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A Seminar on

Distributed Control System

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Contents:

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Automation Overview

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- Automation is one of the rising fields and it has become the backbone of the process and manufacturing industries.

- Industrial automation has taken a giant step to control industrial machineries and industrial processes by replacing human operator.

- In recent days device used for automation is PLC (Programmable Logic Controller) and DCS (Distributed control system).

Tools of Automation

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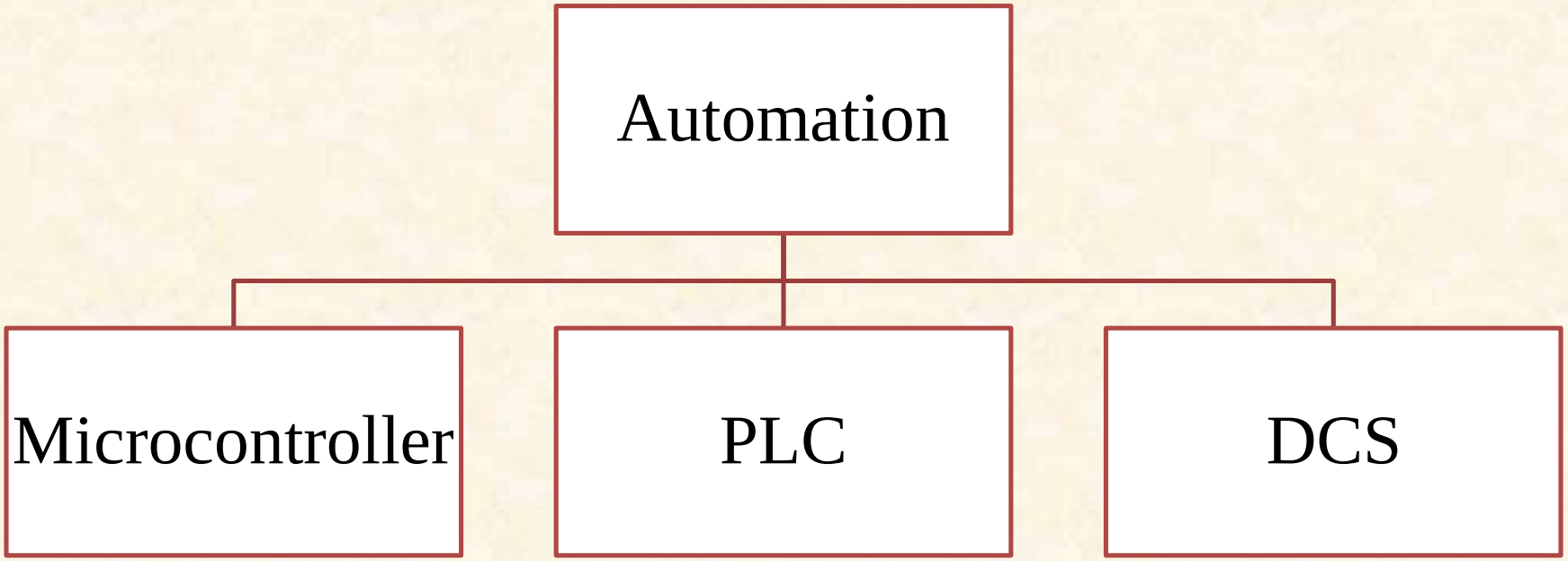

Microcontroller

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- Microcontroller based automation is applied for small applications.
- Example vending machine is one of the microcontroller based application.
- commonly used microcontrollers are ATMEL 89C51,PHILIPS 89V51 etc.
- Microcontroller preferred when application is low cost, small in size.

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Programmable Logic Controller

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- A Programmable Logic Controller is a digital electronic device that uses a programmable memory to store instructions and to implement specific functions such as logic, sequencing, timing, counting, and arithmetic to control machines and processes.
- PLC were develop to replace relay based control.
- It is used for automation of small plants.
- It is used for application containing digital I/O and limited analog.

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PLC Manufacturers

- Allen Bradley
- ABB
- Mitsubishi
- Messung
- Siemens
- Omron
- GE-fanuc

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Types of Control Architecture

