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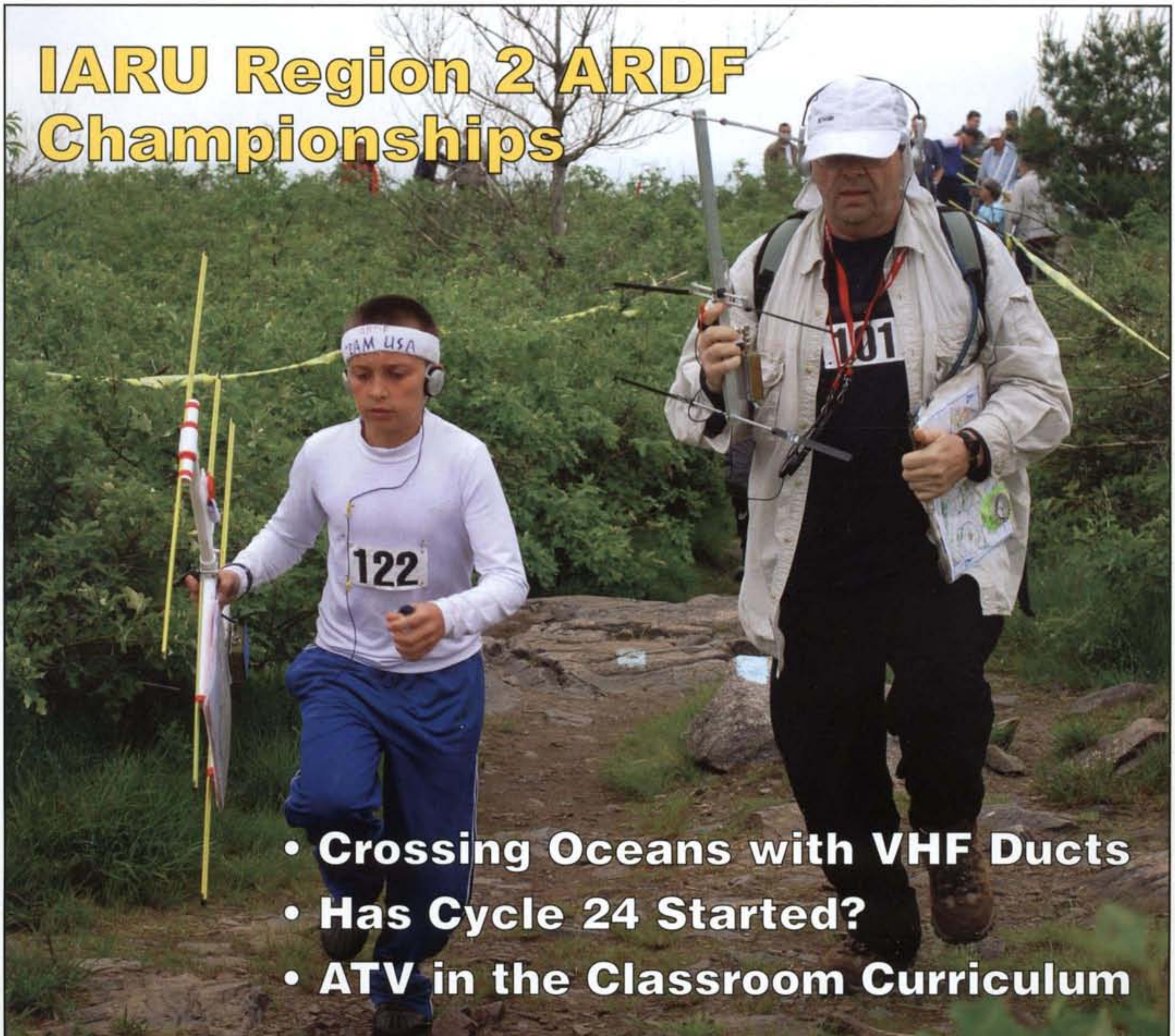

■ VHF/UHF Weak Signal ■ Projects ■ Microwaves ■ Packet Radio ■ Repeaters ■ Amateur Satellites ■ Interviews ■ Plus...Reviews, Product News, and much more!

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contents

Summer 2009
Vol. 13 No. 2

FEATURES

COLUMNS

DEPARTMENTS

On The Cover: The 2009 ARDF Championships for the USA and IARU Region 2 were held in the Boston area. Shown in the 2-meter starting corridor are Addison Bosley (left) and Bill Smathers, KG6HXX. For details see the "Homing In" column on p. 46. (Photo by Joe Moell, KØOV)

CQ VHF Ham Radio Above 50 MHz

LINE OF SIGHT

A Message from the Editor

The World Wide Web: The Double-Edged Sword

It was in the mid-1980s when 28.885 MHz was hopping with reports of real-time 6-meter propagation. When the 6-meter band wasn't open, that frequency became an intercom of sorts—a worldwide intercom. One could announce one's callsign and get an instant response from someone else on the other side of the world.

As the day went on the propagation traveled around the world. For me in Oklahoma, in the morning I could work into Europe and Africa with my TS-440 and Outback antenna for my car. In the evening it was the South Pacific that was open to me.

Now, though, <http://www.dxinfocenter.com> and <http://www.vhfdx.net> are among the most popular "intercoms." Add to these propagation tools Twitter, You Tube, USTREAM, Facebook, and Spy (http://spy.appspot.com/), to name a few, and you have pretty much covered the social network websites that are broadcasting real-time information about whatever you want. Speaking of Twitter, you can find me under the name: JoeN6CL. Add to these social networking sources your own blog on your own website and you have the world covered.

You can post a propagation report to VHFDX.net at the same time you can post a 140-character message to Twitter and the world knows about who you are working and what your QTH is. Imagine a DXpedition posting to Twitter stating who a team is working and on what bands! Regarding your QTH, dare I mention APRS? How about D-STAR?

The double-edge of the sword of the World Wide Web is that people with whom you wish to have nothing to do bother you with spam and other nuisances. Additionally, time spent on the WWW is not time spent on the air. Nevertheless, it seems that the availability of instant worldwide communications outweighs the downsides.

The Future of Our Youth

In this issue's "ATV" column Miguel Enriquez, KD7RPP, discusses Jhovana Peralta, KF7DDD, who is a student in his school. He shares how she will play a leading role in this fall's experimental class "Amateur Radio, Space and Wireless Technologies." He speaks very highly of her and hopes that she will be able to attend a prestigious university in two years when she graduates. Jhovana has made her parents proud, being the first in her family who plans to attend college.

In the "Homing In" column Joe Moell, KØOV, discusses Addison Bosley of Erlanger, Kentucky, who is the grandson of Dick Arnett, WB4SUV. At age 11, Addison was the youngest competitor in the IARU Region 2 ARDF Championships this year. Addison earned gold medals in the M19 category on both bands.

I've written about my passion for youth here before, and I reiterate my point: The future of our hobby lies in our youth. Knowing that our future is in the hands of our youth compels me to want to provide every means of encouragement possible for them to succeed. When you have two wonderful examples such as Jhovana and Addison, you cannot help but cheer for our future.

If you have a story about a youth in amateur radio, please share it with me. I love to present their stories here in *CQ VHF*.

Innovations and Insights

For those of us who were able to attend the HSMM seminar at HamCom in Plano, Texas, we were treated with an exciting presentation on the latest in HSMM. MESH networking is a form of digital communications that is designed to route data, voice, and instructions between nodes. This routing is accomplished by continuous connections and reconfiguration around broken or blocked paths by "hopping" from node to node until the destination is reached. Thus, HSMM-MESH® networking is using HSMM in a mesh network.

John Champa, K8OCL, led the two-hour forum with an introduction to the difference between WiFi and HSMM. He highlighted the need for developing a means of digital transmission that is significantly faster than the technology that existed in the aftermath of 9/11. He also spoke of how under-utilized the VHF-plus ham bands have been. Additionally, he discussed the need to update our emergency communications so as to bring ourselves in line with the rest of the world.

With the migration of commercial television to digital, we amateur radio operators are also a bit behind the curve. John covered amateur digital video and compared it with what has just gone away, analog NTSC standard television.

Glenn Currie, KD5MFW, followed John with a presentation on HSMM-MESH®. Glen discussed the city-wide deployment of HSMM-MESH® in the Austin, Texas area. Austin was picked for the deployment because of its central location and the critical role that it played in recent hurricanes.

John's extensive coverage of HSMM-MESH® begins on page 38.

Regarding insights is Dave Petersen, N7BHC, who is doing pioneering work on unraveling transoceanic propagation. His article on subsidence temperature inversions begins on page 6.

Another insightful article in this issue was written by Mark Morrison, WA2VVA. The connection between amateur radio and the cosmos has long been known. In Part 1 Mark discusses some of the early pioneers in this curious connection with our hobby.

What We are Working On

Echoes of Apollo was a great success. Among the highlights were the QRP EME contacts between the 26-meter Mt. Pleasant dish in Tasmania, Australia, and the dishes in Switzerland and The Netherlands. Extensive coverage of the successes is planned for a future issue of *CQ VHF* magazine.

While I was at Dayton, I came across a display concerning the South Carolina Healthcare Emergency Amateur Radio Team and its Statewide Communication Network (see: <http://www.scheart.us>). This display was within the ARRL area.

I was so impressed with the team's statewide network of repeaters that tie into hospitals that I asked them to write an article about their operation and how it came into existence. For me, I am interested in how they were able to get tower space on their statewide educational television network as a means of knowing if it is possible to replicate this network in Oklahoma using our statewide educational television network. I look forward to sharing their articles in a future issue.

And Finally . . .

Because of the time sensitivity of several of the articles in this issue, we are holding over articles on working 2 meters terrestrially, using batteries in emergency communications, and emergency communications and AMSAT. We have lots in this issue and lots in store for future issues of this, your source for the great things that are happening on the VHF-plus ham bands. 73 de Joe, N6CL

Crossing Oceans with VHF Ducts
Subsidence Temperature Inversions

In an effort to cross oceans with amateur radio signals, N7BHC has been working tirelessly to find propagation paths where no amateur radio signal seemingly has gone before. Here he discusses subsidence temperature inversions and how they may be used for making record-establishing transoceanic QSOs.

By Dave Pedersen,* N7BHC

VHF and UHF operators have used temperature inversions and the ducting propagation they create for many decades. There are several types of ducts that occur over both land and sea. These include frontal, evaporative, and subsidence ducts. Surface ducts reach all the way to the Earth's surface, while elevated ducts do not.

Ducts are caused by a change in the refractive qualities of the medium through which the radio signal is traveling—in this case, the lower atmosphere. The key mechanism is a temperature inversion. The sun's energy heats the Earth, which in turn heats the air in contact with it. Thus, the warmest air is usually at the Earth's surface. The air progressively cools as the altitude increases. This is shown in figure 1(A). The solid line is temperature, while the dashed line is humidity.

Under certain conditions, the temperature stops cooling and increases by as much as 5–15 degrees F over just a few hundred feet elevation. This is a *temperature inversion* and forms the top of the *trapping layer,* or duct. A temperature inversion is illustrated in figure 1(B). Note that in the temperature inversion, the humidity can decrease sharply. The humidity change actually has a much greater effect on the index of refractivity than does the temperature.

The keen observer will notice a small temperature inversion almost at the surface in figure 1(A). This is probably an evaporative duct, suitable for microwave paths in the 3–24 GHz range. Evaporative ducts are very reliable across the oceans and have the potential for very long-distance contacts. This propagation mode is worthy of a lot more amateur research for stations literally at the beach. Very little work has been done on this topic for point-to-point communications, and it may be covered in a future article.

This article is not an exhaustive explanation of temperature-inversion creation and physics. The reader is encouraged to conduct further research online. Several web pages are referenced in this article and in the references section at the end.

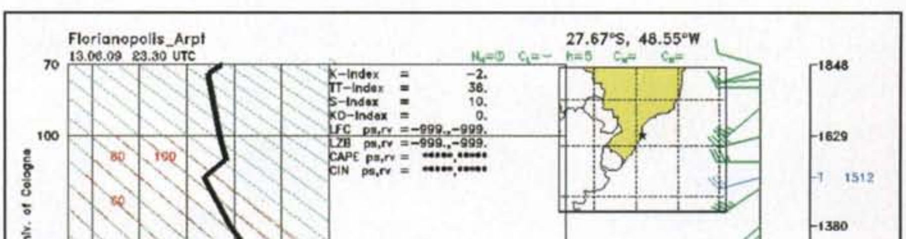

Figure 1(A). No inversion. Note the steady temperature (solid line) and humidity (dashed line) declines.

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In this article we will focus on subsidence ducts. These subsidence ducts are a primary cause for extremely long-range temperature inversions across open ocean paths. We will explore these ducts, the mechanisms that cause them, and where they appear. We will also investigate why some paths have not been worked yet, and offer a few observations and suggestions on potential strategies to work these paths.

Propagation Mechanism

The primary propagation mechanism for trans-oceanic ducting is the *subsidence* temperature inversion. Large areas of subsiding, or falling, air cause subsidence inversions. The largest subsiding air masses are associated with stable high-pressure systems that form over the oceans. As sunlight strikes the Earth, it heats the air, causing it to rise. The air over the equator, with the most direct sunlight and therefore the highest energy transfer, heats up the most. This rising air eventually spreads out away from the equator, heading north and south. The rising air creates a surface low-pressure system, which is replaced by air flowing in from more temperate areas farther from the equator with higher pressure air. The air rising over the equator, flowing away towards the pole, sinking over temperate regions, and flowing back to the equator is called a *Hadley Cell*. The falling air creates a stable high-pressure system that can exist for many months during the summer.

As the air falls on the downward cycle of the Hadley Cell, it is compressed, raising its temperature. The rising temperature causes the relative humidity in the sinking air mass to drop significantly. Under normal non-inversion conditions, rising air cools and becomes wetter. When the warm, dry sinking air meets the moist, rising air that has been heated locally, a temperature inversion is created.

Fortunately, there are many weather sources available on the web to help us find these stable high-pressure systems where ducting is more likely to form. Probably the most useful and quickest way to see if conditions are possible is by checking the Hepburn Tropospheric Ducting Forecasts at <http://www.dxinfocentre.com/tropo.html>. I have found them to be reasonably accurate for a broad-strokes prediction. The map illustrated here (figure 2) was from the spring of 2008, showing very good conditions across the southern part of the

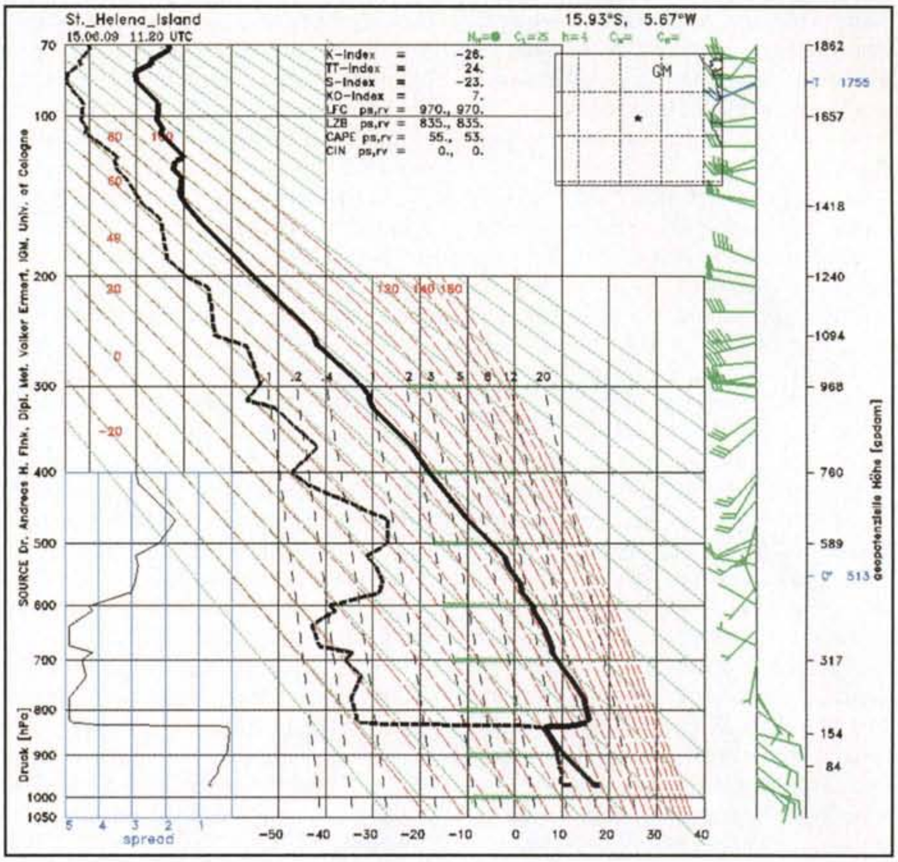

Figure 1(B). A strong temperature inversion. Note the sharp temperature rise and humidity drop at the inversion layer.

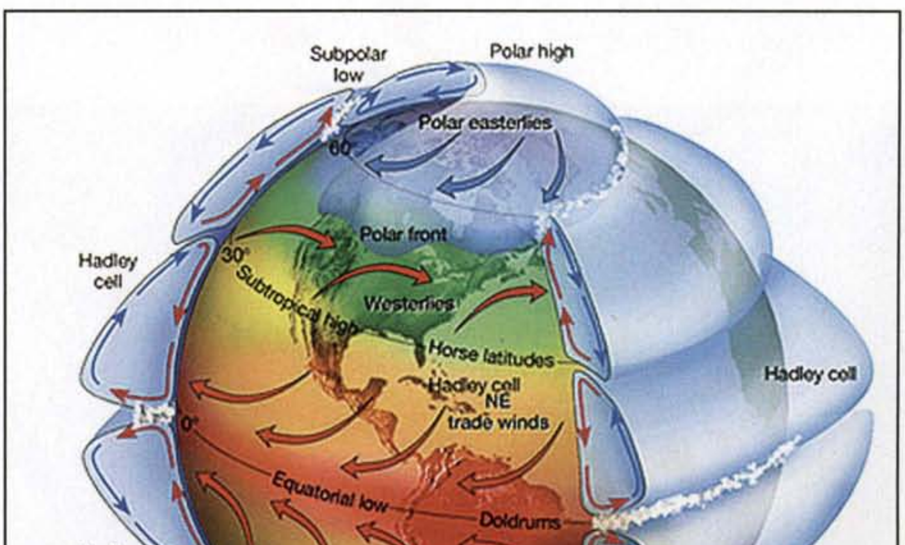

Figure 2. Hadley Cell circulation.

North Atlantic Ocean. As the high pressure moves northward with the summer, so do the conditions. Tropical storm development later in the summer tends to break up any ducts in the southern extremes.

Isobaric weather maps show us just where the high-pressure systems are located and how strong they are. The Oceanweather web page at <www.oceanweather.com/data> provides maps of much of the world. The Marine Observations in each area will show the actual isobaric weather chart.

The Sea Surface Temperature charts, also available on the Oceanweather page, may also be helpful. There is some evidence; published in the "Atmospheric Refraction" article listed in the references section is a chart that correlates sea surface temperature to duct height. This is important, as one can read in the article by VK3KAQ about "Facts and Myths about Tropospheric Ducting" on the DF5AI web page. Essentially, the higher a duct is above the VHF station, the steeper the entry angle and the higher the coupling loss will be into the duct. While the sea surface temperature will have some effect on the height of a subsidence duct, it has a very strong influence on evaporation ducts.

Another helpful tool to zoom in on conditions is radiosonde data. Radiosondes are launched daily by many weather stations around the world. As they ascend, they report back on several atmospheric conditions, including temperature and humidity. Radiosonde data can be easily obtained from <http://www.uni-koeln.de/math-nat-fak/geomet/meteo/winfos/radiosonden/index_erde.html>.

The radiosonde data example in figure 3 shows a very strong inversion over St. Helena Island in the South Atlantic Ocean. This region has exceptionally good and stable ducts that can be present on nearly half the days of the local summer. The solid line represents the temperature, and the dashed line is the relative humidity. Note that at the 750-mb level (about 8000 ft. msl) the air temperature stops decreasing and rises about 8 degrees F. At the same elevation, there is a very sharp drop in humidity. This is evidence of a very strong duct.

There are a few points are worth noting from the diagram:

First, the greater the temperature increase and the relative humidity decrease, the stronger the inversion will be.

Second, the thicker the inversion from top to bottom, the lower the frequency the inversion typically will support for ducting propagation.

Third, the humidity drop has a greater influence on good ducting conditions forming than the temperature increase.

Finally, if a line drawn vertically downward from the right-most point of the inversion reaches all the way to the ground, the duct is referred to as a *surface* duct. If, on the other hand, the vertical line drawn down intersects the rising temperature line above the Earth's surface, the duct is referred to an *elevated* duct.

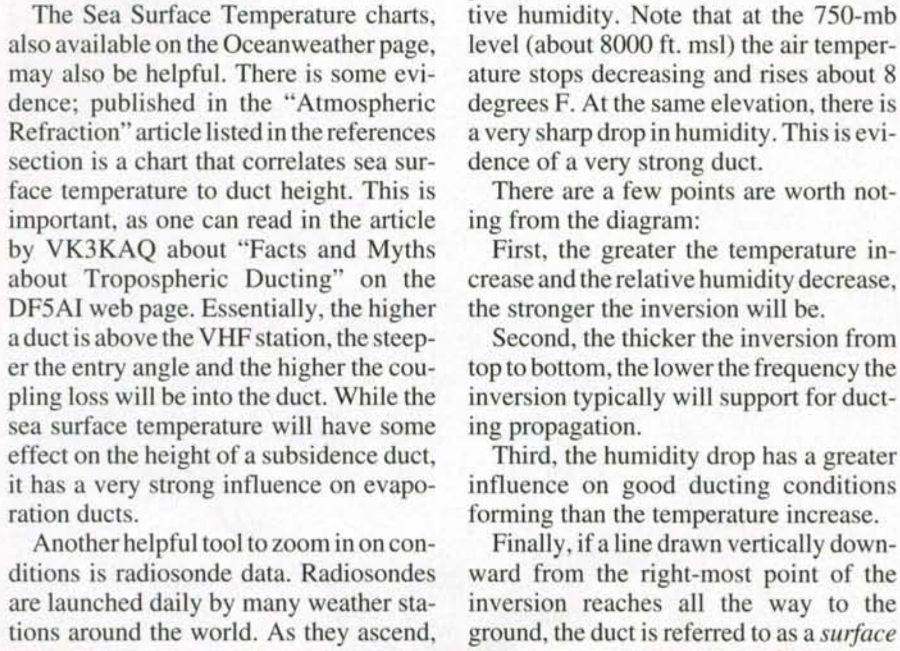

Figure 3. A Hepburn map showing strong potential ducting across the North Atlantic.

Established and Potential Trans-Oceanic VHF Ducts

Tropospheric ducting spanning long trans-oceanic paths has not been fully explored. Several regions are already well proven. Some of these have been worked for more than five decades, while others have been *discovered* more recently. These established paths are shown in figure 4 by dark lines.

Other trans-oceanic ducts have long been suspected. Occasional reports of DX reception over very long oceanic paths have been noted over several paths. The potential paths are illustrated in figure 4 by the lighter lines. Probably the main reason these paths have not yet been worked is the lack of operators interested in and equipped to work these paths in the optimum locations. This list is by no means definitive either and other paths very likely exist (figure 5).

The South Atlantic ducts have been proven to exist. N7BHC directed ZD7 monitoring tests listening for FM broadcast stations in Africa and Brazil. John Turner, an SWL on St. Helena, reported hearing numerous FM stations from South Africa, Namibia, and Angola in early 2008 on a car radio. In late 2008, John and ZD7X heard many African and Brazilian FM stations, and 156-MHz marine radio from Namibia. ZD8I reports many instances of receiving Cape Town Harbor radio on 156 MHz, and ZD8S reports that it is common to listen to Brazilian FM stations using indoor portable radios. On one occasion in late 2008, FM broadcast-band listeners on St. Helena complained that they could not identify an Angolan station due to interference from a Brazilian station on the same frequency!

One more noteworthy point is that all the paths already worked appear to be on the equatorial side of the high-pressure systems. Very few, or none, have been reported traveling over the middle of the high-pressure system, or on the polar side for east-west paths.

Strategies for Finding Trans-Oceanic Ducts

Quite often, band openings go unnoticed because of a lack of activity of both


Kenwood Family
144.390
438.350

transmitting and receiving stations. One approach to catching openings is to watch weather data and propagation maps, and set up schedules with stations across the oceans when a band opening looks likely. This requires a lot of vigilance, and operators need to be available at any time and stay close to their radios. Further complicating matters is that many potential paths do not have active VHF stations at one or both ends.

DXpeditions to likely locations are another approach to duct hunting from locations with no regular activity. A series of expeditions took place in January 2009 to focus on the South Atlantic path between Namibia and Brazil. N7BHC operated from Luderitz Bay in Namibia, and several Brazilian operators operated from their home QTHs or undertook expeditions to the northeast coast of Brazil. ZD8I also operated from Ascension Island. While the path was not successfully worked in January 2009, the conditions are now proven to exist. It is just a matter of time before concerted and long-term efforts by hams on both continents will result in success.

Beacon Projects

Beacons are useful propagation indicators. They transmit a signal at a stable frequency, power, and beam pattern. This allows distant receiving stations to have a signal to monitor for possible band openings.

Beacons are especially useful in locations that don't have a lot of regular activity on the band of interest. In many instances, DX operators have limited resources to invest in equipment. HF operation promises many more QSOs than VHF, so HF stations and operations are much more common. Most have little or no interest in, or equipment available, for VHF. A beacon project could build and deploy beacons at key locations for the purpose of studying extreme-range trans-oceanic ducting propagation. These beacons would be optimized for studying long-range trans-oceanic ducting. The initial focus would be on the North and South Atlantic oceans (figure 6).

Beacons designed specifically to study long-range VHF ducts should have a high ERP (Effective Radiated Power). This requires a higher transmit power than usual for beacons, and a moderately high-gain antenna. Transmit power of 100 watts is quite easily realized. The antenna selection can be more complex, as one has to consider the arc of the stations

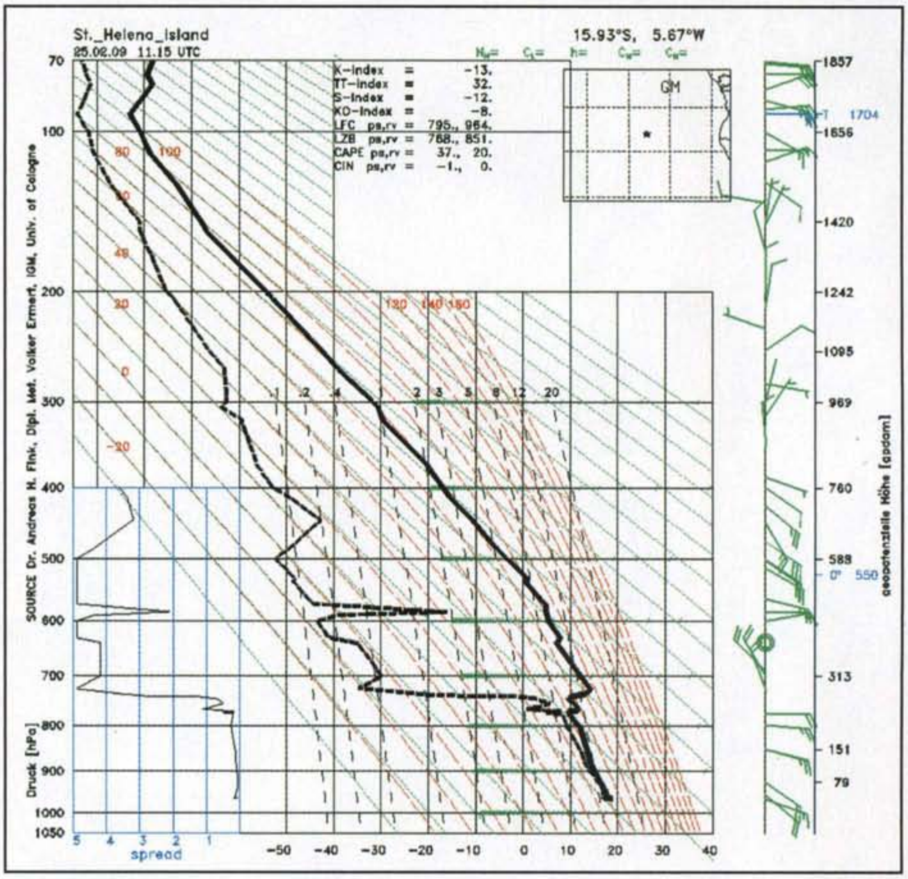

Figure 4. This radiosonde data from St. Helena Island in the South Atlantic shows a very strong elevated duct.

toward which the beacon is transmitting. A point-to-point system, such as Virginia to Portugal, could use a single long Yagi. However, a point-to-multipoint system such as Virginia to an arc stretching from the UK to North Africa requires a much wider beamwidth. This is easily accomplished with a vertical stack of shorter Yagis. It would be very disappointing to have an opening go unworked because the beam was pointed at Europe while the band was open to North Africa. Beacons on mid-ocean islands have more complex antenna requirements if they are to radiate signals in multiple directions and still have high ERP. It may, in fact, be easier to run multiple beacons or a switched antenna network.

It would be very desirable to have a VHF or DX association be the overall coordinating agency for the beacon network. So far, a key collaborator on a North Atlantic beacon project is Paul Trotter AA4ZZ, from the Charlotte, North Carolina, area. The biggest challenge to deploying a tropo-duct, long-range VHF beacon network, though, is not a technical one. Finding a local amateur radio operator who is interested in installing and maintaining a beacon has been the biggest hurdle, even when the equipment is offered free of charge.

The **Simple Multifunction Beacon** concept designed by Dave, N7BHC, goes one step further (figure 7). It is based on multimode radios with an amplifier and keyer. The system operates as a beacon most of the time. When a band opening is reported, the local operator can turn off the beacon and use the same equipment to work DX. The Simple Multifunction Beacon design will be addressed in a future article covering assembly and operation.

The first N7BHC beacon was deployed in FM15PA in the summer of 2008. It runs a Kenwood TR-751A radio with a 160-watt amplifier turned down to 100 watts output. After feedline loss, approximately 60 watts is radiated from a 16-element KLM Yagi beamed towards Gibraltar. In August 2008, bursts from that beacon were copied by CT1HZE in southern Portugal.

An **Advanced Capability Beacon** project is also under way. This is a much more complex beacon that uses a Windows® computer under remote con-

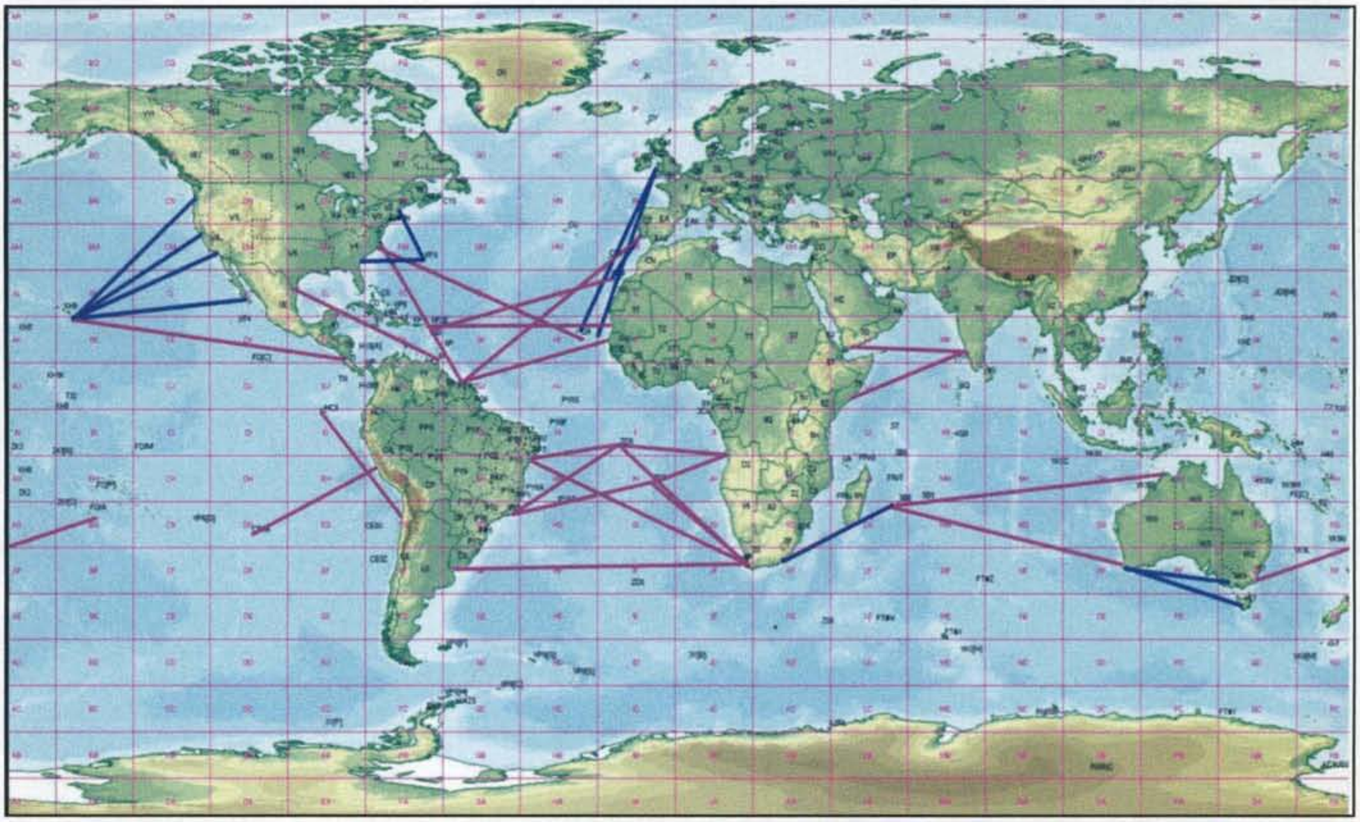

Figure 5. Worked (blue) and possible (purple) VHF tropo duct paths.

trol to operate the beacon. The beacon can operate autonomously, but the remote-access capability allows for the beacon parameters to be changed remotely, new modes to be uploaded, and remote telemetry to be monitored. In addition, the receive audio can be monitored between transmissions, and the system can even be used as a remote base should a band opening occur. Additional information and the design criteria for the Advanced Capability Beacon can be viewed on the N7BHC web page.

Additional beacon topologies await further evaluation. One interesting approach would be to locate the radio remotely, but have the controlling computer at the local shack. The interconnection between the two would rely on RoIP (Radio over Internet Protocol) interfaces such as the JPS NXU-2A.

Non-Amateur Radio Beacons: In addition to building amateur radio frequency beacons, there are many VHF and UHF signals already on the air that do excellent service as beacons. As their frequencies are close to the 144-MHz and 432-MHz bands, they serve as good propagation indicators for those frequency ranges.

FM

FM voice repeaters and stations on 144 MHz and 440 MHz should be part of the serious duct hunter's weapons as well. While CW, SSB, and digital modes offer the best weak-signal performance, the FM repeater and simplex operators win out in sheer number of stations active. Quite often, band openings are discovered by hearing distant FM repeaters first. A dedicated FM system with stacked Yagis makes an excellent system for finding DX. You can always ask the distant operator to switch to FM simplex or weak-signal modes. Also, sometimes those stations may have an all-mode radio hooked to a good vertically polarized antenna system for working distant repeaters, and the operator has never explored the weak-signal mode aspect of his station.

FM and television broadcast stations also make excellent beacons. They are plentiful and widespread. Several new tropospheric ducting paths were first identified and confirmed by listening for FM radio stations, including the paths from St. Helena Island to southern Africa, and Ascension Island to Brazil. Most FM stations stay on the air around the clock and do not shut down late at night and the early morning hours when trans-oceanic ducting is at its best.

A log-periodic antenna is essential to cover the whole band. Quite a few low-power FM stations transmit with vertical polarization, so an antenna that can be rotated in polarity, or two separate antennas for horizontal and vertical polarization, is required. If two antennas cannot be used, then a single Yagi at a 45-degree angle may be a good compromise as it is equally down –3 dB from both horizontal and vertical polarities.

A good receiver is also essential, requiring excellent sensitivity and selectivity. High-performance wideband receivers such as the ICOM R7000, R7100, R-8500, and R-9000 all are excellent choices. Professional-grade receivers such as the Rohde & Schwarz ESM-500A, ICOM R-9500, and Ten-Tec RX-400 are very good performers. Another surprisingly low-cost receiver option with amazing performance is one of the Sony HD radio series. The XDR-S10Hdip is a full receiver, while the XDRF1HD is a tuner only without an amplifier. A good source of information on FM stations is the <www.fmscan. com> web page.

