Fixed access market reviews: Openreach quality of service and approach to setting LLU and WLR Charge Controls Annexes

Redacted for publication [✂]

Consultation

Publication date: 19 December 2013

Closing Date for Responses: 13 February 2014

Contents

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 13 February 2014**.

A1.2 Ofcom strongly prefers to receive responses using the online web form at http://stakeholders.ofcom.org.uk/consultations/fixed-access-market-llu-wlr-charge-controls, 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 WLA2014.Review@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.

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

Paul Laker
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

Fax: 020 7981 3333

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:

- Chris Dodds on 020 7981 3473 for issues related to Charge Controls; or
- Paul Laker on 020 7783 4578 for issues related to Openreach Quality of Service.

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/about/accoun/disclaimer/

Next steps

A1.11 Following the end of the consultation period, Ofcom intends to publish a statement in spring 2014.

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/static/subscribe/select_list.htm

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 Graham Howell, Secretary to the Corporation, who is Ofcom's consultation champion:

Graham Howell
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7981 3601

Email Graham.Howell@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, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at www.ofcom.org.uk/consult/.

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: Fixed access market reviews: Openreach quality of service and approach to setting LLU and WLR Charge Controls

To (Ofcom contact): Paul Laker and Chris Dodds

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

Quality of service review

Question 3.1: *Do you agree that it is appropriate to use the existing SLAs as the basic standard around which to set the new minimum standards? Please provide reasoning for your answer. If you do not agree, please also give your proposed alternative.*

Question 3.2: *Do you agree that it is appropriate to use General Manager areas rather than forecasting regions in the minimum standards and the KPIs? Please provide reasoning for your answer. If you do not agree, please also give your proposed alternative.*

Question 3.3: *Do you agree that it is appropriate to apply the same minimum standards to all regions? Please provide reasoning for your answer. If you do not agree, please also give your proposed alternative.*

Question 3.4: *We have set out the details of our analysis in Annex 5. In light of this analysis, do you agree that the 2011/12 resource deltas from the Resource Simulation Model provide a reasonable basis to assess the resource and associated cost increments associated with minimum standards? Please provide reasoning for your answer.*

Question 3.5: *Do you consider whether it is appropriate to take account of the difference in the resource levels between 2011/12 and 2012/13 in setting the final resource multiple to account for the more challenging conditions in 2012/13? Please provide reasoning for your answer.*

Question 3.6: *Do you agree that the existing MBORC statistics form a reasonable basis for inclusion in the minimum standards? Please provide reasoning for your answer. If you do not agree, please also give your proposed alternative.*

Question 3.7: *Do you agree that it is appropriate to base the repair MBORC allowance on the statistics for 2012/13? Please provide reasoning for your answer. If you do not agree, please also give your proposed alternative.*

Question 3.8: *Do you agree that it is appropriate to use 3% as the faults MBORC allowance and 1% as the provisioning MBORC allowance? Please provide reasoning for your answer. If you do not agree, please also give your proposed alternative.*

Question 3.9: *Do you agree with the minimum standards we have proposed for the third year? Please provide reasoning for your answer.*

Question 3.10: *Do you agree with the range we have identified for the minimum standard in the first year and our proposed recommendation within that range? Please provide reasoning for your answer.*

Question 3.11: *Do you agree with the proposed glide path? Please provide reasoning for your answer.*

Question 3.12: *Do you agree with our analysis of the risks of unintended consequences in the setting of the minimum standards and our proposed approach to addressing the risk, including the use of new KPIs? Please provide reasoning for your answer. If you do not agree, please also give your proposed alternative.*

Question 3.13: *Do you agree with the set of KPIs proposed? Is it sufficient that they are national rather than regional? Do you agree they should be publically available? Please provide reasoning for your answer. If you do not agree, please also give your proposed alternative.*

Service Level cost differentials

Question 4.1: *Do you agree with our proposal on how conceptually to estimate the cost differential? Please provide reasoning for your answer.*

Question 4.2: *Do you agree that the Resource Simulation Model appropriately adjusted for estimating the cost differential is an improvement on the way we previously used to set this differential? Please provide reasoning for your answer.*

Question 4.3: *Do you agree that we have undertaken the correct and appropriate adjustments to the Resource Simulation Model to better reflect reality? Please provide reasoning for your answer.*

Question 4.4: *Do you consider that there may be ways in which the Resource Simulation Model could be changed to make it more reflective of the reality – e.g. Gamma distribution assumptions and exclusion of Saturday working for Service Level 2? Please provide reasoning for your answer.*

Fault rates

Question 5.1: *Do you agree with our approach to establishing base year costs? Please provide reasoning for your answer.*

Question 5.2: *Do you agree that fault rates should remain constant throughout the Charge Control period based on our analysis above? Please provide reasoning for your answer.*

Question 5.3: *Do you agree with our proposed approach to equalising relative fault rates, with MPF = 1, WLR+SMPF = 1, WLR only = 0.87 and SMPF = 0.13? Please provide reasoning for your answer.*

Charge Control Design

Question 6.1*: Do you agree with our revised proposals for baskets and SMPF New Provides? Please provide reasoning for your answer.*

Question 6.2: *Do you agree that we should control (i) WLR Standard Connection when simultaneously provided with SMPF New Provide and (ii) WLR Start of Stopped MPF Line and its simultaneous provision with SMPF New Provide? Please provide reasoning for your answer.*

Question 6.3: *Do you agree with our proposal not to set charge controls that require Openreach to provide a discount when WLR Transfer and SMPF Single Migration; WLR Start of Stopped WLR Line and SMPF New Provide; and WLR Working Line*

Take Over and SMPF New Provide are provided simultaneously? Please provide reasoning for your answer.

Question 6.4: *Do you agree that we should re-allocate costs between the services that have been attributed the cost savings associated with the WLR+SMPF simultaneous connections and migrations services so that all services involving jumpering at the exchange more accurately reflect their underlying costs? Please provide reasoning for your answer.*

Question 6.5: *Do you agree that we should now charge control the Caller Display service? Please provide reasoning for your answer.*

Question 6.6: *Do you agree that we should impose a one-off reduction in the Caller Display charge to LRIC (in 2014/15), with common costs reallocated across WLR and MPF as appropriate? Please provide reasoning for your answer.*

Charge control cost allocations and modelling

Question 7.1*: Do you agree with our proposal to change the approach to the recovery of evoTAMs costs so as to exclude evoTAMs costs from the SMPF line rental? Do you agree with our revised assessment of TAMs costs? Please provide reasoning for your answer.*

Question 7.2*: Do you agree with our proposal to immediately remove 'DSLAM capital/maintenance' costs associated with SFI faults from the Cost Model? Please provide reasoning for your answer.*

Question 7.3*: Do you agree with our proposal by 2016/17 to allocate the remaining 'DSLAM capital/maintenance costs on a consistent basis with our treatment of other fault-related costs, by means of a glide path? Please provide reasoning for your answer.*

Question 7.4: *Do you agree with our approach and estimates of the likely ranges for the WLR/WLR+SMPF minus MPF differentials? Please provide reasoning for your answer.*

Question 7.5: *Do you agree with our proposal to update the cost model base year information for the most recent 2013 RFS cost information (adjusted as proposed in this Consultation) while retaining the 2012 RFS allocation methodologies (as adjusted as set out in the July 2013 Consultation and this Consultation)? Please provide reasoning for your answer.*

Question 7.6: *Do you agree that BT's provision for claims for deafness arising from the use of copper line testing equipment used in the past by engineers should be excluded from the cost base of the Charge Controls? Please provide reasoning for your answer.*

Question 7.7: *Do you consider that BT's CTC costs should be included in the cost base of the Charge Controls? Please provide reasoning for your answer.*

Question 7.8*: Are you aware of any other specific BT RFS cost items which merit further investigation by Ofcom to establish whether they properly constitute efficiently incurred forward looking costs? Please provide reasoning for your answer.*

Proposed Charge Controls

Question 8.1: *Do you agree with our proposal to set the main rental charges such that the differential in charges between WLR+SMPF and MPF is equal to £10 by 2016/17, rather than moving more rapidly to reflect our now lower estimate of the LRIC differential of £0 to £4? Please provide reasoning and information to support your response to this question.*

Question 8.2: *Do you agree with our proposed approach to making one-off adjustments for the removal of evoTAMs costs and DSLAM capital maintenance costs? Please provide reasoning for your answer.*

Annex 5

Service Quality Modelling

Introduction

A5.1 This annex describes our consideration of the Resource Simulation Model and the resource estimates for performance improvements produced by the model in light of Analysys Mason's (AM) QoS Model Report. It also describes our further analysis of the relationship between Openreach's performance and resources that we have used to inform our assessment of the Resource Simulation Model and the resource estimates.

Background

A5.2 In the July 2013 FAMR Consultation we explained that we had undertaken our own analysis of the relationship between engineering resource requirements and service levels and had concluded that the relationship is likely to be non-linear to some extent because Openreach is essentially a queue-based organisation at the operational level.[1]

A5.3 We explained that as part of our work we had considered a range of analysis techniques to investigate the relationship between service performance, fault/order volumes and engineering resources in order to derive our own estimate of the resource increments associated with service quality improvements. The techniques we considered included:

- simple measures of changes in demand levels and resource volumes;
- using relationships between performance, demand and resource levels derived from theoretical models of queue based organisations;
- simple regression of the performance and resource data (to derive a relationship between them); and
- our own discrete event simulation modelling of Openreach's operations of varying degrees of detail.

A5.4 We obtained information from BT under statutory powers to support these analyses. We found, however, that there were significant limitations in the period of time over which the key performance and related data had been retained by BT. This limited our ability to estimate the resource impacts of service changes for the purposes of the July 2013 Consultation in that we were only able to obtain comprehensive data relating to the last two years. We concluded that even with a more comprehensive dataset, there were limitations to the insights that these analysis techniques could give. Consequently, our view was that a very much more detailed approach to the analysis based on simulation techniques was preferable.

[1] Paragraphs A10.19 to A10.30, Ofcom, July 2013 FAMR Consultation - Annex 10.

Further Ofcom analysis of the relationship between performance and resources

A5.5 Since the July 2013 FAMR Consultation we have undertaken further analysis to investigate the relationship between service performance, fault/order volumes and engineering resources in order to derive our own estimate of the resource increments associated with service quality improvements. This has produced some useful findings which can inform our consideration of the estimates produced by the Resource Simulation Model. In particular:

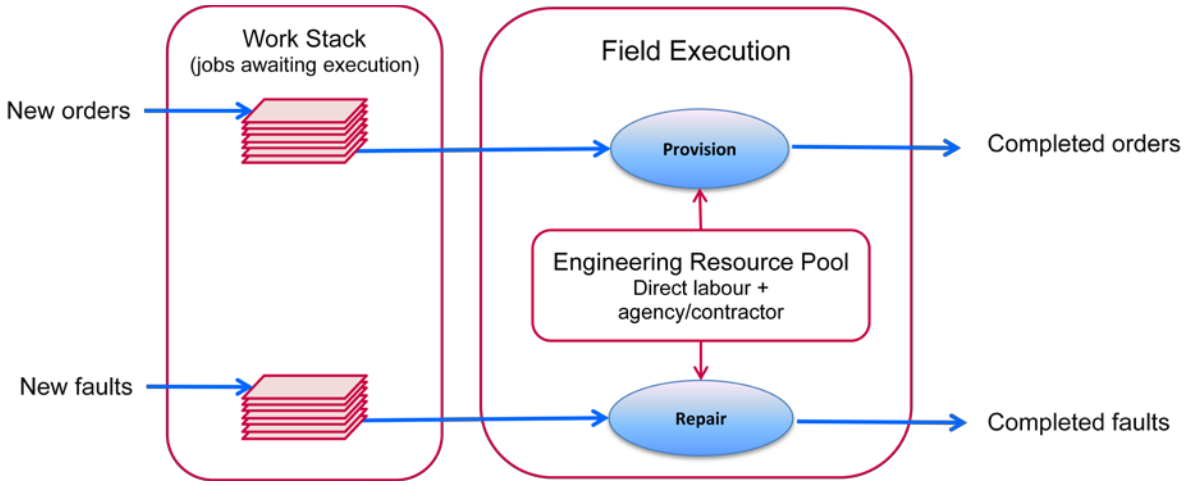
- a further study of the theoretical relationship between resources, demand and performance has provided useful insights about the likely scale of the resource increments required to improve service quality; and
- further analysis of the BT data using simple queuing formulae for the relationship between performance and resourcing has also provided useful insights about the likely scale of resource increments required to improve service quality.

A5.6 We describe our analysis below.

Relationship between demand, resources and performance

A5.7 Figure A5.1 shows a simplified process model of Openreach's field operations.

Figure A5.1: Simplified process model for Openreach



Source: Ofcom

A5.8 As new orders and faults arrive, they are placed in a work stack awaiting execution. Work is undertaken in order of arrival and thus orders and faults are taken from the bottom of the work stack for field execution (subject to necessary prioritisation e.g. by service level).

A5.9 Appointed orders are executed on the appointment date and the work stack is controlled by means of an appointment book which is populated with appointment slots that reflect the volume of field resources that will be made available each day for provisioning work. In normal circumstances sufficient resources are made available to meet provision demand. When fault rates are high, the number of appointment slots can be reduced and resources diverted to repair work and appointment lead times allowed to extend.

A5.10 The primary determinant of the process performance is the balance between the volume of work to be undertaken and the resources available to undertake it.

A5.11 When sufficient resources are available it should be possible to achieve a high quality of service (i.e. to complete the vast majority or faults and orders successfully within the agreed timescales). In practice, a small minority of faults and orders will not be completed successfully for example because of errors or because some jobs are too large to complete within the agreed timescales. Openreach's past performance suggests that when well resourced, Openreach can complete over 90% of orders and over 80% of faults successfully.[2]

A5.12 If work volumes exceed the capacity of the engineering resources available then performance will inevitably suffer. For example faults will not all be repaired within the target time and provisioning lead times will be extended.

A5.13 A particular feature of such processes is that after a period of excess demand, performance will not be fully restored until the backlog of work in the work stack has been cleared. Whilst the backlog exists all incoming work will spend longer than normal in the work stack waiting for resources to become available and consequently performance is impaired on an ongoing basis until the backlog is cleared. This feature means that performance is highly sensitive to the level of resources available to meet demand. In particular, performance is sensitive in the following ways:

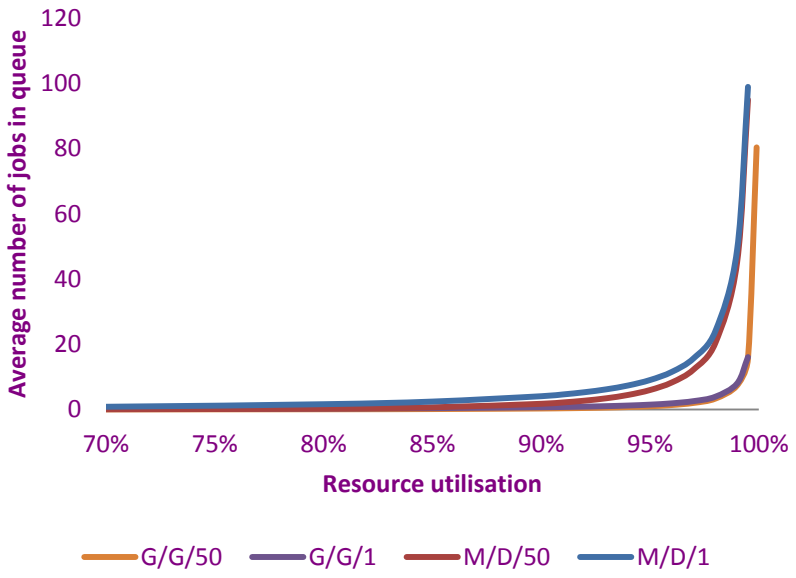
- sensitivity to peaks in demand: the time taken to clear a backlog of work generated by a short term peak in demand will depend on the amount of spare capacity available once demand has fallen back to normal levels. For example, if an organisation is presented with a peak of work 20% above normal for one week after which volumes return to normal, the backlog could be cleared and performance restored in approximately 1 week if the organisation has 10% spare capacity at normal volumes. However, if it has only 2% spare capacity the backlog would take approximately 5 weeks to clear. In the extreme, if the organisation has no spare capacity, performance would not be restored unless demand falls below normal.

- cumulative impact of small resource shortfalls: a small shortfall in resources relative to demand that persists over an extended period will cause the work stack to steadily increase and will consequently have a large impact on performance. For example if 10% of provision resources are diverted to repair activities for an extended period, assuming constant provision demand, order lead times would extend by 0.5 day per week and 2 days over a month.

A5.14 Operational processes of this type are known generically as queuing models and have been subject to detailed theoretical study. The sensitivity of performance to the level of resources is also evident in theoretical resource utilisation curves for such queuing models. Figure A5.2 below shows the theoretical relationship between resource utilisation and the average number of jobs queued for a selection of queuing models.

[2] For example, in 2009/10, completion of WLR orders by the appointment date was consistently above 94% and completion of MPF and SMPF orders consistently above 90%. See FAMR Consultation paragraphs A9.27 to A9.29. In 2009/10, completion of WLR Service Level 1 faults within the SLA timescales was generally above 80% and completion of MPF and SMPF Service Level 2 faults within the SLA timescales was at or above 80%. See paragraphs A9.33-A9.35, Ofcom, July 2013 FAMR Consultation - Annex 9.

Figure A5.2: Theoretical performance for a sample of queuing models[3]



Source: Ofcom

A5.15 Figure A5.2 shows that the number of jobs queued rises sharply as resource utilisation passes a certain threshold (e.g. beyond about 95% in the examples in Figure A5.2). The number of jobs in the queue also has a direct bearing on cycle time (i.e. the overall elapsed time from the arrival of a work item to when it is completed) and therefore performance against cycle time SLAs.[4]

A5.16 Clearly, at high levels of resource utilisation the queue length (and therefore performance) will be very sensitive to small variations in resource utilisation that might arise because of variations in work volumes and resource levels.

Practical considerations

A5.17 In practice, Openreach operates a large number of work queues for orders and faults (reflecting the geographic areas normally covered by teams of technicians and a range of differently skilled engineers required for the work) and thus the observed national performance reflects the overall average achievement for the full group of queues rather than an individual queue as in the theoretical example above.

[3] Figure A5.2 portrays the theoretical performance for queuing systems consisting of a single queue served by one or 50 servers (k=1 or 50). The G/G/k curves assume a generalised probability distribution for both inter-arrival time (the time between jobs arriving) and service time (the time taken to execute jobs). In the G/G/k case the distribution of queue length and associated statistics (mean, variance, etc.) are insensitive to the probability distribution of the inter-arrival time and service time. The curves are theoretical approximations as exact solutions are not available in most cases (see Dennis E. Blumenfeld, *Operations Research Calculations Handbook*, second edition, CRC Press, 2012). The G/G/k curves are for an arrival coefficient of variation (CV) of 0.4 and a service CV of 0.05, values derived from the resource and volume data obtained under our statutory powers. Coefficient of variation is the standard deviation divided by the mean of the sample data. The M/D/k curves assume an exponential inter arrival time distribution (Poisson arrival process) and a constant service time.

