Treatment of the level of faults in the LLU and WLR charge controls for 2014 - 17

A REPORT PREPARED FOR TALKTALK AND SKY

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Executive Summary

Ofcom notes that the "*cost of repairing faults is a significant proportion of the cost of providing the rental services*". Therefore the assumptions that Ofcom makes in its modelling on the level of faults have a significant impact on projected costs during the charge control, and the consequent prices that BT's customers will pay. If faults are elevated due to past or current inefficiencies, then the actual costs of repairing these faults will be above an efficient level and should be adjusted when forecasting future costs. This elevated level of fault rates will also impact on downstream wholesale and retail customers as the costs for dealing with additional faults will be above the competitive level.

While charge controls provide incentives for cost minimisation, there is a risk that current fault rates will be above the level that minimises long term costs for a number of reasons:

- exceptional weather conditions in the base year (2012) do not reflect long run costs;
- the structure of the charge control does not provide sufficient incentives to invest in maintaining the network;
- there are other over-riding commercial incentives; or
- Openreach's management has acted inefficiently, for example because of principal-agent[1] issues which have increased overall costs.

Ofcom's anchor pricing approach also means that fault repair costs should reflect a hypothetical, efficient, copper only operator. As such Ofcom should ensure that the cost base does not include any faults costs which would not have occurred in the absence of NGA roll out.

For these reasons, it is necessary to examine carefully the level of faults that occurred on Openreach's network in the base year and where necessary adjust cost forecasts to reflect elevated fault rates.

Openreach has not supplied to Ofcom a consistent time series of faults volumes for the last four years. However, public statements by BT support Ofcom's initial estimates that the number of faults was less than 2m in 2009, and has rapidly increased since then, with faults now more than 50% higher[2]. Such a rapid deterioration in the quality of the network since 2009 does not appear to be

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1 This could occur if the incentives of Openreach's management are not completely aligned with the incentives of BT's investors.

2 In contrast, Ofcom was unsure of the increase in the level of faults due to the lack of data from Openreach and believed that the increase in faults could have been as low as 23%.

consistent with fault rates being currently at an efficient level. The increase is too great to be explained by exogenous effects such as the weather or an increase in broadband lines as highlighted in a previous Frontier report (the "October Frontier Report").[3]

To the extent that exceptional weather conditions did lead to fault rates being elevated in the base year, the cost base should be adjusted to take account of the average expected weather conditions (i.e. mean reversion).

The October Frontier Report identified two further causes that may have resulted in elevated faults in recent years: a reduction in preventative maintenance on the network; and the roll out of NGA technology. Ofcom has not adequately addressed either of these points.

Reduction in level of maintenance

Ofcom has received information from Openreach that confirms that the level of preventative maintenance has been reduced in recent years. However, Ofcom does not consider that the efficient level of faults can be readily determined; therefore it proposes to assume that the current relatively poor level of network quality is efficient. However, allowing Openreach to keep the benefits of cash savings through reduced capital expenditure[4] whilst passing on the direct and indirect costs of this shortfall in expenditure to wholesale and retail customers, will not provide incentives for Openreach to operate the network efficiently. As such, in order to protect the interests of consumers, it would appear necessary for Ofcom to determine whether the current level of Openreach faults is efficient.

Impact of NGA on fault rates

The rapid decline in the quality of the CGA network since 2009 coincides with the rapid increase in investment in NGA activity (as explained in the October Frontier Report). There are a number of plausible hypotheses as to why NGA activity may have caused faults on CGA lines, such as NGA provisioning or other activity directly interfering with CGA lines and causing faults, or that NGA activity diverts resources from maintaining CGA lines. Ofcom relies on analysis carried out by CSMG to reject any link between NGA roll out and the increased fault rate. However, the CSMG analysis is fundamentally flawed in that it uses a simple cross-sectional approach and does not control for other variables that may

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

4 Reducing capital expenditure would only feed through into reduced allowable revenues over the lifetime of the relevant assets, which could be up to 40 years for duct.

be correlated with both NGA roll out and with fault rates such as population density. As such, the analysis is not sufficiently robust to reject the hypothesis that NGA roll out has led to increased fault rates. An analysis based on a panel approach would allow Ofcom to identify accurately whether there was a link between NGA roll out and elevated fault rates and thus whether the cost base should be adjusted for this effect.

Relative fault rates

The CSMG analysis upon which the estimates of relative fault rates for different services and hence the differential repair costs allocated to services also has methodological flaws:

- a number of faults are not included in the analysis because of missing data ("Unknown" or "Unclassified" products). To the extent these faults are 'common' to all services, they will over-state the differential between services. To the extent that lines used for certain services are more likely to have missing data the analysis may be biased. Ofcom should carry out a further investigation into this missing data to ensure that the faults are analysed appropriately;

- the analysis of fault rate differentials does not control for effects such as line length and as such may not accurately reflect the incremental cost difference due to services but rather differences in the distribution of services across the network; and

- the data shows significant differences in in-life and early life fault rates suggesting there is causality between provisioning work and faults but this causality is not reflected in the cost modelling.

1 Introduction

Frontier Economics has been engaged by British Sky Broadcasting Limited ("Sky") and the TalkTalk Telecom Group PLC ("TalkTalk") to review certain aspects of Ofcom's proposals for the LLU and WLR charge controls from 2014 – 2017 contained in its recent consultation, Fixed access market reviews: Openreach quality of service and approach to setting LLU and WLR Charge Controls dated 19 December 2013 (the "December Consultation"). This report summarises the results of that review.

The report covers the following areas:

- Section 2 reviews the increase in the level of faults since 2009;
- Section 3 considers Ofcom's approach to assessing whether faults are inefficiently high;
- Section 4 considers Ofcom's approach to reflecting costs of exceptional weather in the base year;
- Section 5 considers Ofcom's assessment of the relationship between faults on the copper network and NGA investment; and
- Section 6 considers Ofcom's assessment of the differential between LLU and WLR fault rates.

2 Evidence of increases in fault rates since 2009

2.1 Introduction

Ofcom notes "*The cost of repairing faults is a significant proportion of the cost of providing the rental services*"[5]. Ofcom's cost modelling is based on forecasting costs, including repair costs, forward from the actual level of costs incurred by Openreach in a base year, with the costs in this base year adjusted for known issues. In assessing the repair costs in the base year it is necessary to understand whether the level of faults incurred in that year and hence the repair costs associated with those faults are a reasonable base from which to project repair costs throughout the course of the charge controls (and particularly for 2016/17 which is the year upon which the charge control is based).

In this regard, Ofcom recognises that it needs to understand and interpret recent trends in the underlying level of faults in order to forecast robustly the appropriate level of fault repair costs in order to set the charge control.

In this section we review:

- Ofcom's analysis of the recent trends in fault rates; and
- evidence from BT's public statements on the volume of faults.

2.2 Ofcom's assessment of recent trends in fault rates

Ofcom explains in its December Consultation that Openreach was unable to provide it with a consistent time series of data on faults. This is surprising as it would appear to be a key performance indicator for Openreach to manage its resources. Instead, Ofcom has had to rely on two fault data sets for two time periods, 1994 to 2007 and 2010 to 2012[6]. No data was available for 2008 and 2009.

