Review of spectrum fees for fixed links and satellite services: Initial consultation

EE response to Ofcom's Initial consultation

30 July 2015

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1. Executive summary

EE Limited ("EE") welcomes the opportunity to comment on Ofcom's *Review of spectrum fees for fixed links and satellite services: Initial consultation*, published 21 May 2015 (the "Consultation) and the Plum report "*Support to Ofcom's review of fees for fixed links and permanent earth stations,* dated 16 April 2015 (the "Plum recommendations").

EE supports the forward looking review of the current spectrum fees algorithm for fixed and satellite links - which was last reviewed over 10 years ago in 2004 - to ensure that changing demand and supply conditions, technologies, and other trends are fully reflected in spectrum fees. EE considers that by taking into account likely significant developments in these areas, spectrum fees will better reflect the forward looking long run opportunity cost of spectrum use and fees will be more likely to promote more efficient future investments in, and use of, fixed and satellite links.

EE's fixed links (otherwise known as microwave links), typically operated between two or more fixed points using radio equipment (e.g. antennas and/or dishes), are an essential input to the provision of EE's wholesale mobile backhaul network service, including in relation to remote and rural cell sites. EE self-supplies [✂] of its microwave links, and approximately [✂] of EE's mobile cell sites are connected by microwave links. The other [✂] of sites are connected by leased lines purchased from BT or Virgin Media ("VM"). Accordingly, any changes to microwave link pricing will heavily influence EE's longer term backhaul strategy, including in relation to future investments in ETSI class 4 antenna radio equipment.

As set out in the body of this response, EE agrees with many of the Plum recommendations including Plum's analysis of current and likely future likely demand and supply conditions, and relevant technologies likely to use fixed link spectrum.

EE also agrees with:

1. Plum's cost assumptions and the Least Cost Alternative ("LCA") methodology Plum has used to estimate the opportunity cost of the spectrum; and
2. a number of the specific changes to the fixed links fees algorithms that Plum has recommended (including in relation to geographic pricing).

In particular:

- EE agrees with the following specific Plum recommendations in relation to the fixed link reference rate based on the LCA methodology:
    - applying administered incentive pricing ("AIP") to fixed links where frequency bands remain moderately congested for fixed link self-use based on a reference fee rate of **£42 per 2 X 1 MHz** (i.e. below 20 GHz);
    - applying administrative cost based fees where there is relatively less congestion for fixed link self-use (i.e. **above 20 GHz**); and

  - where mobile is deemed a feasible alternative use (i.e**. 3.6 - 3.8 GHz band**), increased fees to reflect the higher opportunity cost of alternative mobile use in this band, based on a reference rate of around **£365 per 2 x 1 MHz**).

- EE supports in relation to the fixed links fees algorithm the Plum recommendations to implement geographic pricing for fixed links in less congested areas and below 20 GHz, including discounts to AIP based fees (of between 30% - 90%) in areas of low to medium spectrum use, and in areas of very low spectrum use, implementing administrative cost based fees:
  - EE agrees with Plum that geographic pricing will promote efficient future use of spectrum, including efficient use where new links will be required to provide mobile backhaul to new remote and rural sites (i.e. in areas that are relatively uncongested).
  - However, EE suggests a few improvements to the algorithm, including (i) measuring congestion directly based on Radio Frequency ("RF") density rather than indirectly based on population density and (ii) further consideration of both 50km and 100km grid squares options for applying discounts in areas of low and medium spectrum use.

However EE has some concerns regarding certain of the other key Plum recommendations and analysis. In particular:

- EE highlights in the body of this response a number of potential risks that could arise when attempting to revise the fixed links algorithm to reflect measures of high performance antennas, as well as some further suggested improvements.
- EE does not support the use of Automatic Transmit Power Control ("ATPC") as we do not believe a fees algorithm based on ATPC can promote efficiency in bands with existing fixed power radio deployments.
- EE does not support the Plum recommendation to remove the path length factor.
- [✂].

By way of general views on the potential implementation of the Plum recommendations, for the reasons set out in our response to question 15 in Annex 1:

- EE believes that where Ofcom are proposing fee increases (e.g. including in relation to the 3.6 – 3.8 GHz band where mobile is potentially a higher value alternative use for the spectrum), there may be an argument for phasing in, possibly over three years; and
- EE believes that where Ofcom propose fee reductions (including reductions in fees from opportunity cost to cost recovery levels) these should be passed on in full immediately from the date of the implementation of the new fees regulations.

- We propose this conservative approach to reflect the inherent asymmetric risk of setting spectrum fees too high.

In the remainder of this response, EE elaborates on these points and also provides some additional analysis and proposes a number of suggested improvements to the Plum recommendations, which we set out in our response to Ofcom's consultation questions (see Annex 1 of this response).

2. General comments on the Plum recommendations

This section sets out EE's general comments on the Plum recommendations and reflects the structure of the Plum report.

