



Honeywell



Industrial Plant Automation today's Systems Technology

***(ENDUSTRIYEL TESISLERDE GÜNÜMÜZ TEKNOLOJISI
OTOMASYON SİSTEMLERİ)***

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Date : Oct.3, 2016 , Location : KTU Elektrik-Elektronik Muh Bl.-Trabzon

1972-1976 Hocalarımız

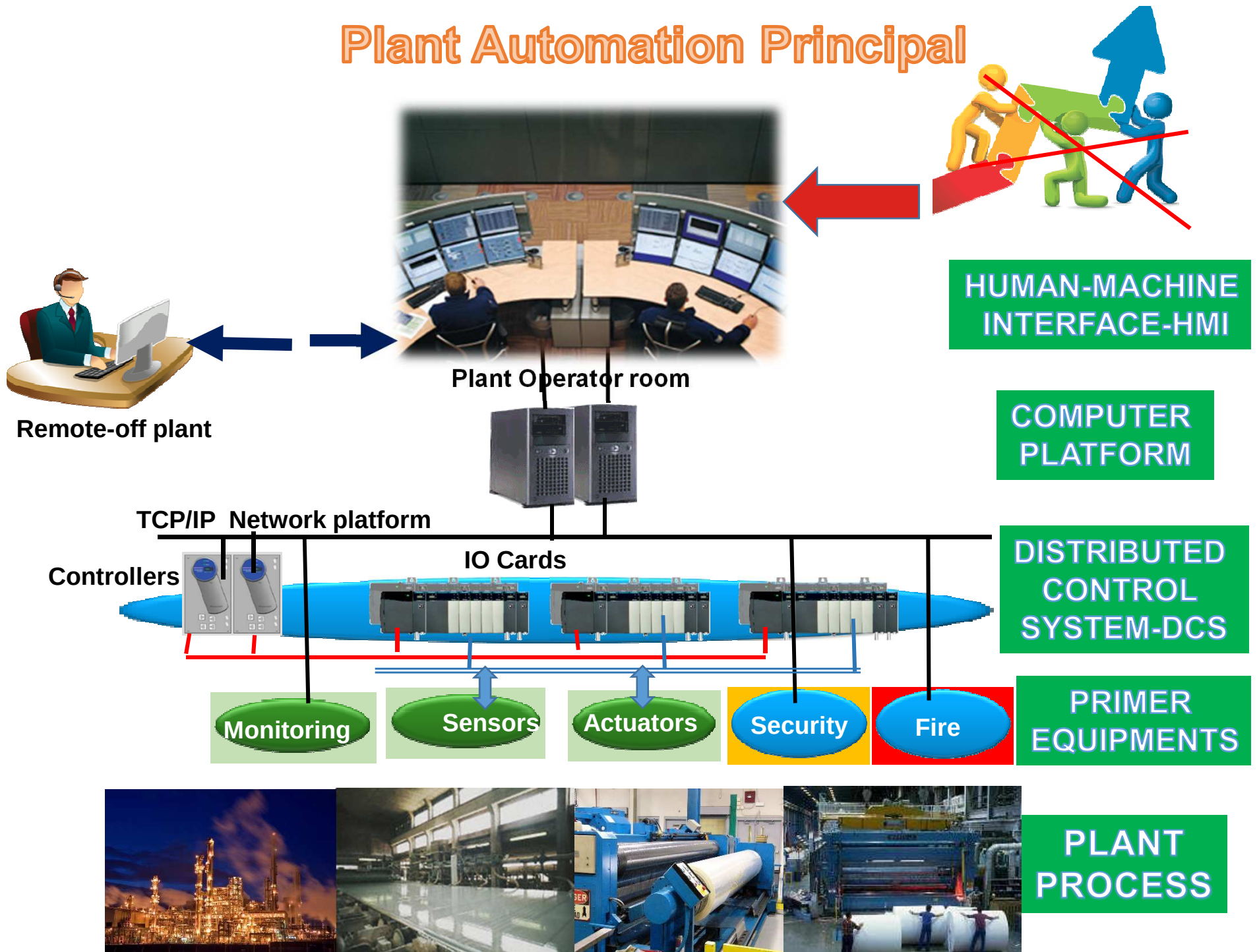
- ✓ Alpar, Saffet Riza (Prof Dr) -Rektor
- ✓ Duman, Halis (Prof Dr)-Dekan
- ✓ Şen, Necdet (Doc Dr)-Elk BI Bşk
- ✓ Yılmaz, Mümtaz (Doc Dr)-KTU
- ✓ Hoşagası, Şevki (Dr)-KTU
- ✓ Buruşuk, Fahri (Dr)-KTU
- ✓ Aldemir, Rasim (Dr)-KTU
- ✓ Ozkaya, Muzaffer (Prof Dr)-ITU
- ✓ Ceyhun, Yurdakul (Yrd Doc Dr)-ODTU
- ✓ Uzgoren, Fikri (Prof Dr)-ITU
- ✓ Ozaklav, Hasan (Prof Dr)-ITU
- ✓ Dervişoglu, Kemal (Prof Dr)-ITU
- ✓ Karafakioğlu, Bedri (Ord.Prof)-ITU
- ✓ Hamit Atalay (Araşt Gorv)-KTU
- ✓ Onal, Hasan (Prof Dr)-ITU
- ✓ Akpınar, Sefa (Asst)-KTU
- ✓ Aytac, Sungur (Asst)-KTU
- ✓ Yucel, Fikret (PTT-Arla)
- ✓ Ozalp, Nuran (Doc Dr)-KTU
- ✓ Saka, Ahmet (Araşt Gor)-KTU
- ✓ Gokalp, Yavuz (Prof Dr)-KTU
- ✓
- ✓

.....Katkılarından dolayı hepsini saygıyla anıyorum

TOPICS

- ☐ **Intelligent Field Sensors& Actuators**
- ☐ **Distributed Control Systems**
- ☐ **Safety Systems**
- ☐ **Computer Environment**
- ☐ **DCS configuration**

Plant Automation Principal



Sensors-Actuators

- ❖ Primary elements of automation system
- ❖ Fitted to production process equipments
- ❖ Wired /communicate to the DCS , IO cards – networking
- ❖ Chosen to meet process requirements
- ❖ Play key role for measurement and controls
- ❖ Designed as harmony of electro-mechanic

Sensors-key process measurements

Pressure

Level %, pressure (bar)



Flow

m³-ltr/min- t/h



Temperature

Degree Celcius



Position

Displacement, distance,
angle,rpm, on/off, accelarator



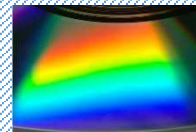
Analytical

pH-Orp-Gas-Conductivity, density, thickness, weight,
purity....etc



Color

420...720nm color spectra



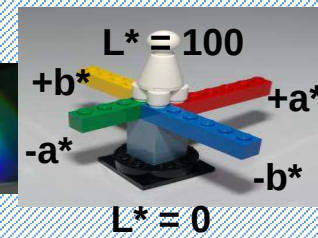
Vision

Optical, camera based



Electric

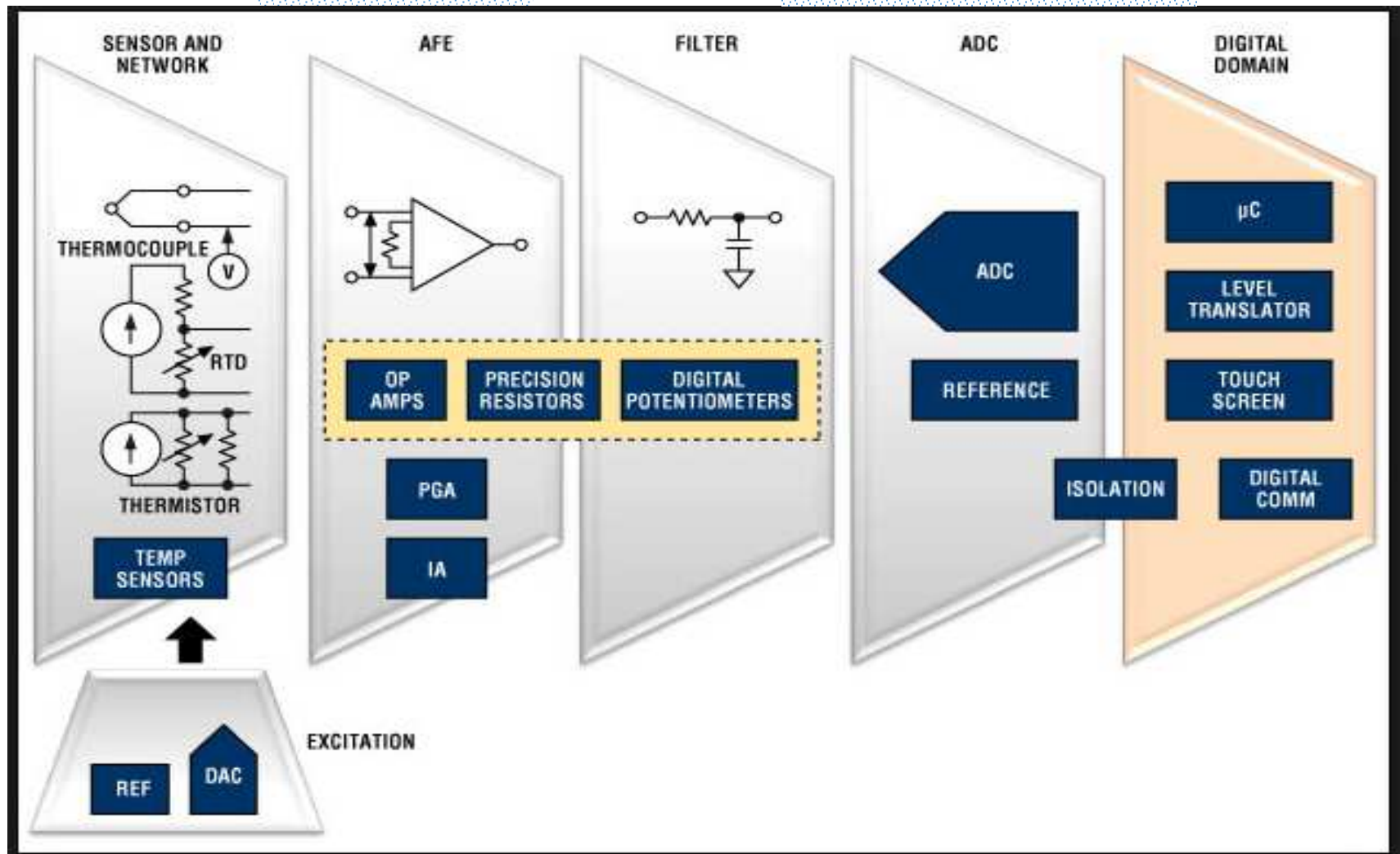
V,A, Kw, kwh



Sensors-Design Electronic

analog front-end

Analog/digital conversion



Sensors-Key Design Algorithms

Physical

Where no chemical reaction take place, measurments are based on absorbance, refractive index, conductivity, mass change,scattering...etc

Chemical

In which a chemical reaction with partipication of the analyte gives raise to the analythcal signal

Bio-chemical

In which a biochemical process is the source of analythcal signal. Typical examples are microbial potentiometric sensors, immunosensors. So , they are called «biosensors»

Electrical

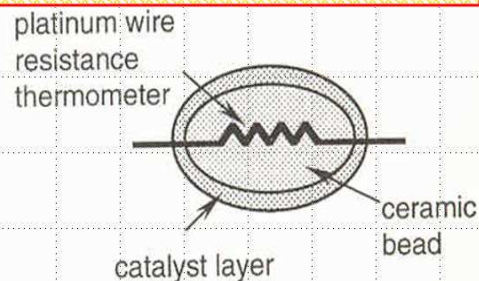
Voltammetric, potentiometric, bi-metal, chemically sensitized field-effect transistor, metaloxide semiconductor, piezo-electric ...etc

Radioactive

Based on radioactive particule absorption, such as beta, gama, X-Ray

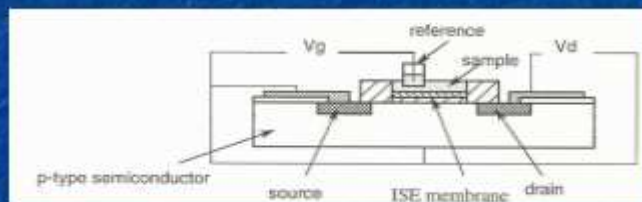
Catalytic sensor (pelistor) using a catalyst layer

PT100-Temperature



Ion-sensitive field effect transistor ISFET

Ph/Orb sensor

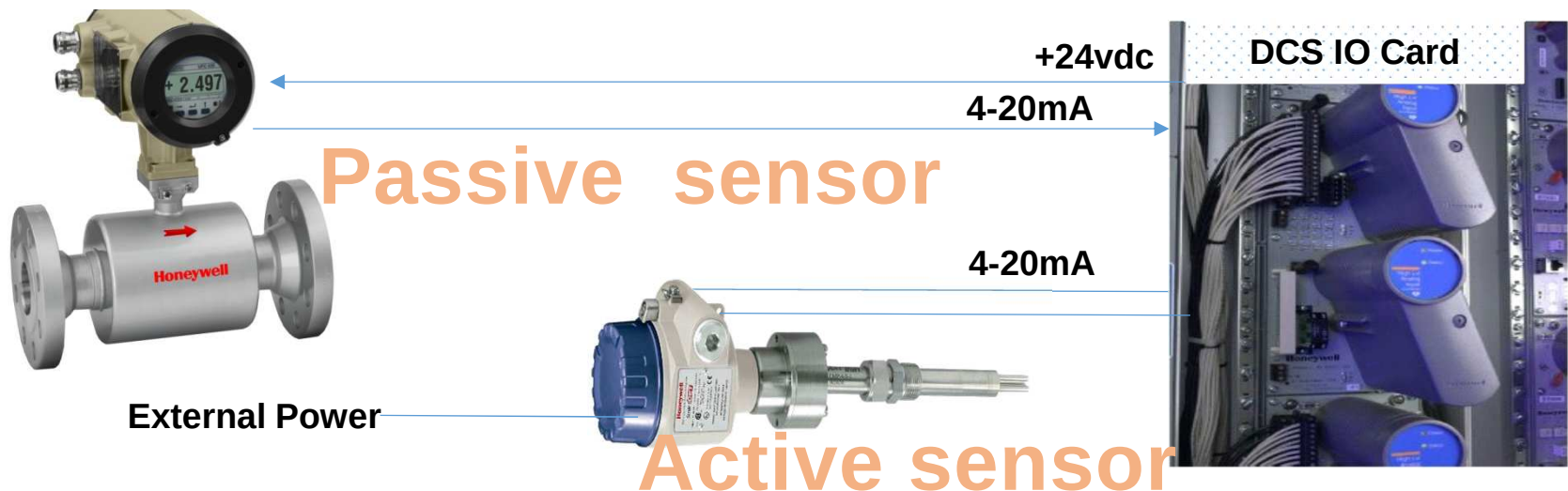


- The gate is then allowed to come in contact with the sample to be tested
- The drain current is measured to indicate the ion concentration.
- The most important use of this device is measurement of pH

Sensors-measurement principles

Active vs. Passive Sensors

- 1) **Active sensors:** Require an external source of power (excitation voltage) that provides the majority of the output power of the signal
- 2) **Passive sensors:** The output power is almost entirely provided by the measured signal without an excitation voltage

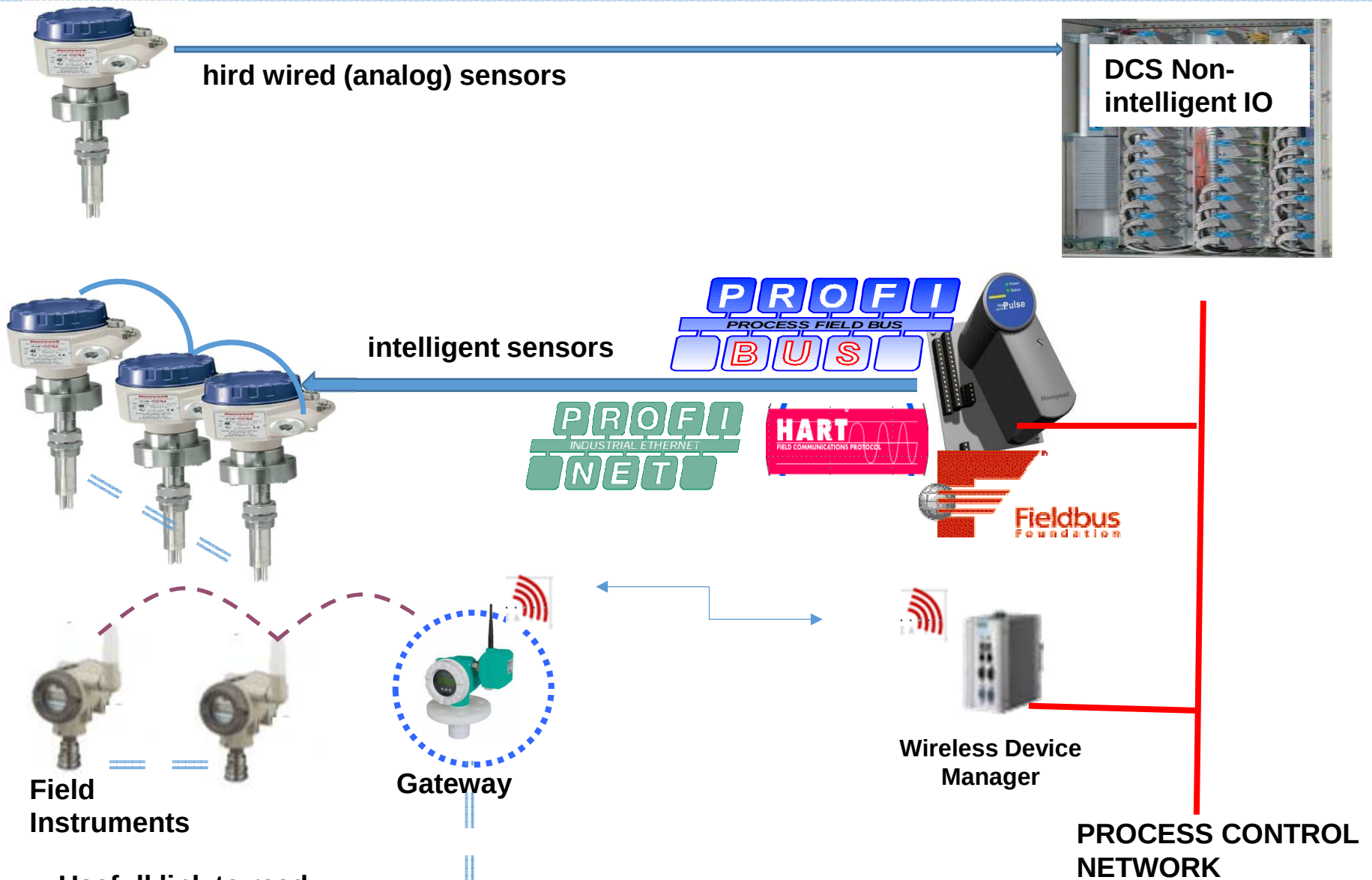


Sensors- Communication

Which FieldBus ?

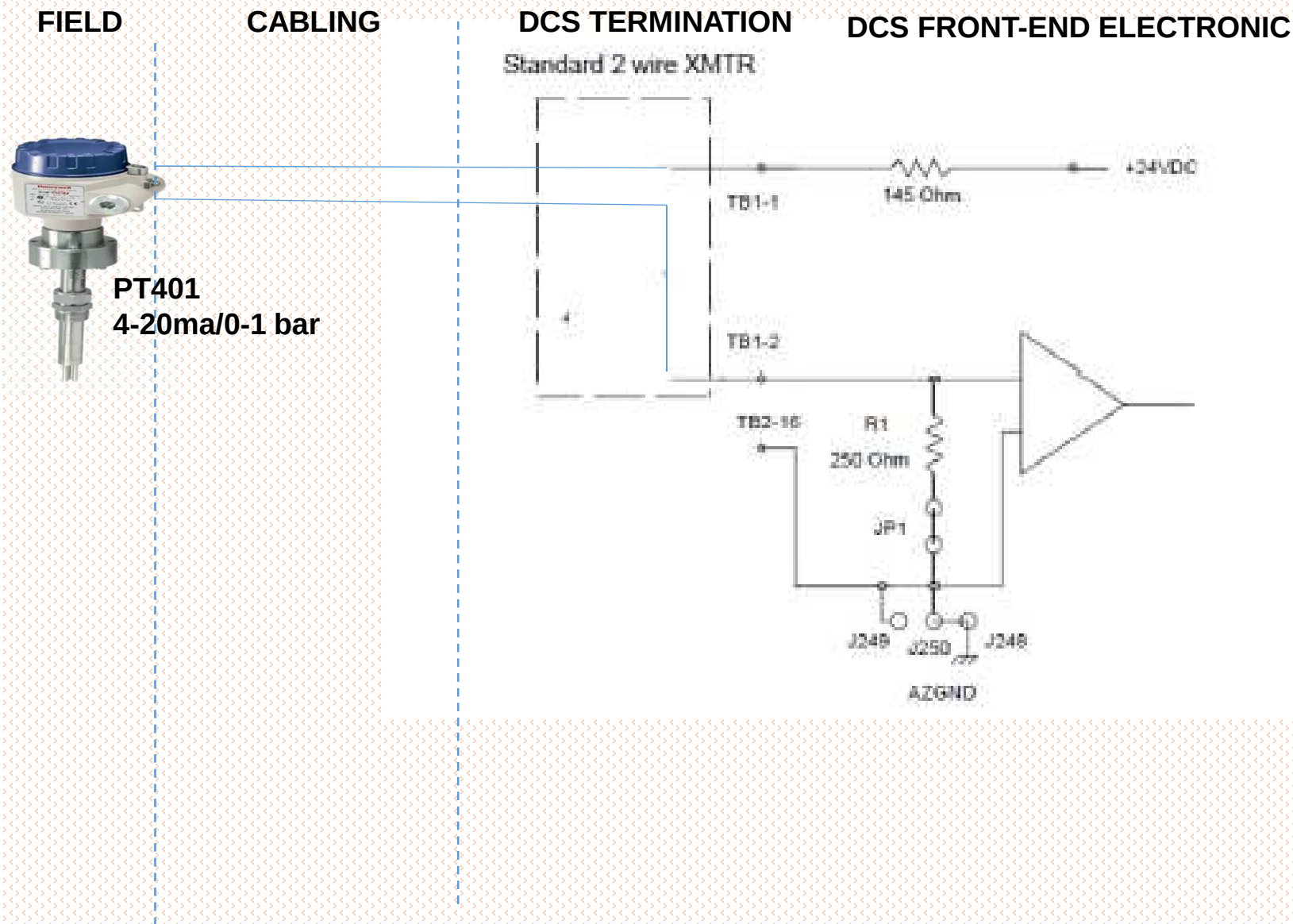
- A-bus
- Arcnet
- Arinc 625
- * • ASI
- Batibus
- Bitbus
- * • CAN
- ControlNet
- DeviceNet
- DIN V 43322
- DIN 66348 (Meßbus)
- FAIS
- EIB
- Ethernet
- Factor
- Fieldbus Foundation
- FIP
- Hart
- IEC 61158
- IEEE 1118 (Bitbus)
- Instabus
- * • Interbus-S
- ISA SP50
- IsiBus
- IHS
- ISP
- J-1708
- J-1850
- LAC
- * • LON
- MAP
- Master FB
- MB90
- MIL 1553
- MODBUS
- * • MVB
- P13/42
- P14
- Partnerbus
- ProfiNet
- * • Profibus-FMS
- Profibus-PA
- Profibus-DP
- PDV
- * • SERCOS
- SDS
- Sigma-i
- Sinec H1
- Sinec L1
- Spabus
- Suconet
- VAN
- WorldFIP
- ZB10
- ...

