

Airwave response to the Ofcom Fixed Wireless Spectrum Strategy Consultation

Redacted Version

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1. Airwave Response

Please find attached the Airwave response to the Ofcom Fixed Wireless Spectrum Strategy Consultation.

The response has been set out in tabular form using the provided question and response format.

Question 1:

- a) Please indicate which user type given in Table 1 best describes your use of fixed wireless links?
- b) If you are a telecom network operator or an organisation providing wireless solutions for different user types, please indicate where possible, a breakdown of the percentage of fixed wireless links used to support the different user types i.e. mobile network operator, emergency services etc.

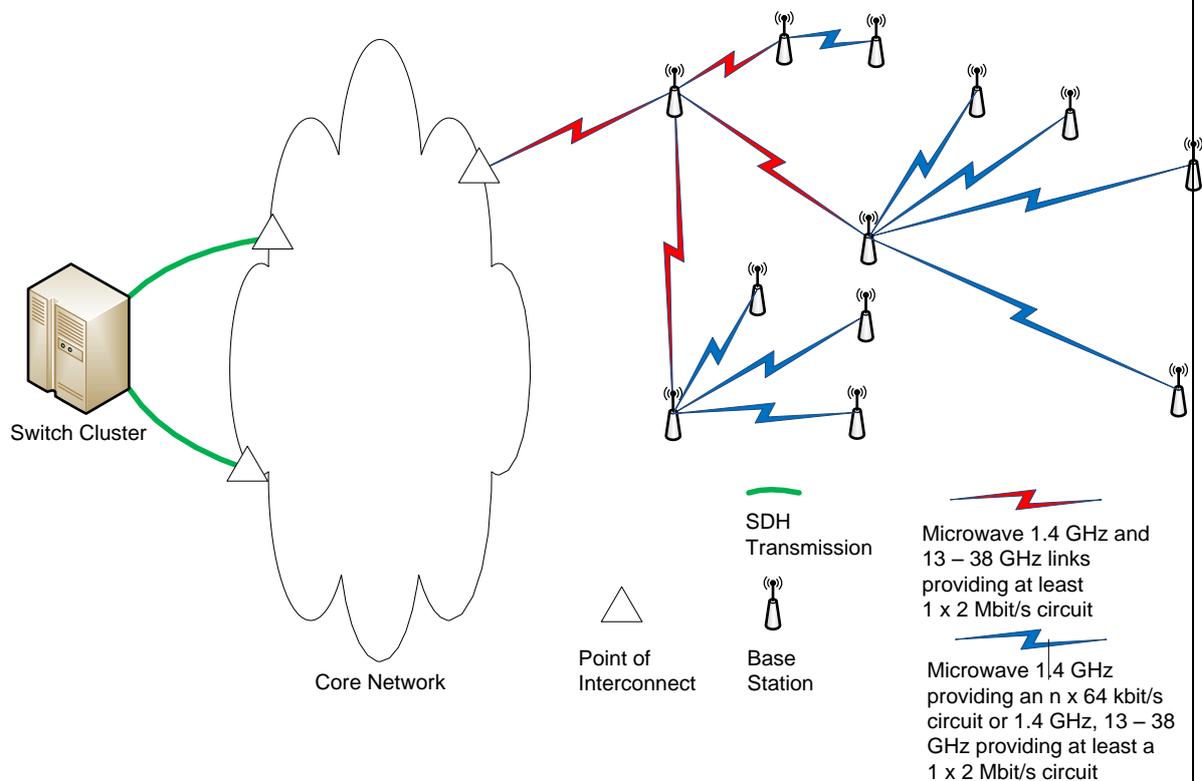
- a) Public Safety. (We assume the reference in the question should have been Table 3).
- b) Approximately 100% emergency services and other allowed users (we do have a few links out of 3230 for other purposes, Utilities Inter-Tripping circuits <10 currently).

