Cambium Networks™

WATER UTILITIES CHOOSE

Fixed Wireless Broadband Communications

"What these water utilities discovered is that there is a vast difference between low-end commercial-grade equipment and purpose-built technology platforms specifically designed for low total cost of ownership."

Kent Brown,
Director of Sales – National and Strategic Accounts,
Cambium Networks

This Application Paper refers to actual field results from two utilities in the southwestern United States:

- A water utility serving a major city trusted with water supply, wastewater collection and treatment, and reuse of water resources serving 1.6 million people
- A river authority conservation and reclamation district that manages water resources for a ten county district

Both of these organizations have deployed wireless broadband connectivity solutions from Cambium Networks. Due to the nature of critical infrastructure security, please contact Cambium Networks for approved customer reference information.

Challenges

Communications technology has a measurable and dramatic effect on the efficiency and cost structure of all phases of water management:

- Water supply and distribution
- Hydro-electric generation
- Water treatment
- Storm water management

Strategic Goals:

Every water utility must maximize efficiency while being vigilant about compliance to water quality and safety standards. The communications infrastructure strategy must support these goals, and utilities must select the most appropriate communications technology to meet their needs. In most cases, fiber may be cost effective at the core or backbone of the network, but fiber or any wired technology can be economically unfeasible to connect a large number of field locations. Fixed wireless is a proven and legitimate solution that provides the reliability and throughput needed at a significant cost advantage.

Once a utility decides to implement a wireless solution, the spectrum strategy must be planned and decided. While licensed spectrum provides protected use of a radio frequency, some parts of the operation may be in locations with little or no interference, and free license-exempt spectrum is readily available. Along with the RF environment, the utility needs to have a clear understanding of the coverage scale and applications required in the network. With this information, a network can be modeled in detail, and a business case can be developed.

There are two key challenges to implementing a communications infrastructure:

1. **Technology challenge:** provide consistently reliable connectivity to support efficient 24/7 operations
2. **Financial challenge:** provide reliable connectivity at a lower total cost of ownership than available alternatives

Applications:

While one set of applications may drive the initial decision to develop a private network, an IP-based network can be leveraged across many applications.

SCADA – the network can enable remote monitoring and control of facilities across the entire field area network. These monitoring functions include but are not limited to:

- Water flow, temperature, and pressure
- Electricity generated
- Alarm conditions and process control (APC)
- Water gate controls
- Valve controls
- Sensors

Security – the network can also provide live streaming video from hundreds of cameras across the field area network to perform:

- Perimeter and facility surveillance
- Verification of water gates' position and operation
- Verification of alarm conditions prior to dispatching technicians
- Analysis of obstructions in water flow conditions
- Safety clearance verification before opening or closing gates

Both of these utilities had chosen wireless broadband years ago because of the attractive return on investment (ROI) compared with leased lines. What they eventually discovered was that while wireless broadband equipment complies with industry protocol standards, communications technology is not a commodity business. There is a vast difference between low-end commercial-grade equipment and purpose-built technology designed for low total cost of ownership (TCO).

Their initial foray into wireless broadband did not achieve the savings projections. While the initial cost of the equipment was dramatically less expensive than leased lines, equipment failures and self-interference caused the network to underperform and required unforeseen maintenance and repair costs.

Wireless Broadband Solutions

At the core of the network, both the water utility and river authority chose high-capacity Point-to-Point (PTP) links. One chose the security of operating in the private 6–38 GHz licensed spectrum, and the other chose to use interference-tolerant systems that optimized performance in the unlicensed 5 GHz spectrum. These PTP links provided a ring architecture at the core and "spokes" that extend connectivity to distant areas in the field area network.

