Modernise your plant with wireless

ebook

www.processonline.com.au

processonline.com.au
Automation, control & instrumentation

WESTWICK-FARROW MEDIA

Of all the challenges facing operators of process plants today, among the greatest are the need to reduce operational costs, reduce energy consumption and improve safety.

Existing plant infrastructure will already have all the technologies necessary to efficiently manage the core processes of the plant, but commonly, plant maintenance is done through manual inspection and scheduled regular downtime - leading to maintenance often being carried out where it may not always be needed, and at the same time exposing maintenance staff to health and safety risks.

With wireless technologies such as Wi-Fi and WirelessHART, it is now possible to further extend the reach of the operator, without incurring the costs of additional wiring. New instrumentation can be added specifically for the purpose of asset condition monitoring, providing information that allows maintenance to be targeted to where it is really needed - proactively and responsively. When plant staff need to inspect and maintain, wireless technology can allow them to have information at their fingertips when then need it - and to get help in real time from their colleagues in the control room. And in the event that an accident happens, wireless technology can be used to alert operators and provide diagnostic information or location of injured staff.

There will always be a cost and a 'learning curve' in adopting new technology, but the dividend received from better available information and improved responsiveness well justifies considering the investment.

Glenn Johnson
Editor – *What's New in Process Technology*

Contents

Modernise and maintain

Implementing wireless to monitor beyond the P&ID

Many operational and maintenance problems around a plant can be solved by deploying WirelessHART transmitters beyond the P&ID together with an asset management system and other software to obtain asset health information and other additional plant data. However, plant procedures must be written so as to make full use of this new information

Plant-wide modernisation can be achieved through installing wireless transmitters beyond the piping and instrumentation diagram (P&ID) and feeding raw data into essential asset monitoring (EAM) software and other applications. The basic deployment phases are illustrated in Figure 1. But with the hardware, software and updated operating procedures in place, central maintenance planning, energy conservation measures, HS&E (health, safety and environment) improvement and remote operations can become a reality. That is, the new plant information must be institutionalised in daily work processes to be effective.

There will be minor differences depending on whether the project is the modernisation of an existing plant or a greenfield installation.

Justification

The initial step is to get buy-in from the plant management that will approve the project. For an existing plant, there is a need to justify modernisation with wireless, and with a new plant, expanding the scope beyond P&ID to include EAM, ECM (energy conservation measures) and HS&E packages as part of the project must also be justified.

The opportunity to improve maintenance, energy consumption and HS&E by modernising should be explained to the plant management, maintenance manager, reliability engineer, HS&E officer and project/turnaround manager. Investment in wireless transmitters and centralised EAM software can be justified on the basis of reduced downtime, lower maintenance cost, lower energy consumption and improved HS&E, provided the new information is institutionalised in the daily work processes and the plant culture.

Typically, critical plant assets such as expensive compressors and large pumps are already monitored, but due to the high cost of traditional machine protection and monitoring systems, the balance of assets may not have previously been monitored. These ‘second-tier’ assets, although essential to the process, are typically only spot-checked manually on a periodic basis (see the breakout for examples). Improving the monitoring of these assets can have a direct positive impact on maintenance and energy costs.

The modernisation has to be accompanied by a culture shift, especially for EAM. Maintenance technicians will be able to tell if assets need to be maintained urgently, if they can wait until the next turnaround or if they need no maintenance at all. This not only enables turnarounds to be shortened, but reduces the crane and crane operator costs, and the need for hoist, scaffolding, fitters, riggers, instrument technicians, electricians, pipe fitters as well as insulation and other material. Incorporation

EAM for second-tier assets

Three common examples of second-tier assets that are prime candidates for wireless EAM are heat exchangers, pumps and steam traps.

Heat exchngers

Plants typically do not know the rate of fouling of heat exchangers, because the manual measurement of the hot fluid involved is difficult and time-consuming. Since cleaning heat exchangers usually requires a process shutdown, cleaning them too often is costly. But if they become severely fouled, they may need to be removed completely to be cleaned - an even far more costly exercise.

