Fieldbus and Foundation Fieldbus Systems

This tutorial on Fieldbus and Foundation Fieldbus Systems is broken up into the following sections:

- Overview of Foundation Fieldbus
- Structure of Foundation Fieldbus
- Physical Layer
- User Layer

Overview

This standard is designed to interconnect field equipment such as instruments, actuators and controllers in a Local Area Network Topology. It is aimed at replacing the standard Distributed Control System (DCS) approach. The typical philosophy of Foundation Fieldbus system is shown in the diagram below. The idea is to have a standardised physical interface where the field instruments and actuators communicate via data communications, which is bus powered and open to all manufacturers.

This is obviously a common target for many of the Fieldbus manufacturers. Foundation Fieldbus goes one step further in many respects. It provides for Intrinsic Safety (similar to Profibus PA) and by use of Function Blocks attempts to move the control right down to the Field Level. This means (theoretically) that there is no need for a PLC to do the control as this can be effected by the instruments and actuators themselves. The Operator Interface becomes a window into the process displaying data and being used to transfer control information (such as a Setpoint) to the instruments and actuators.

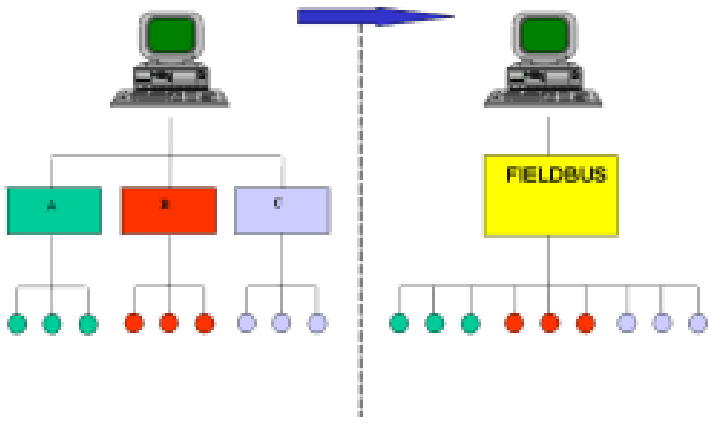

Figure 1 - Fieldbus System
(Courtesy of SMAR)

In figure 1, the systems provided by three different manufacturers (A, B and C) are replaced by one Fieldbus system common to all the three different manufacturers. The term interoperability is used (loosely in this tutorial) to refer to the fact that the systems provided by the different manufacturers are totally interchangeable.

Structure of Foundation Fieldbus

Foundation Fieldbus uses the OSI Model as a basis and uses three layers. The three layers are indicated in the diagram below. They are:

- The Application Layer (broken into the Fieldbus Message Specification and Fieldbus Access Sublayer)
- The Data Link Layer
- The Physical Layer

In addition there is a fourth layer called the User Layer. This is important to define as it allows for interoperability between equipment from different manufacturers by specifying the use of Function Blocks.

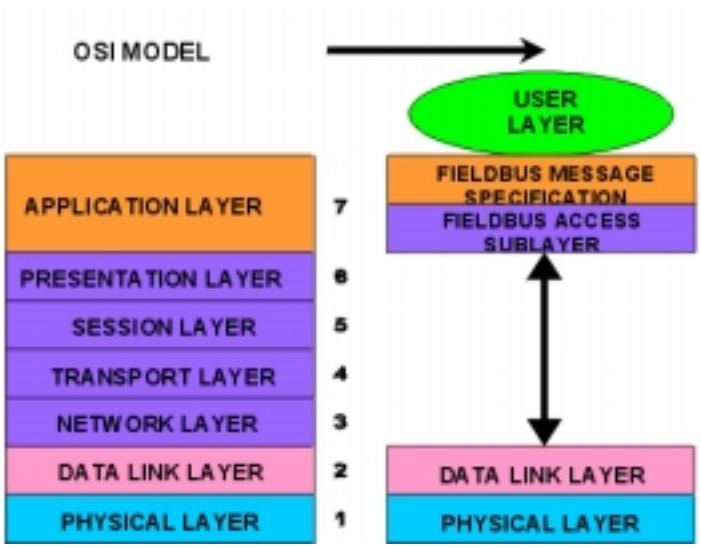

Figure 2 - Structure of Fieldbus vis a vis OSI Model

Physical Layer

The physical layer comprises a 31.25kbps data communications network often referred to as the H1 layer. Both communications signals and the current for each device are conveyed down this pair of wires. A terminator is placed at each end of the pair of wires to eliminate any reflections. There is also a High Speed Standard (HSE) standard which will run on 100 Mbps Ethernet and which is due to be released shortly.

