Special Report 2020

genius water management series

Smart Water Network Innovations: Getting Ahead of the Curve

Content
Special Report 2020

Building Blocks
Overview

As upward pressure on the costs of public agency services – cities, water agencies, etc. – continues to increase, agencies must get smarter.

Progressive leaders are looking for Smart City / Smart Agency initiatives that include scalable communications networks with open architecture that can grow with their communities, and water management is no exception.

» Solutions that help develop and leverage partnerships between water suppliers and their customers will reap the most benefit now and into the future, and one solution has pioneered several innovative features that makes it deserving of a closer look.

Introduction
Smart Community Grids

60%

of the world's population is expected to live in cities by mid-century

As part of a larger move toward "smart communications grids"— those that leverage digital technology to improve infrastructure, asset management, environmental, financial, and social aspects of urban life—open, smart water networks are the wave of the future, and the innovations that form that wave are already making a splash. According to TechRepublic's Smart Cities Cheat Sheet[1], "The International Data Corporation (IDC) defines smart city development as the use of smart initiatives combined to leverage technology investments across an entire city, with common platforms increasing efficiency, data being shared across systems, and IT investments tied to smart missions."

Certainly, water system management is one of those areas ripe—if not overdue—for true smart initiatives. When Automatic Meter Reading (AMR) technology debuted in the mid-1980s and rapidly proliferated through the 1990s, it was a boon for utilities and water management agencies. But it is yesterday's solution to yesterday's challenges.

With the world becoming more urban—60% of the world's population is expected to live in cities by mid-century—it's time this one-way benefit was replaced by modern technology that connects, engages and empowers both water providers and end users. Today's fast-moving agencies require a revolutionary meter monitoring/valve control solution that benefits both utilities and their customers.

Understanding

Part of such a system would include the recognition that, with rapid and ever-changing cyber technologies, agencies are not in the position to own and maintain the kind of large, robust communications networks needed to power Smart Cities. They need to work with vendors who, while fully understanding the technologies they will need to work in concert with, specialize in their area of expertise and leave the rest to experts in their own fields.

Choices

As cited in the Water Online article, "Smart Water Networks And The Choices Ahead[2]," "Historically, a water utility would select a vendor to provide both the metering technology and the communication network infrastructure. While this approach had the benefit of a single point of contact responsible for delivery of an entire system, it didn't take into account all lifetime cost-of-ownership factors, or the possible redundancy that was created due to overlapping communication systems within a single municipality or geographic region."

Freedom

Such oversights are no longer sustainable. Cities that are truly smart will retain or create their independence from proprietary networks that reduce their agility in staying ahead of the curve in anticipating and implementing best-in-class communications capabilities, and the best adjunct solutions that will use those networks. Water management systems are no exception.

The Future
A Sparkling Vision

What would the Ideal Smart Water Network possess?

Ideally, a smart water network would provide affordable, easily deployed hardware that harnesses the power and immediacy of third-party, cutting-edge telecommunications. This would enable access to infrastructure and wireless capabilities that may already be part of the grid in tech-forward communities, or are slated for installation in the near future.

Due diligence concerning available options is critical to making a sound investment in an agency's future as opposed to finding itself trapped in a system of proprietary technologies that only perform well together, but not in concert with others outside their ecosystem.

This ideal network would not only perform remote meter reading, but also allow utilities and their customers to access real-time data on water usage, potential leaks, and even to remotely close a valve, shutting down suspected leaks until they can be assessed or in the case of a major break, mitigating loss until permanent repairs can be made. In addition, it would provide the handling of other IoT applications over the same network to extend levels and capabilities of system management. All of these robust features would provide cost savings to providers by eliminating the need for multiple data handling systems, drive-by or touch meter reading, most search-and-assess field trips, and a host of other functions now handled by direct and costly labor deployment.

Ultimately it would create an important and necessary partnership between providers and customers in meeting tomorrow's ever-growing demand for water conservation.

Today's customers demand more.

With more computing power in their pockets than the first Apollo moon landing mission[3], modern Americans have come to expect immediate, two-way communication with product and service providers.

American consumers are not shy about using social media and the Internet to express unhappiness with dashed expectations, or to get help with needed information. They are also beginning to understand that cyber-communication technology can also help them proactively connect with commodity service providers previously difficult or impossible to reach.

Though a certain amount of patience exists toward unavoidable infrastructure-based service lags, Millennials and every generation to follow will soon be demanding more information about—and control over—their potable water usage.

The Internet of Things (IoT) now powers everything from mobile banking to telecommuting. Tech-savvy citizens are about to start wondering aloud why they must still put up with being ambushed by unexpected bills for massive usage spikes spurred by leaks that were completely unknown to them and/or out of their control. They will be expecting utilities to implement technology that provides them on-demand access to data that can help them anticipate and even control their usage, and to provide early warning of leaks before they become costly and damaging. With all the talk about conservation, it has truly been the end user who has been ill-equipped to participate in the process.

