Deloitte.

Openreach Fault Data
Data analysis

Addendum to the September 2013 report

4 December 2013

Contents

Introduction

This document forms an addendum to the Deloitte report entitled ‘Openreach Fault Data, Data analysis’ issued in September 2013 (the ‘September report’) which was commissioned by Openreach and subject to a contract between Deloitte LLP and Openreach dated 13 August 2013. As an addendum to the September report this Deliverable is subject to the same terms and conditions as our original contract.

The main purpose of this addendum is to update some of the analyses and exhibits provided as part of the September 2013 report and incorporate information Openreach has shared with Deloitte with regard to fault and line data for the three additional months of September, October and early November 2013 subsequent to the September report.

Openreach also asked Deloitte to investigate the growth rate of in-life fault (ILF) rates over the timeframe available in particular in the context of seasonality variations. It also asked Deloitte to extend its analysis to the impact of including faults occurring on NGA lines and associated with a copper product (WLR and MPF).

Notwithstanding that a copy of this report will be provided to Ofcom for publishing, no-one other than Openreach is entitled to rely on our report for any purpose whatsoever and we accept no duty of care or liability to any other party (including, without limitation, any party who is shown or gains access to this report).

Context for data analysis

Scope of data analysis, definitions and data sources

We refer to our earlier report submitted in September 2013 for the broader context of our data analysis and the key definitions used in both this addendum and the September report.

This specific addendum incorporates further analysis drawn from additional data for the months of September, October and early November 2013. It is based exclusively on two data sets which Openreach shared with Ofcom:

- Fault data – a database called CDTA.FAULTS. This database includes information on faults and contains in particular the following key fields: Asset Category (i.e. type of line); Line Age ('state of life', typically IL or EL); Week End Date; CP Group. This database contains 10 million instances of faults in total and consistently spans a period from 16 September 2011 to 8 November 2013, i.e. a period covering 26 months in total, compared to 24 months in the report dated September 2013

- Lines data – a database called CDTA.WSS. This database includes information on the lines on which faults were or were not detected during the period; it contains in particular the following key fields: Asset Category; Week End Date; CP Group; Very Early Life WSS; Early Life WSS; In-Life WSS, the last three fields being used to derive the 'state of life' of the line (IL or EL). This database has 96 million instances of lines and spans a period from 4 April 2011 to 15 November 2013, i.e. covering just over 2.5 years

In order to carry out an analysis of faults per lines (fault rates), the timeframe used for the analyses included in this document covers the period from 16 September 2011 to 8 November 2013, i.e. a total period of 26 months.

Key changes to the underlying data sets

There are two main changes which have been made to the initial underlying datasets used in September compared to the underlying data sets used for the purposes of this addendum report:

- In October 2013 Openreach investigated the impact of Modified Primary Line (MPL) orders on fault rates. MPL orders consist of forwarding calls initially intended to an alternative phone number, for instance to a mobile phone number, for a limited period of time. MPL can be used as a transitory service in the event of a line change order to a different CP or in the event of a line being affected by a fault. The MPL order has the effect of triggering a change of state for the line, typically from an in-life (IL) state to an early-life (EL) state. MPL orders therefore contribute to an increase in the number of lines in EL state whereas they are typically not associated with a new fault and thus contribute to a reduction in ELF rates. The impact of correcting for this in the new underlying data sets is that it has increased the ELF rate and marginally decreased the ILF rate for asset categories including a voice component (i.e. WLR+SMPF and WLR/PSTN). ELF rates are discussed in more detail in Section 4.

- Subsequent to the September report, a number of reconciliation exercises were carried out between the Openreach internal databases holding CP information. This has resulted in a reclassification of the CP for some of the lines. We refer to CPs as the communication provider for the line, rather for either the voice or the broadband service. The characteristics of how fault rates vary by CP are discussed in Section 3.4.

Key findings

Having reviewed fault data for the period September 2011 to early November 2013, our key additional findings to those highlighted in our September report are:

- The changes made to the underlying data sets, between those provided in September 2013 to those used for the purpose of this addendum have resulted in an increase in ELF rates for WLR/PSTN and WLR+SMPF. Whist significant in nature, these changes do not materially affect the key findings from the earlier September 2013 report
- The two most recent quarters (2Q and 3Q FY14) show higher fault volumes than in any of the earlier quarters of the period analysed. In particular, the additional months of September to November 2013 show noticeably higher overall fault rates than the two year average
- Line demography continues to change at a rapid pace, with an annual rate of change in excess of 9%. In particular, MPF growth remains the largest contributor to changing line demography. The changing mix of lines continues to contribute to increasing overall fault rate
- The large majority of lines continue to be In-life (IL) lines, with Early-life (EL) lines representing only 4% (16% of faults). As a result the most significant changes to overall fault rates relate to changes in faults occurring on lines in In-life state
- In-life fault rates have increased in the period September to November 2013 compared to their two year average. IL fault rates remain higher on data (WLR+SMPF and MPF) than on voice only (WLR/PSTN). In a market where broadband penetration is increasing (line demography) this implies an increase in overall fault rates
- In-life fault rates follow a seasonal pattern. Adjusted for seasonality, we find that on average they have increased between September 2011 and November 2013, culminating in most recent months
- WLR+NGA lines have so far been excluded from the calculation of WLR/PSTN fault rates. Should these be included, then WLR/PSTN in-life fault rate for the period September 2011 to November 2013 would be on average 14% higher, increasing to 23% higher for the period September to November 2013
- Early life fault rates have been increasing since 1Q13 in particular in the case of MPF which continues to have a significantly higher Early-life fault rate than other types of lines

1 Line mix

1.1 Evolution of lines by type

Line demography continues to change at a rapid pace, with an annual rate of change in excess of 9%

The mix of asset categories in the overall number of lines has evolved rapidly over the last two years and a half. This has been driven mainly by further broadband penetration (reduction in voice lines), changing network requirements of CPs (shift from WLR+SMPF to MPF), and by Openreach's NGA roll-out (Figure 1). The main changes between April 2011 and November 2013 have been:

- WLR/PSTN: a 9% CAGR reduction in the number of lines and reduction in share of lines from 35% to 27%
- WLR+SMPF: a 9% CAGR reduction in shared data lines and reduction in share of lines from 44% to 34%
- MPF: a corresponding 20% CAGR increase in number of lines and increase from 19% to 30% of lines
- Other: a 108% CAGR increase in 'other' types of lines, mainly NGA, which reached 8% of lines in Nov-13

September and October 2013 saw a continuation of those same trends, with WLR/PSTN and WLR+SMPF lines in early November having reduced versus August 2013 respectively by a further 0.1 and 0.3 million lines, resp. a (7)% and (14)% CAGR, and MPF and other lines each increasing by 0.2 million lines, resp. a 15% and 83% CAGR.

