An End User Functional Comparison of HART® and FOUNDATION™ Fieldbus Protocols

Abstract

HART® and FOUNDATION™ fieldbus both bring significant benefits to process industry users. Both are frequently compared, and the casual comparison may lead a user to believe the protocols are functionally very similar. The main differences frequently cited are HART is a hybrid protocol compatible with the installed base of 4–20 mA instruments, while FOUNDATION fieldbus is intended to be used as a multi-drop bus. While these differences are true, they may create a very wrong impression. HART and FOUNDATION fieldbus were both designed to bring the benefits of intelligent field devices, but each has a unique emphasis. The emphasis of HART is to bring digital information while maintaining compatibility with 4-20 ma. The emphasis of Foundation fieldbus is to bring the control architecture to the bus and the field devices. The resulting protocols have different capabilities that need to be taken into consideration when making an evaluation.

The capabilities covered in this paper include:

- The Design Objectives of HART
- The Design Objectives of FOUNDATION Fieldbus
- Summary of Design Objectives
- Attribute Comparison
  - Integration of the digital protocol with 4–20 mA Control Host
  - Compatibility with Existing Control Wires
  - Compatibility with Existing Knowledge and Work Practices
  - Communications Robustness
  - Multivariable Capability
  - Control Via Digital Signal
  - Control and Calculation Capability
  - Control in the field
  - Alarms and Alerts
  - Access and Usability of Diagnostic Information
- Other considerations

This comparison can help the reader to decide which protocol would be most beneficial for use in a specific application or plant. This white paper does not represent an Emerson endorsement, recommendation, or preference for either protocol over the other.

Introduction

This white paper does not address the Safety Instrumented Systems (“SIS”) and wireless aspects of either protocol.

In the days of pure analog devices, functions such as adjusting span, zeroing a device, adjusting damping, etc. were done with potentiometers. Calibration, ranging, zeroing, and damping were set using potentiometers. A screwdriver and multi-meter were the tools used to communicate with the transmitter.

The signals drifted and required periodic maintenance, were limited to communicating only one piece of information, could stick, or could suffer offset from electrical interference. This could mean an "on-scale" failure, where the process variable looks valid, but is in fact wrong.

The Design Objectives of HART

When devices became smart, better ways to configure, calibrate, maintain devices, and communicate the process variable became possible. The HART protocol was developed to improve the work process for these activities. It had one huge market adoption advantage, in that the 4-20 ma analog signal used for monitoring and control was preserved. Although this solution did not address the issues with 4-20 ma, it maintained compatibility with the entire control system infrastructure installed in the field. HART can provide the process variable(s) digitally, but the 4-20 ma signal continues to be used to provide the process variable in most cases.

The Design Objectives of FOUNDATION Fieldbus

FOUNDATION fieldbus was designed to support all the configuration and maintenance capabilities of HART and more. It was designed to be a completely digital process control network capable of ***being*** the control system. It does all the things that a control system does. It is deterministic and real time, handles alarms and alerts, has trending capability, provides the function blocks used for basic and advanced regulatory control, and the sequencing and logic associated with it. It requires more robust messaging and processing power.

In addition, FOUNDATION fieldbus was designed to support all the configuration, calibration, diagnostics, setup, and maintenance activities associated with both devices and the control strategy.

Summary of design objectives

HART is a hybrid bus designed for configuration, maintenance, and other device functions while maintaining compatibility with the huge installed base of analog only hosts. It continues to be enhanced to provide more and more information. Technical augments such as multiplexers and HART to analog adaptors have been developed to provide access to the digital information in systems that do not support HART digital communications.

FOUNDATION fieldbus is designed to be a distributed control system on a bus. It can be applied as a solution for problems ranging from simple PV acquisition on a multi-drop bus to a complete control system. It is able to perform real time deterministic basic and advanced regulatory control, as well as its associated discrete processing. The instruments and valves on the bus perform this control.

