Studio 5000 Smart Object Configurator

1756 ControlLogix, 1756 GuardLogix, 1769 CompactLogix, 1769 Compact GuardLogix, 5069 CompactLogix, 5069 Compact GuardLogix

Rockwell Automation

Getting Results Guide

Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

This manual includes information about the new Studio 5000 Smart Object Configurator.

Table of Contents

This manual provides technical details on the Studio 5000 Smart Object Configurator.

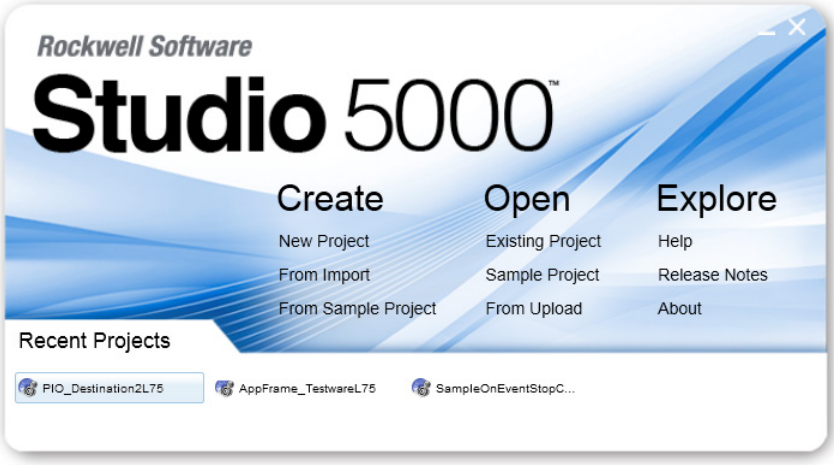
This manual is one of a set of related manuals that show common procedures for programming and operating Logix 5000 controllers.

For a complete list of common procedures manuals, refer to the Logix 5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

The term Logix 5000 controller refers to any controller based on the Logix 5000 operating system.

Studio 5000 environment

The Studio 5000 Automation Engineering & Design Environment® combines engineering and design elements into a common environment. The first element is the Studio 5000 Logix Designer® application. The Logix Designer application is the rebranding of RSLogix 5000® software and will continue to be the product to program Logix 5000™ controllers for discrete, process, batch, motion, safety, and drive-based solutions.



The Studio 5000® environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. The Studio 5000 environment is the one place for design engineers to develop all elements of their control system.

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End User License Agreement (EULA)

You can view the Rockwell Automation End User License Agreement (EULA) by opening the license.rtf file located in your product's install folder on your hard drive.

The default location of this file is:

C:\Program Files (x86)\Common Files\Rockwell\license.rtf.

Additional resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
FactoryTalk Edge Gateway Quick Start Guide	Provides guidelines for using FactoryTalk Edge Gateway.
Logix 5000 Controllers I/O and Tag Data, publication 1756-PM004	This manual shows how to access I/O and tag data in Logix5000 controllers.
Logix 5000 Controllers Tasks, Programs, and Routines, publication 1756-PM005	This manual details how to set up controllers tasks along with the programs and routines for the proper execution of these tasks.
Logix 5000 Controllers Ladder Diagram, publication 1756-PM008	This manual shows how to program Logix 5000 controllers with the relay ladder programming language.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications webpage, available at http://ab.rockwellautomation.com	Provides declarations of conformity, certificates, and other certification details.

View or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact the local Rockwell Automation distributor or sales representative.

Introduction

The Studio 5000 Smart Object Configurator allows customers to turn existing Logix tags into FactoryTalk® Smart Object instances by extending existing base Logix tags with an additional set of user-defined configuration properties. The Studio 5000 Smart Object Configurator allows users to organize their FactoryTalk Smart Object instances into information models and define synchronous data collection based on the model hierarchy. FactoryTalk® Edge Gateway™ consumes the FactoryTalk Smart Object information models and collected data and delivers the contextualized synchronous data to applications.

