IoT Networks and Sensors

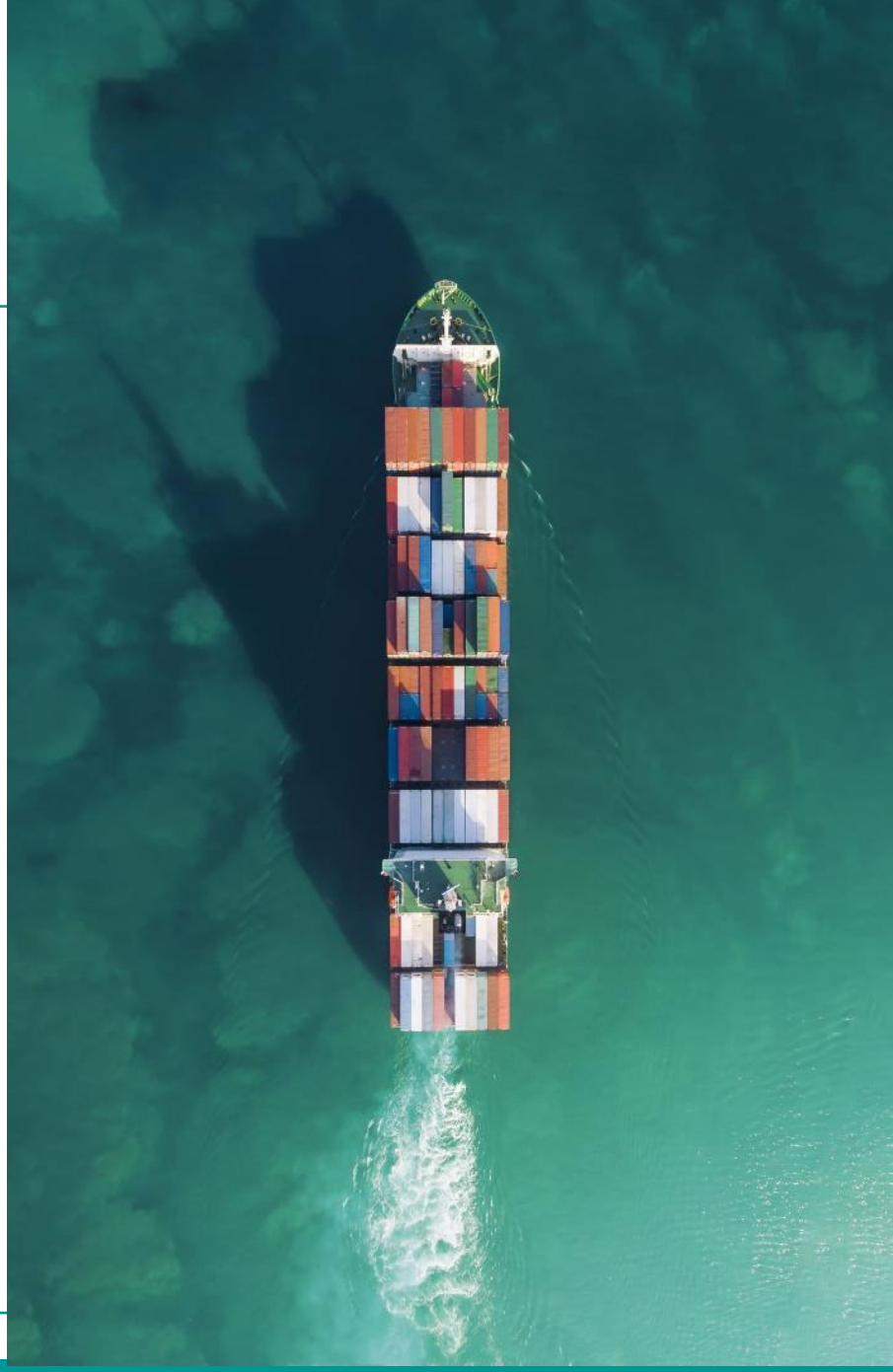
Wastewater Networks

Lena Heinrich

Background to IoT

Data collection from network sensors can be a slow process for water operators and one that takes considerable time and incurs labour costs. Further, network maintenance for sensors such as battery replacement is extremely laborious and inefficient.

Advancements in IoT networks technologies give way to *long range, low cost*, wireless networks that can transmit data from assets operating in remote regions, providing increased data coverage and *faster* transmission of data. IoT enabled sensors can be installed for improved connectivity and better understanding of the network.