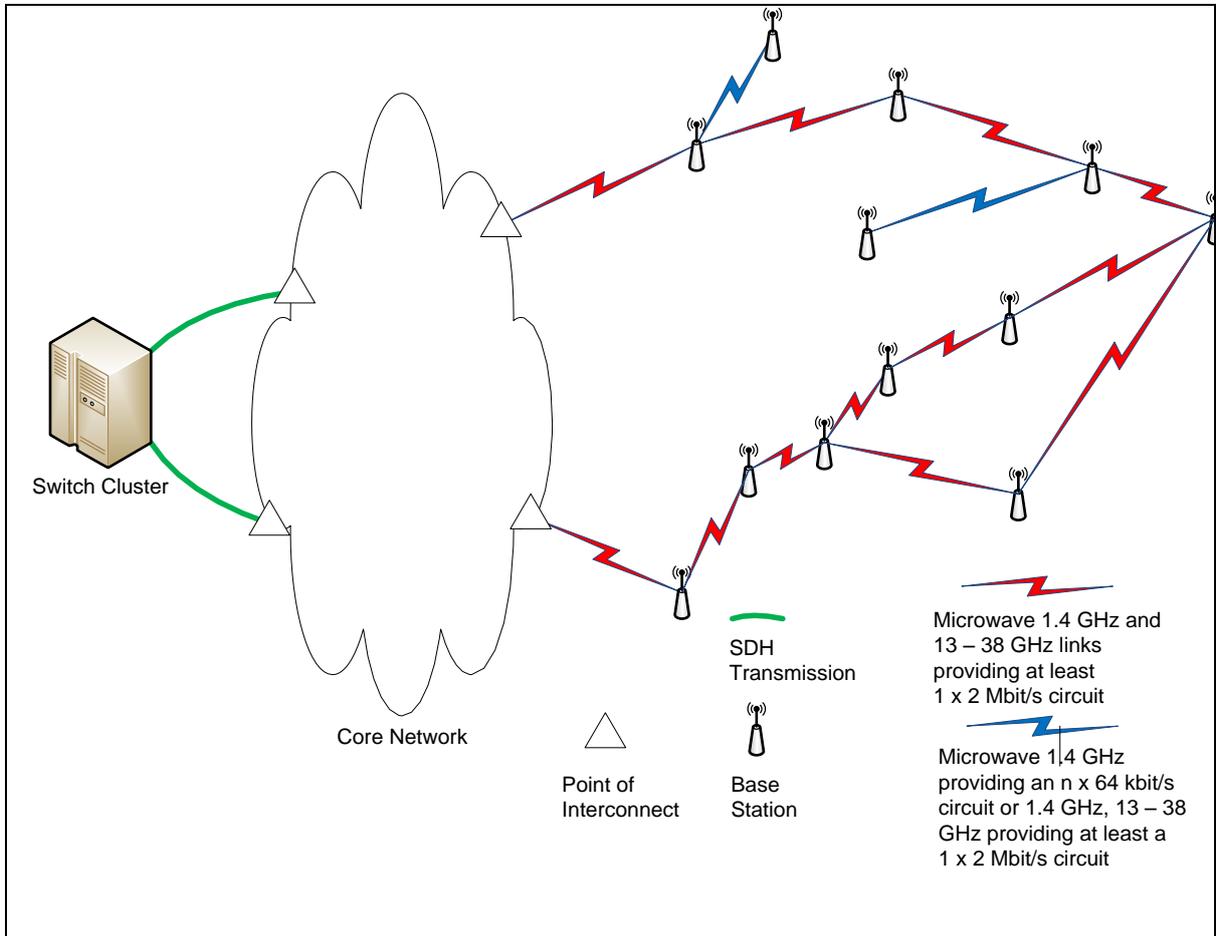
Question 2:

- a) Please indicate the applications provided by your use of fixed wireless links and the benefits these provide to citizens and consumers.
- b) For each application, please indicate the frequency band used and the rationale for choosing that band, i.e. the application specific characteristics that affect your specific choice of frequency band.
- c) For each link, please provide details of the application supported.

- a) Emergency Services Voice, SMS and Data.
- b) All bands; 1.4 GHz, 13 GHz, 15 GHz, 18 GHz, 23 GHz, 25 GHz and 38 GHz. All bands selected to provide the level of availability (typically 99.999%) required to deliver the Emergency Service's Network.
- c) Apart from the few Utilities Inter-Tripping circuits all links are used to provide the Airwave Voice, SMS and Data services to the Emergency Services and other allowed users.

