High-level Smart Meter Data Traffic Analysis

For: ENA

May 2010

Engage Consulting Limited

Document Ref: ENA-CR008-001-1.4

Restriction: ENA Authorised Parties

www.engage-consulting.co.uk

Document Control

Authorities

Version	Issue Date	Author	Comments
0.1	01st April 2010	Viktorija Namavira	First draft
0.2	06th April 2010	Viktorija Namavira	Tom Hainey comments implemented
0.3-0.6	08th April 2010	Jane Eccles/ James Boraston	General check of the report
0.7	12th April 2010	Tom Hainey	Clarifications added
0.8	12th April 2010	Simon Harrison	Comments regarding protocols
0.9	14th April 2010	Tom Hainey	Update following QA of model & ENA ICT Group feedback
1.0	28th April 2010	Viktorija Namavira / Tom Hainey	Update following ENA members responses. Provides insight into potential 'Peak' data traffic requirements.
1.1	5th May 2010	Tom Hainey	Updated with ENA comments on V1.0
1.2	7th May 2010	Tom Hainey / Viktorija Namavira	Updated with ENA comments on V1.1
1.3	10th May 2010	Tom Hainey	Update with some comments on V1.2
1.4	12th May 2010	Tom Hainey	Update of Executive Summary
Version	**Issue Date**	**Reviewer**	**Comments**
0.8	12h April 2010	Tom Hainey	Review of First draft
1.0	29th April 2010	Tom Hainey	Review of Updated Draft
1.1	5th May 2010	Tom Hainey	Review of ENA suggested changes
1.2	7th May 2010	Craig Handford	Quality Review
1.3	10th May 2010	Tom Hainey	Updated with some comments on V1.2
1.4	12th May 2010	Tom Hainey	Updated of Executive Summary
Version	**Issue Date**	**Authorisation**	**Comments**
0.8	12th April 2010	Tom Hainey	Issue to ENA for Distribution together with Excel based ENA data traffic analysis.

1.0	29th April 2010	Tom Hainey	Issued to ENA.
1.1	5th May 2010	Tom Hainey	Issued to ENA
1.2	7th May 2010	Craig Handford	Issued to ENA
1.3	10th May 2010	Tom Hainey	Issued to ENA
1.4	12th May 2010	Tom Hainey	Issued to ENA

Related Documents

Reference 1	Smart Metering Updated Requirements (ENACR006-002-1.1)
Reference 2	Smart Metering Use Cases (ENA-CR007-001-1.1)
Reference 3	Smart Metering Data Traffic Analysis Workbook (ENA-CR008-001-1.4.xls)
Reference 4	Smart Metering Security Assessment (ENA-CR009-002-1.0)

Distribution

Recipient 1: Alan Claxton
Recipient 2: ENA Members

Table of Contents

Executive Summary

This data traffic evaluation is based on a set of assumptions related to the raw data being transferred across the smart metering system and the overheads on that process typically introduced by security and the selected communication protocols being used. This evaluation has assumed that the transport protocol used will be TCP/IP. The reason for choosing TCP/IP protocols is that they are commonly used in smart grids and smart metering communications in pilot projects in Europe, USA, Australia and other regions and because TCP/IP creates a relatively high overhead in data transmission messages. TCP/IP protocols will therefore represent the higher end of requirements of the communications infrastructure in terms of packet sizes associated with data transmission. It follows that assuming TCP/IP will provide a robust indicative estimate of the data packet sizes that each meter and the wider metering system will need to deal with on both an individual activity and annual basis. These assumptions would need to be refined if different protocols were assumed to apply.

The approach uses Use Case scenarios (Reference 2) to define the detail surrounding the data that will need to be exchanged to enable network operators to undertake certain activities in support of network planning and also, to an increasing extent over time, in the active management of smart grids. This includes data storage, data transmission and response time granularity assumptions, which facilitate the understanding of the amount of data stored at the meter, the size the transmitted data packets will need to be, and how often and how quickly they will need to be sent.

To support their requirements, network operators envisage that certain data will need to be stored within the meter for a minimum of 3 months; this aligns with ENA's understanding of suppliers' requirements for data storage at the meter. The meter will therefore need to have sufficient memory capacity to accommodate both these requirements.

Based on the set of assumptions described in this report, the data flow volumes that will be generated by network operators' business processes, both on a 'per meter' and 'total meter population per annum' basis, are shown below (assuming a population of 27 million electricity meters and 20 million gas meters):

Meter Type	**Single Meter p.a.**	**Total Meter Population p.a.**
Electricity	Less than 1.5 MB[1]	30 – 40 TB[2]
Gas	Less Than 1 MB	15 – 20 TB
TOTAL	**-**	**45 – 60 TB**

Table E.1 below summarises for a single electricity or gas meter the following:

- Data granularity registered at the meter – period covered by the data;
- Data Transmission granularity – frequency data will be transferred;
- Latency required – maximum acceptable transfer time for data;

[1] 1 Megabyte = 10^6 bytes
[2] 1 Terabyte = 10^{12} bytes

- Cumulative per activity data volume in bytes;
- Cumulative data volume per activity per year.

