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Application Control Environment
User's Guide

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About This Document

This document describes the Application Control Environment (ACE) node and its configuration, installation, and operation. The document includes the basic information for the interface of the ACE to the OPC Gateway node and the CAB function.

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References

The following list identifies all documents that may be sources of reference for material discussed in this publication.

Document Title

Contacts

World Wide Web

The following Honeywell web sites may be of interest to Process Solutions customers.

Honeywell Organization	WWW Address (URL)
Corporate	http://www.honeywell.com
Honeywell Process Solutions	http://hpsweb.honeywell.com

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Symbol Definitions

The following table lists those symbols used in this document to denote certain conditions.

Symbol	Definition
	ATTENTION: Identifies information that requires special consideration.
	TIP: Identifies advice or hints for the user, often in terms of performing a task.
	REFERENCE -EXTERNAL: Identifies an additional source of information outside of the bookset.
	REFERENCE - INTERNAL: Identifies an additional source of information within the bookset.
CAUTION	Indicates a situation which, if not avoided, may result in equipment or work (data) on the system being damaged or lost, or may result in the inability to properly operate the process.
	CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. CAUTION symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual.
	WARNING: Indicates a potentially hazardous situation, which, if not avoided, could result in serious injury or death. WARNING symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual.

About This Document
Symbol Definitions

Symbol	Definition
	WARNING, Risk of electrical shock: Potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 VDC may be accessible.
	ESD HAZARD: Danger of an electro-static discharge to which equipment may be sensitive. Observe precautions for handling electrostatic sensitive devices.
	Protective Earth (PE) terminal: Provided for connection of the protective earth (green or green/yellow) supply system conductor.
	Functional earth terminal: Used for non-safety purposes such as noise immunity improvement. NOTE: This connection shall be bonded to Protective Earth at the source of supply in accordance with national local electrical code requirements.
	Earth Ground: Functional earth connection. NOTE: This connection shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.
	Chassis Ground: Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.

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Getting Started

This section identifies the tasks you need to complete to add an Application Control Environment (ACE) controller node to your Experion system. If you have previously installed an ACE controller node, you may choose to skip those tasks that describe ACE and its functionality and proceed to the actual installation procedures. Be aware that Experion release R210 includes new ACE controller functionality. The following table lists the tasks in the order in which they are to be completed and provides links to applicable documents where appropriate.

Task	Link or Reference
Review the structure of the ACE node and its functionality	See the listings under ACE Topics
Install and set up the ACE Node computer	See ACE computer manufacturer's documentation.
Connect the ACE node to the Experion network	Click here
Install the Application Control Environment (ACE) software version R210 or greater.	See the Software Installation and Upgrade Guide
Configure and load the ACE node and the ACE/CEE	Click here

ACE Topics

Topic	Link or Reference
Overview	Click here
System configuration considerations	Click here
Software licensing	Click here
Memory and processing resources	Click here
FB scheduling and execution	Click here
Process special	Click here
Control Algorithm Blocks (CAB)	Click here
Peer-to-peer functionality	Click here
Control Functions/Insertion Points	Click here
Operations	Click here
Troubleshooting and Maintenance	Click here

Application Control Environment (ACE)

Overview

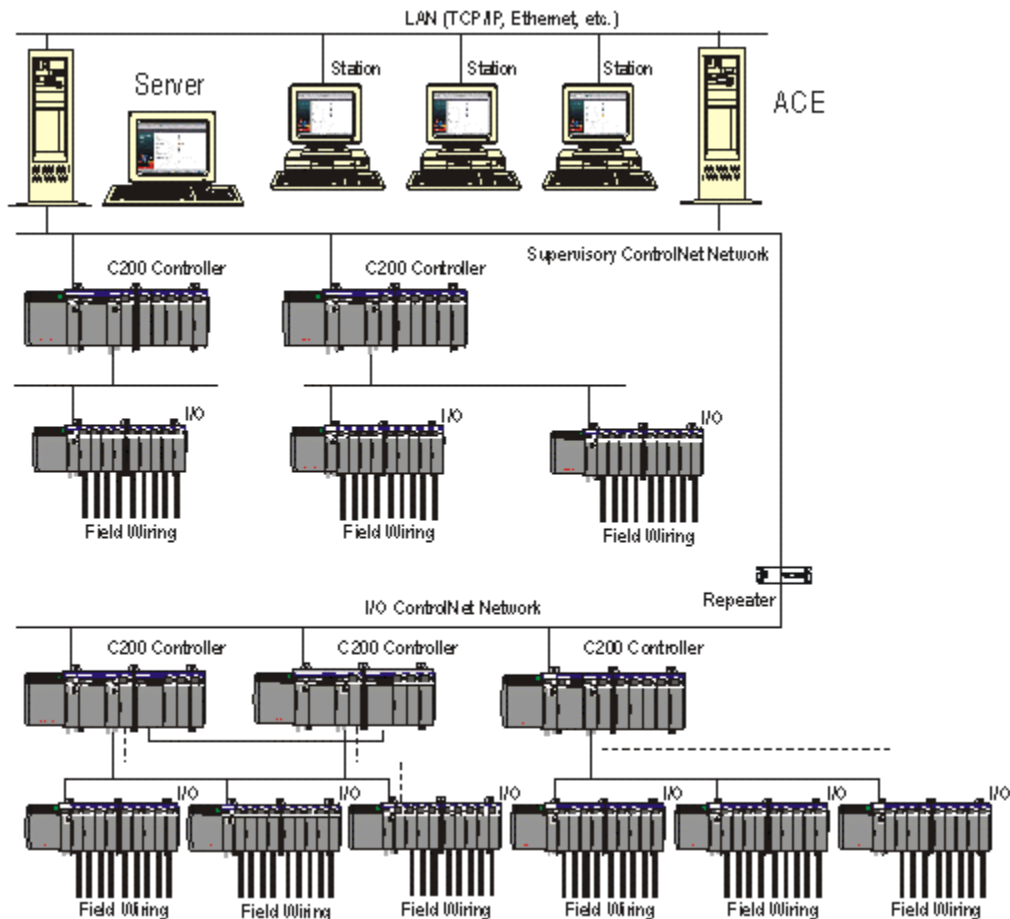
The ACE controller mirrors the basic operations of a Control Processor Module (CPM). It provides the additional capability of communicating with OPC Servers through a Fault Tolerant Ethernet (FTE) or redundant or non-redundant Ethernet network. The ACE program runs on a server grade personal computer using a Windows 2000 Server operating system. Users can optionally connect an ACE controller directly to a supervisory Fault Tolerant Ethernet (FTE) or ControlNet network to support peer-to-peer communications with C200 Process Controllers.

ACE can be included in the following network topologies:

- As part of an existing Total Plant Solutions (TPS) system with Application (APP) node, Network Interface Module/Universal Control Network (NIM/UCN) and/or Hiway Gateway (HG)/TDC2000 Hiway (See [Interface Between ACE and TPS](#))
- As part of a new Experion system with C200 Controllers and FTE Bridge
- As part of an existing Experion system with C200 Controllers

The location of the ACE in a typical medium-size control system is illustrated below:

Application Control Environment (ACE) Overview



ACE as Part of an Experion Control System

ACE and OPC Gateway

The ACE controller supports OPC Server communications via the OPC gateway. See [Using OPC Gateway to Interface ACE to an OPC Server](#)

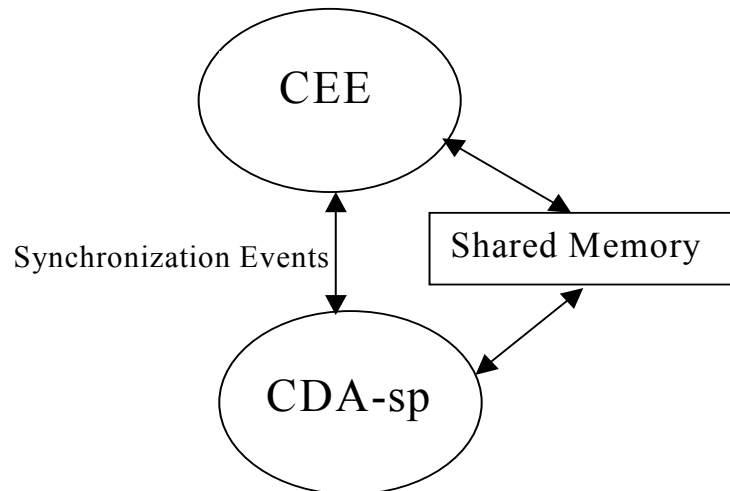
ACE process architecture

The figure below illustrates the process architecture of the ACE controller. It includes the following subsystems:

- Control Execution Environment (CEE)
- Control Data Access – supervisory (CDA-sp)

The subsystems communicate through two basic mechanisms:

- Shared memory
- Windows Synchronization Events



ACE Process Architecture

ACE/CEE database

The ACE/CEE architecture does not contain any permanent, hard-disk-based database. You load ACE/CEE configuration information and command its state (CEE state of Run) through Control Builder.

Application Control Environment (ACE) Overview

Interface between ACE and TPS

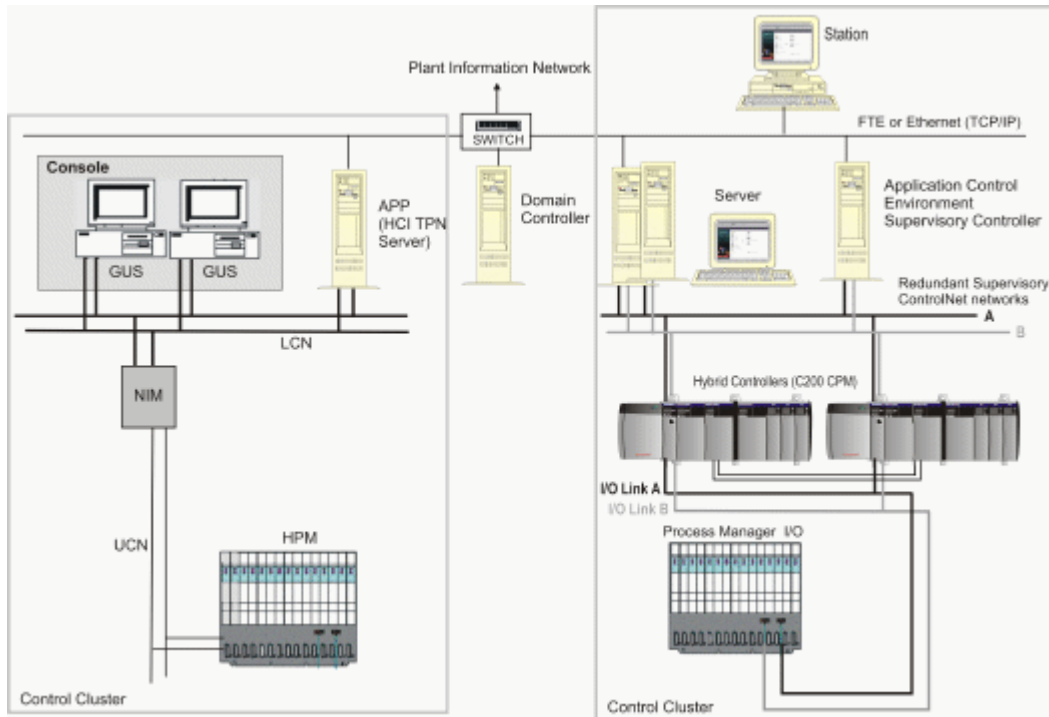
The ACE controller interfaces to the TPS system through an Application (APP) node running Total Plant Network (TPN) server as an OPC server. The TPN server supports both OPC data access and Honeywell Communications Infrastructure (HCI) extensions to OPC. The ACE controller recognizes when it is communicating with an OPC server that includes HCI, such as the APP node, and provides appropriate functional support.



