Digitalisation of the water sector and water education

DigiwatRO

Software for Process Control

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Summary

1. PlantPAx - Distributed Control System - Rockwell Automation

2. Application - ThinManager solution for Rafinary Compressor Control

1. PlantPAx - Distributed Control System

The **PlantPAx® distributed control system**

Is an integrated control and information solution that helps manufacturers achieve Plant-wide Optimization in a wide range of industries.
.

This platform can run entire plant.

Integrates into one common system architecture.:

1. all HMI,
2. controls,
3. optimization,
4. engineering,
5. information,
6. inputs/outputs

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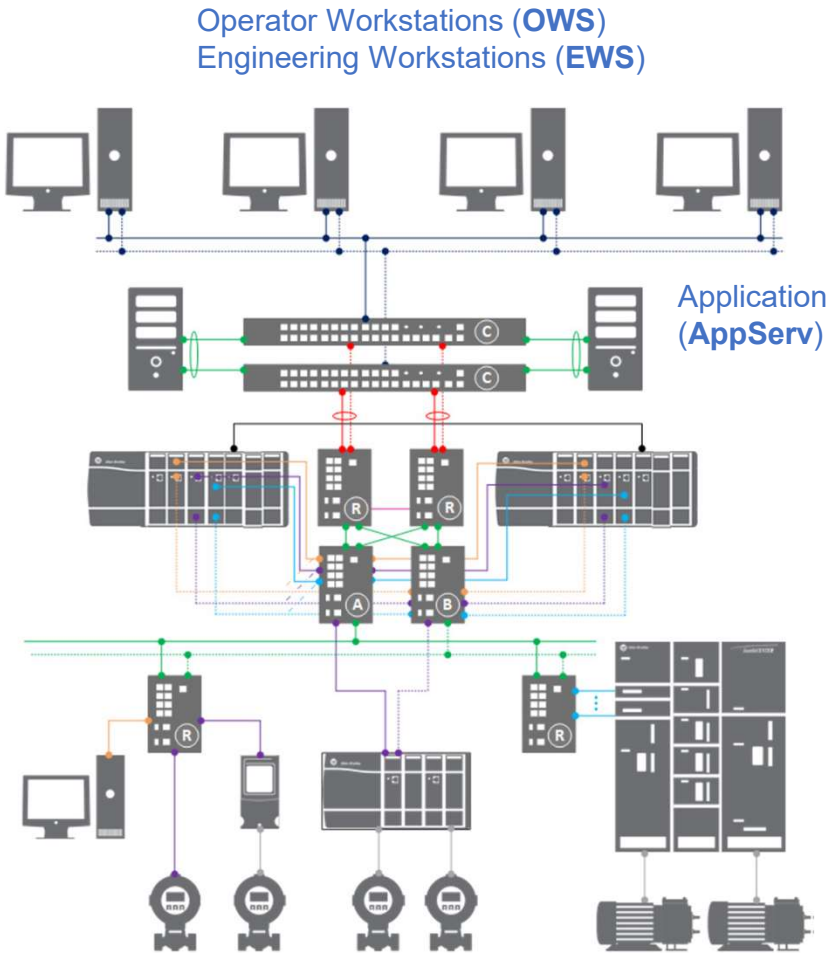
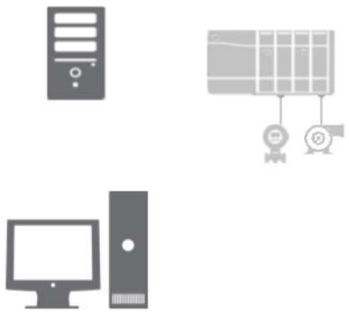


1. PlantPAx – Size, design, implementation

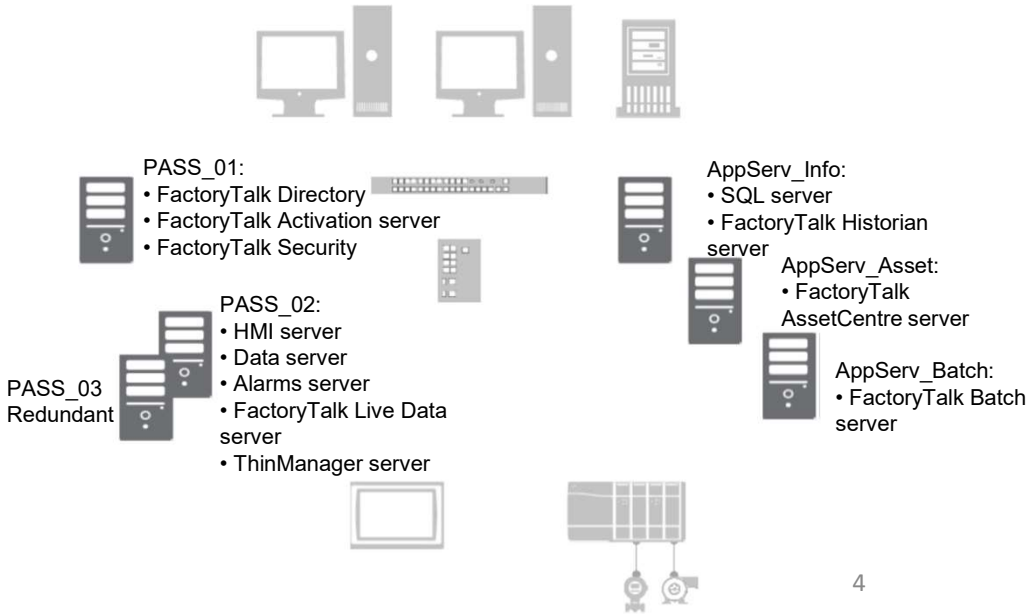
STEP1.
Use the app - **PlantPAx System Estimator** to size the application.
Result:
Smaller System (**PASS-C + OWS-ISO**)
Larger System (**PASS + Application Servers**)

Consolidated Process Automation System Server (PASS-C) smaller systems **skids or stations.**
PASS-C -> **reduced complexity and cost**.



PASS-C
- FactoryTalk Directory
- FactoryTalk Activation server
- FactoryTalk Security
- HMI server
- Data server
- Alarm and Event server
- SQL server
- FactoryTalk Historian server
- FactoryTalk AssetCentre server

Process Automation System Server (PASS) supports larger, distributed systems or customer-defined, critical processes.
Virtualization -> provide greater computing efficiency, enhanced backup and recovery capability, and to offer high availability with server redundancy.
PlantPAx virtual images are available for PASS and application servers to run on server-based computer hardware with a hypervisor, such as VMware ESXi.



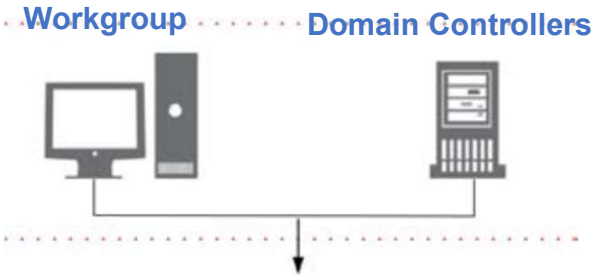
1. PlantPAx – Size, design, implementation

STEP2.
Manage servers and security policies.
• Smaller systems = **Workgroup** - decentralized administration
• **Larger systems** = **Domain Controllers** - centralized administration

A. Configure the Domain Controller or a Workgroup
B. Configure a Redundant Domain Controller
C. Create Roles, Areas, and Users
D. Configure Group Policies

A. Domain controller.
• Microsoft Windows Server operation system
• Active Directory Domain Services, DHCP, and DNS Server Roles.
• Parent and child domains
• Reverse DNS Lookup Zone.
• Configure DHCP server options and authorize server.

B. Redundant domain controller.
• The redundant domain controller has a unique name and IPv4 address.
• Install the Active Directory Domain Services role and promote to domain controller.
• Add the Directory Services Restore Mode (DSRM) password.