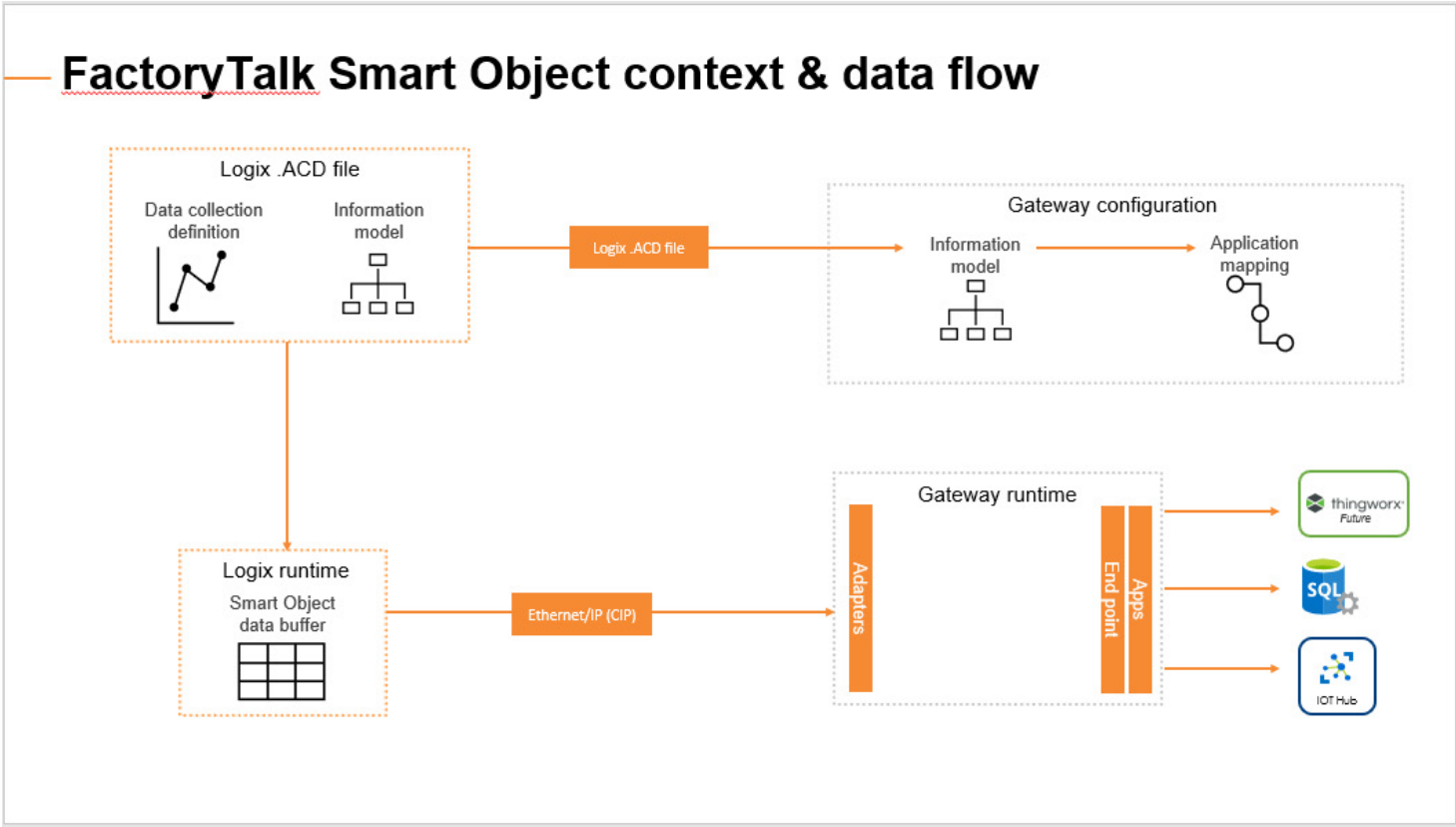
This document provides supplemental technical details on the Studio 5000 Smart Object Configurator functionality.

