



An Coimisiún um  
**Rialáil Cumarsáide**  
Commission for  
**Communications Regulation**

# ComReg Outdoor Mobile Coverage Map

Response to ComReg Information Notice  
and study by Plum Consulting regarding  
5G Outdoor Mobile Coverage Thresholds

**Response to Information Notice**

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# 1 Introduction

- 1.1 On 25 November 2021, the Commission for Communication Regulation (“ComReg”) published the following documents:
- 21/118 - Information Notice: ‘ComReg Outdoor Mobile Coverage Map A study by Plum Consulting on 5G Outdoor Mobile Coverage Thresholds’; and
  - 21/118a - ‘Coverage Thresholds for 5G Services’ – a report from Plum Consulting (“Plum”) (“Plum Report”) regarding appropriate 5G outdoor mobile coverage thresholds.
- 1.2 ComReg received submissions in response from the following interested parties:
- Eircom Limited and Meteor Mobile Communications Limited (trading as ‘eir’ and ‘open eir’) (“Eir”);
  - Three Ireland (Hutchison Limited) (“Three”); and
  - Vodafone Ireland Limited (“Vodafone”).
- 1.3 The non-confidential versions of these submissions are contained in Annex 2 of this document.
- 1.4 Plum has carefully considered these submissions and outlines its views in its technical note which is contained in Annex 1 of this document.
- 1.5 This document sets out ComReg’s consideration of the points raised by respondents in respect of the proposed approach to 5G outdoor coverage mapping thresholds and its final position on same.
- 1.6 The remainder of this document is structured as follows:
- Chapter 2: sets out some background information relevant to the Information Notice 21/118 and provides a summary of the Plum Report.
  - Chapter 3: considers issues related to matters discussed in the Plum Report.
  - Chapter 4: outlines ComReg’s next steps with regard to this matter.

## 2 Background

- 2.1 ComReg has an important role in ensuring that consumers have access to appropriate material which facilitates informed choices and, in turn, contributes to an open and competitive ‘market’<sup>1</sup>.
- 2.2 In 2019, ComReg launched its consumer-focussed online outdoor mobile coverage mapping tool (“Outdoor Mobile Coverage Map”)<sup>2</sup>.
- 2.3 The Outdoor Mobile Coverage Map allows consumers to view the level of outdoor mobile coverage throughout the country, at specific locations or addresses, as defined by the user. The Outdoor Mobile Coverage Map enjoys, on average, 8,000 views per week. It is generated using network data provided by all three mobile network operators (“MNOs”), namely Eir, Three and Vodafone.
- 2.4 This network data is checked before applying a propagation model used to generate independent outdoor mobile coverage predictions. Coverage predictions are generated using the Forsk ‘Atoll’ radio planning tool, together with the ‘Crosswave’ radio propagation model from Orange Labs.
- 2.5 The Outdoor Mobile Coverage Map:
- displays outdoor 2G, 3G and 4G mobile coverage for both MNOs and mobile virtual network providers (“MVNOs”), the latter including: 48, Clear Mobile, GoMo, LycaMobile, An Post mobile, Tesco Mobile and Virgin Mobile; and
  - is presented in colour-coded ranges illustrating “Very Good”, “Good”, “Fair”, “Fringe” and “No coverage”<sup>3</sup>. This format, also referred to as “coverage thresholds”, furthers consumers’ understanding of outdoor 2G, 3G and 4G mobile coverage.
- 2.6 5G services have been provided in Ireland since 2019 and there is a need for consumers to enjoy a similar understanding of 5G outdoor mobile coverage. Consequently, ComReg initiated a project to develop and define appropriate coverage thresholds for the mapping of 5G outdoor mobile coverage.
- 2.7 To this end, ComReg commissioned a study by Plum Consulting (“Plum”) to consider and provide recommendations for appropriate 5G outdoor mobile coverage thresholds (Document 21/118a) (“Plum Report”).

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<sup>1</sup> See, for example, section 10(1)(da) of the Communications Regulation Act 2002 (as amended) (“2002 Act”).

<sup>2</sup> <https://coveragemap.comreg.ie/map>

<sup>3</sup> <https://coveragemap.comreg.ie/faq>

## 2.1 Plum Report

- 2.8 The Plum Report provides analysis of key technical aspects and considerations, which are inputs to the development of the recommended 5G outdoor mobile coverage thresholds.
- 2.9 The definition of appropriate 5G outdoor mobile coverage thresholds, as is the case with 2G, 3G, and 4G, includes appropriate consideration and definition of specific ranges of signal strength associated with each coverage threshold category.
- 2.10 Plum observes that technology differences between 4G and 5G are important factors to consider in the determination of appropriate 5G outdoor mobile coverage thresholds. For example, whereas coverage limits for 4G are generally expressed in terms of 'Reference Signal Received Power' ("RSRP"), those for 5G New Radio ("NR") use 'Synchronisation Signal Reference Signal Received Power' ("SS-RSRP"). The relationship between these parameters with the overall LTE and NR signal structure is summarised within the Plum Report.
- 2.11 Plum considers that if a coverage criterion is to be useful to consumers, it must relate, in some manner, to an expectation of service quality (however defined). In that regard, Plum observes that, in the process of 5G standardisation and promotion, a very wide range of potential use cases for 5G have been defined, each with a specific set of requirements in terms of coverage, reliability, bit rate, latency etc.
- 2.12 Chapter 4 of the Plum Report entitled "5G use cases and performance expectations" provides an overview of 5G network performance metrics and potential use case scenarios and in turn recommends an appropriate baseline performance limit.
- 2.13 Based on currently expected 5G use cases, Plum recommends that the public facing outdoor mobile coverage predictions of 5G should relate to a minimum downlink bit rate requirement of 50 Mbit/s. In that regard, Plum also observes that 5G use cases and expectations are still evolving and, therefore, likely to undergo further change. Consequently, there would likely be a need to revisit this minimum downlink bit rate assumption when patterns of user behaviour are more established.
- 2.14 Plum notes that the proposed download speed of 50 Mbits/s, which represents a reasonable minimum expectation with which to define the edge of a 5G service area, would need to be expressed in terms of SS-RSRP levels to allow for coverage mapping.
- 2.15 In Chapter 5 of the Plum Report entitled "Determination of appropriate levels", Plum details modelling scenarios, determination of RSRP for single user throughput, SINR calculation and transformation of SINR to SS-RSRP.
- 2.16 Plum further notes that, given the uncertainty in 5G use cases (and therefore in

appropriate thresholds) and likely variations in bandwidth and technical configuration between different operators, it seems inappropriate to apply a high level of granularity to the SS-RSRP thresholds. Therefore, it recommends simplifying the thresholds by taking average values of SS-RSRP for some pairs of modelling scenarios<sup>4</sup> as captured in Table 5.4 of the Plum Report.

- 2.17 Plum's recommendations for outdoor mobile coverage thresholds for 5G consider, to some degree, the different bandwidth and technical configurations used in each band.
- 2.18 Given the evolutionary status of 5G use cases, Plum considers that it would be inappropriate to imply that any thresholds correspond to precise quality of service definitions.
- 2.19 Plum recommends the display of the outdoor mobile coverage mapping data for 5G on a technology basis, rather than display per individual spectrum band.
- 2.20 Plum's recommended 5G outdoor coverage thresholds are set out in Table 6.1 of its report.

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<sup>4</sup> The modelling scenarios correlate to individual frequency bands where, for example, Plum recommends pairing the 1.8 GHz and 2.1 GHz band and using one SS-RSRP level to represent both bands.

