System 800xA – The Power of Integration

800xA Device Management and Fieldbus Overview

Power and productivity
for a better world™

ABB

Introduction

In their quest to lower lifecycle costs while improving productivity, companies have integrated intelligent field devices via fieldbus technologies into their process automation solutions. Compared to traditional 4..20 mA technology, digital fieldbus solutions integrate and exploit embedded new levels of field device information in order to streamline work processes, improve process and product quality, and maximize availability. System 800xA seamlessly integrates intelligent field devices as well as electrical equipment and makes the resident information available in the right manner to the right people and in the right context. System 800xA's power of integration makes information available not just within the control system itself, but throughout the plant. System 800xA supports users in managing their field devices.
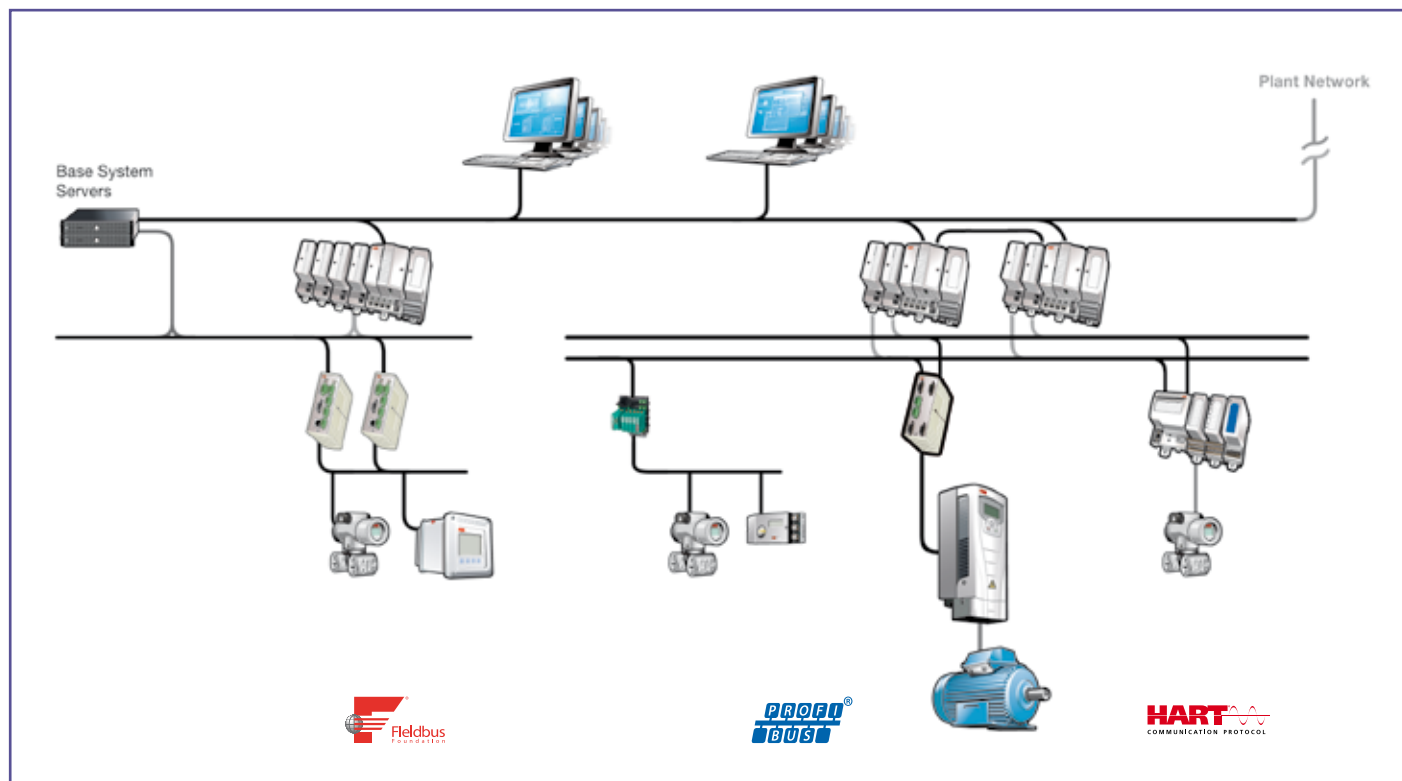
System 800xA's Device Management solutions result in improved engineering efficiency, reduced time for repair, and optimized plant availability and performance, ultimately leading to continuous productivity improvements.

System 800xA provides:
– Seamless integration of fieldbuses, field devices and electrical equipment into the extended automation system environment.
– Integrated solution eliminates the need for separate gateways or PC hardware.
– A full range of products for the three major fieldbus protocols: FOUNDATION Fieldbus, PROFIBUS, and HART is available. The integration is extended into the area of substation equipment with IEC 61850 Connect[1].
– Information availability: The right information at the right time and at the right place. All relevant device status, diagnostic, and process information is available wherever it is needed through the whole plant and across its whole life cycle.
– Preconfigured field device objects extended with aspects to access device data, asset information, and device specific documentation enhance productivity. A full range of System 800xA certified devices supported by the Device Libraries ensure interoperability.
– Fieldbus solutions to meet all plant requirements: System 800xA architecture supports flexible redundancy schemes and allows for installation of devices in all plant environments including explosion hazardous areas.

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1 For more information about integrated process and power automation with IEC 61850 see the brochure 3BSE062087

Figure 1: Schematic example of a system topology

Fieldbus Solutions

The basis for field device manangement

800xA Device Management is based on well-defined fieldbus communication protocols FOUNDATION Fieldbus and PROFIBUS. The digital serial communication provides access to a wealth of information contained in modern field devices. Through the fieldbus components of System 800xA, this information is made available to be used in more efficient process control or asset optimization.

FOUNDATION Fieldbus and PROFIBUS cover a broad range of applications and are widely accepted in the market. Very often regional preferences or customer specific requirements determine, which fieldbus is used. ABB's strength is to offer the freedom to choose what best fits the application needs.

Although HART is technically not a fieldbus, HART devices support additional information via digital communication layered on the standard 4..20mA process signals. The System 800xA I/O portfolio provides options to also take advantage of this data in Device Management for more efficient commissioning and maintenance. With the introduction of WirelessHART, data from HART devices can now also be retrieved and used in Device Management independent from wiring and the 4..20mA signal.

