Globalstar satellites. As long as the satellites have a mutual view of their associated ground Earth stations and the SPOT unit, the position goes onto the internet, along with the status of the SPOT transponder's operator, such as:

- I'm OK; all is well.
- I could use some help (non-emergency).
- Dispatch emergency responders to this location *now*.

OK, as a ham operator well versed in satellite communications, you can quickly see that the SPOT device is an L-band one-way transponder, sending latitude and longitude and one of three messages, and has the capability for all this information to stream into the internet.

You can buy a SPOT transponder at your local West Marine store or at a major camping store. Your registration, to acti-

Several hams from Alaska, as well as some from the "lower 48," attended a recent hamfest and got a chance to see the High Frequency Active Auroral Research Program (HAARP) massive antenna array in Gakona, Alaska. For more information about the HAARP program, see :<http://www.haarp.alaska.edu>. (Photo courtesy of the author)

vate the service, is at: <http://www.findmespot.com>. You will need to provide the electronic serial numbers found in the battery compartment of your new "radio life insurance" package.

The secure site will take your credit card when you sign up for the $99 basic service. Be sure to add the $7.95 yearly fee for the $100,000 private rescue service in case there is no local public search-and-rescue service in the area of your emergency.

First, select a reliable phone number to verify any emergency alert. Next, provide up to 10 e-mail addresses for your friends and family members to receive your messages. You can even put down cellular, short messaging-service numbers, too. You may change any of these e-mail address at any time, at no additional cost.

If you get in a jam with your roving operation, you have up to 10 additional "HELP" e-mail options. This could include your next-door neighbor who has a 4-wheel drive "yank" truck, or ham friends who might get on the air to arrange a help party, or other resources, other than your family and friends, who should get only the "I'm OK" message, not the "need some help" message. Plan your "I need help" e-mail posting cautiously so you don't end up with three towing companies coming on the scene when you only need one. I only have one "help" person listed in my e-mail to avoid the activation of too many resources.

If you sign up for that extra $50 "SPOTCASTING" tracking service, it will send out an "I'm OK" to your family and friends and a numerical track of your progress, like a breadcrumb trail, on Google Maps®!

As a last resort, such as a snake bite at a desolate location, push the 911 button and that will direct an immediate e-mail to Globalstar's emergency rescue facility, GEOS, located in Texas. GEOS offers an entire world of government, county, city, and private emergency services for an immediate response to a SPOT 911 call. If you signal for help on a mountaintop, GEOS will first call your "verify that I'm out with SPOT" phone number to authenticate that you are really out there in radio land doing your ham radio thing. Once they know that this is likely a for-sure distress call, GEOS looks at your coordinates, overlays an emergency response map, and passes your distress information to a local agency to respond to the call for help within their jurisdiction. Up in the mountains, it most likely would be a direct call to the forest service or a ranger station. If the distress call comes from a local city jurisdiction, they call that city's "back door" phone number to their 911 center.

Most of my microwave work takes place in rare ocean grid squares offshore, and if I sent out a 911 call on my SPOT unit, the call would go to our local US Coast Guard station, or if far out at sea, to the US Coast Guard Rescue Coordination Center. The US Coast Guard, according to Kathryn Niles, Office of Search and Rescue, would likely take the same appropriate speed and action as if this call originally emanated from a marine Emergency Position Indicating Radio Beacon. However, just like any EPIRB response, the US Coast Guard would want just as much authentication that this is a real call, rather than an accidental activation on shore. Therefore, if your spouse picks up the phone and confirms to GEOS that you are indeed out on a boat 100 miles offshore, this 911 call would be treated with the same speed and resources as any other type of distress call.

This need for confirmation is why it is vitally important to list several phone numbers on your sign-up application to find someone at home, and someone who is familiar with your ham radio roving activities to verify you may be out in the boondocks. Make certain your phone number reflects someone who has a clue as to where you might be with this little orange transponder!

"When the 911 button is pressed on a SPOT satellite messenger, the distress signal is immediately sent to GEOS, the international response center used by SPOT. This 911 message is position-updated every 5 minutes, providing information if someone is in the water in a current or trying to self-rescue and on the move. The only time the 911 button should be used is in a true life-and-death emergency," comments Derek Moore, SPOT Satellite Manager.

SPOT works from Alaska to South America, throughout all of the United States, and covers much of Europe. See the up-to-date coverage map at: <http://findmespot.com/exploreSPOT/coverage.aspx>.

A satellite ground station located in Wasilla, Alaska had me covered during a recent Alaska hamfest and associated radio operating events at the Arctic Circle. We were well beyond cellular coverage. Nevertheless, it was fun to automatically squawk our position and "I'm OK" updates to my internet friends, knowing we were just a pushbutton away from help if something went terribly wrong in the far north.

Yes, ham radio HF might be used in an emergency, but it's tough in Alaska getting a signal out on HF through the constant aurora. APRS satellite updates might indeed be another way to go, but the SPOT commercial unit would the easiest choice in an emergency.

Therefore, add SPOT as part of your communications resources. Not for a second am I discounting all of the capabilities we have as ham radio operators to send third-party traffic home, and to get help when required. However, for a couple of hundred dollars initial investment, plus a hundred bucks a year service fee thereafter, the Globalstar SPOT program makes good sense for reassuring your family and friends by e-mail that you are "OK" as you do your ham radio roving nearly anywhere in the world. It's great for some added radio life insurance when you're "out there" beyond local cellphone coverage. ■

Tulsa (OK) Technology Center's Innovative Approach to Training Future Engineers

This past spring KE5URH and his students at the Tulsa Technology Center designed and built balloon sats for launch by Oklahoma State University's ASTRO balloon-launch program. Here he discusses his technical and development journey from development of the balloon sats to their launch.

By Doug Benton,* KE5URH

Over the past few years there has much concern has been voiced over the dwindling number of engineers and high-tech technicians in this country. Many of us believe that the roots of this dilemma are found at the high school level. Whether it is because of a lack in preparation or a lack of interest, our young adults are not competing in the engineering curriculums at our country's major research universities.

Various national initiatives have been under way for the past two decades to recruit and develop aspiring young pre-engineers at the high school level, with the hope of refreshing our aging high-tech work force. Recently, these initiatives are being taken more seriously due to increased indications that the United States is losing its role as the world's leader in innovation and technology. Here in Tulsa, Oklahoma, bridges are being built to span the academic gap between our teenage talent and our engineering colleges.

Under the mentorship of Professor Andy Arena, KE5CAB, and PhD candidate Joe Conner, W2OSU, both of Oklahoma State University (OSU), as well as Mr. Harry Mueller, KC5TRB, of Oklahoma Research Balloons, Tulsa Technology Center's "Introduction to Aerospace Engineering" class built payloads to fly on OSU's ASTRO-08 balloon-sat mission, which was successfully flown on February 22, 2008.

The mission objective was to carry student payloads and experiments to the near-space altitude of 100,000 feet MSL, to track and recover the payloads, and then to download and process the data. Student payloads consisted of cameras and temperature data-acquisition equipment. The experimental payloads, built by Joe Conner, consisted of two video cameras, with a third experiment to test a Dual-Tone Multi-Frequency (DTMF) activated cut-down device. This article will focus primarily on the educational aspects of this project, from the perspective of the Tulsa Tech students and their instructor, your author.

Because this type of course work and activity is new in Oklahoma at the high school level, many technological and logistical details needed to be ironed out. All the normal challenges associated with a start-up program were encountered this year. For this mission, I, the instructor, and the students set modest goals. Many lessons were learned through trial and error, and as wisdom would dictate, we learned far more through our failures than we ever could have if everything worked the right first time.

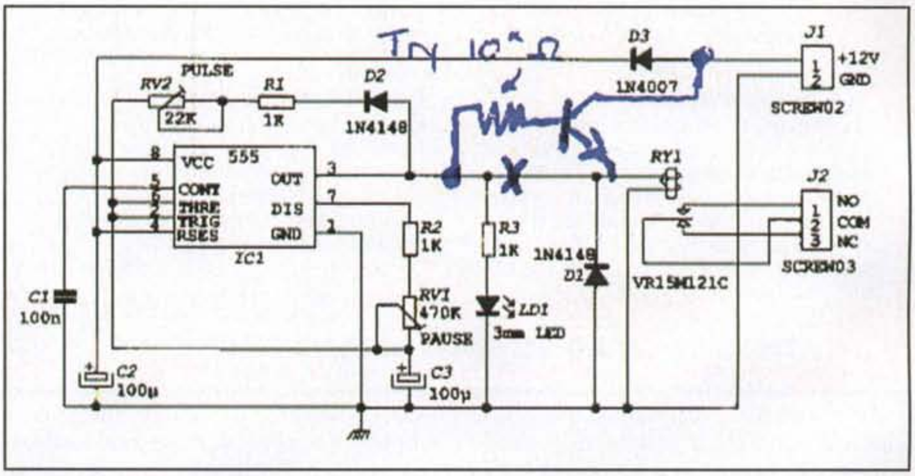

Figure 1. Velleman's MK111 Interval Timer kit modified circuit. Modification courtesy of Barry Lazzer, Tulsa Technology Center's Digital Electronics instructor.

The class objectives for the payloads were to develop reliable and inexpensive technologies for: (1) photographing the Earth at near-space altitudes; (2) gathering atmospheric data; and (3) processing Automatic Position Reporting System (APRS) packets and tracking the payload. Objectives 1 and 2 were reasonably successful, while objective 3 needs further development within the Tulsa Tech class.

Camera Circuit

Based on feedback from multiple sources, we chose the adjustable Interval Timer kit, manufactured by Velleman, to trigger an Aiptek PocketCam on a 20- to 30-second cycle. We found the timer kits easy to assemble, convenient for school purchasing, and inexpensive. At room temperatures the 12-volt kits worked fine. However, we had problems with our kits when they were exposed to even

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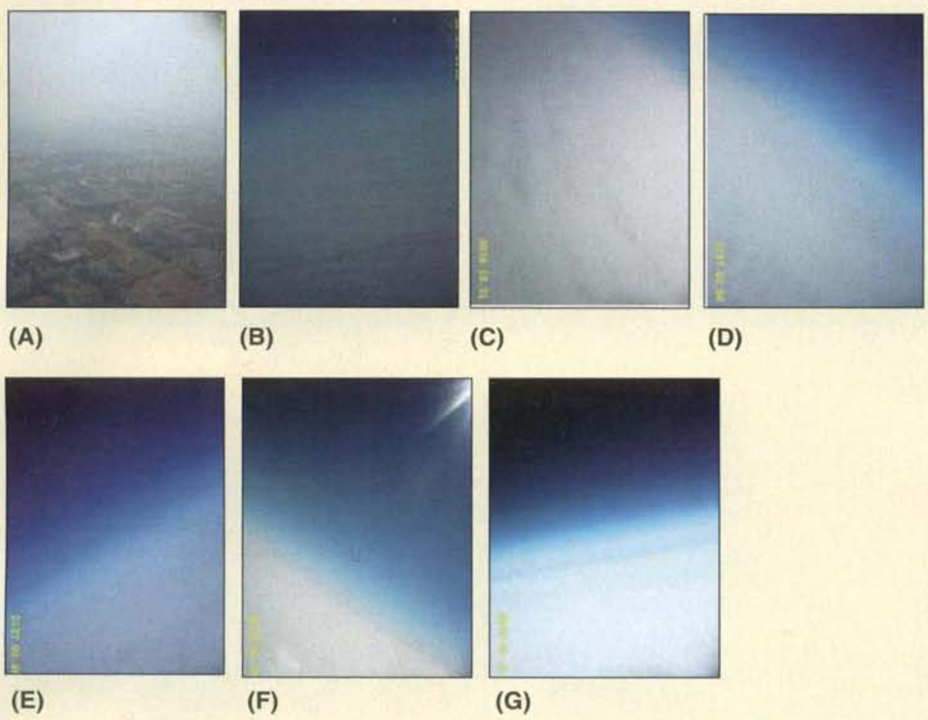


Photos 1A–G. Selected ASTRO-08 mission student photos: (A) approximate altitude 1,900 feet (view of OSU's new stadium); (B) approximate altitude 7,500 feet; (C) approx. alt. 13,500 feet; (D) approx. alt. 18,000 feet; (E) approx. alt. 27,000 feet; (F) approx. alt. 32,600 feet; (G) approx. alt. 99,000 feet.

moderate drops in temperature. Specifically, while at room temperature the timer kit was set for a 1-second pulse and a 30-second pause. Then after the temperature dropped to around zero degrees Celsius, the pulse would extend to over 2 minutes with the pause remaining at the original 30 seconds. This drastic increase in the cycle time would, in turn, cause the cameras to go into sleep mode prematurely and cause battery life to decrease.

A fix was incorporated by placing a transistor on the output pin of the 555 timing chip to drive the relay (see figure 1). With this change in place, the timer kit functioned properly at and below zero degrees Celsius. I observed this modified circuit working fine for over an hour in a freezer without insulation or supplemental heat. Next year's class will use a different, smaller timing circuit. A transistor will be used to switch the camera's trigger, as opposed to a relay switching the camera's trigger.

The PocketCams were inexpensive enough, costing approximately $30 each. They are lightweight and were easy enough to integrate with the timing circuit. The resolution of the photos taken at altitude was acceptable given the extreme temperatures and the low cost. However, two out of the three student payloads' cameras quit taking pictures early during the flight. We have multiple theories as to why the cameras malfunctioned, and it will fall to the next year's class to resolve this problem.

Photos 1A–G were taken at random intervals on the flight up. The atmosphere was very cloudy, resulting in unimpressive photos for this mission. Notice that we need to turn the date-time-stamp off for the next mission, and we need to turn our cameras 90 degrees to the landscape orientation.

Heater Circuit and Temp Data

The Hobo Data Logger, by Onset Computers, was used to gather temperature information for the mission. This is a great device. It is lightweight, easy to use, and collects temperature and relative-humidity data. The price is moderate at approximately $130, with another $25 going towards software. We developed a simple and lightweight thermostat circuit (photo 2) to latch-on the "heaters" (two power resistors) at a preset temperature. The thermostat and heater circuits with the 9-volt battery had a combined weight of 67 grams.

This heater circuit in conjunction with the data loggers will continue to be a nice educational resource. The students will be exposed to more electronics as they build the circuits, and they will be able to collect data on their experiments related to the satellite's thermal conditions during flight. The thermostat will allow the students some flexibility in choosing the start conditions for the satellite's heater.

Because this was the first mission for the Tulsa Tech class, temperature data was collected on the interiors of the satellite boxes, as opposed to collecting the atmospheric temperature data. We were more concerned about the adequacy of our small heaters. Figure 2 is a chart of the temperature data collected on the inside of one of the satellite boxes. You can see that the heater circuit turned on at 18 degrees F, approximately 15 minutes before apogee.

We believe the 5-degree shift in temperature produced by a single battery and two small resistors is adequate for our purposes. Again, our goal is to keep things cheap and lightweight. Note that the elevated temperatures from 15:00 hours to 18:00 hours on the horizontal line are due to the box being stored with a hand warmer accidentally enclosed in the box. A possible improvement for next year's class would be incorporating in the circuit a large amount of hysteresis to turn off the heater when the temperature reaches a level 20 degrees higher than the trigger temperature.

Tracking System

Joe Conner, W2OSU, built the tracking module for this mission, which consisted of three independent tracking systems. The first system, transmitting on 144.360 MHz, used a Kenwood TH-D7A to transmit APRS packets containing position information generated by a Garmin GPS 18. The second tracking system, transmitting packets on 144.390 MHz, used a PocketTracker to transmit information generated by a second Garmin GPS 18. The third system, transmitting CW ID beacons on 147.475 MHz, was a K12 CW Beacon Kit fabricated by Harry Mueller, KC5TRB. All three systems were used in previous ASTRO missions and were already proven reliable. Both Joe Conner and I used mapping software to track the satellite positions on a

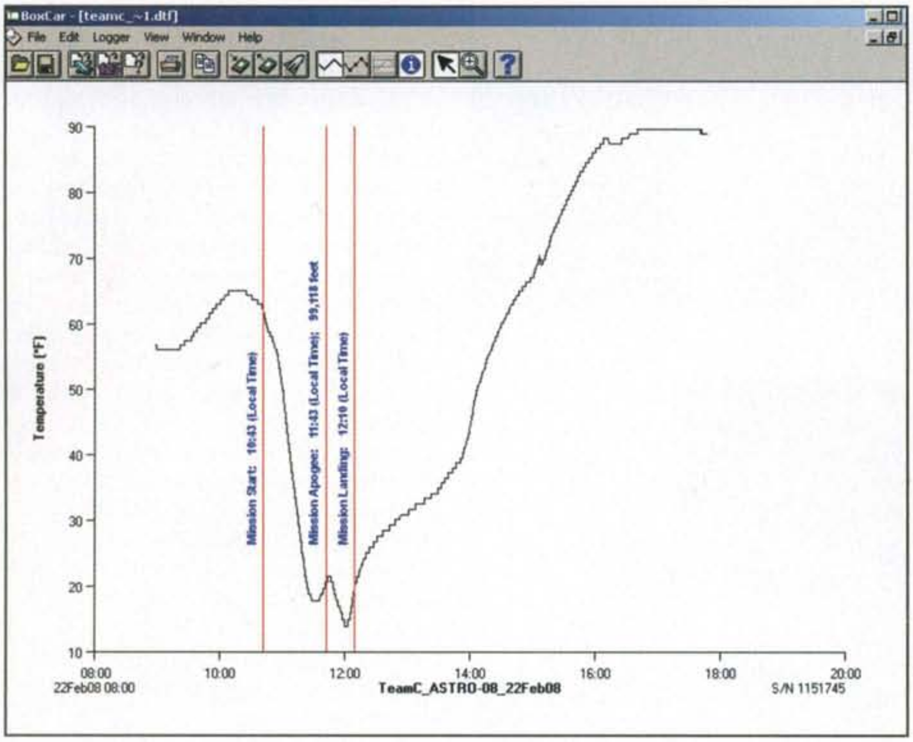


Figure 2. Temperature profile of box interior.

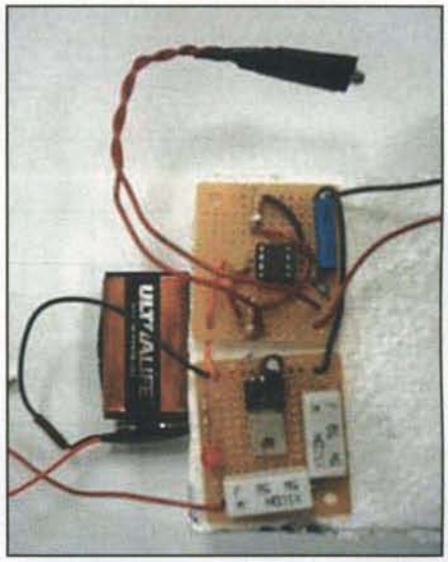


Photo 2. Thermostat and heater circuits. A 741 op-amp is set up as a comparator, which triggers a silicon-controlled rectifier (SCR). The SCR "latches on" the heater circuit. The 9-volt battery is drained through the two resistors (5watt, 5 ohm).

laptop in real-time. I have a goal of building these tracking systems and incorporating them into the class learning activities in the near future.

Educational Benefits

Realistic problem-solving is the one aspect of Project-Based Learning that truly prepares a student for life's challenges. No one would probably question that assertion. However, the problem for us educators is choosing projects that are: (1) skill-level appropriate for the student; (2) skill-level appropriate for the instructor; (3) feasible within the school's budget; and (4) logistically feasible based on factors local to the school (i.e., geography, transportation, and FAA-controlled airspace).

Various aspects of the balloon-sat project are skill-appropriate for a high school junior or senior, provided some prerequisite skills are addressed. The student must be able to solder and read simple electronic schematics before starting the project. Most likely, the high school student should not be expected to make decisions concerning most electronics—at least not at the start of the school year. All aspects of this project need to be well organized and thoroughly communicated before handing it over to the teenage student.

Certain sub-systems need to be taught pedagogically in order to develop a good intellectual foundation for the students. In the early part of next year's class, it is my intention that the students will build, step-by-step, an astable 555 circuit (oscillator), a mono-stable 555 circuit, and a thermostat circuit—all in a pedagogical manner, in order to build a quick foundation in analog electronics. Later, they will be shown how to integrate these circuits. As for telemetry, possibly future classes will build something similar to the TinyTrak kit. However, for the near term, until the instructor acquires a ham license and gains more confidence in using the tracking technology, construction of the

Photo 3. OSU Professor Dr. Andy Arena surrounded by student assistants inflating the sounding balloon.

tracking systems will not be a major part of the in-class learning activities.

The skill-level of the instructor is an important aspect of this project's educational effectiveness. The instructor needs some background in electronics and amateur radio technology to make this project a success. In general, most high school students need a high level of structure to be successful in building these electronics projects.

Only when the instructor has a solid foundation in electronics can this structure be provided to the average teenage student. Otherwise, even the above-average student will lose motivation and then class discipline tends to become an issue. In addition, adult decisions need to be made concerning FAA regulations. This all requires mature supervision, sound engineering judgment, and good shop organization.

The school's budget will also determine whether this project gets off the ground. For one student satellite box with a Aiptek PocketCam, a Hobo Data Logger, and a small heating circuit, the cost was approximately $230, with another $200 of soldering supplies. If three students work on one box, then we arrive at approximately $145 per student per satellite box per year. Additional items include a 1500-gram balloon (Kaymont ~$95); radios (e.g., Kenwood ~$325); antennas (~$50); and lithium batteries (~$50). A rough estimate for four satellite boxes, balloon, tracking equipment, and miscellaneous supplies is approximately $1500 for the first year and $500 each year thereafter.