Sensors- Communication

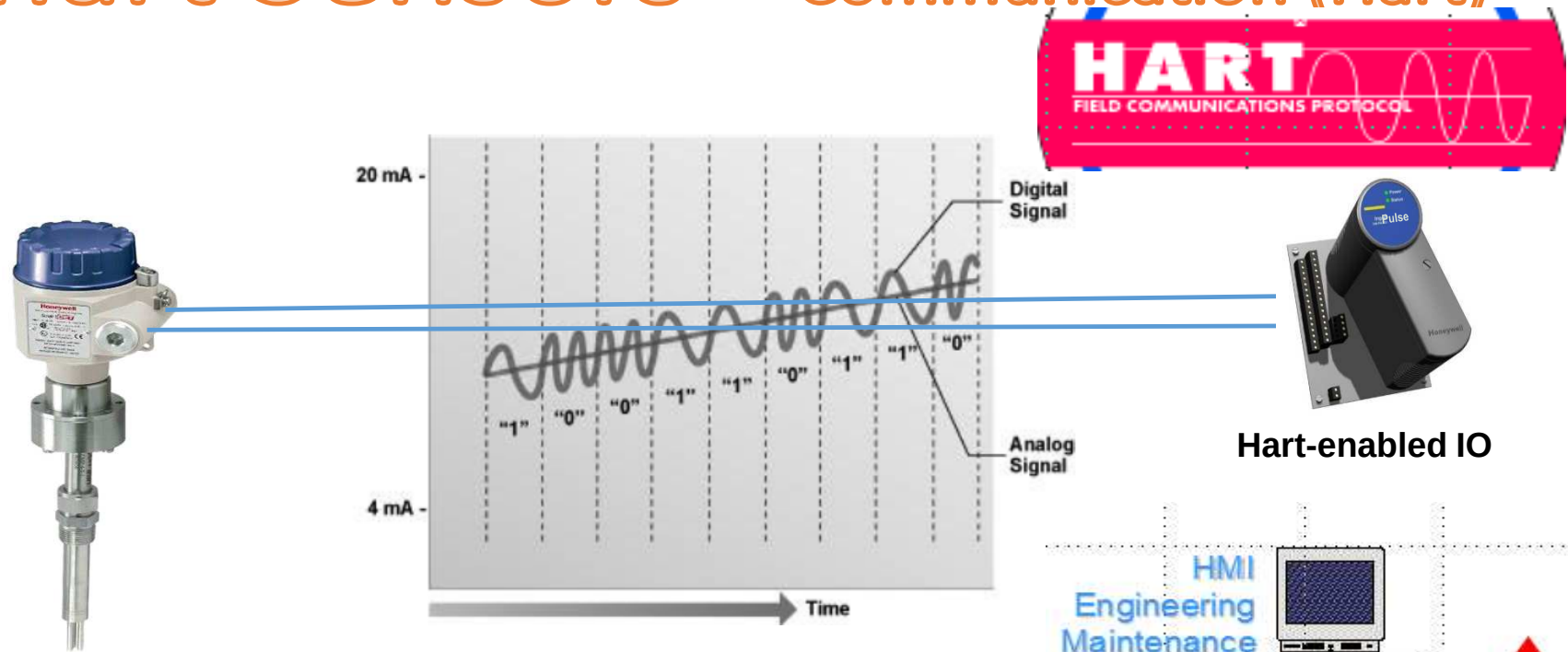


Usefull link to read
<https://polen.itu.edu.tr/bitstream/11527/496/1/3539.pdf>

Sensors- Communication (Hird-wired)



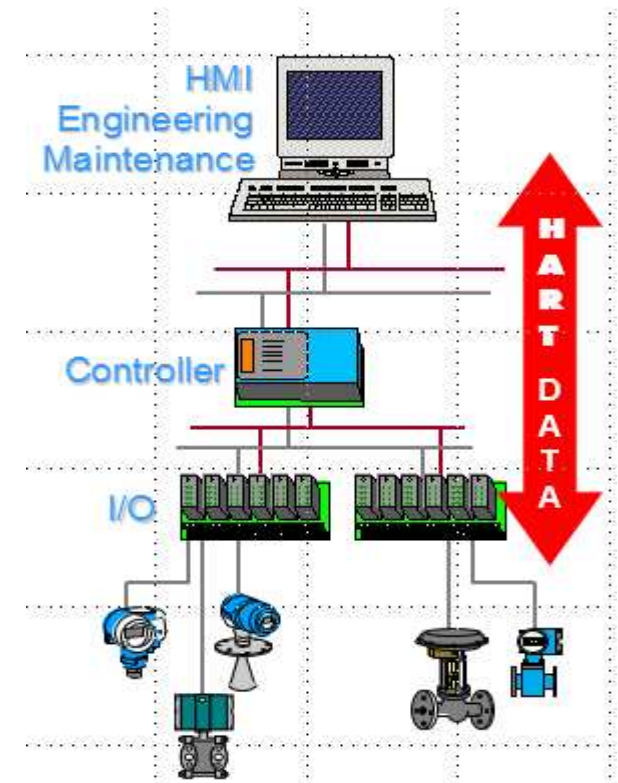
Smart Sensors- Communication (Hart)



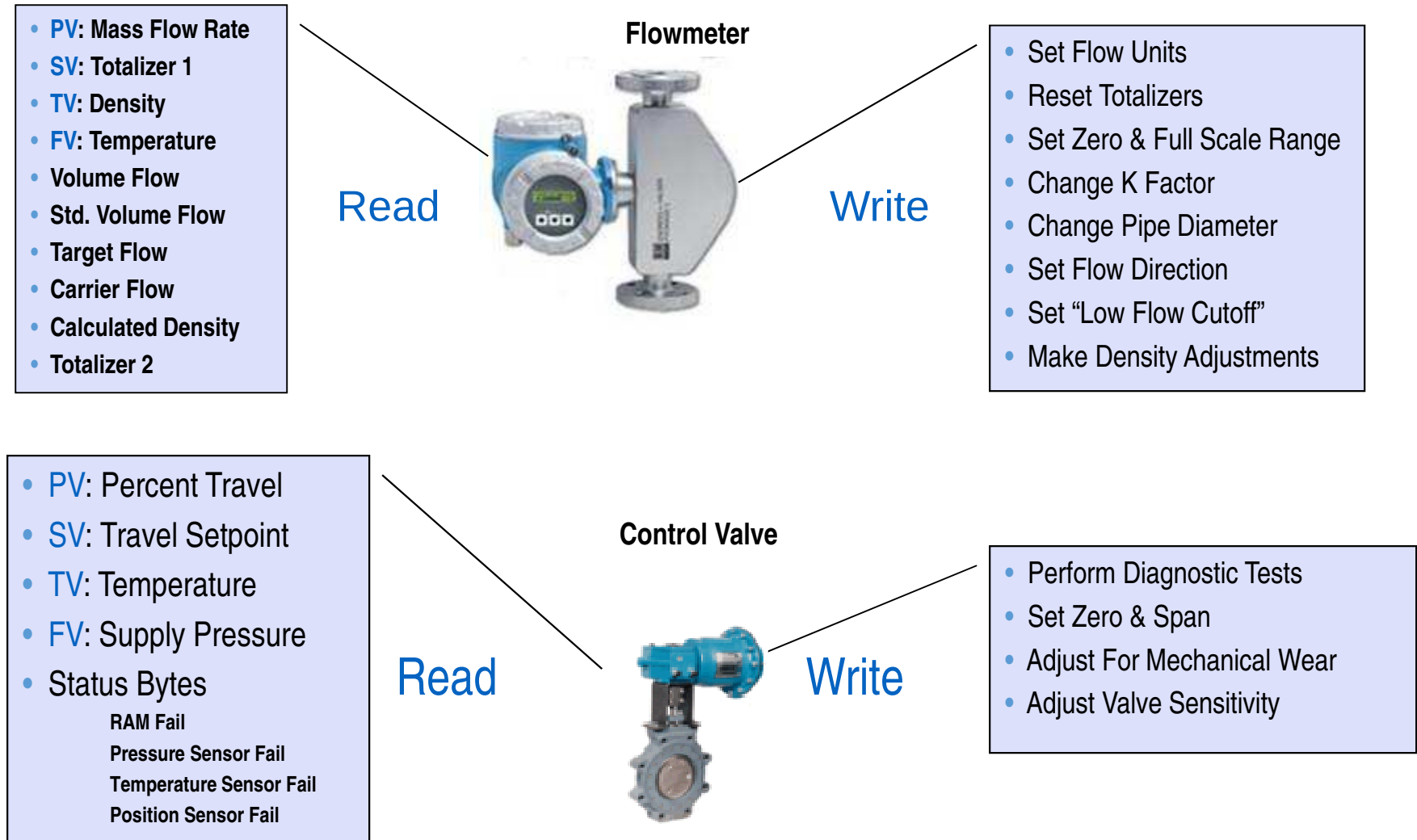
❑ Digital FSK allows *additional information to be carried on the same pair of wires with the 4-20mA analog signal, SIMULTANEOUSLY-TRANSPARENTLY*

❑ 35-40 data items are Standard in every HART device

- ❑ *Device Information*
- ❑ *Basic Calibration Information*
- ❑ *Process Variables*
- ❑ *Diagnostic Status Alerts*

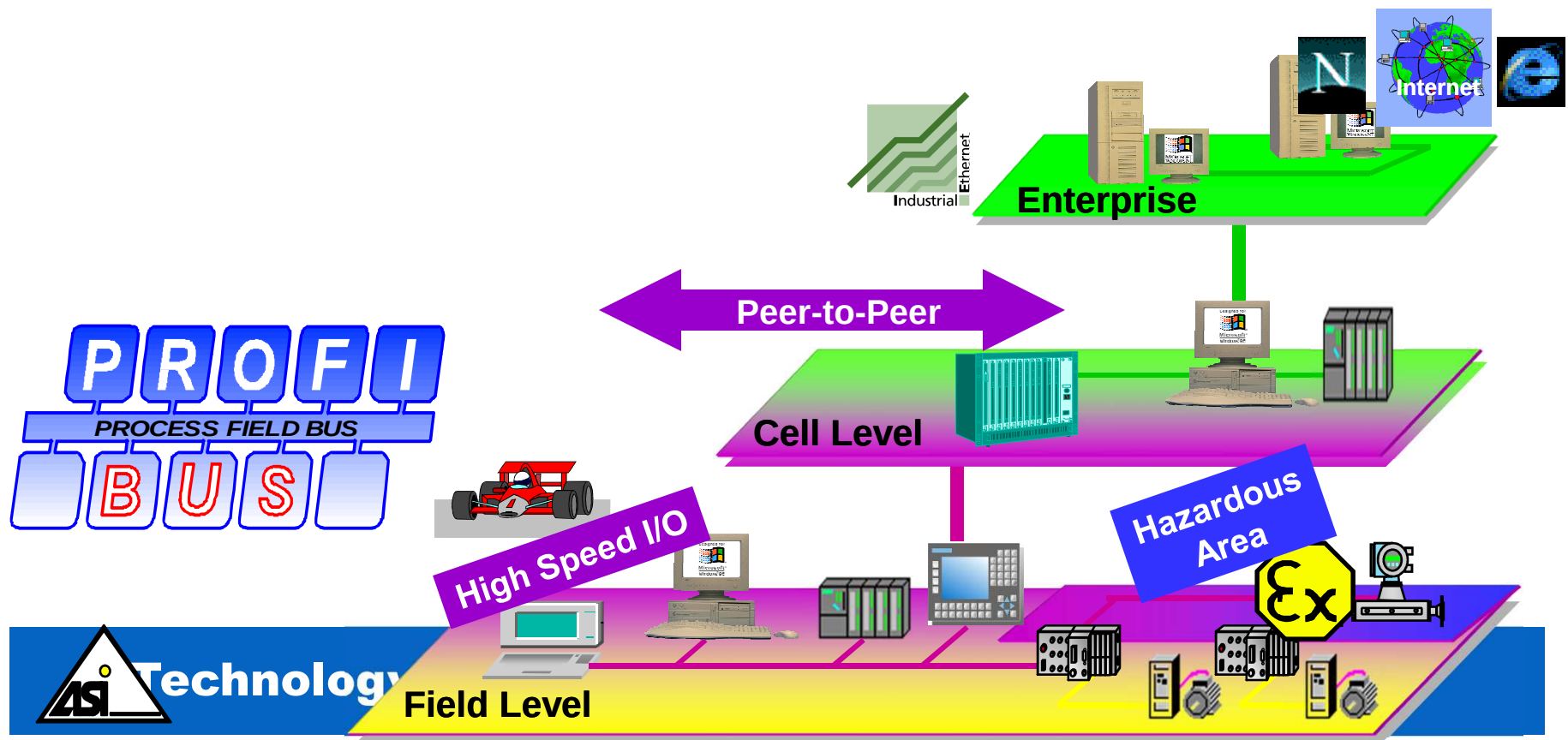


Smart Sensors- Communication (Hart)



Smart Sensors- Communication (ProfiBus)

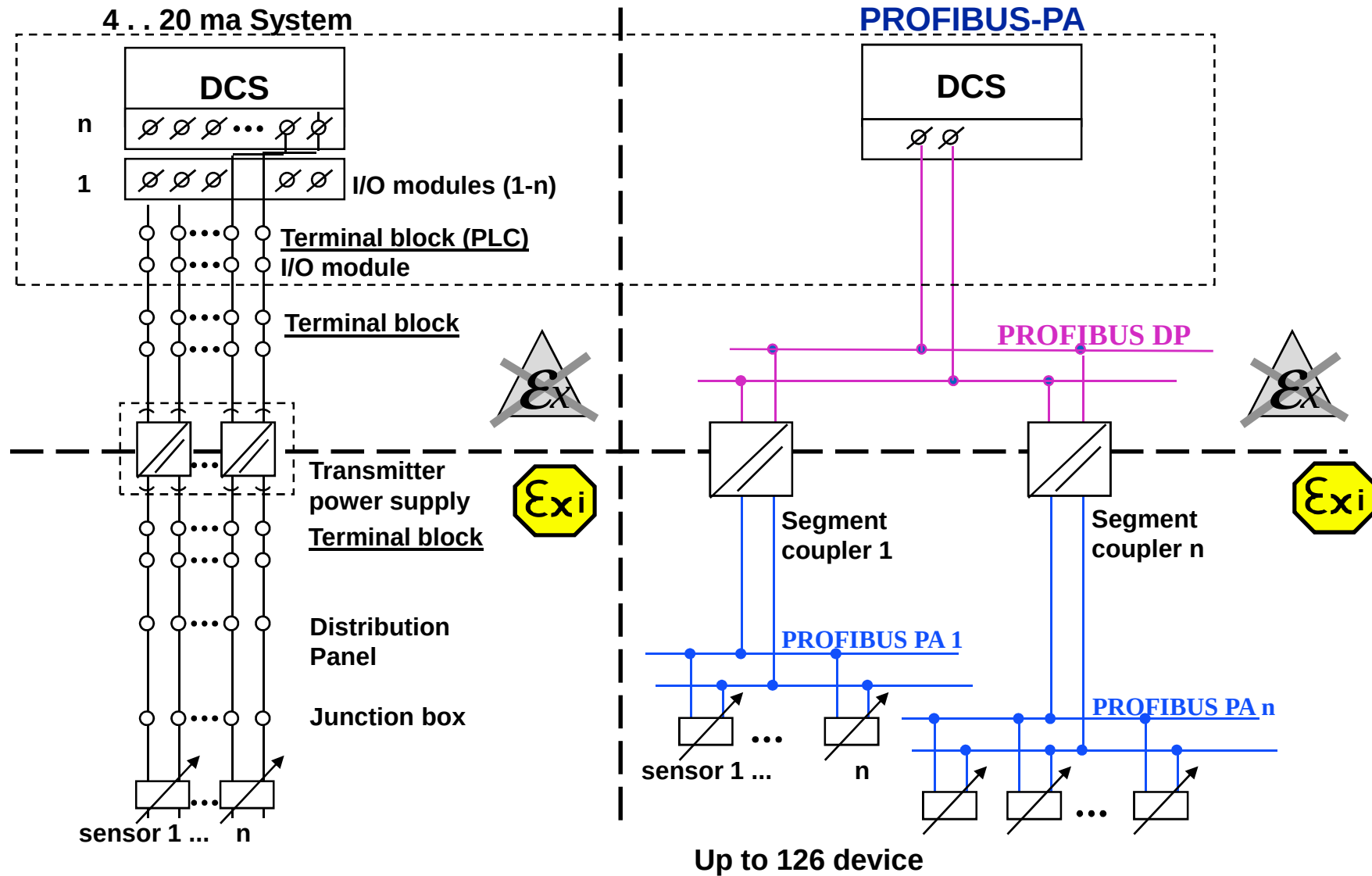
❏ Solution for all your Automation Needs



What is ProfiBus

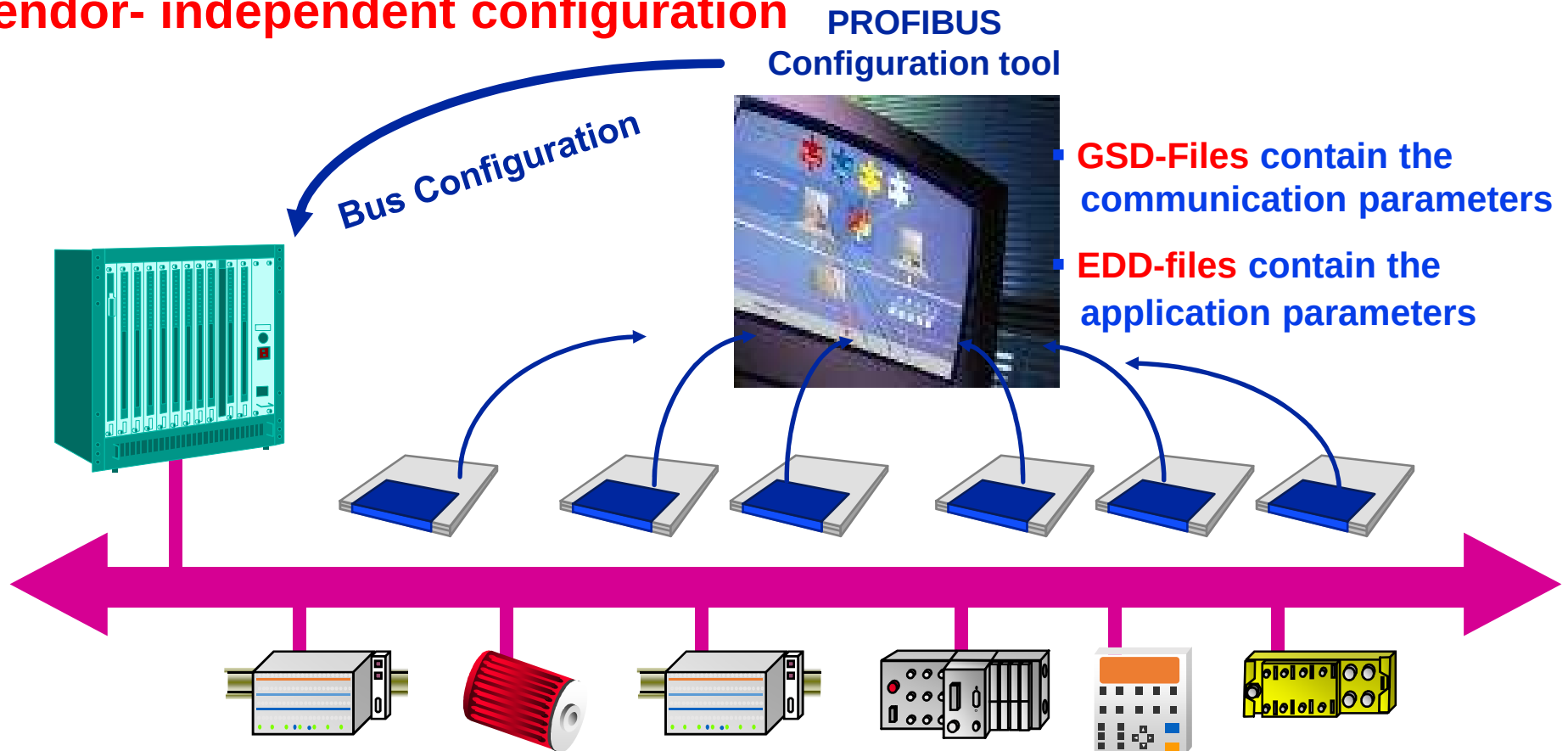
- ⇒ PROFIBUS is a bi-directional digital communication network for field devices.
 - ✓ Multi-drop network, many devices on one cable
 - ✓ communicates not only process values but also diagnostics, device parameters, calibration and performance data etc.
- ⇒ The data can represent analogue values and/or discrete (on/off) values.
 - ✓ But all data is digitally encoded and transmitted.
- ⇒ PROFIBUS is extensively specified.
 - ✓ All PROFIBUS devices are interoperable.
 - Multi vendor systems are easily constructed.
 - Best of breed devices can be selected.
 - Common set of tools for maintenance and engineering.

Sensors- Communication (ProfiBus vs Hard)



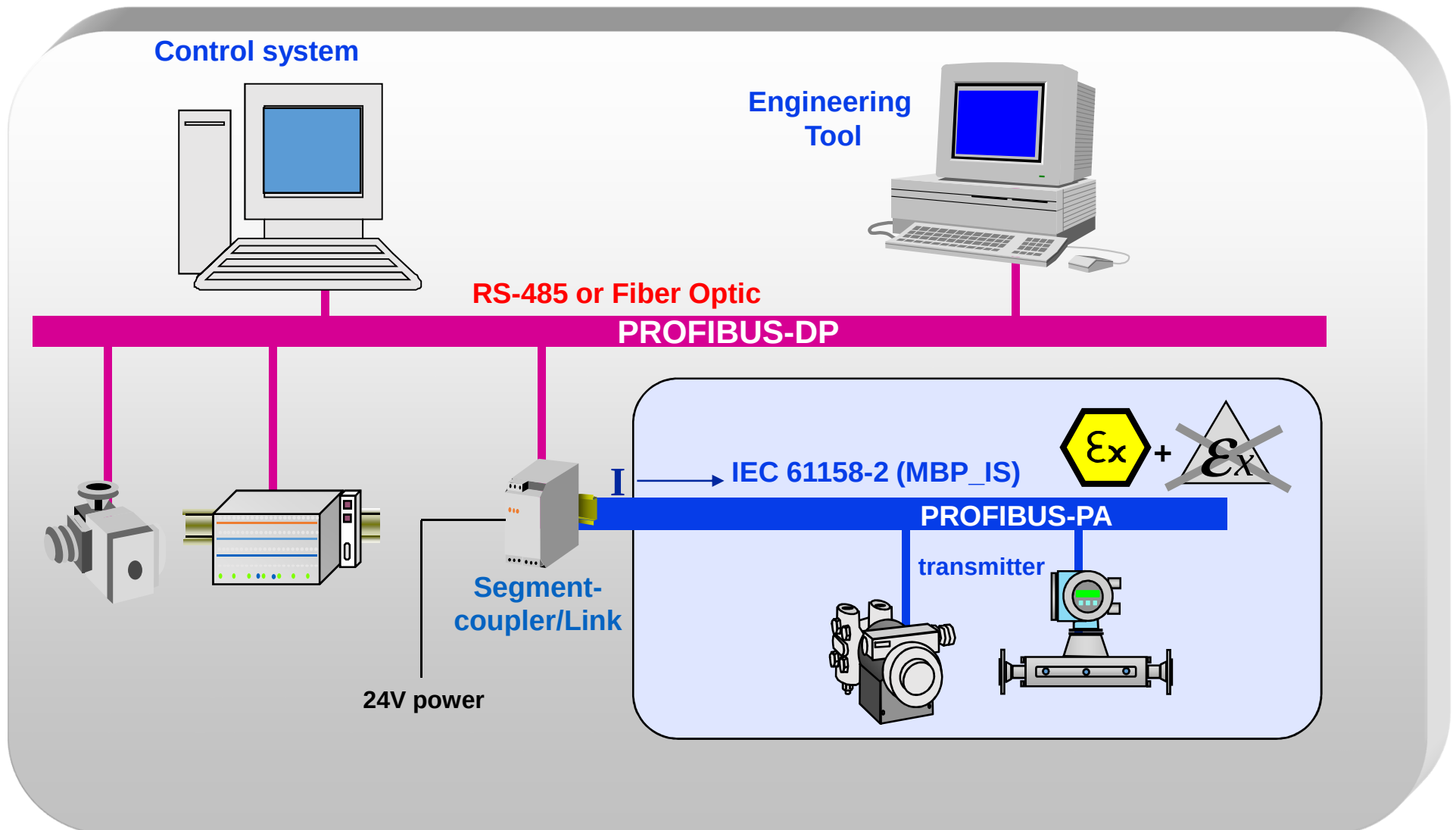
Smart Sensors- Communication (ProfiBus)

Standardized electronic data sheets are used to permit open, vendor- independent configuration



A library with GSD files of PROFIBUS devices is available online at www.PROFIBUS.com

