Fieldbus and Device Networks

This tutorial on Fieldbus and Device Networks is broken down into the following sections:

- Introduction to Fieldbus and DeviceNetworks
- A brief overview of Profibus

Introduction to Fieldbus and DeviceNetworks

There are currently several analogue and digital standards available for communication between field devices and also between field devices and a master system.
The current approach to cabling of a typical control system is shown in Figure 1. Note that each instrument and actuator is connected back to the instrument room (to a controller) with an individual pair of wires.

The strategy espoused today is to replace this with a communication cable (as in Figure 2) which connects all the instruments and actuators together and enables digital communications between all devices, and has several significant advantages listed below. Each instrument and actuator now becomes an “intelligent device”. An intelligent device can be considered to be a computer controlled device which takes analogue data (e.g. flow); performs an operation on it (e.g. square root extraction) and sends this up a communications network to another device(s) which requires this data. Similarly an intelligent actuator can control a valve to a specific position with a data value sent down the communications network from another device.

There are real benefits to be gained from this digital communications approach, including:

- Greatly reduced wiring costs
- Reduced installation and start-up time
- Improved on-line monitoring and diagnostics
- Easier change-out and expansion of devices
- Improved local intelligence in the devices
- Improved interoperability between manufacturers

This method of categorisation allows these Fieldbus and Device Networks to be placed in one of the following three network oriented classes:

- bit(sensor)
- byte(device)
- message(field)

The bit oriented systems are used, for example, with simple binary type devices such as proximity sensors, contact closures (pressure switches, float switches, etc.), simple pushbutton stations and pneumatic actuators. These types of networks are also known as ‘Sensor Bus’ networks due to nature of the devices (sensors and actuators) typically used. An example here is the ASI bus.

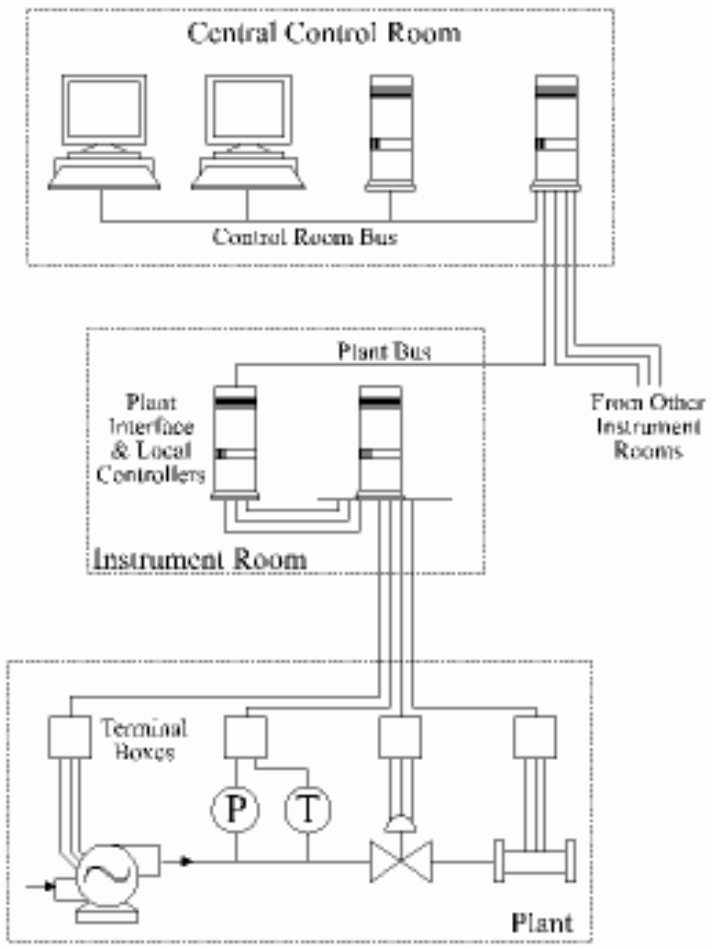

Figure 1 - Current Approach to Cabling of Typical Control System

Byte oriented systems are used in much broader applications such as motor starters, bar code readers, temperature and pressure transmitters, chromatographs and variable speed drives due to their larger addressing capability and the larger information content of the several byte length message format. These networks are also referred to as 'Device Bus' systems or networks. An example of this standard is DeviceNet.

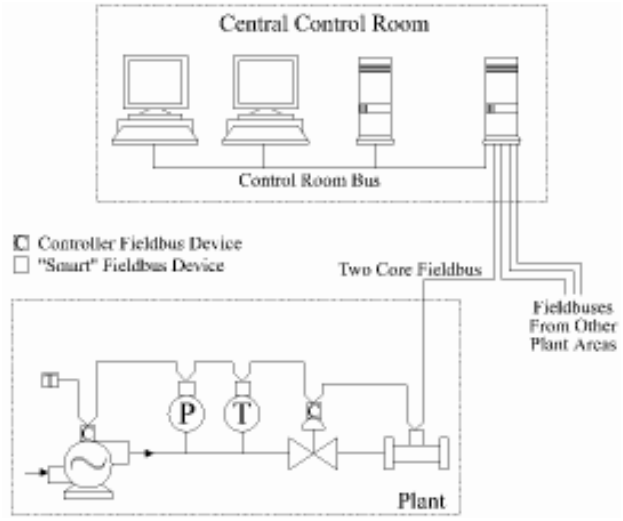

Figure 2 - FieldBus Approach to Cabling of Typical Control System

Message oriented systems, which are those systems containing over 16 bytes per message, are finding application in interconnecting more intelligent systems like PCs, PLCs, operator terminals, instruments and engineering workstations where uploading and downloading system or device configurations is required, or in linking the above mentioned networks together. Example here are Foundation Fieldbus and Profibus.

