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# FTTP or 4G/5G for Ireland's NBP?

5 December 2018

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*Analysys Mason has been asked to provide this paper on the most suitable technology solution for the National Broadband Plan (NBP), and specifically to consider whether 4G and 5G mobile or fixed wireless access (FWA)<sup>1</sup> would be a better choice than the bidder's proposed solution based on fibre to the premises (FTTP).*

In Analysys Mason's assessment, FTTP is the most appropriate approach for Ireland's NBP. There is a clear precedent among policy makers in other markets in favour of FTTP. In terms of Ireland's specific characteristics (and population distribution in particular), an ambitious and long-term vision is necessary to solve long-standing and significant structural issues. Among major European operators, it is becoming increasingly common practice to pursue a dual (fixed-and-mobile) strategy, highlighting 5G's role as a complement to, rather than a substitute for, FTTP. In terms of capacity, a network based on 4G or 5G macro cells cannot compete effectively with FTTP. 5G small cells can help alleviate capacity constraints, but this approach is unproven, likely to be expensive, and does not scale as elegantly as FTTP. Furthermore, all of the original bid responses in the NBP process proposed a deployment based on FTTP, despite the procurement being technology-neutral and the initial speed requirements being relatively modest. Given the evidence that supports the decision to opt for FTTP, as well as the significant risks and uncertainties associated with 4G or 5G mobile deployments, we conclude that the original decision in favour of FTTP is sound. The FTTP solution is well proven, capable of attracting significant private capital, offers a high quality of service, is deliverable, highly scalable and future-proofed.

***Policy makers in other markets are increasingly focussing on FTTP, meaning Ireland is not alone in pursuing rural fibre***

Many European countries have forged ahead with deployment of FTTP, notably Scandinavia and more recently Portugal, Spain and France. The UK has pursued a different strategy, based mainly on BT's roll-out of fibre to the cabinet (including around GBP1.7 billion of public funding for rural areas). More recently, both the UK Government and the regulator, Ofcom, have moved away from their strong stance of technology neutrality towards policies designed to stimulate FTTP deployment ('full-fibre' being the UK policy term for FTTP). In the Ministerial Foreword to DCMS's Future Telecoms Infrastructure Review<sup>2</sup> published in 2018, Secretary of State Jeremy Wright says: "We want to go further, faster – and have set an ambitious target for 15 million premises to be connected to full fibre by 2025, with nationwide coverage by 2033. We also want to be a world leader in the next generation of mobile technology, 5G, with deployment to the majority of the country by 2027 so that UK consumers and businesses can take early advantage of the benefits." The Review goes

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<sup>1</sup> FWA as a wireless solution to fixed locations that can be implemented using mobile technologies

<sup>2</sup> <https://www.gov.uk/government/publications/future-telecoms-infrastructure-review>

on to acknowledge that FTTP will not be commercially viable in all parts of the UK, and that some form of Government intervention (including public funding) will be needed.

It is notable from the above quote that the latest policy thinking in the UK is to follow a dual-track fibre and 5G strategy. Looking more widely, we are not aware of any European market which has made the stark choice of backing only FTTP or only 5G. This is evidence, from a policy perspective, that FTTP and 5G are complementary.

***Ireland has a long-standing significant structural issue due to its rurality which the NBP can address***

Ireland is already benefitting from a significant investment in FTTP roll-out by eir and Siro. However, both operators have made it clear that their investments can only go so far. Roll-out to many rural areas is uneconomic, creating the risk of an urban-rural 'divide'. The population distribution in Ireland creates challenges for extensive roll-out: Ireland is one of the most rural countries in Europe, but the characteristic ribbon developments (as compared to the more 'clustered' settlements in the UK) makes the broadband investment case even more challenging. With an FTTP solution, the NBP can eliminate this urban-rural divide.

