Using Communication Protocols like HART® to Enhance on-site Gas Detection

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Communication is key in all areas of life; in fact, our ability to communicate in such complex ways with each other is arguably one of our most defining features as a species.

With this in mind, it's no surprise that the application of communication capabilities to smart field devices and process monitoring technologies is able to bring valuable dimensions to industry.

Safety control systems are usually organised with a hierarchical system of three core levels of hardware and software. The highest level is represented by the Human Machine Interface (HMI), which is often a PC based solution. This allows an operator to interact and monitor the system, using protected passwords allowing for acknowledgement and or modification as needed.
The second level down is the Programmable Logic Controllers (PLCs). These allow signals from analogue, digital and bus to interface with the HMI. The tertiary level consists of the devices such as Infrared (IR) gas detectors, toxic sensors, pressure and temperature sensors and flow measurement field devices.

The type of communication protocol employed by the system to interface between the PLCs and field devices will determine the type of data that can be obtained from a device and the frequency with which that data can be transmitted or received. Many PLCs tend to use a 4-20mA input.

The Origins of Communications Protocols for Field Devices

The concept of gas detection with communications capabilities is not a new one; in fact, gas detectors have been using protocols like Foundation Fieldbus™, Modbus®, Profibus® and Highway Addressable Remote Transducer (HART®) since the 1980s.

Since the inception of communication protocols, many variants have emerged, with Modbus® being the first to be developed in 1979. Foundation Fieldbus™ was a protocol released in the 1980s and was strongly adopted in the USA. Profibus® soon emerged as an alternative to Foundation Fieldbus™ and became popular in Europe. Today Foundation Fieldbus™ co-exists with Modbus®, Profibus® and Industrial Ethernet (an ethernet concept that offers enhanced data checking and stability).

The plethora of options available is brought about by the varying needs of industry when it comes to communications protocols. Some protocols offer peer-to-peer communication (such as Foundation Fieldbus™), meaning that the PLC is always receiving streamed data from a device as well as being able to request information from the device. Others (such as HART®) work on a master-slave principle where data is not being streamed continuously and the PLC (acting as master) requests the information from the slave device, which in turn sends data back to the PLC.

HART® actually operates with two master functions; a Primary Master (such as a PLC or DCS) and a Secondary Master (such as a HART®-enabled hand-held device); this provides the user with freedom as to how they interact with a field device. For example, an operator can go out into the field with a HART®-enabled handheld interrogator or can use a PLC/DCS situated in a control room or another area.

Modbus® RTU, has been very popular for the last 20 years. This is due to the speed with which it can transmit data and the fact it features an error check mechanism to ensure the reliability of data being sent and received, and continues to be popular due to Modbus® TCP/IP over Ethernet.

Honeywell Analytics released its own digital system in 1985 called Gas Data Acquisition and Control System (GDACS), using a proprietary protocol. It was created to offer flexibility and an enhanced level of interaction to its users, and its value has stood the test of time and today Honeywell Analytics still supports customers using this protocol.

Trends and the Popularity of HART®

Communications protocols all work in slightly different ways and for this reason, they offer varying benefits and disadvantages over each other. Peer-to-peer communication protocols such as Foundation Fieldbus™ require more power because of the extra data being constantly streamed from the device to the PLC, but conversely they offer the additional benefit of allowing constant communication from the field device to the PLC, which is essential for many regulated processes.

HART® is becoming an ever-more popular communication protocol owing to the fact that it communicates over a legacy 4-20mA analogue wiring topology; the digital HART® signal is superimposed over the existing 4-20mA signal and permits bidirectional communication, which allows the operator the flexibility to make device modifications using the HART® signal. Infrastructural costs like wiring are one of the most expensive aspects of a plant, so this ability makes HART® highly attractive to many sites.
In fact, HART®'s growing popularity highlights the large global install base of 4-20mA wiring. Today it is one of the most widely adopted communications protocols, and is used by approximately 30 million devices Worldwide.

HART® allows a PLC to issue three types of command: a Universal command for data, which all HART® field devices respond to, a Common Practice command, which many devices will use and a Device Specific command, which is unique to a particular device.
A Device Description (DD) file is produced by a manufacturer of a HART®-enabled field device, and it allows the user to interact directly with a device such as the XNX Universal Transmitter (XNX) from Honeywell Analytics.
This allows the user to poll the XNX for information and any procedures specific to that device anywhere in the loop, using a HART® enabled handheld that includes the DD file from Honeywell Analytics.

