

SETTING AN ANNUAL LICENCE FEE FOR 412 MHZ SPECTRUM

A report prepared for Arqiva

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EXECUTIVE SUMMARY

Arqiva (and co-licensee, Airwave) has an exclusive licence to use 2 x 2 MHz of spectrum at 412-414 MHz paired with 422-424 MHz across the UK. This spectrum was initially awarded to Arqiva in October 2006 following an auction. Arqiva's licence states that an annual licence fee (ALF) will become payable from October 2021. Ofcom is consulting on its proposed ALF for this spectrum of £1,584,000 per annum.

Arqiva has asked Frontier Economics to assess Ofcom's proposals. This report sets out our assessment.

Ofcom has a statutory duty to ensure that spectrum is used efficiently. Ofcom's policy is to use spectrum pricing as a tool to meet this objective. Specifically, Ofcom's view is that spectrum should be priced to reflect its forward looking opportunity cost. This approach is referred to as Administered Incentive Pricing (AIP). The opportunity cost of spectrum is the value of the spectrum to the best alternative user that is denied access to it. By attempting to equate the price of spectrum to its opportunity cost, Ofcom aims to ensure that spectrum is assigned to the user who values it the most highly.

Ofcom's application of its AIP approach is flawed. Ofcom has overstated demand for the spectrum by assuming that excess demand in some localities would lead to excess demand across of the UK

Spectrum has an opportunity cost only if there is excess demand for it. That is, there is another user, other than the licence holder, who wishes to use a spectrum band. In setting the ALF for the 412 MHz band, Ofcom therefore needs to assess whether there is excess demand for the spectrum and, if so, the value of the spectrum to other users.

Ofcom considers that the 412 MHz band could be used by business radio. Business radio is typically, but not exclusively, used for voice communication between nodes in a defined area. As there is excess demand in the spectrum dedicated to business radio in some localities, Ofcom considers that business radio users would want to use the 412 MHz band. That is, Ofcom's view is that there is likely to be excess demand for the 412 MHz band at a national level going forward.

We agree with Ofcom's position that, in some localities, there is currently excess demand for the 412 MHz band (and hence Arqiva's licence in those localities imposes an opportunity cost on other users). However, Ofcom also argues that there will be excess demand at a national level for the 412 MHz band in the future. We disagree with Ofcom that, in the future, there is likely to be congestion on business radio bands throughout the whole of the UK. As such, we believe that Ofcom has overstated the nature of excess demand for the 412 MHz band in the future.

Ofcom has not considered the impact of existing and emerging technologies on demand for 412 MHz spectrum

We also note that Ofcom has not considered the impact of alternative technologies and potential spectrum reassignment on future demand for the 412 MHz band. Technologies such as LTA, 5G, LPWAN and Push To Talk Over Cellular (PTToC) have the potential to displace demand for business radio in the future.

Furthermore, the likely reassignment of adjacent spectrum currently used by the emergency services (e.g. 380-385 MHz, 410-412 MHz, etc.) will also reduce the extent of any excess demand from business radio users in the future.

Adjusting for areas where there is no evidence of excess demand is likely to lead to a significantly lower ALF.

As Ofcom has likely overstated the extent and nature of excess demand for the 412 MHz band in the future, Ofcom has also overstated the opportunity cost (and hence proposed ALF) for the 412 MHz band.

If Ofcom recognises that there is likely to be excess demand for the 412 MHz band from business radio users in some localities, but not across the entirety of the UK, then the implication is that the value of the 412 MHz band will be lower than is currently assumed by Ofcom. The ALF currently proposed by Ofcom is therefore higher than it would be if Ofcom's pricing methodology had been followed appropriately. Based on the available evidence, it appears that excess demand for spectrum from business radio users is likely to be experienced in London and potentially in a few other metropolitan areas, such as Birmingham, Manchester and Glasgow. Based on this evidence, we have estimated that the ALF for 412 MHz spectrum should be set between £189,600 and £261,600 per annum.

Similarly, following an international benchmarking methodology, as Ofcom did when setting 900 MHz and 1800 MHz ALFs, results in a considerably lower ALF.

International benchmarking also indicates that there should be a lower ALF for the band. We apply a methodology similar to the one used by Ofcom to set ALF for 900 MHz and 1800 MHz spectrum. More specifically, we assess the relative prices of 450 MHz and 700 MHz spectrum in other European countries which have held spectrum auctions for both bands. By calculating this relative price and applying it to the price of 700 MHz spectrum in the UK, the implied value of the 412 MHz band is estimated to be c. £156,000 per annum – considerably lower than the ALF currently proposed by Ofcom.

Ofcom has not properly assessed the risks associated with its provisional ALF. Setting the ALF too high would lead to a number of unintended consequences

Ofcom has not fully considered the risks associated with its provisional ALF. Ofcom acknowledges that setting an ALF too high risks spectrum being left unused (as no potential spectrum users value the spectrum as highly as the ALF). To avoid this risk, Ofcom expresses a clear preference for an ALF that may potentially be too

low rather than too high. That is, Ofcom stated preference is to estimate ALFs on a cautious, conservative basis.

However, Ofcom has not fully assessed the risk of overstating excess demand for 412 MHz spectrum in the future. Specifically, Ofcom has not considered the implication of its ALF proposal if its assumption about the future nature of excess demand for the 412 MHz band is incorrect. If, as we argue above, Ofcom has overstated the value of 412 MHz spectrum, there is the risk that the spectrum will be returned and left unutilised, which is inefficient. We also note that some of the use cases provided by Arqiva involve positive externalities. For example, installing smart water meters leads to significant water savings and reduces greenhouse gas emissions (as does installing smart gas and electricity meters). If the ALF is set too high and the spectrum is left unutilised, there is a risk that these positive externalities will be forgone.

Furthermore, if the ALF is set too high, it might undermine competition in the downstream market in which Arqiva operates. Indeed, Arqiva competes against other providers which have different cost structures (some use unlicensed spectrum and others use cellular spectrum). This means that Arqiva would not be able to pass on cost increases to its customers, given that Arqiva does not have market power and other competitors are not affected by the introduction of the ALF for the 412 MHz band. By overstating the value of 412 MHz spectrum and setting the ALF too high, Ofcom is likely to undermine competition in the downstream markets in which Arqiva operates.

A glidepath is necessary to ensure that innovation is not stifled towards the end of the licence period

Without prejudice to our arguments that the proposed ALF is too high, we also point out that if Ofcom were to impose its proposed ALF or any ALF which is materially different from the price paid by Arqiva initially (on annualised basis), then it is necessary to implement a glidepath. Ofcom's assertion that Arqiva should have anticipated the proposed level of the ALF is unfounded. Arqiva could not have anticipated the level of ALF proposed by Ofcom and therefore could not possibly account for it in its long-term contracts. It is a reasonable expectation that any significant changes in spectrum prices would be communicated to the licensees in advance. If a glidepath is not introduced, there is a risk that innovation will be stifled towards the end of the licence period as licensees may be reluctant to enter into new long-term contracts until there is more clarity on the ALF going forward.

1 INTRODUCTION

In October 2006, Ofcom auctioned 2 x 2 MHz of spectrum at 412-414 MHz paired with 422-424 MHz on a technology and service neutral basis. We refer to this spectrum as the *412 MHz band* in the remainder of the report. Arqiva won all four lots of 2 x 0.5 MHz with a bid of £1,500,025 and was granted a national licence.

In 2008, Arqiva traded its licence to include Airwave, a subsidiary of Motorola Solutions, as a co-licensee.

The 412 MHz band currently has three primary uses. Arqiva uses the band to provide connectivity services for smart (electricity and gas) meters in the North of England and Scotland. Arqiva also uses the band to provide similar services for water meters. Airwave uses the band to support the needs of the Airwave Network – this network is used to provide mission critical communications for the emergency services.

