Report for Openreach

Commentary on Ofcom's PIMR consultation document

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Contents

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1 Introduction

Ofcom is conducting an infrastructure market review with a view to designating Openreach with significant market power (SMP) in a new market for upstream passive infrastructure, with an unrestricted duct and pole access (DPA) product as the remedy. On 02 November 2018, Ofcom published a consultation[1] documentation entitled "Physical Infrastructure Market Review: Access to ducts and poles to support investment" (referred to as PIMR in the remainder of this report) stating a closing date for responses of 18 January 2019.

In the PIMR, Ofcom has proposed four geographical markets[2] as follows:

- **BT-only areas:** areas where there is no or limited alternative telecoms physical infrastructure to BT
- **BT and Virgin Media (VM) areas:** areas where VM's telecoms physical infrastructure is present as an alternative to BT, but there are no or limited other alternatives
- **The Central London Area (CLA):** an area in Central London with uniquely high presence of rival telecoms physical infrastructure deployed to support leased line (LL) networks
- **High Network Reach (HNR) areas (excluding the CLA):** areas outside of the CLA with a high presence of rival telecoms physical infrastructure (at least two rival networks to BT) deployed to support LL networks.

Openreach commissioned Analysys Mason Ltd (Analysys Mason) to undertake an independent review of Ofcom's market definition and market power assessments in the PIMR. This report summarises our review.

Our review of the PIMR consultation document identifies **three key areas** where we believe Ofcom's arguments could be better evidenced or more nuanced. These relate to:

- VM network infrastructure
- use of non-telco infrastructure[3]
- deployment approaches used by network operators.

The remainder of this document is laid out as follows:

- Section 2 discusses Ofcom's assessment of VM's network infrastructure, and presents our comments on this
- Section 3 discusses the potential use of non-telco infrastructure in the context of telecoms deployments and provides examples of how different types of non-telco infrastructure are being used in the UK and internationally

1 https://www.ofcom.org.uk/__data/assets/pdf_file/0014/125420/PIMR-consultation.pdf

2 See 1.12 of PIMR.

3 Examples of non-telco infrastructure are water and gas pipes, and electricity poles.

- Section 4 explains the different deployment approaches adopted by network operators in the UK and Western Europe
- Section 5 provides a summary of our key review findings.

The report includes a number of annexes containing supplementary material:

- Annex A provides the key modelling assumptions and sensitivity analysis results on attractiveness of deployment areas
- Annex B explains the methodology used to estimate VM coverage in South Manchester
- Annex C provides a list of four case studies for deployment approaches and use of non-telco infrastructure.

2 VM network infrastructure

VM has a substantial multi-service telecoms infrastructure in the UK. As of September 2018, VM has passed 15 236 700 homes[4] (representing more than 50% coverage of UK homes) in mainly urban areas. Consequently, its coverage in major cities can be significantly higher than 50%, for example it is around 68% in London[5] and 87% in Birmingham[6]. VM provides consumer broadband services but also business connectivity services in geographical markets defined by Ofcom, such as CLA and HNR.

In the PIMR, Ofcom suggests that VM's infrastructure is not as suitable (for potential access seekers to deploy telecoms networks) as BT's across all geographical markets where both VM and BT infrastructures are present. Ofcom provides four main reasons to justify this view:

- Ofcom's contiguity analysis concludes that VM coverage is not sufficiently ubiquitous to make its infrastructure attractive to potential access seekers. The following are examples of statements made by Ofcom in the PIMR that highlight that Ofcom perceives ubiquity to be a primary consideration:
  - "*unlikely to match the deployment areas desired by potential access seekers*"[7]
  - "*this analysis suggests that the majority of clusters found by our postcode sector contiguity analysis do not map to entire urban areas*"[8]
  - "*ubiquity is critical for leased lines where each connection requires at least two specific sites to be connected*"[9]
- Ofcom states that it is more expensive to use VM's infrastructure because VM has a high percentage of direct-buried cable as lead-in infrastructure (the actual data is redacted)
- Ofcom states that there is no spare space capacity in some of VM's Toby boxes (again, the actual data is redacted)
- Ofcom states that there is no spare space capacity in VM's lead-in infrastructure in Project Lightning[10] roll-out areas as VM has used a narrow trenching technique with micro ducts.

We provide commentary on each of these reasons in the remainder of this section.

4 See page 45 of https://www.libertyglobal.com/wp-content/uploads/2018/11/VirginMedia-Q3-2018-Report.pdf

5 Source: https://labs.thinkbroadband.com/local/london

6 Source: https://labs.thinkbroadband.com/local/birmingham,E08000025

7 See A8.45 of PIMR.

8 See A8.45b of PIMR.

9 See A8.31 of PIMR.

10 https://www.virginmedia.com/corporate/about-us/our-key-projects.html

2.1 Ofcom's contiguity analysis of VM coverage appears to be based on arbitrary and unsubstantiated thresholds

Ofcom's decision process/criteria used for the VM's contiguity analysis is not clear

There is a lack of clarity regarding Ofcom's decision process and the criteria used to determine VM's contiguity analysis outputs, taking into account both LLs and consumer broadband network infrastructure.

It appears that Ofcom's contiguity analysis applies two threshold tests cumulatively at the postcode-sector level:

- >65% for LLs coverage[11], and
- >90% consumer broadband coverage.

If a postcode sector passes these two cumulative tests, then that postcode sector is deemed by Ofcom to be 'attractive' to potential access seekers. If our understanding of Ofcom's contiguity analysis is correct, then Ofcom has concluded that, by way of example, a hypothetical scenario of a threshold combination of 80% broadband and 80% LL[12] is not attractive to potential access seekers as it fails one of the two tests.

In this example, we might expect that an 80% broadband and 80% LL threshold combination could be attractive to some potential access seekers. 'Unrestricted' usage allows more LL connections to be made, which could improve the commercial viability of potential access seekers willing to deploy full fibre to consumers. This suggests that the two-stage test used by Ofcom may not fully reflect the commercial decisions that access seekers would make. Similarly, there may be other threshold combinations that do not fulfil Ofcom's two-stage test that might be attractive to access seekers.

A more holistic approach would be better to determine commercial viability of deployment areas for access seekers

One method that could be used to define the 'attractiveness' of deployment areas is to consider both the revenue and costs of a potential access seeker, and use, for example, the payback period[13] as a

11 This threshold was established in Ofcom's Business Connectivity Market Review (BCMR) 2018, but Ofcom has not substantiated the validity of this 65% threshold in the context of the PIMR. BCMR 2018 uses a 50-metre buffer to define LL coverage, however we are aware that the tail circuits for LLs can be much longer (several hundreds of metres or even in kilometres) for high-value clients.

12 90% LL coverage for large business and mobile sites and 70% premises passed.

13 The 'payback period' refers to the number of years required for an access seeker to achieve a net revenue (revenue – costs) that is equal to zero. In order to calculate the payback period, a detailed business plan (including competition assessment, take-up for each customer/geographical segment, wholesale/retail operations and appropriate profiling of revenue and costs) is required. We have not developed these as part of our analysis as it takes considerable time and effort to investigate various scenarios and run a sensitivity analysis. We have, instead, developed a relatively simple payback period analysis model informed by key metric benchmarks such as EBITDA margin. We do not claim that the outputs of the model are 100% accurate. This relatively simple analysis has been used to illustrate other potentially attractive threshold combinations (for broadband and LL) for potential access seekers. In our opinion, Ofcom needs to analyse the commercial viability of various combinations of broadband and LL scenarios in more detail before reaching its final conclusions.

proxy for attractiveness instead of a contiguity analysis as used by Ofcom. In Figure 2.1[14], we illustrate the sensitivity analysis[15] [16] results of a hypothetical scenario[17] [18] of how such an approach could work[19]. It should be noted that this very simplified model is **not attempting to accurately model the business case** of any particular access seeker; instead we are using it as a broad proxy of the business case to illustrate that there are different ways of looking at this issue.

Figure 2.1: Illustrative sensitivity analysis results using implied Ofcom payback period as reference point [Source: Analysys Mason, 2019]

LL threshold \ Consumer broadband threshold	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
0%	11.2	8.7	7.4	6.6	6.0	5.6	5.3	5.1	4.9	4.7	4.6	4.5	4.4
5%	10.8	8.5	7.2	6.5	5.9	5.5	5.3	5.0	4.8	4.7	4.6	4.5	4.4
10%	10.4	8.3	7.1	6.4	5.9	5.5	5.2	5.0	4.8	4.7	4.5	4.4	4.3
15%	10.1	8.1	7.0	6.3	5.8	5.4	5.2	5.0	4.8	4.6	4.5	4.4	4.3
20%	9.8	7.9	6.9	6.2	5.7	5.4	5.1	4.9	4.8	4.6	4.5	4.4	4.3
25%	9.5	7.8	6.8	6.1	5.7	5.4	5.1	4.9	4.7	4.6	4.5	4.4	4.3
30%	9.2	7.6	6.7	6.1	5.6	5.3	5.1	4.9	4.7	4.6	4.5	4.4	4.3
35%	9.0	7.5	6.6	6.0	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.3
40%	8.7	7.3	6.5	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
45%	8.5	7.2	6.4	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
50%	8.3	7.1	6.3	5.8	5.4	5.1	4.9	4.7	4.6	4.5	4.4	4.3	4.2
55%	8.1	6.9	6.2	5.7	5.4	5.1	4.9	4.7	4.6	4.5	4.3	4.3	4.2
60%	7.9	6.8	6.1	5.7	5.3	5.1	4.8	4.7	4.5	4.4	4.3	4.2	4.2
65%	7.7	6.7	6.1	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.2	4.2
70%	7.6	6.6	6.0	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1
75%	7.4	6.5	5.9	5.5	5.2	4.9	4.8	4.6	4.5	4.4	4.3	4.2	4.1
80%	7.3	6.4	5.8	5.4	5.1	4.9	4.7	4.6	4.4	4.3	4.3	4.2	4.1
85%	7.1	6.3	5.8	5.4	5.1	4.9	4.7	4.5	4.4	4.3	4.2	4.2	4.1
90%	7.0	6.2	5.7	5.3	5.1	4.8	4.7	4.5	4.4	4.3	4.2	4.1	4.1
95%	6.9	6.1	5.6	5.3	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.1
100%	6.8	6.0	5.6	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.1

Note: Ofcom cases represent payback for >90% broadband coverage and >65% LL coverage

Payback ≤ Ofcom's implied payback | Ofcom's cases | Payback ≥ Ofcom's implied payback

The yellow-coloured output (i.e. payback period in years) represents the threshold combinations recognised by Ofcom's implied level of attractiveness, based on a 90% broadband and 65% LL

14 This analysis outputs the payback period (in years) for different broadband and LL threshold combinations, which provides an indication of the commercial viability of a hypothetical operator. The analysis shows the threshold combinations that are likely to be commercially viable (recognised by Ofcom's contiguity analysis (yellow-coloured outputs) as well as those not recognised by Ofcom (green-coloured outputs)) and commercially unviable (red-coloured outputs). The purpose of this analysis is to demonstrate that there are other threshold combinations that are viable.

15 Sensitivity analysis varies both broadband and LL thresholds to derive payback period in years.

16 Green-coloured and yellow-coloured options are deemed to be commercially viable, whereas red-coloured options are deemed to be commercially unviable.

17 Details on the hypothetical scenario are provided in Annex A of this report.

18 There are 50 broadband premises for every LL (i.e. a broadband to LL ratio of 50:1).

19 We acknowledge that different access seekers could use additional business plan metrics (e.g. net present value and internal rate of return) to inform their investments. For the purposes of our analysis, we illustrate our arguments using payback period analysis only.

combination, and on our input assumptions. For the avoidance of doubt, Ofcom has not determined attractiveness based on payback, so all references to payback are Analysys Mason's. The green-coloured outputs represent additional threshold combinations (not recognised by Ofcom) that are as attractive or more attractive than that implied in Ofcom's case (i.e. less or equal to 4.3 years as payback period). In summary, this analysis supports the view that an 80% broadband and 80% LL combination is attractive to potential access seekers, as are a number of other combinations of broadband and LL thresholds. It also **demonstrates that ubiquity is not essential for potential access seekers** given that a number of threshold combinations produce a commercially-viable outcome.

Furthermore, we are aware that several commercial operators find geographical areas attractive for a payback period of c.5 years[20] [21]. This means that potential access seekers are likely to find a postcode-sector attractive for numerous[22] additional broadband and LL combinations, such as a 70% broadband and 40% LL combination as shown in Figure 2.2. Again, this highlights **the fact that ubiquity is not essential for potential access seekers** to make a case for investment.

20 A 5-year payback period appears to be attractive to Gigaclear (page 17 of https://www.researchgate.net/profile/Paolo_Gerli/publication/315440888_Infrastructure_investment_on_the_margins_of_the_market_The_role_of_niche_infrastructure_providers_in_the_UK/links/5b0f36cc0f7e9b1ed70367a8/Infrastructure-investment-on-the-margins-of-the-market-The-role-of-niche-infrastructure-providers-in-the-UK.pdf?origin=publication_list)

21 The FTTH Council Europe seems to suggest a payback period of 5–7 years for active components of fibre to the home (FTTH), which is the equivalent of fibre-to-the-premises (FTTP) deployment using DPA (page 5 of https://www.ftthcouncil.eu/documents/Publications/Primer_UpdateMay2014_FINAL.pdf)

22 We acknowledge that, due to the simplicity of the modelling, not all green-coloured broadband and LL combinations shown in Figure 2.1 and 2.2 are likely to be attractive, but we expect different combinations shown in green are likely to be attractive. As mentioned previously, a detailed business plan needs to be developed to accurately derive the payback period.

