I see the mast: where's the signal?

The UK's TV transmission network, with over a thousand transmitters, has strange anomalies. You don't always get the reception you'd expect, as Bill Wright explains

Bill Wright

Bill grew up with a TV aerial in his hand, helping his aerial installer dad. In 1971 he seized the reins and has never looked back. Nowadays he concentrates on distribution systems, leaving everything else to his son, Paul.

If you can see the transmitter you'll get good reception, right? It isn't that simple for a variety of reasons. Although a clear line-of-sight is regarded as the gold standard for good reception, the gold can seem a bit tarnished when the transmitter is close enough to spit on yet the signal from it is rubbish. Neither closeness to the transmitter nor a clear view of it in the distance guarantee good reception.

Directional transmissions

Most transmitters are directional to a greater or lesser extent. This is partly to conserve power by avoiding sending signals in directions they aren't needed, such as across the sea or straight into the side of a mountain. The main reason, though, is to avoid causing interference to other transmissions.

During the period of dual analogue and digital transmissions the engineers have had to provide two sets of signals when there's really only spectrum space for one. This has led to some severe compromises, with power restrictions in certain directions causing big holes in digital coverage. An aerial installer should never assume that good analogue signals will guarantee good digital signals or, indeed, *vice versa*.

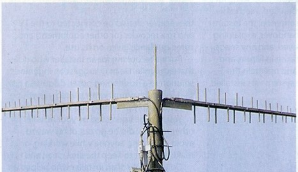
Some of the small relays are very directional, squirting their signal in one narrow beam towards the target zone. Others have complicated radiation patterns tailored so that the signal reaches the desired areas but doesn't spill out into other areas and cause interference. If you can actually see the relay mast it's worth having a look at the transmission aerials to see which way they are pointing. If they aren't pointing towards you there might be a problem! Most of these small relays radiate only tens of Watts of power even in the primary direction, so in other directions it is perfectly possible to receive absolutely no signal when the relay is only 100 yards away.

High-powered transmitters

The main stations and the larger relays – those covering whole cities, for instance – aren't normally as acutely directional as the little relays can be. Usually coverage is almost even in all directions, but sometimes there's a need to drastically restrict (suppress completely) the output in a certain direction to prevent interference to other transmissions. This can cause grief if an aerial installer isn't aware of it and just assumes that line-of-sight will guarantee good signals.

One example of many in the UK is the Sheffield Crosspool transmitter, which covers the whole city for analogue TV, but for DTT (digital terrestrial TV) has a great chunk of coverage missing. The reason is that the channels used for digital are the same as those used for analogue by a small relay a few miles away. If Crosspool radiated DTT in that direction it would wipe out reception of the relay's analogue signals. This means that there is quite a large area of the city where the uninformed aerial rigger will stand on the roof clouting his field strength meter because it seems to be playing up. There's Crosspool only half-a-mile away – an impressive sight up there on the hill – yet the meter says 'No!' The analogue signals are massive, but the DTT is 60dB below them and quite unusable – what DTT signal there is will be reflections from tall buildings in the city centre and will be a mess. Our man should have done his homework.

Directional relay transmitters



01 You can often figure out the radiation pattern of a local relay by looking at the transmission aerials. This is the relay for Hythe, Kent. It sends signals to the east and west, but not to the north, nor the south – which would annoy the French. If you were installing an aerial in the direction this picture was taken from you'd get zilch!

02 This little relay at Kylerhea on Skye, Scotland, is a good example of a small, tightly targeted relay. As you can, see it sends out a single narrow beam of signals. These go across the water to the village of Glenelg on the mainland, and can't be received properly anywhere else.

Hannington is a main transmitter to the west of London. Like Crosspool, it has a great chunk of DTT coverage missing, leaving large areas nearby with terrible DTT reception. Hannington puts good analogue signals into Basingstoke and Reading, as well as most of Berkshire and southern parts of Oxfordshire, but the shortage of channels means that four muxes have to be co-channel with the Guildford relay. This means that there's no DTT signal radiated from Hannington to the east. This annoys the citizens of Basingstoke and Reading. Large aerials are needed, pointing towards far-away transmitters such as Oxford, while the digitally impotent Hannington mast can be clearly seen from many rooftops. Ironically, the number of Hannington viewers inconvenienced far exceeds the total number of Guildford viewers.