Table E.1 – Details of Electricity & Gas assumptions and Use Case data requirements (per meter)

ELECTRICITY USE CASES	Data granularity registered at the meter	Data transmission granularity	ENA Latency req. (command execution time)	Cumulative per activity (bytes)	Cumulative Data volume per year (bytes)
Assessment of network performance					
Use Case 01 - Monitor current flows and voltage levels to identify thermal capacity and statutory voltage headroom					
Basic Flow – Data Periodically	HH average	3 months	on availability	145,888	583,552
Basic Flow – DNO Requests data	On event (assumed once every 3 months) HH average	Once every 3 months (1 month of ½ hour data)	12 hours	41,489	165,956
Use Case 02 - Determine network impact of proposed new demand / generation connections					
Basic Flow	on event (assumed once every 3 months) HH Average	3 months (1 month of ½ hour data)	12 hours	41,489	165,956
Use Case 03 - Determine network impact of proposed increase in demand / generation at existing connection points					
Basic Flow	on event (assumed once every 3 months) HH Average	3 months (1 month of ½ hour data)	12 hours	41,489	165,956
Use Case 04 - Monitor demand and generation profiles for network load forecasting – See Use Case 01					
Use Case 05 - Determine Latent Demand due to Embedded Generation – See Use Case 01					
Use Case 06 - Identify Voltage Quality Issues					
Basic Flow	on event (assumed once a month)	Assumed send Reports every 6 months)	12 hours	656	1,312
Actively manage network / System Balancing					
Use Case 07 - Collect data for active management					
Basic Flow – As in Use Case 01 but with a lower latency required	HH average	As Required	Lower Latency than UC 01	As UC 01	As UC 01
Use Case 08 - Active network management of network voltage – Uses Voltage information captured to instigate actions on DNO Assets to control voltage, as well as having the same data flows as Use Case 09 to undertake actions in the household to address voltage issues via ToU/Peak tariffs, control household equipment etc.					
09 Use Case - Perform Active Management of Network Power Flow					
1. Operation of (Distribution Use of System) Time of Use tariff (Scenario 1)	on occurrence (assumed to happen every 3 months)	3 months	Up to 5-15 min. to configure. TOU Readings 12 hours	2,006	8,024
2. Operation of (Distribution Use of System) Real Time Pricing (Scenario 2)	on occurrence (assumed to happen every 3 months)	3 months	Up to 5-15 min. to configure. RTP Readings 12 hours	1,194	4,776

ELECTRICITY USE CASES	Data granularity registered at the meter	Data transmission granularity	ENA Latency req. (command execution time)	Cumulative per activity (bytes)	Cumulative Data volume per year (bytes)
3. Power Sharing by Maximum Thresholds (Scenario 3)	on occurrence (assumed to happen every 3 months)	3 months	Between Metering System and IHD via HAN – no DNO related data traffic	Not related to DNO	Data flows between Meter & IHD, nothing to DNO
4. Direct Control, by DNOs, of appliance or micro-generation (Scenario 4)	on occurrence (assumed to happen every 3 months)	3 months	5-15 min. for up to 1,000 meters (may need to be repeated across the country)	1,194	4,776
System Balancing					
10 Use Case - Perform System Balancing					
Same data flow as in Use Case 09	On occurrence (assumed to happen every 3 months)	On event (assumed to happen once every 3 months)	5 – 15 min latency (On localised basis, which is constraining factor, only small subset of meters involved – assume 1,000. However at national level could be millions)	See UC 09	See UC 09
11 Use Case - Check effectiveness of active network management / system balancing measures					
1. The Smart Metering System measures power flow and voltage data (as in Use Case 01)	HH Average				
2. DNO requests data 3. Smart System sends data	on occurrence (assumed to happen once every 3 months)	3 months (1 month of ½ hour data)	5-15min.	41,489	165,956
Actively manage network during planned and unplanned outage					
Use Case 12 - Notify consumer of planned outage					
1. Consumer notification of planned / emergency outage 2. Consumer notified that outage is over	on occurrence of the event (assumed one planned outage per year)	once per year	Message confirmation within 12 hours. 5-10 min. (within Hour)	1,791	1,791
Use Case 13 - Query Meter Energisation Status to determine outage source and location					
1. False Outage Report (DNO checks meter energisation status: supply on)	On occurrence of the event (assumed to happen once per year)	once a year	1,000 meters in 15 min. or 100,000 in 1 hour; in cases of	1,791	1,791

