15.5 Fieldbus FOUNDATION™ [1]

1 http://www.fieldbus.org

15.5.1. What is FOUNDATION™ (FF) technology?[1]

The open, non proprietary FOUNDATION architecture provides a communications protocol for control and instrumentation systems in which each device has its own “intelligence” and communicates via an all-digital, serial, two-way communications system.

The FOUNDATION solution is a systemic technology comprised of a bidirectional communications protocol and communicating among field devices, to the control system, and to a Function Block structure for true distributed control. In addition had this protocol a Device Description (DD) technology for parameterization and integration of data, and had a network hierarchy for subsystem integration as well as a well-defined system management structure for reliability and determinism of functional execution.

Figure 15.5.1.-1: Logo FOUNDATION

15.5.1.1 What is FOUNDATION H1?

FOUNDATION H1 is a bidirectional communications protocol used for communications among field devices and to the control system. FOUNDATION H1 is intending primarily for process control, field-level interface, and device integration.

Foundation H1 running with 31.25 kbit/s, the technology interconnects devices such as transmitters and actuators on a field network. Foundation H1 designed to operate on existing twisted pair instrument cabling with power and signal on the same wire. Fiber optic media is optional. It also supports Intrinsic Safety (IS) applications.

15.5.1.2 How is FOUNDATION H1 unique?

FOUNDATION H1 is the only digital fieldbus protocol developed to meet the original IEC 61158 requirements. Unlike other protocols, FOUNDATION H1 provides explicit synchronization of control and communication for precisely periodic (isochronous) communication and execution of control functions with minimized dead time and jitter. It synchronizes clocks in fieldbus devices for support of Function Block scheduling and alarm time stamping at the point of detection.

Additionally, FOUNDATION H1 provides automatic address setting, eliminating the need to manually set addresses off-line using a tool or DIPswitches and avoiding subsequent mistakes. FOUNDATION H1 uses peer-to-peer communication where devices communicate directly using a publisher/subscriber communication relationship enabling data to be sent to several devices in a single message-thus reducing overhead.

FOUNDATION H1 includes alarm and event reporting for efficient diagnostics and process alarms. Online firmware download makes it possible to upgrade devices in order to stay ahead of the obsolescence curve. Lastly, a rigorous interoperability-testing program ensures quality connectivity.

1 FOUNDATION Fieldbus, Technical Information L 454 EN, SAMSON AG

15.5.1.3 Is FOUNDATION H1 easier to use than traditional technology?

FOUNDATION H1 has made it possible to “mine” important information from the plant floor. When used correctly, this information empowers operators and technicians to make plant operation and maintenance easier. Some end users report commissioning timesaving is as high as 75% compared with conventional analog technology by switching to FOUNDATION technology.(see Figure 15.5.1.3.-1)

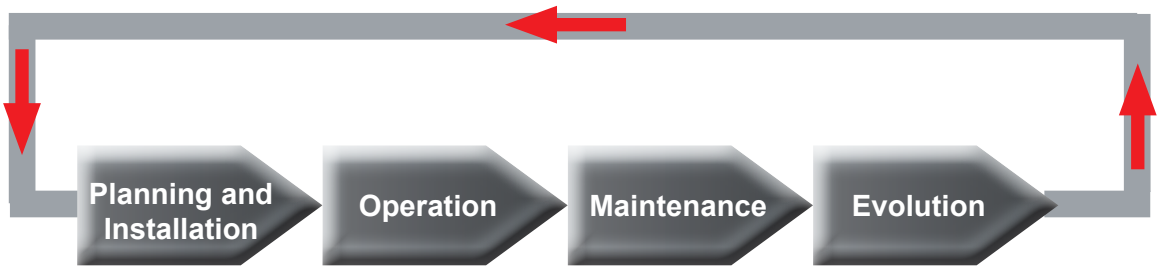

Figure 15.5.1.3.-1: FOUNDATION Fieldbus

15.5.1.4 What are the benefits of H1?

Specific benefits of FOUNDATION technology include reduced wiring, multi-variables from a single multi-channel field instrument, simpler integration, and easier maintenance. Ultimately, FOUNDATION technology will be the key to greater manufacturing flexibility and productivity, higher quality products, and improved regulatory compliance. This can be achieved by predictive maintenance scheduling and better upkeep enabled by the diagnostics, performance analysis data, and operational statistics. Better-adjusted and properly calibrated devices ensure lower process variability.

The isochronous bus cycle enables tighter loop tuning, and as a result, better process control. Firmware download gives the ability to stave off obsolescence, giving fieldbus plants longer life than other plants with greater ease.

FOUNDATION technology enables improved asset management using device management software, as many failures can be predicted and faults can be diagnosed in detail (see Figure 15.5.1.4.-1).

