

Application Note

Northern California Municipality Sees the Full Reward of Comprehensive Service

Elevate Wireless was contacted by Wonderware California to assist with a new wireless network project for a Northern California municipality. The City was considering various options to connect data from its Wastewater system (lift stations, pumps, etc.) and Freshwater system (storage tanks, etc.) to the SCADA Master station. While radio had been used at certain sites throughout the system, some stations did not have any radio telemetry. End-to-end connectivity was thought to be challenging, due to the rolling terrain and thick vegetation in some locations. Both licensed UHF and unlicensed 900 MHz modems were being considered.

The City's greatest concerns focused on the reliability and design of the network, avoidance and minimization of third party interference and overall cost (including equipment, installation and continued maintenance).

Elevate Wireless was commissioned to perform an onsite radio path study to aid in the consideration, installation and use of a radio network. Following the path study, Elevate Wireless provided a general overview of the network, bill of materials with technology selection recommendations, site profiles, path surveys, radio configuration, antennas specifications, and images depicting terrain.

After acceptance of the proposal, the City commissioned Elevate Wireless in sourcing all recommended radio hardware and accessories, along with onsite commissioning and optimization of the network radios. Elevate Wireless was also available throughout the process for technical support and onsite technical services. This allowed for reliable connectivity and data transmission to the Wonderware SCADA system.

Path Study Scope of Work

The onsite path study consisted of physical radio propagation testing, site inspection, and environmental evaluations. The scope of the onsite tests was to:

- 1) Determine the feasibility of radio communications for the Freshwater and Wastewater systems
- 2) Measure the signal strengths at every site
- 3) Offer a recommendation of the most reliable frequency band to be used
- 4) Offer recommendations about suitable antenna elevations and antenna types
- 5) Plan the system in order to avoid or minimize possible future interference from third parties
- 7) Determine if repeaters would be needed, and if so, where
- 8) Submit a comprehensive report of all measurements and recommendations



Application Note



The City's telemetry network is comprised of two separate and independent networks: Freshwater and Wastewater.

The Freshwater network is comprised of a single master station connecting to four fixed locations: two remote sites and a repeater which extends the network to two additional locations.

The Wastewater network is comprised of a single master station connecting to 15 fixed locations: nine remote sites and two repeaters which extend the network to an additional four locations.

All tests were performed by simulating the final system layout and installation as closely as possible.

In order to provide the highest reliability and a strong immunity against possible interference, a received signal of at least -80dBm was recommended at all stations.

License-Free 900 MHz vs Licensed UHF

The City requested a test with 900 MHz Spread Spectrum equipment as a possible way to make the system immune from local interference. Although it is agreed that the Frequency Hopping technology offers a high degree of immunity from nearby unwanted transmissions, it is also true that it is a widely unregulated band, thus three main issues may disturb the normal performance of a system that utilizes this band:

- 1) Disruptive users who leave continuous transmissions at all times, thus utilizing a considerable portion of the band and leaving statistically fewer portions of the spectrum free for other users.
- 2) Legitimate users who use this band legally but with very large bandwidth, thus "hopping" with very massive sections of band, as opposed to smaller "slices" more commonly utilized for critical data. This type of utilization leaves less spectrum available for other users that are within transmission range.
- 3) In many areas of California "Smart Meter" readings for utility companies are being implemented using the same 902-928MHz band. Although the amount of data is very small and the duty cycle very limited, the number of users can be very high.

In addition to the above issues, it should be noted that the wavelength at 900 MHz is half that of 450MHz, thus the size of obstacles plays a much more significant role than in the UHF band. Spread Spectrum technology is best suited for line-of sight systems, rather than in a hilly, mountainous or forested terrain.

Lastly, the FCC imposes a restriction in the emitted power of all equipment using the 900 MHz License Free Bands. The maximum allowed power in the 902-928 MHz band is 4 Watt ERP. ERP stands for Effective Radiate Power, i.e. the actual power emitted by the antenna, thus including the antenna gain. The UHF band instead allows for higher power, which can prove very useful when sending signals further and deeper into forests, limiting the need for repeaters at stations that are difficult to reach via radio.



Application Note



The on-site survey clearly showed that the hilly terrain of the City's Northern California rural environment prevented the reliable utilization of 900 MHz Spread Spectrum technology. A UHF 450-470 MHz system was determined to provide the most reliable results, with repeaters only required at locations where stations already existed. In the UHF band, every single station reached a signal strength of -80dBm or better.