Analog (non-digital) TV stations are being replaced by lower power digital transmissions in many countries. VHF high-band stations in the 174–216 MHz range are good indicators of 144-

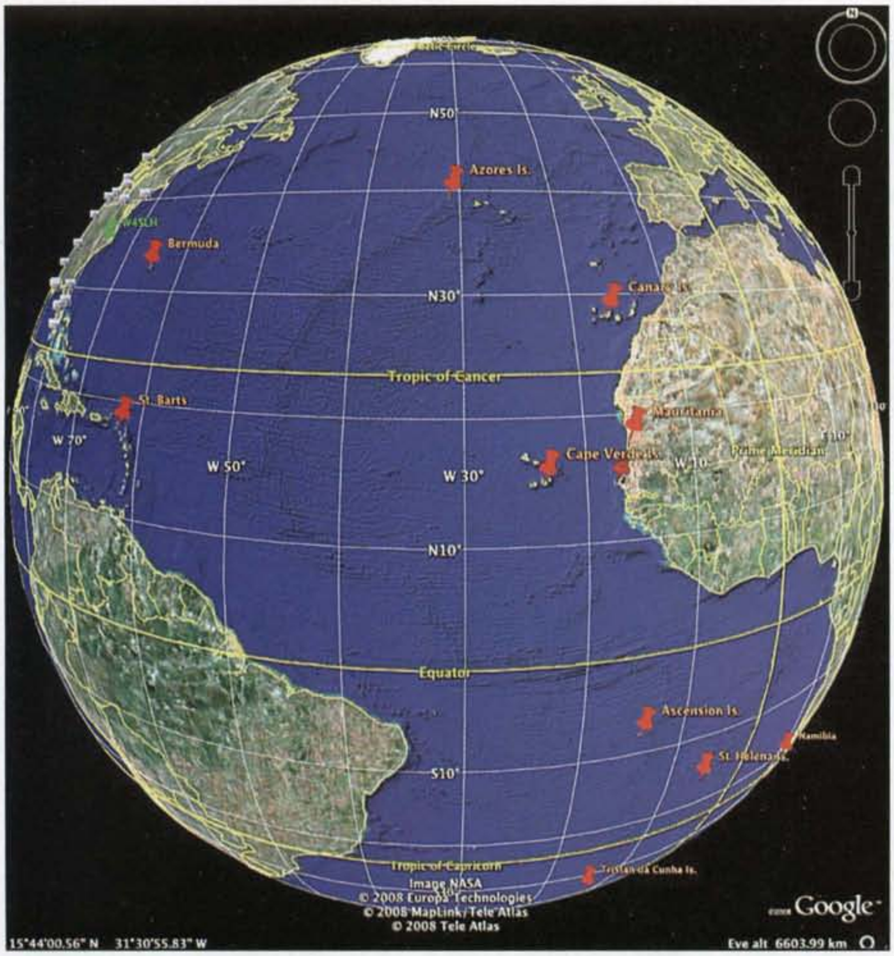

Figure 6. Potential sites for a North Atlantic VHF beacon network.

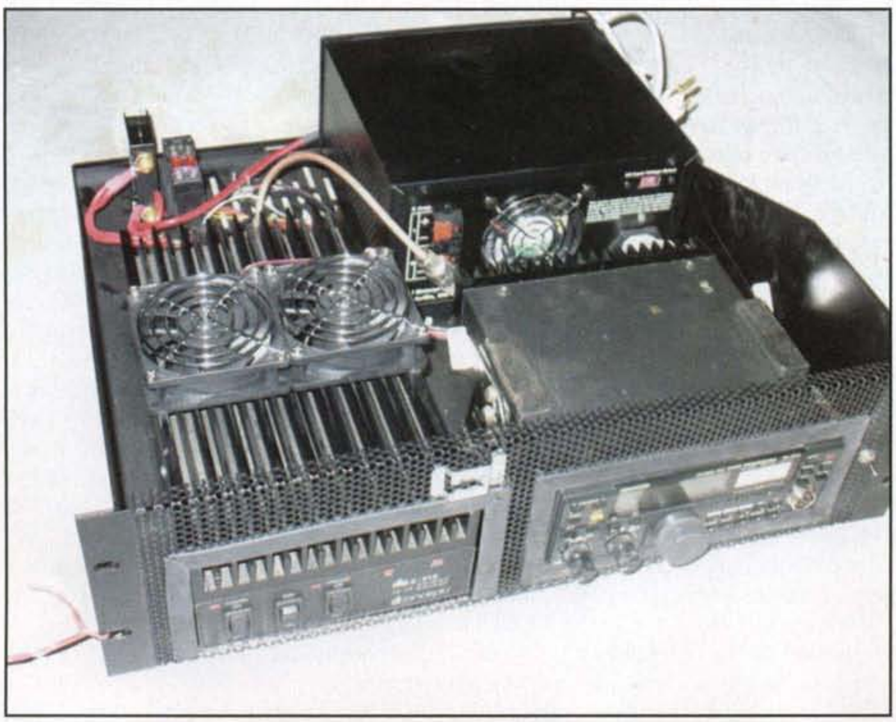

Figure 7. The N7BHC Simple Multifunction Beacon/station.

MHz propagation, while UHF stations are excellent indicators of 430-MHz openings. Many TV stations go off the air late at night. They often run higher power than FM stations. On an analog TV signal, the video carrier is the strongest component of the TV signal, but is not easily identified. The only practical way to identify video carriers is by knowing their frequency *very* precisely. However, they are useful for showing that the band is at least open in a general direction.

Wideband receivers such as those used for monitoring FM stations are good choices for listening to TV stations. The analog TV signal has to be very strong before a picture good enough to serve as identification is visible, but the FM audio channels can be well received considerably before the video comes in well.

With TV stations in many countries switching to lower power digital format, video carriers are not as strong. A plus factor is that the digital data stream includes the station call letters, making station identification much easier.

As with FM broadcast stations, a good log-periodic antenna is the best all-around TV DX antenna. Several very good commercial products are available that cover both the FM and TV bands, plus public safety and utility bands between the broadcast station assignments.

Aviation Band Stations

Aviation band signals from 108–136 MHz have been used for many years to indicate the presence of VHF ducts. Some years before amateurs first worked the duct between California and Hawaii, pilots taking off from San Francisco would report contacts with the control tower in Honolulu as they climbed above the Golden Gate Bridge. As they climbed higher, above the duct trapping layer, the communication was lost until the aircraft came within visible sight of the station in Hawaii. Airport stations are also on well-publicized lists, and the air traffic controllers usually identify on every transmission.

Marine Band Stations

Marine band stations in the 156–163 MHz range are useful to monitor for band openings. The duct from Ascension Island to Cape Town was first identified by the reception of Cape Town Harbor Radio on Ascension. However, voice transmissions can be fairly sporadic, and ships usually only communicate with the

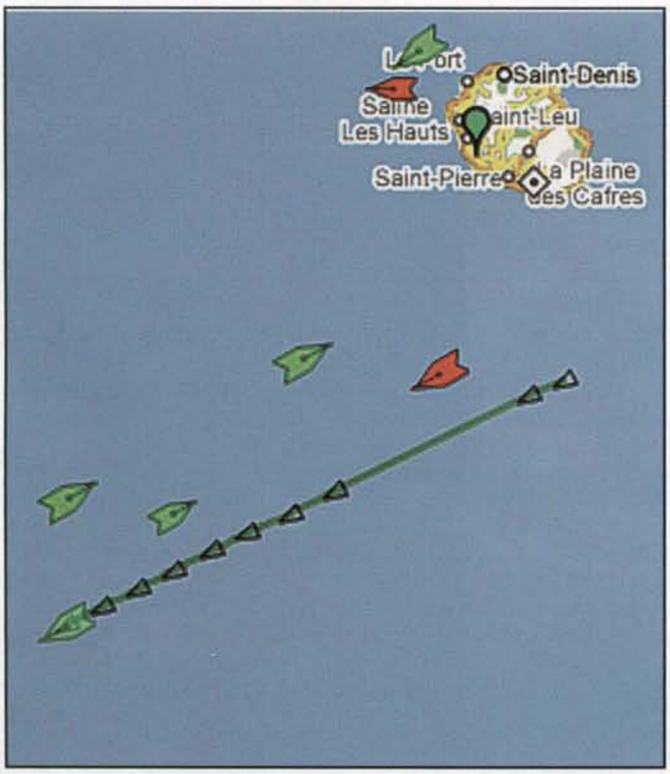

Figure 8. An AIS display showing ship positions. We're not concerned with the specific ship data as much as the fact that it was received by a given station, indicating an opening.

port facilities when they are fairly close to the harbor. With commercial vessels ranging the full extent of the oceans, it would be very helpful if they were transmitting frequently as they crossed the oceans, our area of interest. Essentially, that would amount to a beacon network with thousands of stations spread across the oceans. Fortunately, that beacon network is exactly what is available!

The Maritime AIS

The Maritime AIS (Automatic Identification System) is a system used by ships for identifying and locating vessels (figures 8 and 9). AIS provides identification, position, course, and speed, similar to a maritime equivalent of APRS. This information can be displayed on a PC using simple receivers and PC software, or dedicated receivers with internal modems can also be used. While intended for exchanging data directly between vessels, and between vessels and shore-based vessel tracking services, it is also monitored by many private individuals operating on two channels around 162 MHz. Several of the software packages also link the data onto internet position servers.

The AIS transmissions use low-power 9600-baud data and omni-directional antennas. While these low ERP signals do not meet the ideal of a high ERP beacon, they are pervasive and plentiful across the oceans. They are easily monitored using specialized receivers or 9600-baud capable 2-meter amateur radio sets. This material is to be covered extensively in a future article. The reader is encouraged to review the author's web page referenced at the end of this article as a starting point for more information.

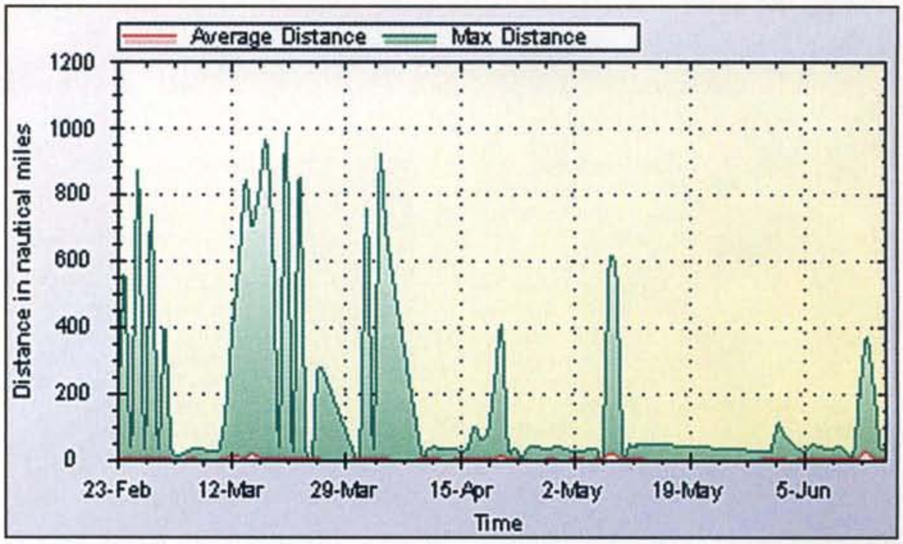

Figure 9. Historical data from an AIS station showing the standard range of 50 miles and the tropo ducting ranges of up to 1000 miles.

Phil, FR5DN, built a system in just a few hours over one weekend. Phil's station typically receives ship signals from 150 miles away and quite often reports ships more than 500 miles towards South Africa. His real-time data is added to the hundreds of other sites already posting their data to the internet AIS pages. The web pages also provide statistical data on the last several weeks of stations heard, such as average and peak ranges. At least one university has an active research project using AIS to study and indicate trans-oceanic ducting.

Public Service Band Stations

Public service band signals are not as universally helpful as the other services listed above. As with television video carriers, they typically are more useful for showing the presence of an opening rather than the specific source. Most operators do not identify with a location. Many public service radio systems are switching to digital radio, further complicating identification.

Summary

The potential for VHF ducting over new trans-oceanic paths is very high. The main limitations so far have been lack of equipment and dedicated, patient operators. Paths will be worked as more people take up the challenge. The key discipline of study to understand this propagation mode is meteorology rather than ionization.

References: Additional Information on Ducting

There are several good articles on the internet on this tropospheric ducting. The reader is encouraged to begin with a review of the following articles on the web.

- Temperature inversion basics: <http://www.mike-willis.com/Tutorial/PF6.htm> and <http://en.wikipedia.org/wiki/Temperature_inversion>.
- DF5AI has several excellent pages on tropospheric trans-oceanic ducting at: <http://www.df5ai.net/Material/articles3.html#ArticlesDucting>.
- Australian National VHF DX Group: <http://www.users.bigpond.com/anvdg/propagation.htm>.
- "Atmospheric Refraction: How Electromagnetic Waves Bend in the Atmosphere and Why it Matters" provides a good synopsis of inversions. Go to: <http://www.google.com/url?sa=U&start=1&q=http://www.weather.nps.navy.mil/%7Epsguest/EMEO_online/module4/Atmospheric_Refraction_of_EM_Waves.doc&ei=48FNSbO6KYyc8wT9q9SiDw&usg=AFQjCNF4rUNqYYkONQ0OGk2CCCM7n-MTfQ>.
- "Thermodynamic Structures of Subsidence Inversions" is a good white paper on the climatology of subsidence inversions at: <http://handle.dtic.mil/100.2/ADA265406>
- The N7BHC web page on tropospheric ducting: <http://sites.google.com/site/n7bhcvhf/trans-oceantic-ducting>.
- AIS Maritime Beacon information: <http://sites.google.com/site/n7bhcvhf/trans-oceanic-ducting/beacon-project/non-amateur-beacons/marine-band-beacons>

Amateur Radio and the Cosmos
Part 1 – From Our Meager Beginnings

Threaded throughout our hobby's history is a curious connection between amateur radio and the cosmos. Here in Part 1 of this article WA2VVA explores this connection while reporting on the history of some of the early players.

By Mark Morrison,* WA2VVA

As a young boy growing up near the Bell Telephone Laboratories in the 1960s, it was hard to appreciate what went on behind those brick walls. Situated on the first ridge of the Watchung Mountains, with a nature preserve to the rear and an expansive manicured lawn to the front, the sprawling campus of the Murray Hill, New Jersey facility and its otherwise unassuming tan buildings provided little clue as to what went on inside. Although history would reveal that "Bell Labs" was behind the Telstar satellite, the first transistor, the touch tone, video and cellular telephones, the laser, fiber optics, and software developments such as the Unix operating system and the C programming language, such things didn't achieve public recognition until years later.

Even the people who worked at Bell Labs and lived in the surrounding neighborhoods didn't talk much about what went on there. It was a curious thing that your next-door neighbor could be a policeman, a carnation grower, or a world-famous radio astronomer. Indeed, George C. Southworth, inventor of the waveguide and one of the first persons to detect radio emissions from the Sun, lived just around the corner, something I only just came to realize. Still, Bell Labs did invest in public relations, as my classmates and I well remember.

Our first glimpse at Bell Labs technology was at the local elementary school. In a gesture inconceivable by today's standards, the father of one of my fourth-grade classmates, P. K. Tien, arranged for a public laser demonstration in the halls

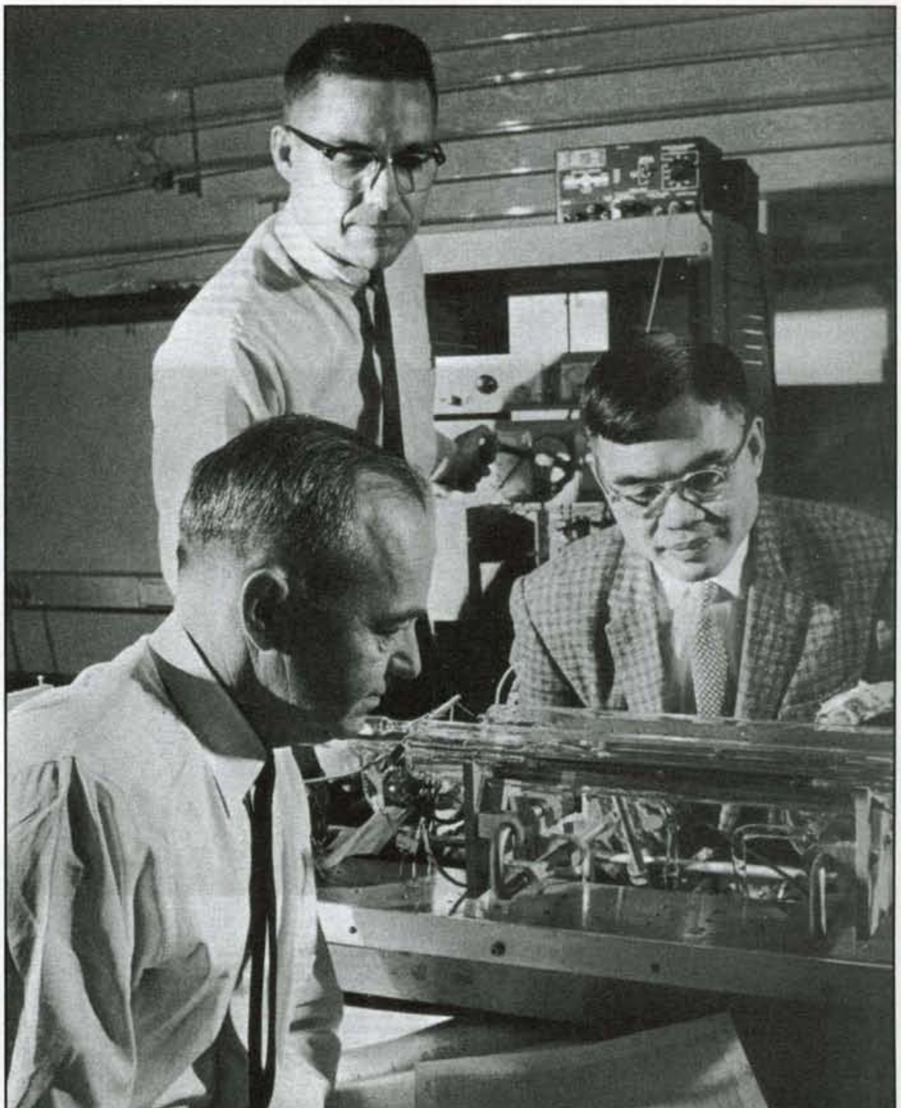

Photo 1. Shown are Bell Labs scientists P. K. Tien (right), D. McNair (left), and H. L. Hodges (center). They are examining their new triode lasers (there are two shown) which allowed laser light intensity to be modulated using an internal grid. (Source: From Semaphore to Satellite, *published by the ITU in 1965)*

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e-mail: <mark1home@aol.com>

of the local elementary school. I still remember how that mysterious light projected down the longest hallway of the school, revealing nothing more than a small dot at the other end. Photo 1 shows P.K. Tien and his colleagues working with a laser in the 1960s.

Although much of the work at Bell Labs would eventually receive widespread public recognition, such as the first television broadcasts using satellites, much of the technology and achievements were appreciated more in technical circles than by the general public. Nowhere is that more evident than in the world of radio astronomy. Starting in 1931, it was a Bell Labs radio engineer by the name of Karl Jansky who first discovered radio waves of extraterrestrial origin. Assigned to investigate sources of noise affecting overseas phone communications, Jansky directed a carpenter in the construction of a rotating wooden frame supporting an array of metal tubes and glass insulators. Photo 2 shows a replica of the Jansky antenna that is on display at the National Radio Astronomy Observatory in Green Bank, West Virginia.

Jansky's antenna was of the Bruce design, the namesake of yet another Bell Labs employee, Edmund Bruce, who patented this design as illustrated in photo 3.

Jansky's version used wheels from a Model T to rotate the antenna on a brick track, thus allowing him to isolate the direction of various noise sources. At the suggestion of George C. Southworth, Jansky plotted out his data, making the daily patterns of static more clearly visible. As a result, Karl came to recognize how one pattern peaked every 23 hours 56 minutes, or 4 minutes earlier each day. This corresponds to the movement of the Earth with respect to the stars, not the Sun, a clear indication that Jansky's static originated beyond our solar system. Jansky later concluded that this noise was coming from the Milky Way galaxy itself.

Jansky's discovery received little attention at first, possibly because it came during the Great Depression when few astronomers had the resources to do serious follow-up work. More likely is that it conflicted with the science of the day. At that time it was generally believed that hot objects such as the Sun and stars radiate most of their energy in the visible part of spectrum, and not at radio wavelengths. Whatever the reason, further thought on the subject would be left to three amateur radio operators: Hiram Percy Maxim, W1AW, Grote Reber, W9GFZ, and John Kraus, W8JK.

Hiram Percy Maxim, who co-founded the ARRL in 1914, published a book on the possibilities of extraterrestrial communications called *Life's Place in the Cosmos* in 1932. *QST* magazine, the official publication of the ARRL, had this to say about the book in its May 1933 issue: "It provides food for intriguing conjecture on the subject of interstellar communications—a field so far quite as virgin as the field that Marco Polo operated in 600 years ago. It leads us to the thrilling thought that, from our meager beginnings, some future generation of ama-

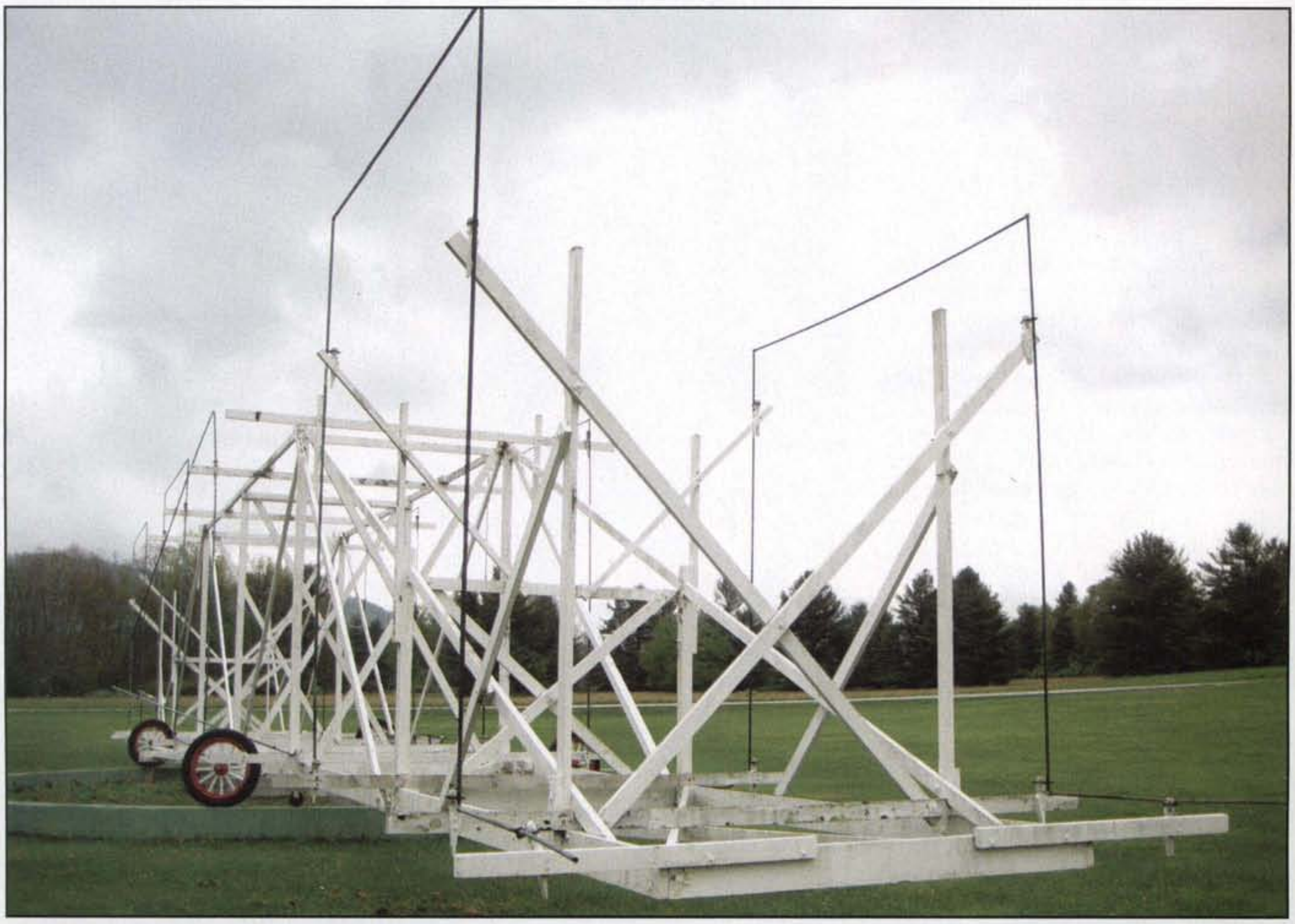


Photo 2. A replica of the Jansky antenna that is on display at the National Radio Astronomy Observatory in Green Bank, West Virginia.

teurs may figure their DX in megamiles."

It's not clear that Maxim was aware of Jansky's work, but the idea of communicating with extraterrestrial civilizations wasn't exactly new either. In the late 1800s some were speculating that light waves might be used to communicate with life on nearby planets. Later, the possibilities of communicating by radio waves also became a popular notion. In 1909 *The New York Times* published a letter to the editor from inventor Nikola Tesla entitled "How To Signal Mars" in which he extolled the virtues of radio waves over light waves. Tesla claimed, "It is evident, then, that in my experiments of 1899 and 1900, I have already produced disturbances on Mars incomparably more powerful than could be attained by any light reflectors, however large." That Tesla would choose Mars is to be understood by the popular notion that if life existed elsewhere in the solar system, it would most likely be found on the red planet. This view was popularized by astronomer Percival Lowell, who had speculated the canal-like features he observed on Mars were an indication of intelligent life there. Maxim may well have been influenced by such thinking, as both Mars and radio were favorite subjects of his.

Grote Reber, who lived in Wheaton, Illinois, was so interested in Jansky's work that he applied to Bell Labs in hopes of actually working with him. When Reber learned that Jansky had been assigned to other work, he looked for other ways to satisfy his appetite for the subject. His first step was to improve the UHF (>56 Mc) receivers of the day. Throughout the 1930s Reber's designs were published in a West Coast magazine popular with hams and shortwave listeners known simply as *Radio*. The January 1938 issue of *Radio* shows a Reber designed receiver for $1^{1}/_{4}$ meters using concentric line couplers instead of traditional lumped elements.

In the 1930s vacuum tubes weren't commonly available for use above 56 Mc, so Reber had to build or modify everything himself. Complicating matters was not knowing exactly what frequencies to use. So it was that Reber started his quest to build receivers that worked not only at uncommon frequencies, but also without any knowledge whatsoever if anything would be heard at those frequencies. When Reber built his third receiver in 1942, one designed to operate at 160 MHz, his long hours of work were finally rewarded. Photo 4 shows the first successful receiver used by Reber in his early radio astronomy work. Note the concentric-line receiver placed upon the cabinet in the right of the picture.

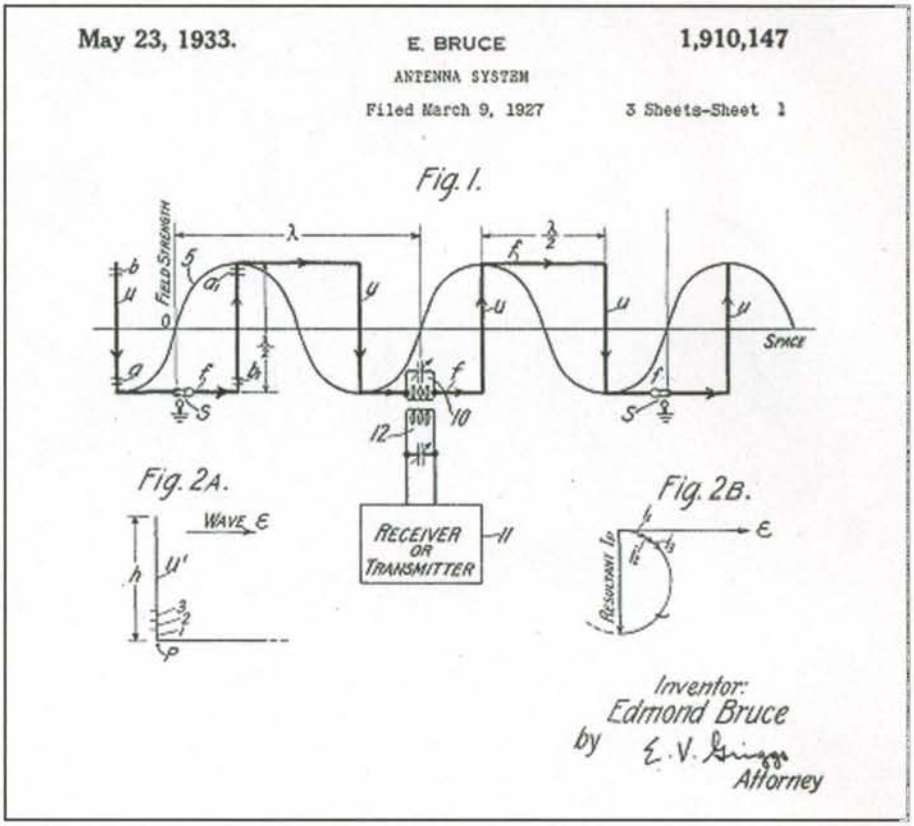


Photo 3. Jansky's antenna was of the Bruce design, the namesake of another Bell Labs employee, Edmund Bruce, who patented this design as illustrated here.

Also unusual for the time was Reber's choice of antenna. During the 1930s the most popular antenna was arguably the flat top beam developed by Kraus, W8JK, and, coincidentally, discussed more than once in that same issue of *Radio*. Although directional beams had their draw, Reber decided on the parabolic dish for his studies of extraterrestrial radio sources. How he made that decision is not clear. Perhaps he was influenced by advances in optical astronomy that were made possible by large parabolic mirrors. Not surprisingly, Reber's parabolic dish is now considered the prototype of the modern radio astronomy dish. Reber made this dish himself and mounted it on a rigid frame that allowed the angle of the dish above the horizon to be changed but not rotated. Photo 5 shows Reber's dish antenna now on display at the entrance to the National Radio Astronomy Observatory (NRAO) in Greenbank, West Virginia. The turntable was added years later.

Reber used a pen recorder to capture signals of extraterrestrial origin as the Earth's own rotation directed the dish toward different parts of the sky, much as Karl Jansky had done years earlier. However, by changing the elevation of the dish each day, Reber could piece together a mosaic of the entire sky. From his backyard location Reber created the first radio maps of the heavens and published his work in some important journals of the time.

In 1945 George Southworth made his own mark in radio astronomy when he detected radio emissions from the Sun, following similar work by J. S. Hey, and giving proof to the predictions of Oliver Heaviside, who in the late 1800s had predicted that such emissions existed. By this time Southworth had established something of a regular correspondence with Reber and shared many ideas on solar emissions with him. In one letter dated 1945, Southworth laments to Reber about not being able to do more solar observing, mainly due to the war effort, and he encouraged Reber to continue doing whatever observing he could (see photo 6). This is perfect example of the

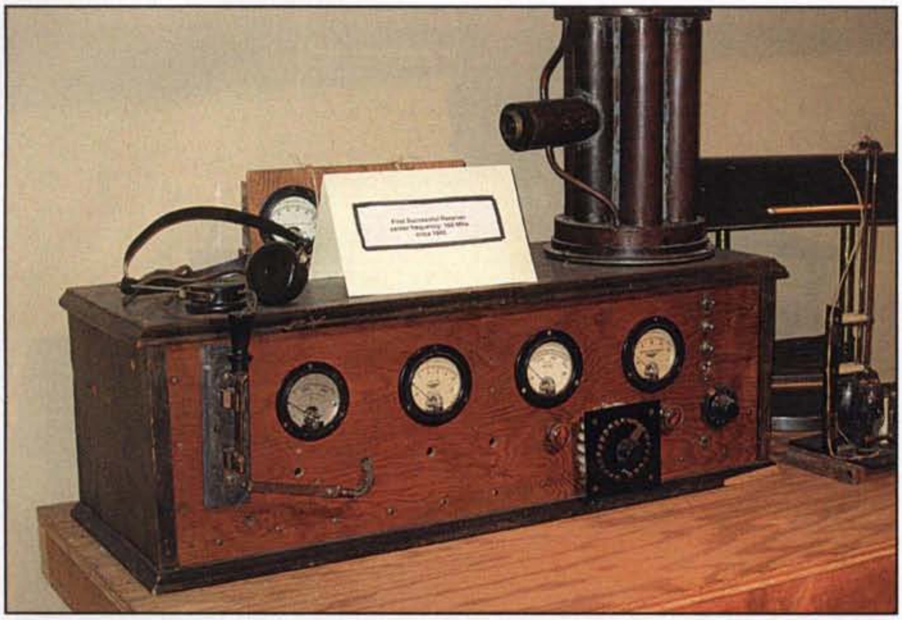


Photo 4. The first successful receiver used by Reber in his early radio astronomy work. Note the concentric-line receiver placed upon the cabinet on the right.

role that amateur radio can play when scientists are otherwise engaged.

In 1945 Reber's work received some important recognition when one of the world's great (optical) astronomers was visiting Chicago, not far from Wheaton. Years earlier, Van de Hulst had speculated that neutral hydrogen might be a source of extraterrestrial radio energy at 1420 MHz. Van de Hulst spoke with Reber about building a receiver for this frequency, which Reber apparently did contemplate, but due to other work was not able to follow through on.

Another amateur hampered by the war effort was Jack DeWitt, N4CBC (his call when he passed away on January 25, 1999). During the war DeWitt was stationed at Evans Signal Laboratory in Wall, New Jersey. This was the secret radar lab of the U.S. Signal Corps and also a former Marconi receiving site. Before the war DeWitt had pondered moonbounce, and when the war ended he received permission from his superiors to attempt such a feat. On January 10, 1946 DeWitt and his colleagues became the first in history to bounce a signal off the moon and detect it back on Earth.

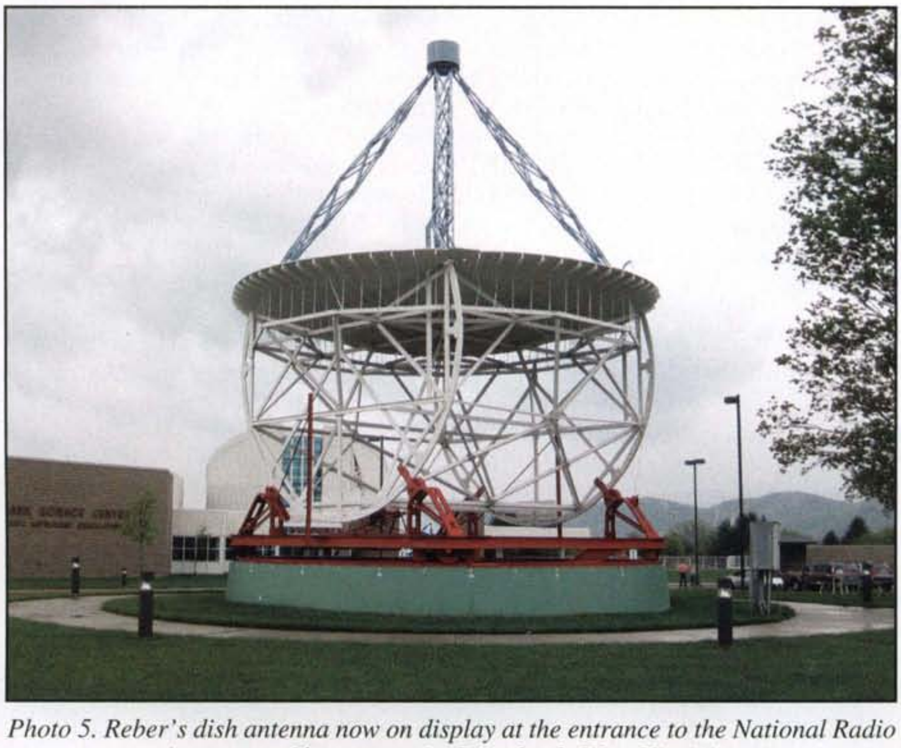


Photo 5. Reber's dish antenna now on display at the entrance to the National Radio Astronomy Observatory in Greenbank, West Virginia.

In 1951 two Harvard scientists, Harold Ewen and Edward Purcell, took it upon themselves to design and build a horn antenna and receiving apparatus for the express purpose of detecting the hydrogen emissions Van de Hulst had speculated about years earlier. On March 25, 1951 they succeeded in detecting these emissions, the very first spectral line ever observed in radio astronomy. Soon after, scientists theorized that if hydrogen was moving with respect to an Earth-bound observer, one might determine its speed and relative direction using Doppler techniques already familiar to terrestrial radar operators. Using such methods, astronomers discovered that our own Milky Way galaxy has a spiral shape, something impossible to discern using optical telescopes.

In 1953 DeWitt's moonbounce work would be continued when amateurs Bill Smith, W3GKP, and Ross Bateman, W4AO, succeeded in hearing their own moon echoes using a rhombic antenna in Virginia. Two years later, Jim Kmosko, W2NLY, would build a huge array of long Yagis in New Jersey and use it for a series of moonbounce tests with interesting results. By transmitting single CW pulses every 5 seconds and listening for echoes in between, Jim could gauge his ability to track the moon and also its potential for reliable communications. In one experiment, Jim detected 30 echoes out of 120 pulses transmitted, perhaps the first amateur record of the effect of the moon's libration.

In 1955 radio astronomers Kenneth Franklin and Bernard Burke were working on an antenna array in a Maryland field, when they accidentally discovered radio emissions emanating from the planet Jupiter. This was the first time that radio signals had ever been detected from another planet. These naturally occurring signals had a unique frequency near 22 MHz and were also detected the following year by Dr. John Kraus, W8JK, using a backyard interferometer.

It is interesting to note that in 1955 Walt Morrison, W2CXY, revisited the idea of using light waves to communicate via the moon. The U.S. Army showed considerable interest in Walt's proposal but concluded the lack of a suitable light source would make it impractical for serious consideration at that time. It is interesting to note, however, that MIT researchers did bounce a light signal off the moon years before the laser was invented. The Army's response to Walt included a letter from astronomer Dr. John O'Keefe, the scientist who would discover the Earth's pear shape based on orbital data from the early satellites. After a lengthy discussion on thermodynamics, in which he explained why it would not be possible using current technology to communicate via the moon using terrestrial light sources, Dr. O'Keefe hinted at a possible means of reflecting radio signals from outer space that to my knowledge has never been investigated. Here's what he had to say:

"According to V. G, Fessenkov, the Gegenschein is a sort of tail of the Earth, formed from material driven by radiation pressure out of the high atmosphere. It is at a distance, he says, of about 80,000 miles, and subtends an angle of 3° to 4°. Is there any possibility of getting a reflection from it, on radio frequencies?"

Those familiar with optical astronomy will recognize the Gegenschein as a faint glow in the nighttime sky resulting from the backscatter of sunlight off microscopic particles on the side of Earth opposite the Sun. If such particles are capable of reflecting radio waves, the Gegenschein may present a unique alternative to moonbounce, especially since it is always there. Who woukd like to be first to give Gegenschein bounce a try?

