Wholesale Local Access Market Review

Consultation on possible approaches to fibre cost modelling

[Non-confidential version]

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About this document

This document is a consultation in relation to Ofcom's current Wholesale Local Access (WLA) Market Review, which examines the market for the provision of access connections used to provide telephone and broadband internet services (including superfast broadband) to residential and business consumers.

We intend to consult on our proposals for future regulation of these services later this year. In order to progress the market review and be able to consult fully on all options for future remedies, if a provider is found to have Significant Market Power (SMP), we want to understand better the wholesale costs of providing fibre access services.

This consultation document sets out the general approach we intend to take to cost modelling in order to estimate the costs of fibre based access services. These estimates will be used to inform the WLA Market Review.

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Section 1

Executive Summary

Purpose of this document

1.1 This document sets out our proposals on the general approach we intend to take to cost modelling if estimates of the costs of fibre based access services are required for the Wholesale Local Access Market Review. We invite stakeholders' views on these proposals.

1.2 We have not taken a view on whether or what, if any, price regulation of fibre services may be necessary. However, in order to progress the market reviews and be able to consult fully on all options for future remedies in case any provider is found to have significant market power (SMP), we want to understand better the wholesale costs of providing fibre access services.

1.3 Fixed (wireline) services are provided in the UK by a variety of different businesses (retail communications providers) who either use their own network, or pay another provider (a wholesale communications provider) to supply end customers. As the UK's communications regulator, Ofcom's primary duty is to further the interests of citizens and consumers. One way we fulfil this duty is to review certain markets for local access services (as required under the EU regulatory framework for electronic communications) and, in that review, to set rules that may be necessary if the markets are not effectively competitive.

1.4 We have begun our review of wholesale local access markets and intend to consult on our proposals for future regulation of those services later this year. The wholesale markets covered by this review comprise fixed connections from the local exchange/access node to the end user. That connection is an input into a variety of services including broadband (both standard and superfast).

1.5 In 2014 the Fixed Access Market Review (FAMR)[1] we concluded that in the Wholesale Local Access (WLA) market in the UK, excluding the Hull Area, BT had SMP and that remedies were necessary.

1.6 We imposed charge controls on copper based services but not on newer services delivered over fibre. Since 2014 the take-up and usage of fibre services has increased and in order to carry out the current market review we need to develop our understanding of the costs of providing these services.

[1] Ofcom, *Fixed Access Market Reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30: Volume 1: Statement on the markets, market power determinations and remedies*, 26 June 2014, and Ofcom, *Fixed Access Market Reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30 –: Volume 2: LLU and WLR Charge Controls*, 26 June 2014, http://stakeholders.ofcom.org.uk/telecoms/ga-scheme/specific-conditions-entitlement/market-power/fixed-access-market-reviews-2014/statement/

Proposals in this document

1.7 We are now consulting on our proposed general approach to cost modelling of fibre access services. Specifically:

a) We intend to use a bottom-up approach to estimate the costs to a hypothetical efficient operator of building a modern efficient Next Generation Access (NGA) overlay network2;

b) We set out the proposed design of the modelled NGA overlay network; and

c) We set out our proposals regarding the design of the cost model.

1.8 We are also publishing a spreadsheet model, reflecting the proposals above. We are making the model available now in order to give stakeholders the chance to comment on our approach and make any specific points about the model before we publish any specific proposals. This model is able to generate "unit costs" for NGA overlay services to the extent that it is sufficiently populated to do so. We have provided this capability at this time so interested stakeholders are able to see the impact of changing model assumptions. However, the input numbers are placeholders and the outputs from this current model do not form the basis of any proposals for price regulation.

Next steps

1.9 The closing date for responses to this consultation is 6 June 2016.

1.10 We anticipate publishing a consultation setting out our full proposals in relation to the Wholesale Local Access Market Review later this year. The consultation will set out proposed relevant markets, our proposed determinations as to SMP and, if relevant, any proposed remedies.

1.11 If we develop the cost model further and use it to inform the proposals in the WLA Market Review, we will publish a further version of the model at that time.

[2] By overlay network we mean an NGA deployment on top of an existing copper network. The bottom-up model does not include assets that form part of the copper access network or assets that are shared between copper and fibre networks.

Section 2

Introduction

2.1 In this section we set out the regulatory framework and background and how the issues covered in this document fit within our wider review of wholesale local access markets.

Regulatory framework

2.2 The regulatory framework for electronic communications has its basis in EU Directives, which have been implemented into national legislation. It imposes a number of obligations on relevant national regulatory authorities (NRAs). One of these obligations is to carry out periodic reviews in certain markets.

2.3 A review is carried out in three stages:

2.3.1 we identify and define the relevant markets;

2.3.2 we assess whether any of the markets are effectively competitive, which involves assessing whether any operator has significant market power (SMP) in any of the relevant markets; and

2.3.3 we assess the appropriate remedies which should be imposed, where there has been a finding of SMP, based on the nature of the competition problem identified in the relevant markets.

2.4 In carrying out the review, we are obliged to define relevant markets "appropriate to national circumstances". In so doing, we must take "utmost account" of European Commission Recommendations and SMP Guidelines.[3]

2.5 Where we have identified that one or more providers holds SMP in a relevant market, we may impose remedies to address competitive concerns within that market which result from the SMP identified. These include, among others, access remedies, non-discrimination obligations and price remedies such as a charge control.

Background

2.6 In 2014, the Fixed Access Market Review (FAMR) concluded that in each of the Wholesale Local Access (WLA) and Wholesale Fixed Analogue Exchange Line (WFAEL) markets in the UK, excluding the Hull Area, BT had Significant Market Power (SMP) and that remedies were necessary.

[3] Commission Recommendation of 9 October 2014 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services (2014/710/EU) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014H0710&from=EN and European Commission guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services (2002/C 165/03) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2002:165:0006:0031:EN:PDF

2.7 We imposed charge control remedies on copper based services: Wholesale Line Rental (WLR), Metallic Path Facilities (MPF), and Shared Metallic Path Facility (SMPF).

2.8 The 2014 FAMR Statement set out Ofcom's view that BT should retain broad flexibility over the level of Virtual Unbundled Local Access (VULA) prices during the market review period. To protect and promote competition at the retail level an SMP condition was placed on BT requiring a minimum margin be maintained between VULA prices and prices for retail services.[4]

2.9 We are now reviewing the WLA and WFAEL markets again. The 2017 Narrowband Market Review will consider the WFAEL market (amongst others). The 2017 Wholesale Local Access Market Review will consider the WLA market. These reviews will consider the scope of the relevant markets and whether BT retains SMP in these markets. The reviews will also consider what remedies should be imposed if we find a party holds SMP, including whether any charge controls are necessary.

2.10 We plan to consult on the 2017 Narrowband Market Review including market definition, SMP assessment and proposed remedies in relation to WFAEL in the second quarter of 2016/17, and we propose to consult on the 2017 WLA Market Review in the third quarter of 2016/17.

2.11 In order to progress the 2017 WLA Market Review and to be able to consult fully on such remedies as may be appropriate, we consider it is necessary to understand the costs of broadband services provided over fibre access networks. Therefore, we need to consider how we would model the cost of fibre access services. To achieve this, we have developed a fibre cost model.

