Title:

Best Practices in Data Handling Security and Advanced Temperature Measurement Methodology Utilizing Foundation Fieldbus

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Abstract

Emerson Process Management has recently been the automation R&D partner to GTI for the Carbona and PWR gasification programs. Two areas of involvement are of particular interest.

The first one addresses data and therefore IP security handling issues. As various technologies are being developed, the issues of IP associated with operating conditions, contacting technology and media, producer and syngas clean-up methods as well as other considerations are seen as very important. A secure control system is key in achieving this. Novel process data handling deployed as part of the ongoing projects are a good example of how the IP security can be maintained.

The second area of interest addresses issues and solutions associated with high density temperature measurements, utilizing Foundation Fieldbus high throughput communication bus, especially in the producer and/or syngas regions of the Gasifier. Accurate and efficient way of handling this issue contributes to gasification efficiency, lower operating temperature, and better control of the exiting gas composition as well as improved overall system performance.

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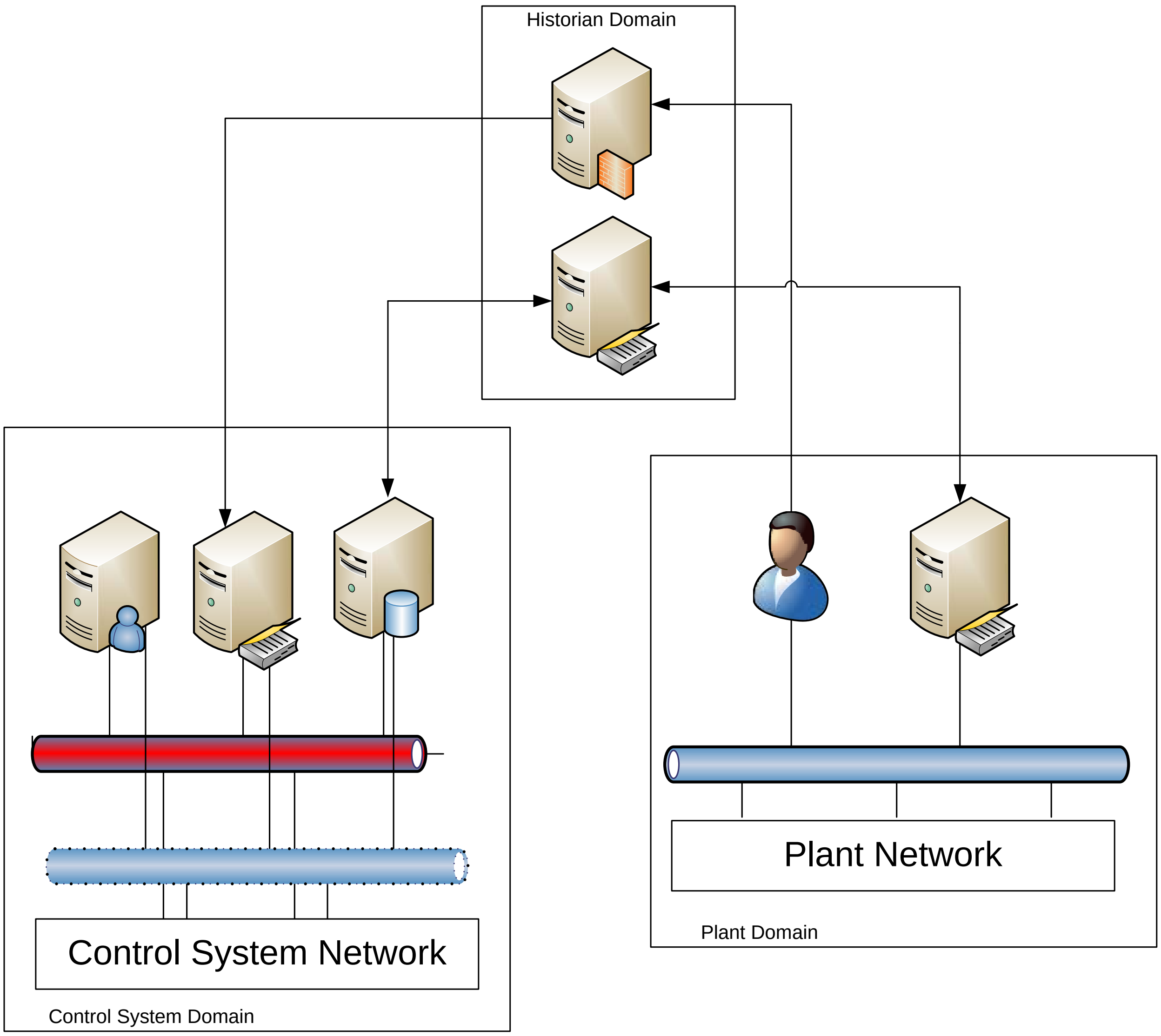
The development of various gasification technologies has gone through a number of high activity phases of development, beginning in the 1940's (Germany), then through the 1970's (Sasol), and 80's. Each time during the high development phases on the technology, process control and automation level of development has progressed somewhat, however only in the past 10 years or so, it has been in position to make a significant difference in overall system performance. Although a number of areas are good candidates for process control best practices and therefore optimization and potentially better overall system performance, two are discussed in this paper. These address some of the most novel solutions.

