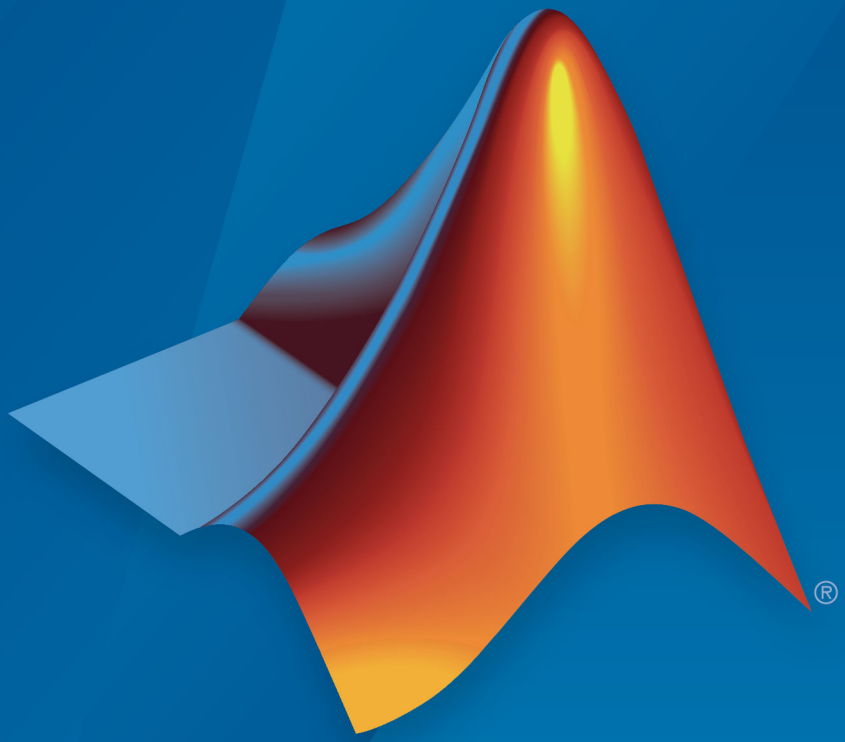
Embedded Coder®

AUTOSAR



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Embedded Coder® AUTOSAR

Revision History

October 2014	Online only	New for Version 6.7 (Release 2014b)
March 2015	Online only	Revised for Version 6.8 (Release 2015a)
September 2015	Online only	Revised for Version 6.9 (Release 2015b)
October 2015	Online only	Rereleased for Version 6.8.1 (Release 2015aSP1)
March 2016	Online only	Revised for Version 6.10 (Release 2016a)
September 2016	Online only	Revised for Version 6.11 (Release 2016b)
March 2017	Online only	Revised for Version 6.12 (Release 2017a)
September 2017	Online only	Revised for Version 6.13 (Release 2017b)
March 2018	Online only	Revised for Version 7.0 (Release 2018a)
September 2018	Online only	Revised for Version 7.1 (Release 2018b)

Check Bug Reports for Issues and Fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

Contents

1 Overview of AUTOSAR Support

2 Modeling Patterns for AUTOSAR

3 AUTOSAR Component Creation

4 AUTOSAR Component Development

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Overview of AUTOSAR Support

AUTOSAR Standard

Embedded Coder software supports *AUTomotive Open System ARchitecture* (AUTOSAR), an open and standardized automotive software architecture. Automobile manufacturers, suppliers, and tool developers jointly develop AUTOSAR components.

The AUTOSAR standard addresses:

- Architecture – Three layers, *Application*, *Runtime Environment* (RTE), and *Basic Software*, enable decoupling of AUTOSAR software components from the execution platform. Standard interfaces between AUTOSAR software components and the run-time environment allow reuse or relocation of components within the Electronic Control Unit (ECU) topology of a vehicle.
- Methodology – Specification of code formats and description file templates, for example.
- Application Interfaces – Specification of interfaces for typical automotive applications.

For more information, see:

- `www.autosar.org` for details on the AUTOSAR standard.
- "Modeling Patterns for AUTOSAR" to model AUTOSAR software components and related concepts in Simulink®.
- "Workflows for AUTOSAR" on page 1-4 to use the code generator to produce code and description files that are compliant with AUTOSAR.
- `https://www.mathworks.com/automotive/standards/autosar.html` to learn about using MathWorks® products and third-party tools for AUTOSAR.

Install Support Package for AUTOSAR Standard

Embedded Coder software provides add-on support for the AUTOSAR standard in the Embedded Coder Support Package for AUTOSAR Standard. With the support package installed, you can perform a wide range of AUTOSAR-related workflows in Simulink.

To install the support package:

1. On the MATLAB® **Home** tab, in the **Environment** section, click **Add-Ons > Get Hardware Support Packages**.
2. In the **Add-On Manager** window, find and click the support package, and then click **Install**.

To update an installed support package:

On the MATLAB **Home** tab, in the **Environment** section, click **Add-Ons > Check for Updates > Hardware Support Packages**.

To uninstall a support package:

1. On the MATLAB **Home** tab, in the **Environment** section, click **Add-Ons > Manage Add-Ons**.
2. In the **Add-On Manager** window, find and click the support package, and then click **Uninstall**.

For more information, see “Support Package Installation” (MATLAB).

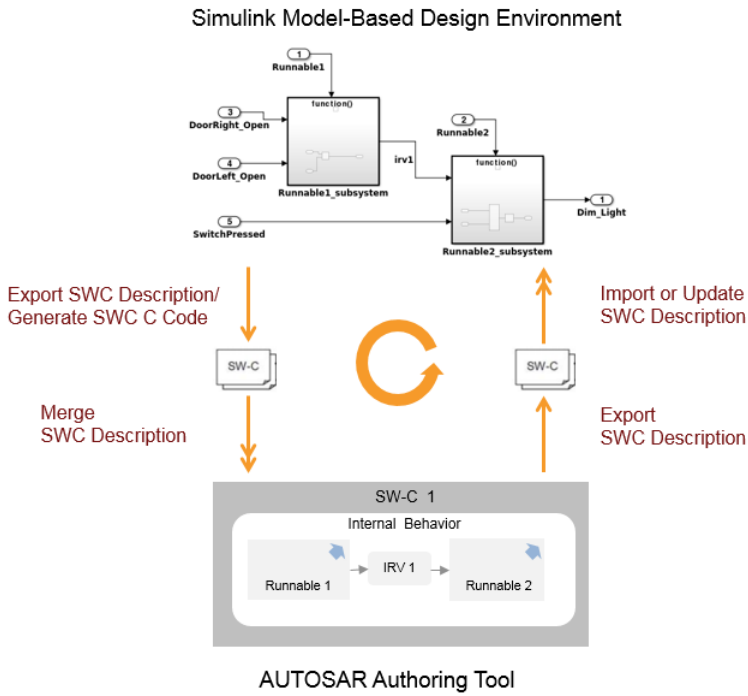
Workflows for AUTOSAR

This topic describes how you use Embedded Coder software to configure a Simulink representation of an AUTOSAR application for model-based design, and subsequently generate AUTOSAR-compliant code from the model.

Two typical workflows are

- The *round-trip* workflow, in which you import AUTOSAR software components created by an AUTOSAR authoring tool (AAT) into the Simulink model-based design environment, and later export XML descriptions and C code for merging back into the AAT environment.
- The Simulink originated, or *bottom-up*, workflow, in which you take a model-based design that originated in Simulink, configure and evolve it for AUTOSAR code generation, and export XML descriptions and C code for use in the AUTOSAR environment.

This diagram shows the round-trip workflow.



In the round-trip workflow, you perform the following tasks:

1. Import previously specified AUTOSAR software components, including definitions of calibration parameters, into Simulink. See:

   - “Import AUTOSAR Software Component” on page 3-4
   - “Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)
   - “Import AUTOSAR Composition to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)
   - “Model AUTOSAR Calibration Parameters and Lookup Tables” on page 2-26

2. Develop the model using Simulink model-based design. This process includes configuring AUTOSAR elements, mapping Simulink model elements to AUTOSAR component elements, and validating the AUTOSAR configuration. See:

   - “Model AUTOSAR Software Components” on page 2-3
   - “AUTOSAR Component Configuration” on page 4-3
   - “Design AUTOSAR Components, Simulate, and Generate Code” (Embedded Coder Support Package for AUTOSAR Standard)
   - “Modeling Patterns for AUTOSAR Runnables”

3. Export the AUTOSAR component from Simulink, generating XML description files and C code files. See:

   - “Generate AUTOSAR C and XML Files” on page 5-15
   - “Getting Started with AUTOSAR Code Generation” on page 5-2

   You can also verify your generated code in a simulation. See “Verify AUTOSAR C Code with SIL and PIL” on page 5-38.

4. Merge generated code and description files with other systems using an AUTOSAR authoring tool.

   You can use the authoring tool to export specifications, which can be imported back into Simulink. If the `arxml` code contains AUTOSAR software component changes, you can update the model to reflect the changes. See “Import AUTOSAR Software Component Updates” on page 3-11.

In the Simulink originated (*bottom-up*) workflow, you perform the same tasks as with the round-trip workflow, except that rather than importing AUTOSAR software components

from an AAT (step 1), you start with a Simulink model-based design and use Simulink to create a customized AUTOSAR component. See “Create AUTOSAR Software Component in Simulink” on page 3-21. Subsequent tasks in the workflow are as listed above.

Sample Workflows

Embedded Coder and Embedded Coder Support Package for AUTOSAR Standard provide the following examples to demonstrate AUTOSAR workflows.

Example	How to ...
"Getting Started with AUTOSAR Code Generation" on page 5-2	Generate AUTOSAR-compliant C code and export AUTOSAR XML (`arxml`) descriptions from a Simulink model.
"Design AUTOSAR Components, Simulate, and Generate Code" (Embedded Coder Support Package for AUTOSAR Standard)	Develop AUTOSAR components by implementing behavior algorithms, simulating components and compositions, and generating component code.
"Import AUTOSAR Component to Simulink" (Embedded Coder Support Package for AUTOSAR Standard)	Create Simulink representation of AUTOSAR component imported from AUTOSAR authoring tool `arxml` file.
"Import AUTOSAR Composition to Simulink" (Embedded Coder Support Package for AUTOSAR Standard)	Create Simulink representation of AUTOSAR composition imported from AUTOSAR authoring tool `arxml` file.
"Modeling Patterns for AUTOSAR Runnables"	Use Simulink models, subsystems, and functions to model AUTOSAR atomic software components and their runnable entities (runnables).
"Simulate AUTOSAR Basic Software Services and Runtime Environment" (Embedded Coder Support Package for AUTOSAR Standard)	Simulate AUTOSAR component calls to Basic Software memory and diagnostic services using reference implementations.
"AUTOSAR Property and Map Function Examples" on page 4-321	Programmatically add AUTOSAR elements to a model, configure AUTOSAR properties, and map Simulink elements to AUTOSAR elements.

AUTOSAR Terminology

Term	Notes

AUTOSAR Runtime Environment (RTE)	• Layer between Application and Basic Software layers
	• Realizes communication between:
	  • AUTOSAR software components
	  • AUTOSAR software components and Basic Software

AUTOSAR Software Component	• A software component containing one or more algorithms, which communicates with its environment through ports • Connected to the AUTOSAR Runtime Environment (RTE) • Relocatable (not tied to a particular ECU)
Characteristics	Values of characteristics can be changed on an ECU through a calibration data management tool or an offline calibration tool.
Client-Server Interface	• PortInterface for client-server communication • Defines operations provided by server and used by client
Composite data types	Category of data types, such as one of the following: • Array — Contains more than one element of the same type, and has zero-based indexing • Record — Non-empty set of objects, where each object has a unique identifier
ComSpec	Defines specific communication attributes.
DataElementPrototype (data element)	Data value (signal) exchanged between a sender and a receiver.
Data types	• Either primitive or composite • Types data elements, arguments of operations in a Client-Server Interface, and constants

Term	Notes
ErrorStatus	Indicates errors detected by communication system. Runtime Environment defines the following macros for sender-receiver communication: • `RTE_E_OK: no errors` • `RTE_E_INVALID: data element invalid` • `RTE_E_MAX_AGE_EXCEEDED: data element outdated`
OperationPrototype (operation)	• Invoked by a client • Provides value for each argument with direction `in` or `inout`, which must be of the corresponding data type • Client expects to receive a response to the invoked operation, part of which is a value with direction `out` or `inout`
PortInterface	• Characterizes information provided or required by a port • Can be either Sender-Receiver Interface or Client-Server Interface
Primitive data types	Category of data types that allow a direct mapping to C intrinsic types.
Provide port (PPort)	Port providing data or service of a server.
Require port (RPort)	Port requiring data or service of a server.

Term	Notes
RTEEvent	Event or situation that triggers execution of a runnable by the Runtime Environment (RTE). The software supports the following RTEEvents: • TimingEvent • DataReceivedEvent • DataReceiveErrorEvent • ExternalTriggerOccurredEvent • ModeSwitchEvent • OperationInvokedEvent (applicable to server operations) • InitEvent
Runnable entity (runnable)	Part of AUTOSAR Software-Component that can be executed and scheduled independently of other runnable entities (runnables).
Sender-Receiver Interface	• PortInterface for sender-receiver communication • Defines data elements sent by sending component (with `Provide` port providing Sender-Receiver Interface) or received by receiving component (with `Require` requiring Sender-Receiver Interface)
Sender-Receiver Annotation	Annotation of data elements in a port that implements Sender-Receiver Interface.
Sensor Actuator Software Component	AUTOSAR software component dedicated to the control of a sensor or actuator.
Service	Logical entity of Basic Software that offers functionality, which is used by various AUTOSAR software components.

Modeling Patterns for AUTOSAR

Simulink Modeling Patterns for AUTOSAR

The following topics present Simulink modeling patterns for common AUTOSAR elements. You can use these modeling patterns when developing models for AUTOSAR-compliant code generation.

Model AUTOSAR Software Components

In Simulink, you can flexibly model the structure and behavior of AUTOSAR software components. Components can contain one or multiple runnable entities, and can be single-instance or multi-instance. To design the internal behavior of components, you can use Simulink modeling styles, such as rate-based and function-call based.

In this section...

About AUTOSAR Software Components

An AUTOSAR application is made up of interconnected *software components* (SWCs). Each software component encapsulates a functional implementation of automotive behavior, with well-defined connection points to the outside world.

In Simulink, you can model:

- *Atomic* software components — An atomic software component cannot be split into smaller software components, and runs on exactly one automotive electronic control unit (ECU).
- *Parameter* software components — A parameter software component represents memory containing AUTOSAR calibration parameters, and provides parameter data to connected atomic software components.

The main focus of AUTOSAR modeling in Simulink is atomic software components. For information about parameter software components, see “Model AUTOSAR Calibration Parameters and Lookup Tables” on page 2-26.

Note Do not confuse *atomic* in this context with the Simulink concept of atomic subsystems.

An AUTOSAR atomic software component interacts with other AUTOSAR software components or system services via well-defined connection points called *ports*. One or more *runnable entities* (runnables) implement the behavior of the component.

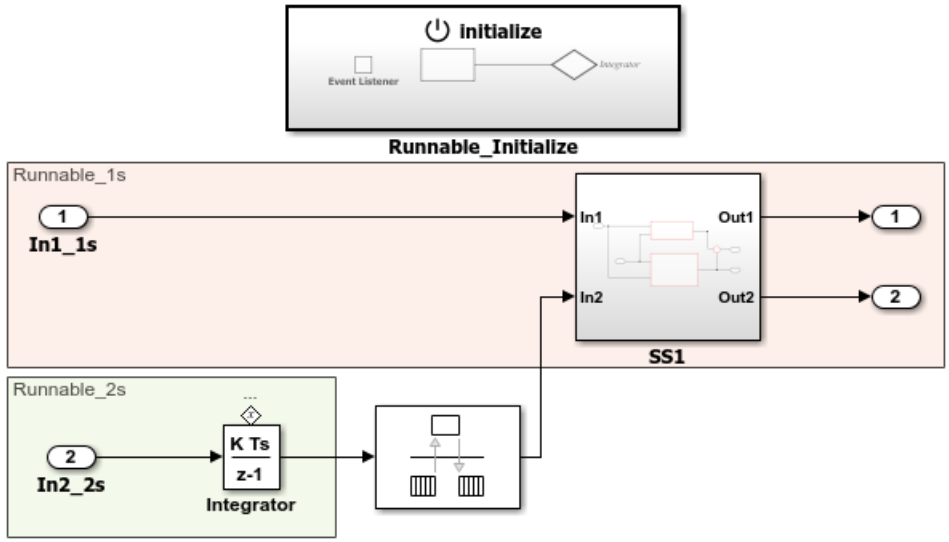
Implementation Considerations

To develop an AUTOSAR atomic software component in Simulink, you create an initial Simulink representation of an AUTOSAR component, as described in "AUTOSAR Component Creation". You can either import an AUTOSAR component description from `arxml` files or, in an existing model, build a default AUTOSAR component based on the model content. The resulting representation includes:

- Simulink blocks, connections, and data that model AUTOSAR elements such as ports, runnables, inter-runnable variables, and parameters.
- Stored properties, defined in the AUTOSAR standard, for AUTOSAR elements in the software component.
- A mapping of Simulink elements to AUTOSAR elements.

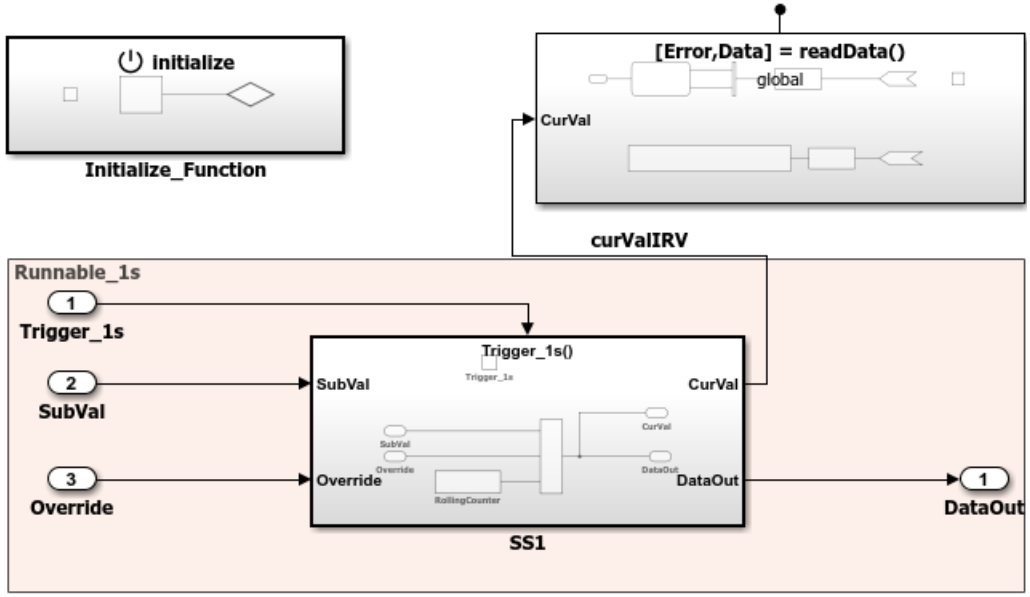
Usually, the Simulink representation of an AUTOSAR component is a rate-based model, in which periodic runnables are modeled as atomic subsystems with periodic rates.

Consider AUTOSAR example model `rtwdemo_autosar_swc`. This model shows a rate-based implementation of an AUTOSAR atomic software component. The model implements periodic runnables using multiple rates. An Initialize Function block initializes the component.



However, if your component design requires server functions or periodic function calls, the Simulink representation can be a function-call based model. The model can contain Simulink Function blocks or function-call subsystems with periodic rates.

Consider AUTOSAR example model `rtwdemo_autosar_swc_slfcns`. This model shows a function-call based implementation of an AUTOSAR atomic software component. The model uses a Simulink Function block and a periodic function-call subsystem at root level. An Initialize Function block initializes the component.



If your AUTOSAR software component design contains periodic runnables, you must decide whether your component requires a rate-based or function-call based modeling approach. Before you create an initial Simulink representation of your AUTOSAR component, designate how to model periodic runnables:

- If you are importing an AUTOSAR component description from `arxml` files using `arxml.importer` object function `createComponentAsModel`, specify the property `ModelPeriodicRunnablesAs` as `AtomicSubsystem` (default) for rate-based or `FunctionCallSubsystem` for function-call based.
- If you are building a default AUTOSAR component in an existing model, populate the model with rate-based or function-call based content.
  - For rate-based modeling, create model content with one or more periodic rates. To model an AUTOSAR inter-runnable variable, use a Rate Transition block that handles data transfers between blocks operating at different rates. The resulting component has *N* periodic step runnables, where *N* is the number of discrete rates in the model. Events that represent rate-based interrupts initiate execution of the periodic step runnables, using rate monotonic scheduling.
  - For function-call based modeling, at the top level of a model, create function-call subsystems — or (for client-server modeling) Simulink Function blocks. Add root

model inports and outports. To model an AUTOSAR inter-runnable variable, use a signal line to connect function-call subsystems. The resulting component has *N* exported-function or server runnables. *N* is the number of function-call subsystems or Simulink Function blocks at the top level of the model. Events that represent function calls initiate execution of the function-based runnables.

Select rate-based modeling, the default, unless your design requires function-call based modeling.

Sometimes, conditions in your AUTOSAR software component can prevent use of rate-based modeling. For example:

- The AUTOSAR software component contains a server runnable.
- The AUTOSAR software component contains an inter-runnable variable (IRV) that multiple runnables read or write.
- The AUTOSAR software component contains a periodic runnable with a rate that is not a multiple of the fastest rate.
- The AUTOSAR software component contains multiple runnables that access the same read or write data at different rates.
- The AUTOSAR software component contains a periodic runnable that other events also trigger.
- The AUTOSAR software component contains multiple periodic runnables that are triggered at the same period.

If your AUTOSAR software component supports multiple instantiation (that is, `SwcInternalBehavior` attribute `supportsMultipleInstantiation` is set to `true`), you cannot model periodic runnables as function-call subsystems. Either use rate-based modeling and model periodic runnables as atomic subsystems, or set `supportsMultipleInstantiation` to `false`.

For examples of different ways to model AUTOSAR software components, see “Rate-Based Components” on page 2-7, “Function-Call Based Components” on page 2-9, and “Modeling Patterns for AUTOSAR Runnables”.

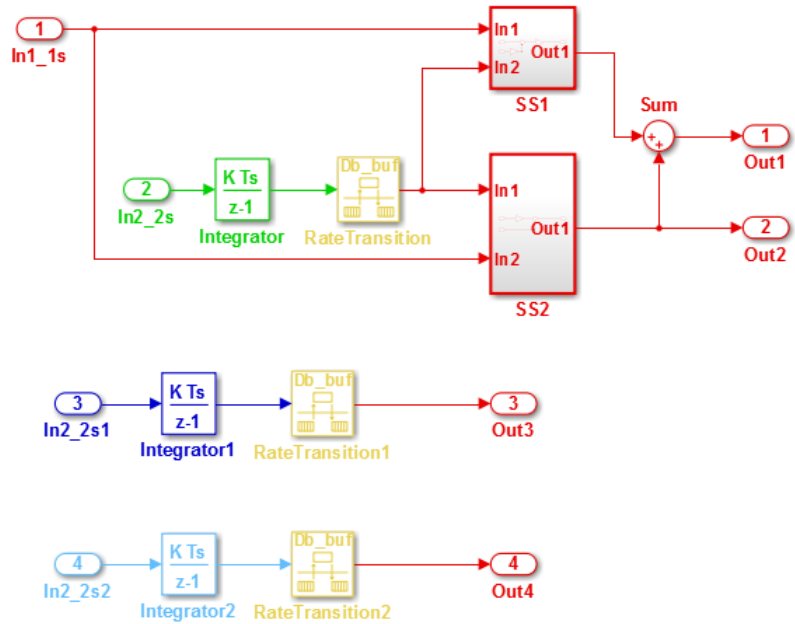
Rate-Based Components

You can model AUTOSAR multi-runnables using Simulink rate-based, multitasking modeling. First you create or import model content with multiple periodic rates. You can:

- Create a software component with multiple periodic runnables in Simulink.
- Import a software component with multiple periodic runnables from `arxml` files into Simulink. Use `arxml.importer` object function `createComponentAsModel` with property `ModelPeriodicRunnablesAs` set to `AtomicSubsystem`.
- Migrate an existing rate-based, multitasking Simulink model to the AUTOSAR target.

Root model inports and outports represent AUTOSAR ports, and Rate Transition blocks represent AUTOSAR inter-runnable variables (IRVs).

Here is an example of a rate-based, multitasking model that is suitable for simulation and AUTOSAR code generation. (This example uses the model *`matlabroot`*`/help/toolbox/ecoder/examples/autosar/mMultitasking_4rates.slx`.) The model represents an AUTOSAR software component. The four colors displayed when you update the model (if **Display** > **Sample Time** > **Colors** is selected) represent the different periodic rates present. The Rate Transition blocks represent three AUTOSAR IRVs.

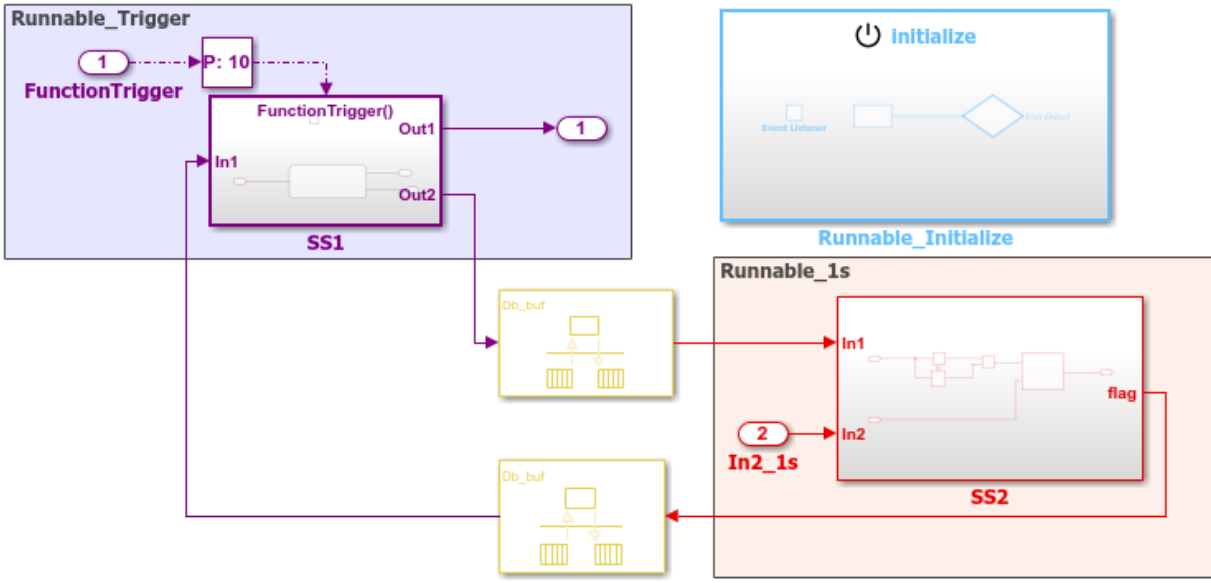


When you generate code, the model C code contains rate-grouped model step functions corresponding to AUTOSAR runnables, one for each discrete rate in the model. (The

periodic step functions must be called in the manner of a rate-monotonic scheduler.) For more information, see “Modeling Patterns for AUTOSAR Runnables”.

A rate-based AUTOSAR software component can include both periodic and asynchronous runnables. For example, in the JMAAB type beta architecture, an asynchronous trigger runnable interacts with periodic rate-based runnables.

Consider AUTOSAR example model `rtwdemo_autosar_swc_fcncalls`. This model shows a rate-based implementation of an AUTOSAR atomic software component that includes an asynchronous (triggered) function-call subsystem at root level. An Initialize Function block initializes the component.



For more information, see “Add Top-Level Asynchronous Trigger to Periodic Rate-Based System” on page 4-263.

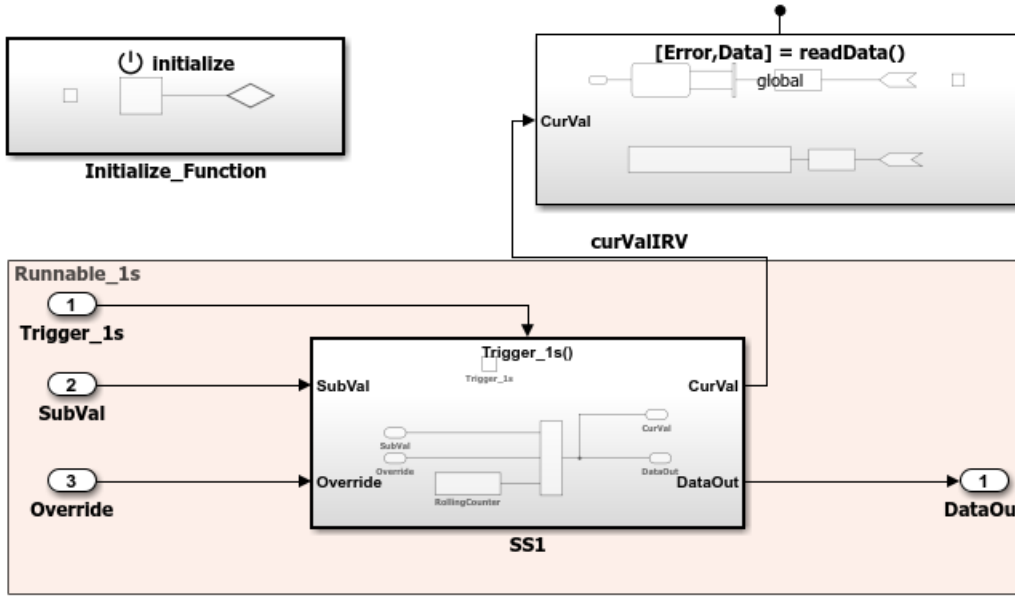
Function-Call Based Components

You can model AUTOSAR multi-runnables using Simulink function-call subsystems — or (for client-server modeling) Simulink Function blocks — at the top level of a model. First you create or import model content with multiple functions. You can:

- Create a software component with multiple runnables modeled as function-call subsystems or Simulink Function blocks in Simulink.
- Import a software component with multiple runnables from `arxml` files into Simulink. Use `arxml.importer` object function `createComponentAsModel` with property `ModelPeriodicRunnablesAs` set to `FunctionCallSubsystem`.
- Migrate an existing function-based Simulink model to the AUTOSAR target.

Root model inports and outports represent AUTOSAR ports, and signal lines connecting function-call subsystems represent AUTOSAR inter-runnable variables (IRVs).

Here is an example of a function-call-based model, with multiple runnable entities, that is suitable for simulation and AUTOSAR code generation. (This example uses AUTOSAR example model `rtwdemo_autosar_swc_slfcns`.) The model represents an AUTOSAR software component. The function-call subsystem labeled `SS1` and the Simulink Function block `readData` represent runnables that implement its behavior. An Initialize Function block initializes the component. The signal line `curValIRV` represents an AUTOSAR IRV.



When you generate code, the model C code includes callable model entry-point functions corresponding to AUTOSAR runnables, one for each top-model function-call subsystem or

Simulink Function block. For more information, see “Modeling Patterns for AUTOSAR Runnables”.

Multi-Instance Components

You can model multi-instance AUTOSAR SWCs in Simulink. For example, you can:

- Map and configure a Simulink model as a multi-instance AUTOSAR SWC, and validate the configuration. Use the `Reusable function` setting of the model parameter **Code interface packaging** (Simulink Coder).
- Generate C code with reentrant runnable functions and multi-instance RTE API calls. You can access external I/O, calibration parameters, and per-instance memory, and use reusable subsystems in multi-instance mode.
- Verify AUTOSAR multi-instance C code with SIL and PIL simulations.
- Import and export multi-instance AUTOSAR SWC description XML files.

Note Configuring a model as a multi-instance AUTOSAR SWC is not supported when the model contains either of the following blocks:

- Simulink Function
- Model-level Inport configured to output a periodic function-call

---

Startup, Reset, and Shutdown

AUTOSAR applications sometimes require complex logic to execute during system initialization, reset, and termination sequences. To model startup, reset, and shutdown processing in an AUTOSAR software component, use the Simulink blocks Initialize Function and Terminate Function.

The Initialize Function and Terminate Function blocks can control execution of a component in response to initialize, reset, or terminate events. You can place the blocks at any level of a model hierarchy. Each nonvirtual subsystem can have its own set of initialize, reset, and terminate functions. In a lower-level model, Simulink aggregates the content of the functions with corresponding instances in the parent model.

The Initialize Function and Terminate Function blocks contain an Event Listener block. To specify the event type of the function — `Initialize`, `Reset`, or `Terminate` — use the

Event type parameter of the Event Listener block. In addition, the function block reads or writes the state of conditions for other blocks. By default, Initialize Function block initializes block state with the State Writer block. Similarly, the Terminate Function block saves block state with the State Reader block. When the function is triggered, the value of the state variable is written to or read from the specified block.

AUTOSAR models can use the blocks to model potentially complex AUTOSAR startup, reset, and shutdown sequences. The subsystems work with any AUTOSAR component modeling style. (However, software-in-the-loop simulation of AUTOSAR initialize, reset, or terminate runnables works only with exported function modeling.)

In an AUTOSAR model, you map each Simulink initialize, reset, or terminate entry-point function to an AUTOSAR runnable. For each runnable, configure the AUTOSAR event that activates the runnable. In general, you can select any AUTOSAR event type except `TimingEvent`.

For more information, see “Configure AUTOSAR Initialize, Reset, or Terminate Runnables” on page 4-255.

See Also

Event Listener | Initialize Function | Rate Transition | Simulink Function | State Reader | State Writer | Terminate Function

Related Examples

- “Import AUTOSAR Software Component” on page 3-4
- “Modeling Patterns for AUTOSAR Runnables”
- “Configure AUTOSAR Runnables and Events” on page 4-251
- “Configure AUTOSAR Initialize, Reset, or Terminate Runnables” on page 4-255
- “Add Top-Level Asynchronous Trigger to Periodic Rate-Based System” on page 4-263
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “AUTOSAR Component Configuration” on page 4-3

Model AUTOSAR Communication

In Simulink, you can model AUTOSAR sender-receiver (S-R), client-server (C-S), mode-switch (M-S), nonvolatile (NV) data, parameter, and trigger communication.

In this section...

About AUTOSAR Communication

AUTOSAR software components provide well-defined connection points, ports. There are three types of AUTOSAR ports:

- `Require` (In)
- `Provide` (Out)
- Combined `Provide-Require` (InOut — introduced in AUTOSAR schema version 4.1)

AUTOSAR ports can reference the following kinds of interfaces:

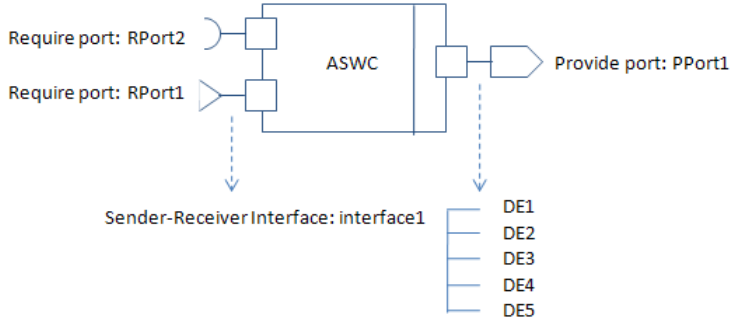
- Sender-Receiver
- Client-Server
- Mode-Switch
- Nonvolatile Data
- Parameter
- Trigger

The following figure shows an AUTOSAR software component with four ports representing the port and interface combinations for Sender-Receiver and Client-Server interfaces.

A `Require` port that references a Mode-Switch interface is called a mode-receiver port.

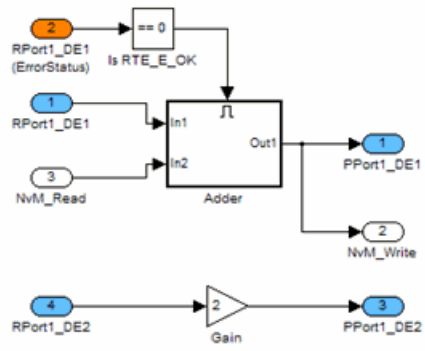
Sender-Receiver Interface

A Sender-Receiver Interface consists of one or more data elements. Although a `Require`, `Provide`, or `Provide-Require` port can reference a Sender-Receiver Interface, the AUTOSAR software component does not necessarily access all of the data elements. For example, consider the following figure.



The AUTOSAR software component has a `Require` and `Provide` port that references the same Sender-Receiver Interface, `Interface1`. Although this interface contains data elements `DE1`, `DE2`, `DE3`, `DE4`, and `DE5`, the component does not utilize all of the data elements.

The following figure is an example of how you model, in Simulink, an AUTOSAR software component that accesses data elements.



`ASWC` accesses data elements `DE1` and `DE2`. You model data element access as follows:

- For `Require` ports, use Simulink inports. For example, `RPort1_DE1` and `RPort1_DE2`.
- For `Provide` ports, use Simulink outports. For example, `PPort1_DE1` and `PPort1_DE2`.
- For `Provide-Require` ports (schema 4.1 or higher), use a Simulink inport and outport pair with matching data type, dimension, and signal type. For more information, see “Configure AUTOSAR Provide-Require Port” on page 4-102.

ErrorStatus is a value that the AUTOSAR Runtime Environment (RTE) returns to indicate errors that the communication system detects for each data element. You can use a Simulink inport to model error status, for example, `RPort1_DE1 (ErrorStatus)`.

Use AUTOSAR Dictionary and Code Mapping Editor to specify the AUTOSAR settings for each inport and outport. For more information, see “Configure AUTOSAR Sender-Receiver Communication” on page 4-100.

Client-Server Interface

AUTOSAR allows client-server communication between:

- Application software components
- An application software component and Basic Software

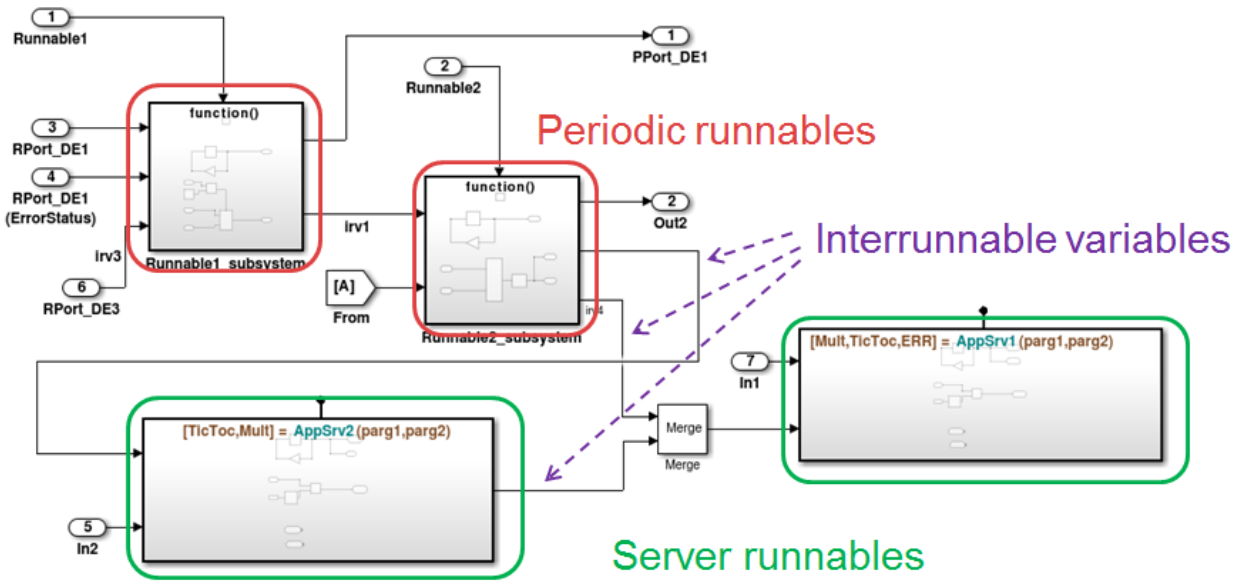
An AUTOSAR Client-Server Interface defines the interaction between a software component that *provides* the interface and a software component that *requires* the

interface. The component that provides the interface is the server. The component that requires the interface is the client.

To model AUTOSAR clients and servers in Simulink, for simulation and code generation:

- To model AUTOSAR servers, use Simulink Function blocks at the root level of a model.
- To model AUTOSAR client invocations, use Function Caller blocks.
- Use the function-call-based modeling style to create interconnected Simulink functions, function-calls, and root model inports and outports at the top level of a model.

This diagram illustrates a function-call framework in which Simulink Function blocks model AUTOSAR server runnables, Function Caller blocks model AUTOSAR client invocations, and Simulink data transfer lines model AUTOSAR inter-runnable variables (IRVs).



The high-level workflow for developing AUTOSAR clients and servers in Simulink is:

1 Model server functions and caller blocks in Simulink. For example, create Simulink Function blocks at the root level of a model, with corresponding Function Caller blocks that call the functions. Use the Simulink toolset to simulate and develop the blocks.

2. In the context of a model configured for AUTOSAR, map and configure the Simulink functions to AUTOSAR server runnables. Validate the configuration, simulate, and generate C and `arxml` code from the model.
3. In the context of another model configured for AUTOSAR, map and configure function caller blocks to AUTOSAR client ports and AUTOSAR operations. Validate the configuration, simulate, and generate C and `arxml` code from the model.
4. Integrate the generated C code into a test framework for testing, for example, with SIL simulation. (Ultimately, the generated C and `arxml` code are integrated into the AUTOSAR Runtime Environment (RTE).)

For more information, see “Configure AUTOSAR Client-Server Communication” on page 4-144.

Mode-Switch Interface

AUTOSAR mode-switch (M-S) communication relies on a mode manager and connected mode users. The mode manager is an authoritative source for software components to query the current mode and to receive notification when the mode changes. A mode manager can be provided by AUTOSAR Basic Software (BSW) or implemented as an AUTOSAR software component. A mode manager implemented as a software component is called an application mode manager. A software component that queries the mode manager and receives notifications of mode changes is a mode user.

- “Mode User” on page 2-17
- “Application Mode Manager” on page 2-20

Mode User

To model an AUTOSAR mode user software component in Simulink:

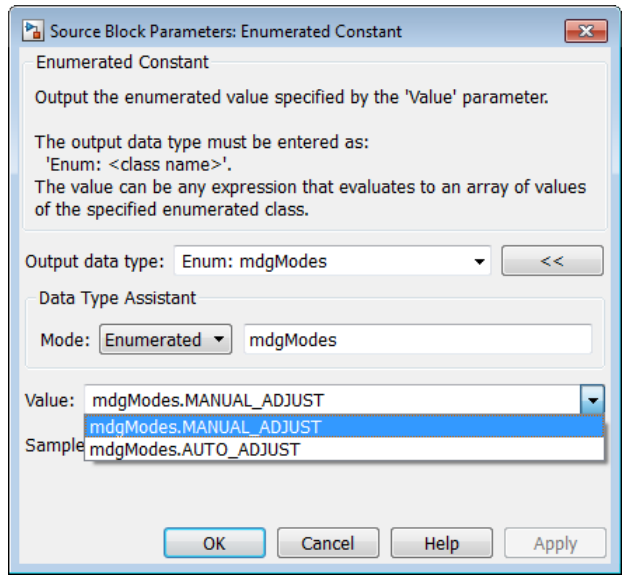
- Create an AUTOSAR mode-switch interface.
- Create an AUTOSAR mode receiver port and map it to a Simulink inport.
- For an initialization or other AUTOSAR runnable in the model, specify a mode-switch event to trigger the runnable.

To model an AUTOSAR software component mode-receiver port, general steps can include:

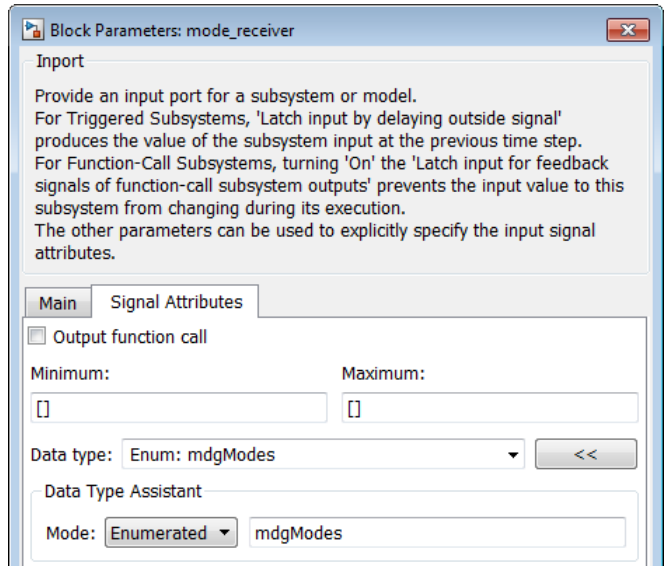
1. Declare a mode declaration group — a group of mode values — using Simulink enumeration. For example, you could create an enumerated type `mdgModes`, with

enumerated values `MANUAL_ADJUST` and `AUTO_ADJUST`. Specify the storage type as an unsigned integer.

```
Simulink.defineIntEnumType('mdgModes', ...
  {'MANUAL_ADJUST', 'AUTO_ADJUST'}, ...
  [18 28], ...
  'Description', 'Type definition of mdgModes.', ...
  'HeaderFile', 'Rte_Type.h', ...
  'DefaultValue', 'MANUAL_ADJUST', ...
  'AddClassNameToEnumNames', false,...
  'StorageType', 'uint16'...
);
```

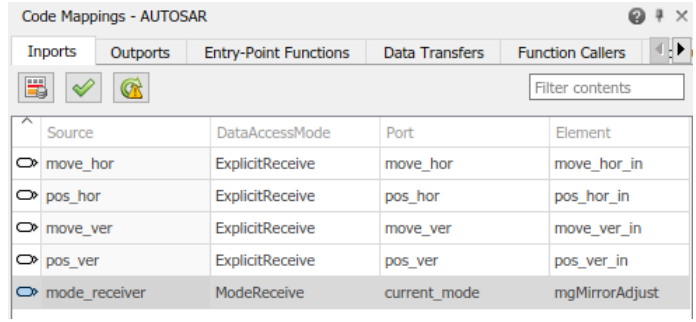


2 Apply the enumeration data type to a Simulink inport that represents an AUTOSAR mode-receiver port. In this Inport block dialog box, enumerated type `mdgModes` is specified as the inport data type.



3 To specify the mapping of the Simulink inport to the AUTOSAR mode-receiver port, use Code Mapping Editor (or equivalent AUTOSAR map functions).

In the following example, in the **Inports** tab of Code Mapping Editor, Simulink inport `mode_receiver` is mapped to AUTOSAR mode-receiver port `current_mode` and AUTOSAR element `mgMirrorAdjust`.

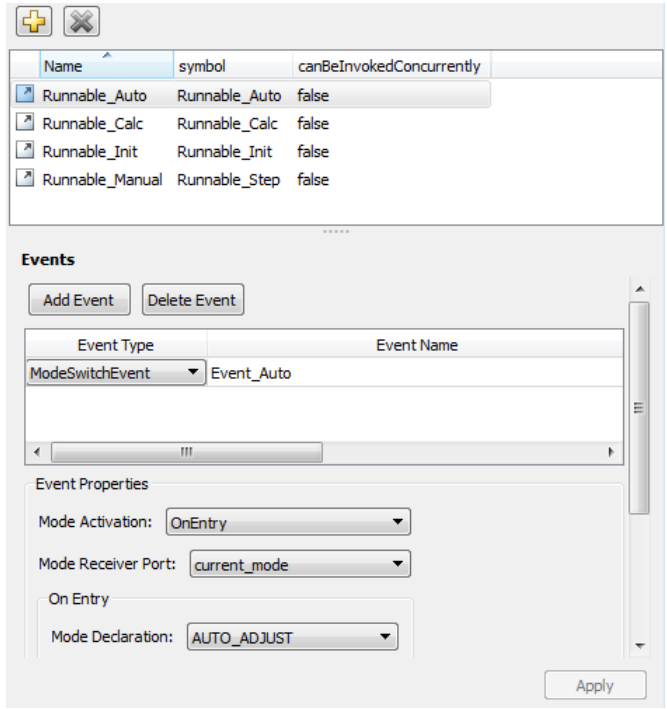


To specify a mode-switch event to trigger an initialize runnable or exported runnable, general steps can include:

1 To edit, add, or remove AUTOSAR mode-switch interfaces and mode-receiver ports, use AUTOSAR Dictionary (or equivalent AUTOSAR property functions).

2 In your model, choose or add a runnable that you want a mode-switch event to activate.

3 In the **Runnables** view of AUTOSAR Dictionary, select the runnable that you want a mode-switch event to activate. Configure the event. In the following example, a mode-switch event is added for `Runnable_Auto`, and configured to activate on entry (versus on exit or on transition). It is mapped to a previously configured mode-receiver port and a mode declaration value that is valid for the selected port.

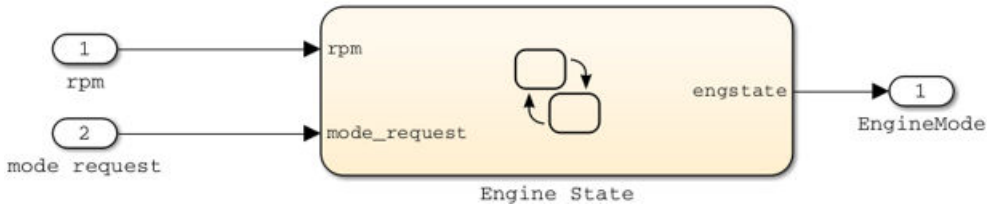


For more information, see “Configure AUTOSAR Mode-Switch Communication” on page 4-172.

Application Mode Manager

To model an application mode manager software component in Simulink, use an AUTOSAR mode sender port (as defined in AUTOSAR Release 4). Mode sender ports output a mode switch to connected mode user components. For example, here is an

application mode manager, modeled in Simulink, that uses a mode sender port to output the current value of `EngineMode`.



You model the mode sender port as a model root outport, which is mapped to an AUTOSAR mode sender port and a mode-switch (M-S) interface. The outport data type is an enumeration class with an unsigned integer storage type, representing an AUTOSAR mode declaration group.

In Simulink, you can:

- Import AUTOSAR mode-switch communication elements from `arxml` code.
  - The software imports ModeSwitchPoints, ModeSwitchInterfaces, and ModeDeclarationGroups.
  - For each AUTOSAR provider port that references an M-S interface, the importer creates a root outport with `ModeSend` data access and with an AUTOSAR mode declaration group enumeration class.
  - The importer maps the model outport to an AUTOSAR mode sender port with an M-S interface.
- Create AUTOSAR mode-switch communication elements.
  - Create a model root outport, and set the outport data type to an enumeration class that represents an AUTOSAR mode declaration group.
  - Create an AUTOSAR mode sender port with an associated M-S interface.
  - In Code Mapping Editor, set the outport data access mode to `ModeSend`, and map the outport to the AUTOSAR mode sender port.
- Generate `arxml` and C code for AUTOSAR mode sender ports and related AUTOSAR M-S communication elements.
  - The `arxml` code includes referenced ModeSwitchPoints, ModeSwitchInterfaces, and ModeDeclarationGroups.

- The C code includes `Rte_Switch` API calls to communicate mode switches to other software components.

For more information, see “Configure AUTOSAR Mode-Switch Communication” on page 4-172.

Nonvolatile Data Interface

AUTOSAR Release 4.0 introduced port-based nonvolatile (NV) data communication, in which an AUTOSAR software component reads and writes data to AUTOSAR nonvolatile components. To implement NV data communication, AUTOSAR software components define provide and require ports that send and receive NV data.

In Simulink, you can:

- Import AUTOSAR NV data interfaces and ports from `arxml` code.
- Create AUTOSAR NV interfaces and ports, and map Simulink inports and outports to AUTOSAR NV ports.

  You model AUTOSAR NV ports with Simulink inports and outports, in the same manner described in “Sender-Receiver Interface” on page 2-14.
- Generate C and `arxml` code for AUTOSAR NV data interfaces and ports.

For more information, see “Configure AUTOSAR Nonvolatile Data Communication” on page 4-181.

Parameter Interface

AUTOSAR parameter communication relies on a parameter software component (`ParameterSwComponent`) and one or more atomic software components that require port-based access to parameter data. The parameter software component represents memory containing AUTOSAR parameters and provides parameter data to connected atomic software components.

In Simulink, you can model the receiver portion of AUTOSAR port-based parameter communication. In an AUTOSAR atomic software component, you create a parameter interface with data elements and a parameter receiver port.

For more information, see “Configure Receiver for AUTOSAR Parameter Communication” on page 4-184.

Trigger Interface

AUTOSAR Release 4.0 introduced external trigger event communication, in which an AUTOSAR software component or service signals an external trigger occurred event (`ExternalTriggerOccurredEvent`) to another component. The receiving component activates a runnable in response to the event.

In Simulink, you can model the receiver portion of AUTOSAR external trigger event communication. In a component that you want to react to an external trigger, you create a trigger interface, a trigger receiver port to receive an `ExternalTriggerOccurredEvent`, and a runnable that the event activates.

For more information, see “Configure Receiver for AUTOSAR External Trigger Event Communication” on page 4-187.

See Also

Related Examples

- “Configure AUTOSAR Provide-Require Port” on page 4-102
- “Configure AUTOSAR Client-Server Communication” on page 4-144
- “Configure AUTOSAR Mode-Switch Communication” on page 4-172
- “Configure AUTOSAR Nonvolatile Data Communication” on page 4-181
- “Configure Receiver for AUTOSAR Parameter Communication” on page 4-184
- “Configure Receiver for AUTOSAR External Trigger Event Communication” on page 4-187

More About

- “AUTOSAR Component Configuration” on page 4-3

Model AUTOSAR Basic Software Service Calls

The AUTOSAR standard defines important services as part of Basic Software (BSW) that runs in the AUTOSAR Runtime Environment (RTE). Examples include the NVRAM Manager (NvM) and the Diagnostic Event Manager (Dem). In the AUTOSAR RTE, AUTOSAR software components typically access BSW services using client-server or sender-receiver communication.

To support system-level modeling of AUTOSAR components and services, Embedded Coder Support Package for AUTOSAR Standard provides an AUTOSAR Basic Software block library. The library contains preconfigured Function Caller blocks for modeling component calls to AUTOSAR BSW services.

- Diagnostic Event Manager (Dem) blocks — Calls to Dem service interfaces, including DiagnosticInfoCaller and DiagnosticMonitorCaller.
- NVRAM Manager (NvM) blocks — Calls to NvM service interfaces, including NvMAdminCaller and NvMServiceCaller.

To implement client calls to AUTOSAR BSW service interfaces in your AUTOSAR software component, you drag and drop Basic Software blocks into an AUTOSAR model. Each block has prepopulated parameters, such as **Client port name** and **Operation**. If you modify the operation selection, the software updates the block inputs and outputs to correspond.

To configure the added blocks in the AUTOSAR software component, click the **Update** button  in Code Mapping Editor view of the model. The software creates AUTOSAR client-service interfaces, operations, and ports, and maps each Simulink function caller to an AUTOSAR client port and operation.

For more information, see “Configure Calls to AUTOSAR Diagnostic Event Manager Service” on page 4-192 and “Configure Calls to AUTOSAR NVRAM Manager Service” on page 4-199.

To simulate an AUTOSAR component model that calls BSW services, create a containing composition, system, or harness model. In that containing model, provide reference implementations of the NvM and Dem service operations called by the component.

The AUTOSAR Basic Software block library includes an NVRAM Service Component block and a Diagnostic Service Component block. The blocks provide reference implementations of NvM and Dem service operations. To support simulation of component

calls to the NvM and Dem services, include the blocks in the containing model. You can insert the blocks in either of two ways:

- Automatically insert the blocks by creating a Simulink Test™ harness model.
- Manually insert the blocks into a containing composition, system, or harness model

For more information, see “Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207 and “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).

See Also

Diagnostic Service Component | DiagnosticInfoCaller | DiagnosticMonitorCaller | NVRAM Service Component | NvMAdminCaller | NvMServiceCaller

Related Examples

- “Configure Calls to AUTOSAR Diagnostic Event Manager Service” on page 4-192
- “Configure Calls to AUTOSAR NVRAM Manager Service” on page 4-199
- “Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207
- “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard)

More About

- “Model AUTOSAR Communication” on page 2-13

Model AUTOSAR Calibration Parameters and Lookup Tables

In Simulink, you can model AUTOSAR calibration parameters and lookup tables, which support run-time tuning of the AUTOSAR application with measurement and calibration tools.

In this section...
“AUTOSAR Calibration Parameters” on page 2-26
“Calibration Parameters for STD_AXIS and COM_AXIS Lookup Tables” on page 2-27

AUTOSAR Calibration Parameters

A calibration parameter is a value in an Electronic Control Unit (ECU). You tune or modify these parameters using a calibration data management tool or an offline calibration tool.

The AUTOSAR standard specifies the following types of calibration parameters:

- Calibration parameters that belong to a *calibration component* (`ParameterSwComponent`), which AUTOSAR software components can access. You can import a calibration component from `arxml` files into Simulink or create a calibration component in Simulink.
- Internal calibration parameters, which only one AUTOSAR software component defines and accesses.

The software supports `arxml` import, `arxml` export, and C code generation for both types of calibration parameters.

To provide your Simulink model with access to calibration parameters, reference the calibration parameters in block parameters.

To map Simulink parameter objects in the model workspace to AUTOSAR calibration parameters, open AUTOSAR code perspective and use Code Mapping Editor, **Parameters** tab. Use the Property Inspector to configure parameter code and calibration attributes. For more information, see “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77.

Calibration Parameters for STD_AXIS and COM_AXIS Lookup Tables

You can model standard axis (STD_AXIS) and common axis (COM_AXIS) lookup tables for AUTOSAR applications. AUTOSAR applications can use lookup tables in either or both of two ways:

- Implement fast search operations.
- Support tuning of the application with measurement and calibration tools.

A lookup table uses an array of data to map input values to output values, approximating a mathematical function. An *n*-dimensional lookup table can approximate an *n*-dimensional function. A COM_AXIS lookup table is one in which tunable breakpoints (axis points) are shared among multiple table axes.

The AUTOSAR standard defines calibration parameter categories for STD_AXIS and COM_AXIS lookup table data:

- CURVE, MAP, and CUBOID parameters represent 1-D, 2-D, and 3-D table data, respectively.
- COM_AXIS parameters represent axis data.

In Simulink, you can:

- Import `arxml` files that contain AUTOSAR lookup tables in STD_AXIS and COM_AXIS configurations:
  - For a lookup table in a STD_AXIS configuration, the importer creates an n-D Lookup Table block and initializes it with a `Simulink.LookupTable` object.
  - For a lookup table in a COM_AXIS configuration, the importer creates a Prelookup block initialized with a `Simulink.Breakpoint` object and an Interpolation Using Prelookup block initialized with a `Simulink.LookupTable` object.
  - The importer maps each created Simulink lookup table to AUTOSAR parameters with code and calibration attributes.
  - If the `arxml` code defines input variables that measure lookup table inputs, the importer creates corresponding model content. If the input variables are global variables, the importer connects static global signals to lookup table block inputs. If the input variables are root-level inputs, the importer connects root-level inports to lookup table block inputs.

- Create STD_AXIS and COM_AXIS lookup tables and map them to AUTOSAR parameters. You map lookup table objects to AUTOSAR parameters using Code Mapping editor, **Parameters**.
  - To model an AUTOSAR lookup table in a STD_AXIS configuration, create an n-D Lookup Table block. To store the data, create a single `Simulink.LookupTable` object in the model workspace. Use the object in the n-D Lookup Table block.

    Data appears in the generated C code as fields of a single structure. To control the characteristics of the structure type, such as its name, use the properties of the object.
  - To model an AUTOSAR lookup table in a COM_AXIS configuration, create Prelookup and Interpolation Using Prelookup blocks. To store each set of table data, create a `Simulink.LookupTable` object in the model workspace. To store each breakpoint vector, create a `Simulink.Breakpoint` object in the model workspace. Use each `Simulink.LookupTable` object in an Interpolation Using Prelookup block and each `Simulink.Breakpoint` object in a `Prelookup` block. You can reduce memory consumption by sharing breakpoint data between lookup tables.

    Each set of table data appears in the generated C code as a separate variable. If the table size is tunable, each breakpoint vector appears as a structure with one field to store the breakpoint data and, optionally, one field to store the length of the vector. The second field enables you to tune the effective size of the table. If the table size is not tunable, each breakpoint vector appears as an array.
  - Add AUTOSAR operating points to the lookup tables. Connect root level inports to n-D Lookup Table or Prelookup blocks. Alternatively, configure input signals to n-D Lookup Table or Prelookup blocks with static global memory.
  - To map Simulink lookup table objects in the model workspace to AUTOSAR calibration parameters, open AUTOSAR code perspective and use Code Mapping Editor, **Parameters** tab. Use the Property Inspector to configure parameter code and calibration attributes. For more information, see “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77
- Generate `arxml` and C code with STD_AXIS and COM_AXIS lookup table content.

  In the Simulink Configuration Parameters dialog box, **Interface** pane, select the AUTOSAR 4.0 code replacement library for C code generation.

  The generated C code contains required `Ifl` and `Ifx` lookup function calls and `Rte` data access function calls.

The generated `arxml` files contain information to support run-time calibration of the tunable lookup table parameters, including:

- Lookup table calibration parameters that reference the application data types — category CURVE, MAP, or CUBOID for table data, or category COM_AXIS for axis data.
- Application data types of category CURVE, MAP, CUBOID, and COM_AXIS, with the data calibration properties that you configured. The properties include **SwCalibrationAccess**, **DisplayFormat**, and **SwAddrMethod**.
- Software record layouts (`SwRecordLayouts`) referenced by the application data types of category CURVE, MAP, CUBOID, and COM_AXIS.

For more information, see “Configure STD_AXIS and COM_AXIS Lookup Tables for AUTOSAR Measurement and Calibration” on page 4-220.

See Also

Interpolation Using Prelookup | Prelookup | `Simulink.Breakpoint` | `Simulink.LookupTable` | `getParameter` | `mapParameter` | n-D Lookup Table

Related Examples

- “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77
- “Configure STD_AXIS and COM_AXIS Lookup Tables for AUTOSAR Measurement and Calibration” on page 4-220

More About

- “AUTOSAR Component Configuration” on page 4-3

Model AUTOSAR Component Behavior

In Simulink, you can model AUTOSAR component behavior, including behavior of runnables, events, and inter-runnable variables.

In this section...

AUTOSAR Elements for Modeling Component Behavior

To model AUTOSAR component behavior, you model AUTOSAR elements that describe scheduling and resource sharing aspects of a component. The AUTOSAR elements that bear on component behavior include:

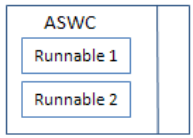
- Runnables and the events to which they respond
- Inter-runnable variables, used to communicate data between runnables in the same component
- System constants, used to specify system-level constant values that are available for reference in component algorithms
- Per-instance memory, used to specify instance-specific global memory within a component
- Static and constant memory, for access to global data and parameter values within a component

This topic describes how to model the AUTOSAR elements that help you define component behavior.

Runnables

AUTOSAR software components contain runnables that are directly or indirectly scheduled by the underlying AUTOSAR operating system.

This figure shows an AUTOSAR software component with two runnables, `Runnable 1` and `Runnable 2`. RTEEvents, events generated by the AUTOSAR Runtime Environment (RTE), trigger each runnable. For example, TimingEvent is an RTEEvent that is generated periodically.



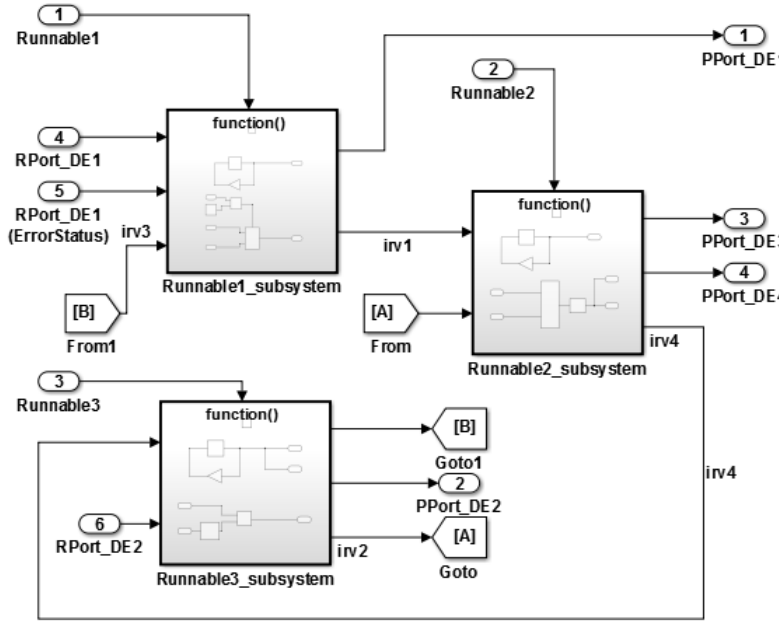
A component also can contain a single runnable, represented by a model, and can be single-rate or multirate.

Note The software generates an additional runnable for the initialization function regardless of the modeling pattern.

For more information, see “Configure AUTOSAR Runnables and Events” on page 4-251.

Inter-Runnable Variables

In AUTOSAR, *inter-runnable* variables are used to communicate data between runnables in the same component. You define these variables in a Simulink model by the signal lines that connect subsystems (runnables). For example, in the following figure, `irv1`, `irv2`, `irv3`, and `irv4` are inter-runnable variables.



You can specify the names and data access modes of the inter-runnable variables that you export.

System Constants

AUTOSAR system constants (`SwSystemConstants`) specify system-level constant values that are available for reference in component algorithms. To add AUTOSAR system constants to your model, you can:

- Import them from `arxml` files.
- Create them in Simulink, using `AUTOSAR.Parameter` objects with **Storage class** set to `SystemConstant`.

You can then reference the AUTOSAR system constants in Simulink algorithms. For example, you could reference a system constant in a Gain block, or in a condition formula inside a variant subsystem or model reference.

When you reference an AUTOSAR system constant in your model:

- Exported `arxml` code contains a corresponding `SwSystemConstant` and a corresponding AUTOSAR variation point proxy (`VariationPointProxy`) that references the `SwSystemConstant`. If you generate modular `arxml` files, the `SwSystemConstant` is located in *`modelname`*`_datatype.arxml` and the `VariationPointProxy` is located in *`modelname`*`_component.arxml`.
- Generated C code uses the generated `VariationPointProxy` in places where the model uses the `SwSystemConstant`.

For an example of an AUTOSAR system constant used to represent a conditional value associated with variant condition logic, see “Configure AUTOSAR Variants in Runnable Condition Logic” on page 4-307.

Per-Instance Memory

AUTOSAR supports per-instance memory, which allows you to specify instance-specific global memory within a software component. An AUTOSAR run-time environment generator allocates this memory and provides an API through which you access this memory.

Per-instance memory can be AUTOSAR-typed or C-typed. AUTOSAR-typed per-instance memory (`arTypedPerInstanceMemory`), introduced in AUTOSAR schema version 4.0, is described using AUTOSAR data types rather than C types. When exported in `arxml` code, `arTypedPerInstanceMemory` allows the use of measurement and calibration tools to monitor the global variable corresponding to per-instance memory.

AUTOSAR also allows you to use per-instance memory as a RAM mirror for data in nonvolatile RAM (NVRAM). You can access and use NVRAM in your AUTOSAR application.

To add AUTOSAR per-instance memory to your model, you can:

- Import per-instance memory definitions from `arxml` files.
- Create model content that represents per-instance memory.

To model `arTypedPerInstanceMemory`, you can use block signals, discrete states, or data stores in your AUTOSAR model:

- To use block signals and discrete states, use Code Mapping Editor, **Signals** or **States** tab, to select a signal or state and map it to `arTypedPerInstanceMemory`. Property Inspector displays code and calibration attributes for the static memory, which you can modify.

- To use data stores, configure data stores to use `PerInstanceMemory` storage class. After setting the storage class, configure per-instance memory attributes.

For more information, see “Configure AUTOSAR Per-Instance Memory” on page 4-270.

Static and Constant Memory

AUTOSAR supports static memory (StaticMemory) and constant memory (ConstantMemory) data, introduced in AUTOSAR schema version 4.0. Static memory corresponds to Simulink internal global signals. Constant memory corresponds to Simulink internal global parameters. In Simulink, you can import and export `arxml` descriptions of AUTOSAR static and constant memory. When exported in `arxml` code, static memory and constant memory allow the use of measurement and calibration tools to monitor the internal memory data.

To model AUTOSAR static memory in Simulink, use Code Mapping Editor, **Signals** or **States** tab, to select a signal or state and map it to `StaticMemory`. Property Inspector displays code and calibration attributes for the static memory, which you can modify.

To model AUTOSAR constant memory in Simulink, use Code Mapping Editor, **Parameters** tab, to select a parameter and map it to `ConstantMemory`. Property Inspector displays code and calibration attributes for the constant memory, which you can modify.

For more information, see “Configure AUTOSAR Static Memory” on page 4-275 and “Configure AUTOSAR Constant Memory” on page 4-278.

See Also

`AUTOSAR.Parameter` | Data Store Memory

Related Examples

- “Configure AUTOSAR Runnables and Events” on page 4-251
- “Configure AUTOSAR Variants in Runnable Condition Logic” on page 4-307
- “Configure AUTOSAR Per-Instance Memory” on page 4-270
- “Configure AUTOSAR Static Memory” on page 4-275
- “Configure AUTOSAR Constant Memory” on page 4-278

More About

- “AUTOSAR Component Configuration” on page 4-3

Model AUTOSAR Data Types

The AUTOSAR standard defines platform data types for use by AUTOSAR software components. In Simulink, you can model AUTOSAR data types used in elements such as data elements, operation arguments, calibration parameters, measurement variables, and inter-runnable variables. If you import an AUTOSAR component from `arxml` files, Embedded Coder imports AUTOSAR data types and creates the required corresponding Simulink data types. During code generation, Embedded Coder exports `arxml` descriptions for data types used in the component model and generates AUTOSAR data types in C code.

In this section...

About AUTOSAR Data Types

AUTOSAR specifies data types that apply to:

- Data elements of a sender-receiver Interface
- Operation arguments of a client-server Interface
- Calibration parameters
- Measurement variables
- Inter-runnable variables

The data types fall into two categories:

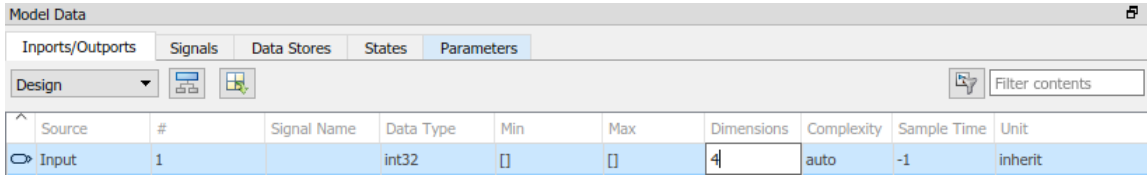
- Platform (primitive) data types, which allow a direct mapping to C intrinsic types.
- Composite data types, which map to C arrays and structures.

To model AUTOSAR data types, use corresponding Simulink data types.

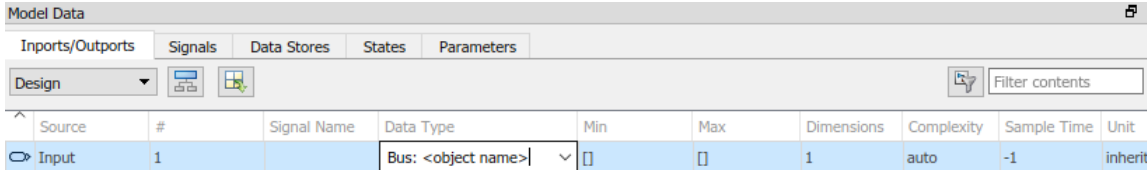
AUTOSAR Data Type		Simulink Data Type
R4.x Platform Type	**R2.x/3.x Primitive Type**	
`boolean`	`Boolean`	`boolean`
`float32`	`Float`	`single`
`float64`	`Double`	`double`
`sint8`	`Sint8`	`int8`
`sint16`	`Sint16`	`int16`
`sint32`	`Sint32`	`int32`
`uint8`	`Uint8`	`uint8`
`uint16`	`Uint16`	`uint16`
`uint32`	`Uint32`	`uint32`

AUTOSAR composite data types are arrays and records, which are represented in Simulink by wide signals and bus objects, respectively. To configure a wide signal or bus object through Inport or Outport blocks, use the Model Data Editor. In the model, select **View** > **Model Data Editor** and select the **Inports/Outports** tab. Select the `Design` view. From the list of inports and outports, select the source block to configure.

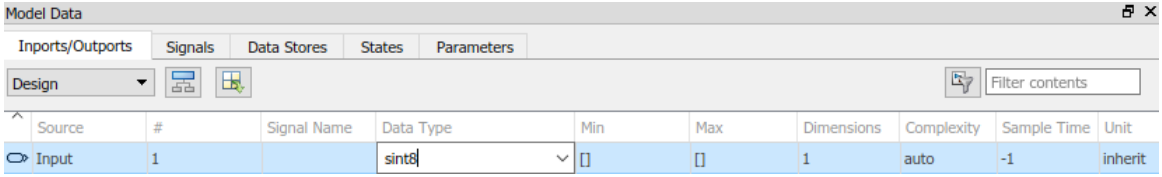
The following figure shows how to specify a wide signal, which corresponds to an AUTOSAR composite array.



The following figure shows how to specify a bus object, which corresponds to an AUTOSAR composite record.



To specify the data types of data elements and arguments of an operation prototype, use the drop-down list in the **Data Type** column. You can specify a Simulink built-in data type, such as `boolean`, `single`, or `int8`, or enter an (alias) expression for data type. For example, the following figure shows an alias `sint8`, corresponding to an AUTOSAR data type, in the **Data Type** column.



For more guidance in specifying the data type, you can use the **Data Type Assistant** on the **Signal Attributes** pane of the Inport or Outport Block Parameters dialog box or in the Property Inspector.

Enumerated Data Types

AUTOSAR supports enumerated data types. For the import process, if there is a corresponding Simulink enumerated data type, the software uses the data type. The software checks that the two data types are consistent. However, if a corresponding Simulink data type is not found, the software automatically creates the enumerated data type using the `Simulink.defineIntEnumType` class. This automatic creation of data types is useful when you want to import a large quantity of enumerated data types.

Consider the following example:

```
<SHORT-NAME>BasicColors</SHORT-NAME>
  <COMPU-INTERNAL-TO-PHYS>
  <COMPU-SCALES>
     <COMPU-SCALE>
        <LOWER-LIMIT>0</LOWER-LIMIT>
        <UPPER-LIMIT>0</UPPER-LIMIT>
        <COMPU-CONST>
           <VT>Red</VT>
```

The software creates an enumerated data type using:

```
Simulink.defineIntEnumType( 'BasicColors', ...
     {'Red', 'Green', 'Blue'}, ...
     [0;1;2], ...
     'Description', 'Type definition of BasicColors.', ...
     'HeaderFile', 'Rte_Type.h', ...
     'AddClassNameToEnumNames', false);
```

Structure Parameters

Before exporting an AUTOSAR software component, specify the data types of structure parameters to be `Simulink.Bus` objects. See “Control Field Data Types and Characteristics by Creating Parameter Object” (Simulink). Otherwise, the software displays the following behavior:

- When you validate the AUTOSAR configuration, the software issues a warning.
- When you build the model, the software defines each data type to be an anonymous `struct` and generates a random, nondescriptive name for the data type.

When importing an AUTOSAR software component, if a parameter structure has a data type name that corresponds to an anonymous `struct`, the software sets the data type to `struct`. However, if the component has data elements that reference this anonymous `struct` data type, the software generates an error.

Release 2.x and 3.x Data Types

The following table shows how the software translates AUTOSAR R2.x and R3.x data types to Simulink data types. For information about Release 4.x data types, see “Release 4.x Data Types” on page 2-39.

AUTOSAR	Simulink

Primitive types (excluding fixed point), for example, `myInt16`
 	
Covers Boolean, integer, real
	`myInt16 = Simulink.AliasType;`
	`myInt16.BaseType = 'int16';`
	`myInt16.HeaderFile = 'Rte_Type.h';`

Primitive type (fixed point), for example, `myFixPt`	`myFixPt = Simulink.NumericType;`
	`myFixPt.DataTypeMode = …;`
	`myFixPt.IsAlias = true;`
	`myFixPt.HeaderFile = 'Rte_Type.h';`

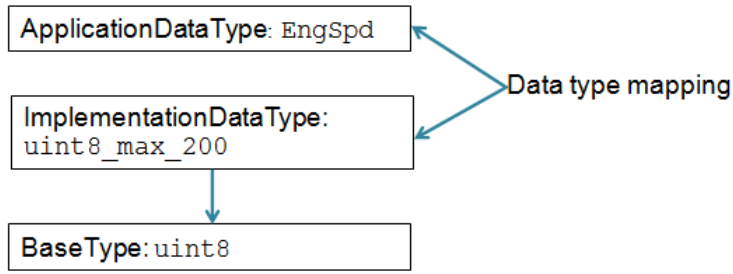
Enumerations, for example, `myEnum`	`Simulink.defineIntEnumType('myEnum',...`
	` {'Red','Green','Blue'},...`
	` [1;2;3],…);`

Record types, for example, `myRecord`	`myRecord = Simulink.Bus;`

Release 4.x Data Types

AUTOSAR Release 4.0 introduced a new approach to AUTOSAR data types, in which base data types are mapped to implementation data types and application data types.

Application and implementation data types separate application-level physical attributes, such as real-world range of values, data structure, and physical semantics, from implementation-level attributes, such as stored-integer minimum and maximum and specification of a primitive type (for example, integer, Boolean, or real).



The software supports AUTOSAR R4.x compliant data types in Simulink originated and round-trip workflows:

- For AUTOSAR components originated in Simulink, the software generates AUTOSAR application, implementation, and base types to preserve the information contained within Simulink data types.

  In the AUTOSAR package structure created for Simulink originated components:

  - You can specify separate packages to aggregate schema 4.x elements that relate to data types, including application data types, software base types, data type mapping sets, system constants, and units.
  - Schema 4.x implementation data types are aggregated in the main data types package.

  For more information, see “Configure AUTOSAR Packages” on page 4-88.
- For round-trip workflows involving AUTOSAR components originated outside MATLAB, the `arxml` importer and exporter preserve data type information and mapping for each imported AUTOSAR data type.

For information about mapping value constraints between AUTOSAR application data types and Simulink data types, see “Application Data Type Physical Constraint Mapping” on page 2-43.

For AUTOSAR R4.x data types originated in Simulink, you can control some aspects of data type export. For example, you can control when application data types are

generated, or specify the AUTOSAR package and short name exported for AUTOSAR data type mapping sets. For more information, see “Configure AUTOSAR Release 4.x Data Types” on page 4-281.

- “R4.x Data Types in Simulink Originated Workflow” on page 2-41
- “R4.x Data Types in Round-Trip Workflow” on page 2-42
- “Application Data Type Physical Constraint Mapping” on page 2-43

R4.x Data Types in Simulink Originated Workflow

In the Simulink originated (bottom-up) workflow, you create a Simulink model and export the model as an AUTOSAR software component.

The software generates the application and implementation data types and base types to preserve the information contained within the Simulink data types:

- For Simulink data types, the software generates implementation data types.
- For each fixed-point type, in addition to the implementation data type, the software generates an application data type with the `COMPU-METHOD-REF` element to preserve scale and bias information. This application data type is mapped to the implementation data type.

Note The software does not support application data types for code generated from referenced models.

Simulink Data Type	AUTOSAR XML	
	Implementation Type	**Application Type**

Primitive (excluding fixed point), for example, `myInt16`
 	
Covers Boolean, integer, real
 	
`myInt16 = Simulink.AliasType;`
`myInt16.BaseType = 'int16';`
	`<IMPLEMENTATION-DATA-TYPE>`
	`<SHORT-NAME>myInt16</SHORT-NAME>`
	`<CATEGORY>VALUE</CATEGORY>`
	…
		Not generated

Simulink Data Type	AUTOSAR XML	
	Implementation Type	Application Type

Primitive (fixed point), for example, `myFixPt`
 	
`myFixPt = Simulink.NumericType;`
`myFixPt.DataTypeMode = …;`
`myFixPt.IsAlias = true;`
	`<IMPLEMENTATION-DATA-TYPE>`
	`<SHORT-NAME>myFixPt</SHORT-NAME>`
	`<CATEGORY>VALUE</CATEGORY>`
	…
		`<APPLICATION-PRIMITIVE-DATA-TYPE>`
		`<SHORT-NAME>myFixPt</SHORT-NAME>`
		`<COMPU-METHOD-REF>…`

Enumeration, for example, `myEnum`
 	
`Simulink.defineIntEnumType('myEnum',...`
`{'Red','Green','Blue'},...`
`[1;2;3],…);`
	`<IMPLEMENTATION-DATA-TYPE>`
	`<SHORT-NAME>myEnum</SHORT-NAME>`
	`<CATEGORY>VALUE</CATEGORY>`
	`<COMPU-METHOD>…`
		Not generated

Record, for example, `myRecord`
 	
`myRecord = Simulink.Bus;`
	`<IMPLEMENTATION-DATA-TYPE>`
	`<SHORT-NAME>myRecord</SHORT-NAME>`
	`<CATEGORY>STRUCT</CATEGORY>`
	…
		Not generated

R4.x Data Types in Round-Trip Workflow

In the round-trip workflow, you first use the XML description generated by an AUTOSAR authoring tool to import on page 3-4 an AUTOSAR software component into a model. Later, you generate AUTOSAR C and XML code from the model.

If the data prototype references an application data type, the software stores application to implementation data type mapping within the model and uses the application data type name to define the Simulink data type.

For example, suppose that the authoring tool specifies an application data type:

```
ApplDT1
```

In this case, the software defines the following Simulink data type:

```
ImplDT1
```

AUTOSAR XML		Simulink Data Type
Application Type	Implementation Type	

`<APPLICATION-PRIMITIVE-DATA-TYPE>`
`<SHORT-NAME>myFixPt</SHORT-NAME>`
`<COMPU-METHOD-REF>…`
	`<IMPLEMENTATION-DATA-TYPE>`
	`<SHORT-NAME>myInt</SHORT-NAME>`
	…
		`myFixPt = Simulink.NumericType;`
		`myFixPt.DataTypeMode = …;`
		`myFixPt.IsAlias = true;`

If the data prototype references an implementation data type, the software does not store mapping information and uses the implementation data type name to define the Simulink data type.

The software uses the application data types in simulations and the implementation data types for code generation. When you re-export the AUTOSAR software component, the software uses the stored information to provide the same mapping between the exported application and implementation data types.

Application Data Type Physical Constraint Mapping

In models configured for AUTOSAR, the software maps minimum and maximum values for Simulink data to the corresponding physical constraint values for AUTOSAR application data types. Specifically:

- If you import `arxml` files, `PhysConstr` values on `ApplicationDataTypes` in the `arxml` files are imported to `Min` and `Max` values on the corresponding Simulink data objects and root-level I/O signals.
- When you export `arxml` code from a model, the `Min` and `Max` values specified on Simulink data objects and root-level I/O signals are exported to the corresponding `ApplicationDataType` `PhysConstrs` in the `arxml` files.

CompuMethod Categories for Data Types

AUTOSAR software components use computation methods (CompuMethods) to convert between the internal values and physical representation of AUTOSAR data. Common uses for CompuMethods are linear data scaling and measurement and calibration.

The `category` attribute of a CompuMethod represents a specialization of the CompuMethod, which can impose semantic constraints. The `CompuMethod` categories produced by the code generator include:

- `BITFIELD_TEXTTABLE` — Transform internal value into bitfield textual elements.
- `IDENTICAL` — Floating-point or integer function for which internal and physical values are identical and do not require conversion.
- `LINEAR` — Linear conversion of an internal value; for example, multiply the internal value with a factor, then add an offset.
- `RAT_FUNC` — Rational function; similar to linear conversion, but with conversion restrictions specific to rational functions.
- `SCALE_LINEAR_AND_TEXTTABLE` — Combination of `LINEAR` and `TEXTTABLE` scaling specifications.
- `TEXTTABLE` — Transform internal value into textual elements.

The `arxml` exporter generates CompuMethods for every primitive application type, allowing measurement and calibration tools to monitor and interact with the application data. The following table shows the `CompuMethod` categories that the code generator produces for data types in a model that is configured for AUTOSAR.

Data Type	CompuMethod Category	CompuMethod on Application Type	CompuMethod on Implementation Type
Bitfield	`BITFIELD_TEXTTABLE`	Yes	Yes
Boolean	`TEXTTABLE`	Yes	Yes
Enumerated without storage type	`TEXTTABLE`	Yes	Yes
Enumerated with storage type	`TEXTTABLE`	Yes	No

Fixed-point	`LINEAR`
	`RAT_FUNC` (limited to reciprocal scaling)
	`SCALE_LINEAR_AND_TEXTABLE`
		Yes	No

Floating-point	`IDENTICAL` `SCALE_LINEAR_AND_TEXTABLE`	Yes	No
Integer	`IDENTICAL` `SCALE_LINEAR_AND_TEXTABLE`	Yes	No

For floating-point and integer data types that do not require conversion between internal and physical values, the exporter generates a generic `CompuMethod` with category `IDENTICAL` and short-name `Identcl`.

For information about configuring CompuMethods for code generation, see “Configure AUTOSAR CompuMethods” on page 4-287.

See Also

Related Examples

- “Organize Data into Structures in Generated Code”
- “Application Data Type Physical Constraint Mapping” on page 2-43

- “Configure AUTOSAR Release 4.x Data Types” on page 4-281
- “Automatic AUTOSAR Data Type Generation” on page 4-285
- “Configure AUTOSAR CompuMethods” on page 4-287

More About

- “AUTOSAR Data Types”

Model AUTOSAR Variants

AUTOSAR software components use variants to enable or disable AUTOSAR interfaces or implementations in the execution path, based on defined conditions. Components:

- Enable or disable an AUTOSAR port or runnable.
- Vary the array size of an AUTOSAR port.
- Vary code inside an AUTOSAR runnable.
- Specify predefined variants and system constant value sets for controlling variants in the component.

In Simulink, you can:

- Import and export AUTOSAR ports and runnables with variants.
- Model AUTOSAR variants.
  - To enable or disable an AUTOSAR port or runnable, use Variant Sink and Variant Source blocks.
  - To vary the array size of an AUTOSAR port, use Simulink symbolic dimensions.
  - To vary code inside an AUTOSAR runnable, use Variant Subsystem blocks.
- Resolve modeled variants by using predefined variants and system constant value sets imported from `arxml` files.

In this section...

Variants in Ports and Runnables

AUTOSAR software components can use `VariationPoint` elements to enable or disable AUTOSAR elements, such as ports and runnables, based on defined conditions.

In Simulink, you can:

- Import AUTOSAR ports and runnables with variation points.

  The `arxml` importer creates the required model elements, including workspace variables for modeling with variation points, Variant Sink blocks, and Variant Source blocks to propagate variant conditions.
- Model AUTOSAR elements with variation points.
  - To define variant condition logic, use `Simulink.Variant` data objects.
  - To represent AUTOSAR system constants, use `AUTOSAR.Parameter` data objects with storage class `SystemConstant`.
  - To propagate variant conditions for the AUTOSAR elements, use Variant Sink and Variant Source blocks.
- Run validation on the AUTOSAR configuration. The validation software verifies that variant conditions on Simulink blocks match the designed behavior from the imported `arxml` code.
- Export previously imported AUTOSAR ports and runnables with variation points.

For more information, see “Configure AUTOSAR Variants in Ports and Runnables” on page 4-302.

Variants in Array Sizes

AUTOSAR software components can flexibly specify the dimensions of an AUTOSAR element, such as a port, by using a symbolic reference to a system constant. The system constant defines the array size of the port data type. The code generator supports models that include AUTOSAR elements with variant (symbolic) array sizes.

In Simulink, you can:

- Import AUTOSAR elements with variant array sizes.
  - The `arxml` importer creates the required model elements, including `AUTOSAR.Parameter` data objects with storage class `SystemConstant`, to represent the array size values.
  - Each block that represents an AUTOSAR element with variant array sizes references `AUTOSAR.Parameter` data objects to define its dimensions.
- Model AUTOSAR elements with variant array sizes.

    - Create blocks that represent AUTOSAR elements.
    - To represent array size values, add `AUTOSAR.Parameter` data objects with storage class `SystemConstant`.
    - To specify array size for an AUTOSAR element, reference an `AUTOSAR.Parameter` data object.
- Modify array size values in system constants and simulate the model, without regenerating code for simulation.
- Generate C and `arxml` code with symbols corresponding to variant array sizes.

For more information, see “Configure AUTOSAR Variants in Array Sizes” on page 4-305.

Variants in Runnable Condition Logic

AUTOSAR software components can specify variant condition logic inside an AUTOSAR runnable. You can model variant condition logic inside a runnable by using the following Simulink elements:

- Variant Subsystem blocks, containing variant implementations with associated condition logic.
- `AUTOSAR.Parameter` data objects to model AUTOSAR system constants, representing the conditional values associated with the variant condition logic.
- `Simulink.Variant` data objects in the base workspace to define the variant condition logic.

For more information, see “Configure AUTOSAR Variants in Runnable Condition Logic” on page 4-307.

Predefined Variants and System Constant Value Sets

To define the values that control variation points in an AUTOSAR software component, components use the following AUTOSAR elements:

- `SwSystemconst` — Defines a system constant that serves as an input to control a variation point.
- `SwSystemconstantValueSet` — Specifies a set of system constant values.
- `PredefinedVariant` — Describes a combination of system constant values, among potentially multiple valid combinations, to apply to an AUTOSAR software component.

Suppose that you have an `arxml` specification of an AUTOSAR software component. If the `arxml` files also define a `PredefinedVariant` or `SwSystemconstantValueSet`s for controlling variation points in the component, you can resolve the variation points at model creation time. Specify a `PredefinedVariant` or `SwSystemconstantValueSet`s with which the importer can initialize `SwSystemconst` data.

After model creation, you can run simulations and generate code based on the combination of variation point input values that you specified.

In Simulink, using the AUTOSAR property function `createSystemConstants`, you can redefine the `SwSystemconst` data that controls variation points without recreating the model. You can run simulations and generate code based on the revised combination of variation point input values.

Building the model exports previously imported `PredefinedVariant`s and `SwSystemconstantValueSet`s to `arxml` code.

For more information, see “Control AUTOSAR Variants with Predefined Value Combinations” on page 4-310.

