Line length and line costs

3 October 2011 • Updated report

1 Introduction

Analysys Mason was commissioned by BSkyB and TalkTalk Group to review the impact of local loop line length on the allocation of cost to MPF and WLR rental products. We found that there is a 33% to 35% length difference between a typical MPF line and a typical WLR line. Taking into account such a difference would result in a materially different cost allocation between the two products than Ofcom has proposed in its Consultation.

The activities known as "use of exchange-side copper and duct" and "use of distribution copper and duct" allocate their costs to the MPF rentals product (among others). According to the Cost Allocation model released by Ofcom on 18 May, these two activities represent a contribution of GBP39.03 (operational costs and depreciation) in 2013/14, out of GBP90.89 per year. That is 43% of the total cost stack for MPF rentals.

These two activities both use the same usage factors to allocate their costs to MPF rentals, WLR rentals ("PSTN basic rental") and ISDN 30 rentals products. The calculation for these usage factors is described in paragraphs A8.132 to A8.138 of the Annex to the consultation document.

One key modification to the methodology used to calculate these usage factors since Ofcom originally set the MPF charge is that, previously, it excluded 16% of the D-side copper costs on the basis of data provided by Openreach[1]. This data showed that copper loops used to deliver a 2Mbit/s broadband service were on average 19% shorter than the average copper loop.

More recently, in 2009 during the last price control study, Openreach made the case[2] that the cost of a copper pair is a function of thickness and age as well as length. Using this argument as well as the assumption that the copper loops used to provide broadband services were getting on average longer, the average cost of an MPF was estimated to be 6% less than an average WLR residential line[3]. It was noted by Ofcom that WLR business lines would cost around 8% less than a WLR residential line. As a result, Ofcom included in 2009 a 'line length adjustment' in its model.

During this present consultation, Ofcom, on the basis of an unpublished report provided by BT (BT Local Line Costing Study, mentioned in A8.146 as well), concluded that there is no meaningful difference between the average amount of copper in a WLR line (business and residential lines included) and that in a MPF line. As such, Ofcom no longer plans to make a line length adjustment for MPF lines.

1 Consultation document, paragraph A8.135

2 Consultation document, paragraph A8.136

3 Consultation document, paragraph A8.136

During bilateral discussions between Ofcom and TalkTalk and BSkyB, it was noted by Ofcom that the data provided by BT actually showed a 3% difference between the amount of copper in a WLR line and that in a MPF line (and therefore a 3% difference in the cost of copper). Putting this in perspective: Ofcom's decision to include a 'pair-gain' factor for WLR lines in its calculation of costs, which introduces a 0.6% difference in copper usage factors between WLR and MPF.

Later in September 2011, Ofcom informed TalkTalk Group and BSkyB that it had received clarification from BT on the BT Local Line Costing Study and that this study did not include an estimate of the average amount of copper in a WLR line or in a MPF line.

The current position of Ofcom is now unclear regarding this material issue.

2 Source data and references

To conduct this study we used the following sources:

- Ofcom's assumptions in Consultation, in particular paragraphs A8.130 to A8.138 and A8.146;
- Ofcom's consumer survey on broadband speeds published in March 2011;
- A study by Sagentia for Ofcom on theoretical DSL speeds, including estimates of the distribution of local loop lengths (based on public information from BT)[4];
- The BDO study, commissioned by Ofcom, that audited BT's network valuation, including a discussion on the availability and quality of data in BT's databases[5]; and
- The study by Analysys Mason commissioned by the Broadband Stakeholder Group on the cost of deploying access networks. [6] This study was widely reviewed and accepted by the industry.

3 Area investigated and methodology

We seek here to test Ofcom's assumptions that line cost adjustments are no longer required between MPF and WLR.

We have first investigated publicly available information on the distribution of copper loop length in the UK and sought to reconcile these with high-level data provided by BT. This provides important data to calculate the average line length of local copper loops used by alternative operators to provide broadband services. We also reviewed the BDO study published by Ofcom that comments on weaknesses in data availability and quality in PIPER, the database used by BT

4 Report titled "Assessment of the theoretical limits of copper in the last mile", by Sagentia for Ofcom, published 16 July 2008.

