Types of Wireless Products

Product Overview

Weidmuller industrial wireless products provide secure and reliable solutions for a wide range of industries and applications, as an alternative for signal and data wiring. These products fall into four groups:

Wireless Meshing I/O, combines multi I/O and/or gateway functionality with the reliability of secure, scalable mesh distance communications. The IP-based addressing provides mesh/self-healing of network communications, multi-hop repeating and remote over the air re-configuration and diagnostics. The Meshing I/O units further complemented by its ease of commissioning and integration into existing plant infrastructure plus seamless interface with non-meshing systems.

Wireless Meshing I/O

Wireless I/O, also known as radio telemetry, connect directly to sensor and control signals and transmit the signal values by radio. The signals are either re-created as similar signals, or output as a data connection — Ethernet, Profibus, Modbus etc. Wireless I/O networks can be as simple as two units transferring a small number of signals from one point to another, or they can be complex data-acquisition networks with multiple “master” interfaces to external systems.

Wireless I/O

Wireless Gateways provide wireless connectivity between data buses - connectivity between devices using the same data bus, or between different data buses (Ethernet to Profibus to DeviceNet to Modbus etc). Wireless gateways are similar in operation to wireless modems, however gateways only provide a register interface to the data bus, transferring I/O registers only.

Wireless Gateways

Wireless Modems transmit serial or Ethernet data, providing a wireless extension of the data link. Example applications are PLC to PLC connections (point-to-point), connecting SCADA to a group of PLCs (point-to-multipoint), or forming a wireless PLC LAN (multidrop). Wireless modems transmit the data with minimal transformation.

Wireless Modems

Wireless System Architecture

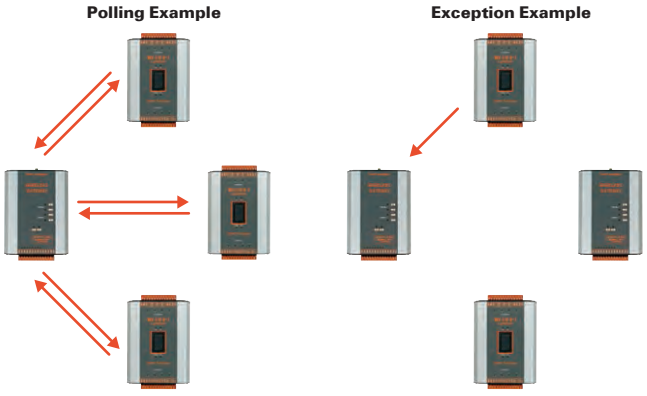
Weidmuller's solutions enable innovative WIB-net™ communications protocol specifically designed for highly reliable and secure operation on open license-free radio bands. Weidmuller wireless units form a WIB network—Wireless Information Backbone. A WIB is an effective plant-wide wireless information network for transferring data and connecting signals and data- buses in a highly efficient exception-reporting, peer-to-peer network. WIB-net provides the following features:

- **Exception-reporting transmissions for maximum wireless efficiency**

  Wireless messages are only transmitted whenever a signal value changes, yielding effective real-time performance. Integrity check messages ensure reliable operation of the wireless network as well as signal link accuracy. Exception-reporting reduces signal traffic to messages of only real significance.

- **Error-checking with automatic re-transmission for high reliability operation**

  Every radio message has a probability of corruption, so automatic error detection, acknowledgement and re-transmission is critical to reliable operation.



Event-driven communication

WIB-net will send and then re-transmit up to five times. After the fifth attempt, a communication failure status is logged and an alarm set externally.

- **Listen-before transmit wireless operation to maximize the chance of successful message transmission**

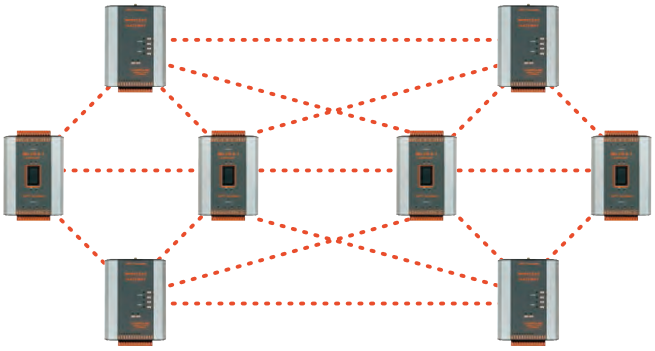
- **Peer-to-peer networking for maximum network flexibility**

Peer-to-Peer Example

Each Weidmuller wireless gateway and transceiver unit can transmit/receive directly to/from any other wireless gateway and transceiver, and can transmit/receive to/from multiple wireless units. There are no master units and no slaves. Any module in a network can talk to any other. Input signals can be transmitted to multiple destinations.

- **Wireless mesh structure**

  WIB-net enables every Weidmuller wireless gateway/transceiver to act as a repeater to optimize wireless message propagation. Messages can hop through multiple gateway/transceiver units to reach a destination. If these units have a reliable wireless link to at least one other gateway/transceiver, a wireless mesh forms to enable reliable links to the whole network.