Finding the optimum cleaning time for heat exchangers requires performance data at least daily to calculate the rate of fouling. This can be achieved by measuring hot and cold fluid inlet and outlet temperatures and flow using wireless transmitters. The raw data is transmitted back to EAM software and the plant historian, to allow the automatic computation of all the factors necessary to trend the rate of transfer degradation, making it possible to predict the optimum time for cleaning.

Pump health

A pump can be affected by many different problems, with one type of problem often leading to another. Cavitation, for example, can be caused by a plugged suction strainer before the pump creating a pressure drop, or a downstream flow restriction causing internal recirculation across the impeller - leading to impeller damage and vibration. Vibration can also be caused by poor mounting or misalignment, poor lubrication or worn bearings. The list goes on …

Most pump problems can be detected by vibration testing, but in many cases, manual checking may not occur frequently enough to capture impending failures. Early detection of problems can be achieved by wirelessly monitoring various factors, depending on the pump, and processing the data in the EAM system. Wireless instruments that can be used to do this include vibration transmitters, DP transmitters (detecting pressure drop caused by strainers and seals), level switches (for sealing fluid), temperature transmitters (for bearings and motor windings) and hydrocarbon sensors to detect leakage. Not all pumps will need all these factors monitored, but EAM applications can be customised to suit the individual pump applications.

Steam traps

Typically a steam trap has a life expectancy of four years, so if they are only inspected yearly, then on average, 25% of them may be found to have failed or be ready for replacement - and a typical plant may have thousands of them. Manually checking them is therefore difficult, because of the quantity, and the fact that many of them are difficult to access. They also require a high level of technical experience to diagnose.

Using a wireless acoustic transmitter on the outside of the steam trap inlet, with a built-in temperature transmitter, allows the detection of the ultrasonic noise and temperature change caused by steam or condensate that results from steam trap failure. The status of all steam traps can therefore be displayed in the EAM software for easy review by technicians.

of EAM in daily maintenance practices must be a management directive, with follow-up to ensure new work processes and EAM tools get adopted, and continue to be used to derive value from the asset health information. Deployment will have associated engineering hours and cost.

Audit existing plant

For an existing plant to deploy EAM, ECM and HS&E packages as part of a brownfield modernisation project, it is necessary to audit the entire plant's assets, processing equipment, machinery and valves to identify shortcomings in measurements beyond the P&ID which need to be filled before work practices based on asset health and automatic data collection can be adopted. The audit is an opportunity to rate the plant's asset management readiness. The assessment should also include a look at the current work processes and procedures for operation and maintenance, as well as the maintenance regime, culture and the skills of the plant staff. That which is missing in the existing plant architecture to support essential asset monitoring, energy conservation measures and HS&E becomes the input for the front-end engineering design (FEED) stage of the project.

Define scope

The asset management system for the EAM, ECM and HS&E packages can be a standalone or can be integrated with the DCS. The plant-wide asset health information will mostly be used by the maintenance department for daily maintenance scheduling and turnaround planning, but operations can also benefit from being aware of assets which have failed or are degraded, as the plant can be operated differently to work around the limitations. Conversely, the EAM diagnostic algorithms in the EAM software often use process measurements already available by connecting to the DCS.

WirelessHART and OPC are the enabling technologies that permit easy deployment of automation beyond the P&ID in an existing plant. An OPC server should be added to the DCS in the event that OPC is not already available.

The scope has to be defined early on in the modernisation project and should involve the project/

turnaround team, the DCS team, instrumentation team, modernisation solution supplier and the maintenance group. It should be documented in the form of a basis of design, a functional design specification including system architecture, network protocols to be used for DCS integration, hardware and software as well as associated services. For an existing plant, the system architecture requirements will be based on the plant audit and gap analysis.

No essential asset should be left stranded without EAM.

A remote site may not have personnel with the necessary skills required for analysis of asset health information. For such locations, remote access infrastructure such as a wired or wireless backhaul network between the site and a centralised location should be considered.

