

Case Study: Water/Wastewater Modernization Without Compromise: Wastewater SCADA System Upgrade

Sussex County, Delaware
Jim Ralston, DATA-LINC Group

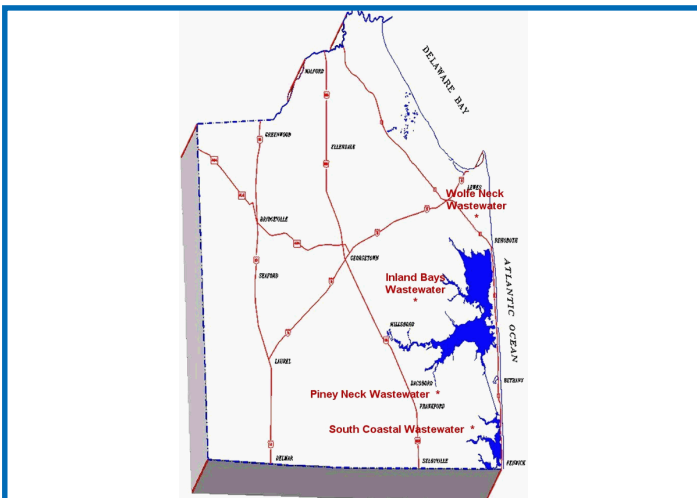
The evolution of Sussex County's water/wastewater SCADA system from a Motorola Infrac™ VHF communication network to a wireless Ethernet configuration is an ongoing project of significant modernization. An upgrade of the system was needed to modernize the pump station hardware and improve SCADA communications because the system was expanding so rapidly.

The total number of pump stations currently being monitored is 250. This is accomplished through a combination of T1 circuits, wireless Ethernet modems and VHF serial modems. The new SCADA system architecture has improved efficiency and easily accommodates expansion.

The Dilemma

Sussex County is one of only three counties in Delaware.

As a result it is quite a substantial landmass of nearly 1,000 square miles. The following map shows the amount of area being covered.



Sussex County covers an area of nearly 1,000 square miles.

Steve Hudson, Director of Maintenance for the Sussex County Engineering Department, was a proponent for the implementation of an Ethernet backbone.

“When the initiative began, Sussex was using a Motorola Infrac™ system for pump station and treatment plant alarming. This system was alarms only, no control. The 150 remote pump sites Sussex was operating at the time overwhelmed the Infrac™ equipment,” according to Mr. Hudson.

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At this point Mr. Hudson concluded that it was time to move into a full-blown SCADA architecture. Sussex County then hired the Engineering firm of Whitman, Requardt and Associates, LLP to assist in finding a solution. Sussex

County looked into microprocessor based and proprietary systems but decided that wireless Ethernet radios coupled with Modicon™ technology was the appropriate combination. The spread spectrum technology would permit wireless Ethernet transmission to most pump stations. For locations with limited line-of-sight, they would continue to use the existing VHF serial radios.

United Electric and Trijay Systems Inc. helped to integrate the Modicon™ technology that would facilitate wireless Ethernet connectivity. It was a tough decision bringing in a non-licensed frequency where interference from other systems could be a problem, but Sussex County felt that license-free technologies offered performance advantages.

The Advantages of Ethernet PLCs

After considering several PLC architectures, the advantages of Ethernet became clear. Ethernet communications would support much faster data rates for dramatically improved scan times, real time diagnostics and online PLC programming. Additionally, the open architecture would allow flexible system configurations, and be compatible with wireless and high-speed leased line telephone services. By installing Ethernet PLCs at every site, an Ethernet wide area network (WAN) would be created.

The Approach To System Integration

Trijay Systems, Inc., an instrumentation systems integrator, began working with Sussex County in 1998 converting the Motorola Intrac™ VHF system. Trijay handled the PLC programming, HMI development and communications design. The original contract was to adapt the Intrac™ system before it experienced anticipated problems with the approach of Y2K. The first phase integrated Modicon™ PLCs with a VHF system on the 154 MHz band, good for long distances although a major caveat was the very slow data transfer rate. Sussex County also took into consideration that this type of radio system could run into bandwidth problems and the licensing was expensive. They brought over 20 of the existing 150 stations into this architecture.

Phase II began to introduce spread spectrum technology. Data Linc-Group was contacted and subsequently gave a demonstration showing how wireless Ethernet technology could enhance the system architecture. Sussex County realized that wireless Ethernet radios would enable them to run system diagnostics and human machine interface (HMI) access from any location.

