Smart Water

A Guide to Ensuring a Successful Mobile IoT Deployment

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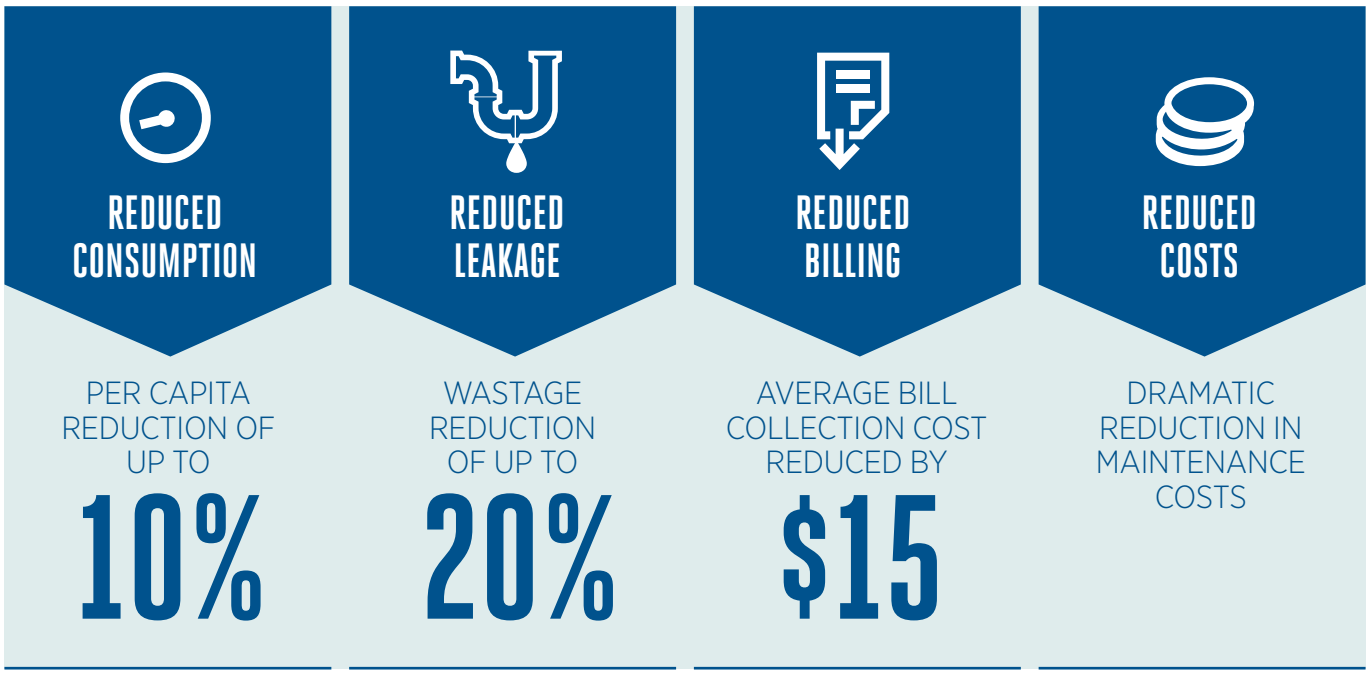
Introduction

Managing the supply of water is becoming a critical task for cities and their water utilities around the world. Particularly as they try to create sustainable businesses and deal with the effects of climate change, which increases the propensity of drought in many parts of the world. At the same time, the Internet of Things (IoT) is being adapted more widely to fit the unique needs of monitoring water networks.

Domestic, commercial and industrial water services are increasingly utilising IoT capabilities for metering, leakage detection, distribution and planning. Smart metering allows water companies to manage the consumption of water, build a better relationship with their customers and bill accurately for the amount of water consumed by each household and business. Both cities (where they are responsible for water supply) and water utilities can benefit from smart connected water meters and other IoT sensors in the water network. Other areas of water network operation are assisted by the move towards the use of IoT for network monitoring and management. Leakage control, distribution and planning can all be enhanced by the improved data available to the water company from smart water meters and network monitoring devices. Water networks struggle to identify and fix leaks, which can regularly result in 20% of potable water being lost from the network (Source: Ofwat). Likewise, water demand can be hard to predict. The use of accurate consumption data means that better models can be used and alterations made to water distribution networks to better suit demand.

