IMPROVING PLANT AND WORKER SAFETY

Joshua Hernandez and Amanda Alexander, Emerson, explain how adding new personnel location systems and toxic gas monitoring functions via existing wireless networks can help ease implementation and save money.

When process control systems made the change from panelboards to computer-driven platforms, the greatest advance was integration. With a panelboard, a pressure transmitter sent its signal via a dedicated cable to a dedicated display showing its specific reading. Using the new approach, it became possible to show the pressure value anywhere needed, and on multiple display types. Many limitations disappeared, allowing unimagined flexibility for data collection, display, and analytics.

Building on those gains, digital transformation in the last five or so years has been equally dramatic. Integration has advanced even further to the point where many systems that were separated (basic process control, equipment condition monitoring, data historians, etc.) are now linked and share

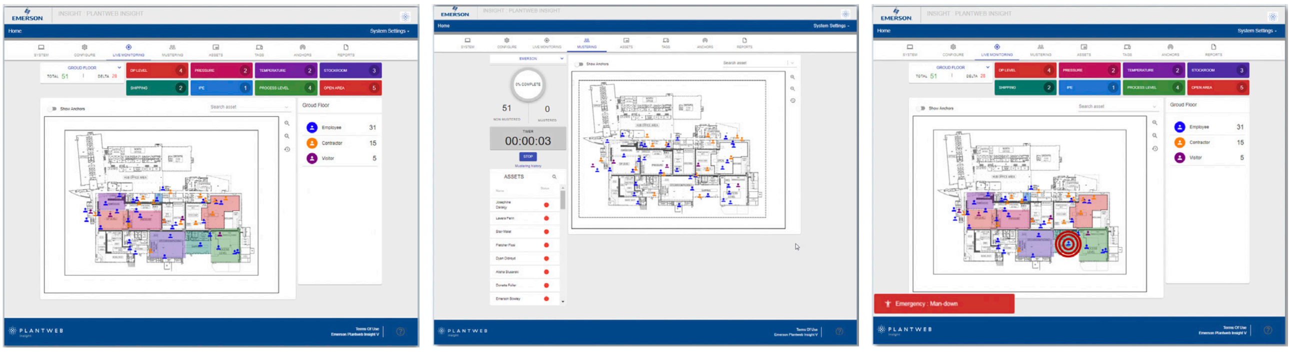

Figure 1. Software designed to support location system functions can include pre-designed user graphics, including geofencing (left), safety mustering (middle), and safety alerts (right).

Figure 2. Refineries and general process plants often have many levels, so location systems have to consider height.

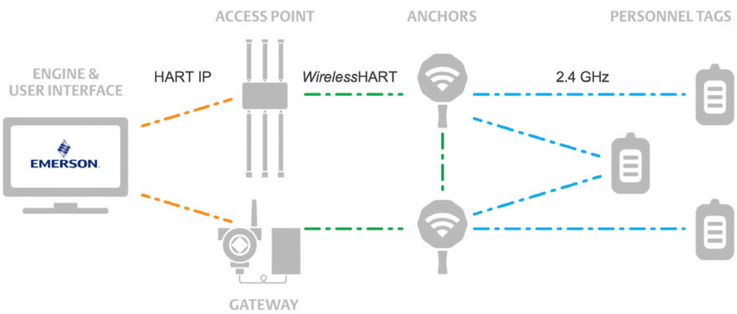

Figure 3. Individual personnel tags communicate with the anchors, which in turn communicate with the WirelessHART gateways and access points.

information freely. These improvements have been facilitated by new networking technologies, especially the internet and wireless networks.

The one area that has been reluctant to join the integration transition is safety. Plant operators and organisations responsible for writing standards have leaned towards keeping safety systems minimally integrated, if at all, and far more basic in functionality. Simplicity is thought to equal reliability, and in many contexts, this is a good idea, as one wants the pressure-relief system on a reactor filled with toxic product to do its job every time.

However, every situation does not call for the highest degree of separation and isolation, and in many instances, integration creates a safer system. Moreover, it is possible to capture data from safety systems without interfering with their critical functions. This article will look at two examples of where safety-related functions can be extended and integrated to improve safety.

Personnel location systems

Plant managers have long wanted a mechanism to determine who is in the plant and where each individual is at any given moment. If there is a safety incident, it is important to know which people might still be in harm's way, or if they have moved to safe areas. Implementing this type of system has seen many barriers due to cost, design, and installation investments required.