Arqiva and Airwave do not currently pay an ALF. However, their licences specify that an ALF shall become payable from 5 October 2021.

In a consultation published on 3 June 2021,¹ Ofcom proposed to introduce an ALF of £396,000 per MHz per year (£1,584,000 per year in total for the 2 x 2 MHz band). This ALF is equivalent to the annual fee of a national business radio licence with 4 MHz of “high demand” spectrum.

Arqiva has commissioned Frontier Economics to review Ofcom’s proposal and to assess whether it is consistent with Ofcom’s spectrum management objectives.

Our report is structured as follows:

- Section 2 – we set out Ofcom’s spectrum management duties and objectives, and describe Ofcom’s methodology for setting ALFs both in general terms and for the 412 MHz band.
- Section 3 – we present reasons why we believe Ofcom has misjudged future demand conditions for the 412 MHz band.
- Section 4 – we show that Ofcom has overstated the value of the 412 MHz band as a result of misjudging future demand conditions. We further show that international benchmarks also indicate that Ofcom has overstated the value of the 412 MHz band.
- Section 5 – we argue that Ofcom has not properly assessed the uncertainty that is inherent in its assessment of future demand conditions for the 412 MHz band. We also highlight the need for Ofcom to introduce a glidepath.

¹ Ofcom (2021) Setting licence fees for 412 MHz: Proposal to apply Administered Incentive Pricing for the 412-414 MHz, paired with 422-424 MHz, frequency bands.
https://www.ofcom.org.uk/data/assets/pdf_file/0008/220220/consultation-licence-fees-412-mhz.pdf

2 OFCOM HAS AN ESTABLISHED FRAMEWORK FOR SETTING ANNUAL LICENCE FEES

This section begins by summarising the statutory obligations which inform Ofcom’s approach to spectrum management. The section then concludes with a description of Ofcom’s methodology for setting ALFs. Ofcom’s methodology is discussed both in general terms and with specific reference to the spectrum relevant to this report.

2.1 Ofcom considers statutory objectives when setting spectrum fees

Ofcom’s objectives with regards to spectrum management are set out in the 2006 Wireless Telegraphy Act. According to this, Ofcom is obliged to ensure that spectrum is used optimally, i.e. “in a way that maximises the value that citizens and consumers derive from it, including the wider social value of spectrum use”.²

Ofcom’s duties also include:

- the promotion of competition in the provision of electronic communication services;
- the encouragement of efficient investment and innovation in relevant markets; and
- adhering to the principles of transparency, accountability, proportionality and consistency when carrying out its functions (including spectrum management).

Ofcom sets out its rationale for setting ALFs for spectrum in the “Strategic Review of Spectrum Pricing (SRSP): The revised Framework for Spectrum Pricing.” Ofcom states:³

“benefits to society will be maximised over time if spectrum is priced to reflect opportunity cost. The opportunity cost is the price that would emerge in a well functioning market and reflects the value of spectrum to the best alternative use or user that is denied access to it.”

That is, Ofcom wants to incentivise spectrum users who do not have the highest value to relinquish this spectrum or to sell it to the users who value it more highly:⁴

“If the value of spectrum to a particular user is less than the opportunity cost, then the spectrum is, by definition, valued more by someone else. If spectrum were reassigned to that alternative use or user then we would expect that user to generate greater benefits to consumers and therefore increase the efficiency of the spectrum use”.

² Ofcom (2010) Strategic Review of Spectrum Pricing: The revised Framework for Spectrum Pricing, paragraph 1.4

³ Ofcom (2010) paragraph 3.41

⁴ Ofcom (2010) paragraph 4.30

In summary, therefore, Ofcom aims to set ALFs at a level that would result in an efficient allocation, i.e. at a level that would incentivise the existing users to relinquish their spectrum if there are other users who value that spectrum more highly.

2.2 Ofcom's approach to setting ALFs reflects the best alternative use of spectrum

As discussed, Ofcom's general policy for setting spectrum fees is outlined in its *Strategic Review of Spectrum Pricing (SRSP)* from 2010.⁵ The SRSP sets out the principles, or rationale, of Ofcom's approach as well as its specific methodology.

Ofcom's methodology is described by the following process.

Step one: determine the current and alternative uses of the spectrum in question.

In the present case, Ofcom has determined that there is one alternative use of the 412 MHz band: business radio.

Step two: assess whether there is excess demand for the spectrum in question from either the current or alternative uses.

Ofcom states that business radio users have excess demand for the 412 MHz band. Ofcom has reached this conclusion by assessing congestion in other Ultra High Frequency (UHF) bands which are assigned to business radio. In effect, Ofcom has concluded that *if* business radio users could apply for a business radio licence in the 412 MHz band then they would do so.

If there were no evidence of excess demand for the 412 MHz band, then Ofcom's methodology would result in a cost-based⁶ ALF being applied. However, as Ofcom considers that there is evidence of excess demand, an opportunity cost based ALF is appropriate.

The rationale is that if Arqiva and Airwave continue to hold the licence for the 412 MHz band, then business radio users are denied the opportunity to use the band. In order to make sure this is the socially optimal (statically efficient) allocation of the band, the licence fee paid by Arqiva and Airwave must match the value of the 412 MHz band to the business radio users who are denied access to it.

Step three: determine the opportunity cost of the spectrum in question.

Ofcom has concluded that the value to business radio users of the 412 MHz band must be at least as high as the price of existing business radio licences. If this were not the case then business radio users would be returning their licences.

Ofcom's provisional view is that, "as both the UK-wide Business Radio licences and 412 MHz licence provide licensees with exclusive use of a national channel, the UK-wide business radio fee of £9,900 per 2 x 12.5 kHz provides an appropriate starting point for calculating the value of the 412 MHz spectrum".⁷

⁵ Ofcom (2010) – see footnote 2 above.

⁶ In other words, the ALF would need to reflect the cost of spectrum management.

⁷ Ofcom (2021) paragraph 3.27

Step four: conduct an impact assessment of the fee proposal.

The SRSP states that Ofcom will assess the impact of its proposals on spectrum users, consumers and citizens with a view to identifying detrimental impacts.⁸ Under the SRSP, Ofcom must also “consider carefully the balance of benefits and risks of the implementation of all changes in fees”.⁹

Ofcom’s eighth pricing principle also states that “when there is uncertainty in our estimate of opportunity cost, ... [Ofcom] will consider the risks from setting fees too high, or too low, in light of the specific circumstances”.¹⁰

In terms of the 412 MHz band, Ofcom recognises that if it sets the ALF too low, then Arqiva and Airwave may hold onto their licences when it would be more efficient for the spectrum to be used by business radio users. Correspondingly, if the ALF is set too high, then there is a risk that the spectrum is unused by Arqiva, Airwave or business radio users. Ofcom’s position is to set conservative ALFs to minimise the latter risk.¹¹

Ofcom considers that setting the 412 MHz band ALF equivalent to the UK-wide business radio fee is conservative because, as already stated, business radio users would return their licences if these licences were too expensive.¹² Ofcom further states that the growth in demand for business radio licences also implies that they are not excessively priced.¹³

Ofcom considers that there is no adverse impact on citizens, consumers, competition or investment from its proposed ALF for the 412 MHz band.¹⁴ In other words, Ofcom considers that there is no risk to dynamic efficiency, competition or consumers from its proposal.

We have identified a number of issues with Ofcom’s application of the AIP approach, which are discussed in detail in the following sections of the report.

⁸ Ofcom (2010) page 103

⁹ Ofcom (2010) page 103

¹⁰ Ofcom (2010) page 4

¹¹ Ofcom (2021) paragraph 3.28

¹² Ofcom (2021) paragraph 3.29

¹³ Ofcom (2021) paragraph 3.30

¹⁴ Ofcom (2021) paragraphs 4.22, 4.24, 4.27

3 OFCOM'S PROPOSED FEE IS BASED ON UNPROVEN DEMAND FOR MORE NATIONAL BUSINESS RADIO LICENCES

This section presents arguments that Ofcom's provisional view of the appropriate ALF for the 412 MHz band is not consistent with Ofcom's objective of securing optimal (statically efficient) use of the spectrum. While we agree with Ofcom that business radio is an alternative user of the 412 MHz band, we consider that Ofcom has likely misjudged demand conditions for the 412 MHz band in the future.