[4] In a single server scenario a queue length of 16 jobs indicates a cycle time equivalent to the time taken by the server to complete 16 jobs in the queue plus the time taken to service the job in the server (e.g. if the server completes 4 jobs per day, the cycle time would be 4.25 days to complete the 17 jobs).

A5.18 In practice, the demand patterns faced by Openreach are also more complex and vary from day to day as well as seasonally and from region to region.

A5.19 Openreach also has a significant amount of flexibility to manage its resources to meet demand. For example:

- Periods of low demand can be used to reduce or eliminate backlogs built up in periods of high demand provided resources are not reduced in line with the demand reductions. Sustaining resource levels can also be used to keep order and fault lead times low under normal circumstances to make performance more resilient to peaks of demand.

- Preventative maintenance work can be undertaken in periods of low demand to keep staff fully utilised that are not immediately required for provision and repair work. Preventative maintenance should reduce fault volumes.

- The level of resources available for repair can be increased during periods of high demand by:

  - redeploying staff from preventative maintenance activities;

  - using overtime;

  - by moving staff from areas with low demand to areas with high demand;

  - temporarily extending order appointment lead times within the range permitted by the SLA in order to redeploy field staff to repair activities;

  - using contractors; and

  - recruiting additional staff.

A5.20 Given this flexibility we would expect performance to be somewhat more resilient to variations in demand than the theoretical curve presented in Figure A5.2. We would nevertheless expect Openreach's performance to exhibit the generic characteristics of queuing models. In particular, we would expect:

- the balance between demand and resources to be the primary determinant of Openreach's provision and repair performance;

- Openreach's performance to become less resilient to peaks in demand at high levels of resource utilisation;

- a small shortfall of resources compared with demand to lead to a large drop in performance, particularly if the shortfall persisted for an extended period; and

- a small increase in resource (of the order of 5 to 10%) to lead to a significant improvement in performance in cases where performance has been impaired by resource shortages.

Ofcom analysis of cycle times and resource utilisation

A5.21 As explained above, provision and repair job cycle times consist of time spent waiting in the queue and time spent servicing the job. When the volume of orders and faults exceeds Openreach's resource capacity, excess work is placed in

queues thereby increasing provision and repair cycle times. Similarly if the volume of orders and faults is less than the resource capacity then the excess capacity will reduce the number of jobs in the queue and reduce cycle times. If over a period of time the volume of orders and faults matches the resource capacity then the number of jobs in the queue and the cycle time at the end of the period will not change compared to the beginning of the period.[5]

A5.22 The Average Time to Install (ATTI) orders and the Average Time to Clear (ATTC) faults provide an average measure of the cycle time over the measurement period. As cycle time is directly related to the number of jobs waiting in the queue, ATTI and ATTC provide direct indications of the volume of work not completed throughout each averaging period, e.g. each week or month. Increasing the resource capacity over some preceding period by an amount equivalent to the resource required to complete the outstanding work should significantly reduce the volume of work not completed and in turn reduce the ATTI and ATTC cycle time measures.[6]

A5.23 This relationship allows us to make a simple observation to gauge the potential impact of a small increase in Openreach's field resources on its performance in periods when performance is impaired by resource shortages. We observe that a 5% increase in Openreach's field resources would be equivalent to adding one extra working day per month to field resources.[7] These resources would be sufficient to reduce provision and repair cycle times by up to one day per month or up to 12 days per year (i.e. to reduce ATTI by one day per month or 12 days per year and similarly to reduce the ATTC by 14 hours per month[8]). This suggests that an increase of this size could have a significant impact on cycle time performance and therefore performance against the cycle time SLAs.

A5.24 The relationship between demand, resource and cycle times can also be used to derive a useful measure of resource utilisation which can show the resource shortfall or surplus causing an increase or decrease respectively in the cycle time over some period. Hence differences in ATTI or ATTC between an averaging period of interest and the preceding period provide a direct indication of the change in number of jobs not completed (queued) and hence an indication of the difference between demand and resources, i.e. resource utilisation, for the averaging period of interest compared to the preceding period.

A5.25 Assuming the outstanding work (queue length) does not reduce to zero during the period of interest then the change in queue length (dQ) at the end of the month of interest is the difference between the demand (D) arriving and resource (R) deployed in that month,[9] i.e.:

[5] However over time scales shorter than the period of interest there will be some fluctuation in queue length and cycle time due to the irregular arrival of provision and repair requests and the less but still irregular nature of servicing the jobs.
[6] The irregular arrival of provision and repair work may result in short periods when there is no work for the additional resource, resulting in inefficient use of the additional resource. Consequently deploying additional resource equivalent to the volume of work not completed may not always reduce the volume of incomplete work to zero. However this is less likely when the queues are operating in the high resource utilisation regions previously described in connection with Figure A5.2. The preceding period over which additional resources are deployed should be at least one and preferably many ATTI or ATTC averaging periods, i.e. typically many weeks or months.
[7] There are approximately 20 week days per month on average less bank holidays.
[8] There are 14 working hours per day for repair.
[9] This is likely to be the case when cycle times are extending.

$$dQ = D - R$$

A5.26 This can be re-arranged to show that resource utilisation (U) can be expressed as:

$$U = D/R = 1 + dQ/R$$

Where dQ is the difference between ATTI (or ATTC) for adjacent averaging periods, i.e. a week or month, and D, R and dQ must be expressed in common units, e.g. KMH (kilo-man hours).

A5.27 We have used this resource utilisation measure to gain an insight into the scale of the resource shortfall relative to demand in 2012/13 when Openreach suffered its most sustained period of reduced performance.

A5.28 In 2012/13 both provision and repair cycle times rose steadily from a low point in April 2012 after the weather deteriorated, peaking in January 2013. Table A5.1 below shows the cycle time changes that occurred over this period.

Table A5.1: Change in Provision and Repair Cycle Times in 2012/13

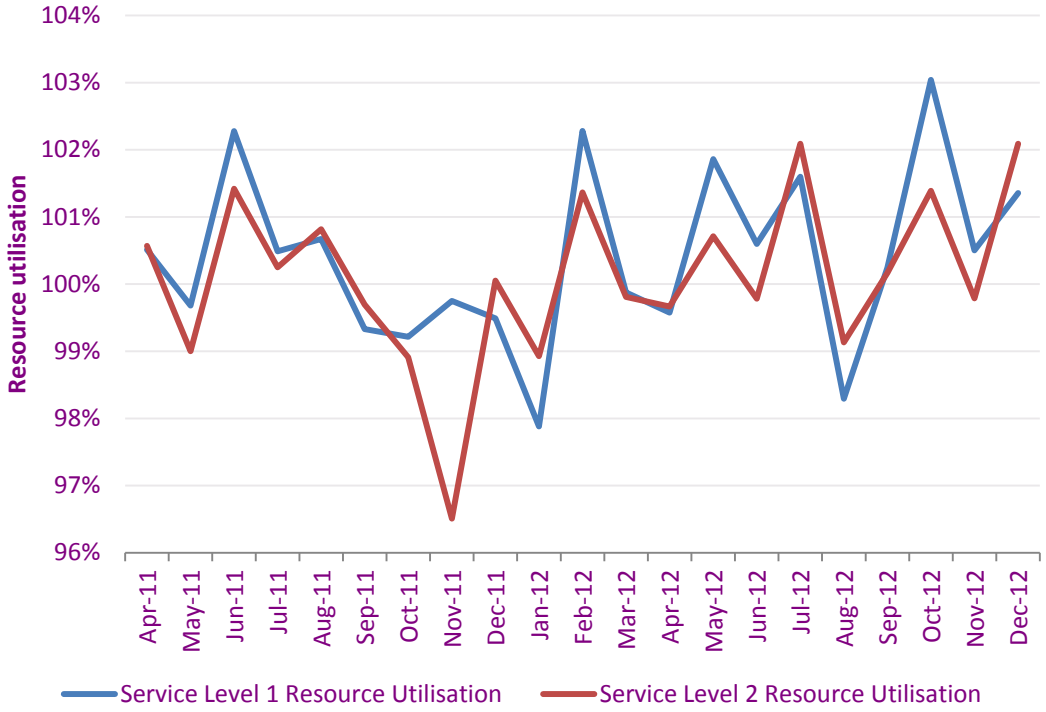
Measure	Service	April 2012 (low point)	January 2013 (peak)	Change
Provision Appointed ATTI (Working Days)	MPF	11.2	21.3	10.1
	WLR3	11.5	25.4	13.9
Repair ATTC (Working Hours)	MPF	19.4	34.5	15.1
	WLR3	23.3	50.8	27.5

Source: Openreach

A5.29 Figure A5.3 and Figure A5.4 below shows respectively for repair and provision, resource utilisation estimates derived from monthly ATTI/ATTC and resource information[10] using the second formula presented above.

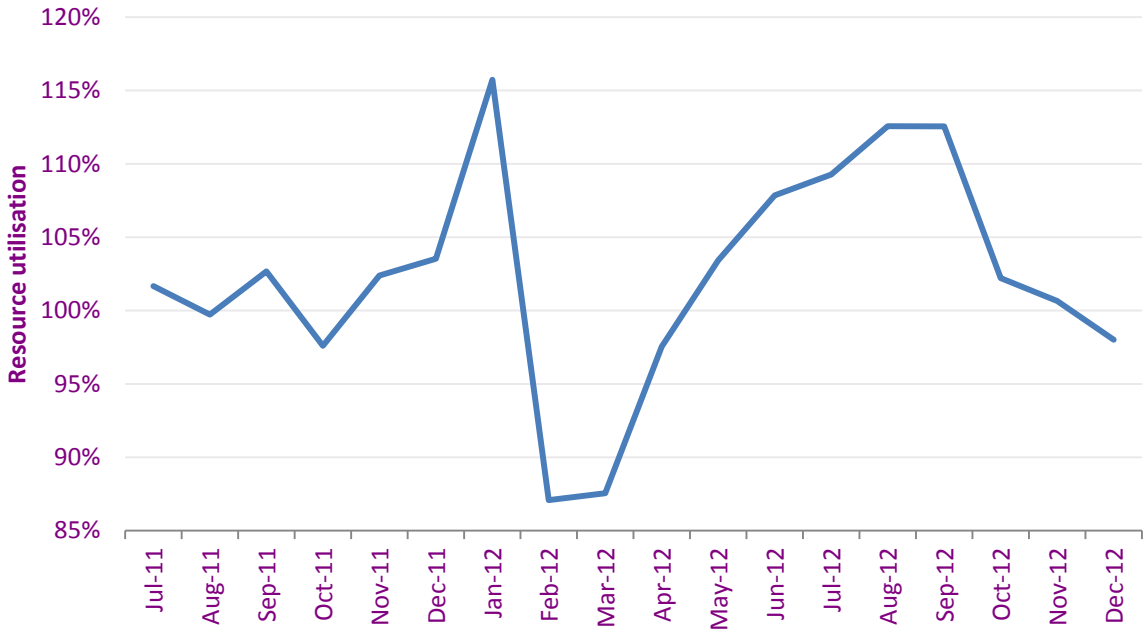
[10] Man hours booked to provision and repair activities.

Figure A5.3: Openreach repair resource utilisation[11]



Source: Ofcom analysis of Openreach data

Figure A5.4: Openreach provision resource utilisation (appointed orders)



Source: Ofcom analysis of Openreach data

[11] Service Level 1 includes WLR3 analogue and BT Classic while Service Level 2 includes WLR analogue, BT Classic, MPF and SMPF products.

A5.30 In Figure A5.3 and Figure A5.4, utilisation above 100% indicates that demand exceeded resources and therefore cycle time extended. Conversely, utilisation below 100% indicates that resources exceeded demand and cycle times reduced.

A5.31 These measures illustrate the balance between resources and demand but do not give any insight into the absolute level of resources deployed. They must therefore be considered in the context of Openreach's decision to divert resources from provision to repair after the weather deteriorated in 2012. Table A5.2 below shows the overall differences between 2011/12 and 2012/13 field resourcing for copper provision and repair field activities recorded by Openreach.

Table A5.2: Openreach field resourcing[12]

Man hours (thousands)	2011/12	2012/13	Difference between 2011/12 and 2012/13
Field provision (excluding NGA)	[✂]	[✂]	[✂]%
Field Repair (excluding payphones)	[✂]	[✂]	[✂]%
Total	[✂]	[✂]	[✂]%

Source: Openreach

A5.32 We observe in Table A5.2 that Openreach chose to divert resources from provision to repair in 2012/13. This was consistent with priority given to repair by Openreach and its customers and reflected the increase in repair demand. There was a small overall resource increase in 2012/13 compared with 2011/12 of [✂]%.

A5.33 Figure A5.3 suggests that after these mitigating actions, between April 2012 and December 2012, the shortfall in repair resources was relatively small, ranging from 1% to 3% per month. Figure A5.4 suggests that for provision the imbalance between demand and resources peaked at about 13% in July and August 2012 and is likely to be mainly a function of the diversion of resources to repair.

A5.34 We consider that these estimates give a reasonable indication of the shortfall in resources that led to the fall in performance in 2012. The steady increase in cycle times indicates that from April onwards, there was a sustained shortfall in resources relative to demand and therefore Openreach was generally operating in the high utilisation region of the theoretical curves in which the cycle time and resource utilisation formulae are valid. However, these estimates treat Openreach as a single queue and use monthly data for the whole of Openreach. They therefore represent a blended average picture for the whole of Openreach and do not show local and regional variations which could be better or worse. They should therefore be regarded as indicative.

Our review of the Resource Simulation Model

A5.35 As we explained above, we have investigated the Resource Simulation Model to determine whether it could provide a sound basis for estimating the resource

[12] Eleventh LLU WLR information request of 4 October 2013 sent to and received from British Telecommunications plc.

impacts of service quality improvements that could form an appropriate input to our regulatory cost models.

A5.36 Here we review the Resource Simulation Model specifically in the context of the resource estimates for performance improvements. In Section 4 we review it in the context of the service level resource differential estimates.

Overview of the model

A5.37 The Resource Simulation Model is a model commissioned by Openreach from Ernst and Young to explore the relationship between QoS and resources for its main services (MPF, analogue and digital WLR, SMPF and GEA).The model was also subsequently adapted to explore the resource differential for fault repairs between Service Level 1 and Service Level 2 services. We discuss this feature further in Section 4.

A5.38 The model is of a type known as a 'discrete event simulation' that is often used to model the operation of queue based processes. With this type of model, the arrival, queuing and processing of individual events (in this case faults and orders) is explored using a time sequence simulation in order that the performance characteristics and resource requirements of the process can be assessed.

A5.39 Typically such queuing models are used to estimate the performance that can be achieved by different resource algorithms given a specified pattern of inbound work to a queue. The Resource Simulation Model operates in a different way. With this model, the performance achieved by Openreach on a weekly basis is also taken as an input and the main output is an estimate of the volume of resources required to achieve that performance. The model is first calibrated so that the simulated weekly performance closely matches that actually achieved by Openreach. Performance can then be adjusted by altering the distribution of job completion times and the resource impacts assessed. In effect, this means that performance improvements are simulated by uplifting the baseline performance profile.[13]

A5.40 The model is built using a combination of Microsoft Excel and the simulation software package Simul8 and follows a three stage process:

- Calculation of input parameters for a given scenario in Excel;
- Simulation of the scenario in the Simul8 package and export of the results to Excel; and
- Post-processing of the simulation results in Excel.

A5.41 The model simulates Openreach's performance for the operational areas of each of Openreach's 9 GM areas for the years 2010/11 and 2012/13. It takes as its main inputs summaries of faults and orders received each half day, weekly performance figures and average job durations.

Independent review of the model

A5.42 We considered it appropriate to seek independent verification of the model and the resource estimates produced by it. We therefore commissioned consultants AM to

[13] See Section 2.2.3, Analysys Mason, QoS Model Report for further details.

undertake a thorough review of the model. AM obtained a copy of the model for review and also replicated many of the resource estimates produced by Openreach.

A5.43 We have published AM's QoS Model Report detailing their findings alongside this consultation.

Openreach's resource estimates

A5.44 Openreach first ran the model with 2011/12 and 2012/13 data to simulate the week by week performance achieved in each year in order to produce the baseline resource estimates against which the resource estimates for performance improvements can be assessed.

A5.45 When originally modelled with the 2012/13 input data, the large fall in provisioning performance led to an unrepresentative spike in resource requirements. This was because the backlog in orders became a key driver of the resource estimates particularly towards the end of the year. Openreach considered these results to be unrepresentative and as a result adjusted the input data such that the weekly performance was held constant at the annual average.

A5.46 Table A5.3 below presents the 2011/12 and the re-modelled 2012/13 baseline results together with the overall annual average performance achieved. As we explain later in this Section, these figures have a bearing on our conclusions about the model.

Table A5.3: Openreach's baseline resource estimates

	2011/12	2012/13
Repair performance excluding MBORC faults (% faults completed within SLA timescales)	79%	63%
Provision performance for provisioning appointment SLA of 13 days (% orders completed within 13 days)	65%	42%
Resource estimate Full Time Equivalents	[✂]	[✂]
Resource estimate Man hours (thousands)	[✂]	[✂]

Source: Openreach Resource Simulation Model outputs submission to Ofcom on 7 November 2013.

A5.47 We asked Openreach to simulate a range of performance improvements as illustrated in Table A5.4 so that the relationship between performance and resources could be assessed.

Table A5.4: Performance scenarios modelled

Base line resource estimates	2011/12 & 2012/13
Performance improvement estimates	As per table below for each base year

Repair Performance excluding MBORC faults (% of faults completed by SLA target)	Provision Performance for Provisioning Appointment SLA of 13 days, 12 days and 11 days (% of orders completed within Appointment Timescale)		
	75%	80%	85%
75%	X	X	X
80%	X	X	X
85%	X	X	X

A5.48 Table A5.5 and Table A5.6 below present Openreach's estimates of the resource impacts of various improvements in provision and repair performance in 2011/12 and 2012/13 respectively. Results are presented for both a 13 day and an 12 day appointment availability SLA. The estimates are expressed as percentage increases in field engineering FTE against the baseline resource estimates shown in Table A5.3 above.

A5.49 The resource estimates reflect average achievement of the performance targets across each of Openreach's 9 General Manager areas (the units used for the simulations). Openreach considered that the estimates would need to be increased if Ofcom were to apply more granular targets such as Openreach's 26 forecast areas or its 58 Senior Operations Manager areas.

A5.50 The simulation includes all faults handled by Openreach including those affected by a force majeure declaration (referred to as Matters Beyond Our Reasonable Control or MBORC by Openreach). However, the performance targets exclude faults affected by MBORC. Thus a repair performance measure based on all faults (including MBORC) would be slightly lower as a small proportion of faults are affected by MBORC declarations.