BENEFITS OF SMART WATER



Sources: UWE, Ofwat, Fariness On Tap, Water UK

Mobile operators are at the heart of this change, providing advanced solutions to cater for the needs of the water industry as they look to embrace the opportunities offered by the IoT. Newly developed Low Power Wide Area (LPWA) networks, also known as Mobile IoT networks, are designed to support the IoT sensors and data that enables smart water metering and advanced water networks. These networks are intended to be secure, scalable, future-proof and cost-effective.

The smart water value chain

Before investigating and procuring a smart water metering service, it helps to understand the water value chain, the stakeholders within it and their desired needs from any new technology driven solution.

SMART WATER VALUE CHAIN

Consumer	Utility	Regulation	External Forces
Consumption	Distribution	Legal parameters	Climate change
Billing	Quality management	Technology drivers	Technology
Installation	Customer engagement	Price controls	Water sources
Communications			

CONSUMER

Water consumption can run out of control if it is unchecked. And issues arising from leaks, empty properties and inappropriate use of water can all affect the quality of supply to homes and businesses in a surrounding area. A connected, smart water meter goes some way to solving these issues with minimal intervention.

Consumption

Water companies have different drivers for control of water consumption in the home, depending on their location and other factors.

1. **Leakage detection and prevention**
   Leakage is a major concern for water utilities and homeowners. Water leakage on the supply side can result in large volumes of water being lost, and on the customer's property excessive bills and in some cases significant damage and cost to repair.

   Smart water meters can highlight potential leaks on customer property through monitoring for excessive meter readings, allowing the water company to contact their customer and highlight the potential issues for them. When the total volume of consumption from all connections in an area are viewed, leakage volumes within the wider water network can be highlighted through comparison of water inputted against water consumed. The location of these leaks can be broadly assessed through meter data alone, and isolated through specific IoT technologies within the water mains themselves. As energy costs mostly attributed to pumping and transporting water can account for as much as 65% or more of a water utility's annual expenditure, reducing this figure by 20% will have a dramatic reduction in operational expenditures for water utilities (Source: WaterUK).

2. **Management of excessive water consumption**
   Smart water meters mean that the household pay for what they consume, so excessive water consumption, particularly from items such as garden sprinklers, can be directly discouraged through tariff management. Additionally, the water company can actively manage excessive water consumption through direct contact with a customer who is causing problems with water supply. Smart water meters allow the patterns of consumption to be monitored, highlighting the difference between deliberate water use and leakage.

3. **Water demand management**
   Water follows peak demand patterns in the same way as other utilities, with the majority of water being consumed during morning and evening peaks. This can create issues with the supply of water in some areas, as water pressure must be maintained even at times of high peak to ensure supply can be maintained. IoT allows these peaks and related issues to be monitored and managed, and the case for new services such as water storage on site or peak time tariffs, to smooth the demand profile can be introduced.

Billing

Water consumption without water metering is billed on a flat rate charge, which means that large households pay less per head than small households. Smart water meters change this dynamic, and allow accurate billing based on consumption. The more granular the consumption data, the more accurate bills are over a given period. Smart water meters taking regular consumption reads can also build up a profile of the household – the likely number of people resident for example that can be used to build new tariffs and marketing approaches.

To enable accurate billing and customer support, meter reads need to be transmitted on demand to the water utility. Mobile IoT networks offer real-time messaging so if a customer calls to query a bill, a real-time meter read can be sent to validate any concerns.

Installation

Water meters are typically located in hard to reach places – in underground access holes, basements and generally at the boundary to the property to be metered. This makes the installation of a smart meter difficult as there is no access to power or communications networks within the home. In the past access to readings from a water smart meter have relied on drive-by or radio reads, where a data collector is pointed at the meter to upload historic data locally. New LPWA networks allow collection via a wide area network without having to visit the meter site. Devices using these networks are battery powered, with a battery life of 10 years or more. Additionally, regular reads can be taken – every hour or less to provide advanced meter capabilities.

Maintenance of water meters can be expensive, so Mobile IoT sensors offer a very long battery life so that once installed, sensors do not need to be re-visited.

