# WLR and LLU Fault Rates Additional Analysis

## Final Report

**Version 0.4**

**NON-CONFIDENTIAL VERSION**

15 May 2014

Prepared for:

Ofcom

## Version History

| Version | Date | Author | Changes | Distribution | Approval |
|---|---|---|---|---|---|
| 0.1 | 2 APR 2014 | N Jessee | Final draft for Ofcom review | Ofcom | M Dargue |
| 0.2 | 24 APR 2014 | N Jessee | Updated draft incorporating Ofcom comments | Ofcom | M Dargue |
| 0.3 | 30 APR 2014 | N Jessee | Updated draft incorporating additional Ofcom comments | Ofcom | M Dargue |
| 0.4 | 15 MAY 2014 | N Jessee | Updated draft incorporating additional Ofcom and Openreach comments | Ofcom | M Dargue |
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## About Cartesian

Cartesian is the new brand name for CSMG and its parent company TMNG Global Inc. The company unified its global business units under the new Cartesian brand in February 2014. We are a specialist consulting firm of industry experts, focused exclusively on the communications, technology and digital media sector.

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# 1. Executive Summary

*December 2013 Report*

1.1. In July 2013, Ofcom commissioned Cartesian (then "CSMG") to produce a report determining the fault rates for three types of BT Openreach lines in 2011/12 and 2012/13: Wholesale Line Rental (WLR) only lines, WLR and Shared Metallic Path Facility (WLR+SMPF) lines, and Metallic Path Facility (MPF) lines.

1.2. The initial analysis was conducted using databases of Faults and Working System Size (WSS) provided by BT Openreach.

1.3. Where differences were found to exist between the fault rates for WLR+SMPF lines and MPF lines, Cartesian was asked to investigate the reasons for these differences.

1.4. Finally, Cartesian was asked to forecast the fault rates for the three types of line in 2016/17.

1.5. Cartesian's report was published on 19 December 2013 alongside Ofcom's fixed access market review consultation.[1] The report was published under Cartesian's former brand name "CSMG".

*April 2014 Report*

1.6. In response to its consultation, Ofcom received comments from stakeholders including BT, Sky and TalkTalk.

1.7. In its response, BT observed that the filter criteria applied to identify relevant faults in the December 2013 report was incorrect. BT recommended new filter criteria be applied.

1.8. In March 2014, Ofcom received an updated and extended datasets from BT Openreach. These datasets included faults and WSS data for 20 weeks (Sep. 2013 – Jan. 2014) which was not available for the December 2013 report.

1.9. In light of the new information, Cartesian was asked to repeat a subset of its analysis to determine the impact of these changes on the conclusions outlined in the December 2013 report. The scope of this subsequent engagement focused on the observed fault rates and did not further investigate the reasons for differences in WLR+SMPF and MPF fault rates included in the December 2013 analysis.

1.10. Cartesian was also tasked with assessing the potential distortion of fault rates due to the volume of faults for which the product category could not be determined.

1.11. Using the updated fault filtering criteria, Cartesian analysed fault rates based on the most recent (Mar. 2014) fault and WSS datasets, comparing the Early-Life (EL), In-Life (IL), and overall fault rates by product

1.12. Finally, Cartesian also analysed fault rates and Service Level Agreement (SLA) breaches associated with MBORC (Matters Beyond Our Reasonable Control) declarations. Cartesian assessed the proportion faults exceeding Service Level Agreements (SLAs) that can be attributed of High-Level and Local MBORC faults.

[1] Ofcom: "Fixed access market reviews: Openreach quality of service and approach to setting LLU and WLR Charge Controls", 19 December 2013

1.13. Cartesian also analysed the impact of excluding faults from worst-affected MBORC areas on the overall within-SLA fault repair percentages. The faults occurring in the two General Manager (GM) areas with the highest volumes of faults exceeding SLAs attributed to High-Level MBORCs were excluded to determine what impact this would have.

*Data Sources*

1.14. For its April 2014 analysis, Cartesian utilised the two datasets previously provided by BT Openreach and used for the December 2013 report: the database of faults from April 2011 to August 2013; and the database of the weekly working system size of lines for each week of the same time period. In addition, Cartesian used more recent datasets (in the same format) covering April 2011 – January 2014. All the datasets covered England, Scotland, Wales and Northern Ireland.

1.15. In the fault database, each fault was categorised by date, line type and whether the fault occurred in early-life (EL) or in-life (IL). Early-life was defined as within the first 28 days after a transition activity.

1.16. The working system size was also categorised by week, line type and segmented into EL and IL volumes.

1.17. The analytical results are bound by the quality and sufficiency of the source data. In particular, some caution must be applied when assessing the significance of long-term trends inferred from the relatively short-run dataset (most recent data covering less than three years).

## 2. Scope and Objectives

2.1. In March 2014, Ofcom engaged Cartesian to conduct further assessment of fault rates for Wholesale Line Rental (WLR) and Local Loop Unbundling (LLU) products based on new Openreach-provided data and fault filtering criteria, as well as an assessment of fault repairs exceeding SLAs due to High-Level MBORC declarations.

2.2. This report describes Cartesian's approach, the source data, the analysis undertaken and the conclusions of the assessment.

*Faults Analysis*

2.3. The assessment was required to validate and/or update previous inputs to the proposed 2014-17 charge controls for WLR and LLU products. Specifically, the objectives of the engagement were to determine:

- Impact of updated filtering criteria on previous results, segmented into in-life fault rates and early-life rates;
- Fault rates based on most recent BT Openreach-provided extended data through January 2014, comparing the impact of including/excluding particular clear codes; and,
- The appropriate level of likely faults for the end year (2016/17) given the most recent BT Openreach data, with justifications for any differences from previous analyses.

2.4. The scope of the assessment was limited to faults occurring within BT Openreach's operational domain. The relevant products were WLR, Shared Metallic Path Facility (SMPF) and Metallic Path Facility (MPF).

2.5. Cartesian was tasked with: analysing the data to determine any changes to current and historic fault rates when applying the updated faults filtering criteria; calculating the fault rates given the extended datasets, including any changes to observed trends; forecasting the level of faults at the start and end of the charge control period.

*MBORC Analysis*

2.6. Cartesian was also asked to analyse fault rates and Service Level Agreement (SLA) breaches associated with MBORC events.

2.7. This analysis evaluated MBORCs at the GM area level as well as the whole of the UK for each of the financial years 2011/12 to 2013/14, subject to available data.

2.8. The assessment also examined how High-Level MBORC declarations are distributed across the GM regions in 2011/12, 2012/13, and 2013/14, including the typical durations of the High-Level MBORCs.

2.9. Finally, Cartesian conducted an analysis of the impact of excluding the 2 GM regions with the highest volume of High-Level MBORC fault repairs exceeding SLA from overall within-SLA completion calculations.

# 3. Methodology

*Overview*

3.1. In this additional phase of analysis, Cartesian followed a similar high-level approach to the preceding engagement. Cartesian took datasets supplied by BT Openreach, filtered and segmented these to obtain the relevant records, and analysed these to determine fault rates for specified products. The analysis investigated in-life, early-life and overall fault rates. Our findings are documented in this report.

3.2. Cartesian received five datasets from BT Openreach:

- Reported Fault database (April 2011 – January 2014);
- Working System Size (WSS) database (April 2011 – January 2014);
- High-Level MBORC Declaration database (April 2011 – January 2014);
- List of MDF Site IDs mapped to relevant SOM and GM areas;
- MBORC Faults Exceeding SLA database (April 2012 – January 2014).

3.3. The fault rate analysis required the fault and WSS databases to be used in conjunction, while the MBORC analysis utilised the faults database and the MBORC datasets and the MDF site mapping to assign SOM and GM areas to individual fault records

3.4. The analysis in this report is based on the records contained in these five BT Openreach databases. The contents of the databases are described below.

*Fault Database (April 2011 – January 2014)*

3.5. The Fault Database contained approximately 13.8 million fault records, with each record containing field identifiers enabling aggregation and segmentation of the data into a variety of categories. The fields included in the dataset are listed in the table below.

***Figure 1: Faults Database Fields***

| Field | Description |
|---|---|
| **Record Identifiers** | Unique Fault Reference ("Journey ID"), ID to link previous faults databases, Telephone Number / MPF ID |
| **Exchange Code** | MDF Site identifies relevant Exchange |
| **Asset Category** | Product on which fault occurred (e.g., MPF, WLR-Only, WLR+SMPF |
| **Line Age** | Age of the line at the date the fault was recorded (difference between Chapter Start Date and Fault Recorded Date); categorized as Very Early Life (VEL),Early-Life (EL) or In-Life (IL) |
| **Chapter Start Date** | Date of most recent Transition Activity on the line |
| **Fault Recorded Date** | Initial Date & Time when Fault Recorded |
| **Fault Cleared Date** | Fault Cleared Date & Time |
| **CSS Week End Date** | End date of week for grouping with BT CSS calendar |
| **Transition Activity** | Last Line Event processed on the line to start the current chapter - also referred to in this report as the provisioning activity (new provide, modify, cease, etc.) |
| **Fault Clear Code** | Engineer-provided Clear Code when fault is resolved |
| **Exclude from WSS** | Y or N field; Y denotes Internal BT Service Lines not relevant to analysis |
| **Broadband Boost** | Field denotes whether faults are related to BB Boost service |
| **Special Fault Investigation** | Field denotes whether faults are related to a Special Fault Investigation (SFI) |
| **CP Group** | CUPID lookup to Customer Owning CP group based on the Primary Line; only Major CP Groups included |
| **Product Faulted** | Specific type of product fault was raised against (SMPF, NGA, WLR, MPF, etc.) |
| **Main Fault Location** | Initially identified location of the fault when reported |
| **CDTA FLAG** | Denotes Conscious Decision to Appoint (Y or N field) |
| **CDTnA FLAG** | Denotes Conscious Decision to Not Appoint (Y or N field) |
| **Customer Care Level** | Care Level associated with Line (Either 1,2,3 or 4) |
| **MBORC** | Matters Beyond Our Responsible Control (Y or N field) |

3.6. The raw data required pre-processing before it could be used in the fault analysis. This involved filtering out irrelevant records, and aggregating categories that were more granular than required

3.7. To extract the relevant faults from the Fault Database for the analysis, a series of records were filtered out as shown in the following figure. The filtering criteria was updated following discussions between BT Openreach and Ofcom and differs from the filtering criteria applied in Cartesian's December 2013 report. The changes are as follows:

- Faults flagged as "SFI" are included (previously these had been excluded);
- Faults flagged as "CDTA" or "CDTnA" are included; and,
- Additional clear codes (beginning 152 and 172) are added to the clear code filtering list (i.e., faults matching these clear codes are included in the analysis).

***Figure 2: Faults Database Filtering (Total Number of Faults)***

| | | |
|---|---|---|
| **Starting Database** | | **13,779,586** |
| **Excluded Records** | **BB Boost** | 808,983 |
| | **Exclude from WSS** | 386,533 |
| | **VOICE + NGA (GEA) Products** | 445,175 |
| | **MPF + NGA (GEA) Products** | 50,374 |
| | **Unknown Products** | 446,072 |
| | **Excluded Clear Codes** | 4,450,641 |
| **Total Faults in Analysis** | | **7,191,808** |

3.8. The impact of not excluding faults flagged as "SFI" was minor, as the total fault volume excluded from this filter in the December 2013 Report was 45,000 faults, some of which were still excluded due to NGA or unknown product categories.

3.9. The change in fault volumes due to the CDTA / CDTnA inclusion was also minimal. In Cartesian's December 2013 Report fewer than 20,000 faults of these faults were excluded due to their "Fault Not Found" clear codes, so the removing this filter has only a small impact on total volumes.

3.10. Updated clear code filters accounted for the overwhelming majority of the differences in fault volumes between the previous and updated filtering criteria. In the original data (used in Cartesian's December 2013 report), 570,000 faults had 172 clear codes, and 350,000 had 152 codes prior to any filtering.

3.11. It was necessary to map some records from more granular categories to the aggregated categories in the terms of reference for the study. In the product categories, PSTN-Only lines (i.e., WLR Classic) were included in the WLR Voice Only category. The Very Early Life "Line Age" (within 28 days of transition activity) category in the BT Openreach dataset was categorised as "Early-Life" in Cartesian's analysis. The Early-Life (between 29 and 90 days after transition activity) and In-Life (more than 90 days after transition activity) Line-age categories in the BT Openreach dataset were categorised as "In-Life" in the analysis.

3.12. Disaggregating the faults on WLR+SMPF lines into discrete fault rates for the individual WLR and SMPF services on these lines would have been desirable. However it was found that this could not be achieved with accuracy. Both the Product Faulted and Transition Activity fields proved to be unreliable for this segmentation. The WLR and SMPF rates are therefore considered only in aggregate.

*Working System Size Database (April 2011 – January 2014)*

3.13. The Working System Size (WSS) database contained aggregate totals of the BT Openreach WSS for each week in the date range (147 total weeks). Within each week, the WSS was segmented as shown in the following figure.

***Figure 3: WSS Database Fields***

| Field | Description |
|---|---|
| **CSS Week End Date** | End date of week for grouping with BT CSS calendar (WSS a snapshot at this date) |
| **Asset Category** | Product categories within WSS (e.g., MPF, WLR-Only, WLR+SMPF |
| **Transition Activity** | Lines grouped into most recent event that start current line chapter (e.g., modify, new provide, cease) |
| **Exclude from WSS** | Y or N field; Y denotes Internal BT Service Lines not relevant to analysis |
| **CP Group** | CUPID lookup to Customer Owning CP group based on the Primary Line |
| **Exchange Code** | MDF Site identifies relevant Exchange |
| **Very Early Life (VEL) WSS** | Number of Active Lines in the Very Early Life State (VEL = less than 28 days since activity) |
| **Early-Life (EL) WSS** | Number of Active Lines in the Early Life State (EL = between 29 and 90 Days since last activity) |
| **In-Life (IL) WSS** | Number of Active Lines in the In-Life State (In-Life = greater than 90 days from last activity) |
| **Total WSS** | Sum of all Active lines during the period (VEL + EL + IL) |

3.14. The WSS database also required some pre-processing before it could be used in the analysis.

3.15. For consistency with the Faults database, PSTN-Only lines (i.e., WLR Classic) were again mapped to the WLR Voice Only category. The three BT Openreach Line Age categories were also mapped to the "Early-Life" vs. "In-Life" categorization of this study.

3.16. Some filtering of the WSS records was also required to remove extraneous data and map with the Faults database. Internal BT lines, Unclassified WSS lines, as well as NGA and GEA products were excluded from the fault rate calculations.

