

# Annual licence fees - you cannot have your cake and eat it

A report for EE

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## Executive Summary

Ofcom are proposing the introduction of Annual Licence Fees (ALF) for spectrum at 900 MHz and 1800 MHz following a Direction from Government to set fees at full market value.

Ofcom state in their October 2013 consultation that their proposals are consistent with their statutory duties. The proposed ALF and the current annual fees for 900 MHz and 1800 MHz based on Administered Incentive Pricing (AIP) are shown in Table 1.

**Table 1: Ofcom's proposed ALF and current AIP fees for 2x1 MHz of spectrum**

Fee	900 MHz	1800 MHz
AIP in 2012/13	712,800	554,400
Proposed ALF	3,980,000	2,380,000
Increase	5.6 fold	4.3 fold

Ofcom argue that ALF is necessary to promote spectrum efficiency but their own assessment of the impact of the proposed ALF indicate there is little or no impact on services to consumers, competition, investment, innovation and spectrum trading. These arguments do not seem internally consistent.

We analyse Ofcom's arguments alongside other evidence and reach the opposite conclusion, namely that ALF would not promote (and may actually harm) spectrum efficiency and would likely reduce investment and/or raise prices. Therefore the proposed ALF would involve harm rather than benefits. Our reasoning is as follows:

- ALF is unnecessary to promote efficient use of spectrum since operators face a constant trade-off between efficient use of spectrum, capital expenditure and acquisition of new spectrum i.e. they face the market value of spectrum holdings without ALF.
- Ofcom put considerable weight on the claimed inefficiency of trading as justification for the proposed ALF. However, trading is likely to be of secondary importance to forthcoming auctions in achieving the efficient re-allocation of spectrum over time. Incentives for the efficient use of existing spectrum holdings are strong given the need to meet data growth. Therefore, there is no justification for a high level of ALF based on the assumed trading inefficiency. We also disagree with Ofcom's assumption that trading would not be efficient.
- ALF may harm efficient spectrum use by discouraging otherwise efficient trading, a point made by Ofcom Chief Executive Ed Richards in response to a question from the Culture, Media and Sport Commons Select Committee in relation to fees: *"Well, you made too much money out of that so we have to somehow claw it back. I think that would remove all incentive, in certain circumstances, to trade."*<sup>1</sup>
- ALF would raise network operators' costs in cash terms and would therefore reduce investment, raise prices or reduce returns. We conclude that a mix of these outcomes is likely, and that this would harm consumers to the extent that prices rise and/or investment is reduced.

<sup>1</sup> Commons Select Committees; Culture, Media and Sport. "Mobile network operators and their spectrum use." Paragraph 32. <http://www.publications.parliament.uk/pa/cm201012/cmselect/cmcmcomeds/1258/125806.htm#note28>

Ofcom's statements in relation to ALF may also raise expropriation risk in relation to sunk investment, thereby discouraging investment and innovation. Ofcom acknowledge this risk, yet argue that the risk of setting ALF at such a high level that it would trigger inefficient spectrum return is low because of sunk investment: *"...to the extent that there is some value associated with sunk investment in the existing licences, the point at which ALF would trigger a return of spectrum should be that much higher still."*<sup>2</sup>

However, in a separate consultation on fixed access price controls in August 2013, Ofcom argue that the circumstances they describe in relation to ALF would constitute expropriation and harm investment: *"If investors believed that their costs, once sunk, would be regarded by the regulator as irrelevant for pricing purposes, they would be reluctant to invest in assets which could be regarded as sunk once the investment had been made."*<sup>3</sup>

Ofcom should seek to reduce expectations of expropriation risk by setting ALF conservatively.

In relation to the interpretation of benchmarks in setting ALF we note that the market value of spectrum can only be estimated approximately at a given point in time and will constantly adjust in response to changes in the expected supply and demand for spectrum. Spectrum value is both uncertain and volatile. Demand and supply side developments and uncertainty should be taken into account in setting ALF, in particular:

- On the demand side scenarios utilised in modelling for Ofcom by Real Wireless differ by over an order of magnitude out to 2030. Demand side uncertainty is therefore substantial, implying that value is uncertain. ALF should therefore be set conservatively given that ALF involves costs in terms of investment and/or prices without offsetting benefits in terms of spectrum efficiency.
- On the supply side there have been regulatory statements and decisions regarding a number of potential future bands for mobile broadband since the 4G auction in February 2013. These have increased the anticipated likelihood and/or brought forward the anticipated timing of future spectrum release. These developments not only increase expected supply, but may also make different spectrum bands more fungible. The market value for spectrum for capacity may therefore have fallen relative to values in the Ofcom 4G auction.

In relation to impact assessment we conclude that Ofcom's consultation, by any reasonable standard including previous Ofcom assessments of much less material changes in spectrum charges, does not constitute a complete impact assessment. Impacts of the proposed ALF are not assessed relative to the current situation and the assessment is qualitative and partial. Ofcom's conclusions that there is little or no impact on consumers, competition, investment, innovation and spectrum trading also appear to contradict their argument that ALF is necessary for efficient spectrum use.

In conclusion, Ofcom's proposals in relation to ALF appear disproportionate and would in our view harm spectrum efficiency, industry and consumers. A study of the impact and costs and benefits associated with the proposed ALF should be undertaken. The decision on the levels of ALF should be evidence based and in full accordance with the purpose of the Government Direction.

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<sup>2</sup> Ofcom. "Annual licence fees for 900 MHz and 1800 MHz spectrum," October 2013. Para A9.4.

<sup>3</sup> Ofcom. "Fixed access market reviews: Approach to setting LLU and WLR Charge Controls," August 2013. Para 3.21. [http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/summary/LLU\\_WLR\\_CC\\_2014.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/summary/LLU_WLR_CC_2014.pdf)

## 1 The rationale for ALF has changed over time and has arguably fallen away

In December 2010, the Government issued a Direction<sup>4</sup> which, in addition to liberalising the use of 900 MHz and 1800 MHz spectrum, requires Ofcom to revise annual licence fees (ALF) to reflect full market value. The Direction includes the following objectives:

*“The Secretary of State gives these directions for the purposes of: ensuring the release of additional electromagnetic spectrum for use by providers of next generation wireless mobile broadband; allowing early deployment and maximising the coverage of those services; creating greater investment certainty for operators; and implementing Directive 2009/114/EC(b) and the Decision(c) on the liberalisation of frequencies in the 900MHz and 1800MHz bands.”*

Ofcom also have a range of statutory duties and operate according to regulatory principles that are relevant to the assessment of ALF. Ofcom state in their consultation document that they consider that their proposals for implementing the requirement in the Direction are consistent with their statutory duties and set out their objectives as follows:

*“In making these proposals we have considered our principal duty to further the interests of citizens, and the interests of consumers where appropriate by promoting competition, and we have considered our duties relating to the optimal use for wireless telegraphy of the electromagnetic spectrum, the desirability of encouraging investment and innovation, the desirability of encouraging competition, having regard to the interests of consumers in respect of choice, price, quality of service and value for money.” (Para 3.35, Ofcom, October 2013)*

The original rationale for the revision of annual fees for 900 MHz and 1800 MHz was to reflect changes in value (or “asymmetric profit shocks”) resulting from liberalisation<sup>5</sup>. This was discussed in the September 2007 and February 2009 consultations on spectrum liberalisation and trading. At the time AIP rather than ALF was considered:<sup>6</sup>

*“...we continue to acknowledge that large asymmetric profits shocks of this type resulting from regulatory policy could have an impact on investment incentives in the sector in general. Therefore, some form of intervention may be justified to prevent this.” (Para A8.113, Ofcom, February 2009)*

*“We consider that correctly applying AIP could substantially reduce asymmetric profit shocks since AIP should reflect the value of the spectrum.” (Para A8.114, Ofcom, February 2009)*

The primary focus then was on redressing asymmetric profit shocks which could have an impact on investment incentives in the mobile sector, not on promoting spectrum efficiency (Ofcom now argue that ALF is necessary to promote spectrum efficiency). Furthermore most of the discussion was around 900 MHz rather than 1800 MHz.

Looking at more recent documents we find that:

<sup>4</sup> “The Wireless Telegraphy Act 2006 (Directions to OFCOM) Order 2010.”  
[http://www.legislation.gov.uk/ukxi/2010/3024/pdfs/ukxi\\_20103024\\_en.pdf](http://www.legislation.gov.uk/ukxi/2010/3024/pdfs/ukxi_20103024_en.pdf)

<sup>5</sup> Commission Decision 2009/766/EC <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:274:0032:0035:EN:PDF>

<sup>6</sup> Ofcom. “Application of spectrum liberalisation and trading to the mobile sector – A further consultation”, February 2009  
<http://stakeholders.ofcom.org.uk/binaries/consultations/spectrumlib/annexes/annex8.pdf>

- The December 2010 Direction does not give a rationale for ALF (beyond the statement of objectives above).
- The March 2010 Government response to the Independent Spectrum Broker's report states that: *"Revised annual licence fees that reflect in future the full market value of these radio spectrum bands in order to encourage its more efficient use. (p.32)"*<sup>7</sup> It also implies that ALF may redress effects on competition from liberalisation *"There has been considerable debate as to the possible effect of this [liberalisation] on competition and ways to address potential effects."* (p.5)
- The May 2009 Independent Spectrum Broker's report provides no rationale for ALF, instead it refers to Ofcom's February 2009 consultation: *"Furthermore, as proposed by Ofcom in its most recent consultation document, 2G spectrum liberalised in the hands of existing users should be subject to revised administrative incentive pricing (AIP) to reflect the full economic value of the spectrum"* (p.22)<sup>8</sup>

The rationale for ALF has therefore changed over time from addressing asymmetric profit shocks arising from liberalisation to promoting the efficient use of spectrum. With liberalisation now implemented, 2x15 MHz of 1800 MHz spectrum reassigned and the 4G spectrum auction completed, the market equilibrium has shifted significantly from the pre-liberalisation, pre-4G auction situation. Today all four mobile network operators have access to sub-1 GHz spectrum while the total spectrum available has increased substantially.

