GSMA Connected Living

GSMA SMART CITIES GUIDE: WATER MANAGEMENT

Why mobile operators are key partners for cities seeking to deploy sustainable water management solutions

INTRODUCTION

Over the next three decades, urban populations will continue to grow, as will incomes and water usage per capita, against a backdrop of a changing climate. By 2050, the UN forecasts that more than six billion people will be living in cities and global water demand will be about 55 per cent higher than today[1]. These factors could disrupt two of the essential services that are required for cities to flourish: the availability of affordable, safe, clean water and sewerage services.

Cities are increasingly looking to work with mobile operators and other stakeholders to address these challenges. Mobile operators' smart water management solutions employ Internet of Things (IoT) technologies to continuously monitor the environment, water resources and infrastructure, helping to ensure citizens have reliable and affordable safe, clean drinking water and sewerage services 24 hours a day, seven days a week.

[1] Source: UN World Water Development Report 2014

USES FOR SMART WATER MANAGEMENT TECHNOLOGY

Mobile operators are natural and effective key partners for cities and other stakeholders; the smart water management solutions they provide are underpinned by efficient, reliable and secure communications delivered using licensed spectrum. Mobile operators already provide a wide range of communication services over an extensive geographic area, encompassing the city water catchments and the remote water assets within them.

Mobile operators' smart water management solutions have evolved rapidly in recent years, enabled by advances in mobile communication technologies and the growing availability of high performance, relatively low-cost IoT sensors. Operators can intelligently combine and quickly analyse data from remote IoT devices monitoring the environment, water resources and infrastructure with other data sources. That enables them to provide cities and utilities with visibility, control and situational awareness in near real time.

Mobile operators also have a range of enterprise capabilities that can be used to support smart water solutions, enabling them to provide additional services across the water cycle value chain, including those illustrated in Figure 1. Further details of mobile operator capabilities are provided later in this guide.

Figure1 Mobile Operator Smart Water Management Service Offerings

IOT DEVICES	COMMUNICATION SERVICES	IoT SERVICES	BIG DATA & ANALYTICS	ENTERPRISE APPLICATIONS
↘ Sensors	↘ 2G/3G	↘ Platform Hosting	↘ Data Storage	↘ Leakage Detection
↘ Smart Meters	↘ LTE	↘ Device Discovery	↘ Situational Awareness	↘ Network Optimisation
↘ Cameras	↘ M2M	↘ Data Acquisition	↘ Predictive Insights	↘ Asset Condition Monitoring
↘ Controllers	↘ Mobile IoT	↘ Device Management		↘ Environmental Monitoring
↘ Actuators	↘ VPN	↘ Remote SIM Provisioning		↘ Water Quality
↘ Alarms				

End to End Privacy and Security

Smart water management solutions from mobile operators can help deliver specific benefits, such as:

- Improving water conservation;
- Optimising the repair and replacement of ageing infrastructure;
- Improving the response to climate change and extreme weather events;
- Improving public health, water quality and environmental protection.

IMPROVING WATER CONSERVATION

Given the growing threat of water shortages, governments, regional legislators and city leaders are establishing and promoting citizen engagement and participation in water conservation programmes. These programmes often include several aspects each addressing different opportunities and motivations for water conservation, including:

- Public education and citizen engagement
- Financial incentives and penalty surcharges
- Targeted water conservation initiatives, such as
  - Domestic water conservation and usage reduction
  - Landscape/outdoor water conservation and usage reduction
  - Institutional, commercial, and industrial water conservation and usage reduction

A high priority is to reduce leakage or Non-Revenue Water (NRW) as it is known in the water industry. NRW is safe, clean water that is "lost" from within the water supply network before it reaches a paying customer. Losses can be real leakage losses from fractured pipes or apparent losses (for example, through theft, metering inaccuracies, or internal use by the water service provider). The need to conserve water and to reduce NRW are often the drivers behind the city-wide deployment of mobile-enabled smart water meters[2].

Smart water meters provided by mobile operators reduce NRW typically by communicating details of water consumption daily to the city water service provider. Some smart water meters also have the ability to detect and report leaks. Other IoT sensors can monitor pressure, flow volume and direction, delivering considerable information and insight into the conditions within the water supply networks.

The information provided by smart water meters can also empower citizens. A householder could have a smart water application running on their smart phone to monitor their pipework for leakage and to manage their use of water.

Deploying mobile–enabled smart water meters, together with a range of other IoT sensors and smart water management software applications, typically delivers the following water conservation benefits:

- Demand reductions: typically a sustained reduction of more than 10% in residential water demand;
- Improved leak detection, reducing non-revenue water;
- Optimised pressure management, reducing energy consumption and leakage;
- CAPEX savings from deferring augmentation of networks;
- Improved billing accuracy;
  - o Resulting from replacing aged and inaccurate meters;
  - o Resulting from more customers being metered;
- Significant customer satisfaction and customer service improvements.

Additional benefits are likely to emerge in the future, stimulated by advances in metering and communications technologies and the deployment of the latest generation of smart meters supporting near real time communications via mobile networks.

