

Unit 1: Prologue

Why are there so many different industrial automation networks? Why can't there be just one network? We hear these questions very often. Indeed, it could have been, but... Well, that would be a long story.

Here is the short version. In 1985, a bunch of us recognized the need for standardizing network communications for process control and we tried to prepare a standard in advance of the competition under the ISA50 standards committee. We called our effort *fieldbus* since it was meant for field instruments. Almost immediately, we were joined by suppliers of programmable logic controllers (PLCs) who believed that they needed to standardize upon their remote I/O networks and could share the same technology. We completed the physical layer protocol (wiring/cabling and signaling) in 1989 and the data link layer protocol in 1993. However, by then there were already numerous competitive commercial networks. The standards work was eventually completed in 1999 with the adoption of many of these commercial network architectures into the fieldbus standard IEC 61158 (International Electrotechnical Committee), which initially contained eight different protocols (types) and now contains more than 20 types.

Market forces could not wait for a standard, and the standard could not incorporate all market forces into a single protocol. Not only that, but a standard cannot immediately, if ever, displace already implemented commercial products. Seven of the original eight network technologies included in the IEC Fieldbus standard have been implemented in commercial products including the two specifications prepared by the Fieldbus Foundation that were based on IEC 61158 Types 1 and 5 that were originally developed from the ISA50.02 Fieldbus standard. One protocol has never been implemented.

I chaired both ISA50 and the IEC SC65C/WG6 Fieldbus committees during the end of their efforts. They were very turbulent times. Cullen Langford, a user from DuPont, chaired these committees during most of the time that they were creating the fieldbus protocol, while I was a contributing member of the user layer subcommittee. Being surrounded by some of the brightest people in the universe was a rare privilege and the experience of a lifetime. I didn't enjoy many of the political moves being made by major manufacturers, but it did provide a challenge to my management style.

While politics were raging in the ISA/IEC committees, discrete automation identified by the use of PLCs was also developing rapidly. For a while, it appeared that one of the standards bodies, NEMA (National Electrical Manufacturers Association), was going to use the high-speed version (H2) of ISA's fieldbus. However, NEMA concluded that H2 standards were too expensive and too complex for use in discrete manufacturing. As a result, most of the data communications buses developed by PLC manufacturers were incompatible with each other and did not conform to a standard set of specifications. Most of the manufacturers countered criticism about the "closed" nature of these protocols by forming "open" groups to make the long-term evolution for each of these bus technologies independent from the originating manufacturer. These open bus associations contributed five of the additional protocols to the IEC eight-part fieldbus standard.

In retrospect, it is clear that no single bus technology can satisfy the demands for multiple applications in the manufacturing marketplace. This is a political, not a technological, statement. We always knew that the wiring, cabling, and connecting solutions embedded in the physical layer could not span all markets, but the committees used the technique known as the "meld of best features" method of standardization to combine the simple elegance of WorldFIP with the pragmatism of Profibus. In the process, we succeeded in developing a single protocol meeting the needs of both process control and factory automation, but with a complexity that caused it to not be accepted for discrete manufacturing. It was over these issues

that the final approval of the IEC 61158 fieldbus standard was delayed for seven years.

Also dating from the late 1980s were the development of very simple buses for sensors. These, too, were developed by independent manufacturers and typically share nothing in common with each other or with any of the higher level bus architectures. They were designed for low cost and low complexity. However, this did not prevent some of these bus structures from being promoted by their sponsors for higher level applications, thereby adding to the confusion.

This book gives you a perspective on the typical applications for industrial automation bus technology. The emphasis is upon the intended application for each bus, rather than the range of applications for each bus, which you would find in the supplier's literature. With that goes a note of caution: Any bus can generally be used for any application; however, stretching a bus technology outside its intended area creates more problems than it solves.

We will begin by discussing some bus applications and will propose the bus technologies that should be used to provide the needed communications services. Often, several different bus solutions will be appropriate, and their differences in the application context will be discussed. Then we will discuss the bus technologies and requirements from an end user point of view. Although the bus technology sections will talk briefly about the protocol used on the bus, the emphasis is on the wiring/cabling issues and the user interfaces. This book is generally free of mathematics except in those areas where the numbers have real application relevance.

Finally, I have always maintained my independence from all manufacturers to retain an unbiased viewpoint. This is an unbiased book, except for my fondness for the fine points of the fieldbus standard. I continue to be amazed at how little this formalized body of knowledge is used in industry, and I do reference some of these points.