WHY WIRELESS?

Sandro Esposito, SignalFire, USA, provides a practical look at why wireless pipeline monitoring makes good business sense.

Pipelines and their need for flow (and other) measurements pose many unique challenges. There are about as many different pipelines in as many different environmental locations as there are different methods used to measure the flow inside of them. But the final objective remains the same – to reliably get the flow measurement data to a central location in order

to ensure the right amount of product was delivered to the right place at the right time. So, what is the problem?

Today's business, safety and environmental climates require pipeline flow measurement to not only be reliable and accurate but also to be flexible, scalable, cost-effective and available to all levels and locations of the enterprise. Whether the pipeline transports liquid, gas or steam, the pipeline flow measurement data is becoming part of the business analytics that may be included in the company's overall Industrial Internet of Things (IIoT) initiative.

Pipelines currently employ several measurement techniques which provide the required flow data to enable informed business decisions. New measurement points are added for a number of different reasons. But, how does the measurement device data quickly and effectively get added to the flow measurement monitoring database?

This article will examine the benefits of using wireless network technology to better manage the pipeline monitoring application. Since there is much information written and available on the technical issues of wireless technology, the focus will be on the practical business and operational benefits of wireless networks.

Never enough wires

The traditional method of collecting flow measurement data uses a pair of wires running the distance from the flowmeter to a central location or a SCADA system. Most installations are not able to provide data beyond the monitoring system, since the data is basically analog and does not lend itself to digital communication required by IIoT or cloud access. Wires are also finite; they are not expandable, nor do they provide a flexible, expandable infrastructure.

There may also be the need to gather both flow measurement data as well as smart device diagnostic information from the flowmeter, to maintain process efficiency, ensure consistent product quality, prevent equipment failure, and avoid unplanned shutdowns. Since many flowmeters are smart, they can provide the system with valuable information, reducing unnecessary trips to the field only to find and report 'no problem found'.

There are several different costs associated with installing new wire. There is the obvious cost of the wire and the labour cost required to install it. There is also the engineering cost to determine the junction boxes, raceway/cable trays, and most critical is the additional non-productive time it takes before the measurement is added to the monitoring system. In many cases, this additional labour and engineering means weeks or even months before the new data reaches the control room.

Wireless alternative benefits

Field-proven wireless communication is everywhere. With several technologies and/or standards to choose from, wireless technologies are installed worldwide in basically every industry and thousands of applications – including many pipelines. The selection of any given technology is often driven by user preference or by the user's automation supplier or existing sensor technology. There are many published case studies that clearly outline the value proposition and savings for going wireless vs running more wires, including online estimating tools and calculators. The bottom line is that businesses cannot afford to ignore the facts: wireless monitoring is a cost-effective alternative and makes the best business case. Wireless is here to stay.

Business benefits of moving to a wireless monitoring strategy include three categories of business issues – infrastructure, operations and performance.

Infrastructure

- No or minimal wiring – eliminating trenching, conduit, junction boxes, wiring drawings, etc.
- Environmental flexibility – independent of different and changing terrain, type of measuring sensors, safe use for urban or rural applications and other variables.
- Eliminates rip and replace – wireless works in addition to and integrates with a customer's existing monitoring systems, as well as with the existing measurement devices, without disturbing the present and often fragile wiring.
- Access to remote areas – difficult to access areas including long distances, across water, remote tank farms, mountainous or hilly terrain, railroad tracks, rotating equipment, monitoring safety showers, leaking steam traps, environmental air monitoring, etc.
- Expandable infrastructure – a wireless infrastructure allows additional devices to be added as needed with only the cost of the new device, unlike installing a new wire that will only get you one more device, thus making wireless much more future-proof.
- IIoT enabled – using wireless measurement and device diagnostic information, it is now digital and can be integrated into an IIoT or cloud interface for fast and accessible analysis throughout the enterprise.