- Centralized
- Decentralized

Centralized Control Architecture

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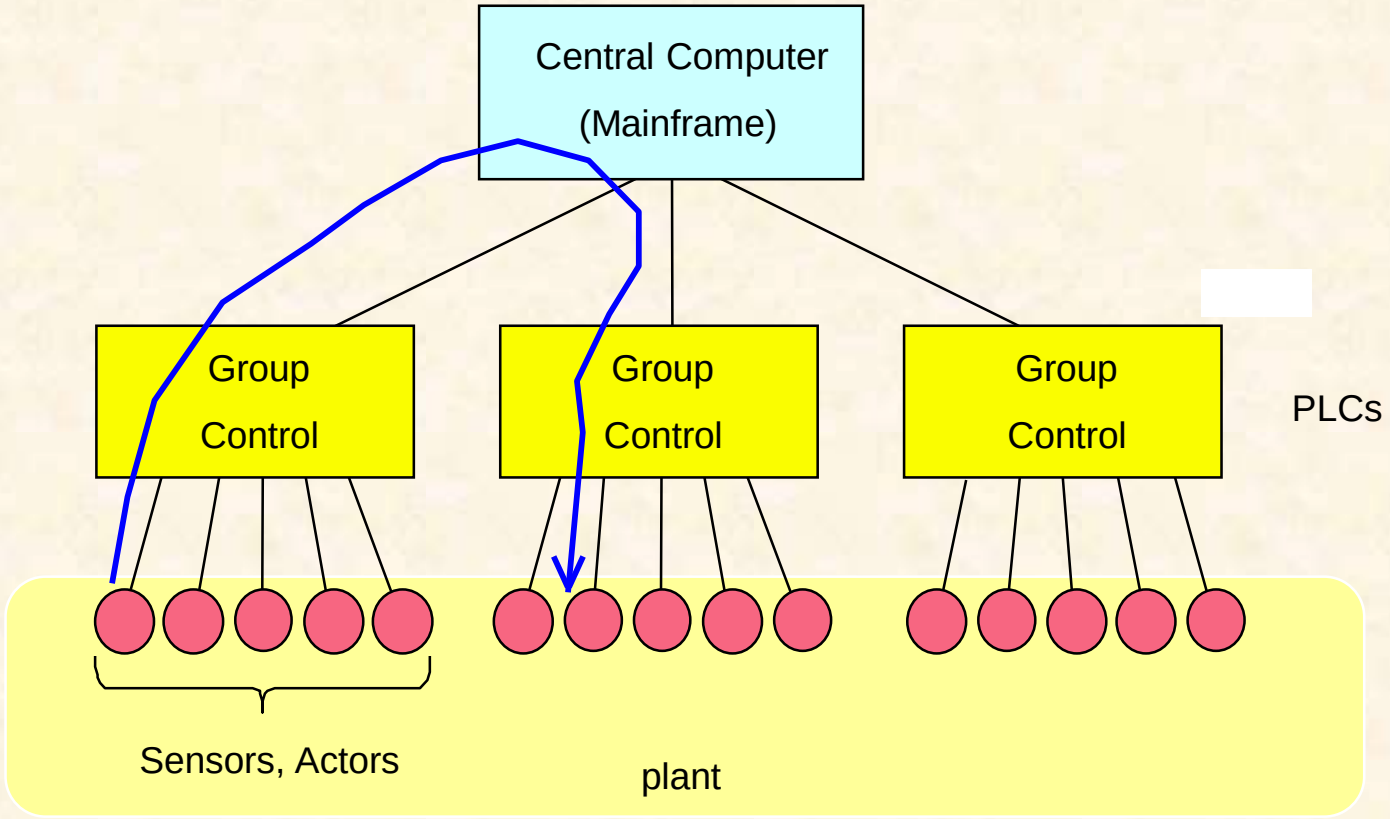

- Classical, hierarchical, centralized architecture.
- The central computer only monitors and forwards commands to the PLCs

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Decentralized Control System (DCS)

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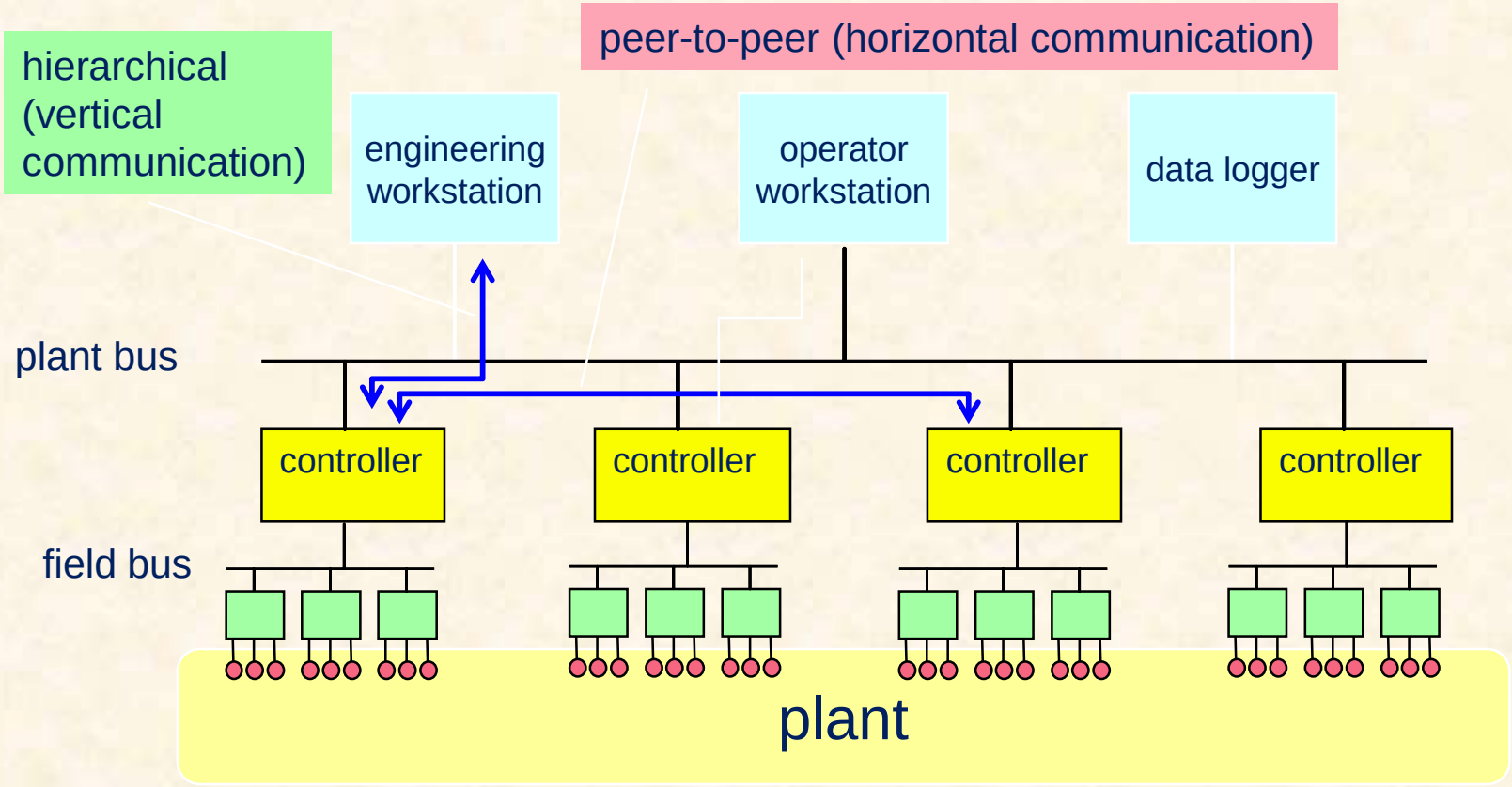

• All controllers can communicate as peers (without going through a central master), restricted only by throughput and modularity considerations.

