Cambium Networks

Improving consumer access to mobile services at 3.6 to 3.8 GHz

Response from Cambium Networks

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Abstract — Cambium's response to the 2016 Ofcom consultation "Improving consumer access to mobile services at 3.6 to 3.8 GHz". It makes some alternative proposals for the use of this frequency band.

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1 Introduction

It is a pleasure to be able to respond to this consultation. 5G has an amazing set of aspirations. The 5G White Paper By NGMN Alliance states that the deployment is expected to start in 2020 and then be improved over many years. The likelihood that 3.6-3.8 GHz will be needed for 5G by 2020 is low.

By contrast, Fixed Wireless Access (FWA) technology is already available in this band and operators need to be able to use it today. Cambium Networks supplies products to 160 countries and many of those countries use frequencies in the 3.3-4 GHz range. In the UK, BDUK is helping fund broadband to the underserved. FWA has been over-promoted over the years but the public wish for broadband at

home and on the move is increasing markedly.[1] The ability for broadband to be supplied to rural areas by wireline is poor and there is a big opportunity, currently supported by companies like Airband, to provide broadband by wireless to places in the South West of England. This situation is repeated nationally.

These companies are using the 5.8 GHz lightly licensed band since that is the only band available to them. There are many areas of the UK that would benefit from FWA in the 3.6-3.8 GHz band. Since higher powers are available and the frequency is lower, the distance and penetration through trees is much better. Consequently the cost of reaching smaller communities that may be shielded by trees is reduced through the use of fewer basestations.

The technologies in use are LTE, WiFi and proprietary. Unlike mobile, FWA operators are already deploying Massive MIMO and getting delivered spectral efficiencies of 2.2 Gbps peak and 900 Mbps average in 40MHz bandwidths (22 b/s/Hz) from a four sectored base site.

Interestingly, the 5G White Paper does not ask for 3.5 GHz spectrum but rather >6 GHz for higher capacity. Nevertheless, I am sure that the mobile operators are pushing Ofcom for 3.6-3.8GHz spectrum availability. What is the solution to these competing demands from mobile and fixed? It is clear that the mobile demand for these high frequencies is for lower distances typically required to cover high streets, stations and stadiums where large crowds are gathered. The FWA need for this band is for rural areas. It is clear that the band can be used for both purposes, to provide mobile coverage in cities and FWA coverage in rural areas. There is little overlap between operators. FWA operators tend to be regional and so a national license is not appropriate, as demonstrated by UK Broadband.

In section 2 the optimum use of spectrum is considered. Section 3 considers the success of rural broadband in the UK. Section 4 considers the success or otherwise of the UK Broadband license. Section 5 considers the case for mobile's need to use this band. Section 6 answers the specific questions.

This response to the consultation will concentrate on rural broadband and alternatives for the proposed options which Cambium believes are in the national interest.

2 Spectrum Use

As a background let me propose some directions for spectrum use which should provide us with guidance on how to proceed.

[1] The village of Rattery in Devon has 92 out of 207 properties requiring much better and more reliable broadband.

- Long links (> 30 miles) are best served by fibre where possible. When wireless is required, 6 to 8 GHz should be preferred. This is because, relative to 3 GHz:
  - the rain fading is negligible,
  - the fading due to ducting is little different,
  - antenna gain is increased by about 12 dB, while path loss only increases by 6 dB, giving a net gain of 6 dB,
  - the available bandwidths are wider, and
  - frequency reuse is better because of higher antenna gains.
- Rural broadband works well at 3.4 to 3.8 GHz. At these frequencies medium powers are generally available and low cost components may be used. These frequencies have been made available for rural broadband in many countries.
- Rural works in 5.15 to 5.9 GHz since WiFi has enabled low cost components and a common band use throughout the world, however there are disadvantages:
  - the regulations are for relatively low power, and
  - the need for radar detection and avoidance.
- Mobile works best at 800 MHz because of the limited gain of mobile antennas. Bandwidth availability has been pushing up the frequency particularly for short range work such as small cells, where line-of-sight down small lengths of street and stations have enabled a greater penetration of data. Mobile also work well indoors at higher frequencies.

Precious spectrum should not normally be used for communication between two fixed points unless there is a great efficiency by doing so. Rural broadband is one such example where there is a need to get from one point of presence to many others, often more than 100. Efficiencies are gained by shared use of the spectrum either simply by TDMA or in a more efficient manner by the use of MU-MIMO[2]. These efficiencies enable a single base site to achieve up to 30 b/s/Hz. Connection by copper (fibre to the cabinet) is generally uneconomic in these locations. A base site can be set up for less than ≈£20k to serve 100 homes and the connection of each home can usually be achieved for less than ≈£300.

