OPENREACH CHARGE CODE APPLICATION METHODOLOGY

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Purpose of paper	Decision
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Summary	On 30 July 2013, the SVG rejected Openreach's application for UMS Charge Codes for its fibre optic broadband cabinets. On 3 September 2014, Openreach submitted a new BSC application for different Charge Codes for the same cabinets based on a revised methodology. This paper proposes an approach to measure whether the new Charge Codes applied for will deliver sufficient predictability of consumption for Settlement.

1. Introduction

What is the purpose of a Charge Code?

1.1 An Unmetered Supplies (UMS) Charge Code is the mechanism by which the BSC arrangements estimate the consumption of unmetered-connected equipment for Settlement. In accordance with the Electricity (Unmetered Supply) Regulations 2001 (Statutory Instrument 2001/3263), it is each Distributor's UMS Operator's (UMSO's) decision whether to provide a UMS connection for equipment in its distribution area(s). If an UMSO gives equipment a UMS connection then there needs to be a Charge Code for Settlement.

1.2 To deliver accurate Settlement, each Charge Code needs to be a sufficiently accurate representation of the average consumption across all the equipment assigned to that Charge Code. This in turn requires the average consumption of that equipment population to be sufficiently predictable. Average consumption above the Charge Code level would result in under-recording, and average consumption below the Charge Code level would result in over-recording, of energy use.

UMS accuracy standards

1.3 BSC S8.1.3 states that the standards of accuracy for data for UMS should be no worse than those which apply generally for metered supplies. There are two aspects to this consideration in respect of the new application: the accuracy of the volume (setting the correct Charge Code value) and the accuracy of the volume allocation (where Half Hourly (HH) UMS will be more accurate than the Non Half Hourly (NHH) Profile Class 3 allocation under which current Openreach metered cabinets are settled).

1.4 The Statutory Instrument (SI) sets out criteria for a UMS connection, including that:

- the electrical load "is of a predictable nature"; and
- either:
    - the electrical load is less than 500W; or

- it is not practical to meter the equipment.[1]

1.5 The National Measurement Office (NMO) has published further guidance on the SI criteria, including on predictability. It considers predictable to mean "a load which can consistently be understood throughout its usage period", and gives a variation of ±3.5% as a guide to measuring this. It encourages adopting a pragmatic approach to small loads or to equipment which will, for the majority of time, require a constant load but may have small load variations from time to time that are insignificant in terms of overall annual consumption.

Openreach's application

1.6 In April 2013 Openreach, a BT Group business, applied for 14 UMS Charge Codes for new installations of its fibre optic broadband cabinets. Openreach has engaged with the Government to deliver super-fast broadband solutions across the country. A summary of its rollout plans can be found in UMSUG109/05A. Openreach derived the Charge Codes using consumption data from its existing metered population of cabinets, which were to remain metered.

1.7 At its April 2013 meeting, the Supplier Volume Allocation Group (SVG) agreed that any provision of UMS Charge Codes for Openreach's cabinets should be:

- based on meeting the criterion of small (<500W) and relatively predictable consumption;
- subject to the normal Charge Code application process (including ELEXON data sampling/verification);
- on the condition that, given the intended scale of the cabinet roll-out and to ensure Settlement accuracy, Distributors (in their role as UMSOs) should provide an Unmetered Supply Certificate that states that the Unmetered Supply is an Equivalent (HH) Unmetered Supply;
- on the understanding that Openreach's existing metered cabinets would remain metered; and
- on the basis that any new cabinet types/configurations that may arise in the future would be subject to new Charge Code applications.

1.8 ELEXON subsequently conducted data sampling which compared, with each Charge Code sought, a year of half-hourly consumption from 10 sample metered Openreach cabinets that (if future equivalent installations were unmetered) would fall within the population for that particular Charge Code.[2] At its July 2013 meeting, the SVG considered the sampling results and the views of its UMS User Group (UMSUG) members. The SVG rejected Openreach's application due to its concerns that the cabinets' consumption was insufficiently predictable and that the original Charge Codes sought therefore risked inaccurate Settlement. For more information, see confidential paper SVG150/01 (Attachment A) and the confidential minutes of SVG meeting 150 (Attachment B).[3]

1.9 On 3 September 2014, Openreach submitted a new application for 45 differently-defined Charge Codes for the same cabinets. The original application proposed one Charge Code per card per cabinet, such that a change in the number of cards in any given cabinet would need to be declared on the inventory with the cabinet reassigned to the appropriate Charge Code. The new application proposes one Charge Code per port band within the same card[4] and this Charge Code will represent the band for which a number of ports are

[1] The SI considers that this may be the case where (1) the anticipated metering costs in the particular case are significantly higher than the usual metering costs associated with that size of electrical load; (2) there are technical difficulties associated with providing such a meter in the particular case; or (3) the operation of law prohibits makes excessively difficult the provision of such a meter in the particular case.

