Contesting

This month's column is focussed on contest propagation at VHF, UHF and microwaves.

One of the delights of operating at VHF and above is the appearance and uncertainty of unusual propagation. The spectrum from 50MHz through to the microwaves plays host to a huge variety of propagation mechanisms, many of which can play a big role in contests. Sometimes VHF propagation is simplified as just being line-of-sight – but nothing could be further from the truth. The bands would be very dull if that were the case. Tropospheric ducting and scatter, aircraft scatter, Sporadic-E, aurora, rain and meteor scatter, amongst others, all play important parts in making VHF contests unpredictable. There's no room to go into detail about each mode here, but there are good analyses of each mode in the freely-available VHF/UHF DX Book [1]. Some modes are also covered in more mathematical detail at G0MJW's excellent website [2].

Troposcatter and aircraft scatter

In spite of the excitement generated by unusual conditions, for much of the time at VHF, contest conditions will be 'normal'. This means that the contacts who you make beyond your local line of sight will usually be worked using Troposcatter. This is the mechanism where signals are scattered from the normal irregularities which are present in the Troposphere and typically allow contacts out to about 700km for stations on 2m CW using 100W and one long Yagi antenna, although these signals can be very weak. More power, bigger antennas, and a very clear horizon (especially a sea path) can help extend this reach by perhaps 200km. For similar equipment, range at 70cm is about 100km less than at 2m.

On days when propagation is normal, we will often find that signals peak up way above normal levels for short periods of time. This is often just for a minute or two at a time and often accompanied by relatively rapid fluttery fading and is caused by the signal being reflected from an aircraft.

The range attainable by aircraft scatter is similar to Troposcatter and, perhaps for that reason, until 10 to 15 years ago the importance of this mode was not well recognised. In reality, it accounts for many of the longest DX QSOs which are made in VHF/UHF contests. Commercial, and some military, aeroplanes are big and high enough to be an effective reflector for VHF/UHF signals when they are correctly located on the path between you so that both you and the DX station can 'see' them. During the daytime and evening there are so many aircraft in the skies above Europe that there are many excellent opportunities for a helping hand with a QSO. This is also why, even in the big contests, the band seems to go quiet overnight as there are fewer aircraft and we're much more reliant on true troposcatter.

Large aircraft like the A380 and Boeing 747/777 generate stronger reflections than smaller aircraft like private jets – but all can be useful. In the past you would need to camp out on the frequency of a DX station for some time and wait for them to come up in signal as an aircraft moved into a favourable position to reflect the signal back to you. However, there is now excellent free software available to help you, including Airscout by DL2ALM [3]. This allows you to accurately predict when a suitable aircraft will be present between you and a QSO partner. This software needs a feed of live plane data (collected from a network of receivers around the world receiving the 1090MHz ADSB transponder information on the aircraft) which has been a challenge in the past. Currently there is a reliable offering from Thomas, OV3T [4] with small donations welcome to offset the costs of running the infrastructure requested (the volume of data to be moved is not insignificant). A sample of some of the information available via Airscout is shown in **Figure 1**.