A Smart Cities Glossary

Advanced Metering Infrastructure (AMI) – Systems that measure, collect, and analyze water usage, and communicate with metering devices on request or on a schedule. These systems include hardware, software, communications, consumer energy displays and controllers, customer associated systems, meter data management software, and supplier business systems.

Automatic Meter Reading (AMR) – Existing older technology for automatically collecting consumption, diagnostic, and status data from water or energy metering devices (gas, electric), and transferring that data to a central database for billing, troubleshooting, and analyzing.

Edge Network – A system of computing devices distributed on a network—at the "edge of the Internet," but not engaging it—that brings computation and data storage closer to the physical location where it's needed, to improve response time and save bandwidth. In this case, onsite digital water meter monitors with their own onboard computer chips, and the ability to speak or "nearcast" to nearby consumer devices such as smart phones, tablets, and smart water use appliances.

Internet of Things (IoT) – A system of interrelated computing devices, mechanical and digital machines, provided with unique identifiers (UIDs). These devices have the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

LoRa® – A non-cellular, long-range, low-power, low-bitrate, wireless telecommunications system, which works in the physical layer as an infrastructure solution for the Internet of Things. End-devices use LoRa across a single wireless hop, to communicate to gateway(s), connected to the Internet. They act as transparent "bridges," relaying messages between end-devices and a central network server, operating in the unlicensed spectrum.

LoRaWan – An open source data sharing protocol that defines the system architecture for the network, ensuring reliable and secure communication.

Low-Power Wide Area Networks (LPWAN) – One range of protocols and technologies that has emerged to fulfill the communication requirements of the IoT, offering radio coverage over a very large area through base stations, adapting transmission rates and power, modulation, duty cycles, etc., so that connected end-devices incur a very low energy consumption.

Bonuses

In-House Benefits

Water customers aren't the only ones to benefit from such technology.

Value-Added
smart-water home applince development potential

Sustainability
increase real-time data transmission long-term, reducing needed bandwidth

Municipal utilities, water authorities, and agencies looking for significant, long-term cost efficiencies can leverage IoT by replacing aging Automatic Meter Reading (AMR) hardware with Advanced Metering Infrastructure/Internet of Things (AMioT) solutions: innovative metering technology that interfaces new local Edge Networks, to remotely report back to the water authority and empower the customer like never before.

Edge Networks
are those whose communications can take place on the ground, without having to engage the Internet—a cloudless solution. Savings could be further ramped up by that Edge Network consisting of utility-owned, Bluetooth-powered communication lines that gather local signals before bouncing them over to the telecom-owned RF or cellular grid. Keeping the signal off such proprietary infrastructure until absolutely necessary would not only speed up real-time data transmission, it would drastically reduce expensive bandwidth usage from the telecom provider.

It is important to mention that an "edge-capable" smart meter could communicate directly with "edge-capable" appliances. For example, an "edge-capable" irrigation controller uses the smart meter as sensor to validate proper irrigation.

This unique technology would create a path for device providers to develop "smart water" home appliances. The water meter—once a one-trick pony—could then become a critical sensor that enables edge machine-to-machine communications, much like Nest consumer level technology.

Last, but by no means least, smart water networks could facilitate artificial intelligence (AI)-driven, 24/7 guardians against growing losses due to unplanned, unauthorized, non-revenue water loss. Let's take a look at this growing problem in municipal water systems:

State of the System

Sobering Statistics About Leakage Loss

According to a 2018 study by Utah State University[4] that surveyed nearly 200,000 miles of water pipelines in more than 300 municipalities in the United States and Canada, serving more than 14 percent of the two countries' total population:

- More concerning is that breakage rates of cast iron and asbestos cement pipe, which make up 41 percent of the installed water mains in the U.S. and Canada have increased by more than 40 percent over those six years.
- 82 percent of cast iron pipes are more than 50 years old and experiencing a 46 percent increase in break rates.
- Nationwide, one mile of installed water main serves 308 people.
- Smaller utilities have two times more main breaks than large utilities.
- The average age of failing water mains is approximately 50 years.
- Over 16 percent of North America's underground water infrastructure is past its design service life at this point.
- Of more than 200 utilities reporting water loss value, estimated average water loss to leakage is 10 percent, but some areas are reaching averages as high as 20-30 percent (including authorized losses).

