

**Wireless Application Stories**



**January 2015**

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# Radioline





## Application Awareness Program

OIL AND GAS

### System Integrator controls pad sites wirelessly

- **Industry:** Oil and Gas
- **Products implemented:** Radioline 900 MHz
- **Total size of project:** \$35,000

#### Customer profile

An Oil and Gas System integrator in Texas does oil pad site installations in the Eagle Ford shale region. Each oil pad site has a combination of oil pumps, water tanks, flare stacks and scrubbers that need to be monitored and controlled from one central location.

#### Challenge

All the instruments in an oil field need to be constantly monitored and controlled. Typically, they wire all the instruments to a local PLC and then use cellular communication to send that information back. The time it takes to trench all the signal wire and the labor costs of doing the installation have continued to rise and they were looking for a better, more efficient way to do this. Not only did they need to monitor all these devices, in the event of an emergency, they need to be able to shut down everything on the site to prevent any accidents or explosions.

#### Solution

Using the Radioline product, they were able to get rid of the wiring from the different instruments to the PLC and instead send that information wireless back to one central location. They were able to network multiple pad sites to one master due to the ability of Radioline to have up 98 remote devices connected to it in an IO to Modbus application. The PLC could then monitor the instruments, and in the case of an emergency, send one signal to shut down any one instrument or a whole pad site. Doing these installations wireless allowed the integrator to decrease install time and labor costs when implementing a new pad site.





## Application Awareness Program

### Wireless eliminates manual monitoring and reduces costs

A glass manufacturer chose Phoenix Contact's Radioline wireless platform to eliminate the time-consuming and expensive cost of monitoring a remote maintenance building a quarter mile away.

- **Industry:** Glass manufacturing
- **Products implemented:** Radioline wireless modules and related accessories, UNO power supplies, TRABTECH surge protection,
- **Total size of project:** Less than \$100,000
- **Phoenix Contact product content:** Less than \$5,000

#### Customer profile

A major glass company manufactures window glass.

#### Challenge

The customer needed to monitor the status of some I/O in a remote maintenance building over a quarter mile away. In the past, they would send someone to check the status every four hours. This was very inefficient. They looked at running control wires to the other building, but that was going to be cost-prohibitive.

#### Solution

To improve the reliability of its monitoring without the cost of running wires, the customer chose Phoenix Contact's Radioline wireless modules as an alternative for wired communications.

Radioline was easy and cost-effective to install. Since the initial installation, the customer has also expressed an interest in using these wireless modules inside their plant for other applications where running conduit is cost-prohibitive.

#### Benefits

- Reduced installation time
- Reduced hardware/software costs
- Minimized downtime
- Reduced maintenance costs
- Increased profitability





## Radioline controls emergency lighting system

A major utility needed a cost-effective and accurate way to control an emergency traffic light system near a natural gas extraction plant.

- **Industry:** Transportation
- **Products implemented:** Radioline wireless modules, power supplies & UPS, PCB terminal blocks and connectors, TRABTECH surge protection
- **Total size of project:** \$100,000
- **Phoenix Contact product content:** \$5,000 to \$25,000



### Customer profile

A major utility manages a natural gas extraction plant.

### Challenge

The customer needed better control of a traffic light system on a public roadway. In the event of an emergency at the natural gas extraction plant, the lights stop all traffic from entering the valley where the plant is located. Lights are not located at intersections, but simply over the roadway. They are typically located one to two miles from the plant, in mountainous terrain.

### Solution

Phoenix Contact's Radioline system wirelessly connects the plant safety system to the traffic signals around the plant. Radioline allows the serial-based safety controller to communicate with discrete I/O points at each traffic signal via Modbus communication. If an emergency occurs at the plant, signal is sent from the PLC to the traffic signal to turn the light red.

Many of the Phoenix Contact products, including Radioline, have Class I, Division 2 approvals, which was important for the natural gas industry. The customer also liked that Radioline is compatible with Modbus, which meant they did not need a PLC at each light, saving money. Couple that with Radioline's easy installation, and the customer saw an immediate cost savings versus local control.

### Benefits

- Fast installation time
- Lower hardware/software costs



## Application Awareness Program

AUTOMOTIVE

### Automotive supplier eliminates cabling costs with Radioline wireless I/O system

- **Industry:** Automotive
- **Products implemented:** Radioline 2400 with I/O (current); in future, will add power supplies, terminal blocks and cabinet components
- **Total size of project:** Less than \$100,000
- **Phoenix Contact product content:** \$5-10,000 with potential for \$25,000

#### Customer profile

An Automotive customer in Virginia manufactures automatic transmission components, such as friction disks, mating plates and assemblies.

#### Challenge

Customer needed to expand its environmental monitoring system.

#### Solution

By using Phoenix Contact's Radioline system the customer saved a large percentage of cost compared to using conventional signal wiring and conduit. This is especially realized on long distance and hard-to-reach applications. The installation was fast and straight forward. Future expansion will be simple with the addition of modules, which will make additions and modifications quick, minimizing downtime.

The customer's local integrator is currently building a panel to control the system, which will include not just the Radioline, but also Phoenix Contact power supplies, terminal blocks and cabinet components. The customer is also looking at mGuard for NAT routing needs and other potential wireless applications.

#### Benefits

- Fast installation time
- Lower hardware/software costs
- Improved cabinet real estate
- Minimized downtime



## Water District uses wireless system to automate water system

- **Industry:** Water/Wastewater
- **Products implemented:** Radioline 900 MHz, mGuard, switches, terminal blocks and relays
- **Phoenix Contact product content:** \$40,000

### Customer profile

A Water district in Texas which handles the water and wastewater operations for a county and a golf course

### Challenge

The county was looking for a way to automate the monitoring and control of lift stations, pumps and water tanks across the county. Currently they had a manual process of an employee driving around to each of their 26 locations to read levels, check alarms and turn on and off pumps creating a lot of man hours and costing the county a lot of labor.

### Solution

The county used the 900 MHz Radioline product to network the 26 sites wirelessly allowing them to read back levels from each of the 26 sites automatically, and turn on and off pumps based on the readings they were getting. Using the mGuard at the host location allowed a secure connection via a VPN connection over the internet so the system could be accessed even if the employee was not physically at the main cabinet. This solution significantly cut down on labor costs and allows the personnel resources to be used on other projects.



Customer case study

## Water | Wastewater

# Water utilities integrator simplifies inventory, eases implementation, and increases uptime with Radioline

### Summary

- A system integrator wanted to simplify the wireless SCADA system for one of its wastewater customers
- Phoenix Contact's Radioline was easy to install in the necessary configurations
- Additionally, by installing the proper power supplies and surge protection, HTM increased uptime for its customer

### Customer Profile

HTM Sales in Omaha, Nebraska, implements SCADA systems to interconnect pumping stations.

### Challenge: Multiple antennas and complicated installation

Initially, HTM used Phoenix Contact wireless module pairs that required multiple antennas at the SCADA location. Due to the configuration of these radio pairs, sometimes it was necessary to install more than one system. This required multiple antennas in one small location. Their second iteration used Phoenix Contact multipoint-to-point radios that eliminated the need to have multiple antennas at the SCADA location, but were complicated by the use of hop-keys. HTM wanted to find a simpler solution.

### Solution: Easy wireless platform

For an installation in McCook, Nebraska, HTM implemented a solution using Phoenix Contact power supplies, surge protection, and Radioline modules.