5 Report titled "Review of the BT duct valuation 2009/2010 report", (redacted version) by BDO for Ofcom, published 21 March 2011.

6 Report titled "The costs of deploying fibre-based next-generation broadband infrastructure", by Analysys Mason for the Broadband Stakeholder Group, published 8 September 2008.

in its BT Local Line Costing Study. This suggests that Ofcom should investigate in detail the BT Local Line Costing Study before it can be used for price control purposes.

We then researched available public information on theoretical and measured DSL[7] speeds in the UK. This data combined with the distribution of local loop lengths was used to estimate a realistic average line length of copper loops used to provide broadband services.

Finally, since copper material costs only represent a portion of the costs involved in building a local loop, we investigated other elements that could be taken into account when comparing the average cost of a MPF line with that of a WLR line.

Overall, we find that the allocation of distribution-side copper and duct costs and the allocation of exchange-side copper and duct costs should take into account different relative costs of MPF and WLR lines. These relative costs are, in our findings, best estimated using the length of the local loop rather than the weight and age of the copper cables.

4 Distribution of line lengths in the UK

Review of the distribution of line lengths

In its report for Ofcom[8], Sagentia analysed data provided on local loop lengths in a paper presented by BT to the Network Interoperability Consultative Committee (NICC).[9]. They used BT's model (also presented in the paper for NICC) for a typical cable in the network (0.5mm).

Sagentia has reconciled its model with the maximum impedance of a cable in the network (stated by BT's SIN351)[10]. Sagentia found that the distribution of line lengths has a broad peak at 3km and that the average line length (from exchange to the customer) is 3.34km. This distance is understood to include the dropwire length as well. The distribution is illustrated in Figure 1 below.

7 DSL: "Digital Subscriber Line". ADSL is a type of DSL.

8 Report titled "Assessment of the theoretical limits of copper in the last mile", by Sagentia for Ofcom, published 16 July 2008.

9 Presentation titled "PNO-DSTG/CP38(04)2 Simulation parameters for discussion in the NICC-DSLTG".

10 We note that Sagentia refers to an older version of SIN351 (3.3) but that the newer version SIN351 (4.5) is also consistent.

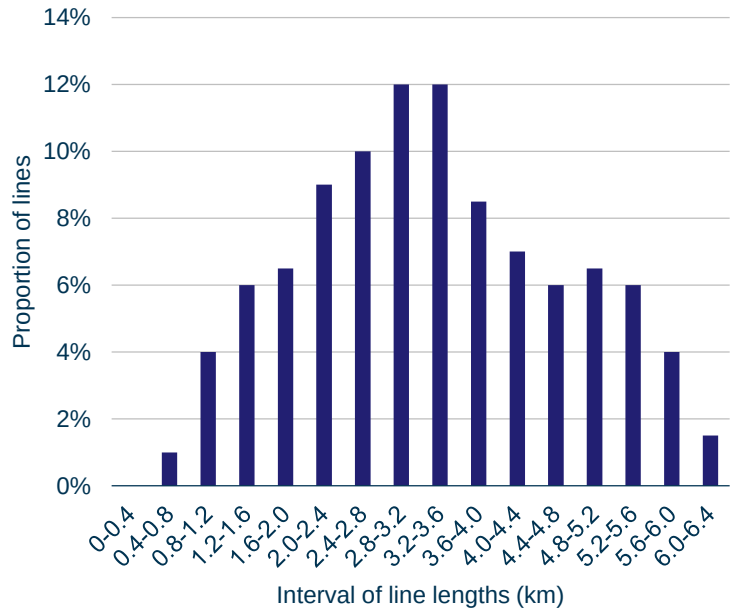

Figure 1: Distribution of copper loop line lengths in the UK [Source: Sagentia, 2008]

In a presentation on access networks in 2004[11], BT confirmed that the typical wire gauge in its network is 0.5mm and that the average line length is 3.47km (including the dropwire length). This provides a reasonably good reconciliation with the Sagentia analysis (3.34km average line length).

The same presentation also confirmed the distribution of lengths between the cabinet and the customer, with a typical 420m length and a small proportion of lines (10%) with a very long length. A snapshot of this presentation is provided below.

