Wireless technology offers mining operations improvements

Wireless technology is a hot topic for anyone involved in the design, operation, maintenance or upgrading of mines or mineral processing plants because wireless technologies overcome barriers that have prevented many useful data inputs. Wireless communications can contribute to worker safety, satisfy environmental concerns, support plant security, track human and physical assets, and improve equipment maintenance.

The cost structure of wireless is compelling and users can realize savings — up to 90 percent less installed cost than wired instruments — since wireless technology eliminates the need for expenses associated with cabling, engineering, construction and documentation. Many applications previously considered too expensive have become economically feasible with wireless. Two examples are continuous monitoring of safety showers to notify operators when one has been activated, and monitoring effluents to ensure environmental regulations are being met.

In many cases, wireless transmitters can be installed where wired devices were too expensive to justify, or were not feasible due to physical or technical barriers. Examples include monitoring temperature measurements inside a rotating reactor or monitoring process variables in a tough, corrosive environment too challenging for a wired solution. Wireless also gives operating personnel mobility with the ability to communicate from remote or hard-to-reach zones.

According to a recent Venture Development Corp. survey covering radio frequency (RF) of microwave industrial monitoring and control products, these features are contributing to the expected nationwide growth rate for industrial wireless applications of 19 percent annually from 2007 to 2012 (Taylor, 2008).

At the same time, mineral producers have many questions about wireless systems including their applicability, reliability and security in this industry. Just what can wireless do? Is it secure and reliable? Can these instruments stand up to the rigors of the industry? Can wireless technology provide the flexibility needed for mining applications?

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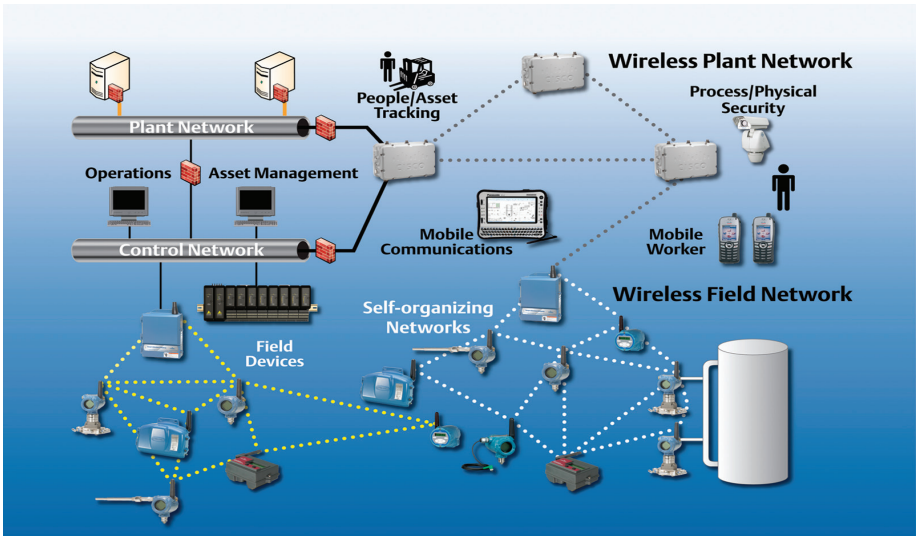
Emerson's two-tiered Smart Wireless solution supports wireless field device networks and wireless plant networks. These communications systems integrate seamlessly with traditional control and asset management applications.



Defining wireless

Wireless technologies can have a dramatic impact on mining operations in two broad categories: wireless field networks for sensor and field device applications, and wireless plant networks for business and operations purposes.

Wireless field network (WFN) — Self-organizing wireless field networks, based on the WirelessHART communications standard, are easily installed and capable of delivering measurement data and diagnostics without the need for investing in a plantwide infrastructure. The WirelessHART standard was approved in September 2007 by more than 200 member companies of the HART Communications Foundation. It's specifically designed for use in process manufacturing, including mine processes. WirelessHART was named one of the "three top automation trends of 2008," according to the ARC Advisory Group of Boston (ARC, 2008).

WirelessHART devices use small amounts of bandwidth, enabling high priority communications. The important characteristics of security and reliability have been engineered into the technology using proven industry techniques. The self-organizing mesh networks ensure maximum integrity by allowing the field devices to communicate with each other. This means there is no single point of failure. Every device serves as a network connector, automatically finding the optimum communication pathway. In the event a temporary obstruction blocks a direct connection, signals are automatically rerouted by an adjacent device, optimizing connectivity and achieving greater than 99 percent data

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transmission reliability.

When planning wireless field networks, there is no need for preliminary radio frequency site surveys or assumptions as to what the RF characteristics are going to be like at any one time. With self-organizing networks, it does not make any difference. Significantly less communications infrastructure is required because these networks operate perfectly well in very dense plant environments.