Architecture

When FactoryTalk Edge Gateway connects to a Studio 5000 .acd file that has a FactoryTalk Smart Object configuration, FactoryTalk Edge Gateway recognizes the FactoryTalk Smart Object information model and replicates it. From FactoryTalk Edge Gateway, you can map all or some of the models to one or more enterprise or cloud applications.

At runtime, FactoryTalk Edge Gateway ingresses the stored FactoryTalk Smart Object data from its Data Buffer in the controller and sends the history and the context of the information model to applications.

Here is a view of the process flow.



FactoryTalk Smart Object

Use the Studio 5000 Smart Object Configurator to insert all elements into the .acd file. All Studio 5000 Smart Object Configurator configurations are transferred to the controller as they are made. However, changes are not saved to the .acd file until the .acd file is saved in the Logix Designer application.

You can create and modify FactoryTalk Smart Object configurations directly in the Logix Designer application without using the Studio 5000 Smart Object Configurator configurator tool. When manually creating FactoryTalk Smart Object instances, they must be program scoped and not controller scoped.

Adding controller scoped FactoryTalk Smart Object instances manually through the Logix Designer application causes the Studio 5000 Smart Object Configurator to detect these upon connecting to the .acd and request that they are removed from the .acd before proceeding. Additionally, all FactoryTalk Smart Object backing tags must be instantiated in code. FactoryTalk Smart Object instances created as tags, but not present in code, cause errors in the model.

Changes that affect the model structure, such as adding or removing FactoryTalk Smart Object instances, changes to backing tags, or names of the element in the information model require the Studio 5000 Smart Object Configurator to rescan the controller and update the .acd file. Use the reconnect function in the Studio 5000 Smart Object Configurator to pick up the changes. New items show under **Broken Elements**.

Use one of these methods to correct broken elements:

- Download the application to the controller. Set the controller to run and save the .acd. If configured correctly, elements show correctly in the Studio 5000 Smart Object Configurator when reconnected.
- Use the Studio 5000 Smart Object Configurator tool to manually correct the issues.

Changes that affect the model structure also impact data collection. Resynchronize FactoryTalk Edge Gateway with the .acd file to apply edits. Refer to FactoryTalk Edge Gateway documentation for details.

FactoryTalk Smart Object configurations are only available in ladder logic language. They can be instantiated in other languages manually, but the Studio 5000 Smart Object Configurator only operates in ladder logic.

Information model

The information model allows user to configure FactoryTalk Smart Object content. Use these three primary components when building a model.

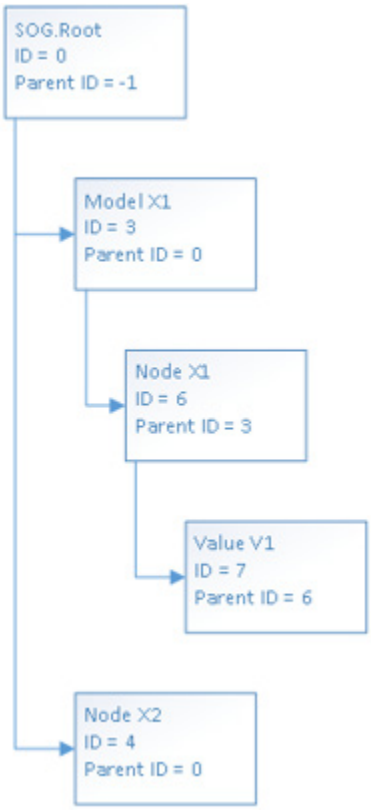
- Model – Define models containing FactoryTalk Smart Object instances. Each model in the Studio 5000 Smart Object Configurator imports into FactoryTalk Edge Gateway as a stand-alone model that can be mapped separately to applications. Models exist in the **Information models** section of the configurator and can only contain nodes.
- Nodes - Used to organize FactoryTalk Smart Object instances within a model. Nodes do not link to values in the controller. Use them to configure children (values and nodes) data collections. Nodes can contain additional child nodes or FactoryTalk Smart Object instances.
- Values – Point to a controller tag (Real, DINT, LINT, String, or Add-On Instruction (AOI)) and can be used to configure parent node or controller tag value data collections. Values can only exist under a node and cannot have children.