Mesh Example

- **High security encryption**

  WIB-net uses a highly secure data encryption technique to protect against misuse of wireless data. Weidmuller wireless networks security matches or exceeds that of wired networks.

Input/Output Mapping

Process signals or sensors convey the value of an input value to a designated output channel:

- System address (15-bit, 1 – 32768)
- Source module address (1 – 127)
- Destination module address (1 – 127)
- Repeater addresses (up to 5 addresses)
- Output channel number
- I/O signal value (16-bit)
- CRC error-checking (16-bit)

All modules in the same system share a unique system address to avoid cross-talk between systems in the same radio environment. The configuration software automatically generates a random system address for each system.

Destination or repeater modules automatically acknowledge messages when received with a correct error-check value, except for messages from transmit-only units. If an acknowledgement is not received within 500 milliseconds, the message is re-transmitted. The message will be transmitted up to five times with random re-try times. After the fifth attempt, a "comms-fail" event will be set, which can be used to trigger an output alarm or register.

Block Messages

Block messages are similar to other transmissions. However, signal information is condensed into "blocks" and these blocks are sent at programmed intervals. Each block message contains up to 64 x 16-bits of values. Block messages are only transmitted or repeated by the wireless gateway product range (D2 W GMD).

Discrete/digital values can be packed [i.e. up to 1024 (64 x 16)] into a block message and unpacked at the destination gateway.

Block messaging creates a more robust, reliable and efficient system by reducing the chance that messages will become corrupt and by minimizing radio frequency congestion.

Message Control

The WIB-net™ protocol is based on exception-reporting for optimum performance. Messages can be triggered by any of the following:

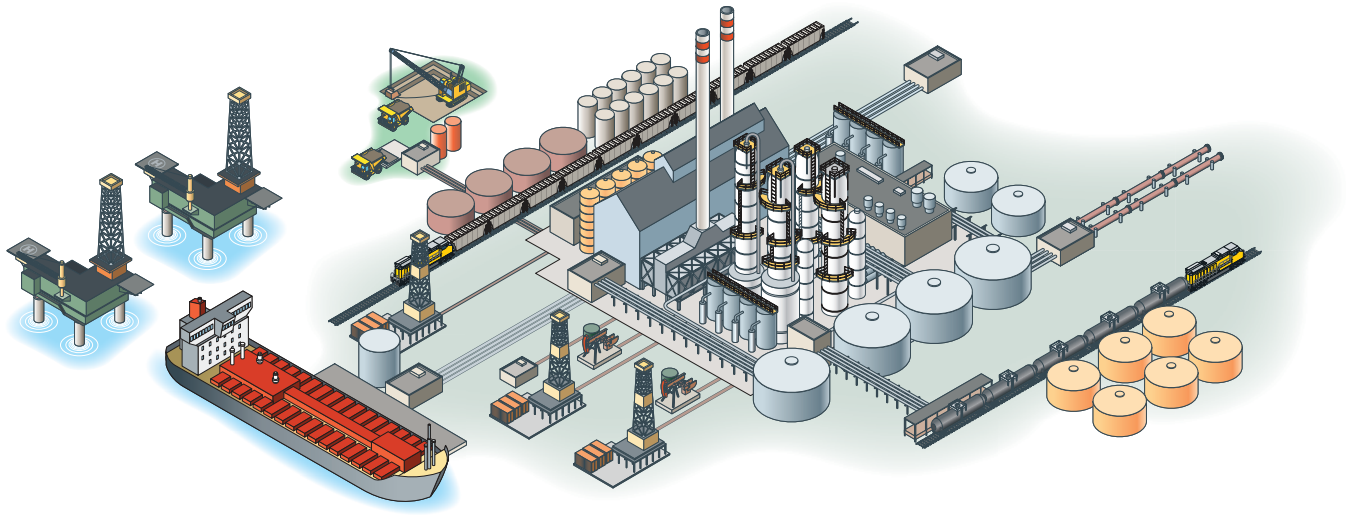
- Exception – change in input value compared to user-configurable "sensitivity" values
- Update time – user-configurable time period since the last message, individually configured for each I/O register
- Real time – block mappings only; messages transmitted on real time values
- On demand – block mappings only; poll command from another wireless unit or write command by a connected databus device

Before a message is transmitted, the radio channel is checked to ensure it is clear (listen-before-transmit). The message is preceded by a lead-in transmission; the length depends on the radio model to allow all other units to lock onto the transmitted message.

Security Encryption

Security encryption of wireless messages is user-selectable. A 64-bit secure proprietary encryption algorithm is used. The 64-bit key is randomly generated by the configuration software and is never disclosed to the user or transmitted by radio. Configuration files are protected by password, up to 256 characters.

Oil and Gas Applications

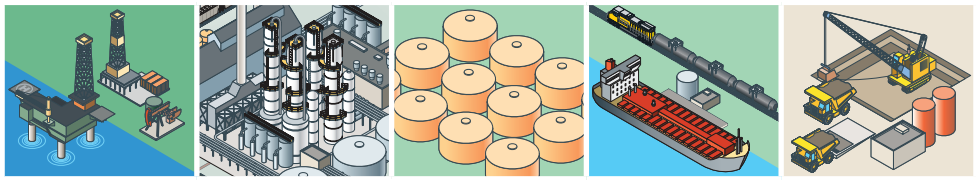


From the control room to the field, wireless solutions provide a wireless control infrastructure for productivity and safety gains in oil and gas applications.

