Technical Information

Honeywell

Experion CEE-based Controllers and I/O Overview

Doc EP03-290-400

Doc # EP03-290-400

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Table of Contents

Document History

EP03-290-rrr (Experion CEE-based Controllers and I/O Overview)

Document rrr number	Revision	Date	Description
301	Version 1.0	6/25/07	First release of this document.
310	Version 1.0	4/9/09	Updated for R310, added PCDI

Revision Description

Section	Change	Description
6.9	A	Added section on PCDI
9	M	Updated simulation section

Legend for Change column:
A -- Added
D -- Deleted
M – *Modified*

1 Introduction

1.1 Experion PKS

As depicted in Figure 1-1 the Experion® Process Knowledge System (PKS) from Honeywell is a modern day open infrastructure that utilizes state of the art technologies to effectively integrate Honeywell and 3rd party process control solutions into a seamless and powerful process knowledge system.

Unifying people with process, business, and asset management, Experion helps process manufacturers increase profitability and productivity. It's the only automation system that focuses on people—making the most of the knowledge they hold. By integrating disparate data across the plant facility, making the most of resources and people, and feeding it all into a unified automation system, users can achieve an operation that's more proactive, efficient, and responsive.

As Figure 1-1 shows, Experion provides a comprehensive automation system that encompasses the entire process domain from field devices to business effectiveness and agility solutions. Experion also provides interfaces to easily integrate legacy Honeywell TDC and TPS systems. This allows the customer to protect their investment while providing an easy, cost effective path forward to solutions empowered by state of the art technologies.

1.2 Document Purpose

For the subjects covered in this document the user will receive:

- Overview level concepts
- An understanding of major components and topologies
- An understanding of the associated Experion specific terminology

It is intended as a primer to allow individuals to better understand and utilize the more detailed successor documents like Specification documents. See section 1.6 for a list of Specification documents.

1.3 Document Scope

Figure 1-1 attempts as much as possible on one page to show the full breadth of the Experion system. Although it does not show every available solution and function, it does show the major and key offerings as follows:

- I/O families and Control Processors
- User HMI's (Human Machine Interfaces)
- Business, process, operator, maintenance, and engineering effectiveness tools and solutions

This document will focus specifically on the items shown in Figure 2-1.

Important: Experion Server and Station are mentioned in this document to provide context and support understanding. This document does not attempt to cover Server/Station in any way. Refer to Server/Station specification documents for complete coverage and details.

1.4 How to use this document

This document is intended for individuals who are new to Experion, its concepts, and its architecture. It is written in a specific sequence starting from section 2 to the end of the document. Concepts needed for later sections may be covered in preceding sections.

If you are a first time reader or new to the Experion system it is suggested that you read each section in sequential order starting with section 2.

1.5 Conventions used in this document

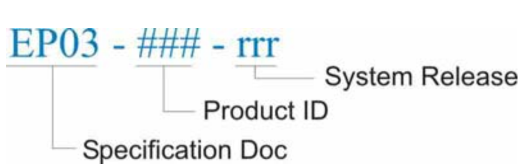
Important! The following conventions will be used in this document:

- Diagrams are intended to help the reader understand the concepts. Although they support the discussion they may not be completely accurate and may not show all required components and devices. Always refer to the associated Specification document for the most accurate and up to date information.
- In some cases, capacity and maximum limit values may be stated. These numbers are for context and to support the discussion. Always refer to the associated Specification document for the most up to date information.
- When applicable, the Experion Release that the function first became available in will be identified.
- Throughout the document, the associated Specification document will be identified. The Spec documents will be identified in BLUE as follows:

EP03-200-rrr (see section 1.6 for a description)

1.6 Specification Document Numbering Scheme

All product specification documents begin with **EP03** and are followed by two three digit numbers. The first three numbers (###) identify the product/function covered in the document. The second three digit number (rrr) identifies the system release that the document covers.



For example, EP03-410-210 would identify a Specification document that is written for the RIOM-A I/O family and the content reflects the functionality available in system release R210.

Important! With every major system release the Specification release number (**rrr**) is incremented and a new Specification document is posted. Older documents are still available and the user should refer to the Specification for the particular system release they are interested in.

Table 1-1 Summary of Specification Documents:

Specification Document Number (Note-1)	Document Title	Document first Introduced with Experion Release- (Note-2)
EP03-200-rrr	Experion Server	100
EP03-210-rrr	Experion Station	100
EP03-220-rrr	Digital Video Manager	100
EP03-240-rrr	Experion Backup and Restore	200
EP03-250-rrr	Understanding your Experion License	200
EP03-290-rrr	Experion CEE-based Controllers and I/O Overview (This document)	301
EP03-300-rrr	CEE-based Experion Controllers and Network Capacities and Specifications	100
EP03-310-rrr	ACE (Application Control Environment)	100
EP03-320-rrr	C300 Controller Hardware	300
EP03-330-rrr	C200 Controller Hardware	100
EP03-350-rrr	CAB (Custom Algorithm Block)	200
EP03-360-rrr	Experion Simulation	301
EP03-380-rrr	Peer Control Data Interface (PCDI)	310
EP03-400-rrr	CIOM-A (Chassis Series-A)	100
EP03-410-rrr	RIOM-A (Rail Series-A)	100
EP03-420-rrr	RIOM-H (Rail Series-H)	100
EP03-430-rrr	PMIO	100
EP03-440-rrr	DeviceNet	100
EP03-450-rrr	Profibus	100
EP03-460-rrr	HART Integration	100
EP03-470-rrr	Foundation Fieldbus Integration	100
EP03-480-rrr	Field Device Manager	201
EP03-490-rrr	Experion Series C I/O	300
EP03-500-rrr	Fault Tolerant Ethernet	200
EP03-510-rrr	Experion Series C GI/IS IOTA	300
EP03-520-rrr	Experion Series C Platform	300

Note-1: The “rrr” in the document number will vary and identify the Experion release that the particular document covers. The user should reference the specification that covers the desired system release with which they are working.

Note-2: The number in this column indicates the release when the document first became available. The user should not expect to locate a document with an earlier release number.

1.7 Important Acronyms and Terminology

The following is a list of important acronyms used in this document.

ACE	Application Control Environment. The Honeywell ACE Node is implemented on a server grade COMPUTER platform. ACE is a CEE-based node.
C200	Honeywell CEE-based control processor in the Chassis Series A form factor.
C200E	Honeywell CEE-based control processor in the Chassis Series A form factor.
C300	Honeywell CEE-based control processor in the Series C form factor.
CEE	Control Execution Environment
IOM	Input Output Module
COTS	This references a Commercial Off The Shelf (commercially available) component.
CIOM-A Series-A Chassis Series-A	Chassis I/O Modules Series-A. A chassis based I/O family and the platform for the C200 and FIM. Also referred to in this document as Series-A, Chassis-A, and Chassis Series-A
FIM FIM2 FIM4 FIM8	Foundation Fieldbus Interface Module. Note: There are two form factors of FIM. The Chassis Series-A and the Series-C form factor. The Chassis Series- A version supports two FF H1 links and is sometimes referred to as the FIM2. The Series-C version supports four FF H1 links and is sometimes referred to as the FIM4. A new Series C FIM8 (with 8 H1 links) will be available with Experion R400.
FF H1 Link	Foundation Fieldbus H1 (Hunk 1) is a low-cost bidirectional serial bus for devices at the lower level, operating at lower speeds like sensors, actuators, and transducers. H1 segments use standard 4–20 mA wiring and operate at 31.25 kilobits per second.
FTE	Fault Tolerant Ethernet. A Honeywell solution for high availability and redundant Ethernet.
PCDI	Peer Control Data Interface
PMIO	Process Manager I/O. Robust/redundant I/O originally designed for use with xPM family of control processors. Integrated with the C200 and C300.
RIOM-A Rail-A Rail Series-A	Rail I/O Modules Series A. A DIN rail mountable I/O family. Also referred to in this document as Rail-A and Rail Series A.
RIOM-H Rail-H Rail Series-H	Rail I/O Modules Series H. A DIN rail mountable I/O family. Suitable for Hazardous locations. Also referred to in this document as Rail-H and Rail Series H.
Series-C	Newest form factor for Honeywell's latest I/O, FIM, and C300 control processor platform. Provides a robust and optionally redundant platform.

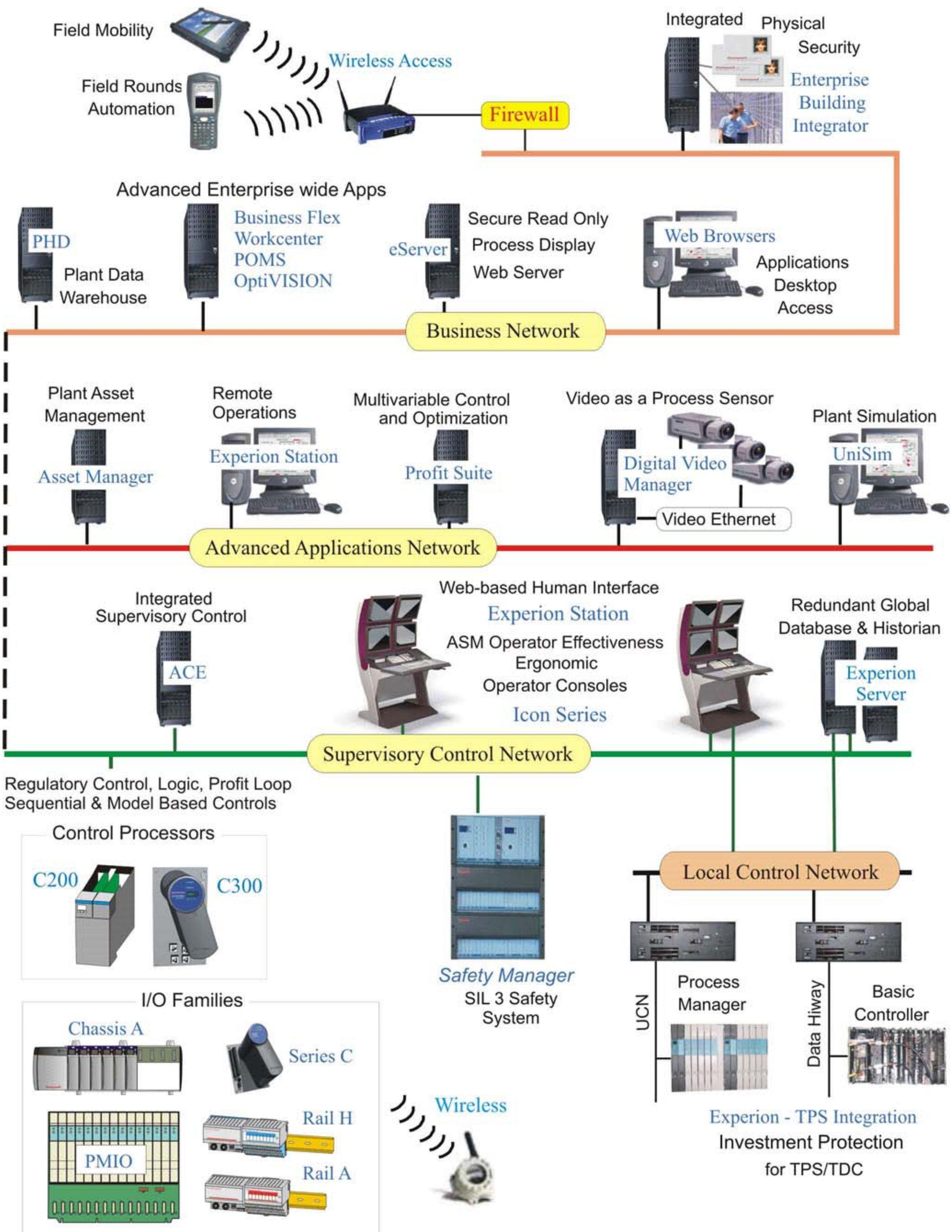


Figure 1-1 Experion System Architecture Diagram

2 Supervisory Control Networks

2.1 Introduction

The components depicted in Figure 2-1 comprise the ***Supervisory Control Network*** and the Experion CEE-based controllers, I/O families, and the nodes that will be covered in this document.

Although other node types can be connected to the Supervisory Control Network, this document will only cover the components listed in the diagram.

Experion Server and Station are mentioned as needed to provide context and to support key concepts. Details about Server are provided in appropriate Specification documents (*EP03-200-rrr* and *EP03-210-rrr*).

There are three types of Supervisory Control Networks as follows:

- **ControlNet** ….. See details in section 2.3
- **CIP** (Control Information Protocol) **Ethernet** …… See details in section 2.4
- Honeywell **FTE** (Fault Tolerant Ethernet) …… See details in section 2.5

The three types differ by protocol, media, transmission speed, capacity limits, and the actual node types that can be connected.

