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Foundation

# FOUNDATION™ Fieldbus Fieldbus Basics

Freedom to  
Choose. Power to  
Integrate.

Presented by  
**Jane Lim, Yokogawa**

On behalf of the  
Fieldbus Foundation Marketing Society  
(Singapore)

# Topics

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- FOUNDATION fieldbus Architecture
- H1 Overview
- H1 Technology
- High Speed Ethernet (HSE) Overview



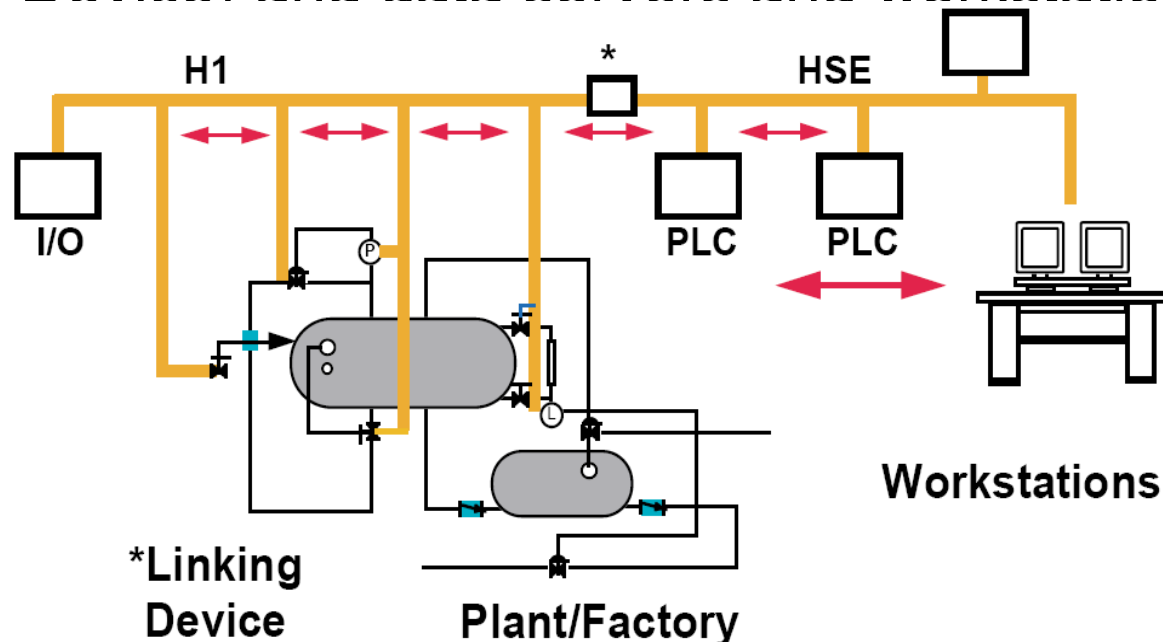
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# FOUNDATION fieldbus Architecture

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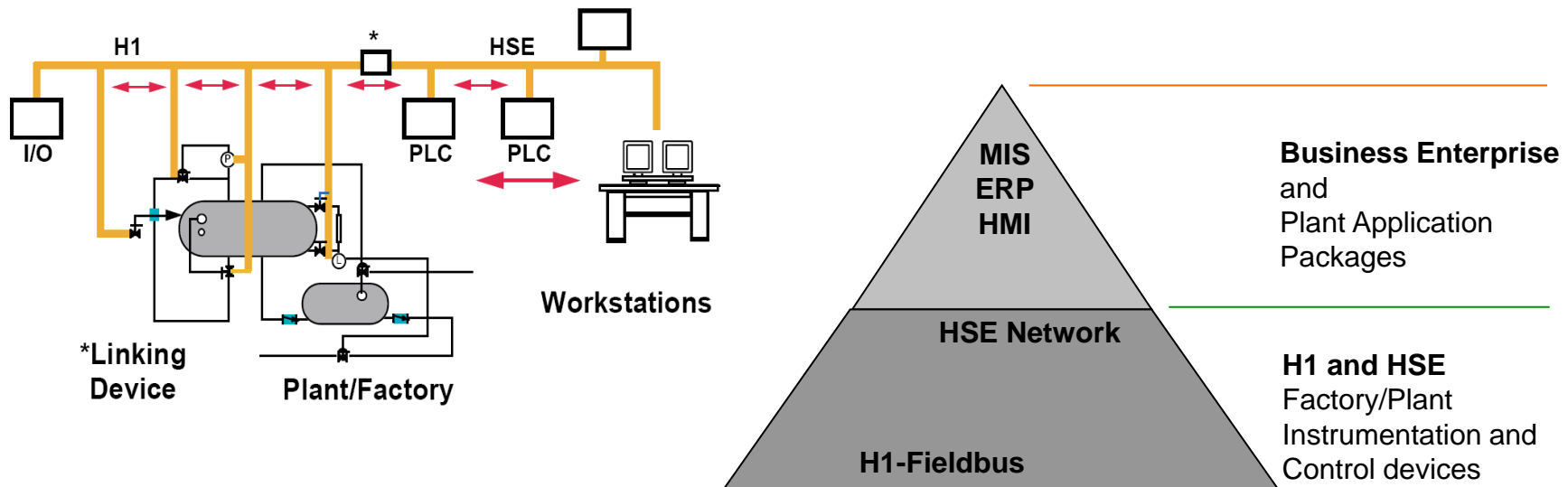
# What is Fieldbus?

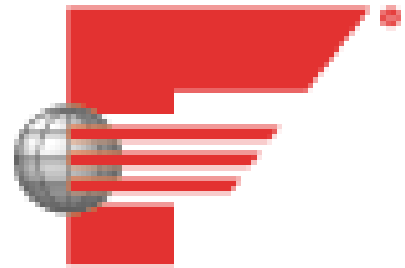
- A fieldbus is an all-digital, serial two-way, multi-drop communication System.
- H1 (31.25kbps) interconnects field equipment (Sensors, Actuators & I/O).
- HSE (High Speed Ethernet, 100mbps) provides integration of high speed controllers, subsystems (via Linking Device) and data servers and workstation.



# Integrated Architecture

- Management Information Systems (MIS), Enterprise Resource Planning (ERP), and Human Machine Interface (HMI) access the H1 Fieldbus information via the Data Servers.





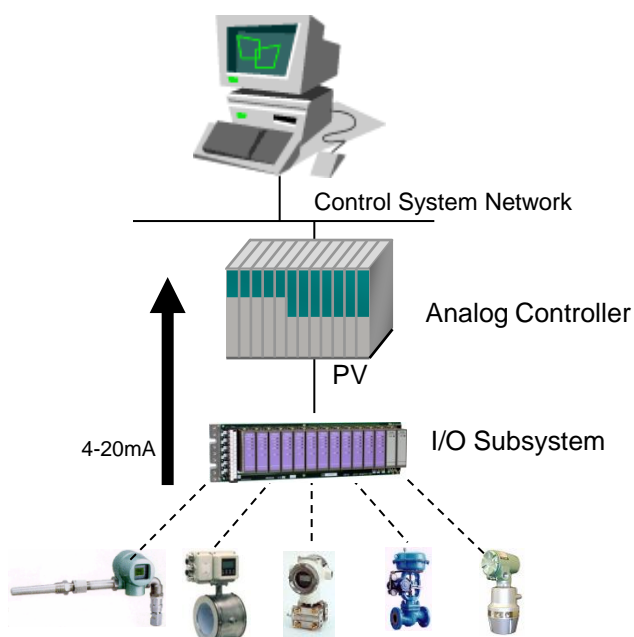
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# H1 Overview

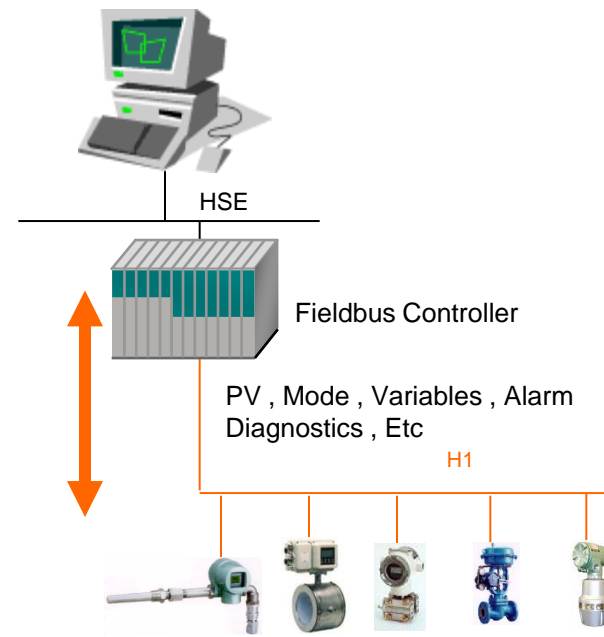
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# Multiple Variables

- Fieldbus allows “multiple variables” from each device to be brought into the control system for archiving, trend analysis, process optimization, reporting, predictive maintenance and for asset management.
- Fieldbus distortion-free characteristics digital communication enables improved control capability which can improve product yields.