Smart Sensors- Communication (ProfiBus)

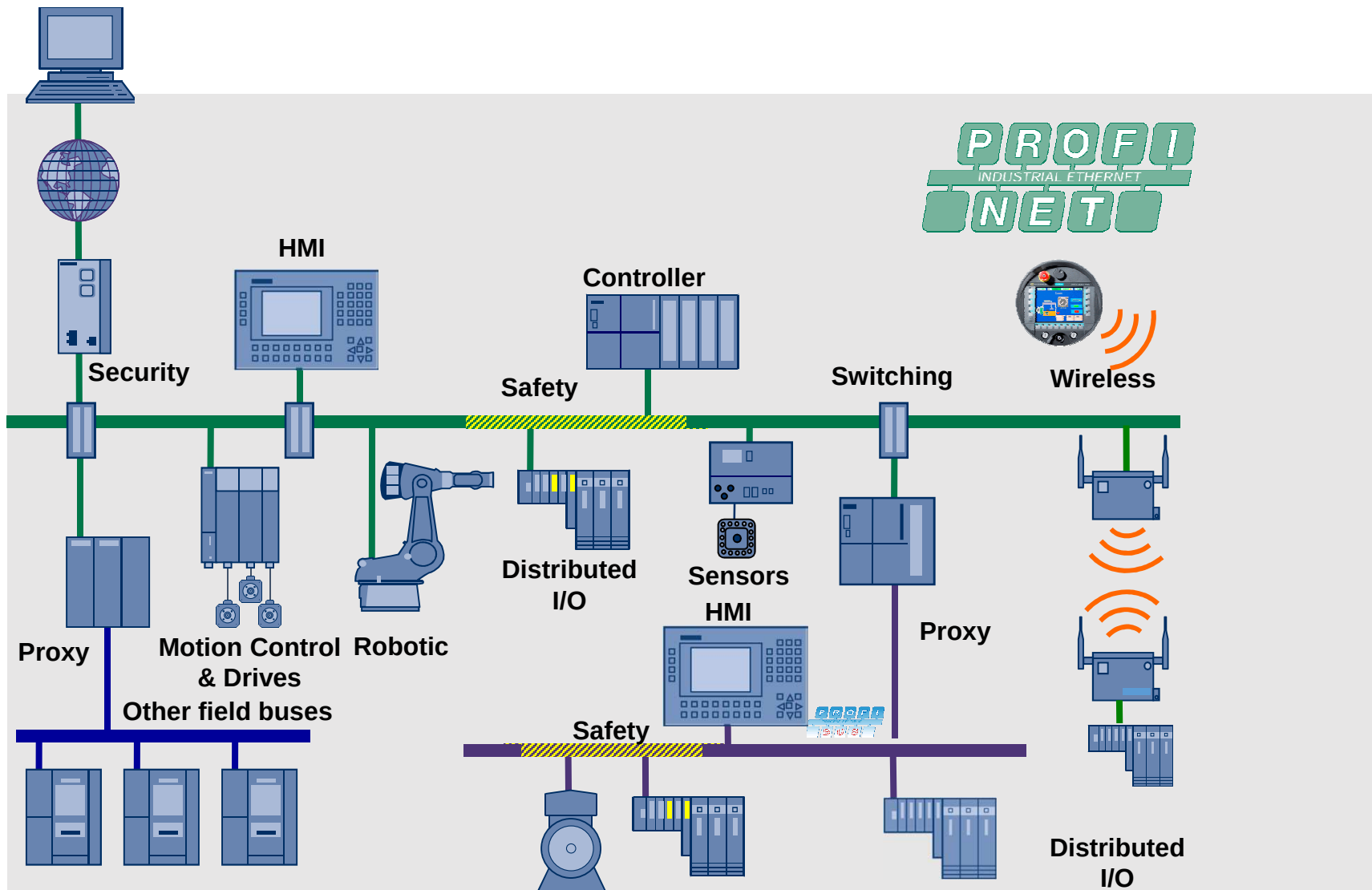


Smart Sensors_Communication (ProfiNet)

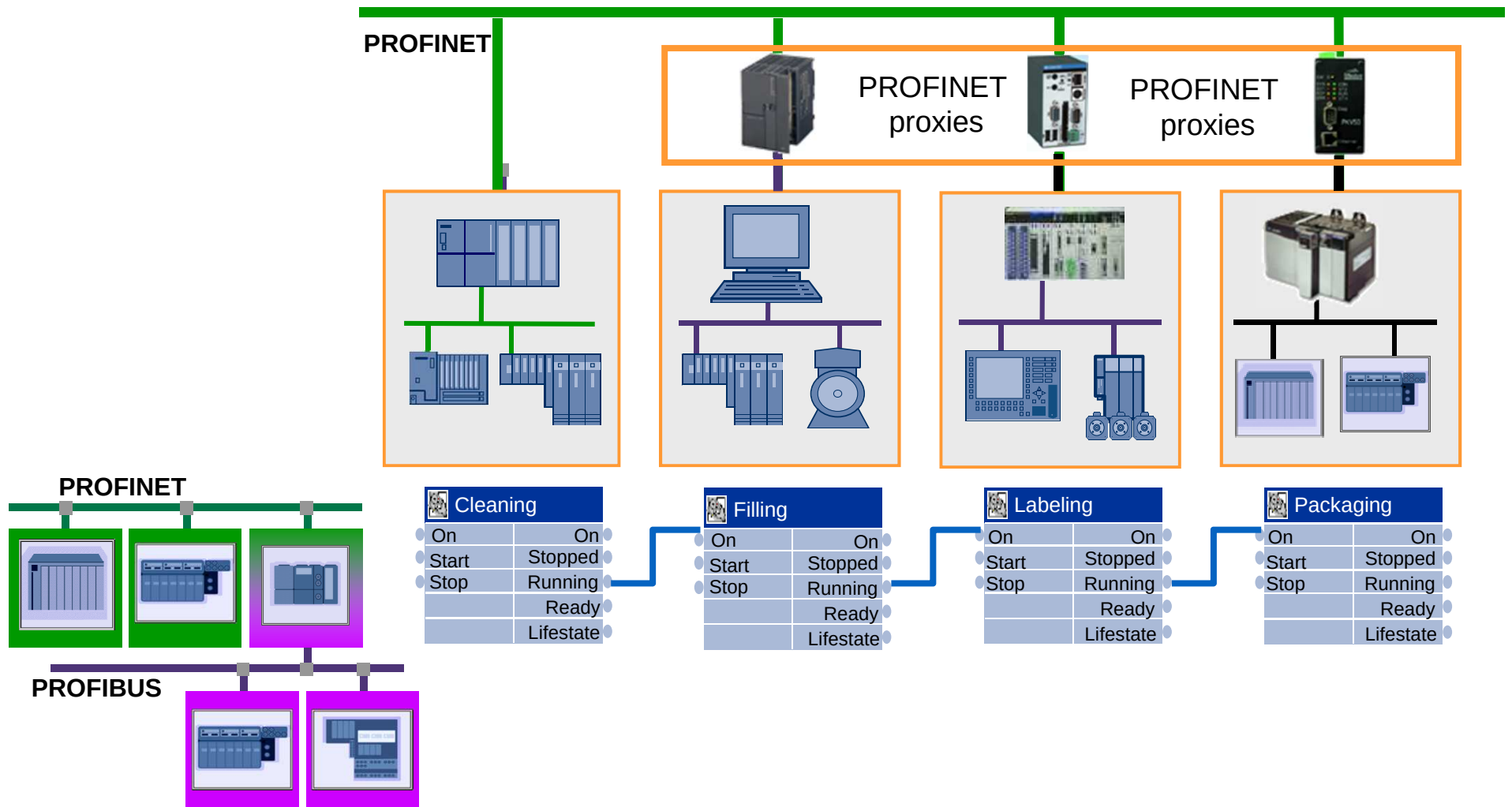


- is the open Industrial Ethernet standard from PROFIBUS International (PI)
- is based on Industrial Ethernet
- utilizes TCP/IP and IT-Standards
- is Real-Time Ethernet
- allows seamless integration of field bus systems

Smart Sensors_Communication (ProfiNet)



Smart Sensors_Communication(ProfiNet)



What is Profinet ?

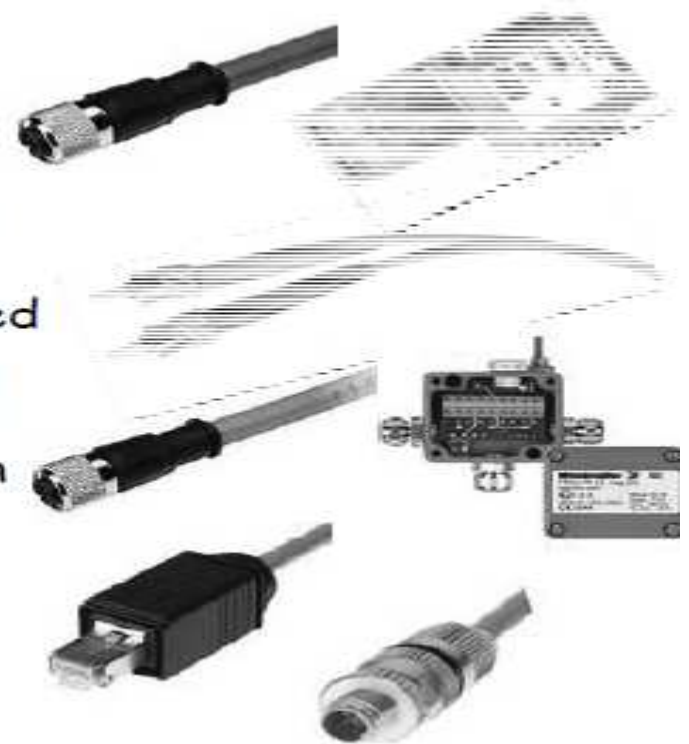
- ⇒ PROFINET is an open Industrial Ethernet standard developed by the PROFIBUS Organisation.
- ⇒ PROFINET
 - ✓ is completely standard Ethernet (IEEE802.3).
 - ✓ operates at 100Mbit/s over twisted-pair copper or fibre-optic cables,
 - ✓ makes use of TCP/IP and other IT standards for non-real-time communications (i.e. configuration and parameters).
 - ✓ Provides a "real-time" channel for time-critical communications (i.e. process data)
- ⇒ PROFINET is NOT PROFIBUS over Ethernet!
- ⇒ However, PROFINET is well thought out to incorporate the requirements of modern systems based on the lessons learned from PROFIBUS.

What is profiNet IO ?

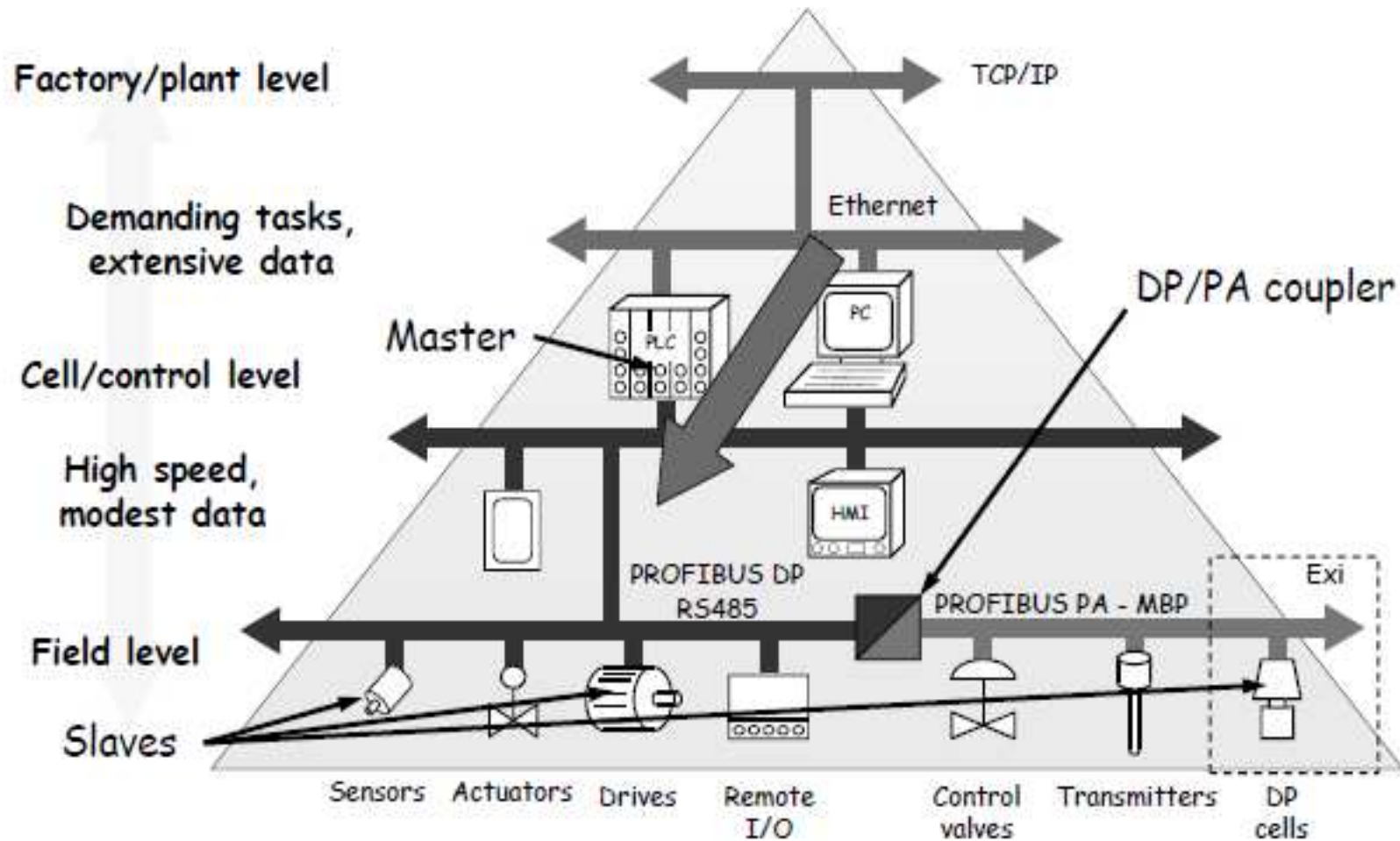
- ⇒ PROFINET IO provides remote IO using Ethernet connection and the PROFINET communication protocol.
- ⇒ PROFINET IO uses Real-Time and Non Real-Time communications.
- ⇒ PROFINET makes use of relevant TCP/IP protocols for setup, configuration and maintenance functions:
 - ✓ DHCP - Dynamic Host Configuration Protocol,
 - ✓ DNS - Domain Name Service,
 - ✓ SNMP - Simple Network Management Protocol,
 - ✓ ARP - Address Resolution Protocol,
 - ✓ HTTP - Web page access, and lots more!

ProfiBus_ProfiNet networking

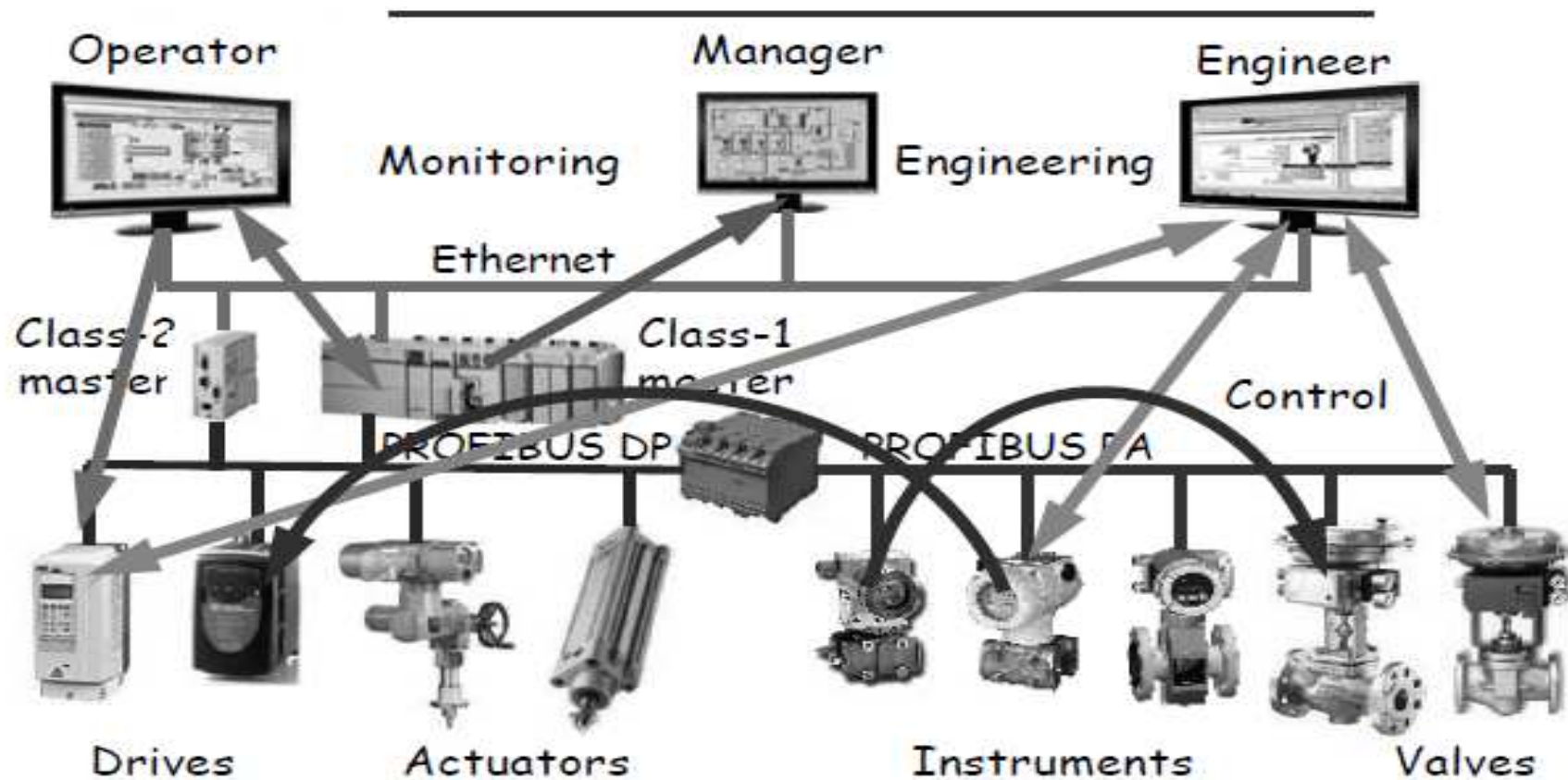
- ⇒ PROFIBUS DP uses 2-core RS485 screened twisted pair wiring.
 - ✓ 9-pin sub-D or M12 connectors extensively used.
- ⇒ DP can also use plastic or glass fibre optic cabling.
 - ✓ BFOC (ST) connectors widely used
- ⇒ PROFIBUS PA uses "Manchester Bus Powered" (MBP) cabling over 2 cores.
 - ✓ Glanded screw or M12 connection normally used
- ⇒ PROFINET uses 4-core Ethernet screened twisted pair cabling.
 - ✓ RJ45 or M12 connectors universally used.



Plant-wide Networking (ProfiBus)

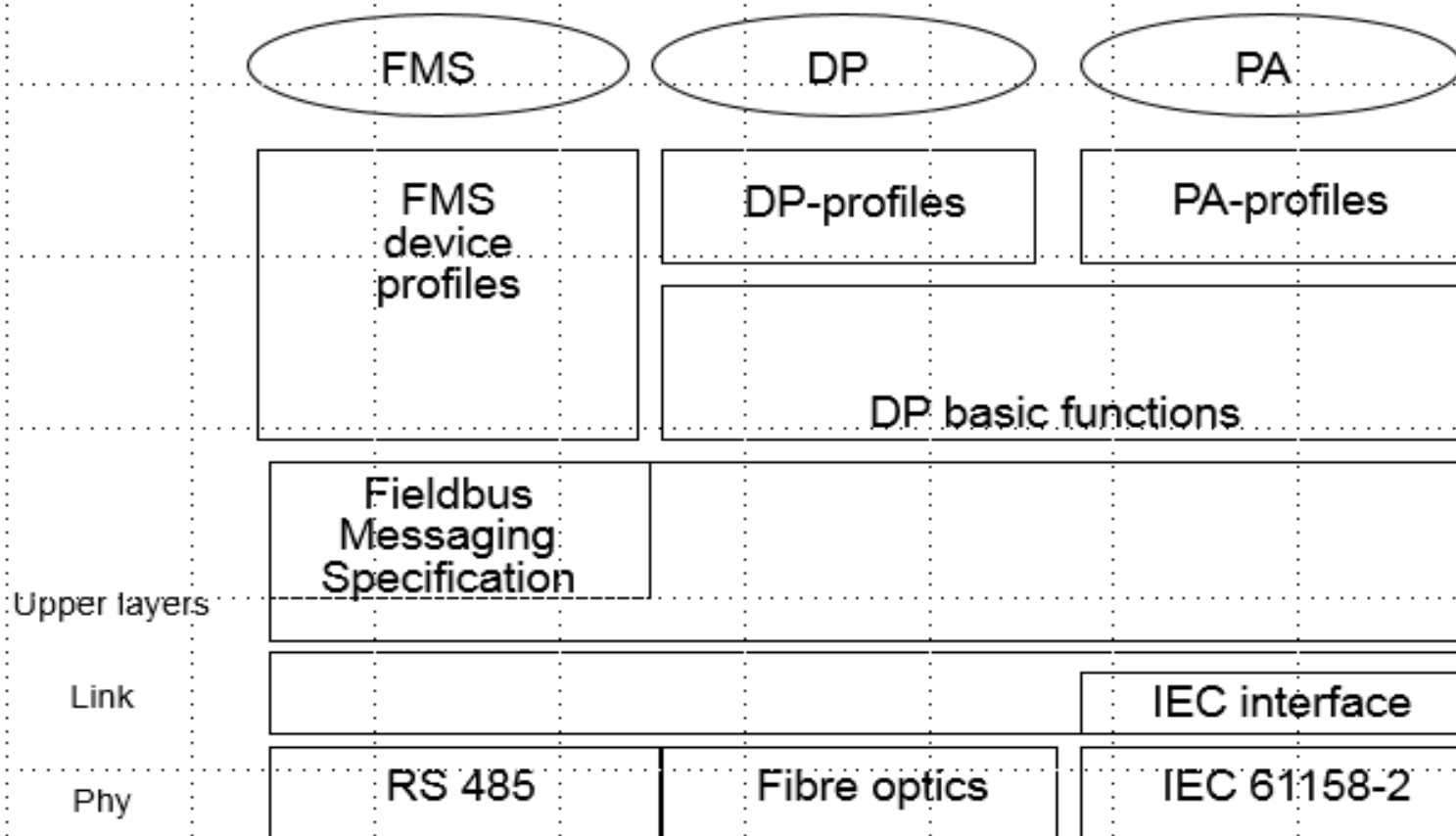


Plant-wide Networking (ProfiBus)



Profibus Stack

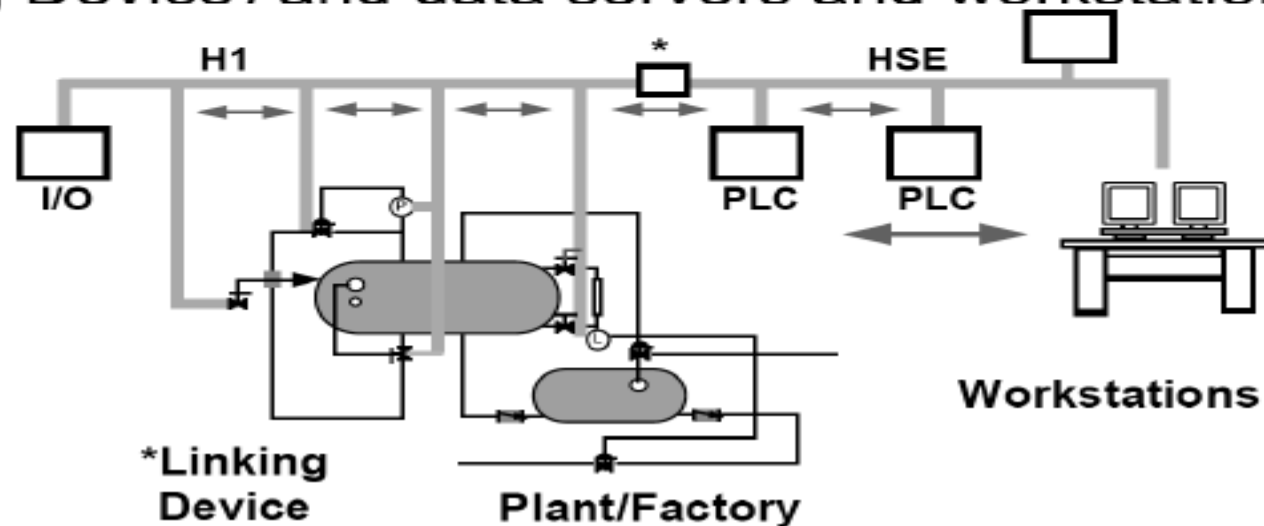
Profibus - Stack



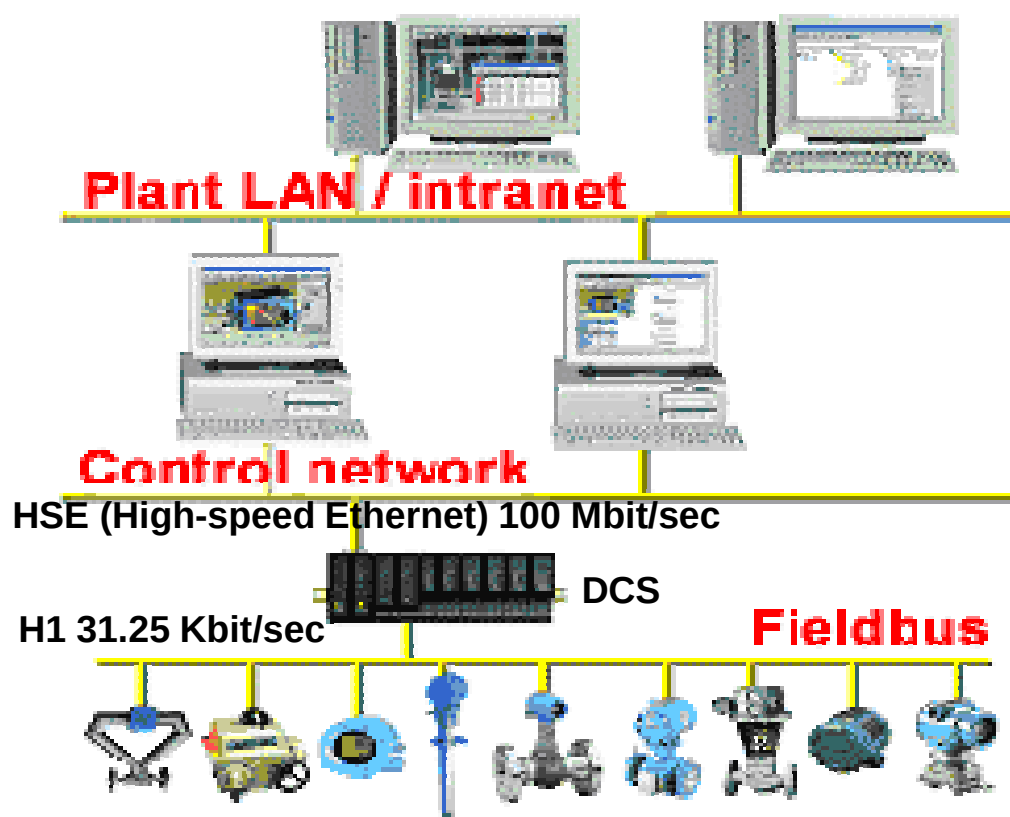
Smart Sensors_Communication (FieldBus)

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.

