# Switching to Wireless

**Now you can detect level without incurring the cost and complexity of laying cables, says *Jonas Berge*.**


A level switch can be used in applications with liquids and slurries, including coating and aerated liquids. Sensing is virtually unaffected by flow, turbulence, bubbles, foam, vibration, solid particles, build-up, or fluid properties. Applications include high and low level detection in liquid tanks as a backup to a continuous level transmitter, activating a pump based on level, and starting or stopping a mixer based on level around the blades.

Now, new developments in wireless communications are enabling an easy and cost-effective solution for level monitoring without laying cable or associated risk of damaging the existing installation, and enable configuration and troubleshooting from a central location.

And intelligence inside the switch can also distinguish between material build-up on the fork and a high product level, reducing inspection in the field. Electronic device Description Language (EDDL) is used to enable level switches to be configured and monitored from the same device management software as a plant's other intelligent devices such as pressure and temperature transmitters.

Opportunities to take advantage of this technology are common. For example, many tanks around the plant may initially not have been fitted with instrumentation connected to the control system. Similarly, coolant and lubricant level in various assets have not been monitored continuously.

In fact, most plants were designed with a minimum amount of instrumentation because of the high cost of hardwiring. Plants relied on operators walking the plant floor with a clipboard. However, increased focus on quality, throughput, availability/reliability, shorter shutdown periods, energy efficiency, and new environmental regulations is driving change in how plants are maintained and operated. This monitoring now has to be automated. Wireless is the ideal solution.

## Overcoming limitations

Adding hardwired level switches into an existing plant can be very costly because it may require laying and connecting new cabling, as well as possibly additional cable trays, system input cards, and system tag license cost. Such hardwired solutions are time consuming, and improvement ideas therefore often get shelved. Wireless level switches overcome these limitations of hardwiring. They can communicate using IEC 62591 (WirelessHart) protocol, the only international standard for wireless in process applications. Wireless level switches can be deployed without running cable or using up spare wires and system input cards, and because there are no wiring connections to ring out, commissioning is also easier. Level switches are also available with an intrinsically safe power module that can last up to 10 years at a 60-second update rate and can be replaced in the hazardous area.

A wireless level switch shares the same network infrastructure as wireless transmitters (e.g. pressure, temperature, pH, vibration, conductivity, level, valve position feedback, etc.), and all of the information is transmitted via the same gateway. One gateway can support up to a hundred IEC 62591 transmitters. Once a gateway is in place, plant personnel can easily expand the network at will. This enables level switches to be installed on points previously not monitored by the control system, to enhance operation and worker safety. This ability to easily add new devices is one of the reasons plants choose to deploy a wireless infrastructure in the first place.

Because all IEC 62591 devices use the same common application protocol, devices and gateways from different manufacturers work together seamlessly. These devices self-organize, forming a mesh network where each device maintains communication with multiple neighbors – establishing multiple communication paths and relaying data from even the most remote devices all the way to the gateway. Other wireless topologies like star or point-to-point are not suitable for the dense plant environment, requiring costly backbone router infrastructure to be wired.

This topology does not require line-of-sight communication between devices and the gateway and eliminates the need to build a web of access points throughout the plant or run power in a hazardous area. The devices automatically find the best communication

path, and the wireless system continuously monitors signal quality to ensure network robustness and greater than 99 percent data reliability. If devices are added or removed, the network automatically adjusts its communication paths, without any interruption in data flow. No manual configuration or reconfiguration is required.

The technology makes it easy to add level switches for improved automation in existing plants – for instance, to eliminate operator rounds to read sight glasses or gauges with a dip stick. These wireless level switches check the level every few minutes or seconds instead of once a day, week, or month – providing insight into plant operations up to thousands of times faster and more accurately than operator clipboard rounds. Other areas of use include asset monitoring, such as oil level in machinery. Because deployment is easy, small wireless projects tend to materialize.

## Principle of Operation

A vibrating fork level switch operates on the principle of a tuning fork. An internal piezoelectric crystal oscillates the external fork at its natural frequency. The frequency changes depending on the medium in which it is immersed. The denser the liquid, the lower the frequency. Thus, the frequency is different depending on if the fork is immersed or dry. Changes to this frequency are monitored.

A short fork with a high natural frequency of approximately 1,400 Hz is used, avoiding interference from other plant vibration which otherwise could cause false switching. The fork is shaped in such a way that liquid quickly drips off as liquid subsides.

From the frequency it is also possible to tell the condition of the fork. Unlike many other level switch technologies, the vibrating fork technology does not have parts that can get stuck and therefore is less prone to failure.

## Build-up detection

Intelligent vibrating fork level switches can detect conditions such as product build-up on the fork that may render a traditional level switch non-operational, with potentially serious consequences such as production downtime, spills, and pump damage.

With a simple on/off signal from a hardwired float level switch it was not possible to tell the difference between a stuck switch and an actual high-level condition. Similarly, it wasn't possible to tell if the level switch was damaged or had failed and the signal was therefore invalid. For this reason, technicians periodically had to go to the field to perform checks just to be sure, often to find nothing wrong.

With intelligent devices, however, changes in frequency are used to detect not only high or low level, but also media build-up on the fork, external damage to the fork, internal damage to the piezo, and excessive corrosion.

This field intelligence eliminates the need to send a technician into the field to inspect on a hunch. Suspected problems can be verified remotely from the control room, and cleaning or service scheduled accordingly.