High availability through redundancy
Fieldbus technology has extended the process control system to the instrument level. As such, fieldbuses must meet the same fault tolerant standards expected of traditional process control systems. System 800xA fieldbus options maximize field device availability with scalable redundancy schemes reaching from full redundancy at all levels to options with media redundancy only.

High Ingegrity and Safety

For safety-related applications, ABB can supply SIL-rated I/O and instruments for temperature, pressure, and flow measurements, and control actuators. HART devices connected to SIL-analog input channels can also be handled in Device Management HART.

Details about 800xA Safety solutions are described in the 800xA Safety Overview Document.

Intrinsic Safety

ABB offers a large portfolio of fieldbus components supporting installation of field devices and remote I/O in explosion hazardous areas.

Intrinsically safe fieldbus components from ABB are proven in fieldbus projects and comply to the FISCO international standard. The FISCO model (Fieldbus Intrinsically Safe Concept) allows quick planning and implementation of intrinsically safe fieldbus segments. Through the use of the FISCO model, PROFIBUS PA or FOUNDATION Fieldbus-H1 networks can be easily designed, deployed and operated in hazardous areas.

Integrated system environment

Configuration and commissioning

Integrated fieldbus management tools

Fieldbus Builder, the integrated fieldbus management tool, supports engineers throughout the planning phase of a project. Selecting device objects from a comprehensive Device Library provides for easy configuration of network structures without the difficulty of manually integrating and testing 3rd party devices.

Navigating through the fieldbus topologies in System 800xA's Plant Explorer supports effective engineering. with all functions for topology design, device configuration, and diagnostics just a mouse click away in a context menu.

Integration with System 800xA Bulk Data Manager enables creating fieldbus topologies efficiently out of project databases, device lists, or signal lists. Existing configurations can easily be duplicated and reused.

Device specific graphical user interfaces, powered by Device Type Managers (DTMs) or (enhanced) Electronic Device Descriptions (EDDs), make device parameterization simple and intuitive. The configuration features of the 800xA fieldbus management tools are available in both on-line and off-line modes, so that configuration and basic parameter settings can be done before the physical devices become available.

When configuration is complete, additional fieldbus management tool features support commissioning and installation of the fieldbus networks and devices.

After initialization of the network, all device configurations are downloaded. Bus timing and schedule are generated automatically, while device parameters can be displayed and modified individually online. The ability to tune device parameters from the control room through the system infrastructure reduces the need for trips to the plant floor and speeds up commissioning significantly. Data stored in the system's data base and in field devices can be reconciled. For larger installations, Bulk Data Manager helps to compare parameters in the field devices with the settings planned in project databases.

When parts of the plant are already running and further fieldbus devices need to be added, System 800xA supports such additions with minimal impact on the running application and field devices.
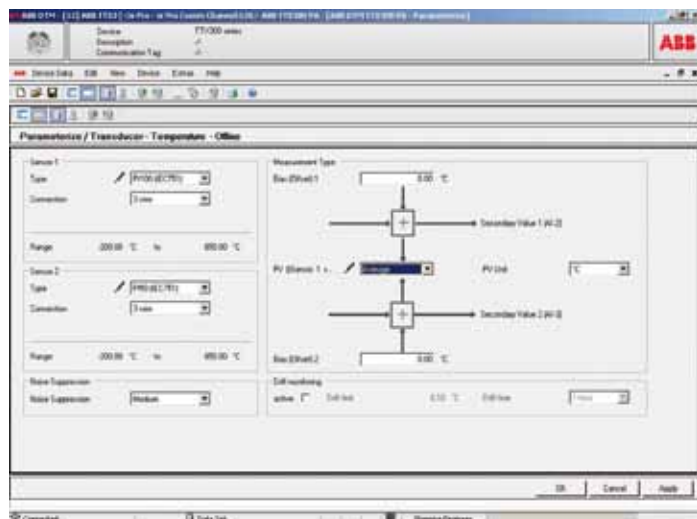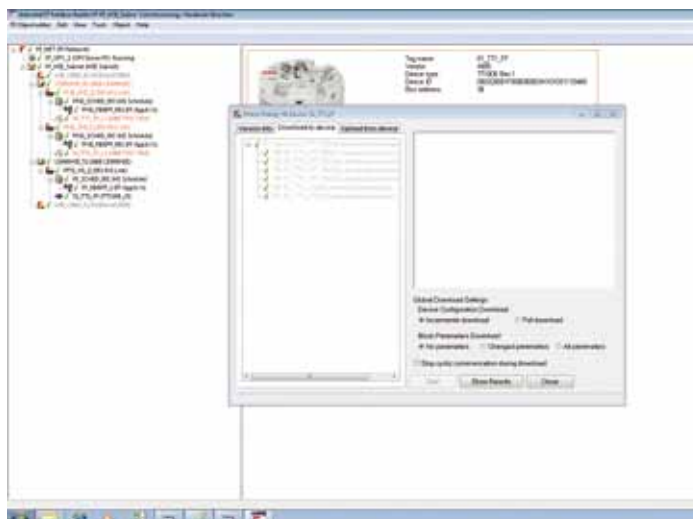
Figure 2: DTM display for device configuration

Figure 3: FOUNDATION Fieldbus reconcile check

Operation and maintenance

Operation

System 800xA's Workplaces are the user interfaces for plant operators, engineers, maintenance technicians, and managers to control and monitor applications based on field devices and to maintain these devices.

Based on different user roles, the workplaces can be adjusted to take advantage of field device data according to different plant operation paradigms.

Operator Workplace

Status information coming with process values of fieldbus devices can be displayed on faceplates to give operators guidance how reliable a signal is, based on the condition of the field device. This data can be enriched with diagnostics or alarms & events created on the device, so that operators become aware of anomalous situations immediately and can take corresponding action. It is even possible to give operators access to DTMs so that they can read detailed diagnostics directly out of the device.

Maintenance Workplace

In plants where maintenance personnel are on site around the clock, direct access to devices will typically be limited to maintenance engineers working out of the Maintenance Workplace.

This workplace allows grouping and structuring of field devices and other plant assets according to maintenance needs, e.g. by device categories or maintenance teams as shown in Figure 4. Device functionality is easily accessible via context menu.

By combining Device Management with 800xA Asset Optimization, additional features become available like overview displays allowing assessing the plant's health at a glance based on continuous monitoring powered by Asset Monitors. Asset Monitors help to track down root causes of failures quicker and enable more efficient preventive maintenance schemes or predictive maintenance. By regularly scanning device status and internal parameters, Asset Monitors can detect upcoming maintenance conditions before a device actually breaks.