Figure 1: Number of lines by line type

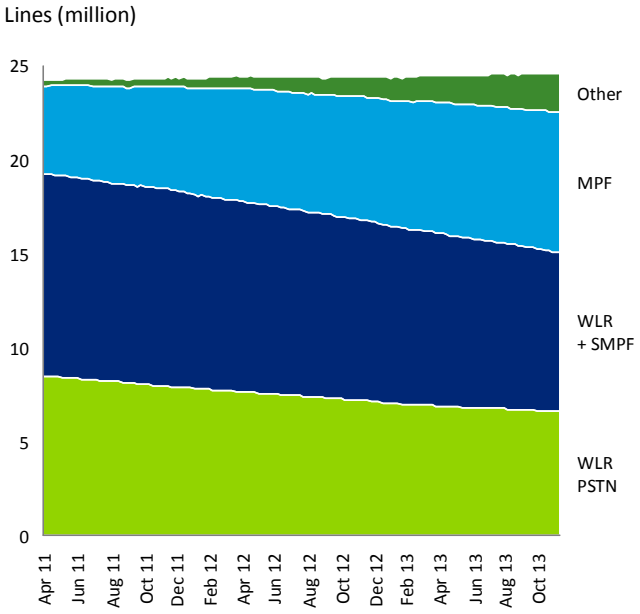


Figure 2: Evolution of lines and fault rates

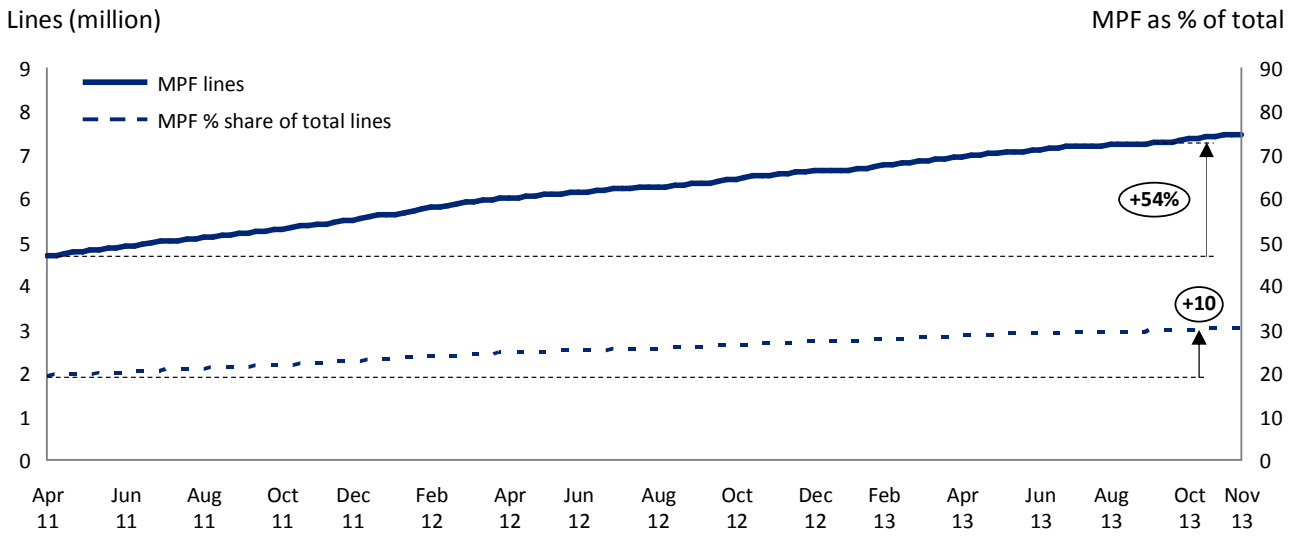
	Lines Apr-11 to Nov-13		Share of lines (%)		Fault rate (faults per week per 1,000 lines)		
	CAGR (%)	Δ (m)	Apr-11	Nov-13	Average	In-life	Early life
Other	108	1.8	1	8	4.1	3.4	9.8
MPF	20	2.8	19	30	2.1	1.7	12.9
WLR + SMPF	(9)	(2.3)	45	35	2.3	2.1	8.6
WLR PSTN	(9)	(1.9)	35	27	1.7	1.5	7.9

The types of lines which are most rapidly increasing (data) are also the ones for which the average overall fault rate is higher. Should fault rates by line type remain stable and line volumes continue to follow the same trends then average overall fault rate would increase.

MPF growth remains the largest contributor to changing line demography

As illustrated in Figure 3, MPF is growing at the fastest rate of all types of lines, an overall growth of over 50 per cent between April 2011 and November 2013. MPF lines now represent approximately 30% of the lines from less than 20% in 2011.

Figure 3: Evolution of MPF lines and share of total



1.2 Evolution of lines by 'state of life'

Lines can also be split between two main types: Early-life (EL), when a work order has been carried out on the line in the last 28 days and In-life (IL) when the last work order on the line was carried out more than 28 days ago.

The large majority of lines continue to be In-life (IL) lines

Lines which are in an In-life state represent typically over 95% of the lines. The activity on fixed lines varies by type of line, with on average at any one point in time around 2% of WLR/PSTN lines; 4% of WLR/SMPF lines and 3% of MPF lines being associated with a work order having taken place within the last 28 days (Figure 4).

Figure 4: Early-life lines vs. In-life lines

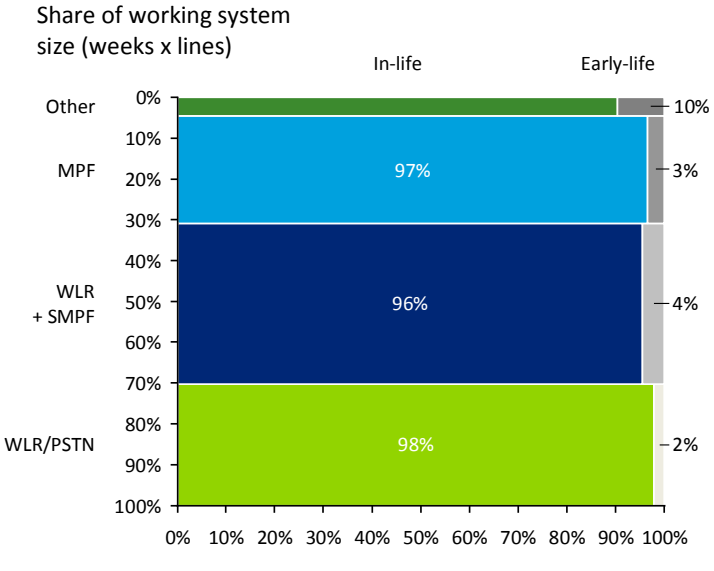
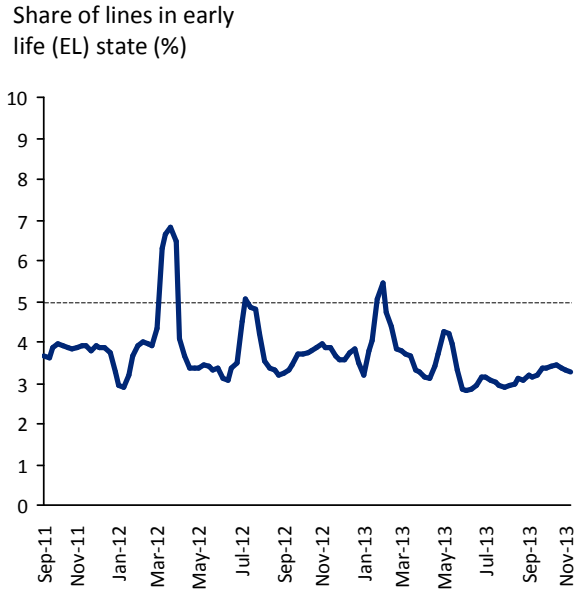


Figure 5: Evolution of the share of Early-life lines



The share of Early-life (EL) lines continues to remain broadly stable at approximately 4%

The share of lines in an Early-life state (Figure 5) has been broadly stable between September 2011 and November 2013, albeit for short transitory periods in April 2011, July 2012, February 2013 and May 2013. The implication on the overall average fault rate is that whilst there have been transitory periods of higher work order activity, the overall level of lines in EL state has remained broadly stable over time, i.e. the level of activity on the lines has not seen any significant non-transitory step change over the two years period reviewed.

2 Fault mix

There are approximately 5.9 million faults falling within the scope of our analysis[1], which were received by Openreach between 16 September 2011 and 8 November 2013. This equates to an average of 52,500 in-scope faults per week over the period. In the months of September, October and in early November 2013, the weekly fault rate stepped up to 61,000 in-scope faults per week, or a 16% higher weekly rate than the two year average.