[2] The 2014 Review of Smart Metering and Intelligent Water Networks in Australia & New Zealand

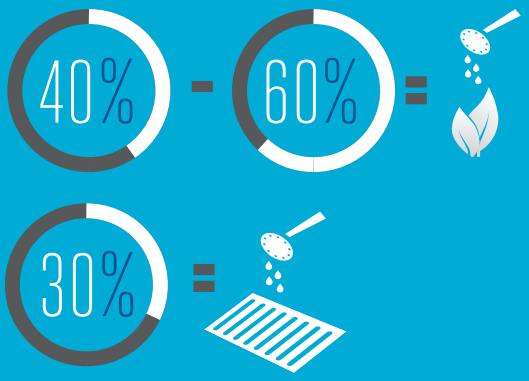
CASE STUDY

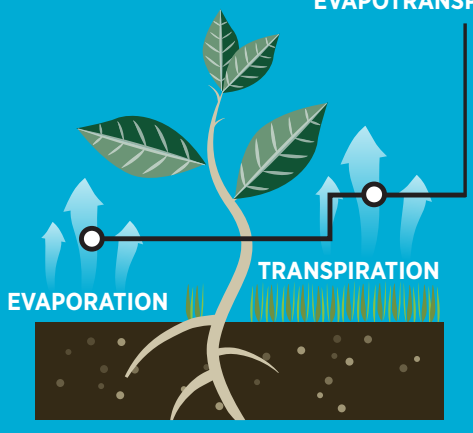
CONSERVING WATER BY REDUCING WASTE

In the landscape irrigation systems used by homes, commercial properties, municipal parks and school properties, the water flow control is generally provided by timers linked to automated valves. In some cases, the irrigation systems are managed by property management groups that have operations spanning multiple sites in different locations. Some groups manage hundreds or thousands of individual properties.

A typical landscape irrigation system delivers approximately the same amount of water each day with little regard to the prevailing (or forecast) weather or how much water is actually needed by the landscape. Often too much water is used, effectively wasting a precious resource and money. In some localities, 40 to 60 per cent of all urban water consumption is used for outdoor irrigation, and of that, at least 30 per cent may be wasted.[3]

Smart water management solutions from mobile operators can transform the management of irrigation systems, helping cites and citizens to conserve water. For example, HydroPoint[4] and AT&T have developed a smart irrigation management solution, called WeatherTRAK, designed to address this market. The WeatherTRAK solution uses a cloud-based high performance "big data" computing platform to calculate a local evapotranspiration value for almost any U.S. location. The key indicator of water need, evapotranspiration is calculated using wind, humidity, solar radiation and temperature as part of the input data.





[3] https://www.business.att.com/content/customertestimonial/hydropoint-internet-of-things-case-study.pdf
[4] https://www.hydropoint.com/

WeatherTRAK uses an IoT solution to connect irrigation control points to its cloud platform, which analyses climate data and determines the appropriate watering required to sustain optimum plant health. Although each irrigation controller does the calculations locally, it also delivers data in near real time to the big data analysis system where it is verified, validated and stored in the cloud. AT&T provides the wireless communications, a secure, dedicated virtual private network and a self-service management platform that supports all of HydroPoint's data transport requirements. "The AT&T wireless network is one of the most important links in the whole process," HydroPoint cofounder Chris Spain remarked. "It's communicating real-time in two directions, so we have a mirror on the database up in the cloud as well as what's on the ground."

In 2015, the HydroPoint solution saved its customers more than 15 billion gallons (over 56 million cubic meters) of water and $137 million in expenses. Examples of customer savings include[5]:

- Salem City, Utah, saved one million gallons of water in 180 days. "Salem is demonstrating that sustainable water use is not only achievable, but that it Is also attractive from financial and operational perspectives. We're excited about our water savings, and we know Salem's citizens will enjoy the healthy landscapes and cost savings that HydroPoint delivers." — Bruce Ward, P.E. Salem City Engineer
- Adobe Creek Homeowners Association, Petaluma, California, saved over nine million gallons of water. "We have saved up to 30% of our water usage year after year." — Joan Murphy National Director of Sustainability, Adobe Creek Committee Chair.
- The Monterey Peninsula Unified School District (MPUSD), California, has achieved a 42 per cent reduction of water use district wide, while one school reduced water use by 57 per cent. "WeatherTRAK is a strong water conservation tool." — David Chandler, Energy Specialist, MPUSD.
- Fort Carson, a US Army post in Colorado, is saving 50 million gallons of water annually and has received a prestigious award for energy and water management.
- Two Lockheed Martin sites in California have saved an estimated 100 million gallons and more than $1 million in a year.

> *"Salem is demonstrating that sustainable water use is not only achievable, but that it Is also attractive from financial and operational perspectives."*
>
> **Bruce Ward,** P.E. Salem City Engineer

[5] https://hydropoint.com/customers/

AGEING WATER INFRASTRUCTURE

Cities generally have extensive networks of buried water and sewerage pipelines of various sizes, which are expensive to replace. The water supply network is often formed of large diameter transmission pipework for bulk water supplies connected to smaller diameter distribution pipework supplying neighbourhoods or individual customers. In many cities, several of these assets were installed in the 1950s and 1960s and are now reaching the end of their useful service life: in some cities up to 40% of safe, clean treated water is lost due to leakage. The challenge for each city water service provider is to balance the expense and disruption of replacing an aged section of pipeline before it fails with the disruption and expense of waiting for it to fail before replacing it in response to a leak. Should a large diameter transmission pipe rupture, it will typically cause massive disruption, damage to infrastructure and properties, and can present a risk to life.

> *"in some cities up to 40% of safe, clean treated water is lost due to leakage."*

A news report about a rupture in Philadelphia[6] described how "a 36-inch transmission main broke under North 52nd Street. Police and firefighters arrived to find water surging up from beneath the street. The water would eventually buckle the asphalt, jostle parked vehicles and quickly turn the street into a river. Those that saw their cars go underwater and homes flooded are expected to make claims against the city. Many lost high value items in their basements. An estimated 10 million gallons flowed from the breach over a three and half to four hour period."