In the 1950s, radio amateur John Kraus, W8JK, would come to invent yet another unique antenna, one even more significant than his flat top beam of the 1930s—the helical antenna. The circular polarization of this antenna makes it possible to communicate between the Earth and space with minimal interference from Faraday rotation. This makes it ideal for use in space communications, and such antennas were often employed in such work. However, Kraus recognized that arrays of such antennas could also be used to make sensitive interferometers, ones capable of detecting and discriminating various extraterrestrial radio sources. That contribution to radio astronomy not withstanding, Kraus's greatest contribution is perhaps the "Big Ear" radio telescope that he designed for Ohio State University (OSU). Similar to Reber's telescope, Kraus' instrument pointed south and used the Earth's own rotation to scan the sky. However, that's where the similarities end.

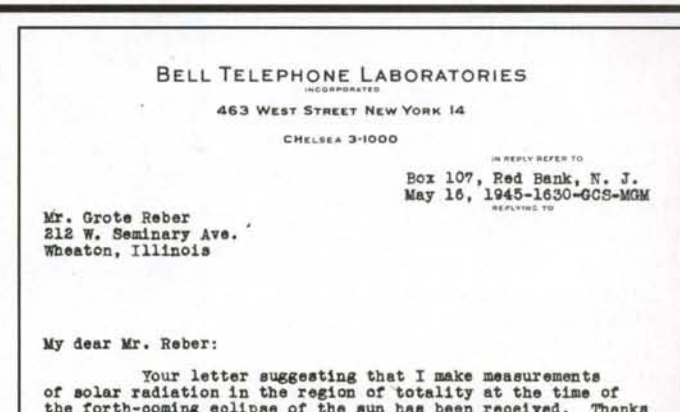
Unlike Reber's telescope, which tilted the entire parabola in order to view different elevations of the sky, Kraus' telescope used a fixed parabola spread out across an entire field, and a tilting reflector to direct the extraterrestrial energy into the parabola. The advantage of such an arrangement is that a much larger parabola can be created without having to worry about supporting and tilting its full weight and also maintaining its precise shape. True, it still required the Earth's rotation to scan the skies, but the impressive size of this instrument afforded Kraus unheard of capabilities. This instrument was used to create some of the most detailed radio maps of the heavens and to probe deeper into space and time than ever before possible.

One radio source identified using this telescope was named OH471. When optical astronomers analyzed the light from this faint object they determined from its red shift value that is was located 90% to the edge of the universe, the most distant object known to man. In a way, astronomers were looking at the last milepost of the universe! This same antenna also captured the so-called "Wow Signal," which had all the earmarks of an extraterrestrial signal and to this day remains one of the great hopes of SETI enthusiasts.

By the late 1950s, the signature frequency of hydrogen at 21cm was about to provide yet another milestone in radio astronomy history. Of all the substances in the universe, hydrogen is the most elemental and also the most abundant. Having confirmed that hydrogen radiates uniquely at 1420 MHz, and further that such emissions could be detected using 20th century technology, suggested to more than a few scientists that if life existed elsewhere in the universe other civilizations might choose this frequency to communicate with others in the cosmos.

Three such scientists were Philip Morrison, ex-W8FIS, Giuseppe Cocconi, and Frank Drake. At that time the largest steerable dish antenna of any significance was the 250-foot dish at Godrell Bank, UK, run by Sir Bernard Lovell. Morrison and Cocconi wrote a short note to Lovell proposing the use of his dish in a systematic search for intelligent life in the star systems nearest the Earth. This appealed to Lovell, but apparently nothing happened. Nonetheless, the Morrison Cocconi papers are considered an important part of radio astronomy history.

Quite independently, Frank Drake was working at the NRAO in 1956 and thinking along the same lines. His so-called "Drake Equation" is now famous for laying out the distances that the most powerful radio transmitter on Earth could be detected



BELL TELEPHONE LABORATORIES
INCORPORATED
463 WEST STREET NEW YORK 14
CHELSEA 3-1000

IN REPLY REFER TO
Box 107, Red Bank, N. J.
May 16, 1945-1630-GCS-MGM
REPLYING TO

Mr. Grote Reber
212 W. Seminary Ave.
Wheaton, Illinois

My dear Mr. Reber:

Your letter suggesting that I make measurements of solar radiation in the region of totality at the time of the forth-coming eclipse of the sun has been received. Thanks very much.

I have had this eclipse in mind for more than a year and at one time I entertained hopes that the thing you are suggesting could be done. However, it has been evident for some time that the pressure of our war work would preclude the necessary long trip. More recently the situation has worsened and it may very well turn out that we cannot make measurements even here at Holmdel. I should think, therefore, that anything you might find it possible to do would have extraordinary significance.

Yours very truly,

G. C. Southworth

G. C. Southworth

Photo 6. Southworth's correspondence to Reber, dated 1945, lamenting to Reber his not being able to do more solar observing, mainly due to the war effort. (Source: <http://jump.cv.nrao.edu/dbtw-wpd/Textbase/Documents/grgc-southworth-reber-05161945.pdf>)

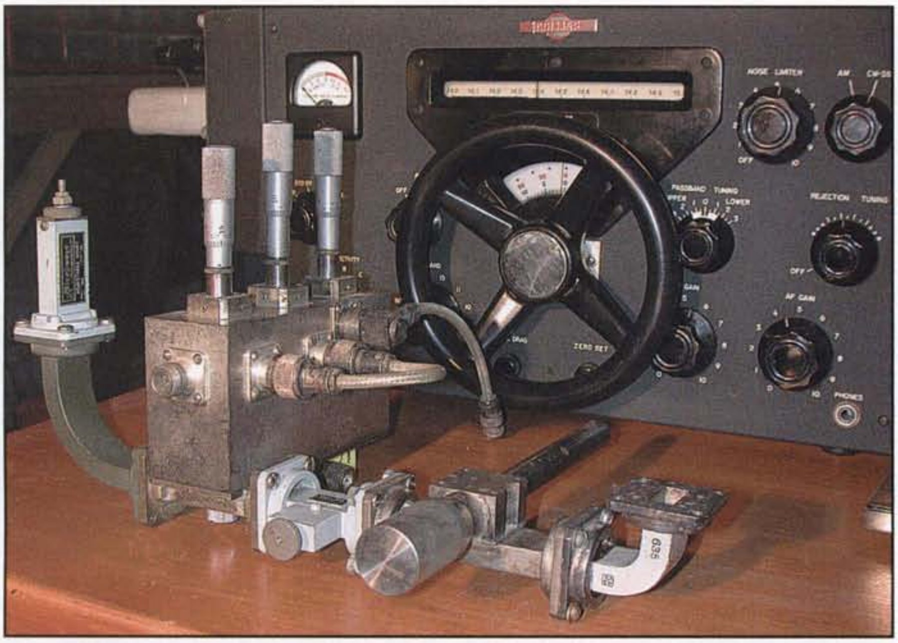


Photo 7. The Microwave Associates parametric amplifier owned by Walt, W2CXY, similar to the one used by Frank Drake, and now part of the Infoage collection at the former Camp Evans site in Wall, New Jersey. The Collins 75A4 receiver in the background is part of Walt's historic meteor-scatter and moonbounce station of the 1950s.

using the most advanced receiving apparatus on Earth at the same time. The result limited the search to just a handful of stars. At that time astronomer Otto Struve was in charge of the NRAO. Years earlier, Struve came to the conclusion that planetary systems were not unique to our solar system, based upon the irregular motion of certain stars. From this he concluded that planets must be circling those stars and, given the large number of such stars, the possibility that life existed on at least some of those planets could not be discounted. When Drake approached him with the idea of searching the nearest star systems at NRAO, using equipment that would also be useful in other work planned there, he was given permission to proceed with the idea. The only thing still needed was a sensitive front-end amplifier to use for the experiment.

In the late 1950s two important developments were made with respect to radio frequency amplifiers. At that time, most telephone and some television signals were transmitted across the country by a network of microwave repeaters spaced every 30 to 50 miles. These repeaters used microwaves in order to increase the number of channels that could be transmitted simultaneously.

When satellites came into being, one limitation was the power available for transmitting. As an example, the Telstar satellite used only a 3-watt transmitter. In order to get around this limitation, ground stations needed to have sensitive receivers. In those days, the cooled maser was the lowest noise receiving device in the world, and although somewhat complex, it was chosen for the earliest satellite experiments by Bell Labs in Holmdel, New Jersey. This type of amplifier would later play a role in radio astronomy, as we shall see shortly. The other type of amplifier was the parametric amplifier, which was less complicated but had higher noise levels than the maser. Invented by radio amateur Sam Harris, W1FZJ, who worked for Microwave Associates in Burlington, Massachusetts, this type of amplifier, in both cooled and uncooled versions, enjoyed many years of service in radio astronomy.

The head of Microwave Associates was Dana Atchley, Jr., W1HKK, who was so interested in the possibility of extraterrestrial communications that he published an article called "Speculations on Communications with Other Planet Civilizations" in the March 1960 issue of *QST*. In this article he suggested once again the possibility of life among the stars. When Atchley learned of Drake's need for a sensitive front-end receiver, he offered him one of the first parametric amplifiers in the world for use in Project Ozma, the name Drake assigned to the first Search for Extra Terrestrial Intelligence (SETI). Years later, in the January 1979 inaugural issue of *Cosmic Search* magazine, Drake recalled the day when this amplifier arrived at the NRAO facility in Green Bank, West Virginia:

"On the appointed day, sure enough, I got a call in my office that the chief engineer of Microwave Associates had arrived with the amplifier. Going downstairs, I got a real jolt but kept my cool as I saw before me: (1) A British sports car, top down , made by Morgan; cars used to be made of wood and this was the last of them, you know, complete with leather straps to hold the hood down. (2) in the driver's seat, a fellow with a long flowing red beard, and wearing a red tam-o-shanter. And (3) in the passenger's seat, the parametric amplifier which had bounced all the way from Boston. The driver was Sam Harris, known to every radio ham as a radio amateur magazine editor, and known to many and soon to me as an electronics genius. He had designed the parametric amplifier, and was the only one in the world who could make it work—and it really worked. He proceeded to install it, make it do its magic, and then taught me how to tune it, the task which became my four-o'clock-in-the-morning pick-me-up for the day. When all was well, he climbed back in his Morgan and drove off. I never saw him again until one day in 1966, when I met that red beard again; this time he was on the staff of my observatory at Arecibo (I had nothing to do with this improbable event), and he has been there ever since, doing his magic."

Photo 7 shows the Microwave Associates parametric amplifier owned by Walt Morrison, W2CXY, similar to that used by Frank Drake, and now part of the Infoage collection at the former Camp Evans site in Wall, New Jersey. The Collins 75A4 receiver in the background is part of Walt's historic meteor-scatter and moonbounce station of the 1950s.

Although Project Ozma did not detect signs of intelligent life in the cosmos, the type of paramp used by Frank Drake would play a significant role in amateur moonbounce experiments in the years that followed.

In Part 2 of this series we'll see further examples of the curious synergy that exists between amateurs and professionals as the quest to understand our place in the cosmos continues.

Was It E Skip or Tropo?

Both new and experienced operators sometimes make mistakes when trying to discern the type of propagation supporting a band opening. In order to help end some of the confusion, WB6NOA discusses some of the general differences between *E* skip and tropo propagation modes.

By Gordon West,* WB6NOA

At the SEA-PAC convention in Seaside, Oregon in June, several 6-meter operators were recounting their recent tropo contacts with KH7Y in Hawaii.

"I have never heard the tropo between Oregon and Hawaii as strong as it was over this 2500-mile path. At one point, Hawaii was coming in well over S9 for about 10 minutes," commented an Extra Class ham, obviously mistaking the double-hop *E* skip band condition for the summertime California to Hawaii tropo openings.

"I live just north of Dallas, and the Florida FM 2-meter repeater gave us a skip opening that lasted for a solid day!" remembered another ham, mistaking a likely tropo opening for short-lived summertime *E* skip.

Yet another ham commented, "It was like a rollercoaster. The signal was strong, then would take a momentary deep fade, and then the tropo would build back up again, cycling this way, over and over." Nope, not tropo.

Ken Neubeck, WB2AMU, author of the book *Six Meters, A Guide to the Magic Band,* describes *E* skip as regularly cycling strong to near disappearing signals within a 30-second time frame, and tropospheric ducting as moderately strong signals with gradual build-up and decay for hours on end. Sometimes tropo conditions will lead to moderately strong signals for days on end!

Sporadic-*E* Skip

Good news! Sporadic-*E* skip occurs twice a year, no matter where we are in the 11-year solar cycle. As we just begin the climb of solar Cycle 24, sporadic-*E* VHF/UHF excitement may be just as strong now as it will be six years from now.

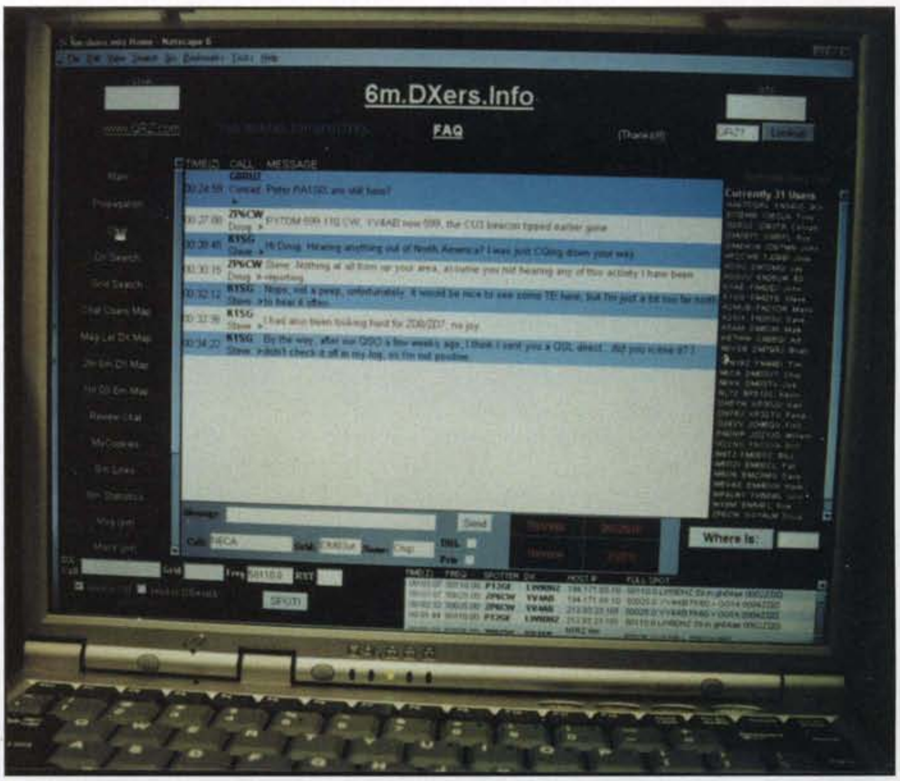
**CQ VHF Features Editor, 2414 College Dr., Costa Mesa, CA 92626*
e-mail: wb6noa@cq-vhf.com>

The *E*-layer of the ionosphere energizes every day at about 50 miles up. Sporadic-*E* VHF/UHF propagation takes place when radio signals *reflect* off drifting clouds of highly ionized *E*-layer particles, slowly moving from west to east. The reflections on VHF and UHF frequencies may be so "spot" intense that you may hear a station 1400 miles away, but your friend 10 miles away hears nothing! A few minutes later, *you* may hear your friend working sky-wave stations, and this time *you* hear nothing! Welcome to *E*-skip!

Sporadic-*E* skip gives Technician class operators on 10 meters CW and SSB some heart-pounding thrills. These 10-meter events can last for several hours, with every half minute peaks and valleys of reception. On 6 meters, sporadic-*E* creates lively contacts, with sometimes even double- and triple-hop cloud-to-cloud reflections which add some serious, short-lived DX to the 6-meter band.

On 2 meters, *E*-skip conditions to your specific location may only last for a few minutes, and your actual contact time won't last much longer than maybe 30 seconds. There is even a recorded 5-second contact on 432 MHz with Pat, N6RMJ, holding a brief QSO from southern California to the Midwest.

Sporadic-*E* skip on VHF and UHF peaks in May through August, with a secondary shallow peak in December and January. The best time to look for *E* skip



Computer propagation sites have all but replaced 10-meter band-opening alerts. (Photos by the author) is mid-morning and late afternoon. At high noon, *D*-layer absorption takes its toll on DX.

The *E* skip patches of highly ionized "clouds" could be caused by charged particles from a single sunspot or could be caused by high-altitude wind currents that develop their own static electricity. Regular 6-meter/10-meter *E* afficioados claim they can anticipate a sporadic-*E* opening by looking at high cirrus cloud formations, yet others (in low-noise areas) claim they can forecast an imminent *E* skip opening by static discharge cracks passed through their DSP noise-reduction receiver audio circuitry. This is confirmed by John, N1OLO, of West Mountain Radio, who has recorded actual ionospheric "hiccups" using his Clear Speech DSP speaker circuitry just before the band magically, and suddenly, pops open.

Geometry of a typical *E* skip reflection works out to a little over 1400 miles. However, during periods of intense *E* "cloud clusters," double- and triple-hop events may lead to extraordinarily strong contacts such as the recent one from Oregon to Hawaii.

"I can give you a 10-minute heads-up before the 6-meter band is ready to open," commented Paul Lieb, KH6HME, the VHF/UHF voice of Hawaii. "I'll hear a hubbub of voices on the calling channel, 50.125, way down in the noise, minutes before an amazingly strong signal pops out of nowhere!"

Scanning for automatic beacons, between 50.060 and 50.080 MHz, is another great way to get set for *E* skip activity. Many hams also monitor the commercial FM music channels, 88 MHz to 108 MHz, for activity, possibly signaling *E* skip happening as high as the 2-meter band.

Now that most TV stations have gone digital and have been assigned UHF channel slots, many of us who dialed in to low TV-band analog VHF carriers are just discovering digital stations via sky waves. There are a handful of low TV-band stations above 54 MHz. It may be time to search out other sources of distant signals that could come in sky-wave under the right *E* skip conditions: <www.VHFDX.net/spots/map.php> and <www.DXWorld.com/50prop/html>.

Predictable Tropo

How is the weather? High-pressure weather systems will trigger long-range VHF and UHF tropospheric ducting.

Weather Triggers Openings

By Gordon West, WB6NOA

For a 6-meter and 2-meter sporadic-*E* bounce, high-altitude atmospheric conditions must be just right. These weather conditions are at the edge of our atmosphere.

Long-range VHF, UHF, and microwave contacts may occur with tropospheric ducting. The weather condition "on the deck" is one that you can feel as heat, smell, and observe with a local barometer. Be a weather "watcher" and you may be able to predict some terrific openings!

Sporadic-E

For the 6-meter and 2-meter sporadic-*E* openings, some experts track the jet stream. The powerful jet stream creates wind shear as river-like volumes of air pass through the atmosphere. The stronger the jet stream, the greater its amplitude in altitude, at times extending into the *E* region of the ionosphere.

Strong wind shears associated with the jet stream, lightning, and sometimes monster storms, strip atoms of some of their electrons, creating a collection of like-charged, mutually repelling ion clusters.

"Ions exhibit a collective behavior, which is why we call that collection of ions the ionosphere. These ions don't generally affect radio signals directly, but they do give a certain sense of direction to the free electrons," says Eric Nichols, KL7AJ, in a soon-to-be published book *Opus* about the technical side of ham radio (KL7AJ@arrl.net).

"Up here in Alaska, we use the HAARP ionosonde, which illustrates the electron density profile for the number of free electrons at any altitude, from 50 km to about 600 km," adds Nichols. Nichol's work describes these free electrons, around 250 km in altitude, which absorb and re-radiate radio signals, leading to exciting 6-meter conditions.

"I am reluctant to describe the ionosphere as reflecting radio waves. It is the acceleration of electrons that creates electromagnetic fields, not their mere movement. Our ions are basically floating on top of the atmosphere, and genuine weather effects down here on the surface *do* eventually transfer to the ionosphere," adds Nichols, suggesting that "electron precipitation may cause ions to travel down the Earth's magnetic fields, where they are dissipated, leaving holes in the ionosphere where 6- and 2-meter strong skip signals may drop into the noise levels for a few seconds."

"The ionosphere is inherently unstable. It's much like trying to float water on top of oil—the slightest disturbance will end up putting the water on the bottom, where it normally belongs. These magnetic fields are irresistible water slides for electrons," illustrating that it takes the right atmospheric conditions to trigger the elusive 6-meter and 2-meter sporadic-*E* openings.

Long-Range Tropo from 50 MHz to Microwave

Hurricanes traveling up from the tropics regularly create "tropospheric ducting." The troposphere is our weather layer of the atmosphere. With normal air, its temperature will drop 1 degree Fahrenheit for every 300 feet of elevation. Barometric pressure decreases logarithmically with altitude, and water content, within our atmosphere, decreases with altitude.

The long formula for calculating the refractive index of air is:

where:

$$N = \frac{77.6 \times P}{T} + \frac{3.733 \times e \times 10^5}{T^2}$$

P = atmospheric pressure in millibars
e = vapor pressure in millibars
T = temperature, Kelvin
N = the refractive index of air

For easier calculations, N = (n–1) × 106 gives us the refractive air as just a bit over 1 (1.000350) on the deck.

On a normal day, for every kilometer in altitude we could expect a change of 40 to 50 units. However, when warm, moist air from an approaching hurricane begins to overlay our "normal" atmosphere, our air becomes "squeezed" (greater pressure aloft), warmer (coming from the southern hurricane), and much more humid (again, the approaching hurricane). As this air stratifies within a high-pressure cell, VHF, UHF, and microwaves are refracted (bent) along the horizon with little attenuation. The Hepburn website mentioned in the article does all these calculations for you! Look for the red and purple propagation enhancements. As the more pronounced tropospheric ducting conditions thin multiple layers of atmosphere, these strata could lead to contacts as high as 10 GHz.

Summary

Weather in the troposphere leads to long-range ducting. Weather wind shears high in our atmosphere lead to the potential of sporadic-*E* clusters of intense ionization.

For a good source of more information on the material mentioned in this article, see the book *VHF Propagation: A Practical Guide for Radio Amateurs,* by Ken Neubeck, WB2AMU, and Gordon West, WB6NOA, available through the CQ Bookstore.

Pat, N6RMJ, 432-MHz record holder, working on his 10,000-MHz gear.

Unlike *E* skip, which tops out not much higher than 430 MHz, tropo may actually develop into waveguide-like DX, *increasing* in signal strength as the frequency goes higher!

"Depending on the depth or thin stratification of the atmosphere, the path between Texas and Florida may sometimes be slam dunk on 2 meters, yet a week later, the temperature inversion thins out to carry 70 cm like gang busters between our coast and their coast, with almost no propagation down at 2 meters," commented Larry Pollock, NB5X. "It all depends on the stratification within a stalled high-pressure cell hanging stationary over the tropo paths."

Range extension propagation within a tropospheric duct temperature inversion is the result of *refraction,* not simple reflection. Sporadic-*E* is usually reflection, and tropospheric ducting is usually refraction.

A common VHF/UHF tropo ducting event occurs when warm air from a developing hurricane rides north and overlays cool undisturbed (no wind) surface air. Hurricane-looking clouds spiral up from the south counter clockwise and ultimately settle over a region and then begin to sink. The air sinks because it formed up in a high-pressure cell surrounded by "normal" air.

Heavier high-pressure air sinking (called *subsidence*) then bottoms out about 500 feet from the surface of the ground or ocean. There is no mistaking a temperature inversion, as it's hot, sticky, and breeze-less due to the southern hurricane air approaching.

As the high-pressure subsidence begins to bottom out and stratify, single and multiple layers of warm and cool air develop a perfect waveguide for VHF and UHF radio waves – any mode, including FM and even my record-breaking reception of amateur television over a 2500-mile path from my southern California QTH to Hawaii!

Via computer (go to: <www.DXINFOCENTER.com/tropo.html), the Hepburn Report shows that 10-degree delta difference in stratified layers, usually illustrating enhanced tropospheric ducting conditions. But local hams may not need the computer.

"I can smell it, I can see it, and when I tune in on the 2-meter beacons, I can usually hear it!" commented Chip Margelli, K7JA, who has an uncanny knack for predicting tropo and weather-related openings. His recent trip to Ham-Com in Texas gave him a close-up look at colliding air masses, and the sometimes range-extension ducts that may form along the line of descending storm cells.

The Hepburn Report is ultra accurate, but just looking over local weather maps and spotting high-pressure cells is another great way to predict tropo VHF/UHF openings.

"Just go outside and sniff, look for the brown haze (which we call smog) just hanging on the horizon," added Margelli.

The typical tropo DX event has signals building over a 30-minute period with relatively constant signal strength, without the huge momentary fades of a sporadic-*E* signal. The refractive tropo duct opening may not be as strong as the reflective *E* opening, but the tropo duct may extend well over 2500 miles for days without major signal fades.

So, next time DX pours into your 6-meter or 2-meter transceiver, consider weather conditions or the *unpredictable* sporadic-*E* events and decide for yourself whether your DX operation will last for minutes with *E* skip, or maybe hours, or even days, when the tropo moves in!

DSP add-on modules will improve weak-signal SSB and CW reception.

An Interview with the "Fire Tower Man" of Tennessee

My friend Melvin, K4JFF, had often told me he could routinely work a station in Tennessee on 2 meters simplex from his house in Atlanta, Georgia, and that this ham has a fire tower atop a mountain there. It intrigued me from the start. This is the story of my search to learn about the tower and the man who built it.

By Jorge de la Torre,* KI4SGU

Many hams have 100+ foot towers for their VHF/UHF antennas. However, John Williams, N4AOW's tower is at the top of a mountain in Tennessee (see photo 1 and notice the small specks in the fields below, as those are cows!). After first hearing about his tower, I thought that this must make for very short antenna runs, but was quickly reminded that he would have very long ground leads. From the moment I heard of N4AOW's tower setup, I knew I had to meet John and visit his QTH. I finally got my opportunity to meet him at the Dalton (Georgia) Hamfest on a frightfully cold day in February 2008.

When I met John, there was a bit of a mental disconnect for me. This legendary ham could easily talk across state lines on 2 meters, defying the curvature of the Earth itself, but the quiet, soft-spoken gentleman before me did not quite fit what I had imagined. As I spoke to John more and more, I came to realize that the magic in all of John's accomplishments is the thousands of details he meticulously handles. To him it is not all about raw, brute power; it is all about the details.

As a ham and an amateur engineer, I was more than a little intrigued as to how a ham would acquire and operate his own 90-foot steel tower atop an equally impressive ridge line in the foothills of the Great Smoky Mountains (technically the northern end of the Red Hills of southeast Tennessee). One detail, which I came to find out later, is that John had acquired not only the tower but also the land with this project in mind. He then finally built the house that is now his home. Wow, that is dedication to the hobby!

Photo 1. John Williams, N4AOW's tower is at the top of a mountain in Tennessee (notice the small specks in the fields below; those are cows!). (All photos by Kevin, N5PRE, unless otherwise noted)

During that first meeting, as we walked and talked amidst the cold bone-yard at the hamfest in northern Georgia, we turned the pages of his photo album, an album that John had compiled as a record of the construction project. My very first question was "Wherever did you find a surplus forestry service tower?" "In Sparta, Tennessee," he said, adding, "for about $300 in the summer of 2001." The tower also had lots of its key parts missing. Apparently, the previous owner had had the tower for a similar project, but had never been able to complete it and had lost many of its parts along the way before selling it to John. I wanted to visit and operate from the shack, and not just the turn the pages and view the pictures. As people often do, we vowed a most excellent and expedient plan for later that year when we would visit the tower and see for it ourselves. I optimistically figured on a few months at the longest, when the weather had warmed up a bit and I would make the trip to John's home in Cleveland, Tennessee. But alas, work and family and all of the other normal

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pressures of life conspired against me and kept me from making the trip.

When the 2009 Dalton Hamfest was announced again for February, it signaled the anniversary of my failure to carry through with the visit. I decided to call my friend Melvin, K4JFF, via ham radio of course, and arrange to set a new date to finally visit John and his tower. We simply would meet at the hamfest and follow John back to his QTH. This time we would right the wrongs and make the trip we had missed out on the year before. (For some reason, Dalton mirrors Punxsutawney, Pennsylvania, with its quaintness, which is in contrast to my more normal, metropolitan environs of Atlanta).

The Tower

Driving through the Tennessee countryside following a collection of now smudgy printouts from Google® Maps, we were slowly making our way through a picturesque sea of pastures and cows. My old GMC van was straining to get up John's rather steep and long driveway, and all I could wonder is why I couldn't see the tower whose transmissions I could hear in Atlanta. The reason is that the tower is nestled deep in the woods, and it is really hard to see. Just a brief walk through the backyard and we were at the base of the tower (see photo 2). Once there, we were eager to pick up where we had left off the year before. We slowly climbed higher, through the center of the tower, and the handie-talkie on my belt came alive with the sounds of an Atlanta repeater (120 miles away). It had been tuned and then forgotten about as we left Mel's place hours earlier.

We began talking about the construction of the tower. John correctly pointed out that the construction came much later in his story. After acquiring the tower, figuring out how to put it together had been a much longer and tougher issue than I had given him credit for in my rush to get to the fun stuff. Like trying to put together a really big bicycle on Christmas morning, but without any instructions, this "present" was close to 90 feet tall, weighed tons, had random missing pieces, and there was no toll-free number to call for some technical hand-holding.

At the beginning of the project, not having engineering drawings or blueprints was more than a bit of a slowdown for John. As John explained, he started by talking to area forestry old-timers who remembered some details about the tower in its glory days, but that left out too many details. He located a still erect tower across the state line near Ringgold, Georgia. That tower was a reasonably close stand-in to his own, and he could now climb it, making measurements and drawings and trying to identify the hundreds of metal members that might resemble his own lying in a heap in his yard. He spent seemingly weeks just measuring the hole spacings and angles on the struts.

During this period John found out that his tower had been built sometime in the 1930s by the Aermotor Windmill Co., and the more he learned the harder the project seemed, as he came to realize that dozens of parts—over 2000 pounds of steel—were missing and would be difficult and expensive to recreate.

We already knew that he had purchased the original tower for about $300, but the rest of the tower cost a little more. How much more took a little more prodding to find out. John is a quiet, humble man, preferring to let his actions talk more than his words. When he does speak, it is in mellow tones, sounding much like a Faulkner inspired gentleman from the bygone South. Therefore, when we first asked about the total project,

Photo 2. John's tower nestled deep in the woods.

John simply said it cost him "a lot." Later, when we pressed him further, he admitted that it cost him at least $8000 (notice, he said "at least"). Having said that, he quickly pointed out that included in the $8000 was another whole tower, as he purchased a 47-foot tower to cannibalize. The current tower owes much of its top 40 feet to that smaller second tower from Sales Creek, Tennessee. The second tower was also built by the same Aermotor Windmill Company.

Now that the story was out in the open, the rest started to flow easier. John stated that he could maybe build yet another 30-foot tower with just the spare pieces and junk left over from the original build. That led us to a logical leap of hope, and I asked him if he would ever consider building a tower for another ham—perhaps me. John just laughed, giving no answer, as he is too polite for a "no," although he commented that once having built one, a second would be much easier. Seeing how far we could push this line of inquiry, we asked if he would do anything differently if he had to do it all over again. After a brief pause, he chuckled and said he should have gotten a bigger one, maybe one of those 100+ foot towers now available in Florida. Ahhh . . . for the clarity of hindsight.

Now, as the word slowly spread about John's project, some help came from many unlikely places. For instance, the

Photo 3. Civilian Conservation Corps (CCC) enrollee Thales Bay of Orin, Illinois, at work on a fire tower, Camp Ingram, Fremont National Forest, Oregon. (Photos 3 and 4 courtesy of Oregon State University Archives' photostream, <http://www.flickr.com/photos/osucommons/3226888156/in/photostream/>)

University of Tennessee at Chattanooga was able to secure the set of blueprints for a similar tower in their forestry archives, thereby enabling John to plan and execute his foundation and base design. With the newly found drawings, he was able to have more confidence about the project, and not only for himself, but for the county inspectors, who eventually gave him their full blessings once they realized John was planning on over-building the base by a factor of 10 and that the tower would be built to withstand 120-mph winds.

This was not a project for the faint of heart, nor for one afflicted with acrophobia. This thing is huge, the climb is steep, and it is perched atop an already tall hill, surrounded on all sides by the stunning beauty of southeast Tennessee. John makes this seem much easier than it really is, but then he is a professional steel and metal fabricator at a factory in nearby Cleveland, Tennessee.

The History

In preparation for this article, I became a bit of a tower expert myself, finding out some of the history about the towers themselves. The towers were originally designed back in 1926 as "Bilby towers," named for their designer Jasper Bilby. As mentioned before, these towers were built by the Aermotor Windmill Co., which went on to build most of the nation's forest observation towers. These fire towers were amazingly narrow at the top due to their windmill pedigree; this allows for only the coziest of shacks near the top. My web searches also yielded that the company is still in business <http://www.aermotorwindmill.com>. They are still building windmills and towers, but mostly for rural water-pumping systems.

The original need for these fire towers was increased by the Great Fire of 1910, a wildfire that burned about 3-million acres in northeast Washington, northern Idaho, and western Montana in just over two days and killed 87 people. Arguably the largest US forest fire in recorded history, the smoke from the fire drifted across the entire country to Washington, D.C., both physically and politically. This energized and challenged the then recently created US Forest Service to address new policies regarding fire suppression and monitoring, prompting towers to be built across the country. In 1933, during the Great Depression, President Franklin D. Roosevelt formed the CCC

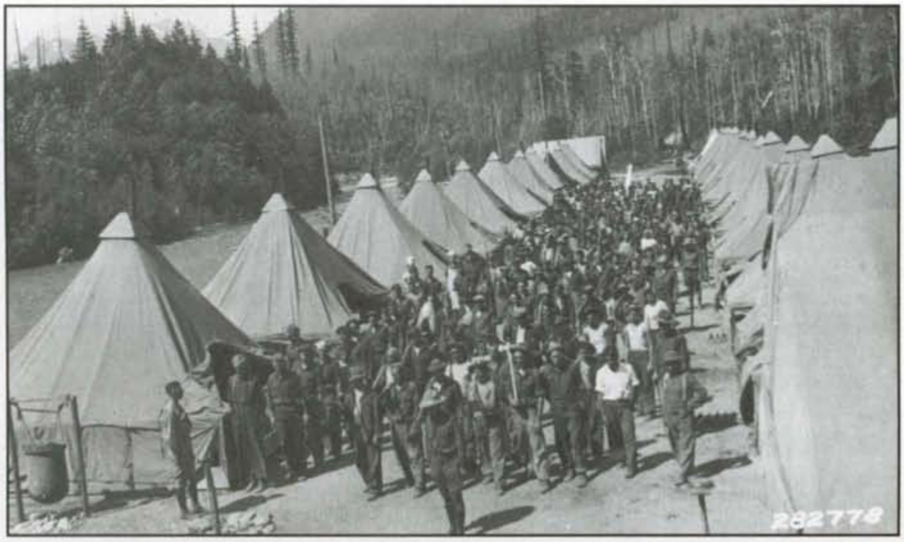

Photo 4. Forest-fire training at Skagit CCC camp, Mt. Baker National Forest, Washington.

Figure 1. A map of some of the places with which John has regular QSOs.

(Civilian Conservation Corps). The CCC was a public work relief program focused on natural resource conservation from 1933 to 1942 and was for unemployed young men and veterans of World War I. It was during this time that the CCC set about building fire lookout towers and access roads to those towers (see photos 3 and 4). By the late 1930s there were about 8000 fire towers in the United States.

The golden age of fire lookout towers was from 1930 through 1950. During World War II, fire lookouts were assigned additional duties as enemy aircraft spotters. However, from the 1960s through the 1990s the towers took a back seat to newer technology, aircraft, and improvements in radios. The further promise of space satellites for fire detection was the last nail for the towers, and many now sit idle, sentinels to the past.

The Man

To understand the tower, it may be easier to focus on the man who built it. John, N4AOW, like many other hams, became interested in radio via the CB craze in the 1970s. With the help of his Elmer, Bill Adams, KE4QS (SK), he got his Technician's license at the age of 16 in 1978 and then went on to General a year later. He has always had the call N4AOW. His main interests are VHF and UHF, although he has enjoyed lots of HF over the years. He looks forward to getting back onto the worldwide bands. We often tease John about his spanking new Kenwood TS-2000, which is still in the original shipping box, because he is having too much fun on VHF and his tower, not having found the time to unpack it. Operating mostly 2 meters FM, John routinely checks into nets two states away!

With boyish excitement in his voice, John told of recently working a repeater in Evansville, Indiana (his original hometown) with less than 1 watt. He has regular QSOs with hams in Tallahassee, Florida and Dothan, Alabama, and I've even worked him simplex from my garden-variety 50-watt mobile in my Jeep on the north side of Atlanta (see figure 1). In the evenings on my commute home, I can count on his signal to crackle in on 146.52, his signal becoming a boom as I clear the ridge north of Kennesaw, Georgia on I-75. He believes his farthest 2-meter QSO was when he recently checked into a net in Rolla, Missouri, more than 500 miles away. Not bad for FM! I'm sure those guys in Missouri were a bit surprised.

John has been known to drive 100 miles to lend a hand to help stranded hams on I-75 with minor automotive emergencies who had called out on 2 meters simplex, acting as his own dispatcher.

I know that you may be thinking that making these kinds long-distance calls you would need a lot of RF power, but you would be wrong. If you would like to get a taste of what a tall tower and antenna in a great spot can do on 2 meters FM, how about a slightly fuzzy 50-milliwatt QSO

Photo 5. The largest and most prominent antenna on John's tower is a 23-foot tall Diamond X700 vertical dual band.

Photo 6. A corner reflector offers a bit more gain and has nice side rejection, placed just above the top hand-rail at 95 feet.

using a pair of Kenwood THF6s HTs. John and Mel can easily work one another, but lest it seem like bragging, Mel, too, lives atop a rather spectacular piece of 1300-foot msl real estate. His house and antenna farm are on the pinnacle of the historic Pine Mountain, just north of Marietta, Georgia, the site of a rather dubious Civil War battle, where poor General Polk met his untimely demise from one of General Sherman's howitzer batteries. Mel is also an amateur historian, and he has shared the story with me.

