

Ofcom Consultation on Improving Spectrum Access in the 5 GHz Band

Response from the Radio Society of Great Britain

July 2016

This response to the above Ofcom consultation document is from the Radio Society of Great Britain (RSGB, www.rsgb.org) on behalf of its members and the wider Amateur Radio community in the UK. The latter includes both individual operators as well as a variety of special interest groups, including the UK Microwave Group (UKuG), Amsat-UK and British Amateur Television Club (BATC) who have a particular interest in this frequency range.

The RSGB is recognised as one of the leading organisations in the world in the field of amateur radio. It collaborates with its fellow national societies via the International Amateur Radio Union (IARU) through IARU Region 1 (www.iaru-r1.org).

Amateur radio is a science-based technical hobby enjoyed by over three million people worldwide. From a statutory point of view, it is fully recognised by the International Telecommunication Union (ITU) as a Service and is listed in the ITU Radio Regulations as the Amateur Service and the Amateur Satellite Service.

Amateur radio is a hobby that promotes experimentation and innovation in radio techniques and propagation. Despite some unjustified UK-specific amateur licensing restrictions, the 5GHz band is home to a significant and growing amount of innovation which should be allowed to prosper and not suffer from harmful interference.

As detailed in our general comments overleaf we are deeply disappointed that Ofcom have so far failed to recognise this and that as incumbents it would have been prudent to engage with us more fully so that both technical and impact assessments could have been far more accurate. We are also deeply opposed to outdoor Wi-Fi usage in the 5730-5850 range where our most sensitive applications are (5760 MHz amateur narrowband usage and 5840 MHz satellite downlinks)

We hope that this input improved Ofcom's awareness and we look forward to further discussions.

General Comments on this Consultation

We are deeply disappointed in respect of Ofcom's compliance with its duties...

We note that in relation to Ofcom's statutory duties:-

"Ofcom will consult widely with all relevant stakeholders and assess the impact of regulatory action before imposing regulation upon a market."

However:-

- a) Ofcom has deliberately not contacted the most innovative incumbents/stakeholders as stated in Para 3.43 (only Wi-Fi) prior to the formal consultation period
- b) As an incumbent we have been blocked from contact during the consultation
- c) Ofcom has ignored their duty with respect to CEPT ECA allocation footnotes ECA17/23¹
- d) We expect Ofcom to make amends and engage, or we will consider escalating this

Ofcom's research is badly flawed and belittles incumbents...

The amateur service and amateur satellite service are not considered in the consultation until a few small and flawed statements tucked away in Annex A5.28 / A5.29. Only the amateur satellite service LEO usage is considered, when in fact deep-space and geosynchronous satellites are also involved. Weak-signal reception of these systems around 5840 MHz has only been possible due to the lack of manmade noise.

Far worse still is that there is no consideration of the amateur service, and in particular its weak-signal sub-bands which is globally harmonised at 5760 MHz (also free of Wi-Fi) as fully documented in CEPT Reports, IARU Region-1 Handbooks and RSGB Band Plans (which is already suffering harmful interference in the USA due to high power non-mitigated access points).

Ofcom's statement re Wi-Fi coexistence in A5.29 is utterly false. In addition to Ofcom and CEPT studies/reports in the 2.4 and 5 GHz bands, further evidence is the fact that Ofcom have had to facilitate re-licensing of amateur repeater systems out of 2.4GHz to other bands (including 3.4 and 5 GHz) in order to mitigate harmful interference from Wi-Fi to end-user receivers – an exercise undertaken in conjunction with the PSSR changes where UK amateurs lost spectrum allocations.

Ofcom strategy for Consumers is also flawed...

Ofcom's own airborne research published for this consultation shows how significant building attenuation at 5GHz is compared to 2.4GHz. Despite some uncertainty², in essence this tallies with consumer and RSGB experience that 5GHz often performs badly indoors due to wall/ceiling attenuation etc. In such cases extra channels will have minimal benefit in domestic premises unless the Wi-Fi modem is in close proximity to users or TV kit (as BT/Sky etc are already aware).

The biggest game changer that would be highly beneficial for consumers would be to proactively rollout UHF-based Wi-Fi solutions – (using a combination of TV White Space and the adjacent 870/92 exempt bands) and thus permit genuinely reliable connections anywhere in a house, supplemented by 802.11ad for high speed short range use (which Ofcom needs to fully liberalise).