Figure 2.2: Illustrative sensitivity analysis results using a payback period of 5 years as reference point [Source: Analysys Mason, 2019]

LL threshold \ Consumer broadband threshold	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
0%	11.2	8.7	7.4	6.6	6.0	5.6	5.3	5.1	4.9	4.7	4.6	4.5	4.4
5%	10.8	8.5	7.2	6.5	5.9	5.5	5.3	5.0	4.8	4.7	4.6	4.5	4.4
10%	10.4	8.3	7.1	6.4	5.9	5.5	5.2	5.0	4.8	4.7	4.5	4.4	4.3
15%	10.1	8.1	7.0	6.3	5.8	5.4	5.2	5.0	4.8	4.6	4.5	4.4	4.3
20%	9.8	7.9	6.9	6.2	5.7	5.4	5.1	4.9	4.8	4.6	4.5	4.4	4.3
25%	9.5	7.8	6.8	6.1	5.7	5.4	5.1	4.9	4.7	4.6	4.5	4.4	4.3
30%	9.2	7.6	6.7	6.1	5.6	5.3	5.1	4.9	4.7	4.6	4.5	4.4	4.3
35%	9.0	7.5	6.6	6.0	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.3
40%	8.7	7.3	6.5	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
45%	8.5	7.2	6.4	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
50%	8.3	7.1	6.3	5.8	5.4	5.1	4.9	4.7	4.6	4.5	4.4	4.3	4.2
55%	8.1	6.9	6.2	5.7	5.4	5.1	4.9	4.7	4.6	4.5	4.3	4.3	4.2
60%	7.9	6.8	6.1	5.7	5.3	5.1	4.8	4.7	4.5	4.4	4.3	4.2	4.2
65%	7.7	6.7	6.1	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.2	4.2
70%	7.6	6.6	6.0	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1
75%	7.4	6.5	5.9	5.5	5.2	4.9	4.8	4.6	4.5	4.4	4.3	4.2	4.1
80%	7.3	6.4	5.8	5.4	5.1	4.9	4.7	4.6	4.4	4.3	4.3	4.2	4.1
85%	7.1	6.3	5.8	5.4	5.1	4.9	4.7	4.5	4.4	4.3	4.2	4.2	4.1
90%	7.0	6.2	5.7	5.3	5.1	4.8	4.7	4.5	4.4	4.3	4.2	4.1	4.1
95%	6.9	6.1	5.6	5.3	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.1
100%	6.8	6.0	5.6	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.1

Note: Ofcom cases represent payback for >90% broadband coverage and >65% LL coverage

Payback ≤ Ofcom's implied payback | Ofcom's cases | Payback ≥ Ofcom's implied payback

It is more appropriate to assess commercial viability using different ratios of broadband premises to large business/mobile sites due to geographical markets' different characteristics

Our sensitivity analysis shows that the ratio of broadband premises to large business/mobile sites is also an important factor to consider, especially as different scenarios can be attractive for different kinds of access seeker. Figure A.2 to Figure A.4 in Annex A presents our sensitivity results for a range of broadband to large business/mobile site ratios between 250:1[23] and 10:1 inclusive.

The key finding from this sensitivity analysis is that an increasing number of large business/mobile sites in a particular region improves the investment case for potential access seekers, which leads to additional broadband and LL threshold combinations being attractive. For example, a 100% LL and 40% broadband combination is not deemed attractive for a 250:1 ratio (Figure A.2), but is deemed attractive for a 10:1 ratio (Figure A.4), all other assumptions being equal.

It is not clear if Ofcom has investigated different ratios of broadband premises to large business/mobile sites before reaching its conclusions. It would seem important to us that Ofcom would do this, given that some geographical markets (e.g. CLA and HNR) have relatively high concentrations of large businesses/mobile sites. For example, a low broadband threshold (e.g. 40%)

23 1000:1 means 1000 broadband premises and 1 large business/mobile site.

and relatively high LL threshold (e.g. 90%) in the CLA region is likely to be attractive to potential access seekers. **A more nuanced analysis would help establish an appropriate view on attractiveness (i.e. threshold combination) for each geographical market, rather than a single threshold combination for all four geographical markets**.

VM's broadband network is not dissimilar to BT's network and the differences could potentially be managed by potential access seekers

As mentioned earlier in Section 2, VM has a significant infrastructure that overlaps with BT infrastructure in many places (three example areas are shown in Figure 2.3[24]). Its network reaches households in broadly the same way as BT's network, **with infrastructure passing down many roads and streets in large parts of urban areas**. VM's infrastructure could potentially be of interest to access seekers given its scale and good levels of coverage in densely populated areas.

Figure 2.3: Extensive VM coverage in three cities [Source: Analysys Mason, thinkbroadband, 2019]

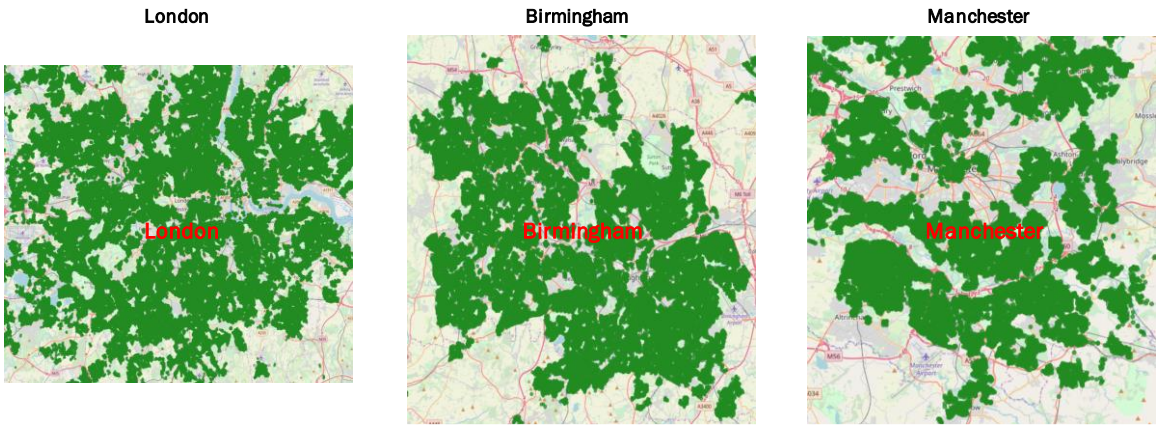


Figure 2.3 shows that VM coverage is not ubiquitous (i.e. it does not cover every single premises). However, VM plans to deploy in-fill[25] hybrid fibre-coaxial (HFC) infrastructure as part of Project Lightning[26] [27]; this suggests that some of those gaps within its own coverage footprint will be filled (and hence are attractive from an investment perspective). It could also be argued that VM has, for many years, operated successfully in the UK market without having ubiquitous network coverage. This suggests that potential access seekers might also view VM's infrastructure as attractive, which would go against the view that ubiquity is essential for potential access seekers.

24 Note that some geographical coverage gaps on the maps represent regions of no premises (e.g. parks).

25 'In-fill' means coverage gaps in existing VM's HFC network infrastructure.

26 https://www.ft.com/content/e6c5218a-b35e-11e4-9449-00144feab7de

27 Project Lightning deploys both in-fill HFC and greenfield FTTP broadband network infrastructure.

The use of a >90% coverage threshold for VM in the contiguity analysis is not justified appropriately

Ofcom has not substantiated the selection of a coverage threshold of >90% per postcode sector for VM. The 90% threshold is not in line with the "[30–80%]" range[28] used to define coverage. Further, Ofcom proposed a 65% coverage threshold at which alternative networks can be considered to provide effective competition (as per Ofcom's latest approach to geographic markets[29]) which is somewhat below the >90% threshold. Using an unsuitable threshold could lead to incorrect conclusions in a contiguity analysis.

Given that it is the first time a PIMR is being undertaken, it would seem important that a detailed and comprehensive analysis is conducted to establish a suitable threshold for such a contiguity analysis. It would also seem reasonable to expect to see a sensitivity analysis[30] to highlight how these thresholds impact the conclusions and to highlight where key, sensitive parameters need to be investigated and evidenced in more detail, before any firm conclusions are drawn.

The lack of an accurate and complete VM coverage map in the public domain does not allow us to replicate Ofcom's contiguity analysis. However, we have been able to make reasonable approximations[31] in this regard to illustrate some potential issues with Ofcom's approach.

In order to run a sensitivity analysis on various thresholds with the aim to select a suitable threshold, we have estimated VM coverage data[32] based on information published on the thinkbroadband website[33] for South Manchester[34], as shown in Figure 2.4.

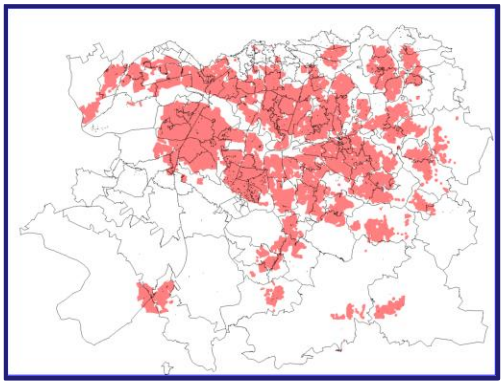


Figure 2.4: Estimated VM coverage in South Manchester [Source: Analysys Mason and thinkbroadband, OS Code-point, 2019]

28 See 3.70 in PIMR.

29 Ofcom's consultation: Promoting investment and competition in fibre networks – Approach to geographic markets (https://www.ofcom.org.uk/__data/assets/pdf_file/0005/130001/Consultation-Promoting-investment-and-competition-in-fibre-networks.pdf)

30 We expect that the sensitivity outputs would need to be published, as Ofcom did for BCMR analysis outputs.

31 We are confident that our geographical analysis is reasonably accurate, as explained in Annex B.

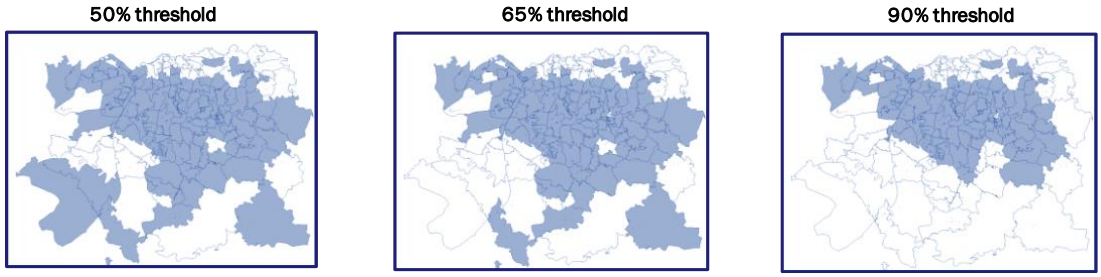
32 It should be noted that the accuracy of the VM coverage has not been verified and an example is being used to illustrate a sensitivity analysis. An explanation of the methodology used to estimate VM coverage can be found in Annex B.

33 https://labs.thinkbroadband.com/local/broadband-map#6/51.414/-0.641/virgin/ [Accessed on 17 December 2018]

34 We have chosen a reasonably-sized area (c.500 000 premises in South Manchester as defined by the selected postcode sectors) that contains a mix of urban and suburban areas, and no ubiquitous VM coverage (c.78% VM coverage in South Manchester).

Our threshold sensitivity analysis at the postcode-sector level demonstrates that different conclusions can be reached by using different thresholds, as depicted in Figure 2.5. For example, a threshold of 65% seems a more appropriate representation of the actual physical network[35] from visual inspection (compared to a threshold of 90%) shown in Figure 2.4. In other words, it could be misleading to represent VM coverage with a 90% threshold for the South Manchester example shown.

Figure 2.5: Sensitivity analysis outputs [Source: Analysys Mason, thinkbroadband, OS Code-point, 2019]



We also note that the analysis output using a threshold of 90% still shows a reasonably large contiguous area[36]. We believe that this contiguous area would still be attractive to potential access seekers, but Ofcom's contiguity analysis would not identify this entire area due to the additional LL threshold test being applied (which would serve to significantly reduce the area in question). In our view, **this further shows that ubiquity is not essential for access seekers** to make a commercially viable case for network deployment.

One issue that arises when Ofcom applies the >65% threshold for LL **in addition** to the >90% threshold for broadband, is that this kind of contiguity analysis will result in a much more 'fragmented' map, where there are fewer contiguous postcode sectors. This would then lead to the conclusion that the geographical region in question (in this case, quite large parts of South Manchester) would be unattractive for potential access seekers. **In our view, that would not necessarily align with the commercial reality**: we would expect significant swathes of potential customers (consumers and businesses) in this area to be highly attractive to access seekers. It does not appear that Ofcom has considered this aspect in sufficient detail to reach the conclusions it has reached, based on what is presented in the PIMR. Furthermore, as demonstrated in Figure 2.2, there are many other threshold combinations (lower than those used by Ofcom) that could be attractive to potential access seekers.