Follow these naming rules when creating the information model.

- Limit the name to 40 characters.
- When naming models, you can start with numbers and use UNICODE characters.
- Make model names unique.
- The children immediately under a node must have a unique name.

A chain of parent-child relationships create the information model. Each FactoryTalk Smart Object backing tag has an input for the parent node. See Predefined elements on page 15 for more information. The input provides the parent ID during runtime. Additionally, each FactoryTalk Smart Object has its own ID. Reserve zero for the base element in the controller. The system

builds the model by collecting all the FactoryTalk Smart Object IDs and parent IDs.



The Studio 5000 Smart Object Configurator creates the FactoryTalk Smart Object ID during development and the AOI timer recalculates the ID when you change the controller to RUN mode. The FactoryTalk Smart Object ID may not be the same after running the controller, but will remain constant while the controller runs.

Online changes

You must be offline to use Studio 5000 Smart Object Configurator to create Logix Designer application tag and rung elements.

IMPORTANT Editing configurable parameters when the program is running can impact data collection.

Once the base objects are inserted into the .acd file and downloaded to the controller, you can create and edit FactoryTalk Smart Object instances directly in the Logix Designer application without using the Studio 5000 Smart Object Configurator tool.

IMPORTANT Edits can impact data collection. You may need to resynchronize FactoryTalk Edge Gateway with the .acd file to apply the edits.

The following sections cover the base objects required for FactoryTalk Smart Object instances and the details of each object type. Use these details to create FactoryTalk Smart Object instances directly in the Logix Designer application.

Predefined elements

FactoryTalk Smart Object functionality requires a set of base objects in the .acd to function. When connecting to an existing .acd, the Studio 5000 Smart

Object Configurator checks for these objects. If the base objects do not exist or are out of date, you are prompted to add or update the objects.

FactoryTalk Smart Object uses a specified naming convention to determine base objects in the controller.

IMPORTANT Do not delete or rename any core objects associated with FactoryTalk Smart Object instances.

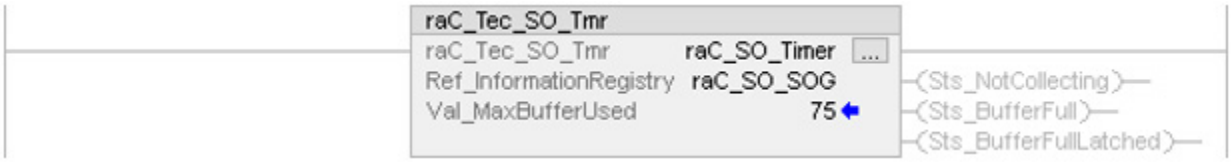
These are the predefined elements.

Object Type	Object Name	Description
Tag	raC_SO_SOG	Contains all the key values used by Studio 5000 Smart Object Configurator instances including the buffer and root nodes.
	raC_SO_Timer	Backing tag for the timer AOI.
	raC_SO_Node	Backing tag for the AOI node. The UDT node backing tag contains all data associated with a Studio 5000 Smart Object Configurator node. The raC_SO_Node reuses all AOI nodes.
UDT	raC_UDT_SO_Buffer	Definition for the buffer configuration. If you see the buffer full error, increase the array size of D.
	raC_UDT_SO_Data	DO NOT MODIFY THIS UDT. Definition for one buffer value element.
	raC_UDT_SO_Global	DO NOT MODIFY THIS UDT. Definition for the FactoryTalk Smart Object memory structure.
	raC_UDT_SO_Node	DO NOT MODIFY THIS UDT. Definition for a FactoryTalk Smart Object node.
AOI	raC_Tec_SO_Tmr	Responsible for all the global operations regarding FactoryTalk Smart Object instances.
	raC_Opr_SO_Node	Executes the code for nodes
	raC_Opr_ST_DINT	Executes the code for collecting double integers.
	raC_Opr_ST_LINT	Executes the code for collecting long integers. Only available on CompactLogix 5480 controllers and Compact GuardLogix 5380, CompactLogix 5380, and CompactLogix 5480 controllers in the Logix Designer application version 32 or higher.
	raC_Opr_SO_String	Executes the code for collecting Strings.