As users make more use of both HART and FOUNDATION fieldbus, the attributes of both will become clearer.

Attribute Comparison

To determine which protocol is most applicable to your situation the desired attributes need to be identified to evaluate user functionality of HART and FOUNDATION fieldbus. Note that different attributes will be desirable to different users, so select and rank attributes in your order of importance.

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host		
Integration of the digital protocol with existing control wires		
Compatibility with existing knowledge base and work practices		
Communications robustness		
Multivariable capability		
Control via digital signal		
Control/calculation capability		
Control in the field		
Alarms and alerts		
Ability to access and deliver diagnostic information		

Integration of the digital protocol with 4–20 mA Control Host

A huge infrastructure of 4-20 ma control hosts were installed before digital protocols became common. Integration with the older, as well as the newer installed base of control hosts needs to be considered.

HART

Older control hosts that could not access the HART information did not integrate directly with the HART protocol. A handheld may be connected to access and use the HART digital information without interfering with the 4–20 mA signal.

Newer control hosts are capable of using or passing, to some degree, the HART information to an asset management system. Many newer control hosts can use the digital HART process variable; however, the digital process variable is rarely used for closed loop control by the system. Analog hosts can frequently be upgraded to access the HART digital information by hardware and software upgrades.

Most newer control hosts can access the HART process variables and status. Asset management information is passed through the control architecture to an asset management host. If an older host is not capable of using or passing the HART information to an asset management system, multiplexers can be used.

HART integration with 4–20 mA control hosts is “GOOD”. Newer hosts usually use the relevant digital information, and older hosts can frequently be upgraded to either use it or pass it through to an asset management system.

FOUNDATION fieldbus

FOUNDATION fieldbus and 4–20 mA cannot exist on the same pair of wires. FOUNDATION fieldbus input/output must be added to an existing 4–20 mA host, or protocol converter that converts FOUNDATION fieldbus to another protocol supported by the host must be used. Almost any modern control host has FOUNDATION fieldbus input/output. Almost all legacy hosts support MODBUS, so FOUNDATION fieldbus can be used with many old control hosts. However, any addition of FOUNDATION fieldbus requires either FOUNDATION fieldbus input/output, or an interface to a protocol supported by the legacy control host. FOUNDATION fieldbus compatibility to 4–20 mA control hosts is “FAIR”.

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair

Compatibility with Existing Control Wires

HART

HART, a .8 –1 mA digital signal superimposed on the analog signal, is 100 percent compatible with existing control wires. Since existing wire, or standard instrument grade wire, is always used for HART, HART compatibility with existing control wires is “EXCELLENT”.

FOUNDATION fieldbus

FOUNDATION fieldbus, an 800 mV differential signal that exists on the wire, is 100 percent compatible with existing control wires and it is not superimposed on any other signal. There is a perception that special wire is needed, but this is not true. Special wire or cable may bring installation benefits, but is not required. FOUNDATION fieldbus compatibility with existing wires is “EXCELLENT”.

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair
Compatible with existing control wires	Excellent	Excellent

Compatibility with Existing Knowledge Base and Work Practices

To achieve the most benefit from either protocol requires significant work practice changes and new knowledge in the plant. For example, to move from reactive to proactive maintenance brings significant benefits for both operations and maintenance. It may improve availability, safety, health, environmental compliance, and reduce waste and rework. Obtaining the benefits requires new knowledge and work practices to be established.

HART

Most instrument work-practices today are structured around HART. HART requires less work practice changes and new knowledge. If you use 4–20 mA for control, and the HART information for basic

device setup and maintenance, you do not need to change any work practices. When work practice change is desired to reduce cost, improve performance, or bring other benefits, these changes can be phased in slowly over time. This gives an adjustment period that can be helpful. The key to obtaining maximum value is to change work practices to take best advantage of the digital information to improve plant performance. The net result is that HART allows work practice changes to be gradual.