2.1 Evolution of faults by type of line

Most recent quarters show higher fault volumes than the two year average

The additional fault data available for the second part of September 2013 confirmed the anticipated step up in weekly faults between 1Q FY14 and 2Q FY14 from the September 2013 report. The first half of 3Q FY14 – i.e. the month of October 2013 and the first two weeks of November 2013 – are also setting 3Q FY14 for being another quarter with higher fault rate than the average of all earlier quarters.

Figure 6: Fault breakdown

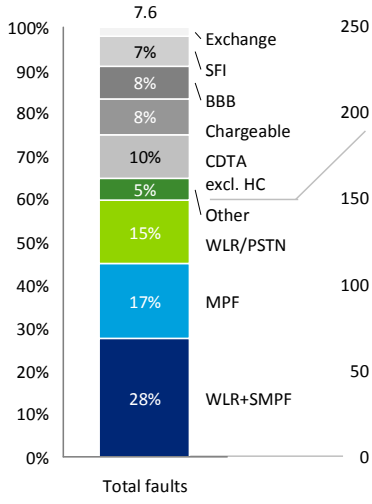


Figure 7: Total faults by line type

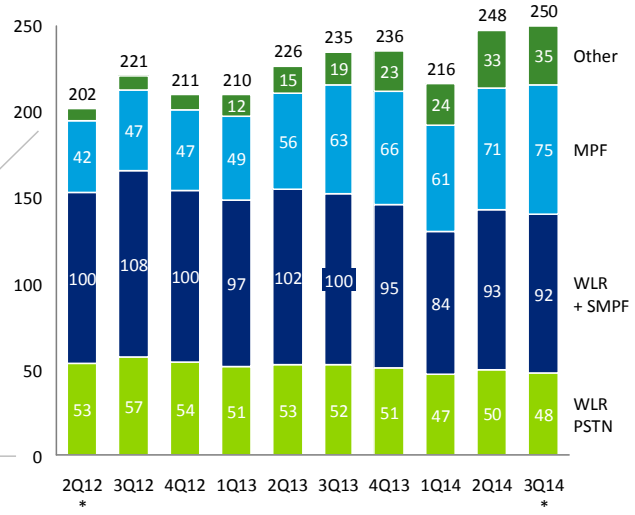


Figure 8: Fault CAGR and share

	CAGR (%)				Share of faults (%)	
	1Q	2Q	3Q	4Q	3Q12	3Q14
Other	141	95	115	103	4	14
MPF	41	25	31	27	21	30
WLR + SMPF	(5)	(13)	(4)	(8)	49	37
WLR PSTN	(6)	(9)	(3)	(9)	26	19

(*) Note: 2Q12 based on 3 weeks of fault data; 3Q14 based on 6 weeks of fault data

The increase in overall fault volumes is broadly in line with the evolution of the mix of lines, suggesting that the primary driving factor for the evolution of faults is the number of lines. Consistent with line volumes, the most important driver of in-scope fault volumes is related to MPF, whilst WLR+SMPF faults are decreasing and the other faults category is increasing rapidly. In the case of MPF, the average rate of increase in fault volumes is higher than the growth rate in terms of lines, indicating an average increase in fault rate.

As a result fault rates in 2Q and 3Q FY14 also increased compared to earlier quarters

Given that the number of lines has not increased significantly during the period September to November 2013, the step up in the number of faults seen in September to November 2013 has resulted in higher overall fault rates (Figure 9).

1 We refer to September report for faults excluded for the purpose of this analysis. Excluded faults comprise exchange faults other than on the MDF, SFI, BBB, other chargeable faults and CDTA faults with the exception of hard clear CDTA faults.

This has been consistent across the three types of lines as illustrated in Figure 10. The increase vs. the two year average has been stronger in the case of MPF (21%) compared with WLR/PSTN (6%) and WLR+SMPF (10%).

Figure 9: Average overall fault rates by line type
(includes both in-life and early-life)

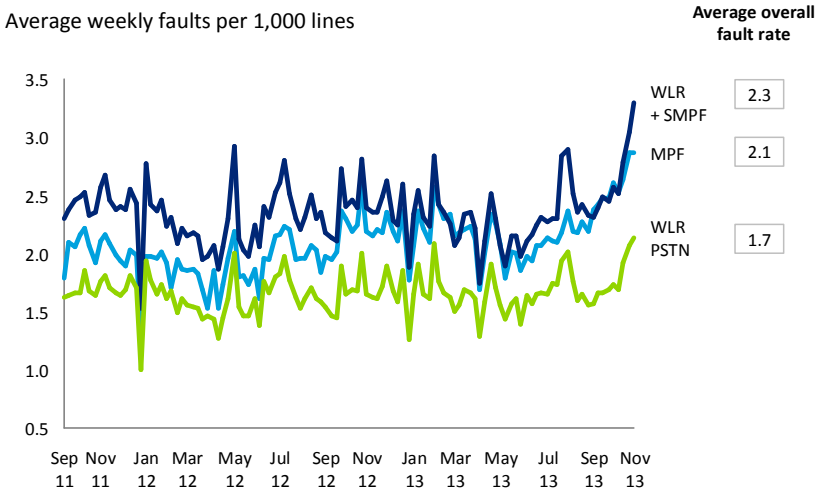
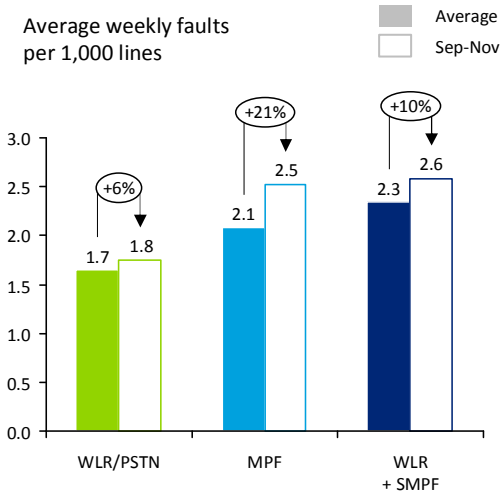


Figure 10: Increase in overall fault rate, Sep-Nov 2013 vs. two year average



2.2 Evolution of faults by 'state of life'

The share of faults occurring on Early-life (EL) lines remains broadly stable at approximately 16%

Over the period September 2011 to November 2013 on average 16% of faults were on Early-life lines compared to 84% on In-life lines (Figure 12). Between September 2013 and November 2013 the share of early life faults to the total number of faults has remained close to its two year average of approximately 16%, hence it does not appear that the increase in faults would have been associated with a higher level of work order activity on the lines.

The number of faults occurring on EL lines varies by type of line (Figure 11); it is higher on other lines and on MPF lines than on WLR+SMPF and WLR/PSTN lines. A similar distribution pattern has remained in the period September 2013 to November 2013.