1. Current and potential alternative uses of bands

EE agrees that in all fixed link bands in the frequencies from 1.4 GHz to 80 GHz (except 1.4 GHz, 3.6 - 3.8 GHz – see below), own fixed link use (i.e. self-use) represents the highest valued current and future use.

Figure 1 illustrates EE's own fixed link use within EE's overall mobile backhaul network architecture. EE makes the following comments about its usage:

- EE self-supplies [✂of its microwave links (i.e.[✂]).[1]
- These links are self-supplied for use both on a unilateral basis (within EE's legacy ex Orange network) and on a shared basis (within the shared network with Hutchison 3G UK Limited ("H3G") operated by Mobile Broadband Network Limited ("MBNL"). [✂].
- [✂] of EE's [✂] radio access network ("RAN") cell sites (i.e. BTS, NodeB's and eNodeB) are connected by microwave links (shown as a red 'electricity bolt' in a red square in Figure 1). These microwave links in turn connect to Ethernet Leased Line ("ELL") hubs for aggregation and onward high speed transmission to EE's core network (e.g. the blue connections in the red square in Figure 1). EE notes the following about this usage:
    - EE typically uses links in the lower frequencies (1.4 GHz – 10 GHz) in rural and remote areas where distances of [✂] are required to connect sites to the nearest ELL hub;
    - EE uses links in the 10-20 GHz range typically to cover distances of up to [✂]; and
    - EE typically uses links the higher frequencies (above 20 GHz) in urban and suburban areas where higher capacity microwave links are needed over shorter distances (as short as [✂]) to connect sites to the nearest ELL hub.
- EE's microwave links can connect to ELL hubs supplied by both BT (shown as blue connections in Figure 1 below) and by VM (shown as green connections below in Figure 1 below). The ELL hubs are typically 1 Gigabit/s Ethernet products (ie up to 1000Mbps) to support LTE backhaul.
- Chains of fixed links tend to drive higher capacity on hops close to the ELL hubs, and higher capacity microwave is required at these locations, including to support LTE.

[1] [✂].

Figure 1 EE's Overall Mobile Backhaul Architecture

[✂]

EE provides detailed comments on the Plum analysis of current and potential alternative uses of bands in response to consultation questions 1-2 at Annex 1. However EE would highlight in this regard that:

- There are rural and remote cell sites where there is no suitable transmission path to the nearest Ethernet hub. These sites are referred to as 'hard to do' sites'. In these cases traditional backhaul solutions such as fixed links or leased lines may not be suitable even if the site is not physically hard to reach.
- [✂]
- For the reasons set out in EE's response to Question 1, EE agrees that in the 1.4GHz and 3.6 - 3.8 GHz bands, mobile is potentially a higher value alternative use for the spectrum.

2. Demand outlook

1.4 – 4 GHz bands

EE agrees that demand for fixed links at 1.4 GHz is broadly static and is low at 4 GHz.

EE expects to have limited additional demand for links at these bands [✂]. Although EE's demand is low for these links, it is important to recognise that these links may be [✂] very important where backhaul to remote and rural areas cannot otherwise be served (e.g. through fixed links in higher bands, leased lines [✂]).

EE considers [✂] both 1.4 GHz and 4 GHz links could support EE to meet its regulatory commitments to extend rural coverage by providing backhaul services to remote and rural sites.

6 – 10 GHz bands

EE agrees that the frequency bands used in fixed links in the 6-10 GHz range are likely to be moderately congested in urban and suburban areas where there is higher link density and heavier spectrum use.

In contrast EE does not consider that there is any evidence to suggest congestion in the 6-10 GHz bands in relation to many rural and remote locations across the UK. However, EE expects to have additional demand for further fixed links in these areas of low link density and spectrum use, in order to connect new rural and remote cell sites to ELL hubs for aggregation and onward high speed transmission to EE's core network

Demand for additional links to these locations in the 6-10 GHz bands arises in part from compliance with regulatory and other requirements to minimise areas of not-spots (e.g. under the Mobile Infrastructure Project ("MIP")) and partial not-spots (including under the new 90% geographic coverage obligation now

reflected in 900 MHz and 1800 MHz spectrum licences.[2] In relation to partial not-spots, many of these areas do not have mobile network coverage because of the difficulties and costs in establishing base stations. Extending coverage further to areas without outdoor coverage today cannot readily be achieved with a small number of high coverage sites owing to a number of practical challenges in such areas, typically dominated by hilly terrain, and that have limited opportunities for backhaul.

EE makes the following further comments about demand for fixed links in the 6-10 GHz range:

- First, EE notes that it has a relatively large number of fixed links in the 10GHz band [✂].
- As a result, the ability to deploy additional fixed links in the neighbouring Ofcom managed 6 GHz and 7.5 GHz bands (as well as in the higher 15 and 18 GHz bands – see below) will be essential to allow EE to provide mobile backhaul over large distances [✂] to remote and rural cell sites. Deploying these microwave backhaul links to these sites will be critical to ensuring compliance with the new 90% geographic coverage obligation within EE's existing 1800 MHz spectrum licenses.
- Second, EE notes that microwave links must also be of sufficiently high 'bit rates' to ensure mobile backhaul can support growing demand for 4G data services including at rural and remote sites. Accordingly microwave links in lower frequencies (and which tend to operate over longer distances) must be capable of supporting both EE's overall coverage and capacity backhaul requirements.

