

Trends in EME

By Rick Rosen K1DS

When the concept of moonbounce communication was developed in 1940, experimentation and successful echoes were made by large military installations in 1946. By 1953, amateur operators were successful in their EME communication attempts. Since then the field has grown and there are several resources and support for getting started in moonbounce. There are monthly electronic newsletters for 144MHz EME operators¹ and for those on 432MHz and Up². The various VHF conferences held across the US usually have presentations and demonstrations of EME communication. There is a biennial EME meeting sponsored by volunteers and various other European ham groups have hosted annual moonbounce meetings.

Since the introduction of the WSJT programs in 2001, and its updates (the current General Availability release³ is WSJT-X 2.0.1), there have been dozens of stations entering the EME world, starting on 144MHz or 432MHz with Yagi antennas.

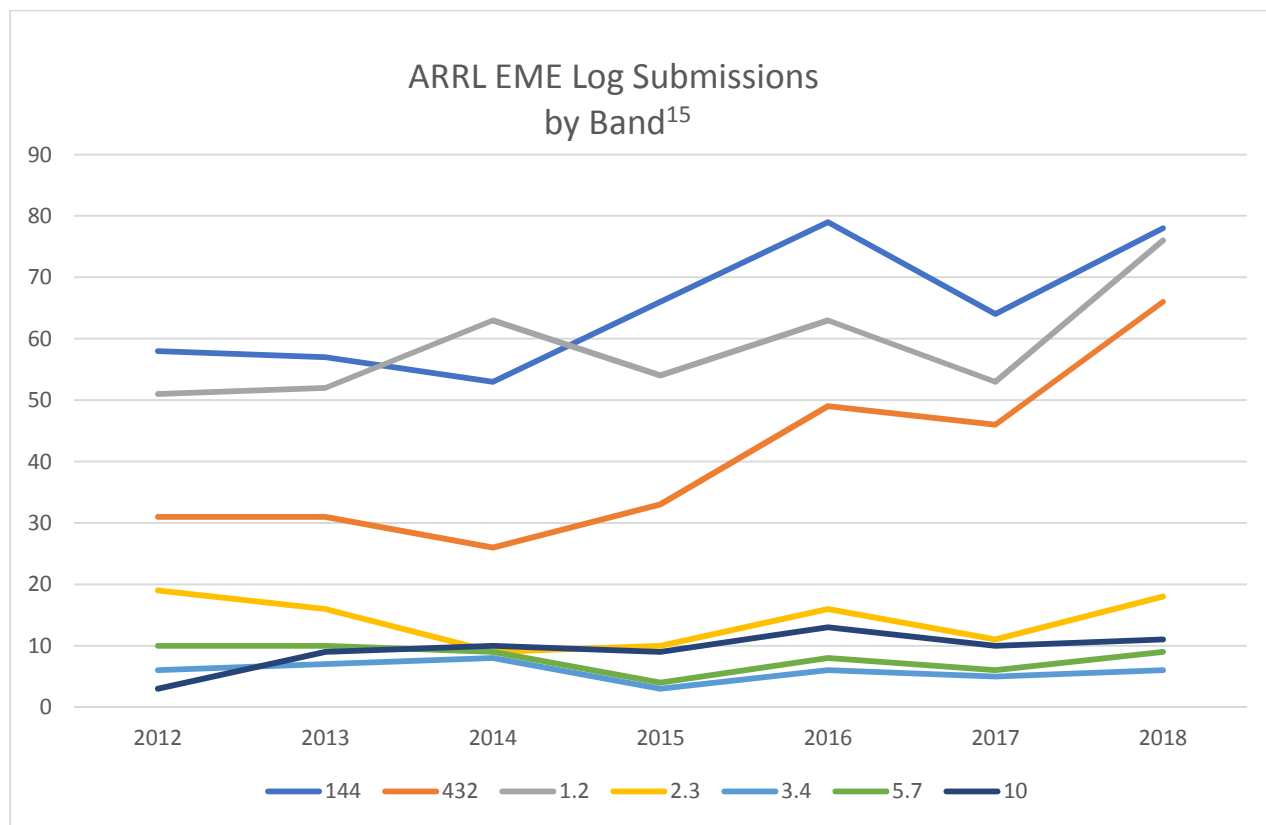
With improved preamps, widely available high-power SSPAs and combiners for the medium-powered microwave amplifiers, SSB EME QSOs have been made regularly by many of the biggest stations. The digital modes have made it possible for some of the smallest stations with small dishes, single Yagis and power levels 100W or less to make several dozen contacts with larger stations. It takes a little bit more engineering to set up and get a dish with a circular feed to track the moon for 1296MHz. Although there are many hams that have used a long Yagi on 1296, since most operators use circular polarization, those with linear polarization give up 3 dB on both transmit and receive. Some of the smallest effective dishes are in the 6'-8' diameter size. Using offset dishes and positioning encoders that are accurate to a tenth of a degree, activity on microwave bands 3.4GHz, 5GHz, 10GHz, and 24GHz has increased. Contacts on 47GHz have been made and experimentation continues at 76GHz. In the past few years we have also had the unique resources of a 1296MHz EME beacon ONOEME⁴ and a 10GHz EME beacon DLOSHF⁵.