Wireless benefits:

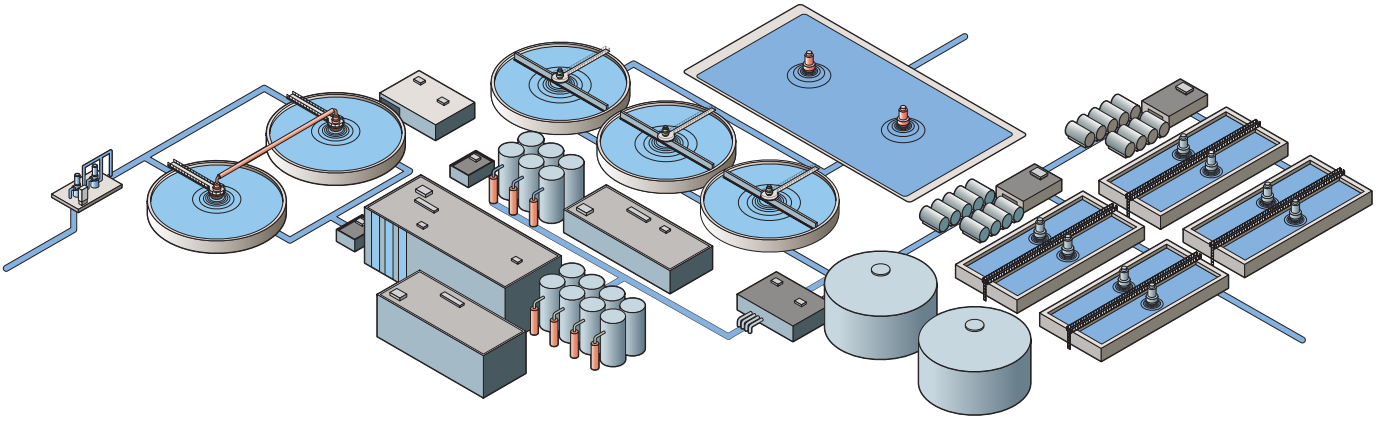
- **Long range:** Current frequencies allow for 20–50 km LoS between clients
- **High speed:** Up to 50 Mbps bandwidth
- **Secure:** Military-grade security encryption
- **Rugged:** Weatherproof casing
- **Reliable:** Advanced, self-healing meshing technology provides high availability
- **Easy deployment:** Deploys more easily and can be redeployed more quickly when compared to wired installation
- **Cost-effective:** Lower installation costs and longer, faster equipment uptime

More than Wireless



	Production	Separation / Refining	Storage	Distribution	Upgrading
Circuit Protection	•			•	•
Industrial Ethernet				•	
Intrinsic Safety		•		•	
Junction Boxes			•		
Marshalling Solutions		•			
Mechanical and Solid State Relays		•			
Power Supplies and UPS		•			
Printing / Marking Systems	•				•
Signal Isolation and Conditioning		•	•		
Surge and Lightning Protection	•		•	•	•
Terminal Blocks	•		•		•
Wireless Communication	•	•	•		•
Wireless Monitoring			•		•
Wireless Technology				•	

Water and Waste Water Applications



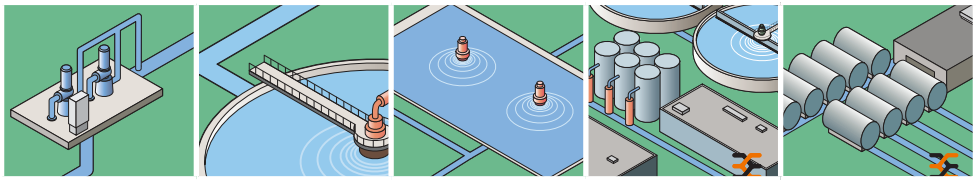
Wireless solutions reduce remote installation costs up to 70% and communicate reliable, secure EPA compliance data for system locations including:

- Head Works, Main Lift Stations, Remote Lift or Pumping Stations
- Storm Sewer Overflow, Sanitary Sewers and Collection Pits
- Effluent Discharge Points: River, Lake and Wetlands Re-use
- Transportation and Paved Runoff Areas
- Potable Water Storage and Processing
- Security and Surveillance

Wireless benefits:

- Optimizes response times and immediately indicates critical diagnostic information
- Improves monitoring and control of water flow over extended distances
- Improves operator safety and efficiency by eliminating travel time to remote site locations
- Reduces labor expenses and maximizes efficiency
- Simplifies installation and commissioning of network with reduced infrastructure required
- Provides enhanced reliability through a flexible network topology that can self-heal, while easing future expansion