The Antennas

The tower is well appointed with antennas of different types for each of the bands to be worked. The largest and most prominent is a 23-foot tall Diamond X700 vertical dual band (see photo 5) This antenna enjoys a large capture area, and John has built a jack-knife and retractable mast, which telescopes to 110 feet. This means the tip nears at 133 feet on the northwest corner of the tower. This is the workhorse of the antennas, being used for most general 2-meter and 70-cm FM work. A corner reflector (see photo 6) offers a bit more gain and has nice side rejection, placed just above the top hand-rail at 95 feet. When he works 220, he uses a Hustler G7 mounted on the southwest corner of the tower. For additional 220 stuff, he also has a 7-element Yagi.

Understandably, John's greatest concern while operating with his tower is lightning. The tower has lots home-brewed lightning-arrestor systems, and he seems to enjoy experimenting with this extreme aspect of the ham radio hobby in sort of reverse QRP. He tells us that after a good storm, and once the actual lightning has stopped, he will climb the tower and can pick up the residual energy in the air. He does this by dropping the squelch control on the radio tuned on a dead channel. Normally this shows nothing (you should try this on your own radio), but hours after a strong storm the meter shows as much as S3. That is residual energy, and the radio is not the only thing that can sense it. Sometimes John can feel it, too. He has heard war stories from many of his friends who have first-hand knowl-

Photo 7. John's station consists of a 2m/440MHz Yaesu FT-8800 matched with a 160-watt Prodigy Amp and a 220 Alinco DR-235MKIII coupled with a Mirage 1012 amp, 120 watts. Either can be mated to a West Mountain Radio CLR DSP audio processor.

edge of lightning strikes, with no one actually getting hurt, but close enough for John to be careful and take it very seriously. However, one has to enjoy "being in the weather," as John puts it. He remembers being up the tower after the remnants of Hurricane Katrina went by near the Tennessee/Georgia border, with 55-mph wind gusts.

To complete the scene and tune in those afternoon games or to help with weather and news, he points out the TV, which is also technically a UHF device and integral part of his shack. His reception is just so-so, but one needs to understand that his TV antenna is a piece of coax with just $4^1/2$ inches of insulation trimmed off mounted to the side of the tower and no antenna at all! He enjoys checking in and helping out with many weather nets, being somewhat part of the weather himself. He maintains a fully automated weather station on his tower, positioned just above the flat-screen TV, to help him gather this information, which he shares with the National Weather group. He believe he is the only ham in his county to talk directly to the National Weather Service in Morristown, Tennessee.

To help lower his lightning profile, the vertical Diamond Antenna can hand-crank down and fold over. This brings it below the top of the tower's flag-pole/lightning arrestor. The grounding system is a series of #2 copper wires from the top of the flag pole, the highest point of the structure, where the X700 is stowed, to four ground rods at the base.

The Radios

After the complexity of the tower, the radios are neat and simple (see photo 7). The station consists of a 2m/440MHz Yaesu FT-8800 matched with a 160-watt Prodigy Amp and a 220 Alinco DR-235MKIII coupled with a Mirage 1012 amp, 120 watts. Either can be mated to a West Mountain Radio CLR DSP audio processor, and boy what a difference that gadget makes, even on FM!

Just think of working 14 states on 2 meters FM with the same Yaesu FT-8800. The FT-8800 also is the height of comfort, really helping out by cross-banding when John wants to be downstairs minding his grill and entertaining friends. He can still tune to UHF one of his vintage HTs from his extensive collection. Meanwhile, the FT-8800 booms out on VHF from the shack. He has a solar 5-watt panel with a 32-amp/hr battery (he plans to erect a 45-watt solar panel soon), and he also has a small 1500-watt generator to complete the gear in the shack.

Just as the original designers had intended, the operating cabin has a commanding view of 360 degrees. On a clear day one can see into Tennessee, northern Georgia, and into parts of Alabama and North Carolina. John can hit remote repeaters on "all SERA repeaters pairs" on the band, sometimes firing off three or more repeaters, making the proper use of PL tones by all involved of the utmost importance.

The main part of the construction took place between February 28 and June 6, 2003, when the top was hoisted. The foundation and base had been put in place a few years before. However, I doubt he will ever actually finish it, as he continues tinkering with improvements. I often hear from hams about the lack of activity on 2 meters FM simplex, and my advice is simple: Tune in on some evenings and you might be surprised to hear a mellow voice from Tennessee. You might hear N4AOW on your commute home.

Summary

Although the trip did take place as depicted here, the day I traveled to John's house was another cold and rainy late winter's day, so we were not able to take any decent pictures of the tower and the surrounding area. Thus, the pictures you see here, and much of the technical details, came from a second trip that I was not able to go on. Ham buddies Mel, K4JFF, and Kevin, N5PRE, came to my rescue and made the trip for me, Mel asked the questions and Kevin took the pictures. This article was written based on an audio recording they made of their trip. Isn't technology wonderful?!

A special, warm thanks to:

Melvin Dishong, K4JFF <k4jff@aol.com>, amateur historian and 40-plus year ham radio operator.

Kevin, N5PRE, <radiotube@gmail.com>, amateur photographer and collector of vintage radios. Many more pictures were taken for this article than we have room for. If you would like to see more tower pictures, visit Kevin's flicker site: <http://www.flickr.com/photos/kt/sets/72157619669149451>.

And of course John Williams, N4AOW, for helping me prepare this article.

Additional Resource

If you are interested in building your own, check out "Fire Towers For Sale!" on the web at: <http://www.firelookout.org/TowerSales03.htm>.

Six-Meter Paths of Glory

While others have been lamenting the lack of sunspots for the past few years, WB2AMU has been researching what happens on 6 meters when there is a lack of sunspots. In particular, he is interested in seeing if there is a correlation between the lack of sunspots and an increase in multiple-hop sporadic-E propagation. Here he presents the results of his research.

By Ken Neubeck,* WB2AMU

As did the summer of 2008, the summer of 2009 represents a unique opportunity for 6-meter operators to take advantage of the quiet geomagnetic conditions associated with the long solar minimum in the area of long-range multiple-hop sporadic-*E* contacts. Geomagnetic activity generally has been observed by 6-meter operators to be an impediment to sporadic-*E* conditions, particularly when geomagnetic storms occur such that these storms create aurora activity, as was experienced in the June 2004 VHF contest, with little sporadic-*E*.

Last year, *CQ VHF* presented a series of articles on the U.S. to Japan contacts that were made on 6 meters during June 2008. As suggested in the articles, the quiet solar activity allowed for multiple-hop sporadic-*E* activity to occur, particularly in the links over the aurora zone, which have been suggested to be a PMSE (Polar Mesophere Summer Echo) related phenomenon.

At the time of this writing, with the current solar activity there is reasonable expectation that similar events may occur this summer as well between the US and Japan. There also may be some new discoveries that could result in "first" contacts between different countries on 6 meters. The key is that some hams in different areas of the world, particularly in the equator and Northern Hemisphere regions, listen consistently on 6 meters. Hams in new locations on 6 meters are going to be at the forefront of some of the new multiple-hop paths that are going to be discovered.

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History of Sporadic-*E* Tracking

In 1957 a graduate student by the name of Dr. Ernest K. Smith wrote a thesis for his doctorate degree that would later become a scientific book, *Worldwide Occurrence of Sporadic-E*, published by the National Bureau of Standards, then a part of the US Department of Commerce. It is probably the first book that was dedicated to the phenomenon of sporadic-*E*. The book made extensive use of worldwide ionosonde station data that was collected from 1948 through 1952.

The majority of ionosondes were set up shortly after World War II, and they consisted of a transmitter that put out a sweep spectrum of frequencies from 1 to 20 MHz in a straight-up or vertical path. Any return signal that reflected off a formation in the ionosphere could be measured and recorded as the critical frequency (f_o).

The hourly data collected by the different ionosondes was used to generate the worldwide maps that were used in Smith's thesis to tabulate the percent of sporadic-*E* occurrences where f_o is greater than 5 MHz. An f_o value of 5 MHz represents an MUF (maximum usable frequency) almost 28 MHz, as shown in figure 1. One of the maps that Smith created is presented in figure 2. Note that there are no ionosonde stations located in the equatorial zone to collect sporadic-*E* data.

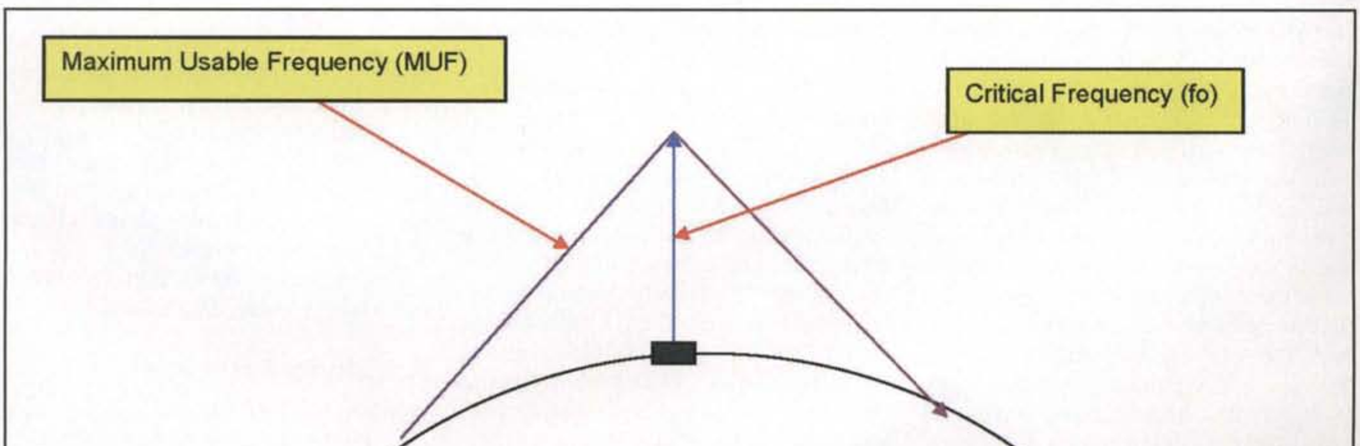

Figure 1. This diagram shows the graphical relationship between MUF and the critical frequency that is measured by ionosonde stations that use sweep frequency in a vertical direction. MUF is approximately 5.3 times the critical frequency.

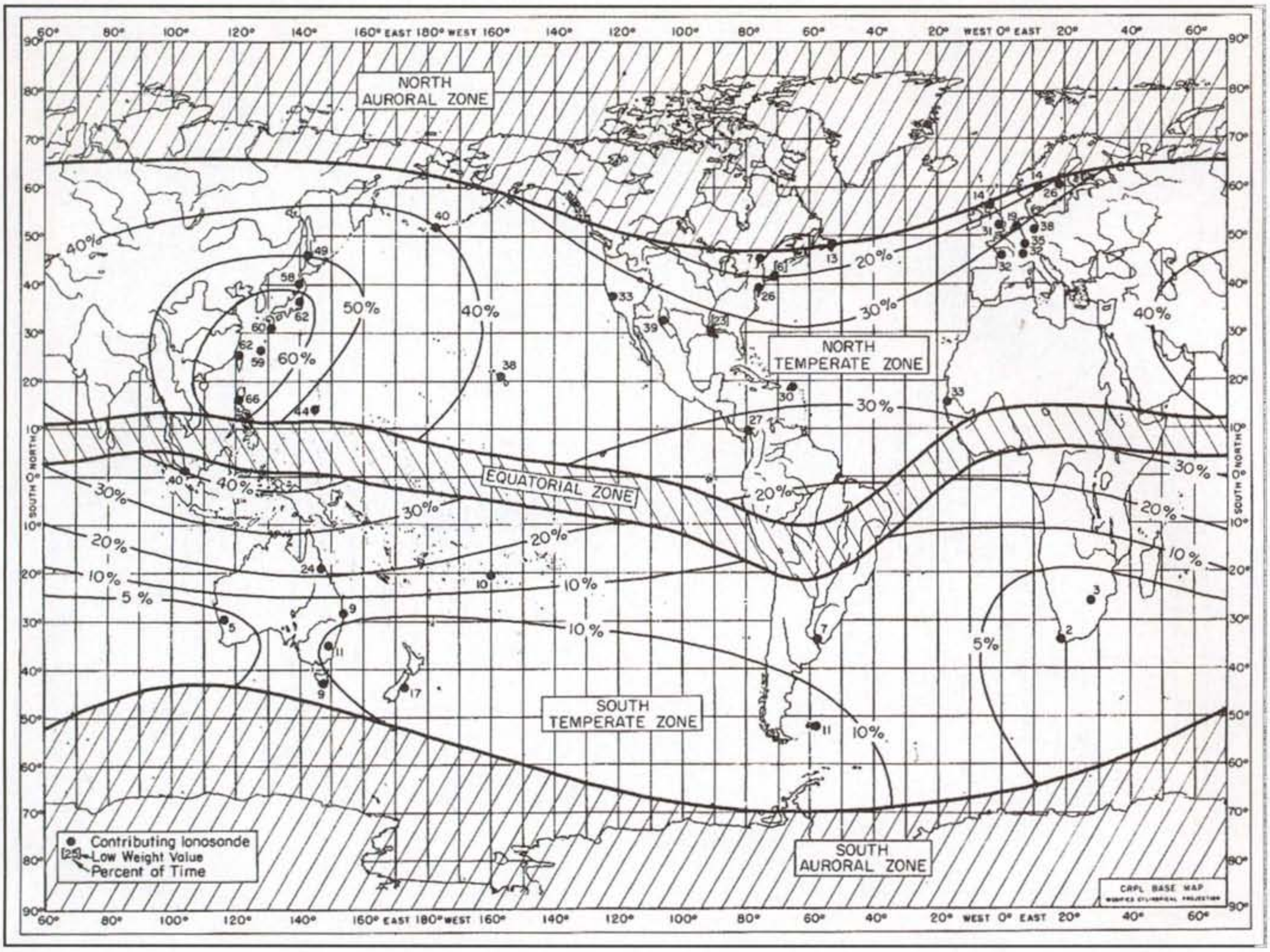

Figure 2. Worldwide plot by Ernest K. Smith of available ionosondes (1948 to 1952) for summer months 0600 to 1800 local time. (Courtesy of Ernest K. Smith)

Later on more stations were built, including seven additional ionosonde stations that were located inside or just outside the equatorial zone. Of particular interest is the station that is located in Huancayo, Peru, where incidents of sporadic-*E* during the summer months (May, June, July, and August) were measured over 80 percent of the days during 0600 to 1800 local time. The data that Smith and others collected during the International Geophysical Year (IGY) included these additional stations (see figure 3). It is striking to realize that the incidence of sporadic-*E* is very high in the equatorial zone and was later noted by scientists to be a special type of sporadic-*E* known as Equatorial Sporadic-*E* (ESQ).

This bit of history is meant to provide a backdrop for what hams have been observing on 6 meters over the years, including the time immediately after World War II. (The 6-meter band was granted to U.S. hams in March of 1946!) Because the 6-meter band was not granted to hams around the world for years after 1946, most of the long-range contacts that were made were between the U.S. and Canada or the U.S. and the Caribbean or South America area. The absence of much activity on 6 meters in Europe (except for Ireland) made it impossible to gauge the long-range DX capability of the band.

Six-Meter Multiple-Hop Sporadic-E Paths

Just like Dr. Smith did in updating his worldwide maps showing the incidence of sporadic-*E* to include additional stations along the equatorial zones, 6-meter operators are updating their knowledge base concerning multiple-hop sporadic-*E* openings in recent years. The almost consistent nature of contacts from Japan into central U.S. during the summer solstice period of 2008 showed that this may be a regular path that is aided by the low geomagnetic activity situation during the solar minimum. Also, a number of things have contributed to capturing these events during recent years. These include the following:

- Internet spotting sites for 6 meters (ON4KST chat page).
- Better receiver designs and more use of directional 6-meter antenna setups.
- Hams being active on 6 meters in areas not previously on the band.

I also believe that in addition to the above, a major key in the discovery of the Japan to U.S. path was when Japanese stations heard the Alaska beacons on 6 meters at the same time that central U.S. stations were hearing these same beacons. Thus, the path was a northeast path that left Japan, whereas the path from central U.S. follows a northwest path to the

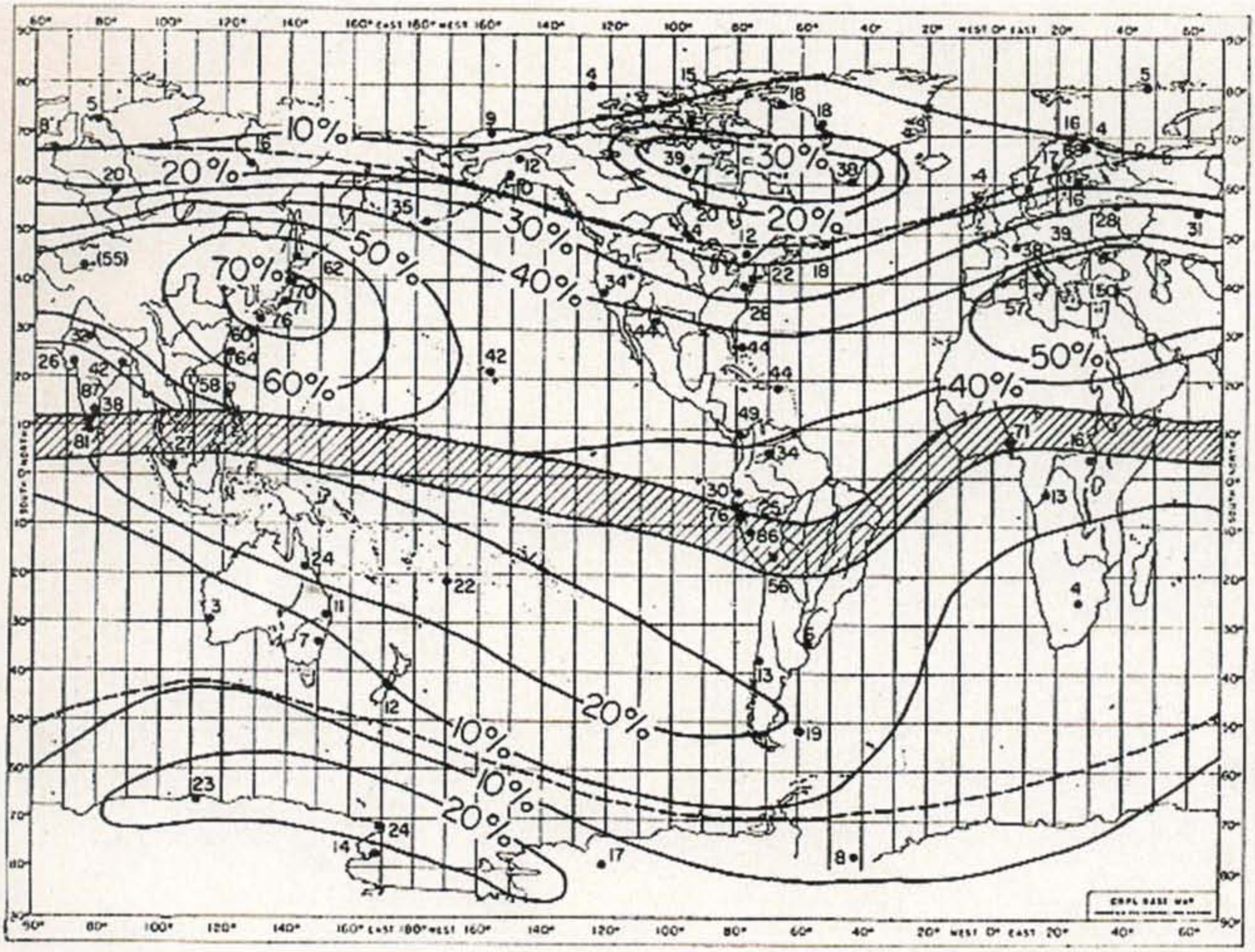

Figure 3. Worldwide plot by Smith of available ionosondes, International Geophysical Year 1957/58 for summer months 0600 to 1800 local time. (Figure courtesy of Ernest K. Smith)

area of Alaska. One could argue whether the path is five- or six-hop sporadic-*E* or four-hop sporadic-*E* aided by an arctic phenomenon, as previously discussed in articles in *CQ VHF* last year. However, the main point here is that the specific direction for hams with directional arrays to point their antennas is the key for the path to work stations!

On May 20th of this year, I came home around 5 PM local time and had about five minutes to spare to listen on the radio before I had to go out. I tuned the dial and on 50.105 I heard a CW signal that turned out to be Jack Henry, OA4TT, in Peru! On the second try, I was able to work him with 559 signal reports both ways. He was the only signal that I was able to hear on the band. I had to rush out again, and I did not think too much about the path, which I thought was double-hop sporadic-*E*.

However, later on, I saw that where Jack is located is near the geomagnetic equator, and because of the distance, the path had to be either a triple-hop sporadic-*E* path or possibly a sporadic-*E* *path* plus a TEP (transequatorial propagation) link. After discussing this with other veteran 6-meter operators, the former seemed to be the more logical path, as the location of OA4TT was not quite in the TEP range, nor was TEP activity particularly high during that part of month and during this point in the solar cycle. If a triple-hop sporadic-*E* path was probable, it is amazing that at any time during the summer a sporadic-*E* path can occur, even one with multiple hops!

Another example of this happened to me on June 22, 2001. I was listening from my car at 12:30 PM local time using a homemade two-element beam that was facing southwest when I heard a very loud sideband signal come booming in. It was PE9PE in the Netherlands, and I quickly turned my beam toward the northeast. He was several dB over 59 signal strength. I worked him with no problem, and shortly thereafter, the late K4MZ in Florida worked him. From my location on Long Island, New York to the Netherlands is at least two hops, and most likely three hops of sporadic-*E* skip. However, for K4MZ, this would have meant at least another hop (I heard both him and PE9PE), meaning possibly four-hop sporadic-*E*. Again, I tuned around the band and heard no other signals. There was no likelihood that any *F*-layer skip was involved, because it was the summer.

As previously discussed in an article in *CQ VHF,* double-hop sporadic-*E* is an occasional phenomenon on the 6-meter band, particularly during the months of June and July in the Northern Hemisphere. It may also be that the likelihood of three-hop and four-hop sporadic-*E* paths is greater during parts of these two months as well—hence the Japan to U.S.

openings that occur during the weeks surrounding the June solstice.

For those of us who are located in the northeast part of the U.S., there are three or four key stations in Europe that we listen for every summer. These include Jose, EA7KW, Gary, CU2JT, and Joe, CT1HZE. A number of veteran stations in the Northeast look for European TV video in the 48-MHz range as a possible early indication of a transatlantic opening on 6 meters. However keep in mind that the TV stations are very high powered and there is still a 2-MHz difference in order to reach 50 MHz, which sometimes seems like an insurmountable gap. Hence, the active European stations tend to be a better indicator.

Joe, CT1HZE, has been one of the more active stations that I have been able to work consistently when there is any semblance of a transatlantic opening. We have an agreement that we will work one another when we hear each other on different openings, as this adds to our observations. In 2008, I was able to work Joe on two different days in late June, four different days in July, and on August 1st. This was one of the best years for me for working transatlantic, and these openings occurred during quiet solar conditions. Joe has put together several charts that sum up his observations, and these can be seen in the July 2009 issue of *QST* in the "World above 50 MHz" column.

At the time of this writing (June 22nd), it appears that similar conditions for long-range DX on 6 meters will occur during the summer of 2009. The Japan to U.S. openings along with the transatlantic openings will be the most likely, along with some possible new paths occurring. The ARRL June VHF QSO Party had excellent sporadic-*E* openings for much of the U.S. both Saturday afternoon and Sunday morning. I did particularly well working many stations in Florida on both SSB and CW while running QRP portable from a hilltop location on Long Island. I even experienced a double-hop sporadic-*E* opening by working NP4A and HI3/LY3UM on CW around noon on Sunday.

In general, signals from multiple-hop sporadic-*E* events tend to be on the weaker side. Of course, some double-hop events can produce very loud signals, but in many cases of multiple-hop events, even when using three-element Yagi antennas and more, signals tend to be weaker and require careful listening. I believe the combination of better receiver and antenna combinations, along with better listening skills and the addition of internet spotting, may be why more of these events have been discovered in recent years.

Some of these events seem to be of significant duration as well. On the evening of June 21st, I observed a double-hop sporadic-*E* opening into the Caribbean. Some of the signals were fairly loud, yet some were consistently weak, similar to EME quality. It started for me with HI3TEJ at 5:43 PM, followed by J39BS at 5:52, and several others over the next three hours. The opening was still hanging in there $2^1/2$ hours later when I worked NP3CW at 8:11 PM. It suggests that the two sporadic-*E* formations involved in this opening did not move significantly, although signal strengths of the Caribbean stations were changing during this time due to the non-uniformity of the formations.

So far observations have been encouraging that this may be a really terrific summer for 6 meters. My intention is to follow up with a summary report of subsequent events in late June and all of July in the next issue of *CQ VHF*.

By John Champa,* K8OCL

Communicating Voice, Video, and Data with Amateur Radio

New Amateur Digital Video (ADV) and Revolutionary HSMM-MESH® at Ham-Com

Ham-Com is the largest amateur radio convention in Texas. Given the size of this state, that is certainly saying something. It is successfully organized every year by a fine team of individuals led by John Beadles, N5OOM, of Richardson, Texas (see <http://www.hamcom.org/> and <http://www.n5oom.org/hsmm/>).

This year was special for HSMM (High-Speed Multimedia) radio experimenters. Glenn Currie, KD5MFW, Alexandre Castellane, F5SFU, and I got two full hours during prime-time Saturday afternoon to demo all the new firmware and hardware developments. It was a standing-room-only audience and we all had a great time.

I was the first presenter, explaining the usual differences between WiFi (FCC Part 15) and HSMM (FCC Part 97) radios operating using spread-spectrum modulation. We discussed the three main reasons why HSMM radio experimentation was started by Paul Renaldo, W4RI, ARRL CTO (Chief Technology Officer):

1. Amateur radio, particularly EmComm (this was just after 9/11), needed some means of data transmission significantly faster than conventional packet radio. HSMM radio can send the entire *ARRL Handbook* in under one minute, so it certainly fits that requirement.

2. Our service definitely needs to better utilize the big VHF and UHF frequency allocations we have been granted. Even bands considered "busy" are largely limited to commuting rush-hour activities, contest weekends, weekly nets, or occasional band-opening phenomena.

3. All of our EmComm served agencies are extensive users of wireless technology, while radio amateurs, "the communications experts," know everything about radios except those which are the most popular in the world—WLAN transceivers and CDMA HTs! My beautiful wife Karen calls this a "time warp.... Hams use post WW II technology (AM, FM, SSB, RTTY, etc.), but seldom have any knowledge whatsoever regarding how the most common radios in the world operate!" Please don't misunderstand me. All the legacy modes are great fun to operate. I have used them all, and I still do everyday. However, let's not deceive ourselves about them being cutting-edge technology, nor the most popular two-way radio, nor certainly making us competition-grade communications experts.

To that list of these three rationales, many others would add a big fourth: We need to attract many more new and younger operators, if our service is to survive. Thus, we need to have modes such as "internet radios" (networked radios) that turn on the younger set.

We discussed the most frequent use of HSMM technology today—Field Day! Hardly any serious Field Day site is set up these days without some sort of intranet connection for common logging, etc. Also, a long-haul 2.4-GHz link is provided back to a ham's home for internet access, if only to order pizza or to ask the family to deliver more cold soda, etc.

The second most common use of HSMM radio is repeater linking. It is the usual stuff many of you are very familiar with already. However, another form of that application is starting to grow quickly. As more D-STAR repeaters are installed, they are finding prime building sites but experiencing difficulty in acquiring their required internet access.

Photo A. My favorite personal pick for a new HSMM radio antenna this year is the ICOM Tri-Bander. In this photo the antenna is shown mounted in the vertical-polarization configuration. I recommend that it be reconfigured to horizontal polarization for the purpose of HSMM radio. (Photo courtesy of L-Com Global Connectivity, <http://www.l-com.com>)

Building owners are saying, "Sure you can have a nice free spot on our roof, but there is no way we will let you connect to our intranet to obtain internet access. Just forget that!"

Thus, HSMM radio provides a point-to-point to the nearest open internet access point.

Amateur Digital Video

At Ham-Com I explained the difference between ADV Amateur Digital Video) (which is internet-grade digital video using software coder-decoders over HSMM radio) and ATV (analog NTSC old, standard television). There is also DATV (new HDTV using hardware coders-decoders). OK, a no brainer, but give me a demo!

That is difficult in print, so for now, try this site: <http://www.youtube.com/watch?v=sb4rhP1LiC4>. If you can do streaming video on the internet you can

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Note: HSMM-MESH® is the registered trademark of Glenn R. Currie, KD5MFW; Richard E. Kirchhof, III, NG5V; Robert B. Morgan, WB5AOH; and David B. Rivenburg, AD5OO. The term HSMM-MESH® is the property of these gentlemen and may not be used without recognition.

Photo B. The ICOM 3-watt bi-directional amplifier (BDA) with Automatic Power Control (APC). (Photo courtesy of L-Com Global Connectivity)

do it on HSMM. It is just that simple. But remember, on the air our amateur radio content rules still apply. Don't worry about pop-ups (you should have a pop-up blocker) and background music as long as they are merely incidental to your traffic, but no business!

As we have recommended numerous times on these pages, all HSMM radio station computers/laptops must be equipped with the latest anti-virus/anti-spyware protection (free programs are available) and be kept current. Also, use a software firewall of some type. Most computers come with a firewall. Just make certain it is enabled so that no changes can be made to your computer without your specific authorization.

HSMM Antenna Pick of the Year

Excellent HSMM radio gear such as shown here is offered at reasonable prices and with good service by numerous distributors: FAB Corporation (http://www.fabcorp.com/home.php), L-Com Communications (http://www.l-com.com), and many others.

As for wireless routers such as the very popular Linksys WRT-54GL, try your local Goodwill store or similar used-electronics outlet. Why buy something new? You are going to hack into to it anyway, right? These popular WiFi WLAN 2.4-GHz transceivers are available for about $29.95 used. Stick to Linksys Models V 1, V2, V2.1, V3, and V4, as these are capable of the HSMM-MESH® crystal hack we will cover in a future issue that allows for some VFO action.

My favorite personal pick for a new HSMM radio antenna this year is the ICOM Tri-Bander (photo A). It is a log-periodic design that covers the 2.4-, 3.5-, and 5.8-GHz bands! Also, it comes with a nice radome for protection from environmental effects. The manufacturer rates it at better than 6 dBi forward gain.

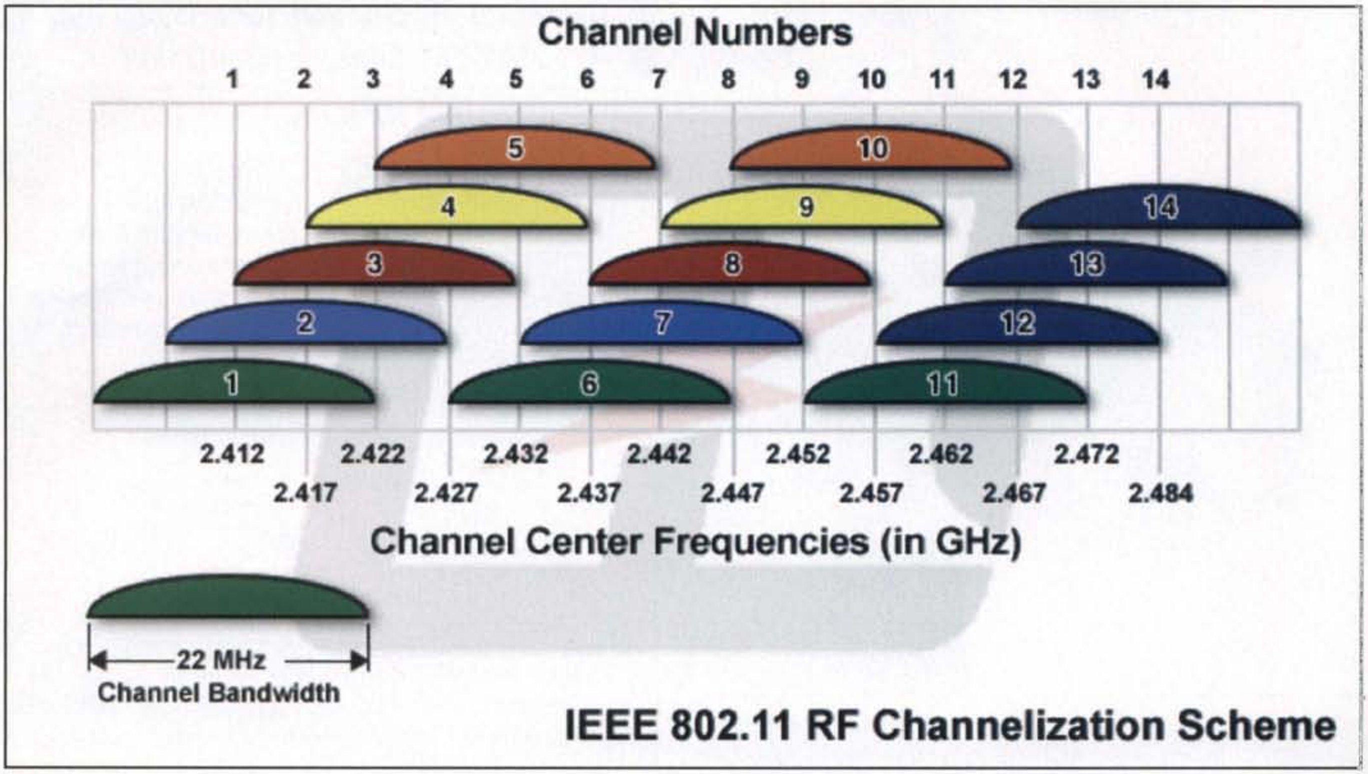

Figure 1. Channel center frequency chart. Some commercial Part 15 service providers use horizontal antennas for the same reason we radio amateurs often do. In that case, if you are operating in the same areas, you should coordinate closely with them regarding specific channel utilization. (Chart courtesy of L-Com Global Connectivity)

In the photo the antenna is shown mounted in the vertical-polarization configuration. I recommend that it be reconfigured to horizontal polarization for the purpose of HSMM radio. Not only does horizontal polarization seem to perform better than vertical polarization at these frequencies, but also using horizontal polarization will provide some slight isolation from the huge number of unlicensed Part 15 WiFi stations, the vast majority of which use vertical polarization. The only issue with using horizontal polarization is working HSMM radio mobile stations, most of which use phased collinear, high-gain, vertical, magnetic-mount antennas. Perhaps for some of us the M2 S-Band Stacked Horn, Sector Antenna (http://www.m2inc.com/com/SBNDHORNFLY2.pdf), or something similar homebrewed, may be a solution.

Also, some commercial Part 15 service providers use horizontal antennas for the same reason we radio amateurs often do. In that case, if you are operating in the same areas, you should coordinate closely with them regarding specific channel utilization. Yes, hams have the legal priority, but we always should try to be good neighbors. For example, at one location the local HSMM radio group coordinated with the Part 15 wireless commercial internet service provider (WISP) such that in the areas where they were both operating, the HSMM group used Channel 1 while the unlicensed commercial group used Channel 3. True, these are not completely non-overlapping channel assignments, but at least it prevented a portion of the possible destructive interference and allowed both groups to operate effectively in the same area. It certainly beats the usual college campus situation in which every single channel is in use! See the accompanying channel center frequency chart, figure 1, for additional details.

My personal favorite for new gear is another item also manufactured by ICOM: It is a 3-watt bi-directional amplifier (BDA) with Automatic Power Control (APC); see photo B. Now I know that the ARRL HSMM Working Group received notice from the FCC via the League's General Counsel that APC is no longer a requirement for hams under the Part 97 Spread Spectrum Rules. The FCC considers APC for hams—who often build their own equipment, including BDAs—"technologically impractical." However, this ICOM BDA has such a feature, which is supposed to provide some advantages. Besides lower power consumption, I have not figured out yet what those are. Perhaps an enlightened reader can let us know how a BDA works better with APC.

WARNING! It is illegal for you to connect this ICOM equipment to your WiFi Wireless Local Area Network (WLAN) router unless you are a licensed radio amateur under FCC Part 97 Regulations. If you are an unlicensed FCC Part 15 station and you connect this equipment to your WiFi WLAN you are subject to fines, confiscation, and imprisonment. Distributors of this equipment also have the right and responsibility to demand a copy of your FCC Radio Amateur license prior to any sale of this equipment to you. *You must be a licensed radio amateur to use this gear!*

More importantly, shocking new revolutionary developments in HSMM-MESH® networking make even reasonably priced BDAs such as this ICOM model less often necessary for most HSMM radio hams. See more details on HSMM-MESH® later.