Introduction to IoT

What is the IoT?

The Internet of Things (IoT) refers to the inter connection and exchange of data among devices/sensors. Many industry applications have specific requirements such as long range, low data rate, low energy consumption, and cost effectiveness. It is these applications that have driven the emergence of a new wireless communication technology: low power wide area network (LPWAN).

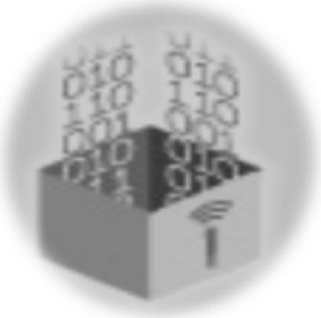
LPWAN Networks

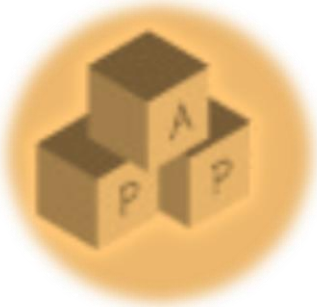
Most utilities and technology providers do not have the resources to build and maintain their own networks as an alternative. Therefore LPWANs (Low Power Wide Area Networks), which utilise unlicensed spectrum radio frequencies to provide low-power and low-cost communications, have become popular options, with many technology providers incorporating these communications into their offerings.

IoT Network Architecture

Internet
Connection

Gateway
RTU





Microcontroller

Sensor

IoT Cloud Platform

Key Criteria of IoT Networks

Criteria	Description
Data Transfer	Data transfer or latency, refers to the speed of which data is communicated (kbps)
Signal Range	Signal range is defined as the distance from which a IoT network can communicate (km)
Energy Consumption	Energy consumed by IoT networks from data transmission (W)
Battery Life	Battery life is the expected number of years before needing to replace batteries (years)
Cost	Costs include license cost for using the IoT network, set-up costs and device costs (Euros)
Payload Size	Payload size or payload length is the size of packet of data that can be sent from data transmission (bytes)
Scalability	The number of devices to cope with scalability and efficient exploitation of diversity in a channel in time and space (number of devices)
Security	Security refers to the protocols and encryption by IoT networks to secure data on the cloud

Comparison of IoT Networks

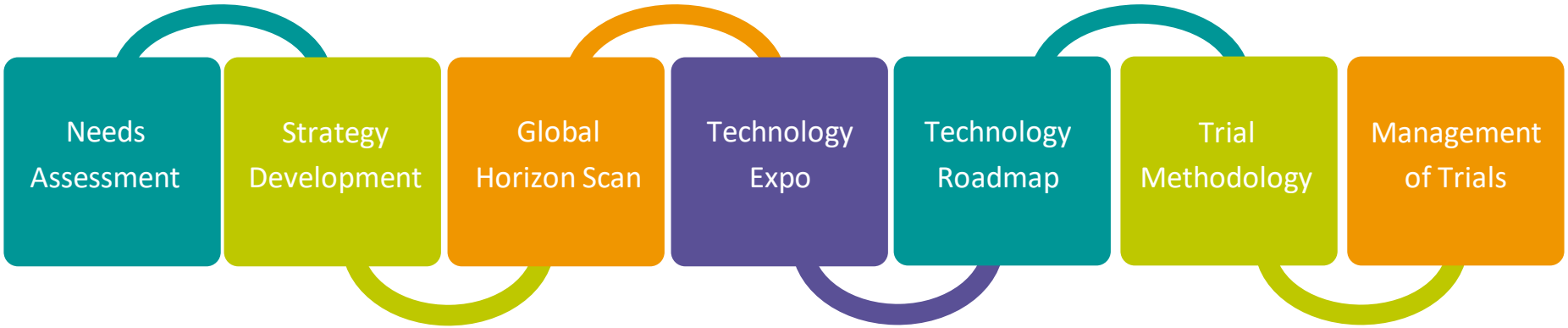
Networks	Data Transfer	Range	Energy Consumption	Battery Life	Cost	Payload Size	Scalability	Security
SigFox	Medium	Very High	Low	High	Medium	Low	Medium	Medium
LoRaWAN (LoRa)	Medium	High	Low	High	Medium	Medium	Medium	Medium
NB-IoT	High	Medium	Medium	Very High	High	Very High	High	Very High
LTE-M	Very High	Medium	Medium	High	High	High	Medium	Very High

IoT Project

Isle was commissioned by a group European utilities whose aim was:

- To determine the existing and emerging IoT-enabled sensors suitable for deployment on water networks,
- To provide a high-level understanding between different IoT communication networks in order to provide the partners with an improved understanding of IoT solutions across categories of interest for pursuing steps towards adopting IoT-enabled technologies.