## 3 Issues related to matters discussed in the Plum Report

### 3.1 Introduction

3.1 In this chapter, ComReg considers a number of issues raised by respondents to Document 21/118a, being:

- Delay publication of 5G outdoor mobile coverage mapping;
- Future review of 5G outdoor mobile coverage mapping thresholds; and
- Technical issues, including:
  - Parameters used for modelling of outdoor coverage thresholds and related coverage predictions;
  - Assumed bandwidth for modelling of outdoor coverage thresholds;
  - Assumed 50 Mbit/s for modelling of 5G outdoor coverage thresholds;
  - Assumed MIMO order for modelling of 5G outdoor coverage thresholds;
  - Anchor cell considerations for outdoor 5G coverage mapping;
  - Interchangeability of spectrum bands for modelling of outdoor coverage thresholds; and
  - Use of carrier aggregation for 5G outdoor coverage mapping.

3.2 ComReg also provides clarifications on certain issues raised by respondents to Document 21/118a being:

- Downlink/Uplink ratios used for modelling scenarios; and
- Precise quality of service definition disclaimer.

### 3.2 Delay publication of the 5G outdoor mobile coverage map

#### Views of Respondents

3.3 Vodafone submits that:



- *“There is a policy objective to have harmonised coverage measurement across Europe: A harmonised approach where possible will benefit consumers, business and operators. In 2020 BEREC concluded its feasibility study on development of coverage information for 5G deployments. The main finding from BEREC was that “it would be too early for BEREC to set out a policy objective to provide harmonised information on 5G coverage and QoS aspects of networks”. A common BEREC position or baseline will be useful in informing a national and pan-European approach. Also, a recent BEREC report on the diversification of the 5G ecosystem also referred to the above 2020 position which further supports the case that further development in spectrum allocation and use cases in Ireland before setting coverage mapping standards.”*
- *“Spectrum Allocations will only be clear on conclusion of MBSA2<sup>5</sup>: The position on spectrum allocations in Ireland and the coverage available to Irish consumers and business is heavily influenced by MBSA2. ComReg have [sic] noted the importance of 700MHz for the provision of widespread coverage, ‘including in rural areas on national transport routes and is highly suitable for the provision of existing 4G and, over time, new 5G services’. The 700MHz band is only allocated at this point in time under temporary licensing frameworks and is assigned entirely without prejudice to MBSA2. In this regard, the position on 5G coverage bands is subject to change. For this reason alone, it is not appropriate to attempt provide meaningful long-term reliable coverage information to consumers and business before the MBSA2 process completes, and customers can be assured the mapping detail provided sets out the longer term coverage available in their specific locations of interest.”*
- *“Plum’s Modelling Scenarios in Table 5.1 of the study list ‘standardised network configurations’ in the 2.1 GHz (2x15 MHz), 2.3GHz (30MHz), 2.6 GHz (2x30MHz) bands. The degree to which these will accurately reflect the configurations and customer experience of these bands could only be clear post Multiband Spectrum Auction (MBSA2). This further supports the case for a wait and see approach.”*

## Summary of Plum’s Response

- 3.4 Plum notes in section 1 of its technical note that “One suggestion is that no action should be taken until discussions on mapping have progressed within BEREC. Plum would note that such discussions can only be informed by the operational experience of member regulators, and that learnings from the ComReg process will be important

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<sup>5</sup> ComReg’s Multi Band Spectrum Award, see <https://www.comreg.ie/industry/radio-spectrum/spectrum-awards/proposed-multi-band-spectrum-award/>

*in building consensus within BEREC.”*

- 3.5 Plum further observes *“We do, however, strongly support the suggestion that the parameters used in modelling (e.g. MIMO order), and hence the adopted threshold values, should be reviewed whenever new information is available. The conclusion of the MBSA2 process would be one such point, and we understand that it is the intention of ComReg to monitor this and undertake a review in light of any significant changes or further information (e.g. regarding user traffic profiles or expectations).”*

### **ComReg assessment: Delay publication of the 5G outdoor mobile coverage map**

- 3.6 Having carefully considered Vodafone’s view, ComReg does not believe it would be appropriate to delay publication of the 5G outdoor coverage map for reasons including the following.
- 3.7 First, ComReg notes and agrees with Plum’s view that discussions within BEREC on 5G coverage mapping can only be informed by operational experience of member regulators, including by ComReg as presently proposed.
- 3.8 Second, whilst 5G services may be provided using the spectrum bands that are the subject of MBSA2, ComReg recalls that 5G services have been provided since 2019<sup>6</sup> and are currently available in Ireland using other spectrum bands to which MNOs have long term rights of use including the 1.8 GHz and 3.6GHz<sup>7</sup> bands. Moreover, MNOs can also provide 5G services using other long term rights of use currently held (e.g. 800MHz, 900MHz etc.).
- 3.9 Third, ComReg also notes that the outdoor mobile coverage map is dynamic in nature and will, therefore, be reviewed and updated, if required, once the MBSA2 bands are awarded and deployments take place. ComReg also notes Plum’s views in this regard.
- 3.10 Given the above, ComReg will not be delaying the publication of the 5G outdoor coverage map as suggested by Vodafone.

## **3.3 Future review of 5G outdoor coverage thresholds**

### **Views of Respondents**

- 3.11 Eir submits that:
- *“As acknowledged in the Plum report developing 5G coverage predictions is more complex than preceding technologies. The approach is expected to*

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<sup>6</sup> In September 2019 Vodafone Ireland switched on 5G services.

<https://n.vodafone.ie/aboutus/press/vodafone-ireland-switches-on-first-5g-network-in-five-cities.html>

<sup>7</sup> See <https://www.comreg.ie/publication/results-3-6-ghz-band-spectrum-award-2/>

*evolve over time. Plum proposes a simplified approach initially and eir does not object to this in principle provided the approach is reviewed regularly.”*

- *“The need to revisit the approach is acknowledged in ComReg’s Information Notice however no timeline is specified. The Plum report suggests revisiting assumptions in five years time. This is too long a period. BEREC concluded in March 2020 that “it would be too early for BEREC to set out a policy objective to provide harmonised information on 5G coverage and QoS aspects of networks” and the current thinking of BEREC is that “it should adopt a wait and see approach” potentially revisiting this topic in two or three years’ time following the “deployment of one or two use cases” as referenced by Plum in the report. Thus BEREC has indicated it will revisit 5G coverage in the next year and a half. This is a more appropriate time period and in the Irish context would suggest that it will be appropriate to revisit the approach immediately following the outcome of MBSA2.”*
- *“As scenario D and E have not yet been licensed yet in Ireland, the assumed Bandwidth, MIMO order, Duplex mode and Numerology cannot be confirmed as accurate or valid at present. These values should be reassessed as and when these frequency bands have been awarded.”*

## Summary of Plum’s Response

- 3.12 Plum notes in section 1 of its technical note *“We do, however, strongly support the suggestion that the adopted threshold values should be reviewed whenever new information is available. The conclusion of the MBSA2 process would be one such point, and we understand that it is the intention of ComReg to monitor this and undertake a review in light of any significant changes or further information (e.g. regarding user traffic profiles or expectations).”*

## ComReg assessment: Future review of 5G outdoor coverage thresholds

- 3.13 ComReg reiterates that the outdoor mobile coverage map is dynamic in nature and, therefore, is committed to the review of 5G outdoor coverage thresholds in light of material developments/further information which would better inform the accuracy of outdoor 5G mobile coverage mapping. For example, future BEREC reviews/recommendations, or any significant domestic changes such as commercial 5G deployments on new bands following the MBSA2 award.

