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# Wholesale Local Access Market Review

## Recovering the costs of investment in network expansion - Annexes

**CONSULTATION:**

Publication Date: 9 August 2017

Closing Date for Responses: 27 September 2017

# Contents

# A1. Responding to this consultation

## How to respond

A1.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. If we do not have enough time to do this, we will hold an open meeting to explain our proposals, shortly after announcing the consultation.

A1.2 Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 27 September 2017.

A1.3 We use this estimate of qualifying premises to determine the network that BT would need to deploy and the costs of that deployment, as discussed in the following sections of this consultation.

A1.4 You can download a response form from https://www.ofcom.org.uk/consultations-and-statements/category-2/wholesale-local-access-market-review-recovering-the-costs-of-investment-in-network-expansion. You can return this by email or post to the address provided in the response form. We also provide a cover sheet https://www.ofcom.org.uk/consultations-and-statements/consultation-response-coversheet) for responses sent by post; please fill this in, as it helps us to maintain your confidentiality, and speeds up our work. You do not need to do this if you respond using the form.

A1.5 If your response is a large file, or has supporting charts, tables or other data, please email it to WLAUniversalBroadband@Ofcom.org.uk, as an attachment in Microsoft Word format, together with the cover sheet (https://www.ofcom.org.uk/consultations-and-statements/consultation-response-coversheet). This email address is for this consultation only, and will not be valid after September 2017.

A1.6 Responses may alternatively be posted to the address below, marked with the title of the consultation:

Jack Gaches
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.7 If you would like to submit your response in an alternative format (e.g. a video or audio file), please contact Jack Gaches on 0207 783 4254, or email jack.gaches@ofcom.org.uk.

A1.8 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt if your response is submitted via the online web form, but not otherwise.

A1.9 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.

A1.10 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex 4. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.

A1.11 If you want to discuss the issues and questions raised in this consultation, please contact Jack Gaches on 0207 783 4254, or email jack.gaches@ofcom.org.uk.

## Confidentiality

A1.12 Consultations are more effective if we publish the responses before the consultation period closes. In particular, this can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish all responses on our website, www.ofcom.org.uk, as soon as we receive them.

A1.13 If you think your response should be kept confidential, please specify which part(s) this applies to, and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.

A1.14 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.15 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further at https://www.ofcom.org.uk/about-ofcom/website/terms-of-use.

## Next steps

A1.16 Following this consultation period, Ofcom plans to publish a statement in early 2018.

A1.17 If you wish, you can register to receive mail updates alerting you to new Ofcom publications; for more details please see https://www.ofcom.org.uk/about-ofcom/latest/email-updates.

## Ofcom's consultation processes

A1.18 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex 2.

A1.19 If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and

residential consumers, who are less likely to give their opinions through a formal consultation.

A1.20 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact Steve Gettings, Ofcom's consultation champion:

Steve Gettings
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
Email: corporationsecretary@ofcom.org.uk

# A2. Ofcom's consultation principles

## Ofcom has seven principles that it follows for every public written consultation:

### Before the consultation

A2.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. If we do not have enough time to do this, we will hold an open meeting to explain our proposals, shortly after announcing the consultation.

### During the consultation

A2.2 We will be clear about whom we are consulting, why, on what questions and for how long.

A2.3 We will make the consultation document as short and simple as possible, with a summary of no more than two pages. We will try to make it as easy as possible for people to give us a written response. If the consultation is complicated, we may provide a short Plain English / Cymraeg Clir guide, to help smaller organisations or individuals who would not otherwise be able to spare the time to share their views.

A2.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.

A2.5 A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.

A2.6 If we are not able to follow any of these seven principles, we will explain why.

### After the consultation

A2.7 We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish all the responses on our website as soon as we receive them. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

# A3. Consultation coversheet

## BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

## CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing ☐

Name/contact details/job title ☐

Whole response ☐

Organisation ☐

Part of the response ☐

If there is no separate annex, which parts? _____

_____

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

## DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here.

Name Signed (if hard copy)

# A4. Consultation questions

**Question 3.1:** Do you agree with our approach to assessing the number of qualifying premises to include in our analysis? Please provide reasons and evidence in support of your views.

**Question 4.1:** Do you agree with our approach to assessing the technologies and technology mix that should be used as the basis for calculating the costs of BT's proposed rollout? Please provide reasons and evidence in support of your views.

**Question 5.1:** Do you agree with our proposed approach to modelling the costs of BT's proposed network expansion? Please provide reasoning for your answer.

**Question 6.1:** Do you agree with our proposal to recover the costs over all broadband lines?

**Question 6.2:** Do you agree with our proposed approach to implementing recovery from all broadband lines?

# A5. Legal Instruments

A5.1 Please see:

https://www.ofcom.org.uk/__data/assets/pdf_file/0024/105684/Annex-5-Draft-Legal-Instruments.pdf

# A6. Volume Impacts

A6.1 In this annex we set out our analysis of the likely impacts of implementing the network expansion associated with BT's proposal for universal broadband on WLA service volumes.

A6.2 The outputs of this analysis inform the take-up assumptions in our bottom-up cost modelling as well as our assessment of the indirect benefits of the forecast network expansion, which is set out in Annex 7.

## Summary

A6.3 We have examined the likely impact of the network expansion on the volumes of copper, fibre and ancillary services in the WLA market during the study period of our bottom-up model.

A6.4 Our analysis indicates that while the additional network deployment appears unlikely to materially change the overall number of broadband lines delivered over the Openreach platform, it is likely to encourage further take-up of SFBB services by lifting the speeds provided by Openreach's GEA services and by expanding the Openreach SFBB network footprint.

A6.5 A faster migration of customers to SFBB means that telecoms providers will reduce their demand for SMPF services. However, consumption of MPF and WLR services is likely to remain unaltered, as we expect telecom providers to continue to use these services in the near future to provide voice services alongside broadband, and to provide line testing capabilities.[1]

A6.6 The remainder of this annex is organised as follows:

- we first analyse the impact of the network expansion on copper volumes, including MPF, WLR and SMPF;
- we then go on to examine the impact on GEA volumes; and
- finally, we assess the impact on ancillary services.

## Impact on copper volumes

### MPF and WLR volumes

A6.7 The proposed network expansion could impact the level of MPF and WLR volumes if, as a result:

[1] We note the potential launch of Single Order GEA (SOGEA) which is a variant of the GEA-FTTC service but without the need for WLR or MPF. In the March 2017 WLA consultation we noted that in cases where the copper bearer is provided through SOGEA, we would expect the charge controlled MPF product to be a reasonable reflection of the costs associated with providing the bearer, suggesting that a testable copper line will have the same cost as MPF. On this basis, we would not include a reduced volume of MPF as SOGEA take-up increases.

- telecoms providers change the MPF/WLR mix they use to provide voice and broadband services; and/or
- landline-only and/or mobile-only customers start taking up fixed broadband in higher volumes than projected in the March 2017 WLA charge control models.

## No material impact on the MPF/WLR mix

A6.8 As discussed in Section 4, if LR-VDSL is used to deploy the network expansion, copper-based broadband services (using MPF or SMPF) would no longer be available to customers connected to PCP cabinets where LR-VDSL is implemented. To avoid disrupting services, existing copper based broadband customers in these cabinets would need to be migrated to GEA.

A6.9 There may be the concern that implementing LR-VDSL could make continuing with MPF uneconomic. However, we note that, while telecom providers would no longer be able to use SMPF in LR-VDSL cabinets, they could still use MPF to deliver voice, while supplying broadband using GEA.

A6.10 In the March 2017 WLA consultation we proposed requirements BT should meet to request a change in its LLU obligations and deploy LR-VDSL.[2] This included the provision of suitable replacement products to ensure no customer is made worse off due to the migration to GEA. These products should provide the same broadband speed as before and at no additional cost to the affected LLU provider.

A6.11 On this basis, we do not expect a change in costs or revenues from continuing to use MPF for voice and the replacement broadband service on LR-VDSL. We expect the same outcome to occur if LR-VDSL is not used given that the economics of using MPF would remain unchanged. Therefore, in our view, telecoms providers will not alter the MPF/WLR mix they use to provide voice and broadband services as a consequence of the proposed network expansion.

## No material impact on the overall level of Openreach broadband lines

A6.12 For the proposed network expansion to impact the total number of Openreach broadband lines we would need evidence to suggest that BT's proposed network expansion would lead to more voice-only and mobile-only customers taking-up fixed broadband. This could be true if these customers have so far opted to not buy fixed broadband because of poor performance levels in the fixed network. This hypothesis can be tested by looking at the factors that determine the choice of voice-only and mobile-only customers to not acquire fixed broadband.

[2] See March 2017 WLA Market Review – Volume 1, 2017, paragraph 6.26 https://www.ofcom.org.uk/__data/assets/pdf_file/0033/99636/Vol1-Market-review.pdf.

A6.13 As of 2015/16, around 20% of Openreach's lines were voice-only customers, albeit we expect this proportion to decline to 12% by the end of the charge control.[3] When examining the reasons for why voice-only customers do not purchase fixed broadband, survey evidence suggests that 30% of these customers have no use or need for fixed-broadband services.[4] This was reported highest among consumers over 65 (41%) when compared to other age groups, explaining why elderly consumers account for a significant proportion (54%) of voice-only customers. This is also a consumer group that is likely to make up a larger proportion of the population in areas with premises that qualify for BT's proposed network expansion relative to the rest of the UK.[5]

A6.14 Other reasons include high prices (19%) and the use of mobile broadband as a substitute (3%). The latter group of consumers may wish to switch to fixed broadband but this is unlikely if their preference for mobile broadband is due to factors such as greater convenience and/or affordability reasons.

A6.15 In terms of mobile-only households, Ofcom market research suggests that around 10% of UK households are mobile-only.[6] We have not seen any evidence to indicate that such households choose mobile over fixed broadband services to access higher speeds or overcome quality related issues. In fact, we would expect broadband performance in the fixed and mobile networks to be highly correlated and experience similar issues in areas likely to be targeted by BT's network expansion proposals, which tend to be more sparsely populated. It may be that other reasons such as convenience or affordability could explain why customers take out mobile broadband.

A6.16 In summary, we do not expect a material number of voice-only and mobile-only customers to start purchasing fixed broadband because of the proposed network expansion. Firstly, households without broadband services account for a small proportion of the total number of UK households (between 10%-20%). Also, market research suggests that a lack of direct need and affordability are more likely to explain why these customers do not take up fixed broadband, rather than dissatisfaction over low speeds.[7]

## SMPF volumes

A6.17 As explained above, existing MPF and SMPF based broadband customers will need to be migrated to GEA in cabinets where Openreach chooses to deploy LR-VDSL. In these

[3] See Volumes module of our March 2017 charge control model. And https://www.ofcom.org.uk/__data/assets/pdf_file/0030/97806/Consultation-Review-of-the-market-for-standalone-landline-telephone-services.pdf.