Traditional 4-20mA and on/off One Variable (One Direction)

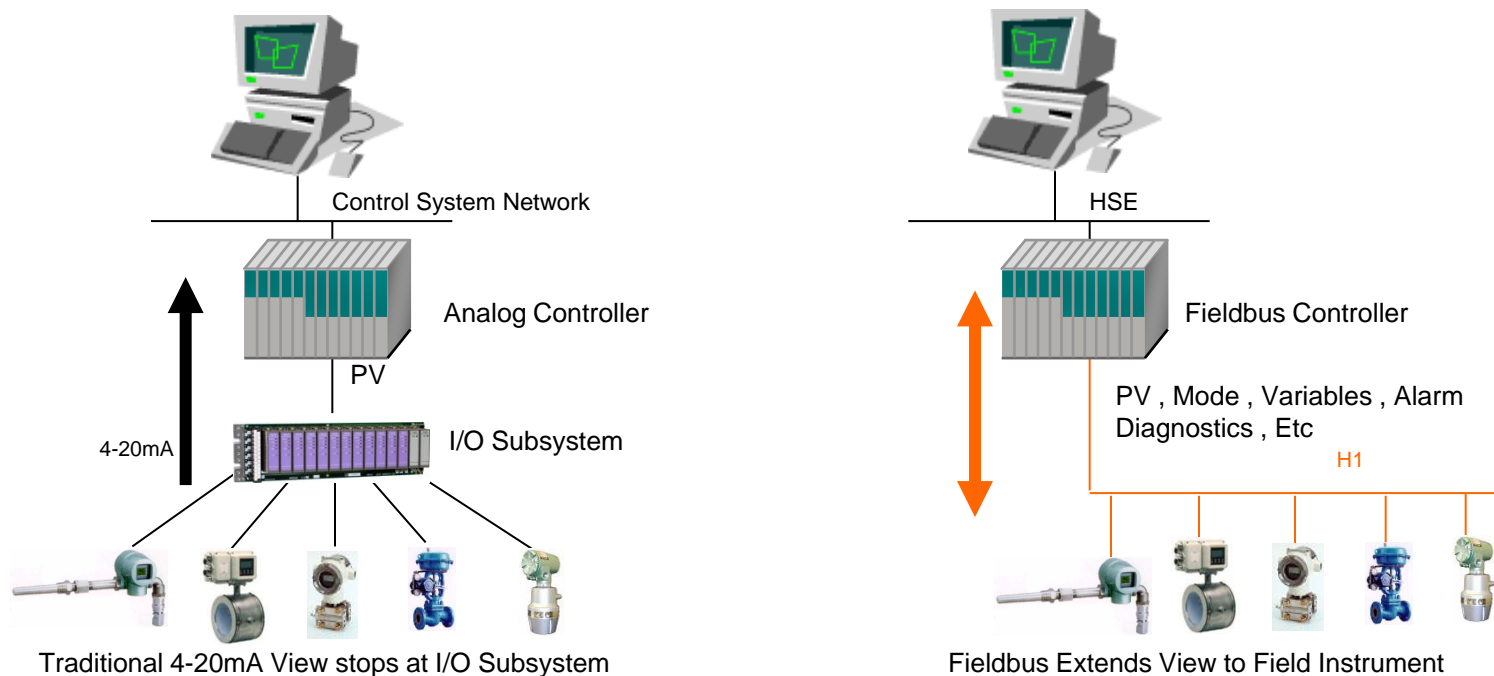


Fieldbus Multiple Variables (Both Directions)

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# Diagnostics

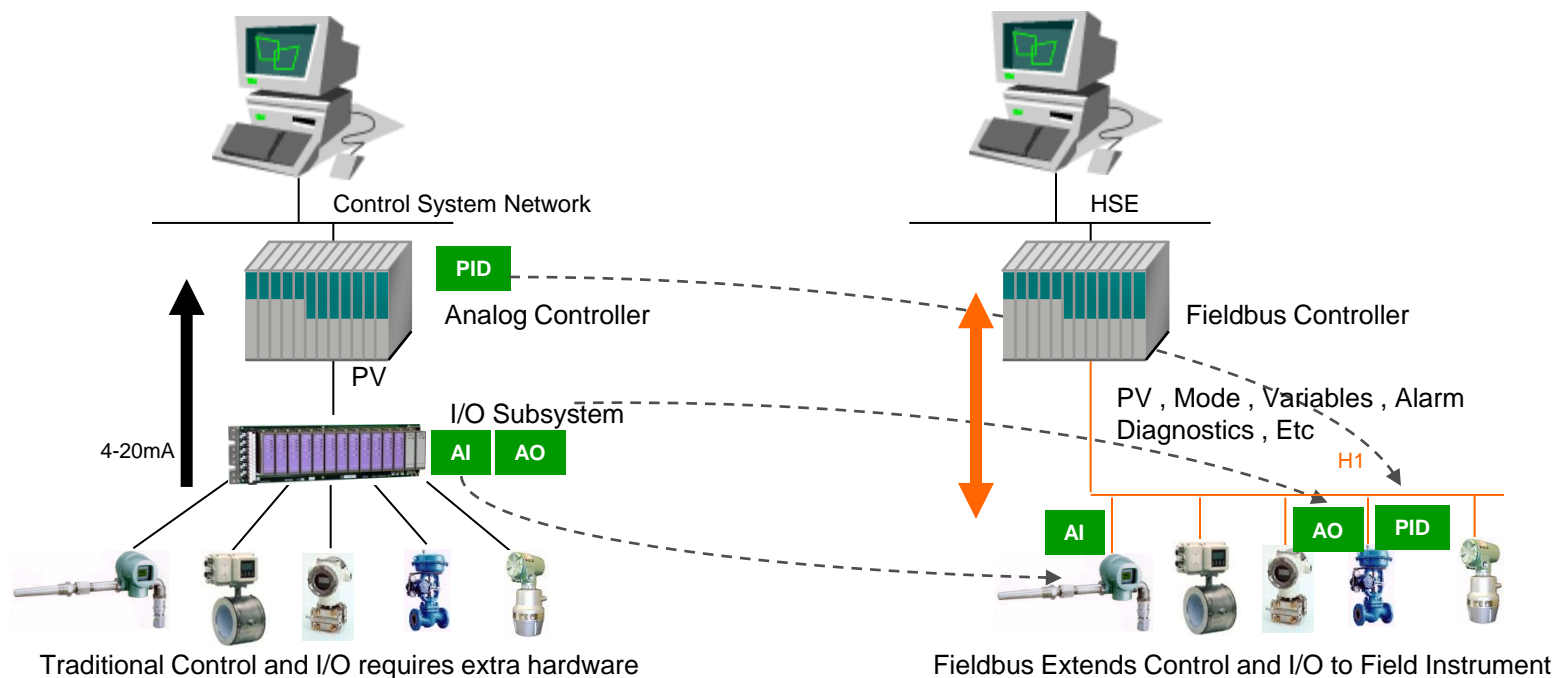
- Self Diagnostics and communication capabilities of microprocessor based fieldbus devices helps reduce downtime and improve plant safety.
- Plant operation and Maintenance personnel can be notified and corrective actions taken quickly and safely.

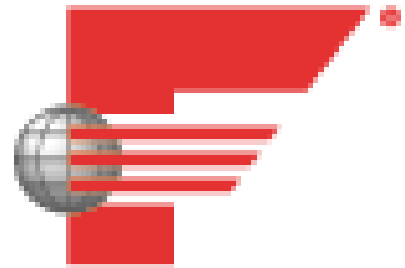




# Control Strategy

- Standard Function Blocks is used to implement the Control Strategy.
- Many control system functions such as AI, PID and AO can be performed by the field device through the use of these Standard Function Blocks.
- Distribution of control into field devices can reduced the amount of hardware and cabinet footprint needed.





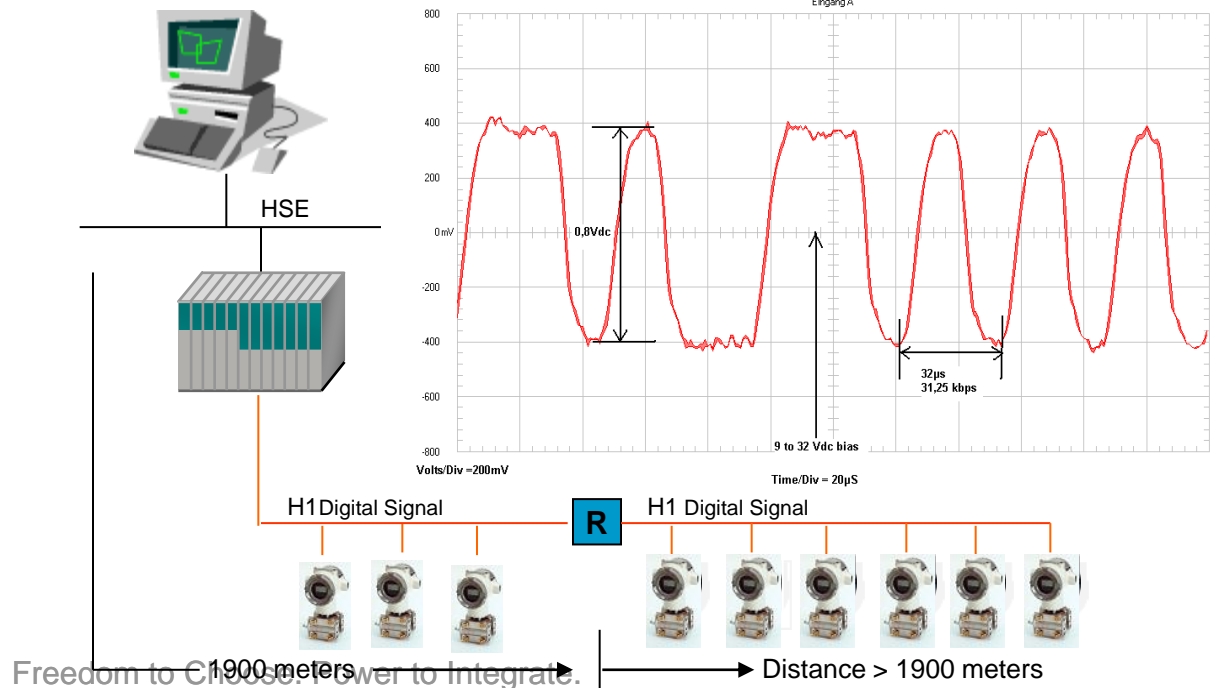
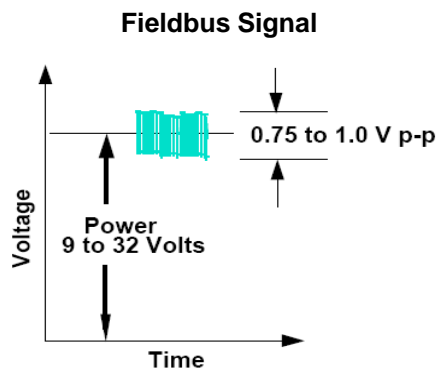
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# H1 Technology