In particular, we argue that:

- there is no evidence that there is currently excess demand for business radio spectrum at a national level;
- there is no evidence that there is likely to be excess demand for business radio spectrum at a national level in the future;
- Ofcom has not considered the emergence of competing technologies that will likely absorb some voice and machine-to-machine (M2M) derived demand for business radio in the future; and
- Ofcom has also not considered that the reallocation of adjacent spectrum will affect whether there is any excess demand for the 412 MHz band in the future.

Taken together, these points strongly suggest that Ofcom has misjudged demand conditions for the 412 MHz spectrum in the future.

3.1 Business radio is an alternative use for the 412 MHz band

Ofcom has concluded that the only possible alternative use of the 412 MHz band is business radio. Ofcom "do not consider that there are any technical reasons why, hypothetically, a Business Radio user would prefer a licence elsewhere in UHF 1 or 2 compared to in the 412 MHz band".¹⁵

We agree with Ofcom that business radio is an alternative use of the 412 MHz band. Ofcom notes in the consultation that it currently licences the 412 MHz band for business radio use offshore. Airwave also currently uses the 412 MHz band as part of the Airwave Network which is an implementation of business radio.

It is therefore consistent with the SRSP methodology that Ofcom assesses whether there is excess demand for the 412 MHz band for either its existing use or alternative uses (in this case business radio).

Ofcom considered whether LTE is another feasible alternative use of the 412 MHz band, but concluded that this was not the case.¹⁶ Geographical restrictions on the use of the 412 MHz band (and indeed the wider UHF 1 band) would prevent the

¹⁵ Ofcom (2021) paragraph 3.11

¹⁶ Ofcom (2021) paragraph 3.12

412 MHz band being used as part of a national LTE rollout. We agree with this conclusion.

3.2 Most business radio licences are for local use and there is no evidence of excess demand for national licences

A brief introduction to business radio

Ofcom offers three types of business radio licences:¹⁷

- **Light licences.** These are designed for when business radio is used in non-critical settings. They allow for mobile-to-mobile systems or systems with a base station covering a small area (less than 1 km²). Spectrum is shared among licensees and there is no technical coordination by Ofcom.
- **Technically assigned.** These licences are designed for systems which cover anywhere between a single site and an area of 30 km². The licence may use either shared or exclusive spectrum, and technical coordination is carried out by Ofcom.
- **Area defined.** These licences are the most flexible and offer exclusive use of spectrum across specific 50 km² grids. Some area assigned licences cover the entirety of the UK.

According to Ofcom, there are currently 43,518 business radio licences held by licensees.¹⁸ Around 120 to 130 of these licences (or less than 1%) are for area defined licences.¹⁹ This means that the majority of business radio licences are used for either on-site communication or local (up to 30km²) communications. Very few business radio licences are used to facilitate communication over a wider area.

Current demand conditions for business radio

It appears that Ofcom relies on the total number of licences as a measure of demand for UHF 1 and UHF 2 spectrum. We note, however, that the number of licences is a poor measure of demand as it does not take into account the amount of spectrum required by each licensee.

However, even if this imperfect measure is used, there appears to be a reduction in the total number of business radio licences since 2017-18,²⁰ indicating that total demand for business radio licences is declining.

Ofcom recognises that in the majority of the UK (geographically), business radio users seeking a localised licence can be accommodated using the existing UHF 1 and UHF 2 business radio bands.²¹ This includes business radio users seeking

¹⁷ Ofcom (2007) Business Radio Trading & Liberalisation https://www.ofcom.org.uk/_data/assets/pdf_file/0019/41347/brstatement.pdf

¹⁸ Ofcom (2021) paragraph 3.30 and footnote 21

¹⁹ Based on the number of UHF 1 and UHF 2 area defined licences in 2021 as per Ofcom (2021) Figure 2.

²⁰ Ofcom (2021) Figure 2

²¹ Ofcom (2021) paragraph 3.13. "Localised licence" is a term used by Ofcom, we interpret this to mean light or technically assigned licences.

exclusive assignments which are, by definition, the most supply constrained assignments. This means that in the majority of the UK (geographically), there is no evidence that there is currently excess demand for spectrum from business radio users.

There are, however, some areas of the country where the UHF 1 and UHF 2 business radio bands are congested. In these areas, which are typically large cities according to Ofcom, business radio licence applications are being rejected. This means that there is excess demand for spectrum from business radio users in these localities: the demand for licences exceeds the amount of licences that can be issued within the spectrum currently assigned to business radio.

Few business radio licences are national: there are currently twelve such licences assigned to five licensees.²² This equates to 0.07% of all technical and area defined business radio licences. Ofcom notes that, while it is currently unable to issue any additional national business radio licences, it has not refused any applications for a national business radio licence. Therefore, there is no evidence to suggest that there is currently excess demand for spectrum on a national basis for business radio users.

To summarise, the available evidence suggests that:

- in the majority of the UK (geographically) there is currently no excess demand for spectrum from local business radio users;
- there is currently no excess demand for spectrum from national business radio users; and
- the total number of business radio licences has declined since 2017-18.

However, in some areas of the UK there is currently excess demand for spectrum from local business radio users.

3.3 There is no evidence that localised congestion will translate into future congestion at the national level

Ofcom's provisional conclusion on excess demand is that there "*would be excess demand for this spectrum in some geographical areas, and that there may also be excess demand for this spectrum on a national basis in the future*".²³

The conclusion that there is excess demand for the 412 MHz band in some geographical areas follows from the observed congestion on bands currently assigned to business radio. Ofcom's view that there will be excess demand in the future on a national basis is based on the "increasing demand for Business Radio use that we have witnessed in recent years".²⁴

While there is evidence of an increase in demand for business radio in recent years, it is not clear how this would translate into future excess demand on a national basis.

²² Ofcom (2021) paragraph 3.18

²³ Ofcom (2021) paragraph 3.10

²⁴ Ofcom (2021) paragraph 3.18

There are 3,057 more technical and area defined business radio licences in 2021 compared to 2007. Fewer than 130 of these additional licences, or 4%, relate to area defined licences. It is unclear how many of these additional area defined licences are national. Nonetheless, it appears that the growth in demand for business radio licences is originating from localised applications rather than regional or national applications.

There is no evidence to suggest that business radio is increasingly being used for national applications (which would necessitate a national licence). The only remaining mechanism by which the observed recent increase in demand for business radio would translate into future excess demand on a national basis would be if:

- business radio is increasingly being used for localised applications in non-congested localities; and
- the increased use of business radio in non-congested localities is significant enough to cause congestion in these localities.

Ofcom has not provided any data in its consultation to suggest that the geographical distribution of local business radio licences is changing. As such, there is no evidence to suggest that business radio is increasingly being used in localities where typically there have been lower levels of demand. However, even if this were to be the case, there is no evidence that business radio will be used in these localities as intensively as it is in areas which are currently congested.

In the absence of any empirical evidence on the latter matter, intuitive reasoning suggests this is unlikely. The greatest demand for business radio licences is in highly populated areas (typically where there is congestion on business radio bands). This means that there is a relationship between population density and business radio demand in a locality. If demand for business radio in a given locality has historically been driven by population density, there is no reason to assume this relationship will fundamentally change going forward. In other words, there is no reason to assume that business radio demand in rural areas will, in the future, be comparable to current levels of business radio demand in urban areas.

To summarise, Ofcom's provisional conclusion is that there "may" be excess demand for 412 MHz band spectrum on a national basis in the future. However, for the reasons set out above, and based on consideration of the same factors as Ofcom, we believe that future excess demand for the 412 MHz band will be local in nature.