Our Strategy

2.12 In February 2016 we published our initial conclusions from the Strategic Review of Digital Communications ("the DCR").[5] Our strategic objective is to promote the interests of consumers by encouraging the large scale deployment of new fibre networks in support of providing competing ultrafast broadband services. In order to deliver this objective we said we would:

2.12.1 Make it easier for competing communications providers (CPs) to build their own fibre networks by providing access to Openreach's ducts and poles;

2.12.2 Price access to BT's network in a way to encourage CPs to invest in new networks, across as much of the UK as is practicable, whilst protecting consumers from excessive pricing;

2.12.3 Deregulate where network based competition is effective; and

[4] Ofcom, *Fixed Access Market Reviews: Approach to the VULA margin*, 19 March 2015, http://stakeholders.ofcom.org.uk/binaries/consultations/VULA-margin/statement/VULA_margin_final_statement.pdf

[5] Ofcom, *Making communications work for everyone: Initial conclusions from the Strategic Review of Digital Communications*, 25 February 2016, http://stakeholders.ofcom.org.uk/telecoms/policy/digital-comms-review/dcr-feb-16/

2.12.4 Continue to promote competition based on other forms of access to Openreach's network where effective network competition does not arise.

2.13 A key element of any decision to introduce superfast broadband charge controls for services based on BT's existing FTTC network is whether the 'fair bet' on these investments has run its course. This issue will be considered in the 2017 WLA Market Review. Understanding BT's costs of providing superfast broadband services over FTTC will be a key factor in this decision. As such, the outputs of the FTTC cost model are likely to be an important input into our decisions on our approach to pricing of access to BT's wholesale superfast services based on the FTTC network.

2.14 It remains important that CPs (including BT) making new investments to deliver ultrafast broadband services also have the opportunity to make returns on their investments. Our approach to regulation of new networks will recognise the need to provide a regulatory environment that is supportive of such investments. In particular, we will consider where pricing decisions related to superfast broadband services could negatively affect network providers' incentives to invest in deploying networks capable of providing ultrafast broadband services.

2.15 In this consultation, we are seeking views on the model structure. We are not seeking views at this stage on what regulation ought to be imposed or how we should determine the matters above. Our next consultation will set out our proposals in these respects.

EC Recommendations

2.16 There are a number of different European Commission and BEREC documents of which we must take "utmost account" when considering what and how we regulate. Of particular relevance to this consultation are the:

2.16.1 European Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (the "**2010 NGA Recommendation**");[6]

2.16.2 European Commission Recommendation of 11 September 2013 on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment (the "**2013 EC Recommendation**");[7]

2.17 The 2010 NGA Recommendation aims to foster the development of the single market by enhancing legal certainty and promoting investment, competition and innovation in the market for broadband services, in particular the transition to NGA. It does so by setting out a common approach for promoting the consistent implementation of remedies with regard to such networks.

[6] Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) (2010/572/EU), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010H0572&from=EN

[7] Commission Recommendation of 11.9.2013 on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment (C(2013) 5761), 11 September 2013, http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2013/c_2013_5761_en.pdf

2.18 The 2013 EC Recommendation concerns the application of non-discrimination, price control, cost accounting obligations and sets out a common approach for NRAs for promoting their consistent and effective implementation. It provides further guidance on the regulatory principles established by the NGA Recommendation, in particular the conditions under which regulation of wholesale access prices should or should not be applied.

Impact Assessment

2.19 At this stage, we are still collecting and analysing data to inform the WLA Market Review, and the modelling set out in this consultation document forms part of that process. The model has yet to be populated with actual data, and the market review has yet to develop policy proposals and reach its provisional conclusions for consultation. Therefore, it is too early to assess any impact of our model approach and design. Our full consultation on the WLA Market Review, to be published later this year, will include a comprehensive impact assessment, including an equality impact assessment.

Scope of this consultation

2.20 This consultation focuses on the overall approach and structure of the model we have developed. We are not consulting on the level of costs calculated by the model.

2.21 Stakeholder responses to this consultation will inform further refinement of the model, which will be used to provide a view of the costs incurred in delivering fibre services in support of the 2017 WLA Market Review.

2.22 Under the current charge controls, common costs in the access network are recovered through charges for MPF and WLR. Charges are set at a level to recover an equal amount of common costs from each of the access services that involve the provision of a line – MPF and WLR. The modelling approach we describe in this consultation does not address the issue of how common costs might be allocated in future – it provides a view of the incremental costs (i.e. excluding common costs) incurred in providing fibre based services. The issue of common cost allocation will be considered in more detail in the WLA Market Review consultation.

Structure of this document

2.23 This consultation is structured as follows:

- First, our approach to building the model, including the choice of technology, the modelling approach we propose to adopt and the geographic scope of the model.
- Second, we describe the structure of the cost model (which is published alongside this consultation) and discuss the key assumptions made, together with possible approaches to calibration and cost verification.

2.24 Alongside this consultation we are also publishing a report prepared by Cartesian which describes the modelling approach in more detail.

Section 3

The 2016 NGA model approach

3.1 This section sets out the proposed modelling choices and assumptions, each of which has a separate sub-heading. These sub-sections are as follows:

- Choice of NGA technology
- Bottom-up cost modelling approach
- Scorched node approach
- NGA network dimensions and geographic coverage
- Span of network in scope
- Timeframe
- NGA services in scope
- Shared current generation access (CGA) and NGA infrastructure

Choice of NGA technology

3.2 NGA services can be delivered over a number of different technologies (or technology configurations). In order to estimate the costs of NGA, we need to decide which technology should be used for cost estimation purposes, taking into account what the proven efficient technology for providing NGA services is.

3.3 Currently, in the UK, NGA services are being provided over a number of different technologies, including:

- **(Coaxial) Cable using DOCSIS**[8] – This is used by Virgin Media (and other cable operators) to provide high speed broadband services, currently up to 200Mbps download. The approach uses fibre between the local exchange and the street cabinet ("fibre to the cabinet" or "FTTC"), with the DOCSIS equipment housed in the cabinet and a coaxial cable connecting from the cabinet to the end-user.
- **FTTC using VDSL2**[9] – This is used by BT to provide high speed broadband services, currently up to 80Mb/s download. The approach uses FTTC, with the VDSL2 equipment housed in the cabinet and a twisted copper pair connecting from the cabinet to the end-user.
- **FTTP** – Fibre spans the full length of the access network, i.e. from the local exchange to the end-user.

[8] DOCSIS: Data Over Cable Service Interface Specification.
[9] VDSL (or Very high data rate Digital Subscriber Line) – a digital technology that allows the use of a standard telephone line to provide very high speed data communications, which is used in fibre-to-the cabinet deployments.

3.4 In addition, during the period covered by this review, BT has announced it will commence deployment using G.fast technology. The G.fast standard is a DSL technology that offers the potential for higher speeds than are provided by the VDSL2 technology. The G.fast equipment can be used in an FTTC deployment but this may limit the speeds that can be achieved. Alternatively it can be placed closer to the customer's premises to reduce the length of the copper connection between the G.fast equipment and the customer. The network architecture is currently being tested by BT.

3.5 To date, BT has primarily deployed VDSL2 based FTTC for delivering NGA services.[10] By the start of the market review period, around 90% of UK homes are expected to have VDSL2 based FTTC services available to them. We note that this is forecast to fall to around 85% by the end of the control period due to take-up of FTTP, but we consider FTTC will continue to be representative of the costs for NGA services in this review period.[11] In contrast only around half of UK homes are currently covered by coaxial cable-based NGA.[12] Therefore we expect FTTC to remain the predominant technology used by BT for delivering NGA services over the period of the review.[13]

3.6 Therefore, in seeking to understand the efficiently incurred costs of the deployment BT has made, a model assessing the cost of an FTTC network using VDSL2 technology would appear appropriate.