EE agrees that 5G use above 6 GHz remains highly uncertain and is not due for consideration until WRC 19 and that for this reason 5G mobile use is not a relevant higher valued alternative use for setting fixed link fees in these 6-10 GHz bands. This view may need to be reconsidered further in any future review (possibly in 5 years).

10-20 GHz bands

EE agrees that demand for fixed links in the 10-20 GHz frequency range is unlikely to decline, meaning these bands will continue to be moderately congested. Given congestion of fixed links in the 10GHz band (which MBNL manages), and the Ofcom managed band of 13 GHz, EE will require additional links in the 15 and 18 GHz band which are suited to longer links.

Above 20 GHz bands

2 The new 90% geographic coverage obligation was agreed with the Secretary of State in principle in December 2014 pursuant to a Statement of Commitments and reflected in voluntary licence variations to each of the current 1800 MHz and 900 MHz licences effected by Ofcom on 31st January 2015. Notably, whilst this coverage obligation for reasons of flexibility and pragmatism allows the 1800 and 900 MHz licensees to fulfil the obligation using also any 2.1 GHz or 800 MHz spectrum which they may additionally hold, it is only a binding term of the 1800/900 MHz licences. It is thus uniquely binding only in relation to the 1800 and 900 MHz spectrum (and accordingly only on anyone who currently or in future may come to hold that spectrum under the present licence terms).

While deployment of 4G networks and small cells is increasing the demand for mobile backhaul capacity, EE considers that there is unlikely to be excess demand for fixed links in bands above 20 GHz. This is because of:

- increased supply of spectrum in high frequency bands (as a result of spectrum awarded by auction in the 20-40 GHz range);
- high levels of reuse; and
- in some urban areas, increased availability of optic fibre, which can be a substitute for higher capacity microwave fixed links for some users.

EE has a current project in the E-Band (70-80GHz) that will start to deliver more fixed links in 2016. [✂]

In this regard, EE notes when Ofcom opened the 70GHz band to use for coordinated links in 2013, the fee arrangements that Ofcom put in place provided for a 5 year stability in the event of this current review recommending increasing fees . EE notes however that if this current review recommends reducing 70GHz band fees this arrangement would not prevent a fee reduction. In such a case, EE considers that any reduction should be implemented immediately after the completion of the review to promote efficient spectrum use at the earliest opportunity.

3. Opportunity cost estimates

EE agrees that Plum has identified the correct options for its LCA analysis by considering the choices facing a user wanting to deploy a new link that is denied access to a congested band – namely (i) deploying a more efficient technology in a less congested, higher frequency band or (ii) deploying an alternative wired service (i.e. leases lines).

EE provides detailed comments in relation to Plum's opportunity cost estimates in response to consultation questions 4, 5 and 6 in Annex 1 to this response.

4. Fixed link algorithm

Given EE's substantial holdings of fixed links, and the importance these links to the provision of EE's wholesale mobile backhaul service, any changes to microwave link pricing will significantly impact EE's longer term backhaul strategy.

EE has technically been assigned links in the Ofcom managed bands 1.4 GHz, 7.5GHz, 13 GHz, 15 GHz, 18 GHz, 22 GHz, 23 GHz, 25 GHz, 26 GHz and 38 GHz. [✂]. These fixed links are currently subject to AIP (and hence are directly affected by the Plum recommendations).

In addition to these technically assigned fixed links, [✂] self-coordinated fixed link licences in the 10 GHz, 32 GHz and 40 GHz bands [✂]. Unlike links operated in the Ofcom managed bands these are presently charged on a cost basis and not subject to AIP (although EE notes that the Plum recommendations could be determined by Ofcom to apply to these links from as early as 2023).

EE also notes that on some hill top sites there is a high propensity to share the site amongst mobile network operators ("MNOs"). This is likely to represent efficient collocation and should not be penalised within the proposed fees algorithm (i.e. should not face higher fees). EE considers that Ofcom should explicitly factor in this into its final fee proposals.

EE provides detailed comments on the Plum's proposed fixed links reference fees and algorithms in response to consultation questions 8-12 and 14 in Annex 1 to this response.

5. AIP fees

EE supports the Plum recommendations for reference fees based on the recognisable trends in demand for fixed link self-use, based on the opportunity cost of the spectrum (i.e. where mobile is not deemed a feasible alternative use).