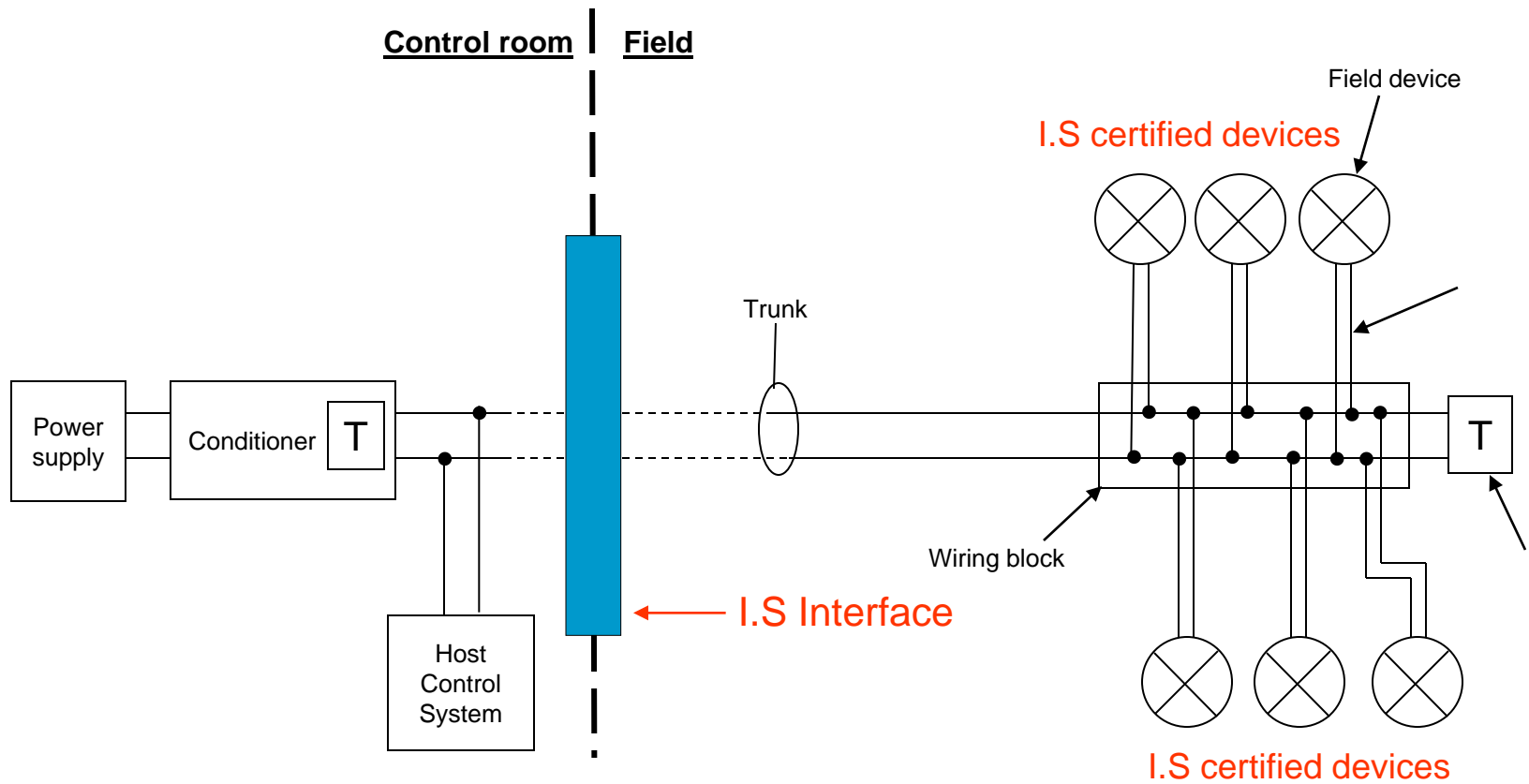
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# H1 Physics

- Multi-Drop wire pair with Power and Signal on same cable.
- Support Intrinsic Safety.
- Function Blocks built into Field Devices.
- Control on the Wire – single loop integrity
- Distance up to 1900 meters
- Add Repeaters to extend > 1900 meters
- Max. of 4 repeaters can be used to a maximum distance of 9500 meters

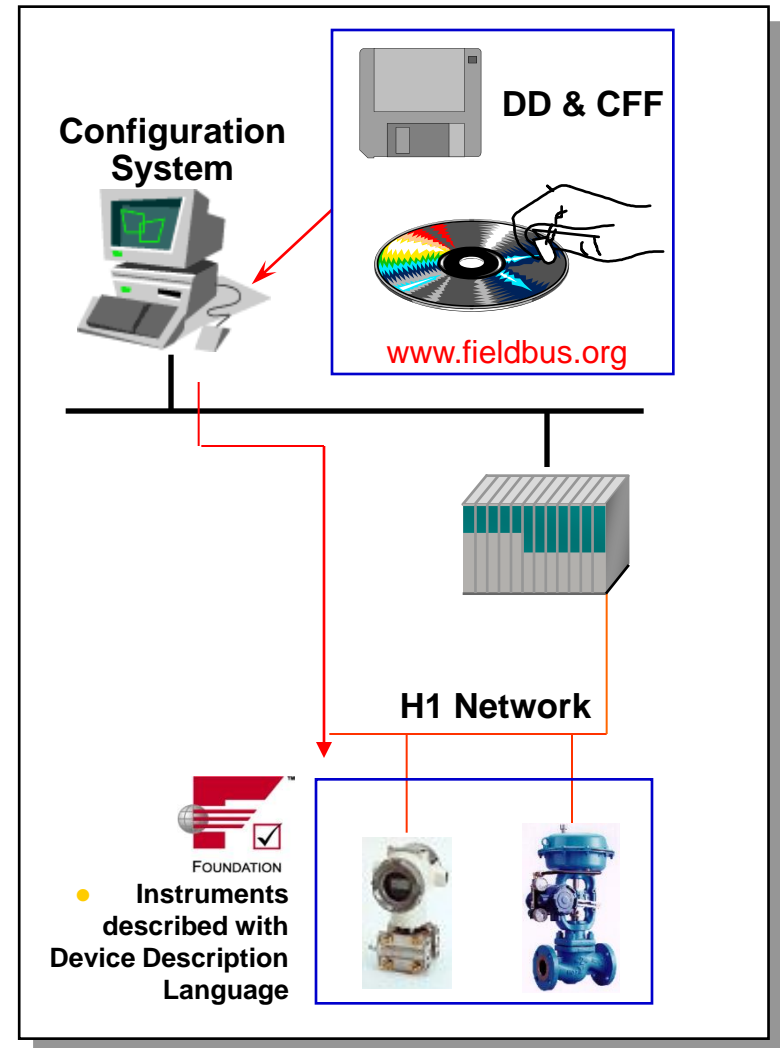


# Intrinsic Safety



# EDDL and CFF Files

- Field Devices will consists of:
  - Actual Physical Device.
  - Device Description (DD).
  - Common File Format (CFF).
- DDs and CFFs made by the Device Supplier
- Parameters and Capabilities are defined in device files – DD and CFF
  - Defines how device shall be displayed in the system



