Coverage obligations in the 700 MHz and 3.6 - 3.8 GHz spectrum award

- Ofcom's approach to verifying compliance

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Executive summary

1. BT supports Ofcom and Government's ambition to further extend mobile coverage across the UK. We agree that coverage obligations included within the forthcoming 700MHz and 3.6 GHz spectrum auction must have a verification method agreed in advance and clearly referenced within the awarded licences. We provided our views on the proposed obligations themselves in our response to the main consultation on the auction, including our concerns about inclusion of "sub-obligations" relating to new sites and new premises coverage. We have explained why these are not suitable to meet Ofcom's policy objectives or to move towards the Government's objective of achieving 95% geographic coverage. Notwithstanding our opposition to the proposed new sites and new premises coverage requirement, within this response we address the verification of these sub-obligations as well as verification of geographic coverage obligations.

2. For verification of geographic coverage we recognise that use of a single Ofcom coverage model is in principle attractive. However, we are concerned that Ofcom's model has not been sufficiently calibrated, evaluated or validated with measurements. The accuracy of the model is therefore unknown, as is whether it tends to predict more or less coverage compared to operator models, either generally or for specific frequency bands that particular operators use. We will continue to evaluate Ofcom's compliance model in the coming months and may provide further feedback to Ofcom if issues are identified. We believe the existing cross-operator forum to evaluate representation of mobile coverage, chaired by Ofcom, is the appropriate place to have these discussions.

3. Given these concerns in relation to Ofcom's coverage model, we are of the view that the operators' own coverage models should be used to verify compliance, at least until further work has been done to be confident that the Ofcom model is more suitable for the purposes to which it is to be used. Ofcom's proposal to calibrate its model against operator models, and to adjust coverage targets accordingly, may effectively come close to the same result as using operators' own models with a fixed coverage target but has no obvious benefit and is not in our view the best solution.

4. For verification of new premises coverage, we agree with Ofcom's proposals to use the operators' own coverage models to ensure that the number of premises without coverage at the date of compliance, when compared to the number immediately after the award, is fewer by at least the amount of the target. This is a pragmatic approach given the inevitable differences in models at the very detailed level, as Ofcom acknowledges.

5. We agree that a new sites obligation could be verified in a straightforward way by Ofcom checking coverage is provided at a sample of the list of new sites that the obligated operator would be required to provide.

6. Finally, we agree that the obligations may need to be adapted in future to include new technologies such as 5G. This will require ongoing collaboration between operators and Ofcom to reach mutual agreement. We also acknowledge that once achieved Ofcom will need to ensure that the obligations continue to be met in accordance with the licences.

1 Introduction

This response should be read in conjunction with our response to the parallel consultation on the 700 MHz and 3.6 – 3.8 GHz auction proposals (which we refer to as the main auction consultation)[1]. In that response we set out our views on Ofcom's proposed coverage obligations.[2] We expressed significant concerns over the inclusion of the sub-obligations that would require 500 new sites to be established and 140,000 new premises to have good mobile coverage. We advocated simple geographic (UK and nations) coverage obligations – or an equivalent requirement to serve new premises in total not spots – as a better means to achieve Ofcom's policy goals and to move towards the Government's 95% coverage ambition. The verification methodology would obviously have to be simplified accordingly.

We set out below our views on the present proposals concerning how the geographic, premises and new sites obligations should be verified if Ofcom were to proceed with such obligations. This responds to Ofcom's consultation question:

> *Question 1: Do you have any comments on the compliance methodology set out in this document? Please give reasons for your views, supported by evidence.*

2 Geographic coverage obligation compliance

2.1 Modelling supplemented by measurements

We note that Ofcom intends to rely on a mixture of coverage predictions and on the ground testing. In principle we agree with such an approach to verifying compliance but would emphasise the need to ensure that such measurements are based on an agreed measurement methodology and are statistically significant before they can be relied on, which can be a very significant undertaking.

The choice of model(s) for predicting coverage is critically important and we address this point below.