[4] Jigsaw residential survey 2015, FX04C: Which of these statements best describes the main reason why you do not take up a bundle of services from your landline supplier that includes broadband? Base: all who do not receive broadband as part of their landline package (n=482).

[5] Findings from Experian's socio-economic analysis based on Ofcom's 2015 Connected Nations data suggest that consumers living in premises with speeds lower than 10 Mbit/s are more likely to be older – 38% of consumers in these premises are aged 65 and over compared to 27% of the UK population as a whole.

[6] Ofcom, Technology Tracker, 2015/16.

[7] Jigsaw residential survey 2015, FX04C: Which of these statements best describes the main reason why you do not take up a bundle of services from your landline supplier that includes broadband? Base: all who do not receive broadband as part of their landline package (n=482).

cabinets, SMPF services can no longer be provided, so to the extent that Openreach uses LR-VDSL, we would expect to observe a decline in SMPF volumes over and above the decline we are already forecasting. This is not the case in our base case scenario which assumes no use of LR-VDSL.

A6.18 As mentioned above, in our March 2017 WLA consultation we set out proposals that no customer should be made worse off because of the implementation of LR-VDSL and that BT should supply a replacement product at no additional cost. Therefore, although a network expansion would reduce SMPF volumes in places where BT chooses to rollout LR-VDSL, BT will be able to continue deriving the same revenue (it currently does from SMPF) through the provision of the replacement product.

A6.19 We have therefore not made any adjustments to the SMPF volumes forecasted in our March 2017 WLA consultation.

## Impact on GEA volumes

A6.20 BT's commitment could impact GEA service volumes, by:

- forcing copper to fibre migration in cabinets where LR-VDSL is implemented; and
- encouraging further SFBB take-up due to higher speeds offered (over and above those of SBB) and/or an extended SFBB network coverage.

A6.21 As explained above, copper-based broadband customers will need to be migrated to GEA services in cabinets upgraded to LR-VDSL. As a result of this, we said that we would expect lower SMPF volumes but that we would not adjust our SMPF volume forecasts in the WLA Volumes model due to BT having to offer a replacement product at no additional cost. Consistent with this, we have not taken these replacement products as incremental GEA volumes, and we have therefore not included them in the Network Expansion Cost module.

A6.22 We recognise that, by not providing the SMPF service, BT will save costs. However, by not including the GEA replacement volumes in the Network Expansion model, the incremental costs associated with these volumes in relation to cumulo, extra faults and SLGs (which are volume sensitive) would not be accounted for in the additional cost (note that the incremental costs associated with migration costs and the extra VDSL network components required to serve SBB migrated customers have been included in the Network Expansion model – see Annex 10). We believe that the difference between the cost savings BT would get by not providing the SMPF service and the volume related costs of supplying the GEA replacement product is not material in size. We have not therefore included the GEA replacement product volumes in the Network Expansion model.

## Higher SFBB take-up

A6.23 In the March 2017 WLA Consultation we estimated the number of SFBB customers by forecasting the total number of Openreach broadband lines and then determining what proportion of them are SFBB customers.

A6.24 As mentioned in paragraphs A6.11 to A6.15, we do not expect the total number of Openreach broadband lines to change as a result of the network expansion. However, we believe the network expansion will encourage higher take-up of SFBB amongst existing broadband customers but will vary depending on whether these customers live in areas already served by a SFBB network (SFBB areas) or in areas where SFBB services are still unavailable (Non-SFBB areas).

### Non-SFBB areas

A6.25 In some areas, network expansion will have the effect of extending BT's fibre access network. To inform the level of take-up of GEA services in these areas we have looked at our take-up forecasts in the March 2017 WLACC model. These forecasts suggest that take-up of GEA services by UK households is likely to reach 75% by 2028/29.

A6.26 We believe that similar take-up rates, if not higher, could be achieved in remaining non-SFBB areas. Evidence from BDUK rollout suggests that take-up of SFBB services in rural areas has been as high or higher than observed in urban areas, in some places exceeding 40% as of March 2017 (compared to national average of around 25%).[8] This could be partly explained by poorer performance of SBB services in more sparsely populated areas and the weaker presence of competing networks in these areas, making Openreach's GEA products more attractive. We have therefore assumed a long-term GEA take-up of 80% in remaining non-SFBB areas.

A6.27 We have also assumed that such long-term take up will be achieved over an 8-year period from when the premises are passed by the new network. In the March 2017 WLA consultation, we estimated that GEA take-up in BDUK/subsidised areas would broadly match the national average by 2021, which is 8 years from the time when take-up of GEA services started to pick up in these areas.[9] We believe a similar period would be needed for GEA take-up in remaining non-SFBB areas to reach steady-state levels.

A6.28 To project take-up for the years over the 8-year period from deployment to long-term penetration, we have assumed that GEA take-up will grow to the 80% mark on a linear basis. We recognise that take-up may not grow linearly in the real-world, but we believe a linear trend will provide a reasonable approximation of the incremental GEA take-up over the years of the charge control period while keeping the modelling relatively simple.

### SFBB areas

A6.29 In areas where SFBB is already available, the impact of the network expansion will be seen through higher speeds offered by SFBB services rather than from extending BT's fibre access network. Therefore, if speed is one of the factors that determines why SBB customers do not currently buy SFBB, we would expect the network expansion to encourage higher SFBB take-up.

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[8] BDUK Local Body Information Spreadsheet, https://docs.google.com/spreadsheets/d/1Hs00bNsyRV1WoOt-fow3rsNXzpcKg26AsOWvk1bvJRk/edit#gid=0.

[9] March 2017 WLA Consultation, Annex 10, Figure A10.10.

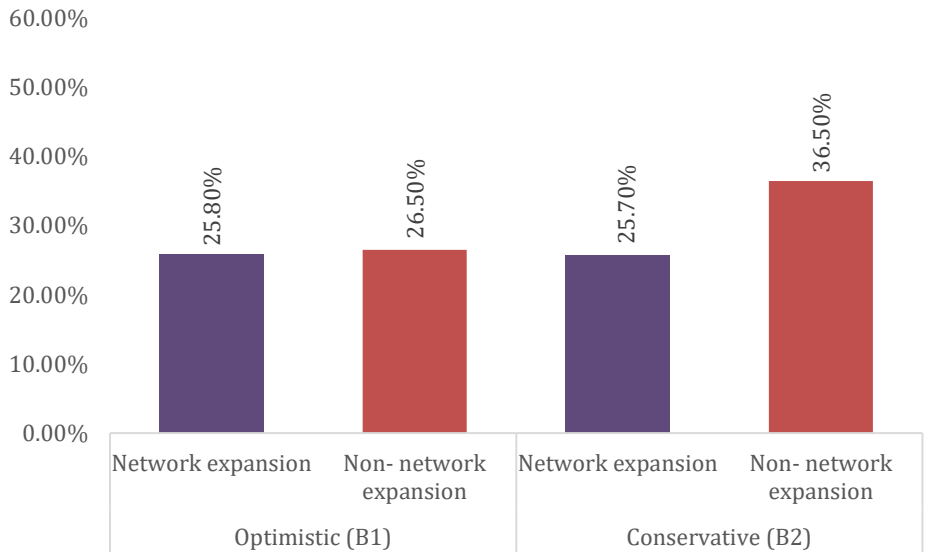
A6.30 To inform the extent to which broadband customers in these areas may increase their take up of SFBB, over and above that projected in the 2017 March WLA Charge Controls model, we have compared the current take-up of SFBB between two different sub-areas:

a) cabinet areas where all premises have access to a minimum of a broadband service capable of 10 Mbit/s download and 1 Mbit/s upload, excluding Virgin Media's footprint (non-network expansion areas); and

b) cabinet areas where at least one or more premises do not have access to a minimum broadband service capable of 10 Mbit/s download and 1 Mbit/s upload (network expansion areas).

A6.31 Based on the 2016 Connected Nations data, our analysis suggests that the take-up gap between these areas ranges from 0.5% to 11% depending on the selected scenario (whether the conservative or optimistic scenario for the number of qualifying premises – see Section 3). This is illustrated in Figure A6.1 below.

**Figure A6.1: SFBB take-up in network expansion and non-network expansion areas**




Source: Ofcom

A6.32 The difference between the optimistic (B1) and conservative (B2) scenarios lies in that the optimistic scenario assumes the fastest speed that at least 20% of broadband customers can achieve, while the conservative scenario assumes the fastest speed achieved by a wider customer base of 80%. Therefore, the conservative scenario is likely to lead to a lower performance as it looks to a broader portion of the speed distribution, resulting in a higher number of qualifying premises. This means that when assuming the conservative scenario the non-network expansion areas attract fewer premises which are likely to receive poorer performance, explaining why we might observe a higher gap in the SFBB take-up across network expansion and non-network expansion areas, relative to the optimistic scenario.

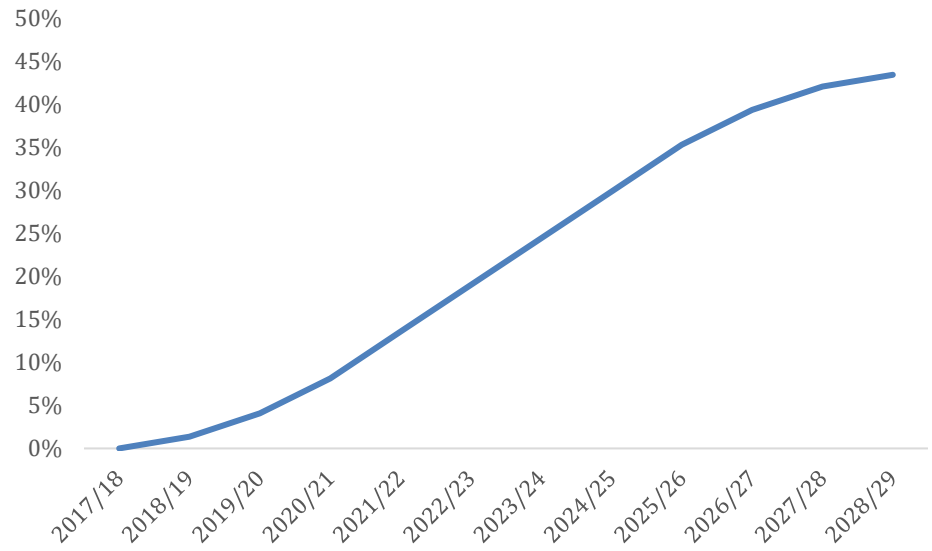
A6.33 However, such take-up gap may not necessarily reflect differences in service quality. Timing of rollout may also be a factor, as SFBB services could have been made available later in network expansion areas than in non-network expansion areas.[10] Evidence from BDUK data does show timing of rollout matters. While average take-up in BDUK Phase 1 was 37% as of March 2017, in BDUK Phase 2 this was 20%.

