FIELDBUS CONTROL SYSTEMS: TELL ME SOMETHING I DON'T KNOW

BY TOM WOODCOCK, P. ENG.
R.V. Anderson Associates Limited

Fieldbus control systems have been widely used in the automotive, manufacturing and process industries since the mid-1990s, but have just recently started to enter the water and wastewater industry. The development of fieldbus control systems is largely credited to the German automotive manufacturing industry of the 1980s and their quest to access information from all devices on a vehicle with a single cable. Since then, many different types of bus systems have entered the market, such as DeviceNet, Foundation Fieldbus, AS-Interface, Modbus, and Profibus. This article will focus on Profibus as it is the most widely adopted fieldbus in the process industry due to its ability to provide both discrete and analog functions.

Traditional control systems consist of hardwired discrete (0 or 1) and analog (4 to 20 mA) signals, each being individually wired to a Programmable Logic Controller (PLC) Input/Output (I/O) module, which reside in a control panel. For control systems that require a great number of I/O signals, these panels can be quite large and lead to increased costs and space requirements. For example, each open/close duty valve actuator requires at minimum four (4) discrete inputs and two (2) discrete outputs for control, alarm, and position status. Fieldbus systems connect devices (sensors, actuators, flowmeters, etc.) to the PLC by means of a single control cable (bus) connected to a "master" module located in the PLC rack (Figure 1). The master communicates with devices over the bus using a digital signal that exchanges bytes, instead of discrete or analog signals. The byte indicates any I/O such as control signals or device status and can be thought of as a multiple character string (such as ABC123), where A in the first position of the string has a specific meaning for the device ("open valve status," for example) as does B in the second position, and so on.

FIELDBUS SYSTEMS UTILIZE A SINGLE CABLE TO CONNECT FIELD DEVICES TO THE PLC, WHEREAS HARDWIRED I/O REQUIRES A SEPARATE CABLE FOR EACH DEVICE.

Profibus has been developed as two separate protocols; decentralized periphery (DP) and process automation (PA) to serve differing functions in manufacturing and process environments. Decentralized periphery provides communication for discrete functions such as motor starters, variable frequency drives (VFDs), and valve actuators, whereas PA provides communication for analog functions, such as flowmeters, pressure and temperature transmitters, and process analysis equipment (such as total/residual chlorine). Process automation devices communicate over the DP bus to the master by way of a DP/PA coupler that is installed in the control panel. A total of 32 devices can be connected to a single master and up to 128 devices can be connected with signal repeaters installed in the field. Process automation also has the ability to provide power to devices over the bus and eliminates the need for a separate power supply cable in the field.

The benefits of using a fieldbus control system are far-reaching and often realized long after the project has been completed. During the installation of the fieldbus system, there are obvious benefits that include reduced installation and equipment costs due to reduced wiring and hardware requirements. Fieldbus systems utilize a single cable to connect field devices to the PLC, whereas

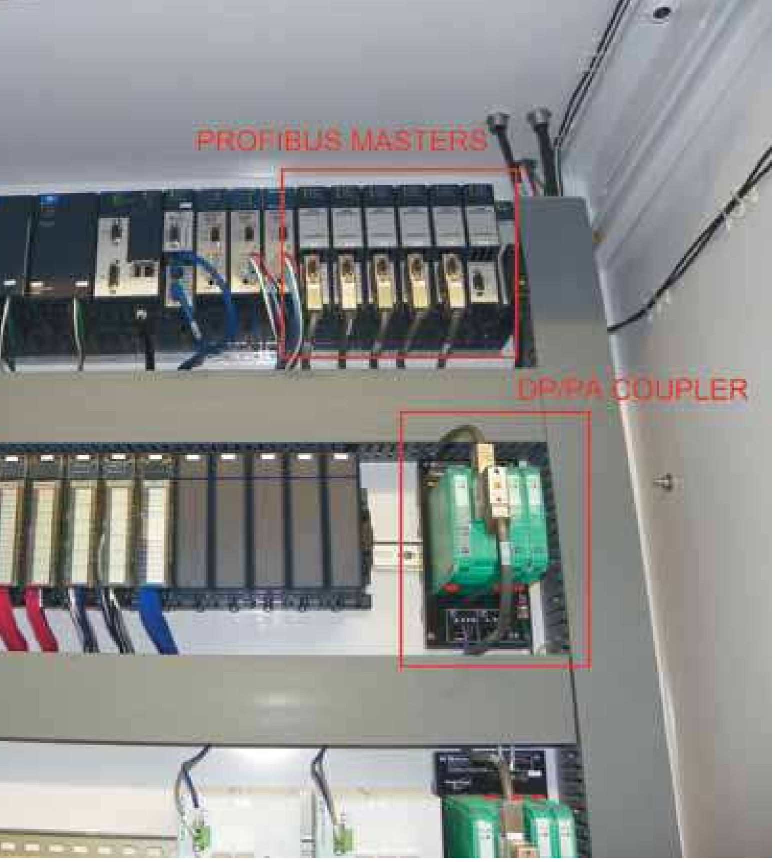

Figure 1: Fieldbus systems connect devices (sensors, actuators, flowmeters, etc.) to the PLC by means of a single control cable (bus) connected to a "master" module located in the PLC rack.

hardwired I/O requires a separate cable for each device. Industry studies have demonstrated that installation and equipment savings can be as high as 18 to 20 per cent. Furthermore, all these separately wired signals require I/O modules in the PLC, which increases the size and cost of the control system. There are also further project cost savings during commissioning and startup of the control system, as labour required to test and verify the instrument wiring is reduced due to the fact that there is a single bus cable to test instead of multiple signal cables in hardwired I/O systems.

Once the owner begins operating the fieldbus control system, major benefits are evident as operations, maintenance, and asset management activities become less onerous. With fieldbus systems, the devices have the ability to communicate issues and process alarms that were once only accessible by connecting the device to a computer in the field. Instead of sending an instrument technician to the field to diagnose an issue, the diagnosis can be completed remotely through the plant SCADA system. Furthermore, calibration of instruments can also be completed remotely through SCADA. The devices are now capable of telling us something we do not already know and allows for a true preventative maintenance system. Another advantage of the fieldbus system is that device information can be tracked with asset management software. Data ranging from year of manufacturer, tag number, calibration date, operation manuals, historical issues, spare parts, etc. can all be collected from the fieldbus by an asset management program. In an industry where owners continually seek to reduce operating costs and improve efficiency, the advantages of fieldbus control systems cannot be ignored.