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Irish Water
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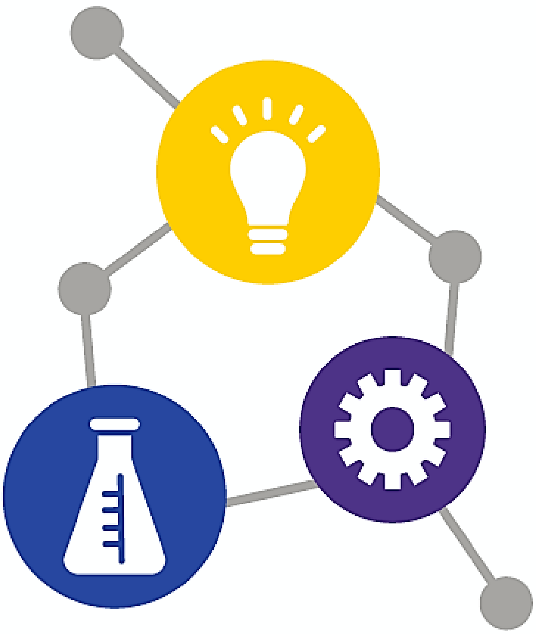
Pilot Technology Trials of Water Metering Systems for Multi-Unit Development



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Commission for Regulation of Utilities (CRU) Water Services Innovation Fund

Pilot Technology Trials of Water Metering Systems for Multi-Unit Development

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ACKNOWLEDGEMENTS

This report is published as part of the Commission for Regulation of Utilities (CRU) Water Services Innovation Fund.

In 2015, the CRU established the Water Services Innovation Fund. The Innovation Fund allows Irish Water to explore innovative technologies and approaches through projects that would not otherwise be funded as part of its normal operating costs or Investment Plans. By their nature, innovation projects may not succeed, however, for a project to be approved, Irish Water must demonstrate that it has a reasonable chance of delivering defined, tangible benefits for Irish Water's customers and that these benefits outweigh the cost of the project. Projects must be designed to deliver improvements in at least one of the following areas:

- Provision of safe, secure, and reliable water services;
- Increased understanding of customer behaviours and their drivers and effective customer engagement;
- Enhanced energy savings in the provision of water services;
- Achievement of relevant environmental standards and the objectives of the Water Framework Directive;
- Mitigation of negative climate change impacts;
- Provision of water services in an economic and efficient manner; *and*
- Improved conservation of water resources.

Irish Water wishes to acknowledge the support and participation of the Centre for Excellence in Universal Design at the National Disability Authority.

Irish Water also wishes to record our appreciation to the five consortia of technology providers, service providers, installation contractors, management companies, etc., that participated in the project.

In particular, we wish to thank the owners and occupants of apartments involved in the five trials for their cooperation. We particularly acknowledge the advice and support provided by the Apartment Owners Network.

DISCLAIMER

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Executive Summary

This is a report into a series of technology trials. Its sole purpose is to provide a commentary on what was observed during these trials.

No adverse comment is intended or should be presumed against any product, technology, service or supplier. The intention of the project is to explore types of technological solutions, rather than specific products or systems. Irish Water is committed to implementation of government policy on bulk metering of apartment buildings. This project commenced prior to the decision by Government to cease general meter-based domestic usage charges. Irish Water does not have any plans to extend domestic water metering to sub-meter individual apartment units.

As part of the revenue review[1] process, the Commission for Regulation of Utilities (CRU) created the Water Services Innovation Fund[2] (the Fund) of €4m. The Fund allows Irish Water (IW) to develop innovative projects that explore novel technologies and operating arrangements outside of 'normal business operations'. These projects are designed to deliver benefits to customers, including better service provision and/or environmental improvements.

In September 2015, the CRU approved an innovation project to investigate technologies appropriate to the metering of multi-unit developments or 'MUDs', such as apartment blocks. This paper represents IW's final report regarding this project.

The Multi-Unit Development Metering Trials project was an innovative project undertaken by consortia of metering technology providers and MUD management companies, working on IW's behalf. Following a procurement exercise, the trials took place in late 2016 and early 2017 in five sites within the Dublin metropolitan area.

The trials involved the design and installation of suitable meter reading technologies for apartment buildings within Dublin and the operation of the technologies for a short period of time to demonstrate their performance. The trials afforded the opportunity to explore the potential integration of MUD meter data into IW's existing meter data management systems.

The trials also provided IW with an opportunity to witness both developed and developing technologies in comparable local environments and prove the performance of the technologies on offer and in development. As this was a technology trial, water consumption analysis in properties was not included in the scope of the trial. A key objective was to use the opportunity to consider as many different technologies and services as possible, within the budget set by the CRU.

The trials involved five consortia who were selected after an open competition. These consortia identified suitable MUD sites in Dublin and made their own arrangements to

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[1] **Revenue Review:** a key responsibility of the CRU is to periodically determine IW allowed revenue under a process called 'a revenue review'. The CRU sets this amount after reviewing IW proposed operational expenditure and capital investment plan

[2] **Ref:** CER/15/076 Water Services Innovation Fund Information Paper, published 10th April 2015. The paper can be found here.

facilitate the trials through communication with the owners and management companies. IW provided communication materials for consortia to use in their engagement with apartment owners and residents.

A list of the five consortia and the key features of the individual trials are as follows:

- **Diehl Metering / GMC Utilities**
  This trial demonstrated a fixed-radio evolution of the existing domestic and non-domestic metering technology in use by IW in Dublin. The trial looked at the installation challenges for sub-metering, and the interaction between bulk meters and sub-meters.

- **Pervasive Nation (TCD) / Actavo**
  Pervasive Nation used the trial to demonstrate the functionality of the LoRa[3] (long range) network, which is a global communication protocol that has been established to support the collection of large volumes of data from smart sensors, i.e. the Internet of Things (IoT).[4]

- **VT IoT / Sigfox**
  Sigfox is another communication protocol designed to support IoT systems, which has been rolled out across Ireland by VT IoT/2RN.[5] This trial demonstrated the functionality of Sigfox and also introduced a range of web portals from Connit, Waylay and Hydroko for the analysis and presentation of usage data to customers and other stakeholders.

- **Suez Water**
  The Suez Water trial placed bulk meters on four apartment blocks and also sub-metered all 66 apartments in one of the blocks. The system employed Ondeo radio technology using the 169 MHz ISM band and GPRS[6] (general packet radio service) to communicate with cloud servers. Again, this trial demonstrated web portals to display data and an App for a smart device for customers.

- **Itron / Coffey Water**
  Finally, Coffey Water used Itron metering technology in a student residence to demonstrate the challenges of metering in a building with complicated plumbing systems. The trial presented data on the Temetra platform which is separately used by IW for domestic and non-domestic meter data.

The consortia worked closely with the management companies in each MUD to progress the trials. The trials were all completed successfully by the consortia and met the objectives set out in the procurement competition.

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[3] **LoRa:** stands for Long Range, and is a low power wide area network developed to support the "Internet of Things"; which is a network of objects that are fitted with microchips and connected to the internet, enabling them to interact with each other and to be controlled remotely.
[4] **Internet of things:** which is a network of objects that are fitted with microchips and connected to the internet, enabling them to interact with each other and to be controlled remotely, as per definition www.collinsdictionary.com
[5] **VT IoT/2RN:** VT IoT (Private Company) & 2RN (formerly RTE Transmission Network Ltd).
[6] **GPRS:** General Packet Radio Service is a packet switching technology that enables data transfers through cellular networks.

Prior to the trials going on site, the Centre for Excellence in Universal Design (CEUD) of the National Disability Authority (NDA) joined the project and provided valuable insight into the importance of universal design principles for all participants.

Key Research Findings

There were a number of key observations from the trials which included the following:

- The trials successfully presented a range of web portals and smart phone apps that would offer customers and management companies a means to monitor the consumption in apartments and MUDs. The systems also offered text alerts and similar alarms for customers in the event of a leak or similar event.
- As this was a technology trial, and not a behavioural or data analysis project, the scope of the project was limited and did not include any requirement to analyse the consumption of water in typical properties. However, certain data sets were gathered necessarily to demonstrate the end-to-end performance of the technology. As these data sets were available, a basic review of the data gave an anonymised indication of water usage patterns in apartments.
- Initial analysis of the data appears to show that a small number of apartments use very large amounts of water; and average water usage in apartments is as high, if not higher, than other households.
- The metering solutions also readily identified leaks within both the MUD and the individual apartments.

Key Research Challenges

There were a number of key challenges identified from this trial which included the following:

(a) Installation/retrofitting of meters onto existing pipework:

- Technical installation challenges experienced by contractors working in basement plant rooms and service shafts. For example, there would be challenges associated with the installation of a new meter onto the existing pipework in a fashion that would minimise disturbance and allow the meter to be accessible.

(b) Radio connectivity & power supply:

- Another challenge was radio connectivity and power supply to the meters in the MUDs, e.g. in basement plant rooms and service shafts.