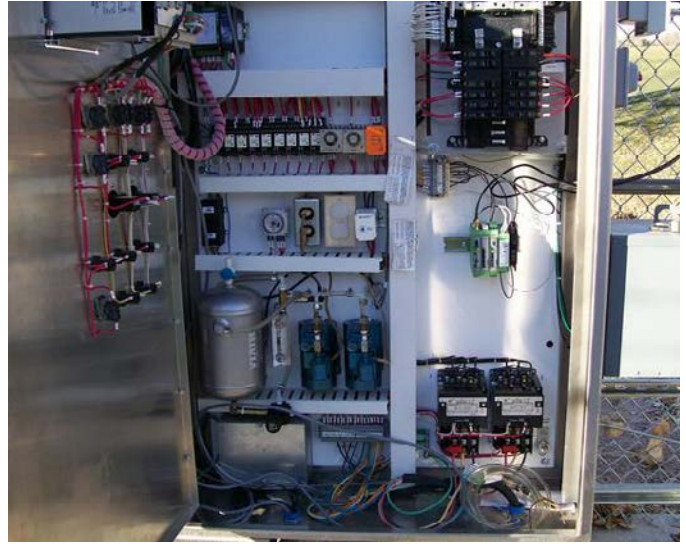
Unlike the previous wireless modules, Radioline required only one antenna at each site.

### Results: Increased uptime and simplified inventory

The Type 3 surge protection for power supplies and proper coax surge protection for antennas increased uptime. By properly protecting their system, HTM stopped losing wireless modules to transient strikes, and additionally benefited from the associated five-year comprehensive warranty.

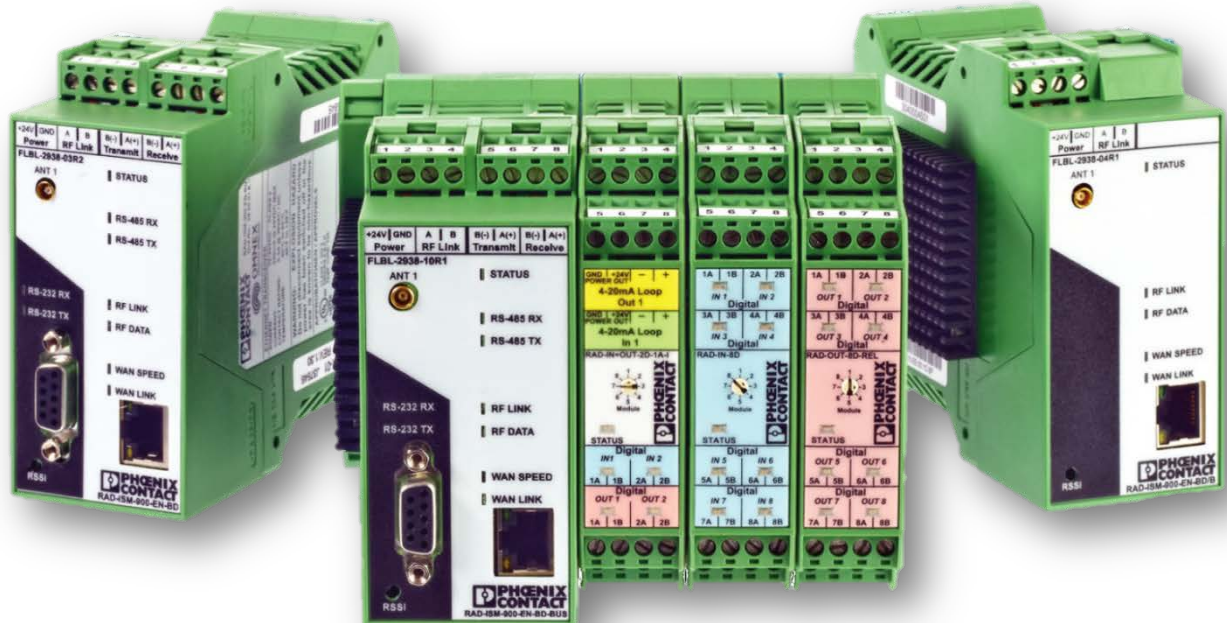
Inventory was simplified two ways. First, HTM no longer has to keep track of the hop-keys necessary for the programming of each site/wireless module. Secondly, Radioline can function as a master, slave, or repeater, so they avoid the need to stock additional modules.

Implementation was also simplified in two ways. First, Radioline had the ability to download the network settings to all spokes from the master. Second, Radioline could communicate point-to-point and point-to-multipoint, as opposed to having two different parts — one for point-to-point and one for multipoint-to-point.



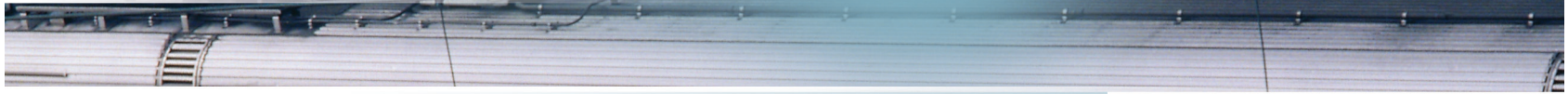
**Radioline can act as a master, slave, or repeater, so it cuts down on the inventory costs. Also, by properly protecting their system from surges, HTM stopped losing wireless modules to transient strikes and benefits from the five-year warranty.**

# TWE



Customer Case Study

## Transportation Infrastructure



# NYC Transit reduces power costs by automating third rail heating system



### Summary

- The New York City Transit Authority wanted to reduce their energy cost for the snow-melt heating on its electric rail transit system when there are no ice and snow.
- The clients worked with Phoenix Contact and Transdyn, Inc. to design a wireless communication network system that would monitor and control the heat traces remotely.
- Thanks to Phoenix Contact's extensive line of industrial radios, Global System for Mobile Communications (GSM)/General packet radio service (GPRS) modems, programmable logic controllers (PLCs), power supplies, transducers, surge protection and more, the authority has already significantly reduced its daily power costs.

### Customer Profile

The NYC Transit Authority, one of the largest rail transit systems in the world, operates a rail-line with more than 860 miles of track. On the above-grade sections, snow and ice prevent trains from running on schedule and at times, cause system shut-down.

### Challenge

The "third rail" of a railroad is the electrified rail that supplies power to the trains. The third rail lies outside or between the subway tracks. A wheel, brush or sliding shoe carries the power from the rail to the train's electric motor.

This client's subway system distributes 625 V DC (nominal power) and up to 4,000 amps to the third rail. The system uses a network of AC/DC rectifiers, power sub-stations and high-voltage cables to supply DC power to the third rail throughout the system.

During the winter, snow and ice can build up on the third rail, interrupting service. To keep snow and ice off the third rail, the

authority uses heat-trace buss along the entire above-grade rail line. Traditionally, these heaters were manually turned on in October and ran continuously through April, even if there was no snow on the tracks. This consumed a huge amount of power. To save energy and reduce costs, the transit authority wanted a reliable way to remotely control and monitor these heat traces during weather event days.

### Solution

Phoenix Contact and Transdyn, Inc., worked in partnership on detailed a design, and Phoenix Contact supported Transdyn during the installation process. The resulting wireless supervisory control and data acquisition (SCADA) network system allows the Transit Authority to remotely monitor and control the all the end points.

Running on Transdyn's DYNAC® Enterprise software suite, the redundant energy management system will prevent ice and snow from bonding on the DC power rail of certain track segments during inclement weather.

Selected Phoenix Contact ILC programmable logic controllers (PLCs) at each end-point location monitor rail heater status and control relays that energize heater segments. The ILC products are compact controllers with advanced control capability. The ILC family comes with optional SD Card and is compatible with Modbus TCP protocol, which this network communicates with. Heat-trace power distribution fused tap boxes are located along the entire length of above-grade track. These 600 V DC "shoe boxes" (a fuse disconnect box) also distribute power to the network control points. The new automated system links wireless control points around the system to rail heaters system-wide.

**The solution included three different types of panels:**

1. Master repeater boxes
2. Slave control point radio boxes
3. Slave DC high-voltage power relay boxes

The “master repeater boxes” are mounted in the traction power substation buildings. They serve as the primary link between the system’s SCADA master and a network of “slaves” – control point nodes throughout the network. Each slave-node collects data and holds this data for SCADA commands via 900 MHz Ethernet radios.