As discussed in the next two subsections, there are additional factors – not considered by Ofcom – which are also relevant when assessing whether there is likely to be excess demand for the 412 MHz band in the future. When these factors are taken into consideration, we consider that demand for spectrum from business radio might actually decrease, rather than increase, going forward.

3.4 Ofcom has not taken into account the fact that some use cases are migrating away from business radio to other technologies

In its analysis, Ofcom relies on historic demand for business radio licences and does not take into account forward-looking trends. For example, taxi companies, which have historically used business radio, are gradually being replaced by app-based taxi services, such as Uber and Bolt. These app-based services rely on mobile and VoIP connectivity rather than on business radio, leading to a reduction in demand for UHF 1 and UHF 2 spectrum.

Another technology used for voice communication is ‘Push To Talk over Cellular’ (known as PTTToC or POC), which allows devices connected to a cellular network to function as if they are on a radio network (i.e. voice messages can be relayed from one source to all receiving units simultaneously). PTTToC equipment can be viewed as a substitute for business radio based equipment. For example, in 2020, Transport for London (TfL) rolled out PTTToC to facilitate voice communication between its bus drivers and control room.²⁵ In the past TfL’s bus drivers carried mobile radios. In another example, when the Victoria Business Improvement District wanted to extend the radio network used by local businesses, it opted to replace its business radio network with a PTTToC solution.²⁶

Although business radio is primarily used for voice services, it is also used for machine-to-machine (M2M) data transmission. It is unclear whether demand for business radio spectrum derived from M2M applications will be maintained in the future due to competition from a range of existing and emerging technologies. The impact that these technologies will have on M2M derived demand for business radio spectrum has not been considered by Ofcom.

One of the emerging technologies is 5G, which has a number of advantages compared to previous cellular standards including offering higher bandwidth (i.e. faster data transfer speeds) and lower latency compared to existing cellular networks. As 5G networks can be configured to deliver low latency with a very high degree of reliability (known as ultra-reliable low-latency communication), these networks can be deployed for M2M communication in critical applications (such as utility networks). IMSI encryption and network slicing also enhance the security credentials of 5G networks.

For M2M applications which transfer a small amount of data at any given point in time, there is a wider range of emerging technologies. Low-power wide-area network (LPWAN) technologies are designed to facilitate M2M communication for devices with a low bit rate at a low cost and while consuming a low amount of energy. LPWAN technologies include cellular based technologies (such as LTE-M or NB-IoT) as well as technologies which utilise unlicensed spectrum (such as Sigfox and LoRA).

Smart meters also provide direct evidence of the substitutability of business radio and cellular technologies for M2M applications. Connectivity for smart meters in

²⁵ <https://www.tairadio.com/TfL#PTToC> [Accessed 22/06/2021]

²⁶ <https://www.audiolink.co.uk/2020/03/03/victoria/> [Accessed 22/06/2021]

Northern England and Scotland is provided by Arqiva (using radio technology), whereas Telefónica uses cellular technology to provide the same service in the rest of the UK.²⁷

In summary, there are multiple examples indicating that business radio users are switching to alternative technologies, including LTE, 5G and LPWAN networks. As consumers of M2M connectivity maintain and update their assets, there is an increasing likelihood that these technologies will play an even bigger role in absorbing some of the demand for business radio spectrum.

3.5 Ofcom has not considered whether adjacent spectrum will be released in the future

In assessing whether there will be excess demand for the 412 MHz band in the future, it is necessary to consider whether the availability of adjacent spectrum will change in the future. If the current users of adjacent spectrum cease to use the spectrum allocated to them, then that spectrum can be reassigned. This would further reduce the likelihood that there will be excess demand for the 412 MHz band.

There is a strong prospect that spectrum adjacent to the 412 MHz band will be released in the future. However, Ofcom has not considered this in setting the ALF for the 412 MHz band.

For example, the emergency services in the UK currently use the Airwave Network for voice communications. However, a cellular based alternative to the Airwave Network, known as the Emergency Services Network (ESN), is currently under development. The ESN will replace the Airwave Network.²⁸ The current expectation is that the emergency services will stop using the Airwave Network in 2024 or 2025.²⁹ When this happens, there may be an opportunity to release at least some of the spectrum currently used by the emergency services.

The emergency services currently use a significant amount of spectrum within the vicinity of the 412 MHz band:³⁰

- 380-385 MHz paired with 390-395 MHz is currently used by the Airwave Network;
- 410-412 MHz paired with 420-422 MHz is held by the Department of Health and is used to supplement the Airwave Network in London; and
- 7 MHz of non-contiguous spectrum is held within the UHF 2 band (450-470 MHz).

In total, 21 MHz of spectrum adjacent to the 412 MHz band is currently used by the emergency services. It is likely that a share of this spectrum will be released once the ESN replaces the Airwave Network. It is reasonable to assume that future

²⁷ <https://www.gov.uk/government/news/award-of-smart-meters-dcc-licence> [Accessed 23/06/2021]

²⁸ <https://www.gov.uk/government/publications/the-emergency-services-mobile-communications-programme/emergency-services-network> [Accessed 22/06/2021]

²⁹ <https://urgentcomm.com/2020/09/15/uk-public-safety-transition-from-tetra-to-lte-based-esn-targeted-for-2024-or-2025-home-office-officials-say/> [Accessed 22/06/2021]

³⁰ Aegis (2014) UHF 1 & 2 Future Demand: Final Report. https://www.ofcom.org.uk/data/assets/pdf_file/0022/51637/aegis-report.pdf

demand for spectrum derived from business radio could be served by some of this released spectrum.

3.6 Ofcom has incorrectly assessed demand conditions in the 400 MHz band

Our view is that Ofcom has incorrectly assessed demand conditions for the 412 MHz band.

Ofcom is right to identify that business radio is an alternative user of the 412 MHz band spectrum. However, Ofcom's provisional conclusion that there "*may ... be excess demand for this spectrum on a national basis in the future*"³¹ is flawed. As we have argued, there is (i) no evidence of excess demand for national business radio licences and (ii) no evidence to suggest that the observed levels of current excess demand for business radio spectrum in some localities will translate into excess demand on a national basis in the future.

Furthermore, we have highlighted that excess demand for spectrum from business radio is likely to be lower in the future due to the emergence of competing technologies (such as LTE, 5G, LPWAN networks and PTTtoC) and potential reassignment of adjacent spectrum currently dedicated to the emergency services (e.g. 380-385MHz, 410-412MHz, etc.).

As such, the opportunity cost of awarding a licence for the 412 MHz band to Arqiva and Airwave is not likely to be the forgone opportunity to award national business radio licences using this spectrum. This means that the value of the 412 MHz band spectrum is therefore not equivalent to a national business radio licence for 4 MHz of "high demand" business radio spectrum.

The next section presents further evidence that Ofcom has overvalued the 412 MHz band.

³¹ Ofcom (2021) paragraph 3.10

4 OFCOM HAS OVERSTATED THE VALUE OF THE 412 MHZ BAND

This section presents two sources of evidence that Ofcom has overstated the value of the 412 MHz band. First, we discuss what an appropriate ALF will be, based on the conclusions of Section 3. Based on the available evidence, it appears that excess demand for spectrum from business radio users is likely to be experienced in London and potentially in a few other metropolitan areas, such as Birmingham, Manchester and Glasgow. Based on this evidence, the ALF for 412 MHz spectrum should be set between £189,600 and £261,600 per annum.

Second, we discuss the value of the 412 MHz band spectrum implied by international benchmarks, which can be used as a cross-check. Based on the international benchmarks, we estimate a slightly lower figure of £156,244 per annum.