***Most major operators across Europe are pursuing a dual (fixed-and-mobile) strategy which highlights that 5G is a complement to, rather than a substitute for, FTTP***

Major operators across the larger European markets are continuing to invest in both fixed networks (including FTTP, but in some cases, cable networks) and mobile networks (most recently acquiring 5G spectrum in auctions), as summarised in Figure 1. We would not expect operators to make these investment decisions if they believed that 5G would become a substitute for FTTP; and it seems extremely unlikely that *all* of these operators can be wrong in their technology assessment of FTTP vs 5G. Furthermore, for the 5G radio network to achieve its potential of higher speeds, it must be supported by a dense fibre network connecting macro and small cells (this is usually termed cell 'backhaul'). It is possible to use radio for backhaul, but this would take away spectrum capacity that could be used for end-users. It is preferable to use spectrum to maximise coverage and capacity in the customer-facing radio network, and use fibre for backhaul. Therefore, a mobile solution for the NBP would still require the deployment of an extensive fibre network.

UK	Germany	France	Italy	Spain
✗ O2 (Telefónica)	✗ O2 (Telefónica)	✓ Orange	✓ TIM	✓ Orange
✓ EE (BT Group)	✓ Vodafone	✓ SFR	✓ Wind Tre (CK Hutchinson)	✓ Movistar (Telefónica)
✓ Vodafone	✓ Telekom Deutschland	✓ Free Mobile (Iliad)	✓ Vodafone	✓ Vodafone
✗ Three (CK Hutchinson)		✓ Bouygues Telecom	✗ Iliad (new entrant)	✓ MásMóvil
Portugal	Netherlands	Sweden	Norway	Switzerland
✓ PT	✓ KPN	✓ Telia	✓ Telenor	✓ Swisscom
✓ NOS	✗ VodafoneZiggo	✓ Tele2/Com Hem	✗ Telia	✓ Sunrise Communications
✓ Vodafone	✓ T-Mobile	✓ Telenor	✗ ice.net	✓ Salt
	✓ Tele2	✗ Tre (CK Hutchinson)		
		✗ Net 1		

Key: ✓ Yes ✗ No (cable-only) ✗ No

*Figure 1: Mobile operators in key European markets pursuing FTTP strategies [Source: Analysys Mason, 2018; based on Telegeography, operator websites, press search]*

The only operators pursuing a mobile-only approach are those that have always been mobile-only players since market entry, and with no fixed assets of any note (e.g. Three in the UK). In Ireland's spectrum auction in 2017, 5G licences (at 3.6GHz) were acquired by eir Mobile and Vodafone, as well as Three Ireland, Imagine and Airspan (a new entrant). It is notable that eir Mobile and Vodafone are also investing heavily in their own FTTP networks. We can conclude that the weight of evidence from the commercial sphere points towards fixed networks (including FTTP) and mobile networks (including 5G) being complements rather than substitutes.

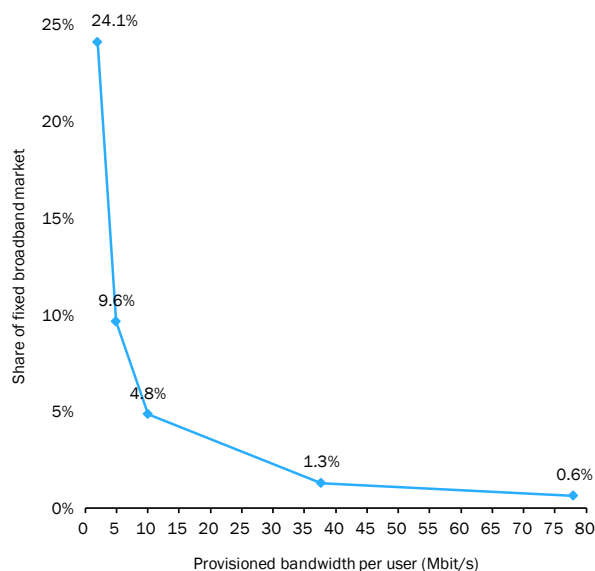
The economics of rolling out any network (4G, 5G, or fibre) mean that most, if not all, countries are expected to have significant gaps in coverage in rural areas, since coverage of those areas is unlikely to be commercially viable. It is this very issue that the NBP is designed to address.