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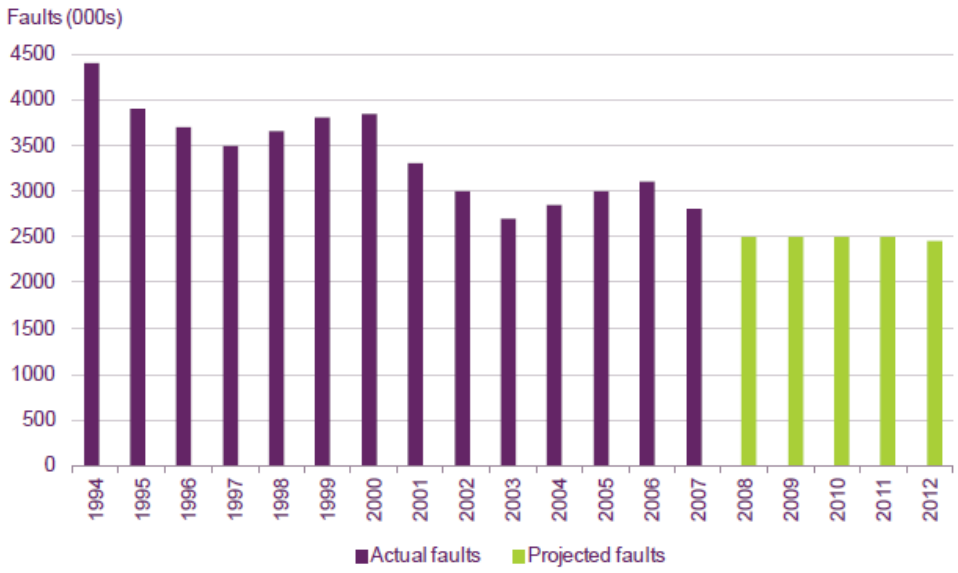
5 December Consultation paragraph 5.1. Ofcom further noted: "*In the base year of the Cost Model in the July 2013 Consultation, the cost of repairing faults represents 16% of the MPF cost stack, 14% of the WLR Basic cost stack and 27% of the SMPF cost stack.*"

6 It is not clear from the data supplied whether the fault rate refers to calendar years or BT financial years which run form 1st April to 31st March. In addition, it is not clear whether the two data sets are on a fully consistent basis.

2.2.1 Faults between 1994 and 2007

For the period 1994 to 2007 fault rates declined by around 3.5% per year[7] from around 4.45m in 1994 to around 2.8m in 2007. This was a period when growth in broadband penetration was significant. BT asserts that broadband lines have higher fault rates than voice only lines – if this were true this would suggest that on a like for like basis, the rate of reduction was even greater. Figure 1 shows the actual fault volumes up to 2007 and projections for 2008 onwards that were made in the 2009 LLU/WLR charge controls.

Figure 1. Historical and projected access fault volumes in 2009



Source: December Consultation Figure 5.1

2.2.2 Faults in the period 2010-2012

The volume of faults increased from 2.5m in 2010 to almost 3m in 2011 and remained at this level in 2012.

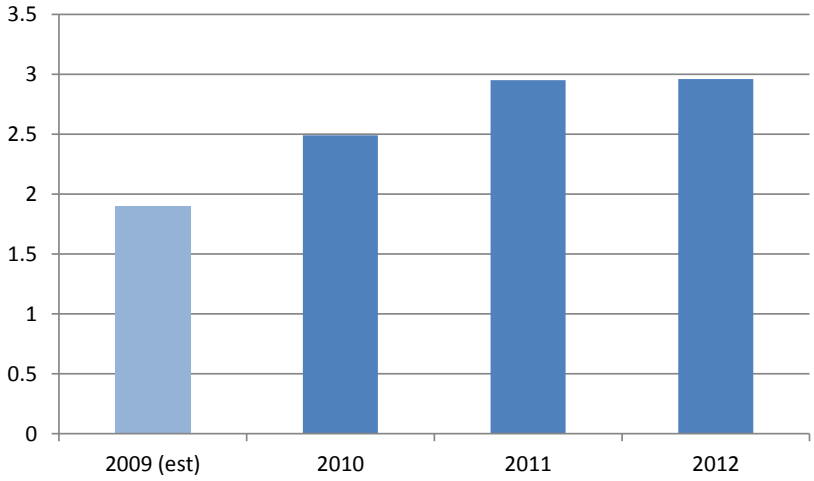
In the July Consultation[8] Ofcom set out its view that there had been approximately 1.9m faults in 2009. It noted that data for 2009 relied on only three months of data which was pro-rated to give an estimate of full year faults.

7 Compound average growth rate.

8 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 ("the July Consultation").

Evidence of increases in fault rates since 2009

Figure 2. Reported faults since 2009



Source: Source: December Consultation Table 5.2. WLR, SMPF and MPF faults.

In its December Consultation Ofcom considered that it could not confidently rely on the 2009 estimate. Given that Openreach was unable to provide Ofcom with data on faults for the period 2008 – 2009, Ofcom also gave weight to a projection of faults that Openreach gave to Ofcom in 2007 (seen in **Figure 1**).

> *"For 2007 (the last year of the historical fault data provided by Openreach in 2009), there were approximately 2.8m faults. To achieve a figure of 1.9m in 2009 as indicated in* [Figure 2 above] *would suggest a reduction in faults of over 15% per annum, as compared to our forecast of 2%. Based on this actual fault data, and our conclusion in the 2009 PFFO Statement that fault volumes should reduce by 2% per annum in the period 2009/10 to 2012/13, we now consider the volume of faults for 2009 published in the FAMR Consultation and reproduced in Table 5.2 above may be under-stated."*[9]

2.2.3 Ofcom's conclusion of trends in the volume of faults

When making its assessment of faults Ofcom gives Openreach the "benefit of the doubt" and assumes that faults between 2007 and 2009 may have remained constant. This leads Ofcom to conclude when assessing Openreach's performance on faults that:

> *"whilst we may assume the volume of faults lies within a range between 1.9m and 2.5m for 2009, compared to the 1.9m presented in our July 2013 FAMR Consultation, we cannot establish a definitive figure of faults for 2009.* ***This range***

[9] December Consultation paragraph 5.13.

would suggest an increase in faults from 2009 to 2012 of between 20% and 53%."[10] [emphasis added]

2.3 Evidence of trends in fault rates

Although Openreach did not provide Ofcom with evidence on the volume of faults, it is clear from BT's public statements that there was a continued reduction in faults on Openreach's network until 2009/10. Since then there been a clear and significant increase in faults. This is contrary to Ofcom's view that it is unclear to what extent the volume of faults has increased.

Evidence on faults from BT's Annual Reports

Information from BT's Annual Reports makes clear that until 2009/10 the volume of faults continued to decline at a faster rate than the long term trend from 1994 – 2007.

BT's 2008 Annual Report (covering the financial year 2007/2008) noted that:

> *"**Service involves more than just reactive provision and repair activity; it also includes the process of reinvigorating the access network infrastructure through investment in the local network – which leads to improved reliability, enhanced service standards and reduced cost**. In 2008, Openreach invested around £35 million in a proactive maintenance programme, **which reduced the number of access network faults by 10%.** At the same time, the number of high-bandwidth services carried rose by around 20%."*[11][emphasis added]

BT's 2009 Annual Report (covering the financial year 2008/2009) noted that in the period covered there was a:

> *"**20%+ reduction** in access faults this year – a line goes wrong only every 13 years on average."*[12].