See Also

Related Examples

- “Configure AUTOSAR Variants in Ports and Runnables” on page 4-302
- “Configure AUTOSAR Variants in Array Sizes” on page 4-305
- “Configure AUTOSAR Variants in Runnable Condition Logic” on page 4-307
- “Control AUTOSAR Variants with Predefined Value Combinations” on page 4-310

More About

- “Variant Systems”
- “AUTOSAR Component Configuration” on page 4-3

AUTOSAR Component Creation

AUTOSAR arxml Importer

The AUTOSAR `arxml` importer imports AUTOSAR software component description files produced by an AUTOSAR authoring tool (AAT) into a Simulink model. The importer first parses `arxml` code that describes an AUTOSAR software component or composition. Then, based on commands that you issue, the importer imports a subset of the elements and objects in the `arxml` description into Simulink. The subset consists of AUTOSAR elements relevant for Simulink model-based design of an automotive application. For example, for an imported component, the subset includes AUTOSAR ports, interfaces, data types, aspects of internal behavior, and packages.

The importer creates an initial Simulink representation of each imported AUTOSAR software component, with an initial, default mapping of Simulink model elements to AUTOSAR component elements. The initial representation provides a starting point for further AUTOSAR configuration and model-based design.

As part of the import operation, the importer validates the XML in the imported `arxml` files. If XML validation fails for a file, the importer displays errors. For example:

```
Error
The IsService attribute is undefined for interface /mtest_pkg/mtest_if/In1
in file hArxmlFileErrorMissingIsService_SR_3p2.arxml:48.
Specify the IsService attribute to be either true or false
```

In this example message, the file name is a hyperlink, and you can click the hyperlink to see the location of the error in the `arxml` file.

To help support the round trip of AUTOSAR elements between an AAT and the Simulink model-based design environment, Embedded Coder:

- Preserves imported AUTOSAR XML file structure, elements, and element UUIDs for `arxml` export. For more information, see “Round-Trip Preservation of AUTOSAR XML File Structure and Element Information” on page 3-18.
- Provides the ability to update an AUTOSAR model based on changes found in imported `arxml` files. For more information, see “Import AUTOSAR Software Component Updates” on page 3-11.

The AUTOSAR `arxml` importer is implemented as an `arxml.importer` object. For a complete list of functions, see the `arxml.importer` object reference page.

See Also

Related Examples

- “Import AUTOSAR Software Component” on page 3-4
- “Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)
- “Import AUTOSAR Composition to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Workflows for AUTOSAR” on page 1-4

Import AUTOSAR Software Component

In Simulink, you can import an AUTOSAR software component description from `arxml` files and create a model representing the AUTOSAR software component. You use the AUTOSAR `arxml` importer, which is implemented as an `arxml.importer` object. For more information, see “AUTOSAR arxml Importer” on page 3-2.

Use `arxml.importer` functions in the following order:

1. Call the `arxml.importer` function to create an importer object that represents the software component information in the specified XML file or files. For example, this call specifies a main AUTOSAR software component file, `mr_component.arxml`, and related dependent files containing data type, implementation, and interface information that completes the software component description.

   ```
   ar = arxml.importer({'mr_component.arxml','mr_datatype.arxml',...
                        'mr_implementation.arxml','mr_interface.arxml'})
   ```

   This call specifies an AUTOSAR software composition file, `ThrottlePositionControlComposition.arxml`, which describes an AUTOSAR composition and its aggregated AUTOSAR components.

   ```
   addpath(fullfile(autosarroot,'autosar_examples','ThrottlePositionControlSystem','arxml'));
   ar = arxml.importer('ThrottlePositionControlComposition.arxml');
   ```

   If you enter the `arxml.importer` function call without a terminating semicolon (;), the importer lists the AUTOSAR content of the specified XML file or files. The information includes paths to software components in the AUTOSAR package structure, which you use in the next step.

   In this example, the path to software composition `ThrottlePositionControlComposition` is `/Company/Components/ThrottlePositionControlComposition`. The path to software component `Controller` is `/Company/Components/Controller`.

   ```
   ar =

   The file "matlabroot/toolbox/coder/autosar/autosar_examples/
            ThrottlePositionControlSystem/arxml/ThrottlePositionControlComposition.arxml" contains:
     1 Composition-Software-Component-Type:
       '/Company/Components/ThrottlePositionControlComposition'

     2 Application-Software-Component-Type:
       '/Company/Components/Controller'
       '/Company/Components/ThrottlePositionMonitor'

     3 Sensor-Actuator-Software-Component-Type:
       '/Company/Components/AccelerationPedalPositionSensor'
   ```

```
    '/Company/Components/ThrottlePositionActuator'
    '/Company/Components/ThrottlePositionSensor'

>>
```

2 To import a parsed atomic software component or composition into a Simulink model, call function `createComponentAsModel`, `createCompositionAsModel`, `createCalibrationComponentObjects`, or `updateModel`. If you have not specified all dependencies for the components, you will see errors.

- `createComponentAsModel` — Create Simulink representation of AUTOSAR `arxml` atomic software component.

  For example:

  ```
  createComponentAsModel(ar,'/Company/Components/Controller',...
    'ModelPeriodicRunnablesAs','AtomicSubsystem')
  ```

  The `ModelPeriodicRunnablesAs` property controls whether the importer models AUTOSAR periodic runnables as atomic subsystems with periodic rates (the default) or function-call subsystems with periodic rates. Specify `AtomicSubsystem` unless your design requires use of function-call subsystems. For more information, see “Import AUTOSAR Software Component with Multiple Runnables” on page 3-8.

  To import Simulink data objects for AUTOSAR data into a Simulink data dictionary, you can set the `DataDictionary` property on the model creation. If the specified dictionary does not already exist, the importer creates it.

  To explicitly designate an AUTOSAR runnable as the initialization runnable in a component, use the `InitializationRunnable` property on the model creation.

  For more information, see the `createComponentAsModel` reference page and the live-script example “Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard).

- `createCompositionAsModel` — Create Simulink representation of AUTOSAR `arxml` software composition.

  For example:

  ```
  createCompositionAsModel(ar,'/Company/Components/ThrottlePositionControlComposition')
  ```

  To include existing Simulink atomic software component models in the composition model, use the `ComponentModels` property on the composition model creation.

For more information, see the `createCompositionAsModel` reference page and the live-script example “Import AUTOSAR Composition to Simulink” (Embedded Coder Support Package for AUTOSAR Standard).

- `createCalibrationComponentObjects` — Create Simulink calibration objects from AUTOSAR `arxml` calibration component.

  For example:

  ```
  [success] = createCalibrationComponentObjects(ar,'/ComponentType/MyCalibComp1')
  ```

  To import Simulink calibration objects for AUTOSAR data into a Simulink data dictionary, you can set the `DataDictionary` property on the calibration objects creation. If the specified dictionary does not already exist, the importer creates it. For more information, see the `createCalibrationComponentObjects` reference page.

- `updateModel` — Update AUTOSAR model with `arxml` changes.

  For example:

  ```
  open_system('Controller')
  ar2 = arxml.importer('ThrottlePositionControlComposition_updated.arxml');
  updateModel(ar2,'Controller');
  ```

  For more information, see the `updateModel` reference page, “Import AUTOSAR Software Component Updates” on page 3-11, and the live-script example “Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard).

After you import your software component or composition into Simulink, you can develop the behavior and configuration of the component or composition model. To refine the component configuration, see “AUTOSAR Component Configuration” on page 4-3.

For parameters from a calibration component, after importing the parameters into the MATLAB workspace or a Simulink data dictionary, assign the calibration parameters to block parameters in your model.

To configure AUTOSAR code generation options and XML export options, see “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11.

To help support the round trip of AUTOSAR elements between an AUTOSAR authoring tool (AAT) and the Simulink model-based design environment, `arxml` import preserves imported AUTOSAR XML file structure, elements, and element UUIDs for `arxml` export. For more information, see “Round-Trip Preservation of AUTOSAR XML File Structure and Element Information” on page 3-18.

See Also

`arxml.importer`

Related Examples

- “Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)
- “Import AUTOSAR Composition to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)
- “Import AUTOSAR Software Component Updates” on page 3-11
- “Round-Trip Preservation of AUTOSAR XML File Structure and Element Information” on page 3-18
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “AUTOSAR arxml Importer” on page 3-2
- “Workflows for AUTOSAR” on page 1-4

Import AUTOSAR Software Component with Multiple Runnables

The AUTOSAR `arxml` importer functions `createComponentAsModel` and `createCompositionAsModel` can import AUTOSAR software components with multiple runnable entities into a new Simulink model. Use the `ModelPeriodicRunnablesAs` property on the model creation to specify whether the importer models AUTOSAR periodic runnables as atomic subsystems with periodic rates (the default) or function-call subsystems with periodic rates.

If you set `ModelPeriodicRunnablesAs` to the default value, `AtomicSubsystem`, the importer creates rate-based models. If the `arxml` code contains periodic runnables, the importer adds rate-based model content, including atomic subsystems and data transfer lines with rate transitions, and maps them to corresponding periodic runnables and IRVs imported from the AUTOSAR software component.

If you set `ModelPeriodicRunnablesAs` to `FunctionCallSubsystem`, the importer creates function-call-based models. The importer adds function-call subsystem or function blocks and signal lines and maps them to corresponding runnables and IRVs imported from the AUTOSAR software component.

Set `ModelPeriodicRunnablesAs` to `AtomicSubsystem` unless your design requires use of function-call subsystems. The following call directs the importer to import a multi-runnable AUTOSAR software component and map it into a new rate-based model:

```
addpath(fullfile(autosarroot,'autosar_examples','ThrottlePositionControlSystem','arxml'))
ar = arxml.importer('ThrottlePositionControlComposition.arxml')
createComponentAsModel(ar,'/Company/Components/Controller',...
  'ModelPeriodicRunnablesAs','AtomicSubsystem')
```

For more information, see “Model AUTOSAR Software Components” on page 2-3.

See Also

`createComponentAsModel` | `createCompositionAsModel`

Related Examples

- “Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)

- “Import AUTOSAR Composition to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)

Import AUTOSAR Software Composition with Atomic Software Components

You can import an AUTOSAR software composition from `arxml` files into a new Simulink model. AUTOSAR compositions aggregate AUTOSAR software components and potentially other compositions. Use the `arxml.importer` function `createCompositionAsModel` to import a composition.

The following types of AUTOSAR atomic software components, if found in the `arxml` description of a composition, are imported and represented as component models.

- Application component
- Sensor-actuator component
- Complex device driver component
- ECU abstraction component
- Service proxy component

Application and sensor-actuator components are frequently imported, created, and modeled in Simulink. For complex device driver, ECU abstraction, or service proxy components that you import from compositions, you can model only the application side of their behavior in Simulink. For example, a complex device driver component can access Runtime Environment (RTE) device driver interfaces as an application-level component. But you cannot model the corresponding Basic Software (BSW) device drivers in Simulink.

See Also

`createCompositionAsModel`

Related Examples

- “Import AUTOSAR Composition to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)

Import AUTOSAR Software Component Updates

After you create a Simulink model that represents an AUTOSAR software component, the `arxml` description of the component can change independently. Using `arxml.importer` function `updateModel`, you can import the modified `arxml` description and update the model to reflect the changes. The update generates an HTML report that details automatic updates applied to the model, and additional manual changes that you must perform.

In this section...

Update Model with AUTOSAR Software Component Changes

To update a model with AUTOSAR software component changes described in `arxml` files:

1. Open a model for which you previously imported or exported `arxml` files. This example uses the `Controller` model created by live script “Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard).

```
% Create and open AUTOSAR controller component model
addpath(fullfile(autosarroot,'autosar_examples','ThrottlePositionControlSystem','arxml'))
ar = arxml.importer('ThrottlePositionControlComposition.arxml');
createComponentAsModel(ar,'/Company/Components/Controller',...
  'ModelPeriodicRunnablesAs','AtomicSubsystem');
```

2. Issue MATLAB commands to import `arxml` descriptions into the model and update the model with changes.

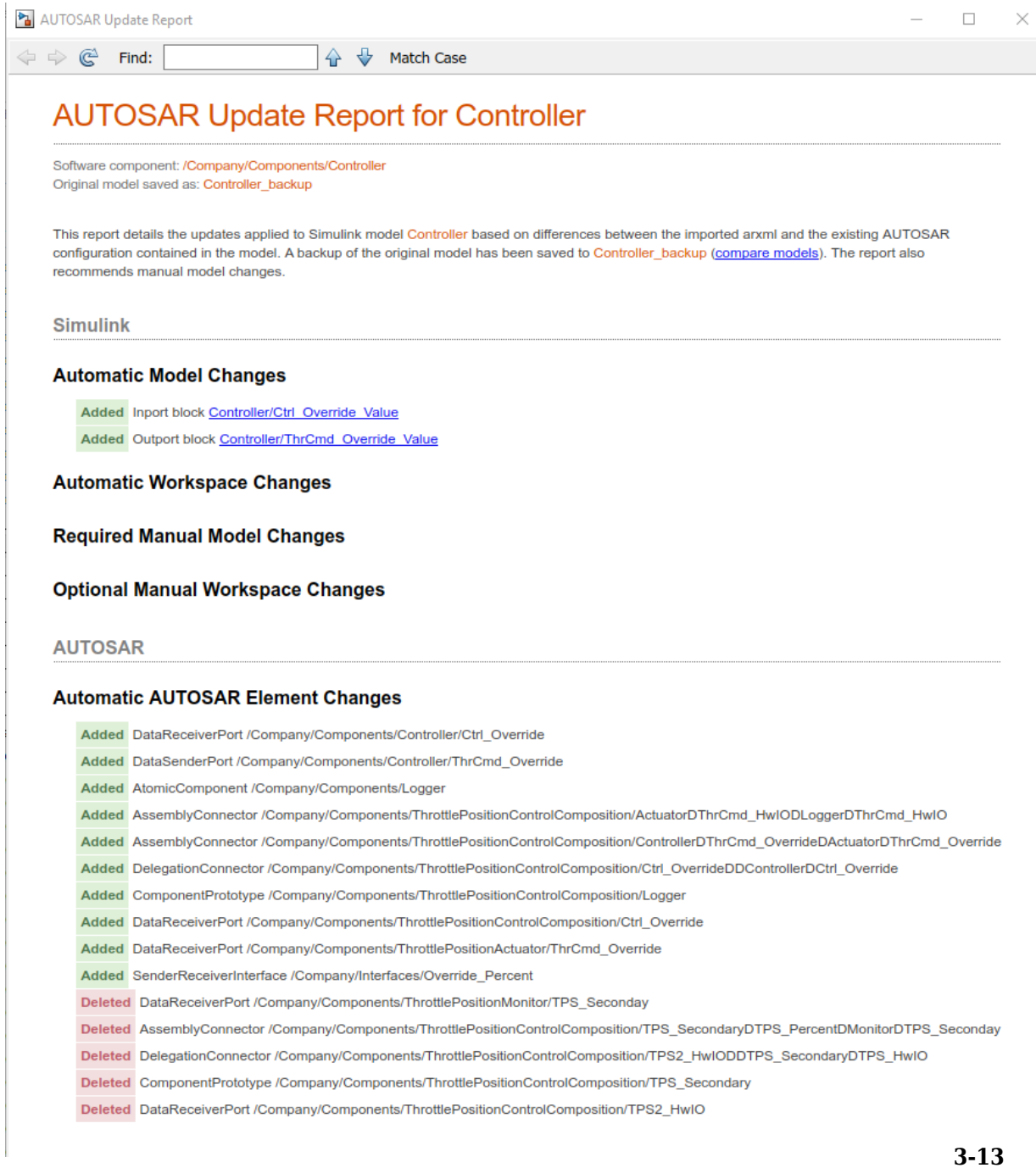
   Note The imported `arxml` descriptions must contain the AUTOSAR software component mapped by the model.

   For example, the following commands update model `Controller` with changes from `arxml` file `ThrottlePositionControlComposition_updated.arxml`.

```
% Update AUTOSAR controller component model
ar2 = arxml.importer('ThrottlePositionControlComposition_updated.arxml');
updateModel(ar2,'Controller');
```

```
### Updating model Controller
### Saving original model as Controller_backup.slx
### Creating HTML report Controller_update_report.html
```

The AUTOSAR Update Report opens.


AUTOSAR Update Report

Find: Match Case

AUTOSAR Update Report for Controller

Software component: /Company/Components/Controller
Original model saved as: Controller_backup

This report details the updates applied to Simulink model Controller based on differences between the imported arxml and the existing AUTOSAR configuration contained in the model. A backup of the original model has been saved to Controller_backup (compare models). The report also recommends manual model changes.

Simulink

Automatic Model Changes

Added Inport block Controller/Ctrl_Override_Value
Added Outport block Controller/ThrCmd_Override_Value

Automatic Workspace Changes

Required Manual Model Changes

Optional Manual Workspace Changes

AUTOSAR

Automatic AUTOSAR Element Changes

Added DataReceiverPort /Company/Components/Controller/Ctrl_Override
Added DataSenderPort /Company/Components/Controller/ThrCmd_Override
Added AtomicComponent /Company/Components/Logger
Added AssemblyConnector /Company/Components/ThrottlePositionControlComposition/ActuatorDThrCmd_HwIODLoggerDThrCmd_HwIO
Added AssemblyConnector /Company/Components/ThrottlePositionControlComposition/ControllerDThrCmd_OverrideDActuatorDThrCmd_Override
Added DelegationConnector /Company/Components/ThrottlePositionControlComposition/Ctrl_OverrideDDControllerDCtrl_Override
Added ComponentPrototype /Company/Components/ThrottlePositionControlComposition/Logger
Added DataReceiverPort /Company/Components/ThrottlePositionControlComposition/Ctrl_Override
Added DataReceiverPort /Company/Components/ThrottlePositionActuator/ThrCmd_Override
Added SenderReceiverInterface /Company/Interfaces/Override_Percent
Deleted DataReceiverPort /Company/Components/ThrottlePositionMonitor/TPS_Seconday
Deleted AssemblyConnector /Company/Components/ThrottlePositionControlComposition/TPS_SecondaryDTPS_PercentDMonitorDTPS_Seconday
Deleted DelegationConnector /Company/Components/ThrottlePositionControlComposition/TPS2_HwIODDTPS_SecondaryDTPS_HwIO
Deleted ComponentPrototype /Company/Components/ThrottlePositionControlComposition/TPS_Secondary
Deleted DataReceiverPort /Company/Components/ThrottlePositionControlComposition/TPS2_HwIO

3. Examine the report.
   a. Verify that the `arxml` importer has updated the model content and configuration based on the `arxml` changes.
   b. Optionally, click **compare models** to compare the original model with the updated model. Tabular and graphical views of the differences open. You can click a changed element in the tabular view to navigate to a graphical view of the change.
   c. Optionally, use the **Find** field to search for a term. You can quickly navigate to specific elements or other strings of interest.
4. If the report lists required manual model changes, such as deleting a Simulink block, perform the required changes.

   If you make a required change to the model, further configuration could be required to pass validation. To see if more manual model changes are required, repeat the update procedure, rerunning the `updateModel` function with the same `arxml` files.

For live-script update examples, see “Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard) and “Import AUTOSAR Composition to Simulink” (Embedded Coder Support Package for AUTOSAR Standard).

AUTOSAR Update Report Section Examples

An `arxml` update operation generates an AUTOSAR Update Report in HTML format. The report displays change information in sections:

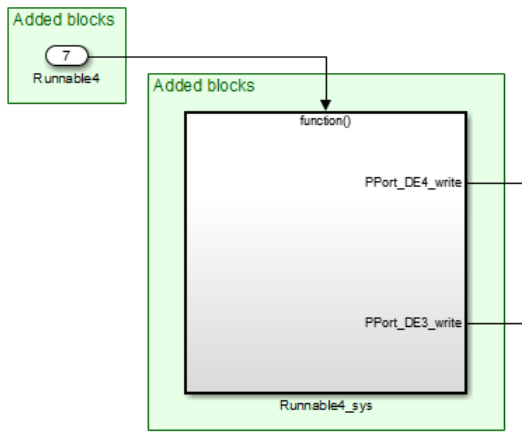
Automatic Model Changes

The AUTOSAR Update Report section **Automatic Model Changes** lists Simulink block additions, block property updates, and model parameter updates made by the importer. For example:

Automatic Model Changes

Updated	OutDataTypeStr of Outport mySWC/Runnable3/TicToc_irv from Inherit: auto to int8
Updated	PortDimensions of Outport mySWC/Runnable3/TicToc_irv from -1 to 1
Updated	SignalType of Outport mySWC/Runnable3/TicToc_irv from auto to real
Updated	SamplingMode of Outport mySWC/Runnable3/TicToc_irv from auto to Sample based
Added	SubSystem block mySWC/Runnable4_sys
Added	TriggerPort block mySWC/Runnable4_sys/function
Added	Inport block mySWC/Runnable4
Added	Outport block mySWC/Runnable4_sys/PPort_DE4_write
Added	Outport block mySWC/Runnable4_sys/PPort_DE3_write

In the updated model, green highlighting identifies added blocks.



Automatic Workspace Changes

The AUTOSAR Update Report section **Automatic Workspace Changes** lists Simulink data object additions and property updates made by the importer. For example:

Automatic Workspace Changes

Added	AUTOSAR.Parameter INC2
Updated	Value of AUTOSAR.Parameter INC from 1 to 2
Updated	DataType of AUTOSAR.Parameter INC from UInt8 to uint8

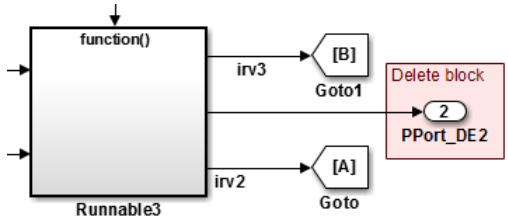
Required Manual Model Changes

The AUTOSAR Update Report section **Required Manual Model Changes** lists model changes, such as block deletions, that are required. For example:

Required Manual Model Changes

Delete Port mySWC/PPort_DE2 from mySWC

In the updated model, red highlighting identifies the block to delete.



Automatic AUTOSAR Element Changes

The AUTOSAR Update Report section **Automatic AUTOSAR Element Changes** lists AUTOSAR element additions and property updates made by the importer. For example:

Automatic AUTOSAR Element Changes

Added Runnable /pkg/swc/ASWC/IB/Runnable4
Added TimingEvent /pkg/swc/ASWC/IB/Event
Added IrvData /pkg/swc/ASWC/IB/IRV5
Added IrvData /pkg/swc/ASWC/IB/IRV6
Added ConstantSpecification /pkg/dt/Ground/INC2
Added DataConstr /pkg/dt/DataConstrs/UInt8
Added SwBaseType /pkg/dt/SwBaseTypes/uint8
Updated SwCalibrationAccess of ParameterData /pkg/swc/ASWC/IB/INC from ReadOnly to ReadWrite
Updated Value of LiteralReal /pkg/dt/Ground/INC/INC from 1.0 to 2.0
Added DataConstr reference /pkg/dt/DataConstrs/UInt8 to /pkg/dt/UInt8
Added SwBaseType reference /pkg/dt/SwBaseTypes/uint8 to /pkg/dt/UInt8
Updated InternalBehaviorQualifiedName of AUTOSAR XmlOptions from /pkg/swc/ASWC_ib to /pkg/swc/IB
Updated InternalDataConstraintExport of AUTOSAR XmlOptions from false to true

See Also

`updateModel`

Related Examples

- “Import AUTOSAR Software Component” on page 3-4
- “Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)
- “Import AUTOSAR Composition to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Workflows for AUTOSAR” on page 1-4

Round-Trip Preservation of AUTOSAR XML File Structure and Element Information

To support the round trip of AUTOSAR elements between an AUTOSAR authoring tool (AAT) and Simulink, `arxml` import preserves imported AUTOSAR XML file structure and content for `arxml` export. When you import `arxml` files for an AUTOSAR component into Simulink, the importer preserves:

- AUTOSAR XML file structure. You can compare the `arxml` files that you import with the corresponding `arxml` files that you export.
- AUTOSAR element information, including properties, references, and packages. The importer preserves relationships between elements.
- AUTOSAR UUIDs for identifiable elements. If an imported element does not have a UUID, none is created.

After import, you can view and configure AUTOSAR software component elements and properties in the AUTOSAR Dictionary. Use the AUTOSAR Dictionary to configure AUTOSAR elements. The properties that you modify are reflected in exported `arxml` descriptions and potentially in generated AUTOSAR-compliant C code. For more information, see “Configure AUTOSAR Elements and Properties” on page 4-7.

AUTOSAR elements that you create in Simulink export to one or more *`modelname`*`*.arxml` files, which are separate from the imported XML files. You control the file packaging of new elements by configuring XML options in the AUTOSAR Dictionary. For example, you can set XML option **Exported XML file packaging** to `Single file` or `Modular`. For more information, see “Configure AUTOSAR XML Options” on page 4-63.

When you export `arxml` files from a Simulink model, the code generator preserves the imported XML file structure, element information, and UUIDs, while applying your modifications. The exported files include:

- Updated versions of the same `arxml` files that you imported.
- One or more *`modelname`*`*.arxml` files, based on whether you set **Exported XML file packaging** to `Single file` or `Modular`. The *`modelname`*`*.arxml` files include:
  - Implementation descriptions.
  - If you added AUTOSAR interface or data-related elements in Simulink, interface and data descriptions.

Suppose that, in a working folder, you create a Simulink model named `Controller.slx` from example `arxml` file *`matlabroot`*`/help/toolbox/ecoder/examples/autosar/ThrottlePositionController.arxml`.

```
% Create Controller model from AUTOSAR component
addpath(fullfile(matlabroot,'help','toolbox','ecoder','examples','autosar'));
ar = arxml.importer('ThrottlePositionController.arxml');
createComponentAsModel(ar,'/Company/Components/Controller','ModelPeriodicRunnablesAs','AtomicSubsystem');
```

In the created model, add an AUTOSAR software address method (SwAddrMethod) named CODE and reference it from an AUTOSAR runnable function.

```
% In AUTOSAR model, add SwAddrMethod CODE to SwAddrMethods package
arProps = autosar.api.getAUTOSARProperties('Controller');
addPackageableElement(arProps,'SwAddrMethod',...
    '/AUTOSAR_Platform/SwAddrMethods','CODE','SectionType','Code')
% Map step runnable function to SwAddrMethod CODE
slMap = autosar.api.getSimulinkMapping('Controller');
mapFunction(slMap,'StepFunction','Runnable_Step','SwAddrMethod','CODE')
% Display SwAddrMethod CODE path and step function mapping information
swAddrMethodPath = find(arProps,[],'SwAddrMethod','PathType','FullyQualified',...
    'SectionType','Code')
[arRunnableName,arRunnableSwAddrMethod] = getFunction(slMap,'StepFunction')

swAddrMethodPath =
    {'/AUTOSAR_Platform/SwAddrMethods/CODE'}

arRunnableName =
    'Runnable_Step'

arRunnableSwAddrMethod =
    'CODE'
```

You can view the modifications in the AUTOSAR Dictionary, **SwAddrMethods** view, and Code Mapping Editor, **Entry-Point Functions** tab.

Build the model, for example, by using the command `rtwbuild('Controller')`. If the model has **Exported XML file packaging** set to `Modular`, the build exports three `arxml` files:

- `ThrottlePositionController.arxml` — Updated version of the `arxml` file from which the model was created. To track changes, you can compare earlier versions of an `arxml` file with the most recent exported version.
- `Controller_implementation.arxml` — Component implementation information (always generated).
- `Controller_datatype.arxml` — Data-related information that reflects your SwAddrMethod changes to the component model. In the file, AUTOSAR package `/AUTOSAR_Platform/SwAddrMethods` contains SwAddrMethod CODE.

See Also

Related Examples

- “Configure AUTOSAR XML Options” on page 4-63

More About

- “Configure AUTOSAR Elements and Properties” on page 4-7

Create AUTOSAR Software Component in Simulink

To create an initial Simulink representation of an AUTOSAR software component, you either import an AUTOSAR software component description from `arxml` files into a new Simulink model or create an AUTOSAR software component for an existing Simulink model. To create an AUTOSAR software component for an existing model, two methods are available:

- Use Embedded Coder Quick Start and select AUTOSAR code generation (recommended).
- Use AUTOSAR Component Builder and choose automatic or interactive component creation.

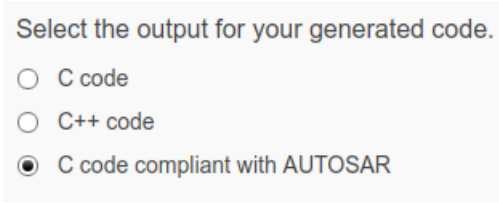
Each method creates a mapped AUTOSAR component for your model and opens the model in the AUTOSAR code perspective.

In this section...
“Create Mapped AUTOSAR Component with Quick Start” on page 3-21
“Create Mapped AUTOSAR Component with Component Builder” on page 3-22

Create Mapped AUTOSAR Component with Quick Start

To create a mapped AUTOSAR component using Embedded Coder Quick Start:

1. Open a Simulink model that is not configured for AUTOSAR.
2. In the model window, click **Code > C/C++ Code > Embedded Coder Quick Start**.
3. To configure the model for code generation, work through the quick-start procedure. In the Output window, select output option **C code compliant with AUTOSAR**.



With this option selected, the software configures AUTOSAR code generation settings and creates a mapped AUTOSAR component for the model.

4 In the last window, when you click **Finish**, your model opens in the AUTOSAR code perspective. To continue configuring the component model, see “AUTOSAR Component Configuration” on page 4-3.

Create Mapped AUTOSAR Component with Component Builder

To create a mapped AUTOSAR component using AUTOSAR Component Builder:

1 Open a Simulink model that is not configured for AUTOSAR.

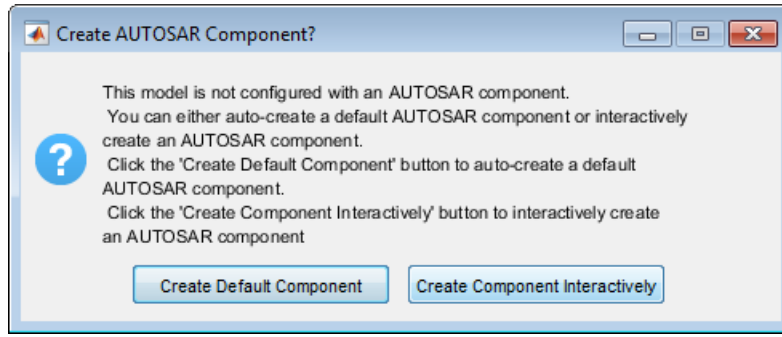
2 Open the Configuration Parameters dialog box. Click **Simulation > Model Configuration Parameters**.

3 On the **Code Generation** pane, use **System target file** to select the target for AUTOSAR code generation, `autosar.tlc`. Click **Apply**.

4 In the model window, select **Code > C/C++ Code > Configure Model in Code Perspective**. This opens the **Create AUTOSAR Component?** dialog box. The dialog box offers two paths for creating an AUTOSAR software component:

- **Create Default Component** — Automatically create an AUTOSAR component with default settings and open it in the AUTOSAR code perspective.
- **Create Component Interactively** — Interactively create an AUTOSAR component using the AUTOSAR Component Builder dialog box.

Note In most situations, **Create Default Component** is the recommended path. Default component creation automatically creates a starting AUTOSAR configuration in which existing Simulink model content is mapped to a framework of AUTOSAR packages and elements. Interactive component creation can be time consuming and more prone to error.



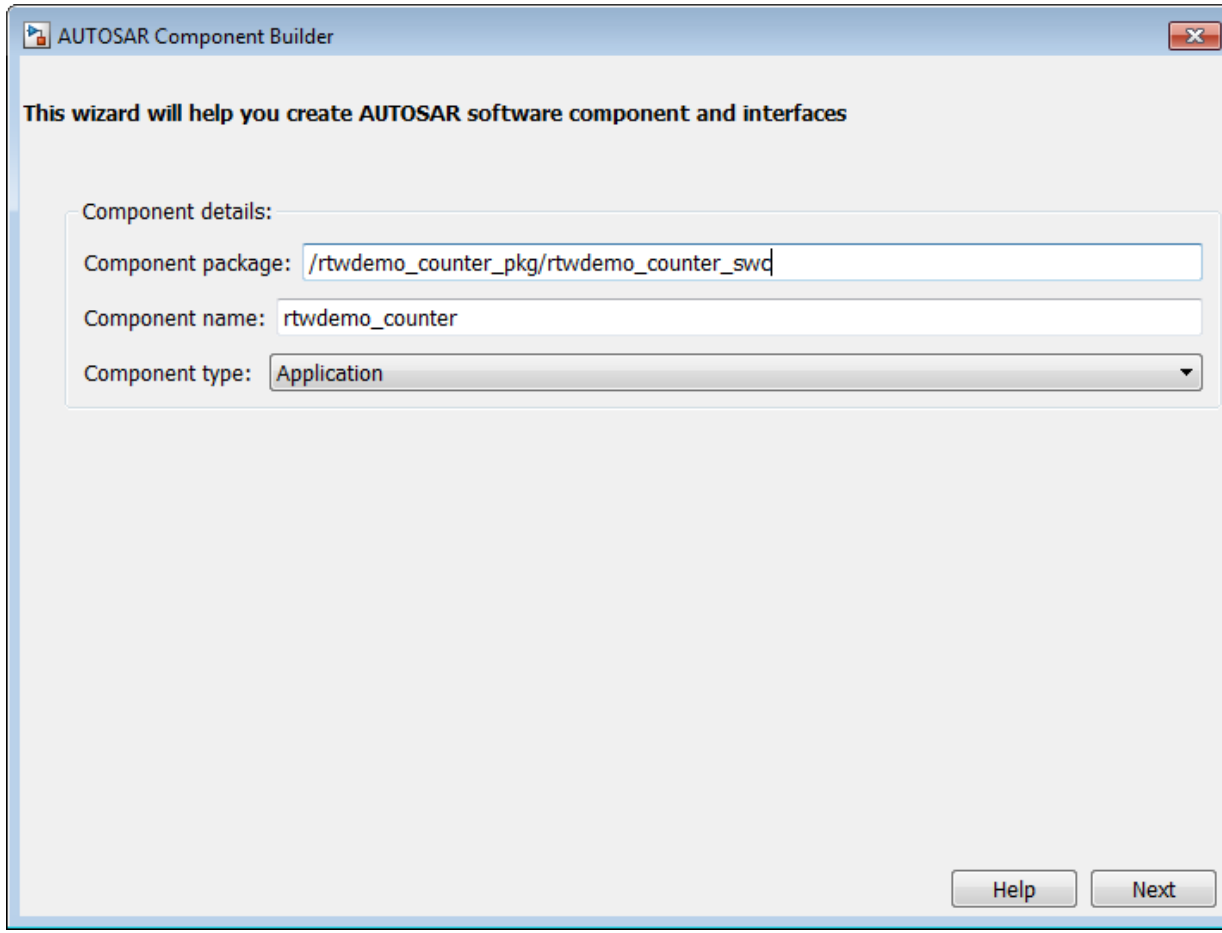
5 Choose one of the two paths. If you click **Create Default Component**, the software creates a default AUTOSAR component and opens the model in the AUTOSAR code perspective. To continue configuring the component model, see “AUTOSAR Component Configuration” on page 4-3.

If you click **Create Component Interactively**, the AUTOSAR Component Builder dialog box opens.

6 In the initial view of the AUTOSAR Component Builder dialog box, you specify the following items:

- Path for the AUTOSAR component package.
- Name for the AUTOSAR component.
- AUTOSAR component type:
  - `Application` for application software component
  - `ComplexDeviceDriver` for complex device driver software component
  - `EcuAbstraction` for ECU abstraction software component
  - `SensorAccuator` for sensor or actuator software component
  - `ServiceProxy` for service proxy software component

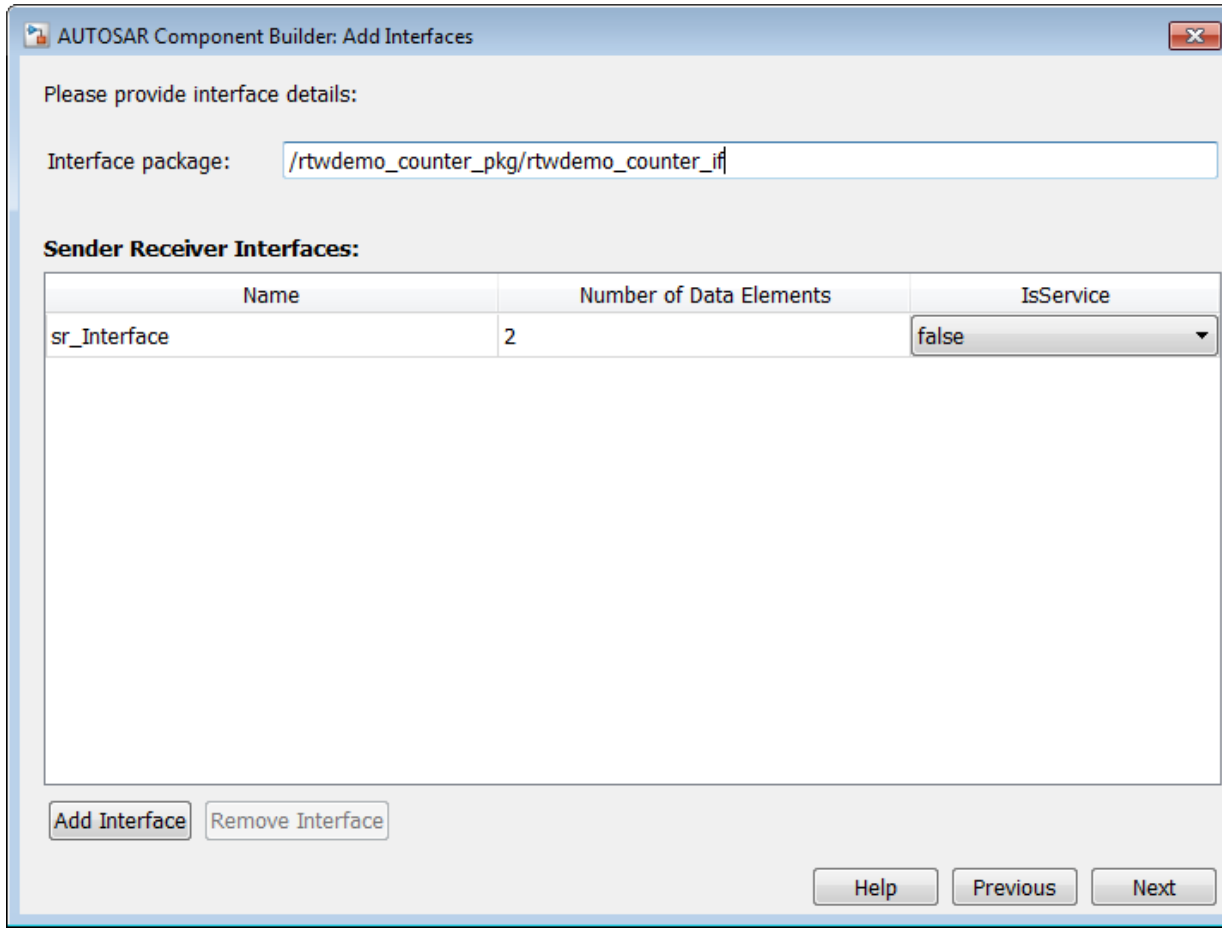
  `Application` and `SensorAccuator` are common component types.



Click **Next** to go to the sender-receiver Add Interfaces view.

7 In the sender-receiver Add Interfaces view of the AUTOSAR Component Builder dialog box, you can:

- Modify the name of the Interface package.
- Click **Add Interface** to add more interfaces to the displayed list.
- Click **Remove Interface** to remove a selected interface.
- For each listed interface, edit the name and the number of data elements it contains, and select whether the interface is a service.

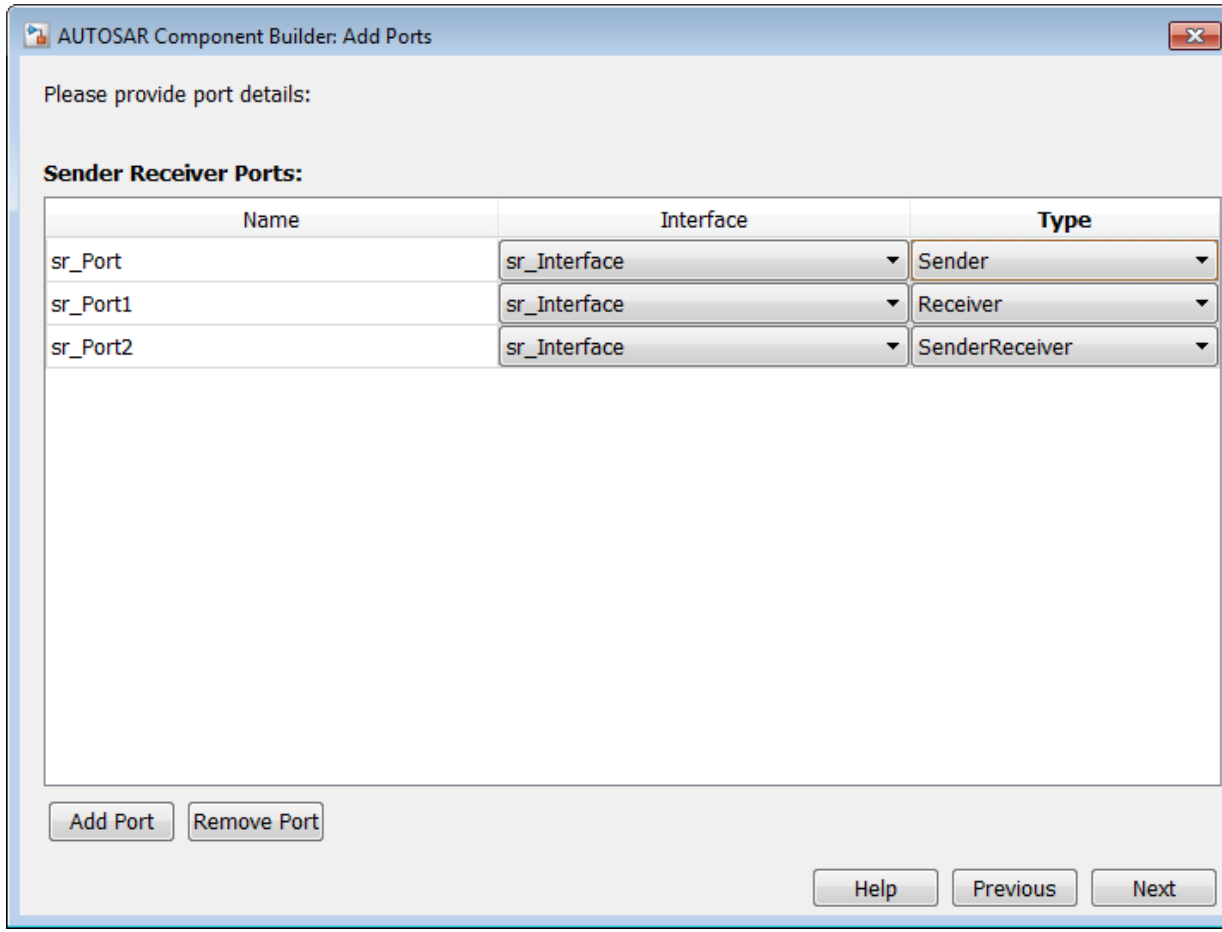


Click **Next** to go to the sender-receiver Add Ports view.

8 In the sender-receiver Add Ports view of the AUTOSAR Component Builder dialog box, you can:

- Click **Add Port** to add more sender, receiver, or sender-receiver ports to the displayed list.
- Click **Remove Port** to remove a selected port.
- For each listed port, edit the name, select the associated S-R interface, and select whether the port type is `Sender`, `Receiver`, or `SenderReceiver`. (AUTOSAR

sender-receiver ports require configuring the model for AUTOSAR schema version 4.1 or higher.)

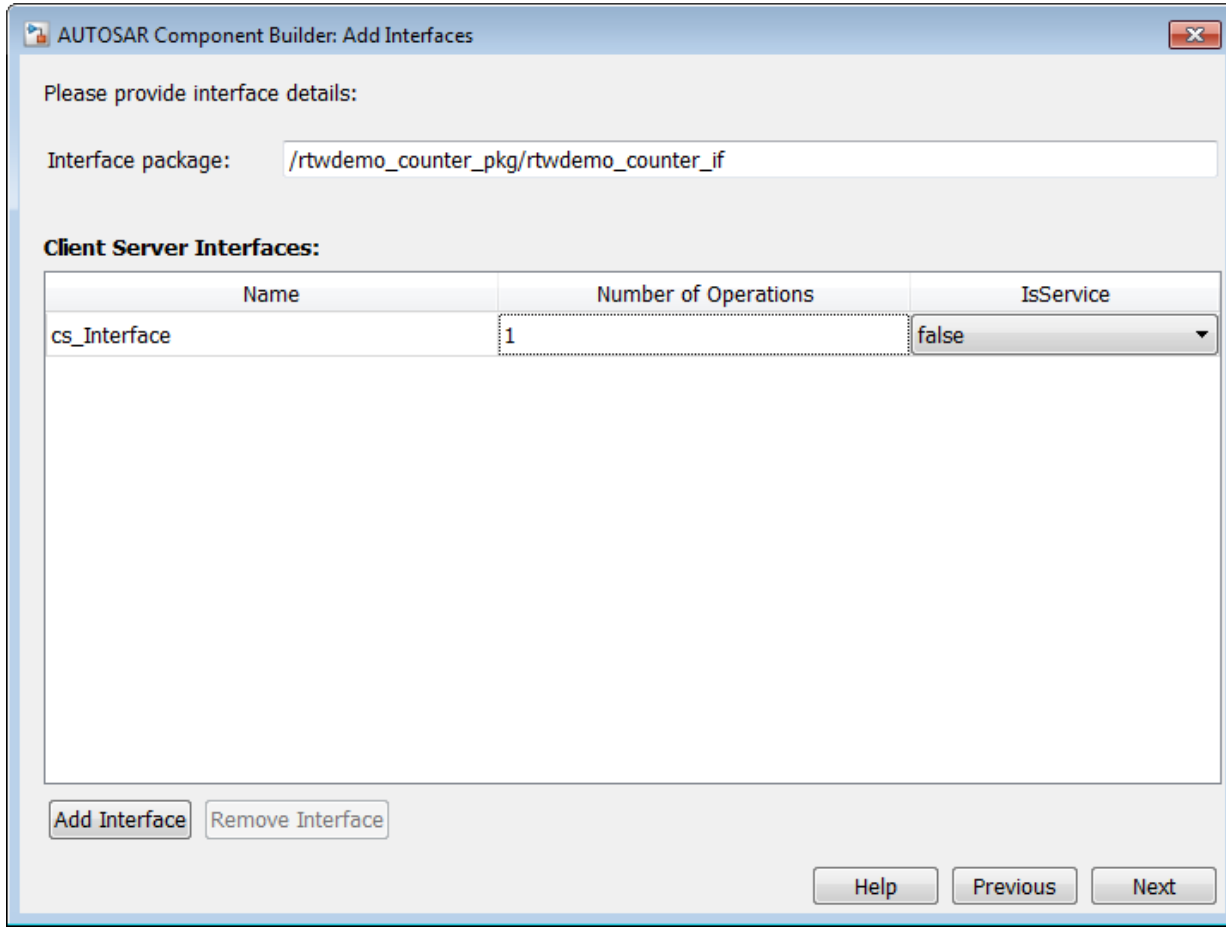


Click **Next** to go to the client-server Add Interfaces view.

9 In the client-server Add Interfaces view of the AUTOSAR Component Builder dialog box, you can:

- Modify the name of the Interface package.
- Click **Add Interface** to add more interfaces to the displayed list.

- Click **Remove Interface** to remove a selected interface.
- For each listed interface, edit the name and the number of operations it contains, and select whether the interface is a service.

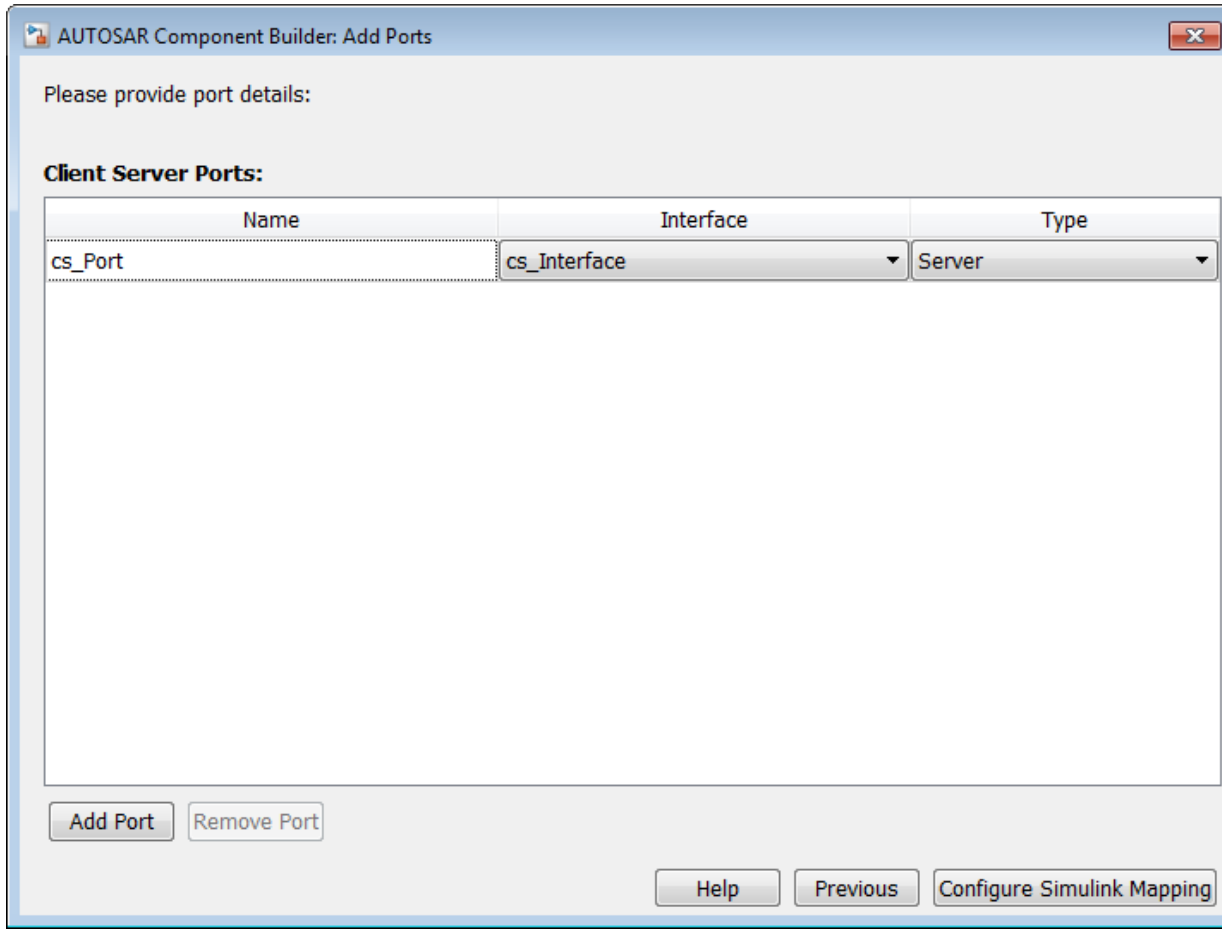


Click **Next** to go to the client-server Add Ports view.

10 In the client-server Add Ports view of the AUTOSAR Component Builder dialog box, you can:

- Click **Add Port** to add more ports to the displayed list.

- Click **Remove Port** to remove a selected port.
- For each listed port, edit the name, select the associated C-S interface, and select whether the port type is `Client` or `Server`.



Click **Configure Simulink Mapping**. Your model opens in the AUTOSAR code perspective. To continue configuring the component model, see “AUTOSAR Component Configuration” on page 4-3.

Import or Update Shared AUTOSAR Reference Element Definitions

You can import external AUTOSAR element definitions, defined in `arxml` files, for sharing among multiple AUTOSAR components and services. Benefits of sharing and reusing AUTOSAR element definitions include lower risk of definition conflicts and easier code integration. You can manage shared definitions in a centralized way.

Suppose that you have many AUTOSAR software components that use similar packageable AUTOSAR elements in similar ways. You can define sets of *reference elements* in `arxml` files, and your software components can share them on a read-only basis. Each software component can import the element definitions it requires and reference them. When you build the model, exported `arxml` code contains references to the shared elements, but not their definitions. Their definitions remain in the reference element `arxml` source files.

If definitions of reference elements change, you modify them in the `arxml` files, and then import the updated definitions into the affected software components.

To set up and share AUTOSAR reference element definitions:

1. Create one or more `arxml` files containing definitions of AUTOSAR packageable elements for components to share. Elements that are supported for reference use in Simulink include:

   - `CompuMethod`, `Unit`, and `Dimension`
   - `ImplementationDataType` and `SwBaseType`
   - `ApplicationDataType` (requires explicit request with path to AUTOSAR data type mapping set)
   - `SwSystemConst`, `SwSystemConstValueSet`, and `PredefinedVariant`
   - `SwRecordLayout`
   - `SwAddrMethod`
   - `ClientServerInterface`, `SenderReceiverInterface`, `ModeSwitchInterface`, `NvDataInterface`, `ParameterInterface`, and `TriggerInterface`.

2. For each component that must add external definitions, or update previously imported definitions with revisions, open the model and use `arxml.importer` function `updateReferences`. For example:

```
>> open_system('mySWC')
>> ar = arxml.importer(fullfile(pathToFile,'ExternalElements.arxml'));
>> updateReferences(ar,'mySWC');
### Updating references in model mySWC
### Saving original model as mySWC_backup
### Creating HTML report mySWC_update_report.html
>>
```

Optionally, using property-value pairs, you can specify subsets of elements to import. For example:

- CompuMethods in a specific AUTOSAR package.
- Definitions in per-element definition files.
- A single element definition specified using a path to a packageable element.

The importer generates a report that details the updates applied to the model.

When you import a read-only element definition, its dependencies are also imported. For example, importing a `CompuMethod` definition also imports `Unit` and `PhysicalDimension` definitions. Importing an `ImplementationDataType` also imports a `SwBaseType` definition.

3. Your model can reference the imported elements in various ways. For example, you can select imported `SwAddrMethod` values for some forms of AUTOSAR data to group the data for measurement and calibration.
4. When you generate model code, the exported `arxml` code contains references to the imported elements, but not their definitions. The definitions remain centralized in the reference element `arxml` source files.

Limitations and Tips

The following limitations apply to AUTOSAR component creation.

In this section...

Cannot Save Importer Objects in MAT-Files

If you try to save an `arxml.importer` object in a MAT-file, you lose the AUTOSAR information. If you reload the MAT-file, then the object is null (handle = –1), because of the Java® objects that compose the `arxml.importer` object.

ApplicationRecordDataType and ImplementationDataType Element Names Must Match

The element name of an imported `ApplicationRecordDataType` must match the element name of the corresponding `ImplementationDataType`. For example, if an imported `ApplicationRecordDataType` has element `PVAL_1` and the corresponding `ImplementationDataType` has element `IPVAL_1`, the software flags the mismatch and instructs you to rename the elements to match.

AUTOSAR Component Development

AUTOSAR Component Configuration

After you create an AUTOSAR software component model in Simulink, use Code Mapping Editor and AUTOSAR Dictionary to further develop the AUTOSAR component. Code Mapping Editor and AUTOSAR Dictionary provide mapping and properties views of the component model, which can be used separately and together to configure the AUTOSAR component:

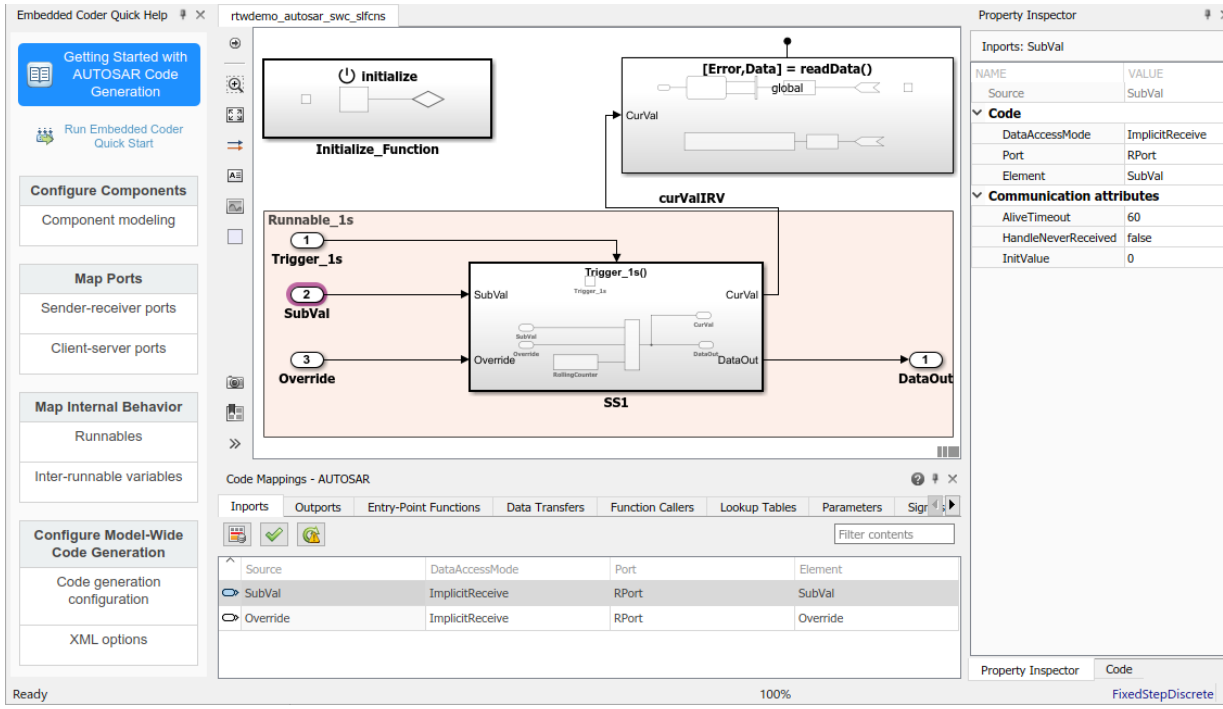
- Code Mapping Editor — Using a tabbed table format, displays model inports, outports, entry-point functions, data transfers, function callers, lookup tables, model workspace parameters, block signals, and block states. Use this view to map model elements to AUTOSAR component elements from a Simulink model perspective.
- AUTOSAR Dictionary — Using a tree format, displays a mapped AUTOSAR component and its elements, communication interfaces, computation methods, software address methods, and XML options. Use this view to configure AUTOSAR elements from an AUTOSAR component perspective.

Alternatively, you can configure AUTOSAR mapping and properties programmatically. See “Configure and Map AUTOSAR Component Programmatically” on page 4-313.

In a model for which the AUTOSAR system target file (`autosar.tlc`) has been selected, create or open a mapped view of the AUTOSAR model. In the model window, do one of the following:

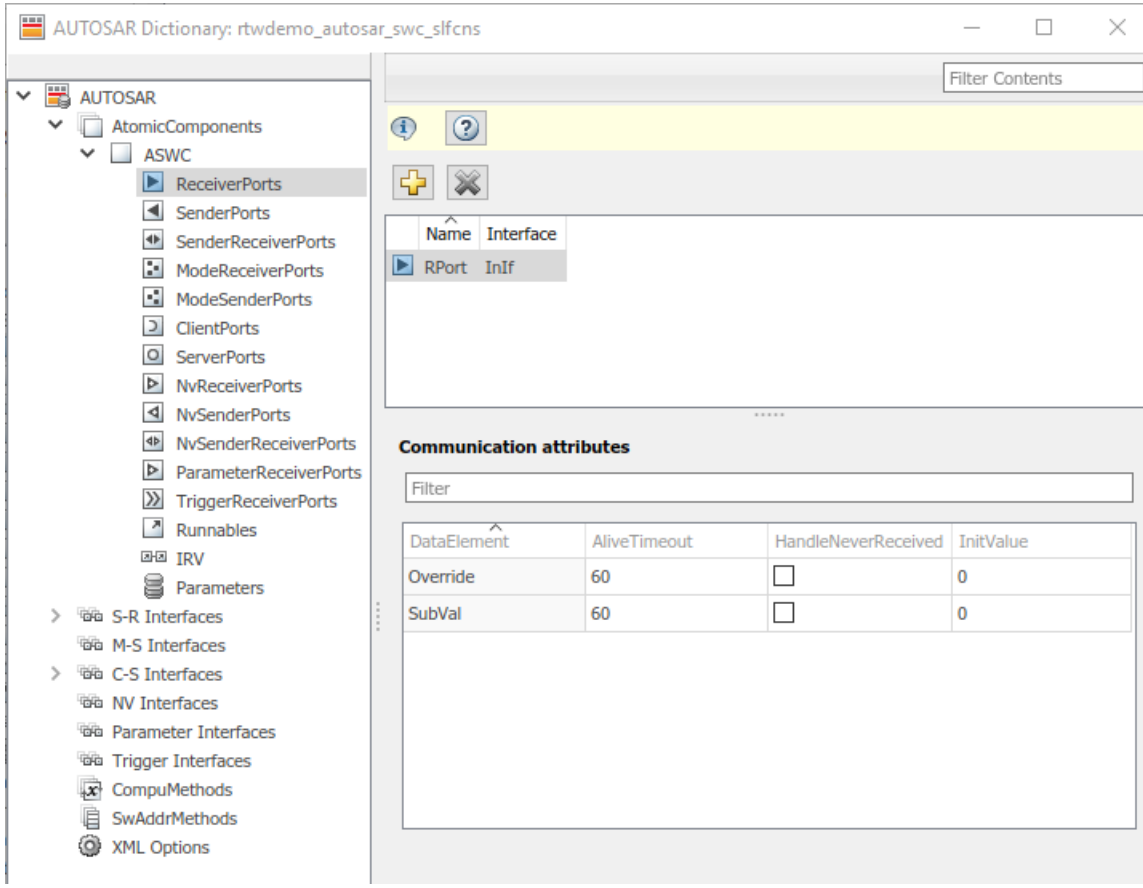
- Select **Code > C/C++ Code > Configure Model in Code Perspective**
- Click the perspective control in the lower-right corner and select **Code**.

The model opens in the AUTOSAR code perspective. This perspective displays a help panel, a Property Inspector dialog box, and, directly under the model, Code Mapping Editor.



Code Mapping Editor provides in-canvas access to AUTOSAR mapping information, with batch editing, element filtering, easy navigation to model elements and AUTOSAR properties, and model element traceability.

To open an AUTOSAR properties view of the component model, either click the **AUTOSAR Dictionary** button  in Code Mapping Editor or select **Code > C/C++ Code > Configure AUTOSAR Dictionary**. AUTOSAR Dictionary opens.



As you progressively configure the model representation of the AUTOSAR component, you can:

- Freely switch between the Simulink and AUTOSAR perspectives, by selecting **Code > C/C++ Code** menu entries or by clicking buttons.
- Use the **Filter contents** field (where available) to selectively display some elements, while omitting others, in the current view.
- In Code Mapping Editor, click the **Update** button to update the Simulink to AUTOSAR mapping of the model with changes to Simulink data transfers, entry-point functions, and function callers.

- In Code Mapping Editor, click the **Validate** button  to validate the AUTOSAR component configuration.

Note Configuring an AUTOSAR component requires an Embedded Coder license. If Embedded Coder is not licensed, Code Mapping Editor and AUTOSAR Dictionary dialog boxes run in read-only mode.

See Also

Related Examples

- “Map AUTOSAR Elements for Code Generation” on page 4-68
- “Configure AUTOSAR Elements and Properties” on page 4-7
- “Configure and Map AUTOSAR Component Programmatically” on page 4-313

Configure AUTOSAR Elements and Properties

In Simulink, you can use AUTOSAR Dictionary and Code Mapping Editor separately or together to graphically configure an AUTOSAR software component and map Simulink model elements to AUTOSAR component elements. For more information, see “AUTOSAR Component Configuration” on page 4-3.

Use AUTOSAR Dictionary to configure AUTOSAR elements from an AUTOSAR perspective. Using a tree format, AUTOSAR Dictionary displays a mapped AUTOSAR component and its elements, communication interfaces, computation methods, software address methods, and XML options. Use the tree to select AUTOSAR elements and configure their properties. The properties that you modify are reflected in exported `arxml` descriptions and potentially in generated AUTOSAR-compliant C code.

In this section...

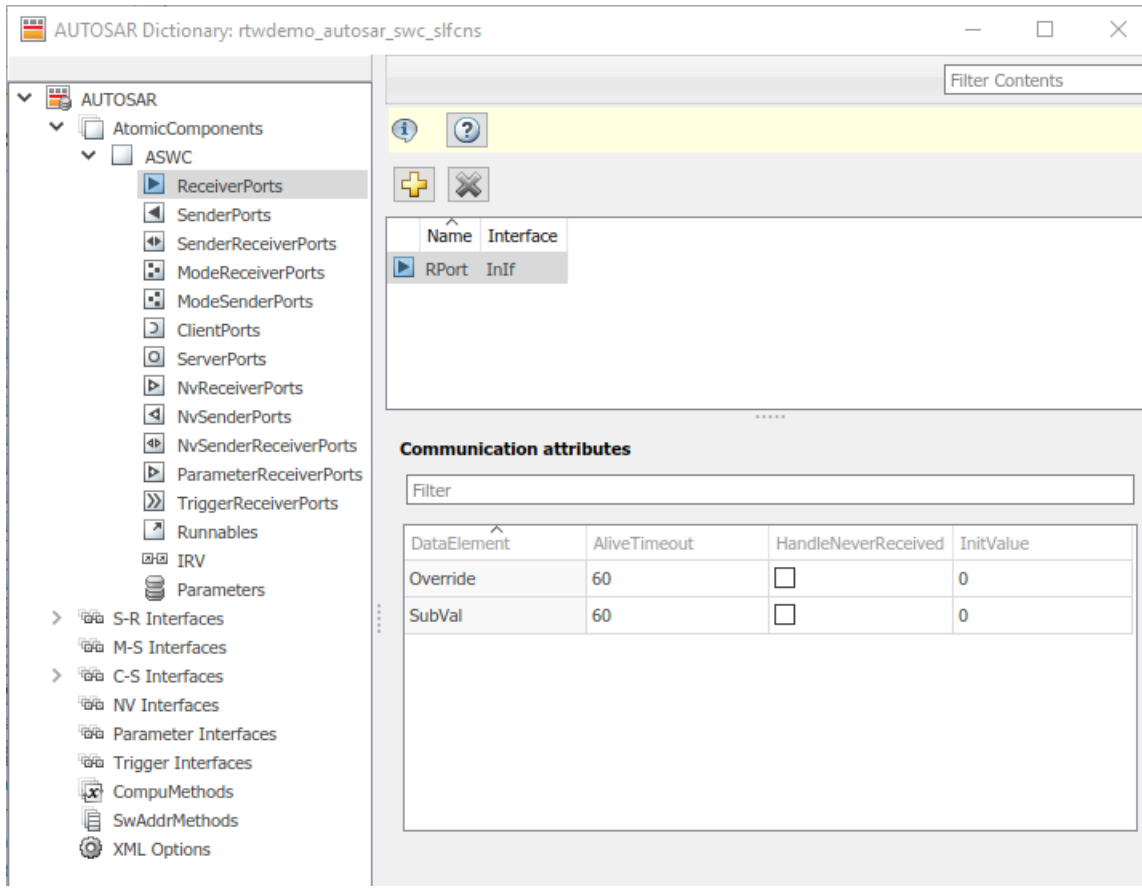
AUTOSAR Elements Configuration Workflow

To configure AUTOSAR component elements in Simulink:

1. Open a model for which the AUTOSAR system target file (`autosar.tlc`) has been selected.
2. If the model does not yet have a mapped AUTOSAR software component, create one. Select **Code > C/C++ Code > Embedded Coder Quick Start**. Work through the quick-start procedure. When you click **Finish**, the model opens in the AUTOSAR code

perspective. For more information, see “Create AUTOSAR Software Component in Simulink” on page 3-21.

3 Open AUTOSAR Dictionary. Either click the **AUTOSAR Dictionary** button  in Code Mapping Editor or select **Code > C/C++ Code > Configure AUTOSAR Dictionary**.

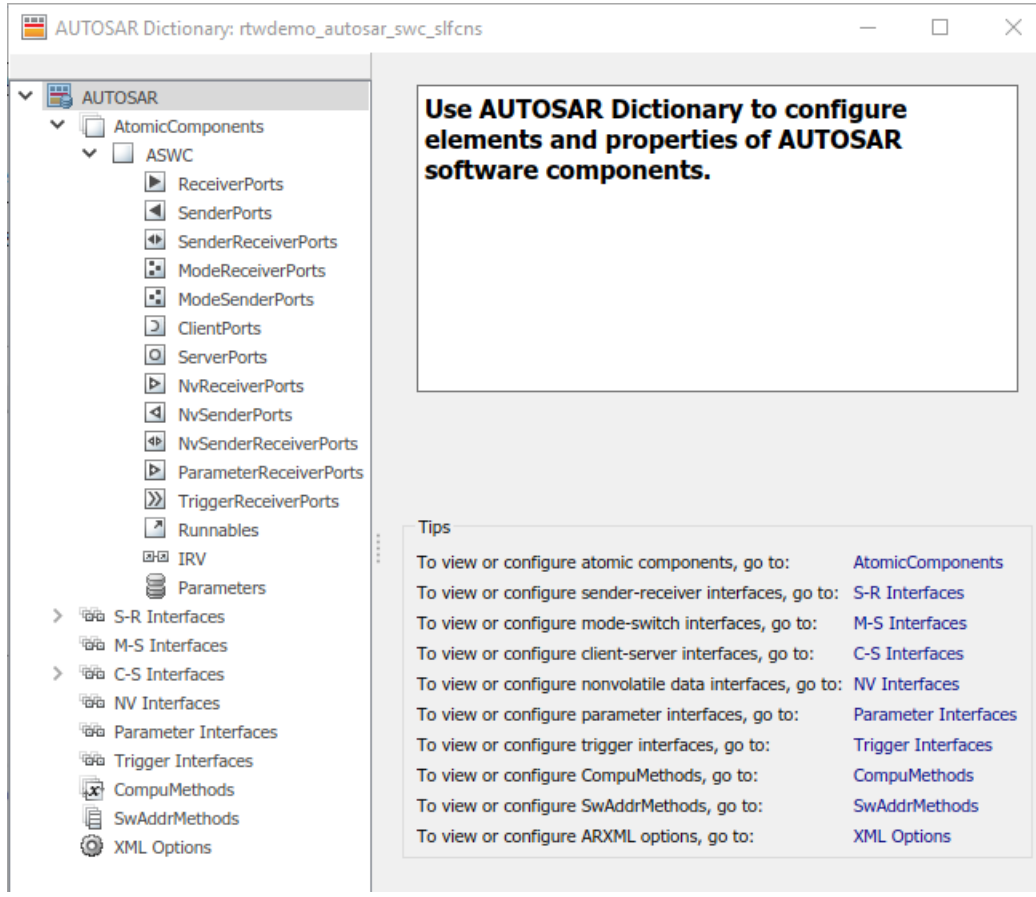


4 Navigate the AUTOSAR Dictionary tree to configure AUTOSAR elements and properties. You can add elements, remove elements, or select elements to view and modify their properties. Use the **Filter Contents** field (where available) to selectively display some elements, while omitting others, in the current view.

5. After configuring AUTOSAR elements and properties, open Code Mapping Editor. Use Code Mapping tabs to map Simulink elements to new or modified AUTOSAR elements.
6. Click the **Validate** button  to validate the AUTOSAR component configuration. If errors are reported, address them and then retry validation.

Configure AUTOSAR Atomic Software Components

AUTOSAR atomic software components contain AUTOSAR elements defined in the AUTOSAR standard, such as ports, runnables, inter-runnable variables (IRVs), and parameters. In AUTOSAR Dictionary, component elements appear in a tree format under the component that owns them. To access component elements and their properties, you expand the component name.

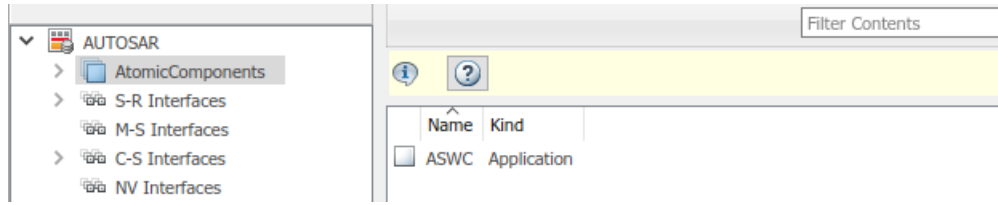


To configure AUTOSAR atomic software component elements and properties:

1. Open a model for which a mapped AUTOSAR software component has been created. For more information, see “AUTOSAR Component Creation”.
2. Open AUTOSAR Dictionary. Either click the **AUTOSAR Dictionary** button in Code Mapping Editor or select **Code > C/C++ Code > Configure AUTOSAR Dictionary**.
3. In the left-hand pane of AUTOSAR Dictionary, under **AUTOSAR**, select **AtomicComponents**.

The atomic components view in AUTOSAR Dictionary displays atomic components and their types. You can:

- Select an AUTOSAR component and select a menu value for its kind (that is, its atomic software component type):
  - `Application` for application component
  - `ComplexDeviceDriver` for complex device driver component
  - `EcuAbstraction` for ECU abstraction component
  - `SensorAccuator` for sensor or actuator component
  - `ServiceProxy` for service proxy component
- Rename an AUTOSAR component by clicking its name and then editing the name text.



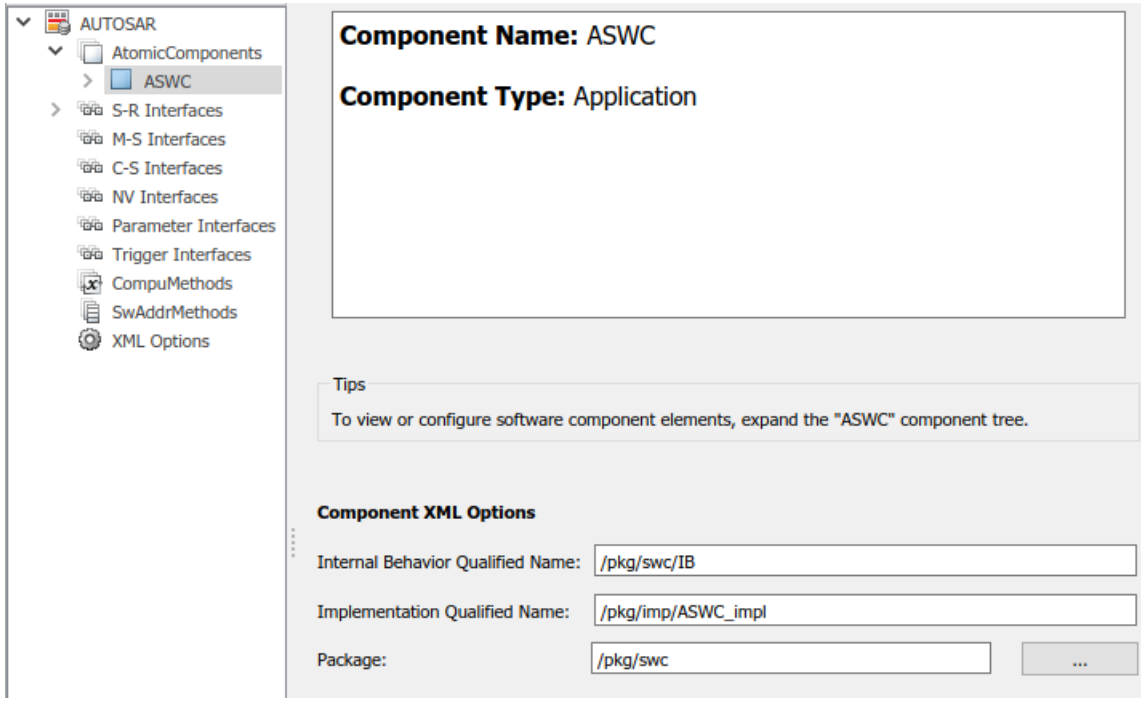
4 In the left-hand pane of AUTOSAR Dictionary, expand **AtomicComponents** and select an AUTOSAR component.

The component view in AUTOSAR Dictionary displays the name and type of the selected component, and component options for `arxml` file export. You can:

- Modify the internal behavior qualified name to be generated for the component. Specify an AUTOSAR package path and a name.
- Modify the implementation qualified name to be generated for the component. Specify an AUTOSAR package path and a name.
- Modify the AUTOSAR package to be generated for the component. To specify the AUTOSAR package path, you can do either of the following:
  - Enter a package path in the **Package** parameter field.
  - Click the button to the right of the **Package** field to open the AUTOSAR Package Browser. Use the browser to navigate to an existing package or create a new package. When you select a package in the browser and click **Apply**, the component **Package** parameter value is updated with your selection. For more

information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.

For more information about component XML options, see “Configure AUTOSAR Packages” on page 4-88.



Configure AUTOSAR Ports

An AUTOSAR software component contains communication ports defined in the AUTOSAR standard, including sender-receiver (S-R), client-server (C-S), mode-switch (M-S), nonvolatile (NV) data, trigger, and parameter interfaces. In AUTOSAR Dictionary, communication ports appear in a tree format under the component that owns them and under a port type name. To access port elements and their properties, you expand the component name and expand the port type name.

- “Sender-Receiver Ports” on page 4-13

Sender-Receiver Ports

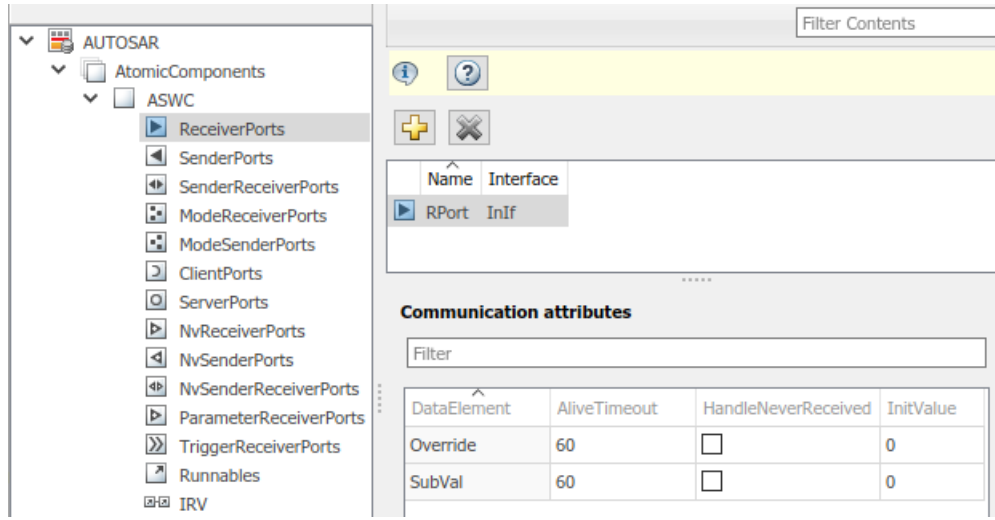
The AUTOSAR Dictionary views of sender and receiver ports support modeling AUTOSAR sender-receiver (S-R) communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR S-R ports, S-R interfaces, and S-R data elements in your model. For more information, see “Configure AUTOSAR Sender-Receiver Communication” on page 4-100 and “Configure AUTOSAR Queued Sender-Receiver Communication” on page 4-119.

To configure AUTOSAR S-R port elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

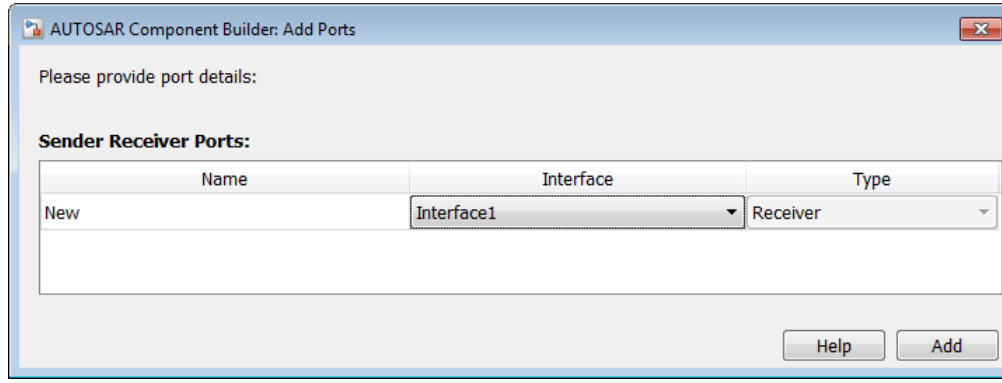
1. In the left-hand pane of AUTOSAR Dictionary, expand the component name and select **ReceiverPorts**.

   The receiver ports view in AUTOSAR Dictionary lists receiver ports and their properties. You can:

   - Select an AUTOSAR receiver port, and view and optionally reselect its associated S-R interface.
   - Rename an AUTOSAR receiver port by clicking its name and then editing the name text.
   - When you select a port that is configured for `QueuedExplicitReceive` data access, AUTOSAR Dictionary displays additional port communication specification (ComSpec) attributes. For AUTOSAR receiver ports, you can modify ComSpec attributes `AliveTimeout`, `HandleNeverReceived`, and `InitValue`. For more information, see “Configure AUTOSAR Sender-Receiver Port ComSpecs” on page 4-115.
   - Click the **Add** button  to open an Add Ports dialog box to add a port.
   - Select a port and then click the **Delete** button  to remove it.



The Add Ports dialog box lets you add a receiver port and associate it with an existing S-R interface. To add the port and return to the receiver ports view, click **Add**.

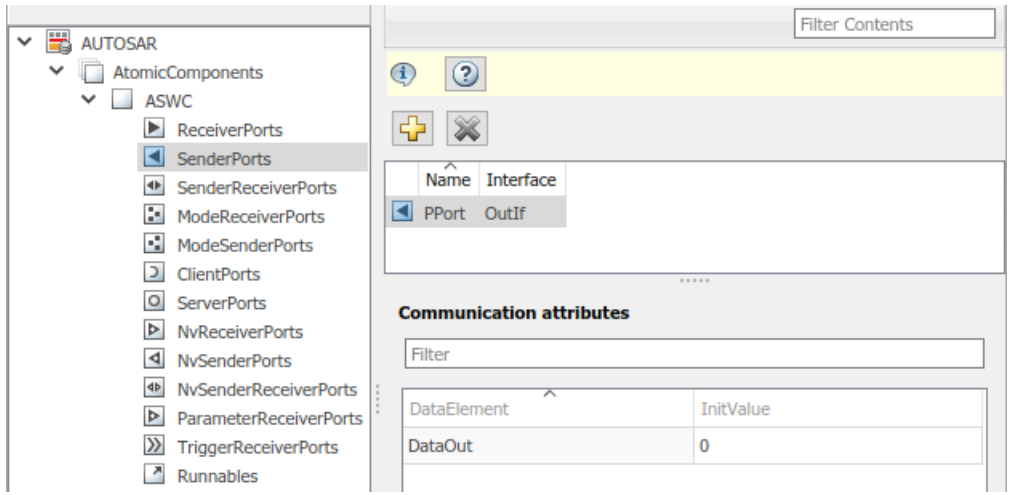


2 In the left-hand pane of AUTOSAR Dictionary, select **SenderPorts**.

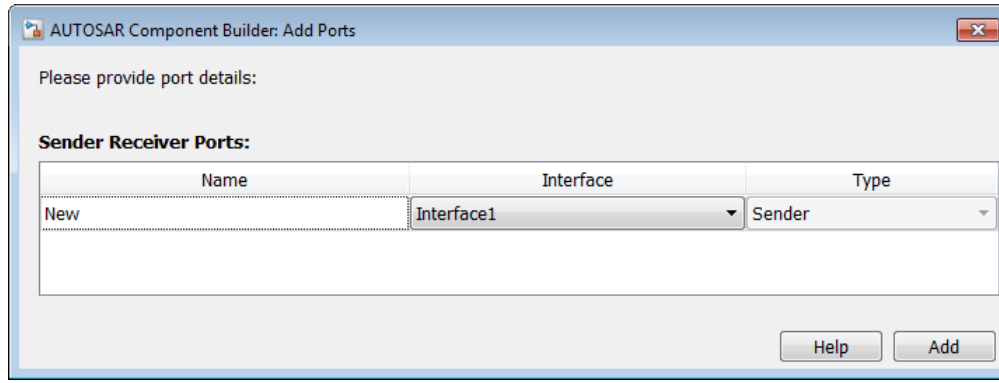
The sender ports view in AUTOSAR Dictionary lists sender ports and their properties. You can:

- Select an AUTOSAR sender port, and view and optionally reselect its associated S-R interface.

- Rename an AUTOSAR sender port by clicking its name and then editing the name text.
- When you select a port that is configured for `QueuedExplicitSend` data access, AUTOSAR Dictionary displays additional port communication specification (ComSpec) attributes. For AUTOSAR sender ports, you can modify ComSpec attribute `InitValue`. For more information, see “Configure AUTOSAR Sender-Receiver Port ComSpecs” on page 4-115.
- Click the **Add** button  to open an Add Ports dialog box to add a port.
- Select a port and then click the **Delete** button  to remove it.



The Add Ports dialog box lets you add a sender port and associate it with an existing S-R interface. Click **Add** to add the port and return to the sender ports view.

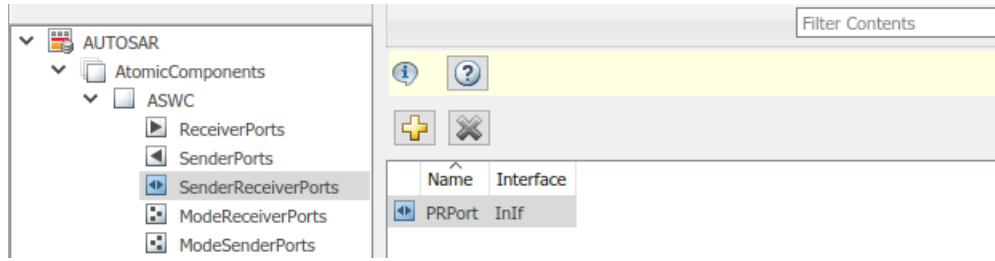


3 In the left-hand pane of AUTOSAR Dictionary, select **SenderReceiverPorts**.

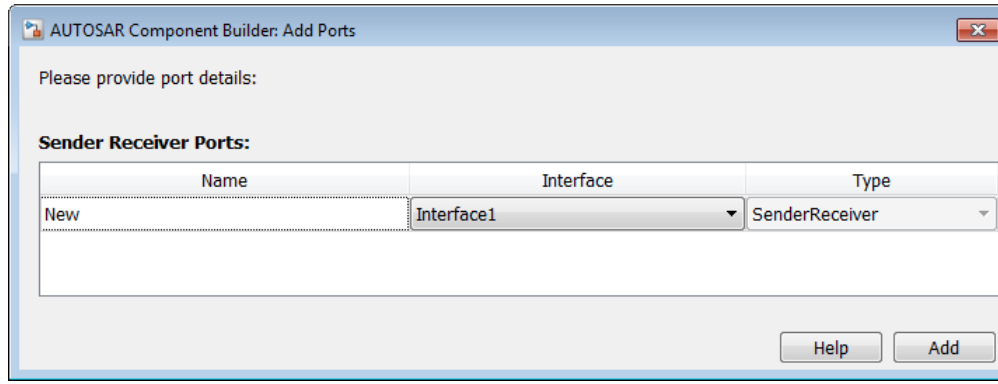
The sender-receiver ports view in AUTOSAR Dictionary lists sender-receiver ports and their properties. You can:

- Select an AUTOSAR sender-receiver port, and view and optionally reselect its associated S-R interface.
- Rename an AUTOSAR sender-receiver port by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Ports dialog box to add a port.
- Select a port and then click the **Delete** button to remove it.

Note AUTOSAR sender-receiver ports require AUTOSAR schema version 4.1 or higher. To select a schema version for the model, go to **AUTOSAR Code Generation Options** in the Configuration Parameters dialog box.



The Add Ports dialog box lets you add a sender-receiver port and associate it with an existing S-R interface. Click **Add** to add the port and return to the sender-receiver ports view.



Mode-Switch Ports

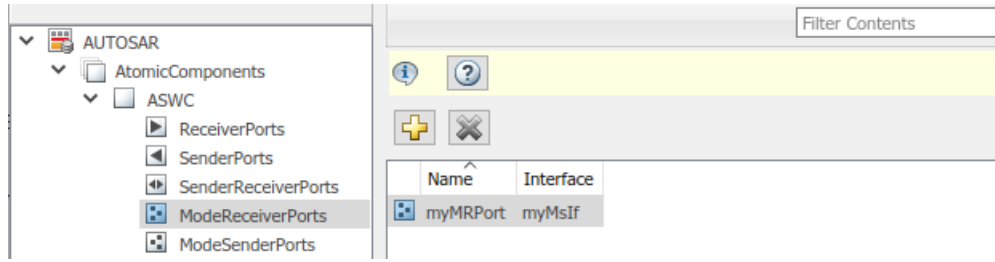
The AUTOSAR Dictionary views of mode sender and receiver ports support modeling AUTOSAR mode-switch (M-S) communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR M-S ports and M-S interfaces in your model. For more information, see “Configure AUTOSAR Mode-Switch Communication” on page 4-172.

To configure AUTOSAR M-S port elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

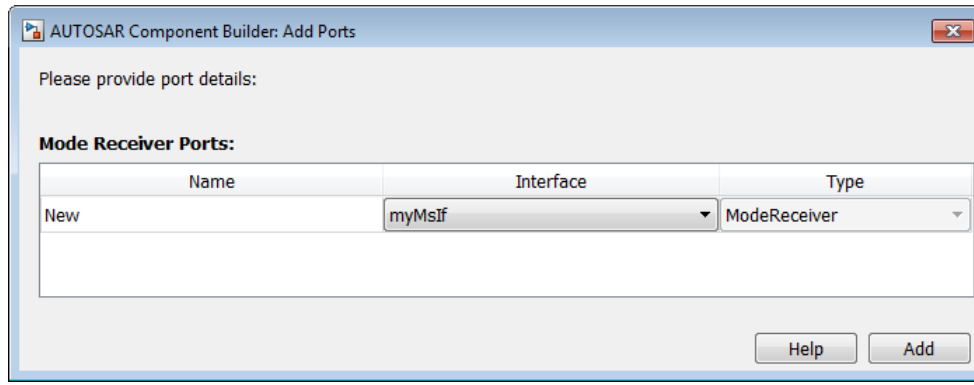
1. In the left-hand pane of AUTOSAR Dictionary, expand the component name and select **ModeReceiverPorts**.

   The mode receiver ports view in AUTOSAR Dictionary lists mode receiver ports and their properties. You can:

   - Select an AUTOSAR mode receiver port, and view and optionally reselect its associated M-S interface.
   - Rename an AUTOSAR mode receiver port by clicking its name and then editing the name text.
   - Click the **Add** button  to open an Add Ports dialog box to add a port.
   - Select a port and then click the **Delete** button  to remove it.



