RAJANT

APPLICATION NOTE

More Efficient, Sustainable Water Management with **a Rajant Kinetic Mesh® Network**

As with other utilities, the water utility industry is constantly changing, with some changes posing challenges to service delivery. In the majority of municipalities, aging water infrastructure has reached or exceeded its useful life and requires major modernization to meet current and future needs. In many cases, pipes, pumps, lifts, and valves need to be repaired or replaced. Over time, automated meter reading (AMR) systems, Supervisory Control and Data Acquisition (SCADA) systems, and the communication networks supporting these systems can become slower and less reliable. In more severe cases, critical information may not even get from the source to its destination.

Simultaneously, worldwide population growth and the trend to urbanization are increasing demands on existing water supplies and wastewater treatment facilities. As a result, water departments are pursuing ”smart water” infrastructure, methods, and technologies that will ensure reliable, always-connected information and applications while positioning them to service the growing population.

Regardless of the challenges, your customers expect vital water services to be available all day, every day, without fail. To continue to provide high-quality services, many water utilities are upgrading their systems to enhance overall operational efficiencies. A number of key objectives are driving investments in updated infrastructure and systems while leveraging investments in existing systems.

- Gain **remote control** of pumps, lifts, and valves
- Achieve **real-time** data, analytics, and application access
- **Tighten security** to protect critical, high-risk facilities
- Implement **IoT and smart meters** to improve water management
- Support **more bandwidth** for video surveillance and other applications
- Enhance **customer service**
- Improve employee **health and safety**
- Increase **water conservation**
- **Reduce costs**

Wireless networks are proven in water utilities to be a reliable, flexible, and cost-effective communications platform for improving efficiency and reducing costs. However, by providing connectivity over a web of interconnected wireless nodes, mesh networks can take wireless networking to a higher level of performance and capacity. A wireless mesh can deliver continuous, high-bandwidth communications between stationary and mobile personnel and assets while providing anytime, anywhere access to critical data and applications.

The American Water Works Association estimates that **$1 trillion is necessary** to meet drinking water demands **OVER THE NEXT 25 YEARS.**[1]

With 56 million new users expected by 2032, the EPA estimates that **$271 BILLION** is needed to meet wastewater demands over the next 25 years.[1]

[1] American Society of Civil Engineers, “2017 Infrastructure Report Card.”

Rajant Kinetic® Mesh Networks: Ideal for Today's Mobility-Driven Water Utilities

Rajant private Kinetic Mesh networks offer reliable, intelligent, secure connectivity that thrives in evolving and mobility-driven environments – a "living" mesh network that moves with and adapts to your evolving communication requirements. Our private, wireless mesh networks deliver highly available, agile, and adaptable connectivity that is unmatched by other broadband and mesh offerings.

Using Rajant BreadCrumb® wireless nodes powered by our patented[2] InstaMesh® networking software, Rajant mesh networks employ any-node to any-node connectivity to continuously and instantly direct data using the most-efficient traffic path and frequency.

POWERING THE LIVING NETWORK™
RAJANT KINETIC MESH

A Kinetic Mesh solution thrives in evolving and mobility-driven environments, powering a "living" mesh network that moves with and adapts to your evolving communication requirements.

- **Easy-to-Deploy BreadCrumb Wireless Nodes:** Our industrial-strength, light-weight BreadCrumbs can be deployed quickly on assets such as water towers, elevated storage tanks, vehicles, pump stations, and command centers. BreadCrumbs support Wi-Fi and integrate easily with any Ethernet-connected devices to deliver low-latency, high-throughput data, voice, and video applications across the meshed network. Even where no communication infrastructure exists, you can quickly deploy a self-healing, peer-to-peer wireless mesh network using multiple radio frequencies, including 900 MHz, 2.4 GHz, 4.9 GHz and 5 GHz. Anywhere an ingress/egress point is needed, our Automatic Protocol Tunneling (APT) feature can enable reliable and fast off-loading to a wired Ethernet network.

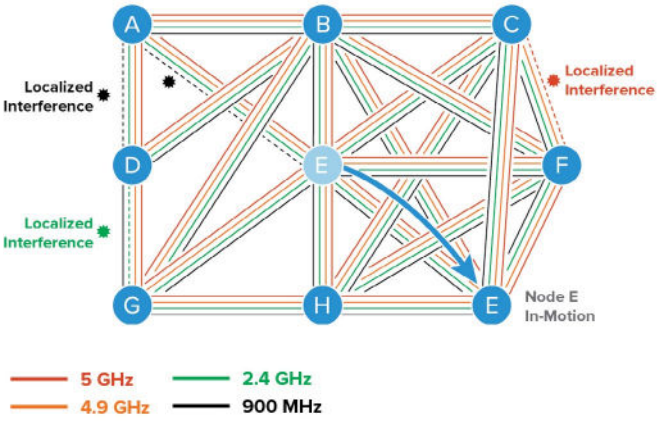


Diagram showing how a Rajant network with LX5 BreadCrumbs adapts to changes caused by the movement of node E while redirecting packets over the best available radio frequencies to mitigate interference.