LPWA networks allow water meter installation in any location. Tests have shown that up to 500 messages per day can be sent from a water meter using NB-IoT, with a 20dB enhancement in coverage ensuring that 100% of meters can be connected, no matter their location.

UTILITY

The water utility companies themselves are a core part of the water metering value chain, and smart water meters can help with various aspects of their operations.

Distribution

The water grid used to distribute water is a key part of a water utilities infrastructure. The IoT, including smart meters, is able to simplify the management of this is a number of ways.

1. Granular data provided from connected smart water meters means that near real-time consumption patterns and flows can be measured and monitored, which assists with the management of water distribution

2. Water demand response is an important factor for water companies to consider. Water demand can peak in the same way as other utilities, and the use of smart water meters allows supply to be monitored and controlled effectively.

3. Leak detection is important in the distribution water grid. There is significant evidence that finding leaks earlier will result in fewer bursts, reduced costs and improved customer service. LPWA communications sensors can be connected to the water distribution system via above ground infrastructure including fire hydrants and pump stations, as opposed to connected directly to valves, where environmental conditions are very harsh. These sensors are an excellent means of transmitting all forms of leak occurrences. These sensors can enable early detection and intervention, resulting in savings not only in reduced water loss as leaks will be found earlier, but also in reduced risk to operations.

Water Quality

Water quality is a critical KPI for water utilities. Poor water quality is a major cause of poor health, and can affect economic progress. Water quality can be affected by leaks and contamination from various external sources. In order to maintain water quality, IoT sensors can be used throughout the water distribution network. Water quality can be measured by IoT sensors in both open water environments, such as reservoirs, and closed water in water mains. In this way water quality can be tracked and the water company is in a position to see where the contamination may have occurred and take remedial action. Sensors can measure a wide range of chemical and particulate pollution, meaning that a broad range of water quality KPIs can be measured in real-time by use of the IoT.

Customer Engagement

Smart water meters and other IoT sensors create a range of new opportunities for water companies to engage with their customers. Without smart meters, water utility companies would only be in contact with customers when there is an issue or when a bill is due. With the new data insights that smart meters bring, water utilities can change the way that they communicate with customers and engage with them in new ways. From giving advice on reducing water consumption to comparing water consumption to others in the neighbourhood, new strategies and campaigns can be adopted by the water utility to ultimately increase customer satisfaction and decrease resultant operating costs. Smart water meters results in decreased contact with customer call centres, and the ability to move more easily to digital account management (Source: Thames Water).

IoT Big Data capabilities allow mobile operators to combine the data being generated by smart water meters with other data sources, such as weather, distribution data and historical demand patterns, and create intelligence they can use give advice to customers on their water usage as well as set appropriate tariffs to guide behaviours.

REGULATION

Water companies must operate in a regulated environment in most parts of the world. This means that to operate, the water company must meet key performance indicators that are set by the local regulator in order to keep their licence. The water utility must report back on performance against these measures on a regular basis. The regulator can also set new measures in order to solve specific issues within the local water market.

As well as KPIs, water regulators can shape the way in which a local water market is structured. For example defining the ownership model of water distribution and water retail, whether customers can change supplier or how customer data can be shared through the industry to facilitate better services.

Smart water meters and other IoT sensors are key to enabling both measurement of regulated KPIs and enabling certain regulated initiatives within the water market. It is clear that data from water meters and other IoT sensors can be used to measure and alter behaviour around water consumption, water quality and water distribution. Water meters can also be used to enable more customer and industry centric mechanisms such as better planning through better data, improved choice and cost comparisons for consumers, reducing water losses from leaks or improving response times to burst pipes.

Price Controls

A key area for regulation is water tariffs. Smart water meters allow for new pricing mechanisms to be set by tying consumption to cost. This means that where water is scarce or where consumers do not consume excessive water, they can be managed appropriately within a price control framework, but where a consumer is using excessive water, the framework can be altered to a penalty to be applied. Smart water meters allow any price control mechanism to be flexible and adaptable to specific customer needs rather than blanketing all consumers with the same model.