Lastly, there will be a myriad of external factors that may affect local decisions. Some other considerations might be:

- Geography—western and central Oklahoma are great places to recover weather balloons due to the lack of trees and people.
- Transportation—the fewer the number of students to transport to the launch and recovery sites, the simpler transportation becomes.
- FAA Controlled Airspace—the launch and recovery sites should not be located near busy airports.
- Available Mentors—if a large number of students are involved with launch and recovery, the instructor will need assistance supervising the teenage students.

As interest increases in the Introduction to Aerospace Engineering courses at Tulsa Tech, all of these logistical challenges will increase. It remains to be determined how next year's 32 students will all participate in launching and tracking one or two balloon-sat missions.

Photo 4. The launch crew enjoying the view of their first mission launch.

Summary

Incorporating high-tech, challenging projects into the high school environment is difficult. We want to stretch the students without breaking their motivation. We want to push them to acquire deeper math, science, and engineering skills so they can do well in their early college years. However, we don't want to push them away from the hard sciences either. It's a tough balancing act.

Added to the mix are teens behaving like adolescents and a market pulling well-trained technical professionals away from the classroom. Most high schools are not equipped to handle the more in-depth technical projects. Fortunately, Oklahoma has a well-developed CareerTech system that has made a commitment to the pre-engineering curriculum. Many of Oklahoma's Technology Centers are in a strong position to fund these projects and to hire instructors with the appropriate experience to lead them.

Genuine problem-solving skills were necessary for the completion of this project. The mistakes made in the course of this first balloon-sat project at Tulsa Tech were priceless. Both the students and I were forced to adapt and overcome technical difficulties. In the end, this project was a great example of what Project-Based Learning should look like. In our next phase at Tulsa Tech we will turn our sights toward organizing this project and making it accessible to a broader scope of students, with the hope of challenging the next generation of engineers.

Equally important to our project-based learning efforts is mentorship by our community's professionals. For this project we had help from key individuals associated with Oklahoma State University, Oklahoma Space Grant Consortium, Oklahoma Research Balloons, *CQ VHF* magazine, and other Tulsa Technology Center instructors (Barry Lazzer and Jim Snow). The message is out; our community's engineers are getting involved with raising-up new engineering talent. These types of practical relationships are critical for incorporating challenging projects at the high school level. The question is: Do we have enough of these processes in place to grow enough engineers in the next decade? ■

Links

http://www.kenwoodusa.com/Communications/Amateur_Radio/Portables/TH-D7A(G)
https://buy.garmin.com/shop/shop.do?cID=139&pID=6445
http://www.byonics.com/pockettracker/
http://members.cox.net/hhm_74665/orb/k12/
http://www.byonics.com/
http://www.kaymont.com/pages/home.cfm

Contact: Another First (On Earth)

A growing number of school teachers are finding creative ways to use amateur radio in the classroom as a learning tool. Here VE3NCE describes how he used amateur radio to teach about archeology, as well as expose his students to the benefits of amateur radio communications.

By Neil Carleton,* VE3NCE

"V-E-3-B-S-B at Murphys Point Provincial Park, this is V-E-3-N-C-E in room 24 at R. Tait McKenzie Public School in Almonte."

With this first call, my Grade 5 students stirred with excitement at their desks as we launched our on-air connection with an archaeological site on the other side of Lanark County in eastern Ontario. It was the start of two successful contacts in which amateur radio linked the students in the classroom with archaeologists in the field at the Hogg Bay excavation site, near the town of Perth. This was a first in Canada—to have elementary students in the classroom connected by amateur radio with archaeologists at an excavation site.

As part of our Grade 5 social studies program, my students and I visited Murphys Point Provincial Park on October 2, 2007 to take part in a real archaeological dig. Details about this remarkable full-day program for Grade 5 classes are available at the website of the Friends of Murphys Point Park: <http://www.friendsofmurphyspoint.ca>; click at the top of the page on "The Hogg Bay Dig," or click at the left on "Project" and then "Hogg Bay Project."

My Grade 5 students, and the parent volunteers who helped out, said our visit to Murphys Point Park and the opportunity to take part in a real archaeological dig was the best field trip ever. Our two amateur radio contacts with the site archaeologists made it just that much better.

On Monday, October 1, the day before our field trip, half of the class had their questions about archaeology answered on the air by the archaeologists at the Hogg Bay site. As a follow-up to the visit, the other half of the class spoke via amateur radio with an archaeologist on Thursday, October 4, about their field trip observations and the things they learned.

Grade 5 teacher Neil Carleton, VE3NCE, and his students in room 24 at R. Tait McKenzie Public School, in Almonte, spoke via amateur radio with archaeologists at Murphys Point Provincial Park. (Photo by Jennifer Eldridge, Almonte Gazette)

These two special contacts were made with my classroom VHF amateur radio station. We sent our signals from the school to a repeater station on a communications tower at Lavant, about 40 kilometres to the northwest. Our voices were retransmitted by the repeater station at Lavant (VE3KGJ, 146.640 MHz) and heard at Murphys Point Park, as well as other locations across the region. The answers to the students' questions were transmitted from temporary stations set up at the excavation site, and the examination location in the park, by volunteers of the Lanark North Leeds Amateur Radio Emergency Service (LNLARES).

The student voices from room 24 were also heard across eastern Ontario through three other repeater stations that are linked to the Lavant site at Christie Lake (VA3TEL, 145.230 MHz), Tweed (VE3RNU, 145.370 MHz), and Toledo (VE3HTN, 46.865 MHz). The coverage area of the four repeater stations extends from Stittsville to the east and south to Morrisburg on the St. Lawrence River, west to Picton in Prince Edward County, up to Havelock in the northwest, and over to Renfrew in the north. Listeners in New York State south of Brockville on the St. Lawrence River were also able to hear the students at R. Tait McKenzie talking with the site archaeologists at Murphys Point Park.

A dedicated group of very helpful and kind volunteers in the Perth area, from the LNLARES, were our community partners at the park for these special contacts. The radio operators on site for our contacts were Barrie Crampton, VE3BSB, Al Niittymaa, VA3KAI, and Tony Wilson, VE3XNT. George Ward, VE3GXW, was on hand to take photos on both days. Many thanks to the generous volunteers of the LNLARES group for making the radio component of our archaeological adventures such a success.

Special thanks as well to archaeologists Jeff Earl and Brenda Kennett for taking part in our unique amateur radio contacts. Your adventurous spirit and enthusiasm for the project were appreciated very much.

**3 Argyle Street, Almonte, ON K0A 1A0 Canada*

This article first appeared in the March/April 2007 issue of The Canadian Amateur *magazine. It appears by permission of Radio Amateurs of Canada and the author.*

LNLARES volunteers Al Niittymaa, VA3KAI (left), and Barrie Crampton, VE3BSB (right), listen as archaeologists Jeff Earl and Brenda Kennett answer student questions from the classroom via amateur radio at the Hogg Bay excavation site at Murphys Point Provincial Park. (Photo by George Ward, VE3GXW)

For our contact, on Monday, October 1, the LNLARES volunteers set up one station at the excavation site and a second station at the examination location. An archaeologist at each station took turns answering the questions from R. Tait McKenzie students.

Our second contact, on Thursday, October 4, was during the Media Day activities at the site with sponsors, supporters, school board representatives, and media reporters in attendance. Only one amateur station was needed at the park that day, at the examination location, because the busy site schedule prevented both archaeologists from taking part.

I recorded both contacts to create a transcript of the student questions from the classroom and the replies from the archaeological site. As a surprise holiday gift before the December break, each student in my class received a CD with the transcript of our contacts and a selection of photos from the field trip.

R. Tait McKenzie is a participating school in the national Youth Education Program (YEP) of Radio Amateurs of Canada. Supported by Canadian astronaut Dr. Robert Thirsk, VA3CSA, the program was created to encourage the use of amateur radio at schools across the country. Details are available on the RAC website at <http://www.rac.ca/YEP/>.

I use amateur radio each year at school to bring the world, and space, into my classrooms. Thanks to amateur radio, contacts with archaeologists, astronauts, and Antarctic researchers have enriched the learning of students at our school.

You can read about some of the radio projects here at R. Tait McKenzie Public School on the website of *The Canadian Teacher* magazine; at <http://www.canadianteachermagazine.com>, click at the left on "Back Issues," then click on "Fall 2006" and scroll down to page 8.

The amateur radio program in my classroom is supported by volunteers from the Almonte Amateur Radio Club (AARC) through their generous donation each year of time, expertise, and equipment. Under the leadership of Bob Clermont, VE3AKV, AARC volunteers have helped in so many ways for students at R. Tait McKenzie to talk with radio amateurs around the world, and in orbit, as part of their learning at school.

If your amateur radio club hasn't considered it yet, I encourage you to think about adopting a school so amateur radio can be used to reach out and bring the world into a local classroom in your community, too. ■

By Miguel Enriquez, KD7RPP

Thanks to ATV, Parents Can View Their Children Teaching Math on the Internet

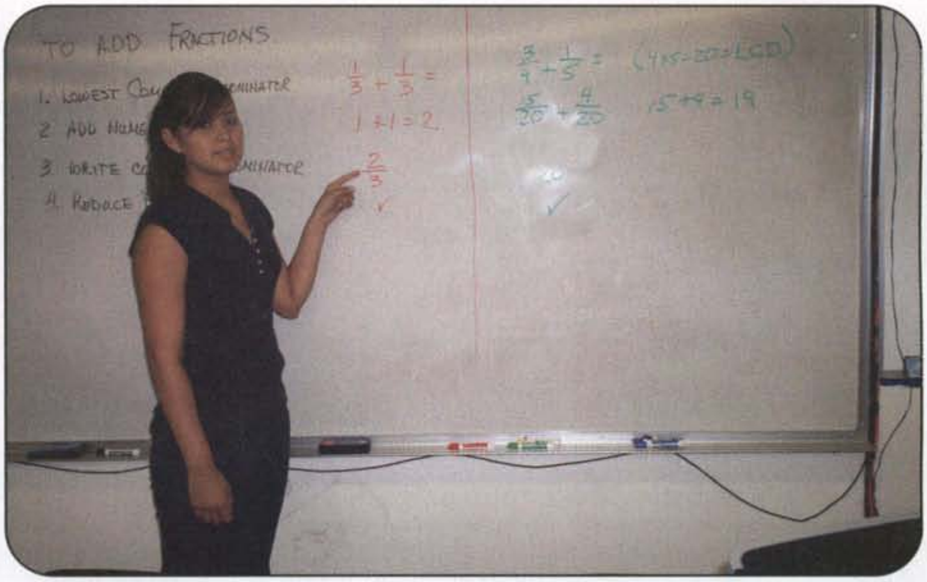
Putting amateur radio to work and demonstrating the benefits it provides to mankind has been confirmed countless times since day one of our hobby. Amateur radio operators in near and far-away places rising to assist or save folks in peril make the news reports quite frequently. However, we hardly ever hear of the skills and dedication required to make that particular rescue possible. Therefore, we go about our lives, safer and happier because of ham radio, not fully appreciating the full impact that amateur radio has on us all.

Amateur Television, on the other hand, does not suffer this same degree of indignity. It suffers an even greater level of indifference. This is because few people, including some ham radio operators, tend to view ATV as capable of delivering little in terms of community services. Sure, we televise picnics and gatherings, bicycle events, local parades, and even the Rose Bowl Parade many years ago. However, it is the opinion of this author that ATV has been allowed to sink to a low level of importance, not because of its limited capabilities but because only a few ham operators are actively participating in its development.

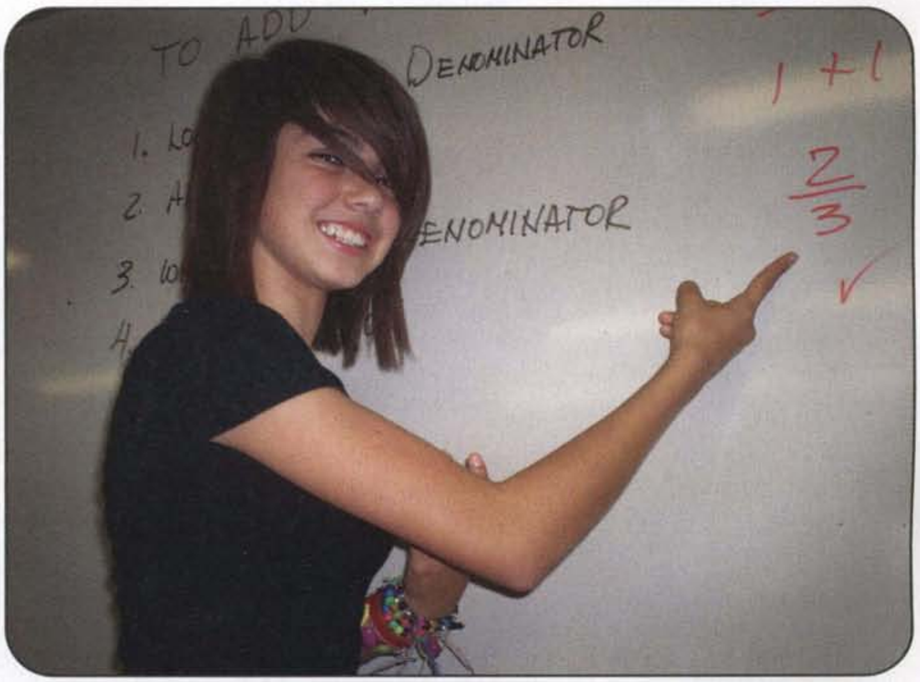
Perhaps those days are coming to an end. In trying to figure out a way to put our own ATV resources to better use, the students in the Pueblo Magnet High School Amateur Radio Club are embarking on a new venture—the delivery of math instruction to elementary schools via ATV and the internet.

Pueblo ARC students are busy preparing 3–5-minute vignettes that will be aired live to any classroom wishing to

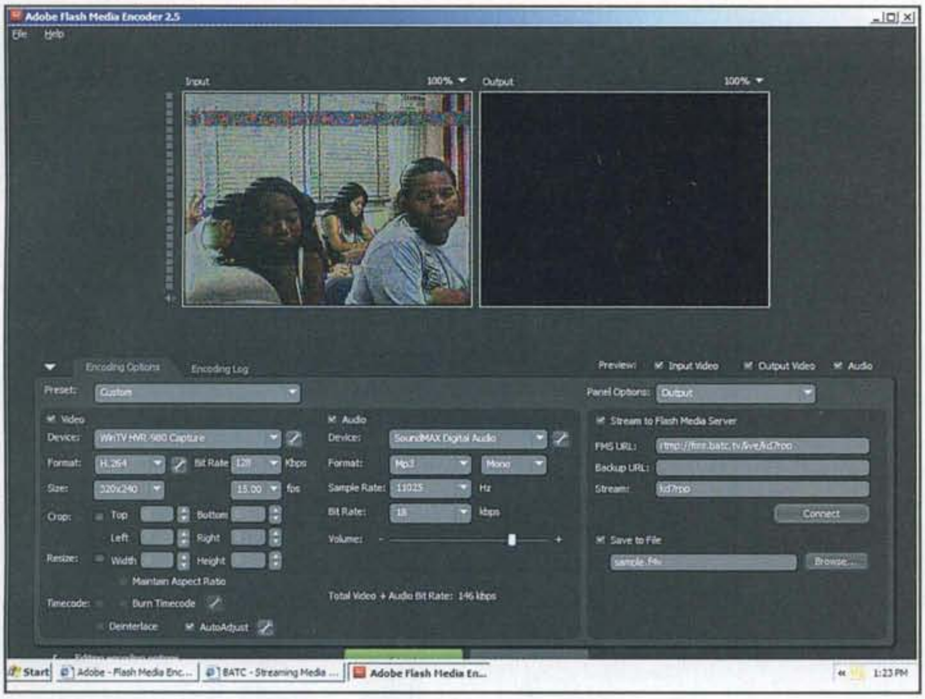
*c/o Pueblo Magnet High School Amateur Radio Club, 3500 S. 12th Ave., Tucson, AZ 85713
e-mail: <enriquezma@cox.net>



Carolina Martinez demonstrating how to add fractions in three easy steps.



Shani Coca explaining how to add fractions with different denominators.



Marcus Nesbitt and Olivia Payne posing for the camera as the ATV signal is calibrated for live streaming via BATC.TV.

view and benefit from these presentations. Interested classroom instructors must have a computer connected to the internet in the classroom. What this means is that in the next few weeks, you too can tune to our ATV signal via your computer. These same presentations will also be videotaped and "rebroadcast" at later times.

The premise of the program, which is called "Kidz-Teaching-Kidz," is that children learn faster and more easily from other children. Call it more appropriate levels; call it better comprehension; call it what you must. However, research has demonstrated repeatedly that kids learn better from other kids.

The Pueblo ARC students will not be presenting math instruction in its entirety. Rather, the Pueblo ARC students will be teaching those areas in which many students traditionally have problems. Subjects such as fractions, decimals, number sense, and recognizing patterns are first on the teaching schedule. Admittedly, the math instruction via ATV concept is still in its infancy and we have yet to articulate an entire curriculum. However, as one of my students said, "So what if we're not good at this? At least we are getting more confidence standing in front of a camera and having our friends and parents see us trying to do the math. We can't go wrong."

While our efforts at introducing ATV to other Tucson hams have not been as successful as we would like, our efforts continue. The school has three stations, one fixed and two portable. The students use the two portable stations at other schools, hamfests, and other venues to demonstrate ATV QSOs. It is via these students' efforts that we hope to grow ATV activity in Tucson and the outlying areas. In my next column I will highlight some of our successes in increasing ATV activity. In the meantime, we remain true to our cause: to develop our ATV knowledge and skills as we find ways to use ATV to make a significant contribution to our community.

The efforts to get and improve the ATV signal from our classroom to the repeater atop Mt. Lemmon and back are on the "completed" list. Our efforts to get that same signal from our downconverter into our classroom computer and onto the internet required a more circuitous route. Thanks to the steadfast leadership of Ron Phillips, AE6QU; the technical brilliance of Mike Collis, WA6SVT; the know-how, advice, and direction of Don Hill, KE6BXT; and late-night and early-morning testing QSOs with Ian Abel, G3ZHI, in England, that activity is now also on the "completed" list.

To feed the signal into the internet, we are using the Hauppauge WinTV-HVR-950 Hybrid Stick. The "F" connector to USB connector function makes it ideal for PC and laptop use. The Adobe Flash Media Encoder 2.5 is a free download and is easy to setup and use. Finally, what makes this entire process possible is the British Amateur Television Club site in England, where our signal is streamed to and presented over the World Wide Web.

Already our students' parents are anticipating watching their children on their computers at home. Already our ARC is preparing for the delivery of those lessons and working hard to create the supportive television environment and required facility. Already the Pueblo ARC students are scheduling themselves to visit other amateur radio clubs in our community and to tell them about their activities.

Plans to connect our students with a school in England have been preliminarily discussed. The biggest challenge we face in doing this is the seven-hour difference between the two locations. Yet I suspect that because ham radio is involved, the dedication, commitment, and resilience that have made ham radio magic for over a hundred years will rise once again to find an equitable solution even for that issue.

If you are interested in watching our students hard at work, please send an e-mail to <miguel.enriquez@tusd1.org> for specific instructions on how to access our site, or simply go to <http://www.batc.tv> and look for KD7RPP or W7ATN in the Members Streams menu.

73, Miguel, KD7RPP

About KD7RPP and AE6QU

CQ VHF magazine ATV column editor Miguel Enriquez, KD7RPP, is a mathematics teacher at Pueblo Magnet High School in Tucson, Arizona. He also sponsors the Pueblo Magnet High School Amateur Radio Club. W7ATN is the repeater that sits atop Mt. Lemmon at an altitude of 9,238 feet.

Ron Phillips, AE6QU, is a benefactor of the Pueblo Magnet Amateur Radio Club who provides untiring technical advice, equipment, and other contributions to the ARC. Ron also attends ham-radio-related meetings and conferences in the Phoenix, Arizona area to the benefit of the Pueblo ARC.

By Dr. H. Paul Shuch,* N6TX

THE ORBITAL CLASSROOM

Furthering AMSAT's Mission Through Education

AMSAT and Teacher Professional Development

Our last column (Summer 2008 *CQ VHF*) discussed the National Science Education Standards. In it I attempted to show why AMSAT must demonstrate compliance with those standards in developing a meaningful Teacher's Institute. It was my intention to show how AMSAT can provide a credible professional development opportunity for educators, while advancing our own educational goals. Since that column was submitted, there have been significant changes in AMSAT's educational direction. It is my hope to explain those changes in this, the final installment of "The Orbital Classroom."

Most school districts tie advancement (and in some cases continued employment) to specific continuing education requirements. Generally, a teacher is required to receive a specified number of Continuing Education Units (CEUs) during a stated period of time to meet a given school district's professional development requirements. Unfortunately, the scope of acceptable activities and level of rigor necessary to grant CEUs vary from state to state. However, AMSAT intends to provide continuing education opportunities for teachers from all 50 states. In order to grant CEUs, we would need to have our curriculum scrutinized and approved by 50 Departments of Education in separate states (each of which may have different, possibly conflicting, standards). Thus, it is my recommendation that we *not* pursue granting of CEUs.

There is, however, an alternative to CEUs. Most school districts will allow professional development credit for relevant postgraduate-level courses from any accredited university. Also, AMSAT, by virtue of its Memo of Understanding with the University of Maryland, Eastern Shore (UMES), is party to an educational partnership that just might make such postgraduate-level courses feasible.

UMES is home to the Hawk Institute for Space Sciences (HISS), host for the AMSAT Satellite Integration Facility ("AMSAT Lab"). We have already partnered with HISS on a number of educational initiatives, including student involvement in satellite construction activities in our lab, and student participation in balloon launches carrying amateur radio payloads. Thus, using their facility to educate educators is a logical next step.