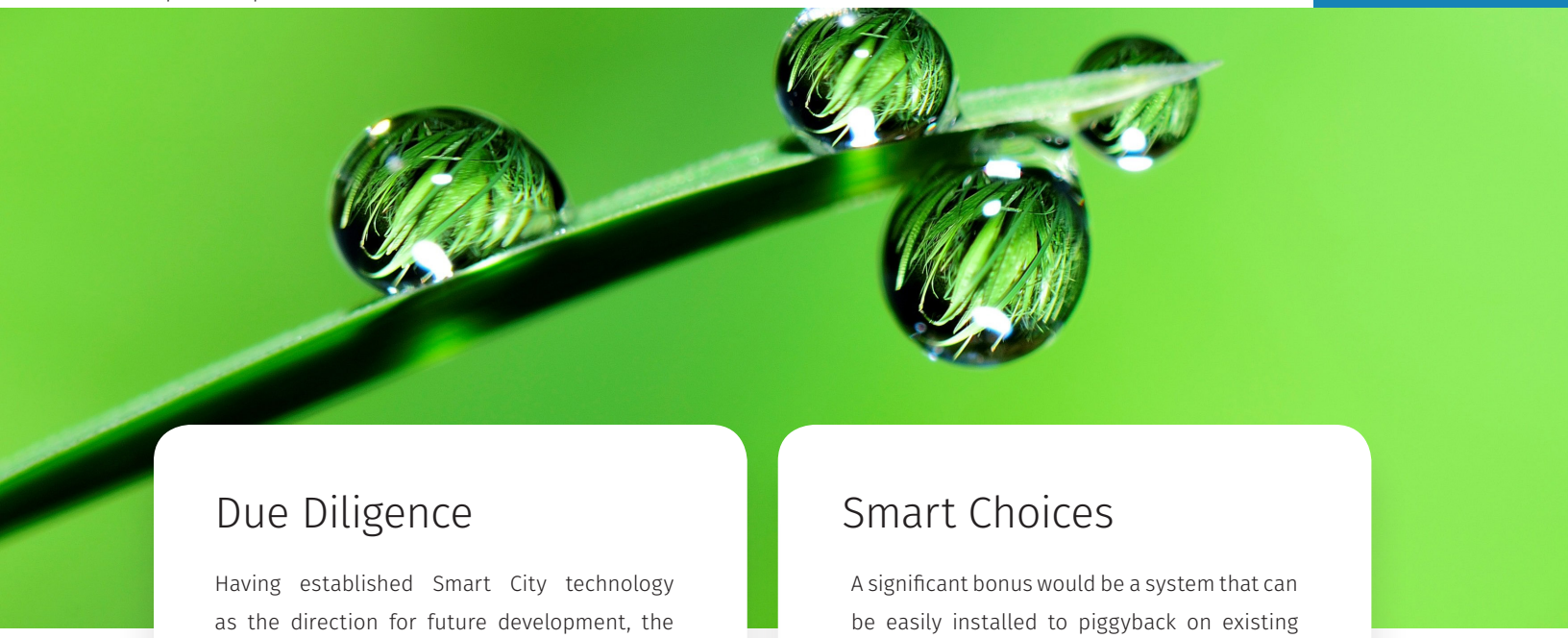
+27%

Between 2012 and 2018, overall water main break rates increased by 27 percent, from 11.0 to 14.0 breaks/100 miles/year.

It's clear that non-revenue water is taking a serious bite out of operating budgets, both through leakage loss and the costs of infrastructure repair and replacement. But is Smart City technology really the solution?

It appears so. That same report from IDC noted that around the world, smart city technology spending reached $80 billion in 2016, and is expected to grow to $135 billion by 2021—nearly doubling in just five years. With the increased urbanization previously cited, it's difficult to imagine a scenario in which this trend will not continue for the foreseeable future.

Obviously, those with control over the purse strings recognize the economies of scale and efficiencies to be achieved through bundling together the digitization of many municipal functions. That's exactly what Smart City technology makes possible.



Due Diligence

Having established Smart City technology as the direction for future development, the next logical question for utility managers to consider would be which specific technologies to embrace. The right choices now will see savvy water authorities reaping the benefits of staying ahead of the curve with technologies poised for extensibility and scalability. Those who skimp on due diligence in discovering the right solutions will find themselves saddled with an installed base of quickly outmoded proprietary equipment and distribution components.

Aside from primary water-related functions, informed technology specifiers will understand the importance of choosing an AMioT (not just limited AMI) water monitoring and reporting system that:

- integrates smoothly with both utility enterprise systems and wider Smart City systems
- is designed to grow with the water distribution system itself
- supports diverse, ubiquitous and user-friendly monitoring and control interfaces
- Is backed by responsive technical support, from installation to deployment to troubleshooting

Smart Choices

A significant bonus would be a system that can be easily installed to piggyback on existing infrastructure. This would save huge amounts of time and money compared to other systems that require removal of old equipment. If the new system is modular in nature, it can be installed on an as-needed basis to replace old AMR and manual-read meter registers as they fail or become too costly to maintain. This way, managers can decide whether it's more efficient and cost effective to retrofit entire blocks at a time, or just on an individual basis.