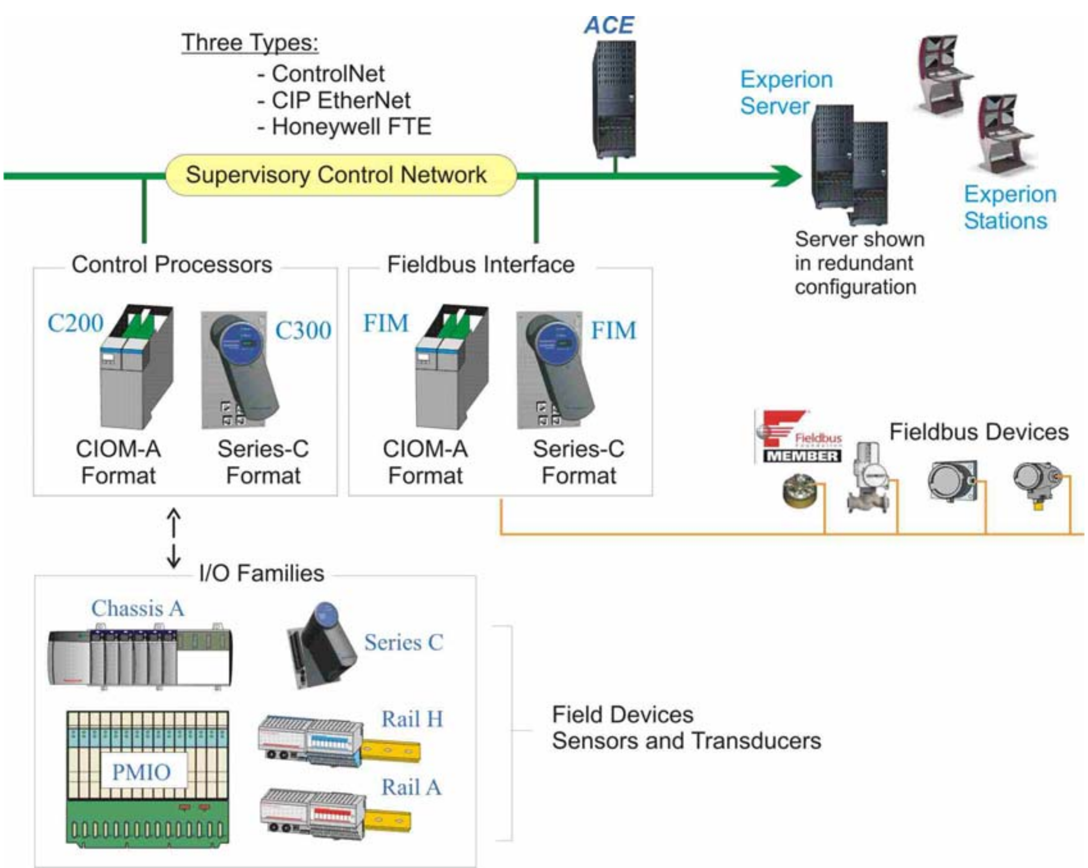


Figure 2-1 Supervisory Control Network and Major Components

2.2 Key Concepts

Refer to Figure 2-1. Note that this is a functional diagram and does not show the actual network interface modules. These modules are shown in the detailed diagrams that follow.

The various **I/O families** provide the physical connection to the process (sensors and transducers) through a comprehensive set of I/O modules. I/O families differ by form factor and the feature/option set provided by each (see section 6 for details). The available modules cover discrete (on/off) inputs and outputs, analog (0-100%) inputs and outputs, HART enabled I/O, pulse counters/accumulators, and serial networks (like Profibus, DeviceNet, Foundation Fieldbus, and Modbus). Each module provides a given number of input and/or output channels.

Not explicitly shown in the diagram, the Honeywell **CEE** (Control Execution Environment) provides user access to a comprehensive library of automatic control, logic, data acquisition, and calculation function blocks. The environment is common to the C200/C200E, C300, and ACE allowing them to meet the control needs of continuous processes, batch processes, discrete operations, and machine control applications. The use of a common execution environment also enables engineering efficiency and effectiveness. See section 3 for details.

The user connects and configures I/O modules to desired **C200/C200E**, or **C300** control processors. This enables the control processor to utilize the field inputs and outputs as part of sophisticated user configured automatic control and logic schemes. The CEE (resident in the control processor) provides an efficient and effective control environment and user access to a comprehensive library of control related function blocks. See section 4 for details.

Both form factors of the **FIM** (Fieldbus Interface Module) are gateways that provide direct connection to Fieldbus type smart devices. The FIM can be placed on the network in a stand-alone fashion or it can be used in conjunction with the C200/C200E or C300 control processors. See section 5 for details. The Chassis Series-A version supports two FF H1 links per FIM and is sometimes referred to as the FIM2. The Series-C version supports four FF H1 links per FIM and is sometimes referred to as the FIM4. See section 5 for more details.

The **ACE** Node is implemented on a server grade computer platform. It performs the same basic set of control and logic functions as a C200/C200E/C300, but does not have any direct connection to I/O or field devices. It can access (read and write) information from any C200/C300, FIM, or other ACE node on the same network. As the ACE has access to all information on the network it is well positioned to serve as a supervisory controller to the C200/C200E, C300, and FIM's. See section 4.3 for details.

> Note: The ACE can communicate with other node types using OPC connections and legacy Honeywell TPS/TPN/LCN systems. These interfaces are covered in the ACE specifications document, EP03-310-rrr.

With respect to the Supervisory Control Network and the C200/C200E/C300/ACE nodes, **Experion Server** collects, maintains, and distributes the typical operator information like process data, alarms/events, system status, trends, logs, and history. It then makes this information available to the various Experion (Operator) Stations and their associated user displays.

Experion Stations provide the user interface and viewing portal into the process. Operators use standard and user created custom displays to monitor and manage the process and system nodes. Server and Station provide many additional functions and features not covered in this document. For details see the Server & Station Specification Documents.

Table 2-1 provides a listing of each Supervisory Control Network and the node types that can be connected to each.

Table 2-1 Supervisory Control Network Types and Node Compatibility

Network Type	Refer to section	C200	C200E	Series-A FIM	C300	Series-C FIM	ACE Node
ControlNet	2.3	Yes	Yes	Yes	No	No	Yes
CIP Ethernet	2.4	Yes	Yes	No	No	No	Yes
FTE	2.5	Yes	Yes	Yes	Yes	Yes	Yes

Redundancy: For essential and critical control loops requiring high availability, Experion provides robust and bumpless redundancy solutions. The user can add redundancy for selected components and create a configuration with no single point of failure.

Table 2-2 lists the components and identifies which can be redundant.

Table 2-2 Component Redundancy Summary

Component	**Can it be Redundant?**	**Notes**
Networks		
ControlNet	Yes	Only the media is redundant. CNet Network module circuitry is common to both cables.
CIP Ethernet	No	
FTE	Yes	Full robust redundancy with tolerance for multiple faults.
Processors/Server		
C200	Yes	Full robust redundancy with high availability
C200E	Yes	Full robust redundancy with high availability
C300	Yes	Full robust redundancy with high availability
FIM2 and FIM4	Yes	Full robust redundancy with high availability
ACE	No	Although standard redundancy is not available, ACE can be implemented on a high availability platform. See specifications document for details.
Server	Yes	Full robust redundancy with high availability
I/O Families		
Chassis Series-A	No	
Rail Series-A	No	
Rail Series-H	No	
PMIO	Yes	Full robust redundancy with high availability
Series-C I/O	Yes	Full robust redundancy with high availability

2.3 ControlNet as a Supervisory Control Network

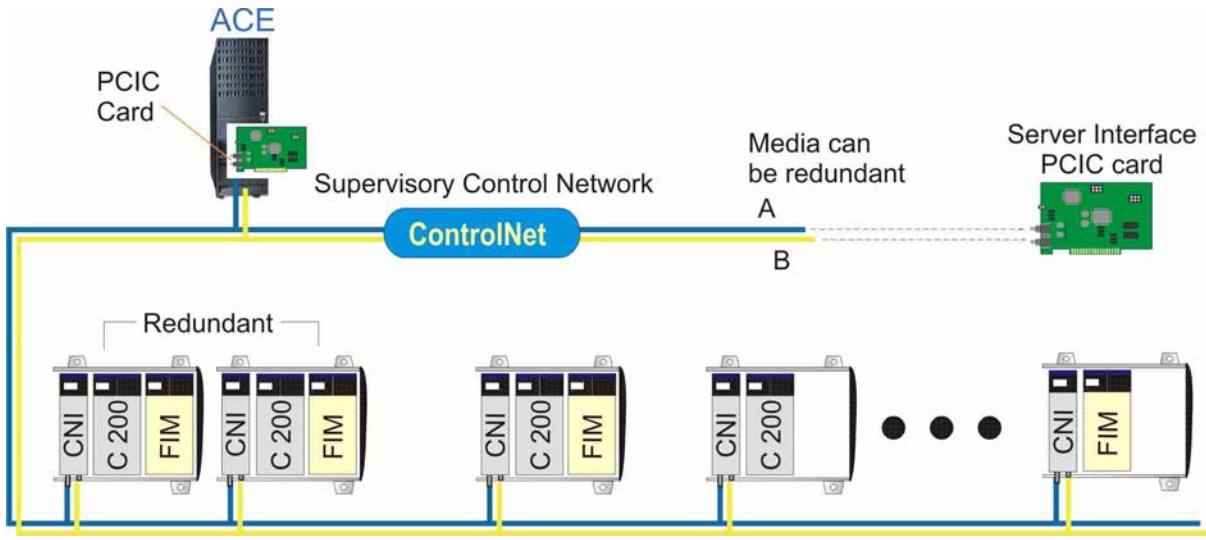


Figure 2-2 ControlNet Supervisory Control Network

Figure 2-2 shows the ControlNet protocol implemented as a Honeywell Supervisory Control Network. ControlNet is an open communication protocol developed by Rockwell and is based on RG-6 coax at 5 mega bit transmission speed. Coax segments can be extended using repeaters and fiber optic modules. Although the media can be redundant, the interface modules have a single set of electronics for both A and B cables.

The ControlNet version supports the C200/C200E, FIM2, and ACE only. The C300/FIM4 cannot be connected to this network type (see FTE section 2.5).

The C200/C200E and the FIM2 are interfaced through the **CNI** (ControlNet Interface Module). CNI comes in a single and dual media version. The CNI, C200/C200E and FIM2 are mounted in a standard Series-A multi-position chassis.

The ACE Node and Server are interfaced through a ControlNet PCI card referred to as the **PCIC** card.

All I/O modules are connected to the C200/C200E processor through a separate CNI and ControlNet network (not shown). Although identical in media, protocol, and topologies, when used for I/O it is referred to as the **I/O Control Network**. See Section 6.2 for more details.

The FIM2 can be used in conjunction with the C200/C200E or it can exist independent of the C200/C200E. The FIM2 occupies two slot positions in the chassis and serves as a gateway to access information from Fieldbus devices connected to its FF links.

C200/C200E, FIM2, and Server can be implemented in a redundant configuration. ACE is not redundant at this time, but can be implemented on a high availability platform.

The limiting factor is the number of nodes (C200/C200E/FIM2/ACE) that can be managed by the Server. See *EP03-300-rrr*.

2.4 CIP Ethernet as a Supervisory Control Network

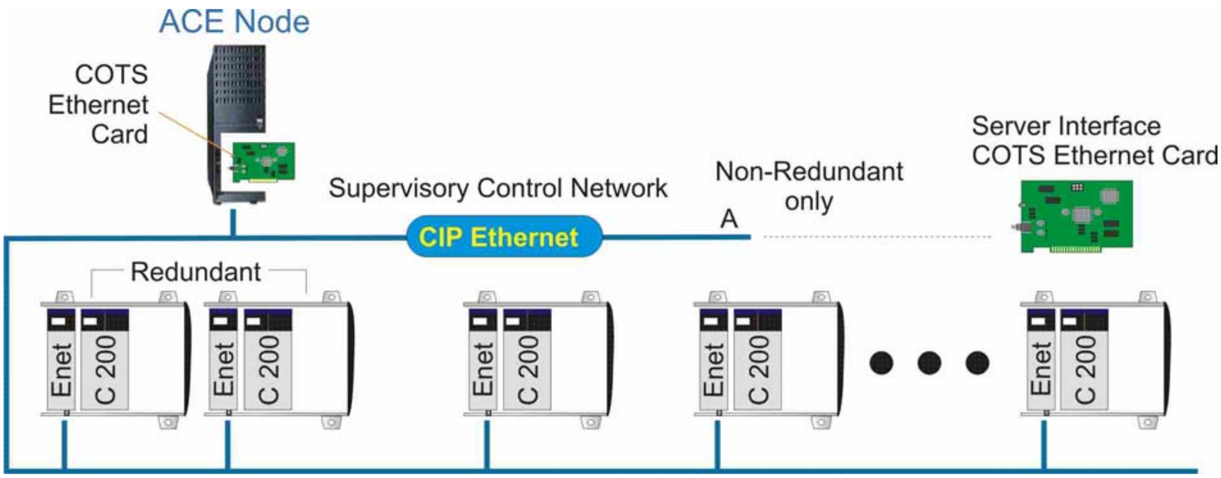


Figure 2-3 CIP Ethernet Supervisory Control Network

Figure 2-3 shows the CIP Ethernet protocol implemented as a Honeywell Supervisory Control Network. CIP (Control Information Protocol) Ethernet was developed by Rockwell as an Ethernet alternative to ControlNet. It utilizes standard Ethernet media and TCP/IP principles with ControlNet relevant extensions for data transfer. It can be implemented as a single non-redundant network only.

The CIP Ethernet version supports the C200/C200E and ACE only. The C300/FIM4/FIM2 cannot be connected to this network type (see FTE section 2.5).

The C200/C200E is interfaced through the **ENet** (Ethernet) Module. The ENet, and C200/C200E are mounted in a standard Chassis Series-A (CIOM-A) multi-position rack.

The ACE Node and Server are interfaced through a Honeywell qualified COTS Ethernet card.

All I/O modules are connected to the C200/C200E processor through a separate CNI and ControlNet network (not shown). When used for I/O it is referred to as the **I/O Control Network**. See Section 6.2 for more details.

C200/C200E and Server can be implemented in a redundant configuration.