A6.34 Furthermore, where BT chooses to deploy LR-VDSL, network expansion could have the opposite effect of suppressing demand for SFBB if customers migrated to GEA would be less incentivised to switch to SFBB given the enhanced speeds offered by the replacement product supplied at no additional cost.

A6.35 Based on the above we believe the evidence is not strong enough to support the case for the network expansion driving incremental GEA volumes in SFBB areas, over and above those projected in the March 2017 WLA consultation. In particular, take-up data at the cabinet level does not suggest a SFBB take-up gap exists between network expansion and non-network expansion areas because of differences in the speeds offered. On this basis, we have assumed no incremental GEA volumes, over and above that projected in the March 2017 WLA model, in SFBB areas.

A6.36 Our estimated incremental GEA take-up for the proposed network expansion is illustrated in Figure A6.2 below for each year over the study period.

**Figure A6.2: Incremental GEA take-up as a proportion of homes passed**




## Impact on GEA bandwidth mix

A6.37 In the March 2017 WLA Charge Controls model we have used our projection of the split of GEA volumes by bandwidth to allocate common costs across GEA products over the charge control period.

[10] Our analysis suggests network expansion areas tend to be less densely populated areas, and hence areas which were likely to be passed by a SFBB network later than more densely populated ones.

A6.38 There are two factors which could impact the split of GEA volumes by bandwidth in connection to the network expansion:

- the type of GEA products taken-up by new SFBB customers within the network expansion footprint; and
- the possibility of existing SFBB customers trading up to higher speed services as a result of the network expansion.

A6.39 We have assessed these factors by distinguishing the impact that the network expansion may have on GEA volumes in SFBB areas and non-SFBB areas.

Impact in non-SFBB areas

A6.40 In these areas we expect take-up of SFBB will follow a similar pattern as observed across the whole of the UK in terms of the split of GEA volumes by bandwidth. We believe this assumption is reasonable given that SFBB take-up in subsidised areas has been similar to that observed in commercial areas, so there is no reason to believe that the bandwidth mix should be any different in remaining non-SFBB areas.

A6.41 Therefore, for each year of the modelling period we have distributed additional GEA volumes based on the split of GEA volumes by bandwidth estimated in the WLACC model for the commercial and BDUK deployments.

Impact in SFBB areas

A6.42 We expect customers currently buying SBB in areas already served by SFBB to be less prepared to pay for SFBB when compared to existing SFBB customers, as suggested by their current choice of not buying SFBB.

A6.43 Therefore, it seems reasonable to assume that if these customers upgrade to SFBB they would more likely take lower-speed products such as 40/2, 40/10 and 55/10, than higher speed ones like 80/20. For simplicity, we have assumed that new GEA customers in these areas will take up the 40/10 product. This assumption seems reasonable given that in our March 2017 WLA consultation we projected that SFBB customers would mainly take 40/10 services over the charge control period.

A6.44 For existing SFBB customers, we have examined whether network expansion could lead to some of these customers switching to alternative broadband products. For example, GEA 40/10 customers may decide to trade-up to the GEA 80/20 product after the network expansion is completed.

A6.45 In our view, existing SFBB customers will only be encouraged to trade-up to higher-speed services if the performance offered by these services (relative to lower speed services) improves in a material way because of the network expansion. We would not expect existing SFBB consumers to change their current consumption if the implementation of the network expansion led to the speeds of all SFBB products increasing in the same proportion.

A6.46 LR-VDSL is a nascent technology that BT is still trialling. BT's initial trials indicate that the impact of LR-VDSL on speeds could be variable, ranging from 0.1 Mb/s to 22 Mb/s.[11] In addition, these trials suggest the speed uplift is independent of the speed initially provided. On this basis, we would not expect this technology to improve the performance of higher speed FTTC services relative to lower speed FTTC services in a way that might encourage this type of switching.

A6.47 By contrast, the use of technologies such as FTTP and G.Fast may expand the product offering available to existing SFBB customers by allowing them to access UFBB services. However, we do not expect material switching from SFBB to UFBB to occur in this case, or at least not over the charge control period. UFBB services are still a nascent service in the UK, with highly uncertain demand.

A6.48 We have also considered the possibility of existing SFBB customers downgrading to lower speed SFBB services which will offer an enhanced performance due to the network expansion. We believe this scenario is unlikely to happen given that broadband customers rarely choose to revert back to lower speeds[12], and the fact that network expansion will lift the speeds of both lower- and higher- speed services makes this scenario even less likely.

A6.49 Based on the above, we do not anticipate that existing SFBB customers would trade their existing service up or down in a material way as a result of the proposed network expansion. Therefore, we have assumed no changes to the bandwidth mix forecasted in the 2017 March consultation in connection to existing SFBB customers.

## Impact on ancillary services

A6.50 To estimate the impact of the network expansion on ancillary services, we have taken a similar approach to the one taken in our March 2017 WLA consultation. There, we estimated ancillary volumes as a proportion of the total number of rentals, except for connections which were calculated by summing the change in the number of rentals in a given year, with respect to the previous year, and ceases in the given year.

A6.51 We have estimated volume impacts for the following ancillary services:

- GEA connections (including Engineer installs, PCP only and Start of Stopped lines);
- Bandwidth changes;
- CP to CP migrations; and
- Ceases.

[11] Openreach, May 2017, "LR-VDSL GEA-FTTC Delivering faster broadband to more customers", Industry consultation, page 4, http://www.fcs.org.uk/image_upload/files/CustomerConsultationLongReachVDSL.pdf

[12] Consumer research conducted as part of the WLA market review found that amongst broadband customers who had switched, 20% switched to faster BB services and only 2% switched to lower speed services (see WLA market review – Residential Broadband Research. 10th November 2015, https://www.ofcom.org.uk/__data/assets/pdf_file/0031/99643/Broadband-residential-research.pdf). In addition, evidence from telecom providers suggests that downgrades account for on average, less than 0.5% of SFBB consumers (see WLA market review – Quarterly telecom provider upgrades and downgrades, July to September 2015. BT, EE, Sky and TalkTalk responses to s135 requests).

A6.52 We have calculated these volume impacts by applying similar proportions as in the March 2017 WLA Volumes module. The only exception being ceases, for which we use the long-term cease rate (of 8%) assumed in the WLA volumes module, which we believe is more consistent with the churn rate we would expect in the network expansion areas where Openreach is less likely to face competition from alternative networks – the only ceases happening because of customers switching back to copper or because of them ceasing their line all together (e.g. to become a mobile-only customer).

A6.53 These volume forecasts are implemented in the Volumes module of the model.

# A7. Indirect Benefits

A7.1 In Annex 6 we identified the service volume impacts from the proposed network expansion on the WLA market. In this annex we assess whether Openreach could derive incremental revenues from these service volume impacts. We also examine whether there could be other benefits for Openreach from expanding its network, including copper recovery and brand-related benefits. We go on to outline the size of the indirect benefits that we propose to offset against the cost of the network expansion.

## Introduction

A7.2 In Section 5 we set out our approach for modelling the costs of the proposed network expansion. We said that when assessing these costs we would look at the net cost of delivering the network expansion, taking into account any incremental benefits Openreach may realise in excess of the costs of deploying and operating the expanded network.

A7.3 We identified the impacts of network expansion on Openreach's GEA volumes, including copper to fibre forced migration in LR-VDSL cabinets and higher SFBB take-up. In this annex we assess whether these volume impacts may result in incremental revenues for Openreach, over and above our proposed surcharge on broadband line rental charges.

A7.4 The remainder of this annex is structured as follows:

- we first assess the incremental benefits from higher GEA volumes, including migrations and higher SFBB take-up; and
- we then go on to examine whether there are any wider incremental benefits that we should take account for in our analysis.

## Incremental benefits from higher GEA volumes

### Migration in LR-VDSL cabinets

A7.5 In Annex 6 we explained that all SBB customers connected to cabinets that are to be upgraded to LR-VDSL would need to be migrated to BT's GEA network in order to avoid their services from being disrupted.

A7.6 In these instances, in line with our March proposals, we expect that Openreach would be required to provide a replacement GEA product to these customers at no additional cost to them.[13] Consequently, we do not expect Openreach to derive any incremental revenue from this group of customers.

### Higher SFBB take-up

A7.7 In Annex 6 we also identified that a number of SBB customers are likely to take-up SFBB as a result of the network expansion. Where this take-up materialises, Openreach will

[13] We expect that these replacement GEA services will provide similar speeds to a SBB service.

generate additional revenue from delivering GEA rental volumes in excess of those anticipated in the March 2017 WLA consultation.

A7.8 In this scenario Openreach would generate two separate revenue streams in connection with its network expansion: i) any additional cost included in the charge control to recover the costs of the proposed network expansion charge and ii) the GEA rental charge. Given that we are proposing to allow BT to recover its efficiently incurred costs associated with its proposed network expansion through the additional cost, any additional GEA rental revenue would represent pure profit for Openreach.

A7.9 There are two ways we could deal with this incremental GEA rental revenue. One option is to adjust our GEA volume forecasts in our WLA Volumes module to account for the additional volumes. This would allow us to capture any economies of scale effects that may derive from having higher GEA volumes, in the form of a lower GEA rental charge. We refer to this option as the economies of scale effects approach.

A7.10 This approach, however, would give rise to consistency issues between our network expansion cost modelling and our WLA cost modelling. This is because while the proposed network expansion looks at a deployment across the whole of the UK, the WLA cost model looks at a commercial-only deployment. Therefore, the WLA model would not be able to capture any incremental volumes coming from non-commercial areas within the network expansion footprint, as they would fall outside the scope of the model.

A7.11 An alternative method would be to deduct any incremental GEA rental revenue from the estimated network expansion costs. We refer to this method as the net cost approach.

A7.12 We believe the net cost approach would be a more appropriate approach in this case since it would allow us to keep two distinct cost modelling exercises separate, making the effects of each model transparent to everyone. It would also give us the flexibility to more easily remove the costs of the proposed network expansion from our wider charge control review if Government and BT did not ultimately agree to commit BT to undertake the proposed network expansion. On this basis, we propose to use a net cost approach to capture any incremental GEA rental revenue arising from BT's proposed network expansion.

## GEA unit price

A7.13 To estimate any incremental GEA revenue we need to determine what unit price to apply for each additional volume. We propose to use the following unit prices:

- For GEA 40/10 volumes, we propose to apply the unit price determined in our WLACC model.
- For GEA services other than 40/10, we propose to assume the bandwidth gradient observed in BT's current pricing and apply it to the GEA 40/10 price. This would be consistent with the approach we have taken to allocate common costs across GEA services in the March 2017 WLA Consultation.

A7.14 Our forecast of incremental rental revenue by GEA service is presented in Table A7.1 below for each year of the charge control period. It shows that we expect incremental revenues in the order of £1m in 2018/19, £2m in 2019/20 and £4m in 2020/21. These represent around 10% of our modelled CCA costs over the same time period.