C. The PlantPAx Roles.
• PlantPAx Administrator
• PlantPAx Engineering
• PlantPAx Maintenance
• PlantPAx Maintenance Supervisor
• PlantPAx Manager
• PlantPAx Operator
• PlantPAx Operator Supervisor
• PlantPAx View Only
Name areas based on access, for example:
• Area01_Advanced (engineering access)
• Area01_Basic (non-engineering access)

D. Group Policies.
• Windows NTP client
• Windows time service

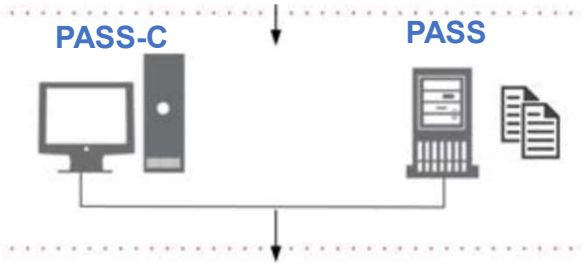
1. PlantPAx – Size, design, implementation

STEP3.
Configure the **Process Automation System Server** (**PASS**).
• Smaller systems = PASS-C + OWS-ISO
• **Larger systems** = Virtual templates

A. FactoryTalk Components
B. Configure the PASS
C. Configure Servers on the PASS
D. Configure the Runtime Security

A. FactoryTalk Components
• FactoryTalk® Administration Console
• FactoryTalk® Directory
• FactoryTalk® Activation
• FactoryTalk® Security
• FactoryTalk® Diagnostics
• FactoryTalk® Alarms and Events

B. Configure the PASS (standalone or distributed)
• Specify FactoryTalk Directory
• Configure the FactoryTalk Directory
• Run the Windows® Firewall Configuration Utility
• Configure FactoryTalk Activation servers



C. Configure Servers on the PASS
• HMI server – Stores HMI project components, such as graphic displays,and provides these components to Operator Workstations (OWS) upon request
• Data server – Accesses information from the process controllers and provides information to servers and workstations in the PlantPAx® system
• Tag Alarm and Event server – Provides alarm information from the controllers and servers to each OWS upon request

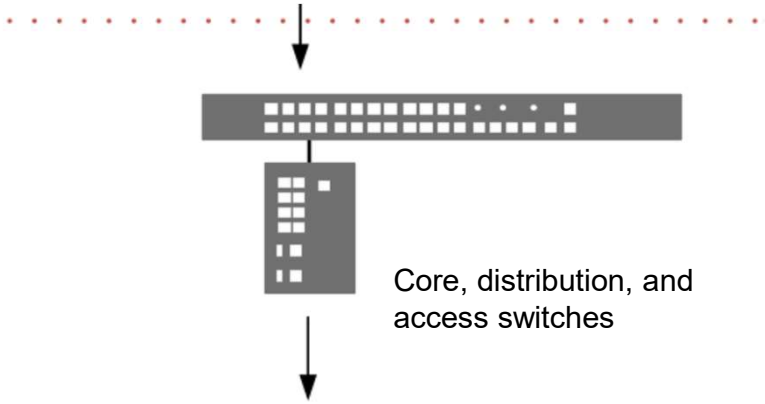
D. Configure the Runtime Security
Runtime security must be configured to provide each account or user group with the correct FactoryTalk View security codes. The security codes verify that operators, maintenance personnel, and engineers have permission to run secured commands, open secured graphic displays, or write to secured tags at runtime.

1. PlantPAx – Size, design, implementation

STEP4.
Design the Network Infrastructure
• Select network topologies
• Configure switches

A. Redundant PRP Topology (Parallel Redundancy Protocol)
B. Resilient DLR Topology(Device Level Ring)
C. Simplex-Star Topology

A. Redundant PRP Topology
• NIC teaming for dual connections between PASS servers and supervisory controllers
• EIGRP (Enhanced Interior Gateway Routing Protocol) provides Layer 3 routing capabilities
• HSRP provides redundant PRP 'RedBox' functionality
• PRP provides dual connectivity between two devices
• RedBox (redundancy box) connects devices without PRP technology to both LAN A and LAN B
• Cisco® Stackwise provides redundancy at core switches



B. Resilient DLR Topology
• NIC teaming for dual connections between PASS servers and supervisorycontrollers
• EIGRP (Enhanced Interior Gateway Routing Protocol) provides Layer 3 routing capabilities
• Redundant DLR gateway functionality
• DLR is a ring topology that recovers after a single point of failure
• Cisco® Stackwise provides redundancy at core switches

C. Simplex-Star Topology
• No disruptions to the network when you connect or remove devices.
• IMPORTANT: If a connecting network device fails, there's no redundancy and connected nodes can't communicate on the network.
• EtherNet/IP™ backbone between devices in a STAR topology
• NIC teaming is optional.

1. PlantPAx – Size, design, implementation

STEP4 - Design the Network Infrastructure
Select network topologies
Paralell redundant PRP Topology

Parallel Redundancy Protocol (PRP) is defined in international standard IEC 62439-3 and provides high-availability in Ethernet networks.
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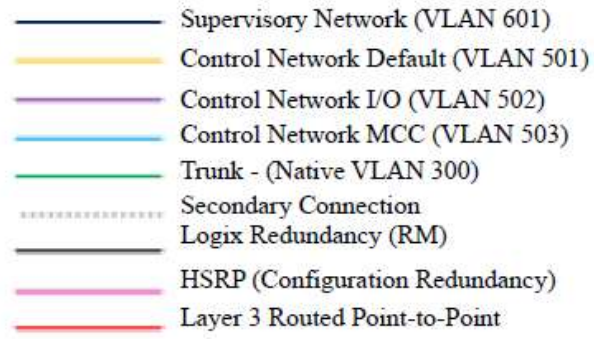
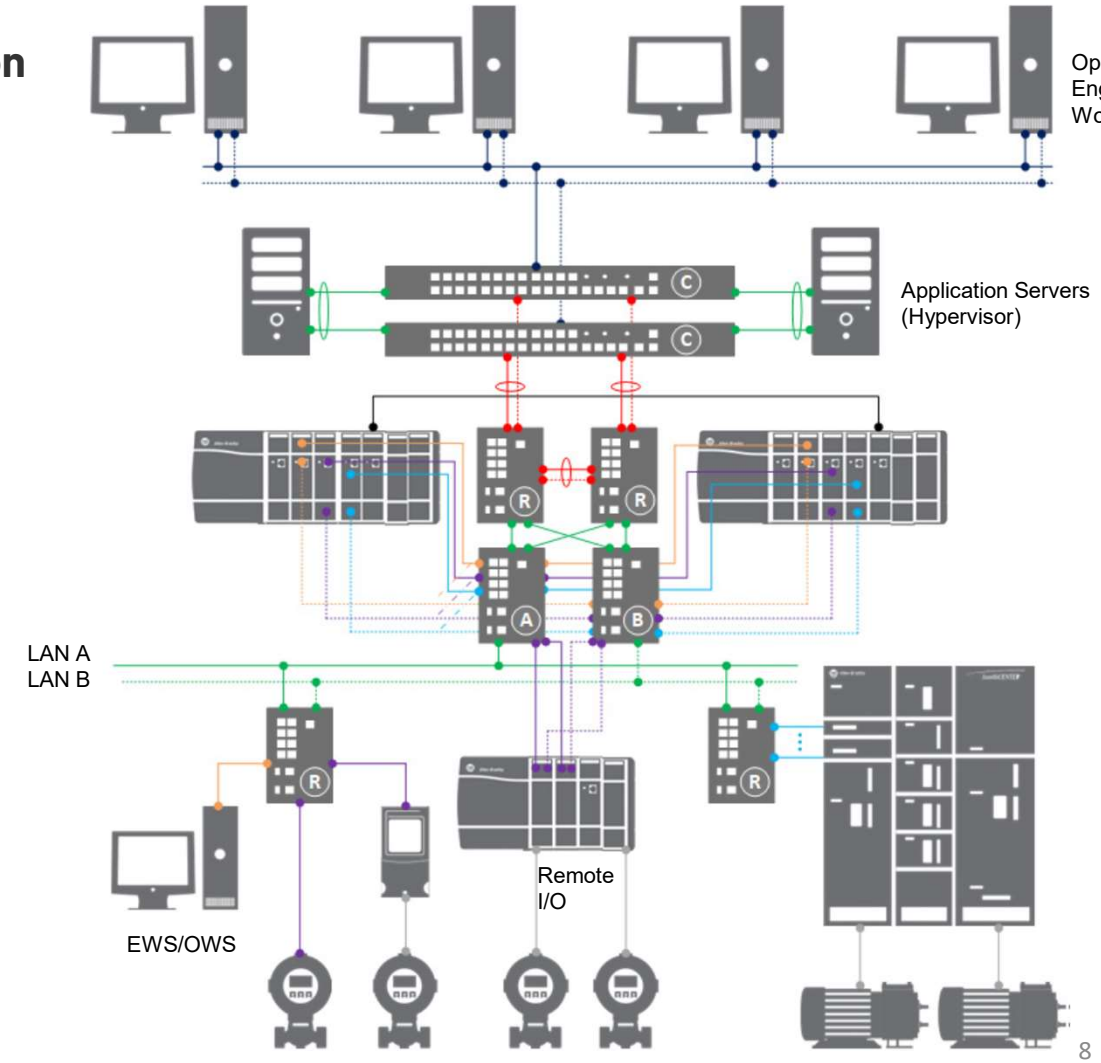
PRP technology creates seamless redundancy by sending duplicate frames to two independent network infrastructures, which are known as LAN A and LAN B.