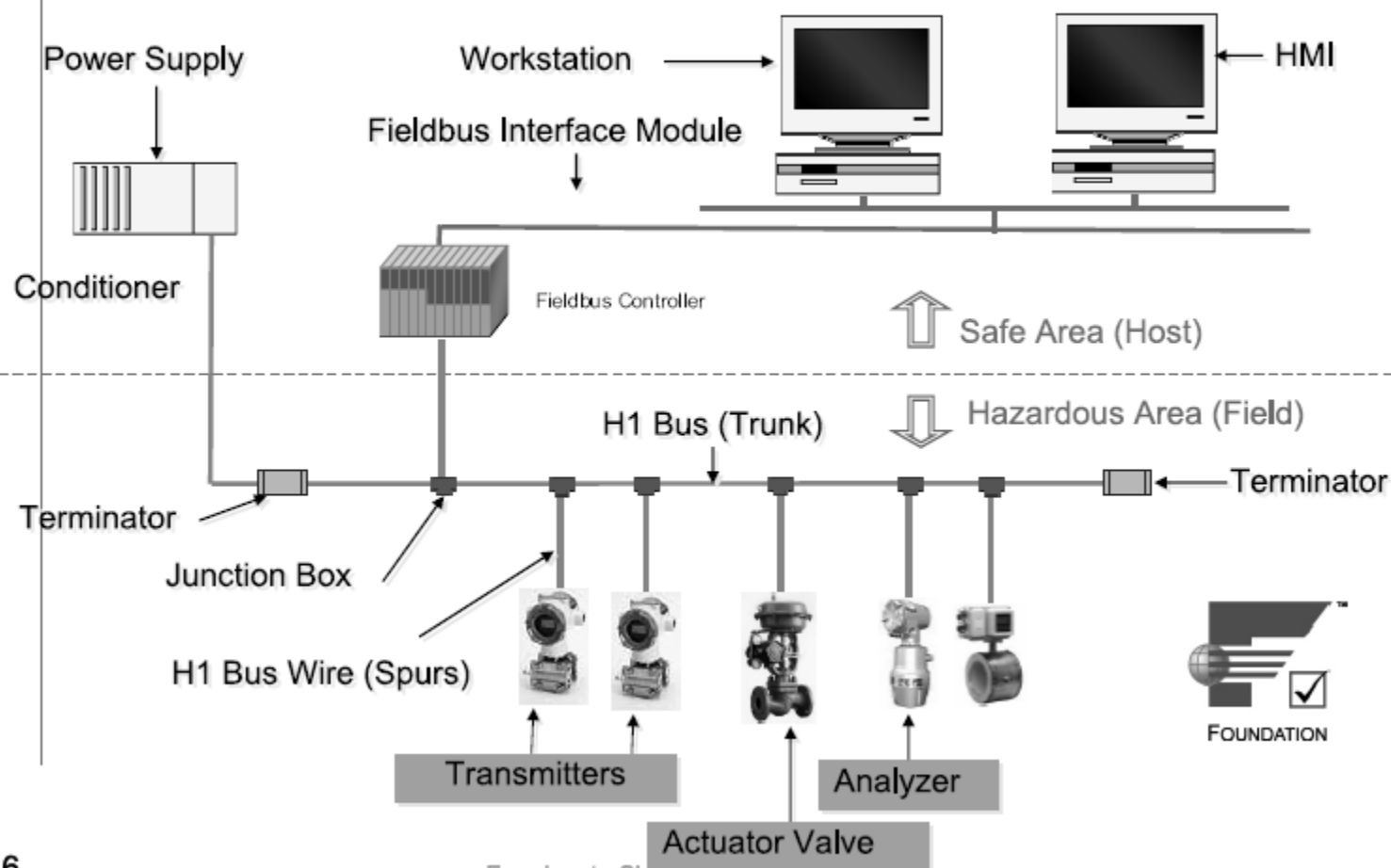


Smart Sensors_Communication (FieldBus)

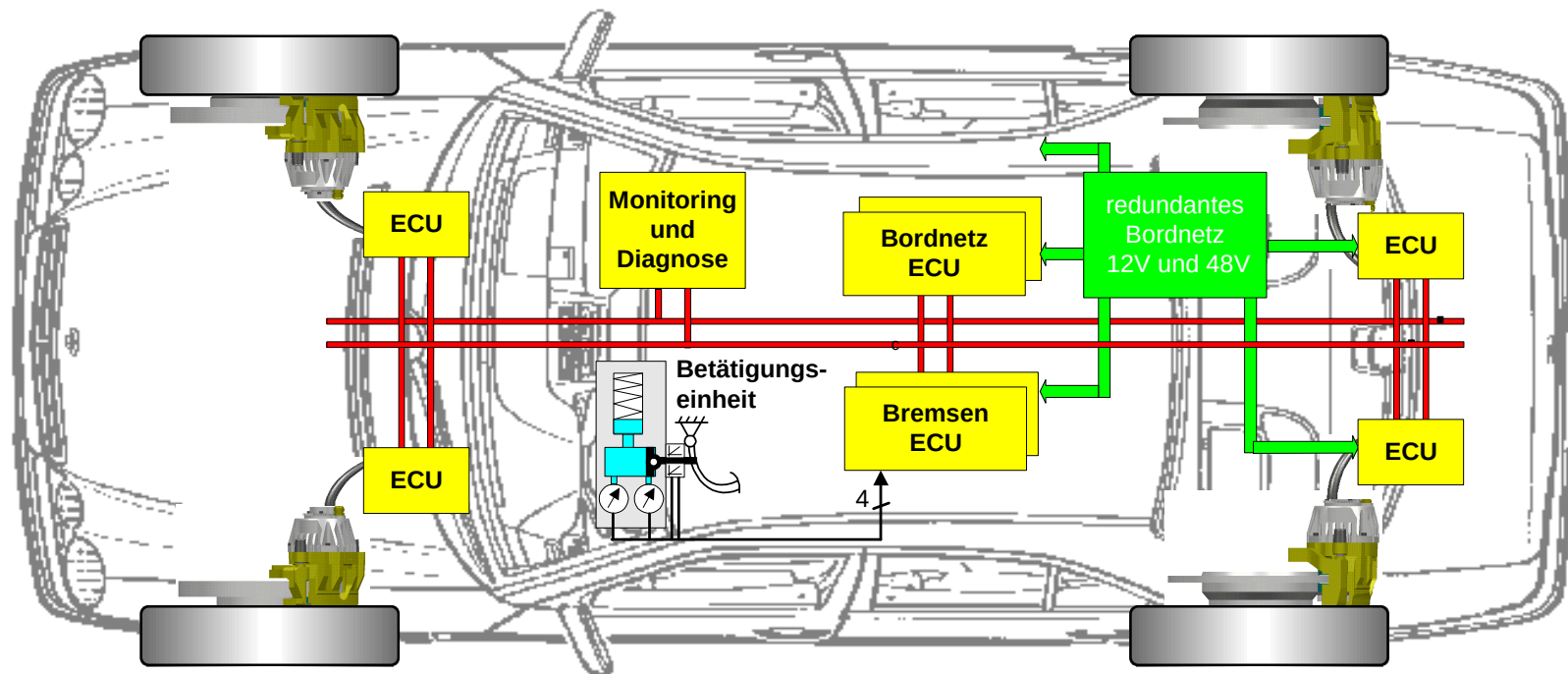


Smart Sensors_Communication (FieldBus)

Fieldbus Components



Smart Sensors_Communication (FieldBus)

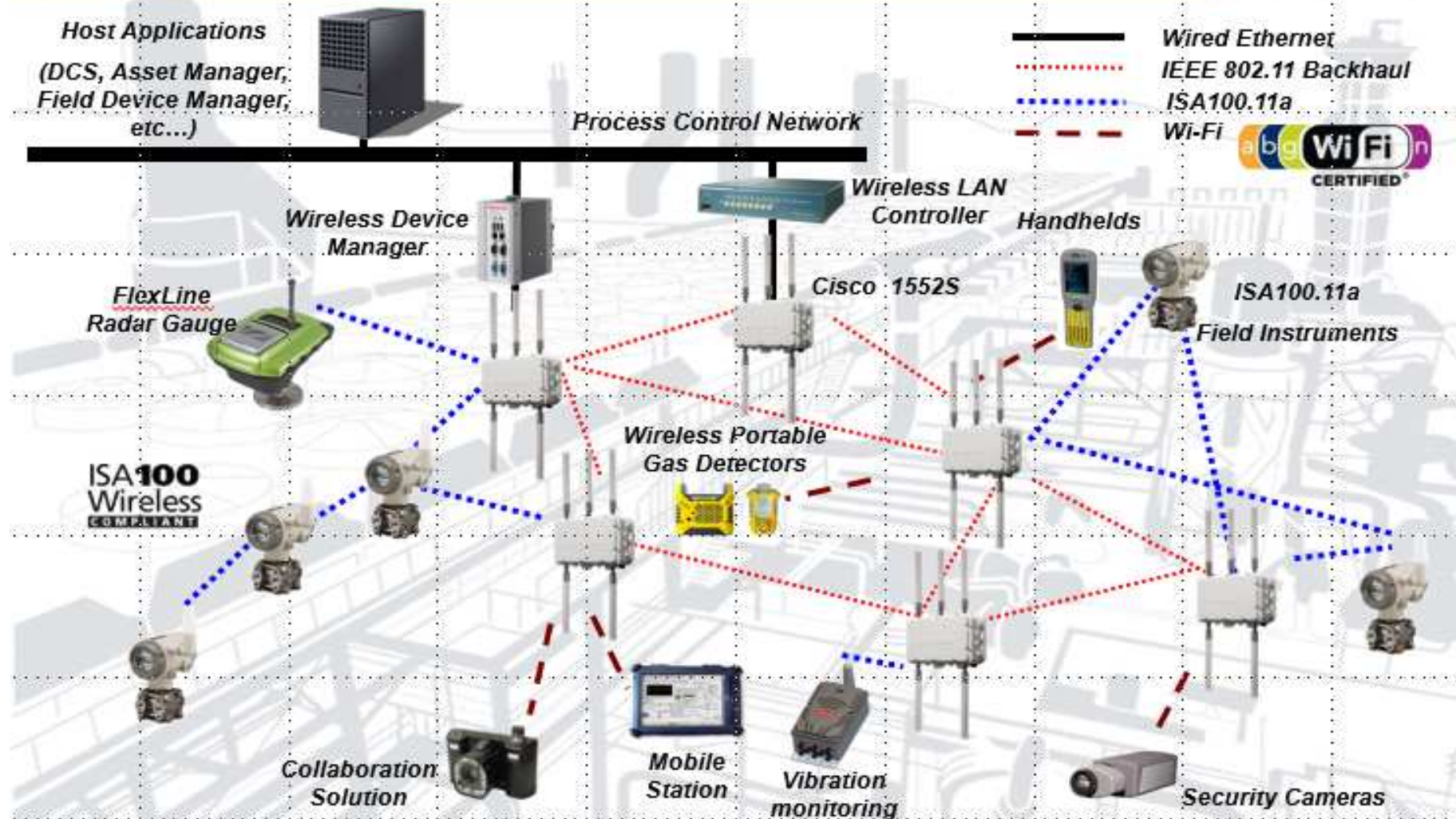


- Electromechanical wheel brakes
- Redundant Engine Control Units
- Pedal simulator
- Fault-tolerant 2-voltage on-board power supply
- Diagnostic System

Smart Sensors_Communication (Wireless)

OneWireless Network

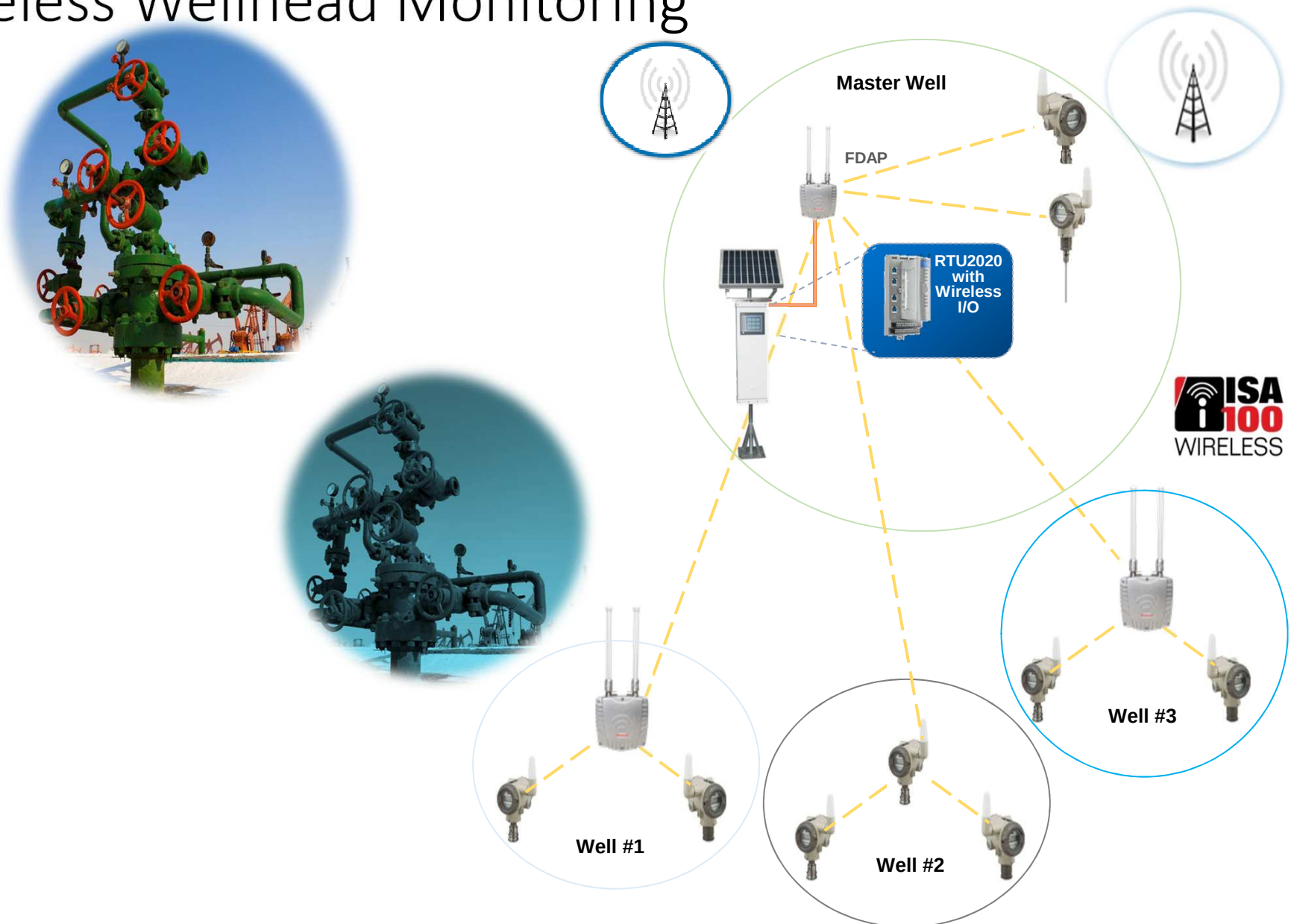
Honeywell



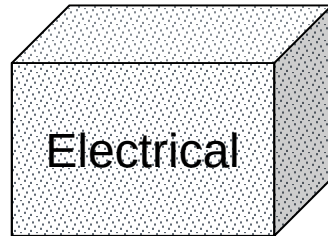
Leading technology – the wireless platform for now and the decades to come

Smart Sensors_Communication (Wireless)

Wireless Wellhead Monitoring

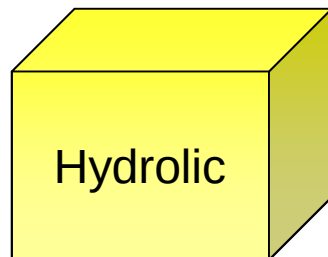


Smart Actuators



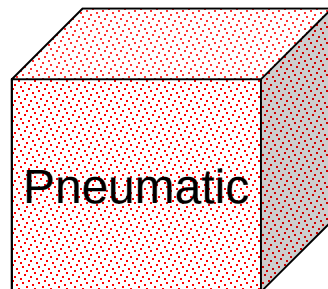
Electrical

Motors-valves



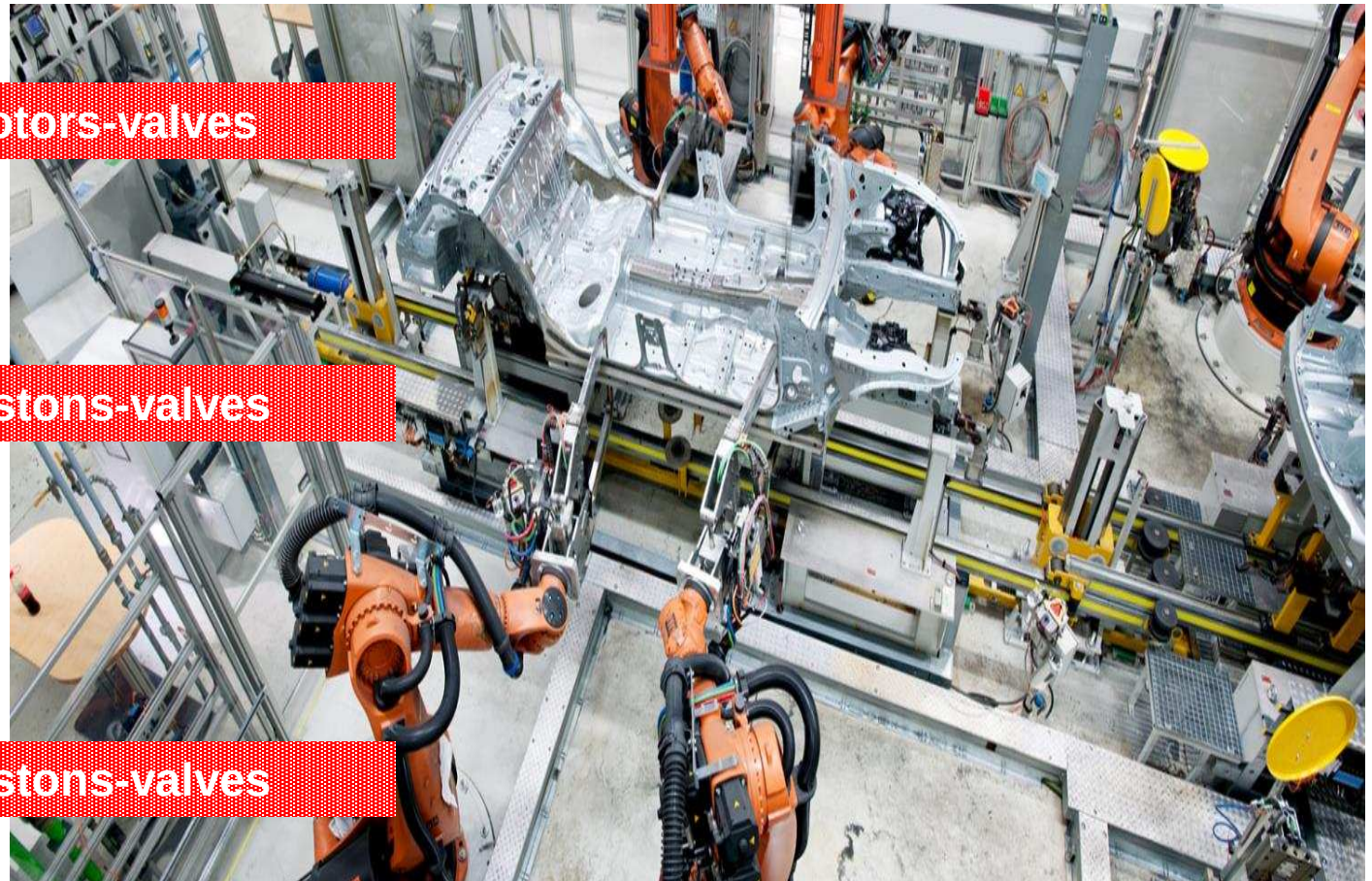
Hydraulic

Pistons-valves



Pneumatic

Pistons-valves



Smart Actuators (Motors)