Below 20 GHz (except 3.6 – 3.8 GHz)

As set out above, EE agrees with the Plum analysis that below 20 GHz, there is likely to be continued modest congestion in the 6-10 GHz and 10-20 GHz bands. Accordingly, EE agrees that there is likely to be a case for AIP fees to apply in these bands in the future. EE's further detailed comments are as follows:

- EE supports Plum's recommendation to use 13 GHz as the reference band and considers that reference fees should be no greater than **£42 per 2 X 1 MHz** for all bands under 20 GHz (except for 3.6 – 3.8 GHz see below).
- EE notes that, in areas of low fixed link density, significant discounts must be applied to the LCA based reference fees (and in areas of very low use, cost reflective fees only).
- EE queries Ofcom's statement in the Consultation that supports marginally higher fees than Plum below 20 GHz (see Ofcom's paragraph 1.10). We would be grateful if Ofcom could explain why it takes this view, absent any further contrary evidence and noting that stakeholders have not yet commented on the Plum recommendations.

Above 20 GHz

As set out above, EE agrees that spectrum is relatively uncongested in Ofcom managed bands above 20 GHz. EE accordingly agrees with the Plum recommendations that in the future administrative cost based fees may be appropriate.

3.6 – 3.8 GHz

Where mobile is deemed a feasible alternative use (i.e. currently in the 3.6-3.8 GHz band) EE agrees with Plum that there may be a case for increased fees to reflect the higher opportunity cost of alternative mobile use in this band.

EE agrees with the proposed direction in fees proposed in the Plum recommendations – i.e. an increase. EE also agrees with the Plum

recommendation that the fees should be based on a reference rate of around **£365 per 2 x 1 MHz**.

Self- managed bands

EE notes that fixed links in the MBNL self-managed bands including in the 10, 32 and 40 GHz bands are not currently subject to AIP fees. However these could potentially become subject to AIP from 2023.

6. Implementation

EE believes that where Ofcom are proposing fee increases (e.g. including in relation to the 3.6 – 3.8 GHz band where mobile is potentially a higher value alternative use for the spectrum.) there may be an argument for phasing in, possibly over three years. In contrast, EE believes that where Ofcom propose fee reductions (including reductions in fees from opportunity cost to cost recovery levels) these should be passed on in full immediately from the date of the implementation of the new fees regulations. EE's rationale for these recommendations is set out in our response to question 15 in Annex 1.

As noted above in section 2, EE does not believe that the fee arrangements Ofcom put in place in 2013 when it opened the 70GHz band to use for coordinated links would prevent a fee reduction being implemented prior to 2018, in event that this current review recommends reducing 70GHz band fees. In such a case, for the reasons explained in section 2, EE considers that any reduction should be implemented immediately after the completion of the review.

EE provides detailed comments on implementation issues in response to consultation question 15 in Annex 1 to this response.

Annex 1: EE specific comments in response to Ofcom's consultation questions

Question 1 Do you agree with Plum's view of the potential higher value alternative mobile use of the 3.6-3.8 GHz bands over the next seven to ten years?

Yes. EE agrees that over the next seven to ten years in mobile is likely to be a higher value alternative use for spectrum in the **3.6 - 3.8 GHz** bands than use of these bands for fixed links.

First the **3.4 - 3.8 GHz** bands are currently harmonised for mobile broadband in Europe.

Second, Ofcom have proposed to make spectrum in the **3.4 - 3.6 GHz** bands available for mobile use in the very near future (i.e. before the end of 2016).[3]

Third, the **3.6 - 3.8 GHz** bands could be made for available mobile services in the UK as soon as 2022 (or possibly earlier).

Question 2 Do you agree with Plum's analysis of current and future demand for spectrum for fixed links? Please give your reasoning.

Please see EE's comments in section 2 of this response.

Question 3 Do you agree with Plum's analysis of current and future demand of spectrum for PES and TES? Please give your reasoning.

Plum suggests that the use of spectrum by satellite earth stations (PES and TES) has not grown significantly in the last three years and that there is likely to be only modest future demand grow. [✂].

Question 4 Do you agree with the approach taken by Plum to calculate the opportunity cost of the spectrum? If not, how would you suggest the LCA is calculated? Do you also agree that this methodology is likely to provide a more conservative estimate?

EE agrees with the LCA approach taken by Plum to calculate the opportunity cost of the spectrum.

EE notes that fixed links are inherently different to an exclusive scarce mobile spectrum allocation (e.g. 1800 MHz or any other mobile spectrum) . Given that fixed link bands are a shared resource between multiple users and that no individual user has a specific responsibility for overall efficient management, without explicit financial incentives to moderate behaviour in face of particular

3 Public Sector Spectrum Release: Award of the of the 2.3 GHz and 3.4 GHz spectrum bands: Statement and Further Consultation, published 26 May 2015. Ofcom's current proposal is to auction at least part of this spectrum within financial year 2015/16. [✂].

band scarcity, the spectrum would be at risk of falling victim to the 'tragedy of the commons'.

This is in stark contrast to where there is exclusivity of mobile use with substantial committed infrastructure costs, no readily available substitute resource and external demand drivers incentivising efficiency. For these reasons, EE maintains that explicit spectrum fees are unnecessary in relation to exclusive scarce mobile spectrum (e.g. 900 MHz and 1800 MHz) as MNOs presently face the opportunity cost of this spectrum.