Data Security

Security begins with the physical environment. It's surprising how many users pride themselves on a top-notch security model, but then leave their data historian in an unlocked server room, or sitting out in a control room. First and foremost, the server should be in an access and temperature controlled server room. Within the server room, the data historian should be in an approved, secured rack or tower enclosure with uninterruptable power supplies. It should also go without noting that if the server has two power supplies, they should not be fed from the same power source whenever possible. Lastly, always log off when the server is not in use. If someone does gain access to the server cabinet, at least they should have to log in first, not find a server already logged in as "administrator".

Once the physical security has been addressed, it's time to examine the network. Ideally the data historian server will be on its own domain and be its own domain controller. This Historian domain will then have a one-way trust with both the Control system Domain and the Plant Domain, in that it will allow any authenticated user from either the DeltaV Domain or the Plant Domain access to it. However, any user that has authenticated on the Historian domain and then attempts to access either the Plant Domain or the DeltaV Domain will be challenged for credentials. This architecture is detailed in the diagram below.



Whenever possible, firewalls should be utilized to secure the data historian from other network segments. This is the case with many data servers, but it is particularly true with data historians as they often act as the boundary to process control networks which often do not, or cannot, have the latest security and anti-virus measures deployed. The security advantage is enormous in that often the only firewall ports required opened by the data historian are ports 5450 and those used by Windows for Name Resolution, Authentication, and Administration. These vary depending on the operating systems in use and network types, but typically include 53 or 137 for Name Resolution and 135 and 445 for Administration. Additional ports may be required depending on the particular architecture utilized, and other trusts, particularly those associated with applications, can create the need for additional port openings.

The only true stumbling block for firewall-based security comes with the use of OPC based communication. Whenever possible, the data historian and OPC Server should be placed on the same side of the firewall. This is because OPC, in its current release, utilizes Microsoft's near-defunct DCOM technology. DCOM requires all ports above 1024 to be available, roughly 64,000 ports. It is really not practical to place a firewall between the OPC Server and the Historian~~PI~~ Server because of this limitation. There are third party tunneling products which can drive OPC through a single port, however, if removing the firewall from the path is not possible.

The ultimate goal of security in a data historian is to secure the data. The real key to obtaining Security Nirvana, or as close as one can achieve in this world, is to setup trusts. One has to create users on the data historian to match the users coming from the Windows (business network) world. Once the users have been duplicated in the data historian environment, and groups created on the data historian server to organize these users, trusts are used to map users, applications, or connections from the business network into the data historian users and groups. This allows for users to be placed into whatever access groups they need to be in without requiring additional user names and passwords, although that is always an alternative.

Once the groups are established, each point in the data historian must have its owner and group specified. Finally, once the owners and groups have been specified, the access level for each should be assigned on a point by point basis.