(c) Universal Design:

- It was evident that the marketplace has yet to develop a complete appreciation of the demands of accessibility or universal design in the development of products or technical solutions to meet the needs of consumers.

The technical installations performed in accordance with expectation, generally returning daily reports of hourly water usage through the meters. In each case a CSV file[7] of usage data was submitted to IW to demonstrate that the reading data could be imported into IW systems.

Benefits of the trials output

The lessons learned from these trials may be used as inputs to the development of IW technical solutions and specifications for metering of MUDs where relevant. They may also be used in the procurement and design of any potential programme of apartment metering, should such a requirement arise in the future. It is recommended that the anonymised usage data gathered from these trials be retained and analysed to better understand water usage patterns in MUDs.

In 2015, with the approval of the CRU and with funding provided by the CRU, Irish Water began a study to examine the technology available to meter Multi Unit Developments (MUDs). The data information gathered from this study shows the challenges faced by the various technologies from an installation and operation perspective, as well as some practical applications for such technology. It also indicated that it was feasible to undertake metering at such developments.

However, it is important to note that this study occurred prior to the removal of domestic water charges under the Water Services Act 2017.As a result of the technical and financial challenges, the metering of MUDs is unlikely to occur in the foreseeable future.

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[7] **CSV File:** is a simple file format that can be used to store tabular data, such as a spreadsheet or database.

1. Introduction

1.1 CRU Water Services Innovation Fund

The Water Services Innovation Fund was established by the CRU in April 2015. The CRU is the economic regulator of IW as the provider of public water and wastewater services. As part of the revenue review, the CRU created the Water Services Innovation Fund to enable IW to invest in research and innovation projects. This was with a view to addressing issues across the IW network, and to find new ways to provide and improve services outside 'normal business operations'.

The intent of the Fund is to promote innovative projects that have a reasonable probability of delivering defined, tangible benefits to customers of IW in a defined timeframe. IW must also demonstrate that proposed innovative projects provide value for money, and meet at least one of several other objectives included in the CRU Water Services Innovation Fund Information Paper (April 2015).[8] IW must also report to the CRU on a quarterly basis, outlining progress on the approved project.

In June 2015, IW made an application to the CRU for an allocation from the Fund for the purpose of a trial to investigate meter data collection in MUDs. The business case presented by IW is described in further detail later. Approval to proceed with the project was granted by the CRU in September 2015, with a budget capped at €100,000 (excl. VAT).

1.2 Background

In 2012 the Government published a position paper entitled "Reform of the Water Sector in Ireland", which addressed universal water metering.[9]

IW installed c.894,000 water meters on domestic connections during the IW Domestic Water Metering Programme between July 2013 and February 2017. This represents c. 60% of domestic connections. The meters are read four times a year by IW using very efficient drive-by automatic meter reading (AMR) technology.

The meter reading data assists IW in the identification and location of leaks from the water network, and allows IW to undertake critical repair works, such as the First Fix Free Programme. These repairs works reduce water leakage.

- ### Apartment Metering

The scope of the Domestic Water Metering Programme did not extend to MUDs, such as apartment buildings. It was considered that these were likely to have complex plumbing scenarios that would be more time consuming and costly to address.

IW has taken steps to investigate the issues associated with the metering of apartments and other MUDs. Specifically, IW ran a project to investigate the scale and feasibility of apartment metering, which was concluded in December 2013. This project looked at the

[8] Ref: CER/15/076 Water Services Innovation Fund Information Paper published 2015/04/15, which can be found here.
[9] Ref: *Reform of the Water Sector in Ireland Position Paper*, January 2012, which can be found here.

number of apartment buildings, their age and forms of construction. It also explored the costs associated with bulk metering and sub-metering of different categories of MUDs.

The study established that there are significant numbers of apartments, typically in buildings built since 2000 that could be individually metered at reasonable cost. However, the study did not address technologies required to read meters that may be installed within apartment buildings.

There are many different configurations and ages of MUDs in Ireland. For example, older apartment buildings may have more complicated plumbing systems that are not conducive to cost-effective metering solutions.

For the trials, IW envisaged that MUDs with single feeds to each apartment would provide sufficient opportunity to demonstrate the functionality of proposed metering reading solutions.

- **Water meter read technologies.**

In the IW Domestic Water Metering Programme, the meters are read using a 'drive-by' AMR technology, which relies on the propagation of low power radio frequency (RF) data packages from the meter. As the meter reader drives past, the reading technology in the van automatically collects the usage data and alarms from the meters in the footpath outside the houses. These readings are then transmitted from van to a meter data management system, and subsequently to IW IT systems as demonstrated in Figure 1 below.

Figure 1: Example of a Meter Reading Technology – Flow diagram

However, this water meter reading technology is not as suitable for apartments where the meters are distant from the public road. Radio signals would typically not be strong enough to propagate from the middle of an apartment building to a meter reading van on a nearby street.

There are various alternative meter reading technologies for apartments available or under development. Should MUD metering be progressed in the future, the most robust and appropriate technology to the built Irish environment would need to be considered.

In the context of exploring meter reading systems for MUDs, the opportunity may also arise to look at additional benefits that could be available from a fixed radio meter reading system. This could include, inter alia, systems to make metering data available to customers to better control their water usage.

1.3 Business Case

A business case was prepared to support the Fund application to the CRU. This set out a proposed trial with technology providers, in partnership with MUD management companies, to survey suitable apartment buildings and propose a concept remote meter reading solution using their technology.

The primary objectives of the trials were described as follows:

- Provide IW with an opportunity to see both developed and developing technologies in practice in a local built environment, and prove the performance of the technologies on offer and in development;
- Prove the processes required to survey, design, install, operate and maintain meter reading systems for MUDs;
- Inform the cost-benefit analysis of potential future phases of water metering in MUDs should the need arise; and
- Provide opportunities to test customer engagement processes.

It was intended that the information gathered from these trials would inform the extension of metering to certain MUDs, if required by Government in future. This is because IW, or any utility, would not typically have the opportunity to do these trials as part of the normal procurement process, but would rely on experience and performance exhibited elsewhere.

The ultimate objectives of a future programme of metering of MUDs could include:

- Provision of water services to MUDs in an economical and efficient manner;
- Improved conservation of water resources;
- Extension of customer benefits of metering to those living in MUDs;
- Enhanced energy savings in the provision of water services; and
- Mitigation of negative climate change impacts.

The outcome of these trials would support the application of new technologies and inform the procurement strategy of IW for any future implementation of metering systems for apartments (MUDs).

This trial also provided an opportunity to explore extending the benefits of metering into at least 100,000 apartments where internal plumbing is thought to be suitable for separate metering in common areas. This would enable both customers and IW to conserve water and provide largely the same benefits that have previously been quantified by the Government as being achievable from the IW Domestic Water Metering Programme. These include:

- A reduction in overall domestic consumption due to behavioural change and customer-driven repairs to internal domestic plumbing systems;
- Deferred capital expenditure due to reduced water treatment requirements; and
- A reduction in CO_2 emissions.

In addition, there are unquantifiable benefits such as improved network management from additional usage data, equity, reduced energy use by households, and reduced abstraction impacts on the environment.

1.4 NDA Support

IW has participated in a working group with the CRU and the Centre for Excellence in Universal Design (CEUD) at the National Disability Authority (NDA) since 2014. This working group has sought to identify practical technical solutions to afford greater access to meter reading data for domestic customers.

In the context of the above working group, in late 2016 the CEUD/NDA was invited by IW to participate in this project as an observer. Representatives of the CEUD/NDA were afforded the opportunity to visit the sites where the meter reading systems were installed and to attend the follow-up reporting sessions with the consortia.

A brief report prepared by the CEUD/NDA is contained in the appendices to this report, and this main report is informed by the perspective offered by the CEUD/NDA on Universal Design principles.

Universal Design is a set of principles that may be applied to inform the design and development of products, services and the built environment such that they are made accessible, understandable and useable by all people regardless of their age, size, ability or disability.

2. Procurement

2.1 Competition

A key aim of the trial was to consider as many different reading technologies and services as possible within a defined budget. In November 2015, IW placed a notice in the Official Journal of the European Union (OJEU) seeking Expressions of Interest (EoI) from a range of organisations, either presenting individually, or as a consortia.

Submissions were sought from technology providers, service providers, MUD management companies, installation contractors, and any other interested parties. IW received 18 EoI.

IW separately engaged with the Apartment Owners Network (AON) regarding the development of the project.[10] The AON is an independent organisation that represents apartment owners in Ireland.

In early 2016 IW reviewed the EoI and prepared tender documents for a competition to select the most economically advantageous consortia to proceed to the trials. Those that had submitted expressions of interest, along with representatives of the AON, were invited to an event in Dublin in March 2016 where the "Request for Tenders" (RfT) document was launched. This event afforded an opportunity to those that had expressed interest individually to form consortia necessary to deliver the project. The presence of the AON also gave an opportunity for each consortium to make arrangements with the management of a MUD to install the technology.

2.2 Specification & Scope

The RfT detailed the scope of the trial and the terms by which the competition would be judged.