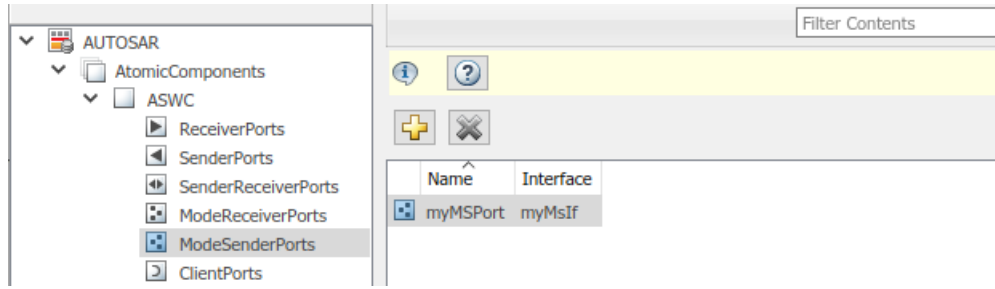
The Add Ports dialog box lets you add a mode receiver port and associate it with an existing M-S interface. If an M-S interface does not exist in the component, you must create one before adding the port. Click **Add** to add the port and return to the mode receiver ports view.



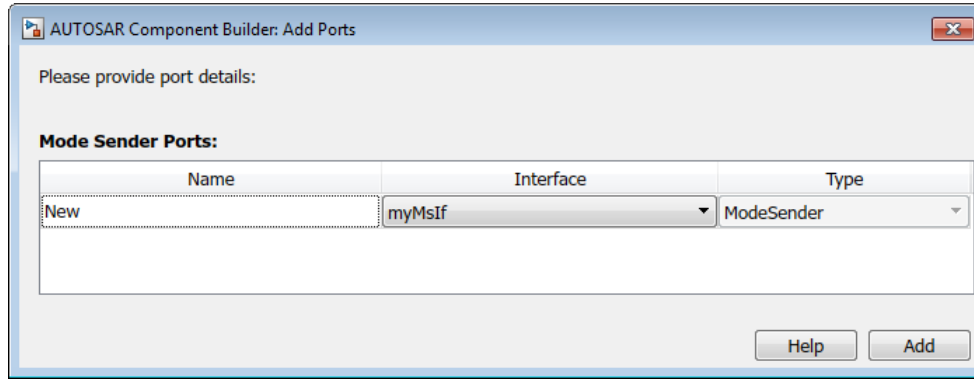
2 In the left-hand pane of AUTOSAR Dictionary, select **ModeSenderPorts**.

The mode sender ports view in AUTOSAR Dictionary lists mode sender ports and their properties. You can:

- Select an AUTOSAR mode sender port, and view and optionally reselect its associated M-S interface.
- Rename an AUTOSAR mode sender port by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Ports dialog box to add a port.
- Select a port and then click the **Delete** button to remove it.



The Add Ports dialog box lets you add a mode sender port and associate it with an existing M-S interface. If an M-S interface does not exist in the component, you must create one before adding the port. Click **Add** to add the port and return to the mode sender ports view.



Client-Server Ports

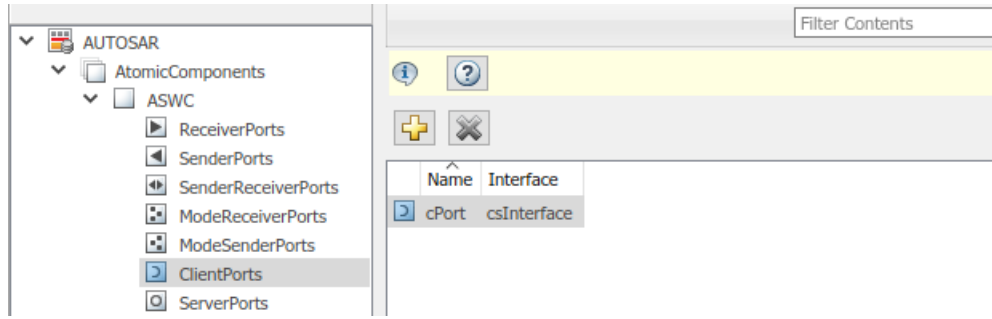
The AUTOSAR Dictionary views of client and server ports support modeling AUTOSAR client-server (C-S) communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR C-S ports, C-S interfaces, and C-S operations in your model. For more information, see “Configure AUTOSAR Client-Server Communication” on page 4-144.

To configure AUTOSAR C-S port elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

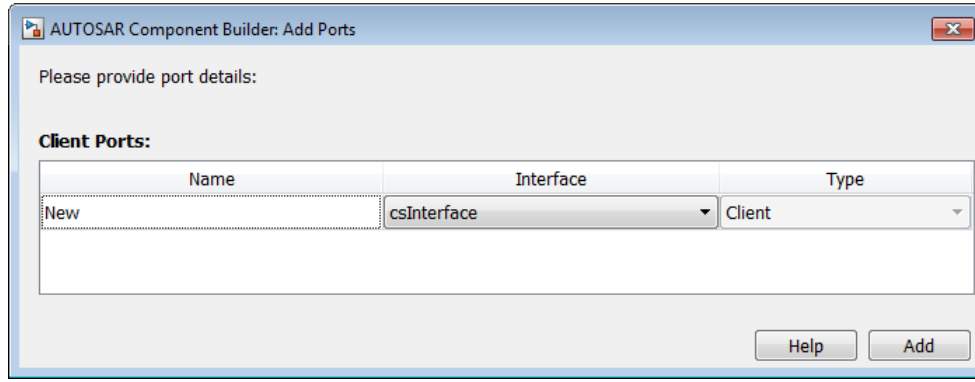
1 In the left-hand pane of AUTOSAR Dictionary, expand the component name and select **ClientPorts**.

The client ports view in AUTOSAR Dictionary lists client ports and their properties. You can:

- Select an AUTOSAR client port, and view and optionally reselect its associated C-S interface.
- Rename an AUTOSAR client port by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Ports dialog box to add a client port.
- Select a port and then click the **Delete** button to remove it.



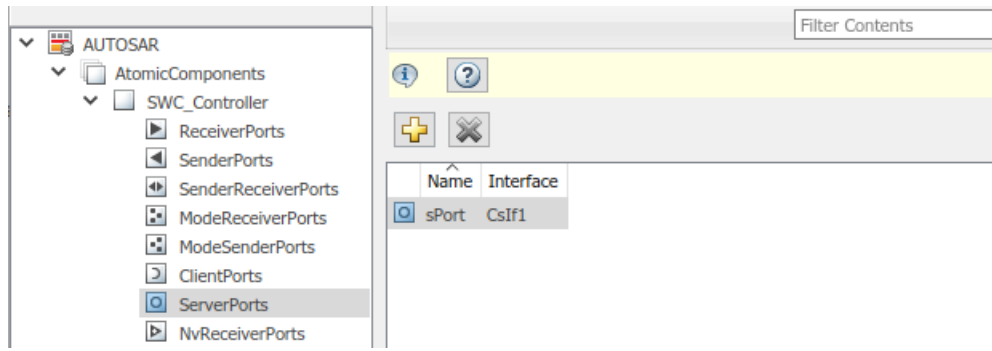
The Add Ports dialog box lets you add a client port and associate it with an existing C-S interface. If a C-S interface does not exist in the component, you must create one before adding the port. Click **Add** to add the port and return to the client ports view.



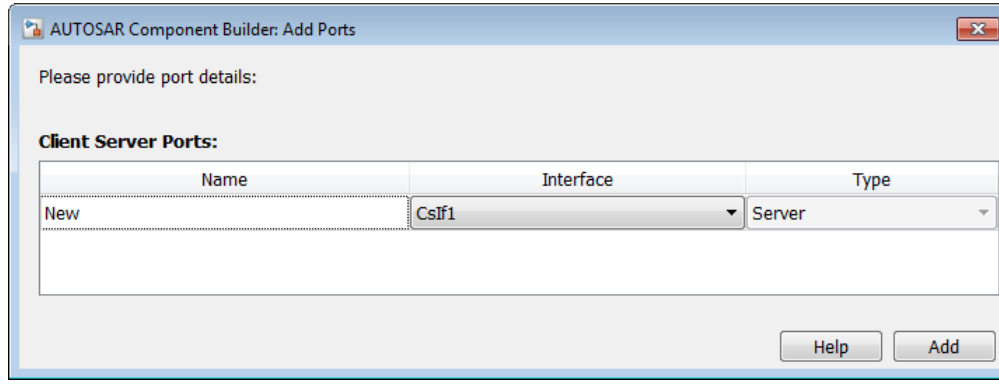
2 In the left-hand pane of AUTOSAR Dictionary, select **ServerPorts**.

The server ports view in AUTOSAR Dictionary lists server ports and their properties. You can:

- Select an AUTOSAR server port, and view and optionally reselect its associated C-S interface.
- Rename an AUTOSAR server port by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Ports dialog box to add a server port.
- Select a port and then click the **Delete** button to remove it.



The Add Ports dialog box lets you add a server port and associate it with an existing C-S interface. If a C-S interface does not exist in the component, you must create one before adding the port. Click **Add** to add the port and return to the server ports view.



Nonvolatile Data Ports

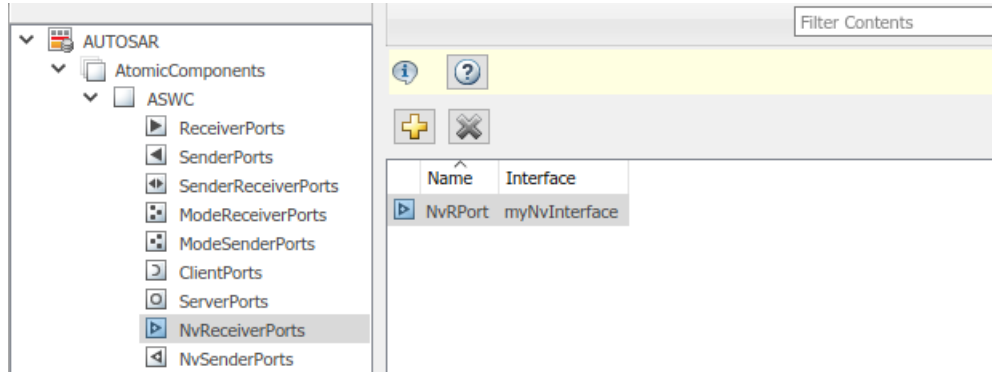
The AUTOSAR Dictionary views of nonvolatile (NV) sender and receiver ports support modeling AUTOSAR NV data communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR NV ports, NV interfaces, and NV data elements in your model. For more information, see “Configure AUTOSAR Nonvolatile Data Communication” on page 4-181.

To configure AUTOSAR NV port elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

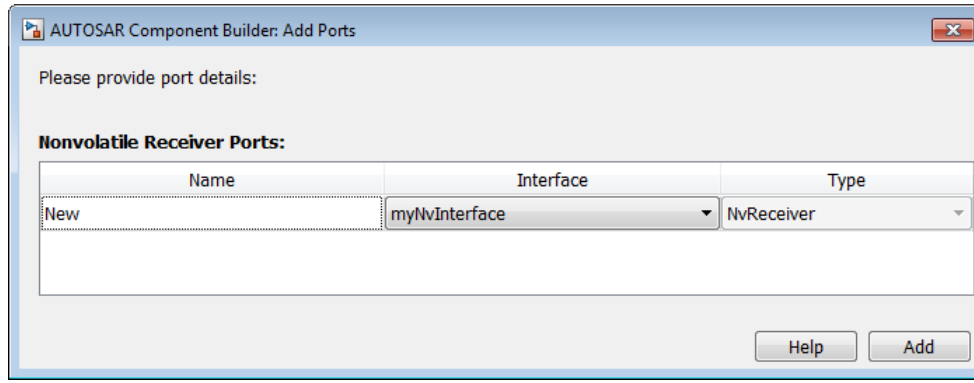
1 In the left-hand pane of AUTOSAR Dictionary, expand the component name and select **NvReceiverPorts**.

The NV receiver ports view in AUTOSAR Dictionary lists NV receiver ports and their properties. You can:

- Select an AUTOSAR NV receiver port, and view and optionally reselect its associated NV data interface.
- Rename an AUTOSAR NV receiver port by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Ports dialog box to add a port.
- Select a port and then click the **Delete** button to remove it.



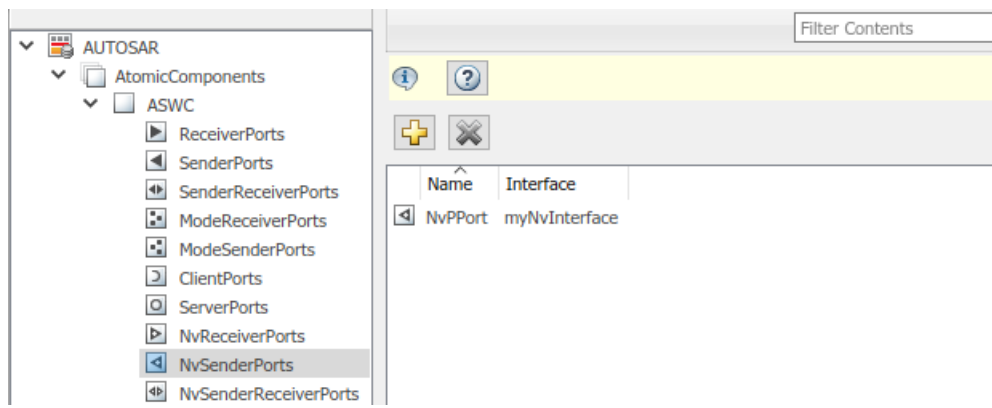
The Add Ports dialog box lets you add an NV receiver port and associate it with an existing NV interface. Click **Add** to add the port and return to the NV receiver ports view.



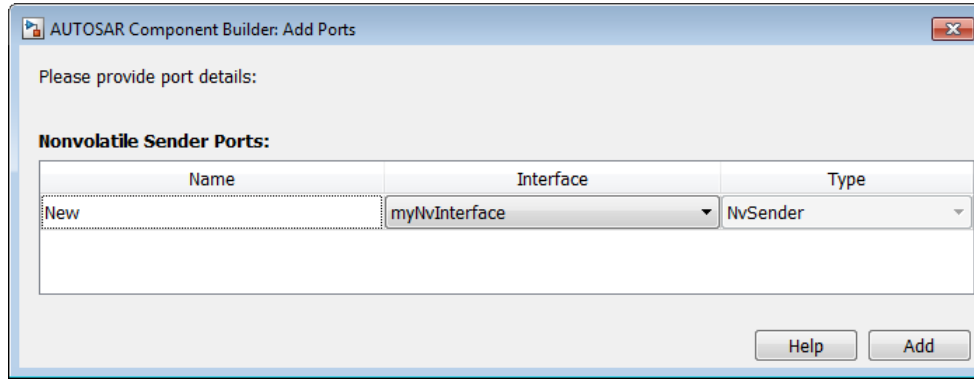
2 In the left-hand pane of AUTOSAR Dictionary, select **NvSenderPorts**.

The NV sender ports view in AUTOSAR Dictionary lists NV sender ports and their properties. You can:

- Select an AUTOSAR NV sender port, and view and optionally reselect its associated NV data interface.
- Rename an AUTOSAR NV sender port by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Ports dialog box to add a port.
- Select a port and then click the **Delete** button to remove it.



The Add Ports dialog box lets you add an NV sender port and associate it with an existing NV interface. Click **Add** to add the port and return to the NV sender ports view.

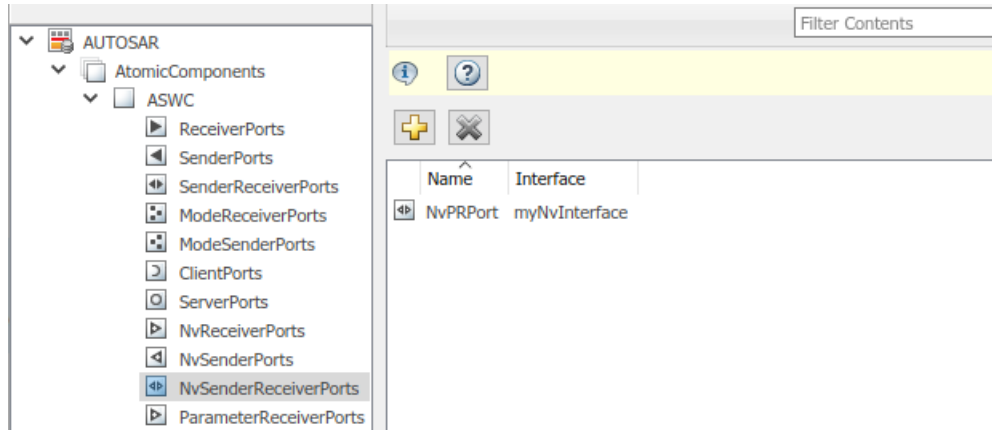


3 In the left-hand pane of AUTOSAR Dictionary, select **NvSenderReceiverPorts**.

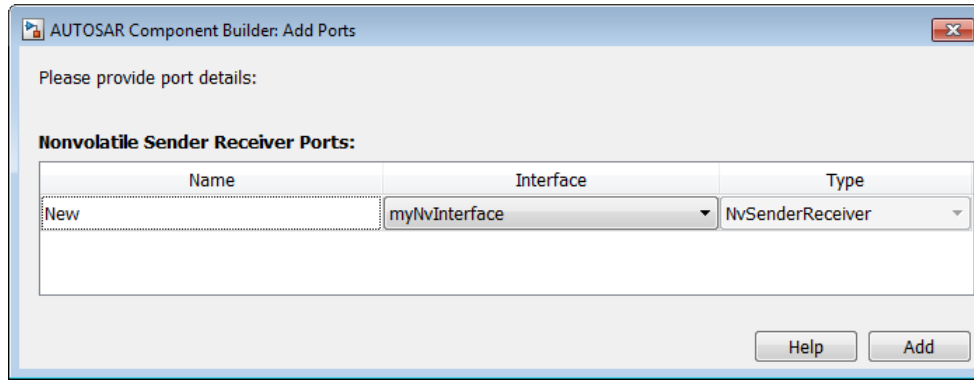
The NV sender-receiver ports view in AUTOSAR Dictionary lists NV sender-receiver ports and their properties. You can:

- Select an AUTOSAR NV sender-receiver port, and view and optionally reselect its associated NV data interface.
- Rename an AUTOSAR NV sender-receiver port by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Ports dialog box to add a port.
- Select a port and then click the **Delete** button to remove it.

Note AUTOSAR NV sender-receiver ports require AUTOSAR schema version 4.1 or higher. To select a schema version for the model, go to **AUTOSAR Code Generation Options** in the Configuration Parameters dialog box.



The Add Ports dialog box lets you add an NV sender-receiver port and associate it with an existing NV interface. Click **Add** to add the port and return to the NV sender-receiver ports view.



Parameter Receiver Ports

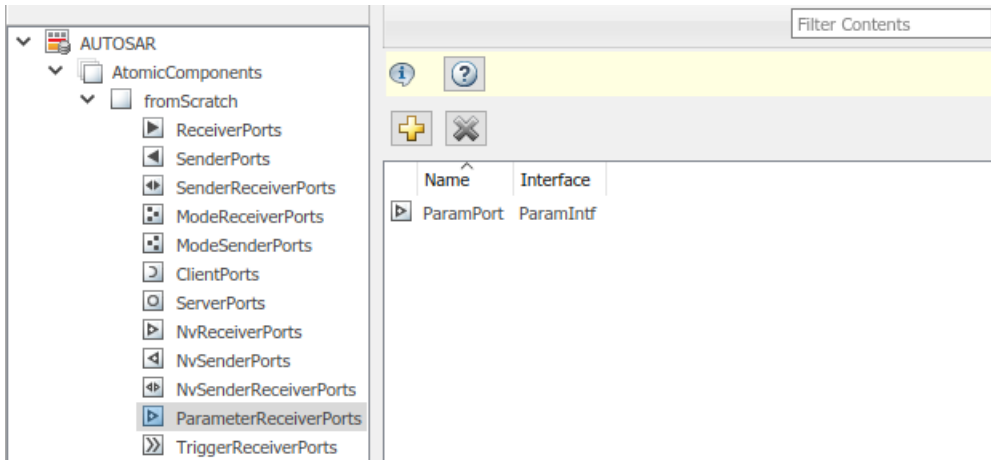
The AUTOSAR Dictionary view of parameter receiver ports supports modeling the receiver side of AUTOSAR parameter communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR parameter receiver ports, parameter interfaces, and parameter data elements in your model. For more information, see “Configure Receiver for AUTOSAR Parameter Communication” on page 4-184.

To configure AUTOSAR parameter receiver port elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR

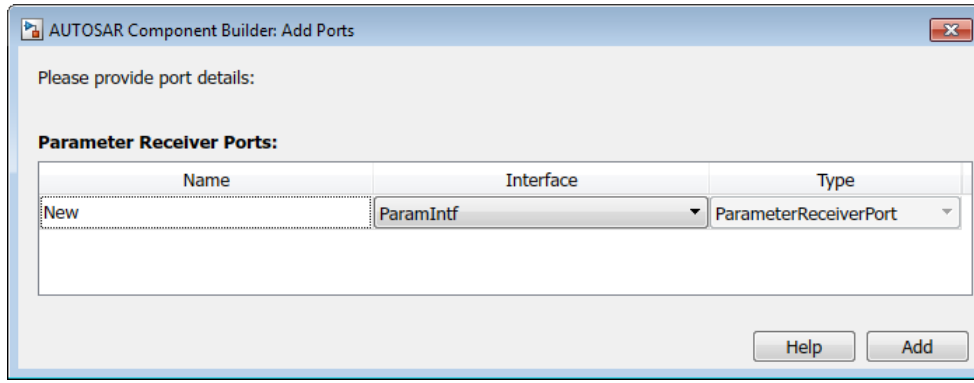
Dictionary. In the left-hand pane of AUTOSAR Dictionary, expand the component name and select **ParameterReceiverPorts**.

The parameter receiver ports view in AUTOSAR Dictionary lists parameter receiver ports and their properties. You can:

- Select an AUTOSAR parameter receiver port, and view and optionally reselect its associated parameter interface.
- Rename an AUTOSAR parameter receiver port by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Ports dialog box to add a port.
- Select a port and then click the **Delete** button to remove it.



The Add Ports dialog box lets you specify the name of the new port and associate it with an existing parameter interface. Click **Add** to add the port and return to the parameter receiver ports view.



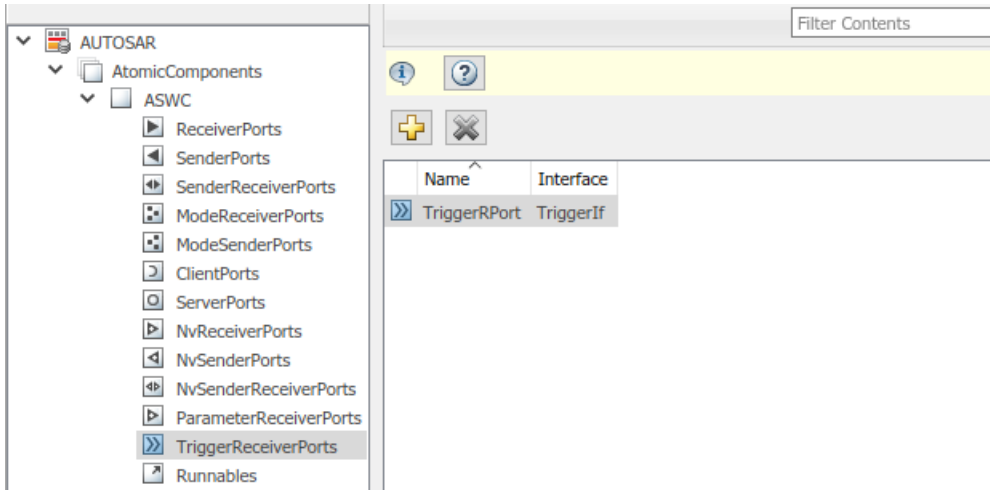
Trigger Receiver Ports

The AUTOSAR Dictionary view of trigger receiver ports supports modeling the receiver side of AUTOSAR trigger communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR trigger receiver ports, trigger interfaces, and triggers in your model. For more information, see “Configure Receiver for AUTOSAR External Trigger Event Communication” on page 4-187.

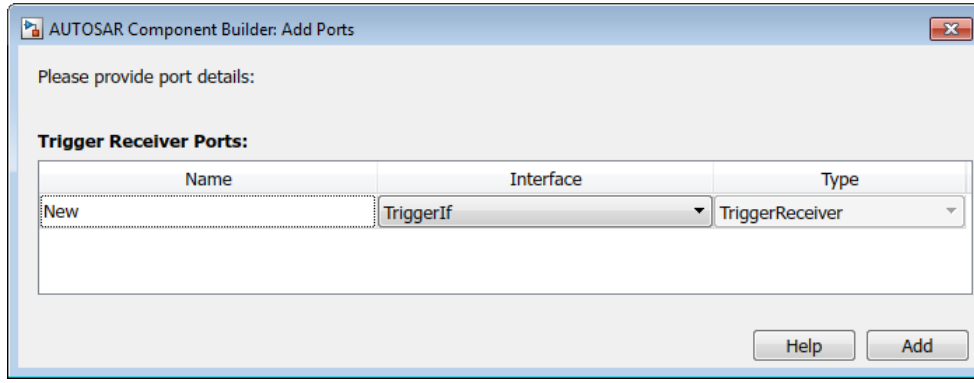
To configure AUTOSAR trigger receiver port elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary. In the left-hand pane of AUTOSAR Dictionary, expand the component name and select **TriggerReceiverPorts**.

The trigger receiver ports view in AUTOSAR Dictionary lists trigger receiver ports and their properties. You can:

- Select an AUTOSAR trigger receiver port, and view and optionally reselect its associated trigger interface.
- Rename an AUTOSAR trigger receiver port by clicking its name and then editing the name text.
- Click the **Add** button  to open an Add Ports dialog box to add a port.
- Select a port and then click the **Delete** button  to remove it.



The Add Ports dialog box lets you specify the name of the new port and associate it with an existing trigger interface. Click **Add** to add the port and return to the trigger receiver ports view.



Configure AUTOSAR Runnables

The **Runnables** view in AUTOSAR Dictionary supports modeling AUTOSAR runnable entities (runnables) and events, which implement aspects of internal AUTOSAR component behavior, in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR runnables and associated events that activate them. For more information, see “Configure AUTOSAR Runnables and Events” on page 4-251.

In AUTOSAR Dictionary, runnables appear in a tree format under the component that owns them. To access runnable and event elements and their properties, you expand the component name.

To configure AUTOSAR runnable and event elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary. In the left-hand pane of AUTOSAR Dictionary, expand the component name and select **Runnables**.

The runnables view in AUTOSAR Dictionary lists runnables for the AUTOSAR component. You can:

- Rename an AUTOSAR runnable by clicking its name and then editing the name text.
- Modify the symbol name for a runnable. The specified AUTOSAR runnable symbol-name is exported in `arxml` and C code. For example, in the display below, if you change the symbol-name of `Runnable1` from `Runnable1` to `test_symbol`, the symbol-name `test_symbol` appears in the exported `arxml` and C code as shown below.

  Example 4.1. rtwdemo_autosar_multirunnables.arxml

```
<RUNNABLE-ENTITY UUID="...">
    <SHORT-NAME>Runnable1</SHORT-NAME>
...
    <SYMBOL>test_symbol</SYMBOL>
...
</RUNNABLE-ENTITY>
```

  Example 4.2. rtwdemo_autosar_multirunnables.c

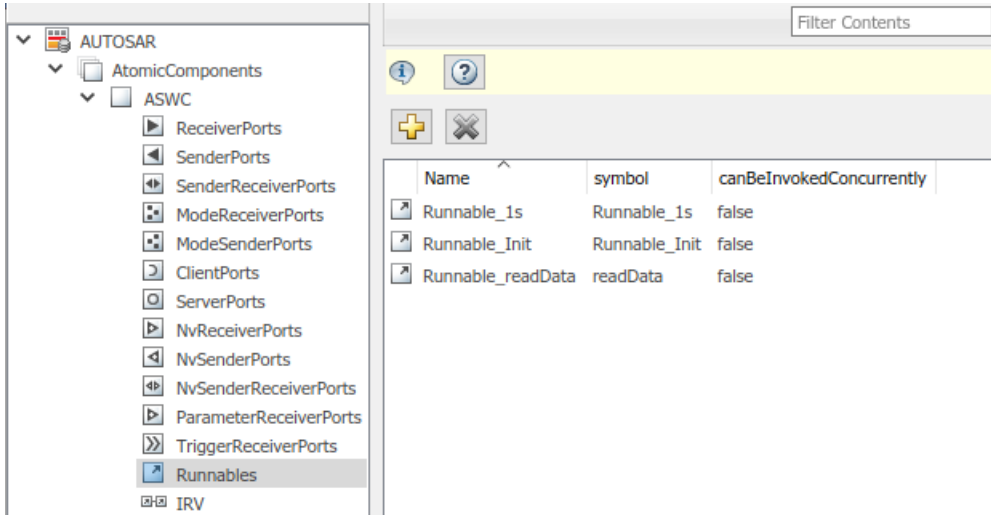
```
/* Output function for RootInportFunctionCallGenerator:
   '<Root>/RootFcnCall_InsertedFor_Runnable1_at_outport_1' */
void test_symbol(void)
{
...
}
```

  Note For an AUTOSAR server runnable — that is, a runnable with an `OperationInvokedEvent` — the **symbol** name must match the Simulink server function name.

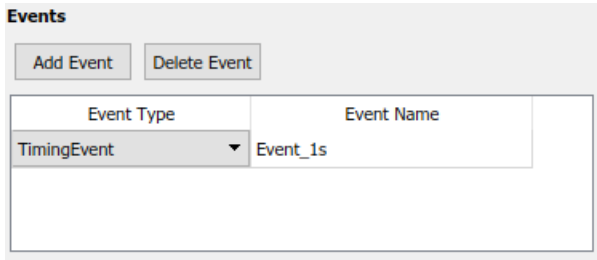
- For an AUTOSAR server runnable, set the runnable property `canBeInvokedConcurrently` to designate whether to enforce concurrency constraints. For nonserver runnables, leave `canBeInvokedConcurrently` set to

`false`. For more information, see “Concurrency Constraints for AUTOSAR Server Runnables” on page 4-168.

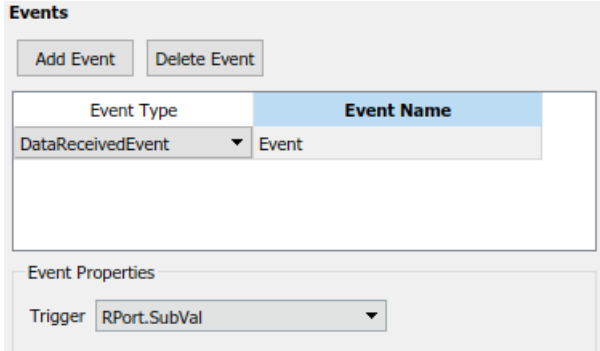
- Click the **Add** button to add an AUTOSAR runnable.
- Select an AUTOSAR runnable and then click the **Delete** button to remove it.



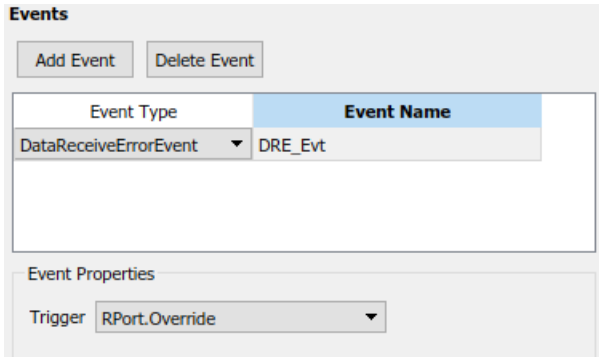
Select a runnable to see its list of associated events. The **Events** pane lists each AUTOSAR event with its type — `TimingEvent`, `DataReceivedEvent`, `ModeSwitchEvent`, `OperationInvokedEvent`, `InitEvent`, `DataReceiveErrorEvent`, or `ExternalTriggerOccurredEvent` — and name. You can rename an AUTOSAR event by clicking its name and then editing the name text. You can use the buttons **Add Event** and **Delete Event** to add or delete events from a runnable.



If you select an event of type `DataReceivedEvent`, the runnable is activated by a `DataReceivedEvent`. Select the event name to display its **Trigger** property. Select a trigger for the event from the list of available trigger ports.

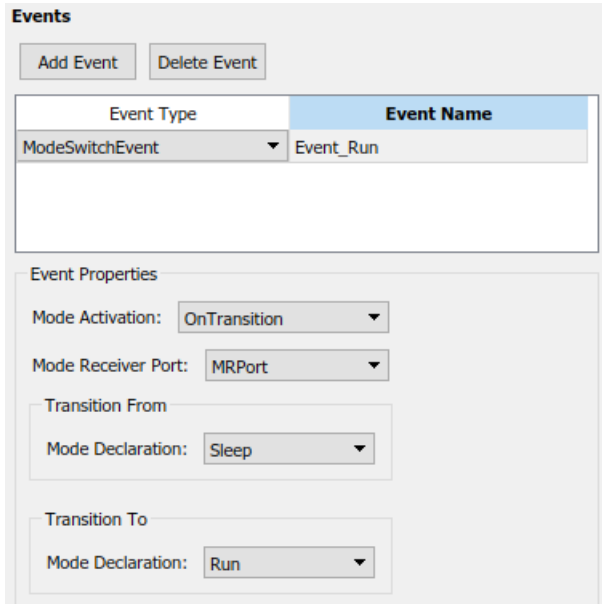


If you select an event of type `DataReceiveErrorEvent`, the runnable is activated by a `DataReceiveErrorEvent`. Select the event name to display its **Trigger** property. Select a trigger for the event from the list of available trigger ports. (For more information on using a `DataReceiveErrorEvent`, see “Configure AUTOSAR Receiver Port for DataReceiveErrorEvent” on page 4-112.)

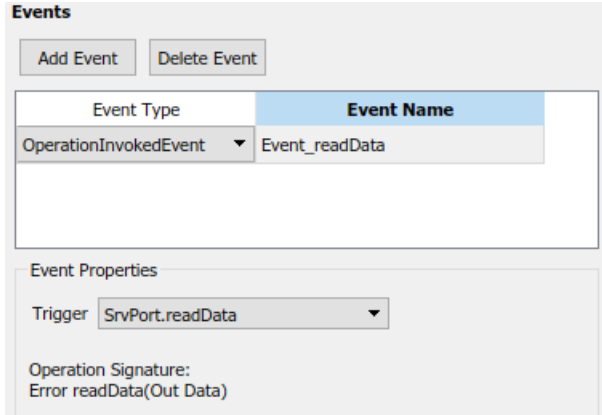


If you select an event of type `ModeSwitchEvent`, the **Mode Activation** and **Mode Receiver Port** properties are displayed. Select a mode receiver port for the event from the list of configured mode-receiver ports. Select a mode activation value for the event from the list of values (`OnEntry`, `OnExit`, or `OnTransition`). Based on the value you select, one or two **Mode Declaration** drop-down lists appear. Select a mode (or two modes) for the event, among those declared by the mode declaration group associated

with the Simulink inport that models the AUTOSAR mode-receiver port. (For more information on using a `ModeSwitchEvent`, see “Configure AUTOSAR Mode-Switch Communication” on page 4-172.)

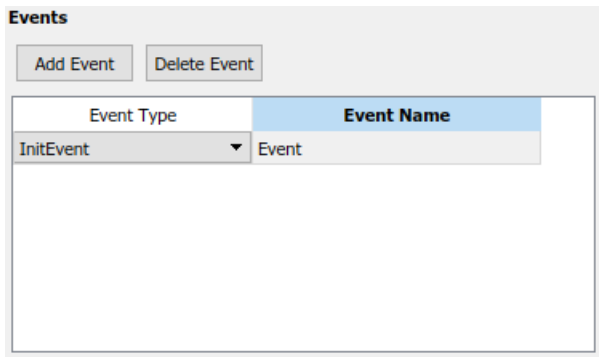


If you select an event of type `OperationInvokedEvent`, the runnable becomes an AUTOSAR server runnable. Select the event name to display its **Trigger** property. Select a trigger for the event from the list of available server port and operation combinations. The **Operation Signature** is displayed below the **Trigger** property. (For more information on using an `OperationInvokedEvent`, see “Configure AUTOSAR Client-Server Communication” on page 4-144.)



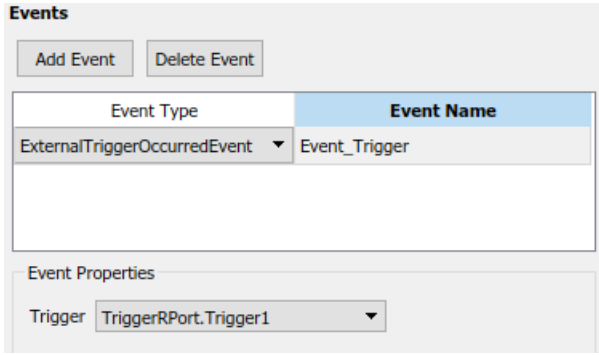
If you select an event of type `InitEvent`, you can rename the event by clicking its name and then editing the name text. (For more information on using an `InitEvent`, see “Configure AUTOSAR Initialization Runnable (R4.1)” on page 4-266.)

Note AUTOSAR `InitEvents` require AUTOSAR schema version 4.1 or higher. To select a schema version for the model, go to **AUTOSAR Code Generation Options** in the Configuration Parameters dialog box.



If you select an event of type `ExternalTriggerOccurredEvent`, the runnable is activated when an AUTOSAR software component or service signals an external trigger event. Select the event name to display its **Trigger** property. Select a trigger for the event from the list of available trigger receiver port and trigger combinations. (For more

information on using an `ExternalTriggerOccurredEvent`, see “Configure Receiver for AUTOSAR External Trigger Event Communication” on page 4-187.)



Configure AUTOSAR Inter-Runnable Variables

The **IRV** view in AUTOSAR Dictionary supports modeling AUTOSAR inter-runnable variables (IRVs), which connect runnables and implement aspects of internal AUTOSAR component behavior, in Simulink. You use AUTOSAR Dictionary to create AUTOSAR IRVs and configure IRV data properties. For more information, see “Configure AUTOSAR Data for Measurement and Calibration” on page 4-236.

In AUTOSAR Dictionary, IRVs appear in a tree format under the component that owns them. To access IRV elements and their properties, you expand the component name.

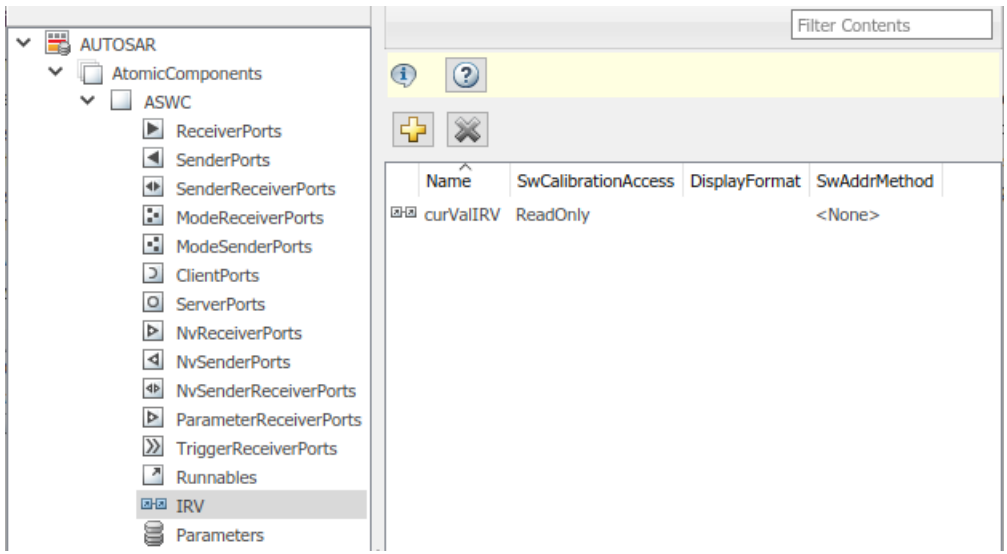
To configure AUTOSAR IRV elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary. In the left-hand pane of AUTOSAR Dictionary, expand the component name and select **IRV**.

The IRV view in AUTOSAR Dictionary lists IRVs for the AUTOSAR component. You can:

- Rename an AUTOSAR IRV by clicking its name and then editing the name text.
- Specify the level of measurement and calibration tool access to IRV data. Select an IRV and set its **SwCalibrationAccess** value to `ReadOnly`, `ReadWrite`, or `NotAccessible`.
- Optionally specify the format to be used by measurement and calibration tools to display the IRV data. In the **DisplayFormat** field, enter an ANSI® C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a

displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.

- Optionally specify a software address method for the IRV data. Select or enter a value for **SwAddrMethod**. AUTOSAR software components use `SwAddrMethods` to group data in memory for access by measurement and calibration tools. For more information, see “Configure AUTOSAR SwAddrMethods” on page 4-61.
- Click the **Add** button to add an AUTOSAR IRV.
- Select an AUTOSAR IRV and then click the **Delete** button to remove it.



Configure AUTOSAR Parameters

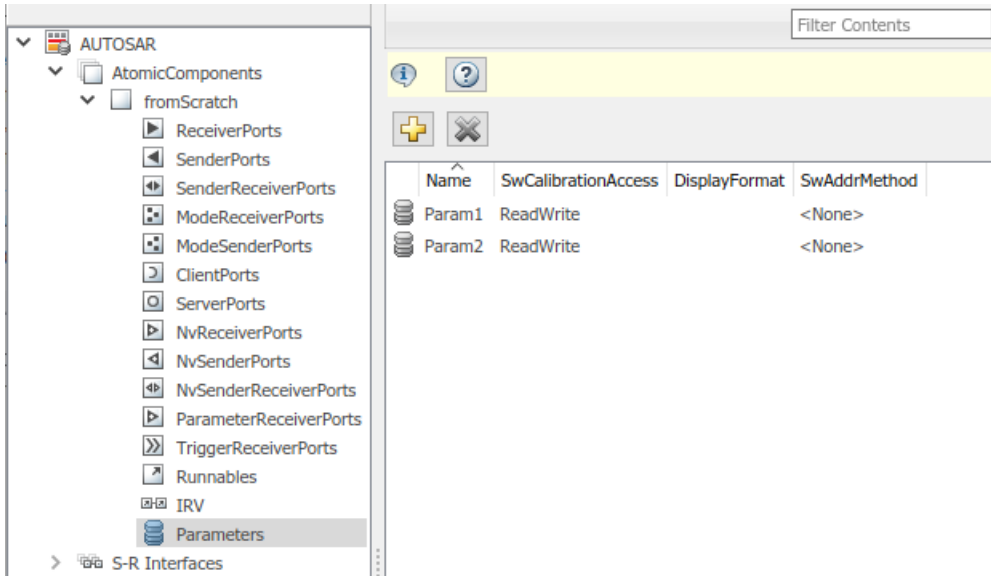
The **Parameters** view in AUTOSAR Dictionary supports modeling AUTOSAR internal calibration parameters, for use with AUTOSAR integrated and distributed lookups, in Simulink. You use AUTOSAR Dictionary to create AUTOSAR internal parameters and configure parameter data properties. For port-based calibration parameters, you create “Parameter Interfaces” on page 4-51.

In AUTOSAR Dictionary, internal parameters appear in a tree format under the component that owns them. To access parameter elements and their properties, you expand the component name.

To configure AUTOSAR parameter elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary. In the left-hand pane of AUTOSAR Dictionary, expand the component name and select **Parameters**.

The parameters view in AUTOSAR Dictionary lists internal parameters for the AUTOSAR component. You can:

- Rename an AUTOSAR parameter by clicking its name and then editing the name text.
- Specify the level of measurement and calibration tool access to parameters. Select a parameter and set its **SwCalibrationAccess** value to `ReadOnly`, `ReadWrite`, or `NotAccessible`.
- Optionally specify the format to be used by measurement and calibration tools to display the parameter data. In the **DisplayFormat** field, enter an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.
- Optionally specify a software address method for the parameter data. Select or enter a value for **SwAddrMethod**. AUTOSAR software components use `SwAddrMethod`s to group data in memory for access by measurement and calibration tools. For more information, see “Configure AUTOSAR SwAddrMethods” on page 4-61.
- Click the **Add** button  to add an AUTOSAR internal parameter.
- Select an AUTOSAR internal parameter and then click the **Delete** button  to remove it.



Configure AUTOSAR Communication Interfaces

An AUTOSAR software component uses communication interfaces defined in the AUTOSAR standard, including sender-receiver (S-R), client-server (C-S), mode-switch (M-S), nonvolatile (NV) data, trigger, and parameter interfaces. In AUTOSAR Dictionary, communication interfaces appear in a tree format under the interface type name. To access interface elements and their properties, you expand the interface type name.

- “Sender-Receiver Interfaces” on page 4-37
- “Mode-Switch Interfaces” on page 4-41
- “Client-Server Interfaces” on page 4-43
- “Nonvolatile Data Interfaces” on page 4-48
- “Parameter Interfaces” on page 4-51
- “Trigger Interfaces” on page 4-55

Sender-Receiver Interfaces

The **S-R Interfaces** view in AUTOSAR Dictionary supports modeling AUTOSAR sender-receiver (S-R) communication in Simulink. You use AUTOSAR Dictionary to configure

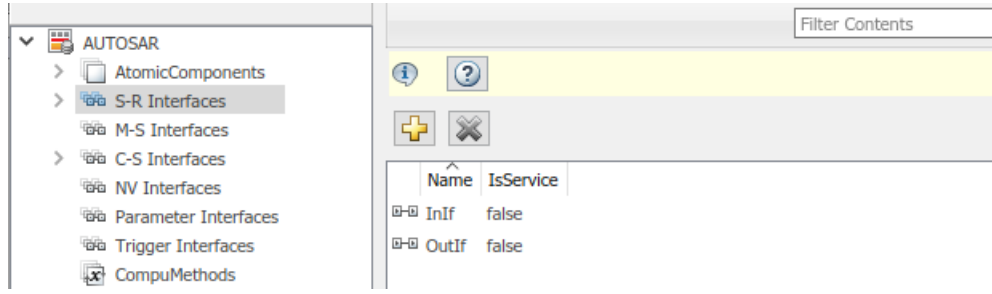
AUTOSAR S-R ports, S-R interfaces, and S-R data elements in your model. For more information, see “Configure AUTOSAR Sender-Receiver Communication” on page 4-100 and “Configure AUTOSAR Queued Sender-Receiver Communication” on page 4-119.

To configure AUTOSAR S-R interface elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

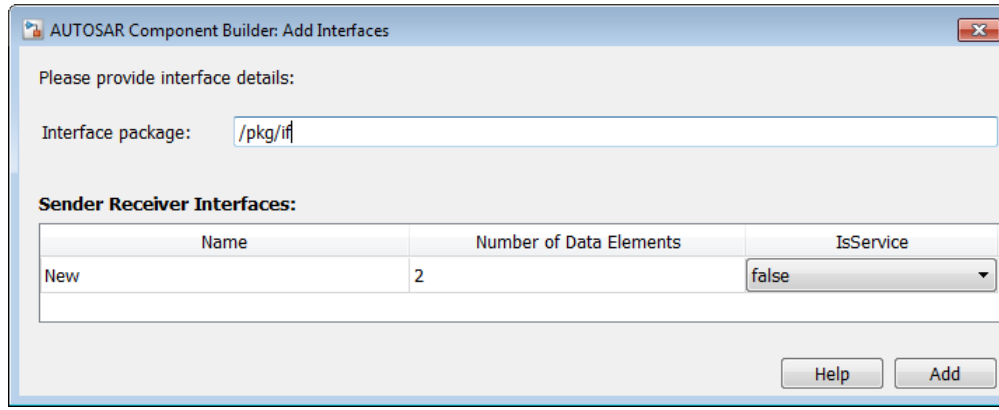
1 In the left-hand pane of AUTOSAR Dictionary, select **S-R Interfaces**.

The S-R interfaces view in AUTOSAR Dictionary lists AUTOSAR sender-receiver interfaces and their properties. You can:

- Select an S-R interface and then select a menu value to specify whether or not it is a service.
- Rename an S-R interface by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Interfaces dialog box to add one or more S-R interfaces.
- Select an S-R interface and then click the **Delete** button to remove it.



The Add Interfaces dialog box lets you specify the name of the new interface, the number of associated data elements it contains, whether the interface is a service, and the path of the Interface package. Click **Add** to add the interface and return to the S-R interfaces view.



2 In the left-hand pane of AUTOSAR Dictionary, expand **S-R Interfaces** and select an S-R interface from the list.

The S-R interface view in AUTOSAR Dictionary displays the name of the selected S-R interface, whether or not it is a service, and the AUTOSAR package to be generated for the interface.

To modify the AUTOSAR package for the interface, you can do either of the following:

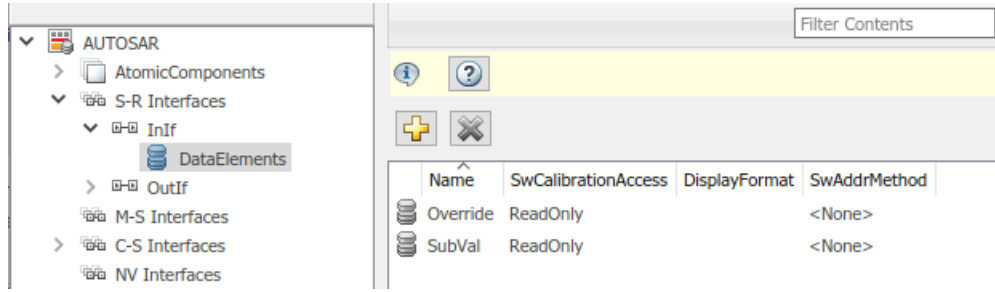
- Enter a package path in the **Package** parameter field.
- Click the button to the right of the **Package** field to open the AUTOSAR Package Browser. Use the browser to navigate to an existing package or create a new package. When you select a package in the browser and click **Apply**, the interface **Package** parameter value is updated with your selection. For more information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.

3 In the left-hand pane of AUTOSAR Dictionary, expand the selected interface and select **DataElements**.

The data elements view in AUTOSAR Dictionary lists AUTOSAR sender-receiver interface data elements and their properties. You can:

- Select an S-R interface data element and edit the name value.
- Specify the level of measurement and calibration tool access to S-R interface data elements. Select a data element and set its **SwCalibrationAccess** value to `ReadOnly`, `ReadWrite`, or `NotAccessible`.
- Optionally specify the format to be used by measurement and calibration tools to display the data element. In the **DisplayFormat** field, enter an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.
- Optionally specify a software address method for the data element. Select or enter a value for **SwAddrMethod**. AUTOSAR software components use `SwAddrMethod`s to group data in memory for access by measurement and calibration tools. For more information, see “Configure AUTOSAR SwAddrMethods” on page 4-61.

- Click the **Add** button  to add a data element.
- Select a data element and then click the **Delete** button  to remove it.



Mode-Switch Interfaces

The **M-S Interfaces** view in AUTOSAR Dictionary supports modeling AUTOSAR mode-switch (M-S) communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR M-S ports and M-S interfaces in your model. For more information, see “Configure AUTOSAR Mode-Switch Communication” on page 4-172.

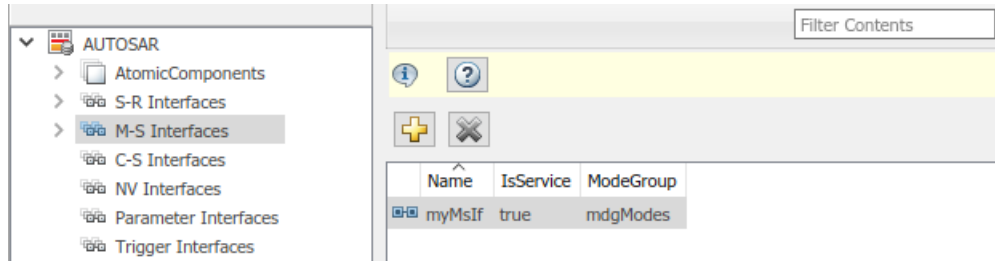
To configure AUTOSAR M-S interface elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

1 In the left-hand pane of AUTOSAR Dictionary, select **M-S Interfaces**.

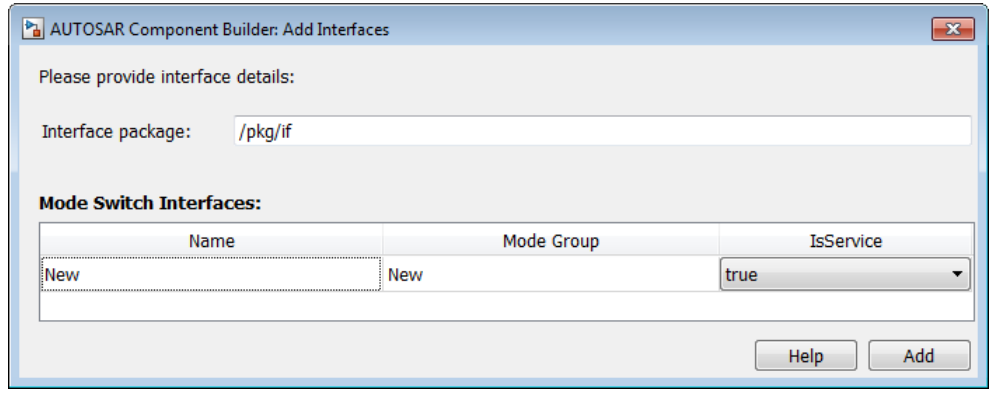
The M-S interfaces view in AUTOSAR Dictionary lists AUTOSAR mode-switch interfaces and their properties. You can:

- Select an M-S interface, specify whether or not it is a service, and modify the name of its associated mode group.
  - The **IsService** property defaults to `true`. The `true` setting assumes that the M-S interface participates in run-time mode management, for example, performed by the Basic Software Mode Manager.
  - A mode group contains mode values, declared in Simulink using enumeration. For more information, see “Configure AUTOSAR Mode-Switch Communication” on page 4-172.
- Rename an M-S interface by clicking its name and then editing the name text.

- Click the **Add** button  to open an Add Interfaces dialog box to add one or more M-S interfaces.
- Select an M-S interface and then click the **Delete** button  to remove it.



The Add Interfaces dialog box lets you specify the name of the new interface, the name of a mode group, whether the interface is a service, and the path of the Interface package. Click **Add** to add the interface and return to the M-S interfaces view.

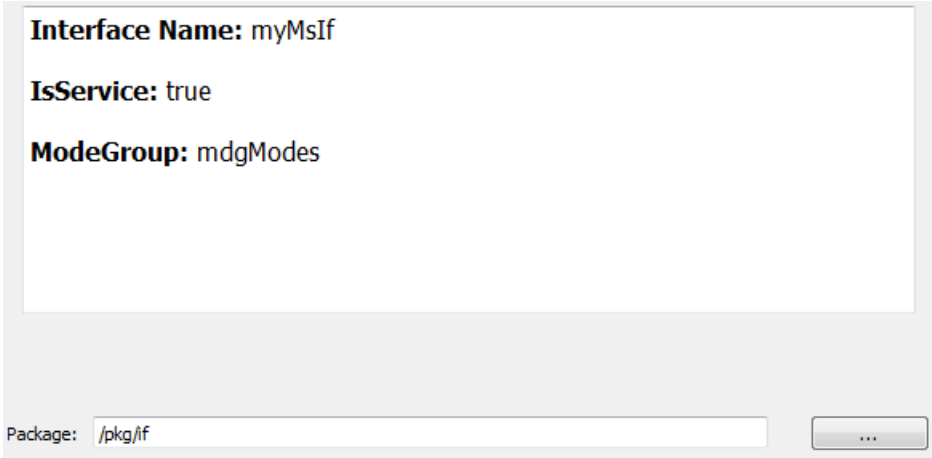


2 In the left-hand pane of AUTOSAR Dictionary, expand **M-S Interfaces** and select an M-S interface from the list.

The M-S interface view in AUTOSAR Dictionary displays the name of the selected M-S interface, whether or not it is a service, its associated mode group, and the AUTOSAR package for the interface.

To modify the AUTOSAR package for the interface, you can do either of the following:

- Enter a package path in the **Package** parameter field.
- Click the button to the right of the **Package** field to open the AUTOSAR Package Browser. Use the browser to navigate to an existing package or create a new package. When you select a package in the browser and click **Apply**, the interface **Package** parameter value is updated with your selection. For more information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.



Client-Server Interfaces

The **C-S Interfaces** view in AUTOSAR Dictionary supports modeling AUTOSAR client-server (C-S) communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR C-S ports, C-S interfaces, and C-S operations in your model. For more information, see “Configure AUTOSAR Client-Server Communication” on page 4-144.

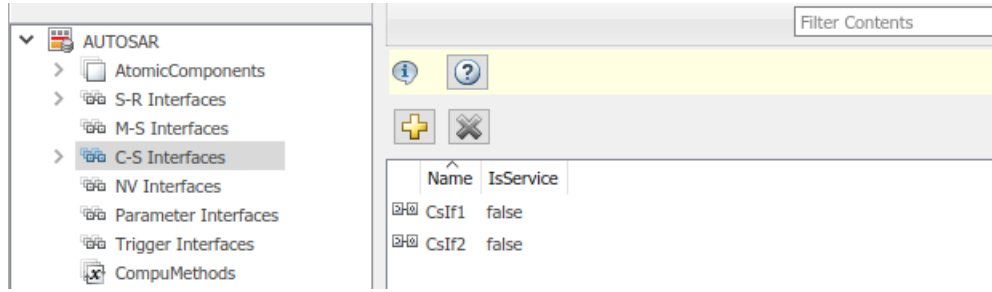
To configure AUTOSAR C-S interface elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

1 In the left-hand pane of AUTOSAR Dictionary, select **C-S Interfaces**.

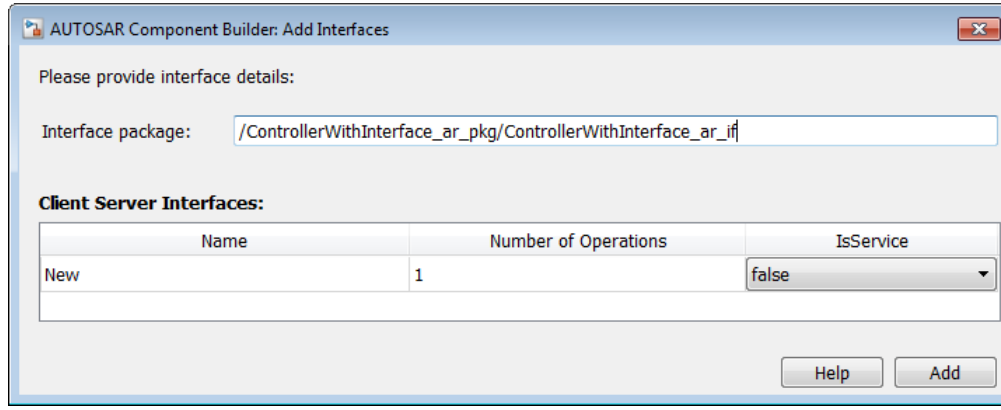
  The C-S interfaces view in AUTOSAR Dictionary lists AUTOSAR client-server interfaces and their properties. You can:

  - Select a C-S interface and then select a menu value to specify whether or not it is a service.

- Rename a C-S interface by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Interfaces dialog box to add one or more C-S interfaces.
- Select a C-S interface and then click the **Delete** button to remove it.



The Add Interfaces dialog box lets you specify the name of the new interface, the number of associated operations it contains, whether the interface is a service, and the path of the Interface package. Click **Add** to add the interface and return to the C-S interfaces view.



2 In the left-hand pane of AUTOSAR Dictionary, expand **C-S Interfaces** and select a C-S interface from the list.

The C-S interface view in AUTOSAR Dictionary displays the name of the selected C-S interface, whether or not it is a service, and the AUTOSAR package for the interface.

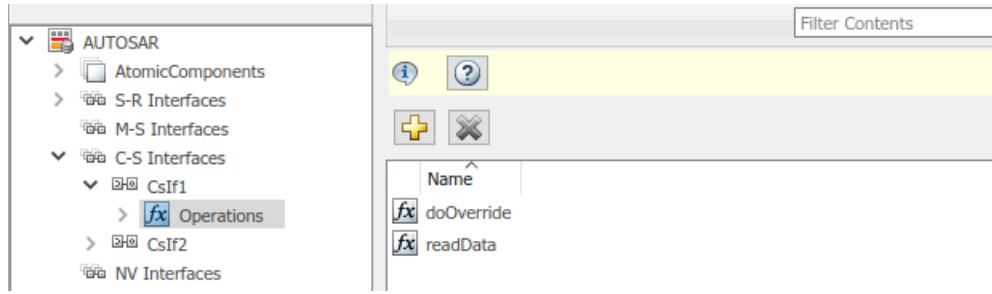
To modify the AUTOSAR package for the interface, you can do either of the following:

- Enter a package path in the **Package** parameter field.
- Click the button to the right of the **Package** field to open the AUTOSAR Package Browser. Use the browser to navigate to an existing package or create a new package. When you select a package in the browser and click **Apply**, the interface **Package** parameter value is updated with your selection. For more information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.

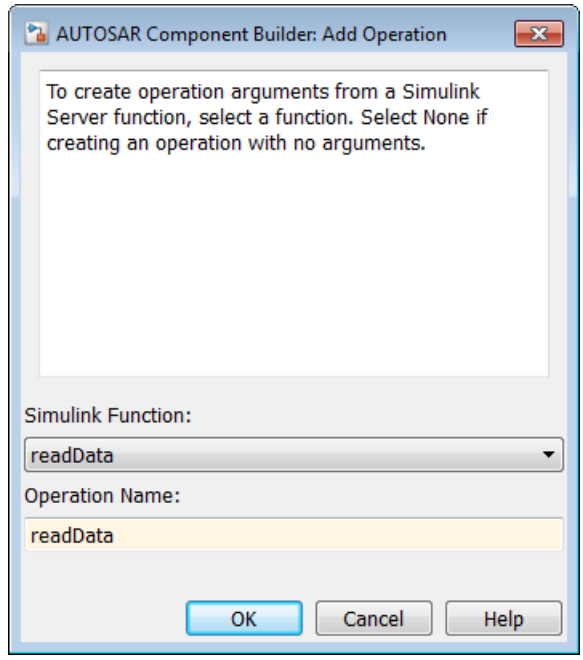
3 In the left-hand pane of AUTOSAR Dictionary, expand the selected interface and select **Operations**.

The operations view in AUTOSAR Dictionary lists AUTOSAR client-server interface operations. You can:

- Select a C-S interface operation and edit the name value.
- Click the **Add** button to open an Add Operation dialog box to add a C-S interface operation.
- Select an operation and then click the **Delete** button to remove it.

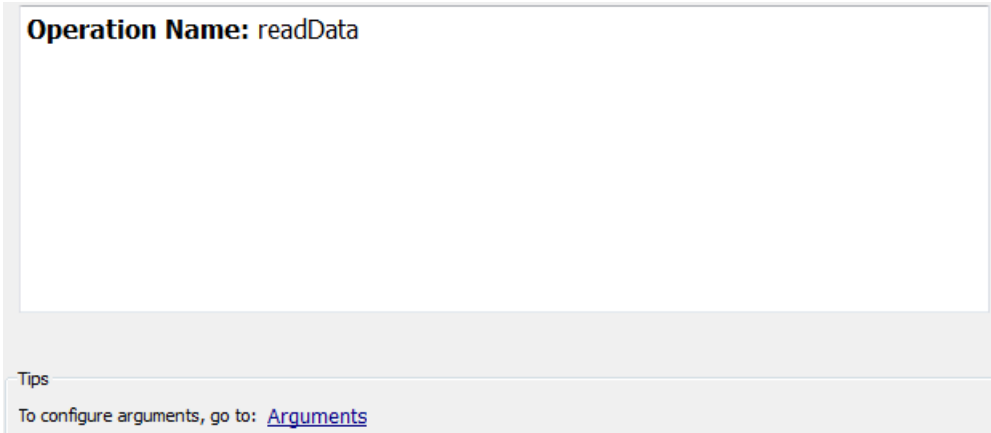


The Add Operation dialog box lets you specify the name of a new C-S interface operation. To create operation arguments from a Simulink function, select the associated Simulink function among those present in the configuration. Select `None` if you are creating an operation without arguments.



4 In the left-hand pane of AUTOSAR Dictionary, expand **Operations** and select an operation from the list.

The operations view in AUTOSAR Dictionary displays the name of the selected C-S operation.



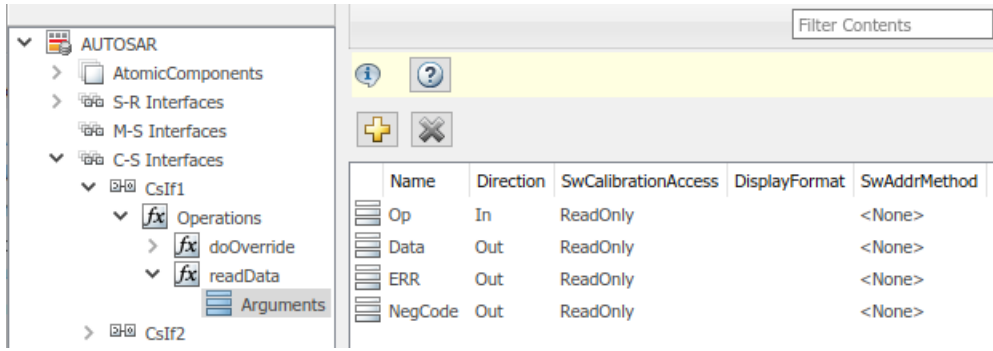
5 In the left-hand pane of AUTOSAR Dictionary, expand the selected operation and select **Arguments**.

The arguments view in AUTOSAR Dictionary lists AUTOSAR client-server operation arguments and their properties. You can:

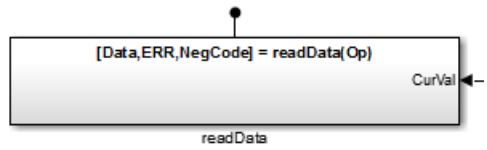
- Select a C-S operation argument and edit the name value.
- Specify the direction of the C-S operation argument. Set its **Direction** value to `In`, `Out`, `InOut`, or `Error`. Select `Error` if the operation argument returns application error status. For more information, see “Configure AUTOSAR Client-Server Error Handling” on page 4-163.
- Specify the level of measurement and calibration tool access to C-S operation arguments. Select an argument and set its **SwCalibrationAccess** value to `ReadOnly`, `ReadWrite`, or `NotAccessible`.
- Optionally specify the format to be used by measurement and calibration tools to display the argument. In the **DisplayFormat** field, enter an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.
- Optionally specify a software address method for the argument. Select or enter a value for **SwAddrMethod**. AUTOSAR software components use `SwAddrMethods`

to group data in memory for access by measurement and calibration tools. For more information, see “Configure AUTOSAR SwAddrMethods” on page 4-61.

- Click the **Add** button to add an argument.
- Select an argument and then click the **Delete** button to remove it.



The displayed server operation arguments were created from the following Simulink Function block.



Nonvolatile Data Interfaces

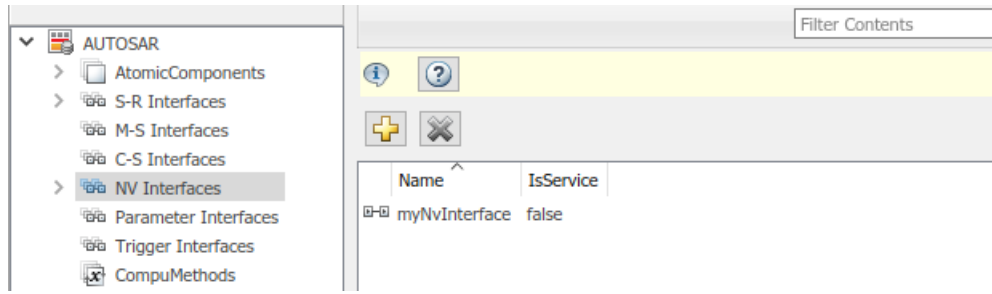
The **NV Interfaces** view in AUTOSAR Dictionary supports modeling AUTOSAR nonvolatile (NV) data communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR NV ports, NV interfaces, and NV data elements in your model. For more information, see “Configure AUTOSAR Nonvolatile Data Communication” on page 4-181.

To configure AUTOSAR NV interface elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

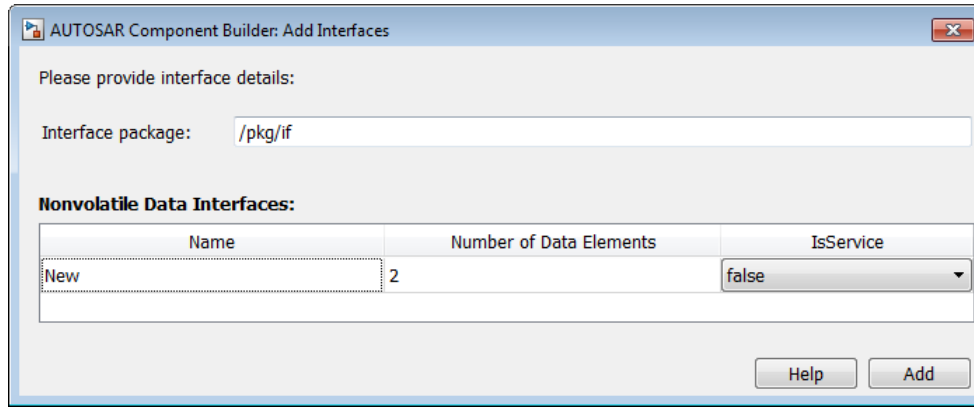
1 In the left-hand pane of AUTOSAR Dictionary, select **NV Interfaces**.

The NV interfaces view in AUTOSAR Dictionary lists AUTOSAR NV data interfaces and their properties. You can:

- Select an NV interface and then select a menu value to specify whether or not it is a service.
- Rename an NV interface by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Interfaces dialog box to add one or more NV interfaces.
- Select an NV interface and then click the **Delete** button to remove it.



The Add Interfaces dialog box lets you specify the name of the new interface, the number of associated data elements it contains, whether the interface is a service, and the path of the Interface package. Click **Add** to add the interface and return to the NV interfaces view.



2 In the left-hand pane of AUTOSAR Dictionary, expand **NV Interfaces** and select an NV interface from the list.

The NV interface view in AUTOSAR Dictionary displays the name of the selected NV data interface, whether or not it is a service, and the AUTOSAR package to be generated for the interface.

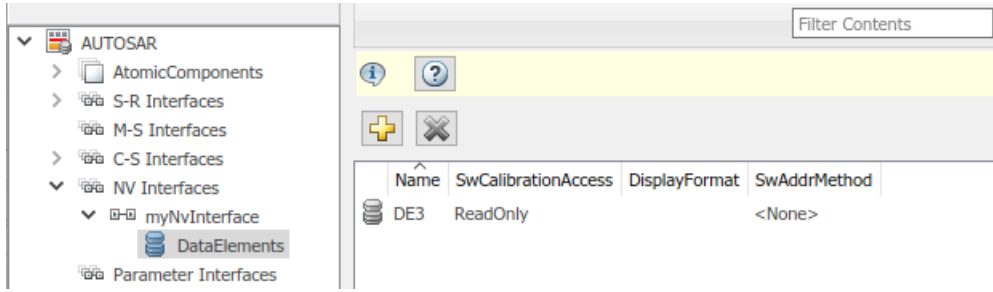
To modify the AUTOSAR package for the interface, you can do either of the following:

- Enter a package path in the **Package** parameter field.
- Click the button to the right of the **Package** field to open the AUTOSAR Package Browser. Use the browser to navigate to an existing package or create a new package. When you select a package in the browser and click **Apply**, the interface **Package** parameter value is updated with your selection. For more information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.

3 In the left-hand pane of AUTOSAR Dictionary, expand the selected interface and select **DataElements**.

The data elements view in AUTOSAR Dictionary lists AUTOSAR NV interface data elements and their properties. You can:

- Select an NV interface data element and edit the name value.
- Specify the level of measurement and calibration tool access to the NV interface data elements. Select a data element and set its **SwCalibrationAccess** value to `ReadOnly`, `ReadWrite`, or `NotAccessible`.
- Optionally specify the format to be used by measurement and calibration tools to display the data element. In the **DisplayFormat** field, enter an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.
- Optionally specify a software address method for the data element. Select or enter a value for **SwAddrMethod**. AUTOSAR software components use `SwAddrMethod`s to group data in memory for access by measurement and calibration tools. For more information, see “Configure AUTOSAR SwAddrMethods” on page 4-61.
- Click the **Add** button  to add a data element.
- Select a data element and then click the **Delete** button  to remove it.



Parameter Interfaces

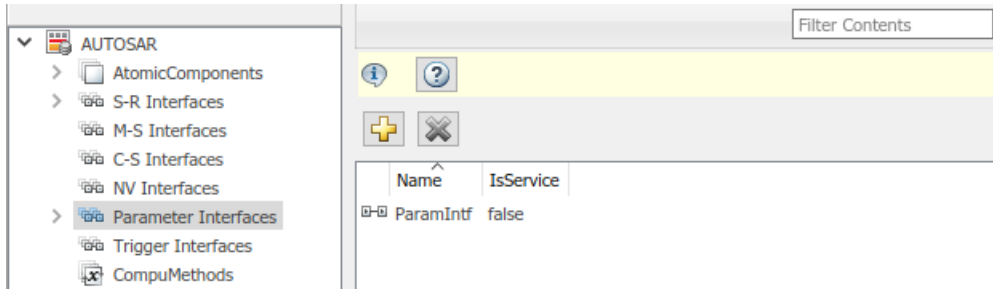
The **Parameter Interfaces** view in AUTOSAR Dictionary supports modeling the receiver side of AUTOSAR parameter communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR parameter receiver ports, parameter interfaces, and parameter data elements in your model. For more information, see “Configure Receiver for AUTOSAR Parameter Communication” on page 4-184.

To configure AUTOSAR parameter interface elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

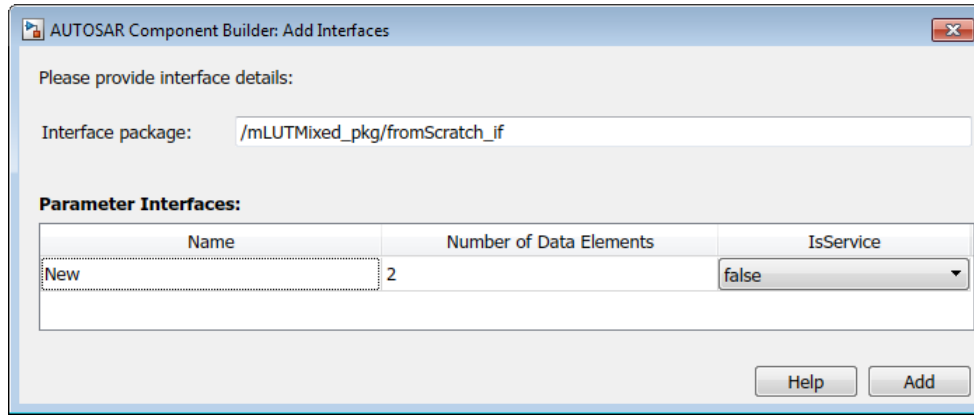
1 In the left-hand pane of AUTOSAR Dictionary, select **Parameter Interfaces**.

The parameter interfaces view in AUTOSAR Dictionary lists AUTOSAR parameter interfaces and their properties. You can:

- Select a parameter interface and then select a menu value to specify whether or not it is a service.
- Rename a parameter interface by clicking its name and then editing the name text.
- Click the **Add** button  to open an Add Interfaces dialog box to add one or more parameter interfaces.
- Select a parameter interface and then click the **Delete** button  to remove it.



The Add Interfaces dialog box lets you specify the name of the new interface, the number of associated data elements it contains, whether the interface is a service, and the path of the Interface package. Click **Add** to add the interface and return to the parameter interfaces view.



2 In the left-hand pane of AUTOSAR Dictionary, expand **Parameter Interfaces** and select a parameter interface from the list.

The parameter interface view in AUTOSAR Dictionary displays the name of the selected parameter interface, whether or not it is a service, and the AUTOSAR package to generate for the interface.

To modify the AUTOSAR package for the interface, you can do either of the following:

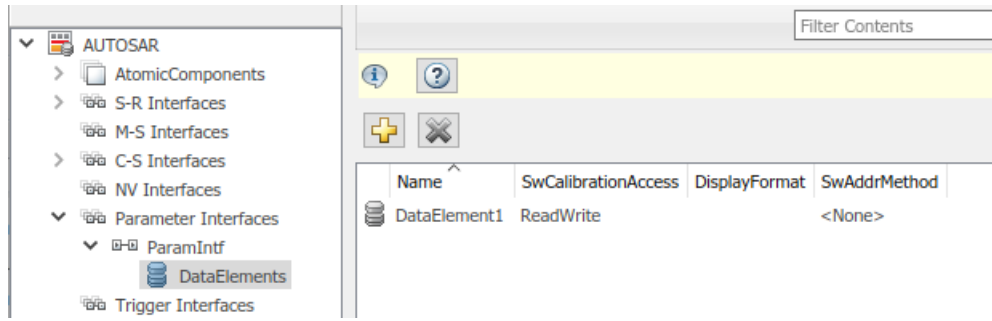
- Enter a package path in the **Package** parameter field.
- Click the button to the right of the **Package** field to open the AUTOSAR Package Browser. Use the browser to navigate to an existing package or create a new package. When you select a package in the browser and click **Apply**, the interface **Package** parameter value is updated with your selection. For more information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.

3 In the left-hand pane of AUTOSAR Dictionary, expand the selected interface and select **DataElements**.

The data elements view in AUTOSAR Dictionary lists AUTOSAR parameter interface data elements and their properties. You can:

- Select a parameter interface data element and edit the name value.
- Specify the level of measurement and calibration tool access to parameter interface data elements. Select a data element and set its **SwCalibrationAccess** value to `ReadOnly`, `ReadWrite`, or `NotAccessible`.
- Optionally specify the format to be used by measurement and calibration tools to display the data element. In the **DisplayFormat** field, enter an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.
- Optionally specify a software address method for the data element. Select or enter a value for **SwAddrMethod**. AUTOSAR software components use `SwAddrMethods` to group data in memory for access by measurement and calibration tools. For more information, see “Configure AUTOSAR SwAddrMethods” on page 4-61.

- Click the **Add** button to add a data element.
- Select a data element and then click the **Delete** button to remove it.



Trigger Interfaces

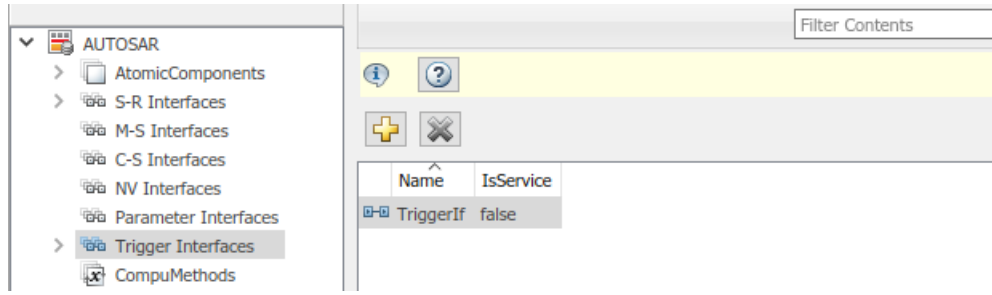
The **Trigger Interfaces** view in AUTOSAR Dictionary supports modeling the receiver side of AUTOSAR trigger communication in Simulink. You use AUTOSAR Dictionary to configure AUTOSAR trigger receiver ports, trigger interfaces, and triggers in your model. For more information, see “Configure Receiver for AUTOSAR External Trigger Event Communication” on page 4-187.

To configure AUTOSAR trigger interface elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary.

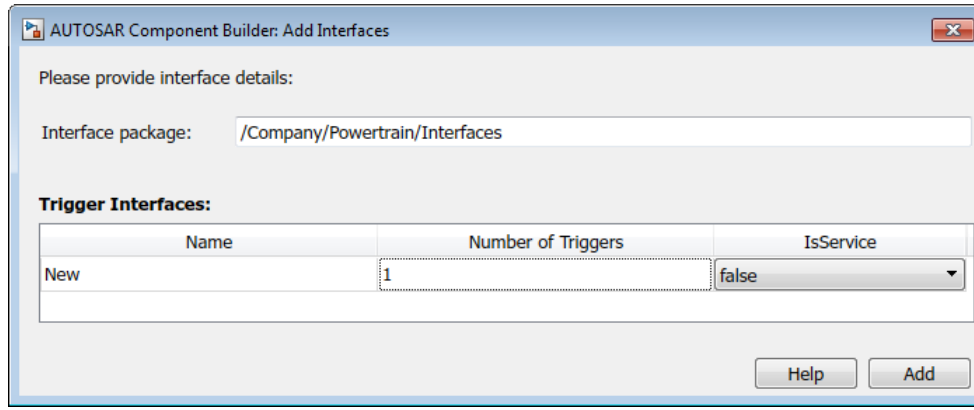
1 In the left-hand pane of AUTOSAR Dictionary, select **Trigger Interfaces**.

The trigger interfaces view in AUTOSAR Dictionary lists AUTOSAR trigger interfaces and their properties. You can:

- Select a trigger interface and then select a menu value to specify whether or not it is a service.
- Rename a trigger interface by clicking its name and then editing the name text.
- Click the **Add** button to open an Add Interfaces dialog box to add one or more trigger interfaces.
- Select a trigger interface and then click the **Delete** button to remove it.



The Add Interfaces dialog box lets you specify the name of the new interface, the number of associated triggers it contains, whether the interface is a service, and the path of the Interface package. Click **Add** to add the interface and return to the trigger interfaces view.



2 In the left-hand pane of AUTOSAR Dictionary, expand **Trigger Interfaces** and select a trigger interface from the list.

The trigger interface view in AUTOSAR Dictionary displays the name of the selected trigger interface, whether or not it is a service, and the AUTOSAR package to be generated for the interface.

To modify the AUTOSAR package for the interface, you can do either of the following:

- Enter a package path in the **Package** parameter field.
- Click the button to the right of the **Package** field to open the AUTOSAR Package Browser. Use the browser to navigate to an existing package or create a new

package. When you select a package in the browser and click **Apply**, the interface **Package** parameter value is updated with your selection. For more information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.

3 In the left-hand pane of AUTOSAR Dictionary, expand the selected interface and select **Triggers**.

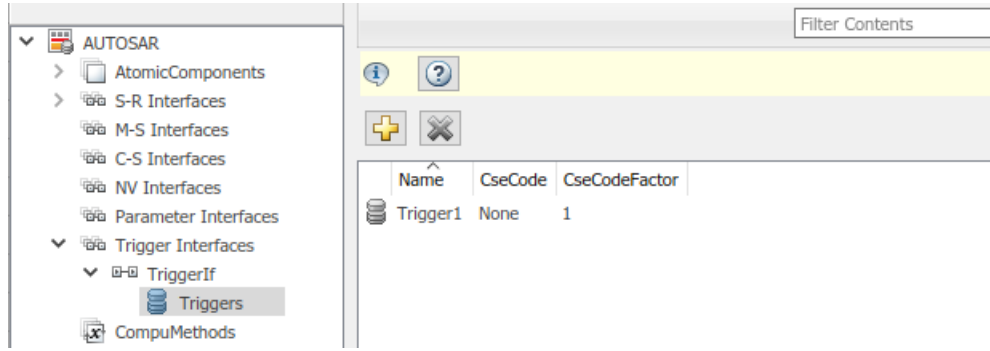
The triggers view in AUTOSAR Dictionary lists AUTOSAR triggers and their properties. You can:

- Select a trigger and edit the name value.
- If the trigger is periodic, you can use **CseCode** and **CseCodeFactor** to specify a period for the trigger. (Otherwise, leave the period unspecified.)
  - To specify the time base of the period, select a value from the **CseCode** menu. The values are based on ASAM codes for scaling unit (CSE).
  - To specify the scaling factor for the period, enter an integer value in the **CseCodeFactor** field.

  For example, to specify a period of 15 milliseconds, set **CseCode** to `CSE3` (1 millisecond) and set **CseCodeFactor** to `15`.

CseCode	Time Base
None	Unspecified (trigger is not periodic)
CSE0	1 µsec (microsecond)
CSE1	10 µsec
CSE2	100 µsec
CSE3	1 msec (millisecond)
CSE4	10 msec
CSE5	100 msec
CSE6	1 second
CSE7	10 seconds
CSE8	1 minute
CSE9	1 hour
CSE10	1 day
CSE20	1 fs (femtosecond)
CSE21	10 fs
CSE22	100 fs
CSE23	1 ps (picosecond)
CSE24	10 ps
CSE25	100 ps
CSE26	1 ns (nanosecond)
CSE27	10 ns
CSE28	100 ns
CSE100	Angular degrees
CSE101	Revolutions (1 = 360 degrees)
CSE102	Cycle (1 = 720 degrees)
CSE997	Computing cycle
CSE998	When frame available
CSE999	Always when there is a new value
CSE1000	Nondeterministic (no fixed scaling)

- Click the **Add** button to add a trigger.
- Select a trigger and then click the **Delete** button to remove it.



Configure AUTOSAR Computation Methods

The **CompuMethods** view in AUTOSAR Dictionary supports modeling AUTOSAR computation methods (CompuMethods), which specify conversions between internal values and physical representation of AUTOSAR data, in Simulink. You use AUTOSAR Dictionary to create and configure AUTOSAR CompuMethods. For more information, see “Configure AUTOSAR CompuMethods” on page 4-287.

To configure AUTOSAR CompuMethod elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary. Select **CompuMethods**.

The CompuMethods view in AUTOSAR Dictionary displays CompuMethods and their properties. You can:

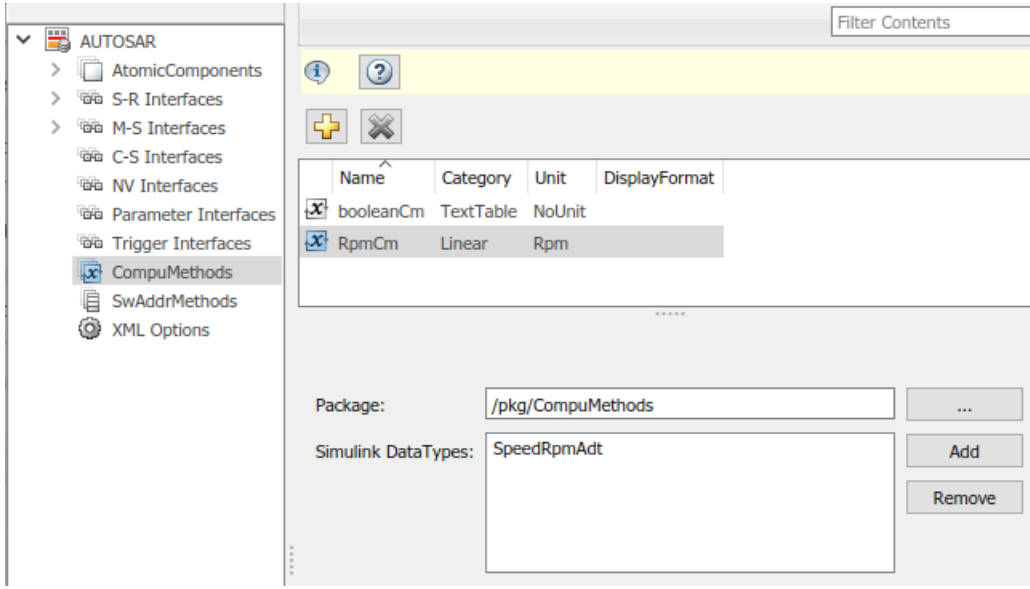
- Select a CompuMethod and modify properties, such as name, category, unit, display format for measurement and calibration, AUTOSAR package to be generated for the CompuMethod, and a list of Simulink data types that reference the CompuMethod. For property descriptions, see “Configure AUTOSAR CompuMethod Properties” on page 4-287.
- Click the **Add** button to open an Add CompuMethod dialog box to add a CompuMethod.

- Select a CompuMethod and then click the **Delete** button  to remove it.

To modify the AUTOSAR package for a CompuMethod, you can do either of the following:

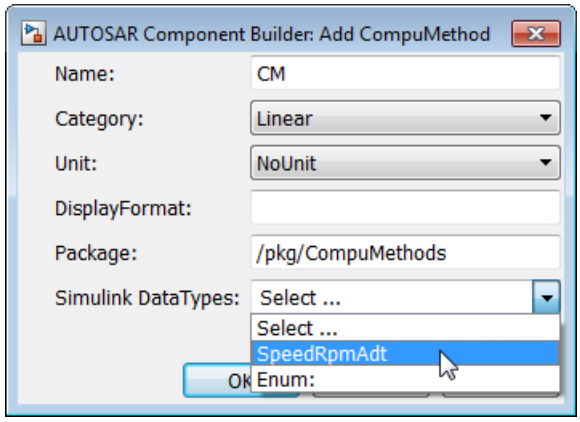
- Enter a package path in the **Package** parameter field.
- Click the button to the right of the **Package** field to open the AUTOSAR Package Browser. Use the browser to navigate to an existing package or create a new package. When you select a package in the browser and click **Apply**, the CompuMethod **Package** parameter value is updated with your selection. For more information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.

To associate a CompuMethod with a Simulink data type used in the model, select a CompuMethod and click the **Add** button to the right of **Simulink DataTypes**. This action opens a dialog box with a list of available data types. Select a data type and click OK to add it to the **Simulink DataTypes** list. To remove a data type from the **Simulink DataTypes** list, select the data type and click **Remove**.

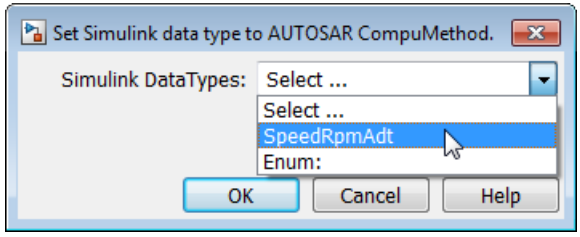


The Add CompuMethod dialog box lets you create a new CompuMethod and specify its initial properties, such as name, category, unit, display format for measurement and

calibration, AUTOSAR package to be generated for the CompuMethod, and a Simulink data type that references the CompuMethod.



Clicking the **Add** button to the right of **Simulink DataTypes** opens the Set Simulink data type to AUTOSAR CompuMethod dialog box. This dialog box lets you select a Simulink data type to add to **Simulink DataTypes**, the list of Simulink data types that reference a CompuMethod. In the list of available data types, select a `Simulink.NumericType` or `Simulink.AliasType`, or enter the name of a Simulink enumerated type.



