FactoryTalk® Logix Echo

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expanding **human possibility**®

Digital Engineering Use Cases

Machine Prototyping
Easily design and build the next generation of machines with confidence

Virtual Commissioning
Design, test, validate, & commission machines before they go into service

Throughput Analysis
Optimize throughput with real-time 3D simulation of dynamic processes

Operator Training Simulators
Reduce risk by training your workforce in a safe, virtual environment
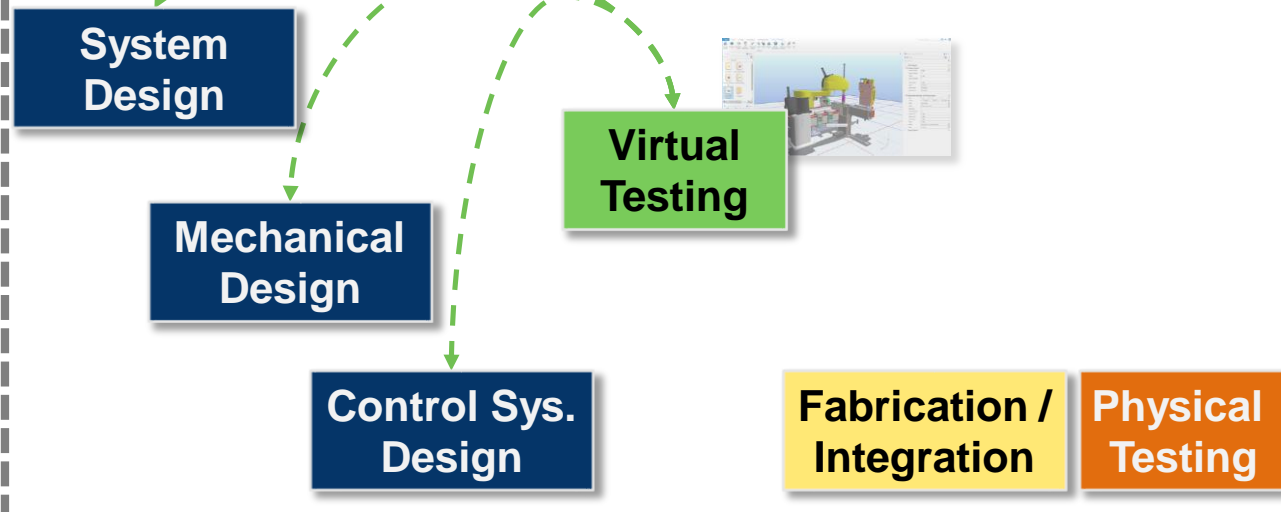
Digital Twin Workflow

Mitigates risks and adds flexibility in your projects

Improve project delivery timeline

Improve quality of design

Reduce hardware dependencies

Reduce commissioning risks

TRADITIONAL SCHEDULE

System Design	Mechanical Design	Control Sys. Design	Fabrication / Integration	Physical Testing	Rework	Physical Testing

DIGITAL TWIN SCHEDULE

System Design

Mechanical Design

Control Sys. Design

Virtual Testing

Fabrication / Integration — Physical Testing

SAVINGS

FT Logix Echo
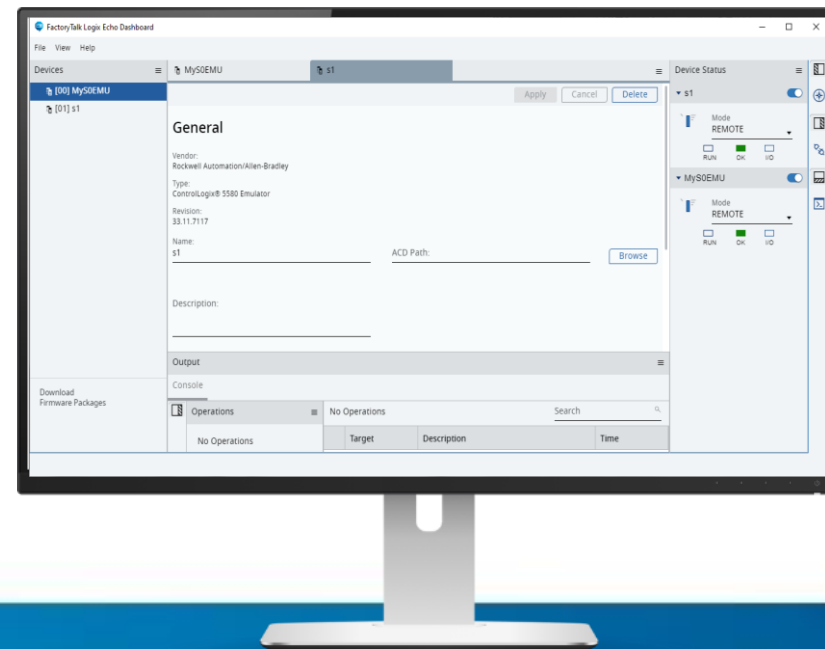
Emulate ControlLogix® 5580 Controllers

- Fully test your control code in a safe, virtual environment
- The emulated chassis supports up to 17 controllers
- Execute controller project as designed without modifications

Ethernet Connectivity

- Front port of controller emulated
- Produce/Consume and MSGs between emulated controllers
- Connect to HMI or other software with Class 3 MSGs

SDK (Public Interface)

- Interface with high fidelity process simulators and Operator Training Simulators (OTS)
- High-speed data exchange
- Virtual time-scaling
- Snapshots

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2021

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Access is Similar to a Physical Controller

Setting up an emulated controller is fast

- Get the corresponding emulator firmware kit from the PCDC
- Create emulated controller instance with appropriate firmware revision and IP address
- Configured controllers appear in FactoryTalk® Linx software
- Create up 17 emulated controllers in one emulated chassis

FT Logix Echo
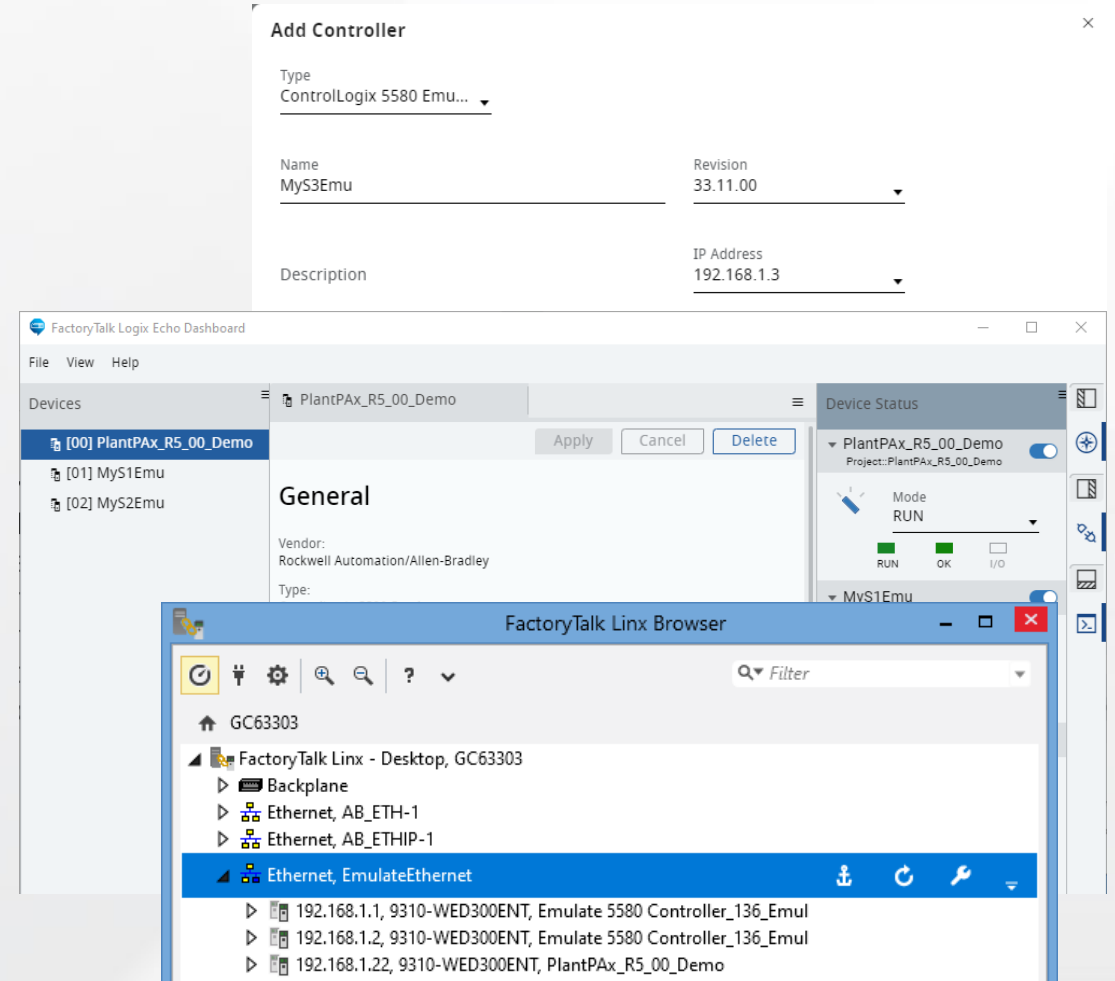
Apply Same Project to Physical or Emulated Controller
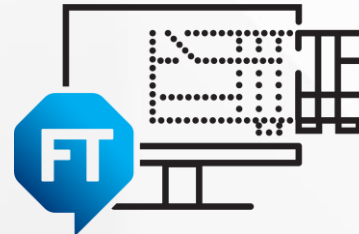
Same Project File

