Smart Metering Programme

Technical Review

Commission for Energy Regulation
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REVISION HISTORY

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EXECUTIVE SUMMARY

The Commission for Energy Regulation (CER) recently appointed DNV KEMA to conduct an independent technical review of the high-level end to end technology solution which has been proposed for the Irish smart metering roll-out. DNV KEMA was specifically asked to evaluate the system architecture and the functional requirements as laid out in Section 5 of decision paper CER 12 008 (published on 4th July 2012).

Each of the decisions regarding the high level solution architecture (around Section 5) has been separately reviewed and where necessary, DNV KEMA has gathered further information to inform its conclusions:

- From the stakeholders who are ultimately to be responsible for the smart metering roll-out in Ireland (ESB Networks (ESBN) and Bord Gáis Networks (BGN)),
- From its international experiences gained as a result of working on a variety of other roll-outs, and
- From its international experts working in the areas of smart meter testing, communication protocols and cyber security.

During the review, DNV KEMA has found a large portion of the proposed end to end technology solution to be appropriate in the sense that it aligns well with the projected benefits which were laid out in the cost benefit analyses for electricity and gas (papers CER/11/080c and CER/111/180c). However, DNV KEMA has also uncovered a number of areas which would appear to be either excessive or under-engineered in terms of their specification and has provided some detailed commentary around these.

A traffic light system was considered the most appropriate means to illustrate which areas DNV KEMA was in agreement with and which areas were deemed to be requiring more thought as the design phase progresses. Therefore, it follows that the “amber” or “red” items highlighted are areas that in DNV KEMA’s opinion require either increased focus going forwards or further refinement. These include:

- Security and data protection: This is a highly sensitive issue and in many programmes the subject of security and data privacy has been left quite late resulting in unplanned delays. Following stakeholder meetings we are assured that the subject ranks highly on ESBN and BGN's list of priorities in Ireland. This area, and the consequent risks associated with it, is developed further in the main body of the report;
- Half hourly (HH) gas profile data transmission to IHD: The requirement for HH gas data transmission to the In Home Display (IHD) was thought to be overstated in the initial decision statement but through the review process was deemed to be relevant given the comparative

requirement in GB and other supporting functionality linked to this. We develop this in the G-Meter section of the report;

- Daily poling of meter data: DNV KEMA questions whether daily poling of metered data is necessary in all cases, particularly in respect of residential customers. We discuss this in the report and recommend a review of the requirement during Phase 2 of the project;
- Prepayment options – in particular the 'thick' Vs 'thin' debate: Given that both options can be supported technically, we suggest deeper research (particularly in terms of what customers are prepared to accept) in relation to both models. Such research should help to determine whether there are any significant differences between the two models when it comes to customer management (legacy customers) and whether telephone (or similar) based information is a suitable option for the majority of prepay customers;
- System configuration: The proposed systems solution as shown in the high level design architecture, has been reviewed in terms of the technical application and the respective costs of two independent systems Vs a single shared arrangement operated by ESBN on behalf of BGN. Our findings indicate that a dual system model is likely to be the more favourable option. Overall it carries less project risk and any additional cost, in our opinion, is likely to be minimal, especially when considering the integration costs on the BGN side and possible additional system management burden on the ESBN side. Our findings are developed in Section 6.10.1
- Provision of a dedicated data portal: There are a number of issues around the provision of a data portal in terms of data provision to customers for energy efficiency purposes. We believe the requirements of the Third Package are adequately served by inclusion of an IHD and the requirement to store HH data on the meter. We also believe that a data portal could be part of stakeholder/supplier initiatives, aimed at differentiating themselves in a broader commercial sense. DNV KEMA conclude that more work is therefore required to crystallise customer need and expectation;
- Testing, certification and interoperability: DNV KEMA recommends the establishment of appropriate processes around testing, certification and interoperability assurance to ensure the smart metering solution is fully compliant with the requirements and the asset life is utilised in the most efficient way.

The report structure follows a similar sequence to section 5 of the decision paper, dealing with metering functionality first, followed by Wide Area Network (WAN) and Home Area Network (HAN) technologies. Procurement, systems and broader IT issues are covered off within the latter sections. On the request of the CER, DNV KEMA has also provided some supplementary thoughts around WAN technologies, security and product testing and assurance.

DNV KEMA recognises that the systematic approach being adopted by the CER and the lead participants' is structured to eradicate the programme risks as far as is humanly possible. In this regard DNV KEMA fully supports the process that is being adopted and, with certain documented reservations, the overall solution proposed in Ireland.

CONTENTS

LIST OF TABLES

1 INTRODUCTION

The introduction of smart meters in Ireland will provide consumers with more visibility and control over their energy consumption and spending, with information provided via their in-home displays and individually tailored supplier led initiatives. Supported by a range of incentives to promote energy efficiency, consumers will be empowered to make use of more accurate consumption data and tariff signals which will in turn help drive a change in behaviour.

Recent trials have shown that smart meters will allow consumers to play a more active role in the energy market. In doing so, they will have more control over when and how they use energy and will be able to switch more easily between suppliers. Furthermore, as more data becomes available, industry participants (suppliers, network operators and producers) will inevitably be looking for new ways to manage their operations, leading to further benefits.

Time-of-use tariffs (ToU) and other incentives will help to reduce demand at peak times, which will in turn reduce the need for costly investment in network and generation capacity. Subject to appropriate consumer permissions and protections, smart metering data will enable network operators to make better-informed investment decisions and deploy smart grid technologies to create a more cost-effective infrastructure, thus further supporting the transition to a lower carbon economy.

The forecast benefit of the impending infrastructure will, however rely, to a large extent, on the successful implementation of supporting equipment, technologies and infrastructure and carefully structured and managed pre-deployment programmes. This is essential if forecast benefits are to be realised (or exceeded) and deployment costs managed within original budget expectations.

The process adopted in Ireland has been structured to provide deep understanding of the technologies available and gain an informed appreciation of the extent to which customers are likely to embrace the benefits (cost information, tariff choice, new products and services) that ensue. In this regard the Irish market is more advanced than other European counterparts, and has some of the most comprehensive and relevant data from initial customer trials.

Having published the high level requirements, the Commission for Energy Regulation (CER) is now pushing forward with the second phase of the National Smart Metering Programme, whereby the design will continue to be developed with the involvement of all relevant stakeholders under an appropriate governance structure and against a detailed implementation plan.

2 SMART METERING

Smart meters are the 'new generation' of meters, which will replace electro-mechanical/diaphragm meters and offer a range of benefits for both electricity and gas customers and for the electricity and gas industry in general.

A smart meter can facilitate many useful functions, not least the timely provision of a customer's usage patterns allowing them to make more informed decisions around how and when they use energy. Behavioural changes can further be stimulated via a range of tariff options (and energy products). As time goes on, suppliers, network operators and producers will benefit from vastly improved access to meter data by delivering enhanced system management, cost reduction and more efficient customer supplies and services.

Technology is advancing all the time, and what was initially appropriate in early deployments, may not be appropriate in all of those that follow. What is important is that the learning's that are available are heeded, mistakes are not repeated and the solution chosen is right for the situation intended. The solution should also be 'future proofed' in the context of the system's assumed asset lifetime but not over-engineered. Smart meters and the associated communications infrastructure needed to support them are costly and, by the nature of their deployment there is more to go wrong with them than the more traditional meters - therefore any new risks need to be understood and where possible eliminated at the design stage.

Infrastructure security and data privacy is becoming increasingly important in smart metering deployments and happens to be a key focus area of this review. Although general security rules and standards are available, the whole subject of data security and privacy for smart meters is still evolving. It is therefore critical at this stage of the project that what is proposed is viable, and reflects the best system security and data protection offerings available at the time.

The European Smart Meter Industry Group (ESMIG) is chairing a group which was created by the European Commission to look at 'regulatory recommendations for data safety, data handling and data protection', and it would be reasonable to expect outputs from this group to find their way into the architectural design evolving in Ireland.

As well as giving suppliers access to accurate data for billing and to improve their customer service, it is also intended that customers will have ready access to tariff and consumption information allowing them to make more informed decisions regarding the way energy is used in the home and to take more control over Time of Use (TOU) pricing options and energy efficiency/management incentives.

Not all of this innovation will necessarily be available at the point of deployment; indeed, it is more likely that products and services will evolve over time as suppliers, network providers and customers grow, both in terms of their understanding and expectations. It is something of a certainty that more customer research will be needed to validate key customer facing requirements and justify any outstanding data/infrastructure refinements that might be incorporated (or otherwise) as part of the regulated infrastructure programme.

2.1 EU Legislation and Early Movers

The benefits of smart metering have been recognised internationally and there are a number of key EU legislative instruments which promote smart metering. These are contained in within the third package requirements for Electricity and Gas – which are designed to deliver a competitive, efficient and integrated energy market allowing European consumers to choose between different suppliers, irrespective of their size and ease of access to the market.

To date, progress in Europe has been mixed; but there are a large number of projects beginning to gather momentum. With the exception of Italy, Sweden and Finland, where varying forms of smart metering have already been implemented, many other projects are in the design/trial phases, not least Great Britain (GB). In some countries, individual energy companies are making (or have made) their own decisions to roll out smart metering to their customers. Denmark is a prime example - where there is no national plan as such. Most of the newer projects, stimulated by the Energy Services Directive and the Third Energy Package, have a much greater focus on energy savings as opposed to just operational efficiencies.

On an international note, smart metering production volumes continue to rise at a frightening pace. Whichever part of the world you look at, there remains a good deal of uncertainty about the ultimate realisation of benefits (the smart meter being merely the enabler). There is also a great deal of uncertainty around the longevity of smart metering technology as it is not until the smart meters have been on the wall for a number of years that statistical data becomes meaningful. There are a number of barriers which continue to have the potential to delay smart metering projects:

- Most utilities have difficulty justifying the costs on the basis of their own benefits alone – this is why there is now an increased focus on energy efficiency.
- Large scale roll outs are very long and costly processes, requiring considerable capital investment from the responsible parties. This is coupled with the inevitable back-drop of rising energy prices.
- Lack of ‘open standards’ has inevitably slowed the adoption of smart metering: Mandate M/441 and the FP7 Open Meter Project, with the support of industry, delivered a major programme to define the requirements and put a set of standards in place. DNV KEMA had a

major role in the project. There remains a lack of best practice, particularly when it comes to security.

However, the trials that have taken place in Ireland have helped to inform many of the local uncertainties and in DNV KEMA's opinion, provide a particularly well informed platform from which the decisions to date have been made. There are, however, a number of key areas that will benefit from further refinement and these have been highlighted in the review.

3 PROGRESS TO DATE

The rollout of electricity and gas smart meters in Ireland represents a major investment in national infrastructure, estimated to be in the order of €1 billion. Supporting cost-benefit analyses (CBA) states that the long-term benefits that should be realised could exceed the investment cost by around €229 million (net present value over a period of 20 years). It also indicates that further, non-quantifiable benefits, are possible in terms of informed consumers, technological innovation, and synergies with other areas of utility provision.

By firming up on the high level design and requirements for the smart metering programme, the CER is able to move the National Smart Metering Programme forward into Phase 2. The high level design and requirements set out in the decision paper will be refined with the involvement of all relevant stakeholders so that the detail and procurement arrangements can be finalised.

Within the decision paper published by the CER in July 2012 (CER/12/008) and following consultation with relevant stakeholders, a number of position statements were published pertaining to:

- Electricity smart meter functionality;
- Gas smart meter functionality;
- Wide Area Network (WAN) technology proposals;
- Home Area Network (HAN) technology proposals;
- Back end systems; and
- The 'end to end' procurement model

The final CER position on each of these proposals is to be developed further during the current phase of the programme (Phase 2) as per the high level timelines shown in Figure 1.

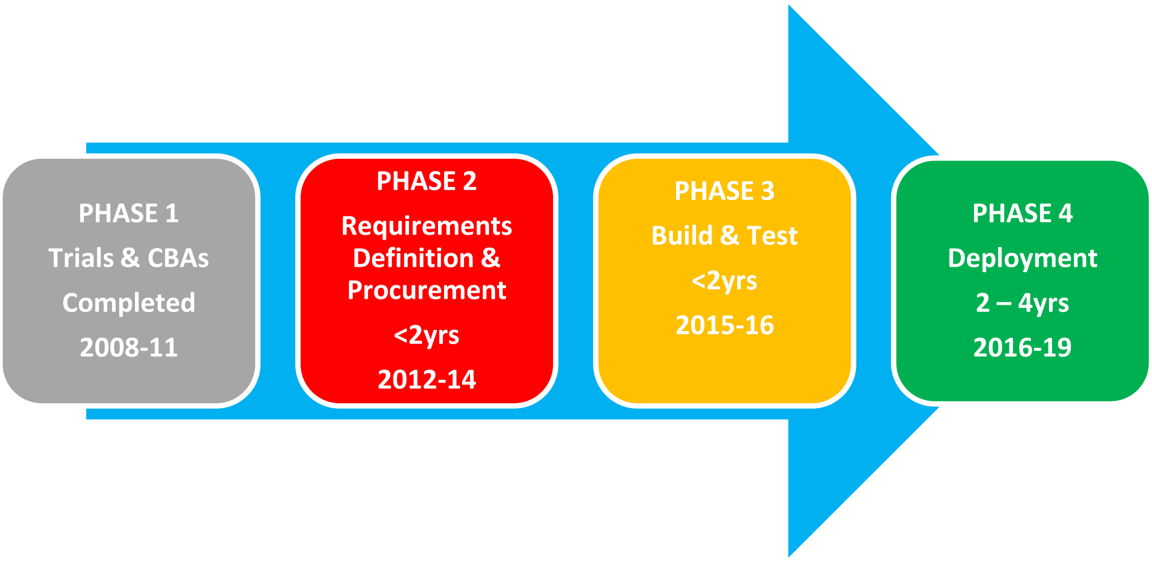

Figure 1: CER timescales

The following points highlight the progress made by CER to date:

- The CER and the Department of Communications, Energy and Natural Resources (DCENR), established the first phase of the smart metering programme in late 2007.
- Between 2008 and 2011, a number of smart metering trials were conducted to assess performance characteristics, costs and benefits.
- In 2011, comprehensive electricity and gas smart metering trials findings reports, and cost-benefit analyses reports were published by the CER which suggested there was a compelling business case to move forward with smart metering for electricity and gas customers in Ireland.
- This was further confirmed by a decision paper (published in July 2012) covering CER's decision to move forward with a 'requirements definition and procurement phase'.

4 PURPOSE AND METHODOLOGY

DNV KEMA was engaged to carry out a detailed review of the CER's position statements regarding the proposed end to end smart metering architecture, as laid out in the decision paper, CER/12/008. The analysis was primarily focused on section 5 of the paper, but there were also a number of other areas which came up during the review.