Consistent with these differences in spectrum characteristics, EE agrees with the Plum recommendations that explicit fees to reflect opportunity will promote efficient deployment of fixed links where the spectrum is a shared resource and where there is clear risk of overuse and negative externalities.

Question 5 Do you agree that Plum has identified the correct options for its LCA analysis? If not, what option(s) do you suggest we consider for the Least Cost Alternative?

EE agrees that Plum has identified the correct options for its LCA analysis by considering choices facing a user wanting to deploy a new link that is denied access to a congested band – (i) deploying a more efficient technology in a less congested, higher frequency band or (ii) deploying an alternative wired service (i.e. leased lines). EE's reasoning is as follows:

- For new point-to-point fixed links, there will be a clear choice between using a higher frequency requiring more infrastructure investment (where this is practically feasible) but imposing a lower opportunity cost, and using a lower frequency, which requires fewer links to cover the distance but possibly denies spectrum to a higher valued fixed link user.
- In relation to existing links, in practice most links will already be deployed using legacy technologies that cannot be easily upgraded to operate in higher frequencies. In these cases (i.e. for legacy links) EE considers that higher fees to reflect congestion will be more likely to promote release of redundant links than the two options identified by Plum.
- However in identifying the correct options for its LCA analysis, EE agrees that Plum should take a conservative approach based on the choices facing a new user, which will give lower values than the case of an existing user.

Question 6 Do you agree with the cost assumptions that Plum has used in its analysis? Please provide documentary evidence if you disagree.

EE broadly agrees with the cost assumptions that Plum has used in its analysis.

Question 7 Are there any other pieces of publicly available evidence we could use to estimate the opportunity cost of the use of 3.6-3.8 GHz for mobile use now?

EE considers that the forthcoming Ofcom spectrum auction of 3.4-3.6 GHz could provide benchmarks for estimating the opportunity cost of the 3.6 - 3.8 GHz spectrum. However, EE considers that the forthcoming 2.3 GHz and 3.4 GHz auction results would need to be interpreted with caution to ensure that the bids were truly reflective of relevant competitive market based values for the purpose of developing benchmarks for 3.6 – 3.8 GHz.

Question 8 Do you have any comments on Plum's suggestion to remove the path length factor?

EE does not support Plum's recommendation to remove the path length factor from the fixed links fees algorithm. EE believes the path length factor should be retained. EE considers that removing the path length factor would undermine the disincentive to deploy many short links in the lower frequencies where there is already moderate congestion (and where EE is likely to have demand for additional links in the future). Short links can be significantly disruptive. [✂]. The Plum recommendations regarding the frequency band factor (see EEs response to Question 10 below) may only partially mitigate this harmful effect, but would not ameliorate it.

Question 9 Do you have any comments on Plum's suggestion to add a location factor?

EE supports Plum's recommendation in principle to implement locational (i.e. geographic) pricing including fee discounts for fixed links deployed in areas of low to medium spectrum use as this approach is likely to promote more efficient spectrum use in fixed links over the next 10-20 years.

Under the current spectrum fees algorithm for fixed links, there is no explicit recognition that congestion varies by geographic location across the UK. Fixed link users, such as EE, are effectively penalised by having to pay the same reference fees for fixed links deployed in rural and remote areas (typically areas of low spectrum use), compared to urban areas (i.e. typically areas of heavy spectrum use).

This approach to setting fees is especially perverse given EE's investment plans include deployment of links in these remote and rural areas including to meet regulatory commitments.

For instance, MNOs are currently required to comply with commitments to minimise areas of not-spots or partial not-spots, including the new 90% geographic coverage obligation. These obligations are ongoing and will need to supported at least over the next 10 - 20 years. Many total and partial not spots do not have mobile network coverage because of the difficulties and costs in establishing base stations. Extending coverage further to areas without outdoor coverage today cannot readily be achieved with a small number of high coverage sites owing to a number of practical challenges in such areas, typically dominated by hilly terrain, and that have limited opportunities for mobile backhaul.

Unless geographic pricing is implemented in uncongested areas of low and medium spectrum use , the current fees algorithm is likely to result in future sub

optimal use of fixed links in areas of low spectrum use, deterring efficient fixed link deployments that are critical to the MNOs' mobile backhaul service.

EE also believes that the long term benefits of implementing geographic pricing (i.e. promoting more efficient spectrum use over the next 10-20 years) are significant. EE considers that these substantial long term benefits are likely to far outweigh the likely costs of implementation of geographic pricing. EE believes that geographic pricing can be easily implemented and considers that the costs of implementation should be very minimal, including where own fixed link use is the highest valued use (these costs and benefits are further discussed in EE's response to Question 14)).

EE makes the following comments on, and suggested improvements to, the Plum proposals which should form the basis of any further detailed consultation proposals.