Centralized and Decentralized

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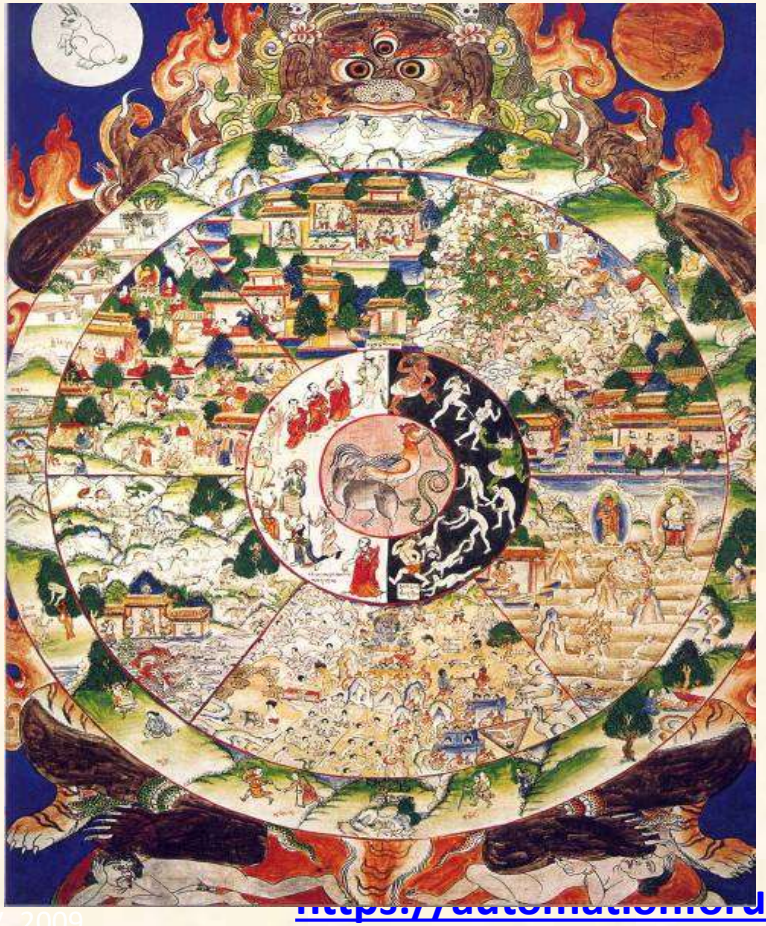
Centralized(simple)

Decentralized(Complex)



Distributed Control System (DCS)

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- Distributed Control System refers to a control system usually of a manufacturing System, process in which the controller elements are not central in location but are distributed throughout the system with each component sub-system controlled by one or more controllers.

DCS-History

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- DCS was introduced in 1975 by:
  - » Honeywell-TDC 2000
  - » Yokogawa – Centum
- Today Centum is Having around 14,000 installations around the world.
- Advances in centum: CS1000 and CS3000
- Advances in Honeywell: TDC-3000, TPS & at present **EPKS**

DCS Available in Market

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- Yokogawa-Centum CS3000
- Emerson-Delta V
- Siemens
- Bailey
- Foxboro
- Fisher-Rosemount
- Honeywell-EPKS

DCS-Concept

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- ✓ It distributes information and control functions that previously required central computer.
- ✓ A DCS typically uses computer(usually custom designed processor) as a controller and proprietary interconnection and protocols for communication.
- ✓ It is not concentrated in a specific geographic location or around a single center computer.

DCS General Architecture

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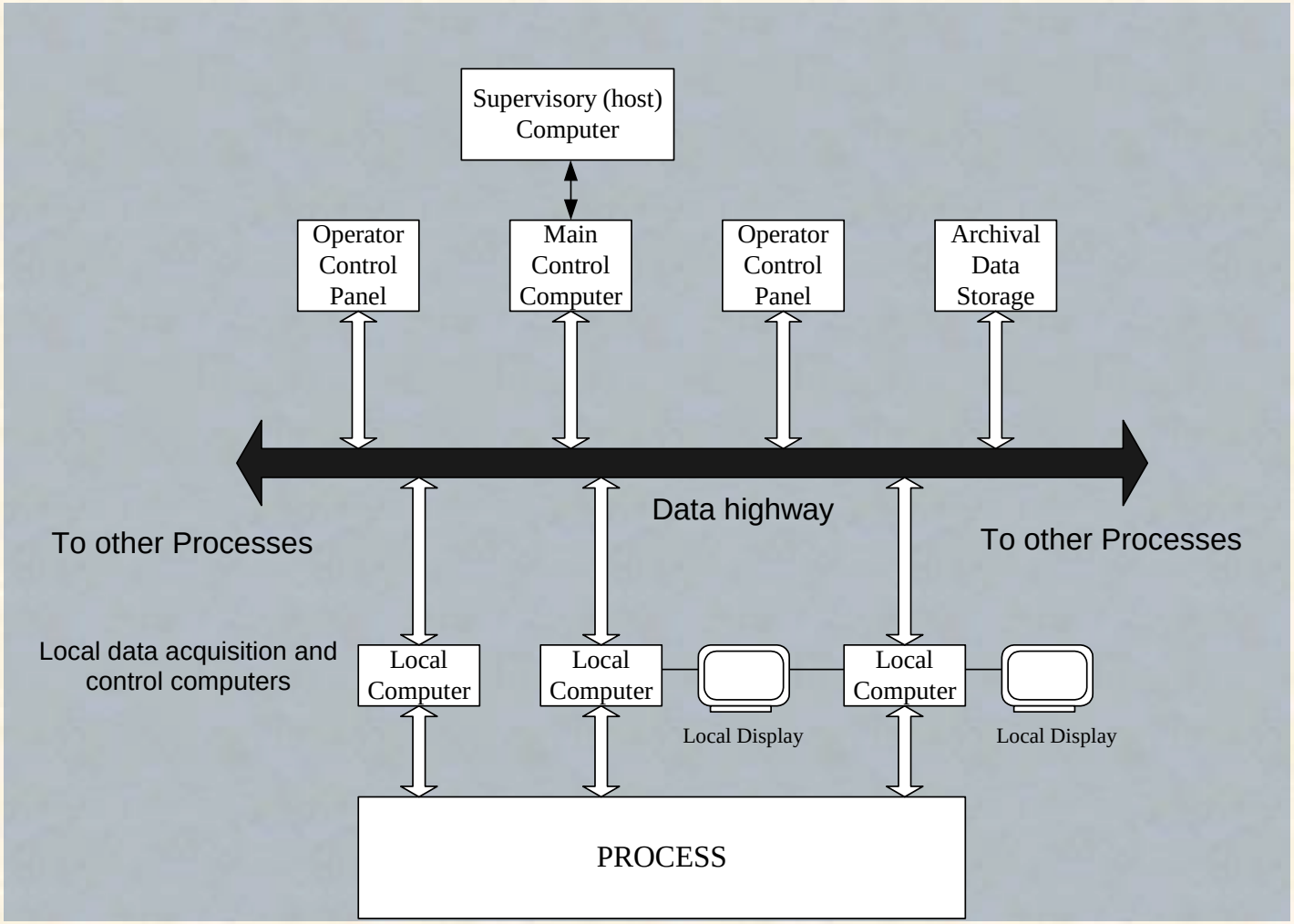

