

First Steps in Setting up an APT Ground Station

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Perhaps you have visited one of the rallies this summer and seen weather satellite images on display. Maybe a friend with a PC has let you into the secret that you too can receive such images, in real time, from the skies. Or you may have discovered the hobby when browsing the Web. Either way, armed with a personal computer, suitable antenna and dedicated receiver for the 137 MHz band, you could be running your own ground station in next to no time and for relatively little cost.

The Satellites

There are currently three American satellites dedicated to the return of so-called Automatic Picture Transmission (APT) weather images of our planet. Operated by the National Oceanic and Atmospheric Administration (NOAA), the NOAA-12, NOAA-15 and NOAA-17 satellites occupy low Earth orbits 840 kilometres in altitude and pass completely round the planet once every 104 minutes. As the satellite orbits are fixed in space with respect to the Sun, the rotation of the Earth carries every part of the globe within the view of any of these satellites at least twice per day.

Receivers

In order to gain access to the signals from these satellites, you require a receiver tuned to the 137 MHz band. There are several options for European enthusiasts; the dedicated Proscan II receiver, the RX2 (which is only available in kit form) or the Czech RX137-141 or a scanner. Details can be found at:

<http://www.geo-web.org.uk/hard.html>



Fig.1 - A cased RX2



Fig.2 - The Proscan II

The fact that these satellites approach the observer, pass high overhead then recede towards the opposite horizon superimposes a significant and constantly varying Doppler effect on to their transmitted frequencies (the same as you hear when a police-car

siren approaches then recedes from you). Receivers must be able to accommodate this and a bandwidth of 40 kHz is required. Both Proscan and RX2 receivers were specifically designed to combat this but the majority of scanners were not.

Consequently, many scanners are totally unsuitable for weather satellite imagery, and even those that are (e.g. the Icom PCR 1000) produce inferior results compared with the Proscan and RX2.

The Antenna

Signals from the NOAA weather satellites are transmitted with right-hand circular polarisation, and you therefore require an antenna specifically constructed to receive this type of signal. Use of a makeshift antenna will certainly allow you to hear the audio signal through your receiver, but it will not be possible to decode it into a satisfactory image.

Most APT enthusiasts utilise one of two basic designs of dedicated antenna, the crossed dipole (turnstile) or quadrifilar helix (QFH). Turnstile antennas can be bought for around £30. Commercial QFH antennas are notoriously expensive, but many enthusiasts build their own from PVC conduit tubing, junction boxes and



Fig.3 - A turnstile antenna

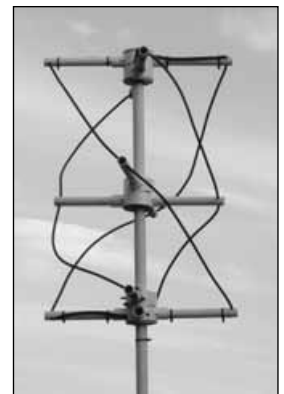


Fig.4 - A QFH antenna

co-axial cable. Chris van Lint's popular QFH project, originally published some years ago is reproduced on page 46, and takes just an afternoon to construct.

The antenna should be mounted with clear horizons all around. The best situation is at the top of your TV mast (above the TV antenna), but loft-mounted antennas can give excellent results as can an antenna mounted on a stake in the garden, just a metre or so off the ground. So long as there are no obstructions between the antenna and the satellite, nor large nearby metallic objects to cause signal reflections, good results can usually be obtained.

The Display Unit

These days, weather satellite images are almost always displayed on the screen of a personal computer. But before you can view the weather pictures, you must first convert the received radio signals into images, and for this an interface is required. There are two options: either a purpose-built decoder in the form of a PC card or external unit, or the PC's existing soundcard. The simpler option (and also the cheaper) is the latter, and this is the route described in this article.

Your receiver will possess an audio output and signals from this must be fed into the PC soundcard, generally via the line-in socket, though the microphone input is another possibility—which one you use depends on the signal level output by the receiver itself. Check which works best for your set-up.

Connecting It All Together

Once your antenna is safely mounted where you intend to deploy it, use good quality screened co-axial download (RG 59 is ideal) to connect it with your

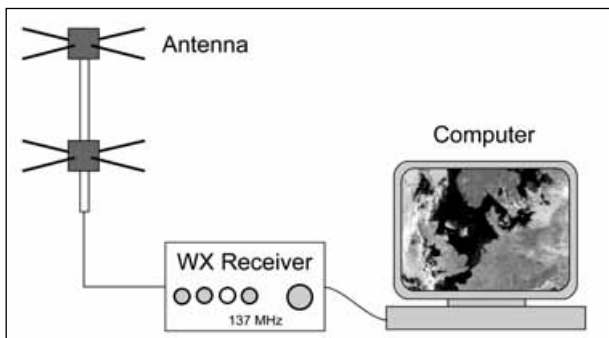


Fig.5 - How the units connect

receiver. The receiver in turn must be connected to your PC soundcard by a length of screened audio lead. Suitable short audio leads with a jack-plug at each end are readily available at rallies and computer fairs.

