



An Coimisiún um
Rialáil Cumarsáide
Commission for
Communications Regulation

Improving connectivity in Ireland

Challenges, solutions and actions

Information Notice

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Commission for Communications Regulation

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1 Introduction

1. We live in a period of rapid innovation, with leaps in technology changing consumers' choices and behaviours. These developments present new opportunities. They also create new connectivity challenges which require new solutions.

“Connectivity” in this context describes the ability of users and their devices to connect and communicate with each other and their networks, which has quickly become a fundamental aspect of consumers' everyday lives. Connectivity can take different forms, with many different networks and devices being used, increasingly seamlessly, to communicate and consume content and applications in the course of a typical day.

2. As the communications regulator, the Commission for Communications Regulation (“ComReg”) has an important role to play in facilitating market outcomes which promote efficient investment and effective competition to the benefit of consumers. Further in its role as manager of the radio spectrum in Ireland, ComReg has an important role in designing appropriate conditions for the award of spectrum rights of use.
3. To assist ComReg in its development of award proposals for its forthcoming spectrum awards,¹ and in particular its consideration of appropriate coverage obligations, ComReg commissioned three studies to provide advice on different aspects of providing connectivity in Ireland, including estimated costings to extend mobile broadband (MBB) coverage to high levels.² As outlined below, the 30 Mbit/s MBB service modelled in these studies is a mobile service and is not the same level of service outlined in the NBP service requirements which are notably higher
4. ComReg is pleased to publish the results of these studies today in the form of three reports, all of which are available on our website. These reports are:
 - “*Meeting Consumers’ Connectivity Needs*” – a report (Document 18/103b) and accompanying infographic (Document 18/103a) from Frontier Economics Ltd. (“Frontier”) which provides an overview of the challenges in providing connectivity for consumers in Ireland and outlines actions that can be taken by all stakeholders,

¹ In June 2018, ComReg set out its preliminary view that four spectrum bands should be included in its next spectrum award. These are the 700 MHz Duplex, paired 2.1 GHz, 2.3 GHz and 2.6 GHz bands. Source: ComReg Document [18/60](#), Proposed Multi Band Spectrum Award, June 2018.

² While these studies are primarily focused on the connectivity experience for consumers, ComReg is of the view that these studies should complement government plans such as Project 2040 and the National Development Plan 2018-2027 where the digital connectivity requirements encompassing broader sectors of the economy are considered.

including consumers, industry, government and ComReg, to optimise the levels of connectivity given these challenges (“Frontier Report”);

- *“Future Mobile Connectivity in Ireland”* - a report (Document 18/103c) from Oxera Consulting LLP (“Oxera”), with Real Wireless Ltd., which considers the future mobile connectivity services likely to emerge in Ireland and the estimated costs of providing connectivity to such services at high coverage levels in Ireland (“Oxera Report”);
 - *“Coverage obligations and spectrum awards”* – a report (Document 18/103d) from DotEcon Ltd. (“DotEcon”) which considers options as to how appropriate coverage and rollout obligations could be included in future spectrum awards (“DotEcon Report”).
5. Readers are encouraged to read and consider these reports, all of which usefully contain brief executive summaries. These reports will help inform interested parties’ views on the wider connectivity discussion including the use of policy or regulatory interventions to secure extensive coverage outcomes, and the appropriate level of coverage obligations for forthcoming spectrum awards.
 6. To further assist readers, the remainder of this document provides a summary of the key messages contained in these reports

2 Connectivity in Ireland

2.1 User demand for connectivity is increasing

7. Connectivity enables users to access the content and applications they need, and to communicate with one another. Digital services are becoming fundamental to economic and social activity, and there is a corresponding increase in demand for connectivity: both a requirement for higher quality connectivity (such as faster speeds) and a need for connectivity to be available at more locations.
8. Over the course of a day, a user may access the same content and applications from the same device – or possibly even seamlessly from a different device - but using several different networks. For example, he or she may check email or use social media using home Wi-Fi in the morning and evening, using a mobile data network when travelling and using Wi-Fi networks at work and in public locations during the day. As a result, users have come to expect that their devices will work in an ‘*always on*’ mode at home, at work, when travelling and in leisure areas.
9. The demand for connectivity is growing fast. Over the year to June 2018, total data usage in Ireland grew by 26.6%, with mobile data growing at 46%. At present, 87% of the data volume is consumed on fixed networks (including Wi-Fi) but mobile data is growing faster and **mobile data usage is expected to quadruple in the next 5 years.**