TIP

The additional HCI related functions are transparent to the Control Modules and Sequential Control Modules in control strategies that are executing in the ACE controller. No changes are required in control strategy configurations through Control Builder whether the OPC server being accessed supports HCI or not.

The relation between ACE and TPS is illustrated below.



Relationship Between ACE and TPS

Planning and Design

Configuration Considerations

Points to consider when implementing ACE controllers.

- The ACE controller requires system Server and Station programs to support Operator Interface, History, and other functions, just like the Control Processor Module (CPM).
- Only one ACE environment is supported per dedicated computer running Windows 2000 Server operating system.
- Do **not** load system Server/Client, Station, or Control Builder program on a dedicated ACE controller computer.
- Up to 5 ACEs are supported per Experion Server (in addition to the C200 Controllers supported by Experion Server)
- Redundant ACE controllers are **not** supported.
- The ACE controller can peer-to-peer with other ACE controllers connected to the same Server over Fault Tolerant Ethernet or Ethernet network.
- The ACE supervisory controller that has a direct connection to the ControlNet or FTE supervisory network can peer-to-peer with C200 Controllers that belong to the same Server.
- ACE is **not** qualified to run on the Experion Server node.
- Up to 2 ACEs are supported directly connected to the same ControlNet
- A single ACE can have a maximum of 30 connections to components connected via FTE Bridge or via PlantScape ControlNet. Connected components include C200s, and FIMs.
- Also see [Configuring ACE for CAB](#)

Connecting ACE to the Experion Network

ACE LAN connection types

ACE is connected to the Experion LAN using

- FTE
- Experion Redundant Ethernet
- Experion Non-redundant Ethernet

ACE supervisory network connection types

ControlNet connection

ACE requires the installation of RSLinx software and a PCIC card for ControlNet communication with C200 through a ControlNet Interface Module.

FTE connection

ACE requires the installation of FTE software and a NIC card for FTE communication with C200 through an FTE Bridge Module.

Restrictions



ATTENTION

The following restrictions apply when configuring an Experion system using the ACE

- The ACE node is **not** supported when connected to an Ethernet supervisory network configuration.
- FTE connected Servers do **not** support Ethernet supervisory network, since FTE does **not** run on nodes with three network interface card ports.
- The ACE node can be directly connected to the supervisory ControlNet or Fault Tolerant Ethernet segment, if required to support peer-to-peer communication with C200 Controllers.
- All ACE to Server traffic uses the Ethernet or FTE media link. Only ACE peer-to-peer connections with C200 Controllers will use the ControlNet or FTE supervisory network link.

Connecting to the network



REFERENCE - INTERNAL

Refer to the *Fault Tolerant Ethernet Bridge Implementation Guide* for more information about FTE network connections.

Refer to the *ControlNet Installation Guide* for more information on ControlNet connections.

ACE Licensing

Licensing check

Application Controller Environment Software and Function Block Libraries are subject to licensing. The license always applies to the Experion Server to which the ACE Server is connected. Licenses are not transferred between servers. There are two types of licenses, as indicated per model number:

A – a fixed number of instances can be loaded to the system, regardless of controller assignment,

B – the Function Block library or feature is enabled; the number of instances of a Function Block does not matter.

Use the following table to verify the ACE software license:

Model Number	Model Description	License Type
TC-SWSC01 ¹	ACE Base Software License	A
TC-OPCL01 ²	OPC Extension Library	B
TC-UCNL01 ²	UCN Output Extension Library	B

(1) The ACE Base software requires a dedicated Windows 2000 Server PC

(2) TC-OPCL01 and TC-UCNL01 are additional libraries to the ACE Node. These require TC- SWSC01

Scheduling and Execution

Scheduling and execution topics

Topic	Description	For Details ...
Period	The amount of time between two consecutive executions of a CM or SCM block.	Click here
Phase	Determines the set of cycles in which a container block executes.	Click here
Slow execution periods	ACE functionality which allows extension of the base periods by executing container blocks at specified hours and minutes from the startup of the ACE node	Click here
Execution Order	The time sequence in which container blocks execute	Click here
Overruns	Failure of container blocks to execute within the specified time cycle	Click here
Execution Balancing	Procedure by which overruns are eliminated or minimized by automatically assigning scheduling parameters to container blocks.	Click here
Process Special	Configuration option that permits an Operator, CAL program, CM, or SCM to trigger the execution of another Control Module.	Click here

Period

The period of a CM or SCM container block is the amount of time between two consecutive executions of the block.

The periods available to container blocks in the current Experion CEEs are summarized below:

5 ms CEE/CPM	50 ms CEE/CPM	500 ms CEE/ACE
5, 10, 20, 50, 100 and 200 ms (Default is 200 ms)	50, 100, 200, 500, 1000, and 2000 ms (Default is 1000 ms)	500 ms, 1s, 2s, 5s, 10s, 20s, 30s, <i>1min, 2min, 5min, 10min, 20min, 30min, 1hr, 2hr, 4hr, 8hr, 12hr, 24hr.</i> (Default is 2s; <i>italicized values require use of phasing parameters as described below</i>)

When a CM or an SCM is assigned to any CEE, the selected period is validated against the permitted execution periods for that CEE and that module. The assignment is disallowed if the period is not supported. For example, any attempt to assign a CM executing at a period greater than 2 seconds to a CPM's CEE is rejected.

If a CM is already assigned to a C200 and the user attempts to configure its period to one that is only supported by ACE, the change is also rejected. The same is true if the CM has already been loaded to a C200 and the change is made on-line.

Since SCMs do not support periods greater than 20 seconds, any attempt to change the period to a slower period is rejected. This includes changes at configuration time, assignment time and load time.

Phase

The phase parameter determines the set of cycles in which a container block executes.

ACE has a base cycle of 500 ms and in each phase blocks are executed and then parameter requests originating from peer environments and operator displays are serviced. CMs are assigned a phase in which their execution starts. From that point on, the CMs are executed at a frequency based on their configured period. Currently, ACE supports 120 phases, allowing for periods up to 1 minute (120 x 500 ms) using the PHASE parameter alone. Longer periods require the use of the PHASEMIN and PHASEHOUR parameters as noted in the slow execution periods discussion below.

Slow execution periods

To support slower periods, two new phase parameters are added to allow the user to select which minute of an hour to begin execution and which hour in a 24-hour time-span to begin execution. This is in addition to the selection of one of the 120 phases. The new parameters, PHASEMIN and PHASEHOUR are not valid for every possible period. If the parameter is not valid, it will remain at its default of -1. The two tables below show all the periods with the valid ranges and values for each of the PHASE related parameters.

Period	PHASE Range	PHASEMIN Range	PHASEHOUR Range
500 ms, 1s, 2 s, 5 s, 10 s, 20 s, 30 s	0-119	N/A	N/A
1 m, 2 m, 5 m, 10 m, 20 m, 30 m, 1hr	0-119	0-59	N/A
2 hr, 4hr, 8 hr, 12 hr, 24 hr	0-119	0-59	0-23

Period and Phase Ranges

Period	PHASE	PHASEMIN	PHASEHOUR
500 ms	0	N/A	N/A
1 s	0,1	N/A	N/A
2 s	0 thru 3	N/A	N/A
5 s	0 thru 9	N/A	N/A
10 s	0 thru 19	N/A	N/A
20 s	0 thru 39	N/A	N/A
30 s	0 thru 59	N/A	N/A
1m	0 thru 119	0	N/A
2 m	0 thru 119	0,1	N/A
5 m	0 thru 119	0-4	N/A
10 m	0 thru 119	0-9	N/A
20 m	0 thru 119	0-19	N/A
30 m	0 thru 119	0-29	N/A
1 h	0 thru 119	0-59	0
2 h	0 thru 119	0-59	0,1
4 h	0 thru 119	0-59	0-3
8 h	0 thru 119	0-59	0-7
12 h	0 thru 119	0-59	0-11
24 h	0 thru 119	0-59	0-23

Period and Valid Phase Assignment

Execution order

Control Modules that are executed within the same phase are executed in the order defined by the parameter, ORDERINCEE. If two CMs are created and CM1 must execute before CM2, they both could be configured to begin execution in phase 0 and CM1 would have an ORDERINCEE value less than that of CM2. Now if there was a CM3 that needed to execute every 20 seconds, starting in phase 0, its ORDERINCEE would also be considered when these three CMs lined up in the same phase, which in this case would be phase 0. If CM3 is not dependent on any other CM executing before it or after it, then the value for ORDERINCEE could be left at its default.

With the addition of slower periods and 120 phases, nothing changes with respect to ORDERINCEE. If two CMs, CM4 and CM5, must execute once a minute with CM4 executing first, then both can be configured to start in phase 0 with CM4 having the lower value for ORDERINCEE. When CM4 and CM5 execute in the same 500-ms time slice as CM1, ACE will use the ORDERINCEE to determine which one to execute first. No priority is given to the Control Module with the faster period.



TIP

If several CMs must execute once a minute their execution could be ordered by selecting different phases as appropriate. This would also help balance the execution load over the minute if [execution balancing](#) were not selected.

Scheduling example

The scheduling execution will be described using the following configuration:

CM NAME	PERIOD	ORDERINCEE	PHASE	PHASEMIN	PHASEHOUR
CMSEC1	1 sec	5	1	N/A	N/A
CMSEC2	½ sec	30	0	N/A	N/A
CMSEC3	30 sec	50	0	N/A	N/A
CMMIN1	20 min	20	119	5	N/A
CMMIN2	1 min	15	1	0	N/A
CMHR1	8 hour	10	119	2	5
CMHR2	24 hour	40	1	5	5

Configuration Example

The following table is used to illustrate the execution schedule resulting from the above configuration. All CMs are activated at the same time the CEE is activated. This time is considered hour 0, minute 0.

Phase	0 (500 ms)	1 (500 ms)	2 (500 ms)	3 (500 ms)	..	29 (500 ms)	..	117 (500 ms)	118 (500 ms)	119 (500 ms)
Order	CMSEC2	CMSEC1	CMSEC2	CMSEC1		CMSEC1		CMSEC1	CMSEC2	CMSEC1
	CMSEC3	CMMIN2 (1)		CMSEC2		CMSEC2		CMSEC2		CMHR1 (3)
		CMSEC2				CMSEC3				CMMIN1 (4)
		CMHR2 (2)								CMSEC3

Execution Order

- a) Execution begins on hour 0, minute 0 and occurs every minute after that
- b) Execution begins on hour 5, minute 5 and every 24 hours after that
- c) Execution begins on hour 5, minute 2 and every 8 hours after that
- d) Execution begins on hour 0, minute 2 and occurs every 20 minutes after that

Overruns

An overrun occurs when any container blocks assigned to a cycle fail to execute within the cycle. Overruns can generate alarm events as noted below.