Assign roles and responsibilities

A number of persons are involved in the initial deployment of the EAM, ECM and HS&E package, the instrumentation and in sustaining the EAM software and associated work processes for the long term. The person that is responsible for the rollout of new practices for maintenance should be on the modernisation team and is best suited as a lead for the team. The plant management is also instrumental in leading the cultural change required to institutionalise EAM, ECM and HS&E packages in daily plant activities, so a senior member of the management should be the executive sponsor to drive the change. This includes providing required resources for the deployment of the EAM software and the continued running of the system for the long term.

The turnaround manager or project manager also needs to be on the modernisation team to manage the work and resources required to deploy the EAM software. It is also necessary to identify the persons responsible for work processes associated with the EAM software and to establish a cross-functional modernisation team of instrumentation, control system and maintenance specialists. These will be the experts on essential asset monitoring, energy conservation measures and HS&E to continue the modernisation for the long term.

It is a good idea to develop an organisation chart for the team with roles and responsibilities - defining who is responsible for delivering what.

Plan deployment

The modernisation team leader should develop and document a plant-wide and site-specific modernisation plan for how the EAM software, OPC server and underlying wireless infrastructure and transmitters will be deployed at the specific site. This should include a schedule for when each phase of the modernisation project will take place and the resources required, when people will take on their new roles as well as detailed plans for the training of people in different roles.

Detail design

Based on the short-listed assets and the types of asset health diagnostics required for each asset, the number of WirelessHART transmitters can be determined. Next, the number of gateways and supporting networking equipment can be determined. Lastly, assets need to be ranked and their health alarms prioritised in a rationalisation process to ensure effective plant-wide alarm management.

System implementation

The overall system implementation is normally done by the modernisation solution supplier. This will involve building the EAM database, including the graphics, tags, historian, alarm management and reports based on the detail design, and also the ECM database with steam trap information.

Automatic pressure, temperature, flow, level, pH and conductivity measurements as well as safety shower and eye wash stations, valve position feedback, along with automatic vibration, temperature and leak testing data can be routed to the existing DCS or a separate HMI for HS&E purposes.

FAT

The factory acceptance test (FAT) is done at the modernisation solution supplier's staging area, witnessed by the buyer. A FAT test plan shall be agreed on and forms the basis for the FAT test procedures to verify the graphics, asset health alarm management and reports etc.

For the IDM software, verify all versions of all device types from all manufacturers are integrated, that is, their EDDL files are loaded. This involves the IDM supplier, plant instrument specialist and plant system engineer.

Installation

In an existing plant, a local contractor installs the wireless transmitters as well as the wireless gateways with network infrastructure and power. In a new plant, the EPC does this work.

The modernisation package vendor can help supervise the installation of wireless transmitters and gateways.

If the correct make and model of manual valves, relief valves, safety showers and eye wash stations etc have been identified in the design phase and the correct mounting kits have been specified, the wireless transmitter installation will be smooth.

Commissioning

The wireless transmitters and the software have to be commissioned. Normally a local contractor would commission the transmitters and gateways, including setting the network ID and join key, as well as the device tag and update period if this was not configured in the factory. The site instrument technicians should also take part in the commissioning so they become familiar with the WirelessHART technology.

Wireless commissioning should at least involve checking all instruments join the network and meet the requirements for number of neighbours, signal strength and reliability, and that they are transmitting correct measurement values.

The EAM system would normally be commissioned (and the baselines and weightings tuned) by the EAM system supplier.

Site integration

The modernisation solution supplier works with the DCS supplier to establish communication between the two systems: for operators to receive asset health information and alarms, and for the EAM diagnostic algorithm to receive process variables already measured by wired transmitters. Site integration starts by establishing the bidirectional OPC link between the plant DCS and the EAM software.

Having a list of parameters to be linked between the systems developed in the detail design phase speeds up the integration work in the two systems.