2.2 But there are gaps in the provision of connectivity

10. Many users are satisfied with the connectivity available to them, but there are gaps in the provision of connectivity. These predominantly occur in three scenarios: indoors, in rural areas and when travelling.
11. A consumer survey commissioned by ComReg in 2017³ shows that **4 out of 5 Irish consumers are satisfied** with their current mobile service where they live (i.e. at their homes) and in other areas where they visit/travel, although some mobile users reported experiencing performance issues. According to the survey, while consumers can experience connectivity issues regardless of their location, **performance issues occur more frequently while indoor and in more rural parts** of the country. Performance issues were also reported at other locations and when travelling, albeit at a lower rate.

³ ComReg Document [17/100a](#) - *Mobile Consumer Experience Survey*, December 2017.

12. The gaps in mobile connectivity are exacerbated by gaps in fixed network connectivity. When good quality fixed network broadband is available, it can be used to provide indoor data connectivity and even indoor voice connectivity via native Wi-Fi calling.
13. However, the Government has identified approximately 540,000 premises in rural Ireland which do not have high-speed fixed broadband connections and which are likely to be too expensive to be served on a commercial basis in the near future. These premises are also on average more likely to be in areas of poorer mobile connectivity.
14. The **Government's National Broadband Plan (NBP)** has the objective of making high-speed broadband fixed connectivity available to all those premises in Ireland that would not receive such connectivity on a commercial basis.⁴ The project aims to roll out a high-speed broadband network which will support the premises in rural areas which otherwise would not have access to adequate high-speed broadband.
15. Noting that connectivity performance issues were identified by consumers as occurring more frequently while indoor, in rural areas and while travelling, the remainder of this document outlines the key messages of the 3 reports in a similar order.

2.3 There are solutions for addressing indoor connectivity

16. It has become more challenging to obtain a reliable direct connection between a device inside a building and a mobile network base station.
17. All building materials reduce the strength of signals to some extent, but **modern building materials** are unintentionally affecting the delivery of mobile signals inside buildings to a greater degree. This is detailed in recent ComReg research, which shows that the modern materials being used to retain heat in buildings are also, to a varying but significant extent, keeping mobile radio signals out.⁵
18. Another factor is the varying performance of the **mobile handsets** currently being used by consumers. ComReg's research into the performance of mobile handsets for voice⁶ and data⁷ services shows a notable difference in quality, depending on the service used. Importantly, mobile handsets are not equal in their ability to effectively operate with weak signals.
19. Notwithstanding these issues, it is normally possible to access mobile connectivity indoors. Indeed for some users, this can be an alternative to a fixed connection. With new and existing homes increasingly using better insulation materials, however, indoor

⁴ The [National Broadband Plan](#) (DCCA website).

⁵ ComReg document [18/73](#), The Effect of Building Materials on Indoor Mobile Performance, August 2018.

⁶ ComReg document [18/05](#), Mobile Handset Performance (Voice), February 2018.

⁷ ComReg document [18/82](#), Mobile Handset Performance (Data), September 2018:

reception cannot be assured with sufficient reliability to meet the needs of all users and other solutions are therefore needed to ensure comprehensive indoor connectivity. ComReg has identified two specific solutions, namely:

- the use of Wi-Fi and **native Wi-Fi calling on a fixed broadband connection**; and
- the use of **licence-exempt mobile phone repeaters**.