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DCS Elements

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- **Data Acquisition Unit**: Digital (discrete) and analog I/O can be handle.
- **Batch Sequencing Unit**: This unit controls a timing counters, arbitrary function generators, and internal logic.
- **Local Display**: This device provides analog display stations, and video display for readout.
- **Bulk Memory Unit**: This unit is used to store and recall process data.

DCS Elements

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- **General Purpose Computer** : This unit is programmed by a customer or third party to perform optimization, advance control, expert system, etc
- **Central Operator Display**: This unit typically contain several consoles for operator communication with the system, and multiple video color graphics display units
- **Data Highway** : A serial digital data transmission link connecting all other components in the system. It allow for redundant data highway to reduce the risk of data loss
- **Local area Network** *(LAN)*

Advantages of DCS:

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- Access a large amount of current information from the data highway.
- Monitoring trends of past process conditions.
- Readily install new on-line measurements together with local computers.
- Alternate quickly among standard control strategies and readjust controller parameters in software.
- A sight full engineer can use the flexibility of the framework to implement his latest controller design ideas on the host computer.

PLC V/S DCS

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Sr. No.	Functions and Features	PLC	DCS
1	System Design	designed for mainly digital I/O control.	designed for mainly analog I/O control.
2	Redundancy	required to be engineered.	in built
3	Control Algorithms	Engineered	Built in Configurable Complex Algorithms
4	PID Function Blocks	Limited Loops with limited functionality	Multiple loops with enhanced functionality
5	Self tuning Supported	No	Yes
6	Software Signal Filters	Not Supported	Supported
7	Discrete logic Execution	Fast(10-100ms)	Slow(250ms-1sec)

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PLC V/S DCS

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8	Networking	Engineered Networking as per requirement	Normally all Components tightly Integrated on the network
9	Modularity	Modular	Less Modular
10	Distribution Of Functionality	Limited	Distributed architecture.
11	I/O variety	Large Collection of I/O	Limited Variety
12	Ruggedness & Reliability of hardware	Rugged and reliable	Relatively lower reliability and ruggedness
13	Third party Connectivity	yes	Limited

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Introducing Experion Process Knowledge System

- Experion PKS is sophisticated management and control application that:
- Displays system data in manner that you can easily understand.
- Allows you to control your system by sending appropriate commands.
- Automatically performs schedule tasks.
- Notifies you of system activities, including alarms and system events.
- Produces comprehensive report.

Simplified Experion PKS

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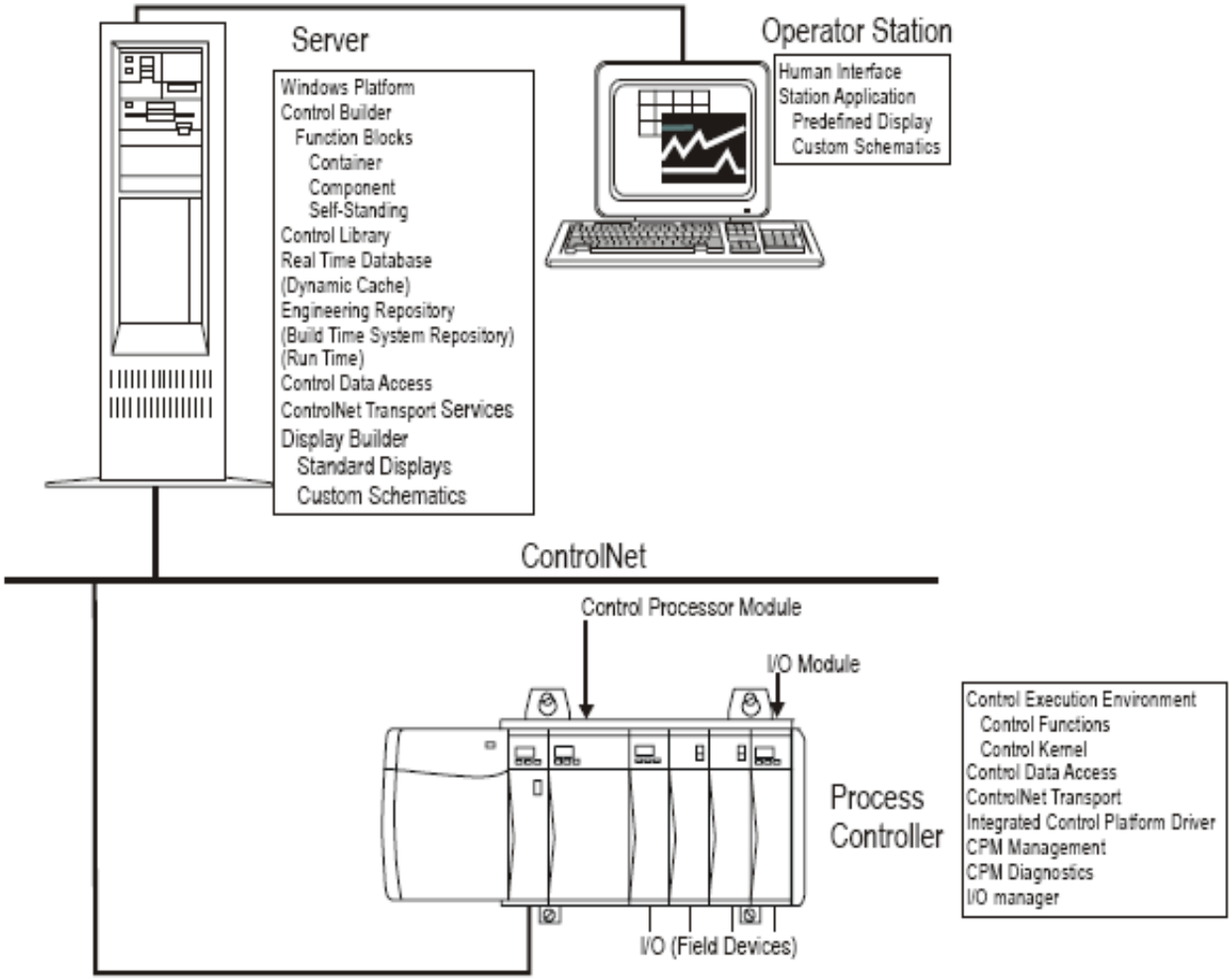

