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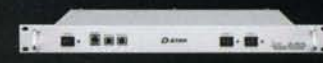

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contents

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FEATURES

On The Cover: Mark Morrison, WA2VVA, continues with part 2 of "Amateur Radio and the Cosmos," this time telling of the Crawford Hill, New Jersey site. The cover photo shows the Holmdel antenna as it appears there today. (Photo provided by Tom Brown, W2EQ)

CQ VHF Ham Radio Above 50 MHz

LINE OF SIGHT

A Message from the Editor

AMSAT-NA's Future is Launched

For the past few years AMSAT-NA seemingly has been living in its past, relishing its relative successes with a couple of high-Earth-orbit satellites, its leadership dreaming of launching another and another of these high-dollar satellites. Fortunately, however, on its 40th birthday it seems to have come of age.

Under the leadership of President Barry Baines, WD4ASW, the organization has taken a deep and broad look at its past and future. The organization's leadership has come to realize that the high-Earth-orbit satellites are very expensive to launch and time consuming to design. The leadership has also realized that there is a growing interest around the country in higher education science, engineering, physics, and aerospace programs in cubesats, This interest in cubesats is not limited to higher education, however. Commercial interest in cubesats is growing as pocketbooks are shrinking for the larger, more sophisticated birds.

Also, regarding education, in a report to its members during the business meeting at this year's symposium, Baines commented on how important it is for AMSAT-NA to be perceived as interested in education. Not only is it important from a public relations' standpoint, it is also important in attracting development capital for its future operations. Baines indicated that, given the right public image, AMSAT could ride along with this growing interest in education and thus benefit from investors that understand AMSAT-NA's linking its space exploration with leadership in education.

In response to this satellite reality check, the organization's strategic planning for the short term includes a concerted effort to become more involved in education and cubesats.

Regarding the future for satellite development, this strategic planning does not end with a decision on what kind of bird to fly in the immediate future. The leadership also has directed its engineering people to work on developing off-the-shelf satellite components that will be ready to fly on short notice. These components will include consideration for the possibility of high-Earth-orbit satellites.

Along with these important items of education and the type of satellite to focus on comes strategy to deal with past problems that continue to plague the organization. First, in response to the generally positive report from the U.S. State Department over its voluntary report on possible ITAR (International Traffic in Arms Regulations) violations, the leadership has applied for transference some of its compliance problems to the less stringent Department of Commerce. Hopefully, by the time you read this, their request will have been approved.

Another problem is over the organization's clean room. Allegedly, what began as a positive relationship with an organization over AMSAT-NA's use of the organization's facility to house AMSAT-NA's clean room turned sour. Caught in the legal mire is the clean room, which is somewhat permanently installed in the organization's building. With legal claims going both ways, both sides have agreed to arbitration. Hopefully, the arbitration will help the two sides come to an amicable solution in the not too distant future.

Generally speaking, I came away very impressed with AMSAT-NA's leadership's efforts to relaunch the organization for the next 40 years and beyond.

Pay for Play

Earlier this year the phrase "pay for play" received lots of publicity over its meaning associated with political corruption and kickbacks. Recently, however, the phrase has taken on a new meaning within the amateur radio community. As a result of one amateur radio operator's braggadocios comments about receiving his salary for operating his amateur radio station at work, the new FCC cop Laura Smith slapped his wrist pretty hard.

While the anti-EmComm enthusiasts gleefully proclaimed the end of EmComm on the amateur radio frequencies, other were not so quick to jump to that conclusion. Even so, Smith's comments about Section 97.113 (a)(3) of the Commission's rules sent chills down the spines of many of us who unwittingly operate on the edge of these rules.

Commenting on this newfound dilemma, I wrote in my November 2009 "VHF Plus" column in *CQ* magazine the following:

According to Smith's strict interpretation of the Commission's rules, it could affect me and everyone who writes for CQ's publications and is compensated by CQ Communications for our writings. Therefore, seemingly I am prohibited from operating an amateur radio station because CQ Communications benefits from my use of my amateur radio station. For that matter, anyone who writes for any publication, reports on amateur radio activities, and is compensated for their writings seemingly is also covered by Smith's e-mail to the above-referenced amateur radio operator. For example, if in a QSO with another amateur radio operator, I casually ask that operator to send me a report on his or her on-the-air activities for my column or this magazine, seemingly I am in violation of Smith's interpretation of the FCC rules…

The unintended consequences of this strict ruling get worse. Nearly every NASA astronaut is an employee of NASA. Those NASA-employed astronauts who are also licensed amateur radio operators seemingly are also prohibited from operating the amateur radio stations onboard the ISS or the Shuttle because their employer benefits from their operations.

Smith's interpretation has also muddied the understanding of school teachers' use of radio during classroom time. Because the teacher isn't being paid to provide communications, but rather to teach, there is not a violation of the no compensation rule. Based on conversations I heard at the AMSAT-NA symposium, there is no longer a clear understanding of what is and what is not permitted for school teachers. Certainly, this issue about compensation and amateur radio operating needs to be clarified in the very near future.

Next Issue

Regarding school teachers, regular readers of Miguel Enriquez, KD7RPP's ATV column may have noticed a drift away from ATV and toward education. This drift is not without a good reason. As a high school teacher in Tucson, Enriquez's primary focus is on education. Therefore, we decided to change his column from ATV to Education effective with the next issue of this magazine.

In replacing Enriquez, I have been fortunate to locate a very talented young man, Tom Dean, KB1JIJ. Tom is a junior at the U.S. Military Academy in West Point, New York. He is brilliant and an excellent writer. After receiving a very positive recommendation from my friend and *QEX* editor Larry Wolfgang, WR1B, and reading Dean's first D-ATV article, I asked him to come onboard. I expect excellent columns from him, as well as possibly an occasional feature article about the academy's increasing involvement and interest in balloon sats and cubesats and other VHF-related amateur radio activities.

Until next time… 73, de Joe, N6CL

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Working the Continental U.S. on 2 Meters Terrestrial

Working the lower 48 states terrestrially on 2 meters is a goal that few have achieved. You can only do it if you live in the right part of the country. Here W9GKA tells how it has been done and by whom.

By Kevin Kaufhold,* W9GKA

One very interesting piece of operating lore has to do with the vast distances that can be traversed on 2 meters. A small section of the U.S. lies within meteor-scatter and *Es* range of both coasts on 2 meters. Some causal operators may not realize the potential, but for many years serious VHF operators have circulated among themselves the callsigns of stations that have worked all 48 states on 2 meters using only terrestrial means.

Two-Meter Efforts in the Early Years

Dick Hart, KØMQS (photo A), may have been the first person to realize that stations located in the middle of the country could work both coasts on 2 meters via only terrestrial means. Dick attempted WAS (Worked All States) on 2 meters in two separate spans of time. His general goal to was to first work as many stations as he could terrestrially, and then move to EME (Earth-Moon-Earth) to finish WAS. Dick felt that he had a reasonably good chance of completing the first 2-meter WAS because he was equidistant from both coasts, being 1200 miles away from his location in Iowa. He also believed that the maximum MS (meteor scatter) limit was around 1400 miles, based upon 335 MS schedules he made over the years.[1] Initially, KØMQS was not taken seriously, but by mid-1969 he had worked 45 states terrestrially from Cedar Falls, Iowa.

Dick then moved to Delta, Iowa and had to start his quest all over again, as he was just outside of the permitted boundaries under the WAS rules. Within three years he again climbed back to 45 states. To finish all states on 2 meters, Dick experimented with non-steerable rhombic antennas for EME work.[2] It is unknown who KØMQS completed with on states number 46 and 47, but number 48 was achieved via the Moon with KH6NS on September 20, 1973. His 49th state was with W7UBI in Idaho, who ran an astounding 56 EME schedules with Dick before completing a QSO on August 2, 1976. A QSO to the last state, Alaska, occurred a few weeks later through a noteworthy EME portable DXpedition by K6YNB (now N6NB). On August 17, 1976, WAS number 1 on 2 meters was finally accomplished.

Photo A. This photograph of Dick, KØMQS, is from November 1976 QST *and would have been taken around the time that his WAS number 1 on 2 meters was achieved. (Photo courtesy of the ARRL and* QST *magazine)*

Interestingly, KØMQS very likely confirmed only 47 states terrestrially. Several amateurs have felt that KØMQS worked 48 states twice, while others believe he still needed one or more states terrestrially. In preparing for the July 2008 *QST* article, Gene Zimmerman, W3ZZ, even telephoned Dick Hart, but was unable to confirm exact details after so many years. The 1976, 1979, and 1980 *QST* articles cited herein infer that KØMQS attempted WAS twice, but was still missing Idaho or some other state terrestrially when WØSD achieved 48 states without the Moon. Correspondence in the 2002 timeframe between Mike King, KMØT, and Dick Hart indicated that KØMQS was still missing California terrestrially.[3] Photo A of Dick is from November 1976 *QST*, at contact 49, and would have been taken around the time that WAS number 1 was achieved.

Within a few years after WAS number 1, the possibility that the continental United States could be worked on 2 meters terrestrial was being seriously contemplated. Bill Tynan, W3XO, wrote: "I have yet to be informed of a bona fide 2-meter contact across the U.S. on any mode but EME. Thus, when one has worked all the states which can be worked from a particular QTH, EME offers the only hope of ascending the list any further."[4] In November 1979, Bill Tynan then penned an article appropriately entitled "Challenges" in which he stated: "How many states can be worked without using the moon? Can the 48 continental states be worked using terrestrial propagation modes alone? I don't know, but it sure would be interesting to try."[5]

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e-mail: <kkaufhold@yahoo.com>

Photo B. Mike, KMØT, circa 2001, as Mike was working towards all 48 states terrestrial. Note the extensive use of digital and computer technologies. (Photo courtesy of Mike, KMØT)

Little did W3XO know, but WØSD had just worked his last state in August 1979. Tynan got wind of it the next year (news must have traveled slowly back then!) when he commented in November 1980: "Few imagined how short a time it would be before someone would do it. That someone is WØSD. At the Central States Conference, Ed displayed the cards (all but one had yet to arrive from K1WHS; that one has now been received). I am sure that everyone congratulates WØSD on accomplishing a most notable feat."[6]

A year later, Frank, WØEMS, in Nebraska, also completed QSOs with all 48 continental states terrestrially. During the 1981 *Perseids*, Frank made a contact with Oregon, and then his final state was Vermont, being made with K9AKS/1. WØEMS was "certainly due congratulations from all of us" for the accomplishment.[7] At the time, the feat was thought to be the second time that the lower 48 had been completed by only terrestrial means. Eventually it came to light that W5CM finished 48 states without EME a short time before WØEMS, in December 1980.

Over the years, VHF ops continued to keep tabs on who else was close. It became sort of a guessing game, and also a point of pride. Informal lists of how many states the top VHF operators had confirmed were kept by several stations in the Midwest. "How many states do you have the hard way?" was a much bandied about question. It was commonly felt that the Moon was actually easier than working the same 48 states terrestrially. This was the case among even the biggest stations on 2 meters.

Simply reviewing the number of recipients for the various operating awards shows just how difficult working coast-to-coast on 2 meters really is. Almost 700 have obtained VUCC on the band. 150 ops have also achieved WAS on 2 meters via EME, and over 25 have obtained 2 meters DXCC via the moon.[8] However, only a handful of stations have ever worked and confirmed the lower 48 states via tropo, MS, and Es.

More Recent Efforts at 48 States on 2 Meters

In Joe Lynch, N6CL's November 1992 "VHF Plus" column in *CQ* magazine, he reported that Greg, WQØP had completed his 48th state terrestrially on 2 meters. That column went into some detail on Greg's activities, with several of the last states being worked during the 1992 *Perseids* meteor shower. State number 45 was Washington, 46 was Vermont, 47 was Massassachusetts, and number 48 was a contact with Oregon. Greg wondered at the time how many others had worked the lower 48 without the moon.[9]

In 1997, Emil Pocock, W3EP, heard that several people had worked 48 states over the intervening years, and he published two separate articles on the matter in his "World Above 50 MHz" column in *QST*. Emil reported that seven people had worked the contiguous 48 states on 2 meters terrestrial, and he drew a map in one of his articles showing the locations of the first four ops he knew of.[10] For the first time, the approximate geographical area in which a person could work coast-to-coast had now been visualized, and the informal lists traded between Midwest ops had found their way into print.

By 2001, Mike King, KMØT, was dominating the Above 50 MHz States Award sponsored by Central States VHF Society. Mike worked 48 states two years in a row in his quest, and wrote about his accomplishments in *CQ VHF*.[11] He was the first person to confirm 48 states partially using digital modes, as KØMQS and so many other pioneers pre-dated the development of K1JT-style contacts. Photo B is of Mike, KMØT, circa 2001–2001, as Mike was working towards all 48 states terrestrial. Note the extensive use of digital and computer technologies. Mike says he has changed his station layout three times since then!

Early in 2008, the I began collecting information on VHF stations that were close to working all 48 states. Requests were sent out to VHF reflectors in February and March 2008. There were over two dozen replies in the first round of e-mails, some with confirmed status of 48 states. Many responses gave names or callsigns of people to contact for more information. This generated a second round of e-mails, resulting in still more responses.

Earlier versions of this article then appeared in both the SMC *Black Hole* and the 2008 Central States VHF Conference *Proceedings*. A presentation on the topic was also made at that year's Central States Conference. Gene, W3ZZ, featured the CS VHF article in his July 2008 "World Above 50 MHz" column, along East and West Coast lists and a beautiful color-coded map of all stations known to be at 48 states.[12] As a result of both the presentation at Central States and W3ZZ's column, more people sent in information on who was close to working all 48 contiguous states terrestrially. There were also several first-person comments received on the early and significant exploits of Dick Hart, KØMQS. This was followed by additional information received in the summer of 2009. In all, over 75 people have now supplied infor-

mation on various stations. Most of the sources involve stations in the central part of the country, but several operators also sent in their totals from both the East Coast and the West Coast.

Table 1 summarizes the information for the central part of the nation. For each callsign the source of information is cited, as documentation is vastly important in any serious effort of historical recollection. Updated information can be found in a file at: <http://www.w9smc.com/SMC%20VHF/2%20Meter%2048%20States%20Summary.pdf>.

Accomplishments in 2008 and 2009

After Mike, KMØT's achievement of 48 states terrestrial in both 2001 and 2002, efforts at working across the nation receded into the background. The reflector activity and articles written on the topic in 2008 raised awareness of operators' abilities to work across the country. Several stations attempted new states in the summer of 2008.

The culmination of these efforts occurred during the *Perseids* meteor shower. Phil, NØPB, completed all 48 contiguous states during the August 2008 *Perseids* using WSJT from EM39wo in Missouri.[13] Digital modes were used in

48 States Terrestrial, 2 Meters

Call	State	Grid	Other Info	Source Documentation
Confirmed				
WØSD	SD	Pre-grid; (EN13)	Aug. 1979	11-80 *QST*, at 77; 11-81, at 85; 6-97, at 91
K5CM	OK	Pre-grid; (EM25)	Dec. 1980	6-97 *QST*, at 91
WØEMS	NE	Pre-grid; (EN11)	Aug. 1981	6-97 *QST*, at 91; 11-81 *QST*, at 85
KØALL	ND	EN16	7 May 84	10-97 *QST*, at 101; e-mail KØALL, 2-08
K5UR	AR	EM35	1985	10-97 *QST*, at 101; e-mail K5UR, 2-08
WØRRY/K5BXG	OK	EM26	1986	e-mail from WØRRY, 2-8-08
W5ZN (as WB5IGF)	AR	EM45	Aug. 1992	10-97 *QST*, at 101; e-mail W5ZN, 2-08
WQØP	KS	EM29	Aug. 1993	6-97 *QST*, at 91
W7XU	SD	EN13	13 Aug. 97	e-mail from W7XU, 2-7-08
NØQJM	SD	EN13	Late 1990s	e-mail from W7XU, 2-7-08
KMØT	IA	EN13	2001/2002	*CQ VHF*, Summer 2003
NØPB	MO	EM39wo	Aug. 2008	e-mail NØPB, 8-08; NØPB website
NØLL	KS	EM09	July 2009	e-mail NØLL, 7-29-09
K2DRH	IL	EN41	Aug. 2009	K2DRH e-mail 8-13-09
Close				
KØMQS	IA	EN31	Missing CA?	*QST*, 11-76, KMØT e-mail 11-08
K5SW	OK	EM25	Missing OR	e-mail K5SW, 6-13-08
K9HMB	IL	EN52	Missing a 7?	e-mails W9RM, 3-08
W9UD	IL	EN41	Missing CA	e-mail K9AKS, 2-8-08
WBØDGF	NE	EN10	Missing VT	e-mail WBØDGF, 6-20-08
NØJK	KS	EM17	Missing RI	e-mail, NØJK 8-09
KØSQ (ex-KØGJX)	MN	EN35	OR, RI	e-mail KØSQ 8-13-09
WØRLI	MN	EN34	CA, NV	e-mail WØRLI, 6-12-08
KMØA	MO	EM48	CA, WA	e-mail WØFY, 2-08
NØUK	MN	EN34jv	CA, WA	e-mail NØUK, 2-08
WAØKBZ	MO	EM48	OR, CA	e-mail, W3ZZ, 8-13-09
WØRT	KS	EN27	OR, VT, RI	e-mail W0RT 7-08
WØFY	MO	EM48	CA, OR, WA	WØFY e-mail 2-08
KWØA	MO	EM48	CA, OR, DE	e-mail KWØA, 3-08
N9LR	IL	EN50du	CA, OR, WA	e-mail N9LR, 3-08
KA9CFD	IL	EN40om	CA, OR, WA	NN1N e-mail, 3-08
NØHJZ	MN	EN34	44 states	e-mail NØHJZ, 3-09; RI, CA, OR, NV
KB9NM (now W9JJ)	WI	EN55	44 states	e-mail W9JJ, 8-15-09
K9CT	IL	EN50	43 states	K9CT e-mail, 3-08
W9GA (WA9KGQ)	WI	EN53	43 states	Comments, 2008 CSVHF Conf.
KA9UVY	IL	EM58	43 states	Comments, 2008 CSVHF Conf.
KØTLM	MO	EM29	42 states	Comments, 2008 CSVHF Conf.
K1LL/Ø	SD	DN84	42 states	active 86–95; e-mail K1BX 2-08
KC8P	MI	EN63	42 states	Active mid 90s; e-mail W8GP 6-08
W9RM	IL	EN52	41 state	e-mail, W9RM 8-15-09
W8PAT (WB8PAT)	OH	EN81vg	41 states	e-mail, W8PAT, 8-15-09
W5SXD	TX	EL29ep	40 states	e-mail, W5SXD, 8-13-09
W9WOK	IL	EN62	41 states	e-mail W3ZZ 6-08
AA9D	IL	EN52	41 states	AA9D e-mail, 3-08
K5YPV	MS	EM54	41 states	2-Meters Standings Box
WO9S	IL	EN52	40 states	WO9S e-mail, 3-17-08
K9SM	IL	EM59	40 states	2-Meters Standings Box

Table 1. Totals for the central part of the U.S. (Compiled by W9GKA)

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Photo C. Phil, NØPB, just completed all 48 contiguous states during the August 2008 Perseids *using WSJT from EM39wo in Missouri. The station was relatively modest, consisting of 2 × 2-meter antennas driven by a maximum of 350 watts. Most states were worked using far less power. Phil has even worked all 100 EM grids on 2 meters terrestrial using the same setup, again with many digital completions. (Photo courtesy of NØPB)*

the effort, but otherwise the station was relatively modest, consisting of 2 × 2-meter antennas driven by a maximum of 350 watts. Most states were worked using far less power. Phil has even worked all 100 EM grids on 2 meters terrestrial using the same setup, again with many digital completions. Photo C amply illustrates Phil's low-profile setup.

Larry Lambert, NØLL, in Kansas, EM09os, became the 13th person to work all 48 states when he completed with K1WHS in Maine on July 29, 2009. After trying to work Maine for over 12 years, and after chasing all continental states for some 33 years, Larry worked K1WHS in Maine in a tremendous *E*-skip opening to the East Coast. Distances were on the order of 1459 miles (2337 km). Larry ran a pair of 4cx250s at around 600 watts to 9913 and a 15-element Cushcraft antenna. All states were worked via tropo, *Au*, and *E*-skip, without the use of the Moon or digital modes. Photo D is of Larry's modest tower, complete with turkey vultures sitting on top of the 2-meter antenna! An audio file of the NØLL–K1WHS July 29, 2009 *E*-skip QSO can be found at: <http://www.kcvhfgridbandits.com>.

Jon, NØJK, EM17, Kansas, also worked K1WHS in the same e-opening as NØLL. In so doing, Jon completed with his 47th state. In fact, shortly after working Maine, Jon called NØLL, alerting him to the opening. Jon almost worked his last state of Rhode Island in this opening. A neighbor of Jon's, NØIRS, worked Rhode Island, N1DZ, FN41 at around the same time as both NØLL and NØJK worked K1WHS in Maine.

Less than a month after NØLL completed with Maine, Bob Striegl, K2DRH, became the 14th person to work all 48 states by terrestrial means. Located in EN41vr, Bob worked Pat, N6RMJ, in DM14cp, California during the August 2009 *Perseids*. Using FSK441, the two completed in a 1.3-second burn with calls and reports. This was after several tries at various times during the meteor shower. Total distance was 1572 miles (2530 km) from tower to tower. The QSO may be a distance terrestrial record over land on both sides of the contact (K5UR has a longer QSO in the 1990s to KP4, with much of the path being over water). Photo E is of K2DRH's antennas.

From the East Coast

While only the mid-section of the country can work all 48 states terrestrially, a review of distances worked from both coasts also demonstrates significant achievements. For many years, it was commonly believed that only 37 states could be worked from the East Coast via tropo, *Au*, *Es*, and scatter.[14] Basically, all territory east and immediately west of the Mississippi River can be easily worked. The next tier of western states (ND, SD, NE, KS, OK, TX) have been repeatedly confirmed, as well. While working 37 states has generally been the goal to achieve from the northeast, it has recently been noted that a few stations have confirmed 38 to 39 states. Colorado has been worked by one eastern station (W3ZZ), while New Mexico was worked by another operator in the same grid (K1RZ/3). One station in FN10 (W3HMK, now W3CMP) has even worked 39 states, including both Colorado and New Mexico. Table 2 lists some of the better known 2-meter stations from the east, but is by no means exhaustive. Southeastern states are included in the table as a separate group, since many of these stations are physically closer to the west coast.

From the West Coast

As far back as the late 1970s, it was felt that 18 states was around the maximum possible from the three far west states of California, Oregon, and Washington.[15] At the 2008 Central States VHF Conference however, one person (WØYW) indicated that he worked 34 states from Mt. Palomar, California as part of a multi-op team many years ago. After deducting states confirmed via EME, 22 states were thought to be worked. This includes Hawaii via the Pacific duct! Another amateur of great stature, K5MAT, stated that he had completed an amazing 37 states from a nearer location in New Mexico. In 2009, several other southwestern stations reported to the author that they have worked between 31 and 41 states. Thus, the exact number of workable states from the West Coast or other western locations may be in need of further refinement before a good appraisal of capabilities can be made. Table 3 includes known totals, to date.

Analysis of Information: How Far is Possible?

As can be seen from a review of the Table 1, 14 stations have worked 48 states terrestrially, according to either published articles or direct reports from the operators themselves. Some of the stations that are close to all 48 states have something of a "rumor" quality to them, although most of these are based on direct e-mails from the stations involved.

It is striking to see who is on the "confirmed" and "close" lists. The list reads like a "who's who" of the all-time greatest stations ever assembled in the central part of the country.

It is also fascinating to see exactly where the stations are located. Figure 1 is adapted from W3EP's June 1997 *QST* article. Emil had four dots on his original map, for those he knew about at the time. The other red dots have been added to indicate the

Photo D. Larry Lambert, NØLL, in Kansas, EM09os, became the 13th person to work all 48 states when he completed with K1WHS in Maine on July 29, 2009. This photo shows Larry's modest tower, complete with turkey vultures sitting on top of the 2-meter antenna! (Photo courtesy of NØLL)

rough location of all 14 stations. The author thanks Bill Van Alstyne, W5WVO, and his graphic arts abilities for developing the map from the tables contained in this article.

The map shows a very distinct north-south line-up of stations. The original seven stations reported in 1997 showed a very tight alignment due north and south. More recent stations working all continental states are somewhat more dispersed, but still are mostly within a circle as noted by W3EP. The solid lines in the figure represent the 1400-mile distance to any of the coasts.

When a presentation on this topic was made by the author at the 2008 Central States VHF Conference, a discussion occurred on just how far one could realistically work on meteor scatter or *E*-skip. Some participants at the conference felt that 1200 miles was a normal or typical range for many meteor storms. Indeed, nine of the 14 stations completing all states lie along the north-south line, while 11 lie within 1400 miles of the coast. Under typical conditions, then, only those stations located on the "knife-edge" may be able to work the lower 48 states. In marginal situations, this may not even be feasible, as the distances on the map (figure 1) are measured from the northern tip of Florida; the eastern edges of California, Oregon, and Washington; and to the western edge of Maine and Rhode Island. Since most of the population in those states is beyond this range, working the continental United States in less than typical situations may be out of the question for all stations, including those located on the sharp north-south line in the mid-section of the country.

In major meteor storms, however, many Central States Conference participants felt that stations at 1400 miles were certainly workable. This is consistent with W3EP's 1997 map of the outlined area, as well as KØMQS's own observations. Still other participants indicated that they had worked meteor scatter beyond 1400 miles on occasion, and reported some rare situations of double-hop *E*-skip on 2 meters. This is in accord with the recent efforts of NØLL and K2DRH, who completed their 48th state at 1400 to 1500-plus miles. All of this evidence suggests a broader theoretical range, possibly extending to 1500 miles and beyond. One written source from long ago even believed that 1800 miles was possible on 2 meters, given the right conditions.[16]

A more expansive terrestrial 2-meter range is also shown in the map. The broader range of around 1500 miles is now shown as a dashed line. The triangles show stations that are close (at least 40 confirmed states terrestrially). These stations effectively fill out the range of possibilities, as we now see much activity to the edges of the defined geographical areas.

It is appropriate to view completion of QSOs over great distances within the context of probabilities. For instance, it is highly probable that an experienced operator could work all 48 lower states if his station has significant power levels, great antenna height and gain, and is

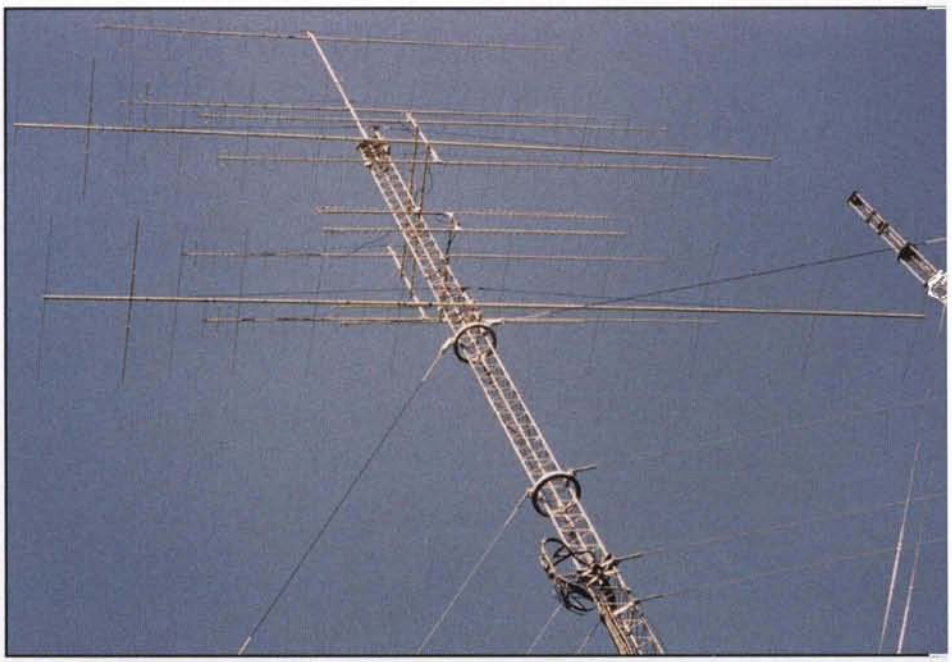

Photo E. The K2DRH antenna stack which sits at 125 feet on a rotating tower. (Photo courtesy of Bob, K2DRH)

located in the middle of the country. KMØT is the perfect example of such a highly probable situation, having worked 48 states terrestrially two years in a row from close to the Iowa-Nebraska-South Dakota borders. The probability of success is reduced as one moves away from the geographical mid-point, has smaller power levels, or antennas at lower height. The probability of completing all states becomes increasingly remote as stations are located farther away from the geographical mid-point of the country. Note that the three stations in Arkansas and Kansas who have confirmed 48 states (K5UR, W5ZN, NØLL) lie between 1400 and 1500 miles from both coasts. These are examples of great operators with tremendous stations who were able to succeed in less than perfect locations.

Controversy over Digital Capabilities

The probabilities of success potentially can be increased for any station by the use of the newer digital modes. Many marginal contacts on the edges of the theoretical ranges can be accomplished via digital means. In coming years, digital may allow stations to move from a very narrowly defined edge to the broader areas identified on the map. Three of the last four stations to have completed 48 states used digital modes (KMØT in 2001/2002; NØPB in 2008; and K2DRH in 2009).

The comparison between traditional modes and the more recent digital capabilities was very apparent to many observers when the last two stations completed their 48 states literally within weeks of one another. NØLL on the far western edge of the circle accomplished the feat on July 29, 2009, relying on a huge *E*-skip, having never made a QSO on digital. K2DRH on the far eastern side of the circle completed his 48th state on August 13, 2009 using FSK441 during the *Perseids*.

Many comments recently were made on the VHF reflectors concerning the use of digital for very long-distance QSOs. To a large extent, the statements and arguments echo the ongoing discussion over digital within the EME community. With digital capabilities now obviously maturing on terrestrial VHF, perhaps the controversy that had been chiefly limited to EME is now spilling over to terrestrial QSOs as well.

Some amateurs who have been active for many years described themselves as "purists," believing that CW and SSB QSOs are significantly harder to achieve over very long distances. A few people even suggested that awards and honors achieved via digital modes be designated as such, much like the

From Northeast

Call	State	Grid	Other Info	Source Documentation
W3HMK	PA	FN10	39 w NM & CO	e-mail, W3CMP, 8-16-09
W3ZZ	MD	FM19	38 w/ CO	*QST*, 7-08, at 89
K1RZ/3	MD	FM19	38 w/ NM	*QST*, 7-08, at 89
K1NY	NY	FN30	38 states	2-Meters Standings Box
WA4PGM	VA	FM07ti	37 states	e-mail 8-13-09
K1JX	CT	FN31	37; circa 1983	e-mail K1JX, 8-2-08
W1VD	CT	FN31	37; 1980–86	e-mail K1JX, 8-2-08
AE3T	PA	FN20	37 states	2-Meters Standings Box
K1TEO	CT	FN31	37 states	2-Meters Standings Box
WB2CUT	NJ	FN20	37 states	2-Meters Standings Box
K4RTS	VA	FM08	37 states	2-Meters Standings Box
W2CRS	NY	FN32	37 states	e-mail W2CRS, 8-08
VA3ST (VE3DSQ)	ONT	FN03ib	37 states	1991-2001, 8-14-09
W1EP	ME	FN31	36 states	2-Meters Standings Box
AK3E	MD	FM19	36 states	2-Meters Standings Box
W3EP/1	CT	FN31	36 states	2-Meters Standings Box
KM1H	NH	FN42	35 states	e-mail, KM1H, 8-13-09
W1ZC	NH	FN42	35 states	2-Meters Standings Box
N4MM	VA	FM09	35 states	2-Meters Standings Box
VE3TMG	ONT	EN82	35 states	2-Meters Standings Box
W2KV (ex N3AHF)	NJ	FN20ok	34 states	e-mail W2KV, 8-15-09
VE3KKL	ONT	FN25	33 states	e mail VE3KKL, 6-08
From Southeast				
W4WA	GA	EM84	42 states	2-Meters Standings Box
WB4JGG	TN	EM75ne	41 states	e-mail 8-14-09
K4RF	GA	EM84	40 states	e-mail K4RF 8-4-08
W4DEX	NC	EM95	40 states	2-Meters Standings Box
K4QI	NC	FM06	38 states	2-Meters Standings Box
K4LY	SC	EM85	38 states	e-mail K4LY, 8-08
K4RWP	TN	EM86	38 states	2-Meters Standings Box
AA4H	TN	EM86	38 states	2-Meters Standings Box
K4MM	FL	EL97	34 states	2-Meters Standings Box
N4HN	NC	EM95	34 states	e-mail N4HN 8-5-08
N6ZE	NC	Unk.	30 states	e-mail N6ZE 8-14-09
N6ZE	FL	EL95	30 states	1980s, N6ZE, 8-14-09

Table 2. Some of the better known 2-meter stations from the east. Southeastern states are included in the table as a separate group, since many of these stations are physically closer to the West Coast.

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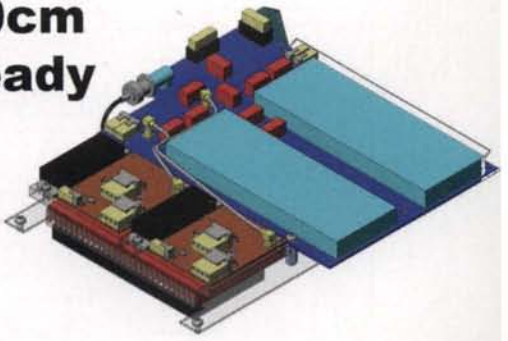

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From West Coast

Call	State	Grid	Other Info	Source Documentation
N6ZE	CA	DM04ne	22 states	8-15-09 e-mail, N6ZE
WØYW (as a 6 call)	CA	DM13	22 states	w/ HI; Comments, 2008 CS VHF Conf.
WB6NMT	CA	pre-grid	18 states	*QST*, 12-78, at 74
From the West/ Southwest				
K5QE	TX	EM31cj	41 states	e-mail K5QE, 8-15-09
AA5JG	OK	EM04to	39 states	e-mail AA5JG, 8-14-09
K5MAT	NM	DM65	37 states	Comments, 2008 CS VHF Conf.
WA5JCI	TX	EM21	36 states	e-mail WA5JCI, 8-15-09
WA5IYX	TX	EL09	33 states	50-80 w, 11 ele at 20 ft; e-mail 8-15-09
K5AM	NM	DM62	31 states	2-Meters Standings Box
WA7GSK	ID	DN13	30 states	2-Meters Standings Box
WA7JTM	AZ	DM33	27 states	2-Meters Standings Box
K7XC	NM	DM09	25 states	e-mail K7XC, 8-18-09
NJ7A	UT	DN30xp	24 states	e-mail NJ7A, 8-14-09

Table 3. Known totals, to date, of the terrestrially workable states from the West Coast or other western locations.