The slave-control points consist of two NEMA 4x enclosures: a control-point radio box and high-voltage relay boxes. The radio box holds low-voltage radios and I/O. The HV box holds relays, power supplies and all power wiring. For further reliability, the boxes also include Phoenix Contact’s VAL-MS surge protection. In partnership with Transdyn, Phoenix Contact configured the radio network. A “cell cluster” has between 20 and 30 end-point slaves. Each slave-node control point consists of a radio box and a high-voltage relay box, as well as a third relay box where needed. A slave-node monitors, controls and switches the third rail heaters.

GSM/GPRS modems are installed at strategic locations that require a long-distance backhaul link to the SCADA master. The modem’s connection to the main station’s master controller is routed through a VPN, keeping all data secure to the master controller. This connection can be used for collecting site data, turning rail heaters on/off and performing program changes on local master PLCs. As a redundant connection to each of the mater cell repeaters and tied to the local ILC PLC. A text message option is available to alarm network conditions.

Most of the time the control system will be manned, and there will be time when it will run automatically. They can also be manually switched in the field.

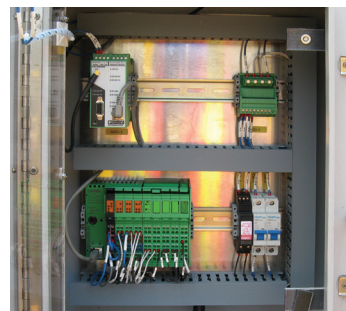
**Result**

To date, 276 control point nodes (321 heat traces) are automated. The current installation NYCT is already saving \$3,500 per day in power costs. Because of a collaborative partnership and effort by all parties, when this wireless SCADA system is fully implemented, the total power savings will exceed more than \$1.5 million annually.



**The New York City Transit Authority operates a rail-line with more than 860 miles of track.**

**The “shoe box” power distribution boxes located on the third rail track provide electricity to heat the third rail during inclement weather. The automated heating system includes two NEMA 4X at each slave control point node: one for the high-voltage power equipment and one for the radio and other low-voltage control equipment.**



**The Ethernet radios in the lower-power box communicate the data from the ILC 150 back to the SCADA data master. VAL-MS surge protective devices increase the reliability of the communication.**

Customer Application Story

## Irrigation and Fertilization

# Keeping the greens green: Wireless technology links irrigation/fertilization system at golf course



### Summary

- A golf course located in the desert needed a more reliable automated irrigation/fertilization system to keep the course in top condition
- By installing Phoenix Contact RAD-ISM-900-EN... radios, Cloudburst Engineering improved the reliability of the water and fertilizing pumps without interrupting golfers during rounds of play
- The new system reduced maintenance costs and improved course conditions



The automated pump irrigation/fertilization system keeps the course in championship condition, despite the dry desert conditions.

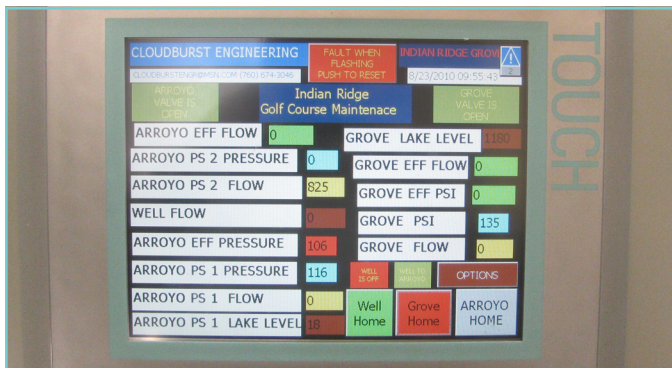
### Customer Profile

Cloudburst Engineering in Palm Desert, Ca., is an engineering firm specializing in pump repair, irrigation, and system control. One of Cloudburst's customers is Indian Ridge Country Club, an exclusive gated community with two championship golf courses designed by Arnold Palmer. They also service several other high-profile golf courses in and around Palm Springs.

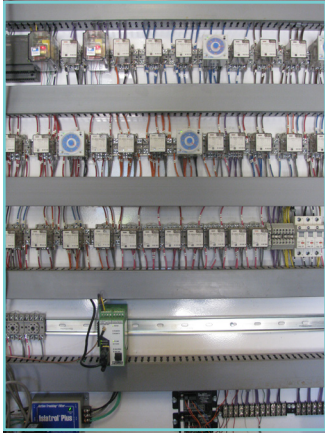
### Challenge

Palm Desert boasts 350 days of sunshine and just 3.38 inches of rainfall per year. These dry conditions practically guarantee a sunny day for golfers, but they make it difficult to maintain a healthy course. To ensure the championship-caliber conditions that members expect, Indian Ridge needed a dependable fertilization and irrigation system.

The club already had an automated system consisting of PLCs interfacing to remote pump sites via another company's radio solution. However, the radios were unreliable due to local interference. The golf course was suffering due to inconsistent watering and fertilization. The club needed a new system, but did not want to interrupt play to dig trenches for wiring.



The HMI at the control station makes it easy to monitor irrigation and instrumentation status in one convenient location.



The master radio at the control center communicates data from each of the slaves to the system's PLC.

bus slave radios with I/O, each located at a remote pump station on the course. Using the Modbus protocol, each slave radio reports data back to the central control building. Here, the master radio communicates the Modbus data with a Siemens PLC and HMI with a web browser.

The system's primary function is to monitor the water levels at the ponds around the golf course and to turn on and off pumps to maintain a specific water level. The system also monitors timed irrigation and instrumentation status, relaying the information back to the central HMI.

In addition to the RAD-ISM-900-EN..., the system also included Phoenix Contact analog I/O modules, MINI power supplies, lighting and surge protection and antennas in the design.

Cloudburst Engineering evaluated several other radios, but cited Phoenix Contact's service and product reliability as key points in their decision.

An engineer from Cloudburst stated, "This was our first chance to use Phoenix Contact radios, so we experienced a small learning curve. We received great technical support from both our local distributor and from Phoenix Contact personnel. Since the first installation, we have installed Phoenix Contact in other projects, and we've needed less follow-up and support calls on our subsequent projects."

## Solution

Cloudburst Engineering worked with Phoenix Contact and Steven Engineering, a Phoenix Contact distributor. Together, they designed a system that used Phoenix Contact radios at six locations to control irrigation, fertilization and water feature control around the course.

The system consists of one master and five Phoenix Contact RAD-ISM-900-EN...



Five remote pump stations maintain specific water levels at various sites around the course.

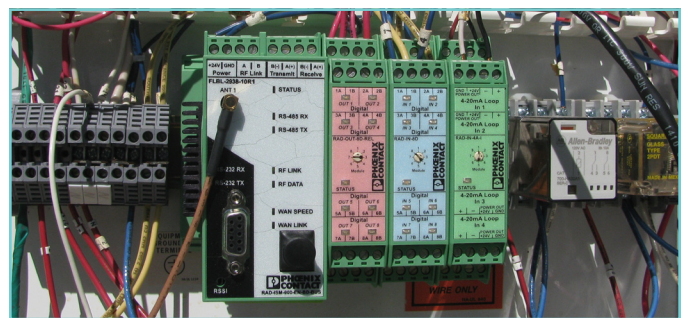
## Results

The golf course saw an immediate return on investment. The entire installation never interrupted rounds on the course. Revenue was never impacted, and facility managers were very happy with the entire project.

Although interference was a problem in the original system, the RAD-ISM-900-EN... radio's robust frequency-hopping proprietary technology performed very well within an interference-prone environment where the other radios failed.

The old system required a high level of monitoring and maintenance, but the new system has reduced maintenance costs considerably, even in the hot and dusty desert environment. Because the system is so dependable, Cloudburst now uses the installation as a showcase for prospective clients.