Configure AUTOSAR SwAddrMethods

The **SwAddrMethods** view in AUTOSAR Dictionary supports modeling AUTOSAR software address methods (SwAddrMethods). AUTOSAR software components use SwAddrMethods to group data and function definitions in memory, primarily for efficiency, performance, and data access by run-time calibration tools. In AUTOSAR Dictionary, you can view or create AUTOSAR SwAddrMethods and then assign SwAddrMethods to data and functions that you want to group together. For more information, see “Configure SwAddrMethod” on page 4-243.

To configure AUTOSAR SwAddrMethod elements and properties, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary. Select **SwAddrMethods**.

The SwAddrMethods view in AUTOSAR Dictionary displays SwAddrMethods and their properties. You can:

- Select a SwAddrMethod and modify properties, such as name, section type, and AUTOSAR package to be generated for the SwAddrMethod.

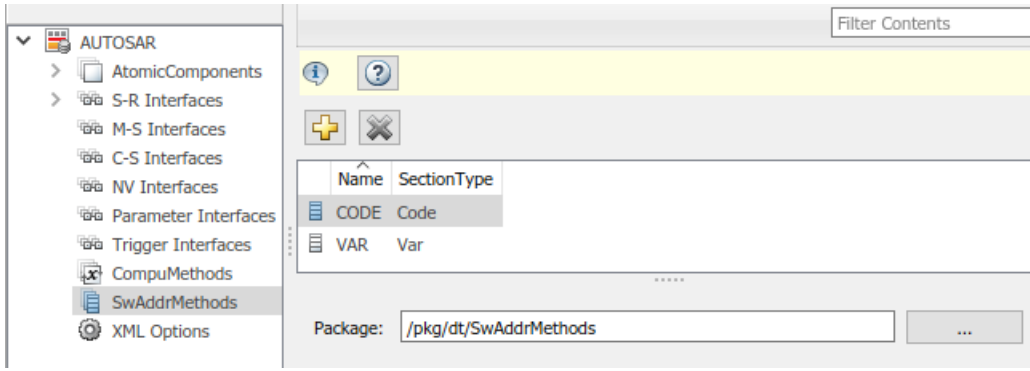
  To modify the section type, select a value from the **SectionType** drop-down list. The listed values correspond to SwAddrMethod section types listed in the AUTOSAR standard.

SectionType Value	SwAddrMethod Section Type
`CalibrationVariables`	CALIBRATION-VARIABLES
`Calprm`	CALPRM
`Code`	CODE
`ConfigData`	CONFIG-DATA
`Const`	CONST
`ExcludeFromFlash`	EXCLUDE-FROM-FLASH
`Var`	VAR

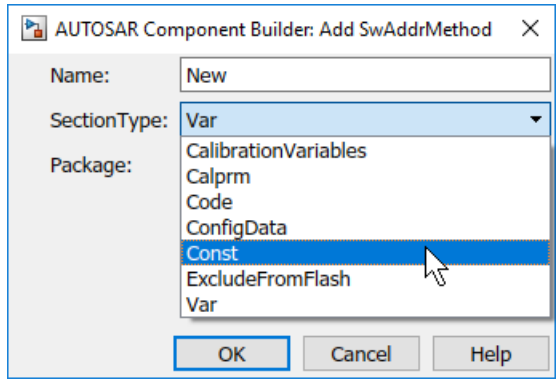
- Click the **Add** button  to open an Add SwAddrMethod dialog box to add a SwAddrMethod.
- Select a SwAddrMethod and then click the **Delete** button  to remove it.

To modify the AUTOSAR package for a SwAddrMethod, you can do either of the following:

- Enter a package path in the **Package** parameter field.
- Click the button to the right of the **Package** field to open the AUTOSAR Package Browser. Use the browser to navigate to an existing package or create a new package. When you select a package in the browser and click **Apply**, the SwAddrMethod **Package** parameter value is updated with your selection. For more information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.



The Add SwAddrMethod dialog box lets you create a new SwAddrMethod and specify its initial properties, such as name, section type, and AUTOSAR package to be generated for the SwAddrMethod.



Configure AUTOSAR XML Options

To configure AUTOSAR XML options for `arxml` file export, open a model for which a mapped AUTOSAR software component has been created and open AUTOSAR Dictionary. Select **XML Options**.

The XML options view in AUTOSAR Dictionary displays XML export parameters and their values. You can:

- Specify the granularity of file packaging for exported XML. Select one of the following values for **Exported XML file packaging**:

- `Single file` — Exports XML into a single file, *`modelname`*`.arxml`.
- `Modular` — Exports XML into multiple files, named according to the type of information contained.

Exported File Name	By Default Contains...
`modelname``_component.arxml`	Software components, including calibration components. This is the main `arxml` file exported for the Simulink model. In addition to AUTOSAR software components, the file includes elements for which AUTOSAR packages (AR-PACKAGEs) are not configured, and AR-PACKAGEs that do not align with the package paths in the other exported `arxml` files. For more information on AR-PACKAGEs and their location in modular exported `arxml` files, see "AR-PACKAGE Location in Exported ARXML Files" on page 4-96.
`modelname``_datatype.arxml`	Data types and related elements.
`modelname``_implementation.arxml`	Software component implementation.
`modelname``_interface.arxml`	Communication interfaces, including S-R, C-S, M-S, NV, parameter, and trigger interfaces.
`modelname``_behavior.arxml`	Software component internal behavior (generated only for schema 3.x or earlier).

For more information, see "Generate AUTOSAR C and XML Files" on page 5-15.

- Configure AUTOSAR packages (AR-PACKAGEs), which contain groups of AUTOSAR elements and reside in a hierarchical AR-PACKAGE structure. (The AR-PACKAGE structure for a component is logically distinct from the single-file or modular `arxml` file partitioning selected with the XML option **Exported XML file packaging**) Inspect and modify the AR-PACKAGE parameters grouped under the headings **Package Paths** and **Additional Packages**. For more information, see "Configure AUTOSAR Packages" on page 4-88.
- Optionally override the default behavior for generating AUTOSAR application data types in `arxml` code. To force generation of an application data type for each AUTOSAR data type, set **ImplementationDataType Reference** to `NotAllowed`. For more information, see "Control Application Data Type Generation" on page 4-281.

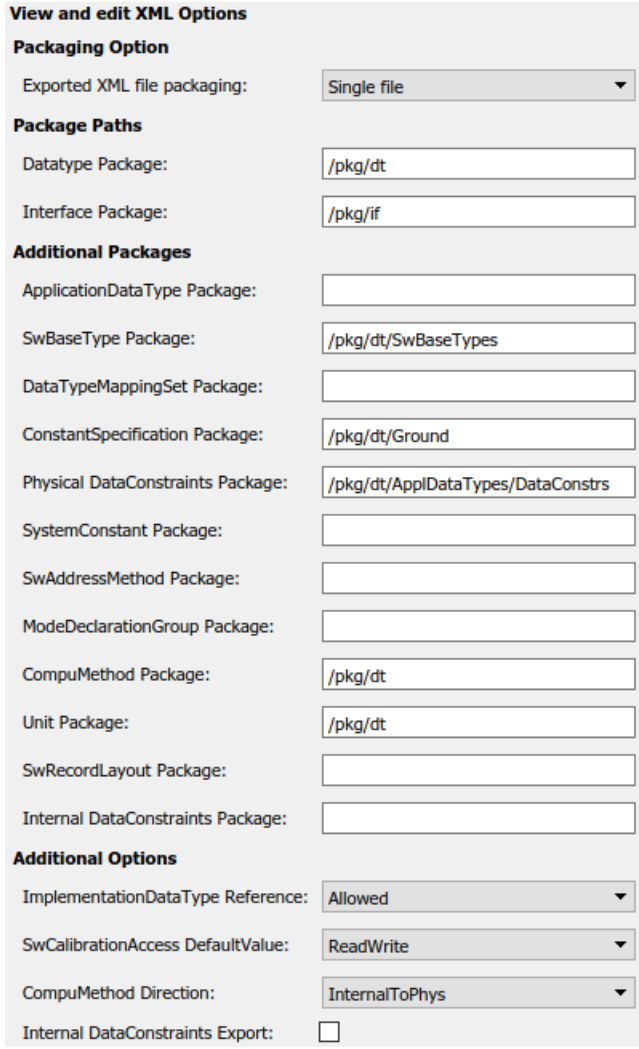
- Control the default value of the **SwCalibrationAccess** property of generated AUTOSAR measurement variables, calibration parameters, and signal and parameter data objects. Select one of the following values for **SwCalibrationAccess DefaultValue**:

  - `ReadOnly` — Read access only.
  - `ReadWrite` (default) — Read and write access.
  - `NotAccessible` — Not accessible with measurement and calibration tools.

  For more information, see “Configure SwCalibrationAccess” on page 4-237.
- Control the direction of CompuMethod conversion for linear-function CompuMethods. Select one of the following values for **CompuMethod Direction**:

  - `InternalToPhys` (default) — Generate `CompuMethod` sections for conversion of internal values into their physical representations.
  - `PhysToInternal` — Generate `CompuMethod` sections for conversion of physical values into their internal representations.
  - `Bidirectional` — Generate `CompuMethod` sections for both internal-to-physical and physical-to-internal conversion directions.

  For more information, see “Configure CompuMethod Direction for Linear Functions” on page 4-290.
- Optionally override the default behavior for generating internal data constraint information for AUTOSAR implementation data types in `arxml` code. To force export of internal data constraints for implementation data types, select the option **Internal DataConstraints Export**. For more information, see “Configure AUTOSAR Internal Data Constraints Export” on page 4-300.


View and edit XML Options
Packaging Option
Exported XML file packaging:
Single file
Package Paths
Datatype Package:
/pkg/dt
Interface Package:
/pkg/if
Additional Packages
ApplicationDataType Package:
SwBaseType Package:
/pkg/dt/SwBaseTypes
DataTypeMappingSet Package:
ConstantSpecification Package:
/pkg/dt/Ground
Physical DataConstraints Package:
/pkg/dt/ApplDataTypes/DataConstrs
SystemConstant Package:
SwAddressMethod Package:
ModeDeclarationGroup Package:
CompuMethod Package:
/pkg/dt
Unit Package:
/pkg/dt
SwRecordLayout Package:
Internal DataConstraints Package:
Additional Options
ImplementationDataType Reference:
Allowed
SwCalibrationAccess DefaultValue:
ReadWrite
CompuMethod Direction:
InternalToPhys
Internal DataConstraints Export:

See Also

Related Examples

- “Map AUTOSAR Elements for Code Generation” on page 4-68
- “Configure and Map AUTOSAR Component Programmatically” on page 4-313
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “AUTOSAR Component Configuration” on page 4-3

Map AUTOSAR Elements for Code Generation

In Simulink, you can use Code Mapping Editor and AUTOSAR Dictionary separately or together to graphically configure an AUTOSAR software component and map Simulink model elements to AUTOSAR component elements. For more information, see “AUTOSAR Component Configuration” on page 4-3.

Use Code Mapping Editor to map Simulink model elements to AUTOSAR component elements from a Simulink model perspective. The editor display consists of several tabbed tables, including **Inports**, **Outports**, **Entry-Point Functions**, and **Data Transfers**. Use the tables to select Simulink elements and map them to corresponding AUTOSAR elements. The mappings that you configure are reflected in generated AUTOSAR-compliant C code and exported `arxml` descriptions.

In this section...
“Simulink to AUTOSAR Mapping Workflow” on page 4-68
“Map Inports and Outports to AUTOSAR Sender-Receiver Ports” on page 4-70
“Map Function Callers to AUTOSAR Client-Server Ports and Operations” on page 4-72
“Map Entry-Point Functions to AUTOSAR Runnables” on page 4-73
“Map Data Transfers to AUTOSAR Inter-Runnable Variables” on page 4-75
“Map Base Workspace Lookup Table Objects to AUTOSAR Parameters” on page 4-75
“Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77
“Map Block Signals and States to AUTOSAR Variables” on page 4-80
“Specify C Type Qualifiers for AUTOSAR Static and Constant Memory” on page 4-82

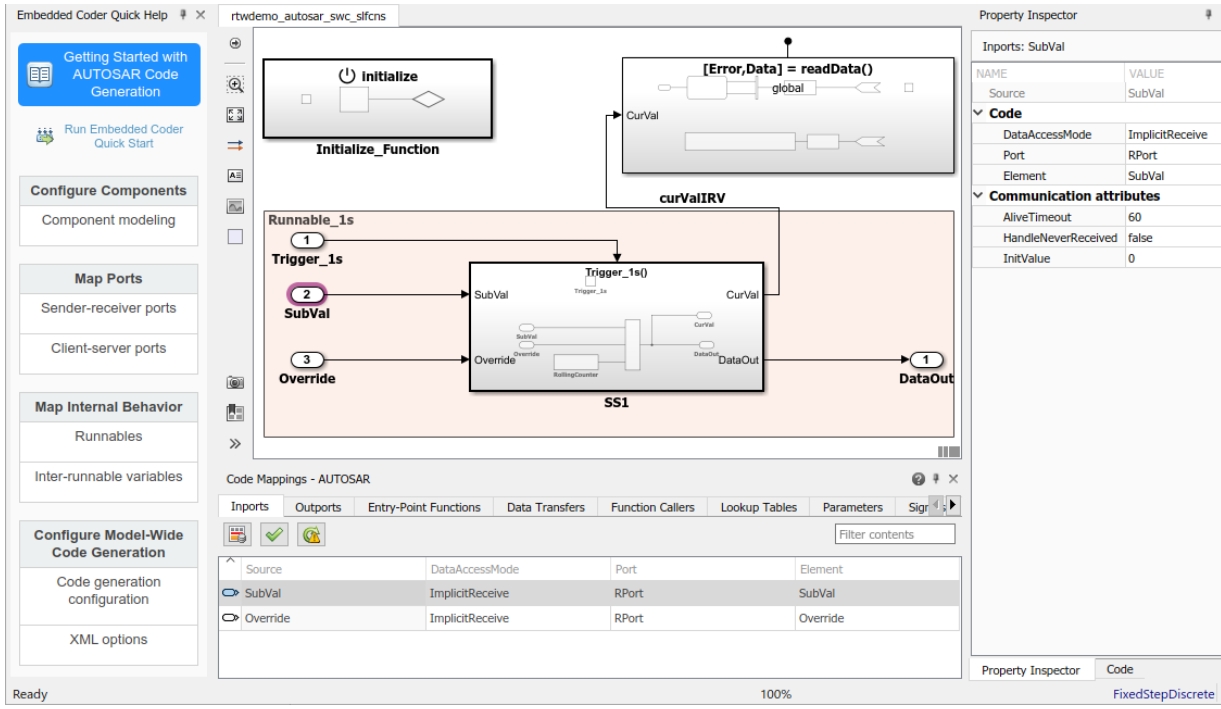
Simulink to AUTOSAR Mapping Workflow

To map Simulink model elements to AUTOSAR software component elements:

1. Open a model for which the AUTOSAR system target file (`autosar.tlc`) has been selected.
2. Create or open a mapped view of the AUTOSAR model. In the model window, do one of the following:
   - Select **Code > C/C++ Code > Configure Model in Code Perspective**

- Click the perspective control in the lower-right corner and select **Code**.

The model opens in the AUTOSAR code perspective. This perspective displays a help panel, a Property Inspector dialog box, and, directly under the model, Code Mapping Editor.



Code Mapping Editor provides in-canvas access to AUTOSAR mapping information, with batch editing, element filtering, easy navigation to model elements and AUTOSAR properties, and model element traceability.

3 Navigate Code Mapping Editor tabs to perform these actions:

- Map a Simulink inport or outport to an AUTOSAR receiver or sender port and a sender-receiver data element, with a specific data access mode.
- Map a Simulink entry-point function to an AUTOSAR runnable.
- Map a Simulink data transfer line to an AUTOSAR inter-runnable variable (IRV).
- Map a Simulink function caller to an AUTOSAR client port and a client-server operation.

- Map a Simulink lookup table to an AUTOSAR parameter.
- Map a Simulink model workspace parameter to an AUTOSAR component internal parameter.
- Map a Simulink block signal or state to an AUTOSAR variable.

Use the **Filter contents** field (where available) to selectively display some elements, while omitting others, in the current view.

4. After mapping model elements, click the **Validate** button to validate the AUTOSAR component configuration. If errors are reported, address them and then retry validation.

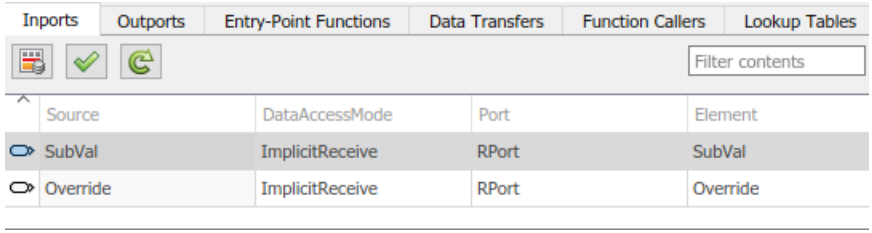
Map Inports and Outports to AUTOSAR Sender-Receiver Ports

The **Inports** and **Outports** tabs of Code Mapping Editor support modeling AUTOSAR sender-receiver (S-R) communication in Simulink. After using AUTOSAR Dictionary to create AUTOSAR S-R ports, S-R interfaces, and S-R data elements in your model, open Code Mapping Editor. Use the **Inports** and **Outports** tabs to map Simulink root inports and outports to AUTOSAR receiver and sender ports and AUTOSAR S-R data elements.

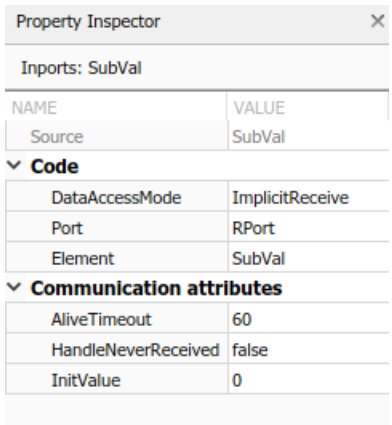
For more information, see “Configure AUTOSAR Sender-Receiver Communication” on page 4-100 and “Configure AUTOSAR Queued Sender-Receiver Communication” on page 4-119.

The **Inports** tab of Code Mapping Editor maps each Simulink root inport to an AUTOSAR receiver port and an S-R interface data element. In the **Inports** tab, you can:

- Map a Simulink inport by selecting the inport and then selecting menu values for an AUTOSAR port and an AUTOSAR element, among those listed for the AUTOSAR component.
- Select an AUTOSAR data access mode for the port: `ImplicitReceive`, `ExplicitReceive`, `ExplicitReceiveByVal`, `QueuedExplicitReceive`, `ErrorStatus`, `IsUpdated`, `EndToEndRead`, or `ModeReceive`.

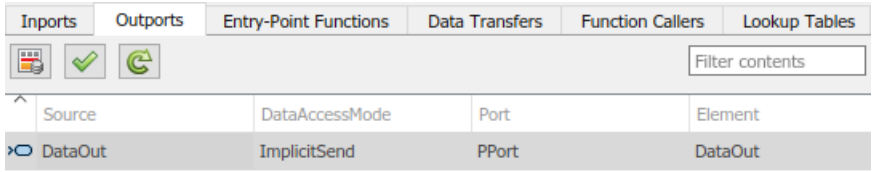


When you select an inport that maps to an AUTOSAR nonqueued receiver port, the Property Inspector displays additional port communication specification (ComSpec) attributes. For AUTOSAR receiver ports, you can modify ComSpec attributes `AliveTimeout`, `HandleNeverReceived`, and `InitValue`. For more information, see “Configure AUTOSAR Sender-Receiver Port ComSpecs” on page 4-115.

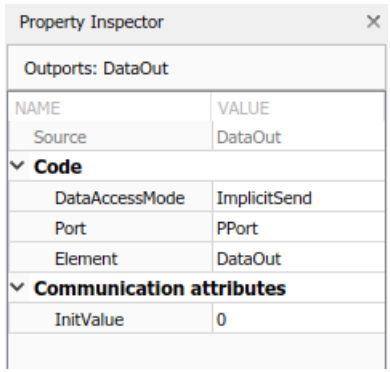


The **Outports** tab of Code Mapping Editor maps each Simulink root outport to an AUTOSAR sender port and an S-R interface data element. In the **Outports** tab, you can:

- Map a Simulink outport by selecting the outport and then selecting menu values for an AUTOSAR port and an AUTOSAR element.
- Select an AUTOSAR data access mode for the port: `ImplicitSend`, `ImplicitSendByRef`, `ExplicitSend`, `QueuedExplicitSend`, `EndToEndWrite`, or `ModeSend`.



When you select an outport that maps to an AUTOSAR nonqueued sender port, the Property Inspector displays additional port communication specification (ComSpec) attributes. For AUTOSAR sender ports, you can modify the ComSpec attribute `InitValue`. For more information, see “Configure AUTOSAR Sender-Receiver Port ComSpecs” on page 4-115.



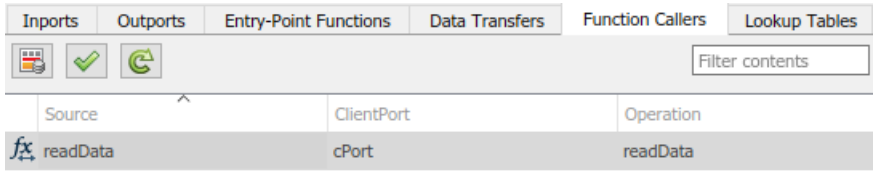
Map Function Callers to AUTOSAR Client-Server Ports and Operations

The **Function Callers** tab of Code Mapping Editor supports modeling the client side of AUTOSAR client-server (C-S) communication in Simulink. After using AUTOSAR Dictionary to create AUTOSAR client ports, C-S interfaces, and C-S operations in your model, open Code Mapping Editor. Use the **Function Callers** tab to map Simulink function callers to AUTOSAR client ports and AUTOSAR C-S operations.

For more information, see “Configure AUTOSAR Client-Server Communication” on page 4-144.

The **Function Callers** tab of Code Mapping Editor maps each Simulink function caller to an AUTOSAR client port and an AUTOSAR C-S interface operation. Click the **Update** button to load or update Simulink function callers in the model.

In the **Function Callers** tab, you can map a Simulink function caller by selecting the function caller name and then selecting menu values for an AUTOSAR client port and an AUTOSAR operation, among those listed for the AUTOSAR component.



Map Entry-Point Functions to AUTOSAR Runnables

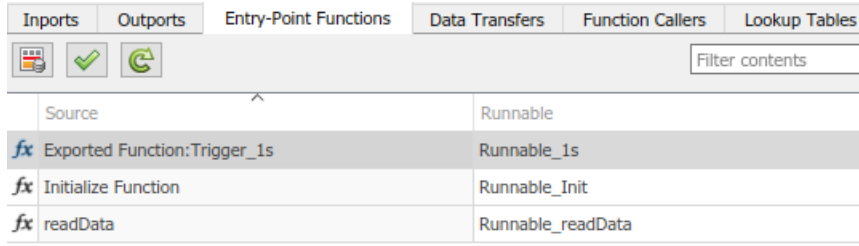
The **Entry-Point Functions** tab of Code Mapping Editor supports modeling AUTOSAR runnable entities (runnables) in Simulink. After using AUTOSAR Dictionary to create AUTOSAR runnables and AUTOSAR events, which implement aspects of internal behavior in an AUTOSAR component, open Code Mapping Editor. Use the **Entry-Point Functions** tab to map Simulink entry-point functions to AUTOSAR runnables.

For more information, see “Configure AUTOSAR Runnables and Events” on page 4-251.

The **Entry-Point Functions** tab of Code Mapping Editor maps each Simulink entry-point function to an AUTOSAR runnable. Click the **Update** button to load or update Simulink entry-point functions in the model.

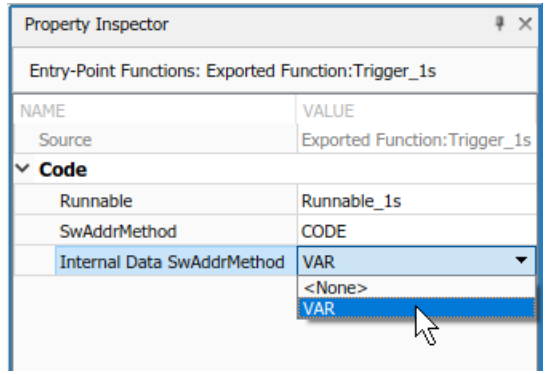
In the **Entry-Point Functions** tab, you can:

- Map a Simulink entry-point function by selecting the entry-point function and then selecting a menu value for an AUTOSAR runnable, among those listed for the AUTOSAR component.



- Specify software address methods (`SwAddrMethods`) for the runnable function code and internal data. If you specify `SwAddrMethod` names, code generation uses the names to group runnable function and data definitions in memory sections. For more information, see “Configure SwAddrMethod” on page 4-243.

  To specify `SwAddrMethods` for a runnable, select the corresponding entry-point function. Property Inspector displays the code attributes **SwAddrMethod** and **Internal Data SwAddrMethod** for the selected function. In the Property Inspector, select `SwAddrMethod` names among the valid values listed for each property.



  To create additional `SwAddrMethod` names in the component, use the AUTOSAR Dictionary, SwAddrMethods view. For more information, see “Configure AUTOSAR SwAddrMethods” on page 4-61.

Note Code generation for runnable internal data `SwAddrMethods` requires setting the model configuration option **Code Generation > Interface > Generate separate internal data per entry-point function** (`GroupInternalDataByFunction`) to `on`.

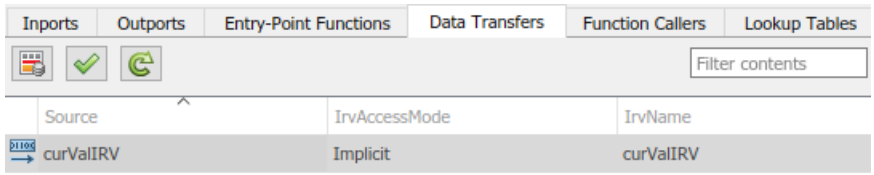
Map Data Transfers to AUTOSAR Inter-Runnable Variables

The **Data Transfers** tab of Code Mapping Editor supports modeling AUTOSAR inter-runnable variables (IRVs) in Simulink. After using AUTOSAR Dictionary to create AUTOSAR IRVs, which connect runnables and implement aspects of internal behavior in an AUTOSAR component, open Code Mapping Editor. Use the **Data Transfers** tab to map Simulink data transfer lines to AUTOSAR IRVs.

For more information, see “Model AUTOSAR Component Behavior” on page 2-30. For illustrations of how IRVs are used with rate-based and function-call-based runnables, see the example models in “Model AUTOSAR Software Components” on page 2-3.

The **Data Transfers** tab of Code Mapping Editor maps each Simulink data transfer line to an AUTOSAR IRV. Click the **Update** button  to load or update Simulink data transfers in your model.

In the **Data Transfers** tab, you can map a Simulink data transfer line by selecting the signal name and then selecting menu values for an IRV access mode (`Implicit` or `Explicit`) and an AUTOSAR IRV name, among those listed for the AUTOSAR component.



Map Base Workspace Lookup Table Objects to AUTOSAR Parameters

Embedded Codersupports modeling AUTOSAR calibration parameters for integrated and distributed lookups. You model AUTOSAR lookups using Simulink lookup table and breakpoint objects, which can reside in the base workspace as global parameters or in the model workspace as component parameters.

- To map lookup table or breakpoint objects created in the base workspace, use the **Lookup Tables** tab.

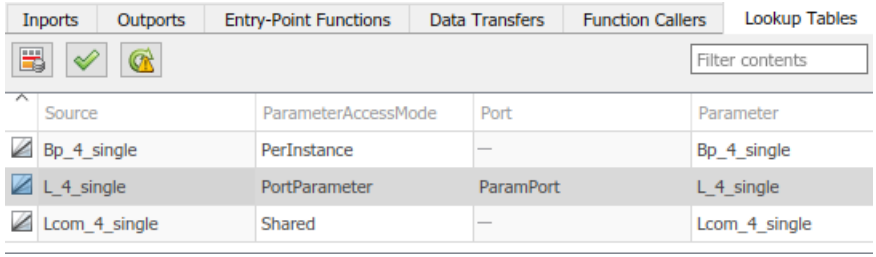
- To map lookup table or breakpoint objects created in the model workspace, use the **Parameters** tab. See “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77.

Use the **Lookup Tables** tab of Code Mapping Editor to map base workspace lookup table objects to AUTOSAR calibration parameters for integrated and distributed lookups. After using AUTOSAR Dictionary to create AUTOSAR internal or port-based parameters, open Code Mapping Editor.

The **Lookup Tables** tab of Code Mapping Editor maps each base workspace Simulink lookup table or breakpoint object to an AUTOSAR parameter. Click the **Update** button to load or update Simulink lookup tables in your model.

In the **Lookup Tables** tab, you can map a Simulink lookup table by selecting a lookup table or breakpoint object name and then selecting menu values for an AUTOSAR parameter access mode (`PortParameter`, `PerInstance`, `Shared`, or `ConstantMemory`) and an AUTOSAR parameter name, among those listed for the component.

If the AUTOSAR parameter is a parameter interface data element (access mode `PortParameter`), select a parameter receiver port and data element, among those listed for the AUTOSAR component. For more information, see “Configure AUTOSAR Port-Based Calibration Parameters” on page 4-215 and “Configure Receiver for AUTOSAR Parameter Communication” on page 4-184.



In this example:

- `Simulink.LookupTable` object `L_4_single` is mapped to an AUTOSAR port-based parameter of the same name.
- `Simulink.Breakpoint` object `Bp_4_single` is mapped to an AUTOSAR internal parameter of the same name. Each instance of the AUTOSAR software component has its own copy of the parameter.

- `Simulink.LookupTable` object `Lcom_4_single` is mapped to an AUTOSAR internal parameter of the same name. The parameter is shared by all instances of the AUTOSAR software component.

Map Model Workspace Parameters to AUTOSAR Component Internal Parameters

The **Parameters** tab of Code Mapping Editor supports mapping Simulink model workspace parameters to AUTOSAR parameters for AUTOSAR run-time calibration. Examples of model workspace parameters you can map include:

- Simulink parameter objects
- Simulink lookup table objects
- Simulink breakpoint objects

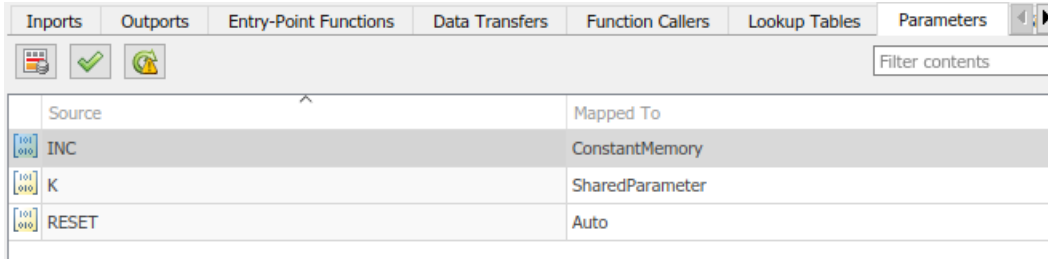
By mapping lookup table and breakpoint objects to AUTOSAR internal calibration parameters, you can model AUTOSAR parameters for integrated and distributed lookups. For more information, see “Configure STD_AXIS and COM_AXIS Lookup Tables for AUTOSAR Measurement and Calibration” on page 4-220.

After creating model workspace parameters, for example, using Model Explorer, open Code Mapping Editor. Use the **Parameters** tab to map Simulink model workspace parameters to AUTOSAR component internal parameters, such as shared parameters or constant memory.

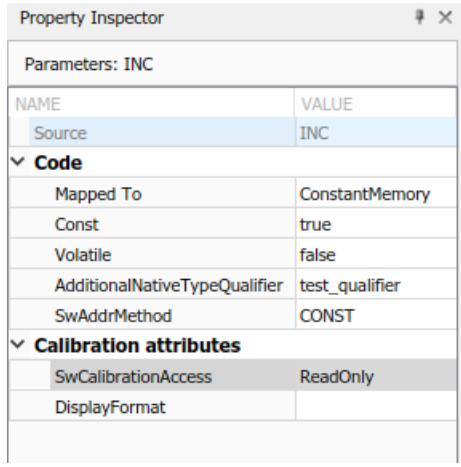
For more information about constant memory, see “Configure AUTOSAR Constant Memory” on page 4-278.

The **Parameters** tab of Code Mapping Editor maps each Simulink model workspace parameter to an AUTOSAR parameter. In the **Parameters** tab, you can:

- Map a Simulink model workspace parameter by selecting the parameter and then selecting a menu value for an AUTOSAR parameter type: `ConstantMemory`, `SharedParameter`, or `Auto`. To accept software mapping defaults, specify `Auto`.



- If you select a parameter type other than `Auto`, use Property Inspector to view or modify other code and calibration attributes for the parameter.



Attribute	Purpose
Const (`ConstantMemory` only)	Specify whether to include C type qualifier `const` in generated code for the AUTOSAR parameter. For more information, see “Specify C Type Qualifiers for AUTOSAR Static and Constant Memory” on page 4-82.

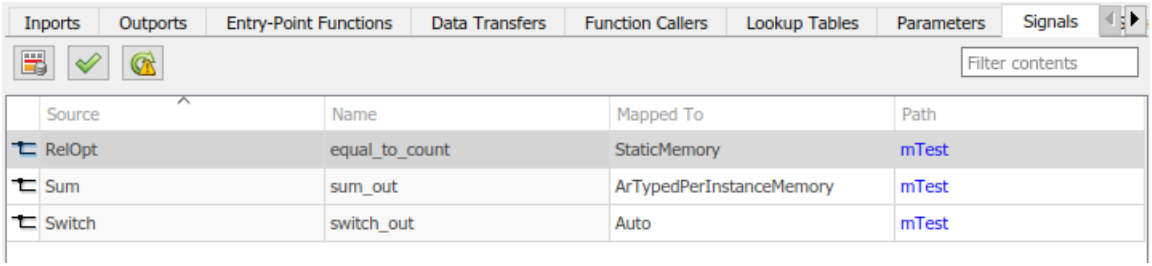
Attribute	Purpose
Volatile (`ConstantMemory` only)	Specify whether to include C type qualifier `volatile` in generated code for the AUTOSAR parameter. For more information, see “Specify C Type Qualifiers for AUTOSAR Static and Constant Memory” on page 4-82.
AdditionalNativeTypeQualifier (`ConstantMemory` only)	Specify an AUTOSAR additional native type qualifier to include in generated code for the AUTOSAR parameter. For more information, see “Specify C Type Qualifiers for AUTOSAR Static and Constant Memory” on page 4-82.
SwAddrMethod	Select a `SwAddrMethod` name among those listed as valid for the AUTOSAR parameter. Code generation uses the `SwAddrMethod` name to group AUTOSAR parameters in a memory section for access by measurement and calibration tools. For more information, see “Configure SwAddrMethod” on page 4-243.
SwCalibrationAccess	Specify how measurement and calibration tools can access the AUTOSAR parameter. Valid access values include `ReadOnly`, `ReadWrite`, and `NotAccessible`. For more information, see “Configure SwCalibrationAccess” on page 4-237.
DisplayFormat	Specify display format for the AUTOSAR parameter. AUTOSAR display format specifications control the width and precision display for measurement and calibration data. For more information, see “Configure DisplayFormat” on page 4-240.

Map Block Signals and States to AUTOSAR Variables

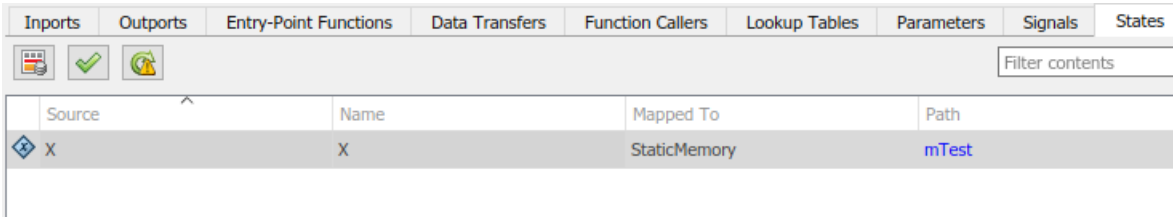
The **Signals** and **States** tabs of Code Mapping Editor support mapping Simulink block signals and states to AUTOSAR variables for AUTOSAR run-time calibration. After creating named or test-pointed Simulink block signals or Simulink state owner blocks in your model, open Code Mapping Editor. Use the **Signals** and **States** tabs to map the block signals and states to AUTOSAR variables, such as AUTOSAR-typed per-instance memory or AUTOSAR static memory.

For more information, see “Configure AUTOSAR Per-Instance Memory” on page 4-270 and “Configure AUTOSAR Static Memory” on page 4-275.

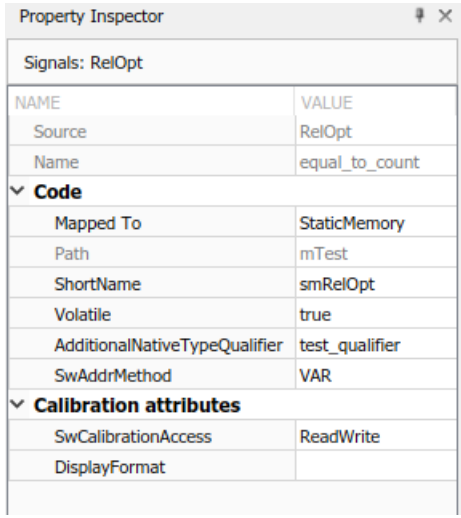
The **Signals** tab of Code Mapping Editor maps each named or test-pointed Simulink block signal to an AUTOSAR variable. In the **Signals** tab, you can map a Simulink block signal by selecting the signal and then selecting a menu value for an AUTOSAR variable type: `ArTypedPerInstanceMemory`, `StaticMemory`, or `Auto`. To accept software mapping defaults, specify `Auto`.



The **States** tab of Code Mapping Editor maps each configurable Simulink block state to an AUTOSAR variable. In the **States** tab, you can map a Simulink block state by selecting the state and then selecting a menu value for an AUTOSAR variable type: `ArTypedPerInstanceMemory`, `StaticMemory`, or `Auto`. To accept software mapping defaults, specify `Auto`.



In either tab, if you map a signal or state to a variable type other than `Auto`, you can use Property Inspector to view or modify other code and calibration attributes for the variable.



Attribute	Purpose
ShortName	Specify short name for the AUTOSAR variable. If unspecified, `arxml` export automatically generates a short name. • For signals, the auto-generated short name can differ from the signal name. • For states, the auto-generated short name is based on the state name if one exists. If the state is unnamed, the generated name can differ from the block name.
Volatile (`StaticMemory` only)	Specify whether to include C type qualifier `volatile` in generated code for the AUTOSAR variable. For more information, see “Specify C Type Qualifiers for AUTOSAR Static and Constant Memory” on page 4-82.

Attribute	Purpose
AdditionalNativeTypeQualifier (`StaticMemory` only)	Specify an AUTOSAR additional native type qualifier to include in generated code for the AUTOSAR variable. For more information, see “Specify C Type Qualifiers for AUTOSAR Static and Constant Memory” on page 4-82.
SwAddrMethod	Select a `SwAddrMethod` name among those listed as valid for the AUTOSAR variable. Code generation uses the `SwAddrMethod` name to group AUTOSAR variables in a memory section for access by measurement and calibration tools. For more information, see “Configure SwAddrMethod” on page 4-243.
SwCalibrationAccess	Specify how measurement and calibration tools can access the AUTOSAR variable. Valid access values include `ReadOnly`, `ReadWrite`, and `NotAccessible`. For more information, see “Configure SwCalibrationAccess” on page 4-237.
DisplayFormat	Specify display format for the AUTOSAR variable. AUTOSAR display format specifications control the width and precision display for measurement and calibration data. For more information, see “Configure DisplayFormat” on page 4-240.

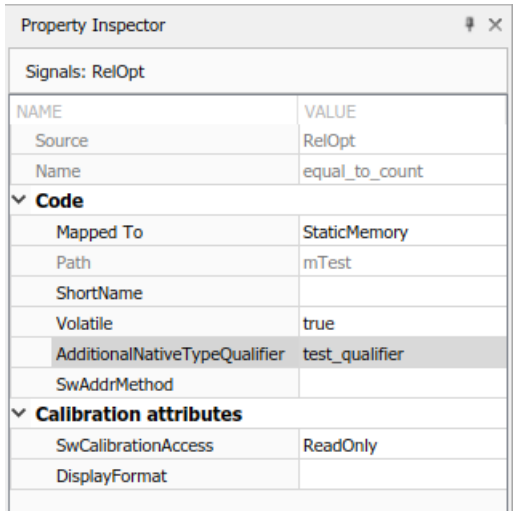
Specify C Type Qualifiers for AUTOSAR Static and Constant Memory

For an AUTOSAR component, you can configure C type qualifiers to customize generated AUTOSAR-compliant C code for AUTOSAR static memory and AUTOSAR constant memory. For example, you can apply C type qualifiers such as `const` or `volatile` to control compiler optimizations.

In an AUTOSAR model, use Code Mapping Editor to configure C type qualifiers for model signals, states, and parameters that are mapped to AUTOSAR StaticMemory or AUTOSAR

ConstantMemory. Building the model exports type qualifiers to `arxml` files and generates AUTOSAR-compliant C code that uses the type qualifiers.

For example, in Code Mapping Editor, **Signals** tab, suppose that you map a signal to `StaticMemory`. Select the signal to display code attributes in Property Inspector.



If you set the `Volatile` attribute to true and specify `AdditionalNativeTypeQualifier` to be `test_qualifier`:

- Exported `arxml` files define the `AdditionalNativeTypeQualifier`:

  ```
  <ADDITIONAL-NATIVE-TYPE-QUALIFIER>volatile test_qualifier</ADDITIONAL-NATIVE-TYPE-QUALIFIER>
  ```

- Generated C code uses the C type qualifiers, for example:

  ```
  /* Static Memory for Internal Data */
  boolean volatile test_qualifier mTest_equal_to_count;
  ```

For more information, see “Map Block Signals and States to AUTOSAR Variables” on page 4-80 and “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77.

See Also

Related Examples

- “Configure AUTOSAR Elements and Properties” on page 4-7
- “Configure and Map AUTOSAR Component Programmatically” on page 4-313

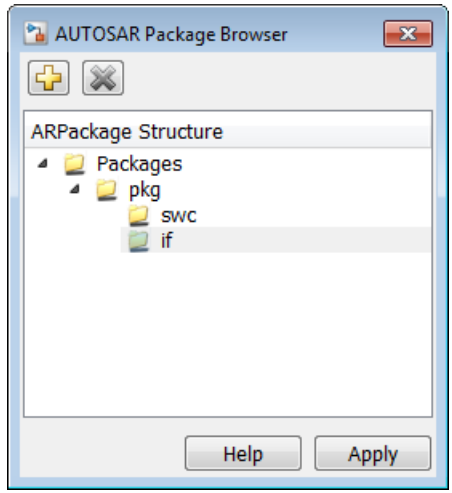
More About

- “AUTOSAR Component Configuration” on page 4-3

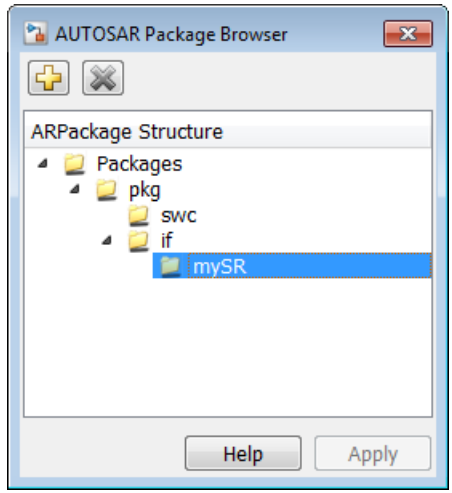
Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod

As part of configuring an AUTOSAR component, interface, CompuMethod, or SwAddrMethod, you specify the AUTOSAR package (AR-PACKAGE) to be generated for individual components, interfaces, CompuMethods, or SwAddrMethods in your configuration. For example, here is the AUTOSAR Dictionary view for an individual interface.

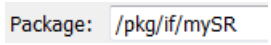
You can enter a package path in the **Package** parameter field, or use the AUTOSAR Package Browser to select a package. To open the browser, click the button to the right of the **Package** field. The AUTOSAR Package Browser opens.



In the browser, you can select an existing package, or create and select a new package. To create a new package, select the containing folder for the new package and click the **Add** button  . For example, to add a new interface package, select the `if` folder and click the **Add** button. Then select the new subpackage and edit its name.



When you apply your changes in the browser, the interface **Package** parameter value is updated with your selection.



For more information about AR-PACKAGEs, see “Configure AUTOSAR Packages” on page 4-88.

See Also

Related Examples

- “Configure AUTOSAR Elements and Properties” on page 4-7
- “Configure and Map AUTOSAR Component Programmatically” on page 4-313

More About

- “AUTOSAR Component Configuration” on page 4-3

Configure AUTOSAR Packages

In Simulink, you can modify the hierarchical AUTOSAR package structure, as defined by the AUTOSAR standard, that Embedded Coder exports to `arxml` code.

In this section...

AR-PACKAGE Structure

The AUTOSAR standard defines AUTOSAR packages (AR-PACKAGEs). AR-PACKAGEs contain groups of AUTOSAR elements and reside in a hierarchical AR-PACKAGE structure. In an AUTOSAR authoring tool (AAT) or in Simulink, you can configure an AR-PACKAGE structure to:

- Conform to an organizational or standardized AR-PACKAGE structure.
- Establish a namespace for elements in a package.
- Provide a basis for relative references to elements.

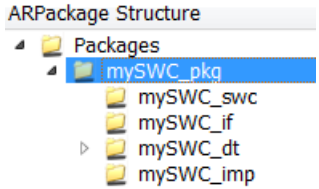
The `arxml` importer imports AR-PACKAGEs, their elements, and their paths into Simulink. The model configuration preserves the packages for subsequent export to `arxml` code. In general, the software preserves AUTOSAR packages across round-trips between an AAT and Simulink.

If your AUTOSAR component originated in Simulink, at component creation, the AUTOSAR component builder creates an initial default AR-PACKAGE structure, containing the following packages.

- Software components (including calibration components)
- Data types
- Port interfaces
- Internal behavior (schema 3.x or earlier)

- Implementation

For example, suppose that you start with a simple Simulink model, such as `rtwdemo_counter`. Rename it to `mySWC`. Configure the model for AUTOSAR code generation. (For example, open Embedded Coder Quick Start and select AUTOSAR code generation.) When you build the model, its initial AR-PACKAGE structure resembles the following figure.



After component creation, you can use the **XML Options** view in AUTOSAR Dictionary to specify additional AR-PACKAGEs. (See “Configure AUTOSAR XML Options” on page 4-63.) Each AR-PACKAGE represents an AUTOSAR element category. During code generation, the `arxml` exporter generates a package if any elements of its category exist in the model. For each package, you specify a path, which defines its location in the AR-PACKAGE structure.

Using XML options, you can configure AUTOSAR packages for the following categories of AUTOSAR elements:

- Application data types (schema 4.x)
- Software base types (schema 4.x)
- Data type mapping sets (schema 4.x)
- Constants and values
- Physical data constraints (referenced by application data types or data prototypes)
- System constants (schema 4.x)
- Software address methods
- Mode declaration groups
- Computation methods
- Units and unit groups (schema 4.x)
- Software record layouts (for application data types of category CURVE, MAP, CUBOID, or COM_AXIS)

- Internal data constraints (referenced by implementation data types)

Note

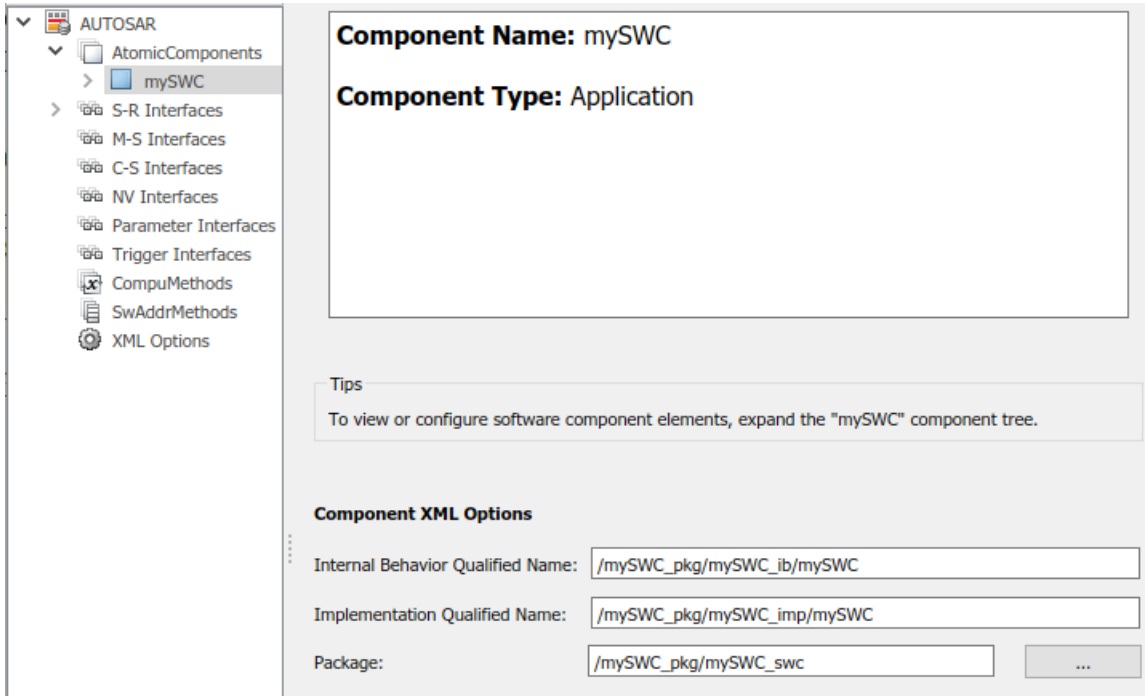
- For packages that you define in XML options, the `arxml` exporter generates a package only if the model contains an element of the package category. For example, the exporter generates a software address method package only if the model contains a software address method element.
- If your component uses schema 4.x, you can specify separate packages for the listed schema 4.x elements, for example, application data types. Schema 4.x implementation data types are aggregated in the main data types package.

The AR-PACKAGE structure is logically distinct from the single-file or modular-file partitioning that you can select for `arxml` export, using the XML option **Exported XML file packaging**. For more information about AUTOSAR package export, see “AR-PACKAGE Location in Exported ARXML Files” on page 4-96.

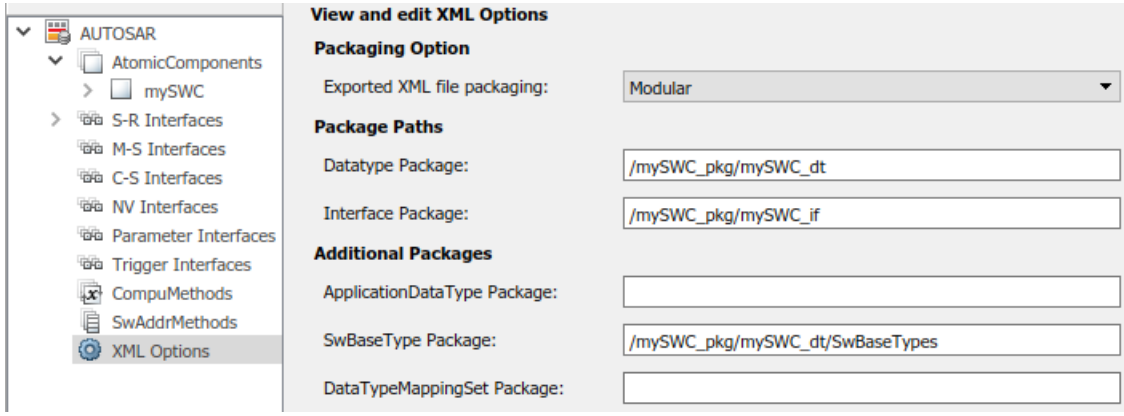
Configure AUTOSAR Packages and Paths

If you import an AR-PACKAGE structure into Simulink, the `arxml` importer preserves package-element relationships and package paths defined in the `arxml` code. Also, the importer populates packaging properties in the component and **XML Options** views in AUTOSAR Dictionary. If the `arxml` code does not assign AUTOSAR elements to packages based on category, the importer uses heuristics to determine an optimal category association for a package. However, a maximum of one package can be associated with a category.

Suppose that you start with a non-AUTOSAR Simulink model and configure the model for AUTOSAR code generation. (For example, open Embedded Coder Quick Start and select AUTOSAR code generation.) The software creates an initial default AR-PACKAGE structure. After component creation, the component view in AUTOSAR Dictionary displays **Component XML Options**, including package paths for the component, internal behavior, and implementation.



The **XML Options** view displays paths for AUTOSAR data type and interface packages, and additional packages.



Using the **Additional Packages** subpane, you can populate path fields for additional packages or leave them empty. If you leave a package field empty, and if the model contains packageable elements of that category, the `arxml` exporter uses internal rules to calculate the package path. The application of internal rules is backward-compatible with earlier releases. The following table lists the XML option packaging properties with their rule-based default package paths.

Property Name	Package Paths Based on Internal Rules
InternalBehaviorQualifiedName	*modelname*_pkg/*modelname*_ib/*modelname*
ImplementationQualifiedName	*modelname*_pkg/*modelname*_imp/*modelname*
ComponentQualifiedName	*modelname*_pkg/*modelname*_swc/*modelname* (dialog box displays the component path without the short name)
DataTypePackage	*modelname*_pkg/*modelname*_dt
InterfacePackage	*modelname*_pkg/*modelname*_if
ApplicationDataTypePackage	*DataTypePackage*/ApplDataTypes
SwBaseTypePackage	*DataTypePackage*/SwBaseTypes
DataTypeMappingPackage	*DataTypePackage*/DataTypeMappings
ConstantSpecificationPackage	*DataTypePackage*/Ground
DataConstraintPackage	*ApplicationDataTypePackage*/DataConstrs
SystemConstantPackage	*DataTypePackage*/SystemConstants
SwAddressMethodPackage	*DataTypePackage*/SwAddrMethods
ModeDeclarationGroupPackage	*DataTypePackage*
CompuMethodPackage	*DataTypePackage*
UnitPackage	*DataTypePackage*
SwRecordLayoutPackage	*ApplicationDataTypePackage*/RecordLayouts
InternalDataConstraintPackage	*DataTypePackage*/DataConstrs

To set a packaging property in the MATLAB Command Window or in a script, use an AUTOSAR property `set` function call similar to the following:

```
open_system('rtwdemo_autosar_counter');
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_counter');
set(arProps,'XmlOptions','ApplicationDataTypePackage','/rtwdemo_autosar_counter_pkg/ADTs');
get(arProps,'XmlOptions','ApplicationDataTypePackage')
```

For a sample script, see “Configure AUTOSAR XML Export” on page 4-339.

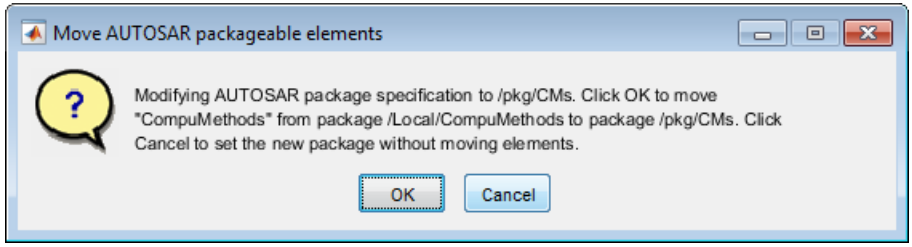
For an example of configuring and exporting AUTOSAR packages, see “Export AUTOSAR Packages” on page 4-94.

Control AUTOSAR Elements Affected by Package Path Modifications

If you modify an AUTOSAR package path, and if packageable elements of that category are affected, you can:

- Move the elements from the existing package to the new package.
- Set the new package path without moving the elements.

If you modify a package path in AUTOSAR Dictionary, and if packageable elements of that category are affected, a dialog box opens. For example, if you modify the XML option **CompuMethod Package** from path value `/Local/CompuMethods` to `/pkg/CMs`, the software opens the following dialog box.



To move CompuMethod elements to the new package, click **OK**. To set the new package path without moving the elements, click **Cancel**.

If you programmatically modify a package path, you can use the `MoveElements` property to specify handling of affected elements. The property can be set to `All` (the default), `None`, or `Alert`. If you specify `Alert`, and if packageable elements are affected, the software opens the dialog box with **OK** and **Cancel** buttons.

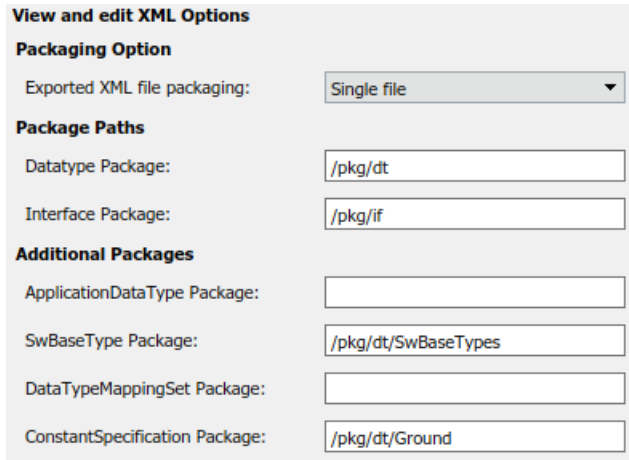
For example, the following code sets a new CompuMethod package path without moving existing CompuMethod elements to the new package.

```
arProps = autosar.api.getAUTOSARProperties('cmSpeed');
set(arProps,'XmlOptions','CompuMethodPackage','/pkg/CMs','MoveElements','None');
```

Export AUTOSAR Packages

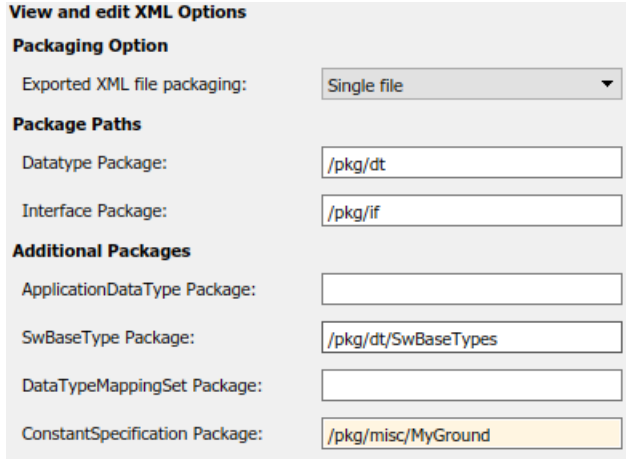
This example shows how to configure and export AUTOSAR packages for an AUTOSAR software component that originated in Simulink.

1. Open a model that you configured for the AUTOSAR system target file and that models an AUTOSAR software component. This example uses the example model `rtwdemo_autosar_multirunnables`.
2. Open AUTOSAR Dictionary and select **XML Options**. Here are initial settings for some of the AUTOSAR package parameters.



   In this example, **Exported XML file packaging** is set to `Single file`, which generates a single, unified `arxml` file. If you prefer multiple, modular `arxml` files, change the setting to `Modular`.
3. Configure packages for one or more AUTOSAR elements that your model exports to `arxml` code. For each package, enter a path to define its location in the AR-PACKAGE structure. Click **Apply**.

   The example model exports multiple AUTOSAR constant specifications. This example sets the **ConstantSpecification Package** parameter to `/pkg/misc/MyGround`. (This value overrides the rule-based default, `/pkg/dt/Ground`.)



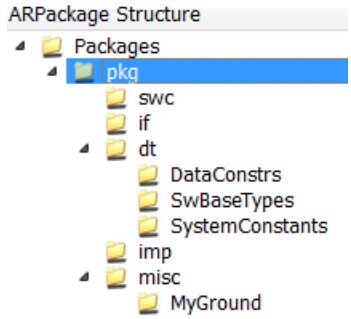
4. Generate code for the model.
5. Open the generated file *modelname*`.arxml`. (If you set **Exported XML file packaging** to `Modular`, open the generated file *modelname*`_component.arxml`.)
6. Search the XML code for the packages that you configured, for example, using the text AR-PACKAGE or an element name. For the example model, searching `rtwdemo_autosar_multirunnables.arxml` for the text `MyGround` finds the constant specification package and many references to it. Here is a sample code excerpt.

```
<AR-PACKAGE UUID="95f4dcf1-66ea-5f72-cd27-34f4eb36ad65">
    <SHORT-NAME>MyGround</SHORT-NAME>
    <ELEMENTS>
        <CONSTANT-SPECIFICATION UUID="be03b363-5267-5a11-531f-22a443475036">
            <SHORT-NAME>DefaultInitValue_Double</SHORT-NAME>
            <VALUE-SPEC>
                <NUMERICAL-VALUE-SPECIFICATION>
                    <SHORT-LABEL>DefaultInitValue_Double</SHORT-LABEL>
                    <VALUE>0</VALUE>
                </NUMERICAL-VALUE-SPECIFICATION>
            </VALUE-SPEC>
        </CONSTANT-SPECIFICATION>
        <CONSTANT-SPECIFICATION UUID="f1220406-2ece-568f-f709-693cc6b12b8a">
            <SHORT-NAME>DefaultInitValu_036fab392deee624</SHORT-NAME>
            <VALUE-SPEC>
                <ARRAY-VALUE-SPECIFICATION>
                    <SHORT-LABEL>DefaultInitValu_036fab392deee624</SHORT-LABEL>
                    <ELEMENTS>
                        <CONSTANT-REFERENCE>
                            <SHORT-LABEL>DefaultInitValu_d172891e92bde674</SHORT-LABEL>
                            <CONSTANT-REF DEST="CONSTANT-SPECIFICATION">/pkg/misc/MyGround/DefaultInitValue_Double</CONSTANT-REF>
                        </CONSTANT-REFERENCE>
                        <CONSTANT-REFERENCE>
                            <SHORT-LABEL>DefaultInitValu_2d898f9704c2f030</SHORT-LABEL>
                            <CONSTANT-REF DEST="CONSTANT-SPECIFICATION">/pkg/misc/MyGround/DefaultInitValue_Double</CONSTANT-REF>
                        </CONSTANT-REFERENCE>
```

AR-PACKAGE Location in Exported ARXML Files

Grouping AUTOSAR elements into AUTOSAR packages (AR-PACKAGEs) is logically distinct from the `arxml` output file packaging that the AUTOSAR configuration parameter **Exported XML file packaging** controls. Whether you set **Exported XML file packaging** to `Single file` or `Modular`, `arxml` export preserves the configured AR-PACKAGE structure.

Suppose that you configure the example model `rtwdemo_autosar_multirunnables` with the following AR-PACKAGE structure. (See the steps in “Export AUTOSAR Packages” on page 4-94). In this configuration, the specified path of the constant specification package, `/pkg/misc/myGround`, overrides the rule-based default, `/pkg/dt/Ground`.



If you export this AR-PACKAGE structure into a single file (**Exported XML file packaging** is set to `Single file`), the exported `arxml` code preserves the configured AR-PACKAGE structure.

`rtwdemo_autosar_multirunnables.arxml:`

```
<AR-PACKAGES>
    <AR-PACKAGE UUID="...">
        <SHORT-NAME>pkg</SHORT-NAME>
        ...
                <SHORT-NAME>swc</SHORT-NAME>
                ...
                <SHORT-NAME>if</SHORT-NAME>
                ...
                <SHORT-NAME>dt</SHORT-NAME>
                ...
                        <SHORT-NAME>SwBaseTypes</SHORT-NAME>
                    ...
                <SHORT-NAME>misc</SHORT-NAME>
                ...
                        <SHORT-NAME>MyGround</SHORT-NAME>
                        ...
                <SHORT-NAME>imp</SHORT-NAME>
                ...
    </AR-PACKAGE>
</AR-PACKAGES>
```

If you export the same AR-PACKAGE structure into multiple files (**Exported XML file packaging** is set to `Modular`), the exported `arxml` code preserves the configured AR-PACKAGE structure, distributed across multiple files.

The exporter maps packages to `arxml` files based on package path, not on package content or element category. For example, the exporter maps the data-type-oriented package, `/pkg/misc/myGround`, to the component file, `rtwdemo_autosar_multirunnables_component.arxml`, based on the package path.

To group the package with other data-type-oriented packages, both in the AR-PACKAGE structure and in `arxml` output, specify a package path beginning with `/pkg/dt/`.

rtwdemo_autosar_multirunnables_component.arxml:

```
<AR-PACKAGES>
    <AR-PACKAGE UUID="...">
        <SHORT-NAME>pkg</SHORT-NAME>
        ...
                <SHORT-NAME>swc</SHORT-NAME>
                ...
                <SHORT-NAME>misc</SHORT-NAME>
                ...
                        <SHORT-NAME>MyGround</SHORT-NAME>
                        ...
    </AR-PACKAGE>
</AR-PACKAGES>
```

rtwdemo_autosar_multirunnables_interface.arxml:

```
<AR-PACKAGES>
    <AR-PACKAGE UUID="...">
        <SHORT-NAME>pkg</SHORT-NAME>
        ...
                <SHORT-NAME>if</SHORT-NAME>
                ...
    </AR-PACKAGE>
</AR-PACKAGES>
```

rtwdemo_autosar_multirunnables_datatype.arxml:

```
<AR-PACKAGES>
    <AR-PACKAGE UUID="...">
        <SHORT-NAME>pkg</SHORT-NAME>
        ...
                <SHORT-NAME>dt</SHORT-NAME>
                ...
                        <SHORT-NAME>SwBaseTypes</SHORT-NAME>
                        ...
    </AR-PACKAGE>
</AR-PACKAGES>
```

rtwdemo_autosar_multirunnables_implementation.arxml:

```
<AR-PACKAGES>
    <AR-PACKAGE UUID="...">
        <SHORT-NAME>pkg</SHORT-NAME>
        ...
                <SHORT-NAME>imp</SHORT-NAME>
                ...
    </AR-PACKAGE>
</AR-PACKAGES>
```

See Also

Related Examples

- “Import AUTOSAR Software Component” on page 3-4
- “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85
- “Configure AUTOSAR XML Options” on page 4-63
- “Configure AUTOSAR XML Export” on page 4-339
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “AUTOSAR Component Configuration” on page 4-3

Configure AUTOSAR Sender-Receiver Communication

In AUTOSAR port-based sender-receiver (S-R) communication, AUTOSAR software components read and write data to other components or services. To implement S-R communication, AUTOSAR software components define provide and require ports that send and receive data.

In Simulink, you can create AUTOSAR S-R interfaces and ports, and map Simulink inports and outports to AUTOSAR ports. You model AUTOSAR provide and require ports with Simulink root-level outports and inports, as described in “Sender-Receiver Interface” on page 2-14.

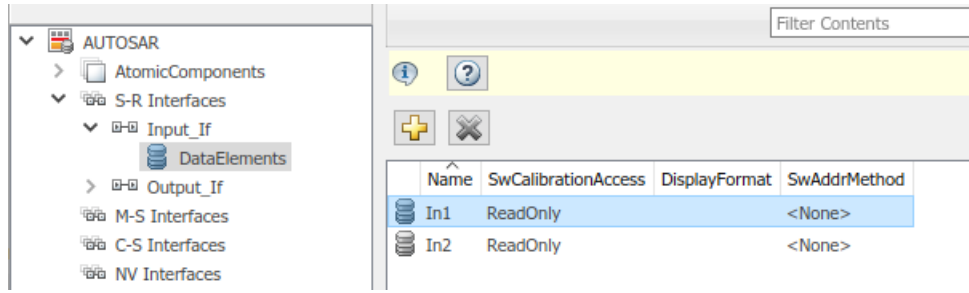
For queued sender-receiver communication, see “Configure AUTOSAR Queued Sender-Receiver Communication” on page 4-119.

In this section...

Configure AUTOSAR Sender-Receiver Interface

To create an S-R interface and ports in Simulink:

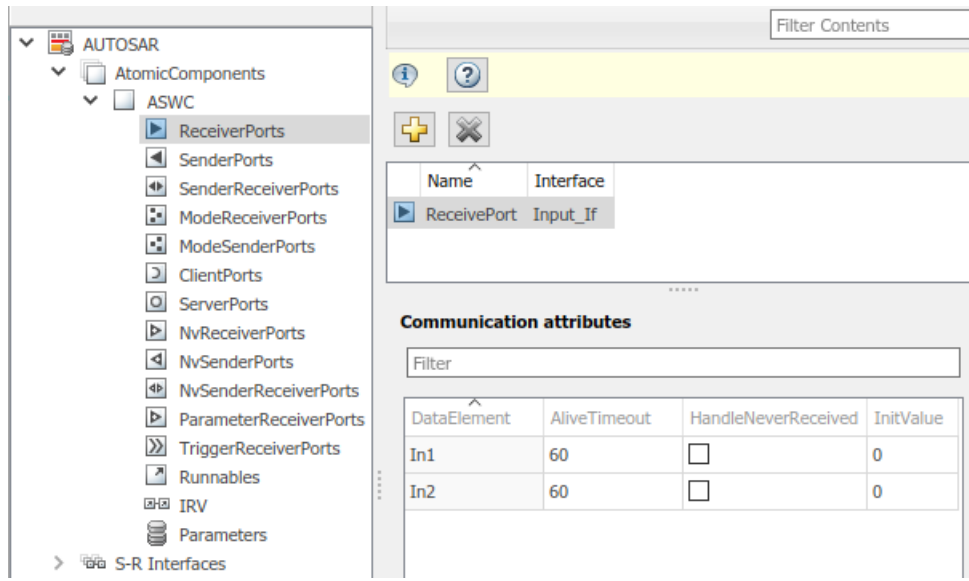
1. Open AUTOSAR Dictionary and select **S-R Interfaces**. Click the **Add** button  to create a new AUTOSAR S-R data interface. Specify its name and the number of associated S-R data elements.
2. Select and expand the new S-R interface. Select **DataElements**, and modify the AUTOSAR data element attributes.



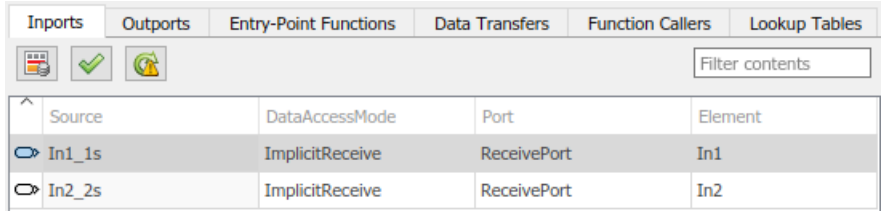
3 In AUTOSAR Dictionary, expand the **AtomicComponents** node and select an AUTOSAR component. Expand the component.

4 Select and use the **ReceiverPorts**, **SenderPorts**, and **SenderReceiverPorts** views to add AUTOSAR S-R ports that you want to associate with the new S-R interface. For each new S-R port, select the S-R interface you created.

Optionally, examine the communication attributes for each S-R port and modify where required. For more information, see “Configure AUTOSAR Sender-Receiver Port ComSpecs” on page 4-115.



5 Open Code Mapping Editor. Select and use the **Inports** and **Outports** tabs to map Simulink inports and outports to AUTOSAR S-R ports. For each inport or outport, select an AUTOSAR port, data element, and data access mode.



Configure AUTOSAR Provide-Require Port

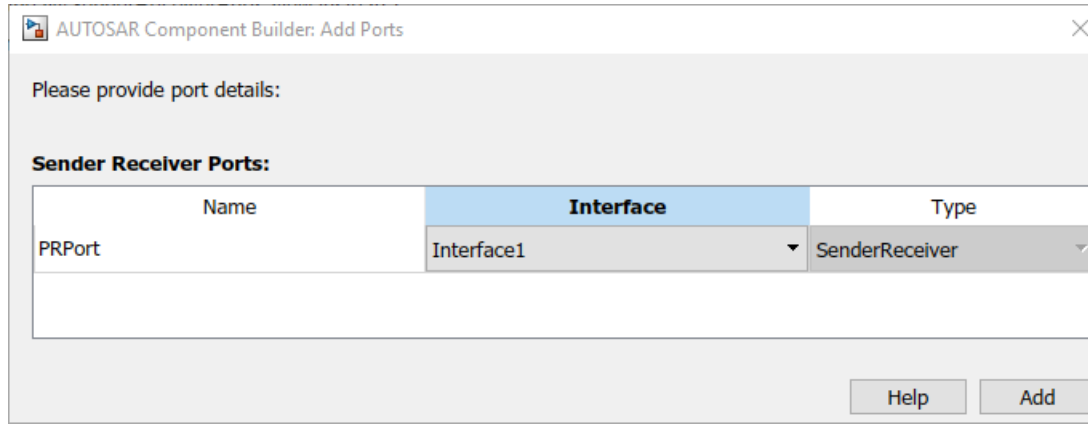
AUTOSAR Release 4.1 introduced the AUTOSAR provide-require port (`PRPort`). Modeling an AUTOSAR `PRPort` involves using a Simulink inport and outport pair with matching data type, dimension, and signal type. You can associate a `PRPort` with a sender-receiver (S-R) interface or a nonvolatile (NV) data interface.

To configure an AUTOSAR `PRPort` for S-R communication in Simulink:

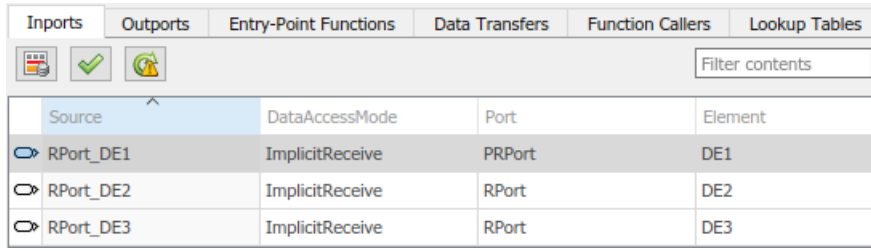
1 Open a model that is configured for AUTOSAR, and in which a runnable has an inport and an outport suitable for pairing into an AUTOSAR `PRPort`. In this example, the `RPort_DE1` inport and `PPort_DE1` outport both use data type `int8`, port dimension 1, and signal type `real`.

2 Open AUTOSAR Dictionary and navigate to the **SenderReceiverPorts** view. (To configure a `PRPort` for NV communication, use the **NvSenderReceiverPorts** view instead.)

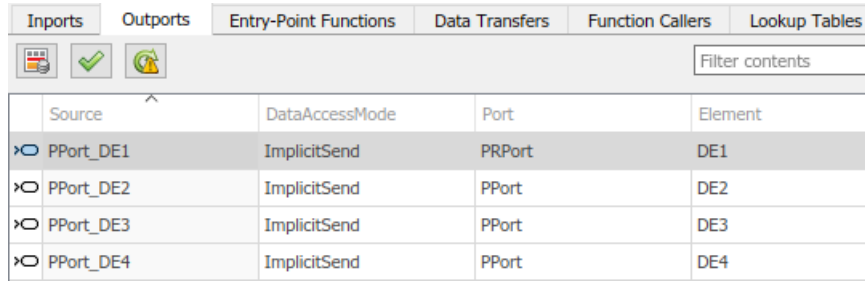
3 To add a sender-receiver port, click the **Add** button  . In the Add Ports dialog box, specify **Name** as `PRPort` and select an **Interface** from the list of available S-R interfaces. Click **Add**.



4 Open Code Mapping Editor and select the **Inports** tab. To map a Simulink inport to the AUTOSAR sender-receiver port you created, select the inport, set **Port** to the value `PRPort`, and set **Element** to a data element that the inport and outport will share.



5 Select the **Outports** tab. To map a Simulink outport to the AUTOSAR sender-receiver port you created, select the outport, set **Port** to the value `PRPort`, and set **Element** to the same data element selected in the previous step.



6. Click the **Validate** button  to validate the updated AUTOSAR component configuration. If errors are reported, address them and then retry validation. A common error flagged by validation is mismatched properties between the inport and outport that are mapped to the AUTOSAR `PRPort`.

Alternatively , you can programmatically add and map a `PRPort` port using AUTOSAR property and map functions. The following example adds an AUTOSAR `PRPort` (sender-receiver port) and then maps it to a Simulink inport and outport pair.

```
open_system('my_autosar_multirunnables')
arProps = autosar.api.getAUTOSARProperties('my_autosar_multirunnables');
swcPath = find(arProps,[],'AtomicComponent')
```

```
swcPath =
    'ASWC
```

```
add(arProps,'ASWC','SenderReceiverPorts','PRPort','Interface','Interface1')
prportPath = find(arProps,[],'DataSenderReceiverPort')
```

```
prportPath =
    'ASWC/PRPort'
```

```
slMap = autosar.api.getSimulinkMapping('my_autosar_multirunnables');
mapInport(slMap,'RPort_DE1','PRPort','DE1','ImplicitReceive')
mapOutport(slMap,'PPort_DE1','PRPort','DE1','ImplicitSend')
[arPortName,arDataElementName,arDataAccessMode] = getOutport(slMap,'PPort_DE1')
```

```
arPortName =
PRPort

arDataElementName =
DE1

arDataAccessMode =
ImplicitSend
```

Configure AUTOSAR Receiver Port for IsUpdated Service

AUTOSAR defines quality-of-service attributes, such as `ErrorStatus` and `IsUpdated`, for sender-receiver interfaces. The `IsUpdated` attribute allows an AUTOSAR explicit receiver to detect whether a receiver port data element has received data since the last read occurred. When data is idle, the receiver can save computational resources.

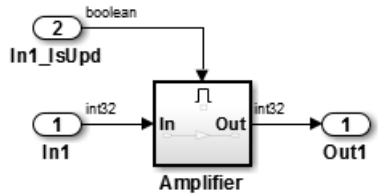
For the sender, the AUTOSAR Runtime Environment (RTE) sets the status of an update flag, indicating whether the data element has been written. The receiver calls the `Rte_IsUpdated_`*`Port_Element`* API, which reads the update flag and returns a value indicating whether the data element has been updated since the last read.

In Simulink, you can:

- Import an AUTOSAR receiver port for which `IsUpdated` service is configured.
- Configure an AUTOSAR receiver port for `IsUpdated` service.
- Generate C and `arxml` code for an AUTOSAR receiver port for which `IsUpdated` service is configured.

To model `IsUpdated` service in Simulink, you pair an inport that is configured for `ExplicitReceive` data access with a new inport configured for `IsUpdated` data access. To configure an AUTOSAR receiver port for `IsUpdated` service:

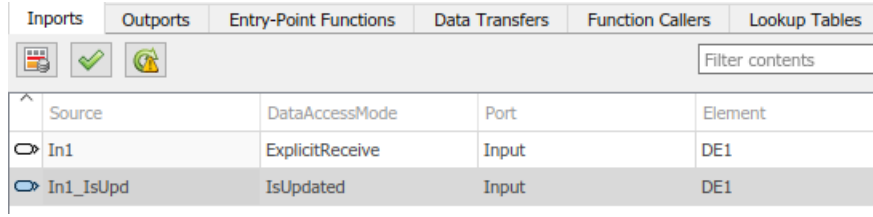
1. Open a model for which an AUTOSAR sender-receiver interface is configured.
2. Identify the inport that corresponds to the AUTOSAR receiver port for which `IsUpdated` service is required. Create a second inport, set its data type to `boolean`, and connect it to the same block. For example:



3. Open Code Mapping Editor. Select the **Inports** tab. In the inports view, configure the mapping properties for both inports.

   a. If the data inport is not already configured, set **DataAccessMode** to `ExplicitReceive`. Select **Port** and **Element** values that map the inport to the AUTOSAR receiver port and data element for which `IsUpdated` service is required.

   b. For the quality-of-service inport, set **DataAccessMode** to `IsUpdated`. Select **Port** and **Element** values that exactly match the data inport.



4. To validate the AUTOSAR component configuration, click the **Validate** button  .

5 Build the model and inspect the generated code. The generated C code contains an `Rte_IsUpdated` API call.

```
if (Rte_IsUpdated_Input_DE1()) {
  …
  Rte_Read_Input_DE1(&tmp);
  …
}
```

The exported `arxml` code contains the ENABLE-UPDATE setting `true` for the AUTOSAR receiver port.

```
<R-PORT-PROTOTYPE UUID="...">
    <SHORT-NAME>Input</SHORT-NAME>
    <REQUIRED-COM-SPECS>
        <NONQUEUED-RECEIVER-COM-SPEC>
            <DATA-ELEMENT-REF DEST="VARIABLE-DATA-PROTOTYPE">/pkg/if/Input/DE1
                                                            </DATA-ELEMENT-REF>
            …
            <ENABLE-UPDATE>true</ENABLE-UPDATE>
            …
        </NONQUEUED-RECEIVER-COM-SPEC>
    </REQUIRED-COM-SPECS>
    …
</R-PORT-PROTOTYPE>
```

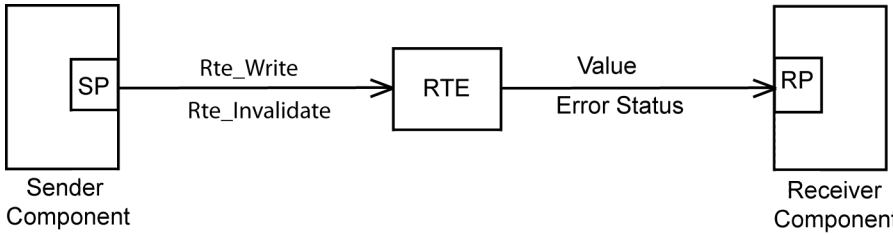
Configure AUTOSAR Sender-Receiver Data Invalidation

The AUTOSAR standard defines an invalidation mechanism for AUTOSAR data elements used in sender-receiver (S-R) communication. A sender component can notify a downstream receiver component that data in a sender port is invalid. Each S-R data element can have an invalidation policy. In Simulink, you can:

- Import AUTOSAR sender-receiver data elements for which an invalidation policy is configured.
- Use a Signal Invalidation block to model sender-receiver data invalidation for simulation and code generation. Using block parameters, you can specify a signal invalidation policy and an initial value for an S-R data element.
- Generate C code and `arxml` descriptions for AUTOSAR sender-receiver data elements for which an invalidation policy is configured.

For each S-R data element, you can set the Signal Invalidation block parameter **Signal invalidation policy** to `Keep`, `Replace`, or `DontInvalidate`. If an input data value is invalid (invalidation control flag is `true`), the resulting action is determined by the value of **Signal invalidation policy**:

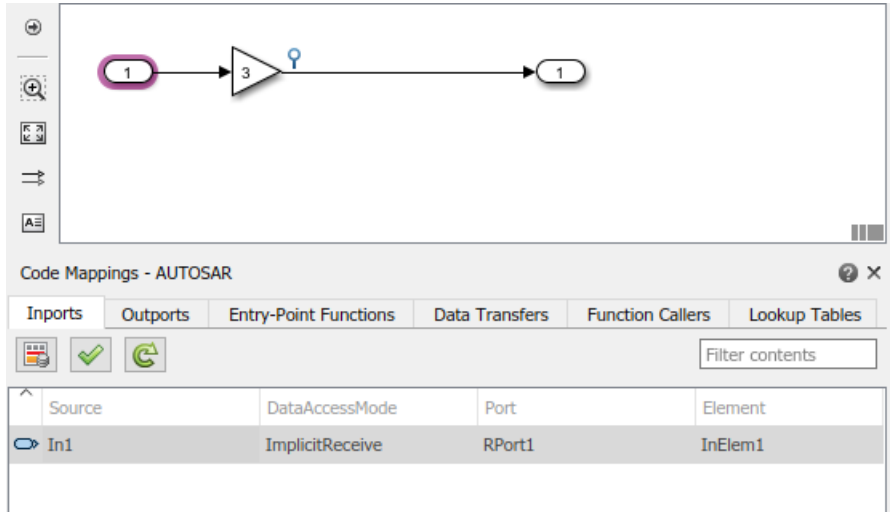
- `Keep` - Replace the input data value with the last valid signal value.
- `Replace` - Replace the input data value with an **Initial value** parameter.
- `DontInvalidate` - Do not replace the input data value.



To configure an invalidation policy for an AUTOSAR S-R data element in Simulink:

1. Open a model for which an AUTOSAR sender-receiver interface is configured. For example, suppose that:

   - A Simulink outport named `Out` is mapped to AUTOSAR sender port `PPort` and data element `OutElem`. In AUTOSAR Dictionary, AUTOSAR sender port `PPort` selects S-R interface `Out`, which contains the data element `OutElem`.
   - A Simulink inport named `In1` is mapped to AUTOSAR receiver port `RPort1` and data element `InElem1`. In AUTOSAR Dictionary, AUTOSAR receiver port `RPort1` selects S-R interface `In1`, which contains the data element `InElem1`.



2 Add a Signal Invalidation block to the model.

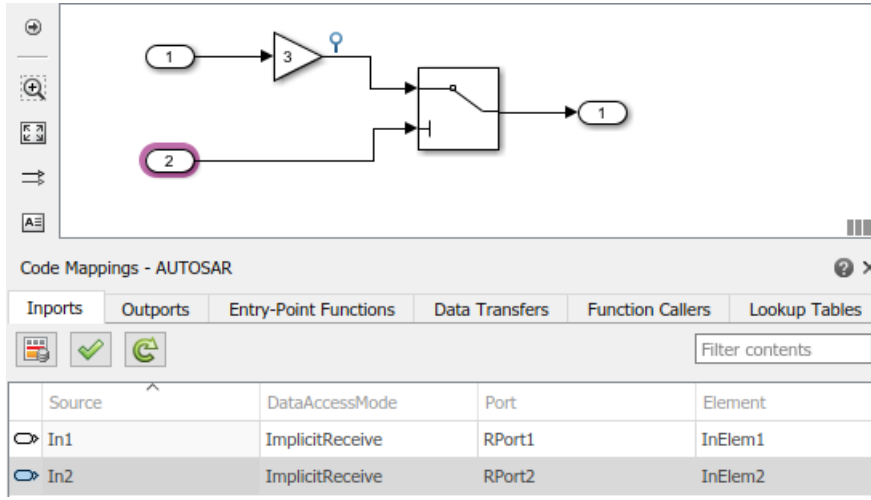
   a The block must be connected directly to a root outport block. Connect the block to root outport `Out`.

   b Connect the first block input, a data value, to the data path from root inport `In1`.

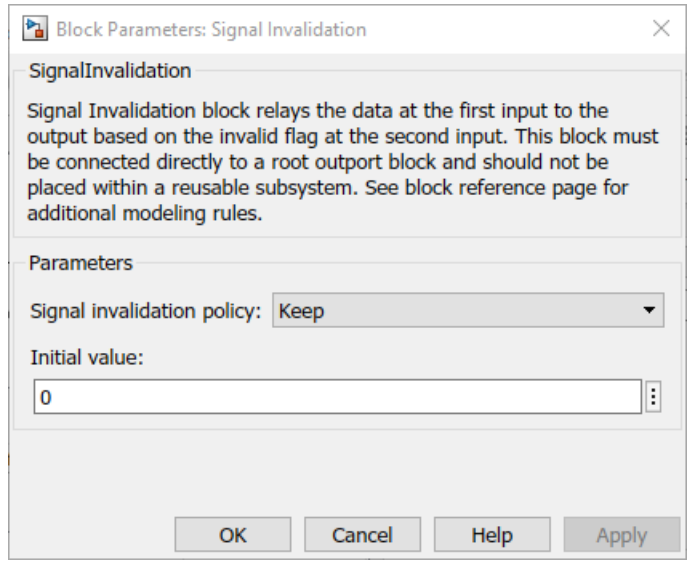
   c For the second block input, an invalidation control flag, add a root inport named `In2` to the model. Set its data type to scalar `boolean`. Map the new inport to a second AUTOSAR sender port. If a second AUTOSAR sender port does not exist, use AUTOSAR Dictionary to create the AUTOSAR port, S-R interface, and data element.

   In this example, Simulink inport `In2` is mapped to AUTOSAR receiver port `RPort2` and data element `InElem2`. In AUTOSAR Dictionary, AUTOSAR receiver port `RPort2` selects S-R interface `In2`, which contains the data element `InElem2`.

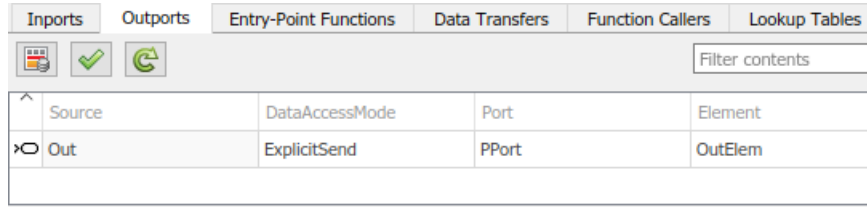
   Connect the second block input to root inport `In2`.



3 View the Signal Invalidation block parameters, for example, in Property Inspector or the block parameters dialog box. Examine the **Signal invalidation policy** and **Initial value** attributes. For more information, see the Signal Invalidation block reference page.



4 Open Code Mapping Editor and select the **Outports** tab. For the root outport `Out`, verify that the AUTOSAR data access mode is set to `ExplicitSend` or `EndToEndWrite`.



5 To validate the AUTOSAR component configuration, open Code Mapping Editor and click the **Validate** button  .

6 Build the model and inspect the generated code. When the signal is valid, the generated C code calls `Rte_Write_`*`Port_Element`*. When the signal is invalid, the C code calls `Rte_Invalidate_`*`Port_Element`*.

```
/* SignalInvalidation: '<Root>/Signal Invalidation' incorporates:
 *  Inport: '<Root>/In2'
 */
if (!Rte_IRead_Runnable_Step_RPort2_InElem2()) {
  /* Outport: '<Root>/Out' */
  (void) Rte_Write_PPort_OutElem(mSignalInvalidation_B.Gain);
} else {
```

```
  Rte_Invalidate_PPort_OutElem();
}
```

The exported `arxml` code contains the invalidation setting for the data element.

```
<INVALIDATION-POLICY>
    <DATA-ELEMENT-REF DEST="VARIABLE-DATA-PROTOTYPE">/pkg/if/Out/OutElem</DATA-ELEMENT-REF>
    <HANDLE-INVALID>KEEP</HANDLE-INVALID>
</INVALIDATION-POLICY>
```

Configure AUTOSAR S-R Interface Port for End-To-End Protection

AUTOSAR end-to-end (E2E) protection for sender and receiver ports is based on the E2E library. E2E is a C library that you use to transmit data securely between AUTOSAR components. End-to-end protection adds additional information to an outbound data packet. The component receiving the packet can then verify independently that the received data packet matches the sent packet. Potentially, the receiving component can detect errors and take action.

For easier integration of AUTOSAR generated code with AUTOSAR E2E solutions, Embedded Coder supports AUTOSAR E2E protection. In Simulink, you can:

- Import AUTOSAR sender port and receiver ports for which E2E protection is configured.
- Configure an AUTOSAR sender or receiver port for E2E protection.
- Generate C and `arxml` code for AUTOSAR sender and receiver ports for which E2E protection is configured.