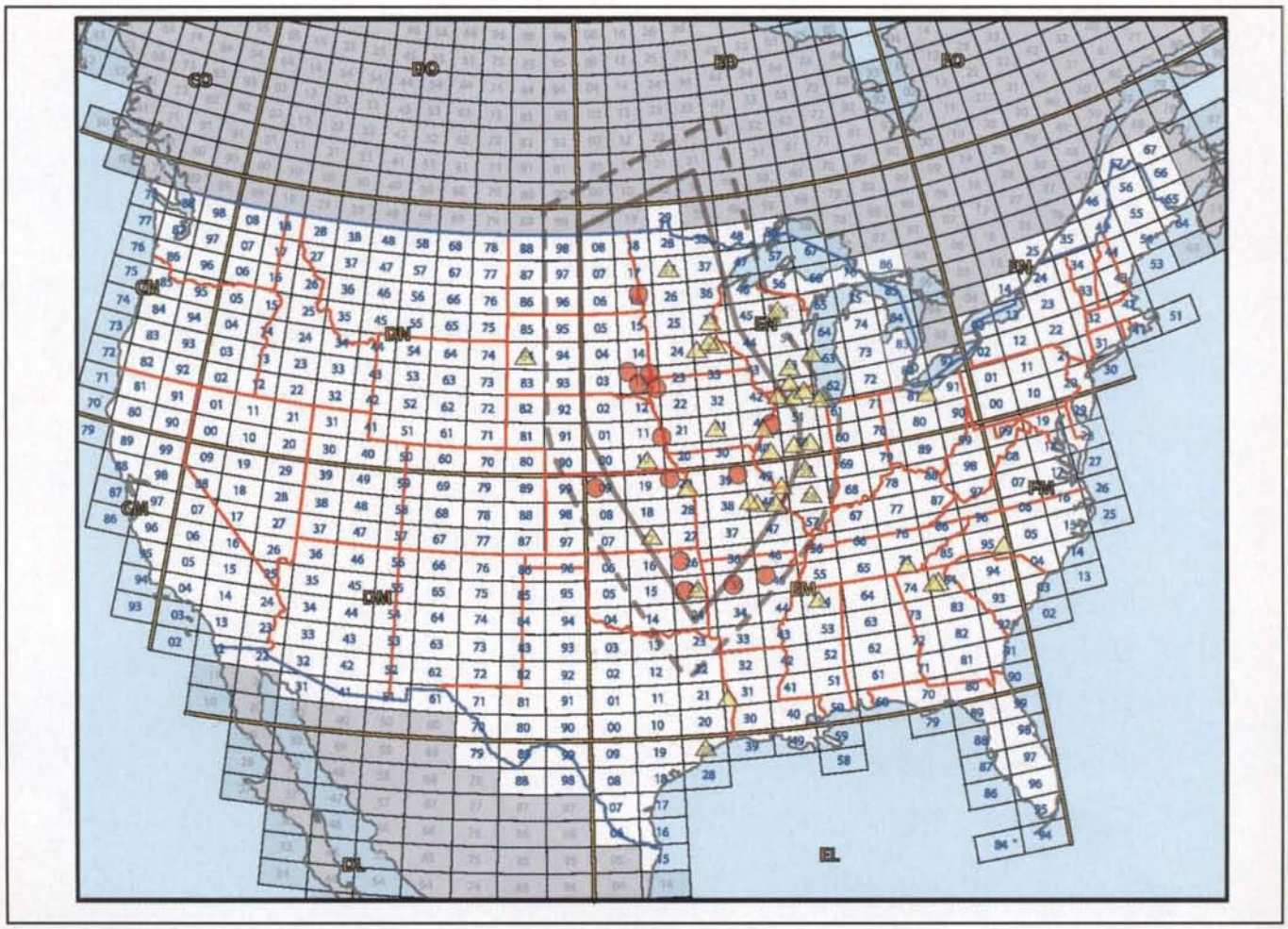

Figure 1. An expansive terrestrial 2-meter range. The map displays varying distances. The dots are the 12 stations known to have worked all 48 lower states. The 1400-mile limit from the two coasts is depicted by the heavy line, and the broader range of around 1500 miles is now shown as a dashed line. The triangles show stations that are close (at least 40 confirmed states terrestrially). These stations effectively fill out the range of possibilities, as we now see activity to the edges of the defined geographical areas. (The author thanks the ARRL, QST *magazine, and Bill Van Alstyne, W5WVO, and his graphic arts abilities for developing the map from from the tables contained in this article.)*

Roger Maris home-run asterisk. There was also some disappointment expressed that so few people were using CW or SSB modes during the recent meteor showers, opting for FSK441 instead. A few stations even believed that QSOs "between computers" were somehow invalid, as no human deciphered the message.

Other amateurs felt, however, that digital is nothing more than a natural progression of continuing technological progress. In fact, much of the discussion is reminiscent of the AM versus SSB debate of the 1960s. Whenever new technologies come onto the scene that are so completely superior to older means of communication, a hesitation to change or even supplement established ways is inevitable. As to the computer-to-computer argument, virtually all of the newer high-end equipment utilizes very sophisticated computer and speech-processing algorithms. It is well within current technological levels for all forms of speech transmissions to be converted into digital packets for transmission, and then reconverted to audio on reception. The analog versus digital distinction may therefore become increasingly blurred in future years.

Another person (Jay, W9RM) summed up the recent internet discussions when he stated that in this debate between traditional modes and digital there are no winners, only losers. I believe that anyone managing to work all 48 contiguous states using only terrestrial means on 2 meters is truly a legendary figure, regardless of what mode is employed.

Conclusion and Acknowledgments

Working the lower 48 states "the hard way" has proven to be quite a challenge, possibly being more difficult than VUCC, WAS, WAC, or even DXCC on 2 meters. While possible, only the most skilled operators who possess great stations and who live in an area of the Midwest have accomplished the feat.

If anyone has information on other stations that may be at or close to all 48 states terrestrially on 2 meters, please send a note to me at <w9gka@arrl.net>. Also, if anyone knows of other articles referring to the general topic of 2-meter terrestrial activities, please send that information, too. Data on East and West Coast station activity would be quite helpful, as well.

The author thanks everyone who provided information for this article, especially the contemporaries of early pioneers on 2 meters for supplying their personal knowledge of the subject matter. The author also thanks the Society of Midwest Contesters; the Central States VHF Society; the ARRL; Gene Zimmerman, W3ZZ; *CQ* magazine; and Joe Lynch, N6CL, for publishing or featuring various versions of this article in their own magazines, *Proceedings*, and columns. Additionally, Bill, W5WVO, is thanked for the wonderful map that he developed for this article.

Notes

1. From "Worked All States on 144 MHz," *QST*, Nov. 1976, p. 49.
2. *QST*, Nov. 1976, p. 49, indicated that a 1100-foot rhombic was built at Delta, Iowa for EME, while there were conflicting sources at the 2008 CS VHF Conference. One person felt there was a rhombic at only Cedar Falls, while another contemporary of KØMQS felt that Dick constructed a 660-foot rhombic at Cedar Falls, and another smaller rhombic at Delta, Iowa.
3. Source: 11-08 e-mail from KMØT to the author, referring to correspondence between KØMQS and KMØT.
4 *The World Above 50 MHz*, Bill Tynan, *QST*, Dec. 1978, at 74.
5. "Challenges," Bill Tynan, *QST*, Nov. 1979, p. 81.
6. "The World Above 50 MHz," Bill Tynan, *QST*, Nov. 1980, p. 77.
7. "The World Above 50 MHz," Bill Tynan, *QST*, Nov. 1981, p. 85.
8. Statistics on 2-meter operating awards taken from the VE2PIJ website.
9. See, Joe Lynch, N6CL's "VHF Plus" column, *CQ* magazine, Nov. 1992, p. 96. Comments on WQØP were also made in *CQ*, April 1994, p. 106. June 1997 *QST*, p. 91, identified WQØP's 48th state as Oregon, completing with Arliss, W7XU/7. Both Arliss and his wife Holly, NØQJM, also completed all 48 states terrestrially.
10. The 1997 articles are: "Two Meter Challenges," Emil Pocock, *QST*, June, 1997, pp. 90-91; and *QST*, Oct. 1997, p. 101.
11. "Working the Lower 48," Mike King, *CQ VHF*, Summer 2003.
12. "48 States WAS by Terrestrial Modes," Gene Zimmerman, W3ZZ, *QST*, July 2008, pp. 88–90.
13. A nice description of NØPB's contact with his last state can be found online at: <http://n0pb.mystarband.net/>.
14. For instance, see Bill Tynan, supra, n.13, p. 74, who felt that 37 states "was about the limit from the East Coast."
15. See supra, n. 13.
16. "The World Above 50 MHz," Bill Tynan, Dec. 1978 *QST*, p. 74. No details of specific QSOs were cited in the article, however, and any 2-meter QSO beyond 1400 miles remains noteworthy to this day.

Amateur Radio and the Cosmos
Part 2 – Crawford Hill

In part 1 of this series WA2VVA began his exploration of the curious connection between amateur radio and the cosmos. In this segment he continues his exploration, this time going as far back as the dawn of time.

By Mark Morrison,* WA2VVA

Traveling along New Jersey's Garden State Parkway, just north of the Holmdel exit, is an area of great significance to cosmologists and VHF enthusiasts alike. Rising gently from the roadway, and hidden from view just beyond the trees, is a modest geological feature known simply as Crawford Hill, the highest point in Monmouth County. In the 1930s it was here that Karl Jansky first detected radio emissions from outer space. In the 1940s it was here that George Southworth, who joined the ARRL in 1915, developed his so-called "waveguide technique," including transmission lines, filters, and electromagnetic horns, all descendents of his waveguide invention. Horn antennas would become an integral part of AT&T's microwave repeater system, with their distinctive burnt-orange colors dotting the towers across America. The brooks and streams in this area still bear witness to an ancient time, with bones and teeth of prehistoric animals still being found there. However, in the 20th century Crawford Hill would bear witness to an even older age, the dawn of time itself.

In 1959, when AT&T learned of NASA's plans to launch a metallized balloon for studies of the upper atmosphere, its potential as a microwave relay system was quickly recognized. John R. Pierce, a colleague of George Southworth, convinced AT&T to enter into a joint venture with NASA. Bell Labs would develop the communications equipment and NASA would provide the launch hardware. The program, known as Project Echo, would involve three ground stations: the JPL station at Goldstone, California, the Naval Research Laboratory station at Stump Neck, Maryland, and the Bell Labs station at Crawford Hill in Holmdel, New Jersey.

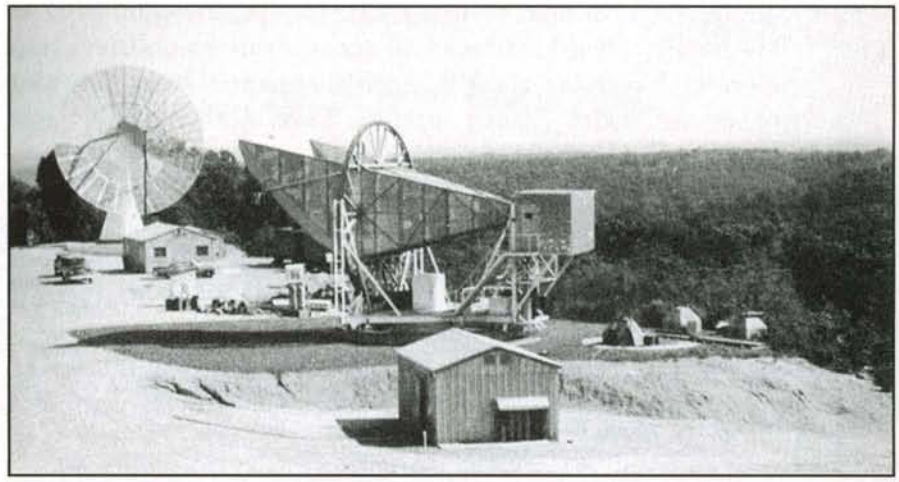

Photo 1. This NASA photo shows the Crawford Hill site as it appeared in 1959.

The Holmdel site would employ two antennas, a 60-foot Kennedy-type dish used for transmitting and a scaled-up version of the microwave repeater horn receiving at 2.4 GHz. The NASA photo, photo 1, shows the Crawford Hill site as it appeared in 1959.

The unique construction of the "Holmdel horn" was such that it minimized ground noise entering the main feed system, an essential requirement for detecting the extremely weak signals reflected off the Echo satellite. On the receiving side, a cooled maser was used to obtain maximum amplification with minimal noise. The tracking radar included a special receiver designed by Bell Labs engineer M.Uenohara, as illustrated in photo 2. Note the parametric amplifier in the middle of the photo.

The earliest tests of the Echo project involved vertical launches from Wallops Island, Virginia, intended to verify major systems operation prior to attempting Earth orbit. The first such launch, Operation Shotput, was held on October 28, 1959 and reported in the November 1959 issue of *QST* (photo 3).

Although the balloon ruptured into thousands of tiny pieces, making it visible all the way to Canada, no mention was made of this in the press, even in *QST*, due to public-relations concerns. Rather, *QST* reported the success of several VHF enthusiasts as their signals were heard up and down the East Coast. Although no two-way QSOs were reported, the amateurs who successfully bounced their signals off this prototype satellite became the first in history to communicate via such means, thus underscoring the great ama-

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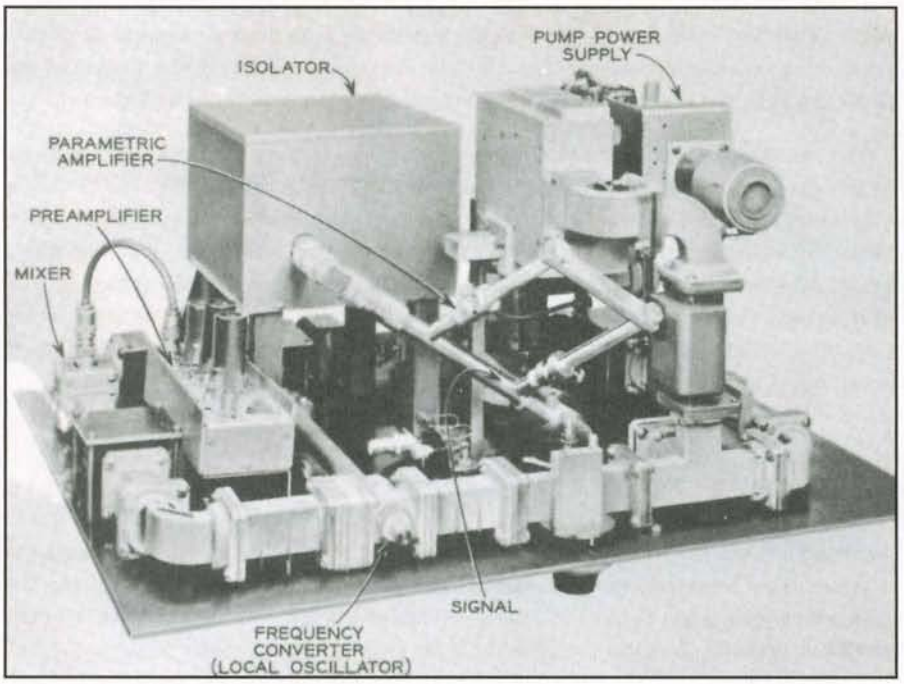

Photo 2. At the Crawford Hill site the tracking radar included a special receiver designed by Bell Labs engineer M.Uenohara. Note the parametric amplifier in the middle of the photo.

Operation SHOTPUT Provides V.V.F. Reflector

The first successful firing in the Operation *Shotput* series, Oct. 28, demonstrated something of the potential of these metallized balloons for reflecting v.h.f. signals. This was the first test of what will eventually be an orbiting satellite, capable of reflecting v.h.f. and u.h.f. signals over very long paths. As such it was of more than ordinary interest to v.h.f. men.

Word of the anticipated firing from Walloups Island at 1740 EST spread rapidly, and alert v.h.f. enthusiasts the length of the Atlantic Seaboard were ready for it. W4RMU, Jacksonville, Fla., W4FJ and K4EUS of the Richmond, Va., area, W4LTU, Springfield, Va., and W2CXY, Chatham, N. J., made 15-second transmissions in sequence, aiming at the anticipated trajectory of the 100-foot sphere. Nothing was heard by or from W4RMU, but all the others achieved positive results. Signals of various characteristics were reported. W4LTU heard W2CXY on some, but not all, of his transmissions, and at times noted something approximating auroral distortion on the signal. W3GKP recorded the entire test, including interesting doppler effects. K2LMG, Ithaca, N. Y., was able to copy W2CXY. Tests on 50 Mc. by W3OJU, Washington, D. C., and K2RRG, Upper Saddle River, N. J., were negative.

Three more rocket shots of this type are planned, before an attempt is made to put a balloon into orbit early in March. These will put ballons into the F_2 region of the ionosphere in a northeast trajectory, starting about 250 miles out over the Atlantic from the firing point, about 40 miles north of Norfolk, Va. Shots are planned for the last week of November, the first week of January, and the first week of February. Precise data on firing times, if available in time, will be put out on W1AW.

Photo 3. The earliest tests of the Echo project involved vertical launches from Wallops Island, Virginia. The first such launch, Operation Shotput, was held on October 28, 1959 and reported in the November 1959 issue of QST.

teur tradition of using whatever means available to extend the reach of their signals. Although two such satellites would eventually be placed into orbit, tracking them with a good-size amateur antenna was considered impractical. Thus it was that amateurs set their sights on another passive satellite, the moon.

By the late 1950s amateur, military, and commercial interests all considered the moon as a reflector of radio signals. Amateurs looked to the moon as a means of extending the reach of their VHF signals. Military interest centered on the stealthy interception of foreign transmissions reflected off the moon. Commercial interest was a matter of public relations, and the first company to use moonbounce for this purpose appears to be the Eitel McCullough Company (EIMAC). In 1959, Eitel used a moonbounce link between College, Alaska and Palo Alto, California to officially open its new facility in San Bruno, California. This is how Bill Orr, W6SAI, described the event in the September 1960 issue of *QST*:

The idea slowly evolved that it would be newsworthy if the plant could be opened by a radio pulse reflected to California from some distant point on the moon. Finally, through the kind assistance of E. Finley Carter, K6GT, director of Stanford Research Institute, a 10-kilowatat 440-Mc. transmitter located at College, Alaska, equipped with a sixty-foot parabolic "dish" antenna, was made available for the moon-bounce exhibit. Suitable receiving equipment for the California end was built by Granger Associates, Inc. of Palo Alto, California. ...The grand opening went off without a hitch!

This particular event heralded the start of EIMAC's participation in amateur moonbounce activity. Long recognized as being "ham friendly" in the sense that equipment would be "loaned" to radio amateurs for experimental use, by 1959 EIMAC had delivered Klystrons to amateurs Sam Harris, W1FZJ, Hank Brown, W6HB, and Walt Morrison, W2CXY. In the years that followed amateur legends John Chambers, W6NLZ, and Ralph "Tommy" Thomas, KH6UK, would also have Klystrons.

It's a curious thing that while the U.S. Navy was secretly developing a two-way moonbounce network between Washington, DC and Oahu, radio amateurs in the military were openly following a parallel path. In a letter from KH6UK to W2CXY, Tommy mentions how amateurs in the U.S. Air Force, not far from his QTH in Kahuku, were also working on moonbounce. The success of the Navy moonbounce project led to further plans to build a 600-foot dish antenna at Sugar Grove, West Virginia, one capable of detecting Soviet radar signals and other communications bounced (unintentionally) off the surface of the moon. A U.S. Navy illustration (photo 4) shows the proposed design of the 600-foot dish. Note the size of the cars in the foreground!

When news of this dish came to light, the National Radio Astronomy Observatory (NRAO) gave serious consideration to using it for radio astronomy work rather than building its own 300-foot dish in nearby Greenbank. In the end, due to concerns about sharing a dish with the military, the NRAO would move forward with plans to build its own large dish. This turned out to be a good decision, because the 600-foot dish was ultimately abandoned, possibly due to cost, but more likely because emerging satellite technology could do the same job for less. Eventually the military lost interest in using the moon as a reflector altogether, leaving this field exclusively to hams and radio astronomers.

As early as 1957 ham radio operator Sam Harris, W1FZJ, and his fellow members of the Rhododendron Swamp VHF Society (RSVHFS), W1BU, were hearing echoes off the moon on 144 MHz, but due to the lack of other stations on the air

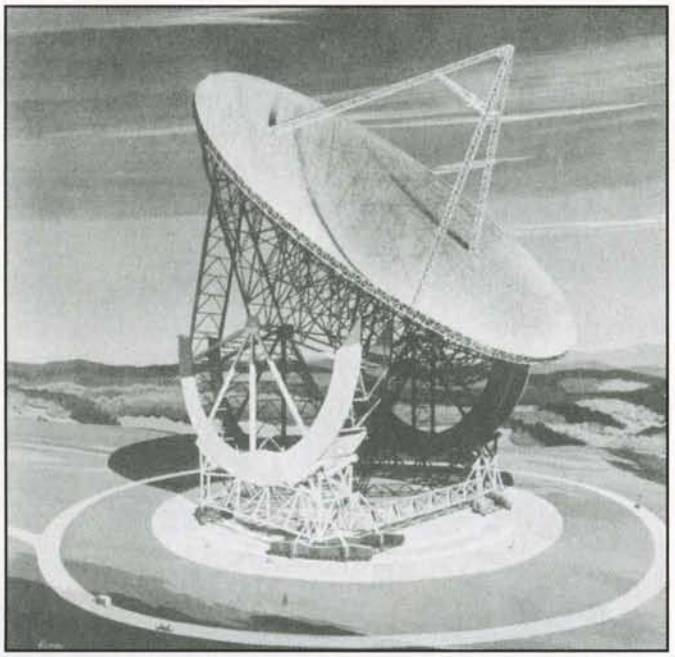

Photo 4. U.S. Navy illustration showng the proposed design of the 600-foot dish antenna at Sugar Grove, West Virginia. Note the size of the cars in the foreground.

no QSOs were made. Additionally, Jim Kmosko, W2NLY, was hearing his echoes off the moon as early as 1955.

VHF contacts between New Jersey and Massachusetts were not uncommon. The QSL card shown in photo 5 shows a contact between radio astronomer Gordon Pettengill, W1OUN, in Massachusetts and Walt Morrison, W2CXY, in New Jersey, when Gordon was operating the VHF station of Henry Cross, W1OOP, back in 1955.

Gordon is recognized as one of the first radar astronomers, having used MIT's Millstone Hill antenna for some of the earliest work in planetary radar. In the late 1950s and early 1960s this dish was beaming radar signals toward the planet Venus. By 1961 reliable reflections were being detected. When asked to comment on the recent accomplishment of German amateurs along these same lines, Gordon remarked, "Very impressive feat, no question!" *(Editor's note: For more information on the German amateurs' accomplishment, please see the "VHF Plus" column in June 2009* CQ *magazine, beginning on page 97.)*

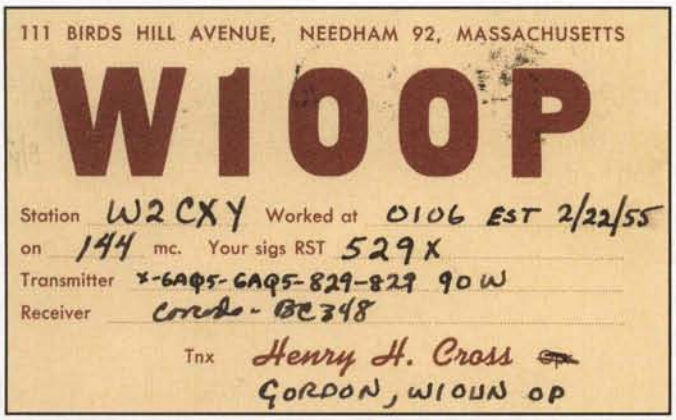

Photo 5. QSL card showning a contact between radio astronomer Gordon Pettengill, W1OUN, in Massachusetts and Walt Morrison, W2CXY, in New Jersey, when Gordon was operating the VHF station of Henry Cross, W1OOP, in 1955.

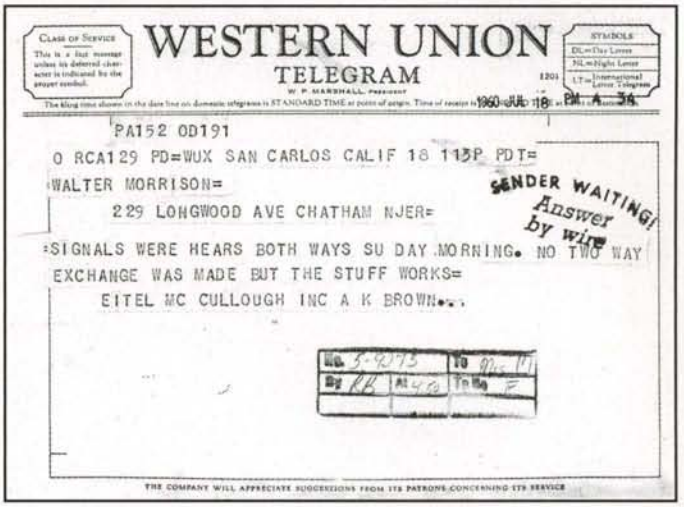

Photo 6. By 1960 Sam Harris's RSVHFS would be holding regular 1296-MHz moonbounce schedules with Hank Brown, W6HB, and the gang at EIMAC. Partial success was scored on July 17, 1960 as illustrated in the Western Union telegram from Hank to Walt Morrison, W2CXY.

Both W1OUN and W1OOP were members of the RSVHFS, as was Dana Atchley, W1HKK, who was mentioned in part 1 of this series in the Summer 2009 issue of *CQ VHF*. By 1960 Sam Harris's RSVHFS would be holding regular 1296-MHz moon-

bounce schedules with Hank Brown, W6HB, and the gang at EIMAC. Partial success was scored on July 17, 1960 as illustrated in the Western Union telegram (photo 6) from Hank to Walt Morrison, W2CXY. Only a few days later, on July 21, 1960, the first amateur QSO via the moon would become history.

In those days, moonbounce was truly a team effort, with each person contributing in his own way. Gordon Pettengill recently commented how he was responsible for calculating moonrise and set, as well as the path loss, libration, and other aspects of the echoing attempts. Key to their success appears to be the parametric amplifier developed by Sam Harris and used at both ends of that historic QSO. The distance from Massachusetts to California set a new amateur distance record for the VHF band. In 1962 Walt Morrison, W2CXY, and his "basement engineers" would be also heard by Sam via the moon, and later Ralph Thomas, KH6UK, would begin a spectacular series of moonbounce QSOs with Sam, first on 1296 MHz, then on 432 MHz, breaking one DX record after another. Thanks to these early pioneers, moonbounce is now a popular communications mode enjoyed by amateurs around the world.

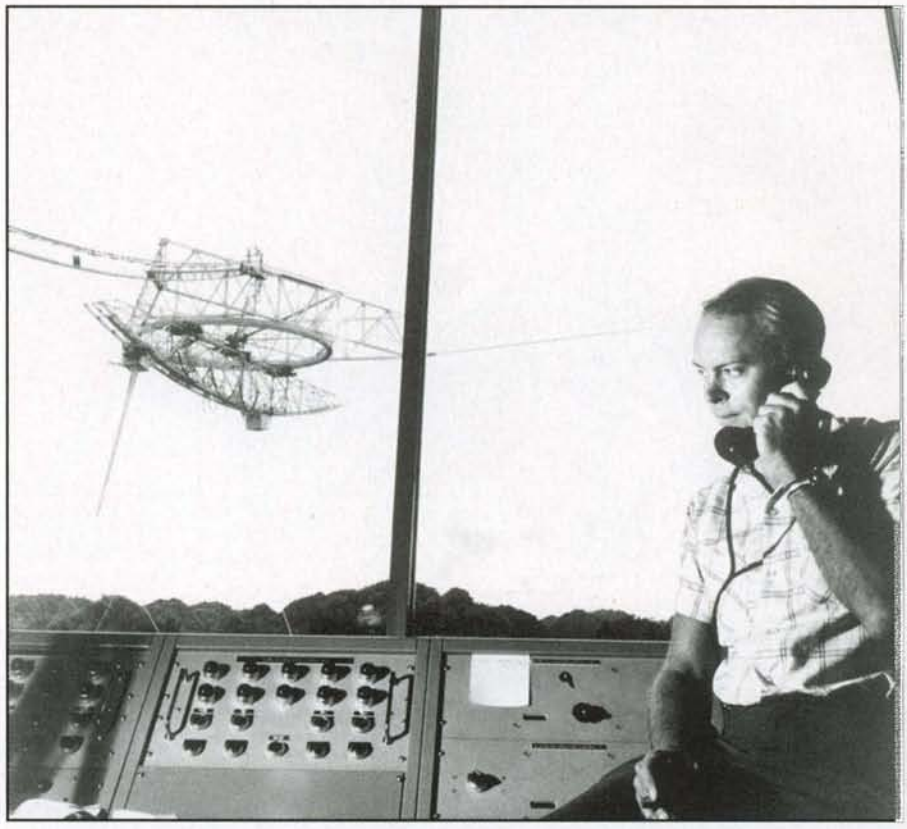

Photo 7. In 1963, Gordon, W1OUN, became Associate Director of the largest dish in the world at Arecibo Observatory. This photo, supplied by Gordon, shows him in the Arecibo control room.

Photo 8. This photo, provided by Tom Brown, W2EQ, shows the Holmdel antenna as it appears today, with its horn facing downward, protecting it from the elements.

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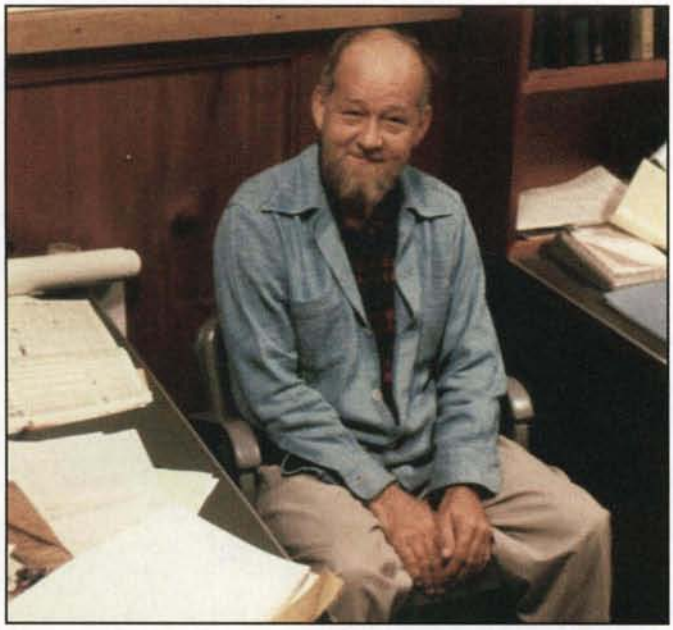
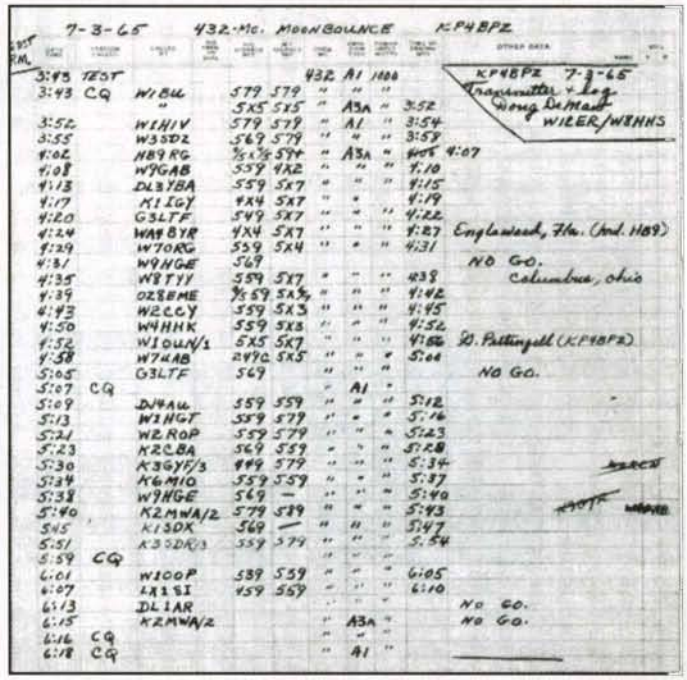


Photo 9. In 1965 Gordon, W1OUN, convinced Sam Harris, W1FZJ, to join him at Arecibo as the on-site RF electrical engineer there. (Photo by W1OUN)



7-3-65 432-Mc. MOONBOUNCE KP4BPZ

EST P.M.										OTHER DATA
3:43	TEST				432	A1	1106			KP4BPZ 7-3-65 Transmitter + Log Doug DeMaw W1CER/WIHNS
3:43	CQ	W1BU	579	579	"	"	"			
		"	5X5	5X5	"	A3A	"	3:52		
3:52		W1HIV	579	579	"	A1	"	3:54		
3:55		W3SDZ	569	579	"	"	"	3:58		
4:02		HB9RG	5X5	594	"	A3A	"	4:06	4:07	
4:08		W9GAB	559	4X2	"	"	"	4:10		
4:13		DL3YBA	559	5X7	"	"	"	4:15		
4:17		K1IGY	4X4	5X7	"	"	"	4:19		
4:20		G3LTF	549	5X7	"	"	"	4:22		
4:24		WA1BYR	4X4	5X7	"	"	"	4:27		Englewood, Fla. (Ind. 1189)
4:29		W7ORG	559	5X4	"	"	"	4:31		
4:31		W9HGE	569							NO GO.
4:35		W8TYY	559	5X7	"	"	"	438		Columbus, Ohio
4:39		DZ8EME	559	5X5	"	"	"	4:42		
4:43		W2CCY	559	5X3	"	"	"	4:45		
4:50		W4HHK	559	5X8	"	"	"	4:54		
4:52		W1OUN/1	5X5	5X7	"	"	"	4:56		20. Pettingill (KP4BPZ)
4:58		W7KAB	249	5X5	"	"	"	5:04		
5:05		G3LTF	569		"	"	"			NO GO.
5:07	CQ				"	A1	"			
5:09		DJ4AU	559	559	"	"	"	5:12		
5:13		W1HGT	559	579	"	"	"	5:16		
5:21		W2ROP	559	579	"	"	"	5:23		
5:23		K2CBA	569	559	"	"	"	5:28		
5:30		K3GYF/3	449	579	"	"	"	5:34		
5:34		K6MIO	559	559	"	"	"	5:37		
5:38		W9HGE	569	—	"	"	"	5:40		
5:40		K2MWA/2	579	589	"	"	"	5:43		
5:45		K1SDX	569	—	"	"	"	5:47		
5:51		K3SDK/3	559	579	"	"	"	5:54		
5:59	CQ				"	"	"			
6:01		W1OOP	589	559	"	"	"	6:05		
6:07		KA1SI	459	569	"	"	"	6:10		
6:13		DL1AR			"	"	"			NO GO.
6:15		K2MWA/2			"	A3A	"			NO GO.
6:16	CQ				"	"	"			
6:18	CQ				"	A1	"			

Photo 10. Although Gordon, W1OUN, was on vacation in Massachusetts in July 1965, he still managed to work Arecibo using his W1OUN/1 call as revealed in the copy of the KP4BPZ logbook recorded by Doug De Maw, W1CER, in the September 1965 issue of QST.