Throughout the engagement, DNV KEMA utilised the extensive knowledge of its specialist consultants primarily in GB, the Netherlands, Germany and the US to assist in providing constructive critique and/or validation of the position statements, to the extent that they are:

- Likely to broadly align with the CBAs undertaken;

  - To achieve this, DNV KEMA has considered the intent of the earlier electricity and gas CBA's and the possible impact that any variation or departure from intended functionality, information exchange and/or technology choices might have on the perceived outcomes.
- In line with international best practice and EU requirements;
  - DNV KEMA has drawn on its international experience of smart metering in the Netherlands, Germany, Spain, the US and Australia (Victoria and South Australia). Importantly, DNV KEMA has used its intimate knowledge of the GB programme and its association with vendors and manufacturers to qualify and compare what is currently being proposed in Ireland.
- Technically possible (from a high-level);
  - In the application of smart metering, much is technically possible from both a functionality point of view and in terms of the infrastructure and devices that support it. Making certain that the system works efficiently and economically everywhere however, is a much broader debate. In this regard, DNV KEMA has again drawn on experience of smart metering trials (particularly in the Netherlands, Germany, Cyprus, California).
- Pragmatic, from a future proofing point of view (if and where necessary) and not over-engineered;
  - This applies to the general application architecture that is currently being proposed and the functionality/service delivery (e.g. customer data/information and frequency) that key participants feel it is necessary to put forward for support by this programme.

As well as reviewing the position statements provided, DNV KEMA also explored a number of other topics, as requested by the CER. This included a brief look at ESB Network's (ESBN) white paper covering security issues and some of the original responses (in particular from the suppliers) to CER's consultation prior to the announcement on 4th July 2012. As the project has progressed, there have been a number of face to face meetings and teleconferences with the CER, ESBN and Bord Gáis Networks (BGN) to focus in on some of the key decision points and obtain further information to inform this review.

A rolling 'issues log' was created to track and follow up on all technical enquiries and information requests, and thus forms the basis for this report. Note, that throughout the report, where DNV KEMA has suggested that a proposed functionality or technology may carry a cost premium, this has been ranked as high, medium or low. Similarly, any additional benefit that might (as a result of inclusion) be realised, has been ranked as high, medium or low.

As will become apparent in the subsequent sections, a traffic light approach was adopted to indicate where DNV KEMA is broadly in agreement with specific proposals (green); where a more detailed investigation was thought to be relevant (amber) and where there is thought to be some cause for concern that should be further addressed in Phase 2 of the programme (red).

5 END TO END SOLUTION

When considering the proposed solution in Ireland DNV KEMA has been mindful of ESBN's role in the overall deployment of the system; CER's position in ensuring independence and impartiality; and the differences in industry structure in Ireland, and in other countries used in this review, to compare technology choice, deployment methodologies and supporting business processes. The following schematic depicts the high level smart metering architecture considered in Phase 1 of the programme.

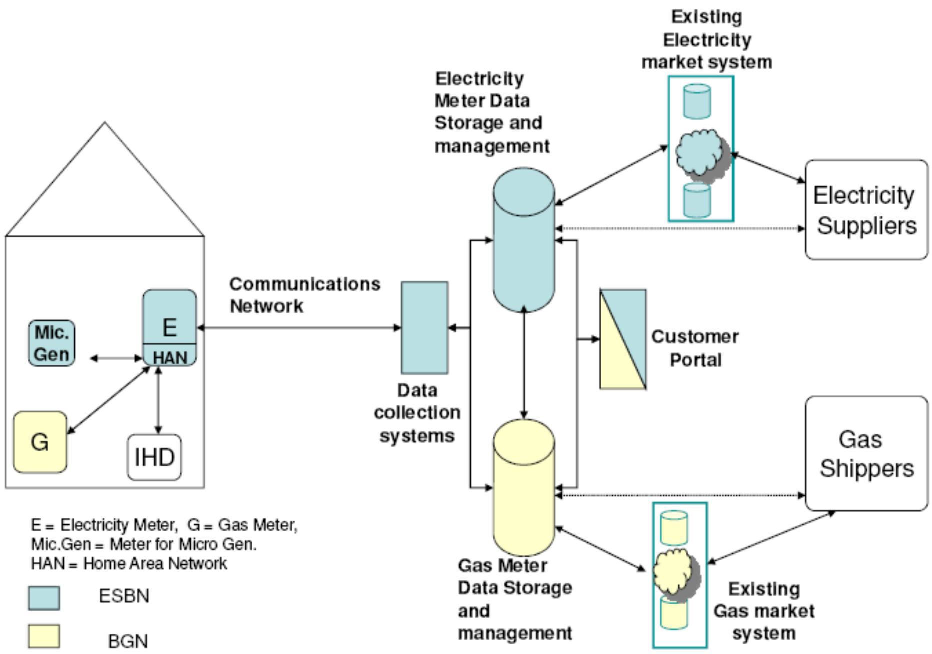

Figure 2: Smart metering architecture proposed in CER/12/008

DNV KEMA has reviewed the schematic and is able to confirm that the proposals i.e. the high level design of the solution, are broadly compliant with the requirements of the programme. It has been acknowledged that a key feature of the solution design is that both electricity and gas smart metering will leverage a single communications (WAN and HAN) arrangement where the gas meter (owned and operated by BGN) will piggy back the infrastructure arrangements provided by ESBN. This is a common undertaking in multi utility projects, whereby the lead utility procures the communications infrastructure.

Using the electricity meter as a communications hub for the gas meter and other in home services is not uncommon. Modular communications options are becoming more popular (for future-proofing) as WAN technologies continue to evolve rather than that of the meters themselves. Clearly there are variations on this; most notably the situation in the GB case where a separate WAN communications module is proposed; and the Dutch Smart Metering Requirements (DSMR) where the agreed model is to operate a series of meter ports to facilitate connection to the various utility and non-utility elements of the system.

Whatever the high level arrangements and aspirations, if the programme is to be successful, the solution should be fully integrated, where ongoing operation and maintenance priorities are considered alongside interoperability, data privacy and security issues. DNV KEMA would make the observation that there is insufficient detail at this stage regarding these matters, other than passing references to data encryption and security. We recognise that Phase 2 will deliver this detail and suggest that these requirements are given some further clarity (in a planning sense) before proceeding too much further. Items such as testing, certification and interoperability also require special attention and whilst we note that Phase 3 of the project provides for this, we would advise the CER to consider the implications for testing at the design phase.

DNV KEMA has identified a number of functional/technology requirements that, in our opinion, need further consideration prior to accepting their absolute need for inclusion, particularly when we compare and contrast with other programmes at this time. These are picked up in full in the subsequent sections. With regard to the high level architecture that is proposed, there is a question over the need for two separate data management systems (ESBN and BGN) and this has also been considered in our analysis.

There are of course risks as with any large scale deployment; perhaps the primary one being that it is not possible to categorically predict how the performance of the system (that is ultimately procured) will pan out relative to the specification. DNV KEMA recognises that the systematic approach being adopted by the CER and the lead participants is structured to eradicate the risks as far as is humanly possible and in this regard DNV KEMA fully support the process that is being adopted and the solution proposed in Ireland.

6 REVIEW OF HIGH LEVEL REQUIREMENTS

The regions with the closest similarities to Ireland are clearly those closest to home, namely GB and the Netherlands and from DNV KEMA's perspective the proposed Smart Meter specification, with certain exceptions, is broadly in line with what has been seen in these programmes. Naturally all utilities considering deployment options at this time are seeking to incorporate functionalities that appear to maximise benefit, and in all cases, where DNV KEMA has been involved, the cost/benefit trade off is an often a key focus area that requires lengthily consultation between participants and decision making support on the part of the regulatory authorities and peripheral advisors. There are, however, some obvious differences and these are discussed in detail in the following review of the CER's position statements. Following consultation with stakeholders and industry participants, the decisions, taken by the CER, has led to broad agreement between participants regarding the functionality to be incorporated in the provision of smart meters (electricity and gas) in Ireland.

During the requirements definition and procurement phase of the project it is intended that these proposals will take on more detail and clarity in terms of their function and application, and in the way customer data will be transmitted, exchanged, managed and protected once the system is rolled out. The following section therefore covers DNV KEMA's independent review of the CER's decision/ position statements addressing:

- Electricity smart meter functionality;
- Gas smart meter functionality;
- WAN technology proposals;
- HAN technology proposals;
- Back end systems; and
- The 'end to end' procurement model

DNV KEMA has examined the above areas using experience gained during other smart metering programme preparations and technology trials. This is in conjunction with the extensive work carried out in DNV KEMA's smart meter test facilities in Arnhem, Madrid, Dresden and the US. With this in mind the review of each decision area incorporates a general overview, to set the scene and provide broad opinion in relation to the specific review area, followed by a more detailed breakdown (aligned to the decision paper) of the key elements/proposals contained within each area.

6.1 E-Meter

The decision in GB is to go with a separate communications hub for local HAN and remote WAN communications; whereby the meters and the In Home Display (IHD) communicate with the communications hub via mostly low power radio (using Zigbee 1.x) and the hub provides customer data to all relevant systems via (what could be up to three) different communication service providers and a single data services provider. The chosen protocol for the WAN is DLMS COSEM[1],

[1] **DLMS** or Device Language Message Specification (originally Distribution Line Message Specification) is the suite of standards developed and maintained by the DLMS User Association and has been co-opted by the IEC TC13 WG14 into the **IEC 62056** series of standards and **COSEM,** or Companion Specification for Energy Metering, includes a set of specifications that defines the Transport and Application Layers of the DLMS protocol.

albeit depending on the communications solution chosen, there maybe a need for a translation at each end to ensure efficient data transit. Some of the more contentious issues, such as interoperability (of devices and components) and system security are still being debated. A key learning for the Irish roll-out is to try and address such issues as early as possible in the design phase, accepting that there are no de-facto standards. There are a number of debates going on in this area however.

The Dutch model also differs from the Irish model in that the metering system provides a series of ports from the meter to which other metering equipment and ancillary devices may be connected. The ports are numbered P0 – P4 and are applied as follows:

- P0 used for communication with external devices (e.g. hand-held terminal) during installation and on-site maintenance of the metering installation;
- P1 for communication between the metering installation and auxiliary equipment if and when required (a maximum of 5 appliances can be connected). P1 is a read-only interface, i.e. it cannot be used for sending data to the metering system;
- P2 for communication between the electricity metering system and up to four other meters, and/or utility devices;
- P3 for communication between the metering installation and the central access server; and
- A further port (P4) is often referred to and this represents the connection between the central access server and the data provision to other industry participants.

The Dutch implementation is based on a single defined set of functionalities across the entire deployment that will be delivered as part of the smart meter for a single fixed price. Smart metering in the Netherlands has been a sensitive subject with much debate surrounding data privacy and mandated deployment. The current status is that consumer groups have accepted bi-monthly billing and additional functionality on the meter that provides an 'administrative off' function that can be exercised at the consumer's request; it has also been agreed that the consumer will have the option to refuse a smart meter if they so wish.

6.2 E-Meter Functionality

In the context of what is proposed in Ireland, the following table summarises DNV KEMA's findings and actions in relation to the CER's electricity meter functionality proposals.

DNV KEMA Alignment to E-Meter Proposals	DNV KEMA Review	DNV KEMA Concerns
12/18	5/18	1/18

Table 1: E-Meter Review

Given that we are comfortable with twelve of the eighteen decision points, each of the elements highlighted in the amber and red sections (where a further review has deemed to be necessary) are expanded upon below.

6.2.1 **E-Meter – Green items**

DNV KEMA broadly agreed with the following electricity meter requirements:

Ref	E-Meter Function
1	Half-hourly profile data.
2	Facilitate a minimum of three types of tariffs: energy import tariffs, energy export tariffs and possible network tariff. The meter will provide a minimum of twelve rate registers - this will be kept under review during the Design stage.
3	Import and export measurement.
4	Wattless energy measurement (where justifiable).
5	Events such as power outages recordable on the meter.
6	Alerts can be recorded on the meter, for example if there are attempts to remove the meter cover or tamper with the meter.
9	Single controllable physical circuit for legacy loads such as night storage heating (only where legacy load requires).
11	Firmware upgradeable.
14	Life of meter typically 15-20 years.
16	Potential requirements for prepayment functionality on the meter will be determined during the Design stage.
17	Meter serial number or other identifier
18	Clock synchronisation

Table 2: E-Meter – Green items

6.2.2 E-Meter - Amber Items

Table 2 itemises each of the features categorised as amber, and reviewed by DNV KEMA. The reference numbers correspond directly to the CER's current decision on E-Meter functionality, as per the decision paper of 4th July 2012.

Ref	E-Meter Function
7	Voltage / Power quality monitoring available as required
8	Remotely operable embedded switch for de/re-energisation
10	Load Limiting Capability
13	Ability to Store Data on the Meter for Agreed Period of Time
15	The communications module, which will provide the WAN and HAN capability, will be incorporated in the electricity meter

Table 3: E-Meter – Amber Items

Voltage/Power quality monitoring available as required: This relates to a distributor benefit that allows the network operator to remotely monitor voltage quality (and hence network disturbance) in the immediate vicinity of embedded generation facilities.

Voltage control around distributed generation projects can also be managed adequately using embedded network technology. For example, control technology developed by Senergy Econnect can enable the connection of additional power generation on a remote part of a network. GenAVC – an Active Voltage Control scheme - has been successfully trialled to assist in the connection of distributed generation and is being referenced generally as a practical example of available technology/systems. GenAVC is sited as a network technology that can be applied selectively, as the need arises, rather than providing functionality through the meter where in the majority of cases it will remain a dormant function for the service life of the meter.

Having investigated the proposal it is widely accepted that voltage/power quality monitoring functionality is generally embedded in the metering software and provided at no additional cost. There may, however, be other costs associated with monitoring the condition of the network in specific areas and this might involve additional software packages, additional data transmission costs and system management applications that need to be factored into the proposed solution.

Having discussed this with ESBN, DNV KEMA understands that their interest is confined to highlighting the inclusion of voltage/power quality monitoring in the proposed functionality of the E-Meter. The interest at this stage is in making sure information of this kind can be captured. Voltage quality monitoring, the investigation of voltage complaints and outage management are intended to feed into a separate stand alone system forming part of an independent ESBN network management project. DNV KEMA supports this functionality as a no cost (embedded) item that ESBN value as being integral to future voltage monitoring/investigation programmes.

Remotely operable embedded switch for de/re-energisation: In discussions with the CER it is DNV KEMA's understanding that the de/re-energisation switch has been mandated and agreed as a feature that will be incorporated in the functionality of the meter. In this regard switch standards and capability should be rigorously scrutinised to ensure the function (and therefore the meter) is fit for purpose and retains function capability over the maximum predicted life of the meter (see load limiting review). Standards and capability testing may be advisable to ensure long term viability of the feature, safety of customers and avoid unnecessary premature failure and consequent meter replacement. On a practical note, customer confirmation of remote supply re-energisation is essential to ensure that the household is aware the electricity has been switched back on. Such issues should feature somewhere within the design principles.

Again, from a practical point of view, it is important to highlight that remote de-energisation capability of the meter should not be overused. Suppliers should not be able to disconnect customers immediately after a first payment is missed because they could be vulnerable/elderly customers. Arrangements should be put in place to ensure that this ‘technical feature’ is used for only the reasons intended. There is also an issue around security (malicious attack) which should be considered alongside the broader security arrangements.

This item is considered to be the norm in all other programmes. It tends to go hand in hand with anti tamper features to deter non payment and repeated utility disregard. As a fairly blunt (but effective) instrument DNV KEMA recommends that a relevant Code of Practice (COP), or similar, is established to ensure compliance regarding its application and process. Consumer safety is particularly important and features highly elsewhere. The method by which customers are disconnected and reconnected must therefore be described in detail; particularly the sequence of actions that will be adopted to instruct consumers to reconnect their supply following disconnection. Overall, DNV KEMA supports the inclusion of this function.