## Interface issues

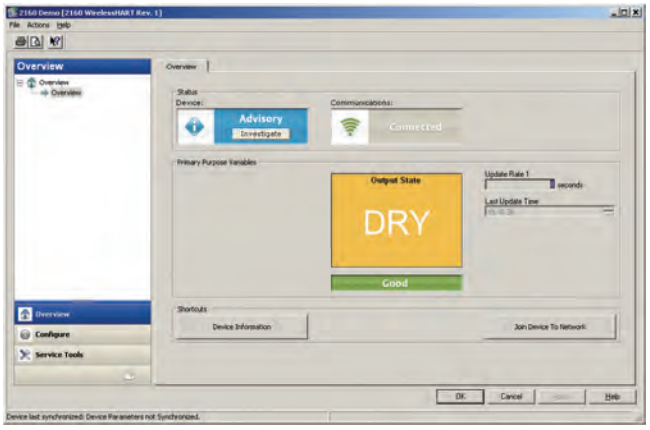
Maintenance technicians must manage many types of intelligent devices from different manufacturers. Remote setup has existed in transmitters for two decades but is relatively new to level switches.

To make this easier, device manufacturers use EDDL (www.eddl.org) to define how a device is to be displayed in the system. This technology is used for continuous devices such as transmitters and positioners as well as with discrete devices like level switches, on/off valves, and electric actuators.

The use of EDDL enables IEC 62591 level switches to be set up and checked using the same intelligent device management software as the other devices in the plant. The information from level switches is displayed side-by-side with information from wireless transmitters for pressure, temperature, and other process parameters. They are also displayed the same way as Foundation fieldbus and Profibus devices.

This consistency makes work intuitive and enables technicians to apply what they have already learned from working with other devices to the level switches. That is, systems based on EDDL makes managing the mix of devices easier, thus eliminating the errors and learning curve associated with using a different software or driver for each one. Manufacturer know-how in the form of text and illustrations is brought into the system through the EDDL file organized based on human centered design principles to guide less experienced technicians in setting up the level switch.

For instance, on the device overview page, the process state is clearly indicated as "wet" or "dry" and is accompanied by device health status indicating the validity of the information. The operator can easily tell the difference between media build-up on the fork and an extreme actual high level and act accordingly.




*Dashboard with process state display and device health indication.*

Build-up of material on the vibrating fork is detected in the early stages and flagged on the screen as an advisory alarm. This enables Operations to schedule cleaning of the forks before build-up accumulates to the point where it causes a false process state indication. Identifying the build-up problem early helps avoid an unnecessary shutdown, thus reducing downtime. Maintenance technicians can also focus on the cleaning and repairs which are really needed, instead of inspecting a fork which need not be cleaned.

As a supporting troubleshooting tool, the fork's frequency is also displayed as a dynamic needle gauge with a color band on the scale to distinguish normal from abnormal operation. The health of the internal power module is also indicated. The EDDL technology is the key to interoperability with access to all device functionality through a hierarchical menu structure. The information page also includes a photo making the level switch easy to identify in the field.

The EDDL file from the device manufacturer is copied onto the system to tell it how to interface with the device. Unlike other device integration technologies, no software installation skills or license key management are required for the file in order to commission a new device type or revision.


*Device details such as frequency and power module status facilitate troubleshooting.*

# Gateway to the Past

Modern distributed control systems (DCS) have native support for wireless. However, an older control system can also make use of wireless level switches or any other IEC 62591 transmitters using a wireless gateway that converts the signal to Modbus/RTU, Modbus/TCP, or OPC. Wireless support in the control system engineering console is not required as the network setup is done through a web server embedded in the gateway, and devices are configured through intelligent device management software. Hence, no additional software is required to be loaded onto the control system or other PC for operations or security. Instead, the existing Hart configuration tools including asset managers and handheld configurators are used to bring the network online. Once the network is in place, more devices can be added for all kinds of measurements without disturbing the existing live wireless network.


*Because the wireless gateway can convert the signal to Modbus/RTU, Modbus/TCP or OPC, older control systems can interface to new wireless devices like the level switch.*

Each version of each device from every manufacturer has its own unique EDDL file. There are no shared files, thus ensuring that adding a new device does not overwrite another.

Since it is a compressed text file independent of the Windows operating system, EDDL technology gives a system administration advantage over other device integration technologies in that existing device files are not made obsolete by new Windows versions. Conversely, new device files do not force a Windows upgrade for the system. Time is saved by minimizing upgrade administration, and new versions of Windows and software can be adopted and benefitted from sooner.

Time delay can be configured to minimize false switching due to turbulence or splashing, such as in the presence of agitators. To set delay time on traditional level switches they must be opened up and a potentiometer adjusted by screwdriver. This is inconvenient in the field and exposes electronics to the harsh environment.

With a WirelessHart vibrating fork level switch the delay time and other settings can easily be checked and adjusted remotely from the control room without going to the field. The EDDL technology enables the device management software to maintain a single audit trail for all devices including level switches where configuration changes are logged.

## Expanding the benefits

Once an IEC 62591 gateway has been deployed, it can be used for many functions. Transmitters can be added at-will to achieve on-going process improvement. These incremental steps, like "mini projects", can be quickly and easily implemented where it would have been impractical with hardwired monitoring technology.

There are many level points around existing plants not being monitored due to the high cost of hardwiring. At the heart of the digital plant architecture that uses the power of field intelligence to improve plant performance, WirelessHart technology offers the ability to cost effectively monitor level without laying power or communication cables with associated risk of damaging the existing installation.

And using EDDL technology, device manufacturers can use human centered design principles to develop wizards which guide setup of intelligent devices around the plant, thus making management of a mixture of simple and sophisticated device types from different manufacturers using different protocols easier. **CEA**

Jonas Berge is Director of PlantWeb Consulting, Emerson Process Management.