In addition to presenting such alarms in maintenance alarm groups on the system workplace, the system's SMS and email messaging service can be used to notify key plant personnel via mobile telephones, email accounts, and pagers.

Comprehensive fault reports including relevant operating procedures can be created out of Asset Monitors and automatically transmitted to a Computerized Maintenance Management System (CMMS) to initiate the work order process.

For the Device Object Types of 800xA Device Libraries, all aspects are preconfigured to take advantage of the enhanced Asset Optimization features.

Further details and additional options like integration with calibration management tools are described in the 800xA Asset Optimization Overview document.

In summary, the flexibility of System 800xA combined with the integrated Device Management solution can make device information available wherever needed in the system in a seamless fashion.

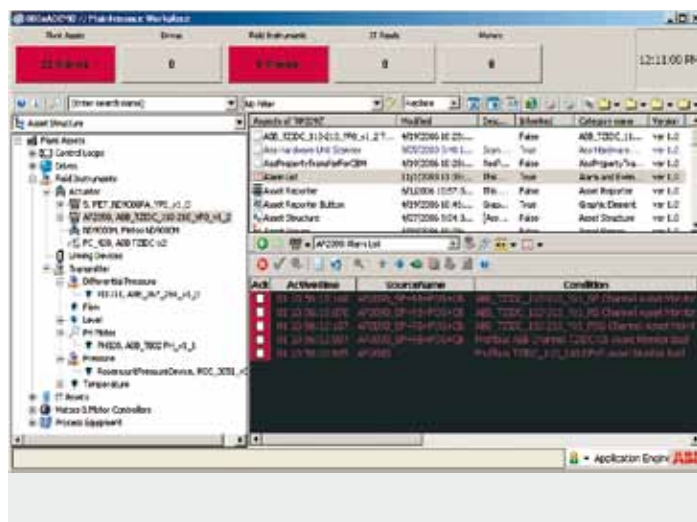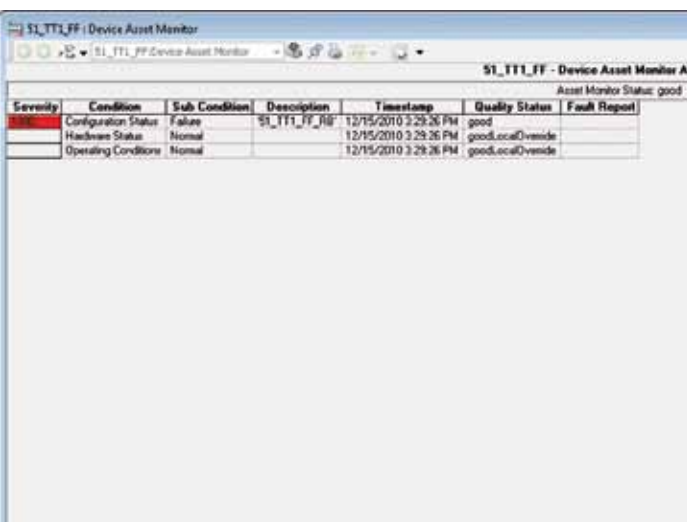**Figure 4: Example of Maintenance Workplace easy diagnostics**

Figure 5: View Asset Monitor.

Device Mananagement HART

HART field communications protocol is widely accepted in the industry as a standard for digitally enhanced 4..20mA communications with smart field instruments. A wide range of products is available today in the marketplace. HART preserves the 4..20 mA signal and enables two-way digital communications to occur without disturbing the integrity of the 4..20mA signal. The HART protocol is field proven, simple to implement, use and maintain.

HART field devices are connected to System 800xA via S800 and S900 remote I/O modules and AC 800M local I/O modules. In addition, HART devices can be connected to System 800xA via HART Multiplexers or a WirelessHART Gateway.

HART Configuration

HART field devices are configured using Fieldbus Builder PROFIBUS/HART. The tool allows device access from the control room and eliminates wiring costs for separate service busses.

The main tasks of Fieldbus Builder are:
– Managing (add, move, remove, or copy) HART devices connected to local I/O or remote I/O
– Topology planning down to HART devices
– Assignment of HART devices to I/O channels
– Device Driver call up from System 800xA clients
– Comparison of field device on- and off-line data
– Upload, download and commissioning
– Configuration of the 800xA Fieldbus OPC Server

With this fieldbus management tool, the user has the capability to configure HART field devices from each System 800xA client using FDT/DTM technology. For more information about FDT/DTM technology see www.fdtgroup.org. Device Management HART is the basis for all further HART device related Asset Management Applications in the System.

HART OPC Server

The OPC Server HART has been designed specifically for asset monitoring within the 800xA system. Included in the HART Device Management package, it enables access to HART field devices for maintenance purposes without requiring additional field wiring. Asset Monitors of 800xA Asset Optimization read specific field device data through the Filedbus OPC Server and turn raw data like device status, and diagnostic data into actionable information for maintenance personnel.

OPC connectivity is prepared for all field device Object Types, included in the field device library.

Device Library

The HART Device Library contains ABB and third party field device Object Types enhanced with the essential Aspects for:
– Configuration
– Parameterization
– Commissioning/Diagnostics
– Asset monitoring
– CMMS connectivity
– Operation
– Device documentation.