More than Wireless



	Head Works	Influent	Aeration	Treatment	Effluent
Circuit and Surge Protection	•		•		
Distribution Blocks				•	
Engineered Systems				•	
Industrial Ethernet Networks		•			•
Interface Systems		•			
Intrinsic Safety	•		•	•	
Mechanical and Solid State Relays					•
Power Supplies and Battery Backup	•	•			•
Printing / Marking Systems / Ferrules			•		
Signal Conversion and Isolation			•	•	
Terminal Blocks		•			
Wireless Communication			•		•
Wireless Systems		•			
Wireless Technology	•			•	

Application Notes

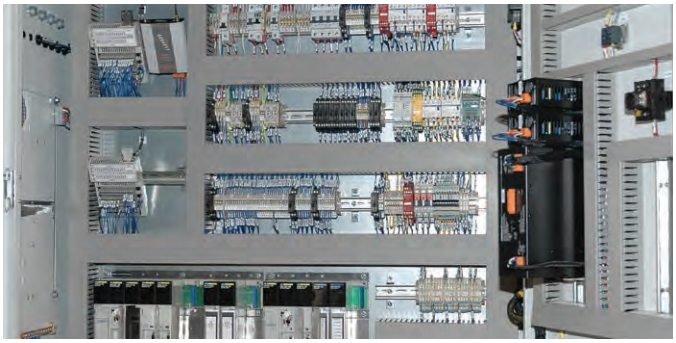
Factors Affecting Distance & E.R.P

- Frequency (as frequency increases, distance decreases proportionally)
- Receiver sensitivity, antenna gain, cable loss
- Noise / interference (the noisier the environment the more careful you have to be with antenna placement)
- Transmitter power, antenna gain, cable loss
- Attenuation of radio signal
- Heights of antennas, Obstructions in radio path
- Other factors Atmospheric, Ground Mineralization

In most applications it is desirable to have an overall dB gain as opposed to a loss to ensure good communication between radios.

Gain Sources	
Radios	1 W radio = 30dB Gain
	300mW radio = 24dB Gain
	100mW radio = 20dB Gain
Antennas	(see antenna selection chart for Antenna dB Gains)

Points of Loss	
Connection points	~0.1dB loss per connection
Jumper cables	see cable selection section (p. 64)
Surge Protection	see surge protection section (p. 65)
Bulkhead adapters	see Bulkhead Adapter section (p. 65)



***Sample assembly showing radios, power supply, surge arrestor (bottom of cabinet), terminals & relays.**

WIBnet

WIBnet makes use of all the standard features of the Weidmuller Wireless radios.

- Exception-reporting transmission for maximum wireless efficiency.

Wireless messages are only transmitted whenever a signal value changes, yielding effective real-time performance.

- Error-checking with automatic re-transmission for high reliability operation.
- Listen-before-transmit wireless operation to maximize the chance of successful transmission.
- Peer-to-peer networking, giving the maximum network flexibility.

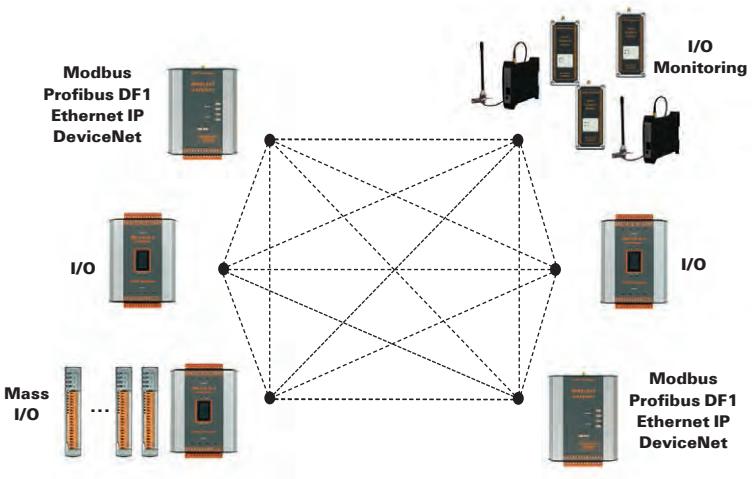
WIBnet communications protocol is specifically designed for highly reliable and secure operation on open license-free radio bands.

WIBnet provides the following features:

- Any of the 900Mhz I/O or Gateway radios can be used on the WIBnet system
- Up to 95 radios can be put into one network

Messages can hop through multiple units to reach a destination providing each Wireless I/O unit has a reliable wireless link to at least one other unit. A wireless mesh forms to ensure reliable links are established within the whole network.

Wireless system flexibility and scalability



Application Examples

Remote Wastewater Overflow Protection

Company: JEA, City of Jacksonville, Florida

Introduction

JEA is the municipal utilities provider for Jacksonville Florida. They were facing a problem with sanitary sewer overflows (SSO) in the downtown section of Jacksonville. Avoiding sewage overflow, aside from being a safety, environmental and public relations necessity, is good business for JEA.

Objective

The engineers at JEA needed a way to monitor underground sewer levels throughout the city.The plan involved the placement of measuring devices in strategically located manholes around the city in order to monitor the various fluid levels at each location.

This approach required the city to install power and control circuits at the strategic locations. Since the manholes were proven to be a very harsh Class1, Division 1 environment, they knew that the solution was not going to be easy. JEA had already invested in a very robust SCADA system to control and monitor over 1200 lift stations. The end goal was to locate a monitoring system from the sewer manhole to the existing SCADA system.