There have been multiple moonbounce demonstration activities around the world with the temporary use of existing large dish antennas. In April of 2010, the KP4AO⁶ station at the 1000' diameter dish in Arecibo, Puerto Rico was activated on 432MHz. The moonbounce signal was easily received by the most minimal stations, and two-way CW and digital QSOs were able to be made by relatively low-powered single-Yagi setups. Other large dish stations such as the 25-meter Dwingeloo⁷ dish in the Netherlands, the 60' Diana⁸ dish in NJ and the Haystack⁹ 37-meter dish in Massachusetts have been activated for moonbounce activity.

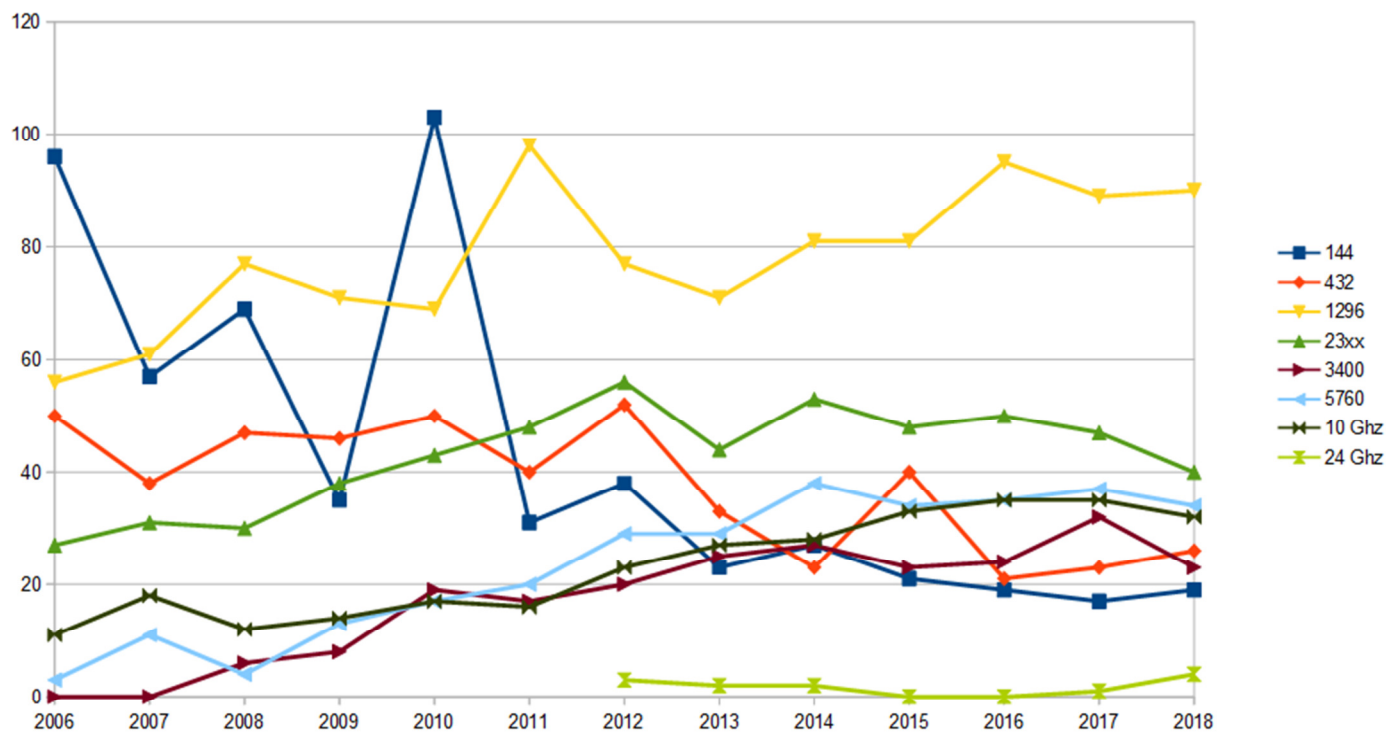
There are several internet-based aids to assist stations seeking help or scheduling EME QSOs. Reflectors for those on 144MHz¹⁰ and others on 432MHz¹¹ and up are active. The NOUK¹² and HB9Q¹³ web pages allow for instant messaging between moonbounce operators, with separate sections for different bands and modes. The definition of a minimum valid QSO is that both stations have copied all of the following:

1. Both callsigns from the other station
2. Signal report from the other station (or some other previously unknown piece of information, e.g. the other station's Locator grid)
3. R from the other station, to acknowledge complete copy of 1 and 2.

A list of capable and active EME stations is available at the PAOPLY website¹⁴. There are more than 450 stations listed for 432MHz, another 450 on 1296MHz. For 2.3GHz we note 150 stations and 3.4GHz has more than 60 active. The 5.7GHz list has almost 100 active and another 150 on 10GHz. The 24GHz EME group includes 40 amateur stations. As you can see from the following charts, EME activity has been growing, especially on the higher microwave bands. The 1296MHz band remains most popular on CW and WSJT, while activity on 144MHz is almost all digital. There has been a resurgence of attention to the 432MHz band.



DUBUS CW EME Contest Participants 2016-2018¹⁶



My Back Story

As I became more intertwined with operating EME, attending the international EME meetings and operating VHF contests, I became the author of the QST ARRL EME Contest report for the past several years. This opportunity afforded me a look into the technological advances, the use of digital communications, and the growth of moonbounce activity. The calendar is filled with EME operating events for almost every weekend that moonbounce conditions are favorable. With predictions of the moon closer to the earth and in a quiet sky location, organizers of EME activity have selected prime weekends for single band and single mode activity. Some of the activity is informal, while there are three organizations, ARRL, DUBUS¹⁷, and ARI¹⁸ that sponsor contests with various recognition awards.

Have you come under the EME spell, wanting to or actually making your first half-million-mile QSO? There have been many influences that have increased VHF, UHF and microwave moonbounce activities in recent decades. I'm one of those hams who was always intrigued by the thought of EME. I was exposed to a portable EME operation, but then banished the thought as it seemed to require massive gear for little return—whispers of a CW signal needing multiple repeats just to exchange call signs and a signal report.

Several Packrat members had established an EME station in the 1970's on 432MHz. Packrats also helped install a 28' Kennedy dish at the QTH of K2UYH. In the mid-1970's, a plan was hatched for an EME DXpedition to Columbia, South America in order to put the first 432MHz EME station on the air from South America. The story of that DXpedition¹⁹ has been often told at Packrat meetings, complete with pictures and artifacts of that trip. Led by K3JJZ, the group put together an EME station and shipped it in 13 crates to Columbia. There they operated HK1TL (Tierra-Luna) for a week in 1976, using CW, fighting the heat, power outages and sagging line voltage, but being amazingly successful in their efforts. K2UYH was able to complete the first WAC on 432MHz. In 1997, I moved from Rhode Island to Pennsylvania and transitioned from the NEWS VHF club to the Packrats and heard the moonbounce DXpedition story and saw the presentation. Once again, my EME thoughts were piqued.

The K2UYH station was about an hour's drive from my new home in PA and I was anxious to see what a well established EME station was about. The massive dish at the QTH is not easily seen from the front of the property, blocked mainly by the house and trees. From the back yard, up close and personal, it sure appears huge. And the CW signals we heard on 432MHz and 1296MHz were huge also. During an ARRL EME contest at K2UYH, I got to listen and help log stations. In a subsequent year I got to sit in the operator's seat and run the station myself. I was truly under the moonbounce spell.

A funny thing happened on the way to Frenchtown, NJ. Steve and Sandra at Downeastmicrowave were planning their transition to move to Live Oak, FL. They were doing some clearance sales and dumping some old 2-meter antennas. I took part in both phases, buying several items that I could use for my VHF rover van and also transporting those 4 long (32') Yagis back to PA. Not having room for the antennas at my QTH, I stored them outdoors at the barn where the Packrat VHF contest station gear was kept indoors. A year later I resurrected two good long Yagis from the original set of 4, as many of the boom pieces and elements were no longer useable. It was still a dream to use a pair of those antennas to start my own EME career.