FOUNDATION fieldbus

If you have an existing plant, FOUNDATION fieldbus requires more work practice changes and new knowledge than HART. If you have a new plant, the training and work practice implementation of FOUNDATION fieldbus may be the best way to go. Since Foundation fieldbus requires work practice changes, it can drive a plant toward faster adoption of new and beneficial practices.

Foundation fieldbus also requires significant new knowledge. To obtain the full benefits of an FF installation, training and work practice changes are needed early in the project cycle. If this is not done, project execution can be slowed, and the benefits available are only partially realized. The net is that Foundation fieldbus requires work practices and knowledge that may not exist in the current workforce.

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair
Compatibility with existing control wires	Excellent	Excellent
Compatibility with existing knowledge and work practices	Excellent	Fair

Communication Robustness

Communication robustness is defined as the ability of the communication signal to be sent and received in a timely manner, in harsh environments, with the ability to detect errors, or faulty information. The information gets to its destination on time and is accurate.

HART

The two components to HART communication that must be covered are the robustness of the 4–20 mA signal (since most HART devices use that signal for communicating the process variable) and the robustness of the digital HART signal used for configuration and for process variables.

The 4–20 mA signal is considered robust, but this can be a misconception. Since the signal is sent and received continuously, it provides excellent response for process control. The 4–20 mA signals have trouble detecting when communication errors take place, or the information is faulty. If the signal is between 4–20 mA, it is assumed valid. Issues such as grounding, ground loops, and electrical interference from high current or electromagnetic sources can impose an undetectable bias on the 4–20 mA signal. Since the entire control signal is 16 mA total, a bias of the current of only 1 mA represents an error of over six percent in the process variable received by the control host. In addition, on-scale failures of devices are generally undetectable; and if a process variable goes

significantly above or below the calibrated range of the device, the analog signal saturates and the operator has no idea what the actual process variable is. Often the actual process variable is within the range of the transmitter and would be available on a digital protocol.

To achieve good robustness, special care must be taken when installing, routing, powering, grounding, and terminating 4–20 mA wires. The reputation for robustness is because error detection is limited and most problems are undetected. By using good installation practices and instrument grade wiring, the robustness of 4-20 ma can be good. HART can help improve the robustness of 4-20 ma. The HART digital value can be compared to the analog value in the host, and the user can be alerted to any significant differences. HART can improve the robustness of 4-20 ma to "EXCELLENT".

If HART is used as a digital protocol for process variables, the potential analog bias is eliminated and communication messages that are missed can be detected. Also, process variables within the range of the device, but outside the analog calibration, can be read. HART protocol robustness is a function of master – slave communications.

Communications scheduling, message retries, and determination of the operational status of the communications link is built into the host, not the HART protocol. This requires knowledge of the communications capabilities of the host in order to evaluate communications robustness since it is not specified or managed by the Hart protocol. HART relies on the robustness of the analog signal, augmented by digital information if configured, for signal robustness. Overall, the robustness of HART digital communications is "FAIR". Since the analog signal is usually used for control, HART signal robustness is "GOOD". If both the analog and digital signals are used, and the values compared on the host to detect errors, robustness is "EXCELLENT".

FOUNDATION fieldbus

FOUNDATION fieldbus uses a differential signal equal to the current draw of the device, typically 15 mA peak-to-peak, at a frequency of 31.25 Kbps. FOUNDATION fieldbus has fast updates for good process control, and so, electrically the FOUNDATION fieldbus communication signal is robust.

FOUNDATION fieldbus is a deterministic, peer-to-peer protocol with individual devices communicating control information on a very precise schedule without the need for a host to initiate communications. Scheduled communications for a given device can be as frequent as every 62.5 ms, but in most cases the actual schedule is every 500 ms.