Load limiting capability: This feature can be closely linked to the disconnect/reconnect item above, the driver being the provision of an early warning feature that can serve as a first step towards disconnection in extreme non payment situations. In this context it has potential, from a regulatory point of view, to aid debt recovery without fully applying the disconnection principle. Such a function can, arguably, help to reduce supplier costs and thus should benefit customers in general, provided that adequate safeguards are in place for the vulnerable, the elderly and fuel poor customers.

Load limiting/emergency conservation options are also considered in the network management context. How this might be applied in practice however, requires careful consideration as it is likely that customers would need to ’opt-in’ to a scheme and/or be incentivised to do so. Additionally there might be technical issues following restricted use on a broader scale than the pre-disconnection concept described above. The experience in the Netherlands was that remote switching and load limiting options became an issue regarding supply quality and the maintenance of supplies generally, post event.

An important criterion is also the frequency of switching and/or load limiting operations during the life of the meter. For industry standards to be met, switching frequency compliance should align to switching events of > 10.000. However, load limiting standards for this feature are not specifically defined and should be considered on a case by case basis.

The cost of such a function (over and above the standard functionality provided) is likely to be a 'medium' additional cost. On balance the benefits that might arise, as a result, are best described as 'medium' to 'low' over the short term, possibly rising to 'medium' over the long term, as network centric management functions become more commonplace and customers are prepared to buy in to demand side incentives.

DNV KEMA is supportive of this feature primarily because it provides a practical pre-disconnection option and, to a lesser extent, a network management feature that has possible potential. The existing consumer protection measures that apply to debt should obviously still apply when smart meters are introduced, but the CER will need to review the legislation, licence conditions and codes of practice governing the final stages of debt recovery/disconnection, and any potential uses of load limiting, to ensure customers are adequately protected.

Ability to store data on the meter for agreed period of time: The embedded meter functionality provides for most circumstances, although to date there is no firm decision on the Irish requirement.. DNV KEMA notes that a position on this will be reached during Phase 2 of the project. Requirements however, vary from country to country. In GB 13 months is stipulated as a long term requirement and an annual rolling position is thought to be of value to customers if made available through the IHD.

As an example, the GB Smart Metering Equipment Technical Specifications (SMETS) does not specify a time period, it specifies the number of entries required for each data type, i.e. 4320 entries of RMS voltage profile or 12 entries comprising tariff (TOU) register matrix or 13 months of Active Energy Imported which is arranged as a circular buffer so that when it is full, the oldest data can be overwritten/refreshed. Specifying the number of entries provides a clearer indication for meter manufacturers as to how big the memory should be. Much of what is likely to be specified, if aligned to other programme requirements, is delivered within the standard metering package and therefore carries no additional cost premium.

The EU Energy Efficiency Directive makes provision for smart metering in relation to data access and data availability. It includes a specific requirement regarding the provision of easy access to historical daily/weekly/monthly/annual consumption data for at least the previous 24 months via the internet or the meter interface. The following extract explains this:

Meters installed (in accordance with Directives 2009/72/EC and 2009/73/EC)[2] *shall enable accurate billing information based on actual consumption. Member States shall ensure that final customers have the possibility of easy access to complementary information on historical consumption allowing detailed self-checks. Complementary information on historical consumption shall include cumulative data*[3] *for at least the three previous years or the period since the start of the supply contract if this is less. The data shall correspond with the intervals for which frequent billing information has been produced. Complementary information on historical consumption shall also include detailed data according to the time of use for any day, week, month and year, and shall be made available to the final customer via Internet or the meter interface for the period of at least 24 previous months or the period since the start of the supply contract if this is less.*

DNV KEMA's position on this item is as follows:

- The outline proposal complies with the terms of the Directive in that;
    - It is able to deliver a meter memory that will service the day, week, month and year requirement locally; Beyond this, it is the suppliers responsibility to furnish customers with details of their consumption history up to at least 24 months; and
    - It is acceptable to provide this over a dedicated or supplier specific website (with appropriate account/password access) or by other means.

On this basis DNV KEMA is supportive of the functionality as described, but would caveat this with the statement that more precise detail of what is to be specified will be added in Phase 2.

The communications module, which will provide the WAN and HAN capability, will be incorporated in the electricity meter: Incorporating the WAN/HAN modules in the meter is a perfectly supportable solution. However, in certain situations, a non changeable WAN module could be a significant

[2] Interpretive note on directive 2009/72/EC concerning common rules for the internal market in electricity and directive 2009/73/EC concerning common rules for the internal market in natural gas.

[3] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:315:FULL:EN:PDF (see page L315/19)

oversight and prevent the meter owner taking advantage of new (rapidly changing) communications technologies, without significant and unnecessary cost.

With an integrated interchangeable WAN module this can be avoided as the communication module can be upgraded independently from the meter. DNV KEMA's assessment is that the additional costs are 'low' per meter but the benefits, including the likelihood of the communications module needing to be changed, are valued as 'medium'.

To put this into context, at present Dutch distribution companies are investigating 3rd Generation (3G) wireless and Code Division Multiple Access (CDMA) in place of General Packet Radio Service (GPRS) because of reported disappointing results with GPRS. Given the rapid changes that are taking place in the telecommunications space generally, in DNV KEMA's opinion the projected life of a communication module (in a wireless network context) is likely to be 5-7 years, whereas a Gas Meter is up to 30 years, however the gas battery life is estimated to be around 15 years taking into account a certain level of utilisation, and an Electricity Meter is regarded as 15 – 20 years. To maximise the benefit of this and ensure competition moving forward, DNV KEMA would like to see a universal footprint for circuit boards and power and data connections so that upgrade equipment/components are fully interchangeable (common connections) regardless of manufacturer.

The above commentary does however need to be considered in the overall context of the WAN technology selected. If, in the final analysis, PLC was selected, a modular solution is likely to be inappropriate, carrying additional costs with little or no medium/long term benefit. In the broader European context, PLC solutions tend to employ integrated communications technologies that support whole life deployment principles without the need for periodic upgrades.

6.2.3 E-Meter – Red Items

Ref	E-Meter Function
12	Strong Encryption and Secure Mechanisms for Joining the Smart Metering Network

Table 4: E-Meter – Red Items

Strong encryption and secure mechanisms for joining the smart metering network: Security measures are described at high level in the decision paper and provide recognition of the need for it to be seriously addressed as a priority area of the programme. However, whilst the intent is clear the detail had yet to be addressed, hence this being flagged as a red item. Added to this, in other smart metering examples the subject of security and data privacy has been left quite late, and this has resulted in unplanned delays and unforeseen difficulties for the advancement of projects; in the

Netherlands, for example, it is well known that the industry was blind sided by security and data privacy to the extent that it completely derailed proceedings until a form of resolution could be found; and even in GB security requirements are yet to be finalised.

The stakeholder meeting with ESBN that took place on the 9th October 2012 enabled DNV KEMA to gain a clearer understanding of the process that is already underway. During the meeting DNV KEMA learnt that significant preliminary progress is being made regarding security and data privacy arrangements in Ireland. ESBN have now published their early thoughts on this, outlined in their major guiding principles document (Full Rollout Security Principles – September 2012). It is designed to provide assurance to all stakeholders, that security and data privacy is integral to the design of the system, and that all possible safeguards will be put in place to maintain the security and privacy of customer data. The document is an excellent demonstration of ESBN's intent for Phase 2.

In terms of cost, the GB smart metering CBA network security cost is included in the communications service charges, which is estimated at £5.30 per household per year. In present value terms the programme costs amount to £1,312m in total. DNV KEMA have observed that a cost of around €5m for security has been included in the Irish business case under business and networks operations centre costs which equates to approximately £2.27 per customer. Some clarification regarding what is likely to be delivered is recommended so that the cost allocation can be assessed as reasonable or otherwise.

Having been through the process, DNV KEMA is confident that this important area is very high on ESBN and BGN's list of priorities. In summary we believe ESBN is moving in the right direction, is highly informed and is heeding learning's from elsewhere e.g. the Netherlands where a great deal of work has been carried out on data protection and security, this is noted in the major guiding principles paper provided by ESBN. Quite obviously, the next steps will form an important feature of Phase 2 in terms of the solution that is to be applied, how it will be implemented and the project cost.

DNV KEMA has provided some further thoughts around security in section 8.

6.2.4 E-Meter Functionality Summary

6.2.4.1 Main observations

The major points coming out of the E-Meter review are as follows:

- The **voltage quality monitoring** facility was initially thought to be an issue. However, the review confirmed that no additional costs are incurred by its inclusion and the stakeholder feedback also confirmed that the interest is confined to highlighting the inclusion of voltage/ power quality monitoring in the proposed functionality of the E-Meter at this early stage. This will enable more effective voltage complaint/outage management investigation and resolution which we understand, quite separately, will form part of an independent ESBN network management project. DNV KEMA is supportive of this item in the context described;

- The **disconnect/reconnect** feature is supported by DNV KEMA and carries a cost that has already been factored into the projected analysis. However, safety requirements should be brought out in the detailed smart metering functional requirements as remote re-energisation and de-energisation brings with it safety risks. Appropriate governance should also be put in place to deal with the de-energisation of customers i.e. the method by which customers are disconnected and reconnected should be described in detail; particularly the sequence of actions that will be adopted to instruct consumers to reconnect their supply following disconnection.
- DNV KEMA is supportive of **load limiting functionality** primarily because it provides a practical pre-disconnection option for customers. To a lesser extent it also provides a network management feature that has possible potential for demand side measures in the future. There is an additional cost for this (over and above standard functionality) but this is thought to be outweighed over the medium term by the benefits that it will deliver. In relation to pre-disconnect the existing consumer protection measures that apply to debt should obviously still apply when smart meters are introduced. The CER should therefore review the legislation, licence conditions and codes of practice governing the final stages of debt recovery/disconnection, and any potential uses of load limiting, to ensure customers remain adequately protected.
- In relation to **storing data on the meter** for an agreed period of time there is a need for more detail – we recognise that this is to be finalised during the design stage. In this regard, similar to SMETS, there should be a focus on clarifying exactly what data should be permanently on the meter and what data can be on a rolling memory, also specifying the number of data entries that CER, ESBN, BGN & Suppliers would like the meter to store, for example;
    - Device identifier and firmware version – permanent data;
    - Voltage requirements;
    - Configuration data - can be changed or updated, i.e. thresholds for block tariffs, TOU tariffs;
    - Operational data such as demand and consumption information which could be retained for a pre-determined time period; and
    - The period that data is to be held for.

In principle this is an important customer information feature that DNV KEMA supports for inclusion. However, a practical balance needs to be struck between the provision of data at the IHD and the requirement for data specified by the Energy Efficiency Directive; which for compliance can be provided via supplier web access or other means.

- DNV KEMA believe that in appropriate situations, for example, wireless applications, a **modular WAN** is essential to allow for future upgrades independently from the meter, making the solution cost efficient and future proof. However, we recognise that one size does not fit all circumstances, and where PLC is applied, for example a modular solution is likely to be inappropriate, carrying additional costs with little or no medium/long term benefit. Phase 2 of the programme will naturally determine the technology choice for Ireland and hence the most appropriate WAN capability at the meter.
- By far the most important area in our opinion is that of **system security**. The description provided - 'Strong Encryption and Secure Mechanisms for Joining the Smart Metering Network' - indicates that data privacy and security is being taken seriously. Having discussed this area with stakeholders and had access to the Full Rollout Security Principles document being produced by ESBN, DNV KEMA is confident that this important area is very high on ESBN's list of priorities. In summary we believe ESBN is moving in the right direction, is highly informed and is heeding learning's from projects elsewhere. With this in mind we are assured that security and data privacy will be integral to the solution and that all possible safeguards will be put in place to maintain the security and privacy of customer data. System security nevertheless remains a red flag item to illustrate its priority in relation to other proposed E-Meter functionalities and infrastructure choices.

6.2.4.2 Other areas for consideration

Electricity Prepayment: The CER smart metering consultation paper considers two models for prepayment, namely, the 'thick' and 'thin' models. From a technical perspective both models are equally achievable within the system architecture proposed. Primarily the differences are that the 'thick' solution favours a customers credit balance to be held locally (at the meter), whilst the 'thin' option relies on credit balances to be held remotely by the utility i.e. a central systems function. For information the GB requirements call for the prepayment calculations to be done at the meter and credit balance information to be displayed at the IHD i.e. the thick model.

Ideally all meters should be able to operate in prepay and credit mode and be remotely switchable between the two. This common functionality (in all meters) has the advantage of helping to reduce the costs of procuring, installing and managing meters. In theory it has the added advantage of equalising costs (and services) between credit and pre-payment options over a universal pre-pay platform. Economically and technically this favours a 'thin' solution as the base prepay functionality is generally available in a standard smart meter package. Applying a thick option would mean either procuring a more expensive meter for use across the entire deployment platform or making prepay specific meters available to individual customers as required.

A key success factor in applying prepayment services in this way is the method(s) by which account balance information is handled by the supplier. The success of prepay mobile phone tariffs indicate that the ways of topping up credit are likely to increase over time and energy companies can learn from this. Payment over the phone and internet are obvious options, but others could include ATM's, supermarket checkouts, banks, post office counters and/or via mobile operators (transfer part balance to energy accounts) through their current top up arrangements.

We note that the CER has carried out trials of the thin model due to it being fairly new to the industry. In these trials daily balances were made available to participants by phone (IVR) and by text message (SMS) and accounts found to be in breach of an agreed threshold received a reminder by SMS. The key issue here, is what is likely to be the optimally acceptable update (credit balance) frequency for the vast majority of customers and this may require more research across a more representative sample of the prepay customer base.

Supplier tolerance and flexibility is also likely to play an important part in the change process, retaining such measures as:

- Emergency credit - a fixed value of gas or electricity available to be consumed at any time of day regardless of credit status;
- Specific non-disconnection or friendly credit periods where supply will not disconnect at certain times of the day (at night and weekends/holidays) regardless of credit status and however much is used; and
- Load limiting - as proposed in the E-Meter functionality and commented on in Section 6.2.2.

DNV KEMA consider the 'thin' model to be practically, technically and economically viable. However, it is likely that some legacy prepay customers might be reluctant to change given that legacy prepayment solutions are closely aligned to the 'thick' model and this is what many of them are familiar with. The necessary research to support the likely outcomes, and the way legacy customers are managed, we suggest, should be an important part of Phase 2.

Micro Generation: DNV KEMA would like to reference a debate that was had at the stakeholder workshop regarding the facility to provide micro-generation output values via the smart meter to the head-end system. We would make the observation that as micro-generation becomes more prolific, there may be a significant benefit to the distribution company if the amount of latent demand could be assessed. Latent demand is the amount of demand in a property which is being supported by the micro-generation at any one time i.e. is different to the net import/export to/from the home. The aggregated latent demand (from a system perspective) could become very significant; in the event of a frequency disturbance, microgeneration tends to trip off – therefore the latent demand would need to be instantly be picked up by the distribution system. Whilst this issue may not exist today, it may become an issue during the lifetime of the meter and should be considered. DNV KEMA would assess this as a low cost item with medium/high benefit and would raise the question as to whether it is included in the 12 registers proposed.