Basics

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- Is well suited for both small and large system.
- It provide power and flexibility required to handle the full spectrum of process control applications.
- It interfaces with foundation Fieldbus, Profibus, DeviceNet, HART, LON, ControlNet and interbus.
- Robustness, security, compliance, control, safety and reliability are plant-wide.

Features

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- Sophisticated human-machine interface.
- Tightly integrated database, engineering tools, and control applications.
- Open deterministic, high-speed control network communication system for predictable and repeatable control linking servers, controllers, and remote I/O.
- A configurable Control Execution Environment(CEE) provides deterministic, consistent, and reliable control application execution.

Architecture

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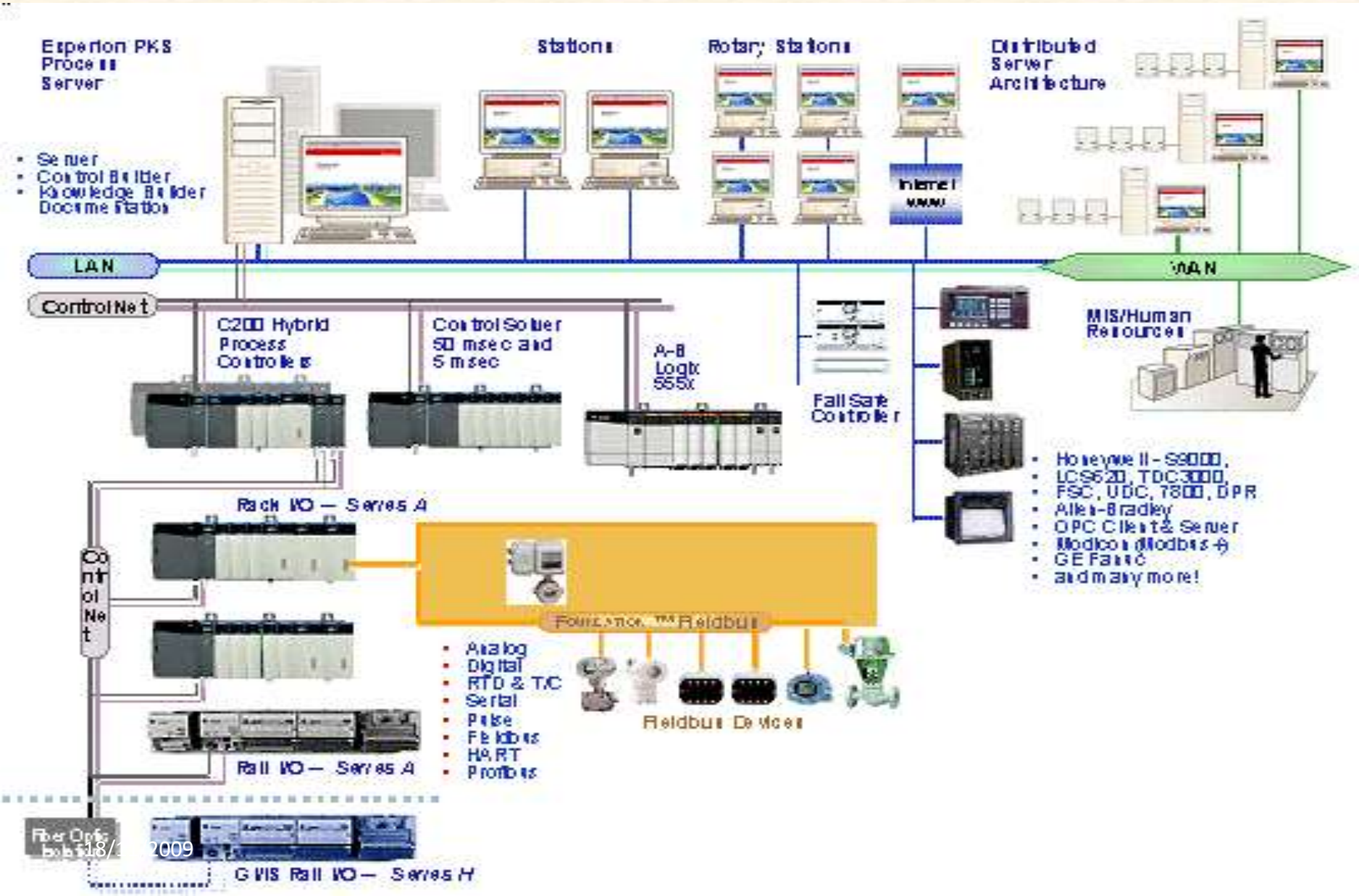