Motor-fix speed



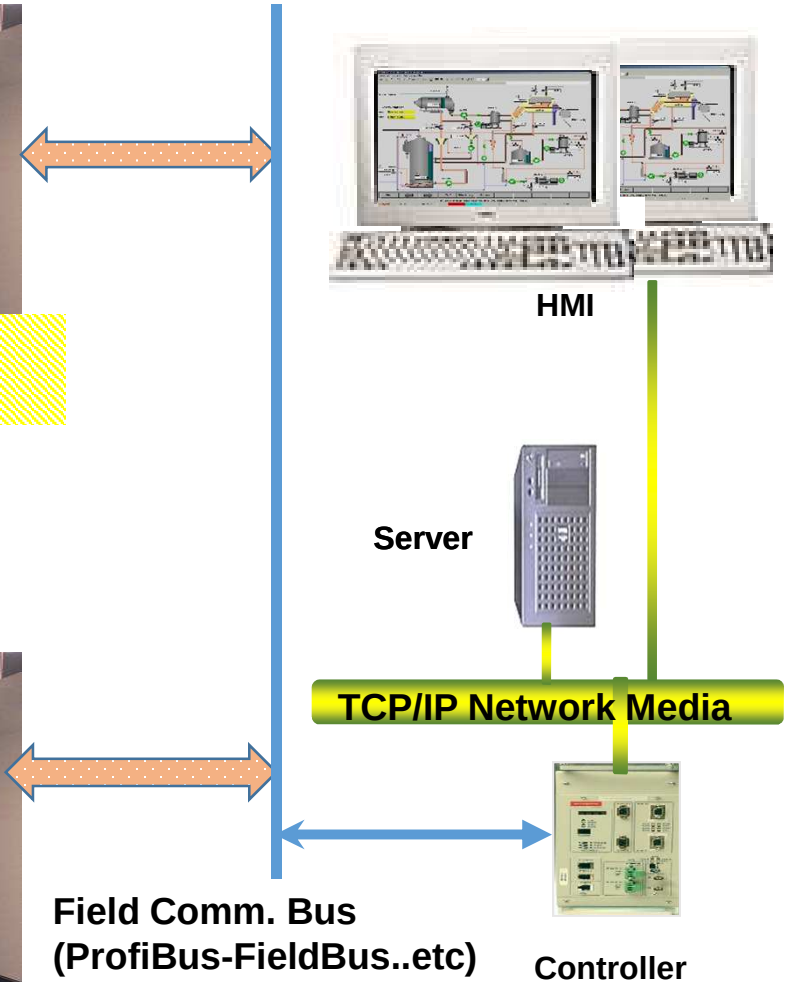
**Universal Motor starters
Star /Delta**



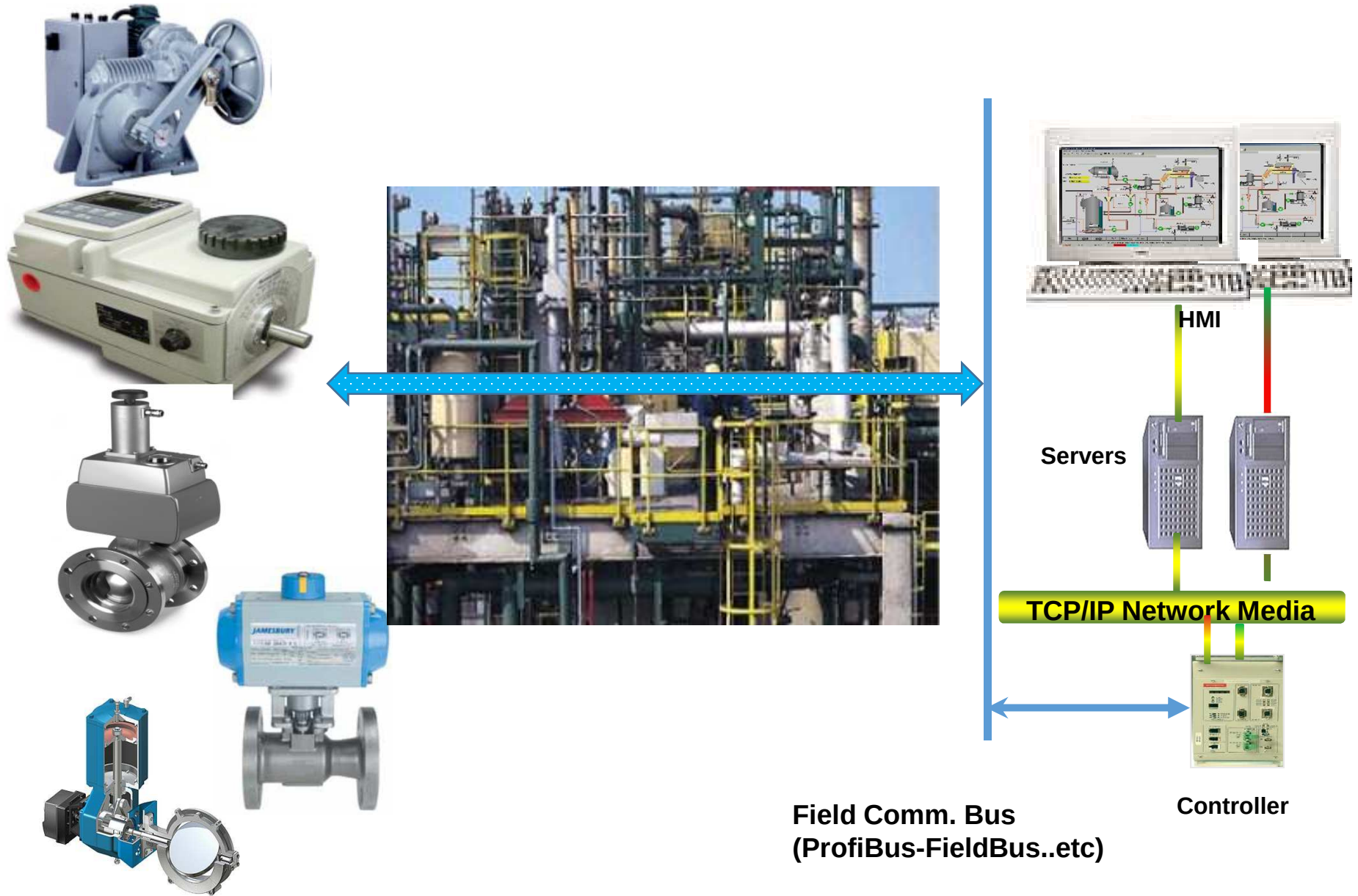
**Motor-variable speed
/soft starter**



**Frequency inverters-soft
starters**



Smart Actuators (Valves)



Which Smart Sensor /Actuator ?

Design Criterias based on plant :

- ❖ **Safety**
- ❖ **Performance**
- ❖ **Runnability**
- ❖ **Flexibility**
- ❖ **ROI (return of investment)**

Distributed Control Systems (DCS)

What is A DCS ?

**It is copy of a human ?
Some «YES» , some «NO»**



Distributed Control Systems (DCS)

What is «Distributed « Control

- ❖ Control the different process points/ area of the manufacturing plant , locating transmitters , actuators and interface units w/pre-determined control logics (algorithms) and computer media
- ❖ Distributed Control System is most popular which is specially designed with single or redundancy and diagnostic capabilities to improve control reliability and performance. It gives greater flexibility to control distributed discrete field devices and its operating stations

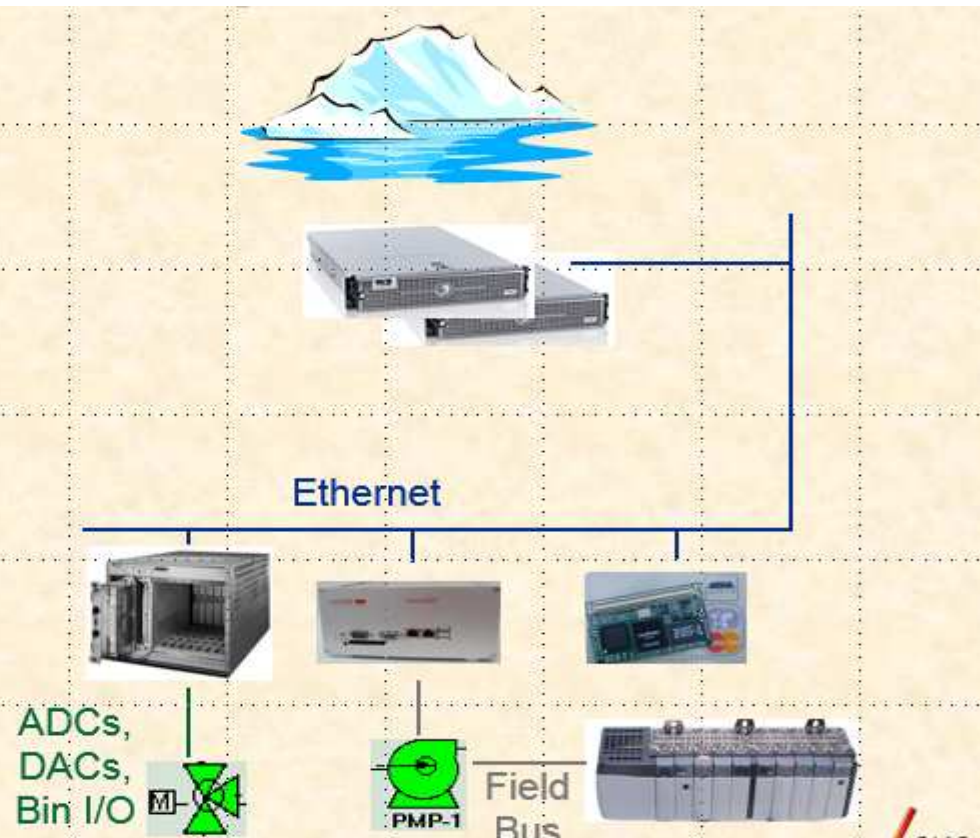
- ❖ • Workstations, operator interfaces.

- Data processing middle layer.

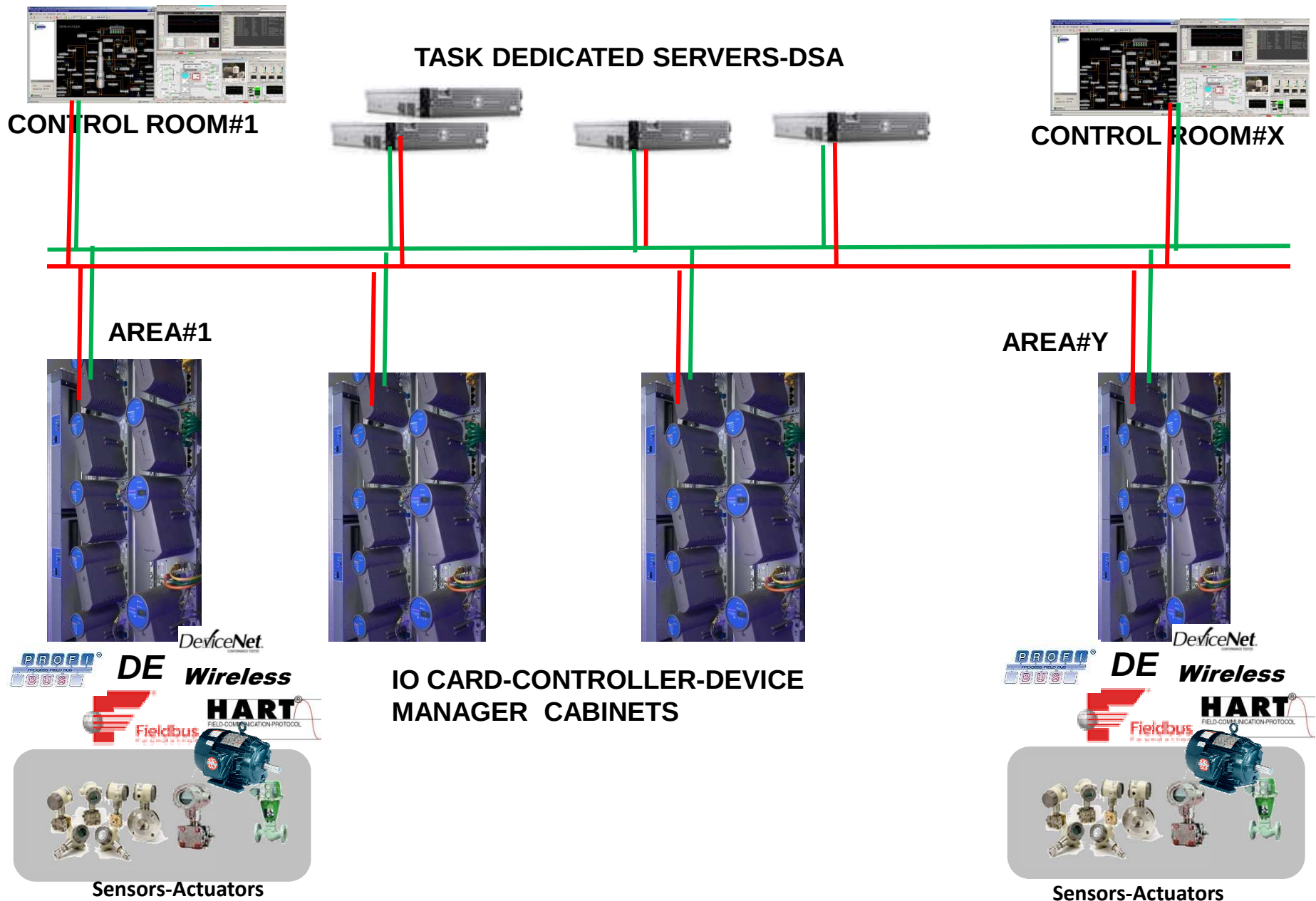
Front-end Computers

- I/O, PLCs, ...

- Plant



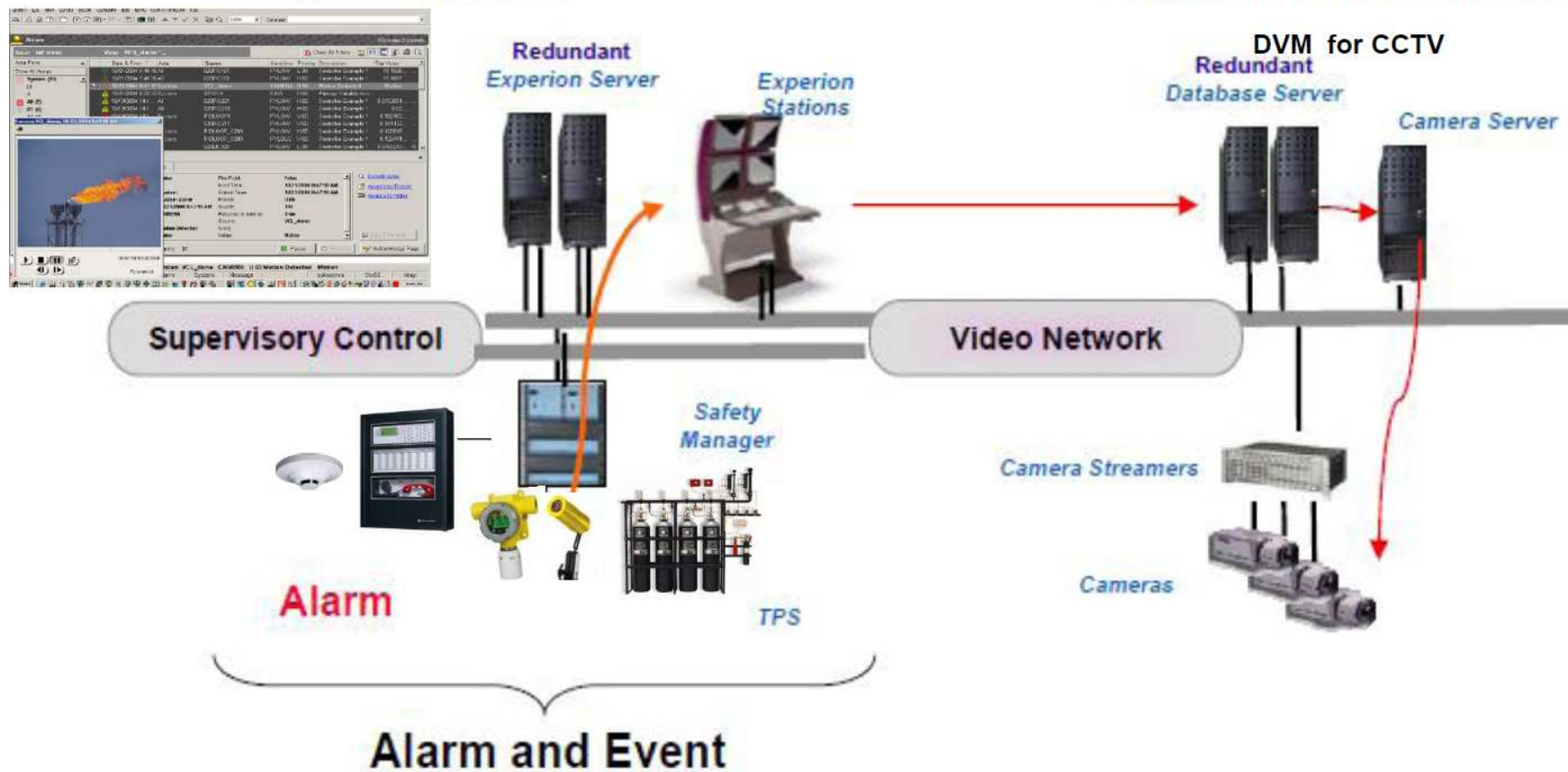
Distributed Control Systems (DCS)



Safety & Fail Safe Systems

Display Video of alarm related camera

Start recording of alarm related camera



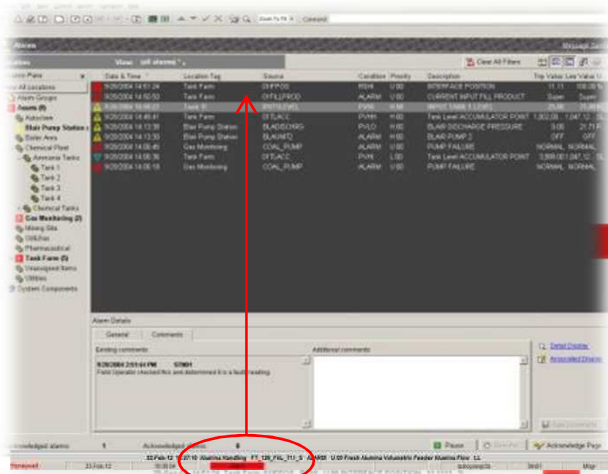
Safety & Fail Safe Systems

Process Monitoring Scenario

A Gas leak alarm is triggered

Associated PTZ Camera automatically turn to the preset alarm location

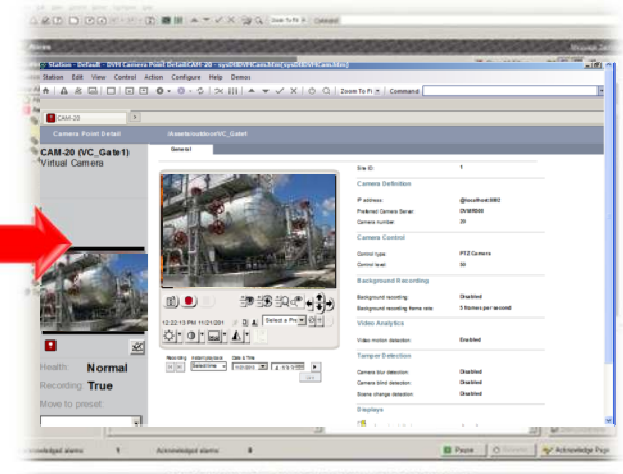
Operator Clicks on alarm to access camera page



Experion PKS Displays the Alarm



Automatic recording is started and includes the events before the alarm (pre-recording)



