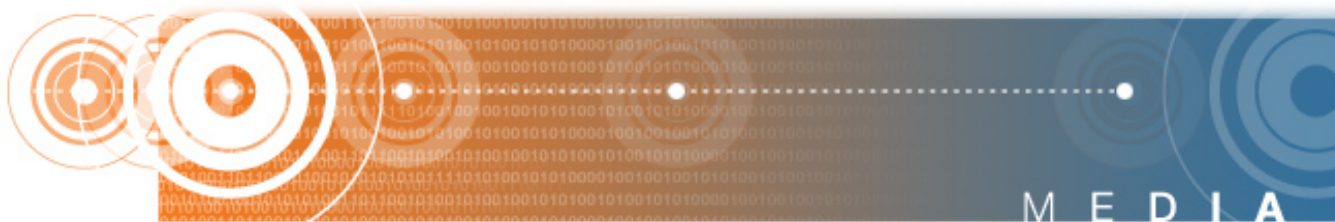


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ANDREW SEYBOLD MEDIA

### Radio in Space and Interference Issues

**Tuesday, August 19, 2008**

On August 19, 2008, at exactly 8:35 am Pacific Daylight Time, on the roof of one of the physics buildings at UC Santa Barbara, a group of ham radio operators and a Boy Scout troop from the area made a radio call into space. This call was answered by [Dr. Gregory Chamitoff PhD \(KD5PKZ\)](#) who is one of the astronauts currently stationed on the [International Space Station \(ISS\)](#). The radio session lasted for ten minutes, which is as long as the ISS was passing over the Santa Barbara area. Many of the space station astronauts, as well as space shuttle astronauts, have been ham radio operators and they spend time talking from their ships in space to schools and Scout troops across the United States.

The most amazing thing about this type of contact is that it is being accomplished with off-the-shelf ham radio equipment operating in the [2M \(144 MHz\) band](#). That is not to say that the system is not sophisticated, it is made up of a PC with an orbit prediction program and tracking interface that controls a rotor which, in turn, controls the azimuth and elevation of the antenna so it precisely tracks the path of the ISS. The transmit power necessary to make this happen is about 150 Watts. All of the equipment was been placed on the roof of the building and tested ahead of time to make sure it was working properly. There was also a back-up station that uses a smaller antenna in case there was a problem with the main system.

The Scouts were able to ask questions of the astronaut with the licensed amateur radio operators handling the actual transmissions. This was a great opportunity for the Scouts to find out about what

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amateur radio can do, and both the evening before and night after the contact, the amateur radio operators of the Santa Barbara Amateur Radio Club were working with the Scouts so they can qualify for their radio merit badges. The contact was videotaped and was streamed live (before this Commentary was published) but it will also be available online at [N6KTH.com](http://N6KTH.com) after the event for anyone who might want to listen in.

In addition to the ISS communications, the amateur radio community has several [orbiting satellites](#) and uses them to communicate with others around the world. There are also a number of hams who routinely bounce radio signals off the moon and the signals are reflected back to another part of the world. All of this is done without any public funds or assistance, it is self funded by the ham radio community.

I am sure this was a thrilling once-in-a-lifetime experience for the Scouts, and for the hams on the ground as well. I was following the progress while the club was putting this all together and started thinking about the fact that, like the true radio technicians, the amateur radio community is aging and neither of these groups is attracting many young people who are interested in the inner workings of radio systems or learning to design systems, repair them and troubleshoot them when there is a need.

Hopefully, this type of activity will interest one or two Scouts in communications and they will enter the field in one capacity or another. I still work on two-way amateur repeater systems and we have a system that runs from [San Diego up to Sacramento](#). It is made up of a series of high mountaintop radios that are all tied together with radio links, and I often talk to hams who are mobile in San Diego or San Jose or elsewhere when I am sitting in my office with a handheld radio not much bigger than a cell phone.

Today, with cellular service and the Internet, this does not seem like such a big deal, but putting this system together and having it sound as though the person you are talking to is simply across the room is still something that challenges our engineering skills and ability to design systems that work over such distances. In times past, amateur radio operators have contributed greatly to the advancement of commercial communications technologies.