Permanent low power

Because of the risk of causing interference in other areas, many transmitters broadcast one or more muxes at permanently reduced power. This can happen in both pre- and post-DSO areas. It's usually muxes A, C and D that suffer. An example is Wenvoe, which has muxes A and C at one-tenth the power of the others, and another is Mendip with muxes A, C and D at one-tenth full power. At the end of the DSO process, when all the analogue signals have gone, it's possible that some of these power restrictions will be relaxed. Meanwhile, the installer has the potential problem of amplifying and distributing signals that arrive at very different strengths.

Freeview Lite

It's worth remembering that almost all of the relay stations will only broadcast three muxes after DSO. This is the despised 'Freesat Lite', and is a good reason why installers should try to get good reception from a main station.

In post-DSO areas it's already noticeable how many new aerials point not at the relay on the nearby hill but at a distant main station. That's one reason we are starting to see what is probably the beginning of the end for some (maybe all) relays. Another factor is that many relays were installed just because of multipath (ghosting) problems with main station reception. As multipath is less of a problem for DTT the *raison d'être* for the relay has gone.

One main station will broadcast three muxes only after DSO, and that's Freemont Point on the Channel Islands.

As the public service broadcasting ethos has taken such a hammering in recent years, I foresee the time when broadcasters declare certain relays uneconomic and tell the public 'It's Freesat or nowt!' There is a sort of precedent. When the Whitby relay was relocated many people lost reception and were told it was just hard luck.

The temporary HD muxes

In the pre-DSO areas we also have the temporary High Definition muxes to

03 This relay transmits in all directions but one – the rectangular support acting as a reflector for the four dipoles. The radiation pattern is cardioid (heart-shaped), like the Sheffield Crosspool transmitter, shown on the next page in red. If your receiving aerial cannot see the dipoles because of the support, then reception will either be poor or non-existent.

Polarisation peculiarities

It's essential to get the polarisation right. The top aerial is vertically polarised while the lower one (a log-periodic) is horizontally polarised

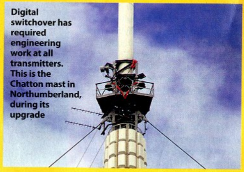
The signals from main stations are almost always horizontally polarised, and those from relays almost always vertically polarised. We all know to install aerials accordingly but, of course, there are complications.

A few relays have horizontal polarisation, and (here's the really strange part) some relays transmit horizontally polarised signals in some directions and vertically polarised ones in others. So the correct polarity of the receiving aerial will depend on just exactly where it is, and it can change from one street to the next.

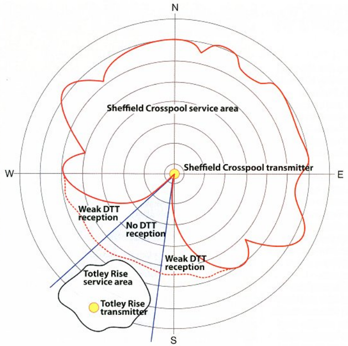
At the Kinlochbervie transmitter the horizontal signals come from crossed stacks of log periodic aerials and cover a wide area, while the vertical signals come from a single stack of logs and target on one small area. Look closely at any relay transmitter and you can figure out the polarisation and directional characteristics. The use of both polarisations is usually done to maximise the use of available frequencies or counter co-channel interference, but it can confuse the aerial installer. Get it wrong and the results are rubbish.