Although UMES is an undergraduate institution, it is part of the University of Maryland system, which does indeed grant graduate credits. If our Teacher's Institutes can be approved by that university for graduate credit, participating educators from all states can apply it toward the continuing education and professional-development requirements of their particular school districts.

OK, so we began to develop a game plan for offering accredited, post-graduate training for educators through our existing university partner. Of what should such training consist? Clearly, we would love to see schools across the country equipped with OSCAR ground stations, tracking and communicating through ham satellites. Remember, though, that any effort in that direction must be consistent with the National Science Education Standards outlined in the previous "Orbital Classroom" column. Simply preparing teachers to have their students play ham radio through satellites isn't going to cut it.

Here's where a serious curriculum development effort appeared needed, and I am proud to say that several AMSAT educational volunteers stepped up to the plate. However, before reinventing the wheel, I thought it prudent to survey other professional-development opportunities for educators which also focused on satellite communication and related technologies. To my surprise, I found quite a few competing programs already well in place.

Closest to home for most AMSAT members is the excellent ARRL educational program headed by our friend Mark Spencer, WA8SME. Mark was most helpful and encouraging to me when I first was appointed AMSAT Director of Education in early 2006, and he generously offered to share his curriculum with us. He presents four to six Teacher's Institutes a year in various parts of the country, and through a partnership with an accredited university is able to offer participating teachers postgraduate credit suitable for their professional-development needs. These week-long intensive courses cover many aspects of amateur radio, including an excellent introduction to amateur satellites. In fact, in their professional capacity as classroom teachers, a number of AMSAT members have already taken Mark's courses. As the national association for amateur radio in the U.S., the ARRL has been quite successful in securing financial contributions toward its educational efforts. Consequently, many participating educators are able to attend these ARRL courses free of charge, and some have even been awarded grants to equip their laboratory facilities and campus amateur radio stations. AMSAT salutes the ARRL for making this worthy educational contribution.

The ARRL is not alone in its continuing education offerings, although the extent of its emphasis on amateur radio is unique. Professional organizations such as the American Astronomical Association, American Association for the Advancement of Science, American Institute of Aeronautics and Astronautics, and others also offer professional development to educators in areas that overlap AMSAT's expertise. Because of the extensive financial resources of these large

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<www.AMSAT.org>

organizations and their commercial sponsors, the cost to individual teachers is minimal, with stipends offered to encourage the most cash-strapped school districts to participate. Often, these workshops are offered at exotic vacation venues, making it easier for participating educators to gain the support of their respective families. I once attended such a summer course under the sponsorship of the school district where I was then employed. Although, regrettably, it lacked amateur radio content, that course emphasized the use of computers in the classroom at a time when that idea was still novel and provided an enjoyable and professionally rewarding experience.

NASA has long promoted aerospace education through its SpaceMobile program, run for it for decades by the University of Oklahoma. The program features laboratory and demonstration equipment built into vans, fanning out across the country to visit primary and secondary schools in every state. Astronauts are frequent speakers at SpaceMobile events, and although their emphasis has been motivation of students, many a classroom teacher has received professional development credit through SpaceMobile workshops.

Recently, a new contract for the NASA Aerospace Education Services Project (AESP) was issued to the Pennsylvania State University's Center for Science and the Schools. With PSU becoming NASA's new ASEP higher education partner, some changes in emphasis ensued which promised to prove valuable to AMSAT. Instead of just sending SpaceMobiles around to the K–12 schools to put on road shows for the students, they announced a new thrust in teacher continuing education. Because this meshes well with AMSAT's proposed professional development plans for educators, I met in December 2007 with Dr. Bill Carlsen, Penn State's Principal Investigator for this new NASA contract. From that meeting an AMSAT action plan began to emerge.

As worthy as it might be for AMSAT to provide teachers with continuing education in satellite communications, I reasoned, the cost (both monetary and in terms of effort required) threatened to siphon off AMSAT resources already stretched thin by our various satellite development programs. Why not instead, I suggested, partner with the ARRL, NASA, Penn State, and AIAA and everybody else already filling the educators' technology professional development niche? In January 2008 I proposed to the AMSAT leadership team that our talents could best be spent by developing, and volunteering to teach, satellite design, satellite construction, and satellite operations *modules* for all of those organizations currently offering teacher continuing education in related fields. It's not as glamorous as having our own Teacher's Institute, I realize, but it just might be more compatible with AMSAT's primary mission.

I had thought I had made a reasonable case, but I am an educator, not a policy maker. Ultimately, the AMSAT board decided to go in a different direction, and in February 2008 I was asked to step down as AMSAT Director of Education. I will not second-guess our leadership in that decision, but did want the AMSAT membership to know the path that brought us to this juncture. Also, I will continue to support, to whatever extent I am able, the educational efforts the AMSAT Board ultimately decides to pursue, consistent with our organization's vision and mission statements.

I urge all of you to support such future AMSAT educational efforts as well.

73, Paul, N6TX

CQ's Satellite WAZ Awards

(As of October 1, 2008)

By Floyd Gerald,* N5FG, CQ WAZ Award Manager

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

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.

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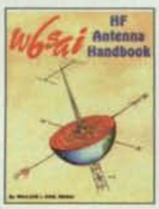

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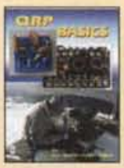

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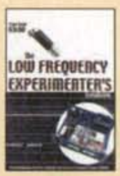

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QUARTERLY CALENDAR OF EVENTS

Current Contests

November: The second weekend of the **ARRL 50 MHz to 1296 MHz EME Contest** is November 15–16, 2008.

January: The ARRL VHF Sweepstakes is scheduled for the weekend of January 17–19, 2009.

For ARRL contest rules, see the issue of *QST* prior to the month of the contest or the League's URL: <http://www.arrl.org>.

Current Meteor Showers

November: The *Leonids* shower is predicted to peak around 0900 UTC on November 17.

December: Two showers occur this month. The first, the *Geminids*, is predicted to peak 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 100–120 meteors per hour at its peak.

The second, the *Ursids*, is predicted to peak around 0730 UTC on December 23. It is an east-west shower, producing an average of no more than 10 meteors per hour, with the rare possibility of upwards of 90 meteors at its peak.

January: The *Quandrantids*, or *Quads*, is a brief, but very active meteor shower. The expected peak is on January 3–4, with the best time being the morning of January 4 just after midnight and working through dawn, 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 starting on page 77. Also visit the International Meteor Organization's website: <http://www.imo.net>.

Quarterly Calendar

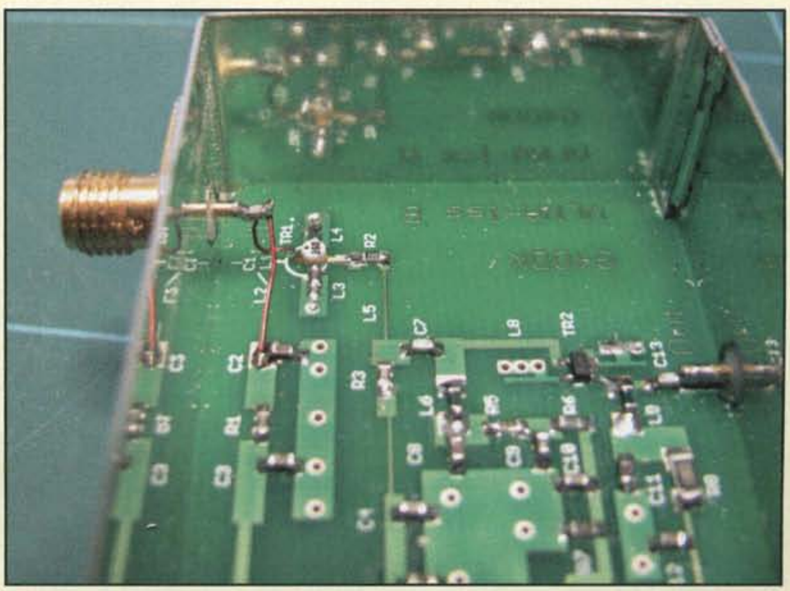
The following is a list of important dates for EME enthusiasts:

Nov. 2	Moon Apogee. Very poor EME conditions.
Nov. 6	First Quarter Moon.
Nov. 9	Good EME conditions.
Nov. 13	Full Moon.
Nov. 14	Moon Perigee.
Nov. 16	Moderate EME conditions.
Nov. 17	*Leonids* Meteor Shower Peak.
Nov. 19	Last Quarter Moon.
Nov. 23	Moderate EME conditions.
Nov. 27	New Moon.
Nov. 29	Moon Apogee.
Nov. 30	Very poor EME conditions.
Dec. 5	First Quarter Moon.
Dec. 7	Good EME conditions.
Dec. 12	Full Moon, Moon Perigee and Full Moon.
Dec. 13	*Geminids* Meteor Shower Peak.
Dec. 14	Moderate EME conditions.
Dec. 19	Last Quarter Moon.
Dec. 21	Winter Solstice. Moderate EME conditions.
Dec. 27	New Moon.
Dec. 28	Very poor EME conditions.
Jan. 3	Moon Apogee.
Jan. 4	*Quadrantids* Meteor Shower Peak and First Quarter Moon. Moderate EME conditions.
Jan. 10	Moon Perigee.
Jan. 11	Full Moon. Good EME conditions.
Jan. 18	Last Quarter Moon. Moderate EME conditions.
Jan. 23	Moon Apogee.
Jan. 25	Very poor EME conditions.
Jan. 26	New Moon.
Feb. 1	Moderate EME conditions.
Feb. 2	First Quarter Moon.
Feb. 7	Moon Perigee.
Feb. 8	Very good EME conditions.
Feb. 9	Full Moon.
Feb. 15	Poor EME conditions.
Feb. 16	Last Quarter Moon.
Feb. 19	Moon Apogee.
Feb. 22	Poor EME conditions.
Feb. 25	New Moon.

—EME conditions courtesy W5LUU.

Correction

In the Summer 2008 issue of *CQ VHF* in the article "Loe-Noise Pre-amplifiers for the 1.3, 2.3, and 3.4 GHz Amateur Bands," by Sam Jewell, G4DDK, photo D was a duplicate of photo B. The correct photo of the 3.4 GHz LNA, L1 and L2 input hairpin loop details appears here. We apologize for any confusion caused by the error.



By Joe Moell,* KØOV

HOMING IN

Radio Direction Finding for Fun and Public Service

A Decade of ARDF in the USA

In 1998, amateur radio hidden-transmitter hunting in the USA was almost exclusively a vehicular activity. A weekend hunt in most places meant hours of driving in a well-equipped vehicle. There might be an on-foot "sniff" at the end to get to a transmitter a few yards off the road, but that was the extent of fox-hunting on foot.

Back then, only a handful of North American hams had experienced the kind of transmitter hunting that was predominant in Europe and the Asian mainland. In those countries, hams had combined radio direction finding (RDF) with map-and-compass orienteering to create a sport that challenged both the mind and body. In some places, particularly Russia and former Soviet bloc nations, it was being used in physical-education classes for youth in schools and by the military for field training.

This international on-foot-only sport had acquired several names, including foxtailing, foxteering, radio-orienteering, and ARDF, for Amateur Radio Direction Finding. Official rules were put in place by a committee of the International Amateur Radio Union (IARU). A course has five "fox" transmitters in a large wooded area of at least 500 acres, and usually much larger. Participants start near one end and proceed to the other end, punching in at each fox along the way.

Radio-orienteers must pay constant attention to all bearings, because each fox is on for 60 seconds, one at a time, in sequence. For instance, when #1 goes off, then #2 comes on and #1 won't be back for four minutes. A continuous transmitter on a separate frequency is near the finish to aid hunters who have lost their place on the map.

The first foxtailing events were on 80 meters with CW transmitters sending "MO" followed by dits indicating the transmitter number (MOE, MOI, MOS, MOH, and MO5). Later, a separate contest on 2 meters was added to each meet, with CW tones on AM carriers. This was before the popularity of narrowband FM on 2 meters, but AM predominates on VHF at international ARDF events to this day.

Starting with separate divisions for all men and all women, the organizers began to add categories for youth and "old timers," as regular participants reached the ripe old age of 40. All women, regardless of their age, were placed into a fourth category.

National team members must work independently. No assistance or cooperation of any kind is allowed on the courses, except for injuries and other emergencies, of course. Team scores are aggregates of individual member scores. Use of GPS and other navigation devices on the course is forbidden.

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

The first ARDF Team USA in Hungary at the 1998 World Championships. Left to right are Gyuri Nagy, HA3PA; Marvin Johnston, KE6HTS; Dennis Schwendtner, WB6OBB; Dale Hunt, WB6BYU; and Jack Loflin, KC7CGK. Nobody brought a mast for the American flag, so WB6OBB, who is blind, offered his white cane. (Photo by Barbara Johnston, KE6OTF)

A Good Start in Hungary

The first ARDF "world" championships in 1980 attracted participants from only 11 European countries. Asia was not represented until four years later, but activity grew quickly there, especially in China and Japan. In the mid-1990s, over 20 countries were participating, but IARU officials bemoaned the "black hole" in Region 2 (North and South America), where no foxtailing was taking place. That was about to change, because some hams on our West Coast had tried ARDF, liked it, and wanted to move it into the mainstream of American ham radio.

An informal ARDF Task formed in 1997 with the goal of hosting the first IARU Region 2 ARDF Championships in Portland, Oregon during the summer of 1999.[1] This would be combined with the sixth Friendship Radiosport Games, a sister-cities event with participation by hams from Khabarovsk in Russia, Niigata in Japan, and Victoria in British Columbia, Canada.

In early 1998, the ARRL Board of Directors formally recognized the desirability of developing ARDF in the U.S. I was appointed to be the ARRL's ARDF Coordinator. There was no formal job description (and still isn't one), but it was agreed that I would lead the promotion and development of ARDF in the U.S., working closely with radio clubs and organizations here, as well as with IARU and other member societies in the scheduling and promotion of foxtailing events.

Shortly thereafter, I received an invitation from Rik Strobbe, ON7YD, the Interim Chair of Region 1's ARDF Working Group. He wanted the U.S. to send a team to the 1998 ARDF World Championships (WCs) in Hungary. This would be an excellent opportunity for stateside hams to observe the mechanics of international-style competitions, which would be important for our upcoming event. We would also learn course strategies by watching and meeting with the medal-winning experts.

I put out the word, and by the middle of summer the U.S.'s first team had formed. Dale Hunt, WB6BYU, Marvin Johnston, KE6HTS, and Jack Loflin, KC7CGK, would try the courses. Dennis Schwendtner, WB6OBB, and Barbara Johnston, KE6OTF, would accompany them. Then an e-mail arrived from Gyuri Nagy, HA3PA. As an engineer for an international company, he often traveled to the U.S. and had been given resident alien status.

Gyuri offered to meet the delegation in his native country and help prepare everyone for the competition. He also offered the use of his 80-meter ARDF equipment. In return, he wanted to know if he could join our team and compete for the U.S. A check with IARU officials revealed that Gyuri's green-card status made it okay for him to represent our country.

Gyuri picked up the stateside delegates at the Budapest airport and drove everyone to Nyiregyhaza, the site of the competitions. The amount of pomp and ceremony there was surprising. Like the Olympics, there was a parade of the ath-

On the 2008 ARDF World Championships awards podium for category M50, left to right are silver medalist Stanko Cufer, S57CD, of Slovenia; gold medalist Igor Kekin of Russia; and bronze medalist George Neal, KF6YKN of the USA. (Photo by Jay Hennigan, WB6RDV)

The U.S. delegation to the 2008 ARDF World Championships in Korea. Left to right are Bob Cooley, KF6VSE; Ken Harker, WM5R; Jen Harker, W5JEN; Dale Hunt, WB6BYU; Harley Leach, KI7XF; Nadia Scharlau; George Neal, KF6YKN; Scott Moore, KF6IKO; Vadim Afonkin; Jay Thompson, W6JAY; Charles Scharlau, NZØI; and Jay Hennigan, WB6RDV. Not pictured is Richard Thompson, WA6NOL, who took the photo. (Photo courtesy Vadim Afonkin) letes by nation, each team following a placard-carrying local escort. The opening festivities also included native dancing and other entertainment.

The next day was the 2-meter event, then a day of rest and organized tours, followed by the 80-meter hunt day. All Team USA members successfully completed the courses, but our inexperience and Gyuri's lack of recent training kept us off the winners' podium. Most medals went to eastern European and former Soviet Union countries because of their high level of experience and participation in local events.

Bringing It Home

This trip to Hungary, as the old song goes, was the start of something big. WB6BYU used the knowledge he had gained to set challenging 2-meter and 80-meter courses at well-mapped sites for the 1999 Friendship Games and IARU Region 2 Championships. Besides the Friendship Society participants from Russia, Japan, and Canada, the event attracted foxtailers from Australia, Bulgaria, Kazakhstan, and Sweden to the City of Roses.

Before traveling to Portland, Gyuri visited KE6HTS in Santa Barbara. They went to a VE session where Gyuri easily passed the tests to become KF6YKN. On the courses in Oregon, it became clear that he had resumed his ARDF training. He posted the best five-fox time of the day in the 80-meter event, even though he was the oldest in his age category.

The 2000 WCs were on the Asian continent for the first time. The Chinese Radiosports Association hosted and WB6BYU was invited to serve on the international jury. Nine hams represented the U.S. on the courses, including 15-year-old Jay Thompson, W6JAY, whose mother is of Chinese descent. KF6YKN ran in the prime-age Senior category with five foxes to find, even though he was qualified by age for the four-fox Old Timers category. There was also a new four-fox category for Veterans, meaning men ages 55 and up. One of the USA's two Veterans was Bob Cooley, KF6VSE, who became the first Team USA member to finish in the top ten in his category.

IARU rules allow a maximum of three persons in any age/gender category on any national team at the WCs. Even with the addition of the Veteran category, the growing interest in the sport would soon make it impossible to allow everyone with the desire to join Team USA. I set two qualifying courses in southern California to help select and train Team USA 2000, but something better was needed for the future.

Amateur radio societies all over the globe stage national ARDF championships to build interest and to find out who is most deserving of a spot on their teams. Members of the Albuquerque Amateur Radio Club stepped forward to host the First USA ARDF Championships in the summer of 2001. National championships have become an annual tradition ever since, open to anyone of any age, with or without a ham radio license. Besides the best radio-orienteers of the states, there have been visiting competitors from seven foreign countries over the years.

In 2002, IARU rules changed to specify nine age categories, five for males and four for females. Men over 60 and women over 55 need to find only three of the five foxes. Competitors don't get to choose which foxes not to find. The skipped foxes in each category are specified in the IARU rules.

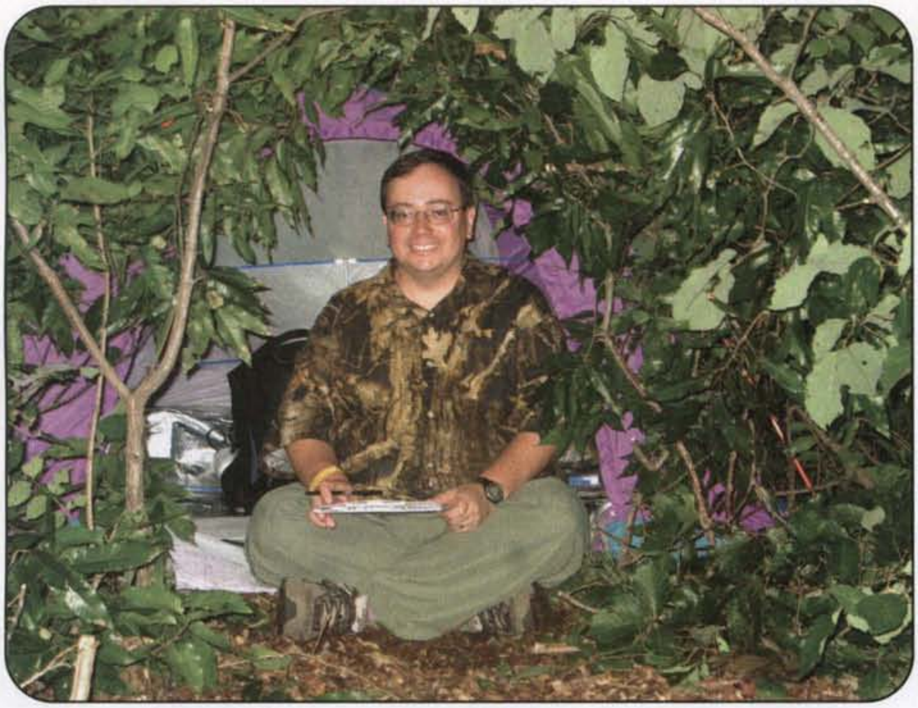
U.S. teams continue to improve in this decade, with Gyuri in the lead. For the 2002 WCs in Slovakia and the 2004 WCs in

Harley Leach, KI7XF, in the 2-meter finish corridor at the 2008 World Championships. He fabricated his Yagi antenna from aluminum stock. Notice the holes in the boom to make it lighter. (Photo by Dale Hunt, WB6BYU)

the Czech Republic, he put on training camps beforehand near his home town of Pecs, Hungary. Most Team USA members participated, as well as two Team Australia members who had visited at our 2001 national championships. KF6YKN rented a house for the group and put out several full-length ARDF courses, plus sprints and orienteering practice. After that, everyone went to the Hungarian national championships for even more practice on very long courses.

Bob Frey, WA6EZV, our team's co-captain in 2002, wrote, "I was tickled to death with Gyuri's training camp! It was fantastic!" KF6YKN took fifth in his category in the 2-meter hunt at the WCs in Slovakia, less than six minutes short of a medal. He accomplished that even though he was in need of knee surgery, which took place shortly thereafter.