A5.51 In estimating the resource impact of achieving an 85% target on both provision and repairs, BT has applied an uplift to average task times. BT's position is that to achieve a performance of 85%, would require technicians to be deployed outside their normal local area of work more frequently and that this would result in increased task times. In Table A5.5 and Table A5.6 we show two sets of figures for additional resources that would be required to achieve an 85% performance standard. The first includes the uplift applied to average task times by Openreach whilst the second set, calculated by Analysys Mason assumes no uplift. We discuss this further in paragraph A5.66 below.

Table A5.5: Resource Simulation Model outputs for 2011/12 baseline showing additional resources required for specified performance improvements[14]

Repair Performance excluding MBORC faults (% of faults completed by SLA target)	Provision Performance for Provisioning Appointment SLA of 13 Days (% of orders completed within 13 days)			
	75%	80%	85% with uplifted task times	85% without uplifted task times[15]
75%	1.3%	3.7%*	6.3%* - 10.1%*	6.0%
80%	1.6%	3.3%	6.0% - 9.3%	6.0%
85% with uplifted task times	6.7% - 10.0%	9.0% - 12.3%	11.0% - 17.5%	-
85% without uplifted task times[15]	3.3%	5.1%	-	7.1%

Repair Performance excluding MBORC faults (% of faults completed by SLA target)	Provision Performance for Provisioning Appointment SLA of 12 Days (% of orders completed within 12 days)			
	75%	80%	85% with uplifted task times	85% without uplifted task times[15]
75%	2.2%	3.7%	5.7% - 9.6%	5.5%
80%	2.6%	3.9%	6.3% - 9.7%	6.3%
85% with uplifted task times	8.4% - 11.8%	10.3% - 13.9%	12.4 % - 19.0%	-
85% without uplifted task times[15]	5.0%	6.5%	-	8.1%

Source: Openreach Resource Simulation Model outputs submission to Ofcom on 7 November 2013 and Ofcom analysis.

Note: Empty cells relate to scenarios not modelled.

[14] Openreach considers that the model results marked with asterisks have been affected by outlying data points and are likely to be a slight over estimate.
[15] Non-uplifted figures calculated by Analysys Mason.

Table A5.6: Resource Simulation Model outputs for 2012/13 baseline showing additional resources required for specified performance improvements[16]

Repair Performance excluding MBORC faults (% of faults completed by SLA target)	Provision Performance for Provisioning Appointment SLA of 13 Days (% of orders completed within 13 days)			
	75%	80%	85% with uplifted task times	85% without uplifted task times[17]
75%	14.1%	17.2%	20.5% - 24.1%	-
80%	14.9%	18.1%	20.8% - 26.3%	20.7%
85% with uplifted task times	20.4% - 24.5%	22.9% - 27.1%	24.9% - 29.5%	-
85% without uplifted task times[17]	-	21.1%	-	23.3%

Repair Performance excluding MBORC faults (% of faults completed by SLA target)	Provision Performance for Provisioning Appointment SLA of 12 Days (% of orders completed within 12 days)			
	75%	80%	85% with uplifted task times	85% without uplifted task times[17]
75%	16.3%*	19.25%*	-	-
80%	16.8%	20.0%	22.0% - 24.6%	20.1%
85% with uplifted task times	-	24.3% - 26.6%	26.7% - 31.5%	-
85% without uplifted task times[17]	-	22.0%	-	24.9%

Source: Openreach Resource Simulation Model outputs submission to Ofcom on 7 November 2013 and Ofcom analysis.

Note: Empty cells relate to scenarios not modelled.

Analysys Mason review of the simulation model

A5.52 AM's overall impression was that a useful and productive effort had been made to significantly improve the understanding of the relationship between Openreach's QoS and resources that previously had not been addressable in a systematic way. The model appeared to be well built and to be without significant errors in the coding and implementation and not to be biased towards results more favourable to

[16] Openreach considers that the model results marked with asterisks have been affected by outlying data points. Figures presented are Openreach's estimates based on interpolation of adjacent data points.
[17] Non-uplifted figures calculated by Analysys Mason.

Openreach. The model outputs also appeared to be consistent and replicable. AM did however, consider that there were some material issues with the model which reduced their confidence in the model outputs. In particular, AM highlighted the following:

- In the model a gamma distribution is used to represent the waiting time of jobs in the queue prior to execution. AM considered that the method used to shape the distribution to simulate different levels of performance was not unreasonable per-se. However, other methods with similar levels of justification could have been chosen which could reasonably have increased or decreased the peak of the distribution and therefore the resource estimates.[18]

- The uplift applied to job durations for performance above 80% which had a significant impact on the resource estimates and in AM's view lacked justification.

- The reporting of the peak resources, which implies a level of idle resource, which may lead to a systematic overestimate of resource requirements; and

- The significant impact on the resource estimates of the choice of the 'resource re-distribution' methodology used to take into account the flexibility between skill groups in Openreach's workforce.

A5.53 AM noted the actual resource estimates for performance improvements produced using the 2012/13 as a base year were much larger than when using 2011/12 data to achieve the same performance standard. AM said it was not in a position to determine which year would be the most representative of future years, though it noted that Openreach advocated 2012/13. AM did however, find that the adjustment made to the 2012/13 provision input performance data (as discussed in paragraph A5.45 above) would have the effect of increasing the resource estimates for performance improvements.

A5.54 AM also reviewed the methodology used to assess the resource differential between repair Service Levels 1 and 2. We discuss this in Section 4.

Our assessment of the resource simulation model

A5.55 We share AM's view that a useful attempt has been made to investigate the relationship between performance and Openreach's resources. We do, however, consider that AM's review of the model has identified some significant issues, which need to be taken into account in our consideration of whether the resource estimates can form a suitable input for our regulatory Charge Control models. Below we consider five issues before then considering the suitability of the 2012/13 and the 2011/12 resource estimates for our purposes in light of those issues.

Consideration of the simulation approach

A5.56 We explained above that the simulation approach used in this model differs from a normal discrete event simulation in that the model takes the actual performance achieved by Openreach as an input. Simulating the week-by-week performance and then uplifting it to explore the resource impacts seems a reasonable way of exploring the resource impacts of performance improvements. Taking account of the observed variations in performance arguably makes the simulation less

[18] For an explanation of the gamma distribution and how it is used to adjust performance, see Section 3.2, Analysys Mason, QoS Model Assessment.

theoretical than a more traditional approach to discrete event simulation (which would assess resource requirements only by reference to order and fault arrivals) since the variations of performance could reflect factors impacting performance that are not modelled directly such as local variations in demand. It does, however, mean that the resource estimates for performance improvements are being assessed against an imperfect outcome that reflects the resourcing decisions that led to performance being below the desired level in the first place. It could therefore be likened to correcting a problem rather than preventing it. A particular risk is that the resource estimates may be a function of much larger volume of resources required to clear backlogs that have built up over a prolonged period rather than the smaller increases required to prevent them occurring in the first place. This appears to be the case with the 2012/13 simulation which, prior to the adjustments made by Openreach, produced an unrealistic peak in the resource estimates towards the end of 2012 to address a backlog of orders. Consequently, we consider this simulation approach is most likely to produce representative results in years when performance was relatively stable and large backlogs did not occur.

Consideration of the resource estimation approach

A5.57 The Resource Simulation Model uses a two-step process to estimate the resources required in any given performance scenario. Firstly the discrete event simulation is executed and used to determine the resource requirements for each skill group on each day of the year. These initial resource estimates do not take full account of the flexibility within the skill groups to undertake other skill groups' work. Consequently, a further calculation referred to as "resource re-distribution" is performed to take this flexibility into account.

A5.58 The model contains two versions of the resource re-distribution calculation referred to as the Maximum Day approach and the Top N approach. Both assess resources by reference to peaks in demand for resources in each skill group. The Maximum Day approach assesses the amount of resources available to work on lower skilled work on off-peak days by reference to the highest peak observed (the 'maximum day'). The Top N approach assesses the amount of resources available to work on lower skilled work on off-peak days by reference to the average of the Top N days where N is a number set by the user. AM considered the Top N calculation not to be a useful measure of resources because it had the effect of restricting the amount of spare resources made available to do lower skilled work on off peak days, thereby leading to higher resource estimates. The Top N method is only used to produce the service level differential resource estimates and we therefore discuss its use further in Section 4.

A5.59 AM concluded that the Maximum Day approach used for all of the baseline resource estimates and the performance improvement resource estimates would systematically overestimate the resource requirements. This is because resource requirements are estimated by reference to the highest peak in demand for each skill group and a significant proportion of resources are assumed to be idle on most days of the year. The potential of these idle resources to be usefully deployed and to improve performance on off-peak days is not taken into account by the model.

A5.60 AM was not however able to determine what impact the overestimates would have on the resource estimates for performance improvements (resource deltas) which are the percentage difference between baseline estimates and a resource estimate for improved performance. For our regulatory models, it is the resource deltas that are of most interest. Therefore the absolute levels of the resource estimates are less important provided the resource deltas are not adversely affected.

A5.61 AM also found that the resource re-distribution methodology used had a strong influence on the resource deltas. AM tested an alternative version of the Top N calculation. AM's methodology used the average resource requirement for the top N days as both the resource to redistribute (to make available for lower skilled work on off-peak days) and the required resource per skill level.[19] This approach sets resources at a level somewhat below the highest peak in resource requirements (i.e. demand will not be fully resourced on those days). AM used 2011/12 data to model 85% provision performance against a 12 day appointment lead time and 85% performance for repair. AM found that with values of N greater than 1, its method gave lower absolute resource estimates and lower resource deltas than the Max Day method used by Openreach for its estimates. Increasing the value of N gave progressively lower absolute resource estimates and resource deltas. With N set to 25 (the highest value tested) AM's method gave a resource delta of 0.55% compared with 8.11% for the Max Day method used by Openreach.

A5.62 AM did not suggest that its alternative Top N calculation should be adopted but on the basis of its analysis concluded that the Maximum Day calculation may result in an overstatement of resource deltas for improvements in performance or SLA targets.

A5.63 In our view, AM's analysis suggests that the Maximum Day approach may overstate the resource deltas somewhat. In particular it suggests that the model may put too much emphasis on uplifting resources on days of peak demand and that performance improvements could more efficiently delivered by improving performance on off peak days. However, given the complexity of the model and the sensitivity of the results to the observed patterns in the fault and order data it is difficult to be definitive as to the extent of any overstatement.

Consideration of the method used to shape the gamma distribution

A5.64 In the model, the mode (peak) of the gamma distribution was set at one day before the SLA target for provision and repair Service Level 1 jobs. For repair Service Level 2 and above the peak was set at half a day.[20] AM considered that this approach was reasonable for the baseline modelling as it did not introduce a significant error when compared with the empirical completion distribution data. However, it was less clear that it was appropriate to use these settings for other performance scenarios.[21] AM considered that alternative choices with similar levels of justification could reasonably have increased or decreased the resource estimates.

A5.65 We share this view. Whilst the method used does not seem unreasonable, it is unclear whether it gives a representative distribution of job completions as performance increases. This may be more of an issue for provision jobs given the very much longer timescales involved than repair jobs and the greater degree of influence that Openreach is able to exert over the workflow via its appointment books. The resource estimates are driven by the peaks in the gamma distribution so

[19] For details of the resource redistribution methodologies used by Openreach see Section 2.4, Analysys Mason, QoS Model Report. See Section 3.3 for further details of Analysys Mason's alternative methodology.
[20] For an explanation of the gamma distribution and how it is used to adjust performance see Section 3.2, Analysys Mason, QoS Model Report.
[21] The method used was to set the mode (peak) of the gamma distribution at 1 working day before the SLA target except for repairs with a one day SLA for which the mode was set at 0.5 working days before the SLA target.

an unnecessarily 'peaky' profile would lead to resources being overestimated. In our view, this warrants further consideration as a possible refinement to the model.

Consideration of the uplift to average job durations

A5.66 In the model, the average task times used for each task type are the monthly averages achieved in each GM area in the base year. Openreach considers that this does not capture the increase in average task times associated with higher levels of performance that would arise because technicians would have to travel outside their normal working area more frequently. Consequently for performance above 80% Openreach has applied an uplift to the average task times as a sensitivity to the resource estimates. For provision the uplift is 0% to 5% and for repair 5% to 10%. Openreach has explained the basis for the uplift in the documentation accompanying the Resource Simulation Model.[22] AM recognised that job durations might increase as performance increases but considered that the ranges specified by Openreach to be aggressive. They considered the non-uplifted estimates presented in Table A5.5 and Table A5.6 for 85% performance to be most realistic because the information given by Openreach in their view implied an overall uplift of around 1%.

A5.67 We also have concerns about the explanation given. Firstly, Openreach has not provided any empirical evidence that the incidence of out of area working would increase at higher levels of performance and it is not clear to us that this would necessarily be the case. It might equally be the case that the improvement in performance would be enabled by the additional resources estimated by the model rather than more out of area working. Secondly, the uplifts applied by Openreach to average task times implies a very much larger increase in out-of-area working than suggested by Openreach in its explanation. Table A5.7 below summarises Openreach's estimates of the increase in out-of-area working and task times. It also shows our calculation of the implied increase in overall average task times derived from these figures and our calculation of the increase in out of area working implied by the increases in overall average task times proposed by Openreach.

[22] Pages 6-10, Openreach, *Openreach analysis of additional factors impacting service costs in very high performance scenarios*, November 2013 (Openreach Supporting Document on the Model).

Table A5.7: Resource uplift estimates

	Repair	Provision
Openreach estimate of increase in out-of-area working for performance about 80%[23]	1% to 5%	1% to 5%
Openreach estimate of difference in task times between in-area and out-of-area jobs	At least 16% higher than normal in-area jobs	
Ofcom calculation of the increase in resources implied by the estimates above	1.1% to 5.8%	1.1% to 5.8%
Average task time uplift sensitivities applied by Openreach as a sensitivity to all jobs	5% to 10%	0% to 5%
Ofcom calculation of the increase in out-of-area working implied by the Openreach task uplifts [24]	31% to 62%	0% to 31%

Source: Openreach Supporting Document on the Model and Ofcom analysis of Openreach data

A5.68 Openreach considers that at high levels of performance around 85% technicians would be required to work further afield more often and as a result average task times for out-of-area working could rise significantly above their 16% estimates. Even if this were the case and for example the average task time for out-of-area working rose to 40% above the general average task time, the uplifts would still imply a large increase in out-of-area working.

A5.69 Since AM completed their report, Openreach has provided information about two other factors that would be likely to increase average task times at higher levels of performance. Firstly, Openreach has said that it would be necessary to divert technicians more frequently from work in progress to work on other jobs in jeopardy of failing. Secondly, Openreach has said that at higher levels of performance, a greater proportion of particularly complex and labour intensive jobs would need to be completed within SLA timescales and that as a result peak resource levels would need to increase.[25] We acknowledge that these factors may have a bearing on average task times. However, from the information presented, it has not been possible for us to determine whether they would have a material impact on average task times as performance increases.

A5.70 In light of the above considerations, we consider that the uplift has not been adequately justified and therefore we do not propose to take it into account in our considerations of the resource estimates.

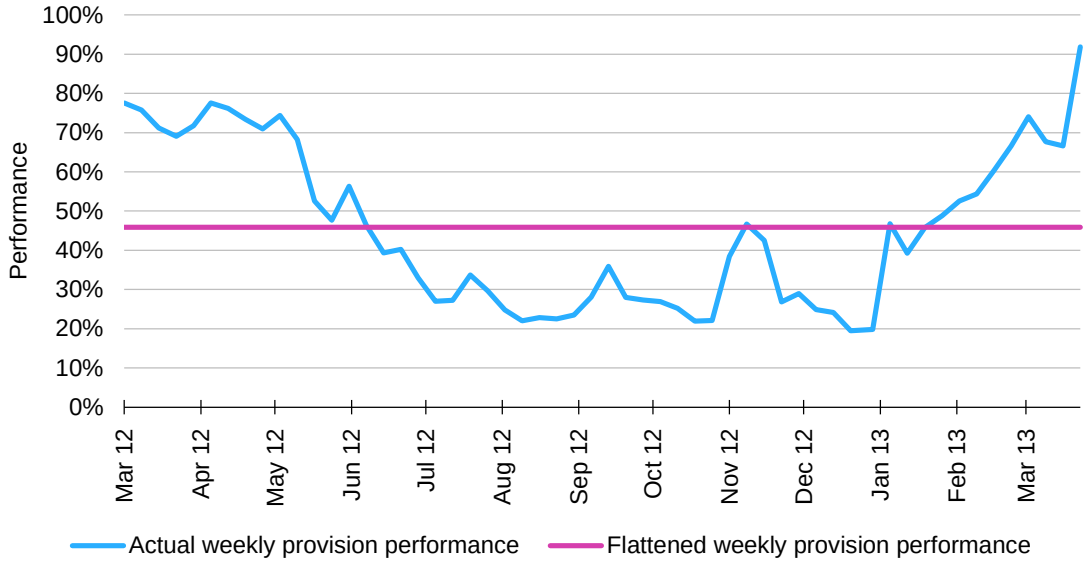
Consideration of the resource estimates

A5.71 We consider that the limitations in the simulation and resource estimation approaches discussed above are particularly apparent with the modelling of

[23] This increase would be in addition to the level of out-of-area working already allowed for in the average task times for the base years.
[24] In addition to the level of out-of-area working in the base year.
[25] Page 9, Openreach, Supporting Document on the Model.

2012/13. When originally modelled the 2012/13 input data produced an unrealistically high peak in the resource estimates towards the end of the year. This was because provisioning performance fell to a very low level in the summer leading to a backlog of orders, which in turn led the model to estimate an unrepresentative spike in resource requirements. As a result, Openreach adjusted the input data by completely flattening the provision performance profile, setting it at the annual average for the whole year.[26] Figure A5.5 below reproduces Figure 4.6 from the AM report showing the adjustment.

Figure A5.5: 2012/13 provision performance profile and adjustment made by Openreach



Source: Analysys Mason's QoS Model Assessment

A5.72 AM examined the impact of the adjustment and found that it had the effect of increasing the resource deltas for improvements in performance. This was because performance in the lowest performing weeks had been adjusted upwards with the result that more resources are required to improve performance than with a normal 'peaky' performance distribution.

A5.73 Whilst we acknowledge that 2012/13 may have been more challenging for Openreach than 2011/12 we find it difficult to reconcile the differences in the 2011/12 and 2012/13 estimates with the differences in the operational challenges faced by Openreach. In particular:

- We note there is a marked disparity in the movement in the baseline resource estimates produced by the model and Openreach's recorded resourcing patterns, the former being [✂]% higher in 2012/13 than 2011/12 and the latter [✂]% higher.