The barriers to weak-signal communications were largely overcome by the development of the parametric amplifier. In 1963 it was a parametric amplifier developed for the Echo project that would forge another connection between amateur radio and radio astronomy. In his book *Big Ear*, John Kraus, W8JK, describes the need for a sensitive front-end amplifier for his radio telescope of the same name and how he managed to obtain one from Bell Labs.

At the Bell Telephone Laboratories in New Jersey, "Mickey" Uenohara (Wayne-o-hara) had developed a very sensitive parametric type amplifier for use in satellite communication relay stations. Mickey had received his doctor's degree in electrical engineering at OSU a year or so before. Bell Labs was willing to have Mickey build us one of his best parametric amplifiers or "paramps" for a 21 centimeter wavelength if we provided the basic hardware required costing about $6000. We were delighted with this arrangement, and in 1963 Steve O'Donnell and Bob Townsend from our observatory drove to Murray Hill in a rented truck to pick up the amplifier. We connected it to our "big ear," and turned it on. It has kept going 24 hours a day, 365 days a year ever since with only a few days of down time for maintenance.

Although the moonbounce work at RSVHFS began well before the first Venus echo attempt, by 1960 Gordon, W1OUN, and his MIT associates would be using the Millstone radar facility not only to reflect VHF signals off the moon, but also to map its surface, something that proved useful for future Apollo missions. In addition, they would use Millstone to collect significant information about Venus, including the all-important ranging data used by the Mariner 2 space probe. After these successes, in 1963, Gordon would become Associate Director of the largest dish in the world at Arecibo Observatory. Photo 7, supplied by Gordon, shows him in the Arecibo control room. In 1964, Gordon (now KP4BPZ) would use the dish at Arecibo to repeat the Millstone Venus experiments. According to Gordon, the planetary echoes at Arecibo were 10,000 times stronger than those obtained at Millstone just four years earlier!

By 1964, Crawford Hill was no longer being used for Echo experiments, and its relatively small 20-foot radiating aperture would seem to limit its usefulness for radio astronomy work. However, all that was about to change. In 1965 two Bell scientists, Arno Penzias and Robert Wilson, would use the "Holmdel Horn" along with a cooled maser to make one of the greatest discoveries of modern astronomy. Penzias and Wilson were attempting to locate a source of noise in their receiving system that was always present.

After a lengthy investigation, and consultation with Princeton scientist Robert Dicke, it was finally concluded that this noise was actually the faint background radiation left over from the creation of the universe, direct evidence for the "Big Bang" theory! For this discovery, Penzias and Wilson shared the Nobel Prize. Photo 8, provided by Tom Brown, W2EQ, shows the Holmdel antenna as it appears today, with its horn facing downward, no doubt protecting it from the elements. Gordon, W1OUN, recently commented that "Holmdel's advantage over reflecting antennas was a very tightly controlled sidelobe spillover, making it ideal for studies of absolute sky temperature. No dish could have given the accuracy they achieved with the horn."

In June 1964, KP4BPZ arranged for the 1000-foot dish at Arecibo to be available for an amateur moonbounce experiment on 432 and 144 MHz. Sam Harris wrote of this historic event in the August 1964 issue of *QST*. Because "dish time" had to be scheduled long in advance, and considering how much time was required to get amateur equipment into position, it was expected to be quite some time before this experiment would be repeated. However, in 1965 all that would change, as Gordon, W1OUN, would convince Sam Harris, W1FZJ, to join him at Arecibo as the on-site RF electrical engineer there. Photo 9, of Sam, was taken by Gordon while stationed at Arecibo.

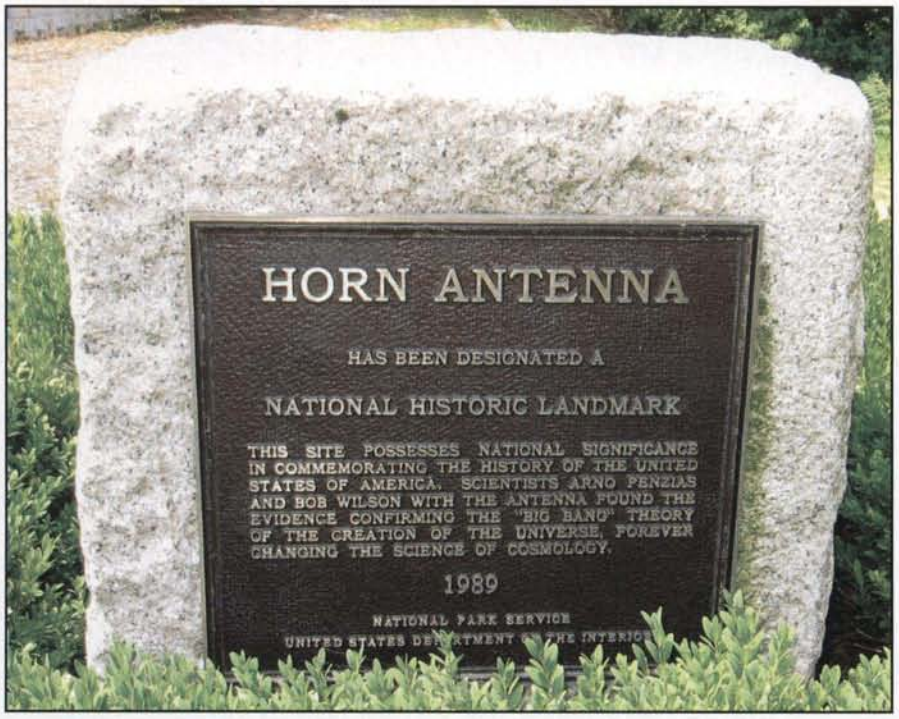


Photo 11. In 1989 the National Park Service designated the Horn Antenna at Crawford Hill a National Historic Landmark and erected this monument. (Photo courtesy of Tom Brown, W2EQ)

By July 1965 Arecibo would once again be used for amateur experiments, this time with Sam Harris at the key. It is interesting to note that although Gordon was on vacation back in Massachusetts at the time, he still managed to work Arecibo using his W1OUN/1 call as revealed in the copy of the KP4BPZ logbook recorded by Doug De Maw, W1CER, and which appeared in the September 1965 issue of *QST* (photo 10).

In the years that followed, other large dishes would be put to amateur service, including the 60-foot Kennedy dish originally used for Project Echo back at Crawford Hill. Under the guidance of Dick Turrin, W2IMU, this dish would became part of an amateur 1296-MHz moonbounce station, with the transmitter and most of the receiving equipment designed and built by amateurs. Dick is widely known for his series of moonbounce technical articles called the "Crawford Hill Technical Notes." Another Bell Labs engineer named Bob Buus, W2OD, recently commented how this station, operated as W2NFA, completed many two-way 1296-MHz EME contacts from Crawford Hill, including some with PAØSSB, OZ9CR, VK3ATN, G3LTF, and W9WCD, to name just a few. Unfortunately, when Bell Labs management realized the only ones using the dish were radio amateurs, they decided to sell it. According to veteran moonbouncer Al Katz, K2UYH, the 60-foot dish went to Vic Michaels, W3SDZ. Vic was never able to mount it and eventually sold the dish to a commercial electronics surplus dealer. Al picked up the feed from Vic, and eventually gave it to Tom Mott, W2DRZ, who is presently using it for 1296 EME. Al also ended up with one of Dick, W2IMU's ring PAs (converted UPX-6) that he used for many years. Al's 28-foot dish came from Bell Labs, Crawford Hill, although it was not the one that W2IMU used.

In 1989 the National Park Service designated the Horn Antenna at Crawford Hill a National Historic Landmark and placed the monument shown in photo 11, courtesy of Tom Brown, W2EQ.

The inscription on the plaque reads:

This site possesses national significance in commemorating the history of the United States of America. Scientists Arno Penzias and Bob Wilson with the antenna found the evidence confirming the "Big Bang" theory of the creation of the Universe, forever changing the science of cosmology.

The next issue of *CQ VHF* will contain part 3 of this series.

Review of 6-meter Sporadic-E Activity During Summer 2009

Were you on 6 meters this past summer? If you were, you enjoyed propagation rated to be the best in years. In this article WB2AMU reviews some of this summer's 6-meter plethora of propagation events.

By Ken Neubeck,* WB2AMU

As suggested in my previous article in the Summer 2009 issue of *CQ VHF*, I had a feeling that for North American stations the summer of 2009 might be something special in comparison to previous years. This feeling was based on the fact that the sunspot cycle was at its prolonged lowest point for quite a while.

Sporadic-*E* activity has always been known to have its nuances, especially with regard to location of the individual formations that can line up for the possibility of long-range contacts. Thus, in looking at the summer of 2009, it could be considered as a less than average season for transatlantic QSOs between the U.S. and Europe on 6 meters. However, QSOs in other directions were made in significant quantity.

For moderately powered stations with directional antennas, it was quite effective to call CQ on 6 meters, particularly when the low-power beacons were being heard with good signal strength. Calling CQ in the CW portion of the band when the beacons were coming in and not many stations were on the air proved to be a good strategy for me and others in "opening up the band." A lot of stations were listening on the band and not transmitting. They came out of the woodwork when they heard a fairly strong CQ. I was getting responses from western states via double hop during some openings when initially I only heard the single-hop sporadic-*E* skip beacons.

It seems to me that in the 15 years that I have been on 6 meters, on average an active 6-meter operator in the U.S. may see one or two "major" sporadic-*E* events during any particular summer season. Some years the events may actually develop further into 2-meter openings. However, in many cases these "major" events may take the form of multiple-hop situations that last for several hours.

In general, a major event can occur at any time between May 1st and August 15th, the time period for the sporadic-*E* summer season in the Northern Hemisphere. Statistically, the odds are especially high for such an event to occur sometime within the last ten days of June or within the first ten days of July, near the peak of the summer solstice. August 1, 2008 was an oddity for me in that I worked into Europe on 6 meters CW during the day, with two new countries for me, Morocco (CN) and the Balearic Islands (EA6).

Also, a major sporadic-*E* event may favor one region of the U.S. more than another, a situation that is more the luck of the draw during any given summer season. For example, on June 25, 1994 the Saturday of Field Day weekend, Damon

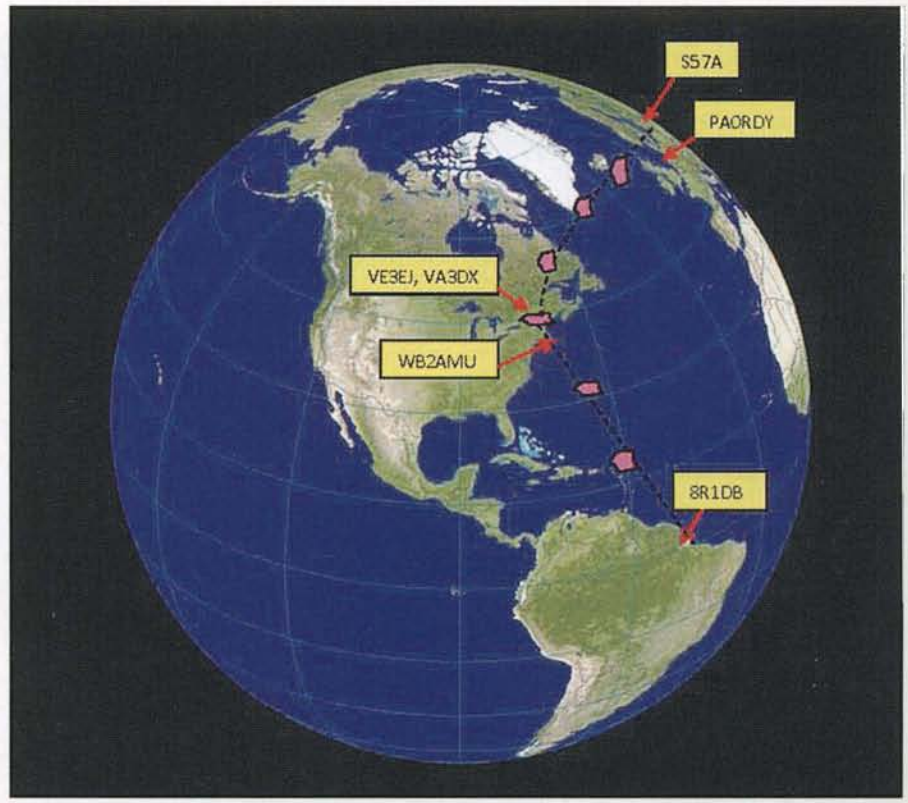


*Figure 1. Approximate locations of sporadic-*E *formations, June 26, 2009 (2040 to 2100 UTC). Note that sporadic-*E *formations are in pink.*

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UTC	Callsign	QTH	Mode	Frequency	Direction	# of Hops
1804	CT1HZE	Portugal	CW	50.115	Northeast	2
1813	CT4NH	Portugal	CW	50.098	Northeast	2
1816	CT1ILT	Portugal	CW	50.108	Northeast	2
1835	GØJHC	UK	CW	50.095	Northeast	3
1841	MDØCCE	Isle of Man	CW	50.100	Northeast	3
1845	G4RRA	UK	CW	50.092	Northeast	3
1858	MMØAMW	Scotland	CW	50.123	Northeast	3
1900	GIØRQK	N. Ireland	CW	50.098	Northeast	3
1904	PA2M	Netherlands	CW	50.115	Northeast	3
1919	GM3SEK	Scotland	CW	50.096	Northeast	3
1931	GM4ISM	Scotland	CW	50.100	Northeast	3
2042	VE3EJ	Ontario-FN03	CW	50.078	North	1
2043	VA3DX	Ontario-FN03	CW	50.077	North	1
2044	PAØRDY	Netherlands	CW	50.081	East	3
2046	8R1DB	Guyana	CW	50.122	South*	2
2055	S57A	Slovenia	CW	50.089	Northeast	4
2103	GW3YDX	Wales	CW	50.089	Northeast	3
2107	G3TBK	UK	CW	50.096	Northeast	3
2114	9A5CW	Croatia	CW	50.079	Northeast	3
2116	F8DBF	France	CW	50.086	Northeast	3
2118	G3LDI	UK	CW	50.082	Northeast	3
2136	S57RR	Slovenia	CW	50.085	Northeast	4
2236	ON7GB	Belgium	CW	50.113	Northeast	3
2322	IK5MEJ	Italy	CW	50.125	Northeast	4
2328	GI6ATZ	N. Ireland	SSB	50.096	Northeast	3
2332	K1LOG	Maine	CW	50.089	Northeast	1
2341	EI7IX	Ireland	SSB	50.140	Northeast	3

**Three-element Yagi was facing northeast and 8R1DB was worked off the back of the beam.*

Table 1. Multiple-hop sporadic-E opening from WB2AMU, June 26, 2009, European contacts.

Morrison, KJ4E, in Sanford, Florida, experienced a long-duration multiple-hop sporadic-*E* opening into much of western Europe. Beginning with I4XCC in Italy worked at noon time local time, Damon proceeded to work over 100 stations on 6 meters CW that covered 21 European and North African countries. The opening lasted for over five hours, the last QSO being with EH1YV in Spain at 6:30 PM local time in Florida. QSO rates averaged about 25 an hour, with the 2 to 3 PM time period netting 30 QSOs for Damon.

During the same time period, from my location on Long Island, New York, I was only able to hear some of this opening and was able to work CU1EZ in the Azores. but signals were very weak. It appeared that I was at the fringe location for this opening and that stations in the Florida area were in the "sweet spot" of this event.

This example shows the necessity of dedicated operators to monitor the 6-meter band regularly during the months of June and July in order to capture the one or two "major" events that could possibly occur. In my experience, during some previous events, including the June 1998 opening that took place during Field Day weekend, much of the contiguous U.S was able to be worked on 6 meters during a good portion of weekend. At the Field Day station W2AMC on eastern Long Island, I was operating the 6-meter station and was able to make over 270 QSOs on the "Magic Band" during the weekend, a significant number for this band for a 24-hour Field Day period.

In general, I observe a handful of transatlantic openings into Europe from my Long Island QTH each summer, with the average duration being one or two hours at best. During the past 15 years, I had not been fortunate to have that three-hour-plus opening in the fashion that KJ4E had, as cited in the earlier example. That was the case, until the day of June 26th this year.

A Major 6-meter Event Observed from Long Island

In my current job, I work a nine-day, 80-hour work schedule with alternate Fridays off. Thus, on June 26th I had the day off, and in between errands during in the morning I was listening on 6 meters. I heard some evidence of weak sporadic-*E* and also saw an occasional spot between the U.S. and Europe being posted on 6-meter internet sites such as the ON4KST site.

At 2 PM local time I finally was able to work into Europe with three stations in Portugal being worked in a period of ten minutes, beginning with Joe Kraft, CT1HZE, on CW. I thought that things were looking good on 6 meters and hopefully, some other areas of Europe would start to come in besides the western coast.

At 2:30 PM local time I started to hear other areas coming in, with Neil, GØJHC, coming in weakly from the UK on CW. Looking back, this was the trigger, or the turning point, for what would be one of the biggest sporadic-*E* openings I had ever experienced on 6 meters.

After I worked GØJHC, more signals started coming in from the UK area, and over the next hour or so I began working different parts of this area as seen in Table 1. GØJHC's signal picked up in strength after we made our contact, and he was one of the louder signals on the band, sometimes reaching 589 to 599.

I was focusing primarily on the CW portion of the 6-meter band, and I observed signals spreading out into the lower part of the CW band and mixing

UTC	Callsign	QTH	Mode	Frequency	Direction	# of Hops
2343	WA2USA	Kentucky	CW	50.086	Southwest	1
2358	K5TDA	New Mexico	CW	50.092	Southwest	2
2359	N7KA	New Mexico	CW	50.092	Southwest	2
0003	W8TU	Michigan	CW	50.099	West	1
0005	KN5O	Louisiana	CW	50.099	Southwest	1
0007	VE7SL	British Columbia	CW	50.099	West	2
0012	W7XA	Arizona	CW	50.091	Southwest	2
0112	W6OUU	Idaho	CW	50.088	West	2
0115	K5RC	Nevada	SSB	50.135	West	2
0120	K7XC	Nevada	CW	50.091	West	2
0123	ND9E	Illinois	CW	50.095	West	1
0124	W5VYH	Arkansas	CW	50.095	Southwest	1
0127	N4LI	Tennessee	SSB	50.174	Southwest	1
0142	K2DRH*	Illinois	SSB	50.165	West	1
0152	W8BZY	Ohio	CW	50.089	Southwest	1
0155	K5QEA	Oklahoma	CW	50.082	Southwest	1
0157	WØFLS	Iowa	CW	50.092	West	1
0226	NT6K	California	CW	50.095	West	2
0243	K5FA	Mississippi	CW	50.096	Southwest	1
0332	K0RW	Illinois	CW	50.093	Southwest	1

**K2DRH was super 59 and he told me later that he experienced 2.5 hours of European contacts.*

Table 2. Multiple-hop sporadic-E opening from WB2AMU, June 26/27 2009, western U.S. contacts.

with the beacon signals that are present in the 50.060-MHz to 50.080-MHz range. I found it amazing that just about every area of the UK was present on the band at the same time: Scotland, England, Ireland, Northern Ireland, and the Isle of Man. Yet I could not find MUØFAL from Guernsey, who, as reported later in this article, was left out along with some other stations in the southern UK area.

For any significant 6-meter opening, I look back at the path patterns and make it a point to work everyone I hear. Thus, during the height of this particular opening, beginning at 2042 UTC, I worked two Canadian stations consecutively on CW, VE3EJ and VA3DX in the FN03 grid in lower Ontario, both with very loud signals. Indeed, it turns out that these two contacts may have been the most important ones that I made during this big opening, as it laid down the likely sporadic-*E* path that allowed me to reach into Europe. I also want to point out that at no time during the opening did I hear any stations (beacons or otherwise) in the Newfoundland area.

This last point is important, as typically many of the openings into Europe from the northeast U.S. involve a single hop into the Newfoundland area (where either stations are worked or the beacon heard) and then one hop into the outer reaches of Europe (Azores, Portugal, Scotland). New England stations in particular generally observe this path almost regularly every summer on 6 meters. For this particular opening, it appears that a very short skip was the first hop for me (where I worked into Ontario), and then two more sporadic-*E* formations needed to be in line for me to work into the UK area. An additional sporadic-*E* hop would be needed to get from the UK area into eastern Europe and Italy. Thus, the most likely scenario for me to be able to work stations in Croatia and Slovenia would be at least four sporadic-*E* formations that lined up!

The two Canadian QSOs during the height of the opening were a major key in being able to determine the probable geometry of this path. (The location of this first sporadic-*E* formation was reinforced again a little while later when I worked K1LOG in Maine.)

As if this was not interesting enough, shortly after I worked PAØRDY in the Netherlands, I heard 8R1DB in the opposite direction in Guyana in South America and managed to work him off the back of the beam, as I could not turn it fast enough. It was incredible to hear four hops of sporadic-*E* in one direction and two hops in the opposite direction! Therefore, the math was showing at least six major (and fairly stable) sporadic-*E* formations present at the same time. See figure 1 for the approximate location of these formations at the peak of the opening.

I actually heard a station in Germany, but then his signal dropped out completely, so there appeared to be some instability in what was probably the fourth sporadic-*E* hop. However, I did manage to work into Italy and parts of eastern Europe such as Slovenia, and a new DXCC for me, Croatia, with Patrik, 9A5CW, down on 50.079. Thus, at times the fourth sporadic-*E* hop was stable.

The loudest signal on SSB that I heard was EI7IX, and I managed to work him about 20 minutes before midnight UTC time (8 PM EST). Then something magical started to happen. The signals from Europe started to fade and I started to hear signals to the west of me that were one hop away. Then about five minutes before 0000 UTC, I worked K5TDA and N7KA from the DM grid field in New Mexico on CW! It was almost like a classic wintertime *F2* skip on 6 meters when the band "changes direction" from east to west, except that this was sporadic-*E*. What probably was happening was that the clouds were shifting and the stations west of me were now being heard better by me. Thus, for the next two hours, I started calling CQ on CW and worked as many stations as I could with the results reflected in Table 2. A highlight for me was working Steve, VE7SL, in British Columbia, someone I had occasionally worked during the intense *F2* season in the fall of 2001.

In looking back at this opening and realizing that there was an unusual path because of the location of the large number of sporadic-*E* formations involved, I realized that it was inherently possible to work into areas of Europe that I normal-

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ly do not hear during the summer season, so my focus was on listening to signals rather than calling CQ. You can only hope that the word gets out quickly on internet sites for stations in Europe to get on at a late hour for them (late evening to midnight for many of the stations in central and eastern Europe). I also wanted to get a general idea as to how widespread the coverage was for the large amount of sporadic-*E* formations that were present on this day, so it was necessary to pull data from other stations.

June 26 Observations from Other Locations

After this opening, I solicited comments from other 6-meter operators in different locations in the Northern Hemisphere to see what they had observed. The old saying "location, location, location" being important with regard to sporadic-*E* openings was certainly appropriate here. Some stations that I had expected to be in the thick of things with this long-duration and seemingly widespread coverage actually were only on the fringe and thus heard only a small part of the event. (This is similar to the example that I cited earlier concerning KJ4E, where I was on the fringe of that June 1994 opening.)

I found out that several stations were on the fringe of the opening, away from the major action that the coverage favored. While I was able to work many stations in the UK area, there were some stations in the UK area that were left out. Colin, MUØFAL, reported to me that he heard nothing at all during the opening, and that F6KNM, who was located two grids to the west of him, along with F8BDF who was a little farther away than that, were both running many stations. He reported that another UK station, Mike, G3SED, in the IO90 grid just north of him heard no signals either!

A number of U.S. stations seemed to be on the outer edge as well. Lefty, K1TOL, who always seems to be in on European openings from his location in Maine, reported that most of the signals were going over his head and many were weak and fluttery sounding. He did manage to work TF8GX in Iceland around 2128 UTC, but nothing in the UK area. He seemed to think that the opening favored the W2, W3, W5, and W8 call areas. As I discussed previously, the path was not the normal path from the New England area up to Newfoundland and then to Europe. This would explain why this day some of the New England stations did not do as well as the stations in the W2, W3, W5 and W8 call areas. Other stations, such as Jon, NØJK, reported that only a few Europeans, such as in the Canary Islands, made it into the Kansas area on that day.

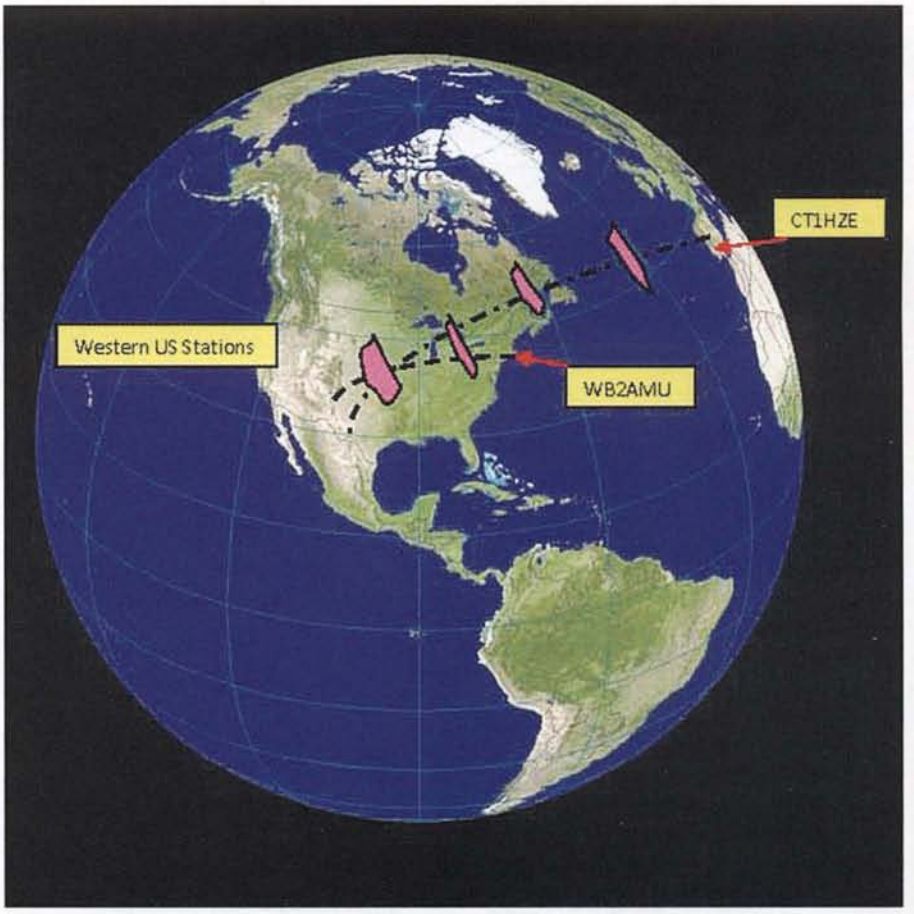

*Figure 2. Approximate locations of sporadic-*E *formations, June 26, 2009 (0000 to 0100 UTC). Note that sporadic-*E *formations are in pink.*

Perhaps the most interesting observations came from the very active 6-meter operator Joe Kraft, CT1HZE, in Portugal. Joe reported that this was the best 6-meter opening into North America for 2009. He was able to make over 250 QSOs during two separate time periods: 1349 UTC to 1454 UTC, and 1752 UTC to 0045 UTC the next day!

In addition to the straightforward stuff from the east coast of the U.S., Joe was able to make contacts into the Texas and Louisiana area. Later in the opening, Joe worked into new territory with contacts in New Mexico and Arizona. Thus, at the time I was hearing the west coast, Joe was working into DM grids in the California area. A good estimate of the number of sporadic-*E* hops from Portugal to California would be at least four, possibly five. It was not just the number of hops, but also the fairly long durations that the signals were present for these contacts to be made on 6 meters!

What was interesting to me was that I did not hear anyone from Europe after 0000 UTC, while I was working double-hop sporadic-*E* into the western U.S. I think that I have a rough idea as to what the plot must have looked like for the four sporadic-*E* formations that were in play at the time, and this is sketched out in figure 2. In this figure you can see that the two sporadic-*E* formations to the west of me were in good alignment for me to work into the western U.S. and that these two formations coupled with the two formations to the east allowed CT1HZE to work the same western states. However, the first formation located to the east of my station (WB2AMU in the figure) was not in a good position for a path that would be in place and would be able to connect my station to Europe at this point during the opening. Thus, only the western path was there for me with the two

sporadic-*E* formations west of me, while all four sporadic-*E* formations were in play for CT1HZE to be able to work long-distance into the western states!

Indeed, the geometry and math can get kind of tricky when trying to construct the probable path for multiple-hop sporadic-*E* paths, so the rule of thumb is to work with approximations that would fit the data and not strictly plot each path for each station that is worked. It is best to use approximate methods because of the changing dynamics of four sporadic-*E* formations and the signals that can actually be heard during a specific time period on 6 meters.

Summary

As it turned out, June 26th was the major high point for the summer of 2009. After June 30th, when I worked CT3HF at 5 PM local time in New York, I did not work any more stations that were directly east of me across the Atlantic Ocean for the rest of the summer. No more European or African stations were entered into my log book. However, during the month of July, I observed 26 days of sporadic-*E* activity, with 10 of those days being double-hop events. (I had observed 26 days of sporadic-*E* activity in July 2004, so this was not a new record for my station location.) Double-hop events that I observed were typically toward the south into the Caribbean, and toward the west into the western U.S. states. One of the memorable QSOs was with HK7AAG in Colombia on CW on July 22nd.

I received a report from Tom, K4SUS, of an extraordinary day for him when he worked four Hawaiian stations on July 6th from 2018 UTC to 2122 UTC from his location in Georgia. He had an antenna setting using his 8-element 6-meter quad of 270 degrees, and he pulled in KH6/K6MIO, KH6HI, KH7T, and KH7XS at about 5-level signal strength. Tom even worked Japan, JL8GFB, on July 2nd on CW. So there were surprises at times on the "Magic Band" during the summer of 2009 for many 6-meter regulars.

In terms of geomagnetic activity, July 2009 was one of the quietest months in many years, with the following observations being made:

1. The 3-hour *Kp* value only exceeded 3 on two days (July 14th and 22nd).

2. No sunspots were observed from July 11th through July 31st.

3. The solar flux at Earth value did not exceed 71.6.

4. Only two Class C flares were observed (July 5th and 6th).

All of this made for a very quiet month with regard to solar activity. There was no flare activity or coronal holes that would have induced auroras to extend into the lower regions of Earth and impact 6-meter propagation in a negative manner.

Thus, if you were to ask a veteran 6-meter operator from the northeast U.S. if the summer of 2009 was a good time period from an overall perspective, many might cite the lack of European contacts during July as a negative factor. Even the remarkable Japan to U.S. contacts that were made in the summer of 2008 were not made in the same number as during the summer of 2009.

I am not too sure if the observations that I made during the summer of 2009 were conclusive enough to state that sporadic-*E* activity is better during the quiet sunspot years of the solar minimum. However, it can be stated that there did not seem that there were any factors that inhibited the season, so at least average to better-than-average conditions were generally observed throughout North America on 6 meters.

Just like in the sport of baseball, you have to play the game and not be on the sidelines. In the case of 6 meters, it means monitoring the band on a regular basis a few times during the course of a day during the summer, with the emphasis on the mid-morning and early evening hours. This also means calling CQ to generate activity at the point when beacons are being heard. The event of June 26th was fortunately one of long-duration and significant coverage area such that many 6-meter operators were able to take advantage of it. I hope that many of our readers found similar results.

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Combine extremely high frequencies, extremely low power, extremely good weather with extreme enthusiasm and what do you get? The answer is in the results of the ARRL 10 GHz and Up contest. WB6NOA describes the activities of California hams on 10 GHz.