Figure 11: Early-life faults vs. In-life faults

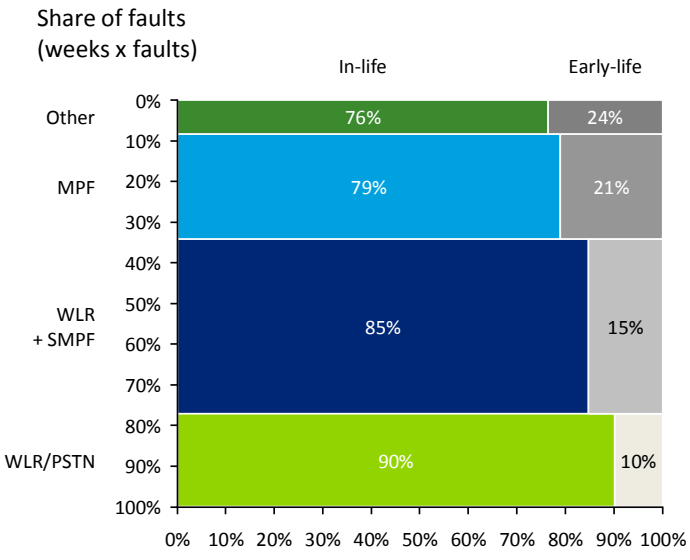
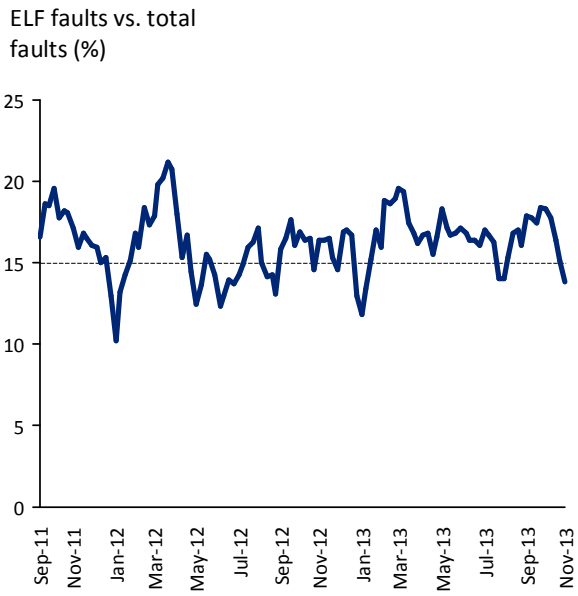


Figure 12: Evolution of the share of Early-life faults

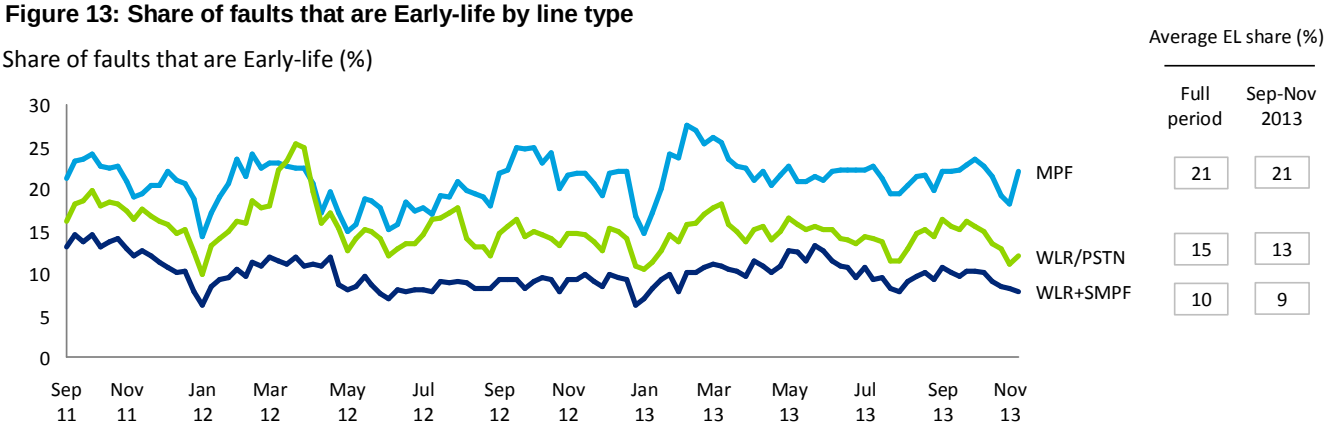


The share of faults occurring on Early-life lines has remained higher on MPF than on other types of lines

Whilst there were more faults between September 2013 and November 2013 than in earlier periods, the share of faults which occurred on Early-life lines was not greater than in earlier periods. This was also the case for MPF and WLR+SMPF despite these type of lines having seen an increase in overall fault rate during Sep-Nov 2013; for these the share of EL faults remained broadly stable at respectively 21% and 9%.

The share of faults occurring on EL lines continued to be higher for MPF than for other types of lines, partly as a result of a higher rate of customer driven interventions on MPF compared to other types of lines.

Figure 13: Share of faults that are Early-life by line type



3 In-life fault (ILF) rates

The impact of the change in the underlying data sets on In-life fault (ILF) rates is minimal (see Section 'Context for Data analysis' at the start of the document). The main reason is that the scale of the reclassification is several orders of magnitude lower than the overall number of In-life lines (approximately 96% of the lines).

The main changes to ILF rates in the period September 2013 to November 2013 is an increase in ILF rates for all types of lines and an increase in the difference between ILF rates of data lines vs. the ILF rate of WLR/PSTN.

3.1 In-Life fault (ILF) rate by type of line

ILF rates for all types of lines have increased in September-November 2013 vs. their two year average

In the period September to November 2013 the ILF rate of WLR+SMPF remained the highest compared to the ILF rate of WLR/PSTN and of MPF (Figure 14). In-life rates increased in the period September to November 2013 when compared to their two year average over the 26 months period, by 6% in the case of WLR/PSTN, by 20% in the case of MPF and by 11% in the case of WLR+SMPF (Figure 15).

Figure 14: In-life fault rates by line type

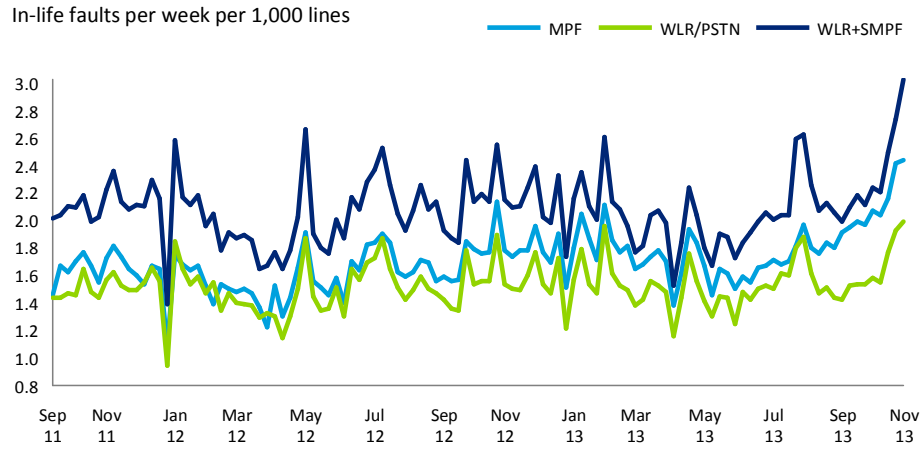


Figure 15: Increase in ILF rate, Sep-Nov 2013 vs. two year average

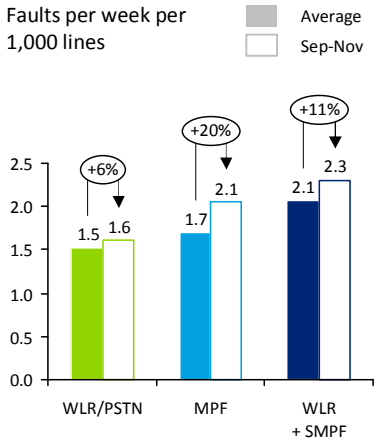


Figure 16: In-life fault rates differential versus voice only lines (WLR/PSTN)