The limiting factor is the number of nodes (C200/C200E/ACE) that can be managed by the Server. See *EP03-300-rrr.*

2.5 FTE as a Supervisory Control Network

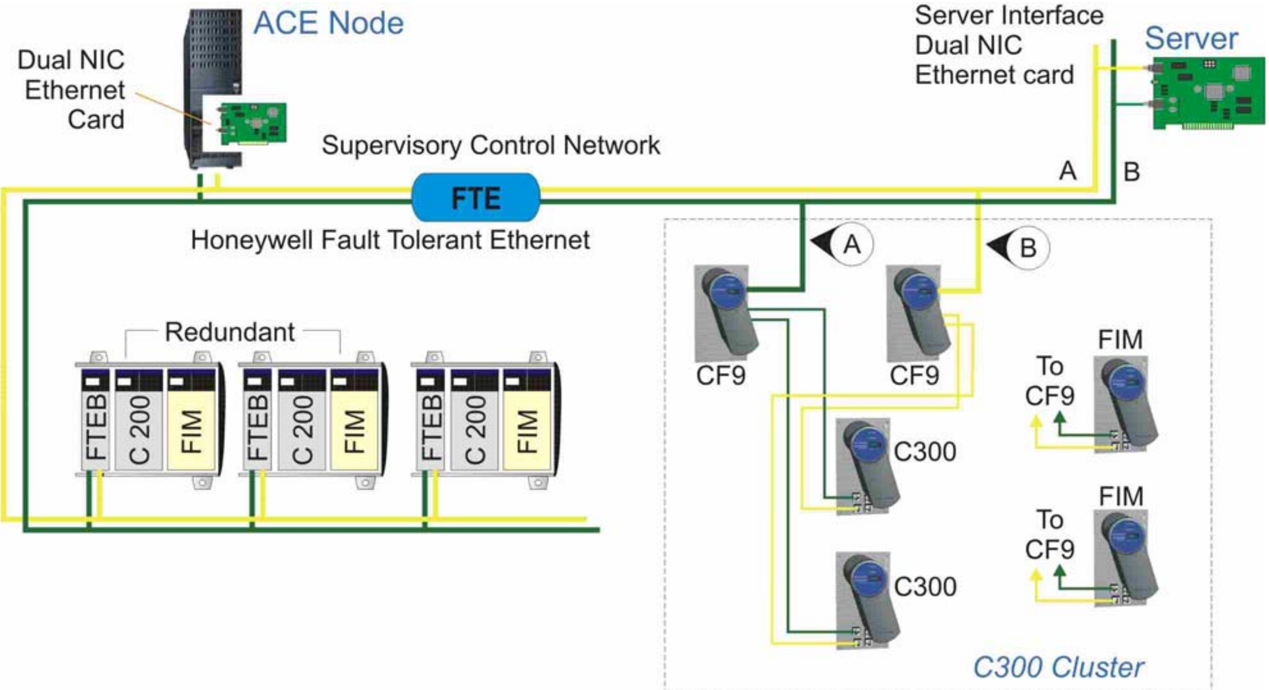


Figure 2-4 FTE as a Supervisory Control Network

FTE (Fault Tolerant Ethernet) is a Honeywell patented solution that adds high availability and robust redundancy to a standard Ethernet network. It is implemented by installing Honeywell FTE software on nodes that have redundant Ethernet communications electronics. FTE software continuously monitors the health of the entire network and when a fault occurs, it directs information over the best available communication path. This allows FTE to maintain network integrity even in the face of multiple media and electronics failures.

- FTE nodes can coexist on the same network with non-FTE nodes.
- FTE can be implemented on non-Honeywell (3rd party) computers.

Chassis Series-A form factor modules (C200/C200E and FIM2) are interfaced to the FTE network using the **FTEB** (Fault Tolerant Ethernet Bridge) module. The ACE node and Server use a qualified COTS dual port NIC. Honeywell FTE software is installed on each node.

C300 processors and Series-C form factor FIM4 are connected to the FTE network through the CF9 (Control Firewall with 9-connectors). The CF9 (one for cable-A and one for B) serves as a firewall to prevent abnormal communications from disrupting control critical traffic. The CF9 has nine Ethernet connectors total. One is required to connect to the network while eight more are available for C300 processors and FIMs. A given grouping can consist of one C300 (if non-redundant) or two C300's (if redundant) with the remainder of the connections available for FIMs. A C300 is not required. That is, the FIM can be implemented without a C300. FIM's can be implemented in a non-redundant or redundant configuration.

The limiting factor is the number of nodes (C200/C200E/C300/FIM/ACE) that can be managed by the Server. See *EP03-300-rrr* and *EP03-500-rrr*.

2.6 Supervisory Control Network Selection Guide

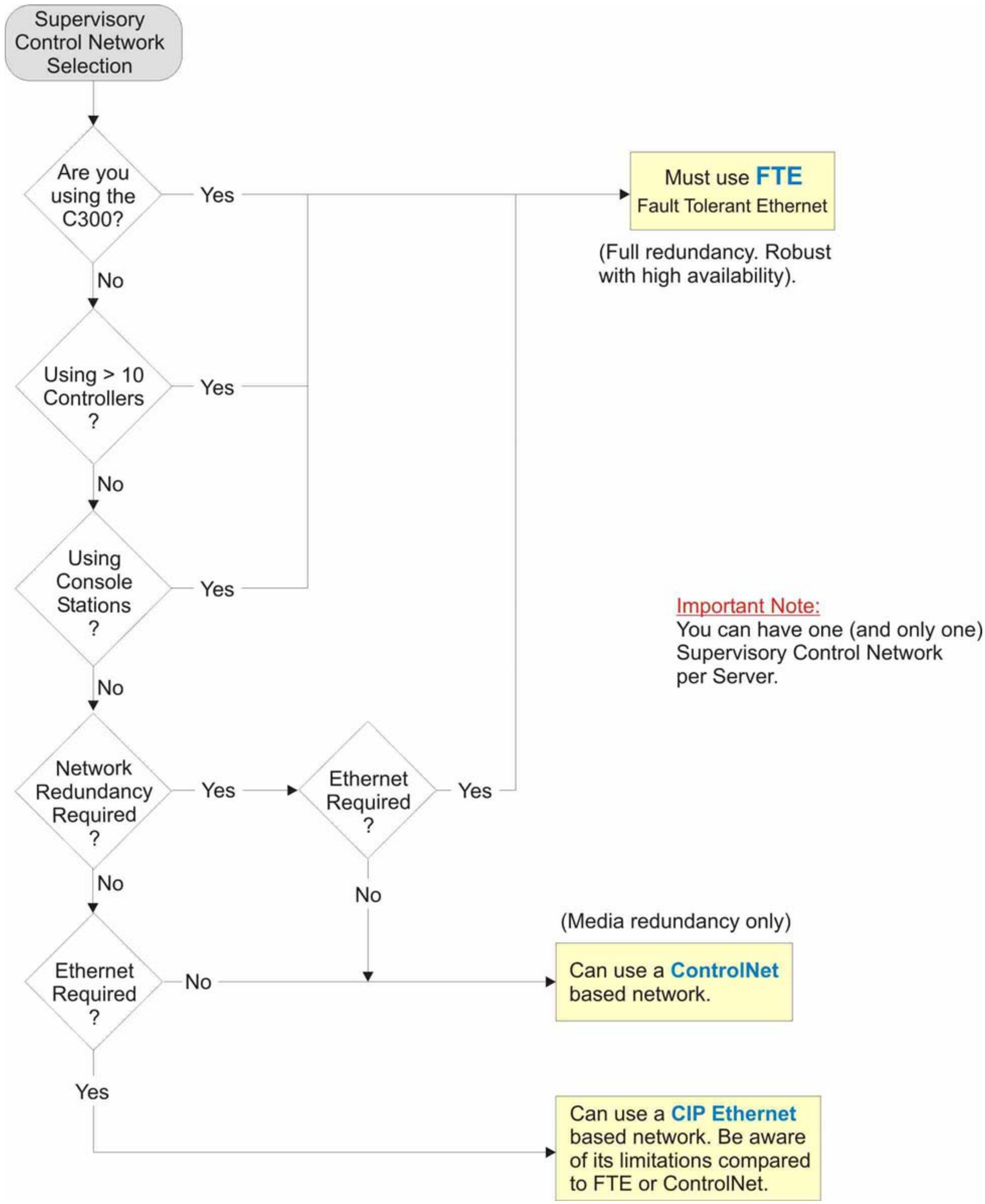


Figure 2-5 Supervisory Control Network selection process and flow chart

3 CEE-Concepts

3.1 CEE Introduction

The Honeywell CEE (Control Execution Environment) provides the control execution platform for all Experion "CEE-based" control processors. It brings forward over 30 years of Honeywell controller development and technology and provides a deterministic, consistent, and reliable control execution platform. The solution combines robustness, flexibility, and uniformity in a Control Execution Environment (CEE) that can be hosted on different platforms. Today, the CEE software is hosted on the C200/C200E, C300, and ACE node.

3.2 CEE Strategy Configuration

Each control processor is configured to meet the specific control and logic requirements of their assigned portion of the process plant. All CEE related configuration is completed using the Honeywell **Control Builder** environment. For details see section 8.

3.3 CEE Function Blocks

The CEE is loaded into the memory of the C200/C200E, C300, and ACE nodes enabling them to meet the control needs of continuous processes, batch processes, discrete operations, and machine control applications.

The CEE provides access to a comprehensive library (see Table 3-1 for examples) of control related FB's (**Function Blocks)**. Each **FB** provides a specific control task (like, PID automatic control, ramp/soak, logic blocks, etc.). As shown in Figure 3-1, the end user develops the plant-specific control strategies by selecting the desired FB (from the library) and interconnecting the correct block inputs and outputs. In the case of the C200/C200E and C300 the control strategy can include inputs and outputs (shown as Blue blocks) from I/O modules and real field sensors and transducers.

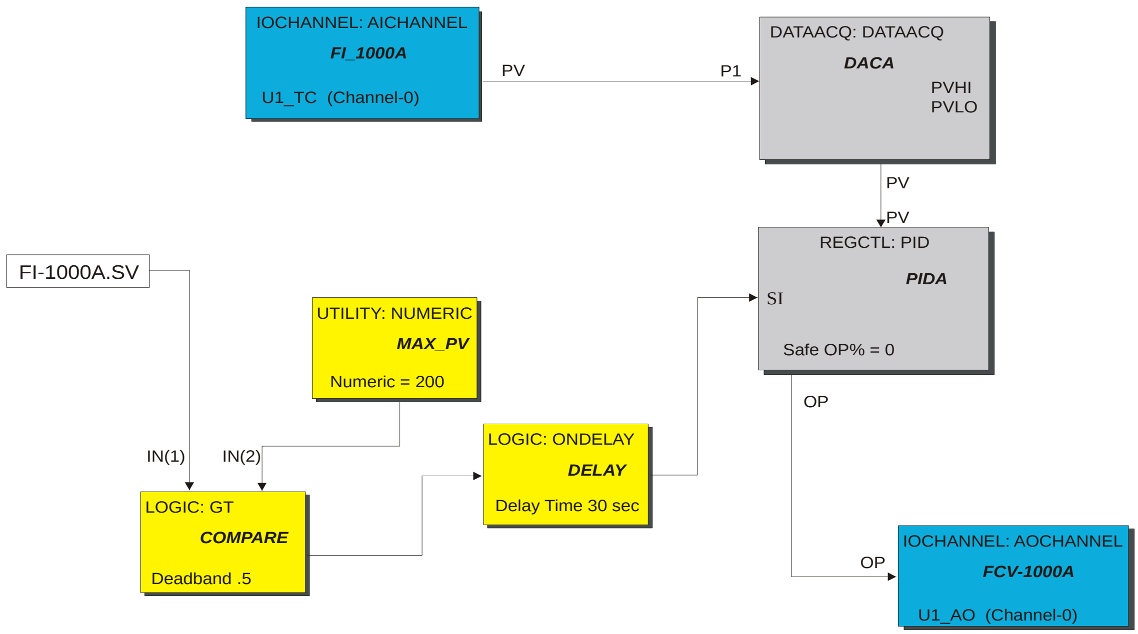


Figure 3-1 Sample CEE Control Loop

Table 3-1 Examples of Block Types Supported by CEE-based Controllers

Important: The table is provided for context. Each CEE-based node may have a different set of function blocks that it supports. Always consult the appropriate specifications document for details.

General Purpose (Utility)		
Flag	Numeric	Text array
Type Convert Block	Numeric array	Timer
Push	Flag array	Operator message
PV Algorithms (Auxiliary)		
General Linearization	Totalizer	PV Calculator
Flow compensation	Dead Time	Lead / Lag
Signal Selector	Enhanced PV Calculator	Summer
PV handling		
	Data Acquisition	
Regulatory Control Algorithms		
Profit Loop	Fanout Block (1 input/up to 8 outs)	Ramp / Soak
Proportional, Integral, Derivative (PID)	Inter cluster cascade support	Positional Proportional
PID with Feed forward	Regulatory Calculator	Pulse Length
PID with External reset	Enhanced Regulatory	Pulse Count
Override Selector (4 inputs)	Calculator	Regulatory Control Summer
Auto Manual	Ratio Control	Remote Cascade support
Switch (8 input single pole)	Ratio Bias	
Device Control - DEVCTL (multi input, multi output, multi state)		
Discrete Logic (per IEC 1131 standard)		
2oo3 (2-out-of-3 Voting)	MIN (Minimum)	QOR (Qualified OR)
AND	MINPULSE (Minimum Time)	ROL (Rotate Left)
CHECKBAD	Limit Pulse	ROR (Rotate Right)
CHECKBOOL	MUX (8-Input Multiplexer)	RS (Reset-Dominant Flip-Flop)
DELAY	MUXREAL (8-Input)	RTRIG (Rising-Edged Trigger)
EQ (Compare Equal)	Multiplexer, Real Number	SEL (Selector Function)
GE (Compare Greater Than or Equal)	MAXPULSE (Maximum Time Limit Pulse)	SELREAL (Selector Function, Real Number)
FTRIG (Falling-Edged Trigger)	NAND	SHL (Shift Left)
GT (Compare Greater Than)	NE (Compare Not Equal)	SHR (Shift Right)
LE (Less Than or Equal)	nOON (n-out-of-N Voting)	SR (Set-Dominant Flip-Flop)
LIMIT	NOR	STARTSIGNAL
LT (Compare Less Than)	NOT	TRIG (Change Detect Trigger)
MAX (Maximum)	OFFDELAY	WATCHDOG
	ONDELAY	MVOTE (Majority Vote)
Sequential Control Functions (in line with the ISA S88.01 standard)		
Step	Synchronize	
Transition	Handler: Main, Interrupt, Check, Restart, Hold, Stop, Abort	

3.4 CEE Container Concept

Containers: As a CEE concept, containers allow the user to partition the overall control strategy into logical and manageable sub-groupings that best meet the needs of their particular process and plant site. The following container types are available:

CM's (Control Modules) and **SCM's** (Sequence Control Modules)

Both types allow the user to assign function blocks (along with any field inputs and outputs) into containers. The CM and SCM differ in the type of control paradigm that they are designed to address. The CM is suited for continuous control tasks while the SCM is especially suited to sequential (step-by-step) and procedural control tasks. It is completely up to the user to determine how they will partition all plant controls into control processors and then CM/SCM containers.