No changes to the project file required. The same project file developed for the physical controller will download to the emulator. The I/O tree will be maintained, all languages and instructions supported.

Studio 5000
Logix
Designer®
Project File

Logix Echo

Co-located

Logix Echo

Remote
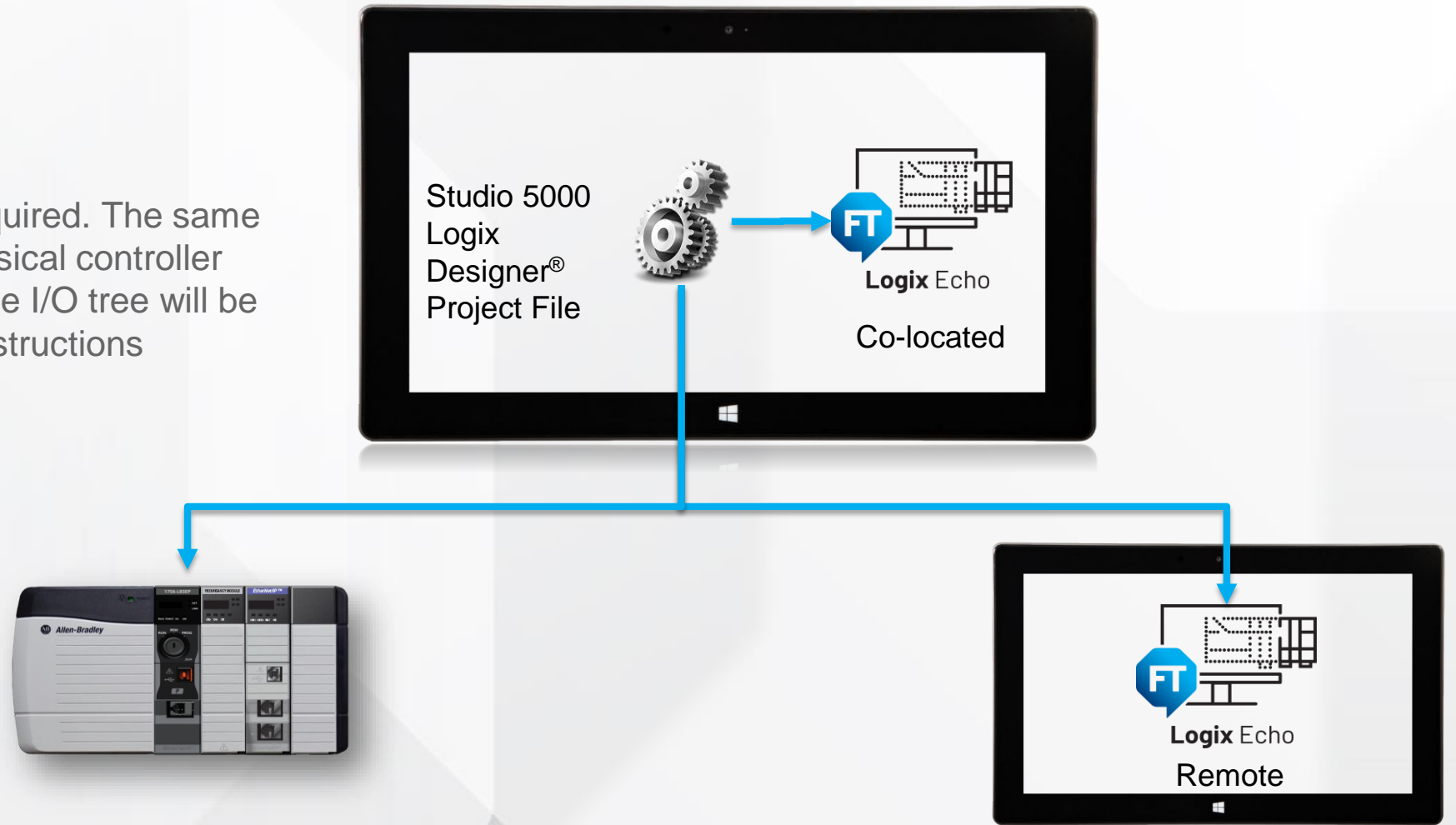
Logix Echo

Supported Controllers

ControlLogix® 5580 Controllers

All -E, -XT, -NSE and –P controllers

Logix Echo

Firmware version 33 or later

Catalogs

1756-L81E	1756-L82E	1756-L83E	1756-L84E	1756-L85E
1756-L81EK	1756-L82EK	1756-L83EK	1756-L84EK	1756-L85EK
1756-L81E-NSE	1756-L82E-NSE	1756-L83E-NSE	1756-L84E-NSE	1756-L85E-NSE
1756-L81EXT	1756-L82EXT	1756-L83EXT	1756-L84EXT	1756-L85EXT
1756-L81EP		1756-L83EP		1756-L85EP

Future Releases: GuardLogix® 5580, CompactLogix™ 5380 and Compact GuardLogix® 5380 Controllers

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Simulate Control Code and HMI Interaction All from a Single Workstation or Distributed