Operations

- Reduced cost – significant reduction of installation, engineering and retrofit cost.
- Faster start-up – reduced engineering time and installation of required support hardware (junction boxes, cable trays, etc.) allows the operation to quickly return to production rather than long shutdowns.
- Multiple power options – options include battery power, line power, loop power, solar, or other energy harvesting options.
- Easy set-up – automatic built-in functions such as channel hopping, self-configuration network,

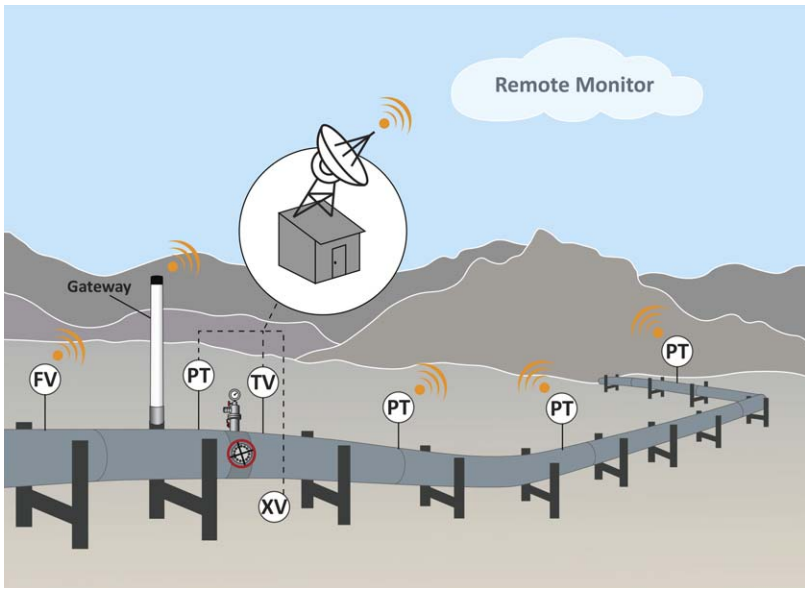

Figure 1. **Wired and wireless devices communicate with the gateway which sends information to the cloud for monitoring and analysis.**

Figure 2. **Pipeline monitoring covers long distances, multiple measurements and challenging environments.**

self-healing, blacklisting, security, selectable device transmission intervals, etc.

- Safety – wireless monitoring can reduce operator rounds and unnecessary trips to the remote and often hazardous locations, ultimately keeping employees safe.

- Asset management – wireless connectivity can provide maintenance staff the ability to tunnel into the smart instrument for communication of configuration, calibration or diagnostics information from smart measurement devices.

Performance

- Reliable data transmission – using industry standard network technology, reliability of data transmission can exceed 99%.

- Secure – uses industry standard 128-bit AES encryption, the same as bank transfer networks.

- Sensor independence – most existing non-wireless devices can be made wireless using their 1 - 5V, 4 - 20mA, Modbus and other outputs.

- Flexible networks and distance – most wireless networks can support from 100 to 240 devices. The common 2.4 GHz radio network with a standard antenna covers approximately 225 m (750 ft). However, a 900 MHz radio network offers a longer range of 0.5 - 3 miles, depending on obstructions (line of sight) and antennae location. This distance can be expanded with long-distance antennae or maximising the multi-hop capability, since a device can also be a repeater which further extends the range of the network.

Wireless network bands: advantages and disadvantages

Without getting into too much technical detail, here is a general review of the main wireless communication bands:

900 MHz

The 900 MHz network band is very robust and has low attenuation, which gives it the ability to travel long distances. This network can also communicate through obstacles like walls and concrete (although it performs best with line of sight). A disadvantage of this band is its speed, because the band is not that large (902 - 928 MHz; 26 MHz), making it limited in the amount of information that can be sent at one time. Unless there is a need to transmit a very large amount of data like voice or video, 900 MHz has been proven to be more than fast enough for reliable measurement communication and even some control applications.

2.4 GHz

The 2.4 GHz band is popular because it allows for greater data rates than the 900 MHz band, due to its larger bandwidth (2400 - 2483 MHz; 83 MHz). Components are generally cheaper than the other two bands because of its popularity. Because there are so many devices that use the 2.4 GHz band – like cordless phones, other wireless networks, and microwaves – it makes it very congested. This means that sometimes it can be difficult to get the wireless network to reliably communicate because of all the interference in the 2.4 GHz network.