BT's 2010 Annual Report (covering the financial year 2009/2010) noted continued reductions in fault rates, for example it stated that:

> *"Faults due to the access network **reduced by 11%** compared with the previous year as a result of our focused network investment and quality programmes. Over the*

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10 FAMR Consultation: Openreach quality of service and approach to setting LLU and WLR Charge Controls, paragraph 5.15

11 BT 2008 Annual Report page 6. See: http://www.btplc.com/Report/Report08/pdf/AnnualReport2008.pdf

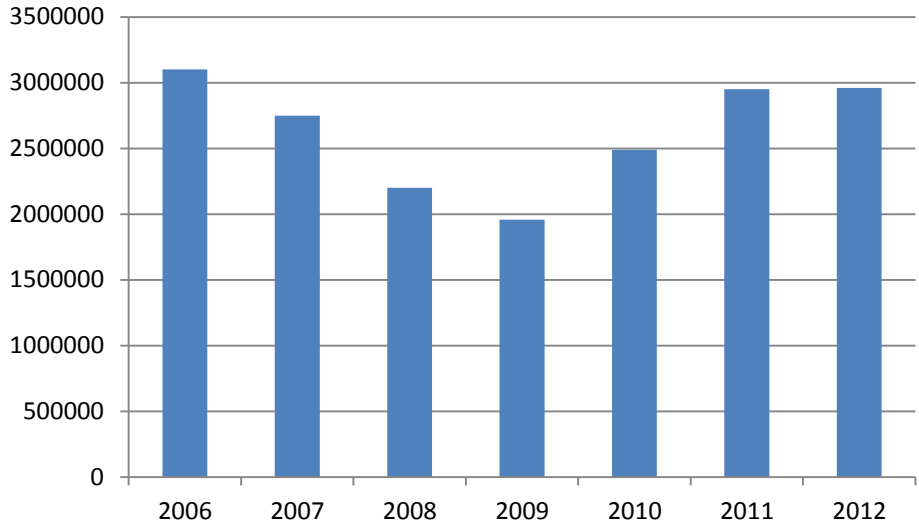
12 BT 2009 Annual Report page 6. See: http://www.btplc.com/sharesandperformance/annualreportandreview/pdf/btgroupannualreport2009smart.pdf

Evidence of increases in fault rates since 2009

past three years, fault rates have reduced from one fault every nine years to one fault every 15 years."[13]

By applying the percentage reductions in faults as reported by BT (in its 2009 and 2010 Annual Reports) to the faults as reported in Figure 5.1 and table 5.2 of Ofcom's December consultation it is possible to come up with a time series of faults spanning 2006 – 2012. It is clear that the volume of faults in the period from 2007 to 2009 on BT's access network continued to decline. The estimates for 2009 based on BT's own statements in its annual reports shows 1.8m faults in 2009 and so a **51% increase in faults since 2009.**

Figure 3. Openreach CGA faults 2006 – 2012



Notes: 2006 and 2007 data estimated from figure 5.1 of the December consultation. 2008 and 2009 estimated by applying the reported fault reductions to 2007 data. 2010 and 2011 show CGA related faults from table 5.1 of the December consultation.

This evidence shows that the estimate for 2009 provided in the July Consultation (based on pro rating the January to March data) is broadly accurate. It also demonstrates that Ofcom should not rely on projections made by Openreach in 2009 that faults in 2009 were projected to have been at a level of approximately 2.5 million[14]. This is shown in **Figure 4** below.

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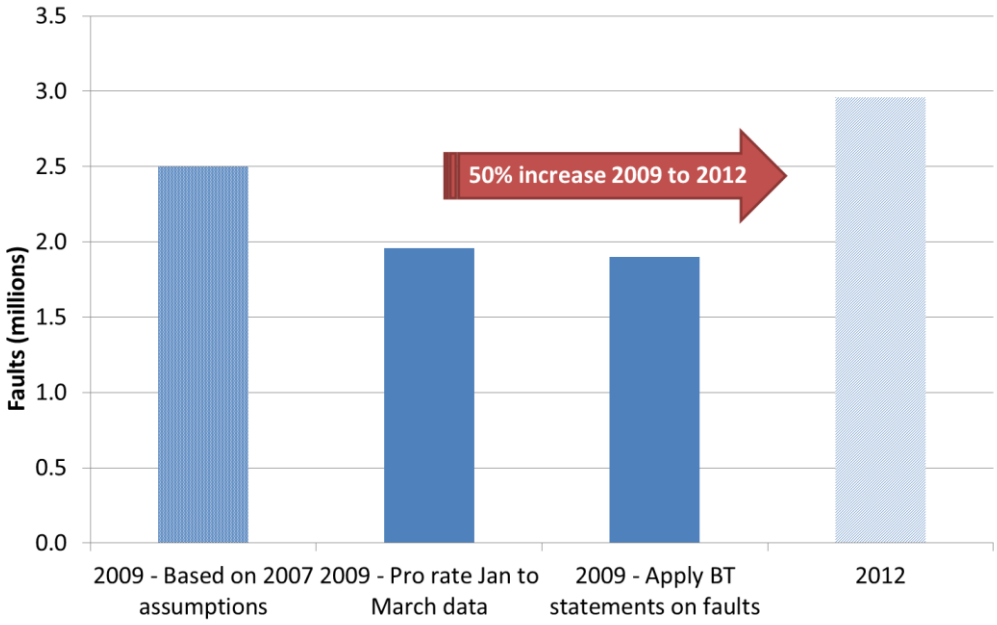
13 BT 2010 Annual Report page 6. See: http://www.btplc.com/Sharesandperformance/Annualreportandreview/pdf/2010_review-of-year-lines-of-business.pdf

14 As described in the FAMR Consultation: Openreach quality of service and approach to setting LLU and WLR Charge Controls paragraph 5.14

Figure 4. Different estimates of the level of faults in 2009



2008 and 2009 estimated by applying the reported fault reductions to 2007 data. 2010 and 2011 show CGA related faults from table 5.1 of the December consultation.

Despite Ofcom's lack of confidence in its estimate of the level of faults in 2009, this estimate is supported by other data. This indicates that there has been a significant deterioration in the level of service in the last three years which coincides with BT's NGA roll out and a reduction in preventative maintenance. Ofcom has not provided a robust quantitative assessment which explains how this increase is consistent with an efficient level of costs.

Evidence of increases in fault rates since 2009

3 Adjusting to the efficient level of faults

3.1 Introduction

Ofcom recognises that if fault rates were inefficiently high it may have to adjust the base year costs to reduce the costs of fault repair[15]. This section therefore considers Ofcom's assessment of whether faults are inefficiently high such that it should adjust base year costs.

In section 2, we explained that there has been a clear deterioration in the quality of Openreach's network (as evidenced by the increase in the volume of faults). There are a number of factors that could have led to this decline in quality. Ofcom and Openreach note that exceptional weather in 2012 contributed to the large number of faults in that year[16]. Other potential explanations include Openreach failing to maintain the quality of the network by reducing expenditure on preventative maintenance or the impact of Openreach's NGA investments on CGA services.