2.2 Calibrating Ofcom's model to measure 90% compliance

Ofcom has considered three options for assessing compliance with the geographic coverage obligations:

(i) verification with Ofcom's model;
(ii) verification with operators' models; and
(iii) verification with Ofcom's model after calibration to operator models to adjust the target thresholds – Ofcom's proposed methodology.

General remarks

Before assessing the various potential options for which model should be used for coverage prediction, it is important to note that no available model can be expected to perfectly predict coverage in all locations within the various geo-types and in different frequency bands. Even if the

[1] Consultation: award of 700MHz and 3.6-3.8GHz spectrum bands, Ofcom, December 2018. https://www.ofcom.org.uk/consultations-and-statements/category-1/award-700mhz-3.6-3.8ghz-spectrum

[2] For the avoidance of doubt, as we explained in our response to Ofcom's main consultation, analysis presented in that response was based on calculations made using BT's coverage model, not Ofcom's model.

models were near perfect, underlying databases of terrain and clutter will be of a limited precision and may need to be updated over time to continually improve or maintain their accuracy. Ultimately, these models can only provide predictions, not an absolute guarantee of actual signal levels at a given location, and should be understood as such.

Because of the inherent complexity of the propagation models and their associated databases, and the need to build confidence in their accuracy with extensive measurements, adoption of a new model requires substantial time and effort to build confidence in its suitability and should not be rushed. A single Ofcom model, that has been evaluated and accepted by operators and is calibrated successfully for all network layers would be an ideal long-term aim, but we question whether that is feasible within the timescales for the upcoming auction. The limited time allowed for operators to assess Ofcom's model creates a very practical problem in this regard as we have not been able to convince ourselves that Ofcom's model can make sufficiently reliable predictions of coverage or how the predictions of Ofcom's model relate to the predictions of our model. We consider that the most appropriate place to discuss the details of such a model is the cross-operator forum that Ofcom is already facilitating to discuss representation of mobile coverage to consumers. This forum has already made good progress in moving forward conversations on properly measuring coverage and seems the ideal place for Ofcom to work with industry to develop its ideas.

Below we discuss each of the potential options for the prediction model to be used in the compliance assessment in further detail and explain why, all things considered, the most practical approach – given the proposed timescales of the auction - would be to use operator models.

Verification only with Ofcom's model – a longer-term option

In principle a single prediction model, if sufficiently accurate and equitable across all operators, would be a simple means to determine and compare operator coverage. This is a laudable longer term goal, but we don't believe it to be the most suitable approach within the timescales of this auction. This is because Ofcom's proposed model has not been verified or evaluated to demonstrate its accuracy, and there is no evidence that it would provide more accurate predictions than operators' own models that have been optimised over many years and for which verification measurement data is available. It is not even clear to us whether the Ofcom model would consistently predict more or less coverage, either generally or for particular frequency bands that are primarily used by two groups of operators (e.g. 900 MHz and 1800 MHz). Furthermore, Ofcom's proposed model does not accurately capture detailed infrastructure information such as actual antenna patterns and nuanced performance of operator Radio Access Network equipment and therefore inherently cannot replicate operator prediction in a fully consistent way.

If Ofcom's model was eventually demonstrated to accurately predict actual coverage for all four operators then we accept that it would provide a fair method of coverage prediction and comparison of coverage (notwithstanding our view as set out in response to the auction consultation document that thresholds for good coverage are overly conservative for 1800MHz relative to 900MHz). Use of a single model would avoid operator requirements to provide signal strength predictions and to demonstrate their accuracy with their own measurements. Instead, operators would submit network base station data for Ofcom to use with its coverage model to produce its predictions.

We are keen to work with Ofcom as it commits resource and develops its model for use in the long term, perhaps within the framework of the existing cross-MNO discussions on coverage predictions chaired by Ofcom.

Verification with a combination of models – Ofcom's proposal

Ofcom presumably understands the drawbacks in relying solely on its proposed model and has proposed to calibrate it against each operator's model, and use this result to adjust the target compliance threshold accordingly, as it has set out in figure 2.1 of the consultation.