Equally as important to the agility of the physical layer of equipment, new IoT systems should generate data that doesn't simply replace that from installed systems, but surpasses it in richness and usability. Such components would continue to be a vital and integral part of a healthy, robust water distribution and monitoring system far into the future.

And of course, any serious candidate for such deployments must be designed to the highest standards of security. Though managers will want an open architecture system to allow for the growth and extensibility previously discussed, that openness must be closely guarded against external cyber-invasion, hacking and malware.

Available Solutions
A Serious Contender

Based on the facts previously established here, one potential comprehensive solution for water providers to consider for upgrading their current water metering to meet Smart City standards now and into the future is the Subeca Water Management System.

Because it's built on open architecture, the Subeca System integrates quickly and easily with any existing IoT infrastructure or expansion into new IoT applications.

This three-component, five-function system forms a complete, end-to-end water metering network that also provides utility and customer monitoring and control interfaces like no other. The dashboards offer not just granular water usage information, but also continuous real-time data and alerts for utilities and their customers, leak detection, and first-of-its-kind, two-way communication for customer-shared remote valve control.

Because it's built on open architecture, the Subeca System integrates quickly and easily with any existing IoT infrastructure or expansion into new IoT applications. Based entirely on wireless standards meeting stringent ISO/IEC 27001 requirements for information security management, this system allows agility rather than locking into some random, proprietary technology that could hinder future growth and robustness.

In fact, once it's installed, the agency then owns an open LoRa IoT network that can be used for more than 200 other Smart City applications.

subecaAMiOT™

The Complete Subeca System Components

Subeca Pin™

The core data collection component, Subeca Pin is a Bluetooth register that replaces the register on existing meters. It collects and transmits data locally ("nearcasting") via Bluetooth to a nearby transmission point, through which it can also receive remote instructions to open or close a valve. This is where the edge network is initiated.

Subeca Link™

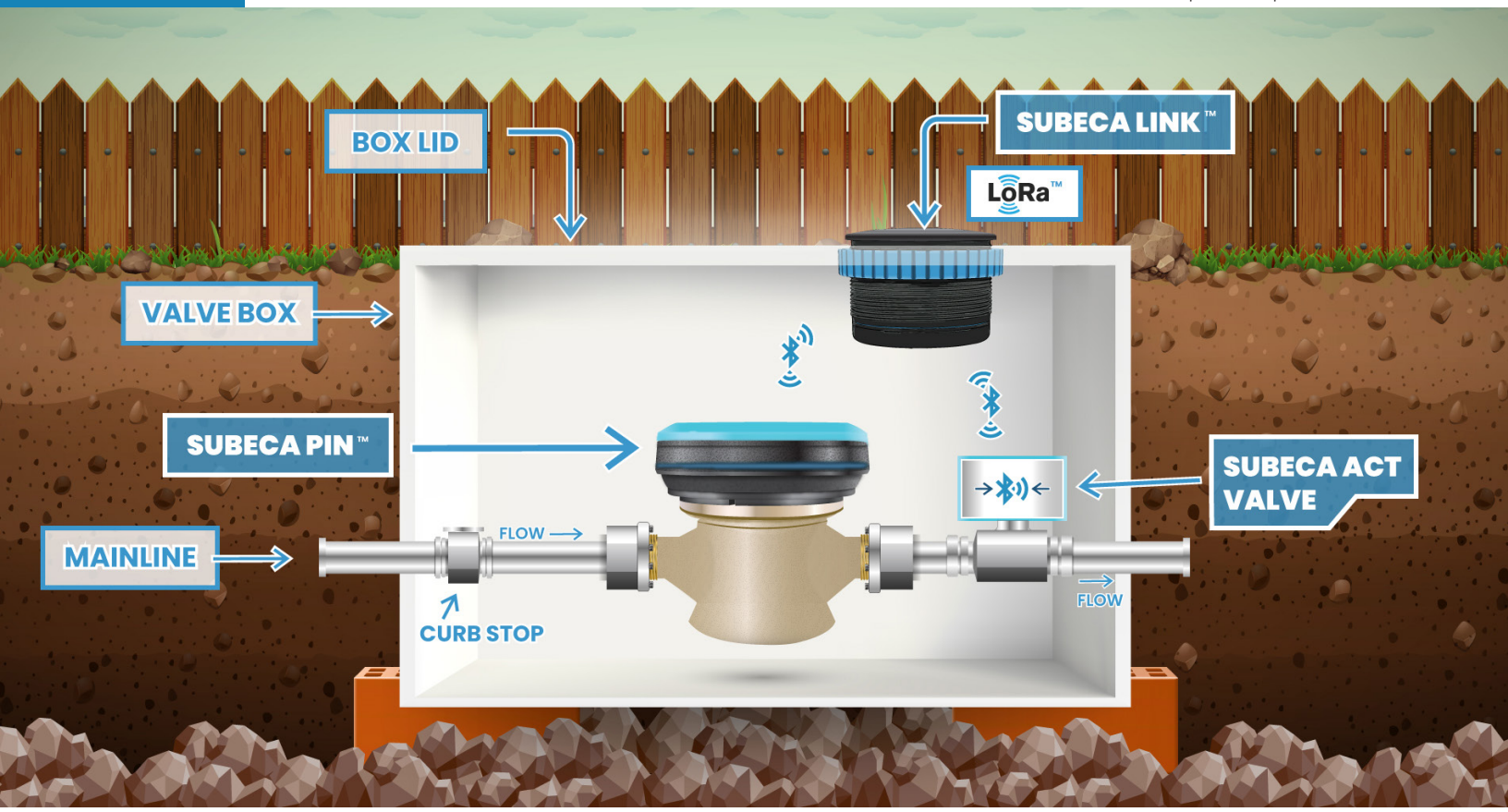
The previously mentioned data transmission point, Subeca Link uses radio Frequency (RF) signals to collect and transmit data from nearby Pins, to and from your agency's LoRa Gateway. From there, data packets are transmitted to and from your utility's (central) data analysis and control center, and your customers' (distributed) app and dashboard.