Other: With regard to the power consumption of the smart meter itself, we think it would be helpful to include reference to the efforts that have been made to minimise the energy consumed by meters and equipment, in effecting the transmission of data and in home messaging. EN 50470-3 is a standard for this; it describes the average power consumption during normal use and during sending/receiving data. In GB the Industry's Draft Technical Specifications[4] states that the smart metering system components at the consumers premises comprising the single phase electricity meter, the communications module and a mandated IHD, shall consume no more than 4.6W (combined) when averaged and under quiescent operating conditions. This assumes a meter baseline consumption of 2W (per phase) plus 2.6W for other components. Unique circumstances in the Netherlands caused this to be a relatively sensitive area, particularly following the well documented data privacy issues that the industry has been dealing with and ESBN has confirmed a similar baseline in Ireland. DNV KEMA recommends including this kind of information in customer briefing material and so pre-empting any issues that might otherwise be raised by consumer advocacy groups and broader industry watchdogs.

6.3 G-Meter

As with the E-Meter, the proposed G-Meter specification is generally in line with other international programmes. Recent information has shown that smart gas metering in Europe is on the move, but without any European consensus on key issues such as standardisation (equipment, devices and functions) and rollout planning. Nevertheless, prime objectives such as interoperability and open standards would seem to be a given at project/country level. Much discussion continues to home in on the current status of applied standards, pilot deployments (proof of concept) and the planning of deployment generally, not dissimilar to the current position in Ireland.

The Netherlands (with the most dense gas network in the world) is following the mandated multi-utility concept, with mass rollout now planned to start in 2015. Functionalities, include temperature compensation, a built in gas valve and absolute encoder functionality; with the inclusion of

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4 http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/smart-meters/2393-smart-metering-industrys-draft-tech.pdf):

communication following EN 13757-1/2/3/4 with AES-128 encryption, which has been specified in some detail. Around 300,000 smart gas meters have been installed since the first pilots in 2006. Approximately 60% are with wired M-Bus and 40% with wireless, with a mix of propriety 433 MHz and 868 MHz Wireless M-Bus. A built-in valve is mandated and the plan is to evaluate their use and effectiveness over the coming years.

The situation in the UK is widely known and there is currently a significant base of installed meters due to the fact that British Gas, along with some other companies have been installing their own smart (gas and electricity) meters ahead of programme decisions being finalised. Some of these early smart meters will not be fully compliant with national technical specifications and costs will be incurred in effecting replacements. However, we understand that there may be some relaxation of the ruling on this so that energy companies who have 'gone early' are permitted to leave certain non-compliant units in place beyond the end of the national rollout in 2019. Meanwhile from a gas metering perspective, meters will include mandated decentralized budget functionalities. The preliminary choice for communication between the communications hub and the gas meter is ZigBee (2.4 GHz).

In Italy the position is somewhat simplified, as gas smart metering is to be rolled out as a single utility programme; having already completed a nationwide Automated Meter Reading (AMR) deployment for electricity. Absolute encoder functionality is mandated, as is temperature compensation, a built-in valve for G4/G6 meters and pressure and temperature conversion for > G10. Italy is the second biggest gas country in Europe with an installed customer base of 21 million. The plan is for 80% of all gas meters to be replaced by mid 2018.

The following table attempts to summarise the gas smart metering standards being applied in other European programmes.

	Austria	Netherlands	GB	France	Germany	Italy
Connection	250mm	22mm	152mm	110mm	250mm	110mm
TC	No	Yes	No	No	Maybe	Yes
Absolute Encoder	Maybe	Yes	Yes	No	Maybe	Yes
Internal Valve	Maybe	Yes	Yes	No	Maybe	Yes
EN 13757	Yes (OMS)	Yes	Maybe	Maybe	Yes (OMS)	Maybe
Communications	tbc	MBus	Zigbee	na	tbc	Zigbee/M bus

Table 5: G-Meter standards – Europe

6.4 G-Meter Functionality

In the context of what is proposed in Ireland the following table summarises DNV KEMA's findings and actions in relation to the CER's gas metering functionality proposals.

DNV KEMA Alignment to G-Meter Proposals	DNV KEMA Review	DNV KEMA Concerns
Output Functionality 0/3 Input Functionality 7/11	Output Functionality 2/3 Input Functionality 4/11	Output Functionality 1/3 Input Functionality 0/11

Table 6: G-Meter review

6.4.1 G-Meter – Green items

DNV KEMA broadly agreed with the following gas meter requirements:

Ref	G-Meter (Input) Function
1	Remote disconnection instruction (valve closure)
2	Remote reconnection enablement instruction (health and safety validation checks required to allow consumer to self re-connect / open valve)
4	Clock synchronization (for the gas meter and communications modules)
5	Tariff settings a. Block (volume related) tariff settings (can be used by IHD if required for advanced tariff and payment systems) b. Seasonal or time of use (ToU) tariff settings (can be used by IHD if required for advanced tariff and payment systems)
6	Firmware upgrades (to meter and communications modules)
9	Life of meter typically 15-20 years (with possibility of one battery replacement if necessary)
11	Optional gas meter input functionality for further consideration: 1. Signal strength indicator (on LCD display) for low power radio link between gas meter and electricity meter/communications hub.
11 (contd)	Optional gas meter input functionality for further consideration: 2. Tariff prices (can be used by in-home ancillary equipment or IHD if required for advanced tariff and payment systems).

Table 7: G-Meter – Green Items

6.4.2 G-Meter Output Functions - Amber Items

The amber review areas are tabulated below in line with the CER's decision on G-Meter functionality, as in their earlier decision paper.

Ref	G-Meter (Output) Function
2	Other data that will be required to support meter equipment servicing; a. Open/closed valve status; b. Meter serial number or other identifier; c. Alarm/Event codes; d. Battery warning flag/code; e. Valve usage counter; f. Excess flow warning.
2 (contd)	Optional gas meter output functionality for further consideration: 1. Volume usage data to support remote reading and provision of data to ancillary devices in the home, to be provided at half-hourly frequencies; a. Temperature sensor readings (gas temperature at meter point); b. Temperature compensated volume index readings (m^3). 2. The gas meter may also be required to provide energy usage interval data (in kWh) for the IHD depending on the final detailed design. 3. Alert in case exceptional energy consumption.

Table 8: G-Meter (output) – Amber items

Other data that will be required to support meter equipment servicing: Firm operating metrics that effectively determine the lifetime of the battery should be sought from vendors. What this means is the amount of valve switches that are anticipated/specified should be and tested (guaranteed) up front in advance of implementation. In DNV KEMA's experience it is not enough to claim a useful battery life without any reference to requirements or capability. Valve switching will use the most battery energy so the number of expected actions, over the life of the meter, is an important reference point /metric to establish.

Optional gas meter output functionality for further consideration: Volume usage data is a very useful/important metric for customers to see, although the 'data refresh' frequency varies from country to country and is usually subject to considerable debate. Providing it at half hourly frequencies (which this item appears to suggest) could be considered to be excessive for the vast majority of customer situations; and as stated throughout the report sending unnecessary data from a wireless gas meter should clearly be avoided so as to prolong battery life, and preserve the predicted economic outcome of the project.

It is likely that 'interested' customers will want to see rolling annual consumption and daily consumption options, it is unlikely, in our view, that they will want to (or need to) view gas data at this level of granularity. However, waking the meter up every 30 minutes to make data transmissions of this kind supports other functionality requirements such as frequent prepay reconnection opportunities which is a highly desirable feature for inclusion.

The provision of data to ancillary devices in the home: The requirement as stated is at a very high level at the moment and could be open to misinterpretation. Following discussions with BGN it is understood to be the Utility HAN requirement between the G-Meter and the E-Meter HAN hub, which is an obvious vital key requirement and is fully supported by DNV KEMA. However, a less ambiguous description of this item (in the decision paper) would in our view, help to avoid future misunderstanding in this regard.

6.4.3 G-Meter Output Functions – Red Items

The output function that DNV KEMA considered worthy of most attention is listed below:

Ref	G-Meter (Output) Function
1	Half hourly profile volume usage data and volume index reads (m^3) with date and time stamp.

Table 9: G-Meter (output) – Red Items

Half hourly profile volume usage data and volume index reads (m^3) with date and time stamp: We note that a number of respondents to the consultation were in favour of providing half-hourly (HH) gas interval data, citing various reasons including, that this level of granularity complements the electricity interval requirement and facilitates consistent energy display information to dual fuel consumers. Additionally reasons were given that it facilitates more frequent refreshes of gas data on the IHD and is a better frequency for facilitating remote network services (reconnections for example) with the gas meter.

In the Netherlands, gas meter readings are taken on an hourly basis. As mentioned in item 2 (other data that will be required to support meter equipment servicing) sending unnecessary data from a wireless gas meter should always be avoided in our opinion, so as to prolong the battery life of the G-Meter.

Exchanging the G-Meter battery (more frequently than planned) will obviously change the outcome of the CBA in a fairly dramatic way. Compared to other countries the requirement as described will double the battery duty, which is a worthy consideration, especially if in the majority of cases it is only for data being sent to the IHD for customer information that has limited possible cost/volume mitigation options. However, weighed against this is the fact that a battery change has been factored into the supporting CBA which (considered over the entire G-Meter estate) should adequately cover the provision of HH data transmission to the IHD.

An option could be (if HH data is proven to be absolutely necessary) to send HH values in one update, once per hour, or perhaps even less frequently. The IHD will have the hourly and half hourly values available periodically, but the process would be more efficient in terms of battery life and the containment of long term programme costs. Consequently there may not be a need for a battery change during the lifetime of the meter; note that in the GB case no battery change was provisioned due to less demanding data transfer requirements. However, this would need to be considered alongside the desired frequency of prepayment reconnection opportunities i.e. alignment to periodic activity when the G-Meter is scheduled to 'wake up' to perform routine functions.

6.4.4 **G-Meter Input Functions – Amber Items**

From the decision paper, the G-Meter input functions classified by DNV KEMA as amber, and therefore deemed worthy of review, are shown in the table below:

Ref	G-Meter (Input) Function
3	Calorific Value where required (can be used by in-home ancillary equipment or IHD for the conversion of volume output data from the meter into energy values - kWh)
7	Encryption key changes for secure data communication
8	Potential requirements for prepayment functionality on the meter will be determined during the Design stage.
10	Ability to store data on meter for agreed period of time (to be finalised during the Design stage)

Table 10: G-Meter (input) – Amber Items

Calorific Value where required: This is not a complex requirement but has been included by DNV KEMA to highlight the duty on the G-Meter battery. There is no additional cost impact in terms of the inbuilt functionality but as before, if the data transmission is unnecessarily frequent it will have an impact on the life of the battery. We have been informed that BGN do not envisage updating calorific values any more frequently than daily. This aligns to GB where the Department of Energy and Climate Change (DECC) is proposing that this kind of information be updated on a daily basis. Following stakeholder discussions, DNV KEMA is in alignment with the proposal as stated.

Encryption key changes for secure data communication: Secure data communications for the provision and exchange of metered gas data must be considered in conjunction with DNV KEMA's comments in E-Meter Section 6.2.3 (Strong Encryption and Secure Mechanisms for Joining the Smart Metering Network). In relation to the provision of secure data pathways across the entire operating platform it will be necessary for ESBN and BGN to agree HAN security criteria so that what is provided at G-Meter level is consistent with what is provided at the E-Meter communications hub. It will also be important for a single stakeholder to be fully responsible for the provision and maintenance of end to end security so that assurance can be provided at all times that data privacy is respected and secure transmissions are supported across all platforms. DNV KEMA recommends that ESBN, as the lead party in infrastructure provision, is charged with this responsibility.

Potential requirements for prepayment functionality on the meter will be determined during the Design stage: All of the comments provided in relation to E-Meter prepayment options apply to the gas prepayment scenario (see Section 6.2.4.2). Additionally BGN has suggested that the exact nature of the gas prepayment solution should be decided in the next phase of the project. We agree that further clarity is needed to understand fully what is being proposed by BGN and support the proposal for further analysis. From BGN's earlier consultation response the 'thick' prepayment model seems to be favoured particularly as BGN have stated that the current solution (already in operation) is essentially a 'thick' arrangement.

In relation to customer disconnection, frequent reconnection opportunity is a desirable feature. BGN has proposed HH intervals for reconnection (supported by HH data transfer to the IHD) where the G-Meter is capable of recording consumption in each thirty minute period and recording details of the HH period to which the consumption relates. DNV KEMA agrees that the G-Meter should be capable of supporting frequent reconnection to facilitate prepayment options.

DNV KEMA therefore recommends a full examination of the costs and benefits of the gas prepayment ('thick'/'thin') models, taking into account how the thin solution might impact existing users, likely energy saving opportunities under both scenarios and common operating arrangements across both gas and electricity platforms.

Ability to store data on meter for agreed period of time (to be finalised during the design stage): In the Dutch case, all values are stored on the E-meter. Both E and G - Meter monthly values are stored in the same buffer which has space for 13 months. There is a combined E and G Meter buffer for the daily values which has space for 40 days. There is also a separate hourly buffer for gas which has space for 10 days. Given the complimentary role of the E-Meter relative to the G-Meter, the E-Meter will need to be installed first (or at the same time as the G-Meter) otherwise return visits will be needed with additional programme costs as a consequence. From discussions with BGN we understand that the Irish proposal is for G-Meter data processing to take place on the meter itself. This does have a consequent impact on battery life but as a battery change (across all gas meters) has been factored into the CBA, we do not see this as a major issue.

6.4.5 G-Meter Functionality Summary

6.4.5.1 Main observations

The major points coming out of the G-Meter review are as follows:

- In relation to 'other data required to support meter equipment servicing', it will be important to establish firm metrics around the actions that are required so that the lifetime of the meter battery can be sensible assessed. A useful battery life should not be supported without some reference to the actions that it is required to support. As valve switching is likely to use most energy this will be an important reference to establish. BGN has confirmed that they will be specifying the requirement and this will form part of Phase 2.
- The item described as 'optional output functionality for further consideration' contains several functionality requests, some of which (temperature sensor readings/compensated volume index readings) may be important from a network management perspective but are unlikely to be of interest to customers; others i.e. the 'provision of data to ancillary devices in the home' are still at a high level and open to misinterpretation. Having discussed this with BGN we understand that it is meant to support data transmissions/messaging over the Utility HAN (between the G-Meter and the E-Meter). If so this represents a vital integral functionality requirement and is fully supported by DNV KEMA.
- In relation to HH profile data (for gas) DNV KEMA's underlying belief is that adequate customer gas consumption data (necessary to achieve energy reduction/efficiency objectives) can be achieved with less frequent IHD refreshes. Our over-riding concern being that sending unnecessary data from a wireless gas meter should always be avoided so as to prolong battery life. However there are always exceptions to this, especially when considering other services/functionalities that need to be supported such as customer reconnection; especially in prepayment situations where reconnection opportunity is aligned to other G-Meter activity i.e. frequency of 'wake up' periods when the G-Meter is scheduled to perform routine functions. We also recognise that a battery change has been factored into the CBA which we believe should adequately support the provision of HH gas data as described. Having fully reviewed this item we therefore support the provision of HH gas data as described.
- From BGN's earlier consultation response the 'thick' prepayment model seems to be favoured particularly as BGN have stated that the current solution in operation is essentially a 'thick' arrangement. DNV KEMA recommends a detailed review to understand fully what is

being proposed by BGN and how this relates to the broader prepayment platform being proposed by others in association with broader stakeholder and customer opinion.