About

The issue faced by Jacksonville in establishing a monitoring system is that the city itself is physically in the way– buildings, bridges, communication lines, power lines and other typical city fixtures. They would need to dig up most of the downtown at a cost of millions of dollars and months of traffic congestion and delays. The idea was proposed to monitor the manholes and their levels wirelessly. This solution could provide the city with a quick way to install a solution that would not require the demolition of the entire city.

A search was conducted to determine who could provide a solution that fit a very specific list of requirements. These requirements included the necessary power to send signals through the ground and steel manhole covers wirelessly to receivers located in control cabinets within the city; the need for ultra low power consumption; the ability to power the solution via batteries; be contained in a Class 1, Division 1 enclosure; the ability to send both analog and discrete signals; and be portable so it could be moved to different locations in the city as needed. After extensive field tests and evaluations for signal strength and durability, along with careful evaluation of different types of equipment, a Weidmuller wireless solution was selected.

The components of the solution include a compact, easy-to-use wireless transmitter (WI-I/O-9-K), coupled with its matching battery pack (WI-BP-I/O-9-K), which does not require any special OEM batteries. The wireless transmitter sends analog and discrete signals to a wireless transceiver (WI-I/O 9-4). This unit collects the data from each transmitter and forwards it via a wired connection into the JEA's SCADA application. The receiver works very well with the existing SCADA system. The programming software for the devices is provided for free via web down load and is easy to use and understand.

The software that is included with each device makes it simple for JEA to map the transmission of signals and control transmit schedules, thus prolonging battery life. Based on the level of power consumption, JEA could replace the batteries once a year, however, they have implemented a proactive battery maintenance program to change out the batteries (standard AA sized Alkaline) every 6 months.

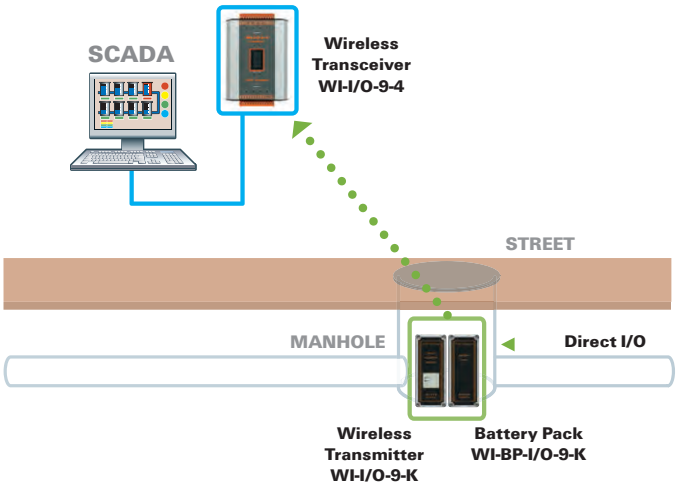
These wireless devices are mounted in a Class 1, Division 1 explosion proof enclosure with a small external antenna. Each enclosure unit is then placed in a cradle within the manhole. Portability is an important feature because it allows JEA to redeploy each wireless radio in other locations in the city as needed.

The transmitter sends signals from each underground manhole installation to set receivers through the downtown area. JEA teamed with a local distributor and packaged the Weidmuller radio system, enclosure, terminals and equipment needed to meet application requirements of this monitoring system.

Outcome

This wireless manhole monitoring system has been used in 17 manholes in Jacksonville. It was implemented in just six months at a savings of millions of dollars and many months of time, versus a wired solution.

The system has proven to be a very successful solution to an important problem. Since the implementation of the manhole monitoring system, JEA has successfully prevented numerous manhole sanitary sewer overflows (SSO), thus protecting the public and the environment– a top priority for JEA and the city.



Remote Pumping Station Monitoring

Company: Pemex, Coatzacoalcos, Mexico

Introduction

Petroleos Mexicanos (PEMEX) is Mexico's state-owned petroleum company. It is the tenth largest oil company in the world in terms of revenue and ranked thirty-fourth in Fortune 500 companies. The company controls the entire oil industry for the nation of Mexico. This includes extraction, storage, refining and marketing to the public.

Objective

The engineers at PEMEX needed to monitor 200+ different remote pumping stations and compressors. The pumping stations are scattered over a 180 square mile area that is covered in very dense forest growth, making the transmission of wireless signals a real challenge. The pumping stations are physically clustered into four groups. Each group has approximately 50 pumping/monitoring locations. These groups are Reforma, Castano, Planta de Agua Samaria and Comalcalo. Each of the remote pumping locations covers an area of 37 square miles. These four remote areas with pumping stations need to send signals back to a central office location.