Customer choice

Increasingly, regulators are looking at how to bring competition to water markets to ensure that customers obtain value for money. They want to ensure that new entrants can enter water markets and able to offer new services to customers through innovative models.

This can take one of two forms, either enabling existing water suppliers to offer new water services and models to their customers, or allowing new entrants to compete for customers. To support this, customers may be able to choose and change water supplier, and suppliers may be able to make their supplies more resilient by creating new partnerships and infrastructure initiatives.

The IoT and smart meters are critical to enabling these new models and letting customers access data to enable to make informed choices. By allowing water companies and consumers access to detailed, accurate consumption data, new processes can be designed to support new market initiatives. Whether it be change of supplier and setting comparative context for the consumer, or understanding the requirements of different types of customers to initiate new product development, the IoT is a key tool to monitor and shape the water network of the future.

Security is crucial when identifying customers' consumption data. A breach of privacy can destroy faith in any water metering service. Mobile IoT is designed to be secure, and all data transmitted is secured, meaning that it cannot be accessed by those without authority.

EXTERNAL FORCES

The water industry in under pressure from external forces in many markets, which the water industry needs to adapt to for future success. IoT sensors and smart water meters will be key to transforming the water industry to meet the challenges that it faces head on.

Climate Change

Climate change is one of the biggest threats facing the water industry today. Occurrence of extreme weather brought about as a result of global warming including floods and drought are increasing in regularity and severity. In the long term, areas of water scarcity are likely to become more pronounced as average temperatures rise and desertification of some regions becomes a real risk.

IoT sensors are able to help water utilities adapt and plan to this changing environment. Real-time data from the water network combined with other data from external sources such as weather forecasts allow the utility to plan for extreme events, whether that be tighter control over water consumption during periods of drought, or maintaining water quality during times of flood, IoT sensors give water companies unique insight into how the water network and water consumers are adapting and coping with extreme events.

Technology

Technology within the water industry is driving a great deal of change as more data about performance of the network is revealed and customers demand more from their water supplier. Data that can be derived from IoT sensors will increase in volume over the next few years and more and more connected assets come online. Water utilities need to ensure that they retain flexibility in their approach to future water networks and services, as insights from usage and sensor data become more widespread. The challenge of matching customer expectations with the investment and time required to update water networks should not be underestimated.

The IoT is driving significant change within the water industry. Communications technology and data analytics are now at a point where the water industries needs can be met. The water industry requirements for smart meter communications, such as long battery life, taking readings every hour or less and communications coverage for difficult to reach locations (such as underground or on property boundaries) can now be met by the mobile industry through the use of LPWA networks..

Smart water meters and other IoT sensors within the water network can be securely connected to the mobile network at a low cost and for a long lifespan. Tests on water meter installations have shown 100% connection rates and every meter installed able to deliver up to 500 messages per day. This technology can revolutionise the way that water companies are able to deliver new services, as there is no need for continued reliance on manual or semi-automated processes to understand consumer and water network behaviours.

New Water Sources

The more widespread use of recycled and treated non-potable waste water for agricultural and industrial use is becoming more attractive as water companies look for new efficiencies Re-use and recycling of water for other purposes is difficult today, but new technologies allow for water networks to be diversified and lower quality thresholds applied to water in certain instances. Waste water can be managed more efficiently if there are dedicated IoT sensors in the waste network that allows for suitable water to be classified for re-use. Data on water consumption can also be used to estimate non-potable water volumes generated to allow for efficient water demand planning across a whole water network. Smart water meters provide valuable inputs into this model as consumption can be accurately measured and waste water volumes calculated.

Communications Technology Procurement

Communications and big data technology drive the success of smart water metering and smart water networks. Water utilities need to be sure that their technology selections are fit for purpose and will provide a base for building new services into the future.

Choices today will need to be used throughout a critical period of change in the water industry, and will need to adapt to many technological and behavioural changes on the horizon from the increase of data and decision making available to consumers and decision makers. Selecting a solution which will not adapt to future needs could be a costly mistake.

