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Future Mobile Connectivity in Ireland: Assessment of Respondents' Views

A report from Oxera Consulting LLP

Consultant Report

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Future Mobile Connectivity in Ireland: assessment of respondents' views

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Final

1 Introduction

1.1 This note sets out our consideration of respondents' comments on the Future Mobile Connectivity in Ireland study by Oxera with Real Wireless (ComReg Document 18/103c), henceforth 'the report'.¹

1.2 In summary, having considered the comments on the report made by respondents to ComReg Document 19/59R, we are of the view that the modelling approach and inputs are robust and appropriate, and that the conclusions we draw remain reasonable and justified.²

1.3 This note is structured as follows.

- Section 2 outlines our responses to comments on the modelling approach and conclusions.
- Section 3 gives our responses to comments on the model inputs.

¹ Oxera with Real Wireless (2018), '[Future Mobile Connectivity in Ireland](#)', ComReg 18/103c, 30 November.

² ComReg (2019), '[Proposed Multi Band Spectrum Award: Including the 700 MHz, 2.1 GHz, 2.3 GHz and 2.6 GHz Bands](#)', Response to consultation and further consultation, ComReg 19/59R, 5 July

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- Section 4 gives our overall assessment.

2 Modelling approach and conclusions

- 2.1 Respondents made several comments about the approach used in the modelling and the subsequent conclusions. These comments, with our responses, are detailed below.
- 2.2 **Level of coverage without intervention.** Vodafone (para. 15, 16 and 17 of its response) states that the report may overstate the level of coverage that will be reached without intervention, for the reasons discussed in bullets 2.3, 2.6, 3.4, 3.6 and 3.11 below. On the other hand, Mr Liam Young (paras g–o of his response) states that the report may understate the level of coverage that will be reached without intervention. Supporting views provided by Mr Liam Young are discussed in bullets 2.8, 2.15 and 3.2 below.
- 2.3 Vodafone (in para 16 and 17) states its view, while quoting a ComReg summary of the report, that there is no commercial incentive to roll-out coverage beyond a figure in the lower 90% range of population.
- 2.4 We note that Vodafone's preference for the lower 90% range is informed by ComReg's summary which cites a roll-out period of up to 2025. However, when considering a roll-out period of up to 2027, the report states that a population coverage of 95% is possible.³
- 2.5 In summary, we note that the supporting views submitted by the respondents as discussed here and below do not change our view that the cost modelling is based on robust inputs and assumptions, and that the conclusions and recommendations drawn from them about the level of coverage that may occur without intervention are reasonable and justified.
- 2.6 **Operator budget.** Vodafone (para. 15) states that mobile network operator (MNO) budgets are partly spent on replacement sites for the current network, therefore reducing the level of investment available for new coverage.
- 2.7 In response, we first note that the analysis in section 5.5 of the report is (among other things) based on a conservative estimate of the percentage of network investment being spent on improving mobile coverage (10–20%). While we recognise that MNOs may have high levels of operating expenditure (OPEX) on their existing networks, this is unlikely to have a material impact on

³ ComReg 18/103c, Table 5.8.

the level of investment that MNOs would be willing to make in achieving new coverage. This is because the investment decision regarding future mobile connectivity is likely to be driven by the expected return for that particular investment (rather than by the operating costs of a previous investment).

- 2.8 **Propagation characteristics of 700MHz and the benefits of carrier aggregation.** Mr Liam Young (paras j, m and n) states that the 700MHz band and carrier aggregation technology bring significant coverage benefits, and that the model may not fully account for these positive effects. Mr Liam Young (para. j) also states that the report is unclear on the extent to which the Irish MNOs will deploy carrier aggregation.
- 2.9 In response, we consider that the model comprehensively considers the positive impact of the 700MHz band and carrier aggregation. Further, we consider that the potential deployment of carrier aggregation by Irish MNOs is appropriately accounted for and explained in the report. We note the following.
- 2.10 First, section 4.4 of the report sets out the spectrum availability assumptions used in the model and assumes that 700MHz spectrum would become available from mid-2020 onwards. Section A2.4 of the report sets out the propagation assumptions used in the modelling of the different radio frequencies.
- 2.11 Second, the model assumes different coverage footprints at: a) sub-1GHz, b) 1800MHz, and c) >2GHz.⁴ The model assumes that the outdoor coverage across the 700MHz, 800MHz and 900MHz bands is equal to that at 800MHz. This is because the improvement at 700MHz over 800MHz (under free space loss) is expected at about $20 \cdot \log_{10}(800/700) = 1.2\text{dB}$ —a benefit that may not materialise in reality as in implementations of handheld user equipment the antenna gain and MIMO correlation are slightly worse in 700MHz compared with 800MHz.⁵
- 2.12 Third, section 4.4 of the report explains the carrier aggregation assumptions used in the model, including the fact that carrier aggregation is available for

⁴ ComReg 18/103c, section A2.4.2.