A smart pipeline monitoring solution can be implemented by deploying mobile-enabled IoT sensors, such as pressure sensors, flow meters and acoustic sensors throughout the water supply network. These tools can identify leaks or stagnant water and provide control room staff with enhanced visibility of the operating conditions within the network. Optimising the pressure and flow within the pipelines helps to extend the operational life of assets and reduce energy consumption. Moreover, early identification of leaks and timely repairs help to avoid water loss, conserving a valuable resource, while helping to minimise OPEX costs and defer CAPEX expenditure.

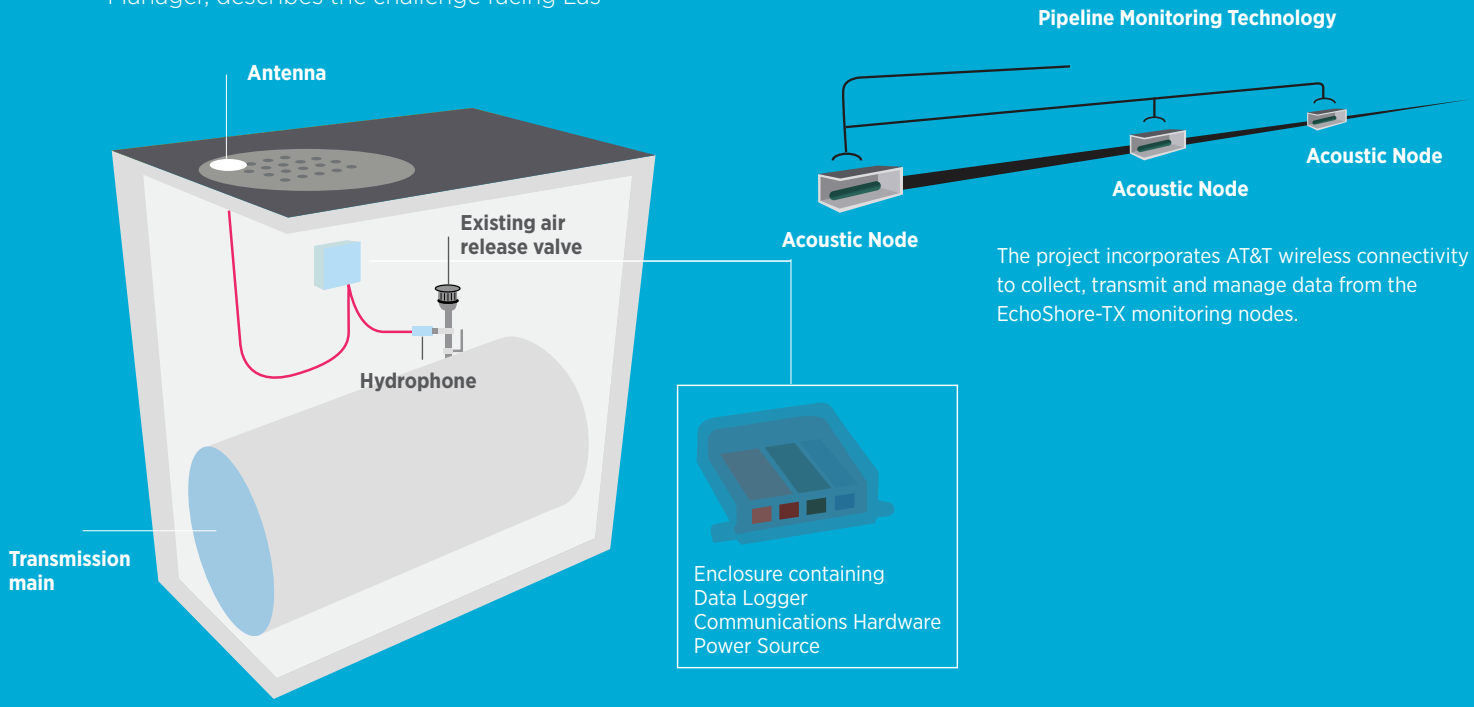
[6] http://6abc.com/news/cleanup-underway-after-west-phila-water-main-break/783385/

LAS VEGAS CASE STUDY
MONITORING AGING INFRASTRUCTURE

The Las Vegas Valley Water District (LVVWD) is a not-for-profit agency that began providing water to the Las Vegas Valley in 1954. It helped build the city's water supply network and now provides water to more than one million people in Southern Nevada. Much of the city's water supply network was installed in the late 1950s and 1960s, including a 30-inch water main running through the heart of the Las Vegas strip that supplies up to 7.5 million gallons of water per day to resorts, casinos and other businesses.

Underground leaks, often referred to as ticking time bombs, could historically go undetected for months before revealing themselves as surface puddles, or system pressure drops. They are the first visible signs that an aging water infrastructure is beginning to severely damage its host city.

Charles Scott, LVVWD Engineering Project Manager, describes the challenge facing Las Vegas: "The pipe was put in sometime around 1963. We had done some inspections and we were able to determine that several sections of the pipe were pretty much degraded. But we didn't really have a history of failures in the pipeline."



