Engineering companies and end-users today are spending efforts to evaluate different systems based on the Foundation Fieldbus technology, trying to better understand this new technology as well as its benefits.

Several questions must be made and answered, but some times we are missing the correct perspective. What should we be looking for? How can we compare different systems based on this technology? Many systems already use this technology, but the more we study, the more we investigate, more variances appear. And we find out that each system has its own approach of the Foundation Fieldbus technology.

Only a few systems can really be considered open Foundation Fieldbus systems, whereas there are also systems that only use part of the Fieldbus Foundation technology, making it just another option of I/O to connect into the system. These last systems are still proprietary, with an option to have a Foundation Fieldbus device attached to them, but do not really use all the features that Foundation Fieldbus technology offers to the end-user.

We cannot define Foundation Fieldbus as a simple digital communication protocol. Its amplitude is much more diverse. Diagnostics, better fault tolerance and distributed function blocks are just some of the characteristics that make Foundation Fieldbus a complete control system and not just a simple digital communication protocol.

Therefore the main question remains! How do we know which one will deliver more benefits? Which one will deliver the full capability of Foundation Fieldbus?

These questions and answers were compiled based on Smar's 6-year experience of working with Fieldbus systems. They are intended to be used as a guide to help evaluate a true Foundation Fieldbus system, so it can be selected wisely and safely.

smar
FIRST IN FIELDBUS
Tel.: +55 16 645-6455
Fax: +55 16 645-6450
www.smar.com
techsupport@smar.com

Evaluating a Foundation Fieldbus System

20 Questions & Answers

system 302
enterprise automation

Fieldbus Foundation · Foundation HSE High Speed Ethernet · OPC OLE for Process Control

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Evaluating a Foundation Fieldbus System

1) Can any Foundation Fieldbus Configuration Tool configure the "Process Control Stations" or "I/O Subsystems" of the system?
We are looking for open systems, even open hardware. In a True Foundation Fieldbus system, even the "Process Control Stations" or I/O Subsystems are designed according to the Foundation Fieldbus Standard, providing interoperability and openness to the system. Therefore, in a Foundation Fieldbus system, a Foundation Fieldbus Configurator should configure all system hardware.

2) Is it possible to use a Foundation Fieldbus Configurator to configure all control functionality of the system, either in the Control Stations or in the Field Devices?
A True Foundation Fieldbus system must allow all its functionality to be configured by a standard Foundation Fieldbus Configurator. Both Field Devices and Control Stations (Linking Devices) must be based on Fieldbus Foundation Standard, and perform control through Foundation Fieldbus function blocks. This guarantees an open system now and in the future.

3) Can a new Foundation Fieldbus device be configured by the system, by only including the Device Description files and the Capability file?
Foundation Fieldbus requires for all approved devices to be fully represented by only two types of files: Device Description and Capability file. A true Foundation Fieldbus system needs only these two types of files to configure and access a Foundation Fieldbus Device. If any other file is required by a system, it is non-standard and shows the proprietary characteristic of such system.

4) Is the System capable of configuring all function blocks present inside the field devices and the linking devices?
Many systems come with some Foundation Fieldbus configuration capability, but only a True Foundation Fieldbus system will not have a Specific System Configurator, but a complete Foundation Fieldbus Configurator capable of configuring all functions inside a Foundation Fieldbus approved device, like a Field Device, Controller or a Linking Device.

5) Is there any license policy to run function blocks in the "Process Control Station" or in the "Field Devices"? What is it?
This issue is very important to define the total cost of the system, as well as, how open and flexible is the system you are acquiring. Some manufacturers may present you their Foundation Fieldbus Device with a set of Function Blocks that you could use. But when you purchase it, you may notice that not all blocks are there. They are actually optional and are enabled by paying an extra fee. Having the capability but being unable to use it will bring you no benefit.

6) Does the System accept both Fixed Foundation Fieldbus Function Blocks and Instantiable Fieldbus Foundation Function Blocks?
Foundation Fieldbus defines both types of function blocks, fixed, where the block is always present, in fixed quantities, running all the time and instantiable, where you can declare for execution the available blocks in a device. Devices with instantiable function blocks have actually a library of function block types that can be executed inside the device. By configuring the device we are actually declaring the blocks we want to use based on the library. We can even declare the same type several times. For instance, cascade loops can be done executing both PID controllers in the valve positioner. Instantiable function blocks add flexibility to your system, because you will only use what you really need in the quantity you need, customizing each device. Devices with instantiable function blocks will also reduce the amount of spare parts, since each device can be customized individually. Only one type of spare part is required. Does your system support this flexibility?