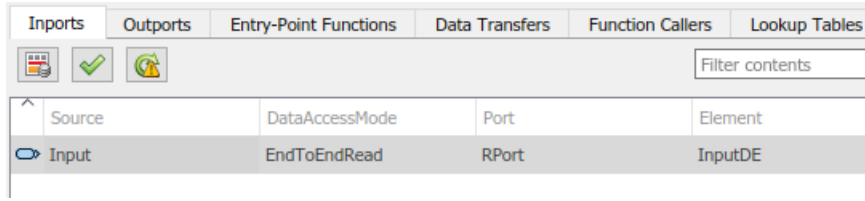
You should configure E2E protection for AUTOSAR sender and receiver ports that use explicit write and read data access modes. When you change the data access mode of an AUTOSAR port from explicit write to end-to-end write, or from explicit read to end-to-end read:

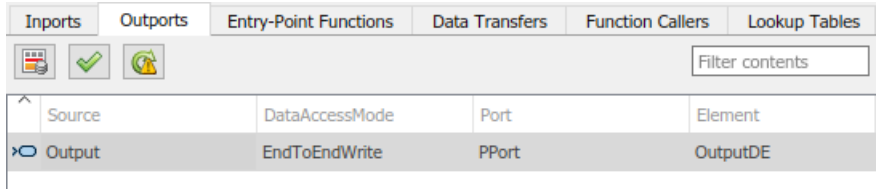
- Simulation behavior is unaffected.
- Code generation is similar to explicit write and read, with these differences:
  - E2E initialization wrapper API calls appear in C initialization code.
  - E2E protection wrapper API calls appear in C step code.
  - When combined with an error status inport, end-to-end read returns `uint32` rather than `uint8`.

- For receiver and sender COM-SPECs, the `arxml` exporter generates property USES-END-TO-END-PROTECTION with value `true`.

To configure an AUTOSAR sender or receiver port for E2E protection:

1. Open a model for which an AUTOSAR sender-receiver interface is configured.
2. Open Code Mapping Editor. Navigate to the Simulink inport or outport that models the AUTOSAR receiver or sender port for which you want to configure E2E protection. Select the port.
3. Set the AUTOSAR data access mode to `EndToEndRead` (inport) or `EndToEndWrite` (outport).





4. To validate the AUTOSAR component configuration, click the **Validate** button  .
5. Build the model and inspect the generated code. The generated C code contains `E2E` API calls.

```
void Runnable_Step(void)
{
  …
  /* Inport: '<Root>/Input' */
  E2EPW_Read_RPort_InputDE(…);
  …
  /* Outport: '<Root>/Output'... */
  (void) E2EPW_Write_PPort_OutputDE(…);
  …
}
…
void Runnable_Init(void)
{
  …
```

```
  /* End-to-End (E2E) initialization */
  E2EPW_ReadInit_RPort_InputDE();
  E2EPW_WriteInit_PPort_OutputDE();
  …
}
```

The exported `arxml` code contains the E2E settings for the AUTOSAR receiver and sender ports.

```
<NONQUEUED-RECEIVER-COM-SPEC>
    …
    <USES-END-TO-END-PROTECTION>true</USES-END-TO-END-PROTECTION>
…
<NONQUEUED-SENDER-COM-SPEC>
    …
    <USES-END-TO-END-PROTECTION>true</USES-END-TO-END-PROTECTION>
…
```

Configure AUTOSAR Receiver Port for DataReceiveErrorEvent

In AUTOSAR sender-receiver communication between software components, the Runtime Environment (RTE) raises a `DataReceiveErrorEvent` when the communication layer reports an error in data reception by the receiver component. For example. the event can indicate that the sender component failed to reply within an `AliveTimeout` limit, or that the sender component sent invalid data.

Embedded Coder supports creating `DataReceiveErrorEvents` in AUTOSAR receiver components. In Simulink, you can:

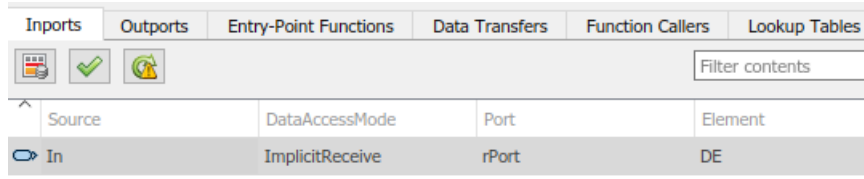
- Import an AUTOSAR `DataReceiveErrorEvent` definition.
- Define a `DataReceiveErrorEvent`.
- Generate `arxml` code for AUTOSAR receiver ports for which a `DataReceiveErrorEvent` is configured.

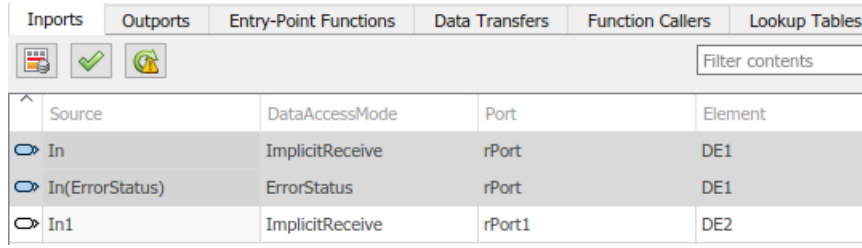
You should configure a `DataReceiveErrorEvent` for an AUTOSAR receiver port that uses `ImplicitReceive`, `ExplicitReceive`, or `EndToEndRead` data access mode.

To configure an AUTOSAR receiver port for a `DataReceiveErrorEvent`:

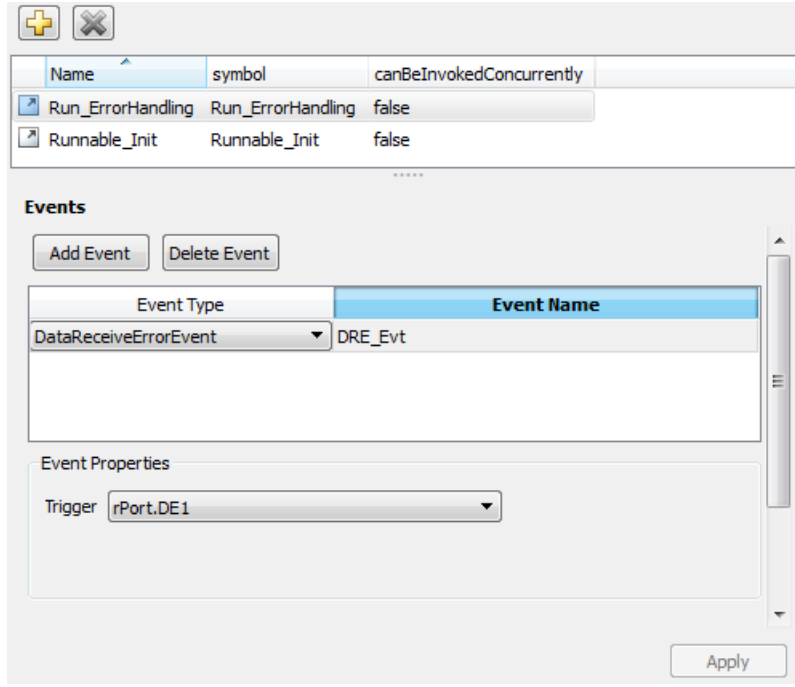
1. Open a model for which the receiver side of an AUTOSAR sender-receiver interface is configured.
2. Open Code Mapping Editor. Select the **Inports** tab. Select the data inport that is mapped to the AUTOSAR receiver port for which you want to configure a `DataReceiveErrorEvent`. Set its AUTOSAR data access mode to

`ImplicitReceive`, `ExplicitReceive`, or `EndToEndRead`. Here are two examples, without and with a coupled ErrorStatus port.





3. Open AUTOSAR Dictionary. Expand the **AtomicComponents** node. Expand the receiver component and select **Runnables**.
4. In the runnables view, create a runnable to handle `DataReceiveErrorEvents`.
   a. Click the **Add** button  to add a runnable entry.
   b. Select the new runnable entry to configure its name and other properties.
   c. Go to the **Events** pane, and configure a `DataReceiveErrorEvent` for the runnable. Click **Add Event**, select type `DataReceiveErrorEvent`, and enter an event name.
   d. Under **Event Properties**, select the trigger for the event. The selected trigger value indicates the AUTOSAR receiver port and the data element for which the runnable is handling `DataReceiveErrorEvents`.



Alternatively, you can programmatically create a `DataReceiveErrorEvent`.

```
arProps = autosar.api.getAUTOSARProperties(mdlname);
add(arProps,ibQName,'Events','DRE_Evt',...
    'Category','DataReceiveErrorEvent','Trigger','rPort.DE1',...
    'StartOnEvent',runnableQName);
```

5 Build the model and inspect the generated code. The exported `arxml` code defines the error-handling runnable and its triggering event.

```
<EVENTS>
    <DATA-RECEIVE-ERROR-EVENT UUID="...">
        <SHORT-NAME>DRE_Evt</SHORT-NAME>
        <START-ON-EVENT-REF DEST="RUNNABLE-ENTITY">
          /Root/mDemoModel_swc/ReceivingASWC/IB/Run_ErrorHandling</START-ON-EVENT-REF>
        <DATA-IREF>
            <CONTEXT-R-PORT-REF DEST="R-PORT-PROTOTYPE">
              /Root/mDemoModel_swc/ReceivingASWC/rPort</CONTEXT-R-PORT-REF>
            <TARGET-DATA-ELEMENT-REF DEST="VARIABLE-DATA-PROTOTYPE">
              /Root/Interfaces/In/DE</TARGET-DATA-ELEMENT-REF>
        </DATA-IREF>
    </DATA-RECEIVE-ERROR-EVENT>
</EVENTS>
...
```

```
<RUNNABLES>
    ...
    <RUNNABLE-ENTITY UUID="...">
        <SHORT-NAME>Run_ErrorHandling</SHORT-NAME>
        <MINIMUM-START-INTERVAL>0</MINIMUM-START-INTERVAL>
        <CAN-BE-INVOKED-CONCURRENTLY>false</CAN-BE-INVOKED-CONCURRENTLY>
        ...
        <SYMBOL>Run_ErrorHandling</SYMBOL>
    </RUNNABLE-ENTITY>
</RUNNABLES>
```

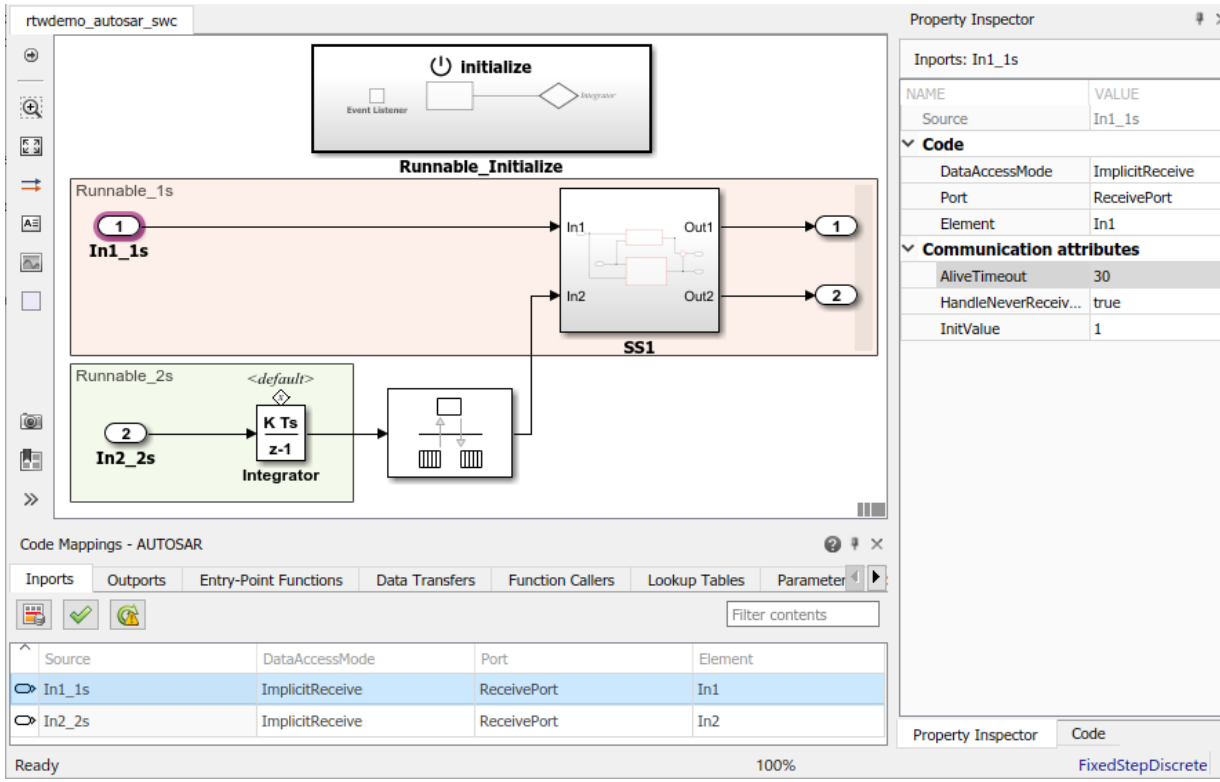
Configure AUTOSAR Sender-Receiver Port ComSpecs

In AUTOSAR software components, a sender or receiver port optionally can specify a communication specification (ComSpec). ComSpecs describe additional communication requirements for port data.

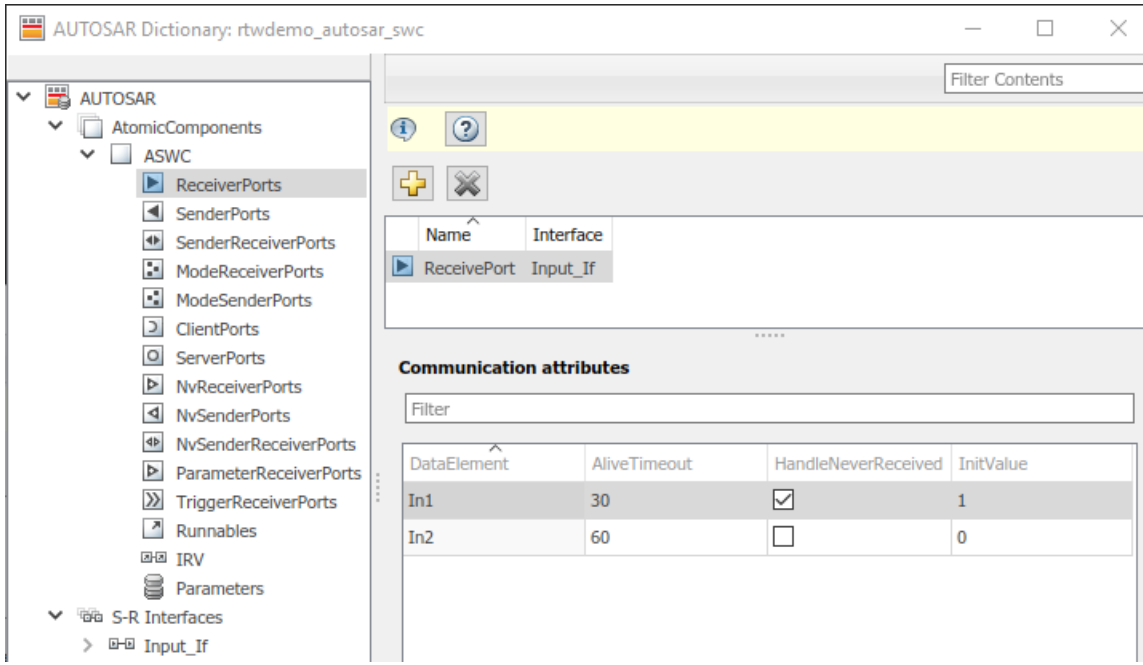
To model AUTOSAR sender and receiver ComSpecs in Simulink, you can:

- Import sender and receiver ComSpecs from `arxml` files
- Create sender and receiver ComSpecs in Simulink
- For nonqueued sender and receiver ports, modify ComSpec attribute `InitValue`
- For nonqueued receiver ports, modify ComSpec attributes `AliveTimeout` and `HandleNeverReceived`
- Export ComSpecs to `arxml` files

For example, if you create an AUTOSAR receiver port in Simulink, you use Code Mapping Editor to map a Simulink inport to the AUTOSAR receiver port and an S-R data element. You can then select the port and specify its ComSpec attributes.



If you import or create an AUTOSAR receiver port, you can use AUTOSAR Dictionary to view and edit the ComSpec attributes of the mapped S-R data elements in the AUTOSAR port.



To programmatically modify ComSpec attributes of an AUTOSAR nonqueued sender or receiver port, use the AUTOSAR property function `set`. For example:

```
hModel = 'rtwdemo_autosar_swc';
open_system(hModel);
arProps = autosar.api.getAUTOSARProperties(hModel);

% Find ComSpec path
portPath = find(arProps,[],'DataReceiverPort','PathType','FullyQualified');
ifPath = find(arProps,[],'SenderReceiverInterface','Name','Input_If','PathType','FullyQualified');
dataElementPath = find(arProps,ifPath{1},'FlowData','Name','In1','PathType','FullyQualified');
infoPath = find(arProps,portPath{1},'PortInfo',...
    'PathType','FullyQualified','DataElements',dataElementPath{1});
comSpecPath = find(arProps,infoPath{1},'PortComSpec','PathType','FullyQualified');

% Set ComSpec attributes
set(arProps,comSpecPath{1},'AliveTimeout',30,'HandleNeverReceived',true,'InitValue',1);
get(arProps,comSpecPath{1},'AliveTimeout')
get(arProps,comSpecPath{1},'HandleNeverReceived')
get(arProps,comSpecPath{1},'InitValue')
```

When you generate code for an AUTOSAR model that specifies ComSpec attributes, the exported `arxml` port descriptions include the ComSpec attribute values.

```
<PORTS>
    <R-PORT-PROTOTYPE UUID="...">
```

```
        <SHORT-NAME>ReceivePort</SHORT-NAME>
        <REQUIRED-COM-SPECS>
            <NONQUEUED-RECEIVER-COM-SPEC>
                <DATA-ELEMENT-REF DEST="VARIABLE-DATA-PROTOTYPE">
                  /Company/Powertrain/Interfaces/Input_If/In1
                </DATA-ELEMENT-REF>
...
                <ALIVE-TIMEOUT>30</ALIVE-TIMEOUT>
                <HANDLE-NEVER-RECEIVED>true</HANDLE-NEVER-RECEIVED>
...
                <INIT-VALUE>
                    <CONSTANT-REFERENCE>
                        <SHORT-LABEL>DefaultInitValue_Double_1</SHORT-LABEL>
                        <CONSTANT-REF DEST="CONSTANT-SPECIFICATION">
                          /Company/Powertrain/Constants/DefaultInitValue_Double_1
                        </CONSTANT-REF>
                    </CONSTANT-REFERENCE>
                </INIT-VALUE>
            </NONQUEUED-RECEIVER-COM-SPEC>
        </REQUIRED-COM-SPECS>
    </R-PORT-PROTOTYPE>
</PORTS>
...
<CONSTANT-SPECIFICATION UUID="...">
    <SHORT-NAME>DefaultInitValue_Double_1</SHORT-NAME>
    <VALUE-SPEC>
      <NUMERICAL-VALUE-SPECIFICATION>
          <SHORT-LABEL>DefaultInitValue_Double_1</SHORT-LABEL>
          <VALUE>1</VALUE>
      </NUMERICAL-VALUE-SPECIFICATION>
  </VALUE-SPEC>
</CONSTANT-SPECIFICATION>
```

See Also

Signal Invalidation

Related Examples

- “Model AUTOSAR Communication” on page 2-13
- “Import AUTOSAR Software Component” on page 3-4
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

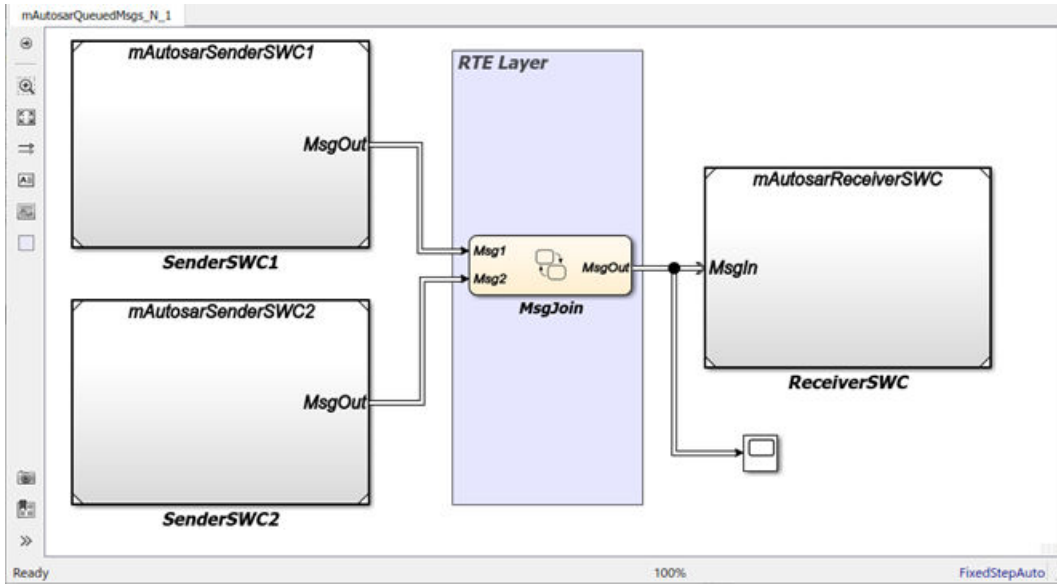
- “AUTOSAR Component Configuration” on page 4-3

Configure AUTOSAR Queued Sender-Receiver Communication

In AUTOSAR queued communication, data sent by an AUTOSAR sender software component is added to a queue provided by the AUTOSAR Runtime Environment (RTE). Newly received data does not overwrite existing unread data. Later, a receiver software component reads the data from the queue.

In Simulink, you can use Stateflow® messages to model sending and receiving AUTOSAR data using a queue. You can handle errors that occur when the queue is empty or full. You can specify the size of the queue.

You can simulate AUTOSAR queued sender-receiver (S-R) communication between component models, for example, in a composition-level simulation. Data senders and receivers can run at different rates. Multiple data senders can communicate with a single data receiver.



To get started, you can import components with queued sender and receiver ports from `arxml` files into Simulink, or use Simulink to create queued sender and receiver ports.

In this section...

Simulink Workflow for Modeling AUTOSAR Queued Send and Receive

Here is the general workflow for modeling AUTOSAR queued sender and receiver components in Simulink.

1. Configure one or more models as AUTOSAR queued sender components, and one model as an AUTOSAR queued receiver component. For each component model, use AUTOSAR Dictionary and Code Mapping Editor to:

   a. Create an S-R data interface and its data elements.

   b. Create a sender or receiver port.

   c. Map the sender or receiver port to a Simulink outport for sending or inport for receiving. Set the AUTOSAR data access mode to `QueuedExplicitSend` or `QueuedExplicitReceive`.

   For example, see “Configure AUTOSAR Sender and Receiver Components for Queued Communication” on page 4-121.

2. To implement AUTOSAR queued sender or receiver component behavior, use Stateflow messages. Follow the general procedure described in “Model Event-Driven System” (Stateflow). Create a chart, add message states, implement state entry actions, specify state transition conditions or events, and define data to store state variables. Finally, connect the chart message-line inputs and outputs to Simulink root inports and outports.

For more information, see "Implement AUTOSAR Queued Send and Receive Messaging" on page 4-124.

3 When you build an AUTOSAR queued sender or receiver component model:

- Generated C code contains calls to AUTOSAR `Rte_Send_<port>_<DataElement>` or `Rte_Receive_<port>_<DataElement>` APIs. The generated code handles the status of the message send and receive calls.
- Exported `arxml` files contain descriptions for queued sender-receiver communication. The generated `ComSpec` for a queued port includes the port type and the queue length (based on Simulink message property `QueueCapacity`). In the `SwDataDefProps` generated for the queued port data element, `SwImplPolicy` is set to `Queued`.

4 To simulate AUTOSAR queued sender-receiver communication in Simulink, create a containing composition, system, or harness model. Include the queued sender and receiver components as referenced models.

- If you have one sender component and one receiver component, you potentially can connect the models directly. For example, see the 1-to-1 composition model used in "Configure Simulation of AUTOSAR Queued Sender-Receiver Communication" on page 4-130.
- If you are simulating N-to-1 or event-driven messaging, you provide additional logic between sender and receiver component models. For example, see "Simulate N-to-1 AUTOSAR Queued Sender-Receiver Communication" on page 4-131 and "Simulate Event-Driven AUTOSAR Queued Sender-Receiver Communication" on page 4-135.

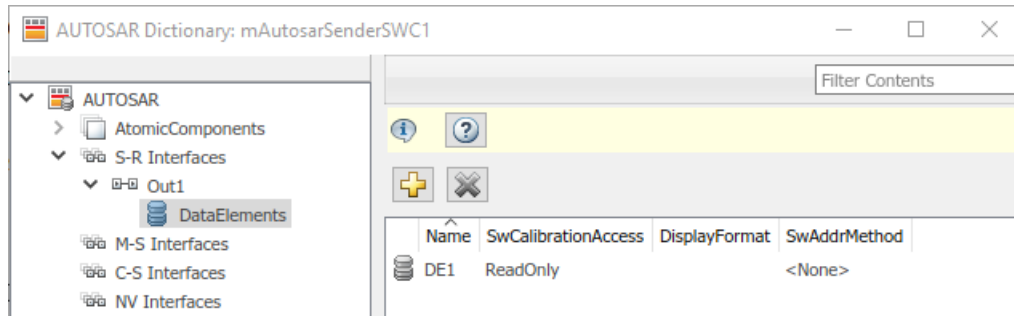
Configure AUTOSAR Sender and Receiver Components for Queued Communication

This example configures AUTOSAR queued sender and receiver components in Simulink. The example uses two models in the folder *`matlabroot`*`/help/toolbox/ecoder/examples/autosar` (open). If you copy the files to a working folder, collocate the models. To see these models connected for simulation, see "Configure Simulation of AUTOSAR Queued Sender-Receiver Communication" on page 4-130.

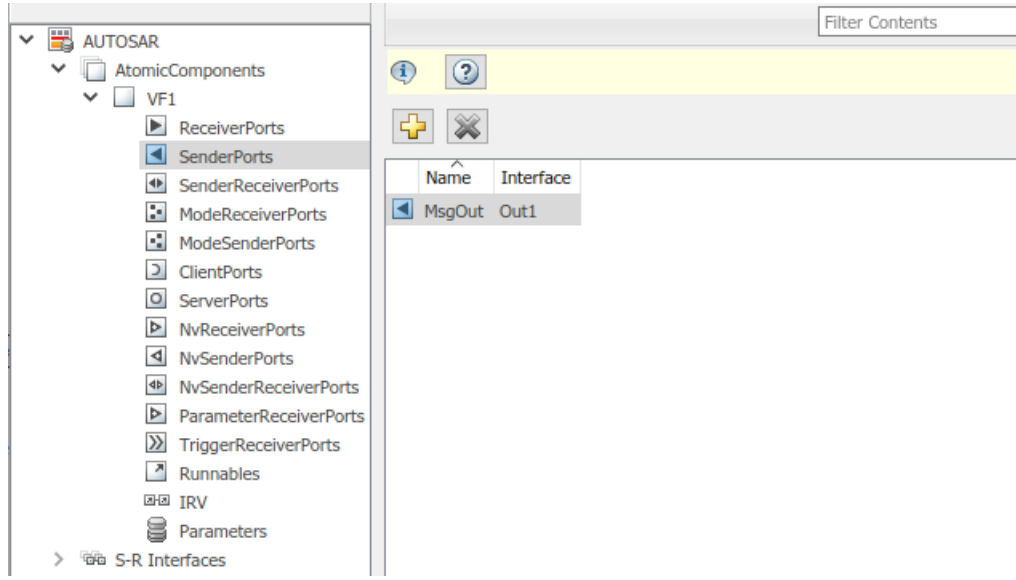
- `mAutosarSenderSWC1.slx`
- `mAutosarReceiverSWC.slx`

Open an AUTOSAR model that you want to configure as a queued sender or receiver component. To create an S-R data interface and a queued sender or receiver port:

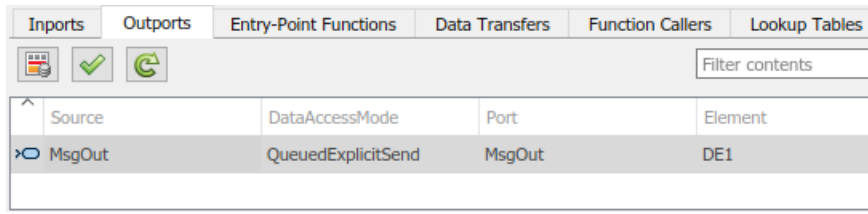
1. Open AUTOSAR Dictionary.
2. Select **S-R Interfaces**. To create an S-R data interface, click the **Add** button  . Specify its name and the number of associated S-R data elements. This example uses one data element in both the sender and receiver components.
3. Select and expand the new S-R interface. Select **DataElements** and modify the data element attributes. Here is data element `DE1` for the sender component.



4. Expand the **AtomicComponents** node and select an AUTOSAR component. Expand the component.
5. Select the **SenderPorts** or **ReceiverPorts** view and use it to add the sender or receiver port you require. For each S-R port, select the S-R interface you created. For the sender component, here is sender port `MsgOut`, which uses S-R interface `Out1`.



6 Open Code Mapping Editor. Select the **Inports** or **Outports** tab and use it to map a Simulink inport or outport to an AUTOSAR queued S-R port. For each inport or outport, select an AUTOSAR port, data element, and data access mode. Set the AUTOSAR data access mode to `QueuedExplicitSend` or `QueuedExplicitReceive`. In the sender component, here is Simulink outport `MsgOut`, which is mapped to AUTOSAR sender port `MsgOut` and data element `DE1`, with data access mode `QueuedExplicitSend`.



When you build an AUTOSAR queued sender or receiver component model:

- Generated C code contains calls to AUTOSAR `Rte_Send_<port>_<DataElement>` or `Rte_Receive_<port>_<DataElement>` APIs. The generated code handles the status of the message send and receive calls.

- Exported `arxml` files contain descriptions for queued sender-receiver communication. The generated `ComSpec` for a queued port includes the port type and the queue length (based on Simulink message property `QueueCapacity`). In the `SwDataDefProps` generated for the queued port data element, `SwImplPolicy` is set to `Queued`.

To implement the messaging behavior of an AUTOSAR queued sender or receiver component, use Stateflow messages. See “Implement AUTOSAR Queued Send and Receive Messaging” on page 4-124.

Implement AUTOSAR Queued Send and Receive Messaging

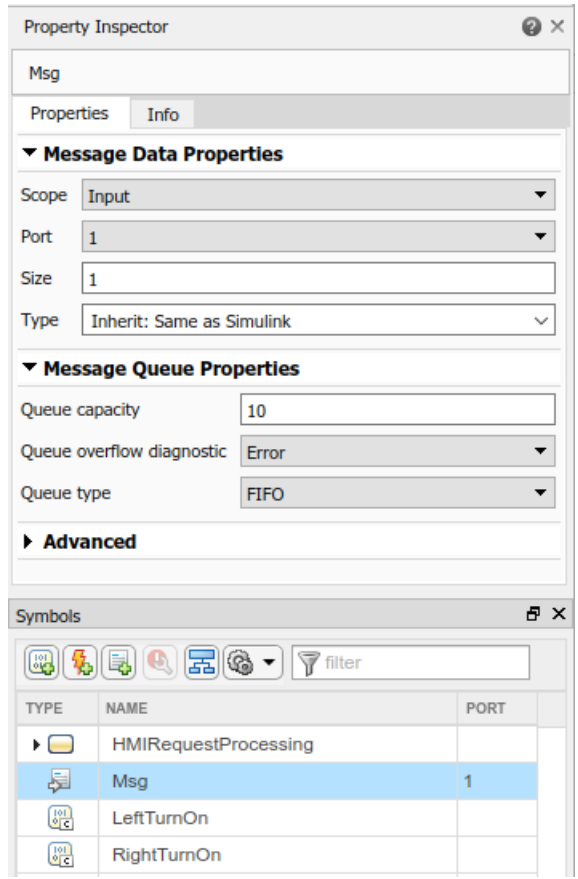
To implement AUTOSAR queued sender or receiver component behavior, use Stateflow messages. To create a Stateflow chart, follow the general procedure described in “Model Event-Driven System” (Stateflow).

1. Add a chart to the AUTOSAR queued sender or receiver component model. Name the chart.
2. Open the chart and add message-related states.
3. For each state, add entry actions. Supported message keywords include:
   - `send(M)` -- Send message M.
   - `receive(M)` -- Receive message M.
   - `isvalid(M)` -- Check if message M is valid (popped and not discarded).
   - `discard(M)` -- Explicitly discard message M. Messages are implicitly discarded on state exit after a message receive operation completes.
4. Add state transition lines and specify transition conditions or events on those lines.
   - Use conditions when you want to transition based on a conditional statement or a change of input value from a Simulink block. For more information, see “Transition Action Types” (Stateflow).
   - Use events when you want to transition based on a Simulink triggered or function-call input event. For more information, see “Communicate with Simulink Subsystems by Broadcasting Events” (Stateflow).
5. Define data that stores state variables.
6. Connect the chart message-line inputs and outputs to Simulink root inports and outports.

For more information, see “Messages” (Stateflow).

In the context of a Stateflow chart, you can modify message properties, such as data type and queue capacity. (For a list of properties, see “Set Properties for a Message” (Stateflow).) You can access message properties in Property Inspector, a Message properties dialog box, or Model Explorer. To view or modify message properties with Property Inspector:

1. Open a chart that uses messages.
2. In the model window, select **View > Property Inspector** and **View > Symbols**.
3. In the Symbols view, select a message. Property Inspector displays panes for **Message Data Properties** and **Advanced** properties. If the chart is in a receiver component, Property Inspector also displays **Message Queue Properties**.

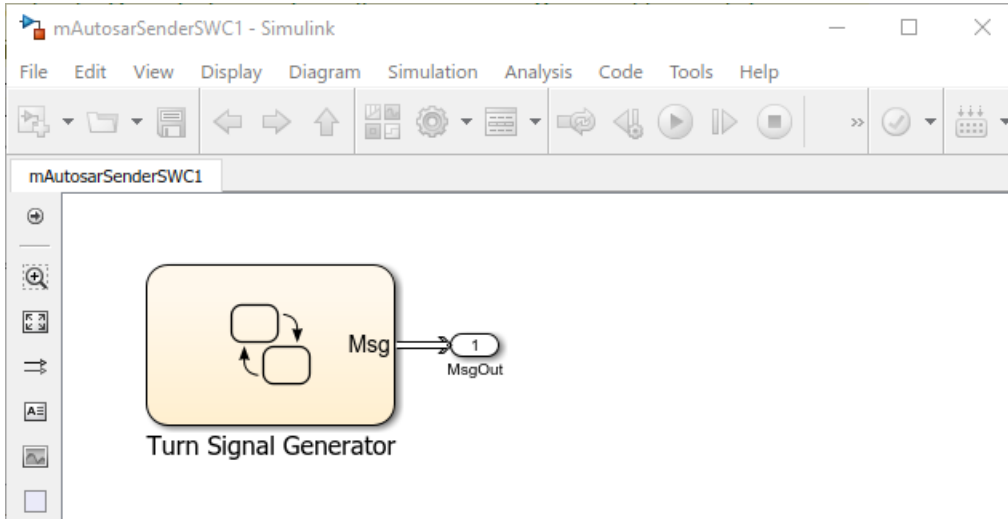


By default, message data type and queue capacity values are inherited from the Stateflow message to which a Simulink root port is attached. Message data can use Simulink parameter data types, such as `int` types, `uint` types, floating-point types, fixed-point types, `boolean`, `Enum`, or `Bus` (`struct`).

If you use imported bus or enumeration data types in Stateflow charts, typedefs are required for simulation. To generate typedefs automatically, select the Simulink configuration option **Generate typedefs for imported bus and enumeration types**. Otherwise, use Simulink configuration parameter **Simulation Target** > **Custom Code** > **Header file** to include header files with the definitions.

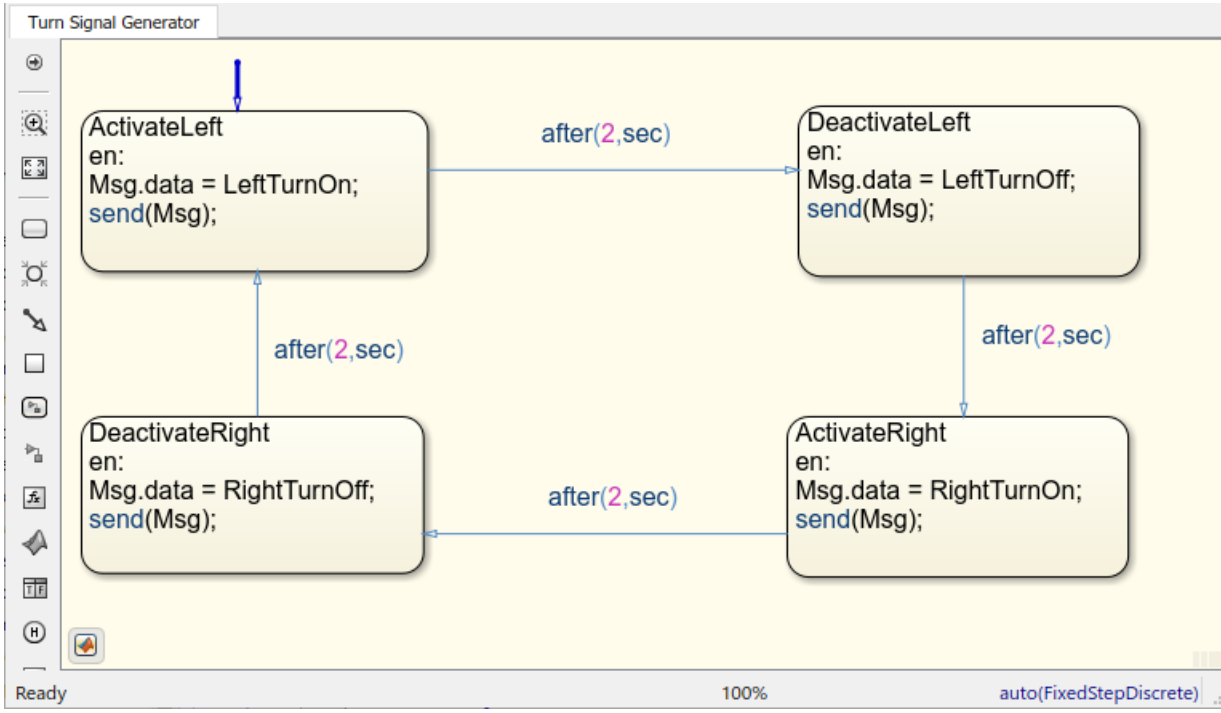
For sample implementations of queued sender and receiver components in a 1-to-1 configuration, see the example component models used in both “Configure AUTOSAR Sender and Receiver Components for Queued Communication” on page 4-121 and “Configure Simulation of AUTOSAR Queued Sender-Receiver Communication” on page 4-130. Models `mAutosarSenderSWC1.slx` and `mAutosarReceiverSWC.slx` are located in the folder *`matlabroot`*`/help/toolbox/ecoder/examples/autosar` (open).

Here is the top level of AUTOSAR queued sender component `mAutosarSenderSWC1`, which contains Stateflow chart `Turn Signal Generator`. The chart message-line output is connected to Simulink root outport `MsgOut`.

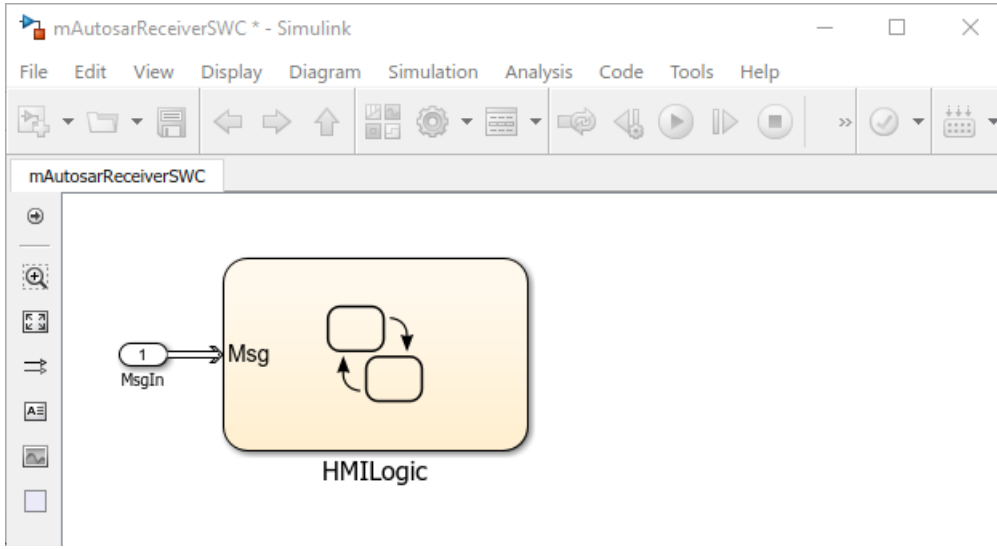


Here is the logic implemented in the `Turn Signal Generator` chart. The chart has four states – `ActivateLeft`, `DeactivateLeft`, `ActivateRight`, and `DeactivateRight`.

Each state contains entry actions that assign a value to message data and send a message. (See “Communicate with Stateflow Charts by Sending Messages” (Stateflow).) Periodic timing drives the message output.



Here is the top level of AUTOSAR queued receiver component `mAutosarReceiverSWC`, which contains Stateflow chart `HMILogic`. The chart message-line input is connected to Simulink root inport `MsgIn`.



To receive a message, queued receiver logic uses `receive(M)`:

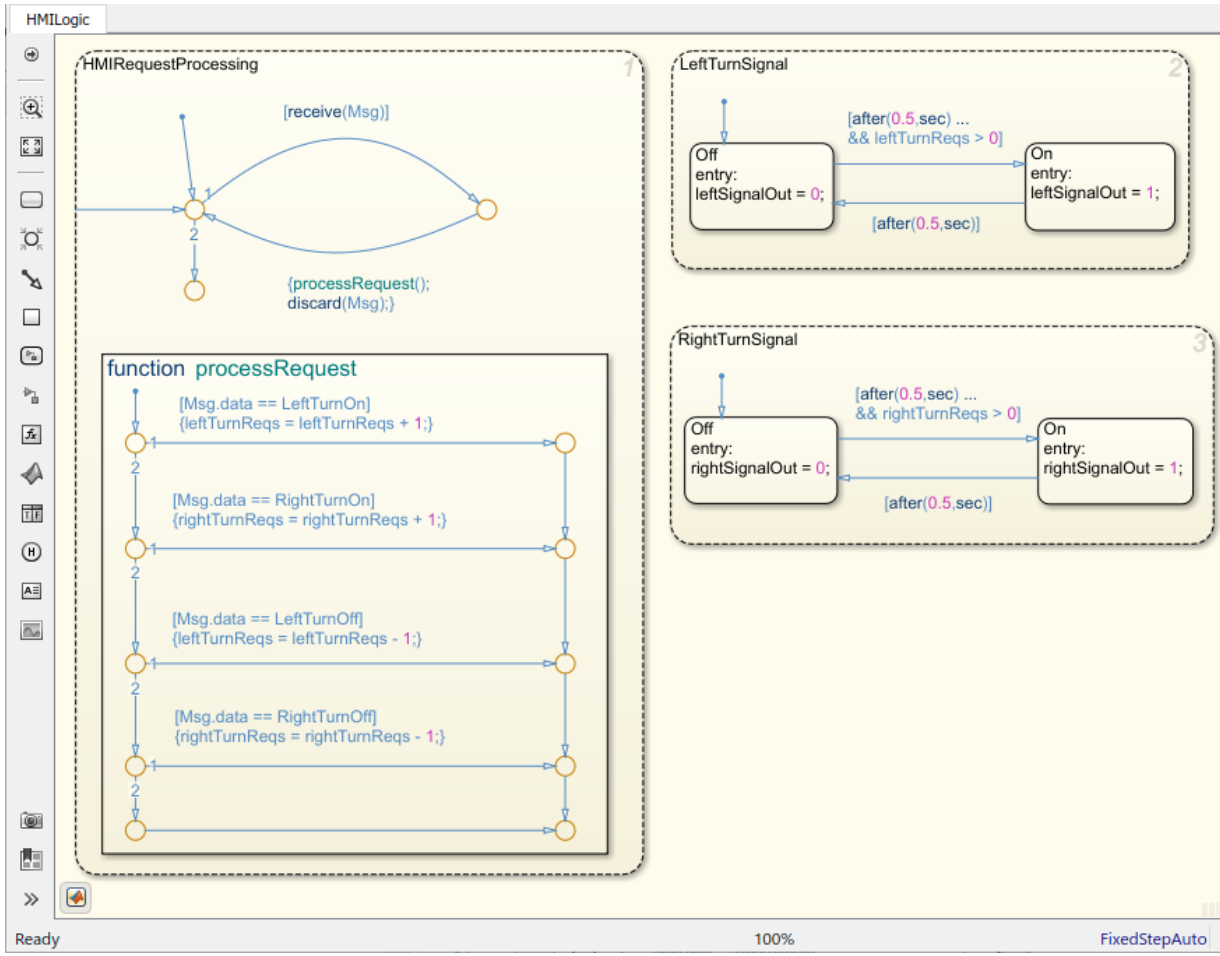
- If a valid message M exists, `receive(M)` returns true.
- If a valid message does not exist, the chart removes a message from its associated queue, and `receive(M)` returns true. If `receive(M)` removes a message from the queue, the length of the queue drops by one.
- If message M is invalid, and another message could not be removed from the queue, `receive(M)` returns false.

You can place `receive` on a transition (for example, `[receive(M)]`. Or, within a state, use an `if` condition (for example, `if(receive(M))`). For more information, see “Communicate with Stateflow Charts by Sending Messages” (Stateflow).

Here is the logic implemented in the `HMILogic` chart. `HMILogic` contains states `HMIRequestProcessing`, `LeftTurnSignal`, and `RightTurnSignal`.

- `HMIRequestProcessing` receives a message from the message queue, calls a function to process the message, and then discards the message. The `processRequest` function tests the received message data for values potentially set by the message sender -- `LeftTurnOn`, `RightTurnOn`, `LeftTurnOff`, or `RightTurnOff`. Based on the value received, the function increments or decrements a request counter variable, either `leftTurnReqs` or `rightTurnReqs`. Periodic timing drives the message input.

- `LeftTurnSignal` and `RightTurnSignal` each contain states `Off` and `On`. They transition from `Off` to `On` based on the value of request counter `leftTurnReqs` or `rightTurnReqs` and a time interval. When the request counter is greater than zero, the charts set a variable, either `leftSignalOut` or `rightSignalOut`, to 1. After a time interval, they transition back to the `Off` state and set `leftSignalOut` or `rightSignalOut` to 0.



For sample implementations of queued sender and receiver components in an N-to-1 configuration, see the example models used in “Simulate N-to-1 AUTOSAR Queued Sender-Receiver Communication” on page 4-131.

For sample implementations of event-driven queued messaging, see the example models used in “Simulate Event-Driven AUTOSAR Queued Sender-Receiver Communication” on page 4-135.

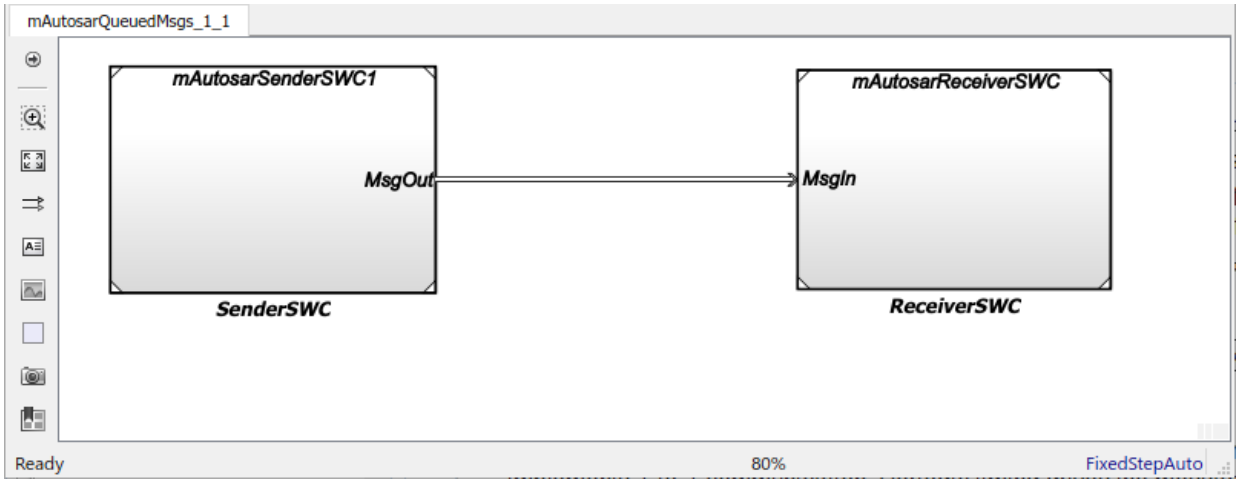
Configure Simulation of AUTOSAR Queued Sender-Receiver Communication

To simulate AUTOSAR queued sender-receiver communication in Simulink, create a containing composition, system, or harness model. Include the queued sender and receiver components as referenced models.

- If you have one sender component and one receiver component, you potentially can connect the models directly. This example directly connects sender and receiver component models.
- If you are simulating N-to-1 or event-driven messaging, you provide additional logic between sender and receiver component models. For example, see “Simulate N-to-1 AUTOSAR Queued Sender-Receiver Communication” on page 4-131 and “Simulate Event-Driven AUTOSAR Queued Sender-Receiver Communication” on page 4-135.

Here is a composition-level model that contains queued sender and receiver component models and implements 1-to-1 communication. Periodic timing drives the messaging. This example uses three models in the folder *`matlabroot`*`/help/toolbox/ecoder/examples/autosar` (open). If you copy the files to a working folder, collocate the models.

- `mAutosarQueuedMsgs_1_1.slx` (top model)
- `mAutosarSenderSWC1.slx`
- `mAutosarReceiverSWC.slx`



Models `mAutosarSenderSWC1` and `mAutosarReceiverSWC` are the same sender and receiver components configured in "Configure AUTOSAR Sender and Receiver Components for Queued Communication" on page 4-121 and implemented in "Implement AUTOSAR Queued Send and Receive Messaging" on page 4-124. Composition-level model `mAutosarQueuedMsgs_1_1` includes them as referenced models and connects sender component port `MsgOut` to receiver component port `MsgIn`.

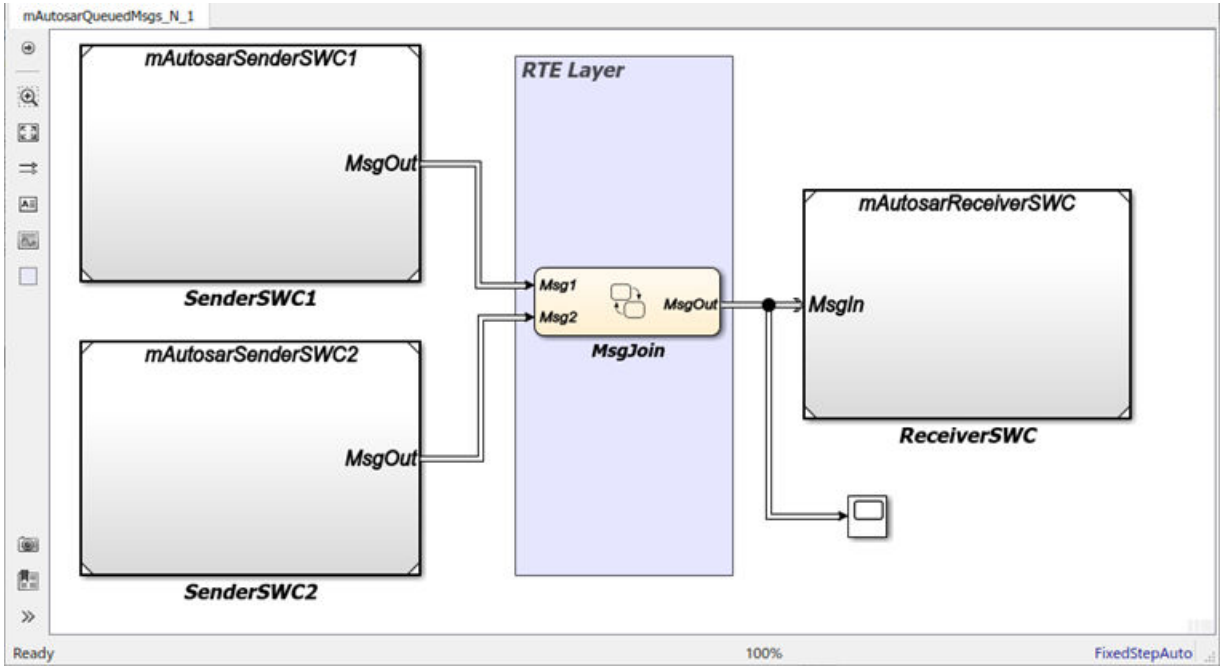
The top model `mAutosarQueuedMsgs_1_1` is for simulation only. You can generate AUTOSAR C code and arxml files for the sender and receiver component models, but not for the containing composition-level model.

Similarly, you can run software-in-the-loop (SIL) simulation for the sender and receiver component models, but not for the composition-level model.

Simulate N-to-1 AUTOSAR Queued Sender-Receiver Communication

Here is a composition-level model that contains two sender and one receiver component models, and implements N-to-1 communication. Periodic timing drives the messaging. This example extends the 1-to-1 example by adding a second sender model and providing flow logic between the senders and receiver. This example uses four models in the folder *`matlabroot`*`/help/toolbox/ecoder/examples/autosar` (open). If you copy the files to a working folder, collocate the models.

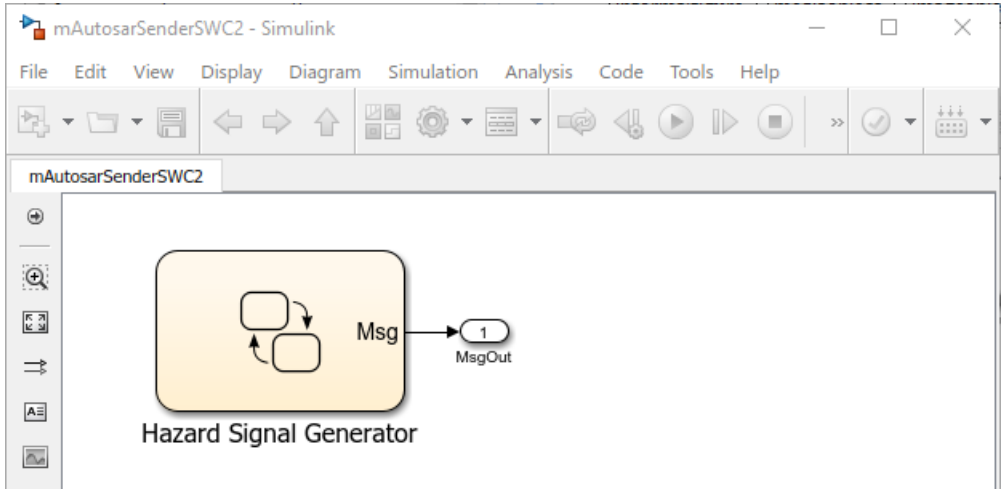
- `mAutosarQueuedMsgs_N_1.slx` (top model)
- `mAutosarSenderSWC1.slx`
- `mAutosarSenderSWC2.slx`
- `mAutosarReceiverSWC.slx`



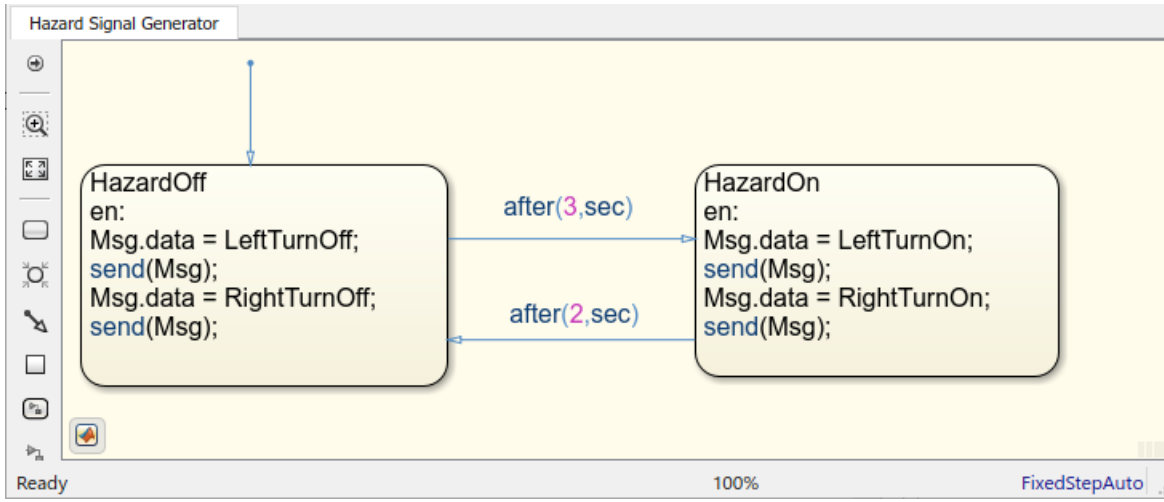
Composition-level model `mAutosarQueuedMsgs_N_1` includes two sender components and a receiver component as referenced models. It connects the sender component `MsgOut` ports to intermediate `MsgJoin` processing logic, which in turn connects to a receiver component `MsgIn` port.

Models `mAutosarSenderSWC1` and `mAutosarReceiverSWC` are the same sender and receiver components configured in "Configure AUTOSAR Sender and Receiver Components for Queued Communication" on page 4-121 and implemented in "Implement AUTOSAR Queued Send and Receive Messaging" on page 4-124. The second sender component, `mAutosarSenderSWC2`, is similar to `mAutosarSenderSWC1`, but implements a second type of message input for the receiver to process.

Here is the top level of AUTOSAR queued sender component `mAutosarSenderSWC2`, which contains Stateflow chart `Hazard Signal Generator`. The chart message-line output is connected to Simulink root outport `MsgOut`.

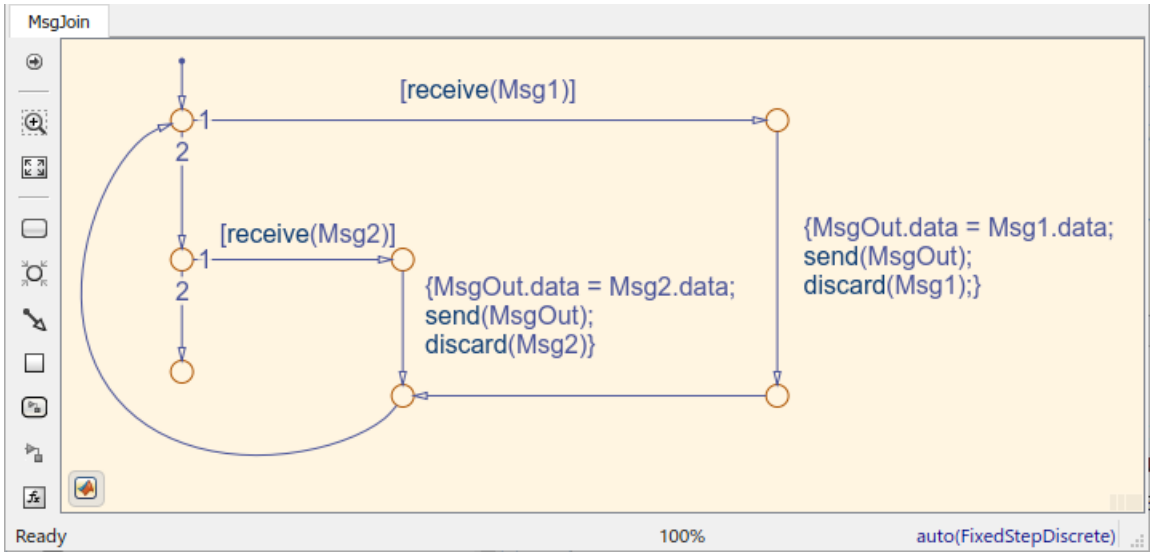


Here is the logic implemented in the `Hazard Signal Generator` chart. The chart has two states – `HazardOff` and `HazardOn`. Each state contains entry actions that assign values to message data and send messages. (See “Communicate with Stateflow Charts by Sending Messages” (Stateflow).) Periodic timing drives the message output.



Here is the `MsgJoin` chart located between the sender and receiver components.

Here is the logic implemented in the `MsgJoin` chart. The chart receives queued messages from both sender components and outputs them, one at a time, to the receiver component. Messages from the first sender component, `mAutosarSenderSWC1.slx`, are processed first. For each message received, the chart copies the received message data to the outbound message, sends the data, and discards the received message. (See “Communicate with Stateflow Charts by Sending Messages” (Stateflow).)



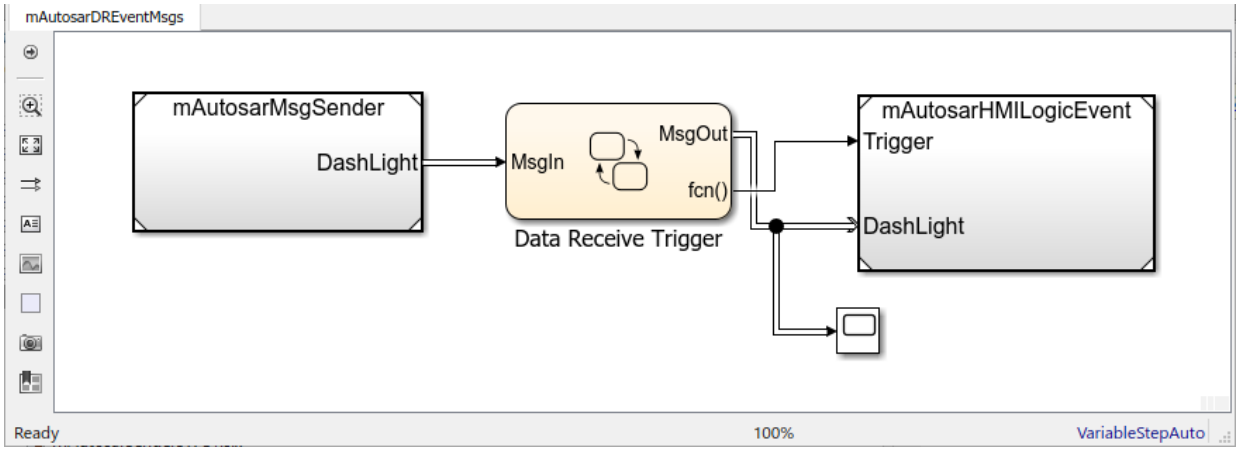
The top model `mAutosarQueuedMsgs_N_1` is for simulation only. You can generate AUTOSAR C code and arxml files for the referenced sender and receiver component models, but not for the containing composition-level model.

Similarly, you can run software-in-the-loop (SIL) simulation for the sender and receiver component models, but not for the composition-level model.

Simulate Event-Driven AUTOSAR Queued Sender-Receiver Communication

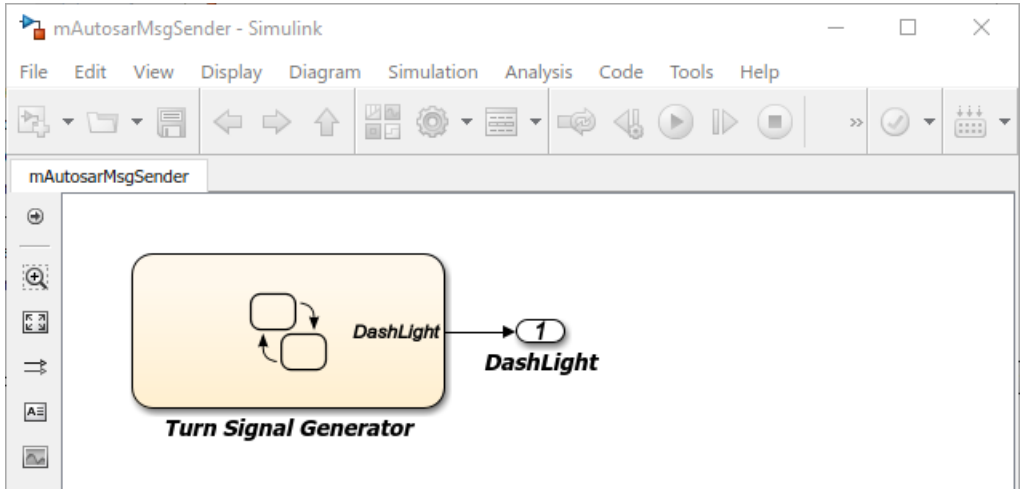
Here is a composition-level model in which a Simulink function-call input event activates receiver component processing of a queued message. This example uses three models in the folder *`matlabroot`*`/help/toolbox/ecoder/examples/autosar` (open). If you copy the files to a working folder, collocate the models.

- `mAutosarDREventMsgs.slx` (top model)
- `mAutosarMsgSender.slx`
- `mAutosarHMILogicEvent.slx`

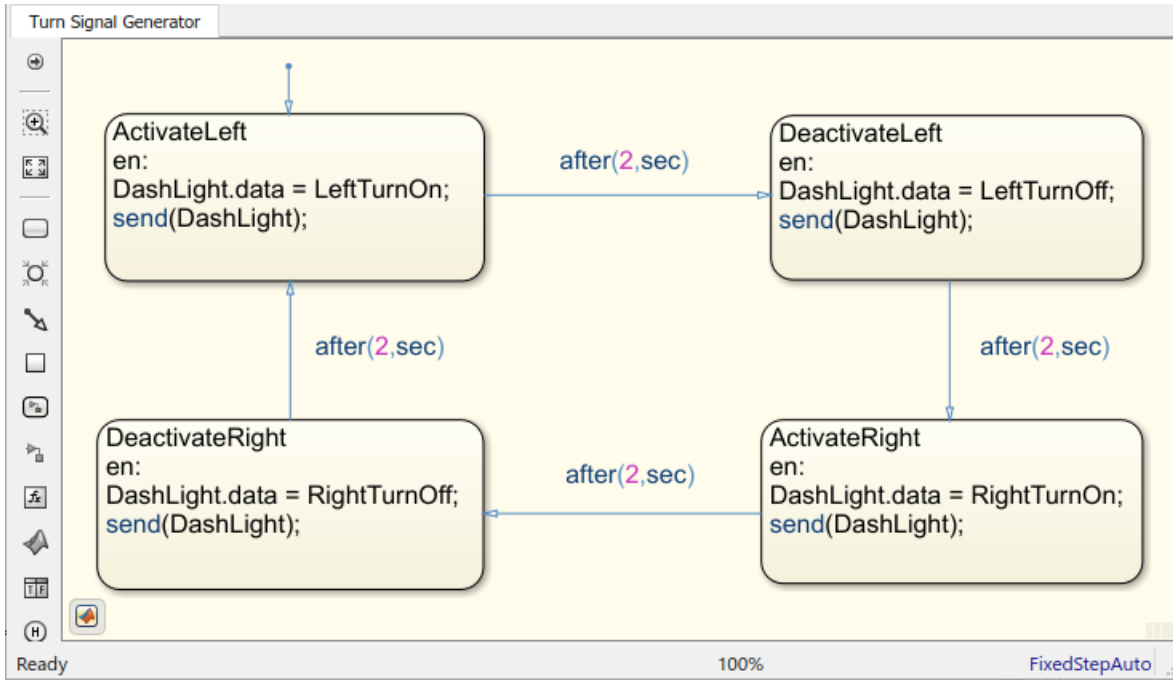


Composition-level model `mAutosarDREEventMsgs` includes a sender component and a receiver component as referenced models. It connects the sender message port `DashLight` to intermediate `Data Receive Trigger` logic, which in turn connects to receiver message port `MsgIn` and function trigger port `Trigger`.

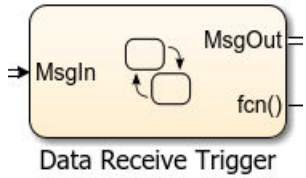
Here is the top level of AUTOSAR queued sender component `mAutosarMsgSender`, which contains Stateflow chart `Turn Signal Generator`. The chart message-line output is connected to Simulink root outport `DashLight`. (This sender component is similar to component `mAutosarSenderSWC1` in the 1-to-1 and N-to-1 simulation examples.)



Here is the logic implemented in the `Turn Signal Generator` chart. The chart has four states – `ActivateLeft`, `DeactivateLeft`, `ActivateRight`, and `DeactivateRight`. Each state contains entry actions that assign a value to message data and send a message. (See “Communicate with Stateflow Charts by Sending Messages” (Stateflow).) Periodic timing drives the message output.



Here is the `Data Receiver Trigger` chart located between the sender and receiver components.

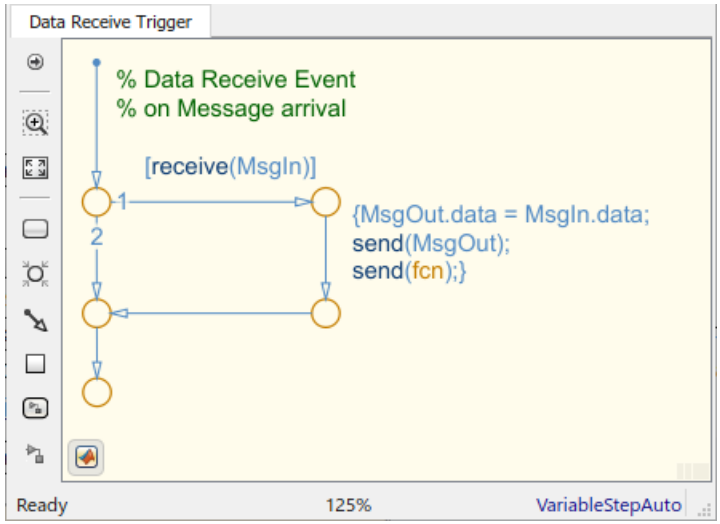


To receive a message, queued receiver logic uses `receive(M)`:

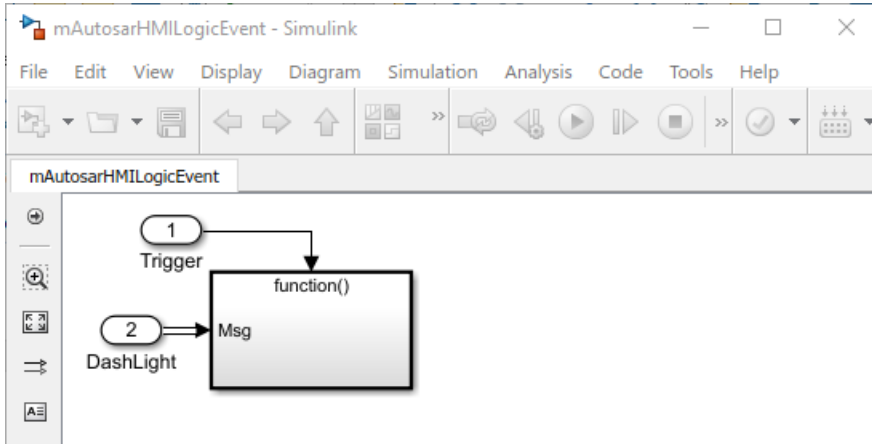
- If a valid message M exists, `receive(M)` returns true.
- If a valid message does not exist, the chart removes a message from its associated queue, and `receive(M)` returns true. If `receive(M)` removes a message from the queue, the length of the queue drops by one.
- If message M is invalid, and another message could not be removed from the queue, `receive(M)` returns false.

You can place `receive` on a transition (for example, `[receive(M)]`. Or, within a state, use an `if` condition (for example, `if(receive(M))`). For more information, see "Communicate with Stateflow Charts by Sending Messages" (Stateflow).

Here is the logic implemented in the `Data Receiver Trigger` chart. The chart receives queued messages from the sender component. For each message received, the chart copies the received message data to the outbound message, sends the data, and sends a function-call event. (See "Communicate with Stateflow Charts by Sending Messages" (Stateflow).)

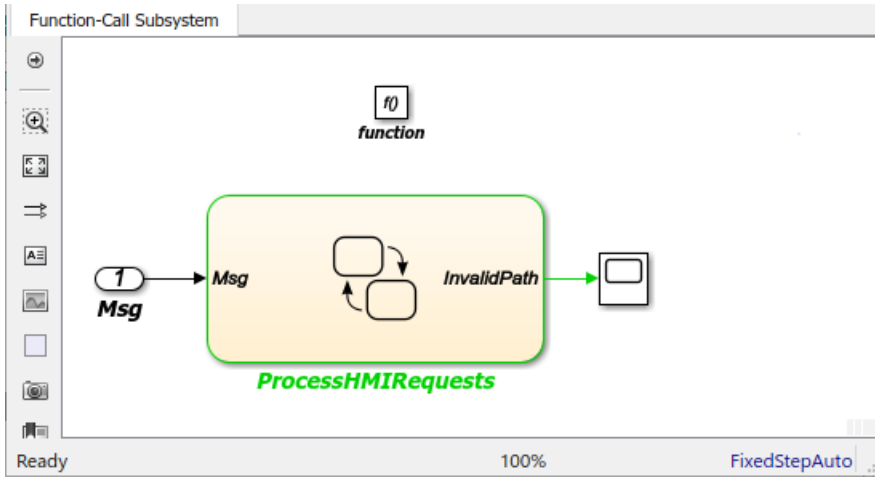


Here is the top level of AUTOSAR queued receiver component `mAutosarHMILogicEvent`, which contains a Simulink function-call subsystem. The subsystem inports are a function-call trigger and message receiver port `DashLight`, which is configured for AUTOSAR data access mode `QueuedExplicitReceive`.



The function-call subsystem contains Stateflow chart `ProcessHMIRequests` and a Trigger Port block. The chart message-line input is connected to Simulink root inport `Msg`. A scope is configured to display the value of an `InvalidPath` variable.

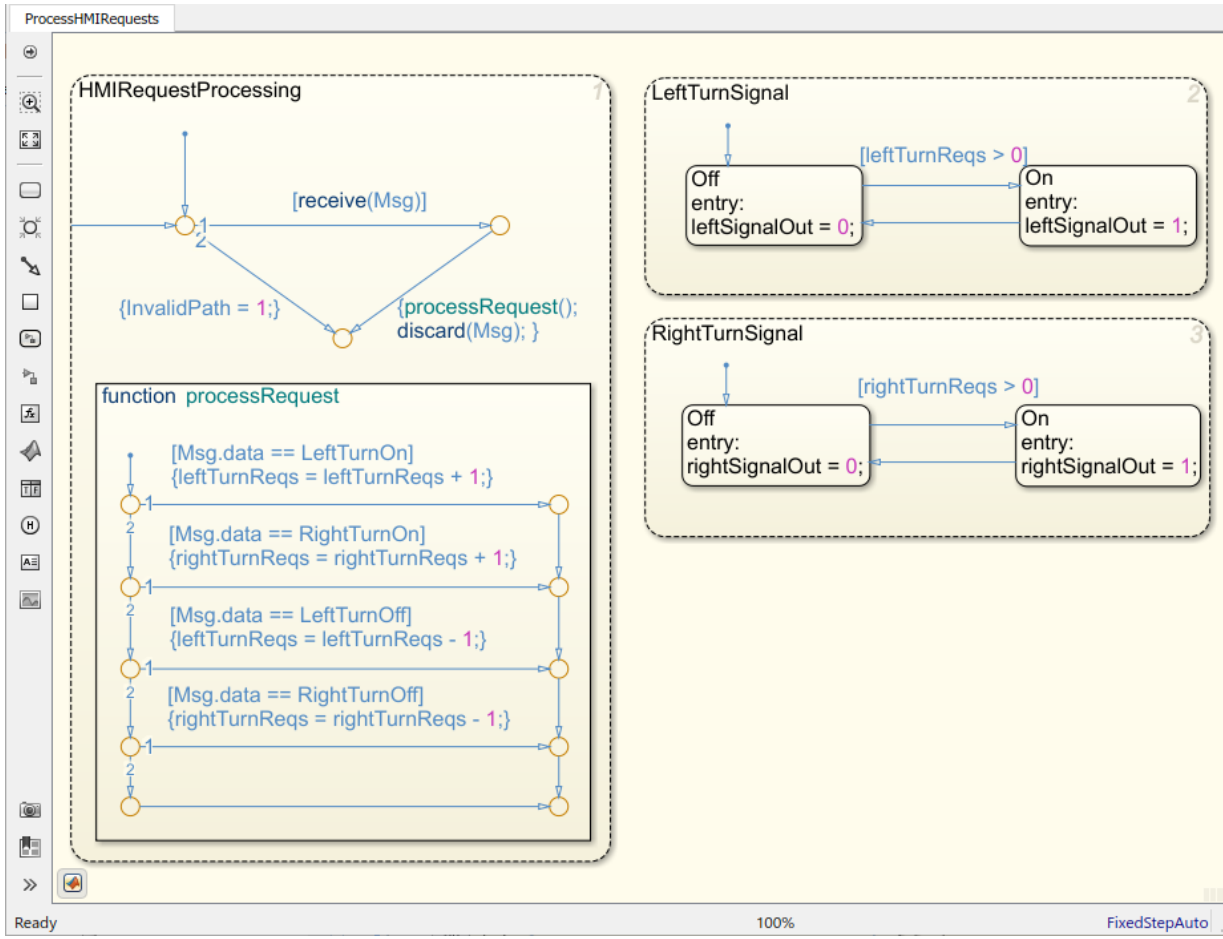
The Trigger Port block is configured for a function-call trigger and triggered sample time. Function-call input events sent from the `Data Receiver Trigger` chart in the top model activate the chart.



Here is the logic implemented in the `ProcessHMIRequests` chart. `ProcessHMIRequests` contains states `HMIRequestProcessing`, `LeftTurnSignal`,

and `RightTurnSignal`. (This receiver chart is similar to chart `HMILogic` in the 1-to-1 and N-to-1 simulation examples.)

- `HMIRequestProcessing` receives a message from the message queue, calls a function to process the message, and then discards the message. The `processRequest` function tests the received message data for values potentially set by the message sender -- `LeftTurnOn`, `RightTurnOn`, `LeftTurnOff`, or `RightTurnOff`. Based on the value received, the function increments or decrements a request counter variable, either `leftTurnReqs` or `rightTurnReqs`. Function-call input events drive the message input. If the chart is incorrectly activated, the `InvalidPath` variable is set to 1.
- `LeftTurnSignal` and `RightTurnSignal` each contain states `Off` and `On`. They transition from `Off` to `On` based on the value of request counter `leftTurnReqs` or `rightTurnReqs`. When the request counter is greater than zero, the charts set a variable, either `leftSignalOut` or `rightSignalOut`, to 1. Then they transition back to the `Off` state and set `leftSignalOut` or `rightSignalOut` to 0.



The top model `mAutosarDREventMsgs` is for simulation only. You can generate AUTOSAR C code and arxml files for the referenced sender and receiver component models, but not for the containing composition-level model.

Similarly, you can run software-in-the-loop (SIL) simulation for the sender and receiver component models, but not for the composition-level model.

See Also

Related Examples

- “Model Event-Driven System” (Stateflow)

More About

- “Messages” (Stateflow)
- “AUTOSAR Communication”
- “AUTOSAR Component Configuration” on page 4-3

Configure AUTOSAR Client-Server Communication

In Simulink, you can model AUTOSAR client-server communication for simulation and code generation. For information about the Simulink blocks you use and the high-level workflow, see “Client-Server Interface” on page 2-15.

To model AUTOSAR servers and clients, you can do either or both of the following:

- Import AUTOSAR servers and clients from `arxml` code into a model.
- Configure AUTOSAR servers and clients from Simulink blocks.

This topic provides examples of AUTOSAR server and client configuration that start from Simulink blocks.

In this section...
“Configure AUTOSAR Server” on page 4-144
“Configure AUTOSAR Client” on page 4-154
“Configure AUTOSAR Client-Server Error Handling” on page 4-163
“Concurrency Constraints for AUTOSAR Server Runnables” on page 4-168
“Configure and Map AUTOSAR Server and Client Programmatically” on page 4-170

Configure AUTOSAR Server

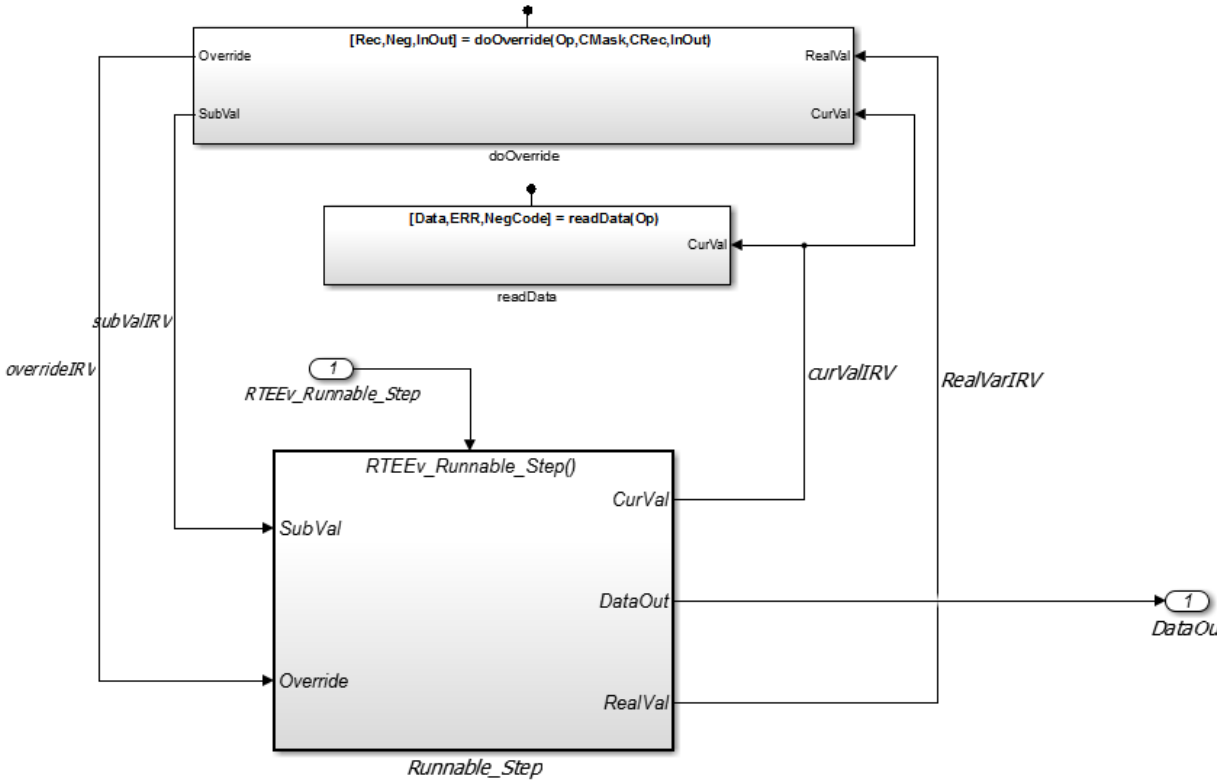
This example shows how to configure a Simulink Function block as an AUTOSAR server. The example uses these files in the folder *`matlabroot`*`/help/toolbox/ecoder/examples/autosar` (open):

- `mControllerWithInterface_server.slx`
- `ExampleApplicationErrorType.m`

If you copy the files to a working folder, collocate the MATLAB file with the model file.

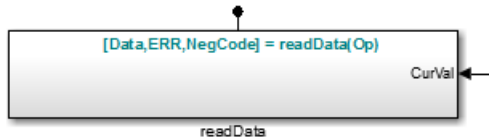
1. Open a model in which you want to create and configure an AUTOSAR server, or open the example model `mControllerWithInterface_server.slx`.
2. Add a Simulink Function block to the model. In the Simulink Library Browser, the Simulink Function block is in **User-Defined Functions**.

The example model provides two Simulink Function blocks, `doOverride` and `readData`.



3 Configure the Simulink Function block to implement a server function. Configure a function prototype and implement the server function algorithm.

In the example model, the contents of the Simulink Function block named `readData` implement a server function named `readData`.

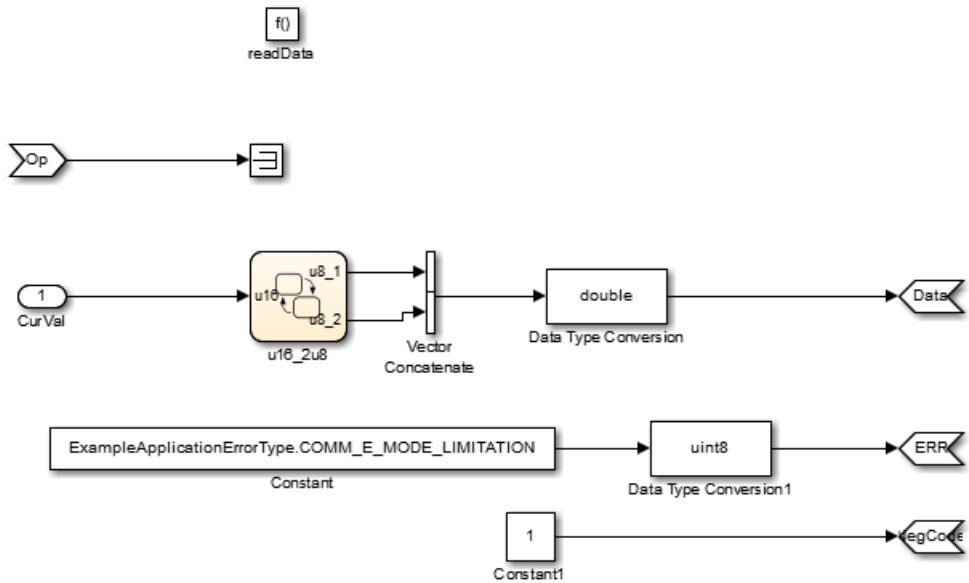


The contents include:

- Trigger block `readData`, representing a trigger port for the server function. In the Trigger block properties, **Trigger type** is set to `Function call`. Also, the option **Treat as Simulink function** is selected.
- Argument Inport block `Op` and Argument Outport blocks `Data`, `ERR`, and `NegCode`, corresponding to the function prototype `[Data,ERR,NegCode]=readData(Op)`.

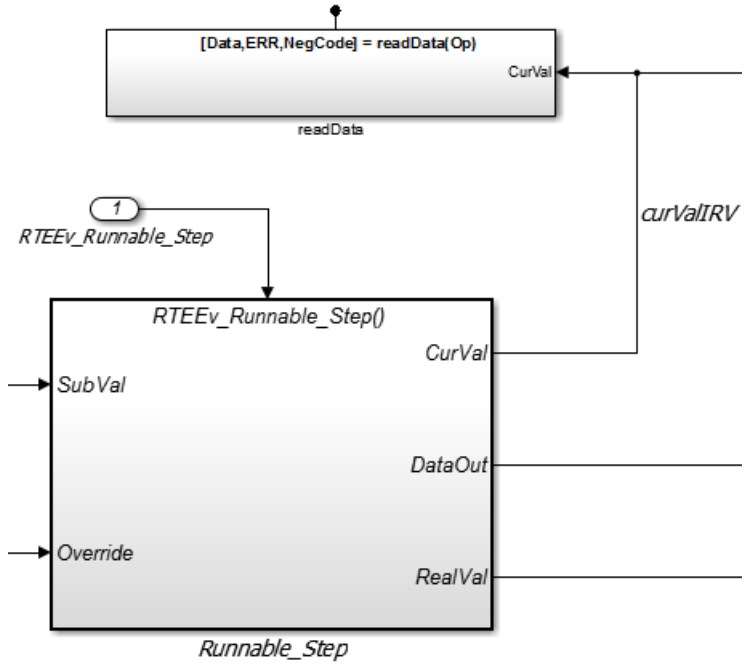
  Note When configuring server function arguments, you must specify signal data type, port dimensions, and signal type on the **Signal Attributes** tab of the inport and outport blocks. The AUTOSAR configuration fails validation if signal attributes are absent for server function arguments.

- Blocks implementing the `readData` function algorithm. In this example, a few simple blocks provide `Data`, `ERR`, and `NegCode` output values with minimal manipulation. A Constant block represents the value of an application error defined for the server function. The value of `Op` passed by the caller is ignored. In a real-world application, the algorithm could perform a more complex manipulation, for example, selecting an execution path based on the passed value of `Op`, producing output data required by the application, and checking for error conditions.



4 When the server function is working in Simulink, set up the Simulink Function block in a model configured for AUTOSAR. For example, configure the current model for AUTOSAR or copy the block into an AUTOSAR model.

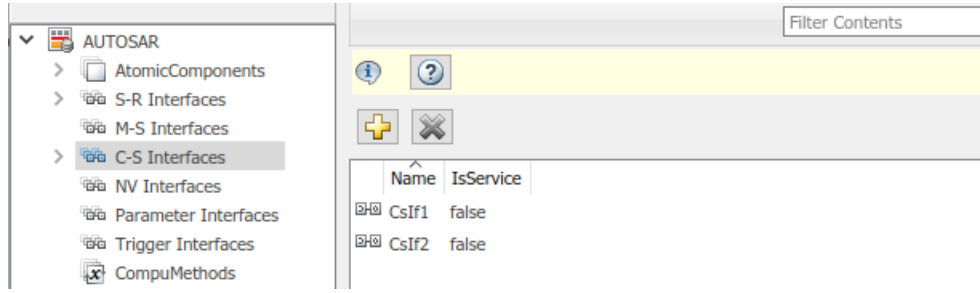
The example model is an AUTOSAR model, into which the Simulink Function block `readData` has been copied. In place of a meaningful `Op` input value for the `readData` function, Simulink data transfer line `CurVal` provides an input value that is used in the function algorithm.