*High-Level MBORC Declarations (April 2011 – January 2014)*

3.17. Data for High-Level MBORC declarations was provided at the SOM area level, with dates for the MBORC declaration in each SOM area. The fields are detailed in the figure below.

***Figure 4: High-Level MBORC Declarations Fields***

| Field | Description |
|---|---|
| **SOM Area** | Specific SOM area in which a High-Level MBORC has been declared |
| **GM Area** | GM area in which the affected SOM is located |
| **Declaration Start Date** | Date a High-Level MBORC was declared in a specific SOM area |
| **Declaration End Date** | Date the MBORC declaration in the SOM was lifted |
| **Duration** | Length of time (in days) the High-Level MBORC declaration was in effect (start – end date) |
| **MBORC Grouping** | All SOM-level MBORCs grouped into the MBORC event causing the service disruption |

*MBORC Exceeded SLA Faults Database (April 2012 – January 2014)*

3.18. BT Openreach provided a separate list containing a subset of faults that were classified as MBORC faults and also exceeded the service level agreement for time to repair the fault. The fields are detailed in the figure below.

***Figure 5: MBORC Exceeded SLA Faults Fields***

| Field | Description |
|---|---|
| **SLG Month** | Calendar Month in which the fault occurred |
| **Auto / Manual Flag** | Faults were flagged as either "Auto" or "Manual" MBORCs, which can be used as a proxy to identify "Local" or "High-Level" MBORCs (respectively) in the data |
| **Ticket Type** | Field identifies faults as either WLR or LLU. WLR tickets may relate to either WLR Only or WLR+SMPF asset categories. |
| **Product Name** | For LLU Ticket Types, identified MPF or SMPF products |
| **Ticket ID** | Unique identifier for each fault repair ticket |
| **Exchange Code** | MDF Site identifies relevant Exchange |
| **SOM Area** | Specific SOM area in which a High-Level MBORC has been declared |
| **GM Area** | GM area in which the affected SOM is located |

3.19. The Ticket Type and Product Name fields enable the faults to be segmented by product; however these do not match the granularity provided by the asset categories in the fault and WSS databases. Specifically, it was not possible to distinguish between WLR Only and WLR+SMPF asset categories in the MBORC fault records. To align the two datasets, Cartesian assigned faults in the MBORC database as follows:

- Fault records with Product Name "MPF" were categorized as MPF;
- Fault records with Product Name "SMPF" or Ticket Type "WLR" were categorized as "WLR / WLR+SMPF".

*MDF Site, SOM, and GM Mapping*

3.20. BT Openreach provided a database of all MDF Site codes mapped to the SOM and GM area in which the exchange is located. The database contained three fields: MDF Site, SOM, and GM.

3.21. This database was used to assign SOM and GM areas to fault records based on the common MDF site. The data in this file was up to date as of March 2014.

3.22. BT Openreach noted that some of the SOM areas may labelled differently in the past, though no additional information on previous terminology for SOM areas was provided to Cartesian.

*Data Quality and Sufficiency*

3.23. Three observations on the source data pointed to potential data quality issues in the fault data received from BT Openreach:

- The first was that a small number of fault records had incompatible field codes (for example, a broadband fault on a WLR-only line). This is likely a result of incorrect data entry by technical staff when updating and/or closing trouble tickets. The extent to which this quality issue was manifest in fault records with internally-consistent field codes is unknown.
- Secondly, the first week of fault data in the time-series was incomplete, resulting in very low fault rates compared to the following weeks, for both ELF and ILF.

- Finally, while faults could be classified into High-Level MBORCs based on the reported fault date and exchange code, no reliable flag for Local MBORCs was provided.

3.24. For the supplied MBORC data, Cartesian also observed a number of limitations:

- Data for the High-Level MBORC declarations contained an additional 23 SOM areas not listed in either the faults database, MBORC faults exceeding SLA database, or list of MDF Sites, SOMs, and GMs supplied by BT Openreach for mapping with other data.
  - These SOMs may have experienced a change in name; the document supplied by BT Openreach for matching MDF sites with SOMs and GMs did not contain data for alternate SOM area names
  - Records for these SOM areas were excluded from the analysis To the extent that these MBORC records were otherwise valid, this exclusion will under-report the number of faults associated with high-level MBORCs.
- The database of MBORC faults only included faults exceeding SLAs, and therefore did not include the total number of MBORC faults for either Local or High-Level MBORCs
- The "Auto" and "Manual" fields in the MBORC database are considered a proxy for identifying either Local or High-Level MBORCs, and therefore may not constitute the actual volumes of faults occurring under Local or High-Level MBORCs.
- A small number of SOMs with High-Level MBORC declarations did not yet have an "End Date" for the MBORC declaration, and therefore the duration could not be reliably calculated. This only impacted the most recent declaration, which started after the faults in the database (faults through Jan 2014, declaration in Feb. 2014) so had little to no impact on the actual fault rates and MBORC faults
- MBORC faults data was also limited in its date range to fiscal year 2012/2013 and part of 2013/2014, with no records for FY2011/2012.

3.25. Beyond these observations, no formal assessment was made of the source data quality.

3.26. Regarding the sufficiency of the data, the relatively short time period of the available data limits the confidence that can be placed on long-run trend analysis.

# 4. Faults Analysis

4.1. The faults analysis was segmented into two separate modules, which are detailed below:

- Module 1 includes an assessment of the impact of the changes in filtering criteria on overall fault rates, and how the changes impacted specific products; and an analysis of the potential impact from excluding fault records with "Unknown" product categories.
- Module 2 focuses on the new extended sets of fault and WSS data, calculating the fault rates and comparing the results to conclusions reached in Cartesian's December 2013 Report.

4.2. The analysis compares fault volumes and rates across two distinct datasets provided by Openreach, which are referred to as follows:

- **Original Data:** Refers to the fault and WSS data provided by Openreach in October 2013 and used by Cartesian to prepare the December 2013 report; this dataset extends from April 2011 through August 2013

- **Extended Data:** Refers to the most recent fault and WSS data provided by Openreach dated January 2014 and used by Cartesian to prepare this report; this dataset extends from April 2011 through mid-January 2014

4.3. In both Cartesian's December 2013 report and this report, the Openreach-provided faults database was filtered based on inclusion/exclusion criteria established through discussions between Openreach and Ofcom. Due to the multiple iterations of filtering criteria for the inclusion/exclusion of specific types of faults, we use the following terminology for identifying which filtering criteria are used for specific figures and analyses:

- **Previous Filtering:** Refers to the fault filtering criteria used in Cartesian's report published in December 2013;
- **Updated Filtering:** Refers to the revised filtering criteria for the new analyses in this report, concerning different treatment of SFI and CDTA/nA faults, as well as included clear codes beginning 152 and 172
- **Modified Filtering:** Based on the Updated Filtering criteria, the Modified Filtering excludes clear codes beginning 152 and 172 to determine the impact of including these specific codes on the overall fault rates

## Module 1

*Updated Filtering Criteria Comparisons*

4.4. Following the publication of Cartesian's December 2013 Report, BT recommended changes to the filtering criteria that had been used to determine the total addressable faults for the fault rate analysis.

4.5. The most significant change to the filtering criteria is the addition of clear codes that had previously been filtered from the analysis.

4.6. Clear Codes beginning 152 and 172 are added to the list of included clear codes, accounting for ~922,000 faults. These codes were excluded from the data used to complete the December 2013 Report.

4.7. The updated filtering criteria also now includes all Special Fault Investigations (SFIs) and faults with CDTA/CDTnA designations for which no fault was found on the line. These faults were excluded from the December 2013 Report on the basis that they could be chargeable faults.

4.8. Including SFI-designated faults and all CDTA/CDTnA faults has a limited impact on the total fault volumes used in the analysis. The December 2013 Report excluded only 60,000 faults on these classifications.

4.9. The final 2 weeks of the faults database received in September 2013 and used in the December 2013 Report contained fault volumes for part of September; however, WSS data did not contain corresponding weekly values so these faults were excluded from the analysis.

4.10. The volumes of faults excluded from the database under the previous and updated criteria are compared in the table below.

*Figure 6: Previous vs. Updated Filtering with Initial (September 2013) Data (Total Number of Faults)*

| | | Previous Criteria | Updated Criteria |
|---|---|---|---|
| **Starting Database** | | **11,842,085** | **11,842,085** |
| **Excluded Records** | **BB Boost** | 717,542 | 717,542 |
| | **Exclude from WSS** | 324,173 | 324,173 |
| | **Excluded Clear Codes** | 4,528,572 | 3,851,952 |
| | **Special Faults Investigations (SFI)** | 45,042 | - |
| | **VOICE + NGA (GEA) Products** | 292,850 | 327,463 |
| | **MPF + NGA (GEA) Products** | 25,281 | 26,599 |
| | **Unknown Products** | 293,704 | 451,210 |
| | **CDTA & CDTnA w/ FNF Clear Codes** | 16,015 | - |
| | **Last two weeks** | 40,698 | 44,961 |
| **Total Faults in Analysis** | | **5,558,208** | **6,098,185** |

4.11. The changes to the excluded clear code filter had the greatest single effect on the fault volumes in the analysis, with over 900,000 fewer faults eliminated at that stage of the process under the updated criteria. Some of these faults were later eliminated due to the type of service line on which they occurred (either NGA or Unknown products), resulting in a final difference of 540,000 more faults included in the analysis.

4.12. Cartesian understands that Ofcom questions the relevance of the inclusion of clear codes 152 and 172 to their assessment of the trends relevant to fault-related costs, and Ofcom requested that Cartesian investigate the effect on fault rates of including and excluding these clear codes.

4.13. At a product level, the changes in filtering criteria resulted in a larger impact to WLR Only and WLR+SMPF products. The figure below details these differences

*Figure 7: Annual Fault Volume Comparisons, Previous vs. Updated Filtering*

| Products | Fault Volume, Previous Filter | | | Fault Volume, Updated Filter | | |
|---|---|---|---|---|---|---|
| **Overall** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** |
| MPF | 523,100 | 693,164 | 309,873 | 543,672 | 720,445 | 322,838 |
| WLR ONLY | 633,612 | 586,906 | 224,829 | 700,291 | 665,090 | 259,744 |
| WLR+SMPF | 1,125,092 | 1,069,232 | 392,320 | 1,239,036 | 1,200,209 | 446,860 |
| **Total** | **2,281,804** | **2,349,302** | **927,022** | **2,482,999** | **2,585,744** | **1,029,442** |

4.14. As a percent of the fault volumes used in the December 2013 Report, fault volumes for MPF products increased by approximately 4% on an annual basis compared to over 10% for both WLR Only and WLR+SMPF products. The figure below details the annual volume impacts, as well as the percentage increase over the volumes used in the December 2013 Report.

***Figure 8: Annual Fault Volume Impact, Previous vs. Updated Filtering***

| Products | Fault Volume Increase | | | Fault Volume, % Increase | | |
|---|---|---|---|---|---|---|
| **Overall** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** |
| MPF | 20,572 | 27,281 | 12,965 | 3.9% | 3.9% | 4.2% |
| WLR ONLY | 66,679 | 78,184 | 34,915 | 10.5% | 13.3% | 15.5% |
| WLR+SMPF | 113,944 | 130,977 | 54,540 | 10.1% | 12.2% | 13.9% |
| **Total** | **201,195** | **236,442** | **102,420** | **8.8%** | **10.1%** | **11.0%** |

4.15. The percentage changes in fault volumes correspond directly with changes in the calculated annual fault rates, as the WSS was not impacted by the updated filtering criteria. A comparison of the fault rates in the December 2013 Report and the rates calculated based on the updated filtering criteria are shown in the table below.

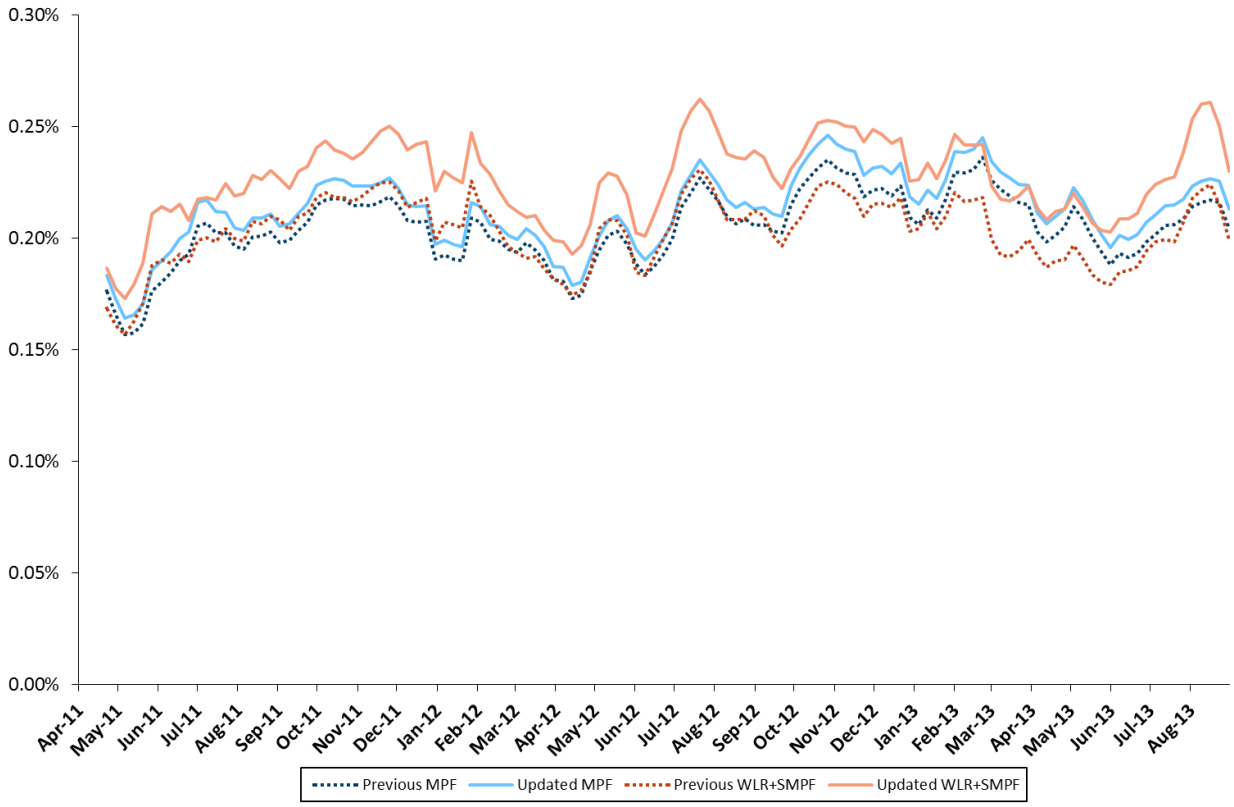
***Figure 9: Annual Fault Rate Comparisons, Previous vs. Updated Filtering***

| Products | Fault Rates, Previous Filter | | | Fault Rates, Updated Filter | | | Rates, Absolute % Increase | | |
|---|---|---|---|---|---|---|---|---|---|
| **Overall** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** |
| MPF | 10.3% | 11.1% | 4.5% | 10.7% | 11.5% | 4.6% | 0.4% | 0.4% | 0.2% |
| WLR ONLY | 8.1% | 8.4% | 3.5% | 9.0% | 9.6% | 4.0% | 0.9% | 1.1% | 0.5% |
| WLR+SMPF | 10.5% | 10.8% | 4.3% | 11.5% | 12.1% | 4.9% | 1.1% | 1.3% | 0.6% |
| **Overall** | **9.7%** | **10.2%** | **4.1%** | **10.5%** | **11.2%** | **4.6%** | **0.9%** | **1.0%** | **0.5%** |

4.16. The fault rates in the December 2013 report (the "original" fault rates) placed WLR+SMPF highest in 2011 and MPF highest in 2012. Under the updated criteria, the fault rates of WLR+SMPF are highest in both years. This is due to the WLR+SMPF fault volumes being more affected than MPF by the changes to the filtering criteria.