My first partial 2-meter QSO was scheduled with W5UN who has a huge bank of antennas and a gigantic signal. I took one Yagi in three pieces on my rover van, assembled it on a mast atop the van and pointed it at the setting moon. Using my FT736R and a 150W brick, I dutifully sent CW in 2.5-minute-long sequences. I tuned and heard nothing. Time after time I sent and listened but heard nothing until the hour was almost up. I clearly heard my OOO signal report, but missed the call sign exchange. Dave later emailed to me that he copied me each sequence, but I explained that I only copied him at the end of the schedule and then the moon had set at my portable location. Buoyed by the partial success, I went on to use my TS2000x for portable EME, a TE 350W amp with its built-in preamp and made several other CW QSOs with European stations.

Joe Taylor, K1JT, introduced the WSJT communications program in 2001. He had joined the Packrats and spoke at a club meeting about how it could be used for EME. He invited the club members to come to his QTH and see the program in

action, and actually operate his station. After that demonstration and the experience at the K2UYH station, plus my own successful EME 2-meter CW QSOs, I was fully into the EME sphere. Another set of opportunities came my way: a 10' parabolic dish for "free" and a used set of four long 432MHz Yagis as a great buy. More tools for moonbounce. The dish was removed from one of the K2UYH neighbors, dissembled into 4 parts and stored again at the Packrat equipment depot. The Yagis made their way into my garage.

Because I lived in a CCR community that did not allow for outdoor antennas, my ham activities were usually done portable or mobile. Although I did have an HF wire antenna and a VHF log-periodic in the attic, home operations were limited. I purchased a used 4' x 8' trailer to use as a base for my EME portable operations, most of which eventually took place from right in front of my house. N3ITT helped me by welding the dish mounting frame into a useable AZ-EL structure instead of the original polar mount design. He also added an erecting fixture to the trailer to enable an electric winch to raise and lower the dish into operating and storage positions. Of course, I had to add a trailer hitch to my rover van, a winch on the wall of the garage to pull the trailer back up the driveway after use, a circular feed and scalar ring for 1296MHz, preamps, relays, sequencers, power supplies, and a 270W PE1RKI SSPA. Now I was really having fun with 1296MHz CW EME, able to work other similarly sized stations and so many of the QRO stations.

Another opportunity was the purchase of a 160W 2304MHz SSPA. More visions of operating another band on EME. After adding a WD5AGO preamp and circular feed, this too was on the moon successfully making more CW QSOs. Operation on 432MHz took a back seat but added a few contacts on EME contest weekends.

Aside from the experiences with K2UYH and K1JT, much of my moonbounce knowledge and inspiration has come from the international moonbounce community. The 432MHz and Up group holds an international meeting every two years. The group is informal, has no true structure, just a rotating handful of energetic volunteer hams who organize a great 1-2-day symposium and tour with a program for spouses and families.

Since we have headed south, I have transitioned most all of my moonbounce gear to others who will put it to good use. I have retained enough gear to be active on 144, 432 and 1296 MHz with single Yagis from our new QTH in EL96 Florida. If you have the opportunity to visit or operate an EME station, watch out, you too may get bitten by the EME bug.



Notes

1. <http://www.df2zc.de/newsletter/>
2. <http://www.nitehawk.com/rasmit/em70cm.html>
3. <https://physics.princeton.edu/pulsar/k1jt/wsjsx.html>
4. <http://users.skynet.be/on0eme/ON0EME/Welcome.html>
5. http://www.pa0ehg.com/dl0shf_beacon.htm
6. https://physics.princeton.edu/pulsar/k1jt/Moonbounce_at_Arecibo.pdf
7. http://www.eme2008.org/papers/Sistem%20components/pi9cam_Presentation.pdf
8. https://en.wikipedia.org/wiki/Project_Diana
9. https://en.wikipedia.org/wiki/Haystack_Observatory
10. <http://mailman.pe1itr.com/mailman/listinfo/moon-net>
11. moon@moonbounce.info
12. <https://www.chris.org/cgi-bin/jt65emeB>
13. <https://logger.hb9q.ch/>
14. <http://www.pa0ply.nl/directory.htm>
15. <https://contests.arrl.org/ContestResults/2018/EME-2018-FinalFullResults.pdf>
16. <https://www.qrz.com/db/dj3jj>
17. <http://www.marsport.org.uk/dubus/eme.htm>
18. <http://www.eme2008.org/ari-eme/contest.html>
19. <https://www.packratvhf.com/attachments/article/30/hk1tl.pdf>