- The 2012/13 resource estimates for performance improvements are very high indeed and much higher than the 2011/12 resource estimates particularly when the [✂]% difference in the baseline resource estimates is taken into account. We find these estimates difficult to reconcile with the very much smaller differences in

[26] See Section 4.3.1, Analysys Mason, QoS Model Report for Analysys Mason's discussion of this adjustment.

the fault and order volumes between the respective years that we discussed in the July 2013 FAMR Consultation. They are also very much larger than the shortfall indicated by our resource utilisation studies described earlier in this Section.[27]

A5.74 In light of the above, our judgement is that there is little evidence that the differences in the operational challenges faced by Openreach could be responsible for the very much larger resources estimates in 2012/13 than 2011/12. In our view it is likely the differences have been driven more by a combination of the impact of the adjustment to the provision data as identified by AM and the limitations of the simulation and resource approaches in dealing with large drops in performance and the associated backlogs. We are therefore not persuaded that the 2012/13 resource estimates are sufficiently representative to form the basis of our Charge Control calculations.

A5.75 We consider that the 2011/12 modelling is likely to provide more representative estimates of the resource increments required to improve performance because unlike the 2012/13 estimates they are based on unadjusted input data. Also performance was more stable in 2011/12 and the results are less likely to have been unduly influenced by sustained backlogs which were, in turn influenced by resourcing decisions made by Openreach.

Our conclusions about the resource estimates produced by the Resource Simulation Model

A5.76 Our overall assessment is that the Resource Simulation Model has been partially successful in simulating Openreach's operations. The simulation approach adopted, whilst reasonable, has not coped well with the large fall in performance observed in 2012/13. Consequently we consider that the 2012/13 results are not reliable and are not therefore suitable for use as an input to our Charge Control models.

A5.77 We consider that the 2011/12 results are likely to be more representative because they are based on unadjusted input data and are modelled on a year in which performance was more stable. However, there remains some uncertainty about the resource deltas for performance improvements. As discussed above, the resource estimation approach appears likely to have an upward bias in determining the resource deltas and there is some uncertainty about the impact of alternative approaches to shaping the gamma distribution.

A5.78 However, a model of this type is necessarily a highly simplified representation of Openreach's operations and consequently there will be an irreducible level of uncertainty about the resource estimates even if the issues discussed above were addressed.

A5.79 Our view is that the 2011/12 resource estimates provides us with a reasonable basis to assess the resource increments and therefore the cost impacts associated with the imposition of minimum standards. Whilst we acknowledge that there is some uncertainty, they are also in line with our own analysis discussed in this annex, which indicates that even the significant fall in performance in 2012/13 stemmed from a relatively small shortfall in resources and also that a relatively small increase in resources would have a significant impact on performance.

[27] See July 2013 FAMR Consultation - Annex 10.

A5.80 We acknowledge Openreach's view that the difference between fault levels in 2011/12 and 2012/13 represents the differences in the demand Openreach experiences and it would be desirable to model resource demands in 2012/13 as well as 2011/12. However, as discussed above we do not consider that the model can produce reliable results for 2012/13.

A5.81 Accordingly, therefore there is a possibility that the 2011/12 resource deltas would underestimate the additional resources required to maintain performance in a more challenging year. We have observed that despite a [✂]% increase in overall field resources 2012/13 performance was still significantly below 2011/12. Clearly in part this was a factor of the environmental conditions leading to higher fault volumes and increased average task times (particularly in the latter part of the year).

A5.82 However, it is clear resources were not the only factor leading to lower performance in 2012/13. In particular, the available evidence suggests that Openreach was very slow to recruit additional resources in response to the increase in fault volumes in the summer of 2012. It is, therefore, unclear that meeting the demands of 2012/13 would necessitate a substantially greater resource base than 2011/12.

A5.83 We consider that that our proposal to base our MBORC allowance on 2012/13 outcomes addresses this concerns. This approach should ensure that the higher peak demands that led to MBORC declarations in that year are accounted for.

A5.84 We would also welcome the views of stakeholders as to whether it is appropriate to apply resource deltas for performance improvements to the higher 2012/13 outturn resource level rather than 2011/12 to account for the more challenging conditions in 2012/13.

A5.85 We have included questions about these points in Section 3.

Annex 6

EY Model Methodology Document (PDF)

A6.1 Please see the separate PDF document published alongside this consultation entitled, *Openreach's Discrete Event Simulation Model: Methodology Documen*t. This will be available here:

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-llu-wlr-charge-controls/annexes/annex6.pdf

Annex 7

Openreach Supporting Document on the Model (PDF)

A7.1 Please see the separate PDF document published alongside this consultation entitled *Openreach analysis of additional factors impacting service costs in very high performance scenarios*. This will be available here:

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-llu-wlr-charge-controls/annexes/annex7.pdf

Annex 8

Explanatory note for the Redistribution Worksheet

Introduction

A8.1 This Annex describes the Redistribution Worksheet, which forms part of the Resource Simulation Model commissioned by Openreach from Ernst & Young (EY) to explore the relationship between service quality and resources.

A8.2 As explained in Annex 5, the Resource Simulation Model is built using a combination of Microsoft Excel and the simulation software package Simul8. It follows a three stage process:

- calculation of input parameters for a given scenario in Excel;
- simulation of the scenario in the Simul8 package and export of the results to Excel; and
- post-processing of the simulation results in Excel.

A8.3 While it is not possible to provide the models underpinning the first two stages due to confidentiality restrictions, we are able to make the Redistribution Worksheet available. This worksheet performs the post-processing of the simulation results in Excel. It has been populated with randomised data, but can allow testing of alternative redistribution options.

A8.4 The spreadsheet can be downloaded here:

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-llu-wlr-charge-controls/annexes/redistributionworksheet.xlsx

A8.5 For details of the other steps that Ofcom has taken to ensure transparency about the model please refer to paragraphs 2.31 to 2.32 in the Introduction (Section 2).

Spreadsheet function

A8.6 The Resource Simulation Model is of a type known as a ‘discrete event simulation’. With this type of model, the arrival, queuing and processing of individual events (in this case faults and orders) is explored using a time sequence simulation, in order to assess the performance characteristics and resource requirements of a process.

A8.7 The Resource Simulation Model estimates the resources required in any given performance scenario via a two-part process. Firstly the discrete event simulation is executed and used to determine the resource requirements for each engineering skill group on each day of the year. These initial resource estimates do not take full account of the flexibility within the skill groups to undertake other skill groups’ work. Consequently, a further calculation referred to as ‘resource re-distribution’ is

performed to take this flexibility into account.[28] This function is performed by the Redistribution Worksheet.

A8.8 Below we set out our description of how the calculations in the Redistribution Worksheet are performed. Further descriptions are also included in EY's Model Methodology Document[29] and in Analysys Mason's QoS Model Report.[30]

Spreadsheet description

A8.9 The Redistribution Worksheet is located in the worksheet labelled Redistribution Spreadsheet.

Inputs

A8.10 The Redistribution Worksheet takes as its main input the simulation estimates of the number of technicians required in each of Openreach's four engineering skill groups on each day of the simulation. These are entered in the Max FTE Calculation area of the worksheet (columns B to E starting at row 28). Skill 4 is the most skilled group and Skill 1 the least skilled. Each group can do work of a lower skilled group e.g. Skill 3 can do Skill 2 or Skill 1 work.

A8.11 The other input field is the 'Top Days' parameter (cell E12). This is used to specify the number of days over which the 'Top N' resource averages are calculated.

Outputs

A8.12 The outputs of the model are resource estimates for each skill group and are displayed in cells I22, M22, Q22 and U22.

Calculation

A8.13 The Redistribution Worksheet performs a set of calculations that reference the daily resources estimates from the simulation to produce the output resource estimates. There are three main steps in this calculation:

- Step 1: Calculation of Top N averages;
- Step 2: Resource redistribution calculations; and
- Step 3: The output calculation.

<u>Step 1 – Calculate the Top N averages</u>

A8.14 The Top N averages, calculated for each skill group, are the resources that are made available for 'redistribution', meaning to do lesser skilled work on days when they are not fully occupied with work for their own skill group.

A8.15 The Top Days parameter is used to specify the number of days over which the Top N resource averages are calculated. The average is taken over the specified

[28] For a description of this algorithm see Section 2.4, Analysys Mason, *Quality of Service model assessment: Final Report for Ofcom*, November 2013 (Analysys Mason QoS Model Report).
[29] Section 3.8, Ernst & Young, *Openreach's Discrete Event Simulation Model: Methodology Document*, November 2013.
[30] Section 2.4, Analysys Mason, QoS Model Report.

number of days with the highest resource requirements. Thus, if Top Days is set to 10, the Top N averages are taken over the 10 days with the highest resource requirements. If Top Days is set to 1, the Top N figures are the same as peak resource values for each skill group (referred to as the Maximum Day or Max Day).

A8.16 The Top N averages are calculated by formulae in cells I24, M24, O24 and U24. The results of these calculations are referenced by the resource redistribution calculations.

Step 2 – Resource redistribution calculations

A8.17 The redistribution calculations are in the Max FTE Calculations area of the worksheets (columns I to U, starting at row 28). An identical set of calculations is performed for each set of daily resource estimates from the simulation.

A8.18 Starting with the most skilled work group, Skill 4, the number of spare resources available for redistribution on the day is calculated in column I by subtracting the Skill 4 resource estimate produced by the simulation from the Top N average for the skill group.

A8.19 These spare resources are then carried forward to work on tasks for the next skill group, Skill 3. The number of Skill 3 resources required is then calculated in column K by subtracting the Skill 3 resource estimate produced by the simulation from the spare Skill 4 resources.

A8.20 Next, the number of spare resources available for redistribution to the next most skilled group, Skill 2, is calculated in column N. This is calculated by subtracting the number of Skill 3 resources used from the Skill 3 Top N average and then adding any remaining spare Skill 4 resources.

A8.21 In columns O to U, the redistribution calculations are then repeated for the remaining two skill groups: Skill 2 and Skill 1.

A8.22 The results of these calculations are the adjusted daily resource estimates for each skill group, taking into account the redistribution of spare resources. The results are displayed in columns I, M, Q and U for the Skill 4, Skill 3, Skill 2 and Skill 1 groups respectively.

Step 3 Outputs

A8.23 The output resources estimates are calculated and displayed in cells I22, M22, Q22 and U22. These show the maximum values of the adjusted daily resource estimates for each skill group from columns I, M, Q and U.

Annex 9

Analysys Mason Quality of Service Model Report (PDF)

A9.1 Please see the separate PDF document published alongside this consultation entitled *Quality of Service model assessment: Final report for Ofcom*. This will be available here:

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-llu-wlr-charge-controls/annexes/annex9.pdf

Annex 10

CSMG Fault Rates Report (PDF)

A10.1 Please see the separate PDF document published alongside this consultation entitled *WLR and LLU Fault Rates Analysis: Final report, prepared for Ofcom*. This will be available here:

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-llu-wlr-charge-controls/annexes/annex10.pdf

Annex 11

Cost modelling for simultaneously provided services

Introduction

A11.1 In section 6 we set out our proposals to require BT to discount the price of services within the WLR Connections[31] basket when those services are provided simultaneously with SMPF New Provide[32] (we refer to this as "WLR+SMPF Simultaneous Connections"). We also noted in that section that there had been changes to our estimates of the costs underlying the simultaneous provision of WLR Conversion[33] and SMPF New Provide (we refer to this as "WLR+SMPF Simultaneous Migrations"). In addition, we explained our proposal to re-allocate costs across services involving jumpering work at the exchange to address some concerns raised by Openreach relating to under-recovery of their costs of providing these services, which arise out of our proposals in relation to simultaneously provided services.[34]

A11.2 In this Annex we explain our methodology for deriving the costs of the WLR+SMPF Simultaneous Connections and Migration services and provide further detail on our proposal to reallocate costs across services involving jumpering work at the exchange.

A11.3 In response to statutory information requests, Openreach has indicated to us that it does not hold information on the costs associated with the simultaneous provision of WLR and SMPF services.[35] In the absence of cost information on simultaneously provided services, we propose to use other services for which Openreach does report cost information to estimate the costs of those simultaneously provided services. This is the approach we proposed for WLR+SMPF Simultaneous

[31] This is a basket of two connection services. In particular, services "Supply of new Basic line - Per line" which we refer to as "WLR Standard Connection" and "Supply of new line - Per line – using previously stopped LLU MPF line" which we refer to as "WLR Start of Stopped MPF Line" in Openreach's price list, WLR Pricing, Wholesale Access (Analogue Lines), 25 June 2013, http://www.openreach.co.uk/orpg/home/products/pricing/loadProductPriceDetails.do?data=ccWy9ZJoVtf1gb2YRVL3pYSkcG%2Bc%2B30URCuKygKmgSNUNeIS4WkJBRh6z%2FRUAIt8maxtgrEro1A7%0Aw5V8nzAZpQ%3D%3D.

[32] This service relates to "SMPF Connection charge, Basic Provide on existing narrowband, Simultaneous Provide of SMPF with narrowband, Singleton Migration (Transfer or change of CP migrations) from Narrowband, MPF, SMPF and ISDN/ Highway" in Openreach price list, LLU Pricing, shared MPF, 24 May 2013, http://www.openreach.co.uk/orpg/home/products/pricing/loadProductPriceDetails.do?data=LI%2BLzfp8sh2Y2DndjiRMoqOJDXc5GerAOSBb9tNt8RglMnGHsqdC0vzO163bJmh34D91D7M0q8u%2F%0AIlSgtIFAKw%3D%3D.

[33] This service relates to "Conversion of Local Loop Unbundling (LLU) Metallic Path Facility (MPF) to a single Wholesale Access line" in Openreach price list, WLR pricing, Wholesale Access (Analogue Lines), 1 March 2013, http://www.openreach.co.uk/orpg/home/products/pricing/loadProductPriceDetails.do?data=PgMT6eI2nnlo4hhO70Yda27EtHRtVUAuOBA%2F5MusDN1UNeIS4WkJBRh6z%2FRUAIt8maxtgrEro1A7%0Aw5V8nzAZpQ%3D%3D.

[34] See paragraph 243, Openreach's Response to the July 2013 Consultation.

[35] See Openreach Response to the Twelfth LLU WLR BT Information Request (Question 12).

Migration in the July 2013 Consultation (i.e. the simultaneous provision of WLR Conversion and SMPF New Provide).[36]

A11.4 We received several comments from stakeholders on our proposed implementation of this approach when deriving the costs for WLR+SMPF Simultaneous Migration in the July 2013 Consultation.[37] In this Annex we summarise these stakeholder comments, describe our updated analysis and set out our proposals. We have structured this Annex as follows:

- first, we address stakeholder comments on our estimation of the costs of automating Openreach's billing systems;
- second, we address stakeholder comments and update our proposed analysis for WLR+SMPF Simultaneous Migration;
- third, we explain our proposals in relation to WLR+SMPF Simultaneous Connections; and
- finally, we explain our proposed approach to re-allocating costs across services involving jumpering work (given that BT's RFS costs for these services already reflect the cost savings associated with their simultaneous provision), including the volume forecasts used to re-allocate costs across these services.

Automated billing system for simultaneously provided connections and migrations

Proposals in the July 2013 Consultation

A11.5 In our July 2013 Consultation, we proposed to require Openreach to discount the price of WLR Conversion when purchased simultaneously with SMPF New Provide. A similar Special Offer had been introduced by Openreach in October 2012[38]. In the July 2013 Consultation we noted that Openreach had indicated to us that if the "Special Offer" were to be made permanent it would set up an automated billing process to substitute the existing manual billing rebate process. It estimated that this automation would cost [✂] [£75k-£150k].[39] Using assumptions regarding the expected lifetime of the asset, weighted average cost of capital and volumes of WLR+SMPF Simultaneous Migration over the charge control period, we estimated the unit cost for the charge control period as shown in Table A11.1 below.[40]

[36] See paragraphs 4.55-4.69, July 2013 Consultation.
[37] Stakeholder responses are available at http://stakeholders.ofcom.org.uk/consultations/llu-wlr-cc-13/?showResponses=true.
[38] For more details see paragraphs 4.53-4.54, July 2013 Consultation.
[39] Paragraph 4.59, July 2013 Consultation.
[40] Paragraphs 4.60-4.64, July 2013 Consultation.

Table A11.1: Annual unit cost from the automated billing system

	2014/15	2015/16	2016/17
Annuitised cost (£K)	[✂] [£20-30K]	[✂] [£20-30K]	[✂] [£20-30K]
Volumes (K)	1,057	1,167	1,273
Unit cost	[✂] [£0-0.05]	[✂] [£0-0.05]	[✂] [£0-0.05]

Stakeholder responses to the July 2013 Consultation

A11.6 We received comments from Openreach and EE on the way we had derived billing costs for our proposal set out in our July 2013 Consultation. Openreach noted that it broadly agreed with Ofcom's cost analysis of WLR+SMPF Simultaneous Migration, as it was consistent with the analysis presented by Ofcom in the 2013 WLR+SMPF Simultaneous Migration Dispute. Openreach explained, however, that the automated billing system development that would be required to fully meet Ofcom's combined product requirements would cost substantially more than the initial cost estimate of £75-£150K ([✂] [£400-650K]). Openreach explained that it had found that the Special Offer rebate process introduced inefficiencies in downstream provisioning processes for around 35% of the orders.[41] This had implications both in terms of the costs (which it estimated to be higher) as well as in delays to the implementation date for the systems development (2015/16 instead of 2014/15). Openreach suggested that we delay the introduction of the one-off price adjustment until 1 April 2015 in order to mitigate the under-recovery of costs that would otherwise result in the first year of the charge control.[42]

A11.7 In addition, Openreach disagreed with Ofcom's view that an automated billing system would only be implemented if the unit cost of automation was lower than that of manual billing. In contrast, it considered that the current manual rebate was unlikely to be an acceptable billing method to Openreach's customers on an ongoing basis because:

- it forced Openreach to track and monitor the correct level of rebates between bills (leading to negative customer experience);
- obliged CPs and Openreach to dedicate resources to reconcile rebates and to activities such as revenue assurance; and
- it is a retrospective billing solution that results in adverse cash flows for CPs.[43]

A11.8 EE agreed with the way we derived the costs of WLR+SMPF Simultaneous Migration. However, it considered that the costs of automated billing could be

[41] In its response to the July 2013 Consultation, Openreach states that "…*during provisioning, the two tasks included in the Special Offer are linked using an order reference number, which then separate during downstream delivery causing additional activity to track and reconcile these two orders".* See footnote 81 of Openreach, *Response to the July 2013 Consultation*, 30 September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Openreach.pdf (Openreach Response to the July 2013 Consultation).
[42] P. 43-45, Openreach Response to the July 2013 Consultation.
[43] P. 44, Openreach Response to the July 2013 Consultation.

spread across an even greater number of services in the event that Ofcom agreed to extend the approach used to include additional connection services.[44]

Ofcom's revised analysis

A11.9 There are significant differences between the cost estimates for the automation of billing systems provided by Openreach (an increase in the estimated development costs from [✂] [£75-150K] to [✂] [£400-650K] since the July 2013 Consultation). We have used the latest cost estimate provided by Openreach for the purposes of this consultation. We are in the process of interrogating further BT's revised cost estimate. To the extent that we maintain our proposals on WLR+SMPF Simultaneous Migration in our final decision on this issue, we will use our best estimate of the efficient cost for the relevant billing system.