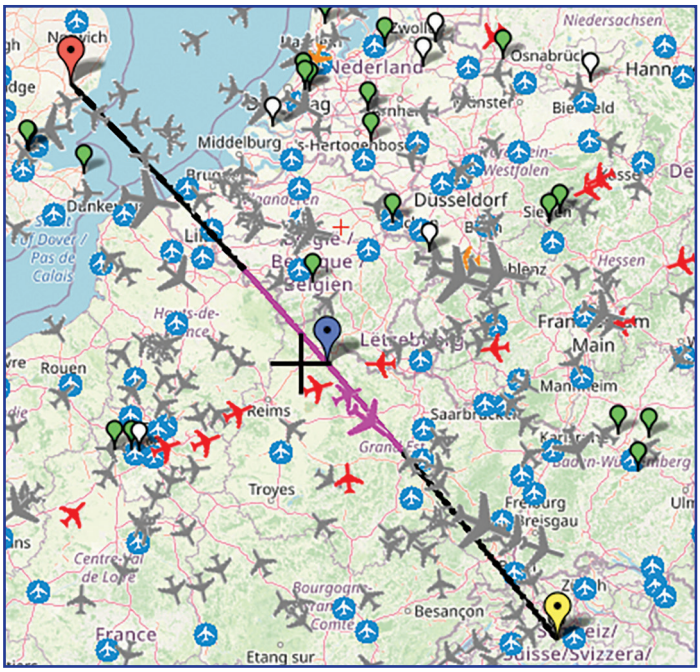

FIGURE 1: **A screenshot from Airscout showing the path from G4PIQ to HB9EFK with two active planes in Magenta. Several planes in red which will shortly cross the path.**

QSOs via aircraft scatter may occur randomly, or tougher ones may be scheduled via the chat on ON4KST to ensure that the narrow beamwidth antennas used at VHF and UHF are correctly aligned at the right time. If you're doing that, wtKST [5] by DL8AAU is a very useful piece of software. It integrates with Airscout and the ON4KST chat server to show a list of stations who are online and either have a plane in range now, or will have one in place soon as shown in **Figure 2**. In terms of operating, you need to be swift and clear. The signals may only be at their peak for a few tens of seconds, so time for repeats can be limited.

Aircraft scatter is a valuable mode all the way from 50MHz right up to 10GHz, although as you reach the higher frequencies with narrower antenna beamwidths, the plane needs to be in just the right place for everything to work and opportunities can be very short.

Tropospheric ducting

Troposcatter and aircraft ccatter are always available but sometimes conditions are much more interesting, and people will say 'there is a lift on'. Signals within normal range may be much stronger than usual, or signals beyond normal range are audible – sometimes very loudly. There are a variety of causes here, but most commonly (and simplistically), there is an area of high pressure in place between you and the DX. This can help establish a temperature inversion which allows VHF signals to be trapped within a duct and propagate much further rather than normal and is known as tropospheric ducting. Sometimes these ducts are very widespread covering, for example, most of the UK into central Europe. At other times they can be very localised

OV3T	Thomas	JO46CM	---	3
OZ1BEF	Dan	JO46OE	52	
OZ1HDF	Ken	JO55UN	---	
OZ1IIL	Jan	JO47HC	---	4
OZ7UV	Svend	JO65DH	---	

FIGURE 2: A sample from wtKST showing OZ1BEF (active on ON4KST 52 minutes ago) and OZ7UV with suitably placed planes now, and OZ1IIL and OV3T with suitable planes due in three and four minutes' time.

and stations audible in one place are inaudible 20km away, and the opening can move about rapidly. Generally, these openings are at their best around dawn, dusk or late evening when the atmosphere is most stable. Higher frequencies tend to benefit more frequently since they need a thinner duct to support propagation.

Being able to predict these 'tropo' openings is helpful, so you know to spend some time pointing the antenna in the right direction. There are two excellent websites to help with this: F5LEN [6] and William Hepburn's site [7]. Each take the surface pressure forecasts and derive tropo forecasts from them. **Figure 3** shows a sample map predicting tropo from the Midlands across the Scandinavia (which is very much present as I write this). There's no need to look at this in real-time – a check before the contest for any relevant colour (even the weakest purple is good enough to make a difference) will help you to think about where to look during the event. 'Old-school' techniques are also really useful. For example, becoming familiar with the normal strengths of the various beacons at your location and checking for any of them being louder than usual – or new ones being audible – is very valuable as well. This can often detect enhancements that the software models may miss.

Sporadic-E and aurora

Less frequent than 'tropo' is Sporadic-E. Sporadic-E is generally a summer-time mode which can be difficult to predict. In the summer it is relatively commonplace on the 6m band and can occasionally appear on the 2m band in a contest allowing QSOs out to beyond 2000km and much further on the 6m band. When it appears take full advantage. Again, speed can be essential – particularly on the 2m band – as QSB can be deep and rapid and openings may be extremely localised and only last tens of seconds. Watching the DX Cluster and PSK Reporter in real time to see what is being worked on FT8 on the bands you are using is perhaps the best notification mechanism.