Thus the original rationale for imposing spectrum fees based on the full economic value of spectrum has arguably fallen away. Indeed the first round impact of ALF itself involves a profit shock which could well have adverse implications on the objective of promoting efficient spectrum use.

The remainder of this report is structured as follows. Section 2 assesses ALF against Ofcom's duty to promote the optimal use of spectrum. Section 3 considers the potential harm that the proposed ALF could impose on investment, prices and efficiency. Section 4 addresses the importance of impact assessment and provides a critical analysis of Ofcom's assessment in the consultation document.

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<sup>7</sup> BIS. "Government Response to the Consultation on a Direction to Ofcom to Implement the Wireless Radio Spectrum Modernisation Programme", March 2010

<http://webarchive.nationalarchives.gov.uk/+http://www.bis.gov.uk/assets/biscore/business-sectors/docs/10-737-government-response-consultation-ofcom-implement-spectrum-modernisation>

<sup>8</sup> "Report from the Independent Spectrum Broker: findings and policy proposals – final report", May 2009

[http://webarchive.nationalarchives.gov.uk/+http://www.culture.gov.uk/images/publications/ISB\\_final\\_report.pdf](http://webarchive.nationalarchives.gov.uk/+http://www.culture.gov.uk/images/publications/ISB_final_report.pdf)

## 2 The proposed ALF may harm rather than promote optimal spectrum use

In this section we assess ALF against Ofcom's duty to promote the optimal use of spectrum. This assessment provides an input to the interpretation of benchmarks and to the impact assessment.

Ofcom argue that in the absence of ALF, spectrum use may be sub-optimal both in terms of use by existing licensees and potential alternative users and uses (Para A9.4, Ofcom, October 2013). Ofcom also argue that ALF may promote optimal spectrum use.

We assess Ofcom's arguments<sup>9</sup> and consider ALF in relation to the following circumstances:

- Efficiency of use of existing spectrum by existing licensees assuming no change in spectrum availability i.e. no possibility of reassignment (between operators) or reallocation (between uses).
- We then introduce dynamics in terms of data growth, capacity growth and the possibility that the amount of spectrum can change via reassignment (between operators) or reallocation (between uses), and consider the following cases:
  - Efficiency of use of existing spectrum by existing licensees with the possibility of reassignment or reallocation.
  - Possible return of existing spectrum holdings which would then be reassigned or reallocated by Ofcom.
  - The allocation of new spectrum to mobile operators via auction.

We find in all these circumstances that ALF would not serve to promote the efficient use and allocation of spectrum. Finally we consider the dependence of our conclusions on the question of whether spectrum trading is efficient (or not) and the potential impact of ALF on the efficiency of spectrum trading.

### 2.1 Efficiency of use of existing spectrum (assuming no change in spectrum availability)

In this section we consider the "static" case where spectrum supply is fixed and conclude that, provided there is excess demand for spectrum, the incentives for efficient use of existing spectrum holdings are appropriate without ALF. The constraint of fixed spectrum supply is relaxed in the next section.

In the absence of an explicit price for spectrum, existing licensees - the mobile network operators - have appropriate incentives for efficient use of their scarce spectrum assets (i.e. productive efficiency is achieved, given current assignments to each operator). This does not depend on the opportunity to trade spectrum (considered later in relation to change of user/use).

When an input is scarce, a profit seeking firm has an incentive to use the input efficiently in order to maximise output and minimise the use of other resources including capital and labour. The reason for this is as follows. Given a constraint on available spectrum (the vertical line) there is an implicit price or opportunity cost of spectrum where supply and demand are in balance. A profit seeking firm will

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<sup>9</sup> Our analysis applies to commercially held spectrum. A government agency or not-for-profit entity might respond to annual fees but not necessarily to opportunity cost.

respond to this scarcity price in the absence of an actual price – see Figure 2-1. Further, if a price for spectrum were applied, it would have no impact on efficiency up to the implicit price.<sup>10</sup> If increased beyond the implicit price, the result would be inefficient non-use of spectrum.

**Figure 2-1: A supply constraint provides an incentive (implicit price) irrespective of ALF**

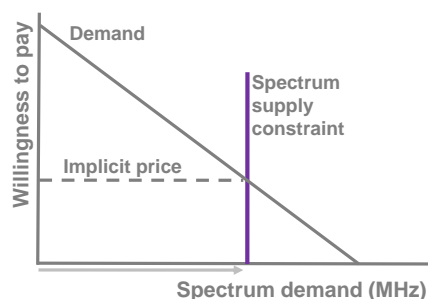


Figure 2-2 also illustrates the argument that an explicit price is not required to ensure efficiency use of scarce inputs by analogy with land.

**Figure 2-2: Analogy with efficient use of scarce land in the absence of annual fees**

An analogy which illustrates the point is to imagine three farmers – one who has inherited his land, one who purchased his land outright and one who rents his land. Assuming that we are focussed on their incentive to use their land efficiently (as opposed to buying or selling land at the margin) they are all motivated to produce the most profitable crop or livestock and to use their scarce input of land efficiently to maximise production irrespective of whether they inherited, purchased or rent their land. At the margin the extra revenue and profit from choosing the right food to produce, minimising costs and using land efficiently are the same.

This argument holds irrespective of the extent of competition since the incentive to maximise profit remains. Further, applying a spectrum price (i.e. ALF) does not alter the outcome in terms of spectrum use, unless the price is set above the implicit price – in which case spectrum would be underutilised, resulting in inefficiency.

## 2.2 Dynamic data growth, capacity growth and spectrum reassignment or reallocation

Ofcom state in the consultation that:

*“...there is a risk that efficiency-improving re-allocation of spectrum will be foregone if ALF is set below market value.” (Para A9.30, Ofcom, October 2013)*

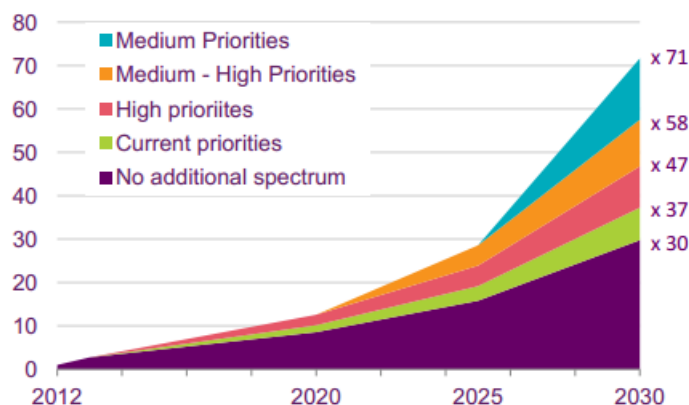
In this section we consider the dynamic case where data demand is growing, network capacity is growing and spectrum may be reallocated or reassigned. We conclude that ALF is not required to ensure efficiency-improving re-allocation of spectrum takes place.

<sup>10</sup> For profit  $\pi = R(x) - C(x)$ , then  $\max \pi \Rightarrow R'(x) = C'(x)$ ; With AIP profit  $\pi = R(x) - C(x) - AIP$ , then  $\max \pi \Rightarrow R'(x) = C'(x)$  i.e. no change.



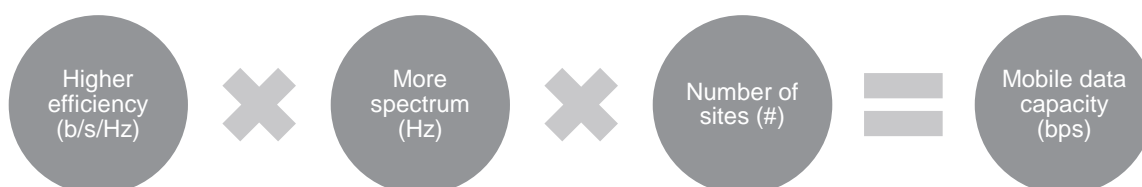
Ofcom focus on this more realistic dynamic scenario in their November 2013 mobile data strategy consultation.<sup>11</sup> Figure 2-3 shows the mobile data capacity scenarios from the Ofcom consultation, which includes scenarios where additional spectrum is made available to meet demand growth.

Figure 2-3: Ofcom mobile data capacity expansion scenarios



Mobile network capacity is determined by spectrum efficiency, the quantity of spectrum and the number of cell sites, as illustrated in Figure 2-4.

Figure 2-4: Mobile network capacity



Operators, in deciding how to meet capacity growth, can be expected to weigh up their options to ensure they are meeting demand at least cost. Operators will therefore consider the efficiency of use of existing spectrum holdings alongside the possibility of acquiring more spectrum at auction or investing in additional sites – irrespective of ALF.

We analyse in more detail a range of possible cases below.

### 2.2.1 Use of existing spectrum with the possibility of reallocation or reassignment

To meet demand growth in mobile data operators will face an ongoing tradeoff between using existing spectrum more efficiently, acquiring spectrum and investing in additional sites. Since both alternatives to using existing spectrum efficiently are costly, operators will weigh up the possibility of improving

<sup>11</sup> Ofcom. “Mobile data strategy”, November 2013. [http://stakeholders.ofcom.org.uk/binaries/consultations/mobile-data-strategy/summary/MDS\\_Condoc.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/mobile-data-strategy/summary/MDS_Condoc.pdf)

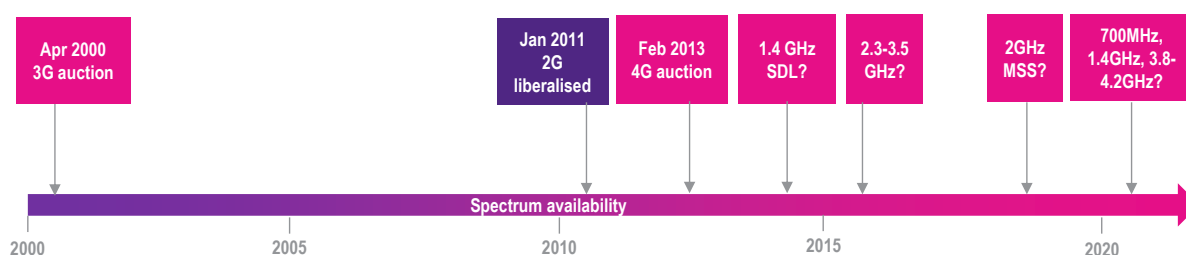
their current spectrum use efficiency against bidding in future auctions and/or additional capital expenditure. ALF on existing spectrum is therefore irrelevant to ensuring that operators use existing spectrum efficiently.