Battery life is an added dimension that is an important aspect of the technology. These wireless devices can be set to a low-power mode to save energy, enabling them to run for an extended period on one battery. Run times depend on how often the device is configured to update. Current battery technology, combined with energy efficient measurement instruments, can extend battery life to 10 years for many temperature and level applications. The wireless plant infrastructure allows cost-effective and seamless integration between the field data and the automation system or asset management systems. Wireless field devices are often widely and remotely distributed throughout a plant, across roads and canals, or on mobile platforms like railcars, barges or trucks where traditional wired data collection is not feasible. The WirelessHART field devices collect the process data and the wireless plant infrastructure provides the means to transmit and integrate the measured data with the process control system.

Wireless plant network (WPN) – Based on IEEE 802.11 standards, WPN use mesh WiFi technology to build cost-effective outdoor wireless networks for plant operations. The WPN is designed to provide a secure, high-bandwidth, reliable and scalable way to access fixed and mobile applications, such as process data monitoring, asset tracking, video surveillance, voice communication, etc. Typically, a wireless plant infrastructure is constructed from mesh access points, a LAN controller and network management software.

Security is a crucial factor to consider when considering a WPN. Fortunately, highly secure WPN technology is available for industrial applications. To prevent wireless eavesdropping and other external attacks, all data transmissions are robustly encrypted with provision for user authentication. Security standards and protocols include 802.11i, WPA2 and AES.

Reliability is the other important requirement for a WPN. An intelligent routing protocol creates and maintains the wireless mesh, providing network self-healing, resistance to interference and resilience against network outages. A remote access point determines the best route connectivity within the mesh, mitigates RF interference and ensures high network capacity.

Questions/answers

Just what can wireless do? Wireless devices can be installed quickly and easily where wired devices cannot, such as in hard to reach locations, areas hazardous to plant personnel, where power does not exist and where running wires is not allowed. The retrieved data will enable mineral processors to respond to equipment problems immediately and even predict when problems will occur in order to avoid unexpected shutdowns. Improved understanding of the process and greater plant availability will come with this. The ultimate benefit is a combination of lower costs and increased productivity.

Wireless technology makes it easier to put people in touch with the information they need to do their jobs more effectively. For example, workers can access desktop applications and perform tasks wherever they happen to be. Personnel and physical assets can be tracked continuously within the plant area. Security systems ensure authorized plant access and video systems not only patrol the fence line, but keep an eye on the process. Wireless technology does all this — easily and cost-effectively – to give personnel better knowledge of what is happening in their operations.

Can you depend on the data? The reliability of any wireless system depends on getting the message through, even if a device fails or a line-of-sight path is blocked. Unlike point-to-point wireless systems, the mesh approach affords many different pathways for transmissions to reach the gateway (or receiver), which channels the communications to a control system or other appropriate location in the plant. This redundancy yields a high level of communication reliability no matter what permanent or temporary obstacles may exist between the transmitting devices and the gateway. In fact, self-organizing wireless mesh networks routinely achieve greater than 99 percent communications reliability.

Can wireless devices withstand the rigors of mines and mineral processing? Emerson's wireless devices are operating successfully in controlling oil sands slurries in northern Canada — one of the harshest environments on earth. They are also being used to monitor heating elements of a seaside bitumen pipeline used for ship unloading in Australia. And they are able to withstand the heat and humidity of a steel rolling mill in West Virginia. No matter the challenge, their reliability rating remains higher than 99 percent.

Can wireless provide the flexibility required for mining and mineral processing? Openness is one of the benefits of the WirelessHART standard. So both suppliers and end users can innovate and develop wireless products and applications that add value to an operation. Useful applications can be developed when mineral processors work with their instrument suppliers to solve difficult challenges.

WFN applications

Wireless field devices are used today in two main application areas:

- New, must-have measurements.
- Want-to-have measurements.

New, must-have measurements are normally the result of laws passed for environmental or safety reasons. Compliance requires measuring flows, levels in storage tanks and the quality of effluents in remote areas. The lawmakers do not care about the challenges that come with the laws, only about the compliance with the law.

For example, a refinery in Alabama must monitor the temperature of cooling water returned to the nearby river. A single Rosemount wireless transmitter monitors the return flow to assure compliance with state regulations and communicates a continuous stream of data to a Smart Wireless Gateway that connects to the distributed control system.

Want-to-have measurements are those that could not previously be cost-justified. Generally, when process plants are built, a number of proposed measurement points are not wired, usually due to the cost. Later, operating personnel find more parameters they would like to measure continu-

ously to improve plant performance. The inherently low cost of installing wireless devices is making it possible to obtain needed information from more of these points.

Frequently, remote measurements are fed into on-the-spot chart recorders or data loggers, and technicians periodically make time-consuming "clipboard rounds" to gather the data. This was the case at one mineral processor, where heat exchangers used to heat digestion slurries had to be monitored for signs of restrictions due to internal scale build-up. However, the sampling rate was so slow the data logger did not capture spikes or establish a meaningful trend. Since wireless pressure transmitters were installed to continuously measure the DP across four digestion slurry heater sets and transmit that data to an Emerson Smart Wireless Gateway, no failures have occurred. Despite torrential rains and poor weather conditions in this area, this network has proven 100 percent reliable.