As we approach and pass solar maximum, aurora is a mode which is making a resurgence on the VHF scene. Primarily impacting the 6, 4 and 2m bands, and in some cases the 70cm band, this is a mode which can be tremendously exciting if there has been a geomagnetic disturbance. Due to the spreading of the spectrum as a result of to the scattering mechanism, CW is very much the mode of choice, although SSB is usable – particularly on the 6 and 4m bands. Again, if there is an auroral opening, it is worth turning the antenna to the north or northeast and looking for the good DX QSOs to places like Scotland and Scandinavia. During more intense events, QSOs can occur much further south in Europe with beam headings correspondingly closer to due east. Weak events may only generate a handful of auroral QSOs, so you may work those and then turn the antenna back to more normal directions. But major events can deliver hundreds of QSOs and, for these, it can be tactically right to leave the antenna on the auroral curtain. It is unusual for a major auroral event to coincide with a contest but when they do it it is truly memorable and generates big scores. Unlike Sporadic-E, the likelihood (but not certainty) of an aurora occurring is known 36 to 72 hours in advance, so keep an eye on the three-hourly predicted K indices at Solarham [8] or elsewhere. As a guide, a prediction of a K index of 5 brings the prospect of a weak aurora in the UK and higher values correspondingly stronger events.

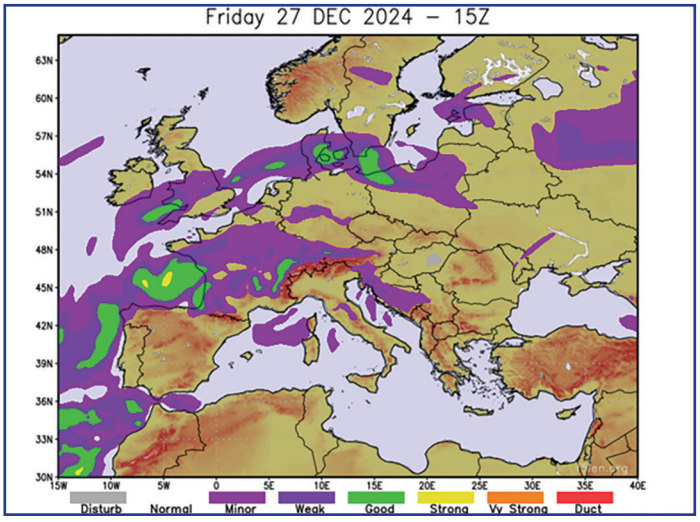

FIGURE 3: A sample F5LEN Tropo forecast.

Anything with a K index of 7 or above can be very interesting. But note that the forecasts – particularly on timing – can be unreliable.

Microwaves

On the Microwave bands, tropospheric modes along with aircraft scatter are the most important. But – particularly on 10GHz (and also on 5.7 GHz) – rain can often be a help rather than a hinderance. Rain clouds can be effective scatterers of microwave signals and many distant 10GHz QSOs at up to about 700km are made by scattering off large rain clouds, with the signal's spectrum spread out sounding much like aurora.

Strategy

Finding the openings is one thing. Making best use of them in the contest so as to optimise your score is another. Big openings are often quite straightforward. Focusing hard on working the DX is usually the right thing to do. If stations have big pile-ups, which you can't crack, make a note of their frequency and come back in a few minutes. Weaker openings, or openings to low activity areas, are much harder to handle. It's easy (and perhaps more fun) to look for more DX – but you may score more highly by just working a few DX QSOs and when the QSO rate falls returning to work more of your 'conventional' QSO mix. If a contest has bonuses or multipliers, make sure you are not ignoring the easy local ones as you get wrapped up in the excitement of working the DX.

References

[1] http://www.trpub.net/assets/applets/VHF-UHF_DX_Book.pdf
[2] http://www.mike-willis.com/Tutorial/propagation.html
[3] http://airscout.eu/index.php
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[5] https://github.com/dl8aau/wtkst/releases
[6] https://tropo.f5len.org/forecasts-for-europe/
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