We acknowledge that a choice needs to be made as regards to the most suitable level of geographical granularity in this kind of analysis, and we note Ofcom's position[37] on the selection of postcode-sector. However, we believe it is important that in making such a choice, the implications are explored in detail, using the kind of sensitivity analysis that we have illustrated here. Figure 2.6

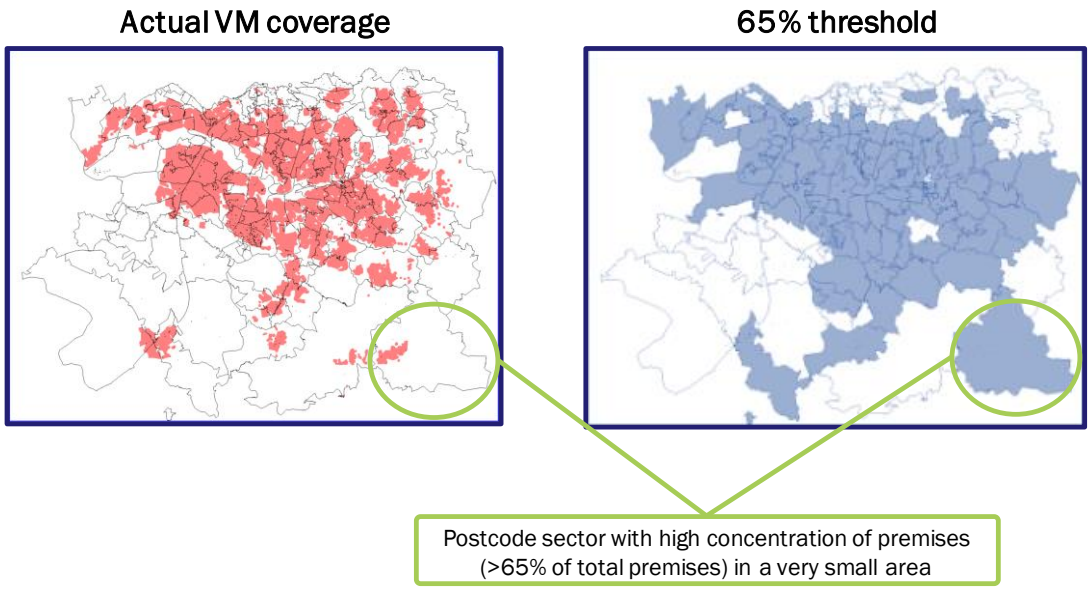
35 This is in line with the 65% threshold for alternative networks to provide effective competition, as per Ofcom's latest approach to geographic markets.

36 Our geographical analysis shows that the contiguous postcode sectors have more than 300 000 premises covered with VM.

37 See 3.57 to 3.65 of the PIMR.

shows a postcode sector that is likely to be attractive due to a high concentration of premises in a very small geographical area even though the postcode sector contains large areas of farmland and open countryside. However, this postcode-sector would be excluded if the Ofcom's proposed threshold of 90% were to be used; such an outcome may not correctly reflect the commercial reality of how operators make their investment decisions to roll out in specific areas.

Figure 2.6: Attractive areas that would be excluded by following Ofcom's contiguity analysis [Source: Analysys Mason and thinkbroadband, OS Code-point, 2019]



Applying a 65% threshold leads to a very different conclusion, i.e. the postcode sector would be attractive. **This illustrates an important asymmetry, and one which can only be discovered through sensitivity testing.** In our view, it would seem much more preferable for this kind of analysis to *include* areas that are partly attractive rather than to *exclude* areas. The benefit of inclusion is that it would allow access seekers to decide where best to deploy their capital efficiently to capture demand, whereas the disbenefit of exclusion is that it could potentially constrain the market artificially. This again supports our view that ubiquity is not essential for access seekers.

Finally, we do not necessarily agree with Ofcom's suggestion that potential access seekers will only be interested if a postcode sector has >90% infrastructure coverage, which is supported by the illustrative payback analysis results shown in Figure 2.2. There are several existing alternative networks using a targeted geographical/customer segment approach or focussed in specific parts of cities, towns or rural areas. For example, Hyperoptic and Community Fibre Ltd (CFL) target mostly multi-dwelling units (MDUs) in urban areas using Openreach infrastructure[38] and Openreach's coverage is more extensive than its targeted geographical/customer segment.

38 Hyperoptic uses DPA products from Openreach.

2.2 Ofcom's cost analysis comparing the use of BT infrastructure and VM infrastructure is not clearly evidenced

Generally, input data[39] on VM infrastructure is heavily redacted by Ofcom in the PIMR. Ofcom has, however, given some qualitative guidance on a number of important aspects of VM's infrastructure, such as:

- VM has a significant amount of direct-buried lead-in infrastructure
- some Toby boxes do not have spare capacity
- VM is using a narrow trenching technique with micro ducts for Project Lightning and there is no spare space capacity in the lead-in infrastructure[40].

In the following subsections, we discuss in more detail aspects of Ofcom's cost analysis and provide our review commentaries and suggestions to Ofcom.

Cost analysis of using VM infrastructure is not clearly evidenced and an independent survey could be useful

Ofcom has concluded that it is more expensive for potential access seekers to re-use VM infrastructure than BT infrastructure and that potential access seekers would therefore always prefer to use BT infrastructure. It appears that Ofcom's cost analysis is based on inputs provided by VM and it is not possible to independently validate Ofcom's claims or VM's inputs. An independent survey, similar to the duct and pole surveys that Ofcom undertook on Openreach's infrastructure in 2009–10[41] [42], could potentially be beneficial, for the purposes of validating the associated costs.

We also note that Ofcom does not mention or consider potential spare duct capacity available in existing VM HFC infrastructure. This could be important as the existing VM HFC infrastructure has a larger footprint than the Project Lightning network infrastructure, and this would likely be an important consideration in estimating the total cost of connecting premises.

Ofcom has not demonstrated that there is a material connection cost difference between VM and BT

Ofcom suggests that it is more expensive for potential access seekers to re-use VM infrastructure compared to BT infrastructure. It states that VM has a significant amount of direct-buried lead-in, which costs more for the lead-in provision per connection, as new infrastructure would need to be deployed. Ofcom's table is shown in Figure 2.7 below.

39 Examples are proportion of direct-buried lead-in and average length of lead-in.

40 Narrow trenching is also used by other UK operators such as CityFibre, and it is therefore not a given that there is no space available in the deployed ducts.

41 https://www.ofcom.org.uk/__data/assets/pdf_file/0023/33971/duct_pole.pdf

42 https://www.ofcom.org.uk/__data/assets/pdf_file/0017/45251/operational_models.pdf

Figure 2.7: Ofcom's assumed cost of manifold deployment and lead-in provision, by type of lead-in infrastructure [Source: Ofcom[43], 2018]

	Overhead (GBP)	Underground – ducted (GBP)	Underground – directly buried (GBP)
Manifold deployment per manifold	100	15	15
Lead-in provision, per connection	160	160	230[44]

There is currently a GBP70 cost difference (i.e. GBP230 – GBP160) between direct-buried and ducted or overhead lead-in provision. This cost difference may appear to be significant on a standalone basis but may be much less so when viewed in the context of customer lifetime value. Similar to our commentary on the thresholds in Section 2.1 of this report, we believe Ofcom could further explore the overall commercial case in the way that access seekers would themselves.

We also note that VM uses different lead-in deployment approaches. A Toby box, for example, can be deployed at varying distances from the street or at the edge of a premises, as shown in Figure 2.8–Figure 2.11, which means the lead-in length varies by deployment approach. The estimated lead-in length for the boxes shown in Figure 2.8–Figure 2.11 varies between less than 1 metre to around 6 metres. While we acknowledge that there may be longer lead-in length in some areas, we would expect a high proportion of lead-in length to be short (~1 metre) in built-up areas. In such areas the Toby box is typically very close to buildings, as illustrated in Figure 2.10 and Figure 2.11. We believe there is merit in Ofcom investigating the distribution of lead-in lengths across the VM footprint to help support the average cost analysis. Such a distribution analysis could be done after conducting a survey and would help to establish whether a straight average, weighted average or median length is the most appropriate to be used for the cost analysis.

43 See Table A8.14 of PIMR.

44 We understand that the key cost difference between 'underground – ducted' and 'underground – directly buried' is the need to deploy new duct for the lead-in by potential access seekers in the 'underground – directly buried' category.

Figure 2.8: Toby box at the edge of a premises wall
[Source: Liberty Global[45], 2019]

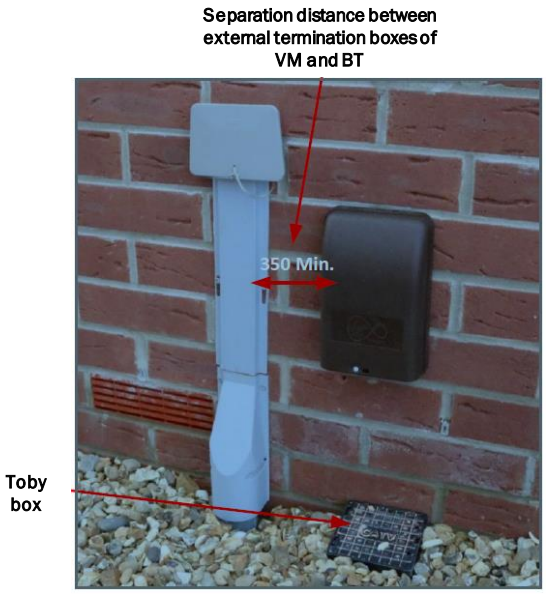


Figure 2.9: Toby box at edge of front-garden wall
[Source: Analysys Mason, 2019]

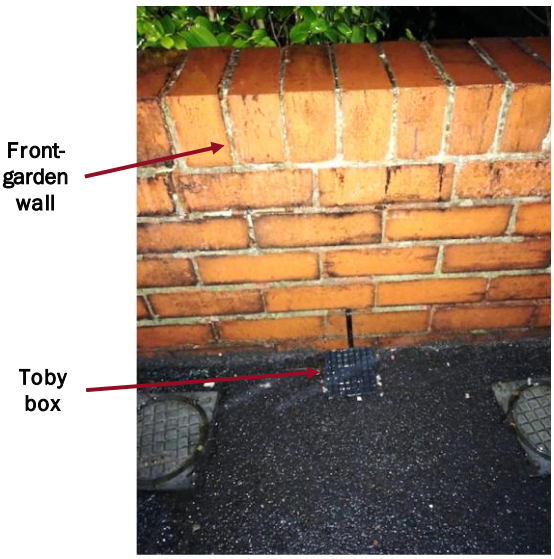


Figure 2.10: Toby box on street in front of an MDU
[Source: Analysys Mason, 2019]

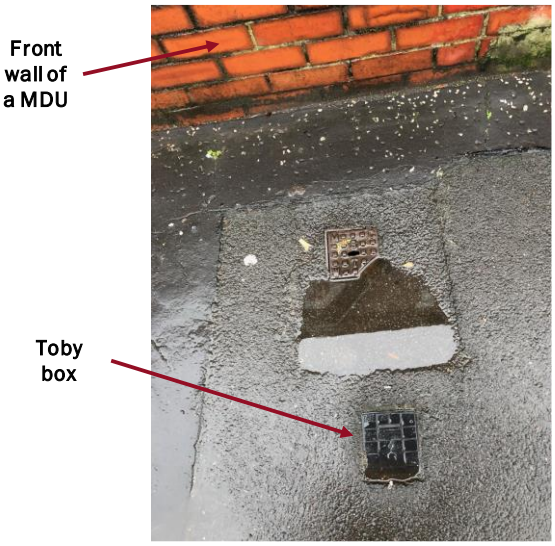
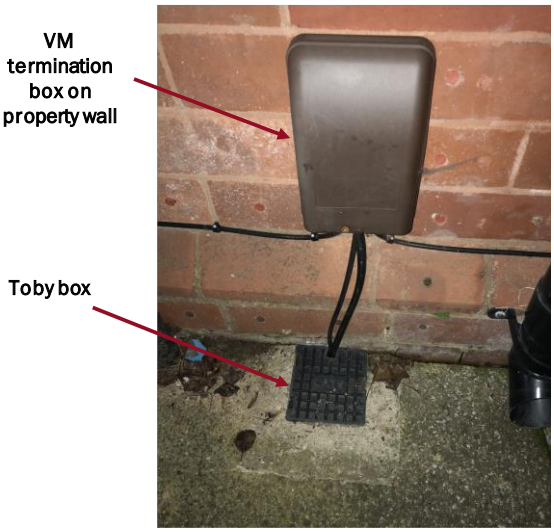


Figure 2.11: Toby box at the edge of a property
[Source: Analysys Mason, 2019]



We observe that VM uses various deployment approaches:

- wall-fixed cable
- cable in underground duct
- cable in 'on-the-ground' duct.

45 Page 12 of https://keepup.virginmedia.com/content/networkExpansion/doc/New%20Build%20Handbook%20v1.58.pdf

These deployment approaches are typically used on walls and across soft ground, as shown in Figure 2.12 and Figure 2.13. In general, the lead-in duct deployment cost per metre is significantly lower than duct deployment cost per metre in the access network. In the latter, the dig depth is deeper and requires more effort and cost.

Figure 2.12: Wall-fixed cable [Source: Analysys Mason, 2019]

Figure 2.13: 'On-the-ground' duct [Source: Analysys Mason, 2019]

We think it could be appropriate to assume GBP30[46] for the cost of deploying the lead-in duct deployment across a premises frontage, yard or similar. This is around GBP40[47] lower than the cost Ofcom has estimated. In other words, we estimate the lead-in provision cost for potential access seekers is GBP190[48]. In the context of an asset lifetime view (as explained above), a cost difference of GBP30 (i.e. GBP190 – GBP160) between direct-buried and ducted lead-in infrastructure will reduce the cost difference materiality or lead to no material cost difference. Practically, an additional capex amount of GBP30 would extend the payback period by around one month which is unlikely to be viewed as significant commercially.

While Ofcom has reasonably derived a blended cost per premises connected for BT and VM[49], there is a lack of transparency on the blended cost[50] per premises connected. It implies that Ofcom has assumed a significantly higher proportion of direct-buried lead-in for VM infrastructure in comparison to BT infrastructure. It is not possible to validate Ofcom's cost without having access to VM lead-in data.