**Table A7.1: Incremental GEA revenue in non-SFBB areas (£m)**

| | 2018/19 | 2019/20 | 2020/21 |
|---|---|---|---|
| Incremental GEA revenue forecast | 0.99 | 2.29 | 4.02 |

## Other indirect benefits

### Copper recovery

A7.15 In addition to the higher GEA rental revenues, network expansion may produce additional benefits to Openreach.

A7.16 One potential additional source of revenue is copper recovery. Expanding the network entails extending BT's fibre network closer to the premises, which means that some copper in the network may be left redundant and thus could be recovered and sold by Openreach at the prevailing market price.

A7.17 However, we do not expect Openreach will be able to extract additional revenue from copper recovery, over and above that projected in our March 2017 WLA consultation, given that:

- we have already assessed and outlined how we propose to capture the impact of e-side copper recovery in our March proposals[14];
- BT and other telecoms providers are likely to continue using copper lines to deliver voice, meaning that e-side copper is unlikely to be removed for the time being; and
- we do not anticipate further copper recovery in the D-side network to be profitable for Openreach, at least in the short to medium term.[15]

### Branding benefits

A7.18 An alternative source of revenue could be branding-related benefits. In the context of determining the net cost of a USO, regulators typically identify intangible revenues in connection with becoming the designated universal service provider. For example, a USO provider could enjoy higher brand awareness amongst consumers due to the advertising it may receive from being the universal service provider.

A7.19 These branding benefits however are unlikely to arise in this case as there will be no designation of USO provider. Instead BT is committing to voluntarily expand its network in order to meet the universal broadband service specification, while providing the associated

[14] See Annex 18 of our March 2017 WLA consultation.
[15] See paragraph A18.10 of our March 2017 WLA consultation.

services at the wholesale level to all interested telecoms providers. As a result we would not expect BT to receive the ongoing publicity that a USO provider would receive.

A7.20 Therefore, we have assumed no further benefits for BT from its proposed network expansion other than the incremental GEA rental revenue.

# A8. Model cross-checks, results and sensitivities

A8.1 In this annex we explain how we have validated our modelling by performing cross-checks against BT data. We also present:

- the base case results of our bottom-up model which calculates the cost of the network expansion;
- the additional cost to add to each Openreach broadband line;
- the sensitivity of our model to changes in key inputs; and
- how we have derived the ranges of results on which we are consulting.

## Cross-checks

A8.2 As set out in Section 5 we have checked the reasonableness of the inputs and outputs of our model. To do this we have compared intermediate outputs of our model against the amount of capex BT estimates it will require to meet its proposed network expansion.

A8.3 We have first sense checked BT's numbers against the capex forecasts included in our advice to the Government on a potential broadband USO and find BT's estimates are broadly in line with the figures in the USO Report, suggesting at a high level they are reasonable.

A8.4 We have then used BT's data to check the outputs of our model. Once we have removed costs to reflect the reduced number of premises in our forecast compared to the number of premises used in our geospatial analysis (as explained in Section 5), we find that the costs forecast in our model are low compared to the figures derived from the USO Report and BT's data. Having investigated these discrepancies, we consider we should make several changes to our cost modelling. We have made the following adjustments:

- Adjusted the technology mix to account for a more intensive use of fixed network technologies relative to FWA; and
- Increased certain costs to reflect the higher costs in more remote (harder to reach) areas where we expect most qualifying premises to be located. These include changes to duct and pole costs, fibre costs, planning costs and power supply costs.

A8.5 These adjustments are explained in turn below.

### Key adjustments to bottom-up model

Changes to account for forecasts and technology mix

A8.6 As explained in Section 4, Cartesian determined the optimal technology mix for the proposed network expansion based on the Connected Nations 2016 data. This analysis identified c.2.4m qualifying premises, while our top-down forecast for 2021 suggests there will be 785k qualifying premises (the final 3%). We believe that the technology mix is likely

to differ for the last 785k premises, compared to the initial 2.4m considered by Cartesian, as the last 785k are likely to be harder and costlier to reach.

A8.7 In Section 5 we explained that we took account of this by removing FTTC/LR-VDSL premises first, and then G.Fast/FTTP premises if the previous were not enough to reach the 785k final figure. This was based on the assumption that G.Fast/FTTP technologies were more likely to be used for the last 3% of the country.

A8.8 The technology mix assumed by BT to serve 750k premises seems to support this , as it assumes less use of VDSL and more use of FTTP than suggested by Cartesian's geospatial analysis of the 2.4m premises.

A8.9 Where the number of premises to be removed is greater than the number of premises served by FTTC, we have taken the view that a complete removal of FTTC would be unrealistic. We have therefore removed all but a small proportion of FTTC lines and then removed the remainder from G.Fast/FTTP premises.

A8.10 We have implemented these adjustments by reducing our modelled CCA costs for each technology. We expect the premises to be removed to be the least expensive to rollout. This is because these are the premises we are forecasting will be covered by additional commercial or BDUK funding and we expect these rollouts will be focused towards premises with the lowest cost of deployment. Therefore, we have not reduced costs by the same factor as the reduction in premises. Instead we have reduced our CCA costs by a lower proportion than the reduction in premises by multiplying the reduction in premises by a high cost factor. For example, if we remove 50% of FTTC premises we would reduce costs by, say 40%, in which case the high-cost factor would be of 20%.

A8.11 It is very likely that such high-cost factor varies by technology. This is because we would expect the costs for G.fast/FTTP to be proportionately higher than for FTTC in order to serve the last 3%, where the distance between the premises and the exchange are longest. As such, we have assumed a high-cost factor of 10% for FTTC, 20% for G.fast and 50% for FTTP.

A8.12 These adjustments are implemented in lines 41 to 92 of the 'Adjustments' worksheet in the Cost Recovery module.

A8.13 In addition, compared to the results of our base case scenario (No use of LR-VDSL), BT proposes to use less fixed wireless and satellite and to cover 99% of premises using fixed network technologies.

A8.14 We believe such a discrepancy could be driven by our less detailed assumptions around wireless technologies, for which Cartesian has done a less granular modelling compared to fixed technologies. In any case, BT's proposed commitment is to use fixed network expansion to reach 99% coverage, with FWA limited to the final 1%. This means that some of the premises that our model counts as being served by FWA will, in fact, be served by fixed technologies. We have assumed that these premises are most likely to be served by FTTP (as we would not expect FWA to be more cost effective than using cabinet based technologies where these are technically able to provide the service). Therefore, we have

applied an uplift to our modelled FTTP related CCA costs, so as to mimic the effect of replacing FWA with FTTP for these premises. This adjustment is implemented in lines 68 to 89 of the 'Adjustments' worksheet in the Cost Recovery module.

## Duct and pole costs

A8.15 When estimating the costs of the proposed network expansion in our model, we assume that a proportion of existing duct and pole infrastructure is reused. This proportion varies from 65% to 80% depending on the network segment (whether it is segment 2 or 3 as defined in the Cartesian Report at Annex 10). We believe this reuse factor may be too optimistic for reaching the last 3% of the country, particularly for the segments of the network closer to the premises.

A8.16 We have adjusted this factor to bring the duct and pole costs per premises estimated by our model more in line with BT's estimates. This means that the reuse factor implied in our model is now 30% for segment 2 and 50% to 80% for segment 3, depending on the technology used (i.e. 50% for FTTP and 80% for G.fast and FTTC). We have assumed a lower reuse factor for segment 2 as we would expect existing ducts to have a poorer condition when closer to the premises, hence increasing the likelihood of BT having to carry out repair work and/or build new duct. For segment 3 we have assumed a lower reuse factor for FTTP, relative to G.fast/FTTC, as this segment of the network captures a portion of D-side network in the case of FTTP (as going from the last premises in the FTTP cluster up to the exchange), while not for G.fast/FTTC which goes from the cabinet/node to the exchange.

A8.17 These adjustments translate into a higher average unit capex per metre of duct, which are included in the 'Input_ElementCosts' worksheet of the Network Cost module.[16]

## Other adjustments

A8.18 We have made additional adjustments to the unit capex assumptions we took from our WLA bottom-up model (which models a commercial FTTC deployment), to take into account the higher installation costs we expect BT will face in more rural and remote areas, where we expect most qualifying premises to be located. These adjustments are:

- increasing the unit capex for deploying fibre from £2 to £3 per metre, consistent with the cost assumption used in our USO Report;
- adding an extra ✂ to the power supply to the FTTC cabinet and applying a 25% uplift to FTTC planning costs as per the assumptions in BT's Chief Engineer's Model for BDUK and SEP areas.

[16] https://www.ofcom.org.uk/__data/assets/excel_doc/0021/105681/Volumes.xlsm
https://www.ofcom.org.uk/__data/assets/excel_doc/0020/105680/Network-Costs.xlsx
https://www.ofcom.org.uk/__data/assets/excel_doc/0028/105679/Cost-Recovery-Model.xlsm

# Model results and sensitivities

## Model results for the base case

A8.19 Our base case additional cost per broadband line over the charge control period is presented in Table A8.1 below. This assumes:

- No use of LR-VDSL;
- 785k qualifying premises by 2020/21;
- The adjustments discussed above;
- 4-year rollout period;
- Openreach access line WACC of 8%; and
- Cost recovery over all broadband lines.

**Table A8.1: Base case model results - Unit cost (£ per annum, nominal)**

| | 2018/19 | 2019/20 | 2020/21 |
|---|---|---|---|
| **Additional cost for network expansion** | 0.39 | 1.19 | 1.93 |

*Source: Outputs from the Cost Recovery module*

## Comparison to BT's capex estimates

A8.20 BT provided information on the total capex it expects to incur in order to meet its proposed network expansion. This information was supplied by network component and for two scenarios, one with low use of LR-VDSL and another with no use of LR-VDSL.[17] For our base case we have taken the case without LR-VDSL.

A8.21 BT's capex forecast for this case is ✂ with final drop and ✂ without final drop. By comparison, our capex when the adjustments discussed above are included is £546m, which only includes the portion of the final drop capex that we expect BT will incur over the 4-year rollout period.

A8.22 Whilst BT's capex figures imply that the costs of installing some final drop assets (though not the costs of providing the connection to the customer, including CPE, etc.) are incurred as the network gets deployed, in our model we assume these investments are made only as customers take-up the service. Taking this into account, we consider that the capex figure produced by our model (£535m, excluding final drop) aligns reasonably closely to BT's view on costs ✂.

Figure A8.1 below sets out a comparison of the resulting modelled capex by technology and BT's capex estimates.

**Figure A8.1: Estimated capex with no use of LR-VDSL, including final drop (£m, nominal)**

✂

[17] BT response to formal information request 4 August 2017.

✂

*Source: BT response to formal information request 4 August 2017, Ofcom*

## Sensitivity analysis

A8.23 We have performed a sensitivity analysis on our estimated additional cost for Openreach broadband prices in 2020/21 caused by the network expansion by flexing several key model inputs in relation to:

- geospatial analysis: network expansion specification scenario and technology set (as described in Annex 10);
- volumes: incremental take-up (as described in Annex 6)
- network deployment: network rollout (as described in Section 5);
- network costs: WACC and element unit costs (as described in Section 5 and Annex 10); and
- indirect benefits: unit revenue (as described in Annex 7).