7) How many types of Foundation Fieldbus Function Blocks does the system offer inside the field devices and linking devices?
Foundation Fieldbus technology is not only a digital communication protocol between field devices, it is a new concept on a control system -- offering more ways to do process control. One new way is to distribute control throughout the field devices which leads to better control performance, higher reliability of your plant and reduces the expenditures with maintenance and the consumption of raw material while at the same time maximizing your production through higher availability of the plant. Placing control in the field devices means less hardware, since many controllers are not required anymore, minimizing parts and spare parts, as well as, the initial investment and the total cost of ownership. This new concept is achieved by the distribution of function blocks between the hundreds of field devices in your system. This new concept is Field Control System. To achieve this concept we need function blocks in the field devices that can contribute with more than 90% of the functions typically found in control systems.

8) Does the System use open Data Highway or open Control Network? Be careful with ETHERNET, it can also be proprietary.
Although Ethernet is an open standard, it does not define the complete network protocol. Ethernet is only related to the first two layers of any network protocol (Physical Layer and Data Link Layer). An open network protocol must have all layers defined by an open standard. Foundation Fieldbus HSE is such a standard, defining a network using only open standard protocols: Ethernet + TCP/IP + Foundation Fieldbus. Only with the Foundation Fieldbus HSE standard we will have a complete open control network.

Fieldbus Foundation

FOUNDATION HSE High Speed Ethernet

9) Does the system support Foundation Fieldbus Bridges on both H1 and HSE?
Foundation Fieldbus bridges define how devices in different channels can communicate to guarantee full plant integration with excellent control performance. Some systems will have this communication done inside their proprietary CPU, not guaranteeing, the Foundation Fieldbus schedule, the control performance and the openness of the system. Others will not even have this feature, which will limit their control capability to only small loops.

10) Can we have redundant Foundation Fieldbus interface modules connected to the same Foundation Fieldbus H1 channel? Are they treated redundantly?
Redundancy is usually a very important point to be considered in control systems. Using Foundation Fieldbus systems a great portion of the redundancy can be reduced like controllers for instance. Performing control at the field devices makes controller redundancy not necessary. But there are still the linking devices working as interfaces between the field devices and the Process Visualization tool. These interfaces should be made redundant to guarantee the high availability of your plant. You may want a smart and reliable plant, but most of the time not that independent from the operator.

11) How are "Process Control Station" CPU and Ethernet redundancy handled?
Redundant CPUs are always requested for large control systems, so how is it done? Are both CPUs connected to the same backplane or rack, being subjected to its failures, or can they be connected in different backplanes for better reliability? Is the Ethernet data highway redundant? Ethernet by itself is not redundant, and it brings us again to the use of Foundation Fieldbus High Speed Ethernet networks, which defines a way to make the network redundant. Does the system comply with this standard?

12) Can any computer be used in the system or only special brands? What are the minimum requirements?
Having good components is the primary requirement to have a good system. This also applies to the operator workstation but this doesn't require removal of all options except one. Open systems should accept different components, such as different operator workstations. Knowing and applying the minimum requirements should be enough to guarantee the performance of the system.

13) What kind of Fieldbus Foundation safety barriers for I.S. applications does the system use? How many devices can be connected to each safety barrier?
Intrinsically Safe systems require barriers, no matter if they are Foundation Fieldbus or Conventional. With Foundation Fieldbus you will save on barriers since you can have many devices connected to a single barrier. So how much will you save? How many devices can be connected to the safety barrier? This will depend on the current consumption of each device, as well as on the above output current.

14) Do we need to use a repeater connected to the safety barrier or it is already embedded in the barrier?
Some Safety Barriers require Foundation Fieldbus repeaters to be connected to them when you have more than one Foundation Fieldbus safety barrier in a Foundation Fieldbus H1 channel. This happens because these safety barriers are passive and do not regenerate the Foundation Fieldbus signal. There are also safety barriers with repeaters inside, which means that the Foundation Fieldbus signal is regenerated and any segment coming out of a safety barrier is independent of another safety barrier segment, distance wise and power wise.