A11.10 We explained in section 6 that we did not consider it appropriate to delay the one-off adjustment on simultaneously provided services until April 2015. Instead, we propose that our modelling reflects the costs of providing the services at each point in time. In other words, it will reflect the costs of a manual billing system until April 2015 and the costs associated with an automated billing system thereafter (as Openreach has indicated that it will develop the automated billing system by April 2015). This way our cost model will reflect the expected resource costs at each point in time (addressing Openreach's concerns that it should be allowed to recover the costs of supply) while at the same time ensuring charges are cost reflective.

A11.11 We continue to consider that an automated billing system is likely to be more efficient than a manual rebate system, and for this reason, we remain of the view that we should sense check the unit costs of an automated billing system against that of the existing manual system to ensure that the former is a lower cost solution.

A11.12 We have set out our proposals to set a charge control on the simultaneous provision of WLR Connections and SMPF New Provide in section 6. We expect that an automated billing system would also be used to provide these services. We therefore propose that our cost model should spread the total costs of automating Openreach's billing systems for these simultaneously provided services across both WLR+SMPF Simultaneous Migrations and Connections.

A11.13 In Table A11.2 we estimate the unit costs of such an automated billing system. We assume a unit cost of [✂] [£0-£0.50] in 2014/15 (to reflect the costs of a manual billing system).[45] In contrast, the unit cost is lower in the remaining years of the control, as we assume that Openreach will have developed an automated billing system from year 2015/16. This is consistent with our proposals in section 6. We only estimate the unit costs up to 2016/17, the last year of the charge control.

[44] P. 21, EE, *Response to the July 2013 Consultation*, September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/EE.pdf (EE Response to the July 2013 Consultation).

[45] We obtain the manual billing cost from Ofcom, *Dispute between BT and TalkTalk relating to MPF to WLR+SMPF simultaneous migration offer - Determination*, 23 April 2013: http://stakeholders.ofcom.org.uk/binaries/enforcement/competition-bulletins/closed-cases/all-closed-cases/cw_01097/Final_Determination_Non_Con1.pdf (2013 WLR+SMPF Simultaneous Migration Dispute Determination). In this dispute we estimated that Openreach's existing manual billing system had a unit cost of [✂] [£0-£0.50] in 2012/13 prices (see Table 6 of the dispute). We inflate this cost to reflect 2014/15 prices.

Table A11.2: Annual unit cost from the automated billing system

	2014/15	2015/16	2016/17
Annuitised cost (£K)	N/a	[✂] [£100-200K]	[✂] [£100-200K]
Volumes (K) – Migrations	N/a	834	909
Volumes (K) - Connections	N/a	958	942
Unit cost	[✂] [£0-0.50]	[✂] [£0-0.10]	[✂] [£0-0.10]

A11.14 In order to estimate the unit cost for the automated billing system we have used the same assumptions as in the July 2013 Consultation:

- we amortise the costs of the automated billing system (an upfront billing system cost of [✂] [£400K-£650K]) using an annuity approach;
- we assume the expected asset life of the billing systems will be 5 years;
- we apply an annual rate of return on this asset that is consistent with our estimate of Openreach's cost of capital of 8.8%; and
- we use the volumes for WLR+SMPF Simultaneous Migrations and Connections in our Base case volume forecast.

A11.15 Using these assumptions we estimate the annuitised cost to be [✂] [£100-200K]. Taking into account our base case volume forecast, this results in a unit cost between [✂] [£0-0.10] for each of WLR+SMPF Simultaneous Migration and WLR+SMPF Simultaneous Connection for the years 2015/16 and 2016/17 (when Openreach expects to have developed its automated billing system). This is below the unit cost of [✂] [£0-£0.5] for manual billing, as estimated in the 2013 WLR+SMPF Simultaneous Migration Dispute Determination.[46]

WLR Conversion when provided simultaneously alongside SMPF New Provide

Proposals in the July 2013 Consultation

A11.16 In the July 2013 Consultation we noted that BT had provided information on the costs underlying the simultaneous provision of WLR Conversion and SMPF New Provide services in the context of the 2013 WLR+SMPF Simultaneous Migration Dispute Determination referred to us by TalkTalk on 3 December 2012. In that dispute we compared the costs of an MPF Single Migration (on which we had financial data that we could use as a benchmark) to those of a WLR Conversion when provided simultaneously alongside SMPF New Provide ("WLR+SMPF Simultaneous Migration"). This allowed us to derive the difference in LRIC costs between the two services in 2012/13 prices and ultimately the underlying costs of WLR+SMPF Simultaneous Migration.[47]

[46] Paragraph 3.60, 2013, 2013 WLR+SMPF Simultaneous Migration Dispute Determination.
[47] Paragraphs 4.55-4.58, July 2013 Consultation.

A11.17 We estimated the differences between the two services (on a cost component basis) in 2012/13 and adjusted these 2012/13 costs to reflect the costs in every year of the charge control.

Stakeholder responses to July 2013 Consultation

A11.18 We received several comments from stakeholders on our approach to deriving the underlying costs of WLR+SMPF Simultaneous Migration. All stakeholders that provided comments, including FCS[48], [✂][49] Openreach (with the only exception of our approach to estimating billing systems costs)[50] and Verizon[51] agreed with the proposed approach to estimating the costs of WLR+SMPF Simultaneous Migration.

Ofcom's revised analysis

A11.19 We note that since the publication of the 2013 WLR+SMPF Simultaneous Migration Dispute Determination we have updated our assumptions regarding the costs of jumpering in the determination of a dispute relating to Single Jumpered MPF (the "Single Jumpered MPF Dispute").[52] In Table A11.3 below we present the differences between the costs of MPF Single Migration and WLR+SMPF Simultaneous Migration using jumpering costs consistent with those presented in the Single Jumpered MPF Dispute. This results in a slightly lower MDF Hardware Jumpering incremental cost difference than the one we presented in the July 2013 Consultation.

[48] P. 3, Federation of Communication Services, *Response to the July 2013 Consultation*, 23 September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Federation_of_Communication_Services_Ltd.pdf (FCS Response to the July 2013 Consultation).
[49] [✂]
[50] P. 45, Openreach Response to the July 2013 Consultation.
[51] Paragraphs 31-32, Verizon, *Response to the July 2013 Consultation*, September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Verizon.pdf (Verizon Response to the July 2013 Consultation).
[52] Paragraphs 4.101-4.105, CW/01109/06/13, *Dispute between TalkTalk Group and BT Openreach about single jumpered MPF*, 15 November 2013, http://stakeholders.ofcom.org.uk/enforcement/competition-bulletins/closed-cases/all-closed-cases/cw_01109/ (Single Jumpered MPF Dispute).

Table A11.3: LRIC differences between MPF Single Migration and WLR+SMPF Simultaneous Migration (excluding automated billing system) (2012/13)

Cost component	Incremental cost difference
MDF Hardware Jumpering	[✂] [£0 - £1.50][53]
Service Centres - Provision	Negligible
LLU Systems Development	-
Sales Product Management	[✂] [£0-£0.20]
Total	[✂] [£0-£1.70]

A11.20 Table A11.4 sets out our estimates of the cost differences between MPF Single Migration and WLR+SMPF Simultaneous Migration using the same approach as in the July 2013 Consultation but using the updated billing and jumpering costs described above.[54]

Table A11.4: Cost differences between MPF Single Migration and WLR+SMPF Simultaneous Migration (nominal prices) (2012/13-2016/17)

	2012/13	2013/14	2014/15	2015/16	2016/17
LRIC difference	0.69	0.68	0.66	0.65	0.63
Billing costs (manual and automated)	0.39	0.39	0.39	0.07	0.07
Total LRIC difference	1.08	1.07	1.05	0.72	0.70
Total FAC difference[55]	1.16	1.15	1.13	0.77	0.75

A11.21 We are proposing to use the above estimate of costs for WLR+SMPF Simultaneous Migration in our cost model.

[53] In the 2013 WLR+SMPF Simultaneous Migration Dispute Determination we estimated that the average number of jumper movements of the MPF Single Migration was [✂] [3.5–4], compared to 4 jumper movements in the case of the WLR+SMPF Simultaneous Migration. In the recent Single Jumpered MPF Dispute we estimated that the cost associated with a single jumper removal should be approximately [✂][£1.5-£3] (see paragraph 4.105 of the Single Jumpered MPF Dispute). Using these two assumptions we derive an incremental cost difference between the two services in terms of jumpering of [✂] [£0-£1.50] which is close to the differential we estimated in the 2013 WLR+SMPF Simultaneous Migration Dispute Determination.
[54] For more details see paragraphs 4.65 to 4.68 of the July 2013 Consultation.
[55] The FAC difference is obtained applying the estimated LRIC:FAC ratio of 0.93.

WLR Connections when provided simultaneously alongside SMPF New Provide

Ofcom's proposed approach

A11.22 In Section 6 we have set out our proposal to create a new WLR Connections basket that would encompass two services: (i) WLR Standard Connection (when there is no line in the exchange) and (ii) WLR Start of Stopped MPF Line. In Section 6 we have explained that we are proposing to require BT to discount the price of either of these two WLR Connections services when provided simultaneously alongside SMPF New Provide. We set out below our proposed approach to deriving the underlying costs of the services within the WLR Connections basket and SMPF New Provide when provided simultaneously.

A11.23 We requested information on the simultaneous provision of connection services from Openreach using our statutory information gathering powers (including cost, volume and revenue data). Openreach has confirmed that it does not capture any information on these services.[56] In addition, Openreach had no cost information on the WLR Start of Stopped MPF Line service. In these circumstances, we are proposing to derive the costs of these WLR and SMPF services as follows:

- **WLR Start of Stopped MPF Line**: we propose to use the costs of the WLR Standard Connection service as a benchmark (as this is the closest WLR service in terms of the underlying activities involved);

- **WLR Connections simultaneously provided alongside SMPF New Provide:** we propose to assess the costs of each of WLR Standard Connection and WLR Start of Stopped MPF Line, as well as those associated with an SMPF New Provide, and from this derive the costs of both services when provided simultaneously. In addition, we have undertaken a cross-check of our calculation against the costs of the equivalent MPF New Provide service.

A11.24 In Table A11.5 we present the costs allocated to each of (i) MPF New Provide; (ii) WLR Standard Connection; and (iii) SMPF New Provide in 2012/13 by our cost model.[57] We also present our estimate of the costs of (i) WLR Start of Stopped MPF Line and (ii) the simultaneous provision of WLR Connections (including for both WLR Standard Connection and WLR Start of Stopped MPF Line). The costs in Table A11.5 are the costs before we reallocate costs across services sharing jumpering-related work (as described from paragraph A11.28 below).

[56] Openreach Response to the Twelfth LLU WLR BT Information Request.
[57] Our cost model currently uses 2011/12 as the base year, however, we use the forecast costs for 2012/13 as these are more likely to reflect latest costs and because the year used to derive the costs of the WLR+SMPF Simultaneous Migration in the dispute was also 2012/13 (see paragraph 3.40 of the dispute).

Table A11.5: FAC of MPF New Provide, WLR Connections, SMPF New Provide and WLR+SMPF Simultaneous Connection services in 2012/13 (£)

	MPF New Provide	WLR Standard Connection	WLR Start of Stopped MPF Line	SMPF New Provide	WLR+SMPF Simultaneous Connection
Jumper movements	0, 2, 3 or 4[58]	1	3	3	2 or 4[59]
Wholesale Access Specific	0.00	1.21	1.21	0.00	1.21
Routing and Records	5.96	5.96	5.96	0.00	5.96
MDF Hardware Jumpering	30.42	21.12	25.35	25.35	[✂]
Service centres-Provision	2.93	10.07	2.93	2.93	[✂]
Sales Product Management	0.24	0.07	0.07	0.12	0.24
LLU Systems Development	0.13	0.00	0.00	0.13	0.13
TOTAL	39.68	38.43	35.52	28.53	[✂]

A11.25 In terms of the costs of the WLR Start of Stopped MPF Line, our estimated costs assume that the main differences between the costs of a WLR Standard Connection and the WLR Start of Stopped MPF Line are that the latter: (i) requires less engineering activity (because the line is already in place – e.g. it is unlikely to require a visit to the cabinet or the customer premises) and (ii) involves 3 jumper movements (i.e. remove 2 and install 1 jumper) compared to only 1 jumper movement in the case of the WLR Standard Connection. Thus, we assume the following on a cost component basis:

- **Wholesale Access Specific:** this cost component captures the cost of research and development projects, undertaken on behalf of Openreach, that are specific to access products including WLR. Development projects can range from high-level strategy, down to operational and logistical development.[60] We therefore assume identical costs in the case of WLR Standard Connection and WLR Start of Stopped MPF Line (as they are both WLR services).

[58] The jumper movements will depend on the underlying service within the MPF New Provides basket: (i) MPF Standard Connection: 2 jumper movements; (ii) MPF Start of Stopped Line: 0 jumpers (if same CP), 2 jumpers (from MPF), 3 jumpers (from WLR) and 4 jumpers (from WLR+SMPF); (iii) MPF Working Line Take Over: 0 jumpers (if same CP), 2 jumpers (from MPF), 3 jumpers (from WLR) and 4 jumpers (from WLR+SMPF).
[59] There will be 2 jumper movements when simultaneously supplying WLR Standard Connection and SMPF New Provide and 4 jumper movements when simultaneously supplying WLR Start of Stopped MPF Line and SMPF New Provide.
[60] The majority of operating and capital costs within Wholesale Access Specific come from Openreach's "Openreach Systems and Development (Product Specific)" plant group (PG772A). The description of this plant group can be found in p. 237, BT's DAM 2012.

- **Routing and Records:** this component captures the pay, non-pay, depreciation and balance sheet costs of routing and records work for provision of PSTN, ISDN, LLU and Private Circuts.[61] Routing and records is the physical verification of routings within the network, and records the time associated with the initial recording of routing details on BT systems.[62] We therefore assume identical costs in the case of WLR Standard Connection and WLR Start of Stopped MPF Line (as they are both WLR services).

- **MDF Hardware Jumpering:** this component captures the pay, stores and other non pay, depreciation and capital costs associated with jumpering activities on the Main Distribution Frame (MDF). MDFs are the interface between the Exchange-side cables and the Exchange-side switching equipment.[63] An MDF jumper is a copper connection that provides a flexible connection between two terminal ends, commonly used to connect the Line-Side to the Exchange-Side of the MDF. On the Exchange side the jumper is connected to tie cables that connect to various pieces of equipment: for example, in the case of WLR a PSTN Switch, for MPF a Test Access Matrix (TAM) and MPF operator equipment (e.g. MSAN), and for SMPF a DSLAM and subsequently the PSTN Switch. We assume that the MDF Hardware Jumpering cost for WLR Start of Stopped MPF Line should be higher than that allocated to a WLR Standard Connection (which involves only one jumper movement) and equal to the cost of the SMPF New Provide (which like WLR Start of Stopped MPF Line also involves 3 jumper movements).

- **Service centres – Provision:** this component captures the costs associated with Openreach's service division. These teams are call centre based and support the provisioning and repair of Openreach services. As the various teams support specific services, their costs cannot be spread on a direct pay or revenue basis.[64] We assume that the provision cost is the same as for MPF New Provide and SMPF New Provide. This is because in the case of WLR Start of Stopped MPF Line the line is already in place and tested and therefore the costs associated with this component should be lower than in the case of WLR Standard Connection.

- **Sales and Product Management:** these costs cover non-engineering costs incurred within the Sales and Product Management division of Openreach. The various sub-teams of this management division support specific services and thus their costs cannot be spread on a direct pay or revenue basis.[65] We therefore assume identical costs in the case of WLR Standard Connection and WLR Start of Stopped MPF Line (as both are WLR services).

- **LLU Systems Development:** this captures the cost of research and development projects, undertaken on behalf of Openreach, that are specific to products including LLU.[66] There is no LLU Systems Development in the case of

[61] P. 170, BT DAM 2012.
[62] P. 129, BT DAM 2012.
[63] The Exchange-side cable is the cable that links the exchange to the primary cross connection point In general, each pair of copper wires run from the customer's premises to the primary connection point (PCP). The PCP's are the cabinets that are located at the side of the road. The PCP connects the wires from the customer's premises to a pair of wires from the exchange. Inside the exchange the wires in the external cable are terminated on the main distribution frame (MDF) and then are connected to the internal exchange equipment.
[64] P. 224, BT DAM 2012.
[65] P. 222, BT DAM 2012.
[66] P. 237, BT DAM 2012.

WLR Start of Stopped MPF Line and we thus assume a zero cost in this category.

A11.26 In terms of the costs of the simultaneous provision of WLR Connections (both "Standard" and Start of Stopped MPF Line) and SMPF New Provide, our cost estimates are based on the following assumptions:

- **Wholesale Access Specific:** identical costs to WLR Standard Connection and WLR Start of Stopped MPF Line (as there are no SMPF New Provide costs involved);
- **Routing and Records:** identical costs to WLR Standard Connection and WLR Start of Stopped MPF Line (as there are no SMPF New Provide costs involved);
- **MDF Hardware Jumpering:** the simultaneous provision of WLR Standard Connection with SMPF New Provide would result in only 2 jumper movements, compared to 4 jumper movements in the case of WLR Start of Stopped MPF Line. We estimate that the WLR Connections basket when provided simultaneously with SMPF New Provide is likely to result in approximately [✂]. We therefore assume [✂] for this cost component[67];
- **Service centres – Provision**: the cost associated with this component will depend on whether the WLR service is either a WLR Standard Connection (which incurs higher provision costs) or a WLR Start of Stopped MPF Line (which incurs lower provision costs – as the line is already in place). We assume that service centre provision costs will be incurred once. We therefore assume [✂] for this cost component[68];
- **Sales Product Management**: we assume the same level of costs for the MPF New Provides and WLR+SMPF Simultaneous Connections;
- **LLU Systems Development**: we use the total costs allocated to SMPF New Provide.

A11.27 The costs derived in Table A11.5 above relate to the year 2012/13. To estimate the costs in each year of the charge control, we have used the same approach as proposed in the case of WLR+SMPF Simultaneous Migration.[69] We present our results in Table A11.6 below. The costs in Table A11.6 are after we have reallocated costs across services sharing jumpering-related work (as described from paragraph A11.28 below) and so are higher than those in Table A11.5 above.

[67] [✂]
[68] [✂]
[69] Paragraphs, 4.55-4.69, July 2013 Consultation.