It is somewhat similar to the classic question: "Do I need an amplifier?" The answer is if you have a good propagation path, you probably do *not* need a BDA. This reminds me of my

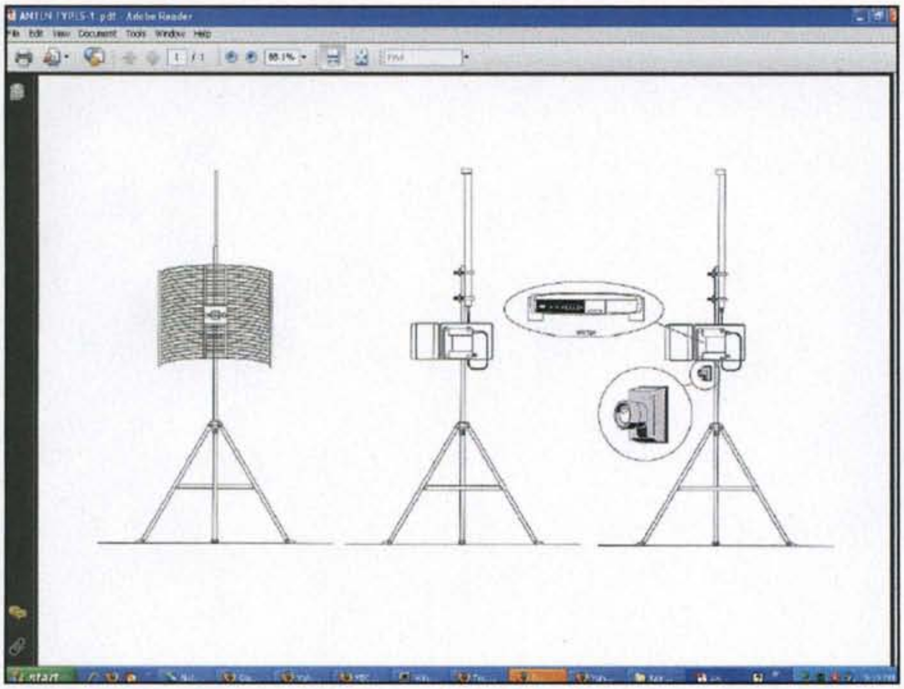

Figure 2. How a typical HSMM-MESH® node is designed. The nodes are fully automatic and self-powered. (© 2009, Glenn R. Currie, KD5MFW)

Photo C. This is typical stand-alone, omni-directional, fully automatic HSMM-MESH® node. (Photo credit David B. Rivenburg, AD5OO)

DXpedition to Zimbabwe in southern Africa as Z2/ K8OCL. I tried to check into a stateside HF DX net. They all were running big antenna arrays and powerful linear amplifiers. They all apparently could hear one another. I could easily and loudly hear nearly all of them. However, try as I might, with my 100-watt SSB rig and my dipole antenna, they could not hear me!

What is HSMM-MESH® Networking?

Simply put, mesh networking is a form of digital communications that is designed to route data, voice, and instructions between nodes. This routing is accomplished by continuous connections and reconfiguration around broken or blocked paths by "hopping" from node to node until the destination is reached. Thus, HSMM-MESH® networking is using HSMM in a mesh network.

Glenn Currie, KD5MFW (kd5mfw@arrl.net) with the Austin HSMM Special Interest Group (Austin HSMM SIG) and the Roadrunners Microwave Group (RMG) was the second presenter at Ham-Com 2009. The presentation was dedicated to Glenn's fine father, Job H. Currie, who recently passed away. Glenn's session was a blockbuster.

Glenn immediately gave credit to all the fine organizations, and their members, that are helping with the implementation and city-wide deployment of HSMM-MESH® networked radios:

- The Austin Amateur Radio Club (http://www.austinhams.org/)
- The Roadrunner Microwave Group (http://www.k5rmg.org/)
- The North Texas Microwave Society (http://www.ntms.org/)
- The Austin HSMM Special Interest Group (Travis County ARES SIG)
- The Travis County ARES (http://www.your-website-in-24-hours.com/travishams/tcares.org/index.php?option=com_content&task=view&id=17&Itemid=1)
- Williamson County ARES (http://www.wc-ares.org/)

Figure 2, the design, and photo C show a typical HSMM-MESH® node. The nodes are fully automatic and self-powered. Any EmComm ham unfamiliar with HSMM or microwave radio can transport the node to a designated site and simply turn it on. The rest is automatic! The node connects to the HSMM-MESH© network and starts passing high-speed data traffic within a few seconds.

The Austin HSMM Special Interest Group has developed hardware and software changes to make use of inexpensive 802.11 wireless computer networking radios but under Part 97 FCC rules. The major changes include:

- Range extended to 10–15 miles with good line of sight.
- Automatic address negotiation so radios link automatically with no user intervention within 5 seconds of coming into RF range of each other. We use Optimum Link State Routing (OLSR). See this link for more info: <www.olsr.org>.
- The RF section of the common Linksys WRT54GL Wireless Router has been modified so that only like-modified radios can see it. They are invisible to all Standard 802.11 radio devices.
- There are many new features in progress, but HSMM-MESH® has

reached a point where it is being deployed to augment existing Amateur Radio Communications Healthcare Emergency Services (ARCHES) radio stations in the hospitals, Emergency Operation Centers (EOC), and the Red Cross in the Austin, TX area (photo D).

Background

Quote from the ARRL website:

"The Amateur Radio bands above 50 MHz can support computer-to-computer communications at speeds high enough to support multimedia applications.

"Multimedia in this case refers to voice, data and image communications.

"One approach that has been extensively explored is an adaptation of IEEE 802.11 technologies, particularly 802.11b operating in the 2400-2450 MHz band, known as the *Hinternet*.

"Also under the HSMM umbrella has been an orthogonal frequency division multiplex (OFDM) system developed by John Stephenson, KD6OZH, and tested on the 6-m band."

Photo D. This is Robert "Bob" Morgan, WB5AOH, mounting HSMM antennas on the Austin Texas Red Cross Tower, which is part of the AARC club station, W5KA. (Photo credit David, AD5OO)

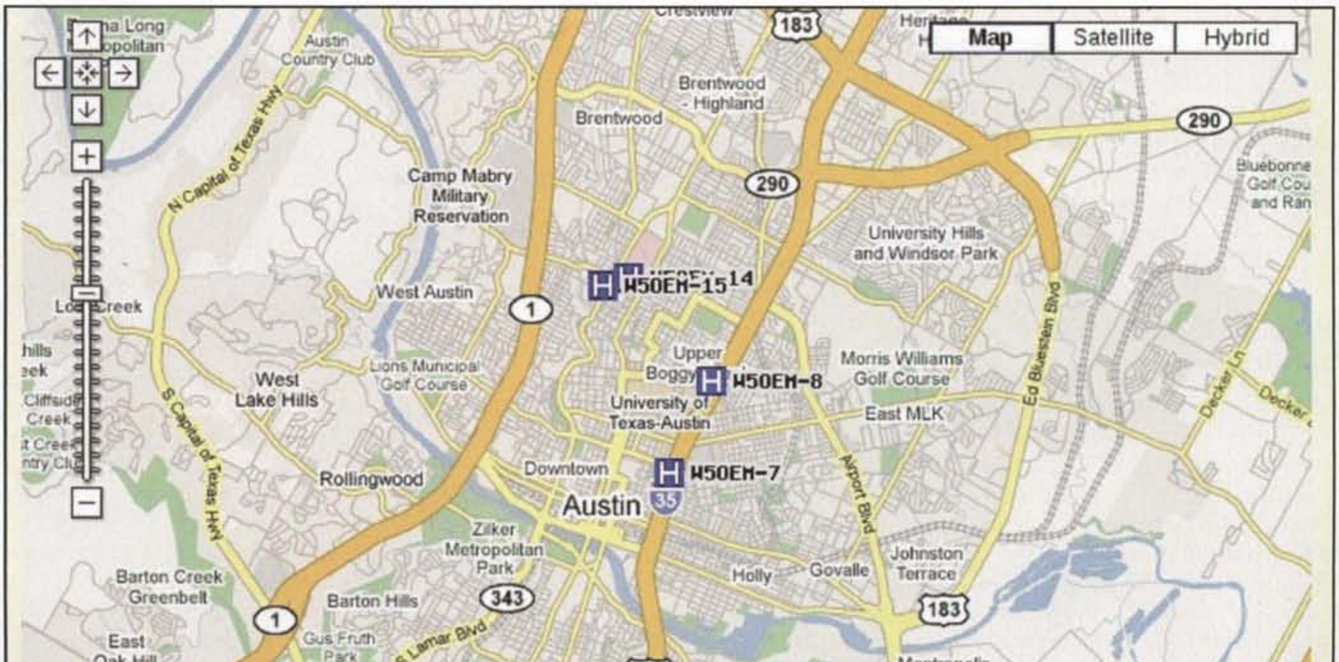

Figure 3. This map shows the hospitals that are online and help new operators find hospitals via internet maps. Go to <http://findu.com/> and do a wild-card search for stations W5OEM- and you will see the hospital stations.*

(Editor's note: We would also add D-STAR 1.2-GHz HSMM radio to this list.)

Figure 3 is a map of all the ARCHES node equipped hospitals in Austin, TX. The highly successful ARCHES 2m/70cm voice and packet radios at nine Austin area hospitals provide key patient data to the City of Austin Emergency Operations Center during significant incidents even if normal communications are unavailable.

All ARCHES stations beacon on APRS every 20 minutes. If one of the monitor computers does not hear from a station for an hour, the operator in charge is paged, with an automated message that the automatic beacon has gone out at the hospital.

During every activation, patient data and other traffic passed more quickly and accurately than all other techniques tested during the activations. The ARCHES program has been so successful that hams have been asked to expand the system to approximately 40 additional area hospitals and clinics in central Texas! Here is the crunch! During activations with just nine area hospitals, the EOC, and several portable "jump kits," all packet frequencies were more than full, leading to many collisions of packets. With 40 or more packet stations in the area, passing packet data could slow to a crawl due to packet collisions.

The stations could only transfer data at 1200 baud, at best. Attempts at using 9600 baud showed that common radios do not pass 9600-baud data well. They distort the data so badly that many resends are needed to get data through. The effective data rate seldom exceeds 1200 baud.

The obvious solution was to use an HSMM radio technique of adapting inexpensive Part 15 802.11 radios repurposed to use under Part 97. The question was could the necessary links be achieved in the Austin area. The answer: AD5OO, NG5V, and KD5MFW achieved a 10-mile point-to-point link across downtown Austin using only 35 mw (photo E)! Figure 4 is a sample map of the open routes that were found on the 2.4 GHz band.

Photo F shows a North Austin Mobile HSMM radio test site. Note the ubiquitous MFJ-1800 antenna. They work extremely well but must be protected by a thin plastic radome when used outside in permanent installations.

The secret of HSMM-MESH® success is in the use of OLSR (Optimal Links State Routing). OLSR is state-of-the-art mobile networking software. Andreas Tonnesen wrote the version of OLSR software being used for his Master's thesis. He wrote the code and made it to run on the Linksys WRT54G Wireless router. It is written on top of Open-WRT firmware for several reasons: Andreas suggested keeping track of one- and two-hop neighbor mesh nodes, not *all* mesh nodes in the network. The trick is to

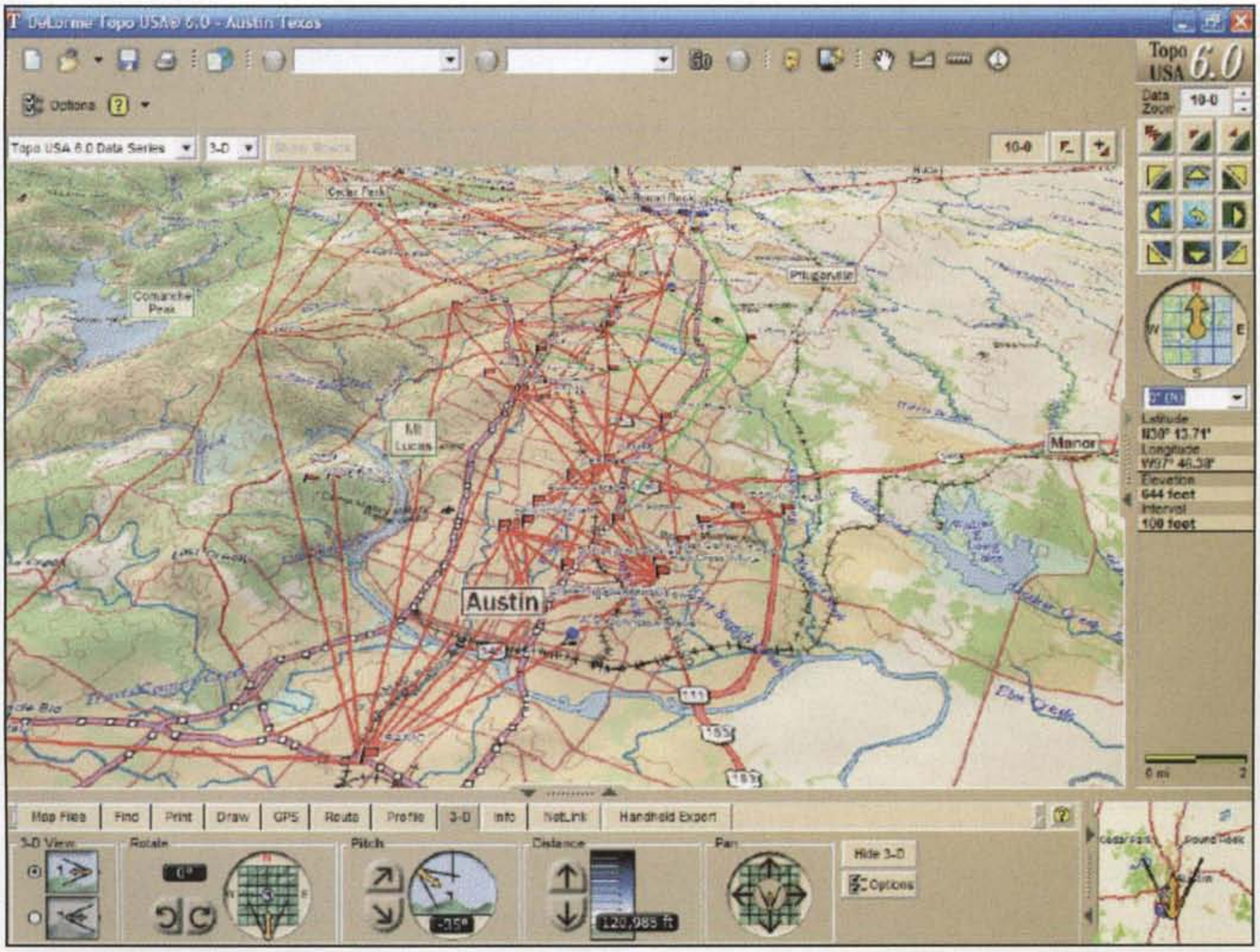

Figure 4. This is a sample of Glenn's use of DeLorme Topo USA© to plot potential microwave routes for HSMM-MESH® in the Austin area.

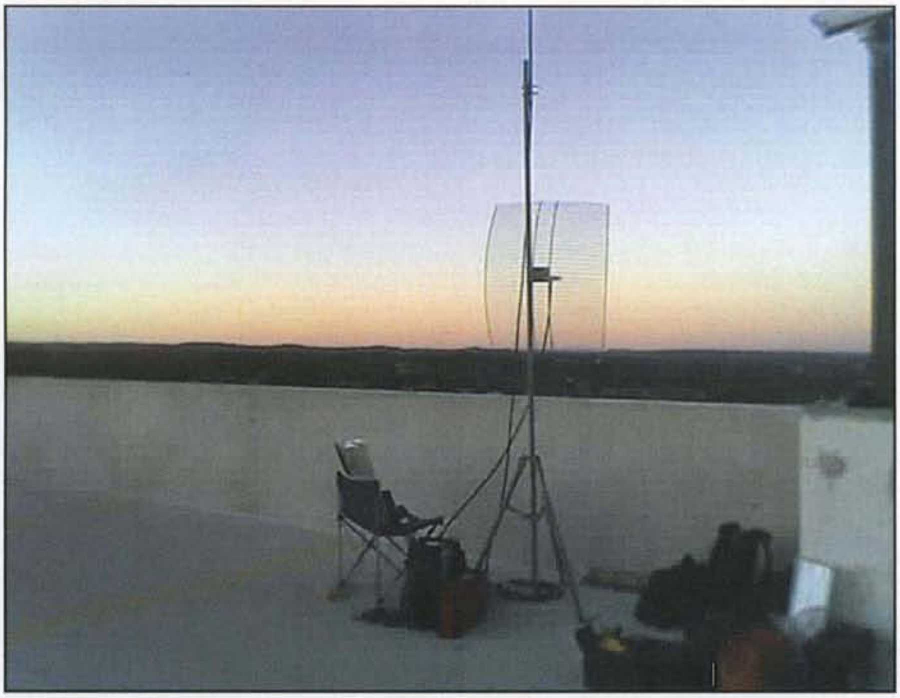

Photo E. Shooting to AD5OO on the north side of town over the heavily populated University of Texas, Austin campus area showing 35 mw can go 10 miles over thousands of access points and microwave ovens in between. This is an HSMM radio test site at the South Austin Medical Center. (Photo credit Glenn Currie, KD5MFW)

update the routing table list about every 2 seconds. This allows nodes to come and go as conditions allow. They will be linked and passing data in 5 seconds when in RF range. Absolutely no user interaction is needed! If a link is lost, data is automatically rerouted through other nodes, again with no user interaction.

HSMM "VFO" Crystal, or the "Slide-Band" Radio Mod

Crystal frequency change makes it impossible for standard 802.11 devices to connect with an HSMM-MESH® "slide band" radio network. The tests showed that by making a simple 59-cent crystal change the HSMM signals could be moved to between IEEE Channels 2–3.

Figure 5 is from Wi-SPY® by MetaGeek (http://metageek. com). The yellow shaded area shows the official 802.11 Channel 2 center. The red shaded section shows the official 803.11 Channel 11. Glenn had one crystal-modified Linksys WRT54G and one unmodified Linksys WRT54G. He then directed the software for both of them to go to Channel 11.

The CPU clock and ethernet clocks are totally different from the radio crystal, so both units "think" they are on Channel 11. Only the crystal-modified "slide band" unit is somewhere between Channels 2 and 3 as shown by the green and blue accumulated readings. Both units were tested for about 3 hours for frequency stability, etc.

The Wi-SPY spectrum analyzer cannot follow the slide band as it goes much lower in frequency out of the ISM band. Glenn put it on Channel 11 so he could see the slide band with this inexpensive spectrum analyzer. The shift was right on the money of what the crystal-modification calculations predicted. This frequency shift makes the HSMM-MESH® signal completely invisible to Part 15 stations, and even to WiFi search engines such as NetStumbler (http://www.netstumbler.com/). The signal is totally WiFi stealth! The only way the signal is detected is by using a spectrum analyzer.

Wow! Now we have it: A complete ham radio (Part 97) inexpensive spread-spectrum transceiver on 2.4 GHz with different frequency(s), different antennas, and different firmware. The Hinternet has arrived!

ADV Demonstration

Alexandre Castellane, F5SFU, conducted the highlight of the entire Ham-Com 2009 HSMM 2-hour presentation with his Amateur Digital Video (ADV) live demonstration. Alexandre had prepositioned four HSMM-MESH® battery-powered/fully-automatic nodes throughout the huge Plano Convention Center. Using free streaming video software and an inexpensive web cam, Alexandre was able to walk through the entire complex while we watched his progress in the meeting room via this mini-Hinternet arrangement. The mesh nodes functioned perfectly. Each time Alexandre walked out of range of one node with its simple rubber-duck antenna, his streaming video traffic would

Photo F. David, AD5OO/HSMM mobile with his trusty MFJ-1800 antenna. (Photo credit AD5OO)

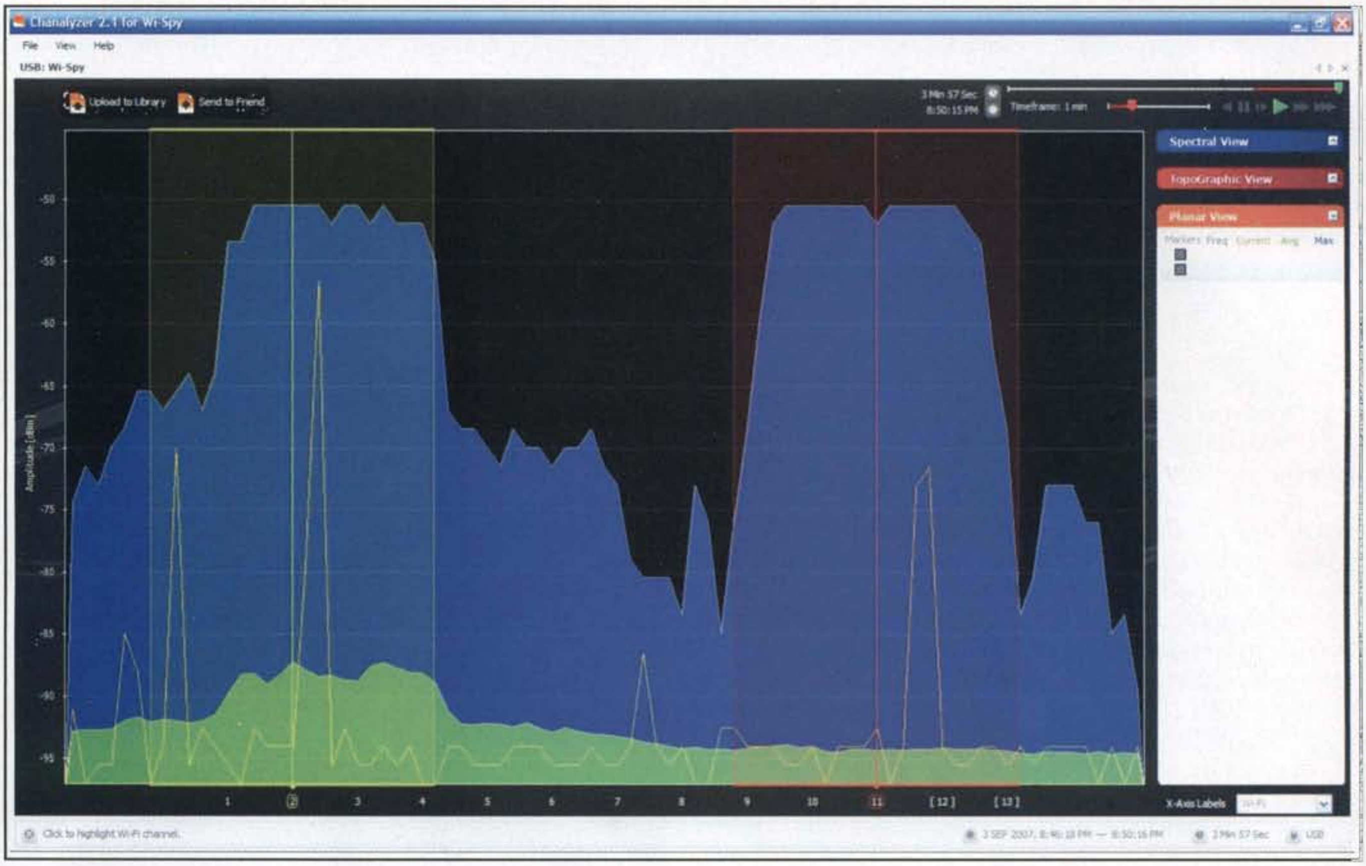

Figure 5. This spectrum analysis is from Wi-SPY® by MetaGeek (http://metageek. com). The yellow shaded area shows the official 802.11 Channel 2 center. The red shaded section shows the official 803.11 Channel 11.

Photo G. A typical inexpensive web cam purchased used for $39.95. (Photo credit Glenn, KD5MFW)

automatically be relayed to the next node. It was stunning to watch!

Photo G shows a typical inexpensive web cam purchased used for $39.95. John, K8OCL, uses one he purchased new at the Dayton Hamvention® that is even smaller and sold for even less. Couple this with some free video streaming software such as Microsoft NetMeeting® and you are on ADV! Hope to see you soon!

Until next time, feel free to write with your questions and comments to: <k8ocl @arrl.net> or <kd5mfw@arrl.net>.

73, John, K8OCL

References

HSMM references in order of preference for getting started. All of these are available from the ARRL Book Store: <http://www. arrl.org/catalog/?category=Digital+ Communications&words=>.

ARRL's VHF Digital Handbook, by Steve Ford, WB8IMY. Without complicated "owner's manual" jargon this book presents the material through a unique how-to approach and friendly, conversational style. Readers will understand how to setup and operate their equipment and software, and make the best use of their VHF digital station. Contents include: Packet Radio Fundamentals, APRS, D-STAR, High Speed Multimedia, Digital Meteor Scatter and Moonbounce, Technical Descriptions, plus digital applications in public service and emergency communications.

Building Wireless Community Networks, 2nd Edition, by Rob Flickenger. This book is about getting people online using wireless network technology. The 802.11b standard (also known as WiFi) makes it possible to network towns, schools, neighborhoods, small business, and almost any kind of organization. The first edition of this book helped thousands of people engage in community networking activities. This revised and expanded edition adds coverage on new network monitoring tools and techniques, regulations affecting wireless deployment, and IP network administration, including DNS and IP Tunneling. (182 pages. Second edition, © 2003, published by O'Reilly & Associates, Inc.)

802.11 Wireless Networks: The Definitive Guide, by Matthew S. Gast. Creating and administering wireless networks. Wireless networks are also more flexible, faster and easier for you to use, and more affordable to deploy and maintain. The de facto standard for wireless networking is the 802.11 protocols, which include Wi-Fi (the wireless standard known as 802.11b) and its faster cousin, 802.11g. But it's wise to be familiar with both the capabilities and risks associated with the 802.11 protocols. This book the perfect place to start and is designed with the system administrator or serious home user in mind. It's a no-nonsense guide for setting up 802.11 on Windows and Linux. Among the wide range of topics covered are discussions on: deployment considerations, network monitoring and performance tuning, wireless security issues, how to use and select access points, network monitoring essentials, wireless card configuration, and security issues unique to wireless networks.

By Joe Moell,* KØOV

HOMING IN

Radio Direction Finding for Fun and Public Service

Championship Foxhunting Brings the World to Boston

Ten-thousand years ago the area south of today's Boston was the home of Algonquian natives called the Massachusett, meaning "people of the great hills." That's how the state got its name. Nowadays, those hills are a major source of recreation, with skiing every winter followed by hiking, fishing, camping, and swimming in the warm months. This year, for the first time, they were the site of a multi-nation RDF (radio-direction-finding) contest.

International-rules on-foot RDF contesting (also called foxtailing), radio-orienteering, and ARDF, came to the USA 18 years ago. In the early years, the only stateside activity was on the West Coast. The first major event east of the Mississippi didn't take place until 2002. Ideal radio-orienteering locations exist in New England, but only one person from that part of the country became an ARDF regular. He is Vadim Afonkin, ex-UZ3AYT, of Boston.

Vadim learned the sport as a youth in his native Russia. Indeed, he learned it well, because beginning with his first USA championships in 2003, he has taken overall top honors almost every year. Last fall, he volunteered to put on the 2009 championships for USA and IARU (International Amateur Radio Union) Region 2 (North and South America).

A Mostly One-Man Show

Normally it takes a club or a large committee to put on an ARDF event of this size and scope. However, Vadim, now KB1RLI, did almost all of the leg work himself. He got excellent cooperation from the NEOC (New England Orienteering Club) in arranging for the site and getting detailed orienteering maps. In return, he taught ARDF to interested NEOC members—more about that later.

With diplomatic help from ARRL Headquarters, Vadim invited ARDF experts from eastern Europe to come to America to take part. He found discounted lodging for participants and extra RDF gear to loan to beginners. Most important, he set two world-class ARDF courses, one on 2 meters and the other on 80 meters. "I want to take our USA team up to the next level," he told me, "so we all will do better at future world championships."

Vadim and I discussed two possible forest locations for the contests. One was in the western part of the state, a lengthy drive from Boston. The other was Blue Hills Reservation, the former home of the Massachusett natives, just 10 miles south of the Cradle of Liberty. These 7000 acres are the largest open space within a major metropolitan area. Most of the woods are runable, if you don't mind trails that go up and down 300-foot hills.

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Every five minutes, up to four competitors in different age/gender categories are started as fox #1 begins transmitting. In the 2-meter starting corridor are Addison Bosley from Kentucky, the youngest competitor at this year's championships, and Bill Smathers, KG6HXX, a long-time radio-orienteer from California who is now in M50 category. (All photos by Joe Moell, KØOV)

The Blue Hills Reservation is away from the expensive downtown area, yet it's easily reached by commuter rail. My only concern about this site was that high levels of urban ham activity and other RF sources might adversely affect 2-meter ARDF receivers, especially older European models which have wide intermediate-frequency stages. As it turned out, these worries were mostly unfounded[1] and Blue Hills was an ideal location.

Radio-orienteering championships in the USA always attract interest around the world, despite the difficulty of getting visas from some countries to visit the states. For a while, it appeared that foxtailers from China and Mongolia would attend, but that didn't work out. The final list of competitors included representatives from Australia, Canada, Germany, Japan, Russia, Sweden, the United Kingdom, and the Ukraine.

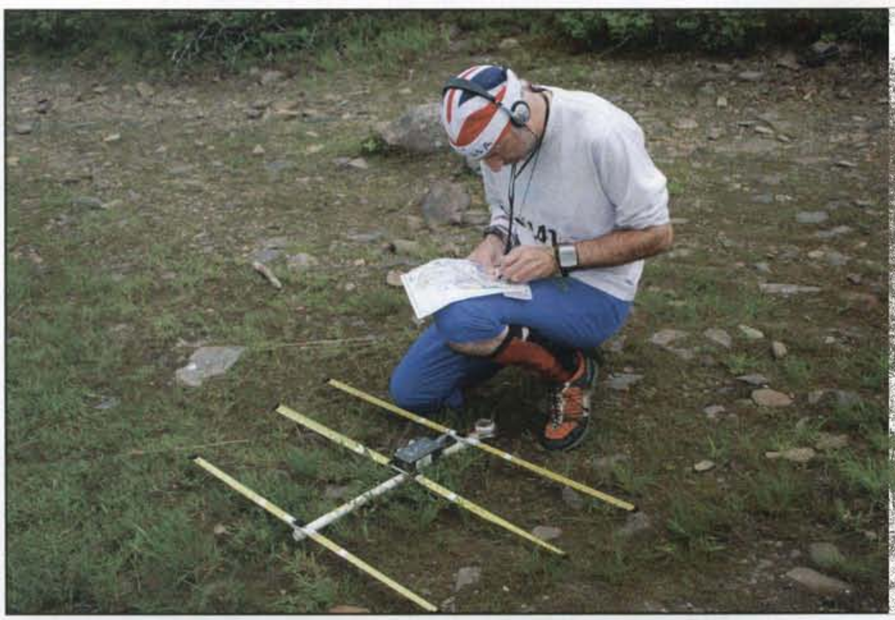
Among the starters were eight Massachusetts residents, none of whom had been to a large ARDF event before. Five of them

At Friday's equipment checkout session in Breakheart Reservation, Bob Frey, WA6EZV, shows his home-built 2-meter ARDF receiver to the two Japanese participants, Kentaro Kurogi and Masahiko Mimura.

Russian ARDF champion Igor Kekin didn't look winded as he punched in at the finish line of the 2-meter foxhunt. Even though he is over age 50, he competed against runners in their 20s and found all five transmitters in just under two hours to win a bronze medal. ⟶

were members of the NEOC. Their experience with map-and-compass navigation gave them a good start in the sport. Beginning in March, Vadim helped them achieve RDF skills by putting on practices and "dry runs" in sites such as Franklin Park.

In the three decades since international rules for ARDF were first set down in the nations of Europe, the number of official age/gender divisions has grown from three to nine. Males between 20 and 39 years of age must search for all five transmitters. Those in the two categories covering ages from 40 through 59 need find only four, and those 60 and over need go for only three.[2] However, men of any age can sign up for the M21 category, putting them up against men in their 20s and 30s and having to seek all five transmitters.

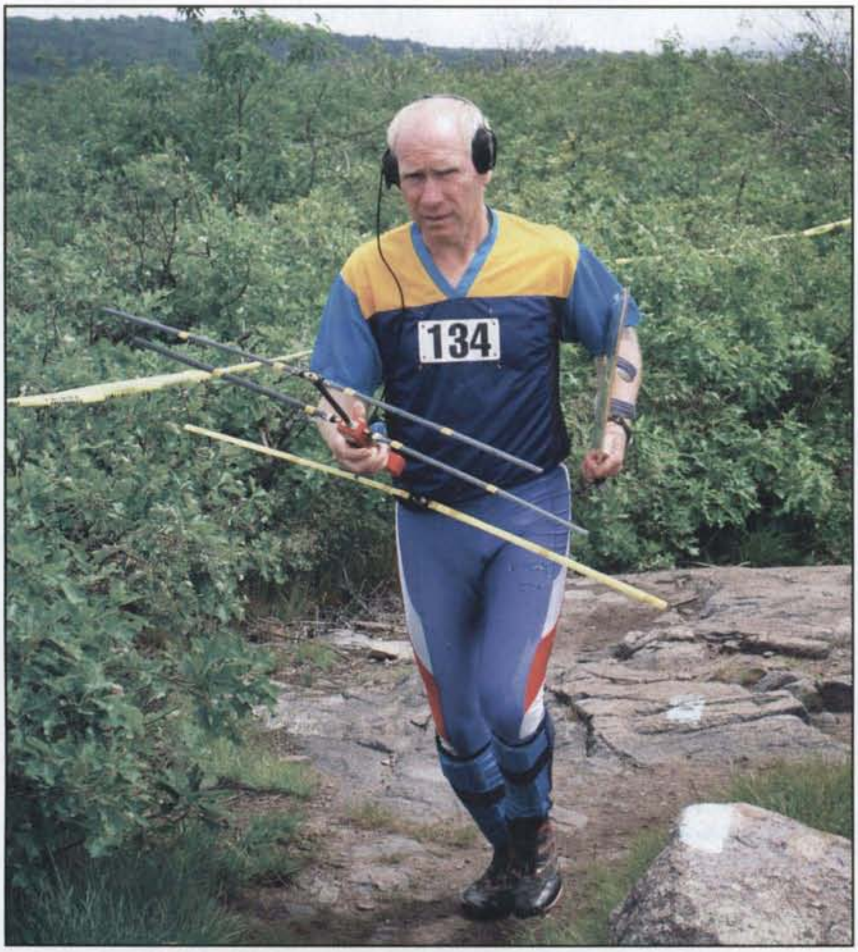


Because it was on a hilltop, many competitors stopped at the end of the 2-meter corridor to plot bearings on all the transmitters. David Williams, M3WDD, of the UK went on to win gold in the category for men over age 40 by finding four foxes in less than an hour and a half. The GPS device on his left wrist does not help him with navigation, but it records his route for later analysis.

Up and Down

NEOC's map of the western section of Blue Hills encompasses almost 2000 acres. All of it was used for each of the two transmitter hunts. The finish areas for

Organizer and host Vadim Afonkin, KB1RLI (at left), congratulates Boston orienteer Leszek Lechowicz, NI1L, on his success in his first ARDF championships. Leszek was fourth in the M40 category on 2 meters and second on 80 meters.



Nikolay Ivanchihin, UR8UA, runs up the 2-meter starting corridor. This amazing Ukrainian competed in the same category as 20- to 40-year-olds and was over 15 minutes faster than any of them on both bands.

2 meters on Saturday and 80 meters on Sunday were close to the beaches of Houghton Pond in the south. The starts for the two days were at opposite ends. Knowing that 2-meter signals can be blocked and reflected by terrain features and wanting to make sure that all of them could be heard, Vadim chose the top of Buck Hill for the start of that event. At 480 feet elevation, it is the highest point in the eastern half of the hunt area.

Vadim's world-class 2-meter course was 3.5 miles point-to-point from start to each of the five transmitters in optimum order and then to the finish. Actual routes of the competitors were considerably greater than that, of course. Four of the foxes were near the tops of Burnt Hill, Tucker Hill, Houghton Hill, and Hemenway Hill. The fifth was on the steep eastern slope of Great Blue Hill near Wildcat Notch.

The undisputed "Best in Show" for 2009 was 58-year-old Nikolay Ivanchihin, UR8UA, of the Ukraine. He chose the five-fox M21 category and easily defeated men half his age and younger. Impressive performances on 2 meters in M21 were turned in by Matthias Kuehlewein, DL3SDO; Igor Kekin; Jay Thompson, W6JAY; and Ian Smith, but UR8UA beat them all by 27 minutes or more.

What is Nikolay's secret? It isn't his equipment, which for 2 meters is a standard Ukrainian ARDF receiver built into the boom of a three-element Yagi. According to David Williams, M3WDD, of the UK, Nikolay has perfected the ability to predict the likely hidden transmitter locations and to continuously estimate his distance from each one by listening to the signal.[3]

Many hunters closely followed their bearings and navigated directly toward each fox in what they judged to be the optimum order. Going cross-country slowed them down, as they had to go over hills and through heavy vegetation. By contrast, Nikolay and some other experts made good guesses about the fox locations, and then mentally plotted fast courses to each using the trails. They would continue on the trail until the signal was close and directly to the side, and then dive into the woods to punch in at the transmitter.

David's performance was outstanding, as well. M3WDD was the runaway leader in the four-fox M40 category both days. He was more than an hour faster than second place on 2 meters. Two weeks before, he had won the 2-meter hunt at the British ARDF Championships in Shropshire, England.

At last year's World Champions near Seoul Korea, UR8UA took fifth place on 2 meters in the M50 category. This was the category in which George Neal, KF6YKN, was third, making him the second Team USA member to bring home a medal from a World Championship event.[4] On the podium with George that day was Igor Kekin of Russia, who won the gold in that category. KF6YKN couldn't be in Boston this year, but Igor came as a visitor. He chose to run in M21 and took third place on 2 meters behind UR8UA and DL3SDO.

At every USA championships there is friendly rivalry between the OH-KY-IN (Ohio, Kentucky, and Indiana) group in the Cincinnati area and the foxtailers from California to see who will get the most medals. This year, it looked like the battle ended in a draw with one of each color medal won by each group. For California, Bob Cooley, KF6VSE, took gold in M60 on 80 meters and bronze on 2 meters. Jay Hennigan, WB6RDV, got silver in M50 on 80 meters. For the Cincinnati group, Dick Arnett, WB4SUV, captured gold In M60 on 2 meters, Matthew Robbins, AA9YH, picked up silver in M40 on 2 meters, and Bob Frey, WA6EZV, took home bronze in M60 on 80 meters.

But wait, there was a new team member from OH-KY-IN. Addison Bosley of Erlanger, Kentucky is the grandson of Dick Arnett. At age 11, he was the youngest competitor at these championships. Addison earned gold medals in the M19 category on both bands. Congratulations, Addison!

Also performing well as a group were the new hunters from Massachusetts. Lori Huberman[5] won gold in W21 category on both bands. Brendan Shields was awarded bronze in M21 on 80 meters. Leszek Lechowicz, NI1L, received silver in M40 category on 80 meters. The best group of all in the medal count comprised the visitors from abroad. Seven gold, seven silver, and two bronze medals went into suitcases for overseas flights home.

Complete results and many more photos are on my "Homing In" website at <www.homingin.com>.