20. Native Wi-Fi calling significantly improves indoor voice connectivity for mobile devices. It is particularly relevant for Ireland given the challenges in providing mobile connectivity to all premises and the use of modern building materials which can significantly impair the availability of radio signals indoors. With native Wi-Fi calling, calls and texts on a smartphone, rather than going through the mobile network directly, instead use the available Wi-Fi connection. In Ireland, eir is the only mobile operator that currently offers this service⁸, although ComReg notes that Vodafone is reportedly planning to introduce a similar service in the near future.⁹ As support for native Wi-Fi calling increases to solve indoor connectivity, and consumers become aware of the usefulness of native Wi-Fi calling, one would expect competitive pressure to encourage at least all of the main operators to offer this service.¹⁰
21. By ensuring widespread access to high-speed fixed broadband connectivity, the NBP is clearly critical to the penetration and uptake of Wi-Fi and Native Wi-Fi calling services by which to improve indoor connectivity.
22. For premises that do not yet have a fixed broadband connection, and where there are still difficulties in obtaining indoor mobile connectivity, the use of a mobile phone repeater offers a viable solution. These act to strengthen the mobile signals that are received indoors. In July this year, ComReg cleared the use of specific mobile phone repeaters in Ireland¹¹, meaning that consumers can now purchase and install such repeaters themselves regardless of their service provider.

2.4 Mobile can improve connectivity in rural areas and when travelling but prioritisation will be needed

23. For most users, improving connectivity in rural areas and when travelling means extending the coverage of mobile networks that provide a good quality mobile voice and broadband service. It is, however, important to recognise that other technologies

⁸ Wi-Fi calling on [eir mobile](#) .

⁹ Vodafone switches on VoLTE [voice over LTE] service on its network, [Irish Independent](#), July 2017.

¹⁰ See the DotEcon Report, section 2.2.2

¹¹ Wireless Telegraph Act 1926 (Section 3) (Exemption of Mobile Phone Repeaters) Order 2018, [S.I. 238 of 2018](#)

may provide solutions to the specialised connectivity needs of specific users, including future uses such as agricultural sensor networks.¹²

24. Ireland’s landscape and population characteristics present considerable challenges for the commercial delivery of connectivity solutions to very high coverage levels. In particular, and when compared to other EU countries, Ireland has a low population density¹³, and is also predominantly rural:

- 76% of Ireland is covered by forests or farmland;
- 37% of the population live across 98% of Ireland’s landmass;
- 71.8% of the houses in rural areas are categorised as “one-off” houses¹⁴; and
- Ireland’s road network density per population is twice the EU average.

25. To better understand the feasibility of enhancing the connectivity of mobile networks in Ireland, ComReg asked Oxera to provide estimates on the cost, number of new sites¹⁵ and rollout time¹⁶ that an average existing mobile operator would require in order to extend the provision of a MBB service from current coverage levels. In particular, we asked Oxera to look at three different types of coverage dimensions – population coverage, geographic coverage, and motorways and primary road coverage – and two different MBB speeds at cell edge - 3 Mbit/s and 30 Mbit/s.¹⁷

26. ComReg commissioned these reports to inform its consideration of future **mobile** connectivity. Therefore, it is important to note that the 30 Mbit/s MBB service modelled by Oxera would **not** deliver the level of service outlined in the NBP service requirements which are significantly higher. The Oxera model is based on providing a 30 Mbit/s MBB service **outdoors** and **to a single user** at the cell edge and does not take into account requirements¹⁸ in the NBP service specification such as the need to:

¹² For example some Internet of Things (“IoT”) services can be provided by narrowband-IoT (“NB-IoT”) or other Low Power Wide Area Networks (“LP-WAN”) technologies. Deployments using licence-exempt spectrum in the 868 MHz band also allow the possibility of end-users deploying their own low power IoT network.

¹³ Ireland’s population density of 69.3 people per km² is considerably lower than the EU28 average of 117.5 people per km²: [Eurostat, ‘Population density’ 2016](#).

¹⁴ Source: <http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?Maintable=E1063&Planguage=0>

¹⁵ Based on licensing information it is estimated that Irish MNOs currently have circa 2000 to 2500 sites in each of their networks, the majority of which are co-located.