Table A11.6: Assumed cost for WLR+SMPF Simultaneous Connection (nominal prices) (2012/13-2016/17)

	2012/13	2013/14	2014/15	2015/16	2016/17
MPF New Provide (FAC)	45.18	44.22	43.23	42.33	41.33
% change		-2.13%	-2.22%	-2.10%	-2.35%
Cost difference	-0.27	-0.26	-0.26	-0.25	-0.25
Billing costs (manual and automated)	0.39	0.39	0.39	0.07	0.07
Total FAC difference	0.12	0.13	0.13	-0.18	-0.18
WLR+SMPF Simultaneous Connection (FAC)	45.30	44.34	43.37	42.14	41.15

Re-allocation of costs across services sharing jumpering-related work

Introduction

A11.28 In section 6 we have noted Openreach's comments stating that it already reflects the cost savings associated with the simultaneous provision of WLR and SMPF services in the costs reported in its RFS, although these savings have been spread across other services involving jumpering work in the exchange (rather than being attributed to the services that generate them).[70] To address this we propose in section 6 to identify the services to which these cost savings are attributed and to re-allocate costs to ensure that they reflect the true underlying costs of provision. In this Annex we explain in more detail our proposed approach to re-allocating these costs. We also present our updated volume forecast for the services involving jumpering work at the exchange, which we use to re-allocate costs across these services.

Ofcom's analysis

Methodology to re-allocate costs across services sharing jumpering-related work

A11.29 In order to re-allocate the costs and attribute the cost savings associated with simultaneous provision only to those services that generate them, our proposed approach follows three steps.

A11.30 In **Step 1**, we identify the services to which Openreach has spread the cost savings from the simultaneous provision of WLR and SMPF services. We note that these cost savings stem from a reduction in the work done at the exchange, in terms of reduced jumpering work and other activities for Openreach engineers. These costs are reported by Openreach in the cost component MDF Hardware Jumpering (described above). Thus, we propose to assume that the cost savings from the simultaneous provision of WLR and SMPF services will have been spread across

[70] See paragraph 243, Openreach Response to the July 2013 Consultation.

the services that get costs attributed from the MDF Hardware Jumpering component. These services are:

- Migration services, specifically: MPF Single Migration, SMPF Single Migration, MPF Bulk Migrations, SMPF Bulk Migrations and WLR Conversion;
- MPF and SMPF Hard ceases; and
- Connection services, specifically: MPF New Provide, SMPF New Provide and WLR Standard Connections.

A11.31 In **Step 2**, we note that the costs of the services identified in **Step 1** in BT's 2011/12 RFS already reflect the cost savings associated with the simultaneous provision of WLR and SMPF services. Thus, the total costs for these services in BT's 2011/12 RFS (i.e. the volumes multiplied by their FAC in 2011/12) provides the total FAC that should be recovered from the services identified in **Step 1** after introducing the discount on charges for WLR+SMPF Simultaneous Migration and Connection services. The costs that need to be re-allocated across the services identified in **Step 1** to ensure that the total costs recovered through these services does not change can be calculated as the sum of:

- $\left(FAC_{SMPF\ New\ Provide} + FAC_{WLR\ Conversion} - FAC_{WLR+SMPF\ Simultaneous\ Migration}\right) \times Volumes_{WLR+SMPF\ Simultaneous\ Migration}$; and
- $(FAC_{SMPF\ New\ Provide} + FAC_{WLR\ Connections} - FAC_{WLR+SMPF\ Simultaneous\ Connections}) \times Volumes_{WLR+SMPF\ Simultaneous\ Connections}$

A11.32 Third, we spread the costs calculated under **Step 2** across the services identified in **Step 1** according to their cost-based weighting (i.e. volumes x FAC). In the next sub-section we explain how we derive the volumes forecast (for each of these services) that is needed for the re-allocation of costs.

A11.33 For reference, the re-allocation of costs can be found in sheet "SPM cost recovery" in our cost model. The implication of the re-allocation of costs is to increase the costs of the services identified in **Step 1** by approximately 15% when compared to the approach we used in the July 2013 Consultation. In contrast, we are expecting reductions in the prices of WLR+SMPF Simultaneous Migrations and Connections of nearly 50% over the charge control period.

Volume forecasts for services sharing jumpering-related work

A11.34 In addition to the volume forecasts published in the July 2013 Consultation, we have now calculated forecasts for the volumes of three services sharing jumpering-related work that we use to re-allocate costs across these services (as described in the previous section). These are:

i) WLR Start of Stopped MPF Line;

ii) WLR+SMPF Simultaneous Connections;

iii) MPF and SMPF Hard Ceases;

WLR Start of Stopped MPF Line

A11.35 The service WLR Start of Stopped MPF Line is used when two events happen sequentially:

i) an MPF line has been stopped (soft ceased); and,

ii) a WLR line is ordered.

A11.36 We expect that these series of events will mainly occur when there is a change in the tenants of a household (home movers), where the old tenants used MPF and the new tenants order a WLR connection.[71] We thus propose to peg our forecast of the volume of WLR Start of Stopped MPF Line volumes to the number of home movers.[72] As we have no readily available data on home movers, we propose to derive these from our estimate of WLR Connections in the July 2013 Consultation.

A11.37 In the July 2013 Consultation we said that WLR Connections are driven by

i) new households;

ii) churn from cable; and,

iii) home movers.

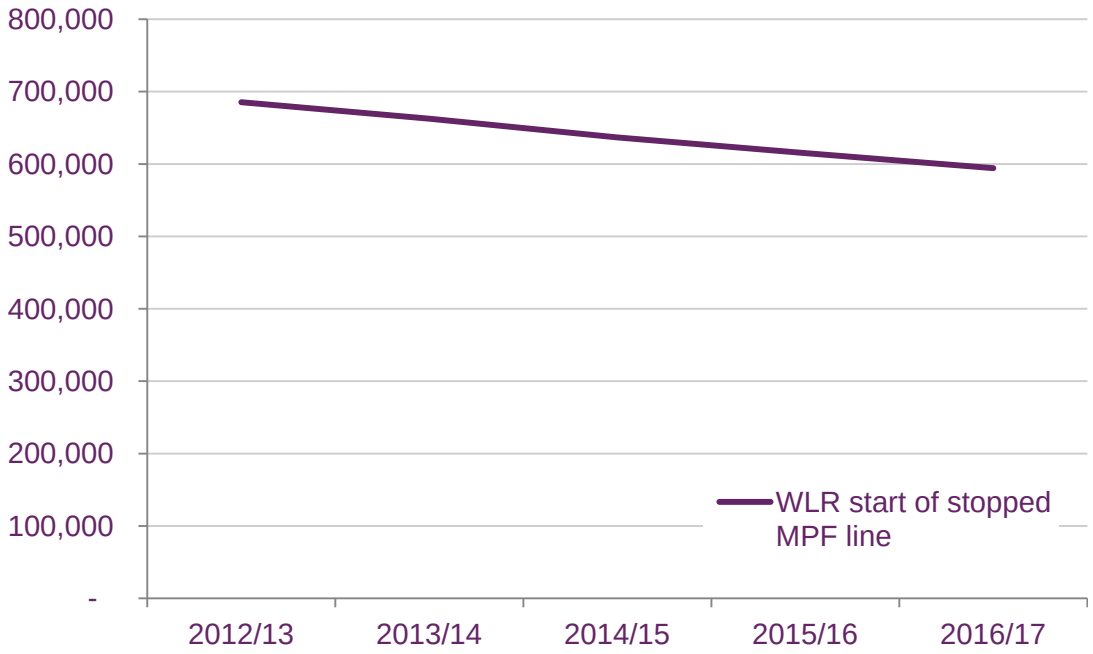
A11.38 Therefore, we can derive the number of home movers by subtracting the estimated new households taking a WLR line and customers churning from cable to WLR from the total number of WLR Connections. We thus derive a forecast of the volume of WLR start of stopped MPF lines as follows:

$$\bar{N}_{WLR\ start\ of\ stopped\ MPF} = (\bar{N}_{WLR\ connections} - \bar{N}_{new\ hhs} - \bar{N}_{cable\ churn})$$

A11.39 Our forecast of the number of WLR start of stopped MPF lines is given in Figure A11.1.[73]

[71] We recognise, however, that this will not always be the case. For example, in home mover scenarios there may be instances where the CP may decide to fully disconnect the MPF line (i.e. a hard cease) rather than simply stop it (e.g. if the property is unoccupied for a long period of time).
[72] We do not consider that we should account for scenarios where a customer using MPF switches to cable and then back to WLR, as we do not consider that a WLR Start of Stopped MPF Line would be used in this event. This is because a customer switching to cable is likely to remain on cable for a long period of time. Virgin Media's annual churn rate of 15% (Virgin Media publishes a monthly churn rate each quarter, which must be multiplied by 3 to give the total churn for the quarter: (1.1% + 1.4% + 1.4% + 1.2%) * 3; P.44, Virgin Media, *Annual Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934. For the fiscal year ended December 31, 2012*, http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9MTcxMTYzfENoaWxkSUQ9LTF8VHlwZT0z&t=1 implies that customers remain on average for almost seven years. This means that when switching to cable the LLU CP is likely to completely disconnect the line (i.e. a hard cease) and that a customer switching back from cable to WLR is more likely to require a WLR Standard Connection (rather than a WLR Start of Stopped MPF Line).
[73] Volumes of WLR Start of Stopped MPF Lines are growing, despite falling total WLR Connections due to the increase in MPF lines making it more likely that any given WLR Connection will take place on a stopped MPF line.

Figure A11.1: Forecast volumes of WLR start of stopped MPF lines, 2012/13 to 2016/17



Source: Ofcom

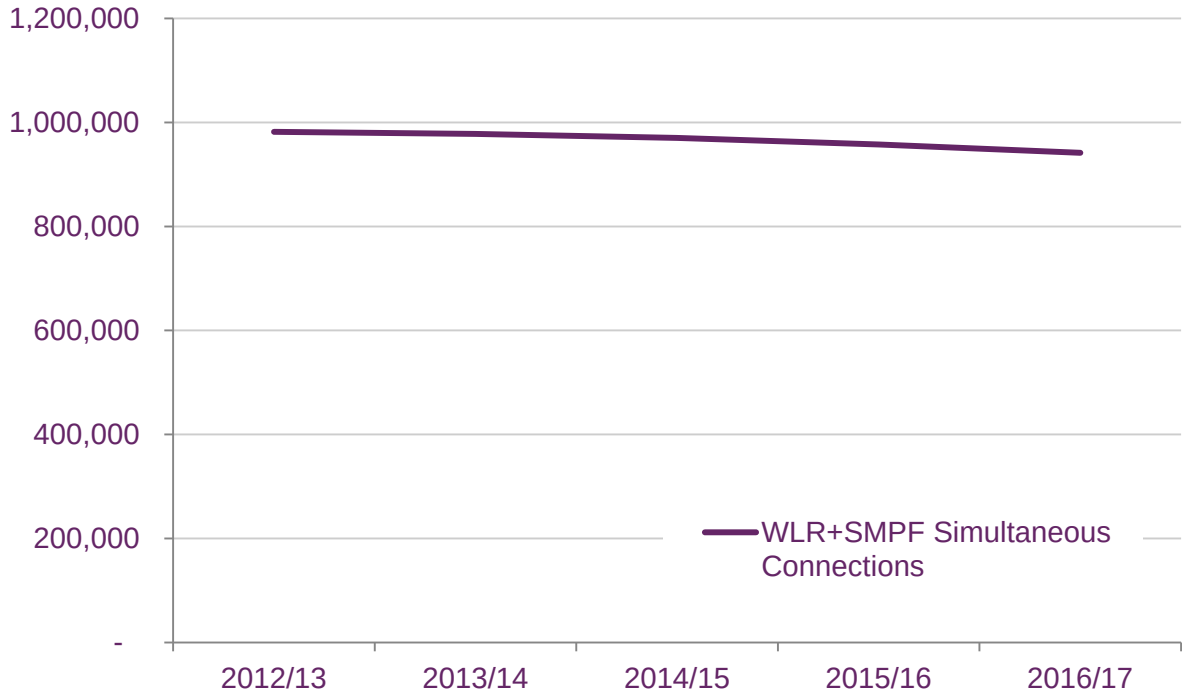
WLR + SMPF Simultaneous Connections

A11.40 The WLR+SMPF Simultaneous Connection refers to the simultaneous supply of a WLR Connection and SMPF New Provide. We derive the forecast volumes of WLR+SMPF Simultaneous Connections from our forecast of WLR Connections. We have assumed that the proportion of customers purchasing WLR Connections that will simultaneously request an SMPF New Provide is likely to be driven by the number of households that would order a broadband connection together with their voice connection. We have therefore approximated this using the rate of broadband penetration on Openreach lines.[74]

A11.41 Our forecast of the number of WLR + SMPF Simultaneous Connections is given in Figure A11.2.[75]

[74] We calculate broadband penetration on Openreach lines as the ratio of the total number of SMPF and MPF connections over the total number of WLR and MPF connections.
[75] We estimate the number of WLR+SMPF simultaneous connections to decline as LLU operators switch from SMPF to MPF in increasingly more exchanges and continue their rollout plans.

Figure A11.2: Forecast volumes of WLR+SMPF simultaneous connections, 2012/13 to 2016/17



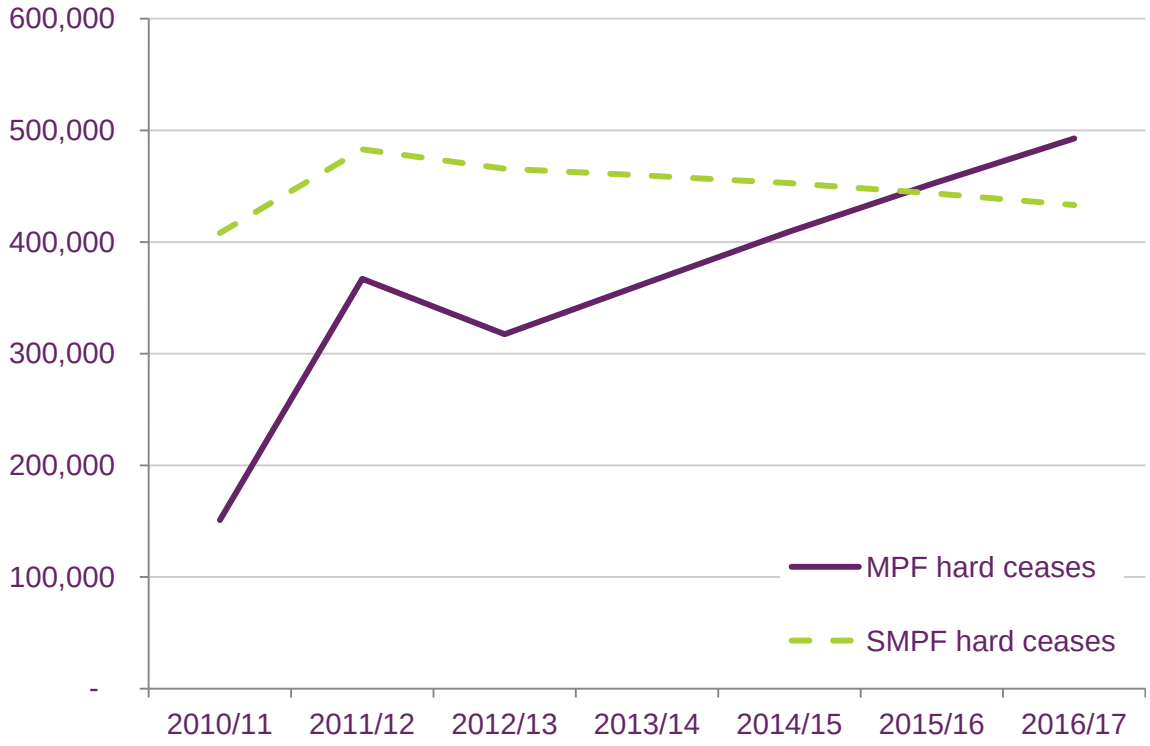
Source: Ofcom

Hard ceases

A11.42 For the purposes of this consultation we have based our forecasts of MPF and SMPF Hard Ceases on data received from Openreach on the proportions of MPF and SMPF ceases resulting in jumper removals in 2010/11 and 2011/12. We have applied the average proportion of each across the two years to our forecasts of total ceases (i.e. including hard and soft ceases).

A11.43 Our forecast of MPF and SMPF Hard Ceases is given in Figure A11.3.

Figure A11.3: MPF & SMPF hard ceases, 2010/11 to 2016/17



Source: Ofcom and Openreach

Annex 12

Cost Model

A12.1 This Annex outlines changes that have been made to the July 2013 model (used to produce costs estimates for the WLA and WFAEL services) in order to produce the December 2013 model. Apart from the changes outlined in this annex, we have not changed the model from the version released on 20 August 2013. We also use this annex to detail the way we have changed the model to account for the revised approach to fault rates and the service level allocation.

A12.2 The majority of the changes to the December 2013 model have been described in earlier sections:

- The adjustment to TAM and evoTAM costs (Section 7);
- The adjustment to cost recovery to account for simultaneous provision of connections and migrations (Section 6);
- The adjustments to the total DSLAM capital maintenance costs and the allocation of these costs (Section 7);
- The removal of caller ID costs (Section 6);
- The redesign of some of the charge control baskets (Sections 6);
- Adjustment to the differential between WLR+SMPF rentals and MPF rentals (Section 7); and
- Adjustments for the quality of service, fault rates and service level cost differential (Section 3, 4 and 5).

A12.3 In all other ways we have sought to keep the model as consistent with the July 2013 model. However, where we have identified specific part of the model which we believe are erroneous, we have sought to correct them.

- 2011/12 cost data provided by BT: After the publication of the model, BT identified some errors in the data submitted to Ofcom under the first s135 request regarding depreciation values in operating costs and GRC values. We have therefore corrected these data in the model.
- Adjustment to steady state capital expenditure and disposals: the capital expenditure and disposals in the steady state must be equal to the OCM depreciation. But because of the adjustments to asset lives, the OCM depreciation in 2011/12 is not equal to the actual capital expenditure and disposals in that year. We have therefore set capital expenditure and disposals to be equal to OCM depreciation in the base year (2011/12).
- Adjustment to the Cumulative Additional Capex: the calculations for Cumulative Additional Capex when Unit Capital Costs included the RAV adjustments did not include asset price changes for the cost component CL144 Wholesale Access Specific in 2013/14 and all components included in the model in the following three years. We have now included the impact of the asset price changes.

- Correction to the duct NRC for class of work mapping: the NRC of duct in the class of work mapping incorrectly used its GRC value. We have corrected this error.

- Correction to the asset value adjustment: the Openreach and Ofcom product volume demand forecasts in the asset value adjustment did not read from the correct years. This has been rectified with a switch to allow for the correction.

A12.4 As can be seen in Table 8.4 of Section 8, the net impact of the above changes is to reduce the base year cost stack by circa £0.30 per line for WLR and MPF rentals and circa £0.07 per line for SMPF rentals.

Charge control cost modelling approach to proposals on fault rate and service level allocation

July 2013 Charge Control proposals

A12.5 In the July 2013 Consultation we proposed to use the total level of 2011/12 faults related costs reported in the RFS for the base year of the Cost Model. We also explained that, for the purposes of the consultation, we proposed to use the fault rate allocation implicit in BT's 2011/12 RFS to allocate repair costs to different services.