ACE overrun alarms are reported when two consecutive 60-second macro-cycles have at least one cycle with an overrun. *The alarm is cleared when two consecutive 60-second macro-cycles have no cycle with an overrun*

In addition to the events, statistics for 120 base cycles are kept to indicate the number of overruns in the current hour and previous hour. This information is shown in a CPU Overrun tab that appears in Control Builder as well as the Station Detail Display for a CEE block. This display also shows the following additional statistics:

- Number of overruns per cycle in the last 24-hour cycle

- Number of overruns per cycle in the previous 24-hour cycle
- Max Overruns per cycle in any given 24-hour period

All of these statistics are calculated since CEE activation time or since the last time the user reset the statistics via a command.

There is also a CPU Loading tab that shows the average CPU usage per cycle as well as the max CPU usage per cycle. This tab appears on the CEE monitoring form as well as the Station Detail Display. The tab shows the CPU utilization as a percent of the 500 ms cycle time, and the maximum CPU usage for 120 cycles of CPU usage.

Analysis of overrun data

The CPU usage and overrun displays are used to diagnose problems as explained with the following example.

If an ACE has 1000 CMs to execute, 750 configured to run every second, 250 configured to run every minute in phase 0 then once a minute the worst-case CPU usage is realized. Let's say that the 750 most frequently executing CMs can execute fine but every minute the additional 250 CMs cause the CPU utilization for cycle 0 to go over 500ms. This situation will not result in an alarm. However, the number of overruns per current hour displayed in row 0 will increment once a minute until the problem is fixed. The next step is to find all the Control Modules that execute in the cycle with the overrun indication.

For each CM and SCM a read only arrayed parameter of Booleans is supported to indicate in which cycles (0-119) the module will execute. This parameter is calculated each time it is requested. For the CMs in the previous example that execute once a second in phase 0, every other array element starting with 0 will return a TRUE value. For the CMS that execute every minute, only array element zero returns TRUE. This parameter allows the user to find all CMs that execute in the cycle or cycles that overran.

Once the CMs that execute in the cycles with overruns are identified, the user must re-distribute their execution. If the execution balancing option was not used initially, it is recommended that all CMs without order dependency be loaded using the execution balancing option described below. If execution balancing is not desired, then the user must re-distribute the CMs and SCMs by phasing them (e.g. change Phase parameter to achieve a more balanced execution).

Execution balancing

CEE provides execution balancing for distributing the execution of CMs and SCMs over the 60-second macro-cycle (120 cycles), a 1-hour macro-cycle and the 24-hour macro-cycle based on the total number of modules to execute in each of 500-ms cycles in a minute as well as the number of modules to execute in each minute of an hour and each hour of the day. Execution balancing is not done based on CPU resource requirements.

For all periods, the user can request execution balancing over the 120 cycles, by setting the PHASE parameter to -1 on the CM or SCM configuration form and then doing a load. When the CEE receives the configuration, it chooses a PHASE, changes the value from -1 to the chosen phase and places the CM or SCM on the execution chain according to the specified ORDERINCEE. For the slower periods, the user can request execution balancing over a 24-hour period by setting PHASEHOUR to -1. Execution can also be balanced over a given hour by selecting PHASEMIN of -1. Note that the default value for all of these parameters is -1.

When CMs/SCMs are loaded, the module count for each 500-ms cycle, each minute and each hour are incremented. When CMs/SCMs are deleted, the appropriate counts are decremented.

A checkpoint restore or a reload from project or monitoring results in the same execution schedule as long as both of the following actions are taken after a load with execution balancing requested or after any on-line changes to Phase/Period parameters:

- ○ Upload and update to project - updates monitor and project sides of database with latest scheduling information.
- ○ Checkpoint save - updates checkpoint file with latest scheduling information.



ATTENTION

If two CMs or SCMs execute at the same frequency and have an execution dependency then their execution order in relationship to one another cannot be guaranteed if execution balancing is selected. The ORDERINCEE would be used to order the execution in relationship to other CMs/SCMs executing in the same cycle but there is no guarantee that the two CMs or SCMs will be placed in the same phase. For this case, the user must configure the PHASE and ORDERINCEE parameter. To get the best execution balancing based on counts, any CMs with order dependencies should be loaded first so the others can be balanced around them.

Using the [example configuration](#), with the same ORDERINCEE but with PHASE, PHASEMIN and PHASEHOUR all set to -1, the schedule might end up as follows assuming that the CMs are loaded in the order they appear in the table:

Planning and Design

Blocks with No Periods: Process Specials

Phase	0	1	2	3	4	5	6	7	8	9
Order	CMSEC1	CMSEC2	CMSEC1	CMMIN1 (1)	CMSEC1	CMMIN2 (2)	CMSEC1	CMHR1 (3)	CMSEC1	CMSEC2
	CMSEC2	CMSEC3	CMSEC2	CMSEC2	CMSEC2	CMSEC2	CMSEC2	CMSEC2	CMSEC2	CMHR2 (4)

Execution Order

1. Execution begins on hour 0, minute 0 and occurs every 20 minutes after that
2. Execution begins on hour 0, minute 1 and every minute after that
3. Execution begins on hour 1, minute 2 and every 8 hours after that
4. Execution begins on hour 2, minute 3 and occurs every 24 hours after that

Blocks with No Periods: Process Specials

The ACE provides a configuration option and a scheduling mechanism for an Operator, CAB program, CM or SCM to trigger another Control Module to execute.

ACE supports an execution period value of NOPERIOD to support on-demand CM execution for CMs that do not need to execute periodically. When a CM with this option is loaded to ACE, it is not assigned to any cycle, its PHASE parameter is defaulted to 0 and the ORDERINCEE is not applicable. The Control Module must be activated just like any other Control Module in order to execute. Execution however, only occurs when an operator, program or another function block does a store to a Process Special Trigger parameter. After the CM executes, the parameter is reset and processing can be triggered again. Multiple stores done prior to the CM's execution are not queued. Storing a FALSE or zero value to this parameter when it is TRUE will cause the Process Special request to be cancelled. An additional process special parameter is supported which requires program access level. This allows SCMs and other function blocks, such as CAB to trigger execution to occur after x seconds where x is the integer value stored to the parameter. Similar to the Boolean parameter, subsequent stores to this parameter are ignored until the block executes. Storing a value of zero to this parameter causes it to execute immediately. If a process special has been triggered using either of the trigger parameters, all stores to either of the parameters are rejected until the block executes.



ATTENTION

Process Special is not supported for SCMs or for any CMs loaded to a C200. For SCMs, the selection of NOPERIOD is rejected at configuration time. For CMs, the selection of NOPERIOD is rejected at assign time and load time if the CM is assigned to a C200. On-line changes to a value of NOPERIOD are also rejected for SCMs and any CM running in a C200.

Initiating a process special request

A process special request is triggered using either the BPS or the BPSDELAY parameters on a CM.

BPS: Storing a TRUE value to the BPS parameter initiates a process special request. Consecutive stores of a value TRUE to the BPS parameter once a process special request is in progress are ignored. However, as soon as a process special request is complete, the next store of a TRUE value to BPS initiates a new process special request. Storing a FALSE value to the BPS parameter cancels any outstanding process special request on a CM.

BPSDELAY: Storing a non-negative value to the BPSDELAY parameter is used to initiate a timed delay process special request. The process special request is initiated on the write to the parameter but it isn't executed until after a delay equal to the number of seconds written to the BPSDELAY parameter. While the BPSDELAY parameter is a floating-point value, the actual delay time is adjusted to be in increments of the CEE base cycle. Writing the value zero to the BPSDELAY parameter is equivalent to writing a TRUE value to the BPS parameter. As with the BPS parameter, additional writes to the BPSDELAY parameter are ignored once a process special request is initiated. There is no way to cancel a process special request using the BPSDELAY parameter. However, a process special request initiated with the BPSDELAY parameter can be canceled by writing a FALSE to the BPS parameter.

The process special execution of CM blocks is carried out based on the order in which the process special requests are initiated and taking into account delays specified in the request in the following fashion.

- A process special request initiated by BPS is executed after any CM already scheduled for process special by BPS and after any CM scheduled for process special by BPSDELAY where the delay time remaining is equal to zero.
- A process special request initiated by BPSDELAY is executed after any CM with a remaining delay less than or equal to the request delay time and then in the order in which process special requests were initiated.

Planning and Design

Blocks with No Periods: Process Specials

When a process special request is made, the CM is executed on the first available CEE cycle, based on the above description, after any timed delay has passed. An available CEE cycle is determined based on time remaining in a CEE base cycle after all scheduled blocks have been executed. In addition, only a limited number of process special CMs will be executed in any one CEE base cycle regardless of time remaining in the cycle. This is to avoid overloading CDA with a large number of request-response peer data requests.

No effort will be made to provide between block execution “store retries” when a block is executed by process special. This means that if a store by inside connector fails, there will be no way to retry the store until the next time the block executes, no matter how much later the next execution occurs.

When a CM has a period of NONE and it is being executed by process special, it’s up to the control engineer to scale period-related values in blocks placed on the CM. The control engineer does this by writing the SCALEPERIOD parameter on the CM with the desired scaling period. The default scaling period for a CM with a period of NONE is equal to one minute unless another value is set using the SCALEPERIOD parameter on the CM.

You can get a Control Module with an execution period of None to process itself, after being awakened from process special parameters, by first storing a FALSE or zero value to the BPS parameter to cancel the process special request in this Control Module

Process special and periodic CMs

A process special request is normally associated with a CM having a period of NONE. However, a request can be initiated on a CM that has a period other than NONE. If a process special request is made on a CM that has a period other than NONE, one of two things will happen.

- If the CM process special execution occurs before the next scheduled periodic execution of the block, then the CM will perform both the process special and the periodic block executions.
- If the next scheduled periodic execution of the CM occurs before the process special execution takes place, because of a process special time delay or a simple race condition, then occurrence of the periodic execution will cause the process special execution to be cancelled.

Process special control loop considerations

If you associate a process special with a Control Module that contains a control loop, which includes a DATAACQ block connected to a PID block, be sure you configure the ORDERINCM parameter value for the DATAACQ block to be **less than** the

ORDERINCM value set for the PID block. This allows the DATAACQ block to get the latest input value for the cycle before the PID block fetches its PV data.

Process special for slow periods

Typically, process special is used to trigger execution of blocks that do not need to execute periodically. It can however, be used to trigger periodic execution instead of using the configuration option. This can be useful if execution is dependent on wall clock time or if other periods not supported by the PERIOD parameter are desirable.

Example: If there are two Control Modules, CM1 and CM2, to be executed every 8 hours, both must be configured with a period of NOPERIOD. Two other Control Modules, CM3 and CM4 are configured to run once a minute (PERIOD = 60s, PHASE = any valid phase) to determine if it is time for CM1 and CM2 to execute. If it is time for them to run, then CM3 and CM4 store to CM1 and CM2's Process Special trigger parameter causing both to execute. CM3 and CM4 can be configured such that they cause CM1 and CM2 to execute at the appropriate time based on either of the following:

- Wall-clock time; for instance, every 8 hours at 8 a.m., 4 p.m., 12 p.m.
- Another CM's activation time; for instance, every 8 hours since CM3 has been activated.