Basic control system Topology

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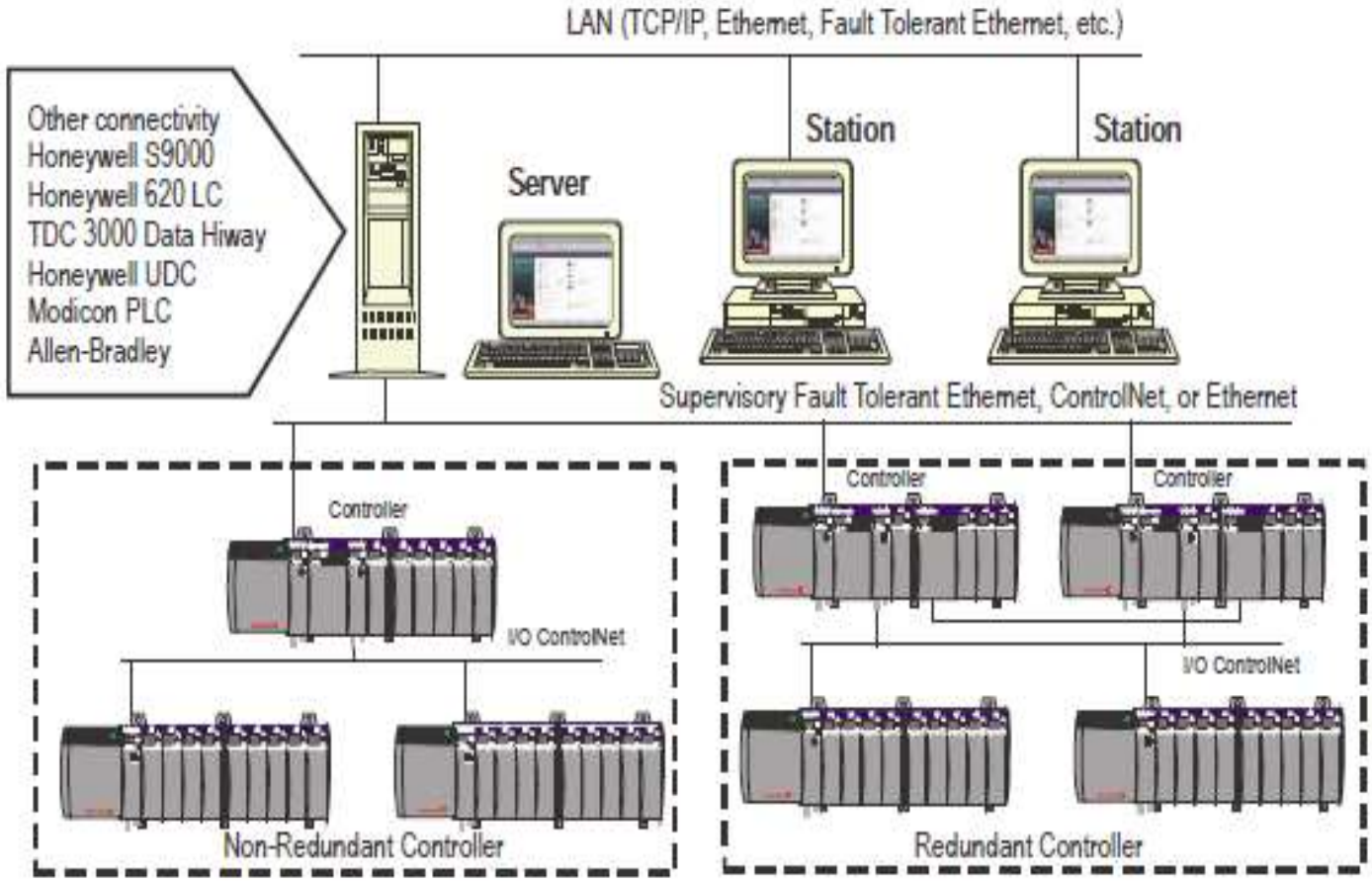

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Basic control system Topology

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- In basic Experion PKS system topology, the server and C200 process controllers share a global database, so you only need to enter data ones.
- EPKS can be segmented into basic sites of hardware component platforms:
  - Supervisory Platform
  - C200 Controller
  - Integrated Controller
  - Third Party Controllers
  - Communication Platform

Configuration Studio

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- Configuration Studio Provides a Central location from which you can configure your EPKS system.
- The individual tools required to configure parts of your system are launched from configuration studio.
- Tools in Configuration studio are as follows:-
  - Enterprise Model Builder
  - Quick Builder
  - System display
  - Control Builder
  - HMI Web Display Builder

Configuration Studio

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- Enterprise Model Builder:
  - It is graphical tool for building asset model
- Quick builder:
  - It is graphical tool for building hardware items such as Flex Stations ,Printers, Controllers, and standard(non C200) points in the system.
- System Display:
  - Displays that are used to configure items such as reports, groups display, trends, station setting and console station.
- Control Builder:
  - A graphical tool for building your control strategy for process controllers.
- HMI Web display builder
  - It is graphical tool for creating your own displays using web based features.

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Control Builder Introduction

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- About Control Builder
  - The Experion PKS Process Engineering Tool is Control Builder.
  - Control Builder is a Windows-based application and offers the latest in control building functions and strategies.
  - It is a graphical, object-oriented configuration environment that reduces the effort required to design, implement and document control applications.