By Gordon West,* WB6NOA

As California hams, we need to continuously upgrade our image at every opportunity. This includes wild and wacky stations set up during the ARRL 10 GHz and up two-part contest held in August and September every year. First, we have activity monthly, thanks to the San Bernardino Microwave Society (www.ham-radio.com/SBMS). It even televises its meetings over ATV via the ATN network!

We have a good number of hams on board, about fifty southern California operators during the contests, plus another couple of dozen in the San Francisco Bay area. Some are old hands at this with their own homebrew transverters, and some are new hams with DB6NT transverters for nearly plug-and-play to any 10- or 2-meter multimode low-power transceiver (www.SSBUSA.com/ham). We don't stop at 10 GHz either. For every dozen X-band rigs, there is at least one 24-GHz operator, plus a few higher up in the bands as well.

Each year, a month before the ARRL's 10 GHz contests the San Bernardino Microwave Society holds a "tune-up" party at a big open park, serving up a well-calibrated antenna range. Each station gets a down-range ERP (effective radiated power) measurement, and all stations compete to be the last receiver standing as the down-range test signal drops into the ozone.

"The best part is eyeballing how the gear hangs on to the antenna system!" comments Bill Alber, WA6CAX. "Some of the most bizarre-looking lash-ups did best in the tune-outs," he adds, shaking his head at some of the wild open-wired rigs with almost half running below 1 watt output. Most of the traveling-wave tubes could be seen resting comfortably in the back seat, not pressed into action during this short-range shootout. (Measured ERP = power meter reading, plus attenuator, plus path loss, plus cable and mixer loss, minus amplifier and horn gain.)

San Bernardino Microwave Society "tine-up" party held each year before the ARRL's 10 GHz contests.

In southern California, we have the luxury of working on our receivers at home, getting tuned up for picking up *four* continuous X-band CW beacons: 10,368.300 MHz, N6CA, Palos Verdes; 10,368.310, N6CA, Frazier Mountain; 10,368.330, KE6JUV, Santiago Peak; and 10,368.070, WB6IGP, San Diego.

In the Bay area, these beacons serve the bench tech well for final receiver tune-ups: 10, 368.325, W6ASL, Mt. Vaca; and 10,368.020, KK6TG, Mt. St. Helena.

Much credit goes to Paul Lieb, KH6HME, who is always ready to drive to the top of the Mauna Loa volcano to light off 10.368.350 MHz, the KH6HME Mauna Loa beacon, yet to be heard here on the mainland.

For the 2009 contest, there were even digital modes on 10 GHz, including JT65, along with PSK-31. Word has it that a few exchanges were accomplished.

However, likely the most SSB exchanges came from the monster signal of Robin, WA6CDR, high atop Nevada's Mt. Potosi, DM25GW, using an undisclosed amount of power and his 6-foot dish. His incredible signal and receive system was able to give a knife's edge over the Sierra Nevada snowcapped mountain range to link up with stations north of the Bay area. Robin is also the control operator for the Cactus linked repeater system, serving as the UHF coordination channel, with multiple repeaters tied in for the party-line effect.

The 10-GHz operators on UHF coordination sounded a bit like air-traffic controllers, passing instructions in less than 3 seconds, making listening even to the intercom channel a thrill (and very important!).

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This dish has plenty of gain to work out 700 miles on 10 GHz with 10 watts.

The "El Gordo" 10-GHz horn has a lot of gain.

"NOA, CDR, my carrier to you on 175."

"CDR, NOA, have your carrier, drop and listen to mine."

"NOA, we got a peak; go sideband now."

All the while, multiple other conversations were going on, on intercom, too. The 10-GHz operators were quick to stand by if they sensed some path records ready to be set.

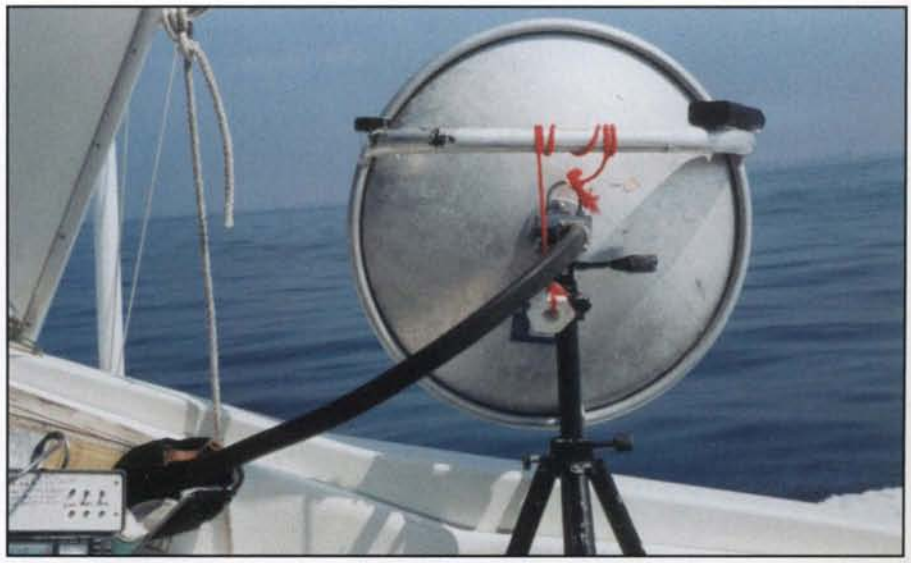
Famous microwave expert Chip Angle, N6CA, offered plenty of DX after his 1000-mile round trip drive from southern California to the San Francisco Bay area. I think his best DX was something like 700 miles to Robin, with only a moderate-size dish and a few watts of power. A 1000-mile drive certainly gives credit to the many rovers who went nearly that far as well.

"Do not drive a 40-year-old highly modified sports car up dirt roads," comments Tony, KC6QHP. Tony explained that nighttime driving with H4 headlights is not recommended to find the microwave hot spot. "So here I am, in the middle of nowhere, broken bulbs in the pitch black, with no cell-phone coverage, and I end up duct-taping flashlights to finally get to my destination." His bad luck was leaving his FT-470 HT intercom radio somewhere at the operating site.

Tony also operated 24 GHz, and he indicates there were enough people on 24 GHz to make it worthwhile, but says there is a lot more to learn about 24-GHz propagation.

Many 10-GHz hams operated as a group on a hill, giving out multiple contacts on multiple rigs for some good point counts. Thanks to Frank, WB6CWN, on Frazier Mountain, running a 4-foot dish with 15 watts on 10 GHz and 8 watts on 24 GHz, the Frazier Mountain station was able to hear from the Mexican border and all the way north to Sacramento.

I like to work 10-GHz maritime mobile. The flat ocean makes for easy operating. The 3-watt SSB Electronics setup sits securely on the back of the Anixter dish



Flat seas lead to strong 10-GHz signals and contacts in the September ARRL 10 GHz and Up Contest.

Tom, N6DCL, works 10 GHz dingy mobile.

using a Cassegrain feed and a short section of X-band flexible waveguide. Everything is lashed to a 5-foot tripod, and a compass keeps me pointed in the right direction. As long as a steady course is steered, the rolling motion is hardly noticed on transmit or receive. Likely, the conductive ocean water acts as a reflector. Our best DX was well over 400 miles on several occasions with this relatively small dish.

"I squeaked out 200 miles plus, running 300 milliwatts and my little horn antenna, right at the water line," comments Tom Redler, N6DCL. The small horn was attached to flexible waveguide, and this allowed for easy pointing. Just be sure to keep the horn's polarization horizontal!

When not out on the water, I operated 10 GHz dune-buggy mobile-at-rest using both the Anixter dish as well as the Prodelin 0.84 MKu-Band System, with a KC6UQH homebrew transition.

Robin reported some amazing contacts with milliwatt stations hundreds of miles away. On the UHF intercom channel, he had a distant to weak station continuously transmit a carrier. When a passing airliner briefly opened up the path, he would hear, "go sideband, call now." The importance of monitoring the liaison frequency in "real time" was paramount, as the aircraft enhancement scatter only lasted for about 10 seconds.

Some operators found that the local southern California fires had closed off their secret mountaintop operating locations, and for some of the forestry locations, wary Forest Rangers were rumored to be looking for special operating permits for this equipment.

WB6NOA's 10-GHz dune-buggy system.

Mel, WA6JBD, collects and posts planned operating locations for anyone looking to be listed. This posting begins about a month before the event and serves as a very important "heads up" for this successful operating event. When you see three pages of planned ham radio operator activity, you quickly get the message that not operating during this important weekend will be duly noted by your absence from the list. It also serves as an excitement-builder when you see where some of the operators are spending a whole day to work for distant-contact records.

"When you see Pat, N6RMJ, driving well over 10 hours to get to a microwave high spot, you can no longer complain that your 45-minute hike up a hill lugging all your gear was any big deal!" adds Alber, WA6CAX.

Where higher power than 1 watt was absolutely required, the signal needed to be jammed through a huge mountain range. When Robin, WA6CDR, was blasting his monster signal through the Sierras, receiving stations indicated an amazing 15-degree reception azimuth when rotating *their* dish antennas for maximum incoming signal strength.

Out in the open, Chip, N6CA, actually operated *mobile-in-motion* with an omnidirectional 10-GHz antenna, giving out grid sub-squares every 10 miles. "The only hard part was keeping a log," laughs Chip, sounding pretty happy after making some extremely long contacts between Mt. Potosi and north Sacramento.

Best of all, on 10 GHz is the sense of camaraderie among the operators. The liaison channels were full of non-stop coordination calls, and every operator took turns getting a quick word in with friendly discipline during these two contests.

"And don't forget your key," adds Robin, WA6CDR, indicating CW is still the ultimate mode to pull DX out of the microwave mud.

For those of you thinking of going up to 10 GHz, go to <www.SSBUSA.com/ham> and see how the imported from Europe transverters are 95% plug-and-play. Just make sure your local rig stays locked on to *no more than 1 watt output*, and you'll be set to explore the X-band. Oh sure, there was a smattering of FM operation as well, but the serious X-bander works SSB, CW, and now, some of the digital modes.

Hear you on X-band soon!

QUARTERLY CALENDAR OF EVENTS

Quarterly Calendar

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

Nov. 1	Moderate EME conditions.	Jan. 1	Moon perigee.
Nov. 2	Full Moon.	Jan. 3	Excellent EME conditions.
Nov. 7	Moon perigee.	Jan. 4	*Quadrantids* meteor shower.
Nov. 8	Good EME conditions.		
Nov. 9	Moon last quarter.	Jan. 7	Moon last quarter.
Nov. 15	Moderate EME conditions.	Jan. 10	Poor EME conditions.
Nov. 16	New Moon.	Jan. 15	New Moon.
Nov. 17	Leonids meteor shower.	Jan. 15	Solar eclipse.
Nov. 22	Moon apogee. Poor EME conditions.	Jan. 17	Moon apogee. Poor EME conditions.
Nov. 24	Moon first quarter.	Jan. 23	Moon first quarter.
Dec. 2	Full Moon.	Jan. 24	Moderate EME conditions.
Dec. 4	Moon perigee.	Jan. 30	Moon perigee.
Dec. 6	Excellent EME conditions.	Jan. 30	Full Moon.
Dec. 9	Moon last quarter.	Jan. 31	Excellent EME conditions.
Dec. 13	*Geminids* meteor shower. Poor EME conditions.	Feb. 5	Moon last quarter.
		Feb. 7	Poor EME conditions.
Dec. 16	New Moon.	Feb. 13	Moon apogee.
Dec. 20	Moon apogee. Poor EME conditions.	Feb. 14	New Moon. Poor EME conditions.
Dec. 21	Winter Solstice.	Feb. 21	Poor EME conditions.
Dec. 22	*Ursids* meteor shower.	Feb. 22	Moon first quarter.
Dec. 24	Moon first quarter.	Feb. 27	Moon perigee.
Dec. 27	Moderate EME conditions.	Feb. 28	Full Moon. Moderate EME conditions.
Dec. 31	Full Moon.		
Dec. 31	Lunar eclipse.		*—EME conditions courtesy W5LUU.*

Current Contests

November: The **ARRL 2.3 GHz and UP EME Contest** will be held on November 7–8, 2009.

January: The ARRL VHF Sweepstakes is scheduled for the weekend of January 16–18, 2010.

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

Current Meteor Showers

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

December: Two showers occur this month. The first, the *Geminids*, is predicted to peak around 0510 UTC on December 14. The actual peak can occur 2.5 hours before or after the predicted peak. It has a broad peak and is a good north-south shower producing an average of 120 meteors per hour at its peak.

The second, the *Ursids*, is predicted to peak around 1330 UTC on December 22. It is an east-west shower, producing an average of no more than 10 meteors per hour, with the very rare possibility of upwards of 90 meteors at its peak.

January: The *Quandrantids,* or *Quads*, is a brief but very active meteor shower. The expected peak is on January 3–4, with up to 40 meteors per hour at its peaks. The actual peak can occur three hours before or after the predicted peak. The best paths are north-south. Long-duration meteors can be expected about one hour after the predicted peak.

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

What Is Your Location?

During the course of most amateur radio contacts, giving your precise location is not critical. However, during emergency communications correctly giving your location is essential. Here K6SOJ describes how to properly state your location.

By D. W. Thorne,* K6SOJ

If you hear someone ask, "What is your location?" or say, "Say your location." (on phone), or send "QTH?" (on CW) how do you reply? The correct answer will vary based upon the time, place, and situation. To state your location effectively and appropriately takes knowledge and experience in proper operating procedures plus a little common sense.

If I break a pile-up working a DXpediton station, I would say to the DX: "You are 59 in northern California." That information is all the DX station would need or desire. If I say much more, I will probably be ignored (or worse) and run the risk of being labeled "a lid."

However, "armchair DX operators" (engaged in a casual QSO) in other countries may be interested in knowing what county or city I live in, or some other geographical or historical information about the area in which I live. For example, "I'm 40 miles northeast of Mt. Shasta, which is 14,192 **feet** high." VHF and UHF operators are often interested in knowing from what grid square your signal is originating. For example, "I am in Siskiyou County, California, grid square CN91."

By contrast, most stations in a public service net need to know a station's approximate location because they may have message traffic to a certain general area. Say your location in a manner such that most people will recognize where you are located. When working DX or stations around the U.S., I usually say my location as, "I am located in northern California, 10 miles south of the Oregon border." The reason I add the second part is because many people think of Sacramento and San Francisco as "northern California," and I am actually 300 miles north of those population centers! I might also add, "I am 115 miles inland from the Pacific Coast," and/or add, "I am in Siskiyou County," or the name of my nearest town, which is Macdoel. My location information depends upon the type of contact.

In EmComm (emergency communications) work, whether it is local VHF or in wider-area HF nets and contacts, the casual guidelines change. Information must be more specific! When reporting an *emergency* incident, such as an automobile accident or some lost hikers just found in the woods and urgent help is needed, all the examples given above are useless to first responders!

Once contact with another station is established, the location provided must be accurate and *specific*. The location must be stated in such a way that rescuers can find it and in such a manner that the location stated *cannot* be mistaken for *any other place*! The location must also be sent in a way that the receiving station and/or agency will recognize any landmark references you are saying. (Of course, you must know where you are!) When reporting to an amateur radio operator who will be relaying the message to local authorities who (hopefully) are familiar with the area, you should reference local roads, landmarks, and other topographical features.

Saying Your Location Effectively

Here are some examples of how to say your location effectively:

"I am reporting a house fire at 811 North Flame Street, Belltown; cross street 8th Ave."

"The accident is on HWY 97, approximately 14 miles south of Midland."

"I am on HWY 39, one-quarter mile north of mile marker 14 in Cormorant County."

"The smoke is on the west side of Sheep Mt. at about 5500 feet elevation."

"I have broken down east of Interstate 5 approximately 20 miles in on forest service road 46N32W in the Goosenest Ranger District." In this case you should also give your color and type of vehicle so that the emergency responder can know what to look for when responding to your disabled vehicle emergency.

Suppose you are enjoying a boating vacation and you are called upon to make a distress call from somewhere on the shores of Lake Powell, Utah. Your home is far away and you are not familiar with the area. After calling "Mayday, Mayday, Mayday" on 20 meters, you establish contact with a capable station in Palm Beach, Florida and you say, "I am reporting an *emergency* on Lake Powell in Utah; houseboat explosion with 14 injured persons." <pause> "Notify Utah State Police." <pause> "We are six miles northeast of the fuel dock at north end of lake." <pause> "I am standing by for your reply." The receiving station then confirms that the information has been received and understood.

As long as the signals are sufficiently readable, the receiving station *must* maintain control of the frequency. If other stations "break," he/she should say, "I am handling *emergency* traffic. All stations please stand by and monitor unless called."

I was once in the process of handling an actual emergency situation and had to ask five stations, all of whom "wanted to help," to please stand by. Good intentions and a willingness to help *may* delay a rescue. If you hear actual emergency traffic

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in progress, do the following: *Listen carefully, write down everything you hear, and stand by in case you are needed.*

The receiving station in the above incident would then notify the Utah State Police directly, or call his/her own local 9-1-1, or even the U.S. Coast Guard. Then the receiving station confirms to the station reporting (originating the distress call) that the incident has been reported to a competent authority.

The calling station and the receiving station should maintain contact until help has arrived, and possibly even after first responders are "on scene." (Responders may not have contact with the dispatch center.)

If the "on scene" station is on battery power, the transmissions should be minimized. Ask the receiving station to maintain a radio watch and keep the frequency clear. Make a schedule as to when you will call again—for example, "I will call every ten minutes," or "I will call you at the top and bottom of each hour."

Other traffic from the reporting station might include: "We will signal with smoke or aerial flare when rescue craft are spotted." If you have a GPS receiver, "Our position is 37 degrees 30.3 minutes north by 110 degrees 28.7 minutes west." (The EMCOMMWEST bulletin No. 176 covers how to send geographical coordinates. See: <http://www.emcomm.org/svares/archives/number176.htm>.)

To review: How you reply to the question "What is your location?" will vary depending upon the time, place, and situation. To "say your location" effectively and appropriately requires knowledge, experience, and (most importantly) being able to *think clearly* under pressure!

How *Not* to Say Your Location

Here are a few voice replies to the query: "What is your location?" These responses were actually heard on the air. Sadly, some of these responses occurred during actual emergencies.

"I'm at home." (I guess this person believes that he is so famous that everyone must know where he lives!)

"I'm on the highway, just past the SPEED LIMIT 55 sign."

"I'm parked by the big green gate."

"I don't know. Honey, where are we?"

"I'm on Interstate 5." (Interstate 5 is a long highway, which narrows location possibilities to about 2000 miles. One might as well have said, "I'm on Main Street.")

"I'm at the college."

One day as I was serving as net control for a regional net, a station checked in and identified as being in northern California. I was interested in knowing more and asked, "Can you be more specific as to your location?" He replied by saying the name of a mountain peak, with which I was not familiar. I queried the operator again who replied by giving his latitude and longitude. Well, I guess I got what I deserved! Without having a map of his area handy (with latitude and longitude lines), a ruler, and maybe a divider, I still had no clue as to his location. Be careful what you ask for—and be ready for it!

Occasionally we hear a mobile operator give his/her location as, "I'm en route or headed to ————." Now that's very nice to know, but it doesn't have anything to do with where he/she is at that time! One can be "en route to" somewhere from anywhere! NCS and other net stations need to know where you are *now* in the event there is a request for current road or weather information. Where you are headed may or may not be of value.

EmComm Gets Sky-High Boost From AMSAT's Phase IV Geostationary Satellite

A new era for amateur radio in disaster communications may soon be ushered in. Under consideration by AMSAT is a proposal to equip a geostationary satellite with AMSAT Eagle/Phase IV Advanced Communications Payload (ACP). Should this proposal become reality, it could enable the quick deployment of amateur radio teams into disaster zones and thereby provide unprecedented disaster communications support. Here K9JKM describes how that proposal may roll out.

By JoAnne Maenpaa,* K9JKM

Amateur radio has an outstanding record of assisting with emergency communications. Emergency services recognize the hard work of hams around the world. We are sometimes the first and only link to the outside world until more help arrives. We provide additional communication links when the public safety channels clog with disaster traffic. We fill in the coverage holes that almost every communications system experiences.

One of the most common disaster communications interoperability problems arises when multiple agencies are required to respond to an incident. Each agency may utilize different radio frequencies, digital vs. analog modulation, and have limited ability to retune its equipment. At times, the geographic realities of the response environment impose additional constraints. Communication problems of this type are so common that the US Department of Homeland Security has established its Office for Interoperability and Compatibility to address the problem.[1] Amateur radio operators have been able to fill in various interoperability problems with our frequencies and equipment.

Hams are well acquainted with radio coverage problems while providing emergency communications. The high-frequency bands suffer from hourly to daily propagation challenges. VHF and UHF simplex channels have limited geographic coverage. A repeater improves coverage while restricting all operations to its fixed channel pairs. Most of our current operating modes offer voice communications only. If data is transmitted it is supported at low rates such as 300, 1200, or 9600 baud.

Real world experience following disasters such as 9/11, Hurricane Katrina, and most recently with Hurricane Ike have shown that the first responders face damaged or destroyed communication infrastructure. Adding to the problem is

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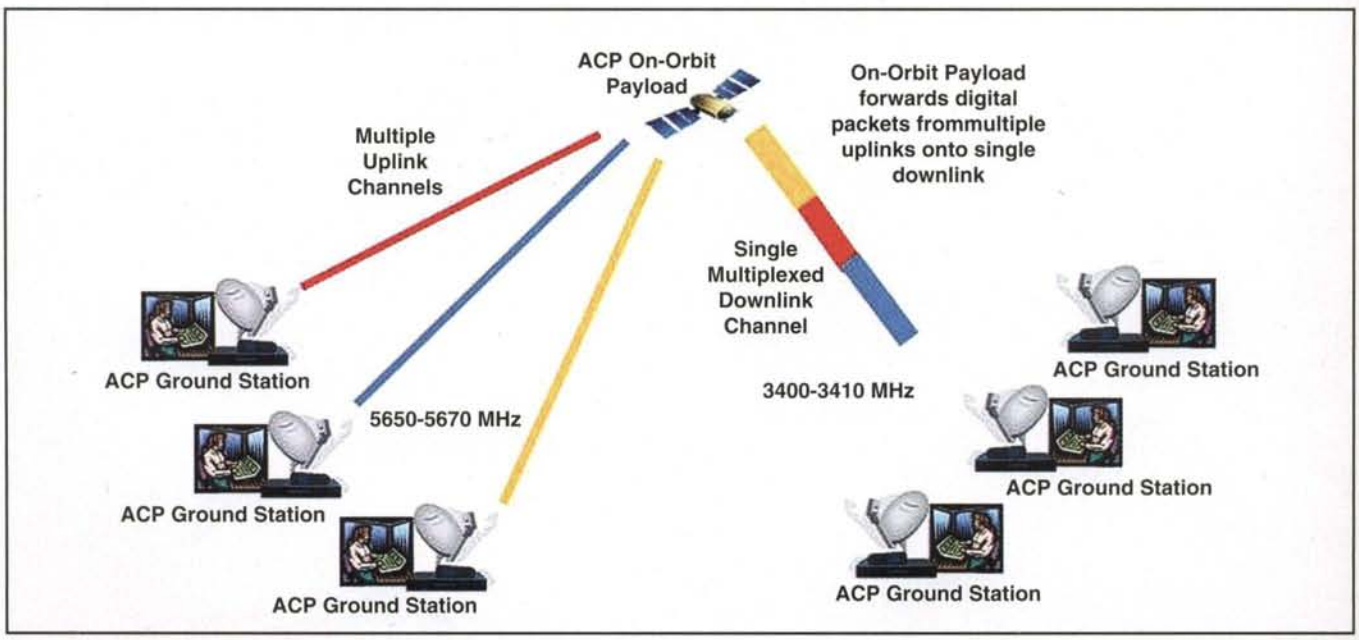

Figure 1. Advanced Communications Package multi-user network design proposed by Tom Clark, K3IO. Tim Salo, AB0DO proposed an IP-based design for the Earth stations and satellite, greatly expanding the transport of multiple-user applications, including voice, video, and data. Both papers were presented at the 2008 AMSAT Space Symposium in Atlanta, Georgia.

Learn More about Your Role in Emergency Communications Support

Many resources are available to familiarize yourself with the Incident Command System and to help you understand the Section roles that you may be called upon to provide amateur radio communications support.

The ARRL offers interactive, on-line training in its Continuing Education catalog at <http://www.arrl.org/cce/courses.html>. Refer to the Amateur Radio Emergency Communications (AREC) course offerings.

FEMA offers a version of the National Incident Management System – Incident Command System Emergency Field Responder Field Operating Guide (undergoing review) at: <http://www.fema.gov/pdf/emergency/nims/erfog.pdf>.

On-line training is available from FEMA for:

- Individuals—see <http://www.fema.gov/about/training/individuals.shtm>.
- Emergency Management Responders—see <http://www.fema.gov/about/training/emergency.shtm>.
- Role of Volunteer Agencies—see: <http://www.training.fema.gov/EMIWeb/IS/is288.asp>.

that the remaining few wireless channels available become quickly clogged.

OK already! Enough discussion of the problems we are all aware of! How about some solutions? A design under study at AMSAT proposes flying an analog and digital 5- GHz uplink/3-GHz downlink on a geostationary satellite carrying the AMSAT Eagle/Phase IV Advanced Communication Payload (ACP). This could enable an amateur radio "Go Team" to quickly provide unprecedented disaster communication support services between stations within range of the satellite's footprint. Stay tuned to learn more about this satellite being designed. You will learn how it may fit into the US Department of Homeland Security's National Incident Management System and its Incident Command methods of operating.

The AMSAT Advanced Communications Package

The AMSAT Eagle design team is proposing a communications payload that utilizes the amateur microwave allocations. With K3IO's "strawman" design, the digital ACP channels would also be accompanied by some more conventional "bent pipe" linear transponder channels. Realizing that microwave Earth station design is beyond the scope of most hams, the Eagle team is considering options to make an ACP-capable Earth station within reach of most radio amateurs. The design work is still ongoing, but it has been proposed that the Earth station may be distributed along the lines of the project kits offered by the Tucson Amateur Packet Radio group (TAPR). Radio-link budgets are being designed so the average Earth station could leverage the use of 0.9–1.0 meter (36–40 inch) diameter dishes and would appear similar to installations used for home satellite television.

A rideshare opportunity for the Eagle ACP means that AMSAT would be allowed to attach its radio payloads to a geostationary communications satellite. The "mother ship" would provide hundreds of watts of DC power over a span of 10 to 15 years. The main satellite would also perform all station-keeping and Earth-pointing navigational duties for keeping high-gain antennas pointed at Earth. For the amateur operator on Earth, within the satellite's footprint, it means that no tracking would be required once the signal is acquired. You would be able to aim your antenna at a predictable, fixed point in the sky.

Launch opportunities under study will place the amateur payload over the equator, offering 365/24/7 amateur satellite availability for 30–40% of the Earth below. Future geostationary rideshare opportunities over the upcoming years will allow AMSAT to expand the Eagle constellation to provide 365/24/7 worldwide amateur satellite coverage. Exciting times are ahead for amateur radio in space!

Unprecedented Emergency Communications Opportunity

The Unified Command/Incident Command System (UC/ICS) has evolved to be the standard model for most local, state, and federal emergency response. Modern emergency management includes pre-planning as many likely disaster scenarios as possible. Logistical support is enhanced when the emergency responder's equipment is either rapidly deployable or already pre-positioned based upon these pre-planned scenarios.

When an incident activates the responding agencies, the key participants

U.S. Environmental Protection Agency, Chair
U.S. Coast Guard, Vice-Chair
U.S. Department of Agriculture
U.S. Department of Commerce
U.S. Department of Defense
U.S. Department of Energy
U.S. Department of Health and Human Services
U.S. Department of the Interior
U.S. Department of Justice
U.S. Department of State
U.S. Department of Labor
U.S. Department of the Treasury
U.S. Federal Emergency Management Agency
U.S. General Services Administration
U.S. Nuclear Regulatory Commission
U.S. Department of Transportation

Table 1. U.S. National Response Team member agencies.

are those teams included in these pre-planned scenarios and that have participated in the Incident Command training and drill situations. In many cases responding individuals or teams outside of the scope of the Incident Command pre-planned environment are treated as convergent volunteers. Convergent volunteers—who are viewed as well-intentioned but untrained, unprepared, and incompatible-with-ICS responders—may be turned away in most scenarios or held in a holding area until a need is identified. In other words, in the modern emergency communications environment, simply showing up with a radio likely will not automatically get you a seat on the communications team.

Reliable, constant-coverage satellite communications could offer a unique communications tool to enhance an Emergency Manager's capability to stay in touch with the diverse teams operating as segments of the Incident Command System. Amateur radio operators have become part of the UC/ICS response models in their communities and have already begun to fit into pre-planned roles as a communications interoperability solution.

The Eagle ACP multi-channel, multi-mode (voice, digital, video) capability needs to be introduced to the Incident Command community and become a part of its disaster planning scenarios in order (1) to gain acceptance by the responder community as a viable communications solution, and (2) as a means of securing the interest and support of launch fund-

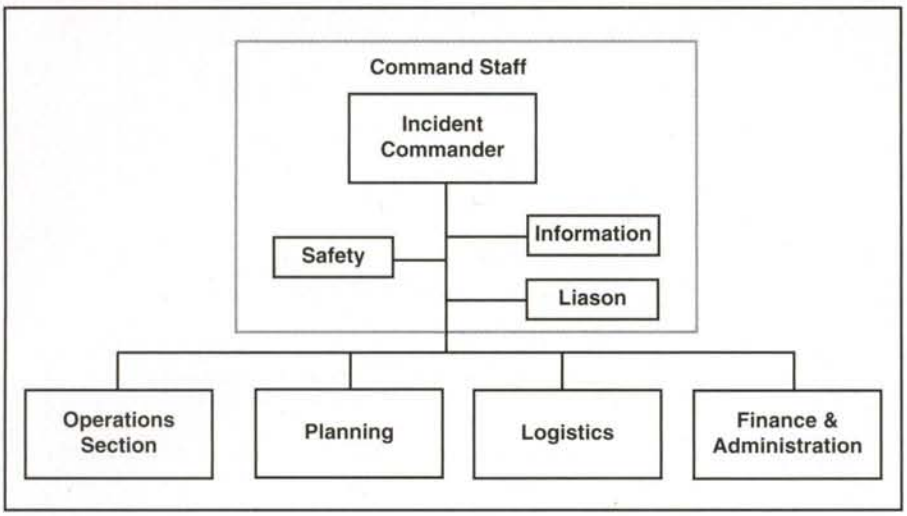

Figure 2. Basic Incident Command structure.

ing sources in the new pay-as-you-go launch environment.

In previous discussions of launch opportunities, AMSAT discovered that the business environment for getting into orbit has changed considerably over the years. Many prior amateur satellites reached orbit riding along as ballast to balance out the primary payload. It used to be that increasing the payload weight meant an equal reduction in fuel capacity. In contrast, modern lift vehicles have excess boost capacity over the requirements of most of their primary payloads. However, both commercial and government launch organizations have discovered the commercial value of every cubic inch of space and ounce of weight aboard their vehicles. AMSAT will need to generate a mission that excites potential funding sources. Amateur radio projects in space will have to justify our use of the resources beyond launching a platform that supports casual conversations by a group of hobbyists and experimenters.

Let's next explore the National Incident Management System (NIMS) and demonstrate how amateur radio in space enhances disaster communications.

Chemical Emergencies
Dam Failure
Earthquake
Flood
Hazardous materials
Heat
Hurricane
Landslide
Nuclear Power Plant
Terrorism
Severe Thunderstorm
Tornado
Tsunami
Volcano
Winter Storm
Wildfire

Table 2. Federal disaster-type planning.

National Response Overview

Of the multitude of disaster scenarios likely to affect the civilian population, most may be managed by the agencies participating in the National Response Team. This is an organization of 16 federal agencies with emergency resources that are empowered via legislative authority to plan, coordinate, and participate in emergency response. These agencies are summarized in Table 1.

The National Response Team

Natural disasters such as hurricanes, tornadoes, earthquakes, and wildfires require the resources of several local, state, and federal agencies. The US National Response Team also provides technical assistance, resources, and coordination on preparedness planning, response, and recovery activities for emergencies not caused by nature. This includes emergencies involving hazardous substances, pollutants, contaminants, and weapons of mass destruction in natural and technological disasters. (See Table 2.)

The UC/ICS response system provides a flexible management tool, allowing agencies best equipped to handle specific events to assume lead roles. For example, a hurricane response may likely require more involvement of FEMA personnel than from the Department of State. At times, geographic demarcation of the disaster area may require specific response of certain agencies or assets. Incident response pre-planning has identified the appropriate agencies and gained their agreement to the response plans.

The major building blocks of the UC/ICS response system are pre-planned and rehearsed by the responsible agencies within their own jurisdictions and with the entire Response Team. These building blocks are defined by the Incident Command System. For AMSAT and amateur radio operators to provide an effective solution as a communications asset, the associated disaster pre-planning should include the capability of amateur radio operators equipped with the ACP satellite link in the Incident Commander's toolbox.

Incident Command System

The Incident Command System allows for systematic, standardized, on-scene management that adopts an integrated organizational structure growing to match the complexity and demands of any single incident or multiple incidents and is not hindered by jurisdictional boundaries.[2]

The basic structure of an Incident Command System is shown in figure 2. Each of the functional sections of the UC/ICS provides AMSAT and amateur radio operators an opportunity to introduce an interoperability radio link. Many radio links may be required within individual sections when they are composed of several functionally divided teams or are geographically separated. The ICS is designed to telescope outward as responding resources are brought to bear and to telescope inward as the incident is resolved.