While we acknowledge that some input values can be commercially sensitive, it is difficult to validate the output cost per premises connected. These cost outputs are fundamental to Ofcom's conclusions. It would seem important that Ofcom explains how this cost difference (between BT and VM) arises in practice, particularly as it states that "*...the overall cost of using BT's lead-in*

46 Material cost is GBP10 and labour cost is c.GBP20 (we assume that two engineers are required to do the required work over an hour with an hourly rate of GBP10 (page 6 of https://keepup.virginmedia.com/content/networkExpansion/doc/New%20Build%20Handbook%20v1.58.pdf).

47 Difference between GBP70 (Ofcom estimate) and GBP30 (Analysys Mason estimate).

48 Ofcom lead-in provision cost is GBP230 and Analysys Mason estimates this cost to be lower by GBP40.

49 See Table A8.15 of PIMR.

50 Blended cost means that both ducted and direct-buried lead-in infrastructures have been considered.

infrastructure is significantly lower than the overall cost of using Virgin Media's lead-in infrastructure"[51]. It is not clear what "significantly lower" means in this case.

Regardless of the proportion of VM's direct-buried lead-in, the blended cost difference between BT and VM may be even smaller. For example, if VM has 20% ducted and 80% direct-buried lead-in, the lead-in provision cost will be only GBP24[52] (with the payback period impact being less than one month). **We believe that there is unlikely to be a significant connection cost difference per premises when using BT infrastructure compared to using VM infrastructure**.

51 See A8.67 of PIMR.

52 BT's average lead-in provision cost is slightly higher than GBP160 due to a small proportion of direct-buried lead-in. VM's average lead-in provision cost is GBP184 (20% ducted and 80% direct-buried), based on Analysys Mason's deployment cost for the lead-in duct using VM infrastructure.

3 Use of non-telco infrastructure

Ofcom indicates in the PIMR that it does not believe that non-telco infrastructure is suitable for potential access seekers. Ofcom gives a number of reasons for this view, including its ubiquity requirement, cost and complexities (e.g. operational and contractual). As a result, Ofcom has dismissed non-telco infrastructure as not being attractive to potential access seekers.

Whilst we accept that certain non-telco infrastructures are more attractive than others, we believe there is evidence that indicates that some non-telco infrastructures may be suitable for both access and backhaul networks. A more nuanced analysis is required in order to assess the suitability of non-telco infrastructures.

3.1 Ofcom considers non-telco infrastructures but dismisses them too readily when there is evidence of at least one UK alternative network using electricity infrastructure

Ofcom has aggregated all non-telco infrastructure types into one 'bucket', which is not appropriate

Ofcom mentions backhaul and access networks to varying degrees, but it does not explicitly differentiate between backhaul and access networks in its discussions about non-telco infrastructure. Some non-telco infrastructure, such as railways and canal towpaths, could be fit for purpose in the context of backhaul networks, but not workable in the access network environment. We accept that some non-telco infrastructures (e.g. water and gas pipes) may be more difficult to use than others which are better suited to that purpose such as 'low voltage' (LV) electricity infrastructure (i.e. the electricity distribution network that connects homes and businesses).

While we acknowledge that sewers present challenges related to health and safety requirements, break-outs and associated costs, there is evidence that they have proven to be valuable assets in some locations, and particularly for business connectivity purposes. For example, Zayo[53] currently re-uses the London's sewer system and national gas pipelines for parts of its network deployment. SSE Telecoms recently announced[54] the deployment of a high-capacity fibre ring in central London using London's sewer system to provide fibre backhaul connectivity to two mobile network operators (Three UK and O2, who share two separate grids). Similarly, alternative network operators in France[55], such as Free[56], have used sewers to deploy telecoms network in Paris.

53 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727885/Zayo_response_to_DCMS_FTIR_call_for_evidence.pdf

54 https://ssetelecoms.com/insights/press-releases/sse-enterprise-telecoms-three-uk-telefonica-uk-o2-agreed-support-fibre-rollout-london/

55 https://www.latribune.fr/technos-medias/dans-la-fibre-orange-est-en-train-de-balayer-tout-le-monde-586446.html

56 https://au-east.erc.monash.edu.au/fpfiles/8332988/monash_110716.pdf

There are UK and international examples of electricity infrastructure being used successfully

LV electricity infrastructure has some similarities with telecoms access networks (much more so than other non-telco networks). However, there is little mention by Ofcom regarding LV electricity infrastructure, despite it being used in a number of markets in Europe, including in the UK.

In the UK, TrueSpeed[57] has signed a deal with Western Power Distribution (WPD) to use its electricity network[58] for FTTP deployment, which aims to reach 75 000 premises. It is not clear why TrueSpeed chose WPD electricity poles over Openreach DPA products, though cost is likely to be one consideration.

Figure 3.1 shows the extensive WPD geographical footprint[59] of 7.9 million customers, representing c.28% of UK premises. Even if this were the only electricity distribution network operator (DNO) with an interest in renting infrastructure to telecoms operators it would still represent a potentially significant footprint for access seekers. It is not known whether WPD has a strategic interest in expanding its business in this way, or if its infrastructure is suitable for fibre deployment across its entire footprint, although it would seem likely that its poles (and ducts) could potentially be used across a wide area. It could therefore be helpful for Ofcom to engage with WPD, and other DNOs, to explore these issues.

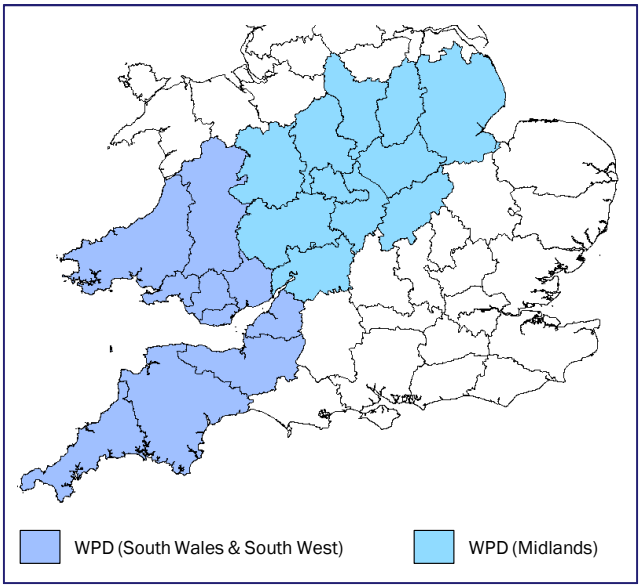


Figure 3.1: WPD geographical footprint [Source: WPD, 2019]

SIRO[60] in the Republic of Ireland is a joint venture between the electricity utility company Electricity Supply Board (ESB) and Vodafone for FTTP deployment using medium voltage (MV) and LV electricity infrastructures nationwide[61]. As of August 2018, SIRO provides FTTP coverage

57 See Section C.1 of Annex C in this report.

58 http://blog.truespeed.com/truespeeds-unique-pole-sharing-agreement-with-western-power

59 https://www.westernpower.co.uk/our-network/location-of-wpds-equipment

60 See Section C.2 of Annex C in this report.

61 It should be noted that SIRO has continued to use non-telco infrastructure despite DPA being made available by open eir (incumbent operator) since 2015.

to 175 000 Irish premises and its plan is to deploy FTTP to 500 000 premises, representing 29% of Irish premises. With at least 29% of the market being covered, it is clear that the electricity network infrastructure in Ireland is well suited[62] for FTTP deployment.

Another international example of extensive FTTP coverage using electricity infrastructure is Open Fiber[63] [64] in Italy, which uses Enel's electricity infrastructure[65]. By the end of 2017, Open Fiber provided FTTP coverage to 2.4 million premises. It plans to reach 9.5 million premises (representing 34% of Italy's premises) using a combination of telco and non-telco assets; the vast majority of the FTTP network is, however, expected to make extensive use of Enel's infrastructure[66]. The significant scale of deployment re-using Enel's infrastructure and its intention to replicate the Open Fiber business model in its other operating countries[67] further demonstrate the suitability of electricity infrastructure for FTTP deployment.

In Germany, Telekom Deutschland (a wholly owned subsidiary of the incumbent operator, Deutsche Telekom)[68] has demonstrated that it is possible to make use of different types of non-telco infrastructure (namely local authority and various utility infrastructures, including electricity). This demonstrates that an incumbent operator could be open to using various types of non-telco infrastructure as long as the fundamental economics work.

Ofcom argues that it is too difficult for potential access seekers to use non-telco infrastructures

The example of TrueSpeed and WPD highlights that potential access seekers could use non-telco infrastructure without too many complications. The fact that TrueSpeed is a relatively young company with limited resources (compared with the more established and larger operators such as BT and VM) suggests that it is not too difficult to deal with issues such as striking commercial agreements with infrastructure providers, agreeing terms of access, and planning and delivering actual network deployment. ITS Technology Group (ITS TG) in the UK is another example which demonstrates that a relatively small network operator has been able to strike commercial agreements with both non-telco (including UK local authorities) and telco network infrastructure providers[69].

In our view, one of the main reasons for the limited use of other non-telco infrastructure in the UK is the fact that FTTP is at such an early stage of its development in the UK market (from both a

62 Enet and eir also showed interest in re-using ESB infrastructure by putting forward their requests, but these were ultimately not accepted by ESB. This further demonstrates the attractiveness of electricity infrastructure for network deployment.

63 See Section C.3 of Annex C in this report.

64 We acknowledge that it will have been operationally easier for Open Fiber to re-use Enel's infrastructure because Open Fiber is part of Enel Group.

65 Enel is the major electricity provider in Italy and has a distribution network of 1 100 000km and c.450 000 cabinets.

66 Open Fiber conducted a survey on the suitability of Enel's infrastructure and found that c.60% of Enel infrastructure (towers, cabinets, ducts and poles) could be re-used for FTTP deployment.

67 https://www.reuters.com/article/us-openfiber-plan-funding/italys-open-fiber-enlists-banks-for-8-billion-broadband-rollout-idUSKBN1HK29X

68 See Figure C.3 of Annex C in this report.

69 See Section C.5 of Annex C in this report.

supply-side and demand-side perspective) rather than it being related to any fundamentals. **We do not believe Ofcom has acknowledged this sufficiently, particularly when the international examples discussed above point towards the potential importance of electricity infrastructure for fibre deployment.** It also seems likely that infrastructures independent of incumbent telecoms operators could potentially support wider competition and innovation benefits. Again, this is an area to which Ofcom does not seem to give sufficient consideration in the PIMR.

Ofcom has not liaised with other sectors (e.g. energy) to reach an informed view on suitability of non-telco infrastructure for telecoms network deployment

In the PIMR, Ofcom highlights that electricity poles are not typically found in urban areas in the UK[70]. In our view, this is not entirely accurate, though we acknowledge that electricity pole distribution in urban areas is not as extensive as in rural areas. We are aware that some cities (e.g. Bristol) have LV electricity poles.

We acknowledge that it is challenging to capture the accurate picture of utility infrastructures across the UK. **Ofcom could collaborate with the energy regulator** (Ofgem) to establish the asset database that could be used to form a more nuanced assessment of utility infrastructures for telecoms network deployment. Our suggestion to Ofcom is consistent[71] with the UK government's recommendation ("*Ofcom should work collaboratively with other regulators to ensure that multi-utility passive sharing opportunities are explored, and barriers addressed*"[72]) put forward in the Future Telecoms Infrastructure Review (FTIR), published in 2018.

3.2 Some UK operators are re-using local authority infrastructure to deploy their networks, and this should be considered more carefully by Ofcom

As mentioned in Section 2, we think the commercial reality is that telecoms operators planning to make an investment decision explore the use of different types of network infrastructure (telco and non-telco), deployment approaches and business models.

Over the last few years, we have observed that some UK telecoms operators have been making use of local authority infrastructure to deploy their networks, despite the fact that local authority infrastructure is typically limited (and hence not ubiquitous). ITS TG, for example, has made use of local authority infrastructure by implementing a concession contract model. Examples of their deployments include:

70 See 3.35a of PIMR.

71 See paragraphs 76, 78 and 246 of the Future Telecoms Infrastructure Review (FTIR) 2018, which can be accessed at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/732496/Future_Telecoms_Infrastructure_Review.pdf

72 Page 74 of the UK FTIR 2018 report.

- **The Bristol Network (BNet Ultra):** ITS TG and Net Support UK signed an exclusive 20-year concession[73] agreement in October 2015[74] to commercialise an asset owned by Bristol County Council. The joint venture between ITS TG and Net Support UK aims to build, operate and commercialise a 75km[75] duct infrastructure, and has an intention to expand the network to more than 180km (which includes some self-build).

- **Hammersmith & Fulham (H&F):** ITS TG signed a 10-year concession contract[76] with H&F Council in February 2014 to access its 17km underground duct network (originally used for a CCTV network) to deploy its fibre network[77].

In addition, ITS TG is a founder member of **Tameside Digital Infrastructure**[78], a co-operative consisting of public- and private-sector organisations. It offers open access network services across the Tameside Digital Infrastructure[79]. A total of 50km[80] of duct-based infrastructure has been installed with fibre[81].

CityFibre is another notable example of a UK operator using local authority infrastructure. CityFibre is making use of local authority infrastructure in Coventry (a 180km network[82]) and Aberdeen (a 100km network[83]) for its fibre network deployments.

Given this trend, we believe Ofcom should consider the use of local authority infrastructure by UK telecoms operators as part of a broader analysis of the use of non-telco infrastructure.