PTP 820 LICENSED MICROWAVE INFRASTRUCTURE	
Frequency	6L, 6H, 7, 8, 11, 13, 15, 18, 23, 26 GHz
Throughput	Up to 1.66 Gbps
Flexible Configuration	All-outdoor, all-indoor, or split-mount options

PTP 650 WIRELESS BACKHAUL INFRASTRUCTURE	
Frequency	4.9 to 6.05 GHz
Throughput	Up to 450 Mbps in a 45 MHz channel
Award-Winning Performance	Highest Capacity in 20 and 40 MHz channel Highest Spectral Efficiency in 20 and 40 MHz channel

Once the connectivity is brought to a distant part of the network, a Point-to-Multipoint (PMP) distribution and access network spreads the connectivity to the individual locations. This can be accomplished using the 3 GHz licensed frequencies, the 2.4 or 5 GHz unlicensed frequencies, or (as is the case with the water utility) the 4.9 GHz public safety band. These connections provide the high throughput and low latency that enable streaming video, voice, and SCADA data to be carried on one IP-based private network.

PMP 450 AND PMP 450I DISTRIBUTION AND ACCESS	
Frequency	2.4, 3.5, 3.65, 4.9–5.9 GHz
Throughput	125 Mbps in a 20 MHz channel
Synchronization	GPS Synchronization

With the increasing number of WiFi devices used by water utility personnel and the WiFi-enabled meters and technology embedded in the network, utilities can also deploy WiFi Access Points (AP) to provide indoor and outdoor connectivity. This ensures that technicians have immediate access to streaming video and information that they need to perform their work efficiently.

*cn*PILOT™ E500 OUTDOOR WIFI ACCESS	
Frequency	Nearly 100 Mbps in a 20 MHz channel
Concurrent Clients	256

*cn*PILOT™ R201P WIFI ROUTER	
Frequency	2.4 and 5 GHz
Throughput	802.11ac access

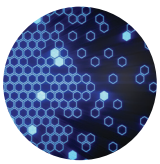
Results

While there are many wireless broadband alternatives, water utilities should be mindful not to view wireless broadband as a commodity. A communications infrastructure touches all components of the business and becomes the core on which mission critical operations depend.

	PREVIOUS WIRELESS SYSTEM	CAMBIUM NETWORKS
Applications	SCADA data	Streaming video Voice SCADA data
Radio Performance	High hardware failure rates Numerous system outages Self-interference	Easy to bring up network Consistent performance
Flexible Configuration	Crowd sourced on Internet blogs	24/7 technical support Consultations with technical experts Online community Crowd sourced on Internet blogs
Technical Support	Removed from network	Extending network Adding IP-based applications

Lessons Learned

Both utilities found wireless broadband equipment that met or exceeded their performance expectations and delivered the projected cost savings. The key factors used in their selection process included:



- **Mean Time Between Failures –** what is the calculated reliability of the equipment, and does field experience bear out this calculation? This is significant because it directly affects network availability and cost of maintenance.
- **Synchronization –** how does the network perform as more equipment is added? Given the development of the Industrial Internet of Things (IIoT) and the ever-increasing demand for bandwidth, it is a fair assumption that connectivity needs will increase. The system should scale to accommodate new IP-based capabilities.
- **Network Planning –** how is the wireless network designed? Connecting a half dozen locations is a simple task, but designing a scalable network over a vast coverage area requires a communications strategy. Does the solution have software tools and expert technical support to understand near-term needs and strategic goals?

- **Network Management –** what tools are available to manage the network? Water utilities are not telecommunications service providers, and for some, it is a significant step to own and operate a private communications network. Tools should provide actionable information, quickly identify degradation and alarm conditions, and make it easy to manage the end-to-end communications hardware and software across the entire network.

- **Support –** what support is there when the network needs hardware or software upgrades or has problems? A water utility is a 24/7 operation that vitally affects large populations. The communications network must function at peak performance at all times.

Water utilities require communications solutions that fully support their mission of providing consistently high-quality services. While operating a private network may be a new endeavor for utilities, just as they do for other technology partners, they should seek out a partner that provides them confidence.

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