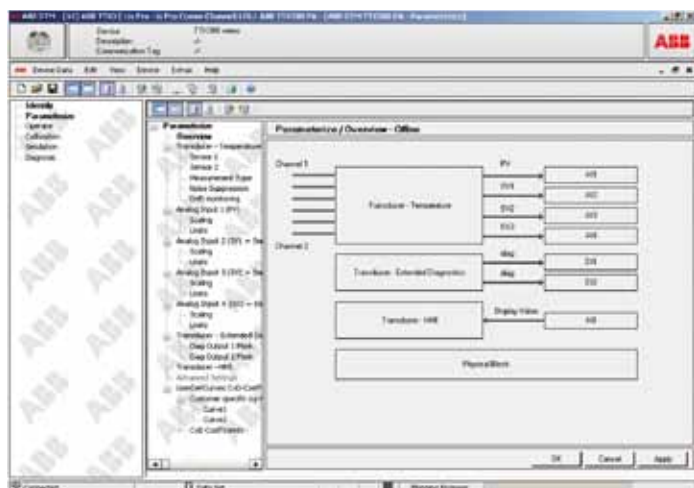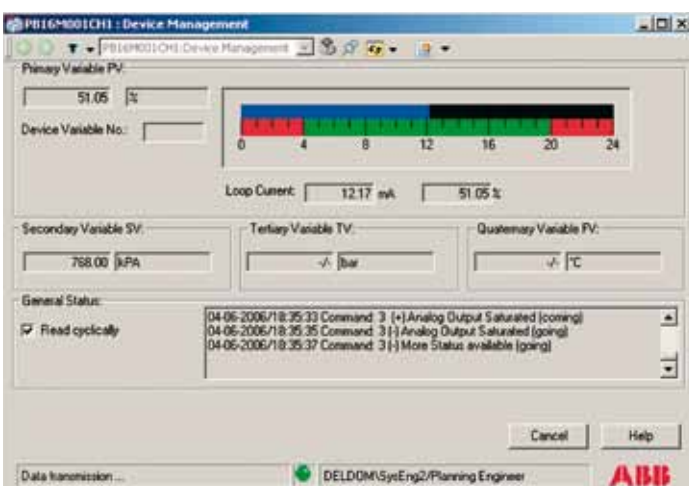**Figure 6: Graphically supported configuration of HART Devices**
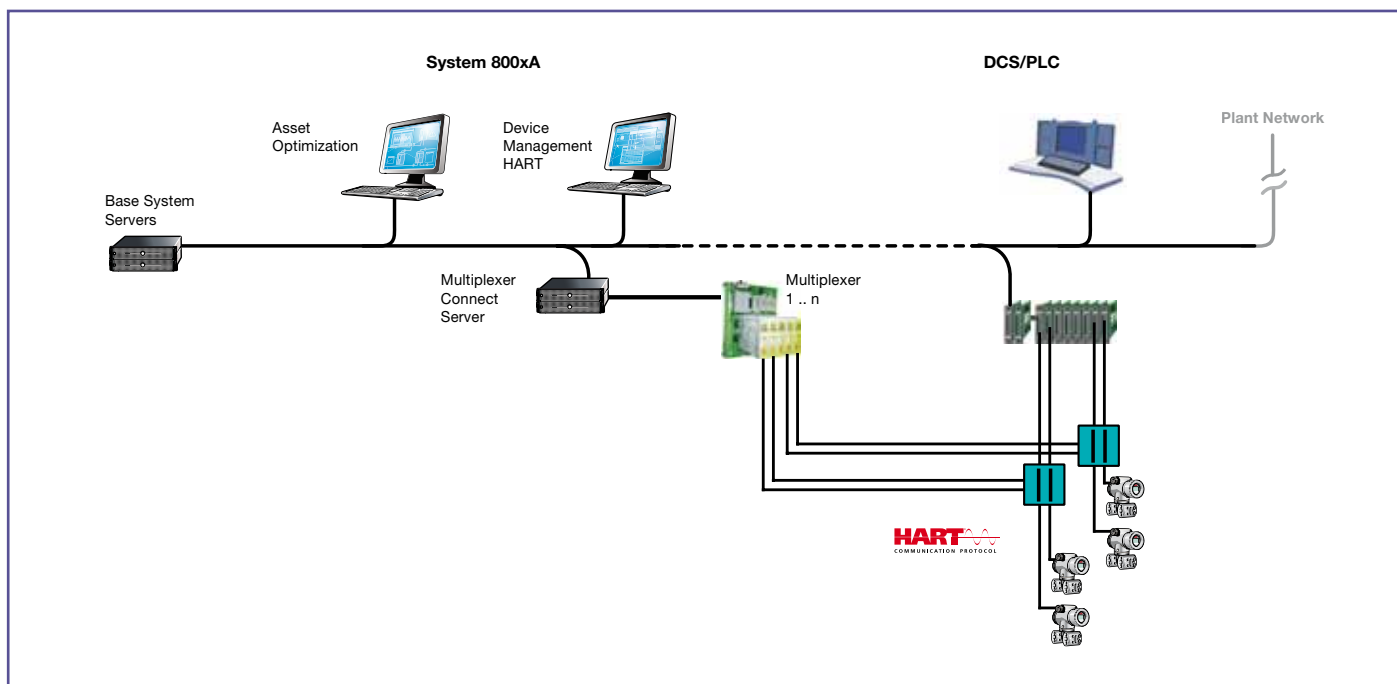

Figure 7: Basic HART DTM

Figure 8: Example of a HART Multiplexer system topology

Basic HART DTM

When device specific DTMs are not available, the Basic HART DTM is used for basic configuration and parameterization of HART devices by means of standardized Universal and Common Practice HART Commands. If preconfigured HART devices are used, this functionality is sufficient to commission a wide range of available HART devices. The Basic HART DTM also allows reading of additional process variables and diagnostics information of HART devices. In addition, it can force the device's output to constant current mode, for simulating a certain measurement value.

DD-based DTM

When a device vendor does not provide a specific DTM but an electronic device description (DD), the Device Object Type in the HART Device Library will carry a DD-based DTM. This type of DTM turns device descriptions into simple but efficient user interfaces for most required device functions like configuration, observation, and diagnostics. The functionality is focused on online interaction with device and can be considered to be a handheld configurator on the control room workplace.

Device-specific DTM

A device-specific DTM is provided by the device vendor and integrated in the Device Object Type of the HART Device Library. A device-specific DTM provides sophisticated user interfaces (applications) to work most easily and efficiently with the device. Typical functions are graphical commissioning aids, wizards providing a guided way for special configuration and advanced diagnostics, or graphical diagnostics means like valve signatures. As the DTM is an application designed by the device vendor, it optimally supports all features of a device.

HART Multiplexer Connect

HART Multiplexer Connect is used to integrate HART devices from systems, such as traditional DCS, that do not allow direct access to specific HART data. HART Multiplexer Connect integrates multiplexer specific DTMs, OPC communication components, and HART multiplexer networks with System 800xA system applications. Standard HART multiplexer hardware can be used. As a result, the benefits of the HART Device Library and its aspect functionality can also be implemented on traditional control systems.