1. PlantPAx – Size, design, implementation

STEP4 - Design the Network Infrastructure
Configure switches
Parallel redundant PRP Topology

1. Configure the Cisco stack switches.
a. Connect to distribution switches
b. Connect to application servers

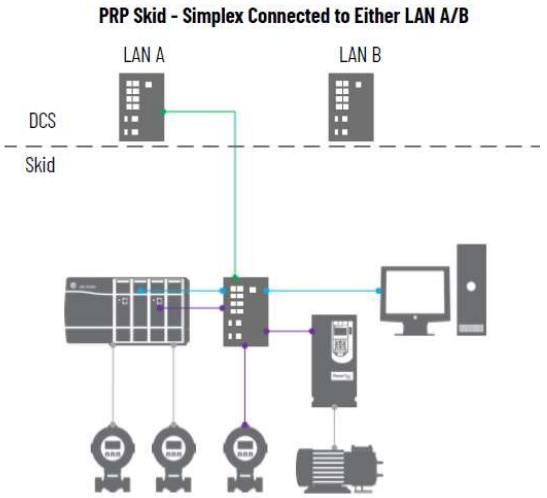
2. Configure the HSRP distribution switches.
a. Connect distribution switches to the core stack
b. Configure PRP

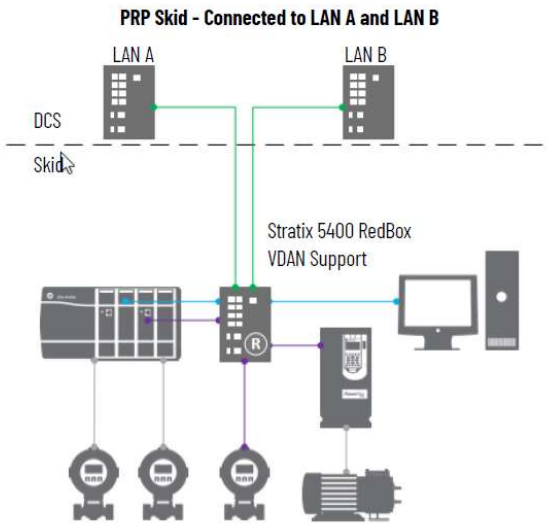
3. Configure the LAN A/B access switches.

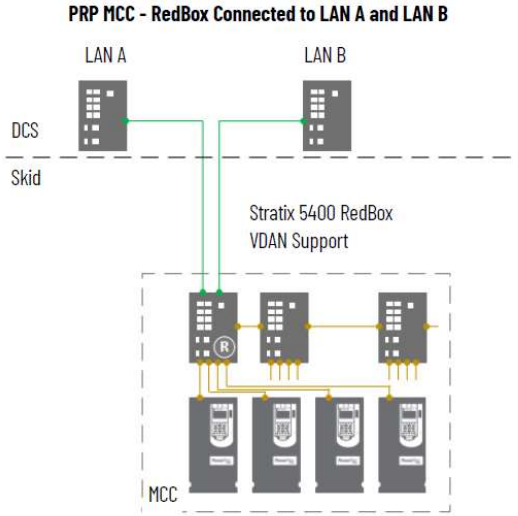
4. Configure the RedBox switches.

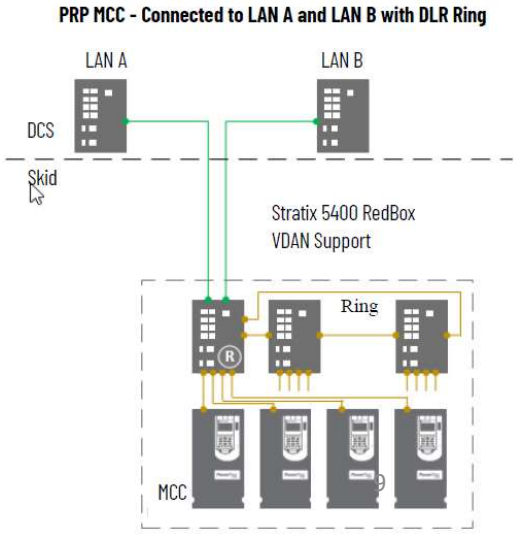
5. Add PRP devices or skids.