For example, all of the control function blocks and I/O blocks required to monitor and control a particular flow line could be placed under one CM called FIC100a. Or the user may decide to put several flow lines and the pump controls and logic under a single CM. The point is the user can partition the plant controls in any manner that makes sense for the process and operations.

CM (Control Modules): Each CM is a CEE "container" that houses a user defined set of control Function Blocks. The Function Blocks in a CM are associated with continuous type tasks and controls. Figure 3-1 is an example of a CM. The gray blocks represent two continuous function blocks. The DATAACQ block provides PV ranging, characterization, and input alarming while the PID block provides the standard automatic control loop function. The two blue blocks represent an input and an output from an I/O module. The input is coming from a flow transmitter while the output goes to a control valve. The yellow blocks represent some interlock logic that is associated with the loop. In this case, if the field input from FI-1000a is greater than 200 for more than 30 seconds the PID is placed into shutdown mode and the output is set to zero. Every CM is given a unique user assigned name (or Tag).

CM's in the same control processor (C200/C200E, C300, and ACE) can pass data from CM to CM allowing the user to create complex and comprehensive control strategies. Peer-to-Peer data transfer can also be configured between CEE-based controllers on the same Supervisory Control Network.

CM's are continuous in nature and are configured to run on predefined processor execution periods. The user determines the CM execution period and where the CM runs with respect to other CM's in the same processor.

SCM (Sequence Control Modules): In the CEE, SCM's are "containers" that house sequential (step-by-step) process related function blocks. SCM's greatly simplify **batch** logic implementation and the SCM implementation follows the S88.01 standard. The user configures each SCM by implementing the standard function blocks (Step, Transition, Synchronize, Handlers- Main, Interrupt, Check, Restart, Hold, Stop, and Abort) to create the desired procedure.

Other procedural and batch related functions and features are available to augment the SCM functionality. See appropriate documentation for details about **RCM** (Recipe Control Module), **UCM** (Unit Control Module), and Interactive Instructions.

Naming and Strategy Structure: The CEE provides a very flexible structure and allows the end user to decide how they wish to subdivide the total plant process requirements into individual control processors, CM's, and SCM's. The end user also determines the naming convention used to identify each particular CM and SCM.

3.5 CEE Notes and Processing Limits

Processing Limits: Each control processor (C200/C200E, C300, ACE node) is limited by available memory and processing power. This will limit the total number of CM's and SCM's that can be loaded into a given processor.

Actual Function Blocks: Although all Experion CEE-based control processors (C200/C200E, C300, and ACE) share the fundamental concept of the CEE they may differ in the list of available control Function Blocks provided by that specific node.

Refer to *EP03-300-rrr* for CEE details and capacities.

4 Experion-CEE-based Control Processors

4.1 C200/C200E Control Processor

The C200 has been available from the very first release of Experion. The C200 control processor is mounted into a standard Series-A chassis assembly. The C200 occupies two physical slot positions in the chassis. The chassis-A power supply provides power for all modules mounted in the chassis.

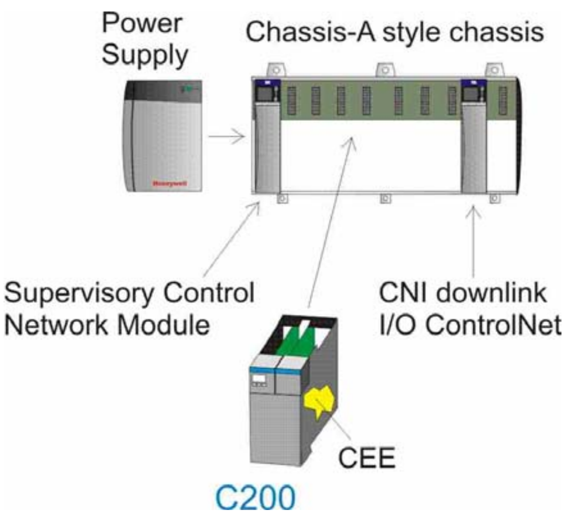


Figure 4-1 C200 Controller

The C200 can be implemented in a single or fully redundant configuration. In a redundant configuration two C200 processors are mounted into two different chassis assemblies with an identical complement of modules. An RM (Redundancy Module) is mounted in each chassis to manage redundancy synchronization and the automatic swap between the primary and backup C200. Data is continuously synchronized between C200's with a fiber-optic cable that connects the RM's.

The CEE is loaded into the C200 memory providing the execution platform for the comprehensive set of automatic control, logic, data acquisition, and calculation function blocks (see examples in Table 3-1). Using the Honeywell **Control Builder** (a graphical configuration tool) the user creates and downloads the control strategy to be executed by the C200 processor. Control Builder is also used to configure all hardware connected to the C200 (I/O modues and gateways to smart serial networks).

The C200 is interfaced to the Supervisory Control Network using one of the available network interface modules (see section 2).

The C200E controller is introduced with Experion PKS release 400. It contains all of the existing functionality in the C200 controller, and adds additional memory and functionality. The C200E supports the full S88 batch standard and the power function blocks that were introduced in Experion PKS R310.

For C200/C200E details refer to Specification Doc *EP03-300-rrr, EP03-400-rrr,* and *EP03-330-rrr.*

I/O Connection: The C200/C200E (and its control strategy) are connected to I/O modules (and real field devices) through the CNI down link module and the I/O ControlNet media. The following I/O families and their associated modules can be connected to the C200/C200E:

- CIOM-A (Chassis-A I/O Modules) See Section 6.1 & 6.2
- RIOM-A (Rail-A I/O Modules) See Section 6.1 & 6.2
- RIOM-H (Rail-H I/O Modules) See Section 6.1 & 6.2
- PMIO (Process Manager I/O) See Section 6.1 & 6.4

4.2 C300 Control Processor

The C300 control processor is Honeywell's most powerful Experion "CEE-based" control processor and was first available with Experion R300. The C300 was developed in Series C form factor and is mounted on a dedicated printed circuit board (there is no chassis or rack associated with the C300). The passive circuit board provides connections to all external interfaces (CF9, communication networks, I/O, redundancy cable, power supply, etc.).

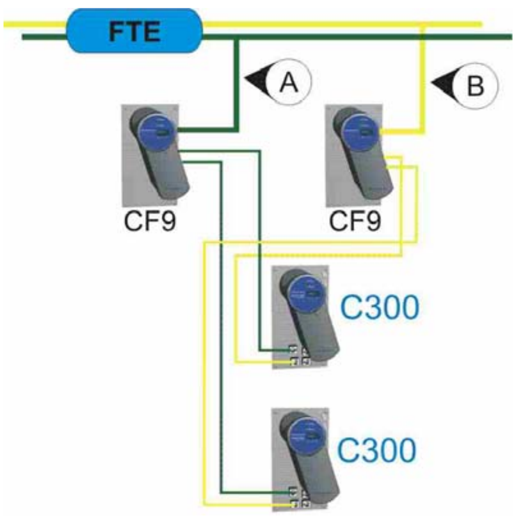


Figure 4-2 C300 and CEE

All C300's reside on the FTE Supervisory Control Network (see section 2.5). To fully protect the integrity of the control mission and prevent cyber attacks the C300 is always interfaced to the FTE network through the CF9 (Control Firewall). CF9 is pre-configured to filter all non-C300 traffic.

The C300 can be implemented in a non-redundant or fully redundant configuration. The C300 provides all redundancy management and swap functions.

The CEE is loaded into the C300 memory providing the execution platform for the comprehensive set of automatic control, logic, data acquisition, and calculation function blocks (see examples in Table 3-1). Using the Honeywell **Control Builder** (a graphical configuration tool) the user creates and downloads the control strategy to be executed by the C300 processor. Control Builder is also used to configure all hardware connected to the C300 (I/O modules and gateways to smart serial networks).

For C300 details refer to Specification Doc *EP03-300-rrr* and *EP03-320-rrr*

I/O Connection: The C300 (and its control strategy) are connected to real field devices through the following I/O families and their associated modules:

- Series-C I/O — See Section 6.1 & 6.5
- PMIO (Process Manager I/O modules) — See Section 6.1 & 6.4
- CIOM-A (Chassis-A I/O Modules) — See Section 6.3

4.3 ACE Node

The Honeywell ACE Node is implemented on a server grade computer platform. The ACE-CEE is loaded into the memory providing the control execution platform and access to a comprehensive set of automatic control, logic, data acquisition, and calculation function blocks (see Table 3-1).

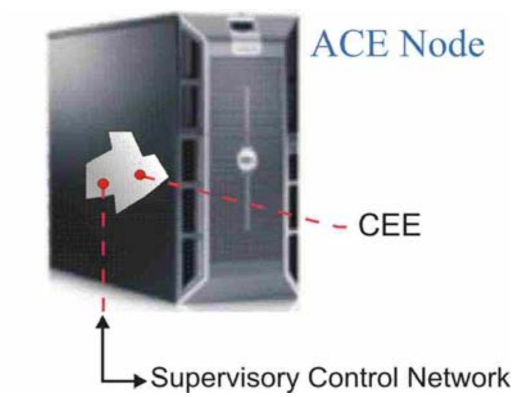


Figure 4-3 ACE Node

Its position on the Supervisory Control Network (see section 2) enables the user to create effective and powerful supervisory control strategies using process data resident in any connected C200/C200E, C300, FIM, and other ACE nodes.

Unlike the C200/C200E and C300 processors the ACE does not have any directly connected I/O. However, it can gain access to field inputs and outputs through any of the connected C200/C200E, C300, and FIM nodes. An ACE can also access (read/write) data resistant in other ACE nodes on the same Supervisory Control Network.

By reading information from C200/C200E/C300/FIM nodes the ACE node can be aware of process input conditions from all field inputs on the control network. It can then use this information in control function blocks and direct the calculated outputs back to the C200/C200E/C300/FIM nodes to manipulate and control the process. ACE function blocks can serve as primary controllers to function blocks (secondary controls) located in C200/C200E/C300/FIM nodes.

Using the Honeywell **Control Builder** (a graphical configuration tool) the user creates and downloads the control strategy to be executed by the ACE processor.

ACE can be implemented on a high availability PC platform.

Custom Function Blocks:
In addition to the standard function block library provided by the Honeywell CEE, the ACE allows the user to create custom function blocks referred to as CAB (Custom Algorithm Blocks) and CDB (Custom Data Blocks). Custom blocks have user-defined algorithms and data structures, but once a CAB block type has been created it behaves and acts the same as any standard function block.

Other Interfaces:
Although not covered in this document, in addition to the interfaces described above, the ACE can also access information from other control related nodes and devices such as:

- Data transfer between OPC compliant nodes
- Inter-Cluster Communications between other Supervisory Control Networks
- Connection to Honeywell legacy systems and nodes (TPS/TPN/LCN). Referred to as an ACE-T.

For more details see the Specification Doc *EP03-310-rrr*

5 FIM- Important Control Concepts

Both the Chassis-A (FIM2) and Series-C (FIM4) versions of the FIM serve as a gateway to Foundation Fieldbus smart devices (transmitters, valves, analyzers, etc.). FIM2 supports 2 FF H1 links and FIM4 supports 4 FF H1 links per FIM. See specification *EP03-470-rrr* document for the number of devices allowed per each H1 link.

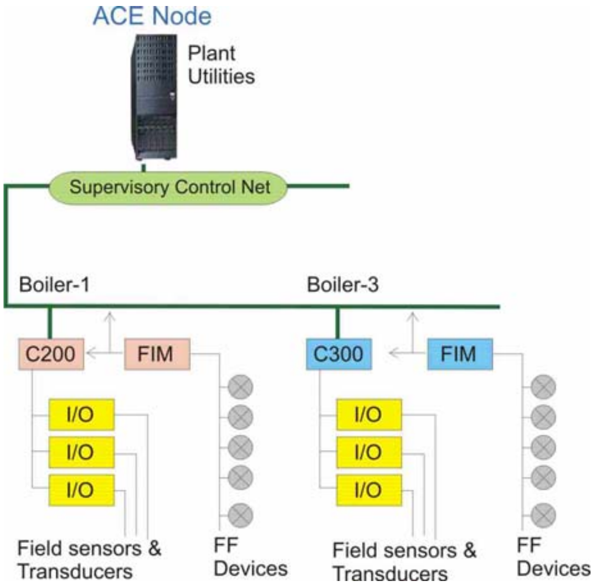


Figure 5-1 FIM Concepts

Along with the usual process connected tasks (like flow, temperature, pressure, level, valve positioners, drive units, solenoids, etc.), FF devices also provide a comprehensive set of status, event, and diagnostic information.