⁵ For example, 'To make the best use of MIMO, the antenna correlation between adjacent antennas should be low. The best MIMO performance is achieved when data channels are uncorrelated to each other. A MIMO antenna in a small commercial handset, the antenna correlation is inherently high as closely packed antennas are strongly coupled to each other. Such problem is more critical for the lower frequency range (e.g., E-UTRA LTE band 17, 704–746MHz), as the wavelength is longer and antennas are electrically closer'. Chung, J.-Y., Yang, T. and Lee, J.Y. (2011), 'Low Correlation MIMO Antennas With Negative Group Delay', *Progress In Electromagnetics Research C*, **22**, pp. 151–163.

deployment on new sites and upgrades from mid-2020 onwards. Section 4.4 of the report also sets out the network roll-out rate for new sites and upgrades.

- 2.13 Fourth, Figure A2.5 of the report sets out information on the indicative range of the carrier aggregation spectrum combinations used in the model. This shows that carrier aggregation can result in significant improvements in coverage, which reflects the compounding effect suggested by Mr Liam Young (i.e. the benefits of adding the 700MHz band to an existing 'stock' of spectrum). Indeed, section 5.1 of the report discusses the considerable impact that the availability of carrier aggregation and 700MHz spectrum has on the estimated network costings in the simulation results:⁶

Both the 700MHz band and Carrier Aggregation reduces the cost of providing coverage (as site upgrades cost less than building new sites). Therefore, the incremental cost of providing coverage is reduced in the immediate years following mid-2020 (mid-2020 appears as a 'kink' in many of the charts in section 5).

- 2.14 Lastly, section 5.5 of the report provides observations on what the market would deliver commercially, noting, among other things, the benefits associated with deploying carrier aggregation in relation to estimated network costings in the simulation results:⁷

We consider that from mid-2020, the commercial extension of the mobile network is likely to switch to a focus on extending higher-speed connectivity (e.g. minimum 30Mbit/s population coverage). This is partly because more spectrum will become available, which will also more readily enable three-band Carrier Aggregation (a key technology that will reduce the cost of high-speed connectivity).

- 2.15 **Technology advancements, 5G and future demand patterns.** Mr Liam Young (para. g) states that the model does not include 5G technology, and therefore is 'somewhat retrospective rather than forward looking'. Mr Liam Young (para. h) notes that the report focused on interviews with Irish MNOs and equipment vendors and did not include an end-user demand survey, and that end-users will determine how the market develops. Mr Liam Young (para. i) further notes that international comparisons cannot include 5G networks, as they have yet to be developed. Mr Liam Young (para. l) also notes that the

⁶ ComReg 18/103c, section 5.1.

⁷ ComReg 18/103c, section 5.5.

model does not consider improved antenna, beam-forming, small cell and fixed wireless access solutions.

- 2.16 In response, we consider that the model has reasonable assumptions based on the likely gradual evolution of the mobile networks in Ireland, and we note the following.
- 2.17 The international comparisons are reasonable because the use cases identified in the report were not specific to 5G technology, and therefore do not require 5G-specific networks to be developed. For example, Internet of Things (IoT) and mobile broadband services (MBB) have been around for many years and will continue to be delivered with 4G (LTE) technology as modelled for some time.
- 2.18 While 5G networks will be deployed and evolve in the future, it would be unreasonable to assume that the MNOs will upgrade their networks with the latest technology (e.g. 5G) or features (e.g. beam-forming) all at once. It is more likely that this will happen gradually, and that 4G technology will remain in the coverage layer of networks for a number of years to come, similar to the way that 2G and 3G technologies remain in use today. Further, in relation to Vodafone and eir's launch of 5G services using the 3.6GHz band, we note that these launches are incremental improvements on their existing networks, and that these 5G networks are likely to develop further over time.⁸
- 2.19 It is reasonable to assume that service providers (i.e. MNOs) will assess the demand carefully and upgrade the network to deliver services in the most efficient way, and that the MNOs have a good knowledge about the end-user demand for services and the cost of delivering those services.
- 2.20 At the time of writing the report, small cells had not been widely used as a solution to fill coverage gaps in Ireland. We did consider fixed wireless access, but the interviews informed us that this would be a niche use case.⁹ Further, fixed wireless access is not a solution to mobile broadband because it is by definition fixed at a location and not mobile.

⁸ Vodafone (2019), '[Vodafone Ireland switches on first 5G network in five cities](#)', press release, 17 September. RTE (2019), '[Eir launches its 5G network in 10 towns and cities](#)', 24 October.

⁹ ComReg 18/103c, section A1.6.