ELECTRICITY USE CASES	Data granularity registered at the meter	Data transmission granularity	ENA Latency req. (command execution time)	Cumulative per activity (bytes)	Cumulative Data volume per year (bytes)
			extreme weather events. 30 sec per single meter		
2. Confirmed network outage	On occurrence of the event (assumed to happen once per year)	once a year	1,000 meters in 15 min. or 100,000 in 1 hour; in cases of extreme weather events. 30 sec per single meter	1,194	1,194
Use Case 14 - Send Alarm to DNO during network outage					
1. Outage alarm sent to the Distribution Network Operator	On occurrence of the event (assumed to happen once per year)	once a year	For customers associated with LV faults (1,000 max) 5 mins, where as volumes associated with HV faults, 15 mins is adequate	597	597
Use Case 15 - Verify restoration of supplies after outage					
1. Meter notifies DNOs of power restoration	On occurrence of the event (assumed to happen once every 6 months)	6 months	For customers associated with LV faults (1,000 max) 5 mins, where as volumes associated with HV faults, 15 mins is adequate	597	1,194
Use Case 16 - Regulatory Reporting of outages					
1. DNO requests stored outage information 2. Meter sends outage report	on event (assumed once every 3 months)	3 months (Reporting period)	12 hours	1,161	4,644
Use Case 17 - Restore and maintain supply during outages					
1. Smart Metering System sends "power restored" message to the DNO	On occurrence of the event (assumed to happen once every 6 months)	6 months	5 min.	597	1,194
2. DNO activates the maximum power consumption threshold 3. Smart Metering confirms activation of the maximum	On occurrence of the event (assumed to happen once every 6 months)	6 months	15 min.	1,194	2,388

ELECTRICITY USE CASES	**Data granularity registered at the meter**	**Data transmission granularity**	**ENA Latency req. (command execution time)**	**Cumulative per activity (bytes)**	**Cumulative Data volume per year (bytes)**
power consumption threshold					
Manage safety issues					
Use Case 18 - Manage meter safety alarm					
1. Smart Metering System sends alarm to DNOs	on event (assumed once a year)	once a year	15 min	597	597
2. DNO remotely disconnects the supply through the Smart Metering System (where necessary) 3. The Smart Metering sends the confirmation message to the DNO	on event (assumed once a year)	once a year	15 min.	1,194	1,194
Use Case 19 - Manage extreme voltage at meter					
1.The Smart Metering System sends alarm of a voltage level outside its configured tolerance levels 2.(Optionally) the Smart Metering System auto-disconnects itself from the network supply of electricity sending confirmation of disconnection to the DNO 3.Supply is enabled by DNO after emergency/safety action	On occurrence of the event (assumed to happen once every 6 months) on event (assumed once a year)	6 months once a year	Alarm in up to 15 min. 5 min.	1,791	2,388
Support network activities					
Use Case 20 - Configure Smart Metering System					
1. DNO configures meter reading registers	on event (assumed every 3 years)	every 3 years	Assumed 15 minutes up to 12 hours (i.e. confirming meter changes)	1,194	1,194
2. DNO configures meter alarms	on event (assumed every 3 years)	every 3 years	As Above	1,194	1,194
3. DNO configures meter load threshold	on event (assumed every 3 years)	every 3 years	As Above	1,194	1,194
Basic Flow Total (Everything works as required)				**332,980**	**1,288,818**

GAS USE CASES	Data granularity registered at the meter	Data transmission granularity	ENA Latency req. (command execution time)	Cumulative per activity (bytes)	Cumulative Data volume per year (bytes)
Use Case 1 - Gather information for planning					
1.The Smart Metering System sends the recorded gas demand data to the GDNO (6min)	Every 6 minutes all day for the winter period (Was November-March) - 6 months	once a year	5 days	351,544	351,544
2.The Smart Metering System sends the recorded gas demand data to the GDNO (daily)	every day at 6 am	every 6 months	5 days	1,302	2,604
Use Case 02 - Configure Smart Metering System					
1. GDN configures meter reading registers	on event (assumed to happen every 3 years)	every 3 years	confirmation almost real time	2,388	2,388
Use Case 03 - Disable Supply of Gas					
1. Gas is disabled by GDNs	on event (assumed once every 3 years)	every 3 years	Up to 1 hour (was almost real time)	1,791	1,791
Use Case 04 - Display Messages from Gas Distribution Network					
1.GDN sends notification to IHD	on occurrence to happen once every 10 years	every 10 years	Up to 1 hour (was almost real time)	1,194	1,194
Use Case 05 - Measure and Store Calorific Values at the meter					
Update CV	daily	daily	Up to 1 hour (was almost real time)	1,177	429,605
(Optionally) GDN update the message	on occurrence (assumed to happen once a month)	monthly	Up to 1 hour (was almost real time)	1,177	14,124
Tampering Notification send to GDNs					
meter sends tampering notification to GDNs	on occurrence (assumed once a year)	once a year	almost real time	597	597
Basic Flow Total (Everything works as required)				**361,170**	**803,847**