Art Grimes, Application-Solution Engineer for Steven Engineering, helped coordinate the project. He reported, "There was zero impact to facility operation, and maintenance costs have been reduced. More importantly, the golf course looks incredible, and Cloudburst has a happy customer."



Although interference was a problem in the original system, the RAD-ISM-900-EN... radio's robust proprietary technology allowed it to perform very well in an interference-prone environment.

Customer case study

## Water | Wastewater

# Water authority uses wireless, VPN technology for remote communication

### Summary

- A water authority in Pennsylvania needed to automate communication from its remote wells and pump stations to meet new EPA rules
- Control Systems 21, a system integrator, implemented a new system that provided accurate, real-time data
- The solution used Phoenix Contact Ethernet radios to transmit data back to the main control center; where wireless was not possible, Phoenix Contact's FL mGuard router provided a secure VPN connection to communicate the data over the Internet
- Thanks to faster and more accurate data reporting, the township has reduced labor and costs and can avoid costly EPA fines



**Middlesex Township needed to improve communication from several remote sites, such as this water tank.**

### Challenge

The Middlesex Township Water Authority, near Carlisle, Pa., provides drinking water to 3,300 customers. Due to new EPA regulations, the Water Authority needed to update its remote pump monitoring system. The new rules required the township to report its trending data for chlorine levels and turbidity more accurately, and to respond to alarms within a half-hour.

Previously, the township monitored these levels manually. They would send personnel to the sites to manually record the data and for regular maintenance. The staff would then upload this local trending data via USB on the hour.

Because this was a manual process, the township only had data about the chlorine levels during normal business hours. They could not run the pumps after the maintenance staff's normal shift ended. To supply water after hours, the township had to purchase water from nearby municipalities.

The township wanted to upgrade this antiquated system. A new automated SCADA system would reduce the cost of manpower/maintenance and ensure they always had accurate, timely information at the main control center.

### Customer Profile

Control Systems 21 is a system integrator in Dillsburg, Pa., that specializes in the service, calibration, design and installation of process control instrumentation. From precision industrial manufacturing to modern municipal water and wastewater treatment, Control Systems 21's manageable size and no-nonsense style of business helps to optimize automation and control system budget dollars.

## Solution

Middlesex Township contracted with Control Systems 21 to implement automatic monitoring and control its remote wells and pump stations. The solution featured a wide variety of Phoenix Contact products, including the ILC 150 VLC programmable logic controller (PLC), managed and unmanaged Ethernet switches, serial communication servers, firewall routers and several different Ethernet radios.

The new system connects different PLCs, PCs and DVRs over a wireless and VPN network. The application uses several different protocols, including EtherNet/IP, Modbus/TCP, Modbus RTU and OPC.

Corey Heckman, automation manager at Control Systems 21, said, "Phoenix Contact had everything we needed to complete the project – the ability to talk to the existing controller, the wireless systems, VPN and data logging. They pretty much covered it completely."

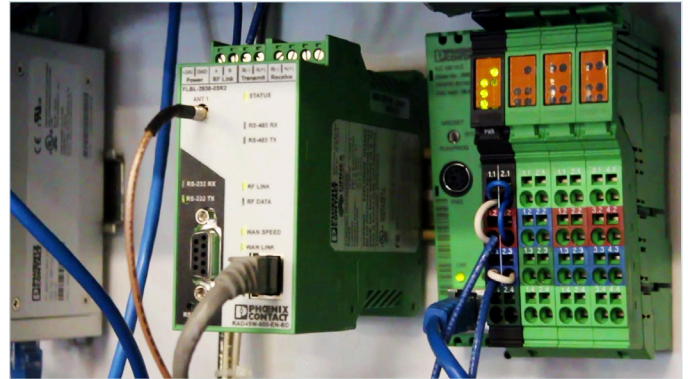
In particular, Heckman cited the ILC 150's gateway capability as a key factor in the decision. The ILC acted as a communications gateway to the system's legacy PLCs, communicating via EtherNet/IP to Modbus/TCP, then to Modbus RTU via a com server.

Steve Redcay, automation sales engineer at Phoenix Contact, explained, "The legacy PLCs had data that we needed to communicate back through a VPN tunnel. With the ILC, we were able to communicate with those PLCs and change the protocol to work better with a wireless network."

There was no Internet connection at the remote sites, Control Systems 21 installed Phoenix Contact Trusted Wireless Ethernet (TWE) radios. The application used both 400 MHz and 900 MHz versions, along with different gain antennas, depending on the specific requirements of the sites. Phoenix Contact cabling and surge protection enhanced the system's reliability.

Most of the sites were reachable via 400 MHz, 5 W radio. However, the township's size and topography presented a challenge in one location. The hilly terrain made line-of-sight impossible, so the radios could not reach the main office on one hop.

Heckman stated, "We would have needed a 150 foot tower to overcome the topographical issues of a 400 MHz radio. Another option was a cellular system, but that would have incurred monthly cellular fees."



**The ILC controller acts as a communications gateway to the system's legacy PLCs, communicating via EtherNet/IP to Modbus/TCP, then to Modbus RTU via a com server. The TWE radios then transmit this data back to the authority's headquarters.**

At this location, Control Systems 21 selected Phoenix Contact's FL mGuard. The mGuard is an all-in-one firewall, router and VPN, designed to meet the harsh conditions common in industrial applications. The mGuard created a secure VPN tunnel to communicate critical video and Ethernet data over the Internet and back to the main office.

## Results

Middlesex Township now has accurate and on-time data on chlorine and well levels. According to Rory Morrison, authority manager, the water authority no longer needs to send maintenance personnel to drive to remote sites, reducing both labor and transportation costs.

"The system is better now because we don't have to spend so many man hours at the well site. We were visiting the site several times a day, turning pumps on or off. Now we can do that remotely over a laptop or cell phone," he said.

The automation has also eliminated the need to buy water from neighboring municipalities. In addition, Heckman estimates that Phoenix Contact Technical Service and local sales support saved approximately 40 hours of labor.

"The Phoenix Contact employees are very knowledgeable," he said. "They were out for technical support, and were there for the start-up. They really trained us for the project."

Ultimately, the system's faster update times and reliable communication will help Middlesex Township keep the clean water flowing and avoid EPA fines.



## Solution

Glens Falls contracted with Siemens Building Tech Division and, with the help of Phoenix Contact, designed a wireless network system. The team came up with a hybrid solution, combining two different kinds of wireless Ethernet technologies to meet the requirements of different locations.



**In locations with no line power, solar panels power the radios.**

The city's water reservoirs are located several miles from the control center. Because the signal from a traditional Ethernet radio would not travel the required distance, the city installed GSM/GPRS Ethernet modems at the reservoirs, which could communicate over the cellular network.

The local ILC controllers monitor water levels, then report any unusual conditions via the modem over the cellular network. The modem sends updated level alarm information to the central SCADA system at the facility's headquarters. The master control system activates the necessary process control systems. All of the reservoirs' locations are so remote that no line power is available. These field installations use solar power.

The second phase of the installation involved the city's wastewater lift stations. The lift stations are closer to the master treatment facility. This proximity made it possible to use Phoenix Contact's Trusted Wireless Ethernet, or TWE, radio to transmit status levels.

The TWE is a busable radio with I/O technology. It operates in the 900 Megahertz range, and typically can transmit data several miles. Back at the treatment facility, the Phoenix Contact ILC series controller receives the data via digital and analog I/O.