6.4.5.2 Other areas for consideration

Meter Communications: An additional observation relating to the G-Meter functionality concerns the general communications configuration between the E-Meter communications module and the G-Meter. We note from the decision paper that the trials that have taken place in Ireland have sufficiently proven effective (Mbus) wireless communications between the E-meter and G-meter. Notwithstanding this, from DNV KEMA's experience elsewhere, if using Mbus, there is evidence to show that it may be advisable to retain an alternative wired option at this stage, for use in certain difficult cases. This was one of the lessons coming out of the pilots in the Netherlands where it is now required that two options (wired and wireless) are retained due to the risks associated with wireless technologies in certain cases.

6.5 WAN

Robust WAN communications are a key facet to a successful smart metering roll-out, yet this is an area where many challenges remain, despite technology trials undertaken in many participating countries (including Ireland). Indeed, there is no definitive 'one size fits all' communications solution that will reliably deliver in 100% of cases from DNV KEMA's experience.
Therefore a balance must be struck when it comes to:

- Technology issues, centring on the secure and reliable transmission of data,
- Issues around standardisation including security considerations,
- The frequency of and size of the messages flowing between the meters and the head-end systems (including meter reads, tariff updates, firmware upgrades) and the way in which these are managed, and
- The costs associated with the provision of the infrastructure itself, which includes any capital investment that may be required as well as any ongoing operating costs.

For example, a 'future proofed' wireless solution is likely to support the functional requirements, but the operating costs of doing so are generally quite expensive when compared to a Power Line Carrier (PLC) solution where at the very least the local area network solution (LAN) – between the meter and the nearest substation is provided and operated by the utility.

In DNV KEMA's experience, the most recent power line carrier (PLC) technologies, based around Orthagonal Frequency Division Multiplexing (OFDM) (e.g. G3/PRIME) are capable of meeting the requirements whilst carrying a low cost of ownership. However, the case for PLC becomes less compelling outside of towns and cities as the number of nodes per concentrator reduces, hence the need for more wide area network (WAN) collection points. Rural customers therefore require a viable alternative such as wireless GPRS, 3G or radio network option.

Sticking with PLC and on the downside, unpredictable and varying noise floors on the distribution network, can adversely affect performance – DNV KEMA has recorded availability figures varying between 60 – 80% in some of the worst cases. Clearly these availabilities depend on where and how the technology is applied. In most cases, after fine tuning it is possible to improve this to around 80% - 93%. Getting this figure closer to 100% is costly and often results in having nodes that have variable and intermittent performance (e.g. second/third level nodes which have to pass their signal via a parent before they can be transferred to the concentrator). Hybrid solutions are likely to be the answer to this dilemma.

Trials with 3G technologies and wireless CDMA have delivered far better results; the costs are high but so are the benefits. Security is an additional consideration, often overlooked in early trials / deployments, which can have a significant bearing on technology choice with consequent impact on project cost. Indeed security is one area that DNV KEMA has flagged up as a necessary precursor to any decision regarding the WAN.

Broadband and fibre options have been considered elsewhere but involve a range of practical difficulties which to date remain unresolved. The most prominent of these is available infrastructure coverage in any given jurisdiction. In Greece, where fibre is to be widely rolled out in the major cities of Athens and Thesaloniki, the Public Power Company (PPC) are following a fibre solution; and in Northern Ireland, the base economics of a broadband application is being considered, although the technical feasibility and practical application of such a solution has, to the best of our knowledge, not yet been tested. This option is predicated on broadband services being available to at least 95% of the population, the establishment of virtual private network(s) (VPN) to support broadband services and strategic placing of routers and other network devices.

Discussions that have taken place between DNV KEMA, the CER, BGN and ESBN have been very helpful in gaining insights into current thinking around the WAN options in Ireland. Clearly the programmes with the greatest alignment to the Irish programme are GB and the Netherlands where similar discussions on detailed specifications are taking place despite each of the impending deployments being different in their own way. In terms of operating protocols, more work has to be done, but our understanding is that DLMS COSEM is likely to be favoured, which is a common feature of other European deployment programmes and one that DNV KEMA supports based on experience and participation elsewhere. From the perspective of procurement, smart meters that utilise DLMS COSEM are likely to be some of the most widely available.

DNV KEMA has also noted that ESBN are planning a number of smaller trials (around 100 meter points or so) to start to narrow down WAN options. This will include further PLC trials to test next generation technologies (physical layer performance) and areas that previously trialled poorly. In addition, ESBN are planning to work with wireless operators to see if a multi-point wireless mesh solution (aligned to a European model) can be developed to combine the advantages of advanced wireless technology with the operating economics of a multi point wireless mesh that incorporates a single take off/entry point. This thorough examination of the infrastructure options in Ireland in advance of any hard and fast WAN decisions is an approach that is fully supported by DNV KEMA.

This ongoing work is illustrative of the challenges described earlier and underlines the need for further trials and investigations in advance of any firm commitment on one or more WAN technologies. Following a request from the CER, DNV KEMA has provided some supplementary thoughts regarding WAN technologies currently being considered, or in use, in Europe; this is included in Section 7.

Whilst reviewing the WAN requirements, and in discussion with the CER, we noted that there is an aspiration to update customer data daily, implying that meters will be polled on a daily basis. This is described in 4.3.9 of the decision paper – Decisions Relating to Ownership, Display and Provision of Smart Metering Data/Information. Whilst we recognise that this is to be further discussed in the coming months, we felt it necessary to include daily collection of metered data as an 'appropriate area for review item' within this section.

The following high level WAN requirements were specified by the CER in the decision paper. As aforementioned, Item 6, (daily collection of metered data) has been added for completeness:

1. Facilitate two-way communication with the back-end smart metering infrastructure;
2. Facilitate the collection of both on-demand (real-time) and cyclical data from the meter e.g. daily interval reads;
3. Facilitate remote operation of the meter to de-energise and re-energise the customer (subject to safety arrangements);
4. Facilitate remote re-configuration and upgrades of meter;
5. The CER would like to emphasise that all viable wide area network (WAN) solutions will be considered for the national smart metering rollout solution and ultimately the guiding principle will be to ensure that the most cost effective communications solution is put in place through a public procurement process; and
6. Daily collection of metered data.

6.6 WAN Requirements

The WAN requirements as described in the decision paper are generally fully supported by DNV KEMA. Having reviewed the response summary our opinion is that the essential infrastructure requirements/specification have been distilled to provide for a successful smart metering deployment (initial service provision) with adequate foresight to deliver more aspirational in-home applications (frequent customer interaction) and network services (smart grid) that will undoubtedly follow in the medium/long term. DNV KEMA's view is summarised in the following table:

DNV KEMA Alignment to WAN Proposals	DNV KEMA Review	DNV KEMA Concerns
4/6	1/6	1/6

Table 11: G-Meter (input) – Amber items

6.6.1 WAN – Green Items

DNV KEMA was in broad agreement with the following WAN items:

Ref	WAN Functionality Requirements
1	Facilitate two-way communication with the backend smart metering infrastructure.
2	Facilitate the collection of both on-demand (real-time) and cyclical data from the meter e.g. daily interval reads.
3	Facilitate remote operation of the meter to de-energise and re-energise the customer (subject to safety arrangements).
4	Facilitate remote re-configuration and upgrades of meter.

Table 12: G-Meter – Green items

6.6.2 WAN - Amber Items

The amber item identified in this section is described, and expanded on below:

Ref	WAN Functionality Requirements
5	The CER would like to emphasise that all viable wide area network (WAN) solutions will be considered for the national smart metering rollout solution and ultimately the guiding

	principle will be to ensure that the most cost effective communications solution is put in place through a public procurement process.

Table 13: WAN – Amber items

Consider all WAN choices with an emphasis on the most cost effective solution: The WAN requirements are very high level at this stage; with the intent of developing the detail during Phase 2 of the project. Thus Phase 2 will be highly significant in determining the most appropriate WAN solution.

We note that in order to specify the WAN requirements in detail, ESBN plans to carry out further 'mini' trials to test alternative WAN solutions in selected areas/regions. We further understand that the trials will comprise representative sample groups (around 100 meter points per trial) and a range of technologies including GPRS, PLC and Wireless Mesh combinations. Clearly trials of this kind are invaluable in helping to determine the best WAN solution; however, the results will obviously be limited by the sample size used and the duration of the tests.

The complexity of managing the WAN will increase as more smart meters are installed. Thus appropriate attention to governance issues, such as service level agreements (to achieve the desired performance) will need to be given. Assessing the level of traffic, the protocols (and any necessary conversions that may be needed), the prioritisation given to each message and the level encryption required for each message will all feed into the decision regarding the WAN.

Expanding on this further, Section 4.3.9 of the CER decision paper implies that there may be a requirement for metered data to be transmitted daily; this is picked up in Section 6.6.3 of this report below. DNV KEMA believes that further work is needed in this area to address the following:

- Data types/size;
    - which type of data is expected to be transmitted i.e. half hourly electricity profile data, meter diagnostic, alerts, estimated message size;
- Frequency of communication (traffic);
    - how often each data type is expected to be transmitted for different parties, i.e. suppliers and distributors;
- Number of meters to be read simultaneously during a particular time period;
- Latency (response time);
    - the time required for the command or data to be received and the reason for the daily data transmission to explore whether alternative more efficient ways are available.
- Data overheads and Security;

  - the amount of preamble in each message and the level of encryption needed in relation to each message type.
- Central systems requirements
  - Specification including data storage requirements

The information will help inform the choice of WAN technology. Every solution has its limitations - some WAN solutions might not be able to deliver services instantly i.e. in seconds, or to contact multiple meter points within a defined time period i.e. simultaneously.

6.6.3 **WAN - Red Items**

As mentioned earlier, the major point that has been picked up and included in this section is the reference to daily collection of metered data.

Ref	WAN Requirements
CER12008 4.3.9	A data portal that will be provided through which suppliers can access data for their customers, updated daily on a push and pull basis

Table 14: WAN – Red items

We note that in the Irish model, ESBN will be responsible for the data collection on behalf of other market participants. From stakeholder discussions, DNV KEMA observes that the processes that will eventually support this have not yet been clearly defined. From a wider industry perspective the transfer of increased volumes of interval data between market participants, and its impact on existing industry systems and supporting infrastructure needs to be examined and clearly understood; and this needs to be coupled with the fact that, as far as DNV KEMA could determine, there is not yet any clarity regarding the messaging (between BGN and ESBN) that will be required to support meter commands and customer information/data update transmissions. There is therefore an obvious need for this methodology to be defined in support of what is eventually required (roles, relationships, service levels etc) in relation to data collection frequency and so on.

DNV KEMA notes that a key reason sited in support of daily data transmission in Ireland was to provide customer consumption information over a common data portal. By comparison the GB model does not mandate a data portal for customers; this is regarded as a supplier specific development that will be justified commercially through supplier differentiation. Customers will have the option of being able to access up to 13 months of HH data using supplier specific (or future third party) devices and/or applications that will communicate directly with the smart meter HAN.

When considering daily data transmission it is also important to take into account customer/data privacy. International experience, demonstrates that failure to consider the subject of data privacy can lead to a series of unscheduled delays; the Netherlands being a case in point where the programme has suffered several years delay and isolated cases in the US where customers have refused to accept smart meters in their homes.

As well as the cost of transmitting data on a daily basis, it potentially increases data privacy sensitivities. Discussions with the CER, ESBN and BGN has highlighted a raised awareness in this area to the extent that a set of guiding principles are being developed to steer the specification of robust security arrangements during Phase 2 of the programme. Regardless, a vital feature in this is likely to be customer choice; customers may opt to choose who has access to their data.

For example, DECC in relation to customer sensitivities around data access and data protection is considering the following options for access by suppliers:

- Monthly (or less granular) energy consumption data, without customer consent, for billing and for the purposes of fulfilling regulated duties;
- Daily (or less granular) energy consumption data, with clear opportunity for the customer to opt out; and
- Half-hourly energy consumption data only if the customer wishes to opt in.[5]

In the GB case DECC has stated that the case for suppliers accessing data daily on an ad hoc basis, without customer consent, should apply only for the purposes of accurate billing when a consumer changes tariff.

6.6.4 WAN Review Summary

The main points coming out of the WAN review are as follows:

- There is still no 'one size fits all' solution available and thus the best solution will always be country specific.
- Appropriate attention to governance issues, such as service level agreements, will need to be given to ensure the solution is fit for purpose to meet the requirements coming from all of the parties including, Suppliers, ESBN and BGN.
- In order to specify WAN requirements in the most efficient way, analysis into the types of data that will need to be transmitted and the size of such transmissions should be conducted.

[5] http://www.decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/4933-data-access-privacy-con-doc-smart-meter.pdf

- Frequency of communication should also be estimated to facilitate the best data management solution.
- The number of meters that would need to be read or communicated with simultaneously should also be specified to ensure the WAN solution can deal with these requirements.
- Suppliers, ESBN and BGN should specify the needs for latency - how quickly they would need the commands to be processed or for the data to be sent to them to ensure appropriate levels of service and smart grid facilitation.
- Data overheads and Security can significantly increase the size of the messages transmitted over the WAN and thus can influence the WAN solution; therefore it is recommended that these be considered.
- In Section 4.3.9 of the CER Decision paper it was stated that certain data from smart meters will be sent on a daily basis on a push and pull basis. If the data is planned to be sent via WAN on a daily basis, it is essential to ensure that appropriate customer privacy and customer protection measures are in place, as there are more risks for the data to be intercepted. Transmission of customer data on a daily basis will also result in significant cost. There is a need for a clear methodology in support of what is eventually required (roles, relationships, service levels, etc.).
- It is recommended to outline in further requirement specifications that customers should be able to opt who has access to their data when it comes to more detailed data access i.e. half hourly or daily. Naturally this may have an impact on the design itself.

6.7 HAN

The HAN is one of the most critical parts of the smart metering system, in that it provides the platform for devices to talk to each other and for data to appear on the IHD, which is where a lot of the customer benefits are derived from. It follows therefore that the HAN must be robust, which means picking a technology that works in a vast array of different properties/circumstances and one that is well supported in terms of its specification and general availability. The HAN also needs to deliver 'interoperability' whereby a new device (e.g. an alternative IHD) can be connected seamlessly to the existing system without any loss in functionality. This extends to the non-utility HAN which in future provides the means for customers to control their usage using smart appliances which will be another key benefit further down the line.

On a European level, there have been many debates regarding which technology is most appropriate for the HAN and the most common conclusion is – it depends. It is therefore prudent to look at the wider factors (beyond performance alone) such as 'open' standards, ongoing support, future proofing etc.

For the GB roll-out, DECC is minded to use Zigbee Smart Energy 1.x as the application layer for the gas meter and the IHD. There are two frequency bands being discussed at the moment – these being 868MHz and 2.4GHz, albeit there is some uncertainty surrounding the implementation of SE 1.x for 868MHz. There is also some debate around the readiness of SEP2.0 which is an IP-based solution. The reason that DECC is minded to opt for 1.x is because it works for a wide number of applications (for example - is used widely in the medical field). Some elements of the Zigbee standard are in a state of flux – for example there is a new IP based network layer under development. It is on top of this that SEP2.0 sits, whereas 1.x sits on top of an established network layer (Zigbee PRO). Figure 3 shows this in more detail.

Note that DECC is currently collating responses to its latest SMETS2 consulation but there is significant pressure on DECC from most of the stakeholders to make a decision on this which may happen towards the end of 2012. In section 6.8.1, DNV KEMA has provided some words as to why an early decision is important - this was one of the key areas that came up from the stakeholder sessions that took place during the review.