In 2006, KF6YKN was granted U.S. citizenship and he changed his name to George Neal. On the Black Sea coast of Bulgaria that year, Team USA captured its first WC medal. Nadia Scharlau of North Carolina was awarded a tie for third place on 80 meters in the four-fox category for women over 35. She would have won it outright, but the homing beacon transmitter failed just as she punched in at her last fox and needed the beacon to navigate quickly to the finish line. After a thor-



As a member of the international jury at the 2008 World Championships, Ken Harker, WM5R, was stationed at fox #4 during the 2-meter and 80-meter competitions. Ken was co-chair of the organizers of the 2008 USA ARDF Championships in Bastrop, Texas. (Photo courtesy WM5R)

ough review, the international jury gave her the medal.

Another Medal This Year

Radio-orienteers of the world returned to Asia this year, as the Korean Amateur Radio League hosted the 14th ARDF WCs from September 2 through 7 at a resort in Hwaseong, just outside of Seoul. As the USA's ARDF Coordinator, I issued invitations to 22 persons to compete for our country, based on their finishes in the 2007 and 2008 national championships. Because of economic considerations and activity conflicts, only 11 were able to accept.

Among those accepting was WB6BYU, but a few weeks before the trip Dale was diagnosed with gout. Although he was hopeful that his foot pain would diminish enough for him to run in Korea, it was not to be. He traveled there anyway to attend meetings with officials from IARU Regions 1 and 3. He also served as Team USA's Captain, which meant going to even more meetings.

As one who had organized ARDF championships in the past, WB6BYU was impressed by the Koreans' high level of organization and attention to detail. "There were a lot of things that can go wrong that the officials had anticipated," he told me. "I was amazed by the number of volunteer hams that they had to help them. Everywhere you went, there were about 20 people in black vests with 'KARL volunteer' on them. At the opening ceremony, there had to be a hundred folks handling things."

These championships drew far more people than the 300 originally planned for. The final attendance was about 330 competitors and more than a hundred official visitors. The hotel had a limited number of rooms with beds, so those arriving later ended up with Korean-style sleeping arrangements—thin mats on the floor. "The pillows were little tiny things that felt like they were full of Rice Crispies," one reported.

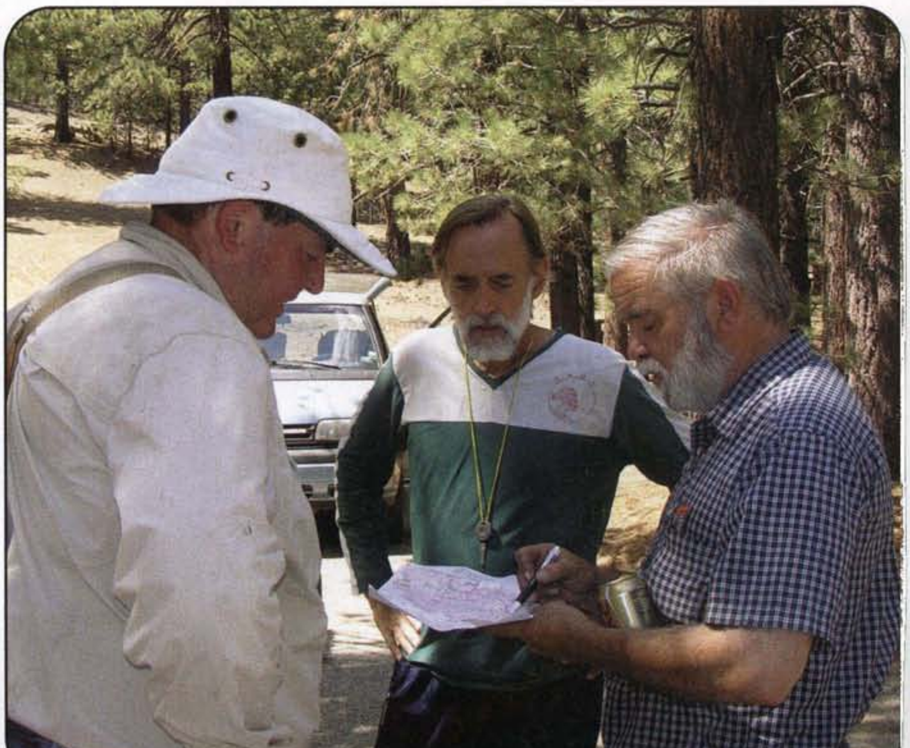
Team USA gave good marks to the food, which was served from large buffet tables in the gardens outside the hotel when weather permitted. "They had something for everyone," WB6BYU explained. "There was bread for the Russians, processed meat for the Germans, and so forth. One of our team members expressed surprise that they were serving lasagna for breakfast. He was even more surprised when he took a bite of it and it turned out to be kimchi."

Lined up at the start of the Bastrop Park 2-meter competition on May 9 are, left to right, Vadim Afonkin, Michael Bayern, W2CVZ, and Mike Urich, KA5CVH. Several runners, all in separate age/gender categories, started together as fox #1 came on the air each cycle. At age 12, W2CVZ was the youngest competitor at this year's national championships. (Photo by Joe Moell, KØOV)

Jennifer Harker, W5JEN, unfolds her 2-meter measuring-tape Yagi in preparation for the 2-meter hunt at the 2008 World Championships. She designed the courses for this year's USA Championships in Bastrop State Park after earning her team position at South Lake Tahoe in 2007. (Photo by Dale Hunt, WB6BYU, courtesy W5JEN)

The 2400-acre 2-meter contest site was a far cry from the usual European forests. About 40 percent of the map was marked yellow, meaning easy to navigate. However, these parts turned out to be drained rice paddies and fields of other crops, such as soybeans and bok choy. This was a first for most competitors. They wore new trails through these muddy areas and couldn't help trampling some of the plants. The farmers' dogs could be heard barking in the distance, but fortunately the dogs were confined and the farmers didn't seem to mind.

As always, the Russians, Ukrainians, and Czechs dominated the medal count,[2] taking home 92 percent of the gold medals. However, the U.S. did better than ever, with four finishes in the top ten. For the second time at the WCs, the Stars and



Marvin Johnston, KE6HTS (right), organized two training camps in the mountain forests for ARDF Team USA 2008. Participants included first-time team member Scott Moore, KF6IKO (left), and Bob Cooley, KF6VSE (center), who finished in seventh place in his category during the 80-meter event in Korea. (Photo by KØOV)

Stripes were displayed in the awards ceremony. This time it was by George Neal.

KF6YKN led our team by capturing a bronze medal in the category for men between ages 50 and 59 in the 2-meter foxhunt. He found all four required transmitters and got to the finish line in 1:23:42, less than six minutes behind gold medalist Igor Kekin of Russia. Our other top-ten finishers, all in the 80-meter event, were Vadim Afonkin of Boston, who was fifth in M40 category, Bob Cooley, KF6VSE, of Pleasanton, CA, who was seventh in M60, and Nadia Scharlau of Cary, NC, who was ninth in W35.

Selecting and Training the Team

For most Team USA members, the road to Seoul went through central Texas. This year's USA ARDF Championships took place from May 8 through 10 in Bastrop State Park, about an hour's drive east of Austin. Unlike most of the Lone Star State, Bastrop Park is hilly and heavily wooded, with loblolly and other pines, making it ideal for radio-orienteering. Houston Orienteering Club has done an excellent job of mapping it.

Organizing the USA Championships this year were Kenneth and Jennifer Harker, WM5R and W5JEN, of Austin. They had competed at the USA Championships in 2003, 2005, 2006, and 2007. Each won medals on both bands at South Lake Tahoe last year. W5JEN qualified for ARDF Team USA in the W21 category. WM5R was invited to serve on the international jury in Korea.

This year's participants ranged in age from 12 to 66 and came from nine states, plus Canada. They braved snakes, spiders, and poison ivy to track down the transmitters without injury. Packing gold medals in their suitcases for the trip home were Vadim Afonkin (M21, 2m and 80m); Michael Bayern, W2CVZ (M19, 2m and 80m); Jerry Boyd, WB8WFK (M50, 2m); Bob Cooley, KF6VSE (M60, 2m); Jay Hennigan, WB6RDV (M50, 80m); Harley Leach, KI7XF (M60, 80m); Nadia Scharlau (W35, 2m and 80m) and Charles Scharlau, NZØI (M40, 2m and 80m).

Ken and Jen got high marks for organizing a successful championships, which included a catered lasagna feast on Friday night when the 2o-meter medals were presented. The 80-meter hunt on Saturday started early and the electronic scoring (provided by KE6HTS and the Los Angeles Orienteering Club) made it possible to award the medals and get the out-of-towners to the airport in time to be home for Mother's Day.

Following the qualifying events in Texas, there were two excellent preparation opportunities for Team USA members this summer. KE6HTS organized a pair of weekend training camps in the Sierra Madre mountains of southern California, near Mount Pinos. All of the Californian members of the team took part as Marvin used the training techniques he had learned from KF6YKN. He started by putting them through a world-class 2-meter ARDF course on Saturday morning, starting at 8425 feet elevation.

After snacks and recovery of the transmitters, Marvin set out a low-power sprint course in the campground. The hunters' goal was to find each fox during its first one-minute transmission of the sequence. A perfect run would take just five minutes, plus a couple of minutes to return to the finish line. On Saturday evening everyone gathered in a nearby park, and Marvin heated up the charcoal and roasted Santa Barbara style tri-tip beef for everyone. Then on Sunday morning, KE6HTS set a full five-fox course on 80 meters.

A Big Year Ahead

ARDF activity is winding down for 2008. There will be a couple more local hunts in southern California before the holidays, but it is getting too chilly for radio-orienteering in most of the rest of the country. Now the plans for 2009 are coming together. The three IARU regions will hold championships for member countries and visitors. The Region 1 championships will be in Bulgaria during September and Region 3 in Thailand during November.

In addition to Region 2, the ARRL is a dues-paying member of IARU Region 3 because of the American territories in the western Pacific. As a result, the U.S. has officially been invited to send a team to compete in Thailand next year. If you are interested in going, please contact me.

I expect to announce the USA and IARU Region 2 championships location and dates soon. Check my "Homing In" web site,[3] as the dates and location may be available by the time you read this. My site also has many photos of the 2008 USA and World ARDF Championships as well as links to even more photos from the participants.

Our 2009 national championships will start the selection process for the 2010 team, which will go to the Adriatic coast of Croatia for the next WCs. Some new rules will be in effect, realigning the women's age categories to be the same as they are presently for men: W19, W21, W40, W50, and W60. A new category for men age 70 and up will be added.

Many thanks to all of you who have sent information on transmitter hunting activities in your area, both mobile and on foot. I welcome your stories and photos via e-mail or postal mail to the addresses at the beginning of this article.

73, Joe, KØOV

Notes

1. ARDF WCs take place in even-numbered years. In odd-numbered years, each of the three IARU regions is encouraged to hold its own international ARDF championship event.

2. Read about a visit to the USA from the Ukrainian ARDF Team Physician in "Homing In" in the Winter 2008 issue of *CQ VHF*.

3. <http://www.homingin.com>

By Bob Witte,* KØNR

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

How to Crossband on VHF/UHF

One handy feature that has made its way onto the list of standard features for many dualband FM transceivers is *crossband repeat* mode. This mode can be really useful for extending our radio range, and but it does come with a few challenges to consider.

Photo A. A typical dualband radio that includes crossband repeat mode. (Photo via KØNR)

Two Radios in One

In a dualband FM transceiver (photo A) crossband repeat capability takes the signal from one band and retransmits it on the other band. Typically, the two bands are 2 meters (146 MHz) and 70 cm (440 MHz), although other bands may come into play. Not all dualband transceivers are able to do crossband repeat. A key enabler is that the dualband rig must have two independent receivers that can operate simultaneously. Examples of two-receiver dualband rigs are the Alinco DR-635T, ICOM IC-2820H, Kenwood TM-V71A, and Yaesu FT-8800 and FT-8900. (The crossband repeat feature is not shown in the IC-2820H manual, so visit the ICOM website for details on how to enable it.) Examples of dualband radios that are "one frequency at a time" and don't offer crossband repeat are the Yaesu FT-7800R and the ICOM IC-208H.

As you may have experienced, a transmitter operating in close proximity to a receiver can overload the receiver, causing radio interference. In the case of 2 meters and 70 cm, the frequency spread is wide enough such that the front end of a well-built transceiver can keep the two bands from interfering. Note that these radios only repeat between different bands. They don't have the ability to repeat one 2-meter frequency to another 2-meter frequency, as there is insufficient isolation inside the radio. (Real repeaters use very large cavity filters to accomplish this.)

Inside the radio, crossband repeat is implemented via a logical connection between the squelch line of the receiver and the transmit control of the transmitter. In other words, when the squelch opens on one of the receivers, it causes other band's transmitter to turn on. The audio is routed from the receiver to the transmitter so that the signal is repeated. This feature generally works in both directions; signals on 2 meters are repeated on 70 cm and signals on 70 cm are repeated on 2 meters. Some transceivers offer a "one way" crossband repeat that allows the retransmissions to occur in only one direction. Early implementations of crossband repeat mode had limitations such as simplex only (no repeater transmit offset) and limited use of CTCSS. These days, crossband repeat can take advantage of all of the rigs' normal features, including transmit offset and CTCSS encode/decode.

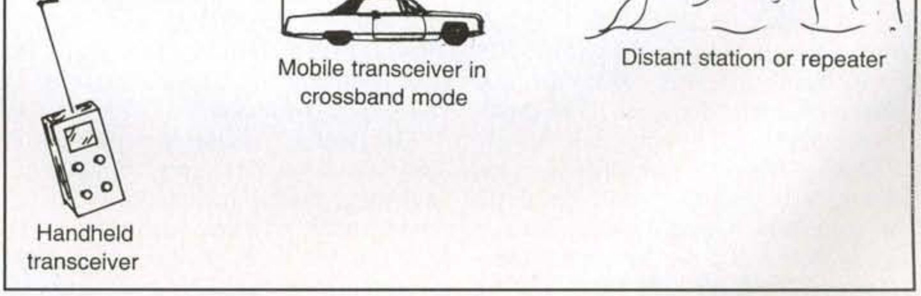


Figure 1. A system diagram that shows how a dualband mobile transceiver in crossband repeat mode can extend the range of a handheld radio.

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There are several reasons to use the crossband repeat feature. Probably the most common use is to extend the range of a handheld radio, as shown in figure 1. In this example, the handheld radio is set for simplex operation on the 70 cm band and the mobile transceiver is set to crossband from the same 70-cm simplex frequency to a 2-meter frequency. The distant station operates simplex on the same 2-meter frequency. I've arbitrarily shown the handheld radio on 70 cm and the other station on 2 meters, but there is no reason why the bands couldn't be swapped.

Another common use for a crossband radio is to fill in radio coverage gaps, perhaps on a temporary basis for a special event or emergency. For example, an ARES team might have trouble maintaining radio contact in a narrow canyon. Careful placement of a crossband rig can help fill in the gaps. Another common example is operating from inside a building where the radio waves don't penetrate very well. A crossband repeater out in the parking lot can help boost the signal.

One application where the typical crossband rig *doesn't* work well is in use at a conventional repeater site. The receiver performance of these radios may not hold up in an environment with strong interfering signals present. Also, these rigs are not really intended for heavy-duty, long-term repeater use.

Warnings and Tips

There are a number of things to watch out for when using crossband repeat. You need to be careful when selecting a frequency to avoid interfering with other radio amateurs' operation. There is no simple recommendation here, but understanding how the VHF/UHF bands are used in your area is the key. Check your local band plan to find a suitable spot and carefully listen for other activity. You may find that the band plan has a specific frequency designated for crossband repeat operation. Otherwise, you'll probably need to choose a lightly used set of simplex frequencies, one that conforms to the band plan.

Amateur VHF/UHF transceivers usually are designed for low duty cycle, with a mix of transmit and receive. They are not intended to transmit for long periods of time, so you need to take steps to keep the crossband transceiver from being continuously keyed at full power. One obvious thing to do is to set the transmit power to a lower level, which decreases the heat generated by the transmitter. This is especially true for radio links that only need to go a short distance (e.g., the handheld to mobile link in figure 1). Most of these transceivers have a transmit timer, which should be set to a reasonable time limit, say 3 minutes. If possible, using CTCSS decode on receive is highly recommended, as this can prevent unexpected signals from activating the transceiver and keeping the transmitter on.

We'd like to be able to access conventional repeaters using the crossband repeat function, but it might be a little trickier than you expect. Referring back to figure 1, suppose the distant station is really a repeater we want to access on 2 meters. Of course, we need to program the 2-meter transmitter in the crossband radio with the right tone and offset to access the repeater. Whenever the repeater transmits, the crossband radio will hear the 2-meter signal and repeat it on 70 cm. The 70-cm transmitter stays on until the repeater drops, so the crossband radio will not hear anything on the 70-cm side during that time. In other words, the crossband radio gets locked into repeating 2 meters to 70 cm and won't open up until the repeater stops transmitting.

Many amateur radio repeaters keep the transmitter on for 5 seconds or so after the user stops transmitting. If other repeater users respond quickly, the repeater transmitter may not drop during the contact. If there is an active net, or just some long-winded ragchewers, the repeater transmitter could remain on for hours at a time. The handheld user (figure 1) will be listening on 70 cm waiting for a chance to break in, but it may never come. This is a serious limitation of the crossband approach. It requires the signal from the other side of the radio to go away before the crossband repeater can switch direction, enabling a response.

This same principle keeps crossband repeat from being used to access the autopatch function on a repeater. As soon as the autopatch is turned on, the repeater will be transmitting the phone-line audio for the user to hear it, which will lock up the crossband transceiver.

You can probably think of other ways to use the crossband repeat mode. Referring again to figure 1, sometimes the handheld radio user can hear the distant station or repeater just fine but does not have a strong enough signal to get back to it. One approach is to have the HT listen to the distant station directly and only use the crossband repeat when it transmits. This requires a dualband handheld, since it will be listening on 2 meters and transmitting on 70 cm.

Photo B. Handheld radios are "handy," but they can often use a signal boost from a crossband mobile radio. (Photo courtesy <rigpix.com>)

Another approach is to have both stations use dualband radios to transmit on 70 cm and listen on 2 meters. This means that the crossband repeater is always listening on 70 cm and transmitting on 2 meters, much like a conventional repeater but with transmit and receive on two separate bands.

Control Point

For radio amateurs in the U.S., there are some FCC regulations that we need to adhere to when using a crossband radio. This quickly takes us into the realm of armchair lawyer, which is always a tricky place to be. I'll outline a few issues that I see in the FCC Part 97 regulations, but you'll be the judge of how you are going to handle them.

Like all amateur radio stations, the crossband rig must have a control operator and a control point for the radio. The FCC regulations (Part 97.105) say, "The control operator must ensure the immediate proper operation of the station, regardless of the type of control." Most crossband rigs do not have the ability to be controlled remotely; you flip them into the crossband mode from the front panel and the radio stays in that mode until someone manually turns it off. You might consider the radio to be *automatically controlled,* which is allowed for repeater stations and auxiliary stations. (Refer back to the Spring 2007 *CQ VHF* FM column "What is this Auxiliary Operation Stuff?" for more information on auxiliary stations.) The control operator does not have to be present at an automatically controlled station.

Independent of the type of control used, the important point is that the FCC does expect you to be in control of your radio, since you are responsible for its transmissions.

Identification

The other regulatory issue with crossband repeat mode is transmitter identification. There are two transmitters in the crossband repeater and both need to send their assigned callsigns consistent with the FCC's 10-minute rule (Part 97.119). Most dualband rigs do not have an identification feature included that can be used for crossband mode. One exception is the Kenwood TM-V71A, which has a 10-minute Morse code identifier that can be programmed with your callsign. (The radio also can do voice identification if the optional voice synthesizer is installed.) Unfortunately, Kenwood implemented this feature to transmit an ID every 10 minutes in crossband repeater mode, even if there is no activity on the channel. This is very annoying for practical use and will increase the probability of causing interference for other users on the frequency. (Most repeater systems are implemented to stay quiet when there is no activity on the input frequency.)

I'll assume that the crossband transceiver does not have an automatic identifier in use (which is usually the case). Referring back to figure 1, both transmitters in the mobile transceiver need to be identified. We'll assume that the mobile rig is under the callsign of the handheld user, so when the handheld user transmits the callsign, it will also be transmitted on the 2-meter crossband transmitter. That can take care of that transmitter ID. In the reverse direction, the distant station's callsign will get sent (might be a repeater callsign) and repeated on the crossband 70-cm transmitter. We already said the mobile transceiver is operating under the callsign of the handheld user, so this doesn't work out very well. Some people say that the callsign of the distant station is used to ID the 70-cm mobile transmitter, especially if that distant station is a repeater. Of course, this would require the agreement of the distant station and it effectively makes it responsible for the ID function. As an alternative, the handheld user could flip over to the 2-meter frequency and identify, which would be repeated on the crossband 70-cm transmitter. Clearly, this situation is not ideal.