## 2.2.2 Possible return of existing spectrum holdings followed by reallocation or reassignment

Given mobile data demand growth and efforts by national and international spectrum regulators to allocate additional spectrum for mobile use, the likelihood that it would be efficient to return 900 MHz or 1800 MHz spectrum and for Ofcom to reallocate this spectrum for an alternative use appears remote. ALF is therefore irrelevant in this respect.

It is however possible that existing spectrum holdings might be reassigned between operators. A reassignment of 1800 MHz spectrum has already occurred while additional 800 MHz and 2.6 GHz spectrum was assigned at auction in early 2013. Future spectrum for mobile broadband is also anticipated at 700 MHz, 1.4 GHz, 2.3 GHz and 3.5 GHz (see Figure 2-5). The likelihood of trades involving existing mobile spectrum may therefore be low, particularly once potential transaction costs and regulatory hurdles are taken into account.

Figure 2-5: Past and prospective spectrum supply for mobile data services



In any case, should reassignment of existing spectrum between operators be efficient we consider that this would be more efficiently achieved via trading between operators than via ALF which entails the return of spectrum and subsequent reallocation by Ofcom.

In early work on spectrum liberalisation Ofcom held the above view in relation to 1800 MHz spectrum, namely that the allocation was likely to be efficient and if it were not, the market would achieve an efficient outcome through spectrum trading:<sup>12</sup>

*“...First, ...Ofcom does not consider that changes to the existing distribution of 1800 MHz are likely to be necessary to promote competition or secure efficient use of the spectrum. Second, given that conclusion, if it were the case that some more efficient distribution of the spectrum did exist, it would be reasonable to expect the market to achieve that outcome through trading (or commercially-offered roaming services)...” (Para 1.36, Ofcom, September 2007)*

<sup>12</sup> Ofcom. “Application of spectrum liberalisation and trading to the mobile sector”, September 2007. <http://stakeholders.ofcom.org.uk/binaries/consultations/liberalisation/summary/liberalisation.pdf>

### 2.2.3 Allocation of new spectrum for mobile via auction

Operators may, in part, meet demand growth by acquiring additional spectrum via auction.<sup>13</sup> In this case operators will have to pay for spectrum, irrespective of ALF on existing spectrum. ALF is therefore irrelevant to ensuring that operators face the opportunity cost of acquiring additional spectrum at auction. The efficiency of spectrum trading is also not a relevant consideration in this case.

## 2.3 The efficiency of trading is not a material consideration

In the arguments made in Sections 2.1 and 2.2, an assumption regarding the efficiency of trading is not required, or trading appears to be of secondary importance.

We therefore conclude that Ofcom's emphasis on the claimed inefficiency of secondary trading as justification for a high level of ALF is misplaced. We nevertheless also consider the potential efficiency of trading since inter-operator trades are a possibility, and because ALF may actually undermine prospects for otherwise efficient trades.

## 2.4 Trading and the potential impact of ALF on trading

In 2002 an Independent Review of Radio Spectrum management was conducted by Professor Martin Cave<sup>14</sup> with a view to advising on principles that should govern spectrum use and actions required to ensure all users are focused on using spectrum in the most efficient way possible. The Review's overarching vision (Para 24) was that auctions and the trading of licences would apply where feasible and administratively set prices would apply elsewhere. The Cave Review considered that:

*"once spectrum trading is enabled, then licensees will face a market determined opportunity cost of their spectrum use ..."*

The issue of applying market mechanisms to Government spectrum use was addressed in 2005 in the Independent Audit of Spectrum Holdings also conducted by Professor Martin Cave<sup>15</sup>. The Audit regarded AIP as an important mechanism for promoting spectrum use in the public sector, particularly for those bands where the opportunity to trade remains limited.

In 2011 when trading of spectrum by mobile operators was allowed Ofcom commented favourably on the prospects for trading to promote optimal spectrum use:<sup>16</sup>

*"By allowing operators to trade their spectrum, Ofcom believes that there will be greater opportunity to use it more efficiently. Ultimately, it is believed that this will bring benefits to citizens and consumers in terms of improved mobile services." (Ofcom, June 2011)*

<sup>13</sup> Ofcom are also considering the possibility of two sided incentive auctions. Ofcom. October 2013. "Spectrum management strategy." [http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum-management-strategy/summary/spectrum\\_management\\_strategy.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum-management-strategy/summary/spectrum_management_strategy.pdf)

<sup>14</sup> Professor Martin Cave. "Review of Radio Spectrum Management." March 2002. [http://www.ofcom.org.uk/static/archive/ra/spectrum-review/2002review/1\\_whole\\_job.pdf](http://www.ofcom.org.uk/static/archive/ra/spectrum-review/2002review/1_whole_job.pdf)

<sup>15</sup> Professor Martin Cave. 2005. "Independent Audit of Spectrum Holdings." <http://www.spectrumbaudit.org.uk/final.htm>

<sup>16</sup> Ofcom. "Mobile spectrum trading given go ahead", June 2011. <http://media.ofcom.org.uk/2011/06/20/mobile-spectrum-trading-given-go-ahead/>

In the current consultation Ofcom are however more sceptical regarding trading of mobile spectrum, observing that no trades have occurred in the UK mobile sector since trading was first allowed in June 2011 (other than a trade which was required).

It would seem premature to judge the efficiency of trading as a mechanism for reassigning spectrum in the mobile sector based on the absence of trades since 2011 given the short period of time that has elapsed since trading was permitted and given that in this time mobile operators would have been focussed on obtaining additional spectrum from the auction of 800 MHz and 2.6 GHz spectrum. We also note that trading of spectrum outside the mobile sector has occurred in the UK<sup>17</sup> and that trading in the mobile sector has occurred elsewhere, in particular in the US.<sup>18</sup>

We conclude that there is no *a priori* ground for assuming that trading is inefficient. However, it is possible that ALF might actually harm spectrum efficiency by discouraging otherwise efficient trades.

Ofcom argue in their consultation document that ALF would not harm the prospects for trading:

*“ALF would reduce the buyer’s willingness to pay for spectrum, it would also reduce the price at which the seller was willing to sell by the same amount; accordingly, it would not alter the potential gain from trade.” (Para 9.16, Ofcom, October 2013)*

However, by reducing the value of prospective trades ALF is likely to reduce the prospects for trading to promote efficient spectrum re-allocation. Spectrum pricing may undermine the scope for efficient trading in a range of circumstances with transaction costs, asymmetric information and uncertainty.<sup>19</sup> For example, the impact of a spectrum price on trading is illustrated by comparing Figure 2-6 (without a price) and Figure 2-7 (where price is related to value with a coefficient  $\beta = \frac{1}{2}$ ).

<sup>17</sup> <http://spectruminfo.ofcom.org.uk/spectrumInfo/trades>

<sup>18</sup> We note that in the US where property rights are clear, spectrum pricing is not applied and the prospects for near term primary spectrum allocations were low trading has occurred in relation to spectrum assigned for mobile use. For example: AT&T and Verizon completed a US\$1.9b spectrum trade deal involving 700 MHz and AWS spectrum in September 2013. <http://www.fcc.gov/document/att-verizon-wireless-grain-transactions-approved>

In January 2014, T-Mobile and Verizon announced a spectrum swap deal involving 700 MHz, AWS and PCS licences worth US\$3.3bn. <http://newsroom.t-mobile.com/phoenix.zhtml?c=251624&p=irol-newsArticle&ID=1833844&highlight>

<sup>19</sup> Phillipa Marks and Brian Williamson. “Can spectrum trading and pricing co-exist?”, January 2011. [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1739107](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1739107)

Figure 2-6: Spectrum trading without AIP

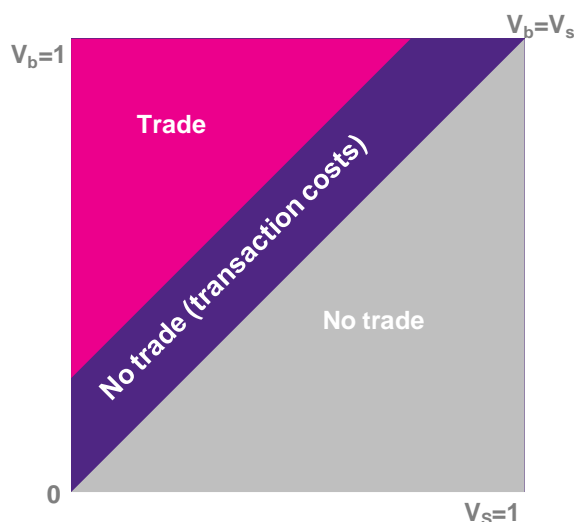
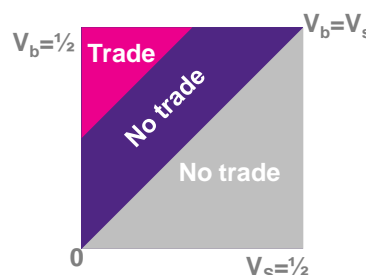


Figure 2-7: Spectrum trading with AIP set at half the current use opportunity cost



In Figure 2-6 a continuous range of possible spectrum values are shown for the potential seller (horizontal axis) and potential buyer (vertical axis) in the interval 0 to 1. Transaction costs are assumed to be 0.25 (25% of the maximum value for  $V_s$  and  $V_b$ ) and are represented by the diagonal purple band. Trade is profitable whenever the value to the buyer exceeds the value to the seller plus transaction costs, i.e. potential trades are in the upper left hand magenta triangle.

Suppose price is introduced and set equal to half of current use spectrum opportunity cost; then the values to the potential seller and buyer on each axis in Figure 2-6 are halved, as shown in Figure 2-7. In the absence of transaction costs all trades that would have occurred without a spectrum price would still occur i.e. even though gains from trade are halved they are still positive. However, with the same fixed level of transaction costs as shown in Figure 2-6, the diagonal band is proportionately larger compared to the potential gains from trade. The magenta zone of prospective trade is relatively smaller as a result – indicating a reduction in the scope for trade.