Another typical want-to-have measurement involves the continuous vibration monitoring of rotating equipment where periodic "route checks" have been the only means of gathering data for analytical purposes. New wireless vibration monitors are making it possible to keep a closer watch on a range of remotely operating motors and pumps. This is expected to become a prime application area for wireless in the mining industry.

Wireless valve position monitoring also makes sense for mineral processors because so many benefits are to be gained. Many operations today have "blind valves" that are either manual or semi-automated, providing no diagnostic feedback at all. In most cases, cost and/or location dictated against enabling these valves to give feedback. Device diagnostics are important since incorrectly positioned valves represent a significant cause of safety-related incidents.

Another reason for giving control valves the communications power of wireless is to obtain performance information. It is basically impossible to look inside an operating control valve to determine how well it is actually performing. For example, valve deviation from the desired position cannot be determined externally. Yet, a deviation in excess of five percent for five seconds could be an indication of trouble that can only be detected by a smart digital valve controller – or tearing down the valve.

For valves in remote or inaccessible areas, wireless is the best and least expensive means of communicating the problems that can cause slow response times and reduced process efficiency. With up to 90 percent savings over a wired installation, wireless applications are now a lot more attractive.

Smart Wireless devices are easier and less costly to install than wired instruments in remote areas and hard-to-reach locations. They transmit data and diagnostics reliably regardless of the density of the surrounding infrastructure.

WPN applications

With wireless plant networks, mobile personnel will be able to stay connected to the systems and applications they need to be efficient and effective. For example, mobile worker applications will enable field operators and maintenance personnel to use ruggedized or classified PCs or PDAs to wirelessly access process data and business applications throughout the site. Field personnel can follow real-time work instructions to perform operations, use process data or asset data for troubleshooting, document work status, or collect material and equipment bar code information. This can improve plant worker productivity and efficiency, especially since operator presence in the field is so common in mining.

Location tracking. Location tracking integrates multiple visibility technologies, using standard WiFi infrastructure and advanced location engines to track people and assets in plants. This application improves personnel safety, enhances plant security and optimizes the use of critical assets in harsh environments. If an emergency evacuation is ordered, personnel gathered at mustering stations are automatically identified and recorded by wireless tracking. This same application can provide information on field personnel moving in and out of hazardous or restricted areas.

Emerson's Location Tracking System is designed to work in harsh environments, using a standard mesh WiFi network as the backhaul to transfer location data in real time. Location receivers, exciters and active RFID tags work together to accurately monitor the location of people and assets in mining operations. WiFi, ultra-wide band, GPS, choke-point and RFID technologies are integrated in a single network infrastructure. Time spent looking for assets can be reduced, minimizing production disruptions and delays during major turnarounds, emergencies and new construction projects.

Using wireless technology, mission-critical video feeds can be delivered to the control room, office buildings and other areas in a flexible way that is not possible with a wired plant. A wireless, high-data-throughput video system can be deployed faster and with less complexity to patrol the fence line, or cost-effectively monitor the process.

Voiceover wireless LAN (VoWLAN) is intended to support mobile voice communications over the WPN infrastructure. Internet protocol (IP) phones in a VoWLAN system operate like cell phones, except that calls made over a wireless plant network use voiceover Internet protocol (VoIP).

VoWLAN affords greater mobility to field personnel

and helps workers to be more responsive to work orders and emergencies. Immediate communication among managers, supervisors and operators improves coordination during startups and shutdowns, and the time saved reduces downtime during daily operations. VoIP phones keep field personnel connected all of the time. In case of emergency, requests for help are immediate and rescue teams receive real-time information.

VoWLAN leverages an existing WPN infrastructure, providing voice and data services – with no monthly charges. The cost of ownership is lower than other communication options.

Goals/results

Reliability, low installed cost and industrial grade security based on established standards lead the list of mining industry requirements for wireless. Their goals are in tune with other industrial processors, i.e. reduced costs, improved efficiency for greater productivity and less unplanned downtime. Specific benefits will be:

- More and better data from inaccessible points.
- Faster response to equipment problems.
- Improved understanding of the process.
- Lower installed costs by eliminating wire and cable.
- Reduced maintenance costs.
- Flexibility in response to change.

In the final analysis, quality, throughput and availability go up while costs for operations and maintenance, safety, health and the environment go down through the application of wireless technology.

Getting started

Most major instrument suppliers are supporters of the WirelessHART standard and can be of service to mineral processors in initiating wireless applications. Emerson is currently the only major automation system supplier shipping standard wireless products for integration with control systems. This includes not only Smart Wireless field devices, but the Smart Wireless Gateway, which receives transmissions from up to 99 transmitters and integrates that data with automation systems. In addition, the AMS Suite predictive maintenance software gives plant personnel an easy way to manage assets using device diagnostics to determine when and if maintenance is required.

To enable potential users to gain experience without large expenditures for infrastructure or components, Emerson offers a SmartPack startup kit consisting of a selection of wireless transmitters, a Smart Wireless Gateway and instructions on configuring a self-organizing wireless mesh network. This is all that is needed to create a functional wireless network. ■