6. Verify the PRP configuration.







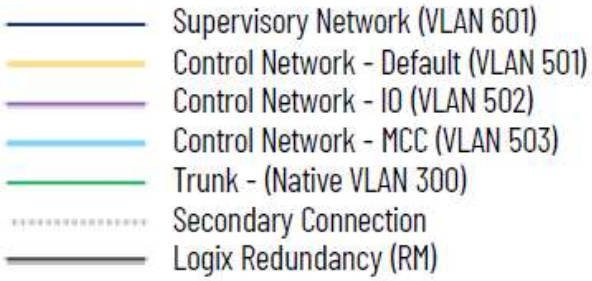


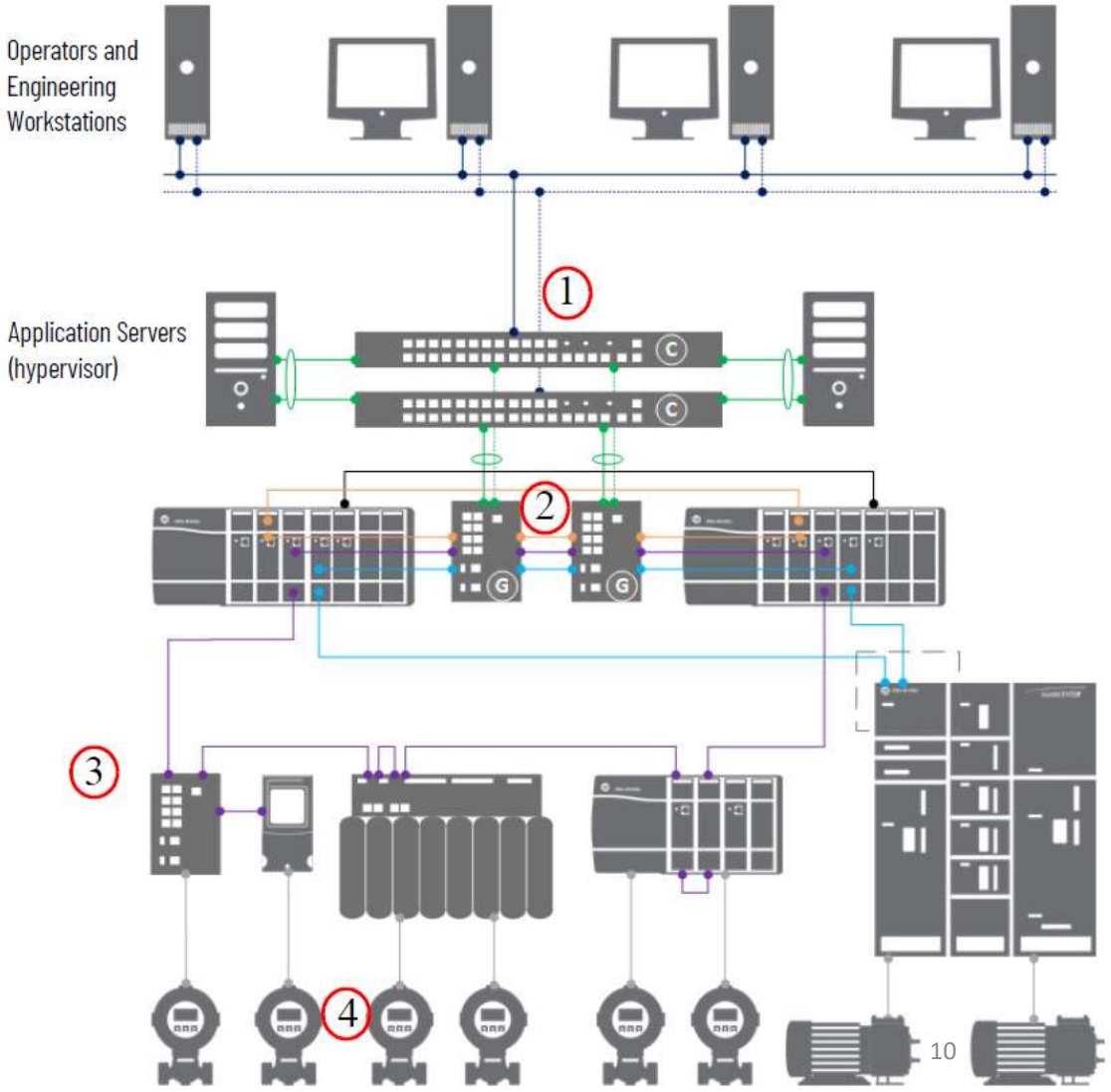
1. PlantPAx – Size, design, implementation

STEP4 - Design the Network Infrastructure
Select network topologies
Resilient DLR Topology

Device Level Ring is an EtherNet/IP protocol that is defined by the Open DeviceNet® Vendors' Association (ODVA)..

DLR provides a means to detect, manage, and recover from single faults in a ring-based network...





1. PlantPAx – Size, design, implementation

STEP4 - Design the Network Infrastructure

Configure switches

Resilient DLR Topology

1. Configure the Cisco stack switches.

.

a. Connect to distribution switches

b. Connect to application servers

2. Configure the gateways.

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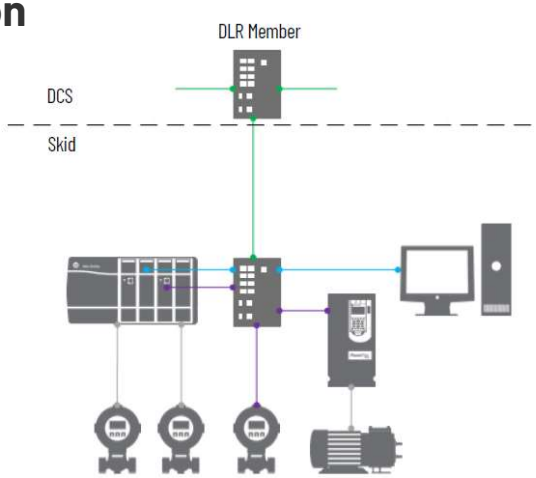
3. Configure the ring access switches.

4. Add DLR devices or skids.

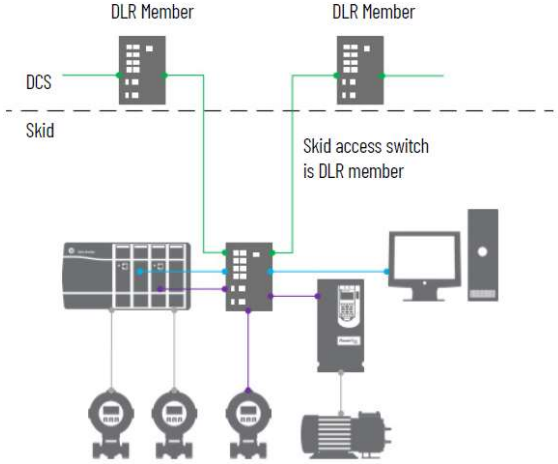
.

5. Verify the DLR configuration..

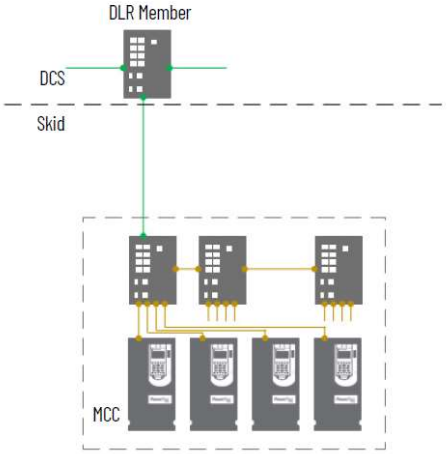
DLR Skid - Simplex Connected to DLR Ring