If a message is not received by one of the subscribers of the data, FOUNDATION fieldbus has message retry capability and the message retry takes place during the same communications cycle as the original message. That way, even if individual messages are lost, communications take place on schedule. Communications statistics, such as message retries, are available on FOUNDATION fieldbus, which help users evaluate if a FOUNDATION fieldbus segment is having communication difficulties, and can frequently isolate problems to a specific node. If FOUNDATION fieldbus segments are experiencing a significant number of message retries not limited to a single device, any analog signal wires running in the same areas should be checked for undetected signal errors. These and other attributes of FOUNDATION fieldbus make communications robust. Overall, the

communications robustness of FOUNDATION fieldbus is “EXCELLENT”. It is important to remember that power, grounding, and other good wiring practices are necessary to use to achieve the communications robustness potential of Foundation fieldbus.

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair
Compatible with existing control wires	Excellent	Excellent
Compatibility with existing knowledge and work practices	Excellent	Fair
Communications robustness	Good/Excellent	Excellent

Multivariable Capability

Multivariable devices exist for both HART and FOUNDATION fieldbus and both can communicate multiple variables via the communications protocol but does not evaluate the capability of the individual devices. The two factors when considering multivariable capability are the power budget and the ability to communicate multiple variables via the communications protocol. Note that both FOUNDATION fieldbus and HART support 4-wire devices, so the ultimate power budget is large, however, since the majority of devices are 2-wire, which is the power budget we will consider.

HART

Because of advances in low power electronics, a great deal of functionality is available on the 3.6 mA power budget and the minimum specified voltages available to a HART device. However, the power budget poses a limit on the number of sensors, speed of sensors, and computational capability.

With a single 4–20 mA signal available, most HART devices report a single process variable to the control host. There are devices that take multiple variables digitally from a HART device and deliver the variables to a host over multiple 4–20 mA analog channels. Since additional hardware devices and multiple sets of wiring are required, this is expensive.

The alternative is to communicate multiple variables digitally, which is possible since HART supports sending multiple variables with a single command. HART supports up to four process variables per device. Most control hosts do not use the digital variables for control. HART protocol multivariable capability is “FAIR”.

FOUNDATION fieldbus

FOUNDATION fieldbus has two advantages for multivariable devices: a large power budget and support of a large number of process variables in a single device. FOUNDATION fieldbus allows power budgets exceeding 20 mA, although most devices use less, with 10–15 mA being common. This leaves a larger power budget for powering multiple sensors, or performing calculations.

FOUNDATION fieldbus can support a large number of process variables in a single device. For example, eight point temperature transmitters are common. FOUNDATION fieldbus has input and output blocks that are used to communicate process variables. A single input or output block can have a single process variable, or multiple process variables depending on the type of input/output

block. All process variables in input/output blocks can be linked into a control strategy. There are some implementation considerations. Each input/output block has a communications relationship with the blocks that use the variables, if that block is in a different device or the host; this is called a virtual communications relationship. The host H1 card may have a limited number of virtual communications relationships it can support, which limits the total number of process variable's on a segment.

FOUNDATION fieldbus multivariable capability is "EXCELLENT".

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair
Compatible with existing control wires	Excellent	Excellent
Compatibility with existing knowledge and work practices	Excellent	Fair
Communications robustness	Good/Excellent	Excellent
Multivariable capability	Fair	Excellent

Control Via Digital Signal

Using a digital signal for control is desirable for two reasons. First, there is no analog conversion from the device to the signal wires, and then from the signal wires to the host, which increases the accuracy of the process variable. Second, additional information such as health, variability, and status may be communicated with the process variable to provide more control.

HART

Most control using process variables from HART devices is done using the 4-20 mA signal. If the user wants to perform control using more than one process variable from a device, the digital variables must be used. HART provides a digital process variable frequently enough to allow control for most loops in a typical plant. Control is almost never done using the digital HART signal since an analog signal is provided for control.

HART is a request and reply protocol, where the host must request the information every time, and throughput for PV and status type information is 1-2 messages per second. Burst mode, where the device continually transmits the process variable, brings the PV and status update rate to about 2–3 per second. However, in burst mode no communications other than the parameters and status in the selected message is sent. If both the transmitter and valve are HART and digital communication is used, the fastest practical loop for HART is two seconds. If the device does not reply to the host request for information there can be a lag approaching one second before another attempt may be made.