If the two CMs need to execute in a specific order, CM1 followed by CM2, the following options exist:

- CM 3 could be configured to execute in Phase 0 and CM4 in Phase 1, thus causing the triggers to occur 500 ms apart and the subsequent execution order for CM1 and CM2 are maintained.
- CM3 and CM4 can be configured to execute in the same phase with CM3 having a lower ORDERINCEE value than CM4. CM3 would trigger CM1 to execute and then CM4 would trigger CM2. ACE maintains the execution order of the triggered blocks based on the order the parameter store occurred.
- CM3 can request CM1's execution to occur immediately and CM4 could request CM2 to execute in 1 second.

Process special and scaling

The CM parameter SCALEPERIOD is supported to allow a program or another function block to store a scaling value just before the module is to execute. The parameter can only be written if the CM PERIOD is set to NONE. A write to this parameter is rejected if the CM has any other period. This allows blocks with period-related parameters to be scaled appropriately based on the time since the CM's last execution. The CM supplies this value to each of its contained function blocks. The floating-point value written is the

number of seconds in the period. The value will be validated against the valid range of between the minimum ACE period and 24 hours.

If this parameter is read while the period is NONE, it will return the last value written to it or the default value of one minute if it has not been written. If the parameter is read while the CM period is something other than NONE, the parameter will return the current period value.

CEE/ACE Memory and Processing Resources

CEE/ACE processing resources

CEE/CPM and ACE Processing Resources		
<u>Definitions:</u> <i>PU = Processing Unit. The PU represents a platform independent amount of processing resources (time) required to complete a predefined amount of computational (control) work.</i> <i>Maximum Cycle Loading: Over a cycle (0-39), the "Average CPU Used" (CPUCYCLEAVG) statistic is not to exceed the stated maximums.</i>		
Minimum Reserved CPU to be Maintained During Runtime	20% - CPM 20% - ACE (See Note below)	
	<i>PU Maximum</i>	<i>Maximum Cycle Loading</i>
500 ms CEE/ACE	15000 PU/sec	60%
50 ms CEE – Non-Redundant Configuration	3600 PU/sec	60%
50 ms CEE – Redundant Configuration	1600 PU/sec	60%
5 ms CEE – (Non-Redundant only)	2400 PU/sec	40%

Note: CPUFREEAVG is not supported by ACE. CPU Usage from Windows Task Manager provides the %CPU used; ACE reserved is 100% - %CPU being used

CEE/ACE memory resources

CEE/CPM Memory Resources and Block Configuration		
<i>Definition: MU = Memory Unit = 1 Kbytes = 1024 bytes</i>		
	CPM	ACE
Maximum Available CEE Memory Resources	4000 MU	32000 MU
Maximum Total Number of CMs, SCMs and IOMs Configurable per CEE	1000	4000* (*IOMs not supported)
Maximum Number of Control Modules with PERIOD of NOPERIOD, Process Special	N/A	4000
Maximum Number of Component Blocks per CM	40	40
Maximum Total Number of Steps and Transitions (in all handlers) per SCM	160 (80 Step/Transition pairs)	160 (80 Step/Transition pairs)

Typical requirements

The following table identifies typical processing and memory resource requirements for SCMs based on Processing Resources per module and Memory Resource usage. The Processing Resources are computed as "Processing Resource Consumption (PU/module execution) divided by Execution Period (sec/module execution)". Please refer to [CEE/CPM and CEEACE Memory Resources](#) sections for more information about the terms PU and MU.

Planning and Design
 CEE/ACE Memory and Processing Resources

Typical Module Types (FB Content in Parenthesis)	Processing Resource Consumption (Per Module)	Memory Resource Usage
Sequence Control Module A (1 each of Main, Hold, Stop and Abort Handlers, 10 Steps with 8 Outputs each, 10 Transitions with 5 Conditions each, 10 Recipe items, 5 History items) SCM has <u>total</u> of 10 Steps and 10 Transitions among the 4 Handlers	2.0	28.9
Sequence Control Module B (1 Main Handler, no other Handlers, 20 Steps with 4 Outputs each, 20 Transitions with 3 Conditions each, 10 Recipe items, 5 History items) SCM has <u>total</u> of 20 Steps and 20 Transitions	2.0	35.7
Sequence Control Module with an alias table size of 45 rows by 100 columns (1 each of Main, Hold, Stop and Abort Handlers, 10 Steps with 8 Outputs each, 10 Transitions with 5 Conditions each interspersed in all the handlers, 10 Recipe items, 5 History items) SCM has <u>total</u> of 10 Steps and 10 Transitions among the 4 Handlers	2.0	128.5

Sequence Control Module with an alias table size of 500 rows by 9 columns (1 each of Main, Hold, Stop and Abort Handlers, 10 Steps with 8 Outputs each, 10 Transitions with 5 Conditions each interspersed in all the handlers, 10 Recipe items, 5 History items) SCM has <u>total</u> of 10 Steps and 10 Transitions among the 4 Handlers	2.0	124.5
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Configuring ACE for CAB

The use of Custom Algorithm Blocks (CAB) and Custom Data Blocks (CDB) affect the ACE node in the following areas:

- [Processing requirements](#)
- [Memory utilization](#)
- [Operations](#) (ACE shutdown to clear CAB memory)



REFERENCE - EXTERNAL

The sections that follow provide the basic considerations to be used in ACE planning and operations. For a complete discussion of the effect of CAB/CDB on ACE, see *CAB and CDB System Planning and Design*

ACE processing requirements for CAB/CDB

The CPU utilization for CAB and native blocks is covered in *Control Builder Components Theory*. There is no processing requirement for CDB.

ACE memory utilization for CAB/CDB

Refer to the document Determine ACE memory utilization

Peer-to-Peer Considerations

Peer-to-peer operations using ACE

You can implement peer-to-peer communications among CEEs in multiple Application Control Environment (ACE) supervisory controllers that belong to the same system Server over the Fault Tolerant Ethernet (FTE) or Ethernet network. The ACE supervisory controller can peer-to-peer with CEEs in multiple C200 CPMs through an optional direct connection to the ControlNet supervisory network.



REFERENCE - INTERNAL

The basics of Experion peer-to-peer operations can be found in *Basic Peer-to-Peer design Concepts*

Peer-to-peer update rates

The configurable peer-to-peer update rates for the ACE are 500 ms; 1 s; 2 s; 5 s; 10 s; and 20 s. The default is 2 s.

CEE/ACE communications performance

The maximum total parameter access response rate for the 500-ms CEE/ACE (including display, Fast/Slow History, Excel I/ODBC Exchange, and peer communications) is 2000 parameters/second (PPS). Peer-to-peer communications performance is summarized below:

CEE to CEE - Peer-to-Peer Communications Performance per CEE	500 ms CEE/ACE
Maximum number of peer-to-peer connections to other ControlNet resident CEE type environments (CPM, FIM, IOLIM)	30
Maximum number of peer-to-peer connections as target initiated by other ControlNet resident CEE type environments (CPM, FIM, IOLIM)	30
Maximum Initiator Node Pull/Get Request Rate - To all target nodes. <i>(Based on the number of requests for peer data and</i>	500 PPS
	ControlNet

<i>the peer update rate.) (There are no guarantees that an Ethernet network can assure the timely delivery of critical data packets. Users are cautioned to consider the non-deterministic nature of an Ethernet network before designing and configuring a mission critical control strategy to use it. An Ethernet network is subject to collisions, deferred transmissions, and other anomalies that may delay; the arrival of critical data packets. The results of internal tests show that under a full load condition approximately 1 in 30,000 peer fetches arrive at a peer node at greater than twice the configured peer update rate.)</i>	250 @ 500 ms 500 @ 1 sec 1000 @ 2 sec 2500 @ 5 sec 5000 @ 10 sec
	Ethernet
	250 @ 500 ms 500 @ 1 sec 1000 @ 2 sec 2500 @ 5 sec 5000 @ 10 sec
Maximum Target Node Response Rate to Pull/Get Requests - From all initiator nodes.	500 PPS
Maximum Initiator Node Push/Store Request Rate - To all target nodes. (The SCM Step and Push are the only block types that can currently initiate peer push/store requests for CEE-to-CEE peer communications.)	50 PPS
Maximum Target Node Response Rate to Push/Store Requests - From all initiator nodes.	50 PPS
Maximum Initiator OPC Pull/Get Request Rate - To all target OPC servers. (There is no limit imposed on number of different OPC servers that can be accessed by the ACE/CEE.)	1000 PPS
Maximum Initiator OPC Push/Store Request Rate - To all target OPC servers. (There is no limit imposed on number of different OPC servers that can be accessed by the ACE/CEE.)	100 PPS

Timed function block execution

Since the ACE/CEE runs on a time-sharing operating system, the timed event for function block execution may be delayed or interrupted by other tasks. The ACE/CEE function block includes statistical parameters for calculating timed event for function block execution.

The time is measured from the previous cycle's start of FB execution to the current cycle's start of FB execution. Minimum, Average, and Maximum statistics are provided. Ideally, all three values would be equal to the Base Execution Period (500 msec for ACE).

Planning and Design
Peer-to-Peer Considerations

The parameters are:

BASPERIODMIN	Minimum Time Between Execution Cycles
BASPERIODAVG	Average Time Between Execution Cycles
BASPERIODMAX	Maximum Time Between Execution Cycles

Peer environments and subscription periods










You can identify different peer environments and configure individual subscription periods and store response time values through the applicable CEE configuration form in Control Builder. This includes other ACE supervisory controllers, C200 Process Controllers, and external servers, such as OPC servers. The configuration form also specifies default subscription period and store response time values to be used for all peer environments without individually specified settings. The individual parameters are described below. In addition to system wide default values; the values for specific CEE peers can be adjusted by users with an Engineer access level or higher in the Monitor mode of Control Builder.

Parameter	Description
All Environments	
SUBSCPERIOD	The Peer Update Rate (SUBSCPERIOD) parameter is the rate at which this CEE subscribes to data from other CEEs through peer-to-peer communications. In the event of a peer-to-peer communications problem such as a broken cable, the connection will timeout, returning an error
STRRESP	Store Response - Specifies the default store response expiration time to be used for all peer environments in seconds.
Individual Environments	
PEERENV[]	Peer Environment - Specifies the peer environment that is to have specific peer subscription period (PEERSUBSCPER[]) and peer store response time (PEERSTRRESP[]) values configured for it.
PEERSUBSCPER[]	Peer Subscription Period - Specifies the specific update period to be used for the corresponding peer environment number (PEERENV[]) in seconds.
PEERSTRRESP[]	Peer Store Response Time - Specifies the specific store response expiration time to be used for the corresponding











	peer environment number (PEERENV[]) in seconds. If a store response is not received within the configured expiration time, the store is marked failed
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Function block support (CPM/ACE comparison)

Since ACE controller operation is based upon the Control Processor Module (CPM) design, ACE supports many of the same function blocks as the CPM. The ACE controller does not support any of the existing function blocks associated with I/O communication interface. The CPM does not support the new UCNIF block. The following table summarizes the Function Block Libraries in Control Builder and identifies which control environment supports them.