A8.24 The sensitivities we have tested are summarised in the table below.

**Table A8.2: Model sensitivities**

| Assumption | | Low | Base case | High |
|---|---|---|---|---|
| **Geospatial analysis** | Technology | LR-VDSL OFF | | LR-VDSL ON |
| **Demand** | Incremental GEA take-up | -20% on base case | Base case (see Annex 6) | +20% on base case |
| **Network deployment** | Speed of rollout | 5-year | 4-year | 3-year |
| **Network costs** | WACC | Openreach access line WACC of 8% | | Other UK Telecoms WACC of 9.4% |
| | Unit capex | -20% on base case | Base case (see Network Cost module) | +20% on base case |
| | Unit opex | | | |
| **Cost recovery** | BB lines growth | BB: 1%<br>SFBB: 7% | BB: 2%<br>SFBB: 8% | BB: 3%<br>SFBB: 9% |
| | Incremental revenue | -20% on base case | Base case (see Annex 7) | +20% on base case |

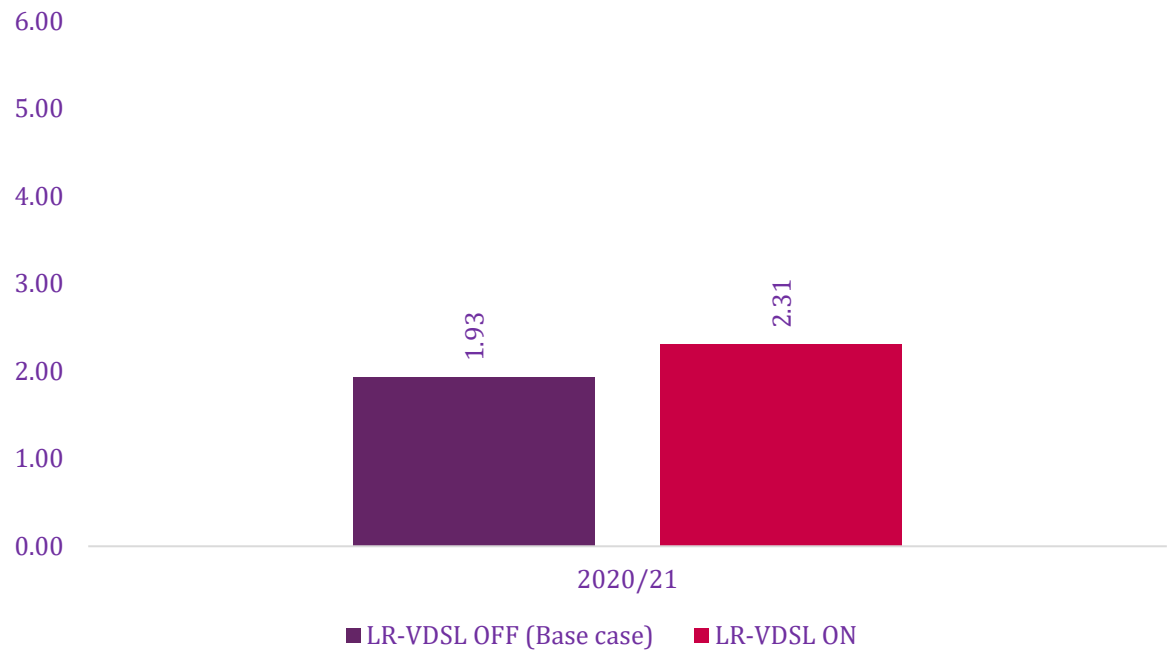
*Source: Ofcom analysis*

A8.25 We show the results for each of these sensitivities in a series of graphs below and discuss each in turn. In each case, we present the base case forecasted additional cost in the middle, and the low case to the left and the high case to the right of it (except for the two cases where we compare our base case against a single alternative scenario).

## Inputs from geospatial analysis

A8.26 Figure A8.2 shows the sensitivity of the additional cost to inclusion and exclusion of LR-VDSL in the technology mix. Note that the additional cost is higher when LR-VDSL is included. This can be explained by two main factors. First, LR-VDSL assets tend to be shorter lived than the assets of other technologies, resulting in higher CCA costs and thus in a higher additional cost. Second, migration costs associated with moving customers onto fibre services at LR-VDSL cabinets are incurred and recovered over the charge control period.

**Figure A8.2: LR-VDSL sensitivity – additional cost in 2020/21 (£/year, nominal)**



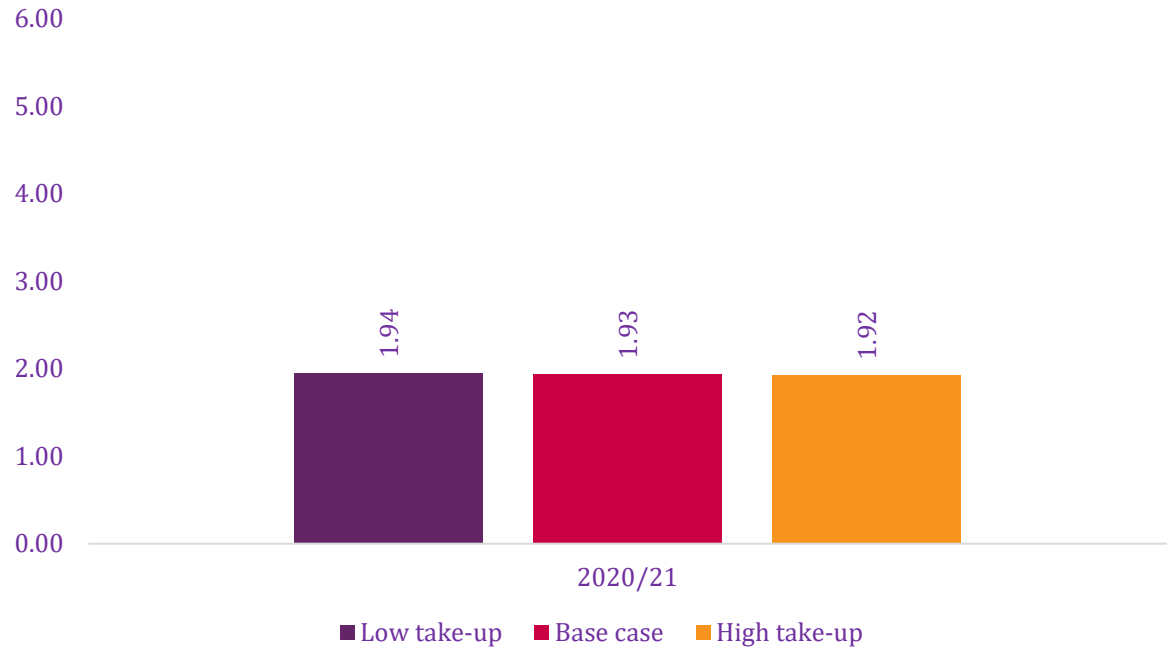

*Source: Outputs from the Cost Recovery module.*

## Demand inputs

A8.27 In terms of demand inputs, Figure A8.3 below shows the sensitivity of the additional cost to the incremental GEA take-up arising from the network expansion. Compared to our base case, outlined in Annex 6, the low case assumes 20% less take up and the high case 20% more in each year over the charge control period. Our results are fairly insensitive to these scenarios, with the low case producing slightly higher unit costs and vice versa in the high case. This is explained by the fact that the increase in CCA costs because of higher volumes

is off-set by the increase in incremental revenue which gets deducted from our the total CCA costs.

**Figure A8.3: Incremental GEA take-up sensitivity – additional cost in 2020/21 (£/year, nominal)**

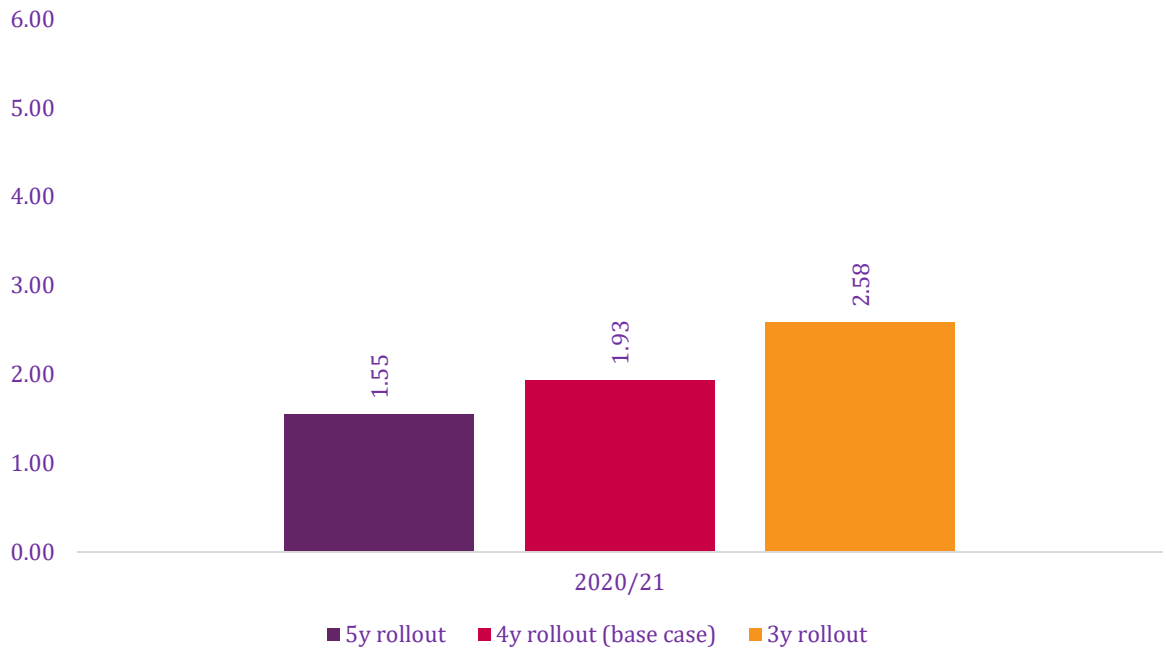



*Source: Outputs from the Cost Recovery module.*

## Network inputs

A8.28 Figure A8.4 below shows the sensitivity of the model outputs to the assumed speed of network rollout. In the low case, we assume a 5-year rollout and in the high case a 3-year rollout, compared to a base case assumption of a 4-year period. The additional cost appears sensitive to this assumption, varying by £0.50 per annum between scenarios. As expected, the additional cost is higher the faster the network rollout, as the CCA cost stack builds up quicker over the charge control period.