## 3.4 Technical Issues

3.14 In this section, ComReg considers a number of technical issues raised by respondents to Document 21/118a, being:

- Parameters used for modelling of outdoor coverage thresholds and related coverage predictions;
- Assumed bandwidth for modelling of outdoor coverage thresholds;
- Assumed 50 Mbit/s for modelling of outdoor coverage thresholds;
- Assumed MIMO order for modelling of outdoor coverage thresholds;
- Interchangeability of spectrum bands for modelling of outdoor coverage thresholds;
- Anchor cell consideration for 5G outdoor coverage mapping; and
- Use of carrier aggregation for 5G outdoor coverage mapping.

### Parameters used for modelling of outdoor coverage thresholds and related coverage predictions

#### Views of Respondents

3.15 Three submits that:

- *“There are many variable factors which influence the correct choice of signal level to represent 50Mb/s at cell edge, and we accept that some of these will be unknown to ComReg or may vary across location and time. In these cases, some simplifying references might need to be assumed. Some factors will be known though, e.g. bandwidth, antennae type, etc. and these factors should be included in ComReg’s model so as to give an accurate representation of the absolute coverage from each network but also the differences from one network to another.”*
- *“For any user on the Three network, we will exert control over the conditions under which a user is switched between sites or between technology, e.g. drop to 4G service. As a result of this, the network itself has considerable control over the boundary of the 5G service area. To the maximum extent possible, ComReg should try to use the same parameters as the operator as otherwise there will be differences between the map and actual service provided.*

## Summary of Plum's Response

3.16 Plum outlines in section 1 of its technical note that

*“It is important to emphasise that simplifying assumptions regarding network parameters are used only for the purposes of deriving generic coverage thresholds. ComReg’s prediction of the individual network’s outdoor coverage will be based on the specific, current, parameters provided by each mobile network operator.*

*We do not consider that it is appropriate to attempt to reflect the exact parameters of specific networks at particular moments in time in the proposed modelling of coverage thresholds, as this would significantly complicate the coverage mapping process for potentially little gain to consumer value as the intention is to provide a reasonable estimation of coverage, for which a large number of simplifying assumptions will be necessary in the derivation of thresholds. Further, given the other inherent uncertainties (e.g., cell loading, handset performance) and the possibility that user experience may, depending upon the particular circumstances of the user, vary from results shown on the outdoor coverage map, it would be inappropriate at this point to attempt to match any network parameters precisely for the modelling of thresholds for potentially little gain. It would, furthermore, impose a significant bureaucratic burden to track, for the purposes of defining coverage thresholds, the exact network parameters used by all MNOs as they evolve over time – a burden that would be unlikely to be justified in terms of improved consumer messaging. “*

### ComReg assessment: Parameters used for modelling of coverage thresholds and coverage predictions

3.17 ComReg notes and agrees with Plum’s view that it is not appropriate to attempt to reflect the exact parameters of specific networks at particular moments in time in the proposed mapping of thresholds because, among other things, this could add significant complexity to the process for potentially little gain.

3.18 Furthermore, in relation to the conditions that control network mobility, ComReg notes that the Outdoor Mobile Coverage Map does not represent network mobility parameters to switch between network technologies and/or sites, for any technology type. The Outdoor Mobile Coverage Map displays the best level of outdoor coverage which is available to consumers at specific geographical locations based on the data provided by MNOs in the .ATL file. The methodology that MNOs implement to manage network mobility or traffic using parameters is not within scope of the Outdoor Mobile Coverage Map, as it would require a degree of complexity which would be inappropriate and would be unlikely to be justified by improved consumer messaging

## Assumed bandwidth for modelling of outdoor coverage thresholds

### Views of Respondents

3.19 Three and Vodafone provided responses related to assumed bandwidths used for modelling of 5G outdoor coverage thresholds.

3.20 Three submits that:

- *“Scenario F of the table specifies the parameters for the 3.5/3.6GHz band. It uses a bandwidth of 80MHz which is incorrect for Three’s network. Three’s network uses a uniform 100MHz bandwidth on all sites nationally and this is not variable. It is not one of the variable parameters where it is necessary to make simplifying assumptions. This 100MHz bandwidth should be used to produce the map showing Three’s coverage. If necessary, then a new Scenario G should be introduced which has this bandwidth. We see no reason why this should be changed to 80MHz when it is known and fixed.”*
- *“There is no reference in either the Plum report or ComReg’s document to Dynamic Spectrum Sharing (DSS). We believe the other operators in Ireland currently use DSS, while on the Three network we only use dedicated spectrum for 5G NR. There is a significant difference between the effect produced by having dedicated spectrum vs DSS on 5G service. In effect with DSS the bandwidth available for the 5G service is variable, which in turn can impact on the receive signal required for 50Mb/s at cell edge. In order to reflect this correctly in the coverage map, ComReg should only include the bandwidth that is guaranteed to be available to the 5G service”*

3.21 Vodafone submits that:

- *“The existing 4G coverage map is capability agnostic and does not distinguish capability provided by different spectrum holdings between bands. The same threshold for 800MHz (2x10 MHz) applies for 1800 MHz (2x20MHz).”*

### Summary of Plum’s Response

3.22 In section 4 of its technical note, Plum notes:

- *“A number of comments make reference to the bandwidth values assumed in setting the coverage thresholds. We would emphasise that the intention is not to match the deployment characteristics of any particular network for the modelling of thresholds, but to give an appropriate ‘order of magnitude’*

*characterisation for each band, while accepting that there will be variations between operators and between regions. At 3.5 GHz, for example, available bandwidths will range from 60 MHz to over 100 MHz. Using the same modelling assumptions given in the report, the thresholds derived for the 80MHz and 100 MHz bandwidth cases differ only by 0.2dB. “*

- *“A related issue, raised by one respondent, concerns the use of Dynamic Spectrum Sharing (DSS). This has not been accounted for in the modelling of threshold values as it would require a degree of complexity in the modelling that would not appear to be justified. As noted above, the proposed 5G coverage thresholds aim to provide a reasonable estimation of coverage, for which a large number of simplifying assumptions will be necessary in their derivation. Using a simplified threshold model would appear to achieve this aim while also avoiding the need for continuous revision of threshold assumptions in line with changing MNO network configurations. We would, however, expect ComReg to continue to review the impact of actual DSS implementation on the validity of assumed threshold values. “*
- *“We consider it inappropriate to attempt to capture these (relatively small) intra-band variations in what is intended to be a reasonable estimate of coverage for consumer information; indeed, this reflects the case of the 4G thresholds, where the same value is applied at 1800 MHz as at 800 MHz, despite the doubling in available bandwidth.”*

### **ComReg assessment: Assumed bandwidth for modelling of outdoor coverage thresholds**

3.23 By way of general response, ComReg recalls that it is not the intention to directly match deployment characteristics of particular network/s for the modelling of 5G outdoor mobile coverage thresholds. For example, ComReg recalls Plum’s observation at section 5.1 of Document 21/118a (regarding the level of granularity in differentiating between networks) that: *“It could, therefore, be appropriate to make some simplifying assumptions; such simplifications will, inevitably lead to some distortion of the relative position of operators, either underestimating the coverage of an MNO which has slightly more bandwidth, or a higher-order MIMO scheme than assumed, or the reverse. If chosen appropriately, such differences might be insignificant in comparison to, e.g. variability in handset performance, the details of network traffic and scheduling and propagation model prediction errors”*

3.24 Second, and in relation to Three’s point regarding its 100 MHz 3.6 GHz bandwidth, ComReg notes that supplementary modelling undertaken by Plum (as detailed in section 4 of the Plum technical note), using 100MHz rather than 80MHz, resulted in a non-significant difference of 0.2dB in the threshold values for modelling scenario F

for 3.5/3.6GHz. This would support Plum's observation above.