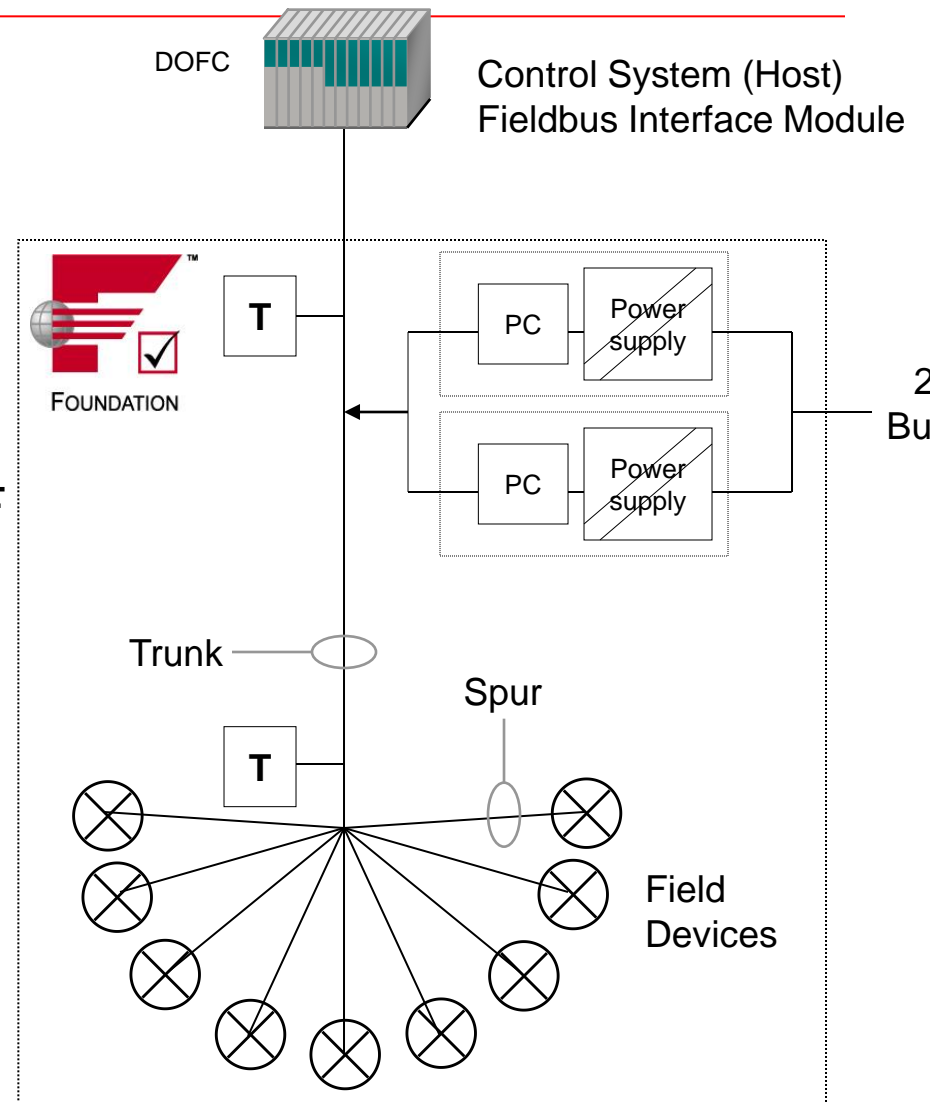
# DD and CFF Files

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- Device Descriptor (DD) File allow operation of devices from different suppliers on the same fieldbus with single host system.
- Common File Format (CFF) is a file which describes the functions and capabilities of a field device.
- The CFF file is used in conjunction with the Device Descriptor file to enable a host system to configure the system off-line.
- CFF files are standard ASCII text file.

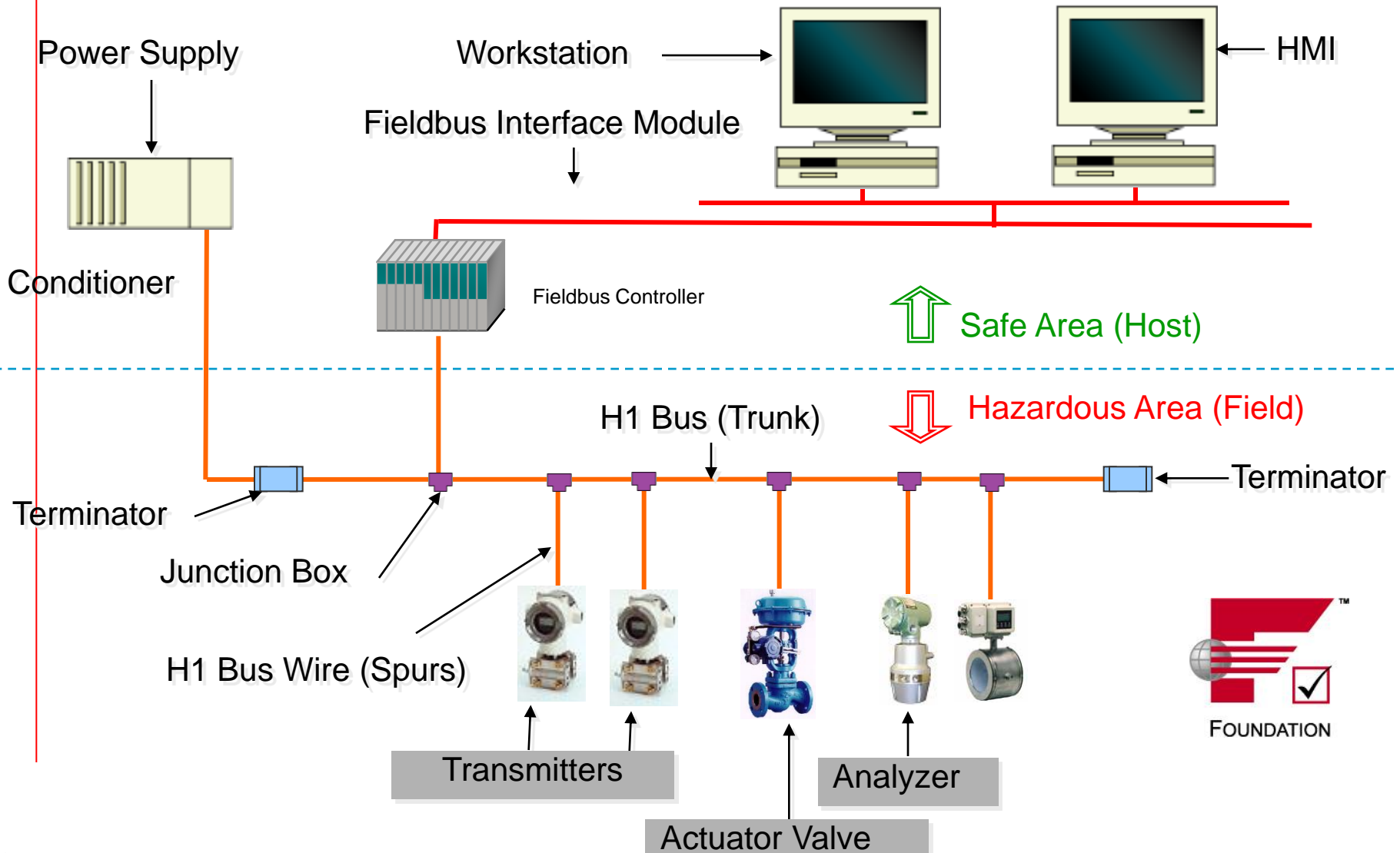
# Typical Fieldbus Installation

- An example of the Chicken foot (tree) topology.
- Redundant, isolated power conditioning defined
- Typically 10-12 bus-powered fieldbus devices per segment.
- 120 m distance from FF JB to FF Device
- Spur short-circuit protection.
- Up to 1900 meters.
- Maximum of 9500 meters via repeaters.



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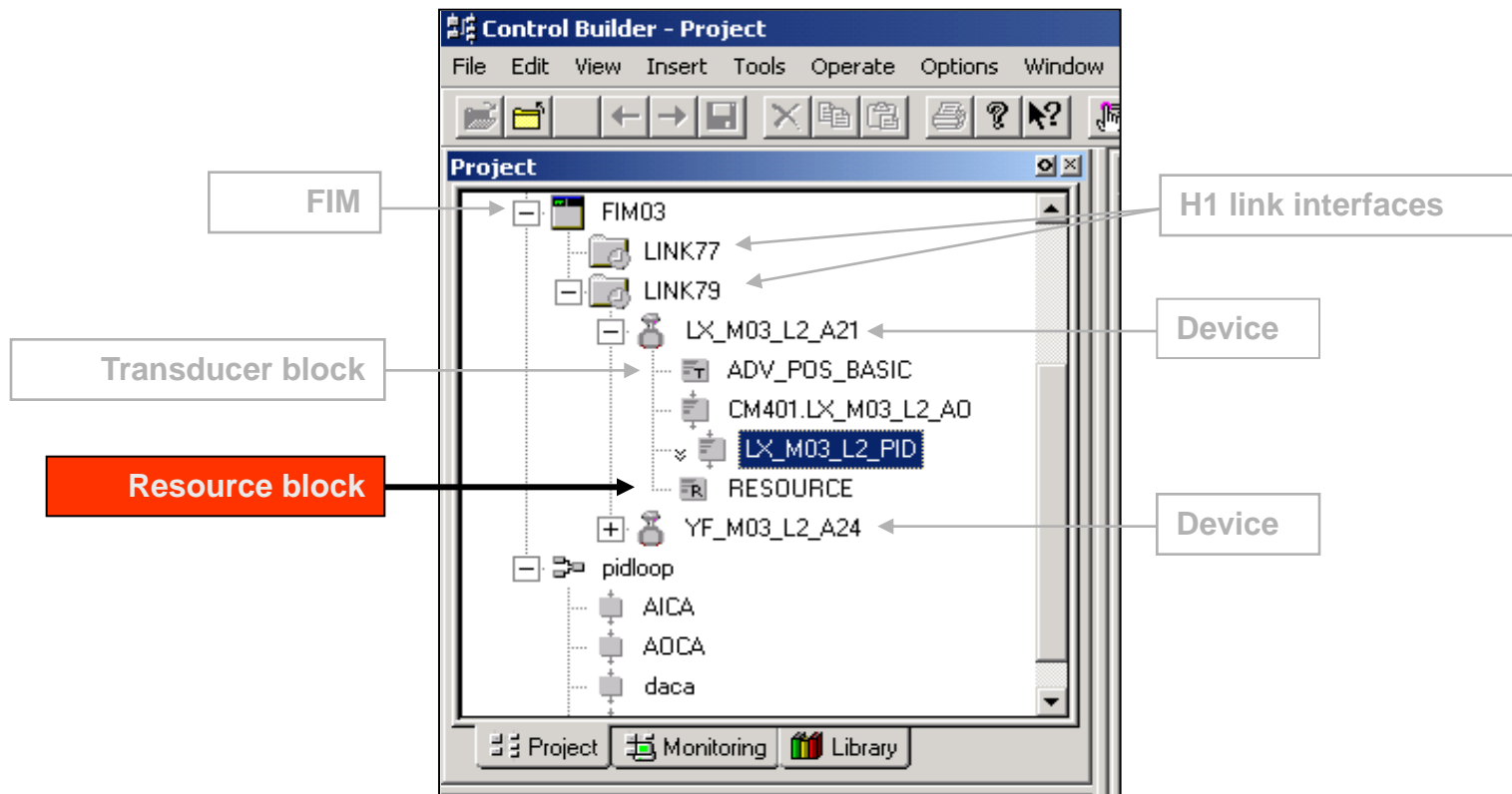
# Fieldbus Components