Step 1: create Logix application and run in FactoryTalk Logix Echo
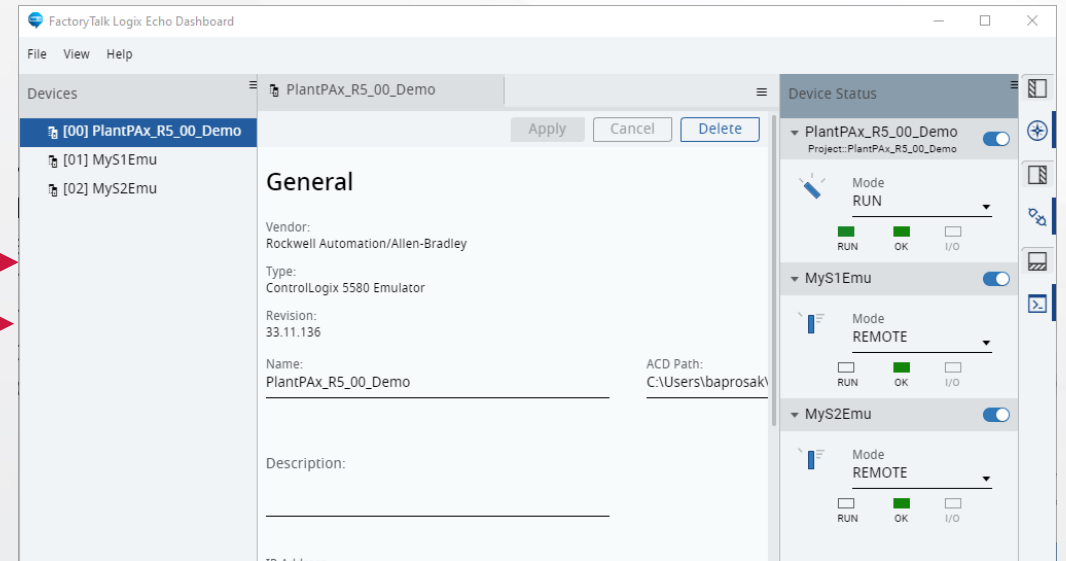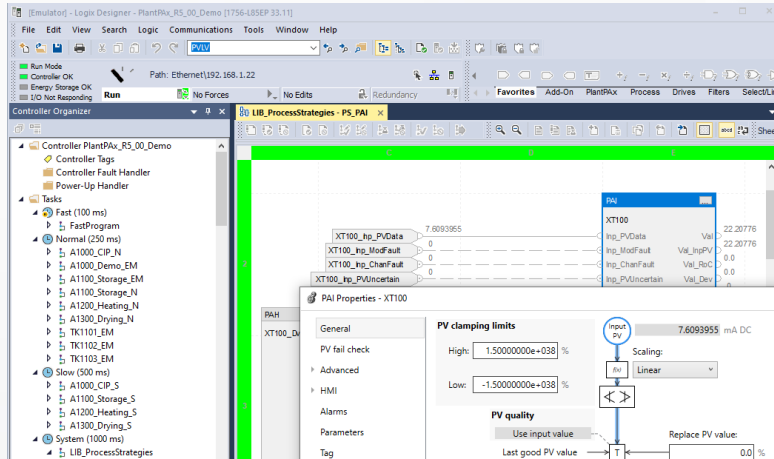
Step 2: Existing HMI shortcut(s) will work provided the emulated controller is at same IP as physical controller

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Support for SD Cards

- By default, a virtual SD card is attached to a controller (as a folder on your Windows directory)

- You can backup/restore projects, read/write data from the controller applications, log, just as you would with a physical SD card in the controller.

- Unlike the physical controller:

    - Firmware is not stored to the virtual SD

    - The content is stored unencrypted

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FT Logix Echo
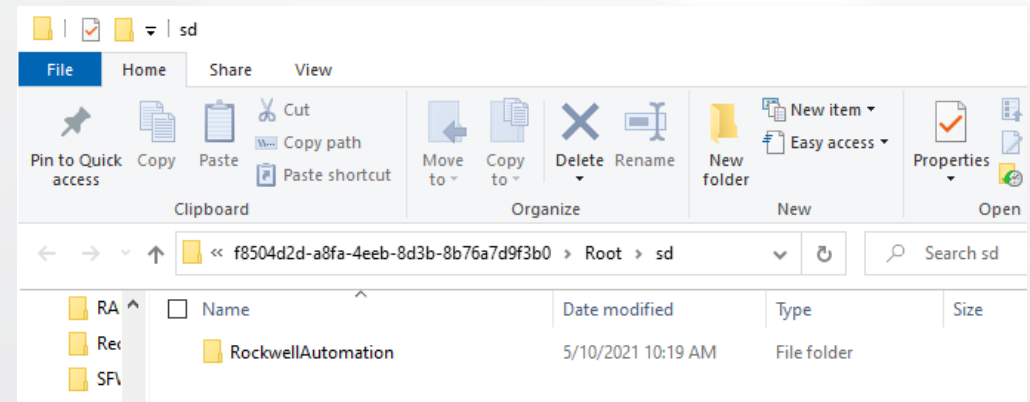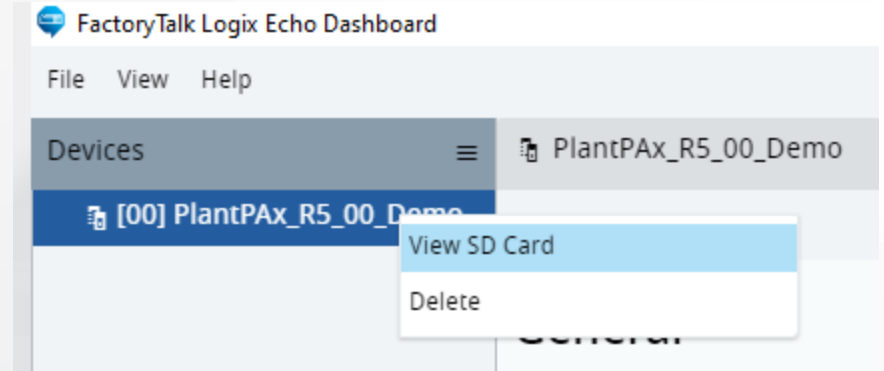
Studio 5000 Logix Designer® to Emulator Instance

Studio 5000 Logix Designer® can download over Ethernet. It can also bridge through one emulator instance connected over Ethernet to another emulator instance through the emulated backplane.
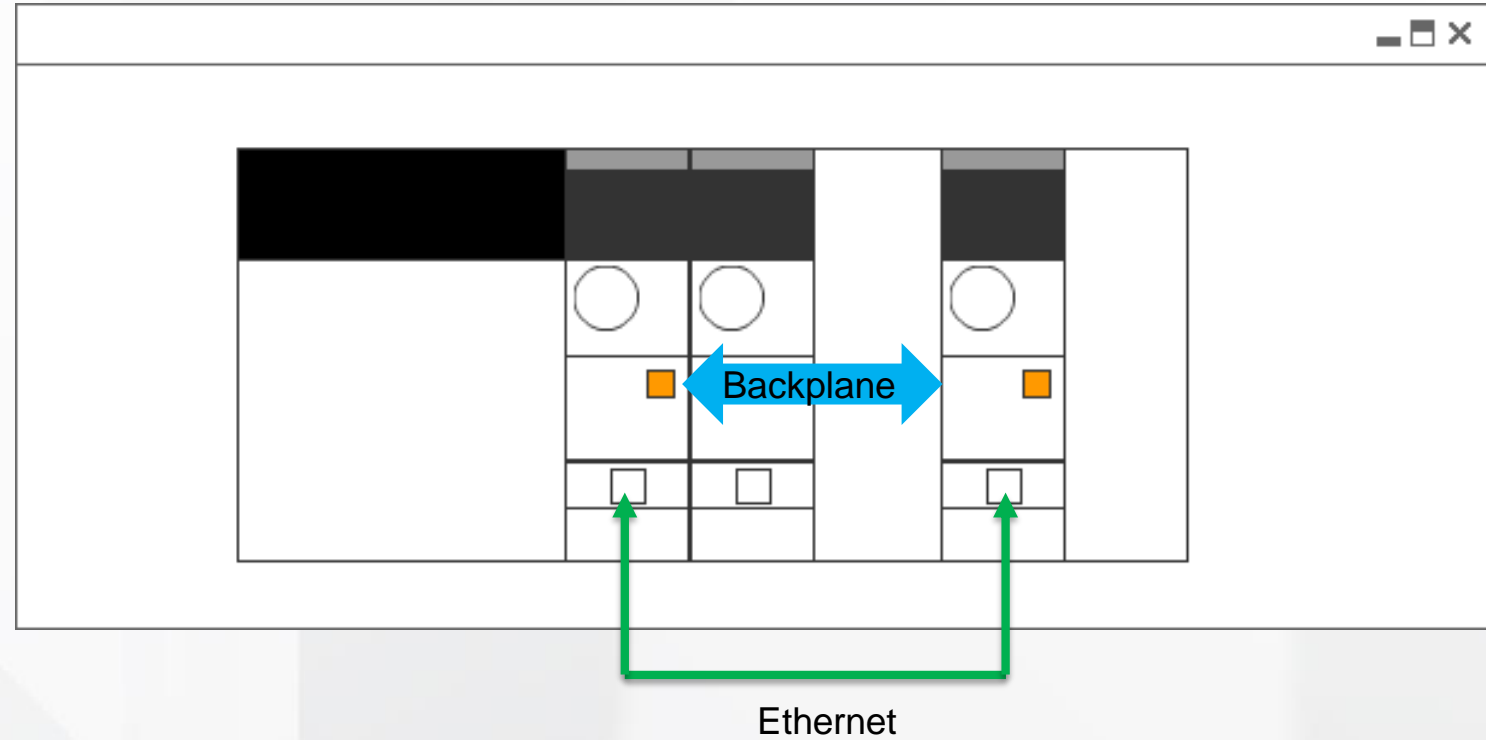
Studio 5000 Logix Designer®