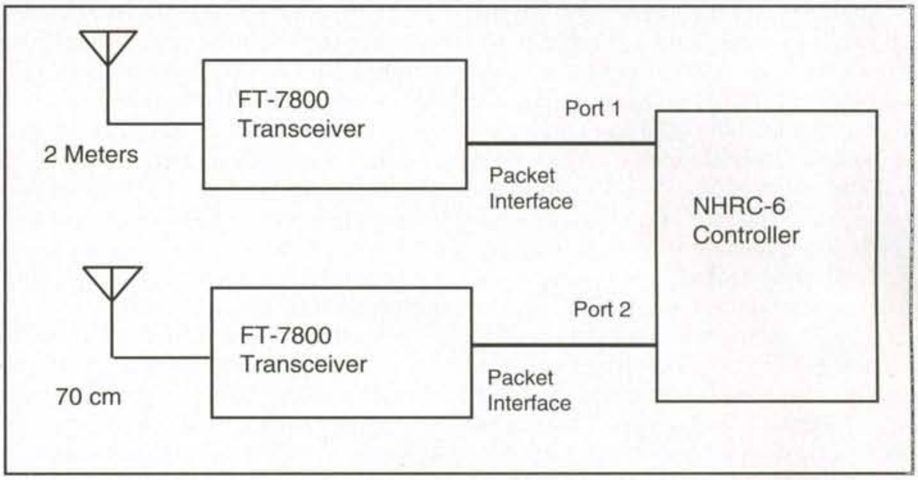

Figure 2. Block diagram of the two-transceiver crossband repeater.

Pin	Label	Description	Repeater Interface
1	PKD (Data In)	Packet Data Input	Transmit Audio
2	GND	Signal Ground	Ground
3	PTT	Ground to Transmit	PTT
4	RX9600	9600 bps Packet Data Output	—
5	RX1200	1200 bps Packet Data Output	Receive Audio
6	PKS (SQL)	Squelch Control	CAS

Table 1. FT-7800R packet port.

Crossband Repeater System

To deal with the issues of identification and control, I decided to use a repeater controller to control two independent 2-meter/70-cm transceivers. Most repeater controllers are set up for conventional repeater control with a fixed receiver and fixed transmitter. What I needed was a controller that incorporated the concept of two independent transceivers that could be linked together, independently controlled, and independently identified. The NRHC-6 Bridging Repeater Controller is designed to handle this specific case of connecting two transceivers. The block diagram of this crossband repeater system is shown in figure 2.

I used a pair of FT-7800R transceivers which have a packet port on the rear panel that provides a convenient interface point for the repeater controller. This port has the required transmit audio, receive audio, PTT line, and squelch line. The squelch line indicates the condition of the receive squelch, including the effects of CTCSS decode if enabled in the transceiver. (Not all transceivers behave this way; some only provide carrier squelch even if CTCSS decode is enabled.) Table 1 shows the signals available from the packet port and how they are used in the repeater interface.

The NHRC-6 controller has a versatile feature set that requires some programming to make it work. It supports two radio ports that can be configured to handle two back-to-back simplex radios. The controller has DTMF control, which can be accessed from either radio port. The five saved setups are handy for storing away specific repeater configurations. Each radio port can have its own courtesy tone and CW identifier, along with the usual set of hang timer, ID timer, timeout timer, etc. The crossband repeater can be turned on and off remotely using DTMF on either band.

Figure 2 shows two separate antennas, one for 2 meters and one for 70 cm. In most cases, I use one dualband antenna and a 2-

Photo C. The crossband repeater built using two independent FT-7800R transceivers controlled by an NHRC repeater controller.

meter/70-cm duplexer to allow the two radios to feed the antenna. I also keep the radios set at less than full power to minimize the heat-dissipation problem.

This crossband repeater is housed in a portable case that has standard 19-inch rack hardware (photo C). The two transceivers are mounted to a 19-inch shelf using their normal mobile mounts. The NHRC-6 controller has its own 19-inch rack-mountable chassis. The case has front- and rear-panel covers that snap on, protecting the equipment during transit. The system runs off 12 VDC. I did not include an AC power supply inside the case. Depending on the location, I simply connect the repeater to a 12-volt car battery or a compact AC switching power supply.

Tnx and 73

This has been an overview of using crossband repeating FM transceivers, along with an example of a more complete crossband repeater system. I hope this gets you thinking about how crossband methods can aid your radio operating. 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. FCC Part 97 Rules
2. <http://www.arrl.org/FandES/field/ regulations/news/part97/>
3. NHRC Repeater Controllers: <http: //www.nhrc.net/>

By Keith Pugh,* W5IU

SATELLITES

Artificially Propagating Signals Through Space

Amateur Radio Satellite Meetings

I spent the last half of the month of July 2008 attending amateur radio satellite meetings. First came the Amateur Radio on the International Space Station (ARISS) Face-to-Face Meetings in Moscow, Russia, and second was the annual AMSAT-UK Space Colloquium at the University of Surrey in Guildford, UK. This was my first-ever trip to Russia and the most recent of several trips to the AMSAT-UK Space Colloquium. I will attempt to relay my impressions and knowledge gained during these meetings in the following paragraphs.

ARISS Face-to-Face Meetings

Over the years, ARISS has held at least one face-to-face meeting in addition to the regularly scheduled telephone conferences and e-mail activity utilized to conduct the day-to-day business of ARISS. These meetings give the ARISS international delegates and others a chance to meet one another and conduct discussions, etc., that are difficult to do without the free exchange in a face-to-face setting. Typically, these meetings are held in conjunction with other amateur radio satellite meetings such as the annual AMSAT-NA Space Symposium and the AMSAT-UK Space Colloquium. Occasionally, the ARISS Face-to-Face Meeting is held independent of other meetings. The meeting in Russia was originally planned to take place near the time of the 50th anniversary of the launch of Sputink I on October 4, 1957.

Sergy Samburov, RK3DR, and his famous great-grandfather, K. E. Tsiolkovsky.

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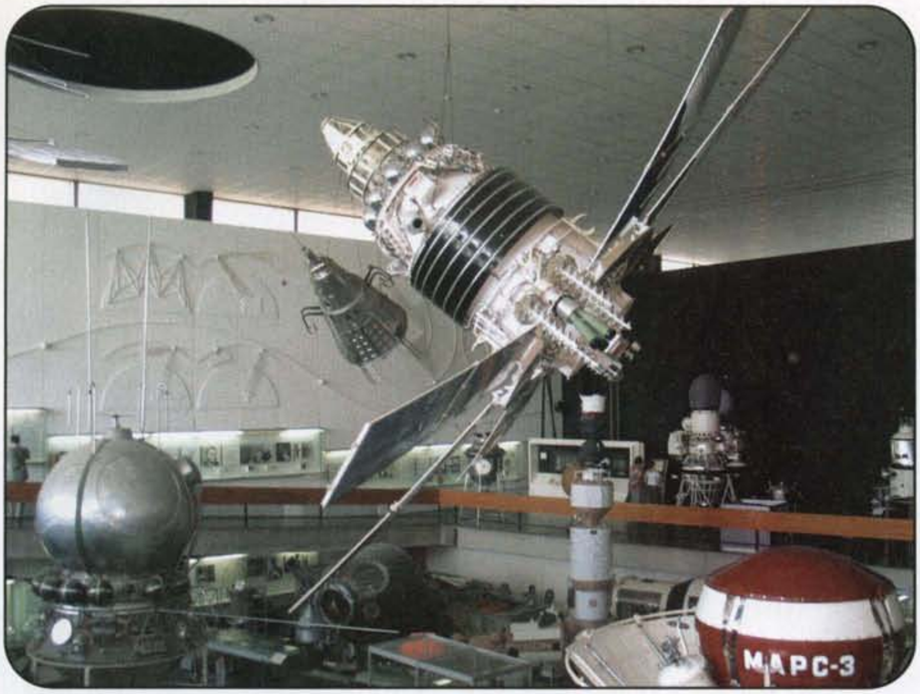
Sputnik-1 opened up for access to payloads at the Space Museum of the Energia Corporation.

K. E. Tsiolkovsky and his "Ear Trumpet."



Space hardware in the Kaluga Museum.

Due to the planning and logistics involved in arranging such a meeting, it was nearly a year late.

This was actually a series of meetings involving several different aspects of the ARISS program. In addition to the core ARISS International meeting, there was a meeting of a newly formed Amateur Radio Working Group—a group of delegates made up of selected representatives of the various space agencies involved in ARISS. There were also meetings of the people involved in crew training relative to ARISS and Technical Interchange Meetings to discuss current and future ARISS programs such as SuitSat II. These meetings were held in a combination of NASA leased facilities in the hotel at which we stayed, the Energia Corporation Moscow facilities, and the Gagarin Crew Training Center in Star City, Russia.

Full-size model of a Soyuz vehicle and its launcher at the Kaluga Museum.

We were also able to tour the excellent Space Museum at Energia Corporation. Many examples of actual space hardware were available to look at in this museum. Some actual hardware was available, along with test articles, spares, etc.

I was able to attend the ARISS International core meeting and the technical interchange meetings. At the ARISS international meeting held in the hotel, most of the delegates were present, but those who were not were tied in by teleconference and e-mail. Reports were given by each country or region represented on their activities over the past year. Status of the equipment currently on board the ISS was discussed. Plans for this equipment in the future, including updates, were spoken about. With the addition of more modules to the ISS comes the possibility of expanding station functions and increasing activity with more crew members present. Current thinking on these potential expansions and upgrades was discussed.

Technical Interchange Meetings were held the following week at Energia Corp. A principal focus of these meetings was for all parties involved to better understand the SuitSat II project. Some limited hardware was available for fit check into a genuine Russian Orlon Suit, and measurements were taken for making up cabling between the equipment inside the suit and the antennas and control box on the exterior of the helmet. Plans for the expanded functionality of SuitSat II were discussed, including location of solar panels for battery charging and interfacing of experimental payloads. Two representatives from a Russian university were present to discuss their proposed payload. With increased functionality, renewable power source, and experimental payload capability, SuitSat II will become a full-fledged amateur radio satellite, not just a neat publicity trick. It will fulfill a very valuable educational and inspirational service, as well.

Of course "all work and no play makes Jack a dull boy" came into play, and a weekend train trip to Kaluga, Russia, about 125 km southwest of Moscow, was planned by Sergy Samburov, RK3DR, the Russian ARISS International representative. The process started with a

RK3XWM amateur radio club station at the space school in Kaluga.

learning experience in the Moscow Public Transportation System, obtaining tickets for the Kaluga trip, and visiting a new, up-to-date shopping center for a first-class dinner. Kaluga is Sergy's home town and the town in which his famous great-grandfather, Konstantin Eduardovich Tsiolkovsky (1857–1935), lived and taught in most of his life. Kaluga is justifiably proud of K. E. Tsiolkovsky, Father of Manned Space Flight Theory, and has preserved many mementos of his career in his home, erected several memorials to him, and hosts an excellent space museum in his honor.

The highlight of the visit to Kaluga was the going to a special space school in Kaluga, where "hands on" techniques are used to introduce math, science, and other space-oriented disciplines to young students. While there, we were able to see a

Sergy and a picture of his great-grandfather in Sergey's original home in Kaluga.

Listening for DO-64 at the AMSAT-UK Space Colloquium.

presentation about the school, models the students had made, their amateur radio club station, and also witness model rocket launches. We were able to meet a number of the students and the faculty.

My impression of Russia after this trip is drastically different from the Cold War days image I had in my head. Russia has indeed joined the western world in goods, services, and prices. There are still remnants of the old Russia around, too, as evidenced by the bureaucracy that abounds everywhere.

Additional information about the ARISS program can be found at: <http://www.ariss.org>.

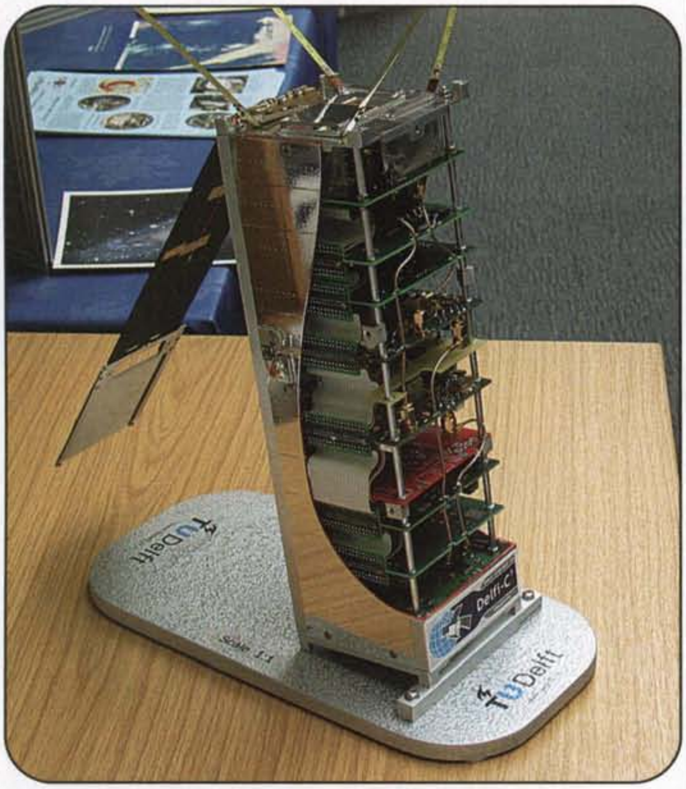
AMSAT-UK Space Colloquium

Before my return to the U.S., I stopped in London and traveled to the University of Surrey for the AMSAT-UK Space Colloquium. This was an opportunity to renew old friendships from "the other side of the pond," make some new acquaintances, and catch up on the latest amateur radio satellite technology. The AMSAT-UK Space Colloquium still creates the feeling that you are back in school. Campus facilities—including meeting rooms, residence halls, and dining halls—are used for all activities. The British put on a good show and complete coverage of presentations, etc., is available at <http://www.uk.amsat.org>.

Highlights this year included an excellent presentation on the Delfi-C3 program by the Delfi-C3 Team, and the AMSAT-DL presentation by Peter Guelzow, DB2OS, on the Phase IIIE program.

The Delfi-C3 Team led us through the design, development, construction, and test of their triple CubeSat, now known as DO-64. Of particular interest to me was the presentation on developing and testing the mechanism for deployment of the antennas after launch. In the evening, following the presentations, we were able to witness the first pass, in range of the UK, with the DO-64 Mode U/V transponder active in amateur radio service. This satellite, like AO-07, is only useful if the satellite is in sunlight. There are no batteries in the satellite and operation relies on sunlight on the solar panels.

Return to High Earth Orbit (HEO) continues to be a dream of all satellite operators. We have been starved for HEO activity



Full-size model of Delfi-C3, DO-64, roughly 4" × 4" × 12".

since the untimely demise of AO-40. Peter, DB2OS, President of AMSAT-DL, gave a presentation on the status of the Phase IIIE program. In a nutshell, Phase IIIE is complete and ready to launch except for delivery, installation, and integration of the latest version of the Integrated Housekeeping Unit. This unit, an AMSAT-NA responsibility, is near completion but has been plagued by U.S. ITAR problems. ITAR governs release ability of technology developed in the U.S. to other countries. This is complicated by the fact that AMSAT-DL is running out of funds to keep its laboratory open for business until the "bird" is complete.

Now for an even bigger problem: No affordable launch has been found to date. Launches are available, but none of the AMSAT units alone or in combination have been able to come up with the funds to launch the "bird." AMSAT-DL continues to look and negotiate, but so far these efforts have borne no fruit. There is still hope that some help will become available if the German government decides to fund the AMSAT-DL Phase 5A program, but don't "hold your breath."

Summary

This column reported on the activities at a couple of amateur radio satellite meetings. Attend and support these meetings whenever you can. The next one is the AMSAT-NA Space Symposium, which will be held in Atlanta, Georgia, October 24–26, 2008. It will be over by the time you read this, but you can start now to plan for next year's meetings.

Don't forget to support AMSAT in its education and fundraising efforts so that we can continue to put more "birds" in the air. In particular, support Phase IIIE, Eagle, and the Intelsat Phase IV Ride Share projects so that we can get back into the HEO satellite business.

'Til next time! 73, Keith, W5IU

By John Champa,* K8OCL

HSMM

Communicating Voice, Video, and Data with Amateur Radio

New High-Speed Multi-Media Radio Mesh Networking

If you have not been tracking the events of the North Texas Microwave Society (ntms-hsmm@yahoogroups.com) on the HSMM web page, you are missing a lot of action! The NTMS is in the heart of wireless Telco development country in the Dallas/Plano area. New developments and innovative thinking are taking place all the time.

de KD5MFW

For example, recently I had an opportunity to interview Glenn Currie, KD5MFW, who is working with a team of HSMM radio experimenters in the Round Rock (Austin), Texas area. This team is called the Austin HSMM Special Interest Group (SIG). There are some key participants from the Roadrunners Microwave Group (RMG).

An interesting development Glenn reports is that by using Optimized Link State Routing Protocol (OLSR) their new mesh nodes auto link and are passing data within five seconds of coming into RF range. For more information on OLSR, go to <http://www.olsr.org>. With a large mesh, when two nodes are passing data and a node in the link goes down, OLSR automatically switches to another route through the mesh. The user usually notices nothing. This development puts HSMM on the cutting edge of mesh networking!

Figure 1 is a web page served up from inside the WRT54G router running the Austin HSMM SIG version of the OLSR mesh software. Under "Links" are shown all the current nodes within RF range. These nodes include node 71, which is serving up the web page (10.1.71.1:1978). Port 1978 is the OLSR status port address for each node.

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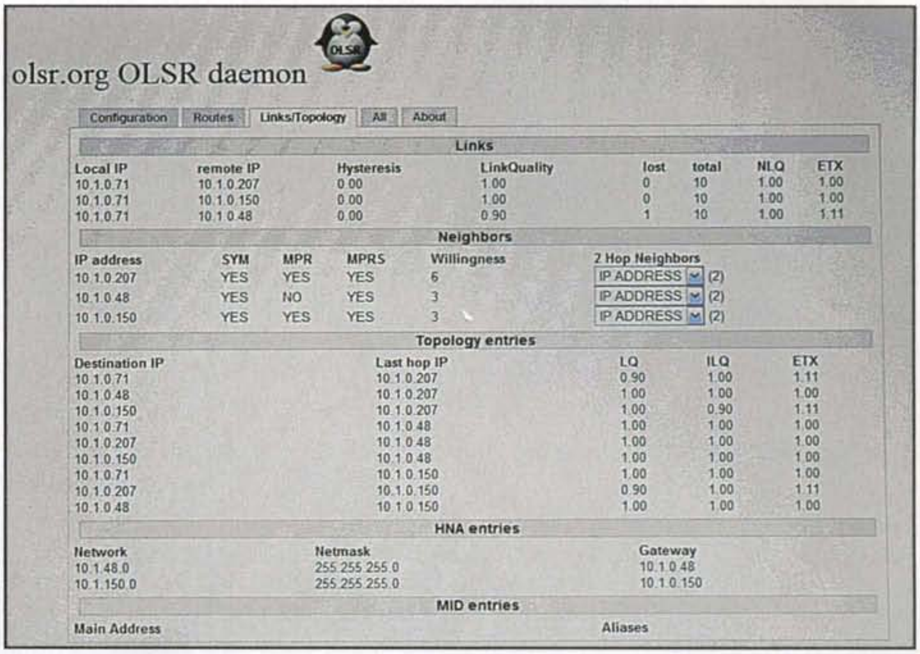

olsr.org OLSR daemon

Configuration | Routes | Links/Topology | All | About

Links

Local IP	remote IP	Hysteresis	LinkQuality	lost	total	NLQ	ETX
10.1.0.71	10.1.0.207	0.00	1.00	0	10	1.00	1.00
10.1.0.71	10.1.0.150	0.00	1.00	0	10	1.00	1.00
10.1.0.71	10.1.0.48	0.00	0.90	1	10	1.00	1.11

Neighbors

IP address	SYM	MPR	MPRS	Willingness	2 Hop Neighbors
10.1.0.207	YES	YES	YES	6	IP ADDRESS (2)
10.1.0.48	YES	NO	YES	3	IP ADDRESS (2)
10.1.0.150	YES	YES	YES	3	IP ADDRESS (2)

Topology entries

Destination IP	Last hop IP	LQ	ILQ	ETX
10.1.0.71	10.1.0.207	0.90	1.00	1.11
10.1.0.48	10.1.0.207	1.00	1.00	1.00
10.1.0.150	10.1.0.207	1.00	0.90	1.11
10.1.0.71	10.1.0.48	1.00	1.00	1.00
10.1.0.207	10.1.0.48	1.00	1.00	1.00
10.1.0.150	10.1.0.48	1.00	1.00	1.00
10.1.0.71	10.1.0.150	1.00	1.00	1.00
10.1.0.207	10.1.0.150	0.90	1.00	1.11
10.1.0.48	10.1.0.150	1.00	1.00	1.00

HNA entries

Network	Netmask	Gateway
10.1.48.0	255.255.255.0	10.1.0.48
10.1.150.0	255.255.255.0	10.1.0.150

MID entries

Main Address	Aliases

Figure 1. ARES-MESH status screen as displayed by mesh node 71 by looking at address 10.1.71.1:1978 using a web browser. Three other nodes can be seen with good link quality.

Moving to the right on the top section, local node 71 can see remote nodes 207, 150, and 48. There is no delay (hysteresis) set. RF link quality between all nodes is "perfect = 1" except for node 71, which has a less than perfect, but usable, link to node 48, and thus the 0.90 rating. It looks as if that 0.90 link quality was because one packet was lost out of the last ten (but was resent and correctly received). Therefore, the net link quality to all nodes is perfect = 1.00, because no data was lost, although a resend was needed from node 48. The next group of data shows an IP address that node 71 can see. SYM, MPR, MPRS explanations will not fit in the caption.

Willingness shows the number of possible ways a node has to get to other nodes. Two Hop Neighbors show the IP address of the two different hops a node can make to other nodes. You have to click on the down arrow to see the addresses. In a big network the list would be huge.

The Topology entries show all combinations and permutations of links between nodes in the network: LQ, ILQ, and EXT all are measures of link quality.