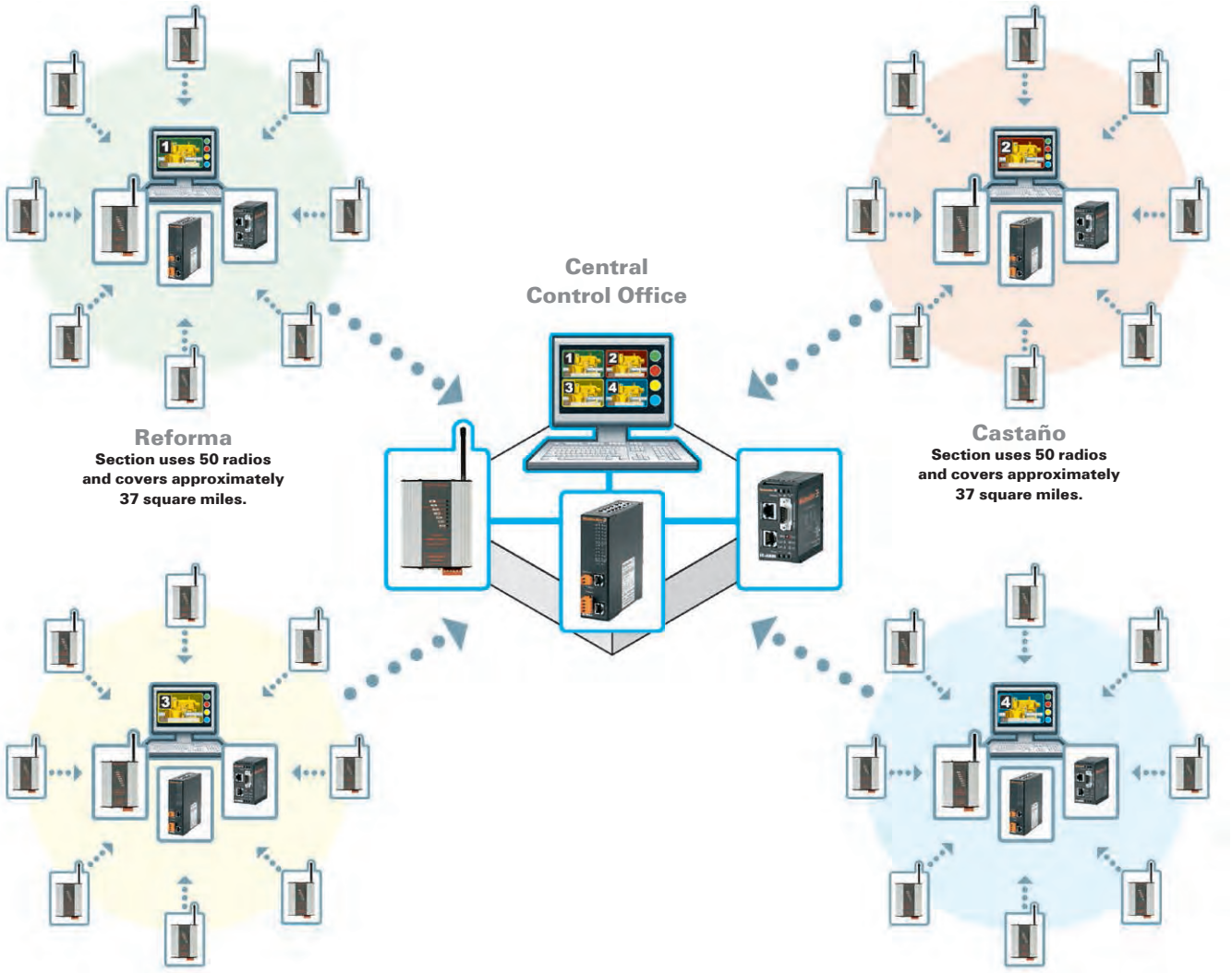
Solution

Weidmuller designed a solution that uses wireless Ethernet modems (WI-MOD-E) at each pumping location (Level 3) to acquire and transmit the requested information to a central point in each of the four pumping areas (Level 2). Another identical Ethernet modem is used to transmit all the needed information from each central point in each pumping area back to the Central Control office (Level 1). The Weidmuller modems, with 300mW broadcast power, were the only ones with a powerful enough transmitter to penetrate the dense forest growth with a clear and reliable wireless signal.

Each wireless Ethernet modem communicates between each pump location (Level 3) to each central pumping section (Level 2) and back to the Central Office (Level 1) via ModBus TCP. The components used in this installation include 250 Ethernet modems (WI-MOD-E), 5 unmanaged Ethernet switches, 5 Ethernet routers, 250 DC-DC converting power supplies (to isolate radios from the rest of the system) and all necessary terminal and fuse blocks to complete the system connectivity.

Outcome

PEMEX now has a simple easy-to-use solution for monitoring their remote pumping stations. They were able to deploy this solution quickly and it was up and running in a matter of months. Training and maintenance is streamlined because the solution employs one type of product, using one software interface for all three levels of their system, from 200+ remote stations to the central office location. The wireless products were coupled with other Weidmuller components, providing a complete and seamless system that is easy for PEMEX to maintain and support.


Central
Control Office
Reforma
Section uses 50 radios
and covers approximately
37 square miles.
Castaño
Section uses 50 radios
and covers approximately
37 square miles.
Planta de Agua Samaria
Section uses 50 radios
and covers approximately
37 square miles.
Comalcalco
Section uses 50 radios
and covers approximately
37 square miles.