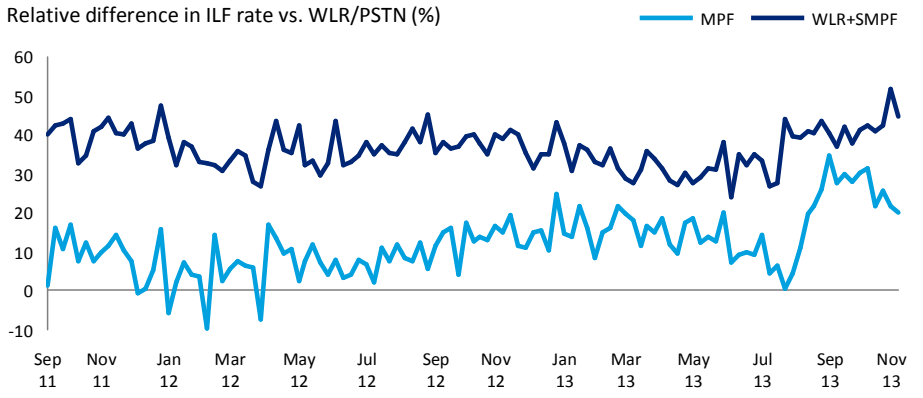
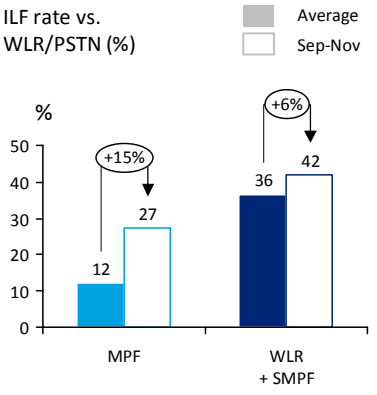


Figure 17: ILF rate differential, Sep-Nov 2013 vs. two year average



The ILF rates of WLR+SMPF and of MPF remain on average higher than the ILF rate of WLR/PSTN

As illustrated in Figure 16, there remains a clear difference between the ILF rates of data lines (WLR+SMPF, MPF) compared to the ILF rate of voice only lines (WLR/PSTN). The rate differential increased further during September 2013 to November 2013, to almost 27% in the case of MPF and 42% in the case of WLR+SMPF (Figure 17).

3.2 Seasonality

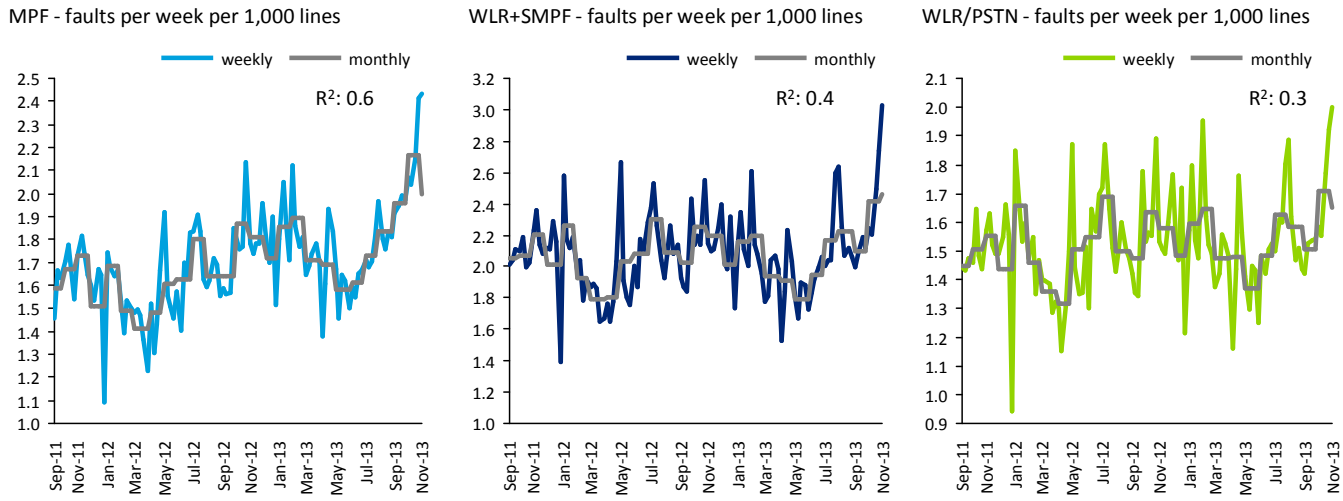
Figure 14 illustrates the short term volatile nature of IL fault rates. Whilst there appears to be clear transitory exceptional periods of higher fault rates (e.g. May 2012, August 2013), average in-life fault rates appear to follow a cyclical evolution, to increase in the winter and mid-season months and then decrease during summer months.

The availability of two years of data allows a year on year comparison of fault rates to derive a seasonality curve, i.e. what average monthly variations have there been compared to a yearly average. This then allows the adjustment of fault rates to those seasonal variations as to investigate underlying patterns of change.

Our overall approach has been as follows:

- Average IL weekly fault rates by calendar month in order to remove short term volatility (Figure 18). The determination coefficient R2 of this monthly model remains satisfactory for the purpose (e.g. MPF: 0.6)
- Compare IL monthly fault rates to the annual average and derive monthly variations to this average ('seasonal variations', expressed in per cent), this for each of year 1 and year 2. Identify whether those variations are comparable from year 1 to year 2 to validate a seasonality hypothesis (Figure 19)
- Assess whether the average seasonal variations are comparable across line types (Figure 20)
- Remove seasonal variations from actual monthly fault rates ('adjusted fault rates') and compare these rates with the first two months of the two years period as to assess increasing or declining trends (Figure 21)

Figure 18: In-life fault rates monthly versus weekly fault rates



In-life fault rates follow a seasonal pattern

The availability of two years of data is typically not sufficient to conclude on a repetitive multi-year seasonal trend. However the comparison of in-life fault rate variations between year 1 and year 2 (Figure 19) suggests that there was a repetitive evolution pattern from one year to the other. In the period September to January, fault rates are typically higher, except for the month of December which despite more adverse weather conditions in both year 1 and year 2 is repeatedly a month with lower fault rates. In the period March to June on the contrary fault rates are typically lower than the annual average. This pattern can be observed for both year 1 and year 2 with broadly similar periods and amplitude. There is however in year 2 a seasonal delay of approximately one month vs. year 1, which can also be observed with regard to overall weather conditions in year 2 vs. year 1 (longer winter in year 2).

The comparison by type of line of average fault rate variations to the in-year average (Figure 20) suggests that the seasonal variations are less influenced by the type of line itself than by external factors, as the variations follow a very similar pattern across all line types.

Whilst the average of year 1 and year 2 variations cannot substitute itself to a multi-year analysis of seasonality factors calculated over a longer period of time, the fact that evolution patterns between year 1 and year 2 are comparable suggests that these variations can be used as adjustment factors.