¹ Example - **ECA23**: In the sub-bands 5 660 - 5 670 MHz (earth to space), **5 830 - 5 850 MHz (space to earth)** and 10.45 - 10.50 GHz the amateur-satellite additionally operates on a secondary and non-interference basis to other services. In making assignments to other services, **CEPT administrations are requested wherever possible to maintain these allocations in such a way as to facilitate the reception of amateur emissions with minimal power flux densities.**

² Uncertainties that may have given optimistic results include the relatively high altitude, polarisation losses and whether rooftiles/walls might have had high moisture levels due to recent wet weather

Ofcom's preference risks causing harmful interference at home and internationally

A combination of suggestions in the consultation refers to removing mitigation mechanisms and enabling some bands on a unilateral basis (especially in the 5760-5840 area). This would create significant potential for high power unregulated devices to freely roam across the UK and Europe prematurely and generate harmful interference.

Note that, in the absence of interference, terrestrial amateur narrowband reception ranges are beyond line of sight and in the order of 100s of km (the UK record is 1244km to the Czech Republic), complemented by truly global reach via Earth-Moon-Earth (EME, moonbounce).

Ofcom have failed to consider some of the easiest alternatives...

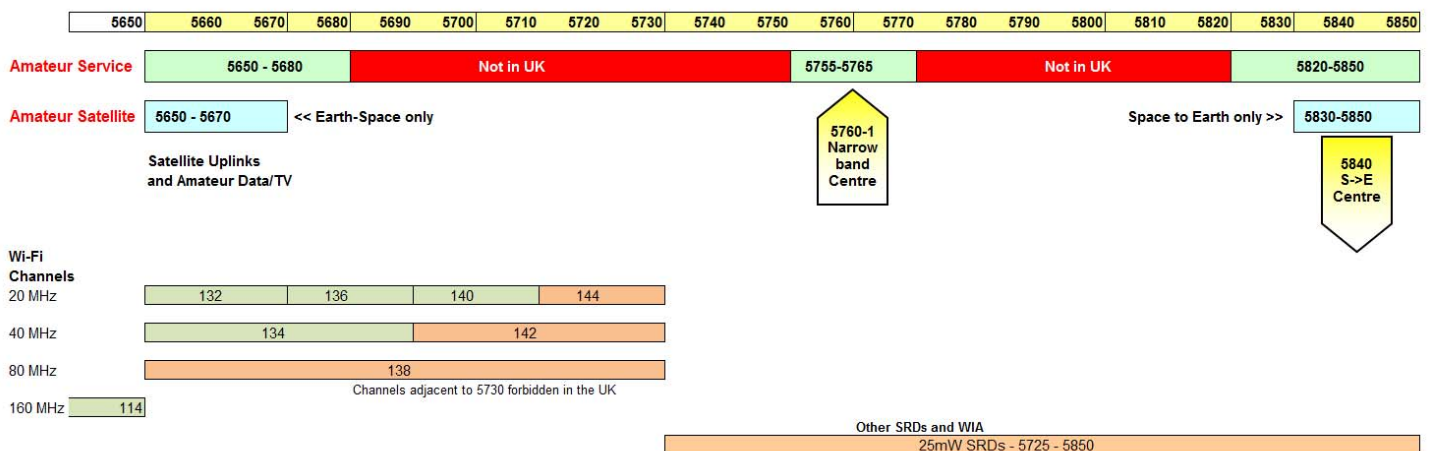
Given the fact that low power SRDs are not protected there is no explanation for why 'forbidden channels' below/near the 5730 MHz boundary such as 144 (20 MHz BW), 142 (40MHz BW) and 138 (80 MHz BW) have not been previously released.

Likewise, indoor and outdoor use could be liberalised in the existing segments near 5150 MHz

Ofcom continues to unfairly suppress the most innovative stakeholder in the band, and undermine technology for innovation and emergency communications...

The UK Amateur Licence is uniquely restricted in having large unavailable gaps in the amateur service allocation which internationally is 5650-5850 MHz continuous (see diagram below). In Europe, which has no such restrictions, amateur Hamnet technology is deployed with long range 5GHz links complementing shorter range access. This is impossible in the UK due to only one 20 MHz channel being available/overlapping our 5650-5680 MHz segment, making recent attempts to develop and exploit HSMM-Mesh³ challenging and conflicts with exempt Wi-Fi channels where channel access compatibility is desirable for spectrum efficiency and other reasons. Hamnet was originally developed to provide amateur emergency communications and data in avalanche/flood conditions when commercial internet failed in Austria, whilst HSMM also has considerable potential for adhoc emergency team communications. Our position is that any liberalisation of Wi-Fi undermines the raison-d'etre for past spectrum restrictions on the UK amateur service and that Ofcom must consider complementary measures for incumbents.