In many host implementations, a single HART modem is shared over several analog input/output channels. This reduces HART digital message throughput for any one point, unless the modem is locked on that point, meaning HART digital information is not available from other points. To solve this problem, many hosts have two or more HART modems on an analog input/output card so if one modem is locked on point, the other modem can be shared by the remaining points. The result is that the frequency of HART messages from a device may be variable and lower than anticipated.

The capability to control via the digital signal for HART is “FAIR”.

FOUNDATION fieldbus

All process variables from FOUNDATION fieldbus devices are digital. In addition, alarms, process variable status, and other information is communicated along with the process variable on a very precise schedule to one or more devices, or hosts, that may need the information.

FOUNDATION fieldbus supports control in the field device. By having process variables and the blocks that use them in the same device, control can be executed without the need to communicate a specific process variable outside the device where it originates.

FOUNDATION fieldbus is designed for digital signal control and does better than any other protocol at this. The capability to control via the digital signal for FOUNDATION fieldbus is “EXCELLENT”.

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair
Compatible with existing control wires	Excellent	Excellent
Compatibility with existing knowledge and work practices	Excellent	Fair
Communications robustness	Good/Excellent	Excellent
Multivariable capability	Fair	Excellent
Control via digital signal	Fair	Excellent

Control and Calculation Capability

Calculation capability includes the resources available to the device to perform calculations, and the support the protocol provides for communicating the information externally.

Hart

Generally, memory and microprocessor have limited resources available for control or calculation. HART can pass any four values to a host and these can be calculated values.

Sophisticated calculations ranging from mass flow to valve diagnostics have been implemented on this power budget. In addition, sophisticated diagnostics including statistical process monitoring have been implemented on HART devices. Calculate capability in HART is generally “GOOD” for typical continuous process variable calculations.

Control is generally not done in the field using HART protocol, as peer-to-peer communications between devices, such as a transmitter and valve, is not supported. Communication and control are generally done through a host. This is not applicable for HART.

FOUNDATION fieldbus

The FOUNDATION fieldbus protocol is designed to support control and calculate capabilities in the device. FOUNDATION fieldbus devices generally have a larger power budget, more memory and microprocessor capability, which supports both control and calculation.

FOUNDATION fieldbus has interoperable function blocks for control and calculations, in addition to supporting peer-to-peer communications between devices, so control and calculations can use information from other devices. The peer-to-peer communication supports transmitters talking directly to valves, allowing closed loop control without the intervention of a host.

The combination of greater device resources and interoperable function blocks and peer-to-peer communications makes FOUNDATION fieldbus very well suited for control and calculation. Overall FOUNDATION fieldbus capability for control and calculation is “EXCELLENT”, but note that the capabilities actually implemented are quite different device to device, and vendor to vendor.

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair
Compatible with existing control wires	Excellent	Excellent
Compatibility with existing knowledge and work practices	Excellent	Fair
Communications robustness	Good/Excellent	Excellent
Multivariable capability	Fair	Excellent
Control via digital signal	Fair	Excellent
Control capability	N/A	Excellent
Calculation capability	Good	Excellent

Control in the field

Availability for process control is a function of the reliability of all the individual components in the loop. The components in a host-based loop include the instrument(s), wiring, power to the field; host input card, power, backplane, controller, output card, signal to the control element, and the final element.

Improvements over time in reliability of the individual components, and the appropriate use of redundancy for components, especially shared components, have combined to create surprisingly high reliability for this automation architecture. By traditional standards, availability of process control using HART is better than ever; however, there is room for improvement. The overall availability of process control in the host is “GOOD”.

FOUNDATION fieldbus

FOUNDATION fieldbus requires fewer components in the process control loop. If control in the field is used, host system input cards, host system power, controllers, and communications, and host system output cards are not involved in closed loop control. A typical analysis of the Mean Time Between Failure of control in the host versus control in the field shows that control in the field has a Mean Time Between Failure about twice as long as control in the host.