Wireless Remote Vehicle Control

Company: Meggitt Training Systems, Inc.

Company Profile

Meggitt Training Systems, Inc.(MTSI), a part of Meggitt Plc, provides training systems used by militaries, law enforcement and security agencies around the world. They develop, manufacture, market and service high quality virtual and live fire training systems. MTSI employs over 500 people at their headquarters in Atlanta and in other facilities in Australia, Canada, Singapore, the Netherlands, the UAE and the United Kingdom. They are the industry leader of interactive simulation systems for the handling and use of small and supporting arms training.

Overview

Meggitt designed and installed one of the most advanced live fire ranges ever provided to the U.S. Military. The range, installed and operating in Fort Carson, Colorado, is a digitally controlled heavy armor range. It is comprised of 14 moving targets located across a 60 square kilometer area. Each of the 14 moving targets includes one bunker location and a separate remote vehicle or mover. The bunkers are made of reinforced concrete and contain the technology to operate the movers including a wireless Ethernet modem.

The mover is a 3000 lb. vehicle that is mounted onto a raised metal track. This remote vehicle has four lift arms that enable it to raise and lower a target, which is a silhouette of an armored vehicle. A control box located on the mover contains another wireless modem and the circuitry to operate the drive motors and the lift arms of the vehicle. The raised metal tracks vary in length from 300 to 500 meters, depending on the range. Each of the 14 moving target ranges is controlled via Ethernet signals from a central Range Operations Center (ROC).

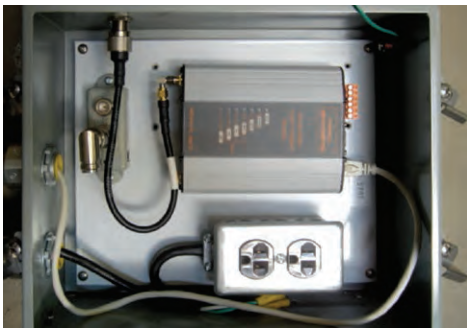
Problem

Meggitt faced two major problems at the Fort Carson, Colorado range. The first challenge was environmental. Operating conditions on a live fire heavy armor range are not favorable to electronic equipment– especially highly sensitive, high technology wireless devices. The temperature inside the control box on each mover varies from -40°C (-40°F) in the winter to +65°C (+149°F) in the summer months. In addition to temperature issues, operating on a range with tanks firing live ammunition necessitated a wireless device that withstands shock and vibration.

The second challenge was to secure reliable and stable wireless communication between each bunker location and its respective mover. The mover needs to be controlled at every point along its track so it can move in either direction, stop, raise and lower the target. The mover rolls on a set of raised tracks that extend away from the bunker at a distance of 300 to 500 meters, with various elevation changes and turns. Normally, a large antenna placed at each bunker and on each mover would solve any signal communication issues. However, the antennas at Fort Carson could not extend beyond the protective wall that guarded each mover from the live ammunition.

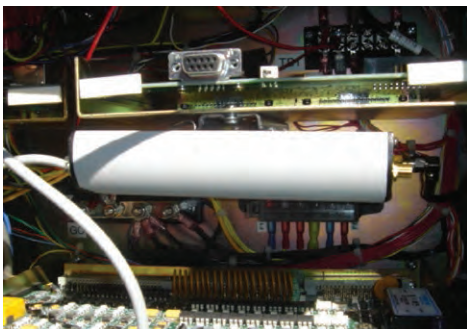
Solution

Weidmuller's WI-MOD-E-300 modems were tested and selected for the application because of their ability to operate within the required temperature ranges. They were also the most powerful production 802.11b modems available. Weidmuller sent a team to Fort Carson to install ten WI-MOD-E-300 wireless modems at 5 bunker-mover locations. The modems were installed using antenna and connecting cables that were already on-site from a previous vendor. Signal strength was improved and the Weidmuller team was able to get four of the five ranges communicating successfully.



Wireless Ethernet Modem mounted within an enclosure located inside bunker

The new installations were tested for several months after installation and it was determined that communications were not as consistent as desired. The Weidmuller team returned to Fort Carson and performed extensive site surveys at each of the 14 different bunker-mover locations. This information enabled an accurate diagnosis of each installation and the results determined that the previously installed cables and antennas were at fault. They had not been properly installed by the previous vendor and in some cases incorrect cables and antennas had been used. The Weidmuller team developed a solution to correct the communication issues at each range location. The recommended solution was accepted by Meggitt Training Systems and installed.