**Figure A8.4: Speed of rollout sensitivity – additional cost in 2020/21 (£/year, nominal)**

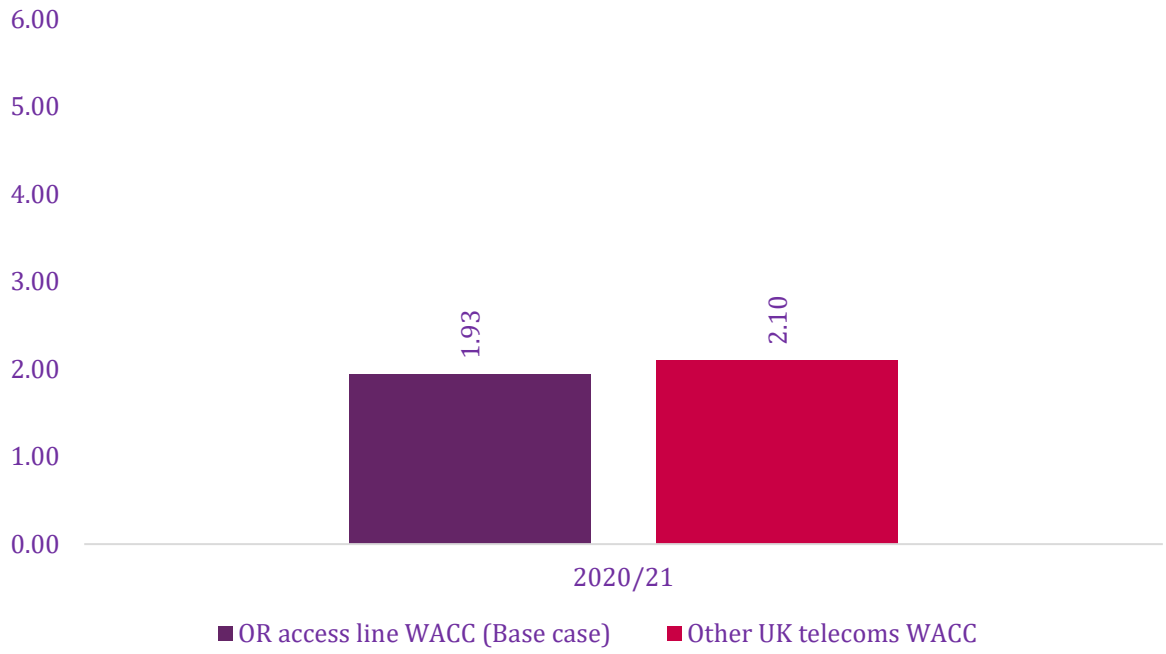



*Source: Outputs from the Cost Recovery module.*

## Cost inputs

A8.29 Turning to cost inputs we find that there is a small impact on the forecast additional cost when changing the WACC, as shown in Figure A8.5 below. Our base case assumes the (pre-tax nominal) Openreach access lines WACC of 8.0%, and our high case assumes the (pre-tax nominal) Other UK telecoms WACC of 9.4%. As we would expect, a higher WACC results in a higher additional cost.

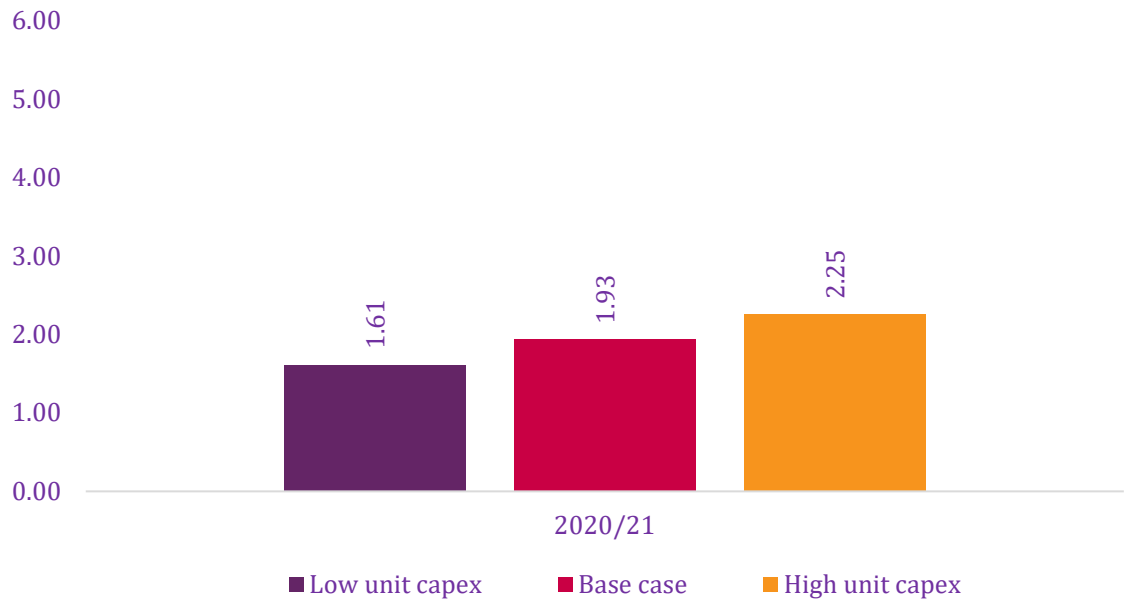
**Figure A8.5: WACC sensitivity – additional cost in 2020/21 (£/year, nominal)**




*Source: Outputs from the Cost Recovery module.*

A8.30 Figure A8.6 below shows the sensitivity of our additional cost forecast to changes in the unit capex assumptions. In the low case, we assume unit capex is 20% lower than in the base case, and 20% higher in the high case. The additional cost appears sensitive to these scenarios, varying by more than £0.30 between them. As we would expect, a lower unit capex results in a lower additional cost and vice versa.

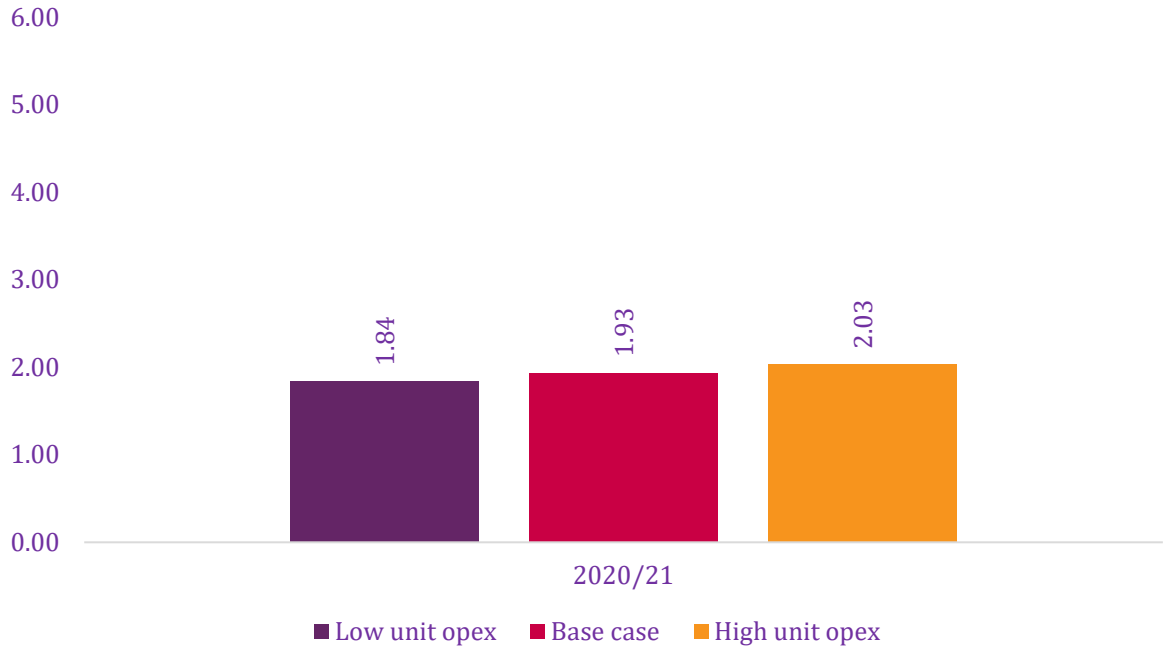
**Figure A8.6: Unit capex sensitivity – additional cost in 2020/21 (£/year, nominal)**




*Source: Outputs from the Cost Recovery module.*

A8.31 The additional cost forecast is much less sensitive to a change in the unit opex assumptions compared to changing the unit capex assumption, as shown in Figure A8.7 below. As with our unit capex sensitivity, we assume unit opex is 20% lower in the low case and 20% higher in the high case, relative to our base case. The additional cost varies by less than £0.10 between these scenarios. We would expect the bottom-up model outputs to be less sensitive to changes in opex given that the network expansion is a capex heavy investment.

**Figure A8.7: Unit opex sensitivity – additional cost in 2020/21 (£/year, nominal)**

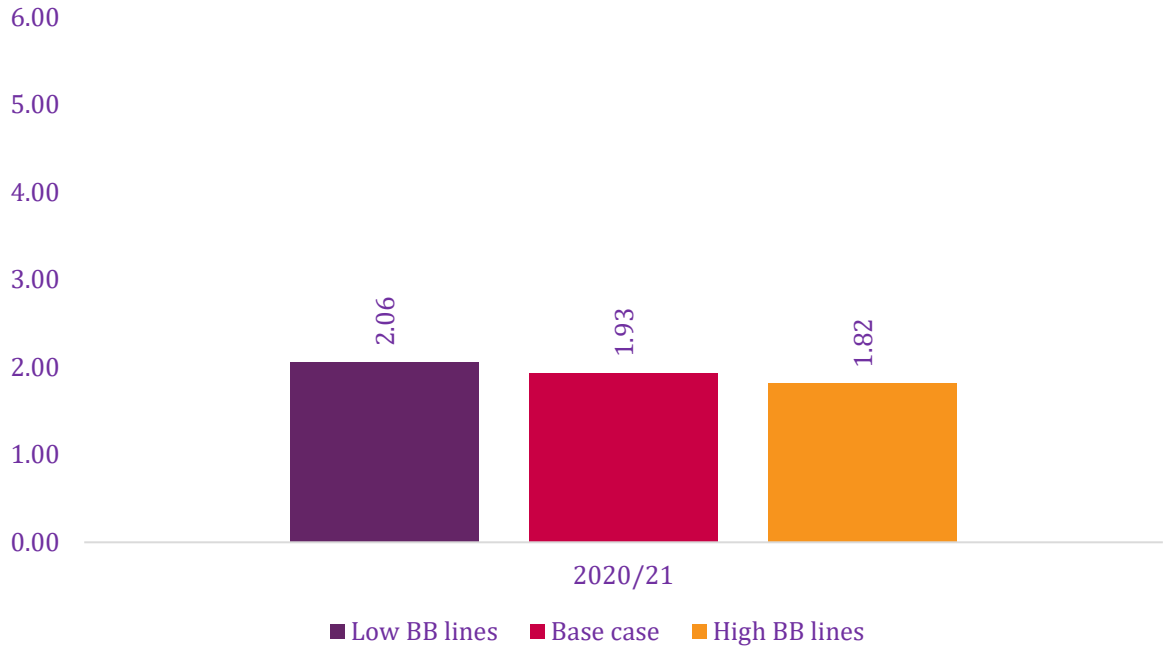



*Source: Outputs from the Cost Recovery module.*

## Cost recovery inputs

A8.32 Turning to cost recovery inputs, Figure A8.8 below shows the sensitivity to the assumed number of broadband lines over which modelled costs are recovered. In the low case, we assume 1% BB growth and 7% SFBB growth, and in the high case 3% and 9% growth respectively. These compare to base case assumptions of 2% BB growth and 8% SFBB growth, which are consistent with our demand assumptions in our March 2017 WLA model. Lower BB and SFBB growth results in a lower number of BB lines. The low and high case scenarios have a modest impact on the additional cost, varying by c.£0.10 around our base case. The impact is as we would expect, with the additional cost increasing with fewer BB lines.