3 Rural Broadband

WISPs are the main providers of rural broadband around the world. The WISP industry has not been very successful in the UK due in part to the following:

[2] Multi-user MIMO is a system by which different streams of data are transmitted from the base site to multiple subscribers simultaneously.

- ADSL coverage has been good enough from BT because there is universal coverage of telephony and most houses are less than 4 km to the cabinet giving ≈2 Mbps,
- BT's anti-competitive practices. Whenever a WISP has started up BT has suddenly found a way to provide service when previously it was unable to,
- UK Broadband have been unable or unwilling to make effective use of the existing 3.5 GHz license. We note that they have not deployed nationally, or in any rural locations, and they have not responded to the rural contracts offered by BDUK/Connecting Devon and Somerset. We believe that this does not arise from any lack of demand, or from any fundamental limitation of the available technology, but rather from a lack of enterprise on the part of the company.
- lack of willingness of investors because of:
  - business failure of Ionica,
  - the expectation of broadband being delivered by wireless in 2000 which did not materialise.
- low power availability of 5 GHz Spectrum

The economics for UK WISPs has now improved because:

- customers are demanding higher speeds than achievable over ADSL,
- wireless technology can deliver higher speeds at low cost
- government subsidies for rural broadband are available

There are other countries where WISPs have been very successful. Examples include USA, Italy, Poland, Hungary and Canada. In most of these countries there has been a mix of licensed frequencies, lightly licensed and unlicensed at 900 MHz, 3.5 and 5 GHz. In order to finally deliver to all properties in the UK, WISPs will need availability of spectrum not simply at 5 GHz but also at 3.5 GHz.

4 UK Broadband

168 MHz of spectrum nationally licensed to one operator, UK Broadband, has not delivered the anticipated benefits. UK Broadband should not be allowed to continue with the license for a significant piece of valuable spectrum unless they can demonstrate the ability to use it more effectively, or to share the spectrum with other operators who are better placed to provide a service to the public. In thirteen years the coverage achieved is 0.1%[3] and the number of subscribers is about 10k.

[3] Cambium's estimate

The opportunity lost to the nation is extremely disappointing and urgent action is needed to ensure that the present state of affairs does not persist.

The spectrum should be re-farmed to those that will use it. Since the government is investing money in rural broadband this spectrum should be leased under favourable terms to companies who will provide coverage to an area. The cost of delivery to Dartmoor and Exmoor would have been substantially reduced if Airband had been allowed to use this spectrum. They are using 5.8 GHz because that is the only spectrum available to them. Higher power and lower frequency would have enabled them to achieve longer ranges, which would have substantially lowered the cost and reduced the number of masts required in this environmentally sensitive area.

5 Mobile 5G Spectrum

The case for providing this spectrum for 5G mobile may not be as strong as has been considered. Clearly the case has been made to Ofcom by very well funded mobile operators. However, it is Ofcom's job to take a balanced view of the benefits of the various options to businesses and the public.

The mobile industry is ensuring that the spectrum is available at the earliest possible moment in order to make it easy for them to plan. We need to consider whether efficient use of the spectrum has already been achieved and also whether 3.6 GHz deployment will be as Ofcom have suggested. The 5G White Paper by NGMN Alliance does not ask for 3.5 GHz spectrum.

Cambium believes that ranges for 3.6 GHz mobile deployment will be low and generally line-of-sight. The requirement is for increased delivery of bandwidth in city centres, stadia and stations where large groups are gathered. The coverage of 3G and 4G mobile is not yet universal. 4G has not been deployed yet to the limit of its technological capability. The majority of mobile phones sold today have the capability to be deployed using MU-MIMO, however, I do not believe that there are any production deployments which use MU-MIMO. In principle the current technology enables eight times the density to be delivered using 8x8. By contrast, Fixed Wireless Access has been delivering broadband using 2x2 for 6 years and for a few months has been deploying 14x14 MU-MIMO in the 5 GHz bands.

Mobile operators have not yet used the full capability of the 4G system so granting nationwide licenses in the 3.6-3.8 GHz band is not justified when there are other operators ready to use these frequencies today.

6 Detailed responses to the questions

Question 1 *Do you have any comments on the use of the 3.6 to 3.8 GHz band by existing services?*

My comments are;

- Consideration has not been given to using this band for Fixed Wireless Access. Section 2 highlights that this band of frequencies is particularly useful and economical for Fixed Wireless Access.
- UK Broadband have made very inefficient use of their national license to operate in this band (see section 4). In nine years they have used the spectrum to cover 0.1% of the land area of the nation. They should have the rest of the nation taken away under a "use it or lose it" method.
- Fixed links in this band are squandering the spectrum either by not using the available fibre, or by not going up in frequency to 6 to 8 GHz which is more efficient. Normally one of these links could be moved up in frequency for less than £20k. As described in the paper, this would free a huge tract of land for much more efficient rural broadband use.