Because of tradition, or the availability of function blocks in the host that are not available in the field devices, many people prefer control in the host. FOUNDATION fieldbus supports control in the host but has the capability of field control if host control is lost, even if control in the host is the normal operational choice. This combination makes availability of control in FOUNDATION fieldbus "EXCELLENT" whether control is in the field or in the host.

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair
Compatible with existing control wires	Excellent	Excellent
Compatibility with existing knowledge and work practices	Excellent	Fair
Communications robustness	Good/ Excellent	Excellent
Multivariable capability	Fair	Excellent
Control via digital signal	Fair	Excellent
Control capability	N/A	Excellent
Calculation capability	Good	Excellent
Control in the field	N/A	Excellent

Alarms and Alerts

Alarms are associated with either process control or process monitoring. Alerts are associated with device or equipment health or performance.

HART

HART does not provide process alarms. The design is that a process variable is provided to the host, and the appropriate input/output and function blocks in the host provide process alarms, so alarm capability in HART is not applicable. Because the design intent of the HART protocol is that control is done in the host, HART protocol currently does not support some functions such as real time clock. This means that time stamping is not provided by HART devices, but is provided by the host, applied in the order in which the specific input/output point is processed. For alarms that are separated in time by several control loop execution cycles, the user can determine the order in which alarms occurred. For alarms that are close together, the exact sequence and timing cannot be determined.

HART alert capability can report diagnostic conditions, or environmental conditions the device is experiencing over the digital HART protocol. For example, the highest pressure, or temperature, a device has experienced, or plugging, fouling, sensor or electronics failure. Some device vendors have

implemented the ability to approximate time by tracking elapsed time since an alert generated event took place, but the biggest shortcoming is it is difficult to synchronize elapsed time.

HART alarm capability is primarily a function of the host, and is “NOT APPLICABLE”. HART alerts capability is extensive; however, the lack of accurate time stamping and time synchronization does limit post alert analysis. Some control host vendors are adding the HART alerts capability on the operator interface. HART alert capability is “GOOD”.

FOUNDATION fieldbus

FOUNDATION fieldbus is designed for control in the field within the individual devices on the segment. Input/output and function blocks are processed in the devices, and process alarms are supported. An advantage of FOUNDATION fieldbus is that each device is an independent processing node and can process alarms and alerts independent of other devices. Each device has a real time clock that is synchronized with other devices on that segment, and, potentially through FOUNDATION fieldbus high speed Ethernet, with other segments. Alarm processing and time stamping can be very accurate, and since the timestamp of the alarm is communicated to the host along with the alarm condition, later analysis of the sequence of alarms is not altered by the host scan order or frequency of updates.

FOUNDATION fieldbus supports alerts the same way it supports alarms. Individual devices time stamp alert or diagnostic conditions, and both the alert and time are available to the host for later diagnostic processing. FOUNDATION fieldbus does an “EXCELLENT” job supporting both alarms and alerts.

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair
Compatible with existing control wires	Excellent	Excellent
Compatibility with existing knowledge and work practices	Excellent	Fair
Communications robustness	Good/Excellent	Excellent
Multivariable capability	Fair	Excellent
Control via digital signal	Fair	Excellent
Control capability	N/A	Excellent
Calculation capability	Good	Excellent
Control in the field	N/A	Excellent
Alarm support	N/A	Excellent
Alert support	Good	Excellent

Access and Usability of Diagnostic Information

Access and usability means diagnostic information is available to both a control and asset management host in a timely manner, and can be used by the automation to adjust process control. It will also consider any additional hardware or application programs that may be necessary to obtain the information from the host. Usability considers if the information can be used for asset management, for use in effecting process control, and for analysis with control information. This

section does not evaluate the value of individual diagnostics, it only evaluates the ability of the protocols to deliver and make use of the information.