In this section we explain that:

- the decline in the quality of the network is unlikely to be consistent with an efficient network operator;
- there are wider costs and inefficiencies as a result of faults which Ofcom should consider when setting the charge controls;
- Ofcom cannot rely on the charge control alone to incentivise Openreach to operate at an efficient level of faults; and
- Ofcom should implement the charge controls in such a way that Openreach is incentivised to maintain the quality of its network, for example by adjusting base year costs.

3.2 Ofcom's approach to considering whether faults are inefficiently high

Ofcom's charge controls model estimates the costs of a hypothetical efficient network operator of a copper only network. In doing so, it is attempting to set prices such that incentives on Openreach and its customers mimic the incentives that would be observed in competitive markets.

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15 December Consultation paragraph 5.83.

16 The weather does not appear to be a strong contributory factor in explaining faults given that in 2012 it was significantly worse than 2011, but the overall level of faults was similar.

Given the difficulty of modelling the costs of an efficient access network operator from the 'bottom up', it is reasonable to start with Openreach's reported costs in a base year and then apply adjustments as necessary to estimate an efficient level of costs.

In making its assessment Ofcom has considered whether the level of faults that is observed in the base year is higher than would be observed in competitive markets (i.e. is inefficiently high) because the level of investment in preventative maintenance has been lower.

Ofcom noted that:

> "*were* [it] *to conclude that there had been under-investment such that the increased level of faults resulted in the overall costs being too high,* [it] *could consider making an adjustment to the base year costs."*[17]

Furthermore, Ofcom's analysis found that:

- in the period 2011/12 – 2012/13 Openreach had reduced the amount of preventative maintenance on its network by 10% compared with the years 2008/09 and 2009/10[18]; and
- there has been a reduction in Openreach's overall investment in copper cable.

It noted that these *"reductions in preventative maintenance and investment may be a cause of increased fault volumes"*[19].

However, Ofcom decided that it would not make an adjustment to base year costs for two reasons:

- first, Openreach did not provide Ofcom with information with which to assess the level of faults between 2007 and 2010. Therefore Ofcom considered that it was unable to determine the trend in fault rates between 2007 and 2012, noting that the increase between 2009 and 2012 could be anywhere between 20% and 53%[20]. As set out above, the increase in faults since 2009 has been around 50%; and.
- second, Ofcom considered the assessment of the appropriate level of quality simply too difficult. It noted:

  > *"we have been unable to determine whether Openreach has under-invested compared to an efficient level, such that fault rates are inflated, or, even if this*

17 December Consultation paragraph 5.83.

18 December consultation paragraph 5.86.

19 December Consultation paragraph 5.89.

20 December Consultation paragraph 5.15.

Adjusting to the efficient level of faults

> *were the case, what the extent of any such under-investment might be. … We are not able to determine whether an adjustment would be appropriate, and, even if it was, we are not able to determine the level of any such reduction to the level of faults (and therefore fault costs), or associated increases in investment, to make to the base year cost data."*[21]

While it may be difficult to identify with precision the level of quality that would be observed in competitive markets, this should not mean that *any* level of quality observed in the base year is acceptable during the charge control. The sudden and significant deterioration in the level of quality at the same time as the decline in investment in preventative maintenance provides reasonable grounds for further investigation, to ascertain what other factors could possibly explain this.

3.3 Wider costs of allowing quality to decline

An increase in the fault rate will lead to a direct increase in costs through an increase in fault repair costs. However, Ofcom should recognise the wider costs of giving Openreach discretion to reduce the quality of its network.

An increase in the propensity for lines to fault directly leads to consumer harm over and above the cost of repairing the faults, as consumers lose service and incur the cost and inconvenience of having to report faults and facilitate repairs. In a competitive market customers could take these costs into account when choosing between providers resulting in an incentive for operators to lower fault rates. Under a charge control Openreach may only take into account its own costs of faults. Ofcom recognises the costs to consumers of loss of service, and of having to arrange engineer visits for remedial repairs in the context of its assessment of the quality of service standards[22] which relate to the remedial repair of faults. It should also recognise these costs in its assessment of the level of faults.

3.4 The current charges may result in fault rates which are above an efficient level

Ofcom's approach to setting charges controls aims to ensure that prices reflect its costs forecast (which is extrapolated from the base year). In contrast to other sectors, it has considered that assessing the level of quality of the network should not be a matter for it and instead is purely a matter for Openreach. It noted that

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21 FAMR Consultation: Openreach quality of service and approach to setting LLU and WLR Charge Controls paragraph 5.91

22 See FAMR July Consultation paragraph A9.55 to A9.105.

> *"In our view, Openreach is best placed to assess the balance between investment, preventative maintenance and the cost of fixing faults that occur."*[23]

While the charge controls may have provided sufficient incentives for cost minimisation in the past, if costs were significantly above the efficient level, charge controls alone may not result in an efficient level of faults. BT may rationally choose to under-invest in preventative maintenance for the following reasons:

- reductions in preventative maintenance below an efficient level can give an immediate cash saving in the early years of a charge control, with a lag in the resulting increase in fault rate meaning that the consequent increase in repair costs could feed into the next charge control;

- the overall increase in repair costs can be restricted by reducing the quality of the fault repair process. For example, Openreach can choose to divert fewer resources to repairs or reduce the quality of repairs; and

- an increase in fault rates may provide BT with a competitive advantage in downstream retail markets where consumers may (incorrectly) believe that BT retail's services are in general of better quality than those of Openreach's external wholesale customers, or that NGA offers better quality than copper-based products. Should increased fault rates drive a flight to (perceived) quality then BT could gain as consumers would switch away from retail competitors to BT, stay with BT or migrate towards products which yield Openreach higher wholesale revenue.

This could give Openreach a strong incentive to reduce the amount of preventative maintenance on its network. As the volume of faults increases as a result of the reduction in investments, it may assume Ofcom will allow it to fully recover costs of remedial work to repair avoidable costs in subsequent charge controls.

Openreach's reduction in the level of expenditure on preventative maintenance has potentially contributed to the significant deterioration in the level of quality of the network. Ofcom has provided no explanation of how a 51% increase in faults since 2009 is consistent with the level of quality that would be observed in competitive markets. We are not aware of other competitive sectors where quality of service has sharply deteriorated to the extent as has occurred in Openreach's network. In general, consumers in technology markets expect improving quality, not significant year on year reductions in quality.

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23 FAMR Consultation: Openreach quality of service and approach to setting LLU and WLR Charge Controls paragraph 5.83

Adjusting to the efficient level of faults

It is axiomatic that a firm with market power would set the price above that which would be observed in competitive markets absent regulation, if doing so would maximise its profits. Where prices alone are regulated, firms can still set *effective* prices above that which would be observed in competitive markets by reducing quality below the competitive market level. Hence to minimise the loss of consumer welfare, it is common for regulators (such as Ofgem or OFWAT) to constrain how regulated firms can act, both in terms of the prices that they set and in the level of quality that they provide.

Regulating quality in energy and water distribution

Other economic regulators such as OFGEM and OFWAT recognise that the quality of the network cannot be ignored or left to the discretion of a firm with market power. They use incentive based regulation; set minimum standards and review business plans to ensure that regulated firms are not able to circumvent the control by lowering quality. These tools provide the mechanisms to ensure that regulated operators are unable to reduce costs below those forecast in price controls simply by running down the quality of their networks.