Currently, Network Operators are able to rely on Radio Teleswitching, which has the capability to address large populations of meters in a matter of seconds, for control of 'off-peak' appliances such as electric storage (space) and water heating. However, this service is due to be withdrawn in 2014. Network Businesses also have the capability, through their SCADA systems, to identify major disruptions to their network that affect many thousands of their customers. In both these examples, the communications system is able to transmit the data at the necessary transmission granularity and latency. With regard to the smart metering communications system, one concern for network operators will be to ensure that where required to do so, it will be able to simultaneously transmit data to or from a few hundred, or perhaps up to a thousand, meters that are geographically closely located (e.g. covering one or more 11kV feeders over a small geographical area e.g. less than 1 km^2). Some communication technologies that could be deployed would support fast response times for several hundred meters. For example an LV network Power Line Carrier system acting through a local concentrator could provide a dedicated communication path for perhaps 100 meters at premises served from a given distribution substation. However, with some communication technologies, such as GPRS where a local transmitter might serve an area covered by perhaps hundreds of distribution substations, the communication infrastructure might be put under considerable strain should it be called upon to handle simultaneous data flows to or from all meters associated with the networks served by those substations. The risk is that if the communication infrastructure is not sufficiently sized to deal with these 'peak' activities within the required response times (latency), this could result in the local communications infrastructure becoming overloaded and unable to provide the functionality required by network operators. In a 'worst case scenario this could conceivably result in the network operating outside its thermal and voltage capabilities.

Clearly the required response times for processes supporting planning activities tend not to be too onerous; for example 12 hours is a typical latency figure used for these activities in the 'Assess Network Performance' Use Cases. However, where there is a need to actively manage parts of the network, the latency will need to align with network operators' requirements to receive, assess and act on the information within a given critical timescale. In general terms, the active management of networks will require that the communications infrastructure is able to support a higher speed of data transfer. How quickly and widely active network management will need to become commonplace will depend on the speed of uptake of new sources of electricity demand and production such as electric vehicles (EVs), heat pumps and micro-generation. However, it is anticipated that there will be some early clustering of these sources of demand and generation that will require pockets of the network to be actively managed in the very near future.

To gain an insight into these 'peak' activities Section 4.3 of the report considers a number of Use Case examples for a varying number of meters and different potential requirements for latency. An example is illustrated in Section 4.3.1.2 (Use Case 01 – Request latest month's data for all relevant electricity parameters). This data capture process supports the assessment of the network's performance (planning activities) initially assuming relatively high acceptable latency, but it will also form a key part of the active management of the network in the future (Use Case 07) with the deployment of new sources of demand such as EVs and heat pumps etc. The latency in this active management stage will then need to be much lower e.g. 15 minutes.

If the network operator needed to acquire data from 600 - 1,000 meters from a localised part of their network to support planning processes, and this needed a response only within 12 hours, then the local communication infrastructure covering these meters would only need to support a speed of 5 – 8 kbps[3]. However, once new types of demand have been connected to the network and there is an increasing need for network operators to proactively manage their networks, they will need to capture certain data in a much shorter timeframe to facilitate the necessary speed of operational response. If this resulted in a requirement for a response time of 15 minutes rather than 12 hours, then the local communication infrastructure would need to deal with data traffic in the 0.2 – 0.4 Mbps range (Million bits per second). These figures assume no group addressing or broadcast capability in place, so represent what could be considered as a worst case response time requirement.

In conclusion the key points to note from this work are as follows:

- Initially network operators only need data for network planning purposes which will normally be collected on a rolling 3 month basis. The volume of this data and the required latency should be easily managed by any communication solution deployed;
- The required latency for communicating with the smart metering system will reduce as new demand and production are deployed and this will require any communication infrastructure to be able to deal with these potential local 'peaks' within the operational timescales that network operators can respond.

This report and analysis supports the conclusions stated above and describes how network operators' requirements of the smart metering system will evolve over time to support the needs of a smart grid.

[3] Kbps = Kilo bits per second = 1,000 bits per second

1 Introduction

For Great Britain (GB) smart metering, we now know the high level structure of the Central Communications model. We are therefore able to make some key assumptions on the structure and scope of services within that model.

The particular data traffic scenarios that have been used within this analysis reflect the smart meter related data flows associated with domestic and small-to-medium enterprise smart meters and the use of the communications infrastructure to support smart grid functionality. The scenarios are aligned with specifically developed Use Cases. This approach has enabled a structured and easy to understand analysis of the data traffic to be performed.

By applying the Use Case approach, the GB smart metering requirements will remain solution and technology agnostic, supporting innovation and communication technology interoperability in the future. The use of Use Cases will also provide the basis for assessment of data volumes and traffic, which will be critical in selecting the communications service options and subsequent solutions.