The Incident Command System was originally developed to manage rapidly moving wildfires. It was designed to address problems such as:

- Too many people and job roles reporting to one supervisor
- Different organizational structure for every responding agency
- *Incompatible and inadequate communications*
- Uncoordinated planning capability for multiple agencies

As the ICS has evolved, many local and federal agencies have mandated its use. Almost all emergency response is initiated at the local level when a problem is discovered. The ICS allows the scope of the response to telescope out-

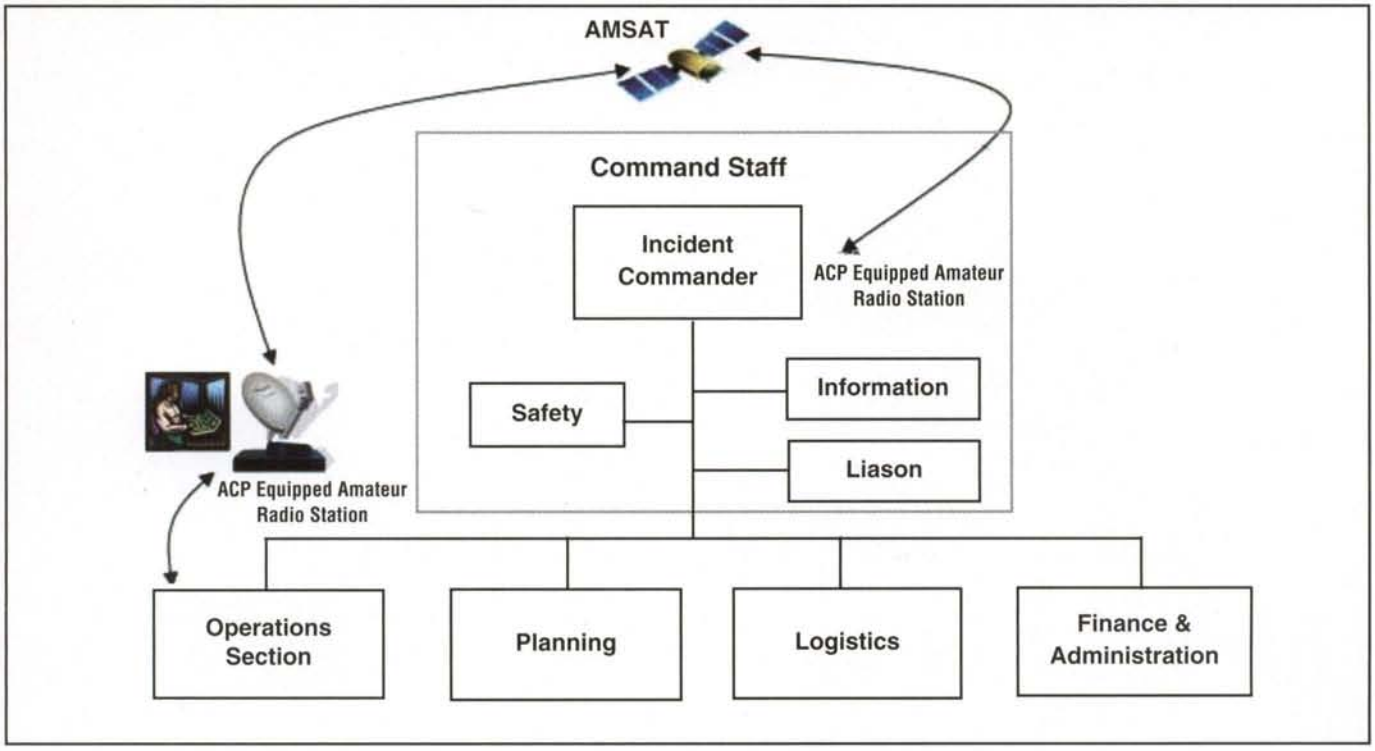

Figure 3. Communications support scenario—Incident Commander with remote operations section.

ward as additional resources are added. The emergency response maintains a manageable span of control by dividing the key tasks into sub-units commonly called "Sections":

• **Command Operations Staff**—The Incident Commander is responsible for developing the incident objectives and managing all incident operations.

Information Section—the Information Officer's role is to develop and release information about the incident to the media.

Liaison Section—the Liaison Officer serves as the point of contact to coordinate activity between the Incident Command and groups such as law enforcement, Congress, etc.

Safety Section—the Safety Officer assures the health and safety of the responders and affected public population.

• **Operations Section**—responsible for all work directly applicable to the primary mission of emergency response. This section usually includes the fire fighters, search-and-rescue teams, emergency medical system, law enforcement, flood rescue, etc.

• **Planning Section**—responsible for collecting, evaluating, and reporting the tactical information related to the incident, and for preparing and updating the Incident Action Plan.

• **Logistics Section**—responsible for providing facilities, services, and materials for the incident response. This section provides vehicles, staff, shelter, food and water, and manages the staging areas.

• **Finance and Administration Section**—responsible for all financial, administrative, and cost analysis of the incident.

Each of the operating sections may be co-located in a command post with the Incident Commander or may be located elsewhere in the field. Staffing of the sections may be provided by a single agency or by several agencies. Inter-section communications may be relatively simple in the co-located, single agency response, growing increasingly complex as the scope of the disaster response requires.

Communications become more challenging when the Incident Commander needs to add more agencies to the incident team and to move operational components out to the field. The added agencies may not have compatible radios; remote sites will require establishment of a solid communications link back to the Incident Commander.

The Incident Commander may remain in a centralized location, but the Operations Section's work and responding staff may be spread over several miles, cities, counties, or states due to geographic accessibility, location of resources, or simply being cut off from the outside world. The Incident Command System's flexibility allows all Sections and their staff to be remotely located.

Taking the multiple agency response example further, the types of agencies that could be included in the Operations Section include fire, law enforcement,

Learn More about AMSAT and the Eagle Advanced Communication Package

AMSAT's vision is to deploy satellite systems with the goal of providing wide-area and continuous coverage. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups. Visit us online at: <http://www.amsat.org>.

Eagle is AMSAT's project to develop high-orbit, wide-area-coverage communications satellite systems. A dual-use approach is utilized to provide maximum flexibility to allow AMSAT to respond to high Earth orbit launch opportunities. The same Advanced Communication Package payload is anticipated to be used for both a highly elliptical high Earth orbit as well as the rideshare geosynchronous satellite.

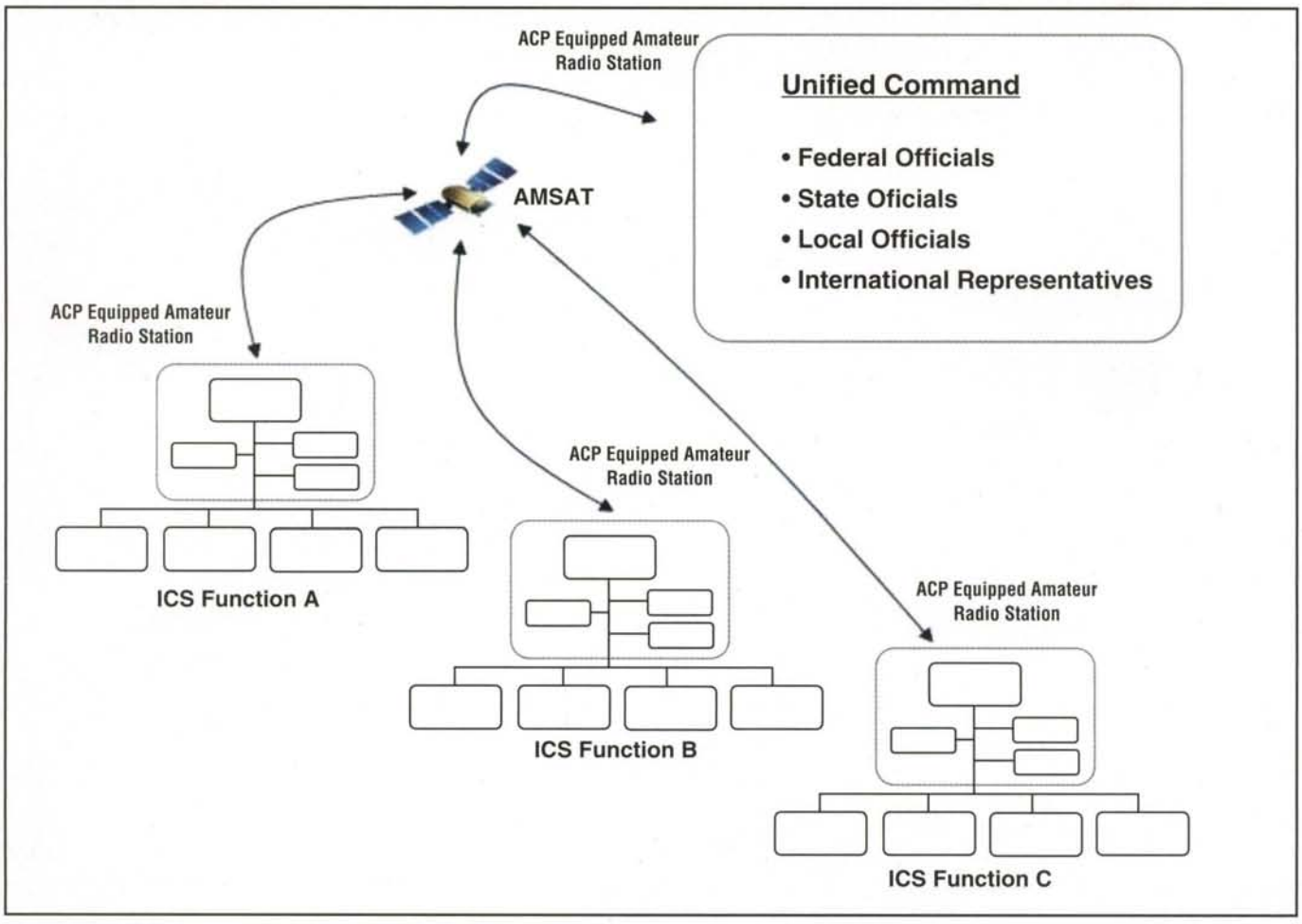

Figure 4. Multiple incidents operating under unified command with AMSAT Eagle ACP communications support.

public health, public works, and emergency medical services, working together as a unit or in combinations depending on the situation. Many incidents may also involve private individuals, companies, or non-governmental organizations, some of which may be fully trained and qualified to participate as partners in the Operations Section.[3] Training and qualification will be the key to successfully introducing the Eagle ACP and amateur radio in space operators into the National Response Plan.

The Incident Commander and staff decide upon the best organization of the Operations Section depending on the type of incident and their operating plan. The organizational layout of the Section may depend upon geographic divisions; other times it may make sense to organize the Section according to functional responsibilities.

Incident communication plans generally establish radio networks organized as:

• **Command Net**—links together the Incident Commander with the command staff and section chiefs.

• **Tactical Net**—several networks may be organized to support the multiple functions or geographic areas of the Operation Section.

• **Support Net**—tracks the status of resources and logistical response to handle resource requirements.

Figure 3 illustrates the expansion of the basic Incident Command System with a centrally located Command Staff and remote Operations Section employing the Eagle ACP for communications support.

Operation in a Unified Command Environment

An Incident Command structure may be expanded into a Unified Command (UC). The UC is a structure that brings together the "Incident Commanders" of all major organizations involved in a major incident in order to coordinate an effective response while at the same time carrying out their own jurisdictional responsibilities. The UC links the organizations responding to the incident and provides a forum for these entities to make consensus decisions. Under the UC, the various jurisdictions and/or agencies and non-government responders may blend together throughout the operation to create an integrated response team.

The UC may be used whenever multiple jurisdictions are involved in a response effort. These jurisdictions could be represented by:

• Geographic boundaries (e.g., two states, Indian Tribal Land)

• Governmental levels (e.g., local, state, federal)

• Functional responsibilities (e.g., fire fighting, oil spill, Emergency Medical Services);

• Statutory responsibilities

International Response

The U.S. National Response Team has established planning for international coordination with Canada, Mexico, the Canal Zone, and other international agencies:

• **With Canada**

* Canada-U.S. Joint Inland Pollution Contingency Plan, Annex III

* Canadian Coast Guard
* Environment Canada
* Emergency Preparedness Information Exchange
* Public Safety and Emergency Preparedness Canada
* CANUTEC—Canadian Transport Emergency Centre of the DOT
* Canadian/US Atlantic (CANUSLANT) Joint Response Team

- **With Mexico**
  * U.S. Mexico Joint Contingency Plan (1999)
- **The Canal Zone**
- **With Additional International Agencies**
  * Organization for Economic Co-operation and Development (OECD)
  * Environmental Media Services (EMS)
  * United Nations Environment Programme
  * European Space Agency (ESA)
  * International Federation of Red Cross and Red Crescent Societies

International emergency response coordination presents additional opportunities for AMSAT to offer ACS ground station equipment and amateur radio assistance. Some of these agencies may also be potential funding sources when the AMSAT's emergency communications capability is discussed with them.

Conclusion

The National Incident Management System and the Incident Command System provide AMSAT with the opportunity to offer communications interoperability between several responding agencies. Our satellite link may prove most useful and more interesting to Emergency Managers when offered in the context of international, national, regional response, and in multiple agency scenarios.

Some question the viability of seeking government funding for amateur radio projects. With the Eagle ACP AMSAT could expand amateur radio's emergency communications capability into a viable national and international resource. We need to first build a mission that excites potential funding sources, which is why this discussion has been focused on government response to disasters. Our beneficial side effect will be the availability of high-orbit transponders for amateur radio experimentation and communication in all the ways we enjoy them.

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3. NIMS-9.0, National Incident Management System, Department of Homeland Security, March 1, 2004

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By Miguel Enriquez, KD7RPP

ATV

Amateur Television for Fun and Education

"To the Moon, Alice"

Many of you will remember the above declaration, which is from the 1950s television program *The Honeymooners*, as Ralph Kramden's vacuous threat whenever Alice, his astute wife, put him in his place. However, to our amateur radio club members at Pueblo Magnet High School in Tucson, Arizona, far from being inane, the phrase "To the Moon" also is more than a trivia answer to a distant sitcom question. Furthermore, it is a message of hope and growth and commitment.

Small ideas, hard work, and fun can become something really big. That is what has happened to the "little engine that could," otherwise known as the Pueblo Magnet High School Amateur Radio Club.

It Started with My HT

Four years ago my 2-meter HT came to life while I was teaching algebra. The students wanted to know what the funny-looking cell phone was all about. Lots of demonstrations and explanations ensued.

This serendipitous event led to the beginning of ham radio use in the classroom to motivate the students to learn and to apply the math. That same year our Arizona Instrument for Measuring Standards (AIMS) math scores skyrocketed at Pueblo. Several reasons were attributed to the significant improvement, and one of those reasons was the increased application of math in the classroom because of ham radio.

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

Our club has continued to experience other ham radio successes: an ARISS (Amateur Radio on the International Space Station) contact, students earning their Technician and General Class licenses, the creation of the only amateur television station in a public school in the state, and other significant events.

At present the Pueblo ARC has 27 members. Sixteen of those members are also enrolled in a ham radio class I have begun teaching this year. The class— Radio, Space and Wireless Technologies—is offered as an elective through our Career and Technologies Education Department. The class focuses on the Technician and General licenses, providing instruction and support to students so that they may earn their amateur radio licenses.

The class also focuses on space technologies, with special interest in and study of amateur satellites. The Pueblo ARC has a station setup to monitor and, once more of the students have their licenses, to use the "birds" for QSOs. As part of the preparation for satellite communication, the Pueblo ARC has dedicated many hours to understanding how this particular technology works.

Now CubeSats

For the last eight months we have been floating a trial balloon, of sorts, to see if we can muster community support for a next-to-impossible objective: the design, construction, and launching of a CubeSat ATV satellite by Pueblo Magnet High School students.

This would necessitate resources way above our present means. It would also require some of our students to complete

Miguel Enriquez, KD7RPP, and a Pueblo Magnet High School student talk about amateur radio and CubeSats to a class in a nearby school.

Two students from the Pueblo Magnet High School show a model of a CubeSat to students in the nearby school.

high school and college, majoring in mathematics and engineering, and then return to Pueblo in five or six years to help construct the CubeSat satellite.

Initial inquiries to Raytheon engineers and to professors of mathematics, space sciences, and computer engineering departments at the University of Arizona have yielded positive results. When individuals were approached with this idea, almost every single person expressed support but wanted to wait for plan details before committing time and resources to the project.

Therefore, for the last three months the Pueblo ARC students have been working on a project management for the design, construction, and launching of the Pueblo ARC CubeSat by the year 2019. The objective is to launch a bird that would allow digital ATV with astronauts colonizing the moon.

Student-led Presentations

As the pictures demonstrate, our radio club members are very busy making presentations to elementary school children, other high school students, and parent and administrator groups. These demonstrations and presentations are designed to both inform the audiences about the exciting activities we have undertaken and to generate support for this ten-year project.

The students are scheduled to make a presentation to the Tucson Unified School District in November, notifying them that we have embarked on a mission of serious consequence and that we are not asking for any monies from them. The costs of the satellite will be earned through grants and contributions to the project. We already have a "Pennies for Satellite" box in the radio shack where students, parents, and teachers are encouraged to drop their pocket change on a daily basis.

Presently, the students are using a cardboard model in their explanations, but thanks to the magnanimous support and resources of the American Radio Relay League's (ARRL) Education and Technology Program, specifically the genius of Mark Spencer, WA8SME, the students will be able to use a simulator CubeSat model beginning in a few weeks to show how a real satellite works out in space.

Jefferson Park Elementary Joins the Project

Students at Jefferson Park (JP) Elementary School have now joined our project. Mr. Stewart Slonaker, a fourth/fifth grade teacher at JP is presently studying for his Technician license. The Pueblo ARC has begun providing the equipment and energy to help Jefferson Park School build its own amateur space station. Within weeks, JP students will be able to listen to the International Space Station as in flies above the Tucson skies from horizon to horizon. Some of the students are also preparing for their Technician license exam.

The station will also provide them with the ability to track and receive weather satellite signals, which the students will begin to convert into weather images from space. In addition, an ATV station is in the plans for this year, allowing our students to provide instruction via ATV to the elementary school, which is located about six miles across town.

The vision required to successfully deliver and launch a CubeSat satellite in ten years requires commitment and courage. Commitment of soul is the more difficult. The students who are dreaming of this very difficult challenge are already demonstrating a new level of dedication to their studies and to ham radio. They understand that a personal sacrifice will be required from each one of them if we are to succeed in our mission. Their parents are also expressing support and demonstrating it as well by talking to their children about the heavy responsibilities they are undertaking.

Furthermore, I, as a mathematics and amateur radio teacher, love it. My job gets easier and infinitely more fun by the second.

73, Miguel, KD7RPP

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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 Welcome Page* on the *CQ* website.

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By Mark Thompson, WB9QZB

DIGITAL RADIO

Digital Technology on VHF, UHF, and Microwaves

Digital Resources from TAPR

The premiere national digital communications group is called TAPR. TAPR was founded in 1982 as Tucson Amateur Packet Radio. TAPR has a long history of pioneering new digital technologies. It developed some of the earliest packet radio terminal node controllers (TNCs), the TNC-1 and TNC-2, upon which virtually all subsequent packet TNCs are based. TAPR's developments led to the packet revolution in ham radio from the mid-1980s to the mid-1990s. Over the years TAPR and its members have continued to be at the forefront of technical innovation in digital communications techniques such as digital data sound-card modes and software defined radio (SDR) technology.

In the early 1980s the ARRL began hosting the annual Computer Networking Conference. In the early 1990s the name of the CNC was changed to the Digital Communication Conference (DCC). In the mid-1990s the ARRL DCC was merged with the TAPR annual meeting. The ARRL and TAPR developed a memo of understanding in which TAPR was given responsibility for organizing the annual DCC and the ARRL published the DCC *Proceedings*.

The ARRL/TAPR Digital Communication Conference has become well known as the event at which to debut new digital technologies, modes, and operating activities. The DCC is a 2 1/2 day event. There are two full days of technical forums on Friday and Saturday. On Friday night is the TAPR social event, and on Sunday morning "deep-dive" sessions explore topics such as SDR. On Saturday there are concurrent introductory forums for those new to the digital modes. Additionally, TAPR conducts its annual meeting at the DCC. You can learn more about the DCC at: <http://www.tapr.org/dcc>.

At the annual Dayton Hamvention® TAPR has a booth displaying its latest projects. TAPR also conducts a digital forum at the Hamvention® with several digital topics covered every year. For many years TAPR held a Digital Bash Evening Banquet at the Hamvention®. Since 2006 TAPR and AMSAT have held a joint banquet organized by AMSAT. The banquet is an event you don't want to miss while at the Hamvention® and it typically sells out wel in advance. You can learn more about TAPR's Dayton Hamvention® activities at: <http://www.tapr.org/dayton>.

If you are unable to attend the TAPR Forum at the Dayton Hamvention® or the Digital Communication Conference, you can still learn about what's covered at TAPR conferences and forums from the following resources:

• Technical papers submitted to TAPR prior to the DCC are included in the DCC's published *Proceedings* distributed to DCC attendees. The *Proceedings* are available afterward from TAPR at: <http://www.tapr.org/pub_dcc.html>.

*P.O. Box 457, Palatine, IL 60078
e-mail: <wb9qzb@arrl.net>

This photo was taken at the 2008 ARRL/TAPR Digital Communication Conference in Chicago, Illinois.

• Amateur Radio Video News (ARVN) in conjunction with TAPR has recorded on video the TAPR and D-STAR forums at the 2007, 2008, and 2009 Dayton Hamventions® and the forums at the 2008 and 2009 Digital Communications Conferences. These videos are professionally produced and are a great resource of information.

• DVDs of the Digital Communication Conference forums are available from ARVN at: <http://www.arvideonews.com/dcc2008/index.html>.

• DVDs of the Dayton Hamvention® TAPR, SDR, and D-STAR forums are available from ARVN at: <http://www.arvideonews.com/Dayton/index.html>.

• TAPR publishes a quarterly journal, the *Packet Status Register* (PSR). TAPR solicits submissions to the PSR. Information about how to submit an article to the PSR plus back issues of the PSR are available at: <http://www.tapr.org/psr>.

• During summer of 2009 TAPR created a Twitter account to keep TAPR members and digital enthusiasts apprised of TAPR's events and activities. Join TAPR's Twitter account at: <http://www.twitter.com/taprdigital>.

I encourage you to support TAPR's efforts to develop and foster new digital communication techniques. Annual membership in TAPR is only $25. You can join TAPR at: <http://www.tapr.org/organization>.

I look forward to seeing many of you at the TAPR Forum and Banquet at the Dayton Hamvention® and at the Digital Communication Conference.

73, Mark, WB9QZB

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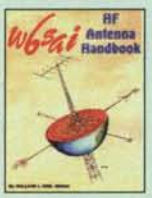

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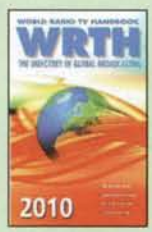

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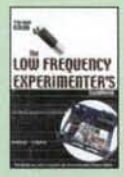

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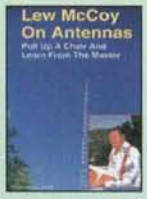

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By Bob Witte,* KØNR

FM

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

D-STAR Action Continues to Grow

In the amateur radio world D-STAR continues to be a hot topic. In this column I'll provide visibility to some of the exciting developments happening with D-STAR. The main message here is that the technology continues to evolve, including major involvement from the ham radio community.

The number of D-STAR users continues to increase at a rapid pace. D-STAR registrations (required to use the gateway-based features of D-STAR) are tracked on DStarUsers.org, so we have reliable data on how many individuals are on the system. There were roughly 8000 registered users in April 2009, which grew to over 9200 in three months, representing an annual growth rate of 60%. While still a small percentage of the overall radio amateur population, the growth rate is impressive.

Since most D-STAR repeaters have gateways that connect their users to the internet and other D-STAR systems, we can monitor this information in real time. The DStarUsers.org website shows recently heard stations on the network. For example, figure 1 shows a listing of recent stations present on the D-STAR system with my callsign (KØNR) listed as the fifth most recent station heard. The listing indicates the time heard, the repeater accessed (WØTLM), and the location of the repeater. Notice that the list is international in nature, with stations listed from several different countries.

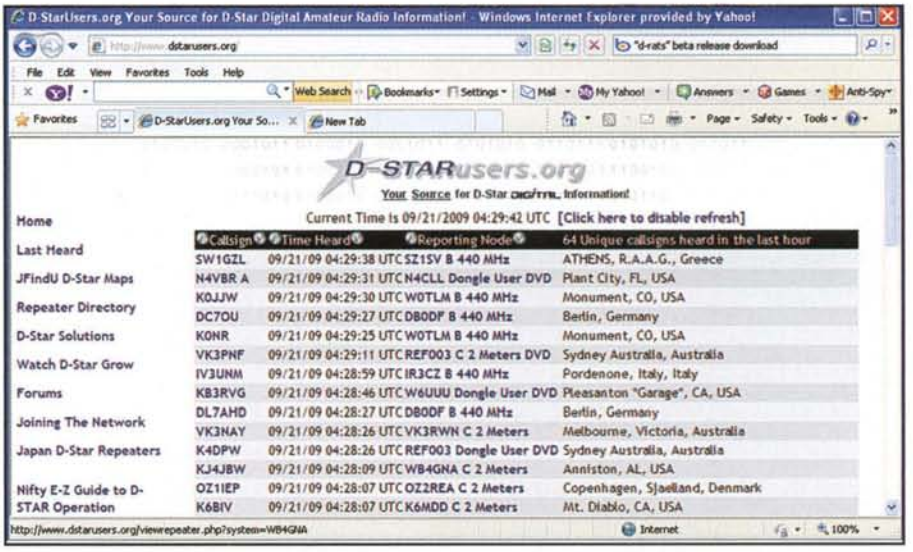

Figure 1. The DStarUsers.org website lists stations that have recently accessed the D-STAR network.

D-STAR on the Internet

There are some excellent sources of basic information for ham radio operators starting out with D-STAR. One of the challenges is getting your D-STAR transceiver configured correctly so that your signal goes to the right user and repeater. D-STAR has callsign routing built into the protocol, which generally requires you to enter up to four callsigns into your transceiver:

MYCALL: your callsign
URCALL: the callsign of the station you are calling *or the default "CQCQCQ" for calling any station*
RPT 1: the callsign of your local repeater (if any)
RPT 2: the callsign of the remote repeater (if any)

While this gives you a rough idea of the nature of D-STAR call routing, you'll need to do a little more homework before trying to access your local D-STAR repeater. For a more complete explanation, see the ARRL Alabama Section website "D-STAR Get-On-The-Air Radio Configuration Guide." This guide provides an overview of callsign routing to help you program your radio correctly.

Another great source for D-STAR information is the dstarinfo.com website, which offers an online tool called the D-STAR Calculator (figure 2). The D-STAR Calculator lets you specify the type of contact you are trying to make—for example, call a specific user on another D-STAR repeater—and gives you the callsign programming required for your rig. The dstarinfo.com website, sponsored by Georgia D-STAR, has other information to aid in understanding D-STAR operating. Georgia D-STAR also publishes an excellent source of D-STAR news called the "D-STAR Newsletter."

Amateur Radio Video News (Gary Pearce, KN4AQ) produces some professional videos about amateur radio subjects. The "Digital Voice for Amateur Radio" DVD has a 35-minute section on D-STAR and P-25 (mostly D-STAR). This video is a great introduction to D-STAR and can serve as a presentation for your next club meeting (figure 3). Take a look at the ARVN website and check out the free previews of the various videos.

Software Applications

D-STAR has captured the attention of many of our software-programming hams, who have written application software to add new capability to D-STAR.

*21060 Capella Drive, Monument, CO 80132
e-mail: <bob@k0nr.com>

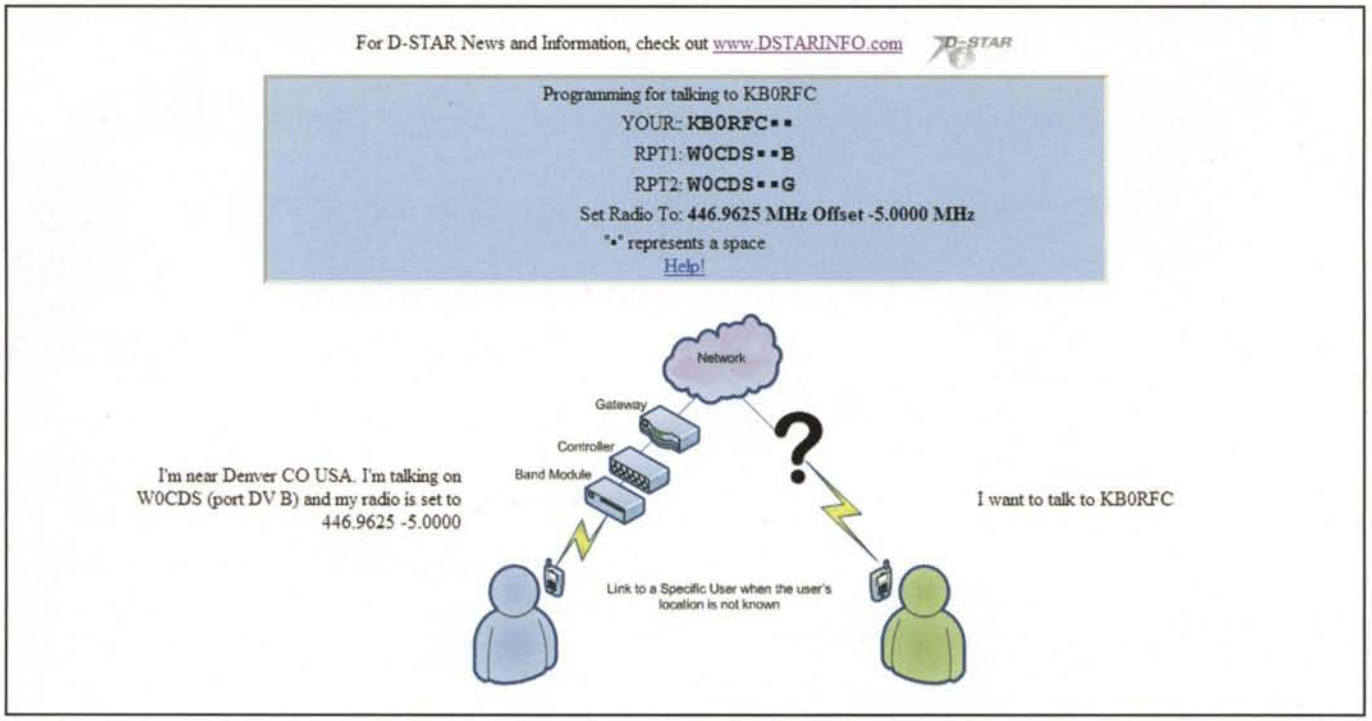

Figure 2. The D-STAR Calculator web page "calculates" the callsign routing configuration based on the communication path you specify.

This shouldn't surprise us, as the ham radio community has a long history of experimenting and innovating with new technology (whether it is hardware or software).

D*Chat (by Brian Roode, NJ6N) is a Windows® keyboard-to-keyboard application that enables text communication between D-STAR stations using simplex or through a repeater. This software works with all current ICOM D-STAR radios, can send a periodic QST message, and supports seven "quick send" predefined messages.

DStarLet is a web-based text messaging application by Dean Gibson, AE7Q, that uses Java and HTML to support text messaging. Multiple browser windows on the same or multiple computers can be used to create, send, receive, and manage multiple messages in parallel.

DStarQuery was written by Pete Loveall, AE5PL, to provide a universal query mechanism for ICOM D-STAR enabled radios with a low-speed port. DStarQuery is designed to run on any OS with any recent Java Virtual Machine.

D-RATS

D-RATS is a communications tool written by Dan Smith, KK7DS, for D-STAR DV-mode communications. (The name D-RATS is derived by reversing "STAR" to get "RATS.") It provides keyboard-to-keyboard chat capability, file transfers, automatic messages/beaconing, e-mail gateway support, and GPS/ mapping capability. D-RATS runs on Linux, Windows®, and Mac. This software program has captured the attention of the D-STAR equipped hams in my area, as Dan continues to add new capabilities on a weekly basis. Dan received the 2009 ARRL Technical Innovation Award for his programming contributions to digital communications.

Figure 4 shows a typical D-RATS chat window, which operates similarly to other instant messaging or chat systems on the internet. In fact, D-RATS is designed so that you chat over the air or chat via the internet (without the need for a radio). This adds flexibility for routing messages in the most effective manner. (You can use the internet when available or switch to RF when it's not.)

D-RATS also has a robust message-handling system that operates like conventional e-mail (figure 5). Again, we can deliver messages via the internet or via ham radio, whichever works out the best for a particular situation. The message system supports the concept of forms, which includes the standard NTS Radiogram format. D-RATS also supports direct file transfer between stations.

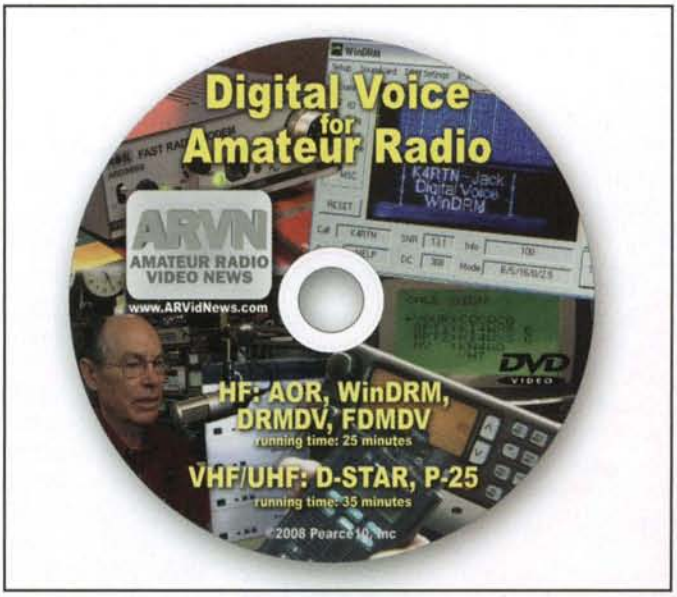

Figure 3. The Amateur Video News Network offers a DVD on digital voice technology, including D-STAR.