- **The Groundbreaking Power of InstaMesh:** InstaMesh networking software orchestrates all network traffic and continuously discovers and updates BreadCrumb information with each packet. Because each BreadCrumb can have multiple connections to its neighboring nodes, you have fully redundant connectivity throughout the network. Consequently, there will always be a viable pathway to deliver your information. As nodes are added, moved, or removed, InstaMesh automatically adapts to the changes, establishing new links in real time while keeping the network available, intact, and secure. Any network can scale to hundreds of BreadCrumb nodes providing thousands of possible data delivery paths. The more nodes you add, the more communication pathways you establish, and the more resilient your network becomes.

In the event of interference, the software will dynamically redirect data packets over available frequencies to mitigate interference. For example, if a four-transceiver BreadCrumb network encounters interference on one or two frequencies, InstaMesh will simply redirect packets over the frequencies that are not experiencing interference.

With no central controller, you have no single point of failure to bring the network down. Other networks require a central controller that can become a communications bottleneck and potential point of failure, resulting in network outages as people and assets move from one location to another.

[2] U.S. Patent 8341289B2

Applications: Improving Efficiency and Service

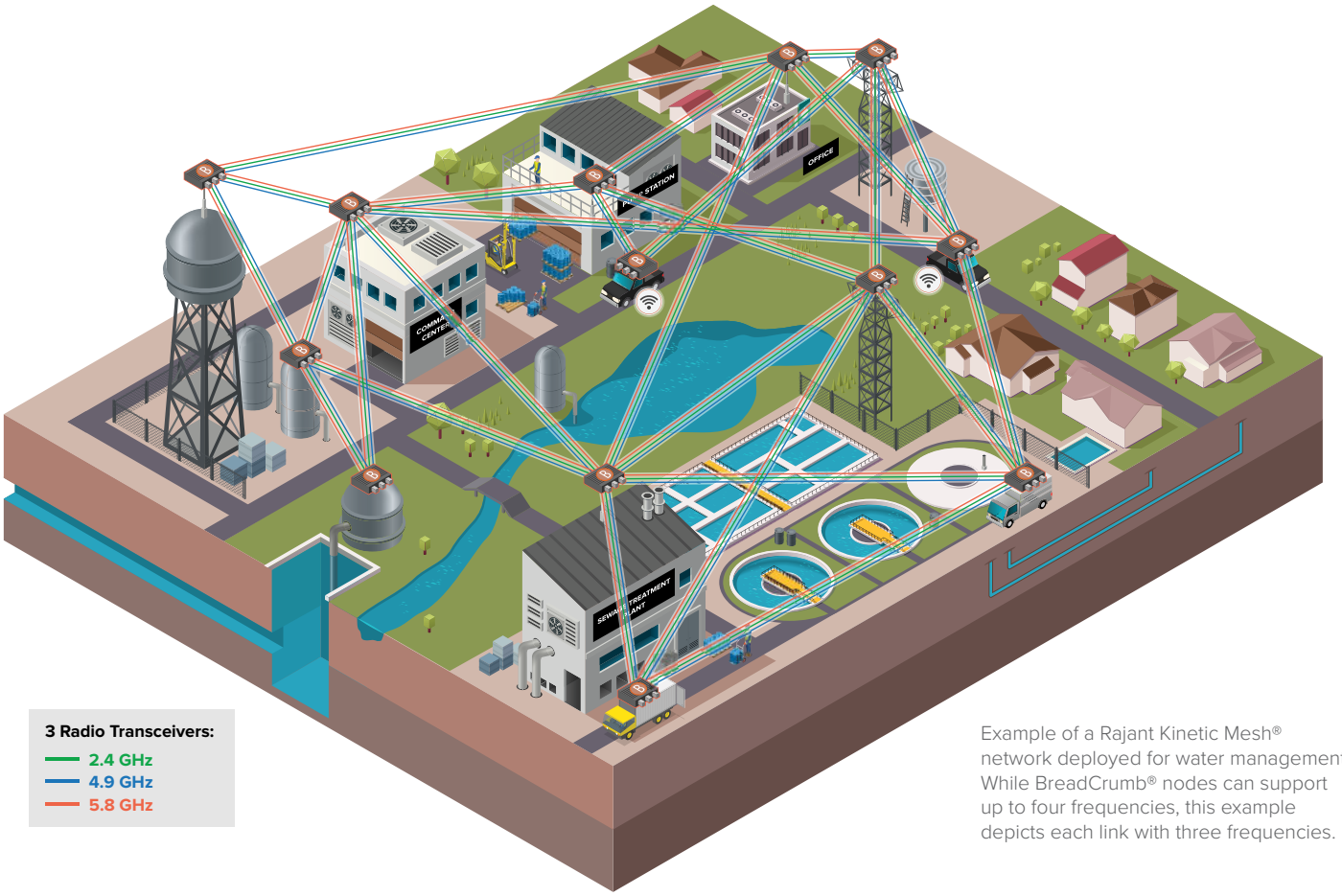
A Rajant wireless mesh network can provide real-time, high-capacity connectivity to support a variety of water utility applications.