5 The required elements to configure an AUTOSAR server, in the general order they are created, are:

- AUTOSAR client-server (C-S) interface
- One or more AUTOSAR operations for which the C-S interface handles client requests
- AUTOSAR server port to receive client requests for a server operation
- For each server operation, an AUTOSAR server runnable to execute client requests

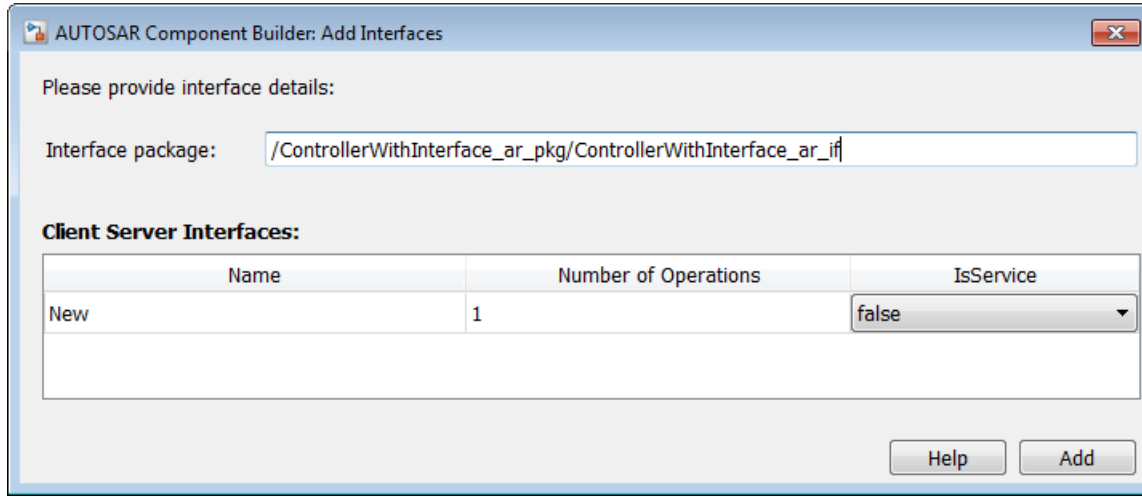
Open AUTOSAR Dictionary. To view AUTOSAR C-S interfaces in the model, go to the **C-S Interfaces** view. The example model already contains client-server interfaces.



If a C-S interface does not yet exist in your model, create one.

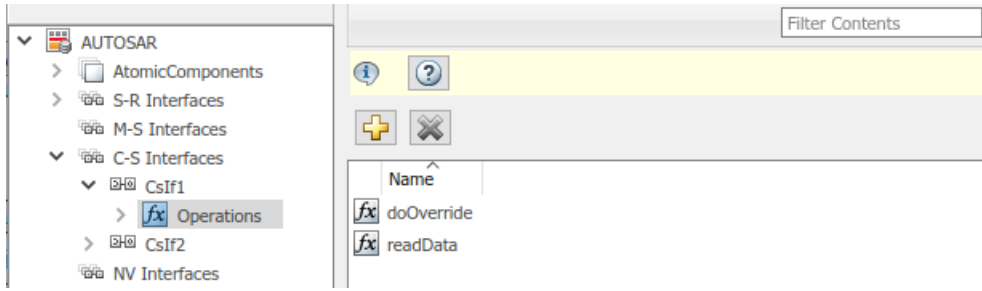
a In the C-S interfaces view, click the **Add** button  . This action opens the Add Interfaces dialog box.

b In the dialog box, name the new C-S Interface, and specify the number of operations you intend to associate with the interface. Leave other parameters at their defaults. Click **Add**. The new interface appears in the C-S interfaces view.



6 Under **C-S Interfaces**, create one or more AUTOSAR server operations for which the C-S interface handles client requests. Each operation corresponds to a Simulink server function in the model.

Expand **C-S Interfaces** and expand the individual C-S interface to which you want to add a server operation. (In the example model, expand `CsIf1`.) To view operations for the interface, select **Operations**. The example model already contains AUTOSAR server operations named `doOverride` and `readData`.

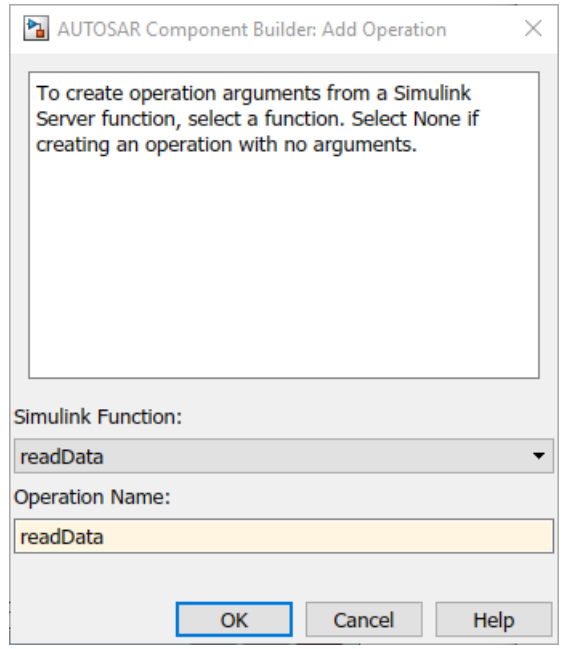


If a server operation does not yet exist in your model, create one. (If your C-S interface contains a placeholder operation named `Operation1`, you can safely delete it.)

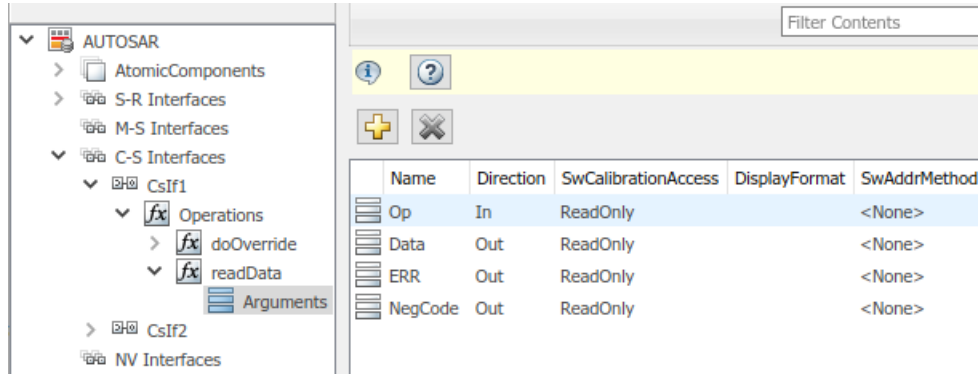
a In the operations view, click the **Add** button  . This action opens the Add Operation dialog box.

b In the dialog box, enter the **Operation Name**. Specify the name of the corresponding Simulink server function.

c If the corresponding Simulink server function has arguments, select the function in the **Simulink Function** list. This action causes AUTOSAR operation arguments to be automatically created based on the Simulink server function arguments. Click **OK**. The operation and its arguments appear in the operations view.

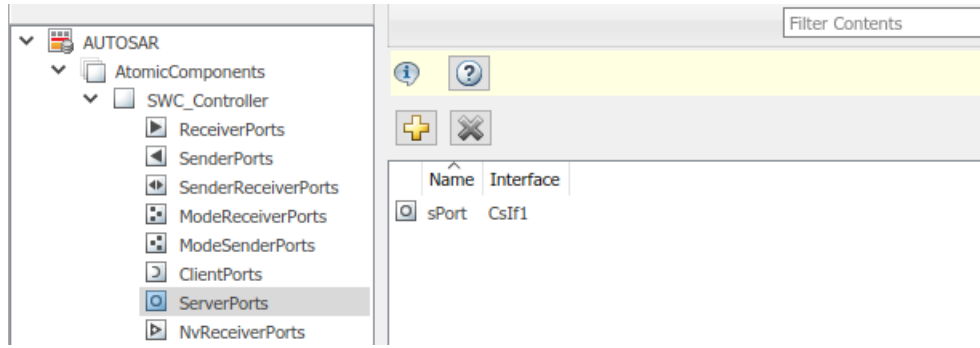


7 Examine the arguments listed for the AUTOSAR server operation. Expand **Operations**, expand the individual operation (for example, `readData`), and select **Arguments**. The listed arguments correspond to the Simulink server function prototype.



8 To view AUTOSAR server ports in the model, go to the server ports view. Expand **AtomicComponents**, expand the individual component that you are configuring, and

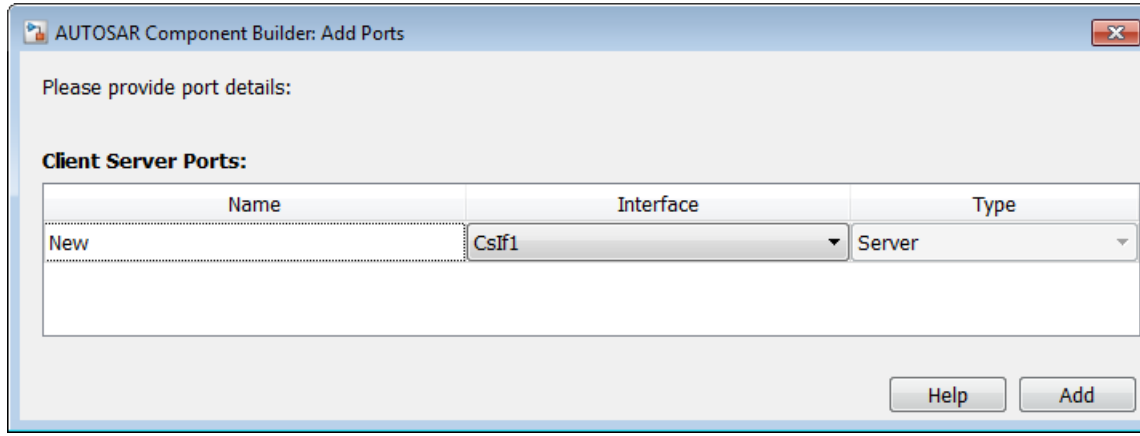
select **ServerPorts**. The example model already contains an AUTOSAR server port named `sPort`.



If a server port does not yet exist in your model, create one.

a In the server ports view, click the **Add** button  . This action opens the Add Ports dialog box.

b In the dialog box, name the new server port, and select the C-S interface for which you configured a server operation. Click **Add**. The new port appears in the server ports view.



9 For each AUTOSAR server operation, configure an AUTOSAR server runnable to execute client requests. To view AUTOSAR runnables in the model, select

Runnables. The example model already contains a server runnable for `readData`, named `Runnable_readData`.

If a suitable server runnable does not yet exist in your model, create one.

a. In the runnables view, click the **Add** button  . This action adds a table entry for a new runnable.

b. Select the new runnable and configure its name and symbol. The **symbol** name specified for the runnable must match the Simulink server function name. (In the example model, the **symbol** name for `Runnable_readData` is the function name `readData`.)

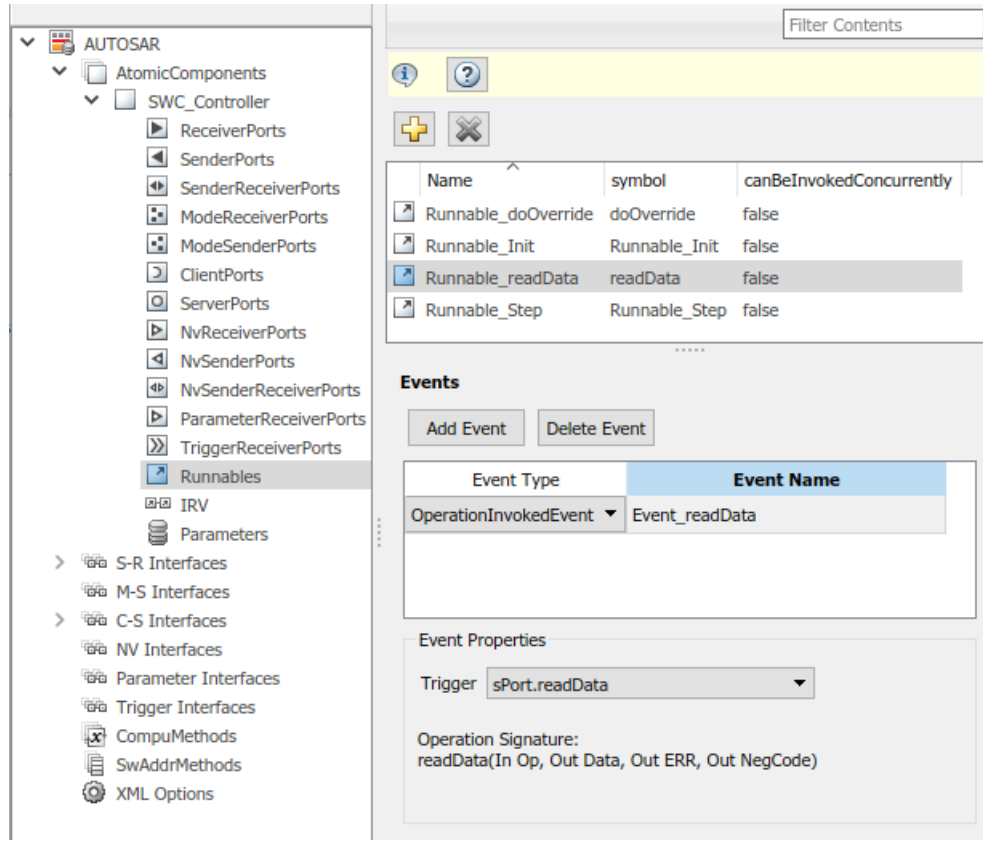
c. Create an operation-invoked event to trigger the server runnable. (The example model defines event `event_readData` for server runnable `Runnable_readData`.)

   i. Under **Events**, click **Add Event**. Select the new event.

   ii. For **Event Type**, select `OperationInvokedEvent`.

   iii. Enter the **Event Name**.

   iv. Under **Event Properties**, select a **Trigger** value that corresponds to the server port and C-S operation previously created for the server function. (In the example model, the **Trigger** value selected for `Runnable_readData` is `sPort.readData`, combining server port `sPort` with operation `readData`.) Click **Apply**.

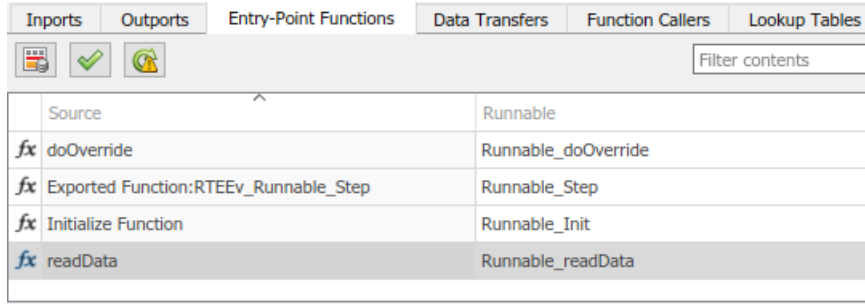


This step completes the configuration of an AUTOSAR server in the AUTOSAR Dictionary view of the configuration.

10 Switch to the Code Mapping Editor view of the configuration and map the Simulink server function to the AUTOSAR server runnable.

a Open Code Mapping Editor. Select the **Entry-Point Functions** tab.

b Select the Simulink server function. To map the function to an AUTOSAR runnable, click on the **Runnable** field and select the corresponding runnable from the list of available server runnables. In the example model, the Simulink function `readData` is mapped to AUTOSAR runnable `Runnable_readData`.



11 To validate the AUTOSAR component configuration, click the **Validate** button . If errors are reported, fix the errors, and retry validation. Repeat until validation succeeds.

12 Generate C and `arxml` code for the model.

After you configure an AUTOSAR server, configure a corresponding AUTOSAR client invocation, as described in “Configure AUTOSAR Client” on page 4-154.

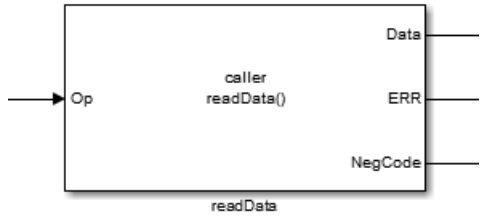
Configure AUTOSAR Client

After you configure an AUTOSAR server, as described in “Configure AUTOSAR Server” on page 4-144, configure a corresponding AUTOSAR client invocation. This example shows how to configure a Function Caller block as an AUTOSAR client invocation. The example uses the file *`matlabroot`*`/help/toolbox/ecoder/examples/autosar/mControllerWithInterface_client.slx`.

1 Open a model in which you want to create and configure an AUTOSAR client, or open the example model `mControllerWithInterface_client.slx`.

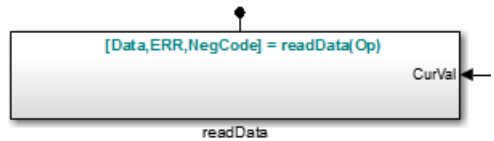
2 Add a Function Caller block to the model. In the Simulink Library Browser, the Function Caller block is in **User-Defined Functions**.

The example model provides a Simulink Function block named `readData`, which is located inside `Runnable3_Subsystem`.

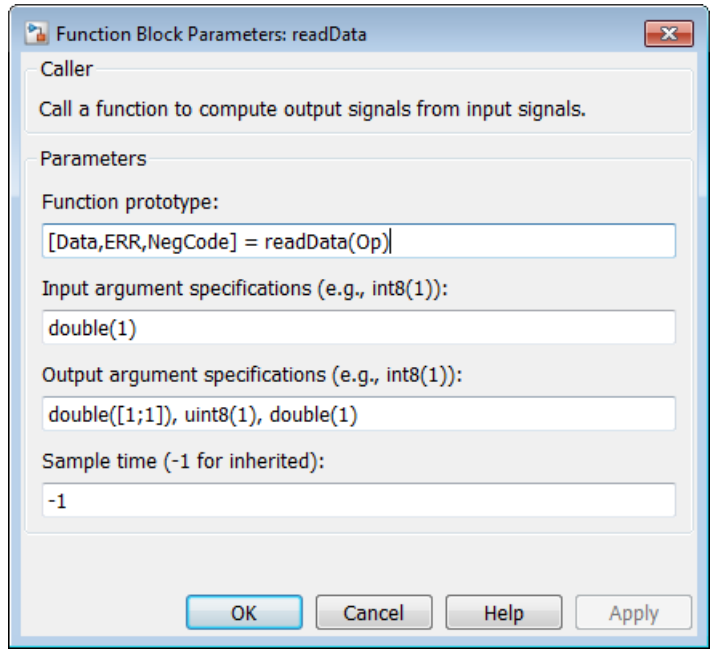


3 Configure the Function Caller block to call a corresponding Simulink Function block. Double-click the block to open it, and edit the block parameters to specify the server function prototype.

In the example model, the `readData` Function Caller parameters specify a function prototype for the `readData` server function used in the AUTOSAR server example, “Configure AUTOSAR Server” on page 4-144. Here is the `readData` function from the server example.



The Function Caller parameters include function prototype and argument specification fields. The function name in the prototype must match the **Operation Name** specified for the corresponding server operation. See the operation creation step in “Configure AUTOSAR Server” on page 4-144. The argument types and dimensions also must match the server function arguments.

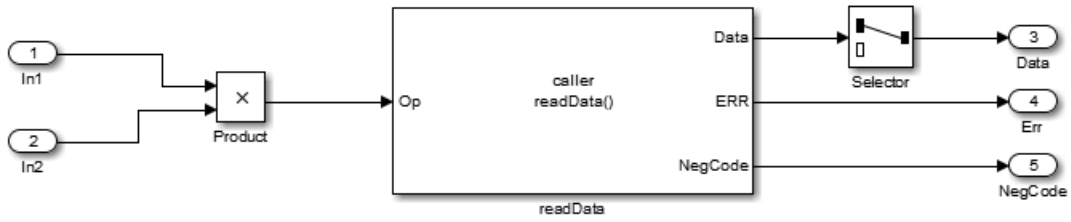


Note If you want to simulate the function invocation at this point, you must place the Function Caller block in a common model or test harness with the corresponding Simulink Function block. Simulation is not required for this example.

4 When the function invocation is completely formed in Simulink, set up the Function Caller block in a model configured for AUTOSAR. For example, configure the current model for AUTOSAR or copy the block into an AUTOSAR model.

Tip If you create (or copy) a Function Caller block in a model before you map and configure the AUTOSAR component, you have the option of having the software populate the AUTOSAR operation arguments for you, rather than creating the arguments manually. To have the arguments created for you, along with a fully-configured AUTOSAR client port and a fully mapped Simulink function caller, select **Create Default Component** rather than **Create Component Interactively**. For more information, see “Create AUTOSAR Software Component in Simulink” on page 3-21.

The example model is an AUTOSAR model, into which the Function Caller block `readData` has been copied. The block is connected to inports, outports, and signal lines matching the function argument data types and dimensions.

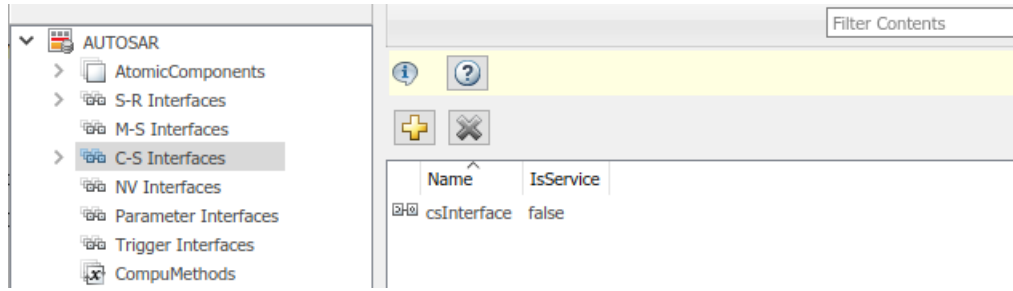


Note Whenever you add or change a Function Caller block in an AUTOSAR model, update function callers in the AUTOSAR configuration. Open Code Mapping Editor (**Code > C/C++ Code > Configure Model in Code Perspective**). In the dialog box, click the **Update** button  . This action loads or updates Simulink data transfers, function callers, and numeric types in your model. After updating, the function caller you added appears in the **Function Callers** tab of Code Mapping Editor.

5 The required elements to configure an AUTOSAR client, in the general order they should be created, are:

- AUTOSAR client-server (C-S) interface
- One or more AUTOSAR operations matching the Simulink server functions that you defined in the AUTOSAR server model
- AUTOSAR client port to receive client requests for a server operation offered by the C-S interface

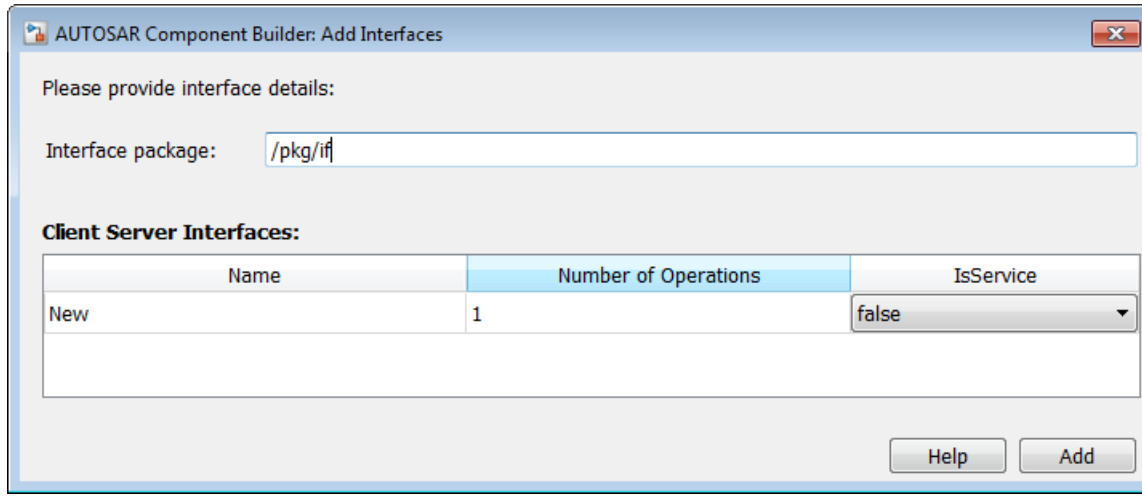
Open AUTOSAR Dictionary. To view AUTOSAR C-S interfaces in the model, go to the **C-S Interfaces** view. The example model already contains a client-server interface named `csInterface`.



If a C-S interface does not yet exist in the AUTOSAR configuration, create one.

a In the C-S interfaces view, click the **Add** button  . This action opens the Add Interfaces dialog box.

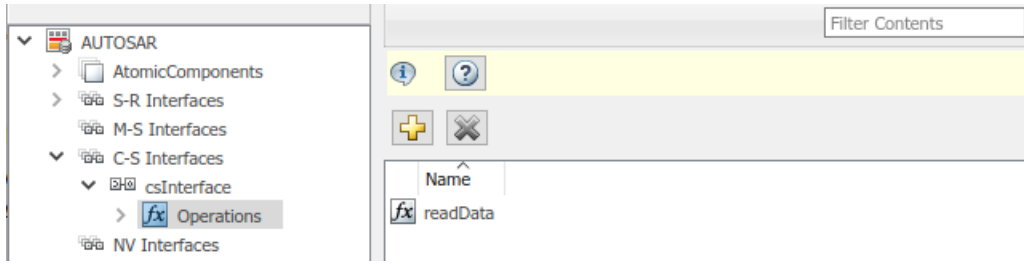
b In the dialog box, name the new C-S Interface, and specify the number of operations you intend to associate with the interface. Leave other parameters at their defaults. Click **Add**. The new interface appears in the C-S interfaces view.



6 Under **C-S Interfaces**, create one or more AUTOSAR operations matching the Simulink server functions that you defined in the AUTOSAR server model.

Expand **C-S Interfaces** and expand the individual C-S interface to which you want to add an AUTOSAR operation. (In the example model, expand `CsInterface`.) To view

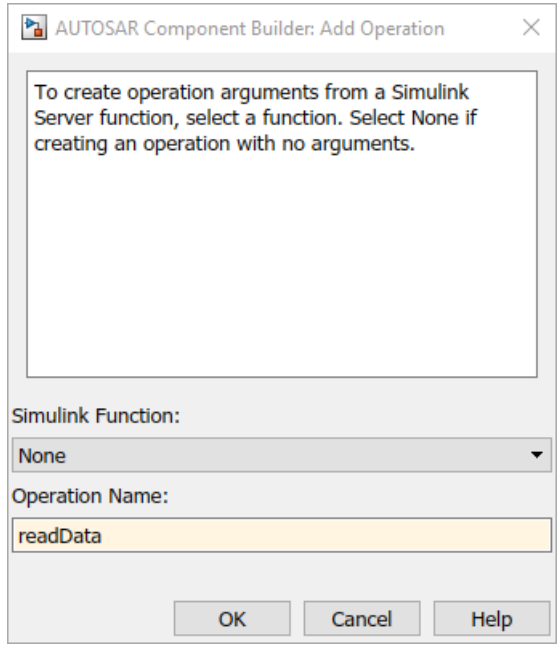
operations for the interface, select **Operations**. The example model already contains an AUTOSAR operation named `readData`.



If an AUTOSAR operation does not yet exist in your model, create one. (If your C-S interface contains a placeholder operation named `Operation1`, you can safely delete it.)

a In the operations view, click the **Add** button  . This action opens the Add Operation dialog box.

b In the dialog box, enter the **Operation Name**. Specify the name of the corresponding Simulink server function. Leave **Simulink Function** set to `None`, because the client model does not contain the Simulink server function block. Click **OK**. The new operation appears in the operations view.

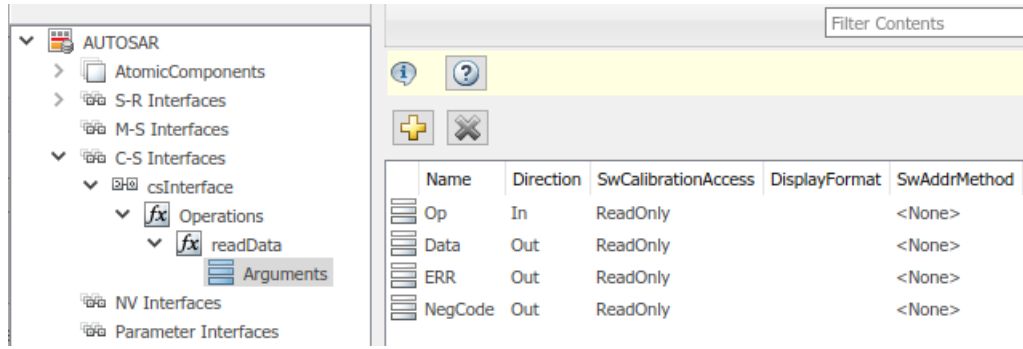


7 Add the AUTOSAR operation arguments.

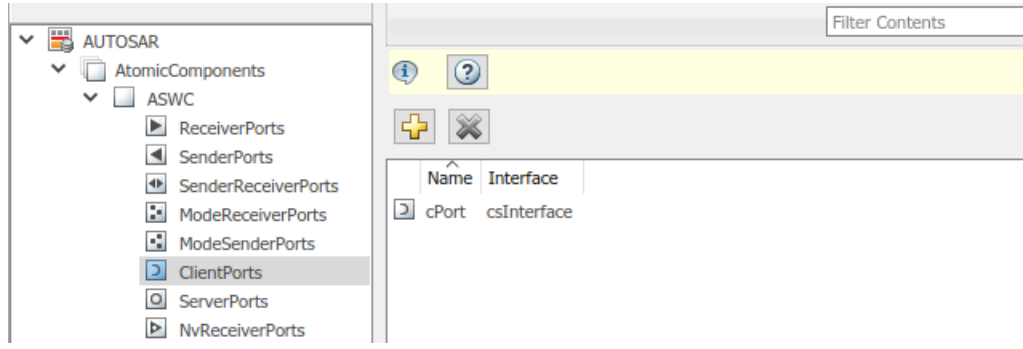
a Expand **Operations**, expand the individual operation (for example, `readData`), and select **Arguments**.

b In the arguments view, click the **Add** button  one time for each function argument. For example, for `readData`, click the **Add** button four times, for arguments `Op`, `Data`, `ERR`, and `NegCode`. Each click creates one new argument entry.

c Select each argument entry and set the argument **Name** and **Direction** to match the function prototype.



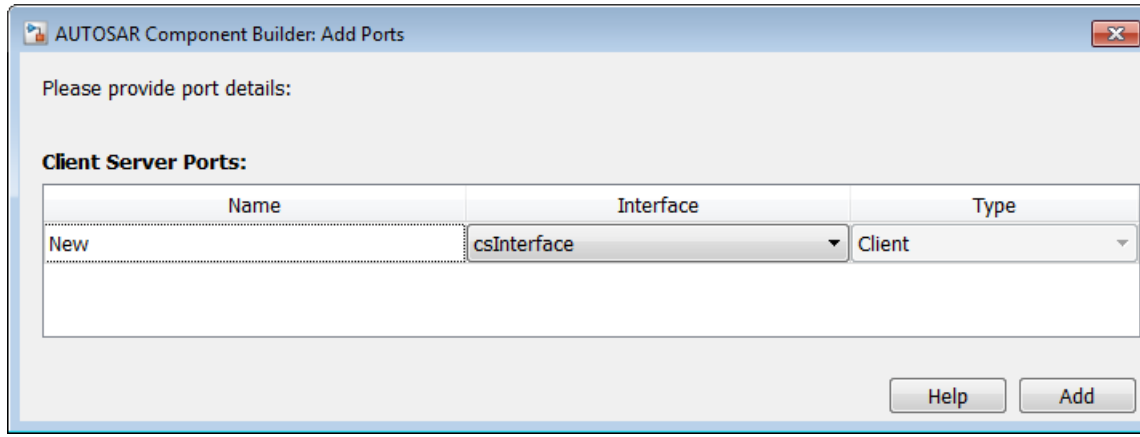
8 To view AUTOSAR client ports in the model, go to the client ports view. Expand **AtomicComponents**, expand the individual component that you are configuring, and select **ClientPorts**. The example model already contains an AUTOSAR client port named `cPort`.



If a client port does not yet exist in your model, create one.

a In the client ports view, click the **Add** button  . This action opens the Add Ports dialog box.

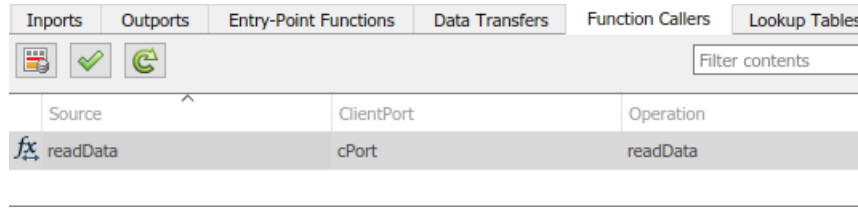
b In the dialog box, name the new client port, and select a C-S interface. Click **Add**. The new port appears in the client ports view.



This step completes the configuration of an AUTOSAR client in the AUTOSAR Dictionary view of the configuration.

9 Switch to the Code Mapping Editor view of the configuration and map the Simulink function caller to an AUTOSAR client port and C-S operation.

- **a** Open Code Mapping Editor. Select the **Function Callers** tab.
- **b** Select the Simulink function caller. Click on the **ClientPort** field and select a port from the list of available AUTOSAR client ports. Click on the **Operation** field and select an operation from the list of available AUTOSAR C-S operations. In the example model, the Simulink function caller `readData` is mapped to AUTOSAR client port `cPort` and C-S operation `readData`.



10 To validate the AUTOSAR component configuration, click the **Validate** button . If errors are reported, fix the errors, and retry validation. Repeat until validation succeeds.

11 Generate C and `arxml` code for the model.

Configure AUTOSAR Client-Server Error Handling

AUTOSAR defines an application error status mechanism for client-server error handling. An AUTOSAR server returns error status, with a value matching a predefined possible error. An AUTOSAR client receives and responds to the error status. An AUTOSAR software component that follows client-server error handling guidelines potentially provides error status to AUTOSAR Basic Software, such as a Diagnostic Event Manager (DEM).

In Simulink, you can:

- Import `arxml` code that implements client-server error handling.
- Configure error handling for a client-server interface.
- Generate C and `arxml` code for client-server error handling.

If you import `arxml` code that implements client-server error handling, the importer creates error status ports at the corresponding server call-point (Function-Caller block) locations.

To implement AUTOSAR client-server error handling in Simulink:

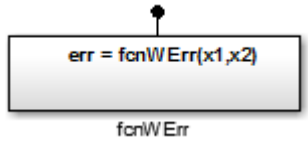
1 Define the possible error status values that the AUTOSAR server returns in a Simulink data type. Define one or more error codes in the range 0-63, inclusive. The underlying storage of the data type must be an unsigned 8-bit integer. The data scope must be `Exported`. For example, define an enumeration type `appErrType`:

```
classdef(Enumeration) appErrType < uint8

   enumeration
      SUCCESS(0)
      ERROR(1)
      COMM_MODE_LIMITATION(2)
      OVERFLOW(3)
      UNDERFLOW(4)
      VALUE_MOD3(5)
   end

   methods (Static = true)
      function descr = getDescription()
         descr = 'Definition of application error type.';
      end

      function hdrFile = getHeaderFile()
         hdrFile = '';
      end

      function retVal = addClassNameToEnumNames()
```

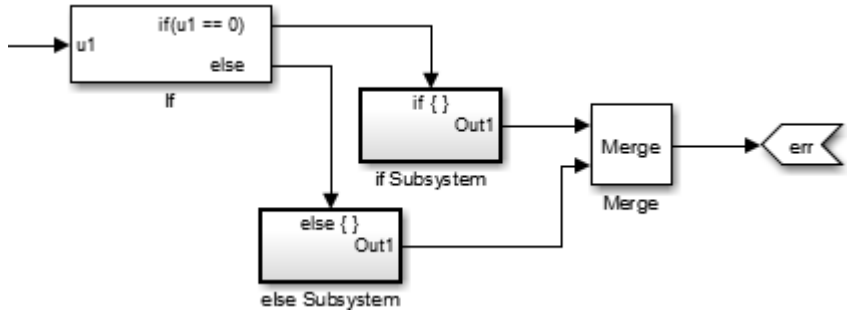
```
            retVal = false;
        end

        function dataScope = getDataScope()
            dataScope = 'Exported';
        end
    end

end
```

Note The Simulink data type that you define to represent possible errors in the model does not directly impact the AUTOSAR possible errors that are imported and exported in `arxml` code. To modify the exported possible errors for a C-S interface or C-S operation, use AUTOSAR properties functions. This topic provides examples.

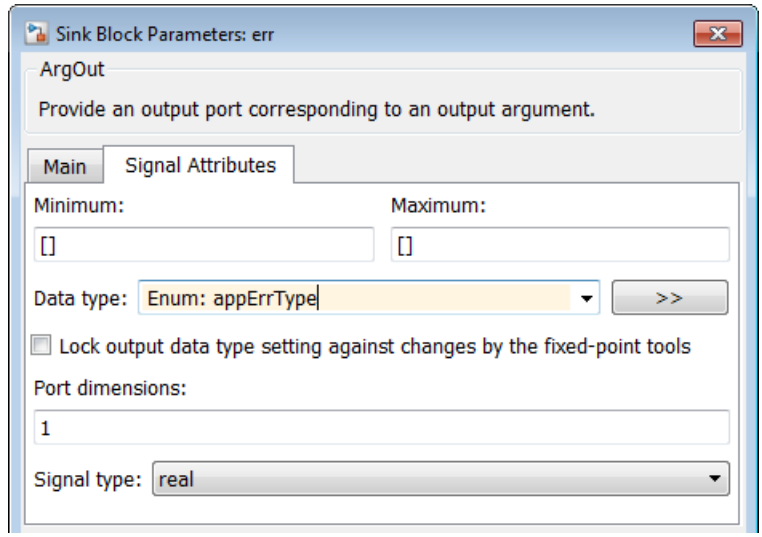
2 Define an error status output argument for the Simulink Function block that models the AUTOSAR server. Configure the error status argument as the only function output or add it to other outputs. For example, here is a Simulink Function block that returns an error status value in output `err`.



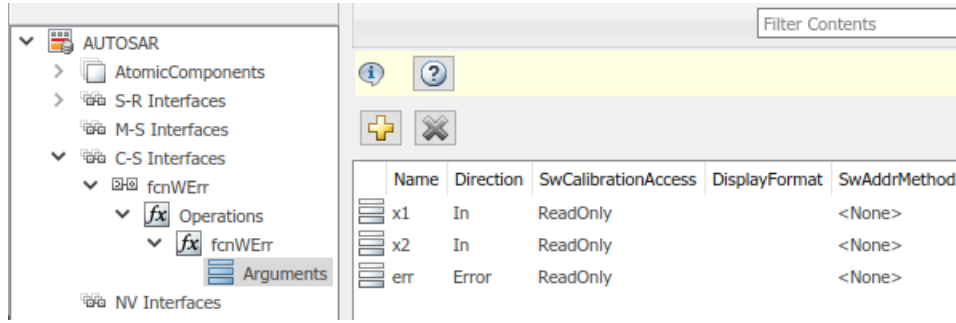
The Simulink Function block implements an algorithm to return error status.



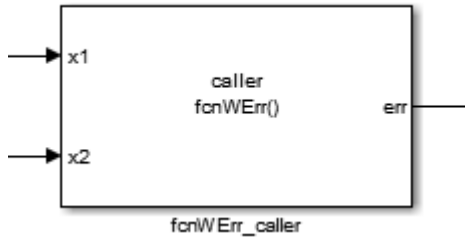
3 Reference the possible error values type in the model. In the Argument Outport block parameters for the error outport, specify the error status data type, in this case, `appErrType`. Set **Port dimensions** to 1 and **Signal type** to `real`.



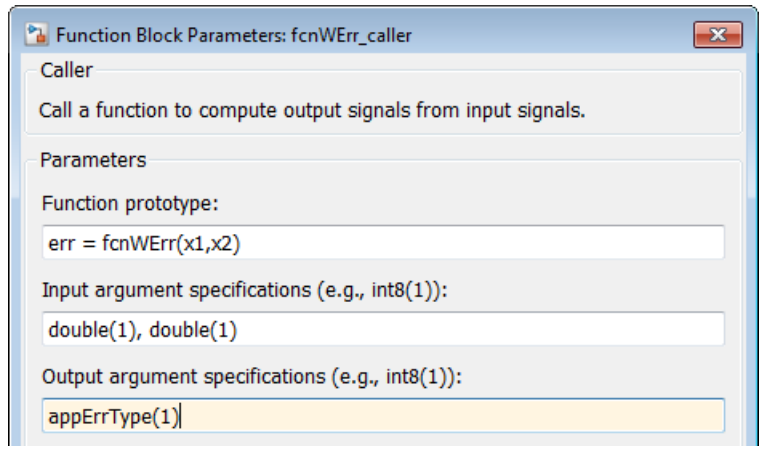
4 Configure the AUTOSAR properties of the error argument in the client-server interface. Open AUTOSAR Dictionary, expand **C-S Interfaces**, and navigate to the **Arguments** view of the AUTOSAR operation. To add an argument, click the **Add** button  . Configure the argument name and set **Direction** to `Error`.



5 Create an error port in each Function-Caller block that models an AUTOSAR client invocation. For example, here is a Function-Caller block that models an invocation of `fcnWErr`.



In the Function-Caller block parameters, specify the same error status data type.



Configure the AUTOSAR properties of the error argument to match the information in AUTOSAR Dictionary, **Arguments** view, shown in Step 4.

The generated C code for the function reflects the configured function signature and the logic defined in the model for handling the possible errors.

```
appErrType fcnWErr(real_T x1, real_T x2)
{
  appErrType rty_err_0;
  if (...) == 0.0) {
    rty_err_0 = ...;
  } else {
    rty_err_0 = ...;
  }

  return rty_err_0;
}
```

Additionally, for the enumeration type class definition used in this example, the build generates header file `appErrType.h`, containing the possible error type definitions.

The exported `arxml` code contains the possible error definitions, and references to them.

```
<POSSIBLE-ERRORS>
   <APPLICATION-ERROR …>
      <SHORT-NAME>SUCCESS</SHORT-NAME>
      <ERROR-CODE>0</ERROR-CODE>
   </APPLICATION-ERROR>
   <APPLICATION-ERROR …>
      <SHORT-NAME>ERROR</SHORT-NAME>
      <ERROR-CODE>1</ERROR-CODE>
   </APPLICATION-ERROR>
   …
   <APPLICATION-ERROR …>
      <SHORT-NAME>UNDERFLOW</SHORT-NAME>
      <ERROR-CODE>4</ERROR-CODE>
   </APPLICATION-ERROR>
   <APPLICATION-ERROR …>
      <SHORT-NAME>VALUE_MOD3</SHORT-NAME>
      <ERROR-CODE>5</ERROR-CODE>
   </APPLICATION-ERROR>
</POSSIBLE-ERRORS>
```

You can use AUTOSAR property functions to programmatically modify the possible errors that are exported in `arxml` code, and to set the **Direction** property of a C-S operation argument to `Error`.

The following example adds UNDERFLOW and VALUE_MOD3 to the possible errors for a C-S interface named `fcnWErr`.

```
>> arProps = autosar.api.getAUTOSARProperties(bdroot)
>> get(arProps,'fcnWErr','PossibleError')
ans =
    'fcnWErr/SUCCESS'    'fcnWErr/ERROR'    'fcnWErr/COMM_MODE…'
    'fcnWErr/OVERFLOW'
>> get(arProps,'fcnWErr/OVERFLOW','errorCode')
ans =
         3
>> add(arProps,'fcnWErr','PossibleError','UNDERFLOW')
>> set(arProps,'fcnWErr/UNDERFLOW','errorCode',4)
>> add(arProps,'fcnWErr','PossibleError','VALUE_MOD3')
>> set(arProps,'fcnWErr/VALUE_MOD3','errorCode',5)
>> get(arProps,'fcnWErr','PossibleError')
ans =
    'fcnWErr/SUCCESS'    'fcnWErr/ERROR'    'fcnWErr/COMM_MODE…'
    'fcnWErr/OVERFLOW'    'fcnWErr/UNDERFLOW'    'fcnWErr/VALUE_MOD3'
```

You can also access possible errors on a C-S operation. The following example lists possible errors for operation `fcnWErr` on C-S interface `fcnWErr`.

```
>> arProps = autosar.api.getAUTOSARProperties(bdroot)
>> get(arProps,'fcnWErr/fcnWErr','PossibleError')
ans =
    'fcnWErr/SUCCESS'    'fcnWErr/ERROR'    'fcnWErr/COMM_MODE…'
    'fcnWErr/OVERFLOW'
```

The following example sets the direction of C-S operation argument `err` to `Error`.

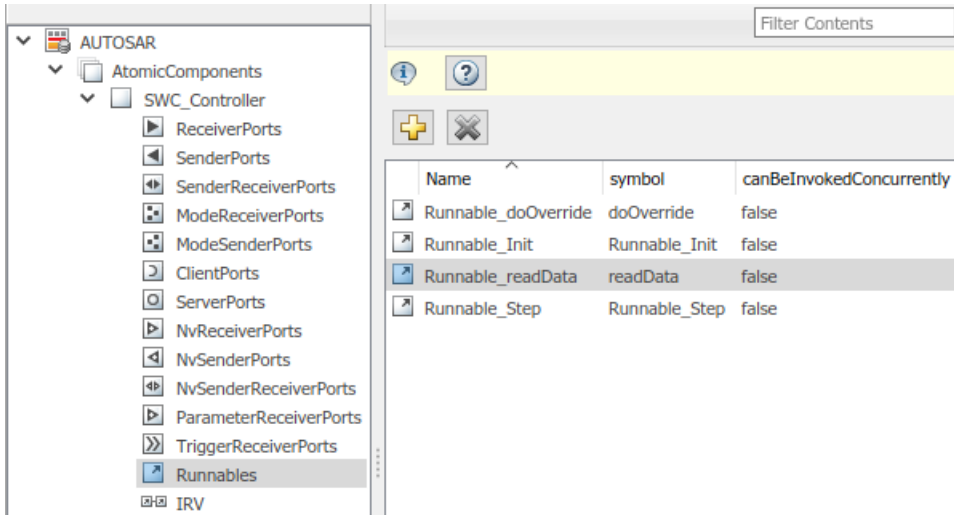
```
>> arProps = autosar.api.getAUTOSARProperties(bdroot)
>> set(arProps,'fcnWErr/fcnWErr/err','Direction','Error')
>> get(arProps,'fcnWErr/fcnWErr/err','Direction')
ans =
    Error
```

Concurrency Constraints for AUTOSAR Server Runnables

The following blocks and modeling patterns are incompatible with concurrent execution of an AUTOSAR server runnable.

- Blocks inside a Simulink function:
  - Blocks with state, such as Unit Delay.
  - Blocks with zero-crossing logic, such as Triggered Subsystem and Enabled Subsystem.
  - Stateflow charts.
  - Other Simulink Function blocks.
  - Noninlined subsystems.
  - Legacy C function calls with side effects.
- Modeling patterns inside a Simulink function:
  - Writing to a data store memory (per-instance-memory).
  - Writing to a global block signal (for example, static memory).

To enforce concurrency constraints for AUTOSAR server runnables, use the runnable property `canBeInvokedConcurrently`. The property is located in the **Runnables** view in AUTOSAR Dictionary.



When `canBeInvokedConcurrently` is set to `true` for a server runnable, AUTOSAR validation checks for blocks and modeling patterns that are incompatible with concurrent execution of a server runnable. If a Simulink function contains an incompatible block or modeling pattern, validation reports errors. If `canBeInvokedConcurrently` is set to `false`, validation does not check for blocks and modeling patterns that are incompatible with concurrent execution of a server runnable.

You can set the property `canBeInvokedConcurrently` to `true` only for an AUTOSAR server runnable — that is, a runnable with an `OperationInvokedEvent`. Runnables with other event triggers, such as timing events, cannot be concurrently invoked. If `canBeInvokedConcurrently` is set to `true` for a nonserver runnable, AUTOSAR validation fails.

To programmatically set the runnable property `canBeInvokedConcurrently`, use the AUTOSAR property function `set`. The following example sets the runnable property `canBeInvokedConcurrently` to `true` for an AUTOSAR server runnable named `Runnable_readData`.

```
open_system('mControllerWithInterface_server')
arProps = autosar.api.getAUTOSARProperties('mControllerWithInterface_server');
SRPath = find(arProps,[],'Runnable','Name','Runnable_readData')
```

```
SRPath =
    'SWC_Controller/ControllerWithInterface_ar/Runnable_readData'
```

```
invConc = get(arProps,'SWC_Controller/ControllerWithInterface_ar/Runnable_readData',...
  'canBeInvokedConcurrently')
```

```
invConc =
     0

set(arProps,'SWC_Controller/ControllerWithInterface_ar/Runnable_readData',...
  'canBeInvokedConcurrently',true)
invConc = get(arProps,'SWC_Controller/ControllerWithInterface_ar/Runnable_readData',...
  'canBeInvokedConcurrently')

invConc =
     1'
```

Configure and Map AUTOSAR Server and Client Programmatically

To programmatically configure AUTOSAR properties of AUTOSAR client-server interfaces, use AUTOSAR property functions such as `set` and `get`.

To programmatically configure Simulink to AUTOSAR mapping information for AUTOSAR clients and servers, use these functions:

- `getFunction`
- `getFunctionCaller`
- `mapFunction`
- `mapFunctionCaller`

For example scripts that use AUTOSAR property and map functions, see “Configure AUTOSAR Client-Server Interfaces” on page 4-335.

See Also

Argument Inport | Argument Outport | Function Caller | Simulink Function | Trigger

Related Examples

- “Client-Server Interface” on page 2-15
- “Configure AUTOSAR Client-Server Interfaces” on page 4-335
- “Import AUTOSAR Software Component” on page 3-4
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Model AUTOSAR Communication” on page 2-13
- “AUTOSAR Component Configuration” on page 4-3

Configure AUTOSAR Mode-Switch Communication

AUTOSAR mode-switch (M-S) communication relies on a mode manager and connected mode users. The mode manager is an authoritative source for software components to query the current mode and to receive notification when the mode changes (switches). A mode manager can be provided by AUTOSAR Basic Software (BSW) or implemented as an AUTOSAR software component. A mode manager implemented as a software component is called an application mode manager. A software component that queries the mode manager and receives notifications of mode switches is a mode user.

In this section...
“Configure Mode Receiver Port and Mode-Switch Event for Mode User” on page 4-172
“Configure Mode Sender Port and Mode Switch Point for Application Mode Manager” on page 4-177

Configure Mode Receiver Port and Mode-Switch Event for Mode User

To model a mode user software component, use an AUTOSAR mode receiver port and a mode-switch event. The mode receiver port uses a mode-switch (M-S) interface to connect and communicate with a mode manager, which provides notifications of mode changes. You configure a mode-switch event to respond to a specified mode change by activating an associated runnable. This example shows how to configure an AUTOSAR mode-receiver port, mode-switch event, and related elements for a mode user.

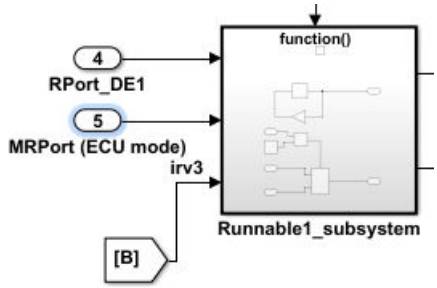
Note This example does not implement a meaningful algorithm for controlling component execution based on the current ECU mode.

1. Open the example model `rtwdemo_autosar_multirunnables`. Save a copy to a writable work folder.
2. Declare a mode declaration group — a group of mode values — using Simulink enumeration. Specify the storage type as an unsigned integer. Enter the following command in the MATLAB Command Window:

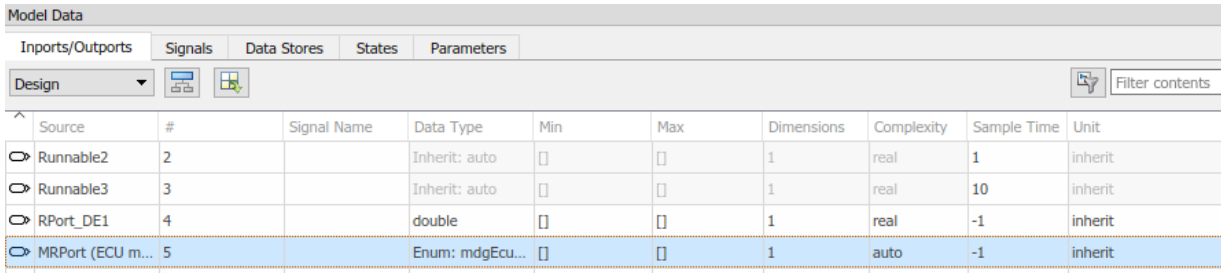
```
Simulink.defineIntEnumType('mdgEcuModes', ...
 {'Run', 'Sleep'}, [0;1], ...
 'Description', 'Mode declaration group for ECU modes', ...
 'DefaultValue', 'Run', ...
```

```
'HeaderFile', 'Rte_Type.h', ...
'AddClassNameToEnumNames', false,...
'StorageType', 'uint16');
```

3 Rename the Simulink inport `RPort_DE1 (ErrorStatus)` to `MRPort (ECU mode)`. For example, in the model window, open the Model Data Editor (**View > Model Data Editor**). Use the **Source** column to rename the inport. In a later step, you will map this inport to an AUTOSAR mode-receiver port.



4 Next, apply the mode declaration group `mdgEcuModes` to the inport. In the Model Data Editor, for the inport, set **Data Type** to `Enum: mdgEcuModes`. Additionally, set **Complexity** to `auto`.

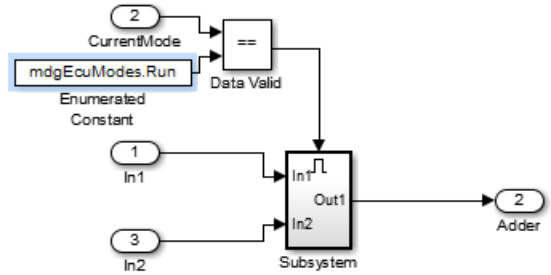


Source	#	Signal Name	Data Type	Min	Max	Dimensions	Complexity	Sample Time	Unit
Runnable2	2		Inherit: auto	[]	[]	1	real	1	inherit
Runnable3	3		Inherit: auto	[]	[]	1	real	10	inherit
RPort_DE1	4		double	[]	[]	1	real	-1	inherit
MRPort (ECU m...	5		Enum: mdgEcu...	[]	[]	1	auto	-1	inherit

5 In the model window, open the function-call subsystem named `Runnable1_subsystem` and make the following changes:

   a Rename inport `ErrorStatus` to `CurrentMode`.

   b Replace Constant block `RTE_E_OK` with an Enumerated Constant block. (The Enumerated Constant block can be found in the Sources block group.) Double-click the block to open its block parameters dialog box. Set **Output data type** to `Enum: mdgEcuModes` and set **Value** to `mdgEcuModes.Run`. Click **OK**.

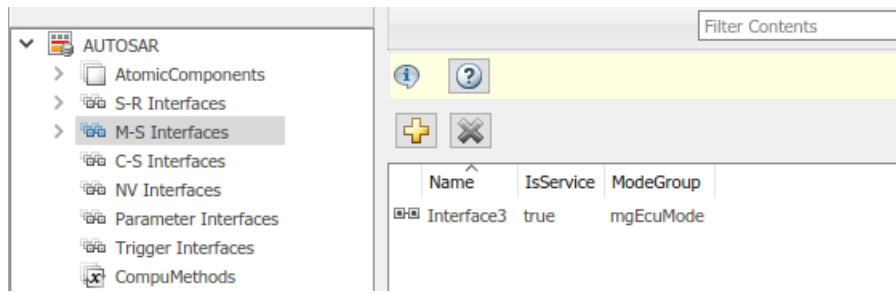


6 Add an AUTOSAR mode-switch interface to the model. Open AUTOSAR Dictionary.

Select **M-S Interfaces**. Click the **Add** button . In the Add Interfaces dialog box, specify **Name** as `Interface3` and specify **ModeGroup** as `mgEcuMode`.

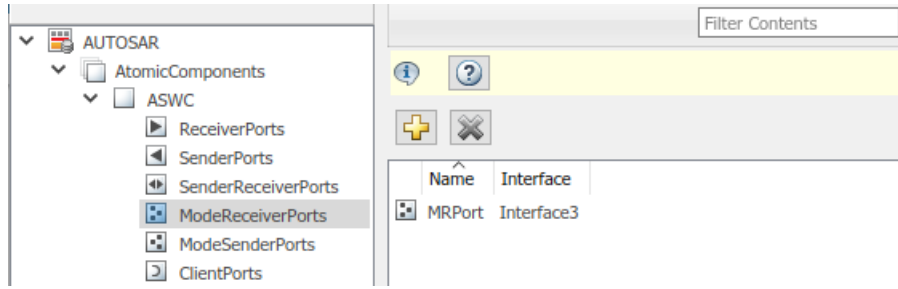
The **IsService** property of an M-S interface defaults to `true`. For the purposes of this example, you can leave **IsService** at its default setting, unless you have a reason to change it.

Click **Add**.

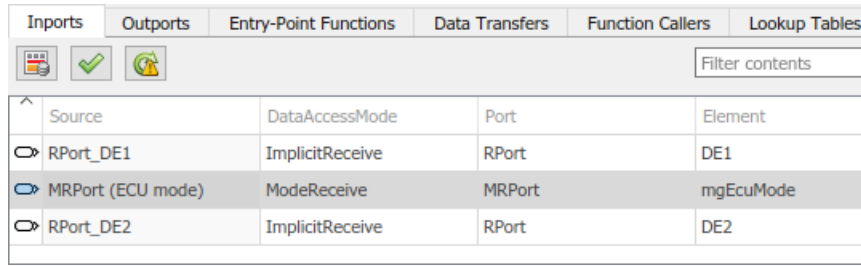


The value you specify for the AUTOSAR mode group is used in a later step, when you map a Simulink inport to an AUTOSAR mode-receiver port and element.

7 Add an AUTOSAR mode-receiver port to the model. Expand **AtomicComponents**, expand component `ASWC`, and select **ModeReceiverPorts**. To open the Add Ports dialog box, click the **Add** button . In the Add Ports dialog box, specify **Name** as `MRPort`. **Interface** is already set to `Interface3` (the only available value in this configuration), and **Type** is already set to `ModeReceiver`. Click **Add**.



8 In Code Mapping Editor, map the Simulink inport `MRPort (ECU mode)` to the AUTOSAR mode-receiver port and element. Open Code Mapping Editor and select the **Inports** tab. In the row for inport `MRPort (ECU mode)`, set **DataAccessMode** to `ModeReceive`, set **Port** to `MRPort`, and set **Element** to `mgEcuMode`. (The AUTOSAR element value matches the **ModeGroup** value you specified when you added AUTOSAR mode-switch interface `Interface3`.)



This step completes the AUTOSAR mode-receiver port configuration. Click the **Validate** button to validate the AUTOSAR component configuration. If errors are reported, address them and then retry validation. When the model passes validation, save the model.

Note The remaining steps create an AUTOSAR mode-switch event and set it up to trigger activation of an AUTOSAR runnable. If you intend to use ECU modes to control program execution, without using an event to activate a runnable, you can skip the remaining steps and implement the required flow-control logic in your design.

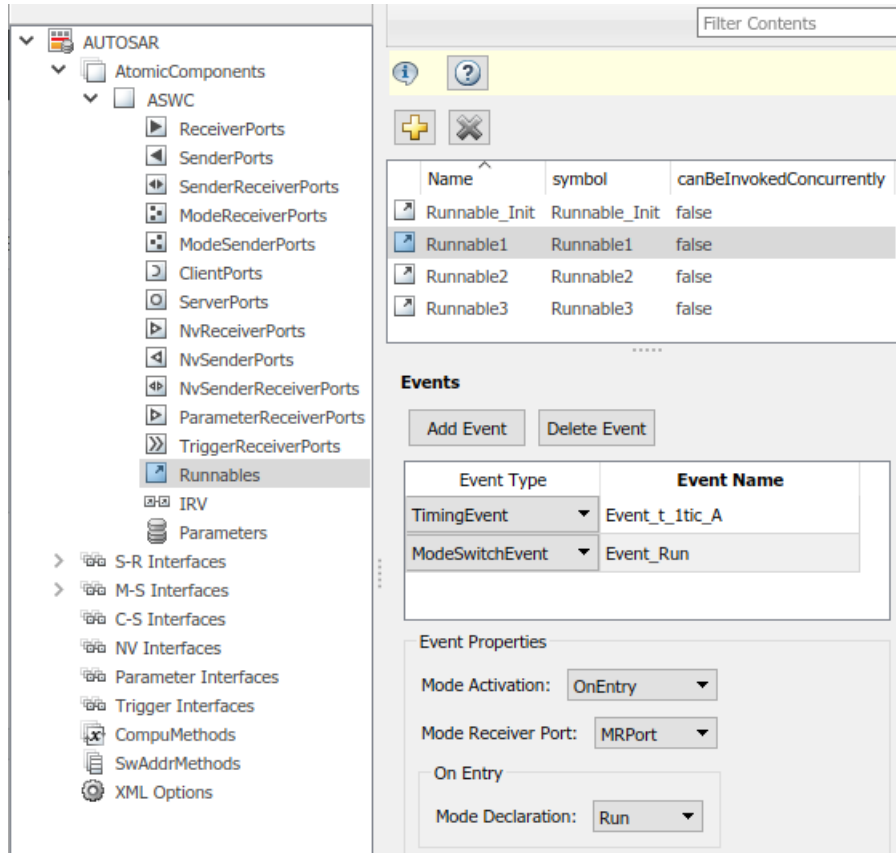
---

9 To add an AUTOSAR mode-switch event for a runnable:

a Open AUTOSAR Dictionary. Expand **AtomicComponents**, expand the `ASWC` component, and select **Runnables**. In the list of runnables, select `Runnable1`. This selection activates an **Events** configuration pane for the runnable.

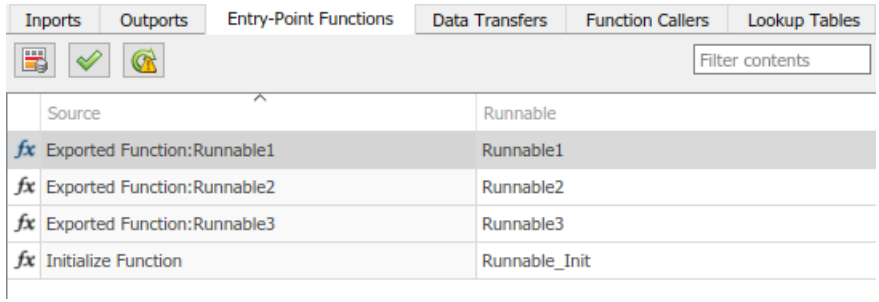
b To add an event to the list of events for `Runnable1`, click **Add Event**. For the new event, set **Event Type** to `ModeSwitchEvent`. (This activates an **Event Properties** subpane.) Specify **Event Name** as `Event_Run`.

c In the **Event Properties** subpane, set **Mode Activation** to `OnEntry`, set **Mode Receiver Port** to `MRPort`, and set **Mode Declaration** to `Run`. Click **Apply**.



10 Open Code Mapping Editor and select the **Entry-Point Functions** tab. In this example model, Simulink entry-point functions have already been mapped to

AUTOSAR runnables, including the runnable `Runnable1`, to which you just added a mode-switch event.



11 This completes the AUTOSAR mode-switch event configuration. Click the **Validate** button to validate the AUTOSAR component configuration. If errors are reported, address them and then retry validation. When the model passes validation, save the model. Optionally, you can generate XML and C code from the model and inspect the results.

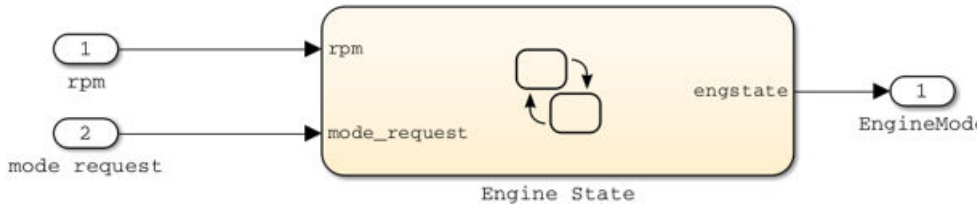
Configure Mode Sender Port and Mode Switch Point for Application Mode Manager

To model an application mode manager software component, use an AUTOSAR mode sender port (as defined in AUTOSAR Release 4). Mode sender ports use a mode-switch (M-S) interface to output a mode switch to connected mode user components.

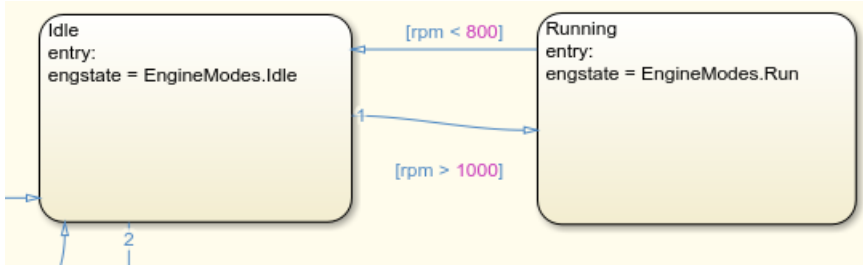
You model the mode sender port as a model root outport, which is mapped to an AUTOSAR mode sender port and a mode-switch (M-S) interface. The outport data type is an enumeration class with an unsigned integer storage type, representing an AUTOSAR mode declaration group.

This example shows how to configure a mode sender port and related elements for an application mode manager.

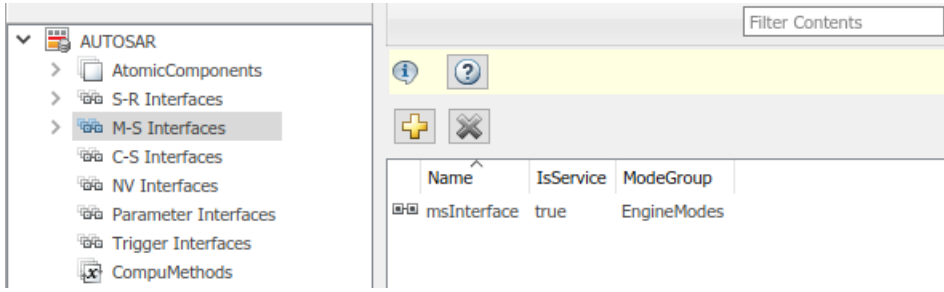
1 Open a model configured for AUTOSAR code generation. This example uses a model that contains Stateflow logic for maintaining engine state. The model outputs the current engine mode value.



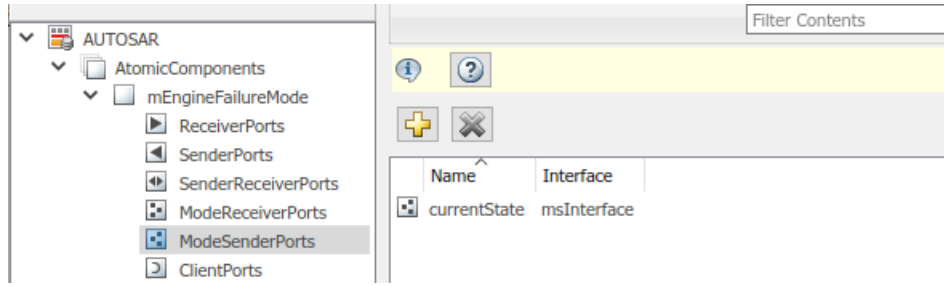
2 Declare a mode declaration group — a group of mode values. You can declare mode values with Simulink enumeration. In this example, the Stateflow logic defines `EngineModes` values `Off`, `Crank`, `Stall`, `Idle`, and `Run`. For example:



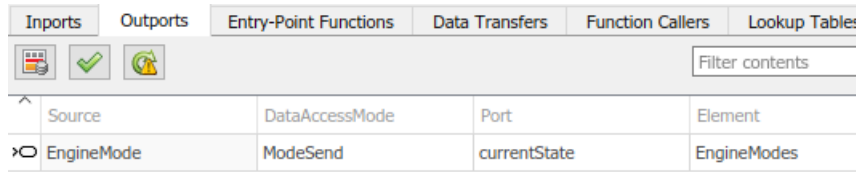
3 Add an AUTOSAR M-S interface to the model. Open AUTOSAR Dictionary and select **M-S Interfaces**. Click the **Add** button  . In the Add Interfaces dialog box, set **isService** to `true` and enter a **ModeGroup** name. In this example, the mode declaration group is `EngineModes`.



4 Add an AUTOSAR mode sender port to the model. Expand **AtomicComponents**, expand the component, and select **ModeSenderPorts**. Click the **Add** button  . In the Add Ports dialog box, set **Interface** to the name of the M-S interface you created.



5 Map the Simulink outport that outputs the mode value to the AUTOSAR mode sender port you created. Open Code Mapping Editor and select the **Outports** tab. To map the outport to the AUTOSAR mode sender port, set **DataAccessMode** to `ModeSend`, select the **Port** name, and for **Element**, select the mode declaration group name that you specified for the M-S interface.



6 Generate code for the model.

The `arxml` code includes referenced ModeSwitchPoints, ModeSwitchInterfaces, and ModeDeclarationGroups. For example, the following `arxml` code describes the ModeSwitchPoint for the AUTOSAR mode sender port.

```
<RUNNABLE-ENTITY>
  ...
  <MODE-SWITCH-POINTS>
    <MODE-SWITCH-POINT UUID="...">
      <SHORT-NAME>OUT_currentState_EngineModes</SHORT-NAME>
      <MODE-GROUP-IREF>
        <CONTEXT-P-PORT-REF DEST="P-PORT-PROTOTYPE">/pkg/swc/mEngineFailureMode/currentState
          </CONTEXT-P-PORT-REF>
        <TARGET-MODE-GROUP-REF DEST="MODE-DECLARATION-GROUP-PROTOTYPE">
          /pkg/if/msInterface/EngineModes</TARGET-MODE-GROUP-REF>
      </MODE-GROUP-IREF>
    </MODE-SWITCH-POINT>
  </MODE-SWITCH-POINTS>
  ...
</RUNNABLE-ENTITY>
```

The C code includes `Rte_Switch` API calls to communicate mode switches to other software components. For example, the following code communicates an `EngineModes` mode switch.

```
/* Outport: '<Root>/EngineMode' */
Rte_Switch_currentState_EngineModes(mEngineFailureMode_B.engstate);
```

See Also

Related Examples

- “Mode-Switch Interface” on page 2-17
- “Configure AUTOSAR Mode-Switch Interfaces” on page 4-338
- “Import AUTOSAR Software Component” on page 3-4
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Model AUTOSAR Communication” on page 2-13
- “AUTOSAR Component Configuration” on page 4-3

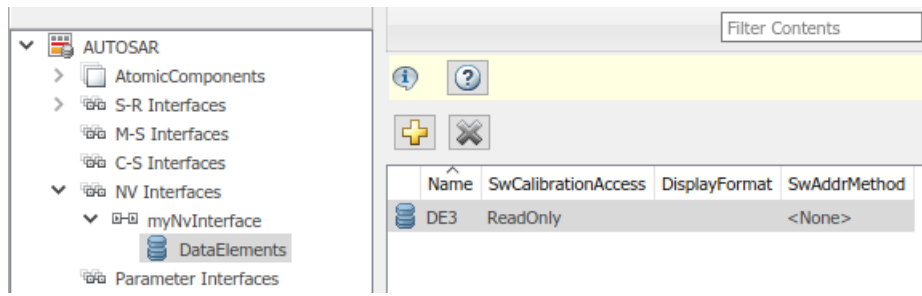
Configure AUTOSAR Nonvolatile Data Communication

AUTOSAR Release 4.0 introduced port-based nonvolatile (NV) data communication, in which an AUTOSAR software component reads and writes data to AUTOSAR nonvolatile components. To implement NV data communication, AUTOSAR software components define provide and require ports that send and receive NV data.

In Simulink, you can create AUTOSAR NV interfaces and ports, and map Simulink inports and outports to AUTOSAR NV ports. You model AUTOSAR NV ports with Simulink inports and outports, in the same manner described in “Sender-Receiver Interface” on page 2-14.

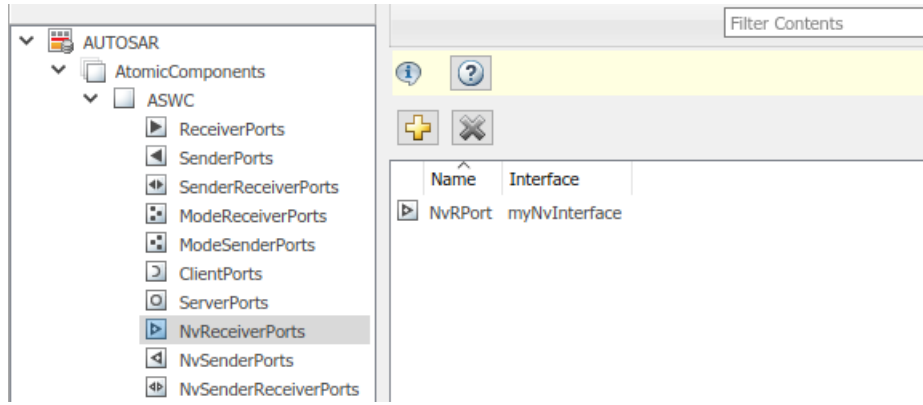
To create an NV data interface and ports in Simulink:

1. Add an AUTOSAR NV interface to the model. Open AUTOSAR Dictionary and select **NV Interfaces**. Click the **Add** button  . In the Add Interfaces dialog box, specify the interface name and the number of associated NV data elements.
2. Select and expand the new NV interface. Select **DataElements** and modify the data element attributes.

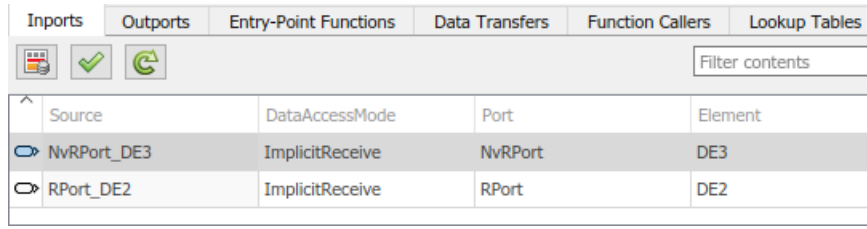


3. Add AUTOSAR NV ports to the model. Expand **AtomicComponents** and expand the component. Select and use the **NvReceiverPorts**, **NvSenderPorts**, and **NvSenderReceiverPorts** views to add the NV ports you require. For each NV port, select the NV interface you created.

4



5 Map Simulink inports and outports to the AUTOSAR NV ports you created. Open Code Mapping Editor. Select and use the **Inports** and **Outports** tabs to map the ports. For each inport or outport, select an AUTOSAR port, data element, and data access mode.



To programmatically configure AUTOSAR NV data communication elements, use the AUTOSAR property and mapping functions. For example, the following MATLAB code adds an AUTOSAR NV data interface and an NV receiver port to an open model. It then maps a Simulink inport to the AUTOSAR NV receiver port.

```
% Add AUTOSAR NV data interface myNvInterface with NV data element DE3
arProps = autosar.api.getAUTOSARProperties(hModel);
addPackageableElement(arProps,'NvDataInterface','/pkg/if','myNvInterface');
add(arProps,'myNvInterface','DataElements','DE3');

% Add AUTOSAR NV receiver port NvRPort, associated with myNvInterface
add(arProps,'ASWC','NvReceiverPorts','NvRPort','Interface','myNvInterface');

% Map Simulink inport NvRPort_DE3 to AUTOSAR port/element pair NvRPort and DE3
slMap = autosar.api.getSimulinkMapping(hModel);
mapInport(slMap,'NvRPort_DE3','NvRPort','DE3','ImplicitReceive');
```

See Also

Related Examples

- “Nonvolatile Data Interface” on page 2-22
- “Configure AUTOSAR Sender-Receiver Interfaces” on page 4-334
- “Import AUTOSAR Software Component” on page 3-4
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Model AUTOSAR Communication” on page 2-13
- “AUTOSAR Component Configuration” on page 4-3

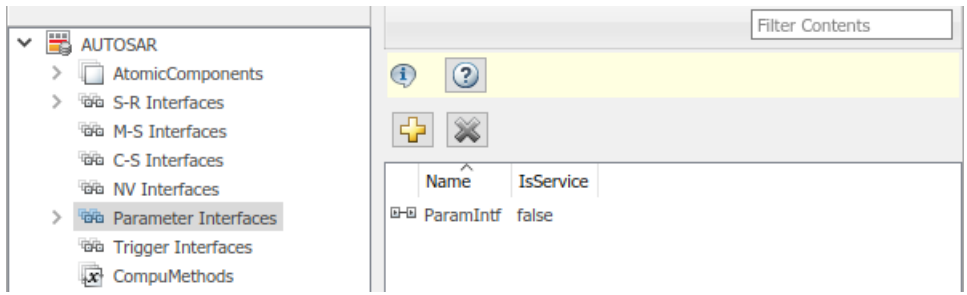
Configure Receiver for AUTOSAR Parameter Communication

AUTOSAR parameter communication relies on a parameter software component (`ParameterSwComponent`) and one or more atomic software components that require port-based access to parameter data. The parameter software component represents memory containing AUTOSAR parameters and provides parameter data to connected atomic software components.

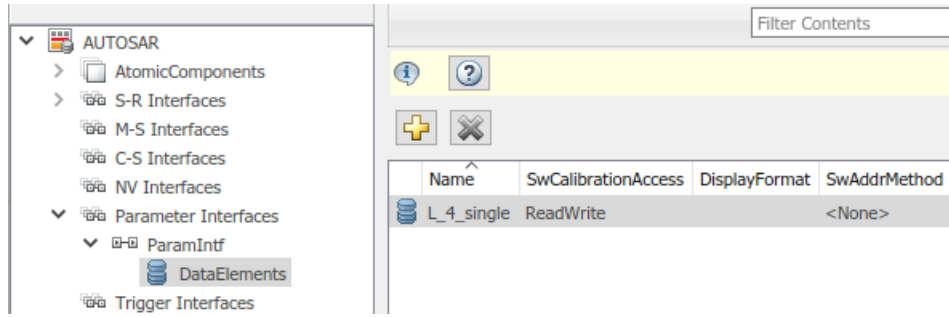
In Simulink, you can model the receiver portion of AUTOSAR port-based parameter communication. In an AUTOSAR atomic software component, you create a parameter interface with data elements and a parameter receiver port.

This example shows how to configure an AUTOSAR software component as a receiver for parameter communication.

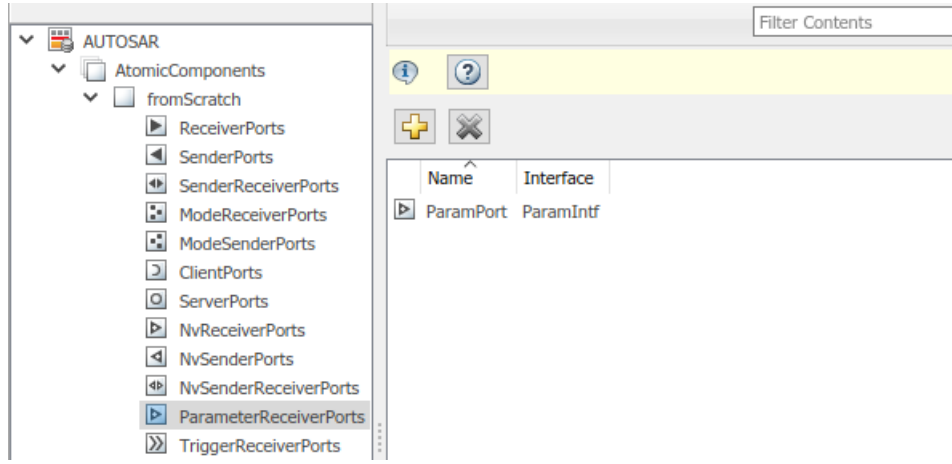
1. Open a model configured for AUTOSAR code generation in which the software component requires port-based access to parameter data.
2. Open AUTOSAR Dictionary. Select the **Parameter Interfaces** view and use the **Add** button  to add a parameter interface to the model. In the Add Interfaces dialog box, specify the name of the new interface and set **Number of Data Elements** to 1.



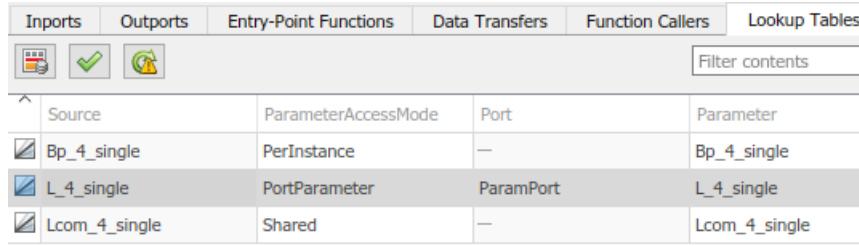
3. Expand **Parameter Interfaces** and select the **DataElements** view. Examine and modify the properties of the associated data element that you created.



4 Expand **AtomicComponents** and expand the component. Go to the **ParameterReceiverPorts** view and use the **Add** button to add a parameter receiver port to the model. In the Add Ports dialog box, specify the name of the new port and set **Interface** to the name of the parameter interface you created.



5 The AUTOSAR parameter interface data elements that you create then are available for Simulink lookup table mapping, using Code Mapping Editor or AUTOSAR map functions. Open Code Mapping Editor and select the **Lookup Tables** tab. Select a Simulink lookup table or breakpoint object. To map the lookup table to a port-based AUTOSAR parameter, select parameter access mode `PortParameter`, and select a parameter receiver port and a parameter interface data element.



See Also

Related Examples

- “Configure AUTOSAR Port-Based Calibration Parameters” on page 4-215
- “Import AUTOSAR Software Component” on page 3-4
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Model AUTOSAR Communication” on page 2-13
- “AUTOSAR Component Configuration” on page 4-3

Configure Receiver for AUTOSAR External Trigger Event Communication

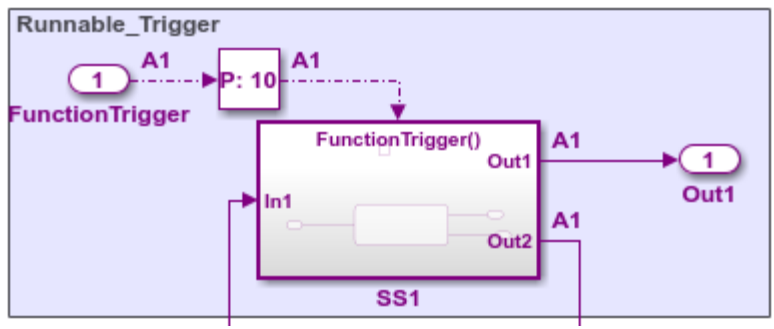
AUTOSAR Release 4.0 introduced external trigger event communication, in which an AUTOSAR software component or service signals an external trigger occurred event (`ExternalTriggerOccurredEvent`) to another component. The receiving component activates a runnable in response to the event.

In Simulink, you can model the receiver portion of AUTOSAR external trigger event communication. Select a component that you want to react to an external trigger. In the component, you create a trigger interface, a trigger receiver port to receive an `ExternalTriggerOccurredEvent`, and a runnable that the event activates.

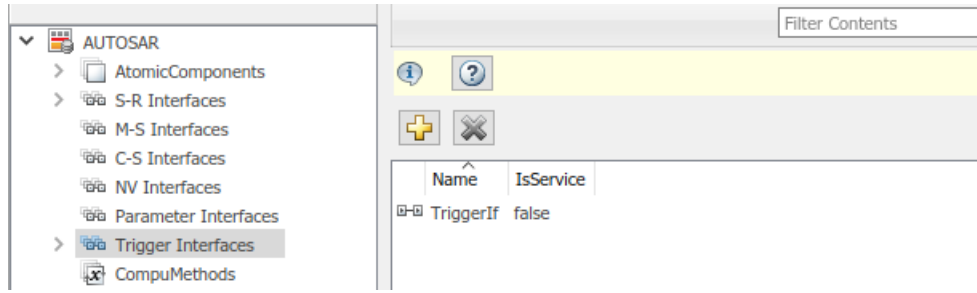
This example shows how to configure an AUTOSAR software component as a receiver for external trigger event communication.

1. Open a model configured for AUTOSAR code generation, in which you want to activate a runnable based on receiving an AUTOSAR `ExternalTriggerOccurredEvent`.

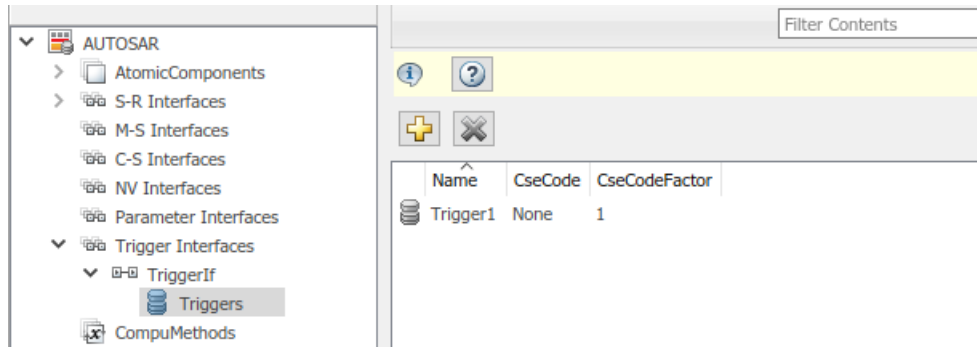
   For a sample model that uses external trigger event communication, see `rtwdemo_autosar_swc_fcncalls`. In `rtwdemo_autosar_swc_fcncalls`, asynchronous function-call subsystem SS1 models an AUTOSAR runnable. An `ExternalTriggerOccurredEvent` activates the runnable.



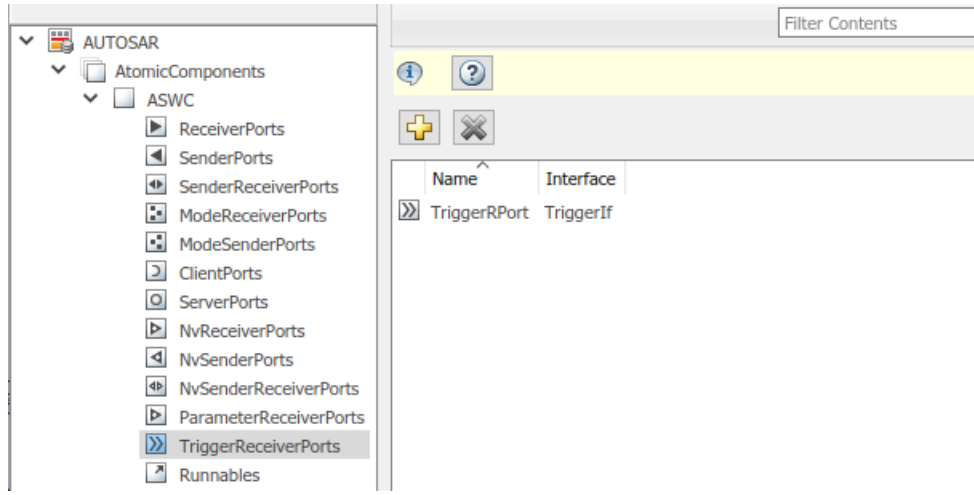
2. Open AUTOSAR Dictionary. Select the **Trigger Interfaces** view and use the **Add** button  to add a trigger interface to the model. In the Add Interfaces dialog box, specify the name of the new interface and set **Number of Triggers** to 1.



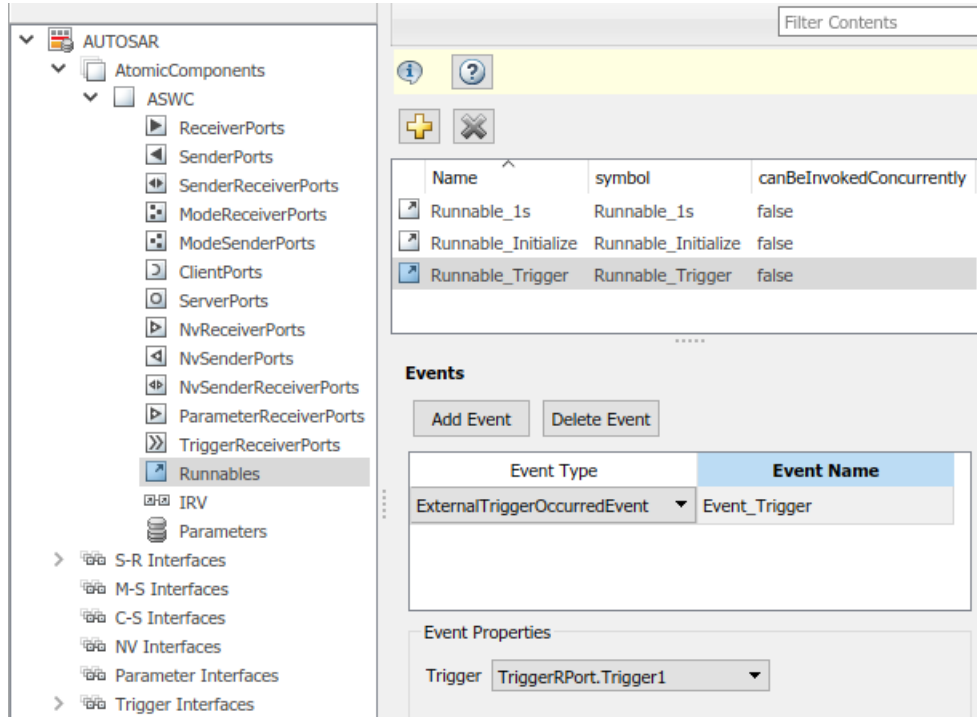
3 Expand **Trigger Interfaces** and select the **Triggers** view. Examine the properties of the associated trigger. For an asynchronous (nonperiodic) trigger, set **CseCode** to `None`, indicating an unspecified trigger period. For more information about specifying trigger periods, click the help button in the triggers view.



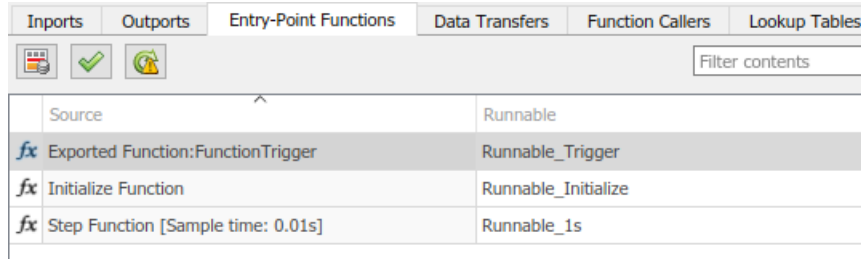
4 Expand **AtomicComponents** and expand the component. Select the **TriggerReceiverPorts** view and use the **Add** button  to add a trigger receiver port to the model. In the Add Ports dialog box, specify the name of the new port and set **Interface** to the name of the trigger interface you created.



5 Select the **Runnables** view and select the runnable that you want to activate based on receiving an AUTOSAR `ExternalTriggerOccurredEvent`. In the **Events** subpane, set **Event Type** to `ExternalTriggerOccurredEvent`. To display event properties, select the event name. For **Trigger**, select the value corresponding to the trigger receiver port and trigger you created.



6 To complete the trigger receiver configuration, open Code Mapping Editor and select the **Entry-Point Functions** tab. Select the Simulink entry-point function for the subsystem that models the AUTOSAR `ExternalTriggerOccurredEvent` runnable. In the **Runnable** field, select the runnable name.