¹⁶ The network rollout time is based on a 2.5% Compound Annual Growth Rate (CAGR) for new sites. This is calculated from the historical site licensing date of Irish MNOs. This means that a network of 2,000 sites would add 50 new sites in a year, while a network of 2,400 sites would add 60 new sites in a year.

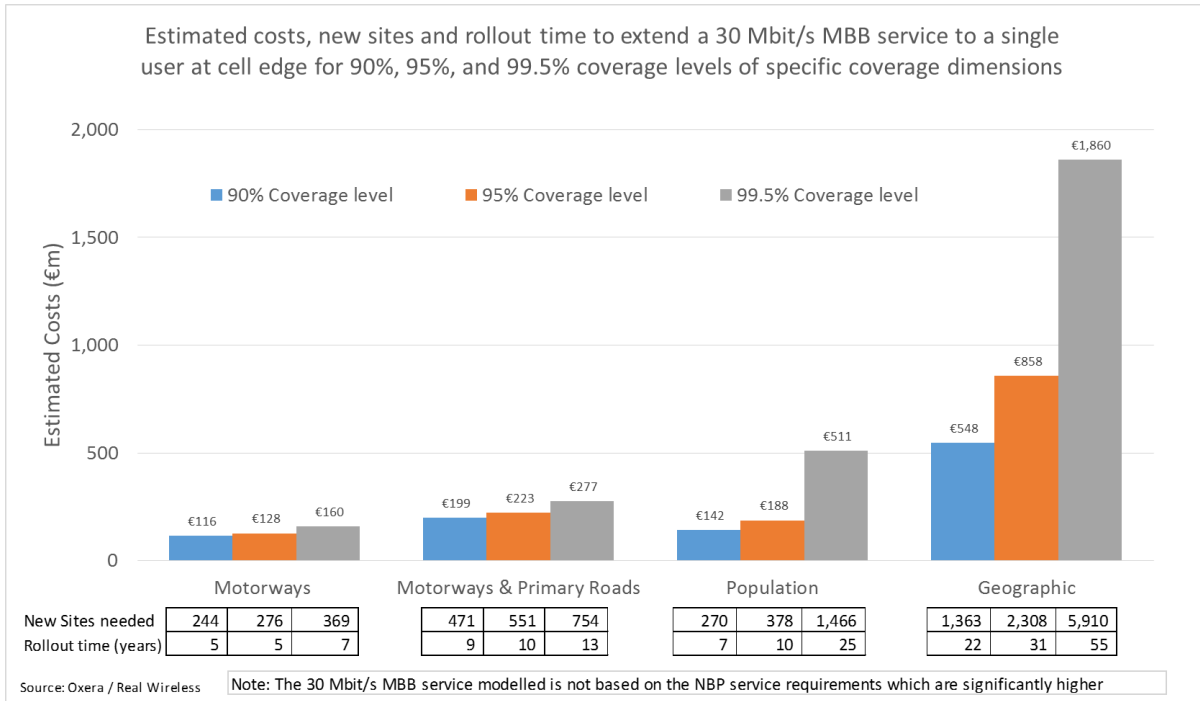
¹⁷ The results for all simulations are available in section 5 of the Oxera Report.