Control Builder Introduction

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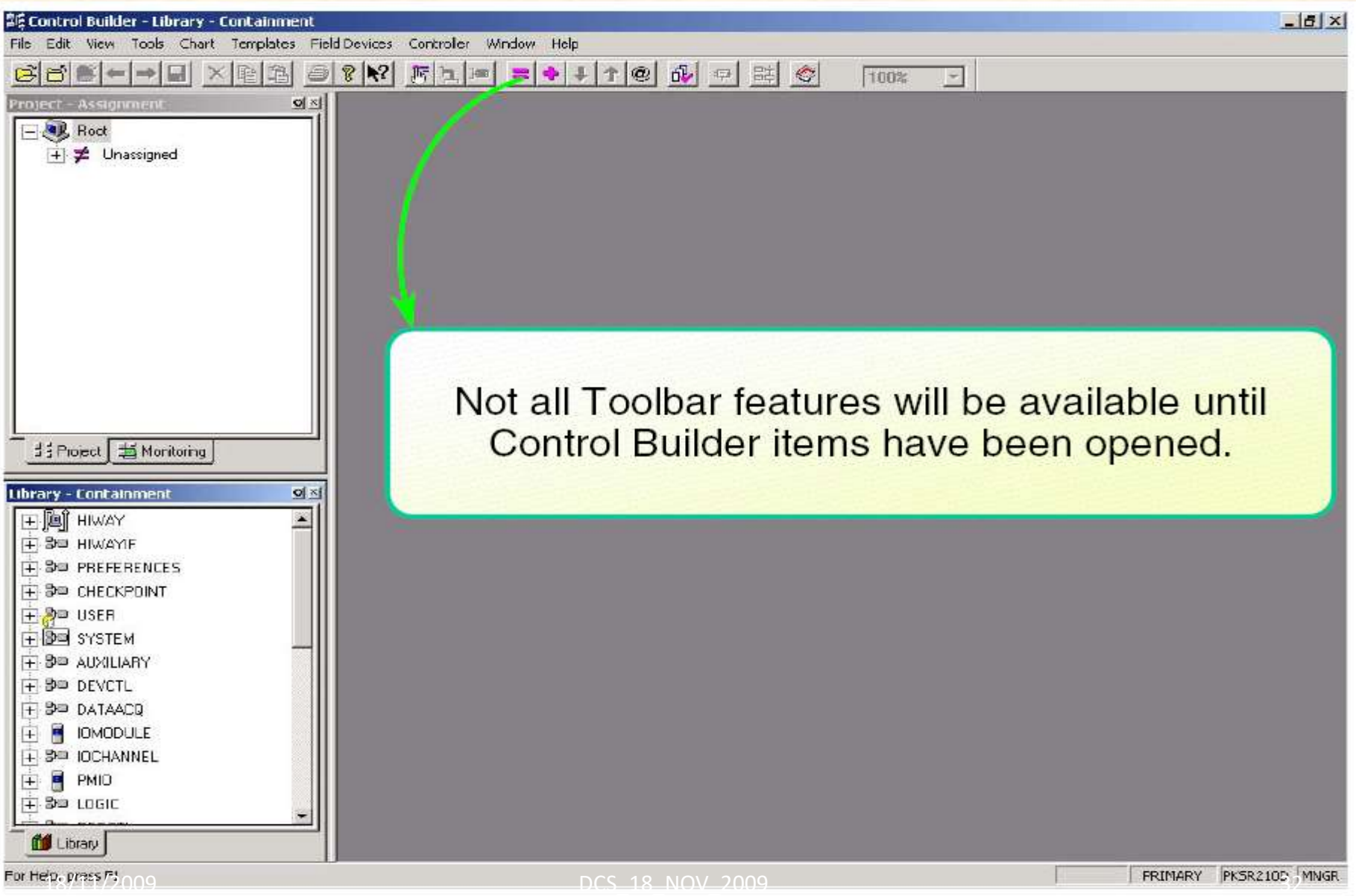

Control Builder Introduction

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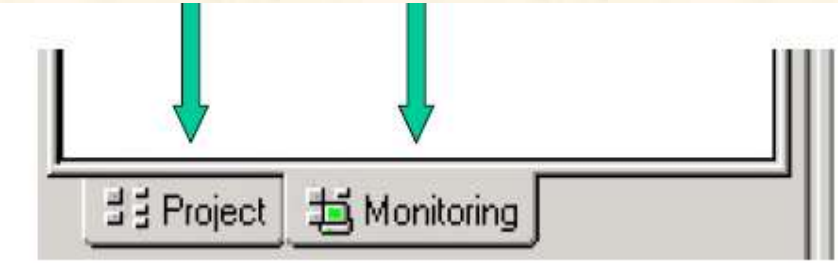
✓Tabs appear at the bottom of each tree window:

– Project -- Displays your CPM, IOMs, CMs and SCMs in the current project.

– Monitoring -- Displays all objects that have been loaded to the Control Processor Module (CPM). Permits active modules to be viewed and controlled during process.

– Library -- Displays all available System CMs and Function Blocks grouped into type categories.