The diagrams below show where the different radio types are used and the typical circuit bandwidths they provide.





Question 3:

- a) How do you envisage the current and future applications provided by your use of fixed wireless links to change in the next 5-10 years?
- b) What market trends and drivers will affect the use of fixed wireless links to deliver the relevant applications in the future?
- c) What bands will be relevant to support the future changes?
- d) Could your use of fixed wireless links be provided by alternative solutions? If so please give details of alternatives.

- a) The applications will materially stay the same.
- b) The Airwave network will eventually be decommissioned at some point beyond 2019, at which time the majority of links will no longer be required.
- c) N/A
- d) No, as BT is withdrawing its Kilostream service we are increasing our use of fixed wireless links to replace the Kilostreams. Many Airwave sites are located where there are no other telecoms services or alternatives, apart from wireless fixed links or very low quality BT copper.

Question 4:

- a) How will Fixed Service equipment continue to evolve to meet the increasing capacity requirements?
- b) What is the timescale for implementation in equipment?

- a) In urban and dense urban areas higher frequency bands are and will continue to be capable of providing increasing bandwidth in conjunction with fibre optic solutions. However, in rural and isolated areas fixed links in the current bands (13 and 15 GHz predominantly) will be required to enable the long distances between sites to be delivered, and as bandwidth demands increase (for all of Emergency Services users, Fixed Rural Broadband, and Rural mobile broadband roaming) multiple aggregated links will be required, utilising multiple links within bands and probably multiple bands. An example might be 4 links at 13 GHz plus 4 links at 15 GHz, all using XPIC techniques aggregated together to deliver multiple Gbit/s over a distance of 25 km or possible more. The current trend of ever higher modulation schemes does little to answer these longer link requirements as the modulation becomes more complex the range for the same quality of performance falls off very quickly. Currently for reasonably long links of high availability 256 or 512 QAM is the practical limit. Fibre is not a realistic alternative to much of these rural and isolated areas.
- b) The replacement Emergency Services Network is presumably being rolled out now into the Rural and isolated areas as should be Fixed Rural Broadband and Rural mobile broadband roaming, though the latter two examples may follow later to meet Government targets for broadband availability to the public.

Question 5:

- a) What capacity enhancing techniques are you deploying or intend to deploy?
- b) How does this affect your future demand for spectrum?
- c) Do you see any barriers in the current authorisation approaches preventing use of such technology? If so, please indicate the changes you consider would be required to facilitate this?

- a) For the rural and isolated areas Airwave in recent years have designed their microwave links such that they can be upgrade to provide much higher bandwidths (typically the maximum the radio equipment can provide at 256 QAM) without the need to swap out hardware, unless a change in license forced a frequency band change.
- b) In rural and isolated areas far more of the existing lower frequency wireless fixed link band spectrum will be required to deliver high bit rate services to the Emergency Services and public alike.
- c) The only barrier would be if insufficient channel capacity existed due to either congestion (too many single operator networks instead of shared infrastructure to provide the maximum efficiencies at minimal overall cost) or it being used for other purposes. This may be self limiting to some degree because if these frequency bands were used to deliver mobile broadband services then those same services would need these same frequency bands to deliver the backhaul connectivity back into the mobile core network.

Question 6:

- a) How do you expect future mobile backhaul network architecture to evolve as part of the 5G ecosystem?
- b) How would this impact on future demand for fixed wireless links as a backhaul solution in the next 5-10 years and beyond? Please explain in terms of specific frequency bands i.e. which bands will be important for macro and small cell backhaul and why.
- c) What is the most appropriate authorisation regime to facilitate this?

- a) In urban and dense urban areas fibre will be the predominant delivery medium, with very short range fixed links (P2P and P2MP) being used to distribute the delivered backhaul bandwidth to individual cells. These very short range links can use the highest frequency bands and still provide large bandwidth at reasonable availability, especially as many devices will have multiple choices for their serving cell connectivity.