Link quality is important for such things as Voice over Internet Protocol (VoIP). If the link quality is poor, you may be able to sputter files through without errors, but there will be dropouts for VoIP or video. No user intervention is needed to link with the mesh. This is why it is good for the field—no messing with addresses in the field. Exciting stuff! I will report more details on that in the next column. I also will try to strike a careful balance between giving recognition and at the same time protecting developers' time by preventing them from getting swamped with questions, which could interfere with their part-time work.

It appears that the Austin HSMM SIG is way ahead of what most other groups are doing in HSMM. John, N5OOM, and the crew in the North Texas Microwave Society HSMM SIG have done a lot of good work, and John's presentations are well done and informative. Some of that material has been published here, and I highly recommend it to people interested in HSMM. However, nothing has been published yet about crystal modifications to the WRT-54G or making serious modifications to the firmware. We are looking for material on those subjects.

Glenn promotes HSMM for several reasons. Hams need to make use of the inexpensive WiFi gear that can easily be operated on the ham bands and get into broadband computer-based radios. Hams need to be active in this or the hobby will fade. It is related to what the younger tech folks are doing with the internet.

Glenn grew up with computers and radios. He has one foot in each camp, as do all the key developers he is working with. That puts them in a position to have just the right perspective to see the great value of HSMM and how it needs to come together. Glenn has a 16-GB USB thumb drive on a lanyard that he carries around with him. It is full of academic papers related to the U.S. Department of Defense's Defense Advanced Research Projects Agency (DARPA) and other robot and communications topics, and the material they have collected on their HSMM projects. I hope to convince him to publish some of that material in future columns.

Years ago Glenn worked for the McDonald Observatory associated with the University of Texas and had one of the early ARPANET e-mail addresses. That was 25 years ago, and he has worked with the early 4.1 BSD Unix on a VAX11780. After tinkering with Unix/Linux systems for 25 years, you can't help but pick up a few things.

Glenn is a founding member and on the board of directors of The Robot Group Inc., a non-profit technology corporation for building stuff they won't let them build at work. He was also a team member of the Austin Robot Technology autonomous SUV entered in the DARPA Grand Challenge, having a vehicle drive 130 miles through open country with absolutely no human intervention. They did not win, but their "Marvin" was competitive. He had access to and interest in DARPA information for a long time, and as the ARPANET morphed into the internet, it is much easier to follow trends in robotics and communications. Glenn blasts through many published papers each week—anywhere from 30 to over 100. Commercial and military folks have been using mesh technology for some time and are still refining significant details. Glenn tries to follow what they publish:

I have been pushing for integration of 802.11 wireless technology into our emergency ham radio stations at area hospitals since 2002. This is called the ARCHES project. I am lucky enough to have some very capable friends who are interested in HSMM and they have done a lot of the development work, so it is truly a group effort. I serve as the "spark plug" and evangelist for the project. The project stays interesting, as we are learning new things all the time.

We have a wealth of information we have collected for 5 years or more of development. I have given a handful of presentations to key groups in the Austin area. Austin is the state capital, and as such, there are some hams high up in a number of the big agencies and large high-tech companies in the area. This has provided offers of microwave sites that we need to make the project work. We don't have the funds to rent space like the cell phone companies can. The strategy has worked well.

Glenn recognizes the need to get hams up to speed on what they have done so far, and they have a specific planned deployment to demonstrate it to potential ARES served agencies so they can understand what they can and cannot do with the system. It can be of great use, but explaining it, even to most hams, is more of an education and not an explanation. The administrators of the served agencies need to understand the capabilities of the system *before* they are in the middle of managing a particular disaster response:

We started our HSMM efforts to link area hospitals that already had ham stations in them, with faster links and to free up the 2m/70cm 1200-baud packet traffic frequencies for hams coming in from Llano, Taylor, Luling, etc., where the propagation of 2m/70cm was well suited for the distance they were trying to cover.

We have a great mix of skills and experience! The Roadrunners Microwave Group historically has been oriented toward conventional high-power narrowband modes—e.g. CW. Therefore, the group is well versed in stretching the distance and is essentially used to/from a mesh stand point, doing long-distance, point-to-point fixed and mobile links. They include a bi-directional amplifier (BDA) in their systems as standard operating procedure. However, the Austin HSMM SIG, part of the Travis County ARES (TCARES), found little use for BDA amps around Austin.

Either you had good locations or not and unless your amp was powerful enough to burn a hole through obstructions in the path, it did little good. Our anchor station at the Chapter Red Cross building in Austin is on a tower that needs maintenance. We have a lot of stuff on the tower and the rotor for the main beam needs replacing, as well as feed lines and about a dozen smaller antennas. It has finally cooled off a bit, so the tower work can be done without frying the tower workers. (*Editor's note:* It gets extremely hot in Texas in the summer and that must be taken into consideration when planning to do any antenna work!)

The American Red Cross is working off loans to operate now and needs donations. They did all they could to help during Hurricanes Katrina and Rita and they went more than broke helping in these disasters. So we need to do what we can to help with the tower there, as they are living on credit at the moment.

Hurricane Ike was handled differently and ham radio involvement was limited. The participation of the Red Cross was different as well. All of the background-check stuff is causing hams who have worked maintaining Red Cross and Emergency Operations Center (EOC) ham shacks to tell the agencies to "shove it" when after decades of service, they are being treated like criminals. Therefore, more of the work is done by hired hands with minimal background checks.

When I worked for the McDonald Observatory, my office mate on the UT campus in Austin went to work for the NSA. They did a background check. This stuff of the Red Cross and other agencies is more a cynical attempt to put a sub-contractor between them and any liability of a worker having a criminal history.

Over 20 years ago, the NSA spent over $20,000 checking out my office mate. The Red Cross spends $7 on a "background check." Apples and oranges or whatever—it is fruitcake to compare the two, and terribly misleading. I "throw rocks" as much as anybody, but I feel it is important to try to then close the loop and figure out what can be done to help, after all the dirty cards are on the table.

Anyway, we are looking into setting up HSMM stations for shelter logging, on a somewhat expanded scale of how we have used HSMM to do Field Day logging for the past three years.

The idea is that we drop off the HSMM gear at a shelter, get it on line, and then clear our potentially criminal butts out of the shelter and just collect the data over the mesh network. This circumvents us being physically present at the shelters, except to set up the gear. We never have enough hams to man 60 shelters 24/7 for days on end anyway, but we could make a go of it with HSMM mesh links between shelters.

We hope to set up a few demos of the con-

Photo A. The AeroComm 900-MHz, 1-watt modem.

cept with links between some of the most often used shelters in the area and invite potential served agencies to see what we can do, if allowed to deploy the gear. We have to demo the gear so we are part of the plan ahead of time. Once a disaster is under way, you cannot bug the administrators with new experiments; they have to go with what they have. Hopefully something will come of the demo effort, as ARES disaster support for served agencies has really changed as of Ike.

Thanks to Glenn, KD5MFW, and the RMG, I will report more on the Austin HSMM SIG next time and their cutting-edge mesh networking breakthrough! You will find their amateur digital video (ADV) and VoIP telephony experiments especially interesting.

de KB9MWR

Steve Lampereur, KB9MWR, of Green Bay, Wisconsin, reports that with the AeroComm 900-MHz, 1-watt units (photo A) his team has observed solid non-line-of-sight mobile coverage for 3 miles. This is with a base station at 35 feet into a 6-dBd omni antenna and a magnet-mounted antenna on the car. There is mobile coverage up to 6 miles, but it is not as solid.

The AeroComm CL4490-1000 ConnexLink is a 1-watt, 900-MHz Frequency Hopping Spread Spectrum (FHSS) RS-232 transceiver. The individual transceiver is available from Mouser Electronics (Part No.: 814-CL4490-232-C) for approximately $110 (http://mouser.com/>. Experimenters may wish to pick up the starter pack, which includes two transceivers, software, cables, and rubber-duck antennas (Part No.: 814-CL4490-232-SP) for approximately $225.

The actual RF module itself (AC4490) can be bought for $62 (Part No.: 814-AC4490-200M). The complete AeroComm CL4490 transceiver includes the AC4490 module housed in a nice aluminum case with an internal switching power supply and the necessary RS-232 to TTL conversion circuit. The antenna connection is via a Reverse Polarity SMA (RP-SMA). The CL4490 also includes four handy LEDs, which indicate DC power (PWR), link establishment (LINK), when it is receiving (RX), and when it is transmitting (TX).

Digi-Key (www.digikey.com) sells a handy "SMA Reverse Polarity Plug to SMA Jack" (Part No.: ACX1248-ND) adapter, which changes the CL4490's reverse polarity SMA connector into a normal SMA connector. To obtain specific details on network configuration go to: <http://www.qsl.net/n9zia/aerocomm>.

Until then, keep doing those radio experiments!

73, John, K8OCL

By Kent Britain,* WA5VJB

ANTENNAS

Connecting the Radio to the Sky

Ultra Wide Band (UWB)

We certainly are seeing a lot of articles these days on Ultra Wide Band, or UWB. The FCC has set aside 3.1 GHz to 10.7 GHz for UWB use. There is a lot of bandwidth and there are a lot of challenges for both transmitters and the antennas (photo A).

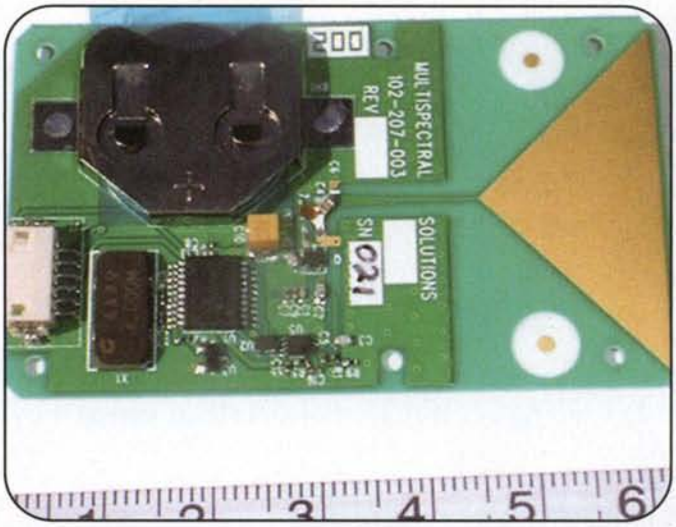

Photo A. Ultra-wide-band transmitter and antenna.

There are three main types of UWB signals being used at this time. The first type is simple FM. If I take my 5-GHz walkie-talkie and crank the FM deviation up to 500 MHz, this meets the FCC definition of UWB. No, that is not a typo. I didn't mean 5 kHz, but 500 MHz. Even the old C-band TVRO only used 30 MHz wide FM video. However, the idea is the signal is spread so thin that there isn't enough signal in any one part of the band to cause much interference. This is legal according to the FCC, but not commonly used.

The next UWB modulation is Orthogonal Frequency Division Multiplexing (OFDM). OFDM can be thought of as hundreds or even thousands of carriers each being separately modulated. It is kind of like one-thousand 9600-kb modems running in parallel. Thousands of these signals can result in data rates of over 250 Megabits/second. Demodulation of all these carriers is somewhat math intensive. However, with such little power in each carrier, again the interference potential is low. Also, to keep the FCC happy, the signals must be spread out over at least 500 MHz, and there are some complex formulas on how evenly the energy is spread out.

Impulse or Pulse Position Modulation was the original UWB modulation. The transmitter in photo A puts out a 1-watt pulse for 1-billionth of a second. This fast pulse isn't done with super-fast digital circuits, but rather with clever oscillator design. As the oscillator is turned on, the oscillator puts out five or six sine waves centered at 6 GHz and then shuts down as all the DC energy is used from the capacitors in the circuit. In many ways this is very similar to the self-squelching oscillators used in super-regenerative circuits for the last 90 years.

We had to use a Tektronix 11801 scope with a 26-GHz bandwidth to look at these fast pulses. The timing between pulses is used to send data. While the transmitter is putting out 1 watt, it has to transmit one-billion pulses to use up just one watt-second from the battery. That lithium coil cell will run the transmitter for over a year.

UWB Antennas

There are two big engineering problems with UWB antennas. The first is bandwidth; the antenna has to work over several GHz of bandwidth. The next problem is the Q of the antenna.

The typical resonant antenna is a high-Q structure. One way of looking at a high Q is to think of it as being similar to a flywheel that is spinning and spinning, thereby storing energy.

As shown in figure 1, on average, an electron must go back and forth on a dipole about 30 times before it leaves as an electromagnetic wave. Furthermore, it is only after the energy has built up on the antenna that it starts to look like 50 ohms. Back on 40 meters, this means that for the

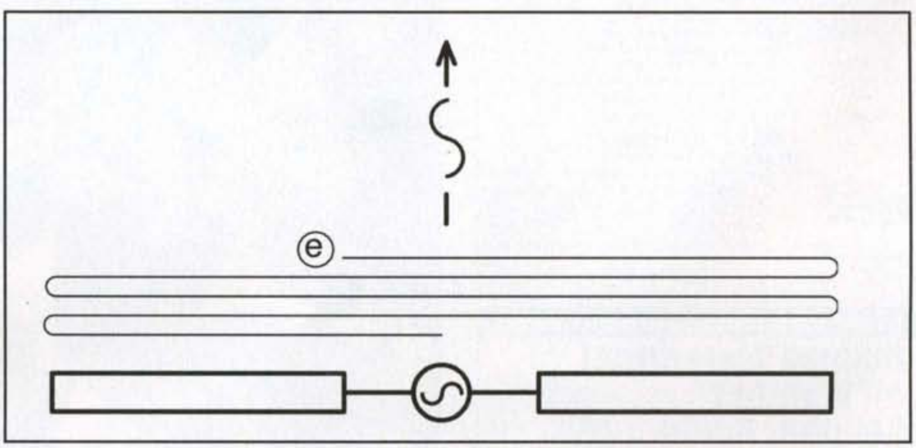

Figure 1. A typical electron takes 30 passes to radiate as a wave.

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Max
Signal
Max
Signal
V Beam
Exponential

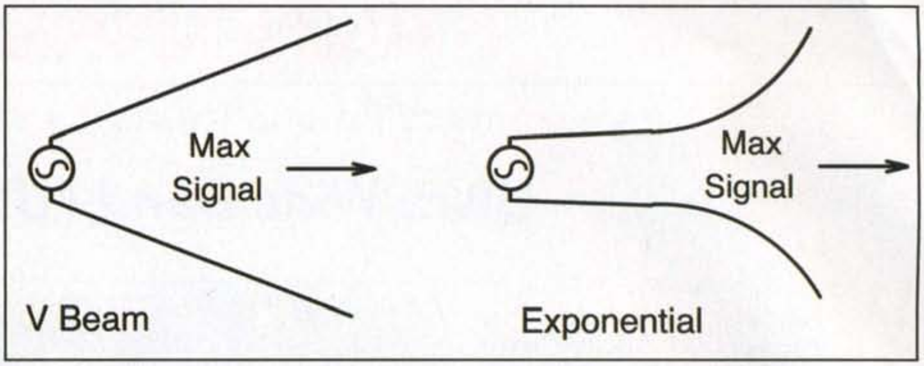

Figure 2. Dipole to V to Vivaldi antenna.

first 1/7,000,000 second your inverted-V looks like a dead short to your transmitter. Then, 1/7,000,000 second later the antenna has an impedance of a few ohms. Also, only after a few dozen waves have gone into the antenna does the voltage start to build up and it begins to approach the typical 50-ohm load. Of course, the average ham isn't all that worried that it takes few millionths of a second for the impedance of the antenna to stabilize.

However, for the designers of high-speed data networks and high-resolution RADAR systems, the transmitter impedance and the antenna impedance may be a lot different for these short pulses than it is for a CW signal. Also, the time it takes for the voltage to build up delays the pulse. Now my nice short pulse has been delayed by the ringing currents in the antenna, lengthening and delaying the data.

Exponential Antennas

If we start out with the simplest beam, we just take a dipole and point the elements forward, as in figure 2. Make the elements longer and longer, and the gain goes up. We now have the V beam, and when several wavelengths long, we start to build a rhombic antenna. On HF the ends of the wires are usually terminated with load resistors. However, if we make the wires thicker and thicker, we get a good SWR without the load resistors and build what is known as the Ram's Horn antenna. The Vivaldi antenna in photo B is from this same family of transmission-line antennas—a very wide bandwidth and modest gain, but unlike the dipole we don't have all that much circulating current.

Log Periodics

Because the log periodic is an array of dipoles, it also has the tendency to resonate and stretch out a sharp pulse. The log periodic in photo C covers 2 to 11 GHz and the entire UWB band. Two years ago we used that same log periodic as the feed for a 12-inch dish and were able to collect data from that 6-GHz trans-

Photo B. Exponential or Vivaldi antennas.

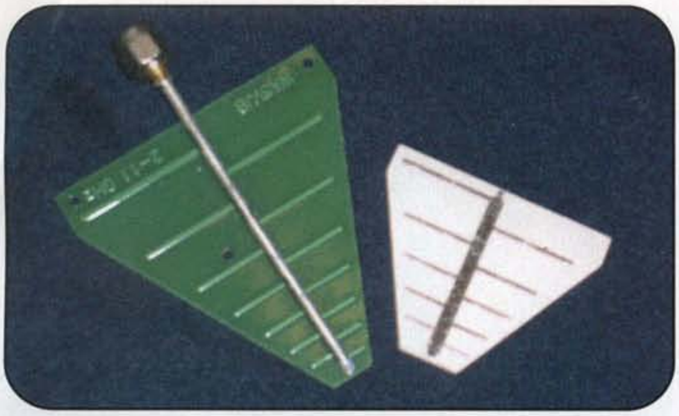

Photo C. Log periodics and UWB.

mitter in photo A at over two miles. UWB is not necessarily a short-range mode.

Scimitar Antennas

The Scimitar antenna has a long history in both electronic warfare and as a telemetry antenna in the Apollo space program. The inner radius sets the high frequency, and the outer radius sets the low-frequency range of the antenna. The Scimitar in photo D has an excellent 400–1500 MHz bandwidth. From a practical side, the antenna has a natural input impedance of about 20 ohms, so some kind of 20–50 ohm matching network is necessary.

Furthermore, it is usually the bandwidth of this matching network that sets the bandwidth of the antenna. A simple Scimitar covering the entire UWB band is small, simple, and becoming popular on many UWB products. When I come up with a simple matching system a multiband Scimitar should make a good ham project.

Fractal Antennas

In photo E you can see my Stage 5 Sierpinski fractal antenna. There has certainly been a lot of hype about fractals, and claims about their use with UWB. On the right you see a triangle of copper the same size as the Sierpinski. Whether the antenna is on network analyzer, or in the field, there is no significant difference in their performance. As to filters, this filter flattened out at 3.1 GHz. Thus, UWB starts at 3.1 GHz with very strin-

Photo D. Scimitar antenna.

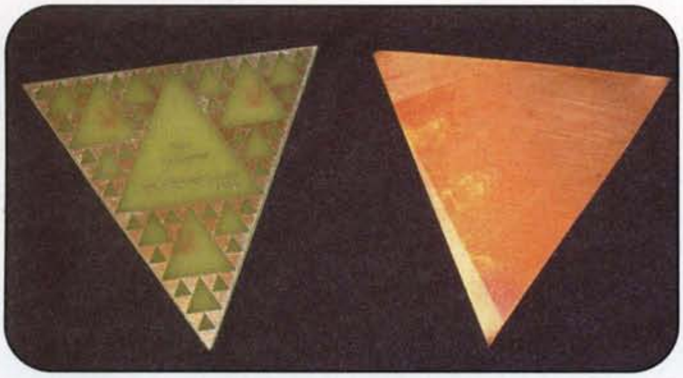

Photo E. Fractal antennas.

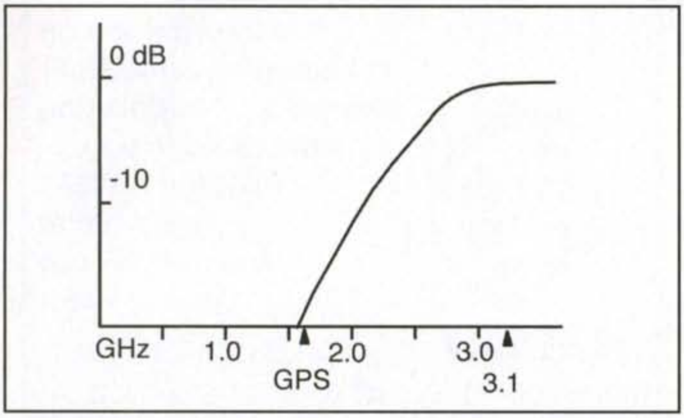

Figure 3. Gaussian response filter protecting GPS.

gent limits on how much signal/noise the UWB transmitter can put on the GPS band.

I always thought that the 3.1-GHz lower frequency limit for UWB was a kind of strange number. The early UWB systems were the impulse types. These short pulses on the order of one-billionth of a second long can make quite a racket. Some of the early UWB systems took out UHF TV, cell phones, and more importantly, GPS. Taking out GPS took out two major systems. First was navigation. For the FAA, this problem became a "safety of flight" issue.

The pulses also took out most cell-phone systems. A little bit of noise on the cell-phone bands just means your range drops a bit, and the battery in your phone gets used up a little faster since the phone has to run more power. However, the cell-phone problem went right back to the navigation problem. All those cell towers are kept in sync with the time signals from a GPS antenna on that same tower.

Without GPS, the cell sites lost sync. Therefore, the "experts" who said those short pulses would never bother anyone did not agree with the field work that showed impulse UWB chew up and spit out a number of systems.