Both approaches suggest that Ofcom has significantly overstated the value of the 412 MHz band. Both approaches also result in ALFs which are similar to the annualised cost of the 412 MHz spectrum implied by the 2006 auction – £117,071 per annum per 2 x 2 MHz (in 2021 prices).³²

4.1 The AIP for the 412 MHz band should take into account local demand conditions

In Section 3 we argued that – taking into account the same factors as Ofcom – there is likely to be excess demand for spectrum from business radio in the future in some localities, but not at a national level.

As such, we consider that the opportunity cost of Arqiva’s and Airwave’s licences is that the 412 MHz band cannot be used to award “local” business radio licences in congested areas. This is distinct to Ofcom’s provisional view that the opportunity cost of Arqiva’s and Airwave’s licences is that the 412 MHz band spectrum cannot be used to award national business radio licences.

We propose that Ofcom sets a 412 MHz band ALF that is consistent with the observation that, in the future:

- In some areas – where there will be excess demand for spectrum on business radio bands – there is an opportunity cost of Arqiva’s and Airwave’s licences.
- In other areas – where there will not be excess demand for spectrum on business radio bands – there is no opportunity cost associated with Arqiva’s and Airwave’s licences.

In practice, we propose that Ofcom:

1. Identifies localities where there is congestion on business radio bands, and the fee for an area defined business radio licence for these localities.

³² Assuming an annualization rate of 5.75% - this is the rate used by Ofcom in its consultation – Ofcom (2021) footnote 24

2. Sets the 412 MHz band ALF equal to the sum of these area defined business radio licence fees.

In Section 3, we also argued that the emergence of competing technologies and the likely reassignment of adjacent spectrum further reduced the prospect that there will be excess demand for spectrum from business radio users in the future. By considering these factors, Ofcom may conclude that there will be fewer localities where excess demand for spectrum from business radio will materialise in future.

The following illustrative example demonstrates the approach we believe Ofcom should follow.

Illustrative example of proposed ALF

Under our approach, we propose that Ofcom identifies the areas where there is likely to be congestion on business radio bands in the future. In practice, this means identifying the “trading units”³³ where there will be excess demand for area defined business radio licences. This could be done by observing and extrapolating demand for business radio spectrum in each “trading unit” relative to the projected availability of spectrum (Figure 1). Ofcom would need to determine over what period of time it is appropriate to assess future demand conditions – we note that it has not explicitly made such a decision in its consultation.

In this example, we consider two scenarios:

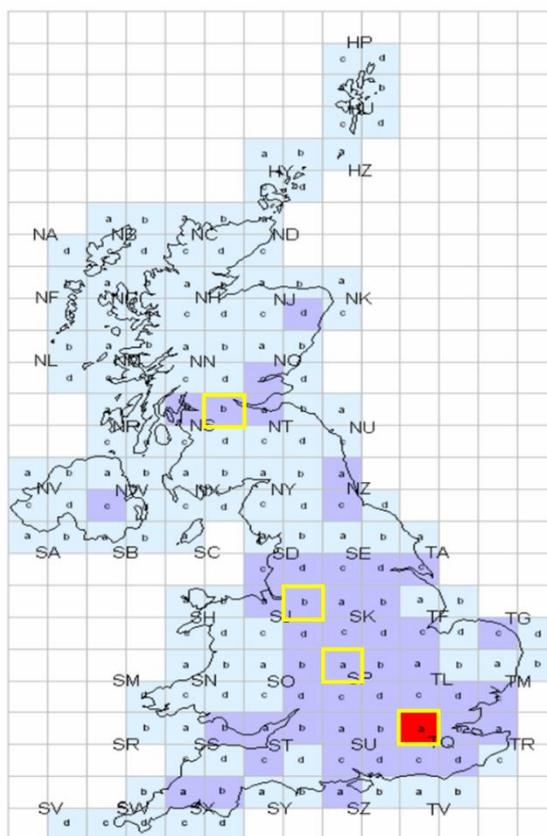
- Scenario 1 – we assume that there is excess demand for business radio licences in London; or
- Scenario 2 – we assume that, in addition to London, there will be excess demand for business radio licences in the “trading units” corresponding to Birmingham, Glasgow and Manchester. These are highly populated, urban areas where business radio congestion could occur.³⁴ We note, however, that the evidence of congestion in these areas is not recent and it is possible that some of the excess demand observed there previously has now moved to other technologies/ other spectrum bands.

Figure 1 shows the trading units in the UK for the purpose of area defined business radio licences. The trading units with a yellow border and those which we have identified as experiencing excess demand in the future.

³³ Trading units are subdivisions of geographical coverage, based on Ordnance Survey national grid.

³⁴ Aegis (2014) footnote 30 reports of anecdotal evidence of congestion in specific areas of Manchester and Birmingham. The report also suggests Glasgow is at risk of congestion in the future. It is also established that there is congestion on business radio bands in London.

Figure 1 Trading units with excess demand in illustrative example



Source: Frontier Economics

Figure 2 calculates the annual fee for an area defined business radio licence in the UHF 1 band that covers the trading units we suggest may experience excess demand in the future. Based on our assumptions above, the ALF for the 412 MHz band should be:

- £189,600 (or £1,185 per 2x12.5 kHz channel) in Scenario 1; and
- £261,600 (or £1,635 per 2x12.5 kHz per channel) in Scenario 2.

Figure 2 412 MHz ALF (per 2 x 12.5 kHz channel) in illustrative example

Trading area	Annual licence fee (£) for 2 x 12.5 kHz channel	Annual licence fee (£) for 2 x 2 MHz channel	Number of areas	Total fee (£)
High population (London)	1,185	189,600	1	189,600
Med population ³⁵	150	24,000	3	72,000
Low population	14	2,240	0	0
Total ALF				£189,600 - £261,600

Source: Frontier Economics

³⁵ Birmingham, Glasgow, Manchester

The calculations above are illustrative and are intended to illustrate the principle of setting the ALF using information about local demand conditions rather than to estimate the actual fee. Given the lack of detailed information on local demand for business radio, we are unable to estimate the ALF precisely. If, based on the information available to Ofcom on recent and forward-looking trends, it is apparent that some of the areas included in the example are not expected to have excess demand, these areas should be excluded.

4.2 Following Ofcom's 900 MHz and 1800 MHz ALF methodology also results in a lower ALF

In setting an ALF for the 412 MHz band, Ofcom could also follow the same methodology it used to set ALFs for 900 MHz and 1800 MHz spectrum in the recent past.

When setting ALFs for 900 MHz and 1800 MHz spectrum in December 2018, Ofcom relied on international benchmarks to assess the price of 900 MHz spectrum relative to 800 MHz spectrum in other jurisdictions.³⁶ The ALF set by Ofcom for the 900 MHz spectrum was based on an adjustment to the price of 800 MHz spectrum in the UK,³⁷ informed by international benchmarks.

Ofcom is able to adopt a similar approach to determine the ALF for the 412 MHz band. Specifically, an ALF for the 412 MHz band can be determined from international 450 MHz band price data.

450 MHz spectrum has recently been auctioned in several European countries: Denmark, Germany, Norway and Sweden. We propose to compare the prices paid for the 450 MHz spectrum with prices paid for 700 MHz spectrum in Norway and Sweden.³⁸ We have chosen to calculate 450 MHz prices relative to 700 MHz prices as the 700 MHz band has relatively similar propagation characteristics to the 450 MHz band, and an auction for 700 MHz spectrum has recently (April 2021) concluded in the UK.

In our calculations, we followed the methodology used by Ofcom in setting the ALFs for 900 MHz and 1800 MHz spectrum. First, we calculate the ratio of the 450 MHz spectrum price to the 700 MHz spectrum price (appropriately adjusted to take into account the licences' duration, the timing of the auctions, and the amount of spectrum sold).³⁹ This ratio can then be applied to the price of 700 MHz spectrum in the UK in order to calculate the value of 450 MHz spectrum.