Brief Overview of Profibus

Profibus is arguably the most popular fieldbus system used internationally at present. It is based on the classical means of communications outlined in earlier sections (ie token passing and master-slave methods).

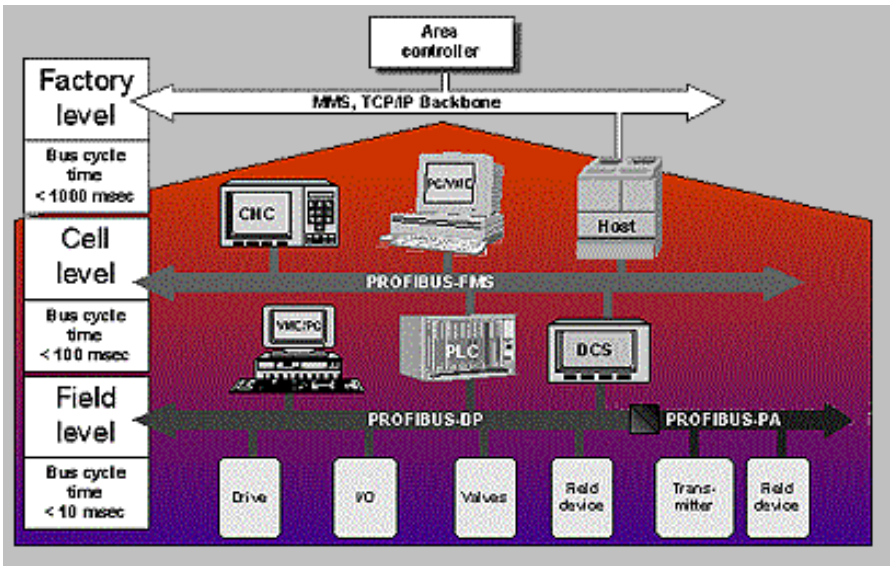

Figure 3 : Application areas for Profibus.
(courtesy of Profibus International)

Profibus consists of an assortment of compatible products. These are:

- Profibus-FMS. This is a universal solution for both the field and cell level of the industrial communications hierarchy and is defined in DIN 19245 Parts 1 and 2 since 1990. In order to carry out the extensive communication tasks with acyclic or cyclic data transfers at medium speed, the Fieldbus Message Specification (FMS) services offer a wide range of functionality and flexibility. Profibus-FMS is included in the European standard EN 50170.
- Profibus-DP. This is aimed at time-critical communications between automation and distributed peripherals and is based around DIN 19245 Parts 1and 3 since 1993. It is suitable as a replacement for the costly wiring of 24V and 4-20 mA measurement signals. Profibus-DP is included in the European Fieldbus standard EN50170.
- Profibus-PA. This is a version suitable for industrial automation. It utilizes the transmission technique specified in IEC 1158-2 and permits intrinsic safety and bus-powered stations. Its Physical layer matches up with that of the Foundation Fieldbus Physical Layer specification for the low speed standard.

Profibus comprises two main type of devices:

- Master Devices. These control the bus and when it has the right to access the bus, a master may transfer messages without any remote request. These are referred to as Active stations.
- Slave Devices. These are typically transmitters/sensors and actuators. They may only acknowledge received messages. These are also referred to as Passive stations.

Figure 4 summarises how the various standards fit together.

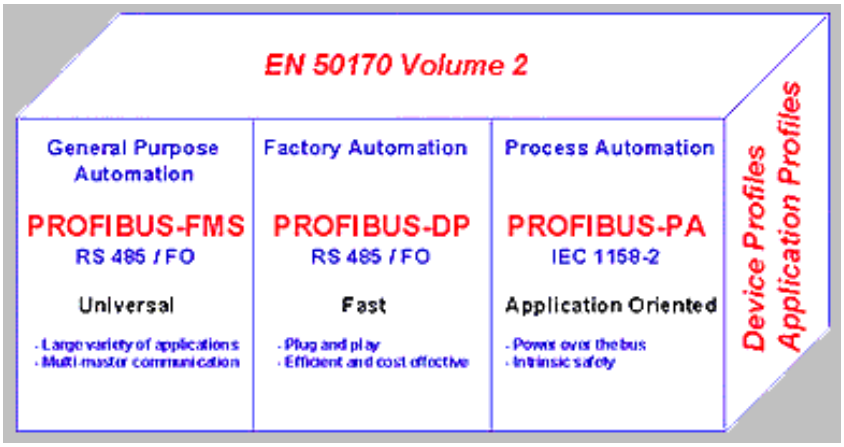

Figure 4 : The PROFIBUS family
(courtesy of Profibus International)

PROFIBUS is based on recognized international standards. The protocol architecture is oriented to the OSI (Open System Interconnection) reference model in accordance with the international standard SO 7498. In this model every transmission layer handles precisely defined tasks. Layer 1 (physical layer) defines the physical transmission characteristics. Layer 2 (data link layer) defines the bus access protocol. Layer 7 (application layer) defines the application functions. The architecture of the PROFIBUS protocol is shown in figure 3.

PROFIBUS-DP uses layers 1 and 2, and the user interface. Layers 3 to 7 are not defined. This streamlined architecture ensures fast and efficient data transmission.

The Direct Data Link Mapper (DDLM) provides the user interface easy access to layer 2. The application functions which are available to the user as well as the system and device behavior of the various PROFIBUS-DP device types are specified in the user interface. RS 485 transmission technology or fiber optics are available for transmission.

Now click here to go to the short quiz based on this tutorial.