Figure 19: Seasonal variations, year 1 vs. year 2

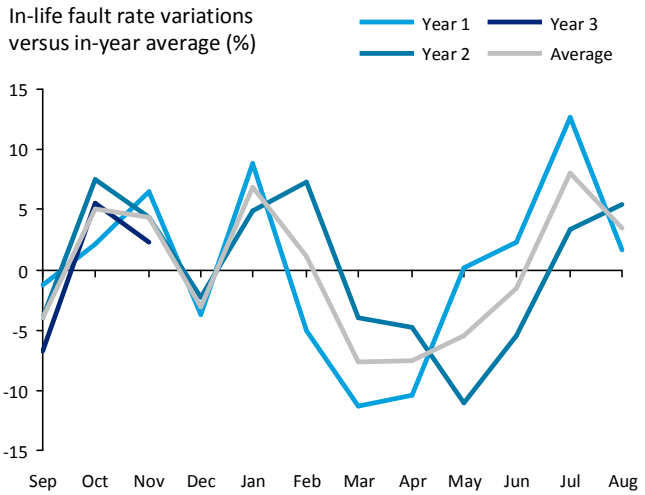
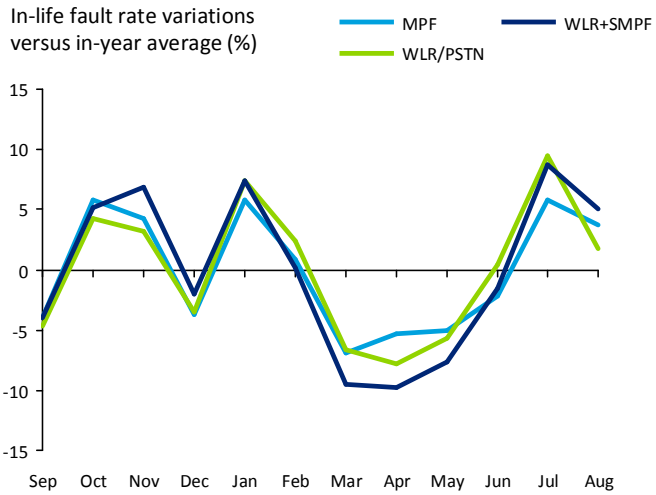


Figure 20: Seasonal variations by type of line

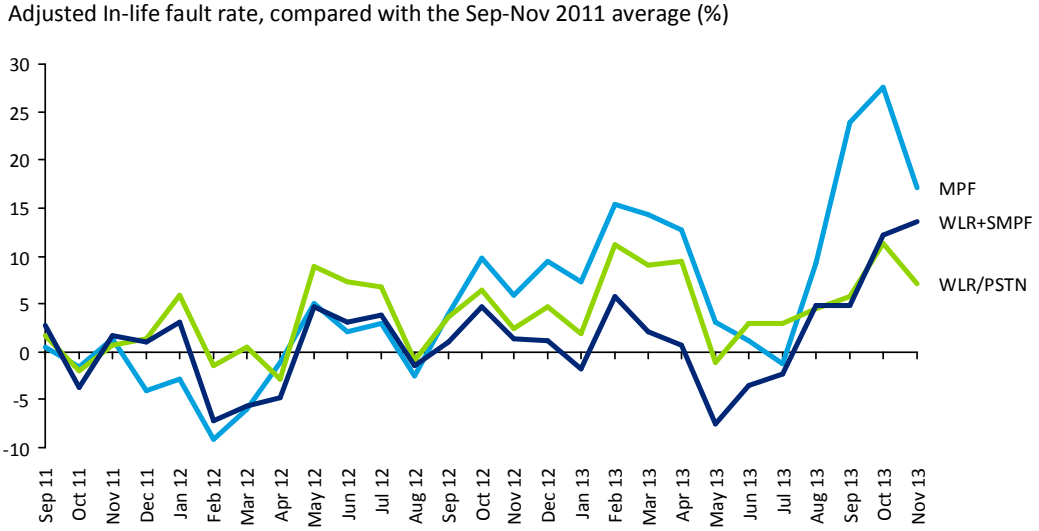


In-life fault rates adjusted for seasonality have increased between September 2011 and November 2013

The adjustment of in-life fault rates for seasonal variations suggests that rates have increased over the period September 2011 to November 2013. Our approach has been to rebase in-life fault rates to the average rates of the first quarter available for the period. This is showing that at the end of the period November 13 in-life fault rates were 17% higher than in the first quarter for MPF, 13% higher for WLR+SMPF and 7% higher for WLR/PSTN, corresponding to compound annual growth rates of respectively 8%, 6% and 3%.

We also used a linear regression fit to estimate the average growth rate of the closest interpolating line over the period. The implied growth rates were respectively 10% for MPF, 3% for WLR+SMPF and 3% for WLR/PSTN.

Figure 21: Evolution of adjusted ILF rates versus the average ILF rate September-November 2011



Sep-11 to Nov-13, in per cent

	Nov-13	CAGR	CAGR of linear fit
MPF	17	8	10
WLR+SMPF	13	6	3
WLR/PSTN	7	3	3

3.3 The impact of including faults on NGA lines

Including WLR+NGA lines into the calculation of WLR in-life fault rates would result in a 14% higher fault rate for the period September 2011 to November 2013, increasing to 23% in September to November 2013

There are a growing number of WLR+NGA and MPF+NGA lines. Such lines fall within the category called 'other' (see section 2, figure 6). They have been deployed recently and are typically associated with a higher in-life fault rate. As such they have been excluded from fault rate calculations for more traditional WLR/PSTN, MPF and WLR+SMPF lines in the other sections of this document. However when a fault is reported on a line it is not possible to distinguish whether it is a fault related to the voice service or a fault related to the data service, it is a

line fault. Should an overall WLR fault rate were to be calculated, the inclusion of WLR+NGA lines would likely change the fault rate. This section investigates what would be such impact of including WLR+NGA and MPF+NGA lines in the calculation of in-life fault rates.

Figure 22: In-life fault rate on WLR, excluding and including NGA lines

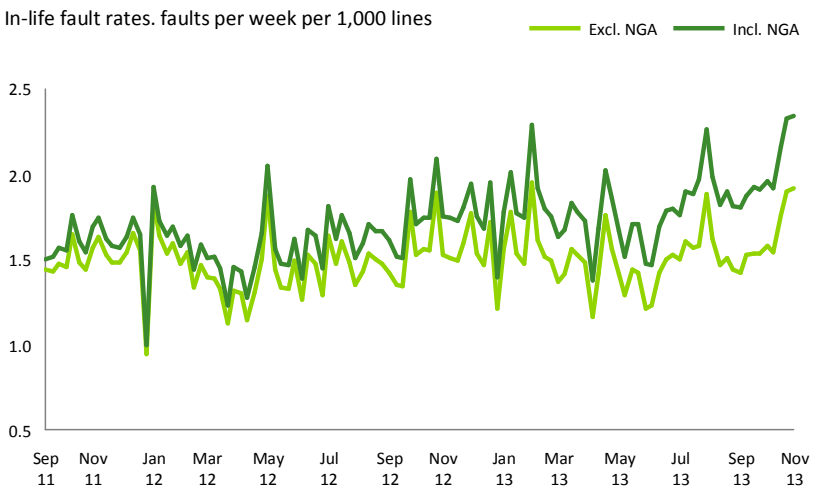
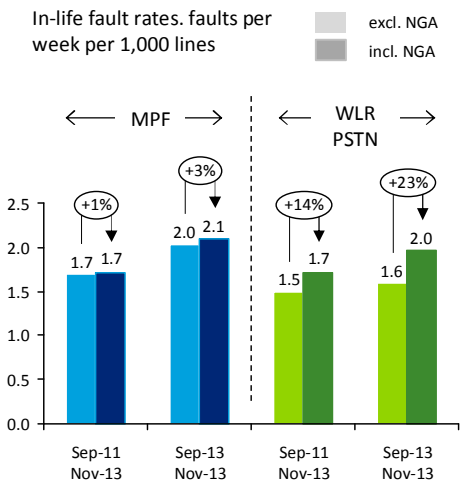


Figure 23: Comparison of NGA impact on WLR/PSTN and MPF



As illustrated in Figure 23, including NGA lines in the calculation of in-life fault rates has a more adverse impact on WLR/PSTN lines than on MPF lines. It increases fault rate by approximately 14% on WLR/PSTN and 1% on MPF on average between September 2011 and November 2013. In the case of WLR/PSTN, the difference between excluding and including WLR+NGA lines in the calculation of WLR/PSTN fault rates also widened over time, partly as a result of the increase in WLR+NGA lines and their increasing weight within overall WLR faults. In the period September 2013 to November 2013 WLR/PSTN in-life fault rate including WLR+NGA lines was approximately 23% higher than excluding them.