A12.6 We proposed to adjust the RFS allocation for the service level differential by replacing the 20% uplift for services with a higher service level in the RFS and replace this with 5.4% derived from the methodology used in the March 2012 Statement.

A12.7 In Section 5 of the July 2013 Consultation, we proposed to undertake further analysis of both fault rates and service levels prior to the Statement.

A12.8 We proposed to use the usage factors set out in Table A12.1 below for both E-side and D-side copper current components in the Cost Model:

Table A12.1: Proposed allocation of Fault rate and Service level allocation for E-side and D-side copper current in July 2013 Consultation:

	WLR Basic Rentals	MPF Rentals	SMPF Rentals
Fault rate allocation	1.0	1.04	0.16
Service level allocation	1.0	1.054	1.054
Combined usage factor – used in modelling[76]	1.0	1.10	0.17

A12.9 In addition, we considered that the service level differential should be reflected in two further component costs related to repairs:

[76] The combined usage factor is calculated as the fault rate allocation multiplied by the service level allocation.

- PSTN drop maintenance, and
- Local exchange general frames current.

Our analysis

A12.10 As explained in Sections 3, 4 and 5 we have undertaken further analysis of the appropriate total costs of fault related activities and the allocation of these costs between different services.

A12.11 As a result of the updated analysis, we have updated the Cost Model to take account of our Quality of Service and fault rate proposals. In summary, the updates to the Cost Model are as follows:

- we apply an uplift to costs for 8 quality of service related cost components to reflect the additional costs associated with the proposed minimum standard for quality of service;
- we adjust the fault rate and service level usage factor to reflect the proposed allocations set out in Sections 4 and 5; and
- we apply the proposed service level allocation and fault rate allocation to five repair and provisioning related cost components.

A12.12 We discuss each of these modelling updates in turn.

Quality of Service: Resource uplift approach

A12.13 As explained in Section 3 of the document, we propose to uplift the costs of repair and provision within the Cost Model by 3.9%. In applying this uplift, we undertook a detailed assessment of these costs included in the base year of the Cost Model.

A12.14 We used our statutory information gathering powers to request information from BT on the 2011/12 engineering costs associated with the provision and repair of LLU and WLR services, as recorded in BT's 2011/12 RFS. In response, BT provided the costs for 8 cost components.[77] For each of these cost components, BT provided a breakdown of i) the engineering costs directly allocated to the component by Class of Work[78], ii) other costs which would not arise in the absence of repair and provision work, e.g. training and transport costs, and iii) the annual capital expenditure.

A12.15 We then made the following adjustments to the engineering cost data provided by BT to estimate the costs which the 3.9% uplift should be applied to. In doing this, for each of the 8 cost components, we:

a) deduct direct costs which are identified as pre-emptive or routine maintenance costs;
b) deduct the same proportion of indirect costs as the proportion we deduct for direct costs for that cost component;

[77] D-side Current, E-side Current, LE Frames Current, MDF Jumpering, Drop Wire Maintenance, Dropwire Capital & PSTN NTE, PSTN Line Test Equipment & Routeing and Records.
[78] Class of Work refers to the type of activity or asset type on which an engineer is engaged and refers to the code used to collect and post such engineering costs to the General Ledger.

c) reduce the sum of a & b by the proportion of 11/12 volumes in the Cost Model divided by 2011/12 volumes in the Cost Model plus internal LLU volumes. This reflects the fact that the Cost Model excludes internal LLU volumes;
d) reduce the annual capital expenditure in the same proportion as the resulting deduction in the total direct and indirect costs (a and b above); and
e) reduce the capital expenditure 'd' by the proportion of 11/12 volumes in the Cost Model divided by 2011/12 volumes in the Cost Model plus internal LLU volumes. This reflects the fact that the Cost Model excludes internal LLU volumes.

A12.16 The uplift of 3.9% is applied to 'c' above for each cost component. The £m uplift is then added to the base year total operating costs for each cost component in the same proportion as the base year pay and non-pay split in the Cost Model prior to the uplift.

A12.17 The uplift of 3.9% is also applied to 'e' above for the Dropwire capital & PSTN NTE[79] cost component. The £m uplift is then added to the base year capital costs for this cost component as follows:

- Gross Replacement Cost (GRC) – the product of 3.9% multiplied by 'e' above is added to the GRC;
- Net Replacement Cost (NRC) - the NRC is increased by the GRC addition less a year of depreciation; and
- Depreciation (HCA and supplementary) - the depreciation is uplifted by the same proportion as the GRC uplift.

Fault rate allocation and service level differential

A12.18 We continue to believe that both the E-side and D-side copper current cost components' usage factors should be adjusted for both the fault rate allocation and the service level differential.

A12.19 Having conducted further analysis, we consider that the usage factors relating to the cost of repairs to two other network components, PSTN drop maintenance and Local exchange general frames current should also be driven by the Fault rate allocation in addition to the Service level allocation as proposed in the July consultation[80]. We consider that this will provide a more representative allocation of repair costs overall as faults relating to these network components are included in the calculation of the fault rate allocations.

A12.20 Finally, we propose to also apply the fault rate and service level differential to the DSLAM (capital maintenance) cost component[81].

[79] The Dropwire capital & PSTN NTE cost component is the only cost component related to provisioning and repairs with material capital expenditure.
[80] The service level allocations are based on an assessment of the copper network outside the exchange. It may therefore be possible that they may not be completely representative of service level differences within the exchange. However, in the absence of any better information, we have used the same ratios.
[81] We understand from BT that the cost component DSLAM capital/maintenance is incorrectly named and does not relate to DSLAM but broadband faults. As such we consider that it would be captured by our analysis of fault rates and should be treated consistently with the other fault related cost components. We discuss this is more detail in Section 7.

A12.21 In Table A12.2 below we set out our revised allocations that we propose to apply to the fault rate and service level differential to all 5 faults-related cost components[82].

Table A12.2: Revised proposals to Fault rate and Service level allocations

	WLR Basic Rentals	MPF Rentals	SMPF Rentals
Fault rate allocation	0.87	1.00	0.13
Service level allocation	1.0	1.141	1.141
Combined usage factor – used in modelling[83]	0.87	1.141	0.15

A12.22 As explained in Annex 13 of the July 2013 Consultation[84], the Cost Model does not include internal SMPF volumes or costs. Where we are adjusting usage factors which include SMPF rentals, we make an off-model adjustment to reflect the fact that total costs included in the Cost Model will change as they are moved to/from SMPF internal rentals. For example, where the allocation to SMPF rentals has increased, we remove an appropriate proportion of the costs from the Cost Model to reflect the fact that some costs would move from MPF rentals and WLR rentals and into internal SMPF rentals which are not captured by the model. If we did not do this, we would be overstating the costs within the Cost Model.

A12.23 We calculate this adjustment to total costs in the Cost Model by calculating the total costs for each cost component for each service, including internal SMPF (calculated as the SMPF unit cost multiplied by SMPF internal volumes). We then reallocate these costs using the new component volumes and usage factors to get an adjusted unit cost for each service. Finally, we calculate the new total to be included in the cost model (total costs less internal SMPF costs) and increase/decrease proportionally the costs in the Cost Model to reflect the increase/decrease to costs as a result of the re-allocation.

[82] D-side Copper Current, E-side Copper Current, LE General Frames Current, Drop Wire Maintenance and DSLAM capital/maintenance.
[83] The combined usage factor is calculated as the fault rate allocation multiplied by the service level allocation.
[84] Paragraphs A13.6 - A13.24, p. 71 - 73, July 2013 Consultation.

Annex 13

Volumes Forecasting Model

A13.1 Please see the separate Excel file published alongside this consultation entitled *LLU and WLR Volumes Forecasts*. This will be available here:

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-llu-wlr-charge-controls/annexes/annex13.xlsx

Annex 14

Correspondence on base year data

A14.1 Correspondence on base year data between Ofcom and BT includes the following letters:

- Letter from Stuart McIntosh, Ofcom to Mark Shurmer, BT, 19 November 2013.
- Letter from Mark Shurmer, BT to Stuart McIntosh, Ofcom, 26 November 2013.
- Letter from Stuart McIntosh, Ofcom to Mark Shurmer, BT, 6 December 2013.

These will be available here:

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-llu-wlr-charge-controls/annexes/annex14.pdf

Annex 15

Draft legal instruments

A15.1 Please see the separate PDF document published alongside this consultation entitled *Draft legal instruments*. This will be available here:

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-llu-wlr-charge-controls/annexes/annex15.pdf

Annex 16

Sources of evidence

Introduction

A16.1 We have noted throughout this Consultation the evidence we have relied upon in relation to our proposals and how we have relied upon that evidence. This Annex lists the main sources of evidence used. We also list all respondents to our consultations and to our formal information requests.

A16.2 Whilst the Annex lists the main evidence we have relied upon, the list is for convenience only and is not intended to be exhaustive.

List of respondents to the call for inputs

A16.3 We published a Call for Inputs (CFI) on 9 November 2012 setting out our proposed approach to this market review and seeking stakeholder input. This can be found at the following link:

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/annexes/FAMR_Consultation_annexes.pdf.

A16.4 21 stakeholders provided written responses to the CFI:

- Axis Telecommunications Ltd;
- Birmingham City Council;
- British Sky Broadcasting Group plc;
- British Telecommunications plc;
- Cable and Wireless Worldwide plc/Vodafone;
- Colt Technology Services;
- Cumbria County Council;
- Derby City Council;
- The Federation of Communication Services Ltd;
- KCOM Group plc;
- Manchester City Council;
- Modern Communications Ltd;
- SSE plc;
- TalkTalk Telecom Group plc;

- Tesco Broadband;
- The Bit Commons Ltd;
- Verizon UK Limited;
- Virgin Media Limited; and
- Two confidential responses

A16.5 We have published the non-confidential versions of the responses from all the stakeholders listed above. These can be found on our website:

http://stakeholders.ofcom.org.uk/consultations/fixed-access-markets/?showResponses=true

List of respondents to the FAMR Consultation

A16.6 We published a Consultation on 3 July 2013 setting out the preliminary conclusions of our review of fixed access markets in the United Kingdom. This can be found at the following link:

http://stakeholders.ofcom.org.uk/consultations/fixed-access-market-reviews/

A16.7 Thirteen stakeholders provided written responses to the Consultation:

- British Telecommunications plc;
- Colt
- EE Limited;
- Federation of Communications Services Ltd
- KCOM Group
- Openreach
- SCS Telecoms
- British Sky Broadcasting Limited;
- TalkTalk Telecom Group plc;
- Verizon UK Limited;
- Virgin Media Limited;
- Vodafone Limited; and
- One confidential response.

A16.8 We have published the non-confidential versions of the responses from all the stakeholders listed above. These can be found on our website:

http://stakeholders.ofcom.org.uk/consultations/fixed-access-market-reviews/?showResponses=true&pageNum=1#responses

List of respondents to the July 2013 Consultation

A16.9 We published a Consultation on 11 July 2013 setting out our proposals for new charge controls for Local Loop Unbundling (LLU) and Wholesale Line Rental (WLR) services and seeking stakeholder input. This can be found at the following link:

http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/summary/LLU_WLR_CC_2014.pdf.

A16.10 Twelve stakeholders provided written responses to the Consultation:

- AdEPT Telecom plc;
- Adaptive Spectrum and Signal Alignment, Inc.;
- British Telecommunications plc;
- EE Limited;
- Federation of Communication Services Ltd;
- Openreach
- British Sky Broadcasting Limited;
- TalkTalk Telecom Group plc;
- Verizon UK Limited;
- Virgin Media Limited;
- Vodafone Limited; and
- One confidential response.

A16.11 We have published the non-confidential versions of the responses from all the stakeholders listed above. These can be found on our website:

http://stakeholders.ofcom.org.uk/consultations/llu-wlr-cc-13/?showResponses=true

Information-gathering using statutory powers (s135)

A16.12 During this market review, we have issued a series of notices under section 135 of the Act requiring various CPs to provide specified information as set out in the notice. These information requests are listed below:

- Information request of 18 January 2013 regarding Openreach's quality of service commitments to communications providers and resource allocations concerning quality of service. Request addressed to and response received from:

  - British Telecommunications plc.

- Information request of 8 February 2013 regarding the provision of data necessary to inform our cost modelling and analysis of the efficiency of BT's copper access network business. Request addressed to and response received from:

  - British Telecommunications plc.

- Information request of 7 March regarding historic and forecast volume data. Request addressed to and response received from:

  - British Telecommunications plc.
  - Cable and Wireless Worldwide plc;
  - Daisy
  - EE Ltd
  - KCOM Group plc
  - O2
  - Plusnet
  - Post Office
  - BSkyB
  - TalkTalk Telecom Group plc
  - Virgin Media Ltd

- Information request of 18 March 2013 regarding information to help inform our cost modelling and the structure of any future such controls. Request addressed to and response received from:

  - British Telecommunications plc.

- Information request of 17 April 2013 regarding information to help inform our cost modelling and the structure of any future such controls and information on the costs incurred in connection with the provision and repair of LLU and WLR lines and how these are accounted for by BT. Request addressed to and response received from:

  - British Telecommunications plc.

- Information request of 23 April 2013 regarding information to help inform our cost modelling and the structure of any future such controls and information on the costs incurred in connection with the provision and repair of LLU and WLR lines and how these are accounted for by BT. Request addressed to and response received from:

  - British Telecommunications plc.

- Information request of 8 May 2013 regarding information to help inform our cost modelling and the structure of any future such controls. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 13 May 2013 regarding the remission by the Competition Appeal Tribunal of the fault rates ground of appeal. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 15 May 2013 regarding historic and forecast information on the amount of installed Digital Access Carrier System equipment and its use and confirmation of the allocation of line testing equipment. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 23 May 2013 regarding the provision of data on Openreach's quality of service commitments to communications providers and resource allocations concerning quality of service. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 29 May 2013 regarding clarification and explanation to better understand how previous information provided by BT in response to section 135 requests reconciles to the RFS and to gather further information on products within the existing charge control baskets. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 13 June 2013 regarding the provision of data necessary to improve our understanding of the basis of BT's efficiency estimates and how the derivation might relate to our charge control modelling. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 28 August 2013 regarding the provision of data necessary to understand how BT constructed the system run which produced the results it supplied, so we are clear about the basis on which it was compiled. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 17 September 2013 regarding the provision of data on Openreach faults and fault repair data. Request addressed to and response received from:
  - British Telecommunications plc.

- Information request of 20 September 2013 regarding the provision of data on average line length per relevant product for each BT exchange. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 4 October 2013 regarding the provision of information on matters for which we do not presently have data where we consider that this information is necessary for the purposes of our review; information to clarify or add to information previously provided by BT; and information to refresh and/or update that previously provided by BT (for example, to capture outturn data where we currently have forecasts). Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 11 October 2013 regarding the provision of information on matters for which we do not presently have data where we consider that this information is necessary for the purposes of our review. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 22 October 2013 regarding the provision of any research commissioned by Openreach on faults. Request addressed to and response received from:
  - British Telecommunications plc.
- Information request of 8 November 2013 regarding the provision of information on matters for which we do not presently have data where we consider that this information is necessary for the purposes of our review; and information to clarify or add to information previously provided by BT. Request addressed to and response received from:
  - British Telecommunications plc.

UK Legislation

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

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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.

ASSIA: Adaptive Spectrum and Signal Alignment, Inc.

ASSIA Response to July 2013 Consultation: ASSIA, *Response to the July 2013 Consultation*, September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Adaptive_Spectrum_and_Signal_Alignment_Inc.pdf

Average Time To Clear (ATTC): An Openreach measure of the average elapsed time (in days) between the acceptance of faults by Openreach and when Openreach advises CPs that the faults have been cleared.

Average Time To Install (ATTI): An Openreach measure of the average elapsed time (in days) between the acceptance of installation orders by Openreach and when Openreach advises the CP of their completion.

Axis: Axis Telecom Limited.

Basket: A set of services where the charge control is applied to the total revenue from those services in a given year, subject to a specified compliance formula.

Birmingham: Birmingham City Council.

Bit Commons: The Bit Commons Limited.

Broadband Boost (BBB): A chargeable investigation product from Openreach.

BT: British Telecommunications plc.

BT's 2011/12 RFS: BT, *Current Cost Financial Statements for 2012 including Openreach Undertakings*, 31 July 2012, and associated documents, http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2012/index.htm

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BT Retail: The retail division of BT.

BT Wholesale: The wholesale division of BT.

Caller Display (Caller ID): Allows the customer to see the caller's number before answering the call, provided they have suitable equipment.

Calling Line Identification (CLI): Data about the calling party, in particular the telephone number that has initiated the call. With the Caller Display service the CLI, or calling number, is displayed provided the end user has a phone with a suitable display (or other equipment that can display the information).

CAT: Competition Appeal Tribunal.

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CEG Memorandum to EE: Paul Reynolds, CEG Europe, *Assessing the glide path for the removal of pricing distortions,* Memorandum to EE, 4 September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/EE_-_Annex_A.pdf

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

CMSG Fault Rates Report: CSMG, *WLR and LLU Fault Rates Analysis: Final report, prepared for Ofcom*, November 2013.

Colt: Colt Technology Services.

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

Communications Provider (CP): A person who provides an Electronic Communications Network or provides an Electronic Communications Service.

Competition Commission (CC): An independent public body that conducts in depth inquiries into mergers, markets and the major regulated industries.

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

Co-mingling Services: All essential support services which are used jointly by SMPF and MPF, including the collocation services. E.g., electricity, ventilation.

Conscious Decision To Appoint (CDTA): A fault report with a customer appointment, raised with Openreach by a CP in cases where the Openreach line test system does not indicate a fault.

Conscious Decision To not Appoint (CDTnA): A fault report without a customer appointment, raised with Openreach by a CP in cases where the Openreach line test system does not indicate a fault.

Cost Allocation Model (CA Model): In this model, costs from the Cost Forecast model were allocated to individual services cost and asset data allocated to services to derive unit cost estimates. The Cost Allocation model also drew on a calculation of the forecast asset values and depreciation, for Copper and Duct, provided by the RAV model.

Cost Forecast Model (CF Model): This was an activity-based costing model, using data linked to historically observed activity levels and costs together with estimates of future level of demand. In this model, we forecast operating costs and capital expenditure at an Openreach level. The output was fed into the Cost Allocation model.

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

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

Cumulo rates: The business rates paid by BT Group 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.

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 Cost Accounting Fully Alocated Cost (CCA FAC): An approach used to measure a company's costs.

Current Generation Network (CGN): A network that uses existing (copper) technology in the core and backhaul.

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

Daisy: Daisy Group plc.

Deloitte Fault Data Report: Deloitte, *Openreach fault data: data analysis,* report for Openreach, September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/Openreach_-_Deloitte_report.pdf.

Derby: Derby City Council.