73 https://www.itstechnologygroup.com/our-networks/bristol-network/

74 https://www.ispreview.co.uk/index.php/2015/10/bristol-city-commercialises-its-ultrafast-bnet-fibre-optic-network.html

75 58km of existing duct is not used currently (https://www.itstechnologygroup.com/our-networks/bristol-network/)

76 http://www.hammersmithtoday.co.uk/shared/hfbroadband001.htm

77 https://www.itstechnologygroup.com/our-networks/hammersmith-fulham/

78 The co-operative brings together public- and private-sector organisations to create and share new digital infrastructure in and around Tameside.

79 https://www.itstechnologygroup.com/our-networks/tameside/

80 As of 24 January 2019.

81 Fibre routes commissioned by Tameside Metropolitan Borough Council, Tameside Hospital, Pennine Care, Tameside College and New Charter Housing Association.

82 https://www.cityfibre.com/gigabit-cities/coventry/

83 https://www.cityfibre.com/gigabit-cities/aberdeen/

4 Deployment approaches used by network operators

In the PIMR, Ofcom uses two key arguments to justify the need for ubiquity of infrastructure for potential access seekers:

- potential access seekers only find it attractive to deploy 'at scale' in a geographical region
- a 'mix-and-match' approach (i.e. using the infrastructure of different players) is costly and complex.

While ubiquity of infrastructure would be ideal, it does not seem an essential requirement for potential access seekers to make a network roll-out decision in any given area, as we explained earlier in Section 2.1. Furthermore, there is evidence of network deployments where a mix-and-match approach (i.e. an approach using either different infrastructures from the same owner or different types of infrastructures from multiple owners) has been adopted in the UK and across Europe.

4.1 Operators do not necessarily need to deploy at scale in a geographical region and therefore do not require ubiquitous infrastructure

In the PIMR, Ofcom's focus on ubiquity suggests that potential access seekers would only be interested in BT's infrastructure. However, we do not believe that Ofcom's view is sufficiently supported by evidence. In the UK, no operator apart from BT has ubiquitous infrastructure, yet there are many operators who have chosen to enter the market over a period of many years. As explained earlier, VM has a substantial infrastructure footprint and continues to operate successfully, including extending its footprint even further through self-build.

There are a number of smaller alternative network operators (e.g. Hyperoptic, CFL, TrueSpeed and ITS TG) that focus on targeting particular geographical/customer segments without the need for ubiquitous infrastructure from a single infrastructure provider, and there is no evidence to suggest that these operators will not continue to operate successfully in the future. We have seen several **small-scale and/or targeted deployments in the UK attracting significant investment from market capital** which supports the view that ubiquity is not essential for alternative network providers. In November 2018, Hyperoptic secured investment from Mubadala Investment Company[84] following debt of GBP250 million raised during the summer of 2018 to support its target of 5 million FTTP homes (in various UK cities) by 2024. Over the last two years, CFL has secured more than GBP36 million of equity investment from RPMI Railpen and the National Digital Infrastructure Fund (managed by Amber Infrastructure Group) to deploy 500 000 premises with FTTP in London[85]. Aviva Investors committed GBP75 million in equity funds to support TrueSpeed's target roll-out of 75 000 premises with FTTP[86].

84 https://www.hyperoptic.com/press/posts/hyperoptic-raises-strategic-investment-from-mubadala-investment-company-and-announces-additions-to-its-senior-leadership-team/

85 https://www.ispreview.co.uk/index.php/2018/04/london-ftth-broadband-isp-community-fibre-raises-extra-25m.html

86 https://www.avivainvestors.com/en-gb/about/company-news/2017/07/truespeed-secures-75-million-from-aviva-investors/

For these reasons, we believe there is a lack of clarity as regards to what Ofcom means when it discusses the opportunity for 'scale' deployment in the UK. Furthermore, it is far from clear where a 'large-scale' deployment might come from, as even the largest UK retail service providers (e.g. LLU operators) have not disclosed plans to invest at a scale that is significantly above other investors such as CityFibre and Hyperoptic.

In the PIMR, Ofcom does not appear to consider how the business case for roll-out varies by geography, nor does it acknowledge that there could be 'marginal' homes in areas (i.e. those that may not be that attractive to operators). This would seem to be important as all investors to date have to some extent 'cherry picked' areas, even with regulated access to BT's ubiquitous duct and pole infrastructure (via DPA).

Finally, most roll-out plans announced to date are relatively small-scale deployments, and even the more ambitious plans (e.g. CityFibre and FibreNation) are unlikely to cover entire urban areas. This suggests that Ofcom's idea of contiguity for large-scale deployment may not be as strong as it thinks.

4.2 Network operators have adopted the mix-and-match approach across the UK and Europe

Ofcom claims that network operators prefer a single ubiquitous infrastructure rather than a mix-and-match approach. It is our view that **network operators are well versed in mixing and matching different network infrastructures and wholesale inputs**. This happened as far back as first-generation broadband, where operators readily mixed LLU-based solutions with WBA-based solutions.

Currently, there are examples[87] of such an approach being adopted in the UK and in Europe. As discussed in Section 3.1 of this document, TrueSpeed and ITS TG in the UK, SIRO in the Republic of Ireland, Open Fiber in Italy and Telekom Deutschland in Germany all appear to be successfully using a mix-and-match approach.

In France, different network operators have taken different approaches[88] in the past to deploy FTTx networks. While France Telecom (now known as Orange) re-used its existing copper infrastructure ducts, Free and Neuf (now part of SFR) deployed fibre in the Paris sewer network. The City of Paris local authority leases sewer space for telecom services. In the City of Montpellier local authority, Free signed an agreement to build an open network using the municipality's infrastructure. SFR uses a mix of own infrastructure (re-use and self-build), and leased telco and non-telco infrastructures (e.g. sewers and electricity poles) for fibre deployment.

There are other successful network operators using a mix-and-match approach for FTTP deployment in other European countries[89]. For example, Adamo Telecom in Spain uses both leased telco and

87 See Annex C of this report.

88 https://www.ofcom.org.uk/__data/assets/pdf_file/0020/25283/csmg.pdf

89 Table 2, Page 41, Telecommunications Infrastructure International Comparison for DCMS (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727891/FTIR_Annex_B-_NERA_Telecommunications_Infrastructure_International_Comparison.pdf)

non-telco infrastructures (electricity poles[90]) for fibre deployment. Various other network operators have thus successfully adopted a mix-and-match approach[91].

In general, we believe operators will always consider the fundamental economics of all the wholesale network options available to them and select the most suitable mix, taking account of cost, suitability to support the services they wish to provide, and other factors.

With regards to business connectivity, Ofcom states that "*ubiquity is critical for LLs where each connection requires at least two specific sites to be connected*"[92]. LLs do not have to be on the same network infrastructure (e.g. SSE providing separate infrastructure for mobile network operator core/backhaul links). However, a mix-and-match approach could potentially lead to innovation from potential access seekers, a competitive benefit that may not have been fully acknowledged by Ofcom. For example, self-building of a network segment could lead to product differentiation such as physical resilient point-to-point (PTP) connectivity services to large businesses, as highlighted by CityFibre[93].

90 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727890/FTIR_Annex_A_-_FE_Report.pdf

91 There are more examples of network operators using mix-and-match deployment approaches in Annex C of this report.

92 See A8.31 of PIMR.

93 Pages 13-14 of "*CityFibre Response to Ofcom's consultation: Promoting network competition in superfast and ultrafast broadband*" (https://www.ofcom.org.uk/__data/assets/pdf_file/0022/110992/CityFibre.pdf)

5 Summary of key points

Our review of the PIMR consultation document identifies three key areas where we believe Ofcom's arguments are not sufficiently evidenced or nuanced:

- VM network infrastructure
- use of non-telco infrastructure
- deployment approaches used by network operators.

Figure 5.1 summarises our key conclusions and implications/suggestions for the three key areas. VM network infrastructure is split into two subcategories (commercial viability and lead-in provision cost per connection).

Figure 5.1: Summary of key points [Source: Analysys Mason, 2019]

Key area	Key conclusions	Implications/suggestions
VM network infrastructure: commercial viability	• Ofcom seems to adopt a two-stage test (>90% broadband threshold and >65% LL threshold) for the contiguity analysis that may not fully reflect the commercial decisions that access seekers would make • Using a more holistic approach reveals several other broadband and LL threshold combinations that are likely to be attractive to access seekers • Ubiquity is not an essential pre-condition for access seekers to make an investment case. Access seekers will assess the commercial viability of a geographical area and our payback period analysis demonstrates that there are additional attractive broadband and LL threshold combinations other than the one identified by Ofcom (90% broadband and 65% LL) • In many geographical areas VM does not cover >90% of premises (e.g. South of Manchester has ~78% coverage) and yet, VM has been operating successfully for a number of years, which supports the view that ubiquity is not essential • In our view, it would seem much more preferable for this kind of analysis to include areas that are partly attractive rather than to exclude areas. The benefit of inclusion is that access seekers would deploy their capital efficiently to capture demand. The disbenefit of exclusion is that it would potentially restrict the market artificially • It is more appropriate to assess commercial viability using different ratios of broadband premises to large business/mobile sites due to the different characteristics of the geographical markets defined by Ofcom (e.g. CLA and HNR)	• A more holistic approach supported by a rigorous analysis is required to gauge 'attractiveness' of deployment areas to access seekers. An example of such analysis is to undertake detailed business plan modelling including appropriate sensitivity analysis • Ubiquity should not be a pre-condition to represent attractiveness from an access seeker's perspective. Instead, a commercial viability analysis is more suited to this kind of exercise • Careful consideration of ratios of broadband premises to large business/mobile sites will establish the appropriate view on commercially viability (and hence threshold combination) for each geographical market, rather than a single threshold combination for all geographical markets
VM network infrastructure: lead-in provision cost per connection	• It appears that Ofcom's cost analysis is based on inputs provided by VM and it is not possible to independently validate them • Ofcom does not mention or consider potential spare capacity available in existing VM's HFC network, which could be a material omission • Considering that a proportion of VM's lead-in is ducted, we think that there is unlikely to be a material connection cost difference per	• An independent survey could be undertaken (similar to the duct and pole surveys that Ofcom undertook on Openreach's infrastructure) to investigate costs differences and the distribution of lead-in lengths to help better inform decision-making

Key area	Key conclusions	Implications/suggestions
	premises when using BT compared to VM infrastructure. The additional lead-in provision cost per connection using VM infrastructure could be ~GBP24 over the asset lifetime, and such small additional cost could be recovered easily	• A more detailed cost analysis could be undertaken, reflecting practical deployment approaches adopted by VM before the final assessment conclusions are made by Ofcom
Use of non-telco infrastructure	• There is little mention by Ofcom regarding the use of LV electricity infrastructure, despite it being used in a number of markets in Europe, and in the UK • The number of electricity poles in some urban areas of the UK may be non-negligible, which is contrary to Ofcom's position • There are cases that demonstrate it is not too onerous for potential access seekers to use non-telco infrastructure for FTTP deployment • Some UK operators are re-using local authority infrastructure to deploy their networks, and this should be considered more carefully by Ofcom	• It could be helpful for Ofcom to engage with WPD, and other DNOs, to explore any potential issues that potential access seekers could face • Ofcom could collaborate with Ofgem to establish the asset database that could be used to form a more nuanced assessment of utility infrastructures for telecoms network deployment • Ofcom should consider the use of local authority infrastructure by UK telecoms operators as part of a broader analysis of the use of non-telco infrastructure
Deployment approaches used by network operators	• Operators do not necessarily need to deploy at scale in a geographical region and therefore do not require ubiquitous infrastructure (e.g. VM has been successful for a long period of time in the UK) • There are a number of smaller alternative networks that focus on targeting particular geographical/customer segments without the need for ubiquitous infrastructure from a single infrastructure provider • Most roll-out plans announced to date are relatively small-scale deployments, and even the more ambitious plans (e.g. CityFibre) are unlikely to cover entire urban areas • Network operators in the UK and Europe are well versed in mixing and matching different (telco and non-telco) network infrastructures. We believe operators will always consider the fundamental economics and select the most suitable mix, generally select the lowest-cost solution • A mix-and-match approach could potentially lead to innovation from potential access seekers, a competitive benefit that may not have been acknowledged by Ofcom	• Ubiquity and scale deployment should not be defined as primary factors for market analysis • A mix-and-match approach should not be seen as a barrier to FTTP deployment; in some cases, there may be potential benefits (e.g. innovation) resulting from such an approach

Annex A Sensitivity analysis results on attractiveness of deployment areas

In order to measure how attractive deployment areas are to potential access seekers, we have developed a high-level commercial viability analysis[94] to calculate expected payback periods (as a proxy for attractiveness) for a combination of broadband and LL connections in a hypothetical geographical area. The key parameters and assumptions used for our base-case scenario are summarised in Figure A.1.

Figure A.1: Key parameters and assumptions for base-case analysis [Source: Analysys Mason, 2019]

No.	Parameters	Broadband assumptions	LL assumptions
1	Coverage	100 000 premises	2000[95] large business and mobile sites
2	Take-up	25%	25%
3	Capex	• GBP250 per premises passed[96] • GBP175 per connection[97]	• GBP250 per premises passed • GBP2000 per connection[98] (GBP1000 for deploying a carrier-grade switch as CPE cost, and GBP1000 for deploying ducted fibre for the final drop[99])
4	Annual revenue	GBP420 (i.e. GBP35 per month)	GBP2000
5	Opex	• ~35% of annual revenue (i.e. 65% EBITDA margin)	• ~30% of annual revenue (i.e. 70% EBITDA margin)

94 This analysis is not intended to represent an operator's full business plan with suitable revenue and cost profiles. For example, a full business plan typically recognises a take-up profile over time that drives revenue – such detailed analysis has not been undertaken in this report.