[2] Although the metered cabinets are settled NHH, they use Automated Meter Reading (AMR) Meters which record half-hourly consumption.

[3] As this paper, and the resulting minutes, were confidential, these attachments are provided to SVG Members only.

[4] E.g. ports 1-16, ports 17-32 etc. Cabinets can contain up to six cards which can contain between 32 and 64 ports.

actually utilised. Similarly, therefore, any change in the number of ports used in a cabinet would need to result in an inventory update and a change to the assigned Charge Code.

1.10 One of the factors in the SVG's rejection of Openreach's earlier application was that the previous analysis demonstrated a variance in consumption between cabinets with the same number of cards. The SVG therefore lacked confidence that the proposed Charge Codes represented an accurate estimate of the average consumption of the cabinet population for each code. Openreach attributes this variance to the cabinets' consumption being sensitive to both the number of cards installed and the number of customers connected to the cabinet (i.e. the number of ports in use). It therefore intends its revised and more granular, port-based approach to address the SVG's previous concerns about predictability, by reducing the size and consumption variance of the cabinet population for each Charge Code.

What has happened in the interim?

1.11 Since the July 2013 SVG meeting, Openreach has approached UMSOs individually for UMS connection decisions under the SI. These discussions have taken place bilaterally outside the BSC. We understand that four Distributors/UMSOs, representing 11 of the 14 GSP Groups, have agreed or agreed in principle to provide Openreach with UMS connections for new installations of their cabinets based on:

- Openreach's revised, port-based Charge Codes methodology;
- different regional sets of UMS Charge Codes per UMSO, constructed using the single revised methodology but different metered cabinet data for each UMSO's specific distribution areas;
- the UMSOs' individual views that this revised methodology meets the criteria for a UMS set out in the SI, including that of predictability; and
- use of 'local' Miscellaneous Charge Codes, granted by each UMSO individually and for use solely within its own distribution areas.

1.12 We are aware that one of these UMSOs believes use of 'local', UMSO-approved Charge Codes to be an interim solution and supports a further application to the SVG. Of the other UMSOs, we understand that one believes that the SI criteria are not met, but has indicated it will provide a UMS connection should Openreach submit a successful application to the SVG. We are unaware of the remaining UMSO's views. SVG approval of Charge Codes does not in itself require UMSOs to provide a UMS connection.

1.13 We understand that Openreach intends its new application to standardise the above regional approach in a single set of national, SVG-approved Charge Codes. If the SVG was to approve the new Charge Codes under the BSC, this would not require the remaining UMSOs to grant UMS connections under the SI but it would provide standardised national codes for use should they wish to do so. Those UMSOs who have already granted UMS connections would not be required to switch from their existing 'local' codes to these national ones, but could choose to do so.

1.14 The UMSOs who have granted UMS connections receive monthly updated inventories detailing changes to Charge Codes, derived from the Openreach central system that details how many ports are utilised on each cabinet.

Purpose of this paper

1.15 This paper invites the SVG to agree ELEXON's proposed methodology to measure the predictability of consumption for each new Charge Code sought by Openreach, and therefore to identify whether they deliver sufficient Settlement accuracy.

1.16 Section 2 sets out the new application in more detail. Section 3 describes our proposed analysis methodology. Section 4 contains our intended progression steps and timescales.

2. New Openreach application

2.1 Openreach has engaged with two cabinet suppliers, Huawei and ECI, and it has been deploying three cabinet types with the respective number of cards and ports per card:

- Huawei MA5603T: 6 cards, 48 ports/card, 288 ports in total
- Huawei MA5616T: 4 cards, 32 ports/ card, 128 ports in total
- ECI M41: 4 cards, 64 ports/card, 256 ports in total

2.2 Openreach's new application (Attachment C) requests 45 Charge Codes for different 16-port bands (i.e. bands of 16 ports each) per card and per cabinet type, with an initial Charge Code to be used when the cabinet is initially operational but before any customers are connected.