¹⁸ [Ireland’s Broadband Intervention Strategy](#), updated December 2015

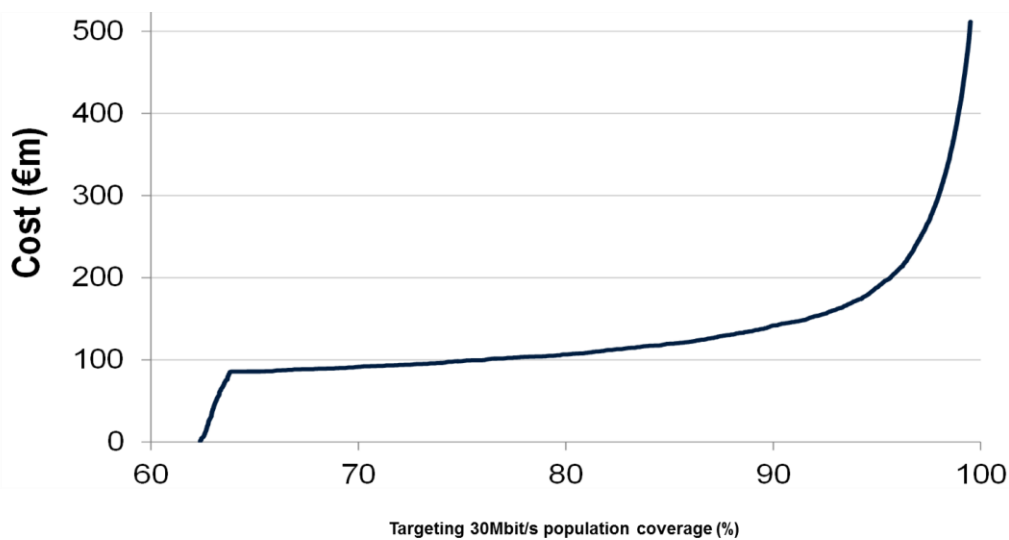
- provide an indoor service - at the cell edge and for many other buildings, additional equipment would be required to provide service indoors;
 - provide a reliable, high quality and consistent service for end users - the Oxera model does not take into account (i) the capacity demands of a mobile network where multiple end-users compete for the same resources in the cell, or (ii) the minimum NBP performance standards such as an upload speed of 6 Mbit/s or a service availability of 99.95%;
 - be future-proofed, so that there is a cost-effective way to meet the growing demands of end- users for increased bandwidth and higher speeds over a 25-year time period; and
 - achieve universal coverage within the specified time frames – the estimated network rollout time to extend a mobile network can be considerable, particularly given the need to more than double the number of cell sites, which will require commercial negotiations and planning permission even before construction begins.
27. In summary, and as shown in the figure below, for an average mobile operator the estimated costs and number of new sites needed to extend a 30 Mbit/s MBB service to very high coverage levels are:
- substantial on a geographic basis (i.e. landmass, fields, forests)¹⁹;
 - sizeable on a population, motorways and primary roads basis; and
 - vary considerably depending upon the required coverage level (e.g. 90%, 95% or 99.5%).²⁰

¹⁹ For example, to achieve 99.5% geographic coverage networks would require up to four times as many cell sites as exist today, would cost nearly €1.9bn and likely take many years to roll-out.

²⁰ For example, to achieve 99.5% population coverage the estimated cost is €511m. To achieve 95% population coverage the estimated cost is €118m.