Alarm video displayed on dedicated station monitor

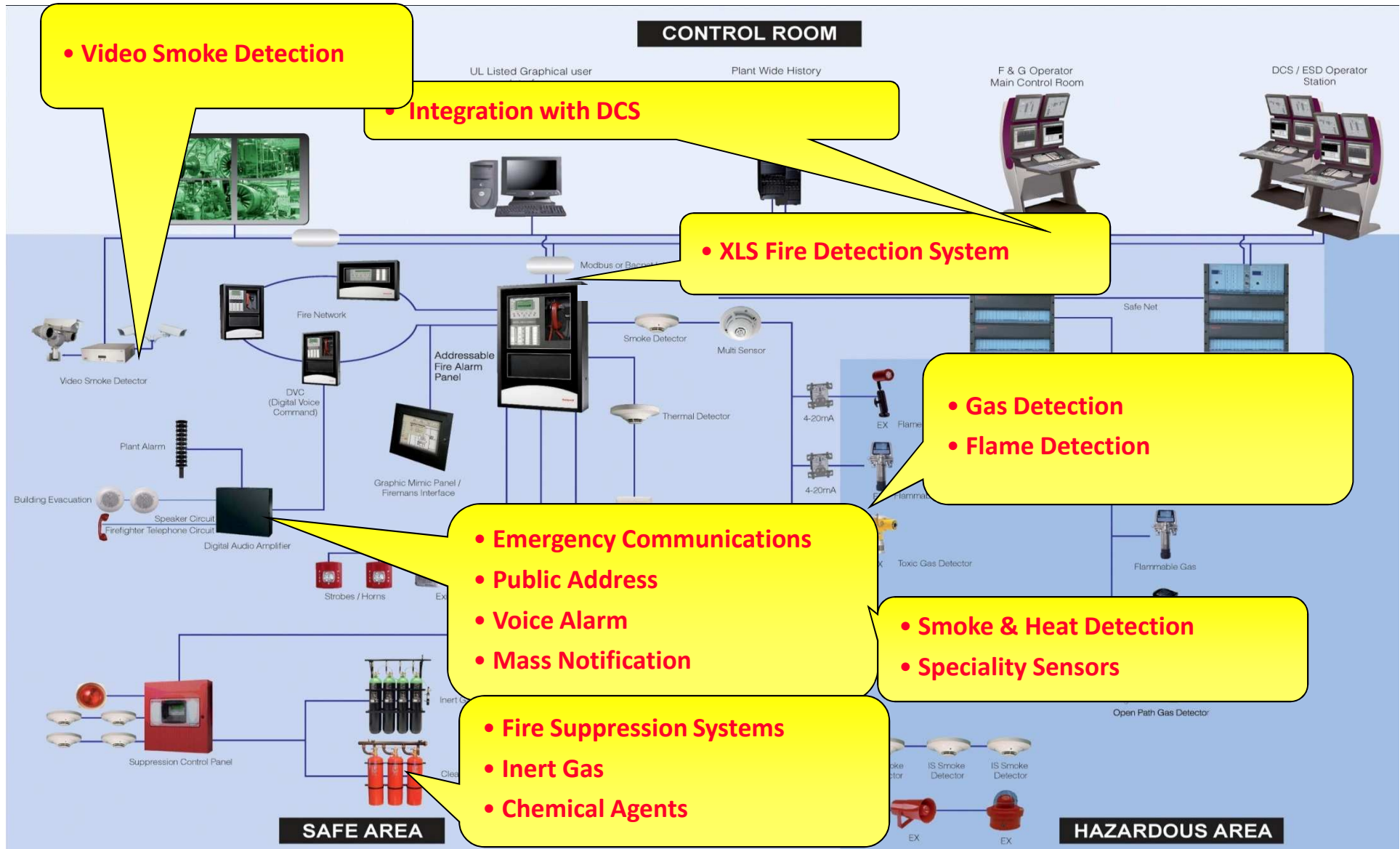


Safety & Fail Safe Systems

PLANT-WIDE SECURITY ARCHITECTURE



Safety & Fail Safe Systems



Safety & Fail Safe Systems

Industrial Security Devices

Intrusion Detection



Access Control



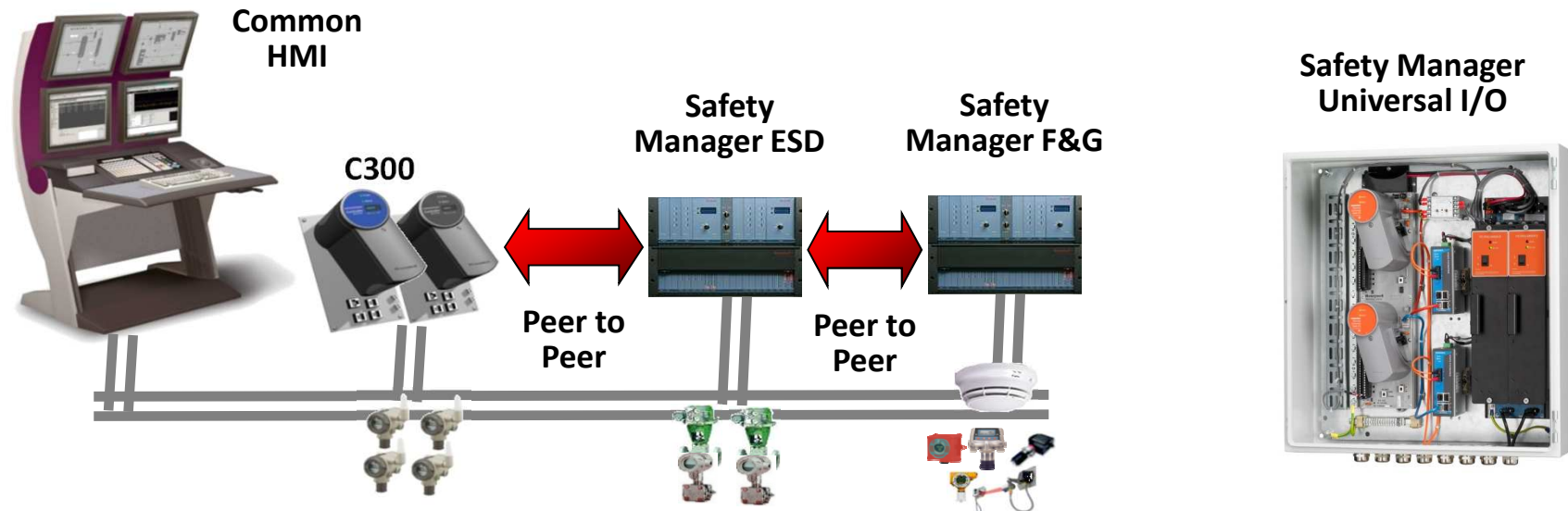
Radar Surveillance



Digital Video



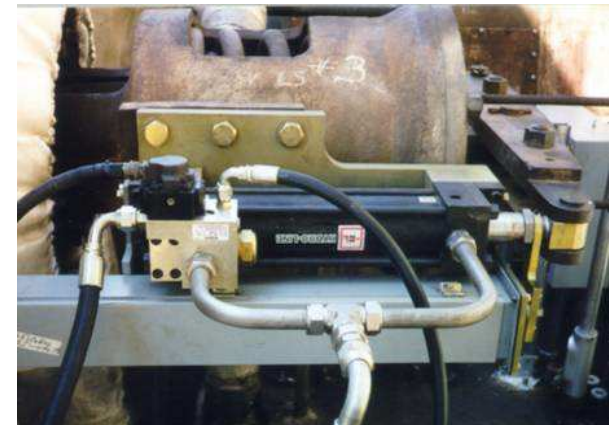
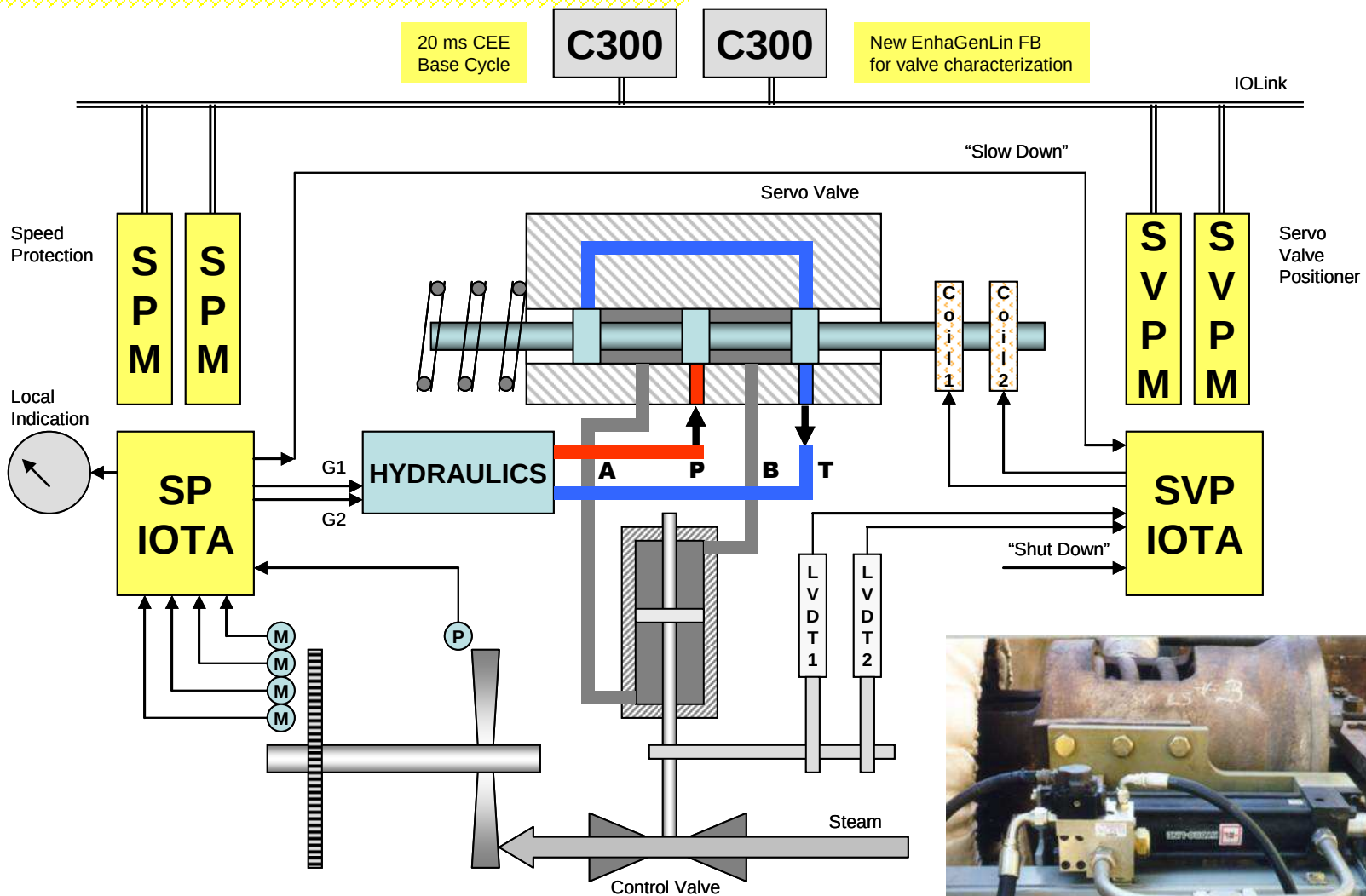
Fail Safe Systems



- **What is Safety Manager?**
 - TÜV approved Safety System (SIL1, 2 and 3)
 - Field of application: ESD, F&G, BMS, HIPPS, etc.
 - Supports redundancy for high availability (Safety and Process)

Fail Safe Systems

TURBINE FAIL SAFE CONTROL



DCS Computer Environmet-Key players

OEM HW & SW (DELL-HP-IBM-MS-ORACLE-VMWARE-McAfee....)

SINGLE /RED. SERVER



Intel Xeon or AMD Processor, raid-5
SATA hd, 3* 500GB, Memory 16...32
GB ,
2*Gigabit NIC , 1Gbit/sec,
MS Windows 2008, SQL, OPC,
Symantec, McAfee

BLADE SERVER



Up to 8 Intel Xeon or AMD Processor
;Memory up to 512 GB ; 4*Gigabit
NIC; PERC H200 Raid controllers
MSWindows 2008, SQL, OPC,
Symantec, McAfee

Network Switch



Up to 48 managable port,
Gbit/s, Cisco is the most
common preffered brand

HMI



**EBR-Back up/restore
unit**

DCS Computer Environment-Key players

DCS SUPPLIER ITSELF



AI-AO-DI-DO moved to one IO card

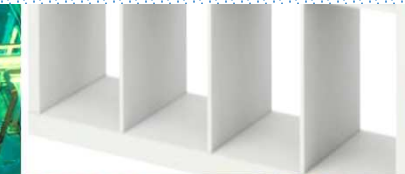
- AI-AO CARDS : 16 CH, 16 BIT RESOLUTION
it means 65236 point vs 4-20mA , 0...1A /15 microA
- DI-DO CARDS 32 CH



UNIVERSAL IO CARDS



CONTROLLER-DEVICE MANAGER



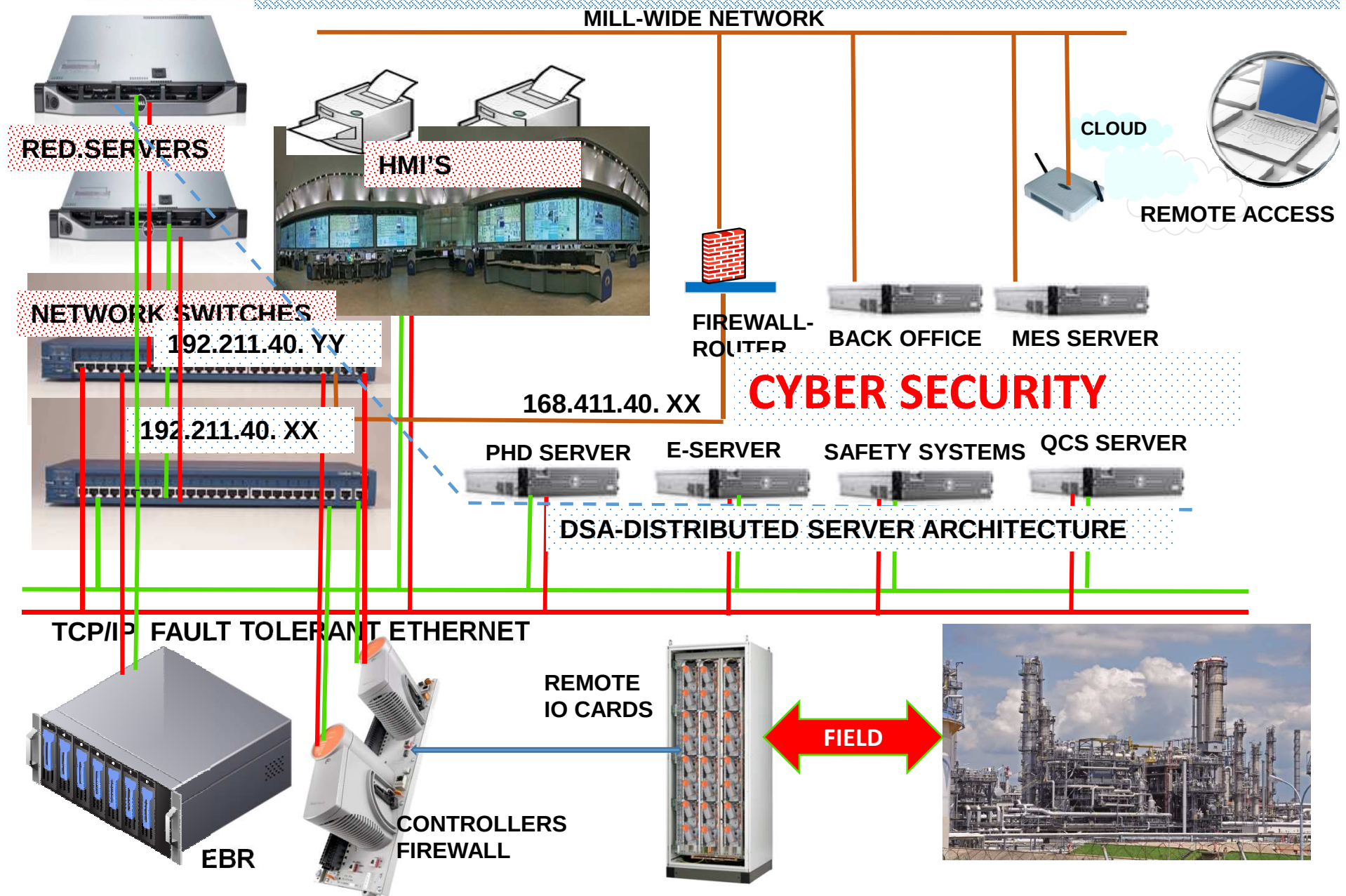
Purpose-Built IO's



FIELD INSTRUMENTS

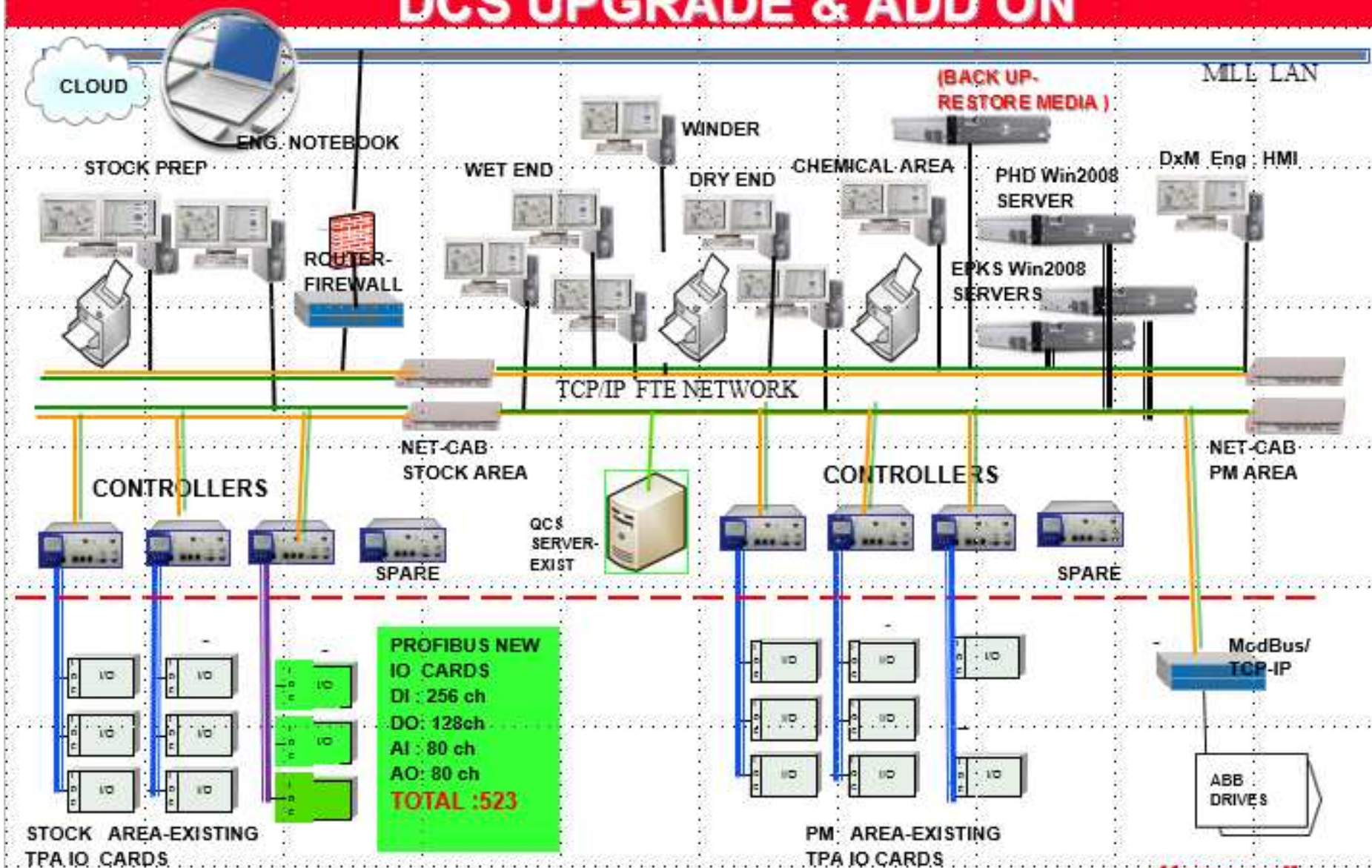
Multi-Purpose(Universal) IO

DCS Computer Environment-Networking



Distributed Control Systems (DCS)

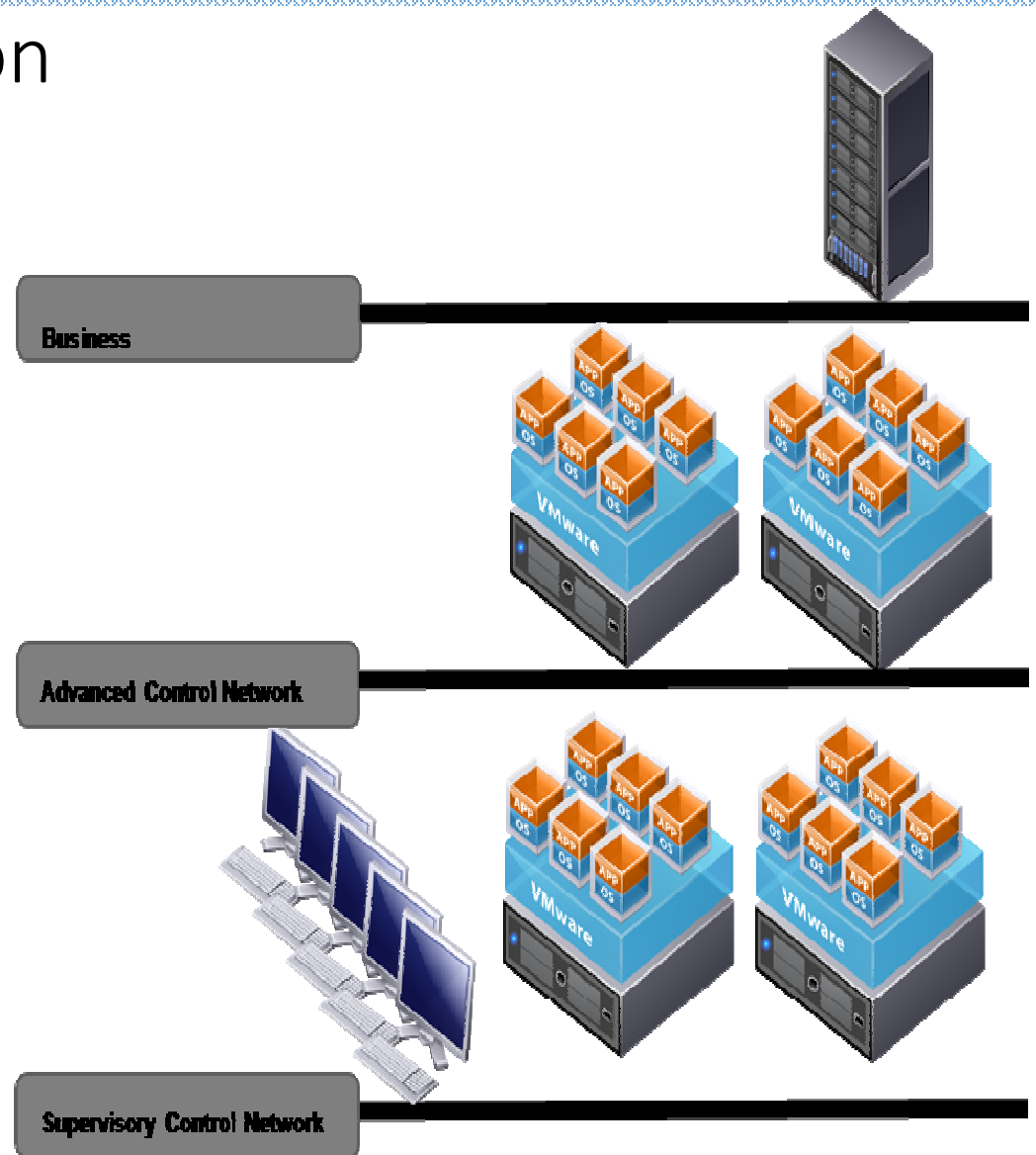
MODERN KARTON BM3, EPKS PMD R800 DCS UPGRADE & ADD ON



DCS Computer Environment-Virtualization

Applying Virtualization

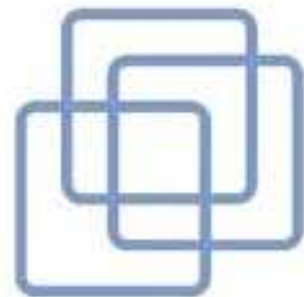
- Hardware/OS
 - Smaller number of Servers and operating systems.
- Server/Client Manageability
 - A virtual machine can run on any server
- Application Interoperability
 - Applications isolated
- Server/Client Agility
 - Rapid deployment



DCS Computer Environment-Virtualization

What is Platform Virtualization?

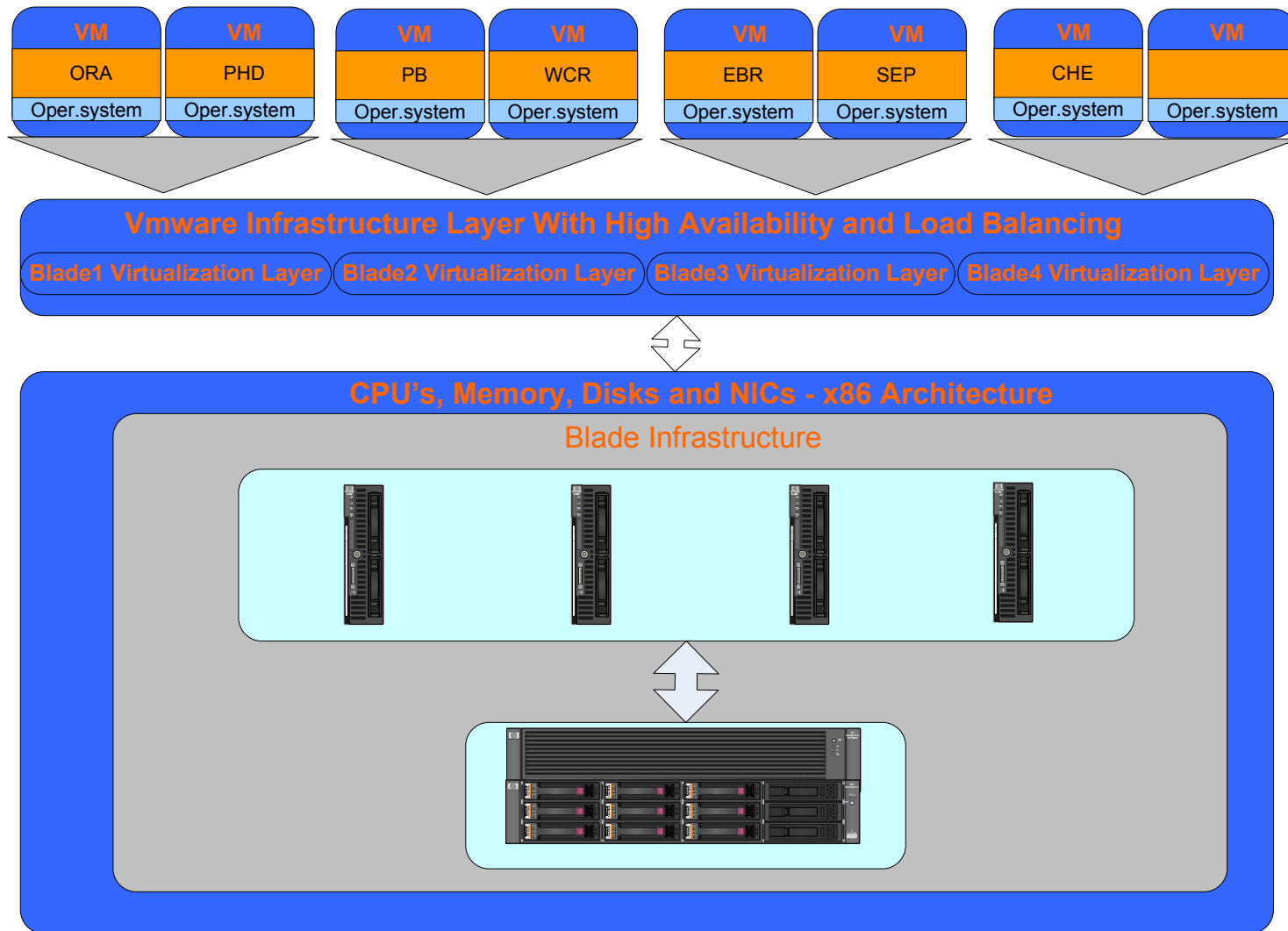
- Platform Virtualization is the **separation of the operating system from the hardware**
- It places a thin software layer called the Hypervisor between the operating system and the hardware
- This Hypervisor presents a complete x86 platform to one or more operating systems - these are called Virtual Machines.