2.3 Below is a breakdown, in summary, of the Charge Codes applied for:

Cabinet type	Initial position	Card 1	Card 2	Card 3	Card 4	Card 5	Card 6	Total no. of Charge Codes
MA5603T	1 Charge Code	3 Charge Codes for ports 1 - 48	3 Charge Codes for ports 49 - 96	3 Charge Codes for ports 97 - 144	3 Charge Codes for ports 145 - 192	3 Charge Codes for ports 193 - 240	3 Charge Codes for ports 241 - 288	19
MA5616T	1 Charge Code	2 Charge Codes for ports 1 - 32	2 Charge Codes for ports 33 - 64	2 Charge Codes for ports 65 - 96	2 Charge Codes for ports 97 - 128			9
M41	1 Charge Code	4 Charge Codes for ports 1 - 64	4 Charge Codes for ports 65 - 128	4 Charge Codes for ports 129 - 192	4 Charge Codes for ports 193 - 256			17

3. Proposed methodology for assessing the new application

Source data

3.1 Similarly to the first application, ELEXON will request snapshot sample half-hourly consumption data for metered cabinets mapped to each of the 45 Charge Codes. However, this time we propose to source the data from Openreach (who will obtain it from their NHH Data Collector) rather than approach the relevant Data Collector ourselves directly. As our analysis will use full-width data (rather than just 10 sample cabinets per Charge Code as last time), we believe it will be more efficient to source the data directly from Openreach in the desired cleansed format.

3.2 Openreach will provide the consumption data in average Watts for an agreed half-hour period on an agreed Settlement day (provisionally, we have agreed 20.00 on 1 August 2014).

3.3 This will be consumption data for a snapshot period covering all distribution regions across the country in a format as the example shown below.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	MPAN	MPAN_ID	INTERVAL_TIME	INTERVAL_VALUE	TN CODE	DSLAMID	ave watts /hour	Cab Type full	Installed Ports	Used Ports	Ports/card	Number of Line Cards	Utilisation band
2	1580000995813	15	23/10/2013 06:00	378890	TNAADBV	NAADBV	378.89	MA5603T	144	143	48	3	9
3	1580000995822	15	23/10/2013 06:00	183200	TNAACVR	NAACVR	183.2	MA5603T	48	47	48	1	3
4	1580000995831	15	23/10/2013 06:00	254810	TNAADOE	NAADOE	254.81	MA5603T	144	92	48	3	6
5	1580000995840	15	23/10/2013 06:00	159940	TNAADPA	NAADPA	159.94	MA5603T	48	25	48	1	2
6	1580000995850	15	23/10/2013 06:00	229600	TNAADOZ	NAADOZ	229.6	MA5603T	96	68	48	2	5
7	1580000995869	15	23/10/2013 06:00	328860	TNAAEAN	NAAEAN	328.86	MA5603T	144	115	48	3	8
8	1580000995878	15	23/10/2013 06:00	164000	TNAADRZ	NAADRZ	164	MA5603T	48	30	48	1	2
9	1580000995887	15	23/10/2013 06:00	253400	TNAADYE	NAADYE	253.4	MA5603T	144	85	48	3	6
10	1580000995896	15	23/10/2013 06:00	262980	TNAAEDN	NAAEDN	262.98	MA5603T	144	92	48	3	6

Figure 1. Example format of consumption data Openreach will provide

Additional information

3.4 In addition to the sample data, we will ask Openreach to provide the following supporting data:

- An undertaking, signed at Director level, that the data provided is accurate and a true reflection of the load on each cabinet during the half hour for which the snapshot was taken;
- A Questions and Answers (Q&A) document to cover off all questions already raised during the previous application (e.g. ability to add additional equipment at a future date);
- Data for example cabinets showing that power consumption is driven by the number of ports being utilised, and is not influenced by whether customers are actually using the connection (i.e. data traffic, to download for example); and
- Evidence from UMSOs that the monthly update of their inventories is an efficient and robust process.

Proposed Charge Code calculation methodology

3.5 ELEXON proposes that we attempt to predict the Charge Code average Circuit Watts[5] from the sample data, together with a confidence interval in our average estimation. We can then assess whether the sample average Circuit Watts fall within our predicted range, based on the variation set out in the NMO's guidance on the UMS Regulations.