Ofgem's RIIO regulatory framework, which regulates the electricity and gas distribution and transmission networks, has a number of explicit financial incentives to ensure that firms do not degrade the quality of their networks. For example, Ofgem's RIIO framework sets explicit targets on the number of faults ("customer interruptions"), and the duration of faults ("customer minutes lost"). Firms face specific financial incentives to meet the targets.

Likewise OFWAT's framework for regulating water companies includes explicit measures to ensure that quality is not degraded[24]. For example, water companies face financial penalties for service failures such as interruptions to supply, or water leakage from the network.

While Ofcom considers that estimating the efficient level of quality may be difficult the efficient level of costs cannot be estimated without reference to quality, as costs and quality are interdependent. When setting forward looking charge controls, quality must be considered in order to avoid higher effective prices due to lower quality levels as a result of a firm with market power reducing costs by under investing in its network, and recovering fault related costs in subsequent controls.

24 See: OFWAT Key performance indicators – guidance http://www.ofwat.gov.uk/regulating/compliance/gud_pro1203kpi.pdf

3.6 Conclusion

The direct costs of allowing quality to deteriorate are significant. Ofcom estimates that faults make up 16% of the MPF cost stack (about £14), 14% of the WLR Basic cost stack and 27% of the SMPF cost stack. However, the economic costs of faults will be higher, as CPs and consumers bear the costs of outages and of arranging engineer visits.

While up to 2009 BT's performance in terms of fault rate reductions suggests that there were incentives to reduce fault rates toward an efficient level, the sudden deterioration in network quality suggests that a charge control alone may no longer be sufficient.

While Ofcom argues that it is difficult to precisely determine the "efficient" level of faults on a network, this does not mean that Ofcom should not attempt to assess whether the current level of faults is consistent with efficiency. Other regulators recognise that firms with significant market power may have incentives to run down the quality of their networks, and therefore use incentive based regulation to attempt to prevent this.

It would be straightforward for Ofcom to make a one off adjustment to Openreach's cost base to reflect an appropriate level of faults. Such an approach would be consistent with the aim of maximising efficiency in that it would mitigate the costs to consumers of reduced network quality. Moreover, it would provide a strong incentive for Openreach to maintain its investments thus avoiding further increases in network faults.

4 Adjusting fault rates for "exceptional" weather in 2012

4.1 Introduction

Ofcom considers that weather (such as extreme rainfall) is a factor in determining the level of faults. While increased rainfall does not appear to be a significant driver of the increased fault rate since 2009, it is likely to have some impact of the level of faults. In order to forecast costs accurately, Ofcom should adjust the base year costs to exclude the effect of weather which departs from the mean. In other words, the fault rate projections should be based on the expected/mean level of rainfall not a continuation of the 'exceptionally' high level of rainfall in 2012.

Ofcom's July Consultation considered the impact of weather on base year costs, and its December consultation considered whether it expects increasing rainfall during the charge control period to increase fault rates over the course of the control. However, when making its preliminary conclusion on using 2012/13 costs from the 2013 RFS it has not considered the impact that the exceptional weather in 2012 had on Openreach's costs.

4.2 Openreach and Ofcom agree that that extreme weather in 2012 led to exceptional fault costs

Ofcom's assessment of the relationship between faults and rain was based on a monthly analysis of national data. We have concerns that the evidence presented by Ofcom on the prevalence of faults does not fully explain the relationship between faults and rain[25]. We note that Ofcom and Openreach both agree that:

- bad weather (extreme rainfall) has a significant impact on fault rates; and
- 2012 was an exceptional year for rain.

Openreach noted that:

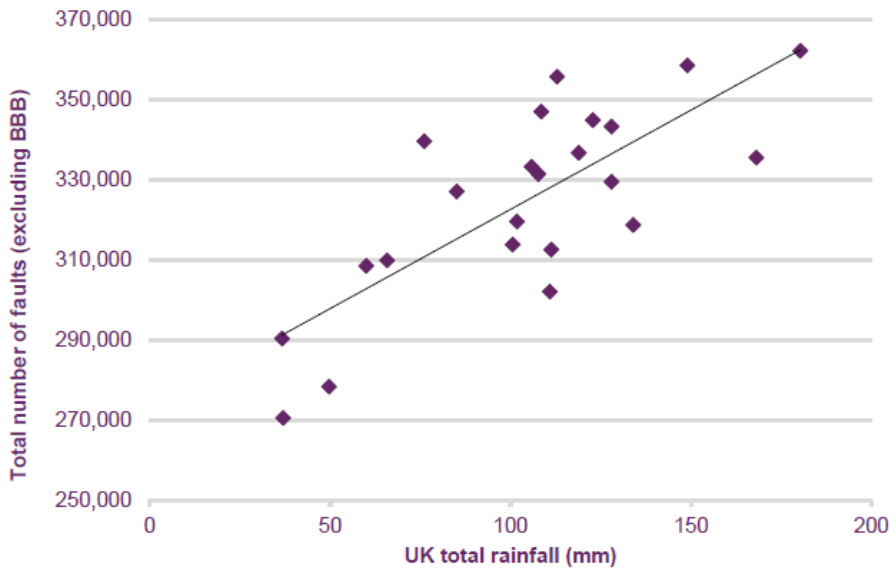
> *"at the beginning of April 2012, before the bad weather started, it had a repair work stack consistently below 16,000 faults, a very low level that allowed provisions to be completed with short lead times of 4 to 6 days. Although* ***bad weather in April nearly doubled the overall work stack*** *it was able to recover to near normal*

[25] For example, the analysis is based on the relationship between rain and faults at a national level which might hide geographic variation in rain and faults, the sample size was relatively small and there is a risk of co-linearity, for example in seasonal variations in both rainfall and fault rates.

> *by the end of May.* ***Further bad weather from June onwards maintained fault volumes throughout the summer and autumn at levels previously only encountered as occasional spikes during periods of severe winter weather."***[26] [emphasis added]

Ofcom concluded that *"there is clearly a relationship between rainfall and fault report volumes"*[27]. It analysed the correlation between the volume of faults and rainfall patterns. It found that *"there is a strong correlation between rainfall and fault report volumes in the following month"*.

Figure 5. Correlation between rainfall and fault report volumes



Source: July Consultation Figure A10.18

In its December Consultation Ofcom concluded that *"the evidence indicates that changes in rainfall may have an effect on fault rates"*[28].

There is also agreement between Openreach and Ofcom that the weather in the base year was exceptional.