Wireless Ethernet Technology for SCADA

The wireless system needed to be fast enough to support Ethernet packets, while facilitating long-range communications to the remote pump stations in a point-to-multipoint topology. Additionally, the modems needed to be very

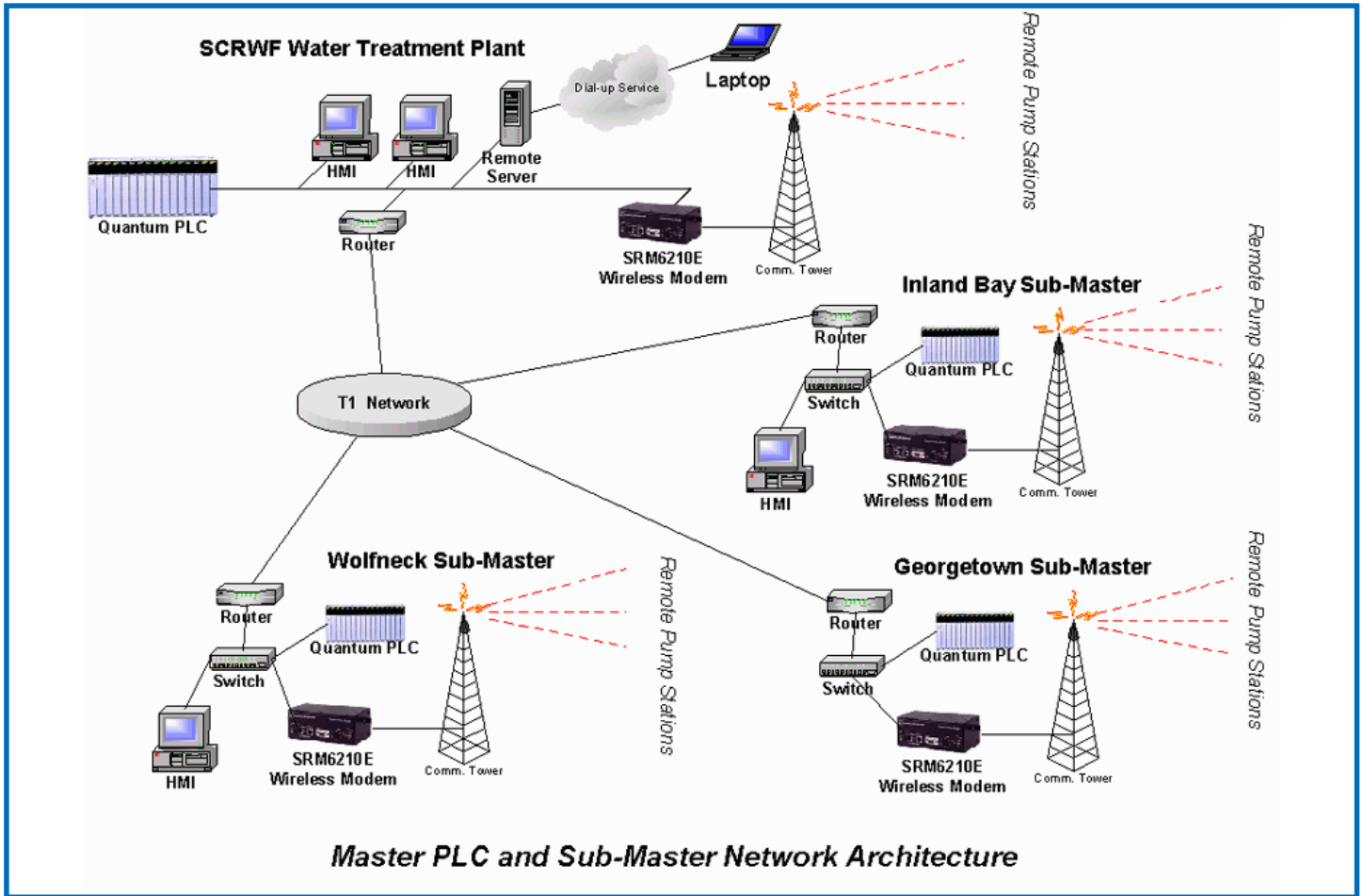
reliable, secure, immune to interference and operate in extreme temperatures. Ken Radley of Trijay Systems proposed to use frequency hopping, 902-928 MHz wireless Ethernet modems with high receiver sensitivity to meet project requirements. This technology supports data throughput rates of 100 Kbps, substantially higher than the 1200 bps VHF system. Currently there are 121 Data-Linc SRM6210E wireless Ethernet modems in operation. The polling rate is 15 to 20 times faster than a VHF radio.