Cities, water utility companies and other decision makers need to take a holistic approach to their choice of communications and platform provider and should be thinking of several questions to ask, such as:

Interest	Question	Answer is relevant when
Performance	Is the system able to scale to meet your demands?	You intend to connect multiple water meters and assets; you intend to have real-time updates
	What are the message delivery times?	You want to use the system to provide real-time updates; you want meter reads at regular intervals through the day
	What is the network coverage?	You intend to offer a service across a city; you intend to connect meters and assets in hard to reach areas such as underground
Security	Does the network support end-to-end encryption and authentication?	You need to meet a required security or privacy standard
Communications Infrastructure	Does the network operate in licensed spectrum?	You value high quality of service and low risk of interference
	What additional infrastructure is needed to support the service?	You want to keep your capex costs low; You don't want a complex implementation
	Can the service provider be changed?	You want to avoid vendor lock-in and re-negotiate contracts periodically
	Does the service have a roadmap to new service features?	You want to take advantage of new service features as they are introduced
Data	Does the service support open data formats?	You intend to use other systems to manage or bill for water services
	Does the platform support Big Data?	You intend to analyse data for trends or have an overall view of the water demand and supply by combining with other data feeds

Mobile IoT is a crucial enabler for smart water meters. It is designed to offer improved coverage, long battery life and lower overall cost, along with a low risk approach to implementation. Mobile IoT is already being deployed for smart water metering in many cities in Europe, America and Asia, proving itself a capable way to improve services and access open data.

Partnerships

Water utilities and cities responsible for water supply should be looking to achieve long term, flexible partnerships with their suppliers. All stakeholders in the value chain should be seeking a mutual relationship with each other that allows for flexibility in water services and use of technology to create efficiencies, build better services and maintain customer satisfaction.

Mobile technology enables new water service deployment models for smart cities. New strategies such as outsourcing of water supply or entering into procurement partnerships with other cities become more realistic when common technological enablers can be sought through the procurement process. By documenting requirements and matching these with open data formats and standardised mobile communications networks, cities will be able to run competitive tendering exercises much more efficiently, ultimately reducing the cost of provision for water services within the city.

There are many different partnership models that a water supplier may wish to pursue. A lot of the flexibility that a water supplier has in this respect will depend on local regulations, and mobile operators are able to support a wide range of relationships with water suppliers.

Financing for smart water meter and IoT sensor rollout is important to get right in any partnership structure. Large capital investment for smart water meters is needed to enable a rollout, and it maybe that a specialist asset finance provider is able to act as a bridge between the different stakeholders in a rollout. By including an asset provider in partner discussions, the water supplier can gain access to new partners and economies of scale, without necessarily taking on the risk of capital investment themselves.

Other areas of cooperation maybe worth investigating when building a new service using smart technologies. Joint R&D and co-development of solutions for large scale deployments reduces risk as does developing an early stage relationship with a mobile operator to understand future roadmaps and potential deployment models.

KPIs

Water utilities and the cities that use them must define desired outcomes before embarking on a smart water metering deployment. They should use these outcomes to define KPIs in the service scope and ensure that potential partners are aware of what is needed to be delivered by the live service.

For each outcome, separate KPIs should be defined. To go further, KPIs can be used to inform regulators and wider communities of performance against key targets. Where regulated KPIs are needed to be met, often there will be other data collected, which can be used to monitor other aspects of performance as a result. Current performance criteria that can be improved by the use of the IoT include a 20% reduction in leaks, reduction of water consumption by around 10% per capita (Source:UWE) and more accurate billing leading to reduced debt collection costs of around $15 per property per year (Source: Fairness on tap)

Typical KPIs that the city or water utility may want to investigate include:

Water Usage	Water Management:
■ How much water is consumed by each property ■ How much water is consumed per capita ■ How much water is used by different water appliances ■ Water lost to leakage ■ How much water is used by commercial & industrial sectors	■ Water scarcity – total amount of water available per capita ■ Import and export volumes ■ Water quality ■ Water pressure ■ Reduction in unplanned maintenance
Customer Engagement	**Technology Characteristics**
■ Customer satisfaction with water utility ■ % revenue collected ■ % billing deviation from total water consumption ■ Enforcement actions needed	■ Number of messages sent/received ■ Message delivery success rate ■ Message latency ■ Battery life of sensors ■ Open data access ■ Network coverage

Tracking of performance and benefits will be key to ensuring that any smart water meter rollout is a success. Monitoring these KPIs against pre-set objectives will allow the water supplier to dynamically change their supply sources to ensure that performance targets are met.