Subeca Engage™

Subeca Engage software is the "brains" behind the System, analyzing and parsing the data behind the scene. It provides a cloud-based, feature-packed, interactive user dashboard. It can be accessed via computers or mobile devices by utility staff and customers, to view data and manage feature settings and Pin functions for valve control.

Subeca Act®

The Subeca Act is a wireless valve for remote water control. The Subeca Act can be shared with customers. so their water mishaps are mitigated. The Subeca Act demonstrates water utility commitment to customer empowerment.



Installation

Physical set-up of the Subeca System occurs completely within the valve box, making planning for purchasing and location easier, as it can be treated as a modular system.

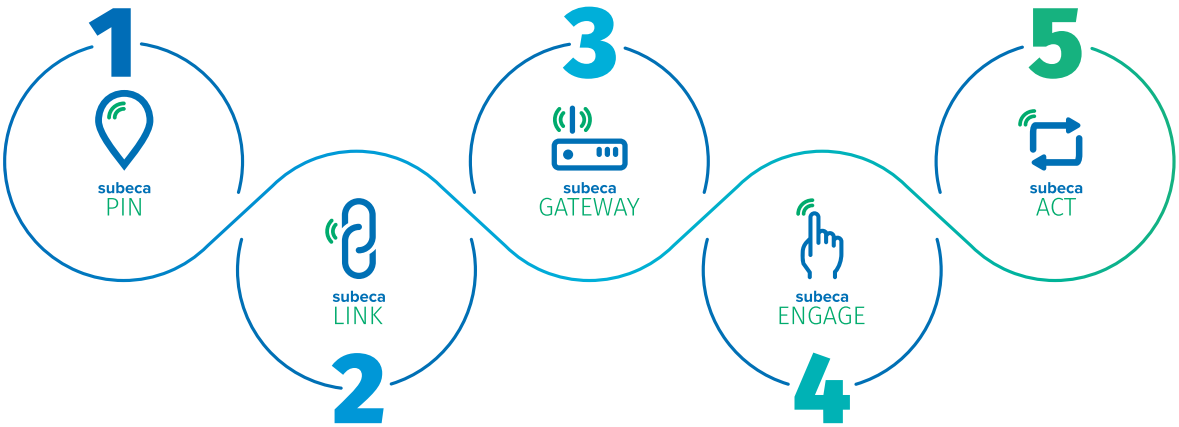
Installation includes removal of the existing AMR meter register (or the entire meter), and replacement with a Subeca Pin; a quick and easy procedure that normally takes less than five minutes.

A Subeca Link is installed in the box lid, and Bluetooth transmission is established between the two components and a remote-control valve. The valve is installed in the service line to replace manual valves.

The Subeca Link is then activated to communicate with your agency's LoRa gateway, and all components tested. The entire process typically takes about 30 minutes on average with a valve, and 4 minutes without a valve.

The System

How the Subeca System Works



01. Collect meter data:

Subeca Pin, a Bluetooth Register, replaces the register on existing meters. Every 900 milliseconds the Pin transmits meter data to the consumer (when within Bluetooth range) and to the Subeca Link.