4.17. In the December 2013 report, there was little conclusive separation between WLR+SMPF and MPF rates over time. However, the differential impact of the updated filter criteria on the WLR+SMPF fault volumes produces an observable difference in the fault rates over time. The resultant fault rates for WLR+SMPF and MPF are compared with those in the December 2013 report in the following figure.

***Figure 10: Overall Weekly Fault Rate Comparisons, MPF and WLR+SMPF Products***




4.18. The dashed lines represent the 4-week rolling average of fault rates for MPF (in blue) and WLR+SMPF (in orange) using the previous fault filtering criteria. The is no clear separation of these two trend lines, as noted in the December 2013 Report

4.19. The solid blue and orange lines represent the MPF and WLR+SMPF fault rates (respectively) using the updated filtering criteria. The WLR+SMPF rate is clearly higher than MPF rate for the majority of the period, with the exception of a few weeks in early- to mid-2013.

4.20. The impact of the updated filter on early-life fault rates is less significant than the overall rate impact, as seen in the figure below.

***Figure 11: Annual Early-Life Fault Rate Comparisons, Previous vs. Updated Filtering***

| Products | Fault Rates, Previous Filter | | | Fault Rates, Updated Filter | | | Rates, Absolute % Increase | | |
|---|---|---|---|---|---|---|---|---|---|
| **Early-Life** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** |
| MPF | 4.2% | 4.8% | 5.2% | 4.4% | 5.0% | 5.5% | 0.2% | 0.2% | 0.2% |
| WLR ONLY | 3.1% | 2.7% | 2.9% | 3.5% | 3.0% | 3.2% | 0.3% | 0.3% | 0.3% |
| WLR+SMPF | 2.4% | 2.8% | 3.6% | 2.7% | 3.2% | 4.1% | 0.3% | 0.4% | 0.4% |
| **Overall** | **2.9%** | **3.4%** | **4.0%** | **3.1%** | **3.7%** | **4.4%** | **0.3%** | **0.3%** | **0.3%** |

4.21. In-life fault rates are impacted to a greater degree than early-life rates, in line with the observed impacts on the aggregate level. These results are shown in the figure below.

***Figure 12: Annual In-Life Fault Rate Comparisons, Previous vs. Updated Filtering***

| Products | Fault Rates, Previous Filter | | | Fault Rates, Updated Filter | | | Rates, Absolute % Increase | | |
|---|---|---|---|---|---|---|---|---|---|
| **In-Life** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** |
| MPF | 8.5% | 9.1% | 3.6% | 8.8% | 9.5% | 3.8% | 0.3% | 0.4% | 0.1% |
| WLR ONLY | 7.4% | 7.9% | 3.2% | 8.1% | 8.9% | 3.7% | 0.8% | 1.1% | 0.5% |
| WLR+SMPF | 9.1% | 9.6% | 3.8% | 10.0% | 10.8% | 4.3% | 0.9% | 1.2% | 0.5% |
| **Overall** | **8.4%** | **9.0%** | **3.6%** | **9.1%** | **9.9%** | **4.0%** | **0.7%** | **0.9%** | **0.4%** |

*'Unknown' Product Impact Assessment*

4.22. In addition to determining the changes in total faults associated with the updated filtering criteria, Cartesian also examined the potential impact of filtering out ~400,000 faults that were excluded due to the product field containing "Unknown", "Unclassified" or "Not Applicable" codes (collectively referred to as "Unknown" products).

4.23. In this assessment we calculated two estimates of the potential magnitude of the impact, applying a "Low Case" and "High Case" for distributing the Unknown product faults across the relevant product categories. The Low and High cases are based on the stage of the filtering process in which the Unknown products are allocated across the known product categories.

4.24. For the Low Case, the Unknown products are allocated across all product categories, including NGA products, resulting in approximately 375,000 Unknown product faults allocated to the three relevant product categories (MPR, WLR Only, WLR+SMPF). Unknown product faults are allocated to known product categories based on the proportion of faults in the product category as a proportion of total faults.

4.25. For the High Case, all the Unknown products are allocated across the three relevant product categories (MPR, WLR Only, WLR+SMPF) only, resulting in approximately 400,000 Unknown product faults allocated to those categories. Unknown product faults are again allocated to these product categories based on the proportion of faults in the product category as a proportion of total faults.

4.26. Applying the Low Case filtering, fault rates across product categories increase by 0.5% - 0.7% points for years 2011/12 and 2012/13 years, and 0.6% points on an aggregate level. This change amounts to 5.5% - 6.4% increase in fault rates relative to fault rates excluding all Unknown products. These changes are detailed in the chart below.

***Figure 13: Unknown Product Faults Allocation, Low Case (Annual Overall Fault Rates)***

| Products | Fault Rates, Excl. Unknowns | | Fault Rates, Low Case | | Rates, Absolute % Increase | | Rates, % Increase | |
|---|---|---|---|---|---|---|---|---|
| **Overall** | **2011/12** | **2012/13** | **2011/12** | **2012/13** | **2011/12** | **2012/13** | **2011/12** | **2012/13** |
| MPF | 10.7% | 11.5% | 11.3% | 12.2% | 0.6% | 0.6% | 5.8% | 5.5% |
| WLR ONLY | 9.0% | 9.6% | 9.5% | 10.1% | 0.5% | 0.5% | 6.1% | 5.7% |
| WLR+SMPF | 11.5% | 12.1% | 12.3% | 12.9% | 0.7% | 0.7% | 6.4% | 6.0% |
| **Overall** | **10.5%** | **11.2%** | **11.2%** | **11.8%** | **0.6%** | **0.6%** | **6.2%** | **5.8%** |

4.27. Applying the High Case filtering, fault rates across product categories increase by 0.6% - 0.7% points for years 2011/12 and 2012/13 years, and 0.7% points on an aggregate level. This change amounts to 5.9% - 6.7% increase in fault rates relative to fault rates excluding all Unknown products. These changes are detailed in the chart below.

***Figure 14: Unknown Product Faults Allocation, High Case (Annual Overall Fault Rates)***

| Products | Fault Rates, Excl. Unknowns | | Fault Rates, High Case | | Rates, Absolute % Increase | | Rates, % Increase | |
|---|---|---|---|---|---|---|---|---|
| **Overall** | **2011/12** | **2012/13** | **2011/12** | **2012/13** | **2011/12** | **2012/13** | **2011/12** | **2012/13** |
| MPF | 10.7% | 11.5% | 11.4% | 12.2% | 0.7% | 0.7% | 6.2% | 5.9% |
| WLR ONLY | 9.0% | 9.6% | 9.6% | 10.2% | 0.6% | 0.6% | 6.7% | 6.4% |
| WLR+SMPF | 11.5% | 12.1% | 12.3% | 12.9% | 0.7% | 0.7% | 6.4% | 6.2% |
| **Overall** | **10.5%** | **11.2%** | **11.2%** | **11.9%** | **0.7%** | **0.7%** | **6.4%** | **6.2%** |

4.28. Both the Low and High Case impact assessments for Unknown products are based on the assumption that faults with Unknown products occur at the same proportion as faults for which the products are known. Because of this, if faults with Unknown products are more likely to occur for specific product types (e.g., MPF) then this analysis will understate (or overstate) the potential impact of these Unknown product faults.

4.29. Due to the limited information available surrounding the faults with Unknown products, Cartesian's other analyses were conducted by excluding all faults with Unknown products.

*Conclusions*

4.30. The majority of the impact of the updated filtering criteria on fault rates is due to the volume of faults now included with 152 and 172 clear codes. The result of revising the filtering criteria on the annual fault rates detailed in the December 2013 Report is a distinctly higher fault rate for WLR+SMPF products than MPF products for both of the full years contained in the data. These rates are detailed below.

***Figure 15: Annual Fault Rates with Updated Filtering Criteria***

| Products | Fault Rates, Updated Filter | | |
|---|---|---|---|
| **Overall** | **2011/12** | **2012/13** | **1H2013/14** |
| MPF | 10.7% | 11.5% | 4.6% |
| WLR ONLY | 9.0% | 9.6% | 4.0% |
| WLR+SMPF | 11.5% | 12.1% | 4.9% |
| **Overall** | **10.5%** | **11.2%** | **4.6%** |

## Module 2

4.31. The objective of the second module was to analyse the new extended datasets from BT Openreach. Cartesian was asked to determine the fault rates for key products (MPF, WLR Only, WLR+SMPF), identify any differences with the December 2013 Report fault rate conclusions, and evaluate whether the extended dataset provided a better view of long-term trend in fault rates.

4.32. Prior to conducting the analysis, Cartesian compared the latest faults database supplied by BT Openreach with the original data used to prepare the December 2013 Report to identify any discrepancies or differences across the two datasets.

*Original vs. Extended Dataset Comparison*

4.33. Using the updated filtering criteria, Cartesian compared the original fault data used for the December 2013 Report with the extended database of faults provided by BT Openreach. The two

databases were compared across the common time period used in the December 2013 Report (April 2011 – August 2013).

4.34. BT Openreach provided more recent and extended faults and WSS databases that included an additional 20 weeks of fault records and corresponding working system size data for analysis. Cartesian compared the extended data with the original data (used in the December 2013 report). The comparison of the two datasets against the updated filtering criteria is shown in the figure below.

***Figure 16: Original Data vs. Extended Data Comparison, Updated Filtering (Total Number of Faults)***

| | | Original Data | Extended Data |
|---|---|---|---|
| **Starting Database** | | **11,842,085** | **13,779,586** |
| **Excluded Records** | **BB Boost** | 717,542 | 808,983 |
| | **Exclude from WSS** | 324,173 | 386,533 |
| | **Excluded Clear Codes** | 3,851,952 | 4,450,641 |
| | **VOICE + NGA (GEA) Products** | 327,463 | 445,175 |
| | **MPF + NGA (GEA) Products** | 26,599 | 50,374 |
| | **Unknown Products** | 451,210 | 446,072 |
| | **Truncated Weeks** | 44,961 | 1,067,001 |
| **Total Faults in Analysis** | | **6,098,185** | **6,124,807** |

4.35. When the updated filtering criteria is applied to both the original December 2013 Report faults data and the extended dataset – including truncating the last 2 weeks of the December 2013 Report data and the 20 extended weeks in the latest dataset – the total relevant faults in the latest dataset includes an additional 25,000 fault records

4.36. At a product level, most of the differences in fault volumes are for WLR Only and WLR+SMPF products, with over 11,000 of the 25,000 additional faults occurring in 2013/2014 fiscal year. The product-level fault volumes across the original data and the extended data are shown in the table below.

***Figure 17: Fault Volume Comparisons by Product, Original data vs. Extended Data***

| Products | Fault Volume, Original Data | | | Fault Volume, Extended Data | | |
|---|---|---|---|---|---|---|
| **Overall** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** |
| MPF | 543,672 | 720,445 | 322,838 | 543,672 | 720,471 | 324,886 |
| WLR ONLY | 700,291 | 665,090 | 259,744 | 702,781 | 667,711 | 262,146 |
| WLR+SMPF | 1,239,036 | 1,200,209 | 446,860 | 1,242,294 | 1,207,110 | 453,736 |
| **Total** | **2,482,999** | **2,585,744** | **1,029,442** | **2,488,747** | **2,595,292** | **1,040,768** |

4.37. At a product level, there are minor differences in fault volumes for WLR Only and WLR+SMPF in all periods. Fault volumes are consistent only for FY 2011/12 and 2012/13 MPF faults, with differences of >2,000 faults observed for all other products and time period. The tables below

detail the changes in faults volume as well as the discrepancy as a percentage of the faults used in the December 2013 Report.

