Fieldbuses for drives

Embedded fieldbus communication

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The technology permitting drives to be networked with controllers is often built directly into the drive. The benefits for the customer are simplified wiring, increased reliability and lower total installation costs.

Although fieldbuses have been around for more than ten years, recent years have seen an increase in focus on application of this technology for drives. One of the problems that has impeded the rapid adoption of fieldbus technology has been the lack of standardization. In the early days, many companies offered proprietary solutions. As these proprietary solutions limidet flexibility, many customers expressed a need for a standard fieldbus. Several competing alliances were created that all strived to develop an open fieldbus that would establish itself as standard. The result is that today there exists a plethora of standards for open fieldbuses.

Manufacturers such as ABB have responded by investing in such technology. In this context, ABB uses the concept of universal connectivity. To understand what this concept implies, a closer look should be taken at fieldbus technology.

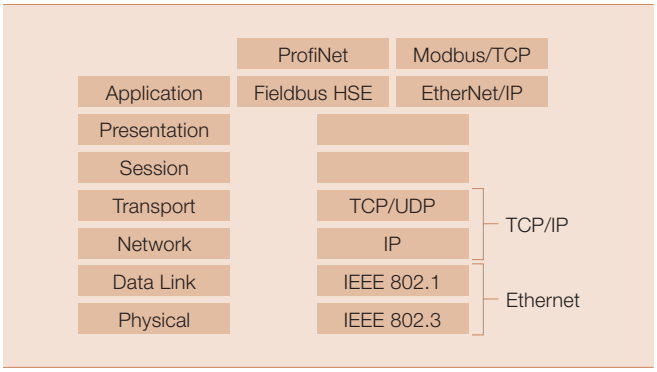
A fieldbus is a fully digital and duplex[1)] data transmission system that connects intelligent field devices and automation systems to an industrial plant's network. A fieldbus replaces conventional wired I/O control. It also differs from point-to-point connections, which allow only two participating devices to exchange data.

A fieldbus transfers information sequentially and is often referred to as a serial communication. To make sure that two devices can communicate over a serial link, a protocol must be agreed on that defines the meaning of each bit in a stream of data. To facilitate the description of a serial communications protocol, engineers often refer to an OSI model that identifies seven layers 1. All layers together are called the communication stack. Each layer in the stack defines a set of functions.

Rather than standardizing the complete communication stack, standards are defined for each layer in the stack, or even for a specific function in a layer. The partly explains the wide array of fieldbus protocols that is available today.

The lower layers of the communication stack, the physical layer and the data link layer, are determined by the hardware. The upper layers are implemented using software alone. This distinction helps explain how universal connectivity can be achieved and also how this concept depends on recent developments in embedded control.

1 The layers of the OSI model and their places in the protocol stack



Universal connectivity

In the absence of a single international standard for the hardware of a protocol, manufacturers have standardized the interface to their own equipment and developed adapters for the different protocols that plug into this interface. Because of continuous miniaturization, these protocol adapters have become smaller and cheaper and are now available as options that are directly built into the drive. Some standardization of the hardware has taken place, which means that different protocols can be implemented using the same hardware solution.

Recent developments in embedded control now make it now possible to implement the upper layers of the protocol stack by simply downloading different software into the field device. This combination of small adapters and downloadable software makes it simple for customers to obtain a drive that easily integrates into their system. ABB supports a wide array of fieldbus protocols, permitting customers to choose a drive independent of the automation system.

Trends in fieldbus technology

The first trend is the continuous rise of fieldbus use. Today around 40 percent of the drives use a fieldbus for remote control. This trend is driven by the falling cost of fieldbus control, as well as by the trend towards increased automation.

The second trend is the rise of industrial Ethernet technology. This technology is relatively new, but promises a major advance in industrial communications. Ethernet applies to the lower two layers of the protocol stack shown in 1.

Industrial Ethernet is a relatively new development but its adoption is progressing very quickly.

Most of the functionality of a fieldbus is defined in the application layer of the protocol stack, but the lower layers are important for the performance. In many systems, the control loops that are closed by the fieldbus need to be fast and need to enable synchronized device responses as can be found in manufacturing automation. In the past this behavior was realized by implementing a physical layer that behaved in a deterministic manner.

Ethernet is in principal non-deterministic, but today it is possible to implement an Ethernet protocol with bit rates of up to 1000 Mbps. This is so fast that for most practical purposes, the control loops that can be implemented behave in a deterministic manner.

On top of the Physical and Data Link layers one can run the TCP/IP protocols that are familiar from the Internet. The result is fieldbus that is compatible with the control buses that are typically used in the higher levels of the control architecture.
The most obvious benefit of Ethernet is that it is based on a open standard. It will allow a standardized network architecture using components that are widely used. Another advantage is that it enables a scalable network architecture. This makes it easier for customers to take advantage of future technical advances compared with proprietary networks. Further, many people are familiar with Internet technology, so that less training will be needed and development time can be shortened.

Industrial Ethernet is a relatively new development but its adoption is progressing very quickly – it will not be long before fieldbuses build on Industrial Ethernet will dominate the market. This is good news for customers, because it increases their manufacturing flexibility.

Where do these developments lead?

For ABB Drives, industrial Ethernet is another important step towards the company vision of the universal connectivity. Shipments of industrial Ethernet have been growing at a rate of 60 percent per year and there is no abating.

Because Ethernet is so widely used in office networks, plants and factories will enjoy the high speed, low cost, wide availability, and compatibility with office networks that Ethernet offers.

Bringing Internet technology into the drive will enable many new applications. Once the drive is given an IP address many functions can be performed remotely. Diagnostics are also improving. This is prerequisite to further improvements in preventive maintenance and the resulting increase in the availability of plant equipment.

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Footnotes

[1] A *half-duplex* channel is one that can carry information in both directions, but not at the same time. A *full-duplex* channel can carry information in both directions simultaneously.