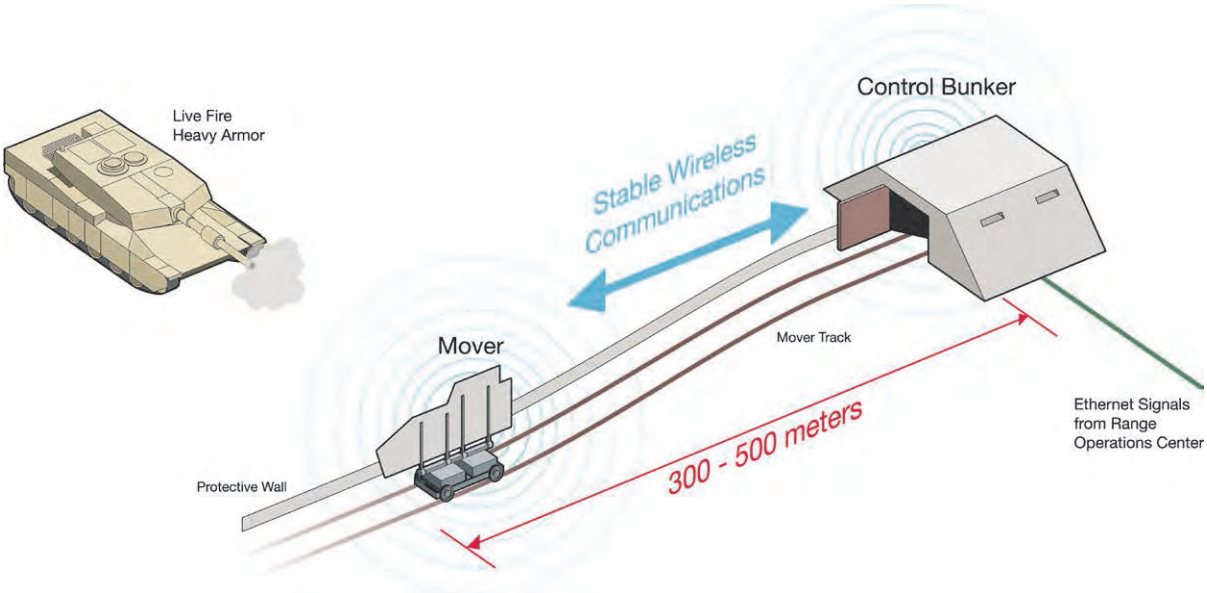
Wireless Ethernet Modem mounted inside control box on a mover

In order to streamline the support and spare parts management for the Fort Carson range, all of the components and equipment used for each bunker-mover location are identical. The technology solution includes a WI-MOD-E-300 wireless Ethernet modem, WI-ACC-LMR400-55FT jumper cable and a WI-ANT24GHz-4DB ONMI antenna. Each mover is equipped with a matching WI-MOD-E-300 wireless Ethernet modem, WI-ACC-LMR195-3FT jumper cable and a WI-ANT-24GHZ-4DB OMNI antenna.

Outcome

Weidmuller and Meggitt Training Systems have replaced all of the original faulty modems from a previous vendor and installed all new connecting cables and Omni antennas in each bunker and on each mover. The entire range is up and fully operational, providing solid data and control connections for each of the 14 bunker-mover locations. MTSI considers their Fort Carson digital range installation a complete success and the U.S. military is actively using the range as a testing facility for tanks and other armored vehicles.

Mover with target raised



Weidmuller Wireless Ethernet

Company: Targa Energy

Overview

Targa Energy owns and/or operates over 11,300 miles of natural gas gathering pipelines and Liquefied Natural Gas (NGL) pipelines through the states of Texas and Louisiana. These pipelines cover a total area of over 14,400 square miles. Targa also operates 22 natural gas processing plants, with a total of over 10,250 MMcf/d of gross processing capacity. In addition to these gathering systems and processing plants, Targa manages an onshore plant facility that provides access to natural gas supplies in the Permian Basin, Fort Worth/Bend Arch Basin, South Louisiana Basin, deepwater and deep shelf Gulf of Mexico.

Problem

The Targa Energy gas plant in Chico, Texas is a multi function location that performs pumping, storage and processing for the natural gas industry. This location covers several square miles, and includes a compressor station and multiple remote pumping stations located around the plant. Most of the pumping stations are very remote and have no access to the plant's communication network. Some of the pumping stations have a satellite uplink that is only used for processing data, production logistics and safety information.

Targa required a solution that could provide network access to their compressor station and numerous pumping station locations, and make a significant section of their gas plant a "Hot Spot" for broadband Ethernet access. Targa's field technicians would require access to this broadband network to conduct system monitoring, access data files and connect with other offices or company resources via the company's Intranet network. The field technicians use laptop computers, therefore a 2.4GHz (WiFi) wireless frequency was necessary.

Targa was having difficulty achieving reliable and stable connections due to the distance between the pumping stations, the compressor station, and the plant (over 3.5 miles in some cases) and the need to use the 2.4GHz (WiFi) spectrum for field technician access.

Solution

At Targa's request, Weidmuller's application engineer visited the plant location and performed a wireless Ethernet site survey. After the site survey was completed, a solution was proposed that included a combination of wireless Ethernet modems (WI-MOD-E-300) and dipole antennas with 3dbi of gain. The Ethernet modems provided the needed level of powerful signal transmission, and combined with a sensitive high performance signal receiver, Targa was able to receive the necessary signal strength and reliability required for their locations.

Compressor Station

This wireless solution provides the required "Hot Spots" for service technicians to access the Intranet network with their laptops, as well as enabling connectivity between Targa's base station locations and several remote pumping stations for an added level of communication and information exchange.

Example Architecture