***Figure 18: Fault Volume Impact by Product, Original vs. Extended Data***

| Products | Fault Volume Increase | | | % Increase in Fault Volume | | |
|---|---|---|---|---|---|---|
| **Overall** | **2011/12** | **2012/13** | **1H2013/14** | **2011/12** | **2012/13** | **1H2013/14** |
| MPF | - | 26 | 2,048 | 0.0% | 0.0% | 0.6% |
| WLR ONLY | 2,490 | 2,621 | 2,402 | 0.4% | 0.4% | 0.9% |
| WLR+SMPF | 3,258 | 6,901 | 6,876 | 0.3% | 0.6% | 1.5% |
| **Overall** | **5,748** | **9,548** | **11,326** | **0.2%** | **0.4%** | **1.1%** |

***Figure 19: Increase in fault volumes between extended and original datasets for the period which they overlap***

| | Increase in ELF volume compared to Original | | | Increase in ILF volume compared to Original | | | Increase in overall fault volume compared to Original | | |
|---|---|---|---|---|---|---|---|---|---|
| **Line Type** | **2011/12** | **2012/13** | **1H 2013/14** | **2011/12** | **2012/13** | **1H 2013/14** | **2011/12** | **2012/13** | **1H 2013/14** |
| **MPF** | 0.0% | 0.0% | 1.9% | 0.0% | 0.0% | 0.3% | 0.0% | 0.0% | 0.6% |
| **WLR Only** | 0.7% | 1.5% | 0.4% | 0.3% | 0.3% | 1.0% | 0.4% | 0.4% | 0.9% |
| **WLR + SMPF** | 0.6% | 0.4% | 1.0% | 0.2% | 0.6% | 1.6% | 0.3% | 0.6% | 1.5% |

***Figure 20: Increase in provisions and working system size between extended and original datasets for the period which they overlap***

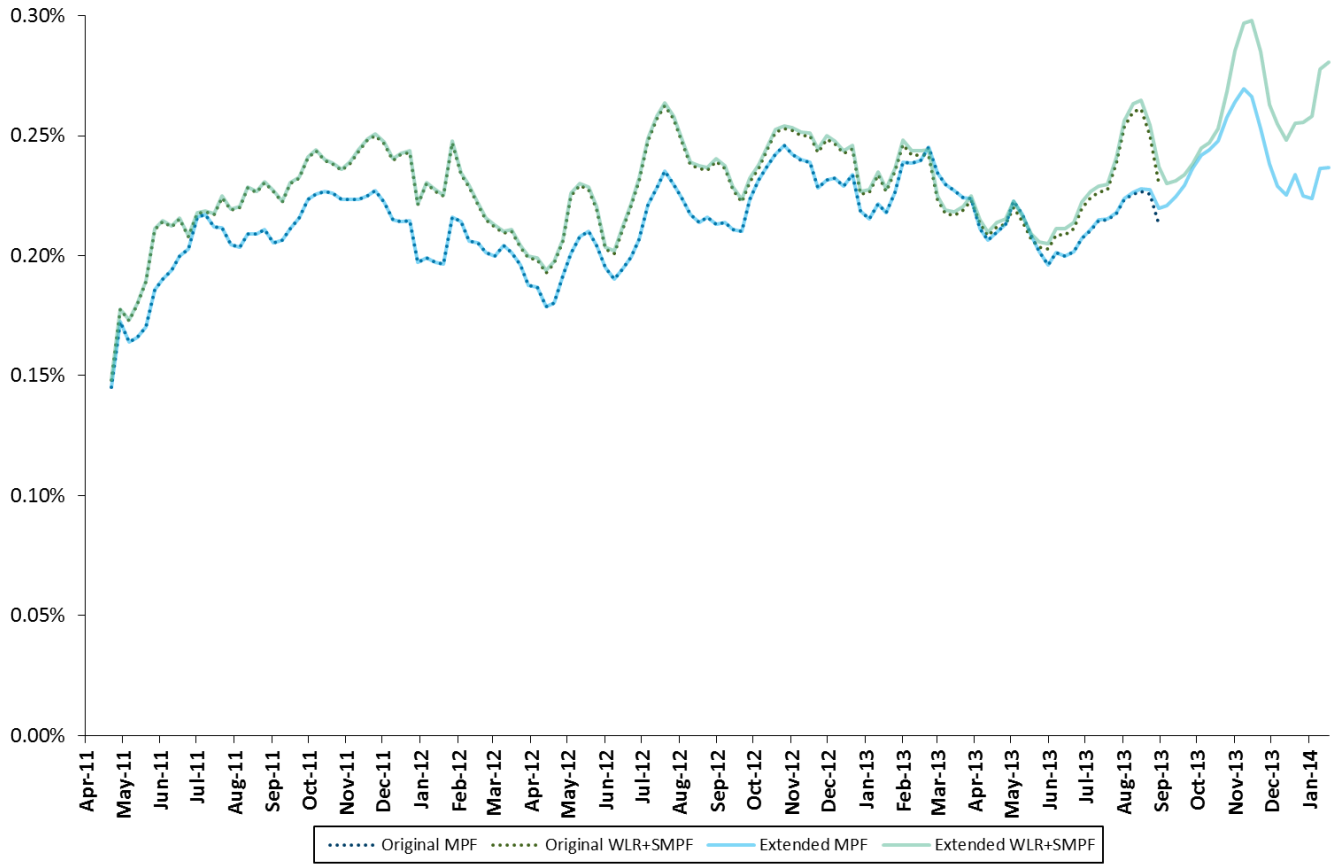
| | Increase in EL provisions compared to Original | | | Increase in IL WSS compared to Original | | | Increase in overall WSS compared to Original | | |
|---|---|---|---|---|---|---|---|---|---|
| **Line Type** | **2011/12** | **2012/13** | **1H 2013/14** | **2011/12** | **2012/13** | **1H 2013/14** | **2011/12** | **2012/13** | **1H 2013/14** |
| **MPF** | 0.0% | 0.0% | 1.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **WLR Only** | 0.6% | 0.6% | 0.3% | 0.0% | 0.0% | -0.1% | 0.0% | 0.0% | -0.1% |
| **WLR + SMPF** | 0.0% | 0.0% | 0.6% | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% |

4.38. On an annual basis, there are minimal differences between the WSS of the extended and original datasets. The most significant difference is 1.0% observed for MPF provisioning activity in the period 1H2013/14. For WLR Only and WLR+SMPF, the annual difference does not exceed 0.6%.

4.39. To evaluate the impact of the differences in fault volumes and WSS on the overall fault rates for key products (WLR+SMPF and MPF) over time, we charted the weekly fault rates using the original (December 2013 Report) data and the extended data provided. The dashed lines represent the

original data fault rates, while the solid lines indicate the extended data fault rates in the figure below. Rates below indicate the 4-week rolling average of the share of lines that experienced a fault for the relevant product.

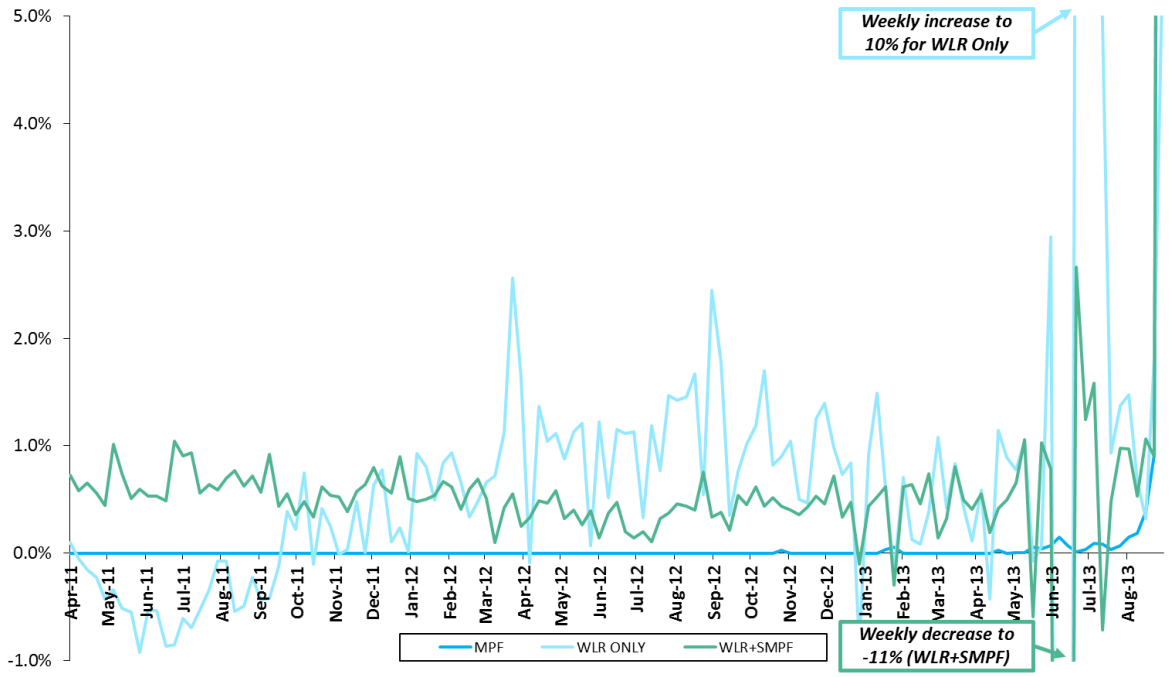
***Figure 21: Original Data vs. Extended Data Weekly Fault Rates, WLR+SMPF and MPF Products***




4.40. The chart above shows only minor differences in actual fault rates within each product category, as the difference in annual faults was significantly less than 1% for all products and fiscal years.

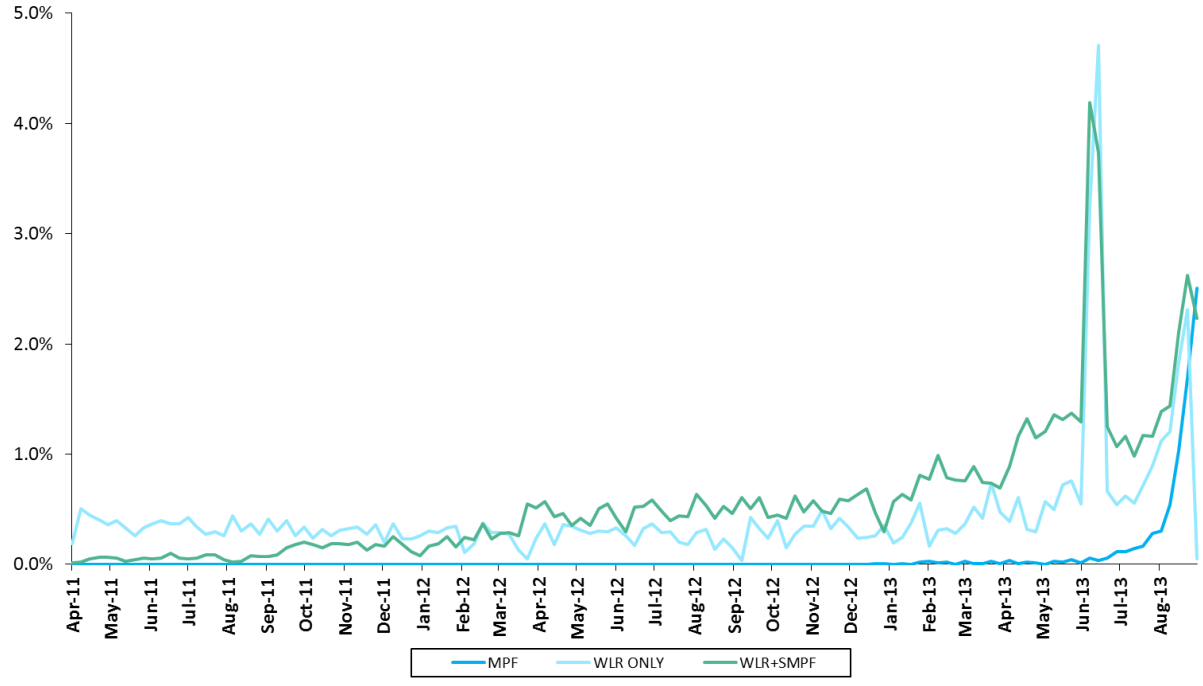
4.41. The following three charts investigate the differences in fault rates across the original and extended datasets in greater detail. Figure 22, shows the percentage difference in weekly ELF rates for each of the three products. The variation for the two WLR product categories is generally between -1% and 3%, however there are a few weeks towards the end of the period which exhibit a greater difference (c. 10%). There is little to no variation in ELF rate for MPF products except for the final few weeks.

***Figure 22: Original vs. Extended Data Weekly ELF Rates, WLR Only, WLR+SMPF and MPF Products***



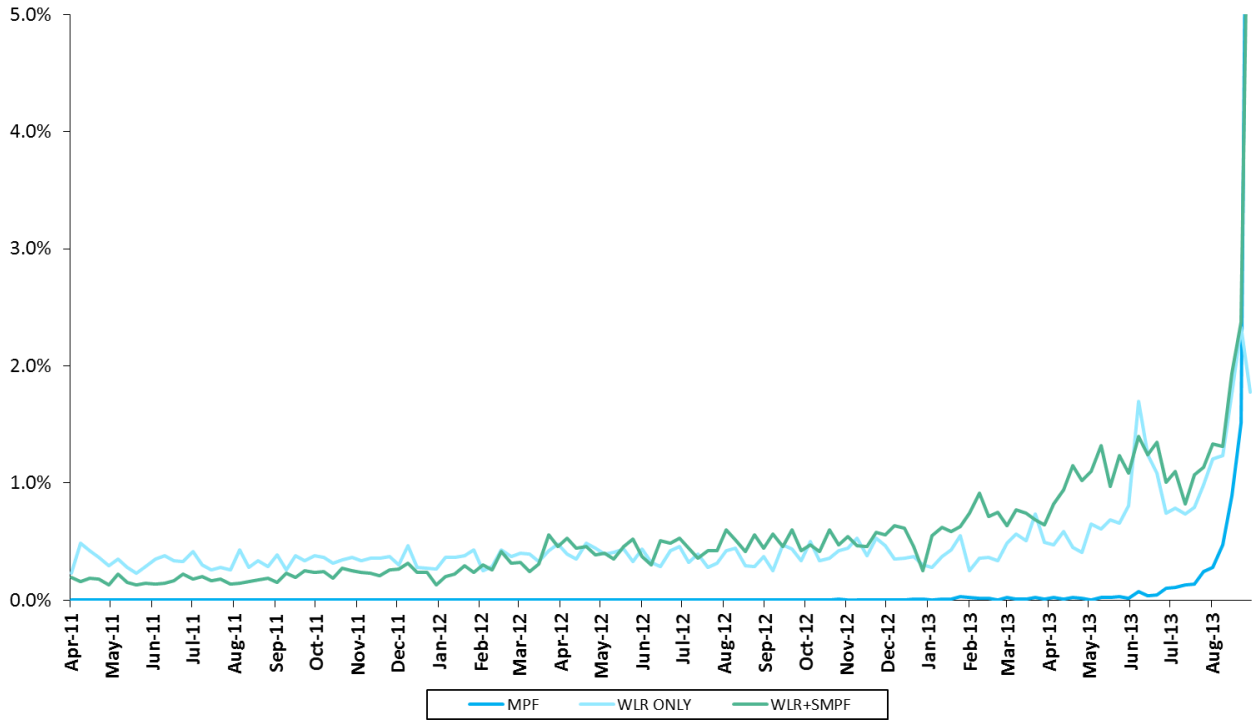

4.42. The next chart examines the difference in weekly ILF rates for the three products. We observe small increase in the updated ILF rates, with most weeks showing an increase of less than 1%. As compared with ELF rates above, difference in ILF rates is less volatile. Again, we observe greater differences at the end of the date range which is also the only period where there is a material difference in the ILF rates for MPF.

***Figure 23: Original vs. Extended Data Weekly ILF Rates, WLR Only, WLR+SMPF and MPF Products***



4.43. The third chart in this series compares the overall rates for the three products. Due to the greater volume of IL faults, the ILF rate is the dominant factor. We also observe some cancelling-out of the volatility towards the end of the period, although the difference is still greatest in the later weeks.

***Figure 24: Original vs. Extended Data Weekly Overall Rates, WLR Only, WLR+SMPF and MPF Products***




4.44. As the aggregate volume discrepancy across the two datasets was just over 25,000 faults, equating to less than 0.5% of the total faults across the time period, Cartesian proceeded with the additional fault rate analyses using the updated filtering criteria and the extended data.