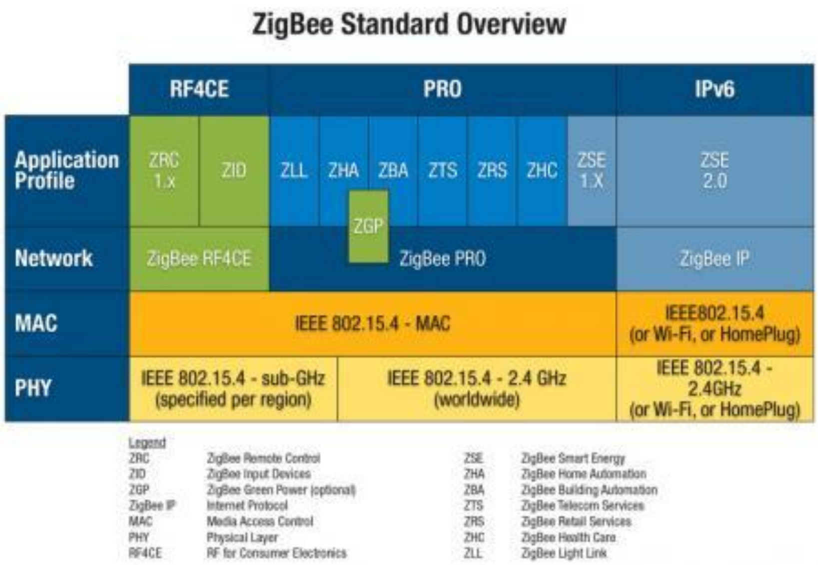

Figure 3: Zigbee standard

In the Netherlands, the HAN solution is a combination of wired and wireless MBus. Approximately 60% of smart meters have wired M-Bus and 40% with wireless, with a mix of propriety 433 MHz and 868 MHz Wireless M-Bus. The general ‘rule of thumb’ is that the higher the frequency, the higher data rate, but the shorter the range. As previously mentioned, there were a number of difficulties which led to the need for both wired and wireless solutions.

DNV KEMA would suggest that a detailed assessment of the different property types in Ireland may be useful to help inform the debate, albeit we would also be partially minded to suggest that the CER opt for the same solution as GB for ease of procurement and to enable an early decision. We note however that ESBN has written to all the relevant standards bodies to gather more information on this topic and DNV KEMA would advise that the responses be analysed carefully.

6.8 HAN Requirements

The following table summarises DNV KEMA's findings and actions in relation to the CER's HAN proposals.

DNV KEMA Alignment to HAN Proposals	DNV KEMA Review	DNV KEMA Concerns
8/9	1/9	0/9

Table 15: HAN review

6.8.1 HAN – Green Items

DNV KEMA was in broad requirement with the following items:

Ref	HAN functionality requirements
1	Utility HAN: The utility HAN will support communications with the mandated in-home display rolled out.
2	Utility HAN: The electricity meter will act as a hub for the gas meter, via the utility HAN, thereby facilitating a single communications infrastructure to support both electricity and gas smart metering
3	Utility HAN: The utility HAN should also accommodate if required a second electricity meter installed to measure actual output of embedded micro generator.
4	Utility HAN: Water metering requirements are out of scope. The CER will continue to engage with the Department of the Environment, Community and Local Government to keep this under review.
5	Non-Utility HAN: The non-utility HAN refers to devices in the home other than utility meters and the mandated IHDs rolled out. The functionality for the smart metering full rollout solution should enable secure communications between the smart meter and in home devices i.e. any authenticated device in the home and not just the mandated in-home display.
6	Non-Utility HAN: Due the immaturity of the associated technologies and evolving business requirements further evaluation of secure communications functionality will be required during the design stage of a full rollout to ensure that a premature

	decision is not taken.
7	Non-Utility HAN: Cost information is part of the requirements for display of data in-home. However, how exactly price information is provided to the in-home devices (i.e. via the smart metering infrastructure or via another method e.g. IP based) will be examined further as part of the Design stage of Phase 2.
8	Non-Utility HAN: A 'watching brief' will be kept on developments in 'Smart Home' and 'Smart Grid' technologies area to ensure that the smart metering solution is 'future proofed' as far as possible to cater for any emerging functionality requirements in these areas, assuming they are technically and economically viable to implement.

Table 16: HAN – Green items

6.8.2 HAN - Amber Items

As in previous sections the amber classification identified is as follows:

Ref	HAN functionality requirements
Main text	The CER would like to emphasise that all viable home area network (HAN) solutions will be considered for the national smart metering rollout solution and ultimately the guiding principle will be to ensure that the most cost effective communications solution is put in place through a public procurement process. The detailed requirements for the HAN will be determined during the Design stage based on the following high level requirements:

Table 17: HAN – Amber items

DNV KEMA can see why this conclusion may have been drawn, however the most cost-effective solution (up-front) does not necessarily result in the most cost-effective outcome. For example, a solution that fails to work as intended would turn out to be a very costly one for a number of reasons, not least delayed (or non-) realisation of benefits. DNV KEMA would recommend that the wording be changed to say the most cost effective solution that best meets all the performance criteria (which are to be defined in Phase 2)' or something similar. Indeed, the same could be said for a similar clause relating to the WAN – see Table 10 (WAN Amber Items) above.

DNV KEMA also noted following conversations with stakeholders that there was a preference for an early decision on the HAN technology. As far as this debate goes, DNV KEMA would very much endorse this view, particularly based on our experiences from the US – where many Automatic Metering Infrastructure (AMI) roll-outs have taken place in the last 10 years. There are two key reasons why it is a good idea to take this decision early:

- Sufficient time must be built into the schedule for vendors and the distribution company to adequately test the (integrated) meter and firmware revisions - this is an iterative process and can take 18 months from start to finish. The HAN should therefore be chosen well before the procurement phase starts.
- Production - Last minute decisions may be unsupportable by either meter manufacturers or by their subcontractors. Production runs can be locked down many months into the future and it's quite possible that vendors may not be able to support a last-minute request.

Zigbee would appear to have the edge over other HAN solutions at the present time. If Zigbee were to be chosen, DNV KEMA would once again highlight that SEP2.0 (IP based) may not be available (with all appropriate features) within the Irish timescales so SE 1.x may be more appropriate for consideration, particularly if water meters remain out of scope. However, we do acknowledge that the use of an IP based solution may make sense in terms of future proofing. Therefore as far as SEP2.0 goes, there may be certain things that can be done to speed up developments, but it could still be sometime before products become available. This situation would be further helped if GB were to head in the same direction, given the number of meters involved is that much greater - but this is looking increasingly unlikely.

In summary, DNV KEMA would recommend that these points be further explored as a matter of priority, but would advise that an early decision on the HAN be taken.

6.9 Procurement

6.9.1 General

Section 5 of the decision paper summarises the high level procurement requirements as follows:

1. *ESB Networks will be responsible for procuring electricity smart meters with a communications module (for wide area network and home area network) that meets the agreed functionality requirements and will be responsible for installation and ongoing maintenance of these meters.*
2. *Bord Gáis Networks will be responsible for procuring gas smart meters with a communications module (for home area network) that meets the agreed functionality requirements and will be responsible for installation (in coordination with ESB Networks) and ongoing maintenance of these meters.*
3. *The CER will approve the functional requirements and the procurement strategy.*
4. *Model for procurement and management of the WAN and back-end IT systems (including meter data management system (MDMS) and Web portal):*

   a. *These will be procured as separate or combined lots and on an ownership or service provision basis.*
   b. *ESB Networks will own the contracts for the WAN and electricity back-end IT systems and will be responsible for their procurement.*
   c. *Bord Gáis Networks will own the contract for the gas back-end IT systems and will be responsible for their procurement.*
   d. *The CER will approve the procurement strategy.*
5. *Model for procurement and management of the in-home display (IHD):*
   a. *The IHDs will be procured on an ownership or service provision basis.*
   b. *The CER will approve the minimum functional requirements and the procurement strategy.*
   c. *ESB Networks will own the contract for the IHD and be responsible for their procurement for all consumers.*

We note that ESBN will be fully responsible for the procurement, installation, maintenance and ownership of the smart electricity meters, and BGN will be responsible for the procurement, installation (in coordination with ESBN), maintenance and ownership of smart gas meters under the CER approval. We also note that ESBN will be responsible for WAN procurement and the IHD thus representing the interests of both electricity and gas stakeholders.

Back-end IT systems for gas and electricity will be owned and procured by BGN and ESBN respectively. For comparison, in the current GB model there will be a centralised Data Communications Company (DCC) responsible for the procurement of data and communications services, whereas suppliers will be responsible for the installation and testing of the meters. Bearing in mind the breadth of difference between the Irish and GB models, the proposed approach to procurement seems highly sensible given the relative position of ESBN and BGN in the current market.

Having an independent party carrying out meter communication services reduces a risk of discriminatory approach to various parties participating on the market i.e. larger and smaller suppliers, hence fully supporting unbundling and competition in the market. Thus, appropriate arrangements should be put in place for the Irish model to reduce such a risk. In this respect, we would highlight the importance of best practice procurement guidelines being established and published, specifically for the deployment programme, and these should be prepared and put in place by each of the respective organisations. Such procurement guidelines should include best practices around installation and would also provide assurance that the programme will continue to run as efficiently and economically as possible. Alongside this we would further recommend that robust cost controls governing the future operation (and upgrading) of the system are also put in place to provide assurance that the programme will continue to run as efficiently and economically as possible. In this context, the ongoing maintenance of systems, equipment, and infrastructure will be vital in ensuring the system continues to operate efficiently and that ongoing benefit is maximised for all stakeholders (participants and customers alike). The procurement of these services should also be considered alongside the initial procurement priorities described in Section 5.

6.9.2 Specific Observations

In reviewing the high level requirements we have been mindful that the guiding principle throughout will be to ensure that the most cost-effective end-to-end national solution is put in place through a public procurement process. In this regard we are fully cognisant of the fact that both of the lead organisations involved have robust procurement processes established and are fully conversant with best practice principles and processes in this important area. All of DNV KEMA's observations are therefore prefaced by this.

As with lead players in other projects of this kind, ESBN and BGN will be responsible for (either directly or through contractors) introducing customers to the smart metering equipment at the point of installation. Both ESBN and BGN will be installing the equipment at the customers' premises and should ensure a satisfactory customer experience is provided. The initial customer experience at the point of installation (i.e. understanding what is being provided and how to use it) will undoubtedly have a significant influence on the overall success of the programme and in turn will help to drive the achievement of anticipated benefits. This is an important area and it should not be overlooked when considering what is required of providers at the procurement stage.

Based on DNV KEMA's experience of equipment and service procurement in various trials and pilot smart metering projects (particularly in relation to installation) the following points are included for completeness:

- Satisfactory customer equipment installation experience;
    - Code of practice guidelines could be drafted detailing the responsibilities of ESBN and BGN with regards to ensuring best customer experience before, during and after smart metering installation. In GB, the Smart Metering Installation Code of Practice (SMICoP) has been developed for this purpose.
- As a minimum, both companies should;
    - Explain to customers the reasons for the change by means of telephone call or letter/maildrop to provide an outline of what will be delivered and how it should be used to achieve best results/customer experience;

  - Ensure appropriate explanation is given to customers as to what the equipment is supposed to do and how it works, and what the information displayed on the meter and on the IHD means;
  - Provide customers with sufficient contact information as to whom to call when they have issues with their equipment;
  - Effective installation pre-planning (usually carried out by contracted installer companies) visits will also ensure that the customer is at home and thus will avoid extra (unplanned) site visit costs, helping the project to align to the original financial projections.
  - Alleviate any concerns that customers may have regarding data privacy and health matters.
- Assurance arrangements should be put in place to ensure smart meters procured (and once installed), meet the CER's requirements. This would generally involve translating a specification into a set of testing regimes. Typically these arrangements would include:
  - MID type approvals (EU directives)
  - EMC testing (for communications elements) – EU directives
  - Protocol conformance tests (e.g. DLMS COSEM, Zigbee etc) in accordance with relevant user association and performed by notified bodies
  - Functional tests (in accordance with local specification e.g. DSMR4.0, SMETS etc)
  - Interoperability tests – to ensure all products provided by the various manufacturers (from a software perspective) can operate seamlessly following a change in supplier (e.g. a product upgrade) with no loss of 'mandatory' functionality.
  - Asset lifetime tests (optional) provide additional assurance around the asset life of the products in accordance with IEC standards.

  DNV KEMA has provided some further thoughts around this topic in section 8.
- As described in the decision paper, ESBN will be responsible for the procurement of the communication network (WAN network) and back-end IT systems for electricity meters, and BGN for the gas meters and a separate BGN specific data storage and management system. When drafting the procurement requirements for the back-end IT the following high level arrangements should be considered for inclusion in new industry legislation supporting the operation of, and access to, the system.
  - Data access;
    - Since both companies will have access to the entire customer consumption data of Ireland, appropriate arrangements will need to be in place to ensure that the data stored by the back end-IT systems of both companies is used for relevant purposes only and is made accessible only to relevant suppliers i.e. non discriminatory treatment of suppliers;
    - Minimum data needed to carry out regulated duties.

- Explanation of what would count as provision of satisfactory services to the suppliers – suppliers and other parties that will be using smart metering data would have to outline the service requirements, particularly data access arrangements i.e. what data they required, frequency, latency, speed (as outlined in Section 8);
- Fair (non-discriminatory) provision of data;
- Future proofing arrangements, how service providers intend to manage this and their ability to foresee/adapt to future changes;
- Arrangements for ensuring that the system/solution remains in service in the event of industry changes and/or financial/operational failures.

We note that ESBN will be responsible for the procurement and maintenance of IHDs. An observation is that procurement of a single type of IHD for all customers might create barriers for innovation in this area – a mix according to customer demographic and likely uptake of services (informed by targeted customer research) could be an alternative route for consideration. Additionally, regardless of the decision (single type of IHD or mix) to ensure anticipated benefits are maximised the minimum requirements should ensure IHDs are user friendly, provide clear and understandable information for customers and are aesthetically appealing to ensure longer asset life and use.

Finally DNV KEMA noted following conversations with stakeholders, that there was a preference for an early decision on the HAN technology. As far as this debate goes, DNV KEMA would very much endorse this view, particularly based on our experiences from the US – where many Automatic Metering Infrastructure (AMI) roll-outs have taken place in the last 10 years. There are two key reasons why it is a good idea to take this decision early:

- Sufficient time must be built into the schedule for vendors and the distribution company to adequately test the (integrated) meter and firmware revisions - this is an iterative process and can take 18 months from start to finish. The HAN should therefore be chosen well before the procurement phase starts.
- Production - Last minute decisions may be unsupportable by either meter manufacturers or by their subcontractors. Production runs can be locked down many months into the future and it's quite possible that vendors may not be able to support a last-minute request.

For completeness the above points are repeated in Section 6.8.1 (HAN Amber Items).