Note that for EAM, only computed information like one overall asset health index for each asset is passed to the DCS, not all of the dozens of raw data points like vibration and temperature for every asset. This way the DCS tag count is kept low and the integration is simple.

Process variables already measured by wired transmitters connected to the DCS come from the DCS through OPC into the EAM software. At sites where the EAM software gets process variables like heat exchanger flows or variable pump speed from the DCS through OPC, the site integration and commissioning may happen in parallel.

Develop procedures

Procedures and work processes should be written making use of the new plant-wide information. Development of these procedures can start early in the project and does not need to wait for the detail design to be completed. A consultant can help in the development of the procedures and work processes for maintenance, energy conservation and HS&E. These services should be included as part of the project budget.

Training for competency

Use of EAM software and other applications requires new skills, therefore training is required for all those involved to get the necessary competency in asset management. With asset management, work is centred around computers, so computer skills are a prerequisite for maintenance work in a modern plant.

Asset management training has to be specific to the competencies required for the tasks which each role has to carry out. Training has to be conducted not at the end of the modernisation project, but throughout the duration of the project before the next phase of the project starts. Once the plant is operational, new employee training and refresher courses should be conducted periodically.

Protecting your workers wirelessly

If staff are a company's greatest asset, then it is in the interests of that company to keep them safe and productive. There are obvious forms of protection such as guardrails and automatic machine cut-offs but more sophisticated technology is increasingly being used to address workplace health and safety issues, particularly in industries such as oil and gas, mining and utilities where employees are often working in hazardous and remote locations.

Accident investigations reveal that human error results in 70-90% of all industrial accidents. While some of these incidents are a result of pure human failure such as disregarding working procedures, the potential for error can be reduced or eliminated using wireless automation, thereby creating a safer working environment.

Wireless technology can improve accuracy and productivity by automating tasks and reducing exposure to hazardous situations. The less time workers spend in the field taking measurements or carrying out inspections, the safer they are going to be. So, wireless technology can be used to remotely monitor many of these tasks to improve overall plant safety and efficiency. Using WirelessHART technology, manual tasks, such as finding and reading gauges, can be minimised. By replacing gauges and meters with wireless transmitters for pressure, temperature, level, flow and many others, readings can be measured wirelessly then transmitted back to the control and asset management systems. Data can be transmitted as often as required by each application. This eliminates the need for technicians to make 'clipboard rounds' and improves the timeliness, accuracy and frequency of measurements, enabling troubleshooting and corrective action before a potential problem grows.

Assisting workers

Wi-Fi is the other major wireless technology and is more frequently used to assist personnel and ensure workers in the field are equipped with the right information at the right time. For instance, inexperienced workers are more likely to suffer harm but with fewer workers now available in some plants and the increasing retirement of experienced workers, job scopes for an inexperienced individual worker have increased and this can lead to potential errors.

When personnel are working in the field, they can have confidence knowing people with greater experience at a central location are easily contactable through a wearable videoconferencing system. By pointing a hands-free camera at a problematic piece of equipment, for example, a Wi-Fi radio link is used to involve the more experienced technician who can probably solve the problem.

Technicians often need to juggle many tasks in the plant: calibrating or troubleshooting in the field, observing field conditions and recording measurements in hazardous classified areas. With Wi-Fi radio infrastructure in place, these tasks can be considerably simplified. For example, armed with a tablet computer with video and voice capability, one operator can easily perform multiple jobs in a single operator round. These tasks may include visual inspections, taking pictures of safety hazards such as a leak on the pipeline, observing measurement of the manual gauges that, for example, may monitor flow to prevent any overflow, etc. This live information (data, video, voice, etc) is fed back through the wireless system to a central point where it can be compared with the previous day's records, retrieved from a central server.

Workers operating in the field are faced with unique safety issues that must be managed. If something does go wrong, the results can be life threatening as help can sometimes be a long way off and communication may be limited. Wireless incident tracking solutions can be used to activate an alarm at a central point when a particular safety station, such as an eyewash or shower, has been used. This allows the operator to quickly dispatch assistance and investigate injuries. For example, using a wireless transmitter installed at each safety shower station, along with a centrally located gateway. The wireless transmitter is intrinsically safe, enabling use in a hazardous location.