Control Builder

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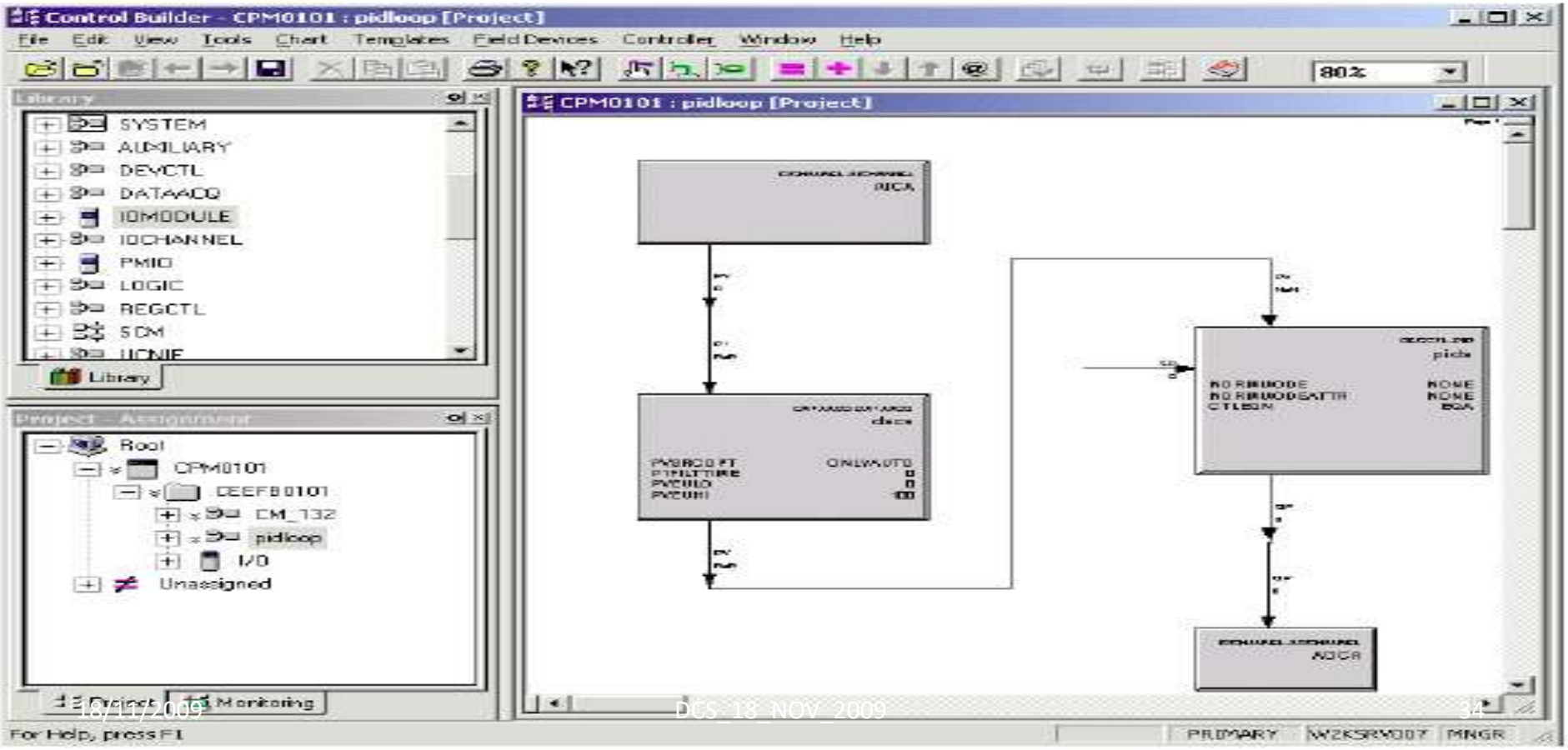
- Control Builder is an engineering tool offering the latest in control strategy building going well beyond looking “pretty” on screen. Its graphical, object-oriented design dramatically reduces the effort required to design, implement and document control applications.



Control Builder

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- Function Blocks
- Control Modules
- Continuous Control Functions
- Logic Control Functions
- Sequential Control Functions
- Batch Control Functions
- Template and hierarchical build functions
- Version Control System
-

Servers and Stations

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- Experion PKS's supervisory infrastructure consists of one or more servers and a number of client computers running the Experion PKS's user-interface application called Station.
- The client computers are usually referred to as "Stations".
- These components provide the infrastructure for engineering and operations software applications.

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Stations

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- **Flex Stations**
- A Flex Station is the most common Station configuration.
- It typically runs on a standard PC and communicates with the server using either of the following two connection types:
- Static: A permanent, dedicated connection. This is the recommended connection type for Flex Stations used by operators.
- Rotary: An “as required” connection. This is the recommended connection type for users who do not need full-time access to the server, or who need remote access (typically through a modem). Rotary connections are advantageous from a licensing viewpoint because the license specifies the maximum number of simultaneous Station connections.

Stations

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- **Console Stations:**
- A Console Station is a Station that connects directly to a Process Controller, FIM,IOLIM, or ACE node as well as to an Experion PKS server.
- Console Stations are advisable in an environment where continuity of view is paramount and where it is important to minimize the impact of a server being unavailable. Because Console Stations can directly access process data, alarms and messages from sources, there is no loss of view of critical data and alarms when the server fails and therefore an operator can still control and monitor the process.

Honeywell Icon console station

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Server

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✓ **Capability:**

- Experion PKS server software runs under Windows 2000 Server.
- A server can support up to 64,000 points.
- The server contains supervisory control functions, the Experion PKS Global Data infrastructure and optional redundancy.
- The server hosts object-oriented graphical tools such as Control Builder and HMIWeb Display Builder and acts as the central repository for all system data.

Process Control Hardware

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- **Basic components:**

➢ The Experion PKS system uses a common hardware infrastructure for both controller and chassis I/O configurations. Common chassis, power supplies and communication cards are employed across the basic system.

➢ Typical control hardware components include:

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- **Control Processor Module (CPM):**

➢ Is the Control module within the C200 Process Controller in which Experion PKS control strategies execute. It communicates with Input/output (I/O) Modules and peer devices via the Integrated Control Protocol (ICP) backplane and the connected ControlNet network. Together with an ICP backplane and I/O devices, the CPM constitutes a controller. It may also be referred to as the C200 controller, since C200 identifies the current version of the CPM.

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- **I/O Modules:**

➢ It provide the terminals and processing power to accept input signals from transmitters, thermocouples, etc. and send output signals to valves, motors, etc. A variety of I/O modules are available for analog inputs/outputs and digital inputs/outputs. Experion PKS also offers Serial Interface and Pulse Input Modules.

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- **ControlNet Interface module:**

➢ Links the controller with remote I/O module chassis (up to 8 via the I/O Network and/or other system controllers and plant networks via ControlNet.

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- **Fault Tolerant Ethernet(FTE):**

➢ can be optionally configured using a Fault Tolerant Ethernet Bridge module for the FTE Supervisory Network connection between the server and the Process Controller.

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- **Redundancy Module(RM):**

➢ with a Controller chassis provides automatic backup for the primary Controller. It can also be used in chassis containing Fieldbus Interface Modules to support redundant Fieldbus operation.

Conclusion

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- DCS is one of the best tool to be used for Process Automation.
- Honeywell EPKS is the most cost effective solution providing DCS for Process Industries.

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Thank You