In addition, the Foundation Fieldbus protocol also allows the vender to embed automatic control algorithms and functions into their FF devices. This provides for the concept of "**Control in the Field"** where two or more FF devices on the same FF link can be configured to perform automatic control tasks.

As an example, the diagram to the right shows a flow control loop implemented with two FF devices. The FF flow transmitter measures the flow rate and provides the signal to the FF valve positioner. The positioner provides a PID automatic control algorithm that compares the flow rate to a set point and automatically repositions the valve to maintain the desired flow rate. This concept allows entire control schemes to be implemented using multiple FF devices connected on the same Fieldbus network.

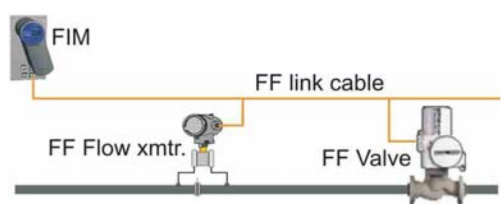


Figure 5-2 Sample FF Control Loop

The FIM (and its connected devices) can be implemented in an architecture that is totally independent of the C200/C200E/C300/ACE processors or can include any combination of FIM's and control processors. This provides a very flexible platform where the user is free to interconnect intelligent FF devices and any of the control processors (C200/C200E/C300/ACE) in any combination or mix that makes the most sense for the process and plant.

A new FIM8 is introduced with Experion R400. It has 8 H1 FF links and all concepts above apply.

A Common Engineering Environment:

The FIM and C200/C200E/C300/ACE are fully integrated with Experion and are configured using the same engineering tool (**Control Builder,** see section 8.1). Using a common tool enables easy configuration, FB interconnection, and management of all nodes involved with the control strategy. FF devices can be fully configured, managed, and monitored from the CB environment. Experion also manages and displays all FF status/events and diagnostics. Refer to Specification Doc *EP03-470-rrr*

6 I/O Families

6.1 Introduction

Experion provides five I/O families that can be used in conjunction with the C200/C200E and C300 control processors. The table below lists each family along with major characteristics.

Figure 6-1 Experion I/O Families

Table 6-1 I/O Family Summary, Description, and C200/C200E/C300 Connectivity

I/O Family (Source)	Mounting Type/style	Major Features and Distinguishing Characteristics	Usable with C200/C200E?	Usable with C300?
CIOM-A (AB-1756)	Chassis	• Wide variety of I/O types and chassis sizes • Good Backplane robustness (but non-redundant) • Good quality I/O when redundancy is not required	Yes	Yes Note-1
RIOM-A (AB-1794)	Din Rail	• Inexpensive installation and wiring • Flexible mounting configurations	Yes	No
RIOM-H (P+F Haz)	Din Rail	• Hazardous area use (no need for IS barriers) • Direct mounting in Zone-1/Div-1 • Field device mounting in Zone-0	Yes	No
PM I/O (Honeywell)	Chassis	• High integrity, robust, redundant I/O • High integrity, robust, redundant Backplane • High integrity, robust, redundant module and field power • Comprehensive error checking/reporting	Yes	Yes
Series-C I/O (Honeywell)	Chassis-less Note-2	• High integrity, robust, redundant I/O • Has no Backplane, no single point of failure • High integrity, robust, redundant module and field power • Comprehensive error checking/reporting	No	Yes
Note-1: C300 supports all CIOM-A I/O modules except FIM2. Note-2: C300 and Series-C I/O modules are mounted on a simple "Carrier". The carrier provides only power to the module. A base panel called an IOTA (Input Output Terminal Assembly) provides connections for communications, as well as, terminations for the field wiring.				

The table below provides a summary of the essential I/O capabilities by each I/O family.

Table 6-2 Essential I/O functions/features by I/O family

Function or Feature	CIOM-A	PM IO	RIOM-A	RIOM-H	Series-C
Chassis sizes (# of slots)	4, 7, 10, 13, 17	7 or 15	N/A	N/A	N/A
AI, AO, DI, DO modules	Yes	Yes	Yes	Yes	Yes
Serial Interface Module	Yes	No	No	No	No Note-1
High speed pulse counter	Yes	No	No	No	No Note-1
Environment rating	G1, G3	G1, G3, Gx	TBD	G1, G3	G3
Corrosion Protection (Conformal Coating)	Optional	Optional	No	Standard	Standard
Operating temperature	0-60 DEGC	0-60 DEGC	0-55 DEGC	0-70 DEGC	0-60 DEGC
Location Certification (See Specification Doc)	Div 2 Haz Loc	Div 2 Haz Loc	Div 2 Haz Loc	Zn 1/0 Haz Loc	Div 2/Zn 2 Haz Loc
24Vdc Field Power	External	Internal	External	External	Internal
RIUP (removal & insertion under power)	Yes	Yes	Yes	Yes	Yes
ProfiBus Interface	Yes	No	No	No	Yes
HART Integration	Yes	Yes	No	No	Yes
Honeywell DE	No	Yes	No	No	No Note-2
DeviceNet	Yes	No	No	No	No Note-1
FF Integration	Yes	No	No	No	Yes
Engineered Cabinet	No	Yes	No	No	Yes
I/O Redundancy?	No	Yes	No	No	Yes
Field wiring method	Front of module or RTP	FTA	Below module on carrier	Below module on carrier	Carrier IOTA
Media used to connect Cx00 processor to I/O	ControlNet	Honeywell IO Link	ControlNet	ControlNet	Honeywell IO Link (2x speed)
Maximum distance Cx00 processor to I/O	TBD	8 K-meters	TBD	TBD	4 K-meters

Note-1: These I/O types are provided by using CIOM-A I/O modules interfaced to the C300 using FTE and FTE bridge modules.

Note-2: DE can be interfaced to the C300 using PMIO modules.

Legend: RTP= Remote Terminal Panel IOTA = Input Output Terminal Assembly.
FTA = Field Termination Assembly.

6.2 CIOM-A, RIOM-A, RIOM-H Communication and Common Concepts

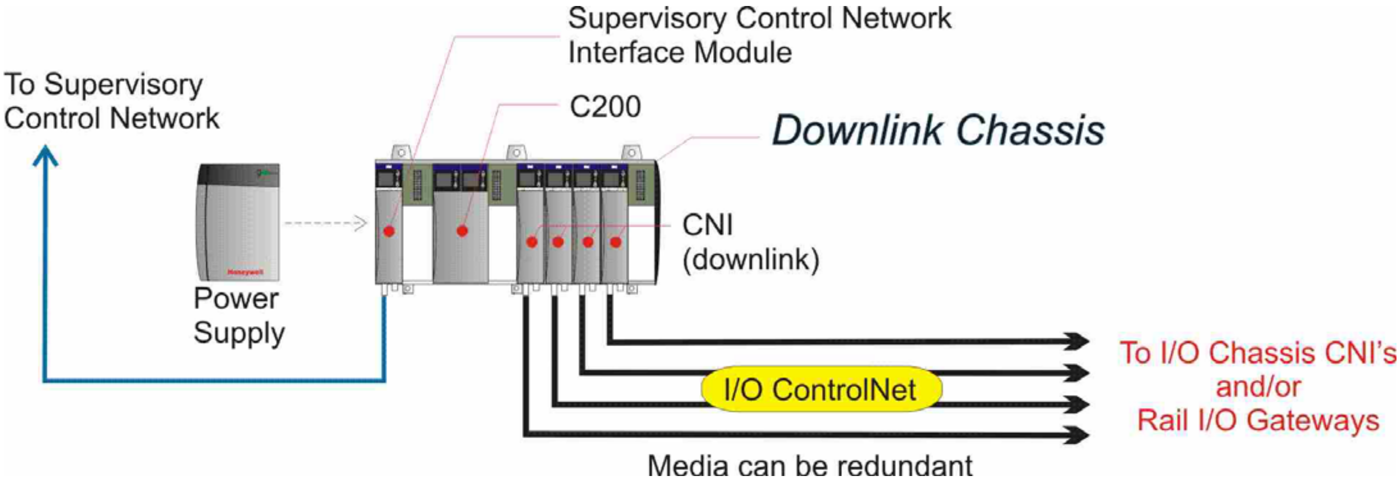


Figure 6-2 CIOM-A, RIOM-A, and RIOM-H common components

The concept and implementation of a Downlink chassis and the I/O ControlNet topology are common to the CIOM-A, RIOM-A, and RIOM-H I/O families.

Downlink Chassis: The "Downlink Chassis" is a standard CIOM-A chassis backplane. These chassis (racks) are Honeywell branded versions of the Rockwell 1756-series platform. The chassis come in five versions (**4, 7, 10, 13, and 17**) of module slot positions. The label "***Downlink Chassis***" is applied to that chassis that contains the Supervisory Control Network interface module and the C200/C200E control processor.

Redundant C200/C200E configurations would consist of two separate chassis with an identical set of modules in each chassis. It would also include an RM (Redundancy Module) in each chassis to manage the redundancy synchronization and swap over.

The CIOM-A **power supply** is mounted to the left side of every chassis providing DC power to each module mounted in the chassis. There is an optional redundant power configuration available. This supply does not provide 24 Vdc for field devices.

Downlink CNI Modules: These are standard CNI (ControlNet Interface) Modules. The CNI comes in a single or dual media version. These CNI modules are referred to as downlink CNI's because they are mounted in the Downlink Chassis.

I/O ControlNet: This is the media used to interface the I/O modules to the C200/C200E. ControlNet is an open communication protocol developed by Rockwell and is based on RG-6 coax at 5 mega bit transmission speed. Coax segments can be extended using repeaters and fiber optic modules. Although the media can be redundant the interface modules have a single set of electronics for both A and B cables.

Figure 6-4 shows one CNI downlink and the interface method used for each I/O family.

A given I/O downlink can consist of one I/O family type or can be a combination of any of the three I/O family types.

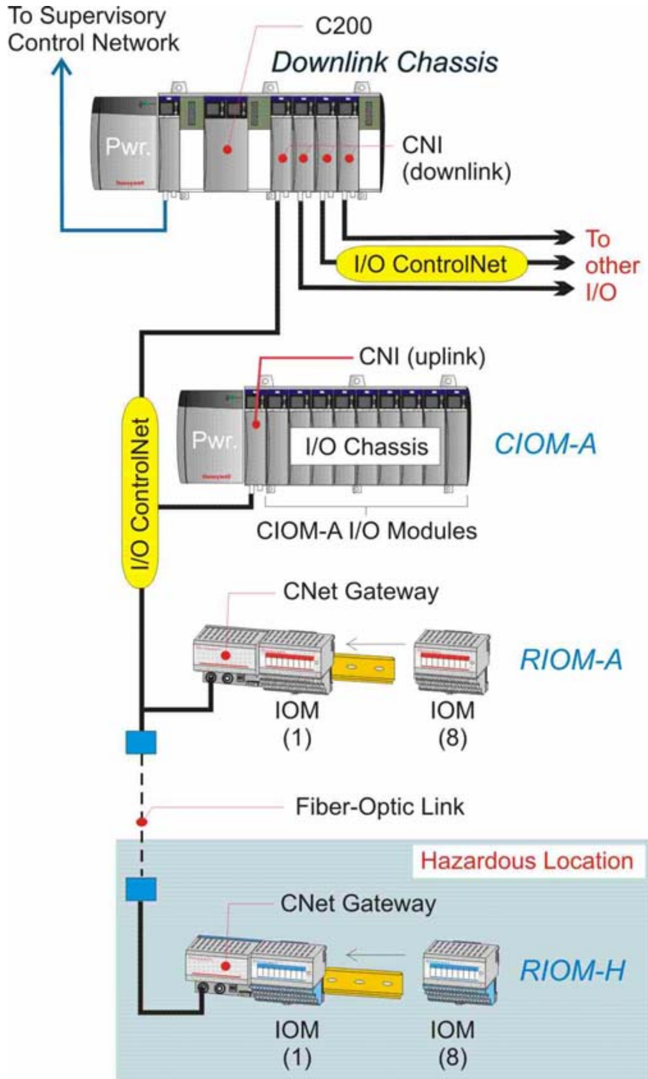


Figure 6-3 Sample I/O downlink showing all I/O families

CIOM-A I/O modules are interfaced through standard CNI modules (single or dual media versions). The number of IO modules is dependent on the chassis type used (4, 7, 10, 13, and 17 slot chassis).

The Downlink chassis and the I/O chassis are identical hardware. Their labels are derived from their position in the topology. Downlink chassis and I/O chassis use the same power supply (mounted to the left of the chassis).

I/O modules can be placed into the Downlink chassis, but only when C200/C200E redundancy is not used.

RIOM-A I/O modules are interfaced through the RIOM-A CNet Gateway (single or dual media versions). The gateway and IOM's are mounted to a DIN rail. All modules clip together to form the power and communication backplane. Each gateway allows for a maximum of 8 I/O modules (IOM's).