For rural and isolated areas (as covered in the responses to other questions) there is no realistic alternative to wireless fixed links in the lower bands to enable high bandwidth to be delivered over long distances that are simply uneconomical to deliver using fibre. To provide the level of coverage required by the Emergency Services the delivery of fibre to some individual Airwave sites has been quoted at over £1M, a few over £2M at 1999 - 2005 prices, needless to say these have been delivered by multi-hop fixed links. For future networks demanding much greater bandwidths than the current Airwave network these issues will be much greater as high bandwidth and range are mutually exclusive within any particular frequency band, i.e. you can have one but not both at the same time.

- b) Not currently relevant to Airwave.
- c) For the Emergency Services and networks providing services to the public, radio spectrum that is used to provide these services needs to be protected from other users to enable reliable services to be provided, necessitating some form of licensing and control.

Equally there is a need to reduce costs for the network operators and the spectrum administrators, so the current scheme for fixed links would not be appropriate with its relatively high administrative costs.

The most appropriate scheme might be limited access databases (limited to approved network operators and organisations) where frequencies or channels in use could be registered against geographic locations, on a first come first serve basis, and an administrator to police against anti-competitive behaviour such as spectrum hoarding (registering frequencies or channels but not having operating links within a reasonable time scale) by any business or organisation. A system like this would require study and development but it is essential that a robust, but cheap, method of allocating and protecting spectrum is implemented.

Question 7:

For each Fixed Service band currently identified for study for 5G under WRC-15 Agenda Item 1.13 and 3.6–3.8 GHz band, please explain the impact on your backhaul use should the bands be identified and be repurposed for 5G given that the viability of in-band sharing between mobile access and backhaul is currently being studied.

Should any fixed link service band used by Airwave (within 1.4 GHz to 38 GHz) be repurposed prior to 2019 (current contract extension), and possibly beyond should the new ESN network be delayed, the Emergency Services for Great Britain would be impacted. The impact could be in two possible forms, a lack of essential services in a geographical area causing a risk to life or a considerable cost to the public finances to replace existing wireless fixed links with fibre cables. The second could be in the £10Ms, possibly higher if the 1.4 GHz band was adversely affected as these links are predominately used in rural and isolated areas where their replacement with fibre or multi-hop radio paths in higher frequency bands would be very expensive.

Question 8

- a) What is the current use in the block assigned bands at 10 GHz, 28 GHz, 32 GHz and 42 GHz bands and how do you expect usage in these bands to evolve given that the 32 GHz and 42 GHz bands are also being considered for study for 5G globally?
- b) For each band, please provide details including geographic location of each fixed wireless link deployed and the application it supports. Where these bands are used for fixed wireless links, please give details in terms of the capacity supported and total numbers of links deployed.

- a) Not used by Airwave.
- b) N/A

Question 9:

What impact does the change in the provision of national emergency service network have on both the future demand and supply of spectrum to support the backhaul requirement for the emergency service network? Please explain in terms of frequency bands, particularly but not limited to the 1.4 GHz, 26 GHz, 38 GHz bands?

The current network will continue until at least 2019, and if there is any delay in the roll out of the new ESN and subsequent adoption by the Emergency Services, possibly beyond. Until this time there will be an increase in the use of these bands as Airwave completes its replacement of BT Kilostreams by wireless fixed links. Many of the proposed fixed links have already been delivered or licenses applied for but there are approximately another 500 links still to be designed and licensed within the 1.4 GHz to 38 GHz bands.

Assuming Emergency Service coverage is required that has the same or similar footprint to that already provided by Airwave (this assumption has been made on the basis that the current coverage has only been provided where it has been required by the Emergency Services) the new network will need far more wireless fixed links in rural and isolated areas than Airwave currently uses. This is based on the extensive use by Airwave of 1.4 GHz links to reach 'beyond the horizon' across paths that do not provide full line of sight (i.e. diffracted paths) or distances in excess of 50 km with low bandwidth links which would not be possible at the bandwidth required for the new ESN. Due to this the new provider will need to build many hop sites utilising many more medium and long range links to skirt around obstacles, or invest £Ms in new fibre routes to very remote locations. Unless this is done it would be impossible to provide Emergency Service coverage to many roads that cross isolated countryside, the many small rural villages or hamlets, deep into the national parks (roads and tourist areas), the Highlands and Islands of Scotland, etc. It should be remembered that in the geographical areas covered by many Airwave sites there is currently no other telecoms services other than Airwave, mobile or fixed.