In summary, the scope of the project required the tenderers to identify and nominate a suitable MUD within which they would install the technology. Each tenderer would be required to survey the MUD property and develop a concept design for the installation of meters and meter reading technology at bulk entry and apartment level. The tenderers were provided with general requirements for the technologies that would be acceptable for the trial. However, the technology providers were given scope to propose innovative technologies in accordance with the objectives of the trials.

The successful tenderers would be required to document the installation process so that the challenges associated with retro-fitting metering technologies into existing large buildings could be evaluated. Similarly, the successful tenderers would be required to operate the metering technology for at least four weeks after commissioning to demonstrate the performance of the systems.

[10] Further information on the Apartment Owners Network (AON) can be accessed on their website www.apartmentownersnetwork.org

In summary, the minimum requirements were to demonstrate that metering data could be collected efficiently and regularly from apartments and exported to the IW data management systems. However, the RfT also afforded an opportunity for the tenderers to propose additional functionalities and added valued services that could benefit IW or other stakeholders.

The tenderers were invited to submit their proposals, along with a budget (up to a maximum of €20,000 per tenderer).

2.3 Tender Outcome

IW received eight responses to the RfT. This reflected some consolidation of the individual parties that expressed interest into consortia offering the full range of services required for the project.

The pre-determined criteria were applied to evaluate the tenders and the five most-economically advantageous tenders were selected as follows:

- Diehl Metering / GMC Utilities
- Pervasive Nation (TCD) / Actavo
- VT IoT / Sigfox
- Suez Water
- Itron / Coffey Water

The aggregate tender amount from the five preferred tenderers was €96,385 (excl. VAT). In August 2016, letters were issued to invite the five (5) successful consortia to proceed with their installation works, once contractual and health and safety requirements had been met.

2.4 Stakeholder Engagement

The key stakeholders in this trial include owners and/or occupiers of apartments, MUD management companies and any other parties affected by the works. The development of appropriate communication methods is a fundamental part of the development of an installation process. The notification and communication procedures implemented for the IW Domestic Water Metering Programme were to be reviewed by the tenderer. This was outlined in the tender.

Prior to the installation works, communication materials (such as information letters advising of the notification of works, details of the trial, as well as FAQs) were issued by IW to the consortia who engaged with MUDs management companies to share with apartment owners and residents.

3. Implementation

3.1 Introduction

As this was a technology trial, IW deemed it inappropriate to set strict requirements for the performance of the metering technology. Context and guidance was provided in the tender regarding water meters and installation. In relation to measurement characteristics of water meters for individual apartments, this was left to the consortia to offer a range of meter types as part of the trial, to explore the relative performance of meters at different flow rates.

In relation to the proposed water meters, all materials and components had to be approved for use in potable water plumbing systems and had to comply with all of the relevant legislative and regulatory requirements.[11]

(a) Meter Technology

As part of the trial, IW specified that a suitably sized bulk meter was to be supplied and installed to the public water main supply connection to the apartment complex. The aim of placing the meter here was to record total water consumption of the entire apartment complex. An example of a metering configuration of an apartment block is outlined in Figure 2 below, however an intermediate meter would not be a typical addition.

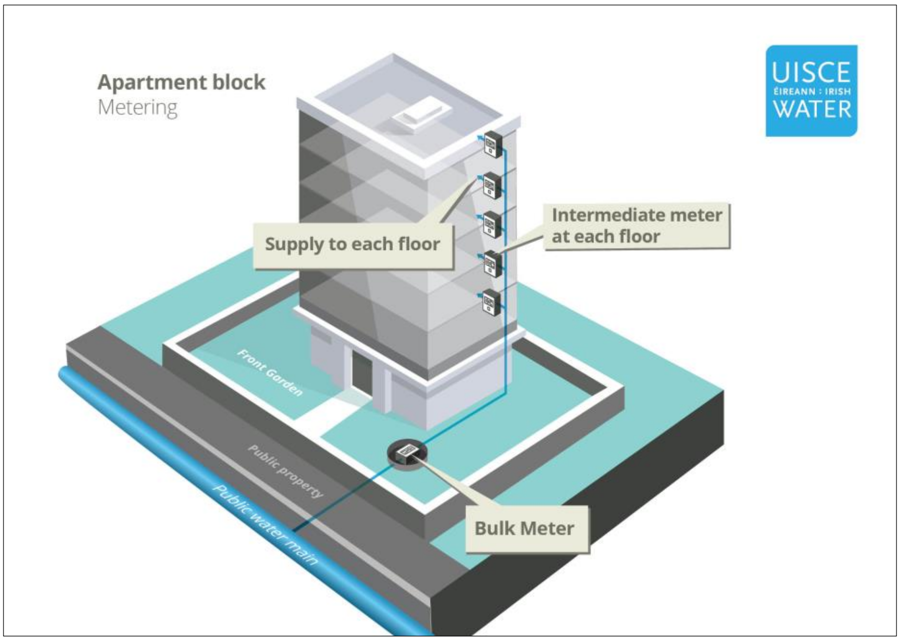

Figure 2: Apartment Block – Metering (Bulk Meter & Intermediate)

Within the apartment block, a sub-meter was to be installed either inside or outside each apartment, for example in a service shaft at each floor. A typical configuration of sub-

[11] Ref: All meters supplied must comply with the European Union (EU) Measuring Instruments Directive (2004/22/EC), as transposed into Irish law, and Directive 2014/32/EU (as amended by Directive 2015/13); and shall be supplied with relevant Certificates of Conformity. All water meters must comply with OIML R49 and/or IS/EN/ISO4064:2014.

meters is shown in Figure 3 below. Again, an intermediate meter is not a typical addition, and was not a requirement of the trial.

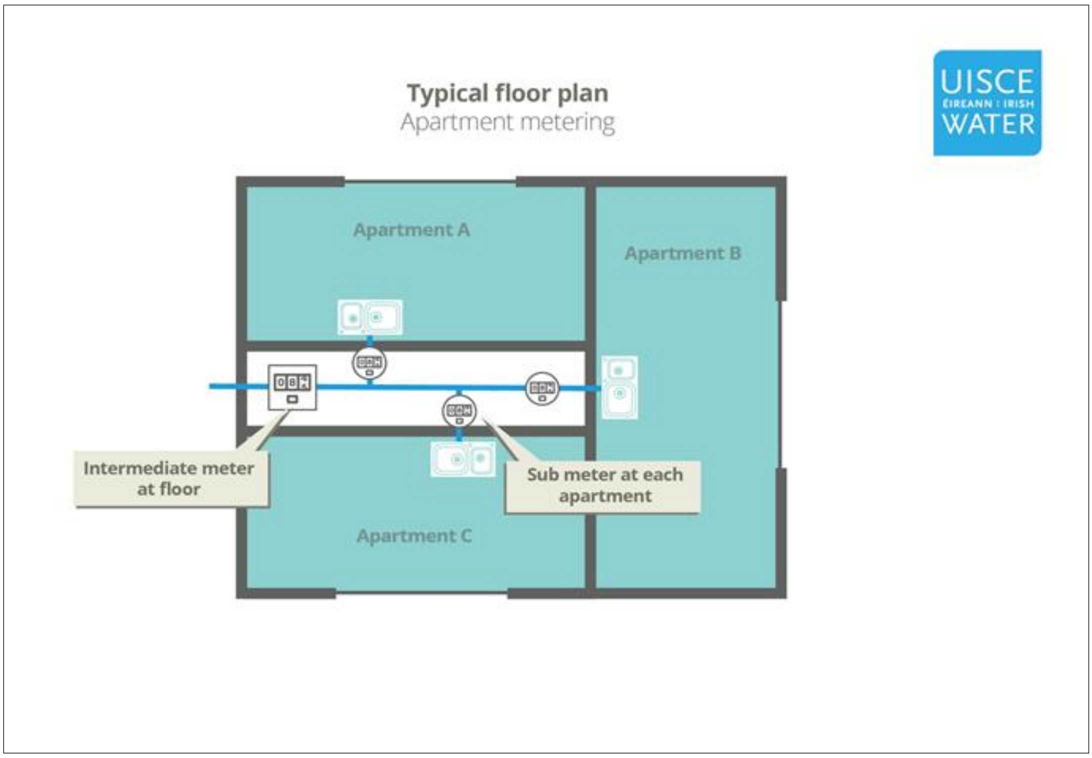

Figure 3: Typical floor plan – Apartment Metering

(b) Meter Installation

Once the metering technology was installed in the apartment complex, it was operated and monitored on a trial basis. The aim was to identify how each of the different technologies would perform. At the end of the trial period, each of the consortia collated the learnings from the trial and compiled a report for IW. All data collected was anonymised and only used for the purpose of the trial.

At the end of the works, the bulk meters were left in-situ for transfer to IW. The sub-meters and reading technology could be removed by the consortia at the end of the trial or could be retained for the sole use by the MUD management company and the occupant and/or resident of the apartment if they wished.