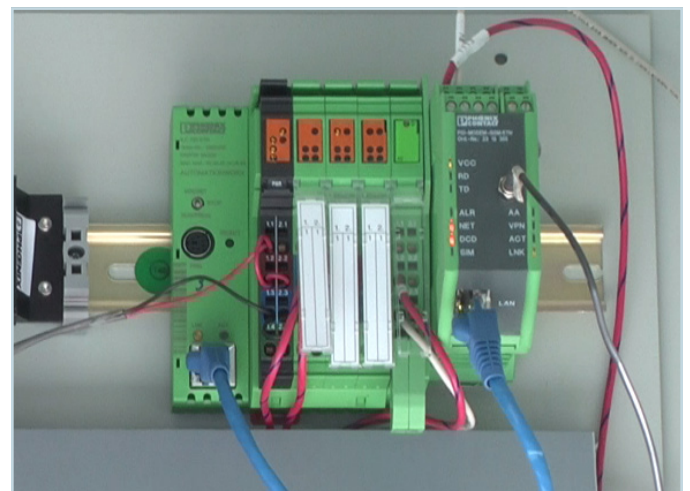
The system taps into an existing OPC link using the Wonderware SCADA system. The technicians at the control center can keep track of all of the data in one location.

Phoenix Contact's FL mGuard enhances the system's security. It provides stateful firewall protection to the city's network, and additionally provides the Layer 3 routing for the cellular modem network for reservoir data and for the Ethernet TWE radio pump station network. The mGuard line also has an optional VPN for an additional layer of authentication and data encryption.

## Results

Collecting diagnostic and alarm data across miles of distances presented many challenges. Phoenix Contact offered system design support and technical expertise in wireless and industrial networking technologies using a diverse range of RF and network products. The end result was a secure Phoenix Contact wireless hybrid solution that provides a reliable, efficient VPN interface link into their SCADA process system.

Tom Albon from Siemens Building Tech, stated, "This entire process was quite involved, and Phoenix Contact provided thorough support throughout. They brought in their technical engineers to help with the coding, installation and networking situations we ran across during this project."

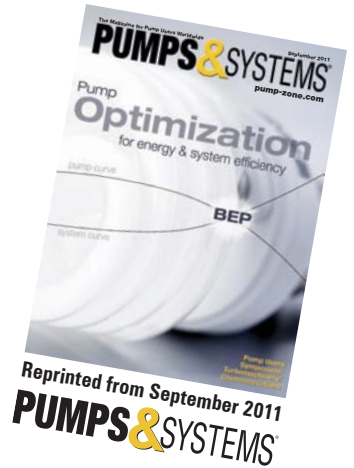


**GSM/GPRS modems and ILC 150 controllers communicate data from the distant reservoirs.**

# Wireless System Keeps Water Flowing

Necmi Sanli, PE, Energy Systems Engineering

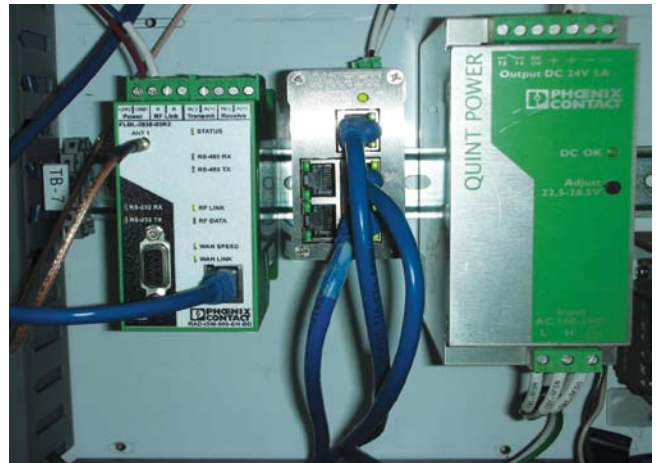
**Lindmore Irrigation District uses Ethernet radios to improve SCADA communications system and pumping efficiency.**



In many areas of the world, agriculture depends on irrigation. This is particularly true in Central California where increased demand and limited water supply creates many challenges for irrigation districts.

Because of their importance to the agriculture base, investments in maintaining and upgrading irrigation systems must have a high priority. Automation is necessarily a part of that investment because it enables water districts to conserve water and power and to lower labor costs and reduce overhead while ensuring accurate billing.

An electrical engineering firm is working with the Lindmore Irrigation District, [www.lindmoreid.com](http://www.lindmoreid.com), in Lindsay, Calif., to upgrade its SCADA network. As part of this upgrade Phoenix Contact was chosen to provide Wireless Ethernet (TWE) radios, antennas, and power supplies (Figure 1).



**Figure 1. A Phoenix Contact radio and power supply mounted in a control cabinet**

## Irrigation Challenges

The Lindmore Irrigation District is located in the east central portion of California's San Joaquin Valley. It receives its water from the Friant-Kern Canal, a 152-mile Central Valley Project aqueduct managed by the U.S. Bureau of Reclamation in Central California.

The district serves the communities of Lindsay and Strathmore, Calif., as well as around 1,200 agricultural customers that grow citrus, olives and almonds in a 100 square-mile (10-mile x 10-mile) area. It also provides supplemental irrigation capacity to Fresno, Tulare and Kern counties.

Completed in 1951, the Friant-Kern Canal begins at Millerton Lake, a reservoir on the San Joaquin River north of Fresno. It flows south along the eastern edge of the San Joaquin Valley, ending at the Kern River near Bakersfield. The canal provides water at 5,000 cubic feet per second (cfs) at its source, gradually decreasing to 2,000 cfs at the Kern River.

On the west side of the district, water is delivered to about 500 farmers on more than 26,000 acres. Water flows from east



**Figure 2. Irrigation pumps deliver water to customers in the higher elevations to the east of the canal.**

**L003024A**

to west from the canal through 18- to 22-inch main pipelines. Pipes connected to the main pipelines run north to south to supply water to the farmers.

The 10-mile by 10-mile area is a very large area to cover, but pumping is not required on the west side of the canal because these pipelines are gravity fed. The three gravity-fed bilateral pipelines (called “avenues”) are approximately five miles apart. Each of the first two is about 10 miles long. The third is about eight miles long. These bilateral pipelines transport the water from the canal to the farmers.

Rise tubes or pipes located every 2 to 5 miles along the bilateral pipelines maintain head pressure. Specifically, a programmable logic controller (PLC) that is part of the district’s SCADA system maintains the head pressure by operating gate valves at the rise tubes. Before the PLCs were installed, operators had to drive to each rise tube to manually open and close the gate valves.

However, locations on the east side of the canal need pumps to push the water to higher elevations. A pumping plant operates several pumps with motors from 25 to 60 horsepower—some with variable frequency drives (VFDs) and some without. Water delivery rates range from 1.7 cfs to 3.3 cfs. The system was largely manually controlled, which left considerable room for improvement.

## Manual to Automatic Control Conversion

The primary objective of the pumping plant is to maintain reservoir level and flow demand (Figure 2). When farmers call with their water requirements, district operators select the number of pumps to operate. Each pump has a selectable setpoint at the reservoir level. Once the reservoir level reaches its setpoint, the pumps stop. Head pressure at the reservoir maintains the line pressure.

In the past, the district relied on manual metering to provide water to its customers. When a customer needed water, a technician had to drive to the customer’s site and manually open a valve. This process provided almost no flow rate or water volume data. The only way to measure how much water was delivered was to note how long the valve was open.

Not knowing exactly how much water each customer received made billing difficult

**Table 1. Bilateral connection parameters**

- Pump status
- Reservoir levels
- Gravity-fed water system information
- Pumping plant PLC data
- Run status
- Run command
- Pit level
- Line pressure
- Communication status
- Line voltage level
- Line voltage condition
- Motor current (for each pump)
- Motor demand
- Motor kVAR
- Motor phase rotation
- Number of run hours per motor per day
- UPS battery status
- Daily recorded data
- Global ratings

**Table 2. Rise tube PLC parameters**

- Level
- Flow
- Gate valve open status
- Gate valve motor control status
- Communication status
- UPS status

**Table 3. Advantages of new wireless communication system**

- More reliable
- Higher speed
- Greater bandwidth
- Supports EtherNet/IP
- Longer warranty
- Superior service and support
- Easier configuration and setup
- Greater scalability

and potentially inaccurate, not to mention the wasting of resources. Deviation between the amount of water actually provided and the estimated amounts could vary from 30 to 40 percent.