If high availability services (equivalent to the current Airwave GBNR service) are required across all areas (urban or rural) this will need to be provided over wireless fixed links to ensure the diversity into each site that is required to provide this high quality service. Again, due to the demands of increased bandwidth and the distances involved this will rely more heavily on the 13 GHz and 15 GHz bands than the narrow bandwidth Airwave service does, in some cases in areas that are already heavily congested in these bands.

Question 10:

- a) How do you expect future public safety use of fixed wireless links to change in the next 5-10 years?
- b) Please indicate the market and technology drivers affecting your future use of fixed wireless links, and whether your use could be provided by alternative solutions. If relevant, please explain in terms of frequency bands, particularly but not limited to 1.4 GHz, 26 GHz and 38 GHz?

- a) There will be a large increasing demand for wireless fixed links over at least the next 3 years as the new ESN rolls out into rural and isolated areas as both will need to be up and running in parallel, potentially for a number of years until all potential users of the new network have transitioned across. The current Airwave contract runs until 2019 for the supply of the existing services across GB. As per our response to question 9 the new ESN is likely to need more wireless links than Airwave as they will have to use 2 or more links to reach from a point where fibre 'runs out' across difficult terrain to where a base station site is needed and Airwave are currently using single narrow band 1.4 GHz or 400 MHz MiMo links to deliver 64 kbit/s or 128 kbit/s.

Where Airwave are currently using VSAT to reach some sites, if these are still required, the new ESN will either have to deploy eNodeB's using broadband satellite links (exceedingly expensive for always on, bi-directional links) or use multi-hop (> than 4 hop site typically) wireless fixed links to reach into these areas (tourist hot spots, remote sections of motorways and major roads, essential national infrastructure, etc.) using I would expect mainly the 13 GHz or 15 GHz bands to provide the range and bandwidth.

- b) In urban and dense urban areas I would expect the new ESN to simply encompass the Emergency Services into it existing and planned future network in terms of backhaul. Though there may be a need for some additional wireless fixed links if a high availability service is required needing high levels of transmission diversity.

In Rural and isolated areas the main demands for fixed link spectrum are likely to be in the 13 GHz and 15 GHz bands due to the distances between sites, though higher frequency links may be used where it is possible to skirt around an obstacle using more, but shorter, links as opposed to fewer longer ones, this will come down to CAPEX and whole life costs. It is unlikely that 1.4 GHz could provide the necessary bandwidth to fully support an eNodeB and its supported services unless the current channel plan was significantly changed. For these rural and isolated locations the cost of providing a fibre solution would be prohibitive and or would take many years to obtain the necessary permissions if a poled aerial cable solution was proposed (National Parks, etc.).

Question 11:

Please indicate whether you consider that the guard band and centre gap of the 6 GHz band would be a suitable substitute for current and future 1.4 GHz applications, particularly in terms of costs to provide for like for like links and if not, the costs of alternative solutions. Please provide detailed evidence to support your answer.

Having desk top analysed a number of Airwave narrow band links it would be feasible to replace some 1.4 GHz links with links in the 6 GHz band. Replacement 6 GHz links for existing 1.4 GHz obstructed links relying on diffracted paths would need to be licensed with a suitable power uplift allowing sufficient fade margin to provide an availability of 99.999%.

Question 12:

- a) How do you expect the utility sector's future use of fixed wireless links to change in the next 5-10 years?
- b) Please indicate the market and technology drivers affecting your future use of fixed wireless links, and whether your use could be provided by alternative solutions. For example, which part of the smart grid network will require fixed wireless links? If relevant, please explain in terms of frequency bands, particularly but not limited to the 1.4 GHz, 26 GHz and 38 GHz bands.