First, EE supports Plum's proposal to implement geographic pricing in the form of either discounts to LCA based fees - or alternatively cost reflective fees - in areas of low to medium link density and therefore areas of low spectrum use.

Second, EE has reviewed Plum's worked example in relation to the 18 GHz band using an approach than defines geographic areas based on 100km grid squares. Plum adopts grid squares defined by well recognised Easting/Northing coordinates (see Figure 6-4 of the Plum Report). These grid squares are then categorised using population density ranges (taken from ONS census data). Plum then use population density as a proxy for fixed link density within each grid square (i.e. where lower population density suggests lower link density). EE makes the following comments about the methodology used in Plum's worked example:

- EE believes that there will be very few links where co-ordination areas exceed 50kms. Accordingly, EE recommends that Ofcom gives consideration to the use of grid squares based on 50km geographic areas (in addition to 100km geographic areas). We consider that this would create the benefit of having a more granular and accurate approach to assessing congestion by geographic area, and that this would promote long run efficient spectrum use. We consider that these benefits should outweigh the relatively small costs of setting up a more granular database to define congestion areas.
- EE believes that while there may be a correlation between population density and link density in some bands, a second order factor such as population density should only be used when information on first order factor (i.e. link density) is unavailable. This is because the rationale for setting (higher) fees is to incentivise behaviour, including minimising overuse and possible interference. Using a direct measure of link density for all bands is most likely to send the correct behavioural signals. The correction to the methodology recommended by EE is important, given that population density will never perfectly correlate with link density (and may in fact diverge significantly from link density in some bands for some fixed link deployments – see below).
- EE recommends that link density is measured based on the first order measure of RF density. EE considers that Statutory Instruments issued under the Wireless Telegraphy Act could specify the relevant RF

density within statutory processes of authorisation of licence fees at the beginning of each fee year. EE notes that RF density may be strongly or weakly correlated to population density depending on the application:

- short links at high frequency in high population areas have a high correlation with population (e.g. possibly at 18 GHz for example as suggested by Plum); but
- long links at low frequency will have a weak correlation with population (e.g. at 6GHz).

- If it could be demonstrated that RF density information was not available – or not available in a suitable format - EE would support Plum's proposed method of implementation using population density as a "second best" indirect measure of fixed link density - with the exception of the 6 GHz band, where this correlation is unlikely to be present.
- We illustrate below how the use of population density as a second order measure of link density might be used to send the correct behavioural signals where direct RF density information is not available, for all bands expect the 6 GHz band. The same principles would apply where link density was measured directly:[4]
  - Areas of very low use where there is no excess demand or congestion should pay fees to reflect cost recovery levels (i.e. not based on opportunity cost)
    - Eg <50 (population per 100 square km);
  - Areas of low and medium use where there is limited or moderate demand or congestion should receive a discount relative to the opportunity cost based fees (Plum suggests discounts in the range 30%-90%. EE considers that these values should be considered further in order to determine the exact appropriate discount values)
    - Eg 50-1200 (population per 100 square km);
  - Areas of high use where there is excess demand or congestion should pay opportunity cost based fees
    - Eg >1200 (population per 100 square km)

Third, EE notes that Ofcom proposes to move to cost reflective fees for links above 20 GHz. Accordingly, no geographic area discounts need to be made since LCA reference fees will not apply in these bands. EE agrees with this proposal.

[4] This illustrative proposal assumes 100kms grid square. As noted above, EE considers that further work needs to be undertaken to assess the merits of 50km grid squares. The population density for the various ranges would of course need to be adjusted if 50km squares were applied.

Question 10 What are your views on the need to revise the bandwidth factor in the fixed link algorithm?

EE notes that the Plum recommendations include:

- no change to the existing *bandwidth* factor; but
- a revised *band* factor, which now represents an intermediate parameter between the current band factor and an inverse frequency relationship.

The *bandwidth factor* is the value of actual system bandwidth (e.g. MHz channel). The *frequency band factor* is determined by the actual frequency band (e.g. an integer value). Both are multiplicative factors in the current fees algorithm.

EE notes that Ofcom does not appear to be consulting on the Plum recommendation to revise the band factor, which will have the effect of adjusting upward the reference fee rate in the lower frequencies and adjusting downward the reference fee rate in the higher frequency bands. Plum recommend a band factor ranging from 4 to 0.1 (between the frequency bands 1.4 GHz and 100 GHz). Previously the band factor ranged from 1 to 0.17 (over the same frequency bands):

- EE considers that this revision directionally supports the overall approach to setting fees to incentivise users to deploy links in higher, less congested, bands. EE continues to assess the specific Plum proposal in relation to all frequency bands.
- As noted above in response to Question 8, EE considers that the Plum recommendations regarding the frequency band factor may partially mitigate the harmful effect of the proposal to remove the path length – which EE does not support at all - but would not ameliorate it.