(c) Meter Reading & Data Systems

One of the key objectives of the trial was to establish the most appropriate, dependable and best-value meter reading technologies that could be deployed in apartment buildings in Ireland. The tenderer had to be able to demonstrate that the reading system could consistently and accurately export the meter data into the IW Meter Data Management System.

In order to record and store the water consumption data, then transmit the data to a receiver, water meters would need to be equipped with radio units (or similar) to carry out this function.

Radio units with functionality for a range of alerts and alarms, and remote reconfigurations of the meters (if available), was open to proposals by the tenderer. A key requirement was for each tenderer to provide all necessary licences and permits and confirm compliance with all Irish regulations (maximum power limits, use of licence free bands).

In relation to data security and data protection, IW required metering and meter reading technologies to employ appropriate levels of data security and data protection during the trial.

3.2 Consortia Implementation

This section provides an overview of the technical solutions offered by each of the five consortia and the installation works required to implement those technologies. The operational outcomes and key findings from each trial are also described.

3.3 Diehl Metering / GMC Utilities

This consortium had been one of the two suppliers of domestic water meters for the IW Domestic Water Metering Programme. This trial afforded an opportunity to demonstrate a MUDs metering solution incorporating meters already in use in Dublin for both domestic and non-domestic customers - the Diehl Altair meter.

Trial Overview

Diehl Metering and GMC Utilities selected 18 apartments over seven floors in a modern apartment complex in the Dublin metropolitan area to trial their metering technologies. The design philosophy of the trial was to compare the performance of water meters with different technical characteristics and investigate the significance of any variability in the performance. Therefore, Diehl/GMC installed one bulk meter for the block, sub-meters for each apartment (18), and an intermediate meter for each floor (7). An operational installation would not normally have such comprehensive levels of metering.

The arrangement was intended to permit an analysis of how well the bulk meter on the apartment block matched the aggregate of the sub-meters at each apartment; and which group of sub-meters performed best. The Dynamic Range (R) indicates the ability of the meter to record accurately at lower flows; with the higher values expected to perform best. By way of reference, the Altair R400 was used in the IW Domestic Water Metering Programme.

Diehl/GMC installed a Diehl Izar RDC (Radio Data Concentrator) Unit in the basement of the apartment block, which wirelessly collected meter readings from RF radio units on each of the 26 meters. For the Altair and Aquarius meters, a Waterbox R4 radio module was clipped to the meter, and transmitted on the 868 MHz ISM band. From a 30 cm aerial on the RDC unit in the basement, hourly readings were transmitted by GPRS (General Packet Radio Service) to a file server in Germany. An additional GPRS aerial on the roof was not required.

Photo 1: Meter reading technology installation & commissioning - IZAR RDC Unit

The contractors also used the trial to identify and resolve some of the technical challenges associated with retrofitting meters into an existing building; albeit a modern building with apparent ready access to services, as shown in Photo 1 above.

The installation challenges included:

- Special socket-type fittings with 4-week lead times required to facilitate later removal of meters;
- Existing shut-off valves not always operating effectively, requiring temporary shut-offs to an entire floor rather than an apartment;
- Contractor installed valves upstream and downstream of the meter installation to facilitate meter exchange;
- The water in the building was found to be boosted to 4 bar by a pump, so bends were minimised to mitigate risk of water hammer; and
- The installation of meters inline was found to be as convenient as the installation of a carrier manifold for the meter, and more secure. The challenge here was to determine which approach would be more suitable, i.e. inline or manifold. However, one of the more difficult challenges was the installation sites for the sub-meters outside the apartments. It was intended to install these meters on the branch pipes in the utility service shafts at each floor. However, the branch pipe for each apartment connected to the main riser at ceiling level.

In order to give visibility of the dial of the meter to each customer, a length of pipe had to be looped down from the branch pipe to eye-level in each service shaft, which is demonstrated in Photo 2**.**

Photo 2: Example of pipe inserts looped down from ceiling to install meters at eye level

Meter Readings

Once the software was configured on the Izar RDC unit, it began to receive the data from all 26 of the meters installed over seven floors and began transmitting the encrypted data hourly. The data was then available for viewing on the Diehl Izar Plus Portal by the building management company and the water service provider.

While the system had the functionality to identify leaks, no leaks were identified during this trial. However an underflow alarm was recorded on one meter after a period of zero consumption.

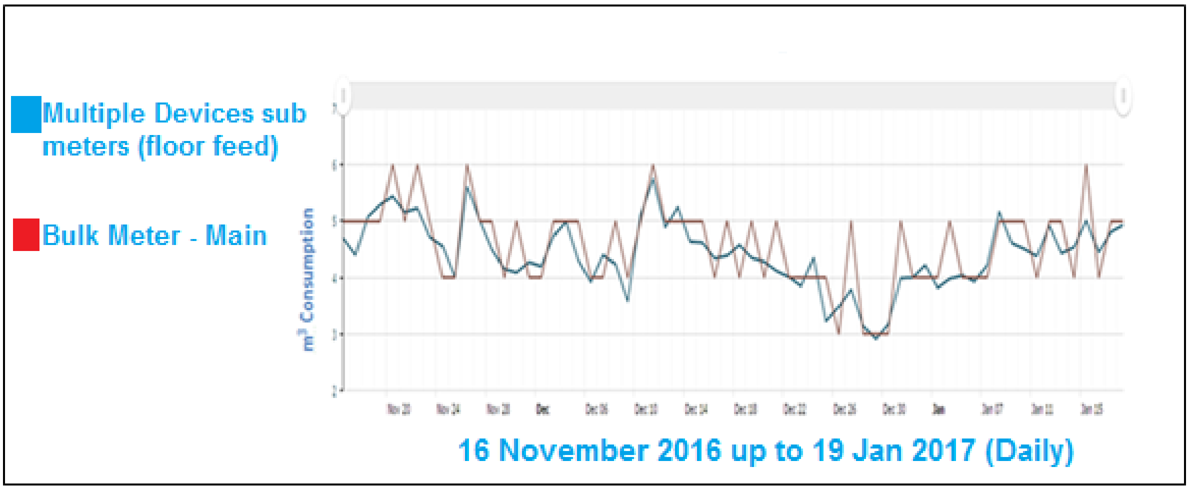

Figure 3: Review of data reports - main bulk meter vs floor feeds (daily) from November 2016 to January 2017

The above graph in Figure 3 shows consumption data for the main bulk water feed (m^3) in comparison to the consumption data for the sub meters (individual meters) at each of the apartments. During the 2-month operational period (Nov 2016 - Jan 2017), the 18 apartments were found to be using an average of 220 litres per day (l/day). However the consumption varied from 4.5 l/day to 430 l/day per apartment over the course of the month. When the bulk meter was considered, the apparent monthly consumption for the 18 apartments rose by 13.28%, i.e. 253 l/day per apartment. The apparent difference in this case was resolved by the intermediate meters at each floor which only varied by 3.47% from the bulk meter.

An average house (with no leaks) has been shown to use approximately 268 l/day, so this limited data suggests that modern apartments use much the same quantities of water as a house.[12]

In relation to the type of meter used for the trial, further examination of the data showed that the R160 meters effectively performed as well as the R400 with very close correlation with the intermediate meter on each floor.

However, the R80 meters, which are not used by IW, showed significant under-recording in some cases. The trial has provided anonymised hourly data from each meter which may provide further opportunities for analysis.

3.4 Pervasive Nation (TCD) / Actavo

The second consortium was formed to demonstrate the functionality of the LoRa (Long Range) network to support meter reading services in apartment buildings. LoRa is a low power wide area network developed to support the “Internet of Things” (IoT). The IoT is a network of objects that are fitted with microchips and connected to the internet, enabling them to interact with each other and to be controlled remotely.[13] LoRa has been rolled out across Dublin, most of Leinster and further national hot-spots by a Trinity College Dublin (TCD) led research programme called Pervasive Nation.

Trial Overview

The consortium selected 15 apartments in a modern 98-unit apartment block in the Dublin metropolitan area to conduct the trial. A DN50 bulk meter and 15 Diehl Altair sub-meters were used for the trial. However in this case the Diehl meters were each fitted with a LoRa enabled radio module. This consortium also sought to install water meters in service shafts in common areas outside individual apartments. The sub-meters were installed in early November 2016 and the bulk meter was installed three weeks later.

The building selected by the consortium was 2.75 km away from the nearest LoRa gateway in the Dublin Metropolitan Area, which was expected to be at the outer range of the technology. Figure 4 below, details the LoRa signal strength of the radio coverage from the Glasnevin gateway by using the following colours a) magenta for deep indoor reception (inside a building), and b) cyan for indoor reception. The MUD is located at the edge of the radio coverage (magenta) for deep indoor reception, accounting for a 40dB loss.

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[12] Ref: CRU/17/339 Report to the Minister: Review of Demand for Water Services (Section 3.3.1 estimated rate of demand to dwellings).
[13] Ref: Internet of things definition sourced from here.