Wireless HART

The HART Multiplexer footprint may be too large when HART data shall not be retrieved from all devices connected to non-HART-capable I/O but only HART-data from selected instruments is needed within the control system. This application can be supported with the newly introduced WirelessHART technology. The transmitters of interest can be equipped with the ABB FieldKey Wireless Adapter NHU200-WL that sends the HART data via radio while the existing 4..20mA loop is retained. The WirelessHART gateway (P+F WHA-GW) integrated with System 800xA picks up the transmitted data and makes it available for usage with DTMs and Asset Monitors in 800xA Device Management. In addition, HART data can be transferred from the gateway to an AC 800M controller via Modbus TCP protocol. The inherent secure and robust WirelessHART technology is also suitable for easily setting up ad-hoc measurements or equipping plant areas, which are hard to reach with cables, with additional measurement points.

Device Management FOUNDATION Fieldbus

Plant Network

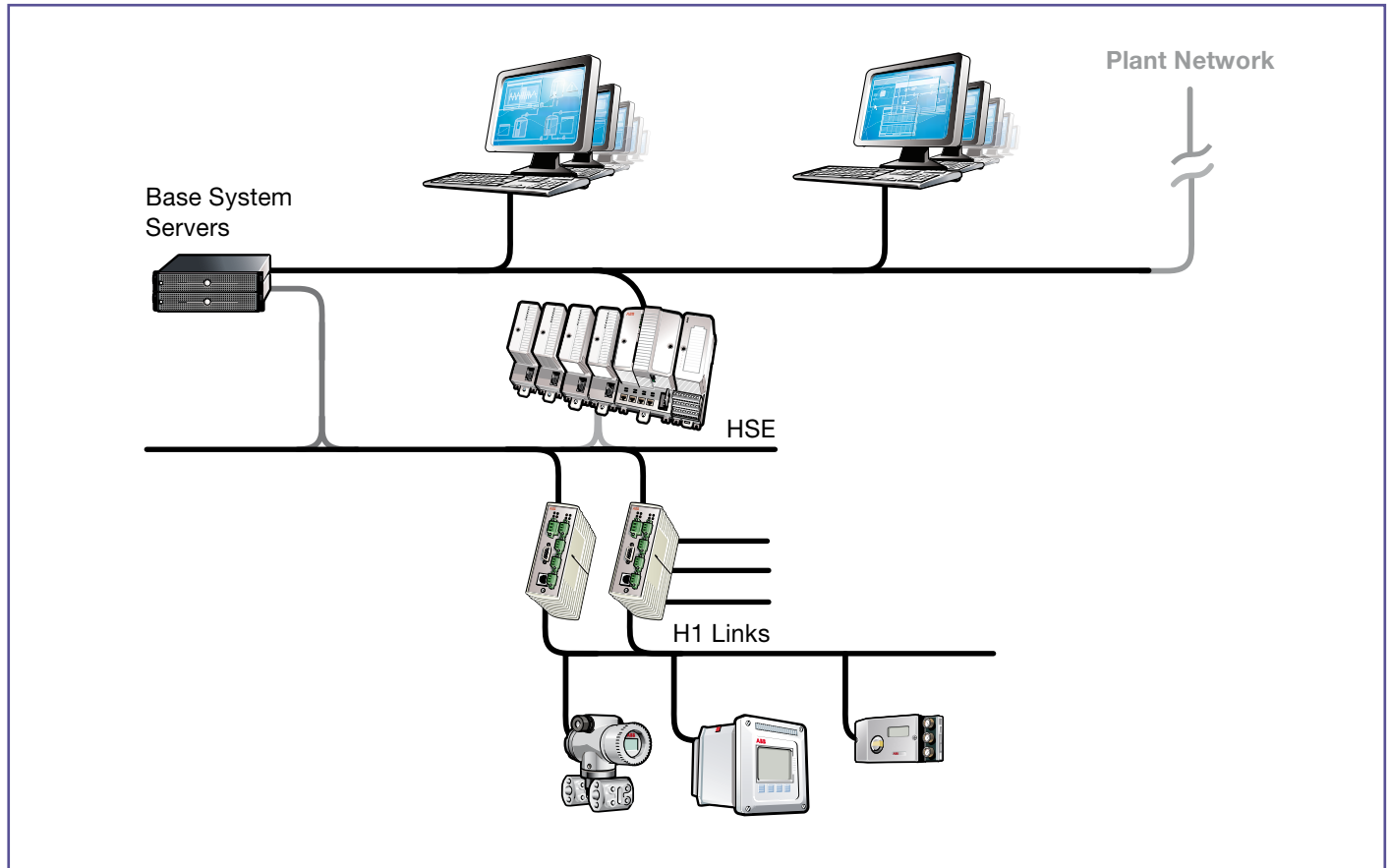Base System Servers

HSE

H1 Links

Figure 9:   FOUNDATION Fieldbus Solution

FOUNDATION Fieldbus (FF) is an open, integrated architecture for distribution of control applications across the network and devices. It provides an open standard for process automation applications and is supported by the major control and process automation product manufacturers. FF is an all-digital, serial, two-way communication system. Two different fieldbus networks are supported:

– H1 link with 31.25 kbit/s designed for connection of 2-wire field devices such as transmitters, actuators and I/O including intrinsically safe applications
– HSE, the High Speed Ethernet bus with 100 Mbit/s, for optimized network design and integration of controllers, H1 subsystems via linking devices, data servers, and workstations.

A key feature of FOUNDATION Fieldbus is the 'Control-in-the-Field' capability. Control logic like a PID controller can run on field devices giving the option to distribute the application completely among the field devices.

ABB offers a complete FOUNDATION Fieldbus solution, containing engineering software and fieldbus interface.

System 800xA supports the entire FOUNDATION Fieldbus architecture including High Speed Ethernet (HSE):

– AC 800M controller is connected to the FF HSE network via the optionally redundant CI860 FF HSE Communication Interface
– H1 subsystems are linked to the HSE subnets through the optionally redundant LD 800HSE Linking Device
– Applications such as 800xA Asset Optimization or Operations are directly connected to the FF network via the FF OPC Server

FF configuration

The configuration of the FOUNDATION Fieldbus application is performed with the Fieldbus Builder FF, the FOUNDATION Fieldbus management tool of System 800xA, which fully integrates the fieldbus topology planning, application configuration, parameterization, commissioning, operation and diagnostics for the entire FF network with HSE subnets and H1 links. Function block application diagrams are used to specify the distributed control functions and can be created via drag & drop mechanisms out of the FF Field Device Library. The available function blocks of each device are listed and ready for use.