In the context of the discussion of Everything Everywhere’s profit from the sale of 1800 MHz spectrum, Ed Richards, the Ofcom Chief Executive, also pointed to the possibility that trading could promote efficiency and that fees which extract all surplus could discourage otherwise efficient trades:<sup>20</sup>

*“...in resource markets of this kind these things sometimes happen. Crucially, we wanted to make trading possible and available in order to make sure the spectrum was in the hands of the people who valued it most highly. [...] The slight difficulty I have with this is that if one permits trading because of the general economic benefits, it is very difficult to then go back and say, “Well, you made too much money out of that so we have to somehow claw it back”. I think that would remove all incentive, in certain circumstances, to trade.”*

On balance we consider that there is a risk that ALF would inhibit otherwise efficient trading, and that this risk increases with the level of ALF.

<sup>20</sup> Commons Select Committees; Culture, Media and Sport. “Mobile network operators and their spectrum use.” Paragraph 32. <http://www.publications.parliament.uk/pa/cm201012/cmselect/cmcomeds/1258/125806.htm#note28>

## 2.5 Conclusion

Spectrum, in particular 900 MHz and 1800 MHz spectrum, is a scarce input in the mobile sector, and scarcity promotes efficient use. From a dynamic perspective, operators will face an ongoing trade-off in terms of how they meet mobile data growth – between more efficient utilisation of existing spectrum, acquiring new spectrum via the primary or secondary market and/or additional capital expenditure on new sites etc. ALF is not relevant to these trade-offs.

Further, these arguments do not hinge on the efficiency of trading. We therefore conclude that the Ofcom emphasis on the claimed inefficiency of secondary trading as justification for a high level of ALF is not relevant.

ALF may however inhibit otherwise efficient trading, and this risk increases with the level of ALF. The likelihood that ALF to harm, rather than promote, the optimal use of spectrum suggests that the efficient spectrum price is zero. If in practice ALF is applied, it should be set conservatively with respect to available benchmarks in order to minimise the potential harm. This conclusion is reinforced when the potential impact on prices and/or investment is taken into account, as discussed in the next section.

### 3 The proposed ALF may reduce investment and raise prices, and that would involve harm

Ofcom argue that the impact of their proposed ALF values on investment and prices is likely to be modest, and that, even if adverse from a consumer and investor perspective, this may be a good outcome (if the spectrum use is not efficient in the first place):

*“...we do not consider that there is a basis for Ofcom bringing about lower consumer prices if this entails introducing a market distortion.” (Footnote 183, Ofcom, October 2013)*

We first consider the idealised static view under which ALF might have no impact on investment and/or prices. We then consider evidence that a negative impact on cash flow might impact investment and/or prices, and relate this back to spectrum efficiency.

#### 3.1 The static view

The static view is that ALF set at or below the incremental value of spectrum would have no impact on:

- Downstream prices – since available spectrum inputs are subject to excess demand, scarcity value will already be reflected in prices and ALF therefore simply involves a transfer of excess returns to the government.
- Investment – since ALF has no impact on prices (as above) and therefore no impact on demand and incremental revenues, nor on incremental investment costs, it will have no impact on project returns and investment.

Ofcom adopt varying and inconsistent positions on these impacts in the consultation document:

- In stating that the consultation document constitutes an impact assessment and yet in failing to adequately assess the impact of ALF on prices, output and investment Ofcom would appear to adopt the static point of view, namely that ALF would have no impact on prices, output and investment.
- Ofcom however argue that ALF would have a material impact on the efficiency of spectrum use and on the demand for spectrum, and therefore potentially on the allocation of spectrum for mobile (Para 4.60 and Annex 9, Ofcom, October 2013). Believing that ALF would have a material, as opposed to purely financial, impact would appear inconsistent with a view that it would have no impact on prices, output and investment.
- Ofcom also appear to accept that ALF may result in higher consumer prices, but argue that this is an acceptable outcome (if spectrum allocation is currently inefficient) since it will reduce demand for additional spectrum to efficient levels.

In particular Ofcom state that:

*“...if consumer demand is made to seem artificially high because prices do not reflect the true opportunity cost of the spectrum used to serve them, then this could lead mobile operators to seek more additional spectrum to meet this demand (at the expense of other uses of the spectrum) than they would seek if downstream prices fully reflected the market value of spectrum.” (Para A9.46, Ofcom, October 2013)*

However, mobile operators face a spectrum price at auction or through trading if they wish to acquire additional spectrum. ALF is therefore irrelevant in this context – excess demand for spectrum will not arise in the absence of ALF.

Further, if operators face appropriate incentives for efficient spectrum use in the absence of ALF (as we argue they do in the previous section), then, to the extent that ALF raises end user prices and reduces output, the outcome would involve a departure from optimal use of spectrum i.e. demand would be artificially suppressed.

## 3.2 Dynamic considerations

The static view does not necessarily hold when dynamics and capital market impacts are considered. Bauer (2001)<sup>21</sup> considered the impacts of up-front auction payments from a dynamic perspective and concluded that they may impact on prices, investment and coverage. Bauer notes that:

*“it is likely that they [license fees] will result in less coverage and a lower-capacity system, even if later expansion is more expensive than building a higher capacity system from the beginning.” (p.9, Bauer, 2001)*

Sutton (1991)<sup>22</sup> also provides evidence across a range of industries that higher entry costs contribute to a more highly concentrated industry structure, analysing the problem as a two stage game. A dynamic assessment does not necessarily correspond to a more static view.

Operators’ revealed preferences in debate over spectrum liberalisation and fees also imply that they anticipate an impact on prices and/or investment, since otherwise they would not be focussed on ensuring their competitors pay more for spectrum. For example:<sup>23</sup>

*“Kevin Russell, then Chief Executive of Three, told us that, although he thought that licence fee levels were unfair, increasing the licence fees for liberalised spectrum would not be sufficient to cure the distortion in the market caused by liberalisation.”*

Ofcom also, at least implicitly, accept that ALF will impact on the competitive position of operators, stating in relation to a 7 to 9 month difference in the timing of fees that:

*“There is the potential for such a payment separation to have an effect on competition although, given the scale of the differential effect compared to the size of operators’ relevant business, any such effect may be limited.” (Para 6.10, Ofcom, October 2013)*

If a difference in timing has a competitive impact, then there must be an impact of ALF on prices, investment or service levels (as opposed to an impact on cash and profits alone). In terms of the overall impact on prices and/or investment we are not however concerned with a small difference in timing, but with the overall magnitude of impact of ALF on the industry as a whole over 20 years. Clearly this impact is likely to be material given the magnitude of proposed fees.

<sup>21</sup> Johannes M Bauer. 2001. “Spectrum auctions, pricing and network expansion in wireless telecommunications.” <http://arxiv.org/ftp/cs/papers/0109/0109108.pdf>

<sup>22</sup> John Sutton. 1991. “Sunk cost and market structure.” MIT Press.

<sup>23</sup> Culture, Media and Sport Committee - Eighth Report Spectrum. Paragraph 25. <http://www.publications.parliament.uk/pa/cm201012/cmselect/cmcomeds/1258/125806.htm>

Also here: <http://stakeholders.ofcom.org.uk/binaries/consultations/srsp/responses/three.pdf>



### 3.2.1 Investment impact of reduced cash due to ALF

Investor views are informed by equity analysts who assess the capacity of firms to pay dividends and invest in terms of financial ratios, for example, net debt/EBITDA, which are not directly related to the net present value of investment opportunities.<sup>24</sup> Companies within groups must also justify capital budgets and reduced capacity to pay returns may lead to a more constrained capital budget position.

An increase in costs to mobile operators due to ALF may therefore result in reduced investment via this capital market/ownership channel (with asymmetric information and agency problems). There is also evidence pointing directly to agency issues in explaining observed investment behaviour.<sup>25</sup> Economic literature on the impact of cash flows on investment draws on both econometric analysis of outcomes<sup>26</sup> and surveys of chief financial officers<sup>27</sup> and finds that reduced cash flow tends to reduce investment.

We also note that Ofcom, when originally considering spectrum liberalisation, discussed the risk of harm to investment from profit shocks:<sup>28</sup>

*“...we continue to acknowledge that large asymmetric profits shocks of this type resulting from regulatory policy could have an impact on investment incentives in the sector in general.”*  
(Para A8.113, Ofcom, February 2009)

Yet what is now proposed via ALF is a profit shock. We conclude that it is likely that at least part of the impact of increased business costs and therefore reduced free cash flow due to the ALF will be reflected in reduced investment. This reduction will involve foregone investments in mobile capacity, coverage and quality which are economically and socially worthwhile, i.e. the reduction would involve harm rather than a reduction in market distortion as suggested by Ofcom.

### 3.2.2 Investment impact of the risk of expropriation associated with ALF

Another channel through which ALF would impact investment is the risk of expropriation of sunk investment, a risk Ofcom acknowledge in the current consultation:

*“We recognise that, in principle, there is a level of ALF which could lead to expropriation of some of the value of existing assets which are tied to the spectrum holdings concerned”* (Para A9.39, Ofcom, October 2013)

<sup>24</sup> For example HSBC. “Four steps to fibre,” February 2012.