The next slides cover the insights gathered from the global study into IoT networks and sensors.



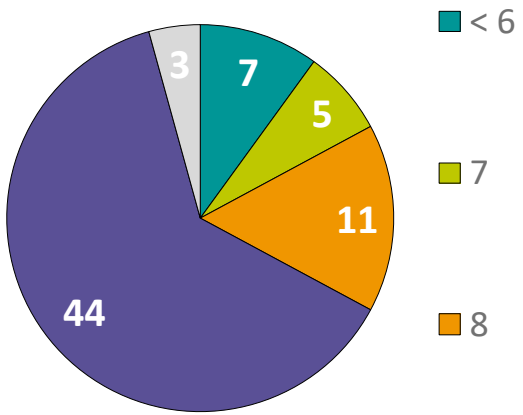
IoT Project

- Isle conducted a technology scout to identify **70 IoT enabled solutions** relevant for the water sector with TRLs ranging between 4 and 9.
- Through a global technology scouting, Isle identified technologies originating from Europe **(36 technologies**), America (**19**) and Australasia (**13**).

Techs 70

Region

TRLs



Example IoT-Enabled Technologies

IoTank Sensor

Description IoTank has developed a solution for septic tank monitoring using a patent-pending sensor. The system uses the electrical properties of the wastewater to measure varying levels of sludge, scum and effluent. IoTank uses machine learning algorithms to predict septic behaviours and failure conditions.

Application Septic Tank Monitoring and Grease Interceptors

Installation location and requirements The IoTank sensor is installed in 3 steps: a single hole needs to be drilled into the riser near the output baffle, the connectivity module is attached inside the riser with the antenna routed outside and the sensor is hung into the tank.

Communication networks The communication module is designed to be interchangeable between different technologies (cellular, Wi-Fi, LoRa)

Case studies The company has developed over 20 prototypes than have gone to market. They are aiming to develop pilot projects with utilities; they were aiming to start their first pilot in June 2020 with a utility in Minnesota (USA).

Isle insights IoTank has potential though the company has currently no deployments from their solutions. It is looking to demonstrate their solution's viability for water utilities by securing pilot trials.

Example IoT-Enabled Technologies

Optimiser Mobile-Rig by BI-ZEN

Description The Optimiser is a mobile IoT-enabled sensor rig built using sensors provided by a third-party partner (Xylem) for WwTW optimisation. The rig can be fitted with various sensors to provide COD, BODeq, ammonium, nitrate, temperature, etc. measurements.

Application Wastewater quality monitoring

Installation location and requirements Bi-Zen's Optimiser allows rapid deployment of process monitoring instruments across wastewater treatment works.

Communication networks Data is sent directly to the cloud for secure incorporation within an easy-to-read, commercially driven process dashboard.

Case studies BI-ZEN has been working with Anglian Water, Yorkshire Water and South West Water. The company has done a trial at Countess Wear WwTW gathering a significant amount of data.

Isle insights BI-ZEN applications are mostly wastewater based on benchmarking Anaerobic Digestion.

Example IoT-Enabled Technologies

2M ENGINEERING

i-SAGO
smart city concepts

2M Engineering Sensor

Description 2M have developed an easy-to-install ultrasonic sensor with Isago for the monitoring of sewerage pipes. Using collected data and machine learning, asset failure mode analyses and predictions can be performed. The system can also detect exfiltration (around 1 L/hr).

Application Water level monitoring, flow and temperature

Installation location and requirements The sensor ring is installed in the sewerage system on wastewater networks.

Communication networks The communication networks for "M Engineering's sensor include NB-IoT network and Cat-M1

Case studies A first proof of concept was developed in Breda (The Netherlands) in 2018 fitting with 300mm diameter pipes. Two operational systems have been installed and are operational in Breda and Roosendaal.

Isle insights The project was funded in part by the European Regional Development Fund as part of OP-Zuid.

CONTACT

Lena Heinrich

www.isleutilities.com

lena.heinrich@isleutilities.com

+49 (0) 176 6136 2662

Twitter - @isleutilities

Linkedin.com/company/isle-utilities