Backplane

Ethernet

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Logix Echo
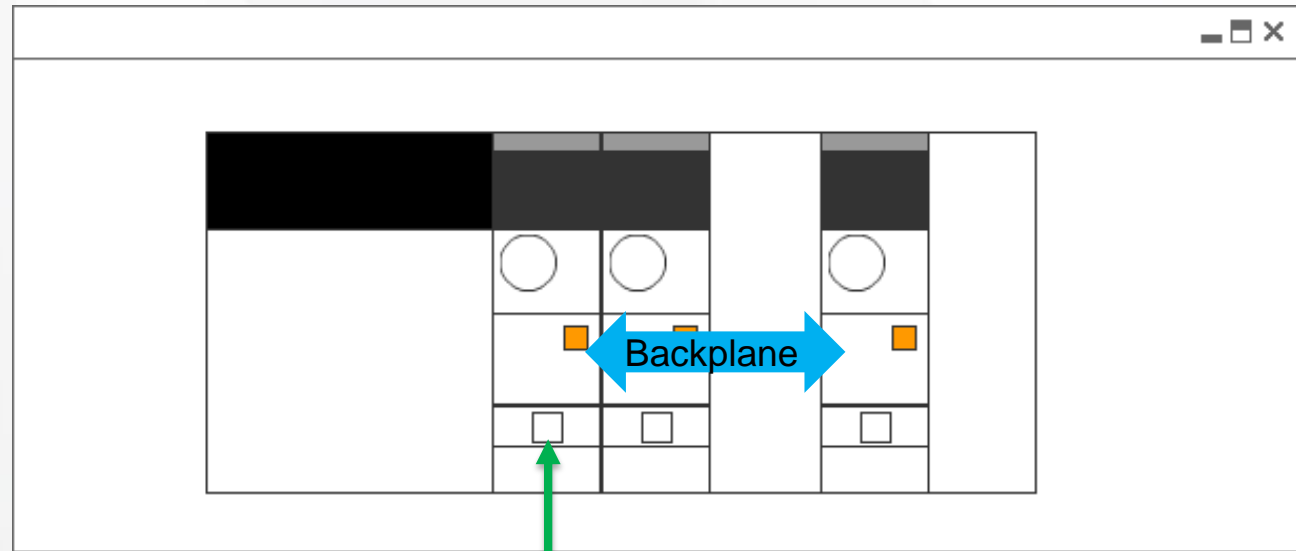
Emulator-2-Emulator Communications

Class 1 (Produce/Consume) or Class 3 (Messages) communication between emulator instances can be established across:
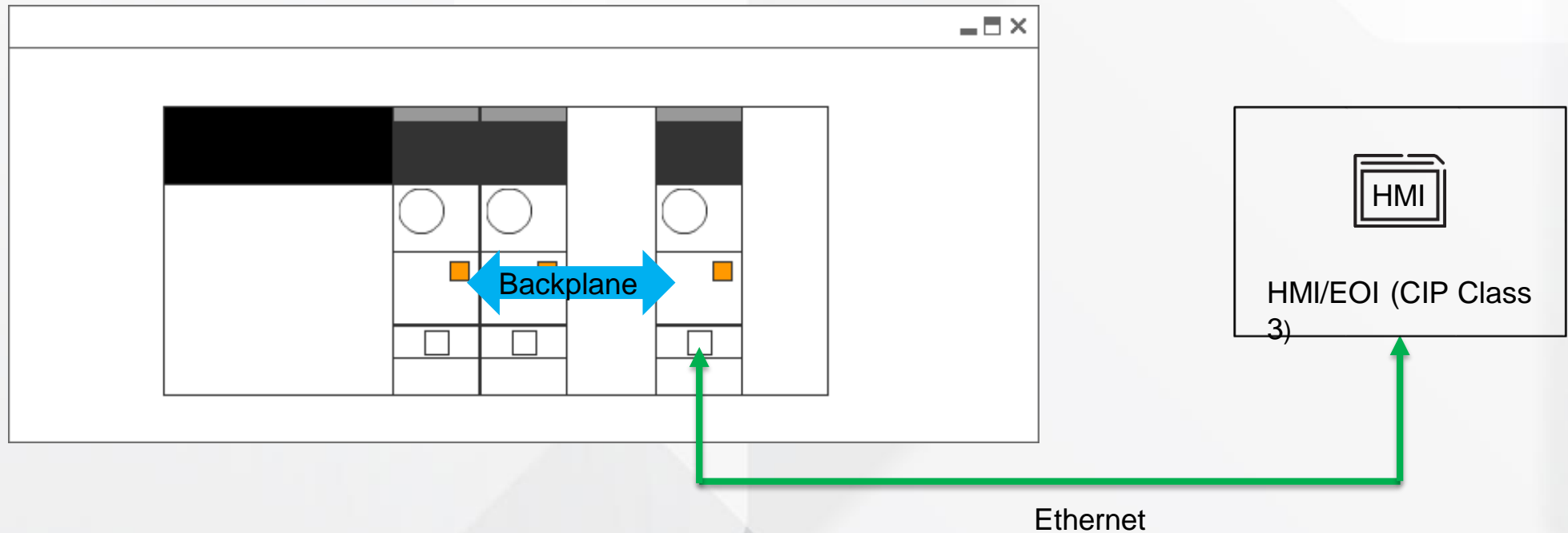- the emulated back plane
- Ethernet using the EtherNet/IP protocol.

Backplane

Ethernet

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Emulator-2-HMI/Other CIP-based software

Class 3 (Messages) communication between emulator instance and HMI/other CIP-based software:
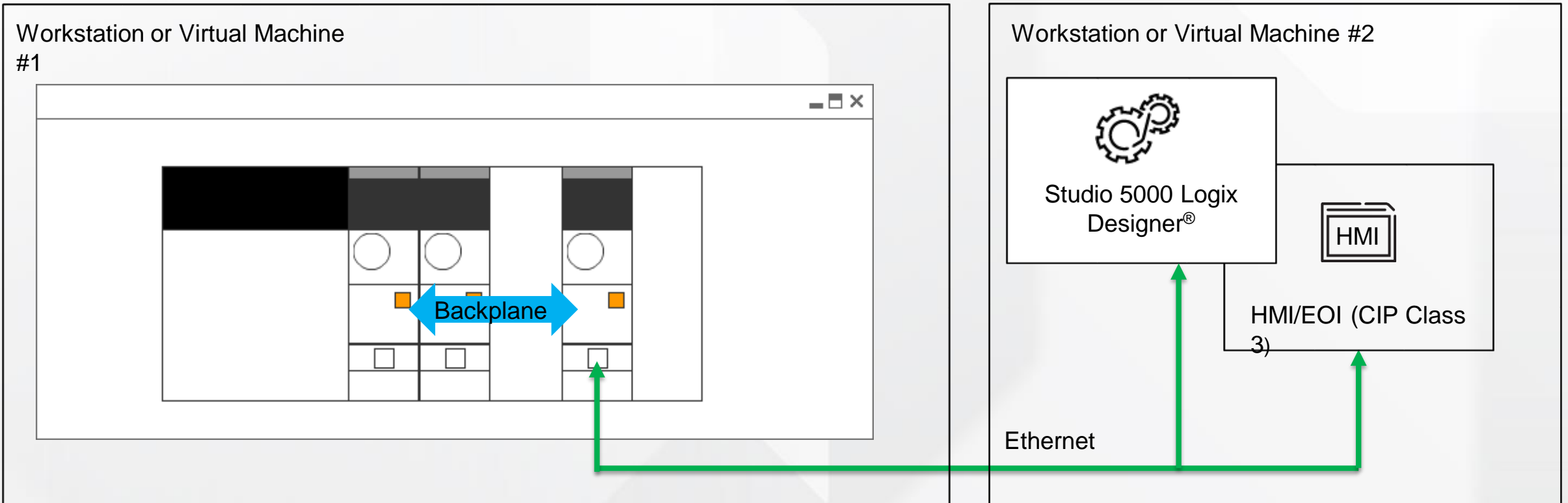- Over EtherNet/IP
- Bridged over backplane to EtherNet/IP

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Remote connections to Emulators

Remote instances of Studio 5000® Logix Emulate™ and HMI software can communicate with the emulator instances over Ethernet.