3.6 Below we present in summary the proposed methodology we will follow to calculate separately the Circuit Watts of the Charge Code for each port band. Appendix 1 provides further details on each of the steps 1-6:

- **Step 1 – Calculation of the mean Circuit Watts lower and upper limits**

  We will select sample consumption data from Openreach's metered cabinets that maps to the lowest and highest number of ports associated with this port band and the Charge Code. For example, for the first port band (range of ports 1-16), we will select sample consumption values for the cases when either one or 16 ports are utilised.

  Using this sample data we will calculate the mean Circuit Watts for the lower and upper limit of this port band. An example is presented in Figure 2 for the first port band of a card.

- **Step 2 – Creation of random Watts sample (ELEXON model)**

  Using the lower and upper mean Circuit Watts calculated in Step 1 we will produce a random sample of N values within this range, using the Rand() function of Microsoft Excel.

- **Step 3 – Calculation of predicted average of the random sample (ELEXON model)**

  We will then calculate the average of these randomly produced Watts values.

[5] Circuit Watts are an estimate of the average load of a population of Apparatus at full power.

- **Step 4 – Calculation of precision of random sample (ELEXON model)**

  At this stage we will calculate the precision (confidence interval) of the random sample we produced in Step 2. The confidence interval can be expressed either in Watts or as a percentage around the predicted average of the sample.

- **Step 5 – Calculation of the real sample average consumption**

  Based on the actual snapshot consumption data for this port band, we will calculate the real sample average consumption.

- **Step 6 – Assessing the predictability of the Charge Code**

  We will compare the real sample average consumption against the predicted average of the random sample. The Charge Code will be deemed to be predictable if the difference is within the range (predicted average of the random sample) ± (confidence interval) and within the defined criteria.

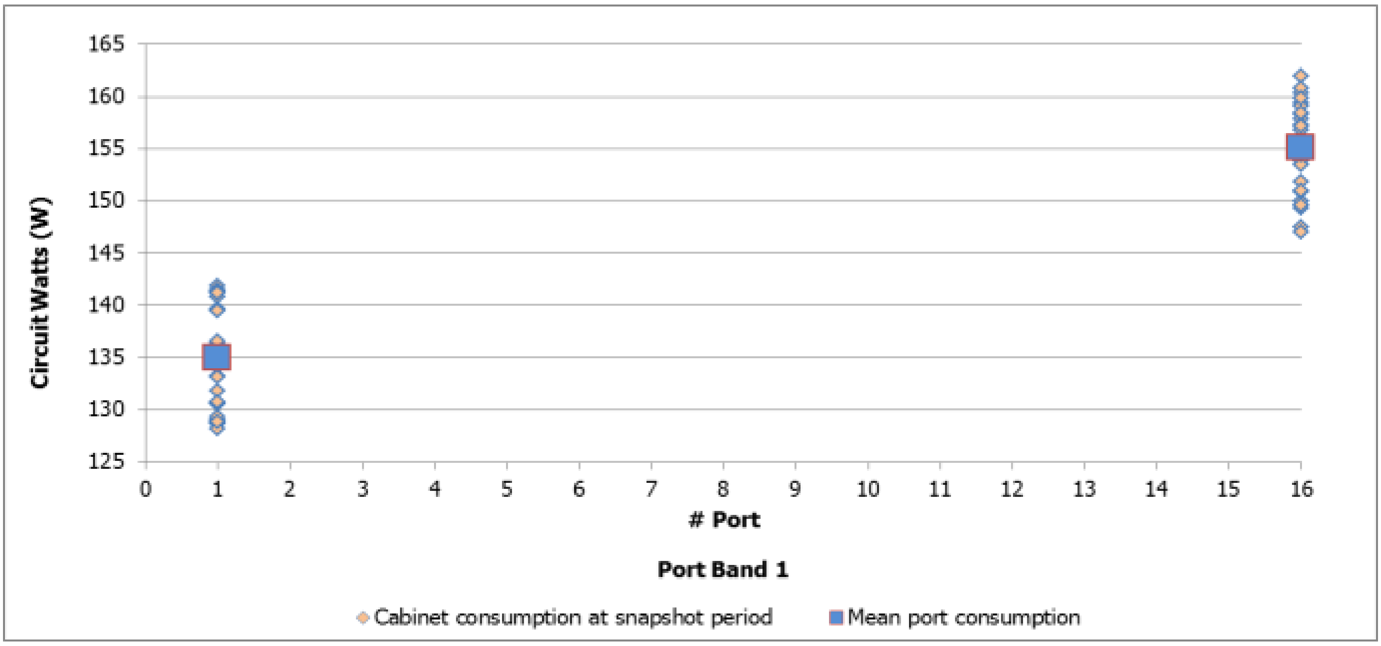


Figure 2. Mean Circuit Watts lower and upper limits for port band 1 (ports 1-16). Note the spread of Circuit Watts at the upper and lower limit are for demonstration purposes; we expect the actual spreads to be much smaller.