Figure 4: Model of pre-described - LoRA signal strength gateway from the Glasnevin Gateway, around the area of the MUD

The consortium reported in detail on the meter installation challenges within a service shaft, such as radio connectivity to the meter. Other challenges included the presence of cable TV splitters, and amplifiers (can also be found in service shafts) which can cause interference with the 868 MHz ISM radio bands. For best radio connectivity, radios (with internal aerials) were installed as far as possible from the masonry and foil-backed surfaces within the service shafts.

Situating radios at the cell edge presents a challenge as it means that there is little margin for additional losses which could arise due to poor positioning of the radio modules, unanticipated building materials, or the existence of other radio sources which either directly interfere or can raise the RF noise floor. Furthermore, the meters were installed in service risers within the western end of the building, with the LoRa gateway to the east, further constraining the radio signal. Despite the constraints, seven of the meters on the upper floors were capable of being read. However a temporary gateway was installed locally to ensure full radio connectivity for the complete installation.

Meter Readings

The data was collected through the LoRa network and securely stored at a data centre in Waterford, from where the data was made available to IW through the Pervasive Nation web portal. The consortium tested the system at a range of reading frequencies, up to 196 messages per day. The system was also able to export CSV files to IW suitable for importation into the IW Meter Data Management System.

The consortium conducted audits and reported bi-directional connectivity greater than 99% (with less than 1% data reading loss) and water reading accuracy also greater than 99%.

The consortium also simulated, as part of the trial, a leak at another remote site in Co. Dublin and successfully recognised the event on the data portal. In addition, the consortium investigated the potential to use the network to drive an actuator for remote shut off of supply where an escape of water is detected.

The trial provided an opportunity to gather consumption data from 15 apartments over a 7-day period at the end of November 2016. A summary of the sub-meter consumption figures can be found below in Figure 5.

Duration of data analysed=	168	hours	From 22/11 @5pm till 29/11 at 5pm		
Meter (Date Duration and code)	Start reading(dL)	Finish reading(dL)	Consumption (dL)	Consumption (L)	
20161129_7days_AF2	99770	136030	36260	3626	
20161129_7days_AE0	27860	40390	12530	1253	
20161129_7days_AE1	54790	76050	21260	2126	
20161129_7days_AE3	54200	74740	20540	2054	
20161129_7days_AE4	85240	114540	29300	2930	
20161129_7days_AE6	13290	15110	1820	182	
20161129_7days_AE7	50830	70500	19670	1967	
20161129_7days_AEF	64920	89300	24380	2438	
20161129_7days_AF0	49910	71660	21750	2175	
20161129_7days_AF1	99200	131160	31960	3196	
20161129_7days_B03	88910	126020	37110	3711	
20161129_7days_B04	71100	97700	26600	2660	
20161129_7days_B05	90170	116650	26480	2648	
20161129_7days_B06	10150	16990	6840	684	
20161129_7days_B08	59370	84080	24710	2471	
Total consumption for 15 apartments for 7 days				34121	litres
Average consumption per apartment per hour				14	litres

Figure 5: Summary sub-meter consumption figures over the trial period (22/11/2016 @ 5pm till 29/11/2016 @ 5pm) for 15 apartments for 7 days

The results showed that the total consumption was 34.1 m^3 over the week. This equates to an average daily consumption of 325 litres per property, with a range of 26 l/day to 530 l/day. The fourth highest reporting meter, of the 15, had a daily consumption of 419 l/day, which is 67% higher than the average of those houses with no leaks from the metering programme.

This level of granularity is not available from the bulk meter alone. The trial successfully demonstrated that the LoRa network could be a viable technology to support meter reading technology in apartments, while also identifying installation and operational issues associated with MUD metering.

3.5 VT IoT / Sigfox

The third consortium was led by VT IoT, which has rolled out the Sigfox communication network in Ireland with its partners 2RN (RTE). Like the previous technology, this is a communication system intended to support the IoT. We are advised that VT IoT have achieved substantial national coverage of Sigfox via the 2RN network of radio masts.

Trial Overview

This consortium used the technology trial to introduce a range of supporting technologies to add value to the trial. The principal parties to the consortium:

- Actavo installed the technology in the apartment building;
- Meters were procured from Arad through their Irish distributors;
- Connit supplied radio devices for the meters and the platform into which the readings were uploaded;
- VT IoT operated the Sigfox network through which the readings were collected;
- Waylay provided middleware software that provided a portal for display and analysis of the consumption data; and
- Hydroko introduced technologies for management of water consumption.

The consortium selected a modern apartment building of 88 units in the Dublin metropolitan area for the technology trial. An Arad Octave ultrasonic bulk meter was installed in the basement plant room, and sub-meters were installed in 13 apartments by agreement with the occupants.

Due to the nature of the plumbing configuration in the building it was not possible to install meters outside the apartments. Therefore the installations were made under sinks in each apartment. Examples of this can be found in Photos 4 & 5 below. These were designed as temporary installations on flexible pipes and were removed after the trial. The operational phase of the trial ran from mid-November to mid-December 2016.

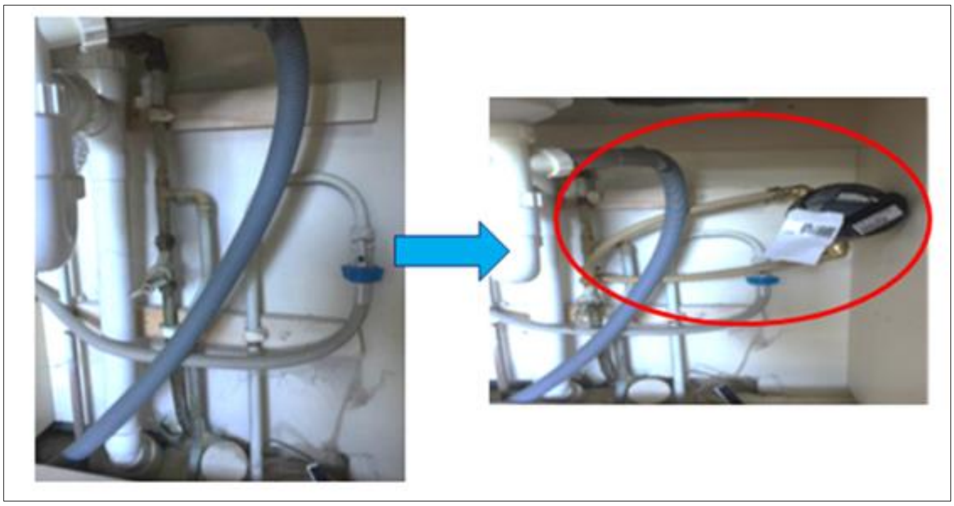

Photo 4 & 5: Shows the plumbing configuration under an apartment sink pre and post a meter being put into place (meter circled in red).

Meter Readings

The data from the trial was presented on a number of different platforms to demonstrate the flexibility and interoperability of the technology. The CSV files of the consumption data were exported to IW.

The Connit Live M2M Platform was the primary portal; this relayed the output from the Connit radio devices. The portal successfully detected a bulk meter leak in early December. An example of the portal can be found below in Figure 6. This portal also displayed the residual battery life on the radio unit and the ambient temperature in the vicinity of the bulk meter.

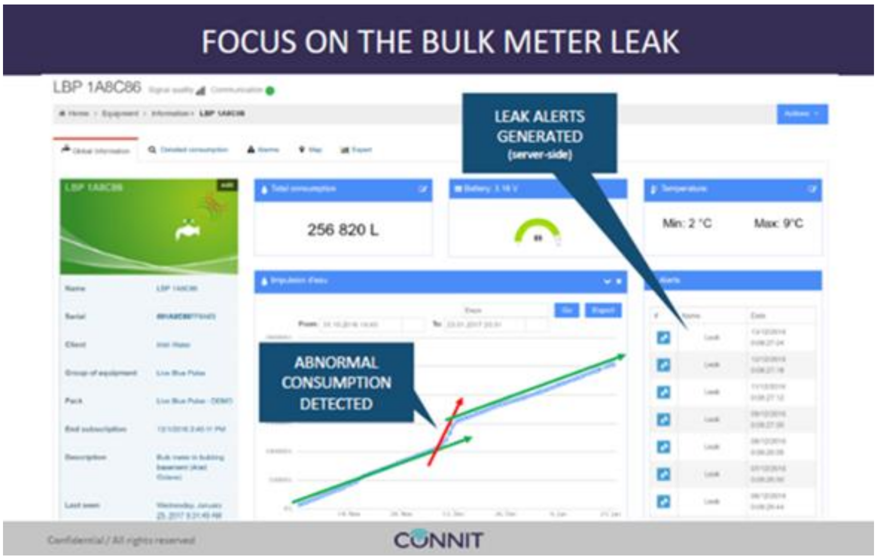

Figure 6: Connit Live M2M Platform Portal

The Connit Live M2M platform displayed similar information for each of the sub-meters in the 13 apartments, including, ambient temperature, daily consumption and aggregate consumption. The technology established that the overall consumption of the 13 apartments over a 30-day period was 109.9 m^3, which equated to an average daily usage of 282 l/day. However, the three largest users had an average daily consumption over this period of 461 litres, which is 84% higher than a typical house (with no leaks).