Location systems indicating where people are in relevant-time serve three main functions (Figure 1):

- Geofencing indicates whether an individual has moved into an area where he or she does not belong due to hazardous conditions, inadequate training, or other issues.
- Safety mustering lets first responders know that people in the plant have moved to the correct safe areas during a drill or actual incident. If they are not in a safe area, the system will alert users to their location.
- Safety alerting allows a worker who is injured to push a button on his or her wearable location tag pendant to indicate an emergency in progress and show responders where to find the person.

These types of systems are not necessarily new, but making them practical to install in an industrial environment has been a challenge since no fully wireless solution has been available. For example, knowing that a worker is somewhere in Unit 2 might be adequate in some cases. In other cases, responders may want to know if the person is next to Surge Tank B. Process plants exist in three dimensions (Figure 2) so height can often be a major factor, which means receivers need to be placed at various levels.

Improving location resolution usually requires adding Wi-Fi routers in more locations, but this is an expensive proposition since industrial routers are costly, especially those rated for hazardous areas, and must be hard-wired for power, raising the installation cost substantially. Fortunately, there are lower-cost options that are just as effective.

Better location infrastructure

One alternative is to use a different approach altogether, extending the wireless infrastructure many plants have already deployed. The same WirelessHART[TM] network used to support process instrumentation can also be the foundation for creating the coverage needed for an effective location system.

Creating a location system using WirelessHART involves more than adding new process instruments to the network. The location triangulation functions operate with a different type of device called a location anchor.

These communicate with each other and the WirelessHART gateways and access points similar to conventional WirelessHART instrument transmitters (Figure 3). Anchors communicate with the location tags that individual workers wear in the plant environment, and they provide the means to triangulate and determine where each tag/worker is located.

Location anchors are small, light, and self-powered, and are therefore easy to install without any additional wiring. Their Class 1/Div 1, Zone 0 rating allows them to be deployed throughout process plant environments. With a long battery life, they require very little maintenance. They are economical enough to increase visibility into personnel status, especially when and where a plant needs them most.

The corresponding rechargeable tags worn by each worker communicate with the anchors using 2.4 GHz, and the anchors communicate with each other and the access points using WirelessHART. The network is self-organising, and it can adapt to changing conditions without manual intervention.

Using this approach typically cuts the cost of implementing a new system by half when compared to a comparable Wi-Fi deployment. It is easily scalable to accommodate the number of employees in a given plant, plus it has the ability to create the kind of three-dimensional resolution desired in critical areas of a plant. Since location anchors are fully wireless, they can be moved if necessary, or additional units can be easily deployed to improve network performance. This capability provides the high level of flexibility needed to achieve the required coverage and ensure worker safety.

The software platform necessary to support such a deployment does not have to be created from scratch. Features such as geofencing, mustering, and safety alerts are pre-configured and packaged together, making it a streamlined and user-friendly solution (Figure 1).

Toxic gas monitoring

As mentioned earlier, the idea of using a wireless network to perform safety functions is still not widely accepted, but some things that appear to be safety functions are not. Consider toxic gas monitoring, which in the oil and gas industry generally begins with hydrogen sulfide (H_2S). Most facilities in the full upstream to downstream production chain deal with H_2S to some extent, so there is the potential for a release, which carries a very serious threat for workers. Some detection method is necessary to protect people who could be affected.

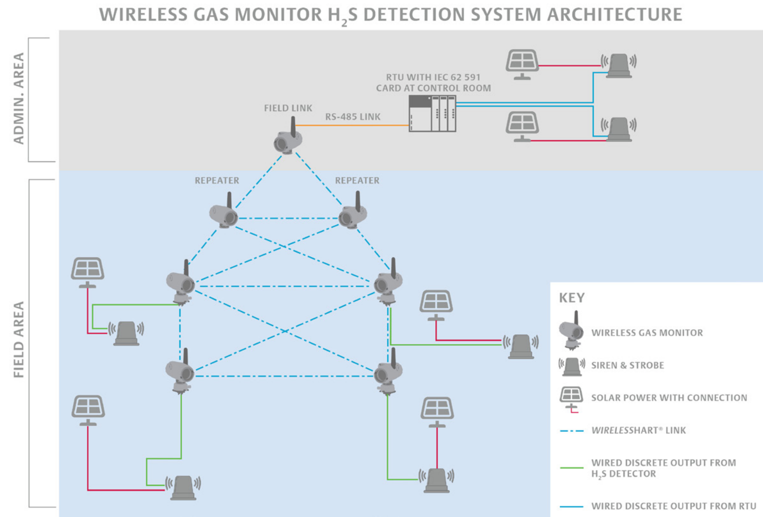

Figure 4. WirelessHART toxic gas monitors can be added to the network, just like any other wireless field instrument.