02. Transmit meter data:

Subeca Link, a Bluetooth-to-LoRa Bridge, takes this IoT data from the Pins that are on up to 10 nearby meters and transmits this data to the secure AWS data cloud every 15 minutes via an IoT LoRa network.

03. LoRa network installed:

Subeca installs a Comcast MachineQ LoRa gateway system to support this data transmission. Once installed, this MachineQ system can support over 200 other IoT applications as well.

04. Access & use meter data:

Data is sent to the Subeca Engage platform and dashboard, which enables utilities and end users to get real-time data, helpful alerts, incredible control and much more.

05. 2-way communication:

Commands can be sent from Engage (either the full agency dashboard or the end user's mobile app) back to the Link, which is capable of opening or closing a motorized electrically-actuated ball valve.

Closer Look
Key Components of the Subeca System

Detailed data sheets for all of these components are available for download at https://www.subeca.com

Subeca Pin

Subeca Pin nearcasters generate readings from the water meter and transmit them to Subeca Links where readings can be used for direct instructions to open or close a valve.

These modules transmit water use data to consumers in near real-time. Other features:

- Works with existing or new water meters
- Installs in less than 5 minutes
- Bluetooth output
- App interface + local display
- Battery-powered, 15+ year life
- Transmits data every 900 milliseconds
- Sealed for ip68 (water ingress)
- Field programmable & updatable

Subeca Pin nearcasters can also be used independently, to create a drive-by meter reading system. Utilities can upgrade to the full cloud-based water management system when ready.

Subeca Link

Subeca Link broadcasters collect and transmit data from close by Subeca Pin nearcasters, to and from the LoRa Gateway. They have enough battery power to control a motorized, electrically actuated ball valve.

- Wireless for Bluetooth inputs
- Can turn valves on or off
- Can receive and transmit data from multiple Pins
- Battery powered, 15+ year life
- Transmits data every 15 minute
- Sealed for ip68 (water ingress)
- Field programmable for settings and firmware

The ability of Subeca Link to broadcast data from many nearcasters reduces data transmission costs, since subscription fees are tied to LoRa activity, not to Bluetooth Pins.

Subeca Engage

Subeca Engage customer computer portal and smartphone app provide complete water management visibility—anytime, anywhere, and on any device.

For water agencies, the Subeca Engage utility dashboard provides intuitive, customizable dashboards that can be shared between departments to display granular water usage data to system managers. The dashboard is accessed by customers through a mobile phone application, which provides near-instant water usage information, alerts, remote valve control and more.

The Subeca Engage dashboard is a single platform offering many applications, including utility, sub-metering, irrigation and groundwater management. Capabilities include:

- Remote customer-shared valve control, a Subeca exclusive feature that includes the ability to automatically shut off valves during water events
- Remote meter reading
- Leak detection and alarms
- Data collection, management and presentation
- Aggregation of data from multiple properties
- Bill generation (via API connection to existing enterprise system)
- Irrigation scheduling
- Ability to push communications to end users via consumer app

The Subeca Engage dashboard supports robust data analysis by allowing utilities to review and compare data and maps for every level of granularity, all the way down to the physical points at which the water is being measured. The system includes filters, tables, charts, graphs, satellite view maps, change logs, comparison options, usage reports, assessments and more.

For agencies that haven't yet implemented their own Smart City communications network, Subeca offers the option of installing the MachineQ™ Open LoRa IoT Gateway.

Key Components Cont'd

MachineQ provides two-way LoRa communications between the installed Subeca system and the cloud. It may also be used with 200+ other IoT applications making it a highly cost-effective, value-added choice over cellular or other proprietary systems. Features include:

- Non-proprietary, open network
- 8-, 16- or 64-channel indoor or outdoor gateways
- High-density coverage
- Scalable to any endpoint population requirement
- Supports cellular VPNs
- Supports LPWANS operating on the LoRa standard
- Robust and dependable
- Supported by Comcast, one of the industry's largest communications companies

Each water purveyor must deeply research its own needs. No single network will fit everyone. Subeca addressed this reality by creating a platform that aggregates data from any network or source, where it is available.