<sup>25</sup> Yihui Pan, Tracy Yue Wang, Michael S. Weisbach. August 2013. “CEO Investment Cycles.” <http://fisher.osu.edu/supplements/10/12706/CyclesAugust2013%20%282%29.pdf>

<sup>26</sup> David J. Denis and Valeriy Sibilkov. December 2011. “Financial Constraints, Investment, and the Value of Cash Holdings.” *The Review of Financial Studies*, 23(1). <http://rfs.oxfordjournals.org/content/23/1/247.abstract>

Ola Melander. April 2009. “The effect of cash flow on investment: an empirical test of the balance sheet channel.” [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1483016](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1483016)

Simon Gilchrist and Charles Himmelberg. July 1999. “Investment, Fundamentals and Finance.” <http://www.nber.org/papers/w6652.pdf>

<sup>27</sup> Murillo Campello, John Graham and Campbell R Harvey. December 2009. “The real effects of financial constraints: evidence from a financial crisis.” NBER Working Paper 15552. <http://www.nber.org/papers/w15552>

<sup>28</sup> Ofcom. “Application of spectrum liberalisation and trading to the mobile sector – A further consultation”, February 2009

Formally, Kydland and Prescott showed in their 1977 paper that the commitment problem is a deep one since it may be rational to behave opportunistically *ex post* even if *ex ante* this possibility is harmful:<sup>29</sup>

*“Even if there is an agreed-upon, fixed social objective function and policymakers know the timing and magnitude of the effects of their actions, discretionary policy, namely, the selection of that decision which is best, given the current situation and correct evaluation of the end-of-period position, does not result in the social objective function being maximized.” (p.473)*

Expropriation risk is also particularly harmful to investment and innovation.<sup>30</sup> Ofcom should therefore seek to minimise expectations of expropriation where possible. The proposal to aggressively set ALF, without discount, based on uncertain estimates of full market value, and the rhetoric surrounding the proposal, arguably heighten rather than minimise expectations regarding expropriation risk.

In particular, Ofcom discount the risk of costs associated with setting ALF too high on the grounds that there are sunk costs, and signal their intention to extract all future value beyond the initial period of application of ALF:

*“Moreover, to the extent that there is some value associated with sunk investment in the existing licences, the point at which ALF would trigger a return of spectrum should be that much higher still. These considerations significantly reduce the chances of the ALFs we propose being set (inadvertently) so much higher than the actual market value that they trigger a return of spectrum. In our judgement, this significantly mitigates the asymmetric risk concern.” (Para A9.4, Ofcom, October 2013)*

*“There is a sound reason for considering that the PV [present value] of the marginal operator at the end of the 20-year period might be zero. This reason is that annual fees might be expected to apply after 20 years and the level of annual fees might be set at the PV for the marginal operator in a competitive market at that time, since this might represent full market value. On this basis the PV, net of ALF, would be zero for the marginal operator.” (Para 5.26, Ofcom, October 2013)*

This sentiment contrasts with that in other policy areas where Ofcom have recognised the importance of minimising a perception of expropriation risk:<sup>31</sup>

*“Disregarding sunk costs may be consistent with allocative and productive efficiency objectives, but not necessarily with encouraging dynamic efficiency. If investors believed that their costs, once sunk, would be regarded by the regulator as irrelevant for pricing purposes, they would be reluctant to invest in assets which could be regarded as sunk once the investment had been made.” (Para 3.21, Ofcom, August 2013)*

<sup>29</sup> Finn Kydland and Edward Prescott. 1977. “Rules rather than discretion: the inconsistency of optimal plans.” *The Journal of Political Economy*, Volume 85(3). [http://www.sfu.ca/~kkasa/prescott\\_77.pdf](http://www.sfu.ca/~kkasa/prescott_77.pdf)

<sup>30</sup> Brian Levy and Pablo Spiller. 1994. “The Institutional Foundations of Regulatory Commitment: A Comparative Analysis of Telecommunications Regulation.” *Journal of Law, Economics and Organisation*, Volume 10(2).

<sup>31</sup> Ofcom. “Fixed access market reviews: Approach to setting LLU and WLR Charge Controls”, August 2013. [http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/summary/LLU\\_WLR\\_CC\\_2014.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/summary/LLU_WLR_CC_2014.pdf)

In addition, Ofcom's Chief Economist Peter Culham introduced the concept of “*dynamically efficient value*”, which “*depends on what is required to avoid expropriation of assets*”, in relation to fixed access pricing.<sup>32</sup>

The introduction of ALF, in particular the level of ALF proposed and the manner in which Ofcom have argued in support of a high level of ALF, may raise expectations of expropriation risk. Ofcom should therefore seek to minimise expectations of expropriation risk, in particular by adopting a conservative approach in setting ALF.

### 3.2.3 Potential price impact of ALF

A naïve view which is expressed from time to time is that fees will not impact on prices in a competitive market.<sup>33</sup> This view is false as in a competitive market a common cost shock is passed through to final prices.<sup>34</sup> Ofcom appears to accept the possibility of pass through since they consider the possibility that prices may rise, but argue that this would be an acceptable outcome (for example, in Para A9.4 and footnote 183 of the current consultation).

In our view the mechanism through which ALF may affect final prices is more complex than a simple cost pass through. The mobile industry is subject to large periodic increases in capacity when spectrum becomes available. Incremental costs for data may then fall from congestion prices to an incremental data cost of close to zero. The current transition to 4G, coupled with additional spectrum at 800 MHz and 2.6 GHz and liberalisation of 900 MHz and 1800 MHz, represents such a substantial capacity increment.

This sort of periodic fluctuation in industry capacity and cost structure can make the achievement of normal returns difficult as individual players may price at incremental costs when they have excess capacity but fail to make up overall returns when capacity is scarce.<sup>35</sup> In the mobile industry ALF may potentially serve as a focal point contributing to a higher floor on incremental prices.<sup>36</sup>

## 3.3 ALF set at full market value would be harmful to spectrum efficiency, investment and/or end user prices

Since Ofcom start from a view that ALF set at full market value is required to promote spectrum efficiency, they also consider any reduction in investment and/or increase in end user prices as redressing a market distortion. In contrast, if spectrum allocation is efficient in the absence of ALF,

<sup>32</sup> Peter Culham. 28 November 2012. “Pricing Access Networks in the Transition to NGA - Promoting Efficient Investment.” ECTA Conference.

<sup>33</sup> Wired. “Ofcom: competitive mobile market should protect consumers in spectrum hike”, 11 October 2013. <http://www.wired.co.uk/news/archive/2013-10/11/ofcom-spectrum-fee-hike>

<sup>34</sup> With more limited competition pass-through of a cost increase may be lower than in a competitive market since prices would already be above competitive levels and the firm/s would take into account the anticipated impact on demand of raising prices.

<sup>35</sup> The semiconductor memory chip market is characterised by large capacity increments and, historically, difficulty in achieving reasonable returns. Financial Times. 29 October 2013. “Strong chip prices offset SK Hynix output after factor blaze.” <http://www.ft.com/cms/s/0/1e484b12-4044-11e3-8882-00144feabdc0.html#axzz2kRkzpESw>

<sup>36</sup> Volodymyr Bilotkach. April 2009. “Hidden Surcharges and Tacit Collusion: a Simple Model.” [https://editorialexpress.com/cgi-bin/conference/download.cgi?db\\_name=IIOC2010&paper\\_id=129](https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=IIOC2010&paper_id=129)

and ALF reduces investment and/or raises end user prices, then ALF is introducing rather than addressing a market distortion.

Our analysis in Section 2 shows that ALF set at full market value would not promote optimal spectrum use. Rather it could potentially harm optimal spectrum use by discouraging otherwise efficient trades and by reducing investment and/or raise end user prices. In other words ALF set at full market value would be unambiguously harmful and the higher the level of ALF the greater the harm.

Ofcom's analysis in Annex 9 of the consultation document is departure from the usual situation where asymmetric impacts are considered i.e. where one wishes to understand which kind of error in setting prices (higher or lower than the efficient level) is more harmful to economic surplus. If it is accepted that the higher the ALF is above a zero baseline, the greater the harm to optimal use of spectrum, then the level of ALF should either be set to zero or set at a low level to minimise harm.

As discussed in Section 2 operators face incentives to economise on spectrum use irrespective of ALF due to spectrum scarcity and the costs involved in meeting data demand growth via capital expenditure and/or the purchase of additional spectrum.

As Ofcom note in the November 2013 mobile data strategy consultation:<sup>37</sup>

*“This is a fast-changing sector, in which future demand and technological developments are subject to considerable uncertainty.” (Para 3.43, Ofcom, November 2013)*

Given the risk of harm which increases with the level of ALF and the level of uncertainty regarding demand<sup>38</sup> and therefore value, at the very least caution in setting ALF is implied. Caution is also justified given evidence that expectations of spectrum supply have increased since the Ofcom 4G auction (Appendix A) and the availability of alternative estimates of value based on avoided cost modelling that are significantly below recent auction values (Appendix B). Therefore, even if ALF is not set at the efficient spectrum price of zero, there are good reasons for Ofcom to set it conservatively. This is especially so given the uncertainty around full market value of 900 MHz and 1800 MHz in the UK.

Since an increase in annual licence fees is likely to be harmful, the impacts of setting an ALF reflecting full market value should be assessed against a counterfactual of the existing AIP fees, and variations up to full market value and down to zero should be assessed. We discuss this in the next section.

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<sup>37</sup> Ofcom. November 2013. “Mobile data strategy”. [http://stakeholders.ofcom.org.uk/binaries/consultations/mobile-data-strategy/summary/MDS\\_Condoc.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/mobile-data-strategy/summary/MDS_Condoc.pdf)

<sup>38</sup> For example, Real Wireless analysis for Ofcom included high and low data traffic scenarios ranging from 7443 PB/month to 575 PB/month by 2030 – a difference of over an order of magnitude. Figure 1-8. <http://www.ofcom.org.uk/static/uhf/real-wireless-report.pdf>

## 4 The impact of ALF has not been properly assessed

### 4.1 The proposed price increase with ALF

Ofcom's ALF proposals involve a 4-5 fold increase in the annual fees paid for 900 MHz and 1800 MHz spectrum licences (see Table 4-1). The total fees paid by the operators will increase from £64.5m to £308.9m/year. This section reviews the impact assessments undertaken by Ofcom and the government for the ALF policy.

Table 4-1: Comparison of AIP and ALF fee levels for 2x1 MHz

Fee	900 MHz	1800 MHz
AIP in 2012/13	712,800	554,400
Proposed ALF	3,980,000	2,380,000
Increase	5.6 fold	4.3 fold

### 4.2 Guidance and experience in relation to impact assessment

There is now a well-established methodology and practice for undertaking impact assessments of regulatory interventions. UK government interventions of a regulatory nature generally require an impact assessment<sup>39</sup>. Guidance on the conduct of impact assessments for government policy decisions is given by BIS in its Impact Assessment Guidelines<sup>40</sup> and Impact Assessment Toolkit<sup>41</sup> and by the Treasury's Green Book<sup>42</sup>. The National Audit Office reviews practice across government and provides guidance on ways of improving the quality of impact assessments<sup>43</sup>.