Permanent acoustic sensors installed in chambers are monitoring 4 miles of the water main pipeline installed under Las Vegas Boulevard

Aware that this critical, but aging asset, could potentially suffer a devastating rupture that could flood streets, cause significant property damage and endanger lives, LVVWD worked with AT&T to install a sophisticated pipeline monitoring solution. The two companies have developed a cost-effective monitoring platform that combines acoustic leak detection technology with AT&T's wireless connectivity and visual dashboards for end-users. This smart water management technology has enabled LVVWD to better understand and manage the critical water supply pipeline and to reduce any potential water loss due to leakage.

In Las Vegas, 13 permanent acoustic sensors are now monitoring four miles of the aging pipeline installed under Las Vegas Boulevard, from Sunset to Flamingo Roads.

"When this technology came along, it allowed us to think outside the box and say, really, the pipes don't fail catastrophically all of a sudden," noted Scott. "They fail by having a very small leak which developed to a larger leak which eventually develops into a sink hole which undermines the pipe. So by having this technology we're allowed to monitor the pipe on a continuous basis to detect those small leaks before they get to be big leaks, and then be able to schedule and act and make repairs as needed. This allows us to extend the life of our pipes significantly by doing this."

Once activated, the acoustic sensors collect data about the pipeline section which is being monitored. At assigned times, the information is uploaded to a secure server where advanced algorithms interpret the data, search for leak signals and generate reports. The utility can integrate the customised information interface into its existing enterprise software programs. In the event of a leak being detected, notification alerts can also be sent to a mobile device.

This state-of-the-art pipeline monitoring technology, combined with mobile communications and data analysis and visualisation, is enabling cities and water utilities to cost effectively gather more data to make more informed decisions that extend asset life and reduce operating risks. "This technology allows us to be proactive," says Scott. "It saves the Valley water by detecting those leaks and being able to fix them before they go on for potentially years unnoticed. It puts us on the cutting edge of leak detection technology in the world. It furthers our programme for large diameter leak detection that we've been doing now for about the last five years. It really gives us some capabilities that we could not do with our portable system. And ultimately, once we are done monitoring the Strip we could take the same equipment and move it to some other pipelines. We could also find some other pipelines that have similar high-risk profiles and apply this technology to them."

The acoustic leak detection solution which has been implemented by the LVVWD has evolved into a new generation of smaller scale packaged technology that is embedded directly into existing fire hydrants – creating intelligent smart water management assets that not only provide water for emergency situations, but listen for leaks in smaller diameter water pipelines.

> *"by having this technology we're allowed to monitor the pipe on a continuous basis to detect those small leaks before they get to be big leaks"*
>
> **Charles Scott,** LVVWD Engineering Project Manager

PUBLIC HEALTH WATER QUALITY AND ENVIRONMENTAL PROTECTION

Urban water sources, such as rivers, lakes, reservoirs and desalination plants, are very diverse and are often not located close to cities. To protect consumers, the water quality throughout the supply network must be continuously or periodically sampled, analysed and monitored for compliance with regulatory standards.

> *"in some cities up to 40% of safe, clean treated water is lost due to leakage."*

If the waste water is returned to a water course untreated, it will contain many contaminants, some of which will be harmful to human life, the local freshwater or the local coastal marine ecosystems. Water quality monitoring is a key part of the process of delivering safe clean drinking water to citizens and returning safe treated wastewater back into natural ecosystems. Mobile operators can supplement existing water quality monitoring programmes by providing IoT water quality solutions that continuously collect data, analyse it in near real time and report results to a water quality application. Whilst not intended to replace established monitoring programmes, these new low cost, easy-to-deploy IoT solutions provide additional benefits. These include enhanced visibility and situational awareness, and reliable early indications of contamination incidents, enabling faster incident response and optimised use of operational resources.

ATLANTA CASE STUDY

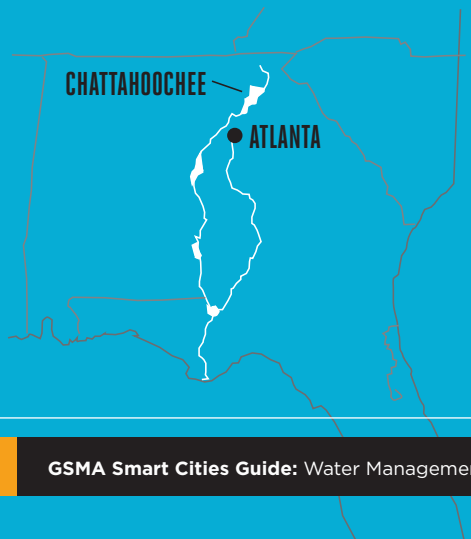
WATER QUALITY AND ENVIRONMENTAL PROTECTION

Working closely with the City of Atlanta and the Chattahoochee River Keeper, AT&T and Ericsson have improved the efficiency and cost effectiveness of the water quality monitoring process along the Chattahoochee River as it flows through Atlanta.

The Chattahoochee River flows for more than 400 miles into Florida from its mountain source around 50 miles north of Atlanta. From there it discharges into the Gulf of Mexico via the Apalachicola estuary. On route to the sea, the Chattahoochee supplies about 70% of metro Atlanta's 5.5 million citizens with drinking water. More than 300 million gallons of safe, clean water are consumed per day (over one million cubic meters per day). Moreover, Atlanta's sewage treatment plants release more than 250 million gallons of treated wastewater back into the Chattahoochee each day. The river is also used for industrial water supply, agricultural irrigation, power generation, transport and recreation and is considered to be the most heavily-used recreational water resource in the state of Georgia. The river faces many threats to its water quality, including storm-water and wastewater pollution from urban, industrial, and agricultural sources.