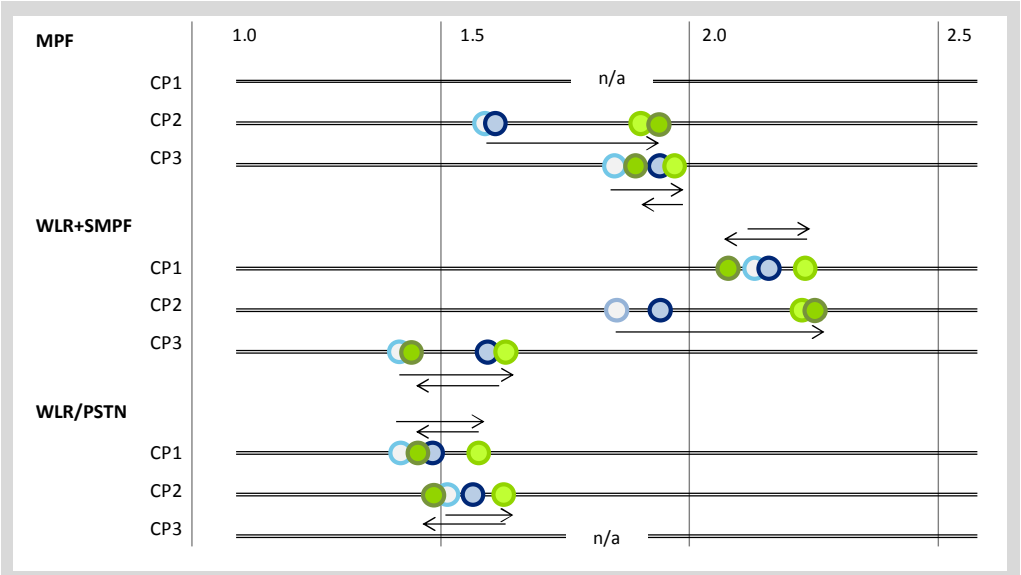
3.4 Average fault rate by CP

In-life fault rate by type of line varies by CP

The section 'Context for data analysis' explains that there was a change in how lines and faults were classified by CP between the underlying dataset used in September 2013 and the dataset used in this addendum. There remain significant variances in the in-life fault rates observed on lines used by different CPs (Figure 24). Also for CP2, the in-life fault rate on MPF and on WLR+SMPF has increased over time.

Figure 24: In-life fault rates by line CP and type of line

Faults per week per 1,000 lines



4 Early life fault (ELF) rates

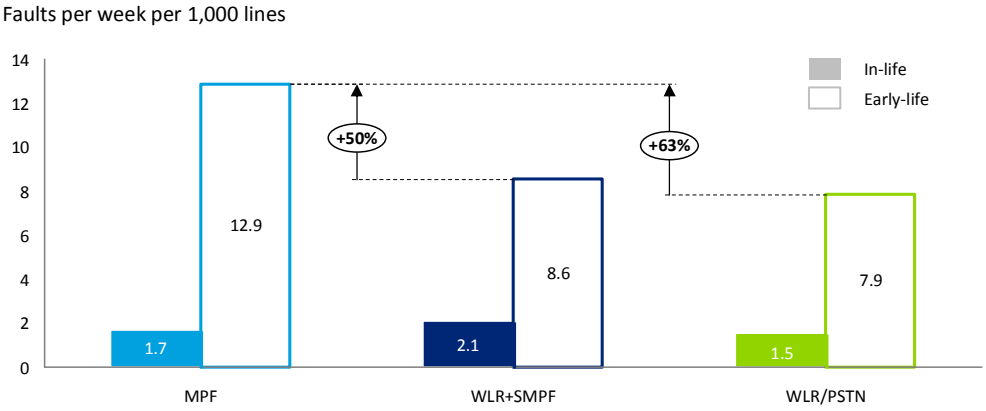
Early life faults cover less than 5% of total lines (Section 1.2) and on average 16% of total faults (Section 2.2).

MPF continues to show a significantly higher Early-life fault rate than other types of lines

The reclassification of lines in the case of Modified Primary Line orders (Section 'Context for Data analysis') has had a significant impact on ELF rates for lines associated with voice products (WLR/PSTN and WLR+SMPF). Between the data set used in the September report and the data set used in this addendum, WLR/PSTN and WLR+SMPF ELF rates have increased from 4.0 and 4.5 to resp. 7.9 and 8.6 faults per week per thousand lines.

Whilst the gap between MPF ELF rates and the ELF rates of other types of lines has narrowed, MPF continues to show a significantly higher ELF rate than other types of lines. As illustrated in Figure 25, MPF ELF rates were still more than 50% above the ELF rates of WLR/PSTN and WLR+SMPF. The contribution of higher ELF rates to the overall fault rate of MPF is compounded by its higher share of EL lines compared to other line types (Section 2.2).

Figure 25: Early-life faults vs. in-life fault rates by type of line



Early life fault rates have been increasing since 1Q13 (financial)

Excluding transitory periods such as February and May 2013, ELF fault rates have been increasing for all types of lines (Figure 26). In particular for the period September to November 2013, ELF rates were between 17% higher (MPF) and 30% higher (WLR+SMPF) than their two year average (Figure 27).

Figure 26: Early-life weekly fault rates by line type

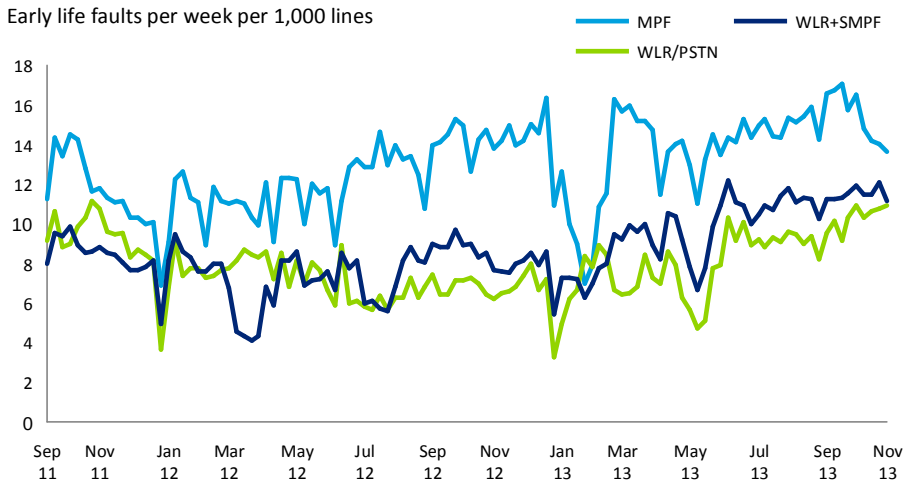
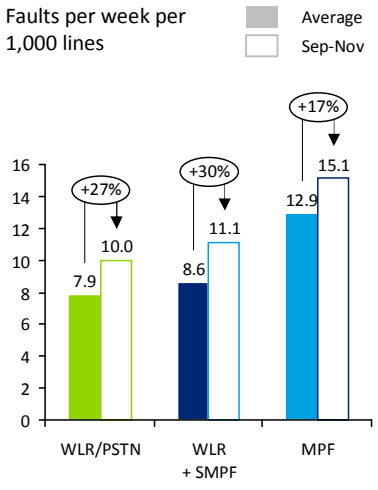