3.7 In addition, in assessing the technology choice for the purposes of modelling the costs of an NGA network, we have given utmost regard to the 2013 EC Recommendation, which states that NGA costs should be modelled "*on the basis of an efficient network using the latest technology employed in large-scale networks*".[14] The 2013 EC Recommendation elaborates on how the technology standard used for NGA cost estimation will need to be tailored to the national circumstances.

> *"In light of the principle of technological neutrality NRAs should consider various approaches to modelling the hypothetical efficient NGA network depending on the access technology and network topology that best fit national circumstances*."[15]

3.8 We therefore propose, to the extent that NGA cost estimates are required as part of the WLA Market Review, to base the modelled costs on those of a national efficient operator, building an NGA network using FTTC and VDSL2 technology.

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[10] According to Analysys Mason forecasts there were around 25m UK homes passed by Openreach FTTx by the end of 2015, but only 0.3m of these were FTTP, meaning around 99% of Openreach's current NGA deployment is based on FTTC. [Analysys Mason, September 2015 UK FTTx forecasts http://www.analysysmason.com/Research/Content/Reports/FTTx-forecast-Sept2015-RDTW0/]

[11] Analysys Mason, UK FTTx forecast. September 2015

[12] In 2015 Virgin Media announced plans to expand its network coverage as part of its 'Project Lightening'. This expansion will lead to coaxial-based NGA coverage of less than 60% of UK premises by 2020, which is substantially less than the 96% NGA coverage forecast for BT in 2020. [http://www.ispreview.co.uk/index.php/2015/06/huge-virgin-media-uk-cable-broadband-expansion-begins-in-manchester.html]

[13] Analysys Mason estimate that by end-2018, less than 4% of all BT FTTx connected lines will be FTTP, meaning around 96% of UK FTTx lines will be FTTC. [Analysys Mason, UK FTTx forecast. September 2015]

[14] 2013 EC Recommendation, page 15

[15] 2013 EC Recommendation, page 20

Bottom-up cost modelling approach

3.9 In determining how we propose to compute cost estimates for an NGA network based on an FTTC topology using VDSL2 technology, we need to consider if we would wish to estimate the costs on a top-down basis (which was the approach taken for copper-based services (LLU/WLR) in 2014); or on a bottom-up basis (as in the 2013 NCC model and the 2015 MCT model). The choice of which approach is best will depend on a number of factors including modelling objectives and data availability.

3.10 A top-down model uses total network cost data and allocates these costs to services based on service usage factors. This type of model does not rely on detailed assumptions about how the network is constructed. Instead, the modelled costs are calculated using cost-volume elasticities which reflect assumptions about the way the cost of high-level network components change as traffic rises or falls.

3.11 A bottom-up model estimates how much network equipment is needed for the forecast level of traffic (based on technical assumptions in relation to network capacity and dimensioning algorithms). It then calculates the total cost of this network equipment using evidence of the capital and operating costs of each piece of equipment. Ofcom has used bottom-up models to set cost-based charge controls in the regulation of Mobile Termination Rates (MTRs)[16] and more recently in the 2013 Narrowband Market Review[17], where we used a bottom-up model to estimate the cost of fixed call termination and fixed call origination respectively.

3.12 We consider that in the present context, cost estimates computed on a bottom up basis will be more robust than top-down estimates. Bottom-up modelling has a number of advantages over top-down modelling:

- By using network build parameters, bottom-up modelling allows us to more accurately model the underlying (long-run) cost/volume relationships (CVEs and AVEs).
- Bottom-up models are generally more transparent than top-down models. This type of model can usually be published without the need to redact large amounts of confidential information. This should mean that it is clearer to all stakeholders why and how services drive network components which in turn drive service costs.
- By comparison, a top-down modelling approach would require estimates of CVEs and AVEs, which will be difficult to obtain (in a robust way) given the lack of historic accounting data. It also relies to a greater extent on the use of confidential information.

[16] Ofcom, *Mobile Call Termination Market Review 2015-18: Statement on the markets, market power determinations and remedies*, 17 March 2015, http://stakeholders.ofcom.org.uk/binaries/consultations/mobile-call-termination-14/statement/MCT_final_statement.pdf

[17] Ofcom, *Narrowband Market Review: Consultation on possible approaches to cost modelling for the Network Charge Control for the period 2013-2016*, 28 September 2012, http://stakeholders.ofcom.org.uk/binaries/consultations/narrow-band-market-review/summary/condoc.pdf

3.13 We therefore propose to use a bottom-up approach to modelling NGA costs. Our proposal is consistent with the 2013 EC Recommendation which states that, for the purposes of setting NGA wholesale (cost orientated) access prices:

> *"NRAs should adopt a BU LRIC+ costing methodology that estimates the current cost that a hypothetical efficient operator would incur to build a modern efficient network, which is an NGA network."*

3.14 The 2013 EC Recommendation goes on to state that:

> *"[A] 'Bottom-up modelling approach' means an approach that develops a cost model starting from the expected demand in terms of subscribers and traffic. It then models the efficient network required to meet the expected demand, and assesses the related costs using a theoretical network-engineering model, for the purpose of calculating the cost on the basis of an efficient network using the latest technology employed in large-scale networks."*[18]

3.15 We will put forward proposals for how we allocate common costs between fibre and copper network components as part of the 2017 WLA Market Review. These proposals will take utmost account of the recommended approach of using a LRIC+ cost standard.

3.16 While we propose using a bottom-up modelling approach, we plan to base some input data on top-down sources (for example in terms of the location of certain civil infrastructure, see 'Scorched node approach', below) as well as the costs associated with shared infrastructure (between CGA and NGA services). We propose to use top-down data for calibration purposes.

Scorched node approach

3.17 In using a bottom up approach, we need to determine whether to model a completely hypothetical NGA network with the most efficient (lowest cost) design and topology (a scorched earth approach), or to use the deployment of existing infrastructure (i.e. network nodes) as a starting point for any modelling exercise (a scorched node approach).

3.18 Although a scorched earth approach would allow us to model the most efficient network possible, it would add considerable complexity to the modelling process and would potentially omit migration costs. That is, the costs of moving from one previously efficient topology to the new efficient topology. Given the model is of an overlay FTTC deployment on an existing copper network, it would not seem appropriate to model this overlay network on a copper network topology that is different from that used to provide existing copper services without incurring some migration costs. A scorched earth approach would also limit our ability to use the model to assess the cost of BT's actual FTTC deployment.

3.19 A scorched node approach allows the bottom-up model to be grounded in reality, since it does not construct an entirely new civil infrastructure network for the purposes of deploying an NGA network.

[18] 2013 EC Recommendation, page 15

3.20 In proposing the scorched node approach, we have had utmost regard to the 2013 EC Recommendation, which states that:

> *"When modelling an NGA network, NRAs should include any existing civil engineering assets that are generally also capable of hosting an NGA network as well as civil engineering assets that will have to be newly constructed to host an NGA network."*[19]

3.21 The 2013 EC Recommendation goes on to say that:

> *"Therefore, when building the BU LRIC+ model, NRAs should not assume the construction of an entirely new civil infrastructure network for deploying an NGA network."*[20]

3.22 We therefore propose, in the scenario of needing to model NGA costs as part of the 2017 WLA Market Review, to use a scorched node approach, whereby the network topology and dimensioning in terms of number and location of network civil infrastructures (namely CGA cabinets and local exchanges) is based on those civil infrastructures that currently exist.