3 Model inputs

- 3.1 Respondents made several comments about the inputs used in the model. These comments, with our responses, are detailed below.
- 3.2 **Macrosite height.** Mr Liam Young (para. k) notes that macrosite height is based on estimates, and that it is lower in rural locations compared with urban locations.
- 3.3 In response, we recognise that the coverage estimation and cost estimates are affected by antenna height. As discussed in section 4.1.3 of the report, the macrosite height assumptions used in our modelling are based on various industry sources, and we note that the aim of the study was to model coverage at a network level as opposed to providing precise coverage for each macrosite. In this regard, we carried out a coverage validation exercise to confirm that the coverage from the synthetic mobile network modelled (which involved calculations based on the assumed antenna height and site locations, etc.) was comparable to other estimates of MNO coverage.¹⁰ Further, we note that the urban topology offers opportunities for relatively high antenna height because of the availability of buildings that reach that height (i.e. rooftop antenna). Therefore, we believe the macrosite height input is appropriate.
- 3.4 **Structural upgrades and associated labour costs.** Vodafone (para. 15) notes that many existing towers would require structural upgrades, and that the associated labour cost for site upgrades would be higher (typically €5,000) than that assumed in the model (€500).
- 3.5 In response, we note that the estimated costs are mostly driven by the cost of new sites¹¹ (rather than upgrades), so we would not expect the higher site upgrade costs as suggested by Vodafone to materially change the simulation results. Further, we note that the model focuses on estimating the cost of upgrading the synthetic network to provide coverage (as opposed to providing capacity), which in the case of spectrum portfolio 1 is done by carrier aggregation across the three sub-1GHz bands. To implement spectrum portfolio 1, the model assumes multi-band antennas that can transmit all three sub-1GHz bands so that the structural upgrades are not needed.¹² Due to the

¹⁰ ComReg 18/103c, section 4.3.

¹¹ ComReg 18/103c, section A2.4.10. New sites have an estimated CAPEX of €250k.

¹² Multi-band antennas are available for MNOs to deploy, and are commonly used by MNOs. See, for example, Sharma, R. (2015), '[Huawei Unveils Hexa-band Miniature Antenna on 700/850-900MHz to Support MBB Market in APAC](#)', The Fast Mode, 7 May.

focus on coverage, the model does not include the cost of upgrading sites for capacity, which would require access to higher bands and more antennas. Such potential additional costs for capacity purposes is already noted in the report.¹³

- 3.6 **Number of new sites per year.** Vodafone (para. 15) states that the speed of roll-out of new sites has decreased since the data set used by ComReg was created.
- 3.7 In response, we first note that this is the roll-out rate for a synthetic operator and is not intended to represent an operator's specific plans. For example, as noted in section 4.4 of the report: 'an incumbent operator with near-ubiquitous network coverage might have a lower roll-out rate, as it would presumably require far fewer new sites for coverage purposes'. On the other hand, section 4.4 of the report also recognises that: 'a new entrant operator is likely to have a higher roll-out rate when it is building out its network to increase coverage'.
- 3.8 Second, the speed of new site roll-out is an input to the model that MNOs can adjust, and we note that faster roll-out speeds are more challenging for MNOs to achieve and would result in MNOs incurring higher costs (than for a slower network roll-out).¹⁴ Based on past evidence, we considered an average roll-out speed that would be applicable across all incumbent MNOs.
- 3.9 Third, we used the roll-out rate of 2.5% CAGR (compound annual growth rate) to determine the maximum number of new sites an operator could roll out in a given year. When site upgrades are deployed the new site roll-out is reduced accordingly as operator resources are deployed for the site upgrade. For example, the synthetic operator new site roll-out rate immediately after mid-2020 is considerably lower than the maximum 2.5% CAGR level, as the coverage gains are provided primarily through upgrades. This is evident from the results of scenario 2 which show a decreased level of new macrosite roll-out after mid-2020 which is due to the increased deployment of site upgrades.¹⁵
- 3.10 Fourth, we note that recent announcements by eir imply that the roll-out rate of 2.5% and the associated investment are likely to be achievable. In particular,

¹³ ComReg 18/103c, section 4, p. 22 and section A2.4.1.

¹⁴ ComReg 18/103c, section 5.1.3.

¹⁵ ComReg 18/103c, section 5.3.2. For example, under scenario 2, in the year from end-June 2020 to end-June 2021, the network expansion model deploys 204 site upgrades and 17 new sites.

eir announced an investment of €150m over two years.¹⁶ This investment will result in: 'Hundreds of additional mobile base stations and existing sites without 4G capacity will be upgraded to it.' This illustrates that the estimates in the report (Table 5.8) of what might be commercially viable are indeed reasonable.

3.11 **Sites where there is no planning permission.** Vodafone (para. 15) states that a small number of areas cannot be served due to a lack of planning permission.

3.12 In response, we recognise that such site acquisition failures or notice to quit can be an issue for MNOs in general (as shown by the Mobile Phone and Broadband Task Force), and that this could potentially lead to a small increase in cost.¹⁷ However, in the context of this modelling exercise, it is unlikely to have a significant impact on the overall cost.

4 Overall assessment

4.1 Having considered the comments made by respondents in relation to the report (as described above), we are of the view that the modelling approach and inputs are robust and appropriate, and that the conclusions we draw remain reasonable and justified.

¹⁶ eir (2019), '[eir's mobile network transformation](#)'.

¹⁷ Mobile Phone and Broadband Task Force (2016), 'Report of the Mobile Phone and Broadband Task Force', December.