1.1.1 Smart Metering Scenarios

To fully inform the Ofgem E-serve process it is important to assess the key Use Cases using relevant data exchange flows. The scenarios highlight the level and detail of data traffic incurred by the specific activity from the meter, or network operator side that the communications infrastructure will need to support. This helps to estimate more detailed data traffic volumes which in turn will highlight the minimum data size requirements that will need to be handled by a smart meter, including data storage requirements at the meter and the data volumes that meter might need to handle at one point in time. The analysis also helps to identify the data communication speed requirements at the meter depending on the activities carried out, which will give some idea of the communication solutions needed for smart meters.

Such analysis additionally provides some facts that will allow the appropriate Cost Benefit Analysis to be undertaken. This will inform the development of the Ofgem Smart Metering Prospectus.

1.2 Background

Use of smart meters will cause significant data traffic flow as meters will be configured, set and read remotely using the communication network for smart meters over different periods e.g. weekly, daily, hourly, etc. In order to optimise network requirements for smart meters, and develop appropriate standards, it is important to keep in mind the data traffic flow requirements to ensure reliable and secure smart metering system data exchange.

1.3 Purpose

The objective of this report is to construct scenarios aligned with each Use Case (Reference 2), identify the information flow and data to be exchanged, and estimate the amount of data that will be flowing from the meter to the network operator and other authorised parties and vice versa. This will help the assessment of smart meter communication requirements for dealing with the smart grid related data requirements. Such analysis provides an overview of the system requirements to ensure a reliable and effective exchange of data and provide the necessary ability to regulate demand, optimise the grid, and allow further innovation.

1.4 Scope

The scope of this report includes the analysis of data traffic between the meter and the network operators. This report does not include network traffic analysis between independent service providers, suppliers or linked entities such as smart home appliances and other utility meters (water, heat).

1.5 Copyright and Disclaimer

The copyright and other intellectual property rights in this document are vested in ENA. Engage Consulting Limited has an unlimited licence to use any techniques or know-how developed by it under this Agreement on its future work.

No representation, warranty or guarantee is made that the information in this document is accurate or complete. While care is taken in the collection and provision of this information, Engage Consulting Limited shall not be liable for any errors, omissions, misstatements or mistakes in any information or damages resulting from the use of this information or action taken in reliance on it.

2 Data Traffic Analysis approach

This data traffic analysis should be considered as a starting point to gain some insight into the potential level of data traffic that any communication network would need to support for each smart meter type over any period of interest. The analysis is based on a number of assumptions stated below for the typical activities that will underpin the Use Cases provided in Reference 2. The assumptions used were considered reasonable for this type of analysis based on feedback from ENA members. However, the assumptions can be modified later to meet any further developments within the sector thus allowing a reassessment of the requirements at a later stage. A Workbook (Reference 3) that forms the basis of this work is also provided as a companion to this report for use by interested parties.

2.1 Annual Data Traffic Level v Potential Peak values

The focus of the evaluation has been on identifying:

1. The overall data traffic for each meter over a year. (See Section 4.2)
2. The potential requirement of needing to notify or receive data from a group of meters at periods of stress on the system (proxy for 'peak' activity). (See Section 4.3).

2.2 Use Case Scenarios - Assumptions

The project has outlined several Use Cases (Reference 2) that are relevant to network business requirements for smart metering to support smart grids. Each Use Case consists of various scenarios, which describe an occurrence, or a general process of data exchange. Use of scenarios helps to identify various data exchange flows depending on the process and trigger event that caused the data to be exchanged, thus making sure that the basic data flow is identified and presented in the analysis.

Table 1 (electricity) and Table 2 (gas) summarise the potential data exchange scenarios relevant to the network operator's smart grid activities and the planning of smart grid activities based on the required interval data requirements. The scenarios will be used in presenting Raw Data Analysis and TCP/IP protocol based analysis later in the report.

The column "Data granularity at meter" indicates how often the data is being recorded at the meter, but is not being sent immediately. This helps to estimate how many values the meter collects before actually transmitting it to the central data depository.

The column "data transmission granularity" shows how often it is estimated that the data will actually be transmitted between the meter and the end party i.e. the Central Data Repository System or network operators. Where it is stated "on occurrence" this means that the data is transmitted as soon as the meter registers the event as occurring. The assumption of how often the scenario is likely to occur is given in brackets and will be used purely for data traffic estimation in the potential smart grid operation scenario.

The column 'Response Time' represents how quickly the network operators would generally require the metering system to execute the commands, or to submit the requested data.