3.7 Following the assessment of Step 6, if the Charge Code is deemed predictable then the real sample average consumption will be used to represent the Circuit Watts in the proposed Charge Code for this port band (as shown in Figure 3).

3.8 Figures 3 and 4 summarize the concept of the one Charge Code per port band. They show how the above approach will be expanded to all port bands of the card, compared to the 'old' method which created card-based Charge Codes.

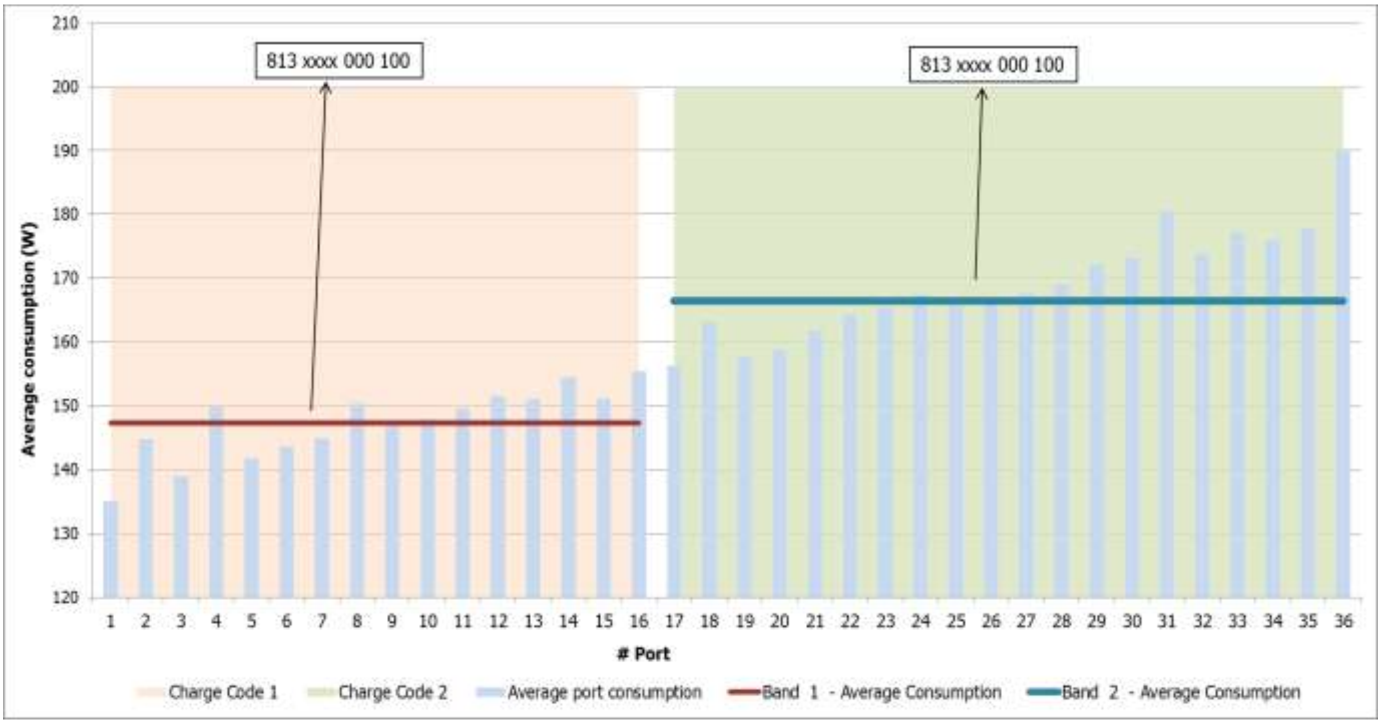


Figure 3. Concept of one Charge Code per port band

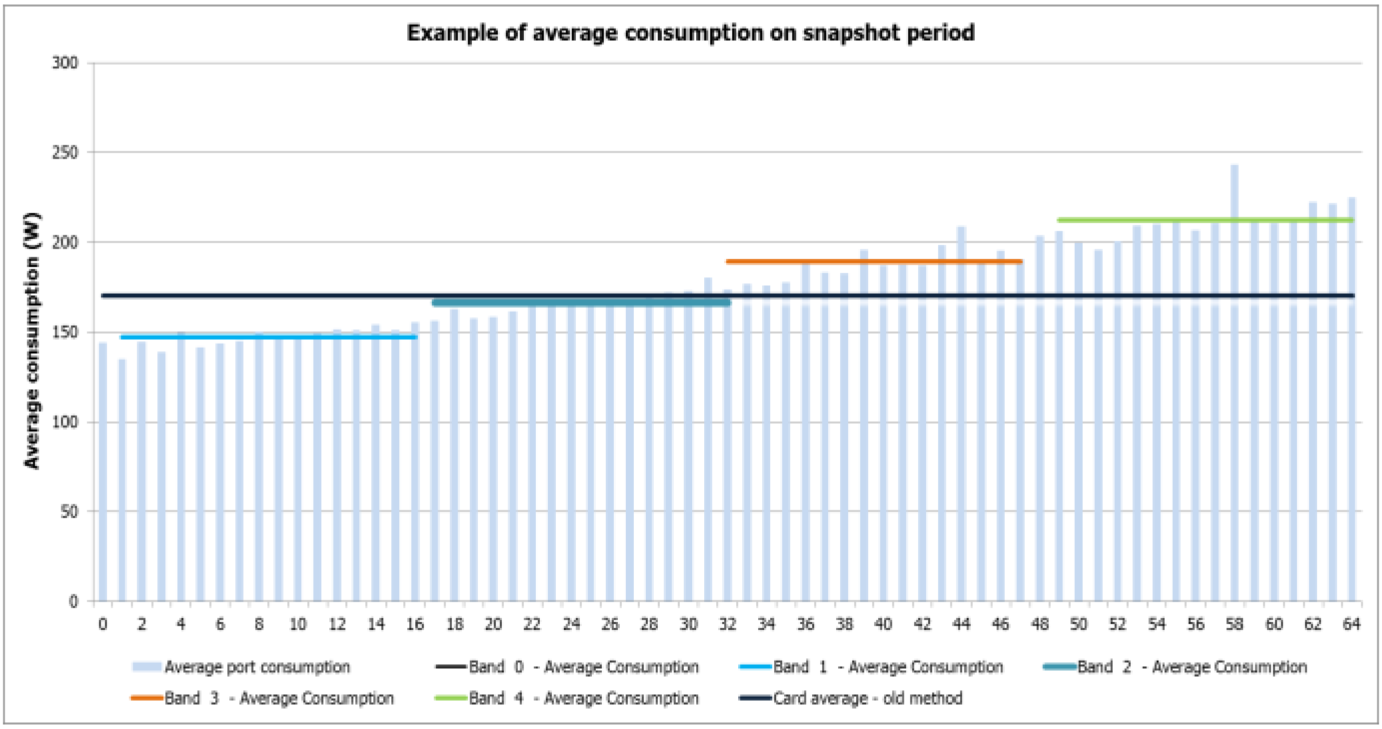


Figure 4. Example of average consumption of each port band to be used in the new Charge Codes

Confidence intervals and criteria for the assessment of predictability

3.9 The NMO's guidance uses ±3.5% as a measure of predictability. We have also included a ±5 Watt measure of predictability (1% of the notional 500 Watt limit), since we would deem the real sample average consumption within this range to be accurate enough to calculate the Settlement energy. A ±3.5% variation at the 500 Watt limit could vary by 17.5 Watts and still meet the criteria, so it seems sensible to set a Watt limit for lower-consumption cabinets.