95 For our base-case analysis, we have assumed a broadband premises-to-large business/mobile sites ratio of 50:1.

96 Openreach Consultation on "*Upgrading the Access Network with FTTP*" (page 21 of https://www.btplc.com/Sharesandperformance/Presentations/keycompanyannouncements/downloads/FTTPCondoc17Jul17FINAL.PDF) suggested GBP300–600 per premises passed in the UK. The cost range was informed by industry benchmarks that seem to have a significant proportion of self-build. We have assumed GBP250 per premises passed on the basis that the access seekers will mostly use duct and pole access products that reduce capex significantly.

97 A GBP175–200 connection cost is mentioned on page 22 of Openreach Consultation on "*Upgrading the Access Network with FTTP*". We have assumed the low-end cost for our commercial viability analysis on the basis that the access seekers will use duct and pole access products, where available.

98 We estimate the connection cost to be ~GBP2000, which is more prudent than the Openreach connection cost (GBP1850 set on 01 October 2018) for a 1Gbps Ethernet Access Direct, referred as EAD 1000 product (https://www.openreach.co.uk/orpg/home/products/pricing/loadProductPriceDetails.do?data=0d0zetWgShsjqKWjcN2Y5WJA8BGGqsBLxL7IgSM4fRpZ6rNZujnCs99NbIKJZPD9hXYmiijxH6wr%0ACQm97GZMyQ%3D%3D))

99 Ofcom assumes large business/mobile sites within a 50-metre buffer of a network infrastructure as covered. Assuming the average distance between the network infrastructure and large business/mobile sites within the 50-metre buffer is 20 metres, we estimate the connection cost to be GBP1000, based on a deployment cost of GBP50 per metre.

No.	Parameters	Broadband assumptions	LL assumptions
		• Fixed opex[100] represents ~70% of total opex	• Fixed opex represents ~70% of total opex
6	Acceptable payback period	• 5 years	• 5 years

The number of large business and mobile sites varies significantly by geography. For example, there is a higher proportion of large business and mobile sites in central business district (CBD) areas compared to residential areas. To cater for this variation in the broadband premises to large business/mobile sites ratio, we have run a sensitivity analysis. This analysis prevents potential premature conclusions on how attractive a geographical area could be from a potential access seeker's point of view.

Figure A.2 to Figure A.4 below show the sensitivity analysis results on the payback period[101] (in years) for different broadband and LL coverage thresholds under various broadband premises to large business/mobile sites ratio scenarios. A ratio of 10:1, for example, represents a ratio of 100 broadband premises to 10 large business/mobile sites.

Figure A.2: Payback period (years) for 250:1 ratio [Source: Analysys Mason, 2019]

LL threshold \ Consumer broadband threshold	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
0%	9.6	7.8	6.8	6.1	5.7	5.3	5.1	4.9	4.7	4.6	4.4	4.4	4.3
5%	9.5	7.7	6.7	6.1	5.6	5.3	5.1	4.9	4.7	4.6	4.4	4.3	4.3
10%	9.5	7.7	6.7	6.1	5.6	5.3	5.1	4.9	4.7	4.6	4.4	4.3	4.3
15%	9.4	7.7	6.7	6.1	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.3
20%	9.3	7.6	6.7	6.1	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.3
25%	9.3	7.6	6.7	6.0	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.2
30%	9.2	7.6	6.6	6.0	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.2
35%	9.2	7.6	6.6	6.0	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.2
40%	9.1	7.5	6.6	6.0	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.2
45%	9.1	7.5	6.6	6.0	5.6	5.2	5.0	4.8	4.7	4.5	4.4	4.3	4.2
50%	9.0	7.5	6.6	6.0	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
55%	9.0	7.4	6.5	6.0	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
60%	8.9	7.4	6.5	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
65%	8.9	7.4	6.5	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
70%	8.8	7.4	6.5	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
75%	8.8	7.3	6.5	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
80%	8.7	7.3	6.4	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
85%	8.7	7.3	6.4	5.9	5.5	5.2	4.9	4.8	4.6	4.5	4.4	4.3	4.2
90%	8.6	7.2	6.4	5.9	5.5	5.2	4.9	4.8	4.6	4.5	4.4	4.3	4.2
95%	8.6	7.2	6.4	5.8	5.4	5.2	4.9	4.7	4.6	4.5	4.4	4.3	4.2
100%	8.5	7.2	6.4	5.8	5.4	5.1	4.9	4.7	4.6	4.5	4.4	4.3	4.2

Note: Ofcom cases represent payback for >90% broadband coverage and >65% LL coverage

Payback ≤ Ofcom's implied payback | Ofcom's cases | Payback ≥ Ofcom's implied payback

100 'Fixed opex' refers to recurring cost items (e.g. some employment costs and DPA rental) that are independent of the number of connections.

101 Green-coloured and yellow-coloured options are deemed to be commercially viable, whereas red-coloured and grey-coloured options are deemed to be commercially unviable.

Figure A.3: Payback period (years) for 50:1 ratio [Source: Analysys Mason, 2019]

LL threshold \ Consumer broadband threshold	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
0%	11.2	8.7	7.4	6.6	6.0	5.6	5.3	5.1	4.9	4.7	4.6	4.5	4.4
5%	10.8	8.5	7.2	6.5	5.9	5.5	5.3	5.0	4.8	4.7	4.6	4.5	4.4
10%	10.4	8.3	7.1	6.4	5.9	5.5	5.2	5.0	4.8	4.7	4.5	4.4	4.3
15%	10.1	8.1	7.0	6.3	5.8	5.4	5.2	5.0	4.8	4.6	4.5	4.4	4.3
20%	9.8	7.9	6.9	6.2	5.7	5.4	5.1	4.9	4.8	4.6	4.5	4.4	4.3
25%	9.5	7.8	6.8	6.1	5.7	5.4	5.1	4.9	4.7	4.6	4.5	4.4	4.3
30%	9.2	7.6	6.7	6.1	5.6	5.3	5.1	4.9	4.7	4.6	4.5	4.4	4.3
35%	9.0	7.5	6.6	6.0	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.3
40%	8.7	7.3	6.5	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
45%	8.5	7.2	6.4	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2
50%	8.3	7.1	6.3	5.8	5.4	5.1	4.9	4.7	4.6	4.5	4.4	4.3	4.2
55%	8.1	6.9	6.2	5.7	5.4	5.1	4.9	4.7	4.6	4.5	4.3	4.3	4.2
60%	7.9	6.8	6.1	5.7	5.3	5.1	4.8	4.7	4.5	4.4	4.3	4.2	4.2
65%	7.7	6.7	6.1	5.6	5.3	5.0	4.8	4.7	4.5	4.4	4.3	4.2	4.2
70%	7.6	6.6	6.0	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1
75%	7.4	6.5	5.9	5.5	5.2	4.9	4.8	4.6	4.5	4.4	4.3	4.2	4.1
80%	7.3	6.4	5.8	5.4	5.1	4.9	4.7	4.6	4.4	4.3	4.3	4.2	4.1
85%	7.1	6.3	5.8	5.4	5.1	4.9	4.7	4.5	4.4	4.3	4.2	4.2	4.1
90%	7.0	6.2	5.7	5.3	5.1	4.8	4.7	4.5	4.4	4.3	4.2	4.1	4.1
95%	6.9	6.1	5.6	5.3	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.1
100%	6.8	6.0	5.6	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.1

Note: Ofcom cases represent payback for >90% broadband coverage and >65% LL coverage

Payback ≤ Ofcom's implied payback | Ofcom's cases | Payback ≥ Ofcom's implied payback

Figure A.4: Payback period (years) for 10:1 ratio [Source: Analysys Mason, 2019]

LL threshold \ Consumer broadband threshold	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
0%	68.3	20.5	13.2	10.2	8.6	7.5	6.9	6.3	6.0	5.7	5.4	5.2	5.0
5%	30.4	15.6	11.2	9.1	7.9	7.1	6.5	6.1	5.7	5.5	5.2	5.1	4.9
10%	19.9	12.7	9.8	8.3	7.3	6.6	6.2	5.8	5.5	5.3	5.1	4.9	4.8
15%	15.1	10.8	8.8	7.6	6.8	6.3	5.9	5.6	5.3	5.1	4.9	4.8	4.7
20%	12.2	9.5	8.0	7.1	6.4	6.0	5.6	5.4	5.2	5.0	4.8	4.7	4.6
25%	10.4	8.5	7.4	6.6	6.1	5.7	5.4	5.2	5.0	4.8	4.7	4.6	4.5
30%	9.1	7.7	6.8	6.2	5.8	5.5	5.2	5.0	4.9	4.7	4.6	4.5	4.4
35%	8.1	7.1	6.4	5.9	5.5	5.3	5.0	4.9	4.7	4.6	4.5	4.4	4.3
40%	7.4	6.6	6.0	5.6	5.3	5.1	4.9	4.7	4.6	4.5	4.4	4.3	4.2
45%	6.8	6.2	5.7	5.4	5.1	4.9	4.7	4.6	4.5	4.4	4.3	4.2	4.2
50%	6.3	5.8	5.4	5.2	4.9	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.1
55%	5.9	5.5	5.2	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.1	4.0
60%	5.6	5.3	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.1	4.0	4.0
65%	5.3	5.0	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.0	4.0	3.9	3.9
70%	5.1	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.0	4.0	3.9	3.9	3.8
75%	4.8	4.6	4.5	4.4	4.3	4.2	4.1	4.0	4.0	3.9	3.9	3.8	3.8
80%	4.7	4.5	4.4	4.2	4.1	4.1	4.0	3.9	3.9	3.8	3.8	3.8	3.7
85%	4.5	4.3	4.2	4.1	4.1	4.0	3.9	3.9	3.8	3.8	3.7	3.7	3.7
90%	4.3	4.2	4.1	4.0	4.0	3.9	3.8	3.8	3.8	3.7	3.7	3.7	3.6
95%	4.2	4.1	4.0	3.9	3.9	3.8	3.8	3.7	3.7	3.7	3.6	3.6	3.6
100%	4.1	4.0	3.9	3.9	3.8	3.8	3.7	3.7	3.6	3.6	3.6	3.6	3.6

Note: Ofcom cases represent payback for >90% broadband coverage and >65% LL coverage

Payback ≤ Ofcom's implied payback | Ofcom's cases | Payback ≥ Ofcom's implied payback

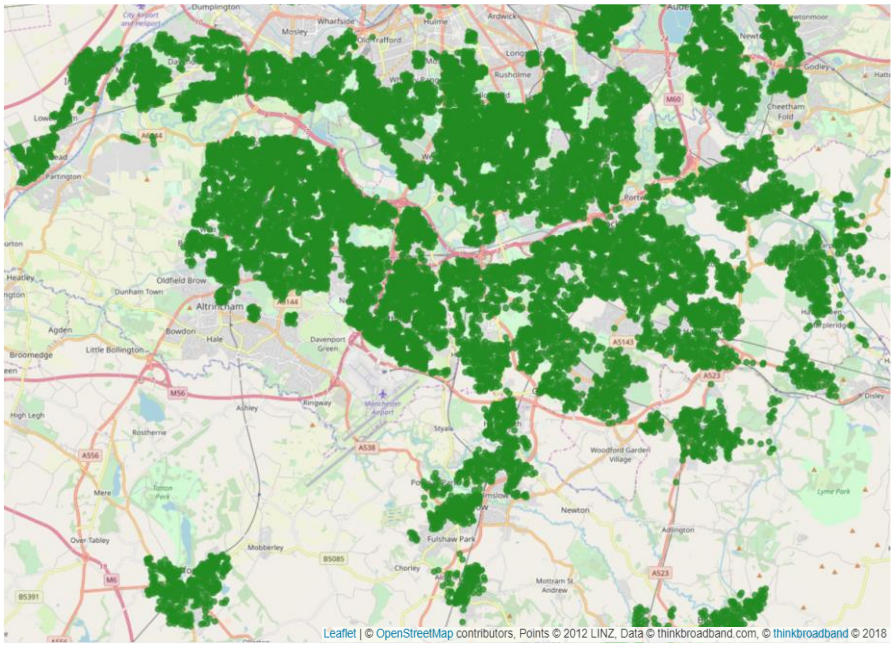
Annex B Methodology used to estimate VM coverage in South Manchester

B.1 Introduction

In this annex, we discuss the steps followed to produce an estimate of VM's coverage in South Manchester. We selected South Manchester as an illustrative sample because VM does not have ubiquitous coverage in the area and it is a reasonably sized region (c.500 000 premises).

We used data from thinkbroadband[102] for the geographical analysis presented in this report. thinkbroadband uses a series of speed test results to estimate VM coverage[103]. thinkbroadband was selected as it offers fairly comprehensive coverage maps for each operator at a reasonable granularity (postcode) level. Figure B.1 shows the geographical area of South Manchester that was used for our analysis.

Figure B.1: VM coverage in South Manchester [Source: thinkbroadband, 2019]



102 https://labs.thinkbroadband.com/local/broadband-map#12/53.3777/-2.1782/virgin/

103 thinkbroadband's methodology can be found at https://labs.thinkbroadband.com/local/

B.2 Methodology used

The steps we took are as follows:

Step 1: Capture VM coverage as an image (snapshot) from thinkbroadband

We captured a snapshot of VM coverage in the South Manchester region, using an image from thinkbroadband.