Openreach emphasised that the **"*weather* [in 2012] *had been wholly exceptional*".** It noted that:

> "[For the UK as a whole, 2012 was the second wettest year since modern records began in 1910 and the latter nine months of 2012 were together

26 July Consultation paragraph A10.5.

27 July Consultation page 126.

28 December Consultation paragraph 5.114.

Adjusting fault rates for "exceptional" weather in 2012

the wettest period in history. As a consequence of these conditions repair levels rose to sustained and unprecedented high levels across wide areas of the country."[29]

For its part, Ofcom noted that "*2012 was the second wettest since 1910 but is not without precedent in recent years*"[30]. In particular it noted that:

> *"**2012 was unusual in several respects** and was characterised by the following distinguishing features:*
>
> - *record levels of rainfall in April and June, the highest since records began in 1766;*
> - *the period April to July also exceeded the 2007 records where rain and its effects were widespread instead of just affecting some regions as in other years;*
> - *a summer period when the rainfall remained relatively high compared to other years; and*
> - *this was followed by an unusually long period of equally high rainfall in the autumn that lasted 4 months. Although there was also a 4 month period of high rainfall in 2000, unlike 2012 it followed a dry period."*[31] [emphasis added]

It further noted in response to the submission by Openreach on climate that:

> *"2012's annual precipitation level was only exceeded or equalled in 1960 and 2000, based on data collected since 1931. 2012's precipitation level is considered to represent **an infrequent, high peak** given that the high precipitation levels in 1960 and 2000 were not followed by one or more years with such high levels of precipitation."*[32] [emphasis added].

Ofcom concludes after a detailed analysis of the relationship between faults and weather that "*This weather pattern led to a sustained rise in fault reports.*"[33]

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29 Openreach's response to Ofcom's Call for Inputs on the Fixed access market reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30 Quality of Service – Questions 10.1 to 10.4 January 2013, page 5

30 July 2013 Consultation A10.59

31 July 2013 Consultation A10.62

32 December Consultation paragraph 5.111.

33 July Consultation paragraph A10.70.

4.3 Ofcom should adjust base year costs to remove the effect of exceptional rainfall

Ofcom is proposing to determine the charge controls based on a forecast of the efficient level of costs in the final year of the charge controls. To the extent that the level of costs is dependent on an exogenous variable, such as rainfall, Ofcom should make forecasts based on the expected value of this variable, e.g. the long term mean level of rainfall. Ofcom proposed to forecast costs based on a projection of the level of costs in a base year. If the level of the exogenous variable differs from the mean, a simple projection of the base year will result in an inappropriate forecast. For example, if rainfall was exceptionally high in the base year, the level of costs would be correspondingly higher in the base year and projecting forwards from this base year would result in a cost forecast that would be above the expected level of costs if rainfall was at the long term mean level.

Ofcom does not appear to have even considered whether it should adjust base year costs to account for their "exceptionally" high level as a result of higher rainfall which is not forecast to be repeated during the charge controls period.

BT itself notes that the exceptional weather meant that faults were higher than expected:

"O*ur service delivery was strong in the first quarter but deteriorated for the next two quarters following some of the wettest weather on record. This meant we had to* ***spend more time than expected on repair work****. There were more faults to fix and it took longer to put them right.*"[34]

This suggests that BT believes repair costs were significantly above the expected level due to exceptional reasons.

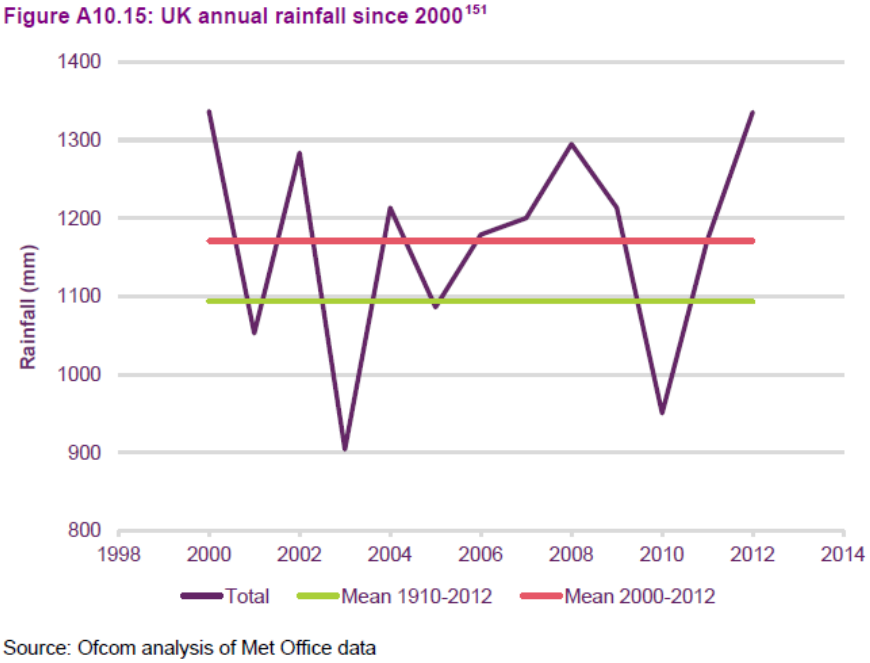
Given Ofcom's conclusions that the base year weather was exceptional, and that it believes that there is a strong relationship between rain and faults, Ofcom should adjust the base year costs so as not to "bake in" the one off costs which related to the exceptional weather of 2012. Both Ofcom and Openreach are in agreement over the substantive issue: that the weather in the base year was exceptional (i.e. by definition the rainfall in 2016/17 would not be expected to be as high), and that it led to additional costs which would not be incurred in years when the rainfall was not exceptionally high.

Ofcom's own analysis of the exceptional nature of national weather suggested that rainfall in 2012 (at around 1340mm) was around 15% higher than the 2000-2012 average and 22% higher than the 1910 – 2012 average.

34 2013 Annual report p30

Adjusting fault rates for "exceptional" weather in 2012

Figure 6. UK annual rainfall since 2000



Source: July Consultation Figure A10.15

Ofcom has analysed the impact of rainfall on faults at a **national level**[35]. It noted that:

> *"the increase in the volume of faults reported to Openreach between a dry period (defined as a rainfall of around 50mm in a month) and a particularly wet period (defined as a rainfall of around 150mm in a month) would be of the order of 50,000 faults or 15%."*[36]

The increased incidence of faults will have increased the costs of providing services. In its submissions to Ofcom, Openreach detailed the additional resource implications of dealing with the "exceptional" weather. Openreach illustrated the increase in costs resulting from exceptional rainfall noting that it expanded its engineering capacity by 20% to deal with what it described as exceptional weather in 2012[37].

35 We have some concerns over the approach used by Ofcom to estimate the effect of weather, as it aggregates geographic variation in rain and faults to the UK level. If the analysis were conducted at a local level (for example at an exchange), then the relationship could be different (and the confidence intervals around the estimate narrower).

36 July 2013 Consultation paragraph A10.68

37 July 2013 Consultation paragraph A10.4.

4.4 Adjusting the cost stack

It would be relatively easy to adjust the costs incurred in the base year to remove the costs resulting from the exceptional weather in 2012. Therefore Ofcom should make an appropriate adjustment to base year costs to ensure they are not inflated by exceptional weather in the base year.

Even adopting Ofcom's analysis of the relationship between faults and rainfall, it is possible to estimate the incremental faults costs caused by rainfall:

- Ofcom found that each additional 100mm of rain contributed 50,000 faults nationally[38];
- it also found that 2012's rainfall (of around 1340mm) was 240mm above the long term average (of 1100mm) and 170mm above the short term average (of 1170mm);
- using the relationship identified by Ofcom this means that between 85,000 (3%) and 120,000 (4%) faults were directly caused by exceptional weather; and
- given that faults are approximately 16% of the MPF cost stack (i.e. about £14.12), this implies that the "exceptional" cost of weather related faults would be at least between £0.41 and £0.57 of the MPF cost stack in 2016/17.