Section 7 of the Communications Act 2003<sup>44</sup> places a duty on Ofcom to carry out impact assessments for important proposals. Ofcom regards an impact assessment as "*an essential part of considering different options for regulation, including alternatives to formal regulation, and then, using objective criteria, selecting the best option*" (Para 2.1, Ofcom, July 2005). Ofcom has produced its own guidelines for undertaking impact assessments<sup>45</sup>. The Guidelines state that:

<sup>39</sup> See Annex A (Principles of Regulation in the Coalition Government) of "Impact Assessment Guidance", HM Government, August 2011. <http://www.bis.gov.uk/assets/biscore/better-regulation/docs/i/11-1111-impact-assessment-guidance.pdf>; see also [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/211981/bis-13-1038-better-regulation-framework-manual-guidance-for-officials.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211981/bis-13-1038-better-regulation-framework-manual-guidance-for-officials.pdf)

<sup>40</sup> BIS. "Producing impact assessments - guidance for government departments", December 2012 <https://www.gov.uk/producing-impact-assessments-guidance-for-government-departments>

<sup>41</sup> HM Government, IA Toolkit, August 2011.

<sup>42</sup> HM Treasury. "The Green Book: appraisal and evaluation in central government", July 2011 <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>

<sup>43</sup> National Audio Office, "Delivering high quality Impact Assessments", January 2009 <http://www.nao.org.uk/report/delivering-high-quality-impact-assessments/>

<sup>44</sup> Communications Act 2003, Part 1, Section 7 <http://www.legislation.gov.uk/ukpga/2003/21/section/7>

<sup>45</sup> Ofcom. "Better Policy Making: Ofcom's approach to Impact Assessment", July 2005 [http://stakeholders.ofcom.org.uk/binaries/consultations/better-policy-making/Better\\_Policy\\_Making.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/better-policy-making/Better_Policy_Making.pdf)

*“it is important that an Impact Assessment should be clearly identified. It will be generally set out in a separate section of annex, although in many cases The Impact Assessment is likely to be a summary of the analysis which forms the main substance of the consultation document or statement.” (Para 6.1, Ofcom, July 2005)*

Ofcom have also previously carried out impact assessments which provide a benchmark in relation to ALF. In particular Ofcom published a statement on the application of spectrum pricing to VHF spectrum use by the aeronautical sector in December 2010 – which is summarised in Figure 4-1.<sup>46</sup>

**Figure 4-1: Impact assessment benchmark - spectrum pricing for VHF use by the aeronautical sector**

A full impact assessment of the proposals was given in the December 2009 consultation document on fees<sup>47</sup> and an accompanying external report by Helios and Plum<sup>48</sup>. The total impact of the proposals was to increase fees paid by up to £4m. Section 7, Annex 7 and Annex 8 of the consultation document presented evidence on the magnitude of impacts on:

- Citizens and consumers.
- Efficient spectrum use.
- Impact on aviation users and other stakeholders.
- Competition.
- Safety.
- Environmental and social and equality impacts.

A key element of the impact assessment was the analysis of the financial impact of the proposals on different types of users including NATS En-Route plc, airports of different sizes, other types of licensee (e.g. flying schools, oil companies etc.) and any consequent impacts on passenger charges and demand for air travel in the UK (and the risk of substitution by airports outside the UK) were quantified. Any regulatory constraints on licensees’ ability to pass on the fees were taken into account in this analysis.

Both Government and Ofcom guidance, as well as best practice in terms of impact assessment, indicate that the main elements of an impact assessment comprise the following steps:

- Identify the problem – in Ofcom’s case with reference to the citizen or consumer interest
- Define the policy objectives – these will be given by Ofcom’s statutory duties
- Identify the policy options – this should include a “no change” base case and then possible options to address the problem identified
- Assess the impacts - including costs and benefits, risks, unintended consequences and distributional effects. Where possible impacts should be quantified.
- Choose the best option - in terms of the impacts on citizens or consumers and the promotion of Ofcom’s statutory duties.

<sup>46</sup> [http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum\\_pricing/statement/statement.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum_pricing/statement/statement.pdf) - a subsequent statement was published in June 2011 concerning bespoke fees for certain types of ground station.  
[http://stakeholders.ofcom.org.uk/binaries/consultations/bespoke-fees-aeronautical/statement/8197\\_statement.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/bespoke-fees-aeronautical/statement/8197_statement.pdf)

<sup>47</sup> [http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum\\_pricing/summary/aip2.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum_pricing/summary/aip2.pdf)

<sup>48</sup> [http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum\\_pricing/aip.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum_pricing/aip.pdf)



We use this checklist to structure the discussion of Ofcom's impact assessment for ALF in Section 4.3 below and compare the approach taken with that used by Ofcom in support of its decisions regarding annual licences for VHF spectrum used for aeronautical communications (Section 5.4). First we briefly describe the impact assessment analyses undertaken by government and Ofcom in the development of ALF policy that took place over the period 2010-2012.

### 4.3 Impact assessments undertaken in the development of ALF policy

The proposals for annual licence fees to be set at full market value were contained in the Digital Britain proposals and subsequently the Government Direction to Ofcom. An impact assessment was conducted in 2010 to support the Government Direction to Ofcom.<sup>49</sup> This analysis assumed that annual licence fees would be set on the same basis with or without the Direction and hence no impact of the requirement to set annual licence fees for 900MHz and 1800MHz to reflect full market value (having particular regard to the sums bid for licences in the (800MHz and 2.6 GHz) auction) was undertaken.

Ofcom consultations<sup>50</sup> which precede the Direction mention setting fees for 900MHz and 1800MHz spectrum to reflect full economic value but do not define what this means. Ofcom first define what they mean by full economic value in their March 2011 consultation on the assessment of future mobile competition and proposals for the 4G auction, namely<sup>51</sup>:

*"We consider full market value is the price that would arise in a well functioning spectrum market. This would be the market clearing price when supply equals demand." (Para 10.3, Ofcom, March 2011)*

*"We interpret the term "full market value" to mean that we do not discount our estimate of the price that would occur in a well functioning market, nor do we set it conservatively compared with the available market information". (Para 10.4, Ofcom, March 2011)*

There is no mention in this or the following consultation in January 2012<sup>52</sup> of the impact of this approach to setting annual licence fees although this constituted a departure from current published policy under the SRSP<sup>53</sup> in the sense fees were not to be set conservatively compared with available market information. The only impact assessment of the policy is given in the current consultation

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<sup>49</sup> BIS. "Impact Assessment for a Direction to the Office for Communications (Ofcom) to intervene in spectrum management", July 2010 <http://www.legislation.gov.uk/ukxi/2010/3024/impacts>

<sup>50</sup> In September 2007 Ofcom proposed to change AIP to reflect the opportunity cost of liberalised spectrum with no elaboration as to what this meant. In October 2009 Ofcom proposed "to review the level of Administered Incentive Pricing (AIP) applying to the 900 MHz and 1800 MHz spectrum so that in future it reflects the "full economic value" (para 1.8).

<sup>51</sup> Ofcom. "Consultation on assessment of future mobile competition and proposals for the award of 800 MHz and 2.6 GHz spectrum and related issues", March 2011 <http://stakeholders.ofcom.org.uk/binaries/consultations/combined-award/summary/combined-award.pdf>

<sup>52</sup> Ofcom. "Second consultation on assessment of future mobile competition and proposals for the award of 800 MHz and 2.6 GHz spectrum and related issues", January 2012 <http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/summary/combined-award-2.pdf>

<sup>53</sup> Ofcom. "SRSP: "The revised framework for spectrum pricing", December 2010 <http://stakeholders.ofcom.org.uk/binaries/consultations/srsp/statement/srsp-statement.pdf>

which states that Sections 4, 5 and 6, along with Annex 9, constitute the required impact assessment (Para 2.21, Ofcom, October 2013).

## 4.4 Ofcom's impact assessment of ALF

Ofcom's impact assessment is not provided as a separate section of the consultation document and there is no comprehensive summary of the impacts. However, we can construct the elements of an impact assessment from Ofcom's consultation. These are given below.

### 4.4.1 The problem

The problem is that current annual licence fees may not promote citizen and consumer interests. This is the main issue given Ofcom's statutory duties. There is also the secondary issue that current annual fees may not be consistent with the requirement in the Direction to set fees based on full market value taking account of the 800MHz and 2.6 GHz auction results.

### 4.4.2 Policy objectives

The Government's Direction to Ofcom in December 2010 includes the following objectives:

*"ensuring the release of additional electromagnetic spectrum for use by providers of next generation wireless mobile broadband; allowing early deployment and maximising the coverage of those services; creating greater investment certainty for operators; and implementing Directive 2009/114/EC(b) and the Decision(c) on the liberalisation of frequencies in the 900MHz and 1800MHz bands"*

These are similar to the policy objectives Ofcom are seeking to achieve in revising fees. In the consultation document, Ofcom note:

*"In making these proposals we have considered our principal duty to further the interests of citizens, and the interests of consumers where appropriate by promoting competition, and we have considered our duties relating to the optimal use for wireless telegraphy of the electromagnetic spectrum, the desirability of encouraging investment and innovation, the desirability of encouraging competition, having regard to the interests of consumers in respect of choice, price, quality of service and value for money." (Para 3.35, Ofcom, October 2013)*

### 4.4.3 Identify options

In impact assessments policy proposals should be considered relative to a "no change" base case. Hence it would be expected that Ofcom's ALF proposals would be considered relative to the base case of the current fees of £712,800 for 2x1 MHz at 900MHz and £554,400 for 2x1 MHz at 1800MHz.

To derive other options for ALF Ofcom examines evidence from the UK 800MHz and 2.6 GHz auction and recent auctions held elsewhere in Europe to derive a base case value and variations from the base case. As noted by Ofcom (paragraph 4.51), there is a limited set of evidence points with a relatively wide distribution of values and no specific evidence can be relied upon in a determinative



way to provide a good estimate of full market value for the 900MHz and 1800MHz bands over the next 20 years. Ofcom exercise their judgement in arriving at a best estimate of lump sum value and then convert to this to a 20 year annuity by using a time profile of payments that is flat in real terms.