Together, device management software and FOUNDATION devices typically enable:

- Identification & information
- Diagnostics, performance analysis & operational statistics
- Parameterization, ranging, reconciliation & audit trail
- Simulation & override
- Calibration trim & log
- Document access
- Device event capture & monitoring
- Commissioning
- Maintenance log & service notes
- Device listing
- Maintenance & calibration scheduling

Foundation H1 devices comprise a function block application, act as a publisher and subscriber of process variables, transmit alarms and trends, and provide server functionality for host access and management functions. Devices can act as a scheduler and time master for regulating communication on a fieldbus segment. They also used for bus interfaces in process control systems or in linking devices. Capable of controlling bus communications and many connections to multiple devices, they support both client and server applications.

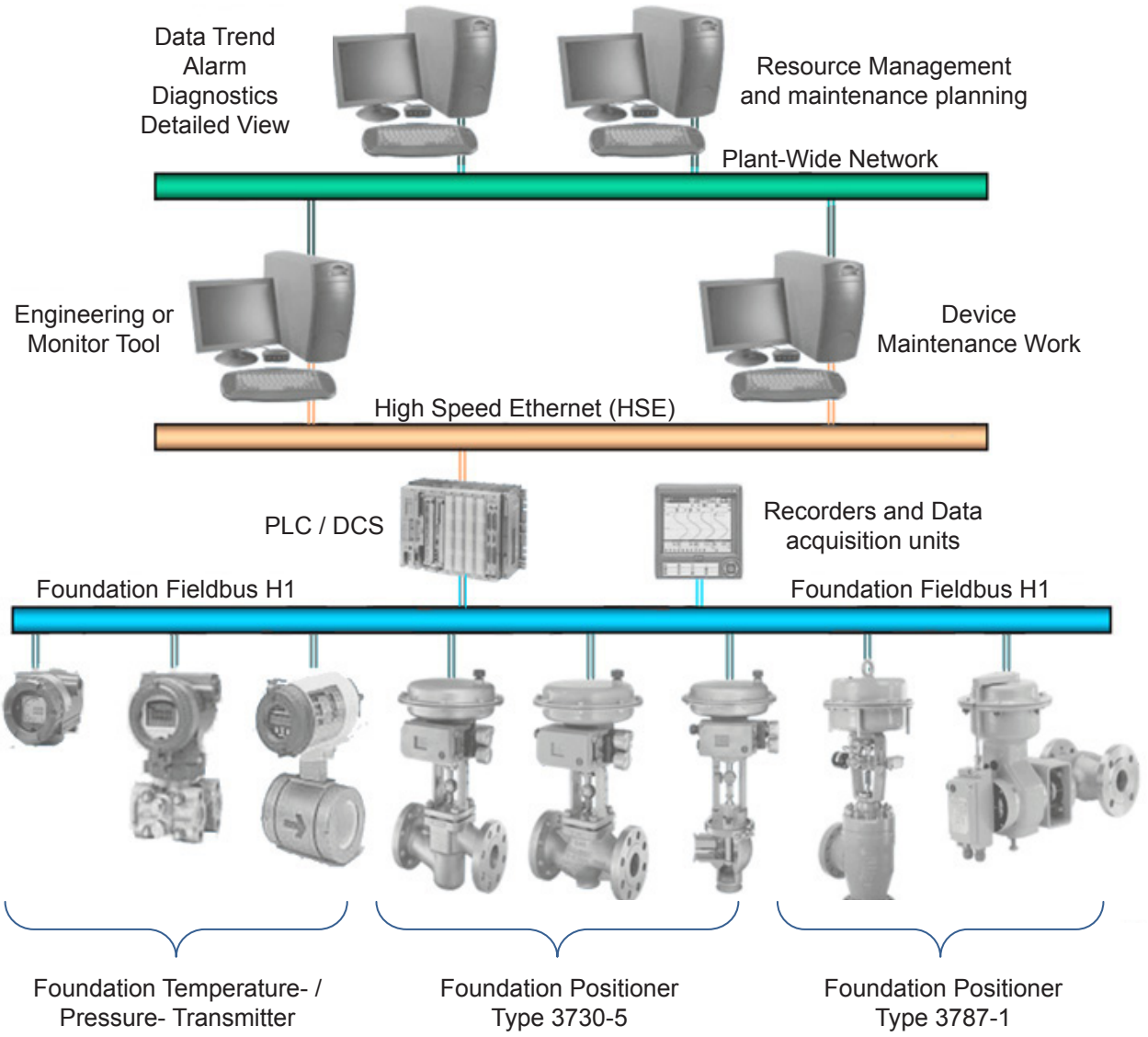

Figure 15.5.1.4.-1: FOUNDATION System Technology

H1 technology enables field instruments and other devices to execute control functions reducing the load on plant computers and workstations. Since the H1 network is digital, I/O conversion subsystems eliminated. The Fieldbus Foundation tests and registers the devices to ensure interoperability of registered instruments from multiple vendors. This enables the end user to select the best instruments for the application regardless of the host system supplier.