This specifies the access that the Owner, Group, and World (anonymous) should have to the point.

By compartmentalizing the data in this fashion, specific users and groups can be allowed access to certain data and denied access to other data. This access security is also propagated into the client applications used for reporting and trending. Once this is complete, all the data in the data historian has been successfully secured.

Temperature Measurement

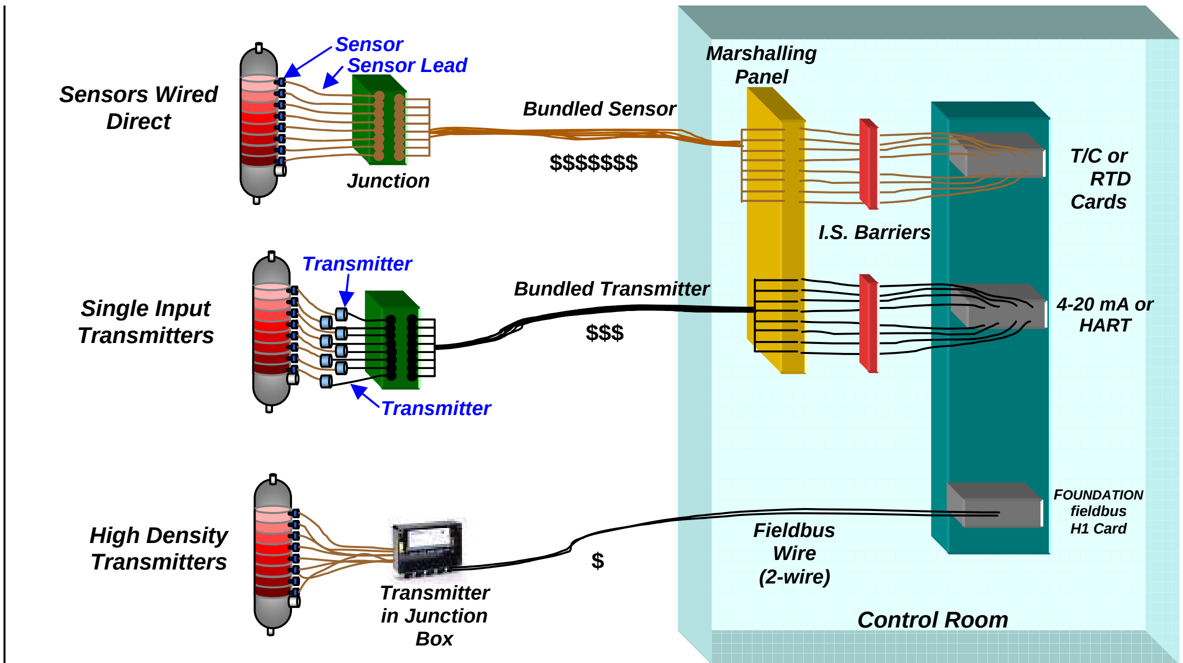
Many users across the process industry need to monitor hundreds to thousands of temperature measurements in a plant to ensure efficient operations. One way for these measurements to be brought back to the control system is through a direct wired configuration. While this configuration is quite common in many plants, it does have some drawbacks. Since each temperature sensor (such as a thermocouple or an RTD) must be wired back to the control system, there is a high cost associated running long senor wires. Wiring sensors directly from the process to the control room can induce a number of different errors into the system. For example, long wire runs are susceptible to measurement drift from electromagnetic interference or electrical noise. Industry best practice suggests keeping sensor wires as short as possible to maintain measurement integrity and reduce the possibility of an inaccurate measurement. The control system must also have enough capacity for the thermocouple or RTD wires and their respective cards.