If Function Block Is From This Library in Control Builder . . .	Then, It Can Be Used With This Control Environment . . .
 HONEYWELL (Typical Fieldbus Device vendor library.)	CPM/CEE
 SYSTEM	ACE/CEE CPM/CEE (Restrictions apply - loaded strategies must contain supported blocks only.)
 AUXILIARY	ACE/CEE CPM/CEE
 DEVCTL	ACE/CEE CPM/CEE
 DATAACQ	ACE/CEE CPM/CEE
 IDMODULE	CPM/CEE
 IOCHANNEL	CPM/CEE
 PMIO	CPM/CEE
 LOGIC	ACE/CEE CPM/CEE
	ACE/CEE

Planning and Design
Peer-to-Peer Considerations

If Function Block Is From This Library in Control Builder . . .	Then, It Can Be Used With This Control Environment . . .
 REGCTL	CPM/CEE
 SCM	ACE/CEE CPM/CEE
 UTILITY	ACE/CEE CPM/CEE
 PULSEINPUT	CPM/CEE
 RAIL_IO_HAZ	CPM/CEE
 PBUSIF	CPM/CEE
 RAIL_IO	CPM/CEE
 FBUSIF	CPM/CEE
 EXCHANGE	CPM/CEE
 UCNIF	ACE/CEE

Installation and Upgrade

Refer to the [Software Installation and Upgrade Guide](#) for Further details.

Configuration

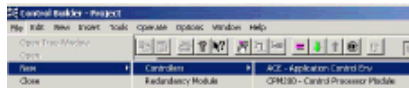
Creating an ACE and CEE

Use the following procedure to create an Application Control Environment (ACE) controller and associated Control Execution Environment (CEE) blocks in the Project Tree that will represent an installed ACE controller. The CEE supports execution of a set of Function Blocks for solving control applications. It runs in the ACE controller as a software layer built on top of the control software infrastructure.

Details of the contents and usage of the Application Control Environment (ACE) Block can be found at [Application Control Environment Block](#). The details and usage of the Control Execution Environment (CEE) block can be found at [Control Execution Environment Application Control Environment Block](#)

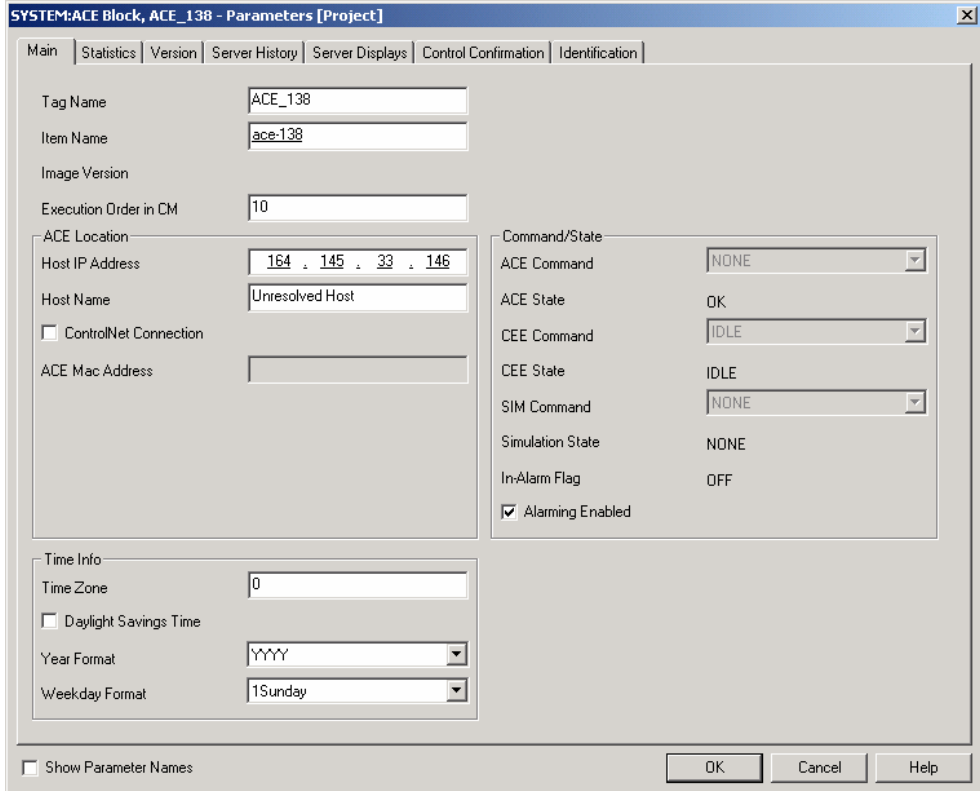
The following procedure assumes that Control Builder is running and two tree windows are open. All illustrations used in the procedure are for example purposes only.


Step	Action	Result
1	Click File -> New -> Controllers -> ACE - Application Control Environment .	Calls up the ACE Block configuration form with Name field highlighted.



Configuration




Creating an ACE and CEE

Step	Action	Result
		
2	Key in desired name of up to 16 characters or accept the default. Press <Tab>	Moves cursor to Item Name field.
3	If the CEE is part of an Enterprise Model, enter its Item Name here. Press <Tab>	Moves cursor to the Execution Order in CM field.
4	Retain the default execution order of 10, or enter a new value. Press <Tab>.	Moves cursor to Host IP Address field.

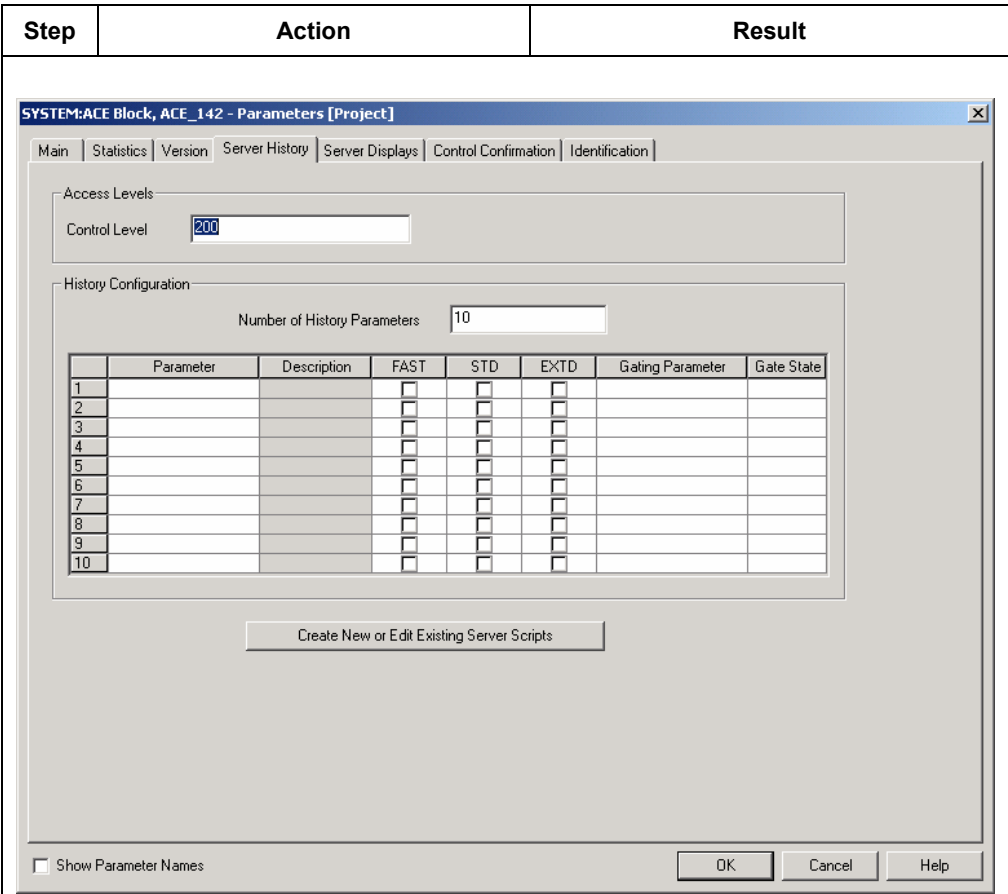
Step	Action	Result
	<p>TIP</p> <p>Host name and Host IP Address are interactive entries. We recommend that you key in the Host IP Address first and let the system determine the Host Name automatically. This is especially true if you are configuring the ACE block with the ACE node offline. In this case, entering the Host IP address first generates a Warning message, but entering the Host Name first generates an error message. When keying in an IP address, use the mouse or the left and right arrow keys to move the cursor to locations within the field. Do not press the <Tab> key until the complete address is keyed in.</p>	
5	<p>Key in the host pc IP address for the ACE node. Press <Tab>. Or, press <Tab> to skip this field and enter Host Name instead. Acknowledge any error message prompts.</p>	<p>System automatically determines the Host Name, when ACE node is online, and moves cursor to Host Name field. (Valid IP address entry results in system automatically determining the Host Name, when ACE node is online.)</p>
6	<p>If Host Name has been automatically determined, press <Tab>. Or, key in name assigned to the host pc for the ACE node. There is a 255-character limit on this field. Press <Tab> (Valid Host Name entry results in system automatically determining the Host IP Address, when ACE node is online.)</p>	<p>Moves cursor to ControlNet Connection field.</p>
7	<p>Leave the box unchecked, if ACE is not connected to the ControlNet network. Check the box, if ACE is connected to the ControlNet network. Press <Tab>.</p>	<p>If the box is unchecked, cursor moves to Alarm Enabled selector, since the preceding fields are unavailable. Go to Step 9. If the box is checked, cursor moves to ACE Mac Address field.</p>
8	<p>Key in the Media Access Control (MAC) address assigned to the PCIC card installed the ACE node for ControlNet connections. Press <Tab>.</p>	<p>Moves cursor to the Alarm Enabled selector.</p>
9	<p>The default is alarming enabled. Remove the check to disable alarming. Press <Tab></p>	<p>Moves cursor to the Time Zone field.</p>

Configuration

Creating an ACE and CEE

Step	Action	Result
	<p>TIP</p> <p>The time zone represents the offset value from the Greenwich Mean Time (GMT) based on your geographical location. For example, the time zone value for a CPM located in the Eastern time zone of the United States that is currently not observing daylight savings time would be -05.0 or -5. Always use the offset value that is not adjusted for daylight savings time as the entry for the Time Zone field. For example, the adjusted offset value for the Eastern time zone of the United States is -04.0, but use the unadjusted value of -5 instead.</p> <p>You may want to visit the http://www.worldtimeserver.com/ website, if you have a question about the appropriate offset value for your given location.</p>	
10	Key in the appropriate time zone offset value for the location where the ACE is installed. Press <Tab>.	Moves cursor to Daylight Savings Time check box.
11	Leave box unchecked, if Daylight Savings Time is not currently being observed at your location. Or, Check the box, if Daylight Savings time is currently being observed at your location. Press <Tab>.	Moves cursor to Year Format field.
12	Accept default or click  down-arrow button and select desired format from the list. Press <Tab>.	Moves cursor to Weekday Format field.
13	Accept default or click  down-arrow button and select desired format from the list. Click the Server History tab.	Calls up the Server History configuration form.