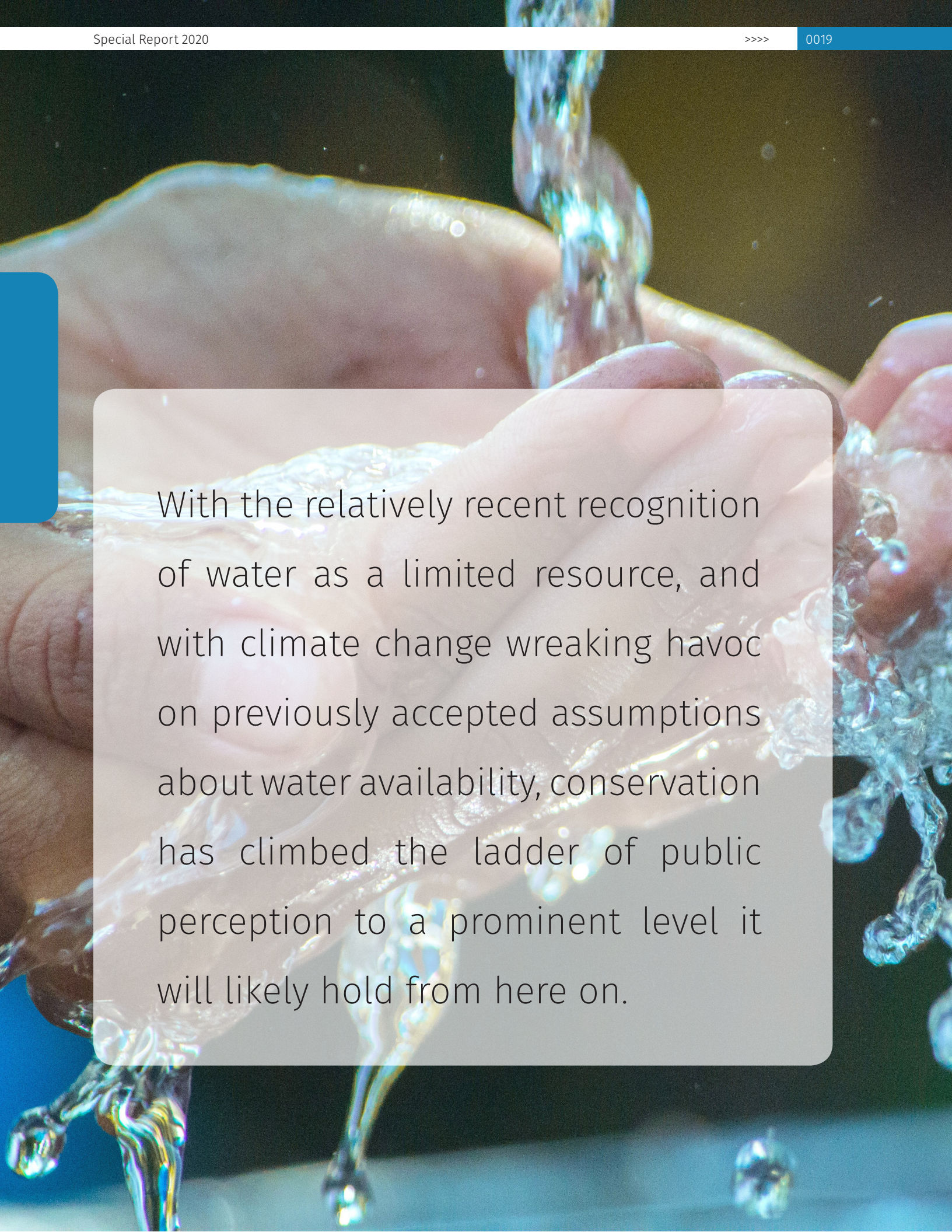
Regulary Considerations

Conservation Compliant

One area in which Smart Meters such as Subeca's stand head-and-shoulders above other water management solutions is in water conservation. In an article in Government Technology magazine[5], Thomas Kelly—strategic coordinator for the Washington Suburban Sanitary Commission in Maryland, and chair of the American Water Works Association Meter Standards Committee—said, "Within the last decade, water has really come into its own as getting the recognition that it deserves for the precious resource that it is. We have more and more people putting increasing demands on the same amount of water," he added. "And what we've got is what we've got."

With this relatively recent recognition of water as a limited resource, and with climate change wreaking havoc on previously accepted assumptions about water availability, conservation has climbed the ladder of public perception to a prominent level it will likely hold from here on. One area being impacted by this development is public policy and governmental legislation. Though prevailing political upheaval in Washington, D.C., has thrown federal conservation policy into flux, many states are taking their own steps toward conserving their own natural resources.

In most such environment-related topics, the state of California has tended to take the lead in studying, formulating and implementing pioneering legislation. Water management is no exception. Their regulations tend to be the strictest, and for that reason, those responsible for implementing such policies pay close attention to California: The state sets the bar for standard levels. So, designing to California standards in most environmental regulation is usually a safe bet for nationwide compliance by developers of any equipment or technology involved in such implementations.



With the relatively recent recognition of water as a limited resource, and with climate change wreaking havoc on previously accepted assumptions about water availability, conservation has climbed the ladder of public perception to a prominent level it will likely hold from here on.