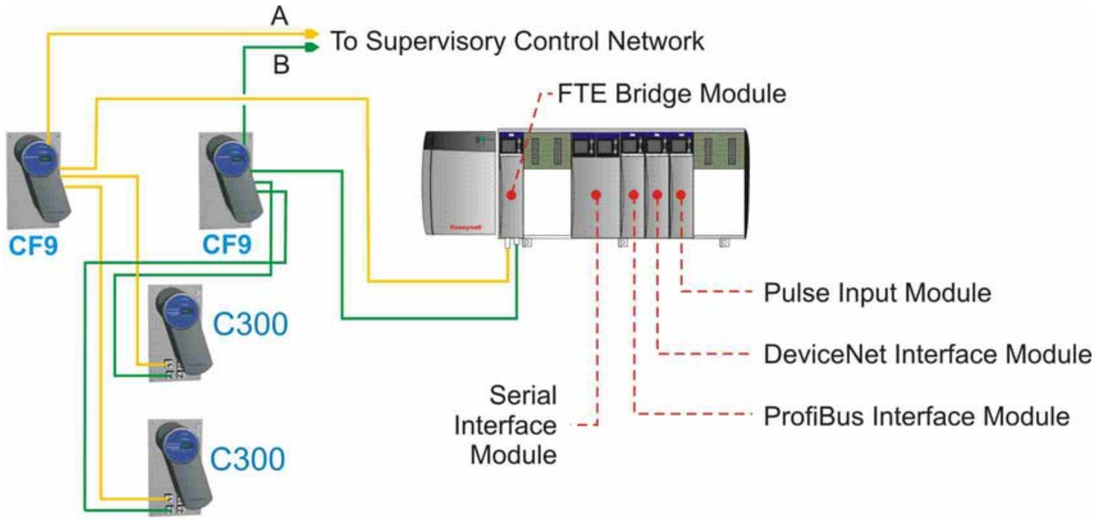
RIOM-H I/O modules are interfaced through the RIOM-H CNet Gateway (dual media type only). The gateway and IOM's are mounted to a DIN rail. All modules clip together to form the power and communication backplane. Each gateway allows for a maximum of 8 I/O modules (IOM's). To separate the non-hazardous and hazardous locations (electrically), RIOM-H gateways must be connected to the I/O CNet through a fiber optic link. Once in the hazardous location, coax cable can be used from gateway to gateway.

For context, the following limits are provided. For up to date specifications see *EP03-300-rrr*.

Maximum CNI I/O downlinks per Downlink chassis	4
Maximum I/O chassis and/or gateways per downlink (any mix of families)	8
Maximum number of IOM's (from all downlinks) per C200/C200E.	64

Note: When PMIO is used, each IO processor will also consume this resource.

6.3 CIOM-A and C300 Interface



6-4 Interfacing CIOM-A I/O modules with the C300

All CIOM-A I/O modules except for FIM2 have been tested and qualified for use with the C300 control processor. The modules are mounted in a standard CIOM-A chassis (4, 7, 10, 13, and 17 slot types). User can implement a single chassis only; no downlink I/O chassis are supported at this time.

Interface to the C300 is through the FTE Bridge module and the CF9.

For actual capacities and rules see the Specification Doc *EP03-300-rrr.*

6.4 PMIO Summary

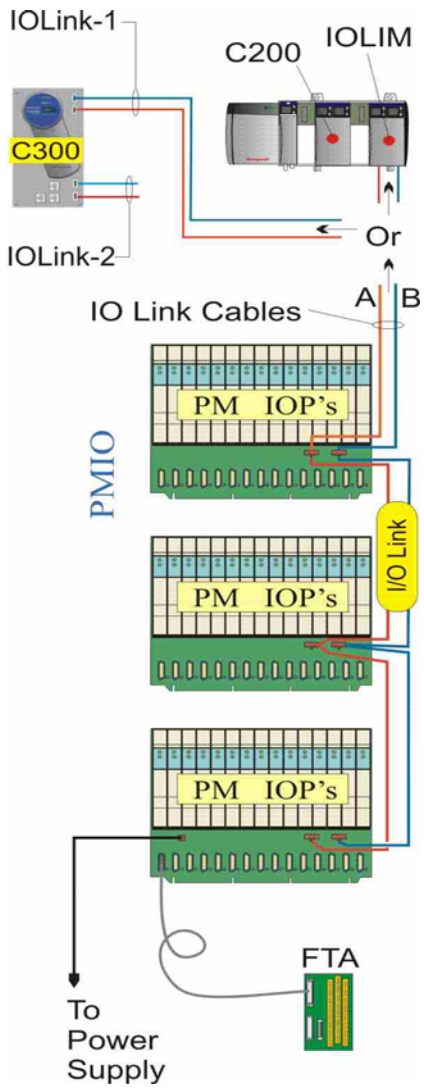


Figure 6-5 PMIO Architecture

PMIO (Process Manager I/O) was originally designed for use with the legacy TPS and the Process Manager family of control processors. It is a mature, highly available, and very robust I/O solution and platform. All components can be implemented in a redundant fashion providing a solution with no single point of failure.

PMIO is a chassis/backplane based platform where **IOP's** (Input Output Processors) are mounted into card slot positions. IOP's are intelligent I/O cards.

The term CFA (Card File Assembly) is used to identify the PMIO chassis. There are two types of CFA based on the number of card positions provided (the **15 slot** shown in the diagram and the **7 slot)**.

FTA's (Field Terminal Assemblies) are connected to each IOP by way of a 50-conductor cable that terminates below the respective IOP card position. In the case of redundant IOP's two cables connect the primary and backup IOP to the single FTA. The FTA provides field terminations to connect to the field sensors and transducers.

IOP's communicate with either the C200/C200E or C300 over a redundant pair of **IO Link** Cables. The IO Link is a very efficient Honeywell proprietary I/O communication link.

The C300 provides two IO Link interfaces (Link-1 and Link-2). Interface to a C200/C200E requires a separate two position IOLIM (IO Link Interface Module). Two IOLIMS are required for a redundant C200/C200E.

One IO Link allows for a maximum of eight card file assemblies total in any combination of 15 and 7 slot types.

Power: Honeywell provides a power supply system (not shown) that was specifically designed for use with PMIO. The power system provides all DC voltages required by the IOP's and also provides 24 Vdc for use with field devices. The power supply system can be fully redundant. Each CFA is connected to the power system by redundant cables that terminate on the backplane.

See Specification Doc *EP03-430-rrr* for more details.

6.5 Series-C I/O

Series C I/O is Honeywell's latest I/O platform. It utilizes state of the art technology and builds on the experience and success of the PMIO family. It also implements a unique hardware platform design that maximizes I/O density while optimizing heat dissipation.

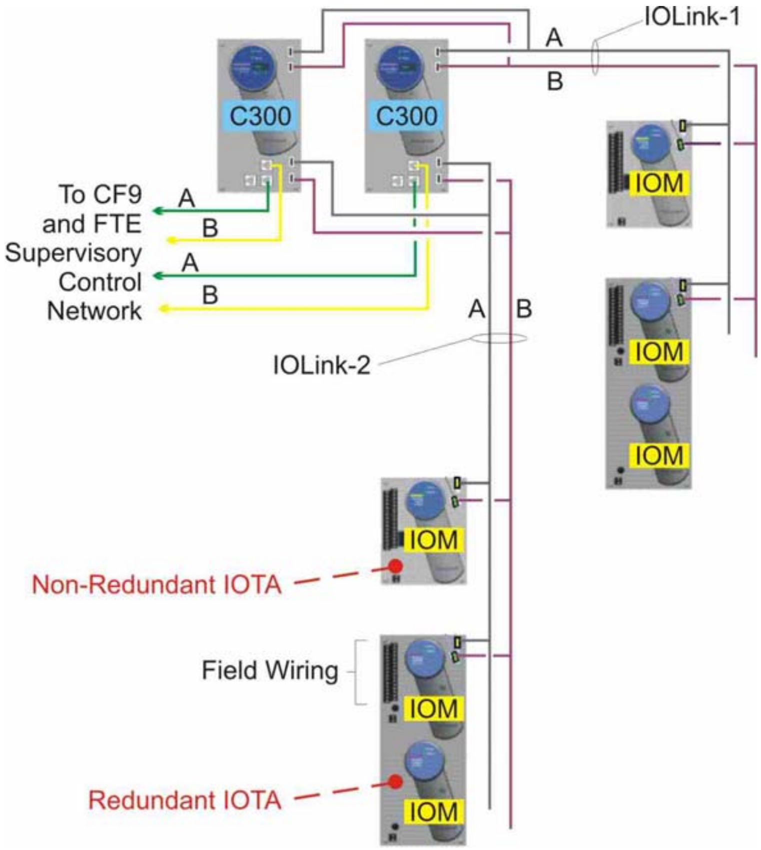


Figure 6-6 Series C I/O Architecture

Like PMIO, Series-C provides high availability on a very robust I/O platform. All components can be implemented in a redundant fashion providing a solution with no single point of failure.

IOLink: Series-C I/O uses an enhanced version of the PMIO IOLink communication protocol to transfer I/O data between **IOM**'s (Input Output Modules) and the C300. Like PMIO this link is fully redundant.

The C300 control processor provides two link interfaces (IOLink-1 and IOLink-2). IOM's can be connected to either link as best meets the needs of the implementation.

The C300 can be non-redundant or redundant.

IOTA: IOM's are mounted on an IOTA (Input Output Terminal Assembly). The IOTA provides field terminations to connect to the field sensors and transducers.

Redundancy: A **non-redundant IOTA** provides a mounting for one IOM and cannot support redundancy. A **redundant IOTA** has two IOM mounting positions and provides the support for redundant IOM's.

Power Distribution: IOTA's are mounted in cabinets on special Series-C mounting channels. Part of this mounting assembly includes a power bus bar system. The activity of mounting the IOTA connects the IOM to the power system. The Power system is fully redundant.

Special note about PMIO: PMIO can be interfaced to the C300 using one (or both) of the IOLink interfaces. This allows the user to mix PMIO with Series-C I/O (only one type can be placed on a given IOLink).

For more information see Specification Doc *EP03-490-rrr*

6.6 CIOM-A Smart Device Interfaces

As the diagram depicts, the Chassis-A I/O family provides several interfaces to communicate with intelligent devices connected to serial communication networks.

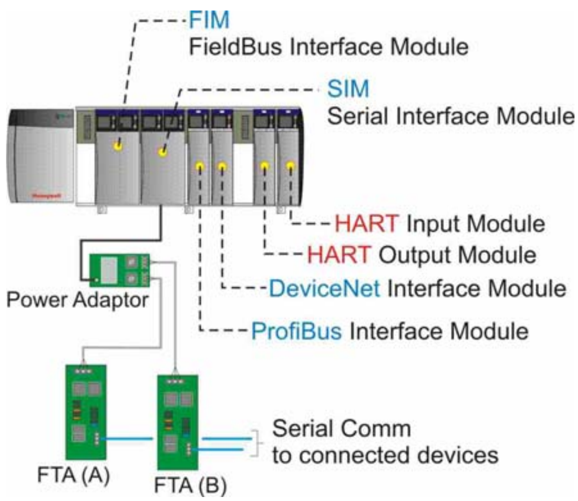


Figure 6-7 Chassis Series-A Smart Modules

FIM: The FieldBus Interface Module is covered in section 2 and 5.

SIM: The Serial Interface Module is a double-width I/O module. It functionally serves as a communications "bridge" between devices connected to the FTA (Field Terminal Assembly) and the C200/C200E/C300.

The SIM supports two serial ports FTA (A) & (B) for communication with connected devices. A single Power Adapter connects the FTA's to the SIM. The FTA provides the bi-directional physical layer functionality and all data from connected devices are transferred to the control processor using flag, numeric, and text blocks. The FTA features a plug-in module that adapts I/O requirements to the specific serial interface for a given field device. The following two versions are available as standard products.

- The Modbus FTA provides a point-to-point Modbus RTU EIA -232 (RS-232) or EIA-422/485 (RS-422/485) multi-drop communications interface.
- The Allen-Bradley (A-B) FTA provides a single EIA-232 (RS-232) communications interface to A-B PLC-2, PLC-3, or PLC-5 devices using the DF1 protocol.

HART: The HART Input Module provides 8 traditional analog inputs and the Output Module provides 8 analog outputs. The user can configure any AI or AO channel to be HART enabled or analog only. A HART enabled channel can handle the analog signal and can read/write digital data from the connected HART field device. The HART digital data rides on top of the standard analog 4-20 mA signal and all HART data and commands are supported through this interface. HART is fully integrated with custom C200/C200E HART function blocks optimized to support the HART protocol.

DeviceNet: The DeviceNet module serves as a gateway between DeviceNet devices and the C200/C200E/C300. DeviceNet is fully integrated with custom function blocks optimized to support the DeviceNet protocol.

Profibus: The Profibus module serves as a gateway between Profibus devices and the C200/C200E/C300. Profibus is fully integrated with custom function blocks optimized to support the Profibus protocol.

6.7 PMIO and Smart Device Interfaces

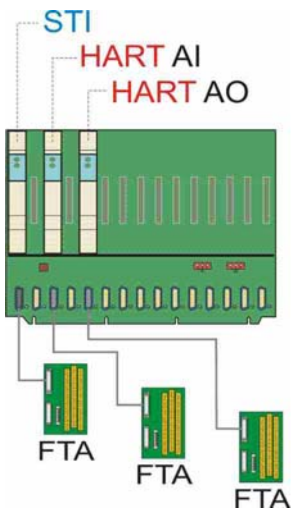


Figure 6-8 PMIO Smart Modules

STI: The Smart Transmitter Interface provides 16 channels that allow the user to connect to Honeywell smart transmitters using the Honeywell DE protocol.

HART: The HART Input Module provides 16 traditional analog inputs and the Output Module provides 16 analog outputs. The user can configure any AI or AO channel to be HART enabled or analog only. A HART enabled channel can handle the analog signal and can read/write digital data from the connected HART field device. The HART digital data rides on top of the standard analog 4-20 mA signal and all HART data and commands are supported through this interface. HART is fully integrated with custom C200/C200E HART function blocks optimized to support the HART protocol.

Both the STI and HART modules can be implemented in a redundant configuration.