UK Amateur Allocations in context



³ For more about HSMM see <http://www.broadband-hamnet.org/>

Ofcom Consultation: Improving spectrum access for consumers in the 5 GHz band

Questions & Answers

Question 1: *Do you agree with our proposal to prioritise consideration of the 5725-5850 MHz frequencies for Wi-Fi, subject to appropriate protections to other users, in particular satellite services?*

We do not agree that this range should be prioritised. Many valuable and innovative incumbent and new services have deliberately focussed on this range including Amateur Radio (inc Satellites), Fixed Wireless, Industrial Automation, Intelligent Transport etc in order to avoid Wi-Fi interference in the lower sub-bands.

Instead Ofcom should be focused on improving the existing 5150-5350 range and enabling 'suppressed' channels in the 5650-5730 range.

Our concern arises because in summary we have:-

- Globally harmonised trans-national weak signal terrestrial communications, propagation beacons and Earth-Moon-Earth communications around 5760 MHz
- A wide variety of satellite systems with downlinks around 5840 MHz
- Modest but rapidly growing data and amateur-TV usage and innovative developments (despite some inhibitions by the current Ofcom authorisation regime for UK amateur radio)

Question 2: *Do you agree with our proposal to re-examine the requirement for DFS across the 5 GHz band, subject to appropriate protections to other users?*

We would be opposed to a withdrawal of DFS and other mitigations without careful justification. Whilst indoor use may be screened by building losses, mitigation for outdoor incumbent services is vital. There is undoubtedly scope for enhanced or smarter approaches to mitigation techniques – be it DFS or others. In particular we are strong supporters of TPC to ensure that any outdoor power usage is mitigated and indeed it makes general sense as Wi-Fi performance can be limited by high-power mutual interference in any case.

Question 3: *Do you think we should pursue the other options we have identified: opening up 5850-5925 MHz; outdoor Wi-Fi use at 5150-5350 MHz; and opening up the 'centre gap' at 5350-5470?*

- 5150-5350 – Fully supported – enhancing the common Wi-Fi band should be the first priority
- 5350-5470 – No comment
- 5850-5925 – No comment other than safety-critical life-saving C2C ITS that can prevent car shunts/accidents appears to us have a high societal value and seems to deserve protection

In addition Ofcom should consider a new option at 5650-5730. At present some channels in this range are not available as they overlap the 5725 MHz limit. However a small adjustment to 5730 (which is low risk) would enable additional channels. Ch-44 (20 MHz BW), 142 (40MHz BW) and 138 (80 MHz BW).

Question 4: *What are your views on the future growth in demand for Wi-Fi? In which use scenarios do you expect to see the greatest pressure for delivery of high quality Wi-Fi access? What evidence do you have to support your views?*

We agree that demand may rise - but not necessarily in 5GHz, or for the widest channels.

- Internet-of-Things often uses other (non-Wi-Fi) protocols and domestically needs good building penetration and battery life. This makes lower bands such as the UHF/2.4 more suitable and may reduce the 5GHz demand. Open-plan Office environments may see significant growth and need good quality but dense use and security would be easier to achieve using 60 GHz docking stations.
- Less certain are new ideas such as LTE-U etc which might compete with 5GHz Wi-Fi, but the business/use case does not seem clear to us.

- Other areas where Wi-Fi needs to improve are Conference venues, Sports Stadia, Shopping centres etc – but these are all in the realm of managed access points (often indoors) which can more easily afford to have proper siting, setup and appropriate mitigation etc
- The fixation with very wide channels also seems to be dubious. In practice it is unlikely that such wide channels would be free of other users (who may use narrower channels) or cope with real-world variable fading/attenuation. Statistical use modelling may show that 20 or 40 MHz channels will be the most common and flexible.

Question 5: *Do you think technology improvements and densification of access points will be sufficient to meet demand or will there also be a need for more spectrum beyond that which we propose to make available?*

What evidence do you have to link between demand for data and demand for additional spectrum?

Both technology and protocol improvements are needed (and quite possible) to improve matters. 'Densification' inherently requires lower power and shorter ranges to avoid mutual interference and maximise spectrum efficiency. Therefore smarter (geolocation?) techniques and more reliable Transmit Power Control (TPC) and other polite protocols are required.