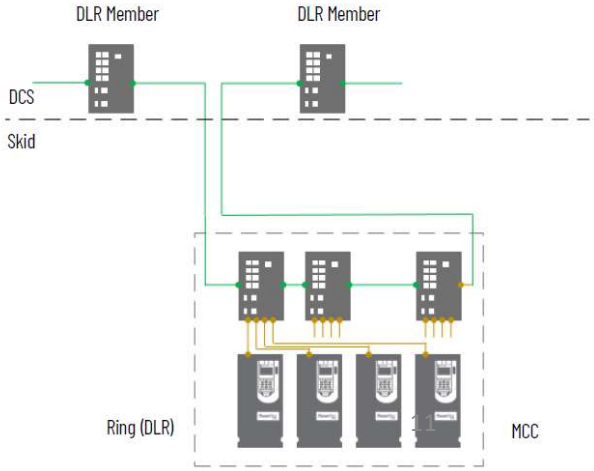
DLR Skid - DCS Integration



DLR MCC - Simplex Connected to DLR Ring



DLR MCC - DCS Integration



1. PlantPAx – Size, design, implementation

STEP4 - Design the Network Infrastructure

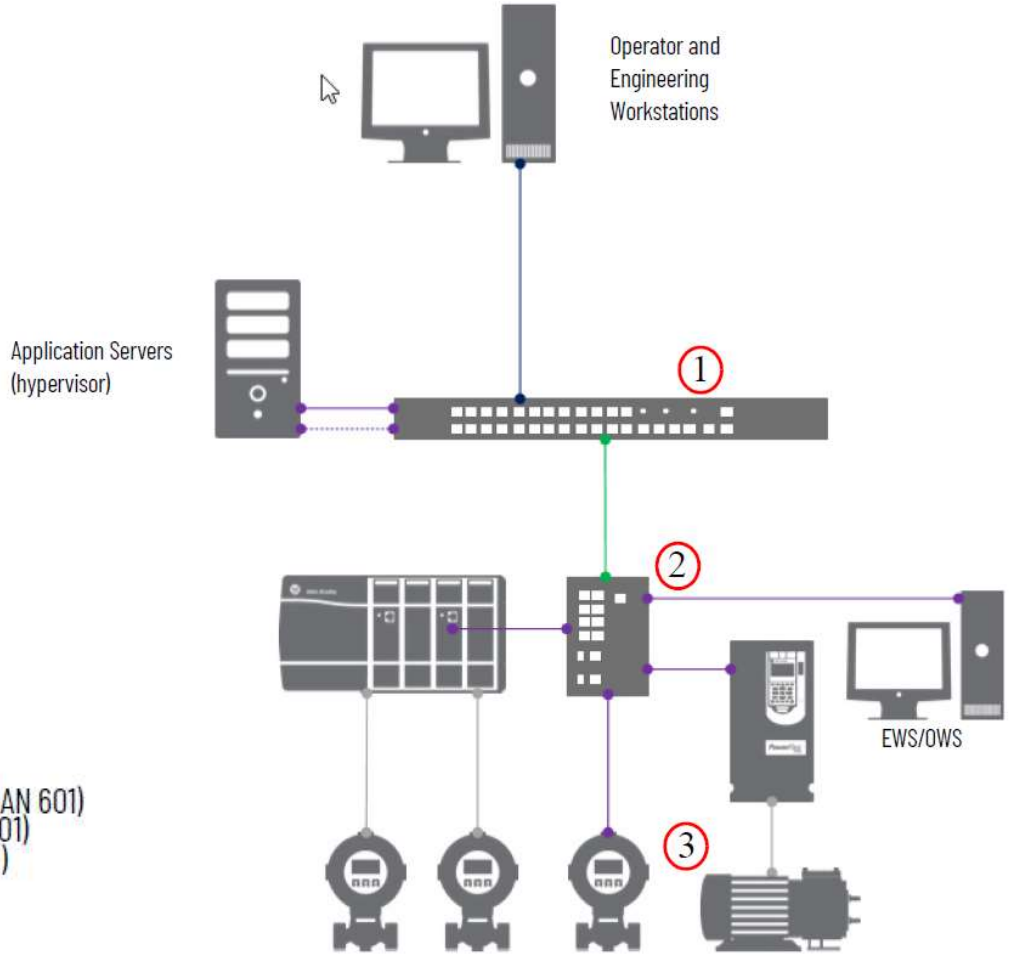
Select network topologies

Simplex-Star Topology

In a **star topology**, access switches serve as an uplink from the servers to the workstations.

Layer 2 switches also send information packets at the controller level from the end devices.

With multiple network levels, access switches control the flow of information to make sure that packets are delivered to the correct network level.



1. PlantPAx – Size, design, implementation

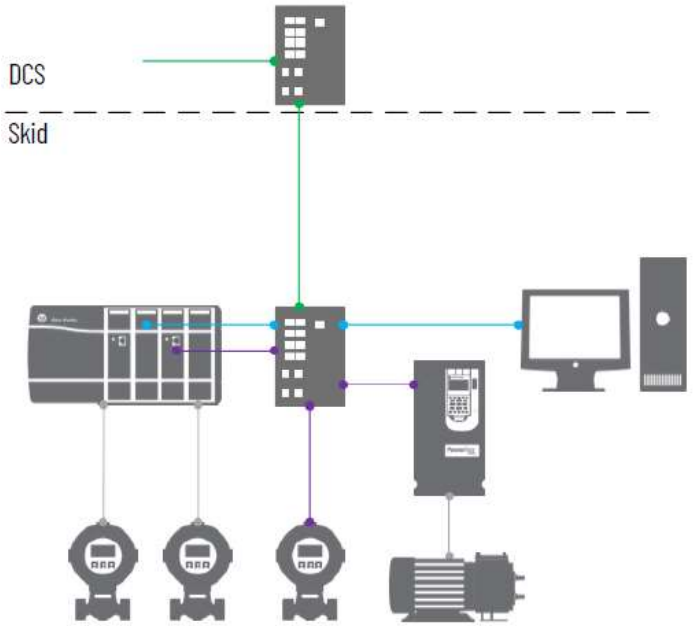
STEP4 - Design the Network Infrastructure

Configure switches

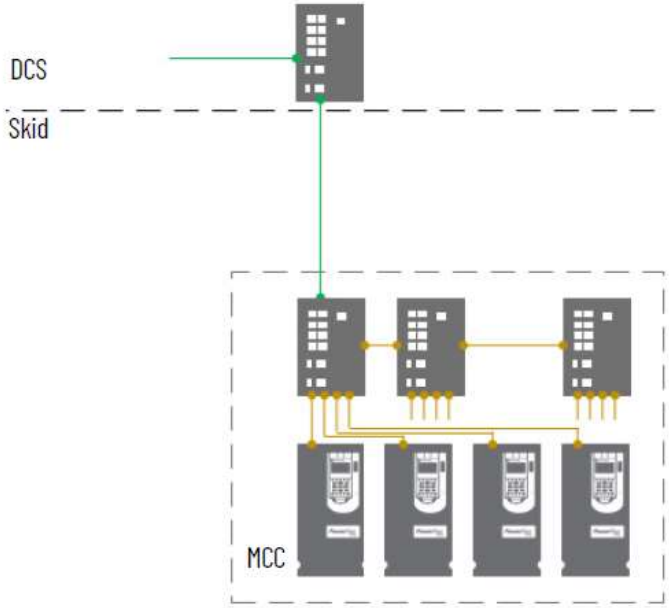
Simplex-Star Topology

1. Configure the Cisco stack switch.
2. Configure the access switches.
3. Add simplex devices.
4. Verify the Simplex configuration.

Skid - Simplex Connected to Simplex DCS



MCC - Connected to Simplex DCS



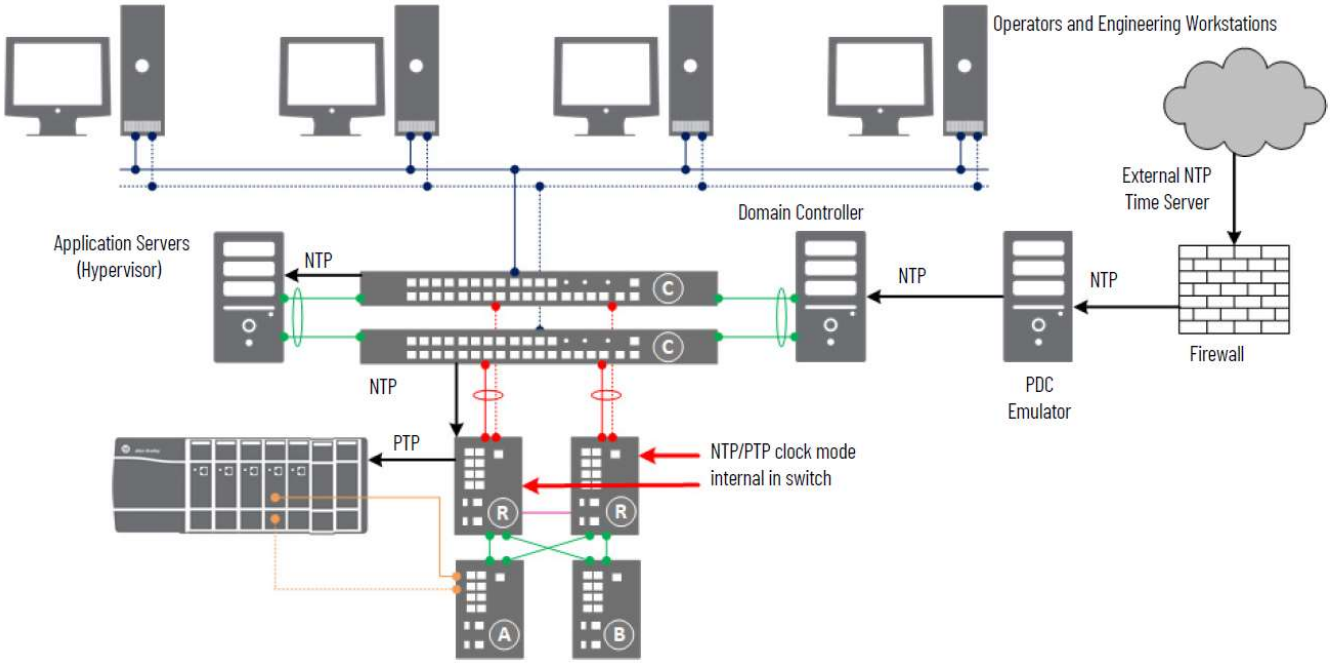
1. PlantPAx – Size, design, implementation

STEP4 - Design the Network Infrastructure

Time Synchronization

System time synchronization is important so that the internal clocks in the controllers, workstations, and servers reference the same time for any event or alarm that occurs.