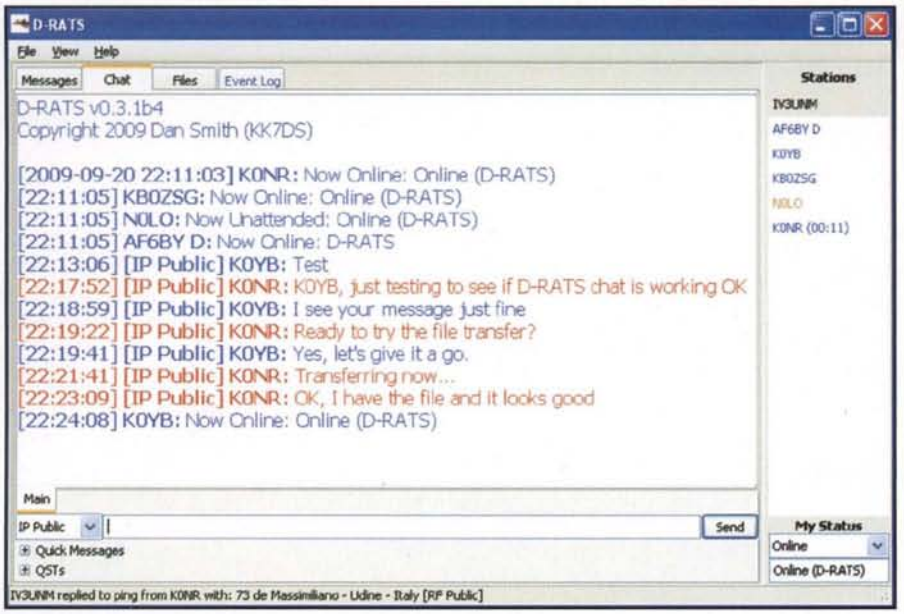

Figure 4. D-RATS has a chat feature, similar to internet instant messaging or chat.

Another feature that D-RATS offers is mapping of position (very similar to APRS but not directly compatible with it). The software automatically keeps track of the positions of other stations and downloads the appropriate maps from the internet for display. This is very slick—no maps to buy and the downloading is automatic. In figure 6, I plotted my home location using D-RATS. I could have included other stations in the same view.

My objective here is to give you a taste of what D-RATS can do and I hope you will check it out further. I haven't hit all of the features of the program (and Dan has probably added a few since this article went to press). Keep in mind that with D-STAR, voice and digital are embedded into one signal. There is no extra TNC to drag around, so my D-STAR radio and a computer with D-RATS (or one of the other programs) are all I need to run voice and data. (Actually, I do have a USB-to-serial adapter in line since my IC-91AD uses old school RS-232 but my notebook PC only has USB ports.)

D-STAR Hardware

One thing that comes up quite frequently as a concern with D-STAR is that ICOM is currently the only major amateur radio manufacturer offering D-STAR compatible equipment. This might make you think that D-STAR is proprietary to ICOM, which is not the case.

Recently, David Lake, G4ULF, and members of the Ashdown Forest Repeater Group in the UK put the GB7MH repeater on the air. This is a homebrew D-STAR

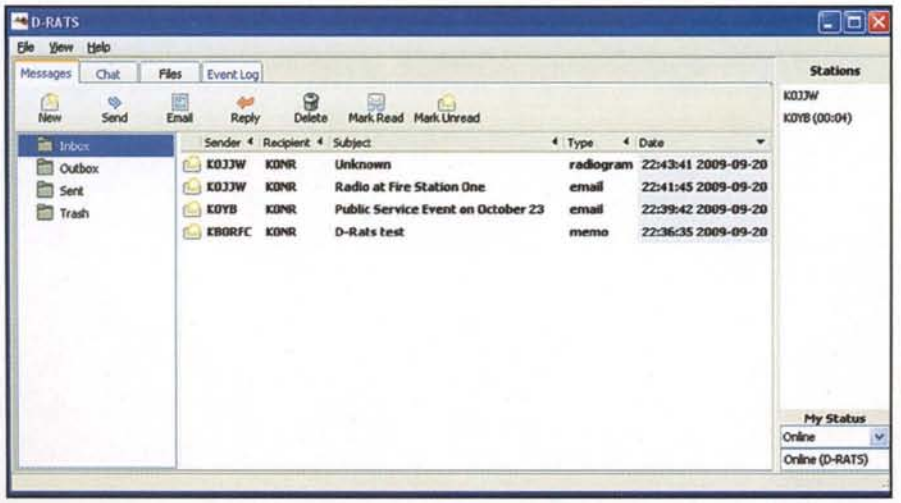

Figure 5. D-RATS offers a messaging system similar to conventional e-mail.

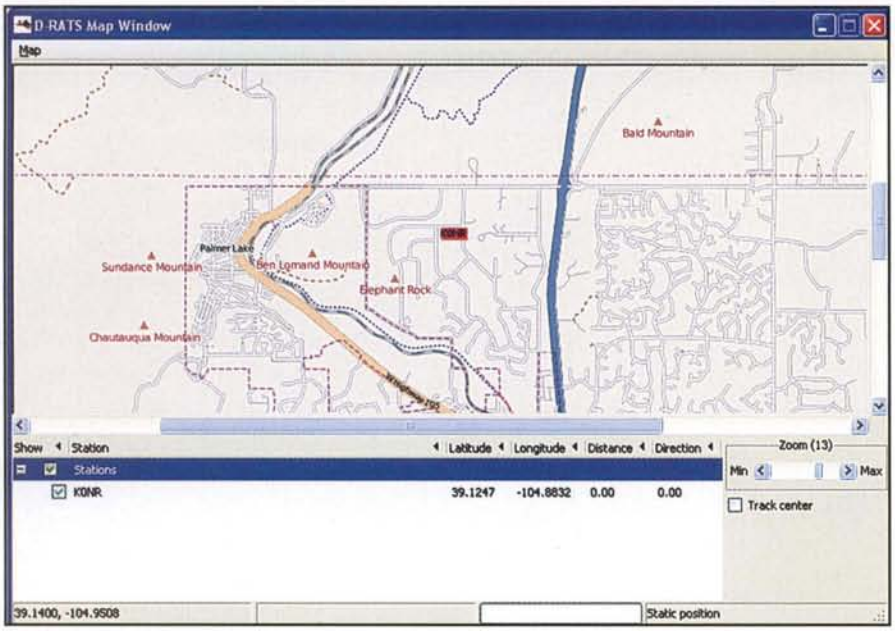

Figure 6. D-RATS has a position mapping feature that conveniently shows the position of stations you contact.

repeater that uses no ICOM hardware! This is living proof that it can be done.

The hardware consists of a Tait T800 repeater modified to handle GMSK modulation used in the D-STAR standard. The system knows how to handle callsign routing and is up and running on the D-STAR network.

Another new development is the Dutch*STAR group in the Netherlands. Their slogan is "D-STAR for the Rest of Us," as they are creating D-STAR compatible radios in kit form (again, no ICOM hardware). The following is from the Dutch*STAR web page:

> The project slogan says it all, really…the goal of the project is to allow D-STAR to be affordable by anyone, and easy to use for anyone. To keep cost down, the products were decided to be complete kits, and not just schematics or a PCB layout file. Complete kits make it easier for people to start building, and some advice was sought from the great people at Elecraft on how to pursue this.

Check out the current offering on the group's website in the references section.

Improving the Network

There have been some really cool developments on how D-STAR repeaters can be linked. ICOM's original implementation relies on the callsign routing method to talk between two repeaters. This method has its advantages for certain scenarios, such as when I want to call a specific radio amateur and no one else. However, many hams wanted a more conventional way to link repeaters together, more like IRLP. In such a system, the repeaters are linked so that anyone on either repeater can hear all stations on both repeaters.

Robin Cutshaw, AA4RC, wrote a software program called dPlus which works with the ICOM gateway software to implement conventional linking between repeaters. D-STAR reflectors have also been created which dPlus can access, creating a "conference bridge" approach to linking multiple repeaters. This is yet another example of a technically oriented ham building on top of ICOM's D-STAR system. There are several other efforts under way to enhance or even replace ICOM's gateway software, so stay tuned for further developments.

Clearly, D-STAR activity is on the increase. More importantly, the amateur radio community is digging in and learning how to apply this technology. Some of our more technical members are building on top of the initial work from ICOM to adapt and improve the D-STAR system. Oh, did I mention D-STAR video? This is essentially slow-scan television over D-STAR. This just the beginning, with more hardware and software still to come!

Tnx and 73

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

73, Bob KØNR

References

"D-STAR Get-On-The-Air Radio Configuration," ARRL Alabama Section: <http://www.arrl-al.org/D-STAR_radio_setup6.pdf>

D-STAR Calculator: <http://www.dstarinfo.com/Calculator/DSTAR%20Web%20Calculator.aspx>

D-STAR Information Site: <http://www.dstarinfo.com/>

Amateur Radio Video News: <http://www.arvideonews.com/>

D-STAR Users Web Site: <http://www.d-starusers.org/>

NJ6N D*Chat web site: <http://nj6n.com/dstar/dstar_chat.html>

AE7Q DStarLet web site: <http://dstarlet.ae7q.net/>

D-RATS web site: <http://www.d-rats.com/>

GB7MH Repeater web site: <http://g4ulf.blogspot.com>

Dutch*STAR web site: <http://www.dutch-star.nl/>

D-STAR video web site: <http://www.dstartv.com>

By Joe Moell,* KØOV

HOMING IN

Radio Direction Finding for Fun and Public Service

Pay to Play? ARDF vs. Park Officials

"Never pick a fight with a man who buys his ink by the barrel." This adage, attributed to Mark Twain, has been on my mind for the past week.

I don't know how many barrels of ink are in each press run of *CQ VHF* magazine, but I know that more than once over the years I have had to resist the urge to use a gallon or two to take on persons or institutions that seem to be threatening my favorite part of ham radio.

That temptation is very great again. Nevertheless, I'll try hard not to rant. Instead, I'll use the situation as an opportunity to present a matter that could have an important impact on the success of international-rules Amateur Radio Direction Finding (ARDF) in the USA.

Kelsey White and her dad, David White, WD6DRI, built a measuring-tape antenna for transmitter hunting at our most recent session. Marvin Johnston, KE6HTS supplied the kit. (Photo by Joe Moell, KØOV)

Not in My Park!

In the last decade, southern California has led the rest of the USA in the development of ARDF, which is also called foxtailing and radio-orienteering. One important factor for our success has been our regular sessions in local parks where beginners can learn the techniques and advanced foxtailers can train for national and world championships. We try to have a session every month, except during the holiday season. At most of the sessions there is a pre-hunt clinic where newcomers can assemble and check out measuring-tape Yagis and offset attenuators to use with their handie-talkies to find 2-meter radio foxes.

We choose our sites from about a dozen large city, county, and state parks, most of which have been well mapped by the Los Angeles Orienteering Club (LAOC). That's important, because good orienteering map-and-compass skills are vital for success in championship ARDF events.

After each session, we head for a local eatery and plan the next one. By "we," I mean Marvin Johnston, KE6HTS; April Moell, WA6OPS; and me, plus any other attendees who are interested. There is no formal club, and there are no dues and no treasury. Hunters pay nothing, except for the LAOC full-color maps and the optional antenna/attenuator kits. That means no politics and fewer hassles. We like it that way!

For a month we planned our last Saturday session at a 670-acre county park east of the city of Los Angeles. I sent dozens of e-mail invitations and put the details in my website. During that time, a very large wildfire broke out in the mountains just to the north. The park became a major staging area for firefighters and their equipment, but there was still plenty of open space for the ARDF course and hundreds of park patrons.

On the Wednesday before the session, I received e-mail from a senior typist clerk in the park office. The first paragraph read: "We have been informed that your group is planning on having a radio-orienteering event. Please be informed that there are no areas available. In order to have your event here you must first apply for a Permit for Use of Regional Parks and provide the required insurance documents. Failure to follow these regulations will result in shutting down your event."

The clerk's e-mail went on to state that our planned gathering area would not be available on a Saturday until three weeks after our planned date. A reservation for that area would cost $150. An alternative area, available one week after our planned date, would cost $400 to reserve.

Minutes later I was on the phone with the person who wrote the e-mail. I asked her if she could assist me and she assured me that she could. I explained that we did not have a need to reserve a specific area and that we often arrive at parks to find that our planned gathering place is unavailable. When that happens, we just find another location and tell late arrivers about it on the talk-in frequency. She continued to insist that our planned gather-

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

ing point was to be the site of a wedding reception and that we had to make a reservation for another spot, apparently thinking that we would be attracting a very large crowd.

Then I asked her about the requirement for a permit. Would she send me the statutory document that spells out the criteria for which regional park activities must have one? She replied that it wasn't available. I asked how her office could demand a permit without knowing anything about the event and without being able to point to a specific ordinance stating that a permit is required in our circumstance.

At that point, she became quite frustrated and put me through to the park superintendent. He also could not produce the documentation I requested, but he said that one reason we needed a permit was because we were "bringing in equipment." I countered that the only equipment our participants would be using would be hand-carried receivers and RDF antennas. I asked how this was different from a group of friends who take their Wiffle balls and bats with them to the park for a friendly game. Would that be "equipment" too? At that point, I was beginning to think about what I could do with several gallons of *CQ VHF*'s ink.

A Balancing Act with Poorly Defined Rules

Before continuing my story and applying it to ARDF and other ham radio outdoor activities nationwide, I should emphasize that I have plenty of sympathy for the problems of park rangers and superintendents. They are responsible for providing a safe and pleasant experience for every patron. They must balance the conflicting desires of diverse individuals and groups. Finances are tight and getting tighter, with many California state parks on the verge of being closed due to budget shortfalls.

Is it possible that park regulations are deliberately vague and often kept unpublished to give staff members the discretion they think they need to handle a wide variety of situations in the way they think is best? Perhaps, but this lack of specificity means that we can't expect uniformity from park to park or superintendent to superintendent.

Six years ago, a park official in another county told me that our small group of foxtailers had to obtain a permit for ARDF because his standard application form had a check box for a "race." In his mind, that was what we were having. It was clear from my own reading of his form that it was intended for organized races such as 10K's, where paths within the park would be coned or taped off and large areas would be unavailable to non-participating park patrons until the last one of hundreds of racers had finished.

Back then I disputed his characterization of our activity as a race. I pointed out that the dozen or so of us would be mixing in among other park patrons and would not make any part of his facility unavailable to others. He would not relent, demanding that we apply 60 days in advance and pay a $56 permit fee that would not be refunded if the application were to be denied. The permit form stated that during the two-month period our application would be reviewed to determine "any additional fees, security deposit, and other items required for permit issuance." Needless to say, we have never done any ARDF in that park.

Fortunately, this Los Angeles County Park superintendent was much more reasonable. Our activity came to the attention of his office because someone had called to inquire if radio-orienteering would still take place in spite of the presence of the fire camp. His staff had assumed that radio-O sessions would be similar to LAOC orienteering meets, which can draw between 100 and 200 people. After I explained that we were an informal non-club group, that there would probably be less than fifteen of us, and that we were flexible about our gathering location, he invited me to meet him in the park on the day before our planned session to select another gathering place and make final arrangements.

That night I told the story at our local ham club. It set off a torrent of comments and complaints from members about their unpleasant encounters with park officials when they had operated from hilltops in VHF and microwave contests. They told me that rangers often hassled them about where and how they set up their operations, citing rules that they couldn't verify. One claimed that he had been told he couldn't use his sealed marine battery for power because that violated an environmental protection rule!

Unlike the clerk, the superintendent seemed eager to have our ARDF session proceed, even saying that it would be good for other park patrons to see this sort of activity. Nevertheless, our session had to take place on his terms. He stated that he had the sole authority to decide what permits and liability insurance we would need. "I'll waive those requirements this time because we were unclear," he said. "But next time you'll need to contact the office well in advance and all our rules must be followed."

Those rules are apparently unwritten, or at least unpublished. I carefully reviewed the county parks website and found no mention of permits, except for film shoots. The only "equipment" items identified were bounce houses, playground sets, and amplified sound gear. There were no criteria for which activities require insurance. A handout in the park office stated that radio-controlled boats, planes, and cars require special authorization, but personal radios and informal sports were not mentioned.

Our ARDF session went on without a hitch. Eight first-timers and four experienced radio-orienteers came out to the park. There was no wedding reception at our originally planned gathering point, but the alternate spot was just as good. Five new antennas were built and tested on the beginner transmitters near by. Six persons went out on Marvin's 4.2-kilometer international-rules five-fox course, including a high school senior on his first hunt with a new antenna. He found all the transmitters with a very good time. Perhaps we have discovered a future champion!

To Insure or Not?

When a club puts on a big ARDF event with dozens of attendees, such as the annual USA Championships, insurance is a must. The club treasury must be protected and the site owners will insist on it, too. A requirement for two-million dollars of liability coverage is typical. Unfortunately, the ARRL Club Liability Insurance Plan has a specific exclusion for "the activities of any participant in a game, contest, race, or sporting event, including practice." (Does that mean that the transformer toss at a club picnic is also not covered?) ARRL club insurance is primarily liability coverage, with medical payments limited to reimbursement of expenses for first aid at the time of an accident.

Some ham clubs have insured their ARDF championship events by getting a local orienteering club to be a co-sponsor and to actively participate. The US Orienteering Federation has an excellent insurance program that is used by most USOF-chartered clubs. There is full liability coverage of the club, its officers, members, and volunteers to a $3,000,000

Steve Noskowicz, K9DCI, mounted the elements of his measuring-tape beam inside the PVC couplings, held in place with short lengths of pipe. This eliminated the need for hose clamps or sticky tape. (Photo by K9DCI)

aggregate. There is also $10,000 of secondary medical coverage for any registered participant who is injured at a USOF club orienteering event.

USOF insurance isn't an option for ham groups in places where there is no active orienteering club. It's also not practical for small-group ARDF sessions such as ours, where no club is involved. For non-group insurance coverage of informal events in Los Angeles County Parks, the least expensive option is Prompt Cover from Municipality Insurance Services. For a fee, event organizers are added to a master policy already in force with the county facilities. The quoted premium is $210 for each sporting event of our type that lasts less than 24 hours and draws less than 50 persons. The policy provides liability coverage protecting the park and the organizers only, with no secondary medical payments. A Municipality Insurance spokesperson told me that it would cost at least twice that amount to get one-time coverage from another company outside the master policy.

Can anyone doubt that fewer persons will participate in ARDF practices if there must be a hefty admission price just to pay for insurance? Imagine telling a family of four coming to learn ARDF that its share of the insurance bill for the event is $50! It's my position that it shouldn't be a requirement. While we were in the park for ARDF last weekend, a dozen people arrived by car and practiced their soccer skills in a grassy area nearby. Should they have been required to get a permit and liability insurance first? Our informal foxtailing sessions aren't significantly different from that.

Park officials seem to have all the power. If they say that you need a permit and insurance, you do. They can stop your group from assembling or evict you if they choose. Personal diplomacy is the best recourse. Tactfully explain that your group is small and that your RDF equipment is analogous to the Frisbees and other sporting goods that park patrons bring in every day without problems. Let them know that ARDF activities don't keep other persons from using any part of the park.

I am investigating the possibility of getting ARDF added to the covered activities of the ARRL Club Liability Insurance Plan. Premiums are presently quoted to each club on an individual basis, according to its activities, so adding ARDF to the list of covered activities seems practical and wouldn't add to the cost for clubs that don't do it. I will report on this matter in future columns.

Robb Queen, KE6FUZ, used his just-completed antenna/attenuator assembly with his handie-talkie to find the hidden transmitters, aided by his daughter Ariel. He is holding the antenna with a short PVC handle behind the reflector. (Photo by KØOV)

I would like to hear your experiences with park officials regarding radio foxhunting activities. What problems have you had and how did you solve them? Has it affected the promotion and development of on-foot transmitter hunting in your area? Please let me know by e-mail.

Souped-up Antennas and Attenuators

I have a limited amount of ARDF equipment available for loan at each of our local sessions, but we encourage newcomers to acquire some equipment of their own as soon as possible. Borrowing something each time isn't the best way, because our loaner sets aren't identical. It's easy and fun to build an antenna for RDF on 2 meters with a handie-talkie or scanner. It can be used for "sniffing" at the end of mobile T-hunts and for tracking interference as well as for radio-orienteering.

The build-it-yourself 2-meter RDF antenna of choice for beginners is a three-element Yagi with elements made from steel measuring tape on a PVC-pipe boom. The flexible tape makes it sturdy and safe when running through the brush. A design by Joe Leggio, WB2HOL, has become the most popular.[1] The two halves of the driven element are mounted to a PVC cross coupling with hose clamps.

The driven element and reflector are secured to the outside of their couplings with hose clamps or cloth tape. Matching to

50-ohm coax is achieved with a "hairpin" made from 5 inches of hookup wire. After the hunt, the ends of each element can be folded back and inserted into the open ends of the couplings for transport and storage.

WB2HOL's documentation on the web doesn't include it, but experience has shown that some sort of balun is important to prevent signal pickup by the feedline from disrupting the directional pattern. Without it, the amount of pattern distortion will vary with antenna orientation and coax length.

At a recent hunt in a local park, one ham reported that the forward lobe of his new measuring-tape Yagi was 30 degrees off-axis when he oriented the beam for vertical polarization. He had about 6 feet of RG-174 coax hanging between the beam in his hand and the receiver on a sling around his neck. I suggested that he put several turns of the coax in a tight wrap on the short handle just to the rear of the reflector. After he did that, the lobe was exactly on-axis.

Steve Noskowicz, K9DCI, of Wonder Lake, Illinois, a long-time RF engineer and regular participant in the transmitter hunts of the Arlington Communications League, wrote to suggest a way to build the antenna without any hose clamps or cloth tape. His director and reflector go through the inside of the PVC coupling and are held in place with short pieces of PVC pipe driven into the coupling, as shown in the detail photo.

In a similar way, the two halves of the driven element are wedged in place. The coax and the hairpin are between them and inside the cross. Photos of the driven element assembly are on Steve's website.[2] "I've had no problem with the one-inch pieces of pipe staying in," Steve wrote. "In fact, when replacing a broken element, it takes quite a hit to knock out the plug."

Because of the plugs, he can't fold the elements in and stuff them in the couplings. Therefore, when not in use, he keeps his antenna in a heavy cardboard shipping tube about 6 inches in diameter. With a twist of the wrist, he pushes the antenna into the tube in one motion. It easily comes back out and springs into place, ready to use. He writes, "I call it my Edward Scissorhands option. It's quite a sight going in and out. I have videos of that on my website."[3]

K9DCI says that his tape-measure beam has been important in finding severe noise from power-line lightning arrestors. "A new 2-mile stretch of dual three-phase 34-kV lines has degraded a nearby 2-meter repeater by 15 dB! We have been working with the power company and the arrestor manufacturer and are waiting for an autopsy on 30 of them that we convinced the power company to replace."

During a Jamboree-On-The-Air event near Santa Barbara, this Scout found it easy to carry my 2-meter measuring-tape Yagi and receiver with one hand using its wooden handle at the balance point. Notice the turns of coax around the boom behind the reflector that serve as a balun. As he closes in on the mini-transmitter, which is behind the conduit below the electrical box, the Scout is using his other hand to shield the receiver from the sun so he can see the display. (Photo by KØOV)

Most builders add a short PVC pipe in the back of their antenna as a hand-hold. Using that puts stress on the user's wrist, making it uncomfortable during a long hunt. Grasping the antenna by a rear boom extension and trying to hold it pointing outward toward the horizon is particularly difficult for children. It's tempting to grip the Yagi on the boom between the driven element and reflector instead, but the presence of a hand there can adversely affect the performance of the beam.

I think the best solution is to add a handle underneath the antenna. Mine is wood, sanded for smoothness, but PVC pipe could also work. Putting the handle at the exact balance point eliminates stress on the wrist and it keeps the hand out of the antenna pattern. My antenna with its wooden handle has been used by dozens of Scouts and other youngsters with good results.

A 2-meter tape beam with WB2HOL's element lengths and spacings works fine for beginner and intermediate foxtailers, but several hams have set out to improve its directional performance and optimize it for championship-level ARDF. I'll report on what they have done and how this type of antenna can be analyzed with NEC-type programs in an upcoming column. Meanwhile, why not schedule some antenna-building and RDF training sessions in your locality? Afterwards, send me an e-mail with photos and stories about it to share with *CQ VHF* readers.

73, Joe, KØOV

Notes

1. <http://home.att.net/~jleggio/projects/rdf/tape_bm.htm>
2. <http://k9dci.home.comcast.net/~k9dci/site/?/photos/>
3. <http://k9dci.home.comcast.net/~k9dci/site/?/page/Amateur_Radio_Control/>

CQ's 6 Meter and Satellite WAZ Awards

(As of October 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	K0SQ	16,17,18,19,20,21,22,23,24,26,28,29,34
67	W3TC	17,18,19,21,22,23,24,26,28,29,30,34
68	IKØPEA	1,2,3,6,7,10,18,19,22,23,26,28,29,31,32
69	W4UDH	16,17,18,19,21,22,23,24,26,27,28,29,30,34,39
70	VR2XMT	2,5,6,9,18,23,40
71	EH9IB	1,2,3,6,10,17,18,19,23,27,28
72	K4MQG	17,18,19,21,22,23,24,25,26,28,29,30,34,39
73	JF6EZY	2,4,5,6,9,19,34,35,36,40
74	VE1YX	17,18,19,23,24,26,28,29,30,34
75	OK1VBN	1,2,3,6,7,10,12,18,19,22,23,24,32,34
76	UT7QF	1,2,3,6,10,12,13,19,24,26,30,31
77	K5NA	16,17,18,19,21,22,23,24,26,28,29,33,37,39
78	I4EAT	1,2,6,10,18,19,23,32
79	W3BTX	17,18,19,22,23,26,34,37,38
80	JH1HHC	2,5,7,9,18,34,35,37,40.
81	PY2RO	1,2,17,18,19,21,22,23,26,28,29,30,38,39,40
82	W4UM	18,19,21,22,23,24,26,27,28,29,34,37,39
83	I5KG	1,2,3,6,10,18,19,23,27,29,32
84	DF3CB	1,2,12,18,19,32
85	K4PI	17,18,19,21,22,23,24,26,28,29,30,34,37,38,39
86	WB8TGY	16,17,18,19,21,22,23,24,26,28.29,30,34,36,39
87	MUØFAL	1,2,12,18,19,22,23,24,25,27,28,29,30,31,32

Satellite Worked All Zones

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

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>.

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By Keith Pugh,* W5IU

SATELLITES

Artificially Propagating Signals Through Space

ARISS International "Face-to-Face" Meeting and New "Birds"

Flags showing the partner nations of the European Space Agency (ESA). (Photos courtesy of W5IU)

In my last column in the Summer 2009 issue of *CQ VHF* I mentioned that I had attended the ARISS International "Face-to-Face" meeting in the Netherlands. This column provides a summary of that meeting and the trip associated with it.

Several new amateur radio satellites have been launched recently. I will introduce some of these satellites and go over the process of integrating them into the active satellite inventory.

ARISS International "Face-to-Face Meeting"

Host for the meeting was the European Space Agency (ESA) at the European Space Research and Technology Center (ESTEC) located in Noordwijk in The Netherlands. June 17–19, 2009 was a little late to see the tulips at their peak, but we had a productive series of meetings and an enjoyable time was had by all. This was my first visit to The Netherlands. A summary of the meetings follows. Detailed minutes are available at: <http://www.ariss.org>.

Activities started on Wednesday, June 17, with a Joint Amateur Radio Working Group (ARWG) and Amateur Radio on the International Space Station (ARISS) meeting for delegates. Gaston Bertels, ON4WF, welcomed all attendees and asked participants to introduce themselves to the group.

Topics discussed during this session were: new VHF-UHF antennas for the Columbus Module, onboard equipment available for use, handling of potential interference issues when more than one station is available for use, equipment deployment planning, and Russian telemetry tests.

In the afternoon participants were treated to a tour of the excellent ESTEC equipment qualification facilities. These facilities

Gaston Bertels, ON4WF, Chairman of ARISS-International.

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Some of the delegates of the ARISS International "Face-to-Face" meeting (left to right): Rosalie White, K1STO; Will Marchant, KC6ROL; Gaston Bertels, ON4WF; and Mark Steiner, K3MS.

More delegates of the meeting: Sergy Samburov, RV3DR; Maurice-Andre Vigneault, VE3VIG; and Keigo Komuro, JA1KAB.

are used to test equipment of all kinds and sizes for the rigors of space travel. Thermal, vacuum, vibration, acoustic noise, radiation, and shock head the list of tests that are performed. The facilities are "state of the art" in most cases. After the tour of the test facilities, participants visited the Erasmus High Bay exhibit area—in which visitors, potential users, and researchers can familiarize themselves with the various experiment facilities—and met some of the ESA astronauts.

After an excellent welcome dinner, an evening session was convened to hear presentations by the Italian delegation on two topics. A "hybrid" ARISS QSO combining telebridge and direct techniques into one contact to extend time availability was the first topic. An initial proposal for an event in honor of Marconi receiving the Nobel Prize was the second topic.

Thursday, June 18, was the first day of the ARISS-International Annual Meeting. In attendance there were 23 attendees representing 11 countries. After a welcome by Mr. Piero Messina—Head of the Coordination Office, ESA Directorate of Human Spaceflight, European Space Agency—Gaston Bertels, ON4WF, again welcomed the delegates and team members. A moment of silence was observed in memory of Dieter Schliemann, KX4Y, who recently became a silent key.

Erasmus High Bay.

Officers were elected to a one-year term to fill the vacancy created when Frank Bauer, KA3HDO, resigned earlier this year. Gaston Bertels became Chairman and Will Marchant became Vice Chairman. Elections for the normal two-year term will take place in 2010.

ARISS reports were heard from Europe, Canada, USA, Russia, and Japan. These delegate reports were followed by reports from the Operations and Hardware committees.

On Friday, June 19, the meeting reconvened to continue with reports from the School Outreach/School Selection Committee, the Public Relations Committee, and the Project Selection & Use Committee. The majority of the time was taken by the Project Selection & Use Committee, since it involved discussion of committee structure as well as several old and new proposals. Principal topics were utilization of the facilities planned for the Columbus Module and the SuitSat-2 Project. Considerable time was spent discussing and illustrating how solar panels might be installed on the legs of the space suit.

It should be pointed out that at the time of this meeting SuitSat-2 was still planned to be integrated into a Russian Orlan Space Suit similar to SuitSat-1. In July, plans changed when the available suits were discarded earlier than originally planned due to storage problems aboard the ISS. The hardware will now be integrated into its own structure and launched as planned. The name has changed to ARISSat-1, and the delivery and launch schedule discussed at this meeting will be preserved.

The last topic discussed was the site and schedule for the 2010 meeting. Proposals were received from NASA Johnson Space Center, Portugal, and

W5IU at Field Day 2009.

Rome. These proposals will be evaluated by the delegates and the selection will be announced later.

We then were also treated to an excellent tour of the Erasmus High Bay exhibits and thoroughly enjoyed this opportunity. ESA/ESTEC was an excellent host, and none of us lost any weight with the excellent cafeteria food provided for lunch each day.

Tourist Notes: As mentioned earlier, this was my first visit to The Netherlands. Most of my extra time was spent in and around Noordwijk and the adjacent beach area. The weather was outstanding. However, it was a little cool for most of us to take full advantage of the beautiful Noordwijk Beach, not to mention the cold waters of the North Sea. We sampled a variety of food from throughout Europe over the several days we were there.

On Saturday, June 20, I did venture out to the nearby town of Haarlem (30 to 45 minutes by bus) on the recommendation of the music director of my home church. Our music director is a native Dutchman and knows I like to listen to pipe organs. He recommended visiting the "Müller-organ Grote of St. Bavokerk Haarlem." I was not disappointed. This is one of the largest, oldest, and most ornate organs in Europe. I did not get to hear a recital, but I did hear organists practicing on this wonderful instrument and obtained a CD from a performance. Of course, I spent time walking and looking around Haarlem before returning to Noordwijk.

My return to the Texas heat was on Monday, June 22, well in time for ARRL Field Day.

New "Birds"

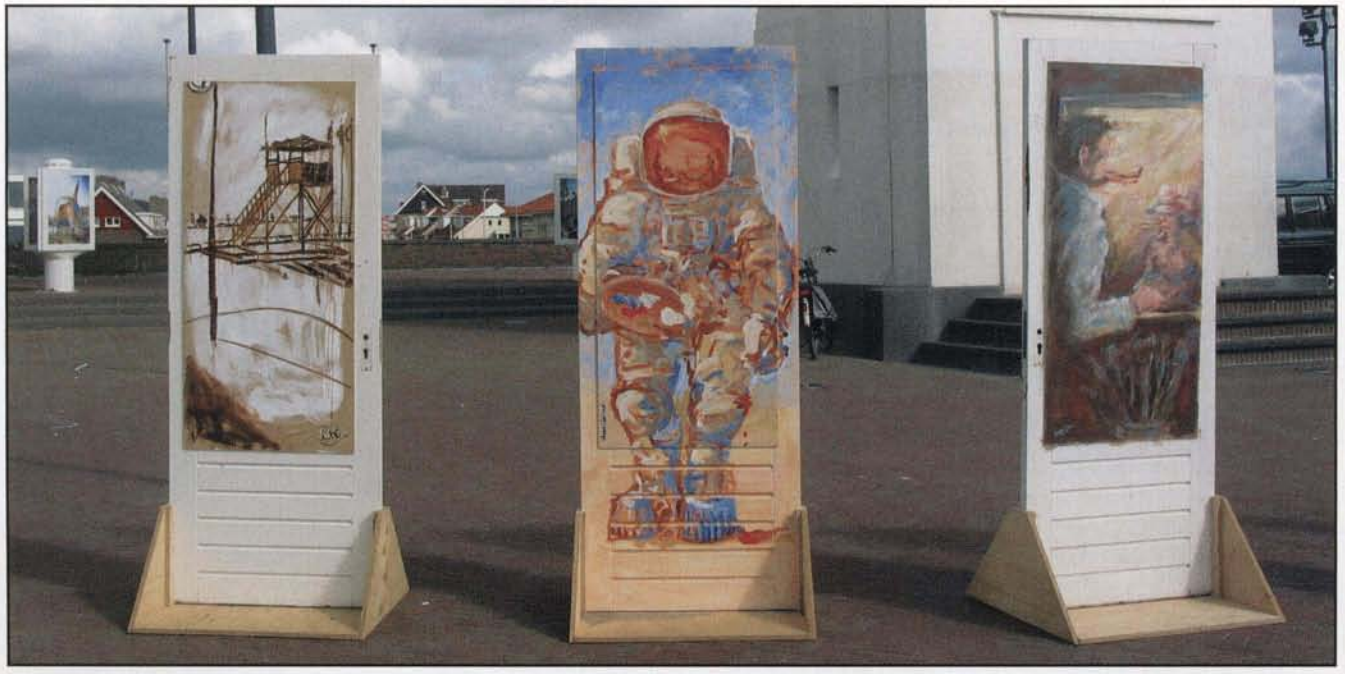
As I write this at the end of September, over the past couple of weeks there have been two major satellite launches. The first was from the Baikonur Cosmodrome in Kazakhstan and included South Africa's SumbandilaSat satellite along with the primary payload, other secondary payloads, and components of the launcher. The second launch was from India and included seven satellites as part of the PSLV-C14 mission. Four of these satellites, BEESAT, ITUpSAT1, SwissCube, and UWE-2, are CubeSats and operate in the amateur radio bands. By the time you read this, these satellites will either be operating or will be history. Details of these satellites are/will be available through the AMSAT web page: <http://www.amsat.org>. The purpose

Noordwijk Beach.

in mentioning these launches here is to illustrate one of the challenges in this business.