See Also

Related Examples

- “Add Top-Level Asynchronous Trigger to Periodic Rate-Based System” on page 4-263
- “Import AUTOSAR Software Component” on page 3-4
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Model AUTOSAR Communication” on page 2-13
- “AUTOSAR Component Configuration” on page 4-3

Configure Calls to AUTOSAR Diagnostic Event Manager Service

The AUTOSAR standard defines important services as part of Basic Software (BSW) that runs in the AUTOSAR Runtime Environment (RTE). Examples include the NVRAM Manager (NvM) and the Diagnostic Event Manager (Dem). In the AUTOSAR RTE, AUTOSAR software components typically access BSW services using client-server or sender-receiver communication.

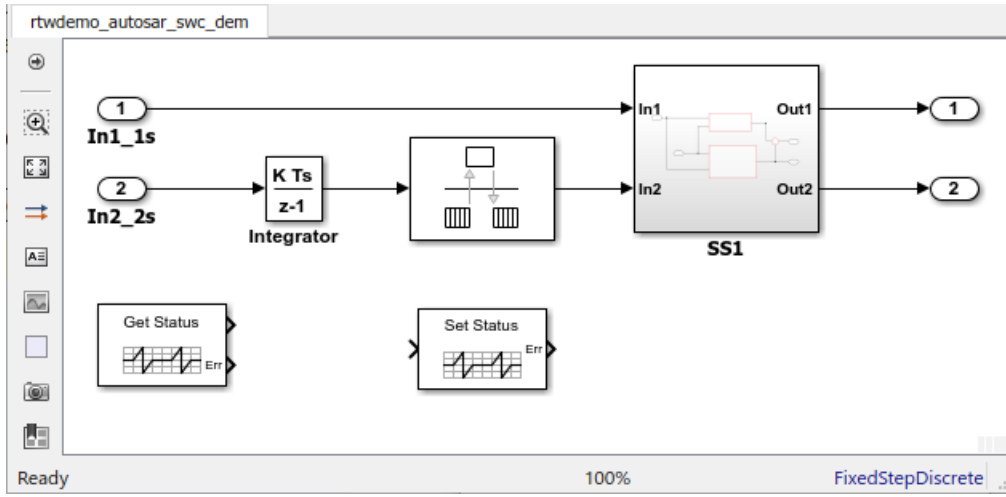
To support system-level modeling of AUTOSAR components and services, Embedded Coder Support Package for AUTOSAR Standard provides an AUTOSAR Basic Software block library. The library contains preconfigured blocks for modeling component calls to AUTOSAR BSW services and reference implementations of the BSW services. For information about using the blocks to model client calls to AUTOSAR BSW service interfaces, see “Model AUTOSAR Basic Software Service Calls” on page 2-24.

For a live-script example of simulating AUTOSAR BSW services, see example “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).

Here is an example of configuring client calls to Dem service interfaces in your AUTOSAR software component.

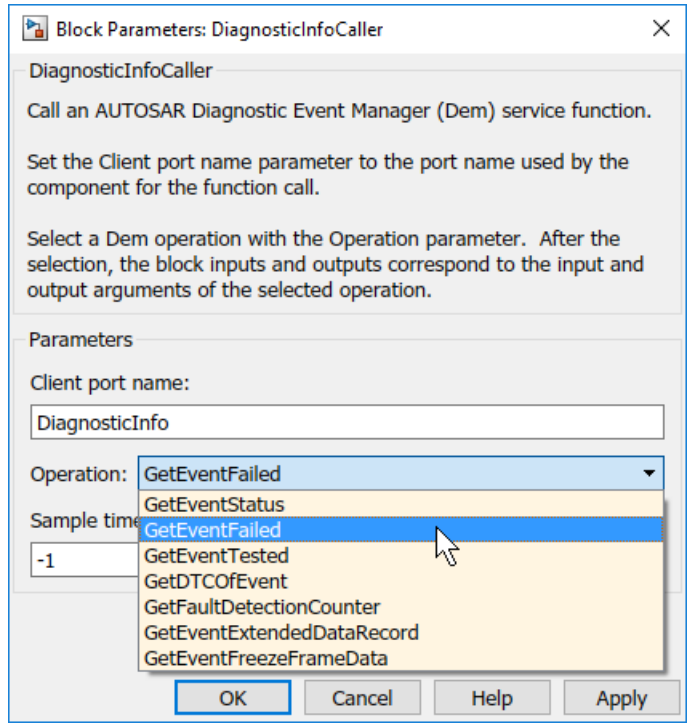
1. Open a model that is configured for AUTOSAR code generation. Using the Library Browser or by typing block names in the model window, add Dem blocks to the model. This example adds the blocks DiagnosticInfoCaller and DiagnosticMonitorCaller to a writable copy of the example model `rtwdemo_autosar_swc`.

   As you insert each block, you are prompted for a client port name, which is the name of the AUTOSAR client port used by this component to call the BSW interface. For the purposes of this example, accept the default names, `DiagnosticInfo` and `DiagnosticMonitor`.

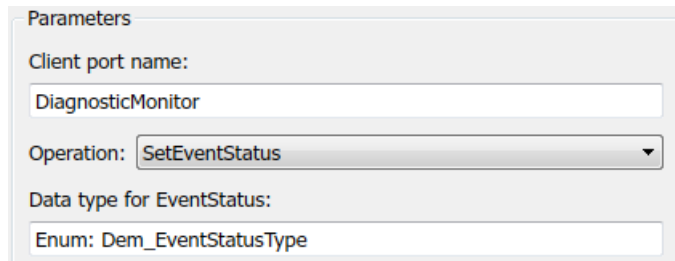


2 Open each block and examine the parameters, especially **Operation**. If you select a different operation and click **Apply**, the software updates the block inputs and outputs to match the arguments of the selected operation.

This example changes the **Operation** for the DiagnosticInfoCaller block from `GetEventStatus` to `GetEventFailed`. (For an example of using `GetEventFailed` in a throttle position monitor implementation, see example “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).)



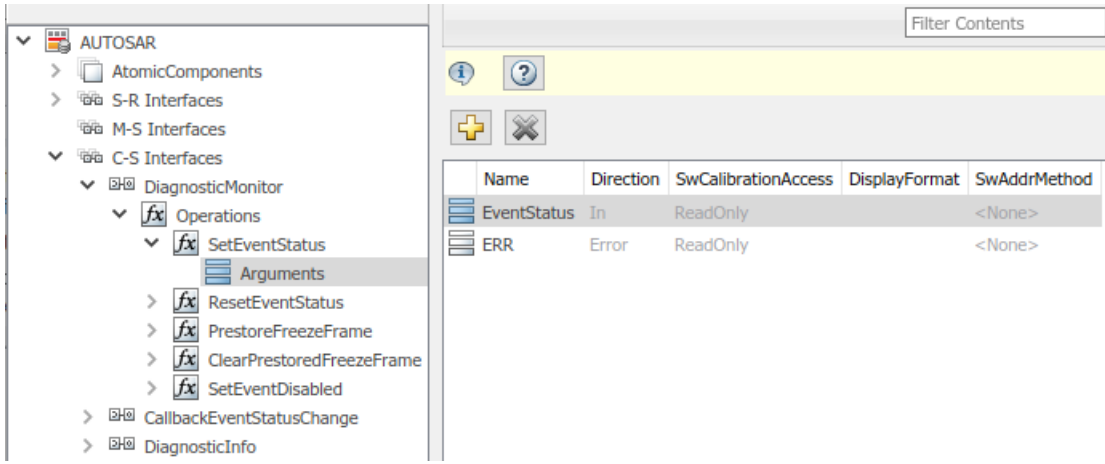
For some Dem operations, such as `GetDTCOfEvent` and `SetEventStatus`, the block parameters dialog box displays a data type parameter. The parameter specifies an enumerated data type for a function input that represents a Dem format type or event status. Default data types are provided, such as `Dem_DTCFormatType` or `Dem_EventStatusType`. For more information about format type or event status values, see the AUTOSAR standard *Specification of Diagnostic Event Manager*.



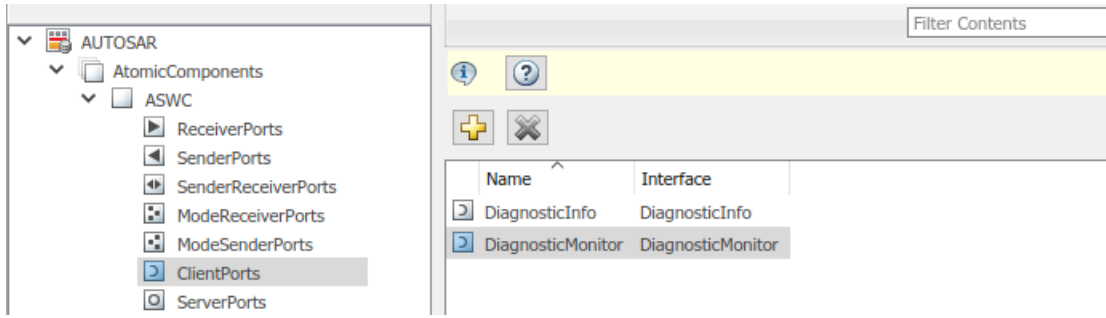
3 Open Code Mapping Editor. To update the Simulink to AUTOSAR mapping of the model with changes to Simulink function callers, click the **Update** button . The software creates AUTOSAR client-service interfaces, operations, and ports, and maps each Simulink function caller to an AUTOSAR client port and operation.

For example, for the DiagnosticMonitorCaller block in this example, for which the `SetEventStatus` operation is selected:

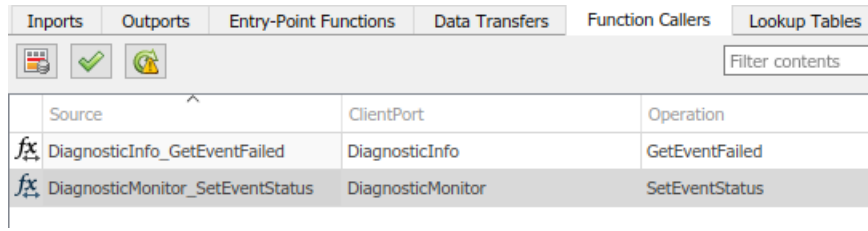
- The software creates C-S interface `DiagnosticMonitor`, and under `DiagnosticMonitor`, its supported operations. For each operation, arguments are provided with read-only properties. Here are the arguments for the `DiagnosticMonitor` operation `SetEventStatus` displayed in AUTOSAR Dictionary.



- The software creates a client port with the default name `DiagnosticMonitor`. Unlike the C-S-interface, operation, and argument names, the client port name can be customized. The client port is mapped to the `DiagnosticMonitor` interface.



- Code Mapping Editor maps the `DiagnosticMonitor` function caller block to AUTOSAR client port `DiagnosticMonitor` and AUTOSAR operation `SetEventStatus`.



4 Optionally, build your component model and examine the generated C and `arxml` code. The C code includes the client calls to the BSW services, for example:

```
/* FunctionCaller: '<Root>/DiagnosticInfoCaller' */
Rte_Call_DiagnosticInfo_GetEventFailed(&rtb_DiagnosticInfoCaller_o1);

/* FunctionCaller: '<Root>/DiagnosticMonitorCaller' */
Rte_Call_DiagnosticMonitor_SetEventStatus(DEM_EVENT_STATUS_PASSED);
```

Generated RTE include files define the server operation call points, such as `Rte_Call_DiagnosticMonitor_SetEventStatus`, and argument data types, such as enumeration type `Dem_EventStatusType`.

The `arxml` code defines the BSW service operations called by the component as server call points, for example:

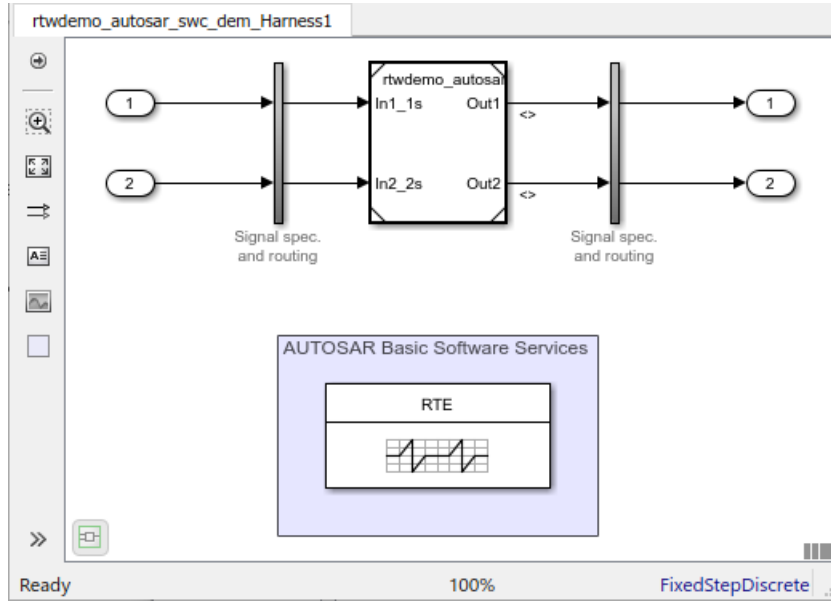
```
<SERVER-CALL-POINTS>
...
    <SYNCHRONOUS-SERVER-CALL-POINT UUID="...">
        <SHORT-NAME>SC_DiagnosticMo_334e61e63627b44b</SHORT-NAME>
        <OPERATION-IREF>
            <CONTEXT-R-PORT-REF DEST="R-PORT-PROTOTYPE">
              /Company/Powertrain/Components/ASWC/DiagnosticMonitor
            </CONTEXT-R-PORT-REF>
```

```
            <TARGET-REQUIRED-OPERATION-REF DEST="CLIENT-SERVER-OPERATION">
              /AUTOSAR/Services/Dem/DiagnosticMonitor/SetEventStatus
            </TARGET-REQUIRED-OPERATION-REF>
          </OPERATION-IREF>
          <TIMEOUT>1.0E-06</TIMEOUT>
        </SYNCHRONOUS-SERVER-CALL-POINT>
    </SERVER-CALL-POINTS>
```

5 To simulate the component model, create a containing composition, system, or test harness model. In that containing model, insert reference implementations of the Dem `GetEventFailed` and `GetEventStatus` service operations.

The AUTOSAR Basic Software block library provides a Diagnostic Service Component block, which provides reference implementations of Dem service operations. You can manually insert the block into a containing composition, system, or harness model, or automatically insert the block by creating a Simulink Test harness model.

For example, in the model window, select **Analysis > Test Harness > Create for Model**. In the Create Test Harness dialog box, click **OK**. The software compiles the model, adds a Diagnostic Service Component block, and creates ports and other elements required for simulation.



For more information, see “Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207 and “Simulate AUTOSAR Basic

Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).

See Also

Diagnostic Service Component | DiagnosticInfoCaller | DiagnosticMonitorCaller

Related Examples

- “Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207
- “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard)
- “Configure AUTOSAR Client-Server Communication” on page 4-144

More About

- “Model AUTOSAR Basic Software Service Calls” on page 2-24
- “Model AUTOSAR Communication” on page 2-13

Configure Calls to AUTOSAR NVRAM Manager Service

The AUTOSAR standard defines important services as part of Basic Software (BSW) that runs in the AUTOSAR Runtime Environment (RTE). Examples include the NVRAM Manager (NvM) and the Diagnostic Event Manager (Dem). In the AUTOSAR RTE, AUTOSAR software components typically access BSW services using client-server or sender-receiver communication.

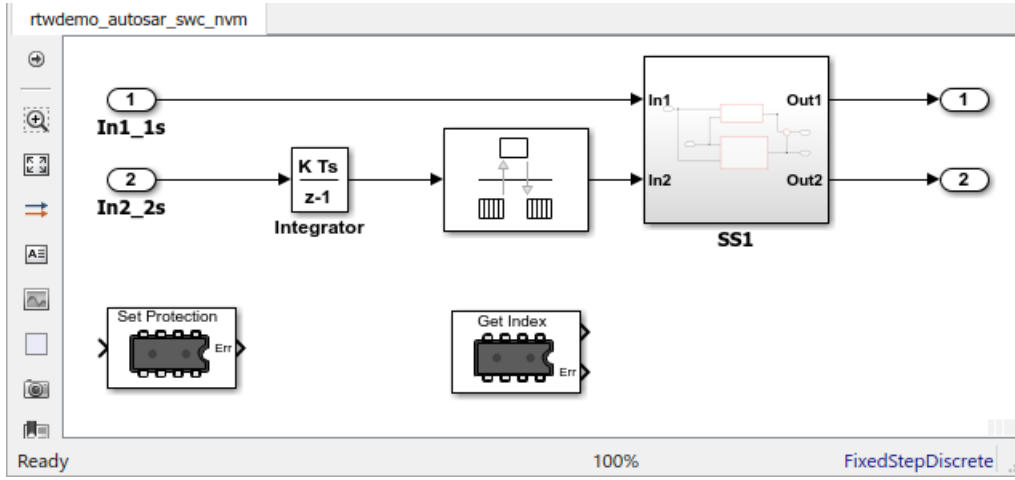
To support system-level modeling of AUTOSAR components and services, Embedded Coder Support Package for AUTOSAR Standard provides an AUTOSAR Basic Software block library. The library contains preconfigured blocks for modeling component calls to AUTOSAR BSW services and reference implementations of the BSW services. For information about using the blocks to model client calls to AUTOSAR BSW service interfaces, see “Model AUTOSAR Basic Software Service Calls” on page 2-24.

For a live-script example of simulating AUTOSAR BSW services, see example “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).

Here is an example of configuring client calls to NvM service interfaces in your AUTOSAR software component.

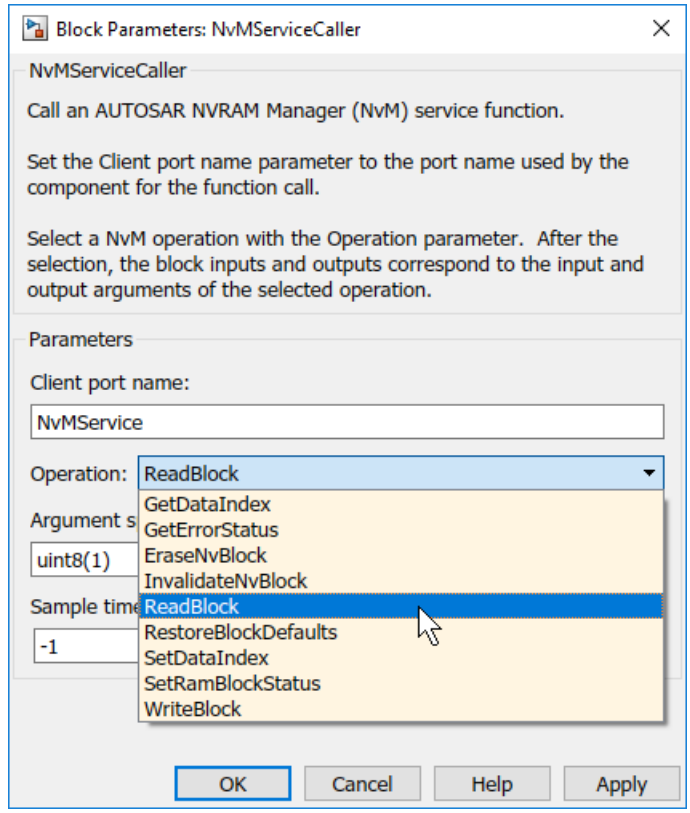
1. Open a model that is configured for AUTOSAR code generation. Using the Library Browser or by typing block names in the model window, add NvM blocks to the model. This example adds the blocks NvMAdminCaller and NvMServiceCaller to a writable copy of the example model `rtwdemo_autosar_swc`.

   As you insert each block, you are prompted for a client port name, which is the name of the AUTOSAR client port used by this component to call the BSW interface. For the purposes of this example, accept the default names, `NvMAdmin` and `NvMService`.

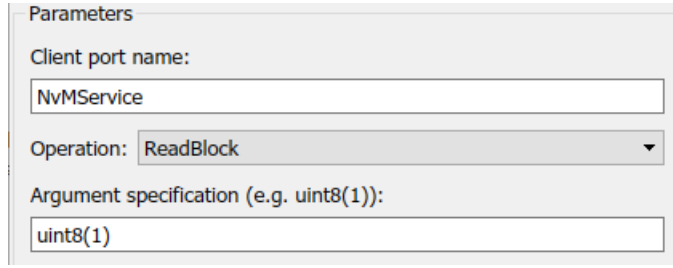


2 Open each block and examine the parameters, especially **Operation**. If you select a different operation and click **Apply**, the software updates the block inputs and outputs to match the arguments of the selected operation.

This example changes the **Operation** for the NvMServiceCaller block from `GetDataIndex` to `ReadBlock`. (For an example of using `readBlock` in a throttle position sensor implementation, see example “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).)



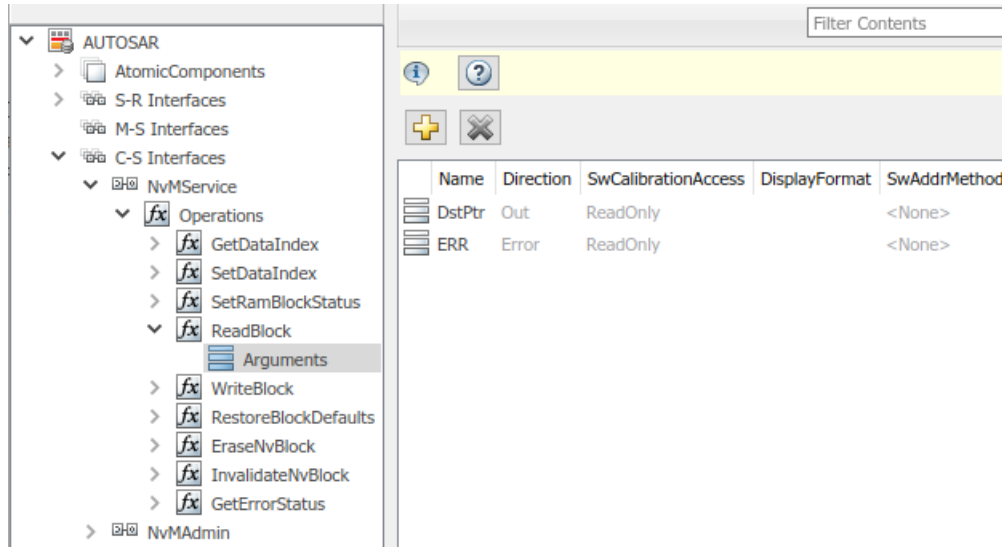
For some NvM operations, such as `ReadBlock` and `WriteBlock`, the block parameters dialog box displays an argument specification parameter. The parameter specifies data type and dimension information for data to be read or written by the operation, set to `uint8(1)` by default. You can specify array and bus data types.



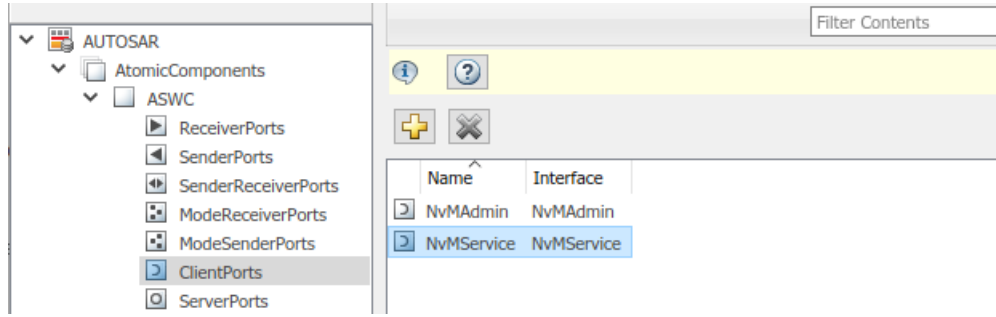
3 Open Code Mapping Editor. To update the Simulink to AUTOSAR mapping of the model with changes to Simulink function callers, click the **Update** button . The software creates AUTOSAR client-service interfaces, operations, and ports, and maps each Simulink function caller to an AUTOSAR client port and operation.

For example, for the NvMServiceCaller block in this example, for which the `ReadBlock` operation is selected:

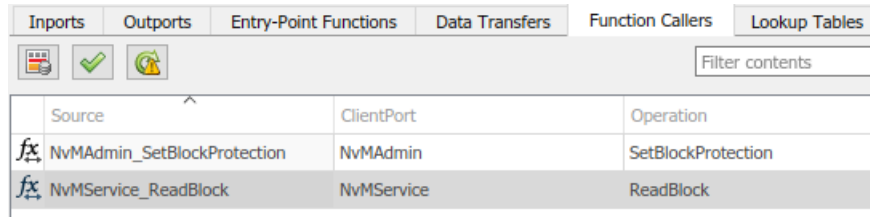
- The software creates C-S interface `NvMService`, and under `NvMService`, its supported operations. For each operation, arguments are provided with read-only properties. Here are the arguments for the `NvMService` operation `ReadBlock` displayed in AUTOSAR Dictionary.



- The software creates a client port with the default name `NvMService`. Unlike the C-S-interface, operation, and argument names, the client port name can be customized. The client port is mapped to the `NvMService` interface.

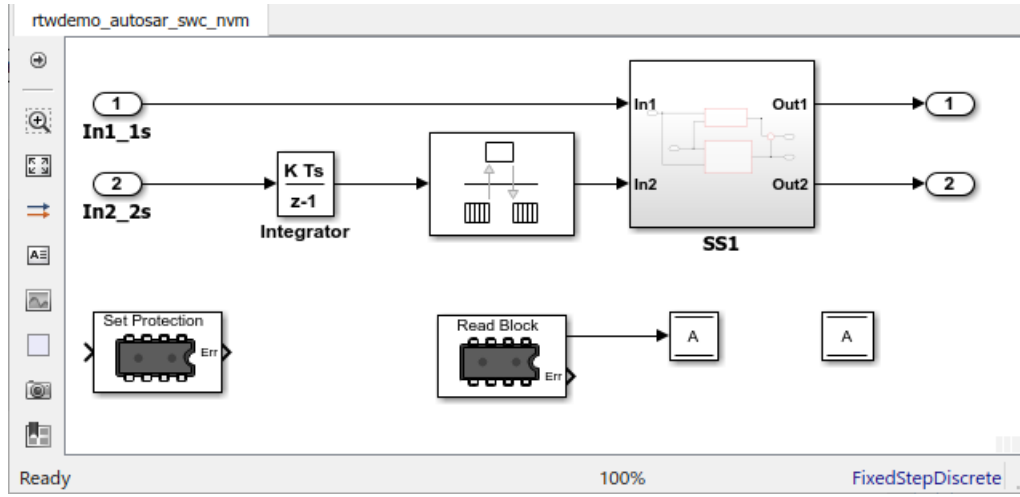


- Code Mapping Editor maps the `NvMService` function caller block to AUTOSAR client port `NvMService` and AUTOSAR operation `ReadBlock`.



4 Optionally, build your model and examine the generated C and `arxml` code.

In the block dialog step, if you selected operation `ReadBlock` for the NvMServiceCaller block, code generation requires adding data store blocks to the model. Connect the block first outport to a Data Store Write block, and add a Data Store Memory block. For both blocks, specify data store name A. For example:



The C code includes the client calls to the BSW services, for example:

```
/* FunctionCaller: '<Root>/NvMServiceCaller' */
Rte_Call_NvMService_ReadBlock(&rtDW.A);
...
/* FunctionCaller: '<Root>/NvMAdminCaller' */
Rte_Call_NvMAdmin_SetBlockProtection(false);
```

Generated RTE include files define the server operation call points, such as `Rte_Call_NvMService_ReadBlock`.

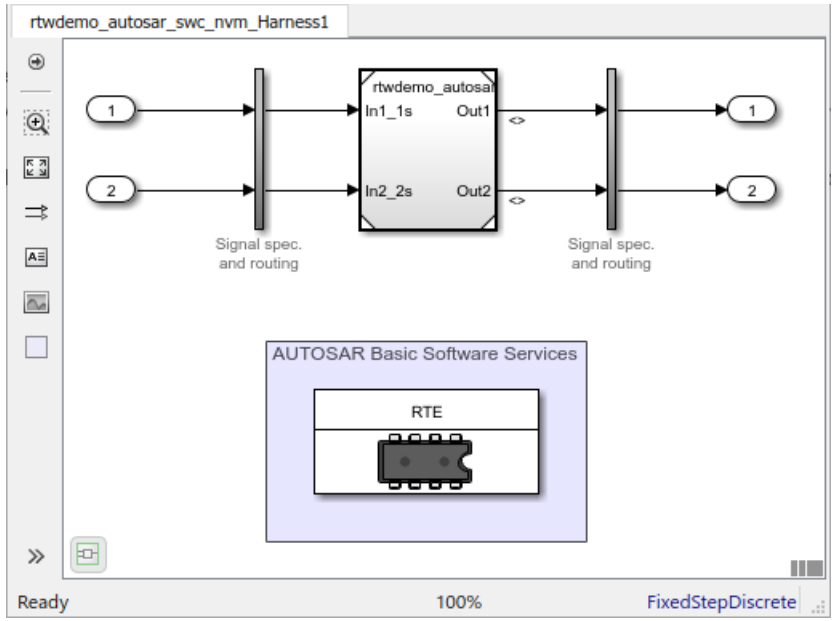
The `arxml` code defines the BSW service operations called by the component as server call points, for example:

```
<SERVER-CALL-POINTS>
...
    <ASYNCHRONOUS-SERVER-CALL-POINT UUID="...">
        <SHORT-NAME>SC_NvMService_ReadBlock</SHORT-NAME>
        <OPERATION-IREF>
            <CONTEXT-R-PORT-REF DEST="R-PORT-PROTOTYPE">
              /Company/Powertrain/Components/ASWC/NvMService
            </CONTEXT-R-PORT-REF>
            <TARGET-REQUIRED-OPERATION-REF DEST="CLIENT-SERVER-OPERATION">
              /AUTOSAR/Services/NvM/NvMService/ReadBlock
            </TARGET-REQUIRED-OPERATION-REF>
        </OPERATION-IREF>
        <TIMEOUT>1</TIMEOUT>
    </ASYNCHRONOUS-SERVER-CALL-POINT>
</SERVER-CALL-POINTS>
```

5 To simulate the component model, create a containing composition, system, or test harness model. In that containing model, insert reference implementations of the NvM `ReadBlock` and `SetBlockProtection` service operations.

The AUTOSAR Basic Software block library provides an NVRAM Service Component block, which provides reference implementations of NvM service operations. You can manually insert the block into a containing composition, system, or harness model, or automatically insert the block by creating a Simulink Test harness model.

For example, in the model window, select **Analysis > Test Harness > Create for Model**. In the Create Test Harness dialog box, click **OK**. The software compiles the model, adds a NVRAM Service Component block, and creates ports and other elements required for simulation.



For more information, see “Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207 and “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).

See Also

NVRAM Service Component | NvMAdminCaller | NvMServiceCaller

Related Examples

- “Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207
- “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard)
- “Configure AUTOSAR Client-Server Communication” on page 4-144

More About

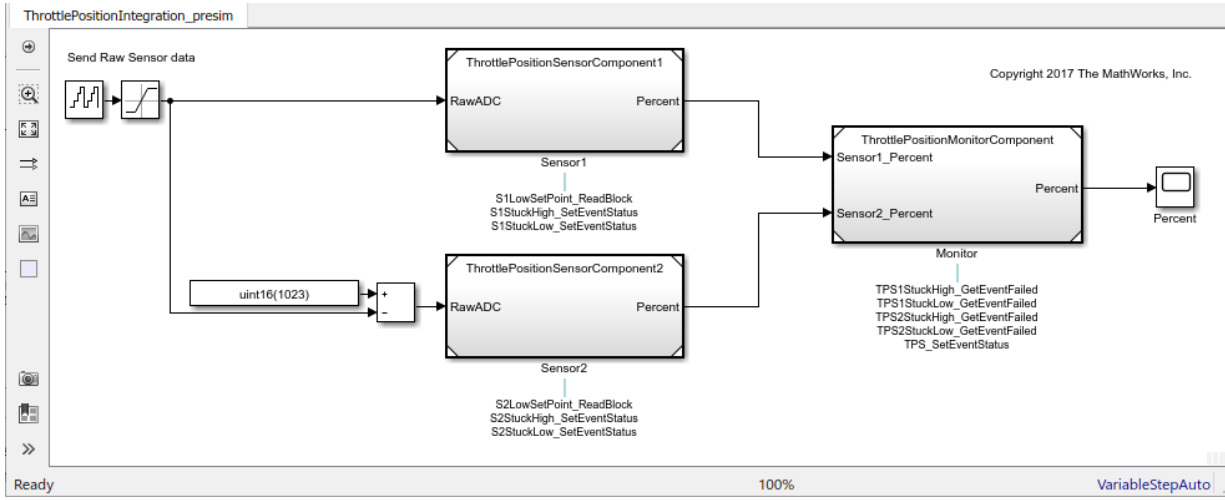
- “Model AUTOSAR Basic Software Service Calls” on page 2-24
- “Model AUTOSAR Communication” on page 2-13

Configure AUTOSAR Basic Software Service Implementations for Simulation

The AUTOSAR support package provides reference implementations of NVRAM Manager (NvM) and Diagnostic Event Manager (Dem) services supported by AUTOSAR Basic Software (BSW) caller blocks. When coupled with the BSW caller blocks, the reference implementations allow you to configure and run system- or composition-level simulations of AUTOSAR BSW service calls. The ability to simulate calls into BSW services can help identify modeling problems before the AUTOSAR generated code reaches the AUTOSAR Runtime Environment (RTE).

To configure BSW caller blocks and BSW service reference implementations for simulation:

1. In one or more AUTOSAR component models, configure calls to the AUTOSAR NvM service or AUTOSAR Dem service. Follow the procedure described in “Configure Calls to AUTOSAR NVRAM Manager Service” on page 4-199 or “Configure Calls to AUTOSAR Diagnostic Event Manager Service” on page 4-192.
2. For simulation purposes, create a composition, system, or harness model that contains instances of the AUTOSAR component models. Here is a containing model used in example “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard). The referenced component models call NvM service operation `ReadBlock` and Dem service operations `SetEventStatus` and `GetEventFailed`.

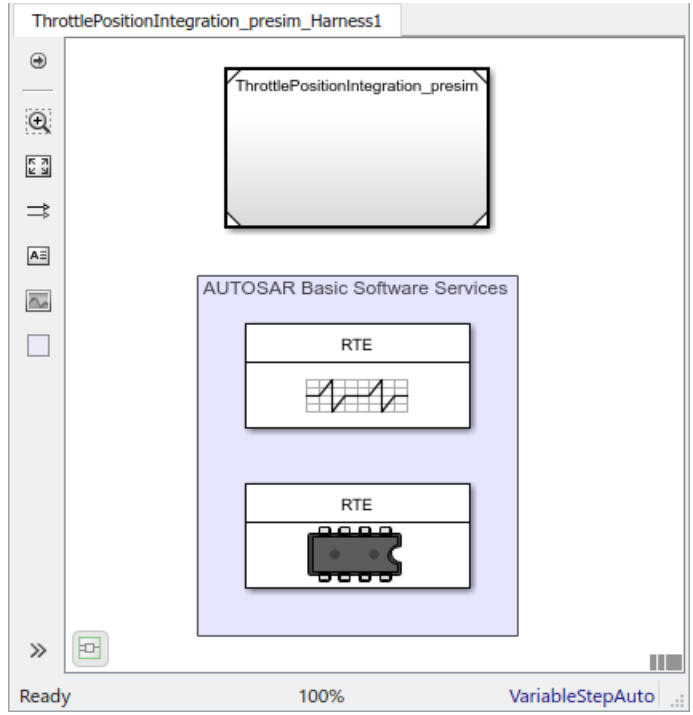


Alternatively, as shown in the next step, you can use Simulink Test to create a harness model.

3 In the containing model, provide reference implementations of the NvM or Dem service operations that your AUTOSAR component models call. For NvM and Dem service operations, the AUTOSAR Basic Software block library provides NVRAM Service Component and Diagnostic Service Component blocks.

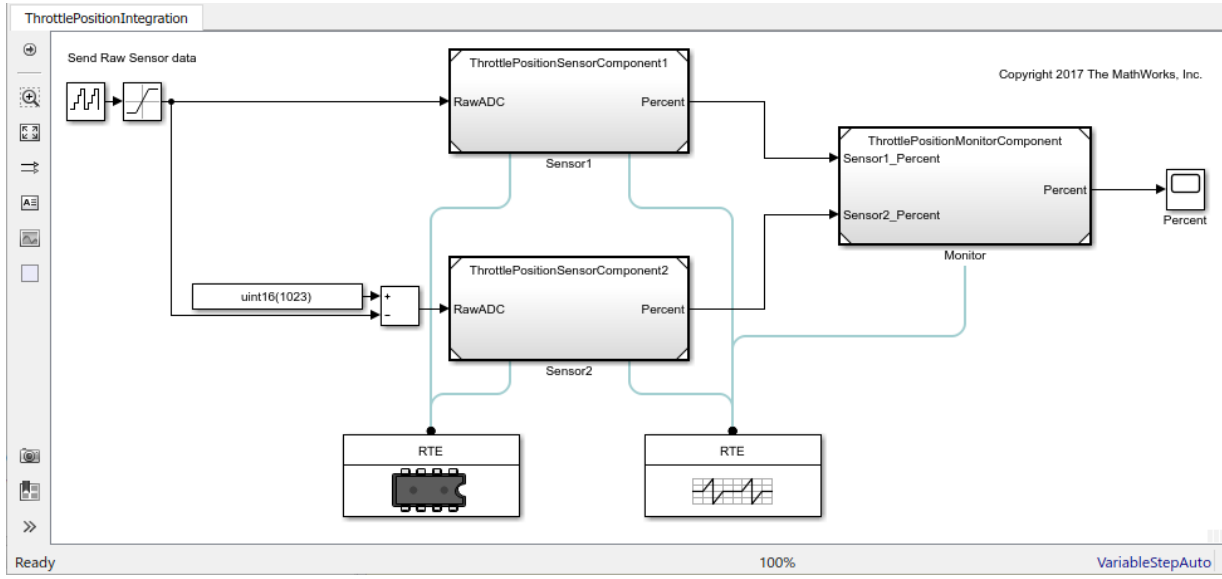
You can insert a Service Component block in either of two ways:

- Automatically insert the block by creating a Simulink Test harness model. In an AUTOSAR component model or a containing model, select **Analysis > Test Harness > Create for Model**. In the Create Test Harness dialog box, click **OK**. The software compiles the model, adds an NVRAM or Diagnostic Service Component block, and creates ports and other elements required for simulation. For example, here is a test harness created for the integration model in example “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).



- Manually insert the block into a containing composition, system, or harness model. Using the Library Browser or `add_block` command, or by typing block names in the model window, add a service component block to the containing model. Example “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard) uses these `add_block` commands to add NVRAM Service Component and Diagnostic Service Component blocks to a containing model.

```
add_block('autosarspkglib/Basic Software/NVRAM Manager (NvM)/NVRAM Service Component',...
          'ThrottlePositionIntegration_presim/NVRAM Service Component');
add_block('autosarspkglib/Basic Software/Diagnostic Event Manager (Dem)/Diagnostic Service Component',...
          'ThrottlePositionIntegration_presim/Diagnostic Service Component');
```



4 Each service component block has prepopulated parameters. Examine the parameter settings and consider if modifications are required, based on how you are using the NvM or Dem service operations. For more information, see NVRAM Service Component and Diagnostic Service Component.

5 Simulate the containing model. The simulation exercises the AUTOSAR NvM and Dem service calls in the component models. For a sample simulation, see example “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).

See Also

Diagnostic Service Component | NVRAM Service Component

Related Examples

- “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard)
- “Configure Calls to AUTOSAR Diagnostic Event Manager Service” on page 4-192
- “Configure Calls to AUTOSAR NVRAM Manager Service” on page 4-199

More About

- “Model AUTOSAR Basic Software Service Calls” on page 2-24
- “Model AUTOSAR Communication” on page 2-13

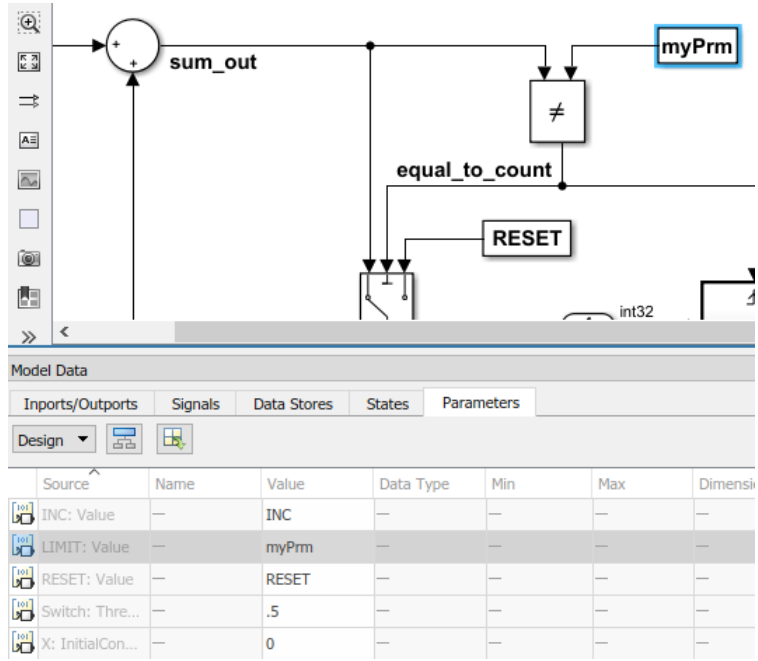
Configure AUTOSAR Internal Calibration Parameters

AUTOSAR internal calibration parameters are internal to an AUTOSAR software component, and are accessed only by instances of the software component in which they are defined. To configure internal calibration parameters in Simulink, you create and configure `AUTOSAR.Parameter` data objects. You reference the parameter data objects from block parameters in your model.

To configure AUTOSAR calibration parameters that can be accessed by other AUTOSAR software components, see “Configure AUTOSAR Calibration Component” on page 4-216.

To configure an AUTOSAR internal calibration parameter:

1. Set the value of a block parameter in your model to reference the name of the calibration parameter. For example, open the example model `rtwdemo_autosar_counter`. Open the Model Data Editor (**View > Model Data Editor**) and select the **Parameters** tab. Change the value of the Constant block from `LIMIT` to `myPrm`.

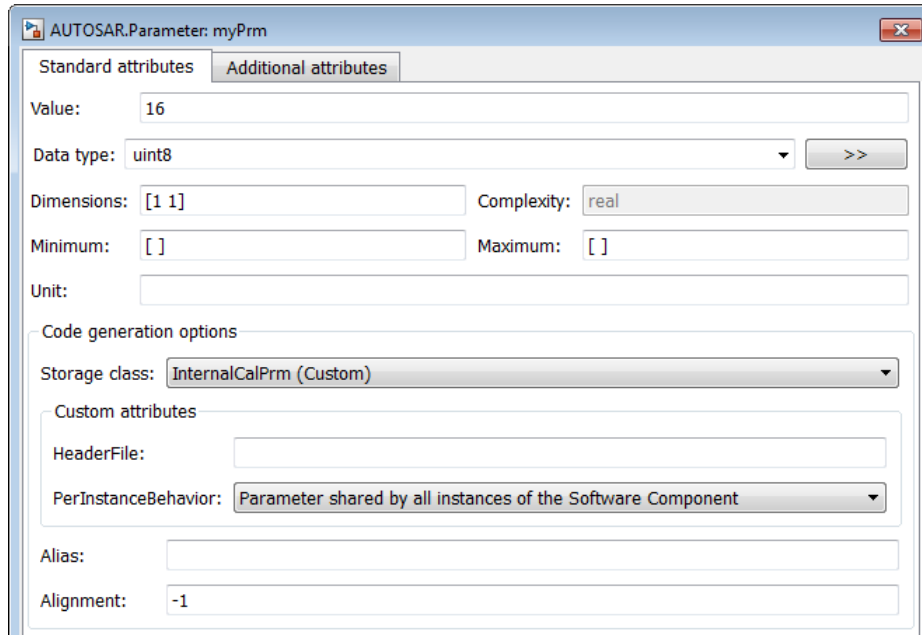


2. Create an `AUTOSAR.Parameter` data object for the calibration parameter. While editing the parameter value in the Model Data Editor, click the action button ⋮ next to `myPrm` and select **Create**.

   In the **Create New Data** dialog box, set **Value** to `AUTOSAR.Parameter` and click **Create**. An `AUTOSAR.Parameter` object appears in the base workspace.

3. In the `AUTOSAR.Parameter` property dialog box, configure these properties:

   - **Value** — Specify a value for the calibration parameter. For an internal calibration parameter, this value represents the initial value.
   - **Data type** — Specify a data type for the calibration parameter. For more information, see “Specify Data Types Using Data Type Assistant” (Simulink).
   - **Storage class** — To specify an internal calibration parameter, from the drop-down list, select `InternalCalPrm`. To specify **Per instance behavior**, select one of the following:
     - `Parameter shared by all instances of the Software Component`
     - `Each instance of the Software Component has its own copy of the parameter`



4 In the Configuration Parameters dialog box, in the **Code Generation > Interface** pane, clear the option **Ignore custom storage classes**, if it is not already cleared.

5 Generate code.

Note The software does not support the use of AUTOSAR calibration parameters within Model blocks.

Configure AUTOSAR Port-Based Calibration Parameters

To map a Simulink lookup table object in the base workspace to an AUTOSAR parameter, you create AUTOSAR calibration parameters (`ParameterDataPrototypes`) using AUTOSAR Dictionary or AUTOSAR property functions. You can create either internal AUTOSAR parameters, defined and accessed only within your software component, or port-based AUTOSAR parameters, associated with a port-based parameter interface.

- Internal parameters — In AUTOSAR Dictionary, **Parameters** view, use the **Add** button to add a new parameter and configure its properties.
- Port-based parameters — In AUTOSAR Dictionary:

  1. In the **Parameter Interfaces** view, use the **Add** button to create a new parameter interface. In the Add Interfaces dialog box, specify the number of data elements to create. Configure the properties for each parameter data element.
  2. In the **ParameterReceiverPorts** view, use the **Add** button to add a parameter receiver port. In the Add Ports dialog box, specify the parameter interface that you created.

The AUTOSAR parameters that you create subsequently are available for Simulink lookup table mapping, using Code Mapping Editor or AUTOSAR map functions.

See Also

Related Examples

- “Configure Receiver for AUTOSAR Parameter Communication” on page 4-184

Configure AUTOSAR Calibration Component

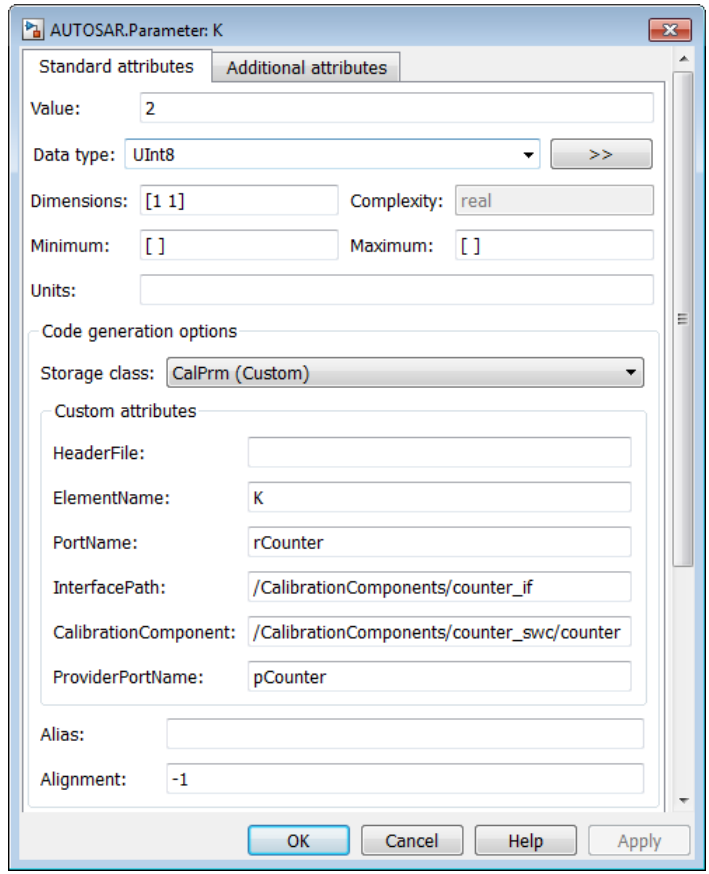
An AUTOSAR calibration parameter component (`ParameterSwComponent`) contains calibration parameters that can be accessed by AUTOSAR software components (SWCs) using an associated provider port. You can import a calibration component from `arxml` code into Simulink or create a calibration component in Simulink.

To create a calibration component in Simulink, open the AUTOSAR parameters in your model and configure them for export in a calibration component. For example:

1. Open a model configured for AUTOSAR that has `AUTOSAR.Parameter` data objects, or to which you can add `AUTOSAR.Parameter` data objects. This procedure uses the example model `rtwdemo_autosar_counter`.
2. Open an AUTOSAR calibration parameter from the workspace or data dictionary. Go to the **Standard attributes** tab of the `AUTOSAR.Parameter` dialog box. Use the following attributes of the `CalPrm` CSC to configure the parameter for export in a calibration component:

   - **CalibrationComponent** — Qualified name of the calibration component to be exported, containing this parameter.
   - **ProviderPortName** — Short name of the provider port associated with the calibration component.

   The following diagram shows the **CalibrationComponent** and **ProviderPortName** values that are specified for the `AUTOSAR.Parameter` data objects used by `rtwdemo_autosar_counter`.



3 Apply any changes and save the model.

When you generate code from the model:

- The software exports the calibration components specified for the AUTOSAR calibration parameters. For example, here is an excerpt of the `ParameterSwComponent` code exported from `rtwdemo_autosar_counter` based on the configuration of the calibration parameter `K`:

```
<AR-PACKAGE UUID="...">
  <SHORT-NAME>counter_swc</SHORT-NAME>
  <ELEMENTS>
    <PARAMETER-SW-COMPONENT-TYPE UUID="...">
      <SHORT-NAME>counter</SHORT-NAME>
      <PORTS>
        <P-PORT-PROTOTYPE UUID="...">
```

```
          <SHORT-NAME>pCounter</SHORT-NAME>
          <PROVIDED-COM-SPECS>
...
            <PARAMETER-PROVIDE-COM-SPEC>
              <INIT-VALUE>
                <CONSTANT-REFERENCE>
                  <SHORT-LABEL>K</SHORT-LABEL>
                  <CONSTANT-REF DEST="CONSTANT-SPECIFICATION">/rtwdemo_autosar_counter_pkg/
                                        rtwdemo_autosar_counter_dt/Ground/K</CONSTANT-REF>
                </CONSTANT-REFERENCE>
              </INIT-VALUE>
              <PARAMETER-REF DEST="PARAMETER-DATA-PROTOTYPE">/CalibrationComponents/
                                                    counter_if/K</PARAMETER-REF>
            </PARAMETER-PROVIDE-COM-SPEC>
...
          </PROVIDED-COM-SPECS>
          <PROVIDED-INTERFACE-TREF DEST="PARAMETER-INTERFACE">/CalibrationComponents/
                                                 counter_if</PROVIDED-INTERFACE-TREF>
        </P-PORT-PROTOTYPE>
      </PORTS>
    </PARAMETER-SW-COMPONENT-TYPE>
  </ELEMENTS>
</AR-PACKAGE>
```

- Parameter initial values are exported on the `ParameterProvideComSpec` in the `ParameterSwComponent` and the `ParameterRequireComSpec` in the `ApplicationSwComponent`. Here is an excerpt of the `ParameterRequireComSpec` code exported from `rtwdemo_autosar_counter`:

```
<R-PORT-PROTOTYPE UUID="...">
  <SHORT-NAME>rCounter</SHORT-NAME>
  <REQUIRED-COM-SPECS>
...
    <PARAMETER-REQUIRE-COM-SPEC>
      <INIT-VALUE>
        <CONSTANT-REFERENCE>
          <SHORT-LABEL>K</SHORT-LABEL>
          <CONSTANT-REF DEST="CONSTANT-SPECIFICATION">/rtwdemo_autosar_counter_pkg/
                                rtwdemo_autosar_counter_dt/Ground/K</CONSTANT-REF>
        </CONSTANT-REFERENCE>
      </INIT-VALUE>
      <PARAMETER-REF DEST="PARAMETER-DATA-PROTOTYPE">/CalibrationComponents/counter_if/
                                                          K</PARAMETER-REF>
    </PARAMETER-REQUIRE-COM-SPEC>
...
  </REQUIRED-COM-SPECS>
  <REQUIRED-INTERFACE-TREF DEST="PARAMETER-INTERFACE">/CalibrationComponents/counter_if
                                                       </REQUIRED-INTERFACE-TREF>
</R-PORT-PROTOTYPE>
```

For calibration component parameters, after you export your AUTOSAR components, you must include your calibration interface definition XML file to import the parameters into an authoring tool.

Note Use the `CalPrm` CSC attributes **CalibrationComponent** and **ProviderPortName** only to originate a calibration component in Simulink, not for a calibration component originated in an AUTOSAR authoring tool.

Configure STD_AXIS and COM_AXIS Lookup Tables for AUTOSAR Measurement and Calibration

In Simulink, you can implement standard axis (STD_AXIS) and common axis (COM_AXIS) lookup tables for AUTOSAR applications. AUTOSAR applications can use lookup tables in either or both of two ways:

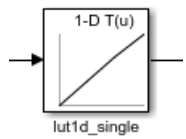
- Implement fast search operations.
- Support tuning of the application with measurement and calibration tools.

To model lookup tables for automotive application tuning, use the classes `Simulink.LookupTable` and `Simulink.Breakpoint`. By creating `Simulink.LookupTable` and `Simulink.Breakpoint` objects in the model workspace, you can store and share lookup table and breakpoint data and configure the data for AUTOSAR code generation.

This example shows how to create STD_AXIS and COM_AXIS lookup tables in Simulink, using `Simulink.LookupTable` and `Simulink.Breakpoint` objects, and configure the lookup tables for AUTOSAR code generation.

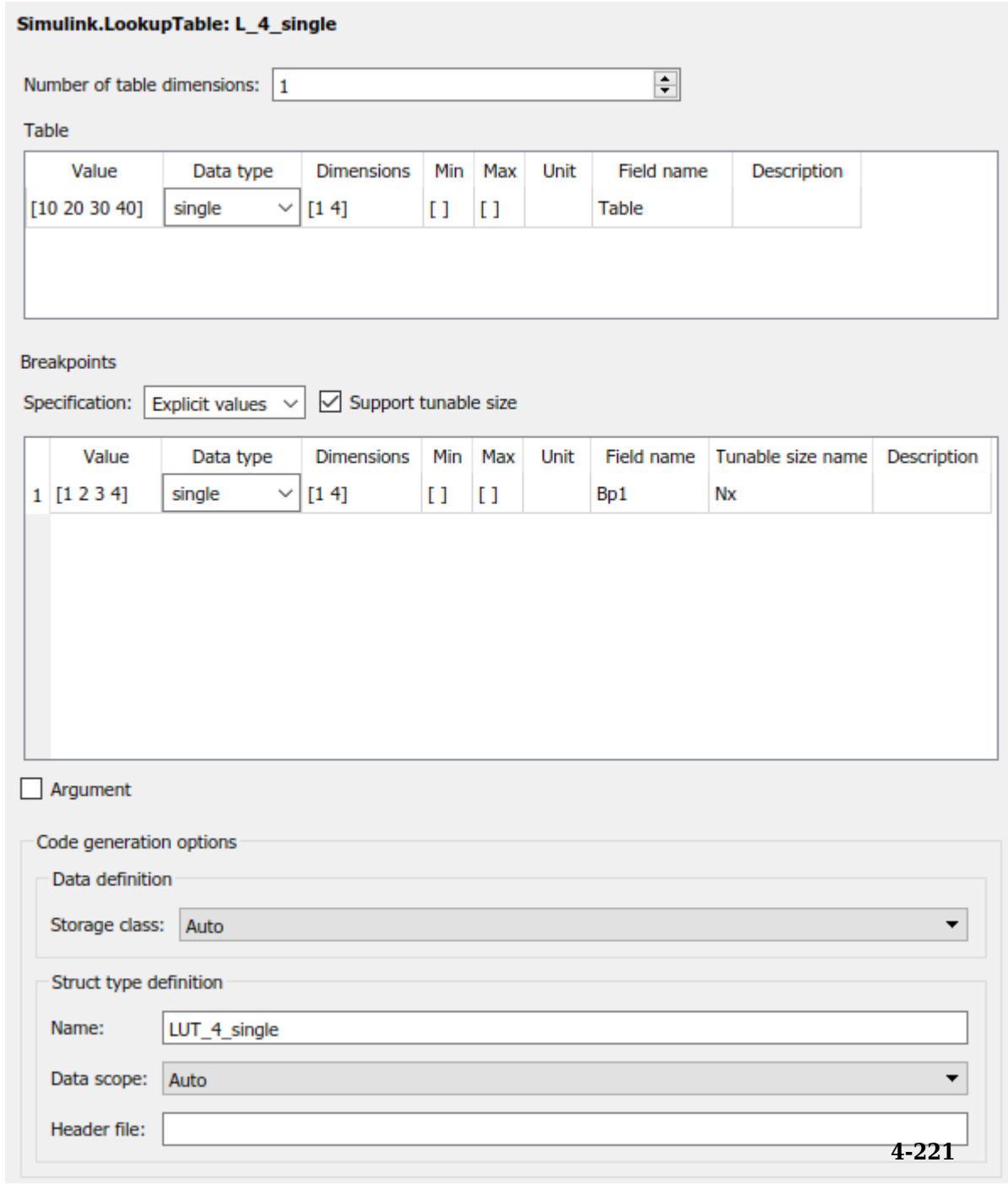
1 Model an AUTOSAR lookup table in a STD_AXIS configuration.

a Create an n-D Lookup Table block.

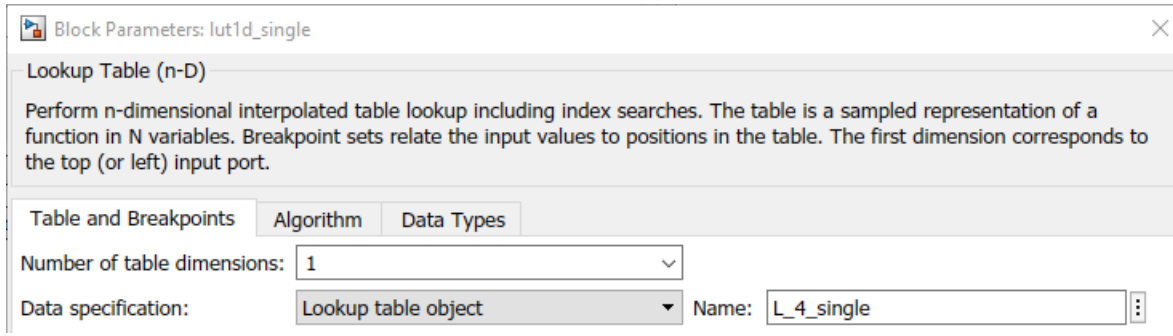


Open the block and set the **Data specification parameter** parameter to `Lookup table object`.

b In the model workspace, create a `Simulink.LookupTable` object and configure it to store the lookup table data.


Simulink.LookupTable: L_4_single
Number of table dimensions: 1
Table
Value
Data type
Dimensions
Min
Max
Unit
Field name
Description
[10 20 30 40]
single
[1 4]
[ ]
[ ]
Table
Breakpoints
Specification: Explicit values
Support tunable size
Value
Data type
Dimensions
Min
Max
Unit
Field name
Tunable size name
Description
1
[1 2 3 4]
single
[1 4]
[ ]
[ ]
Bp1
Nx
Argument
Code generation options
Data definition
Storage class: Auto
Struct type definition
Name: LUT_4_single
Data scope: Auto
Header file:

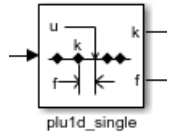
c Use the `Simulink.LookupTable` object name in the n-D Lookup Table block.



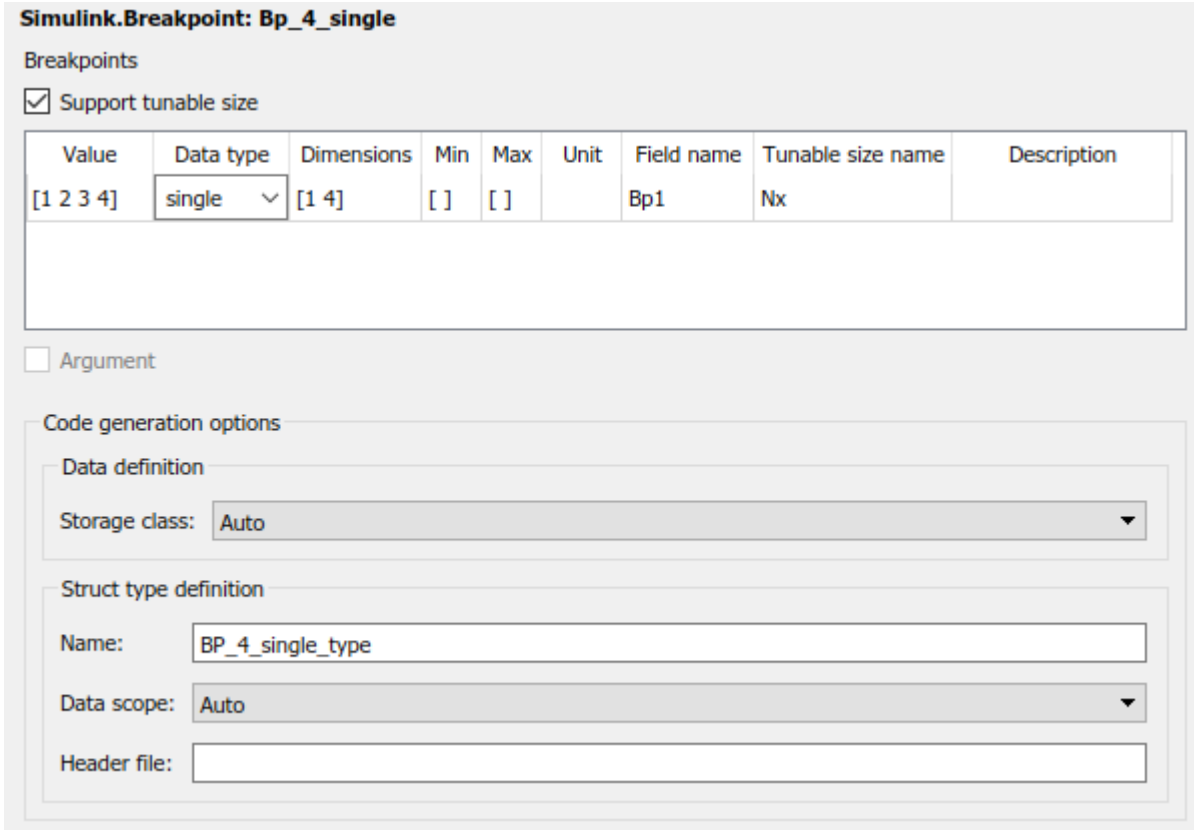
Data appears in the generated C code as fields of a single structure. To control the characteristics of the structure type, such as its name, use the properties of the object.

2 Model an AUTOSAR lookup table in a COM_AXIS configuration.

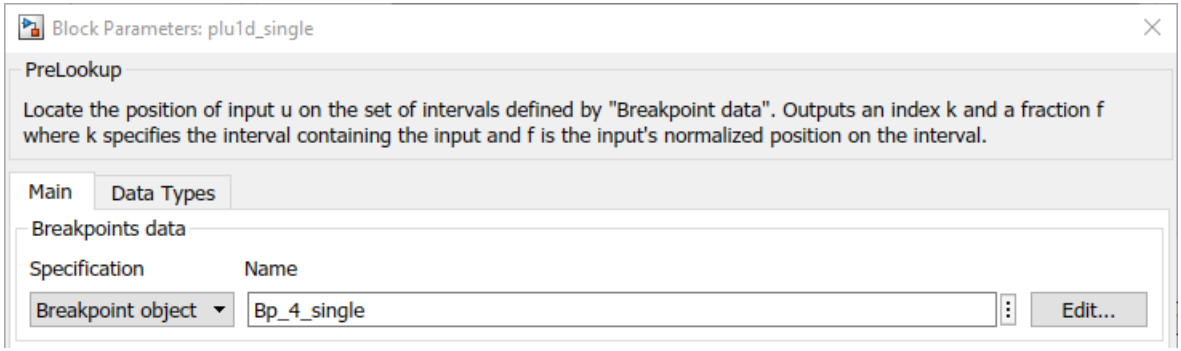
a Create one or more Prelookup blocks.



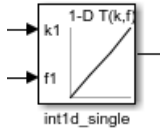
b For each breakpoint vector, in the model workspace, create and configure a `Simulink.Breakpoint` object.



c Use each `Simulink.Breakpoint` object name in a `Prelookup` block. You can reduce memory consumption by sharing breakpoint data between lookup tables.

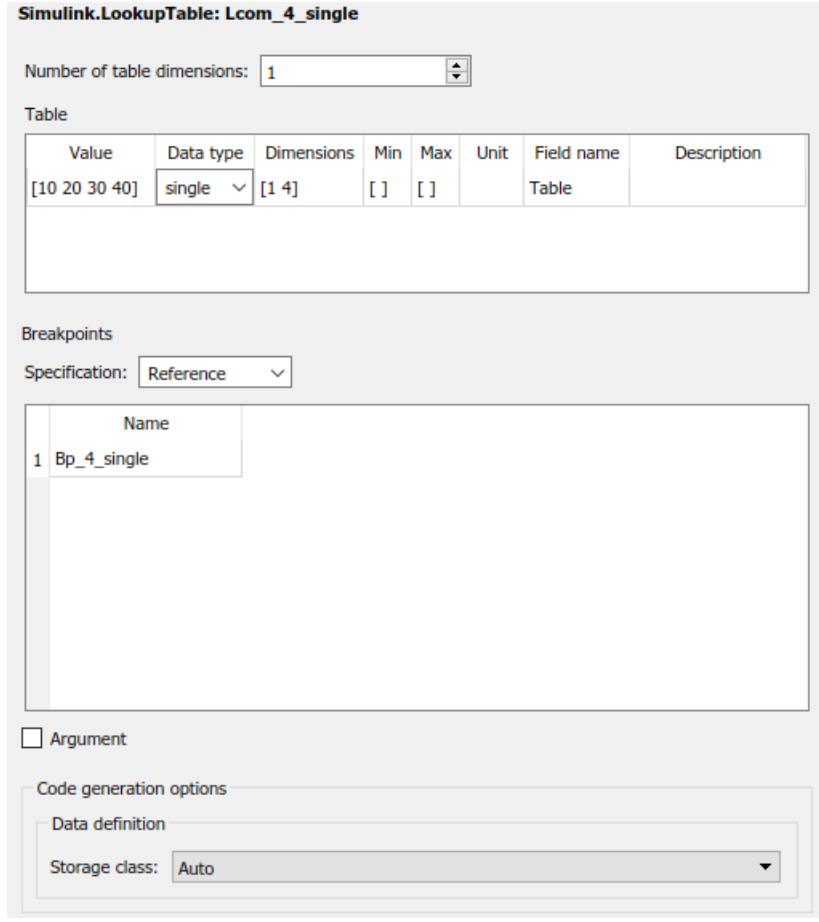


d Create one or more Interpolation Using Prelookup blocks.

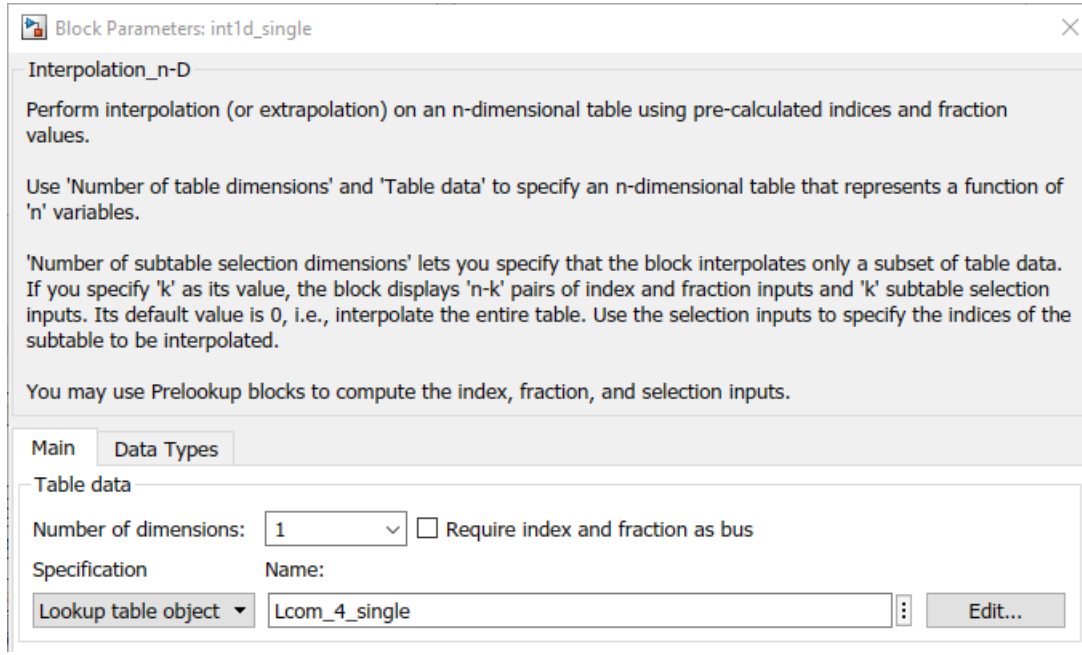


Open each block and set the **Specification** parameter to `Lookup table object`.

e For each set of table data, in the model workspace, create and configure a `Simulink.LookupTable` object.

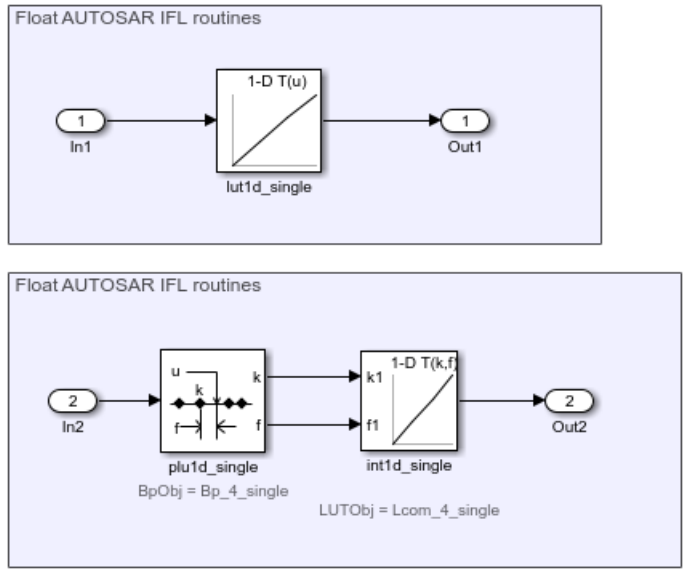


f Use each `Simulink.LookupTable` object name in an Interpolation Using Prelookup block.

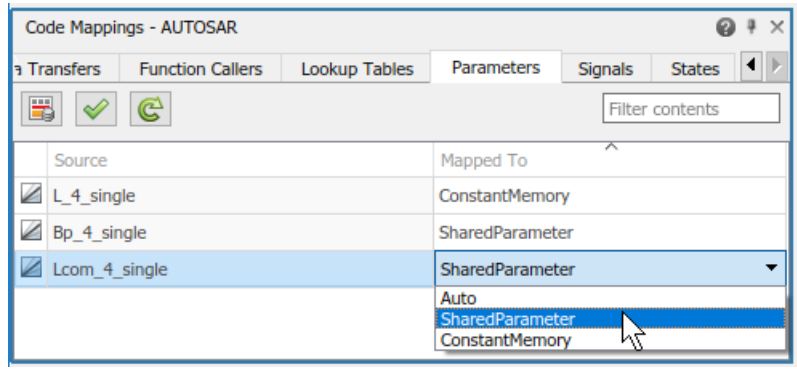


Each set of table data appears in the generated C code as a separate array variable. If the table size is tunable, each breakpoint vector appears as a structure. The structure contains a field to store the breakpoint data and, optionally, a field to store the length of the vector. The second field enables you to tune the effective size of the table. If the table size is not tunable, each breakpoint vector appears as an array.

3 Add AUTOSAR operating points to the lookup tables. Connect root level inports to n-D Lookup Table or Prelookup blocks. Alternatively, configure input signals to n-D Lookup Table or Prelookup blocks with static global memory.



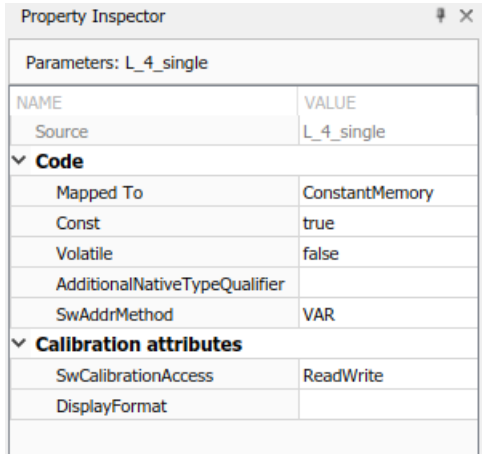
4 In the AUTOSAR code perspective, use Code Mapping Editor to map `Simulink.LookupTable` and `Simulink.Breakpoint` objects to AUTOSAR internal calibration parameters. In the **Parameters** tab, select each `Simulink.LookupTable` and `Simulink.Breakpoint` object that you created. Map each object to AUTOSAR parameter type `ConstantMemory`, `SharedParameter`, or `Auto`. To accept software mapping defaults, specify `Auto`.



In this example:

- STD_AXIS lookup table object `L_4_single` is mapped to AUTOSAR `ConstantMemory`.
- COM_AXIS breakpoint object `Bp_4_single` and lookup table object `Lcom_4_single` are mapped to AUTOSAR `SharedParameters`. All instances of the AUTOSAR software component share the COM_AXIS parameters.

5 For each parameter, if you select a parameter type other than `Auto`, use Property Inspector to view or modify other code and calibration attributes. For more information on parameter properties, see “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77.



6 Configure the model to generate C code based on the AUTOSAR 4.0 library. Open the Configuration Parameters dialog box and select **Code Generation > Interface**. Set the **Code replacement library** parameter to `AUTOSAR 4.0`. For more information, see “Code Generation with AUTOSAR Library” on page 5-17.

7 Build the model. The generated C code contains required `Ifl` and `Ifx` lookup function calls and `Rte` data access function calls. The generated `arxml` files contain data types of category CURVE (1-D table data), MAP (2-D table data), and COM_AXIS (axis data). The data types have the data calibration properties that you configured.

See Also

`Simulink.Breakpoint` | `Simulink.LookupTable`

Related Examples

- “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77

More About

- “AUTOSAR Component Configuration” on page 4-3

Configure COM_AXIS Lookup Table Using AUTOSAR.Parameter Objects

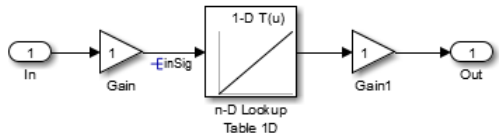
You can model common axis (COM_AXIS) lookup tables for AUTOSAR applications. To model a COM_AXIS lookup table, import COM_AXIS lookup table content from `arxml` files or create a COM_AXIS lookup table in Simulink. For information about the Simulink blocks you use and the high-level workflow, see “Calibration Parameters for STD_AXIS and COM_AXIS Lookup Tables” on page 2-27.

To create and configure a COM_AXIS lookup table:

1. Add an n-D Lookup Table block to your model.
2. If AUTOSAR calibration parameters for the lookup table are not already present in your model, create them. They can include:
   - Internal calibration parameters, modeled as described in “Configure AUTOSAR Internal Calibration Parameters” on page 4-212.
   - Calibration parameters in a calibration component, modeled as described in “Configure AUTOSAR Calibration Component” on page 4-216.
   - Constant memory parameters, modeled as described in “Configure AUTOSAR Static Memory” on page 4-275.
3. Configure the lookup table block for COM_AXIS data. For table data and axis data that you want to tune or manipulate at run time, reference AUTOSAR calibration parameters.
4. To model an AUTOSAR input variable that measures lookup table inputs, do either of the following:
   - Define a static global signal and use it on an input line that connects to a lookup table block input port. Model the signal parameter using an `AUTOSAR4.Signal` data object, as described in “Configure AUTOSAR Static Memory” on page 4-275.
   - Connect a root level inport to a lookup table block input port.

Note Consider selecting the AUTOSAR 4.0 code replacement library (CRL) for the model. Selecting the AUTOSAR CRL customizes the C/C++ code generator to produce code that more closely aligns with the AUTOSAR standard. For more information, see “Code Generation with AUTOSAR Library” on page 5-17.

For example, here is a simple model that contains a 1-D lookup table block.



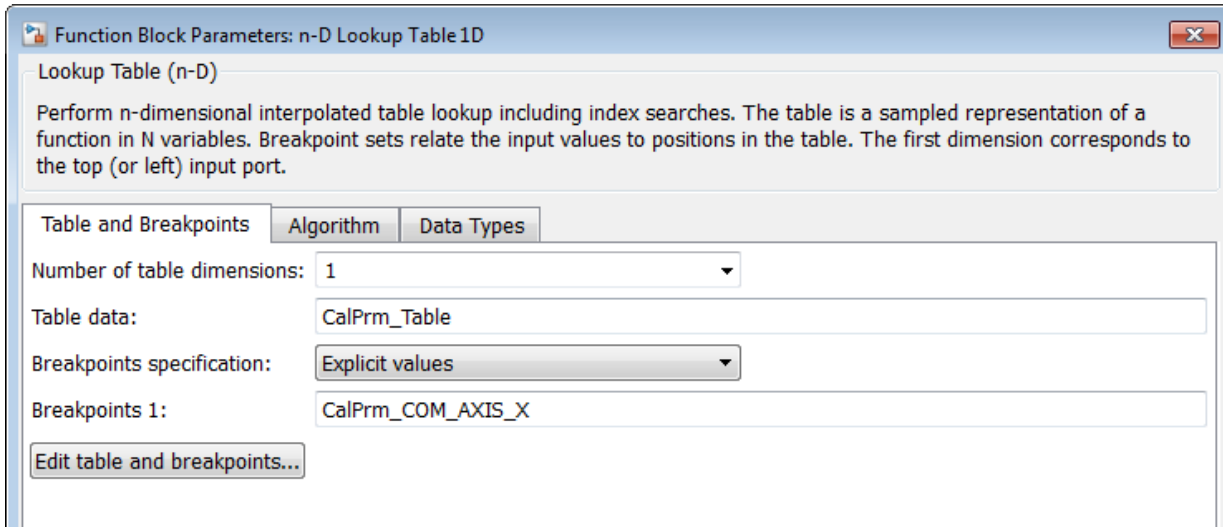
For this model, `AUTOSAR.Parameter` data objects in the workspace define two calibration parameters. `CalPrm_Table` represents table data.

```
CalPrm_Table =

  Parameter with properties:

    SwCalibrationAccess: 'ReadWrite'
          DisplayFormat: ''
                  Value: [4 8 12 16 20]
              CoderInfo: [1x1 Simulink.CoderInfo]
            Description: ''
               DataType: 'int16'
                    Min: 0
                    Max: 100
                   Unit: ''
             Complexity: 'real'
             Dimensions: [1 5]
```

`CalPrm_COM_AXIS_X` represents axis data.

```
CalPrm_COM_AXIS_X =

  Parameter with properties:

    SwCalibrationAccess: 'ReadWrite'
          DisplayFormat: ''
                  Value: [-2 -1 0 1 2]
              CoderInfo: [1x1 Simulink.CoderInfo]
            Description: ''
               DataType: 'fixdt(1,16,0.1,0)'
                    Min: -100
                    Max: 100
                   Unit: ''
             Complexity: 'real'
             Dimensions: [1 5]
```

The lookup table block parameters specify calibration parameter `CalPrm_Table` for table data and calibration parameter `CalPrm_COM_AXIS_X` for axis data.



When you generate code, the `arxml` code for calibration parameter `CalPrm_Table` references application data type `Appl_CalPrm_Table`.

```
<PARAMETER-DATA-PROTOTYPE UUID="...">
    <SHORT-NAME>CalPrm_Table</SHORT-NAME>
    <CATEGORY>CURVE</CATEGORY>
    ...
    <TYPE-TREF DEST="APPLICATION-PRIMITIVE-DATA-TYPE">/MW/ApplDataTypes/Appl_CalPrm_Table</TYPE-TREF>
    ...
</PARAMETER-DATA-PROTOTYPE>
```

The category generated for application data type `Appl_CalPrm_Table` is CURVE, reflecting a 1-D table. `Appl_CalPrm_Table` in turn references application data type `Appl_CalPrm_COM_AXIS_X` (axis data) and a software record layout, `RL_Appl_CalPrm_Table`.

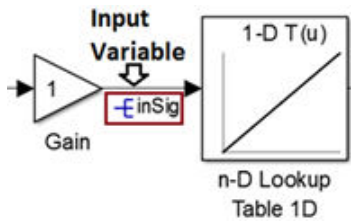
```
<APPLICATION-PRIMITIVE-DATA-TYPE UUID="...">
    <SHORT-NAME>Appl_CalPrm_Table</SHORT-NAME>
    <CATEGORY>CURVE</CATEGORY>
    <SW-DATA-DEF-PROPS>
        <SW-DATA-DEF-PROPS-VARIANTS>
            <SW-DATA-DEF-PROPS-CONDITIONAL>
                <SW-CALIBRATION-ACCESS>READ-WRITE</SW-CALIBRATION-ACCESS>
                <SW-CALPRM-AXIS-SET>
                    <SW-CALPRM-AXIS>
                        <SW-AXIS-INDEX>1</SW-AXIS-INDEX>
                        <CATEGORY>COM_AXIS</CATEGORY>
                        <SW-AXIS-GROUPED>
                            <SHARED-AXIS-TYPE-REF DEST="APPLICATION-PRIMITIVE-DATA-TYPE">
                              /MW/ApplDataTypes/Appl_CalPrm_COM_AXIS_X</SHARED-AXIS-TYPE-REF>
                        </SW-AXIS-GROUPED>
                    </SW-CALPRM-AXIS>
```

```
                </SW-CALPRM-AXIS-SET>
                ...
                <SW-RECORD-LAYOUT-REF DEST="SW-RECORD-LAYOUT">/MW/RecordLayouts/
                                    RL_Appl_CalPrm_Table</SW-RECORD-LAYOUT-REF>
            </SW-DATA-DEF-PROPS-CONDITIONAL>
        </SW-DATA-DEF-PROPS-VARIANTS>
    </SW-DATA-DEF-PROPS>
</APPLICATION-PRIMITIVE-DATA-TYPE>
```

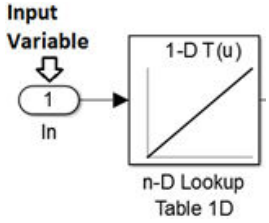
To configure an AUTOSAR input variable that measures a lookup table input in your model, do either of the following:

- Define a static global signal. Use the static global signal on an input line that connects to a lookup table block input port. Model the signal parameter using an `AUTOSAR4.Signal` data object, as described in “Configure AUTOSAR Static Memory” on page 4-275. For example:

```
inSig =

  Signal with properties:

    SwCalibrationAccess: 'ReadWrite'
          DisplayFormat: ''
              CoderInfo: [1x1 Simulink.CoderInfo]
            Description: ''
               DataType: 'fixdt(1,16,0.1,0)'
                    Min: []
                    Max: []
                   Unit: ''
             Dimensions: -1
        DimensionsMode: 'auto'
            Complexity: 'auto'
            SampleTime: -1
          InitialValue: ''
```



- Connect a root level inport directly to a lookup table block input port. For example:



When you export `arxml` code for a model with an input variable, the parameter access for the corresponding calibration parameter makes the corresponding input variable reference. That is, `SwDataDefProps` contains a reference to one of the following:

- A static memory variable corresponding to a static global signal in the model.
- An S-R interface data element corresponding to a root-level inport in the model.

For example, if you generate code for the static global signal example, the parameter access for calibration parameter `CalPrm_COM_AXIS_X` describes an input variable corresponding to global signal `inSig`.

```
<PARAMETER-ACCESS UUID="...">
    <SHORT-NAME>PICALPRM_CalPrm_COM_AXIS_X</SHORT-NAME>
    <ACCESSED-PARAMETER>
        <LOCAL-PARAMETER-REF DEST="PARAMETER-DATA-PROTOTYPE">/MW/SwCompTypes/ASWC/
                                    IB_CompA/CalPrm_COM_AXIS_X</LOCAL-PARAMETER-REF>
    </ACCESSED-PARAMETER>
    <SW-DATA-DEF-PROPS>
        ...
                <AUTOSAR-VARIABLE>
                    <LOCAL-VARIABLE-REF DEST="VARIABLE-DATA-PROTOTYPE">
                      /MW/SwCompTypes/ASWC/IB_CompA/inSig</LOCAL-VARIABLE-REF>
                </AUTOSAR-VARIABLE>
        ...
    </SW-DATA-DEF-PROPS>
</PARAMETER-ACCESS>
...
<STATIC-MEMORYS>
    <VARIABLE-DATA-PROTOTYPE UUID="...">
        <SHORT-NAME>inSig</SHORT-NAME>
        <CATEGORY>VALUE</CATEGORY>
        ...
        <TYPE-TREF DEST="APPLICATION-PRIMITIVE-DATA-TYPE">/MW/ApplDataTypes/SFIX16_SP1</TYPE-TREF>
    </VARIABLE-DATA-PROTOTYPE>
    ...
</STATIC-MEMORYS>
```

See Also

`AUTOSAR.Parameter` | n-D Lookup Table

Related Examples

- “Import AUTOSAR Software Component” on page 3-4
- “Model AUTOSAR Calibration Parameters and Lookup Tables” on page 2-26
- “Configure AUTOSAR Internal Calibration Parameters” on page 4-212
- “Configure AUTOSAR Calibration Component” on page 4-216
- “Configure AUTOSAR Static Memory” on page 4-275
- “Code Generation with AUTOSAR Library” on page 5-17
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Calibration Parameters for STD_AXIS and COM_AXIS Lookup Tables” on page 2-27
- “Static and Constant Memory” on page 2-34
- “AUTOSAR Component Configuration” on page 4-3

Configure AUTOSAR Data for Measurement and Calibration

In Simulink, you can import and export AUTOSAR software data definition properties and modify the properties for some forms of AUTOSAR data.

In this section...

About Software Data Definition Properties (SwDataDefProps)

Embedded Coder supports `arxml` import and export of the following AUTOSAR software data definition properties (`SwDataDefProps`):

- Software calibration access (`SwCalibrationAccess`) — Specifies measurement and calibration tool access to a data object.
- Display format (`DisplayFormat`) — Specifies measurement and calibration display format for a data object.
- Software address method (`SwAddrMethod`) — Specifies a method to access a data object (for example, a measurement or calibration parameter) according to a given address. Used to group data in memory for access by run-time measurement and calibration tools.
- Software alignment (`SwAlignment`) — Specifies the intended alignment of a data object within a memory section.
- Software implementation policy (`SwImplPolicy`) — Specifies the implementation policy for a data object, regarding consistency mechanisms of variables.
- Software record layout (`SwRecordLayout`) — Specifies how to serialize data in the memory of an AUTOSAR ECU.

In the Simulink environment, you can directly modify software data definition properties for some forms of AUTOSAR data. You cannot modify the `SwImplPolicy` or `SwRecordLayout` properties, but the properties are exported in `arxml` code.

For more information, see “Configure SwCalibrationAccess” on page 4-237, “Configure DisplayFormat” on page 4-240, “Configure SwAddrMethod” on page 4-243, “Configure SwAlignment” on page 4-247, “Export SwImplPolicy” on page 4-248, and “Export SwRecordLayout for Lookup Table Data” on page 4-248.

Configure SwCalibrationAccess

You can specify the `SwCalibrationAccess` property for measurement variables, calibration parameters, and signal and parameter data objects. The valid values are:

- `ReadOnly` — Data element appears in the generated description file with read access only.
- `ReadWrite` — Data element appears in the generated description file with both read and write access.
- `NotAccessible` — Data element does not appear in the generated description file and is not accessible with measurement and calibration tools.

If you open a model with signals and parameters, you can specify the `SwCalibrationAccess` property in the following ways:

- “Specify SwCalibrationAccess for AUTOSAR Data Elements” on page 4-237
- “Specify SwCalibrationAccess for Signal and Parameter Data Objects” on page 4-239
- “Specify Default SwCalibrationAccess for Application Data Types” on page 4-240

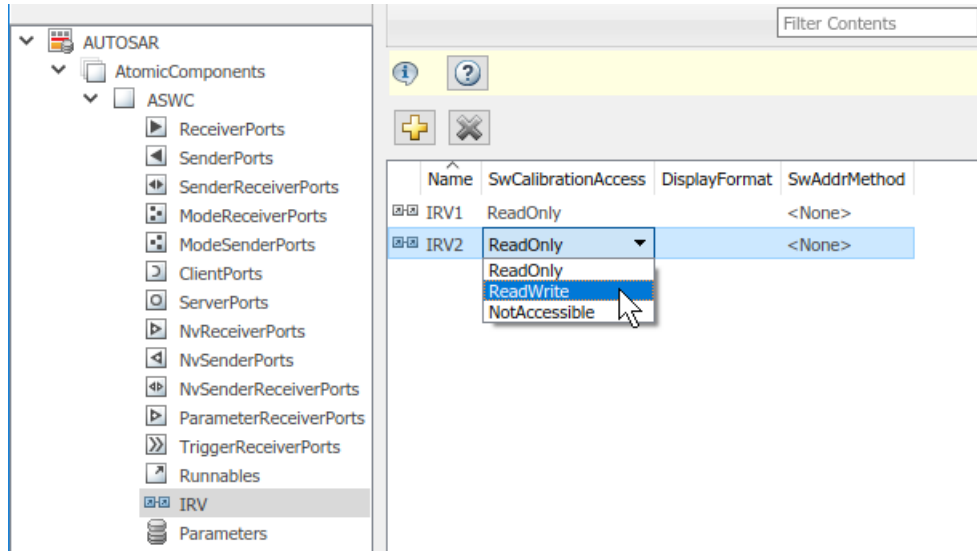
Specify SwCalibrationAccess for AUTOSAR Data Elements

You can use either AUTOSAR Dictionary or MATLAB function calls to specify the `SwCalibrationAccess` property for the following AUTOSAR data elements:

- Sender-receiver interface data elements
- Nonvolatile interface data elements
- Client-server arguments
- Inter-runnable variables

For example:

1. Open a model that is configured for AUTOSAR.
2. Open AUTOSAR Dictionary. Navigate to one of the following views:
   - S-R or NV interface, **DataElements** view
   - C-S interface, **Arguments** view
   - Atomic component, **IRV** view
3. Use the **SwCalibrationAccess** drop-down list to select the level of measurement and calibration tool access to allow for the data element.