- When Studio 5000 Logix Designer® is not installed on the same OS as FactoryTalk® Logix Echo certain workflows are disabled that depend on Logix Designer application services

Workstation or Virtual Machine #1

Backplane

Workstation or Virtual Machine #2

Studio 5000 Logix Designer®

HMI

HMI/EOI (CIP Class 3)

Ethernet

Performance - Communications

Maximum Achievable Specifications

- Class 1 Produced/Consumed messages between emulators: 20,000 pps

- Class 1 chassis total: 160,000 pps

- Class 3: 700 messages/second

- Class 3 chassis total: 3,700 messages/second

- Minimum RPI: 10ms

Important

- As the software runs as a normal user program, it can and will be interrupted by other Windows services and processes adversely impacting performance

- Despite 99.9% of messages getting successfully transmitted/received, CIP connections will occasionally timeout due to interrupts from other Windows services

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Performance – Installation Hardware Requirements

**CPU – 2.2 GHz Intel Core i3 or faster processor:**

- At least one logical core for the OS

- At least two logical cores for the core FactoryTalk® Logix Echo application

- At least one logical core per emulated controller instance

- Additional logical cores dependent on additional software installed on workstation

Memory – at least 8GB:

- 2GB for the base FactoryTalk® Logix Echo application

- 256MB per emulated controller instance (4.52GB for full 17 controller emulated chassis
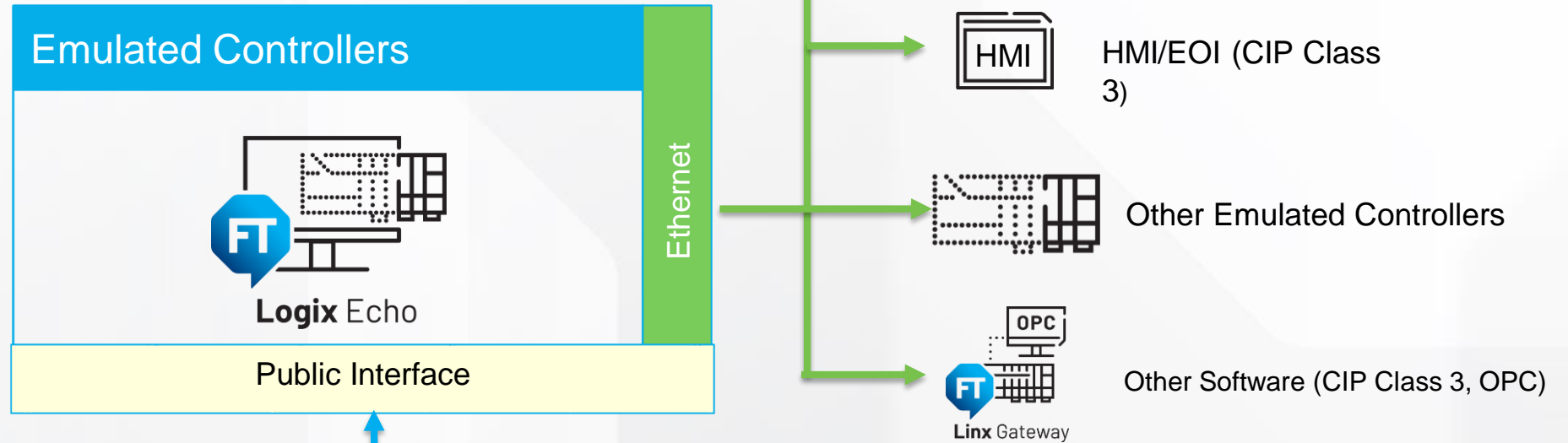
- Additional memory for OS and other software applications

Virtual Machine Consideration

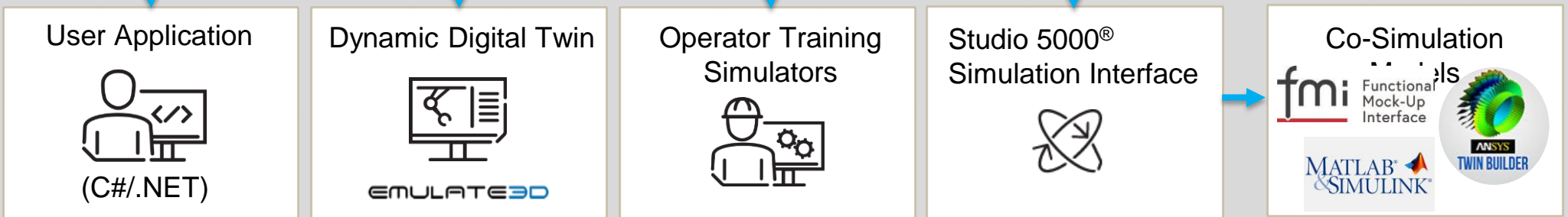- Use Intel Virtualization Technology
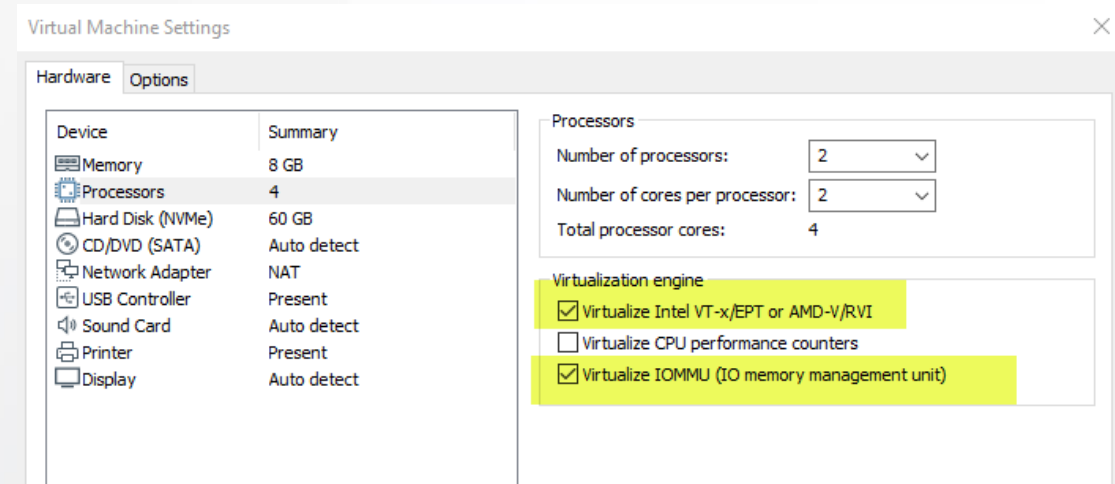
FactoryTalk® Logix Echo SDK

Integrate FactoryTalk® Logix Echo into your own Software Applications

User Application
(C#/.NET)

Integrate all FactoryTalk® Logix Echo functionality into your own software application. Use the SDK and API to build applications to connect directly to controllers for simulation and data analysis

The SDK documentation kit contains:

- Detailed explanations of all the API functions and their uses with sample code
- NuGet package, which includes .NET Standard 2.0 assemblies which allow access to API. (Installable in any .NET application that supports .NET Standard 2.0)
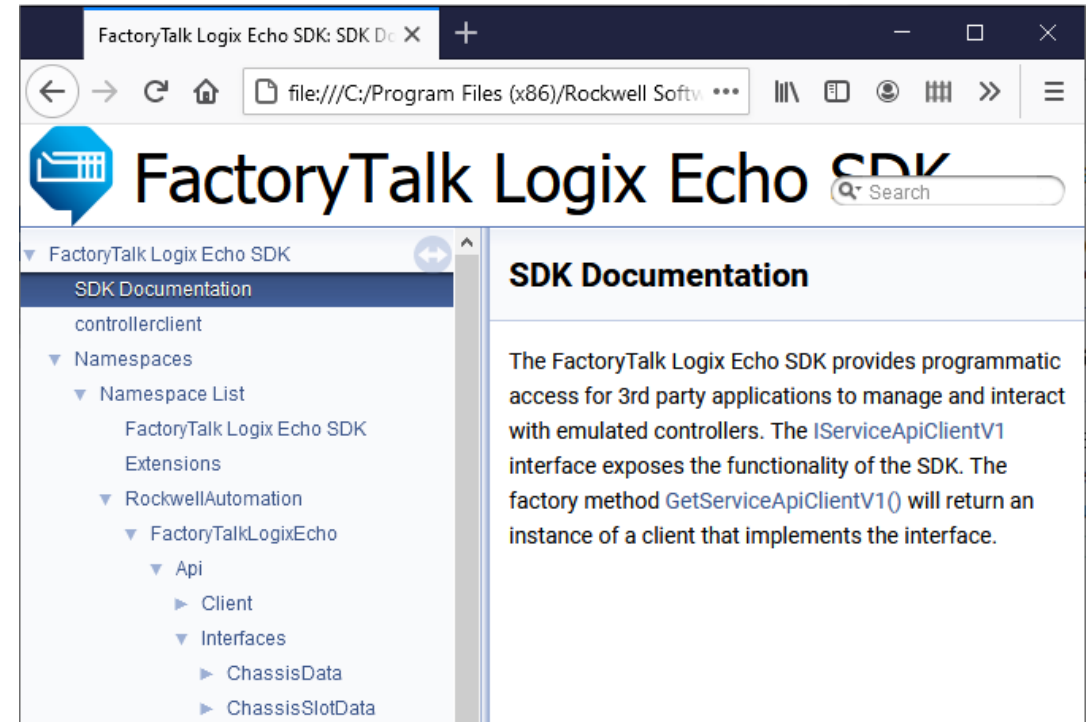
Two Sets of APIs:

- Service API: Use to manage the system and to perform all the functions that can be done from the dashboard
- Controller API: Use to control the execution, scale time, and access tags in an emulated controller

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Emulate3D™ Integration

Available in Emulate3D™ 2020 minor release at launch of FactoryTalk® Logix Echo

Example:

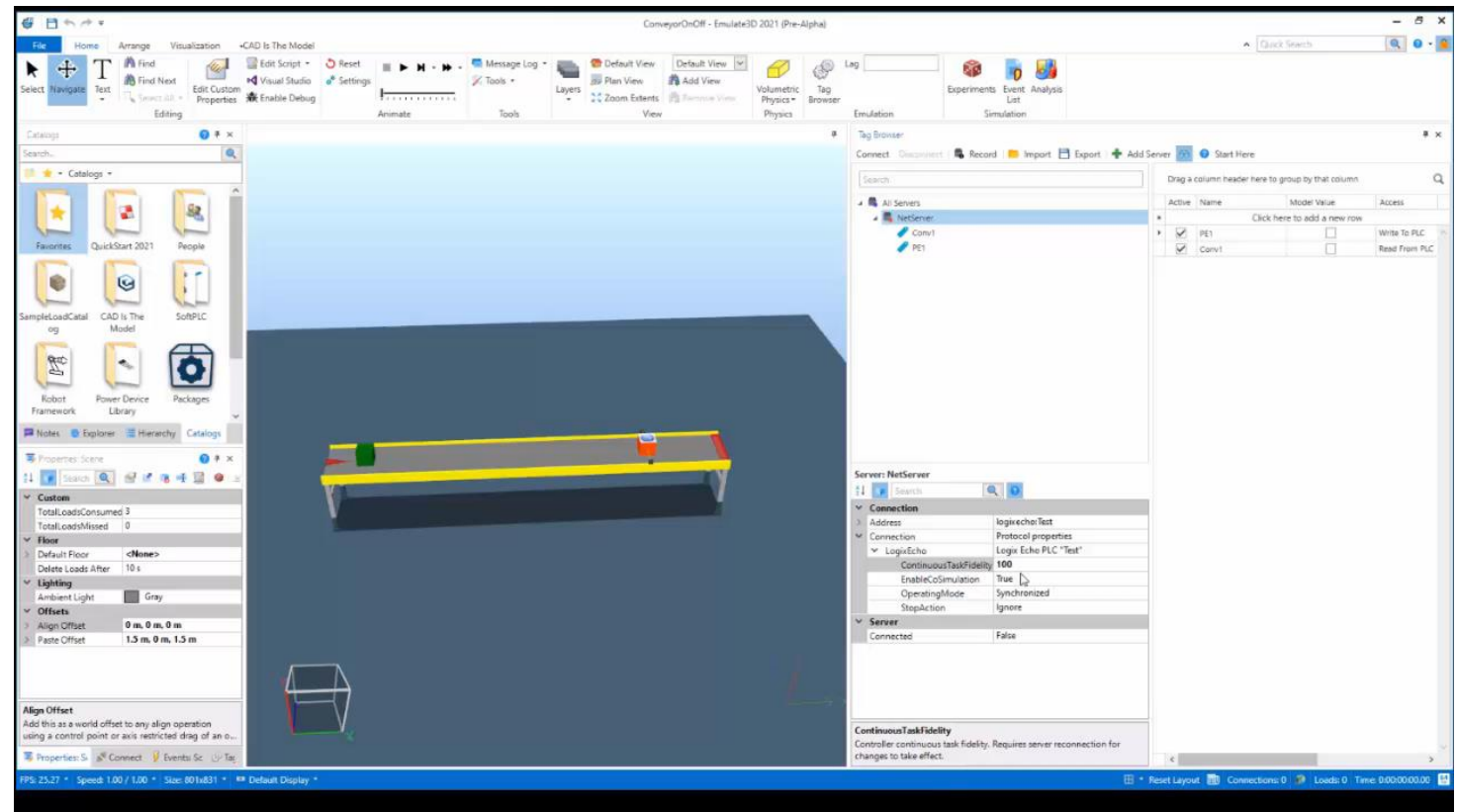- E3D runs as fast as possible with Controller in **Co-Simulation** mode
- Emulate3D™ reports the controller can be scaled to ~3x

Operator Training Simulators

High-Speed Data Exchange and Co-Simulation Interface for Integration with OTS

Overview

- Use your own or 3rd-party party simulation tools to interact with emulated controllers to create and simulate the plant responses

Benefits

- Provides dynamic, real-time responses like the actual plant

- Train operators in specific scenarios in a safe, fully functioning virtual system using the actual displays from operations

- Develop and test new control strategies or plant optimizations in a lab environment

Emulated controllers

Operator Training Simulator

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Snapshot Capabilities
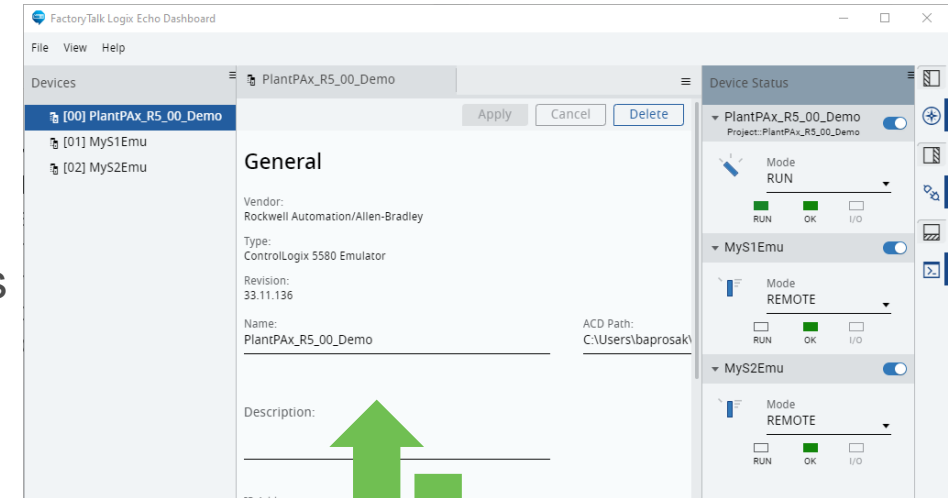
Snapshot Concept