6.10 IT Arrangements

This section covers DNV KEMA's observations on the following items, acknowledging that these are only being discussed at a very high level at the present time given they are driven by other functional requirements:

- Meter Data Management Systems (MDMS)
- Web portal

6.10.1 MDMS

A meter data management system (MDMS) collects and stores meter data from a head-end system and processes that data into information that can be used by other utility applications including billing, customer information systems, and outage management systems. It can manage large quantities of meter data and is able to automate and streamline the complex process of collecting meter data from multiple meter data collection technologies, evaluate the quality of that data (and generate estimates where errors and gaps exist) and deliver that data in the appropriate format to utility billing systems. The critical role of a MDMS is to pre-process granular interval meter data at large volumes very quickly.

The high level representation of the system architecture proposed in Ireland shows separate systems for electricity and gas meter data which DNV KEMA were asked to comment on. Generally a single system, holding electricity and gas data, would be a viable option, particularly as all metered data (gas and electricity) will be collected by ESBN (the lead party in system operation management). Once collected, although technically complex, the gas data could conceivably be sent directly from the central system (located at ESBN's premises) to BGN's internal (as is/as will be) systems for billing purposes and onward transmission to gas market participants and settlements agents.

However, BGN has stated that, operationally, their main reasons for retaining separate systems are as follows;

- BGN is the authorised gas Meter Operator (MOP) and notwithstanding the fact that a shared communications channel (managed by ESBN) is being used, gas data must be separately validated and processed for billing purposes. BGN believe that this is best done using a gas specific system;
- The nature of manual data collection (using handheld tools) and smart data collection is different and should be supported accordingly;
- A gas specific system will ensure coherence of data across all platforms;

- The current system design architecture is still only a suggestion of what might eventually be established. Quite clearly both ESBN and BGN have more work to do regarding the operational/data management process. For example:
    - how meter messaging is to be managed between the parties;
    - will ESBN be mandated to provide this service on behalf of BGN; or
    - will the provision of services be separately contracted between the parties (service level arrangements).

In light of these discussions, supporting detail from both ESBN and BGN and further analysis by DNV KEMA showed that if supported by the programme, there could be a number of advantages in providing separate systems for ESBN and BGN, with a shared head end arrangement, as described in the decision paper.

Central to this belief is the complexity and potential business risk associated with integrating BGN's legacy systems with an ESBN hosted MDMS. BGN have provided demonstration of the systems that need to integrate with the new MDMS arrangement including billing, CIS, GIS, Network Management systems etc. BGN have also made the point that the system architecture under a single MDMS arrangement would potentially require a series of complex B2B interfaces from internal BGN systems to the external (offsite) MDMS, managed and operated by ESBN. The alternative might be to take a single data feed into the BGN environment and provide a separate internal data repository from which data could be distributed to the legacy systems; a solution that potentially overcomes much of the integration complexity, but nevertheless introduces additional costs through the inclusion of an additional inline system.

Operating a shared solution across two entirely separate organisations is viewed as being more challenging than employing separate business specific systems. The overall integration challenge, whilst possible, could introduce more risks to the business. System maintenance, ongoing operation and system upgrades/reconfiguration should also be considered, in our opinion, and the ability to support these elements independently, on a business specific basis, has obvious advantages in the enduring business context.

In addition to the technical elements, a key factor in the determination of the supported solution is cost. A decade ago systems of this kind were far more costly, but supplier costs have decreased considerably over this time. Now the difference between a single system solution and a dual system solution would be, in DNV KEMA's opinion, quite small. BGN have stated that a single system for 2.8m meter points (2.2m electricity meters and 0.6m gas meters) will carry a similar licence and support cost as separate systems for the respective numbers of electricity and gas meters. We feel this is an over simplification that would need to be proven, but we do not disagree with the general thrust of this statement.

Taking account of the evidence and representation provided during the course of the review, DNV KEMA has modified its opinion. Although technically possible, given the potential complexities and risks associated with a single MDMS, the comparative cost of the two models debated, maintenance and operational need and system flexibility (in the enduring context) DNV KEMA believes that, on reflection, a dual system model is likely to be the more favourable option. Overall it carries less project risk and any additional cost, in our opinion, is likely to be minimal, especially when considering the integration costs on the BGN side and possible additional system management burden on the ESBN side.

This does not however remove the need for process arrangements to be developed between ESBN and BGN in Phase 2. DNV KEMA has learnt also that electricity and gas records are not currently cross referenced across gas and electricity systems; i.e. there is no common postal coding arrangement in place in Ireland. This programme provides a good opportunity to address match all gas and electricity accounts. Doing this would make customer communication/identification better, and improve the change of supplier (particularly dual fuel) process in future – thus potentially creating further efficiencies. DNV KEMA would raise the question as to whether these have been captured/looked at.

6.10.2 **Data Portal**

DNV KEMA has noted that with regard to data access there was broad agreement from respondents, including suppliers, on the proposal for providing access to suppliers via a data portal that is able to provide scheduled updates from meters. As we understand it the decision point so far reached is that a data portal will be provided. However precisely how the portal is to be facilitated is yet to be worked out and the work will be undertaken as part of Phase 2 of the programme.

DNV KEMA has reviewed this element of the project and has the following observations:

- The Third Legislative Package for Further Liberalisation of the Electricity in relation to intelligent metering systems, has the aim of better informing consumers of their consumption and in so doing helping them to increase their awareness of energy consumption, and have their consumption data at their disposal so that they can invite competing suppliers to make supply offerings based on those data (supplier switching activity).
- Other locally based programmes (GB and the Netherlands) are providing Third Package compliance through the provision of IHDs. In these cases the information supported by an IHD is deemed adequate in terms of data availability and data transparency, and is able to

provide the level of consumption information required to support customer switching activity and energy efficiency activity.

- Providing a dedicated portal involves frequent poling of meters over the WAN and a large data store that can be securely accessed by the portal facility.
- The planned smart metering architecture should deliver improvements in the change of supplier process regardless of daily data updates or supplementary web portal access/information. The IHD should facilitate adequate consumption history necessary to support switching assuming the E-Meter has adequate consumption storage built in – see Section 6.2.1. Having made the statement that the data belongs to the customer (Section 4.3.9 in CER Decision Paper) DNV KEMA would advise the CER to consider the whole subject of data ownership and data storage on the meter in relation to this.
- It is true that greater levels of sophistication could be provided by a dedicated data portal and web based systems accessed independently by customers. It is also likely that the form of this will change over time and become more supplier/customer specific, and the provision of a programme supported data portal might well be too early at this time.
- DNV KEMA's belief is that market participants will/should find ways of differentiating themselves for both compliance and commercial reasons and as such the development and application of the schemes should be funded by those that will ultimately benefit from them. It should also be acknowledged that the views and/or concerns coming from the smaller suppliers would be a area point to address.

With the above observations in mind DNV KEMA recommends a robust review of the inclusion of a data portal during Phase 2, taking on board feedback from the customer behaviour trials (customer reaction to detailed web based data) and the results of further market research i.e. customer focus groups and demographic research.

7 WAN TECHNOLOGY REVIEW

As part of the review for CER, DNV KEMA was also asked to look into different WAN technologies to help inform the CER's thinking. This section primarily focuses on PLC but also covers other WAN technologies.

7.1 Latest PLC Technologies

Spain, Italy and France are strong advocates for PLC-based smart meters. This is mainly due to less complicated and less layered electric utility structures in these regions than in the UK, Germany or Netherlands. The most advanced PLC solutions currently include PRIME and G3.

PRIME is an open and royalty-free to implement standard for advanced narrowband PLC communication designed for smart grid applications. Development was initiated in 2007 by the international utility Iberdrola. PRIME provides open specifications for a PLC narrowband data transmission system over the low voltage network. The specification defines three building blocks: a) the physical (PHY) layer based on OFDM multiplexing with data rates up to 128 kbps, b) the MAC layer optimised for LV PLC networking and c) the Convergence Layer. In the latest version of the specification, convergence layers for IEC 61334-4-32, IPv4, and IPv6 are specified. These latter 2 convergence layers specify a way for efficient transport of IEC 61334-4, IPv4 or IPv6 packets that contain the application layer payload (usually DLMS COSEM messages), over the PRIME network. In Spain 100,000 PRIME based metering points in urban and rural area are already installed resulting from a pilot project in Castillon. The pilot project completed in 2011 and successfully demonstrated interoperability with multiple vendor solutions, also capabilities in mass field deployment were proved successfully, including remote disconnection and reconnection, on-demand readings, remote firmware upgrades. Recently, Iberdrola contracted for another 1 million smart meters based on PRIME.

G3 are royalty-free open specifications for PLC communication, developed on behalf of ERDF for use in its nationwide smart metering project in France. G3 is a specification for OFDM-based PLC communication for the CENELEC A-band developed in cooperation with Maxim and Sagemcom. Key features include OFDM-based PHY/MAC layers and a 6LoWPAN adaptation layer to transmit IPv6 packets over power-line channels. The specification also includes innovations such as coexistence with S-FSK, adaptive tone mapping for optimal bandwidth utilization, and a robust mode of operation that improves communication under noisy channel conditions.

Standard	Technology	Band Occupied	Data rate Range
PRIME	OFDM	42-90 kHz	21-128.6 kbps
G3	OFDM	35-90 kHz	2.4-33.4 kbps

Table 18: PRIME vs. G3

7.2 WAN Technologies - Overview

An overview of competing technologies used for smart metering installations is provided below in tabular form. The technologies included in the table below are the following:

- BPL (according to the latest IEEE standard);

- PLC (according to the PRIME standard);
- DSL via optical fibre (FTTx) (as used in Boulder, US);
- GPRS (internationally applied);
- UMTS or 4G (Wimax); and
- Wireless Mesh (as used in PG&E, US).
- LRR (Long Range Radio, as used by Arquiva, Smart Reach)

The comparison criteria in the table covers different aspects of the technology deployment including:

- IP communications capability for smart grid applications (including IPv6, VPN capability);
- Data transfer capacity and speed (e.g. bandwidth, latency, reliability, real time response);
- Scalability (e.g. suitability for a very wide range of smart grid applications);
- Costs (broken down in urban and rural applications);
- Home owner involvement (e.g. degree of hassle factor, complaints about EMR, interference with home electronics);
- Control of communications infrastructure (e.g. in terms of ownership, operations, maintenance);
- Simplicity of roll-out (e.g. in terms of ease of installation, needed upgrades, regulatory issues, consumer issues); and
- Existing standards for ICT (e.g. an established set of standards commonly accepted).

Features	PLC (Prime/G3)	GPRS	Wireless Mesh	BPL IEEE1901	PLC	DSL Fibre	UMTS 4G	Long Range Radio
Full IP (IPV6, VPN)	✓	✓✓	✓*	✓✓	x	✓✓✓	✓	✓
Real-time (latency, bandwidth, real-time portal)	✓	x	X	✓	x	✓✓✓	✓	✓
Scalability	✓	x	X	✓✓	x	✓✓✓	✓	✓✓
Costs Urban / Rural (ICT, third party and roll-out process)	✓✓U ✓R	✓✓U ✓✓✓R	✓U ✓✓R	✓U xR	✓✓✓U ✓R	✓U xR	✓✓✓U ✓R	✓✓✓U ✓✓✓R
Home owner involvement	✓✓✓	✓✓✓	✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓

Operation of infrastructure	✓✓✓	x	✓	✓✓✓	✓✓✓	x	x	✓
Simplicity of roll-out	✓✓	✓✓	✓	✓	✓✓	✓	✓	✓✓
Standards for ICT	✓	✓✓✓	✓	✓	✓	✓✓✓	✓✓✓	✓

LEGEND: ✓✓✓= Very Suitable, ✓✓=Quite Suitable, ✓=Suitable but with known issues, x=not suitable

** Silver Spring Networks is developing the use of IPv6 as a networking protocol for the smart grid as well as leading the development of IEEE 802.15.4g for mesh communications.*

Table 19: WAN Communications – key metrics

The above table contains a summary representation of the key technologies and may not be wholly representative of all cases, countries or trials, due to significant differences in utility/market arrangements. Note that PRIME and G3 also have established user groups, as well as conformance test procedures.

From DNV KEMA analysis it is considered that PRIME and G3 would be at the top of the list of PLC standards. Additionally, IEEE P1901.2, a new standardisation project for low frequency (less than 500kHz) Narrow Band Power Line Communications, is also OFDM based, and is based on open standard. PRIME offers less resilience against impulse noise, lower throughputs and higher latencies, less effective frequency interleaving and lacks some advanced features such as jammer cancellation, etc.

IEEE P1901.2 is designed to provide a new benchmark of performance and reliability whilst offering interoperability with the existing "PRIME" and "G3-PLC" OFDM technologies, in order to provide a smooth transition from already established OFDM technologies. One interesting fact is the difference in the MAC Layers/channel access: IEEE 1901.2 is strict CSMA/CA whereas PRIME offers combined CSMA/CA and TDMA opportunities per frame. Both use similar approach for FEC and ARQ. Another difference is PRIME’s 500 Hz symbol rates per subcarrier (96 data subcarriers + 1 pilot) versus much lower symbol rates per subcarrier (and more subcarriers) with IEEE 1901.2. This means IEEE 1901.2 offers potentially much better impulse noise suppression and ISI suppression.

Whilst actual data on performance against real-world impairments is limited, it is suspected that IEEE 1901.2 will work noticeably better in non-radial distribution systems (i.e. meshes/grids). This is because its larger number of (more closely-space) subcarriers, each with lower symbol rates and better frequency-interleaving, will provide much better protection against the resulting longer-delay multipath.

8 SECURITY AND DATA PROTECTION

Considering the review in the round, the greatest area of concern, in DNV KEMA's opinion, relates to security. Whilst, there are a number of ‘catch all’ statements within section 4 and 5 of the CER decision paper we would have expected to see more reference to security (even at this early stage) because it touches on so many different elements of the architectural design.

DNV KEMA has subsequently provided some thoughts around the topic of security which the CER may wish to consider going forward. Given our experiences elsewhere, DNV KEMA would strongly recommend that security (and privacy) be core to the design from the earliest possible stage. However, there are no ‘formalised’ security requirements for smart metering – albeit at a European level; there is increased impetus on developing a standard approach to security and privacy and the relevant certification regimes that are needed. DNV KEMA is aware of discussions already underway between ESMIG and the British Electromechanical and Allied Manufacturers Association (BEAMA) on this topic and is following such debates closely.

To determine what the security elements/measures should look like, DNV KEMA would suggest that the CER first needs to look at the potential vulnerabilities associated with the smart metering architecture that has been proposed thus far. There is also a need to determine what the ‘appetite for risk’ is, initially by quantifying what the physical or financial impact of these vulnerabilities might be. If for example a particular security risk is deemed ‘very undesirable’, all efforts should be made to eliminate it at the design phase. Other risks may be managed on an ongoing basis via other mechanisms (e.g. technology or appropriate governance or both).