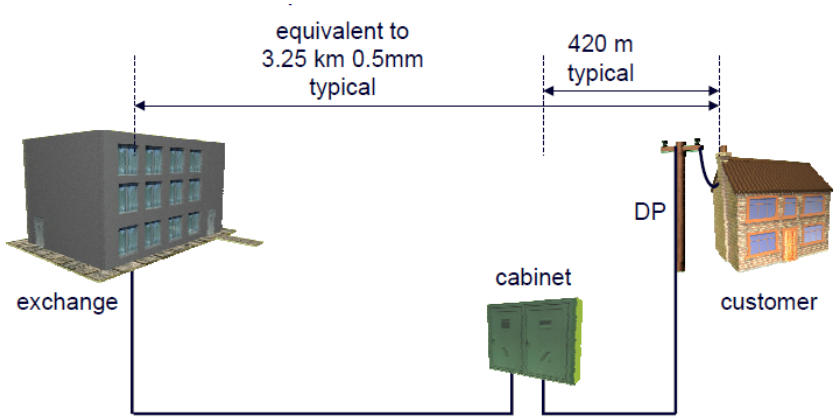

Figure 2: Typical line length in the BT local loop network [Source: BT, 2004]

[11] Presentation titled "Access network spectrum, higher bit-rate broadband over DSL using frequencies above 1MHz", by John Cook, BT, on 4 November 2004.

Discussion on the availability and quality of data in PIPeR

Paragraph A8.133 of the Annex to the consultation indicates that the average cost data (used to calculate the average cost of a WLR line and of a MPF line) is taken from BT's PIPeR information system. We discuss here the possible issues with PIPeR as a source of information.

In 2010 Ofcom asked BDO to audit the methodology used by BT to value its duct network. A redacted version[12] of BDO's report was published on 31 March 2011. In this report, BDO comments on BT's approach the length of the duct network which is based on data from a sample of exchanges and an extrapolation to the remaining exchanges.

In the BDO study, it is made clear that BT does not possess exact information on its access network and relies on sampling, segmentation and extrapolations. For example it is noted that PIPeR only contains data for 769 exchanges out of 5592 exchanges. These converted[13] exchanges are located in certain geographies (Newcastle, Birmingham) and therefore, according to BDO, "there are significant regions where the exchanges have not been converted".[14] It is also mentioned that BT found mistakes in its older estimates and segmentation, [15] which might put the quality of its internal datasets into question.

This study provides a useful review and highlights what kind of information is available within BT's internal systems (including PIPeR[16]). Given that BT's Line Costing Study is based on information available in PIPeR (according to Ofcom's consultation, paragraph A8.133), the assumptions made to extrapolate the limited dataset should be reviewed by Ofcom in detail.

5 Measured DSL speeds

Download speeds

In Ofcom's March 2011 report on broadband speeds[17], the average download speed experienced by consumers is presented. This excludes Market 1[18] where only BT operates. It also excludes consumers that are further than 5km from the exchange. We believe this proportion to be small, as suggested later in this document. [19]

12 Report titled "Review of the BT duct valuation 2009/2010 report", (redacted version) by BDO for Ofcom, published 21 March 2011.

13 Here "converted exchange" means an exchange whose data has been migrated from BT's old databases to PIPeR.

14 Report titled "Review of the BT duct valuation 2009/2010 report", (redacted version) by BDO for Ofcom, published 21 March 2011. Page 25.

15 Report titled "Review of the BT duct valuation 2009/2010 report", (redacted version) by BDO for Ofcom, published 21 March 2011. Page 25.

16 PIPeR: Physical Inventory for Planning and eRecords system

17 Report titled "UK fixed broadband speeds, November/December 2010, the performance of fixed-line broadband delivered to UK residential consumers", by Ofcom, published 31 March 2011.

18 Market 1 is defined as the market served by the exchanges where BT is the only provider of telecommunications services (this includes 14.2% of the UK premises).

19 See Figure 4 illustrating the distribution of line length of DSL2+ customers provided by Ofcom.

This is not the synchronisation ("sync") speed but the experienced download speed. It was found that alternative operators using BT's local loops (here Orange, Plusnet, O2/Be, Sky and TalkTalk) are able to deliver relatively fast download speeds:

- DSL2+ users experience 7.4Mbit/s on average (within a 95% confidence interval) or better; and
- DSL users experience 3.3Mbit/s on average (within a 95% confidence interval) or better.