PASS, application servers, OWS, and EWS must use a single server (for example, a domain controller) as their time reference and keep their clocks synced to it.



1. PlantPAx – Size, design, implementation

STEP4 - Design the Network Infrastructure

Time Synchronization

1: Network Time Protocol (NTP)

NTP synchronizes time over the plant floor on a Ethernet network as shown in the following figure. NTP sources Coordinated Universal Time (UTC) as the universal standard for current time.
Typically for Windows, a domain controller sources UTC time and becomes the Reliable Time Server for the domain.

Two methods are described to use UTC time in your domain:
• Via your local network (intranet) or the Internet (previous diagram)
• Via GPS

The Internet can introduce more propagation delays than GPS that can cause inaccuracies in your system. Although the NTP system affords algorithms to calculate accurate time for either method, the GPS method provides better accuracy.

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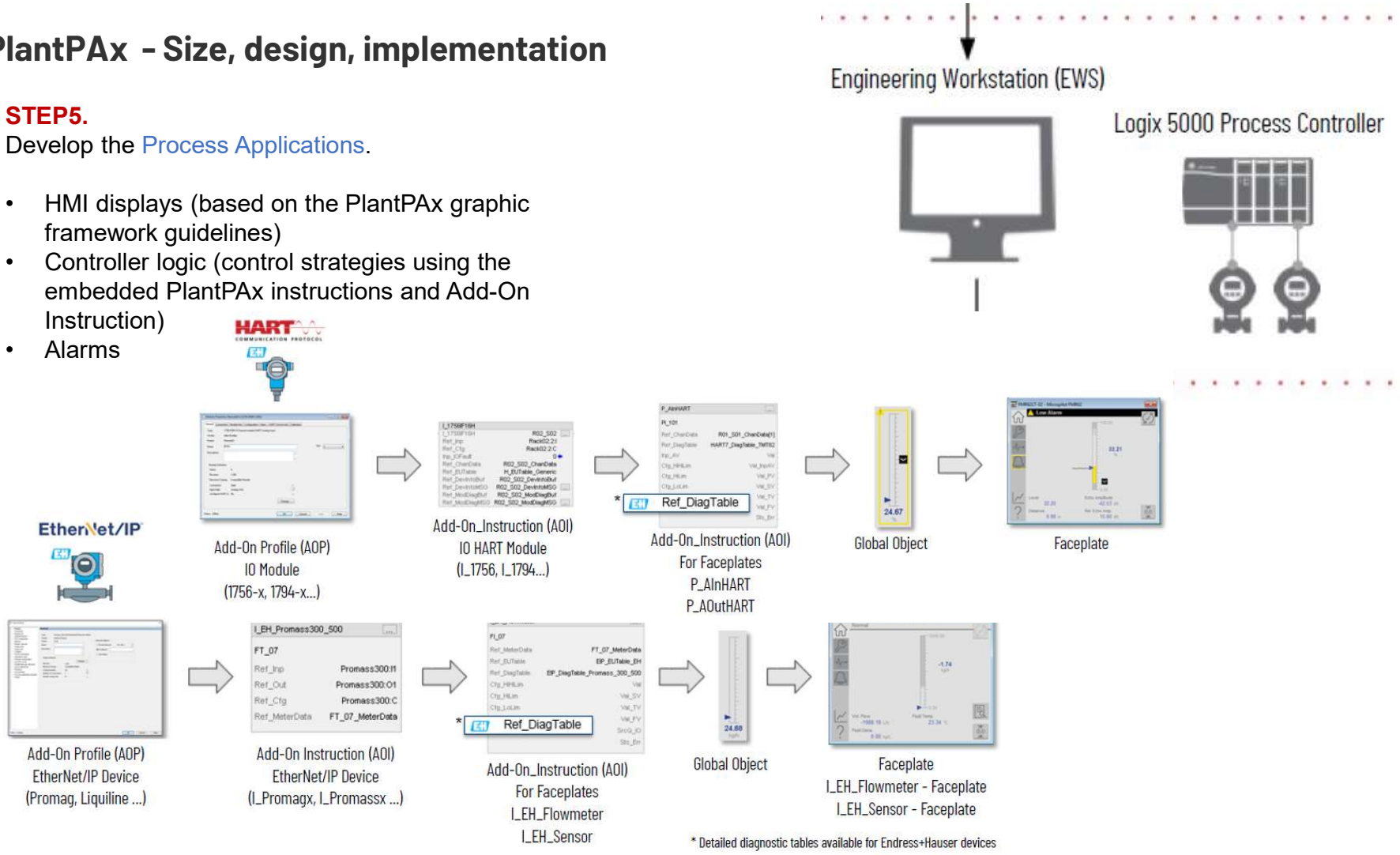
2. Precision Time Protocol (PTP)

The Stratix switch is responsible for converting Network Time Protocol (NTP) to Precision Time Protocol (PTP). This functionality is available only in the Stratix 54x0 family.

1. PlantPAx – Size, design, implementation

STEP5.
Develop the Process Applications.

- HMI displays (based on the PlantPAx graphic framework guidelines)
- Controller logic (control strategies using the embedded PlantPAx instructions and Add-On Instruction)
- Alarms



1. PlantPAx – Size, design, implementation

STEP5.
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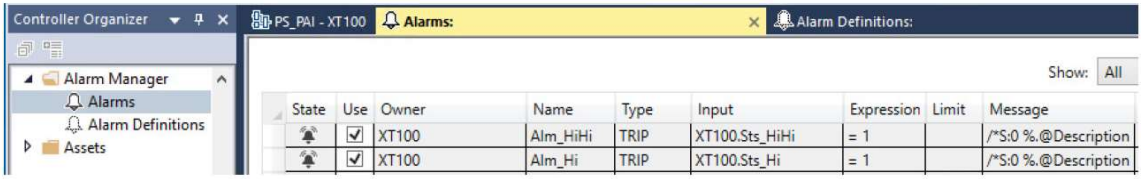
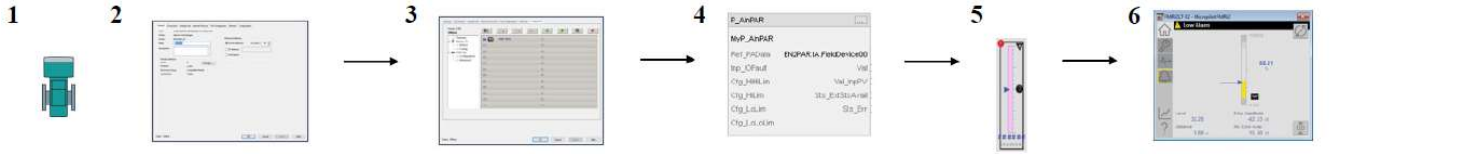
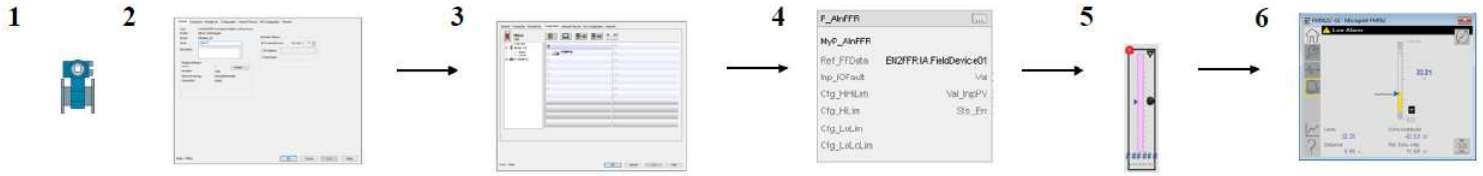