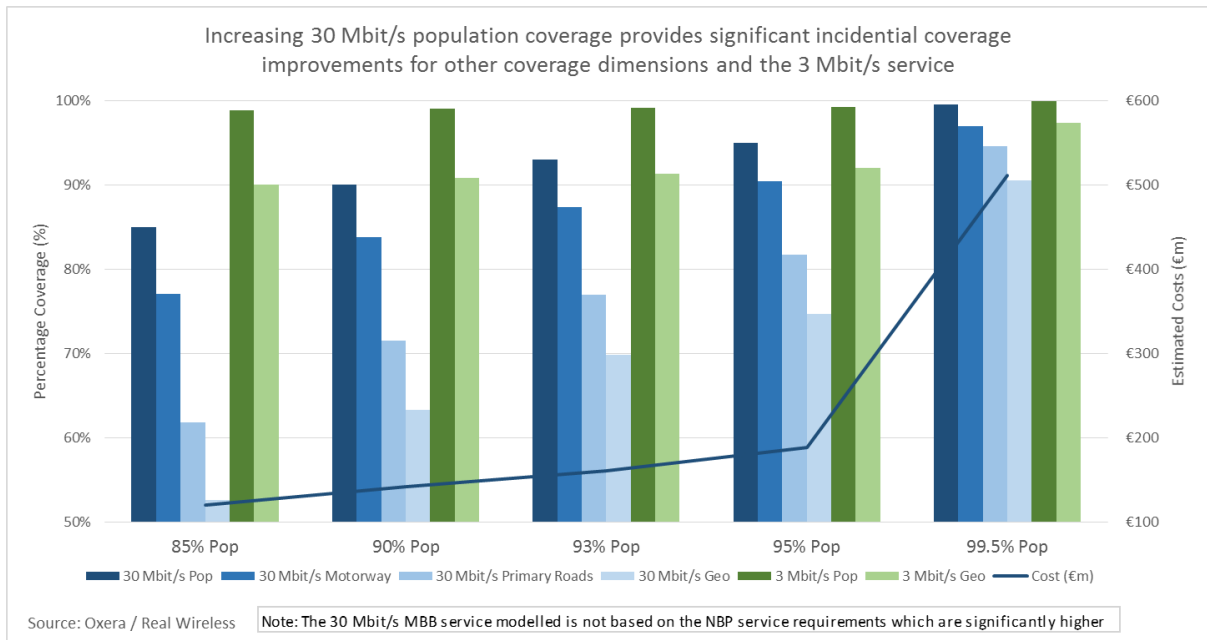


28. The Oxera Report also highlights that, while certain levels of coverage can be achieved with moderate levels of investment, high levels of coverage across all the coverage dimensions modelled causes costs to rise exponentially. For example, the chart below shows the costs of targeting 30 Mbit/s population coverage and highlights that costs accelerate at coverage levels between 90% and 95%, and increase exponentially above 95%.



Source: Oxera / Real Wireless Note: The 30 Mbit/s MBB service modelled is not based on the NBP service requirements which are significantly higher

29. The Oxera Report also highlights that increasing population coverage of 30 Mbit/s leads to significant incidental coverage improvements for the other coverage dimensions (geographic, motorway, primary roads) and for the 3 Mbit/s and voice²¹ service. For example, extending a mobile network to achieve 90% population coverage of 30 Mbit/s (from its current level of circa 62%) would provide above 80% motorway coverage, above 70% primary road coverage and above 60% geographic coverage for 30 Mbit/s. Furthermore, the network coverage would also be increased to above 99% population and above 90% geographic coverage for a 3 Mbit/s service.



30. In the light of these cost estimates, Oxera estimates that there will likely be a commercial incentive to extend 30 Mbit/s MBB coverage to a level in the lower 90 percentile range of population²² in the period up to 2025. Oxera observes that policy or regulatory interventions could accelerate and/or extend coverage beyond these levels, to a certain extent, but this would require stakeholders to assess carefully the costs and benefits involved.

²¹ While a voice service is not explicitly modelled in the Oxera Report, as it would have required significantly different modelling parameters and assumptions to those used for a data service, a 0.2Mbit/s data rate is used as a proxy for a voice service.

²² Section 5.5 of the Oxera Report presents observations on what the market would likely deliver commercially.

2.5 “Precautionary” licence obligations can underpin the role of competition in driving coverage; carefully-determined “interventionist” obligations could take this further

31. ComReg’s strategic vision involves improving the connectivity experience of users in Ireland. In respect of mobile connectivity, our action plan includes providing information that enables consumers and other stakeholders to make more informed choices, removing any unnecessary regulatory barriers within ComReg’s control, and releasing new spectrum rights that can be used to provide fixed wireless and MBB services.
32. In June, ComReg consulted on the spectrum bands that could be included in its next spectrum award.²³ ComReg’s proposals included the release of spectrum suitable for both coverage and capacity purposes which, if implemented, would see a 46% increase in the amount of harmonised spectrum available for the provision of wireless broadband (an increase from 750 MHz to 1100 MHz).
33. When we assign rights of use for spectrum, we need to consider appropriate coverage obligations. In that regard, the DotEcon Report observes that, across Europe, coverage obligations have commonly been set at or below the level that might be expected to be achieved in any case as a result of well-functioning competition in the marketplace. These “precautionary” obligations have been included in mobile licences to reduce the risks of competitive failures. “Precautionary” obligations, in this context, refers to obligations that do not exceed the levels of coverage that might be expected anyway from well-functioning competition between network operators.
34. DotEcon further highlights that “interventionist” coverage obligations – designed to achieve faster or more extensive coverage than would be delivered by competition – need to be carefully designed to ensure that benefits to the community at large exceed the costs of extending coverage. This typically requires some evaluation of the societal benefits of additional coverage. Furthermore, more substantial interventions to increase coverage not only entail greater cost but, if poorly designed, may risk unintended outcomes if they distort competition in providing mobile communications services and on competition in spectrum awards. “Interventionist” obligations, in this context, refers to obligations which can be expected to constrain the commercial choices of network operators and force coverage in excess of competitively-determined levels.
35. While coverage obligations have been traditionally applied to spectrum licences, DotEcon notes that in mature markets such as Ireland, where operators have existing