The report provides a summary of this finding, as in Figure 3 below.

Figure 1.1 Summary of average download speed by ISP package, November/December 2010 (multi-thread tests)

	Average download throughput speed during period	
	24 hours	8 to 10pm weekdays
BT 'up to' 8Mbit/s	4.1 to 4.8Mbit/s	3.8 to 4.4Mbit/s
Orange 'up to' 8Mbit/s	3.3 to 4.3Mbit/s	2.7 to 3.5Mbit/s*
Plusnet 'up to' 8Mbit/s	3.4 to 4.4Mbit/s*	3.3 to 4.2Mbit/s
Virgin Media 'up to' 10Mbit/s	9.5 to 9.7Mbit/s	8.9 to 9.4Mbit/s
BT 'up to' 20Mbit/s	6.9 to 8.7Mbit/s	6.8 to 8.5Mbit/s
O2/Be 'up to' 20/24Mbit/s	9.9 to 11.6Mbit/s**	9.5 to 11.0Mbit/s**
Sky 'up to' 20Mbit/s	7.4 to 8.8Mbit/s	7.3 to 8.7Mbit/s
TalkTalk 'up to' 24Mbit/s	7.7 to 9.3Mbit/s	7.5 to 9.0Mbit/s
Virgin Media 'up to' 20Mbit/s	17.4 to 18.6Mbit/s	16.5 to 18.0Mbit/s
BT 'up to' 40Mbit/s	30.5 to 33.1Mbit/s	27.4 to 30.3Mbit/s
Virgin Media 'up to' 50Mbit/s	43.9 to 47.2Mbit/s	43.1 to 46.6Mbit/s

Source: SamKnows measurement data for all panel members with a connection in November/ December 2010
**Caution: Small sample size (<50)*
*** Results should be treated with some caution as normalisation may not be as effective for O2/Be due to the lower incidence of panellists with longer than average line lengths*
Panel Base: 1081
Notes: (1) Only includes ADSL customers within 5km of the exchange and in Geographic Markets 2 and 3 ; (2) Includes on-net customers only for LLU operators (3) Data for ADSL operators have been weighted to ISP regional coverage of LLU lines and distance from exchange; data for Virgin Media's cable service have been weighted to regional coverage only; (4) Data collected from multi-thread download speed tests; (5) The range shown represents a 95% confidence interval around the mean

Figure 3: Ofcom fixed broadband speed survey results [Source: Ofcom, 2011]

Sync speeds and estimate of line lengths by Ofcom

In the same report, Ofcom measured the actual sync speed achieved in the UK for DSL and DSL2+ customers. Ofcom also noted that sync speed is likely to be 1.2Mbit/s faster than experienced download speeds.

It also used data provided by BT on attenuation by line length (using a random sample for DSL2+ lines) to obtain a distribution of line length for DSL2+ customers (sold as "up to 20/24 Mbit/s" package). This distribution, as in Figure 4 below, shows a clear peak at 1.3km and an average line length of 2.3km for DSL2+ customers.

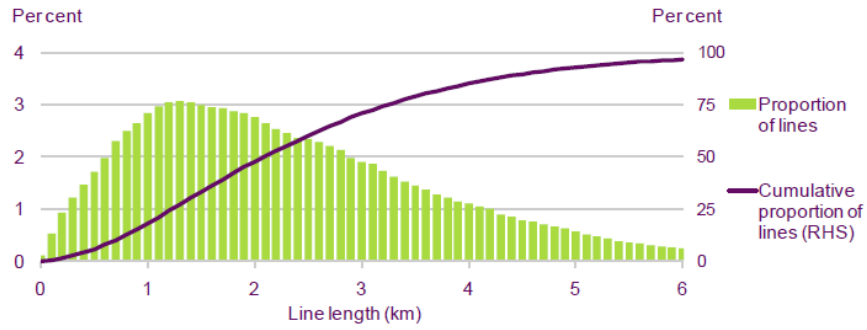

Figure 4: Copper local loop line length for DSL2+ customers [Source: Ofcom, 2011]

6 Average line lengths

On the basis of the distribution of line lengths (Sagentia study) and the experienced download speed (Ofcom study), we have calculated the average line length used by DSL2+ customers in the UK. We have used the DSL2+ theoretical performance curve (sync speed) provided by Ofcom[20] and shown below.