The FCC and FAA's first priority was to protect the GPS band around 1.575 GHz. You can't just put a Drake TVI filter on a UWB signal, because the filters mess up the pulse. Therefore, the engineers looked at a UWB-compatible filter with a notch centered at 1.575 GHz. A pulse gets rounded off and stretched out when it goes through a filter. Also, the "ringing" stretches out the pulse. Therefore, a simple high-pass filter is not going to fix these interference problems. However, there is a class of constant group delay, or Gaussian filters.

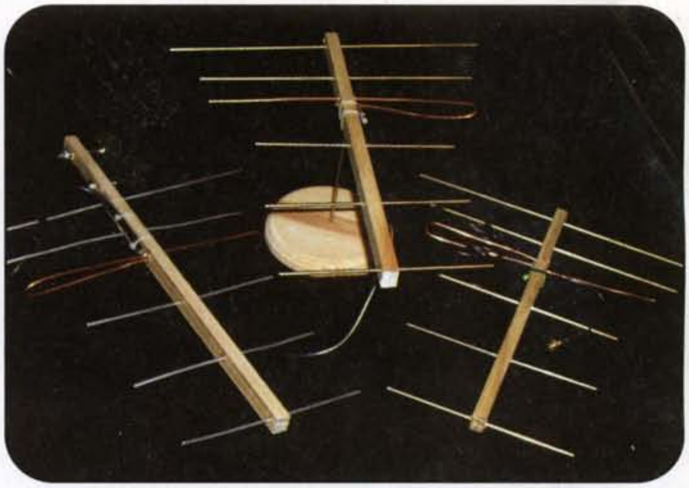

Photo F. UHF HDTV "Cheap Yagi."

These keep the pulse nice and square. Even so, Gaussian filters don't have a very sharp response.

In figure 3 we have a Gaussian filter with the notch right at 1.575 GHz to give maximum protection to GPS. The filter rolls off at 3.1 GHz. Now you know where that 3.1-GHz limit came from for the bottom of the UWB band. The upper limit is 10.7 GHz. Above that frequency are mainly military radars, and they don't like any competition.

Back to the experts who claimed that those high-power one-billionth of a second pulses would never bother anyone on the UHF bands: They missed several little things in the real world. First, most radios have some kind of filter in their front end. These filters again ring and lengthen out the pulses. The high-power UWB systems still have enough power through the filters to saturate the first transistor in the receiver. Now the power supply and bias supplies have to recover from this full-power whack, and this takes a few thousandths of a second. Of course, the pulse continues into IF, and IF filters lengthening out the pulse even longer. Now the pulses are long enough to blank out data, put bars on your TV set, or wipe out GPS systems and any cell towers on which they are located.

The HDTV Transition and Simple TV Antennas

If you subscribe to the other two magazines published by CQ Communications (*CQ* and *Popular Communications*), you know that I write for both of them as well as *CQ VHF*. It is because of the coming transition to digital television before my next *CQ VHF* column that I mention a construction article in *Popular Communications.* You will find a downloadable copy of the construction project for my HDTV version of the "Cheap Yagis" (photo F) at: <http://www.popular-communications.com/23-AntennasWeb92708.pdf>. Of course, a subscription to *Popular Communications* is the best way to go for this timely information, but CQ Communications has made a special exception to its embargo policy of current articles for this HDTV project.

As always, I enjoy your input and suggestions for future topics. You can e-mail me your antenna questions or suggestions at <wa5vjb@cq-vhf.com> and visit <http://visit www.wa5vjb.com> for additional antenna projects.

73, Kent, WA5VJB

By Bill Brown,* WB8ELK

UP IN THE AIR

New Heights for Amateur Radio

Superlaunch 2008

Each year many of the active amateur radio high-altitude-balloon groups across the nation attend the Great Plains Superlaunch (GPSL). This year's event was hosted by Near Space Ventures and CAPnSPACE and was held in the Kansas City area (see photo 1).

On Friday, August 1st, we gathered for an informative conference in a large auditorium at William Jewell College in Liberty, Missouri. This was an opportunity to discover what other groups have been doing and what they've learned in the past year. New payload designs and experiments, long-duration flight techniques, and multi-balloon linking as well as educational outreach efforts were among the topics covered. This year's program also included a unique K-9 search-and-rescue talk complete with live demonstrations of the search-and-rescue dog's ability to locate individual members of the audience using nothing but scent clues. They actually took the dogs into the field to track Near Space Ventures' payload during the following day's launch.

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Launch Day

Near sunrise on Saturday we all gathered in a field near the college and started inflating a total of nine balloons (see photo 2). Due to the rising costs of helium, using hydrogen safely was a hot topic this year. Nick Stich, KØNMS, and Taylor U (KB9ZNZ) each launched hydrogen balloons this year just prior to the release of the helium-filled balloons.

The helium-filled balloons were then launched, filling the sky with nine balloons in the air at once (see photo 3). Nick, KØNMS, ended up flying two balloons which carried APRS as well as the Garmin RINO system (GMRS radio with GPS) and a beacon on 434 MHz. Edge of Space Sciences (AEØSS) flew APRS, a crossband voice repeater (VHF/UHF) that provided coverage over a several-state area, as well as live camera amateur television (ATV) on 426.25 MHz showing dramatic views from the stratosphere in real-time. Taylor University flew two

Photo 1. Attendees at the Great Plains Superlaunch.

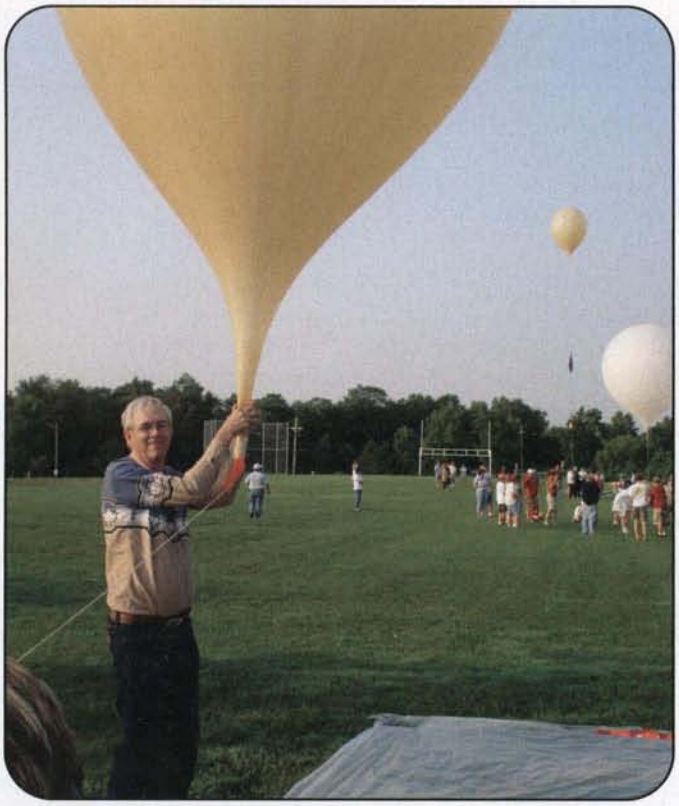

Photo 2. Jerome Doerrie, K5IS, gets ready to launch the WB8ELK balloon.

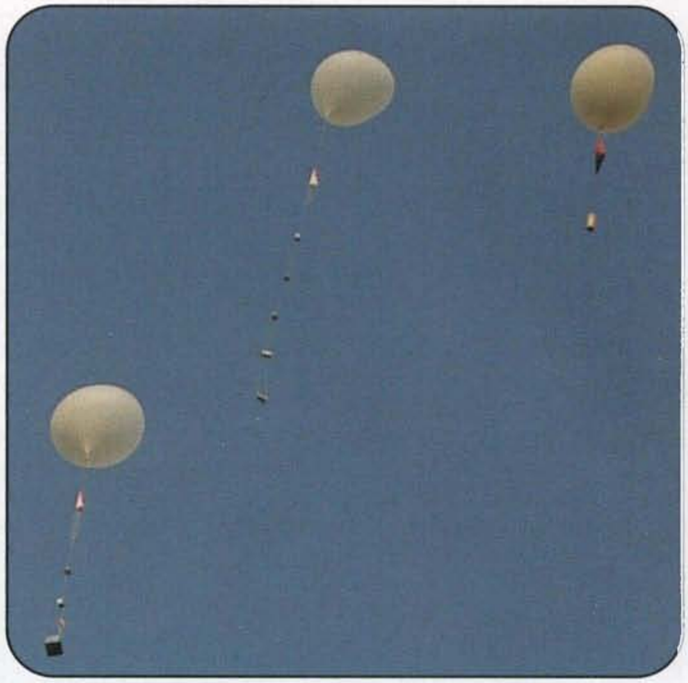

Photo 3. Balloon payloads fill the sky over Kansas City.

different balloons which carried APRS and a spread-spectrum 900-MHz system. BASE from DePauw University (W9YJ) flew APRS and a 900-MHz spread-spectrum system. ORB (KC5TRB) flew APRS as well as a 2-meter audio CW FM beacon and a 10-meter CW beacon. Near Space Ventures (WØNSV) flew a 2-meter APRS transmitter. WB8ELK flew APRS, a 2-meter simplex voice repeater, a 2-meter voice beacon, and a 10-meter HF telemetry transmitter sending down RTTY, Hellschreiber, and DominoEX5.

The Chase

With all these transmitters in the air at once, it was a foxhunter's dream. After liftoff we jumped into our vehicles and headed out on a wild chase toward the predicted landing zone. The real challenge was to get there before our payloads parachuted back down from the stratosphere. Fortunately, most of the payloads landed in a rural area south of Kansas City. One of the Taylor U balloons had a vent valve on it, and it came down with the balloon intact. When their chase team found it, they cut off one of the payloads and sent it up once again for a second flight on the same balloon. This proved to take a very long time to reach burst altitude, staying up for hours and traveling about 100 miles downrange into the Ozarks. The rest of the balloon payloads landed within a few miles of each other, some in trees and others in open fields.

My team was about two miles away when our payload landed, and we could hear the beacons and voice repeater as we closed in on the area. We drove down a new road in a future housing development and heard a very strong signal. Waist-high grass covered the fields on either side of us as we drove up and down the road in hopes of spotting the bright neon orange and yellow parachute. After wandering up and down the road for a half hour, Mike Bogard, KDØFW, and Lynn Trotter arrived on the scene with their direction-finding (DF) equipment. Mike got a fix on the 434-MHz CW beacon and pointed the way while Lynn ran out into the field and found it just 20 feet from the road buried deep in the tall grass (see photo 4).

Photo 4. The WB8ELK payload is recovered from the tall grass. Left to right: Mike Bogard, KDØFW; Lynn Trotter; Bill Brown, WB8ELK; Florence Bower; Jerome Doerrie, K5IS; and Bobette Doerrie, N5IS

After tromping around fields and climbing trees in 100+ degree weather, we all were happy to cool our heels at the victory dinner to swap tales of our many adventures and plan for another fun time next year.

Next year's Great Plains Superlaunch (GPSL 2009) will be held the first weekend of August near Lawrence, Kansas (www.superlaunch.org).

By Tomas Hood,* NW7US

VHF PROPAGATION

The Science of Predicting VHF-and-Above Radio Conditions

Sleeping on the Job . . .

Perhaps you've heard the speculation that our local star is in a coma. Not only amateur radio operators, but now the general press, are picking up the solar buzz, wondering out loud if the sun is in hibernation with a seemingly longer than usual solar cycle minimum. Where are the sunspots? Where's the activity of a new solar cycle? "We're going to see another Maunder Minimum and a mini-ice age!"

Really? The Maunder Minimum occurred during the period starting in 1645 and ending in 1715, an incredible 70 years during which sunspots were rarely observed. To the observer, this period is void of any evidence of 11-year solar cycles. What's more, this period coincided with the famous "Little Ice-Age," a series of extraordinarily cold winters occurring in the Northern Hemisphere. Is a new Maunder Minimum unfolding on our watch?

A fair amount of chatter developed during August 2008 because it was the first time since 1913 that there was a month or more between sunspot appearances. Certainly, it stood out as unique because it was the first time that a whole calendar month went by without observed sunspots. In a practical sense, however, this is not that remarkable; calendars mark arbitrary beginnings and endings, and a 30-day period occurring at any time is just that—30 days without sunspots. Also, such periods are not uncommon during the solar cycle minimums of the past.

On September 11 a sunspot developed that ended a period of 52 continuous days with no spots. This is the fourth longest spot-free period on record. Both May and June 1913 were spotless, in a continuous spotless run of 92 days from April 8 to July 8. Cycle 19 was the biggest solar cycle on record, and it is interesting to note that it was preceded by long periods without spots. There was a 26-day spotless run from February 15 to March 4, 1953, followed by 27 days from January 12 through February 7, 1954, and 30 days beginning on June 3, 1954 and running through July 2.

Then, on September 22, 2008, SOHO (the Solar & Heliospheric Observatory) observed an active region with the first new-cycle sunspot since May 10, 2008 (figure 1). It had both the magnetic orientation and the high-latitude position of a sunspot belonging to solar Cycle 24.

Recent sunspots belong to either the dying Cycle 23 or to the new Cycle 24. How do we know which cycle a sunspot belongs to? Sunspots are classified based on the magnetic polarities occurring in the complex structures within the sunspot group. When one cycle merges into the next, the magnetic polarities reverse. The latest sunspots are more often occurring with the magnetic polarities consistent with the new solar Cycle 24.

Clearly, the new cycle has begun, even though it seems that the period of calm between Cycle 23 and 24 is unusually long. This sunspot, and the shorter time between recent sunspots, appears to indicate that our sun is waking up from a more normal-looking cycle minimum.

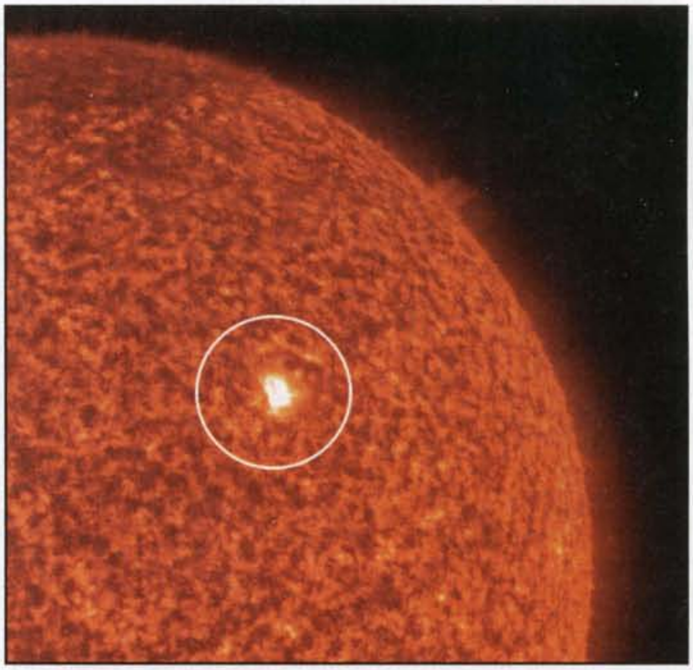

Figure 1. After weeks of a spotless sun and very few sunspots this entire year, SOHO observed an active region (seen here on September 23, 2008) with the first new cycle sunspot since May 10, 2008. (Source: SOHO)

David Hathaway, NASA solar physicist, has reported that the quiet of 2008 is not the second coming of the Maunder Minimum. "We have already observed a few sunspots from the next solar cycle," he says. "This suggests the solar cycle is progressing normally."

During a solar cycle maximum, typically lasting several years, huge sunspots and intense solar flares are a daily occurrence. This in turn triggers spectacular auroras that at times are observable in Florida and New Zealand. VHFers enjoy such periods of intense activity because of the related modes of propagation—bouncing VHF signals off the *E*-layer during aurora or establishing DX contacts by way of a highly energized *F*-layer. I recall driving in my vehicle with a basic 6-meter mobile whip hooked up to an ICOM IC-706MIIG and having a reasonably long conversation with a famous bass player in a southern rock band who was traveling somewhere in the southeastern United States. While the solar maximum of Cycle 23 was not as intense as Cycle 22, there were some memorable moments in the years around 2000–2002.

During solar cycle minimums quite the opposite occurs. Solar flares are almost nonexistent, while whole weeks or even months go by without a single tiny sunspot anywhere on the

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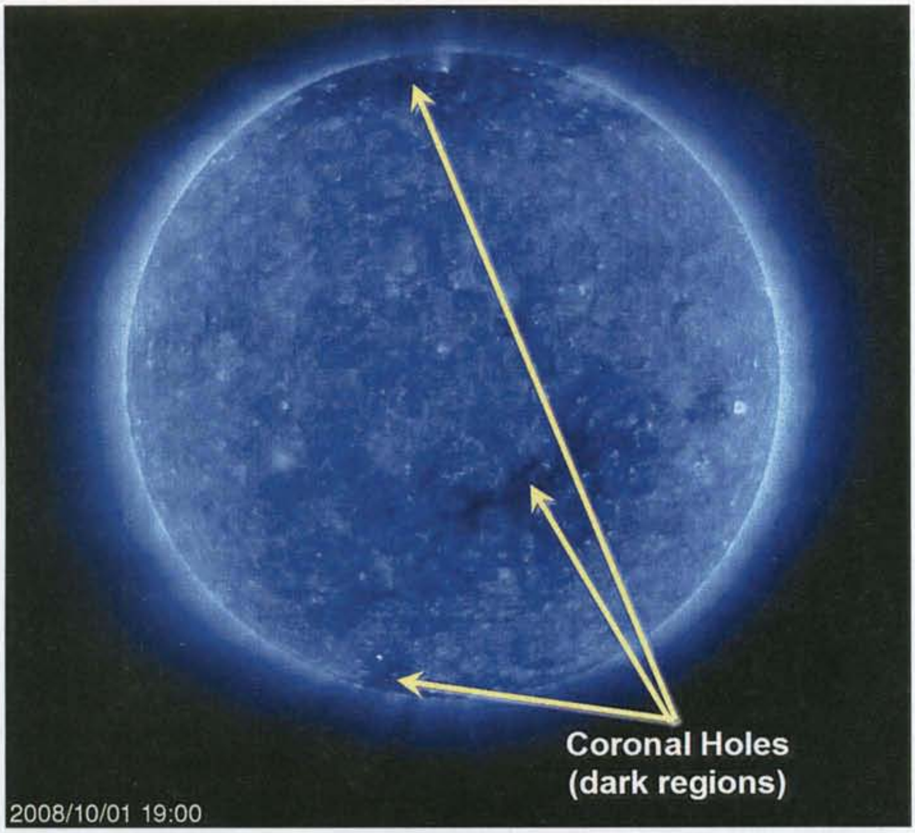

Figure 2. This EIT (Extreme untraviolet Imaging Telescope) image taken at a wavelength of 171 Angstroms reveals a "hole" in the solar atmosphere (corona). Such coronal holes are a source of solar plasma that escapes away from the sun, riding the solar wind. When clouds of solar plasma impact the earth's atmosphere during elevated solar wind storms, aurora may be triggered, resulting in the VHF aurora mode of radio signal propagation. During this period of sunspot cycle activity minimum, such recurring holes provide some life for the VHF weak-signal operator. (Source: SOHO)

sun. While there is continual coronal-hole activity (figure 2), which may trigger some aurora, the intensity and frequency of significant events that birth great VHF moments are rare at this point between solar cycles.

With the sun being so quiet lately, it seems that amateur radio operators are growing restless, asking the question, "Isn't this an unusually lengthy solar minimum?" With the media picking up on these mumblings, many are speculating that it is longer than usual and that perhaps something very significant is occurring.

"It does seem like it's taking a long time," allows Hathaway, "but I think we're just forgetting how long a solar minimum can last." The Maunder Minimum in the early 20th century is a case in point, where there were periods of quiet lasting almost twice as long as the current spell.

Hathaway has studied international sunspot counts stretching all the way back to 1749, and he offers these statistics: "The average period of a solar cycle is 131 months with a standard deviation of 14 months. Decaying solar cycle 23 (the one we are experiencing now) has so far lasted 142 months—well within the first standard deviation and thus not at all abnormal. The last available 13-month smoothed sunspot number was 5.70. This is bigger than 12 of the last 23 solar minimum values."

I concur with David that "the current minimum is not abnormally low or long." If the pattern from the record of the past 400 years holds, we can expect that solar activity will begin to show an increase in the next few months.

A Roaring Lion?

With the lull in ionospheric modes of VHF propagation, weak-signal VHF operators look forward to meteor showers, hoping that storm-level showers will provide exciting opportunities for bouncing their VHF signals off the plasma trails of burning-up meteors. Each year we hope that the November *Leonids* shower will yield a high rate of meteors per hour (the "ZHR," or zenith hourly rate). Will this year yield a major VHF meteor-scatter event?

Appearing to radiate out of the constellation of Leo from November 10 through November 23, the *Leonids* will peak on the night of November 17 and the early morning of November 18. This shower is known to create intense meteor bursts. Since the source of the *Leonids*, the Tempel-Tuttle comet, passed closest to the sun in February 1998, the years following were expected to produce very strong displays. The greatest display since 1998 was the peak of 3700 per hour in 1999. Every year since has been significantly less spectacular. This year the forecast is dismal: expect a ZHR of only 10 or so (there is one forecast, however, calling for a 130 ZHR). Try your VHF luck, because the unexpected may occur. If you are not on the air trying, you will never know.

The best time to work meteor scatter off the *Leonids* is around 11:30 PM local time in the Northern Hemisphere. The shower should increase in rate the closer you get to midnight, and then move toward pre-dawn.

December and January Prospects

After November, the annual *Geminids* meteor shower from December 7 to December 17 will peak on December 13. This is one of the better showers, since as many as 120 visual meteors per hour may occur. It is also one of the better showers for operators trying meteor-scatter propagation from positions in North America. The *Geminids* is a great shower for those trying the meteor-scatter mode of propagation, since one doesn't have to wait until after midnight to catch this shower. The radiant rises early, but the best operating time will be after midnight local time. This shower also boasts a broad maximum, lasting nearly one whole day, so no matter where you live, you stand a decent chance of working some VHF/UHF signals off a meteor trail.

