Cambium Networks

A Simple and Efficient 5G 3.5 GHz Auction Method that enables 100 Mbps Rural Broadband

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Abstract — A method of auctioning the 3.5 GHz bands is presented which would enable Fixed Wireless Access to use the spectrum in rural areas without interfering with the 5G requirements for the mobile companies.

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0.4	2017-03-02	Many changes after reviews.	Nigel King

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1 Introduction

This document presents a simple method of ensuring that the mobile companies only buy 5G 3.5 GHz licenses for the area that they really need. The mobile companies are unlikely to require use outside cities, malls, stadia and stations and so in rural this spectrum can be used to provide broadband by fixed wireless access. The delivery of superfast and faster broadband can be provided by equipment available today. This idea meets the aspirations of the government to achieve broadband for all, and also enables Ofcom to meet their mandate to ensure efficient spectrum use.

In the consultations "Improving consumer access to mobile services at 3.6 to 3.8 GHz"[1], and "Award of the 2.3 and 3.4 GHz spectrum bands. Competition issues and auction regulations"[2], Cambium Networks suggested that the 3.5 GHz spectrum should be reserved for rural broadband delivery to properties outside cities, shopping malls and stadia. The responses did not propose a method for achieving this. Here we propose a simple method of valuing and auctioning spectrum in different areas.

2 Background

As has been stated in the consultations for 3.6 to 3.8 GHz and the 2.3 and 3.4 GHz auctions, auctioning national licences is a very inefficient method of distributing this spectrum. There are two potential users of the spectrum, the mobile providers and WISPs. The mobile providers in areas of dense population including stadia, stations, shopping malls and high streets will be using low height antennas (≈6 m above ground) because the signals can not travel very far to the mobile users at this frequency. WISPs can make very efficient use of these frequencies, in areas which are of no interest to the mobile operator.

Currently, WISPs are providing broadband service to rural properties under difficult circumstances of both anti-competitive practises and limited spectrum. Countries that have less difficult circumstances (USA, Italy etc.) have a thriving WISP industry. The only spectrum which most WISPs have available is in the 5 GHz bands. In practice the main spectrum is the 5.8 GHz portion of the 5 GHz band because of the slightly higher power available than in the 5.4 GHz portion. Unfortunately, the 5.8 GHz portion is badly restricted by RTTT and slightly affected by DFS. The availability of 3.4 to 3.8 GHz to improve the delivery of rural broadband is an opportunity that should not be missed. Higher power and lower frequency will increase the efficiency of WISP deployments by a factor of 2 to 10 where I define efficiency as the number of base sites required per unit area.

The efficiency is increased dramatically by:

- the availability of spectrum at higher power enabling longer range communication to cover larger areas at lower cost, and
- the availability of wider bandwidths (than are available at 5.8 GHz) increases the throughput raising the probability of delivering more than 100 Mbps to rural properties.

How is Ofcom to enable the geographic licensing of these bands without considerable effort on Ofcom's part? A simple solution is to be found in the next section.

[1] https://www.ofcom.org.uk/__data/assets/pdf_file/0035/96893/Cambium-Networks.pdf

[2] https://www.ofcom.org.uk/consultations-and-statements/category-1/award-of-the-spectrum-bands

3 The principle of auctioning spectrum geographically

The country can be divided into 1 km squares using the ordnance survey grid (such as SX7660). The mobile auction would be performed with each company bidding for each square and also the amount of spectrum required in each. Ofcom would put a reserve on each square for each 10 MHz of spectrum of say £1000. This would ensure that the mobile companies only bid for the area they require. Competition in high value properties will push the auction price in many places higher than this.

They may decide to purchase additional squares in order to ensure that there is no interference from the expected rural WISPs in the less likely condition of using high site base stations. There seems to be agreement that the mobile companies are very unlikely to want this spectrum in rural areas since the propagation to mobiles will be very poor.

Currently a number of Fixed Wireless operators receive subsidy under the BDUK rural programme, either through local authority procurements or through voucher schemes. These subsidies are very effective at increasing the availability of superfast broadband services in challenging areas. As we reach the final few percent of premises currently unable to get superfast - and in some cases basic - broadband services, the role of FWA operators likely to increase significantly. Delivering these services using 3.5GHz spectrum will significantly improve performance thus making BDUK subsidies more cost-effective, offering better value for money to the public purse.

An obvious deployment constraint for the rural operator is to ensure that PMP links do not cross the mobile/rural boundary. Since narrow beam antennas (<20°) are normally used for the Customer Premises Equipment (CPE) the mobile bidder can then compute the number of squares needed for his network to be interference free.

4 Some calculations

There are 242,000 square km in the UK[3]. About 7% can be considered urban[4] (17,000 sq. km). A current expectation of license cost might be ≈£1bn for 100 MHz of spectrum. The likely number of squares which the mobile operators may want is less than 17k. An average price is likely to be $£10^9/17k$ = £58k per 100 MHz or ≈£6k per 10 MHz per sq. km. Ofcom need to judge a reserve price which would ensure that the mobile operator really wanted to operate in or near the 1 km being requested. My suggestion would be ≈£1000 per 10 MHz per sq. km.

[3] https://en.wikipedia.org/wiki/United_Kingdom

[4] http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=u60Ugtegc28%3d&tabid=82

5 Conclusion

A very simple method has been presented that enables dual licensing of the 3.4 to 3.8 GHz spectrum to mobile and rural WISPs. The method enables Ofcom to meet its charter of utilising spectrum in the most efficient manner possible and also enable the delivery of superfast to the whole country. This opportunity cannot be lost to the nation.