Save one or more controller's state at a specific point in time which can latter be restored

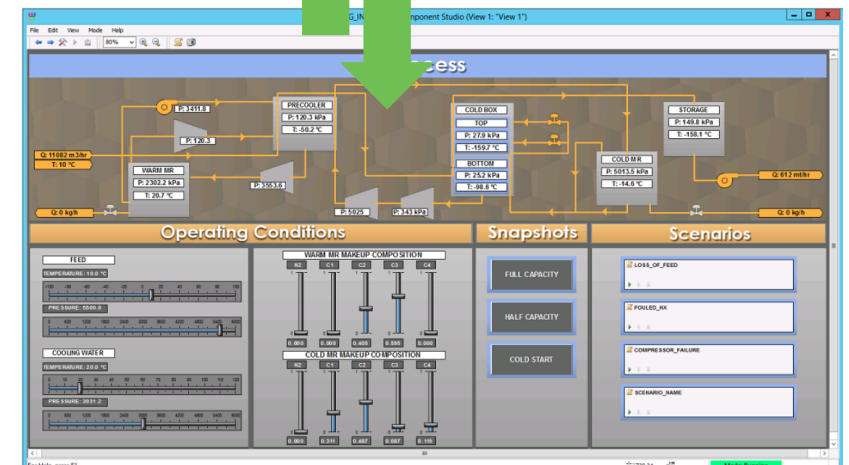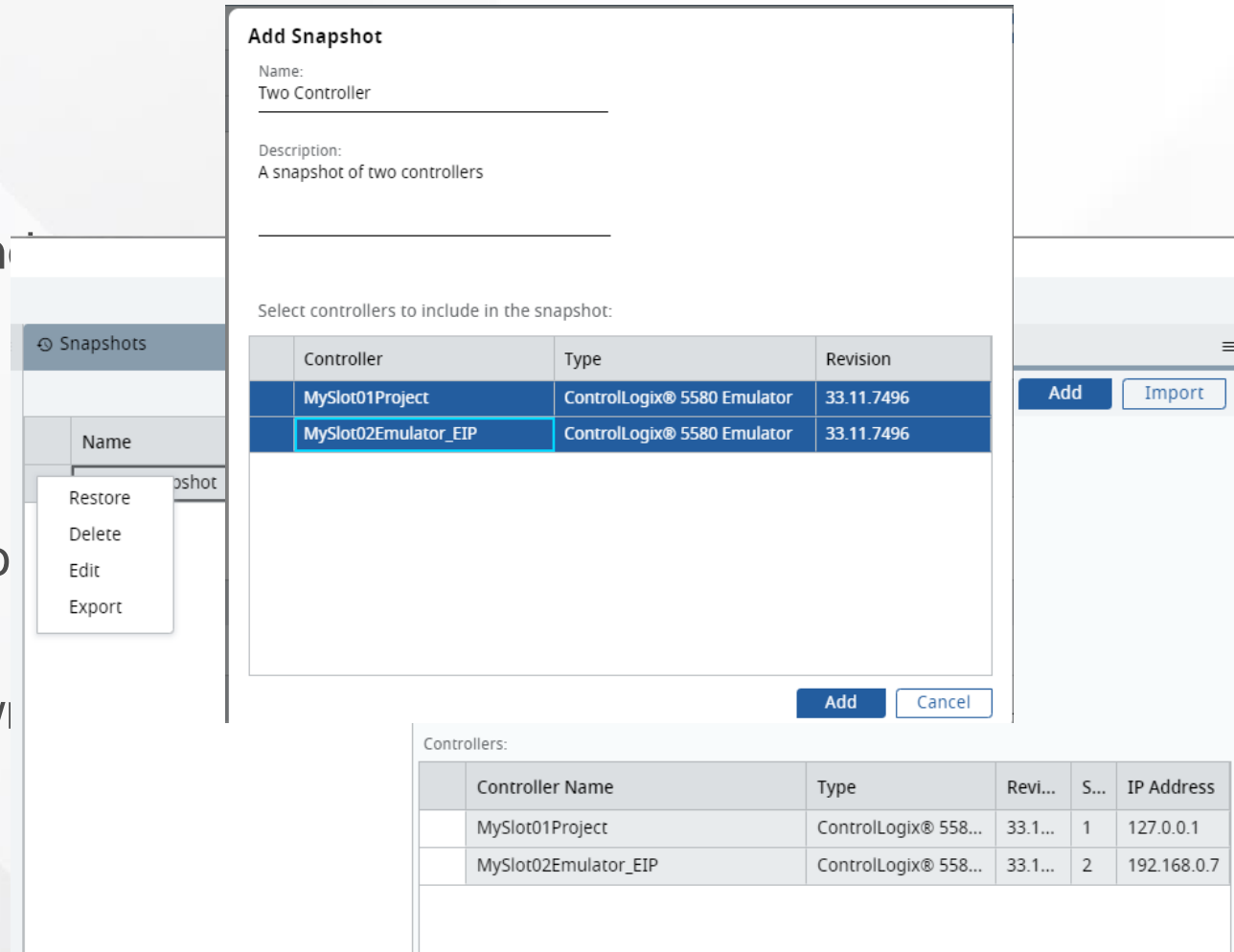- Includes controller time, application tag data and execution context

Use Cases

- Operator Training Simulators: Restore training scenarios that are difficult or time-consuming to recreate

- Automated Testing: Continuously recall a known scenario for testing

Add Snapshot

Name:
Two Controller

Description:
A snapshot of two controllers

Select controllers to include in the snapshot:

Controller	Type	Revision
MySlot01Project	ControlLogix® 5580 Emulator	33.11.7496
MySlot02Emulator_EIP	ControlLogix® 5580 Emulator	33.11.7496

Add   Cancel

🕔 Snapshots

Name

Restore
Delete
Edit
Export

Add   Import

Controllers:

Controller Name	Type	Revi...	S...	IP Address
MySlot01Project	ControlLogix® 558...	33.1...	1	127.0.0.1
MySlot02Emulator_EIP	ControlLogix® 558...	33.1...	2	192.168.0.7

Snapshot – What happens

Saving a Snapshot

A "Power Cycle Persistence Snapshot": We take an entire capture of the controller (static and dynamic data, like what happens during a power down of a physical controller)

Sequence of Events

- Snapshot Command: To prevent data integrity issues the controller is paused at the end of task scanning (beginning or end of continuous task (or idle if no continuous task)

- The controller powers down to save dynamic and static data

- Power up of the controller (first scan and pre-scan skipped)