# Resource Block

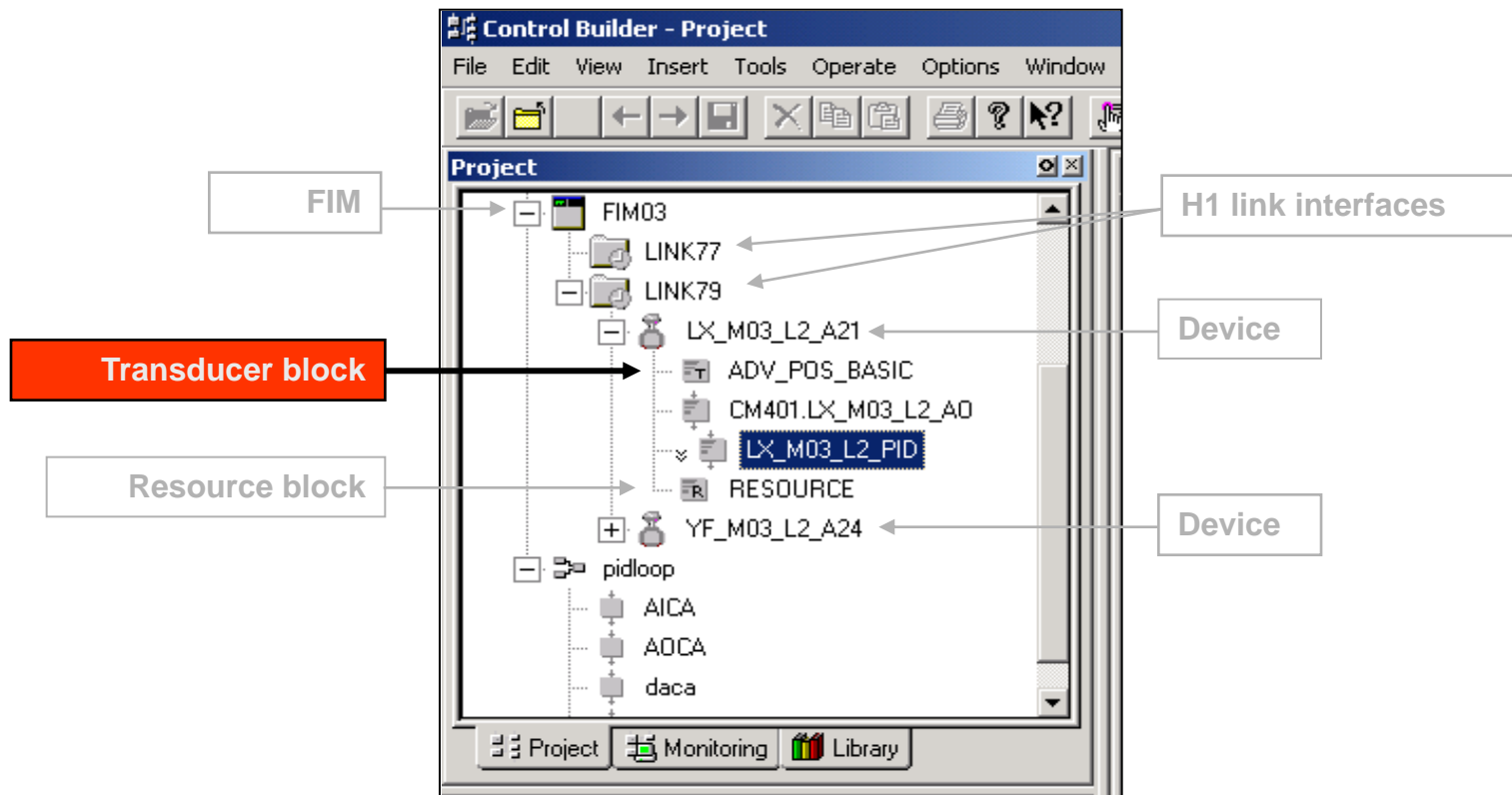
- The Resource Block describes characteristics of the fieldbus device such as device name, manufacturer and serial number, etc.
- There is only one Resource Block in a device.



**Control Builder Project tab**

# Transducer Block

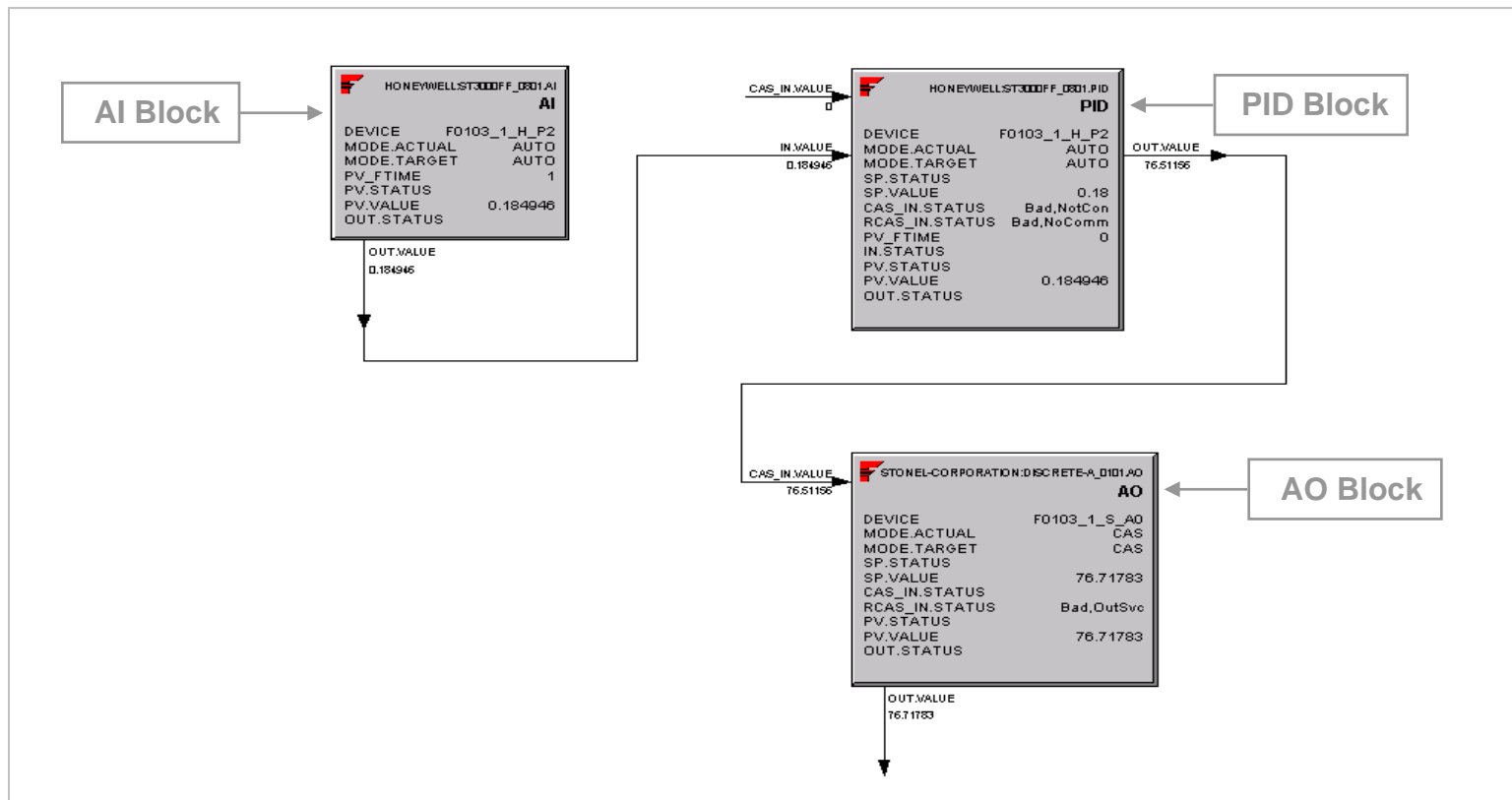
- Transducer Blocks are used to configure devices.
- Transducer Blocks are required to Read sensors value and command output value.



**Control Builder Project tab**

# Function Blocks

- The Control System Strategy is built using Function Blocks.
- Input and output parameters of Function Blocks can be linked over the fieldbus.
- The execution of each Function Blocks is precisely scheduled and there can be many function blocks in a single user application.