Question 2 *Do you agree with our identification of a trend towards the use of mobile in the 3.6 to 3.8 GHz band?*

No — although mobile can use very short range high bandwidth services in this band, these will be located in city centres, not in suburban or rural. The basics of propagation ensure this. Mobile operators continue to make a spectrum grab for higher and higher frequencies rather than using the lower frequencies more efficiently. For example, LTE phones support the use of MU-MIMO which could increase spectral efficiency by a factor of three or more. The base stations that make use of this technology are almost non existent. Instead they are arguing that without spectrum they cannot deliver the higher bandwidth services. There may be a case for using this spectrum eventually in stadia and at stations and town centres, however technology will come to their aid in the form of Massive MU-MIMO and WiFi support.

Question 3 *Do you agree with our high level proposal to make 116 MHz within the 3.6 to 3.8 GHz band available for mobile and 5G services, bearing in mind our statutory duties and the high level trends we have identified?*

No —;

- mobile operators have not yet used the lower frequency bands efficiently, and

- the propagation of these frequencies to mobile devices limits their use short ranges and line-of-sight this implies that their use will be in town centres, stations and stadia where crowds congregate.

Question 4 *Do you agree with our general approach regarding spectrum currently licensed to UK Broadband?*

No - UK Broadband should be penalised on the grounds of "use it or lose it". The area of the nation where UK Broadband operate is less than 0.1% of the nation. (See section 4 for more information)

Question 5 *Do you agree with our assumptions, methodology, and conclusions with regards to potential coexistence between mobile and existing fixed links and satellite earth stations? Please refer to annex 5 for further details.*

Two comments;

- mobile systems should not be allowed to operate macro sites on these frequencies. They should be restricted to low level base sites which will reduce the pollution of the spectrum for earth stations and rural broadband, and
- some fixed links should be pushed towards fibre connectivity.[4]
- Cambium believes that satellite users should be encouraged to reduce the number of earth stations on the basis that all of the data could be received at a smaller number of sites and the data could be distributed by fibre which already connects to each of the sites. The communities that would be affected could be reduced substantially without any effect on the customers of the satellite services.

Question 6 *Do you have a view on any of the two options we identified?*

- Cambium believes that some fixed users should be removed where it is convenient to replace with fibre connectivity. In trying to answer this question I found that one fixed link has already been removed in South Devon. Maybe there are others which should be removed such as the London ones.
- Cambium suspects that satellite users should gain priority on a non interference basis.

[4] One example is between Ivybridge and Beacon Hill where the link has been removed since the publication of the consultation. Since the television relay mast is still used at Ivybridge Cambium assumes that either the frequency was changed or the mast has fibre connectivity.

Question 7 *Do you have any quantitative evidence on the costs and benefits associated with the options? This include costs for existing users and/or consumers of existing services associated with potential changes, and benefits to UK consumers in gaining access to mobile services in this band.*

Cambium does not have quantitative evidence for these options.

Question 8 *Do you have any other suggestions that would allow widespread 5G availability using the 3.6 to 3.8 GHz band across the UK while allowing certainty for at least some existing users to continue to provide the benefits currently provided by use of the 3.6 to 3.8 GHz band?*

If 5G means mobile then these frequencies will only be used in city centres, stations and stadia, and so these proposals are a wasted opportunity.

A further option should have been considered, which is to make the frequency band available to both mobile and fixed in the way described throughout this response.

Question 9 *Do you have any comments in relation to these proposals?*

Consideration should be given to licensing the frequencies for rural broadband usage as well as for small cell usage for mobile in city centres. See the recommendation in section 7 for further details.

7 Recommendations

Cambium makes the following recommendations;

- The 3.6 to 3.8 GHz spectrum should be made available to *both* Fixed Wireless Access and mobile operators. Mobile should be allowed to use it in City centres, stadia, stations and any other place where crowds regularly form, using low level base sites. FWA should be able to use it in rural areas on a light licensed basis to telecommunications operators.
- UK Broadband should be obliged to deliver a useful national service using their valuable spectrum, particularly including rural areas where there are few alternative technologies. Failing this they should lose the national license and be restricted to the areas currently served.
- Reduce the number of fixed links and satellite stations using the band by greater use of fibre connectivity.