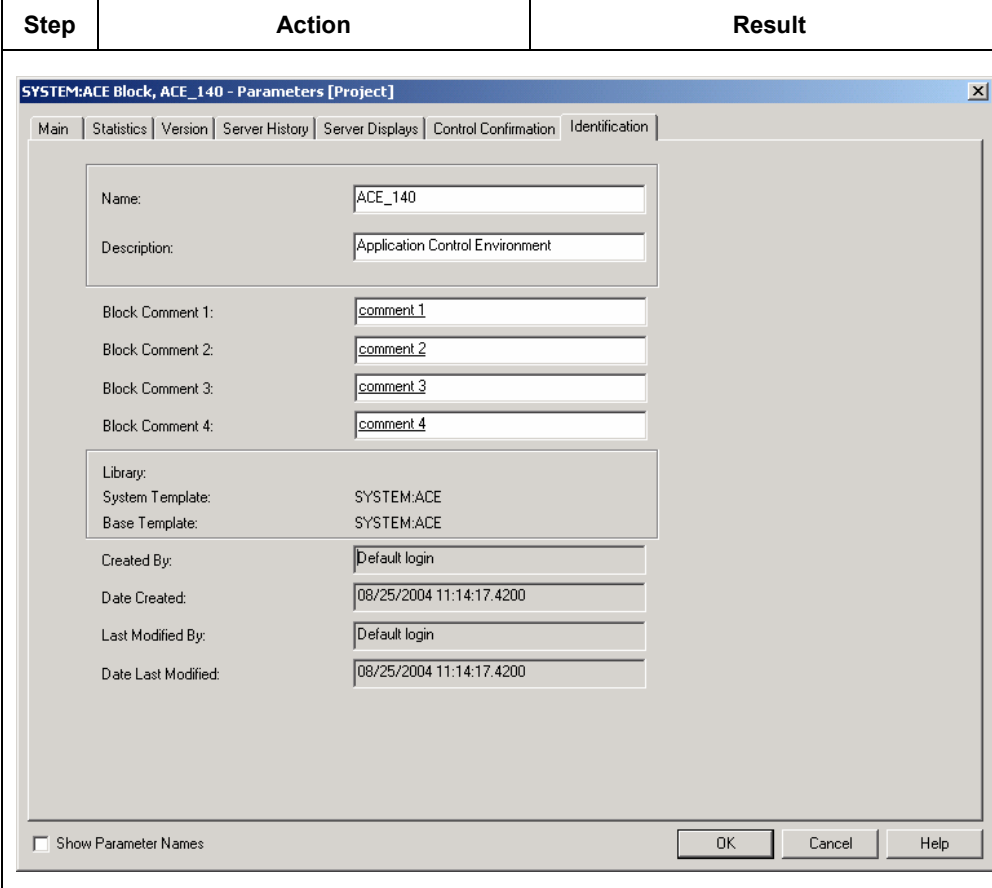

Step	Action	Result
14	<p>Use the on-line help as a guide to complete the configuration entries on this tab. Click the Server Displays tab.</p>	<p>Calls up the Server Displays configuration form.</p>



Configuration

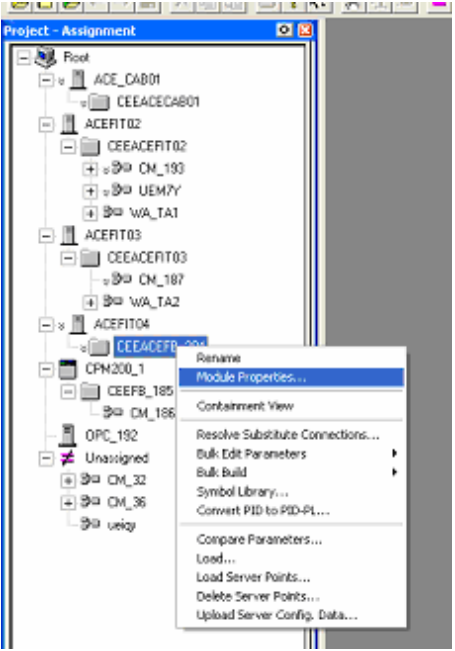
Creating an ACE and CEE

Step	Action	Result
	<p>The screenshot shows the 'Identification' tab of the 'SYSTEM:ACE Block, ACE_138 - Parameters [Project]' dialog. It features several input fields and two tables. The 'Trends' section has a 'Number of Trends' field set to 10 and a table with 5 rows. The 'Groups' section has a 'Number of Groups' field set to 5 and a table with 5 rows. At the bottom, there is a 'Show Parameter Names' checkbox and 'OK', 'Cancel', and 'Help' buttons.</p>	
15	Use the on-line help as a guide to complete the configuration entries on this tab. Click Identification tab.	Calls up the Identification configuration form

Step	Action	Result
		
16	<p>Use the on-line help as a guide to complete the configuration entries on this tab. Click the OK button.</p>	<p>Closes the form and creates ACE/CEE block icons in Project tab.</p> 

Configuration


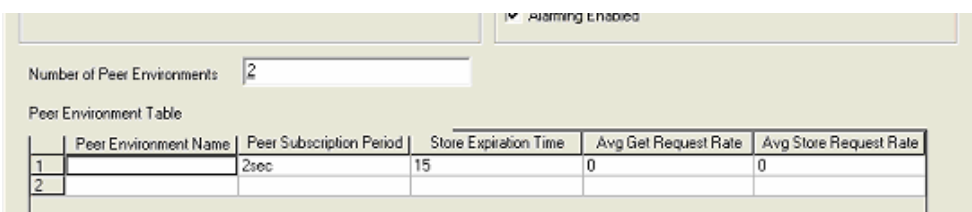

Creating an ACE and CEE


Step	Action	Result
17	Right-click CEEACE block icon.	Calls up shortcut menu.  A screenshot of a software interface titled "Project - Assignment". It shows a hierarchical tree view of project components. The tree includes folders like ACE_CAB01, ACERT02, ACERT03, ACERT04, and various control blocks such as CEEACEFB_185. A right-click context menu is open over the CEEACEFB_185 block, listing options like "Rename", "Module Properties...", "Containment View", "Resolve Substitute Connections...", "Bulk Edit Parameters", "Bulk Build", "Symbol Library...", "Convert PID to PID-PL...", "Compare Parameters...", "Load...", "Load Server Points...", "Delete Server Points...", and "Upload Server Config. Data...".
18	Click Module Properties.	Calls up CEE Block configuration form.

Step	Action	Result
19	Key in desired name of up to 16 characters or accept the default. Press <Tab>	Moves cursor to the Item Name field
20	If the CEE is part of an Enterprise Model, enter its Item Name here. Press <Tab>	Moves cursor to Base Execution Period field.
21	Accept the default. Press <Tab>.	Moves cursor to Subscription Period field.

Configuration

Creating an ACE and CEE

Step	Action	Result																		
22	Accept the DEFAULT or click  down-arrow button and select desired period. Press <Tab>.	Moves cursor to Store Expiration Time field.																		
23	Accept the default or key in desired value. Press <Tab>.	Moves the cursor to the Simulation Enable selector.																		
24	Select if this node is to be used as a SIM ACE. (See SIM ACE User Guide for additional details). Press <Tab>.	Moves cursor to Alarming Enabled field.																		
25	The default is alarming enabled. Remove the check to disable alarming. If peers are to be configured, move to the <i>Number of Peer Environments</i> field and go to item 25. Otherwise, click on the Server History tab and go to Step 30																			
Peer Configuration																				
 <p>The screenshot shows the 'Peer Configuration' screen. At the top right, there is a checkbox labeled 'Alarming Enabled' which is checked. Below it, the 'Number of Peer Environments' is set to 2. Underneath, there is a 'Peer Environment Table' with the following data:</p> <table border="1"> <thead> <tr> <th></th> <th>Peer Environment Name</th> <th>Peer Subscription Period</th> <th>Store Expiration Time</th> <th>Avg Get Request Rate</th> <th>Avg Store Request Rate</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td>2sec</td> <td>15</td> <td>0</td> <td>0</td> </tr> <tr> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				Peer Environment Name	Peer Subscription Period	Store Expiration Time	Avg Get Request Rate	Avg Store Request Rate	1		2sec	15	0	0	2					
	Peer Environment Name	Peer Subscription Period	Store Expiration Time	Avg Get Request Rate	Avg Store Request Rate															
1		2sec	15	0	0															
2																				
	<p>TIP</p> <p>The Number of Peer Environments and Peer Environment Table are interactive. The value entered for the Number of Peer Environments determines how many rows appear in the Peer Environment Table.</p>																			
26	Key in number of peer environments for this ACE. Press <Tab>. Or, skip this field, if no peer environments will be used, click the Server History tab and go to Step 30	If peer environments will be used, cursor moves to the Peer Environment Name column in the Peer Environment Table.																		

Step	Action	Result
27	Key in valid name for existing peer environment. Press <Tab>.	Moves cursor to Peer Subscription Period column.
28	Accept default or click  down-arrow button to select another value specific to the given environment. Press <Tab>.	Moves cursor to Store Expiration Time column.
29	Accept the default value of 15 or enter a non-zero value. Return to Step 27 to enter data for another peer, or click the Server History tab and go to step 30	
Server History Configuration		
30	Use the on-line help as a guide to complete the configuration entries on this tab. Click the Server Displays tab.	Calls up the Server Displays configuration form.
31	Use the on-line help as a guide to complete the configuration entries on this tab. Click the OK button.	Completes CEE configuration and closes the form.
32	This completes the ACE/CEE creation procedure.	

Configuration

Application Control Environment Block

Application Control Environment Block

ACE Block

Description	The ACE controller mirrors the basic operations of a Control Processor Module (CPM). It provides the additional capability of communicating with OPC Servers through a Fault Tolerant Ethernet (FTE) or redundant or nonredundant Ethernet network. The ACE program runs on a server grade personal computer using a Windows 2000 Server operating system. Users can optionally connect an ACE controller directly to a supervisory Fault Tolerant Ethernet (FTE) or ControlNet network to support peer-to-peer communications with a C200 Process Controller. It executes once every 2 seconds.	
Function	Serves as an OPC client for communications with OPC servers. Supports peer-to-peer with other ACE controllers connected to the same Server over Fault Tolerant Ethernet or Ethernet network through associated services. The ACE controller that has a direct connection to the supervisory ControlNet can peer-to-peer with C200 Controllers that belong to the same Server.	
Inputs	Transmission Control Protocol/Internet Protocol (TCP/IP) Integrated Control Protocol (ICP) communications	
Outputs	See above.	
Parameters	ACEMACADDR ALMENBSTATE AUXDESC[0..10] BLCKCOMMENT1 BLCKCOMMENT2 BLCKCOMMENT3 BLCKCOMMENT4 CCLCNT CCLINFO CCLLOADSTAT CCLNAME CCLPACKET CEECOMMAND	NAME NTOTMEMDESC NUMACEINCON NUMACEOUTCON NUMCPMINCON NUMCPMOUTCON NUMEXTBLKS NUMFIMINCON NUMFIMOUTCON NUMFREEBLKS NUMFREEDESC NUMIOLMINCON NUMIOLMOUTCON

