

Why use PROFIBUS for Process Automation?

By James Powell, P.Eng.

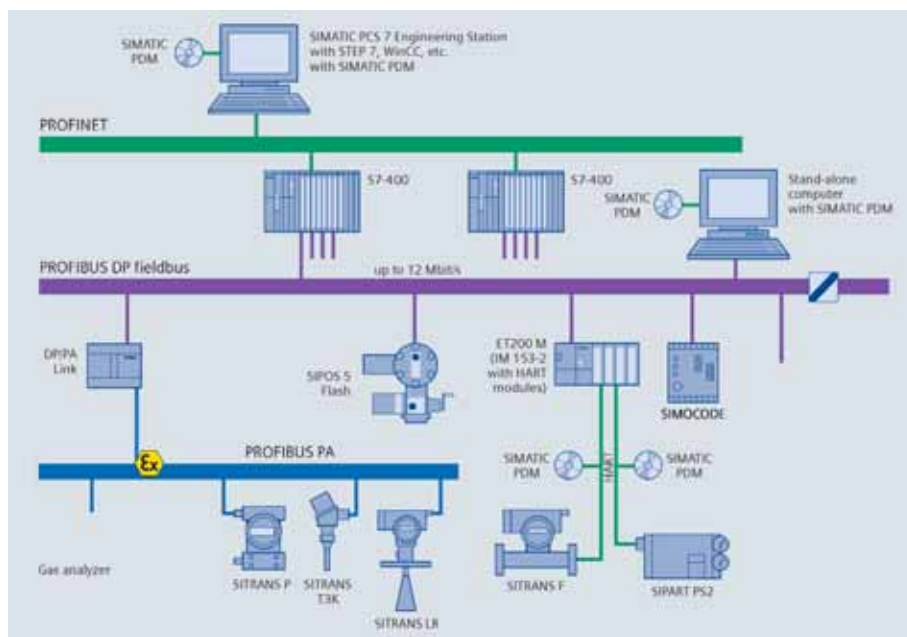
Of the various networks vying for the fieldbus market, PROFIBUS is emerging as the network with the most advantages for totally integrated automation.

Currently, there are three main networks vying for the instrumentation fieldbus market: HART®, PROFIBUS, and FOUNDATION™ Fieldbus. All three have some nice features; however, in a detailed comparison, PROFIBUS stands out as the best solution for total plant automation. It offers a more complete solution, helps ensure high plant availability, and has advanced features that save money.

Aspects of PROFIBUS

PROFIBUS PA is part of the PROFIBUS protocol and is specifically tailored for the needs of the process industry (PA = Process Automation). It allows field instruments to be both monitored and configured over the bus. Instrumentation can be bus-powered and Intrinsically Safe. PROFIBUS PA can be used in any application and, because it can be Intrinsically Safe, it is well-suited for even hazardous environments in chemical and petrochemical plants.

In a process plant, you need more than an instrument fieldbus for the pressure transmitters, level devices and flowmeters. You also need to be able to connect digital I/O, discrete and motion control aspects such as drives, analyzers, and other electrical gear in motor control centers (MCC). PROFIBUS PA is just one chapter in the PROFIBUS book. The PROFIBUS protocol also offers PROFIBUS DP, PROFIdrive and PROFIsafe. These additional chapters let you connect differ-



This example of a PROFIBUS network shows the seamless integration of PROFIBUS PA, PROFIBUS DP and PROFINET.

ent types of devices in a wide variety of applications for a complete, totally integrated solution. No other fieldbus protocol can offer such a complete solution. This has been noted by ARC in a recent white paper that stated “PROFIBUS’ unique value proposition is the ability to seamlessly integrate process instrumentation like pressure transmitters and flow meters with devices for the discrete and motion control side of the application like drives and sensors.”¹

When a plant is down because of a

failed sensor, it is not making money. Maximum uptime is key to profitability. PROFIBUS helps prevent downtime by having diagnostics and preventative maintenance information built into the protocol specification. A device on PROFIBUS will let you know if the measurement value is valid with each update. It also indicates when an instrument should be checked for potential impending problems. This can really reduce operating costs by preventing downtime. It lets you optimize the maintenance schedule with a

predictive approach that keeps things running smoothly and without process upset while reducing your annual operating cost.

There are a number of other features that cut costs over all stages of the plant life cycle. PROFIBUS PA is bus powered, so it saves on installation wiring costs, with only one cable to connect and maintain. It's Intrinsically Safe, saving the cost of any special conduit or cabinets. Moreover, two major advantages are related to device interoperability and interchangeability.

Interoperability is the ability to have multiple vendors' equipment work smoothly on the same network. This is a key PROFIBUS strength. You do not have to worry if a PROFIBUS device from your favorite supplier will work with your DCS system. If the device has gone through PROFIBUS International's conformance testing, you can be confident that it will be compatible with the network. You also do not have to worry about the version of the PROFIBUS standard. If a device is made to DP version 0 and you place it on a network with a DP version 3 device – no problems. This fieldbus standard has maintained backward compatibility as it has made advances with improved features and functionalities. Interoperability saves you a lot of money and headaches during the commissioning phase.

