Driving Operational Efficiencies in Water Management

Monitoring & Management of Water Infrastructure, Assets, and Facilities

Use Cases:

1. **Agriculture and Irrigation**
2. **Pump Station Monitoring**
3. **Predict Leak in a Surface Pipeline**

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Today's Water Management Challenges

Water Management is facing serious challenges with deteriorating infrastructure, storm and flood management, and emerging contaminants to name a few.

- **One of the top issues in the water industry is the aging infrastructure. The aging drinking water and wastewater infrastructure is in poor condition and systems require investments in maintenance, repairs and upgrades.**
- **Many of the components in the drinking water and wastewater infrastructure are reaching the end of their useful life (normally 15 to 95 years).**
- **The condition of many miles of pipelines is unknown, with some pipes dating back many decades.**
- **With respect to leaking pipes, the current rate of replacement or renewal of buried infrastructure is less than 1 percent per year for most utilities.**
- **Water reuse and the use of reclaimed water are widely applied and are increasing.**
- **An important issue in the water technology sector is storm water management. A threat for surface and groundwater quality is the discharge of billions of gallons of untreated sewage each year into surface waters, because of aging wastewater management systems.**
- **Nutrient recovery and removal (e.g., wastewater mining) will be an important topic in the coming years driven by stricter regulations in surface water and drinking water supplies.**
- **The need for disinfection of water and wastewater treatment processes is increasing, driven by industrialization, urbanization and more stringent legislation.**

For Water Management Companies these issues pose a daunting challenge that require more cost-effective assessments (e.g., leak detection, water quality monitoring, prediction models of condition systems, asset management models) and rehabilitation techniques.

State of Monitoring Water Infrastructure

Water Management Companies already have extensive experience with the "things" component of the Industrial Internet of Things (IIoT), given the large number of sensors and other devices already deployed throughout their operations.

Today Water Management Companies use Supervisory Control and Data Acquisition (SCADA) to monitor the status of operations

- **SCADA is 40 year old technology**
- **With the increasing amount of distributed assets, maintaining these complex infrastructures is becoming cost prohibitive and error prone.**

The Water Management Sector is beginning to move towards the convergence of big data, analytics and intelligent systems.

For Water Management Companies this type of transition will challenge the current silos of disparate technologies, from legacy SCADA and asset management, as well as the historian and decision support systems.

Other challenges include telemetry and the difficulty with monitoring plants and assets distributed across large and/or remote areas where fundamental telecommunications infrastructure is extremely limited or in some cases, non-existent.

Current legacy approaches to communications inhibit the advantages associated with real-time analytics. These legacy systems were never built to support high fidelity data streams and analytics.

Due to the remote location of water infrastructure telecommunications systems were developed and deployed based primarily on availability and cost, and not necessarily on driving business outcomes.

Water Management companies need real-time facilities, asset, and infrastructure monitoring to achieve situational awareness, which can be enabled at a much lower cost than most solutions based on SCADA without compromising security.

However, upgrades to operational capabilities using IIoT technologies must complement, not replace, existing SCADA solutions

As IIoT-enabled assets are deployed they must be connected to a robust telecommunications fabric, to enable the massive amounts of data to be available and to give the potential to perform greater analytic analysis and obtain business insights from such data.

Greater automation of asset performance can be achieved as these assets become smarter and control logic is pushed closer to the asset.

Gateways, Remote Terminal Units (RTUs), Smart Devices (sensors, instrumentation, motor drives, meters, etc..) with enabling capability for communication of the status of it function including diagnostic and device health information are critical.

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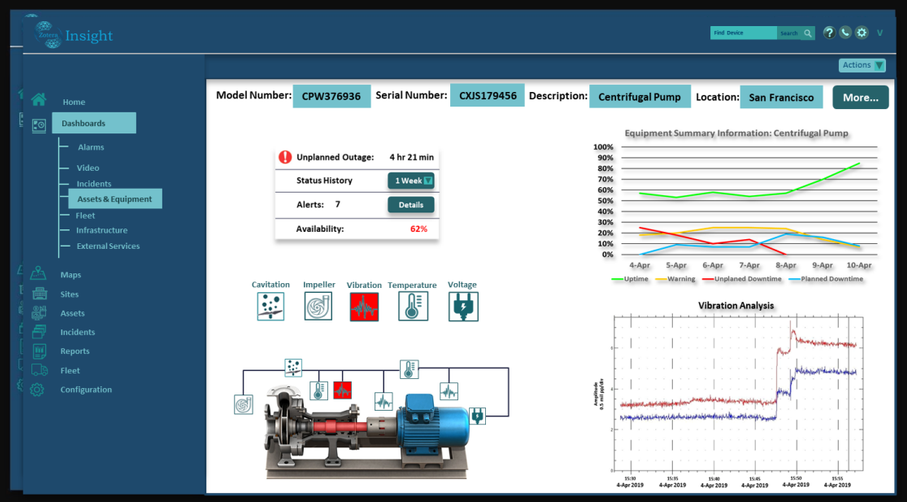

Zotera Radius Gateway™

Zotera Radius Smart RTU™

Zotera Radius Node™

Vortex Flow Meter

Pressure Sensor

Continuous level sensor

Temperature Sensor

iCOMOX Pump Monitor

Water Management Use Case 1: Pump Station Monitoring

Objective:

Early identification of pump failures in order to avoid lost productivity

Value:

- **The water pumping station is used for water and wastewater transportation systems, water conveyance systems that move water from reservoirs and dams to cities and towns, water distribution for agricultural irrigation, and others. Pumps are critically important to these applications and must be kept running safely. Companies must keep up with their equipment to understand maintenance needs and to optimize process efficiency. To meet efficiency requirements these companies need to monitor anomalies with real-time AI-based analytics to determine the time before maintenance is required, and to reduce or eliminate unplanned downtime.**
- **Nearly 20 % of all water pump failures are directly attributed to Cavitation. Cavitation is caused by a sudden and momentary loss of pressure at the water inlet causing air bubbles to form in the vacuum / cavity space where water once occupied the propeller's housing. When pressure is returned to normal, a high spinning propeller will hit the air bubbles, mixed in with the water, at or above supersonic speeds causing minute craters on the surfaces and leading edges of the props. Overtime, this condition causes early prop failures, or reduced performance, leading to very expensive repairs.**

Use Case Implementation Method:

- **To detect cavitation a Zotera SmartRTU, a Zotera Radius Gateway, and Zotera Radius Node will be used to capture, record, and to take action to prevent / minimize the events leading to cavitation. The SmartRTU will perform the Monitoring & Control functions while the Zotera Radius Gateway will perform the real-time analytics and connect to cloud apps via 4G LTE. The Zotera Radius Node will be used to extend the Wireless Sensor Network via Wi-Fi, Ethernet, and Lora WAN.**
- **Sensors to be used: Motor housing temperature sensor, Inlet Pressure sensor, Outlet pressure sensor, Motor mount vibration sensor, Inlet water temperature sensor, Outlet water temperature sensor**
- **A Zotera Smart RTU equipped w/ Predictive monitoring of pump health and Early Warning & Diagnostics of mechanical failures**
- **A Zotera's Radius Gateway equipped w/ Predictive Maintenance Analytics engine**
- **Collect Sensor data and correlate w/ Historian Time-Series data base**
- **Perform deep analytics to produce optimal pump performance profile**
- **Monitor variances in real time to pump profile**
- **Annunciate predictions / alarms**

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Water Management Use Case 2: Predict Leak in a Surface Pipeline

Objective:

Produce a warning / alarm of a possible hazard that may be caused by a water main Leak in a Water Pumping Facility

Value:

As a means of long-distance transport pipelines have to fulfill high demands of safety, reliability and efficiency. Most significant leaks that occur are caused by corrosion, particularly at construction joints, low points where moisture collects, metal fatigue caused by weather condition (expansion during very hot weather and contraction during cold weather), or at locations with imperfections in the pipe. These defects can be identified by inspection tools and corrected before they progress to a leak. Inspections are very costly, require specialized equipment, highly trained but limited number of technicians, and have to be scheduled based on labor availability,

Use Case Implementation Method:

This use case proposes the installation of Zotera nodes devices along a stretch of pipeline. This mesh of node devices will be inter-connected to a Zotera Radius Gateway equipped with pre-defined (trained model) analytics engine. This network of data collection and analysis is comprised of;

A. **Zotera nodes that will connect to sensors as follows:**
   - **Stress gauges along joints to detect expansion / Contracting movements**
   - **Acoustical couplers to detect water flow rates in the pipeline**
   - **Corrosion Detection Sensors equipped to measure Temperature, Humidity, Moisture, and PH**

B. **Zotera Radius Gateway will collect data from the nodes, aggregates the data, performs pre-analysis on the data (for real time alerting) and transmit the data to the Zotera Stratos Cloud-Based analytics engine for deeper analytics. Potential for, or detected as active leaks, can then be modeled as appearing within an analytic region (a geo-fence rule that would be added to the camera) is immediately analyzed for its attributes, including thermal temperature, size, and behavior (e.g. spraying, pooling, spilling). When a leak is determined to be valid based on the set of pre-defined parameters, an alarm notification with leak video is generated and sent to a monitoring station.**

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42% of the world's freshwater is wasted due to leaky irrigation systems

Smart Sensors

Zotera Radius Node™

Zotera Radius Gateway™

Water Management Use Case 3: Agriculture and Irrigation

- **Agriculture is, by far, the biggest user (and waster) of water in the world.**
- **Farmers use 70% of the world's freshwater, but 60% of it is wasted due to leaky irrigation systems, inefficient applications methods and the cultivation of thirsty crops.**
- **It's estimated that as much as 50% of irrigation water is wasted due to evaporation or runoff because most irrigation systems still rely upon simple timers.**

The deployment of sensors and actuators provides farmers with increased visibility over their operation, allowing them to optimize their water usage and minimize waste by assessing a number of metrics including temperature, water pressure and quality.

"Smart" Irrigation Systems

- **monitor soil conditions in real time with low power, wireless sensor networks**
- **Wireless sensor networks report the data to a Zotera gateway, and gateway sends the data central computer.**
- **That data is combined with third party inputs like weather reports from national weather services, letting your system make intelligent decisions about where and when to release water, and in what quantities.**
- **If no rain was predicted the system could decide to release water immediately. But if rain was in the forecast the system could wait, measure the results, and recalculate.**
- **IIoT Provides:**
  - **A Sensor-Based Field And Resource Mapping**
  - **Remote Equipment Monitoring**
  - **Remote Monitoring of Crops & Soil Quality**
  - **Monitor Soil Moisture, Soil Respiration, Soil pH, Soil Salts**
  - **Monitor water levels in storage tanks, Ambient Temperature, Ambient Humidity, and Ambient Moisture levels**
  - **Smart Irrigation**
  - **Determining Custom Fertilizer Profiles Based On Soil Chemistry**
  - **Climate Monitoring And Forecasting**
  - **Predictive Analytics For Crops**
  - **Greenhouse Monitoring And Automation System**