Over the same period, the bulk meter (excluding the water used while the leak was active) indicated an average usage across all 88 apartments of 294 l/day. The gross consumption (including the leak period) was 415 litres per property per day. During the trial, the Waylay platform was integrated with the Connit Live M2M platform and the Hydroko platform to manage the meter data and alarms. The data was stored and analysed by Waylay, and presented on the Connit platform.

Waylay also demonstrated SMS (text) and email solutions to send alerts to customers about their daily consumption and usage alarms. Connit demonstrated their Water Saver app as shown in Photo 6 for smart phones which could be configured to receive alarms and usage data (total consumption).

Photo 6: Example of a Water Saver app (Connit Live)

These are the types of applications and customer services that can be supported by a frequent stream of consumption data through a fixed radio network, subject to the deployment of the necessary infrastructure.

The VT IoT consortium satisfactorily demonstrated the challenges of metering installations within apartments, the performance of the Sigfox network as a meter reading network, and a range of platforms and services for storage, analysis and presentation of usage data for both operators and customers.

3.6 Suez Water

Suez Water established their innovation trial at an apartment complex in the Dublin metropolitan area. This was arguably the most ambitious installation programme of the five projects, involving a bulk meter on each of four (4) buildings and sub-meters of all 66 apartments in one of the buildings.

Trial Overview

The metering technology for this trial was provided by Elster, with the V210 rotary piston meter as shown in Photo 7 below, used outside the apartments and a V200 DN32 used as the bulk meter for each building. An Ondeo radio unit with integral antenna was clipped to the top of each of the meters, and this transmitted on the 169 MHz ISM band to a concentrator.

A roof-top aerial collected the transmissions from the surrounding buildings, and the hourly-data was then transmitted daily via GPRS. The concentrator detected daily variations in the strength of the GPRS signal. Meters were installed in service shafts at each floor level outside apartments.

The congested nature of the individual supply pipes made the installation of the meters, more difficult, as demonstrated in Photo 8. The works also required modification to the insulation around the pipes and fire stopping. While manifolds were used for the works, the contractor also reported that inline meters would offer a more permanent installation. The contractor reported an average site installation time of 22½ minutes per meter.

The concentrator was reported as being fully operational throughout the trial period with no down time. The aerial on the roof was found to be capable of receiving signals from several hundred metres away. This was tested by placing a meter in a boundary box 1.2 km remote from the site. This demonstrated the potential for a fixed-radio communication system at a MUD location to be used to migrate surrounding domestic meters from drive-by AMR to a fixed radio system.

Photo 7: Example of a V210 rotary piston meter with an Ondeo radio

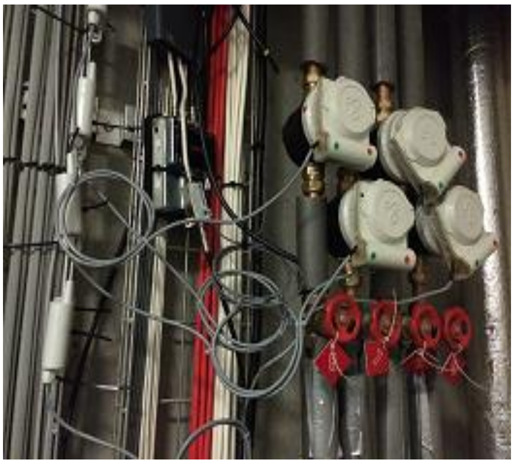

Photo 8: Example of congested nature of water supply pipes with sub meters

Meter Readings

The concentrator was configured to collect and send a full set of readings from the 74 meters every hour. The system delivered an average of 22.73 reads daily, and at least one read was received from every meter each day during the trial period of December 2016 and January 2017. An anonymised CSV file of hourly readings from all meters on the site was delivered to IW.

Suez displayed the data on their Aqualogy platform. Meter readings were studied in two periods, 9 to 22 December 2016 and 10 to 31 January 2017. This analysis showed that the average daily consumption for the 66 apartments in the fully-metered block dropped from 270 to 240 l/day. Meanwhile the daily average for the other three blocks which only had a bulk meter remained consistent at approximately 300 litres per apartment.

The technology identified several leaks in the buildings, including in individual apartments that were sub-metered. One apartment was found to have had a leak of 70 m^3 over a 28-day period from early December to early January. This leak was investigated by the management company and repaired as can be seen from the graph in Figure 7 below.

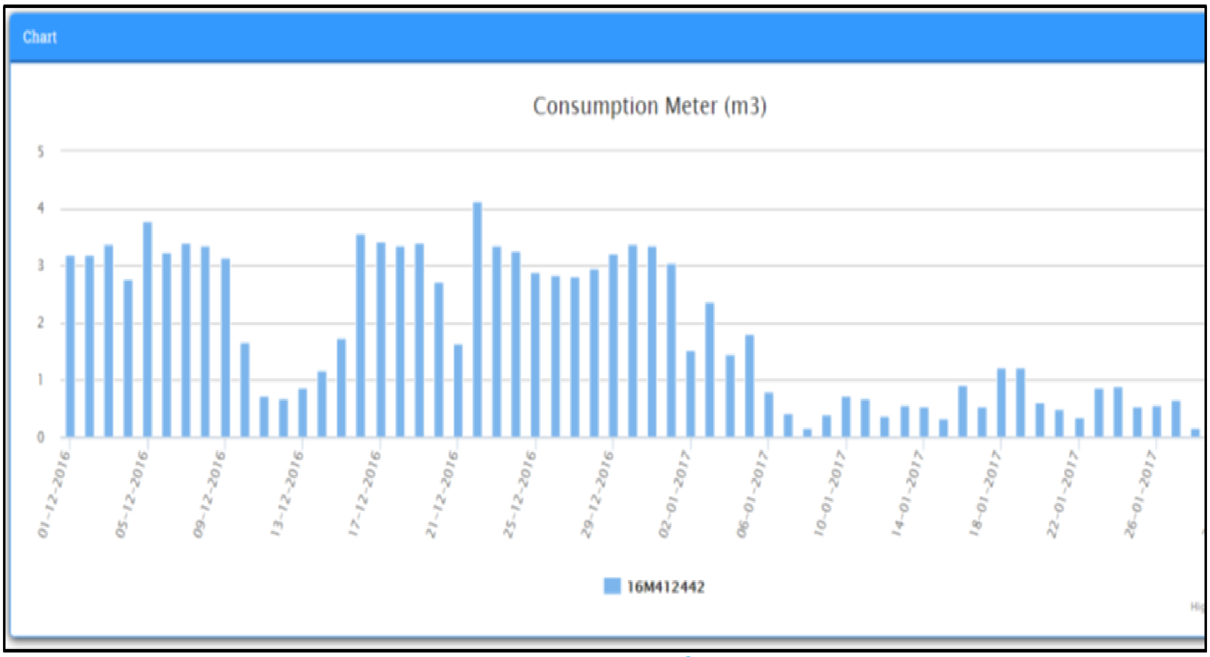

Figure 7: Graph showing water consumption (m^3) of an apartment. Leakage was detected after installation of a sub-meter which can be identified from 13-Dec 2016 to 06-Jan 2017

Suez also introduced the Watertrack App for smart phones, which they demonstrated to the management company and to IW. This App would allow the customer to see their daily consumption and receive alerts for over-consumption or leaks as shown in Photo 9.

This trial successfully demonstrated that the Ondeo reading technology and Aqualogy portal would work in Ireland.

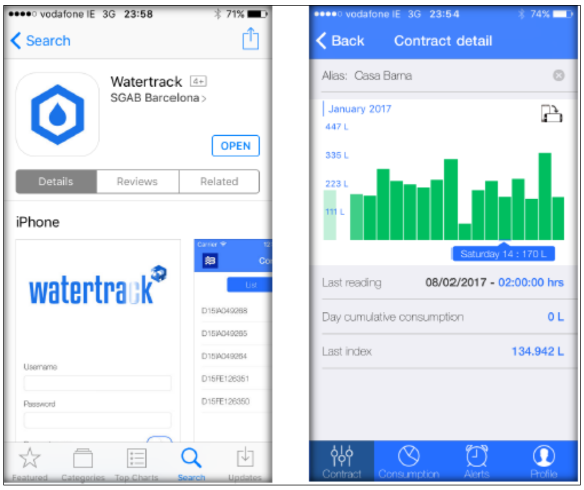

Photo 9: Watertrack app for smart phones (SUEZ)

It also demonstrated the power of the technology to identify leaks and for management companies and customers to track daily water usage. It was noted that the technology was interoperable with other utility services such as gas meters; however, this was not tested in the trial.

3.7 Itron / Coffey Water

The final consortium was led by Coffey Water with the support of Itron, who were also one of the suppliers of domestic meters for the IW Domestic Water Metering Programme (2013-2017).

Trial Overview

In this case the consortium chose a student residence building on a university campus in Dublin. The pre-installation surveys found that the plumbing arrangements were very complicated, with multiple feeds to each bedroom pod. This only allowed partial metering of each unit.