Table 1 – Summary of Electricity Scenarios used for data traffic analysis per each Use Case

Assessment of network performance

Use Cases	Potential data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO	Response time (latency) required by ENA
01_Monitor Power Flows and Voltage Levels to Identify Thermal Capacity and Statutory Voltage Headroom	1. **Data is periodically sent from the Smart Metering System** (import/export; real/reactive flow and voltage as specified by DNOs)	Every HH average	Every 3 months	Assumed that DNO's would be able to access the data by being able to log into the Central data Repository (assumption)[4]
	2. **DNO requests data** (in cases where the data is needed earlier then the configured data submission)	On event (assumed to happen once every 3 months)	Every 3 months	12 hours
	3. **The Smart Metering System sends the requested data** (assumed one month of HH real/reactive import/export, micro-generation real/reactive flow and voltage) (in cases where the data is needed earlier then the configured data submission)	As above	As above (1 month of ½ hour data)	
	Alternative Flows: Metering system failure:			
	1. Smart Metering System rejects the message as invalid	On event (assumed to happen once a year)	Once a year	12 hours
	2. The Smart Metering System does not have any measured data stored	As above	As above	As above
	3. The DNO does not receive the data from the Smart Metering System (in case of scenario 1 and 2)	12 hours is considered reasonable for an error report to reach DNO's in this case If data is requested with an expectation that it arrives within 12 hours, it seems reasonable for a 'fail' alarm to be delivered in the same timescale as above	As above	As above
02_Determine network impact of proposed new demand / generation connections	**1. DNO requests stored HH power flow and voltage data (and micro-generation data where available)**	On event (assumed to happened once every 3 months)	On event (assumed to happen once every 3 months)	12 hours
	2. Smart Metering system retrieves the requested data (assumed one month of HH real and reactive energy import and export, real/reactive generation energy and	As above	As above (1 month of ½ hour data)	12 hours

[4] It is assumed that the DNO's are able to access data from the Central Data Depository. The data is for planning purposes thus a 3 months delay is acceptable.

T 0207 4050740 **W** www.engage-consulting.co.uk **E** info@engage-consulting.co.uk

Use Cases	Potential data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO	Response time (latency) required by ENA
	voltage data)			
	Alternative flow: 1. The DNO does not receive the data	On event (assumed to happen once a year)	On event (assumed to happen once a year)	12 hours
03_Determine network impact of proposed increases in demand / generation at existing connection points	**1. DNO requests stored HH power flow and voltage data (and micro-generation data where available)** **2. Smart Metering system retrieves the requested data** (assumed one month of HH real and reactive energy import and export, real/reactive generation energy and voltage data)	On event (assumed to happen once every 3 months) As above	Every 3 months As above (1 month of ½ hour data)	12 hours
	Alternative flow: 1. The DNO does not receive the data	On event (assumed to happen once a year)	On event (assumed to happen once a year)	12 hours
04_Monitor demand and generation profiles for network load forecasting	1. **At the defined interval the Smart Metering System collects the data and sends it to the DNO** (please see Use Case 01)	Every HH average	Every 3 months	As per UC 01
05_Determine Latent Demand due to Embedded generation	**1. At the defined interval the Smart Metering System collects the data and sends it to the DNO** (please see Use Case 01)	Every HH average	Every 3 months	As per UC 01
06_Identify Voltage Quality Issues	**1. The Smart Metering System accumulates time and date stamped voltage quality events** (assumed 6 events)	On event (assumed to happen once a month)	On event (assumed every 6 months)	12 hours
	Alternative Flow: **1. Meter fails to send the message**	On event (assumed to happen once a year)	On event (assumed to happen once a year)	12 hours

Actively manage network / System Balancing

Use Cases	Potential data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO	Response time (latency) required by ENA
07_Collect data for active management	1. **Data is periodically sent from the Smart Metering System** (import/export; real/reactive flow, real/reactive generation flow and voltage as specified by DNOs) as in Use Case 01	As Use Case 01	As required	Once EVs, heat pumps etc. are common, this may need to happen more often and faster than for UC 01 e.g. 5-15 minutes
	Alternative flow: **1. Meter fails to send the message**	On event (assumed to happen once a year)	On event (assumed to happen once a year)	12 hours
08_Active Management of network voltage	Uses Voltage information captured to instigate actions on DNO Assets to control voltage, as well as having the same data flows as Use Case 09 to undertake actions in			As for UC 09

Use Cases	Potential data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO	Response time (latency) required by ENA
	the household to address voltage issues via ToU/Peak tariffs, control household equipment etc.			
09_Perform Active Management of Network Power Flow	**1. Operation of (Distribution Use of System) Time of Use Tariff**	On event (assumed to happen once every 3 months)	On event (assumed to happen once every 3 months)	Up to 5-15 min. to configure, send to up to 1,000 meters TOU readings – 12 hours
	2. Operation of (Distribution Use of System) Real Time Pricing	As above	As above	As above
	3. Power Sharing by Maximum Thresholds	As above	As above	Related to Metering system and IHD, nothing to DNO
	4. Direct Control, by DNOs, of appliances or micro-generation	As above	As above	5-15 min for command execution to up to 1,000 meters (may need to be repeated across country)
	Alternative Flow:			
	1. Power Sharing by Maximum Power Thresholds – consumer does not turn off appliances	As above	As above	5-15 min.
	2. Power Sharing by Maximum Power Thresholds – consumer turns off some of the appliances	As above	As above	5-15 min.