- **Command and Control of Pumps and Lifts:** Embedded intelligence, controls, smart meters, and machine-to-machine (M2M) and vehicle-to-vehicle (V2V) connectivity can generate valuable data, voice, and video information over the network. With a Rajant wireless mesh, you can monitor water distribution and wastewater systems to pinpoint problems or prevent leakages. Pumps can be turned on and off to maintain proper water levels in tanks and reservoirs. In many cases, problems can be diagnosed remotely. If a pump isn't functioning properly and cannot be diagnosed remotely, a worker can be dispatched to troubleshoot the problem and communicate the results to the control center. Then a manager can direct the resolution of the problem without leaving the office.

  In the same way, sewage pipes and lifts can be monitored to ensure the appropriate flow of wastewater to the sewage treatment plant. If a pipe becomes plugged, a worker can take remote clean-out machinery into the field and set it up. Then clean-up operations can be controlled from the command center wirelessly. In addition, continuous monitoring of sewage infrastructure can prevent sewage overflow and the resulting environmental complaints.

With an estimated **240,000 water main breaks occurring each year,** it is estimated that leaky, **AGING PIPES ARE WASTING 14 TO 18 PERCENT** of each day's treated water in the U.S.[1]

The Worldbank estimates approximately **26,323 BILLION CUBIC METERS OF WATER** are used **per year worldwide.**



Example of a Rajant Kinetic Mesh® network deployed for water management. While BreadCrumb® nodes can support up to four frequencies, this example depicts each link with three frequencies.

- **Real-Time, Remote Data and Application Access:** Giving in-field workers access to information and applications greatly improves productivity. With BreadCrumbs® deployed on stationary and in-motion equipment and vehicles, workers can retrieve information such as work orders, sensor data, customer history, permits, maps, and pump and lift status. They can access their email and prepare and submit reports using a notebook, tablet, or smart phone.

- **Water Facilities Monitoring and Surveillance:**
  Water utilities are potential targets for malicious attacks, so the U.S. Department of Homeland Security has identified critical or high-risk water facilities as high priorities for monitoring and protection. However, many water department networks cannot implement video surveillance due to bandwidth limitations on their existing systems. With a Rajant mesh, you can have high-capacity connectivity throughout the communications network to support a variety of high-bandwidth applications, including video surveillance, video conferencing, and voice-over-IP. This allows you to monitor critical facilities and comply with security requirements.

- **Data and Network Security:**
  The ever-growing volume of critical data and increasing number of interconnected devices such as cameras, sensors, smart meters, laptops, and smart phones has imposed added pressure to ensure the security and integrity of the communications traffic moving in, out, and across your network. Recognizing how absolutely essential security is, our mesh networks offer military-grade security capabilities, including:

  • Multiple cryptographic options
  • Configurable data and MAC address encryption
  • Configurable per-hop, per-packet authentication
  • Layer 2 and Layer-3 client/server and peer-to-peer security solutions compatibility
  • Harris SecNet 54® encryption compatibility

  Our active security certifications include FIPS 140-2, Level 2, Suite A Classified, and AES Suite B - Secret and Below.

- **Upgrades to Existing SCADA Systems:**
  Many SCADA systems have been in operation for several years and are becoming unreliable with low bandwidth and high latency. In some cases, data packets do not reach the receiving end of a transmission, resulting in lost data. With a reliable, high-capacity, low latency mesh network to support updated or existing SCADA systems, you can improve the reliability and speed of data transmissions. If your municipality wants to standardize on one effective wireless technology, you can also expand your Rajant network to integrate added municipal communications. Our scalability, interoperability with Ethernet-connected systems, and robust security can help you easily and cost-effectively transition to a higher-performing, integrated municipal network.