Reports from leading adopters of the Foundation protocol demonstrate the advantages of control in the field with the H1 solution. For example, end users in the petrochemical

industry have realized up to a 30 percent reduction in operating costs due to advanced diagnostics.

Users have also seen that the all-digital H1 communications network is far less susceptible to electrical noise than traditional 4-20 mA analog systems. H1 technology enjoys widespread acceptance throughout the process industries, and is included in the international IEC standard (IEC 61158).

15.5.2. FOUNDATION HSE

FOUNDATION HSE is based on unmodified IEEE 802.3 Ethernet and therefore compatible with standard Ethernet equipment. Unlike mere “Ring topology,” FOUNDATION HSE provides complete “DCS style” redundancy with redundant network switches, redundant devices, and redundant communication ports ensuring unsurpassed availability.

Figure: 15.5.2.-1: Foundation System Technology

FOUNDATION HSE is also based on standard IP, enabling it to coexist with other devices and ensuring compatibility with standard tools. At the highest level, FOUNDATION HSE includes a standard application layer that provides interoperability between devices beyond the mere coexistence provided by Ethernet and TCP/IP.

FOUNDATION HSE communication is schedule-driven to minimize dead time and jitter with support for peer-to-peer communication directly between devices. Again, a rigorous interoperability-testing program ensures quality connectivity.

High Speed Ethernet (HSE) is ideally suited for use as a control backbone. Running at 100 Mbit/s, the technology is design for device, subsystem, and enterprise integration. It supports the entire range of fieldbus capabilities, including standard function blocks and Device Descriptions (DDs), as well as application-specific Flexible Function Blocks (FFBs) for advanced process and discrete/hybrid/batch applications.

HSE supports complex logic functions, such as those performed by Programmable Logic Controllers (PLCs), or data-intensive process devices, such as analyzers and gateways to other networks. HSE enhances access to H1 fieldbus technology via linking devices, while providing expanded capabilities for high-speed automation devices and hybrid/batch applications.

15.5.2.1 A key technology for enterprise integration

HSE enables tight integration and a free exchange of information needed for the plant enterprise. HSE is a superior solution to proprietary, Ethernet-based technologies since it provides end users with interoperable devices from multiple suppliers. In addition, like H1, HSE is an international standard (IEC 51158).

HSE provides the same benefits as H1, but at the subsystem integration level instead of the field device level. It supports interoperability between disparate controllers and gateways in the same way that H1 supports interoperability between transmitters and actuators from different suppliers. FFBs in HSE devices can be set up using programming languages such as those found in the international standard IEC 61131-3.

15.5.2.2 Designed to support mission-critical applications

HSE technology designed from the ground-up to support fault-tolerant networks and devices used in mission-critical monitoring and control applications. All or part of the HSE network and devices can made redundant to achieve the level of fault tolerance required for a particular application. Best of all, redundancy is supported using standard Ethernet equipment, thus eliminating the cost of special network equipment.

HSE also supports standard Ethernet wiring, including a fiber optic media option to provide cost-effective electrical isolation between plant areas or immunity from distortion through noisy environments.

15.5.2.3 Function Block Model (FFB)

A unique characteristic of the Foundation architecture ensuring device interoperability is its use of a fully specified, standard User Layer based on “Blocks” and Device Descriptions (DDs). The User Layer defines a Function Block Application Process (FBAP) using Resource Blocks, Function Blocks, Transducer Blocks, System Management, Network Management and DD technology.

15.5.2.4 Blocks enable fieldbus device functionality

Blocks incorporated into fieldbus devices to achieve the desired device functionality, as well as to define a wide range of features and behaviors that must work in a standard way for devices to inter operate.

For example, a simple temperature transmitter may contain an Analog Input (AI) function block. A control valve might contain a Proportional/Integral/Derivative (PID) function block as well as the expected Analog Output (AO) block. Thus, a complete control loop can built using only a simple transmitter and a control valve.

15.5.2.5 Electronic Device Description Language (EDDL)

Enhanced Device Description Language (EDDL) is a programming language used to create Device Descriptions (DDs) to describe the attributes of field devices in an Operating System (OS) and Human Machine Interface (HMI)-neutral environment. EDDL used to create DDs for functions such as generic digital and analog input/output modules, HMI displays and transmitters, on-off and regulating valves, and closed-loop controller diagnostics.

The DDL languages for Foundation Fieldbus, HART, and Profibus are very similar and therefore they have been grouped into one standard: IEC 61804. To reflect the change in overall specification, the new standard language is referred to as EDDL (Electronic

Device Description Language). The new EDDL language covered new items such as methods, menus, and parameter descriptions.

15.5.2.6 Safety Instrumented Functions (SIF)

The Fieldbus Foundation's Safety Instrumented Systems (SIS) program is delivering the benefits of open, interoperable fieldbus technology to the industrial safety market. The initiative supported by a "who's who" of control industry leaders.