Another thought I had concerned the issue of interoperability for first responders. One of the solutions many communities use are [amateur radio volunteers](#) who are called out during a major incident and who set up ham radio stations to move traffic from one location to another. Since they set up their systems to work on the same channel, they are effective, and while most of the traffic they handle is fairly routine in nature to free up emergency channels for priority traffic, there have been times when hams have been able to help coordinate activities quickly because they were all on one channel and could relay the communications to the command personnel quickly. In some areas such as Santa Barbara, the local first responder community welcomes the assistance of the ham radio community and helps train them for on-the-scene emergency situations. Yet in other parts of the country, the ham community is considered to be a bunch of people who only want to play with their radios and don't contribute.

In any event, it is great to see what is happening with the space station and the Boy Scouts and to see the ham radio club working with the Scouts to help them earn another merit badge. We need more young people in the wireless communications industry—people who are trained how to use their heads, figure out radio problems and find solutions. As we become more wireless, and as wireless proliferates into every aspect of our lives, the chances of interference or poor performance for a number of other reasons will challenge even the best-trained minds.

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solve the problems that are going to become more prevalent as we continue to add more systems to our spectrum.  
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I have related the story before about the tower I have outside of San Jose and the fact that we had a customer who complained about a bad interference problem that was blocking its receiver on a fairly regular basis. We spent several days at the site with all of our test equipment, spectrum analyzers and the like, trying to find the problem. The only way to find the source of these types of interference is to be methodical and to go over each variable several times. After a few days, we finally traced the source to a rusted bolt on one of the towers. It was acting as a mixer for two of the transmitters on the site and when they both were on the air the bolt generated a third frequency, which was on the customer's receive channel. Cleaning the rust off the bolt solved the problem.

Today's cellular systems are on the air 24/7 making some of these problems even harder to find, and some of the networks change the frequencies used at a given site from time to time making troubleshooting problems of interference even more difficult. It is possible to have a legal transmitter that still causes interference to another system because of the proximity to that system. This is one of the reasons [T-Mobile has filed comments](#) regarding the AWS 2 and 3 Spectrum. It understands that there could, in fact, be some interference created that would degrade the T-Mobile system.

The same is true for the [TV White Space debate](#). Today, there are two-way radio systems that make use of the white space between TV transmitters in various cities, but they are licensed by the FCC as are the TV stations. Thus, if there are interference problems, both parties know who the other party is and they can work together on resolving the problems.

The most classic case of interference is the reason that [Nextel \(Sprint\)](#) is paying to reband the 800-MHz spectrum. The problem resulted in the way in which Nextel made use of the spectrum. Originally, all of the licensed users of that band had single or trunked radio systems using high-level sites and fairly high-powered mobile units. When Nextel began converting these high-level systems into a low-level cellular-type network, the others users on adjacent channels were being interfered with when they were near a Nextel cell site. Many of these licensees were first responders, since the Nextel, business and first responder channels were intermingled on the same band.

The issue was becoming life threatening to the first responders and a compromise was worked out that would shift all of the Nextel channels into one portion of the band and the first responders into another. But Nextel was interfering with some of the 850-MHz cell sites as well and the companies that owned those sites had to spend a lot of money buying devices to help minimize the problems.

Interference is only going to get worse. Many of the [muni-Wi-Fi systems](#) were brought to their knees because of the number of private access points they had to contend with. In Anaheim, the cable company sent out cable modems that were also wireless access points and even if they were not in use, they were hardwired to a single channel (6) and put out a beacon every once in a while that created havoc on the EarthLink muni-Wi-Fi system.

As we move forward, we will experience several types of interference. The first is from other licensed and unlicensed operators on adjacent channels, and the second is from devices on the same network. As we add more macro, pico, nano and femto cells, there will be more and more issues at cell edges and with hand-offs. If a femto cell is inside a house and does not see the wide-area network, there will not be a problem. However, if the femto cell does see the wide-area network, the edge-of-cell issues will be exacerbated. 3G CDMA systems tend to reuse the same carrier channels while GSM, which is channelized, can assign different channels to different cell sites.

we will need more people who understand the [nuances of interference](#) and how to solve the problems that are going to become more prevalent as we continue to add more systems to our spectrum. I hope the hams who have provided so much expertise in the world of radio can attract more younger people who want to learn about wireless, which is part physics and part black magic. The communications with the space station is one way to help younger people become excited about the world of wireless and what it is all about.

Andrew M. Seybold

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