3.23 In an FTTC deployment, the relevant nodes would be the street cabinets to which fibre is deployed, and the local exchanges to which these fibres connect. Whilst a new cabinet may be deployed to house the NGA equipment, this would need to be located close to the cabinet to which the end user's copper line connects (the CGA cabinet). These CGA cabinets are connected to local exchanges. The fibre from the cabinet may also connect to these local exchanges or may connect to another local exchange instead.

3.24 Given this approach, the network topology (in terms of number and location of key civil infrastructures) as dimensioned in our model aligns with the network deployed by BT.

NGA network dimensions and geographic coverage

3.25 The geographical scope of the model is based on the coverage area of the current and likely future FTTC Cabinet footprint in the United Kingdom (excluding the Hull area served by KCOM).

3.26 Our current specification of the model covers commercially viable areas only. It excludes coverage areas that were part-funded by BDUK or any other state intervention. We have taken the provisional position of including only BT's commercial rollout. We will consider whether this is the most appropriate approach or whether we should also include BDUK in the main WLA consultation. If we were to include BDUK this would impact specific volumes and costs. However, we do not consider it would affect the overall structure of the model.

3.27 Therefore, the model dimensions a network to the same geographic areas over the same timeframe as we have observed occurring in BT's network.

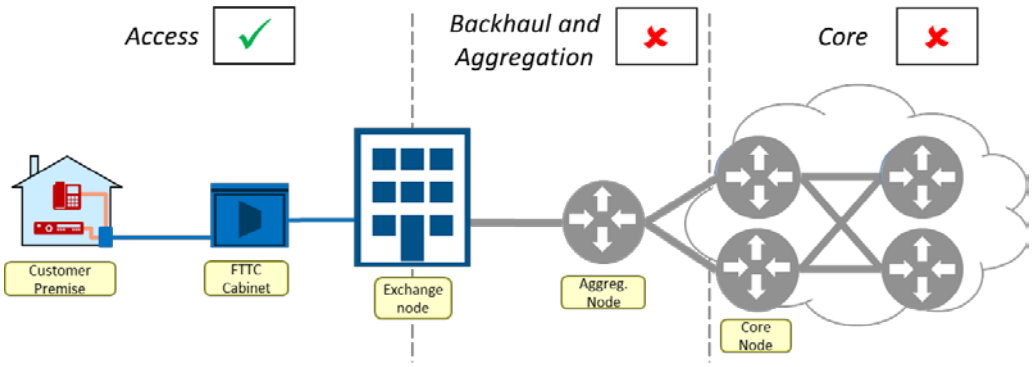
3.28 For future years, we do not expect significant further commercial rollout as we consider BT's commercial deployment of FTTC is largely complete.

[19] 2013 EC Recommendation, para 32
[20] 2013 EC Recommendation, para 32

Span of network in scope

3.29 The scope of the model comprises the portion of the NGA network up to the point of handover i.e. the point where access is made available to other CPs.[21] See Figure 3.1 (below).

Figure 3.1 – Network segments in scope for 2016 NGA Model



Source: Cartesian

3.30 This approach ensures the model only captures the access portion of the network.

Timeframe

Start year

3.31 We consider that the start year for the model (also referred to as year 0), should be determined by the first financial year (FY)[22] in which costs for NGA would have been incurred. Based on the available data, we consider 2007/08 to be an appropriate start year.

3.32 This is based on examining when UK NGA networks began to be deployed. We present in Table 3.1 (below) a summary of the NGA rollouts (implementation and trials) set out in Ofcom's 2009 Communications Market Review,[23] as at July 2009.

[21] In the instance of NGA, the point of handover is the Layer 2 Switch at the Exchange.
[22] I.e. April to March.
[23] Ofcom, *The Communications Market 2009*, August 2009 Table 4.10
http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr09.pdf

Table 3.1: Selected UK super-fast broadband implementations and trials, as at July 2009

Company	Deployment Type	Maximum download speed	Technology	Location	Scale	Launch date
Virgin Media	Commercial	50Mbps	DOCSIS 3.0 Cable	Virgin Media cable footprint	12.6m homes by summer 2009	Rollout started Q4 2008
Fibrecity (H20 Networks)	Commercial	100Mbps	FTTP	Bournemouth and Dundee	c. 88k homes on completion	Rollout started Q1 2009
Titanic Quarter (Redstone plc)	Commercial	100Mbps	FTTP	Belfast	5k+ premise on completion	First tenants in H2 2009
BT	Commercial	100Mbps	FTTP	Ebbsfleet Valley	10k homes on completion	Serving <100 homes by Q2 2009
Virgin Media	Trial	200Mbps	DOCSIS 3.0 Cable	Ashford, Kent	c. 100 homes	May 2009
BT	Pilot	40Mbps	FTTC	Muswell Hill and Whitechurch	c. 15k homes	July 2009

Source: Ofcom, 2009 CMR, Table 4.10

3.33 The final column in Table 3.1 shows that the launch date for most major UK NGA rollouts (i.e., date at which the network rollout/trial commenced) was in the 2008/09 FY. However, we would also expect that some preparatory and planning costs would have been incurred prior to any actual NGA rollout. As such we consider it likely that some costs would have been incurred in the year preceding initial NGA rollout, i.e. 2007/08.[24]

Assessment duration

3.34 In regard to the duration of the assessment, we have sought to base the model on the long run relationships between service volumes and component volumes (and associated costs). We consider that a 40 year horizon is sufficient to capture long run relationships, given the asset lives involved.[25] Costs beyond the 40 year horizon are captured using a perpetuity calculation. We note that we have modelled a 40 year duration in other recent Ofcom bottom up cost models, including the 2013 NCC and 2015 MCT models. Using a long-run cost model also gives us the option to use economic depreciation should we wish to calculate service unit costs.

3.35 Given the difficulty in constructing robust forecasts over long periods, we propose to take an approach (as we have in other models) of assuming a steady state forecast after a certain point. We therefore propose to explicitly model (for example for volumes and costs) out to 2027/28, which is 20 years from the start of the assessment in 2007/08, with forecast values held constant (i.e. in steady-state) thereafter.

[24] However, we do not consider that there would have been any material NGA rollout costs incurred before that (i.e. in 2006/07 or earlier).
[25] The 2016 NGA model has an explicit modelling period until 2027/28 FY with key parameter values (such as subscriber forecasts) held constant thereafter.

NGA services in scope

3.36 The model has been constructed with in-built flexibility, so as to allow the modelling of costs for any service delivered over an FTTC network. This includes connections and rentals as well as ancillary services, including customer site installations and service provision.

3.37 This flexibility means it is possible to use the model to calculate service costs for some or all FTTC services.

Shared CGA and NGA infrastructure

3.38 By using the scorched node approach (outlined above), we propose to model the costs of an FTTC based NGA network making use of existing civil infrastructure, for example D-side copper (i.e. between the cabinet and customer premises) and E-side duct (i.e. between the exchange and the cabinet).

3.39 Given that existing civil infrastructure is shared between CGA and NGA services there will also be common costs shared between CGA and NGA services.

3.40 We consider the work to analyse common costs between CGA and NGA services is best done in the context of a top-down assessment of costs, so as to ensure that there is no over or under recovery of such costs including between WLA and other regulated markets. We therefore propose that such a top-down exercise would fall outside of the scope of the bottom up NGA modelling.[26]

Question 3.1: *Do you agree with our proposed NGA modelling approach? Please provide reasoning for your answer.*

[26] The approach we propose to take in the 2016 NGA model could be described as an FTTC Overlay approach, in that the approach would seek to model the costs of only those components that are specific to NGA services.