# Standard Function Blocks

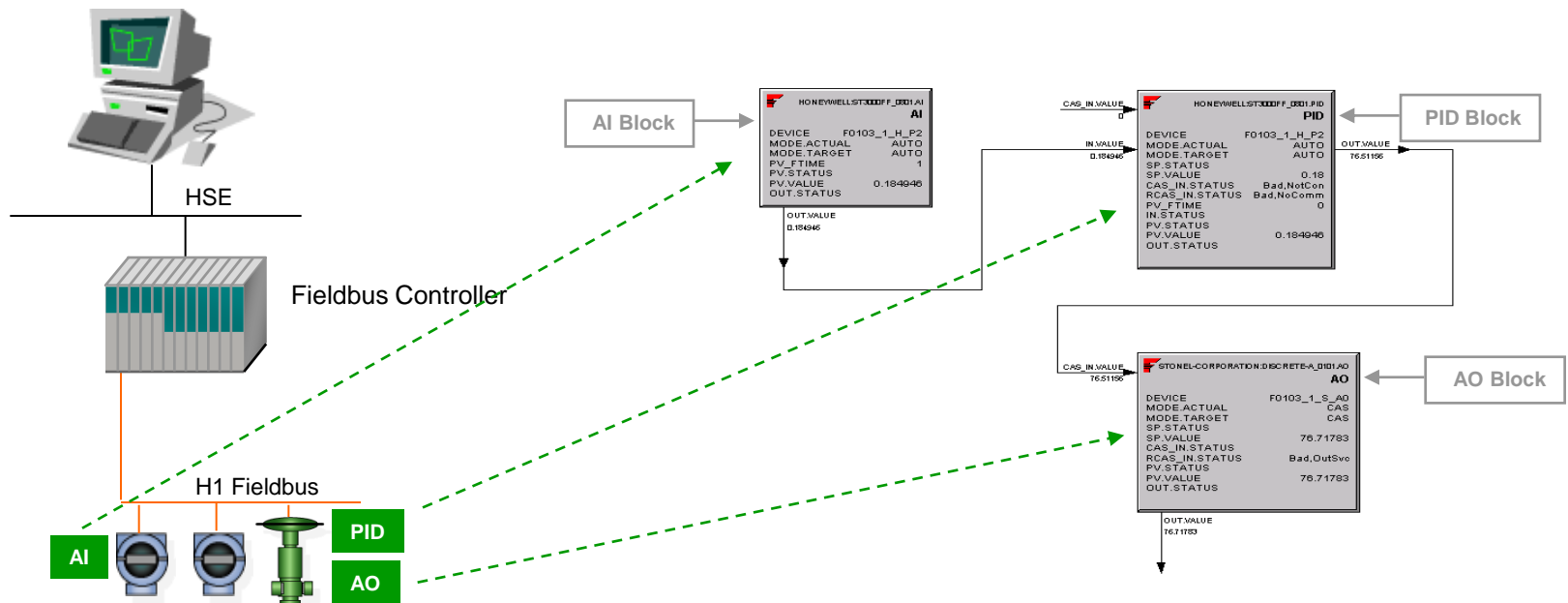
Function Blocks
Analog Input
Analog Output
Bias/Gain
Control Selector
Discrete Input
Discrete Output
Manual Loader
Proportional/Derivative
Proportional/Integral /Derivative
Ratio

Function Blocks
Device Control
Output Splitter
Signal Characterizer
Lead Lag
Deadtime
Integrator (Totalizer)
Setpoint Ramp Generator
Input Selector
Arithmetic
Timer
Analog Alarm

Function Blocks
Multiple Analog Input
Multiple Analog Output
Multiple Discrete Input
Multiple Discrete Output

# Example of a Control Loop

- Control Strategy can be built using Function Blocks built into field devices.
- A simple temperature transmitter may contain an AI function block. A Control Valve might contain a PID function block as well as the expected AO Block.
- Thus, a complete control loop can be built using a simple transmitter and a control valve.

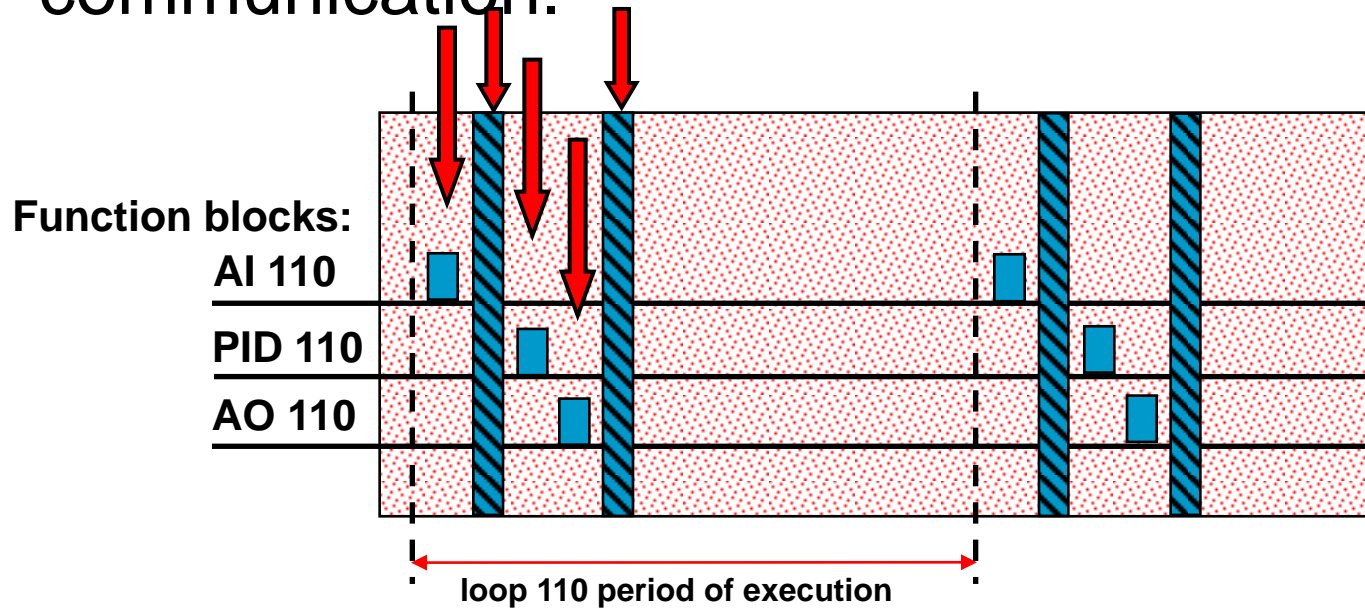


Example of a complete control loop using Function Blocks located in fieldbus Devices.

Example of a complete control module strategy Control on the Wire.

# H1 Link Active Scheduler

- PID Loop scheduled and unscheduled communication.