In a recent application at a paper mill in North America, eyewash and safety shower stations needed to be monitored in the process safety management areas. The mill wanted its operators to be able to respond quickly to emergencies in these areas. A traditional wired solution was cost prohibitive, so an alternative wireless solution was explored.

The paper mill installed five wireless discrete transmitters at its site, which were connected to the eyewash and safety shower stations. A wireless gateway was also mounted on top of its five-storey building. The mill is now able to monitor the switches every 15 seconds and has the capability to timestamp the devices to ensure each one is updating properly. Not only did this improve the overall safety of the mill, but by using a wireless solution versus a traditional wired solution, the mill was able to save nearly 60% in installation costs.

Tracking workers

Government regulations require hazardous sites, specifically extraction sites for oil, gas and mining, to plan for emergencies. Government agencies such as MSHA (US), ATEX 137 (UK), DSEAR (UK) and Australian Emergency Management require site evacuation plans and regularly scheduled drills to plan for emergencies.

Wireless tracking solutions can be used in emergency situations so that instead of taking a time-consuming roll call, the mustering status of all personnel in the process plant can be automatically determined and located. In an emergency, having accurate location information of all plant personnel means those first responders can be immediately sent to the location of an injured person.

Plant personnel can be tracked throughout the plant site using different types of radio technology, depending on the site's requirements. Wi-Fi-based active RFID technology uses standard Wi-Fi (802.11) radio, and that works with standard Wi-Fi equipment such as hazardous zone 2 certified access points to provide real-time people tracking.

Intrinsically safe Wi-Fi tags which are carried by all personnel, contractors and visitors in the plant send out a Wi-Fi message to the nearby access points on a recurring basis. These points then measure the signal using the received signal strength indication (RSSI) or time difference of arrival (TDOA) method and details are sent to a mobility services engine, which is a platform that enables the wireless network to deliver all the location information in a centralised and scalable way to determine the location of the tag worn by an individual. A web-based software platform can provide a full range of applications with visualisation, reporting, management and automated alerting options, as well as the ability to deliver the information to third-party systems such as enterprise resource planning (ERP) software and asset management systems through an Open API (application programming interface).

If in distress, workers can press the tag's panic button, and if a person is not in motion for a period of time, the tag will automatically send an alert to the system. The other personnel can then respond to the incident without delay as the alert will include precise details of the person and his/her location.

Hazardous areas can also be monitored to provide a form of access control, thus minimising the risk of an incident from occurring. Only trained or authorised personnel will be permitted to enter the premises using their tags and instant alerts are given when employees and visitors enter restricted areas. Workers' locations can be monitored in real time and reports provide accurate location data and event history.

At a coal mine in Australia, 200 workers underground were tracked, based on intrinsically safe tags in 50 diesel vehicles throughout the mine. The solution ensured that all workers in the mine were quickly and accurately accounted for at specific mustering points.

The accurate real-time location of each of these diesel vehicles also facilitates better fleet management and streamlines vehicle access into ventilation districts.

At mine sites, Wi-Fi RFID technology can be integrated into cap lamps to bring a greater level of safety to miners without encumbering them with additional equipment. Underground workers will always have their cap lamps with them, so it makes sense to use that same equipment to enable quicker emergency response and to automate the mustering process.

The technology

Wireless technology helps eliminate conventional wiring complexity. All wireless devices can be installed and commissioned within minutes and users can easily add additional devices to their wireless network.

The WirelessHART standard (IEC62591) and the Wi-Fi Standard (IEEE802.11) are both internationally recognised standards. These wireless technologies give a seamless extension of the wired architecture in the process industry. WirelessHART is built on the HART standard providing a cost-effective, simple, reliable and secure way to deploy new measurement and non-critical control points without the wiring costs.