An Itron Aquadis DN40 was fitted in the plantroom on the cold water feed to the apartment 'pods'. An Itron Aquadis+ DN15 meter (30) with an Equascan wMIUrf radio module was installed on the feed to each room within a 'pod' as shown in Photo 10. The meter/radio modules were installed in service cupboards in the corridor outside each of the bedroom/bathroom units. However only the cold water feed to the units was metered. The shared cooking facilities, for six bedrooms, were not metered; nor were hot water supplies in general.

Photo 10: Image of an Itron Aquadis+ DN15 meter

Coffey Water reported that the installation of the bulk meter and the 30 sub-meters took three days in mid-January 2017 and required 15 minutes to drain down each branch. Nevertheless, the average installation time for a sub-meter was 26.5 minutes according to the GeoPal software used to manage the works. The contractor switched from brass to push fittings and pre-assembly to accelerate the work and limit disruption to students.

The radio units on the meters transmitted on the wMBUS protocol to a network of routers within the building. These routers transmitted the data to a coordinator unit which emailed a CSV file of hourly readings once a day to a server. The routers and the coordinators have 5 and 10-year replaceable batteries respectively. The Equascan mesh system can also include other utility meters such as gas.

- **Meter Reading**

Itron facilitated the transfer of the reading data into the platform created by their subsidiary, Temetra. This platform is also used by IW in the collection of both domestic and non-domestic meter data. The usage data from 16 January to 14 February 2017 (29 days) was analysed and found one bedroom unit had a daily consumption of almost 2.0 m^3.

On the other hand, the average daily usage of the lowest 90% of units was just 32 litres of water, which would be consistent with the cold water feed to a bathroom.

This trial gave very useful installation information and consumption data from a group of consumers that would not typically be addressed in the context of multi-unit development.

3.8 General Comments

The five consortia demonstrated a range of technologies and installation techniques across five different MUD locations in the Dublin metropolitan area. In all cases the technology was proven to work and any challenges were overcome.

Further detail on each of the trials is contained in the final reports and presentations prepared by each of the consortia. The CSV files with detailed (but anonymised) consumption data from the trials is held separately by IW and may form the basis of future analysis.

Separate assessments, of the trials is useful. However the following chapter looks at common lessons learnt from the trials in order to identify the key findings.

4. Performance Review

4.1 Introduction

The purpose of this chapter is to discuss the common attributes of the trials and identify key findings. It is not intended to draw specific conclusions about the relative qualities of any technologies or services. Similarly, any recommendations are addressed in the closing chapter.

4.2 Access Challenges

In the normal course of events, international water utilities report that it can be challenging to make arrangements with customers to access apartments for metering works. Although meter installations may be made outside the apartment, access may still be required to prove supply and check pressures.

The consortia worked closely with MUD management companies and owners groups to progress the projects. Within the Dublin metropolitan area, the engagement experience and participation of the apartment occupants/residents was varied. This was also identified in similar MUD metering trials in other jurisdictions, such as the UK.

4.3 Installation Challenges

The sites selected for the trials were typically modern buildings with service shafts and dedicated plant rooms. At the outset of the project, it was reasonable to anticipate that installations in service shafts would have been relatively straightforward compared with other locations. Nevertheless, the trials identified practical challenges that must be considered when designing for retrospective meter installations, even in optimum situations. Some of these technical challenges included:

- Branch pipes for individual apartments at ceiling level, which required a looped pipe insert to bring the new meter down to eye level in the service shaft;
- Fire stopping and insulation materials which needed to be reinstated;
- Absence of working shut-off valves and drain-off valves;
- Presence of other RF generators in the service shaft causing potential radio signal interference; and
- General congestion of services and lack of space.

In addition, contractors reported unexpected delays due to uncommon pipe sizes and materials which required special fittings. Nevertheless, once on site the contractors reported average installation times of approximately 25 minutes per sub-meter.

One of the consortia was forced to make their installations under sinks within apartments due to the nature of the plumbing within the building. As this was a trial, the contractor was able to make a temporary installation using flexible pipe. However, a permanent installation would have been more challenging and disrupted in the tight space under the sinks.

Generally, the radio communication systems were installed without very much difficulty. One consortium found that it required a second temporary gateway in order to capture readings from some meters, but they had chosen a location on the periphery of exiting coverage. Most systems required a power source (socket) for the main device that collected the radio signals from within the building and transmitted them onwards to the cloud server.

4.4 Technical Solutions

All of the trials proved the operability of the proposed technical solutions, and there was no evidence of any significant failure of the technologies in operation.

One consortium explored the relative performance of sub-meters of different formats and designed accuracy over different flow ranges. This was a valuable exercise to explore the viability of using simpler sub-meters to apportion the usage measured from the bulk meter; rather than using more costly (and larger) meters to directly measure each apartment.

The data collected from the trials also provide an opportunity to explore variations in consumption recorded by bulk meters compared with the aggregate of the sub-meters. It also provides an opportunity to examine how this is influenced by the sizing of the meters and the location of the bulk meter with regard to break tanks and booster pumps.

The radio communication systems all appeared to be capable of reliably collecting hourly (or similar) usage data from the meters and transmitting it to the cloud servers. Some of the technologies also collected alarms from the meters, while others used the data to calculate alarms in the back-office systems.

The trials also included technologies that afforded 2-way communication to facilitate remote control of water systems, such as remote shut-off functionality for the customer in the event of a leak alert.

The consortia all demonstrated web portals that could be used by the water utility, the Management Company and/or owners or occupiers. In some cases, these portals have been developed and are operational in other countries; while in other cases the portals were established for the trials simply to demonstrate a proof of concept.

In all cases, the portals would benefit from the application of Universal Design principles. Were such principles to be applied widely, it would be easier for more customers to access the information they require to modify behaviour. It was evident that the marketplace has yet to develop a complete appreciation of the demands of accessibility or universal design in the development of products or technical solutions to meet the needs of consumers.

A couple of the consortia also demonstrated smart phone apps and text message solutions to provide apartment owners and occupants with information about their consumption and alarms. None of the five providers reported that their online solutions had been designed to meet internationally recognised accessibility standards, such as the WAI WCAG 2.0 standards that are required of Irish public bodies.

All of the trials within the project were successful in producing a daily CSV file that could be exported to existing IW meter data and billing systems.

In general terms, the trials demonstrated that it is feasible to introduce sub-metering of multi-unit developments and to capture the meter readings using both traditional fixed-radio technologies and the emerging IoT technologies. The trials also demonstrated that there is functionality to give customers access to their daily usage data and alarms.

4.5 Operational Outputs

While this was essentially a technology trial, it produced anonymised information about the consumption patterns in apartment buildings and individual apartments over the trial periods of up to 2 months.

Further analysis of this data may be warranted. However, it did provide some insights into water consumption in apartments, including:

- The usage reported on a bulk meter does not precisely match the aggregate of the sub-meters in a MUD building due to meter sizing and installation conditions;
- A small number of apartments in a MUD appear to use significantly more water than the average;
- Average consumption in apartments may be comparable (or higher) with metered consumption in houses; and
- Leaks are identifiable through bulk meters, but locatable through sub-meters.

Notably, the bulk meters will report the average consumption per apartment, but will not identify those apartments that are skewing the average through excess usage without sub-meters. Further analysis of the data may give a better insight into the profile of consumption across the daily and weekly cycle.

The partial metering in the student accommodation may give an insight into the amount of water used in bathrooms as a share of the overall usage in a typical domestic property.

4.6 Costs

The consortia provided financial information about the costs of installation and the operational costs of the meter reading technology. As these are self-reported costs, it is sufficient to consider them as being of useful background information. Further financial evaluation would have to be undertaken in advance of any potential programme of apartment bulk and sub-metering.

Nevertheless, for reference purposes, an indicative net capital cost of €5,000 appears to be possible for bulk/sub-metering and a reading system for a nominal 20-unit MUD building.

However, if the bulk meter were to be located in an external chamber, or if the plumbing systems were more complex, these costs would be expected to increase significantly.

4.7 Benefits

The trials demonstrated a number of ways in which the application of fixed-radio meter reading technologies and sub-metering of apartments could provide benefits both directly and indirectly to customers and other stakeholders. The benefits to customers, subject to technology, could include:

- Access to apartment usage data on a web portal or on a smart phone or tablet, including comparison with peer usage;
- Receipt of event alarms (leaks, cold weather, excess use, etc.) by text message or email; and
- Remote operability of valves to isolate supply in the event of an alarm.

There would be additional benefits to management companies, such as the opportunity to rapidly identify and repair leaks within a MUD complex. The data would also be an important input into IW network management and leakage management systems.

While the above benefits were predicted in advance of the trials, the consortia each proved to a greater or lesser extent that the benefits are achievable within the scope of existing commercial technologies. These benefits are limited without adherence to Universal Design principles.

4.8 General Comments

The performance of the technologies used in the trials provides a valuable source of background information which will inform any potential future procurement of metering solutions for MUD developments if required.