HART

HART diagnostic information is generally passed through, or around, the control host to another application such as an asset management host. It can also bypass the control host entirely, such as multiplexers or wireless technology routing it to an asset management host. Generally, diagnostic information is sent from an asset management host to the operator by way of a control host user interface. Diagnostics can affect the status byte monitored by the control host. This can be used to inform an operator of a change in a devices status.

HART diagnostic information is typically accessed in time intervals of minutes, hours, or days. For many equipment related conditions, these frequencies are fast enough to avoid abnormal situations or potential downtime. This may not be fast enough for conditions requiring near real-time analysis and correction. Since HART is a master – slave protocol the host must request the information or it will not be available. Changing work practices to make use of this information can increase plant availability and decrease maintenance costs.

HART can deliver a wealth of diagnostic information most useful for asset management. The benefits of diagnostics delivered over HART protocol can be great, even if access is not frequent or automatic. Overall access and usability of HART protocol to deliver diagnostic information is “GOOD”. Please remember that the value and functionality of the diagnostic itself can be excellent. This section deals strictly with access to diagnostic information, and its usefulness for asset management, improved process control, and analysis.

FOUNDATION fieldbus

FOUNDATION fieldbus has better access to diagnostic information, and it can be used in more ways. The devices proactively time stamp and annunciate diagnostic conditions when they occur so you do not miss diagnostics because you were not asking. The user knows when a condition occurred, that the condition is reported when it occurred, and not later on when the diagnostic information is requested by the host. Diagnostic information is time stamped and can be synchronized with process information for analysis.

Diagnostic information can be used to modify the action of the control strategy. For example, if a diagnostic shows that a process variable is uncertain, then the control strategy can use the last known good value and alert the operator. Or, if a pump shows capitation, that information can be used to increase backpressure or change pump speed. This capability allows FOUNDATION fieldbus diagnostics to be used proactively to improve both process performance and asset reliability and life. Access and usefulness of FOUNDATION fieldbus diagnostics is “EXCELLENT”

Attribute	HART	FOUNDATION
Integration of the digital protocol with 4–20 mA control host	Good	Fair
Compatible with existing control wires	Excellent	Excellent

Compatibility with existing knowledge and work practices	Excellent	Fair
Communications robustness	Good/Excellent	Excellent
Multivariable capability	Fair	Excellent
Control via digital signal	Fair	Excellent
Control capability	N/A	Excellent
Calculation capability	Good	Excellent
Control in the field	N/A	Excellent
Alarm support	N/A	Excellent
Alert support	Good	Excellent
Ability to access and deliver diagnostic information	Good	Excellent

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Other considerations

The practical assumption is there are more analog, HART knowledge, and work practices existing in plants today than FOUNDATION fieldbus knowledge and work practices. This, of course may not be true for your plant.

Specifics need to be determined one plant at a time. Generally, HART will require fewer work practice changes and less new knowledge than FOUNDATION fieldbus. However, FOUNDATION fieldbus will offer more opportunity for change to improve work practices and plant performance.

Both protocols offer potential for improvement that most plants are not taking advantage of today. There will be many cases where either HART or FOUNDATION fieldbus will provide what you need for solving a specific problem or making a specific improvement.

Many plants will have both HART and FOUNDATION fieldbus in the same plant. It is not necessarily an all or nothing situation. Sometimes the best solution is a combination of both.

Summary

Both HART and FOUNDATION fieldbus protocols continue to be enhanced with new functionality, and new and innovative ways to develop and deliver more value. Both protocols currently offer more value than most plants are utilizing.

HART offers better compatibility with an analog host, and the ability to limit and time-manage work practice and knowledge changes. FOUNDATION fieldbus offers more functionality for control on the bus, tighter integration with the control host, and more information and processing capability.

Finally, I have a request for the supporters of both protocols. There are different ways to evaluate the protocols that may lead to different conclusions. So long as the evaluation is based on end user need and end user value, differences of opinion are valuable and welcome.