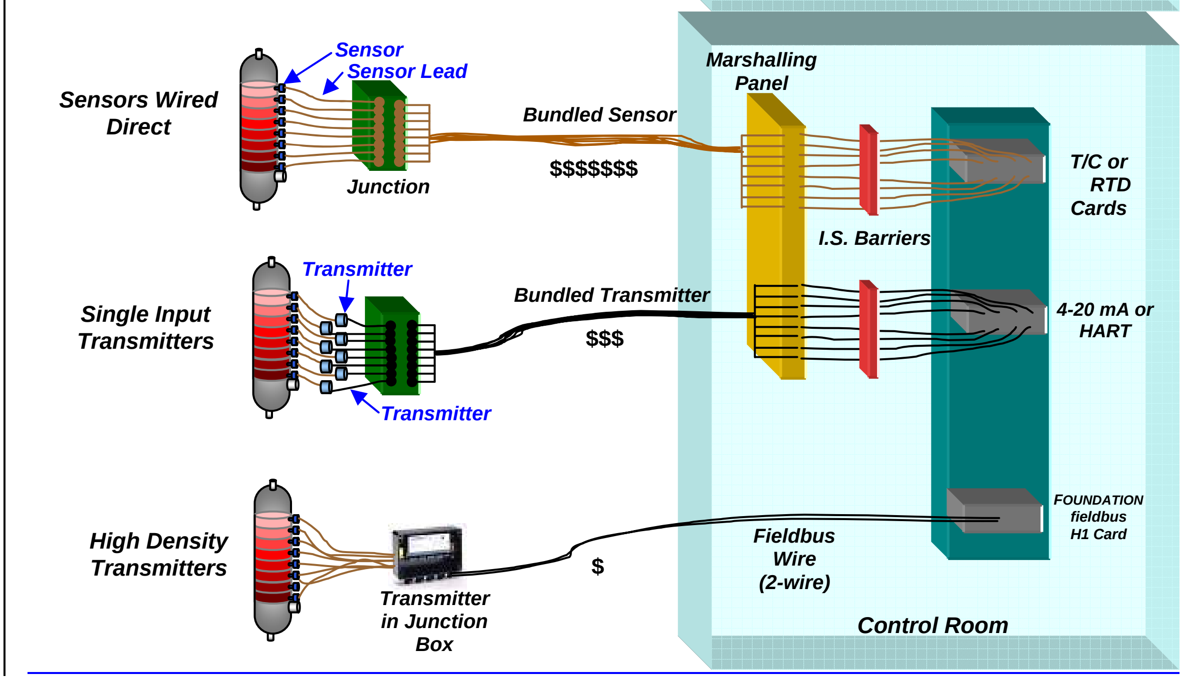
A common alternative to direct wired sensors is the use of a single point temperature transmitter wired directly back to the control system. Transmitters compensate and filter weak sensor signals to deliver accurate and stable temperature measurements, which lowers operating costs. This configuration can allow users to standardize wiring practices and take advantage of simplified control system I/O cards to reduce installed costs. Sufficient I/O card space must be available in the control system, which can be an issue in older plants. The additional cost of the transmitter and wiring must be considered in the overall installation. The use of a smart transmitter would also allow users to take advantage of diagnostics that reside within the device transmitter to troubleshoot installations and reduce maintenance trips to the field, which results in lower operating costs

These two methods of collecting temperature data are the most pervasive in the process automation industry. However, in recent years a new trend has developed which takes advantage of common process design configurations to reduce installation costs and still offers the high accuracy and repeatability of single point temperature transmitters. Many plants have situations where multiple temperature measurements are within close proximity of each other. These measurements often require the protection and proven reliability of transmitter technology. Typical applications would include distillation columns, reactor vessels, boilers, heat exchangers, and motor bearing and wiring temperatures. These measurements can be referred to as high density temperature measurement applications.

High Density Temperature Transmitters

A high density temperature transmitter is a device which can monitor many temperature measurements with a single device. This ensures accurate and stable measurements and allows users to continuously monitor measurement integrity. The use of a high density temperature transmitter can reduce installation and operational costs by as much as 70 percent per point when compared to traditional sensor wire direct application temperature measurements. An example of the three various configurations discussed can be found in the diagram below.