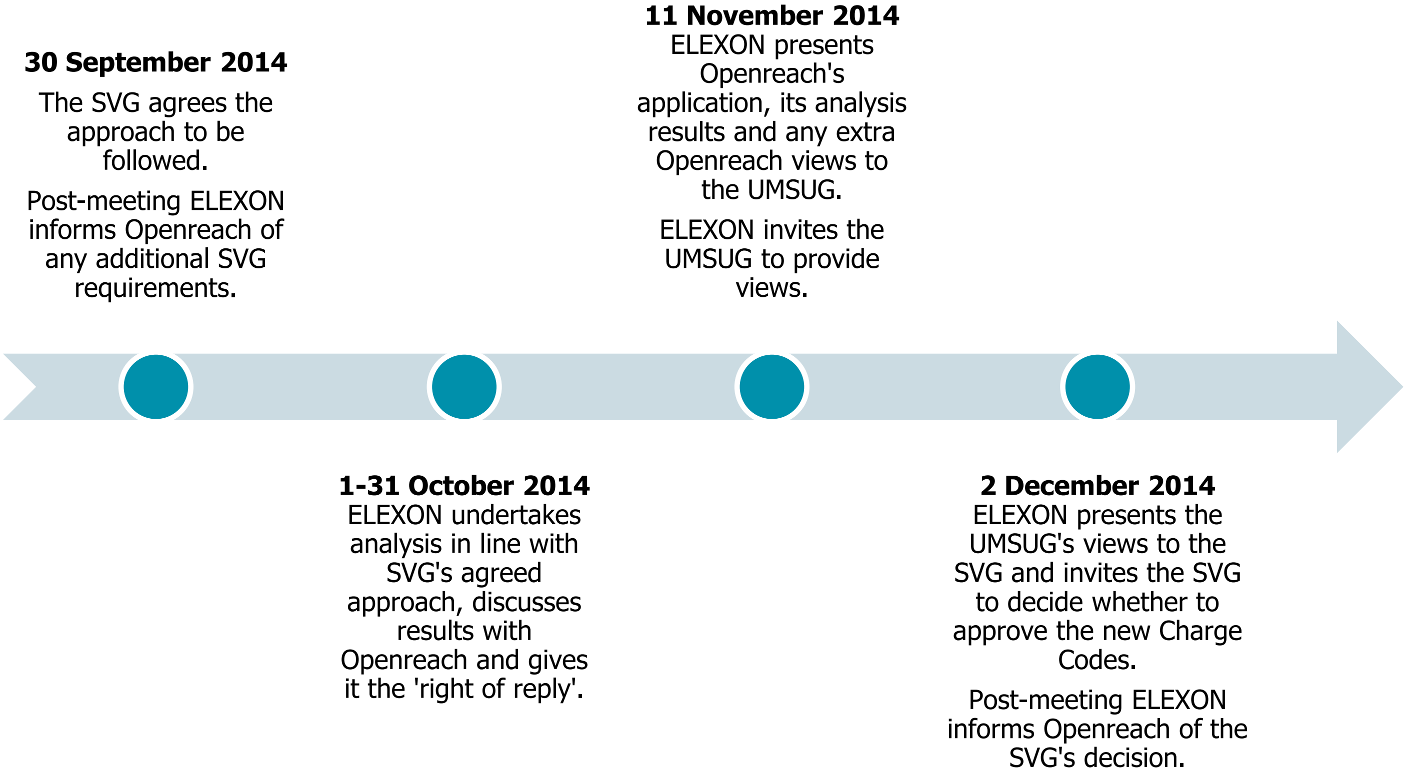
What about cabinets with too few samples to make the assessment?

3.10 We propose that the above approach is used only where there are at least 100 samples available for calculation of the sample average consumption as a proof of concept.

3.11 If the methodology proves that the Circuit Watts are predicable within the set criteria, then the methodology can also be used to set the Circuit Watt values for Charge Codes where fewer samples are available.

4. Proposed timescales

4.1 Below is our proposed timeline for the additional analysis ELEXON will undertake, and the stages that we will follow, should the SVG agree our proposed approach.



5. Recommendations

5.1 We invite you to:

a) **NOTE** Openreach's new application for 45 UMS Charge Codes;

b) **AGREE** ELEXON's proposed model for assessing whether the new Charge Codes deliver sufficient predictability of the equipment's consumption for Settlement;

c) **AGREE** the data and additional information required from Openreach in order to progress the application;

d) **AGREE** ELEXON's proposed criteria for assessing predictability; and

e) **AGREE** ELEXON's proposed progression process and timescales for the application.

Appendices

Appendix 1 – Methodology for analysis of Openreach's cabinet data

Attachments

Attachment A – **Confidential** paper SVG150/01 *(provided to SVG Members only)*

Attachment B – **Confidential** minutes of SVG meeting 150 *(provided to SVG Members only)*

Attachment C – Openreach's September 2014 Charge Code application

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Appendix 1 - Methodology for analysis of Openreach's cabinet data

This Appendix describes the methodology for analysing the Openreach cabinet half-hourly data. The data analysis takes, as its input, snapshot data from Openreach that will provide the number of ports and Watts for each cabinet aligned to the particular Charge Code.