The function block interconnections represent signals that are published on the HSE subnet and/or H1 links. Templates can be built for a single function block application or for an entire H1 link with multiple function block applications and devices. With the aid of Bulk Data Manager, such templates can easily be multiplied to efficiently set up large FF applications. Furthermore, Bulk Data Manager supports the creation of complete FF topologies e.g. based on I/O lists or modification of parameters of FF objects like Linking Devices or H1 devices.

The schedule of the H1 LAS is generated automatically with the ability for manual modifications. Using the field devices' device descriptions and capabilities files, these engineering tasks can be performed without having an online connection to the specific device. Plausibility checks and automatic link setting optimization ensure the correctness of the network and application con¬figuration. Early verification significantly simplifies subsequent download of the configuration to the field devices.

Various helpful features allow for efficient commissioning of FOUNDATION Fieldbus projects:
– Optimized download: parts that need to be downloaded are identified. Download is limited to those parts. This enables fast download up to the entire HSE subnet.
– Optimized parameter reconciliation: easy detection and upload of changes of a device's parameters. The parameters in the database and the device are compared. The user can easily decide whether the parameters from the device shall be taken into the database. Entities up to the entire HSE subnet can be reconciled. Filter functions for efficient handling are also offered.

Parameters and signal values, including status, can be displayed for each device and its function blocks, transducer blocks and resource blocks for diagnostic purposes.

The parameter dialogs for FF devices take advantage of enhanced Electronic Device Descriptions and structuring the information in menus and methods for efficient engineering, commissioning, and diagnostics. Device-specific functions like commissioning wizards or partial stroke test and valve signatures support the user in optimally exploiting the intelligence in the field devices.

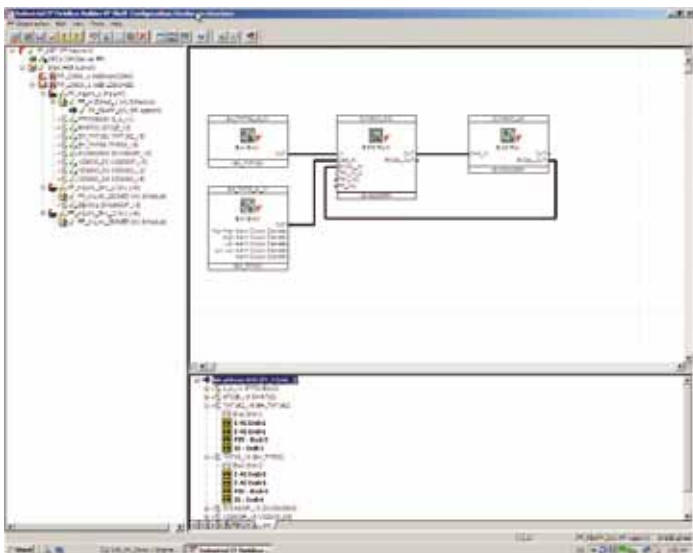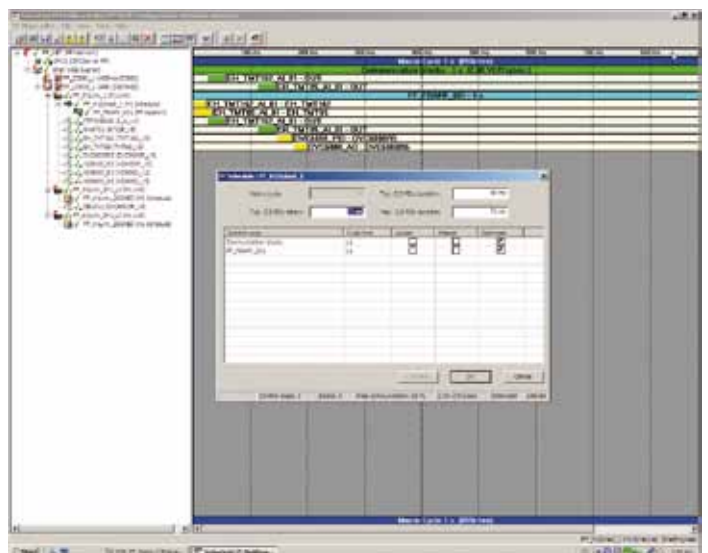Figure 10: FOUNDATION Fieldbus Application Diagram Editor

Figure 11: FOUNDATION Fieldbus Scheduling

FOUNDATION Fieldbus OPC Server

The OPC Server FOUNDATION Fieldbus makes data from FOUNDATION Fieldbus devices available to other System 800xA functions such as 800xA Asset Optimization or Operations. Via this channel, an operator workplace for example, can access the data of the connected field devices directly from the FF-network even in cases where no AC 800M controller is available. This direct link to the field devices is the key feature to fully take advantage of the FF Control-in-the-Field capability. The OPC Server is configured automatically from the FF field-bus management tool.

Field Device Library

In addition to the content of the Field Device Library, the library for FOUNDATION Fieldbus contains device related function block faceplates. Faceplates are the graphical user interface for the operator to the specific process function such as analog input/output monitoring and PID controller. After configuration and download, the correct faceplate is immediately available for operator and maintenance procedures.
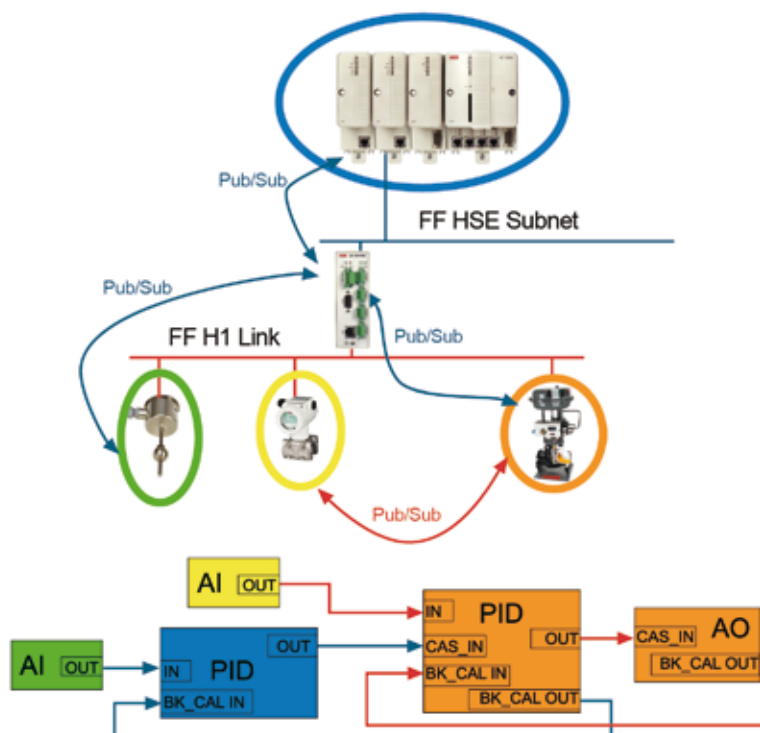
HSE Communication Interface

An FF 100 Mbit/s HSE subnet is connected to AC 800M via the HSE Communication Interface CI860. Up to 12 (6 redundant) CI860 modules can be placed at one AC 800M, each of them can connect to a separate FF HSE subnet. FOUNDATION Fieldbus process data on HSE can be accessed from the IEC 61131-3 applications in the AC 800M controller. For this purpose, the CI860 module maps the value and status parts of FF signals to IEC 61131-3 signals and vice versa.

