

Ten things to do, with a handheld radio

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This series of articles are intended to give the newcomer to ham radio an insight into some of the things you can do with a handheld dual band radio.

7: Satellites

There are many communication satellites orbiting the earth that were built by amateur radio groups. They provide a variety of services, from a simple talk through repeater to digital modes and space borne camera picture transmission. Their serviceability can change at any time, so we will not mention any one spacecraft in this article, but direct you to the links below for up to date information.

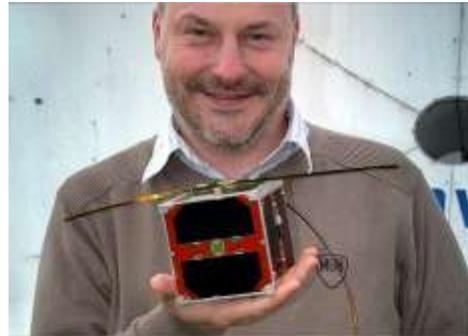


Figure 1 A Ham Satellite

The International Space station is a very large satellite and requires special mention here. Although the crew rarely communicate by voice except for special educational events, they quite often transmit SSTV pictures.

Predictions

Amateur radio satellites are usually in low earth orbit, which means they circle the earth approximately every ninety minutes. Satellite orbits can be inclined relative to the equator but fixed in space with the earth rotating underneath the orbit. This means that like the sun, most satellites “rise” in the East and “Set” in the West. In a typical day there will be two or three orbits visible in the morning. The first low to the East, a second pass almost overhead and then a third pass low to the West with all passes travelling from South to North. Twelve hours later as the earth rotates to the other side of the orbit the pattern repeats but now with the satellites travelling from North to South.



Figure 2 Sample of a Satellite prediction program display

Some satellites are in an orbit across the north and south poles, and in this way, the whole earth is covered.

Therefore satellite "passes" are not seen by any one station on every orbit, so we need to use prediction software to plan our operations.

There are many packages

available, (some are free, see below) and these will calculate when a satellite will come within radio range of your location.

Satellite orbits are tracked by space observation agencies, and these measurements are used to create "Keplerian elements" (orbit data on each satellite used by the prediction programs) and should be downloaded regularly if accurate estimation is to be achieved. If nothing else, it is fun so see which satellites are whizzing over your head!

Frequencies

Unlike ground based repeaters, most satellites in amateur service use two bands for voice communication. Typically the uplink to the satellite will be on UHF (435 to 438 MHz, 70cm band) and the downlink will be VHF (144 to 146 MHz, 2metre band), designated "U/V" although the reverse is sometimes used, and other bands such as 24cm or 10m are also used. Information on each satellite is available on the links shown below. The user will need to setup their radio to transmit and receive on different bands, so dust off that user-manual.

One more frequency consideration; during the pass the satellite frequency will change slightly, called Doppler shift. The very best performance will be obtained if your radio frequency is increased and lowered by 5kHz on approach and retreat respectively.

Transponders and Beacons

The simplest use of a ham satellite is to use it as a voice transponder, as we would a ground based repeater. These communication satellites are very similar in some ways to the normal repeaters on the earth. The most important difference however is that the satellite repeater is constantly moving and the distance to the satellite repeater is constantly changing. Another difference is that the repeater is only available for the short period that the satellite is above the horizon on each pass. These differences make amateur satellite communications much more challenging than using the normal repeater on the surface of the earth.

Many satellites also carry a beacon, which continuously transmits a signal; this maybe just a tone, or additional information in the form of data called telemetry. With the right decoding software the user can receive this and see the health of the satellite.

Antennas

Amateur radio satellites usually carry low power transmitters, but this does not mean you need an enormous dish antenna in your back garden. It is almost possible to use the stubby aerial on your handheld to communicate with a ham satellite, but to give a more successful link you will need either a dual band colinear



Figure 3 A dual band Yagi for use with satellites

or dual band Yagi antenna. The latter, seen in the picture here **Error! Reference source not found.**, can be pointed by hand at the predicted position in the sky, but it is the most "poke you in the eye" prone antenna ever designed!

The community

A worldwide organisation, called AMSAT, was been created to organise the construction and operation of Ham satellites, and this resource will be your greatest asset and source of information. Each country has its own branch, in New Zealand we have AMSAT-ZL.

The challenge of hand held radio satellite operation

While it is possible to use a hand held transceiver to communicate through some amateur satellites it can be quite challenging. The range to the satellite on a typical pass would be about the same distance as the entire length of the South Island. It would be like trying to contact Wellington from Invercargill with a hand held radio. The advantage of the satellite however is that is a line of sight path. With a few watts from a hand held radio it is possible to get a signal into the satellite on a good overhead pass. The real problem is that the satellite has limited power available so is only transmitting about a tenth of a watt or less. Even worse is that much of this power is radiated off into space and only a very small proportion of it reaches the earth. The real challenge is being able to receive this very small return signal.

What next

If you would like to try out satellite operations it is best to set up a contact in advance with an experienced satellite operator who can let you know if you are putting a signal into the satellite and can call you to see if you can hear the downlink signal. So if you want to try out that handheld transceiver email me at alancrewell@xtra.co.nz and I will suggest a satellite to use and the frequencies to set up on and we can give it a try.



Figure 4 Teamwork is needed!

More info

- The AMSAT community can be found here:
<https://www.amsat.org/>
- A source of helpful advice, for amateurs new to satellites:
<https://www.amsat.org/introduction-to-working-amateur-satellites/>
- A selection of satellite prediction software links, paidware or shareware
<http://www.amsat.org/amsat-new/tools/software.php>
- The current status of each satellite can be found here
<https://www.amsat.org/status/>