Wireless solutions for upstream and downstream applications

Wireless control infrastructure for productivity and safety gains in oil and gas applications
The oil and gas industry presents highly demanding environments with unique and challenging communications needs. For more than 30 years, oil and gas companies have relied on Eaton wireless solutions for monitoring, control and networking of critical production assets and operational activities. Eaton products and solutions are used throughout the world in oil and gas exploration, upstream production, pipelines, refining, transportation and storage.

Eaton helps keep you on top and in control of your operations with comprehensive solutions for upstream, midstream and downstream oil and gas applications. You can meet the demands of rugged, long-distance applications with ELPRO products that include long-range wireless mesh I/O, long-range and ultra-long-range Ethernet and serial modems, industrial-grade cellular modems and industrial-grade Ethernet switches. Our network management system lets you manage network complexities and the interoperation of diverse wireless and LAN equipment from a single location.

Eaton wireless solutions support the supermajors, global EPCs and the largest national authorities, improving the management of assets and operations with reliable and secure wireless solutions for applications that include wellhead monitoring and control, pipeline monitoring, leak detection, environmental monitoring, cathodic protection and flow measurements. Today, well owners, rig operators, shallow gas producers and exploration companies are using wireless to increase productivity, reduce costs and improve safety. To facilitate design, implementation and maintenance, the Eaton System Solutions group is ready to work with you to connect diverse automation systems, instrumentation and controls and integrate processes.

Adoption of wireless by the oil and gas industry is fueled by the need for lower infrastructure costs, new government regulations and a demand for improved operational efficiency.
Ensure your long-distance operations stay connected in the toughest environments

Oil and gas companies rely on Eaton automation and control technologies to monitor and manage various operational activities, including leak detection, cathodic protection, flow measurement, wellhead control and environmental monitoring. Well owners, rig operators, shallow gas producers and exploration companies are using wireless to increase productivity, reduce costs and improve safety.

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
Wireless networking—infrastructure, monitoring and solutions

Owners and operators of oil fields and offshore rigs face constant challenges to asset productivity and operational efficiency. Wireless networking infrastructure is the facilitator to provide increased safety and productivity in environmentally challenging applications. Wireless flow, pressure, level, temperature and valve position monitoring are used to streamline pipeline operation and storage while increasing safety and regulatory compliance. Wireless solutions can also effectively manage pipeline corrosion, a growing problem for an aging pipeline infrastructure that can lead to leaks, emissions and even deadly explosions in production facilities and refineries.

Using wireless connectivity, secure extraction of data acquisition from wellhead monitoring devices can be transmitted to a central control room or multiple stations at once for quick and easy analysis. As a result, operators can respond with actions that will reduce or eliminate well downtime.

Video surveillance through wireless connectivity can feed back alerts and video images from unmanned portions of the operation to management facilities, allowing operators to respond quickly to a security breach. These applications and more underscore how wireless solutions can improve productivity, enhance safety and lower the cost of assets and operations.

Upstream/production and downstream/distribution

**Upstream**
- Oil and gas wellhead monitoring systems
- Pipeline pressure, flow and valve monitoring
- Cathodic protection and leak detection monitoring
- Underground gas storage monitoring
- Pump and compressor station monitoring and control

**Downstream**
- Oil and gas tank level gauging and monitoring
- Distribution pipeline pressure, flow and valve monitoring
- Plant IP camera and annunciator security management
- Production emissions monitoring and reporting
- Water and electrical utilities custody transfer verification and monitoring
- Electrical apparatus temperature profiling and monitoring
- Regulatory compliance reporting
“Networking technologies like wireless and Ethernet have moved to the forefront of network solutions for the oil and gas industry as they minimize lifecycle cost, yet remain flexible to allow late design changes, remote commissioning and remote network management during operation.”

Harry Forbes, ARC Advisory Group
Fuel interface detection

Magellan Midstream Partners owns the longest refined petroleum products pipeline system in the U.S. Magellan transports a variety of products, such as gasoline, diesel and jet fuel, to terminals, including some they own. Generally, the same pipeline will transport multiple products. For example, after gasoline has entered the system, it may be followed by diesel fuel. The interface of the two fuels produces a small percentage of mixed products called a transmix. A storage terminal must know in advance what type of fuel is coming so that it can divert any transmix to a separate tank, preventing errors such as pumping diesel into gasoline storage tanks.

Approximately an hour before product arrival at each terminal, density meters (also known as interface detectors) alert terminal operators of the impending arrival of a different fuel type. A 4–20 mA output from the density meters is wired into an ELPRO 905U-1 multi-I/O wireless radio transceiver. At the terminal, another 905U-1 transmits that signal.

Before adopting the ELPRO solution, Magellan relied on analog leased telephone lines. Some sites had also used 450 MHz licensed radios but these were associated with fees and proved too costly in the long term. 900 MHz frequency hoppers from ELPRO resolved the issues associated with fixed-frequency radios and leased lines. The solution provided a viable wireless alternative to expensive wiring.

This solution has proved so successful that at every opportunity Magellan is using ELPRO radios to replace leased lines and other brands of wireless products, at both new and existing IFD sites. In addition to interface detection, Magellan uses ELPRO radios in tank farms for tank pump control and tank gauging.

Tank radar level alarm

An oil refinery fitted ELPRO wireless gateways to its tank radar level gauges. ELPRO was chosen because of the gateways’ ability to connect to a wide range of different level gauges, each using different field bus protocols. The ELPRO gateways were also connected directly to each tank’s independent high-level point alarm. The wireless tank farm system formed part of a plant-wide wireless information system based on ELPRO’s efficient peer-to-peer WIBnet wireless communications. The system also operated as part of the plant energy management system and OBL alarm monitoring system.
Pipeline monitoring and control

The probable causes of pipeline failures are corrosion and leakage. An operator of a long oil pipeline was trying to prevent pipeline failures and possible litigation. Undetected failures of the protection system can lead to expensive corrosion and leaks. A solution was required to provide monitoring and control capabilities across long distances.