As always, first-aid expert April Moell, WA6OPS, was ready for any medical problems. This year she had help from Pavel Nelyubin, a cardiac nurse at Brigham and Women's Hospital in Boston. The most serious injury was to Valeri Georgiev of Montreal, who sprained his ankle and had to drop out of the championships after finding one 2-meter transmitter.

Hats off to KB1RLI for giving a jump-start to ARDF in New England. Judging by the enthusiasm of the East Coast newcomers in attendance, interest in the sport has risen to a new high. However, Vadim can't keep the momentum going by himself. It's time for others to step forward and help arrange local events with publicity sent to all the nearby ham clubs. A session in New England during every warm-weather month would be ideal. Vadim will appreciate your support, too, because he needs to train so that he can be in the running for membership in Team USA 2010.

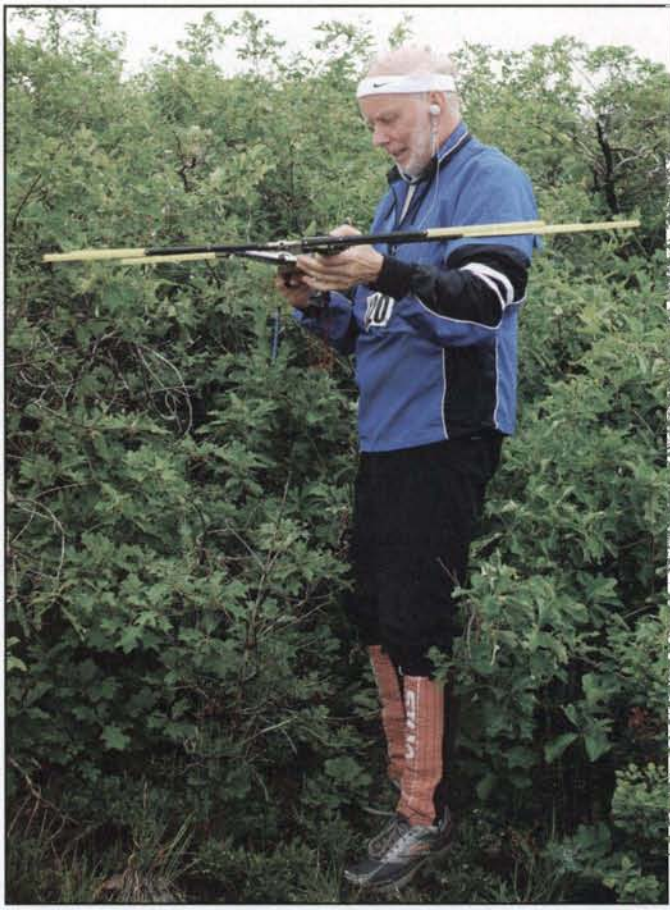
Several attendees at Blue Hills expressed interest in hosting next year's USA Championships in their localities. The 2010 championships must take place no later than mid-June so that Team USA can be selected for the Fifteenth World Championships in Croatia. If you like the idea of having dozens of enthusiastic hams and would-be hams coming to your home town to hunt radio foxes in the woods, see the article on my website about championships hosting[6] and contact me to discuss it.

T-Hunters and FCC Together Again

In previous columns, I have given examples of cooperation between the Los Angeles FCC office and hams in ARRL's Amateur Auxiliary. When Catherine Deaton retired as head of that FCC branch and Riley Hollingsworth stepped down from his enforcement post in Washington, there was concern that things would never be the same again. Indeed, they weren't for a while, with the Los Angles FCC staff being managed by the Denver office and a drop-off in emphasis on response to amateur radio matters. In the fall of 2008, FCC headquarters instructed the field offices that their highest priority was to help consumers with the transition to digital television. Staffers were assigned to give presentations at senior residences and to other consumer groups, leaving them little time for anything else.

Now Laura Smith has taken over ham radio enforcement matters in Washington. A newly appointed District Director, Nader Haghighat, is running the Los Angeles office. The DTV transition is

Ten minutes before their start times, competitors clear their electronic scoring "sticks" and receive their orienteering maps. Mark Diggins, VK3MD, is marking the start and finish locations on his map. He is Australian, but is presently working and living in the Boston area with his family.



Veteran radio-orienteer Per-Axel Nordwaeger, SMØBGU, was course-setter for the 1994 ARDF World Championships in Sweden. Even though he is now over 70 years old, he continues to be a regular competitor. In this first trip for him to the USA for ARDF, he went up against competitors in their early 60s and took home two silver medals.

complete and amateur radio again has visibility in the enforcement branch. For example, there was rapid response in May when the Orange Section Amateur Auxiliary presented the case of the concrete communicators.

In late April, hams in central and northern Orange County began hearing conversations on 146.025 MHz, the output of K6SOA/R, which is owned by SOARA, the South Orange Amateur Radio Association. The transmissions were clearly for business and appeared to be related to construction work. SOARA has regular hidden transmitter hunts, so some members were already equipped to go into action to find the source. Two of them, Richard Saunders, K6RBS, and Richard Clark, N6UZS, reported strong signals in the cities of Orange and Costa Mesa. However, the strength and direction of bearings were not the same from one day to the next.

Transmitter hunters in the Amateur Auxiliary soon joined in. The search wasn't simple, because the activity wasn't daily and it was sporadic on the days when it occurred. Next came reports of strong signals in Anaheim and Yorba Linda. From the sometimes-salty conversations, T-hunters concluded that they were listening to the handie-talkies of a concrete supplier at various job sites.

On May 21, one of the Auxiliary members[7] hit pay dirt at a construction site of the Diemer Filtration Plant in Yorba Linda. Photos and recordings were sent to the FCC, and within a week the interference was gone. The concrete supply firm had obtained its handie-talkies from a commercial two-ray radio supplier, which had mistakenly programmed them to transmit and receive on 146.025 MHz instead of 156.025 MHz. With no frequency readout and with tone squelch operational in their receivers, the concrete workers could not hear the SOARA repeater and had no idea that they were using an amateur radio frequency.

For FCC field engineers, this was a simple case because all they had to do was verify the information provided by the Amateur Auxiliary. It certainly pales in comparison to the work that office had to do on a recent non-amateur matter. According to the FCC Notice of Liability issued May 14, the first complaint came in on February 25. Somebody was deliberately interfering with maintenance and security two-way radios at The Oaks Shopping Center in Thousand Oaks, about 25 miles west of downtown Los Angeles. The perpetrator was harassing the employees by voice and by sending strong pulsating signals on the security repeater input frequency, rendering it useless.

Using one of the agency's mobile direction-finding vehicles, an engineer from the FCC office found the source of the pulsating signals on March 5 at a secure communications building on Oat Mountain, 19 miles northeast of the mall. The agent also discovered a beam antenna for the security frequency pointing toward Thousand Oaks.

The next day, the FCC collaborated with the Ventura County Sheriff's department in an effort to find the person behind the harassing and jamming. By now, NOAA weather radio was being retransmitted on every Oaks two-way channel. FCC told the Oaks workers to get the perp talking and to keep him going for as long as possible. The workers did and then listened to him tell them that he had warned of this three weeks ago, that they needed to cancel their license for the security repeater frequency pair, and that they should request a new frequency because "we need this channel."

That evening the FCC tracked the source of the voice to a vehicle in a parking structure of the National Park Service, just across the street from The Oaks. Kevin Bondy, the person in the vehicle, holds a GMRS (General Mobile Radio Service) station license. He was told that as a FCC licensee he had to allow an inspection of his transmitting equipment or face a possible fine. Bondy did not permit the inspection.

From then on, there was no further interference to radio operations at The Oaks. Three days later, the FCC went back to Oat Mountain and found that the beam antenna was gone. The FCC's Notice of Apparent Liability to Bondy cites unlicensed radio operation and intentional interference on a willful and repeated basis. It imposes a $24,000 fine.

Sheriff's officers executed a search warrant at Bondy's home, finding over 200 pieces of two-way radio gear. There were also a few amateur radio items and some commercial broadcast equipment, including a one-kilowatt FM transmitter. That office is now attempting to determine if any of this equipment was stolen.

Are you using your RDF skills to help the Official Observers in a Local Interference Committee of the ARRL Amateur Auxiliary? Please write and tell me about the success of that cooperation in solving the interference problems in your area.

Notes

1. Almost all of the 2-meter sets worked fine, but to everyone's surprise, many 80-meter receivers were pummeled at the starting line by WGBH-FM, the 100-kilowatt station on 89.7 MHz atop a hill at the southwestern corner of the reservation. Fortunately, the QRM diminished as hunters got into the woods closer to the foxes.

2. Competitors don't get to choose which foxes to omit. They are told in advance which fox numbers are the ones they must seek.

3. Championship 2-meter ARDF transmitters usually send A2 modulation (AM with CW tones). The RF carrier was keyed with the CW at this event, but sometimes the carrier is continuous.

4. The story of ARDF Team USA at the 2008 World Championships is in "Homing In" Fall 2008 *CQ VHF*.

5. Lori is the daughter of Ruth Bromer, WB4QZG, of Raleigh, North Carolina. Ruth also competed and received two gold medals in the W50 category.

6. "Tips for Hosting ARDF Championship Events" at <www.homingin.com/host.html>

7. I would like to credit this person by name, as well as the FCC staffers who handled the case, but they wish to remain anonymous.

By Rich Arland,* K7SZ

BEGINNER'S GUIDE

All you need to know but were afraid to ask . . .

It's Summertime . . . Antenna Time!

Summer is here, and about time, I might add! Man, I don't know about you, but there is something about this time of the year that inspires me to do a number of things around the shack/antenna farm. Coming out of the winter doldrums and the torrential spring rains, performing some antenna maintenance or rearranging the shack seems somehow the "correct" things to do.

In the spring issue of *CQ VHF* we discussed the shack, the ops bench, and a generalized list of things to do to get ready to operate. I had some excellent shots of my new shack ops bench, both uncluttered (shortly after I built it—about 3 hours later) and overrun with "stuff" (about 3 1/2 hours after I built it!), which serves to emphasized the FSS (flat surface syndrome) that accompanies a new piece of shack equipment/gear/furniture. Unfortunately, I managed to either misplace or delete the images in the camera! I *hate* when that happens!! However, you'll be relieved to know that I have conquered FSS, at least temporarily.

The emphasis of this column, to date, is to set up a new shack with the idea of using (and/or reusing) items from the old shack, or, if you are just starting out, guide you through the minefield of spending money when not really necessary. Frugal is the password in this endeavor. With today's economy in a shambles, taking a tight-fisted approach to a new shack is not only a sound idea, but one that should secure easy approval from the rest of the family.

On a recent return trip to our old home in Pennsylvania, I spotted my old shack operating position—a computer desk from the local Ikea store. It wasn't being used, so it made the return trip back to Georgia with us. This desk is quite roomy, in the way only the folks at Ikea can visualize, design, and manufacture. The reacquisition of this ops bench meant that the bench I procured at Wal-Mart earlier could be used as a workbench, thereby allowing me to keep an uncluttered operating area while doing maintenance on a rig or building a new piece of gear for the shack.

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Photo 1. This is the five-pack of colored vinyl tape available for under $2.00 at Wal-Mart. This stuff is great for labeling large coaxial cables using a color code of your choice. Writing the desired cabling info on the tape using an ultra-fine tipped black "Sharpie" permanent marker yields a fool-proof method of keeping track of your cables inside the shack.

Coaxial Cable

One idea that struck me early on in planning phase of this new shack was to be able to route the RF coaxial cable and ladder line via a patch panel mounted on an inside wall of the shack. This idea turned out to be very simple to implement. I brought each coaxial cable from the outside antennas in under the eaves of the roof via holes under the eaves. From there each cable was routed across the inside of the attic and down the inside wall of the shack between the wall joists. An 8" × 8" square hole was cut into the sheet rock on the inside wall of the shack and each cable was brought out for prepping (affixing coaxial connectors) prior to drilling and mounting the aluminum patch panel to the wall. The patch panel, a 9" × 9" × 1/8 " piece of aluminum stock, was drilled for various coaxial feedthrough connectors to include BNC and SO-239 bulkhead connectors. Additionally, I added a set of feed-throughs for 300- and 450-ohm ladder line. The patch panel is attached to the wall via some sheet-rock mounts and makes for a very neat, professional antenna installation.

Each antenna is separately routed either directly to or via an Alpha Delta coaxial switch to the radios. This adds a lot of flexibility to the shack while keeping the rat's nest of wires/cables to a minimum. With the addition of wire labels (both on the input and output side of the patch panel) you can accurately grab the proper RF feed line if the need arises.

Speaking of cable/wire labels, RadioShack sells (or used to) several different types of labels. Of course they are drastically overpriced for what they are, so how about we make our own? Labeling your feed lines and AC/DC power cords not only makes sense, it doesn't need to be expensive.

For RG-6, RG-8X, RG-58, or RG-59, the plastic tabs from loaves of bread makes dandy labels. One side normally has some kind of date/time code stamp while the opposite side is blank, allowing you to write the info regarding the cable. This plastic tab is then placed around the cable near the coaxial fitting and *viola*, each cable labeled!

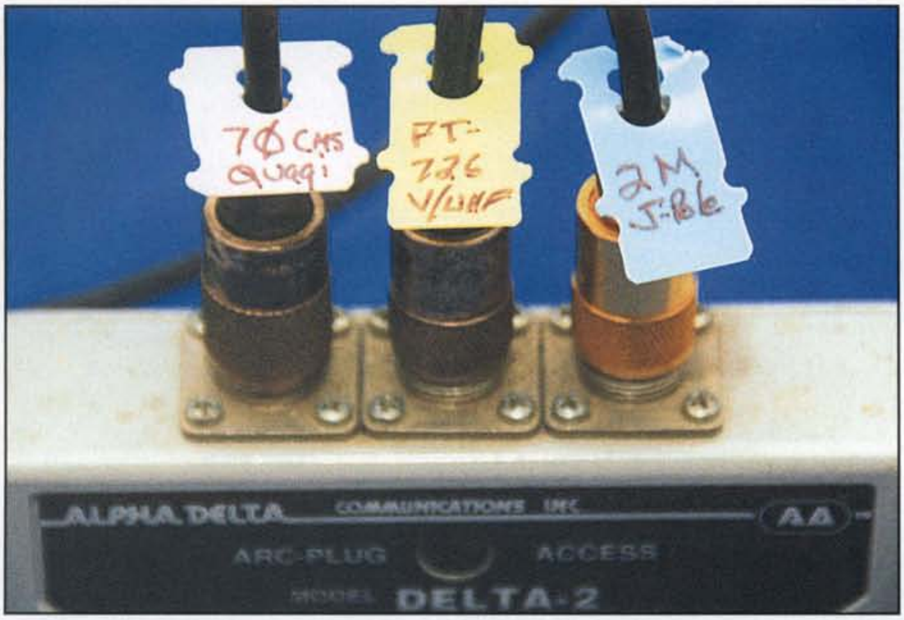

Photo 2. This photo shows how the plastic ties from bread/bagel bags can be used to tag smaller coaxial cable such as RG-8X, RG-58, and RG-59.

For larger cable such as RG-8, RG-11, RG-213, 9913F, or LMR-400/600, we need to do something different. Sure, you can hit the local RadioShack and pick up a selection of their pricey labels, or you can make a run to Wal-Mart and in their automotive center grab a selection of four rolls of colored electrical tape for less than $2.00! The selection of colors normally includes blue, red, yellow. and white, giving you four distinct color-coding schemes: blue for VHF, red for power cabling, yellow for HF, and white for whatever is left over. You can write on this type of tape using Sharpie® permanent markers (I prefer the ultra-fine-point type) so you know at a glance what cable you are looking at.

A spin-off of using the multi-colored electrical tape is you now have a method of labeling the various parts of your vertical and/or Yagi antenna elements. Match the colors to the proper ends of the aluminum tubing and you know instantly where each piece of tubing goes together to make your antenna. This is great for those types of antennas you might use for Field Day, portable/mobile operations, or VHF/UHF hilltopping when you need to quickly assemble the antenna without the instruction manual.

RF Feed Lines and More

Let's back up a bit and talk about coaxial cable and its role as an RF feed line. Coax has been around for over 60 years or so, being developed for the military during WW II. This type of RF feed line is considered to be "unbalanced," since normally one side (the shield) is connected to ground, as opposed to open-

Photo 3. A plastic tag on the coaxial cable for my QRP wattmeter. This is a very inexpensive way to assure that you can easily identify all the cables in your shack at a glance.

Finding *WorldRadio Online*

To access the current issue of ***WorldRadio Online*** as well as past online issues, helpful downloading tips and other information, you'll need to go to the *WorldRadio Online Welcome Page* on the *CQ* website.

Here's how to do it:

(1) Go to the *CQ* magazine homepage at <www.cq-amateur-radio.com>.

(2) Find the *WorldRadio Online* logo to the left of the *CQ* magazine covers. Click on it. This will take you to the *WRO* Welcome Page, where you will have several options. There are links to a variety of informational pages. We recommend that you read the "Viewing and Downloading Tips" before doing anything else. The Back Issues link will take you to previous issues (beginning 2/09) to download and view. **Enjoy!**

Photo 4. Antenna for SATCOM shows your author slaving away shortly before Field Day to put the finishing touches on an 8-element Quagi antenna for the 435-MHz downlink on AO-51. The original article was published in QST *about 20 years ago and it can be found today on the "Members Only" portion of the ARRL website. Follow the instructions and you will have an excellent high-gain, very inexpensive UHF antenna that will work on the low end of 70 cm as well as the satellite sub-band. The antenna in the original article was designed as a 15-element UHF Quagi, but I just shortened it by about half and got good results according to my MFJ Model 269 antenna analyzer. Rest assured that at least one of these 15-element antennas will be on the roof shortly. The 8-element one I built for Field Day 2009 will be my portable UHF antenna.*

wire or ladder (window) line (300, 450, and 600 ohm), which is considered to be "balanced" since both sides are normally above DC and/or RF ground. Coax is much easier to use and to route. Additionally, the outer shield of the coax helps reduce RF radiation from the feed line. There is a trade-off, of course, as coax is lossy, and the losses increase as the frequency of operation is increased.

Coaxial connectors come in a variety of shapes and sizes with the most common being BNC and UHF connectors (PL-259 and SO-239). N-connectors are used in UHF applications, but there is nothing sacred about this. I know hams who use N-connectors for all their RF feed lines, even those in the HF portion of the ham bands.

I know for a fact that there are a *lot* of folks out there in ham radio land who *do not* know how to properly install UHF and N-connectors. This can also be true of the alleged "professional" communications technicians: I recently received about 500 feet of RG-8 and RG-213 cables of various lengths taken from a local TV station during a remodeling of their studios and master control. Over half of them had either faulty or crudely installed PL-259s or N-connectors! This was from a commercial TV station that should be employing competent broadcast engineers! How did I find out about these errant connectors? Visual inspection of each connector caught most of the problem coaxial cables. However, I had the foresight to terminate each cable in a non-reactive 50-ohm "dummy load." Then, using a MFJ model 269 antenna analyzer, I swept each cable from 1500 kHz to 500 MHz. This caught an additional three cables that had what appeared to be properly installed connectors! The moral of this story is don't trust everything you see. Check, then double, check to be thorough.

As for the proper method to install BNC, PL-259 and N-type RF connectors on various sizes of coaxial cable, consult any edition of the *ARRL Handbook* or the *ARRL Antenna Book*. Both have excellent illustrated step-by-step instructions. Also, the *Radio Handbook* by Bill Orr, W6SAI (SK) has a slightly different method that I have used for over 30 years, and never, ever have I had a PL-259 connector fail! Just follow the instructions and you won't have any problems.

Now some of you will be asking yourselves, "Why would Arland use old, discarded coaxial cable in place of buying new, certified quality coax?" Glad you asked! Although these assorted lengths of large-diameter coaxial cable had been used for many years in the TV stations, they were never exposed to the ultraviolet rays of our sun, which will definitely degrade the coax over a period of time. These cables were all used indoors, between studios, master control, and video editing booths, so the normal degradation associated with outdoor coaxial runs does not apply. However, being ultra-conservative in my approach, I swept each piece of coaxial cable (again using the MFJ 269 antenna analyzer) to ensure that each cable would perform from HF right up to and including 70 cm.

Using these varied runs of surplus coax saved me a bundle, since I have four VHF/UHF omni antennas, an HF vertical, and a 3-element Yagi tri-band beam at K7SZ. Future expansion plans call for adding several OSCAR antennas along with a 2- and 6-meter and 70-cm terrestrial weak-signal antennas. These VHF/UHF antennas will get the 9913F or LRM-400 treatment, so the money I saved using the discarded coax from the TV station allows me to go first class on the high-band weak-signal arrays. After all, I am not a big fan of using the checkbook or a piece of plastic to buy my way to a new shack!

Antennas for my new shack consist of a Cushcraft R-5 vertical for HF, a 40-meter dipole fed with 300-ohm ladder line, and three KU4AB VHF/UHF "halo-style" antennas for 2 meters, 6 meters, and 70 cm (www.ku4ab.com). They nest quite nicely in about 4–5 feet of vertical mast mounted on the side of the rear porch. A Blue Star dual-band J-pole sits at the top of the stack (www.bluestarantennas.com). We'll talk more about these antennas next time, but suffice it to say, these antennas are a good value for the money.

On a final note, this column is being written just prior to Field Day. I hope I worked some of you either on HF or 6 meters, if the band opened up. I was providing the satellite station for the W4RG Field Day team. CU on the birds!

73, Rich, K7SZ

By Mark Thompson, WB9QZB

DIGITAL RADIO

Digital Technology on VHF, UHF, and Microwaves

Digital Connectivity: It's About the Network

Until the early 1980s operating the digital modes meant making a contact using RTTY on HF or VHF. In the early 1990s other data modes, such as AMTOR and PACTOR, using multi-mode controllers, were implemented by companies such as AEA, Kantronics, and MFJ. In the late 1990s new digital data modes—PSK, for instance—began to be implemented using software and sound-card technology. What all of these data modes have in common is that they're simplex half-duplex based and require no other network technology in order to use them.

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Packet radio was introduced in the early 1980s; this was the first time a digital network was implemented in ham radio. Every packet TNC (Terminal Node Controller) was a digipeater that could repeat a digital packet of information. In the early days of packet it became common to digipeat through several TNCs. During band openings it was often a challenge to see how far away you could digipeat and either connect to a remote TNC or BBS (Bulletin Board System). As packet radio became more popular, packet frequencies became very congested, with packets often colliding with one another. Digipeaters often were placed at high locations with the expectation of extending the range of digipeating. Unfortunately, these high-location digipeaters caused collisions called the *hidden transmitter effect.* The hidden transmitter effect occurs when not everyone on a frequency can hear one another, resulting in TNCs transmitting at the same time with packets colliding with each other causing a reduction of overall throughput. Consequently, high-location half-duplex digipeaters often increased collisions and reduced overall throughput on a frequency. In some areas, full-duplex FM repeaters were put in place to eliminate the hidden transmitter effect, since all packet TNCs could hear all others on a repeater, resulting in the elimination of packet collisions.

Initially, packet radio was primarily a keyboard-to-keyboard activity. Bulletin Board Systems similar to dial-up BBSes soon were developed to allow users to send messages to one another. The ability to send messages from your local BBS to remote BBSes was added, and a message addressing scheme developed to support sending messages worldwide.

Since packet radio grew and evolved before the advent of the internet, a large terrestrial backbone network and HF backbone network was developed in response to the need to route messages between BBSes. Using packet radio on HF was not very efficient, but it did work. Packet radio network backbones were developed to allow a more efficient connection to a remote network node and to allow BBSes to route messages to one another more quickly and over longer distances. Many of the terrestrial backbone networks operated at a higher speed, 9600 baud, than regular packet radio, which operated at 1200 baud.

Many packet radio groups developed packet radio band plans designating both LAN (Local Area Network) and network backbone frequencies. To alleviate user congestion LAN frequencies were created for specific geographical areas. LAN frequencies reduced the number of users on a particular LAN frequency. LANs also tended to reduce the hidden transmitter effect and allowed digipeaters to be kept at a lower height.

Packet backbone networks were built by both individuals and packet radio groups. By the mid-1990s a very robust network was in place. However, when the internet arrived in the late 1990s hams started to use the internet for e-mail instead of packet radio, resulting in diminished use of packet radio. By the early 2000s network operators started to abandon their support of the networks due to reduced of use of the BBSes and the networks. Consequently, the packet network declined dramatically. Many BBSes were shut down and many packet users quit using packet radio entirely. Packet radio nearly fell into complete disuse until APRS (Automatic Packet Reporting System) was developed, resulting in a completely new use of packet radio on a new nationwide 2-meter frequency of 144.39 MHz.

The Winlink digital messaging system, developed over the last few years, has end-user access and message-routing capability. Winlink can use the internet for user access and message routing. Winlink can also be accessed independent of the internet using packet radio for users with messages routed using RF, typically over HF. Winlink HF routing typically uses the proprietary Pactor III mode. However, a new sound-card-based mode, Winmor, was introduced at the Digital Communication Conference last year with the intent of reducing the cost of implementing Winlink message routing.

D-STAR digital voice repeaters can operate stand-alone and automatically route voice transmissions to other D-STAR repeaters at the same site. However, a significant capability of D-STAR is the ability to use the internet to route digital voice transmissions to remote repeaters. Since all D-STAR transmissions are identified by callsigns, transmissions can be routed using an internet gateway. D-STAR repeater sites in a common geographical area could also be linked via RF using IP-based networking technologies.

The packet radio experience demonstrated that a reliable network is required to implement a robust digital messaging system. While a ham network can now use the internet, it is desirable that a separate network be developed independent of the internet so communications can continue when commercial networks fail during a disaster.

I encourage everyone who has an interest in digital voice and data communications to attend the Digital Communication Conference. The DCC will again be in Chicago this year the last weekend of September (the 25–27). It is a great way for both experienced and new operators of the digital modes to learn more about the technologies. There are both technical and introductory presentations. If you have experience using digital data or voice technology, or have an innovative new digital technology, please consider submitting a paper to be included in the *Proceedings* and/or presenting a topic at the DCC. You can learn more about the 2009 DCC at: <http://www.tapr.org/dcc.html>.

I look forward to seeing many of you at the DCC this year.

73, Mark, WB9QZB

By Mitch Gill, NA7US

EMERGENCY COMMUNICATIONS

The Role of VHF in EmComm

Tips, Tricks, Camping, and Field Day

Good day, and I hope you all are having a great summer. My wife Jan and I do a lot of camping; well, only if you can call living in a 27-foot travel trailer camping. We have gotten too old for lying down on a hard, rocky floor or blow-up mattresses. There is a major advantage of owning a trailer, too, as I am ready for any emergency. I have solar cells, inverters, water, battery power, a place to sleep, food, and my radios. Now I am not suggesting everyone go out and buy a travel trailer, as that would lower my chances of camping wherever I choose, but I do advocate having a fly-away kit set up and ready to go.

Choose Your Radio Carefully

What kind of radio is best? In almost every type of local emergency, in my humble opinion (did I say "humble"?) the best radio is one that operates on 2 meters. There are a lot of reasons I believe this, but I will name only a few. First and foremost is that 146.52 MHz is monitored by more people than any other frequency and is designed to be an emergency frequency. Many people have a 2-meter radio around somewhere. Small antennas, repeaters for greater distances (if they are still up and working), and all operate on a battery or 12 VDC. Everyone in my family has a 2-meter radio in their vehicles. My son Tyler, KD7MJO, is licensed, and my wife is working on her ticket now. We have several radios in the trailer, as I am both prepared for an emergency and when I just want to have fun on HF, VHF, or UHF.

My wife had no problems with my setting up a station in the trailer. OK, she had one rule—no holes in the new trailer, which became my problem. I scouted for ways to bring in the antenna cable. I looked at all the vents, and the only one that would have worked went down to the refrigerator, which was not a good place to put a radio. I also forgot the first rule also applied

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Photo A. The radio towers at Fort Flagler. They are about 10 feet below the ground, as they are attached to the side of the underground bunker. (Photos by the author)

Photo B. The view from the VHF tent overlooking Admiralty Inlet on Puget Sound.

to mounting any radio. I had to put my foot down someplace and this was the time and the place. What was I, a man or a mouse? I decided that this was much too important, and she would just have to let me bend or even break the rule! I went marching into the house and into the kitchen and told her what I was going to do and that there was nothing she could do about it. She merely smiled, opened the refrigerator door, and handed me a piece of cheese. Drat! I will have to find another way.

Returning to the trailer with head lowered and my ego reduced by several notches, I suddenly remembered how I got an antenna into my room in Iraq (see NA7US's column in Spring 2009 *CQ VHF*). I cut the top and bottom off one 1.5-liter bottle and the tops off two more and then taped them together and placed them in the window so that it closed down onto the bottles. I drilled the holes and brought in the cable. No holes in the house. On the serious side, you can do this in the event that you lose electricity and the drill does not work. By poking a hole on each side and taping up the hole, you will lose very little heat in the winter.

I ended up buying the MFJ 4603 Universal Window Feedthrough Panel for my house, as I did not want to drill holes through the cedar siding and the XYL would not like the bottles in the window. It's a great product for us lazy people who do not want to build anything, but it would not work on the trailer, as the windows are a different size and shape. I tried the bottle idea, but my window in the trailer is curved, and I could not get it to work no matter how hard I tried to squeeze that plastic.

I then remembered that my son had some extra Plexiglas lying around in the garage. I created a window and set it in place and it worked! I put a barrel connector in the middle and ran my screwdriver power cable through another hole. The great thing is that I can easily remove it when we are traveling. It's not pretty, but it works.

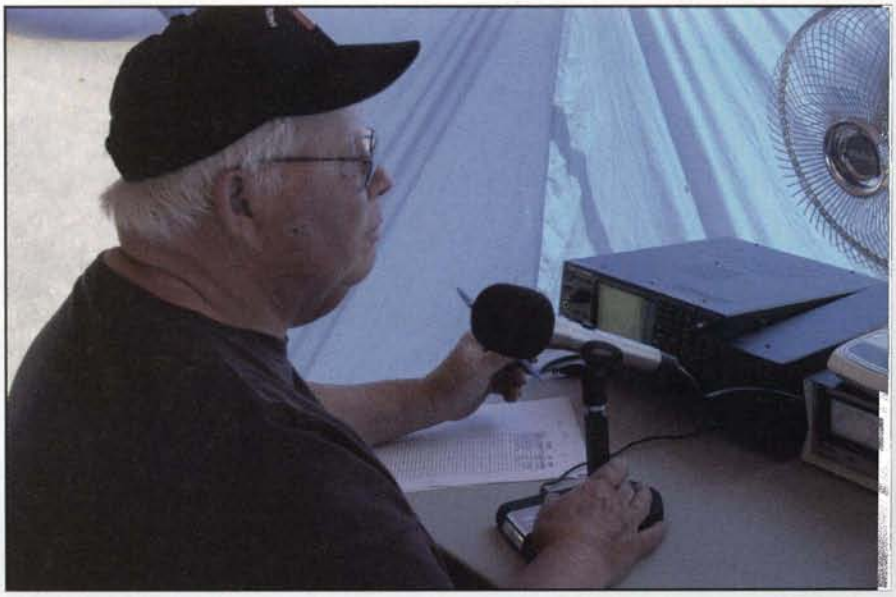

Photo C. John, WA7HQG, the "Upper Band Prince" during Field Day. He can wrack up the points!

I can hear you now: "Hey, Mitch that's great for you, but I don't have a trailer!" That may be true, but you can get a deep-cell battery, a solar panel, and pitch a tent. No tent, you say? In that case you may get wet and the radio may fry! That would not be good.

There are, of course, many more items that can be placed in a fly-away kit, and there are many different ideas of what those items are. Do your research, because only you can choose what you believe needs to be in there.

Field Day: Testing Our Emergency Comm

I love Field Day for so many reasons. The club I belong to (Mike and Key Amateur Radio Club) has been going to Fort Flagler for over 35 years. The view of the ocean, history, campfires at night and walks on the beach with my wife make for a wonderful time, but it is the rush of working a pile-up that keeps me returning every year, as well as the many friends I have made over the years.

Fort Flagler was one of the three forts built in the late 1800s to protect the entrance to Puget Sound. If ships were to get through, they could have destroyed Seattle, Tacoma, Everett, and the Bremerton Naval Shipyard. The radio towers you see in photo A are actually about 10 feet below the ground, as they are attached to the side of the underground bunker.

It may seem to some people that Field Day is more of a contest than a test of emergency communications. There may be some truth to that statement, but personally I believe that any time we go "off the grid" and can effectively communicate, we are demonstrating what we, as ham radio operators, can do. Also, when the generator fails or the rotor dies, we know how to improvise with batteries and dipoles.

Imagine the view from the VHF tent (photo B). It was overlooking Admiralty Inlet on Puget Sound, and there have been times when a pod of orcas or humpback whales can be seen breeching the water in the early evening with the Cascade Mountains in the foreground.

John, WA7HQG, is the "Upper Band Prince" during Field Day (photo C). He can really rack up the points! The four-element 6-meter beam was developed and built by him a few years back. When we were breaking down the antenna I noticed just how well the beam had been built. Send an e-mail to his attention via my e-mail address and ask.

Take to the Field

The real test of emergency communications during Field Day (before I get a lot of e-mails, just remember that this is my opinion) is those who take their batteries, solar panels, and VHF equipment out in the field or up in the mountains. When a real catastrophe strikes, it will be those operators who will first respond and assist their neighbors while I am still trying to start my generator. OK, you now know that I am not mechanically or electrically inclined, but that's what I have sons for. All three of them are mechanics and one is an electrician as well. I had a plan!

What really matters is that we prepare ourselves for a time when we may be called upon to assist. Many of you have been through the storm already and bring tons of experience to the table. Teach and then practice what you have taught. Let your neighbors know that you can be of use in the event that there is no other communication. Prepare for the worst and hope for the best.

Until next time, just remember that VHF rules during local emergencies. Thank you for your service.

73, Mitch, NA7US

By Bob Witte,* KØNR

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

A List of FM VHF Operating Activities

How many times do you hear someone comment, "2 meters FM is just too limiting. All you can do is chat on the local repeater"? It is easy to draw that conclusion, and there is certainly nothing wrong with chatting on repeaters—a lot of good ham activity happens that way. FM is the *Utility Mode*, which means it is the mode that gets the job done *and* it is useful for many different ham radio activities. The use of FM VHF is only limited by your imagination.

Let's see if we can expand our thinking a bit and discover some of the "other" radio activities on FM VHF/UHF. In fact, I've made a first cut at a list of FM VHF operating activities.

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Here are the rules for the creation of this list:

• To be on the list, the activity must be possible using a typical dualband 2m/70cm FM transceiver (handheld, mobile, or base) and associated accessories (antenna, power supply, transmission lines, packet TNC, computer sound card, etc.)

• Commonly available ham radio infrastructure can also be used, such as repeaters, VoIP links, OSCAR satellites, Winlink, etc.

• The author of this column will determine whether an activity is unique or a duplicate of another item. This will be arbitrary and capricious.

I spent some time reviewing the pile of ham radio magazines I have around the house, pulling out anything related to FM VHF. In the process, the following list was created:

Photo 3. Steve, KDØBIM, operating 2 meters FM from a vehicle located on Pikes Peak.

Photo 1. A typical 2-meter FM transceiver is the utility mode rig that can be applied to many different types of operating.

Photo 2. Joyce, KØJJW, operates VHF/UHF FM from the summit of Humboldt Peak.

Photo 4. This sedan has a good collection of VHF/UHF vertical antennas installed. A good mobile installation makes for a fun road trip, but you can probably do just fine with fewer antennas than this.

Photo 6. The vertical 2m/70cm antenna is attached to a mast using a "drive on" mount.

1. Chat with your buddies on VHF simplex. (OK, that was an easy one.)
2. Make a contact via the local FM repeater.
3. Check into your local club FM VHF net.
4. Operate from a mountain or hilltop and take advantage of Height Above Average Terrain (HAAT).
5. Take a road trip with the goal of making contacts on VHF FM.
6. Report severe weather during a Skywarn severe weather net.

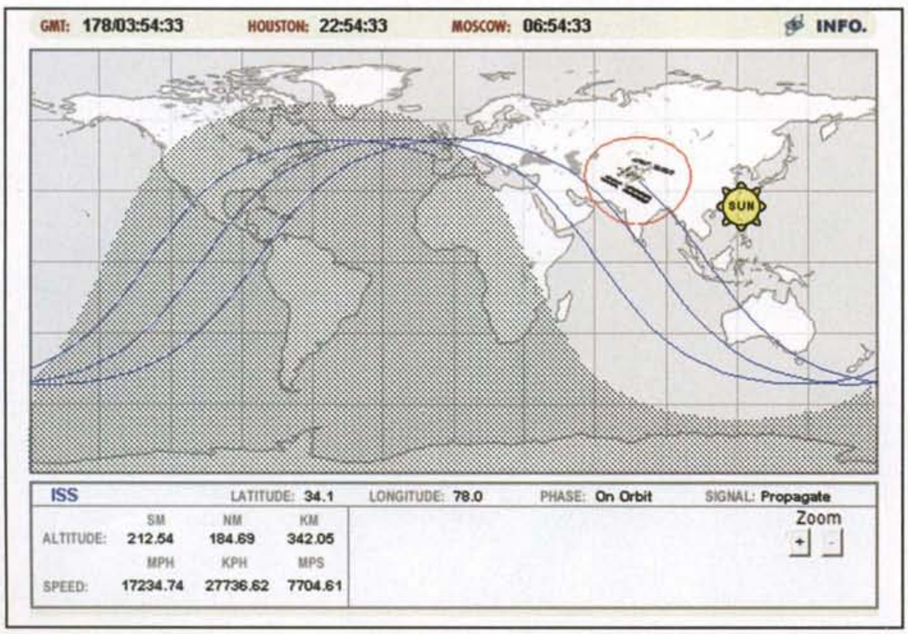

Photo 5. Online tracking of the International Space Station is available on <spaceflight.nasa.gov>.

Photo 7. A QSL card from a contact with the International Space Station.