The Value of Communications Protocols

Communications protocols offer many valuable benefits, helping to improve safety, simplifying maintenance and reducing ongoing costs:

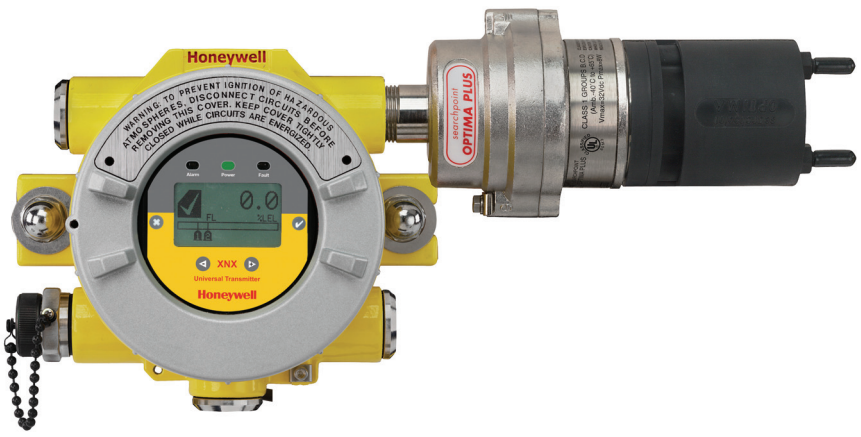
- They can allow the user to access information from the smart field device (such as gas readings, signal level, raw sensor readings and temperature)
- They can allow a user to change calibration and device configuration
- They can help to facilitate proactive, scheduled maintenance over reactive maintenance
- They can reduce ongoing costs because proactive maintenance is less costly than reactive
- They can reduce field engineering costs, because device communication allows you to "know before you go", meaning that an engineer can be prepared for work needing to be undertaken in the field

The true value of HART® becomes apparent in the context of a specific product such as the XNX. In essence, there are two core areas that a site can benefit from HART®; commissioning/set up efficiencies and ongoing maintenance/operational

Reducing the Cost of Commissioning / Set-up

XNX features an Intrinsically Safe (IS) interface to the device via a HART®-enabled handheld device. This enables an operator to go out into the field and set up or modify a device, without the need for a hot work permit. HART® also enables single operator set up, meaning that a second operator does not have to be in a control area inhibiting/un-inhibiting devices or testing modifications.

Rather than requiring multiple proprietary handheld devices to interact with field devices like the XNX, a single HART®-enabled handheld can be use to interface with any HART®-enabled device on site. This helps to reduce set up costs and means that training is also reduced as an operator can use a single handheld device they are familiar with using.



Reducing Ongoing Operational Costs

When it comes to ongoing device operation and maintenance, HART® can allow sites to change to a proactive maintenance regime as opposed to a reactive one. This is favourable because it helps to maximise device uptime and limit the chances of unforeseen issues arising that can negatively influence productivity. Aspects like HART®'s ability to provide sensor performance diagnostic data can be used to help plan maintenance initiatives.

This aspect can be taken a stage further; the adoption of a proactive maintenance schedule combined with the collation and subsequent evaluation of data from a device like the XNX can potentially help to extend the interval between maintenance frequencies. This can allow a site to gain notable maintenance cost savings and minimise production downtime associated with maintenance activities.

Diagnostic field device data also means that a maintenance engineer can know the scope of work required before going into the field. This can save valuable time, sometimes as much as 50% because an initial exploratory trip to assess devices is no longer required.

HART® and Universal Device Use: a Winning Combination

The advent of "one size fits all" devices like the XNX are very much in line with market needs; in fact the perfect solution for most end users is a universal device that can interface with most existing gas sensing technologies onsite, providing one simple, long-lasting solution to ever-changing gas detection needs. This helps to reduce costs and simplify operation considerably.

XNX is an extremely flexible solution that can be configured to accept an input from any of the Honeywell Analytics range of gas sensor technologies (IR Open Path, IR Point, high temperature sensors, electrochemical cell and mV), providing one single interface solution to all flammable, toxic and gas monitoring on site.

The XNX also offers a wide variety of output signals including HART®, Foundation Fieldbus™, Modbus®, 4-20mA and relays, delivering the flexibility to meet the demands of a wide variety of industries and applications including onshore and offshore oil and gas, power stations and chemical and petrochemical plants.

Using a device like the XNX means that users only need to be trained to use a single transmitter for all gas detectors on site, helping to reduce training time and costs. Spares stocks can also be reduced, thanks to common device design.

When this value is combined with the benefits facilitated by HART®, the ongoing cost of gas detection can be reduced further. HART®-enabled, universal-use field device like the XNX are likely to grow in popularity, thanks to their functionality and cost saving potential.