## *Extended Data Fault Rate Analysis*

4.45. Using the extended fault and WSS databases as well as updated filtering criteria, Cartesian analysed the fault rates for each key product across the full date range available in the most recent dataset, April 2011 – January 2014.

4.46. The first stage of the analysis was to calculate fault rates by asset category (MPF, WLR, WLR+SMPF) for 2011/12, 2012/13, and 2013/2014 (42 weeks of data only).

### Overall Fault Rates

4.47. The overall fault rates are calculated as the total faults of an asset category over a given time period (week or year) divided by the average working system size for that asset category over the same period. For example, the equation for the annual rate for MPF lines is as follows:

$$Annual\ MPF\ Fault\ Rate = \frac{Annual\ MPF\ Faults}{Average\ MPF\ WSS\ over\ the\ year}$$

4.48. For the two complete years of the data, WLR+SMPF rates differ by 0.9% in 2011/12 and 1.2% in 2012/13. MPF rates are 0.3% higher in both years. Annual overall fault rates are shown in the table below, comparing the updated filtering versus the modified (excluding clear codes 152 & 172) filtering.

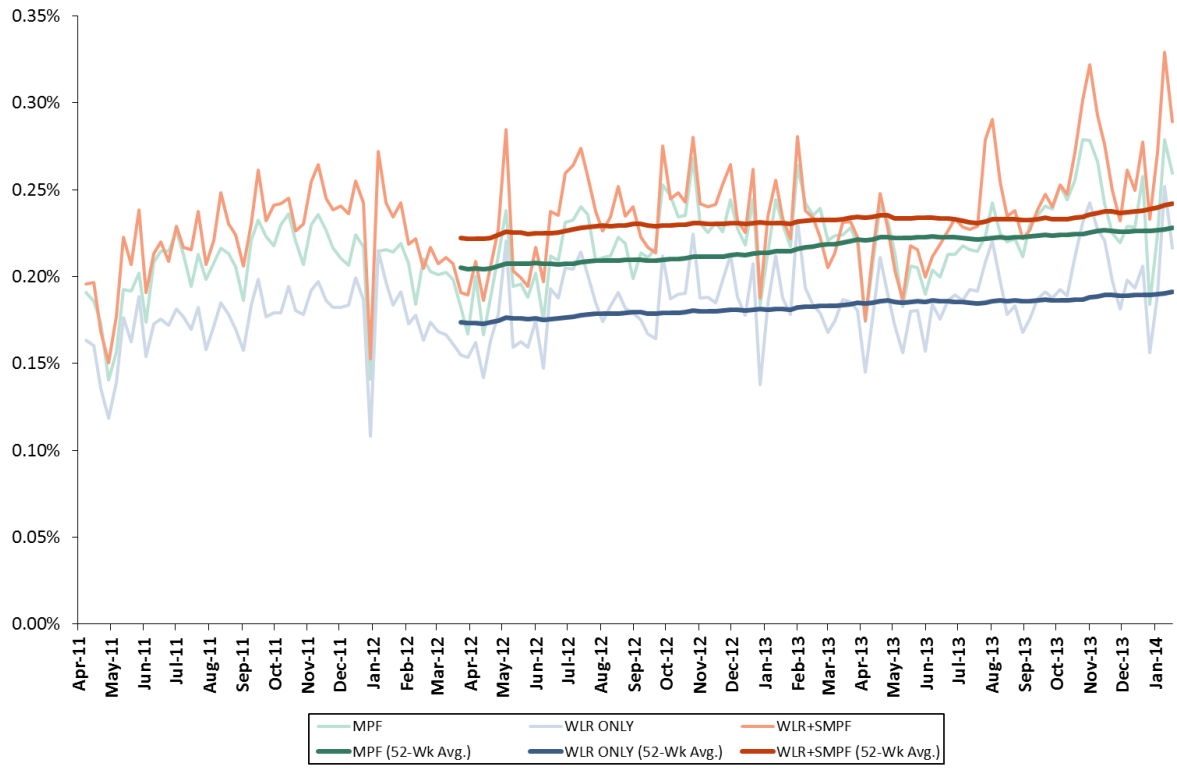
***Figure 25: Annual Overall Fault Rates by Product (Extended Data)***

| | Overall Fault Rates, Modified Filtering (Annual Faults per Avg. Annual WSS) | | | Overall Fault Rates, Updated Filtering (Annual Faults per Avg. Annual WSS) | | |
|---|---|---|---|---|---|---|
| **Line Type** | **2011/12** | **2012/13** | **2013/14** | **2011/12** | **2012/13** | **2013/14** |
| **MPF** | **10.4%** | **11.2%** | **9.2%** | **10.7%** | **11.5%** | **9.6%** |
| **WLR Only** | **8.2%** | **8.5%** | **6.9%** | **9.0%** | **9.6%** | **8.1%** |
| **WLR + SMPF** | **10.6%** | **11.0%** | **9.0%** | **11.6%** | **12.2%** | **10.3%** |

4.49. Note that the above rates for 2013/2014 cover only 42 weeks of data, and are consequently lower than full 52 week rates would be.

4.50. Comparing the fault rates by product on a weekly basis under the updated filter criteria reveals that the rate for WLR+SMPF is higher than MPF in most weeks, as shown in the chart below. Rates below indicate the share of lines that experienced a fault for the relevant product in a given week.

***Figure 26: Weekly Overall Fault Rates by Product (Weekly & 52-Week Avg.), Updated Filtering Criteria***



4.51. Examining the 52-week average overall fault rates for MPF and WLR+SMPF products (0.23% and 0.21%, respectively), the average weekly WLR+SMPF rate is higher than the MPF rate by 0.01% resulting in an average annual rate increase of 0.8%.

4.52. Cartesian's December 2013 Report found no clear distinction between WLR+SMPF and MPF rates, as an average view of the weekly rates indicated a higher MPF rate in some weeks, and a higher WLR+SMPF rate in others. This conclusion is consistent when using the modified filtering criteria (i.e., excluding 152 & 172 clear codes) with the extended datasets, shown in the chart below. Rates below indicate the share of lines that experienced a fault for the relevant product in a given week.

***Figure 27: Weekly Overall Fault Rates by Product (Weekly & 52-Week Avg.), Modified Filtering Criteria***


4.53. Overall fault rates for MPF and WLR+SMPF are much more similar when the modified filtering criteria are applied, which excludes clear codes 152 and 172, while the updated criteria result in a consistently higher WLR+SMPF rate.

## In-Life Fault Rates

4.54. The December 2013 Report also examined the Early-Life and In-Life faults for each product. We applied both the modified and updated filtering criteria to the extended dataset to compare the rates of both ELFs and ILFs

4.55. The ILF rate is calculated as the In-Life faults of an asset category over a specific time period divided by the average IL WSS of the MPF asset category over that same time period. For example, the equation for the annual rate for MPF lines is as follows:

$$Annual\ In\_Life\ MPF\ Fault\ Rate = \frac{Annual\ In\_Life\ MPF\ Faults}{Average\ In\_Life\ MPF\ WSS\ over\ the\ year}$$

4.56. Annual totals are shown in the following figure, with only partial data for 2013/14 (42 weeks).

***Figure 28: Annual ILF Rate by Product, Previous vs. Updated Filtering***

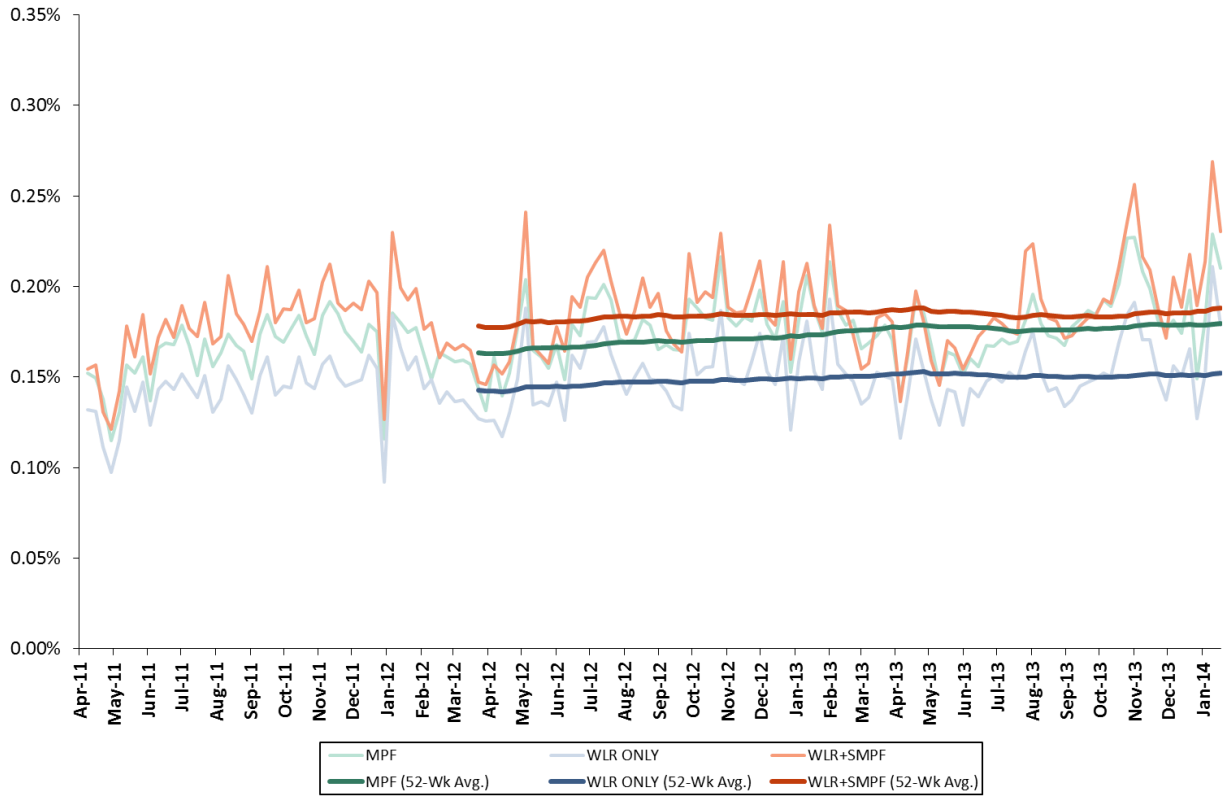
| | ILF Fault Rates, Modified Filtering (Annual ILF Faults per Avg. ILF WSS) | | | ILF Fault Rates, Updated Filtering (Annual ILF Faults per Avg. ILF WSS) | | |
|---|---|---|---|---|---|---|
| **Line Type** | **2011/12** | **2012/13** | **2013/14** | **2011/12** | **2012/13** | **2013/14** |
| **MPF** | **8.5%** | **9.3%** | **7.6%** | **8.8%** | **9.5%** | **7.9%** |
| **WLR Only** | **7.4%** | **7.9%** | **6.4%** | **8.2%** | **8.9%** | **7.5%** |
| **WLR + SMPF** | **9.3%** | **9.7%** | **7.9%** | **10.1%** | **10.8%** | **9.1%** |

4.57. Note that the above rates for 2013/2014 cover only 42 weeks of data, and are consequently lower than the full 52 week rates would be.

4.58. The difference in In-Life fault rates using the updated filter only increases ILF rates for MPF products by 0.2% – 0.3%, while WLR Only and WLR+SMPF rates increase 0.7% to 1.2% annually.

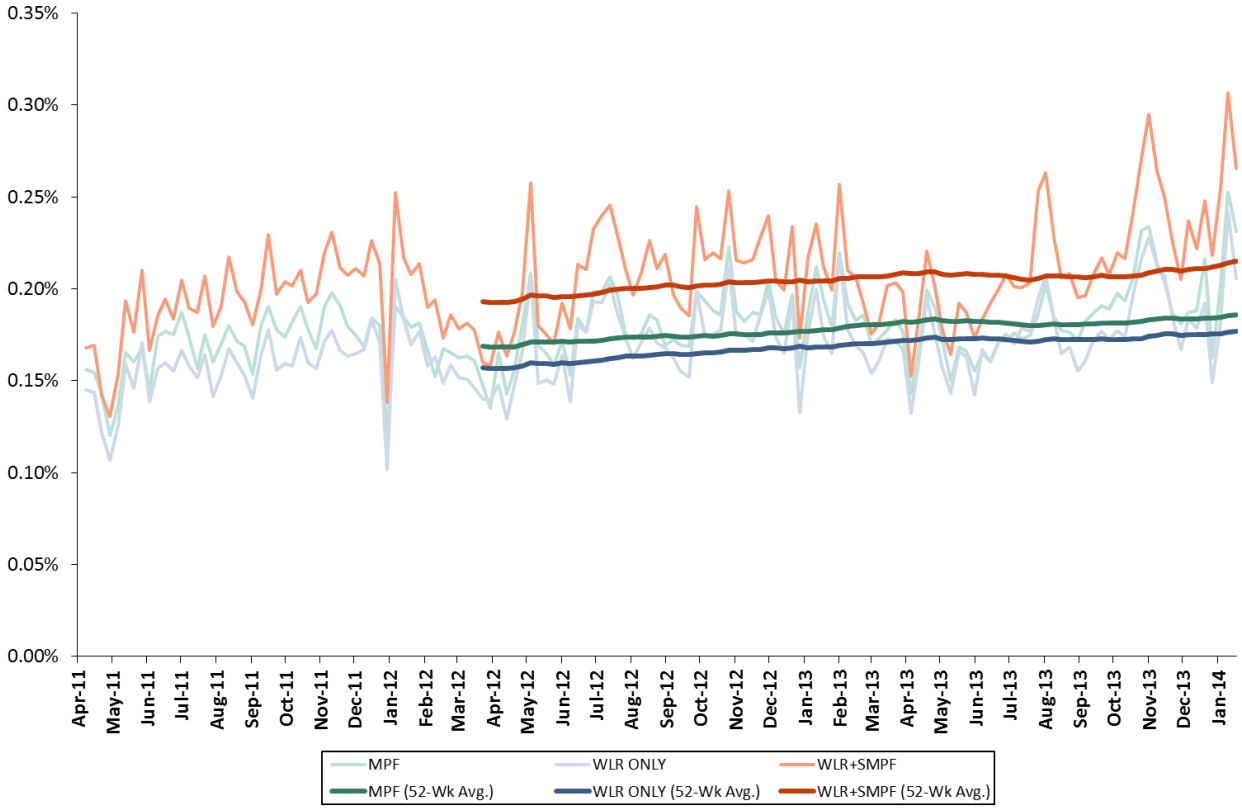
4.59. Weekly MPF ILF rates, using the modified filter are slightly below the weekly WLR+SMPF rates, as shows in the chart below. ILF rates for WLR Only are noticeably lower. Rates below indicate the share of lines that experienced a fault for the relevant product in a given week.