**Figure A8.8: Broadband lines sensitivity – additional cost in 2020/21 (£/year, nominal)**

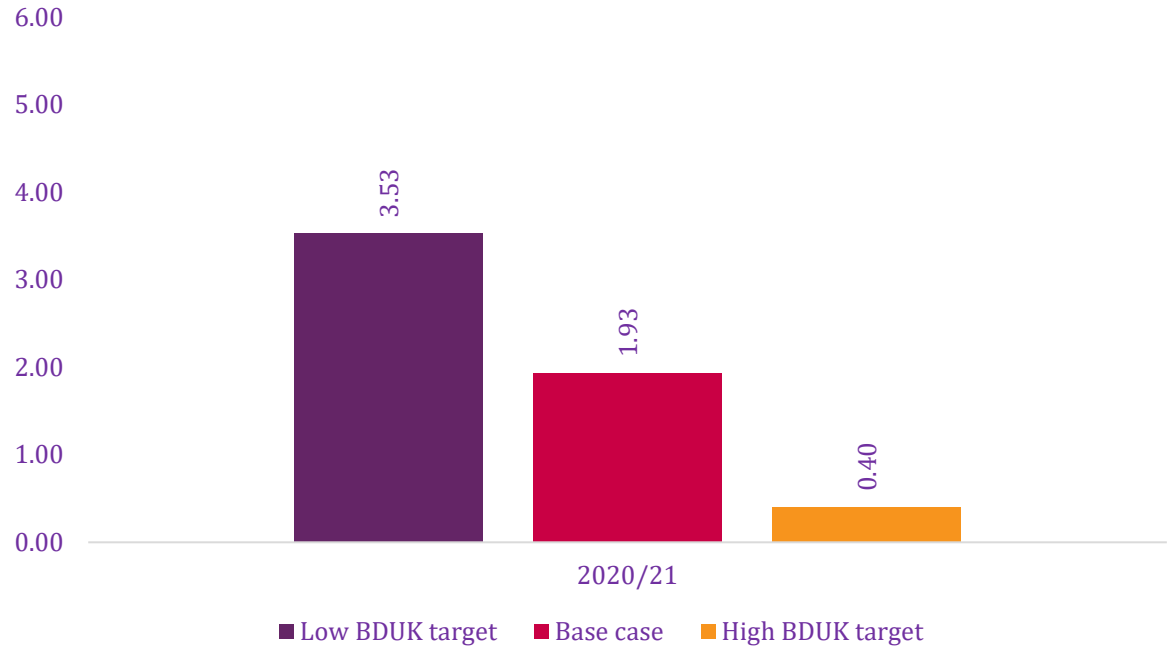



*Source: Outputs from the Cost Recovery module.*

A8.33 Figure A8.9 below shows the sensitivity to the top-down adjustment applied to our model outputs to account for future network rollout. Our base case assumes BDUK will extend access to at least 24 Mb/s service to 97% of UK households by 2021/22. Our low case assumes this proportion is 95% and our high case 99%. The results indicate the additional cost is sensitive to this assumption, varying by more than a pound between the different scenarios. The direction of the impact is as anticipated, with a higher additional cost resulting from a smaller BDUK expansion.[18]

[18] Note that the additional cost in the 99% BDUK target is not zero because we have forced the model to keep a minimum number of VDSL customers.

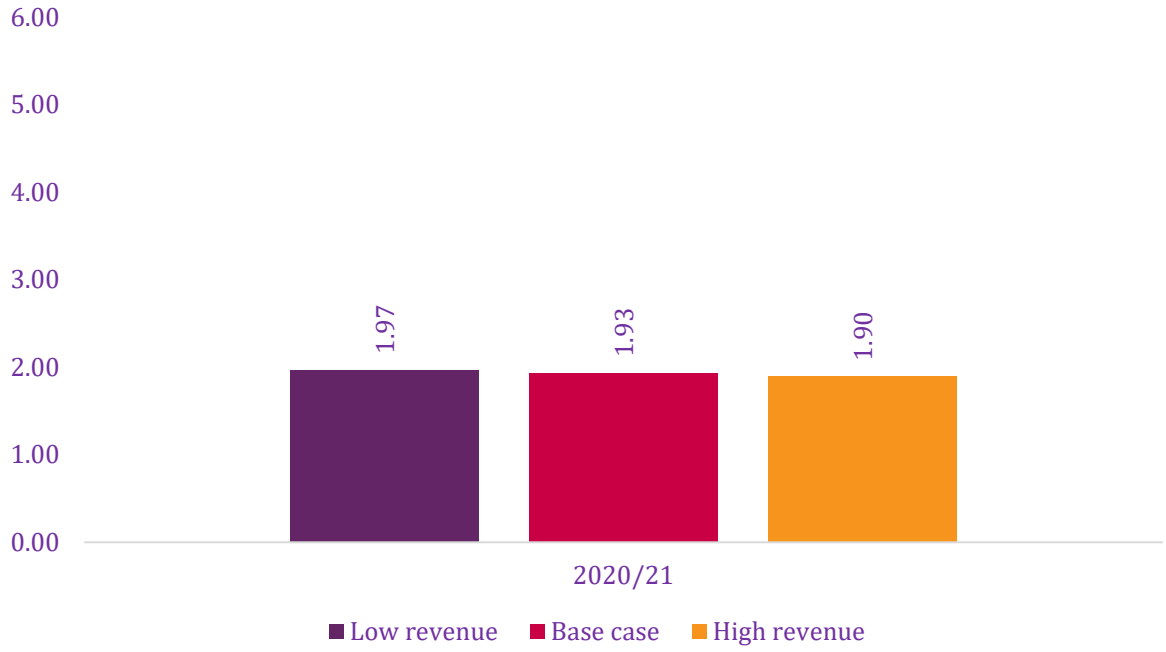
**Figure A8.9: Top-down adjustment sensitivity – additional cost in 2020/21 (£/year, nominal)**




*Source: Outputs from the Cost Recovery module.*

A8.34 Finally, Figure A8.10 below shows the sensitivity of the additional cost to the assumed incremental revenue derived from the network expansion. Compared to our base case, outlined in Annex 7, the low case assumes 20% less revenue and the high case 20% more. The additional cost remains largely flat across the three scenarios, suggesting the results are fairly insensitive to this model parameter. The impact is as expected, with the additional cost declining with higher incremental revenue.

**Figure A8.10: Incremental revenue sensitivity – additional cost in 2020/21 (£/year, nominal)**




*Source: Outputs from the Cost Recovery module.*

## High and low unit costs (combined scenarios for additional cost)

A8.35 In order to produce a range of possible values around our base case results for the additional cost, we have defined high cost and low cost scenarios. These scenarios combine the different assumptions that we have tested individually above. The different sets of assumptions for the three scenarios are summarised below.

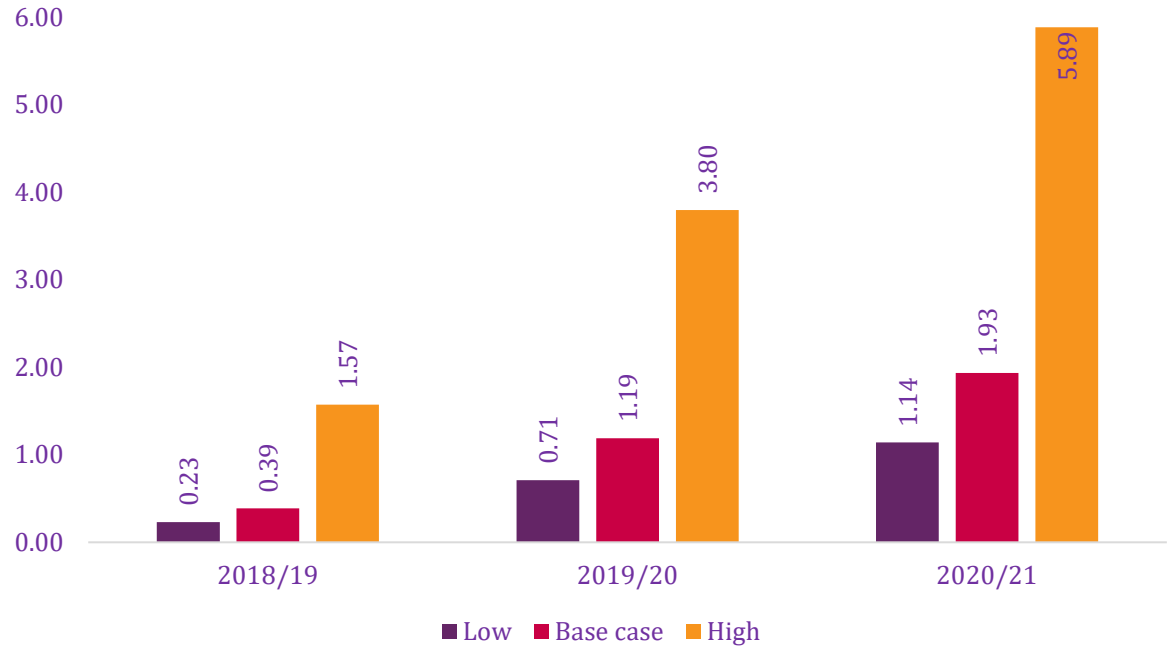
**Table A8.3: Summary of assumptions in low, base case, and high unit cost scenarios**

| | Low unit cost | Base case | High unit cost |
|---|---|---|---|
| **Technology set** | Base case | Base case | LR-VDSL ON |
| **Rollout period** | 5-year | | 3-year |
| **Unit capex and opex** | -20% | | +20% |
| **BB lines** | High | | Low |
| **Top-down adjustment** | Base case | | Low |

*Source: Cost Recovery module*

A8.36 The resulting additional cost can be seen below for each of the years over the charge control period.