7. Provide communications for a public service event.
8. Participate in ARES or RACES activity during an emergency.
9. Activate a rare grid or location, especially during a VHF contest.
10. Transmit your fixed or mobile location using APRS (Automatic Packet Reporting System).
11. Send a text or e-mail message using Winlink via a local VHF node.
12. Experiment with different homebrew antenna designs.
13. Obtain directions to a hamfest via the talk-in frequency.
14. Work the ARRL Field Day on the VHF bands (but don't use 146.52 MHz).
15. Make a phone call using a repeater autopatch.
16. Participate in a transmitter hunt using a directional antenna.
17. Complete a QSO using one of the FM amateur satellites (for example, SO-50, AO-51).
18. Contact the International Space Station on 145.80 MHz.
19. Celebrate the birthday of Edwin Armstrong, the inventor of FM, by making a commemorative transmission on December 18th. (He was born in 1890.)

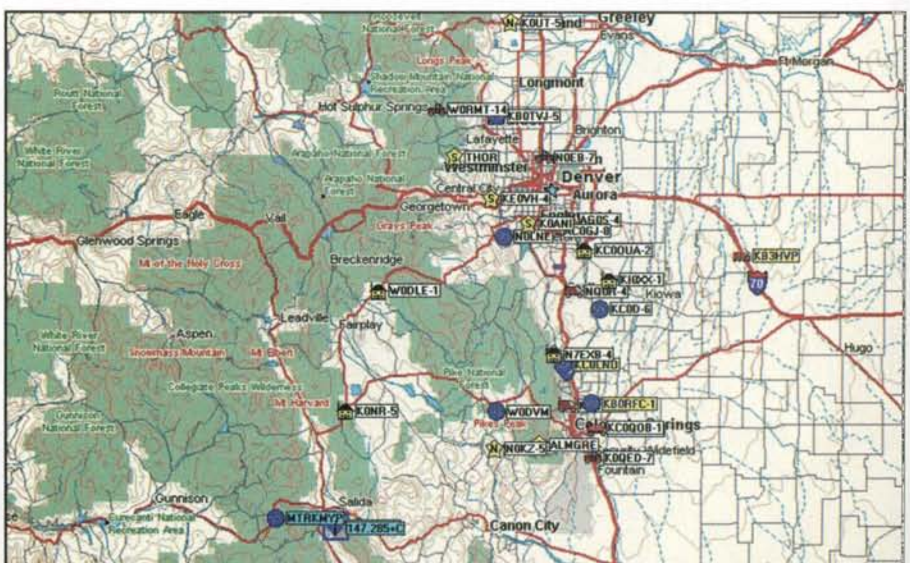

Photo 8. The mapping of station locations using APRS.

Photo 9. The N7EXB portable station in use at Field Day.

Photo 10. The FM OSCAR satellites can be worked using an HT and a handheld Yagi antenna.

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In accepting this certificate, the member-station certifies proficiency in satellite communication by having made a successful contact via a radio amateur satellite.

WA3DHF

AWARD MANAGER

Photo 11. AMSAT offers the Satellite Communicator's Club Award for just one satellite contact.

20. Listen to the NOAA weather radio stations on 162 MHz.

21. Talk to radio amateurs around the world via IRLP or EchoLink.

22. Set up an EchoLink node using your transceiver.

23. Use crossband repeat to extend the range of your handheld radio.

24. Control a remote device using a DTMF sequence.

25. Practice Morse Code using AFSK (keyed audio into the mic input),

26. Work several hundred miles on simplex via tropospheric ducting.

27. Track a radio-equipped balloon or model rocket through its flight pattern.

28. Track down ELTs (Emergency Locator Transmitters) on 121.5 MHz.

29. Track down power-line noise using the AM receive mode on VHF.

30. Set up a packet radio digipeater at your location.

By now, I hope you have found at least one or two things on the list that you might want to add to your ham radio activities, or maybe you found something that I missed. If so, drop me an e-mail and I'll add it to the list.

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

By Bill Brown,* WB8ELK

UP IN THE AIR

New Heights for Amateur Radio

Mobile Streaming Video

Now that high-speed wireless internet service is available in most areas of the country, it's now possible to televise live streaming video while mobile or portable with lightweight equipment. When doing a balloon launch, or any kind of activity—such as Field Day, special events, and hamfests—this is a great way to share your event with viewers from around the world.

I investigated some of the most popular "free to the general public" streaming video websites (Camstreams.com and Ustream.tv, for example), and although you can certainly use these sites for your streaming video and there are many hams using these sites, you may have to put up with some restrictions, such as limited number of viewers at one time as well as some advertising.

For an event that might generate a large viewing audience, I found that the best choice for me was to join the BATC (British Amateur Television Club) with yearly dues of 4 pounds (about $5.50 US). On its website (www.batc.tv) you get a dedicated personal "Members Streams" area where your streaming video link will be always be shown on the list whether you are using it or not and will immediately activate once you start your video. A nice plus is that you get to download the Cyber version of the club's *CQ-TV* magazine as part of the deal. Note that you do not need to be a paid member in order to view the video streams and events.

I have successfully used this to televise a number of balloon launches with great results. At one point we had over 100 viewers in several countries. The BATC indicates that their capacity should allow several hundred viewers at one time. One nice feature is its chat room area next to the viewing screen. Please note that to get your callsign or name to show up (if you haven't logged onto the BATC website as a member) is to use the command: /nick CALLSIGN (e.g., /nick WB8ELK).

At any given time as you scan through the Members Streams, ATV repeaters, or the special Live Events area, you'll see a number of hams around the world sending streaming video.

Photo 1. Alan Sieg, WB5RMG, demonstrates the portable streaming video system. (Photos by the author)

Uplinking Your Video

The hardware needed to uplink a portable or mobile video stream is not at all hard to do anymore. I use an ASUS EeePC netbook computer that weighs just a little over two pounds (see photo 1). Another good choice would be the ACER Aspire One series. If you are near a WiFi HotSpot, you can link in directly that way via the netbook's internal WiFi module. However, for more remote areas, I use the Verizon Wireless USB727 modem. It requires an additional monthly service fee, but the modem cost is fairly reasonable and sometimes is free depending on the length of term of your contract. You get 5 gigabytes of uplink bandwidth each month (I recommend not exceeding this

Photo 2. The Adobe Flash Media Live Encoder software.

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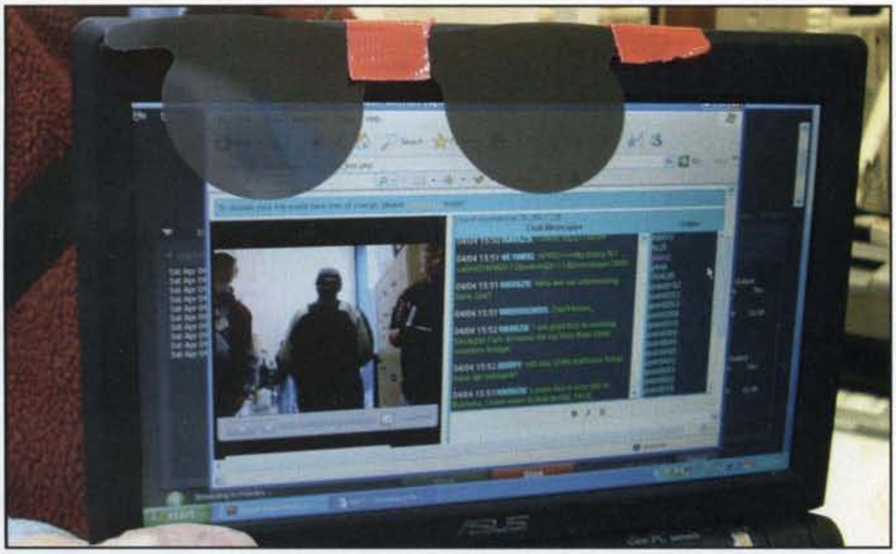

Photo 3. Laptop sunglasses for outdoor use.

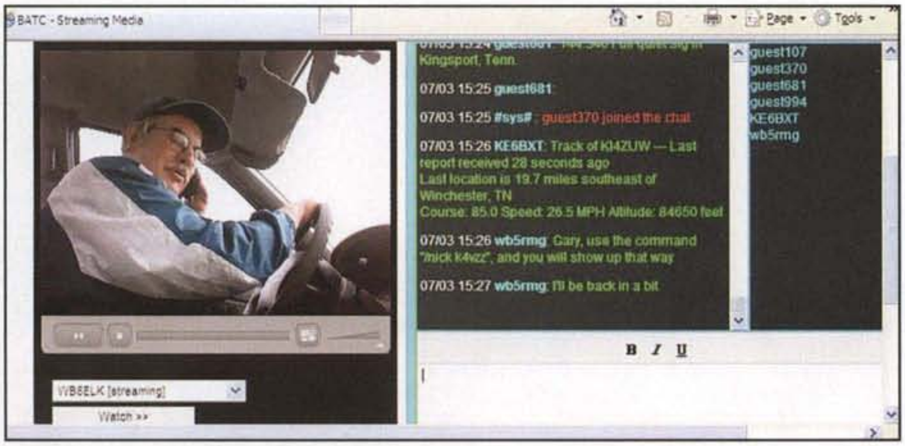

Photo 4. WB8ELK's mobile streaming video as seen on the BATC.TV website.

limit, since the extra charges rack up pretty fast). However, at the streaming video setting recommended by the BATC, it works out to about 80 megabytes an hour of use, which in the case of occasional 4-hour weekend events is plenty for my use. If you are planning to do continuous webcam monitoring, just be careful to monitor your monthly limit or use a WiFi link instead.

All you initially have to do to set up your computer for streaming video via the BATC website is download Adobe's free Flash Media Live Encoder 3 software. This software shows your live camera video on the left and the outgoing streaming video on the right-hand viewport (see photo 2).

Various uplink-speed options can be configured for both the video and the audio. Depending on the quality of your WiFi or cellular wireless connection, you might have to reduce the speed setting for optimal results for both the video and audio uplink. Once you have joined the BATC and requested your own streaming video area, you'll get an e-mail from BATC with its recommended settings for the Flash Media Encoder software. You'll also have to enter the FMS server path provided by BATC as well as the stream name (usually your callsign).

To start your stream, all you do is connect to the internet via your wireless cellular modem or via a WiFi Hotspot. Then start the Flash Media Live Encoder software and click the Connect button. Once connected to the BATC server, just simply click the green Start button on the bottom to start your video stream.

With the stock battery pack in my ASUS EeePC, I get about 2 hours runtime while walking around filming an event. Some of the newer ASUS and ACER units come with larger battery packs with much longer lifetime, but at the expense of making the laptop a bit heavier. Of course, in a mobile application you can use a DC/AC inverter to operate using the existing external AC power supply.

You can use a larger laptop computer as long as you have a video camera attached to it, but for true portability, you'll appreciate these lightweight netbook computers that seem custom-built just for this purpose. The ASUS netbook is so lightweight that I just carry it around like a camcorder. I did find that the built-in webcam is optimized for indoor use and is quite overexposed outdoors. The solution was to use a pair of sunglasses taped to the lid of the netbook, which worked beautifully (see photo 3).

Note that the BATC has a special "Live Events" section on their streaming video website as well. If you expect (or would like) a large audience for your event, you can e-mail them and they may be able to add you to their list of upcoming events with a special link in this section.

The quality of the video and the clarity of the audio is superb (see photo 4). If you're looking for a way to include the world during your event, this is the way to do it. 73, Bill, WB8ELK

By Miguel Enriquez, KD7RPP

ATV

Amateur Television for Fun and Education

ATV in the Classroom: Helping Make History

Jhovana Peralta, KF7DDD, is a junior at Pueblo Magnet High School, where I teach mathematics. Jhovana is also a teacher, of sorts. She is part of an experiment to determine if amateur radio has a place in the public school curriculum.

Beginning with the fall semester of the 2009–2010 school year, the Tucson Unified School District (TUSD) will add ham radio as part of the curriculum in an attempt to evaluate its use toward providing high school students with better math and science literacy and competencies. Students successfully completing the class can use it as an elective to meet high school graduation requirements.

The class, "Amateur Radio, Space and Wireless Technologies," will be funded in part by Joint Technologies Education District (JTED) resources. The ARRL is the major impetus behind this exciting endeavor. Through their generous contributions of equipment and materials and their Teachers Institute, which provides direct support for teachers in the classroom, the ARRL is making this opportunity possible. The combination of student, school district, and ARRL support will, hopefully, pave the way for this class to become part of the established curriculum for the more than 56,000 students attending the 100-plus schools in the TUSD.

Additionally, ATV will be a major part of the implementation strategy for this class. Jhovana will take the lead role of "instructor" both for the students in the classroom and for students elsewhere tuning in on the internet to watch the math and basic electronic lessons that will be presented. These classes will be presented in 3–5 minute vignettes teaching basic concepts. To avoid "broadcasting" issues, licensed hams are being recruited to provide for two-way ATV QSOs.

Stringent Arizona Department of

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

Jhovana Peralta, KF7DDD, at the microphone having her first QSO during Field Day 2009 with Ralph Gibbs, AE5IC, in Carrollton, Texas. Standing behind her is Yaritza Martinez, another Pueblo ARC student.

Education requirements will have to be met. Students must meet 80% of established Academic Standards to successfully pass the class. These standards are defined by industry standard criteria in video and audio production.

Jhovana is spearheading a group of Pueblo Amateur Radio Club students who will be responsible for production both "behind and in front of" the camera. Jhovana will assign duties and responsibilities to her fellow classmate as needed to successfully meet the classroom objectives. Jhovana will also supervise her fellow students as they go about producing the programs, which will ultimately constitute a complete course in basic algebra and basic electronics.

The Pueblo ARC students will also use ATV to demonstrate ham radio to students in other high schools throughout southern Arizona. Plans are under way to schedule trips to nearby communities for the purpose of introducing students in math and science classes to the exciting technologies that amateur radio employs. A marketing plan for "getting the word out" includes use of text messaging and Twitter technologies. Plans also include using MySpace as a venue for developing more student involvement.

Jhovana and the Pueblo ARC students know that our quest is an ambitious but serious undertaking, and they accept the responsibility for making it a successful adventure. However, behind every great dream there is the reality of everyday life and its demands, especially for a bunch of high school students.

As I listen to their plans for accomplishing objectives, I cringe many times as their naiveté has them building castles in the sky, and unless I see disastrous consequences, I let them find out the hard way. They have not made the same mistakes twice, save for connecting the terminal leads from the battery to a power supply before turning it on. Even so, I figure the amount of time and effort it takes to repair the power supply might just save

Jhovana Peralta, KF7DDD, and Yaritza holding TX/RX antennas for ATV QSO during Field Day 2009.

them from more dangerous and expensive mistakes later on.

Our Allies

There are times when unrelated forces seem to converge and present never-before possibilities. The Tucson Radio Society (TRS) is one of the radio clubs in Tucson. They are making plans to get back into ATV, since forest fires destroyed the ATV repeater many years ago. The University of Arizona Amateur Radio Club is also looking to get back into ATV. Also The University of Arizona has dedicated resources for recruitment of high school students into its math and engineering programs. All of these possibilities provide for similar long-term self-interest opportunities for our club.

Jhovana has attended several meetings at the University of Arizona for the purpose of building the social and working networks that will ultimately help make our experimental class using ham radio at a high school a reality.She has grown from a shy, awkward high school freshman into a confident, resilient teenager who accepts the challenges of creating and developing new possibilities for herself and others. Her favorite response when asked to venture to go into unfamiliar territory is "I don't know if I can do it, but I'll do my best."

ARRL Teachers Institute

I conducted the Arizona ARRL's Teacher's Institute (TI) June 15–18, 2009. The institute included 16 local teachers. Three of the teachers were from the University of Arizona. Because of their interest, leadership at UA is also showing an interest in future collaboration and possibly participation in the Arizona Space Grant Program. Additionally, future TI classes may be held in a laboratory on campus.

One of the TI students, Karen William, is a fourth grade teacher from one of the elementary feeder schools for Pueblo. While skeptical of the curriculum at TI at first, she came away in awe with the prospects of incorporating amateur radio into the elementary school curriculum.

An "ah hah" moment occurred for the students when they were experimenting with combining two signals inside a mixer. The result was a new signal on a different frequency. The "ah hah" moment came when the students realized that the mixing process was explained mathematically.

The next generation of the League's Technical Institute training is the Advanced Teacher's Institute, or simply TI-II. It will focus on space technology. Curriculum is under development that will focus on the use of orbiting satellites for amateur radio communication. Thanks go to the genius of Mark Spencer, WA8SME, the League's Education and Technology Program Coordinator, for the curriculum development for this next course.

Field Day

Field Day 2009 proved to be another ally for the Pueblo ARC. Pueblo ARC students were invited by the Tucson Radio Society to join them on Mt. Lemmon and participate in Field Day activities, an event my students had read about but never participated in.

Witnessing ham operators operating various types of rigs using a multitude of antennas was an eye-opening experience for my students, who are used to the limited radio equipment we have available in our school ham shack.

The Pueblo ARC students also had the opportunity to take their portable ATV system on the road. They were successful in transmitting the ATV signal to the repeater, but the system designed by others to provide video streaming to the internet failed. This was perceived by the students as another "Bob-the-Builder" opportunity for them to build their own system for distribution of the signal.

While our students were quite impressed with the Field Day operations, they also impressed the TRS members. Although we were only able to bring three students to the Mt. Lemmon site, other members of the class were present at other Field Day sites, also making an impact on the event.

Summary

We hear and say many times that the future belongs to our youth, but many times those words do not reflect our actions. At Pueblo Magnet High School, the poorest most challenged school in Tucson, Arizona, we are watching a whole bunch of kids defying the odds and rising to the occasion by venturing into areas they do not even know exist, and in doing so they are contributing something of value to mankind.

Our ham radio class is something really big—at least the kids think so. As Jhovana explains, "We don't really know most of the time exactly what we are doing or why, but it's fun!"

73, Miguel, KD7RPP

By Kent Britain,* WA5VJB

ANTENNAS

Connecting the Radio to the Sky

Frequency Selective Surface

Wow . . . 25 years ago you could get into serious trouble with security for even saying the phrase "frequency selective surface" (FSS) outside of a secure area.

The idea is simple—to make a sheet of metal become transparent at some radio wavelengths and reflective at other radio wavelengths. The idea has been used in optics for centuries, a sheet of glass that blocks some wavelengths but passes other wavelengths—blue, red, whatever color you want. I would like to thank Jerome Glaser, W6RSF, of Glaser Associates for photo A of the L-Band FSS.

Back then, 25 years ago, the development of frequency selective surfaces was a very important factor in the design of stealth aircraft. An antenna makes a great radar target. A 1/4-wave whip will reflect radar on all of its 1/4-wave multiples. However, if you put that antenna under a surface that only lets one frequency pass, then your antenna is no longer a microwave radar target. The surface of the aircraft looks like a smooth surface to the microwave radio waves.

Frequency selective surfaces also have ham and commercial uses. In figure 1 we have one of the simpler FSSes. It's just an array of crossed dipoles tuned for the frequency of interest. In this example we will tune the "+" for 12 GHz, the Ku satellite band.

In figure 2 we have an example of a dual-band dish using a FSS. The prime feed at the focus of the dish is tuned to the 4 GHz C-Band. The 12-GHz Ku-Band frequency selective surface is transparent at 4 GHz and the dish works as a prime focus dish at 4 GHz. However, at 12 GHz the signal sees the FSS as a Cassegrainian sub reflector. Thus, for Ku-Band the dish is really a Cassegrainian feed dish. Now both 4-GHz and 12-GHz systems can work without interference or blockage.

Let's take it a step further and add a 6-GHz FSS as shown in figure 3. Again the 4-GHz and the 12-GHz signals do not see this 6-GHz surface and the 6-GHz signals think they have the dish to themselves. This can often result in a more efficient dish design than using a multi-band dish feed and gives the antenna designer a broad range of design options.

Now let's take a piece of good old chicken wire, or as the feed stores like to call it, poultry netting. Chicken wire makes about a 3-GHz high-pass filter. Signals below 2 GHz reflect back from the wire; signals above 4 GHz pass through the holes. Therefore, you can think of chicken wire as a simple high-pass filter.

Next take a pattern that is the exact opposite of chicken wire—in short, a metal pattern that is pretty much the negative image of chicken wire, with copper where the chicken wire had openings, and openings where the chicken wire had

Photo A. L-Band frequency selective surface. (Tnx to W6RSF)

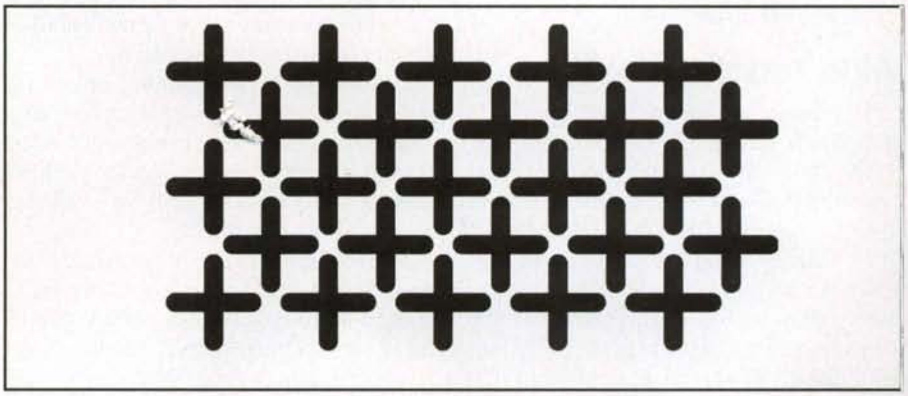

Figure 1. Pattern for a reflective frequency selective surface.

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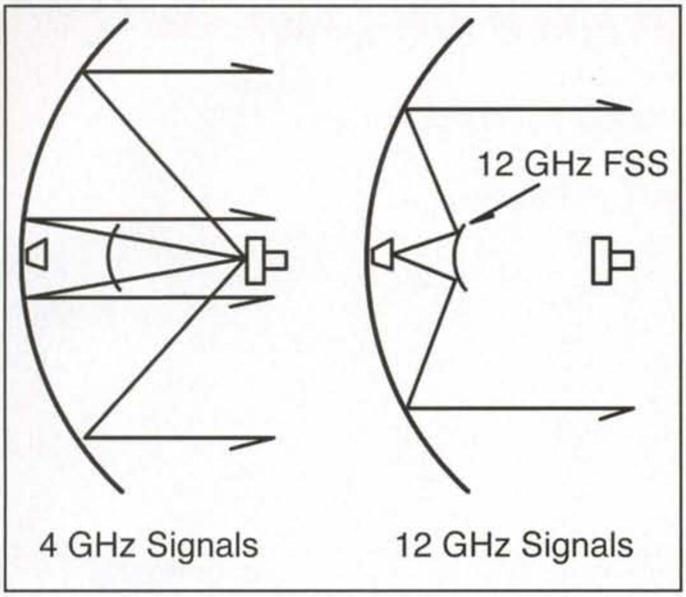

Figure 2. Using a 12-GHz FSS as a dish sub-reflector.

Photo B. AN-125 electronic warfare antenna.

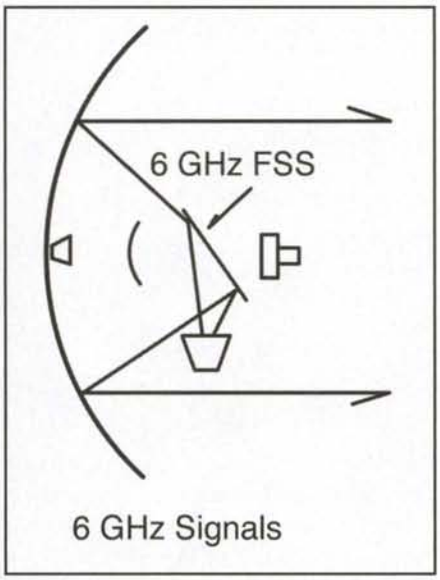

Figure 3. Adding a 6-GHz FSS for a third frequency.

wire. This array of close-spaced hexagons acts like a 3-GHz low-pass filter. Signals below 2 GHz pass right through. The hexagons are too small to stop the radio wave. Above 4 GHz this pattern starts to look like a continuous sheet of metal to the radio waves. Of course, far more sophisticated patterns and techniques are in use, but this gives you the basic idea.

There are FSS designs that are high-pass filters, low-pass filters, passband filters, and band notch filters, giving the antenna engineer or the aircraft electronic warfare engineer a lot of tools with which to work.

The technology of frequency selective surfaces has not really filtered down to any ham radio applications, but keep an eye out. Now you will be able to recognize a FSS when you see one.

Really Neat Antennas

I'm always a sucker for a strange antenna at a fleamarket—well, if the price is in my range. Here we have the receive antenna from an AN-125 jamming system (photo B). If you need to jam a radar or a communications link, you first have to find it. Therefore, this was the receive antenna with which you found the other guy, zeroed in on his frequency, and electronically took him out. That the antenna is marked 1000–6000 mc (megacycles) gives you the first clue as to its age.

As you make the center element in your 1/4-wave vertical wider and wider, it works over a wide range of frequencies. They have certainly made this vertical antenna about as fat as they can, thus giving it a very wide bandwidth.

Next Time

I have some material started on pitfalls in building helix antennas, but you never call tell what might come up to add to it. As always, we enjoy your input and suggestions for future topics. Please use the snail mail and/or e-mail address on the first page of this column. You can also visit <www.wa5vjb.com> for additional antenna construction projects.

73, Kent, WA5VJB

CQ's 6 Meter and Satellite WAZ Awards

(As of July 1, 2009)

By Floyd Gerald,* N5FG, CQ WAZ Award Manager

6 Meter Worked All Zones

No.	Callsign	Zones needed to have all 40 confirmed
1	N4CH	16,17,18,19,20,21,22,23,24,25,26,28,29,34,39
2	N4MM	17,18,19,21,22,23,24,26.28.29,34
3	JI1CQA	2,18,34,40
4	K5UR	2,16,17,18,19,21,22,23,24,26,27,28,29,34,39
5	EH7KW	1,2,6,18,19,23
6	K6EID	17,18,19,21,22,23,24,26,28,29,34,39
7	K0FF	16,17,18,19,20,21,22,23,24,26,27,28,29,34
8	JF1IRW	2,40
9	K2ZD	2,16,17,18,19,21,22,23,24,26, 28,29,34
10	W4VHF	16,17,18,19,21,22,23,24,25,26,28,29,34,39
11	GØLCS	1,6,7,12,18,19,22,23,28,31
12	JR2AUE	2,18,34,40
13	K2MUB	16,17,18,19,21,22,23,24,26,28,29,34
14	AE4RO	16,17,18,19,21,22,23,24,26,28,29,34,37
15	DL3DXX	18,19,23,31,32
16	W5OZI	2,16,17,18,19,20,21,22,23,24,26,28,34,39,40
17	WA6PEV	3,4,16,17,18,19,20,21,22,23,24,26,29,34,39
18	9A8A	1,2,3,6,7,10,12,18,19,23,31
19	9A3JI	1,2,3,4,6,7,10,12,18,19,23,26,29,31,32
20	SP5EWY	1,2,3,4,6,9,10,12,18,19,23,26,31,32
21	W8PAT	16,17,18,19,20,21,22,23,24,26,28,29,30,34,39
22	K4CKS	16,17,18,19,21,22,23,24,26,28,29,34,36,39
23	HB9RUZ	1,2,3,6,7,9,10,18,19,23,31,32
24	JA3IW	2,5,18,34,40
25	IK1GPG	1,2,3,6,10,12,18,19,23,32
26	W1AIM	16,17,18,19,20,21,22,23,24,26,28,29,30,34
27	K1LPS	16,17,18,19,21,22,23,24,26,27,28,29,30,34,37
28	W3NZL	17,18,19,21,22,23,24,26,27,28,29,34
29	K1AE	2,16,17,18,19,21,22,23,24,25,26,28,29,30,34,36
30	IW9CER	1,2,6,18,19,23,26,29,32
31	IT9IPQ	1,2,3,6,18,19,23,26,29,32
32	G4BWP	1,2,3,6,12,18,19,22,23,24,30,31,32
33	LZ2CC	1
34	K6MIO/KH6	16,17,18,19,23,26,34,35,37,40
35	K3KYR	17,18,19,21,22,23,24,25,26,28,29,30,34
36	YV1DIG	1,2,17,18,19,21,23,24,26,27,29,34,40
37	KØAZ	16,17,18,19,21,22,23,24,26,28,29,34,39
38	WB8XX	17,18,19,21,22,23,24,26,28,29,34,37,39
39	K1MS	2,17,18,19,21,22,23,24,25,26,28,29,30,34
40	ES2RJ	1,2,3,10,12,13,19,23,32,39
41	NW5E	17,18,19,21,22,23,24,26,27,28,29,30,34,37,39
42	ON4AOI	1,18,19,23,32
43	N3DB	17,18,19,21,22,23,24,25,26,27,28,29,30,34,36
44	K4ZOO	2,16,17,18,19,21,22,23,24,25,26,27,28,29,34
45	G3VOF	1,3,12,18,19,23,28,29,31,32
46	ES2WX	1,2,3,10,12,13,19,31,32,39
47	IW2CAM	1,2,3,6,9,10,12,18,19,22,23,27,28,29,32
48	OE4WHG	1,2,3,6,7,10,12,13,18,19,23,28,32,40
49	TI5KD	2,17,18,19,21,22,23,26,27,34,35,37,38,39
50	W9RPM	2,17,18,19,21,22,23,24,26,29,34,37
51	N8KOL	17,18,19,21,22,23,24,26,28,29,30,34,35,39
52	K2YOF	17,18,19,21,22,23,24,25,26,28,29,30,32,34
53	WA1ECF	17,18,19,21,23,24,25,26,27,28,29,30,34,36
54	W4TJ	17,18,19,21,22,23,24,25,26,27,28,29,34,39
55	JM1SZY	2,18,34,40
56	SM6FHZ	1,2,3,6,12,18,19,23,31,32
57	N6KK	15,16,17,18,19,20,21,22,23,24,34,35,37,38,40
58	NH7RO	1,2,17,18,19,21,22,23,28,34,35,37,38,39,40
59	OK1MP	1,2,3,10,13,18,19,23,28,32
60	W9JUV	2,17,18,19,21,22,23,24,26,28,29,30,34
61	K9AB	2,16,17,18,19,21,22,23,24,26,28,29,30,34
62	W2MPK	2,12,17,18,19,21,22,23,24,26,28,29,30,34,36
63	K3XA	17,18,19,21,22,23,24,25,26,27,28,29,30,34,36
64	KB4CRT	2,17,18,19,21,22,23,24,26,28,29,34,36,37,39
65	JH7IFR	2,5,9,10,18,23,34,36,38,40
66	KØSQ	16,17,18,19,20,21,22,23,24,26,28,29,34
67	W3TC	17,18,19,21,22,23,24,26,28,29,30,34
68	IKØPEA	1,2,3,6,7,10,18,19,22,23,26,28,29,31,32
69	W4UDH	16,17,18,19,21,22,23,24,26,27,28,29,30,34,39
70	VR2XMT	2,5,6,9,18,23,40
71	EH9IB	1,2,3,6,10,17,18,19,23,27,28
72	K4MQG	17,18,19,21,22,23,24,25,26,28,29,30,34,39
73	JF6EZY	2,4,5,6,9,19,34,35,36,40
74	VE1YX	17,18,19,23,24,26,28,29,30,34
75	OK1VBN	1,2,3,6,7,10,12,18,19,22,23,24,32,34
76	UT7QF	1,2,3,6,10,12,13,19,24,26,30,31
77	K5NA	16,17,18,19,21,22,23,24,26,28,29,33,37,39
78	I4EAT	1,2,6,10,18,19,23,32
79	W3BTX	17,18,19,22,23,26,34,37,38
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

Satellite Worked All Zones

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

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

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

Rules and applications for the WAZ program may be obtained by sending a large SAE with two units of postage or an address label and $1.00 to the WAZ Award Manager: Floyd Gerald, N5FG, 17 Green Hollow Rd., Wiggins, MS 39577. The processing fee for all CQ awards is $6.00 for subscribers (please include your most recent *CQ* or *CQ VHF* mailing label or a copy) and $12.00 for nonsubscribers. Please make all checks payable to Floyd Gerald. Applicants sending QSL cards to a CQ Checkpoint or the Award Manager must include return postage. N5FG may also be reached via e-mail: <n5fg@cq-amateur-radio.com>.

**17 Green Hollow Rd., Wiggins, MS 39577; e-mail: <n5fg@cq-amateur-radio.com>*

By Keith Pugh,* W5IU

SATELLITES

Artificially Propagating Signals Through Space

Working the "Easy Sats" with Portable Equipment: An Update

Over the years writing for *CQ VHF* I have touched on equipment to work the "Easy Sats" several times. However, I believe it is time to summarize this information and provide information on some new options that are now available. I will first discuss the basic modes of operation, and then the radios, and last the antennas.

The simplest satellite radio is a dual-band HT.

The Basic Modes of Operation

The FM satellites are perhaps the easiest satellites to work and require less, simpler equipment. Current popular FM satellites are AO-51, AO-27, SO-50, and the ISS (International Space Station). These satellites are channelized and have one or two channels per satellite. The satellites are crowded and can only accommodate one QSO per channel at a time. Consequently, QSOs are quite short (typically call and grid square only) and timing of a call is everything.

There are multiple uplink and downlink pairs on AO-51 and the ISS that are scheduled for operation one or two at a time. With a couple of minor exceptions, all operation is in FM mode. Doppler correction is much simpler due to the bandwidth of the FM equipment and the FM capture effect. Uplinks or downlinks above 2 meters must be Doppler corrected, but it can be done in as much as 5-kHz steps. You can get by without Doppler correction for 2 meters and below. Full-duplex operation is desirable, but not absolutely necessary. With full-duplex operation, you know you are "making the bird," since you can hear yourself on the downlink. This is good, unless you have no way of preventing feedback of the downlink audio into the uplink. Headphones will prevent this feedback, or careful placement of the speaker and adjustment of downlink audio level will minimize it. For demonstrations, I find using a half-duplex radio, such as the Yaesu FT-817, is very satisfactory.

For the SSB/CW satellites, it is essential to operate full duplex so that you can hear yourself and keep Doppler precisely under control. Current popular SSB/CW satellites are AO-07, FO-29, and VO-52. These satellites have linear transponders with at least a 50-kHz wide passband. Several QSOs can simultaneously take place within the passband and a good, old-fashioned "rag chew" is possible and encouraged.

Full-duplex operation is essential so that you can keep the narrower uplink and downlink signals on the same frequency by hearing yourself and the other stations on the downlink at the same time. Computer control of the uplink and downlink is nice, but not essential. One exception to the full-duplex rule is possible if you do have computer control of the radio. However, I find this less than satisfactory. Operation is typically done using a full-duplex radio or two half-duplex radios. For demos, I typically use two Yaesu FT-817s and find them very satisfactory. Many other combinations are possible and will be discussed under "Radios" below.

Radios

The simplest satellite radio is a dual-band HT (handie-talkie). Another option is two separate single-band HTs. A transmit power level of at least 5 watts is desirable but not absolutely necessary. As mentioned above, full-duplex capability is desirable. Popular HTs that are full duplex are the Yaesu FT-530, the ICOM IC-W32A, and the Kenwood TH-D7. Unfortunately, none of these radios is in current production. Alinco introduced a new full-duplex, dual-band, HT at the Dayton Hamvention® this year and it is

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looking good so far, but the "jury is still out." Two separate single-band radios are inherently full duplex.

Many dual-band, half-duplex radios are available and are satisfactory if they can be operated in split mode and can store split-mode channels in memory. Examples of this type of radio are the following: Yaesu VX-5R and FT-60R, ICOM IC-T90A, and Kenwood TH-F6A. Many additional radios are available, as well.

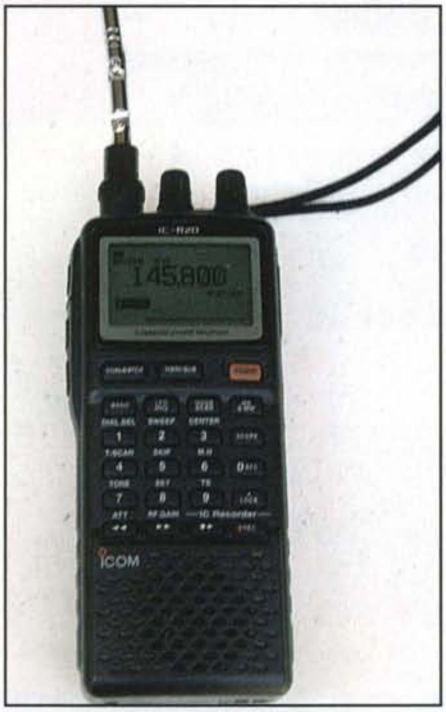
As mentioned before, full-duplex operation is essential for SSB/CW operation, as are multimode radios. Current production multimode base-station radios that are at least dual band and full duplex are the ICOM IC-910H and the Kenwood TS-2000. In keeping with the portable equipment theme, only a few of the radios fit the multimode theme and none of them are full duplex. What this means is you generally will need two radios to satisfy the full-duplex requirement. I use two Yaesu FT-817s very successfully, but I could just as easily use one of the FT-817s and my ICOM IC-7000 as a pair. Another good portable choice would be the Yaesu FT-857 paired with an FT-817 or almost any other multi-band, multimode radio. The sky is the limit here. You could even use HF-only equipment with converters to satisfy the requirements.

Another option is to use a multimode receiver and a multimode transceiver. For example: I have used one of my FT-817s

One of the popular HTs that is full duplex is the Yaesu FT-530, which, however, is not in current production.

Regarding portable equipment, only a few of the radios fit the multimode theme and none of them are full duplex. Therefore, you generally will need two radios to satisfy the full-duplex requirement. I use two Yaesu FT-817s very successfully.

Another option is to use a multimode receiver and a multimode transceiver. I have used one of my FT-817s along with either an ICOM IC-R20 or a Yaesu VR-500 portable receiver.



along with either an ICOM IC-R20 or a Yaesu VR-500 portable receiver. An additional popular multimode receiver to pair with a multimode transceiver is the Kenwood TH-F6A. Some of these combinations may require receive pre-amps for satisfactory service and some of them may suffer in high-RF environments. Doing demos at Dayton the last several years has allowed me to zero-in on the two FT-817s as my best portable choice. They survive the Dayton RF environment well and do not require external pre-amps with short cable lengths, and typical antennas that will be discussed below.