Trijay and United Electric worked with Sussex County to ascertain potential problems with the terrain that might interfere with line-of-sight (LOS), a critical requirement for effective spread spectrum communication. Sites in wooded areas particularly were a challenge due to RF attenuation through the foliage. Sussex County is mostly flat so the majority of the remotes were along the waterway or in housing developments that did not interfere with LOS. Trijay determined how to configure the wireless radios for store-and-forward operation in areas with

terrain problems. The solution was to redirect one wireless radio to another identical unit about 100 yards away and use it as a repeater. In order to test an area, a wireless radio was set up and contact was made with the tower. This would determine whether or not problems with the LOS might occur.

Data Linc-Group gave a demonstration showing how wireless Ethernet technology could enhance the system architecture and enable them to run system diagnostics and human machine interface (HMI) access from any location.

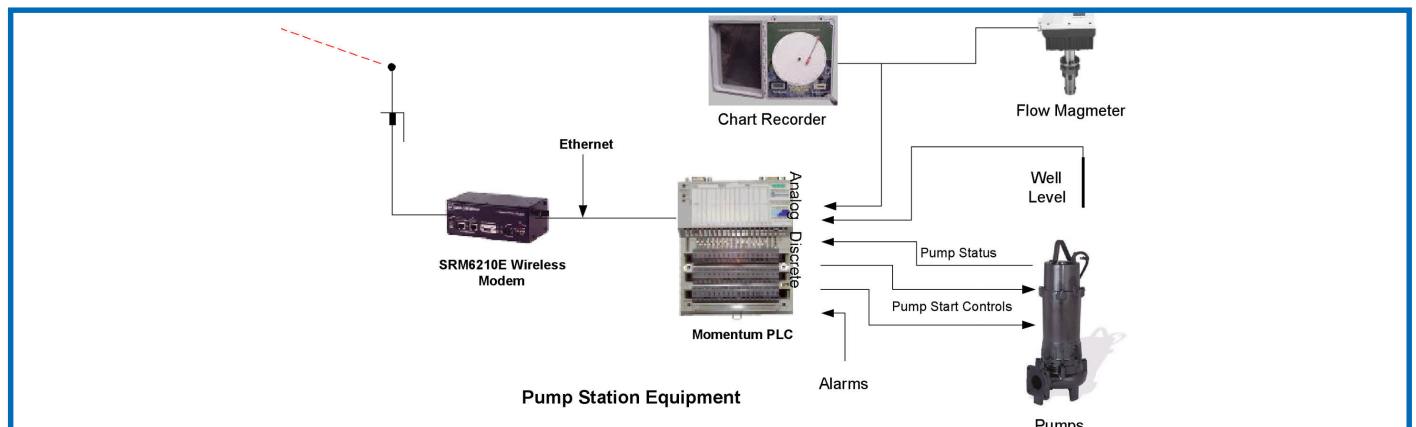
Sussex County was divided into four areas that had large water processing plants to install a system and erect towers that enabled the chosen sites to poll concurrently from the remotes: Wolfe Neck (70 remotes), South Coastal Regional Water Facility (SCRWF, 100 remotes), Georgetown (20 remotes) and Inland Bay (100 remotes). SCRWF was designated as the backbone master PLC that retrieves information from the three sub-master PLCs. A high-speed T1 line connects the sub-masters to the treatment plant network. The four main towers and their remotes were installed one site at a time. The diagram below represents the architecture of the master PLC and the three sub-masters.



Remote access is used to connect to the SCRWF plant, which feeds information from all the major sites. The software permits authorized technicians and plant managers to dial in from any location and have full network access.

The typical pump station has 3 analog inputs, 16 digital inputs and 8 digital outputs. Two pumps generally alter-

nate control. The analog inputs are used for monitoring the level of the wet well and the flow back to the plant. The digital inputs are used for the status of the equipment, alarm condition, and whether the pump is running or not. The digital outputs are used during storm conditions to disable pumps or start them if necessary. They can also be used to enable local manual control. The diagram below reflects the equipment for the pump stations.