³⁶ Ofcom (2018) Annual Licence Fees for 900 MHz and 1800 MHz frequency bands https://www.ofcom.org.uk/data/assets/pdf_file/0020/130547/Statement-Annual-licence-fees-900-MHz-and-1800-MHz.pdf

³⁷ Similarly, the ALF set for the 1800 MHz spectrum was based on an adjustment to the prices of 800 MHz and 2600 MHz spectrum in the UK.

³⁸ The Danish benchmark might not be considered informative given that the spectrum was sold at the reserve price, which was very low – the price of 700 MHz spectrum in Denmark is 1,500 times the price of 450 MHz spectrum. The German benchmark is not informative either, given that (i) the allocation was a beauty contest rather than an auction and (ii) the allocation process effectively guaranteed exclusive rights to provide a number of critical infrastructure applications. This is not comparable to the situation in the UK as Arqiva (as a smart meter connectivity provider) faces competition from other providers.

³⁹ More details on the methodology used are presented in Annex A.

Our comparisons indicate that 450 MHz spectrum is 19 to 22 times less expensive than 700 MHz spectrum (as shown in Figure 3).

Figure 3 Annualised price and relative price of 450 MHz and 700 MHz spectrum

Country	1 MHz of 450 MHz, 20 year licence (A)	1 MHz of 700 MHz, 20 year licence (B)	Relative price (C) = (B) / (A)
Norway	1.0m NOK	22.0m NOK	22.0
Sweden	7.3m SEK	141.3m SEK	19.2
Average			20.6

Source: Frontier Economics

The price of 700 MHz spectrum in the UK is £280m per 2 x 10 MHz for a 20 year licence.⁴⁰ Using the average relative price in Figure 3, the equivalent price of 450 MHz spectrum in the UK would be £13.6m per 2 x 10 MHz for a 20 year licence. When adjusted for the size of the 412 MHz band, the implied price of the band is £2.7m per 2 x 2 MHz for a 20 year licence (or £156,244 per annum using an annualisation rate of 5.75%).⁴¹

The ALF implied by these international benchmarks is £156,244 per annum, which is around 10% of the ALF proposed by Ofcom.

When using international benchmarks, contextual matters should be taken into account. For example, it is appropriate to consider the technologies that have been used in a spectrum band internationally, and the technologies that can be used in the spectrum band domestically. If a profitable technology – such as IoT-LTE – has been used in a spectrum band internationally, but that technology cannot be used domestically, this implies that international benchmarks could potentially overstate the value of the spectrum domestically.

We further observe that in Norway and Sweden 450MHz can be used to deploy IoT-LTE. However, we understand that there are constraints on the use of UHF 1 spectrum in the UK, which do not allow the spectrum to be used for LTE (due to geographical restrictions on usage).⁴² It may be appropriate to revise the Norway, Sweden, or any additional benchmarks in light of considerations above.

4.3 In conclusion, Ofcom has overvalued the 412 MHz band

This section provides two independent pieces of evidence to suggest that Ofcom has overstated the value of the 412 MHz band spectrum. First, we provide an illustrative example showing that the ALF should be much lower if the future excess demand for the 412 MHz band is expected to be localised in nature, rather than national. Based on the available evidence, it appears that excess demand for business radio spectrum is likely to be experienced in London and potentially, in a

⁴⁰ Ofcom (2021) Award of the 700 MHz and 3.6-3.8 GHz spectrum bands – Notice under regulation 121 of the Wireless Telegraphy (Licence Award) Regulations 2020 (“the Regulations”) https://www.ofcom.org.uk/data/assets/pdf_file/0028/217954/notice-reg-121.pdf

⁴¹ See Annex A for more details

⁴² Ofcom (2021) paragraph 3.12

few other metropolitan areas, such as Birmingham, Manchester and Glasgow. Based on this evidence, the ALF for 412 MHz spectrum should be set between £189,600 and £261,600 per annum.

We also show that international benchmarks imply that the value of 450 MHz spectrum is c. £156,000 per annum, which is significantly lower than the provisional ALF proposed by Ofcom.

Both approaches suggest that Ofcom has significantly overstated the value of 412 MHz spectrum.

5 OFCOM HAS NOT PROPERLY CONSIDERED THE RISK OF SETTING THE ALF TOO HIGH

This section argues that Ofcom has not properly considered the risk of setting the ALF too high.

The first subsection details how Ofcom has not properly assessed the risk that it has misjudged the nature and extent of the excess demand for the 412 MHz band. The second subsection provides justifications for introducing a glidepath.

5.1 Ofcom's proposed ALF is likely to overstate the value of the spectrum, which could lead to unintended consequences

As set out in Subsection 2.2, Ofcom has set itself a number of principles which it should follow when setting ALFs. AIP principle 8 states that Ofcom must take account of uncertainty. Specifically, when there is “*uncertainty in our estimate of opportunity cost, for example arising from uncertainty in the likelihood of demand for feasible alternative uses appearing, we will consider the risks from setting fees too high*”.⁴³ Our view is that Ofcom has not properly adhered to this principle.

Ofcom's provisional view is that there *may* be excess demand at the national level for the 412 MHz band spectrum in the future. Based on this position, Ofcom provisionally determines that the appropriate ALF for the 412 MHz band is equivalent to the annual fee for a nationwide business radio licence in the UHF 1 or UHF 2 band.

There is uncertainty in the value of this spectrum to business radio users. Ofcom considers whether the value of the spectrum to business radio users is less than business radio licence fees.⁴⁴ Ofcom determines that this is not the case; however, if it were the case, then the 412 MHz band spectrum would potentially go unused with the ALF set at the proposed level – Ofcom recognises this risk.

Therefore, Ofcom has assessed the risk of uncertainty in the value of the 412 MHz band. But this risk assessment is conditional on its assumption about the nature and extent of the excess demand for the 412 MHz band spectrum in the future.

Ofcom has not considered the risk that its provisional view on the nature and extent of excess demand in the future is incorrect. The uncertainty associated with this provisional view is clear: Ofcom writes that there “*may*” be excess demand at the national level, not that there “*will*” be excess demand. Ofcom should assess the risk that it has misjudged demand conditions – this is explicitly mentioned in AIP principle 8.

If, as we believe, future excess demand for the 412 MHz band will be local in nature, rather than national, then the proposed ALF overstates the value of 412

⁴³ Ofcom (2010) page 4

⁴⁴ Ofcom (2021) paragraphs 3.29 – 3.30

MHz spectrum. This is illustrated in Section 4 above. This, in turn, would mean that Ofcom has not set a conservative ALF despite Ofcom's stated preference for setting ALFs based on a conservative approach.⁴⁵

In general, the risk with setting the ALF too high is that spectrum will be left unutilised, while the risk of setting the ALF too low is that fewer efficiency-improving reallocations of spectrum would occur. Ofcom considers that the former risk is greater than the latter.⁴⁶ We consider the specific risks in relation to the ALF for the 412 MHz band in more detail:

- If the ALF is set too low and Arqiva places the highest value on the 412 MHz band spectrum, then there are no efficiency issues. The 412 MHz band would be used optimally.
- If the ALF is set too low and Arqiva does not place the highest value on the 412 MHz band spectrum, then there is an inefficiency issue. However, Arqiva would have the incentive to sell or lease the spectrum to users who value the spectrum more highly. Arqiva has demonstrated a willingness to do this in the past: it traded its licence for a co-licence with Airwave, and it leases part of its spectrum to Telent in some parts of the country.
- If, on the other hand, the ALF is set too high (i.e. above the market value of the spectrum), then Arqiva will be forced to return the spectrum and it will remain unutilised.