***Figure 29: Weekly ILF Rates by Product (Weekly & 52-Week Avg.), Modified Filtering Criteria***




4.60. Using the updated filtering criteria, the 52-week average ILF rates for MPF products are closer to those of the WLR Only product, as the magnitude of change for both WLR+SMPF and WLR Only is higher than MPF products. This is detailed in the figure below. Rates below indicate the share of lines that experienced a fault for the relevant product in a given week.

***Figure 30: Weekly ILF Rates by Product (Weekly & 52-Week Avg.), Updated Filtering Criteria***




## Early-Life Fault Rates

4.61. To understand the relationship between ELFs and provisioning activities, we calculate fault rates of early-life lines relative to the level of provisioning activities. The Early-Life activity fault rates estimate the volume of faults given a projected number of provisioning activities. The Openreach-provided data did not include total provisioning activities in each CSS week, but did provide figures for the total WSS of lines that were in "Early-Life status" during that week (indicating those lines had been provisioned in the previous 4 weeks).

4.62. Given the lack of more detailed provisioning data, provisioning activities in a given week are estimated to be ¼ of the EL WSS at the end of the week (shown below).

$$Weekly\ MPF\ Provisioning\ Activities = [Weekly\ Early\_Life\ MPF\ WSS]/4$$

4.63. The annual ELF rate is equal to the sum of the ELFs over the year, divided by the estimated total number of provisioning activities. Annual ELF rates using this calculation are shown in the table below. Using the estimation for weekly provisioning activities, the equation for the annual ELF rate for MPF lines is as follows:

$$Annual\ Early\_Life\ MPF\ Fault\ Rate = \frac{Annual\ Early\_Life\ MPF\ Faults}{\text{SUM}[Weekly\ MPF\ Provisioning\ Activities]}$$

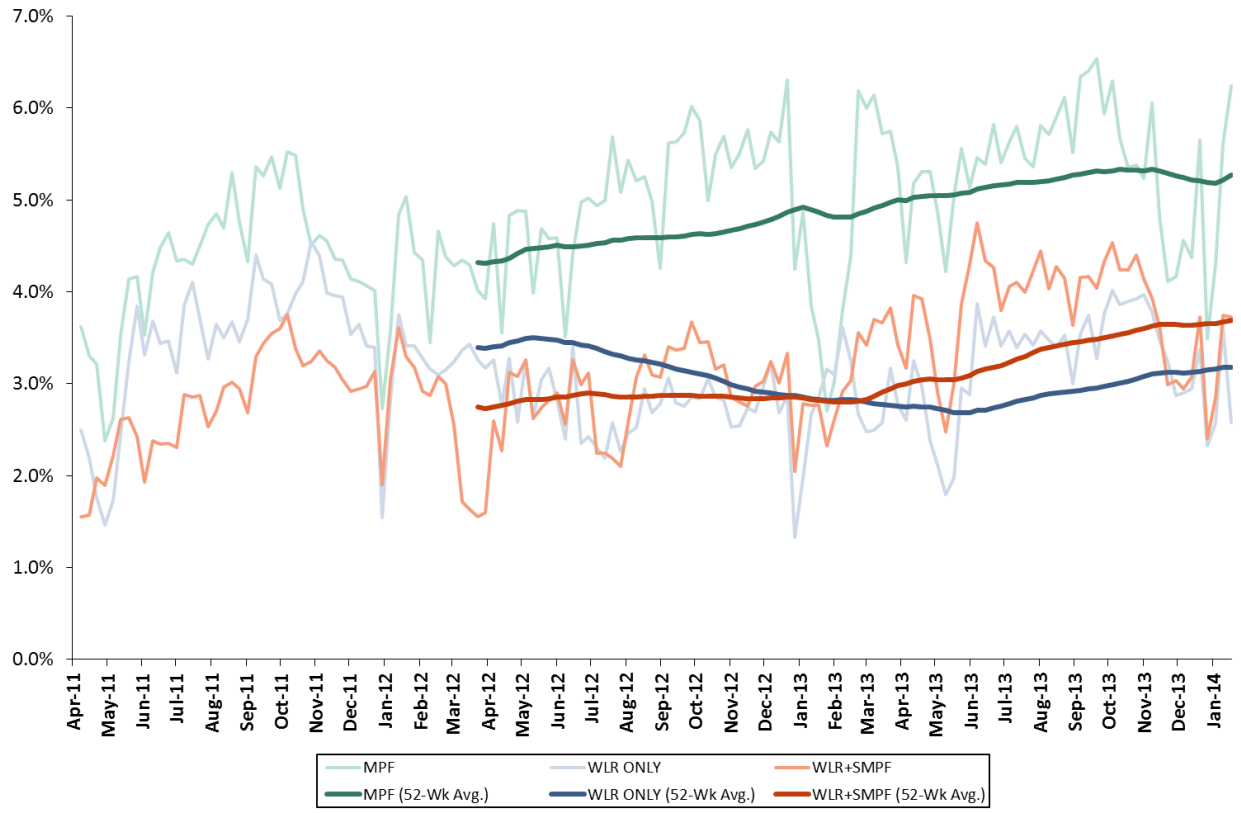
*Figure 31: Annual ELF Rate by Product, Modified vs. Updated Filtering*

| | ELF Fault Rates, Modified Filtering (Annual ELF Faults per Avg. Provisions) | | | ELF Fault Rates, Updated Filtering (Annual ELF Faults per Avg. Provisions) | | |
|---|---|---|---|---|---|---|
| Line Type | 2011/12 | 2012/13 | 2013/14 | 2011/12 | 2012/13 | 2013/14 |
| MPF | 4.2% | 4.9% | 5.3% | 4.4% | 5.0% | 5.5% |
| WLR Only | 3.2% | 2.7% | 3.1% | 3.5% | 3.0% | 3.5% |
| WLR + SMPF | 2.5% | 2.9% | 3.7% | 2.7% | 3.2% | 4.1% |

4.64. Note that the above rates for 2013/2014 cover only 42 weeks of data, and are likely different than the full 52 week rates would be.

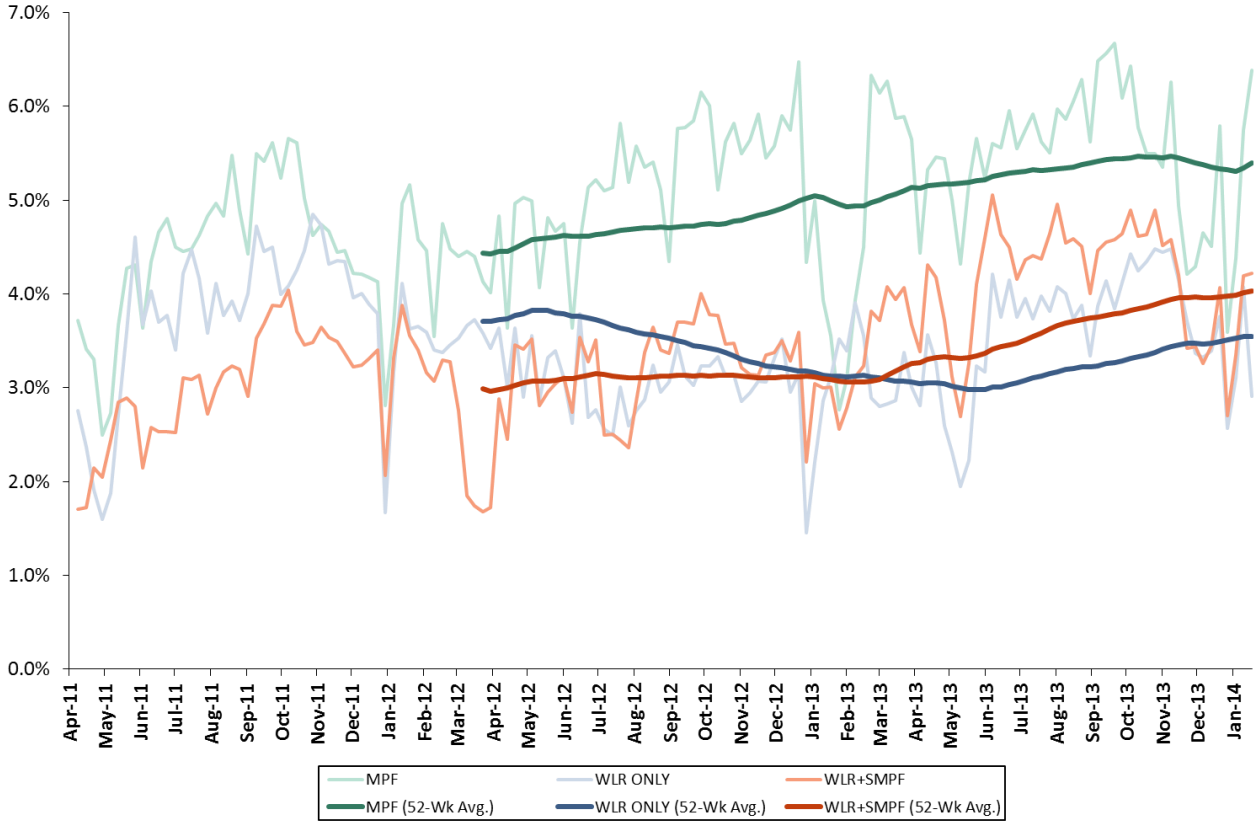
4.65. The weekly ELF rate is calculated as the weekly ELFs of the product over the weekly provisioning activities (shown in the equations above), and charted for all three asset categories in the following figure using the modified filtering criteria. Rates below indicate the number of faults as a proportion of all provisioning activities for the relevant product in a given week.

*Figure 32: Weekly ELF Rates by Provisioning Activity (Weekly & 52-Week Avg.), Modified Filtering Criteria*




4.66. Unlike In-Life fault rates, the Early-Life rates for MPF are significantly higher than WLR+SMPF. This observation was consistent across both the Updated and Modified filtering criteria, as seen in the chart below. Rates below indicate the number of faults as a proportion of all provisioning activities for the relevant product in a given week.

***Figure 33: Weekly ELF Rates by Provisioning Activity (Weekly & 52-Week Avg.), Updated Filtering Criteria***




4.67. While ELF rates for WLR+SMPF and WLR Only increase more significantly than MPF, both WLR-product types are still substantially lower than MPF rates.

4.68. ILF rates have a greater influence on the overall fault rate trends due to the much larger volume of ILFs versus ELFs. Because of this, even though MPF maintains a higher ELF rate than WLR+SMPF, the overall result is a higher WLR+SMPF rate compared to MPF.

## *Conclusions*

4.69. Across the two different sets of fault data, the original data one used in the December 2013 Report and the extended data used for the latest Cartesian analyses, there are small discrepancies in fault volumes. Most of these differences were observed in the data for 2013/2014 fiscal year.

4.70. The updated filtering criteria lead to different results versus those in the December 2013 Report. Using the updated filtering criteria, WLR+SMPF rates are consistently higher than MPF rates. In the December 2013 Report, no conclusive difference was observed.

4.71. Higher WLR+SMPF rates are attributed to the changes in faults filtering by clear code, with additional faults cleared with 152 and 172 codes impacting a disproportionate number of WLR Only and WLR+SMPF faults compared to MPF.

4.72. The impact of the 152 and 172 clear codes is most apparent in applying the 'modified' filter to the extended dataset. It is clear that applying the updated filter to the extended data results in higher WLR+SMPF rates than MPF, while applying the modified filter (excluding 152 and 172 clear codes) leads to similar WLR+SMPF and MPF rates.

4.73. The modified filtering criteria are similar to the filtering criteria used in Cartesian's December 2013 report, and the conclusions reached when applying the modified filter (i.e., that WLR+SMPF and MPF rates are not conclusively different across the available data) are in line with Cartesian's previous observations.

4.74. The extended dataset adds a further 20 weeks of data for analysis. Based on the 42 weeks of data now available for 2013/14, it appears likely that the fault rates for this year will be higher than those for 2012/13.

4.75. Should the fault rates in 2013/14 be higher than those of 2012/13, then the annual fault rates will have increased each year from 2011/12 to 2013/14. However, given the relatively short-run nature of the data available for analysis, it is not possible to say with any confidence that this trend will continue into 2014/15 and beyond.

# 5. MBORC Analysis

5.1. Cartesian was asked to investigate three aspects of faults relating to MBORC events:

- The proportion of total reported faults exceeding SLAs on an overall basis, as well as for High-Level and Local MBORCs;
- The distribution of High-Level MBORCs across GM areas and average duration of MBORC declarations; and
- The impact of excluding two GM regions with the highest volumes of High-Level MBORC faults exceeding SLAs on the rate of "within SLA" completion for each year.

5.2. Note that for the entirety of the MBORC analysis the available data only extends to the end of January 2014, so all figures referencing "2013/14" data are based solely on fault and MBORC data through this time period.

5.3. To enable analysis across the databases provided by BT Openreach for the MBORC assessment and the faults database, a different set of filtering criteria has been applied to the faults database for the MBORC assessment. The exclusions and filtering criteria applied to the overall faults database reflect discussions with Ofcom and BT Openreach concerning the data contained in the MBORC repairs file and is detailed in the figure below.

***Figure 34: Fault Data Filtering for MBORC Analysis (Total Number of Faults)***

| | | |
|---|---|---|
| **Starting Database** | | **13,779,586** |
| **Excluded Records** | **BB Boost** | 808,983 |
| | **Exclude from WSS** | 386,533 |
| | **SFI Flag** | 733,478 |
| | **Unmatched MDF Site** | 283,150 |
| | **No Cleared Date** | 734,710 |
| | **Unknown / Other Products** | 1,280,767 |
| **Total Faults in Analysis** | | **9,551,965** |

5.1. The different filtering criteria is necessary to establish a common denominator of total faults consistent with the Openreach-provided data for Local MBORC faults. The primary difference in the filtering is the lack of a clear code filter. The MBORC repairs database provided by Openreach did not include clear codes and therefore the MBORC data could not be filtered on this basis.

5.2. Faults with no cleared date could not be included in the analysis, as it could not be determined whether these faults were completed within the SLA or not. Faults that did not contain a recognised MDF Site ID (Exchange location) were also excluded, as they could not be attributed to a SOM or GM area for the High-Level MBORC flag.

## Exceeded SLA Product & GM Comparisons

5.3. The first stage of the MBORC analysis was to compare the proportion of faults repaired within SLAs with the total volume of faults over the period. Following this, we determined the volume of faults exceeding SLAs due to Local and High-Level MBORCs.

5.4. BT Openreach provided a set of data containing records of fault repairs exceeding SLAs that were attributed to either Local (flagged as “Auto”) or High-Level (flagged as “Manual”) MBORC faults. This data only included one full financial year, 2012/2013, and did not segment products by MPF, WLR Only, and WLR+SMPF.