Each launch creates several pieces of hardware in orbit. The launcher is usually programmed to separate the individual payloads and other launch components as much as possible. Where possible, launch components are de-orbited as soon as possible; however, there are usually several objects from each launch that must be individually identified. In the case of multiple launches in a short time span, available operators to do the identifications becomes problematic.

Initially, all of these components are close together and NASA/NORAD has difficulty identifying the individual components. They first post the objects without names, and it is left to further observation/interaction to identify which object is which. In the case of objects that emit an RF signature, such as a beacon, telemetry, etc., amateur radio operators track the various objects utilizing the published Keplerian elements and match the AOS/LOS times and message content to the tracks. This process goes on for however long it takes for the individual satellites to drift far enough apart to establish



Spaceman on the beach.

St. Bavokerk, Haarlem.

The Müller-organ Grote of St. Bavokerk Haarlem.

identifiable, individual tracks. This process can take days or weeks depending on the launcher, payloads, and manpower. It's an interesting process to follow on amsat-bb and participate in if you have the equipment, time, and inclination. Eventually the active payloads are identified and the proper names are assigned to the Keplerian data for the individual satellites.

SumbandilaSat in particular should become a very interesting amateur radio satellite once it is commissioned and its primary scientific mission is over.

Summary

The ARISS meeting was very interesting and we can expect more operation from ARISS in the coming years. Near term, look for an ARISSat-1 launch from the ISS in the spring of 2010.

I encourage you to help "sort out" the multiple satellite launches. It can be interesting and rewarding.

As you read this, the 2009 AMSAT Space Symposium—celebrating the 40th anniversary of AMSAT in Baltimore, Maryland, October 8–12, 2009—will be history. AMSAT faces many challenges over the coming years to "Keep Amateur Radio in Space." The next column will contain a report of this meeting. Please support AMSAT in its fund-raising efforts so that it can continue to put more "birds" on the air. 'Til next time!

73, Keith, W5IU

By Rich Arland,* K7SZ

BEGINNER'S GUIDE

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

Try Your Local Hardware Store!

Summer in the Atlanta metro area is hot, HOT, H-O-T!! Now I finally understand why they call it "Hot-Lanta"! Thankfully, as I write this in mid-September, so far our ancient heat pump/air conditioner is still purring away keeping us at a cool 77° F. Any hotter and I can't think!

Well, by now my new shack is starting to really take shape. With the re-acquisition of my old Ikea operating table/console I now have more than enough room to start setting up the HF and VHF+ stations. Having sold off the majority of my gear prior to moving to Georgia, I was in immediate need of a good HF transceiver that could also be pressed into VHF+ service using it as a tunable IF for outboard transverters. Even though I had my old faithful Yaesu FT-726 for VHF+ use, I felt that shopping around for a quality HF transceiver with a contest-grade receiving section would not be a bad idea. That way, should something happen to the 726, I could procure some 6-meter, 2-meter, and 70-cm transverters and still maintain a presence on both the HF and VHF bands.

In January each year the Gwinnett Amateur Radio Society (GARS) holds a "Tech Fest," which strives to showcase various operating modes and equipment to the general public and possibly recruit new hams into the hobby. Tech Fest '09 found me ensconced in a booth next to the South East DX Club (SEDXC) folks. I was showing off some of my military gear and soon found myself talking DX with the SEDXC members at the adjacent table. One thing led to another, and I soon parted with a year's membership dues to the club. That was just the start of things. Via the SEDXC I became acquainted with K1ZZI, Ralph, who just happened to have a near-mint-condition Kenwood TS-940SAT HF transceiver (loaded with crystal filters) and a matching SP-940 station speaker. The price was definitely "right," and soon that cute little (?) TS-940 followed me home and now sits proudly on the operating bench next to the FT-726. Mission accomplished. Don't get me wrong, as the 940SAT cost me a few bucks, but only about 25% of what it originally sold for in the late 1980s. This 20-year-old DX machine has a great receiver and, with the addition of a new IF board from a company called Piexx (www.piexx.com) and a computer running Ham Radio Deluxe, you have an instant computer-controlled radio for either HF or VHF+ operations (via transverters). Arland done good!

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Support Your Local Hardware Store!

Without a doubt, the "Big-Box" stores are great places to shop. I know that between Home Depot and Lowe's, I have spent thousands of dollars remodeling my home, not to mention picking up much needed tools, accessories, and "must have" items at great prices. With all the convenience of these "Big-Box" stores, it is very easy to forget the local hardware emporium, many of which have been in business for half a century or more and are mom-and-pop operations that have remained in the family for several generations.

Often these smaller hardware outlets have things that their bigger counterparts don't offer or fail to stock. Case in point: washers—not the type that you wash clothes in or the things you put on the ends of bolts. I am talking about large rubber washers that I have found very useful for sealing the ingress points of coaxial cables coming into my home. Having scoured the big outlets, I was on a trip back to northeast Pennsylvania and had the chance to drop into the local hardware store on the main street in my former home town of Wilkes-Barre. Good ole "Main Hardware" helped me erect my 55-foot tower about 16 years ago, along with countless other ham-radio-oriented and home-improvement projects over the 20 years I lived here. Going in there was like stepping back in time to my early days in Palouse, Washington, and the Ankorn Hardware store. You could quite literally find the solution to almost any construction project just by cruising the aisles of the store.

This is a photo of my VHF/UHF stack on the end of the house. In ascending order: KU4AB square Halos for 6 meters, 2 meters, and 70 cm; and a BlueStar 2-meter J-pole on the top for local FM work. Although these antennas are relatively close to the ground (only about 20 feet up), they will be moved to the peak of the roof soon to achieve a total height of about 45 feet. (K7SZ photo)

Within five minutes of arriving at Main Hardware, I had purchased half a dozen 2.5-inch diameter rubber washers (approximately 1/8 inch thick) with a center hole about 1/2 inch in diameter. RG-8, RG-213, 9913F, and most of the "large" coaxial cables have a diameter of about 1/2 inch, so these are a great fit! By cutting a single slit from the center hole outward to the edge of the washer, you can slip it over the coax (if, like I had, already run the coaxial cable through the eaves of the house) and then, using some GE-RTV silicone sealant, goop the back side of the washer and firmly place it against the entry point of the coax cable. This will seal the ingress point against moisture and insects. Of course, if you have not run the cables

My 2-meter KU4AB square Halo omni antenna. The wire going to the center pin of the coaxial connector separated. This required a bit of cleanup and a resolder job using quality solder and some flux. (K7SZ photo)

with connectors already in place, you won't need to cut the washer; just seal the washer against the opening hole and feed the coax through the center hole of the washer. After the coax is in place, smear a glop of RTV sealant on the coax where it goes through the washer and you're done! Project completed! Total cost: under $2.00 for six washers. That's not a bad low-cost solution to the problem, a solution *not* available at Lowe's or Home Depot.

The previous example is only one case where the local, small hardware store has come through for me in a pinch. During my tower/TH-7DX beam erection, Main Hardware provided several hundred feet of aircraft control cable, cable guy material, and cable clamps at a much more reasonable cost than the bigger stores. Ditto with refurbishing two Hy-Gain 14AVQ verticals. The ends of the traps had deteriorated and I didn't feel like paying for replacement plastic covers, so back to Main Hardware I went and came up with a fist full of rubber washers of various inside diameters that would correctly seal the traps. Of course, you could use heat-shrink tubing, but that is more expensive and you have to do a lot more work by shrinking the tubing once you have it in place. Too much work ... rubber washers and RTV. Works every time!

My latest "victory" occurred in Dacula, GA, our new home. I needed to erect several antennas in the attic of our home. We had just put a new asphalt shingle roof on, and I thought that having several VHF/UHF antennas and one HF dipole in the attic would allow me to be on the air during thunderstorms without running the risk of zapping a radio due to a nearby lightning strike that would induce excessively high currents in my external antennas.

I had a small TV rotator (the three-wire kind) that would work nicely in the attic. Since all my coaxial cables came down through the inside wall of the shack from the attic, it would be a simple matter of feeding the rotator cable down the same cable run from the attic into the shack. One problem solved.

For mounting the rotator, I envisioned a steel pipe about 1.5 inches in diameter affixed to the floor with a flange. The local hardware store in Dacula provided the parts at a total cost of about $12 (18 inches of 1.5-inch OD water pipe, pipe flange, lag screws, and some other odds-and-ends for the project).

I screwed the pipe flange into the floor of the attic about mid-way between each wall, centering the flange directly under the main center beam of the roof. I screwed the pipe into the flange and mounted the rotator onto the pipe. A short section of chain-link fence top rail (by the way, these 10.5-foot galvanized steel pipes are a lot easier to work with and cheaper than using the 10-foot sections of steel pipe from "The Shack") was affixed into the top of the rotator. Next I mounted a well-used Arrow 4-element 2-meter beam (www.arrowantennas.com/) to the mast so that it would clear the roof joists with a 360-degree rotation of the rotator. This put the Arrow beam about 4 feet off the floor—not great, but definitely usable. The remaining 2.5 feet of pipe was going to be reserved for a UHF Quagi, but it would not quite fit. Therefore, I put a RadioShack (Oops! Sorry, "The Shack") VHF/UHF scanner antenna (cost about $10–12 on closeout) on the top of the pipe. This gives me an omni and a directional 2-meter array that I can use to check into local FM nets or work some distant 2-meter stations. Costing out the hardware needed to do this project netted a $4.00 savings in materials by using the local small-town hardware store as opposed to one of the "Big-Box" competitors. Oh, yeah, I forgot: At $2.50 per gallon for gasoline, I saved a round-trip drive of over 22 miles by shopping and buying locally. I love it when a plan comes together!

KU4AB VHF/UHF Omni Antennas

In the last installment of this column I briefly commented on a trio of VHF/UHF antennas that I erected at K7SZ. These are made by Phillip Brazzell, KU4AB (http://www.dxzone.com/cgi-bin/dir/jump2.cgi?ID=12873). I bought the 6-meter, 2-meter, and 70-cm square omni antennas for use at our new place in Georgia. Originally I had them up briefly (for the ARRL September 2008 VHF contest) at our old home in Wilkes-Barre and they worked, but were so low that it was hard to judge their effectiveness of them. However, for the money they initially seemed to be a good buy.

Since moving south, I have installed all three antennas using separate low-loss coaxial feed lines on a set of 10.5-foot chain-link-fence top rails, butted end-to-end, for a total height above ground of 21 feet (to the 70-cm antenna at the very top). Unfortunately, I still do not have the height needed to make these antennas work effectively. Ultimately they will go on a tripod on my roof and be about 20–25 feet above the peak of the roof line, or over 40 feet above ground.

My one concern is the robustness of the feed points of all three antennas. Over the relatively short time I have had these antennas, I had to repair the 2-meter omni twice, and each of the other two (6 meters and 70 cm) has been repaired once. It seems that the real weak point of the feed system is the wire that runs from the side of the antenna loop into the center conductor of the RF connector (a SO-239 on the 6- and 2-meter and an N on the 70-cm antennas). With a bit of flexing (like one would expect with wind on an external antenna) the wire tends to pop out of the center conductor and needs to be re-soldered. Initially I thought that this was the result of poor soldering technique (not enough heat or inferior solder) at the factory. However, now I think that it is just a shortfall in the design. Not a real show stopper but aggravating, nonetheless, especially when one must climb on a roof to do the work.

I have enclosed several pictures of my KU4AB omnis for your inspection. My last repair work on these antennas occurred over six months ago and so far all is well with the stack. I need to reposition these antennas on the roof with a tripod, so I will thoroughly inspect the connections before remounting them. Hopefully this will be done before winter and I can give some conclusive results on this trio's performance in the next issue of *CQ VHF*.

Contest season is well under way and soon the holidays will be here, so get out there, get your antenna work done, fire up the radios, and get on the bands!

73, Rich, K7SZ

By Bill Brown,* WB8ELK

UP IN THE AIR

New Heights for Amateur Radio

Superlaunch 2009

Well over a dozen amateur radio high-altitude balloon groups from across the country and Canada descended upon Topeka, Kansas this past July to attend the 9th annual Great Plains Superlaunch (GPSL).

Paul Verhage, KD4STH, of Nearsys (www.nearsys.com) hosted the event and provided us with excellent conference and launch facilities at the Kaw Area Technical School in Topeka. This was a three-day event that started out with a great tour of the Garmin GPS headquarters in Olathe, Kansas. We got to see the testing and engineering areas (I'd love to have a fraction of their test equipment!) and had the opportunity to meet with some of the design engineers who helped answer our questions about using their GPS units for high-altitude ballooning.

On Friday, a conference was held where we were presented with fascinating talks from a variety of balloon groups. Paul Verhage demonstrated his environmental test chamber made out of commonly found parts and an inexpensive vacuum pump. It can simulate the near-vacuum and extreme-cold temperatures found in a Near Space environment (see photo 1). Billy Graham, N5QEM, of Northwest Technical Institute wowed us with a demonstration of his powerful potato-gun payload retrieval system that can shoot a tennis ball (with fishing line attached) nearly across the length of a football field (photo 2).

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During breaks between the conference talks, there was a great opportunity to view the many innovative payload designs on the display tables (photo 3). If you are contemplating starting your own Near Space balloon program, the GPSL event is a great place to learn what others are doing. You can really jumpstart your efforts by attending.

We Have Liftoff

On Saturday everyone grabbed a spot in the parking lot of the school and started to inflate their balloons and prepare their payload experiments for flight. Three waves of balloons were launched for a total of 11 balloons in the air at one time (photos 4 and 5). They were ARBONET, EOSS, KØNMS, KØNMS/NSV, Nearsys, NSERT, NSTAR, NTI, ORB, Univ of Minn, and WB8ELK). The weather was perfect with no wind, allowing us to leisurely hang onto the payloads with the balloons standing still overhead. I streamed live internet video of the mass liftoff via my Verizon-enabled Netbook so those who couldn't make it to Kansas could see this amazing spectacle at home. After all the balloons were launched, the chase was on.

The Chase

The challenge with chasing 11 balloons at once is to figure out which one you want to track first. I rode shotgun with Mark Garrett, KA9SZX, as we bounced along over the gravel roads

Photo 1. Paul Verhage, KD4STH, demonstrates his Near Space environmental test chamber. (Photos courtesy of the author)

Photo 2. Billy Graham, N5QEM, demonstrates his potato gun payload retrieval system. (Photo by Keith Kaiser, WAØTJT)

of the Kansas farmland. I discovered that Mark had a few holes in the floorboards as the car filled up with Kansas dust that quickly made us look like Pillsbury doughboys. As we descended upon the sleepy and unsuspecting town of Garnett, Kansas, I could tell that the residents were keeping a wary eye on us as a dozen vehicles covered with strange antenna arrays filled up their small town. I'm certain that as we all stared up into the sky they must have suspected they were about to be invaded by UFOs (and in fact they were—Unidentified Floating Objects). It was so clear that we could see several balloons 100,000 feet above us with the naked eye.

Photo 3. N5NTI payloads with machined Styrofoam for a precision fit.

One by one we watched them finally burst and start their descent. We ended up peppering Garnett with parachuting payloads, as most landed within a few miles of town and three of them ended up landing within a few thousand feet of each other near the golf course. My payload landed way out in the middle of a soybean field. I was amazed that the high-speed cellular coverage was good enough that I could show the recovery effort live on streaming internet video even while standing in the middle of a remote Kansas field.

Only the ARBONET balloon kept flying due to its unusual upside-down parachute. As a result, it ascended at half the rate of everyone else's and flew about 30 miles to the south of Garnett. Unfortunately the GPS had failed and its female voice chip message kept repeating, "As usual, I'm very lost." That payload was the only one not recovered on Saturday, but it was found a week later by a local resident.

Everyone had a great time, and I imagine that the local Pizza Hut probably had its busiest lunch hour of the year as we filled every seat during our celebration of yet another successful Great Plains Superlaunch.

Superlaunch 2010 will be held in Hutchinson, Kansas. For more information, check out <www.superlaunch.org>.

73, Bill, WB8ELK

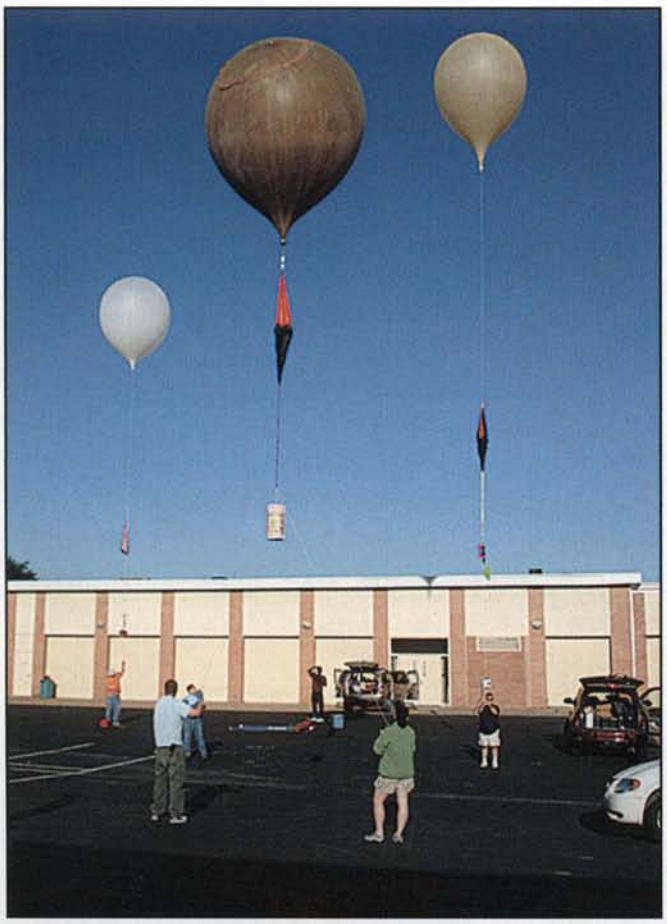

Photo 4. Three balloons take off at once.

Photo 5. ARBONET payload being readied for launch (WB8ELK balloon in background).

By Mitch Gill, NA7US

EMERGENCY COMMUNICATIONS

The Role of VHF in EmComm

Interoperability and YOU!

There has been another shift in emergency communications as the government becomes more and more aware of the capabilities and training that amateur radio operators bring to the table. Due to our proven abilities during emergencies, amateur radio operators in general as well as others in MARS, ARES, and RACES were invited to participate and assist in developing the National Guard Bureau (NGB) Civil Support Task List (CSTL) at workshops throughout the United States. The purpose of the workshops is to assist NGB in finding the best ways to work with civil agencies and first responders in the event of an emergency.

The Washington National Guard volunteered to host the communications portion of the CSTL at Camp Murray, Washington, and the three-day event was a success for all who attended. Representatives from several first responders, FEMA, the FCC, the DHS, and others were there to discuss how we all can work together in an emergency.

How do we communicate in an emergency? If I consider the number of VHF nets that are out there, it sometimes boggles my mind—police, fire, ARES, MARS, hospitals, ambulance services, government agencies, transportation agencies, and the lists go on and on. So how do we communicate with each other during an emergency? How can all those agencies, or any of them, talk to one another when there are so many frequencies and modes? How can you as an amateur radio operator operating an emergency net communicate with the police department when cellular and all other phones are not working? These are just some of the questions that were discussed, and believe it or not, there are some answers. One answer to the problem was developed by Raytheon. It is the ACU-1000 Intelligent Interconnect System (photo A).

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Photo A. Raytheon's ACU-1000 Intelligent Interconnect System.

ACU-1000 Benefits and Features

The following information was taken from Raytheon's website (www.raytheon.com>):

- Connects up to 12 audio devices with the ability to expand to 24 audio devices
- Can interconnect radios in any band including HF, VHF, UHF, P25, 800 trunked; cellular, landline PSTN, and iDEN Nextel
- ACU controller software provides full system status and control from a PC, locally or remotely over an Ethernet network
- Modular interoperability system employing proven radio over IP (RoIP) technology
- Sophisticated DSP algorithms provide adaptive hybrid, VOX, VMR (voice modulation recognition), noise reduction, audio delay, and more
- Radio templates for supported devices simplify and speed system setup
- Connection to a Wide Area Interoperability System (WAIS) using the WAIS Controller
- Easily deployed in tactical, transportable, fixed, and mobile applications
- Remotely change radio channel with the purchase of channel changing option.

The ACU-1000 can simultaneously cross-connect different radio networks, connect radio networks to telephone or SATCOM systems, and network RoIP/VoIP (Voice over Internet Protocol) talkpaths. It is completely scalable and field configurable.

The system is easily controlled using the provided ACU Controller software, offers three different methods of operation for system redundancy, and is neither computer nor network dependent for its operation.

What About Amateur Radio?

In addition to the numerous commercial radios Raytheon's ACU-1000 supports, it also supports the ICOM 706MKIIG. This is a major change wherein a major organization (with, I assume, suggestions from outside sources) decides to include an interface for an amateur radio. This is a large step in the right direction, and hopefully more radios will be recognized in the near future, as this seems to be the only downside right now. In the future I would hope to see almost all modern HF/VHF/UHF rigs have an interface to the ACU-1000.

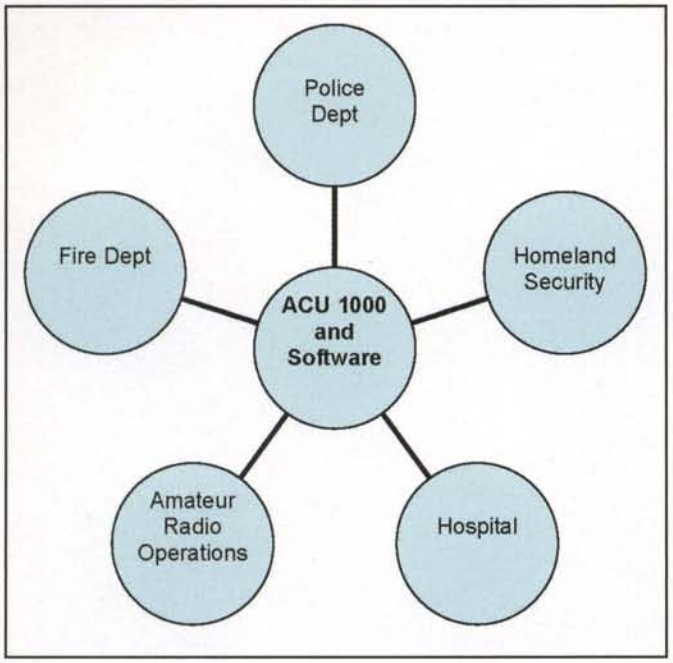

Figure 1. Once connected to the ACU 1000 and with the proper interoperability software, the ICOM 706MKIIG can talk to and receive from any other device on the network. This is a simplistic look at how this all ties together.

Once connected to the ACU-1000 and with the proper interoperability software, the ICOM 706MKIIG can talk to and receive from any other device on the network. Figure 1 is a simplistic look at how this all ties together.

Let's now look at a potential scenario based on figure 1. You, in this example, are an amateur radio operator who is supporting emergency communications after a moderate earthquake. You need to contact the fire department, as there are several people trapped in a building nearby. On an amateur radio VHF repeater designated by the Incident Commander, you are able to directly contact the fire department on its frequency even though you are operating on the amateur radio bands. The ACU-1000 connected to an ICOM 706MKIIG grabs your transmission and forwards it directly to the fire department utilizing the software. The person controlling the software has the ability to attach and detach different radio systems simply by a drop and click, but as those infamous commercials state, "But that's not all!" An example of the software that could be used for interoperability is Mutualink.

Figure 2 is a view of the Mutualink software architecture. It does not show amateur radio, but that does not matter, because if needed any radio systems can connect to other systems.

As stated in the brochure, Wallingford, Connecticut based Mutualink redefines interoperability by creating networks of communities that are instantly capable of sharing radio, voice, text, video, telephone communications, and data files in a secure environment.

In simple terms, an example in this situation could be that an amateur radio operator can contact the operator for Mutualink and request a satellite connection, or a VoIP connection, or whatever the system has available. In addition, it can be a secure system.

The overall benefits of this system are obvious, and with the realization of the value of amateur radio operators responding

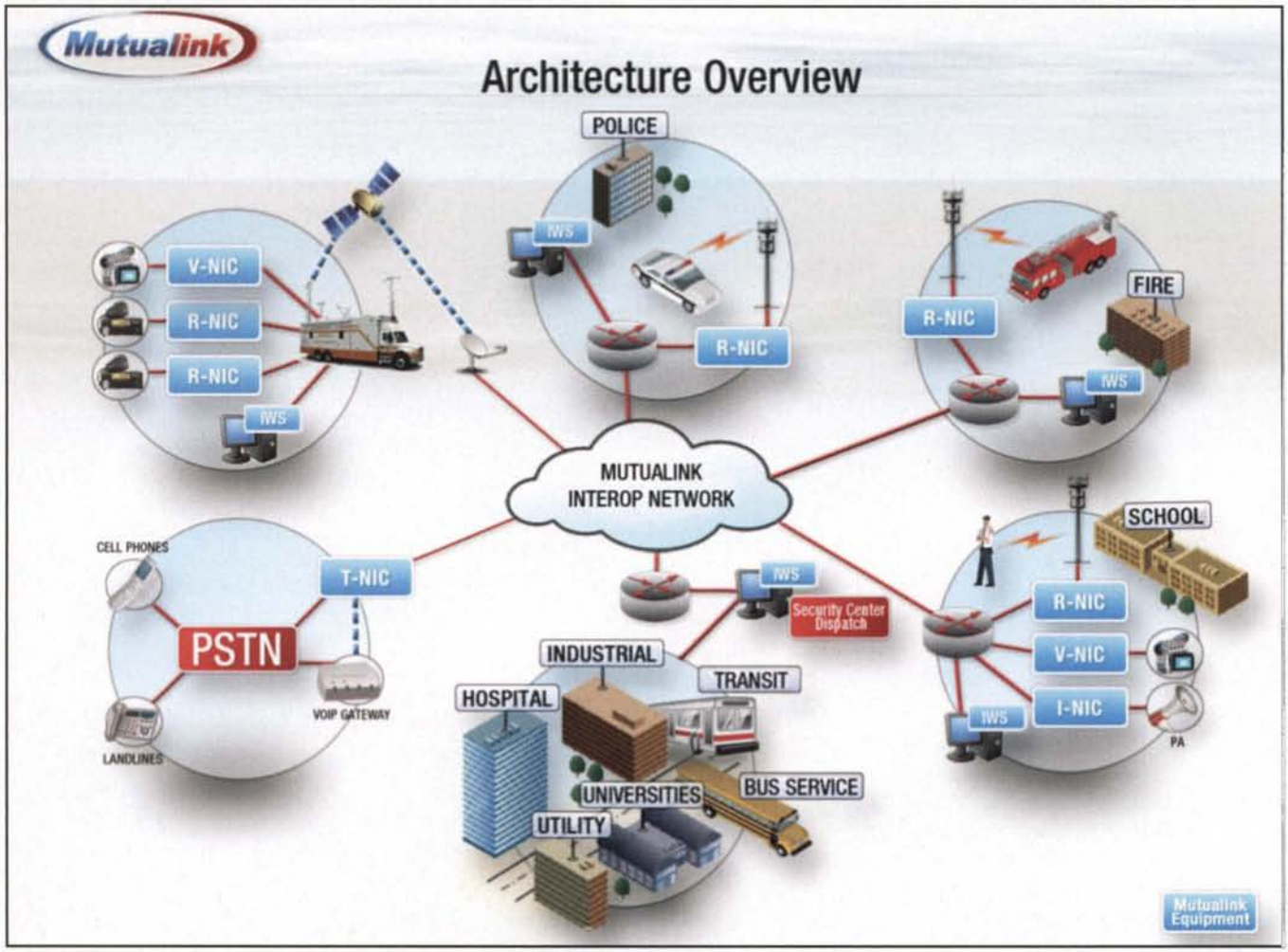

Figure 2. Mutualink is an example of the software that could be used for interoperability. This is a view of the software architecture. It does not show amateur radio, but any radio systems can connect if needed to anyone else's.

to emergencies, I believe that we will see more and more incorporation of amateur radio support in the future.

News from MARS

Here in Washington State, MARS, the Military Affiliate Radio System, has become more and more valuable to the National Guard as well as to the state as a whole. In addition to supporting the National Guard's emergency net, MARS has offered training and assisted in building and configuring our computers and radio systems.

In photo B, Al Mitchell, AAAØWA, the Washington State Army MARS Director, is shown presenting me with cables and connections provided by a MARS member. The cables allowed the MARS station to transmit and receive e-mails utilizing VHF and/or HF using the MARS PACTOR system. The system was tested by sending an e-mail over the air addressed to the National Guard Bureau and members of the Joint Operations Center (JOC). All of the messages were received in their inboxes in less than a minute.

Sergeant Major Andy Knowles, IT and Communications Manager, stated, "MARS is an invaluable asset to the Washington National Guard Joint Operations Center. It is a top notch organization from the State Director on down. Without their assistance, I believe, our mission here at the JOC to support and assist during emergencies would be degraded."

Ham Appointed Chief of Army MARS. The following is from the *ARRL Letter*, Sepember 26, 2009:

"On Friday, September 25, veteran Army communicator Jim Griffin, KE7LJA, became Chief of the Army Military Affiliate Radio System (MARS). Major General Susan Lawrence, Commanding General of the 9th Signal Command (Army), named Griffin to succeed Stuart Carter; Carter has held the Chief's post since December 2006. MARS, the Defense Department-sponsored organization of Amateur Radio operators who volunteer for communications support in emergencies, is a component of the 9th SC (A)."

For more information, please see: <http://www.arrl.org/news/stories/2009/09/26/11093/?nc=1>.

ARRL Board News

The ARRL Board of Durectors recently adopted guidelines and recommendations on the appropriate use of amateur radio. The following is from the *ARRL Letter*, September 26, 2009:

"Entitled *The Commercialization of Amateur Radio: The Rules, The Risks,*

Photo B. SGT Mitch Gill receives cables and equipment from Washington State MARS Director Al Mitchell. (Photo by SPC Amber Peterson)

The Issues (http://www.arrl.org/news/files/ARRL_AppropriateUseGuidelines.pdf), the document offers guidelines to assist radio amateurs and anyone wishing to utilize the capabilities of Amateur Radio in understanding the FCC Rules that prohibit communications in which the amateur has a pecuniary interest, including communications on behalf of an employer. While the FCC Rules in this regard have not changed in many years, there has been increasing discussion of the issue as growing numbers of employers and non-amateur organizations recognize the value of Amateur Radio as an emergency communications resource and encourage their employees to obtain amateur licenses. Also included are guidelines for evaluating the appropriateness of Amateur Radio volunteers providing communications services to commercial enterprises and other entities for which other communications systems are available."

Final Thoughts

If you are serious about emergency communications, then volunteer. Check with your local club and ask about MARS or ARES or any other emergency communications support group you can find. get as much training as possible and although the probabilities are against us, let us hope and pray that we are never called to assist.

Until next time, remember: "The nicest thing about not planning is that failure comes as a complete surprise and is not preceded by a period of anxiety"—*John Preston, 1809–1891*. That is not comforting, but it is so true. Follow the Boy Scout motto and "Be Prepared."

73, Mitch, NA7US

Moondata Update 2010 and Related Comments

One of the most important factors in EME communications is knowing when it is best to communicate via moonbounce. W5LUU presents a summary and table of the best and worst conditions for EME in 2010.

By Derwin King,* W5LUU

The best EME conditions occur when: (1) the Earth-Moon distance is at the absolute minimum and (2) the Moon is in the coldest sky region along the Moon path. The effect of distance is independent of frequency, but sky temperature decreases with frequency, up to ~1 GHz and then levels out. The EME signal-to-noise ratio, in dB, is degraded, from the minimum, by a factor (DGRD, see below) which varies over hourly, daily, weekly, monthly, and yearly time periods. As a guide for the basic weekend EME conditions for 2010 the W5LUU Weekend Moondata 2010 lists the DGRD, in dB, for 144 and 432 MHz, and other pertinent EME information for each Sunday at 0000 UT. Factors such as local noise, antenna beam width, side lobes, polarization, etc., can also affect the signal-to-noise ratio of moonbounce signals. Low sunspot activity in 2010 will minimize disruptive ionosphere disturbances. Good conditions will prevail.

For frequencies below 1296 MHz, 2010 will be the best EME year until 2019 or later. Some good and excellent days will occur on weekends, but more during the week. Days listed below have a 144 MHz DGRD that is a minimum at d, day and h, hour and may last for plus or minus several hours.