Route Maps

Implementing a smart water solution requires an approach that is flexible and able to engage relevant stakeholders in changes needed to make maximum advantage of any investment.

"Starting small" is a good way to get up to speed with new methodologies whilst reducing the risk of mistakes which are difficult to reverse. Building upon this initial step with a series of iterative changes as the project grows will ensure that the full commercial service is more likely to be sustainable and deliver citizen engagement. The core stages of growth for a smart water service are outlined below.

STRATEGY & SCOPE	PILOT	ESTABLISH	SCALE	EVOLVE
Identify issue to be resolved	Refine processes	Incremental Go-live	Scale to multiple sites	Monitor performance
Define required outcomes	Test network performance	Live Data integration	Introduce new public services	Adjust service parameter if needed
Secure budget commitments	Understand installation needs	Apply lessons learnt and changes	Publish open data APIs	Undertake maintenance
Secure stakeholder commitments	Generate test data	Establish trusted foundation system	Integration with city dashboard	Sharing learnings with other cities

SMART WATER				
Identify issues that need resolving	Ensure data formats are open and accessible to stakeholders	Understand impact on wider systems	Ramp-up installation in wider areas	Monitor performance against baseline
Research regulatory requirements & price control issues	Test network performance	Undertake data integration with billing systems	Introduce new tariff and services	Use data to inform future regulatory decision making
Build requirements for data collection	Audit water meter locations	Undertake initial data analysis	Use data for regulatory reporting requirements	Gradually alter service parameters to change consumer behaviour
Understand how the wider city environment will be affected	Obtain feedback on service from users	Begin replacement installation process	Feedback performance to stakeholders	Demonstrate continued savings in other operational areas
Understand learnings from other water utilites				

SCOPE AND STRATEGY

Water utilities need to define their objectives before setting out to procure a smart water metering service. The strategy and scope that the city or service provider adopts will dictate key decision points throughout the implementation and lifetime of the system.

Factors that will influence the strategy include the current issues and the desired changes and outcomes to be bought about by water consumption behaviours. This will be influenced by the budget available, size of the deployment, and the role of the various stakeholders in the utility, regulator and wider environment.

Once a utility has resolved all of these points, it can pull together a strategy and begin to build a list of requirements to go to market with. Critical to ensuring the success of this strategy is the commitment of all stakeholders across the value chain.

PILOT

A small scale pilot is a good way to ensure that the processes that have been scoped around a smart water metering service are fit for purpose, and that every stakeholder is clear of their role in the project. Amongst the deliverables that should be investigated at this stage are – data security, data formats, network performance and installation processes. However a pilot should only been seen as a temporary measure, and the project should quickly move on to ensure time and energy are not wasted in over analysing all aspects of a service. The water utility should also look to other utilities and cities who have implemented IoT sensors and smart water meters to gather lessons learned. Over time, as smart water metering services mature, the pilot phase will likely become redundant as evidence of successful implementations emerges and smart water implementations become more 'out of the box'.

ESTABLISH

Once the pilot has been completed, water utilities should move quickly to establish a trusted system with incremental deliverables. It is best not to focus on all aspects of the service at once, but ensure that processes can come on line in an incremental fashion so that they can be perfected without impacting on rollout timescales. By phasing the approach, the utility can increase confidence in the systems being deployed and ensure that citizens and stakeholders engage with and support the changes.

SCALE

During the phased growth phase, the programme may still only be focussed on one area without any advanced services yet deployed. Once enough confidence has been gained in the system and the required processes have been proven to operate effectively in a live environment, the system can begin to be scaled. Once a large enough number of installations have been achieved in an area, the water utility can also start to introduce new concepts to customers such as dynamic tariffs. Engagement with partners and citizens should continue throughout this phase, and new issues resolved as they arise. Partners such as mobile operators may be able to offer new scope to relationships such as use of integrated services or apps.