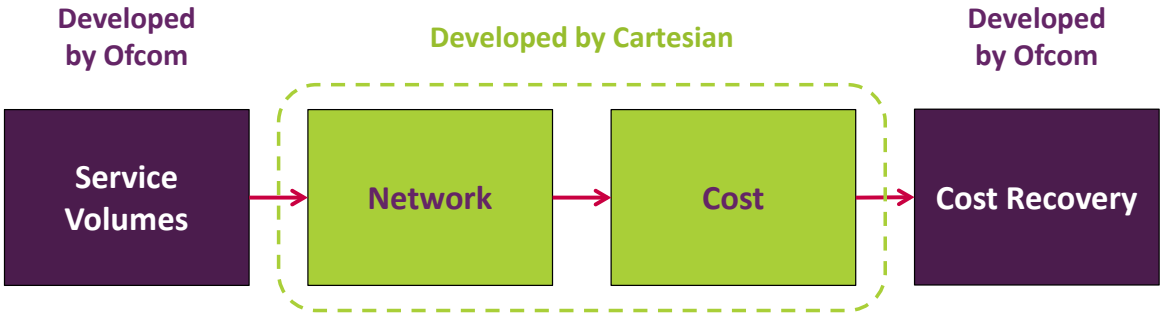
Section 4

The 2016 NGA model design

Structure of the 2016 NGA model

4.1 The 2016 NGA model is composed of four modules, two of which have been developed by Ofcom ('Service Volumes' and 'Cost Recovery'), with the other two ('Network' and 'Cost') being developed by Cartesian. The module structure for the model is shown in Figure 4.1 below.

Figure 4.1 – Module structure of the 2016 NGA model



Source: Ofcom

4.2 Each module is responsible for the following:

- **Service Volumes** – computes the volumes of each relevant FTTC service (e.g. number of connections and rentals) in each modelled year.[27]
- **Network** – combines the service volumes with FTTC capacity and coverage parameters to dimension the access network.
- **Cost** – calculates the capital and operating expenditure required to build and operate the dimensioned access network.
- **Cost Recovery** – uses the outputs from the Cost module (along with the Service Volumes module) to calculate how costs are recovered across services over time.

4.3 We set out more information about each module below. Further details about the modules built by Cartesian (i.e. 'Network' and 'Cost') can be found in the Cartesian report which accompanies this consultation document.

Service Volumes

Introduction

4.4 We consider it appropriate to consult on our broad approach to modelling WLA

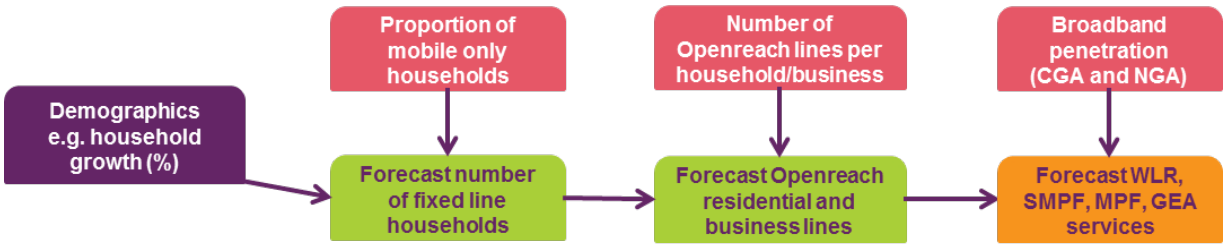
[27] We are using the same service forecast module to estimate volumes of both CGA and NGA services provided by Openreach.

service volumes. This will allow stakeholders to comment on the proposed end-to-end approach to cost modelling fibre based access services. We do not consider it appropriate at this stage to consult on the detail or specific figures currently in our service volumes module. The numbers should be seen only as placeholders. This section sets out the proposed:

- structure of the 2016 NGA Model service volumes module;
- key assumptions and data sources used for forecasting; and
- the key outputs of the 2016 NGA Model service volumes module.

4.5 We set out at a high level how the 2016 NGA model projects service volumes in Figure 4.2 below:

Figure 4.2 – flow chart for WLA service volumes module



4.6 There are multiple approaches that could be used to forecast service volumes but we consider our proposed approach to lead to reasonable service volume forecasts. Furthermore, we consider it beneficial that we follow a consistent approach to forecasting Openreach residential and business lines as in the 2014 LLU/WLR volumes model. However, we now separately forecast NGA service volumes (i.e. GEA services) since they currently represent a significant proportion of the WLA market, and we expect this to increase in the future.

4.7 We compare our forecasts with those provided by CPs (including BT) in order to assess the robustness of the assumptions used when deriving our forecasts. We set out below the main assumptions that feed into the 2016 NGA volumes model. These are split between the general assumptions, that also impact the CGA service volumes, and the assumptions that are specifically used for our NGA forecasts.

General assumptions for forecasting WLA service volumes

4.8 Our general assumptions impact our forecasts for Openreach residential and business lines, as well as the level of general broadband penetration. We also generally use three year average growth rates to forecast specific services. We set these out in more detail below:

- **Household projections**: provided by the Department for Communities and Local Government[28], which we have then adjusted to account for the forecast proportion of households that are mobile only.[29] We have also used the forecast of businesses in the UK as provided by the Department for Business, Innovations

[28] See the live tables on household projections, updated on 3 December 2015 https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections
[29] This is the proportion of households that do not have a fixed voice or broadband service and is based upon annual survey data from Ofcom's Technology Tracker.

& Skills.[30] We have assumed that all businesses have a fixed line, but have modelled the flexibility to adjust the business site forecast based upon forecast GDP growth. This is consistent with the approach used for the 2014 LLU and WLR volumes model.

- **Number of Openreach lines that are provided to UK households**: this is the total number of WLR, MPF and FTTP lines provided by Openreach. We have used the proportion of residential to business lines calculated by Ofcom Market Intelligence to estimate the number of residential and business Openreach lines. This is consistent with the approach used for the 2014 LLU and WLR volumes model.

- **Growth in broadband lines per household**: We have made an assumption for the annual change in broadband penetration, taking into account historic growth as an indication and Analysys Mason's forecasts.[31] Given the importance of broadband penetration, in particular superfast broadband penetration, we now consider it appropriate to explicitly model this within the WLA service volumes module.[32]

- **Growth in service volumes:** for some services, we have used historic volume trends to calculate a moving three year average growth rate, to which we have then applied a 'dampening factor'.[33] This is consistent with the approach used for the 2014 LLU and WLR volumes model. For other services we have made assumptions about the inter-relationship between different services (based on historic data, where available) in order to obtain forecasts.

Assumptions specifically impacting fibre service volumes

4.9 On top of our general forecasting assumptions, we have also made assumptions that specifically impact the fibre service volumes forecasts. This includes an assumption for future fibre take-up and aggregation of GEA services, which we set out below:

- **Fibre broadband penetration:** we forecast the proportion of Openreach broadband lines that are superfast, based upon various forecasts of fibre take-up which currently comprise but ultimately are not necessarily limited to forecasts from:
    - BT;
    - Other CPs; and
    - Analysys Mason.

[30] See the detailed tables on business population estimates for the UK and regions 2014 https://www.gov.uk/government/statistics/business-population-estimates-2014
[31] See the broadband penetration forecasts as found for the underlying to the Analysys Mason research forecast report, *Western Europe telecoms market: interim forecast update (16 countries) 2014–2019*, December 2014 http://www.analysysmason.com/Research/Content/Regional-forecasts-/WE-interim-forecast-16-countries-Dec2014-RDDF0/
[32] We implicitly modelled broadband penetration in the 2014 LLR and WLR volumes model by extrapolating from historic trends (and did not model any superfast broadband penetration).
[33] A dampening factor is a divisor applied to the growth rate in order to reduce growth year-on-year, in order to slow down three-year trends to ensure that they are consistent with plausible and stable long-run levels. At the same time, the use of a three-year moving average means that our forecasts are also a reasonable reflection of shorter-term trends over the forecast period.