EE notes that Ofcom's consultation Question 10 appears to ignore the Plum recommendation in relation to the *band* factor while at the same time proposing its own a change to the *bandwidth* factor (where Plum propose no change). EE requests that Ofcom clarify its position in relation to these factors. Ofcom has provided insufficient information relating to their proposal to revise the bandwidth factor for EE to meaningfully comment on the Ofcom proposal.

Question 11 What are your views on the benefits of additional incentives for the use of high performance antennas? How might these best be implemented in our fees algorithm?

EE agrees that in principle incentives to use higher performing antennas can promote efficient spectrum use. However, there are some important practical considerations that must be factored into a refinement of the proposals, which would need to be done before the impact of the proposals can be properly assessed (see also EEs response to the Plum proposals in relation to ATPC in Question 12):

- First, it is important to note that ETSI Class 4 antennas are not readily available in all bands/sizes, and for that reason, applying penalties for lack of use, rather than incentives for use, would be unfair as users would not be able to respond to higher fees by changing their behaviour including for existing deployments. For instance, many links

are deployed using radio equipment and dishes that cannot operate at higher frequencies and hence substitution to higher, less congested frequencies would only be an option where new deployments were being considered (or where assets lives were nearing their end).

- Second, EE is wary that Ofcom has previously suggested approaches that were well intended, but could have resulted in perverse incentives for use. For instance, in relation to antennas:
  - Ofcom's proposed implementation in 2004 was to apply a factor based on *average bore sight gain of all antennas used within the band* divided by *the actual bore-sight gain of antenna used*. The ratio would be calculated for each link-end and results multiplied to produce the final factor. The problem with this well-intended approach was that the factor generated a distortion towards antennas which are simply larger, rather than providing incentive to use those most efficient and large.
  - EE (then Orange) argued that Ofcom's proposed implementation could be improved by *multiplying* bore sight gain by the square root of the ETSI- 302-217-4-1/2 classification class (1 to 3 or 4) to produce an efficiency-weighted bore sight gain, with the results of *average antenna efficiency weighted bore sight gain*/*actual antenna efficiency weighted bore sight gain* for each link-end to then be multiplied as proposed by Ofcom. This could have helped remove the distortion towards antennas which were simply larger but not necessarily more efficient.
  - In the end, the proposal was dropped in its entirety by Ofcom back in 2004. EE considers that Ofcom should undertake further investigation of this previous proposal and consult on any findings in relation to incentives to promote use of efficient antennas.
- Third, EE has historically argued that a transparency requirement should be placed on Ofcom to publish tables of average values (eg RF density) as part of the statutory process of authorisation of licence fees at the beginning of each fee year, with those values to be used for fee calculation throughout that year. We think this approach still has merit for use in conjunction with the current Consultation proposals.
- Fourth, EE believes that the development of explicit modifiers for specific equipment innovation should be viewed within the context of Ofcom's overall objective to correctly influence behaviour through the pricing algorithm. Setting specific factors tied to specific equipment innovations relies on Ofcom being able to pick innovation 'winners', which inherent carries risk of regulatory failure. The role of the pricing algorithm should be to push behavioural change towards efficiency (where desirable given interference/congestion), one facet of which is to drive equipment efficiency innovation. Innovation does not need, and probably should not be driven, by explicit pricing algorithm components favouring a particular technical solution. Typically it will be more favourable to allow for incentives that allow lowest cost solutions to emerge.

Question 12 What are your views on the suggestion that we further consider ways to incentivise the use of automatic power control, a suggestion we are minded not to take up?

EE does not believe ATPC would promote efficient spectrum use in either (a) bands where there are existing deployments of fixed power radio or (b) new bands with no fixed power deployments and where there is no congestion in own fixed link use.

Radio equipment that is compatible with ATPC typically has a minimum power requirement that can be dynamically increased during period of signal degradation (also known as fade conditions).

Plum argues that ATPC may improve efficiency of spectrum use:

"Implement automatic transmit power control (ATPC) so that additional power is only used during a fade. There is no benefit to the fixed link licensee but there is potential benefit to the fixed link community in terms of accommodating more links overall."[5]

However, Ofcom's legacy spectrum regulator (RA) commissioned a study by BT which demonstrated the detrimental performance of adopting ATPC in bands with significant deployments of fixed power radio's. BT demonstrated a significant disadvantage to a fixed link licensee with ATPC during fading conditions, because even if only one operator has a fixed power link, this will sterilise the entire band for fixed link users with ATPC compatible radio equipment during fade conditions.

ATPC would therefore only be technically feasible in relation to the introduction of new bands, such as 6 GHz or possibly 70/80GHz (i.e. the E band) where there is no legacy fixed power radio equipment . However, in the E-Band where there are presently very few or no fixed link deployments, these bands will not be congested and hence it would not make sense to incentivise ATPC use to ration use (e.g. applying a discount to an opportunity cost based fees for ATPC would not be economically efficient if the spectrum is not scarce, although EE agrees it could still have some value in providing for better coordination and management of the band).