- The full state is captured as a snapshot

Snapshot Command

Stop Controller at Safe Spot

Power Down of controller

Snapshot saved

Snapshot – What happens
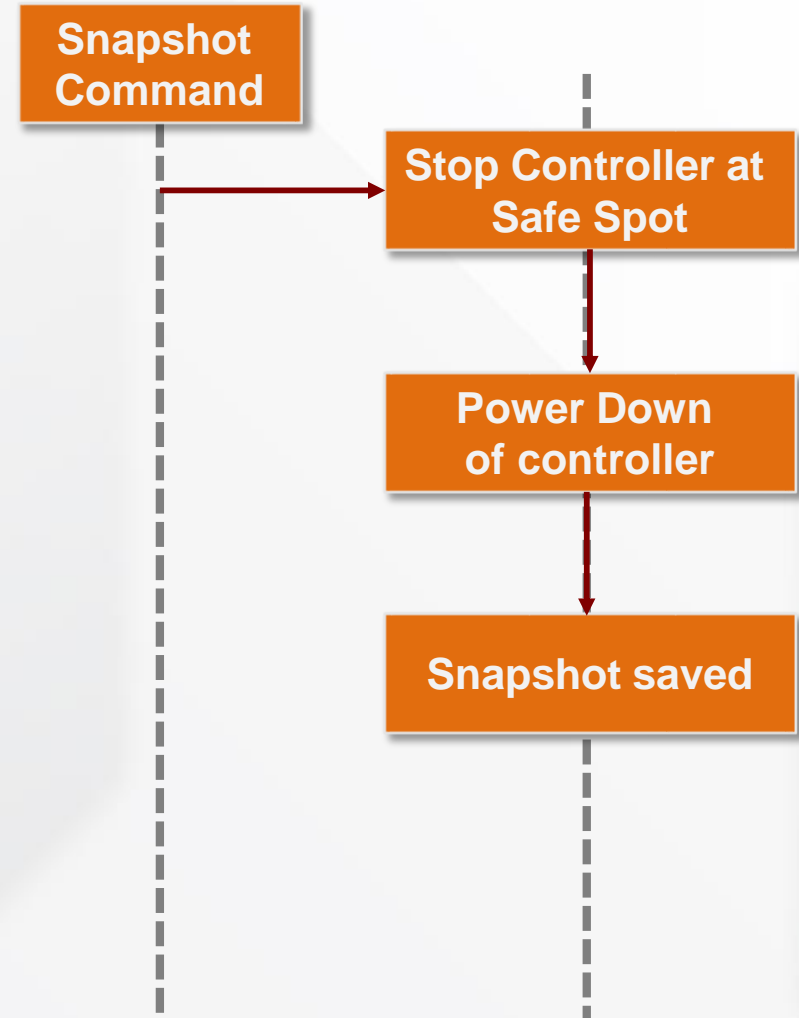
Restoring a Snapshot

Replaces over existing controllers

Sequence of Events

- Snapshot Restore: Turns off existing controllers. Controllers must be present in target slots of the snapshot restore. Inconsistencies presented to the user.

- The persistence files are replaced with the files from the snapshot

- On powerup the controller restores and resumes user execution, skipping first scan or pre-scan operations

- While the IP address from the snapshot will be applied to the controller, it will not bind to the IP address unless that IP is present on the workstation

Snapshot Restore

Turns off existing controller

Replaces Persistence Files

Powerup (no pre/first scan) of controller

Snapshot Restored

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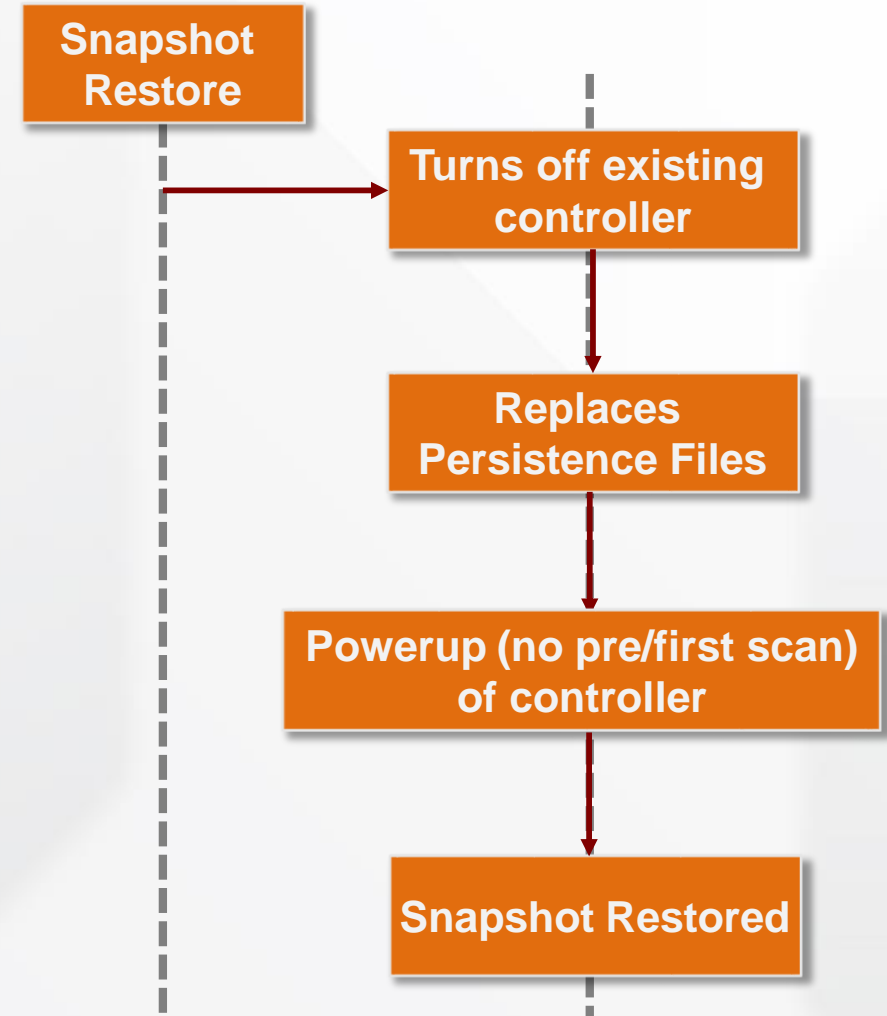
The emulator is designed to be a virtual controller, used in the development, testing and simulation environments

With an emulator, **you can**:

- Download and run logic written in any Logix language
- Be online with Logix Designer application, and all that entails
- Connect from an HMI [except for HMI Button Control (HMIBC)]
- Produce/Consume tags with other emulators
- Use MESSAGE instructions
- Use virtual axes for motion applications. [Future feature call Axis Test Mode will enable simulation of "real" axes"]
- Download a project configured for redundancy, although it will always behave as a "Primary with no Partner" (simplex mode)

With an emulator, **you cannot**:

- Connect to physical I/O devices
- Connect motion axes to real drives
- Produce/consume tags with other physical controllers
- Use licensed-based source protection (precompile & encrypt)
- Emulate a true redundancy primary/secondary pair (duplex mode)

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Differences between emulated controllers and physical controllers

Functionality	Emulated Controller Behavior
Communication to physical devices	The emulated controller is restricted from establishing connections to physical devices. However, the API can be used to simulate input and output values
License-based source protection	Not supported, must be removed before downloading the project
SD card encryption	Content on virtual SD card is not encrypted or digitally signed
Automatic Diagnostics	Only controller instance diagnostics are collected. No I/O device diagnostics supported.
Email	Email functionality is not supported
USB port	Not supported
Serial Number matching	Ignores serial number matching

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Differences between emulated controllers and physical controllers – Con't.

Functionality	Emulated Controller Behavior
Module discovery	Not supported.
Motion support	Motion support is limited to virtual axes and consumed axes only. (Physical axes must be unscheduled). Produce-consume virtual axes supported.
Connections between controllers	Produce/Consume messages work between emulated controllers. Other I/O modules in the I/O Tree will show as faulted.
Time-scaling	Supported through the API.
SNMP	Not supported
Redundancy	Operates only as a primary controller. High availability reports success, but the sync. with a second controller/support of sync modules is not available. Scan time does not reflect redundancy impacts.
Controller webpages	Not supported

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Differences between emulated controllers and physical controllers – Con't.

Functionality	Emulated Controller Behavior
Fault dumps	Fault dumps are always stored in the virtual SD card directory, even if detached in emulated controller properties. Important: contents are not encrypted
HMIBC instructions	HMI Button Control (HMIBC) instructions do not function (no Class 1 connection to HMI)
GSV and SSV instructions	Supports Get System Value (GSV) and Set System Value (SSV) instructions for emulated controller instances only. When GSV and SSV instructions target external objects, the instructions return the result for an unconnected device.