### ***Mobile operators have so far shown no appetite for Government-led broadband intervention schemes***

Whilst most European countries now have a national broadband plan, we are not aware of any – whether in procurement, or in the build or operate phase – that have active involvement from mobile operators. While a 5G-based solution might work well in certain circumstances, the fact that the spectrum holders have shown little interest in publicly funded schemes is important for policy makers. One reason for this lack of interest might be that mobile operators are much more concerned than other kinds of operator about the EC state-aid requirements for open-access obligations (which are mandatory for the provision of public funds). The history of mobile market development has been based on a licensing regime that incentivises the roll-out of multiple, overlapping networks with limited sharing. This suggests that reliance on 5G for a national broadband plan would likely be much more complex from a deliverability perspective than FTTP, and that under normal commercial drivers, 4G and 5G mobile networks will be focussed predominantly on urban areas where the density of demand is sufficient to justify investment.

### ***A 4G or 5G macro-cell-based approach cannot compete effectively with FTTP due to capacity constraints***

It is widely acknowledged that 5G will be able to offer significant improvements in speeds (over 4G) for end-users, supported by new spectrum bands and much more efficient antenna technology. With these developments, end-user speeds of several hundred Mbit/s may be possible. However, mobile and fixed networks, in general, serve different purposes. End-user behaviour on current, *macro-cell-based* mobile networks is markedly different to that on fixed networks: current mobile usage (volume of data per month) is typically between 1/10<sup>th</sup> to 1/100<sup>th</sup> that of fixed usage, due to the different devices and applications that are used on each type of network. For example, viewing large-format video content on a TV screen at home requires much more bandwidth than viewing similar content on a smartphone. This also has major implications if we were to try to use a 4G or 5G network to carry fixed traffic, even in an FWA configuration with an outside antenna. Figure 2 highlights the key issue for a network based on macro cells: there is a clear trade-off between the number of end-users (shown here as share of the fixed broadband market) and the quality of service (shown as provisioned bandwidth per user).



*Figure 2: Illustrative trade-off between provisioned bandwidth and market share for an 'average' 5G-enabled macro cell [Source: Analysys Mason, 2018]*

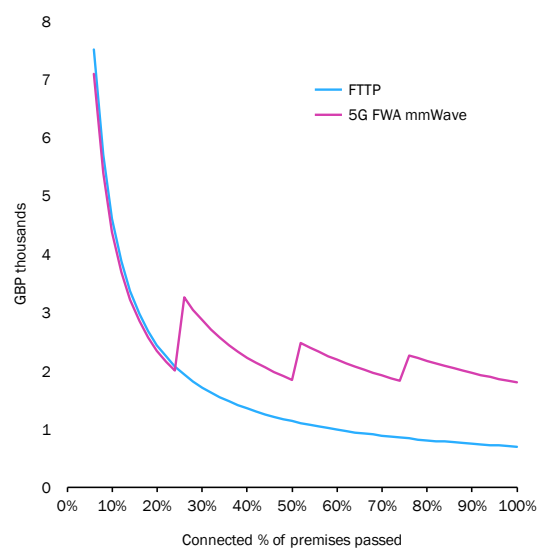
In ten years' time, we might expect around 20Mbit/s of bandwidth to be provisioned per user in Ireland (about ten times the figure today)<sup>3</sup>. At this level, a macro-cell-based network would be able to serve less than 4% of end-users, and would be uneconomic for most, if not all, operators. However, that 20Mbit/s of bandwidth could easily be provided by FTTP networks *today* (~80Mbit/s per end-user is a typical configuration). We therefore do not see 5G FWA based on macro cells as a substitute for FTTP, except in very specific, targeted deployments.

<sup>3</sup> Note: 'Provisioned capacity' is the standard metric used by operators when dimensioning their networks; it is calculated as total capacity / total users. It is *not* the actual speed a typical user would get, which would be significantly higher, as networks rarely (if ever) have all users demanding full capacity at any single point in time.

***5G small cells can help alleviate capacity constraints, but this approach is unproven, likely to be expensive, and does not scale as elegantly as FTTP***

The issue of macro-cell capacity can, to some extent, be addressed through network ‘densification’. By deploying a much higher number of small cells – for example on lamp-posts or building frontages – and using higher-capacity spectrum (so-called ‘millimetre wave’, e.g. at 26GHz<sup>4</sup>), the capacity of each cell would be shared between fewer users. Achieving ‘FTTP-like’ levels of quality of service consistently across any given area would require significant numbers of new small cells, not least because the range of millimetre-wave equipment is short. No European operator has yet deployed small cells in high volumes; in fact, many mobile operators seem to be ‘talking down’ this approach, at least for the next few years, as they see macro-cell networks to be sufficient for most needs.