3.25 Third, and in relation to Three's comments regarding Dynamic Spectrum Sharing (DSS), ComReg:

- notes and agrees with Plum's views on this matter noting that the dynamic nature of DSS requires a level of complexity in the modelling that does not appear justified at this point (whereas a simplified threshold model would avoid continuous revisions of threshold assumptions);
- recalls that interested parties will be aware that single user throughput (i.e an unloaded network) was used for determination of 5G coverage threshold models as outlined in Section 5.2 of Document 21/118a and
- would, however, expect to conduct a review of the impact of DSS implementation on the validity of assumed thresholds in due course.

3.26 Fourth, and in relation to Vodafone's point regarding the existing 4G coverage map, ComReg notes and agrees with Plum's assessment in this regard.

## Assumed 50 Mbit/s for modelling of 5G outdoor coverage thresholds

### Views of Respondents

3.27 Eir submits that:

- *"Whilst we are supportive of a simplified approach initially Eir is concerned by the proposed fixed throughput of 50Mbit/s. Plum offer [sic] no real justification for its selected threshold. The predominant 5G use case is currently the support of mobile data services and consequently the 5G threshold should be set closer to the 4G threshold particularly in respect of lower frequency bands with limited spectral capacity in scenarios A1, A2, A3, B and C"*
- *"Due to limited Bandwidth of those scenarios, a 50Mbit/s fixed throughput would be very limiting compared to that in Scenario F where there is 80MHz or more of Bandwidth available. A 50 Mb/s fixed throughput may also cause confusion to end users when they experience perfectly good 5G service and the ComReg map is showing poor or no coverage."*
- *"It should be considered for scenarios A1, A2, A3, B and C, that a fixed throughput below 50Mbit/s is used which will in turn amend the determination of the RSRP for those scenarios"*



## Summary of Plum's Response

3.28 Plum notes in Section 2 of its technical note that:

*“One respondent questions the adoption of a fixed target throughput of 50 Mbit/s, noting that current typical mobile data use is likely to have a lower requirement. The respondent also notes that such rates will be challenging to deliver in the lower-frequency bands where channel width is constrained.*

*While accepting that any adopted target throughput will, to some extent, be arbitrary, the 50 Mbit/s value was chosen, partly because it is given in a number of 3GPP references and identified by other national regulators (e.g., Ofcom, UK) for some 5G use cases of wide-area services using spectrum below 6 GHz, but also because it represents a modest, but user-perceptible, improvement with respect to 4G services. If a lower threshold were adopted, this might not align with consumer expectations.*

*We continue to believe that 50 Mbit/s is an appropriate target assumption for the present purpose.”*

## ComReg assessment: Assumed 50Mbit/s for modelling of outdoor coverage thresholds

3.29 Having carefully considered Eir's views, ComReg remains of the view that it would be appropriate to use 50Mbit/s for all modelling scenarios for the moment for reasons including the following.

3.30 First, ComReg does not agree with Eir's view that Plum did not offer real justification for 50 Mbit/s and recalls in that regard the Ofcom review of throughput rates potentially required by 5G (which itself was informed by the referenced 3GPP technical report) noted in section 4.3 of Document 21/118a.

3.31 Second, ComReg further recalls Plum's view in section 4.4 of Document 21/118a that 5G services should provide a perceptible improvement to consumer experience with respect to 4G services (and, in that regard, that 50 Mbit/s would seem to meet this criterion). Indeed, ComReg observes that Eir's website highlights that *“5G offers speeds up to 10 times faster than 4G”*<sup>8</sup> and, in such circumstances, it would seem incongruous to set 5G thresholds closer to 4G thresholds as suggested by Eir.

3.32 That said, ComReg reiterates that the outdoor mobile coverage map is dynamic in nature and, therefore, is committed to the review of 5G outdoor coverage thresholds in light of material developments/further information which would better inform the

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<sup>8</sup> <https://www.eir.ie/5G/>

accuracy of outdoor 5G mobile coverage mapping.

## Assumed MIMO order for modelling of 5G outdoor coverage thresholds

### Views of Respondents

3.33 Eir submits that:

- *“The MIMO order of Scenario F assumed a MIMO order of 4. eir has a minimum MIMO order of [ 4 8 ] on its scenario F deployment. This would have a significant impact on the determination of RSRP for a given single user edge throughput. At a minimum, a MIMO order of 8 should be used for the determination of RSRP in scenario F..”*

### Summary of Plum’s Response

3.34 Plum notes in section 7 of its technical note that: *“One respondent noted that the assumption of a MIMO order of 4 is not representative of typical current deployment at 3.5 GHz. We agree that it may be appropriate to assume a higher-order in determining coverage thresholds, and would propose a value of 8. This takes into account the fact that currently-available handsets are still constrained in the number of antennas that can be integrated.”*

### ComReg assessment: Assumed MIMO order for modelling of 5G outdoor coverage thresholds

3.35 ComReg notes and considers Eir’s response and agrees with Plum’s recommendation to use a higher MIMO order of 8 in determining 5G outdoor mobile coverage thresholds. In that regard, threshold values using a MIMO order of 8 for scenario F have been modelled and the revised recommended 5G thresholds are set out in the annex of the Plum technical note.

3.36 ComReg reiterates that the outdoor mobile coverage map is dynamic in nature and, therefore, is committed to the review of 5G outdoor coverage thresholds in light of material developments/further information which would better inform the accuracy of outdoor 5G mobile coverage mapping.

## Anchor cell considerations for outdoor 5G coverage mapping

### Views of Respondents

3.37 Three submits that:

- *“Three note that there is no reference to anchor cells anywhere in the ComReg*

or Plum documents. As all operators currently use NSA, we now request clarification of how this is to be incorporated into the 5G maps.”

- “It is important to note that the signal level required for anchoring 5G NR is different to that required to provide a 4G LTE service as only signalling is required to anchor 5G. Three use a receive signal of [Confidential] to determine the limit of its LTE anchor cells. Three will not be changing this level to -115dBm either on our network. For ComReg’s map to accurately reflect Three’s 5G NR coverage it should also use [Confidential] for the LTE anchor cell.”

## Summary of Plum’s response

- 3.38 Plum states in section 6 of its technical note that “One respondent noted that non-standalone (NSA) 5G deployment will be dependent on LTE anchor cells, and that the LTE limit used for such anchoring may differ from the LTE coverage limit. We agree with this and note that it will be necessary for ComReg and the MNOs to ensure that the appropriate values are implemented in the software used to generate the coverage maps.”

## ComReg assessment: Anchor cell considerations for outdoor 5G coverage mapping:

- 3.39 ComReg notes and agrees with Plum’s view on this matter, and also recalls that:
- network-specific 4G anchor cell information is requested as part of the Section 13D<sup>9</sup> information requirement to MNOs in relation to outdoor coverage mapping; and
  - this information is incorporated into the Forsk recommended methodology for predicting NSA 5G outdoor coverage using the Forsk Atoll radio planning tool.
- 3.40 ComReg will use the operator-configured minimum RSRP signal level for anchoring of NSA 5G NR for the prediction of 5G outdoor coverage maps and this will form part of the Section 13D information requirement with regard to outdoor coverage mapping.