HSE/H1 Linking Device

The ABB FF linking device LD 800HSE acts as a gateway between the H1 links and the HSE subnet. It provides four separate H1 links with independent Link Active Schedulers (LAS) for each H1 link. It supports the standard FF-HSE protocol and can be deployed in redundant mode by using two LD 800HSE linking devices. By the aid of the linking device, the H1 interfaces can be moved from the control room to the field. This reduces the length of H1 trunks enabling significant cost savings. Using the redundant linking devices together with fault tolerant Ethernet rings increases the availability of the FF field installation compared to long single H1 links.

Figure 12: Communication Relationship in a distributed control loop

FOUNDATION Fieldbus enables design of control strategies distributed between controller and field devices. Figure 12 shows an example of an application, which is distributed among different field devices and the controller. The HSE architecture of System 800xA provides an unmatched flexibility in distributing applications among field devices and different controllers. With the HSE Linking Device, non-critical applications might even be distributed over different H1 links using HSE re-publishing without involving the controller. Different controllers may access data on the same H1 link. This enables for variable strategies for load balancing or separating data acquisition applications to dedicated controllers without the need for running extra field wiring to collect the data.

Figure 13: FOUNDATION Fieldbus Linking Device LD 800HSE

Device Management PROFIBUS

PROFIBUS is an international standardized communication protocol for the manufacturing and process industries. Two different physical layers are supported for the 800xA system:

– PROFIBUS DP, with scalable transmission rates up to 12 Mbit/s, optimized for interaction with devices such as remote I/O, drives or motor controllers. This network provides optional line redundancy.

– PROFIBUS PA, with a fixed transmission rate of 31.25 kbit/s, designed for connection of bus-powered two-wire field devices such as transmitters and actuators. It can be also applied to intrinsically safe applications.

ABB offers a complete PROFIBUS solution, including engineering software and fieldbus interface hardware.

System 800xA supports the entire PROFIBUS system architecture:

– AC 800M controller is connected to the optionally redundant PROFIBUS DP network via CI854 Communication Interface

– PROFIBUS PA segments are linked to the PROFIBUS DP network through the PROFIBUS Power Hub[1]. The PROFIBUS Power Hub can provide diagnostic information about

its own status as well as about connected PROFIBUS PA segments. Using an asset monitor, the user gets additional information such as root cause and failure classification, description, and suggested action.

– Redundancy Link Module RLM01 converts non-redundant PROFIBUS DP lines into redundant lines and vice versa

– Applications like 800xA Asset Optimization or Operations are connected via the controller's OPC Server.
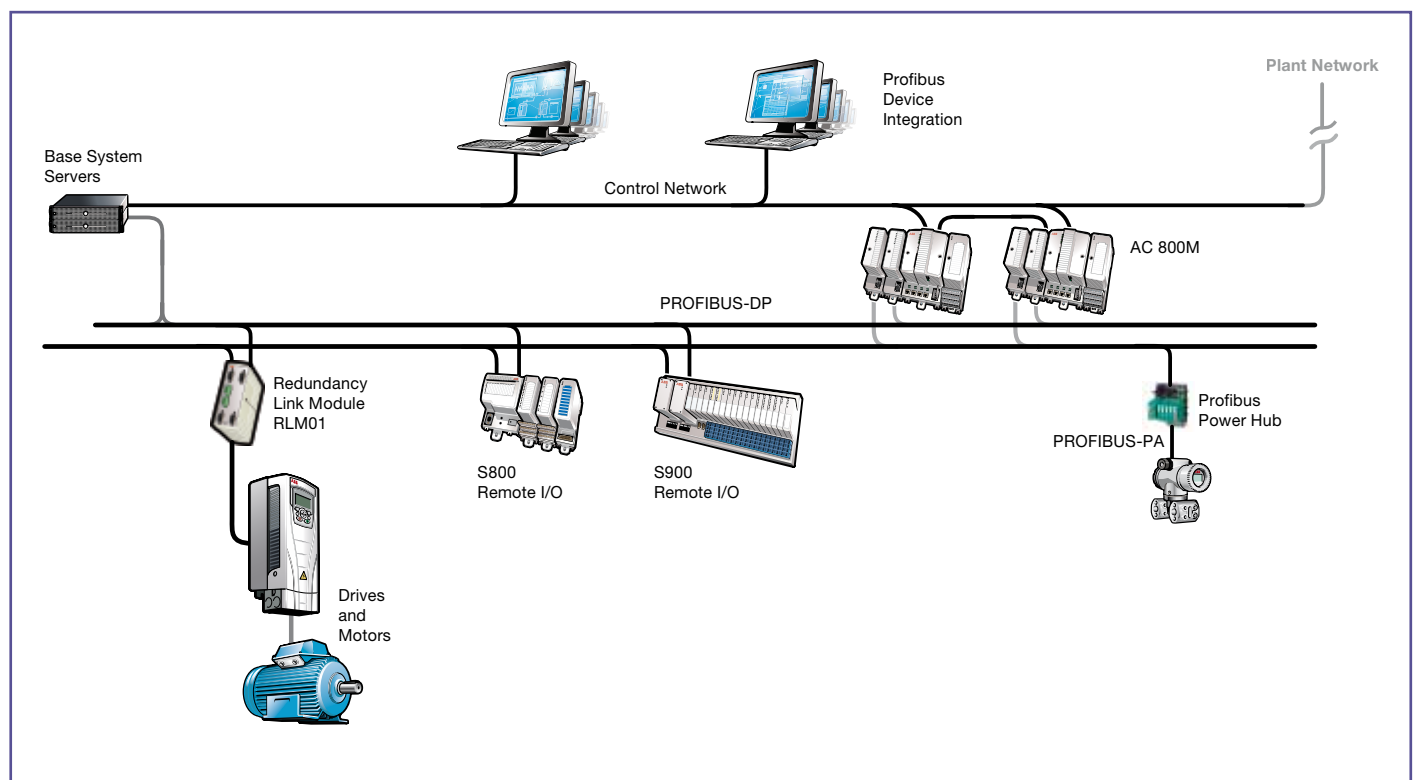
PROFIBUS configuration

Design and configuration of the fieldbus topology and the configuration of the field devices is accomplished with the Fieldbus Builder PROFIBUS/HART, the fieldbus management tool of System 800xA. It enables the integration of field devices by using FDT/DTM technology supporting PROFIBUS DP and PROFIBUS PA.