vmware®

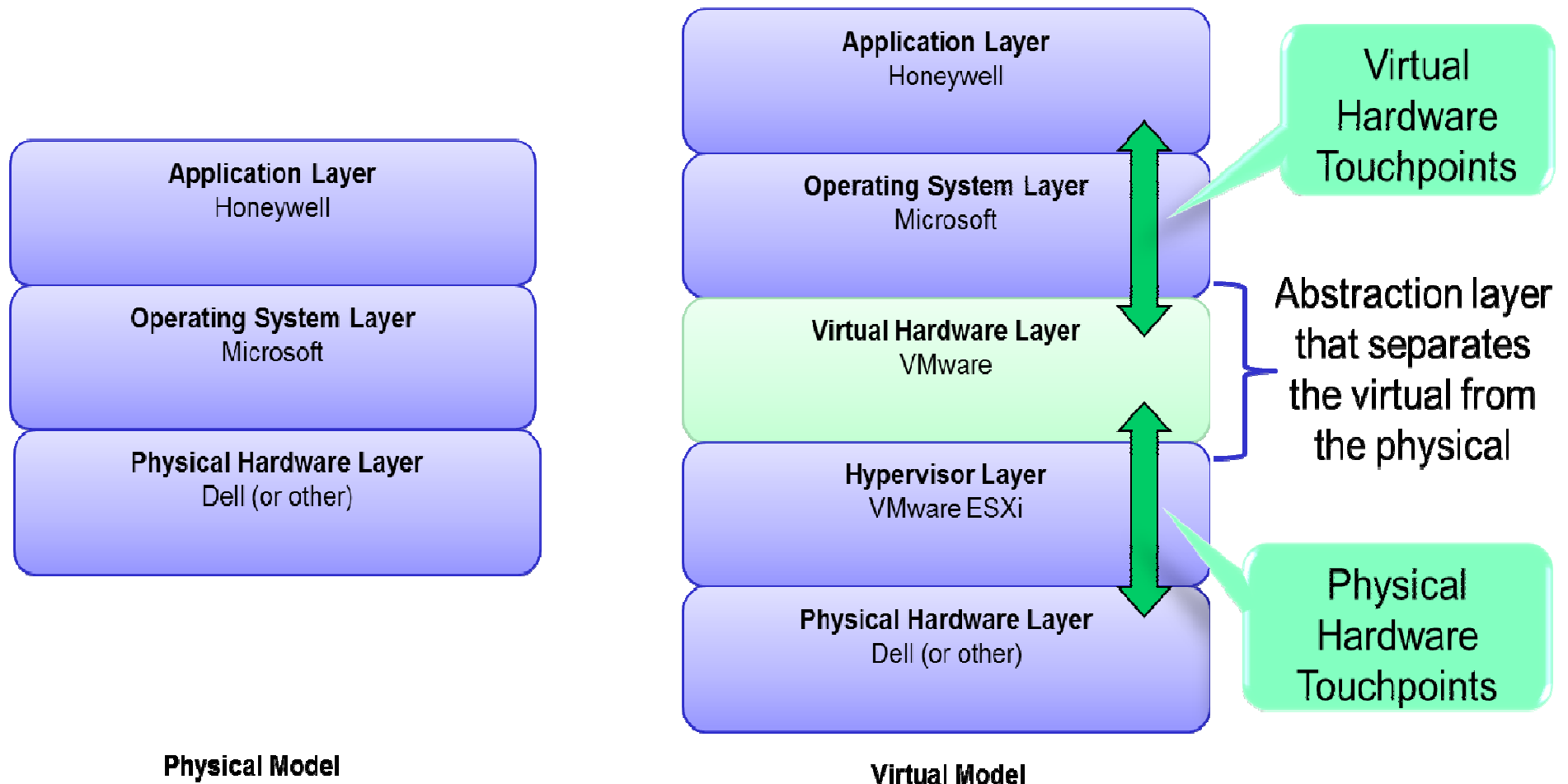
DCS Computer Environment-Virtualization

Architecture

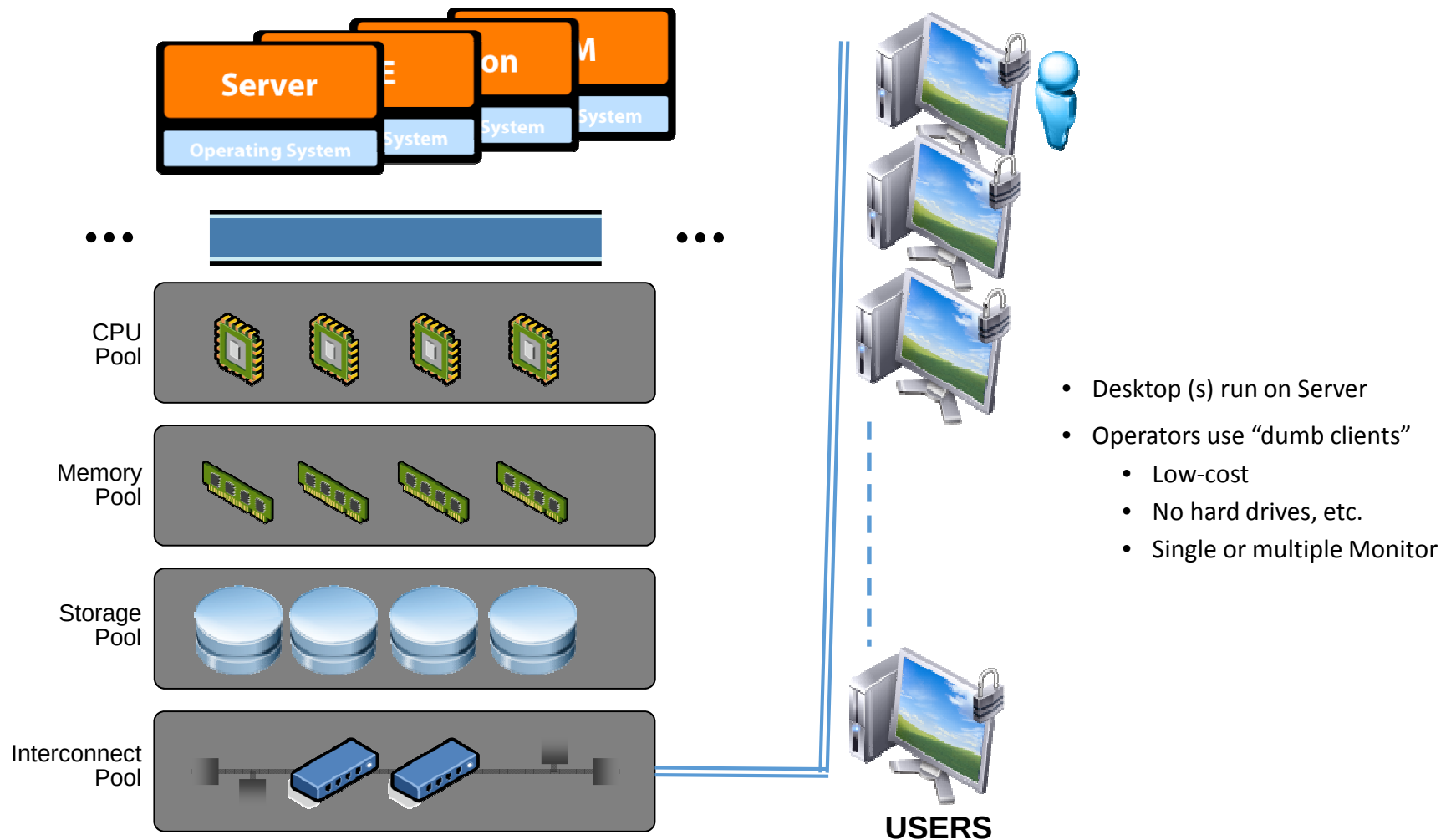


DCS Computer Environment-Virtualization

Virtualization Touch Points

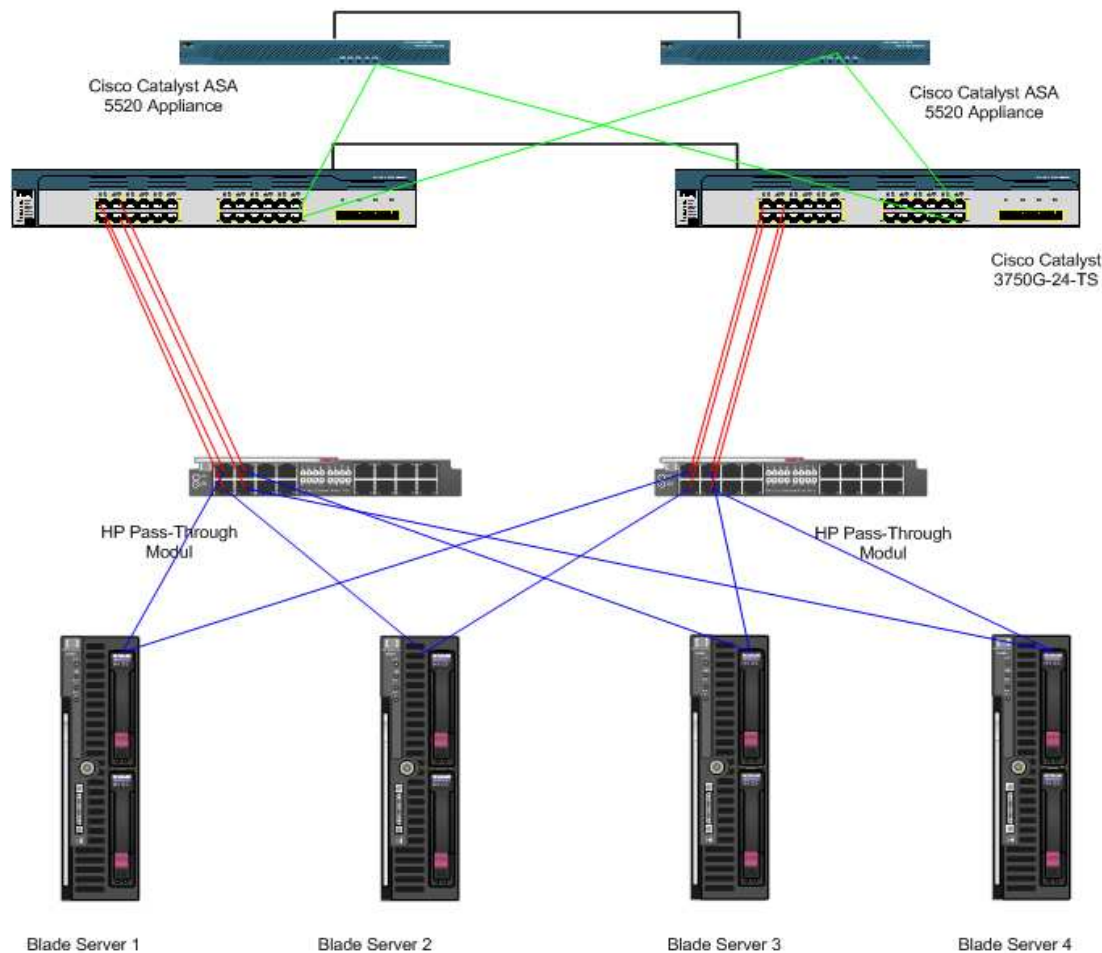


DCS Computer Environment-Virtualization



DCS Computer Environmet-Virtualization

ETHERNET CONNECTIONS



2 x Cisco
ASA 5520 Appliance

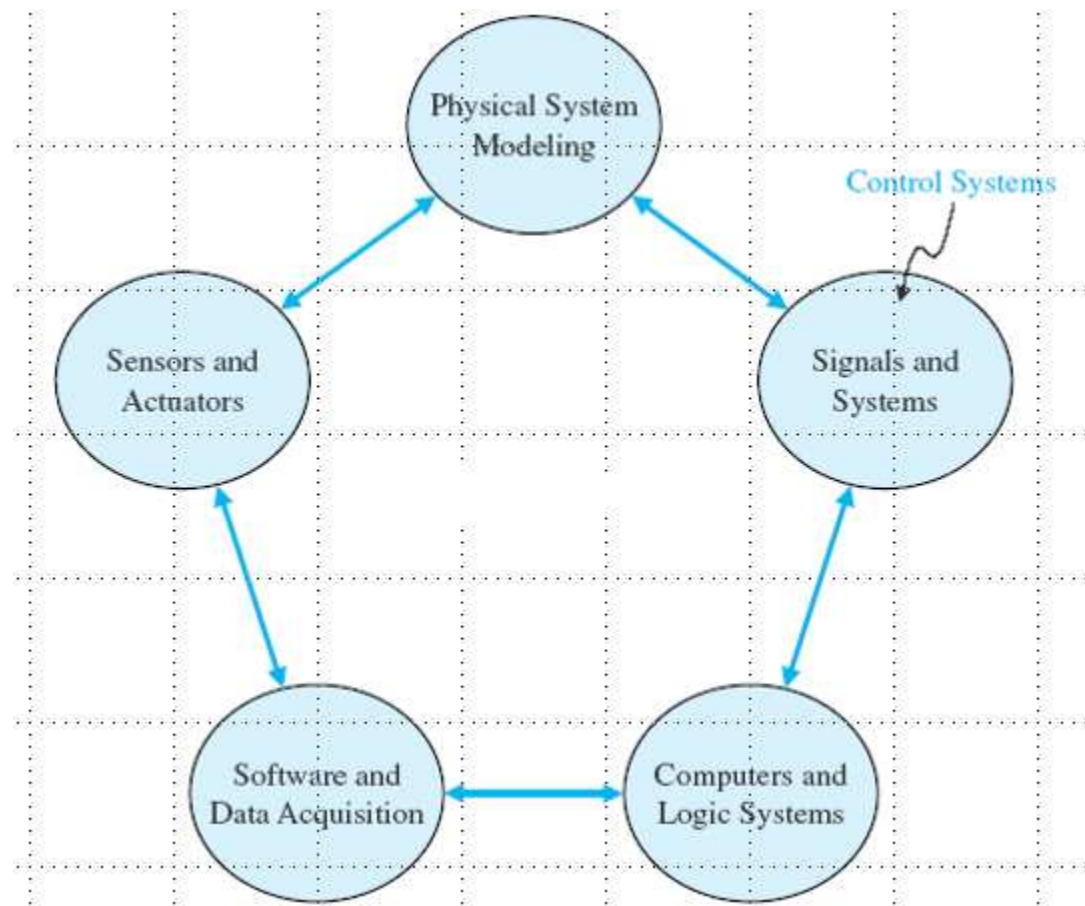
2 x Cisco
Catalyst 3750

HP 1/8 G2 Autoloader
Management server
HP DL380 G5

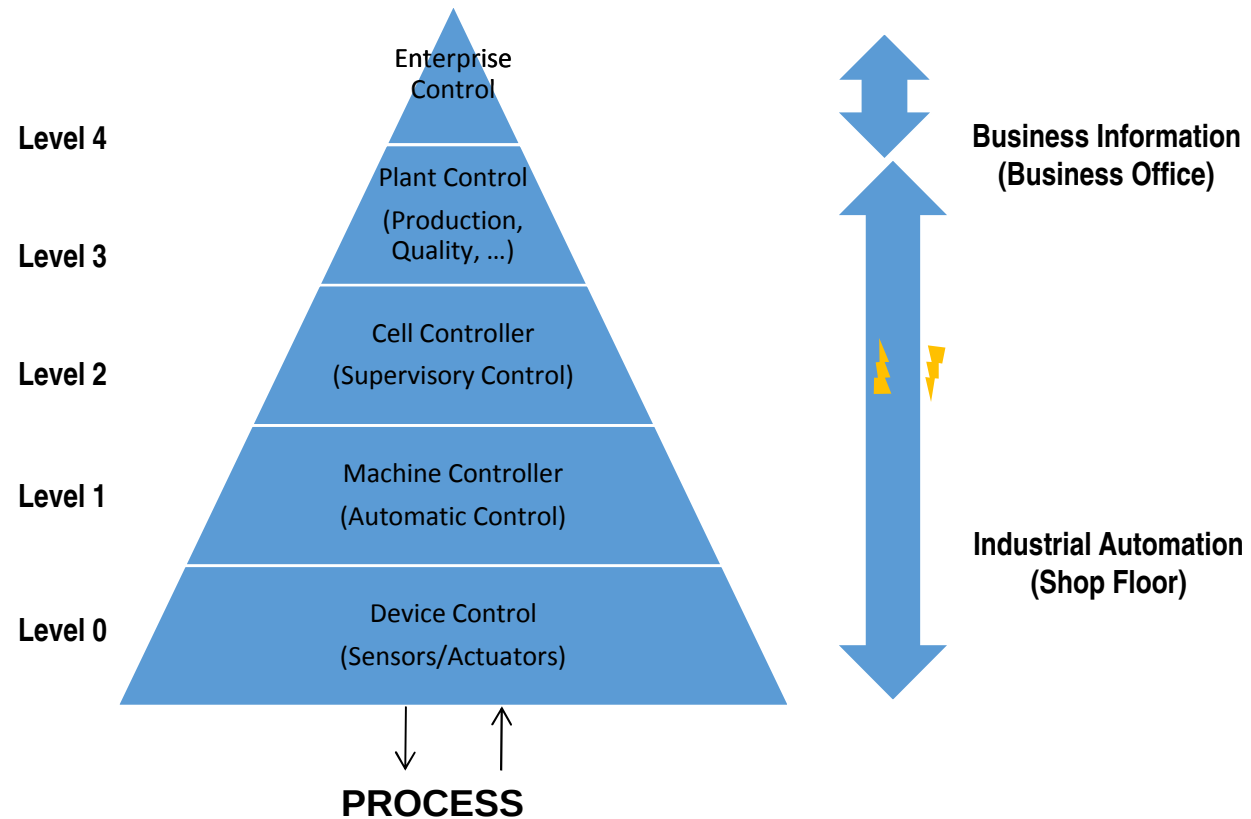
HP EVA 4400
Disk Enclosure
HP EVA 4400
Controllers

HP c7000 enclosure with
4 HP Blade servers HP
BL 460c

DCS Configuration



DCS Configuration



DCS Configuration



Starting initiatives

- **Understanding of the process, work closely with design engineer of process vendor**
- **Understand design intent, including steady-state flows, desired recoveries, conversions, etc.**
 - **Gain insight on potential process disturbances**
 - **Define key control objectives**
 - **Specify instrumentation placement**
 - **Instrumentation selection**
 - **Decouple interactions as much as possible**
 - **Control valve placement, piping layouts**
 - **Safety considerations, interlocks, sequences, group starts, emergency stops**
 - **Remember: always think about process control from the perspective of Chemical Engineering fundamentals**
- **Understand your process, as well as your control objectives**
 - **What needs to be controlled? Which variables effect each other (and how)? Where does variability hurt you most? Etc.**
- **Remember there's a dynamic component**
- **Think about control early in design phase.**

DCS Configuration

Implementing the Control Strategy

Once the control strategy framework has been laid out, *then* you get into the “nuts and bolts” of configuration.

- **Documentation**
- **Resource schedule**
- **Determining Control loop models** (Multivariable –Supervisory-Feedforward -Fuzzy Logic-Neural networks, group starts, emergency shutdown....etc)
- **Computer and peripherals**
- **HMI (operator) Displays**
- **Physical installation**
- **Cold and process run tests**
- **Start up**

DCS Configuration-Sensor /Act List

Position	Description	Manufacturer / Type	Additional information
Location			
HV1-2858	BALL VALVE		R1/2"
FIELD, TS		AISI 316	
GSV1-2858	DIRECTIONAL CONTROL VALVE	NUMATICS	1/2", 5/2, 1-coil, ISO 3
FIELD, TS		134BA4004044Q61	24 VDC, 2,7 W
GSV1.1-2858	PLUG-IN CONNECTOR	NUMATICS	Wide plug, led, vdr, 24 VDC, Pg 11
FIELD, TS		MPM-182-11-TC421	
FDV1-2858	QUICK RELEASE VALVE	NUMATICS	R 1/2"
FIELD, TS		SEV50C	
FCV1-2858	FLOW CONTROL VALVE, SILENCER	NUMATICS	R 1/2"

DCS Configuration -IO List

Position Nr.	Loop name	Type of signal	Scaling of analog signal	Status of binary signal
Signal tag number	- Signal name			
	MACHINE CONTROLS			
	PRE-DRYER GROUP			
2858	WEB CUTTING DEVICE			
HS1.1-2858	- PUSH BUTTON, CONTROL, WEB CUT, OFF-CUT	BI		1 = CUT, 0 = NO CONTROL
GSV1.14-2858	- DIRECTIONAL VALVE, WEB CUT TS, ON	BO		1 = ON, 0 = NO CONTROL
GSV2.14-2858	- DIRECTIONAL VALVE, WEB CUT DS, ON	BO		1 = ON, 0 = NO CONTROL
	SIZER			
2901	HYDRAULIC UNIT			
GS1-2901	- LIMIT SWITCH, PRESS. PUMP 1 SUCT. VALVE, OPEN	BI		1 = OPEN, 0 = NO CONTROL
GS2-2901	- LIMIT SWITCH, PRESS. PUMP 2 SUCT. VALVE, OPEN	BI		1 = OPEN, 0 = NO CONTROL
GS3-2901	- LIMIT SWITCH, COOL. PUMP SUCT. VALVE, OPEN	BI		1 = OPEN, 0 = NO CONTROL
LT1-2901	- OIL LEVEL TRANSMITTER, OIL LEVEL	AI	0...900 mm = 4...20 mA	
TT1-2901	- OIL TEMPERATURE TRANSMITTER, OIL TEMPERATURE	AI	0...100 °C = 4...20 mA	
PT1-2901	- PRESSURE TRANSMITTER, OIL SUPPLY PRESSURE	AI	0...160 bar = 4...20 mA	

DCS Configuration-Applications

LOGIC DESCRIPTIONS

2. Functional Description

according to functional diagram (@Template_Template MERI/R_ reject/ _XE01_ Compax CFX-R)

2.1. Start-Sequence:

- automatic start hydraulic

With the active signal GST at the GCON function block input the group start is set. With the active signal GSP at the GCON function block input the group stop is set. Only one of these signals can be active at the same time and GSP has priority over GST.

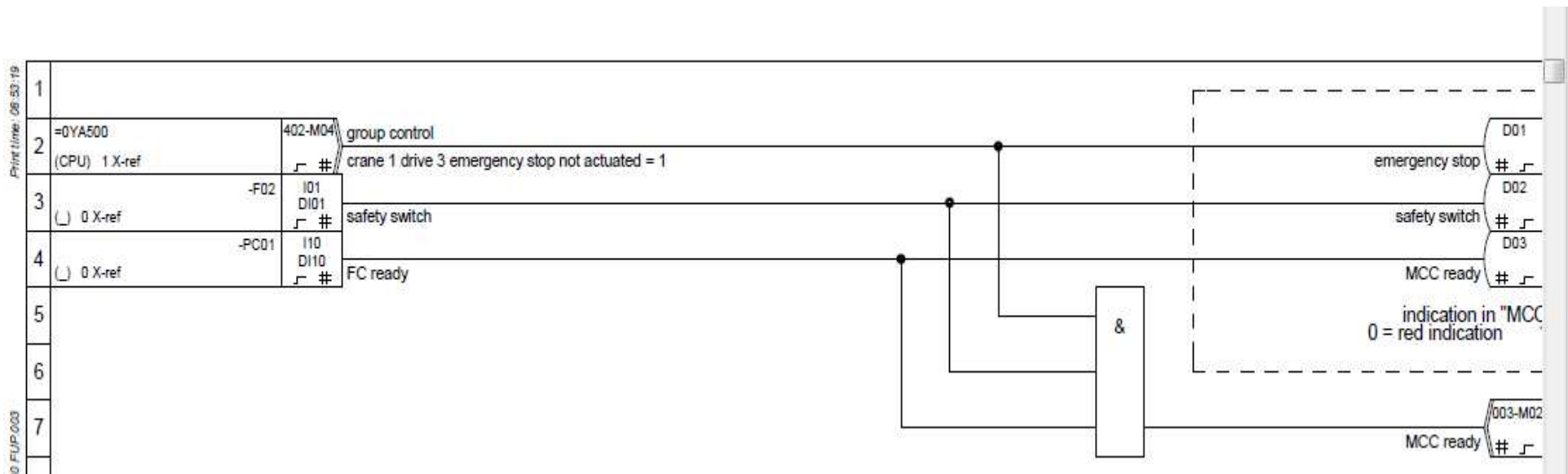
The group can only stop if GSP is active, which set the GCON output ON inactive, and with an inactive GCON input signal STOP, which sets the GCON output OFF active.

The hydraulic motor starts in automatic with the active signal ON ("auto start") at the GCON output, if the input signal RUN at the GCON function block is active as start condition (e.g. belt after the machine).