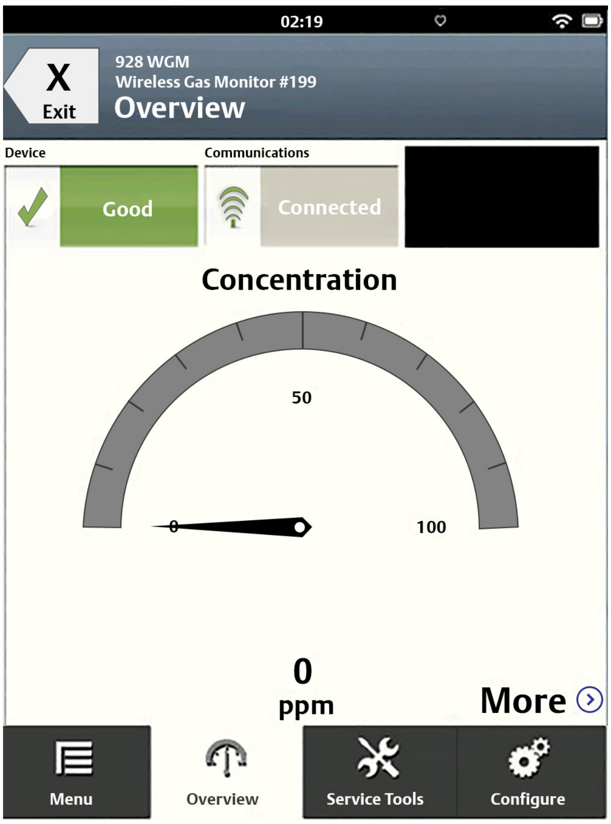

Figure 5. Pre-configured dashboard graphics make the monitoring software easy to set up and with clear indications to operators if conditions change.

Strictly speaking, this is a monitoring effort rather than a safety instrumented function, since there is no automated process-related response, such as adjusting a valve to correct an overpressure incident. The response to a toxic gas release is typically to sound an alarm for workers in the area and to inform operators that something is likely wrong in the plant that is causing the release. It may create awareness of a separate problem indicated by another variable. For example, if the gas is being released by a faulty valve, an adjacent pressure transmitter tied to the process automation system may register falling pressure in the system, or it might trigger a response from a safety instrumented function.

This gives plants the option of installing toxic gas monitors, which can communicate via an existing WirelessHART network (Figure 4).

There are now modular gas monitors designed from the start for wireless operation, so they are fully internally powered, eliminating the need for any field wiring. While the main data is sent via the wireless network, the transmitter also has internal contacts able to activate a local alarm, such as a horn or beacon, if desired. The gas sensor is a self-contained insert which can be plugged into the transmitter, simplifying calibration tasks and even allowing for a different target gas, such as carbon monoxide, to be implemented just by substituting a different sensor. Even flammable gases will likely be added to extend the capabilities of these devices.

These wireless gas monitors are designed for typical refinery environments, are able to withstand temperature extremes and exposure to the elements, and operate in most hazardous areas (CSA Division 1, and ATEX and IECEx Zone 0). Given their low purchase and deployment cost, these gas monitors can be added to areas that were previously considered too impractical to monitor using conventional wired installations. As a result, worker safety can be improved significantly at minimal cost. Monitoring system software is also available as a customisable, pre-configured platform (Figure 5) which is easy to set up and configure.

Integration by extending existing networks

While location systems and toxic gas detection do not integrate directly, they exist side-by-side on the same WirelessHART network, and data from both can be used in conjunction. For example, an alert from a wireless toxic gas detector could prompt operators to check the location of plant personnel who might be exposed.

In most cases, the existing WirelessHART network will also carry data from field instruments to the main process automation system. Once data reaches the gateway and larger plant network, regardless of the originating device, it is accessible and can be distributed to any part of the larger network. If control room operators want to know whether there is a toxic gas leak somewhere in the plant, the necessary data is available for viewing.

Extending a network originally conceived to support field instrumentation also supports digital transformation and integration efforts because no part of a plant and no internal system has to remain isolated. Even safety instrumented systems can send data to other parts of the plant while retaining their ability to function independently. WirelessHART has proven its reliability over more than a decade, allowing users to apply it in new ways they may have not considered just a few years ago.

This kind of integration is not an end in itself but is instead a means to implement new data collection and analytics capabilities to improve plant performance and worker safety, all at far lower costs as compared to traditional solutions.