As an example and in the simplest of terms, the key considerations for data security are illustrated below:

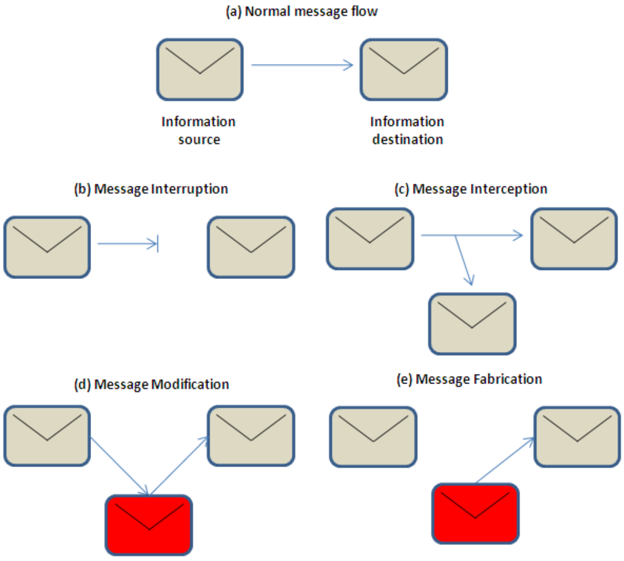

Figure 4: Data/transfer security considerations

Diagram (a) shows a normal flow of information – however, whenever a message is sent, the receiving device / system must be able to verify that the message came from the expected source before acting on that information. This process is known as authentication. If the data is subsequently to be stored on a device or a database, there remains the potential for an unauthorised party to gain access to it. There may therefore be a need to encrypt the data and put control mechanisms in place to limit access to it (passwords etc.). All of these considerations fall under the banner of Data Access Security.

The second area to consider is Data Transfer Security and diagrams (b) to (e) show the different types of intrusive behaviour that may potentially occur during data transit.

- In diagram (b) the message has not been received due to an interruption. Depending on the design, there is a risk that the communications network may become saturated with messages that are continually being re-sent but not being received. The consequences of each message type not arriving at its destination need to be understood.
- In diagram (c) the message has been received as intended, but has also been intercepted by a rogue device. Therefore the information has potentially been compromised and the consequences of an authorised party accessing different types of messages must be understood.
- In diagram (d) the message has been intercepted and modified. This could cause the receiving device to undertake a whole variety of false transactions. Again, the consequences of such events must be understood before determining the measures that are needed to address them.
- Finally in diagram (e) a rogue device is pretending to be the sending device which again could

lead to a range of false transactions.

WAN and HAN technologies have different security mechanisms in place (or under development) and therefore the choice for WAN / HAN should be reflective of the vulnerabilities that are perceived and ultimately the ‘risk appetite’ that the CER wishes to adopt.

DNV KEMA can also foresee that the following items would need to be duly considered:

- Any system that has a ‘line of sight’ to smart metering devices in the field (e.g. MDMS has the potential to be attacked, thus causing widespread disruption to the system as whole. One example of this would be that every meter could be switched to prepayment mode and credited with thousands of pounds.
- Given both the electricity and the gas meter have a means of physical disconnection, an attack on the head-end system could have a significant impact on critical national infrastructure – i.e. sudden loss of load which would cause widespread inconvenience, disruption and cost.

Having assessed all of the items above, there would inherently be significant implications for the design. These extend not only to device/system level considerations but to management systems. As a minimum, DNV KEMA’s expectation is that the CER will have to define some high-level guiding principles which would need to be accommodated during the procurement phase. There may (for example) be a compelling case for a certification scheme that ensures that every device has the correct firmware and that there is appropriate governance in place for issuing digital certificates. DNV KEMA would draw the CER’s attention to the latest DECC announcements here, but would suggest that the CER draws its own conclusions by exploring the different use cases and making an informed judgement.

As previously hinted, the CER should also be aware that the European Smart Meter Industry Group (ESMIG) is chairing a group which was created by the European Commission looking at “regulatory recommendations for data safety, data handling and data protection”. Any outputs from this group should inevitably be considered in the context of the Irish smart metering roll-out. DNV KEMA acknowledges that the CER has already had conversations with the Data Protection Commission (DPC) and would suggest that the DPC be a key stakeholder going forwards as discussions around security progress.

9 TESTING, CERTIFICATION AND INTEROPERABILITY

From DNV KEMA’s experience, a robust Testing, Certification and Interoperability regime forms an essential part of a cost effective and timely smart metering roll-out. As well as facilitating a workable technical solution (which is fundamentally important given the amount of money that customers put into it), it provides manufacturers with the confidence that the buyers will accept their products - subject to compliance with an agreed specification and the certificate to prove it. Depending on the level of testing, it may also provide a level of assurance that the products will last for a finite period of time.

Following a request from the CER, DNV KEMA has expanded on some of the earlier points raised in section 6.9.2. Ultimately, the CER must decide how far to take the specification before handing it over to ESBN and BGN to implement. In GB, DECC has been developing the specification for a number of years and in DNV KEMA’s view, there is still a little way to go before a definitive specification is produced that will enable a testing regime to be designed. Given DNV KEMA’s longstanding experience in providing testing, certification and interoperability, we trust that these points will trigger further thought and debate in the coming months.

Testing in accordance with the Measuring Instruments Directive (MID): The Measuring Instruments Directive (MID) is an EU directive (2004/22/EC) has been in place since 2006. MID approval (achieved via testing) enables meters to be deployed within the EU and be labelled with the CE mark. MID deals with a range of different meters, including E-meters and G-meters. MID approval certificates are an absolute requirement for any manufacturer looking to provide fiscal meters to ESBN or BGN for the Irish smart metering programme.

Electromagnetic compatibility testing (EMC): The EMC directive is another EU directive (2004/108/EC) that is in place to ensure that the essential requirements for health and safety are met by any device that has the potential or the need to generate an electromagnetic field. Tests can be undertaken to ensure that the amount of Radio Frequency (RF) interference is:

- within a defined set of limits such that it would not be detrimental to the performance of other devices operating in its vicinity
- limited to the extent that it will not adversely effect the health and well being of the user or individuals that may come into proximity of it.

Compliance with the EMC directive leads to a CE mark for any communication devices and forms part of the wider MID requirement for measuring instruments. All products sourced into the Irish smart metering programme must meet the requirements of the EMC directive via a valid certificate.

Protocol conformance tests: Regardless of which application layers are chosen for the WAN and the HAN, tests are inevitably needed (ideally constructed from standards published by a well-managed user group (e.g. the DLMS User Association)) to check basic conformance with respect to the relevant protocols. DNV KEMA would see this as another definitive requirement for the Irish smart metering programme.

Functional communication tests: In additional to generic protocol conformance tests, functional tests are typically undertaken to deal with local specifics (in accordance with a local specification e.g. DSMR4.0, SMETS etc). Once a detailed CER specification has been established, it will become clear as to what additional 'use cases' will need to be tested to verify that all the communication functions will work as intended. This should extend to testing end to end security in accordance with the agreed specification.

Interoperability tests: Interoperability tests are undertaken as a separate activity to other functional/protocol conformance tests as they assess the level of compatibility between products provided by different manufacturers. Based on DNV KEMA's experience, 'theoretical interoperability' is very different to 'real interoperability' and a level of testing and assurance is needed to ensure that any new product (or version of) destined to become part of the smart metering system will operate seamlessly from day one. DNV KEMA has witnessed numerous issues in other countries whereby a manufacturer has claimed interoperability and this was by no means an appropriate claim. Given the sheer number of manufacturers delivering products into the market, a lack of governance in this area would be a huge risk to the Irish smart metering programme. As a pre-requisite to an interoperability test, the manufacturer in question should be able to demonstrate conformance with the final CER specification by producing a valid certificate.

Further quality tests – asset lifetime: Asset lifetime tests (optional) provide additional assurance around the asset life of the products in accordance with IEC standards. Traditional electromechanical meters are very much 'proven' technology and are known to last many years. Smart meters however, which have much enhanced functionality, have more small component parts and arguably more to go wrong. Furthermore the cost of a smart meter is significantly more than a traditional one from an asset management point of view. Because of this, the financial risks associated with early replacements can be quite uncertain. There is one test in particular – in accordance with IEC62059-31-1 which can be used to de-risk such investments. The test can be undertaken to 'accelerate' the life time of the device (be it a E-meter, a communications module or the electrical part of the G-meter) and come up with a prediction for the failure rate. In essence, it is a form of quality test and where bad product defects exist, these will be picked up.

10 CONCLUSIONS

DNV KEMA has based this review on the outputs detailed in section 5 of the CER decision paper (CER 12008 – 4th July 2012) and as a consequence this report has been structured to align with the proposals and decision points as set out in the paper. Throughout, we have tried to be as thorough as possible given the material available and the assistance forthcoming from the key stakeholders and the CER. From a high level perspective (as outlined in the proposed architecture) the proposals are generally in line with what is being planned and/or enacted elsewhere. On this basis DNV KEMA is broadly in agreement with the high level proposals.

There are, however a number of areas that we believe need further clarity, in terms of the design detail and assurances that best practice principles are being followed, particularly as the procurement phase approaches. Our understanding is that this is the primary focus of Phase 2. Our concluding remarks are structured to reflect the sequence of the DNV KEMA review and highlight key elements of the programme where, we believe the CER should seek more outline detail as the requirements and definition phase approaches.

DNV KEMA agrees that the majority of electricity and gas smart meter functionalities proposed in the decision paper should be included in the programme (incorporated within the design of the meter) and that this is possible at no additional cost to the project. Where this is not the case and/or in our opinion further work is needed in support of their inclusion, DNV KEMA's commentary is provided in the relevant sections of the report. These are denoted according to metering, infrastructure and system categories discussed in the decision paper.

Notwithstanding this, we have drawn out, at high level, the following key areas as the primary elements of the decision process so far where we feel more detail is required in support of the solution and/or the inclusion of functionality proposals:

E-Meter: In general there are no major issues in relation to the functionality proposed. However, DNV KEMA has highlighted certain functionality proposals as key elements of the programme that require further development in Phase 2. These include:

- Voltage/power quality monitoring: Whilst the functionality should be included, the broader work necessary to realise the benefit of the functionality (outage detection and voltage quality) will form the basis of a separate ESBN project:
- Load Limiting: This should be included as a practical pre-disconnection option but customer protection measures governing load limiting and disconnection should be considered and if necessary reviewed in light of this:
- Stored Data on the Meter: The functionality should be incorporated but the detail of the precisely what will be stored and for how long should be developed in Phase 2. In this regard, a practical balance should be struck between data available at the IHD and the requirements of the Energy Efficiency Directive.
- Communications Module: DNV KEMA strongly supports an interchangeable WAN to facilitate communications upgrades without the need for a full meter change.

G-Meter: As a general comment, the gas meter functionality proposals, in DNV KEMA's opinion, tend to be highly aspirational, yet less well defined at this stage of the process. We feel this is best represented by the following:

- Optional Output Functionality: This item includes sub functions that seem to be described at high level at this stage. We suggest that greater clarity and definition is sought so that the functionality request can be fully evaluated; for example
- The 'provision of data to ancillary devices in the home' is understood to mean Utility HAN transmissions between the G-Meter and the E-Meter. DNV KEMA recommends that BGN describe the remaining requests similarly so that any unintended ambiguity is removed and an unbiased judgement can be made.

In addition to the above functionality extracts, data privacy and security has been highlighted as a primary area for continued attention. Security measures are described at high level in the decision paper and provide recognition of the need for it to be seriously addressed as a priority area of the programme. In other smart metering examples the subject of security and data privacy has been left quite late, and this has resulted in unplanned delays and unforeseen difficulties for the advancement of projects. Following discussions with ESBN, DNV KEMA is confident that good progress is already being made in this area and ESBN's Full Rollout Security Principles document, published in September 2012 is evidence of the major guiding principles being followed. DNV KEMA has therefore concluded that the whole subject of data protection and security is moving in the right direction, the stakeholders are heeding the lessons from elsewhere and are highly informed regarding the system threats, the need to secure the infrastructure and the techniques/technology available to do this.

With regard to the WAN infrastructure we are mindful that suitable technologies have been trialled with favourable results. However, we are also mindful that more work has yet to be done to fully rule in or rule out certain options. DNV KEMA has included a WAN technology review in Section 7 of the report and we have commented more specifically on the WAN proposals outlined in the decision paper in Section 6. In this regard, we have recommended to carry out further work to identify the data requirements and required service levels by each stakeholder in order to identify the most appropriate WAN solution. In general we have concluded that the approach adopted (i.e. reserve judgement on final WAN decision pending the outcome of further trials) is measured and is positioned to deliver infrastructure solutions that will be technically fit for purpose and (within the context of the solution) in accordance with the parameters outlined in the CER's decision paper.

The procurement process as presented in the decision paper has also been reviewed and our commentary is provided in section 6.9 of the report. DNV KEMA is generally in agreement with the proposed procurement requirements. In our opinion it is the most cost efficient model considering the specifics of the Irish energy market. Nevertheless, there are increased risks associated with establishing one of the key players in the energy market as a mediator in data communication and provision for all of the relevant energy market players in Ireland. It is thereby highly recommended that thorough rules are set out in this area to ensure the model is implemented in such a way as to ensure all of the parties are treated fairly and customer data is protected.

The data portal, considered as part of the consultation proposal, raises a number of issues with us, not least of which is; what is required in terms of data provision to customers for energy efficiency purposes. Having reviewed the relevant legislation, DNV KEMA believes the requirements of the Third Legislative Package for Further Liberalisation of the Electricity is adequately served by the inclusion of the IHD and by requiring the smart metering equipment to store one year half hour consumption data. DNV KEMA's view is that market participants will/should find ways of differentiating themselves for both compliance and commercial reasons and as such the development and application of the schemes, such as new/replacement IHD's (more supplier specific customer information and/or access to differentiating web based data, TOU incentives and switching incentives, should be funded by those that will ultimately benefit from them. We conclude therefore, that there is a call for structured market research regarding precisely what customers will be prepared to reach for in this area, especially in light of the feedback from the earlier customer behaviour trials, where response rates were somewhat disappointing.

The proposed systems solution as shown in the high level design architecture, has been reviewed in terms of the technical application and the respective costs of two independent systems Vs a single shared arrangement operated by ESBN on behalf of BGN. Our findings indicate that a dual system model is likely to be the more favourable option. Overall it carries less project risk and any additional cost, in our opinion, is likely to be minimal, especially when considering the integration costs on the BGN side and possible additional system management burden on the ESBN side. Our findings are developed in Section 6.10.1

Finally, DNV KEMA has no major issues with the current HAN proposals. In this area DNV KEMA very much endorses the request for an early decision on the HAN technology so that sufficient time is built into the schedule for vendor/stakeholder testing and to cover off last minute changes that meter manufacturers (or their subcontractors) may not be able to support if the HAN procurement decision is left late.

11 RECOMMENDATIONS

In relation to the areas highlighted for attention throughout the report we strongly recommend that more detail is sought during Phase 2 so that the functional requirements and/or technical solutions proposed, and the application of the functionality by the stakeholders, is fully understood in the broadest context of the deployed solution.

An area where little mention is made in the decision paper is equipment testing. DNV KEMA believes that assurance arrangements should be put in place to ensure smart meters when procured (and once installed), fully meet the CER’s requirements. This would generally involve translating a test specification into a set of testing regimes. Typically these arrangements would include MID type approvals (EU directives), EMC testing (for communications elements) – EU directives and protocol conformance tests (e.g. DLMS COSEM, Zigbee etc). From DNV KEMA’s experience, a robust testing, certification and interoperability regime forms an essential part of a cost effective and timely smart metering roll-out and we strongly recommend its' inclusion.

As with any large scale deployments there are deployment risks, perhaps the primary one being that it is not possible to categorically predict how the performance of the system (that is ultimately procured) will pan out relative to the specification. Overall DNV KEMA fully supports the structured, systematic approach being adopted by the CER and the lead participants'. The commentary provided in this report is therefore positioned to continue to highlight issues of significant importance, such as data security, system design and data management in general, and whilst doing so help to provide a focus for further detail and structure in Phase 2.