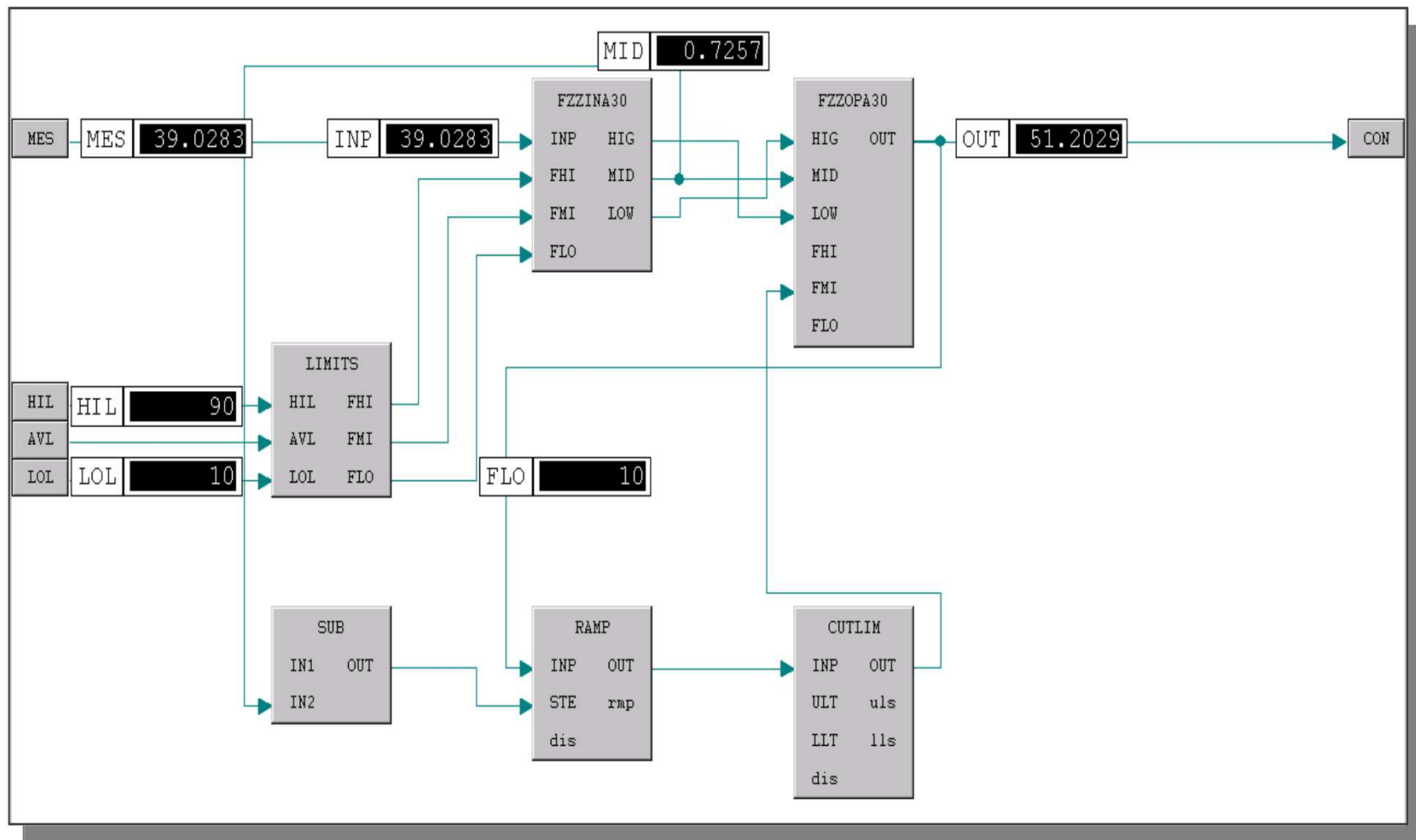
If the input signal RUN at the GCON function block is inactive at any time, the GCON output signal ON is inactive and the GCON output signal OFF is active. In this case the motor stops independent of the GST/GSP signal.

DCS Configuration-Applications

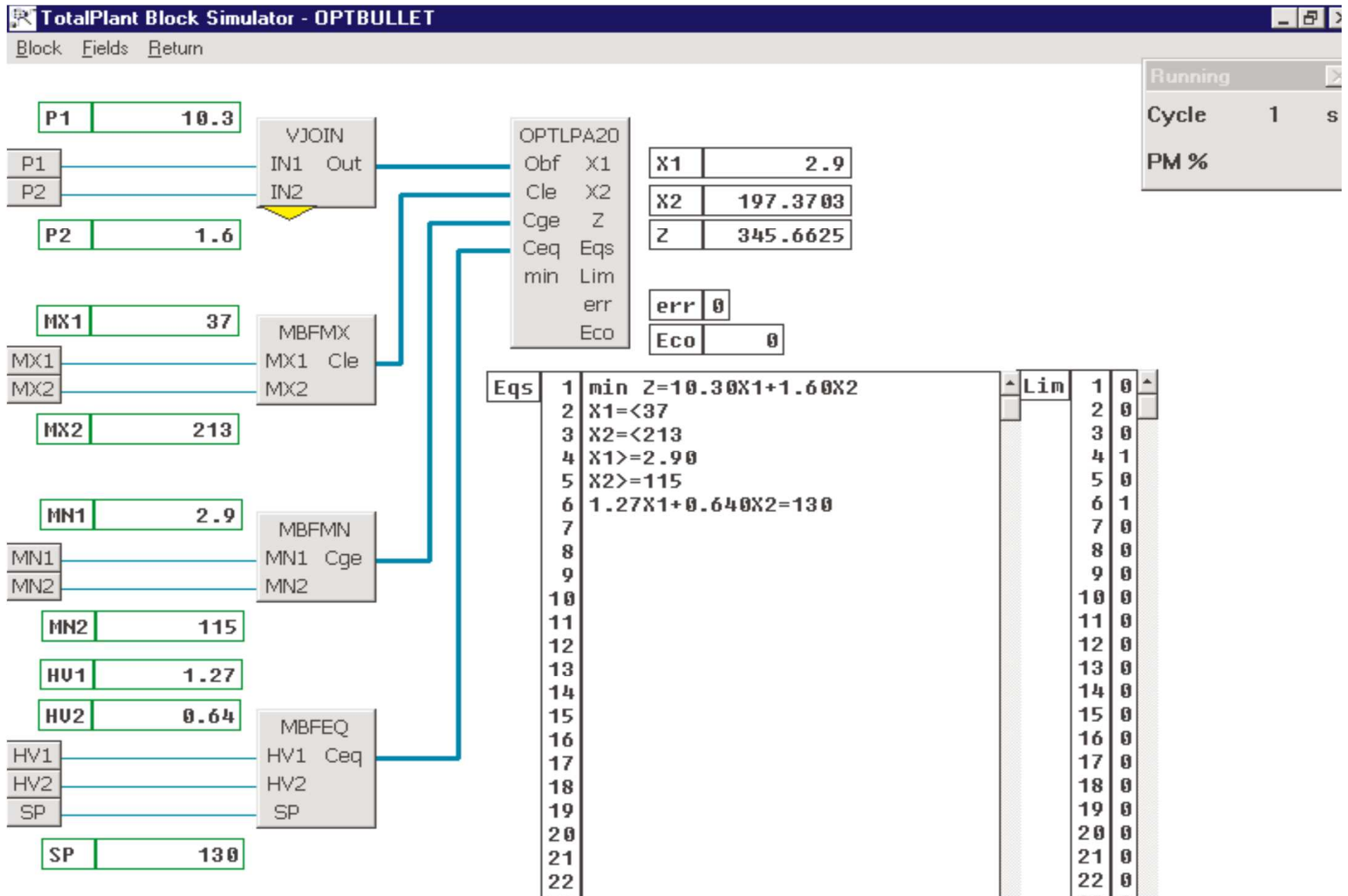
LOGIC DIAGRAMS



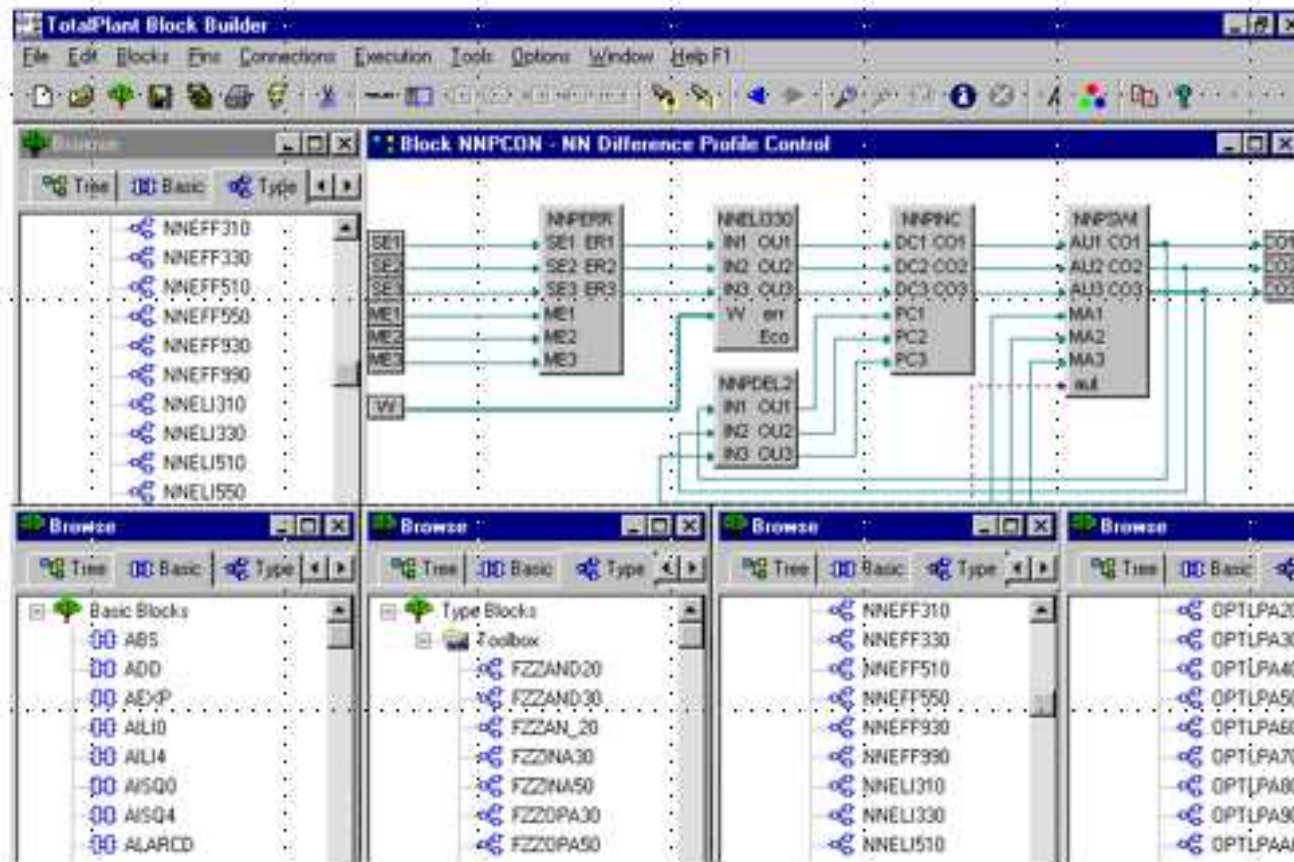
DCS Configuration-Applications



DCS Configuration-Applications



DCS Configuration-Applications



Generic block builder to engineer all controls using different block libraries.

Honeywell-Measurex develops new libraries according to user needs and in consistency with installed systems.

System basic blocks

Fuzzy logic toolbox

Neural net toolbox

Optimisation toolbox

Statistical process control toolbox

DCS Configuration-Applications

Open System Environment

C & Pascal
Programming languages

OLE
Object Linking & Embedding

ODBC
Open Data Base History Server

OPC
OLE for Proces Control

ActiveX
Display object embedding

Fieldbus
LON, Interbus

Excel or Matlab
Data Connectivity

Windows
GUS User Interface

TCP/IP
Open Mill Information Network

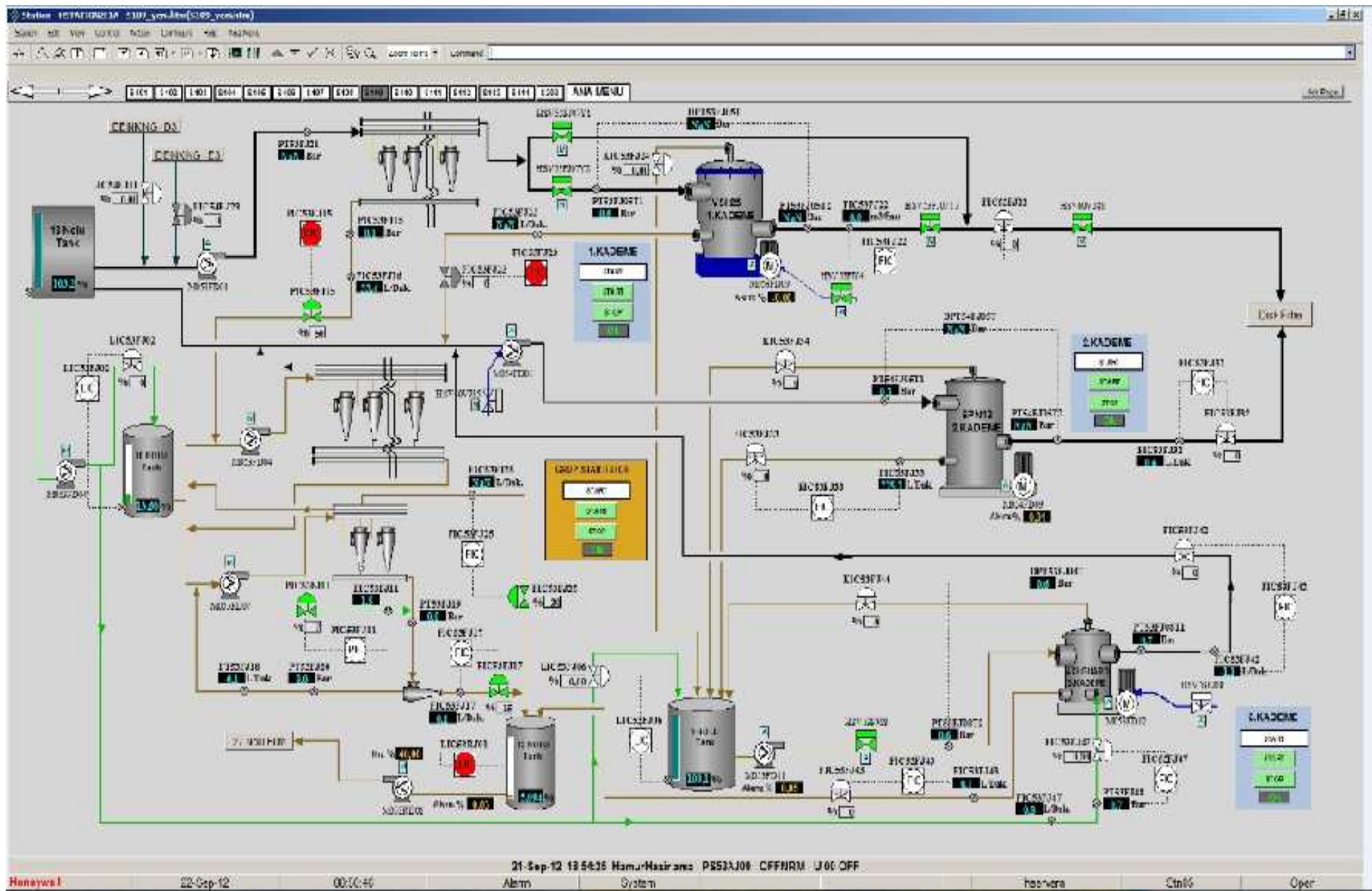
ExperTune & TuneUP
Tuning Tools

ELINA, ALMA, AIM
External Database Integration

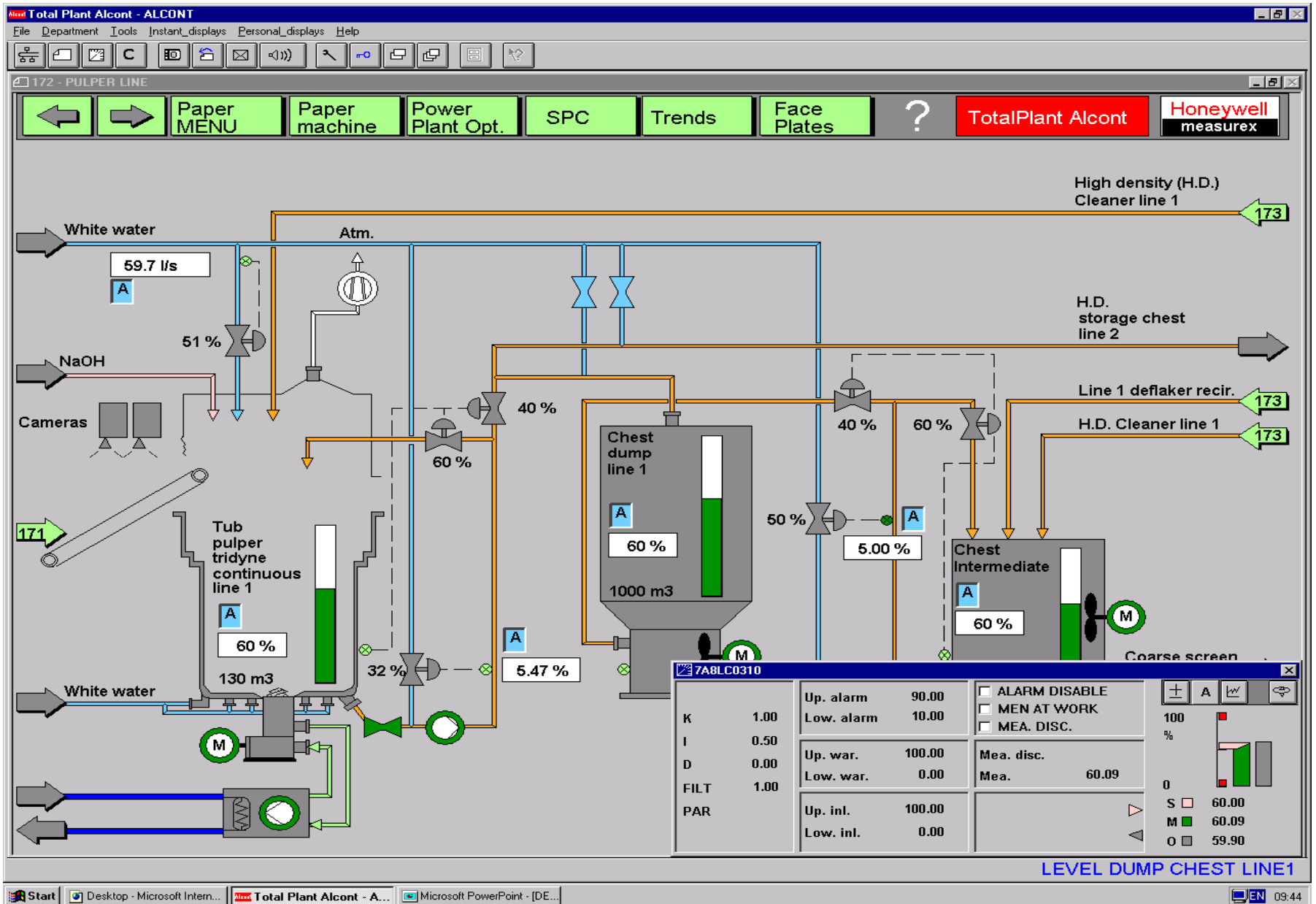
- Allows consistent use of all information generated
- Integrates process, production & millwide information

GRIM SIGHTS

DCS Configuration-Applications



DCS Configuration-Applications



DCS Configuration-Applications

GUS Operator Station; Alarm Management

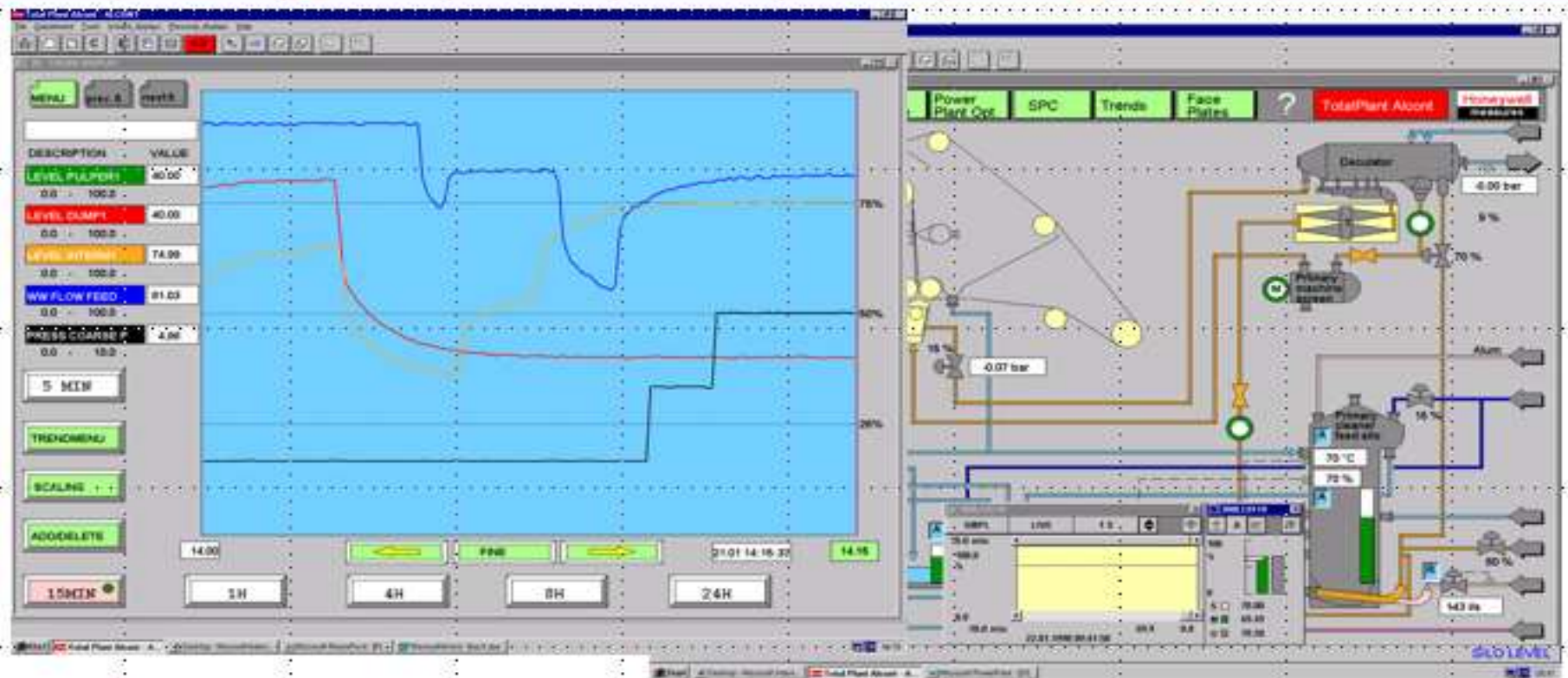
The screenshot displays the GUS Operator Station interface for Alarm Management. The left pane shows a process diagram of 'LINE 1' with various units like conveyors, storage, and a desolting station. The right pane is an 'Alarms' window with a table of active alarms. A dialog box at the bottom right asks to 'CLEAR THE CONVEYOR MR4' with an 'OK' button.

Time	Category	Alarm Description	Action
00:00:00.00	LOGA	STORE TANK LEVEL	
00:16:30.00	GENERAL	Lower limit alarm	
00:00:00.00	FK300	DILUTION WATER FLOW	
00:16:30.00	GENERAL	Alarm/analytys	
00:00:00.00	UC310	DILUTION WATER LEVEL	
00:16:42.00	GENERAL	Lower limit alarm	
00:00:00.00	CONTROL2	CONTROL LOOP INTERLOCK	
00:16:47.00	PAPER	LOWER LIMIT ALARM	
00:00:00.00	SABFAST	REFINER ADD GROUP START	
00:28:00.00	CAUSTIC	Sequence started	
00:00:00.00	000P001	CP DILUTION GROUP START	
00:22:36.30	PAPER	Sequence started	
00:00:00.00	GROUPRUN		
04:42:29.40	GENERAL	JAM ALARM	

- Single button access to all Process and Maintenance Alarms
- Guides the operator for effective alarm management
- (?)=User-programmable expert guidance

DCS Configuration-Applications

GUS Operator Station; Trend Displays



- Process trends provide an immediate picture of process stability
- Groups of trends and individual faceplate trends can be viewed together
- Provides trend information for any selected loop

QUESTIONS ?



THANK YOU TAKING YOUR TIME TO ATTEND !