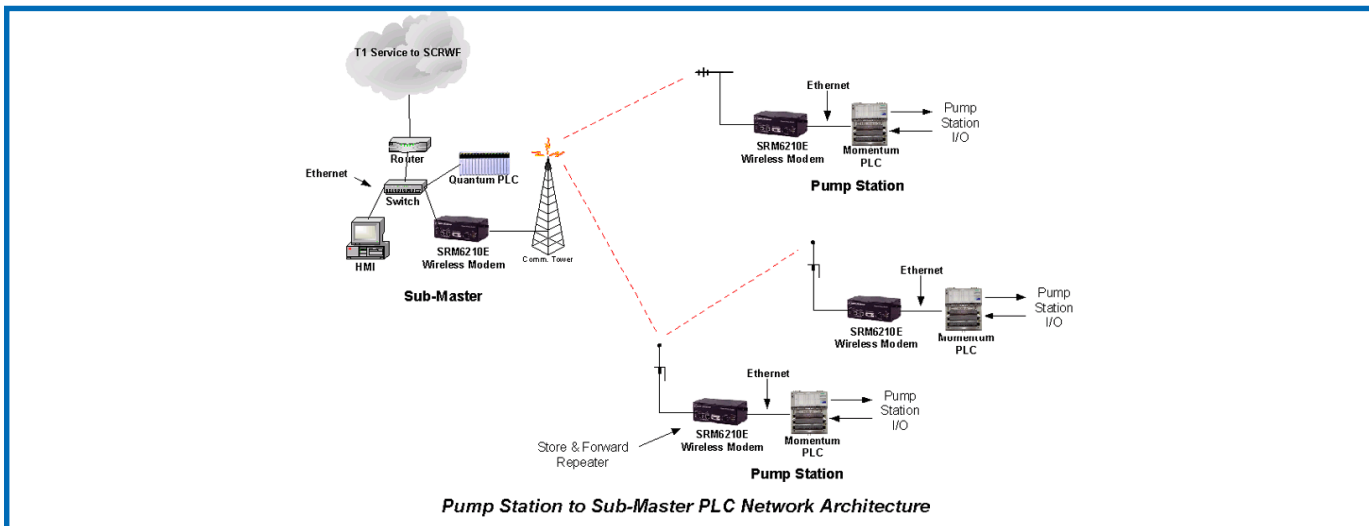


The radios are housed in locked freestanding NEMA-4 type enclosures. These enclosures sit above the well. 12 inch, 3dB gain, omni-directional antennas are an average of 15 feet above ground. 6dB gain, YAGI directional antennas are used at a few locations where there are foliage obstructions such as trees. All of the four main plants have 9dB gain, omni antennas attached. Wolfe Neck has an antenna 100 feet above the plant, Inland Bay 320 feet, Georgetown 180 feet, and SCRWF 250 feet.

The main plant, SCRWF, monitors all of the information from the other three sub-master sites and is the only one of the four main plants that allows remote access to all of the sites. ProWORX NxT™ is the PLC programming software that provides remote PLC program viewing, program changes and system troubleshooting over the wireless network.

At each main tower there is one Modicon Quantum™ PLC. SCRWF has two HMI stations and each of the three other plants have one HMI station that run through a router at Georgetown. Each pump station has a Modicon Momentum™ PLC. The scan times for a master PLC to read and write to station is about 2 seconds. VHF takes about 30 or 40 seconds a station. The illustration below represents an overview of the pump station to sub-master PLC network architecture.

Sussex County is planning to add five new remotes in the next several months. The expansion will continue into the future utilizing their upgraded SCADA system architecture. Steve Hudson is very pleased with the system, as it has met all of Sussex County's expectations for performance and reliability.



About Trijay Systems

TRIJAY Systems, Inc. is an independent systems integrator specializing in the furnishing of process control systems which encompass industrial instrumentation, PLC packages, and PC based control room architectures. UL listed control panel requirements are filled through in-house manufacturing capabilities and field services cover installation, start-up training, and extended maintenance. PLC and computer services cover all recognized brands and include extended warranties on both hardware and software products.

Support services for third party instrument manufacturer products allows for the furnishing of such systems without compromising performance. With a reputation proven by twenty years of on-time and on-budget contract completions, TRIJAY serves primarily the eastern seaboard of the United States. Targeted industries are mainly environ-

mental and pollution control in nature and they are served either directly or through prime contractors.

For more information, visit www.trijay.com or call (215) 997-5833.

About United Electric Supply

United Electric Supply is a nationally recognized full line electrical distributor generating \$130 million in sales from 10 mid-Atlantic locations. The Municipal Applications Group at United focuses on providing comprehensive power distribution, control, telemetry, data acquisition, and reporting solutions for municipal water and wastewater applications. United Electric Supply partners with municipalities, system integrators, and engineering firms to facilitate successful design, implementation, and maintenance of integrated systems founded on best in class products from a variety of manufacturers.

For more information, visit www.unitedelectric.com or call 302-324-3246.

About Data-Linc Group

Data-Linc Group modems are designed for highly reliable performance in challenging industrial environments. Data-Linc's communication solutions include license-free wireless Ethernet and serial radio, leased line, dial-up, dedicated wire, power line and fiber optic modems. Data-Linc has over 14 years industrial communications experience and provides no-charge consultation assistance during project design. Data-Linc products are backed by expert technical support with hands-on knowledge of most major PLC and automation equipment.