Question 13 What are your views on the proposed revisions to the PES algorithm and the TES ratio? In particular, do you agree we should use the relative denial areas to reflect the difference in opportunity cost between PES, TES and fixed links? Do you have any other suggestions for improvement?

EE does not have specific comments in relation to Question 13 as we are neither a PES nor TES user.

[✂].

[5] Plum, page 69.

Question 14 Do you agree that the benefits of implementing geographic pricing are sufficiently high to warrant us considering this further? Should we look at both where mobile is, and is not, an alternative use? Do you have ideas on how this could be implemented?

EE believes that the long term benefits of implementing geographic pricing (i.e. to promote more efficient spectrum use over the next 10-20 years) are significant, and are likely to outweigh the likely minimal costs of implementation. EE considers that a cost benefit assessment would be likely to demonstrate sizeable net benefits of such an approach.

In relation to benefits of geographic pricing, the welfare gain will include extended coverage (and capacity) by deploying fixed links to cells sites in remote and rural areas as well as providing higher capacity microwave in low and medium congested areas. These benefits are clearly significant, given the value of downstream retail mobile services to the UK economy and the fact that fixed links represent an essential and key strategic input to the wholesale mobile backhaul service underpinning the retail mobile service.

In relation to the costs of implementation of geographic pricing, EE notes that since 2004, radio network planning tools, based on vastly increased computer processing power, have improved functionality and hence granular geographic pricing based on easting and northing coordinates on either 50 km or 100 km grid squares can readily be implemented in available software packages and planning tools.

Question 15 Do you have any comments to make on any issues related to next steps and implementation?

EE believes that where Ofcom is proposing fee increases (e.g. including in relation to the 4 GHz band) there may be an argument for phasing in, possibly over three years. In contrast, EE believes that where Ofcom propose fee reductions (including reductions in fees from opportunity cost to cost recovery levels) these should be passed on in full immediately from the date of the implementation of the new fees regulations. EE's reasoning for this approach to implementation is set out below.

Ofcom has previously argued that when setting spectrum fees the risk of setting fees too high (leading to lower investments and higher consumer prices – or in the extreme – spectrum being left fallow) must be compared against the risk of setting fees too low (which may not provide incentive for efficient resource allocation).

Even where licence fees (set at full market value) reflect relevant opportunity costs, there remains a short run risk of disruption to (amongst others):

- making relevant operational changes;
- accommodating financial impacts, including on investments;
- operating costs; and
- consumer pricing.

Ofcom has always considered phasing-in to be an important element of a conservative approach to setting fees in the presence of asymmetric risk . Ofcom has historically recognised that even fee levels consistent with long run opportunity cost could be highly disruptive in the short run if applied for the first

time without any phasing-in. For instance, when consulting on spectrum fees for maritime users in 2009, Ofcom stated:

> *"7.84 We consider that the principle of phasing is particularly important for mitigating the risk of changing fee rates too rapidly, and thereby risking inefficient disruption to service provision. We consider that if fees increase too quickly before action can be taken to reduce spectrum costs and if total cost changes cannot efficiently be passed through to service users, or temporarily absorbed within the business, the financial viability of licensees may be temporarily adversely affected, such that some marginal services could be put at risk and, in the most extreme cases, inefficiently withdrawn. In the extreme scenario, the value of the marginal services could then be forgone temporarily or even permanently, resulting in a loss of benefits for both citizens and consumers*
>
> *7.86 In considering these two potential, opposite risks – from changes implemented too fast and from changes implemented too slowly – we would generally, in light of our duties to consumers and citizens, place relatively more weight on the risks of disruption from phasing in fees too quickly.*
>
> *7.87 We also note that, if fees are subsequently observed to be significantly below the underlying opportunity costs of the spectrum, they can be reviewed and revised upward where appropriate in future as described above, although variations of this nature should generally be restricted to the availability of significant new evidence as set out above. In light of these considerations, we generally adopt a conservative approach to phasing in increases. We believe that such an approach is appropriate in this case, and are therefore proposing phasing-in periods for significant fee increases."(emphasis added)*

Ofcom then concluded that:

> *"2.102 We are proposing to introduce these changes during the first half of 2010, but we propose to phase in some fee changes over up to three years"*
>
> *"7.105 While the changes are typically very small in the context of the licensees' total annual variations in business costs, they represent sufficiently sharp signals that some users may wish to make efficient marginal changes in business structure (including spectrum usage) over time." 115*

A key issue raised in the above Ofcom analysis is that disruptive short run effects could potentially be so great that, at the margin, current or future services could be forgone temporarily or even permanently. This will clearly impact on any cost-benefit assessment, because the financial impacts are so great that they in fact undermine competition and service provision in the market more broadly and reduce aggregate welfare.

In keeping with a conservative approach EE also considers that where Ofcom propose fee reductions (including reductions in fees from opportunity cost to cost recovery levels) these should be passed on in full immediately from the

date of the implementation of the new fees regulations (leaving fees too high is likely to disincentivise efficient spectrum use).