With respect to the second part of the question – we are highly sceptical of traffic forecasts translating in additional spectrum. For example in 3G/4G phones we have already seen huge growth in traffic yet the existing networks have been able to cope quite well with only modest amounts of extra spectrum (courtesy of smaller cells, densification etc etc).

The poor building penetration characteristics of 5GHz and relatively slow practical speeds make it important that additional ideal spectrum available at UHF and 60 GHz is also put to real use. Ofcom should do far more to liberalise regulations and stimulate the market for consumer provision and benefits.

Question 6: *What real life speed and quality of experience can consumers expect in practice from devices using the 5GHz spectrum as authorised in the UK now?*

What changes can we expect as the number of devices increases and technology improves?

What difference in speeds and quality of experience would additional spectrum make?

The key thing is quality of experience. Current personal experience (based on traditional 802.11a and more modern 802.11ac tablets, home hubs etc) is based on the lower 5.1 GHz channels which when connected are fine, but their in-building coverage is very poor. It is important to recognise that the typical display on a consumer device does not say which band or channel is connected – so they are largely oblivious to the spectrum aspect but readily experience the reliability (or lack thereof).

At present the typical use of these devices rarely need more than 10-20 Mb/s for mobile web browsing/streaming and we do not see this significantly changing. An area where change may occur is larger domestic 4K/UHD Smart TVs etc. RSGB and amateur radio generally is highly concerned that poor building penetration (especially for higher bandwidth online and playback services) creates a need for spectrum-polluting Ethernet-over-Powerline devices. 5GHz will not solve this, whereas UHF devices would - if made more widely available (as they can support the data-rate needed).

Question 7: *How important is contiguous spectrum?*

How wide should channels be to support future demand?

Contiguous spectrum is not vital – merely convenient. As per our answer to Q4 we believe that in practice 20-40 MHz channels would accommodate the greater proportion of demand with greatest flexibility/capacity. For consumers, indoors where HD media links may occur, then 80-160 might be ideal but there are unlikely to be many wide channels needed.

Question 8: *Do you believe we have correctly identified the incumbent services in 5150-5925 MHz which need to be taken into account in considering opening up more 5 GHz spectrum for Wi-Fi? Are there any other services which will need to be taken into account in future studies?*

Ofcom does not seem to have fully identified the broad and innovative nature of amateur and amateur satellite services and applications. Some additional information is provided in the annex and some of our individual members and affiliated national groups such as Amsat-UK, UK Microwave Group and BATC can provide additional information.

Question 9: *What coexistence studies, measurement campaigns and mitigation techniques do you believe would be most effective for demonstrating coexistence between Wi-Fi and incumbent users?*

It was clear from the consultation document that Ofcom seemed to be unaware of previous work in SE24 (which Ofcom and IARU/RSGB regularly attend and contribute to). In particular we wish to highlight that detailed coexistence studies have been undertaken for the amateur services in ECC Report 206 and subsequent use of material from that in the ECC Report 244 for more recent 5GHz RLAN studies. These clearly show a risk of harmful interference to amateur terrestrial and satellite reception from outdoor systems (even with TPC mitigation).

Previously, in the 2.3 and 3.4 GHz bands, Ofcom (Baldock) undertook collaborative measurements with amateurs for the PSSR programme. We would welcome such engagement at these frequencies.

Ofcom's own airborne measurements are commendably innovative (but partly based on 2.4GHz), so we feel that further work should be undertaken to resolve uncertainties at 5GHz. Both airborne and terrestrial assessments would be helpful so that there is less uncertainty with respect to antenna/receiver calibration, models for building screening and outdoor interference (and factors such as polarisation losses, building material moisture due to rain etc can be better considered).

Finally specific work should be undertaken with regard to access points and their configuration. All too often we experience multiple SSIDs, competing vendors/APs and excess channels usage for beaconing – wasting valuable spectrum and blocking potentially usable channels. There is surely scope for enhancing best practice and collaboration in the industry and thus spectrum efficiency.

Question 10: *Do you intend to participate and provide technical material into the ITU and CEPT work? In what way?*

Yes – RSGB volunteers are members of CEPT inc WGF, SRD-MG/SE24 and WRC-19. RSGB has already discussed this with Ofcom at a recent forum meeting and plan to be regular attendees at CEPT CPG-PTD. We also liaise with and support colleagues who attend ITU.