Not all 'H+V' transmitters are documented but the ones I know of are: Ayr South, Bleachgreen, Bowmore (originally VP only; HP added to feed Portnahaven relay), Brent, Burgar Hill, Canongate, Chideock, Corsham, Croeserw, Dorking, Eastbourne, Garth Hill, Glen Urquhart (originally VP only; HP added in 2001 to compensate for coverage problems from the change of location), Hemdean (originally VP only; HP added in 1994 to extend coverage to a new housing estate), Killin (originally VP only; HP added to feed Crianlarich self-help relay), Kinlochbervie, Kirkoswald, Lewes (HP added for an area where co-channel interference from the Hastings relay was a problem), Lochmaddy, Melling, Neath Abbey, Newton Abbot, Onich (HP added in 1993 to cover Sallachan), Ovingdean (HP added in 1985 to cover Woodingdean), Plymouth North Rd (VP to the west and HP to the north-east), Ravenscraig, Rhondda, Roose (VP at 8W to the east; HP at 4W to the north because of co-channel interference from Haslinden), Rosneath (the main coverage to the south is VP; HP covers Rosneath town and feeds the Garelochhead relay), St Marks (HP was added to overcome co-channel interference from Reigate. Uniquely VP and HP both target the same service area), Scoval (HP feeds the Crettraval relay), and Sutton (London).

Millbrook (West Southampton) and Ovingdean (Brighton) will transmit H+V after digital switchover.



Digital switchover has required engineering work at all transmitters. This is the Chatton mast in Northumberland, during its upgrade



Crosspool's (Sheffield) DTT output has a transmission null to the south-west so that it doesn't cause interference to Totley Rise analogue reception. This means that viewers in the null area (shown in blue) can't receive DTT, even if they are very close to the transmitter.

contend with. These are transmitted from high-powered main stations, but reception is by no means certain even when the other muxes come roaring in. The HD muxes do not necessarily have the same directional patterns or power as the others. Their brief details are: Black Hill (half power; outside legacy channel group), Crystal Palace (half power), Emley Moor (less than half power), Lichfield (half power, outside legacy channel group, not co-sited with the other muxes, which are from Sutton Coldfield), Pontop Pike (no problems).

Single frequency networks

It's possible to precisely synchronise the signals from several DTT transmitters that have overlapping coverage so that they don't mutually interfere. This is the idea of the Single Frequency network, or SFN. It flies in the face of everything we thought we knew about co-channel interference, so it's something aerial installers will have to get used to. This isn't the place to discuss how it works, but think of the BBC DAB multiplex on channel 12B — that's actually one great big national SFN and you can travel across England with your radio seamlessly receiving digital radio from a sequence of transmitters.

The idea of the SFN is to maximise frequency use, but I think it will probably maximise installer confusion for a while until we get used to it. In an overlap area your analyser will show a group of muxes that will seem to come from several different directions. In brief, you should align the aerial to simply maximise the signal level. Incidentally, it was at one point mooted that we should have a national SFN on channels 35 and 37, but instead the frequencies were given to analogue Channel Five. What a missed opportunity.

The full list to date (or as far as I am able to ascertain it) of SFN groups is as follows:

1. Budleigh Salterton with Beacon Hill (on the air).
2. Laxey with Port St Mary, Union Mills, Jurby, and Beary Peark, Isle of Man (on the air)
3. Bromsgrove with Lark Stoke and The Wrekin (after DSO).
4. Rouncefall with Sudbury (after DSO).

More peculiarities

I can't list all the transmitters in the UK that have transmission nulls and other peculiarities, and installers need to familiarise themselves with the characteristics of their local transmitters. But here are a few oddities.

Heathfield DTT is only beamed north, and Midhurst is a real dog's breakfast of restrictions to the different muxes. Rowridge on the Isle of Wight serves parts of Dorset, Hampshire and West Sussex, but transmits nothing to the south between 85° and 270° which is to avoid annoying the French. This means that Brightstone has to have a relay, despite being within a stone's throw of the huge Rowridge mast.

Rowridge enters the list of peculiarities for the second time because after DSO it will transmit both horizontally and vertically polarised signals at very high power. This will be unique in the UK. The idea is that existing horizontal aerials will continue to work, but it will be possible to mount new aerials vertically so that they discriminate against horizontally polarised interference from continental transmitters.

The Wrekin transmits each of the muxes 1, 2, A, and B on different channels in different directions. Sudbury does the same but only for mux 2.

That's it for this résumé of the whacky world of UK TV transmission. Like much of the world, the UK is enduring the painful death of analogue and the tricky birth of digital TV. Things are certainly a bit peculiar at the moment, so installers simply have to keep tabs on the signals they wish to receive. For anyone planning a work trip outside their normal area research is essential. The days of just 'pointing it at the mast' are long gone.