²³ ComReg Document [18/60](#), Proposed Multi Band Spectrum Award, June 2018.

spectrum holdings capable of providing coverage, there may be options to “decouple” the procurement of interventionist coverage enhancements from the awarding of spectrum licences. This may be achieved by conducting a sequential step as part of the spectrum award or through a separate process. These mechanisms may provide advantages for the State in ensuring that the societal benefits²⁴ created exceed the costs of imposing coverage obligations. It may also provide a useful option to see what “precautionary” coverage obligations and competition between mobile network operators might deliver, retaining the policy option for a significant coverage intervention later if this proved necessary.

2.6 Summary

36. In summary, all three reports provide informative analysis on the challenges, solutions and actions to improve connectivity in Ireland. In particular they highlight that:

- we live in a period of rapid innovation where consumers are demanding more connectivity and increasingly expect their devices to work in an ‘always on’ manner at home, at work, when travelling and in leisure areas;
- Government initiatives, including the NBP and the Mobile Phone and Broadband Taskforce, are fundamental to making high-speed broadband fixed connectivity available to all premises in Ireland, and to identifying solutions to barriers obstructing the provision of improved mobile phone and broadband coverage;
- good solutions for indoor connectivity include the use of Wi-Fi and native Wi-Fi calling on a fixed broadband connection, and the use of licence-exempt mobile phone repeaters. By ensuring widespread access to high-speed fixed broadband connectivity, the NBP is clearly critical to the penetration and uptake of Wi-Fi and Native Wi-Fi calling services;
- it seems feasible for the market by itself to increase the 30 Mbit/s mobile broadband coverage from current levels to at least 90% of the population (where people live) in the period up to 2025. Achieving this coverage level would also provide significant incidental coverage improvements for other coverage dimensions (geographic,

²⁴ A focus group of the Mobile Phone and Broadband Taskforce has provided a guidance [report](#) on the broad categories of locations where mobile services should be available. Based on a ranking of the benefits (economic, societal, safety) of different location categories, it provides the following conclusions:

- 1) *There is a clear emphasis on the provision of mobile phone coverage at locations where large numbers of people work or spend typical working hours. It should be noted that often people do not live where they work.*
- 2) *Residential locations and locations where people pass their free time were the next most important type of location.*
- 3) *Quiet roads, rail lines, cycleways, walking routes and locations where low numbers of people work were considered the lowest priority for mobile phone coverage.*

motorway, primary roads) and for the 3 Mbit/s and voice services, increasing this service to above 99% population and above 90% geographic coverage;

- very high levels of 30 Mbit/s mobile broadband coverage on a geographic basis would not be achieved by the market itself as this would require networks to have two to four times as many cell sites as exist today. This would take many years to achieve and the overall cost to stakeholders would likely be substantial;
- policy or regulatory interventions could be used to secure more extensive coverage outcomes than would result from marketplace competition alone. These would, however, need to be carefully designed, and based on an assessment of the costs and benefits to society of the additional coverage sought.

3 Next Steps

37. As identified in the publication of Document 18/60 in June 2018, ComReg is proceeding with the development of a more informed and detailed set of award proposals for the proposed award of the 700 MHz, 2.1GHz, 2.3 GHz and 2.6 GHz bands. In setting out the award proposals ComReg will consider the above reports and other relevant material before it, including the responses received to Document 18/60, with the aim of publishing a response to consultation and further consultation.
38. ComReg intends to address these matters in its response to consultation and further consultation in early 2019.