The Chattahoochee River Keeper (a local not-for-profit agency) uses water quality samples to determine if the Chattahoochee is safe for human contact and recreational activities. The River Keeper manually collects and analyses water samples from numerous river sites on a weekly basis and conducts monthly lake sampling patrols. Historically, measuring river water quality on an ongoing basis was expensive, time-consuming and inefficient in part because the specialist equipment required is too large and too expensive to be widely deployed. It typically costs about $10,000 per unit.
To address this challenge, Ericsson and AT&T have developed low-cost IoT water quality sensors to measure the conductivity, turbidity, temperature and thermometry of the water. The sensors use a LTE CAT1 communication solution, operating in power saving mode, to connect to the AT&T network and delivers regular data updates to a suite of analysis software. Charles Dasher, the Ericsson technology lead, said: "We've taken a $10,000 device and we've shrunk the cost down to under $300 including connectivity and we've connected it using LTE Category 1 power saving mode, this allows us to have an increased amount of sampling in terms of how often during the day we take samples, but more importantly, it increases our battery life by years and years."

This innovative automated IoT solution, which has mobile communications at its core, provides the Chattahoochee River Keeper with the key scientific data needed to monitor the water quality of this vitally important river.



CLIMATE CHANGE AND EXTREME WEATHER

Water-related extreme weather events account for 90% of all natural disasters[7]. They cause damage to buildings, property, crops and infrastructure, and loss of life, as well as losses in productivity and livelihoods, increased investment risk, indebtedness and human health issues. Cities need to ensure that their supply of water and sewage services is resilient to these types of hazards.

> *"Water-related extreme weather events account for 90% of all natural disasters"*

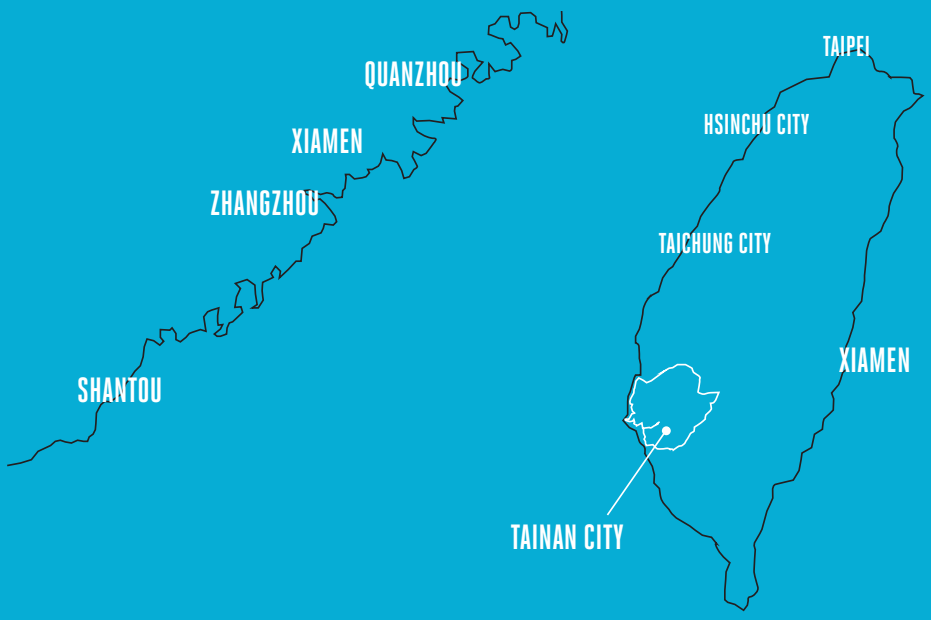
Technology is changing the way societies respond to natural disasters. Global networks of IoT sensors can alert agencies across the globe as soon as seismic activity or extreme weather events are detected. Equipped with advanced weather forecasting capabilities, these networks provide macro scale information, predictions and warnings to help the relevant agencies prepare for extreme weather conditions. To obtain detailed local information and help manage their response to these kinds of events, cities and other agencies can also deploy their own IoT sensor and camera networks, linked by mobile communication technologies.

[7] There isn't a reference to number 7 in the word doc?

TAINAN CASE STUDY

CLIMATE CHANGE AND EXTREME WEATHER

The fifth largest city in Taiwan, Tainan is densely populated with about 1.9 million inhabitants. It is located at the confluence of several major rivers that flow through an extensive low-lying delta into the sea. Much of the newer parts of the city are built on reclaimed land and are vulnerable to flooding following extreme weather events.



This volcanic, tropical island is also frequently hit by typhoons during the monsoon season that can deliver several hundred millimetres of rain in a single day, often many times in a single year.

Here are examples of the types and frequency extreme weather events faced by Taiwan:

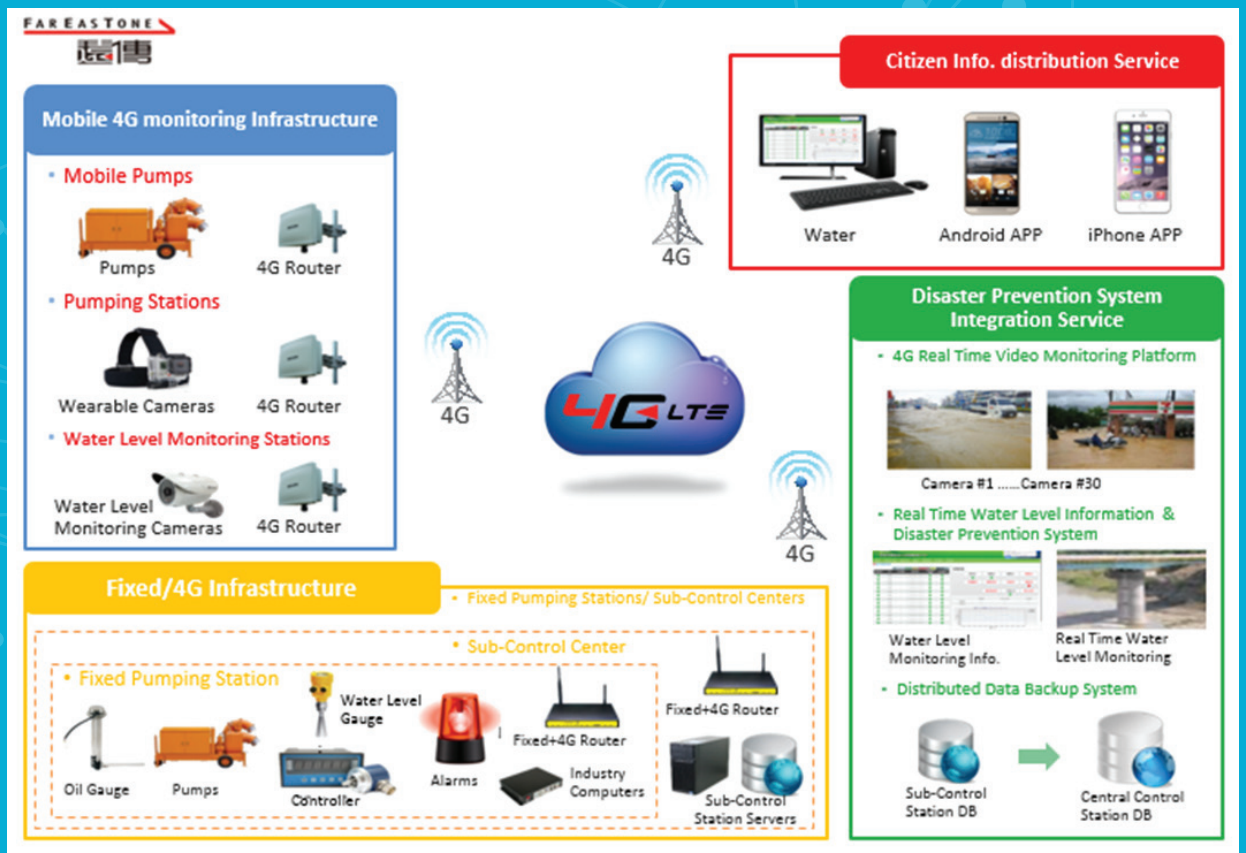
DATE	DESCRIPTION
2016/09/15	Typhoon Meranti
2016/07/09	Typhoon Nepartak
2016/02/14	0206 Earthquake
2015/09/29	Typhoon Duluan
2015/08/24	Typhoon Goni

DATE	DESCRIPTION
2015/08/11	Typhoon Soudelor
2015/07/11	Typhoon Chanhom
2015/07/09	Typhoon Linfa
2015/05/13	Typhoon Noul

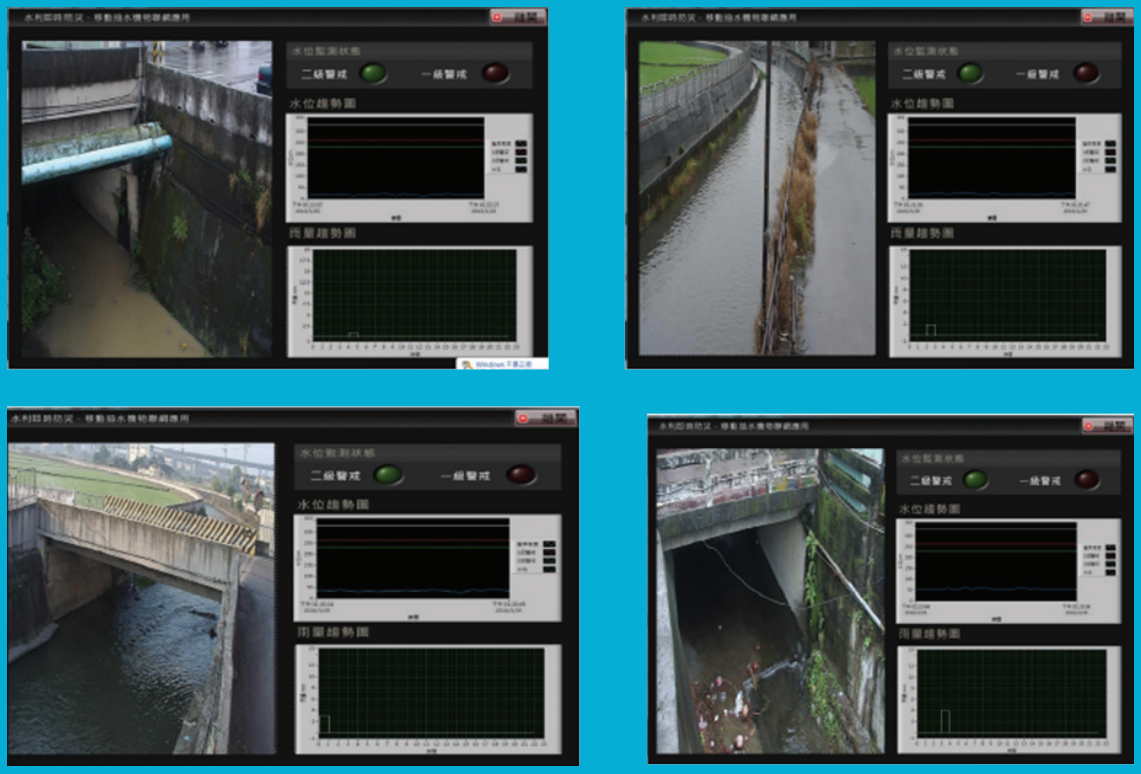
Over the years, Taiwan has earned an international recognition for its expertise in the forecasting of, and response to, extreme weather. A government initiative to improve its extreme weather response prompted the national Water Resource Agency to work with the city of Tainan and local mobile operator Far East Tone (FET) to develop capabilities to improve flood control and disaster recovery.