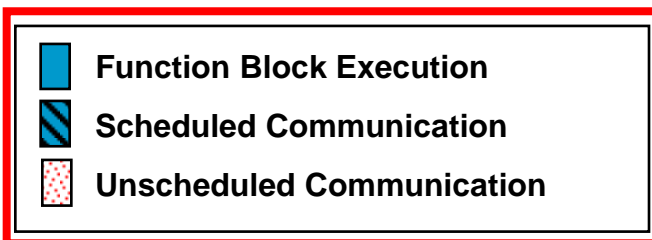


**Scheduled**

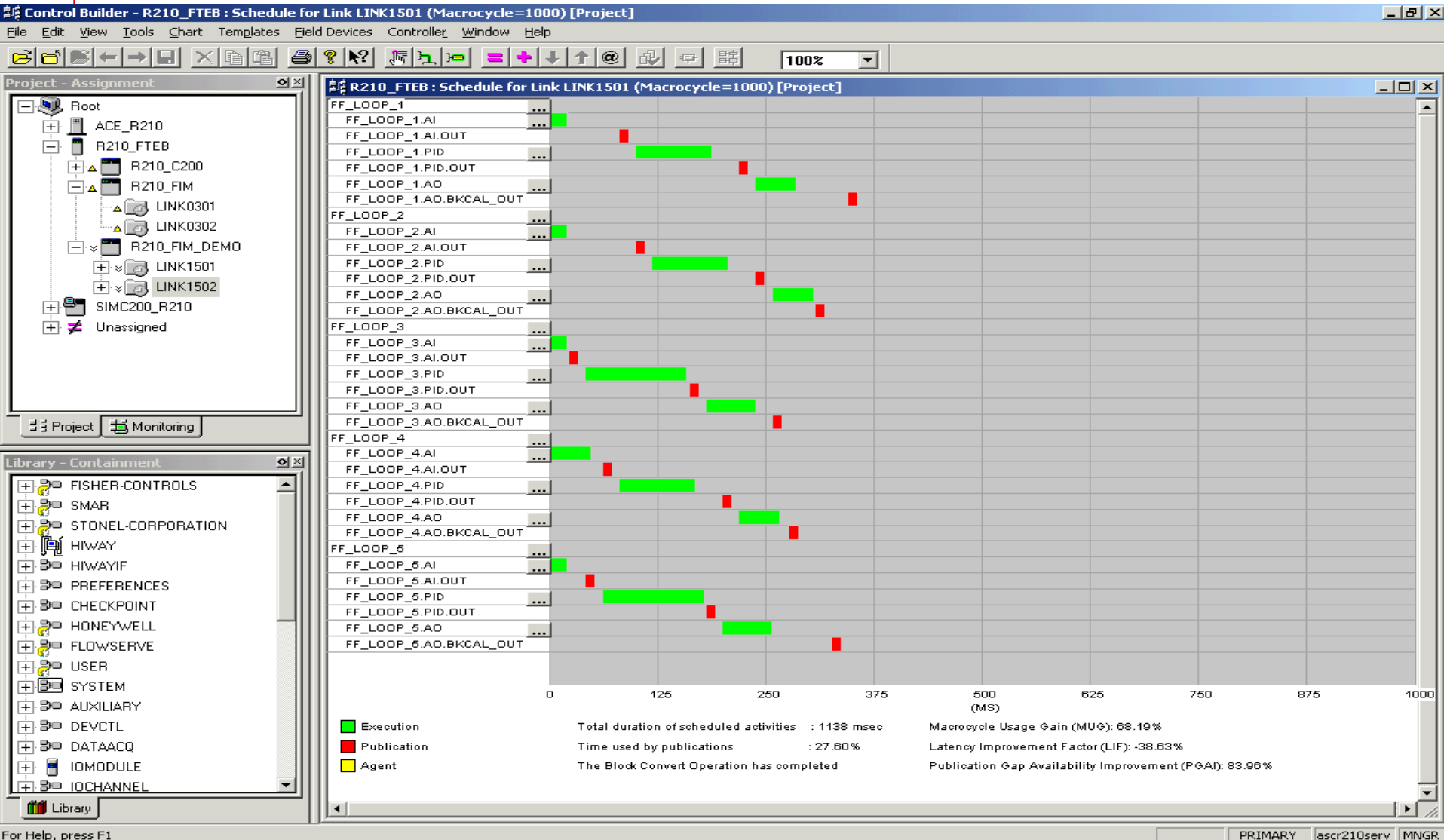
Closed loop control

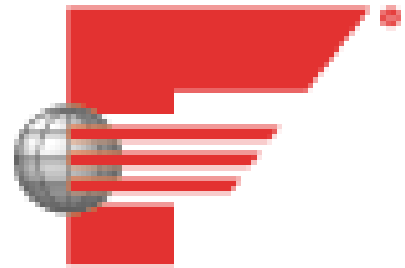
**Unscheduled**

Alarms/Events  
 Maintenance/Diagnostic Information  
 Program Invocation  
 Permissives/Interlocks  
 Display Information  
 Trend Information  
 Configuration



# Link Schedule





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# High Speed Ethernet (HSE) Overview

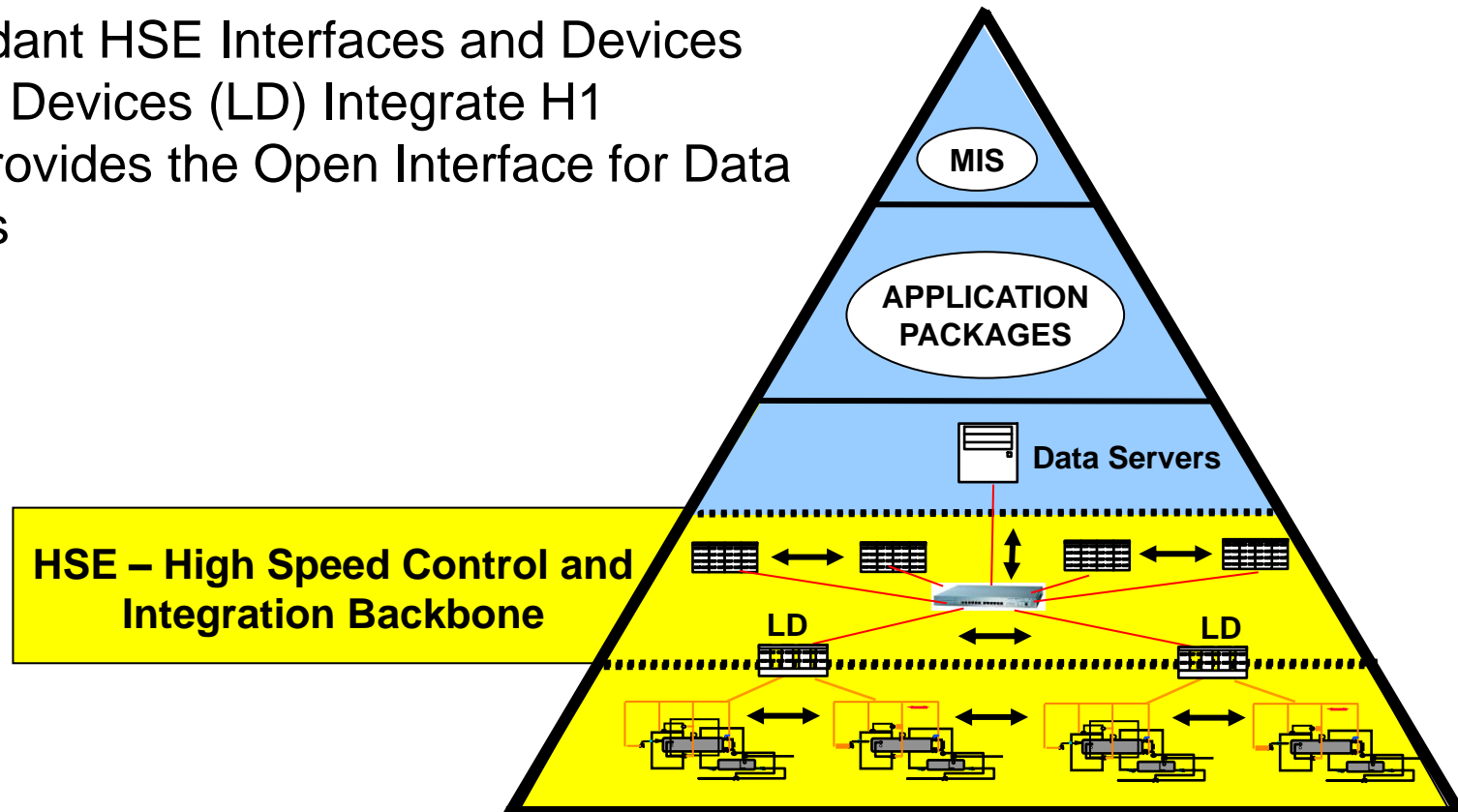
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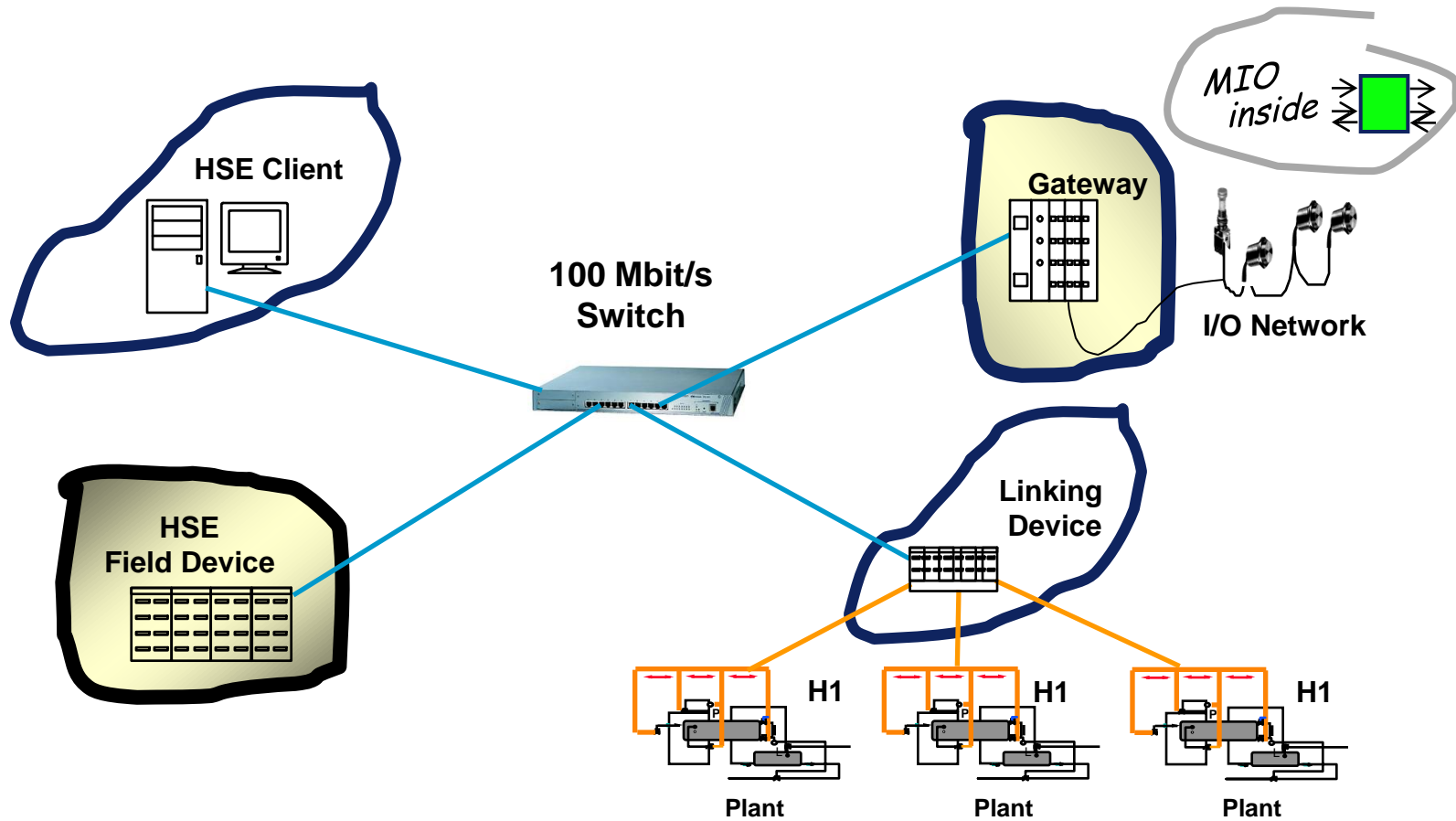
# FF Integrated Architecture