## Interchangeability of spectrum bands for modelling of outdoor coverage thresholds

### Views of Respondents

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<sup>9</sup> Section 13D of the Communications Regulation Act 2002 as inserted by section 6 of the Communications Regulation (Amendment) Act 2007

3.41 Vodafone submits that:

- *“Thresholds do not reflect interchangeable nature of 2.1GHz, 2.3GHz and 2.6GHz. This interchangeability was recognised as part of MBSA2 consultation process, yet the Plum proposal is to impose a 1.6dBm threshold difference between the 2.1GHz and the 2.3GHz and 2.6GHz bands.”*

### Summary of Plum’s Response

3.42 Plum states in section 3 of its technical note that:

- *“The fact that a 1.6dB difference in threshold is assumed between the 2.1 GHz band and the 2.3/2.6 GHz band is questioned by one respondent, who notes that these bands are considered interchangeable (e.g. within the MBSA2 process).”*
- *“In setting out the proposals for thresholds to be used in public-facing messaging, we have simplified the six ‘per-band’ thresholds (Table 5.3) to a smaller number of aggregate threshold values (Table 5.4). This was done because the broad assumptions made in deriving the values, and the inevitable divergence of actual network parameters from these assumptions, do not justify a fine differentiation of threshold on a band-by-band basis.”*

### ComReg assessment: Interchangeability of spectrum bands for the modelling of outdoor coverage thresholds

3.43 ComReg notes and agrees with Plum’s view that the principle is to simplify the thresholds to a smaller number of aggregate thresholds and, as such, does not justify a fine differentiation of thresholds on a band per band basis.

## Use of carrier aggregation for 5G outdoor coverage mapping

### Views of Respondents

3.44 Vodafone submits that:

- *“There is a need to consider capacity increasing techniques. The Plum report does not consider such techniques (such as carrier aggregation). These are supported by ComReg in the MBSA2 consultation process when looking at coverage obligations related to 700MHz.”*

3.45 Three submits that:

- *“In 2022, Three will deploy Inter Band NR Carrier Aggregation [Confidential], thus expanding the usable 3.7GHz NR downlink coverage footprint. In addition, this combines the downlink spectrum to provide greater cell edge*

*throughputs. We will also need this to be accounted for in the ComReg map to ensure it continues to be a correct representation of our coverage and of our coverage relative to other operator networks. We will be happy to work with ComReg on this in early 2022.”*

## Summary of Plum’s Response

3.46 Plum states in section 5 of its technical note that:

- *“The impact of carrier aggregation (CA) on thresholds was mentioned by two respondents.”*
- *“CA is not currently accounted for in determining the 4G coverage threshold and was not addressed in our report, as it would require a degree of modelling complexity that would be inappropriate in the present context. In particular, as noted above, the need to track changes in MNO RAN configuration might represent a significant overhead for potentially little material benefit.”*
- *“We would, however, encourage further dialogue to determine whether allowing for CA would materially impact the estimate of 5G coverage for consumers, and note the offer of respondents to work with ComReg on this issue.”*

## ComReg assessment: Use of carrier aggregation

3.47 ComReg notes and agrees with Plum’s view on this matter, including that:

- Currently, ComReg does not employ carrier aggregation as part of the methodology for definition of 4G mobile coverage map thresholds;
- At this point, accounting for carrier aggregation would introduce a degree of modelling complexity that would be inappropriate in the current context of a simplified approach to definition of 5G outdoor mobile coverage map thresholds; and
- The need to track changes in MNO RAN configuration might represent a significant overhead.

3.48 In addition, establishing how carrier aggregation is deployed on a network or site or combination of sites/cells, will require establishing for each operator the unique fine details of each carrier aggregation setup which is non trivial(e.g. whether it is enabled on every site, enabled between cells on different sites, which spectrum bands are aggregated on each site etc). As such, it is also unclear how much of a benefit currently accounting for carrier aggregation might provide. Adding this layer of overhead and complexity in the modelling does not appear justified considering the

overall approach to the modelling being taken at this point.

- 3.49 That said, and again noting the dynamic nature of the 5G outdoor mobile coverage map, ComReg would welcome further engagement with MNOs and other key stakeholders on this matter, including whether any such changes would materially impact the estimate of 5G coverage.

## 3.5 Clarifications

- 3.50 In this section, ComReg considers a number of clarification raised by respondents to Document 21/118a, being:

- Downlink/Uplink ratios used for modelling scenarios; and
- Precise quality of service disclaimer.

### Downlink/Uplink ratios used for modelling scenarios – Clarification

#### Views of Respondents

- 3.51 Three submits that:
- *“Table 5.1 of the Plum report lists out the chosen modelling scenarios. The fourth column specifies a DL:UL ratio of 80:20, which is correct for Three’s network at this time. In section 5.2.1 “Simplified Throughput Model” an example ratio of 75:25 is provided. For the avoidance of doubt, we want to make sure that 80:20 is used.”*

#### Summary of Plum’s Response

- 3.52 Plum states in section 8 of Annex 1 to this document
- *“One respondent wanted confirmation that the 80:20 downlink/uplink ratio given in Table 5.1 would be used, as a value of 75:25 is also mentioned in the report.”*
  - *“Plum can confirm that the intention is to adopt the 80:20 ratio. The other figure is mentioned only in reference to an Ofcom study which adopted that value.”*

#### ComReg assessment: DL/UL ratio

- 3.53 ComReg notes and agrees with Plum’s clarification on this matter.

## Precise quality of service disclaimer - Clarification

### Views of Respondents

3.54 Eir submitted that:

- *“Given the evolutionary status of 5G use cases, Plum considers that it would be inappropriate to imply that any thresholds correspond to precise quality of service definitions”. This should be clearly sign-posted on ComReg’s public mapping.”*

### ComReg assessment: Precise quality of service disclaimer - Clarification

3.55 ComReg has considered Eir’s observation and considers it appropriate to include text in the disclaimer section of the public facing 5G outdoor mobile coverage maps to the effect that it would be inappropriate to imply that any thresholds correspond to precise quality of service definitions.

## 4 Next steps

- 4.1 For the reasons set out above, and having considered the advice of Plum as set out in ComReg Document 21/118a and its updated technical note, ComReg will progress its 5G outdoor mobile coverage mapping on the basis of the revised recommended 5G coverage thresholds set out in the annex to Plum's technical note.
- 4.2 ComReg will contact MNOs<sup>10</sup> in relation to the proposed first publication of 5G outdoor coverage maps of which the next steps will include:
- Date for publication of 5G outdoor coverage map will be defined by ComReg;
  - Beta access for all MNOs to view 5G outdoor mobile coverage for their relevant organisation, at a time period before ComReg publish the maps online;
  - Publication of 5G outdoor mobile coverage maps.
- 4.3 More generally, ComReg reiterates that the outdoor mobile coverage map is dynamic in nature and, therefore, is committed to the review of 5G outdoor coverage thresholds in light of material developments/further information which would better inform the accuracy of outdoor 5G mobile coverage mapping.

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<sup>10</sup> Using existing communication methodology for the outdoor coverage map programme.



# Annex 1: Plum Consulting Technical Note



# Issues raised in response to Plum report on 5G coverage thresholds

Technical note | 3 March 2022

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With the launch of 5G services in Ireland, ComReg identified a requirement for consumers to view the level of outdoor 5G mobile coverage in a similar manner to that available on the ComReg website for 2G, 3G and 4G services. The results produced by the Outdoor Coverage Map presented are for illustrative purposes only and the actual user experience may, depending upon the particular circumstances of the user, differ considerably from the results shown on the Coverage Map.

The addition of outdoor 5G mobile coverage will require a significant amount of work by ComReg in modelling the detailed parameters of each network to produce accurate 5G outdoor network coverage predictions.