Timer (raC_SO_Timer)

The timer AOI (raC_Tec_SO_Tmr) creates the timestamp used by all FactoryTalk Smart Object data logging and keeps track of the IDs used to create the information model. There cannot be more than one instance of the

timer AOI in the .acd file. Place it in a task at least as fast as the lowest time resolution needed in the application.



The timer AOI determines the time to collect data. If a FactoryTalk Smart Object executes faster than the timer AOI, it does not detect updates in the time stamp and it does not collect data. The clock tick generated by the timer AOI equals the delta between two AOI scans.

EXAMPLE If the timer AOI is located in a 10 ms task, the FactoryTalk Smart Object clock changes on 10 ms increments.

Additional details and examples are covered in Periodic collection on page 21.

These properties are available for use in this AOI:

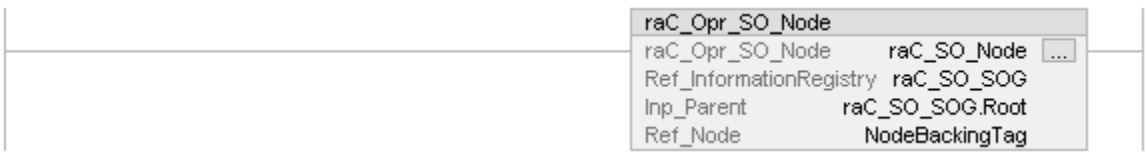
Property Type	Property Name	Data Type	Description
Status indicator	Sts_NotCollecting	Bool	Changes to true after the FactoryTalk Edge Gateway disconnects from the controller for longer than 2 seconds.
Status indicator	Sts_BufferFull	Bool	Changes to true if the FactoryTalk Smart Object data collection is faster than the time it takes the FactoryTalk Edge Gateway to read the buffer.
Status indicator	Sts_BufullLatched	Bool	Changes to true if the FactoryTalk Smart Object data collection is faster than the time it takes the FactoryTalk Edge Gateway to read the buffer. It remains true until the controller or the FactoryTalk Edge Gateway is restarted.
Status value	Val_MaxBufferUsed	DINT	Maximum number of elements sent to the buffer in a cycle. This number resets after you switch the controller to the Run state or you restart the FactoryTalk Edge Gateway.

Status indicators are not latched and change to false as soon as the condition is no longer present. Rockwell Automation recommends creating a latched alarm signal and annunciating errors in an alarm or HMI system.

Nodes (raC_UDT_SO_Node)

Nodes define the hierarchy in the information model. They can contain other nodes and values. An instance of the node AOI is instantiated for every model and node in the information model.

In order to instantiate a node, place the raC_Opr_SO_Node AOI in a rung.



For each node AOI instance:

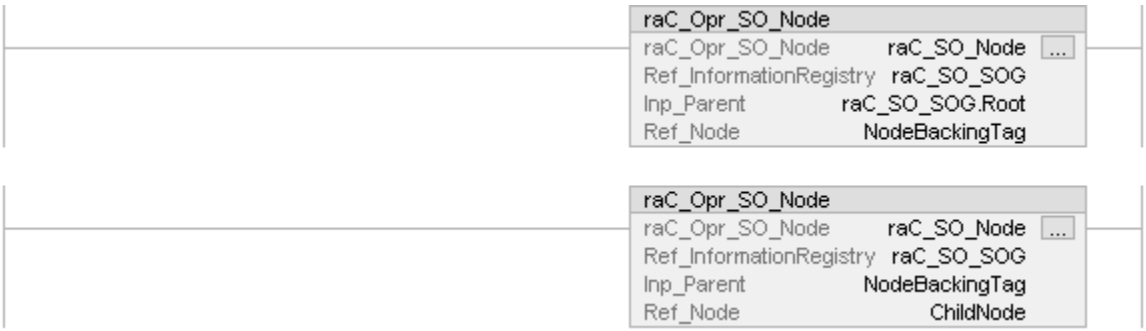
- raC_Opr_SO_Node = raC_SO_Node
- Ref_InformationRegistry = raC_SO_SOG