Step 2: Verify accuracy of thinkbroadband's VM coverage data by using VM postcode checker

We undertook a check on VM coverage, using the VM postcode checker[104] on a sample of randomly selected postcodes that, according to thinkbroadband, is covered by VM. This exercise gave us confidence in the coverage accuracy of thinkbroadband that we can base our analysis on and confirmed that we would use thinkbroadband data for our geographical analysis.

Step 3: Import the image into our GIS software tool

The image was imported into our GIS software tool (Mapinfo Version 16.0 (64-bit)). The accuracy of the VM coverage image was cross-checked against a map representing location of real premises (Bing Maps was used). We found that the VM coverage map image aligns with the location of real premises.

Step 4: Create polygons to map VM coverage image

Polygons were then manually created to map the VM coverage image captured from thinkbroadband to ensure that the polygons represent VM coverage as accurately as possible.

Step 5: Undertake a sanity check to ensure that VM coverage polygons are reasonably accurate

Before running our geographical analysis, it was important to ensure that the manually drawn polygons were a good representation of thinkbroadband's VM coverage map. We undertook a visual check on several regions and were satisfied that the polygons were sufficiently accurate for our geographical analysis: the coverage polygons overlay the built-up areas, which is expected for VM coverage. Examples of this sanity check are shown in Figure B.2 to Figure B.5 below.

104 https://www.virginmedia.com/postcode-checker/

Figure B.2: Poynton and nearby areas [Source: Analysys Mason, 2019]

Figure B.3: Kerridge and nearby areas [Source: Analysys Mason, 2019]

Figure B.4: Knutsford and nearby areas [Source: Analysys Mason, 2019]

Figure B.5: Wilmslow and nearby areas [Source: Analysys Mason, 2019]

Step 6: Identify premises within the VM coverage polygons

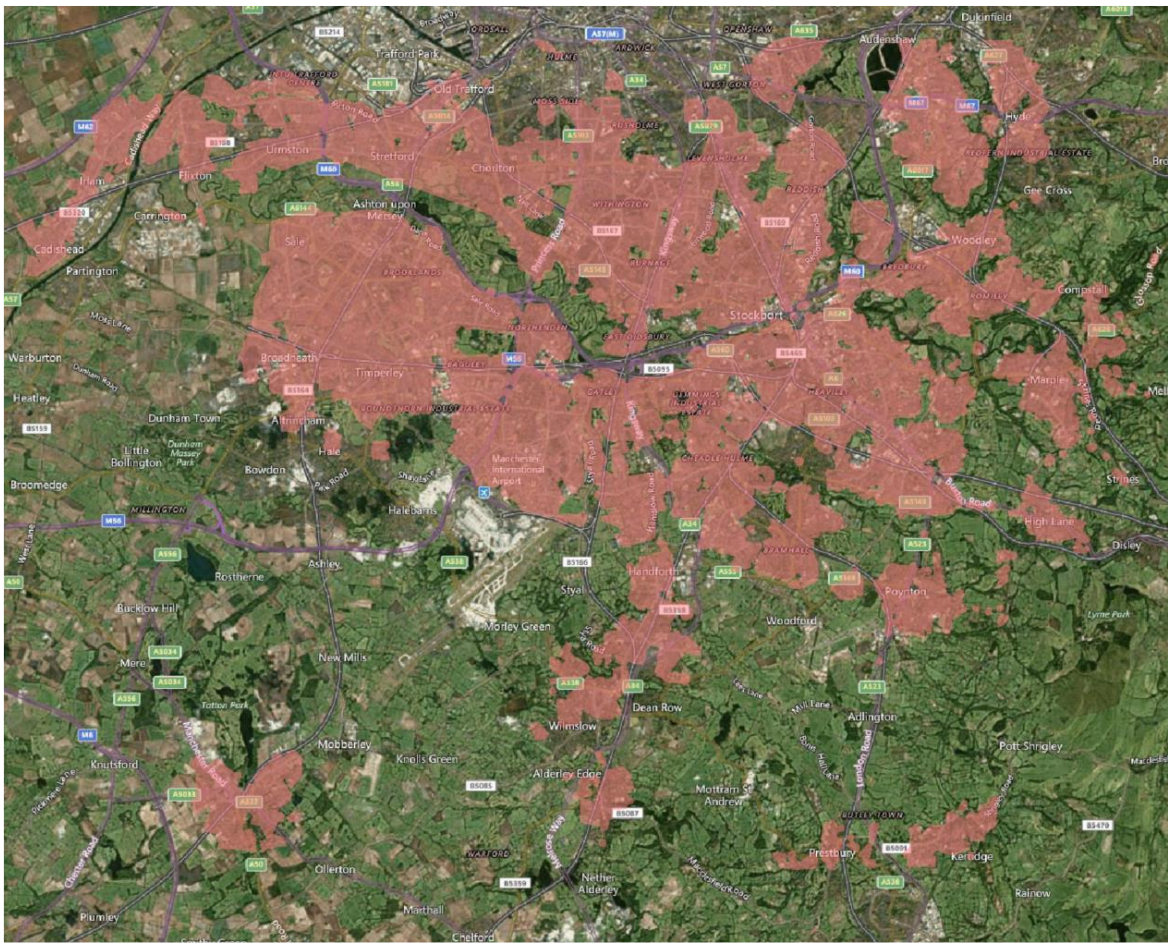
The number of residential and non-residential premises were then identified within the VM coverage polygons.

B.3 Main output

Overall, we are confident that this exercise[105] has produced a sufficiently accurate VM coverage map for South Manchester. The full VM coverage in South Manchester that we produced using the methodology described in Section B.2 is shown in Figure B.6 below.

105 Although it includes some extensive manual tasks.

Figure B.6: VM coverage in South Manchester used for geographical analysis [Source: Analysys Mason, 2019]



Annex C Case studies for deployment approaches and use of non-telco infrastructure

In this annex, we provide some examples from the UK and Western Europe of network operators using mix-and-match deployment approaches and non-telco infrastructure for their FTTP networks. The examples we have selected also provide variety in scale, which is an important consideration before reaching firm conclusions on deployment approaches and use of non-telco infrastructure. The five examples are:

- TrueSpeed in the UK
- SIRO in the Republic of Ireland
- Enel (Open Fiber) in Italy
- Telekom Deutschland in Germany
- ITS Technology Group (ITS TG) in the UK.

In the remainder of this annex, we provide a short summary of each network operator, capturing the key relevant points to support our views in the main body of the report.

C.1 TrueSpeed in the UK

C.1.1 Summary of key points

- A rural-focussed UK operator uses non-telco (LV electricity) infrastructure for its network despite the availability of DPA from Openreach
- It has been demonstrated that it is not too difficult to use non-telco infrastructure
- A new-entrant operator has been able to strike commercial agreement with a large distribution network operator, agree terms of access, plan and deliver the actual network.

C.1.2 Brief description of TrueSpeed

TrueSpeed is a UK network operator offering FTTP broadband to residential and business premises in some rural parts of the South West of England, as shown in Figure C.1.

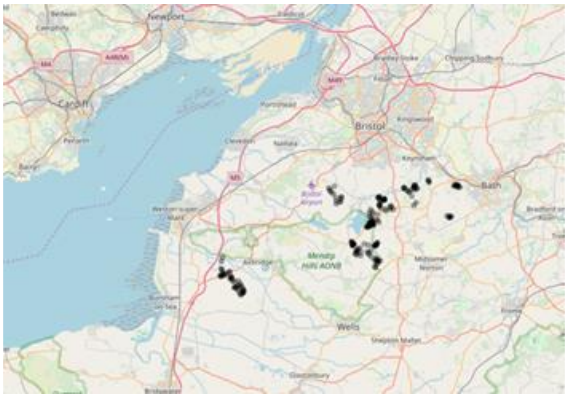


Figure C.1: Current TrueSpeed FTTP coverage [Source: thinkbroadband, 2019]

In early 2016, TrueSpeed started its FTTP broadband network roll-out in the rural village of Priston[106], connecting 80 homes with FTTP. Since then, TrueSpeed has extended its FTTP network footprint to cover 3000 premises[107], covering other villages such as Chew Valley, Compton Dando and Stanton. TrueSpeed aims to build it FTTP network to pass 1800 premises per month to reach 75 000 premises by 2021. It is supported by a GBP75 million investment from Aviva[108], which was announced in July 2017.

Initially, TrueSpeed used a self-build approach (digging through verge in Priston) that was deemed to be costly and time-consuming. To improve efficiency and minimise disruption to local communities, TrueSpeed has been exploring use of third-party infrastructures. In November 2016, TrueSpeed started to use Openreach's ducts and poles (DPA) to roll out FTTP. In March 2017, TrueSpeed announced an agreement with WPD to use its electricity poles to deploy FTTP[109].

WPD already has an established, wide geographical footprint (consisting of 220 000km of overhead lines and underground cables[110]) covering the Midlands, the South West of England and Wales, as shown in Figure C.2.

106 https://www.ispreview.co.uk/index.php/2016/04/truespeed-connect-first-ne-somerset-village-100mb-fttp-broadband.html

107 As of May 2018.

108 https://www.ispreview.co.uk/index.php/2018/05/truespeed-ceo-we-hope-to-reach-200000-uk-premises-with-fttp.html

109 http://blog.truespeed.com/truespeeds-unique-pole-sharing-agreement-with-western-power

110 https://cdn.linesearchbeforeudig.co.uk/pdfs/lsbud-wpd-cs-2017.pdf

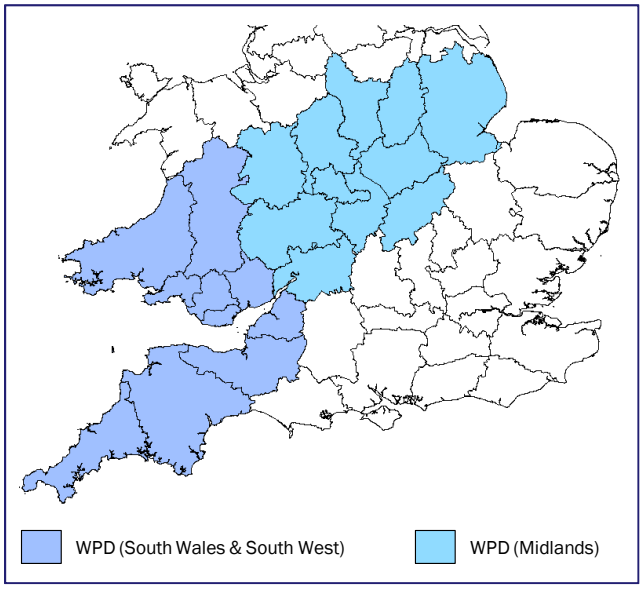


Figure C.2: WPD geographical footprint [Source: WPD, 2019]

The WPD footprint covers 7.9 million premises[111] representing c.28% of UK premises, which is a significant market size. WPD seems to have database and mapping (GIS[112]) tools and a Planning Data Portal [113] for its distribution network infrastructure and location of its poles and towers. This suggests that WPD infrastructure could be used more extensively for FTTP deployment.

Currently, TrueSpeed is using the existing WPD electricity poles to deploy FTTP for its planned coverage of 75 000 premises by 2021.

C.2 SIRO in the Republic of Ireland

C.2.1 Summary of key points

- It is possible for a large network operator (Vodafone) to establish a joint venture with a large energy company
- A substantial amount of the Republic of Ireland (c.29% of premises) is expected to be served by FTTP broadband using non-telco (MV and LV electricity) infrastructure
- Vodafone has continued to use non-telco infrastructure despite DPA being made available by open eir (incumbent operator) since 2015.

C.2.2 Brief description of SIRO

SIRO was established in May 2015 as a joint venture between Vodafone and the Irish power company ESB to build an FTTP network using ESB's distribution network. It should be noted that open eir[114]

111 https://www.westernpower.co.uk/about-us [accessed on 20 Dec. 2018]

112 Geographical information system.

113 https://www.westernpower.co.uk/downloads/3862

114 open eir is a trading name of eircom Limited (https://www.openeir.ie/Home/)

published its first DPA product description in October 2015[115] following a remedy on DPA[116] mandated by the national regulatory authority (ComReg[117]) in January 2013. However, SIRO has not made use of the DPA products provided by open eir to date.

Under this partnership, SIRO is required to pay ESB an annual fee for the right to use ESB's distribution network and provides below-market rate fibre pairs to ESB for its network operational needs. SIRO offers wholesale open access to retail service providers such as Digiweb, Westnet and Sky. It should be noted that two other network operators (Enet and eir) showed interest regarding the re-use of ESB's electricity infrastructure for broadband deployment[118], which demonstrates the attractiveness of electricity infrastructure in the Republic of Ireland.

By the end of 2016, the SIRO network had passed 36 500 premises with FTTP in 17 urban areas. By May 2018, the SIRO FTTP network covered more than 125 000 premises across 25 towns. An additional 50 000 premises were covered by August 2018, reaching 175 000 premises[119] covered in total, with 25 000 homes and businesses connected to the SIRO infrastructure. Ultimately, SIRO plans to cover 500 000 premises (representing c.29% of Irish premises) in 50 towns with a EUR450 million investment. While no commitment has been made on further deployment, it has been mentioned that a further 321 small towns could be part of SIRO's second phase of deployment[120].

SIRO is making use of ESB's existing nationwide electricity network to facilitate its FTTP roll-out. It includes 2.1 million poles, 150 000km of overhead lines and 22 000km of underground cable[121].

The ESB[122] FTTP network deploys optical fibre up to transmission and sub-transmission networks and SIRO operates the FTTP network below 38kV using both MV and LV sections of the distribution network[123]. SIRO deploys fibre cable directly into existing ducts or string to overhead power cable with minimal disruption.