38 July Consultation conclusions on remedies paragraph A10.68.

Adjusting fault rates for "exceptional" weather in 2012

5 The relationship between fault rates and NGA

5.1 Introduction

The prices of CGA services are required to be based only on the costs of CGA and therefore it is necessary to ensure that costs caused by NGA are excluded. Ofcom's anchor pricing approach aims to ensure that the introduction of new technologies should not result in an increase in prices paid by users of legacy technology.

In practice, this means that all costs which are incremental to (or caused by) NGA should be removed from the CGA cost base.

Therefore, Ofcom must ascertain that all costs which are incremental to the provision of fibre are not included in the CGA costs. To this end Ofcom engaged CSMG to review the impact that the deployment of the NGA network has had on faults on the CGA network.

In the section below:

- we explain that the analysis carried out by CSMG is insufficient to support Ofcom's conclusion that it should not adjust the base year costs to account for the impact of NGA related faults; and
- we then present an alternative approach that should be used to assess the impact of NGA on faults.

5.2 Ofcom's assessment of the potential for NGA to cause faults

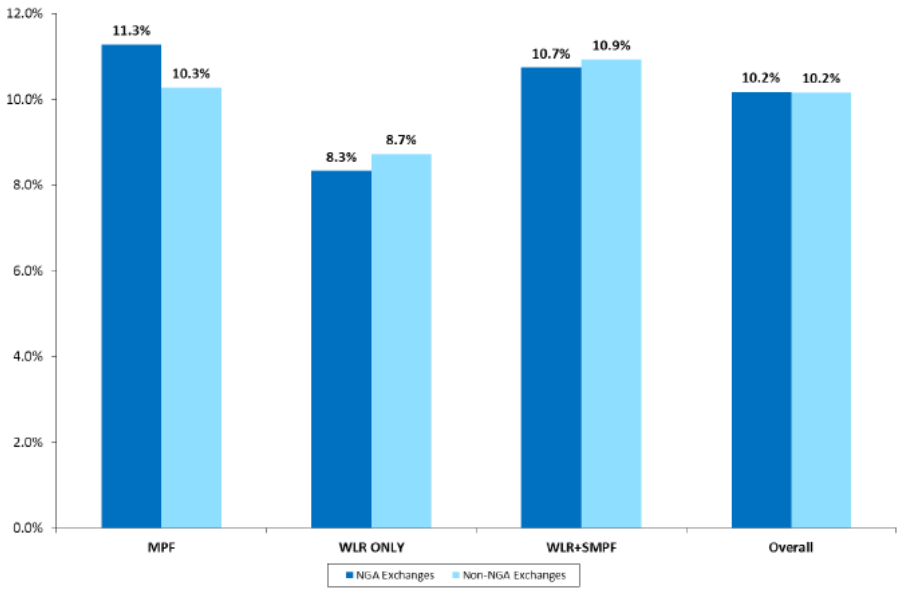
Ofcom has considered whether the roll out of NGA is a contributory factor in the increase in faults. There are a number of mechanisms through which NGA investment might affect the volume of faults. Firstly, the engineering activity across the network (e.g. in exchanges, on e-side duct and in cabinets) to enable NGA services might cause faults. Secondly, work to provision NGA services, which requires more intervention in the access network than other services, may lead to faults on CGA lines.

Ofcom relied on the analysis of CSMG who did not find a strong relationship between fault rates and NGA roll out. CSMG used two approaches to consider the relationship between faults and NGA.

5.2.1 Fault rates recorded in exchanges with and without NGA

CSMG first made an assessment of the fault rates recorded in exchanges with and without NGA. It found that there were some differences between the fault rates[39].

Figure 7. Fault Rates in Exchanges with NGA vs. Exchanges without NGA



Source: CSMG report Figure 28

However, CSMG's analysis does not control for the differences in each type of line which might cause faults (such as line length or age of line) which may be correlated with NGA roll out. Therefore, it is not possible to understand whether the observed difference in fault rates is due to NGA or other factors.

5.2.2 Correlation between NGA activity and fault rates in that exchange.

CSMG also performed a simple correlation between:

- NGA activity (measured by NGA provisioning as a proportion of total provisioning in an exchange in each month); and
- fault rates in that exchange in each month.

CSMG found that the R^2 associated with the correlation coefficient was low (0.0005).

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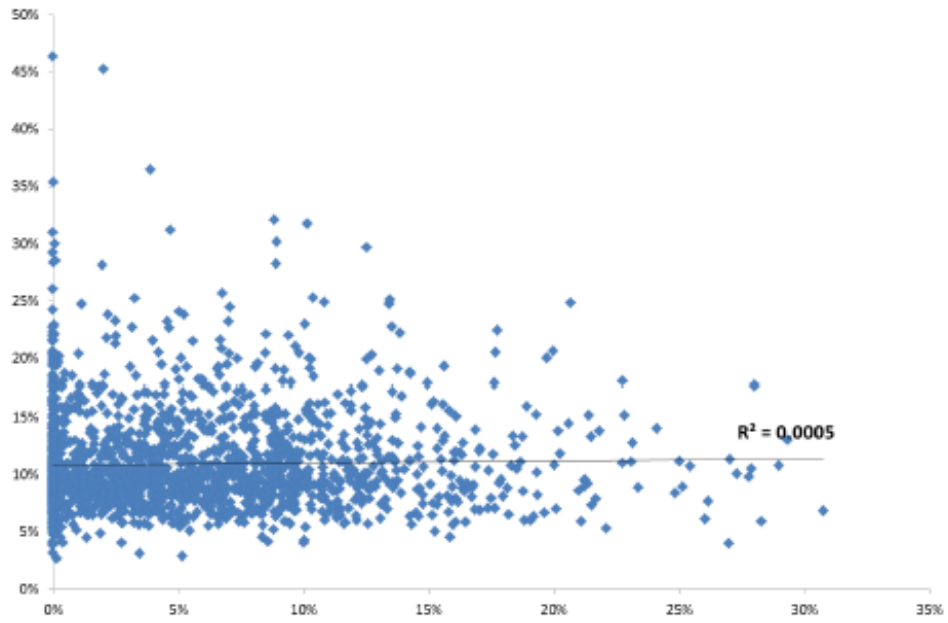
39 It should be noted that this analysis excludes faults on WLR+GEA and MPF+GEA lines and thus does not take account of the direct impact of GEA on faults on the lines in which it is deployed.

Figure 8. NGA Activity (as % of Total Activity) vs. Overall Fault Rate by Exchange



In relation to the correlation between NGA provisioning and faults, while a simple correlation can provide evidence of a statistical relationship between two variables: the absence of a high R^2 in a simple correlation does not necessarily imply that there is no relationship between NGA and faults.

There are further weaknesses with CSMG's approach:

- by considering each exchange and each month as a separate data point there is a large degree of sampling variability which means that the R-squared statistic will always be very low;
- it would be necessary to control for a number of other factors that could affect the prevalence of fault rates alongside NGA provision and which could be negatively correlated with CSMG's measure of NGA activity. These include:
  - exogenous factors such as line length, mix of business and residential lines, age of the network, climate and ducted or aerial network; and
  - endogenous factors such as of levels of maintenance or provisioning activity.