For each node AOI instance:

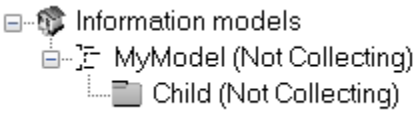
- Ref_Node is a unique backing tag (data type raC_UDT_SO_Node) that must be created for each AOI node.

For Inp_Parent

- If creating a model, use raC_SO_SOG.Root.
- If creating a node, use parent Ref_Node backing tag.



In the sample above the ChildNode node and parent instance are using NodeBackingTag equivalent to this model.



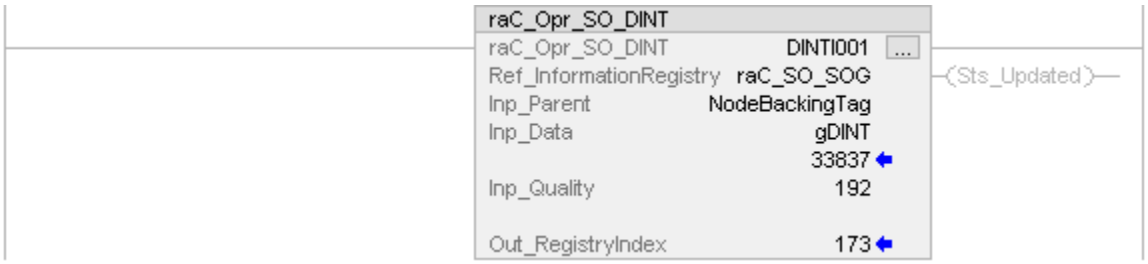
Tip: The names on the model do not have to match the name of the backing tag.

These properties are available for use in this AOI.

Property Type	Property Name	Data Type	Description
Configurable parameter	Inf_Name	STR0080	Node name in the information model.
Configurable parameter	Inp_EventTrigger	BOOL	Used to trigger data collection for UpdateOnEvent property.
Configurable parameter	Cfg_UpdateOnEvent	BOOL	Enables programmatic trigger collection. A 1 value indicates collect data when Inp_EventTrigger is 1.
Configurable parameter	Cfg_UpdatePeriod	DINT	Defines Data Collection Value should be update rate in milliseconds. A 0 value indicates parent collection. A -1 value indicates parent and rate collection disabled.
Status indicator	Sts_Updated	BOOL	Changes to true on the scan the node collects data.

Numeric values (raC_Opr_SO_Real, raC_Opr_SO_DINT, raC_Opr_SO_LINT

To instantiate a numeric value, place the desired AOI in a rung (for example, (DINT).



For each numeric value AOI instance:

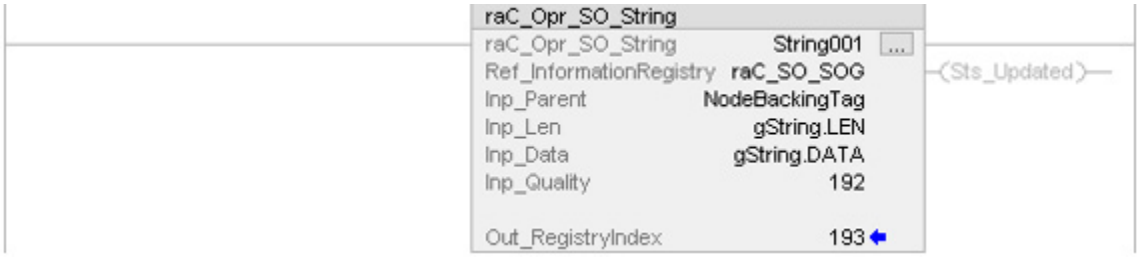
- Ref_InformationRegistry = raC_SO_SOG

For each numeric value AOI instance:

- raC_OPr_SO_(ValueType) is a unique backing tag (data type is the numeric type chosen. For this DINT example, it is raC_Opr_SO_DINT. You must create it for each AOI numeric value.
- Inp_Parent is a reference to the node for the value. Use the same Ref_Node backing tag from the AOI parent node for Inp_Parent.
- Inp_Data is a reference to the tag in the Logix Designer application with the value collected in FactoryTalk Smart Object instances.
- By default, Inp_Quality is hard coded to 192. Inp_Quality uses the OPC Foundation quality enumeration. This information is propagated from the controller to the information system.

String values (raC_Opr_SO_String)

To instantiate a string value, place the raC_Opr_SO_String AOI in a rung.



For each String AOI instance:

- Ref_InformationRegistry = raC_SO_SOG.

For each string AOI instance:

- raC_OPr_SO_STRING is a unique backing tag (data type raC_Opr_SO_String) that must be created for each AOI string.

- Inp_Parent is a reference to the node for the value. Use the same Ref_Node backing tag from the AOI parent node for Inp_Parent.
- String FactoryTalk Smart Object instances can collect data from strings of all sizes. To pass the string value to the FactoryTalk Smart Object, pass the string LEN and data string member to the Inp_Data and Inp_Len properties.
- By default, Inp_Quality is hard coded to 192. Inp_Quality uses the OPC Foundation quality enumeration. This information is propagated from the controller to the information system.

Memory and CPU utilization

Adding FactoryTalk Smart Object base objects to a controller consumes 70 Kb of memory.

Each instance of a FactoryTalk Smart Object tag memory consumes these bytes (blocks):

- Node: 122
- Real: 150
- DINT: 150
- LINT: 188
- String: 142

Each instance of FactoryTalk Smart Object tag and code memory consumes these bytes (blocks):

- Node: 384
- Real: 412
- DINT: 420
- LINT: 456
- String: 468

Each FactoryTalk Smart Object executes in 8 ns in a CompactLogix 5380, CompactLogix 5480, ControlLogix 5580, GuardLogix 5380, and Compact GuardLogix 5380 controllers and 40 ns in a CompactLogix 5370, ControlLogix 5570, GuardLogix 5570, and Compact GuardLogix 5370 controllers.

The maximum number of recommended FactoryTalk Smart Object instances per controller is 1,000.

Data collection

These options are available to configure data collection in Studio 5000 Smart Object Configurator.

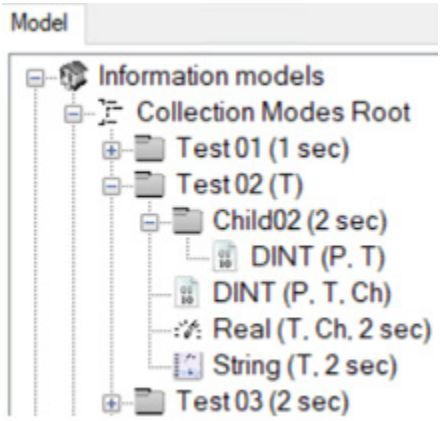
- Parent (P). Enables or disables data collection based on parent node settings (periodic and programmatic trigger). Select **Triggers** to disable the **Parent** option. Configuring parents causes data collection to cascade through the node genealogy in a synchronous manner.

- Periodic (Rate). Configure data collection at time intervals. You cannot collect data using **Parent** and **Periodic** simultaneously. Select **Triggers** to disable the **Periodic** option.
- On Change (Ch). Configure data collection for when the monitored value changes (available for Numeric value AOIs only).
- Programmatic trigger (T). – External logic triggers data collection to the element that defines when the data collection is executed.

Combine the conditional data collection, collection by trigger, and collection by parent to create complex data collection strategies. Data collection methods are additive unless noted otherwise. You can define multiple data collection methods against a single element in the model.