Interchangeability is the ability to switch from one vendor's device to another vendor's similar device. PROFIBUS PA instruments have built into them a standard called "Profiles." Profiles standardize the devices from the network's point of view, giving similar devices an unprecedented level of interchangeability. Switching from one vendor's device to another's device is easier than with any other fieldbus on the market, reducing your reliance on a single vendor. No other fieldbus designed for use in process plants provides this capability. This becomes important about one o'clock in the morning when the plant is down due to a device failure and all you have to do is replace a failed device, e.g. a level

transmitter, with another vendor's level transmitter that is available in the storehouse!²

The Profile standard³ also gives all PROFIBUS PA devices a similarity that makes them easier to work with – two different PA devices will have a common "look and feel" because of the standard. This saves time and money in technician training, programming, setup, and installation. The HART Communication Foundation, PROFIBUS International, and the Fieldbus Foundation all have sub-committees working on Profiles, but PROFIBUS is currently the only one with a released standard. In fact, PROFIBUS released the third version of its Profile standard in 1999, and is far advanced in this area compared to the other networks.

HART

Highway Addressable Remote Transducer (HART) uses an older technology, and is a combination of digital and analog. It superimposes a digital signal over an analog signal. The main process variable is transmitted via the analog signal, while configuration is done over the digital signal. Because HART combines digital and analog, it is considered a transitional bus. A plant can move from analog to HART and then, ultimately, advance to PROFIBUS. In this sense, it competes with PROFIBUS but also complements it.

HART has been around for many years and is now common in many installations. It is a proven, valuable standard for instrument connectivity. PROFIBUS has taken these factors into account and has made integrating HART devices very easy via its HART on PROFIBUS specification.

PROFIBUS PA has a well-established Profile standard, whereas HART is just releasing its Profile standard. It is, therefore, easier to switch similar PROFIBUS PA devices than HART devices.

PROFIBUS PA has FISCO, which makes intrinsic safety conveniently plug and play. With HART, you have to do it the old-fashioned way with calcu-

lations and submissions for approvals.

HART has diagnostics but they are more basic and not as frequently checked as with PROFIBUS PA.

HART's digital signal is relatively slow, running at 1200 bits per second as compared to PROFIBUS PA, which runs at 31.25 kilobits per second. HART's slow baud rate means that, when you are saving parameters to a HART unit or viewing data such as an echo profile, you will have to wait longer.

Many people cite the wiring costs as a major advantage for PROFIBUS PA over HART. In reality, that will depend on the layout and how you do your wiring. If the tanks are close to the control room and you are using cable trays, HART can actually be cheaper than PROFIBUS PA from an installation point of view; however, if there are longer distances or if you are using conduit, PROFIBUS PA will likely be less expensive.

FOUNDATION Fieldbus

FOUNDATION Fieldbus is the other purely digital bus. It started its life in the same industry working group as PROFIBUS. They have a number of things in common; for example, the H1 physical layer of both buses is IEC 61158-2, and they use the same wires, connectors, and physical specifications. Beyond that, however, the protocols are quite different. FOUNDATION Fieldbus is far more complex and requires a lot more memory in field devices than PROFIBUS PA.

FOUNDATION Fieldbus scores lower than PROFIBUS on interchangeability because FOUNDATION Fieldbus does not have Profiles. It also has weaker definitions in its specification that will continue to cause problems for some time to come; for example, FOUNDATION Fieldbus defines a PID function block with defined inputs and outputs but it does not define the algorithm. If you switch from one vendor's device to another vendor's device and just move your tuning parameters from the one PID to the new PID, they will look the same, but the algorithm and therefore



Siemens SITRANS LR 200 (left) radar level and Pointek CLS 300 capacitance point level are among the many recently introduced PROFIBUS devices from Siemens, a major industrial automation and instrument supplier.

of the control system. At the end of the day, does it matter whether the control loop is processed in the field or centrally as long as you have a reliable communication layer and effective device monitoring and control? You could make philosophical arguments either way but, for most applications, the answer to this is “No.”

Conclusion

Over the years, as a specialist in communications protocols and networks, I have been involved with and supported numerous product connectivity methods such as Modbus®, Allen-Bradley® Remote I/O, DeviceNet™, FOUNDATION Fieldbus, PROFIBUS and HART. I have observed a growing interest in PROFIBUS as an open protocol, with increasing demand from customers for PROFIBUS-enabled products. For that reason, companies like Siemens, a major industrial automation and instrument supplier, have introduced numerous products with PROFIBUS built in, with many more planned for future release.

As these various networks have developed, PROFIBUS has moved faster to incorporate Profiles and other significant advances. As a result, it has emerged with numerous advantages for plant operators:

- A one-bus solution that can connect all layers of plant operations for total plant automation
- Bus-powered and Intrinsically Safe for installation savings
- Advanced, faster diagnostics to reduce downtime
- Interoperability to reduce commissioning costs
- Interchangeability through the standard “Profiles” concept
- Easy connection to HART devices
- Fast configuration and troubleshooting
- A growing number of devices available
- Potentially lower wiring costs

PROFIBUS now stands out as the best choice for total plant automation. PROFIBUS, with its many unique

the performance will be different.