N/A

Question 13:

- a) How do you expect the future requirements for fixed wireless links that support HFT applications to change over the next 5-10 years?
- b) Please indicate the market and technology drivers affecting your future use of fixed wireless links. If relevant, please explain in terms of frequency bands, particularly the 70/80 GHz band.

N/A

Question 14:

- a) What is the future demand for HAPS in the UK both in terms of being a network provider and service provider? Please provide details including specific applications and envisaged deployment scenarios for HAPS.
 - b) How could sharing with existing fixed wireless links be facilitated? What would this mean in terms of the most appropriate authorisation regime to facilitate deployment of HAPS?
-
- a) Not known, though potentially, if significantly cheaper than satellite, could be used to provide broadband capacity to rural and isolated areas.
 - b) However the technology is deployed, if sharing spectrum with existing fixed links (or any other services) the priority must rest, in terms of freedom from interference and degradation of service, with the existing users. Where changes would be required to allow HAPS to be deployed any costs to implement the changes for existing users (both CAPEX and OPEX) would be the responsibility of the HAPS service provider.

Question 15:

- a) How could the 8 GHz band and narrowband channels within the guard bands and centre gaps of the existing channel plans for the 6 GHz band meet future demand for fixed wireless links if additional spectrum could be made available?
- b) What types of applications do you consider would be of interest for these bands?
- c) What is the status of fixed wireless links equipment availability in these bands?

- a) Having looked at a number of Airwave narrow band links it would be feasible to replace some 1.4 GHz links with links in the 6 GHz band. Replacement 6 GHz links for existing 1.4 GHz obstructed links relying on diffracted paths would need to be licensed with a suitable power uplift allowing sufficient fade margin to provide an availability of 99.999%.
- b) As a possible extension of the current narrow band services that currently use the 1.4 GHz band.
- c) Airwave is not aware of any equipment that would provide narrow band services within the guard bands and centre gaps of the existing channel plans for the 6 GHz band.

Question 16:

- a) What is the demand for a combined Lower and Upper 6 GHz channel plan that could provide wider channels at 112 MHz bandwidth?
- b) What are the practical implications for existing equipment that operates under the existing band plans who wish to migrate to the new band plan?
- c) What is the status of Fixed Service equipment availability for the wider 112 MHz channels in the combined Lower 6 GHz and Upper 6 GHz band?

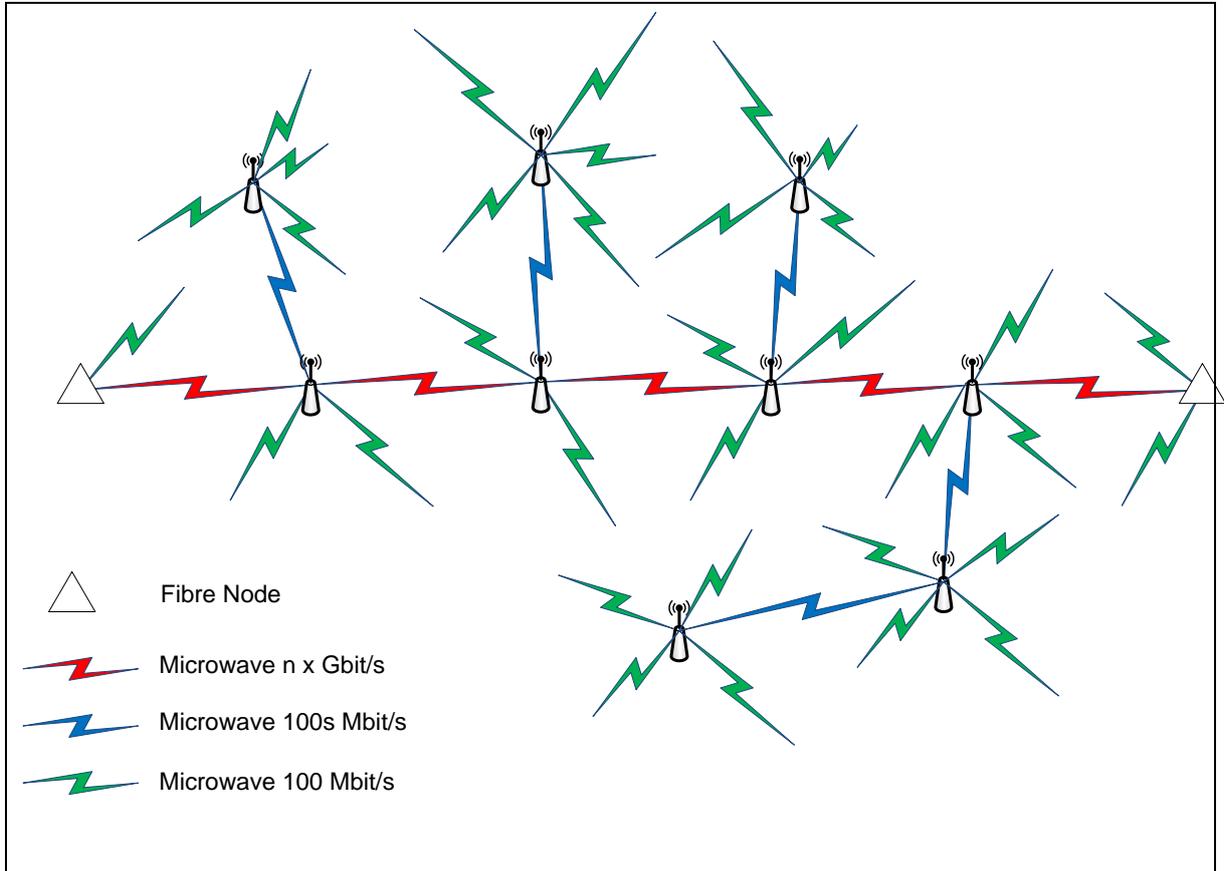
The following is Airwave opinion not what Airwave are currently doing.