ELPRO single-I/O wireless transmitters were implemented to monitor the performance of a cathodic protection system that actively suppresses pipeline corrosion by injecting electrical currents into the pipeline.

Battery-powered ELPRO low-power devices provided wireless communications and delivered injected voltage to cathodic devices.

The ELPRO wireless units monitor the injection current at the active injection sites, and also monitor pipeline voltage at points between injection sites. Hundreds of these measurements are transmitted to a SCADA computer, providing an indication of system performance and early alarm of system failure. The ELPRO units are powered by a compact alkaline battery, powering down between measurements to extend battery life to 3+ years. Multiple wireless repeater units extend the wireless range to cover the complete length of the pipeline.

The combination of ELPRO low-power, small I/O-count wireless modules, ELPRO protocol interface gateway modules, the pipeline’s cathodic protection system and a SCADA system was used to monitor and control the health of the long pipeline. The cathodic protection system actively suppressed pipeline corrosion by injecting electrical currents into the pipeline, and the SCADA system provided supervisory control acquisition of field information to the control room to help prevent costly corrosion, leaks and litigation. Battery-powered ELPRO low-power devices provided wireless communications and delivered injected voltage to cathodic devices. In addition, hundreds of measurements were transmitted to a SCADA computer via wireless gateway repeaters and on to the SCADA system.

An Eaton wireless oil and gas solution provided the wide-ranging monitoring and control needed for the long pipeline. The new system is now able to prevent pipeline failures caused by costly corrosion and leakage.
Problem
PEMEX, the Mexican state-owned petroleum company, needed a secure and reliable solution to connect numerous WirelessHART field devices from remote oil wellhead sites over long distances to their control system. Monitoring temperature and pressure variables in various fields of oil extraction across long distances was well beyond the capabilities of WirelessHART networks.

The land in the fields of PEMEX onshore oil extraction is challenging, making wiring complicated, and since there are more than 30,000 additional points the extraction task is even more difficult. The 1420 WirelessHART gateways needed wireless Ethernet long-haul connectivity for remote locations or installations spread over large distances.

Solution
Eaton deployed a 900 MHz long-range meshing Ethernet network to solve the problem. The ELPRO 945U-E industrial Ethernet modems provided secure, reliable, high-speed data connectivity for PEMEX over very long distances. Installed devices are capable of reading pressure and temperature in each of the “Christmas trees,” and they integrate into a long-range wireless network within the assets of PEMEX oil extraction.

Results
Previously, PEMEX had to hire teams by area within the oil fields to monitor the pressure and oil temperature—variables affecting the extraction yield and potentially raising cost by millions of dollars. The Eaton solution enabled monitoring of all variables from a control center with more granular control over variations. PEMEX was able to take advantage of WirelessHART field devices, without the cost and time associated with traditional wired/fiber solutions.
Coal seam gas wellhead monitoring

Problem
A major coal seam gas supplier in Queensland, Australia, needed a wireless control infrastructure. The site could accommodate expansion to 12 million tons of LNG a year, subject to demand, and had extensions of QGC assets from several hundred wells to several thousand wells.

Solution
ELPRO radios were selected and integrated into an RDC 500 standardized wellhead. The radio design uses a network consisting of wireless access point repeater sites. Each site collects gas flow, pressure, temperature and water flow and can shut down valves or pumps.

Results
Wireless delivers up-to-date production data, provides shutdown capability, lowers the requirement to be onsite and improves personnel safety. One of the world’s largest wireless mesh networks is now in place, with several hundred wellhead sites in a field that will expand to 12 million tons of LNG annually.

Technical requirements
- Ethernet modems with a range of approximately 10 km
- 900 MHz or lower frequency range is strongly preferred over 2.4 GHz
- Ability of modules to act as repeaters due to the nature of the terrain
- Polled system with maximum 30-second poll cycle time
- Meshed RF system to avoid problems with point-to-point failures
- Peak data rate of 2.5 Mbps (point to point)
- AES encryption
- Over-the-air configuration and diagnostics
- Firmware upgradable over the air strongly preferred
- Network management software
- RS-232 and RS-485 ports highly valued

Monitor well sites
A major oil production company in the Permian Basin is using the 450U-E wireless Ethernet modem to monitor flows and levels in addition to transmitting set points to production assets. Each site has a PLC using Modbus TCP to communicate. A master site has an HMI, enabling an operator to quickly see how the entire network is performing. Due to the distances between sites and the lack of line of site at some sites, a licensed 450 MHz radio at 5W of transmit power was used to overcome these barriers. As is common with narrow-band radios, throughput is limited, which means careful selection of a communications protocol is required. Modbus TCP was selected because the messages are very short and the protocol is common enough to match equipment from many different manufacturers.
End-to-end networking solutions
Network connectivity and management

Major oil refinery improves compressor station monitoring productivity from 5:1 to 50:1

“Given the skilled worker shortage, wireless lets us do more with less.”

Director of Process Engineering
“900 MHz frequency hoppers from ELPRO resolved issues with fixed-frequency radios and leased lines at new and existing IFD sites. The solution provided a wireless alternative to expensive wiring.”

Magellan Midstream Partners

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### Information: Monitor and Optimize

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### Controller: Integrate and Extend

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### Machine: More Throughput and Uptime

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