6.8 Series C and Smart Device Interfaces

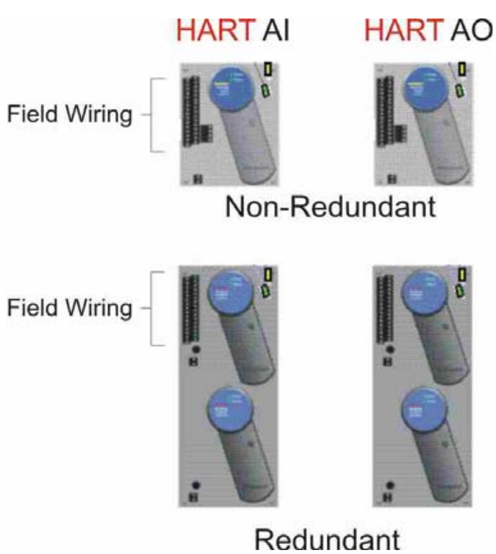


Figure 6-9 Series C Smart Modules

HART: The HART Input Module provides 16 traditional analog inputs and the Output Module provides 16 analog outputs. The user can configure any AI or AO channel to be HART enabled or analog only. A HART enabled channel can handle the analog signal and can read/write digital data from the connected HART field device. The HART digital data rides on top of the standard analog 4-20 mA signal and all HART data and commands are supported through this interface. HART is fully integrated with custom C200/C200E HART function blocks optimized to support the HART protocol.

HART modules can be implemented in a non-redundant or redundant configuration.

6.9 Peer Control Data Interface (PCDI)

The C300 Controller supports peer-to-peer communication with devices using the Modbus TCP protocol over Honeywell's Fault Tolerant Ethernet (FTE) network. Devices include Honeywell's Safety Manager, Analyzers, Fire Alarm Panels (FAP), or Programmable Logic Controllers (PLCs). Communication is also supported to Modbus RTU devices through a COTS Modbus TCP Gateway.

Control Builder includes Peer Control Data Interface (PCDI) function blocks that let you configure communication channels between the C300 Controller and the devices or gateways.

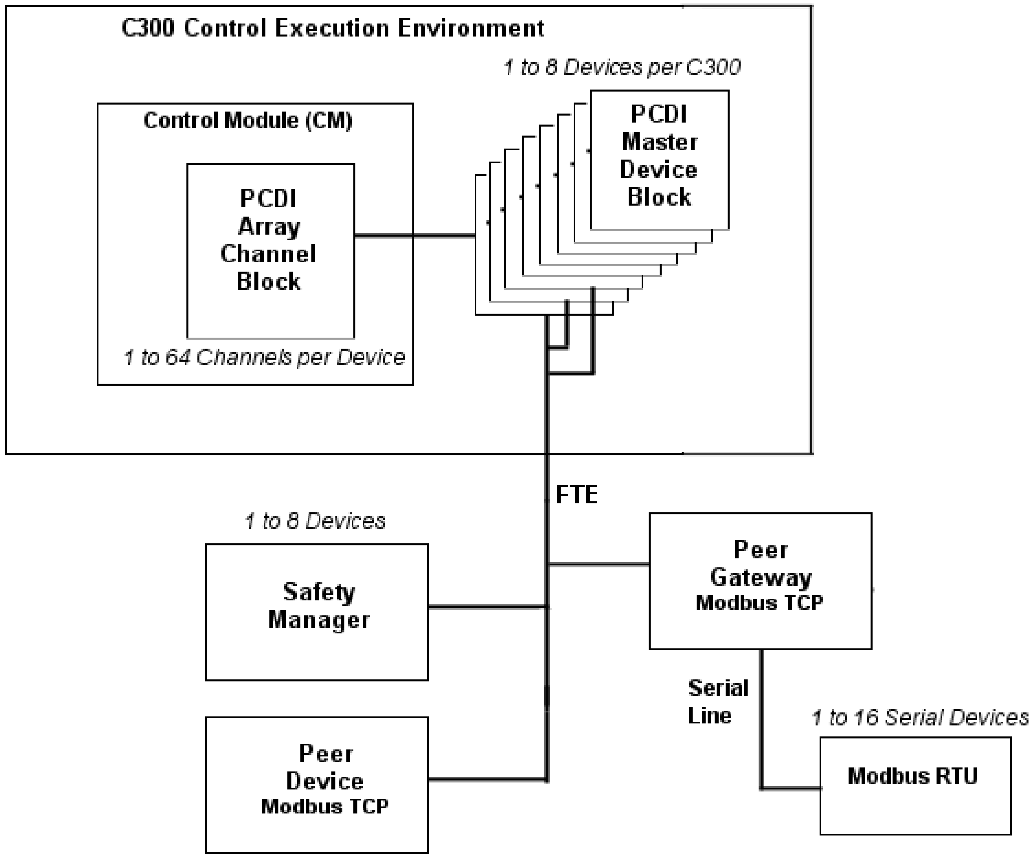


Figure 6-10 Simplified PCDI Block Architecture

7 Control Summary and Essential Concepts

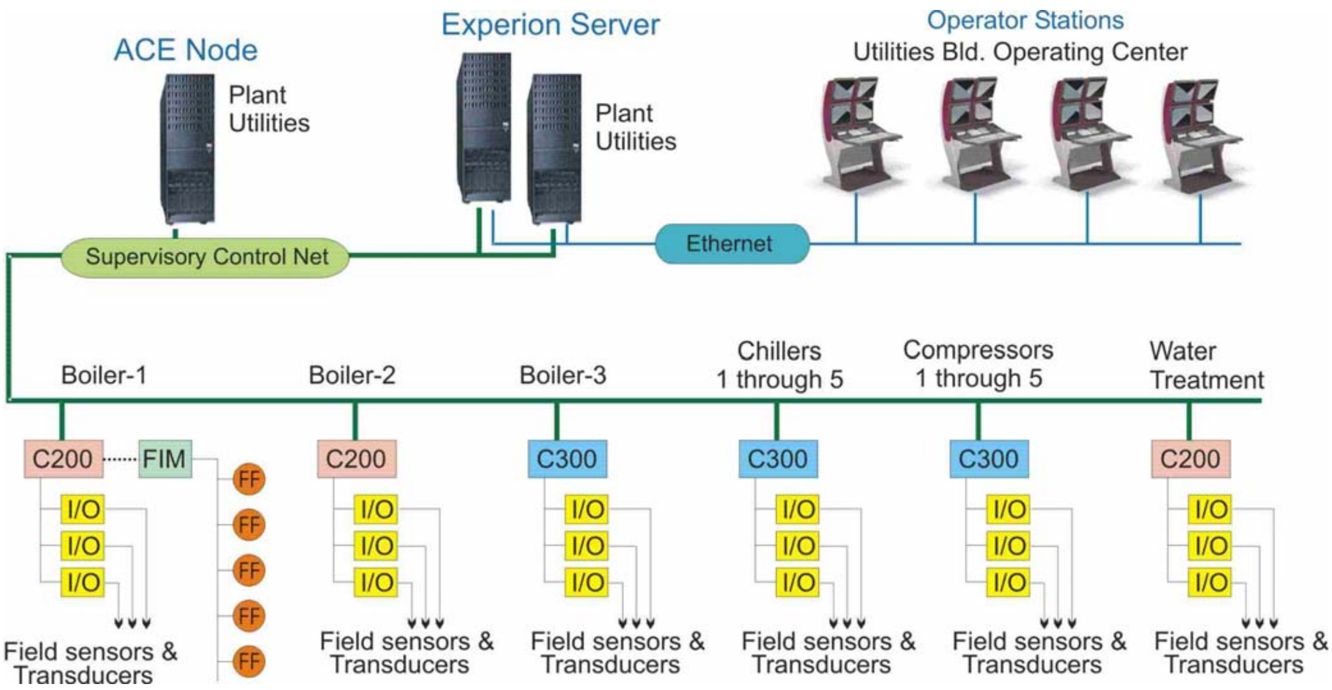


Figure 7-1 Sample Supervisory Control Network Implementation

Figure 7-1 shows an example of a possible plant implementation. Although not shown, keep in mind that I/O, control processors, and communication networks could be implemented in a redundant configuration.

This diagram depicts one major section of the overall plant, in this case, the Utilities Building. This portion of the plant is responsible for producing all utilities for the plant (steam, chilled water, and compressed air). In Experion terms this would be referred to as a "***Control Cluster***".

7.1 The Cluster Concept:

Figure 7-1 is an example of an Experion "**Cluster**". A Cluster consists of the Experion Server, Supervisory Control Network, and all connected control nodes. See *EP03-300-rrr* for capacities and limits.

From a control perspective, a Cluster represents a major subdivision of a plant. As Figure 7-1 shows, the "Utilities Building" Cluster represents a major subdivision of our example plant.

It is entirely up to the end user to determine how a plant will be subdivided. The decision is based on organizational and physical plant boundaries, operational needs, safety and efficiency, and the capacity limitations imposed by the Cluster nodes and components.

What is important to remember is that an Experion Cluster consists of the Server (or redundant pair), the Supervisory Control Network, and all connected control processors and I/O.

In this example, all of the Utilities Building controls have been assigned to one Cluster. As Figure 7-1 shows, the Cluster is further divided into process sub-groupings by individual C200/C200E and C300 control processors. Within the Cluster, different controllers are assigned to control Boiler 1-3, Chillers 1-5, Compressors 1-5, and water treatment. Again, these decisions are made by the end user based on operational needs, safety, efficiency, and cluster and node capacity limits.

To continue the concept, other major portions of the plant would have their own Clusters. For example, let's assume there is a separate Cluster for the mixing and blending plant, production machine-1 through 6, and the packaging machines.

During system configuration each Server (or redundant pair) is configured and associated with a given cluster. Often the term **Server Cluster** is used in Honeywell documentation. A number of Experion Operator Stations (as required for effective and safe coverage) would then be assigned to the Server allowing the operators to monitor and manage the process.

In this example, the process engineer might create the following four Server Clusters:

- Utilities Plant Server Cluster
- Mixing/Blending Server Cluster
- Production Machine Server Cluster
- Packaging Plant Server Cluster

7.2 Cluster Responsibilities by Node

I/O modules provide the physical connection to the field sensors and transducers (transmitters, valves, drives, relays, etc.). I/O modules are specifically assigned to each C200/C200E/C300 and provide the inputs and outputs required to monitor process conditions and manipulate and control outputs to operate the process at safe and desired conditions.

The **C200/C200E** and **C300** utilize their assigned I/O to monitor and control their assigned portion of the Utilities Plant (Boiler-1, Boiler-2, water treatment, etc.). Keep in mind that data can be easily shared between controllers using **Peer-to-Peer** transfer over the Supervisory Control Network.

The FIM provides a gateway to connected Foundation Fieldbus devices (transmitters, analyzers, positioners, etc.). Recall that along with the normal process connect task, FF devices can also run automatic control loop functions ("Control in the Field").

Supervisory Control: In its supervisory position, the **ACE** node can read and write data from any C200/C200E, C300, FIM connected devices, and other ACE nodes on the network. This allows the ACE node to monitor conditions across the entire Utilities Building. Like a manager, the ACE can supervise everything going on and make decisions that would allow the Utilities plant to run at maximum efficiency.
As an example, the ACE could monitor the total plant demand for steam and run the three boilers at an output that minimizes total fuel usage. The ACE could also see a surge in demand and automatically ramp the boilers up with a minimum of process bump. The ACE could also assist operators to complete complicated tasks related to system startup, ramp down, and the switch over or shutdown of desired components. ACE is very powerful and flexible, and it is really up to the imagination of the process engineer to determine how it will be applied.

ACE nodes can also be configured to communicate across Clusters allowing control strategies that include plant wide information.

Server collects, manages, and distributes the typical operator information like process data, alarms/events, system status, trends, logs, and history. It then makes this information available to the various operator stations and their associated displays. Refer to Specification *EP03-200-rrr* for details.

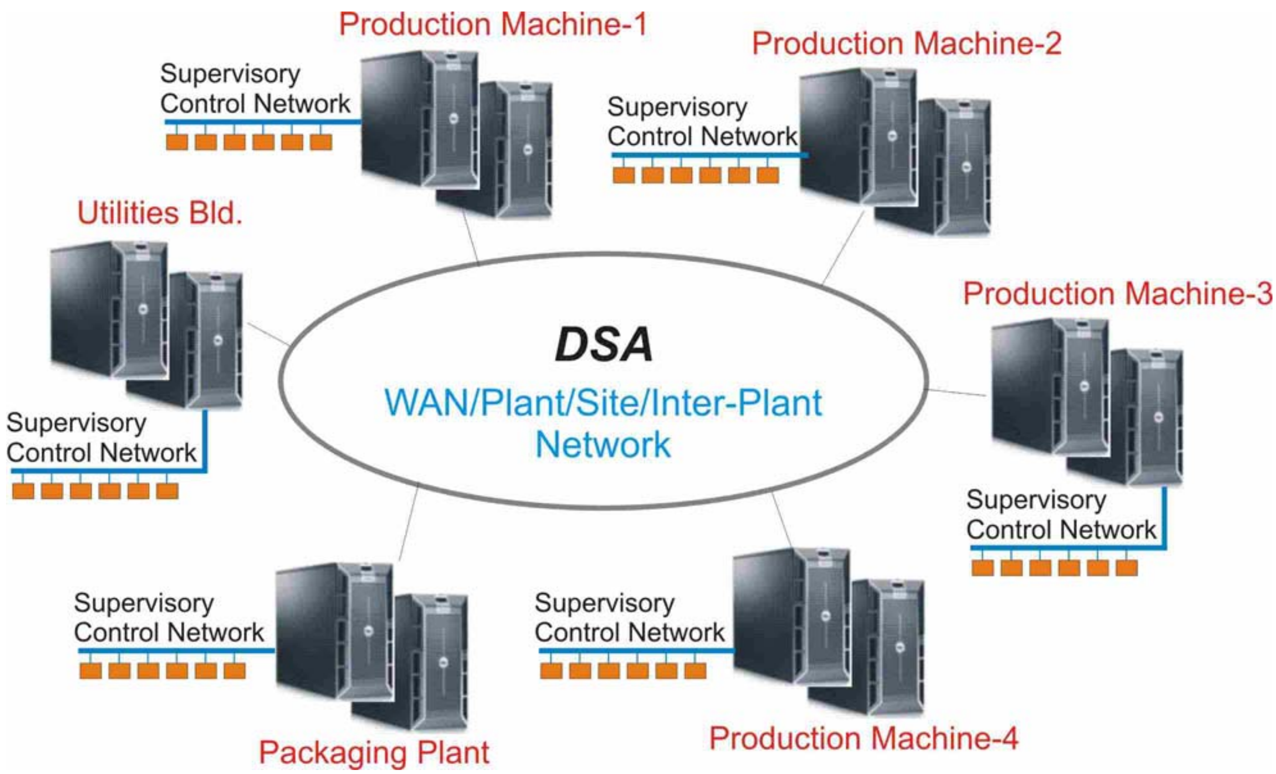
Operator Stations provide the user interface to monitor and manipulate the process. Honeywell provides a comprehensive set of standard displays (Alarm/event, trends, logs, groups, details, etc.). Honeywell also provides powerful graphic building tools that enable the user to create site-specific graphic displays to meet the unique needs of the process plant and the operators.
See *EP03-210-rrr* for details about Stations.

