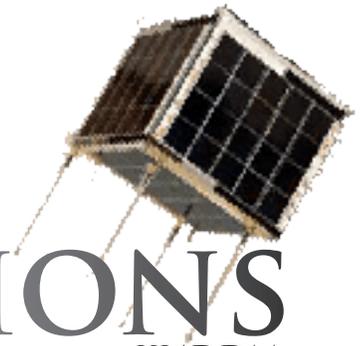




SATELLITE COMMUNICATIONS

BY AARON C. MITCHELL-KJ4DDM



In 1957, the Soviet Union launched "Sputnik," the first artificial satellite to orbit Earth. In January 1958, the United States followed with the Explorer I satellite beginning the "Space Race" between the United States and the Soviet Union. By 1961, the Amateur Radio community, always on the forefront of communications technology research, convinced the U.S. Air Force to replace the ballast on its Agena launch vehicle with their own microsatellite designated as "OSCAR." Oscar (Orbiting Satellite Carrying Amateur Radio) made contact with 570 amateur radio enthusiasts in 28 countries during its 312 orbits of the Earth from December of 1961 to January of 1962.

There are currently over a dozen amateur satellites (including the International Space Station with its own onboard Ham radio station) operating in various communications modes, orbiting the Earth today. These satellites act as radio repeaters bouncing incoming signals from Earth back down on a different frequency providing an effective range of up to 4000 miles! Their communications modes are generally CW (Morse-code) or SSB (AM voice), with a few operating in FM voice mode and various other digital modes.

So, what does it take to get yourself started communicating using amateur satellites? Well, the first thing you need to do is obtain (at least) your Technician License to operate Amateur Radio equipment. For information on attending training classes and testing locations in your area, visit the Platinum Coast Amateur Radio Society's website (<http://www.pcars.org/>) or the American Radio Relay League (<http://www.arrl.org/>). Next, you will need a radio capable of transmitting on one of the frequencies of the satellite you wish to "work" and receiving on a second frequency band (i.e. split-band capable). The least expensive to get started with, in my opinion, are those satellites operating in the FM mode, since you can easily use an HT (Handheld transceiver) for your communications and a directional antenna like the popular Arrow II handheld antenna.

In the early days of satellite communications, amateur radio opera-

tors had to use complex algorithms to calculate the location and trajectories of satellites as they passed over their specific geographic location on Earth for any given date and time. Today, with the advent of personal computers, we now have software that not only perform these calculations, but also graphically illustrates the location of a given satellite over the Earth. Fortunately, all the required software is FREE! Once you have the satellite tracking software installed, you will need to obtain the Keplerian (Two-Line Element) data. You can sign up on the ARRL's website to receive weekly Keplerian updates via email or visit: <http://www.arrl.org/w1aw/kep/> Simply copy the data into a text file using Notepad and save it to your computer. Then using your satellite tracking software load the TLE data and choose the satellites you wish to track. One caveat to this data is that it only includes the Amateur OSCAR satellites. If you wish to track other types of satellites, such as weather satellites, Iridium communications satellites and various government satellites then you need to register for an account at www.space-track.org. You are required to register and wait to be sent a password, as the U.S. government has limited use of such data since September 11, 2001 to protect national interests. As a licensed amateur radio hobbyist you can sign up requesting use of the data for ham radio/research purposes.

One popular satellite that you can begin working is AMSAT-Echo, otherwise referred to as AO-51. AO-51 allows for FM communications and digital packet modes (think: text messaging) depending on the time of month. The AO-51 alternates mode of operation due to power limitations of its onboard batteries. You can check AO-51's current and future schedules at: <http://www.amsat.org/amsat-new/echo/ControlTeam.php>

Once you are up and running, take a listen at the radio traffic being passed through the satellite. You will hear hams passing their call signs as well as their city, state and their GRID LOCATOR information. The grid locator info tells other hams where you are located in

the world. For more information on how to find your grid locator information, visit: <http://www.amsat.org/amsat/toys/gridconv.html>

Here is a sample list of everything you need to get started. Please note that this is only a sample setup for getting started on FM modes and the equipment and software listed below may be substituted with your own equipment and software or upgraded later for various other communications modes as your budget allows.

Minimum Hardware Requirements:

- Dual-Band (140MHz-440MHz) Handheld Transceiver
- Arrow II Antenna (www.arrowantennas.com)
- 10W Duplexer Cable from Arrow
- Personal computer

Minimum Software Requirements:

- Google Earth (www.google.com)
- Orbitron Satellite Tracking Software (www.stoff.pl)
- Keplerian Data (may be obtained from www.arrl.org)

Recommended Options:

- Pre-Amplifier for Downlink. (<http://www.hamtronics.com/lnk.htm>)
- Tripod and Tripod mount kit for Arrow Antenna (www.arrowantennas.com)
- Laptop computer for portability

You can take this hobby as far as your research and wallet will allow. There are specialized receivers to work weather satellites, circularly polarized antennas and remote control antenna rotators that can be controlled by the same software used to track the satellites and much more! For more information on Satellite Communications I recommend visiting the Amateur Satellite Society at <http://www.amsat.org/>

Here you will find more information on AMSAT, articles, photos, and a link to the AMSAT ftp site for downloading software. This is the best place to start when looking for amateur satellite information, especially AO-51. Also has links to other sites.