Interoperability was FOUNDATION Fieldbus’ biggest weakness but the Fieldbus Foundation has implemented a Host Interoperability test to fix the problem. Even with this test, this will continue to be an issue for some time to come. You cannot just buy a FOUNDATION Fieldbus-based DCS and field devices and expect them to work together. You have to make sure that the DCS supports the devices and that you have the correct versions. In other words, a FOUNDATION Fieldbus-based DCS commonly has a “favorites” list of field devices from select vendors whereas such a constraint is never imposed by a PROFIBUS-based DCS.

FOUNDATION Fieldbus currently has fewer devices available on the market than the other buses. It has methods to connect HART devices, but they are not as clean as the PROFIBUS system and do not offer the same level of integration with engineering tools.

For the purposes of complete plant integration, a key advantage of PROFIBUS PA is the easy connection to a

high-speed network through PROFIBUS DP. In response, FOUNDATION Fieldbus has defined an extension called High-Speed Ethernet (HSE), for its so-called H2 layer. Unfortunately, there are few devices for it yet and it cannot accommodate drives that require a high-speed bus to convey large amounts of data at a fast baud rate. If your plant requires drives which you wish to integrate over a fieldbus, you will need to use a bus that supports them – like PROFIBUS. The bottom line is that you can implement a plant-wide solution with PROFIBUS, but you cannot with FOUNDATION Fieldbus.

FOUNDATION Fieldbus promotes the concept of “control in the field.” The control loops are implemented right in the field devices, independent of central controllers. This is a nice feature. In practice, however, most FOUNDATION Fieldbus installations end up not using “control in the field” because of the complexity and cost. By contrast, the two-way communications in PROFIBUS PA and its use of Function blocks make the field instruments part

advantages, serves as an integral component in Totally Integrated Automation – an automation infrastructure that allows a variety of devices and automation components in various parts of a plant to work under a common environment using common engineering tools and communication protocols. For plant operators, it means there will be more PROFIBUS products and even more capabilities available in the future. ■

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- 1 "The Value Proposition of PROFIBUS in the Hybrid Industries," ARC White Paper, ARC Advisory Group, May 2004, p. 14.
- 2 "The Benefits of the Profile Concept in Fieldbus Technologies," by James Powell, Instrumentation Society of America (ISA), Expo 2004 Transactions.
- 3 "PROFIBUS Profile, PROFIBUS-PA, Profile for Process Control Devices", PROFIBUS International publication Order No. 3.042.

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A Glossary of PROFIBUS PA Features

Advanced Diagnostics: A device on PROFIBUS PA will let you know if the value is valid with each update of the main process variable. It also indicates when an instrument should be checked. This reduces operation costs through the prevention of downtime.

Advanced Networking: PROFIBUS is one protocol, allowing easy connection among PROFIBUS DP and PROFIBUS PA. Once connected, the user can easily communicate over different layers, directly to the field device.

Bus-Powered Device: An instrument that can draw all its power from the bus is referred to as "2-wire device." The bus-powered approach saves on installation costs. (Note that some PA devices are 4-wire devices which are devices that get most of their power from an external source.)

Easy Integration of HART Devices: HART devices, common to most installations today, can be easily integrated into a PROFIBUS network via a Siemens ET200M or ET200isP.

Intrinsically Safe: The bus can go through hazardous areas. It conforms to the Fieldbus Intrinsically Safe Concept (FISCO) model which means that implementing it in an IS environment is easy.

One-Bus Solution: In a process plant, you need more than a fieldbus for the instruments. You also need to connect digital I/O, drives, etc. The PROFIBUS protocol offers PROFIBUS PA and PROFIBUS DP to offer a complete solution.

Profile Concept: Profiles are a standardization of a device from the bus point of view, giving devices that use Profiles an unprecedented level of interchangeability. It makes switching from one vendor's device to another easier than it would be with any other bus on the market.

Remote Programming: This is the ability to configure, monitor, and troubleshoot a PROFIBUS PA device directly over the network connection from the control room. This saves time and money.

SIMATIC Process Device Manager (PDM): PDM is a universal cross-manufacturer tool for configuration, parameter assignment, commissioning, diagnostics, and maintenance of intelligent process devices and automation components. With one software program, you can configure a number of field devices from different manufacturers using a single user interface. Process device data can be easily set, changed, checked, managed and simulated. In addition, you can monitor selected process values, alarms and status signals of devices online.

Standardized Function Blocks: Related to the Profile concept, each field device is programmed using standardized blocks. The similarity of the blocks makes programming of different instruments easy, and reduces variations of operator training required.

Versatile Wiring: The cable can be multi-drop, trunk or star shaped. This allows increased versatility in layout design and minimizes installation costs.