January: 02d/2310h (0.18 dB) and 30d/1051h (0.02 dB); February: 26d/2215h (0.60 dB); March: 19d/1930h, (0.41dB); April: 22d/1430h, (0.65 dB); May: 19d/1930h (0.68 dB); June: 16d/0233h, (0.5 dB); July: 13d/1034h, (0.25 dB); August: 09d/2056h, (0.13 dB); September: 06d/0730h, (0.23 dB); October: 04d/1822h, (0.66 dB) and 31d/0003h, (0.75 dB); November: 27d/0534h, (0.81dB); December: 24d/1150h, (0.63 dB).

Definitions

DEC. (deg): Moon declination in degrees north and south (–) of the equator. This is cyclical with an average period of 27.212221 days. The maximum declination during a monthly cycle, plus and minus, ranges from 18.15 up to 28.72 degrees with a period (maximum to minimum and back to maximum) of about 19 years. *The last maximum was on 09/15/2006.*

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

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

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

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

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

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

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

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

W5LUU Weekend Moondata for 2010
For Sundays at 0000 UTC

2010	DEC (deg)	RA (hrs)	144 MHz Temp. (°K)	Range Factor (dB)	DGRD (dB) 144 MHz	DGRD (dB) 432 MHz	Moon Phase	Conditions
Jan. 03	14.8	9.1	166	0.19	0.2	0.2	FM + 2d	Excellent
10	–22.3	15.2	426	1.67	4.1	2.6		Poor
17	–14.3	21.2	336	2.34	4.6	2.9	NM + 2d	Poor
24	19.7	2.7	352	1.40	3.8	2.1		Moderate
31	11.8	9.8	183	0.04	0.4	0.1	FM	Excellent
Feb. 07	–24.1	15.9	491	1.69	5.3	2.8		Poor
14	–10.9	21.8	323	2.54	4.5	3.1	NM	Poor
21	22.0	5.3	365	1.65	4.0	2.3		Moderate
28	8.6	10.2	188	0.09	0.5	0.2	FM	Excellent
Mar. 07	–25.4	16.6	668	1.64	6.5	3.2		Very Poor
14	–7.3	22.3	264	2.28	3.7	2.7	NM – 2d	Moderate
21	23.8	4.4	362	1.38	3.9	2.0		Moderate
28	4.9	10.8	201	0.29	0.9	0.5	FM – 2d	Excellent
Apr. 04	–25.3	17.3	935	1.60	4.8	3.5		Poor
11	–3.6	22.7	244	2.20	3.4	2.5	NM – 3d	Moderate
18	24.8	5.9	412	1.20	4.2	3.0		Poor
25	0.7	11.3	216	0.54	1.3	0.7	FM – 3d	Very Good
May 02	–25.0	17.8	2210	1.63	11.5	5.5		Very Poor
09	–0.0	23.3	244	2.13	3.3	2.4		Moderate
16	25.1	5.6	494	0.94	4.6	2.1	NM + 2d	Poor
23	–3.9	11.9	249	0.72	2.0	1.1		Good
30	–24.7	18.3	2735	1.75	12.3	6.2	FM + 2d	Very Poor
June 06	3.5	23.6	247	2.10	3.3	2.4		Moderate
13	24.6	6.2	500	0.68	4.4	1.8	NM + 1d	Poor
20	–8.5	12.6	306	0.86	2.8	1.4		Moderate
27	–23.0	18.8	1295	1.92	9.4	6.0	FM – 1d	Very Poor
July 04	6.8	0.6	259	2.11	3.5	2.5		Moderate
11	23.7	6.8	410	0.49	3.5	1.3	NM	Moderate
18	–12.6	13.5	315	0.86	2.9	1.3		Moderate
25	–21.2	19.6	633	2.08	6.7	2.7	FM – 1d	Very Poor
Aug 01	10.2	1.2	275	2.13	3.7	2.5		Moderate
08	22.2	9.4	381	0.42	2.8	1.2	NM – 2d	Moderate
15	–16.0	13.9	334	0.77	3.0	1.4		Moderate
22	–18.8	20.1	378	2.19	4.9	2.9	FM–3d	Poor
29	13.4	1.7	290	2.12	3.9	2.6		Moderate
Sept 05	20.1	7.9	267	0.49	1.9	0.9	NM – 3d	Good
12	–18.6	14.5	371	0.68	5.3	1.4		Poor
19	–15.8	20.7	337	2.23	4.5	2.9		Poor
26	16.4	2.3	316	2.03	4.1	2.5	FM + 3d	Poor
Oct. 03	17.3	7.6	200	0.63	1.2	0.8		Very Good
10	–20.6	15.1	411	0.65	3.6	1.5	NM + 3d	Moderate
17	–12.7	21.3	539	2.23	4.5	3.4		Poor
24	19.0	2.8	357	1.86	4.4	2.5	FM + 1d	Poor
31	13.7	9.2	166	0.75	0.7	0.8		Excellent
Nov. 07	–22.1	15.6	450	0.75	4.1	1.6	NM – 1d	Moderate
14	–9.4	21.6	518	2.20	4.3	3.4		Poor
21	21.1	3.4	364	1.65	4.2	2.3	FM	Poor
28	9.5	9.9	185	0.75	1.1	1.6		Very Good
Dec. 05	–23.37	16.3	539	0.78	5.0	2.0	NM	Poor
12	–6.3	22.3	265	2.20	2.6	2.5		Moderate
19	22.7	4.0	560	1.48	4.0	2.7	FM – 2d	Moderate
26	5.2	10.2	197	0.61	1.1	0.9		Very Good

By Tomas Hood,* NW7US

VHF PROPAGATION

The Science of Predicting VHF-and-Above Radio Conditions

The Verdict is Still Out

A year ago we discussed the possibility that the Sun was entering another Maunder Minimum, which occurred during the period starting in 1645 and ending in 1715, an incredible 70 years during which sunspots were rarely seen. To the observer, this period is void of evidence of any 11-year solar cycles. What's more, this period coincided with the infamous "Little Ice-Age," a series of extraordinarily cold winters in the Northern Hemisphere. During the year since we discussed the above possibility, the Sun has not presented much sunspot activity, leading many to yet postulate that we are indeed seeing a possible extended period of solar quiet, perhaps lasting years.

As was demonstrated in this column last year and during the time since then, the sunspots now occurring predominantly belong to the new cycle, as they have the magnetic orientation consistent with the expected reversal from those spots of the old sunspot Cycle 23. However, these new sunspots are few and far between.

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After the appearance of a series of very small sunspots during July 2009, the entire month of August was quiet; not one sunspot was observed. This places August as the month with the lowest observed monthly sunspot activity between sunspot Cycles 23 and 24. This fact will move the statistical solar minimum later than December of 2008.

During September 2009, while most days were spotless, two significant sunspot regions developed and lasted for days (figures 1, 2, and 3). One of the regions even produced a moderate solar flare on September 25th. All of this activity started on September 21st as the first sunspot region rotated into view. The next day a second region appeared. Both sunspots grew larger, causing the 10.7-cm flux to peak at 76 on the 23rd. These two regions indicate that the new cycle is picking up energy, although the increase in activity is much slower than we've observed in past cycles.

Unprecedented Opportunities

Have there been any interesting discoveries in the world of VHF propagation during this extended period of solar quiet? Art Jackson, KA5DWI, has been studying sporadic-*E* (*Es*) prop-

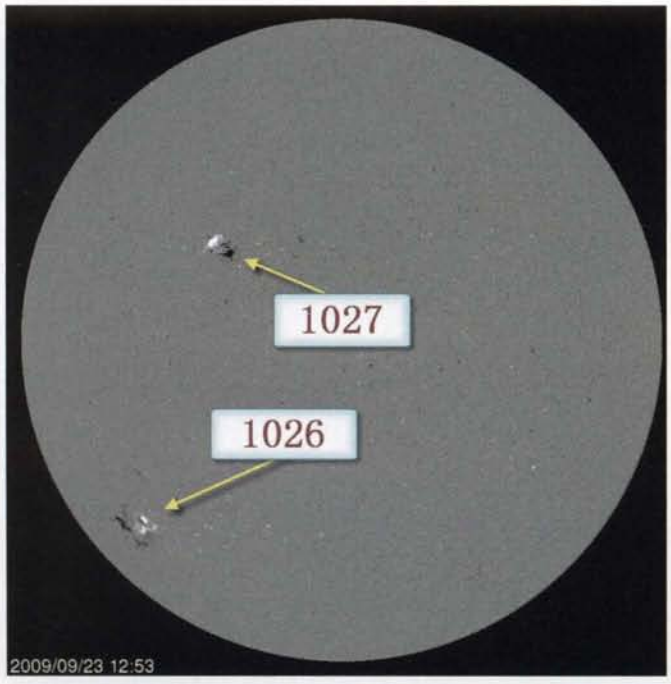

Figure 1. The magnetogram of the Sun using the Michelson Doppler Imager (MDI) on September 23, 2009, showing two sunspot regions. These active regions resulted in a rise as high as 76 in 10.7-cm flux readings during the end of September. These two spots indicate the steady, although very slow, rise in sunspot activity in the new sunspot Cycle, 24. (Source: SOHO, the Solar & Heliospheric Observatory)

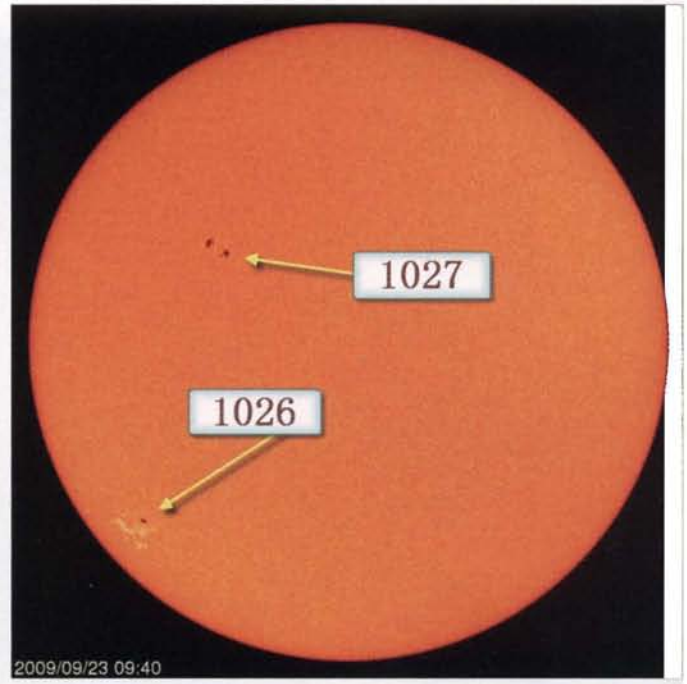

Figure 2. The "intensitygram" of the Sun using the Michelson Doppler Imager (MDI) on September 23, 2009, showing the two active sunspot regions, 1026 and 1027. August 2009 was void of any spots, leaving many to again speculate that we are in a Maunder Minimum. These sunspots in September seem to counter such speculations. (Source: SOHO)

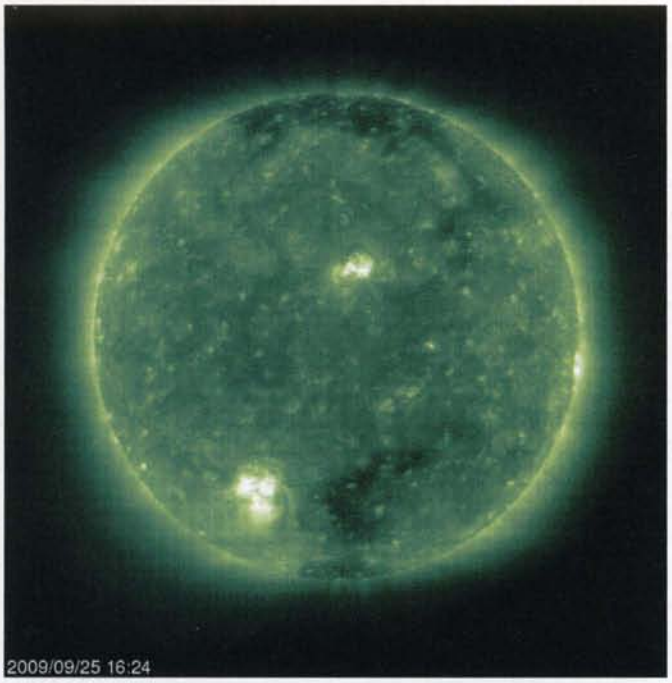

Figure 3. The Extreme ultraviolet Imaging Telescope view at 195 angstroms (Å) of the two sunspot groups (1026 and 1027) on September 25, 2009. Notice the magnetic field lines carrying solar plasma. (Source: SOHO)

agation for the last five years by using data collected from the PropNET project (http://www.propnet.org/). Regarding the 2009 *Es* season, he observes, "The year was phenomenal. I think the best we have had of the past 5 years. What made it special was that 10 meters was open on average 3 hours more each day this season. Some weeks were as much as 6 hours better." He also observes that 6-meter openings were just as reliable and frequent.

Comparing the start of the *Es* season in 2008 with the same period in 2009, Art reports the following:

> In 2008, the first 2 weeks of the season were painfully slow. This year, it started off like gangbusters. From April 22 till August 22, there was a capture every day. As in 2008, the peak daily volume concentrated around the solstice. Also, we had an almost identical late season peak on 7/29, which was the most active day of the season (442) in terms of total captures at this QTH. One notable difference from prior years was a shift of activity towards the second half of the season, sort of similar to 2008, but much more evident this year.

Art observes that sporadic-*E* appears to become stronger each year going into the extended solar cycle minimum. There also appears to be a shift in the time each day when the *Es* peaks. During active years, the peak is earlier in the day, and earlier in the season, while 2009 data suggests that these peaks are later. He concludes that this extended solar cycle minimum, lasting years, is providing unique and unprecedented opportunities to discover more details about sporadic-*E*, as well as offering great DX to radio operators taking advantage of sporadic-*E* propagation.

Art published his 2009 detailed summary of the 2009 spring/summer *Es* season at <http://www.propnet.org/docs/art/KA5DWI_2009_Summary.pdf>. I discussed his research and the 2009 season in the first two episodes of the "NW7US Space Weather and Radio Propagation Podcast" (http://podcast.hfradio.org).

A Roaring Lion?

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

One of the largest yearly meteor showers occurs during November. Appearing to radiate out of the constellation Leo, this shower is known to create intense meteor bursts. Large, spectacular visuals might occur only 10 to 20 times per hour during the peak. Remember, though, that when we are talking about meteor-scatter radio propagation, we count any meteor-formed plasma clouds that will support VHF radio signals.

Astronomers from Cal Tech and NASA say a strong shower of *Leonid* meteors is coming in 2009. Their prediction follows an outburst on November 17, 2008, that broke several years of "*Leonid* quiet" and heralds even more intense activity for this November.

"On November 17, 2009, we expect the *Leonids* to produce upwards of 500 meteors per hour," says Bill Cooke of the NASA Marshall Space Flight Center. "That's a very strong display."

Forecasters define a meteor storm as 1000 or more meteors per hour. That would make the 2009 *Leonids* "a half-storm," says Jeremie Vaubaillon of Cal Tech.

On November 17, 2008, Earth passed through a stream of debris from comet 55P/Tempel-Tuttle. The gritty, dusty debris stream was laid down by the *Leonids*' parent comet more than five hundred years ago, in 1466. Almost no one expected the old stream to produce a very strong shower, but it did. Observers in Asia and Europe counted as many as 100 meteors per hour.

Vaubaillon predicted the crossing with one-hour precision. "I have a computer program that calculates the orbits of *Leonid* debris streams," he explains. "It does a good job anticipating encounters even with very old streams like this one."

The 2008 outburst proved that the 1466 stream is rich in meteor-producing debris, setting the stage for an even better display in 2009. On November 17, 2009, Earth will pass through the 1466 stream again, but this time closer to the center. Based on the number of meteors observed in 2008, Vaubaillon can estimate the strength of the coming display: five hundred or more *Leonids* per hour during a few-hour peak centered on 21:43 UT.

"Our own independent model of the debris stream agrees," says Cooke. "We predict a sub-storm level outburst on November 17, 2009, peaking sometime between 21:34 and 21:44 UT."

December and January Prospects

After November, the annual *Geminids* meteor shower from December 7 to December 17 will peak on December 14 at 0510 UTC. This is one of the better showers, since as many as 120 visual meteors per hour (ZHR) may occur. It is also one of the better showers for operators trying meteor-scatter propagation from positions in North America. The *Geminids* is a great shower for meteor-scatter, since one doesn't have to wait until after midnight to catch this shower. The radiant rises early (starting at

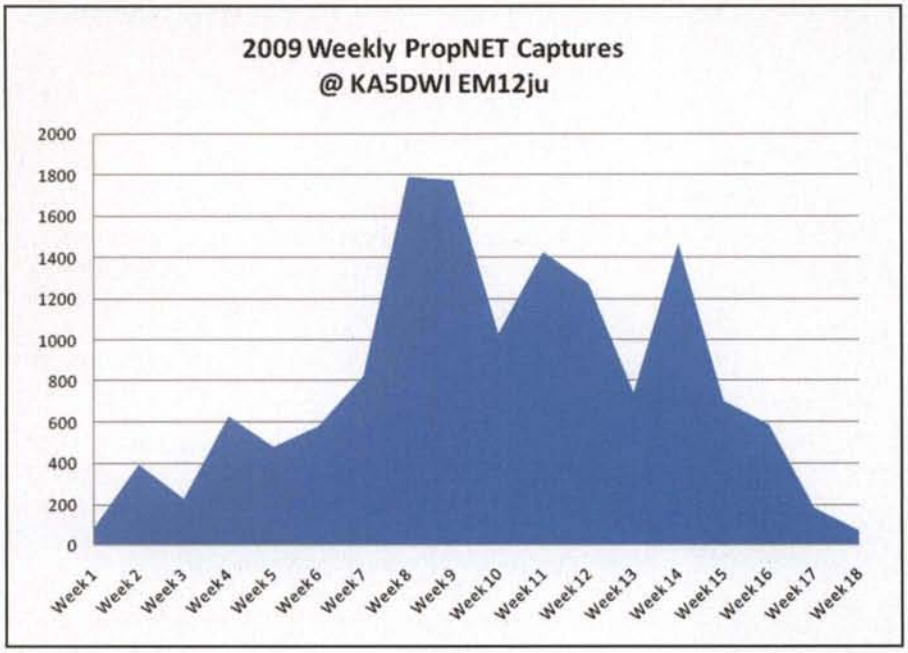

Figure 4. A chart graphing the actual number of 10-meter PropNET captures for one-week periods beginning April 25, 2009 and ending on August 22, 2009 by Art Jackson, KA5DWI. The summer solstice occurs early in week nine. This was the second time in Art's five-year study that the two weeks around the summer solstice were the most active weeks of the season. (Source: KA5DWI)

about 0200 UTC). This shower also boasts a broad maximum, lasting nearly one whole day, so no matter where you live, you stand a decent chance of working some VHF/UHF signals off a meteor trail.

Finally, check out the *Quadrantids* from January 1 through January 5, 2010. This meteor shower is above average with peaks expected this season of around 120 to 200 meteors per hour.

Go to <http://www.imo.net/calendar/> for a complete calendar of meteor showers expected.

Working Meteor Scatter

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

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

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

A great introduction by Shelby Ennis, W8WN, on working High-Speed Meteor Scatter mode is found at <http://www.amt.org/Meteor_Scatter/shelbys_welcome.htm>. Ted Goldthorpe, W4VHF, has also created a good starting guide at <http://www.amt.org/Meteor_Scatter/letstalk-w4vhf.htm>. Links to various groups, resources, and software are found at <http://www.amt.org/Meteor_Scatter/default.htm>.

Autumn Outlook

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

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

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

A secondary seasonal peak in sporadic-*E* ionization should also result in some short-skip openings on low VHF bands between distances of about 800 and 1300 miles at the end of December and early in January. Reports even after the end of the 2009 summer *Es* season indicated surprise openings when no one expected them, so be vigilant and watch for 6-

meter openings throughout November, December, and January.

The Solar Cycle Pulse

The observed sunspot numbers from June through September 2009 are 2.6, 3.5, 0.0, and 4.2. The smoothed sunspot counts for December 2008 through March 2009 are 1.7, 1.8, 1.9, and 2.0. This upward trend gives me cause for hesitant hope that we are seeing a sure, although slow, start of Cycle 24. Even with the lack of observed sunspots during August, the trend will continue upward, as can be seen in the September data.

The monthly 10.7-cm (preliminary) numbers from June through September 2009 are 68.6, 68.2, 67.4, and 70.4. These numbers are higher than one year ago. The smoothed 10.7-cm radio flux numbers for December 2008 through March 2009 are 68.5, 68.7, 68.9, and 69.0.

The smoothed planetary *A*-index (*Ap*) numbers from December 2008 through March 2009 are 4.9, 4.7, 4.7, and 4.5. These numbers are much lower than a year ago. The monthly readings from June through September 2009 are 4, 4, 5, and 3. These also are lower than a year ago. These very quiet conditions contributed to the summer sporadic-*E* season. Expect the geomagnetic activity to increase early in 2010, however, if the new solar cycle picks up as we hope.

The monthly sunspot numbers forecast for November 2009 through January 2010 are 12, 14, and 16, while the monthly 10.7 cm is predicted to be 73, 74, and 75 for the same period. Give or take about two or three points for all predictions.

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

Feedback, Comments, Observations Solicited!

I 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. You are welcome to also share your reports at my public forums at <http://hfradio.org/forums/>. 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/>. Check out my new podcast at <http://podcast.hfradio.org/>.

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

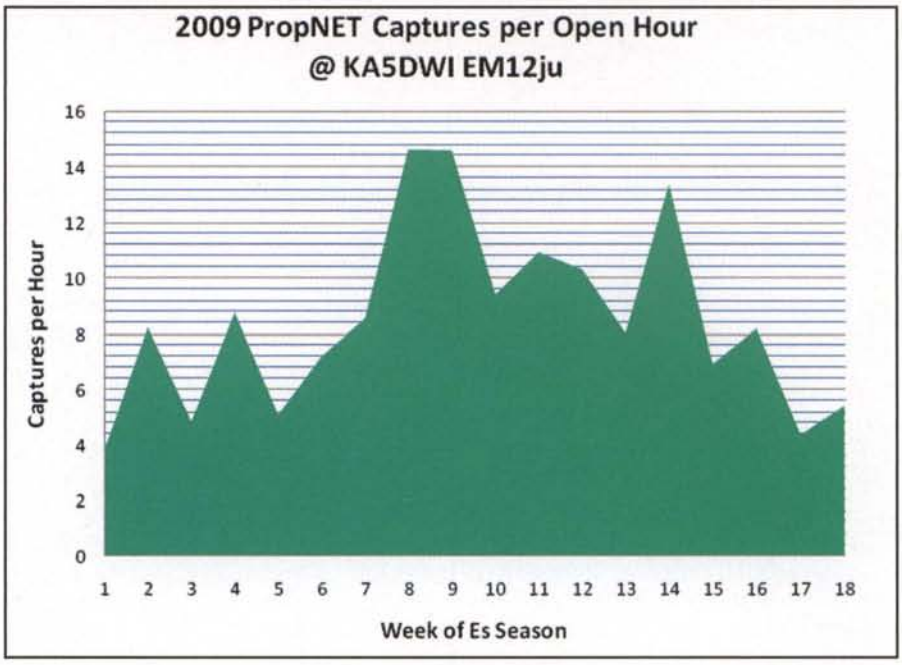

Figure 5. The level of intensity of each opening (measured by open hours) closely coincided with the total number of captures. This meant that for the 2009 Es *season, as we approached the summer solstice each opening was more intense. As the number of opportunities increase (active hours), so does the quality, quantity, and coverage of the opening. This rate chart correlates directly with the weekly capture chart. (Source: KA5DWI)*

By Dr. H. Paul Shuch,* N6TX

DR. SETI'S STARSHIP

Searching For The Ultimate DX

The Day the Earth Called Out

In a December 12, 2008 publicity stunt, 20th Century Fox, producers of *The Day the Earth Stood Still* (the 2008 cheesy remake, not the 1951 cheesy original) beamed its science fiction opus toward Alpha Centauri, our nearest stellar neighbor. A Fox spokesman called it the first "galactic motion-picture release." Wide discussions ensued within the SETI community as to the technical feasibility and societal implications of such interstellar transmissions. Many opined that the transmission could not possibly be detected (four years hence) by its intended audience (four light years distant). Others argued that we cannot place limits on extraterrestrial technology. I argue that we won't know until we run the numbers. However, since the purpose of this supposed interstellar transmission was to promote the release of a motion picture, one could argue that the intended audience was in fact human, rather than extraterrestrial.

This column concentrates on the medium, not the message. Although I am decidedly *not* a film critic, I cannot resist the temptation to comment briefly on the motion picture itself. One wonders why an advanced extraterrestrial would travel all the way to Earth with a message of warning, and then fail to meet with a single scientist, diplomat, or head of state. Had Klaatu, as portrayed by Keanu Reeves, ever bothered to watch any terrestrial television (which question is, in fact, the very focus of this exercise), he surely would have learned how to say "take me to your leader."

As reported in the media, the transmission in question emanated from "NASA's Deep Space Communications Network at Cape Canaveral." Those news reports are factually flawed; Deep Space Communications Network (henceforth DSCN) is a private company, in no way affiliated with NASA, that transmits private messages into space for a fee. Whether by geographical coincidence or marketing design, this company's uplink facility is located in the municipality of Cape Canaveral, FL, USA, but by no means is it on site at the Kennedy Space Center, which shares that address. Mr. Jim Lewis, proprietor of the company in question, asserts that it was never his intention to imply otherwise, a claim which I am inclined to accept at face value.

DSCN's transmission equipment is in fact a standard, commercial-grade C-band remote uplink facility, such as is commonly used for remote news and entertainment broadcasts via satellite. It consists of a trailer-mounted 5.5-meter diameter parabolic reflector and redundant 1-kW klystron FM video transmitters operating in the 5925–6425 MHz TVRO uplink allocation. The transmitters are typically operated at 500 watts average power (+57 dBm), using 10.25-MHz peak deviation, 30-Hz dithering, and a highest modulating frequency of 6.8 MHz, that being the highest available audio subcarrier frequency. These specifications yield a 99% power bandwidth on the order of: $2\Delta f + 2f_m = 34$ MHz, which is wholly compatible with a full 40-MHz DOMSAT transponder, allowing a reasonable guardband for non-significant sidebands.

Note that DOMSAT video being frequency modulated, the signal's energy components are spread out as sidebands across this entire 34 MHz of spectrum. Thus, to recover and demodulate the transmission, a suitable receiver must be designed with a 34-MHz intermediate frequency (IF) bandwidth.

According to the aforementioned Mr. Lewis, the relevant transmission was made on the frequency band for DOMSAT transponder #1, at the low end of the uplink spectrum—i.e., from 5925 to 5965 MHz. At the center of this channel's passband, transmit wavelength is found as:

$$\lambda = c/\nu = (3 \times 10^8 \text{ m/s})/(5945 \times 10^6 \text{ Hz}) = 5.0 \text{ cm}$$

At that wavelength, the manufacturer's stated gain of the 5.5-meter offset-fed parabolic reflector is +48 dBi, suggesting a commercial-standard 55% illumination efficiency. (The gain of this antenna could be improved by nearly 2 dB through the use of a more highly optimized feed geometry, but that is a subject for another occasion.) The computed antenna half-power beamwidth is on the order of:

$$\theta = \lambda/D = 5.0 \text{ cm}/5.5 \text{ m} = 9.4 \text{ mRad}$$

or just over half a degree. The uplink effective isotropic radiated power is:

$$EIRP = P_x + G_a = (+57 \text{ dBm}) + (+48 \text{ dBi}) = +105 \text{ dBm}$$

Optical parallax measurements from Earth show the approximate distance to the Alpha Centauri system to be on the order of 1.3 pc, or 4.0×10^{16} km. Free-space isotropic path loss for transverse electromagnetic radiation is found as:

$$\alpha_{FS} = 10 \times \log_{10} (D/\lambda)^2 = 10 \times \log_{10} (4.0 \times 10^{16} \text{ km}/5.0 \text{ cm})^2 = 380 \text{ dB}$$

Given the EIRP and free-space path loss computed above, one can determine the isotropic power incident upon an assumed planetary body in the Alpha Centauri system as:

$$P_{inc} = EIRP - \alpha_{FS} = (+105 \text{ dBm}) - (380 \text{ dB}) = -275 \text{ dBm}$$

Thus, to recover the transmission, any receiving system at Alpha Centauri must have a detection threshold (receiver sensitivity) at or below this level. That's because in order to be detected and demodulated, a signal in any communications system needs to overcome the omnipresent thermal background noise. This noise power can be quantified as: $P_n = kTB$—where k is Boltzmann's Constant = 1.38×10^{-23} J/K; T is the system thermal temperature; and B is the receiver's bandwidth in Hz. For a DOMSAT video channel, we have already shown the

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required detector bandwidth to be on the order of 34 MHz. Let us optimistically assume a theoretically perfect receiver at Alpha Centauri, whose noise threshold is limited only by the 2.7° Kelvin cosmic background radiation. Noise power now becomes:

$P_n = kTB = (1.38 \times 10^{-23}\ J/K)(2.7K)(3.4 \times 10^7\ Hz) = 1.27 \times 10^{-15}\ J/s = 1.27 \times 10^{-12}\ mW = -119\ dBm$

It can be seen from the above that the isotropic signal incident upon Alpha Centauri is weaker than the minimum cosmic thermal background by a factor of:

$P_n - P_{inc} = (-119\ dBm) - (-275\ dBm) = 156\ dB$

Therefore, the challenge for the Centaurians becomes one of pulling a viewable TV signal out from beneath 156 dB of excess noise.

As almost all hams and radio astronomers know, there is no substitute for capture area. The previously cited signal-to-noise (SNR) deficit assumes an isotropic receive antenna. By creating a directive antenna, one can minimize the isotropic thermal noise intercepted, by the ratio of the antenna gain as compared to isotropic. Thus, a big dish is in order.

It would appear at first glance that a receive antenna with a gain of +156 dBi would raise the signal-to-noise ratio to within detection threshold. In fact, the picture is a little bleaker than that, because demodulation of FM video requires an SNR somewhat greater than unity. Let us assume that a 10-dB signal surplus is required for sparkly-free video reception. This is a level typical of the best phase-locked-loop detectors available on Earth, and we have no reason to suspect that the Centurians have significantly better detectors for detecting Earth's TVRO uplinks. Thus, an antenna gain of +166 dBi will prove adequate for reception of this particular transmission, with modest fade margin and detector threshold.

Is an antenna with +166 dBi of gain feasible? Consider that the Arecibo Observatory, Earth's largest radio telescope, has a theoretical gain at the frequency of interest of a mere +74.8 dBi. Although nothing even approaching the required level of performance has ever been achieved on Earth, let us not limit extraterrestrial intelligence's (ETI's) technological prowess. The laws of physics suggest that if you build an antenna big enough, any gain figure is achievable.

OK, so how big is "big enough"? The gain of a parabolic reflector antenna, in decibels relative to isotropic, is found from:

$G_a = 10 \log_{10} \eta(D/\lambda)^2$

where η represents illumination efficiency factor (on a scale of 0 to 1), D is the antenna diameter, and λ is wavelength in like units. Giving ETI the benefit of the doubt, let's say their engineers can illuminate a big dish to 100% efficiency. Now, solving for D, an antenna with +166 dBi of gain, at an operating wavelength of 5 cm, needs to be a mere 3200 kilometers in diameter!

From the foregoing, I conclude that the challenges of reception, although clearly not insurmountable, are daunting to even the most technologically advanced extraterrestrial civilizations that our (admittedly limited) human imaginations can conceive. Even optimistically assuming that the Alpha Centaurians can build a 100% efficient antenna a continent across, there still remains the thorny problem of aiming it accurately at Earth. That complication will be discussed in our next column.

73, Paul, N6TX

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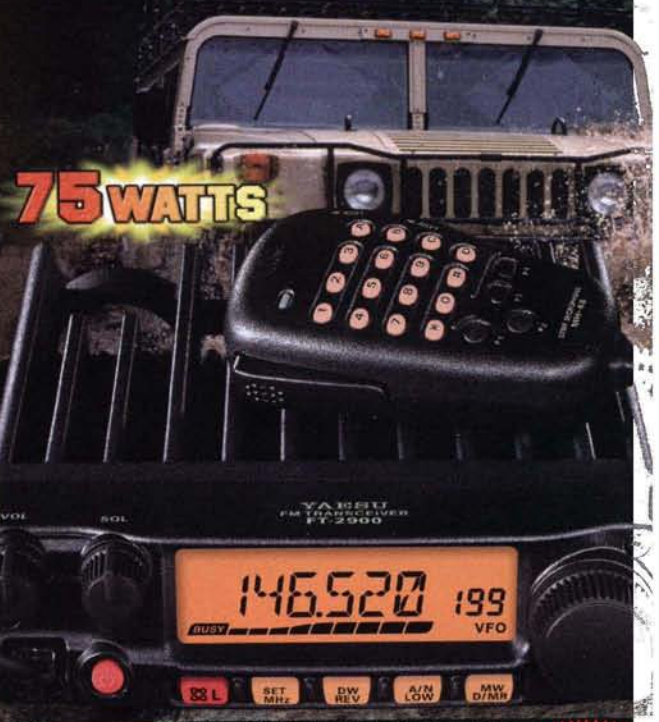

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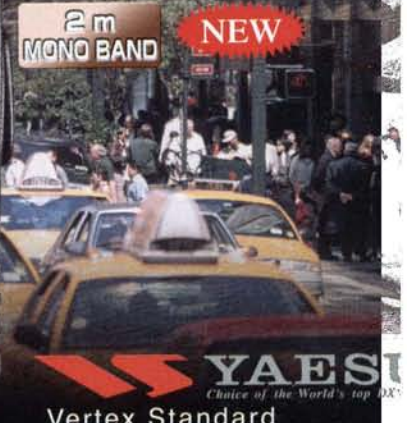

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