	CEESTATE CNETCONNECT CPMCOMMAND[0..NUMCHANS-1] CPMSTATE CPUFREEAVG CPUFREEMIN CTRLCONFIRM CURTIME DAY DAYLIGHTTIME DESC ENBMEMALMFL FREEMEM FREEMEMINK GROUP.NUMPARAMS HIST.NUMPARAMS HOSTIPPRI HOSTNAMEPRI HOUR IMAGEVER INALM MAXFREEBLKSZ MAXFREEINK MINUTE MONTH	NUMREGDESC NUMSCEINCON NUMSCEOUTCON NUMSIG NUMSIOLMINCN NUMSIOLMOUCN NUMUSEDDBLKS NUMUSEDDESC ORDERINCM PRIMARYSIG REASONSET SCANASSOCDSP SCANCTRLVL SCANGRPDTL SCANPNTDTL SECOND SECONDARYSIG SECSIGSECLVL SIMCOMMAND SIMSTATE STATSRESET TIMEZONE TOTALMEM TOTALMEMINK TREND.NUMPARAMS USEDMEM USEDMEMINK WEEKDAY WEEKDAYFMT YEAR YEARFMT
<p>References</p>	<p>Refer to the <i>Control Builder Parameter Reference</i> manual for definitions of each parameter.</p>	

Configuration

Control Execution Environment Application Control Environment Block

Control Execution Environment Application Control Environment Block**CEEACE Block**

Description	Provides control functionality for associated Application Control Environment block. This block's parameters characterize the CEE within the ACE controller. This block always runs at an execution period of 2 seconds.	
Function	Publishes parameters describing the status and configuration of the CEE. Processes the computation of statistical parameters and notification reporting. Runs on the Windows 2000 operating system. Supports configurable subscription rate for peer-to-peer communications. Supports configurable subscription rate and store response time for specific peer environment. Supports peer-to-peer communications among CEEs assigned to CPMs located in the same management domain.	
Inputs	Transmission Control Protocol/Internet Protocol (TCP/IP) Integrated Control Protocol (ICP) communications	
Outputs	See above.	
Parameters	ALMENBSTATE BASEPERIOD BASEPERIODAVG BASEPERIODMAX BASEPERIODMIN BLCKCOMMENT1 BLCKCOMMENT2 BLCKCOMMENT3 BLCKCOMMENT4 BLKTYPCOUNT BLKTYPDISC BLKTYPHLPTXT BLKTYPLIB BLKTYPSIZE CDISPAVGPPS[1..RDI	NAME NOTIFINHIBIT NUMACCRQUAVG NUMACCRQUMAX NUMACEINCON NUMACEOUTCON NUMBLKTYPES NUMCCLRQU NUMCPMINCON NUMCPMOUTCON NUMEXCRQUAVG NUMEXCRQUMAX NUMEXCRSPAVG NUMEXCRSPMAX NUMFIMINCON

<p>SPCONNMAX] CDISPAVGPPSCONN[1..RDISPCONNMAX] CDISPAVGSPSCONN[1..RDISPCONNMAX] CDISPMAXPPS[1..RDI SPCONNMAX] CDISPMAXPPSCONN[1..RDISPCONNMAX] CDISPMAXSPSCONN[1..RDISPCONNMAX] CEECOMMAND CEESTATE CPEERAVGPPS[1..RP EERCONNMAX] CPEERAVGPPSCONN [1..RPEERCONNMAX] CPEERAVGSPSCONN [1..RPEERCONNMAX] CPEERMAXPPS[1..RP EERCONNMAX] CPEERMAXPPSCON N[1..RPEERCONNMA X] CPEERMAXSPSCON N[1..RPEERCONNMA X] CPUCYCLEAVG[0..39] CPUCYCLEMAX[0..39] CPUFREEAVG CPUFREEMIN CRCYCLEOVRN[0..40] CTRLCONFIRM DESC EUDESC EXTGETRQUAVG EXTGETRQUMAX EXTSTRRQUAVG EXTSTRRQUMAX GROUP.NUMPARAMS HIST.NUMPARAMS INALM</p>	<p>NUMFIMOUTCON NUMIOLINCON NUMIOLOUTCON NUMNTFRQUAVG NUMNTFRQUMAX NUMPARRSPAVG NUMPARRSPMAX NUMPEERENV NUMSCEINCON NUMSCEOUTCON NUMSIG NUMSIOLMINCN NUMSIOLMOUCN PEERENV PEERGETAVG[1..30] PEERSTRAVG[1..30] PEERSTRRESP PEERSUBSCPER PRIMARYSIG RDISPDEGIMRCONN[1..RDISPCONNMAX] REASONSET RPEERNAME[1..RPEE RCONNMAX] SCANASSOCDSP SCANCTRLVL SCANGRPDTL SCANPNTDTL SECONDARYSIG SECSIGSECLVL SIMCOMMAND SIMSTATE STATSRESET STRRESP SUBSCPERIOD TREND.NUMPARAMS</p>
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Configuration

Control Execution Environment Application Control Environment Block

	IPeerConnErrCode[1..N] IPeerConnErrInfo[1..N] IPeerConnSts[1..N] IPeerName[1..IPeerConnMax] IPeerPath[1..IPeerConnMax] LSCycleOvrn[0..40] MAXBLKTYPES	
Reference	Refer to the <i>Control Builder Parameter Reference</i> manual for definitions of each parameter.	

Control Functions and Insertion Points

Insertion Point Support

The ACE controller supports CAB insertion points in Data Acquisition and Regulatory Control function blocks. See Control Builder Components Theory



Control Functions and Insertion Points
Insertion Point Support

Operations

Interacting with ACE

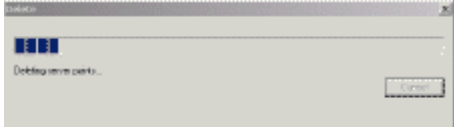
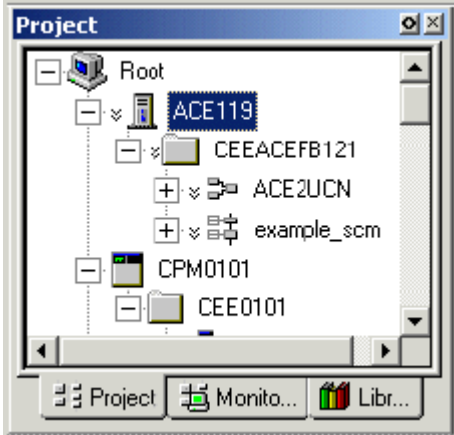

Deleting ACE/CEEACE block

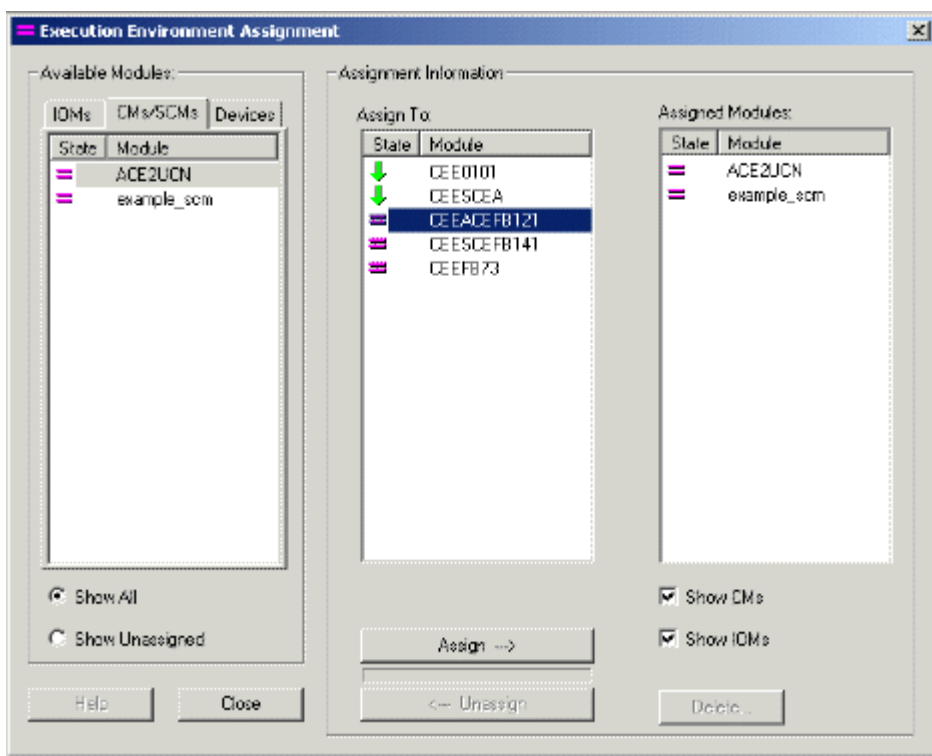

Use the following procedure as a general guide for deleting a loaded ACE/CEEACE block from the Control Strategy. This procedure assumes that Control Builder is running with tree views open. The illustrations used in this procedure are for example purposes only.

Step	Action	Result
1	In Monitor Mode, open root directory for ACE/CEEACE.	Exposes contents of the CEEACE.
2	Right-click the CEEACE block and select Inactivate->Selected CEE(s), IOMs, CMs, Applicable Function Blocks from the shortcut menu.	Inactivates all components including the CEEACE. Block icons turn blue.
	TIP If ACE/CEEACE and its assigned components have been loaded; you must first put the CEEACE in its Idle mode and delete all of its components in the Monitor mode before you can delete them from the Project mode.	
3	Select components contained in CEEACE and click  delete button in the tool bar.	Calls up Delete Selected Objects dialog.
4	Click the Deleted Selected Object(s) button.	Initiates the delete function and progress dialog tracks status until complete.
5	Click the ACE block and click the delete button in the tool bar.	Calls up Delete Selected Objects dialog.

Operations

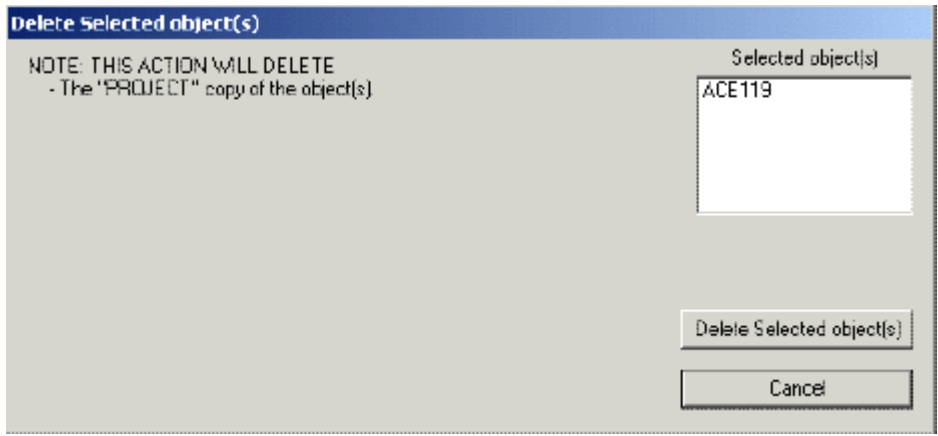
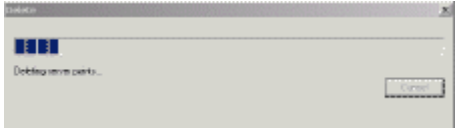
Interacting with ACE

6	Click the Delete Selected object(s) button.	Initiates the delete function and progress dialog tracks status until complete. 
7	Click the Project tab.	Calls up the Project view. 
8	With ACE selected, click  assign button in the tool bar.	Opens the Execution Environment Assignment dialog box.