Example

Possible Studio 5000 Smart Object Configurator data collection combinations.



Size

The default size of the data collection buffer is 500 elements. Each numeric FactoryTalk Smart Object consumes one element. Each string consumes one plus the number of characters divided by 16 elements. The elements consumed on each cycle depends on what was scanned. Use Val_MaxBufferUsed in the timer AOI to determine usage.

The number of elements in the arrays can be modified offline by changing the array size of the D member in the raC_UDT_SO_Buffer UDT. A larger array size consumemore memory (16 bytes per element) but allows more data collection per scan and prevent buffer full errors.

Periodic collection

Collection by rate is a function of the configured rate, the timer AOI execution rate, and the FactoryTalk Smart Object execution rate.

Examples:

- A FactoryTalk Smart Object value effectively collects data at 0 ms, 15 ms, 25 ms..., when:
  - Timer AOI is executing every 5 ms.
  - A value changes every 1 ms and is configured to collect every 12 ms.
- A FactoryTalk Smart Object effectively collects data at 0 ms, 30 ms, 50 ms 80 ms, 100 ms,....
  - Timer AOI executes every 1 ms.
  - A value changing every 50 ms and is configured to collect every 30 ms.

On Change collection

When On Change collection is enabled, the AOI monitors the value between two scans. It triggers a collection if the value changes by more than the configured delta as absolute change in engineering units.

The limits for the delta are:

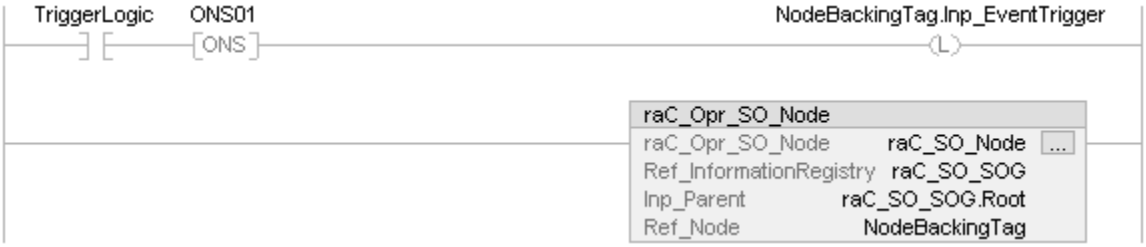
- Real: 0 to 3.4×10^38 compared against the 6 decimal.
- DINT and LINT: 0 to 2,147,483,646.

Programmatic Trigger collection

Triggers provide the flexibility to collect data associated with a particular event, for example, at the beginning of a batch or when an equipment changes status.

Configure the element (node or value) to collect on trigger. Create the necessary code in the controller to generate a Boolean that changes to true at the desire moment.

In the rung above the element, latch the .Inp_EventTrigger. The AOI sets the .Inp_EventTrigger back to false after it executes.



Always use a Latch to trip the .Inp_EventTrigger. Using an Output Energize increases warnings during the Logix Designer application compiles.

Using One Shot is optional to prevent multiple data collection if TiggerLogic stays on for multiple scans. The AOI collects data on each scan of .Inp_EventTrigger.

Conditional collection

To only enable data collection based on a certain condition, for example, to reduce the number of values in the database, enable data collection only when the desired equipment is running.

Collection for node and value AOIs is only active when the run containing the AOI is active. Add instructions to the same rung as the AOI to enable or disable collection, as desired.

Synchronized collection

While all values triggered in the same scan should have the same timestamp, based on code layout, it is possible for the timestamps to not align. To guarantee timestamp alignment, follow these guidelines:

- Define data collection based on Parent.
- Place all FactoryTalk Smart Object instances in the same routine.

FactoryTalk Smart Object instances use the time generated by the Timer AOI to time stampall values.

Additional considerations

All FactoryTalk Smart Object backing tags must be instantiated in code. FactoryTalk Smart Object instances created as tags but not present in code create errors in the model.

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Rockwell Automation support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.

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