15) What is the consumption of each Field device? The lower the better?
The consumption of each Field Device is important, especially in I.S. applications, since this will determine the number of devices that can be connected to the same safety barrier. Of course there is typically a compromise between current consumption and included features. Does the device in question have all the needed functionality? If so, does it consume less than the others do?

16) How many devices can be connected per Fieldbus channel? And how many devices can be connected in one Foundation Fieldbus interface module?
Modularity is the issue here. How many devices can be connected to one channel and still guarantee control performance? . The number of devices connected to the same Foundation Fieldbus channel will affect the control loop performance of the loops on that channel. Therefore we should be looking for 12 to 16 devices to keep the same performance of the conventional DCS and control systems. Another important point is how many interface cards or linking devices will I need? That will depend on how many devices you will be able to connect in one linking device! Can I connect 1, 2, 4 or more Foundation Fieldbus H1 channels on each interface? Wouldn't redundancy be nice here?

17) How many Backup masters can be configured in one channel? Is there any restriction?

Field Backup LAS is also another key feature of Foundation Fieldbus Technology, which improves the reliability and availability of the system. With Field LAS you can guarantee that a critical loop will still run even if the main LAS is lost. So, how many of them can I have in one channel? Several Field LAS in a single channel are especially useful in Fault Tolerant installations where a single failure should affect only one loop.

Can any link master device be used or only specific devices? Do they need any special configuration, like special address?

According to Foundation Fieldbus Standards, no extra configuration is required but the LAS functionality activation.

18) Does the system accept any Foundation Fieldbus approved device with no restriction?

Some systems with Foundation Fieldbus capabilities will not allow you to connect some Foundation Fieldbus approved devices due to lack of functionality on their host side. True Foundation Fieldbus systems will have all necessary functionality to configure any Foundation Fieldbus Approved Device.

19) Can any Scada software or Process Visualization tool available in the market be used with the system?

An open system must allow software from different manufacturers to be used with it. The OPC standard was designed with this idea. OPC technology completes the Foundation Fieldbus standard to deliver open systems. Ask for systems based on OPC if you are looking for complete open systems.

20) Is your system a true Foundation Fieldbus system or is it more like an old DCS with Foundation Fieldbus communication?

Several questions, many different systems. A true Foundation Fieldbus System will take full advantage of the Foundation Fieldbus technology. Some of the advantages we can see are: Field Control System, True distribution of control functions over hundreds of microprocessors, proactive maintenance using on-line field diagnostic information, reduction in hardware and wiring, full system interoperability on devices and "process control stations" and fully integrated open systems. A DCS with Foundation Fieldbus communication on the other hand will only benefit from multidroping several devices in the same pair of wires and from some maintenance information since they will keep all control centralized in their I/O substations. Which one are you looking for?

Glossary

Foundation Fieldbus - A digital, two-way, multi-drop communication link among intelligent measurement and control devices. It serves as a Local Area Network (LAN) for advanced process control, remote input/output and high-speed factory automation applications. It is designed to be compatible with the officially sanctioned SP50 standards project of the ISA and the specifications of the IEC.

Fieldbus Foundation - The Fieldbus Foundation is a consortium of leading controls and instrumentation suppliers throughout the world. Its purpose is to accelerate development and acceptance of a single, open, interoperable fieldbus specification, as well as hardware and software technology for companies that wish to implement it in their automation products.

H1 - The term used to describe a fieldbus network operating at 31.25 kbit/second.

HSE - High Speed Ethernet is the Fieldbus Foundation's backbone network running at 100 Mbit/second.

DD - A Device Description provides an extended description of each object in the Virtual Field Device (VFD), and includes information needed for a control system or host to understand the meaning of data in the VFD.

Link Active Scheduler (LAS) - Is a deterministic, centralized bus scheduler that maintains a list of transmission times for all data buffers in all devices that need to be cyclically transmitted. Only one Link Master (LM) device on an H1 fieldbus Link can be functioning as that link's LAS.

Linking Device - A device used to interconnect H1 fieldbus segments to High Speed Ethernet (HSE) to create a larger network.

Master Backup - A field device containing Link Active Scheduler (LAS) functionality that can control communications on an H1 fieldbus Link.

Schedule - Define when Function Blocks execute and when data and status is published on the bus.

DCS - Distributed Control System

OPC - OLE for Process Control

OLE - Object Linking and Embedding