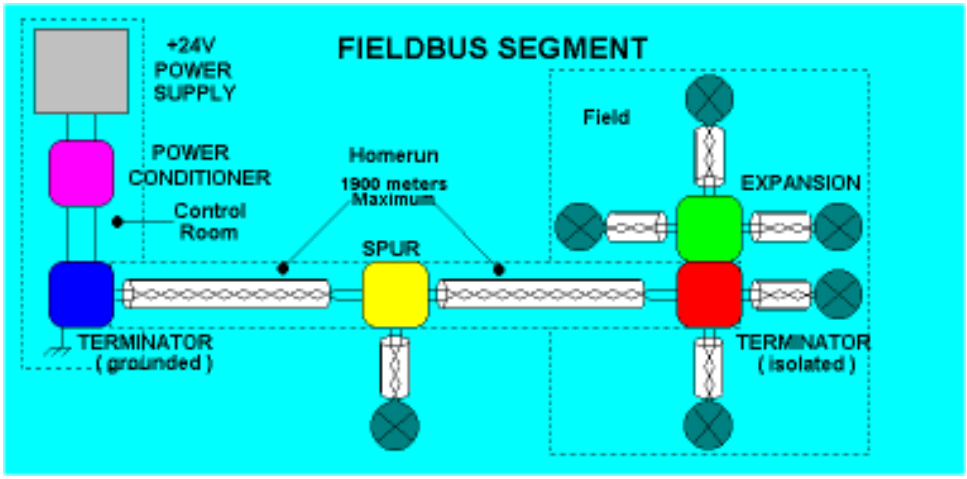

Figure 3 - Typical Physical Wiring Layout (courtesy of Relcom)

Note in the Figure 3, the terminator at each end. The power supply has a power conditioner to ensure that the data signals on the main homerun do not get drained into the low impedance power supply. The maximum length of the homerun is 1900m. In addition, there are spurs that connect off the main homerun. These lengths are defined within the Foundation Fieldbus standard. (Note that RS-485 does not allow any spur lengths off the main homerun).

Data Link Layer

As indicated in figure 3, there are three types of devices specified in the Data Link Layer specification for Foundation Fieldbus. These are:

- Basic Device
- Link Master
- Bridge

Link Master devices have the potential of becoming a link Active Scheduler (LAS). The LAS issues a Compel Data command to devices on the network at defined intervals. When a device receives a Compel Data Command it publishes its data on the bus for all devices to use. The devices that have been configured to read this data in are called Subscriber devices. This scheduled data transfer is used for the regular cyclical transfer of control loop data between devices on the bus.

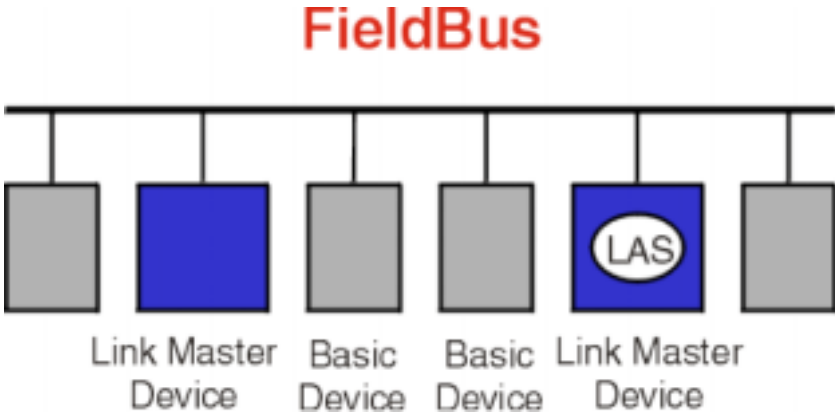

Figure 4 - Operation of Foundation Fieldbus System (courtesy of SMAR)

Bridges are used to interconnect different Foundation Fieldbuses. The Basic Device is effectively an Instrument or actuator. Note that a Basic Device cannot become a LAS.

User Layer

This defines a number of function blocks. Typical function blocks include:

- Analog Inputs
- Analog Outputs
- PID Controllers
- Ratio

Function blocks are built into the field device to achieve a certain level of functionality. For example as a minimum a flow transmitter would have an analog input block whereas a control valve would have an analog output block. The input and output parameters of each of the function blocks are linked over the fieldbus. The execution of each of the function blocks is configured according to some tightly defined schedule. With the use of function blocks residing at the field level, there is no need to have a central controller (such as a PLC).

References

Figures 1,2, and 4 are supplied courtesy of SMAR.
Figure 3 is supplied courtesy of Relcom.

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