More important is the fact that 5G densification can be costly, and at higher levels of take-up, 5G can be more expensive than FTTP, as is illustrated in Figure 3 below. This example is based on a small geographical area: the ‘sawtooth’ cost profile reflects the deployment of additional small cells. This phenomenon would be smoothed out at a city or regional level, but the cost for 5G would still be higher than for FTTP. It is also important to note that this is a highly stylised case as it does not consider radio signal propagation and other real-world deployment issues which make FWA deployments more complex, and even more costly.



*Figure 3: Illustrative average cost per subscriber in a given area as a function of take-up, in the UK [Source: Analysys Mason, 2018]*

This cost behaviour is driven by the fact that, to match fixed network levels of usage and to reduce the level of spectrum sharing, any cell-based network requires significantly more infrastructure closer to end-users (much more so than we see in today’s mobile networks). Whilst it may be possible to build a 5G small-cell network to match FTTP’s current quality of service, difficulties emerge when trying to significantly increase the scale of such a network to accommodate more end-users.

In conclusion, we expect to see small cells being deployed in discrete areas to boost capacity at ‘hot spots’ rather than being deployed across a very wide area contiguously.

<sup>4</sup> This band is not yet generally available in Europe.

***Bidders in the NBP process all proposed to deploy FTTP, despite the procurement being technology-neutral and the initial speed requirements being relatively modest at 30Mbit/s***

The Irish NBP tender was technology-neutral and yet all three bidders that submitted initial bids proposed FTTP-based proposals, enabling them to meet the 30Mbit/s minimum speed requirements, but also to add additional capacity at low incremental cost. This was their choice, and no doubt significantly influenced by the long-term nature of the contract. The bidders needed to assess very carefully the total cost of the solution over the long term, taking account of growth in demand (end-user usage) and the necessary technology upgrades over time to maintain a high quality of service. Related to the bidders' technology choice were a number of other issues, for example, the use of existing infrastructure (i.e. ducts and poles) to reduce costs and increase the speed of roll-out. Had the bidders chosen a 4G or 5G solution they would have faced numerous other practical deployment issues including identifying thousands of suitable new sites to build new towers and masts, and the associated uncertainty of how such a site portfolio might need to grow in future due to increasing end-user demand. Recent policy work in the UK relating to 5G deployment (focussing on small cells)<sup>5</sup> has highlighted 13 specific barriers to planning and deploying such infrastructure, spanning legislation; practical implementation challenges; and communications issues between private- and public-sector stakeholders. Most, if not all, of these barriers are likely to apply in Ireland.

The bidders were therefore giving a very strong signal that they saw FTTP as the most deliverable and future-proofed solution, best suited to meeting the full set of the Government's requirements<sup>6</sup>.

***In summary, the bidder's proposed FTTP solution is well proven and capable of meeting the NBP's aims, whilst there are significant uncertainties surrounding 4G/5G***

For the reasons set out above, we see FTTP and 4G/5G networks as complements rather than substitutes. We do not expect 4G and 5G networks to make the NBP redundant because commercial mobile roll-outs are unlikely to extend to rural Ireland in anywhere near as coherent and consistent a manner as needed by consumers and businesses.

As regards the NBP, the bidder has proposed an FTTP solution that would require a single significant investment from Government which would address long-standing structural issues in the country. Such an FTTP solution is well proven, capable of attracting significant private capital, offers a high quality of service, is deliverable, highly scalable and future-proofed.

If the Irish Government were to re-start the NBP process, there is no guarantee that 4G/5G technology would be chosen, and even if it were, there would remain a number of very significant uncertainties that are not present with today's FTTP technology.

<sup>5</sup> <http://www.analysismason.com/About-Us/News/Press-releases/5g-mobile-deployment-challenges-Jul2018/>

<sup>6</sup> The fact that two bidders subsequently withdrew from the process was not related to technology issues