5.5. Cartesian used the Openreach-provided MBORC fault records as the reference for the Local MBORC analyses. These fault records provided volumes of Local MBORC faults exceeding the SLA.

5.6. For the High-Level MBORC analysis, it was necessary to construct a view of High-Level MBORCs within and exceeding SLA. The Openreach database did not include records of faults cleared within the SLA. To overcome this limitation, Cartesian matched fault records in the larger fault database (used for fault rate analyses) with SOM and GM areas by matching the MDF Site IDs using the master list provided by BT Openreach.

5.7. Once the faults in the database had been assigned SOM and GM areas, Cartesian was able to flag faults occurring during the time period of a High-Level MBORC declaration (detailed in the High-Level MBORC Declarations data provided by Openreach) in the relevant SOM areas. These faults were classified as “High-Level MBORC faults.”

5.8. By flagging the faults contained in the larger database as High-Level MBORCs according to the area and time period in which the faults were reported, we were able to build our own set of data for High-Level MBORC faults extending from April 2011 – January 2014, rather than use the more limited MBORC-specific fault data only containing records from April 2012 – January 2014.

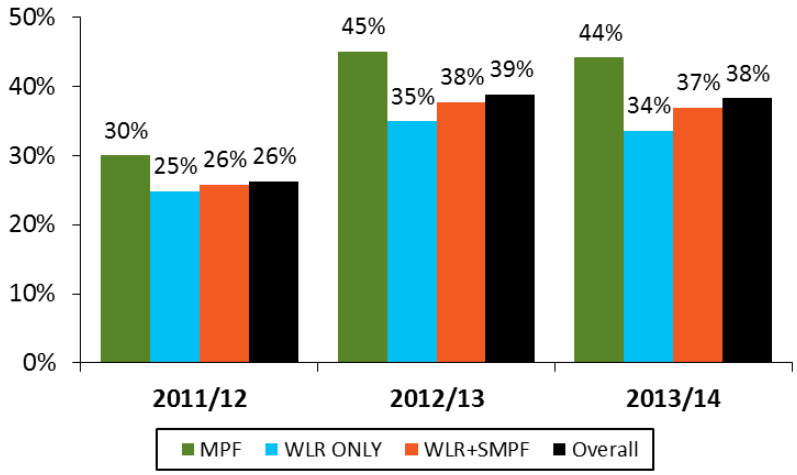
5.9. However, Local MBORC faults cannot reliably be flagged in the overall faults database by the same process, so we are restricted to analysing Local MBORC data for the period in the supplied MBORC fault data (April 2012 – January 2014).

5.10. Cartesian also determined whether a fault had been repaired within or outside of the relevant SLA based on the Care Level reported in the faults database. Care Levels 1 – 4 were assigned different criteria to determine the time period for repairs within the SLA, and used the elapsed time between the fault report date and fault cleared date to determine whether the SLA had been met or exceeded.

5.11. In determining fault repairs exceeding SLAs, Cartesian took into account service care level requirements and the weekday on which the faults occurred, but did not account for bank holidays as a simplifying assumption. The impact of holidays on the overall proportion of fault completed within SLA is minimal, and does not materially impact the overall results of the analysis.

5.12. Annual data, by fiscal year, is shown below for the percentage of fault repairs exceeding the SLA. Product-level outputs as well as the overall exceeding SLA percentages are included.

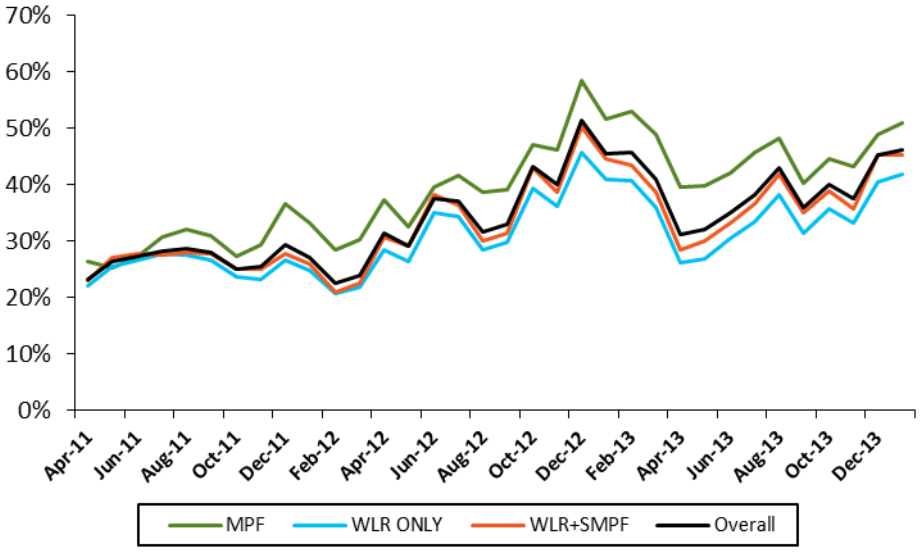
***Figure 35: Annual Fault Repairs Exceeding SLA as % of Total Faults, by Product***




5.13. Our analysis reveals that faults for MPF products are more likely to exceed the SLA, with WLR Only products accounting for the lowest percentage of recorded faults exceeding the SLA across all available fiscal year data.

5.14. On a weekly basis the relative positioning of products in terms of faults exceeding SLA is consistent with the annual data, as seen in the chart below.

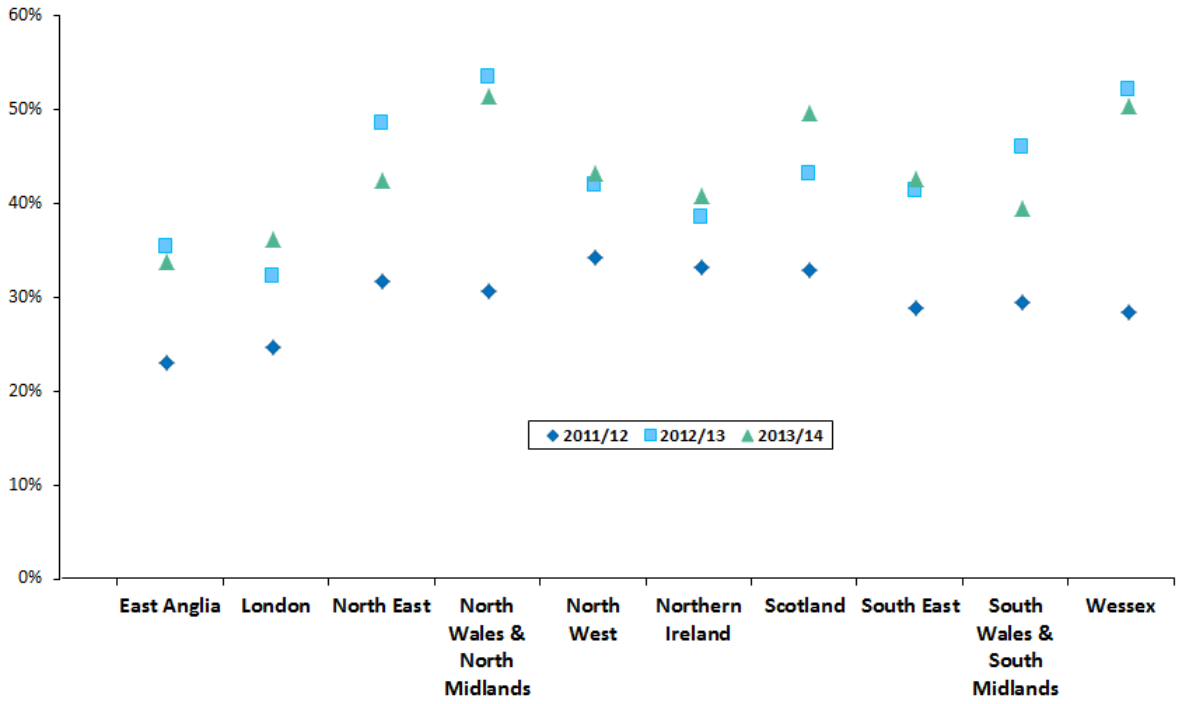
***Figure 36: Weekly Fault Repairs Exceeding SLA as % of Total Faults, by Product***



5.15. The data suggests that either the exceeded-SLA completion for FY 2011/12 was lower than average or that there has been a significant increase in fault repairs exceeding their SLA for 2012/13 and 2013/14.

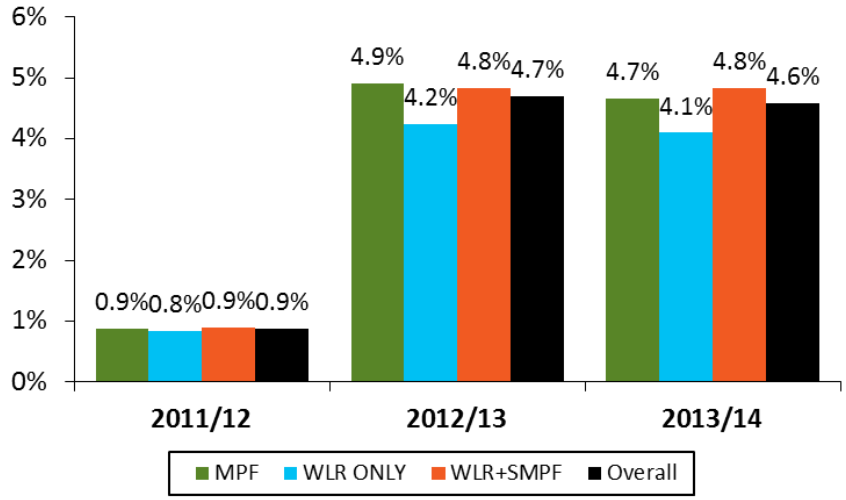
5.16. When examined at a GM level, 2011/12 is the lowest year for fault repairs exceeding SLA across all 10 GMs. For 2012/13 and 2013/14, some GMs had a higher percentage of faults exceeding SLAs in 2012, while for others 2013 was the more difficult year. The figure below details these differences.

***Figure 37: Annual Fault Repairs Exceeding SLA as % of Total Faults, by GM Area***




5.17. Cartesian further investigated how High-Level MBORC declarations impacted repair completion within SLAs. The figure below highlights High-Level MBORC repairs exceeding SLAs as a share of the total faults in the period.

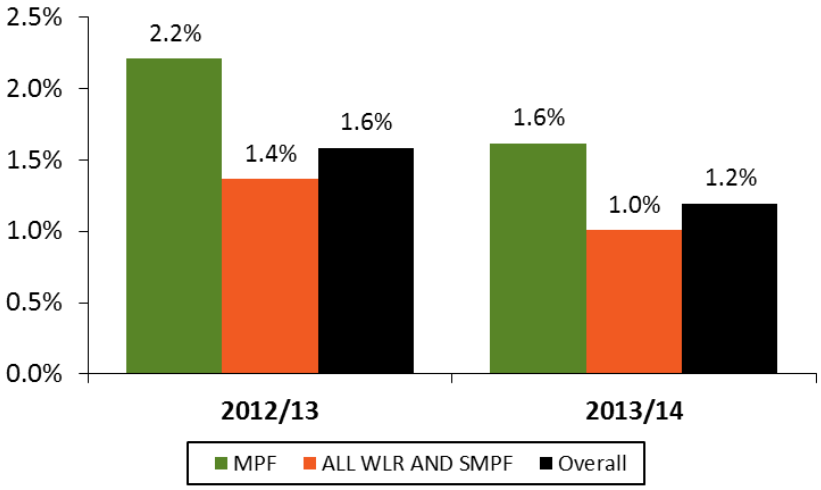
***Figure 38: Annual High-Level MBORC Fault Repairs Exceeding SLA as % of Total Faults, by Product***



5.18. Though 2011/12 contained comparatively fewer High-Level MBORC faults exceeding SLAs, 2012/13 and 2013/2014 are in line across all products, with between 4.1% and 4.9% of faults exceeding SLAs due to High-Level MBORC declarations

5.19. Local MBORCs were also examined independently, though data for 2011/12 was not available and the product categories are limited to MPF and all WLR and SMPF products (including both WLR Only and WLR+SMPF). Annual data shown in the chart below.

***Figure 39: Annual Local MBORC Fault Repairs Exceeding SLA as % of Total Faults, by Product***




5.20. A higher proportion of MPF faults were Local MBORC faults exceeding SLA than for WLR and SMPF, though for all products Local MBORCs result in fewer faults exceeding SLAs than High-Level MBORCs

## High-Level MBORC Distribution by GM Areas

5.21. High-Level MBORC declarations do not necessarily impact all GMs in a given year, though in 2012/13 and 2013/14 nearly all GMs (with the exception of Northern Ireland and London) experienced at least one High-Level MBORC. The table below highlights the volume of faults occurring within a High-Level MBORC declaration in each fiscal year, along with the volume of those faults exceeding SLAs.

***Figure 40: Volume of High-Level MBORC Faults by GM***

| GM Areas | MBORC Fault Volumes | | | MBORC Faults Exceeded SLA | | |
|---|---|---|---|---|---|---|
| | 2011/12 | 2012/13 | 2013/14 | 2011/12 | 2012/13 | 2013/14 |
| East Anglia | - | 12,075 | 22,935 | - | 5,989 | 12,448 |
| London | - | 5,403 | - | - | 1,921 | - |
| North East | 2,392 | 41,071 | 10,846 | 367 | 23,685 | 5,044 |
| North Wales & North Midlands | - | 81,471 | 18,721 | - | 44,103 | 11,558 |
| North West | 4,825 | 16,166 | 5,887 | 2,054 | 5,810 | 3,174 |
| Northern Ireland | - | - | - | - | - | - |
| Scotland | 47,552 | 28,819 | 39,851 | 22,966 | 13,932 | 22,474 |
| South East | - | 23,496 | 58,000 | - | 13,067 | 35,227 |
| South Wales & South Midlands | 7,372 | 36,539 | 12,619 | 1,416 | 19,166 | 6,955 |
| Wessex | 10,818 | 54,404 | 46,932 | 2,774 | 31,416 | 30,705 |
| **Total Volumes** | **72,959** | **299,444** | **215,791** | **29,577** | **159,089** | **127,585** |

5.22. The High-Level MBORC declaration database supplied by BT Openreach contained a list of 15 distinct MBORC declarations across the period of April 2011 through January 2014. The most recent MBORC did not impact or overlap with any of the fault records, resulting in 14 MBORCs available for comparison.

5.23. In the tables below, MBORC declarations are referred to as #1 - #14, referring to the distinct MBORC declarations in chronological order as they appeared in the data provided by Openreach. Each MBORC encompassed multiple SOMs and GMs and each SOM may have different dates for when the MBORC was declared and/or lifted.