Having thus produced accurate field strength predictions, it will be necessary to present these in a simple format accessible to consumers; ComReg therefore initiated a supplementary project to develop and define appropriate generic coverage thresholds for the mapping of 5G outdoor mobile coverage.

As part of this work ComReg commissioned a report from Plum Consulting, "Coverage Thresholds for 5G Services" – a report (Document 21/118a). This was published on 25<sup>th</sup> November 2021 and comments invited from interested parties.

Comments have been received from all three Irish MNOs. These are summarised below, and responses provided. In addition, the Annex sets out revised recommended 5G coverage thresholds.

## 1 Network parameters: initial choice and review

A number of respondents suggested that the parameters used to characterise 5G coverage thresholds should be more closely aligned with specific network parameters (e.g. bandwidth, antenna type, MIMO configuration, etc) on a per-operator basis. In particular, it is suggested that no mapping should be provided until the conclusion of the MBSA2 process, or that parameters should be reviewed following that process.

It is important to emphasise that simplifying assumptions regarding network parameters are used only for the purposes of deriving generic coverage thresholds. ComReg's prediction of the individual network's outdoor coverage will be based on the specific, current, parameters provided by each mobile network operator.

With the launch of 5G services in Ireland there is a need to extend the functionality of the outdoor coverage mapping tool to include 5G. We do not consider that it is appropriate to attempt to reflect the exact parameters of specific networks at particular moments in time in the proposed modelling of coverage thresholds, as this would significantly complicate the coverage mapping process for potentially little gain to consumer value as the intention is to provide a reasonable estimation of coverage, for which a large number of simplifying assumptions will be necessary in the derivation of thresholds<sup>1</sup>. Further, given the other inherent uncertainties (e.g., cell loading, handset performance) and the possibility that user experience may, depending upon the particular circumstances of the user, vary from results shown on the outdoor coverage map, it would be inappropriate at this point to attempt to match any network parameters precisely for the modelling of thresholds for potentially little gain. It would, furthermore, impose a significant bureaucratic burden to track, for the purposes of defining coverage thresholds, the exact network parameters used by all MNOs as they evolve over time<sup>2</sup> – a burden that would be unlikely to be justified in terms of improved consumer messaging.

We do, however, strongly support the suggestion that the parameters used in modelling (e.g., MIMO order), and hence the adopted threshold values, should be reviewed whenever new information is available. The conclusion of the MBSA2 process would be one such point, and we understand that it is the intention of ComReg to monitor this and undertake a review in light of any significant changes or further information (e.g., regarding user traffic profiles or expectations).

One suggestion is that no action should be taken until discussions on mapping have progressed within BEREC. Plum would note that such discussions can only be informed by the operational experience of member regulators, and that learnings from the ComReg process will be important in building consensus within BEREC.

## 2 50 Mbit/s assumption

One respondent questions the adoption of a fixed target throughput of 50 Mbit/s, noting that current typical mobile data use is likely to have a lower requirement. The respondent also notes that such rates will be challenging to deliver in the lower-frequency bands where channel bandwidth is constrained.

While accepting that any adopted target throughput will, to some extent, be arbitrary, the 50 Mbit/s value was chosen, partly because it is given in a number of 3GPP references and identified by other national regulators (e.g., Ofcom, UK) for some 5G use cases of wide-area services using spectrum below 6 GHz, but also because it represents a modest, but user-perceptible, improvement with respect to 4G services. If a lower threshold were adopted, this might not align with consumer expectations.

We continue to believe that 50 Mbit/s is an appropriate target assumption for the present purpose.

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<sup>1</sup> As noted in Section 5.1. of 21/118a, "such simplifications will, inevitably lead to some distortion of the relative position of operators, either underestimating the coverage of an MNO which has slightly more bandwidth, or a higher-order MIMO scheme than assumed, or the reverse. If chosen appropriately, such differences might be insignificant in comparison to, e.g. variability in handset performance, the details of network traffic and scheduling and propagation model prediction errors"

<sup>2</sup> e.g., the MIMO order used at a particular site

### 3 Bands

The fact that a 1.6dB difference in threshold is assumed between the 2.1 GHz band and the 2.3/2.6 GHz band is questioned by one respondent, who notes that these bands are considered interchangeable (e.g., within the MBSA2 process).

In setting out the proposals for thresholds to be used in public-facing messaging, we have simplified the six 'per-band' thresholds (Table 5.3) to a smaller number of aggregate threshold values (Table 5.4). This was done because the broad assumptions made in deriving the values, and the inevitable divergence of actual network parameters from these assumptions, do not justify a fine differentiation of thresholds on a band-by-band basis.

### 4 Assumed Bandwidth

A number of comments make reference to the bandwidth values assumed in setting the coverage thresholds. We would emphasise that the intention is not to match the deployment characteristics of any particular network for the modelling of thresholds, but to give an appropriate 'order of magnitude' characterisation for each band, while accepting that there will be variations between operators and between regions. At 3.5 GHz, for example, available bandwidths will range from 60 MHz to over 100 MHz. Using the same modelling assumptions given in the report, the thresholds derived for the 80MHz and 100 MHz bandwidth cases differ only by 0.2dB.

We consider it inappropriate to attempt to capture these (relatively small) intra-band variations in what is intended to be a reasonable estimate of coverage for consumer information; indeed, this reflects the case of the 4G thresholds, where the same value is applied at 1800 MHz as at 800 MHz, despite the doubling in available bandwidth.

The same cannot apply, however, to the larger inter-band differences (e.g., a tenfold increase between 700 MHz and 3.5 GHz), so we believe that some degree of band-by-band differentiation is required for 5G thresholds.

A related issue, raised by one respondent, concerns the use of Dynamic Spectrum Sharing (DSS). This has not been accounted for in the modelling of threshold values as it would require a degree of complexity in the modelling that would not appear to be justified. As noted above, the proposed 5G coverage thresholds aim to provide a reasonable estimation of coverage, for which a large number of simplifying assumptions will be necessary in their derivation. Using a simplified threshold model would appear to achieve this aim while also avoiding the need for continuous revision of threshold assumptions in line with changing MNO network configurations. We would, however, expect ComReg to continue to review the impact of actual DSS implementation on the validity of assumed threshold values.

### 5 Carrier aggregation

The impact of carrier aggregation (CA) on thresholds was mentioned by two respondents.

CA is not currently accounted for in determining the 4G coverage threshold and was not addressed in our report, as it would require a degree of modelling complexity that would be inappropriate in the present context. In particular, as noted above, the need to track changes in MNO RAN configuration might represent a significant overhead for potentially little material benefit.

We would, however, encourage further dialogue to determine whether allowing for CA would materially impact the estimate of 5G coverage for consumers, and note the offer of respondents to work with ComReg on this issue.

## **6 Anchor cells**

One respondent noted that non-standalone (NSA) 5G deployment will be dependent on LTE anchor cells, and that the LTE limit used for such anchoring may differ from the LTE coverage limit.

We agree with this and note that it will be necessary for ComReg and the MNOs to ensure that the appropriate values are implemented in the software used to generate the coverage maps.

## **7 MIMO order**

One respondent noted that the assumption of a MIMO order of 4 is not representative of typical current deployment at 3.5 GHz.

We agree that it may be appropriate to assume a higher-order in determining coverage thresholds, and would propose a value of 8. This takes into account the fact that currently-available handsets are still constrained in the number of antennas that can be integrated. The revised table of thresholds is annexed to this document.