- **FTTP volumes:** Our model assumes that all NGA services are provided using FTTC based on VDSL2 technology. Therefore we have aggregated Openreach FTTP service volumes into our FTTC forecasts (i.e. we have modelled any NGA service to be FTTC based on VDSL2 technology). We note that GEA-FTTP service volumes (i.e. the FTTP wholesale product provided by Openreach) are currently low. We consider them likely to continue to be low relative to GEA-FTTC over this review period.[34]

- **FTTC volumes:** BT has provided us with FTTC service volumes split by bandwidth for both its actuals (i.e. its 40/2, 40/10, and 80/20 FTTC services) and its forecasts (which also includes its 55/10 and 18/2 FTTC services). We have aggregated these FTTC services with different bandwidths when forecasting NGA service volumes.

- **Split between internal and external FTTC:** We have forecast FTTC service volumes split by internal and external volumes. We have made an assumption about the rate at which internal volumes change over time with regard to consumption of wholesale NGA services provided by Openreach.[35]

- **Ancillary services:** BT has also provided volumes for various ancillary services and for different types of connection services. We have aggregated many of these services when forecasting in order to provide an output from the volumes model that is consistent with the FTTC network build in the Cartesian model.

4.10 We set out how we have aggregated the NGA ancillary and connection services in Table 4.1 below:

Table 4.1 – Openreach ancillary and connection services that have been aggregated to be consistent with the modelled FTTC network build

Service volumes required as input for FTTC network build		
GEA FTTC Provision (without visiting end user)	**GEA Customer Site Installations**	**GEA Software Change**
GEA-FTTC PCP Only Installation	GEA engineer installation	GEA-FTTC Start Of Stopped Line
	GEA managed engineer installation	GEA-FTTC Bandwidth Change
		GEA-FTTC Transfers
		GEA-FTTC Ceases

[34] Furthermore, we consider it likely that non-BT CPs will utilise other wholesale inputs (e.g. self-build or duct access) in order to provide FTTP, rather than obtaining GEA-FTTP.
[35] We have forecast the proportion of LLU service volumes from Openreach that are internal volumes up until 2019/20, and assumed the proportion of internal GEA volumes to tend towards and be capped as this ratio.

FTTC network build

4.11 Details of the Network module are set out in the Cartesian Report which accompanies this consultation document. We provide here a brief summary of the Network module.

4.12 The Network module uses the NGA service volumes and coverage information to calculate the volumes of the NGA-specific network components. Such components include:

- FTTC cabinet (and associated internal equipment/electronics/wiring);
- Connection between PCP cabinet and FTTC cabinet (both in terms of duct and copper wiring);
- E-side fibre;
- NGA equipment in the local exchange; and
- NGA backhaul (both in terms of duct and fibre). See Cartesian report (Annex 7), section 3.36 to 3.39

4.13 In order to determine the component volumes in each year, we propose to use an approach whereby each exchange and cabinet has a NGA enablement date (i.e. the date at which NGA services were first available for provision). The enablement of these core network elements will drive all other associated component volumes over time.

Cost of FTTC equipment

4.14 Details of the Cost module are set out in the Cartesian Report which accompanies this consultation document. We provide here a brief summary of the Cost module.

4.15 The Cost module takes the outputs of the Network module in terms of the volume of each component in each year, and multiplies these by the capital expenditure and operating expenditure for each component to give the total expenditure in each year.

4.16 To estimate the capital and operating costs of each component in each year we start with an assumption for the component capital and operating cost in 2015/16 (i.e. the most recent year for which data is available), and apply an assumption relating to the trend in component unit costs over time (both historically and in the future). This allows us to estimate the component unit costs for every year of the model.[36]

[36] For example, consider the simplified example of the costs of installing an FTTC cabinet. Over a 40 year assessment the cost may vary significantly over time. We start with a cost based on recently available data, suppose this indicated that as of today, it costs £1,000 to install an FTTC cabinet. We then apply an assumption to vary this value over time in light of expectations, for example if we anticipate the cost each year will be 5% less than the previous year, we would forecast the cost to be £950 next year, £902.5 the following year, and so on. In years prior to today, we will seek to use actual costs where available, if under the above example the 5% annual price reduction had existed the costs under the example would be £1,053 one year prior, and £1,108 two years prior, etc.

4.17 Once we have the component unit costs in each year, we need simply to multiply these by the volume of each component in that same year in order to calculate the total expenditure per component.

Cost recovery and service costing

4.18 Once we have calculated the total costs of the NGA network, we calculate the path of cost recovery over time. In the model we have implemented both economic and accounting approaches to depreciation.

Depreciation Approach

4.19 In regard to determining the appropriate path of cost recovery, we consider there are two key objectives:

the profile of cost recovery should provide efficient signals for consumption and investment (which implies that in general the profile of cost recovery should be consistent with the path of prices which would occur in a competitive market); and

regulation should provide operators with the opportunity to recover their efficiently incurred costs, including a reasonable return on investment.

4.20 In considering the approach for determining when costs are recovered over time, we have built the 2016 NGA model with two options:

1. Economic Depreciation (ED);
    - Original Economic Depreciation (Original ED);
    - Simplified Economic Depreciation (Simplified ED); and
2. Current Cost Accounting (CCA).

4.21 We briefly discuss each depreciation approach below.

Economic Depreciation

4.22 The economic depreciation (ED) method matches the cost of equipment to the actual and forecast use over the long term. Consequently, there is relatively little depreciation in years when utilisation is low and relatively high depreciation in years of full, or almost full, equipment utilisation.

4.23 Economic depreciation can come in a number of forms. In our model we have included two forms of ED, Original ED and Simplified ED.

4.24 A key benefit of Original ED is that it seeks to set the optimal path of cost recovery over time by mimicking the outcomes of a benchmark competitive market. In this hypothetical competitive market, we assume that unit prices in a given year do not depend on the level of utilisation at that point in time, but on the level of utilisation achieved over the lifetime of the network.

4.25 This approach to economic depreciation has been used by Ofcom in previous bottom-up cost models, for example the 2013 NCC and 2015 MCT; and has been supported by the Competition Commission (now the Competition and Markets Authority) each time it has been appealed in the context of setting a charge control.

4.26 An alternative form of economic depreciation is “Simplified ED”, which is intended to retain many of the characteristics of Original ED, but uses a simpler functional form. In this approach, the shape of the path of unit cost recovery remains independent of the level of in-year utilisation and is therefore determined by changes in input costs alone, as in the Original ED methodology. However, the entire profile of cost recovery for an asset is given a shape which exactly mimics the profile of input cost trends, scaled so as to achieve full cost recovery.

4.27 While the results produced by the Simplified ED approach are similar to those produced by the Original ED approach (indeed we have used the Simplified ED approach as a cross check in previous charge controls), there is a draw-back from using Simplified ED in terms of deriving a final year unit cost recovery that is consistent with the benchmark competitive market and the cost assumptions.[37]

Current Cost Accounting

4.28 The CCA approach results in the same level of total cost recovery (over the life of the model) as an ED approach, however the chief difference lies in the path of cost recovery over time. The key characteristics of the timing of cost recovery under an accounting depreciation approach is as follows:

- Capital costs are recovered as the sum of depreciation and the cost of capital employed. Depreciation is calculated for each asset as the gross book value of that asset divided by its lifetime, whilst the cost of capital employed is calculated as the cost of capital multiplied by the net book value of the network operator’s total asset base.