IEEE 802.11, commonly known as Wi-Fi, provides a wireless infrastructure for fast transmission of data (voice, video, field data, tracking data, etc) over some distances. Wi-Fi also enables the wireless communication between a WirelessHART gateway and a distributed control system (DCS), and the wireless communication of remote DCS units.

Appendix

Competing for the future - does wireless play a part?

Brett Biondi, Wireless Business Development Manager ANZ and Michael Totten, Wireless Specialist ANZ, Emerson Process Management

There can be no doubt that the heart of any operation is the process control system. More recently, industry is embracing a paradigm shift away from localised operations via distributed control, to embracing the need for remote operations centres controlling and monitoring multiple facilities.

Broader control of multiple facilities would not be possible if it weren't for advances in sensor-based technology, fieldbus communications and in some cases wireless sensors and adapters. Sensors now not only provide information on the health of the device but also the health of the process, making it possible to determine how the process can be improved. This information is communicated up to the control room and to the remote operations centre personnel tracking things like production, pending issues in the process and in measurement devices and the like.

Recent examples include the coal seam gas industry where, despite marginal well heads and the scarcity of experienced personnel, the use of remote diagnostics has made possible timely, cost-effective decision-making. Further examples include applications developed to retrofit and proactively monitor essential assets which have long been overlooked but are at the centre of production slowdowns or even shutdowns. Such applications help to ensure losses in the hundreds of thousands, if not millions of dollars, are avoided.

There are many issues that need to be considered in the implementation of a wireless sensor network. This article looks at these issues from the perspective of WirelessHART technology, but whatever wireless technology is used, the end user needs to take the following factors into consideration.

Network availability, reliability and management

A plant is often a challenging environment for radio frequency (RF) communications. RF systems must contend with having to communicate in the presence of piping, vessels, structural steel, moving objects such as vehicles and other devices emitting an RF signature (which may or may not be noise at the communicated RF signal). It must also do this without user intervention in a self-managed fashion.

Modern wireless sensor systems, such as WirelessHART, have therefore been developed to overcome these issues by providing self-organising, self-healing, adaptive networks featuring multihop, deep mesh architectures. At the heart of such a system is the wireless gateway, controlling communications and perennially challenging the network and devices for path optimisation and alternate path options. Multiple paths are maintained such that when a new obstacle blocks the path, an alternate path is used for the information to reach the gateway and control system. All transmitters - regardless of manufacturer - participate in the mesh topology to ensure a multitude of communication paths are available and that reliability needs are met. If required, redundant gateways are available to provide redundant communication masters that self-monitor and can perform 'hot swaps' - change over in the advent of a failure - reporting the event to the control host.

Naturally, some applications require faster updates and lower latency than others: some, of course, are the exact opposite in a relative sense. WirelessHART, for example, is a user-defined, time synchronised/scheduled communications protocol. WirelessHART transmitters timestamp measurements from the original point of measurement allowing latency to be tracked and have a selectable update period adjustable from 1 second to 1 hour. The user therefore has control over the devices' reporting rate (and power module life) with time-stamped communications. This functionality is all achieved behind the scenes, without user intervention, by the gateway and devices reporting the network availability and alternate path options.

Coexistence

Being based on global standards, a wireless field network potentially has to operate in close proximity to other wireless network technologies in the same 2.4 GHz band (such as Wi-Fi, Bluetooth and ZigBee etc) that may cause in-band interference. To help overcome interference issues, WirelessHART and other wireless sensor technologies use the IEEE 802.15.4 standard utilising direct sequence spread spectrum (DSSS) but also with frequency hopping spread spectrum randomly channel hopping from one communications channel to another on a packet-by-packet basis. If momentary use of the selected channel is detected, the network will migrate to another available channel and re-establish communications. If broad use of a selected number of channels is evident (eg, a Wi-Fi network), the WirelessHART blacklists those channels and communicates within the known set of available channels. Intelligence such as this embedded into the communications protocol ensures coexistence in the event of of in-band interference.