Finally, check out the *Quadrantids* from January 1 through January 5, 2009. This meteor shower is above average, with peaks expected this season of around 120 meteors per hour. The best day should be the morning of January 4, just after midnight, and working through predawn.

Check out <http://www.imo.net/calendar/> for a complete calendar of meteor showers.

Working Meteor Scatter

Meteors are particles (debris from a passing comet) ranging in size from a speck of dust to a small pebble, and some move slowly while some move fast. When you view a meteor, you typically see a streak that persists for a little while after the meteor vanishes. This streak is called the *train* and is basically a trail of glowing plasma left in the wake of the meteor. They enter Earth's atmosphere traveling at speeds of over 158,000 miles per hour. Besides being fast, the *Leonids* usually contain a large number of very bright meteors. The trains of these bright meteors can last from several seconds to several minutes. It is typical for these trains to be created in the *E*-layer of the ionosphere.

Meteor-scatter propagation is a mode in which radio signals are refracted off these trains of ionized plasma. The ionized trail is produced by vaporization of the meteor. Meteors no larger than a pea can produce ionized trails up to 12 miles in length in the *E*-layer of the ionosphere. Because of the height of these plasma trains, the range of a meteor-scatter contact is between 500 and 1300 miles. The frequencies that are best refracted are between 30 and 100 MHz. However, with the development of new software and techniques, frequencies up to 440 MHz have been used to make successful radio contacts off these meteor trains.

Lower VHF frequencies are more stable and last longer off these ionized trails. A 6-meter contact may last from a second to well over a minute. The lower the frequency, the longer the specific "opening" made by a single meteor train. Conversely, a meteor's ionized train that supports a 60-second refraction on 6 meters might only support 1-second refraction of a 2-meter signal. Special high-speed digital-modulation modes are used on these higher frequencies to take advantage of the limited available time, like high-speed CW in the neighborhood of hundreds of words per minute.

A great introduction by Shelby Ennis, W8WN, on working high-speed meteor-scatter mode is found at <http://www.amt.org/Meteor_Scatter/shelbys_welcome.htm>. Palle Preben-hansen, OZ1RH, wrote "Working DX on a Dead 50 MHz Band Using Meteor Scatter," a great working guide at <http://www.uksmg.org/deadband.htm>. Ted Goldthorpe, W4VHF, has also created a good starting guide at <http://www.amt.org/Meteor_Scatter/letstalk-w4vhf.htm>. Links to various groups, resources, and software are found at <http://www.amt.org/Meteor_Scatter/default.htm>.

Autumn Outlook

Autumn (November through January) is a relatively quiet season, with very little if any Transequatorial Propagation (TEP). TEP, which tends to occur most often during spring and fall, requires high solar activity that energizes the ionosphere enough to cause the *F*-layer over the equatorial region to support VHF propagation. The normal TEP signal path is between locations on each side of the equator. However, without the level of solar activity needed to keep the *F*-layer energized enough for VHF propagation, these paths don't materialize. The fall season of TEP usually tapers off by mid-November, but this year TEP will be rare, if it occurs at all.

Tropospheric-ducting propagation during this season is fairly non-existent, as the weather systems that spawn the inversions needed to create the duct are rare. On the other hand, using tropospheric-scatter-mode propagation is possible, but one needs to have very high-power, high-gain antenna systems. Having dual receivers in a voting configuration would also help. The idea is to use brute force to scatter RF off water droplets and other airborne particles, and capture some of that signal at the far end with dual-diversity, high-gain receivers, not everyone's cup of tea.

Aurora-mode propagation is seasonally unlikely. Even if there were periods when the solar wind speed is elevated and is magnetically oriented in a way to impact the geomagnetic field, this is the season in which we statistically see very few aurora events.

The Solar Cycle Pulse

The observed sunspot numbers from June through August 2008 are 3.1, 0.5, and 0.5. The smoothed sunspot counts for December 2007 through February 2008 are 5.0, 4.2, and 3.6. The monthly 10.7-cm (preliminary) numbers from June through August 2008 are 65.9, 65.8, and 66.4. The smoothed 10.7-cm radio flux numbers for December 2007 through February 2008 are 70.5, 70.0, and 69.6.

The smoothed planetary *A*-index (*Ap*) from December 2007 through February 2008 is 7.8, 7.7, and 7.6. The monthly readings from June through August 2008 are 7, 6, and 5.

The monthly sunspot numbers forecast for November 2008 through January 2009 are 11, 14, and 16, while the monthly 10.7 cm is predicted to be 68, 70, and 71 for the same period. Give or take about two or three 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 look forward to hearing from you about your observations of VHF and UHF propagation. Please send your reports to me via e-mail or drop me a letter about your VHF/UHF experiences (sporadic-*E*, meteor scatter?). I'll create summaries and share them with the readership. You are welcome to also share your reports at my public forums at <http://hfradio.org/forums/>. Up-to-date propagation information can be found at my propagation center at <http://prop.hfradio.org/> and via cell phone at <http://wap.hfradio.org/>.

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

Moondata Update 2009 and Related Comments

One of the most important factors in EME communications is knowing when it is best to communicate via moonbounce. W5LUU presents a summary and table of the best and worst conditions for EME in 2009.

By Derwin King,* W5LUU

The Earth-Moon distance and the cosmic (sky noise) temperatures in the direction of the moon are predictable, cyclical variables that set the basic quality of the Earth-Moon-Earth (EME) communications path for frequencies below 1.0 GHz. Best conditions occur when: (1) the Moon is at the absolute minimum perigee distance from the Earth and (2) the Sky Temperature behind the moon is the coldest along the moon path. The effect of distance is independent of frequency, but sky temperature decreases with frequency, up to ~1 GHz and then levels out. The EME signal-to-noise ratio, in dB, is usually degraded from the ideal by a factor (DGRD, see below) which varies over hourly, daily, weekly, monthly, and yearly time periods. As a guide for the basic weekend conditions for 2009, the W5LUU Weekend Moondata 2009 lists the DGRD, in dB, for 144 and 432 MHz, and other pertinent EME information for each Sunday at 0000 UT. Station, location, and factors such as ionospheric disturbances, local noise, antenna beamwidth, side lobes, polarization, etc., can increase the "apparent" DGRD.

EME conditions during 2009–10 will be the most favorable of the 9-year cycle. Now is the "best ever" time to take advantage of this mode. Ten weekends of 2009 are rated as Good to Excellent. Thirteen other days have 2-meter DGRD <1.0 dB. On May 1 it dips to 0.08 dB, and on Nov. 9 to 0.07 dB. However, during the traditional ARRL EME Contest period, sky noise at VHF is a problem for high north Moon declinations. Weekends around Oct. 11; Nov. 1, 8 (Good), and 30; and Dec. 6 (Excellent) are possibilities. For 1296 and up, the weekend around 9–13, high declination near perigee, should also be considered for the contest.

Definitions

DEC (deg): Moon declination in degrees north and south (–) of the equator. This is cyclical with an average period of 27.212221 days. The maximum declination during a monthly cycle, plus and minus, ranges from 18.15 up to 28.72 degrees with a period (maximum to minimum and back to maximum) of about 19 years. *The last maximum was on 9/15/2006.*

RA (hrs): Right Ascension, in hours, gives the east-west position of the Moon against the sky background. Average period of RA cycle is 27.321662 days, but it can vary by a day or so due to effects of the Sun on the Earth and Moon motion.

144 MHz Temp (K): The 144-MHz cosmic (sky) noise in direction of the Moon expressed as absolute temperature.

Range Factor (dBr): The additional EME path loss, in dB, due to Earth-Moon separation distance being greater than absolute minimum (348,030 km surface-to-surface). Varies from a low of 0 to 0 .7 dB at perigee up to 2.33 ±0.1 dB at apogee.

DGRD (dB): The degradation in EME signal to noise, in dB, due to: (1) the excess sky-noise temperature, in dB, at the stated position of the Moon compared to the lowest cold sky temperature and the system noise temperature (all at the frequency of interest); plus (2) the Earth-Moon range factor, dBr, for the listed time and date. The tabulated DGRD is referenced to the lowest possible sky-noise temperature along the Moon path, for a system noise temperature of 80°K at 144 and 60°K at 432, an antenna beamwidth of ~150, and to the absolute minimum Earth-Moon (surface-to-surface) distance.

The dBr affects DGRD equally at all frequencies, but sky noise decreases rapidly as frequency increases. During a monthly lunar cycle DGRD can vary by 13 dB on 144 and 8 dB on 432. DGRD varies less with small antennas than with large ones.

Moon Phase: Shows New Moon (NM) and Full Moon (FM) along with the number of days (d) or hours (h) before (–) or after (+) these events. At NM sun noise is a problem, while at FM the EME conditions (at night) are usually more stable.

Conditions: Summary of EME conditions as controlled by DGRD at 144 MHz and NM. Conditions may be worse due to ionospheric disturbance, local noise, and polarity, but not better than indicated. In general, 144 MHz DGRD <1.0 dB is considered Excellent, 1.0 to 1.5 is Very Good, 1.5 to 2.5 is Good, 2.5 to 4.0 is Moderate, 4.0 to 5.5 is Poor, and over 5.5 is Very Poor. Within a day of New Moon, high sun noise can make conditions Very Poor regardless of the DGRD.

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The information and accompanying table are printed here in CQ VHF *on a non-exclusive basis courtesy of Derwin King, W5LUU*

W5LUU Weekend Moondata for 2009
For Sundays at 0000 UTC

2009	DEC (deg)	RA (hrs)	144 MHz Temp. (°K)	Range Factor (dBr)	DGRD (dB) 144 MHz	432 MHz	Moon Phase	Conditions
Jan 04	7.1	0.4	265	1.35	2.8	1.8		Moderate
11	23.4	7.5	320	0.08	2.2	0.7	FM – 3.5h	**Good**
18	–15.4	13.6	324	1.75	3.9	1.3		Moderate
25	–23.8	19.5	600	2.26	6.7	3.9	NM – 32h	Very Poor
Feb 01	11.4	1.9	282	1.32	3.0	1.9		Moderate
08	21.0	8.4	225	0.27	1.2	0.5	FM – 39h	**Very Good**
15	–18.2	14.1	352	1.70	4.2	2.4		Poor
22	–21.3	20.1	376	2.17	4.9	2.8	NM – 3d	Poor
Mar 01	15.4	1.6	302	1.17.	3.1	1.7		Moderate
08	18.6	8.7	187	0.54	0.9	0.6	FM – 3 d	**Excellent**
15	–20.9	14.6	388	1.70	4.5	2.5		Poor
22	–19.3	20.6	338	2.09	4.4	2.7	NM – 4d	Poor
29	18.9	2.3	341	0.91	3.3	1.5		Moderate
Apr 05	14.7	9.3	175	0.78	0.9	0.8		**Excellent**
12	–23.1	15.2	427	1.80	5.0	2.7	FM + 2d	Poor
19	–15.8	21.1	336	2.06	4.4	2.7		Poor
26	21.3	2.9	364	0.63	3.2	1.3	NM + 21h	Moderate but NM
May03	9.9	9.9	187	0.91	1.3	1.0		**Very Good**
10	–24.5	15.8	482	1.96	5.6	3.1	FM + 1d	Very Poor
17	–12.0	21.7	330	2.07	4.3	2.7		Poor
24	23.8	3.5	357	0.43	2.9	1.1	NM – 12h	Moderate but NM
31.	5.7	10.6	202	0.93	1.6	1.1		**Good**
Jun 07	–25.8	16.4	645	2.11	6.8	3.7	FM – 18h	Very Poor
14	–8.5	22.2	268	2.08	3.6	2.4		Moderate
21	24.8	4.1	374	0.36	3.0	1.0	NM + 44h	Moderate
28	0.9	11.2	217	0.86	1.7	1.1		**Good**
July 05	–26.9	17.1	944	2.21	8.4	4.1	FM – 2d	Very Poor
12	–4.7	22.8	244	2.07	3.3	2.4		Moderate
19	25.8	4.7	437	0.42	3.7	1.3	NM – 3d	Moderate
26	–3.3	11.1	245	0.77	2.0	1.1		**Good**
Aug 02	–26.5	17.8	2450	2.26	12.3	6.7		Very Poor
09	–0.9	23.3	244	1.98	3.2	2.3	FM + 3d	Moderate
16	25.5	5.4	510	0.55	4.4	1.7		Poor
23	–7.7	12.1	282	0.74	2.4	1.1	NM + 43h	**Good**
30	-25.8	18.4	2392	2.25	12.3	6.3		Very Poor
Sept 06	3.3	23.9	250	1.81	3.1	2.1	FM + 32h	Moderate
13	25.5	6.2	470	0.68	4.2	1.7		Poor
20	–10.2	12.7	314	0.83	2.9	1.3	NM + 30h	Moderate
27	–24.4	19.0	1028	2.22	8.8	6.0		Very Poor
Oct 04	7.1	0.4	265	1.60	3.1	1.4	FM – 6h	Moderate
11	23.4	7.0	371	0.72	3.4	1.4		Moderate
18	–13.0	13.2	318	1.03	3.1	1.5	NM – 5h	Moderate but NM
25	–22.7	19.5	607	2.22	6.7	3.6		Very Poor
Nov 01	10.6	0.9	280	1.40	3.1	1.8	FM – 43h	Moderate
08	21.0	7.7	267	0.63	2.1	1.0		**Good**
15	–16.8	13.8	358	1.29	3.6	1.9	NM – 44h	Moderate
22	–20.0	20.0	381	2.25	4.9	3.0		Poor
29	14.1	1.4	293	1.5	3.1	2.0	FM + 3d	Moderate
Dec 06	17.9	8.5	196	0.43	0.9	0.7		**Excellent**
13	–19.6	14.4	379	1.53	4.3	2.2	NM – 3d	Poor
20	–17.5	20.6	339	2.31	4.6	3.0		Poor
27	16.8	1.9	315	1.32	3.4	1.8	FM – 5d	Moderate

By Dr. H. Paul Shuch,* N6TX

DR. SETI'S STARSHIP

Searching For The Ultimate DX

Beckoning Beacons

How do you know if your rig is working? "Easy," you say. "Just call CQ and see who answers." True, but if the nearest DX is light years away, you can grow old, cold, and lonely awaiting that "QRZ" from Beyond. Such is the dilemma facing those radio amateurs pursuing interstellar DX, a practice otherwise known as SETI.

Maybe you're not trying to work DX at all, but are just an SWL. This, in truth, is more the case for the hundreds of amateur observers in the grass-roots, nonprofit SETI League who build sensitive microwave receiving stations, seeking radio evidence of technological civilizations out there among the stars. A receiving station is less costly than one that also transmits, for two reasons. The obvious reason is that a shortwave listener need not invest in a transmitter. However, beyond that truism, on a galactic scale (where transmitters need to radiate power levels that boggle the imagination), being a passive listener puts the burden of generating gigawatts right where it belongs —squarely on the shoulders of our (presumably older, wiser, and wealthier) cosmic companions. Earth is, after all, a young planet orbiting a young star. Other species, if they exist, are likely to be more ancient. If their planet has an expanding economy (a principle terrestrial economists call "inflation"), then they can afford better than we to radiate incredibly strong beacons, which just might reach our modest receivers as incredibly weak noise.

Now, receiving those feeble signals on Earth is no easy task. It requires searching through the quietest part of the spectrum, with the highest gain antennas, the most efficient feeds, the lowest noise receivers, and the cleverest digital signal processors we can muster. Thus, radio astronomers (whether professional or amateur) and those engaged in the scientific Search for Extra-Terrestrial Intelligence go to great pains for that extra tenth of a dB of sensitivity, as do weak-signal microwave DXers and moonbouncers. In fact, the SETI and EME communities have such a commonality of purpose that it makes good sense for them to share their technology, which is where our story begins.

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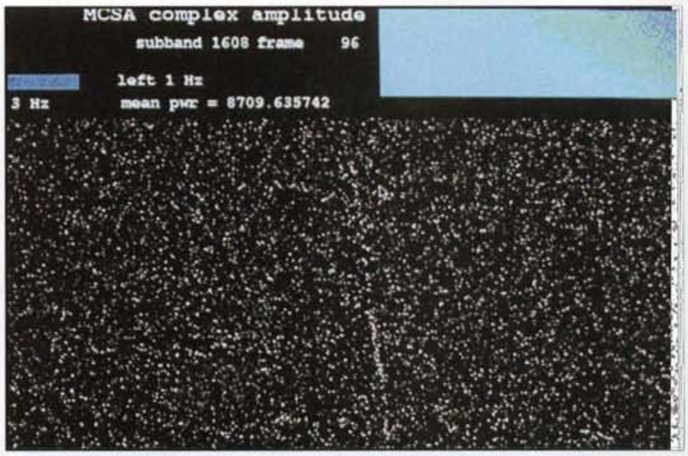

Figure 1. Drift-scan sweep of Quasar 3C273, about 3 dB out of the noise.

Natural Calibration Beacons

"You can't work 'em if you can't hear 'em," the saying goes. But how do you know if you can hear 'em, considering you don't even know for sure that they exist?

Forget ET for just a moment, and consider that the universe

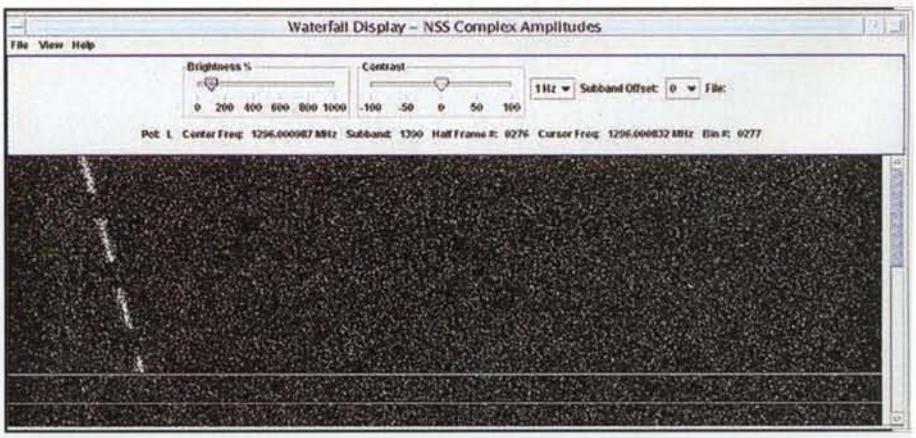

Figure 2. Mars Reconnaissance Orbiter beacon received by F5PL from Martian orbit.

is full of natural radio emissions. Stars, planets, moons, pulsars, quasars, supernova remnants, and even the chemicals that populate the black void between the stars all emit microwave radiation. Since its earliest days, radio astronomy has sought to study these emissions. Some are of known power, so you can calibrate your receiver's sensitivity on them. My favorite quasar, for example, 3C273, is known to emit +46 Janskys (a linear measure of flux density) on Earth at a frequency of 1420 MHz. Therefore, when I receive it 3 dB out of the background noise (see figure 1), I know the sensitivity of my receive station is half that level, or +23 Janskys. (This is, incidentally, a level of sensitivity typical of amateur radio telescopes and 23-cm moonbounce stations.) If I monitor 3C273 after tweaking my station and the received signal strength increases, I know my receiver is working better. If signal strength goes down, I know I should have left well enough alone.

Artificial Calibration Beacons

Since the beginning of the space age a half century ago, humans have been lobbing debris into space. Most of our space probes carry radio transmitters to send scientific (or perhaps less noble) data back to Earth. Might the signals emanating from our own spacecraft serve as calibration signals for terrestrial radio telescopes?

Indeed, they might, do, and have. Figure 2 shows a popular beacon signal from the Mars Reconnaissance Orbiter received in France (which, last time I checked, was on planet Earth) by amateur radio astronomer Bertrand Pinel, F5PL, as the spacecraft entered orbit around the Red Planet in March 2006. Since we know the beacon's power, we can use this signal to verify and quantify our station's performance. (Of course, the distance between Earth and Mars is always changing, so we need to do a little math to calculate the effects of varying path length and corresponding variations in isotropic free-space path loss.) Since we now have spacecraft orbiting or landing on many of our neighboring planets, as well as in orbit around the Sun, and orbiting the semi-stable Lagrangian points of the Earth-Sun and Earth-Moon two-body systems, we can enjoy calibration signals from a plethora of sources in space, all of Earthly origin.

SETI Calibration Considerations

Given the wealth of available natural and artificial calibration sources in space, which would prove most useful for the SETI enterprise? Consider that one challenge facing SETIzens is distinguishing between natural and artificial radio emissions. The latter tend to be extremely broad in spectrum, typically spanning MHz to GHz. Signals of technological origin tend to concentrate their energy in discrete carriers and sidebands. Thus, even in the case of purportedly wideband artificial emissions such as spread spectrum, detection against a backdrop of broadband natural radiation is facilitated by their narrowband spectral components. It follows that while wideband astrophysical sources serve us well as calibrators for continuum radio telescopes, those instruments optimized for SETI detection should be tested against artificial signals that closely replicate the narrow-band intelligent emissions that they seek.

For about three decades a popular SETI calibration source was the 20-watt S-band beacon aboard the Pioneer 10 space probe, the first human artifact to travel beyond the edge of our solar system. By the beginning of the 21st century, this robust calibrator had traveled beyond the range of even our most sensitive radio telescopes, forcing the SETI community to seek a calibration alternative.

In the next column, we will reveal how radio amateurs rallied to fill the gap.

73, Paul, N6TX

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