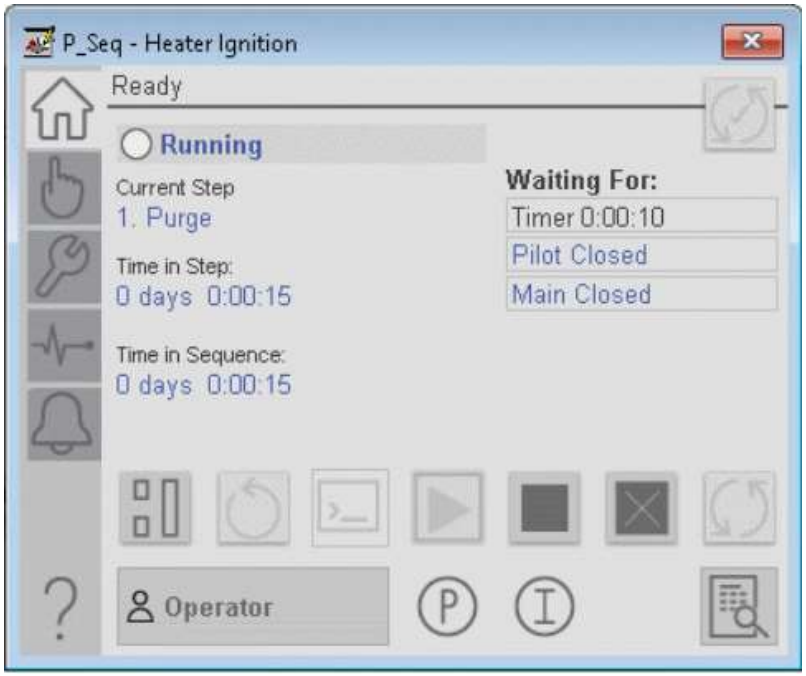
1. PlantPAx – Size, design, implementation

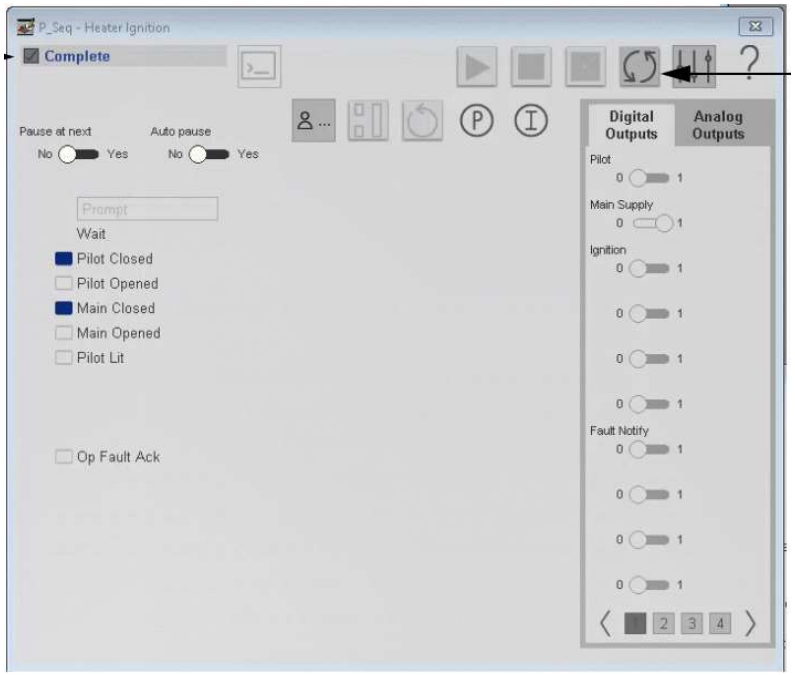
STEP6.
Add **additional servers** for application-specific needs.

- Smaller systems = application servers co-located on a PASS-C
- Larger systems = each application server is separate

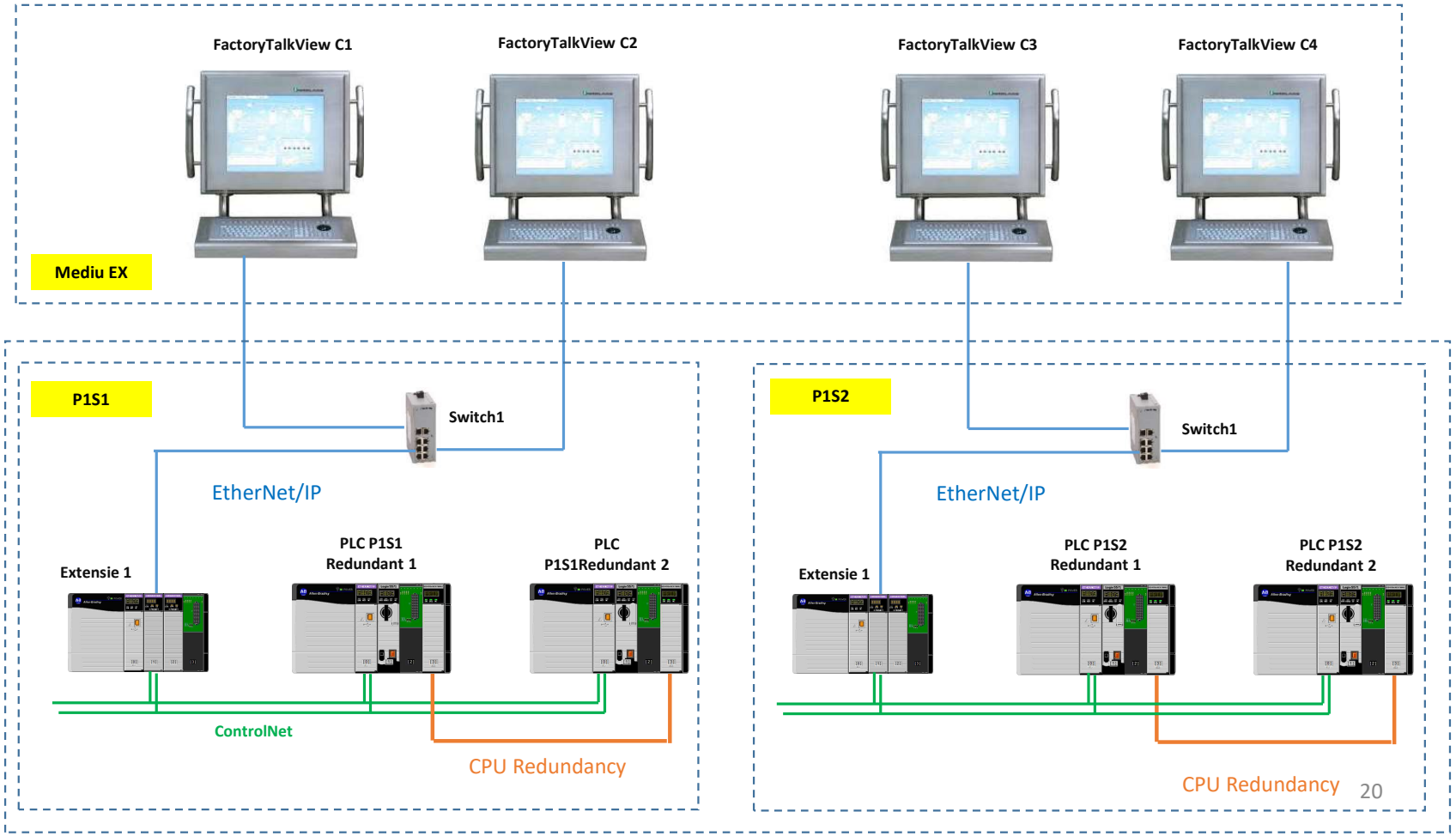
1. PlantPAx – Size, design, implementation

STEP7.
Deploy your application to clients.