The district estimated water volume according to motor horsepower, pump efficiency and elevation. If the district operators knew the field size and flow, they just needed to determine how many pumps they needed to operate. For example, if they needed a flow rate of 6.6 cfs, they turned on three pumps and billed accordingly.

The State of California maintains official flow measurements at the canal water connection points. The state allowed the Lindmore Irrigation District to connect to its meters. The water measurement deviations were based on the difference between the state’s measurements and the district’s estimates.

Before the upgrades, the district’s water delivery and measurement system was not accurate or efficient. Now, the district measures and monitors actual water use. The operators record exactly how much water flows and where it goes, and the database keeps track of the water use and billing.

To make this monitoring possible, the district installed flow meters to measure how much water flows through each pump, and what’s being pumped back to the reservoirs. The district also knows the each reservoir’s capacity and measures the water levels, which were also included in the SCADA system.

Lindmore Irrigation District’s SCADA upgrade included implementing PLCs and VFDs at pump stations, motor-driven valves and wireless communication technology to link all local automation to the human machine interface (HMI) platforms. Converting the district’s SCADA system communications to a wireless platform greatly improved its accuracy and data collection throughput.

Because of the upgrade, the district reduced personnel resource requirements. Technicians will no longer be required to initiate water distribution. Water conservation is improved through more accurate water monitoring, and Lindmore Irrigation District customers can rest assured that their water bills will be accurate.

## SCADA System Upgrade

The electrical engineering firm advised the district to upgrade to a wireless system because of inefficiencies in the communications among the PLCs within the SCADA system. They knew that, with the wireless system, the Ethernet connection at each site would allow remote administration capabilities. This would provide more bandwidth to enable the engineers to perform instant remote diagnostics from their office. The technology would also provide reliable operation.

Six TWE radios have been installed at the time of this article. To provide district-wide radio coverage, a 60-foot antenna tower was erected at the district's central office.

Around 28 additional radios will be installed during the next 12 to 18 months on all reservoirs, pump stations and main trunk lines. As many as 1,200 radios may be installed over several years. Four master radios are planned for the entire project.

A PLC at each reservoir transmits data to the pumping plant to control the pumps. The junction box and the radios at the pumping plant transmit the data to the district's office SCADA computer. One PC with Web client access is used as the SCADA server. The district's other PC is at the district office where the operators can access the Internet, if necessary.

The PLCs' use the EtherNet/IP multicast protocol and the ability of the wireless system to transmit this protocol reliably and quickly contributed significantly to the success of the upgrade project.

Each avenue master junction box is equipped with an HMI to monitor and control the operation of its avenue and the entire district. Operators can make set point changes, monitor and acknowledge alarms at each of the five HMIs. The HMIs communicate with the radios via Ethernet.

The electrical engineering firm controls the level by opening and closing large gate valves based on the number of shaft turns because it has no feedback of gate valve position.

The engineers run the gate valve motor 5 seconds and wait 35 seconds to see if the level is achieved. The next upgrade will use proportional integral derivative (PID) control to maintain the levels.

The engineers used 900 MHz radios for communications from the reservoirs to the pumping plants and for the bilateral connections to the district's offices. The bilateral connection radios provide the parameters listed in Table 1. The rise tube PLCs transmit the parameters listed in Table 2.

The plan was, first, to measure the flow of the main lines to calculate the total volume of water then tie those measurements to the radios that are installed. The engineers needed a saturated radio network so they can cover the entire district.

PLCs use messaging blocks to read and write to the registers. Also, alarm status is passed along in message blocks. These alarms include high and low levels, high and low pressures, uninterruptible power system (UPS) battery status, control door open and the temperature inside the PLC and radio cabinets. The radios transmit these data to the SCADA system.

PLCs control reservoir levels by varying the VFD signals for pump speed. PLCs control individual vessel levels using control

valves. PLC inputs include pump run status; run commands; power loss; and pressure, flow and level indicating transmitters. Analog outputs control the VFDs. The PLCs connect to the radios through Ethernet connections. This scenario allows the engineers to program and maintain PLC programs via a secure virtual private network (VPN) to their office.

## Improved Communications

The district's original radios used serial data and were limited in terms of bandwidth and data. However, the new wireless system uses Ethernet, which allows engineers to connect via the Internet. The flexibility and Web connectivity of the TWE radios allow the district to connect to nearly any device at any site. For example, operators can monitor VFD status to acquire data such as kVAR and kVA demands to make energy adjustments so they can take advantage of off-peak utility hours.

The new radios offer the ability to configure a single radio as a master, slave or slave/repeater via built-in Web-based management pages. Having this configuration software built into the radio also simplifies installation.

Compatibility with third-party control protocols was another important decision criterion. The ability of the TWE radio to wirelessly transmit the PLC's EtherNet/IP multicast protocol in a quick and reliable manner was a big factor contributing to the success of the upgrade.

The wireless system allows engineers to connect to each PLC remotely to diagnose potential problems. It is also expandable to multipoint communication. More bandwidth is available to expand communications to farmers' fields to collect data such as flow, pressure and motor run status. The Ethernet radios also monitor reservoir levels and update the PLCs and the SCADA system to control the pumping plant.

Based on the engineers' recommendation, Lindmore Irrigation District chose the TWE radios because of product availability, technical support, product quality and terms of warranty. The radios were tested and had no communication failures over an 11-month period.

Prior to implementation, the Phoenix Contact engineering team examined the radio signal path. Based on the survey information, it added new functions to the radios—such as network filtering to reduce multicasting and blocking certain frequencies. Because of the reliability of the TWE radios, service calls to the district sites have been virtually eliminated. Reduced service calls translate directly to less travel time.

"We believe we'll achieve better water distribution control both from a logic standpoint as well as a control system design standpoint, and we anticipate much less maintenance," says Lindmore Irrigation District General Manager Michael Hagman.

**P&S**

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# Take Control of your SCADA system wirelessly

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INSPIRING INNOVATIONS

# WLAN



Case study

## Sports Entertainment

# Phoenix Contact industrial wireless Ethernet technology creates reliable communication in Lucas Oil Stadium

### Summary

- Uni-Systems, a company specializing in moveable architecture solutions, needed clear communication to and from cameras and the control center on a retractable roof and a kinetic window wall with six moving wall panels in Lucas Oil Stadium, home to the Indianapolis Colts.
- Several Phoenix Contact [industrial wireless Ethernet](#) radios were installed in multiple locations within the facility to create reliable, accurate communication.

### Customer Profile

#### Uni-Systems

Uni-Systems began its business creating moveable architecture solutions for the aerospace industry over 40 years ago and recently expanded into the sports entertainment industry. The company provided total solutions on retractable roofs for several stadium projects in North America. Five major stadium projects included Uni-Systems' expertise for their designs, including The University of Phoenix, Minute Maid Park, Reliant Stadium, Lucas Oil Stadium and the new Dallas Cowboys stadium.



Ethernet radios with antennas monitor video from the stadium's kinetic wall



A view of the kinetic wall inside the stadium during construction

### Challenge

Lucas Oil Stadium, the new home of the NFL's Indianapolis Colts, opened in August 2008. The stadium features a state-of-the-art retractable roof and a kinetic window wall with six moving wall panels.