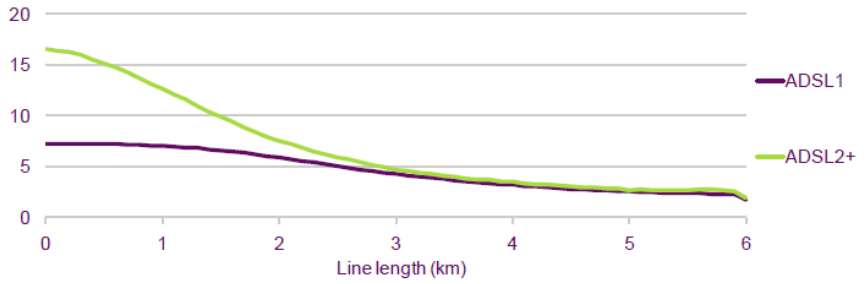

Figure 5: Theoretical sync speed [Source: Ofcom, 2011]

Our model calculates the average speed for DSL2+ customers using different line lengths. The model shows that if DSL2+ customers experience an average 7.4Mbit/s, then their average line length is between 1.7km and 1.9km (with a maximum line length of 2.6km according to the Sagentia distribution), as shown below.

20 Report titled "UK fixed broadband speeds, November/December 2010, the performance of fixed-line broadband delivered to UK residential consumers", by Ofcom, published 31 March 2011. It should be noted that the origin of this figure is an equipment vendor based in Australia. Therefore, caution should be exercised in the interpretation of the results, which are likely to be overstated (in terms of delivered speed). Using this data, our analysis is, therefore, likely to be conservative (i.e. line lengths are likely to be shorter than we estimate).

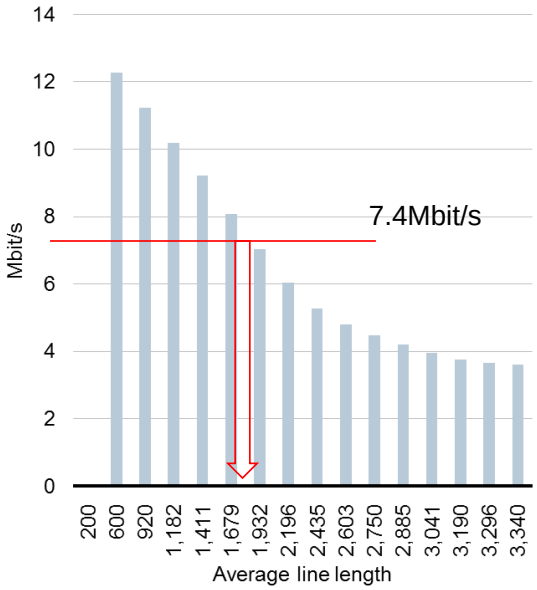

Figure 6: Average DSL2+ speed possible over lines following the Sagentia line length distribution and Ofcom theoretical DSL speed [Source: Analysys Mason]

Our model also shows that if DSL customers experience an average 3.4Mbit/s, then their average line length is between 2.9km and 3.1km (with a maximum line length of 5.2km according to the Sagentia distribution), as shown below:

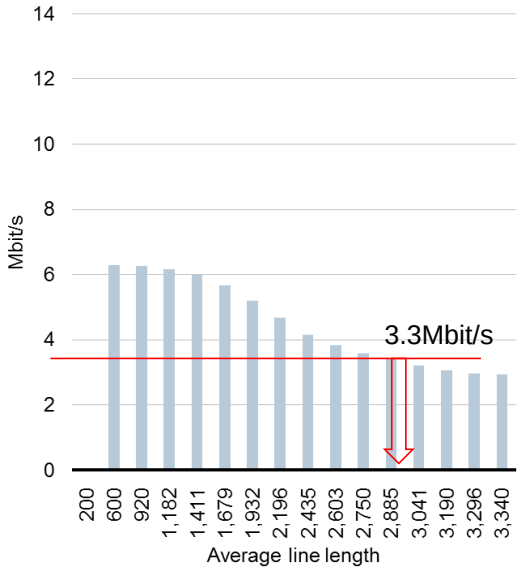

Figure 7: Average DSL speed possible over lines following the Sagentia line length distribution and Ofcom theoretical DSL speed [Source: Analysys Mason]

Therefore, this simple analysis, based on publicly available data sources (from BT and Ofcom), demonstrates that alternative operators, using MPF rental services, predominantly use short lines. They cannot be using long lines (on average) because they would not be able, physically given the DSL technology performance to date, to deliver the measured download speeds recorded by Ofcom.