Digital Subscriber Line Access Multiplexer (DSLAM): A network device, located in a telephone exchange that provides broadband services to multiple premises over the copper access network using DSL technologies. Also includes a multiplexing function for backhaul.

Distributed Long Run Incremental Cost (DLRIC): The LRIC of the individual service with a share of costs which are common to other services over BT's core network.

Distributed Stand Alone Cost (DSAC): An accounting approach estimated by adding to the DLRIC a proportionate share of the inter-increment common costs. Rather than all common costs shared by a service being allocated to the service under consideration, the common costs are instead allocated amongst all the services that share the network increment.

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 an connection point on a telegraph pole where dropwires are terminated.

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

The Draft EC Recommendation: Commission Recommendation of XX 2012 on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment:http://ec.europa.eu/digital-agenda/en/news/draft-commission-recommendation-consistent-non-discrimination-obligations-and-costing

Dropwire: An overhead cable, connecting BT's access network to a customer's premise. Generally a single span between the premise and a telegraph pole with a Distribution Point.

DSL (Digital Subscriber Line): 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.

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).

Early Life Failure (ELF): A fault that occurs within a defined period after the completion of an installation order on a line. Several definitions are used, including 8 days, 28 days and 30 days.

Early Termination Charge (ETC): The total fee that will be charged for early termination of a contract or agreement.

EC: European Commission.

EE: Everything Everywhere Limited.

EE Response to the FAMR Consultation: EE, *Response to the FAMR Consultation*, September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/EE.pdf.

EE Response to the July 2013 Consultation: EE, *Response to the July 2013 Consultation*, September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/EE.pdf

Eighth LLU WLR BT Information Request: The eighth formal LLU WLR information request sent to BT on 29 May 2013

Eleventh LLU WLR BT Information Request: The eleventh formal LLU WLR information request sent to BT on 4 October 2013.

Equal Proportionate Mark-Ups (EPMU): Under EPMU, charges are set to recover the sum of incremental costs and a mark-up for common costs which is the same, as a percentage of incremental costs, for all services.

Europe Economics, Disaggregating the BT Group Asset Beta: Europe Economics, *Disaggregating the BT Group Asset Beta Report for Sky and TalkTalk,* October 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Sky_and_TalkTalk_Group_Europe_Economics_report.pdf

Evolutionary Test Access Matrices (evoTAMs): Industry name given to an improved version of earlier TAMs.

EY Model Methodology Document: Ernst & Young (EY), *Openreach's Discrete Event Simulation Model: Methodology Documen*t, November 2013.

FAMR: Fixed Access Market Reviews.

FCS: Federation of Communication Services.

FCS Response to the July 2013 Consultation: Federation of Communication Services, *Response to the July 2013 Consultation,* 23 September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Federation_of_Communication_Services_Ltd.pdf

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 premise. 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).

Fifth LLU WLR BT Information Request: The fifth formal LLU WLR information request sent to BT on 23 April 2013.

Fifth QoS BT Information Request: The fifth formal QoS information request sent to BT on 22 October 2013.

First LLU WLR BT Information Request: The first formal LLU WLR information request sent to BT on 8 February 2013.

First QoS BT Information Request: The first formal QoS information request sent to BT on 18 January 2013.

First Remittal BT Information Request: The first formal information request on the remission by the Competition Appeal Tribunal of the fault rates ground of appeal sent to BT on 22 October 2013.

Flexible Comingling Product (FCP): Used in the name of services in Openreach price lists

Fourth LLU WLR BT Information Request: Ofcom's third formal LLU WLR information request sent to BT on 17 April 2013.

Fourth QoS BT Information Request: The fourth formal QoS information request sent to BT on 20 September 2013.

Frequency Shift Keying (FSK): A concentrator aggregates telephony traffic for up to 2048 lines before feeding it into the exchange processor. The FSK sender is the part of the concentrator voice platform which sends CLI signalling to the Customer Premises Equipment.

Frontier Economics, Ofcom's LLU and WLR Charge Controls Proposals: Frontier Economics, Ofcom's LLU and WLR Charge Controls Proposals: a report prepared for Sky and TalkTalk, October 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Sky_and_TalkTalk_Group_Frontier_Economics_report.pdf

Frontier Economics, The Profitability of BT's Regulated Services: Frontier Economics, *The Profitability of BT's Regulated Services: A report prepared for Vodafone,* November 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Vodafone_Frontier_Economics_report.pdf

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.

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.

Gamma: Gamma Communications.

General Manager (GM) areas: A geographic area that is the responsibility of an Openreach General Manager. There are currently nine GM areas.

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

Gigabit Passive Optical Network (GPON): A shared fibre network architecture that can be used for NGA.

Gross Replacement Cost (GRC): The cost of replacing an existing tangible fixed asset with an identical or substantially similar new asset having a similar production or service capacity.

Handover Distribution Frame (HDF): An internal wiring frame provided within an LLU operator's equipment area where tie cables are terminated and cross connected to the LLU operator's exchange equipment by flexible wire jumpers.

Historic Cost Accounting (HCA): A method of accounting under which assets and liabilities are recorded at the values at which they were first acquired.

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.

In-Life Failure (ILF): A fault that occurs after the period defined for an ELF.

ISDN2: A type of digital telephone line service that supports telephony and switched data services. ISDN2 allows a business to handle two phone calls simultaneously. It is primarily used by smaller businesses.

ISDN30: A type of digital telephone line service that provides up to 30 lines over a common digital bearer circuit. These lines provide digital voice telephony, data services and a wide range of ancillary services. It is primarily used by larger businesses.

July 2013 Consultation: Ofcom, *Fixed access market reviews: Approach to setting LLU and WLR Charge Controls - Consultation,* 11 July 2013, Updated 20 August 2013, http://stakeholders.ofcom.org.uk/consultations/llu-wlr-cc-13/

July 2013 FAMR Consultation: Ofcom, *Fixed access market reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30: Consultation on the proposed markets, market power determinations and remedies*, 3 July 2013: http://stakeholders.ofcom.org.uk/consultations/fixed-access-market-reviews/

July Consultations: July 2013 Consultation and July 2013 FAMR Consultation.

KCOM: KCOM Group plc, formerly Kingston Communications Limited.

KCOM Response to the FAMR Consultation: KCOM, *Response to the FAMR Consultation,* September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/KCOM.pdf.

Key Performance Indicators (KPIs): A measure of performance of an important aspect of a service or operational process. In this context, generally a measure of Openreach's performance in the provision and repair of WLR and LLU services.

Kilo Man Hour (KMH): A unit of work or resources, equivalent to 1000 hours of work.

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 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.

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

Manchester: Manchester City Council.

March 2011 Consultation: The ‘‘Charge control review for LLU and WLR services – Consultation’, published 31 March 2011: http://stakeholders.ofcom.org.uk/binaries/consultations/wlr-cc-2011/summary/wlr-cc-2011.pdf.

March 2012 Statement: The ‘Charge control review for LLU and WLR services – Statement’, published 7 March 2012:

http://stakeholders.ofcom.org.uk/binaries/consultations/wlr-cc/statement/LLU_WLR_CC_statement.pdf

Link to annexes: http://stakeholders.ofcom.org.uk/binaries/consultations/wlr-cc-2011/statement/annexesMarch12.pdf

Market Review Period: 1 April 2014 and 31 March 2017.

Matters Beyond Our Reasonable Control (MBORC): An Openreach term for a declaration that a fault repair or provisioning task fulfils the *force majeure* clauses in its contracts.

MCB customisation at initial build for FCP: Service in Openreach price lists.

MCL: Modern Communications Ltd.

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.

Minimum Contract Period (MCP): The amount of time a consumer must remain in a contract before being able to cancel it.

Modern Equivalent Asset (MEA): An approach to setting charges that bases costs on what is believed to be the most efficient available technology that performs the same function as the old technology.

Modified Primary Line (MPL): An Openreach service that temporarily diverts calls from a WLR service to an alternative telephone number.

MPF Hostel Rentals: Name of service in BT RFS

MPF Room Build: Name of service in BT RFS

MPF Stopped Line Provide (MPF SLP): Service named “MPF Connection Charge Stopped Line Provide” in Openreach price list

Multiple Service Access Node (MSAN): A network device, located in a telephone exchange which provides telephony and broadband services to multiple premises over copper and/or fibre access networks. Also includes a multiplexing function for backhaul.

Net Replacement Cost (NRC): Gross replacement cost less accumulated depreciation based on gross replacement cost.

Network Terminating Equipment (NTE): Transmission equipment located at the customer premises. Performs a similar function to LTE and also provides the customer interface.

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 already existing copper networks. In most cases, NGAs are the result of an upgrade of an already existing copper of 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.

Ninth LLU WLR BT Information Request: The ninth LLU WLR formal information request sent to BT on 13 June 2013.

O2: Telefónica UK.

October RFS Report: BT, *Report requested by Ofcom describing certain changes to the Accounting Documents for the year ended 31 March 2013 and illustrating the resulting differences to the Current Cost Financial Statements had those changes not applied*, 3 October 2013.

Ofcom: The Office of Communications.

Office of the Telecommunications Adjudicator (OTA): An independent body that facilitates discussion between CPs on operational issues related to new and existing telecoms products and services.

ONS: The Office of National Statistics.

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

Openreach Response to the FAMR and July 2013 Consultations (Quality of service): Openreach, *Response to the FAMR and July 2013 Consultations (Quality of service),* September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/Openreach_-_Quality_of_Service.pdf.

Openreach Response to the July 2013 Consultation: Openreach, *Response to the July 2013 Consultation,* 30 September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Openreach.pdf

Openreach Response to the July 2013 Consultation: Annex A - Volumes: Openreach, *Response to the July 2013 Consultation: Annex A - Volumes,* 30 September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Openreach_Annex_A.pdf

Openreach Supporting Document on the Model: Openreach, *Openreach analysis of additional factors impacting service costs in very high performance scenarios*, November 2013.

Oxera, Assessment of Ofcom's analysis to set the efficiency target: Oxera, *Assessment of Ofcom's analysis to set the efficiency target: Is the proposed 4–6% range consistent with the evidence?,* Report prepared for BT/Openreach, September 25th 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Openreach_Annex_C.pdf

Physical Infrastructure Access (PIA): A regulatory obligation under which BT is required to allow CPs to deploy NGA networks in the physical infrastructure of its access network.

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.

PSTN switch: A public switched telephone network switch that terminates a customer's telephone line and connects a customer's telephone call to other PSTN switches so that the telephone call reaches the intended destination.

Rack Space Unit (RSU): Used in the name of services in Openreach's price lists.

Rate of Return (RoR): The ratio of money gained or lost (whether realised or unrealised) on an investment relative to the amount of money invested.

RAV adjustment: An adjustment to the regulatory asset valuation of the pre-1997 assets to historic cost accounting.

RAV Model: This model calculates the forecast asset values and depreciation, for Copper and Duct. The model also applies a regulatory adjustment (the regulatory asset value adjustment, or RAV adjustment) previously applied by Ofcom.

Regulatory Asset Value (RAV): The value ascribed by Ofcom to the capital employed in the relevant licensed business.

Regulatory Financial Statements (RFS): The financial statements that BT is required to prepare and publish by Ofcom.

Retail Price Index (RPI): A measure of inflation published monthly by the Office for National Statistics. It measures the change in the cost of a basket of retail goods and services.

Return On Capital Employed (ROCE): The ratio of accounting profit to capital employed. The measure of capital employed can be either Historic Cost Accounting (HCA) or Current Cost Accounting (CCA).

RPIJ: RPIJ is a Retail Prices Index (RPI) based measure that will use a geometric (Jevons) formula in place of one type of arithmetic formula (Carli). It was launched in response to the National Statistician's conclusion that the RPI does not meet international standards due to the use of the Carli formula in its calculation.

SCS Response to the FAMR Consultation: SCS, *Response to the FAMR Consultation,* September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/SCS_Telecom.pdf.

Second LLU WLR BT Information Request: The second formal LLU WLR information request sent to BT on 7 March 2013.

Second QoS BT Information Request: The second formal QoS information request sent to BT on 23 May 2013.

Senior Operations Manager (SOM): A geographic area which is the responsibility of an Openreach Senior Operations Manager. There are currently 58 SOM areas.

Service Level 1 (SL1): A repair service contract offered by Openreach for fault repair by the end of the next working day plus one day (excluding Saturday) after the acceptance of faults by Openreach.

Service Level 2 (SL2): A repair service contract offered by Openreach for fault repair by the end of the next working day (including Saturday) after the acceptance of faults by Openreach.

Service Level Agreement (SLA): A contractual commitment provided by Openreach to CPs about service standards.

Service Level Guarantee (SLG): A contractual commitment by Openreach to CPs specifying the amount of compensation payable by Openreach to a CP for a failure to adhere to an SLA.

Service Management Centre (SMC): The contact point in Openreach for CPs requesting LLU, WLR and other services.

Seventh LLU WLR BT Information Request: The seventh formal LLU WLR information request sent to BT on 15 May 2013.

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 the dominant provider 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 who must meet additional obligations under the relevant Directives.

Single Jumpered MPF Dispute: CW/01109/06/13, *Dispute between TalkTalk Group and BT Openreach about single jumpered MPF*, 15 November 2013, http://stakeholders.ofcom.org.uk/enforcement/competition-bulletins/closed-cases/all-closed-cases/cw_01109/

Sixth LLU WLR BT Information Request: The sixth formal LLU WLR information request sent to BT on 8 May 2013.

Sky: British Sky Broadcasting Ltd.

Sky Response to the FAMR Consultation (Quality of Service): Sky, *Response to the FAMR Consultation (Quality of service),* September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/Sky_Quality_of_Service.pdf.

Sky Response to the July 2013 Consultation: Sky, *Response to the July 2013 Consultation,* http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Sky.pdf

SMPF New Provide: Service named "SMPF Connection charge, Basic Provide on existing narrowband, Simultaneous Provide of SMPF with narrowband, Singleton Migration (Transfer or change of CP migrations) from Narrowband, MPF, SMPF and ISDN/ Highway" in Openreach price list.

SMPF Single Migration: Service named "SMPF Connection charge, Basic Provide on existing narrowband, Simultaneous Provide of SMPF with narrowband, Singleton Migration (Transfer or change of CP migrations) from Narrowband, MPF, SMPF and ISDN/ Highway" in Openreach price list.

Special Faults Investigation (SFI): A chargeable fault investigation product from Openreach.

SSE: SSE plc.

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

Sub-Loop Unbundling (SLU): Like local loop unbundling (LLU), except that CPs interconnect at a point between the exchange and the end uder, usually at the cabinet.

Superfast broadband: A broadband connection that can support a maximum download speed of 30Mbps or greater.

Sweeney Pinedo, Fixed and Mobile Research: Sweeney Pinedo, *Fixed and Mobile Research*, prepared for Openreach, August 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Openreach_Annex_B.pdf

TalkTalk: TalkTalk Telecom Group plc.

TalkTalk Response to the FAMR Consultation (Quality of service): TalkTalk, *Response to the FAMR Consultation (Quality of service),* October 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/TalkTalk_Quality_of_Service.pdf.

TalkTalk Response to July 2013 Consultation: TalkTalk, *Response to the July 2013 Consultation*, October 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/TalkTalk_Group.pdf .

Tenth LLU WLR BT Information Request: The tenth formal LLU WLR information request sent to BT on 28 August 2013.

Tesco: Tesco Broadband.

Test Access Matrices (TAMs): A test access matrix connects on demand test signals and measurement equipment to customer lines so that an operator can determine remotely if the connection to the customer is functioning to the required standard. It should be noted that The TAM is owned and operated by Openreach and does not change ownership in relation to the local loop.

Third LLU WLR BT Information Request: Ofcom's third formal LLU WLR information request sent to BT on 18 March 2013.

Third QoS BT Information Request: The third formal QoS information request sent to BT on 17 September 2013.

Thirteenth LLU WLR BT Information Request: The thirteenth formal LLU WLR information request sent to BT on 8 November 2013.

Three: Hutchinson 3G.

Tie Pair Modification: Used in the name of services in Openreach price lists.

Time Division Multiplex (TDM): a method of putting multiple data streams in a single signal by separating each signal into many segments, each having a very short duration. Each individual data stream is reassembled at the destination based on timing.

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

Time-Related Charges (TRCs) : Time Related Charges are raised by Openreach to recover costs incurred when Openreach engineers perform work not covered under the terms of the Openreach service.

Twelfth LLU WLR BT Information Request: The twelfth formal LLU WLR information request sent to BT on 11 October 2013.

UKSA: UK Statistics Authority.

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.

Verizon: Verizon Enterprise Solutions.

Verizon Response to the FAMR Consultation: Verizon, *Response to the FAMR Consultation,* September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/Verizon.pdf.

Verizon Response to July 2013 Consultation: Verizon, *Response to the July 2013 Consultation,* September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Verizon.pdf.

Virgin: Virgin Media.

Virgin Response to the FAMR Consultation: Virgin, *Response to the FAMR Consultation,* September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/Virgin_Media.pdf.

Virgin Response to July 2013 Consultation: Virgin, *Response to July 2013 Consultation,* September 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/responses/Virgin_Media.pdf.

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

Vodafone: Vodafone UK and Cable & Wireless Worldwide Ltd.

Vodafone Response to the FAMR and July 2013 Consultations: Vodafone, *Response to the FAMR and July 2013 Consultations*, September 2013,

http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/Vodafone.pdf

Volumes Forecast Model: Ofcom, *LLU and WLR Volumes Forecasts,* December 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-llu-wlr-charge-controls/annexes/annex13.xlsx

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 UK communications providers 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.

WLR+SMPF Simultaneous Migration: The simultaneous provision of WLR Conversion and SMPF New Provide.

WLR+SMPF Simultaneous Connections: The simultaneous provision of WLR Connections and SMPF New Provide.

WLR Connections basket: This is a basket of two connection services. In particular, services named "Supply of new Basic line - Per line" which we refer to as "WLR Standard Connection" and "Supply of new line - Per line – using previously stopped LLU MPF line" which we refer to as "WLR Start of Stopped MPF Line" in Openreach price list.

WLR Conversion: Service named "Conversion of Local Loop Unbundling (LLU) Metallic Path Facility (MPF) to a single Wholesale Access line" in Openreach price list.

WLR Standard Connection: Service named "Supply of new Basic line - Per line" in Openreach price list.

WLR Start of Stopped MPF Line: Service named "Supply of new line - Per line – using previously stopped LLU MPF line" in Openreach price list.

WLR Start of Stopped WLR Line: Service named "Line Transfer (inc Working Line Takeover and Starting of Stopped lines) Basic line - Per transfer" in Openreach price list.

WLR Transfer: Service named "Line Transfer (inc Working Line Takeover and Starting of Stopped lines) Basic line - Per transfer" in Openreach price list.

WLR Working Line Take Over (WLTO): Service named "Line Transfer (inc Working Line Takeover and Starting of Stopped lines) Basic line - Per transfer" in Openreach price list.