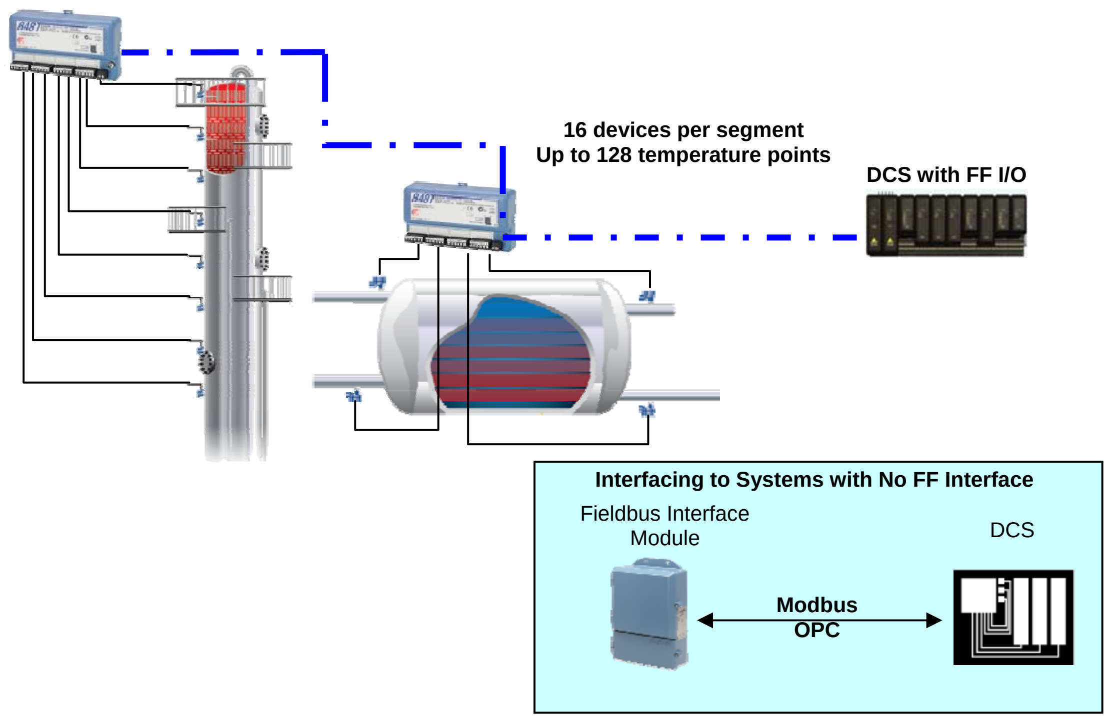
As shown above, this particular high density temperature transmitter can take up to 8 inputs and communicates the readings back to the control system via FOUNDATION™ fieldbus. This not only provides savings of the wiring back to the control system, but helps to preserves valuable spare input capacity of the existing system. The transmitters are also designed to be installed next to the process to reduce sensor wiring costs and maximize savings. All 8 channels are independently configurable and can be used for a mix of input types including RTD, thermocouple, mV, ohm, and 4–20 mA signals. Additional functionality includes Input Selector (ISEL) function blocks which are used to select: Average, Minimum, Maximum, Midpoint, or First Good Temperatures. The transmitter can share H1 Segment wiring with other FOUNDATION™ Fieldbus devices.