With Fieldbus Builder PROFIBUS/HART, field devices can be added to and removed from the system topology. It enables calling up and using DTMs in System 800xA clients. Upload, download and commissioning for PROFIBUS devices are eased. Network information, such as cycle time and device status are available for diagnostics.

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1 PROFIBUS Power Hub is a Product of Pepperl+Fuchs

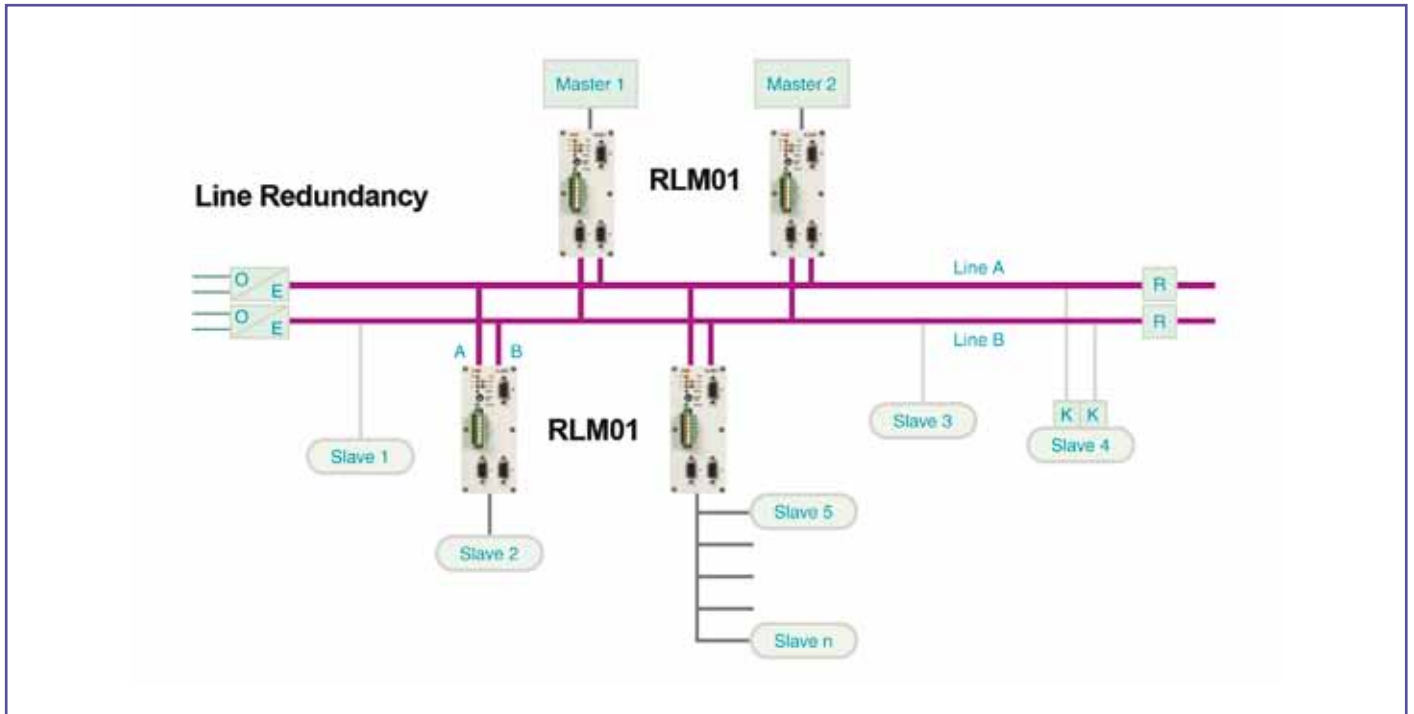**Figure 14: Example of a PROFIBUS system structure**

Figure 15: Profibus Redundancy Link Module RLM01 - example of a system structure

The parameterization of PROFIBUS devices can be performed offline without the connected field device as well as online using the specific DTM or an EDD-based DTM. During commissioning, the configured parameter set of each field device will be downloaded with a single mouse click. The tool provides the option to download a complete pre-configured fieldbus line as well as a selection of single field devices.

Device Library
The PROFIBUS Device Library contains ABB and third party field device objects enhanced with the essential Aspects for:
– Configuration
– Parameterization
– Commissioning/diagnostics
– Asset monitoring
– Maintenance management (CMMS connectivity)
– Device documentation
With the PROFIBUS Device Library, GSD files are pre-integrated so that application engineering can start right away.
As a specific benefit, the PROFIBUS Device Library not only contains Object Types for process instruments but also for electrical equipment like the ABB Universal Motor Controller (UMC). Thus, device management and maintenance for electrical equipment and field instruments can be handled in a unified way.

PROFIBUS Communication Interface
A PROFIBUS network is set up with the PROFIBUS interface module CI854A. The module supports DPV1 services. This is necessary for field device communication via FDT/DTM technology. High availability is achieved through redundant PROFIBUS lines and optional redundancy of the CI854A. Up to 12 CI854A in non-redundant mode can used with o ne AC 800M. Each CI854A can create a separate DP subnet. Each module provides two standard RS 485 interfaces.

PROFIBUS Redundancy Link Module
Field devices equipped with only a single PROFIBUS DP interface, can be integrated into a redundant PROFIBUS DP network by using the Redundancy Link Module RLM01. Acting as an active switch, the RLM01 converts non-redundant lines into redundant PROFIBUS lines and vice versa. The RLM01 amplifies the signal form and amplitude of the incoming data and monitors activities and error status of all three lines.

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