Security

Understandably, security has been at the forefront of end-user concerns in the adoption of wireless technology. In the case of WirelessHART, security measures may be classified into data protection and network protection.

Data protection

Data protection (or confidentiality) is concerned with the privacy and integrity of the data communicated. When transmitting, the WirelessHART standard uses end-to-end (data source to data recipient) 128-bit AES encryption on a message-by-message basis. It also uses CCM*[1] technology to check for tampering during transmission (superimposing or altering data), attacks trying to change the network routing information and to ensure devices and the information shared are authenticated (proven to be from a known source on the network). In addition to this, a separate common network encryption key (autonomously routinely changed subject to site security policy) is shared by devices when broadcast information is shared across the network (eg, challenging network path efficiency). Devices attempting to join the network must pass a separate 128-bit 'join' encryption key test or their access will be denied. In effect, information is checked on transmission for authenticity, packet size/alteration, source and destination and network verification.

Network protection

Network protection is concerned with ensuring the network remains functioning. Attacks may emerge from devices impersonating authenticated devices to steal legitimate information, attempting to insert malicious code or to disrupt network services in the form of a denial-of-service attack. Regarding impersonation, as above, WirelessHART will look to authenticate and validate device communications and deny service to the unauthorised device(s). Moreover, the size of the data frame is small and of a predetermined known size, so that checks via CRC and CCM* mitigate this threat. With respect to denial of service, using a random hopping algorithm with channel blacklisting helps to make DOS attacks more difficult.

In both cases (data protection and network protection) these security mechanisms are on permanently and transparent to the user. All that site personnel have to do is to ensure they follow routine procedures such as not giving out password access to the gateway and then configuring the transmitters via a wired maintenance terminal in the normal fashion. It should also be pointed out that when wireless sensor/ instrumentation networks use a Wi-Fi backhaul network, the end user should also consider the security of the backhaul network.

Interoperability and interchangeability

Using a wireless sensor network based on an IEC standard ensures that multivendor interoperability is possible. Process applications require many types of measurements such as flow, level, valve position, pH, conductivity, vibration, temperature, pressure and acoustic, as well as contact input and level switches. These measurements may come from different transmitter manufacturers and all vendors using WirelessHART, for example, undergo certification from the HART Foundation. Therefore, certified WirelessHART transmitters of many different types, from many manufacturers, integrate into the system in the same way using the same application protocol.

Transparent system integration

There are many considerations in designing and commissioning a wireless network. Plants already have digital devices using hardwired and bus integration into intelligent device management software, using one of the common device description languages available on the market. However, using wireless technology that supports a common device description standard can streamline integration yet provide for many of the benefits such as device and process diagnostics. The WirelessHART standard supports EDDL technology enabling WirelessHART transmitter integration in existing intelligent device management software that utilises EDDL. When the EDDL file for the WirelessHART transmitter is loaded, the system automatically picks the correct EDDL file for the transmitter, requiring no manual intervention.

Forward and backwards integration

A control system has an expected lifespan of 15 years or more. Over its life cycle, new types and versions of wired and wireless transmitters will come into the plant. The control system must be kept up to date with these in order to avoid technical obsolescence. Therefore, using a device integration technology which has no dependency on version releases of Microsoft Windows ensures backwards and forwards compatibility between system and wireless transmitters. With technologies that are text-based, such as EDDL, this means that new versions of WirelessHART transmitters can be deployed without having to upgrade the Windows version on the control system.

Power module considerations

Preserving power is important to extend battery life in remote wireless instrumentation. WirelessHART uses the extremely low-power IEEE 802.15.4 radio communications with sensors turned off between measurements to preserve the life of the power module. Careful selection of vendor can mean that transmitters in a mesh topology may provide a battery life of up to 10 years (depending on sensor type and the configured update period).