Preparing the PC Soundcard for Recording

First-timers frequently stumble at the very first hurdle. Although everything appears to have been set up correctly, no audio signal is heard from the PC speakers and frustratingly, no images are produced. This outcome is almost always the result of an incorrectly configured soundcard.

By default, computer sound-cards are configured for playing back audio through the PC speakers. Often the card's recording mode will not have been initialised. Do this by means of the program *Sndvol32.exe* which you can find in your Windows folder. If in doubt as to where to find this, click on your PC's *START* button and select 'Find'. Type *sndvol32* in the 'Named:' field, 'Look in:' should be drive C:, then click the 'Find Now' button. When the filename *Sndvol32.exe* appears in the browser window, double-click on it to open it. *Sndvol32* first appears with the words 'Volume Control' in its title-bar. Click the <Options> menu, followed by <Properties> to reveal the properties screen. Click the

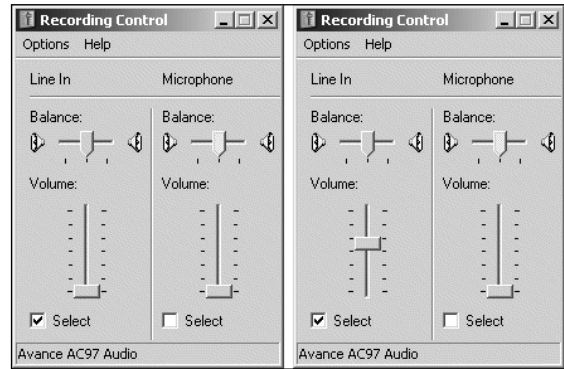


Fig.6 - The soundcard recording control with the line-in input muted (left) and active (right).

'Recording' radio-button, make sure that the 'line-in' option is ticked in the 'Show the following volume controls:' browser, then click OK to reveal the Recording Control panel (figure 6).

The usual input channel for recording from a wxsat receiver is line-in, so this must be activated by firstly checking the 'Select' box in the 'Line balance:' panel, and then elevating the volume control slider to mid-scale (this will require more careful adjustment later). However, depending on the input levels of your soundcard, you may prefer to make use of the microphone input channel instead.

Software

The simplest package, but the most popular among beginners, is *Wxsat* authored by Christian Bock 'way back in 1995. The program's appeal lies in its ability to decode the satellite transmissions into images in real time, while simultaneously recording them on to your hard-drive in the form of WAV files. Although the generation of images requires a degree of experimentation and effort by the user, recording WAV files is relatively straightforward.

Open Wxsat's <Recording> menu and select the third item from the foot, labelled 'Test'. This reveals a window flanked by a grey line at both top and bottom. These two lines represent the maximum permitted amplitude for an incoming satellite signal. Exceed these levels and the signal will be 'clipped', masking out much of the bright cloud detail as full white. This level must be adjusted during reception of a live

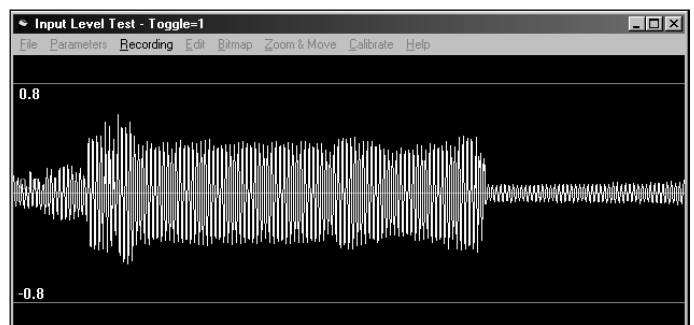


Fig.7 - Wxsat's recording-level test screen

satellite signal, something which may be accomplished by adjusting the *Sndvol32.exe* volume slider position, or by placing a variable potentiometer (volume control) into the audio line feeding the soundcard. The maximum amplitudes in the signal from the receiver must not be allowed to break either grey line.

Figure 7 shows part of a NOAA wave sample with a peak-to-peak value of ± 0.7 , which is more than adequate for the production of good images. Figure 8 was produced from the same NOAA-17 signal as the test screen above. Notice how the image displays a full range of tones from brightest white through full black and that both land and cloud show excellent tonal variation. Figure 9 shows the same transmission, but most of the cloud structure in the visible (left) frame has been lost because of 'clipping'. For the same reason, the infrared image (right) is almost devoid of detail. Although this is an extreme example, for the purpose of illustration, readers do frequently submit images with very washed-out clouds like those in figure 9.