Figure 27: ELF in the period September-November 2013 vs. the two year average



Appendix 1: Technical Annex

Chart Ref.	Filters	Analytical Methodology
Figure 1: Number of lines by line type **Figure 2: Evolution of lines and fault rates**	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only Other (e.g. including NGA) **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Lines: Apr 2011 – Nov 2013 Fault rates: Sep 2011 – Nov 2013	Calculate proportion each Line Type makes up of overall total number of lines by week Identify overall average over the period of analysis, In-Life and Early-Life fault rates for each of the Line Types
Figure 3: MPF share of lines	**Dates** Apr 2011 – Nov 2013	Calculate the total number of MPF lines per week and compare this to the total number of lines per week to calculate the percentage share of all lines
Figure 4: Early-life lines vs. In-life lines **Figure 5: Evolution of the share of Early-life lines**	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only Other (e.g. including NGA) **Dates** Apr 2011 – Nov 2013	Calculate the overall split of the number of lines by line type and the number of faults by Line Age (Early-life vs. In-life)
Figure 6: Faults breakdown	**Dates** Sep 2011 – Nov 2013	Calculate the overall split of the faults which are faults into categories of interest e.g. categories which are excluded in some analyses such as BBB, SFI or CDTA (not Hard Clear) faults
Figure 7: Total faults by line type **Figure 8: Fault CAGR and share**	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only Other (e.g. including NGA) **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear	Calculate the overall split of faults by line type over time (using a three month average)

	Dates Oct 2011 – Nov 2013	
Figure 9: Average overall fault rates by line type **Figure 10: Increase in overall fault rate, Sep-Nov 2013 vs. two year average**	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Divide the number of faults by the working system size by week for each line type; show as faults per week per 1000 lines Average the fault rate calculated on a weekly basis for the months of September 2013 to November 2013, versus the average of the weekly fault rates calculated over the period September 2011 to November 2013
Figure 11: Early-life faults vs. In-life faults **Figure 12: Evolution of the share of Early-life faults**	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only Other (e.g. including NGA) **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Calculate the overall split of the number of lines by line type and the number of faults by age (Early-life vs. In-life)
Figure 13: Share of faults that are Early-life by line type	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **Age** Excluding In-Life faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Divide faults on Early-life lines by type of line, by the overall number of faults by type of line.
Figure 14: In-life fault rates by line type **Figure 15: Increase in ILF**	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types**	Divide the number of in-life faults by the working system size by week for each line type; show as faults per week per 1000 lines

rate, Sep-Nov 2013 vs. two year average	Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **Age** Excluding Early-Life faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Average the fault rate calculated on a weekly basis for the months of September 2013 to November 2013, versus the average of the weekly fault rates calculated over the period September 2011 to November 2013
Figure 16: In-life fault rates differential versus voice only lines (WLR/PSTN) **Figure 17: ILF rate differential, Sep-Nov 2013 vs. two year average**	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **Age** Excluding Early-Life faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Calculate the ratio of the number of faults per 1,000 lines to the working system size of lines per week for each line type. Compare on a weekly basis to the WLR/PSTN only fault rate rate for each line type Average the fault rate calculated on a weekly basis for the months of September 2013 to November 2013, versus the average of the weekly fault rates calculated over the period September 2011 to November 2013
Figure 18: In-life fault rates monthly versus weekly	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **Age** Excluding Early-Life faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Calculate the weekly and monthly average In-life fault rates by line type Calculate the R2 parameter for each weekly versus monthly data series
Figure 19: Seasonal variations, year 1 vs. year 2 **Figure 20: Seasonal variations by type of line**	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults	Calculate the average in-life monthly rate for each month of the analysed period, by line type. Calculate the annual average of in-life fault rate by line type. Seasonal variations are calculated as the relative difference of monthly fault rates versus the annual average for

	Age Excluding Early-Life faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	the year they belong to. Year 1 is September 2011 to August 2012. Year 2 is September 2013 to August 2013. Year 3 is September 2013 to November 2013.
Figure 21: Evolution of adjusted ILF rates versus the average ILF rate September-November 2011	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **Age** Excluding Early-Life faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Adjusted ILF rates are calculated as the actual weekly ILF rates divided by (1+seasonal monthly variation), where seasonal monthly variation has been calculated as defined in Figure 20. Adjusted ILF rates are divided the average ILF rate calculated for the months of September to November 2011 as the first quarter available for data analysis.
Figure 22: In-life fault rate on WLR, excluding and including NGA lines **Figure 23: Comparison of NGA impact on WLR/PSTN and MPF**	**Line Types** WLR/PSTN Only WLR + NGA **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **Age** Excluding Early-Life faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Calculate the weekly and monthly average In-life fault rates for WLR/PSTN only and WLR/PSTN with or without NGA WLR/PSTN with NGA faults are the sum of faults on WLR only lines, PSTN only lines and WLR+NGA lines
Figure 24: In-life fault rates by line CP and line type	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **Age** Excluding Early-Life faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear	Divide the number of faults per by the working system size of lines for each line type and CP. Show as faults per week per 1000 lines

	Dates 4.3 Sep 2011 – Nov 2013	
Figure 25: Early-life fault vs. In-life fault rates by type of line	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Calculate the weekly and monthly average fault rates by line type and Line age
Figure 26: Early-life weekly fault rates by line type	**Line Types** WLR/PSTN Only WLR/PSTN+SMPF MPF Only **Fault Types** Excluding SFI, BBB and Exchange faults **Chargeable** Excluding chargeable faults **Age** Excluding In-Life faults **CDTA/Hard Clear** Excluding faults which are CDTA unless they are a Hard Clear **Dates** Sep 2011 – Nov 2013	Calculate the number of faults per 1,000 lines in the working system size of lines by week for each line type for early-life lines

Appendix 2: Glossary

Term	Description
NGA	**Next Generation Access**. A BT network technology aimed at replacing the copper pair access to customer premises with fibre technology. This requires modifications of the network infrastructure between the local exchange and the customer premises, albeit depending on each local configuration (FTTC/FTTB/FTTH). In most cases this requires modifications at the street cabinet level.
CP	**Communication Provider**. An organisation that provides an Electronic Communications Network or provides an Electronic Communications Service
WLR	**Wholesale Line Rental**. A wholesale product from Openreach for voice service
MPF	**Metallic Path Facility.** A wholesale product from Openreach for both voice and data service
SMPF	**Shared Metallic Path Facility**. A wholesale product from Openreach for data service
WLR+SMPF	Combination of two wholesale products (WLR and SMPF) on a same line, purchased together alongside one another.
ELF	**Early-life Fault**. Fault ,which has happened within less than 28 days from a new service provision
ILF	**In-Life Fault**. Fault, which has occurred more than 28 days after a new service provision.
MFL	**Main Fault Location**. Initial diagnostic for the reason and location of the reported fault
CC	**Clear Code.** Final diagnostic for the reason why the fault occurred
Chargeable	**Chargeable Faults**. Includes CDTA, SFI, BBB
CDTA	**Conscious Decision To Appoint**.
SFI	**Special Fault Investigations.** Standard Line test has been returned as ok but the CP wants to carry out a more detailed line test
BBB	**Broadband Boost**. A service product whereby a chargeable engineering visit can be ordered when a broadband line tests OK but the end user remains not satisfied with the service.

CL	**Care Level.** Openreach products are associated with different levels of service. CL1 is associated with a response time of 2 days to clear the fault. CL2 is associated with a response time of 1 day. The MPF product is associated with a CL2 response time.
PCP	**Primary Connection Point**. Street cabinet
LE	**Local Exchange**. Local building where interconnection for BT lines is done. There are approximately 5,000 local exchanges
MDF	**Main Distribution Frame**. Main point of line interconnection within the Local Exchange

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