The partners are using high availability LTE mobile communication services, coupled with advanced IoT monitoring devices and surveillance technologies, to deliver a comprehensive state-of-the-art solution. The high data throughput and low latency characteristics of FET's ubiquitous LTE network enable a range of low cost IoT technologies that can enable:

- Near real time, data collection, data analysis and dissemination of results;
- Water resource monitoring, through real time pumping station and water level monitoring;
- Disaster awareness planning through water level monitoring, analysis and flood prediction warnings;
- Emergency information broadcast through real time, flood warning, information sharing via mobile applications;
- Distributed data backup, through distributed replicated data stores to provide high data availability at all times;
- Data integration through cross-agency integration of key data flows to deliver faster disaster response.



Real time monitoring of water levels via LTE communications



With all this new data made available in real time, the Water Resource Agency and other agencies have better visibility of events as they unfold and is in a better position to plan and respond accordingly. Through this combination of advanced IoT monitoring technology, high-bandwidth mobile communications and a dedicated, well-trained and well-managed workforce;

- Emergency assets can be deployed faster, to where they can be the most effective;
- Flood prevention equipment can be accessed remotely enabling faster response times;
- Flooding can sometimes be avoided or minimised;
- Water supplies and other utilities can be restored faster;
- The risk of loss of life is reduced;
- The risk of property damage is reduced

CASE STUDY

CLIMATE CHANGE AND WEATHER PATTERNS

Scientists predict that climate change and changing weather patterns will mean more rain in Europe, with heavier, more damaging downpours. The cost of flood damage across the European Union is set to rise from €4.5 billion per year today to €23 billion per year by 2050. In December 2015 the UK experienced its wettest month in a century: about 16,000 homes in England were flooded and repairs could cost £5 billion[8] and take at least a year to complete.

In the UK, the Environment Agency (EA) assesses flood risk and maintains the country's flood defences. It is responsible for more than 30,000 bridges, culverts and grids, all of which play a role in managing flooding. As intense downpours can happen anywhere and at any time, the EA must be at a constant state of readiness to minimise the impact of these events.

Culverts allow water to drain off harmlessly, steering flood water into rivers and drainage systems. A culvert that fails because it is blocked is likely to result in upstream flooding. Historically, this infrastructure has been maintained via a scheduled series of service visits: EA technicians would regularly physically check culverts for blockages.

Now, IoT technology and near ubiquitous mobile communication network coverage is enabling the EA to improve monitoring of these types of assets. Working with the iDefigo Group[9], a remote monitoring specialist, and utilising Vodafone's Global M2M communications platform, the EA has deployed a network of smart IoT cameras, powered by small, solar panels. Connected to a central platform, each camera provides regular, visual updates on the condition of bridges, culverts and drains. The cameras send regular photographic updates enabling field technicians to view details through an online portal, from anywhere, anytime.

> *"In December 2015 the UK experienced its wettest month in a century"*

[8] https://home.kpmg.com/uk/en/home/media/press-releases/2015/12/flooding-economic-impact-will-breach-5bn.html
[9] http://www.idefigo.com/

The EA has placed the cameras at its most critical locations, such as river valleys, where providing mobile connectivity can be difficult. However, the Vodafone Global SIM addresses this challenge by using any available carrier network. The system is integrated with the EA's other field telemetry solutions, allowing technicians to monitor river levels, high tides and more. The EA now has a real-time picture of water levels and the current state of the flood defence infrastructure. As well as providing an early warning system for the UK, the system:

- Allows the EA to better assess flood risk and plan the appropriate emergency response, from a single platform;
- Improves the productivity of service engineers with a solution integrated, in real-time, with mobile devices;
- Provides the scale to connect thousands of remote assets, with the necessary national communication service coverage;

"Our focus is on managing risk. An extreme event provides new challenges, but by making sure our assets are performing as they're expected to, we are better placed to overcome and meet these," said Mick Robinson, Technical Advisor (Flood and Coastal Risk Management) at the EA.

> *"Our focus is on managing risk. An extreme event provides new challenges, but by making sure our assets are performing as they're expected to, we are better placed to overcome and meet these"*
>
> **Mick Robinson,** Technical Advisor (Flood and Coastal Risk Management) at the EA.