Annex – Examples of Amateur activity

For CEPT SE24 WI39 studies, Document M67_03R0_SE24 (28th August 2012) provided some of the first background for amateur activities in 5GHz. Whilst these have evolved, the items below are in a similar format

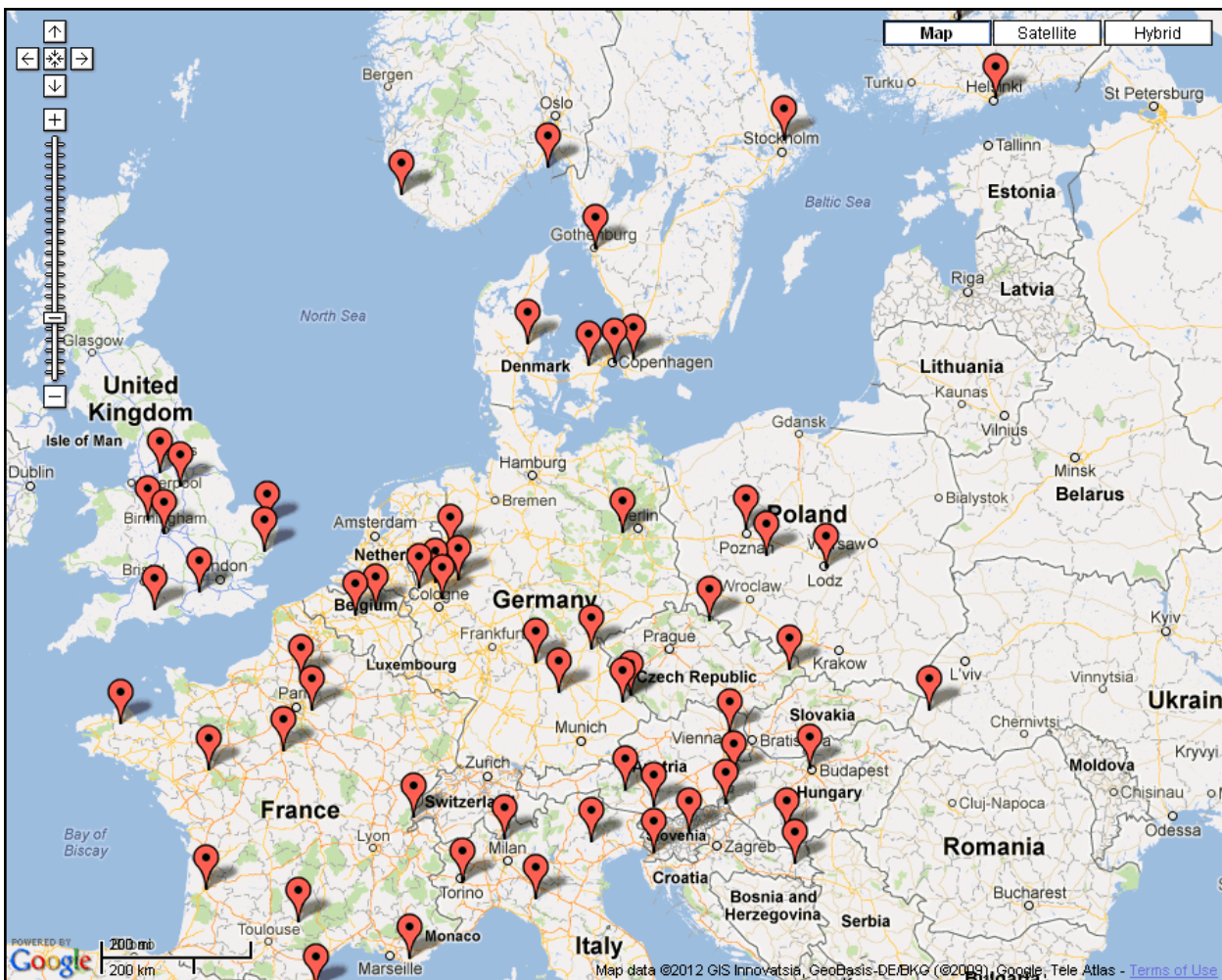
NARROWBAND, EME & PROPAGATION BEACON NETWORK

Narrow bandwidths are commonly used by CW Telegraphy, SSB voice and advanced digital multi-tone weak signal modes such as JT4G and JT65 for long range contacts, EME (moonbounce), contests etc. Signal processing enables the JT modes to be decoded well below -20dB SNR.