- Straight-line depreciation means that depreciation is not deferred from years when utilisation is lower to those when it is higher, as under an economic depreciation approach. Consequently, unit capital costs tend to be inversely related to utilisation.

- Operating costs are recovered in the year in which they are incurred, meaning that, once a network component is purchased, unit operating costs are also inversely related to utilisation (i.e. unit operating costs decrease as utilisation increases).

Summary

4.29 The model is able to calculate depreciation using the three approaches described above. We will consult on our preferred approach to depreciation as part of the 2017 WLA Market Review.

Cost of Capital

4.30 The model currently uses the ”Other UK Telecoms” weighted average cost of capital (WACC) from Ofcom’s three-way disaggregation of the WACC published in the 2016 LLCC Statement. This should be seen as a placeholder. If appropriate, we will make proposals on our choice of WACC as part of the wider 2017 WLA Market Review.

[37] Simplified ED does not calculate the terminal price based on mimicking a hypothetical competitive market; rather, the terminal price is a by-product of scaling the shape of the cost recovery profile to achieve full cost recovery.

Service Costing

4.31 Once we have determined how the costs of a particular network element should be recovered over time, we need to calculate how they will be recovered from different network services. The costs recovered by a particular service are linked to the costs that are driven by that network service. Each network service will have a routing factor relating to each piece of network equipment, which will drive the amount of network equipment needed to carry a unit of the service.

Possible approaches to calibration / cost verification

4.32 We consider that it is desirable to check the reasonableness of the outputs of our model. When we have built other bottom-up models in the past we have calibrated the outputs against actual real-world data wherever possible. In the 2015 MCT modelling, we compared model outputs with mobile CP data to check that the model was producing realistic outputs. We compared the amount of network equipment and the total cost of that equipment (GBV, NBV and opex) against the average, maximum and minimum for these values from the CP data. By comparing these values over time, we were more confident in the robustness of the cost volume relationships in the model.

4.33 When building the 2013 NCC model, we did not have data for a national NGN operator which we could use for calibration purposes. Instead, we calibrated the unit cost outputs against the unit cost of a fully depreciated TDM network and a hypothetical ongoing TDM network.

4.34 We propose to compare outputs of any NGA cost modelling work with actual operator data to ensure their reasonableness. For example, we might calibrate our model outputs in the following way:

4.34.1 Against existing national deployments of FTTC: This is likely to be data provided by BT but will be dependent on us being able to identify NGA only costs from BT's RFS.

4.34.2 Against other NRAs' NGA models: Ofcom is not the only NRA modelling an NGA. We could, for example, check our model outputs against the outputs of other NRA models, or, where the modelling approaches are sufficiently similar, we could look at other metrics such as total network costs and the quantity of network equipment.

4.35 The availability and quality of data will inform our final proposal on our approach to calibration and cost verification.

Question 4.1: *Do you agree with our proposed NGA modelling design? Please provide reasoning for your answer.*

Annex 1

Responding to this consultation

How to respond

A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 7 June 2016**.

A1.2 Ofcom strongly prefers to receive responses using the online web form at http://stakeholders.ofcom.org.uk/consultations/wholesale-local-access-market-review-fibre-cost-modelling/howtorespond/, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.

A1.3 For larger consultation responses – particularly those with supporting charts, tables or other data – please email wlamr@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.

A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation.

Camilla Reinert
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.5 Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.

A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

Further information

A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Camilla Reinert on: 020 7783 4578.

Confidentiality

A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.

A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at http://www.ofcom.org.uk/terms-of-use/

Next steps

A1.11 Following the end of the consultation period, Ofcom will consider all responses and publish a full Wholesale Local Access Market Review consultation later this year.

A1.12 Please note that you can register to receive free mail Updates alerting you to the publications of relevant Ofcom documents. For more details please see: http://www.ofcom.org.uk/email-updates/

Ofcom's consultation processes

A1.13 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.

A1.14 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.

A1.15 If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact Steve Gettings, Secretary to the Corporation, who is Ofcom's consultation champion:

Steve Gettings
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7981 3601

Email Steve.Gettings@ofcom.org.uk

Annex 2

Ofcom's consultation principles

A2.1 Ofcom has published the following seven principles that it will follow for each public written consultation:

Before the consultation

A2.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. 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

A2.3 We will be clear about who we are consulting, why, on what questions and for how long.

A2.4 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 to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will consult for up to 10 weeks depending on the potential impact of our proposals.

A2.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why.

After the consultation

A2.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

Annex 3

Consultation response cover sheet

A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website, www.ofcom.org.uk.

A3.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.

A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.

A3.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email or post you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at http://stakeholders.ofcom.org.uk/consultations/consultation-response-coversheet/.

A3.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don't have to edit your response.

Cover sheet for response to an Ofcom consultation

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 ☐

Whole response ☐

Part of the response ☐

Name/contact details/job title ☐

Organisation ☐

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)

Annex 4

Consultation questions

The 2016 NGA model approach

Question 3.1: *Do you agree with our proposed NGA modelling approach? Please provide reasoning for your answer.*

The 2016 NGA model design

Question 4.1: *Do you agree with our proposed NGA modelling design? Please provide reasoning for your answer*

Annex 5

Link to relevant documents

A5.1 We have noted throughout the document the evidence we have relied upon for our analysis and how we have relied upon that evidence. This annex provides a list of the main sources of evidence used and, where possible, the web links where the evidence used is published online.

A5.2 While the Annex lists the main evidence we have relied upon, the list is for convenience only and is not intended to be exhaustive.

Ofcom documents

A5.3 Ofcom, *The Communications Market 2009*, August 2009, http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr09.pdf

A5.4 Ofcom, *Narrowband Market Review: Consultation on possible approaches to cost modelling for the Network Charge Control for the period 2013-2016*, 28 September 2012, http://stakeholders.ofcom.org.uk/binaries/consultations/narrow-band-market-review/summary/condoc.pdf

A5.5 Ofcom, *Fixed Access Market Reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30: Volume 1: Statement on the markets, market power determinations and remedies*, 26 June 2014, http://stakeholders.ofcom.org.uk/binaries/telecoms/ga/fixed-access-market-reviews-2014/statement-june-2014/volume1.pdf

A5.6 Ofcom, *Fixed Access Market Reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30 –: Volume 2: LLU and WLR Charge Controls*, 26 June 2014, http://stakeholders.ofcom.org.uk/binaries/telecoms/ga/fixed-access-market-reviews-2014/statement-june-2014/volume2.pdf

A5.7 Ofcom, *Mobile Call Termination Market Review 2015-18: Statement on the markets, market power determinations and remedies*, 17 March 2015, http://stakeholders.ofcom.org.uk/binaries/consultations/mobile-call-termination-14/statement/MCT_final_statement.pdf

A5.8 Ofcom, *Fixed Access Market Reviews: Approach to the VULA margin*, 19 March 2015, http://stakeholders.ofcom.org.uk/binaries/consultations/VULA-margin/statement/VULA_margin_final_statement.pdf

A5.9 Ofcom, *Making communications work for everyone: Initial conclusions from the Strategic Review of Digital Communications*, 25 February 2016, http://stakeholders.ofcom.org.uk/telecoms/policy/digital-comms-review/dcr-feb-16/

A5.10 Ofcom, *Statistical Release Calendar: Ofcom Technology Tracker*, http://stakeholders.ofcom.org.uk/market-data-research/statistics/

EC documents

A5.11 Commission guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic

communications networks and services (2002/C 165/03), 7 March 2002, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2002:165:0006:0031:EN:PDF

A5.12 Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) (2010/572/EU), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010H0572&from=EN

A5.13 Commission Recommendation of 11.9.2013 on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment (C(2013) 5761), 11 September 2013, http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2013/c_2013_5761_en.pdf

A5.14 Commission Recommendation of 9 October 2014 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services (2014/710/EU), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014H0710&from=EN

Website articles

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Annex 6

Glossary

Access Network: The part of the network that connects directly to customer premises from the local telephone exchange.