Airwave have taken part in a number of Rural Broadband trials and from this experience we believe that to enable Rural Broadband and Rural Mobile services to be provided in line with the Governments wishes it will be necessary to deliver relatively large bandwidths out to remote and isolated areas. These remote and isolated areas will be significantly beyond the economical reach of fibre optic based solutions. Note, isolated areas may be isolated with respect to dwellings or business premises but can have major roads requiring coverage passing through them.

In a recent study into delivering 4G services into rural and isolated areas Airwave identified a need to be able to deliver multiple Gbit/s over radio fixed links and for these to be then sub distributed at many 100s Mbit/s, and if a reasonable level of availability was required this would need to be configured as per the diagram below, with diversity provided between two (or more) fibre nodes. As these remote areas can be quite large the link lengths would be in 10s of kilometres requiring lower frequency operation and link aggregation. As can be seen from the (fictional) representation below, to deliver service to many small villages and remote dwellings many microwave links are required in an area that could be as small as 50km x 50km. The representation below is a straight line version of a preliminary network desk top design for an area of Scotland to provide LTE type coverage along roads and to dwellings, i.e. mobile and fixed broadband services. The main path (n x Gbit/s links) was in excess of 120km as it wended its way around mountains, etc. and kept to existing radio sites (any site provider not just Airwave) to ensure that suitable and sufficient electric connections would be available.

This type of network will be required in many areas of GB from Scotland, Lake District, Borders area, much of central Wales, down through England to Dartmoor.

To provide fibre to these areas would require investment most probably running into many £Bs, whereas microwave is likely to be merely in the £100Ms!



Question 17:

- a) What are the applications envisaged in the W and D bands?
- b) What is the timescale of equipment availability for these bands?
- c) What would you consider to be the appropriate authorisation regime to facilitate access to spectrum in the W and D bands?

N/A

Question 18:

- a) Do you have a view on potential frequency bands between 275–450 GHz that could be suited for Fixed Service and for what applications?
- b) What are the anticipated timescales for the development of equipment and applications for these bands?

N/A

Question 19:

- a) What is the future demand for bands listed in Table 4 for Fixed Service applications?
- b) What is the status of fixed wireless links equipment availability in these bands?

N/A

Question 20:

Are there other aspects of the review on which you have evidence that would help inform our consideration of future developments in the Fixed Service sector? If so, please provide as much evidence possible.

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