The main reason for this would seem to be an attempt to enhance land detail, which is often quite dark, by increasing the input level. This practice is not recommended, as it destroys most the cloud detail. Instead, the balance between light and dark tones should be adjusted after the image has been created, using the 'gamma' feature of an image editing program such as Paintshop Pro.

The Usefulness of WAV Files

To actually record a WAV file while a screen image builds up you must select the appropriate decoding mode. Click the <Parameters> menu to reveal the default list of decoding options. Start by selecting the topmost item from the list; this will produce twin NOAA images as shown in figure 8, with a visible light image on the left and an infrared image to its right. Other options on the list permit decoding of individual visible or infrared images, as well as allowing the user to combine them as a false-colour image.

To initiate a recording session, select <Start at Subcarrier> from the <Recording> menu, followed by <Save Bitmap and Wave> to prime Wxsat to record a WAV file as it displays the image each time it detects a NOAA weather satellite APT signal.

The great advantage of saving WAV files as well as the actual bitmap images is that the WAV file may be repeatedly decoded through Wxsat (or another program such as *Satsignal* or *Wxtoimg*). This allows parameters to be adjusted until you judge that the final image is the best that can be achieved.

Help With Wxsat

The Wxsat program comes complete with an extensive 'Help' file extending to more than 350 kb in size. This contains dozens of pages of information, many with supporting diagrams and screenshots to help you

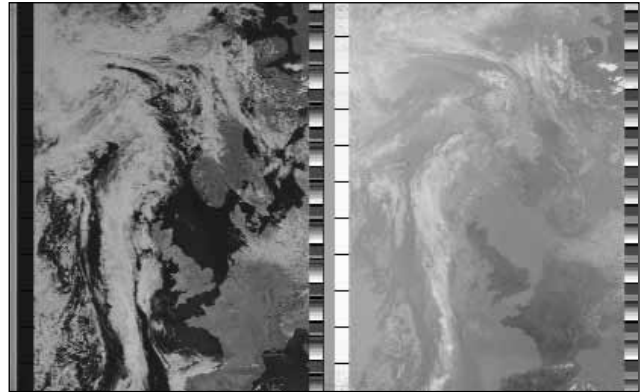


Fig.8 - NOAA 17 - 11:12 UT on July 13, 2003

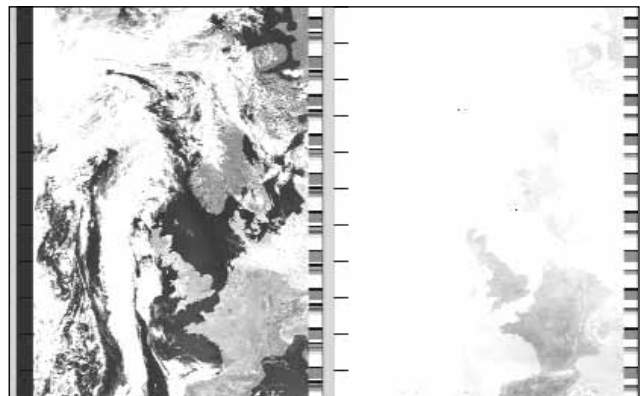


Fig.9 - NOAA 17 - 11:12 UT on July 13, 2003

This is the same image as shown above. This time the input level was far too high and clipping has occurred, destroying tonal detail in the clouds, and washing out the IR frame.

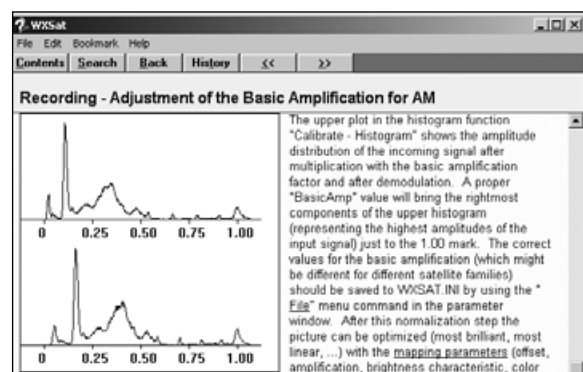


Fig 10 - A WXSAT help screen dealing with histograms

customise the program to meet your requirements. Wxsat may be downloaded from the HF-FAX site at:

http://www.hffax.de/WX_Satellite/WXSat/inst259e.exe

The splendid NOAA-17 APT image on the facing page was acquired by **Hartmut Schaksmeier** of Remscheid, Germany at 11:33 UT on November 13, 2003 and depicts the first serious winter storm to hit Great Britain. Northern Ireland and western Scotland faced the brunt of its power with winds of 120 kph. The image was processed with the software package *WXtoimg*, which will be described in a future issue.