## HSE – Subsystem Integration

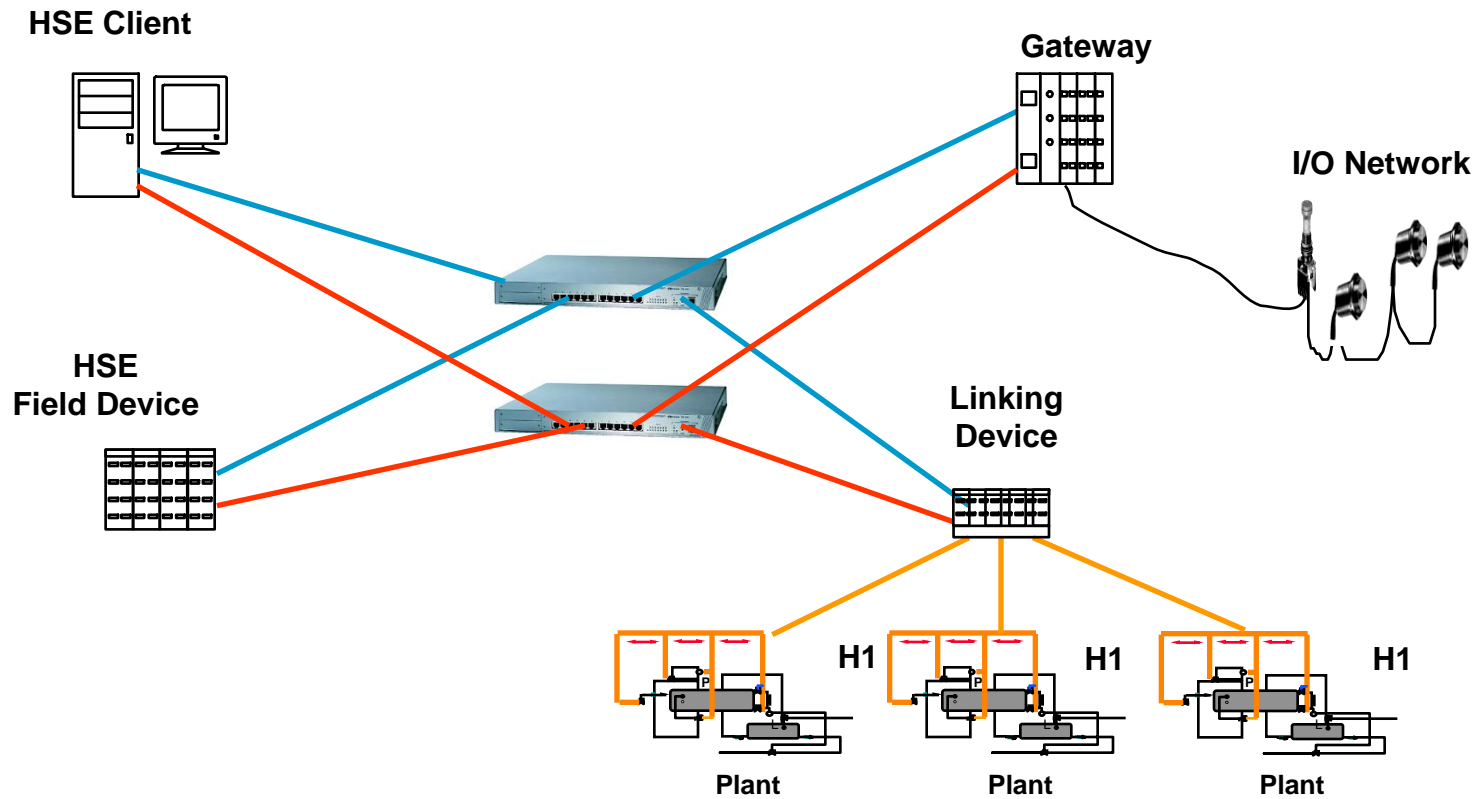
- High Performance Control Backbone
- Standard Ethernet Equipment and Wiring
- Standard Function Blocks PLUS
- Flexible Function Blocks for Discrete/Batch/PLC
- Redundant HSE Interfaces and Devices
- Linking Devices (LD) Integrate H1
- HSE Provides the Open Interface for Data Servers



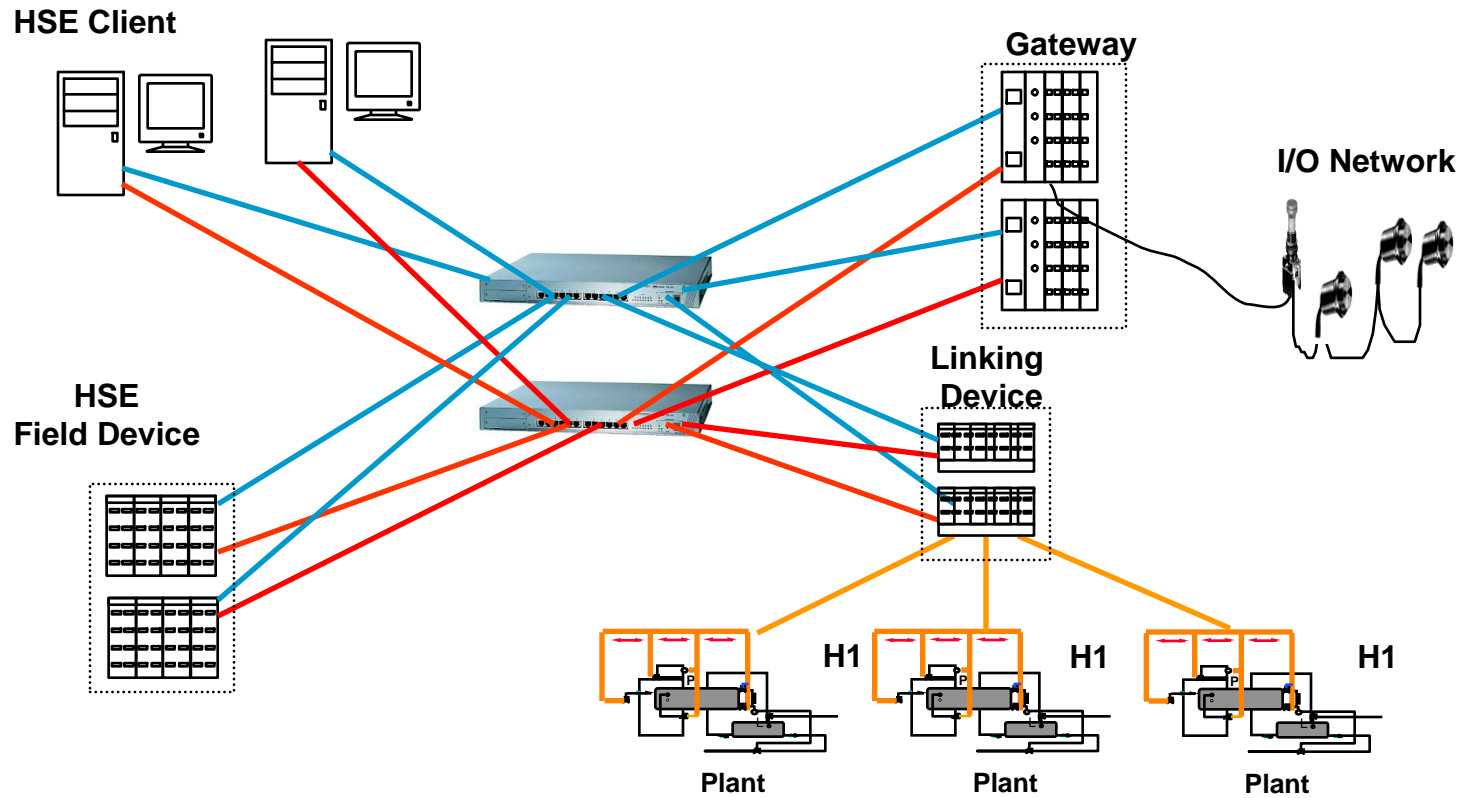
# High Speed Ethernet Devices



# HSE - LAN Redundancy



# HSE - Device Redundancy



# Additional Points

## *Proven:*

- FOUNDATION fieldbus is tried and tested since 15 years
- FF provides closed loop digital control: sensor to actuator

## *Savings:*

- 8 channel temperature transmitters replace 8 regular transmitters
- Fieldbus electric actuators eliminate 6-12 pair of wires

## *Ease of Maintenance:*

- Only FF supports temporary master like handheld or laptop
- Only FF supports firmware upgrade instead of circuit replacement
- Fieldbus provides flexibility to add devices to the bus
- Fieldbus provides flexibility to use additional signals in the device
- Fieldbus eliminates proprietary MOV bus
- No need to change I/O card type when device type is changed
- FF integrates gas chromatograph in asset management software
- Fieldbus is made easy thanks to wizards and EDDL etc.



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