We note a concern with Ofcom's proposed calibration method, and indeed also with the alternative of reliance on operator models, in that materially different levels of actual coverage could be required to be delivered by two operators who supposedly meet the same obligation if Ofcom and operator models differ in their coverage predictions. Furthermore such differences in coverage may have disproportionate differences in cost, noting for example that the cost of 88-90% is likely to be less than 90-92%.

We recognise that Ofcom's calibration method may in effect result in a situation close to simply using the operators' own models, but Ofcom's method has disadvantages relative to this approach:

(i) The percentage difference in coverage prediction would not necessarily be exactly the same if the two models (Ofcom's and operator's) are run before and after extra network build (for example, a ten percentage point improvement on an operator model may not equal a ten percentage point improvement as predicted by Ofcom, from a different starting percentage).

(ii) The method accounts for differences in operators' models and Ofcom's model just after the auction, but not any differences at the time of compliance (e.g. if operator models were to evolve in the intervening period, then the correction is not adjusted).

The complication of Ofcom's proposed calibration approach seems to offer little benefit and potential downside compared to solely using the operators' models.

Verification with operators' models – a pragmatic approach

In light of the above considerations, we propose that Ofcom should by default use operator models for predictions used to verify that geographic coverage obligations have been achieved at the date when compliance with the obligation is assessed. The alternative of the calibration method approach has no benefit and potential disadvantage. The use only of a single Ofcom model is, for the reasons explained above, also not something we would support at this time.

If Ofcom's concern is that operator models may inappropriately be changed ahead of the compliance assessment, and that is why the calibration method is proposed, we note there may be simpler means to address this, such as specifying the version of the operator model to be used. But, in any case, we believe any such concern to be unfounded and that Ofcom should seek to ensure it has trust that operators will be open with Ofcom in deliberations around changes to prediction models; for example operators could share with Ofcom any difference in results between their old and new models and be prepared to justify any changes. Such an approach could enable Ofcom to be confident to accept the operator's model as being the most suitable for assessing compliance, even if this were to be a newer model that reflects further improvement in the model or underlying databases compared to that available at the time of the auction.

We accept that the use of operator models, if they differ significantly, does not eliminate the potential concern we have explained in relation to Ofcom's own proposal whereby different operators could potentially have to deliver different levels of actual coverage. But equally the use of a single model that is not fully assessed and validated for various network layers/frequencies cannot guarantee equivalent coverage improvements.

As stated above, in principle we have no objection to working towards agreement of a single Ofcom prediction model, of acceptable specification and accuracy in relation to all operators' coverage and with no systematic difference in relation to any individual operator, which would ultimately be used instead of separate operator models. But we see this as feasible only in a longer time frame, given the importance of the coverage obligations and the public funding at stake, and should not be used for the purposes of the verification of compliance with licence obligations for the upcoming auction.

We comment on the suitability of Ofcom's methodology to use the median signal predictions to verify the 95% location probability in section 5.

2.3 EAS sites

We have provided our views on the proposed exclusion of EAS sites from the assessment of geographic coverage in our response to the main auction consultation.

2.4 Roaming

We agree that any commercially agreed roaming should count towards the geographic obligation, but only if the 500 new sites requirement is dropped. This would leave a clear focus on outcomes with flexibility for operators on how to achieve the required outcome, whether that is through new site build, roaming, a combination or something else.

2.5 Verifying compliance

We agree with Ofcom's comments in relation to proposed verification, including the need to justify any significant deviations from current coverage trends should operator coverage models change just after the completion of the award. We also acknowledge the case for on the ground measurements at the time of verifying compliance[3], but emphasise the need to follow an agreed methodology and ensure statistical significance which will require extensive measurements. The need to include this step is arguably a reason why the proposed approach of calibrating Ofcom's model and locking that to the version of the operator model as it exists at the time of the award is not optimal.

3 Premises obligation compliance

3.1 Use of operator coverage model

We agree with Ofcom's proposals to use operator models to verify any premises obligation.