5.24. Each MBORC declaration includes multiple SOM and GM areas, with different start and end dates for the declarations within each SOM area. Due to these differences, the duration of each the MBORC may vary across SOM areas within the same GM.

5.25. High-Level MBORCs impacted specific financial years, with MBORC declarations #1 and #2 occurring in fiscal year 2011/12, #3 - #6 occurring in 2012/2013, and the remaining MBORCs taking place in 2013/2014. The average duration of each MBORC[2] is shown below in average number of days from the start of the declaration to when the declaration was lifted.

[2] Average MBORC durations are calculated by averaging the duration of the declaration for each SOM impacted by the MBORC. E.g., if an MBORC impacted two SOMs, with durations of 10 days and 20 days in each, the average duration of that MBORC would be 15 days.

***Figure 41: Average Duration of High-Level MBORCs, by Fiscal Year***

| MBORC # | 2011/12 | 2012/13 | 2013/14 |
|---|---|---|---|
| MBORC #1 | 8.8 | | |
| MBORC #2 | 22.6 | | |
| MBORC #3 | | 6.0 | |
| MBORC #4 | | 23.3 | |
| MBORC #5 | | 29.0 | |
| MBORC #6 | | 27.3 | |
| MBORC #7 | | | 15.0 |
| MBORC #8 | | | 22.0 |
| MBORC #9 | | | 15.5 |
| MBORC #10 | | | 12.0 |
| MBORC #11 | | | 18.5 |
| MBORC #12 | | | 25.4 |
| MBORC #13 | | | 44.4 |
| MBORC #14 | | | 32.1 |
| **Annual MBORC Avg.** | **19.6** | **25.0** | **22.5** |

5.26. On an annual basis the average duration of an MBORC is between 20 and 25 days. The overall average across all MBORCs in all years is 23.3 days. For an individual MBORC, the average duration of the declaration can last anywhere from 6 to 44 days.

5.27. There are some instances in the Openreach-provided MBORC declaration data where the MBORC remained open at the time of the database extraction, primarily MBORC #15 (not shown) in February 2014. This does not overlap with either the fault or MBORC data, so this MBORC declaration is not included in the analysis.

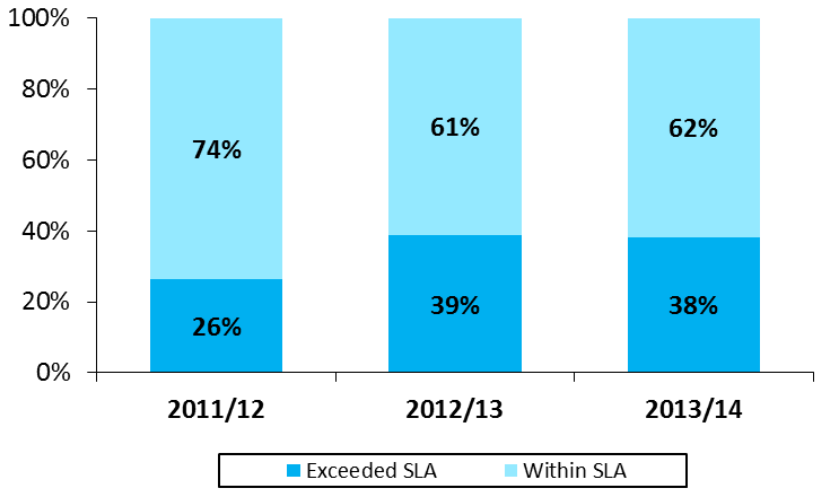
5.28. MBORC declarations did not overlap across the same SOM areas for any of the provided MBORC declaration data, though there was an instances where the beginning of MBORC declaration #13 overlapped with declaration #14 in the Wessex GM areas, though no SOM areas were impacted.

5.29. The overlap in Wessex spanned 30 days, with the latest declaration for MBORC #13 lifted on Feb. 6, 2014 and the earliest declaration for MBORC #14 starting Jan. 7, 2014. Other than this instance, all other MBORC declarations were instituted after the previous MBORC had been lifted in each GM area.

## GM Exclusion Assessment

5.30. The final aspect of the MBORC assessment centred on the potential impact of excluding the two GM areas with the highest volume of high-level MBORC faults exceeding SLA in a given year from calculations of the “within SLA” completion percentages. The overall “within SLA” completion percentages for all faults, including both High-Level and Local MBORCs, are shown below.

***Figure 42: Annual Within-SLA Completion***




5.31. Figure 40, above, lists the volume of High-Level MBORC faults exceeding SLA by GM, and the lists are shown again below with the GM areas for exclusion highlighted in red.

***Figure 43: GM Areas for Exclusion, 2012/13***

| GM Area | Total Faults | Total Faults Exceeded SLA | High-Level MBORCs Exceeded SLA |
|---|---|---|---|
| East Anglia | 394,913 | 142,087 | 5,989 |
| London | 346,189 | 116,879 | 1,921 |
| North East | 369,289 | 148,559 | 23,685 |
| North Wales & North Midlands | 390,838 | 178,239 | 44,103 |
| North West | 334,289 | 112,730 | 5,810 |
| Northern Ireland | 70,045 | 39,344 | - |
| Scotland | 265,139 | 94,000 | 13,932 |
| South East | 433,630 | 150,038 | 13,067 |
| South Wales & South Midlands | 383,832 | 151,800 | 19,166 |
| Wessex | 400,501 | 182,940 | 31,416 |
| **All GM Areas** | **3,388,665** | **1,316,616** | **159,089** |

For 2012/13, North Wales & North Midlands and Wessex had the highest volumes of High-Level MBORCs exceeding the SLA

***Figure 44: GM Areas for Exclusion, 2013/14***

| GM Area | Total Faults | Total Faults Exceeded SLA | High-Level MBORCs Exceeded SLA |
|---|---|---|---|
| East Anglia | 318,494 | 112,432 | 12,448 |
| London | 287,950 | 106,525 | - |
| North East | 297,843 | 104,406 | 5,044 |
| North Wales & North Midlands | 324,562 | 139,614 | 11,558 |
| North West | 277,579 | 97,426 | 3,174 |
| Northern Ireland | 54,452 | 31,210 | - |
| Scotland | 234,106 | 96,313 | 22,474 |
| South East | 344,751 | 125,574 | 35,227 |
| South Wales & South Midlands | 313,643 | 105,626 | 6,955 |
| Wessex | 328,215 | 146,287 | 30,705 |
| **All GM Areas** | **2,781,595** | **1,065,413** | **127,585** |

In 2013/14, South East and Wessex had the highest volumes of High-Level MBORCs exceeding SLAs

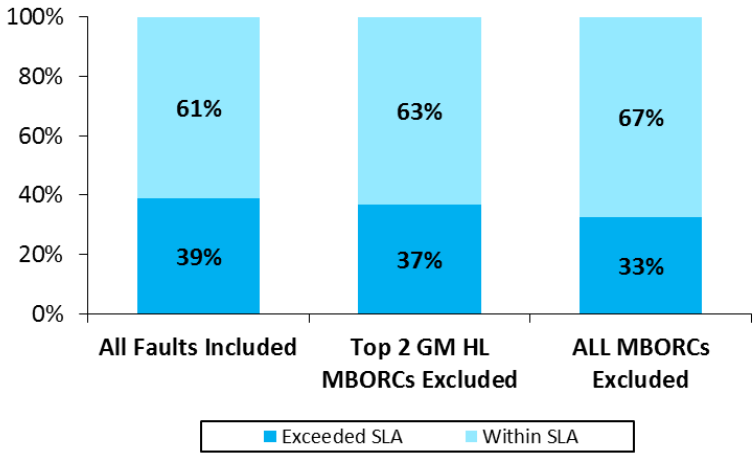
5.32. In 2012/13, North Wales & North Midlands accounted for the highest volume of High-Level MBORC faults exceeding the SLA. In 2013/14 the South East had the highest volumes. In both years, Wessex accounted for the second-highest GM by MBORC faults exceeding SLA.

5.33. For the impact assessment, faults occurring in the top two GM areas that exceed the SLA during a High-Level MBORC are only excluded from the total volume of faults exceeding SLA, and not from the total volume of faults over the period (e.g., in the "exceeded SLA" calculation, they are removed from the numerator but the denominator is constant). In effect, these faults are counted as faults repaired within the SLA.

5.34. Cartesian also calculated the impact on the "within SLA" completion percentages of excluding all MBORC faults, both High-Level and Local. In this scenario, all faults exceeding SLAs and attributed to either a High-Level or Local MBORC are counted as "within SLA" completions. This scenario illustrates the maximum impact of excusing any repair exceeding the SLA that is attributed to any type of MBORC event in any GM area.

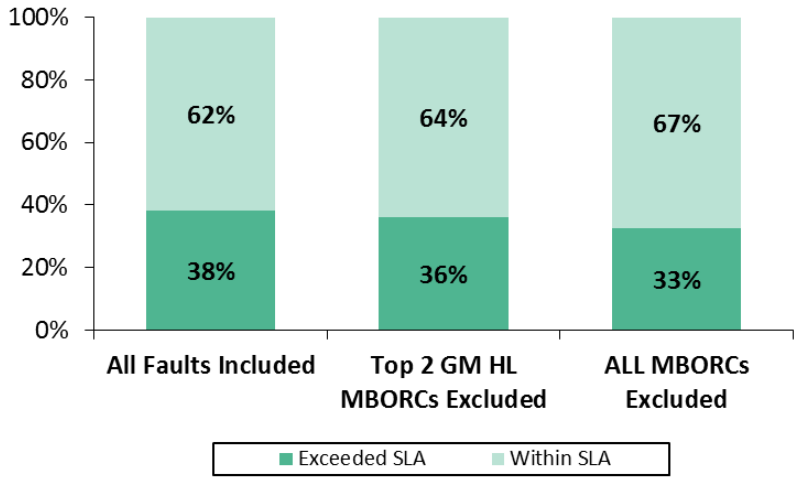
5.35. The two scenarios – High-Level MBORCs faults from the top two GM areas; all MBORC faults in all GM areas – are shown below compared against the within-SLA completion rates if all faults exceeding SLA are included. For clarity the fiscal year 2012/13 and 2013/14 are shown in separate figures.

***Figure 45: 2012/2013 Within-SLA Completion Comparison with Exclusion Scenarios***




5.36. In 2012/13, excluding the top two GMs with HL MBORCs exceeding SLAs improves the within-SLA completion percentage 2.2% points, from 61% to 63%. Excluding all MBORCs exceeding SLAs improves the completion percentage by 6.3% points, from 61% to 67%.

***Figure 46: 2013/2014 Within-SLA Completion Comparison with Exclusion Scenarios***




5.37. In 2013/14, excluding the top two GMs with HL MBORCs exceeding SLAs improves the within-SLA completion percentage 2.4% points, from 62% to 64%. Excluding all MBORCs exceeding SLAs improves the completion percentage by 5.8%, from 62% to 67% points.

5.38. Over the years of available data, excluding the top two GMs for HL MBORCs exceeding SLA improves the within-SLA completion percentage by slightly more that 2% points. Excluding all MBORCs exceeding SLA improves the within-SLA completion percentage by approximately 6% points.

5.39. Cartesian further investigated why the excluded GMs had higher MBORC faults exceeding SLAs by comparing the durations of MBORCs in the excluded GMs against the overall averages for that MBORC across all GM areas. The results are shown in the table below.

***Figure 47: Avg. MBORC Duration of Excluded GMs vs. Overall Avg. MBORC Duration***

| GM Area | MBORC | Avg. Duration | | All GMs |
|---|---|---|---|---|
| | | 2012 | 2013 | MBORC Avg. |
| North Wales & North Midlands | MBORC #4 | 31.8 | - | 23.3 |
| | MBORC #5 | 28.2 | - | 29.0 |
| | MBORC #6 | 23.7 | - | 27.3 |
| South East | MBORC #9 | - | 12.0 | 15.5 |
| | MBORC #11 | - | 20.0 | 18.5 |
| | MBORC #14 | - | 28.7 | 32.1 |
| Wessex | MBORC #4 | 15.3 | - | 23.3 |
| | MBORC #5 | 47.0 | - | 29.0 |
| | MBORC #6 | 36.6 | - | 27.3 |
| | MBORC #8 | - | 22.0 | 22.0 |
| | MBORC #9 | - | 26.0 | 15.5 |
| | MBORC #10 | - | 12.0 | 12.0 |
| | MBORC #11 | - | 16.0 | 18.5 |
| | MBORC #13 | - | 44.4 | 44.4 |
| | MBORC #14 | - | 58.0 | 32.1 |

5.40. In some instances, such as MBORC #5 & #6 in Wessex and MBORC #4 in North Wales, the duration average of the MBORC in those GM areas was over a week longer than the average for that MBORC.

5.41. However, in most instances the average duration of the MBORCs in the excluded GM areas were in line with, and sometimes lower than, the overall average MBORC duration.

## 6. Glossary of Terms

| Abbreviation | Definition |
|---|---|
| **BB Boost / BBB** | Broadband Boost |
| **CDTA / CDTnA** | Conscious Decision to Appoint / Conscious Decision to Not Appoint |
| **CP** | Communications Provider |
| **CSS Week / Year** | BT-defined Calendar; 52 or 53 weeks per year running April - March |
| **DP** | Distribution Point |
| **EL** | Early-Life |
| **ELF** | Early-Life Fault |
| **FNF** | Fault Not Found |
| **GM Area** | General Management areas (10 total in the UK) containing a number of SOMs |
| **High-Level MBORC** | MBORC Declaration for a specific SOM area due to extreme weather events |
| **IL** | In-Life |
| **ILF** | In-Life Fault |
| **LLU** | Local Loop Unbundling (product category for MPF / SMPF) |
| **Local MBORC** | Designation for MBORC faults occurring as a result of events impacting specific service lines but not impacting entire regions or areas |
| **MBORC** | Matters Beyond Our Responsible Control |
| **MDF** | Main Distribution Frame |
| **MPF** | Metallic Path Facility |
| **NGA** | Next Generation Access |
| **SFI** | Special Fault Investigation |
| **SMPF** | Shared Metallic Path Facility |
| **SOM Area** | |
| **WLR** | Wholesale Line Rental |
| **WLR+SMPF** | Combination of WLR and SMPF products on the same line |
| **WSS** | Working System Size |

Cartesian is a specialist consulting firm of industry experts, focused exclusively on the communications, technology and digital media sector. For over 20 years, Cartesian has advised clients in strategy development and assisted them in execution against their goals. Our unique portfolio of professional services and managed solutions are tailored to the specific challenges faced by executives in these fast-moving industries. Combining strategic thinking and practical experience, we deliver superior results.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