In addition, there is a risk of undermining competition in the downstream market if Ofcom overstates the value of 412 MHz spectrum. We note that Arqiva operates in a competitive environment, where it competes with other connectivity providers. For example, in the market for smart metering, Arqiva won one regional contract, while Telefónica won the other two.⁴⁷ Arqiva also competes against Vodafone in the provision of water meters.⁴⁸

Therefore, Arqiva operates in a competitive environment, with competitors who have different cost structures (some use unlicensed spectrum and others use cellular spectrum). This means that Arqiva would not be able to pass on cost increases to its customers, given that Arqiva does not have market power and other competitors are not affected by the introduction of the 412 MHz band ALF. By overstating the value of 412 MHz spectrum and setting the ALF too high, Ofcom is likely to undermine competition in the downstream markets in which Arqiva operates.

We further observe that some of the use cases provided by Arqiva involve positive externalities. For example, Arqiva's spectrum provides connectivity to hospitals and smart water meters. In the case of smart water meters, recent analysis has found that by rolling out one million such meters per year for 15 years, the UK's greenhouse gas emissions could be reduced by 0.5% and one billion litres of water

⁴⁵ Ofcom (2021) paragraph 3.28: "Given our statutory duty to promote the optimal use of spectrum, we therefore propose to take a conservative approach to interpreting the evidence on market price/opportunity cost of spectrum."

⁴⁶ Ofcom (2021) paragraph 3.28

⁴⁷ <https://www.gov.uk/government/news/award-of-smart-meters-dcc-licence> [Accessed 23/06/2021]

⁴⁸ <https://www.waterbriefing.org/home/technology-focus/item/16027-south-east-water-trials-iot-digital-water-meter-trial-with-vodafone-uk> [Accessed 23/06/2021]

could be saved per day.⁴⁹ If ALF is set too high, there is a risk that these positive externalities will be forgone.

It is therefore imperative that Ofcom considers the risk that it has misjudged future demand conditions for the 412 MHz band spectrum. Above we argued that Ofcom’s provisional view overstates the nature of future demand for the 412 MHz band and overstates the value of the spectrum. This would imply a material risk that the 412 MHz band will go unused. It would also risk undermining competition in the downstream market in which Arqiva operates.

Overall, Ofcom has failed to assess the risk of its provisional ALF overstating the opportunity cost of the spectrum and the spectrum being left unutilised.

5.2 Ofcom’s proposal not to introduce a glidepath is not justified

Without prejudice to the arguments raised in the preceding sections, if Ofcom were to implement its proposed ALF, which is materially different from the price paid by Arqiva previously, then it must introduce a glidepath.

This subsection recaps Ofcom’s rationale for not proposing to gradually phase in the ALF. The logic of this rationale is then challenged in the subsequent subsection, before the final subsection explains why a glidepath is necessary.

5.2.1 Ofcom considers that Arqiva should have anticipated its proposals

In the consultation, Ofcom sets out its provisional view that it should not introduce a glidepath for the ALF.⁵⁰ Ofcom’s view is based on the consideration of two factors.

First, Ofcom notes that its original award statement for the spectrum stated that “*after the expiry of the minimum period, if the licensee continues to hold the licence, there may be additional charges in line with Ofcom’s policy on spectrum pricing at that time.*”⁵¹ Ofcom considers that this means Arqiva and Airwave have had a “long notice period” that an ALF will be payable from October 2021.

Secondly, Ofcom argues that Arqiva and Airwave “*should have reasonably expected that the fees for their 412 MHz spectrum would be set at or around the proposed level.*” Ofcom justifies this position by pointing out that the proposed ALF is the same as its fees for national UHF 1 and UHF 2 business radio licences, which use spectrum in adjacent bands.

⁴⁹ Waterwise and Arqiva (2021) Smart water metering and the climate emergency *in* Climate Change Committee (2021) Progress in adapting to climate change: 2021 Report to Parliament, page 155. <https://www.theccc.org.uk/wp-content/uploads/2021/06/Progress-in-adapting-to-climate-change-2021-Report-to-Parliament.pdf>

⁵⁰ Ofcom (2021) paragraph 4.31

⁵¹ Ofcom (2006b) Award of available spectrum: 412-414 MHz paired with 422-424 MHz, paragraph 5.1 https://www.ofcom.org.uk/data/assets/pdf_file/0031/49819/statement.pdf

5.2.2 Ofcom fails to recognise that Arqiva could not have anticipated Ofcom's approach to setting the ALF

We disagree with Ofcom that the approach taken to set, and the ultimate proposed level of, the ALF could have been anticipated.

In terms of the approach to setting the ALF, it was reasonable for Arqiva to expect that Ofcom would follow a similar approach to the one adopted for setting 900 MHz and 1800 MHz ALF. As discussed in Subsection 4.2, it is possible to apply this approach when setting the ALF for Arqiva's spectrum. Using this approach produces a significantly lower ALF - c. £156,000 per annum.

Applying Ofcom's current approach appropriately also produces a lower ALF. As discussed in Section 3, we consider that the opportunity cost of Arqiva and Airwave's licences is the forgone opportunity to issue additional "localised" business radio licences in congested areas, rather than the forgone opportunity to issue additional national business radio licences. This approach also results in a significantly lower ALF - £189,600 - £261,600 per annum. Following the discussion in Section 3, it was reasonable for Arqiva to expect that Ofcom would consider that excess demand for business radio licences in the future would be localised, rather than national, in nature.

Furthermore, given Ofcom's stated preference for setting ALFs on a conservative basis,⁵² Arqiva would reasonably have expected Ofcom to assess future demand conditions in a manner consistent with this preference. As discussed in Subsection 5.1, we do not believe that Ofcom has appropriately assessed the uncertainty inherent in the assessment of future demand conditions for the 412 MHz band. As such, the ALF proposal cannot be considered conservative.

Both estimates presented in Section 4 rely on Ofcom's own methodology, but are significantly lower than Ofcom's provisional ALF.

5.2.3 A glidepath is need to allow Arqiva to adjust to the new level of ALF. This would be consistent with approaches taken in other similar cases

Arqiva has made significant investments in its own infrastructure so that it can provide connectivity for smart meters and water meters (since 2013). These investments include long-lived assets which are not easily reprogrammable. Arqiva has entered into long-term contractual relationships with its customers – the DCC in the case of smart meters, and various water companies in the case of water meters.

As explained above, Arqiva could not have anticipated the level of ALF proposed by Ofcom and therefore could not possibly account for it in its long-term contracts. It is a reasonable expectation that any significant changes in spectrum prices would be communicated to the licensees in advance, well before the new price is introduced and/or that there is a glidepath.

⁵² See Subsection 5.1

For example:

- In the ALF 900MHz and 1800MHz statement in 2015, Ofcom stated, “we have decided that the revised ALFs should be phased-in in two steps with one half of the increase coming into effect on the common effective date (CED), and the second half of the increase becoming effective exactly one year following the CED”⁵³. It is worth noting that this statement was published two years after the first ALF consultation, which means that mobile operators had 2 years to adjust to the new level of ALF.
- The increase in the AIP-based fees for the aeronautical sector was phased in over a 5 year period.⁵⁴
- The increase in the AIP-based fees for satellite earth stations was phased in over a 2 year period.⁵⁵

We consider that a phasing in period is also appropriate in this case. This is in order to ensure that innovation is not stifled towards the end of the licensing period. Indeed, if there is significant uncertainty around future ALFs and there is no glidepath/ no phasing in period, licensees may be reluctant to enter into new long-term contracts until there is more clarity on the ALF going forward.

In light of this risk and the precedents above, we recommend that Ofcom should implement a glidepath.

⁵³ Ofcom (2015) Annual licence fees for 900 MHz and 1800 MHz spectrum: Provisional decision and further consultation
https://www.ofcom.org.uk/data/assets/pdf_file/0022/83146/annual-licence-fees-900MHz-1800-further-consultation.pdf

⁵⁴ Ofcom (2011) Bespoke licence fees for aeronautical VHF communications frequencies: A Statement
https://www.ofcom.org.uk/data/assets/pdf_file/0021/71913/8197_statement.pdf

⁵⁵ Ofcom (2009) Satellite Spectrum Pricing: Decision to make the Wireless Telegraphy (Licence Charges) (Amendment) Regulations 2009
https://www.ofcom.org.uk/data/assets/pdf_file/0025/49921/statement.pdf

6 CONCLUSION

Ofcom has a duty to ensure that spectrum is used optimally, and has an established policy of using opportunity cost based spectrum pricing as a tool to meet this objective. We agree with Ofcom's intention of setting an ALF for the 412 MHz band which reflects the value of the spectrum to alternative users who are denied access to it.