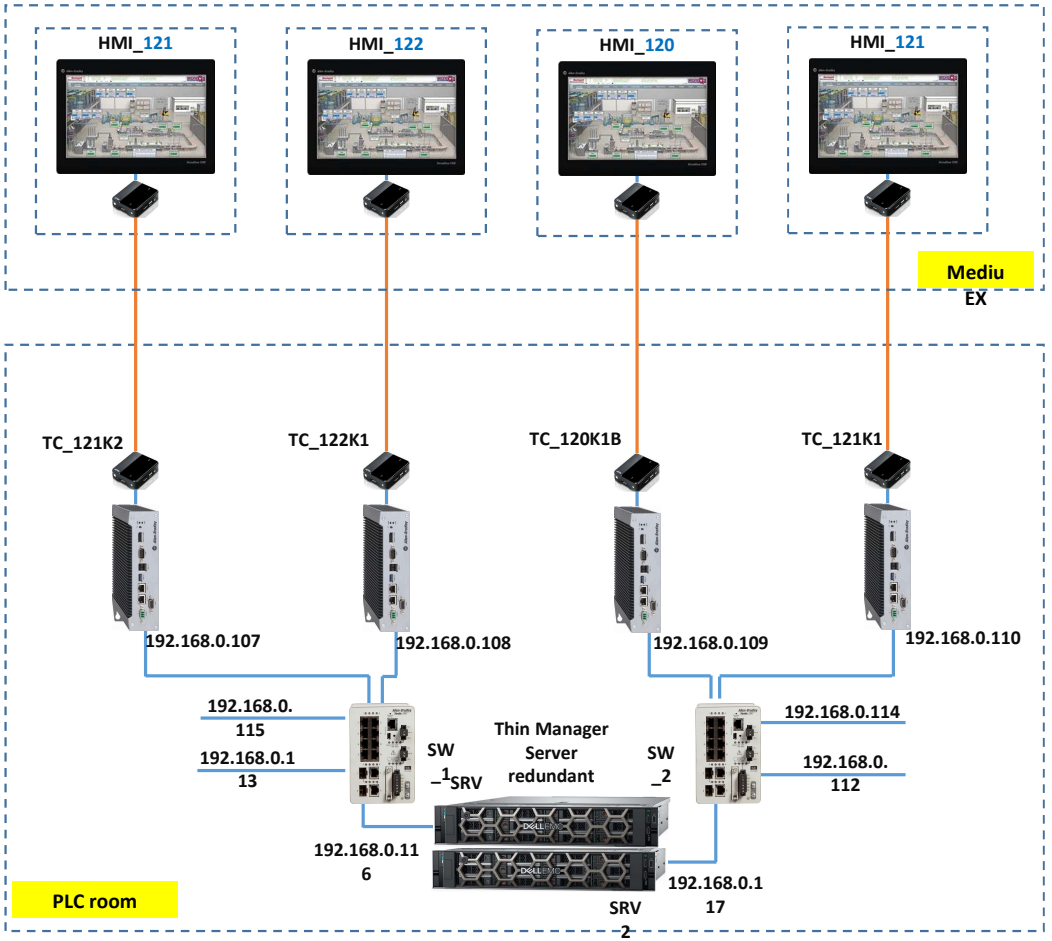




2. Application - ThinManager solution for Rafinary Compressor Control - Existing solution



2. Application - ThinManager solution for Rafinary Compressor Control - Proposed solution



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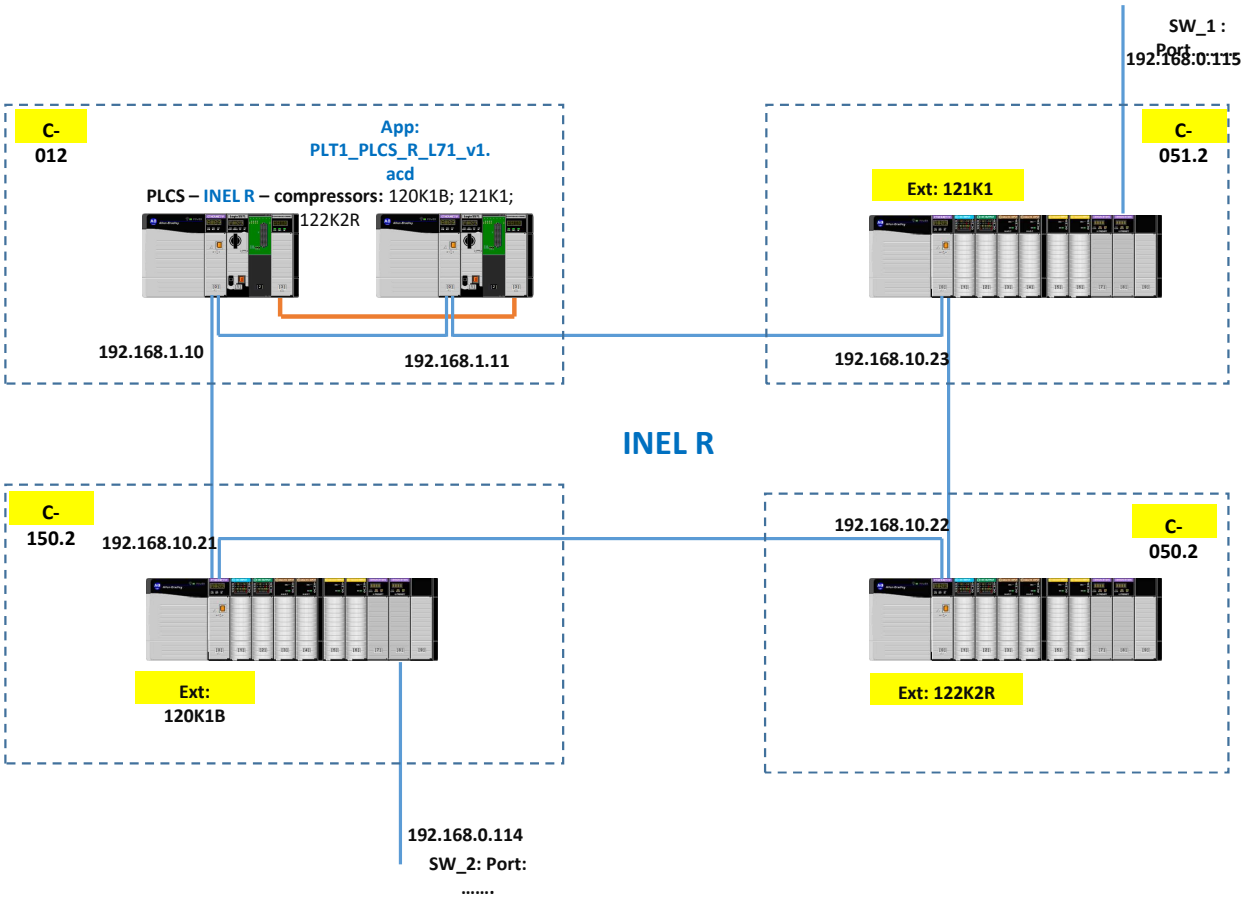

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