- the simple correlation of NGA activity in each exchange and the overall fault rate in the exchange does not take into account the impact of rain, which Ofcom considers is a strong driver of faults;

- CSMG's analysis does not appear to take account of the time dimension (for example whether there was an increase in fault rates after NGA roll out took place) but appears to look at the average fault rate for exchanges over the total time period, including the period before NGA roll out; and

- CSMG's choice of variable for NGA activity may not be a perfect proxy for NGA activity. CSMG's variable focuses on NGA provision activity, whereas it may be other types of NGA activity (for example activity to prepare exchanges and cabinets, or lay fibre to enable NGA) which could cause faults or lead to faults in the CGA network.

CSMG's results presented in Figure 28 of its report show significant differences between fault rates in "Exchanges with NGA" and "Exchanges without NGA" on a service basis. For example, MPF fault rates are markedly lower in non-NGA exchanges. However, when considering all services together the level of faults in the two groups of exchanges are similar. This suggests that some combination of fixed effects and NGA related effects have an impact on fault levels for individual services, but these effects may cancel out at an aggregate level.

5.3 The appropriate approach to investigating the impact of NGA on faults

In this section we explain that there are a number of relatively simple approaches which could provide a more robust estimate of the relationship between NGA and fault rates.

5.3.1 The hypothesis to test

The principal hypothesis to test is that engineering required to enable NGA in MDF areas, or to provision NGA lines, causes faults either during the period in which roll out was taking place or with a lag. This could be as engineers inadvertently interfere with existing CGA lines when installing NGA equipment.

It would be necessary to consider the appropriate measure for NGA activity. When testing the hypothesis that enabling an MDF area for NGA leads to CGA faults, then the NGA variable should reflect only activity to enable lines for NGA (and not to provision them)[40]. Alternatively, if the hypothesis is that NGA

40 Note that the CSMG NGA variable reflected on-going NGA activity.

provisioning activity leads to faults, then the NGA variable should reflect the overall level of NGA activity (for example NGA provisions).

5.3.2 The modelling approach

There are a number of modelling enhancements which could be used to more accurately estimate the impact of NGA on fault rates.

Fixed effects

There are likely to be a number of factors that lead to variation in faults by exchange, but that are fixed over time. These include:

- average line length;
- average age of line;
- number of lines per exchange; and
- population density in an exchange area.

A simple **fixed effects panel**[41] approach could be used to test the relationship between NGA and faults in a way that controls for other factors that affect faults which are fixed over time.

$$(1) \quad \text{fault}_{i\,t} = \alpha_i + \beta\,\text{NGA}_{i\,t} + \mu_i$$

Where:

$\text{fault}_{i\,t}$ is the number of faults in area *i* at time *t*

$\text{NGA}_{i\,t}$ is the measure of NGA activity in the area *i* at time *t*

Controlling for the impact of rain

A further relatively straightforward enhancement to the fixed effects approach is to control for the impact of rain. To the extent that rain might lead to variation in fault rates (but is unrelated to NGA provision) then the estimate of coefficient on NGA activity will be unbiased. However, the standard errors could be large as there is a significant amount of variation in faults which could be explained by rain. By controlling for the impact that rain has on faults, then the standard errors will be smaller.

$$(2) \quad \text{fault}_{i\,t} = a_i + \beta\,\text{NGA}_{i\,t} + \gamma\text{rain}_{i\,t-1} + \mu_i$$

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41 A simple panel approach assumes that the relationship between NGA and faults (estimated by β in equations (1) and (2)) is constant across areas. However, there may be omitted variables which mean that the relationship between NGA and faults varies systematically with the omitted variables. A **heterogeneous panel model** is a relatively simple but efficient way to investigate the impact that NGA has on faults while allowing the effects of rain and NGA to differ over area which is plausible since areas may differ in their susceptibility to these effects.

Furthermore, it is possible that rain could itself be negatively correlated with the prevalence of NGA activity. For example, if high rainfall leads to lower NGA provisioning[42] then the estimate of α_i in equation (1) could be biased unless rainfall is explicitly controlled for.

Controlling for the dynamic relationship between NGA activity and faults

It is likely that the relationship between NGA and faults has dynamic aspects in that there may be a lag between NGA activity and the prevalence of faults. Therefore, the analysis should consider the appropriate lagged effects (or the impact of auto-correlation).

5.3.3 Conclusion

The CSMG evidence assessing the relationship between NGA services and faults is insufficiently robust to support Ofcom's conclusions that there is not a relationship between CGA faults and NGA activity.

This is because:

- the simple cross sectional analysis does not control for fixed effects, which may mean that the exchange areas where NGA has been rolled out tended to have a different level of faults due to factors such as service mix and urbanisation, even before any NGA roll out;
- by conducting a cross sectional analysis of average fault rates over a period of time during which NGA roll out took place, the analysis was not able to ascertain whether fault rates for these exchanges were higher for the period after NGA roll out or provision compared to the fault rate for the same exchanges before NGA roll out;
- the fact that a simple correlation does not reveal a strong causal relationship may be related to the fact that sampling variation and rainfall effects could introduce a significant amount of "noise" in the fault data which has not been controlled for;
- furthermore, the measure of NGA activity is not necessarily the correct variable from which to measure the relationship between faults and NGA activity. Ofcom should first set out the hypothesis that it wishes to test and then construct an appropriate variable to test the hypothesis; and

42 Rainfall might be related to NGA provisioning for example if rainfall makes it more difficult to provision NGA services, or if rainfall leads engineering resources to be diverted to repair work.

- the analysis does not consider the potential dynamic effects in the relationships between faults and NGA (for example exploring lagged effects or potential auto-correlation).

6 Relative fault rates

Ofcom relies on analysis by CSMG to understand the differences between fault rates for different services. In estimating the fault rates for different services CSMG has filtered out records which it considers to be irrelevant to its analysis. It then simply estimated the fault rate as the number of faults as a percentage of the number of active lines.

However, the CSMG analysis upon which Ofcom bases its estimates of relative fault rates for different services also has methodological flaws.

6.1 Exclusion of unknown unclassified products

As a number of faults are not included in the analysis because of missing data ("Unknown" or "Unclassified" products), two potential biases could be introduced.

First, to the extent these faults are 'common' to all services (i.e. equally likely to be on lines with any service) then by excluding these faults the overall fault rate will be under-estimated and the relative fault differential between services (as a percentage of the fault rates) will be over-stated.

Second, to the extent that lines used for certain services are more likely to have missing data than other services, then the analysis may be biased. It seems intuitively reasonable that data is more likely to be missing on lines where the service has not been modified in the recent past and that such lines are more likely to carry certain services than others.

Ofcom should carry out a further investigation into this missing data to ensure that the faults are analysed appropriately rather than simply exclude the data from the analysis.

6.2 Controlling for other factors which explain the variation in fault rates

The analysis of fault rate differentials does not control for effects such as line length and as such may not accurately reflect the incremental cost difference due to services (MPF, WLR and SMPF) but rather differences in the distribution of services across the network.

As Ofcom is proposing to base price differentials on incremental cost differences, the cost difference should not include the costs of other factors which cause faults (such as line length or line age).

6.3 Causality between provisioning work and faults

The data shows significant differences between in-life and early life fault rates suggesting there is causality between provisioning work and faults but this causality is not reflected in the cost modelling.

Relative fault rates

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