Ancillary services: Services that relate to the core rental services and that are of an ancillary nature but which fall within markets in which BT has been found to have SMP.

Asset Volume Elasticity (AVE): The percentage increase in capital costs required for a 1% increase in volume.

Backhaul: For the purposes of this consultation, the term refers to segment(s) of a communications network that connect(s) segments of an access network (e.g. from the Digital Local Exchange to the premises or from a cabinet to the premises) with the core network.

Bandwidth: In digital telecommunications systems, the rate measured in bits per second (bit/s), at which information can be transferred.

BEREC: Body of European Regulators of Electronic Communications, a body of the European Union.

Broadband Delivery UK (BDUK): Department for Culture, Media and Sport project to deliver superfast broadband and mobile connectivity to the UK.

BT: British Telecommunications plc.

Capital expenditure (capex): The firm's level of investment in fixed assets over the course of the financial year.

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

CMR: Communications Market Review.

Common costs: Costs which are shared by several services supplied by a business.

Communications Provider (CP): An organisation that provides electronic communications services.

Competition Commission (CC): A defunct independent public body that conducted in-depth inquiries into mergers, markets and the major regulated industries. Closed on 1 April 2014, its functions have transferred to the Competition and Markets Authority.

Competition and Markets Authority (CMA): An independent public body that brings together the previous role of the Competition Commission as well as many of the competition and consumer functions of the OFT.

Core network: The central part of any network aggregating traffic from multiple backhaul and access networks.

Cost-Volume Elasticity (CVE): The percentage increase in operating costs for a 1% increase in volume.

Current Cost Accounting (CCA): An accounting convention, where assets are valued and depreciated according to their current replacement cost whilst maintaining the operating or financial capital of the business entity.

Current Generation Access (CGA): Wired access network that is wholly based on copper cables.

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

Dampening factor: a divisor applied to a growth rate in order to reduce growth year-on-year, in order to slow down three-year trends to ensure that they are consistent with plausible and stable long-run levels.

Data Over Cable Service Interface Specification (DOCSIS): A telecommunications standard that enables cable TV networks to support broadband internet access services.

Digital Subscriber Line (DSL): a family of technologies generically referred to as DSL, or xDSL, capable of transforming ordinary phone lines (also known as "twisted copper pairs") into high-speed digital lines, capable of supporting advanced services such as fast internet access and video-on-demand.

Distribution Point (DP): A flexibility point in BT's access network where final connections to customer premises are connected to D-side cables. Usually either an underground joint or a connection point on a telegraph pole where overhead cables are terminated.

Duct Access: A wholesale access service allowing a CP to make use of the underground duct network of another CP.

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.

ED: Economic depreciation.

FAMR: Fixed Access Market Review.

Fibre To The Cabinet (FTTC): An access network structure in which the optical fibre extends from the exchange to a flexibility point in the BT network known as a 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 end user'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. Sometimes also referred to as Fibre to the home (FTTH).

G.Fast: A broadband transmission standard that further increases the access speeds possible on copper lines.

Generic Ethernet Access (GEA): BT's wholesale non-physical product providing CPs with access to higher speed broadband products.

Gross Book Value (GBV): Original price paid for an asset, without any deduction for depreciation.

Gross Domestic Product (GDP): A measure of the size of an economy equal to the sum of all goods and services produced in a period.

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).

Incremental costs: Those costs which are directly caused by the provision of that service in addition to the other services which the firm also produces. Another way of expressing this is that the incremental costs of a service are the difference between the total costs in a situation where the service is provided and the costs in another situation where the service is not provided.

KCOM: KCOM Group plc, formerly Kingston Communications Limited.

Local loop: The access network connection between the customer's premises and the local serving exchange, usually composed 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 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.

Long Run Incremental Cost Plus (LRIC+): The long run (average) incremental costs plus an equi-proportionate mark-up for the recovery of shared and common costs. LRIC+ should be taken to mean the same as LRAIC+ (a term used by some other NRAs).

Main Distribution Frame (MDF): An internal wiring frame where copper access network cables are terminated and cross connected to exchange equipment by flexible wire jumpers.

Market Review Period: The period that we expect to last from the date of publication of the final statement till 31 March 2020.

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.

Mobile Call Termination (MCT): a wholesale service provided by a mobile communications provider (MCP) to connect a call to a recipient on its network. When fixed or mobile communications providers enable their customers to call a UK mobile number, they pay the terminating MCP a wholesale charge, called a 'mobile termination rate' (MTR).

Mobile Termination Rate (MTR): The wholesale charge levied by mobile communications providers (MCPs) for MCT.

National Regulatory Authority (NRA): The relevant communications regulatory body for each country in the EU. Ofcom is the NRA for the United Kingdom.

NCC: Network Charge Controls.

Net Book Value (NBV): Original price paid for an asset, less accumulated depreciation costs.

Next Generation Access (NGA): A new or upgraded access network capable of supporting much high capacity broadband services than traditional copper access networks. Generally an access network that employs optical fibre cable in whole or in part.

Next Generation Networks (NGN): An IP based multi-service network capable of providing voice telephony, broadband and other services.

Ofcom: The Office of Communications.

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

Operating expenditure (opex): Costs reflected in the profit and loss account excluding depreciation financing costs such as interest charges.

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

Shared Metallic Path Facility (SMPF): 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 CPs which must meet additional obligations under the relevant Directives.

Strategic Review of Digital Communications (DCR): Overarching review of the UK's digital communications conducted by Ofcom. Ofcom published its initial conclusions on 25 February 2016 in the document entitled *Making communications work for everyone: Initial conclusions from the Strategic Review of Digital Communications*

Superfast broadband: The next generation of faster broadband services, which delivers headline download speeds greater than 30Mbps.

TDM: Top-Down Model.

Ultrafast broadband: The next generation of faster broadband services, which delivers headline download speeds greater than 300 Mbps.

Very high data rate Digital Subscriber Line (VDSL): A digital technology that allows the use of a standard telephone line to provide very high speed data communications, which is used in fibre-to-the cabinet deployments.

Virgin Media: Virgin Media plc.

Virtual Unbundled Local Access (VULA): It provides a connection from the nearest 'local' aggregation point to the customer premises.

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 Fixed Analogue Exchange Line (WFAEL): The provision of wholesale analogue voice services using BT or KCOM's existing voice infrastructure.

Wholesale Line Rental (WLR): The service offered by BT to other CPs to enable them to offer retail line rental services in competition with BT's own retail services. Line rental is offered along with calls (and other service elements, such as broadband) to retail customers.

Wholesale Local Access (WLA): Covers fixed telecommunications infrastructure, specifically the physical connection between end users' premises and a local exchange.

Annex 7

Cartesian report

A7.1 Cartesian's model documentation report *Wholesale Local Access Market Review: NGA Cost Modelling Wholesale Local Access Market Review: NGA Cost Modelling*, May 2016, is available here.

Annex 8

2016 NGA model

A8.1 The 2016 NGA model (excel spreadsheets) is available here