		
<p>9</p>	<p>Click module assigned to ACE in Available Modules list, select CEEACE in Assign To list, select all the modules listed in the Assigned Modules list and click the Unassign button.</p>	<p>Unassigns modules from CEEACE.</p>
<p>10</p>	<p>Click the Close button.</p>	<p>Closes dialog box and returns to Project view.</p>
<p>11</p>	<p>With ACE selected, click  delete button in tool bar.</p>	<p>Calls up Delete Selected Objects dialog.</p>

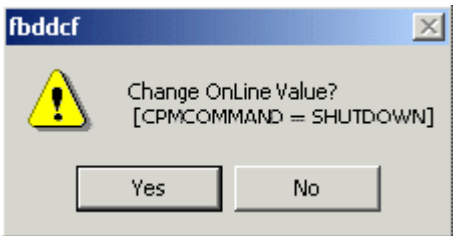
Operations

Interacting with ACE

		
12	Click the Delete Selected object(s) button.	Initiates the delete function and progress dialog tracks status until complete. 
13	This completes the deleting ACE/CEEACE procedure.	Stops the ace.exe on the ACE node, but the Control Data Access for supervisory platform (CDA-sp) continues to run.

Issuing a shutdown command and using checkpoints to restore ACE

Use the following procedure as a general guide for issuing a Shutdown command to a loaded ACE/CEEACE block through the Monitor mode in Control Builder. This procedure assumes that Control Builder is running with tree views open. The illustrations used in this procedure are for example purposes only.

Step	Action	Result
1	In Monitor mode, right-click the CEEACE block and select Inactivate->Selected CEE(s), IOMs, CMs, Applicable Function Blocks from the shortcut menu.	Calls up Change State dialog.
2	Click the Yes button to continue.	Inactivates all components including the CEESCE. Block icons turn blue.
3	Right-click the ACE icon and select Configure Module Parameters.	Calls up the ACE Block configuration form.
4	On Main tab, click down arrow button in ACE Command field and select shutdown.	Calls up warning prompt for confirmation of online change. 
5	Click the Yes button.	Initiates shutdown of ACE, ACE turns yellow and other icons turn red. (The ace.exe stops, but the Control Data Access for supervisory platform (CDA-sp) continues to run. Use Administrative Tools in Windows Control Panel to stop the CDA-sp service on the ACE node.)
6	Right click ACE icon and select Checkpoint->Restore from Checkpoint from shortcut menu.	Opens checkpoint restore dialog.

Operations

Interacting with ACE

7	At this point, perform the operations described in Restoring from checkpoint	
8	Right-click CEESCE icon and select Activate->Selected CEE(s), and its IOMs, CMs and Applicable Function Blocks from the shortcut menu.	Calls up Change State dialog.
9	Click the Yes button to continue.	Activates components and icons turn green.
10	This completes the Shutdown Command and snapshot recovery procedure.	

ACE Restarts

Brief review of startup/restart concepts

A CEE can undergo different kinds of start up. The most basic is when a CEE is started by initial load of its parent controller / device block. When this happens the CEE starts out empty of algorithm blocks and is basically inert. This sort of restart does not pose any special issues, and it will not be described here.

This section deals with startups in which there is previous CEE data that must be handled correctly. These start ups are usually referred to as “restarts

There are two kinds of restarts discussed in this document:

Restart Type	Characteristics
Cold Restart	<p>This kind of restart always happens as a transition in the value of CEESTATE from idle to run. It can happen after the CEEACE FB has just been created and the initial configuration loaded. A more critical form of cold restart happens after restore of a checkpoint so that the CEE database is neither null nor newly loaded from CB. In this case, a careful policy must be followed as to which data is preserved and which is reinitialized.</p> <p>The policy followed by cold restart assumes that much of the state data is stale. Thus, any live data that can be derived directly from the process is wiped out. But in addition, much of the operational data that was captured in the saved checkpoint is reinitialized. All configuration data is of course saved across cold restart</p>
Warm Restart	<p>Warm restart is directly analogous to cold restart in that it always happens as a transition in the value of CEESTATE from idle to run and in that its most critical form occurs after restore of a checkpoint. It differs in the policy it applies in choosing data to preserve and data to reinitialize.</p> <p>Warm restart preserves all data that cold restart preserves but preserves additional operational data as well.</p>

ACE cold/warm startup

When changing the CEE state from Idle to Run, the operator is given the choice of what type of Restart to be performed. The different types of Restart are characterized as follows.

Restart Type	Behavior
Activate-Cold	UCNOUT and HiwayOut blocks connected to xPM points, and TPS-HG points go into initialization. If supported, any remote cascade requests in the secondary blocks are turned off, requiring the Operator to manually change the modes of all secondary Regulatory Control blocks
Activate-Warm	On the first execution, UCNOUT and HiwayOut blocks connected to xPM, or TPS-HG points go into initialization. Any remote cascade requests from the secondary blocks are responded to, thus setting the secondary block Mode to Cascade. On the second execution, automatic control is resumed



TIP

Regulatory Control blocks connected to C200/FIM blocks are considered peer connections and not supervisory connections. On ACE restart these blocks are only affected by the status of their secondaries. Initialization is driven up the chain from the secondary connected to the I/O and not by the type of ACE restart

CEE restart option per SCM/CM

The ACE node shall support a cold/warm activation option for SCMs and CMs. The options permit the SCM/CM to always start warm, always start cold or always follow the CEE. The options are summarized below:

Restart Option	Behavior of the SCM
FollowCEE	For this configuration parent control modules instruct their component blocks to initialize according to whichever type of restart the operator has selected for the CEE as a whole: cold or warm.
AlwaysCold	The operator must intervene to activate the SCM.
AlwaysWarm	The SCM shall start back at the first transition in the main handler.

ACE Reconfiguration

Reconfiguring ACE to a PC other than that originally configured

The user can quickly reconfigure an ACE to another PC to correct configuration errors or in case of a PC problem. The overall procedure:

Step	Action
1	Delete the ACE FB from monitoring
2	Change the IP address of the ACE FB
3	Reload the ACE
4	Reload all peer strategies which reference the reconfigured ACE

ACE Checkpoint and Restore

Checkpoint and restore operations

Checkpoint and restore operations are covered in the Control Building Guide

Operations
ACE Checkpoint and Restore

System Administration

Local ACE Node Administration

ACE node administration is done locally. Keyboard, mouse, and monitor should be available to connect to the ACE node, when reviewing/adjusting administration settings. Node administration function includes:

- checking status of node services,
- using node performance tools, or
- starting and stopping other applications on the node



ATTENTION

The system does not prevent the user from installing and executing other applications on the same node as ACE or Experion applications. For robust and reliable ACE control, it is highly recommended that only ACE related applications be hosted on the ACE node.

Troubleshooting and Maintenance

Recovering from ACE node power failure

Use the following procedure as a general guide for recovering ACE/CEEACE operation after a power failure. This procedure assumes that Control Builder is running with tree views open. The illustrations used in this procedure are for example purposes only.

Prerequisites

The following state should exist, representing a fully functional, active ACE node:

- ACE node is running
- CEEACE function blocks are loaded
- CM/SCM with strategies built are loaded and active

Indications of failure

If the ACE loses power the following occurs:

- Loss of Communications with Controller event is generated
- Errors are indicated on the Monitoring tab icons for the ACE, CEEACE, and CM/SCM FBs associated with ACE
- Lower level strategies dependent on the ACE for supervisory control sheds to their configured backup modes.

Recovering from node power failure

Use the following procedure to recover from an ACE power failure

Step	Action	Result
1	Restore power to ACE node.	Wait for ACE node to return to operation (Boot).
2	Right click ACE icon and select Checkpoint->Restore from Checkpoint from shortcut menu.	Opens checkpoint restore dialog.
3	At this point, perform the operations described in Restoring from checkpoint	
4	Right-click CEEACE icon and select Activate->Selected CEE(s), and its IOMs, CMs and Applicable Function Blocks	Calls up Change State dialog.

Troubleshooting and Maintenance

Recovering from ACE application failure

	from the shortcut menu.	
5	Click the Yes button to continue.	Activates components and icons turn green.
6	This completes the power failure recovery procedure.	

Recovering from ACE application failure

Use the following procedure as a general guide for recovering ACE/CEEACE operation after an ACE application failure. This procedure assumes that Control Builder is running with tree views open. The illustrations used in this procedure are for example purposes only.

Prerequisites

The following state should exist, representing a fully functional, active ACE node:

- ACE node is running
- ACE/CEEACE function blocks are loaded
- CM/SCM with strategies built are loaded and active

Indications of failure

An ACE application failure occurs when the either the CDA-sp or EE component or both fail. If the ACE application fails the following occurs:

- Loss of Communications with Controller event is generated
- Errors are indicated on the Monitoring tab icons for the ACE, CEEACE, and CM/SCM FBs associated with ACE

Recovering from application failure

Use the following procedure to recover from an ACE application failure:

Step	Action	Result
1	Restore power to ACE node.	Wait for ACE node to return to operation (Boot).
2	Right click ACE icon and select Checkpoint->Restore from Checkpoint from shortcut menu.	Opens checkpoint restore dialog.
3	At this point, perform the operations described in Restoring from checkpoint	
4	Right-click CEEACE icon and select Activate->Selected CEE(s), and its IOMs, CMs and Applicable Function Blocks from the shortcut menu.	Calls up Change State dialog.
5	Click the Yes button to continue.	Activates components and icons turn green.
6	This completes the power failure recovery procedure.	

Recovering from an I/O connection error 2299

Prerequisites

The following state should exist, representing a fully functional, active ACE node:

- ACE node is running
- ACE/CEEACE function blocks are loaded
- CM/SCM with strategies built are loaded and active

Indications of failure

In ACE/SimACE you cannot directly connect to I/O unless it is a 1756 channel. You will receive a 2299 error stating “initiator cannot establish connection with the responder”. Ensure your connection is defined as a 1756 channel.

Recovering from OPC Server failure

Prerequisites

The following state should exist, representing a fully functional, active ACE node:

- ACE node is running
- ACE/CEEACE function blocks are loaded
- CM/SCM with strategies built are loaded and active
- OPC Server function block is successfully loaded
- ACE contains control strategies that reference the OPC Server
- Communication between the ACE and the OPC Server is normal

Indications of failure

An OPC Server failure happens if any of the following occurs:

- OPC Server component fails
- The single Ethernet connection to the OPC Server fails
- OPC Server loses power

If OPC Server fails the following occurs:

- Communication errors from ACE strategies that reference OPC Server data. Several process alarms can be reported as a result of:
 - fail-safe data substitution for Gets, and
 - failures for Stores

Recovering from OPC Server failure

Use the following procedure to recover from an OPC Server failure:

Step	Action
1	Restore power to the OPC server node, if power was lost
2	Repair the failure in the communication link, if needed

Honeywell

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