As we discussed in relation to the geographic obligation, if operator models were to change in the period between the auction and the date of verifying compliance, Ofcom would have warning of this and be able to satisfy itself that the change is appropriate as the ongoing statutory information requests would provide visibility of this and the opportunity to resolve any concerns.

We have considered whether build of new premises in the intervening period between the auction and the date when compliance is assessed could present a complication to Ofcom's proposed method of assessing compliance with a premises obligation. However, we understand that Ofcom proposes to use the same version of the premises database at the time of the auction and the date of compliance, which would eliminate this concern.

[3] Consultation para 2.36

3.2 EAS coverage of premises

As explained in our response to the main consultation, the proposed exclusion of premises covered by EAS sites is problematic but can be mitigated significantly if Ofcom removes the sub-obligations of new sites and premises from its proposals.

4 New sites obligation compliance

In our response to Ofcom's main consultation document we explained why we do not support the inclusion of a sub-obligation to build 500 new sites. Notwithstanding this, we have set out our views below on how Ofcom intends to measure compliance for this obligation.

4.1 Rural area definition

We agree with the proposed 2011 census rural area definition. BT however notes that the site definition as being rural or urban should depend on the served area not where the site itself is located, and the definition should be resolved to cell level. It is possible for a site to be physically located in an urban location at edge of town but serving mainly a rural area or vice versa.

4.2 Minimum power and distance

BT has no objection to the proposed 43dBm EIRP minimum base station power as it would allow a reasonable range of site equipment types to be deployed. We also have no objection to the proposed 1km inter-site distance as again this provides a reasonable degree of flexibility over deployment options, even if larger distances usually would be likely to exist in rural areas with high power sites as otherwise new coverage would overlap existing coverage.

4.3 Existing infrastructure

If a new sites obligation were appropriate, we agree that sharing other MNO sites should count towards the new sites target but adding 4G to an MNO's own existing sites should not. This would make sense if the purpose is to achieve new build which is incremental to what operators might anyway build.

4.4 EAS sites

We have provided our position on EAS sites in our response to the main auction consultation where we illustrate that the exclusion of EAS sites would make the proposed new sites obligation particularly problematic.

4.5 Exclusion of roaming

It is unclear why roaming shouldn't count towards the new sites target if such a target is included. Ofcom mentions that it wouldn't extend coverage, but we note it would do for customers of the operator that roamed. If sharing existing sites counts towards the new site target it is unclear why roaming shouldn't also count towards the site target: both methods would give customers of the obligated operator the same extra coverage. This anomaly between how roaming and site sharing are proposed to be considered in relation to the new sites target reinforces our view that the target is not appropriate.

4.6 Information gathering and testing

We agree with Ofcom's proposal to verify that sites are built and providing additional coverage.

5 Compliance model

5.1 Propagation

BT notes that ITU-R P.1812-4 is an untuned model and therefore unlikely to achieve the standards of accuracy of operator own models.

5.2 95% confidence level

BT notes values of the standard deviation of ITU-R P.1812-4, as calculated by σ_L=K_L+1.3log(f) dB are dependent on frequency and environment, and that empirical studies have shown a considerable spread. We note again, in this context, of the necessity of undertaking statistically significant sampling in any ground measurement.

5.3 Antenna patterns

We consider that actual antenna patterns should be used for coverage prediction where these are available rather than patterns taken from standards.

5.4 Calculation

BT has no specific comments on the calculation.

6 Other matters

6.1 Future technology

BT agrees that Ofcom should be open to defining coverage thresholds for other future technologies such as 5G if requested to do so by operators. This will require ongoing collaboration between operators and Ofcom to reach mutual agreement.

6.2 Continued compliance

BT agrees that continued compliance should be assessed beyond the date when compliance is assessed in order to ensure licence obligations continue to be met throughout the licence duration and in accordance with the requirements of the licences.

6.3 Databases

BT notes that the Siradel database is not fully described, with clutter category height attributes being absent. It is therefore not possible to adequately understand a critical component of the selected *ITU-R P.1812-4* coverage model and its likely performance.