The following issues were presented:

- **Two retractable roof panels with four cameras each, separated by at least 600 feet**
- **A window wall panel with a variable frequency drive (VFD) and an I/O module required fast, reliable communication to the control wall**
- **The stadium's steel frame and window wall blocked video signals from the cameras to the control system and between cameras**
- **A single location for a fixed radio to communicate with all six panels while the roof and wall panels moved was not possible**

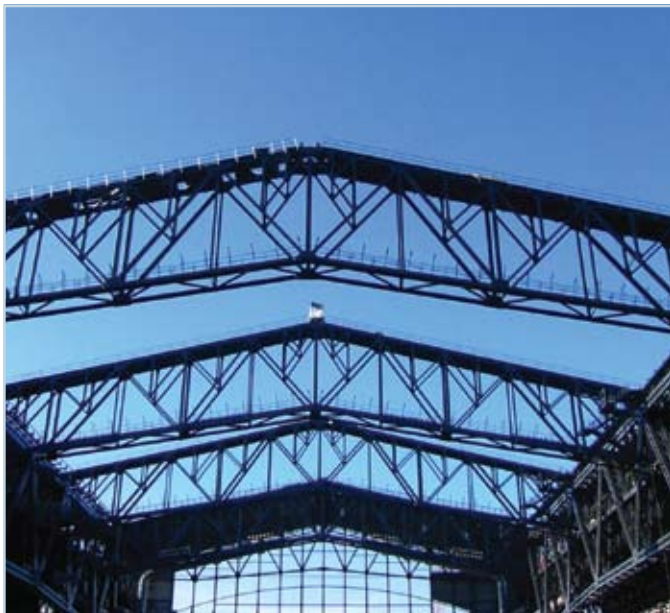
## Solution

To create clear communication for the cameras on the roof panel, one main radio with 10dBi outdoor omni-directional antennas was placed on the fixed structure between the bi-parting roof panels, directly in line with one pair of cameras on each roof panel. IP54 industrial wireless Ethernet radios were set to transmit in the 5GHz RF spectrum because there is less noise interference in this spectrum.

To fix the issue with the wall panels, a DIN rail-mountable radio unit and a single 10dBi omni-directional antenna were installed on each panel for a total of eight industrial Ethernet radios controlling the six paneled walls. Two fixed radios communicate with the individual moving radios on each panel.



Outside view of the kinetic wall at Lucas Oil Stadium



Construction of the retractable roof controlled by Phoenix Contact Ethernet radios



## Results

Phoenix Contact's industrial Ethernet radio solution proved a success for Uni-Systems at Lucas Oil Stadium. The kinetic window wall easily, accurately and reliably transmits data without losing line of site and without the hassle of a hardwired method. The retractable roof is monitored reliably via a streaming video feed, preventing any unwanted issues. A preliminary view of the roof can be seen through the video feed without endangering a worker for manual inspection.

Industrial Wireless Ethernet technology enables additional monitoring and control capabilities that would not have been practical using traditional hardwire methods.

For more information on industrial wireless Ethernet, visit:

[http://www.phoenixcontact.com/signal-level-matching/31240\\_15481.htm](http://www.phoenixcontact.com/signal-level-matching/31240_15481.htm)

Customer Case Study  
**Water/Wastewater**

# 'Flawless' three-mile WiFi connection – Phoenix Contact's WLAN technologies easily cover a 3.1 mile span

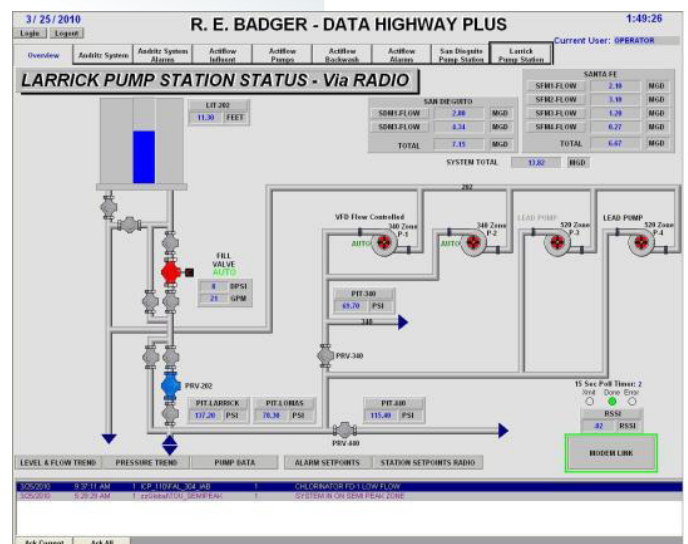
## Summary

- The water system of an arid California community dealt with high water demand
- Water distribution system operators spend most of their time in the field, but need to access HMI at the control room three miles away
- A cabling solution was impossible due to the challenging terrain
- After installing Phoenix Contact high-power WLAN radios, the operators now have a flawless connection and can easily access HMI data in the field

## Customer Profile

Rancho Santa Fe, Ca., is a suburb in northern San Diego County. It is considered to be one of the most beautiful communities in the United States, yet one of the most arid.

This area is prone to extreme drought conditions, increasing the local fire risks. Additionally, the local orchards need water to keep the orange and citrus groves growing. This combination places a high demand on the water system.



Screen shot of the HMI screen that monitors the water district's most critical pump station, the Larrick Pump Station.

## Challenge

District maintenance personnel spend most of their time in the field, resulting in the need to extend the control screen HMI from the control station LAN at R.E. Badger filtration plant. With the installation of the fully automated system, operations wanted a way to monitor this new information directly from their field station, where most of their work priorities are scheduled.

The terrain surrounding Rancho Santa Fe is extremely mountainous. This application requires taking information from the mountain-top plant into town. The mountainous area, along with trees, and the challenge of right-of-way, left cabling directly with copper or fiber out of the question. This is due to high cabling costs and the difficulty of installation along this three mile path.

## Solution

Phoenix Contact's high-power WLAN radio (RAD-80211-XD/HP) created a wireless Ethernet connection across the three-mile, mountainous terrain, resulting in effective throughput of 18 Mbps. This allowed for the extension of the HMI screen on the plant-wide LAN to reach the water operations yard.

## Results

The water district saw an immediate return on investment as directly compared to copper or fiber. The savings totaled well over \$15,000 for this installation. The district operations supervisor reported that the wireless link performance was "flawless."

This installation has moved this water district one step closer to becoming a fully automated system.





## Application Awareness Program

AUTOMOTIVE

### Improved efficiency for automotive assembly

#### Summary

Phoenix Contact's Designline industrial PC and FL WLAN 5101 meet the tough requirements for an automotive factory-floor assembly operation.

- **Industry:** Automotive
- **Products implemented:** FL WLAN 5101 and associated antennas and cables; Designline 15-inch panel PC
- **Total size of project:** \$500,000 to \$1,000,000
- **Phoenix Contact product content:** \$25,000 to \$50,000

#### Customer profile

An Automotive customer is one of the largest manufacturers of professional power and hand tools in the world, serving the vehicle service and assembly, industrial, aerospace, electronics, construction and serious DIY markets. In addition to over 30 owned brands, they manufacture select, premier private label mechanics tools.



#### Challenge

The customer was designing the pilot for an automotive assembly operation. Their customer, a major automotive manufacturer, wanted to upgrade a 12-year-old system for improved efficiency.

#### Solution

They chose the Phoenix Contact FL WLAN 5101 (with associated accessories) and Designline industrial PC. Designline is machine-mountable and IP65-compliant, making it suitable for the factory floor. This eliminates the need for an expensive and bulky enclosure that other IPCs might require.

The FL WLAN 5101 eliminated the need for costly and complex cabling within the factory. The FL WLAN 5101 is a high-speed wireless radio featuring 802.11n technology. It transmits up to 300 Mbps, so it can handle applications that demand high bandwidth. The narrow metal housing saves valuable space on the DIN rail.

#### Benefits

- Faster installation time
- Lower hardware/software costs
- Used less cabinet real estate
- Increased output



## Application Awareness Program

### Cotton ginning company doubles output with upgraded control system

By upgrading to Phoenix Contact's ILC 131, Web panel interface, wireless, and other products, a cotton company doubled the output of its ginning process.