Conservation Compliance
California Strong

This is the case with the Subeca Water Management System. All technology integrated in the Subeca System was designed to meet California's most recent water conservation standards, the most stringent to date.

Specifically, they call for the creation of new urban efficiency standards for indoor use, outdoor use, and water lost to leaks. They also require urban water agencies—starting in November, 2023—to annually calculate their own objectives, with calculations based on water needed in their service areas for efficient indoor and outdoor residential use, as well as commercial, industrial and institutional (CII) irrigation, and on reasonable amounts of system water loss. Highly accurate meters will be required for this, and urban water suppliers who fail to provide this information on deadline will not qualify for water grants and loans.

Urban water agencies in California are required by these bills to meet their stated water use objectives. Those that fail to do so may be subject to enforcement by the State Water Board, which could issue informational orders until 2025, when they will be empowered to issue conservation orders, fines, etc.

To begin, the indoor water use standard will be 55 Gallons Per Capita Per Day (GPCD) until January, 2025. The standard will become stronger over time, decreasing to 50 GPCD in January 2030 and 45 GPCD in 2035. This usage is aggregated across population in an urban water supplier's service area, not calculated to individual households. The outdoor use standard will be based on land cover, climate and other factors, and will be adopted by June, 2022. The water leaks standard will be set by the Board, based on prior legislation (SB 555, 2015) and will take effect by July of 2020.

Bills, SB 606 and AB 1668—signed into law in May of 2018, and whose regulatory standards go into effect no later than June 20, 2022—establish specific regulatory requirements for urban and agricultural water suppliers.

Obviously, these deadlines are not far away, and that for the leak standard is nearly here. Municipalities would do well to specify AMioT type smart water metering and monitoring systems—such as the Subeca System—sooner rather than later, to remain compliant in California. Further, with the burden inevitably on the end user to manage their water use, The AMioT solution engages and empowers that user far beyond standard AMI applications. Other states, especially those in the arid West, are sure to follow with similar legislation before too long.

In the case of monitoring leak losses especially, there is ample motivation to stay ahead of the curve in adopting smart water management systems. This is particularly true in large agencies, where significant economies of scale can be realized, and penalties for not meeting standards are certain to be most painful.

Summary

Recapping AMioT Smart Meter Benefits

The Subeca System offers several solid benefits to utilities and water authorities who implement this AMioT water management system:

- Cost reduction—compared to AMR and traditional AMI systems—for all stakeholders, along affordable hardware, installation, performance and scalability metrics
- Enables water agencies to meet state conservation targets by empowering rather than fining their customers
- The ability to use the Subeca Engage utility/agency dashboard and consumer portal and app to identify issues within a single home or business within seconds, and to take immediate remedial action through the Subeca Act remote valve shut-off before the problem escalates in damage and cost
- The ability to issue water bills without having to drive by homes and businesses to read meters
- The ability to measure water usage in real time
- Allows end users to monitor their own usage, and receive pre-programmed alerts and budget tracking

Summary
In Conclusion

It has always been true that information is knowledge, and knowledge is power.

Subeca has developed its Smart Water Management System to empower both water authorities and their customers through the use of IoT technology to increase the granularity of data to control water usage.

Recognizing the reality that a reduction in water use will not happen without customers feeling they have some control over their usage, Subeca developed the Engage app as a tool to provide not just that feeling, but its reality. This philosophy of enabling the development of partnerships between water authorities and their customers is what powers Subeca as a company, and its efforts to be constantly innovative.

The Subeca Water Management System is a sound choice for many water purveyors to get and stay ahead of the curve in helping to create their own Smart City.

Thank You

Find Out More Now

Those wishing to learn more about the Subeca Water Management System may visit the company's website at https://subeca.com.

Those who would like to speak to a company representative may call (760) 861-3370 and ask for Sales Director, Tom Schmandt.

Ask how to try the
Subeca System Pilot Program.

Footnotes

1 -Smart City Cheat Sheet
https://www.techrepublic.com/article/smart-cities-the-smart-persons-guide

2 –Smart Water Networks and the Choices Ahead
https://www.wateronline.com/doc/smart-water-networks-and-the-choices-ahead-0001

3–Your Mobile Phone vs. Apollo 11's Guidance Computer
https://www.realclearscience.com/articles/2019/07/02/your_mobile_phone_vs_apollo_11s_guidance_computer_111026.html

4 - Utah study – Water Main Break Rates In the USA and Canada
https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1173&context=mae_facpub

5 – Government Technology article
https://www.govtech.com/fs/data/Are-IoT-Enabled-Smart-Meters-the-Next-Step-for-Utility-Providers.html

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700 E Tahquitz Canyon
Way #2
Palm Springs, CA 92262
760.861.3370
info@subeca.com
www.subeca.com

genius water management™