Portable Antennas

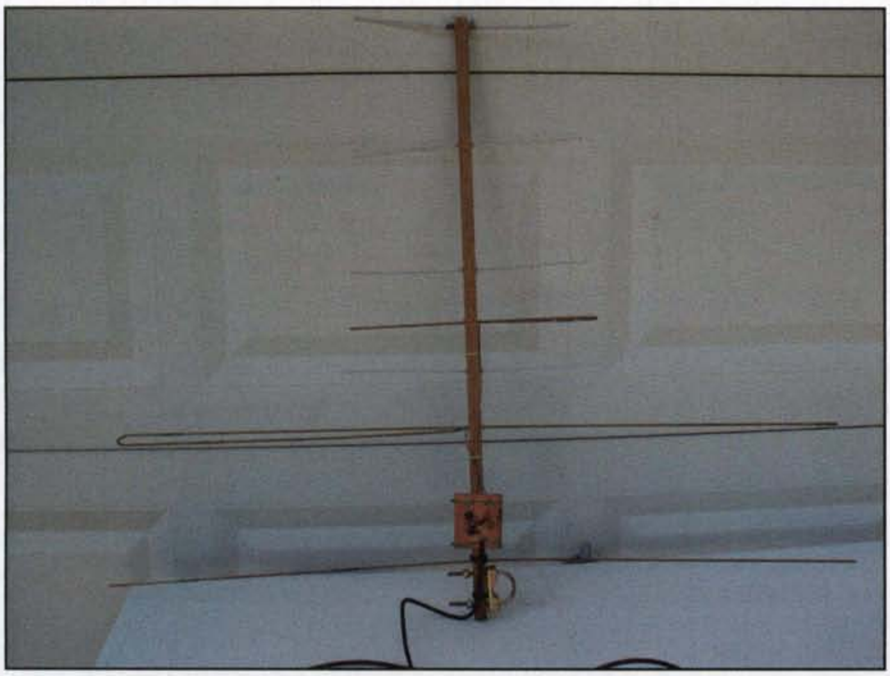
Four popular antennas fit the portable category. They will be discussed individually below.

Kent Britain, WA5VJB, popularized the Cheap LEO antennas in a magazine article several years ago, and since then they have been duplicated successfully worldwide by many operators. Personally, I find these antennas very satisfactory for all portable satellite work. I generally use the two-band antenna with a diplexer for FM satellites and separate 2-meter and 70-cm antennas for the SSB/CW birds. The antennas are very light and easy to hold, since they are made of wood, aluminum wire, and brass welding-rod materials. They are not as easy to disassemble and transport as some of the commercial designs. However, one could improve on this with some innovations. The home-made diplexer can handle several watts of RF and could be used at higher levels with higher voltage capacitors. Of course, these antennas can be fed directly (without the diplexer) at any practical power level.

The Arrow Antenna gets its name from its construction. The elements are made from aluminum arrow shafts. This antenna has been around a long time and is very popular. It is light and easy to use. It can also be disassembled and stored in a small bag for transport. I have taken one with me worldwide in my suitcase. It can handle a lot of power if fed directly or through an external diplexer. Using the diplexer in the handle, it is limited to 10 watts. However, that is not a big handicap.

Qualitatively, I believe the WA5VJB Cheap LEO antennas will out perform the Arrow, but I have used my Arrow successfully for many contacts and demos.

The Elk Antenna is a log-periodic design that works quite well on both bands. It looks like it is only a 2-meter antenna, but it takes advantage of the $^3/_2$-wavelength mode for 70 cm. Since it is only a single feed, it does not require a diplexer and can handle a lot of RF power. This antenna also uses aluminum arrow shafts for its elements. The boom and other framework are aluminum and plastic PVC pipe. It can be disassembled and stored in a small bag. In handheld applications, it is heavier than the Arrow and other antennas, making it a little tiresome to hold. This antenna has not been on the market as long as the Arrow, but it looks and performs like a winner. I like to use it on a Cheap Az-El positioner and an external diplexer to work the SSB/CW birds. The diplexer, in this case, is used to connect the Elk Antenna to my two FT-817s.

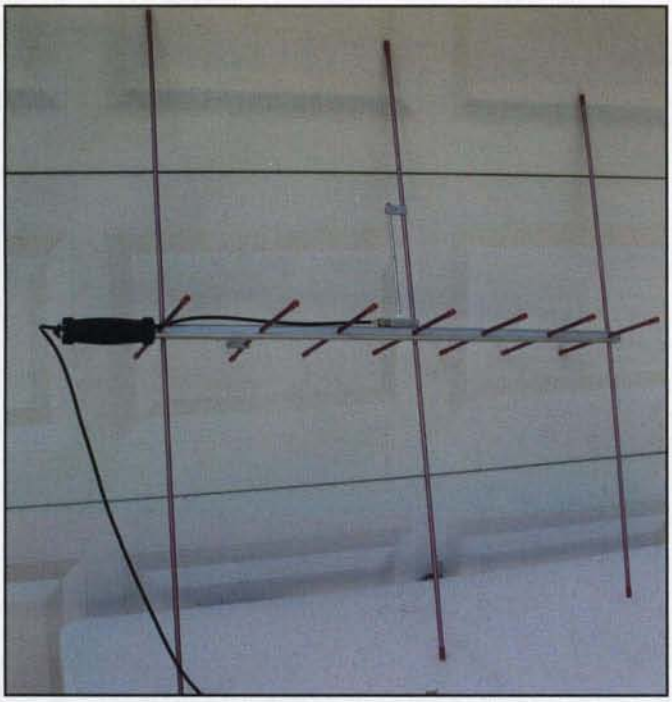


Kent, WA5VJB's Cheap LEO antenna. I find these antennas very satisfactory for all portable satellite work.

Traditional "rubber ducks" are not recommended. However, several "high gain" verticals can be used successfully with additional patience and skill. The skill comes with the ability to use metal plates (such as car hoods) or the ground as reflectors. I have used the MFJ-1717 successfully on a number of occasions. These antennas work, but should not be considered a substitute for one of the handheld beams.

Field Day

Once again we have proven that the FM birds are not a good match for Field Day. Even with the "One Contact per FM



The Arrow Antenna elements are made from aluminum arrow shafts. This antenna has been around a long tim and is light and easy to use

The Elk Antenna is a log-periodic design that works quite well on both bands 2-meters and 70 cm.

Transponder Rule" it is extremely difficult to break into the FM pile-ups. Operation on the SSB/CW birds was much more successful. We had a good time at W5IU with the Lockheed Martin ARC and the Fort Worth Kilocycle Clubs joint operation.

This year I moved my portable operation over to a newer notebook computer running Windows® Vista and no RS-232 serial ports. I also upgraded to SatPC32 Version 12.8. After some difficulty finding and installing a USB to four serial port converter and a missing .dll file for the LabJack Rotor Control, everything is working satisfactorily and was used throughout Field Day. I did have one problem during Field Day with up conversion of one of my FT-817s to L-Band with SatPC32. After Field Day, the author of the program, Erich Eichmann, DK1TB, verified and fixed the problem with a patched file within 24 hours after reporting the problem. Excellent response time!

Summary

I attended a meeting 17–19 June in the Netherlands hosted by the European Space Agency (ESA). This was a very productive meeting and will be discussed in a future column.

I hope this column has given everyone some additional insight into working the "Easy Sats" and the equipment options available.

Don't forget to help celebrate the 40th Anniversary of AMSAT in Baltimore, Maryland, 8–12 October 2009. Actually, the AMSAT BOD Meeting is 8–9 the Space Symposium is 9–11, and the ARISS-Ops "Face-to-Face Meeting is 11–12.

Please support AMSAT in its fund raising efforts so that they can continue to put more "birds" on the air. Until next time!

73, Keith, W5IU

By Tomas Hood,* NW7US

VHF PROPAGATION

The Science of Predicting VHF-and-Above Radio Conditions

Solar Cycle 24 – Expectations

How much credibility should we grant to the panel of solar researchers and scientists that again releases a speculative prediction of the new solar cycle (the 24th since accurate solar cycle records have been kept)? Panel chairman Doug Biesecker of the NOAA Space Weather Prediction Center states, "If our prediction is correct, solar Cycle 24 will have a peak sunspot number of 90, the lowest of any cycle since 1928 when solar Cycle 16 peaked at 78."

NASA's lead representative on the panel, Dr. Dean Pesnell of the Goddard Space Flight Center, adds, "It turns out that none of our models were totally correct.... The sun is behaving in an unexpected and very interesting way."

What I find entertaining is the self-importance prevalent in the solar science community by both professional and some amateur participants. Pesnell states the obvious, "In our professional careers, we've never seen anything quite like it."

Yes, how many solar cycles can one experience during one's professional life? The average cycle lasts between 11 and 12 years. However, the sun is millions of years old. In my view, it is pretty arrogant to postulate that mankind has any real understanding of and handle on what the sun might do next. Pesnell, again: "Go ahead and mark your calendar for May 2013, but use a pencil."

No one can postulate with any credibility just how intense the new cycle will be, because there's no direct correlation between this solar minimum and any regular pattern of past minimums. In 2008 and 2009, the sun was quieter than during any period during the "Space Age" (again, a very short time of reference in relation to the millions of years of solar history). During the last two years we've seen low sunspot counts, weak solar wind, low solar irradiance, and a period without a significant solar flare.

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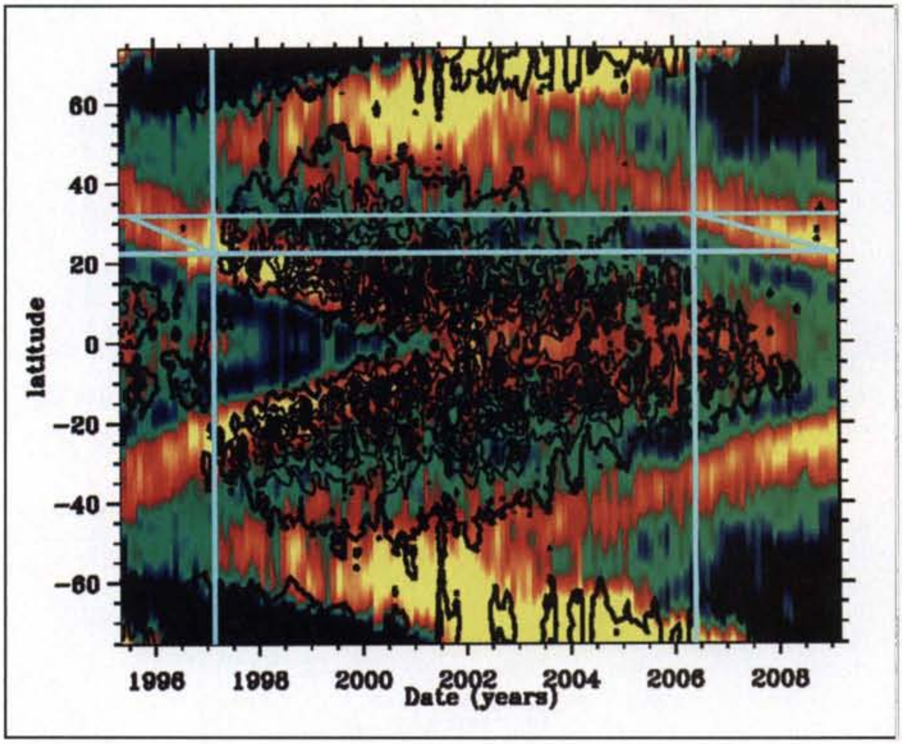
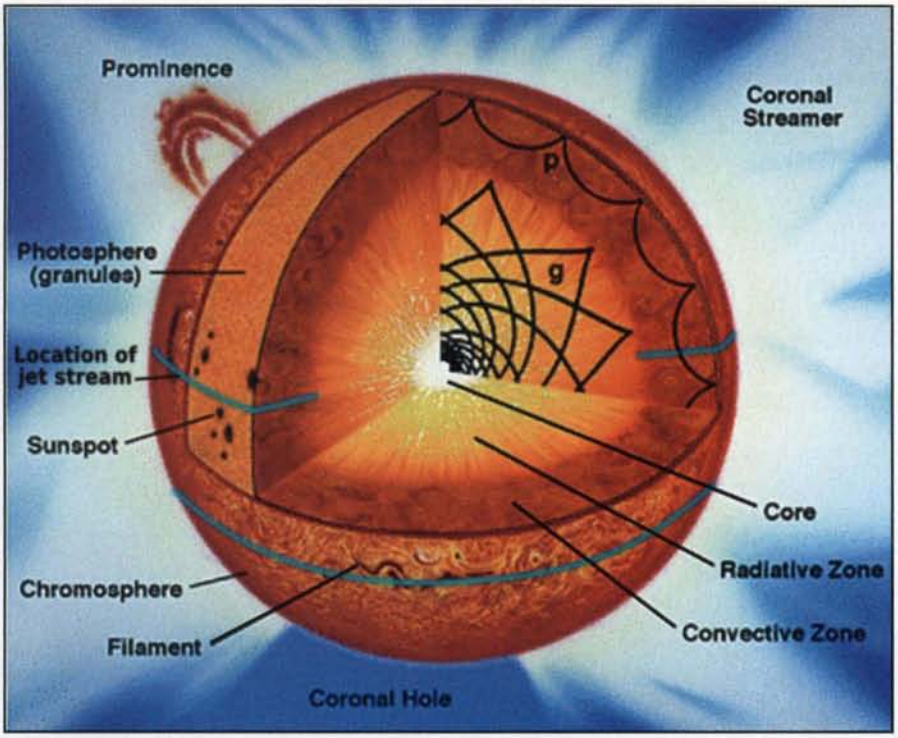


A helioseismic map of the solar interior. Tilted red-yellow bands trace solar jet streams. Black contours denote sunspot activity. When the jet streams reach a critical latitude around 22 degrees, sunspot activity intensifies. (Source: National Solar Observatory [NSO] in Tucson, Arizona)

If none of the models is totally correct, how are they making this current prediction with such dismal expectations? At this point, I'm not holding my breath in favor of supporting any of the predictions. With the slow, yet sure increase in solar activity during recent months as seen with the emergence of more frequent small sunspots (many of which are new cycle spots) and "proto-sunspots," there is hope that the sun is finally awakening. Tiny but significant increases in solar radio emissions are being observed, as well. Further evidence that the sun is experiencing an increase in solar cycle activity is the "zonal flows" (enormous currents of plasma on the sun's surface) that are gaining strength and slowly drifting toward the sun's equator. All of these things are precursors of an awakening solar Cycle 24. The evidence is clear; we are seeing a real start of Cycle 24.

The Sun's Jet Stream

Speaking of the "zonal flows," did you know that the sun has jet streams? Recent research now reveals a powerful dynamic deep inside the sun. Scientists from the National Solar Observatory (NSO) in Tucson, Arizona have discovered that deep inside the sun a powerful solar jet stream migrates through the star's interior. During this current solar cycle minimum, this solar jet stream moved more slowly than in recent past minimum periods. This appears to be the underlying reason for the long period that lacked



This diagram of the sun's internal structure shows the sun's major parts, including the jet streams that arediscussed in the text. The jet streams extend deep into the sun, to the base of the solar convective zone. (Source: NASA)

sunspots and prolonged the solar minimum. The scientists involved in this discovery presented their research at the meeting of the Solar Physics Division of the American Astronomical Society (AAS/SPD) in June 2009.

Drs. Rachel Howe and Frank Hill, both of the NSO, used long-term observations from the NSO's Global Oscillation Network Group (GONG) facility to detect and track an east-to-west jet stream, known as the "torsional oscillation," at depths of about 1000 to 7000 km below the surface of the sun. The sun generates new jet streams near its poles every 11 years; the streams migrate slowly, over a period of 17 years, to the equator and are associated with the production of sunspots once they reach a critical latitude of 22 degrees.

Howe and Hill found that the stream associated with the new solar cycle has moved sluggishly, taking three years to cover a 10-degree range in latitude, compared to two years for the last solar cycle, but has now reached the critical latitude. The current solar minimum has become so long and deep that some scientists have speculated the sun might enter a long period with no sunspot activity at all. The new result shows both that the sun's internal magnetic dynamo continues to operate and heralds the beginning of a new cycle of solar activity.

"It is exciting to see," said Dr. Hill, "that just as this sluggish stream reaches the usual active latitude of 22 degrees, a year late, we finally begin to see new groups of sunspots emerging at the new active latitude." Since the current minimum is now one year longer than usual, Howe and Hill conclude that the extended solar minimum phase may have resulted from the slower migration of the flow.

GONG and its sister instrument, SOHO/MDI (Solar and Heliospheric Observatory/Michelson Doppler Imager), measure sound waves on the surface of the sun. Scientists can then use the sound waves to probe structures deep in the interior of the star in a process analogous to a sonogram in a medical office. "Using the global sound-wave inversions, we have been able to reveal the intimate connection between subtle changes in the sun's interior and the sunspot cycle on its surface," said Hill.

"This is an important piece of the solar activity puzzle," said Dr. Dean Pesnell. "It shows how flows inside the sun are related to the creation of solar activity and how the timing of the solar cycle might be produced. None of the forecasting research groups predicted the current long, extended delay in the new cycle. There is a lot more to learn in order to understand how the sun creates magnetic fields."

The new science of helioseismology, enabled by instruments such as the ground- based GONG, the Michelson Doppler Imager aboard the SOHO spacecraft, and NASA's planned Solar Dynamics Observatory, has revolutionized understanding of the solar interior. "While the surface effects of the sun's torsional oscillations have been observed for some time, understanding of the dynamo and the origin of sunspots depends on measurements of the solar interior that are only possible with helioseismic techniques," said Hill.

Sunspot Group 1024

Now that this solar jet stream has reached the "critical" latitude, are we seeing a rise in the number of sunspots? Yes, and the period between sunspot emergences is becoming shorter and shorter. For instance, during the month of June 2009, sunspots were observed on 13 days of the month. Then, starting on July 3, another new Cycle 24 sunspot emerged, daily growing in size and unleashing numerous flares. By the 4th of July, and for the first time in the new cycle, a C-class flare erupted (it was encouraging to see solar fireworks on Independence Day!). By July 6th, it was clear that this sunspot group was influencing radio propagation, as the 10.7-cm flux rose above 70, and subtle changes in various modes of propagation were observed. This sunspot group comes as part of a series of new sunspots, indicating that the new cycle is certainly alive and gaining in strength.

As this new cycle gains energy, which is clearly occurring, a rise is interplanetary storms and a resulting increase in geomagnetic activity will trigger a livelier autumnal auroral season this year. With the autumnal equinox occurring on September 22, 2009, the chance for auroral activity in the weeks leading up to and the weeks after the equinoctial event will be higher than during the last few years.

Perseids Meteor Shower

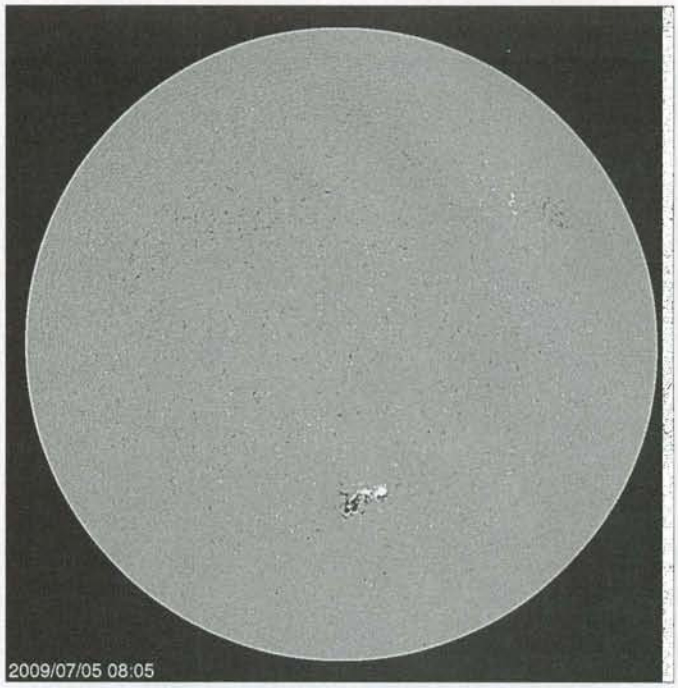
Regardless of what the sun is doing, VHF radio enthusiasts can count on working meteor showers. One of the most reliable yearly meteor showers is the *Perseids*. The *Perseids*, like other meteor showers, is named after the constellation from which it first appeared to have come. This shower's constellation is Perseus, which is located near Cassiopeia. *Perseids* favor northern latitudes. Because of the way Comet Swift-Tuttle's orbit is tilted, its dust falls on Earth's Northern Hemisphere. Meteors stream out of the constellation Perseus, which is barely visible south of the equator.

Lewis Swift and Horace Tuttle, Americans working independently, discovered a comet in August 1862. Three years later, Giovanni Schiaparelli (of Martian "canali" fame) realized it was the source of the August *Perseids* meteors. The comet, known now as Comet Swift-Tuttle, leaves a trail of dust that Earth passes through during August.

This year the shower will be active from mid-July through late August. The peak is expected to be on August 12. The number of visual meteors is expected to be as high as 100 per hour. Visually, this shower will be difficult to enjoy due to the bright moon, but it is possible, using high-speed CW, to realize a higher hourly rate. Many meteors that are not visible might contribute to the ionization necessary for long-distance contacts.

The *Perseids* shower begins slowly in mid-July, featuring dust-sized meteoroids hitting the atmosphere. As we get closer to August 12, the rate builds. For working VHF/UHF meteor scatter, this could prove to be an exciting event.

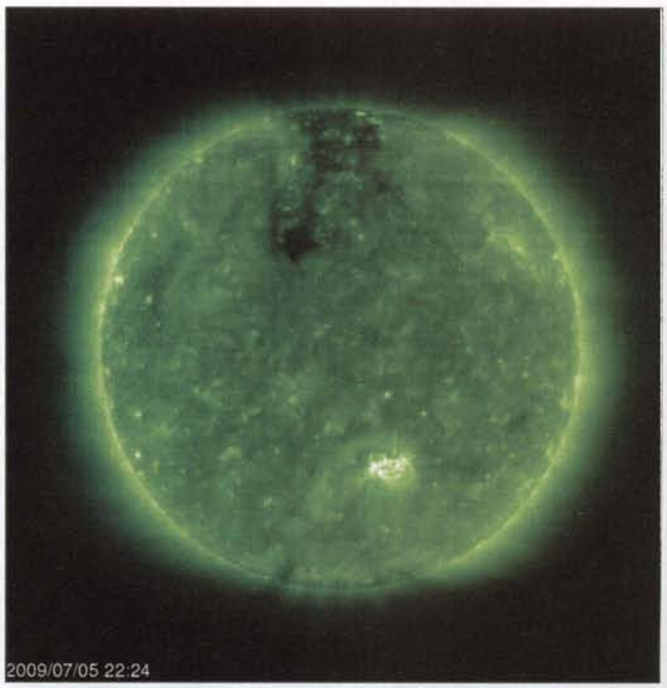
The best time for working the *Perseids* VHF/UHF meteor scatter in North America is during the hours before dawn, as early as midnight, but more likely peaking after 2:00 AM until about 5:00 AM local time.



The magnetograph image from July 5, 2009 showing sunspot group 1024. This Cycle 24 sunspot group unleashed a number of flares, providing solar fireworks for the 4th of July. This new activity is indicative of the long-awaited recent rise in sunspot activity. (Source: NASA/SOHO)

Other Meteor Showers of Summer and Early Fall

Look for the *Draconids,* a primarily periodic shower that produced spectacular, brief meteor storms twice in the last century, in 1933 and 1946. Most recently, in 2005, we saw the stream's parent comet, 21P/Giacobini-Zinner, returning to perihelion. This year's peak is expected to occur on October 8 at 1640 UTC. The shower should be active from October 6 through October 10. The *Draconids* meteors are exceptionally slow-moving, a characteristic that helps separate genuine shower meteors from sporadics accidentally lining up with the radiant. This is a good shower to work meteor-scatter mode, since we might see storm-level activity this year. For more information, take a look at <http://www.imo.net/calendar/2009>.



An EIT (Extreme ultraviolet Imaging Telescope) image of sunspot group 1024 in the Fe XII emission line at 195 wavelength. Fe XII (Fe = iron; 11 times ionized Fe) is common at temperatures of 1.5 million K. Note the huge magnetic field lines between sunspots. This sunspot group unleashed the largest flare yet recorded (at press time) in the new solar cycle, Cycle 24. (Source: NASA/SOHO)

The Solar Cycle Pulse

The observed sunspot numbers from March through May 2009 are 0.7, 1.2, and 2.9. Notice that the record of 0.8 for December 2008 is higher than the 0.5 recorded for both July and August of 2008. It would appear that August 2008 is the lowest point of the minimum between Cycle 23 and Cycle 24. However, scientists are now saying that statistically, December 2008 was the mathematically lowest point in the solar cycle minimum between Cycles 23 and 24. The smoothed sunspot counts for September, October, and November 2008 are 2.2, 1.8, and 1.7, respectively.

The monthly 10.7-cm (preliminary) numbers from March through May 2009 are 69.2, 69.7, and 70.6. The smoothed 10.7-

cm radio flux numbers for September through November 2008 are 68.4, 68.2, and 68.3.

The smoothed planetary *A*-index (*Ap*) numbers for September through November 2008 are 5.8, 5.4, and 5.1. The monthly readings for March through May 2009 are 4 for each month.

The smoothed monthly sunspot numbers forecast for August through October 2009 are 8.0, 9.6, and 11.4. These predictions, however, may be too pessimistic, as they are based on the May 2009 forecast which postulates a solar cycle maximum only reaching a smoothed sunspot count of 90.

The smoothed monthly 10.7 cm is predicted to be 69.5, 70.4, and 71.3 for the same months. If we accept these numbers, we still see that Cycle 24 is upon us.

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

Feedback, Comments, Observations Solicited!

How is your sporadic-*E* season this year? Arthur Jackson, KA5DWI, has been carefully crunching numbers obtained by his activity in PropNET (http://www.propnet.org/) over the past five years. Art, a record-holder in the North American DX Records listings on 2-meter tropo, discusses his research with me in the new "NW7US Space Weather and Radio Propagation Podcast." He explains that the *Es* season in 2009 has been better than any of the past four years. He observes that this is in part due to the very quiet geomagnetic activity during this prolonged solar minimum. Listen to the podcasts by browsing to <http://podcast.hfradio.org/>. In the next issue *CQ VHF* we will take a more in-depth look at this year's sporadic-*E* season and Art's research.

I am looking 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. I look forward to hearing from you. Up-to-date propagation information is 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

QUARTERLY CALENDAR OF EVENTS

Current Contests

August: There are two important contests this month. The **ARRL UHF and Above Contest** is scheduled for August 1–2. The first weekend of the **ARRL 10 GHz** and above cumulative contest is scheduled for August 15–16.

September: The **ARRL September VHF QSO Party** is September 12–14. The second weekend of the **ARRL 10 GHz** and above cumulative contest is September 19–20. The following are the dates for the **Fall Sprints**: The **144 MHz Fall Sprint** is September 21, 7 PM to 11 PM local time. The **222 MHz Fall Sprint** is September 29, 7 PM to 11 PM local time.

October: The **432 MHz Fall Sprint** is October 7, 7 PM to 11 PM local time. The **Microwave (902 MHz and above) Fall Sprint** is October 17, 6 AM to 12 PM local time. The **ARRL 50 MHz to 1296 MHz EME Contest** is October 10– 11. The **50 MHz Fall Sprint** is October 24, 2300 UTC to October 25, 0300 UTC.

November: The **ARRL 2.3 GHz and UP EME Contest** is November 7–8.

For ARRL contest rules, see the issue of *QST* prior to the month of the contest or the URL: <http://www.arrl.org>. For Fall Sprint rules, see the Southeast VHF Society URL: <http://www.svhfs.org>.

Quarterly Calendar

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

Aug. 2	Very poor EME conditions.
Aug. 4	Moon apogee.
Aug. 6	Full Moon.
Aug. 6	Lunar eclipse.
Aug. 9	Moderate EME conditions.
Aug. 12	*Perseids* Meteor Shower.
Aug. 13	Moon last quarter.
Aug. 16	Poor EME conditions.
Aug. 19	Moon perigee.
Aug. 20	New Moon.
Aug. 23	Good EME conditions.
Aug. 27	Moon first quarter.
Aug. 30	Very poor EME conditions.
Aug. 31	Moon apogee.
Sept. 4	Full Moon.
Sept. 6	Moderate EME conditions.
Sept. 12	Moon last quarter.
Sept. 13	Poor EME conditions.
Sept. 16	Moon perigee.
Sept. 18	New Moon.
Sept. 20	Moderate EME conditions.
Sept. 22	Fall equinox.
Sept. 26	Moon first quarter.
Sept. 27	Very poor EME conditions.
Sept. 28	Moon apogee.
Oct. 4	Full Moon. Moderate EME conditions.
Oct. 11	Moon last quarter. Moderate EME conditions.
Oct. 13	Moon perigee.
Oct. 18	New Moon. Moderate EME conditions.
Oct. 21	*Orionids* meteor shower.
Oct. 25	Moon apogee. Very poor EME conditions.
Oct. 26	Moon first quarter.
Nov. 1	Moderate EME conditions.
Nov. 2	Full Moon.
Nov. 7	Moon perigee.
Nov. 8	Good EME conditions.
Nov. 9	Moon last quarter.
Nov. 15	Moderate EME conditions.
Nov. 16	New Moon.
Nov. 17	*Leonids* meteor shower.
Nov. 22	Moon apogee. Poor EME conditions.
Nov. 24	Moon first quarter.
Nov. 29	Moderate EME conditions.

—EME conditions courtesy W5LUU

Current Conferences and Conventions

September: The 2009 **TAPR/ ARRL Digital Communications Conference** will be held September 25–27 in Chicago, Illinois, at the Holiday Inn Hotel Elk Grove Village, Illinois. For more information, see the URL: <http://www.tapr.org/dcc.html>.

October: The 2009 **Microwave Update** conference is to be held October 23–24 in Irving, Texas at the Westin, DFW Airport. For further information, check the Microwave Update website: <http://www.microwaveupdate.org>.

The 2009 AMSAT-NA Space Symposium and Annual Meeting is to be held October 9–11, in Baltimore, Maryland at the Four Points Sheraton Hotel. For more information, see the AMSAT URL pertaining to the symposium at: <http://www.amsat.org/amsat-new/symposium/2009/index.php>.

Calls for Papers

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

Microwave Update: A call for papers has been issue for the 2009 Microwave Update conference, to be held in Irving, Texas. The deadline for submission is August 31. If you are interested in submitting a paper for publication in the *Proceedings,* please contact Kent Britain, WA5VJB, at <wa5vjb@flash.net> for additional information.

AMSAT-NA 2009 Space Symposium: Technical papers are solicited for the 2009 AMSAT Space Symposium and Annual Meeting to be held October 9–11 in Baltimore, Maryland. Proposals for papers, symposium presentations, and poster presentations are invited on any topic of interest to the amateur satellite program. Papers on the following topics are solicited: Students & Education, ARISS, AO-51, P3E, Eagle, and other satellite-related topics.

Camera ready copy on paper or in electronic form will be due by the date announced on the website <http://www.amsat.org> for inclusion in the printed symposium *Proceedings.* Papers received after this date will not be included in the printed proceedings. Abstracts and papers should be sent to the name listed in the announcement on the website.

Meteor Showers

August: Beginning around July 17 and lasting until approximately August 24, you will see activity tied to the *Perseids* meteor shower. Its predicted peak is around 1730–2000 UTC on August 12. A possible tertiary peak may occur around 0900 UTC. The κ-*Cygnids* meteor shower is expected to peak on August 17. The visually-impossible γ-*Leonids* is expected to peak August 25, around 0400 UTC. The α-*Aurigids* is expected to peak on August 31.

October: The *Draconids* is predicted to peak somewhere around 1640 UTC on October 8. The predicted ZHR may reach storm levels. The *Orionids* is predicted to peak on October 21.

November: The *Leonids* is predicted to peak around 1715 UTC on November 17. As with last year's shower, this year's peak may go largely unnoticed.

For more information on the above meteor shower predictions see Tomas Hood, NW7US's VHF Propagation column in this issue. Also visit the International Meteor Organization's website: <http://www.imo.net/calendar/2009>.

By Dr. H. Paul Shuch,* N6TX

DR. SETI'S STARSHIP

Searching For The Ultimate DX

The Bet is Already Won

In our last column in the Spring 2009 issue of *CQ VHF,* we introduced Long Bets (www.longbets.org), the Arena for Accountable Predictions, a web-based wagering facility launched by the futures-oriented Long Now Foundation. The purpose of Long Bets is to improve long-term thinking. You may recall that Long Bets is a public arena for enjoyably competitive predictions, of interest to society, with philanthropic money at stake. As mentioned in that column, I am a party to one of those bets—and so, it turns out, are a couple of my colleagues.

Their wager is intriguing. It was proposed by Tibor Pacher, who runs the Peregrinus Interstellar website, and the challenge was accepted by Paul Gilster of Centauri Dreams. Since both parties to the wager are friends of The SETI League, I felt compelled to follow the debate closely.

The bet in question, as posted by Pacher, reads: "The first true interstellar mission, targeted at the star closest to the sun or even farther, will be launched before or on December 6, 2025 and will be widely supported by the public."

The conditions to be satisfied in winning this bet are quite specific:

1. The mission can be a manned or unmanned flyby probe or to be captured by the target star's gravitational field. It will have been designed expressly as a mission to another star, and not an outer-solar-system mission that keeps going.

2. Allowed launch location of the spacecraft is any place in the solar system within the orbit of Neptune, either from the surface of a solar system body or from any orbital position.

3. As a minimum requirement for the mission the spacecraft shall be capable of delivering data for at least one scientific measurement.

4. Planned mission duration shall be less than 2,000 years.

Gilster is arguing against Pacher's prediction, but it seems to me that the bet has already been won. I would argue that the first interstellar missions have already launched and that (exercising only a little imagination) they meet the above conditions. Those missions involve not spacecraft, but rather streams of photons, the fastest spaceships known to man.

Think about it: Interstellar microwave transmissions probe other civilizations' interest in dialog and pass numerous stars, and thus are "flyby probes," in a sense. They are transmitted specifically for the purpose of reaching other solar systems. They have been "launched" (transmitted) several times from Earth, which is clearly within the 4.5-billion km radius of Neptune's orbit. Some of these transmissions have conveyed scientific information about Earth, which satisfies the condition that they "deliver data for at least one scientific measurement." They travel at the speed of light, so within the 2,000-year mission duration they potentially will reach thousands of stars within 2,000 light years of our own sun. Also, they are widely supported by the public, as witnessed by the large number of humans who have submitted messages to the various projects that beam them into space. Thus, congratulations, Tibor, you win!

Nevertheless, Tibor and Paul agree that what they had in mind is slightly larger interstellar probes. They also had intended provision #3 to require the delivery of scientific data *to,* not *from,* Earth, although they failed to state this clearly in their wager. Thus, honoring the spirit (if not the language) of the bet, I guess we'll have to wait a little longer to see whose position prevails.

Meanwhile, as a side bet, Tibor and Paul have agreed that the loser will buy the winner a beer, probably in Budapest (Tibor's native town, and a favorite venue of Paul's and mine), once the bet is decided. They've invited me to join them there on December 6, 2025, win or lose. Since I hope still to be drinking beer into my eighties, I look forward to doing so, and to reporting the outcome of this wager in Volume 28, Issue No. 1 of *CQ VHF*. So, don't let your subscription lapse!

73, Paul, N6TX

**Executive Director Emeritus, The SETI League, Inc., <www.setileague.org>*
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Commercial Grade Field Radi

Submersible Construction

- Large Backlit LCD Display for easy operation
- 5 Watts of Stable RF Power with Minimum Components for Reliability
- 800 mW of Loud Audio for noisy field operati
- 200 Memory Channels for Serious users
- Commercial Grade Receivers Performance
- Submersible Construction (3 ft. for 30 min)
- Yaesu Exclusive Power Saving Circuit Design Guarantees Longer Operating time
- Hands Free Operation with Optional VC-24 VOX Headset

Wide Range of available Options includes:
- CD-26 Charger Cradle
- VAC-370B 1.5 Hour Desktop Rapid Charger
- External DC Jack for Cigarette-Lighter adapter E-DC-5B or DC Cable E-DC-6
- FBA-25A Alkaline Battery Case (for 6 X AA cells)
- FTD-7 DTMF Paging Unit

Actual Size

VHF FM 5 W COMPACT HANDHELD TRANSCEIVER

FT-270R

Size: 2.4" (W) x 4.7" (H) x 1.3" (D) Weight: 13.8 oz.

NEW | 2 m MONO BAND

Compact Field Radio with Top Mounted LCD and Loud Audi

- Compact Design with Top mount LCD Display
- 5 Watts of Stable RF Power with Minimu Components for Reliability
- 700 mW of Loud Audio for outside fie environments
- 200 Memory Channels for serious use
- Yaesu Exclusive Power Saving Circuit Desi Guarantees Longer Operating time
- Hands Free Operation with Option VC-25 VOX Headset

Wide Range of available Options includes:
- External DC jack for Cigarette-Lighter adapter E-DC-5B or DC cable E-DC-6
- 6 X AA size Alkaline Battery Case FBA-25A

ULTRA-COMPACT 5 W 2 m FM HANDHELD TRANSCEIVER

FT-250R

Size: 2.3" (W) x 4.3" (H) x 1.0" (D) / Weight: 12.4 oz.

NEW | 2 m MONO BAND

YAESU
Choice of the World's top DX'e

Vertex Standard
US Headquarters
10900 Walker Street
Cypress, CA 90630 (714)827-76

For the latest Yaesu news, visit us on the Internet: http://www.yaesu.com

Specifications subject to change without notice. Some accessories and/or options may be standard in certain areas. Frequency coverage may differ in some countries. Check with your local Yaesu Dealer for specific details.