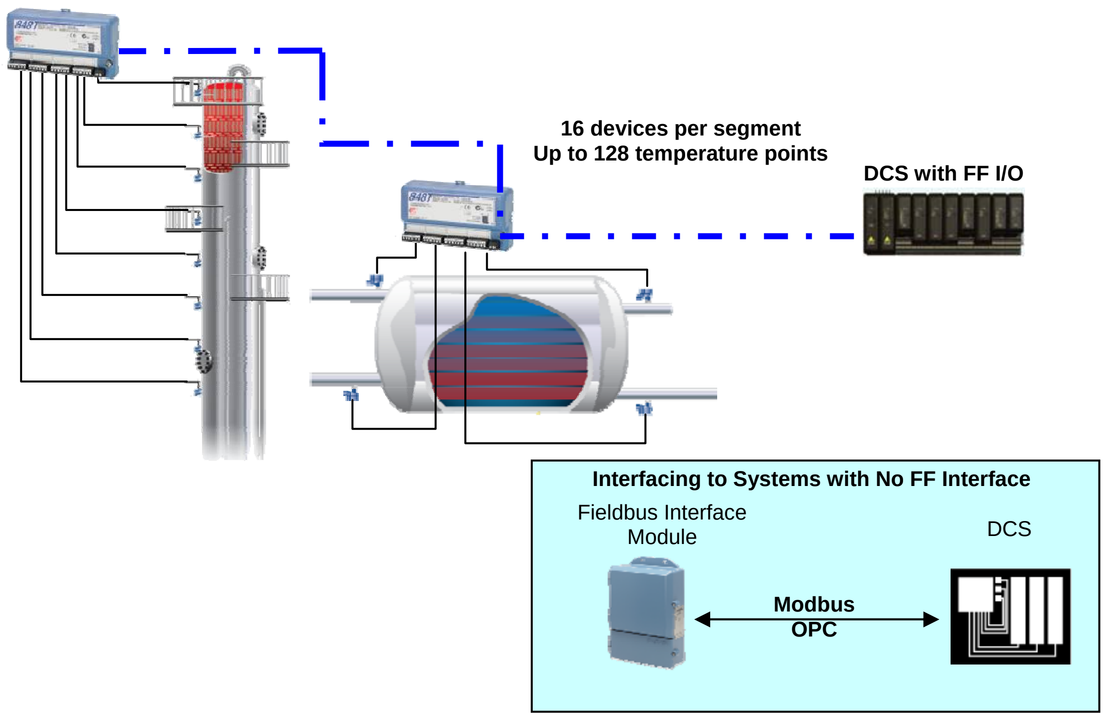
High density temperature transmitters have been proven to improve start-up times. Not only does this solution significantly reduce or eliminate long wire runs to the control room, it eliminates the need for cable trays, extensive loop drawings and large wiring cabinets in the control room. Installing cable trays, completing loop drawings and wiring sensors to cluttered wiring cabinets add to installation time and overall costs to start-up. In addition to eliminating hardware and drawing requirements, high density temperature transmitters can come with enhanced user interfaces to make configuration and maintenance easier. Users can use “wizards” which guide them through configuration steps for sensor types, alerts, engineering units, and more. This makes configuration simple and easy to do.

Interfacing High Density Temperature Transmitters to the Control System

Depending on whether the legacy host system is currently fieldbus capable or not dictates the choice for which interface architecture best fits the existing control system. A system setup with an H1 Fieldbus card currently available to the control system provides a seamless interface for the connection to the fieldbus segment containing the high density temperature transmitters. This architecture can then handle up to 16 high density temperature transmitters per H1 segment warranting up to 128 communicated measurements on one fieldbus segment.

Connecting with systems that do not currently have a fieldbus I/O card requires a gateway interface to communicate via a protocol understood by the governing control system. A Fieldbus Interface Module serves as a gateway interface capable of communicating 4 segments back to the DCS via Modbus or OPC communications. The gateway’s ability to communicate 4 separate fieldbus segments supports up to 512 temperature measurements if paired with high density temperature transmitter technology. Each segment can support between 13 and 16 transmitters depending on whether internal (13) or external (16) power conditioners are being used. This then supports a range of 416 to 512 temperature measurements depending on the governing architectural needs. Below is an example of these two different architectures.





Summary

The development of high density temperature transmitters can offer significant cost savings for temperature measurements, especially in greenfield or brownfield projects through reduced material and labor costs. They provide dependable performance and reliability with stable and accurate measurement for trustworthy data. High density transmitters have enhanced user interfaces, are easy to configure and install, and require reduced labor and fast start-ups.

The flexibility to take not only temperature sensors, but other inputs such as mv, ohm and 4-20mA signals, allows tremendous flexibility for the user in incorporating additional measurement points to the control system. Various interface methods, such as FOUNDATION™ Fieldbus, Modbus, and OPC allow the devices to be incorporated into a wide variety of control systems and allows any user to take advantage of the savings offered by high density temperature transmitters.