- **Industry:** Cotton ginning
- **Products implemented:** ILC 131 controllers; Web panel HMI interface; power supplies, surge protection, Inline I/O, FL WLAN 5101 wireless Ethernet device, wireless Bluetooth MUX
- **Total size of project:** Less than \$500,000

**Phoenix Contact product content:** \$5,000 to \$25,000



#### Customer profile

An electrical contractor in the Southeast needed to develop a control system for a cotton ginning process.

#### Challenge

The customer wanted to increase the output of the cotton ginning process. The company's control system used legacy PLCs and HMI no longer supported by the manufacturer. Replacement parts were hard to find, and maintaining this hardware is also becoming more difficult. Most importantly, the old control systems could not be modified to increase the output.

#### Solution

The customer selected Phoenix Contact's ILC 131 controllers and Web panel HMI interface. By using the PID functionality of the ILC controller, the customer was able to control the gin drive speed and moisture content of the cotton during the process. Parameters for temperature and speed are easily adjusted using the webserver interface on both a fixed Web panel HMI and a wireless iPad. By maintaining tighter control of the gin speed and temperature setting, the output of processed cotton is increased. The operators are also free to move around, which cuts down on staff required to maintain operation.

Using WebVisit, a graphical interface was developed to allow local control with a Web panel, as well as remote control via iPad or other smart handheld device. The system uses Wi-Fi technology and the FL WLAN 5101 wireless device. By using the Inline Bluetooth wireless MUX, the customer avoided digging up the roadway between the cotton gin building and the cotton module feeder building, saving time and money.

#### Benefits

- Doubled output
- Faster installation time
- Lower hardware/software costs
- Improved available cabinet real estate
- Minimized downtime
- Increased profitability



Application Awareness Program

TRANSPORTATION

## Wireless control of heavy-duty lifting jacks

### Summary

To control multiple heavy-duty lifting jacks, this company chose Phoenix Contact's WLAN 5101 radios.

- **Industry:** Transportation
- **Products implemented:** WLAN 5101 radios and antennas
- **Total size of project:** Less than \$100,000
- **Phoenix Contact product content:** \$25,000 to \$50,000



### Customer profile

This Transportation company in Oxford, Conn., engineers, fabricates and installs high-quality moving structures. Among their signature products are heavy-duty lifting jacks and rotary lifting tables for large train and transportation vehicles.

### Challenge

They needed a way to control multiple jacks (8 to 12) simultaneously and wirelessly.

### Solution

They chose Phoenix Contact's WLAN 5101 radios to control the jacks. The radios and antennas are mounted on each control panel on each vertical jack. The cabinet contains an Emerson drive and power supply. The radio sends commands to the drive wirelessly. One drive is the master, and all others are slaves receiving commands from the master.

The WLAN 5101 offers high-speed wireless networking up to 300 Megabits per second. Due to the time-sensitive information needed for the application, the wireless link needed to be reliable 100 percent of the time. Since three of the panels were behind major obstructions, they used the FL WLAN 5101's ability to be a repeater and to whitelist MAC addresses to route obstructed wireless links to more reliable paths. This allowed for fast, reliable communication at a fraction of the cost of running conduit and wire, not to mention the maintenance on those wires.

### Benefits

- Faster installation time
- Lower hardware/software costs
- Reduced maintenance costs
- Local technical support



## Wireless technology improves conveying and other processes for cabinet manufacturer

### Summary

A wood cabinet manufacturing company automated all of its conveying systems, as well as the spray booths and heat tunnels. Working with distributor Graybar, the customer found a solution with Phoenix Contact products.

- **Industry:** Woodwork
- **Products implemented:** Wireless products and accessories, DIN rail terminal blocks and fuse blocks, relays, power supplies & UPS, Ethernet communication and connectivity, Trabtech surge protection, circuit breakers and electronic housings
- **Total size of project:** Less than \$100,000
- **Phoenix Contact product content:** \$5,000 to \$25,000



### Customer Profile

Elkay Wood Products, located in Culver, IN, specializes in high-end wood cabinet manufacturing and assembly.

### Challenge

Elkay faced the difficulty of automating many mechanical processes and having centralized, remote access to controllers and machine interfaces. The company's goal is to have wireless connectivity throughout the plant for conveyor control and monitoring.

### Solution

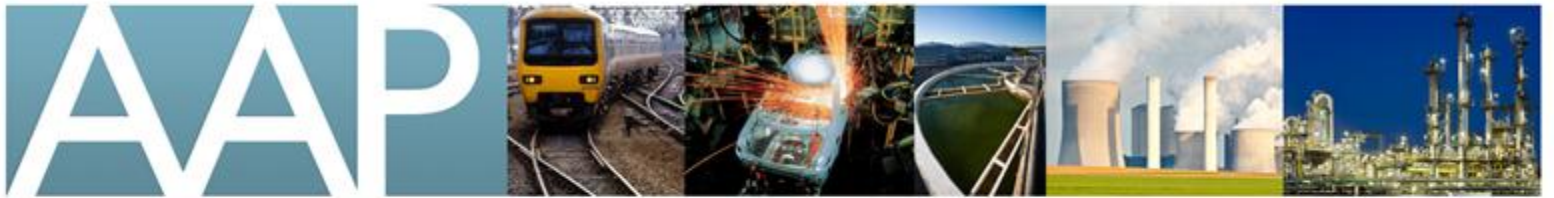
Two large double-door cabinets were designed and mounted, using DIN rail terminal blocks and circuit breakers for common automation products. Trio 10 A 24 VDC power supplies were used with Trabtech surge protection. Each cabinet included FL unmanaged Ethernet switches (8-port) for Ethernet connection handling. Elkay chose to integrate the OMNI Box II with FL WLAN 5101 wireless access points throughout the facility to provide roving access, as well as central access to all control panels. The 5 GHz option was used so as not to interfere with the company's existing 2.4 GHz wireless network.

Mike Beebe, working closely with Graybar, provided local technical support, including a site survey and tuning the wireless access points. The customer expressed that Mike was truly informative and very professional.

Elkay was pleased with the broad product selection available, as well as the industrial look and feel of numerous Phoenix Contact products. Their IT group liked the documentation and option of utilizing different frequencies for the wireless networks.

### Benefits

- Hardware/software costs
- Cabinet real estate
- Minimized downtime
- Reduced maintenance costs
- Profitability
- Outstanding technical support



## Application Awareness Program

### Paper Converting Machine Company needs better connectivity

#### Summary

Paper Converting Machine Company (PCMC) needed a better remote connectivity option, and a more secure connection within their network. In using Phoenix Contact mGuard and WLAN, PCMC achieved a better remote connection and minimized the downtime for the system.

- **Industry:** Machine Building
- **Products implemented:** Wireless products and accessories, power supplies and UPS, Ethernet communication and connectivity, network security



#### Customer Profile

Paper Converting Machine, Co. (PCMC) specializes in tissue converting, packaging, flexographic printing and nonwovens technology. PCMC provides customers with a broad range of automated converting solutions.

#### Challenge

PCMC already used Phoenix Contact managed Ethernet switches and wireless WLAN, but their existing remote connectivity solution was a proprietary system and had limited functionality. They needed a more reliable and consistent solution so they could provide remote maintenance and troubleshooting of the operating machine to their end customers.

#### Solution

The radio, used as a wireless access point for the machine, provides a connection for the end customer to an industrial handheld tablet device. The operator can use this tablet to control the machine from any nearby location. The mGuard operates on the same machine network as the radio and gives remote access to all Ethernet capable devices. Though the PLCs in the system did not come from Phoenix Contact, the project provided the perfect opportunity for the new product launch of the mGuard RS2000 and RS4000, as well as application of the newest addition to the wireless product range, the FL WLAN 5101 wireless Ethernet radio.

The mGuard provides the secure connection that PCMC was looking for by encrypting the network and password, protecting all data that passes through the device. This way, any information passing over the remote connection has extra protection as it transmits from one point to another.

#### Benefits

- Faster installation time
- Increased cabinet real estate
- Minimized downtime
- Increased output