Whilst individual amateurs may use directional antennas, they exploit a well-engineered propagation beacon network that generally uses horizontally polarised omnidirectional antennas and is increasingly using GPS-locked frequency sources.

The long ranges that are regularly achieved result in harmonised band planning. All ITU Regions with amateur activity of this type are centred around 5760 - 5762MHz.

As shown below the current equipment and propagation can result in considerable distances, beyond line of sight, using fairly ordinary powers and antennas. Terrestrial two-way contact distance records are in the 1300-1500km range across the UK/CEPT area and regular operation over a few hundred kilometres is quite common. Beyond that, the more enthusiastic amateurs devote considerable expertise to low-noise high-power operation for EME for global coverage, an example of which is shown overleaf.



Amateur Service Propagation Beacon Network on 5760MHz – Source Data: www.BeaconSpot.eu

In the UK, Ofcom license a range of GB3xxx propagation beacons. Below are recent reception reports:-



GB3SCC Bell Hill



GB3ZME Telford

Reception range examples from 5760 MHz propagation beacons – from www.Beaconsport.eu

Terrestrial Narrowband and EME (Moonbounce)

Most amateur narrowband stations at 5760 MHz uses dishes that may be in the 1-2m range and are either fixed, or portable for hill top use.

At the leading edge of amateur use are larger systems that can generate global reach by bouncing signals off the moon as per example pictured.

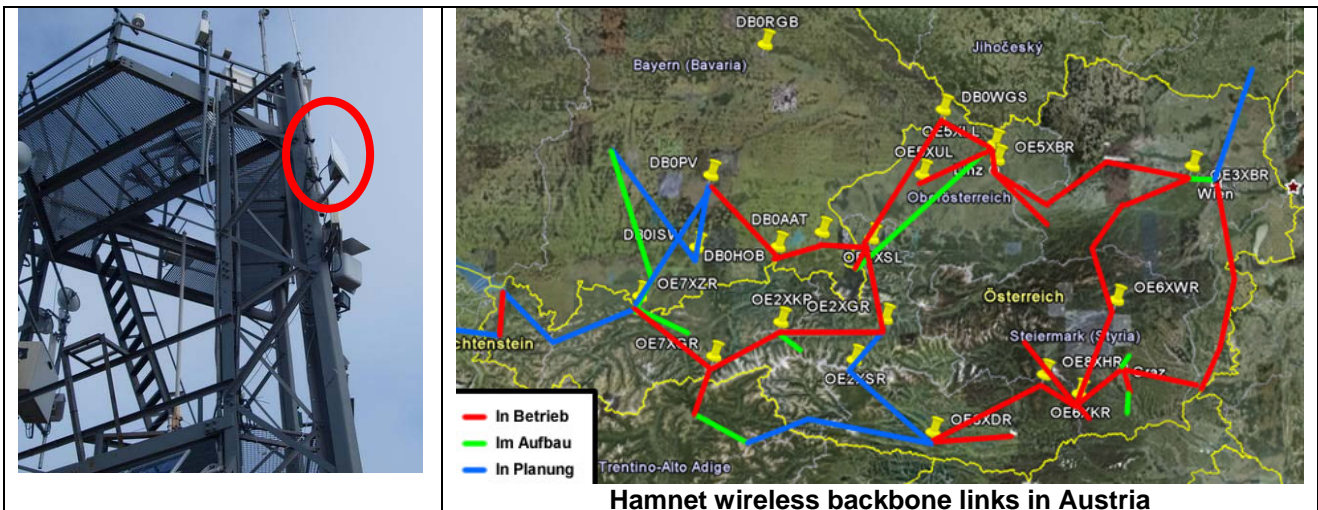
Received signals are often very weak and would be highly vulnerable to local noise from Wi-Fi etc



Data Systems

Hamnet is a dedicated technology and service neutral network, first deployed across Germany, Austria, and Switzerland and now expanding into other countries such as France, Croatia, Hungary, Italy and Netherlands. In the UK it is also being examined along with Mesh based systems.

Hamnet uses fixed point-point links in the 5GHz band in the 20-40km range to provide a TCP/IP wireless backbone dedicated to amateur radio data and digital voice traffic. Local stations connect at lower frequencies (VHF, UHF and 2.4GHz) and internet-like facilities provide VoIP, DATV, messaging, APRS, search etc



Hamnet wireless backbone links in Austria

Satellites

See separate Amsat UK contribution which covers the fact that whilst CubeSats are relatively common, the variety of amateur satellite platforms and operations is far broader