MOBILE OPERATOR CAPABILITIES FOR SMART WATER MANAGEMENT

Using licensed spectrum for communications, mobile operators are able to deliver the following benefits;

- An assured quality of service;
- Managed flexible bandwidth;
- Security and privacy;
- Reliability and resilience;
- Extensive geographic coverage using existing mobile network infrastructure; mobile-enabled IoT devices can be plug and play;
- Open standards minimising the risk of technology "lock-in" to a specific vendor or operator;
- Industry support – an extensive ecosystem of competing service providers, equipment providers, chipset and module makers, which are investing in the technology for the long-term, leading to:
  - Evergreen technology – the latest wireless technology supported by billions of dollars of network investments.
  - Large device ecosystem – allowing for a large number of potential partners.
  - Low cost modules – IoT adoption drives down module cost.
  - Network optimisation – LTE technologies can be optimised for IoT device (see Mobile IoT on page 17).
  - Device cost structure – Mobile IoT technologies enable lower cost devices as a result of improved battery power management and extended in-building and underground propagation.

There are several areas in which mobile network operators can create value for smart water management users:

IOT SERVICES

Working with carefully selected partners, mobile operators are increasing offering a range of IoT services from which utilities can benefit, such as;

- IoT platform-as-a-service (PaaS);
- Smart water software and solutions-as-a-service (SaaS);
- IoT sensor, device and gateway communica tion management;
- IoT sensor and device deployment services;
- IoT sensor, device and gateway hardware provision;
- Fully managed support linked to service level agreements;
- Data management and analytics services;

SECURITY AND DATA PRIVACY

Mobile operators have a track record of providing secure and reliable communication services to their customers. They also have deep domain expertise in the design, deployment and operation of secure IoT solutions. The GSMA's IoT Security Guidelines[10] and IoT Big Data Privacy Principles[11] provide further details on the steps that can be taken to secure mobile operator-led smart water implementations.

THE GSMA EMBEDDED SIM SPECIFICATION AND REMOTE PROVISIONING

To support large scale IoT deployments, the mobile industry has created the GSMA Embedded SIM Specification[12], which allows remote management of mobile communication in IoT devices, and enables over-the-air provisioning of new operator subscriptions without the need for a physical change of SIM. This provides flexibility in the IoT sensor/device supply chain and removes the risk of operator lock in. The benefits delivered by the GSMA Embedded SIM Specification include:

- Decoupling hardware provisioning from mobile communication service provisioning;
- Remotely managing the provisioning of a SIM-profile for the local market, allowing for global supply chains of connected equipment;
- Improving product reliability through reduced SIM failures;
- Securing a product that will work long-term, allowing technology evolution;smartphones. GPS positioning is extremely accurate, widely available in smartphones and provides a

MOBILE IoT

Many water utility assets are below ground or in chambers that are often flooded. In many cases, these assets are also in remote locations where there is no mains power source. To provide reliable connectivity in this challenging environment, the mobile industry is developing a range of low power wide area communications technologies, known collectively as Mobile IoT[13]. The benefits offered by Mobile IoT solutions include:

- The use of licensed spectrum enabling mobile operators to control quality of service, secure over-the-air communications and provide a scalable network.
- Standardised within 3GPP release 13 (June 2016), supporting interoperability between solutions from different vendors.
- Extended radio propagation range.
- Low power requirements leading to long battery life of about 10 years.
- Low device costs.

[10] http://www.gsma.com/connectedliving/future-iot-networks/iot-security-guidelines/
[11] http://mph.gsma.com/publicpolicy/handbook/consumer-protection/
[12] http://www.gsma.com/newsroom/all-documents/sgp-02-v3-1-remote-provisioning-architecture-for-embedded-uicc-technical-specification/
[13] http://www.gsma.com/connectedliving/mobile-iot-initiative/

VALENCIA CASE STUDY
MOBILE IoT

Working with the city of Valencia and the local water utility, Aguas de Valencia, Vodafone[14] is delivering a customer field trial of smart water meters employing Mobile IoT technology. The trial follows on from earlier successful studies that demonstrated the feasibility of deploying Mobile IoT technology for water metering applications.

Proof of Concept/Pilot Coverage
GSM +20dB Coverage

COVERAGE ENHANCEMENT	2G/3G IMPACT	E2E
Verified +20dB (vs GSM)	No service degredation observed	Service layer E2E communication established

[14] https://www.youtube.com/watch?v=Wn1m01ttHBM

CONCLUSIONS

New IoT technologies are transforming the management of the water cycle, helping cities to ensure affordable, safe, clean drinking water and sewerage services are available 24 hours a day, seven days a week for their citizens. Mobile operators' smart water management solutions integrate IoT technologies to capture, intelligently combine and analyse relevant data, delivering visibility, control and situational awareness in near real time. As a result, stakeholders are able to continuously monitor the environment, water resources and related infrastructure.

Today, cities should be evaluating how smart water management services could help to address local issues. They should consider partnering with mobile operators, which have experience and capabilities in this space, including efficient, reliable and secure communication services, IoT solution provisioning and big data technologies. Moreover, new technologies and solutions, such as low power wide area communication networks, will continue to emerge, delivering further benefits to cities and their citizens.

Working together, mobile operators, cities, entrepreneurs and other agencies can deliver sustainable, resilient, affordable, safe, and clean drinking water, coupled with environmentally-friendly waste water and sewage treatment processes for cities and their citizens.

About GSMA Smart Cities

Cities are getting smarter every day, using information and communications technologies to enrich and enhance city life. The growth of the Internet of Things will have a fundamental impact on the development of smart cities, helping to drive efficiencies and delivering rich new services. However, without effective strategies in place, cities will be unable to capitalise on these benefits. As part of the GSMA Connected Living programme, the Smart Cities project is working with mobile operators and cities to create real, long term benefits for businesses and citizens through IoT technologies.

To find out more visit: www.gsma.com/smartcities
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