The information would facilitate the appropriate scoping of the terms of any procurement contracts, based on a better understanding of the minimum requirements that are commercially available, and the added value services that could be sought separately.

As highlighted in the attached observations by the National Disability Authority, the interfaces that were demonstrated did not have the accessibility required under Universal Design principles. This is a matter for consideration in future procurement.

The outputs from the trial also offer usage data that may facilitate further analysis on metering and water demand.

In 2015, with the approval of the CRU and with funding provided by the CRU, Irish Water began a study to examine the technology available to meter Multi Unit Developments (MUDs). The data information gathered from this study shows the challenges faced by the various technologies from an installation and operation perspective, as well as some practical applications for such technology. It also indicated that it was feasible to undertake metering at such developments.

However, it is important to note that this study occurred prior to the removal of domestic water charges under the Water Services Act 2017.As a result of the technical and financial challenges, the metering of MUDs is unlikely to occur in the foreseeable future.

5. Recommendations

5.1 Conclusions

IW is pleased to report that the Multi-Unit Development Metering Trials were a success and fulfilled their objectives. All five of the consortia completed the trials and successfully demonstrated their technology in operation; and fulfilled the key requirement to submit a CSV file of the daily usage data to IW.

The trials also afforded an opportunity to the Centre for Excellence in Universal Design at the National Disability Authority to witness the latest meter reading technologies in operation; and the challenges for implementation.

The trials identified additional technical challenges associated with the installation of water meters within MUDs; and found solutions to those challenges. The radio communication systems, upon which the technologies depended, were found to work from end to end in the locations where they were tested.

The trials demonstrated interoperability between metering systems and radio communication systems which is necessary for supply chain management. The technologies offered different frequencies of data collection, with some offering one-way and others offering two-way communication with the meter points. In some cases the alarms were collected from the radio units on the meters, while in other cases the alarms were generated in the back office systems.

A wide range of web portals and alert systems were demonstrated which showed that there are viable commercial solutions to make usage data available to customers.

5.2 Key recommendations arising from the trials

The lessons learned from the trials should be used as an input into:

(a) The procurement and design of any future project to install and operate metering technology in multi-unit developments (MUDs);
(b) The development of IW technical policy for metering of MUDs; and
(c) Further analysis to better understand water consumption patterns in apartments, using the anonymised usage data gathered from these trials.

Notwithstanding the above, it is recognised that smart data collection technologies are developing rapidly in the context of Smart Cities and other initiatives. Therefore, it is recommended that these developments are monitored as IW considers the future evolution of its existing meter reading technologies and services.

It is also recommended that IW has regard to Universal Design as a requirement for the procurement of customer-facing products and services.

Glossary of Terms and Abbreviations	
Abbreviation or Term	**Definition or Meaning**
AMR	Automatic Meter Reading
AON	The Apartment Owners Network
CEUD	Centre for Excellence in Universal Design
CER	Commission for Energy Regulation changed its name to the CRU in 2017.
CRU	Commission for Regulation of Utilities – Ireland's Independent energy and water regulator.
CSV File	(Comma-separated values) a simple file format use to store tabular data, such as a spreadsheet or database, can be imported or exported from programmes that store data such as Microsoft excel or open office
GPRS	General Packet Radio Service
IoT	Internet of Things which is a network of objects that are fitted with microchips and connected to the internet, enabling them to interact with each other and to be controlled remotely, as per definition www.collinsdictionary.com
ISM Band	Industrial, Scientific and Medical Radio Band
LoRa	Long Range network
M^3	1 cubic metre = 1m^3 = 1,000 litres = approximately 220 gallons e.g.: 10 m^3 = 10,000 litres
M2M Platform	Machine to Machine Platform
MUDS	Multi-Unit Developments
NDA	National Disability Authority
OJEU	The Official Journal of the European Union
RDC	Radio Data Concentrator
RF	Radio Frequency
RfT	Request for Tenders
TCD	Trinity College Dublin
Water Meter	A water meter is a device that measures the amount of water supplied from the mains water supply to a property. The meter is fitted to the pipe supplying water and measures the volume of water that goes into a property in cubic metres. ▪ (1 cubic metre = 1m^3 = 1,000 litres = approximately 220 gallons).
VT IoT/2RN	VT IoT (Private Company) & 2RN (formerly RTE Transmission Network Ltd)

Appendix A – NDA involvement

National Disability Authority (NDA)

National Disability Authority Re: Irish Water – MUD Metering Trials - *Drafted by the National Disability Authority May 2017.*

Background

The Centre for Excellence in Universal Design (CEUD) at the National Disability Authority (NDA) was pleased to be invited to take part in the Innovation project trials of water metering technology at multi-unit developments (MUDs) funded by the Commission for Energy Regulation (CER).

The objective of the CEUD in this context is to ensure that everyone has equal access to information on water usage, regardless of age, size, ability or disability. Some challenges were identified with the previous domestic water metering programme around access to information. Householders who were able to open the lid of the boundary box and see the meter reading could get regular access to their usage information. People who don't have the dexterity, mobility or eyesight to use this method do not have access to information.

There are legal obligations on public bodies under the Disability Act 2005 to ensure that goods and services supplied are accessible for people with disabilities. There are also broad legal obligations under the Equal Status Acts to not discriminate against a customer on grounds of disability or age.

The CEUD Senior ICT Universal Design Advisor took part in four of the five site visits, four of the five presentations and the review meeting with CER.

Observations – site visits

In most cases, the physical water meters are not designed or positioned to be accessible to end users. Some were positioned in service ducts or in basements. In this context, no issues around equal access to metering information arise.

In one case, the meters were positioned under the sink. If this scenario were to be rolled out further, it would be important that equal access to information would be designed into this approach. This could involve physical access to the meter dial, or more likely, using technology to provide equivalent access to information.

Observations – final presentations

The CEUD recognises the potential benefits available from providing direct access to usage information through online channels. This provides users with the information they need to manage their own water consumption. It also provides users with the opportunity to deal with leaks or emergency situations.

The main concern of the CEUD arising from this project became obvious during the final presentations. It was clear that there was little knowledge of and little consideration given to Universal Design or Accessibility in the design or development of the existing generation of solutions by metering providers.

None of the five providers reported that their online solutions had been designed to meet internationally recognised accessibility standards, such as the WAI WCAG 2.0 standards that are required of Irish public bodies. Several of the solutions demonstrated appeared to rely solely on visual presentation of information, through graphs. These would be difficult or impossible for people with sight loss to interpret.

One smartphone app presented did not allow the user to resize text and relied on colour for conveying information.

Future opportunities

IW (IW) should aim to ensure that equivalent services and information are available to all customers, regardless of age, size, ability or disability.

Universal Design of services should be a key procurement criterion, when procuring metering technology and ICT services. This would help to meet legal obligations under the statutory Code of Practice for Accessible Public Services and Information.

IW may want to consider building a panel of diverse end users for testing and assessing online services. Any customer feedback processes such as surveys or focus groups should target a diverse range of customers, including people with disabilities and older people.

The presentations identified three main approaches for providing usage information to end users:

Data provided to IW for integration into billing system Online portal provided by billing or network provider Smartphone app for monitoring.

Each of these options have a range of strengths and weaknesses, which go beyond the scope of this analysis. IW may use a combination of these options over time. Here is a summary of some of the issues with each of the three approaches from a Universal Design point of view.

Data Integration with IW billing system

This provides the simplest and most manageable option for IW in the longer term, from an accessibility point of view. All accessibility issues would be within the scope of the IW billing system and the mywater.ie portal used by IW customers. Solving any accessibility issues which arise would therefore be part of the scope of the team that manages the billing system and portal.

If IW staff or building management can access online services provided by external providers, it is important that those services are also accessible for the widest possible audience. All public bodies are required to increase their employment of people with disabilities from 3% to 6%. IW should therefore ensure that any systems to be used by staff are designed to be accessible.

Online portal provided by billing or network provider

Several of the billing providers demonstrated online portals for billing information. If IW were considering making these portals available to end customers, it would be essential that they are usable by all customers.

Universal Design criteria would be included in any Requests for Tender to procure these portals. This would avoid costly retrofits which tend to result in poor solutions. If this procurement has already taken place, it would be important that the external providers are required to demonstrate their capacity to build and manage services that are usable by the widest possible audience.

Smartphone app for monitoring

A smartphone facility can provide many advantages to end users. However, if they are not designed with the needs of the audience in mind, they can become barriers in themselves. Basic requirements like the ability to resize text or change colours to ensure that text is readable were not available on one app demonstrated during the trials. Relying solely on colour to convey information (red / green traffic light system) is also a common problem, particularly for the 10% of Irish males who have colour-deficient vision.

IW may also want to consider smartphone penetration, particularly amongst older users. Penetration is significantly lower in older populations, partly due to poor experiences with badly designed smartphone apps.

Again, Universal Design criteria should be included in any Requests for Tender to procure smartphone apps, or broader services that would include smartphone apps for end users.

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