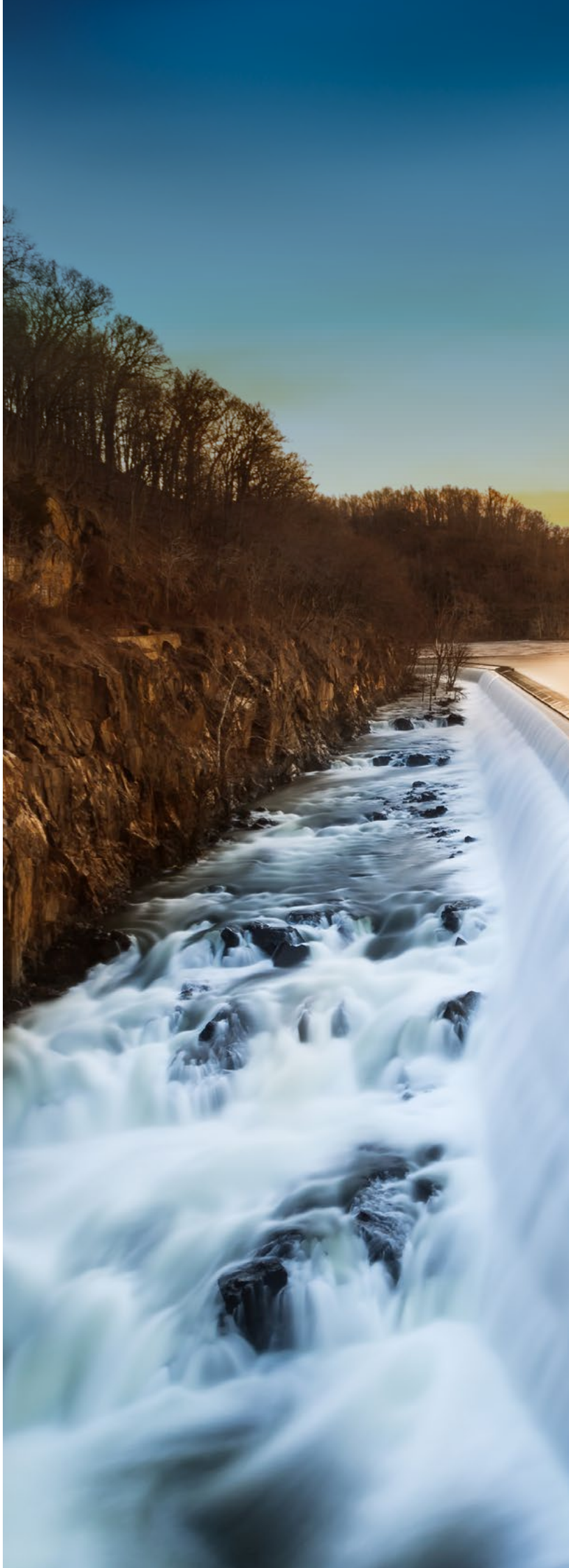
MATURITY

Once the water meter service has been fully deployed, the water utility should review performance and understand how the service is impacting water consumption, leak detection and other parameters. As technology drives change across the water network, new services can be introduced and existing service re-configured to meet user expectations. The use of open standards will ensure that future changes can be more easily managed. KPIs will need to be used to ensure that the smart water metering service continues to meet its objectives and mitigation undertaken if issues are identified.

Conclusion

Smart water metering can be enabled today by Mobile IoT from mobile operators. Mobile operators are strong, low risk, long term partners, well placed to meet all the needs of a smart water metering service – secure communications network and management platform, access to open data and integration of payment and billing systems. Mobile operators and Mobile IoT also have longevity, as they are based on international standards with a roadmap towards integration with future networks and future smart cities needs. Mobile IoT also operates in licenced managed spectrum, so is a robust, scalable choice for all of a water utility or smart cities needs.

Cities and water utilities initiating smart water meter investigations need to consider their mobile operator as a core partner and work alongside them to scope and implement smart water metering and other IoT sensors in the water network. Mobile operators can share their experience of previous deployments, offer economies of scale and understand the intricacies of how to deploy in different environments. All parties in the value chain can benefit from having a mobile operator at the core of a programme, as the data generated can be controlled and managed throughout the value chain in a consistent, accessible and secure manner.



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