#### 4.4.4 Assess the impacts and choose best option

The assessment of impacts given in the consultation document is qualitative and partial. The ALF values proposed are based on Ofcom's judgement and consideration of the impacts of setting fees too high or low relative to the Ofcom estimate of full market value as discussed in Annex 9 of the consultation document. There is no explicit consideration of the proposed fees relative to the counterfactual of the current fee levels.

Ofcom's qualitative analysis of the impact of setting ALF above or below full market value on the efficiency of spectrum allocation and use is examined in Annex 9. The issue of specific concern here is whether there is an asymmetry in the impacts on efficiency of higher versus lower ALF values. There is no explicit discussion of the impact of the proposed ALF values versus the base case of the current fees (i.e. the no change situation) in Annex 9 (or indeed the entire consultation document), although the analysis of impacts of values below the full market value might be interpreted as providing relevant evidence.

Ofcom have not provided a summary of its impact assessment and so we have constructed a summary of the impacts identified by Ofcom which is shown in Table 4-2 together with a summary of our views based on the analysis in Sections 2 and 3 of this paper. Ofcom's analysis seems to suggest that:

- The proposed ALF values will have little or no impact on services to consumers, competition, investment, innovation and spectrum trading.
- The proposed ALF values could result in an increase in consumer prices but that would be appropriate (i.e. promote efficiency).
- The proposed ALF will promote efficient spectrum use.

These conclusions do not seem internally consistent. If the proposed changes to annual licence fees are promoting efficiency relative to the current situation (with much lower annual fees), then there must be some impact on either market outcomes i.e. consumer services or prices and/or investment and innovation as discussed in Section 3.

In Table 4-2 we consider Ofcom's assessment against their objectives. We consider the objectives which contribute to Ofcom's principal duty, namely *"to further the interests of citizens, and the interests of consumers where appropriate by promoting competition."* In our assessment we draw on the conclusions from Section 2 and 3.

**Table 4-2: Assessment of proposed ALF values on Ofcom’s objectives**

Ofcom objective	Ofcom assessment (with references)	Plum assessment
Optimal use of spectrum	Proposed ALF would encourage efficient use and constrain excess demand for additional spectrum. [A9.16-A9.38; 9.45]	Incentives for efficient use are appropriate in absence of ALF. Spectrum is constrained and operators face trade-off with capital expenditure and cost of acquiring additional spectrum to meet data demand growth. Proposed ALF could discourage otherwise efficient trades.
Investment & Innovation	To the extent that ALF discourages investment this involves correction of a market distortion. [A9.39-9.41] Ofcom argue that there would be no impact on innovation. [A9.42-9.44]	Negative impact on investment and innovation is anticipated. This would be harmful i.e. it would involve a reduction from efficient levels.
Encouraging competition	Small negative impact from small difference in timing of payments. [6.9-6.10]	Impact of overall increase in ALF, as opposed to differential, should be considered. Neutral to harmful since the first round impact of ALF is to reduce net the revenue and value of the mobile market thereby discouraging participation and investment/innovation.
Interests of consumers	Ofcom do not assess and comment directly on the interests of consumers. For example, Ofcom note that to the extent that ALF leads to higher end user prices this would involve the correction of a distortion, but do not comment on the impact on consumers. [1.20, 6.19; A9.46, 9.5]	Consumer interests harmed to the extent that proposed ALF discourages otherwise efficient spectrum trades, leads to reduced investment and innovation and/or higher end user prices.

Our analysis suggests that the proposed increases in annual fees could have effects that will harm consumer interests either directly through changes in prices and service levels or indirectly through impacts on investment and innovation.

Finally Ofcom does not provide any quantitative analysis of the impacts of its proposals to increase annual licence fees by a factor of almost 5, despite the acknowledged uncertainty around the value estimates. By contrast a detailed impact assessment was undertaken for the recent application of AIP to the spectrum used for VHF aeronautical communications (see Figure 4-1). The absence of any quantitative analysis is a significant omission given the scale of the increase in fees proposed by Ofcom.

## 4.5 Conclusions

In summary we find that Ofcom’s proposals for revised annual licence fees for 900 MHz and 1800 MHz spectrum are not supported by an adequate impact assessment. The analysis of impacts given by Ofcom:

- Does not compare the proposals with the base case of current fees, as suggested by Ofcom’s guidance on the conduct of impact assessments.

- Provides only a high level qualitative analysis of setting fees higher or lower than the levels proposed, where as a quantitative analysis could have been undertaken and was given by Ofcom when annual licence fees were increased for the aeronautical sector by up to £4m (as compared with over £250m for the mobile sector).<sup>54</sup>
- Is internally inconsistent, in that it suggests efficiency is promoted by higher fee levels but there are no real impacts on services to consumers or investment even though consumer prices may rise.

We disagree with much of Ofcom's analysis of impacts, and find that Ofcom's proposals are more likely to harm citizen and consumer interests rather than promote them.

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<sup>54</sup> The UK aviation sector is large with a direct gross value added in excess of £20bn  
<http://www.niassembly.gov.uk/Documents/Finance/Air-Passenger-Duty/Written-Submissions/Oxford-Economics-Economic-Benefits-from-Air-Transport-in-UK.pdf>

## Appendix A: Spectrum supply expectations have risen

It was clear at the time of the UK 4G auction that more spectrum was likely to come to market at some point – the question is whether expectations regarding the timing or likelihood of future spectrum availability have changed since February 2013.

We conclude that expectations in terms of spectrum supply have firmed up since the auction and that the auction prices may therefore overestimate market value today.

In relation to changes in expectations since the auction in February 2013 the following are relevant:

- The publication by ECC of Report 188 on future harmonised use of 1452-1492 MHz on 27 February 2013,<sup>55</sup> followed by the adoption of ECC Decision 13(06) on use of 1452-1492 MHz for mobile/fixed communications networks supplemental downlink in November 2013.<sup>56</sup> Subject to finalisation of technical specification work at 3GPP (expected mid 2014) and equipment availability this spectrum is available for use in the UK.
- The proposal by BNetzA (Germany) in June 2013 that clearance of 700 MHz should be actively considered with the aim of making the spectrum available from 2018. BNetzA is consulting on the award of the band<sup>57</sup>.
- Ofcom signalled strongly in April 2013 that 700 MHz should be made available for mobile use, potentially around 2020. There have been press reports that the French government may also seek to lease the band<sup>58</sup>.
- The announcement in September 2013 that Ofcom would manage the release of MOD spectrum at 2.3 GHz and 3.4 GHz, with an expectation of award in the 2015-16 financial year.<sup>59</sup>
- The ECC framework agreed in November 2013 for mobile use in the frequency bands 3400-3600 MHz and 3600-3800 MHz.<sup>60</sup> The ECC Decision 11(06) on 3.4-3.8 GHz is being revised based on the new framework.<sup>61</sup>

<sup>55</sup> ECC Report 188. "Future harmonised use of the 1452-1492 MHz in CEPT", 19 February 2013

<http://www.erodocdb.dk/doks/filedownload.aspx?fileid=3952&fileurl=http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP188.PDF>

<sup>56</sup> ECC Decision 13(03). "The harmonised use of the frequency band 1452-1492 MHz for mobile/fixed communications networks supplemental downlink (MFCN SDL)", 8 November 2013 <http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC1303.PDF>

<sup>57</sup> Bundesnetzagentur. "Strategic aspects of the availability of spectrum for broadband rollout in Germany", June 2013

[http://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/Areas/Telecommunications/TelecomRegulation/FrequencyManagement/ElectronicCommunicationsServices/DemandIdentificationProceedings/StrategicAspects.pdf?\\_\\_blob=publicationFile&v=1](http://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/Areas/Telecommunications/TelecomRegulation/FrequencyManagement/ElectronicCommunicationsServices/DemandIdentificationProceedings/StrategicAspects.pdf?__blob=publicationFile&v=1)

<sup>58</sup> Digitag. "The 700 MHz band allocation in Europe", May 2013 <http://www.digitag.org/WebLetters/2013/External-May2013.html>; Also see [http://www.arcep.fr/uploads/tx\\_gsavis/13-0175.pdf](http://www.arcep.fr/uploads/tx_gsavis/13-0175.pdf)

<sup>59</sup> HM Government. "Ofcom to manage release of MOD radio spectrum", 13 September 2013

<https://www.gov.uk/government/news/ofcom-to-manage-release-of-mod-radio-spectrum>

<sup>60</sup> ECC Report 203. "Least restrictive technical conditions suitable for Mobile/Fixed Communication Networks (MFCN), including IMT, in the frequency bands 3400-3600 MHz and 3600-3800 MHz", 8 November 2013

<http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP203.PDF>

<sup>61</sup> EC Decision 11(06). "The harmonised frequency arrangements for mobile/fixed communications networks (MFCN) operating in the bands 3400-3600 MHz and 3600-3800 MHz", 11 November 2013

[http://www.cept.org/Documents/ecc/14301/ECC\(13\)090-Annex09\\_Draft-amended-ECCDEC\(11\)06-for-PC-\(with-rev-marks\)](http://www.cept.org/Documents/ecc/14301/ECC(13)090-Annex09_Draft-amended-ECCDEC(11)06-for-PC-(with-rev-marks))