115 https://www.openeir.ie/Products/Data/Pole_and_Duct_Access/#product_archive

116 Next Generation Access: Remedies for Next Generation Access Markets (https://www.comreg.ie/publication/next-generation-access-remedies-for-next-generation-access-markets/)

117 ComReg stands for Commission for Communications Regulation.

118 https://www.telegeography.com/products/commsupdate/articles/2016/11/01/enet-alleges-esb-is-hampering-irelands-broadband-rollout/

119 https://www.telecompaper.com/news/siro-fibre-broadband-network-passes-175000-premises--1255868

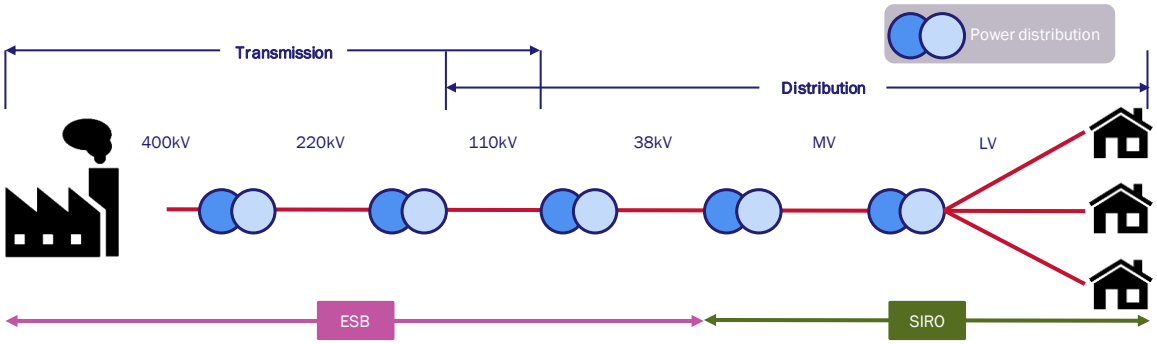
120 https://www.telegeography.com/products/globalcomms/data/company-profiles/we/siro/company-overview.html, SIRO initially aimed to cover 500 000 premises by the end of 2018, but by August 2018 only 175 000 premises had been passed, with no new roll-out plan made available in the public domain.

121 https://www.esbnetworks.ie/tns/contact-us/map-of-divisions

122 Telecoms business established by ESB to focus only on mobile backhaul and long distance.

123 https://www.cru.ie/professional/publications/

Figure C.3: Split of responsibilities between SIRO and ESB [Source: Analysys Mason, 2019]



C.3 Enel (Open Fiber) in Italy

C.3.1 Summary of key points

- One of the largest FTTP operators in Italy, making extensive use of various types of non-telco infrastructure (a survey shows c.60% of Enel's infrastructure including towers, cabinets, ducts and poles can be used for FTTP deployment) and telco infrastructures, demonstrating that a mix-and-match approach can work successfully in practice
- A substantial amount (c.34%) of Italian premises are expected to be served by FTTP broadband by 2021
- The incumbent operator has announced agreements to re-use the non-telco infrastructure (pipes, ducts and public lighting poles) of utility companies A2A and Utilitalia.

C.3.2 Brief description of Open Fiber

In December 2015, Enel, the major electricity provider in Italy, established a new business entity called Enel Open Fiber to deploy FTTP in Italy by re-using Enel's electricity network infrastructure. In 2016, EOF acquired fibre network provider Metroweb and then rebranded it as Open Fiber[124] to provide wholesale products.

Enel's electricity network infrastructure includes a 1 100 000km distribution network and c.450 000 electricity cabinets[125] (roughly three times the number of phone cabinets of the incumbent telecoms operator, Telecom Italia). Following an assessment of the potential to re-use Enel's existing infrastructure, Open Fiber's initial roll-out intended to deploy within Enel's footprint to cover 10 major Italian cities. The findings of a study carried out by Open Fiber revealed that while the opportunity to use the electricity aerial network for fibre roll-out appears universal, the scope for re-using the underground network is much more limited. Therefore, new infrastructure will need to be built in underground deployment areas. Overall, the study showed that c.60% of Enel's infrastructure including towers, cabinets, ducts and poles can be re-used in the fibre roll-out.

124 https://www.telegeography.com/products/globalcomms/data/country-profiles/we/italy/broadband.html

125 https://www.enel.com/aboutus/where-we-are

Open Fiber rolled out FTTP infrastructure to cover 2.4 million homes by the end of 2017 and 6300km of national optical backbone network in September 2018. It thus has an extensive FTTP network infrastructure, and consequently local retail service providers such as Wind Tre, GO Internet, Tiscali and Vodafone Italy have purchased wholesale products from Open Fiber. Open Fiber plans to reach 9.5 million premises (representing c.34% of Italian premises) in 250 cities by 2021, using an investment of EUR3.7 billion (representing a cost of EUR390 per home passed).

Telecom Italia has also partnered with other utility companies and made use of non-telco infrastructure to support its FTTP deployment over the last two years. In September 2016, TIM signed a memorandum of understanding with the regional electricity and gas provider A2A to use A2A's pipe infrastructure to deploy FTTP network in Milan[126]. The agreement was initially signed to cover areas of Milan city where TIM does not have access to fibre via its existing agreement with Metroweb. The agreement between Telecom Italia and A2A is being considered for extension to cover other cities such as Bergamo and Brescia[127]. In September 2017, Telecom Italia revealed a further agreement for the sharing of Utilitalia[128] infrastructures (pipes, ducts and public lighting poles) to deploy fibre-optic cables[129].

C.4 Telekom Deutschland in Germany

C.4.1 Summary of key points

An incumbent operator that is:

- open to using various types of non-telco infrastructure, demonstrating that a mix-and-match approach is not too onerous for operators
- using several types of non-telco infrastructures from regional government and utility companies for its FTTP deployment.

C.4.2 Brief description of Telekom Deutschland

Telekom Deutschland, a wholly owned subsidiary of Deutsche Telekom, has a market share of 39.4%[130] in the fixed broadband market in Germany. Telekom Deutschland focusses on both consumer and small and medium-sized enterprises (SMEs) by providing a portfolio of services such as traditional fixed telephony, LLs, broadband access, IPTV and wholesale services, among others.

Recently, Telekom Deutschland's main focus has been on the roll-out of high-speed technologies such as VDSL, vectoring and FTTH. Telekom Deutschland covered around 46% of households in Germany with minimum speed of 50Mbps by end of 2017 and plans to increase its coverage to 80% of households

126 https://www.reuters.com/article/a2a-broadband/a2a-has-broadband-agreements-with-telecom-italia-and-open-fiber-for-milan-idUSI6N1JX02R

127 https://www.telegeography.com/products/globalcomms/data/country-profiles/we/italy/broadband.html

128 A group of around 500 electricity, gas, water and environmental services companies.

129 https://www.telecomitalia.com/tit/en/archivio/media/note-stampa/corporate/2017/PN-MoU-TIM-UTILITALIA.html

130 As of September 2018, as reported by TeleGeography.

by 2019. Currently, Telekom Deutschland's network consists of over 1.4 million km of copper cables and more than 455 000km of fibre. It planned to deploy additional fibre network spanning 60 000km by end of 2018 but it is not confirmed whether this plan has been achieved.

In order to further expand its network, TD has developed partnerships with regional government, housing associations and utility companies.

Telekom Deutschland and Stuttgart regional government have signed a partnership for joint roll-out of a fibre network to pass 1.38 million households and 140 000 business premises by 2030. Deutsche Telekom will invest EUR1.1 billion, and EUR500 million will be contributed by Stuttgart regional government. The partnership plans to cover 90% of businesses in the Stuttgart region by 2022, 50% of households by 2025 and 90% of premises by 2030. Although it is not explicitly stated, there is a strong indication that Telekom Deutschland will lease the existing infrastructure (e.g. optical fibre and duct) of Stuttgart regional government in the municipalities[131].

By the end of 2017, Telekom Deutschland had passed 218 000[132] households with FTTP. It had partnered with various housing associations such as Deutsche Annington Immobilien, FLUWO Bauen und Wohnen, among others.

Telekom Deutschland has signed several agreements with utility companies to expand its FTTP network. Some examples are provided below:

- In Chemnitz[133] in Germany, the multi-utilities company 'Eins Energie in Sachsen'[134] constructed the fibre network, while Telekom Deutschland was responsible for operating the network. Telekom Deutschland leases the network from Eins and allows open access to its competitors. From April 2012 to the end of 2014, 60 000 households were passed with fibre.

- Telekom Deutschland signed a ten-year deal with Innogy[135], an energy company, in January 2017 to offer services on Innogy's broadband network in rural areas. Telekom Deutschland will offer services to 55 000 households based in the Eifel, Hunsrueck and Muensterland regions. Innogy intends to expand its FTTx network and is considering the use of grid-based infrastructure for broadband expansion, which implies that non-telco assets are being used for broadband deployment[136]. However, the exact type of non-telco assets has not been explicitly stated.

131 https://www.telekom.com/en/media/media-information/archive/fiber-optic-upgrades-530564

132 https://www.telegeography.com/products/globalcomms/data/company-profiles/we/telekom-deutschland/company-overview.html

133 https://www.telegeography.com/products/globalcomms/data/company-profiles/we/telekom-deutschland/company-overview.html

134 Eins has various utility divisions including electricity, natural gas and water (https://www.eins.de/privatkunden/).

135 https://www.telegeography.com/products/globalcomms/data/company-profiles/we/telekom-deutschland/company-overview.html

136 https://www.innogy.com/web/cms/mediablob/en/3875782/data/0/5/Annual-report-2017.pdf

- In December 2017, Telekom Deutschland entered into a 50–50 joint venture with EWE[137], one of the largest energy companies in Germany, to expand its FTTP network to pass more than 1 million households in Lower Saxony, North Rhine-Westphalia and Bremen from mid-2018 onwards[138]. This wholesale arrangement will be available to third-party service providers for commercial use. EWE and TD plan to invest EUR2 billion in this arrangement.

The above partnerships make use of non-telco infrastructure to varying degrees for broadband network deployment and will cover a total of 6–7%[139] of Germany households.

137 EWE has a core energy business and provides electricity, heat and water management services. EWE also has a telecoms branch and has developed a telecoms network over 40 000km in length (https://www.ewe.com/en)

138 https://www.telegeography.com/products/globalcomms/data/company-profiles/we/telekom-deutschland/company-overview.html, https://www.lightreading.com/gigabit/ultra-broadband/dt-seeks-fiber-allies-to-tackle-germanys-gigabit-lag/d/d-id/745412

139 Around 2.8 million premises (premises to be covered through Telekom Deutschland's partnerships) of 41 million premises present in Germany.

C.5 ITS Technology Group in the UK

C.5.1 Summary of key points

A UK operator that is:

- extensively using existing non-telco assets (local authority assets such as CCTV ducts) to deploy its fibre network
- using telco assets for its backbone network.

C.5.2 Brief description of ITS Technology Group

ITS TG is a UK-based telecoms operator that designs, funds, builds and operates full-fibre and fixed wireless access (FWA) networks to serve businesses in both urban and rural areas[140]. ITS TG also provides managed services and hosted telephony solutions to these businesses. ITS TG has more than 1800 connections (SMEs located in business parks).

In terms of network deployment, ITS TG self-builds and also re-uses telco and non-telco infrastructure (i.e. a mix-and-match approach). It has partnered with various local authorities to expand its network, making use of public- and private-sector assets. Key examples of ITS TG using telco and non-telco infrastructure assets include:

- **Nottingham NETwork:** ITS TG signed a 20-year concession agreement with Nottingham City Council in August 2016[141] to connect local businesses. Initially, ITS TG is re-using 17km of the local authority's existing duct infrastructure. It plans to expand the existing duct infrastructure to 100km by building a fibre network (which includes self-build).

- **The Bristol Network (BNet Ultra):** ITS TG and Net Support UK signed an exclusive 20-year concession[142] agreement in October 2015[143] to commercialise an asset owned by Bristol County Council. The joint venture between ITS TG and Net Support UK aims to build, operate and commercialise a 75km[144] duct infrastructure, and has an intention to expand the network to more than 180km (which includes some self-build).

140 https://www.itstechnologygroup.com/about/why-its/

141 https://www.itstechnologygroup.com/our-networks/nottingham-network/

142 https://www.itstechnologygroup.com/our-networks/bristol-network/

143 https://www.ispreview.co.uk/index.php/2015/10/bristol-city-commercialises-its-ultrafast-bnet-fibre-optic-network.html

144 58km of existing duct is not used currently (https://www.itstechnologygroup.com/our-networks/bristol-network/)

- **Hammersmith & Fulham (H&F):** ITS TG signed a 10-year concession contract[145] with H&F Council in February 2014 to access its 17km underground duct network (originally used for a CCTV network) to deploy its fibre network[146].

- **North & Mid Wales network:** ITS TG uses FibreSpeed[147] infrastructure for its backbone network to provide PTP wireless connectivity in the North and Mid Wales regions[148].

The above examples demonstrate that ITS TG uses a mix of self-build and existing telco and non-telco assets (i.e. mix-and-match approach) for long-term investments.

145 http://www.hammersmithtoday.co.uk/shared/hfbroadband001.htm

146 https://www.itstechnologygroup.com/our-networks/hammersmith-fulham/

147 A fibre operator connecting North Wales and now a part of Zayo group (http://www.fibrespeed.co.uk/)

148 https://www.itstechnologygroup.com/our-networks/north-mid-wales/