7.3 Honeywell DSA

Refer to Figure 7-2. Honeywell DSA (Distributed System Architecture) provides a solution that allows multiple Server Clusters to effectively and efficiently share information across Clusters in a seamless fashion.

Using DSA the user can easily incorporate the other sections of the plant into a seamless unified system. With DSA the operators and cluster nodes can share information to enable the entire plant to run in the safest, most efficient manner possible.

For details on DSA see the see Specification Doc *EP03-200-rrr*.



7-3 Sample DSA Topology

7.4 Experion Point Types- An Important Experion Concept

Process Point Types

The term "***Process Point***" is used to identify any uniquely tagged entity that exists on a "Supervisory Control Network".

Control loops (CM's and SCM's) and various hardware components are assigned (by the user) unique ID's (Names/Tags). These objects are referred to as "Named Entities". Any named entity (Tag) assigned to a loop or hardware that exists on the Supervisory Control Network and is associated with a C200/C200E, C300, FIM, or ACE is referred to as a "***Process Point***".

The user purchases Process Point quantities as needed to satisfy the specific implementation.

SCADA Point Types

Although not covered in this document, SCADA (Supervisory Control and Data Acquisition) interfaces and networks provide Server connectivity to other (non-CEE) Honeywell and other 3rd party control processors, PLC's, I/O, and RTU's. These interfaces allow the user to read and write essential parameters (like SP, PV, OP, Mode, etc.) and utilize this information with the rich functions and features provided by Server.

All points that are created to monitor and manipulate information resident in these SCADA nodes are referred to as "**SCADA Points**".

A Server can be configured to have a mixture of Process and SCADA Points allowing the user maximum flexibility to meet the needs of their process and plant in an efficient and cost effective manner.

Refer to the Server Specification document *EP03-300-rrr* for details.

8 System Configuration

8.1 Control Builder

Refer to Figure 8-1. The Honeywell **CB** (Control Builder) is a graphical configuration tool that is used to configure system components and control strategies for the following Supervisory Control Network nodes:

- The C200/C200E and C300 processors and associated I/O, hardware, and control strategies.
- Chassis Series-A FIM's and Series-C FIM's and all connected FF devices.
- ACE nodes and associated control strategies and Custom Blocks.

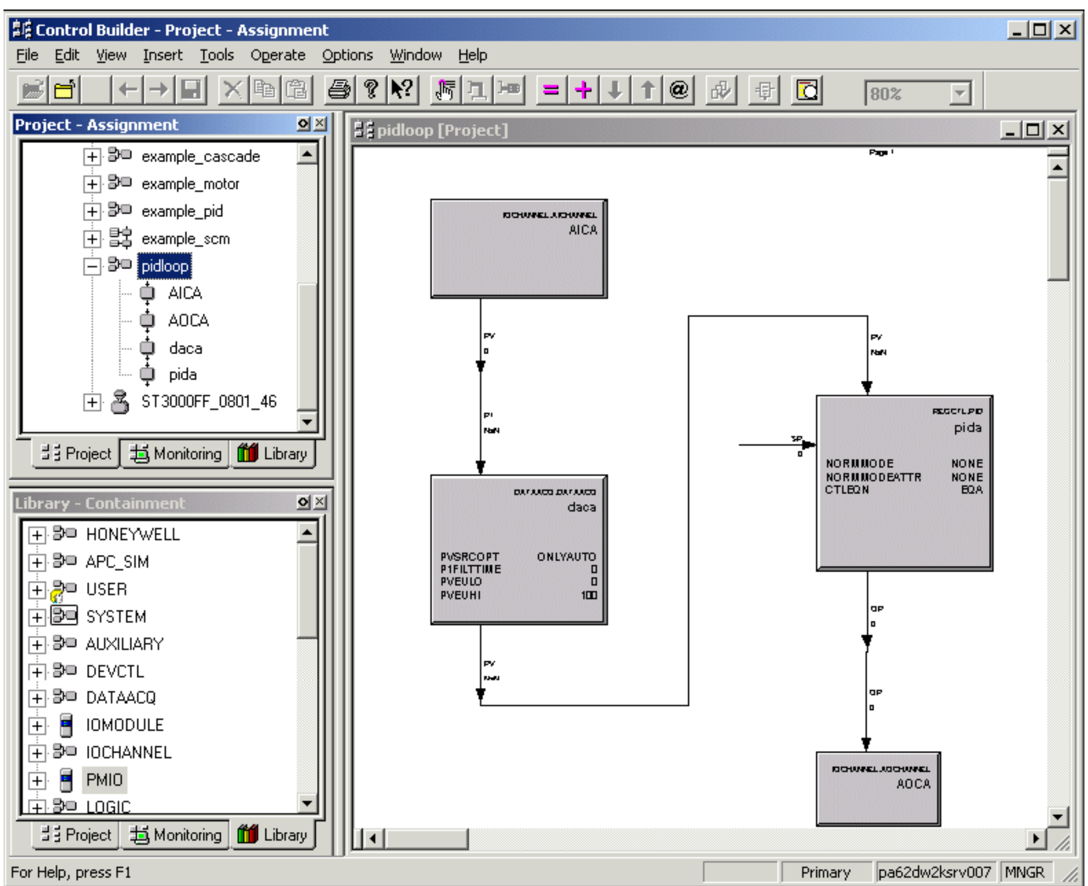
8.2 CB Work Environment

To promote an effective and efficient engineering solution CB provides two distinct working environments as follows:

- **Project**, which is off-line and allows the engineer to create and modify all system configuration without disturbing the current (on-line) configuration.
- **Monitor**, which is on-line and allows any user to observe all facets of the control scheme in a live (as-built) environment. Some changes (operational, limits, constants, etc.) are allowed in this mode.

This enables an effective/efficient environment where the engineer can be creating or modifying configuration in the background while observing the actual (as-built) configuration in the foreground.

Figure 8-1 Sample Control Builder Screen



8.3 ERDB

The ERDB (Engineering Repository Database) is the database that is used to save all work completed in Control Builder. A given ERDB is associated with one Server Cluster and the configuration of all connected C200/C200E, C300, FIM, and ACE Nodes. A given ERDB is stored and maintained in the Cluster Server (both primary and backup when redundant). There is a separate DB area for work done in the “Project Tab” and work done in the “Monitor Tab”.

Where there are multiple Server Clusters (DSA) there will be multiple ERDB’s (one for each Server Cluster). See section 7 for the definition of a Cluster.

CB and the ERDB are supported by engineering effectiveness tools like DB management, Import/Export, and Bulk Build utilities.

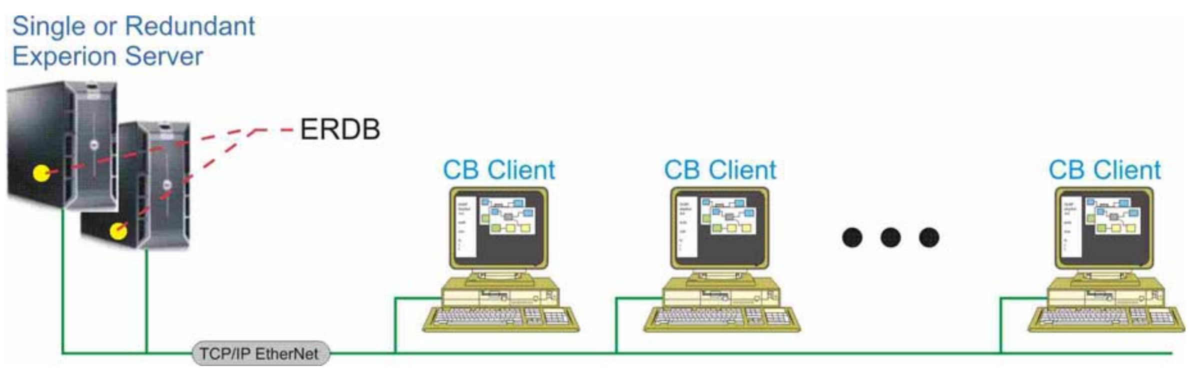


Figure 8-2 CB Client and ERDB

8.4 CB Concepts, Limits, and Rules:

- A given (Licensed) occurrence of CB is associated to one and only one Supervisory Control Network and its connected devices. Another way to say this is that the CB occurrence is associated with one Experion Server (or redundant pair).
- Important: Control Builder does not provide configuration coverage for the Server or Station. This configuration is done by separate tools not covered in this document. See Server Specification document for details.
- **ERDB:** This database is used to save the result of all work done while in CB. The ERDB for a given Supervisory Control Network is stored at the Experion Server (or redundant pair).
- CB is a server/client application and up to 12 concurrent CB users can be working on one ERDB at a time. Access is controlled by user log on credentials. A given occurrence of CB is tied to one and only one ERDB and Server Cluster.
- CB provides engineering effectiveness tools that support import/export, bulk building, templates, and system qualification.

8.5 QVCS

QVCS (Qualification and Version Control System) is an optional extension to CB that simplifies system qualification by defining and enforcing a user-defined development lifecycle. The user also defines what configuration may be loaded to a controller. The enforced lifecycle guarantees an implementation procedure and reduces the number of standard operating procedures while eliminating manual signatures and paper trails. QVCS also has several built in security mechanisms to help the end user achieve 21 CFR Part 11 compliance for their installation.

9 Simulation

Honeywell provides a powerful simulation capability that is optimized for use with the Supervisory Control Network and CEE based control processors.

Figure 9-1 Simulation Environment

The simulation environment is hosted on a server grade computer running the simulated controller software. The server can simulate CEE controllers, including the C200, C200E, C300, and ACE. It can also simulate PMIO with the SIMIOLIM and the Foundation Fieldbus Interface Module, H1 Links, devices, and control strategies with SIM-FFD. The simulation environments are designed to emulate the same Control Execution Environment (CEE) functions found in the Control Processor Module.

The simulation environment can be used in a stand alone fashion, in association with actual connected control processors, and in conjunction with the Honeywell UniSim application. This provides a simulation platform that enables a scalable solution that can satisfy simple control strategy checkout to high fidelity simulation. The platform also provides a cost effective solution for process-specific operator training and certification.

For functions and details refer to Specification Document *EP03-360-rrr.*

10 Rockwell PLC and Device Integration

10.1 Introduction

Programmable logic controllers (PLCs), such as Rockwell's PLC 5, SLC 500 and CLX, are common control devices that are part of a larger automation control project. These devices are part of packaged units or part of the existing automation. Besides control devices, Rockwell operator interfaces and motor drives are frequently part of the scope of an automation project.

Honeywell's Experion® Process Knowledge System platform offers comprehensive integration with these Rockwell devices on the human machine interface (HMI) level, the control level, or both. Comprehensive control level integration ensures that the Experion C200/C200E and C300 controllers can easily exchange data with Rockwell devices.

10.2 Extended Rockwell Device Integration

Extended Rockwell device integration provides even further integration beyond the normal SCADA integration. The extended integration provides access to device-specific status information and control-specific information. Available status data includes processor status and flags, major fault bits and minor fault bits. For the PLC 5, it includes additional fault codes and rack fault information. This information is available as part of the configured controller and does not require extra configuration. A single Experion SCADA point referencing the PID configuration has access to all information stored in that file. This allows the user to change limits, such as the gain and other tuning constants of the PID controller, reducing configuration time and improving maintenance ease-of-use.

10.3 Data Exchange Solutions

On many occasions, data exchange between the PLC devices and the Experion controllers is required. The native Experion controllers can exchange data with Rockwell devices through controller communication blocks. This eliminates the need for hardwired I/O or serial connections and reduces the overall integration cost. Through the exchange function blocks, large amounts of data can be transferred over the common communication network, which can be optionally redundant to provide a high available solution for critical applications.

10.4 Supported Data Protocols

The exchange function blocks support two major data protocols for data exchange. Each exchange block supports the Programmable Controller Communication Commands (PCCC) and the Control and Information Protocol (CIP). PCCC uses the PLC 5 type addressing, where CIP uses the ControlLogix tag name references. Both protocols support read and write actions.

10.5 Rockwell Drive Integration

Rockwell motor drives are supported by the Experion platform through integration with the native Experion C200/C200E controller. Supported motor drives include the 1305 AC and 1336-PLUS-II, integrated through the Rockwell 1203-CN1 communication interface. Other drives, which use the same interface and have the same command and status structure as these drives, can be interfaced through a generic drive function block. All drive-specific information is made available to the controller using a special controller function block. This data includes status and command information. Examples of this information include start, stop, jog, and reverse commands and enabled, running command direction, and at speed status information.

Experion Process Knowledge System (PKS)

For More Information

Learn more about Honeywell's Experion, visit our website www.honeywell.com/ps or contact your Honeywell account manager.

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