Wireless network management diagnostics

Preventing network disruptions and providing for effective troubleshooting are key issues for network design, maintenance and selection. Key metrics in network management diagnostics entail communication statistics such as missed updates, discarded updates, reliability, path stability, signal strength, latency, number of re-joins, timestamps for last join, maintenance of a 'live list' of devices, service denials due to network load and power module status/health. The wireless technology that is chosen should provide communication status for all of the above and provide for user-friendly graphics to aid interpretation of information.

Diagnosing wireless devices

A question often asked by end users concerns any potential differences in diagnosing device issues in a wireless system. This is another area where it is important that the wireless devices comply with a known standard. The WirelessHART standard forms part of the HART 7.1 standard and, as such, no new equipment, training on devices should be required. Universal commands and specific commands are used to access diagnostics in the transmitter, making the transmitters easy to troubleshoot. If an asset management application is used, the richness and ease of use of the wireless system becomes apparent. This can be exemplified by adding a wireless interface to a legacy non-wireless device to provide insights into the device and possibly the process's health (depending on the revision date of the legacy device).

Wireless today and in the future

The increasing uptake of wireless instrumentation and sensor technology due to standards such as IEC 62591 WirelessHART means that it is now applied to a plethora of applications by a diverse range of end users. It is used in diverse industries from the traditional petrochemical, metals, mining and manufacturing to food and beverage and, more recently, retail operations. While a generalisation, wireless sensor use could be classified as conforming to applications of:

1. Process and asset reliability monitoring and control, including motor, pump and valve automation monitoring.

2. Process throughput and efficiency improvements, including automated steam trap monitoring, tank level, rotating kiln and rotating device measurement, and better boiler profiling.
3. Personnel productivity improvement by replacing manual gauge monitoring labour, reducing the need to access hazardous areas.
4. Environmental, health and safety applications including emissions and discharge monitoring, pressure relief valve monitoring, and eye wash and safety shower activation.

In summary, the historical aim has been to optimise production relative to demand needs. Forward-thinking organisations operating in a globally competitive environment are now looking to reduce energy and utility costs to optimise production costs. Wireless sensor technology such as WirelessHART forms part of that planning as firms look to create a competitive framework for the future. ■

Notes: 1. CCM mode (Counter with CBC-MAC) is a mode of operation for cryptographic block ciphers. It is an authenticated encryption algorithm designed to provide both authentication and confidentiality. CCM mode is only defined for block ciphers with a block length of 128 bits. Cipher block chaining message authentication code (CBC-MAC) is a technique for constructing a message authentication code from a block cipher. The message is encrypted with some block cipher algorithm in CBC mode to create a chain of blocks such that each block depends on the proper encryption of the previous block. This interdependence ensures that a change to any of the plaintext bits will cause the final encrypted block to change in a way that cannot be predicted or counteracted without knowing the key to the block cipher.

resources
from our sponsor

EMERSON
Process Management

Emerson Process Management, an Emerson business, is a leader in helping businesses automate their production, processing and distribution in the chemical, oil and gas, refining, pulp and paper, power, water and wastewater treatment, mining and metals, food and beverage, life sciences and other industries. The company combines superior products and technology with industry-specific engineering, consulting, project management and maintenance services. Its brands include PlantWeb, Syncade, DeltaV, Fisher, Micro Motion, Rosemount, Daniel, Ovation, and AMS Suite

Global website:
www.emersonprocess.com

Australian website:
www2.emersonprocess.com/en-au

Essential Asset Monitoring
www.emersonprocess.com/eam

Smart Wireless Process Monitoring Solutions
www2.emersonprocess.com/en-US/plantweb/wireless/applications/Pages/ProcessMonitoring.aspx

Smart Wireless SH&E Solutions
www2.emersonprocess.com/en-US/plantweb/wireless/applications/Pages/SHE.aspx

Smart Wireless Asset Protection Solutions
www2.emersonprocess.com/en-US/plantweb/wireless/applications/Pages/AssetProtection.aspx

Smart Wireless Acoustic Transmitter
www2.emersonprocess.com/en-US/brands/rosemount/Wireless/708-Acoustic/Pages/index.aspx