5 GHz

The 5 GHz network is not used that often, which can be a good thing because there is little to no congestion within this band. That makes it easy to have a 5 GHz network exist with little to no interference. This band, like the 2.4 GHz band, allows for higher speeds due to a large bandwidth and can also transfer large amounts of data. The disadvantage is it suffers from high attenuation, which does not allow the

network to stretch as far as the other two bands. This can be compensated for with high gain antennae.

Direct vs mesh

Wireless communication can use either a direct or mesh communication network technique. The 900 MHz network allows much longer distances and good penetration, facilitating direct communication from the measurement device direct to the receiving gateway. There are several techniques to extend the communication range to what may be needed on certain pipeline monitoring applications.

Installation and set-up is simplified by using the automatic self-configuring mesh network, which allows wireless devices to utilise neighbouring devices to relay or repeat the transmission until it reaches the gateway. The gateway can be located in the centre, end or anywhere in the covered network area. The end node automatically determines the best primary or strongest communication path for the transmission to reliably get the signal to the gateway. Alternate or secondary paths are also determined and continuously updated in case of a sudden obstruction or interference (Figure 1).

Monitoring outside assets such as pipelines and oil wells that are typically spread out over several square miles, it is unlikely that all wireless devices at each location will be able to reach the assigned gateway. However, there are ways to solve location or application problems. For example, if devices are located in a hazardous location, they are possibly battery-powered and can be rated as intrinsically-safe – limiting the communication distance. But the problem can be solved by placing high-power, long-range devices (e.g. for remote shutdown) at certain locations in the network. These devices have high-powered radios as they are not in the hazardous area. The low-powered devices that are in the hazardous area will (automatically without configuration) connect to the gateway by going through the long-range devices in the mesh network. This network configuration is very robust and is an easy-to-deploy solution.

Essentially, the bottom line is that there are several network options to consider, each with advantages and disadvantages. Once the decision to go wireless is made, the business case for the selection of the network should be driven by the best fit for purpose. Reduced down to a basic few items, consider the application, measurement distance, required speed, amount of data and supplier support.

Wireless myths

Wireless technology has been available from many suppliers for more than 25 years. Over that time, many myths have been propagated regarding the technology and its performance. Here are a few of the myths and the real facts to consider:

- Wireless is expensive – it does not have to be expensive. Today's solutions cover a broad range of options ranging from very expensive to very affordable,

giving customers the option to select the best solution for their specific needs.

- If I select a wireless solution, I have to use only one supplier's products – many wireless solutions provide affordable options that enable the use of existing wired products independent of supplier (4 - 20mA, Modbus and other products) to communicate their measurements on a wireless network, making it cost-effective and giving customers the freedom to choose the 'best-in-class' product for their application.

- All products must use batteries – not true! Wireless devices have many power options including battery, line power, loop power, solar, and other energy harvesting solutions.

- Batteries do not last very long – that depends on the application and the update rate. Most wireless devices can be configured to communicate from every one second to one hour – greatly extending the battery life from one/two years to between five and ten years.

- Wireless is not secure – using the industry standard 128-bit AES encryption makes communication information safe and secure. This is the same encryption standard that is used by banks for wireless money and transaction transfers.

- Wireless networks are difficult to configure – most wireless networks are self-configuring and self-healing. Simply configure and install your measurement device as normal, select the update time, apply power and the node will find the gateway directly or via a neighbouring device.

Wireless telemetry solutions

The SignalFire Remote Sensing System™ is a robust long-range wireless network designed for remote monitoring and control in challenging outdoor environments. The system works with level, pressure, temperature and flowmeters, as well as offering critical asset control including valves, pressure and temperature transmitters, pumps, fans, heaters and an array of other devices.

The SignalFire system can provide both communications and power to customers' existing sensors, making their application truly wireless. A wide range of sensor types are compatible, including 4 - 20mA, 1 - 5V, Modbus, HART, Digital IO, and other analog and digital interfaces.

Conclusion

When faced with the need for additional measurement data due to new regulations, improved safety, enhanced reliability, digital transformation or increased performance, instead of just installing more wire, consider the business benefits a wireless monitoring network can deliver to the bottom line.