System Balancing

Use Cases	Possible data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO	Response time (latency) required by ENA
10_Perform System Balancing	**The same data flow as in Use Case 09**	On occurrence (assumed every 3 months)	On event (assumed once every 3 months)	5-15 minutes (On localised basis, which is constraining factor, only small subset of meters involved – assume 1,000. However at national level could be millions).
11_Check effectiveness of network management / system balancing measures	**1. The Smart Metering System measures power flow and voltage data** (as in Use Case 01)	HH Average		
	2. DNO requests data (in cases where the data is needed earlier then the configured data submission)	On event (assumed to happen once a year). This may have low localised impact, but high concurrence. Potentially millions of meters.	On event (assumed to happen once every 3 months)	Within 15 min.
	3. The Smart Metering System sends the requested data (assumed last real import/export and voltage data read)	As above	As above (1 month of ½ hour	As above

Use Cases	Possible data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO data)	Response time (latency) required by ENA
	Alternative flow: 1. Meter fails to send the message	On event (assumed to happen once a year)	On event (assumed to happen once a year)	12 hours

Actively manage network during Planned & Unplanned Outages

Use Cases	Potential data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO	Response time (latency) required by ENA
12 Notify consumer of planned outage	**1. Consumer notification of planned / emergency outage**	On occurrence of the event (assumed to happen once per year)	On occurrence of the event (assumed to happen once per year)	Notification of outage to be sent within 10 days to IHD before the outage; message confirmation within 12 hours. 5-10 mins if within hour.
	2. Consumer notified that outage is over	As above	As above	As above
	Alternative Flow: 1. Smart metering system deems the request invalid for step 1 2. DNOs do not receive acknowledgement message for step 1 3. Smart metering system deems the request invalid for step 2 4. DNOs do not receive acknowledgement message for step 2	On event (assumed to happen once a year) As above As above As above	On event (assumed to happen once a year) As above As above As above	12 hours
13_Query Meter Energisation Status to determine Outage Source and Location	**1. False Outage Report** (DNO checks meter energisation status: supply on)	On occurrence of the event (assumed to happen once per year)	On occurrence of the event (assumed to happen once a year)	Ability to send energisation queries to 1,000 meters in 15 minutes or 100,000 meters in 1 hour in the example of an extreme weather related event. 30secs for one meter
	2. Confirmed network outage	As above	As above	30sec for one meter
	Alternative flow: 1. Smart Metering system deems the request invalid (for step 1) 2. The Distribution Network Operator does not receive the message (for step 1)	As above As above	As above As above	12 hours
14 Send Alarm during Network Outage to Identify Loss of Supply	**1. Outage alarm sent to the Distribution Network Operator** (Note: Need to control number of outage alarms to avoid swamping communication infrastructure e.g. say only first 1,000 meters in any localised region).	On occurrence of the event (assumed to happen once a year)	On occurrence of the event (assumed to happen once a year)	Receive alarm within 5 mins for LV faults (1,000 max); up to 15 min for HV faults.

Use Cases	Potential data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO	Response time (latency) required by ENA
	Alternative flow: 1. Smart Metering System is unable to send the outage alarm message 2. DNOs do not receive notification	As above As above	As above As above	12 hours
15 Verify restoration of supplies after outage	**1. Meter notifies DNOs of power restoration**	On occurrence of the event (assumed to happen once every 6 months)	On occurrence of the event (assumed to happen once every 6 months)	Receive alarm within 5 mins for LV faults (1,000 max); up to 15 min for HV faults.
	Alternative Flow: 1. Smart Metering System fails to detect power restoration 2.DNOs do not receive message	On event (assumed to happen once a year) As above	On event (assumed to happen once a year) As above	12 hours
16 Regulatory Reporting on outages	**1. DNO requests stored outage information**	On occurrence (assumed every 3 months)	3 months (Reporting period)	12 hours
	2. Meter sends outage report	As above	As above	As Above
	Alternative Flow: 1. Smart Metering System rejects the message as invalid 2. Smart Metering System does not have any of the requested information stored 3. DNOs do not receive notification	On event (assumed to happen once a year) As above As above	On event (assumed to happen once a year) As above As above	12 hours
17 Restore and maintain supply during outages	**1. Smart Metering System sends "power restored" message to the DNO**	On occurrence of the event (assumed to happen once every 6 months)	On occurrence of the event (assumed to happen once every 6 months)	Approx. 5 min for command execution
	2. DNO activates the maximum power consumption threshold	As above	As above	15 min
	3. Smart Metering confirms activation of the maximum power consumption threshold	As above	As above	15 min
	Alternative Flow: 1. DNOs do not receive power restored message 2. Smart Metering System deems the request invalid 3. DNOs do not receive the confirmation response	On event (assumed to happen once a year) As above As above	On event (assumed to happen once a year) As above As above	12 hours