While the average UK line, including the dropwire length (around 100m), according to BT, is between 3.34km and 3.47km, our model shows that a reasonable average line length estimate for MPF is 2.23km (as shown in the table below). This results in a 33% to 35% length difference between a typical MPF line (2.23km) and a typical WLR line.

	Average line length	*Proportion of customers with service provisioned on MPF*
DSL2+ customers	1.9km	70%
DSL customers	3.0km	30%
Average broadband customer	2.23km	100%

Figure 8: Typical proportion of DSL/DSL2+ customers and implied average line length used by alternative operators [Source: Analysys Mason]

7 Discussion on line costs

In the consultation, in paragraph A8.137, Ofcom notes that BT's argument for negating the need to differentiate the relative cost of lines between MPF and WLR is based on the "average amount of copper". On this basis, Ofcom suggested that "the allocation of copper costs between MPF and WLR do not reflect any line length adjustment".

The cost of the activities, "use of exchange-side copper and duct" and "use of distribution copper and duct", needs to be allocated in the Cost Allocation model to the different line rental products (MPF, WLR and ISDN30). Therefore the cost of copper cables is part of the total but significant costs such as trenching costs, ducts and manholes should be considered in the allocation method.

In the study for the Broadband Stakeholder Group on the cost of access networks, it was found that cost of civil works (defined as new ducts, fibre cables and installation) represents at least half the cost of deploying a fibre-optic access network. It is also demonstrated that deploying access networks in rural areas is more costly on a per-premise basis [21].

It could also be noted that one would expect the fill-in rate of ducts with in-service copper lines in urban areas might be higher than in rural areas. The copper lines in ducts laid in densely populated areas are likely to fill more efficiently the ducts than in rural areas (where ducts need to be laid but may contain fewer copper lines). Therefore the cost of trenching and ducts in urban areas (where many broadband service customers are) will be allocated to more copper lines.

In the paragraph A8.136, Ofcom notes that Openreach explained that the cost of copper pair is a function of thickness and age as well as length.

It is acceptable to believe that the cost of material (copper) is a function of the volume of copper purchased, rather than the length of the cable. During discussion with Ofcom, it was indicated that Openreach considered that copper local loops in urban areas are using thicker copper cables (higher gauge). This should be verified with Openreach, as thicker cables could indeed be used in

[21] Report titled "The costs of deploying fibre-based next-generation broadband infrastructure", by Analysys Mason for the Broadband Stakeholder Group, published 8 September 2008. Figure 4.2 on page 46 for example.

an access network but generally in areas where local loops are longer, to reduce the amount of interference. This would, therefore, be mostly used for very long lines and not often for lines serving broadband customers.

The above considerations may lead to the conclusion that the length of the local loops (including trench, ducts, copper cables) is as important as (or possibly more significant than) the weight of the copper cables when estimating the cost of the system. We suggest that an allocation based on local loop line length is more appropriate than an estimate based on the weight and age of the copper cables.

8 Conclusion

This issue is material: the cost contribution of the activities "use of distribution-side copper and duct costs and "use of exchange-side copper and duct costs" represent 43% of the cost stack of MPF rentals product by 2013/14.

Overall, we find that the allocation of distribution-side copper and duct costs and the allocation of exchange-side copper and duct costs should take into account different relative costs of line for MPF and WLR. These relative costs are, to our findings, best estimated using the length of the local loop rather than the weight and age of the copper cables.

Our analysis of copper loop lengths shows that, using a simple methodology, the local loops used by alternative operators are on average much shorter (33% to 35%) than the WLR lines. This is consistent with Ofcom's own findings that DSL2+ customers use much shorter lines on average than the national average.