- **Water Conservation:**
  Droughts, population growth, and increasing water usage make water conservation a high priority for water utilities worldwide. Reducing water leaks is a key component in water conservation. Many water leaks go unnoticed for weeks. Until the customer receives an outrageously high water bill, the leak can continue undetected. Early detection of unusually high water consumption and real-time reporting of pump efficiency and water flow can alert personnel to potential leaks and, in some cases, prevent leaks. A Rajant wireless network combined with smart meters and sensors can relay critical information from the water distribution system, enabling personnel to balance water supply and demand.

- **IoT and Autonomy:**
  Many water departments are implementing IoT devices and/or autonomous equipment and vehicles to more efficiently manage operations, personnel, and assets. Smart meters and sensors are at the heart of these “smart water” networks to report and analyze information such as water quality, usage, and pressure while providing problem alerts of leakages, sewer overflows, or power fluctuations - often operating at the network’s edge. A Rajant network can provide the continuous connectivity needed to transmit vital data, voice, and video, provide insights into customer needs, and help identify opportunities for improved services or new revenue streams. In addition, our networks can support unmanned ground and aerial vehicles (UGVs and UAVs) such as robots and drones used for advanced monitoring and surveillance applications.

- **Access Control Security:**
  For health and safety purposes, a Rajant Kinetic Mesh network can provide the reliable, secure connectivity needed to monitor personnel access throughout your water facilities. This allows command personnel to know who is in a facility at any given time should there be potential danger due to incidents such as fire, terrorism, equipment failures, overflows, or sewage leakages.

- **Customer Service:**
  Providing flawless water services to customers requires continuous monitoring and reporting on water distribution and wastewater systems to identify and rectify problems quickly – before customers do or outages occur. In addition, many water departments are giving customers online access to information such as billing and water usage data. A 24/7 communication network helps you improve customer service, reduce complaints, and cut operating costs.

ROI: Raise Productivity, Cut Costs, Improve Service

For water departments and municipalities, ROI can be realized from a variety of benefits provided by a Rajant mesh network such as:

- Anytime, anywhere communications enable better matching of people skills to functions, ensuring that high-level people are not pulled off strategic tasks to handle in-field tactical issues.
- Giving mobile personnel access to data and applications increases productivity by reducing the amount of time workers spend on non-productive tasks such as driving to and from work sites. The actual value is determined by the number of man-hours saved and the cost-per-worker.
- With video monitoring, security risks can be reduced or eliminated, saving the associated disaster recovery costs and damage to the utility's reputation.
- Cost-effectively and efficiently expanding communications to a highly-productive municipal-wide network ensures consistent reliability, security, and capacity.
- Ultra-reliable, high-bandwidth, secure connectivity supporting your IoT devices and autonomous vehicles and equipment can significantly increase productivity, cut operating costs, and improve safety.
- Leverage your investment in existing systems and infrastructure as you transition smoothly from low-bandwidth, high-latency connectivity to high-bandwidth, low-latency communications.
- Reduce insurance and potential litigation expenses by protecting personnel from potential health problems or injuries via more inclusive access control.

Key Rajant Kinetic Mesh® Features

- Up to 300 Mbps physical-layer data rate
- Multiple radios and frequencies – 900 MHz, 2.4, 4.9, and 5 GHz – for interference mitigation
- Multiple, 2x2 MIMO-enabled antenna ports
- Military-grade security
- Scalable to hundreds of high-bandwidth nodes
- Low latency, typically less than 1 ms
- IP 67 certified[3] for rugged environments
- Fully redundant - no single point of failure
- Nodes can be fixed or mobile, infrastructure or edge
- Self-configuring and self-healing operations
- Wi-Fi access

Summary

Drought, aging infrastructure, population growth, and rapid urbanization are bringing a number of challenges to operations in municipal governments and water utilities. The “Smart Water” movement emphasizes technology utilization to help address these issues. Wireless mesh networking is an important element to support your Smart Water initiatives. It can help you overcome individual challenges and meet customer needs by providing real-time information for effective decision-making and overall operational efficiency.

Rajant Kinetic Mesh networks are unlike any other wireless offering on the market today. So, when choosing the right solution for your municipal and water-department requirements, choose the best – a Rajant Kinetic Mesh network.

According to the United Nations’ World Population Prospects report, the **world population** is currently **growing** by approximately **74 MILLION PEOPLE PER YEAR.**

[3] IP67 certification applies to LX5 models; other models are designed for IP67.

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20+ Years OF GAME-CHANGING WIRELESS

RAJANT