Manage Safety Issues

Use Cases	Potential data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO	Response time (latency) required by ENA
18 Manage meter safety alarm	**1. Smart Metering System sends alarm to DNOs**	On occurrence (assumed once a year)	On occurrence (assumed once a year)	15 min
	2. DNOs remotely disconnect the supply through the Smart Metering System (where deemed necessary)	As above	As above	15 mins
	3. The Smart Metering sends the confirmation message to the DNO	As above	As above	15 mins
	Alternative Flow: 1. DNOs do not receive the alarm 2. Smart Metering System deems the request invalid 3. DNO does not receive confirmation of the supply switch activating to cut-off supply	On event (assumed to happen once a year) As above As above	On event (assumed to happen once a year) As above As above	12 hours
19 Manage extreme voltage at meter	**1. The Smart Metering System sends alarm of a voltage level outside its configured tolerance levels**	On occurrence (assumed once every 6 months)	On occurrence (assumed once every 6 months)	Alarm in 15 min
	2. (Optionally) the Smart Metering System auto-disconnects itself from the network supply of electricity sending confirmation of disconnection to the DNO	On occurrence (Assumed to happen once a year)	On occurrence (Assumed to happen once a year)	Alarm in 5min (Possibly require 30 secs to 2 mins)
	3. Supply is enabled by DNO after emergency/safety action	As above	As above	Alarm in 5 min (Possibly require 30 secs to 2 mins)
	Alternative Flow: 1. The Smart Metering System fails to send the extreme voltage alarm 2. The Smart Metering System fails to auto disconnect	As above As above	As above As above	12 hours

Support Network activities

Use Cases	Potential data exchange scenarios:	Data granularity at meter (registered at the meter)	Data transmission granularity to Central Data Repository/DNOs	Response time (latency) required by ENA
20 Configure Smart Metering System	**1. DNO configures meter reading registers (this is confirmed by the metering system)**	On occurrence – assumed to happen every 3 years	On occurrence – assumed to happen every 3 years	Assumed 15 mins up to 12 hours (i.e. confirming meter changes)
	2. DNO configures meter alarms (this is confirmed by the metering system)	As above	As above	
	3. DNO configures meter load threshold (this is confirmed by the metering system)	As above	As above	

Use Cases	Potential data exchange scenarios:	Data granularity at meter (registered at the meter)	Data transmission granularity to Central Data Repository/DNOs	Response time (latency) required by ENA
	Alternative Flow: 1. Smart Metering System deems the request invalid 2. DNOs do not receive notification	On occurrence As above	On occurrence As above	

Table 2 – Summary of Gas Scenarios used for data traffic analysis per each Use Case

Use Cases	Potential data exchange scenarios:	Estimated ENA related Data granularity at meter (registered at the meter)	Estimated ENA Data transmission granularity to Central Data Repository/DNO	Response time (latency) required by ENA
01 Gather information for Planning	**1. The Smart Metering System sends the recorded gas demand data to the Gas Distribution Network Operator (assumed 6min interval data)**	Every 6 minutes every day	Every year	5 days
	2. The Smart Metering System sends the recorded gas demand data to the Gas Distribution Network Operator (assumed Daily registered data)	Every day at 6am	Every 6 months	5 days
	Alternative Flow: 1. Meter does not communicate requested data to the authorised GDN party 2. Meter data reads are missing / corrupted	On occurrence of event (assumed to happen once a year) As above	On occurrence of event (assumed to happen once a year) As above	12 hours
Use Case 02 – Configure Smart Metering System	1. **GDN configures meter reading registers (this is confirmed by the metering system)** (frequency of readings detail)	On occurrence – assumed to happen every 3 years	On occurrence – assumed to happen every 3 years	Confirmation almost real time
	Alternative flow: 1. Smart Metering deems the request invalid 2. GDNs do not receive confirmation	On event (assumed to happen every 3 years) As above	On event (assumed to happen every 3 years) As above	12 hours
Use Case 03 – Disable Supply of gas	**1. Gas is disabled by GDNs, meter sends acknowledgment.**	Assumed every 3 years	Assumed every 3 years	Updated to 1 hour (previously assumed real-time for smart grid needs)
	Alternative Flow: 1. Smart Metering deems the request invalid 2. GDN does not receive confirmation	On event – assumed to happen once every 3 years As above	On event – assumed once every 3 years As above	12 hours
Use Case 04 Display Messages from Gas Distribution Network	**1. Meter displays message from GDNs to customer display**	On occurrence – assumed to happen once every 10 years	On occurrence	Updated to 1 hour (previously assumed real-time for smart grid needs)
	Alternative Flow: 1. Meter fails to send confirmation message	As above	On occurrence	12 hours