Not only did UHF allow for a more straightforward, reliable system, but it also proved less expensive, with far fewer repeater sites being required than with 900 MHz. Less stations meant lower hardware costs and installation expenses, along with lower long-term maintenance requirements.

Recommended Radio Modem

Upon completion of testing, Elevate Wireless recommended XetaWave's Xeta4 UHF Ethernet radio for the City's SCADA system. Compared to other options on the market, the Xeta4 radio offers optimal security, improved over the air rates for faster polling and increased reliability. Specifically the advantages include:

- AES256 encryption
- Over-the-air speed modulation of up to 57 Kbps
- High quality construction and reliability
- Advanced Network Diagnostics Software
- Easy and fast programming
- Made in the USA

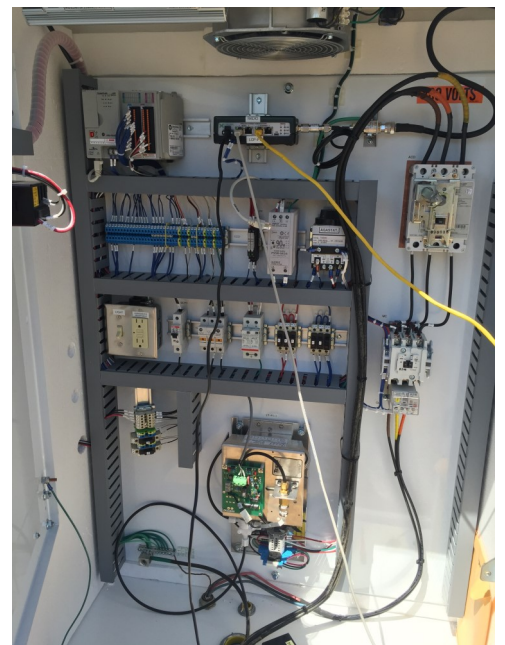
In addition to the radio hardware, Elevate Wireless also provided all supporting accessories, including antenna and radio cables, connectors, antennas, splitters, etc.

Upon completion of our time onsite, we also provided an hour-long demonstration and training on the radio hardware to the Public Works staff. This helped their team have a clear understanding of the equipment, including how to utilize diagnostic tools, troubleshooting tips, etc. By providing this training session, we strive to create a better understanding of the overall network setup, making maintenance easier for all involved.

Onsite Commissioning

After acceptance of Elevate Wireless' proposal and hardware recommendations, Elevate Wireless was commissioned for onsite testing and optimization of the final network installation. The scope of the radio commissioning project included testing and optimizing the following:

- Signal Levels/RSSI
- Settings/Modulation
- Connectivity Test (data transfer over individual links and across repeaters)
- Analysis of link quality
- Visual inspection of antenna installation
- Radio network programming (including IP Address, Subnet and Gateway)



Application Note



At the conclusion of the onsite work, confirmation of end-to-end IP communication to 100% of radio sites was presented in person from the master station. In this live demonstration, data was sent from a test PC to each site sequentially on the Wastewater system and was confirmed as received back. The identical test was completed on the Freshwater system, which was concurrently passing live SCADA data.

The radios were programmed using modulations and packet sizes to give the system a balance of the highest resistance to interference and best possible speed while maintaining a robust, reliable connection. In the event that signal margins fade over time, slower modulations or higher power levels can be utilized to maintain system reliability.

Conclusion

As a result of working with Elevate Wireless, the city was able to establish reliable and robust communications with IP connectivity at every single site in their system. The preliminary services, including onsite feasibility testing and network planning, removed the risk of wasted budget appropriations by ensuring that the radio hardware was guaranteed to work when the city moved forward with their order. This also resulted in a smoother commissioning process and less post-install troubleshooting on this very important part of the overall SCADA improvements project. Thanks to the detailed reports and planning, our team at Elevate Wireless will be able to pick up where we left off if additional sites are added in the future.

For additional information on how we can help you with your communications challenges, please call us at 408-642-5458 or email info@elevatewireless.com.



About Wonderware California

Wonderware California is the exclusive sales, support, and training organization in California for Wonderware—the world market leader in real-time operations management software. Since 1990, Wonderware California has been helping customers across many industries to architect and maintain Wonderware based systems and to utilize and grow those systems to address the varied needs that exist in their industrial operations. Additionally, Wonderware California can draw upon thousands of integration partners to help you implement your Wonderware project.