Step 1 – Calculation of the Mean Per Cabinet Circuit Watts Limits (MPCCWL) for the upper and lower limits of the Charge Code range

For each sample cabinet, we will calculate the mean Circuit Watts limits as follows:

i) Select the sample data Watt values that map to the lowest number of ports associated with the Charge Code;

ii) Using the selected data, calculate the Mean Per Cabinet Circuit Watts Lower Limit (MPCCWLL) as the average of the selected data;

iii) If any sample Watt data is more than three standard deviations below the mean value calculated, then remove it and recalculate the mean;

iv) Select the sample data Watt values that map to the highest number of ports associated with the Charge Code;

v) Using the selected data, calculate the Mean Per Cabinet Circuit Watts Upper Limit (MPCCWUL) as the average of the selected data; and

vi) If any sample Watt data is more than 3 standard deviations above the Mean value calculated, then remove it and recalculate the mean.

Step 2 – Calculation of the Random Sample Watts (RSW)

For each applied for Charge Code, generate N Random Sample Watts (RSW) between the MPCCWLL and the MPCCWUL, where N is the count of the number of available samples for the calculation of the Charge Code.

<u>For example:</u>

If MPCCWLL = 50 W and MPCCWUL = 100 W, then using the Microsoft Excel Rand() function:

Sample 1 =RAND()*(MPCCWUL - MPCCWLL) + MPCCWLL = RAND()*(100 - 50) + 50 = 86.1 W

Sample 2 =RAND()*(MPCCWUL - MPCCWLL) + MPCCWLL = RAND()*(100 - 50) + 50 = 56.5 W

.

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Sample N =RAND()*(MPCCWUL - MPCCWLL) + MPCCWLL = RAND()*(100 - 50) + 50 = 73.2 W

This process will be iterated 100 times to get an accurate estimate of the average Circuit Watts across a number of scenarios.

Step 3 - Calculation of the Predicted Random Sample Average Watts (PRSAW)

For each applied for Charge Code, calculate the PRSAW as the follows:

$$\text{PRSAW} = \sum \text{RSW}/\text{N}$$

Step 4 – Calculation of the Random Sample Precision

Calculate the variance of the generated Predicted Random Sample Average Watts (PRSAW) as follows:

$$\text{Sample Variance (SV)} = (N\sum RSW^2 - (\sum RSW)^2) / N(N-1)$$

Calculate the sample's Standard Error as follows:

$$\text{Standard Error (SE)} = \text{Square Root of } (SV/N)$$

Calculate the T-value of the Student's T-distribution as a function of the probability (0.05) and the degrees of freedom (N-1).

E.g. T-Value = The inverse of the Student's T-distribution (0.05, 99) = 1.984217

Calculate the 95% Confidence Interval in the mean estimate of demand as follows:

$$\text{95\% Confidence Interval in Watts (CIW)} = \text{T-value} \times SE$$

Express the confidence intervals as a percentage of the Predicted Random Sample Average Watts as follows:

$$\text{95\% Confidence Interval (CI\%)} = (CIW / PRSAW) * 100$$

E.g. the results can be expressed as

- PRSAW ± CI% = 77 Watts ± 3.3%; or as
- PRSAW ± CIW = 77 Watts ± 2.55 W

This calculation will be repeated over 100 iterations to get an accurate estimate of the Standard Error across a number of scenarios.

Step 5 – Calculation of the Real Sample Average Watts (RSAW)

For each applied for Charge Code, calculate the RSAW from the Actual Sample Watt (ASW) data provided for each Charge Code as follows:

$$RSAW = \sum ASW/N$$

where ASW = the actual snapshot Circuit Watts for each cabinet that maps to the applied for Charge Code.

Step 6 – Assessing the predictability of the applied for Charge Code

Using the data calculated in Steps 1 to 5 above:

If (RSAW < PRSAW + CIW) and (RSAW > PRSAW – CIW)

then the Charge Code will be deemed to be predictable if CIW <±5 Watts

OR

If (RSAW < PRSAW + (PRSAW * CI%)) and (RSAW > PRSAW – (PRSAW *CI%))

then the Charge Code will be deemed to be predictable if CI% <±3.5%