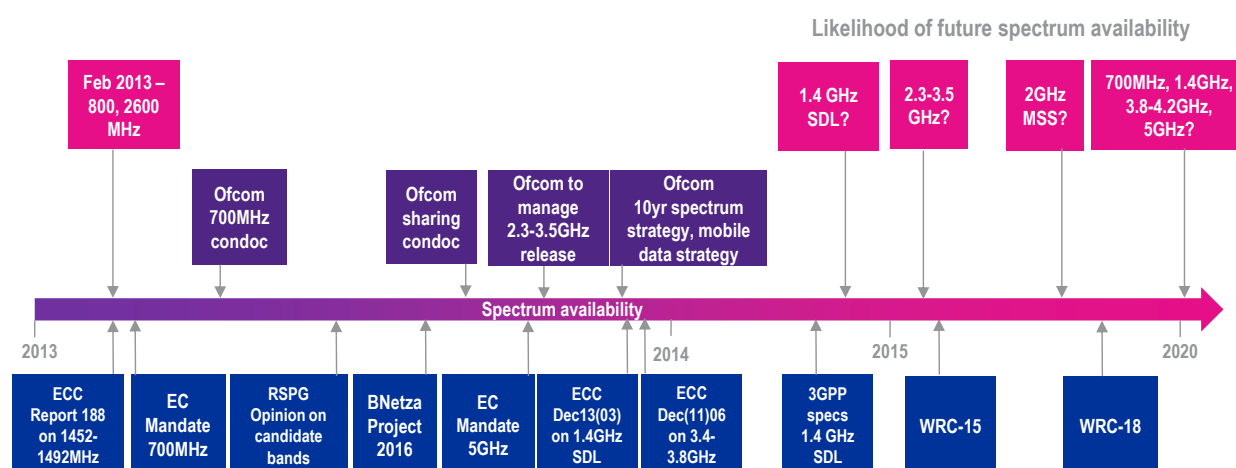
- The Radio Spectrum Committee September 2013 mandate to CEPT to study and identify harmonised compatibility and sharing conditions for Wi-Fi in the bands 5350-5470 MHz and 5725-5925 MHz.<sup>62</sup>

Wider developments also point to a change in expectations, in particular the RSPG interim opinion on policy objectives for WRC-15<sup>63</sup> published in May 2013 and the RSPG opinion published in June 2013 regarding strategic challenges facing Europe in addressing the growing spectrum demand for wireless broadband.<sup>64</sup>

Figure A-1 summarises key developments since the Ofcom auction in February 2013, Table A-1 provides further information on the quantity of spectrum likely to be made available and *Source: Plum analysis, Ofcom Mobile Data Strategy, November 2013*

Figure A-2 shows the growth in sub-1 GHz versus above 1 GHz spectrum.

**Figure A-1: Developments impacting expectations of future spectrum availability**



**Table A-1: Future spectrum available for mobile broadband in UK**

Frequency band	Bandwidth available	Notes
700 MHz	60 MHz	2x30 MHz bandplan for Europe
1452-1492 MHz	40 MHz	Assigned to Qualcomm, likely to be deployed for SDL by 2015
2 GHz MSS (1980-2010/2170-2200 MHz)	60 MHz	Currently assigned to Inmarsat and Solaris across Europe

<sup>62</sup> EC. Mandate to CEPT on 5 GHz RLAN. 2 September 2013. [https://circabc.europa.eu/sd/d/f40c7a87-753a-4882-b09f-a03568fcd36c/RSCOM13-32rev3\\_Mandate%20CEPT%205%20GHz%20RLAN\\_final.pdf](https://circabc.europa.eu/sd/d/f40c7a87-753a-4882-b09f-a03568fcd36c/RSCOM13-32rev3_Mandate%20CEPT%205%20GHz%20RLAN_final.pdf)

<sup>63</sup> RSPG. "Interim Opinion on Common Policy Objectives for WRC-15", 31 May 2013 [https://circabc.europa.eu/d/a/workspace/SpacesStore/989a9929-29b7-4ec2-855a-9ccd7e020393/RSPG-13-525-interim\\_opinion\\_WRC\\_15.pdf](https://circabc.europa.eu/d/a/workspace/SpacesStore/989a9929-29b7-4ec2-855a-9ccd7e020393/RSPG-13-525-interim_opinion_WRC_15.pdf)

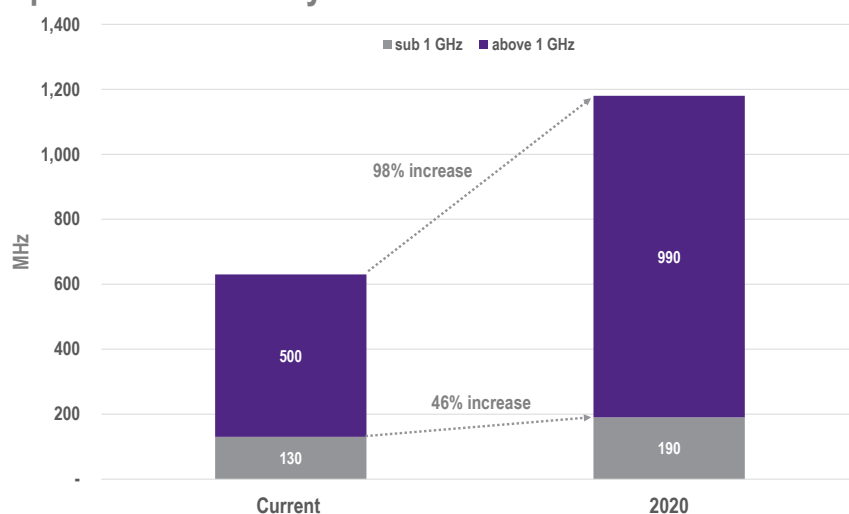
<sup>64</sup> RSPG. "Opinion on Strategic Challenges facing Europe in addressing the Growing Spectrum Demand for Wireless Broadband", 13 June 2013 [https://circabc.europa.eu/d/a/workspace/SpacesStore/c7597ba6-f00b-44e8-b54d-f6f5d069b097/RSPG13-521\\_RSPG%20Opinion\\_on\\_WBB.pdf](https://circabc.europa.eu/d/a/workspace/SpacesStore/c7597ba6-f00b-44e8-b54d-f6f5d069b097/RSPG13-521_RSPG%20Opinion_on_WBB.pdf)

Frequency band	Bandwidth available	Notes
2.3 GHz	40 MHz, potentially another 50 MHz	MoD spectrum to be assigned by 2015-16 Additional 50 MHz likely to be available based on LSA
2.7-2.9 GHz	200 MHz	Potential to be available on shared basis with incumbent users after 2020
3.4-3.6 GHz	150 MHz	MoD spectrum to be assigned by 2015-16
3.6-3.8 GHz	200 MHz	Potentially available between 2015 and 2020 on shared basis where required
3.8-4.2 GHz	Potentially up to 400 MHz	Potential to be available on shared basis with incumbent satellite users after 2020
5 GHz	Potentially up to 320 MHz	Licence exempt, RLAN use

Source: Plum analysis, Ofcom Mobile Data Strategy, November 2013

Figure A-2

### Spectrum availability - current vs 2020



We note whilst total available spectrum for mobile increases from 630 MHz to 1180 MHz between now and 2020 the proportion of spectrum below 1 GHz decreases from 21% today to 16% in 2020 i.e. higher frequency spectrum is becoming relatively more abundant.

## Appendix B: Avoided cost provides additional information

Ofcom focus on auction outcomes in Europe and the 800 MHz and 2.6 GHz auction outcomes in the UK in particular as benchmarks for ALF. We do not assess these benchmarks. We focus here on information available on avoided cost. Avoided cost or technical modelling is considered by Ofcom but rejected on grounds that:

*“Market values derived from technical and commercial cost modelling are highly sensitive to the range of assumptions that need to be made, such that we consider that an attempt to derive point estimates of value based on this approach would be of limited additional benefit.”*  
Para 4.11.

Avoided cost modelling provides a range of information additional to auction values which is relevant to the assessment of benchmarks and setting of ALF, in particular avoided cost modelling provides:

- An alternative source of information on value which does not include strategic value.
- Information on the relative value of different frequency bands.
- Information on the timing of benefits.

Avoided cost modelling is a valuable source of information which should be considered alongside auction values. Indeed Ofcom have utilised avoided cost modelling to inform policy in a range of contexts, in particular avoided cost modelling is relied on as a benchmark in setting AIP. Here we focus on a recent, comprehensive and transparent avoided cost study for Ofcom by Real Wireless.<sup>65</sup> The modelling results of this study indicated that:

- The avoided cost associated with further spectrum may be comparatively low compared to recent auction benchmarks. The estimated net present value of avoided cost for 700 MHz was in the approximate range £1m-£4m per MHz for the UK, significantly below the level of ALF proposed by Ofcom. Even if the estimates were doubled to allow for the different time period they would still be well below the Ofcom proposals of £25m and £15m per MHz proposed for 900 MHz and 1800 MHz respectively.
- 700 MHz is more valuable than higher frequency spectrum for capacity (in addition to coverage) with a relative spectral efficiency advantage.
- Avoided cost benefits are dominated by medium term savings post 2020 when, in absolute terms, most traffic growth and therefore scope for avoided network costs occurs.

The above suggests that (a) ALF based on recent auction values may overstate opportunity cost per MHz over the next 20 years, (b) the value of lower frequency spectrum is higher even from a capacity perspective alone and (c) terminal value is likely to be material and should be accounted for in translating auction benchmarks into ALF.

Avoided cost was calculated for urban, suburban and rural sub-areas with and without availability of 2x40 MHz of 700 MHz spectrum in 2020 and 2026 (using a social discount rate of 3.5% which differs slightly from the discount rate of 4.2% used by Ofcom in converting auction values to annual values). Focussing on release in 2020 we summarise the values below and convert the avoided cost estimates to £ per MHz (Table B-1).

<sup>65</sup> Real Wireless. “Techniques for increasing the capacity of wireless broadband networks: UK, 2012-2030”. April 2012.  
<http://www.ofcom.org.uk/static/uhf/real-wireless-report.pdf>

Table B-1: Real Wireless avoided cost estimates for 700 MHz<sup>66</sup>

	Urban	Suburban	Rural
Weight	3%	2%	1%
No 700 MHz	£8.6m	£14.2m	£12.3m
700 MHz in 2020	£6.2m	£8.4m	£10.5m
Cost saving	£2.4m	£5.8m	£1.8m
Saving scaled up to 100% assuming area is representative of UK	£80m	£290m	£180m
Net present value (NPV) per MHz	£1m per MHz	£3.6m per MHz	£2.3m per MHz

These estimates are underestimates relative to the Ofcom proposed per MHz values since they relate to spectrum available only from 2020 and estimated out to 2030. However, an adjustment for these considerations would not necessarily be that large, in particular as nearly all the traffic growth (in absolute terms) and therefore avoided cost occurs post 2020.

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<sup>66</sup> Real Wireless. April 2012.