## **8 TDD ratio**

One respondent wanted confirmation that the 80:20 downlink/uplink ratio given in Table 5.1 would be used, as a value of 75:25 is also mentioned in the report.

Plum can confirm that the intention is to adopt the 80:20 ratio. The other figure is mentioned only in reference to an Ofcom study which adopted that value.

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## ANNEX - Recommended 5G coverage thresholds (Updated – March 2022)

Table 6.1 of the Plum Report set out the Recommended 5G coverage thresholds

As noted above, we agree that the MIMO order assumed at 3.5 GHz should be increased from 4 to 8. The resulting revised coverage thresholds are set out in the table below.

| SS-RSRP (dBm) | Description                                                                                                                     | < 1 GHz  | 1.8 GHz & 2.1 GHz | 2.3 GHz & 2.6 GHz | 3.5 GHz  |
|---------------|---------------------------------------------------------------------------------------------------------------------------------|----------|-------------------|-------------------|----------|
| Very good     | Strong signal strength with maximum data speeds                                                                                 | ≥ -82.8  | ≥ -91.7           | ≥ -93.3           | ≥ -101.0 |
| Good          | Strong signal strength with good data speeds                                                                                    | ≥ -92.8  | ≥ -101.7          | ≥ -103.3          | ≥ -111.0 |
| Fair          | Fast and reliable data speeds may be attained but marginal data speeds with data dropouts are possible at weaker signal levels. | ≥ -102.8 | ≥ -111.7          | ≥ -113.3          | ≥ -121.0 |
| Fringe        | Marginal or poor data speeds with data disconnections likely to occur                                                           | ≥ -112.8 | ≥ -121.7          | ≥ -123.3          | ≥ -131.0 |
| No coverage   | Signal strength in which no coverage is available to consumers                                                                  | < -112.8 | < -121.7          | < -123.3          | < -131.0 |

## **Annex 2: Non-confidential submissions to document 21/118**

**Eircom Limited and Meteor Mobile Communications Limited (trading as ‘eir’ and ‘open eir’), collectively referred to as ‘eir Group’ or ‘eir’**



**eir Response to ComReg Consultation**

**ComReg Outdoor Mobile Coverage Map**

**A study by Plum Consulting on 5G Outdoor Mobile Coverage Thresholds**

**ComReg Document 21/118**



**23 December 2021**

**DOCUMENT CONTROL**

|                       |                               |
|-----------------------|-------------------------------|
| <b>Document name</b>  | eir response to ComReg 21/118 |
| <b>Document Owner</b> | eir                           |
| <b>Status</b>         | Non confidential              |

The comments submitted in response to this consultation document are those of Eircom Limited and Meteor Mobile Communications Limited (trading as 'eir' and 'open eir'), collectively referred to as 'eir Group' or 'eir'.

## Response to consultation

1. eir welcomes the opportunity to comment on ComReg's proposed approach to predicting outdoor 5G coverage which is based on recommendations made by Plum Consulting. As acknowledged in the Plum report developing 5G coverage predictions is more complex than preceding technologies. The approach is expected to evolve over time. Plum proposes a simplified approach initially and eir does not object to this in principle provided the approach is reviewed regularly.
2. The need to revisit the approach is acknowledged in ComReg's Information Notice however no timeline is specified. The Plum report suggests revisiting assumptions in five years time. This is too long a period. BEREC concluded in March 2020 that "*it would be too early for BEREC to set out a policy objective to provide harmonised information on 5G coverage and QoS aspects of networks*" and the current thinking of BEREC is that "*it should adopt a wait and see approach*" potentially revisiting this topic in two or three years' time following the "*deployment of one or two use cases*" as referenced by Plum in the report. Thus BEREC has indicated it will revisit 5G coverage in the next year and a half. This is a more appropriate time period and in the Irish context would suggest that it will be appropriate to revisit the approach immediately following the outcome of MBSA2.
3. eir notes ComReg's observation "*Given the evolutionary status of 5G use cases, Plum considers that it would be inappropriate to imply that any thresholds correspond to precise quality of service definitions*". This should be clearly sign-posted on ComReg's public mapping.
4. Whilst we are supportive of a simplified approach initially eir is concerned by the proposed fixed throughput of 50Mbit/s. Plum offer no real justification for its selected threshold. The predominant 5G use case is currently the support of mobile data services and consequently the 5G threshold should be set closer to the 4G threshold particularly in respect of lower frequency bands with limited spectral capacity in scenarios A1, A2, A3, B and C
5. Due to limited Bandwidth of those scenarios, a 50Mbit/s fixed throughput would be very limiting compared to that in Scenario F where there is 80MHz or more of Bandwidth available. A 50 Mb/s fixed throughput may also cause confusion to end users when they experience perfectly good 5G service and the ComReg map is showing poor or no coverage.

6. It should be considered for scenarios A1, A2, A3, B and C, that a fixed throughput below 50Mbit/s is used which will in turn amend the determination of the RSRP for those scenarios.
7. As scenario D and E have not yet been licensed yet in Ireland, the assumed Bandwidth, MIMO order, Duplex mode and Numerology cannot be confirmed as accurate or valid at present. These values should be reassessed as and when these frequency bands have been awarded.
8. The MIMO order of Scenario F assumed a MIMO order of 4. eir has a minimum MIMO order of [✕ ✕] on its scenario F deployment. This would have a significant impact on the determination of RSRP for a given single user edge throughput. At a minimum, a MIMO order of 8 should be used for the determination of RSRP in scenario F.

# Three Ireland (Hutchison) Limited



Three Ireland (Hutchison) Limited.  
Registered Office:  
28/29 Sir John Rogerson's Quay,  
Dublin 2, Ireland.

14<sup>th</sup> December 2021

Mr. Louis Cohen  
Commission for Communications Regulation  
One Dockland Central  
Guild Street  
Dublin 1

Dear Louis

### **Comments on Document 21/118 – 5G Coverage Maps**

Three has advocated for the addition of 5G to ComReg's mobile coverage maps and we are pleased to note that ComReg is working to progress this. We have reviewed ComReg document 21/118 and the associated report from Plum Consulting, and there are some items that we wish to bring to ComReg's attention here.

Clearly, any map published by ComReg will be seen as the independent reference that is used to compare networks. The fact that this map receives 8,000 views per week on average shows how important and influential this site is in the view of consumers. For this reason, it is essential that the map gives, insofar as is possible, an objective and straightforward representation of coverage and also of the differences between networks. There are many variable factors which influence the correct choice of signal level to represent 50Mb/s at cell edge, and we accept that some of these will be unknown to ComReg or may vary across location and time. In these cases, some simplifying references might need to be assumed. Some factors will be known though, e.g. bandwidth, antennae type, etc. and these factors should be included in ComReg's model so as to give an accurate representation of the absolute coverage from each network but also the differences from one network to another.

For any user on the Three network, we will exert control over the conditions under which a user is switched between sites or between technology, e.g. drop to 4G service. As a result of this, the network itself has considerable control over the boundary of the 5G service area. To



the maximum extent possible, ComReg should try to use the same parameters as the operator as otherwise there will be differences between the map and actual service provided.

It is important to note that the signal level required for anchoring 5G NR is different to that required to provide a 4G LTE service as only signalling is required to anchor 5G. In practice it is possible to operate LTE anchor cells down to -124dBm at the lower end, though we do not advocate that. Three use a receive signal of [Confidential] to determine the limit of its LTE anchor cells and this represents a conservative approach but it is a level that we have determined is appropriate based on extensive testing and trialling. This is a matter that is best decided by an operator and we will not be changing this level to -115dBm either on our network. Neither will we be changing it on our own coverage map as to do so would not accurately represent how our network actually functions. By the same token, for ComReg's map to accurately reflect Three's 5G NR coverage it should also use [Confidential] for the LTE anchor cell. This means that the plot area for the 4G LTE service might be different than the corresponding area of the anchor signal. We note that there is no reference to anchor cells anywhere in the ComReg or Plum documents. As all operators currently use NSA, we now request clarification of how this is to be incorporated into the 5G maps.