**Figure A8.11: Additional cost (£/year, nominal)**




*Source: Outputs from the Cost Recovery module.*

# A9. Glossary

**40/10**: The speed of broadband measured in megabits per second (Mbit/s). The first number states the headline download speed (e.g. 40 Mbit/s), the second number states the headline upload speed. This speed is usually delivered by GEA (either FTTC or FTTP).

**Access Network**: The part of the network that connects directly to customers from the local exchange.

**AVE Pricing**: An approach whereby an *ex ante* price control is applied to the legacy network service or to a sub-set of services over a new network. This constrains similar services as they are close substitutes.

**Anchor Technology Pricing**: An approach that bases charge control modelling on the cost of existing technology rather than that of any new technology that might be adopted during the control period.

**Ancillary Services**: Services that relate to the provision of core rental services in which BT has been found to have SMP.

**Asymmetric Digital Subscriber Line (ADSL)**: A type of digital subscriber line technology, a data communications technology that enables faster data transmission over copper telephone lines rather than a conventional voiceband modem can provide.

**Bandwidth**: The amount of data that can be transmitted in a fixed amount of time. Usually expressed in bits per second (bps).

**BDUK**: Broadband Delivery UK.

**BEREC**: Body of European Regulators for Electronic Communications.

**BT**: British Telecommunications plc.

**BT Wholesale & Ventures:** The division of BT which provides wholesale services to communications providers.

**Charge Control**: A control which sets the maximum price that a telecoms provider can charge for a particular product or service. Most charge controls are imposed for a defined period.

**Commercial Fibre Access Network**: A network deployed by BT nationwide, excluding areas which have been partly or wholly funded by government subsidies.

**Common Costs**: Costs which are shared by all the services supplied by a firm.

**Connected Nations Report**: An annual report published by Ofcom the availability and quality of broadband across the UK.

**Consumer Price Index (CPI)**: The official measure of inflation of consumer prices in the United Kingdom.

**Copper Rearrangement (CuRe)**: The work required to modify lines between the customer and the exchange in order to connect an FTTC cabinet.

**Core Network**: The backbone of a communications network, which carries different services such as voice or data around the country.

**Cost Orientation**: The principle that the price charged for the provision of a service should reflect the underlying costs incurred in providing that service.

**Cumulo Rates**: The business rates paid by BT on its network business. These relate to the use of public land for assets such as poles, duct, street cabinets and the equipment in exchange buildings.

**Customer Premises Equipment (CPE)**: Also known as consumer equipment or customer apparatus. Equipment on consumers' premises, which is not part of the public telecommunications network and which is directly or indirectly attached to it.

**D-side: Distribution side:** The segment of BT's access network between the Primary Cross Connection Points (street cabinets) and Distribution Points.

**DCMS**: Department for Digital, Culture, Media and Sport.

**Digital Subscriber Line (DSL)**: A family of technologies generically referred to as DSL, or xDSL used to add a broadband service to an existing phone line provided using a pair of copper wires (known as a twisted copper pair).

**Digital Subscriber Line Access Multiplexer (DSLAM)**: A network device, located in a telephone exchange or street cabinet that provides broadband services to multiple premises over the copper access network using DSL technologies.

**Downstream BT**: BT's downstream operations, by which we mean BT Wholesale & Ventures, BT Consumer or any other downstream operation owned or operated by BT.

**Dropwire**: An overhead cable, connecting BT's access network to a customer's premises.

**Duct and Pole Access (DPA)**: A wholesale access service allowing a telecoms provider to make use of the underground duct network and the telegraph poles of another telecoms provider.

**Ducts**: Underground pipes which hold copper and fibre lines.

**E-side:** Exchange side. The segment of BT's access network between telephone exchanges and Primary Cross Connection Points (street cabinets).

**EC**: European Commission.

**Equi-proportionate mark-up (EPMU)**: An approach to allocating common costs to products proportionally to the product's share of total LRIC.

**ERP**: Equity risk premium.

**Fully allocated cost (FAC):** An accounting approach under which all the costs of the company are distributed between its various products and services. The fully allocated cost of a product or service may therefore include some common costs that are not directly attributable to the service.

**Fibre To The Cabinet (FTTC)**: An access network structure in which the optical fibre extends from the exchange to a street cabinet. The street cabinet is usually located only a few hundred metres from the subscriber's premises. The remaining part of the access network from the cabinet to the customer is usually copper wire but could use another technology, such as wireless.

**Fibre To The Premises (FTTP)**: An access network structure in which the optical fibre network runs from the local exchange to the customer's house or business premises. The optical fibre may be point-to-point – there is one dedicated fibre connection for each home – or may use a shared infrastructure such as a GPON. Sometimes also referred to as Fibre to the home (FTTH), or full-fibre.

**Fixed wireless**: An access service where the connection between the network and the equipment located at the customer premises is provided over the radio access medium.

**Full Time Equivalent (FTE)**: A measure of resources or work, defined by reference to the capacity of a full time employee. An FTE of 1 is equivalent to one full time employee.

**G.fast**: A broadband transmission standard that increases the speeds possible over short distances on copper lines, compared to ADSL and VDSL technologies.

**Generic Ethernet Access (GEA)**: BT's wholesale product providing telecoms providers with access to BT's FTTC and FTTP networks in order to supply higher speed broadband services. BT currently meets its obligation to provide VULA using the GEA service.

**Gigabit Passive Optical Network (GPON)**: A fibre access network architecture where part of the network is shared by multiple customers.

**Glidepath**: A series of steps from a point of origin to a target.

**Hull Area:** The area defined as the 'Licensed Area' in the licence granted on 30 November 1987 by the Secretary of State under Section 7 of the Telecommunications Act 1984 to Kingston upon Hull City Council and Kingston Communications (Hull) plc (KCOM).

**Latency**: The time it takes a packet of data to travel to a third-party server and back.

**Local Loop**: The access network connection between the customer's premises and the local serving exchange, usually comprised of two copper wires twisted together.

**Local Loop Unbundling (LLU)**: A process by which a dominant provider's local loops are physically disconnected from its network and connected to a competing provider's networks. This enables operators other than the incumbent to use the local loop to provide services directly to customers.

**Long Reach VDSL (LR-VDSL)**: LR-VDSL uses VDSL technology but makes use of the frequency ranges assigned to both ADSL and VDSL, and utilises higher signal power. LR-VDSL also uses vectoring to minimise the impact of cross-talk and interference, which would otherwise reduce the speed available to customers.

**Long Run Incremental Cost (LRIC)**: The cost caused by the provision of a defined increment of output given that costs can, if necessary, be varied and that some level of output is already produced. The incremental costs of a service are the difference between the total costs incurred by the firm where the service is provided and the total costs incurred where the service is not provided.

**LRIC+**: Long run incremental costs plus a share of common costs.

**Main Distribution Frame (MDF)**: An internal wiring frame where local loops are terminated and cross connected to exchange equipment by flexible wire jumpers.

**Metallic Path Facilities (MPF)**: The provision of access to the copper wires from the customer premises to a BT MDF that covers the full available frequency range, including both narrowband and broadband channels, allowing a competing provider to provide the customer with both voice and/or data services over such copper wires.

**Next Generation Access (NGA) Networks**: Wired access networks which consist wholly or in part of optical elements and which are capable of delivering broadband access services with enhanced characteristics (such as higher throughput) as compared to those provided over copper access networks. In most cases, NGAs are the result of an upgrade of an already existing copper or co-axial access network.

**Next Generation Network (NGN)**: A network that uses IP technology in the core and backhaul to provide all services over a single platform.

**Ofcom**: The Office of Communications.

**Openreach**: The access division of BT established by Undertakings in 2005.

**Primary Cross Connection Point (PCP)**: A street cabinet (or equivalent facility) located between the customer's premises and BT's local serving exchanges, which serves as an intermediary point of aggregation for BT's copper network.

**Regulatory Financial Statements (RFS)**: The financial statements that BT is required to prepare by Ofcom. They include the published RFS and Additional Financial Information provided to Ofcom in confidence.

**Shared Metallic Path Facility (SMPF)/Shared Access**: The provision of access to the copper wires from the customer's premises to a BT MDF that allows a competing provider to provide the customer with broadband services, while BT continues to provide the customer with conventional narrowband communications.

**Significant Market Power (SMP)**: The significant market power test is set out in European Directives. It is used by National Regulatory Authorities (NRAs), such as Ofcom, to identify those telecoms providers which must meet additional obligations under the relevant Directives.

**Single Order Generic Ethernet Access (SOGEA)**: A product planned to be launched by Openreach that enables the provision of wholesale superfast broadband without the need to also purchase WLR or MPF.

**Stand Alone Costs (SAC)**: An accounting approach under which the total cost incurred in providing a service is allocated to that service.

**Standard broadband (SBB)**: A broadband connection that can support a maximum download speed of less than 30Mb/s.

**Strategic Review of Digital Communications**: Also referred to as the Digital Communications Review (DCR), is a document Ofcom published in February 2016 which set out a ten-year vision for communications services in the UK.

**Superfast Broadband (SFBB)**: A broadband connection that can support a maximum download speed of between 30Mbit/s and 300Mbit/s.

**Telecoms provider**: A person who provides an electronic communications network or provides an electronic communications service.

**The Act**: The Communications Act 2003.

**Tie Cable**: A cable that connects equipment to the MDF.

**Ultrafast Broadband (UFBB)**: Broadband services which delivers headline download speeds greater than 300Mbit/s.

**USO**: Universal Service Obligation.

**Vectoring**: A performance improvement technique that reduces the effect of crosstalk on copper lines. It is based on the concept of noise cancellation via the co-ordination of line signals.

**Very-high-bit-rate digital subscriber line (VDSL)**: DSL technologies offering superfast broadband speeds. On Openreach's FTTC network which uses VDSL technology, services of up to 80Mb/s downstream and 20Mb/s upstream are currently offered. VDSL, in this consultation, refers to all generations of the technology."

**Virtual Local Area Network (VLAN)**: a subdivision of the capacity within the network representing the "pipe" provided for a single end user's data traffic through the Openreach network.

**Virtual Unbundled Local Access (VULA)**: Provides access to BT's FTTC and FTTP network deployments. Telecoms providers connect to the VULA service at a 'local' aggregation point and are provided a virtual connection from this point to the customer premises.

**Voice over Internet Protocol (VoIP)**: The method of carrying voice calls on fixed and mobile networks by packetizing speech and carrying it using IP.

**Weighted Average Cost of Capital (WACC)**: The rate that a company is expected to pay on average to all its security holders to finance its assets.

**Wholesale Local Access (WLA)**: The market that covers fixed telecommunications infrastructure, specifically the physical connection between customers' premises and a local exchange.

**Wholesale Line Rental (WLR):** The service offered by Openreach to other telecoms providers to enable them to offer retail line rental services in competition with BT's own retail services.

# A10. Cartesian Report

A10.1 Please see:

https://www.ofcom.org.uk/__data/assets/pdf_file/0025/105685/Annex-10-Cartesian-Report.pdf