However, we disagree with Ofcom's application of this pricing methodology. Specifically, we consider that Ofcom's assessment of future demand conditions for the 412 MHz band is misguided.

Ofcom considers that, in the future, there will be excess demand for business radio spectrum at a national level, and thus concludes that the opportunity cost of awarding the 412 MHz band licence to Arqiva is the forgone opportunity to award further national business radio licences. We argue that, in the future, there will be excess demand for business radio spectrum in some localities only. This would mean that the opportunity cost of the 412 MHz band is the forgone opportunity to award additional local business radio licences in some areas, and non-existent in areas where there will not be congestion on existing business radio spectrum. As such, by overstating demand conditions for the 412 MHz band in the future, Ofcom has overstated the opportunity cost of the band and the appropriate level of the ALF.

We also believe that Ofcom should consider: 1) the likely negative impact of alternative technologies, such as LTE, 5G, LPWAN and PTTtoC, on demand for business radio spectrum in future; and 2) the significant likelihood that some adjacent spectrum may become available, after the re-allocation of spectrum currently used by the emergency services. Both factors will reduce the likelihood that there will be excess demand in the future for the 412 MHz band.

In our view, by misjudging demand conditions for the 412 MHz band, Ofcom has overstated the value of the 412 MHz band. Based on the available evidence, it appears that excess demand for spectrum from business radio users is likely to be experienced in London and potentially, in a few other metropolitan areas, such as Birmingham, Manchester and Glasgow. Based on this evidence, the ALF for 412 MHz spectrum should be set between £189,600 and £261,600 per annum.

Furthermore, international benchmarking also implies a lower ALF for the band. We apply a methodology similar to the one used by Ofcom to set ALF for 900 MHz and 1800 MHz spectrum. More specifically, we assess the relative prices of 450 MHz and 700 MHz spectrum in other European countries which have held spectrum auctions for both bands. By calculating this relative price and applying it to the price of 700 MHz spectrum in the UK, the implied value of the 412 MHz band is estimated to be c. £156,000 per annum – considerably less than the proposed ALF.

We also highlight that Ofcom has not properly assessed the risk of setting the ALF too high. This is despite Ofcom's stated preference for setting conservative ALFs. If, as we argue above, Ofcom has overstated the value of 412 MHz spectrum, there is the risk that the spectrum will be returned and left unutilised, which will be inefficient. We also note that some of the use cases provided by Arqiva involve

positive externalities (e.g. installing smart electricity, gas and water meters reduces greenhouse gas emissions and leads to significant water savings). If the ALF is set too high and the spectrum is left unutilised, there is a risk that these positive externalities will be forgone.

Furthermore, if the ALF is set too high, it would undermine competition in the downstream market for smart meter and water meter connectivity, in which Arqiva operates.

Finally we argue, without prejudice to our preceding arguments, that if Ofcom were to introduce its proposed ALF, then it must also implement a glidepath. We do not share Ofcom's assessment that Arqiva should have reasonably expected the level of Ofcom's proposed ALF, and further argue that a glidepath is necessary to ensure that innovation is not stifled towards the end of the licence period.

ANNEX A INTERNATIONAL BENCHMARKS

This Annex describes the data used for the international benchmark analysis. We follow, at a high level, the approach used by Ofcom in its 900 MHz and 1800 MHz ALF consultation.⁵⁶ Namely, we convert international spectrum awards into the lump sum value for a 20 year licence.

Norway

Norway auctioned three lots of 20 year licences for 2 x 10 MHz spectrum in the 700 MHz band in 2019:

- Telenor paid 180 million NOK for one 2 x 10 MHz block;⁵⁷
- Telia paid 217.8 million NOK for another 2 x 10 MHz block;⁵⁸ and
- Ice Group paid 262 million NOK for the third 2 x 10 MHz block.⁵⁹

As such, the average price for 2 x 10 MHz blocks of 700 MHz spectrum was 200 million NOK, or 22 million NOK for a 2 x 1 MHz block in the 700 MHz band.

Norway also auctioned a single 20 year licence for 2 x 5 MHz spectrum in the 450 MHz band in 2019. Ice group paid 5 million NOK for this licence.⁶⁰ This is equivalent to 1 million NOK for a 2 x 1 MHz block in the 450 MHz band.

It therefore follows that the price of 2 x 1 MHz of 700 MHz spectrum is 22 times the price of 2 x 1 MHz of 450 MHz spectrum.

Sweden

Sweden auctioned spectrum in the 700 MHz band in 2018 with a 20 year licence:

- Ne4Mobility paid 1,442 million SEK in total for two 2 x 5 MHz blocks,⁶¹ and
- Telia paid 1,383 million SEK for a 10 x 5 MHz block.⁶²

As such, the average price for 2 x 10 MHz blocks of 700 MHz spectrum is 1,413 million SEK, or 141 million SEK for a 2 x 1 MHz block in the 700 MHz band.

Also in 2018, a 25 year licence for a 2 x 5 MHz spectrum in the 450 MHz band was awarded to Net1 for 40.2 million SEK.⁶³ We convert this licence into a 20 year licence using a licence duration factor calculated according to the following formula:

⁵⁶ Ofcom (2015) Annual licence fees for 900 MHz and 1800 MHz spectrum (Annexes 1 – 7), Annex 7. https://www.ofcom.org.uk/data/assets/pdf_file/0031/79636/annual-licence-fees-annexes_1-7.pdf

⁵⁷ <https://5gobservatory.eu/nkom-announces-results-of-700mhz-2100mhz-spectrum-auction-in-norway/> [Accessed 29/06/2021]

⁵⁸ <https://5gobservatory.eu/nkom-announces-results-of-700mhz-2100mhz-spectrum-auction-in-norway/> [Accessed 29/06/2021]

⁵⁹ Ice Group (2019) Annual Report 2019, page 3 “Operations”.

<https://icegroup.com/assets/annual-reports/Ice-Group-Scandinavia-Holdings-AS-Annual-Report-FY2019.pdf>

⁶⁰ Ice Group (2019) Annual Report 2019, page 3 “Operations”.

<https://icegroup.com/assets/annual-reports/Ice-Group-Scandinavia-Holdings-AS-Annual-Report-FY2019.pdf>

⁶¹ <https://5gobservatory.eu/700-mhz-auction-results-in-sweden/> [Accessed 29/06/2021]

⁶² Ibid.

⁶³ <https://450alliance.org/net1-sweden-plans-m2m-expansion-beating-telia-450-mhz-licence-auction/> [Accessed 29/06/2021]

$$\sum_{t=0}^{19} \left(\frac{1}{1+WACC} \right)^t / \sum_{t=0}^{24} \left(\frac{1}{1+WACC} \right)^t$$

where $WACC$ is the post-tax real WACC, which is assumed to be 7.5%⁶⁴. The implied licence duration factor is 0.915. As such, the price of a 20 year licence for 2 x 5 MHz of 450 MHz spectrum is 36.74 million SEK, or 7.35 million SEK for 2 x 1 MHz blocks in the 450 MHz band.

It therefore follows that the price of 2 x 1 MHz of 700 MHz spectrum is 19.2 times the price of 2 x 1 MHz of 450 MHz spectrum.

⁶⁴ Ofcom (2015) Annual licence fees for 900 MHz and 1800 MHz spectrum (Annexes 1 – 7), Annex 7. https://www.ofcom.org.uk/data/assets/pdf_file/0031/79636/annual-licence-fees-annexes_1-7.pdf