Table 5.1 of the Plum report lists out the chosen modelling scenarios. The fourth column specifies a DL:UL ratio of 80:20, which is correct for Three's network at this time. In section 5.2.1 "Simplified Throughput Model" an example ratio of 75:25 is provided. For the avoidance of doubt, we want to make sure that 80:20 is used.

Scenario F of the table specifies the parameters for the 3.5/3.6GHz band. It uses a bandwidth of 80MHz which is incorrect for Three's network. Three's network uses a uniform 100MHz bandwidth on all sites nationally and this is not variable. It is not one of the variable parameters where it is necessary to make simplifying assumptions. This 100MHz bandwidth should be used to produce the map showing Three's coverage. If necessary, then a new Scenario G should be introduced which has this bandwidth. We see no reason why this should be changed to 80MHz when it is known and fixed.

There is no reference in either the Plum report or ComReg's document to Dynamic Spectrum Sharing (DSS). We believe the other operators in Ireland currently use DSS, while on the Three network we only use dedicated spectrum for 5G NR. There is a significant difference between the effect produced by having dedicated spectrum vs DSS on 5G service. In effect with DSS the bandwidth available for the 5G service is variable, which in turn can impact on the receive signal required for 50Mb/s at cell edge. In order to reflect this correctly in the coverage map, ComReg should only include the bandwidth that is guaranteed to be available to the 5G service.



Three Ireland (Hutchison) Limited.  
Registered Office:  
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Dublin 2, Ireland.

In 2022, Three will deploy Inter Band NR Carrier Aggregation [Confidential], thus expanding the usable 3.7GHz NR downlink coverage footprint. In addition, this combines the downlink spectrum to provide greater cell edge throughputs. We will also need this to be accounted for in the ComReg map to ensure it continues to be a correct representation of our coverage and of our coverage relative to other operator networks. We will be happy to work with ComReg on this in early 2022.

Yours Sincerely

---

Tom Hickey



# Vodafone Ireland Limited



## Vodafone Response to Information Notice

ComReg Outdoor coverage map

Reference: ComReg Doc 21/118

Version: Non-confidential

Date: 23/12/21

## Introduction

Vodafone welcome the opportunity to respond to ComReg Doc 21/118 focussed on the outdoor coverage map and the inclusion of 5G. The study by Plum has provided some useful insights and Vodafone sets out specific comments on the report below.

In summary Vodafone support the extension coverage mapping to include 5G however Vodafone would be in favour of a more staggered intervention ComReg. This position is broadly driven by two key facts

1. It remains too early to progress in advance of key spectrum allocations
2. A harmonised approach is warranted 5G and ComReg should adopt a wait and see approach consistent with guidance from BEREC regarding its policy objective to provide harmonised information on 5G coverage.

We have provided also further feedback on elements of the Plum document.

### Spectrum Allocations will only be clear on conclusion of MBSA2

The position on spectrum allocations in Ireland and the coverage available to Irish consumers and business is heavily influenced by MBSA2. ComReg have noted the importance of 700Mhz for the provision of widespread coverage, *'including in rural areas on national transport routes and is highly suitable for the provision of existing 4G and, over time, new 5G services.'*

The 700Mhz band is only allocated at this point in time under temporary licensing frameworks and is assigned entirely without prejudice to MBSA2. In this regard, the position on 5G coverage bands is subject to change. For this reason alone it is not appropriate to attempt provide meaningful long-term reliable coverage information to consumers and business before the MBSA2 process completes, and customers can be assured the mapping detail provided sets out the longer term coverage available in their specific locations of interest.

### There is a policy objective to have harmonised coverage measurement across Europe

A harmonised approach where possible will benefit consumers, business and operators.

In 2020 BEREC concluded its feasibility study on development of coverage information for 5G deployments. The main finding from BEREC was that *'it would be too early for BEREC to set out a policy objective to provide harmonised information on 5G coverage and QoS aspects of networks.'*

A harmonised approach is also important for pan-European networks that depend on a set standard to accurately monitor, compare, and benchmark coverage and QoS across multiple operating jurisdictions. A common BEREC position or baseline will be useful in informing a national approach.

We note the further recent BEREC report on the diversification of the 5G ecosystem also referred back to the 2020 position and the wait and see approach adopted by BEREC, a position adopted when many of the countries had already concluded the allocation of 5G bands. This provides further support to the case for further developments in spectrum allocation and use cases in Ireland before setting coverage mapping standards.

### Comments on the Plum report

As detailed above Vodafone support plans to update the outdoor coverage mapping tool with 5G information however it is our view it is too early to do so, firstly, in advance of settlement in Ireland on spectrum allocation and secondly, pending development of a clearer measurement standard position across Europe. As above we welcome the publication by ComReg of this report and will now provide specific comments on proposals put forward.

- **Plum’s Modelling Scenarios** in Table 5.1 of the study list ‘standardised network configurations’ in the 2.1 GHz (2x15 MHz), 2.3GHz (30MHz), 2.6 GHz (2x30MHz) bands. The degree to which these will accurately reflect the configurations and customer experience of these bands could only be clear post Multiband Spectrum Auction (MBSA2). This further supports the case for a wait and see approach.
- **The existing coverage map is capability agnostic** and does not distinguish capability provided by different spectrum holdings between bands. The same threshold for 800MHz (2x10 MHz) applies for 1800 MHz (2x20MHz).
- **Thresholds do not reflect interchangeable nature of 2.1GHz, 2.3GHz and 2.6GHz.** This interchangeability was recognised as part of MBSA2 consultation process, yet the Plum proposal is to impose a 1.6dBm threshold difference between the 2.1GHz and the 2.3GHz and 2.6GHz bands.
- **There is a need to consider capacity increasing techniques.** The Plum report does not consider such techniques (such as carrier aggregation). These are necessary to as supported by ComReg in the MBSA2 consultation process when looking at coverage obligations related to 700MHz. In ComReg document 20/122<sup>1</sup> it was noted that
  - “a RSRP base level of -95 dBm will be used as a proxy for a 30 Mbit/s SUTP42 level for a 10 MHz downlink carrier. Where capacity increasing techniques are used (such as carrier aggregation and or deploying additional bandwidth), a lower RSRP value can be used;
  - where two or three band carrier aggregation is deployed across bands with similar propagation characteristics (e.g. 700 MHz Duplex, 800 MHz Band and 900 MHz Band carriers) an RSRP level of -100 dBm and -105 dBm will apply respectively; “

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<sup>1</sup> Page 407 of ComReg Document 20/122

## Summary of Vodafone position

Vodafone support updating of the outdoor coverage map however this **should only occur on conclusion of MBSA2** and when clearer comparable measures are **informed by BEREC discussions**.

**Incrementally the mapping should develop** and in the earlier stages should be based on a single set of thresholds (similar to the approach adopted for 4G mapping) using one of the lower threshold sets.

Over time enhancements to better reflect 5G experience can be introduced. We would recommend a single threshold recognising the **interchangeable nature of 2.1, 2.3 and 2.6GHz bands**. We would also highlight the **need to consider capacity increasing techniques** such as carrier aggregation.

ENDS