Alternatively, you can use the AUTOSAR property functions to specify the `SwCalibrationAccess` property for AUTOSAR data elements. For example, the following code opens the `rtwdemo_autosar_swc_fcncalls` example model and sets measurement and calibration access to inter-runnable variable IRV2 to `ReadWrite`.

```
open_system('rtwdemo_autosar_swc_fcncalls')
arProps = autosar.api.getAUTOSARProperties('rtwdemo_autosar_swc_fcncalls');
get(arProps,'/Company/Powertrain/Components/ASWC/ASWC_IB/IRV2','SwCalibrationAccess')

set(arProps,'/Company/Powertrain/Components/ASWC/ASWC_IB/IRV2','SwCalibrationAccess','ReadWrite');
get(arProps,'/Company/Powertrain/Components/ASWC/ASWC_IB/IRV2','SwCalibrationAccess')

ans =
    'ReadOnly'
```

```
ans =
    'ReadWrite'
```

Here is a sample call to the AUTOSAR properties `set` function to set `SwCalibrationAccess` for an S-R interface data element in the same model.

```
set(arProps,'/Company/Powertrain/Interfaces/InIf/In1','SwCalibrationAccess','ReadWrite');
get(arProps,'/Company/Powertrain/Interfaces/InIf/In1','SwCalibrationAccess')
```

```
ans =
    'ReadWrite'
```

Specify SwCalibrationAccess for Signal and Parameter Data Objects

You can specify the `SwCalibrationAccess` property for the following AUTOSAR signal and parameter data objects in your model, using either the property dialog box or MATLAB commands:

- `AUTOSAR.Signal`
- `AUTOSAR4.Signal`
- `AUTOSAR.Parameter`
- `AUTOSAR4.Parameter`
- `AUTOSAR.DualScaledParameter`

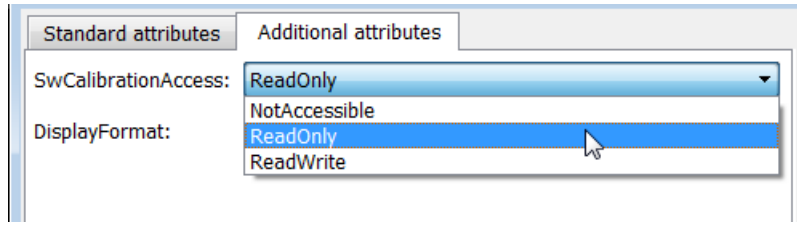
For example:

1. Open MATLAB.
2. Create a signal or parameter data object with a command like the following:

```
arSig = AUTOSAR.Signal
```

```
arSig =

  Signal with properties:

    SwCalibrationAccess: 'ReadOnly'
          DisplayFormat: ''
              CoderInfo: [1x1 Simulink.CoderInfo]
            Description: ''
               DataType: 'auto'
                    Min: []
                    Max: []
                   Unit: ''
             Dimensions: -1
        DimensionsMode: 'auto'
             Complexity: 'auto'
             SampleTime: -1
           InitialValue: ''
```

3. Open the data object, for example, by double-clicking the object in the workspace.
4. Select the **Additional attributes** tab, or for `AUTOSAR.DualScaledParameter`, the **Calibration Attributes** tab. Use the **SwCalibrationAccess** drop-down list to select the level of measurement and calibration tool access to allow for the data object.



Alternatively, you can access and modify the `SwCalibrationAccess` property for AUTOSAR signal or parameter data objects using MATLAB commands. For example:

```
arSig.SwCalibrationAccess = 'ReadWrite'
```

Specify Default SwCalibrationAccess for Application Data Types

The AUTOSAR XML options include **SwCalibrationAccess DefaultValue** (property `SwCalibrationAccessDefault`), which defines the default `SwCalibrationAccess` value for AUTOSAR application data types in your model. You can use the AUTOSAR property functions to modify the default. For example, the following code opens the `rtwdemo_autosar_swc_fcncalls` example model and changes the default measurement and calibration access for AUTOSAR application data types from `ReadOnly` to `ReadWrite`.

```
open_system('rtwdemo_autosar_swc_fcncalls')
arProps = autosar.api.getAUTOSARProperties('rtwdemo_autosar_swc_fcncalls');
get(arProps,'XmlOptions','SwCalibrationAccessDefault')

set(arProps,'XmlOptions','SwCalibrationAccessDefault','ReadWrite');
get(arProps,'XmlOptions','SwCalibrationAccessDefault')

ans =
    'ReadOnly'

ans =
    'ReadWrite'
```

Configure DisplayFormat

AUTOSAR display format specifications control the width and precision display for measurement and calibration data. You can import and export AUTOSAR display format

specifications, and edit the specifications in Simulink. You can specify display format for the following AUTOSAR data objects and elements:

- Signal and parameter data objects (AUTOSAR and AUTOSAR4 classes)
- Inter-runnable variables
- Sender-receiver interface data elements
- Client-server interface operation arguments
- CompuMethods

The display format specification is a subset of ANSI C `printf` specifiers, with the following form:

```
%[flags][width][.precision]type
```

Field	Description

`flags` (optional)	Characters specifying flags supported by AUTOSAR schemas:
	• `(' ')`: Insert a space before the value.
	• `-`: Left-justify.
	• `+`: Display plus or minus sign, even for positive numbers.
	• `#`:
	  • For types `o`, `x`, and `X`, display `0`, `0x`, or `0X` prefix.
	  • For types `e`, `E`, and `f`, display decimal point even if the precision is 0.
	  • For types `g` and `G`, do not remove trailing zeros or decimal point.

`width` (optional)	Positive integer specifying the minimum number of characters to display.
`precision` (optional)	Positive integer specifying the precision to display: • For integer type values (`d`, `i`, `o`, `u`, `x`, and `X`), specifies the minimum number of digits. • For types `e`, `E`, and `f`, specifies the number of digits to the right of the decimal point. • For types `g` and `G`, specifies the number of significant digits.

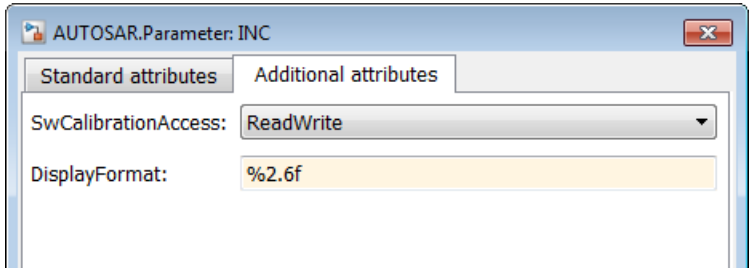
Field	Description

`type`	Characters specifying a numeric conversion type supported by AUTOSAR schemas:
	• `d`: Signed decimal integer.
	• `i`: Signed decimal integer.
	• `o`: Unsigned octal integer.
	• `u`: Unsigned decimal integer.
	• `x`: Unsigned hexadecimal integer, using characters "abcdef".
	• `X`: Unsigned hexadecimal integer, using characters "ABCDEF”.
	• `e`: Signed floating-point value in exponential notation. The value has the form `[-]d.dddd e [sign]ddd`.
	  • `d` is a single decimal digit.
	  • `dddd` is one or more decimal digits.
	  • `ddd` is exactly three decimal digits.
	  • `sign` is `+` or `-`.
	• `E`: Identical to the `e` format except that `E`, rather than `e`, introduces the exponent.
	• `f`: Signed floating-point value in fixed-point notation. The value has the form `[-]dddd.dddd`.
	  • `dddd` is one or more decimal digits.
	  • The number of digits before the decimal point depends on the magnitude of the number.
	  • The number of digits after the decimal point depends on the requested precision.
	• `g`: Signed value printed in `f` or `e` format, whichever is more compact for the given value and precision. Trailing zeros are truncated, and the decimal point appears only if one or more digits follow it.
	• `G`: Identical to the `g` format, except that `E`, rather than `e`, introduces the exponent (where required).

For example, the format specifier `%2.1d` specifies width 2, precision 1, and type signed decimal, producing a displayed value such as 12.2.

The **DisplayFormat** attribute appears in dialog boxes for the AUTOSAR data objects and elements to which it applies. You can specify display format in a dialog box, or with a data object or element API that can modify attributes.

```
INC = AUTOSAR.Parameter;
INC.DisplayFormat = '%2.6f'
```



If you specify a display format, exporting `arxml` code generates a corresponding DISPLAY-FORMAT specification.

```
<PARAMETER-DATA-PROTOTYPE UUID="...">
    <SHORT-NAME>INC</SHORT-NAME>
    <CATEGORY>VALUE</CATEGORY>
    <SW-DATA-DEF-PROPS>
        <SW-DATA-DEF-PROPS-VARIANTS>
            <SW-DATA-DEF-PROPS-CONDITIONAL>
                <SW-CALIBRATION-ACCESS>READ-WRITE</SW-CALIBRATION-ACCESS>
                <DISPLAY-FORMAT>%2.6f</DISPLAY-FORMAT>
                <SW-IMPL-POLICY>STANDARD</SW-IMPL-POLICY>
            </SW-DATA-DEF-PROPS-CONDITIONAL>
        </SW-DATA-DEF-PROPS-VARIANTS>
    </SW-DATA-DEF-PROPS>
    ...
</PARAMETER-DATA-PROTOTYPE>
```

Configure SwAddrMethod

AUTOSAR software components use software address methods (`SwAddrMethods`) to group data and functions into memory sections for access by run-time measurement and calibration tools. For a Simulink model mapped to an AUTOSAR software component, you can associate `SwAddrMethods` with these elements:

- Parameter mapped to AUTOSAR constant memory
- Parameter mapped to AUTOSAR internal calibration parameter
- Signal or state mapped to AUTOSAR static memory

- Signal or state mapped to AUTOSAR per-instance memory
- Entry-point function mapped to AUTOSAR runnable
- Internal data inside an entry-point function

To create and use `SwAddrMethod`s in an AUTOSAR model:

1. Import `SwAddrMethod`s from `arxml` files or create `SwAddrMethod`s in Simulink.

   - To import `SwAddrMethod`s from `arxml` files, use an `arxml.importer` function – `createComponentAsModel` or `createCompositionAsModel` for a new model, or `updateModel` or `updateReferences` for an existing model.
   - To create `SwAddrMethod`s in an existing model, open the AUTOSAR Dictionary, SwAddrMethods view, and click the **Add** button  . Alternatively, use equivalent AUTOSAR property functions. For more information, see “Create SwAddrMethods in Simulink” on page 4-245.

2. Associate `SwAddrMethod`s with model data and functions. Open Code Mapping Editor and select the **Parameters**, **Signals**, **States**, or **Entry-Point Functions** tab. Select an element within that tab and use Property Inspector to set the **SwAddrMethod** attribute. Alternatively, use the equivalent AUTOSAR map function. For more information, see “Associate SwAddrMethod with Model Data or Function” on page 4-246.

3. Generate code for your AUTOSAR model. (This example uses a signal mapped to AUTOSAR static memory in the model `mAutosarCounter.slx` from *`matlabroot`*`/help/toolbox/ecoder/examples/autosar`.) In the generated files:

   - Exported `arxml` files contain `SwAddrMethod` descriptions and references.

```
<VARIABLE-DATA-PROTOTYPE UUID="...">
    <SHORT-NAME>SM_equal_to_count</SHORT-NAME>
    <CATEGORY>VALUE</CATEGORY>
    <SW-DATA-DEF-PROPS>
        <SW-DATA-DEF-PROPS-VARIANTS>
            <SW-DATA-DEF-PROPS-CONDITIONAL>
                <SW-ADDR-METHOD-REF DEST="SW-ADDR-METHOD">
                /Company/Powertrain/DataTypes/SwAddrMethods/VAR
                </SW-ADDR-METHOD-REF>
                <SW-CALIBRATION-ACCESS>READ-ONLY</SW-CALIBRATION-ACCESS>
                <SW-IMPL-POLICY>STANDARD</SW-IMPL-POLICY>
            </SW-DATA-DEF-PROPS-CONDITIONAL>
        </SW-DATA-DEF-PROPS-VARIANTS>
    </SW-DATA-DEF-PROPS>
    <TYPE-TREF DEST="IMPLEMENTATION-DATA-TYPE">
    /Company/Powertrain/DataTypes/Boolean_volatile_my_qualifier</TYPE-TREF>
</VARIABLE-DATA-PROTOTYPE>
```

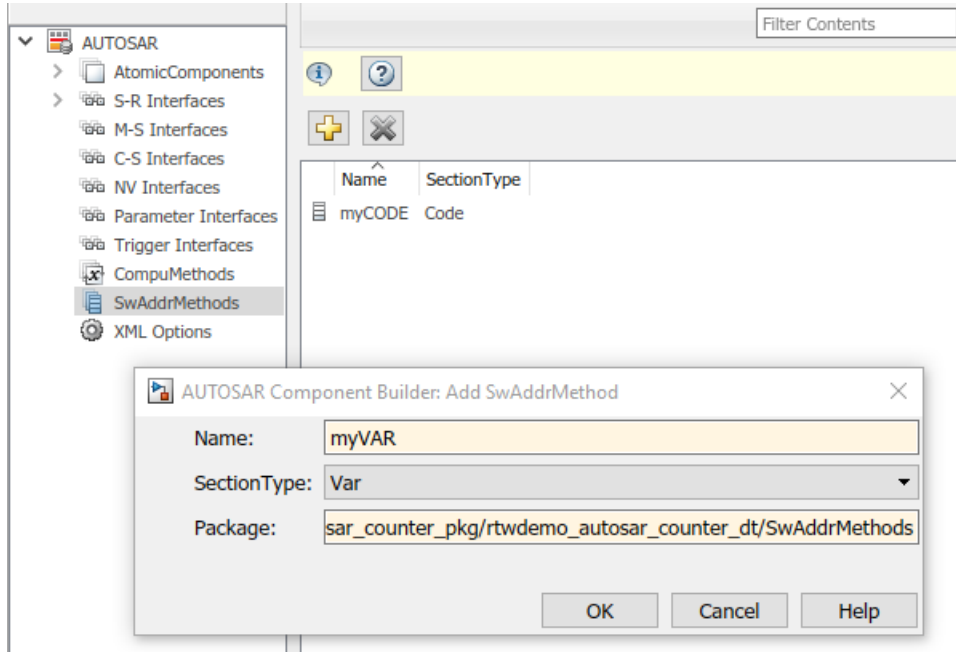
- AUTOSAR-compliant C code contains comments and `#define` statements that bracket data or function definitions belonging to each `SwAddrMethod` memory section.

```
/* Static Memory for Internal Data */

/* SwAddrMethod VAR for Internal Data */
#define mAutosarCounter_START_SEC_VAR
#include "mAutosarCounter_MemMap.h"

volatile my_qualifier boolean SM_equal_to_count;

#define mAutosarCounter_STOP_SEC_VAR
#include "mAutosarCounter_MemMap.h"
```


- “Create SwAddrMethods in Simulink” on page 4-245
- “Associate SwAddrMethod with Model Data or Function” on page 4-246

Create SwAddrMethods in Simulink

To create `SwAddrMethods` in an existing model, open the AUTOSAR Dictionary, SwAddrMethods view, and click the **Add** button  .

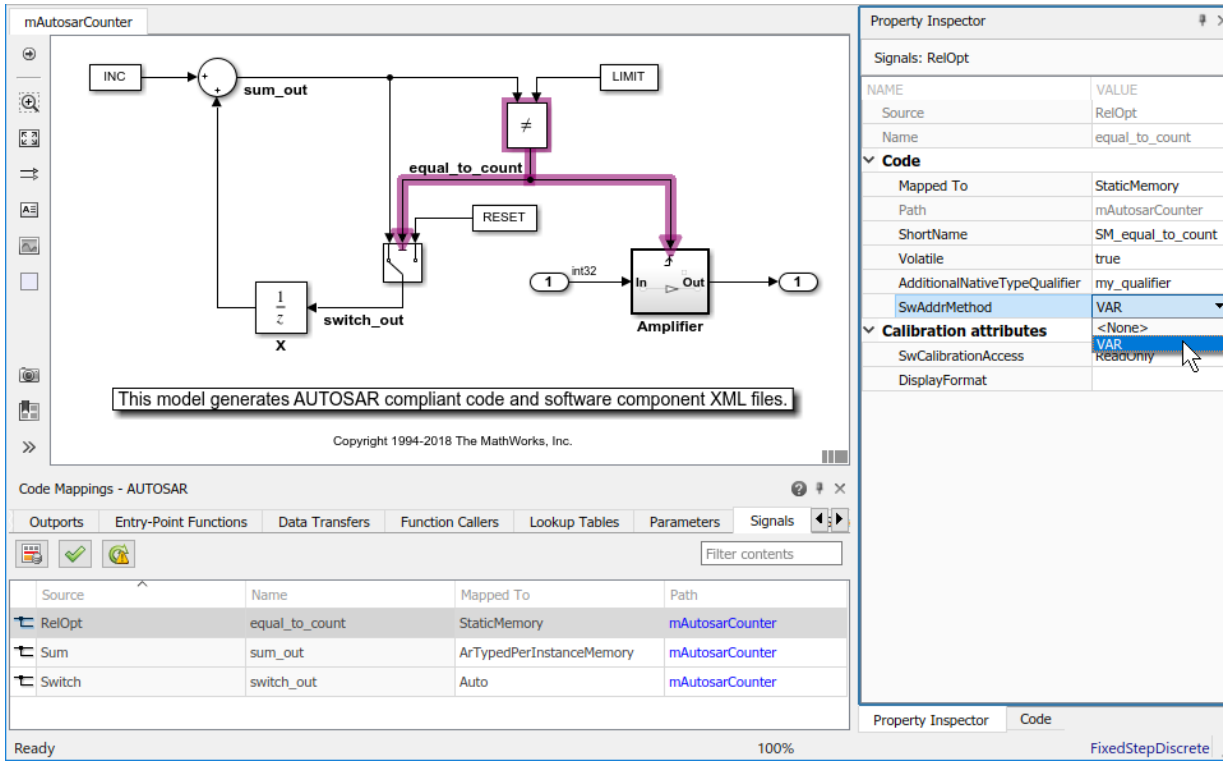


Alternatively, use equivalent AUTOSAR property functions. This code adds SwAddrMethods myCODE and myVAR to an AUTOSAR component model.

```
open_system('rtwdemo_autosar_counter')
arProps = autosar.api.getAUTOSARProperties('rtwdemo_autosar_counter');
addPackageableElement(arProps,'SwAddrMethod',...
    '/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods','myCODE',...
    'SectionType','Code')
swAddrPaths = find(arProps,[],'SwAddrMethod','PathType','FullyQualified',...
    'SectionType','Code')
addPackageableElement(arProps,'SwAddrMethod',...
    '/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods','myVAR',...
    'SectionType','Var')
swAddrPaths = find(arProps,[],'SwAddrMethod','PathType','FullyQualified',...
    'SectionType','Var')

swAddrPaths =
    {'/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods/myCODE'}

swAddrPaths =
    {'/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods/myVAR'}
```

Associate SwAddrMethod with Model Data or Function

To associate `SwAddrMethods` with model data and functions, open Code Mapping Editor and select the **Parameters**, **Signals**, **States**, or **Entry-Point Functions** tab. Select an element within that tab and use Property Inspector to set the **SwAddrMethod** attribute. In this example, `SwAddrMethod` VAR is selected for signal `equal_to_count`, which is mapped to AUTOSAR static memory.



Alternatively, use the equivalent AUTOSAR map function. For more information, see the reference page for `mapFunction`, `mapParameter`, `mapSignal`, or `mapState`.

Configure SwAlignment

The `SwAlignment` property describes the intended alignment of AUTOSAR data objects within a memory section. `SwAlignment` defines a quantity of bits. Valid values include 8, 12, 32, UNKNOWN (deprecated), UNSPECIFIED, and BOOLEAN. For numeric data, typical `SwAlignment` values are 8, 16, and 32.

If you do not define the `SwAlignment` property, the `swBaseType` size and the `memoryAllocationKeywordPolicy` of the referenced `SwAlignment` determine the alignment.

You can use the AUTOSAR property function `set` to set `SwAlignment` for S-R interface data elements and inter-runnable variables. For example:

```
interfacePath = '/A/B/C/Interfaces/If1/';
dataElementName = 'El1';
swAlignmentValue = '32';
set(dataObj,[interfacePath dataElementName],'SwAlignment',swAlignmentValue);
```

To support the round-trip workflow, the `arxml` importer imports and preserves the `SwAlignment` property for the following AUTOSAR data:

- Per-instance memory
- Software component parameters
- Parameter interface data elements
- Client-server interface operation arguments
- Static and constant memory

Export SwImplPolicy

The `SwImplPolicy` property specifies the implementation policy for a data object, regarding consistency mechanisms of variables. You cannot modify the `SwImplPolicy` property, but the property is set to `standard` or `queued` for AUTOSAR data in exported `arxml` code. The value is set to:

- `standard` for
  - Per-instance memory
  - Inter-runnable variables
  - Software component parameters
  - Parameter interface data elements
  - Client-server interface operation arguments
  - Static and constant memory
- `standard` or `queued` for
  Sender-receiver interface data elements

Export SwRecordLayout for Lookup Table Data

AUTOSAR software components use software record layouts (`SwRecordLayouts`) to specify how to serialize data in the memory of an AUTOSAR ECU. The `arxml` importer imports and preserves the `SwRecordLayout` property for AUTOSAR data.

You can import `SwRecordLayouts` from `arxml` files in either of two ways:

- If you create your AUTOSAR model from `arxml` files using importer function `createComponentAsModel`, include an `arxml` file that contains `SwRecordLayout` definitions in the import. The imported `SwRecordLayouts` are preserved and later exported in `arxml` code.
- If you create your AUTOSAR model in Simulink, you can import reference definitions of `SwRecordLayouts` from `arxml` files. Use importer function `updateReferences`. For example:

  ```
  importerObj = arxml.importer(arxmlFileName);
  updateReferences(importerObj,modelName);
  ```

  When you generate model code, the exported `arxml` code contains references to the imported read-only `SwRecordLayout` elements, but not their definitions.

  ```
  <APPLICATION-PRIMITIVE-DATA-TYPE>
      <SHORT-NAME>Appl_L_6_s16En4</SHORT-NAME>
      <CATEGORY>CURVE</CATEGORY>
      <SW-DATA-DEF-PROPS>
                  ...
          <SW-RECORD-LAYOUT-REF DEST="SW-RECORD-LAYOUT">
              /AUTOSAR/Ifx/SwRecordLayouts_Blueprint/IntCur_s16_s16
          </SW-RECORD-LAYOUT-REF>
      </SW-DATA-DEF-PROPS>
  </APPLICATION-PRIMITIVE-DATA-TYPE>
  ```

  For more information, see “Import or Update Shared AUTOSAR Reference Element Definitions” on page 3-29.

See Also

`AUTOSAR.DualScaledParameter` | `AUTOSAR.Parameter` | `AUTOSAR.Signal` | `AUTOSAR4.Parameter` | `AUTOSAR4.Signal`

Related Examples

- “Import AUTOSAR Software Component” on page 3-4
- “Model AUTOSAR Calibration Parameters and Lookup Tables” on page 2-26
- “Configure AUTOSAR CompuMethods” on page 4-287
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “AUTOSAR Component Configuration” on page 4-3

Configure AUTOSAR Runnables and Events

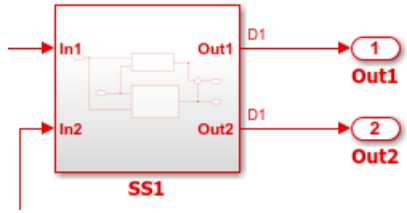
The internal behavior of an AUTOSAR software component is implemented by a set of runnable entities (runnables). A runnable is a sequence of operations provided by the component that can be started by the Runtime Environment (RTE). The component configures an event to activate each runnable – for example, a timing event, data received, a client request, a mode change, component startup or shutdown, or a trigger.

In Simulink, you can configure these types of AUTOSAR events.

Event Type	Workflow	Example
`DataReceivedEvent`	Sender-receiver (S-R) communication	"Configure Events for Runnable Activation" on page 4-329
`DataReceiveErrorEvent`	Sender-receiver (S-R) communication	"Configure AUTOSAR Receiver Port for DataReceiveErrorEvent" on page 4-112
`ExternalTrigger-OccurredEvent`	External trigger event communication	"Configure Receiver for AUTOSAR External Trigger Event Communication" on page 4-187
`InitEvent`	R4.1 activation of initialization runnable	"Configure AUTOSAR Initialization Runnable (R4.1)" on page 4-266
`ModeSwitchEvent`	Mode-switch (M-S) communication	"Configure AUTOSAR Mode-Switch Communication" on page 4-172
`OperationInvokedEvent`	Client-server (C-S) communication	"Configure AUTOSAR Client-Server Communication" on page 4-144
`TimingEvent`	Periodic activation of runnable	"Configure AUTOSAR TimingEvent for Periodic Runnable" on page 4-327

To configure an AUTOSAR runnable in Simulink:

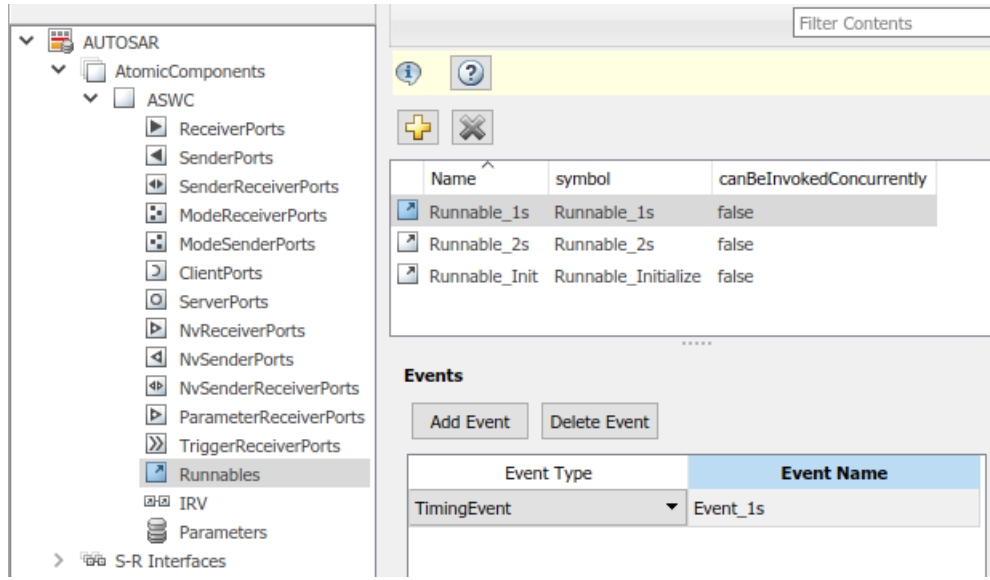
1. Open a model that is configured for AUTOSAR code generation. This example uses a writable copy of the example model `rtwdemo_autosar_swc`.
2. In the model, create or identify a root-level Simulink subsystem or function that implements a sequence of operations. The subsystem or function must generate an entry-point function in C code. In `rtwdemo_autosar_swc`, the subsystem SS1 generates rate-based model step function `Runnable_1s`.



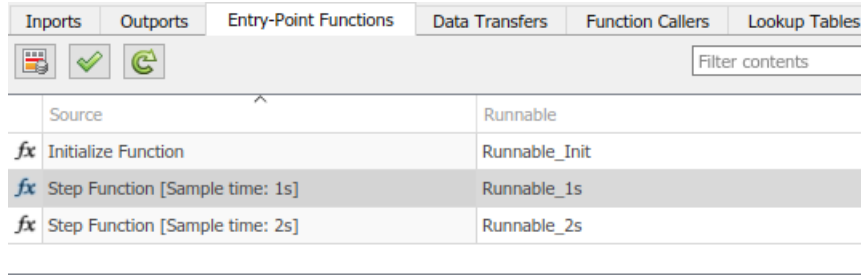
3. Create or identify an AUTOSAR runnable to which to map the Simulink entry point function. Open AUTOSAR Dictionary. Expand **AtomicComponents**, expand the component, and select the **Runnables** view. If you need to create a new AUTOSAR runnable, click the plus sign. The model `rtwdemo_autosar_swc` contains the periodic runnable `Runnable_1s`.
4. Select the row containing the runnable and configure its properties, including name and symbol. The AUTOSAR runnable symbol-name that you specify is exported in `arxml` descriptions and C code. For an AUTOSAR server runnable, set the runnable property `canBeInvokedConcurrently` to designate whether to enforce concurrency constraints. For nonserver runnables, leave `canBeInvokedConcurrently` set to `false`. For more information, see “Concurrency Constraints for AUTOSAR Server Runnables” on page 4-168.
5. Configure an event to activate the runnable. Go to the **Events** pane for the selected runnable. If you need to create an event, click **Add Event**. Enter an event name and set the event type.

   The steps to configure an event depend on the type of event. If the event relies on a communication interface, such as data received (sender-receiver) or client request (client-server), you must first configure the communication interface before configuring the event.

   In the model `rtwdemo_autosar_swc`, the periodic runnable `Runnable_1s` is activated by a `TimingEvent` named `Event_1s`.



6 Map the Simulink entry-point function to the AUTOSAR runnable. Open Code Mapping Editor and select the **Entry-Point Functions** tab. For model `rtwdemo_autosar_swc`, select the model step function with a 1s sample time and map it to AUTOSAR runnable `Runnable_1s`.



To see the results of AUTOSAR runnable and event configuration in `arxml` descriptions and C code, build the model.

See Also

Related Examples

- “Import AUTOSAR Software Component” on page 3-4
- “Modeling Patterns for AUTOSAR Runnables”
- “Model AUTOSAR Software Components” on page 2-3
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “AUTOSAR Component Configuration” on page 4-3

Configure AUTOSAR Initialize, Reset, or Terminate Runnables

AUTOSAR applications sometimes require complex logic to execute during system initialization, reset, and termination sequences. To model startup, reset, and shutdown processing in an AUTOSAR software component, use the Simulink blocks Initialize Function and Terminate Function.

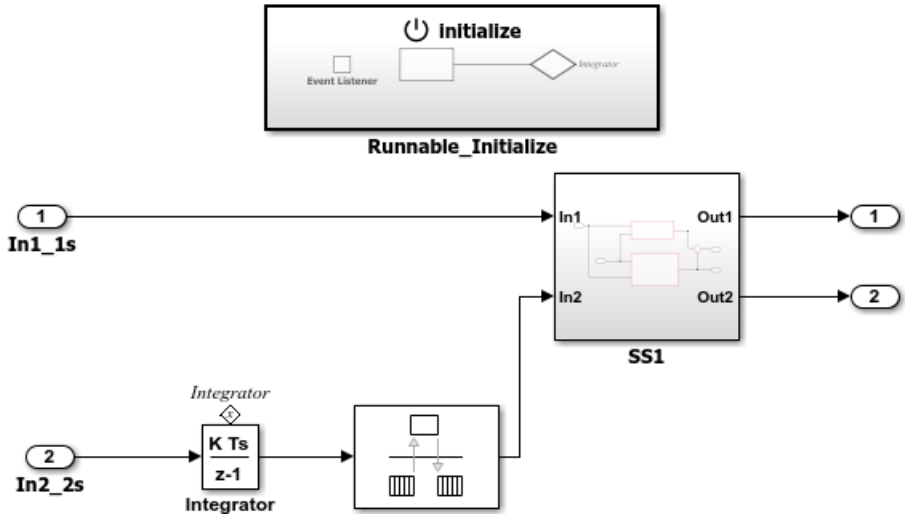
The Initialize Function and Terminate Function blocks can control execution of a component in response to initialize, reset, or terminate events. For more information, see "Customize Initialize, Reset, and Terminate Functions" (Simulink), "Generate Code That Responds to Initialize, Reset, and Terminate Events" (Simulink Coder), and AUTOSAR topic "Startup, Reset, and Shutdown" on page 2-11.

In an AUTOSAR model, you map each Simulink initialize, reset, or terminate entry-point function to an AUTOSAR runnable. For each runnable, configure the AUTOSAR event that activates the runnable. In general, you can select any AUTOSAR event type except `TimingEvent`. The runnables work with any AUTOSAR component modeling style. (However, software-in-the-loop simulation of AUTOSAR initialize, reset, or terminate runnables works only with exported function modeling.)

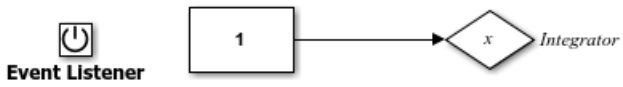
This example shows how to configure an AUTOSAR software component for simple startup and termination processing, using the Initialize Function and Terminate Function blocks.

1 Open a model that is configured for AUTOSAR code generation. This example uses a writable copy of the example model `rtwdemo_autosar_swc`.

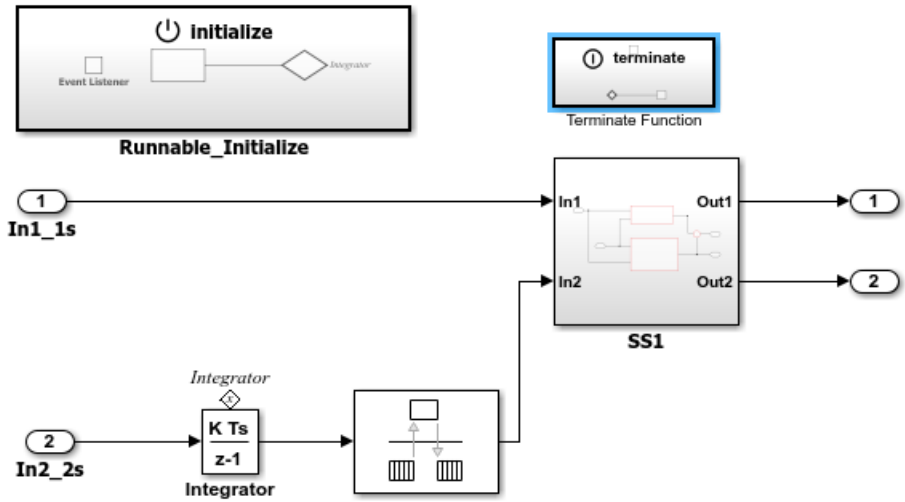
Add an Initialize Function block to the model.



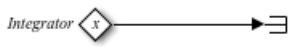
2 In the Initialize Function block, develop the logic that is required to execute during component initialization, using the techniques described in “Customize Initialize, Reset, and Terminate Functions” (Simulink).



3 Add a Terminate Function block to the model.



4 In the Terminate Function block, develop the logic that is required to execute during component termination, using the techniques described in “Customize Initialize, Reset, and Terminate Functions” (Simulink).



In this example, the Terminator block is a placeholder for saving the state value.

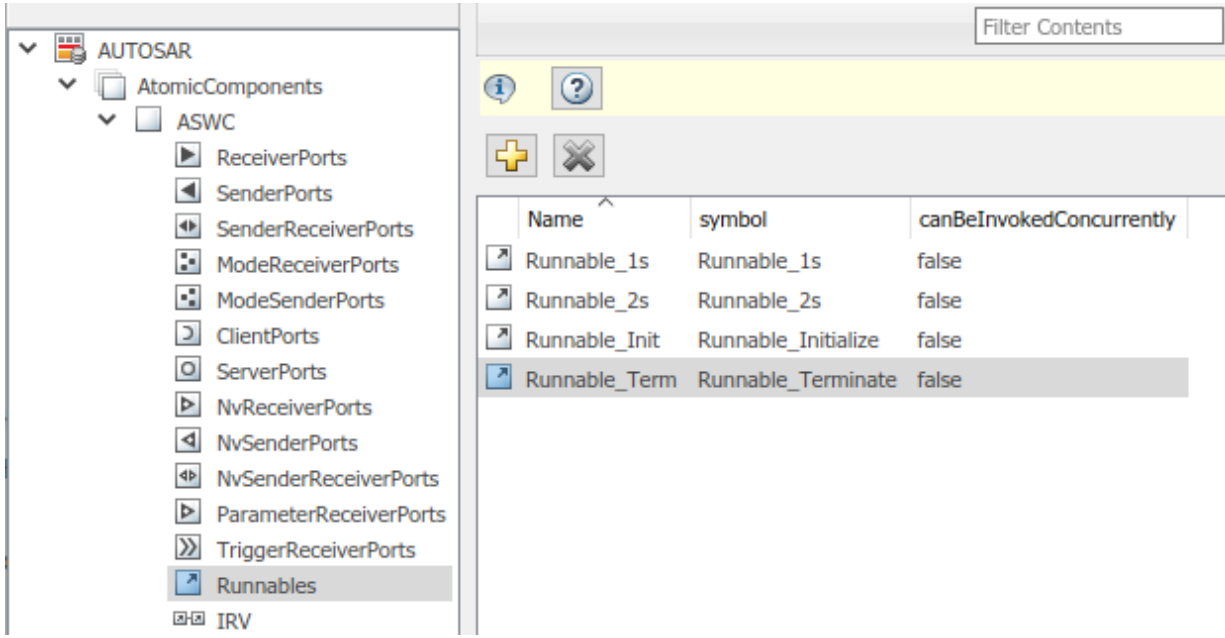
5 Add a terminate entry-point function to the model. In the Configuration Parameters dialog box, in the **Code Generation > Interface** pane, under **Advanced parameters**, select the option **Terminate function required**. Click **Apply**.

6 Open Code Mapping Editor. To update the Simulink to AUTOSAR mapping of the model, click the **Update** button . The mapping now reflects the addition of the Initialize Function and Terminate Function blocks and enabling of a terminate entry-point function.

7 Open AUTOSAR Dictionary. Expand **AtomicComponents**, expand the component, and select the **Runnables** view.

The runnables list already contains an initialization runnable, created as part of the initial Simulink representation of the AUTOSAR software component. Use the **Add** button  to add a terminate runnable to the component. Select each runnable and configure its name and properties.

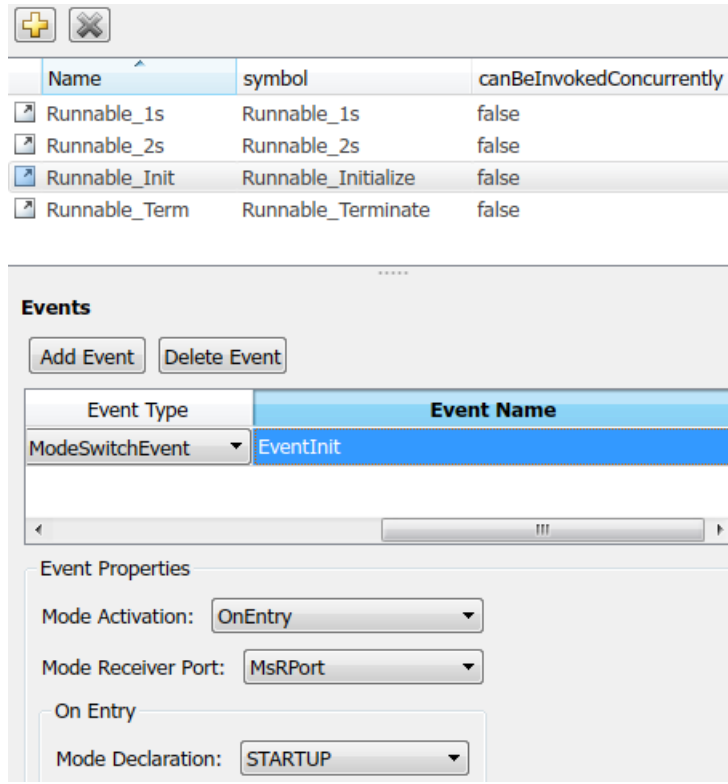
The runnable **symbol** value shown in the runnables view becomes the runnable function name. The runnable **Name** value is used in the names of RTE access methods generated for the runnable.



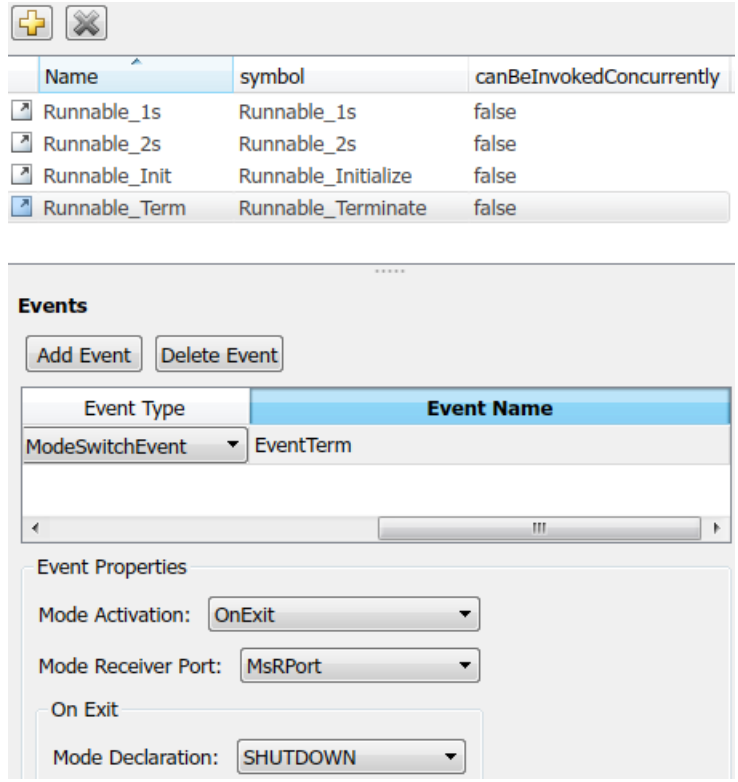
8 For both the initialize and terminate runnables, configure an AUTOSAR event that activates the runnable.

This example defines a `ModeSwitchEvent` for each runnable. Using a `ModeSwitchEvent` requires creating a model declaration group, a mode-switch (M-S) interface, and a mode receiver port for the model. For more information, see “Configure AUTOSAR Mode-Switch Communication” on page 4-172.

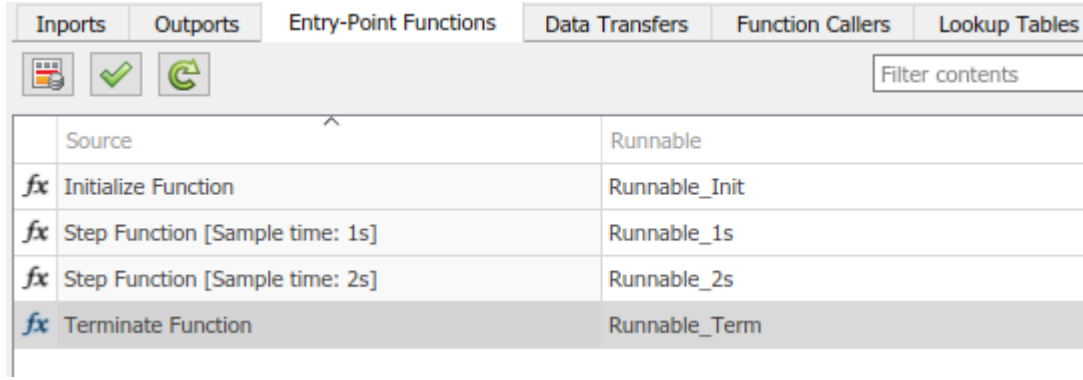
In the runnables view, click the initialize runnable name to display and modify its associated event properties. Add and configure an event.



In the runnables view, click the terminate runnable name to display and modify its associated event properties. Add and configure an event.



9 Open Code Mapping Editor and select the **Entry-Point Functions** tab. Select the Simulink initialize and terminate functions and map them to the AUTOSAR initialize and terminate runnables that you configured.



10 Build the model and examine the generated code.

- The exported `arxml` code contains an AUTOSAR runnable for each initialize, reset, or terminate subsystem in the model, with the specified AUTOSAR runnable name and symbol. The runnable description includes each AUTOSAR data access point and server call point associated with the runnable.
- The generated C code contains RTE access methods for parameters, states, function callers, and external I/O associated with the runnable.

See Also

Event Listener | Initialize Function | State Reader | State Writer | Terminate Function

Related Examples

- “Customize Initialize, Reset, and Terminate Functions” (Simulink)
- “Generate Code That Responds to Initialize, Reset, and Terminate Events” (Simulink Coder)
- “Create Test Harness to Generate Function Calls” (Simulink)
- “Configure AUTOSAR Mode-Switch Communication” on page 4-172

More About

- “Startup, Reset, and Shutdown” on page 2-11
- “Configure Code Generation for Model Entry-Point Functions” (Simulink Coder)

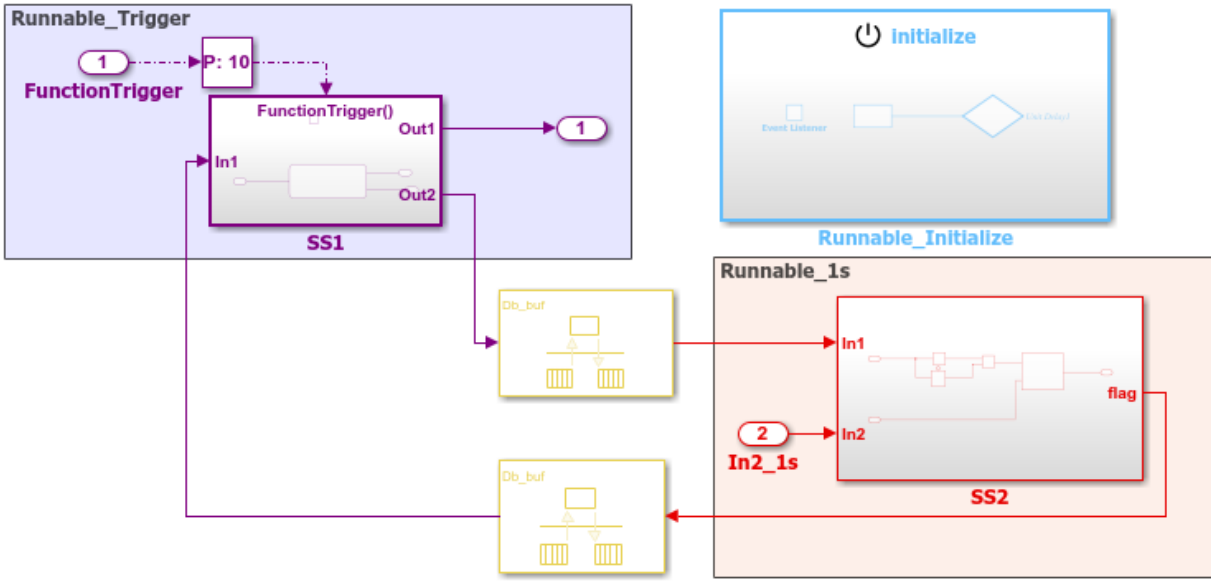
- “AUTOSAR Component Configuration” on page 4-3

Add Top-Level Asynchronous Trigger to Periodic Rate-Based System

In Simulink, you can model an AUTOSAR software component in which an asynchronous function-call runnable interacts with periodic rate-based runnables. This type of component uses both periodic and asynchronous rates (sample times).

The approach can be used to model the JMAAB complex control model type beta (β) architecture. This architecture is described in the Japan MBD Automotive Advisory Board (JMAAB) document *Control Algorithm Modeling Guidelines Using MATLAB, Simulink, and Stateflow - Version 4.01*. The document is available from the MAAB web page at `https://www.mathworks.com/solutions/automotive/standards/maab.html`.

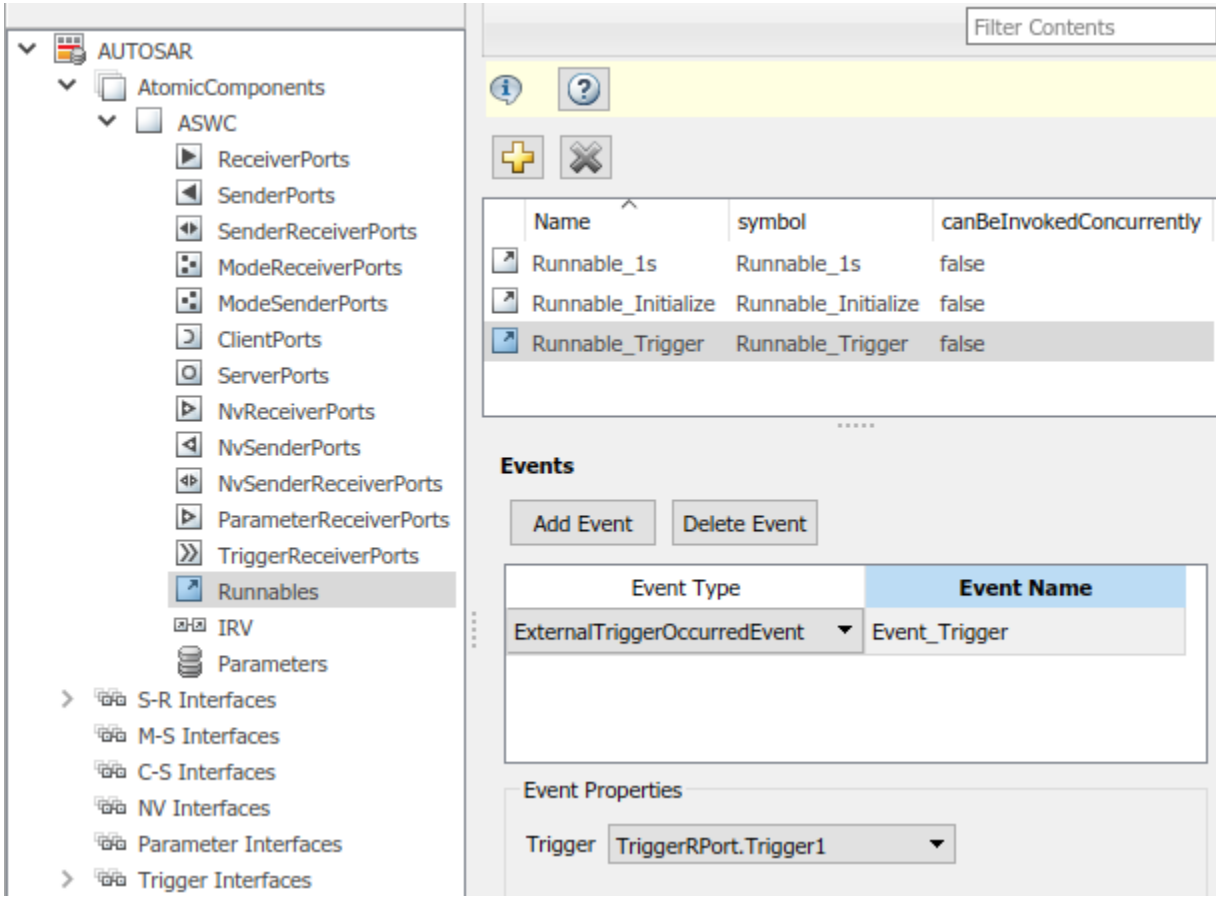
In JMAAB type beta modeling, at the top level of a control model, you place function layers above scheduling layers. For example, here is an AUTOSAR example model, `rtwdemo_autosar_swc_fcncalls`. In this model, an asynchronous function-call runnable at the top level of the model interacts with a periodic rate-based runnable.



Some guidelines apply to AUTOSAR modeling of the JMAAB type beta controller layout:

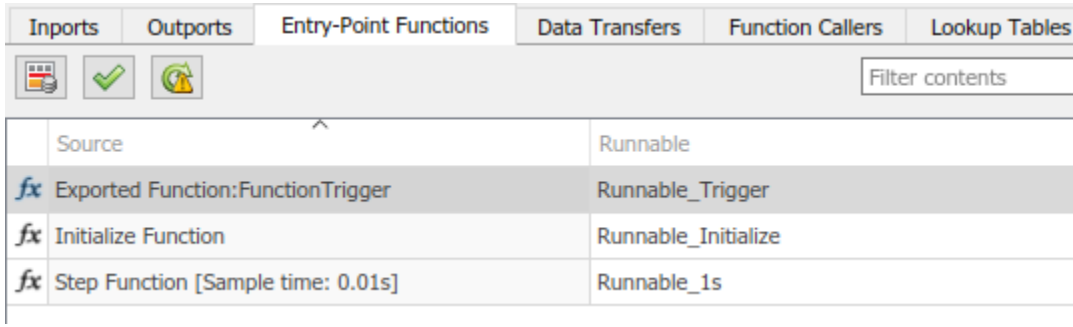
- IRVs must be modeled with Rate Transition blocks.
- Function-call subsystems must have asynchronous rates. (In the function-call subsystem Trigger block, **Sample time type** must be triggered, not periodic.)
- For each asynchronous function-call subsystem, you must insert an Asynchronous Task Specification task block between the function-call root inport and the subsystem.

Here is the AUTOSAR Dictionary view of the runnables. An event triggers the asynchronous function-call runnable. The event must be of type `DataReceivedEvent`, `DataReceiveErrorEvent`, `ModeSwitchEvent`, `InitEvent`, or `ExternalTriggerOccurredEvent`.



In this example, an `ExternalTriggerOccurredEvent` activates the AUTOSAR runnable. A trigger interface delivers the event to a trigger receiver port. For more information about `ExternalTriggerOccurredEvent`s, see “Configure Receiver for AUTOSAR External Trigger Event Communication” on page 4-187.

Here is the Code Mapping Editor view of the Simulink entry-point functions. The functions are mapped to AUTOSAR function-trigger, initialization, and periodic runnables, respectively.



See Also

Asynchronous Task Specification | Rate Transition

Related Examples

- “Configure Receiver for AUTOSAR External Trigger Event Communication” on page 4-187
- “Modeling Patterns for AUTOSAR Runnables”
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Model AUTOSAR Software Components” on page 2-3
- “AUTOSAR Component Configuration” on page 4-3

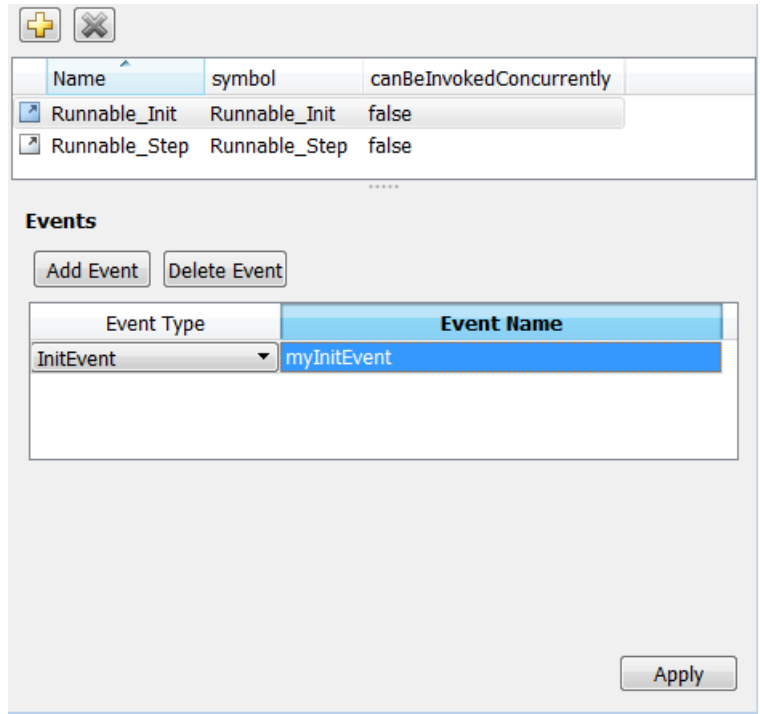
Configure AUTOSAR Initialization Runnable (R4.1)

AUTOSAR Release 4.1 introduced the AUTOSAR initialization event (`InitEvent`). You can use an `InitEvent` to designate an AUTOSAR runnable as an initialization runnable, and then map an initialization function to the runnable. Using an `InitEvent` to initialize a software component is a potentially simpler and more efficient than using AUTOSAR mode management, in which you define a `ModeDeclarationGroup` with a mode for setting up and initializing a software component. (For more information on the mode management approach, see “Configure AUTOSAR Mode-Switch Communication” on page 4-172.)

If you import `arxml` code that describes a runnable with an `InitEvent`, the `arxml` importer configures the runnable in Simulink as an initialization runnable.

Alternatively, you can configure a runnable to be the initialization runnable in Simulink. For example,

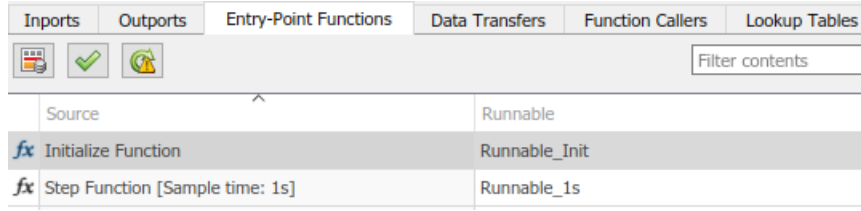
1. Open a model configured for AUTOSAR.
2. Open the Configuration Parameters dialog box, go to **Code Generation** > **AUTOSAR Code Generation Options**, and verify that the selected AUTOSAR schema version is `4.1` or higher.
3. Open AUTOSAR Dictionary. Navigate to a software component, and select the **Runnables** view.
4. Select a runnable to configure as an initialization runnable, and click **Add Event**. From the **Event Type** drop-down list, select `InitEvent`, and specify the **Event Name**. In this example, initialization event `myInitEvent` is configured for runnable `Runnable_Init`.



You can configure at most one `InitEvent` for a runnable.

5 Open Code Mapping Editor and select the **Entry-Point Functions** tab.

6 To map an initialization function to the initialization runnable, select the function. From the **Runnable** drop-down list, select the runnable for which you configured an `InitEvent`. In this example, Simulink entry-point function `Initialize Function` is mapped to AUTOSAR runnable `Runnable_Init`.



When you export `arxml` code from a model containing an initialization runnable, the `arxml` exporter generates an `InitEvent` that is mapped to the initialization runnable and function. For example:

```
<EVENTS>
    <INIT-EVENT UUID="...">
        <SHORT-NAME>myInitEvent</SHORT-NAME>
        <START-ON-EVENT-REF DEST="RUNNABLE-ENTITY">/.../Runnable_Init</START-ON-EVENT-REF>
    </INIT-EVENT>
</EVENTS>
```

Configure Disabled Mode for AUTOSAR Runnable Event

AUTOSAR Release 4.0 introduced the ability to set the `DisabledMode` property of a runnable event to potentially prevent a runnable from running in certain modes.

Given a model containing a mode receiver port and defined mode values, you can programmatically get and set the `DisabledMode` property of a `TimingEvent`, `DataReceivedEvent`, `ModeSwitchEvent`, `OperationInvokedEvent`, `DataReceiveErrorEvent`, or `ExternalTriggerOccurredEvent`. The property is not supported for an `InitEvent`.

The value of the `DisabledMode` property is either `''` (no disabled modes) or one or more mode values of the form `'`*`mrPortName`*`.`*`modeName`*`'`. To set the `DisabledMode` property of a runnable event in your model, use the AUTOSAR property function `set`.

The following example sets the `DisabledMode` property for a timing event named `Event_t_1tic_B`. The `set` function call potentially disables the event for modes `STARTUP` and `SHUTDOWN`, which are defined on mode-receiver port `myMRPort`.

```
addpath (fullfile(matlabroot,'/help/toolbox/ecoder/examples/autosar'));
hModel = 'mAutosarMsConfigAfter';
open_system(hModel)
arProps = autosar.api.getAUTOSARProperties(hModel);
eventPaths = find(arProps,[],'TimingEvent')

eventPaths =
    {'ASWC/Behavior/Event_t_1tic_B'}    {'ASWC/Behavior/Event_t_10tic'}

dsblModes = get(arProps,eventPaths{1},'DisabledMode')

dsblModes =
  1×0 empty cell array

set(arProps,eventPaths{1},'DisabledMode',{'myMRPort.STARTUP','myMRPort.SHUTDOWN'});
dsblModes = get(arProps,eventPaths{1},'DisabledMode')

dsblModes =
    {'myMRPort.STARTUP'}    {'myMRPort.SHUTDOWN'}
```

When you export `arxml` files for the model, the timing event description for `Event_t_1tic_B` includes a `DISABLED-MODE-IREFS` section that references the mode-receiver port, the mode declaration group, and each disabled mode.

The software preserves the `DisabledMode` property of a runnable event across round trips between an AUTOSAR authoring tool (AAT) and Simulink.

Configure AUTOSAR Per-Instance Memory

You can model AUTOSAR per-instance memory (PIM) for AUTOSAR applications. To model AUTOSAR per-instance memory, import per-instance memory definitions from `arxml` files or create per-instance memory content in Simulink. For information about the high-level PIM workflow, see “Per-Instance Memory” on page 2-33.

To model AUTOSAR PIM, you can use block signals, discrete states, or data stores in your model.

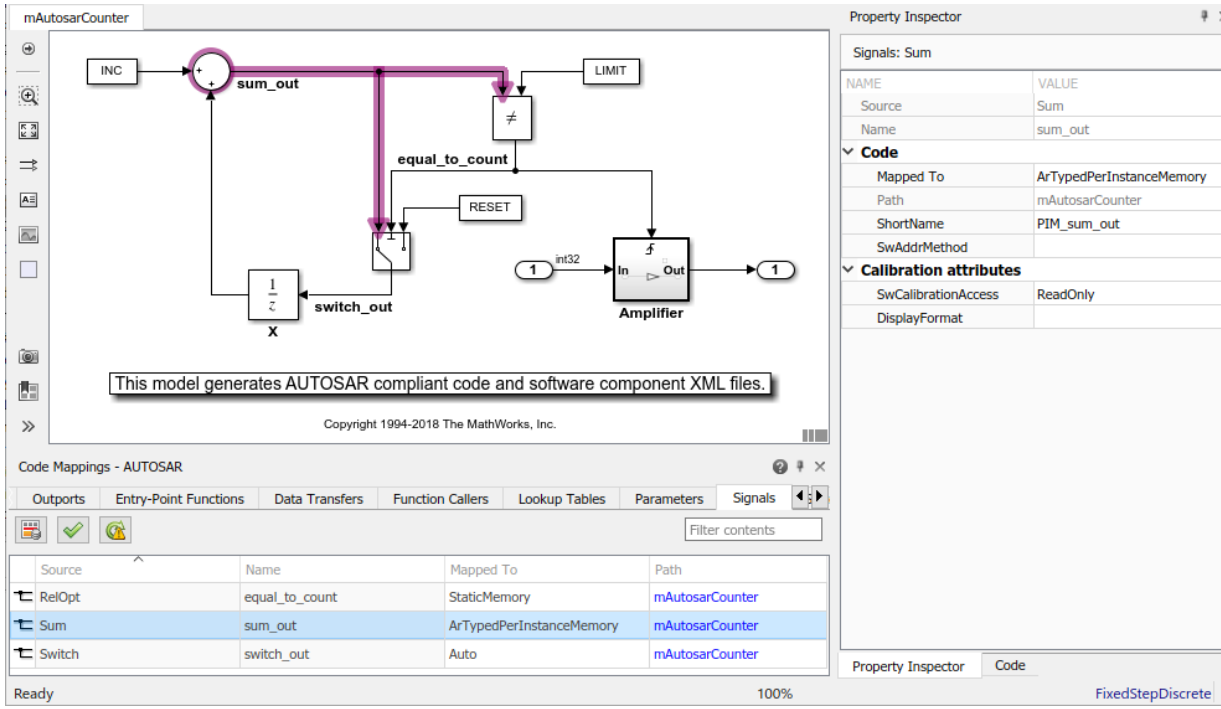
In this section...

Configure Block Signals and States as AUTOSAR Typed Per-Instance Memory

AUTOSAR typed per-instance memory (`ArTypedPerInstanceMemory`), introduced in AUTOSAR schema version 4.0, defines an AUTOSAR typed memory block that is available for each instance of an AUTOSAR software component. In the AUTOSAR Runtime Environment (RTE), calibration tools can access `arTypedPerInstanceMemory` blocks for measurement and calibration.

To generate `arTypedPerInstanceMemory` blocks for block signal and discrete state data in your AUTOSAR model, open Code Mapping Editor. Use the **Signals** and **States** tabs to map signals and states to `arTypedPerInstanceMemory`. For example:

1. Open an AUTOSAR model that contains signals or states for which you want to generate `arTypedPerInstanceMemory` blocks. This example uses model `mAutosarCounter.slx` from *`matlabroot`*`/help/toolbox/ecoder/examples/autosar`.
2. In AUTOSAR Perspective, open Code Mapping Editor and select the **Signals** tab. In the list of available signals, select `sum_out`. Selecting a signal highlights the signal in the model diagram and displays the signal attributes in Property Inspector. Use Property Inspector to modify the signal attributes. In the **Mapped To** drop-down list, select `ArTypedPerInstanceMemory`. For more information about signal code and calibration attributes, see “Map Block Signals and States to AUTOSAR Variables” on page 4-80.



3 Select the **States** tab and select state X. Use Property Inspector to modify the state attributes. In the **Mapped To** drop-down list, select `ArTypedPerInstanceMemory`.

When you generate code:

- Exported `arxml` files contain `AR-TYPED-PER-INSTANCE-MEMORYS` descriptions for signals and states that you configured as `ArTypedPerInstanceMemory`.
- Generated C code contains `Rte_Pim_*` API calls for signal and state variables.

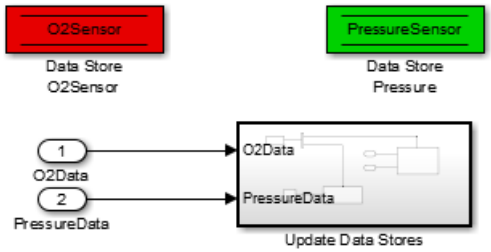
For referenced models within an AUTOSAR component model, Embedded Coder automatically maps internal signal and states for model reference code generation. Internal signals and states automatically map to AUTOSAR `ArTypedPerInstanceMemory` for multi-instance model reference, or AUTOSAR `StaticMemory` for single-instance model reference.

Configure Data Stores as AUTOSAR Per-Instance Memory

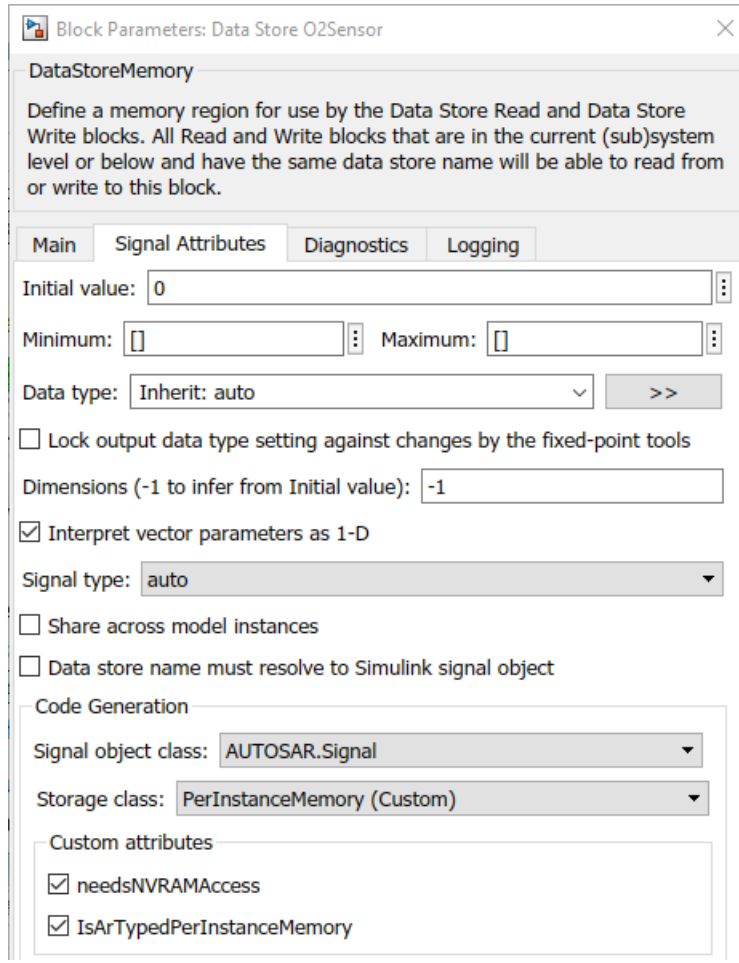
To generate `arTypedPerInstanceMemory` blocks for data stores in your AUTOSAR model, you configure data stores to use `PerInstanceMemory` storage class. Open a Data Store Memory block properties dialog box and use dialog box tabs to select the storage class. (Alternatively, if you want to configure data store calibration properties such as **SwCalibrationAccess** and **DisplayFormat**, create an `AUTOSAR.Signal` object in the base workspace or data dictionary.)

To configure data stores as `arTypedPerInstanceMemory`:

1. Create a Data Store Memory block in a model. This example uses AUTOSAR model *`matlabroot`*`/help/toolbox/ecoder/examples/autosar/mAutosarPIM.slx`, which contains Data Store Memory blocks `O2Sensor` and `PressureSensor`.



2. Select a Data Store Memory block and open the block properties dialog box. In the Main tab, use the **Data store name** field to name the data store. In the Signal Attributes tab, set **Signal object class** to `AUTOSAR.Signal` and set **Storage class** to `PerInstanceMemory`.
3. Selecting `PerInstanceMemory` storage class enables custom attributes **needsNVRAMAccess** and **IsArTypedPerInstanceMemory**.



- **needsNVRAMAccess** — Select to configure this per-instance memory to be a mirror block for a specific NVRAM block.
- **IsArTypedPerInstanceMemory** — Select for AUTOSAR-typed per-instance memory (`arTypedPerInstanceMemory`); clear for C-typed per-instance memory. `arTypedPerInstanceMemory` requires AUTOSAR schema version 4.0 or later

4 Optionally, you can specify an **Initial value** for the global variable corresponding to per-instance memory.

5 Apply the changes.

When you build your model, the XML files that are generated define an exclusive area for each Data Store Memory block that references per-instance memory. Every runnable that accesses per-instance memory runs inside the corresponding exclusive area. If multiple AUTOSAR runnables have access to the same Data Store Memory block, the exported AUTOSAR specification enforces data consistency by using an AUTOSAR exclusive area. With this specification, the runnables have mutually exclusive access to the per-instance memory global data, which prevents data corruption.

Note The software does not support per-instance memory code generation for data stores in referenced models.

If you select **needsNVRAMAccess**, a `SERVICE-NEEDS` entry (schema version 3.0 or later) or `NVRAM-MAPPINGS` entry (schema version 2.1) is declared in XML files. The entry indicates that the per-instance memory is a RAM mirror block and requires service from the `NvM` manager module.

See Also

Data Store Memory | `getSignal` | `getState` | `mapSignal` | `mapState`

Related Examples

- “Map Block Signals and States to AUTOSAR Variables” on page 4-80
- “Model AUTOSAR Component Behavior” on page 2-30

More About

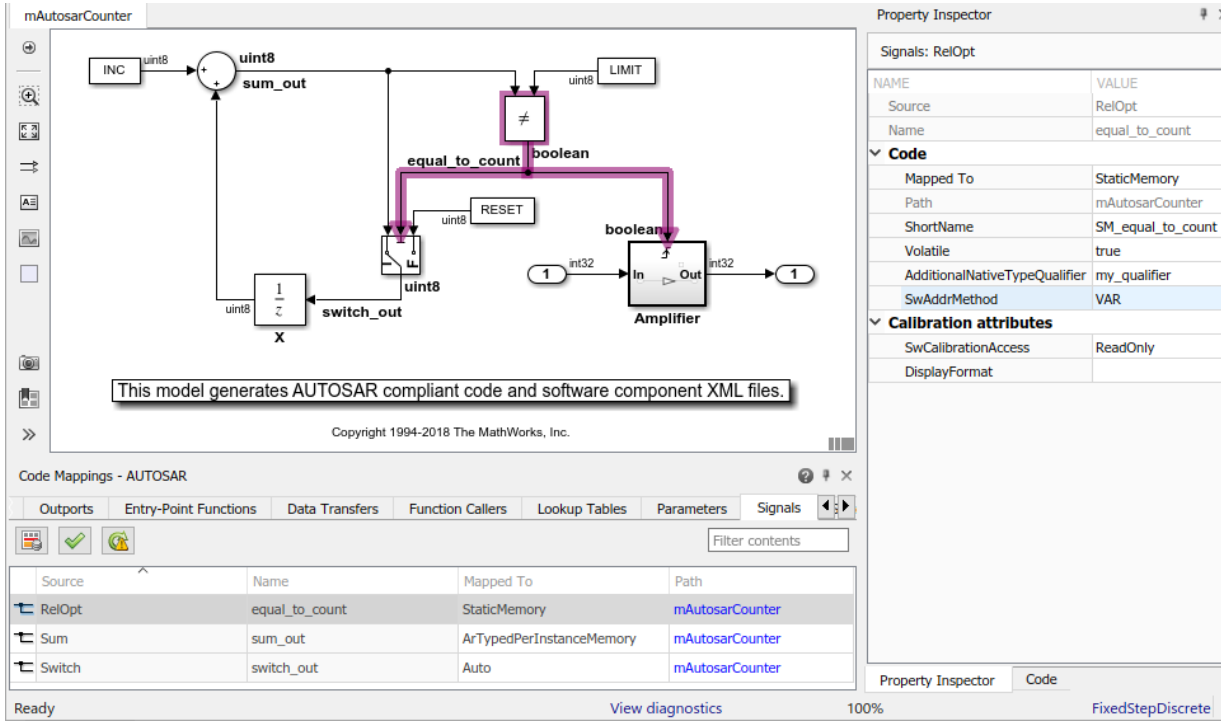
- “Per-Instance Memory” on page 2-33

Configure AUTOSAR Static Memory

AUTOSAR static memory (`StaticMemory`), introduced in AUTOSAR schema version 4.0, corresponds to Simulink internal global signals. In the AUTOSAR Runtime Environment (RTE), calibration tools can access `StaticMemory` blocks for measurement and calibration.

To generate `StaticMemory` blocks for block signal and discrete state data in your AUTOSAR model, open Code Mapping Editor. Use the **Signals** and **States** tabs to map signals and states to `StaticMemory`. For example:

1. Open an AUTOSAR model that contains signals or states for which you want to generate `StaticMemory` blocks. This example uses model `mAutosarCounter.slx` from *`matlabroot`*`/help/toolbox/ecoder/examples/autosar`.
2. In AUTOSAR Perspective, open Code Mapping Editor and select the **Signals** tab. In the list of available signals, select `equal_to_count`. Selecting a signal highlights the signal in the model diagram and displays the signal attributes in Property Inspector. Use Property Inspector to modify the signal attributes. In the **Mapped To** drop-down list, select `StaticMemory`. For more information about signal code and calibration attributes, see “Map Block Signals and States to AUTOSAR Variables” on page 4-80.



3 Select the **States** tab and select state X. Use Property Inspector to modify the state attributes. In the **Mapped To** drop-down list, select `StaticMemory`.

When you generate code:

- Exported `arxml` files contain `STATIC-MEMORYS` descriptions for signals and states that you configured as `StaticMemory`.
- Generated C code declares and references the static memory variables.

For referenced models within an AUTOSAR component model, Embedded Coder automatically maps internal signal and states for model reference code generation. Internal signals and states automatically map to AUTOSAR `ArTypedPerInstanceMemory` for multi-instance model reference, or AUTOSAR `StaticMemory` for single-instance model reference.

See Also

`getSignal` | `getState` | `mapSignal` | `mapState`

Related Examples

- “Map Block Signals and States to AUTOSAR Variables” on page 4-80
- “Model AUTOSAR Component Behavior” on page 2-30

More About

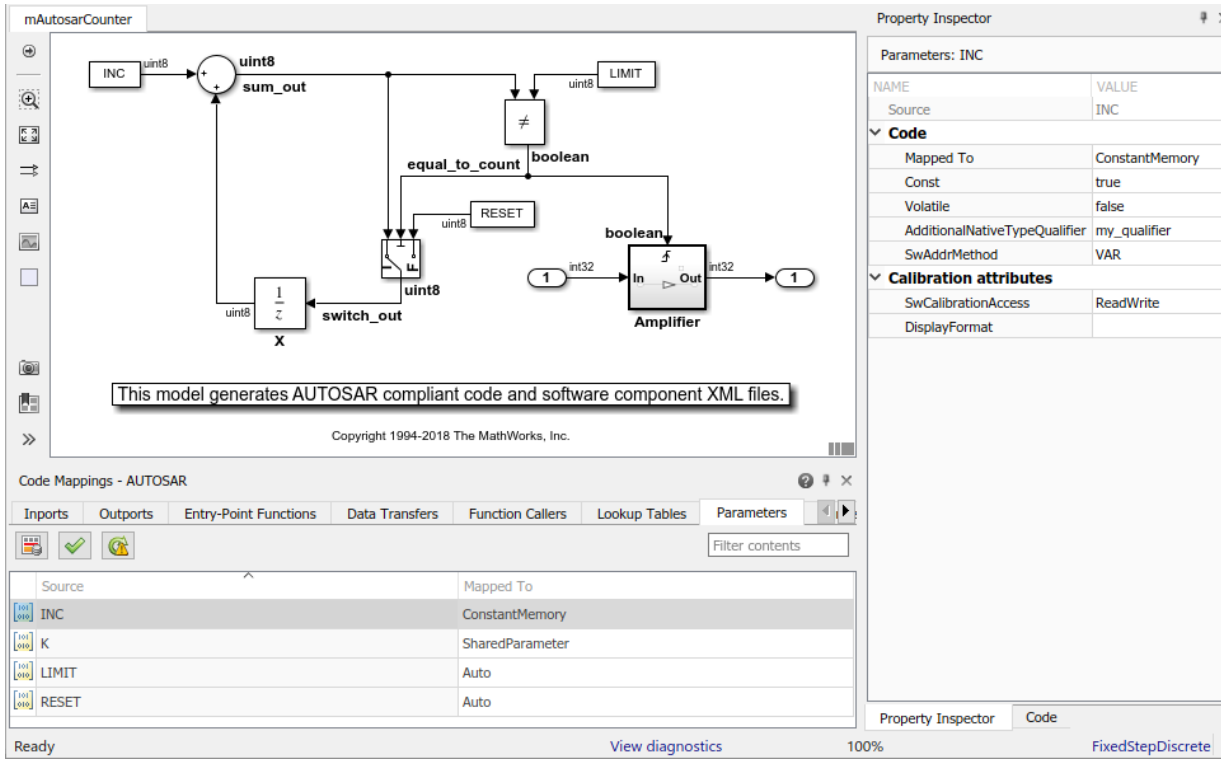
- “Static and Constant Memory” on page 2-34

Configure AUTOSAR Constant Memory

AUTOSAR constant memory (`ConstantMemory`), introduced in AUTOSAR schema version 4.0, corresponds to Simulink internal global parameters. In the AUTOSAR Runtime Environment (RTE), calibration tools can access `ConstantMemory` blocks for measurement and calibration.

To generate `ConstantMemory` blocks for model workspace parameter data in your AUTOSAR model, open Code Mapping Editor. Use the **Parameters** tab to map parameters to `ConstantMemory`. For example:

1. Open an AUTOSAR model that contains model workspace parameters for which you want to generate `ConstantMemory` blocks. This example uses model `mAutosarCounter.slx` from *`matlabroot`*`/help/toolbox/ecoder/examples/autosar`.
2. In AUTOSAR Perspective, open Code Mapping Editor and select the **Parameters** tab. In the list of available parameters, select `INC`. Selecting a parameter displays the parameter attributes in Property Inspector. Use Property Inspector to modify the parameter attributes. In the **Mapped To** drop-down list, select `ConstantMemory`. For more information about parameter code and calibration attributes, see “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77.



When you generate code:

- Exported `arxml` files contain `CONSTANT-MEMORYS` descriptions for parameters that you configured as `ConstantMemory`.
- Generated C code declares and references the constant memory parameters.

See Also

`getParameter` | `mapParameter`

Related Examples

- “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77

- “Model AUTOSAR Component Behavior” on page 2-30

More About

- “Static and Constant Memory” on page 2-34

Configure AUTOSAR Release 4.x Data Types

AUTOSAR Release 4.0 introduced a new approach to AUTOSAR data types, in which base data types are mapped to implementation data types and application data types. Application and implementation data types separate application-level physical attributes, such as real-world range of values, data structure, and physical semantics, from implementation-level attributes, such as stored-integer minimum and maximum and specification of a primitive-type (integer, Boolean, real, and so on). For information about modeling R4.x data types, see “Release 4.x Data Types” on page 2-39.

The software supports AUTOSAR R4.x data types in Simulink originated and round-trip workflows:

- For AUTOSAR components originated in Simulink, the software generates AUTOSAR application, implementation, and base types to preserve the information contained within Simulink data types.
- For round-trip workflows involving AUTOSAR components originated outside MATLAB, the `arxml` importer and exporter preserve data type information and mapping for each imported AUTOSAR data type.

For AUTOSAR R4.x data types originated in Simulink, you can control some aspects of data type export. For example, you can control when application data types are generated, or specify the AUTOSAR package and short name exported for AUTOSAR data type mapping sets.

In this section...

Control Application Data Type Generation

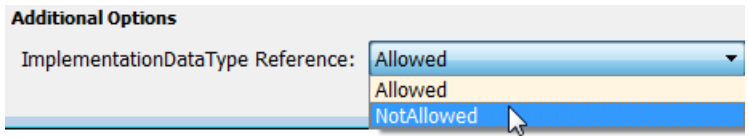
For AUTOSAR data types created in Simulink, by default, the software generates application base types only for fixed-point data types and enumerated date types with storage types. If you want to override the default behavior for generating application types, you can configure the `arxml` exporter to generate an application type, along with the implementation type and base type, for each exported AUTOSAR data type. Use the XML options parameter **ImplementationDataType Reference** (`XMLOptions` property `ImplementationDataTypeReference`), for which you can specify the following values:

- `Allowed` (default) — Allow direct reference of implementation types in the generated `arxml` code. If an application data type is not strictly required to describe an AUTOSAR data type, use an implementation data type reference.
- `NotAllowed` — Do not allow direct reference of implementation data types in the generated `arxml` code. Generate an application data type for each AUTOSAR data type.

To set the `ImplementationDataTypeReference` property in the MATLAB Command Window, use an AUTOSAR property `set` function call similar to the following:

```
open_system('rtwdemo_autosar_multirunnables');
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
set(arProps,'XmlOptions','ImplementationTypeReference','NotAllowed');
get(arProps,'XmlOptions','ImplementationTypeReference')
```

To set the `ImplementationDataTypeReference` property in AUTOSAR Dictionary, select **XML Options**. Select a value for parameter **ImplementationDataType Reference**. Click **Apply**.



Configure DataTypeMappingSet Package and Name

For AUTOSAR software components created in Simulink, you can control the AUTOSAR package and short name exported for AUTOSAR data type mapping sets. To configure the data type mapping set package for export, set the `XMLOptions` property `DataTypeMappingPackage` using AUTOSAR Dictionary or the AUTOSAR property `set` function.


```
open_system('rtwdemo_autosar_multirunnables');
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
set(arProps,'XmlOptions','DataTypeMappingPackage','/pkg/dt/DataTypeMappings');
get(arProps,'XmlOptions','DataTypeMappingPackage')
```

The exported `arxml` code uses the specified package. The default mapping set short-name is the component name `ASWC` prefixed to `DataTypeMappingsSet`.

```
<DATA-TYPE-MAPPING-REFS>
    <DATA-TYPE-MAPPING-REF DEST="DATA-TYPE-MAPPING-SET">
      /pkg/dt/DataTypeMappings/ASWCDataTypeMappingsSet</DATA-TYPE-MAPPING-REF>
</DATA-TYPE-MAPPING-REFS>
...
<AR-PACKAGE UUID="...">
    <SHORT-NAME>DataTypeMappings</SHORT-NAME>
    <ELEMENTS>
        <DATA-TYPE-MAPPING-SET UUID="...">
            <SHORT-NAME>ASWCDataTypeMappingsSet</SHORT-NAME>
...
        </DATA-TYPE-MAPPING-SET>
    </ELEMENTS>
</AR-PACKAGE>
```

You can specify a short name for a data type mapping set using the AUTOSAR property function `addPackageableElement`. The following example specifies a custom data type mapping set package and name using MATLAB commands.

```
% Add a new data type mapping set
modelName = 'rtwdemo_autosar_multirunnables';
open_system(modelName);
propObj = autosar.api.getAUTOSARProperties(modelName);
newMappingSetPath = '/myPkg/mySubpkg/MyMappingSets';
newMappingSetName = 'MappingSetName';
newMappingSet = [newMappingSetPath '/' newMappingSetName];
addPackageableElement(propObj,'DataTypeMappingSet',newMappingSetPath,newMappingSetName);

% Configure the component behavior to use the new data type mapping set
swc = get(propObj,'XmlOptions','ComponentQualifiedName');
ib = get(propObj,swc,'Behavior','PathType','FullyQualified');
set(propObj,ib,'DataTypeMapping',newMappingSet);

% Force generation of application data types
set(propObj,'XmlOptions','ImplementationTypeReference','NotAllowed');

% Build
rtwbuild(modelName);
```

The exported `arxml` code uses the specified package and name, as shown below.

```
<INTERNAL-BEHAVIORS>
    <SWC-INTERNAL-BEHAVIOR UUID="...">
        <SHORT-NAME>IB</SHORT-NAME>
        <DATA-TYPE-MAPPING-REFS>
            <DATA-TYPE-MAPPING-REF DEST="DATA-TYPE-MAPPING-SET">
              /myPkg/mySubpkg/MyMappingSets/MappingSetName</DATA-TYPE-MAPPING-REF>
        </DATA-TYPE-MAPPING-REFS>
...
    </SWC-INTERNAL-BEHAVIOR>
</INTERNAL-BEHAVIORS>
```

Initialize Data with ApplicationValueSpecification

To initialize AUTOSAR data objects typed by application data type, R4.1 requires AUTOSAR application value specifications (`ApplicationValueSpecification`s). Embedded Coder provides the following support:

- The `arxml` importer uses `ApplicationValueSpecification`s found in imported `arxml` files to initialize the corresponding data objects in the Simulink model.
- If you select AUTOSAR schema 4.0 or later for a model that contains AUTOSAR parameters typed by application data type, code generation exports `arxml` code that uses `ApplicationValueSpecification`s to specify initial values for AUTOSAR data.

For AUTOSAR parameters typed by implementation data type, code generation exports `arxml` code that uses `NumericalValueSpecification`s and (for enumerated types) `TextValueSpecification`s to specify initial values. If initial values for parameters specify multiple values, generated code uses `ArrayValueSpecification`s.

Automatic AUTOSAR Data Type Generation

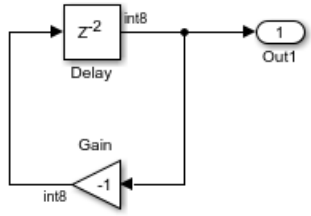
When you generate AUTOSAR-compliant C code for an AUTOSAR component model, Embedded Coder generates AUTOSAR platform data types in the code. AUTOSAR type generation allows you to generate AUTOSAR platform data types for top models, referenced models, and shared utilities without configuring Simulink data type replacement.

The AUTOSAR standard defines platform data types for use by AUTOSAR software components. In Simulink, you can model AUTOSAR data types used in elements such as data elements, operation arguments, calibration parameters, measurement variables, and inter-runnable variables. To model AUTOSAR data types, use corresponding Simulink built-in data types. For more information, see “Model AUTOSAR Data Types” on page 2-36.

When you build your AUTOSAR model, C code generation replaces Simulink data types with corresponding AUTOSAR data types, based on your AUTOSAR schema version.

Simulink Data Type	AUTOSAR Data Type	
	R4.x Platform Type	R2.x/3.x Primitive Type
`boolean`	`boolean`	`Boolean`
`single`	`float32`	`Float`
`double`	`float64`	`Double`
`int8`	`sint8`	`Sint8`
`int16`	`sint16`	`Sint16`
`int32`	`sint32`	`Sint32`
`uint8`	`uint8`	`Uint8`
`uint16`	`uint16`	`Uint16`
`uint32`	`uint32`	`Uint32`

For example, suppose that you create a simple AUTOSAR model containing Gain and Delay blocks, set the AUTOSAR schema version to 4.0 or higher, and set the Gain block parameter **Output data type** to `int8`. When you generate code, in place of Simulink data type `int8`, the AUTOSAR-compliant C code references AUTOSAR data type `sint8`.




```
void Runnable_Step(void)
{
  sint8 rtb_Delay;
  ...

  simple_DW.Delay_DSTATE[1] = (sint8)-rtb_Delay;
}
```

See Also

More About

- “Model AUTOSAR Data Types” on page 2-36

Configure AUTOSAR CompuMethods

AUTOSAR software components use computation methods (CompuMethods) to convert between the internal values and physical representation of AUTOSAR data. Common uses for CompuMethods are linear data scaling and measurement and calibration.

Embedded Coder imports AUTOSAR CompuMethods described in `arxml` code and preserves them across round-trips between an AUTOSAR authoring tool (AAT) and Simulink. In Simulink, you can modify imported CompuMethods or create and configure new CompuMethods.

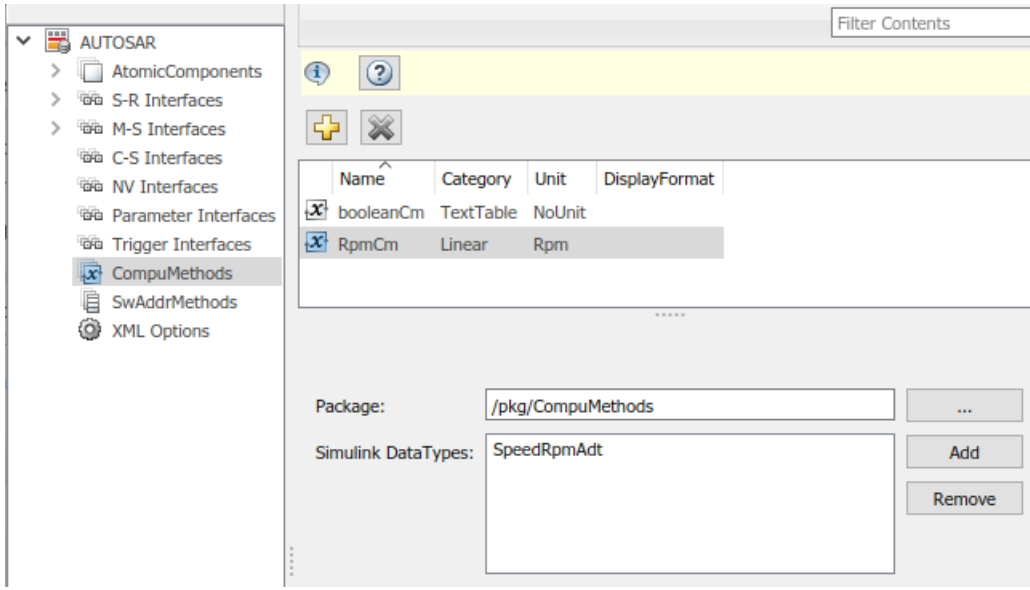
This topic provides examples of configuring AUTOSAR CompuMethods in Simulink.

In this section...
“Configure AUTOSAR CompuMethod Properties” on page 4-287
“Create AUTOSAR CompuMethods” on page 4-289
“Configure CompuMethod Direction for Linear Functions” on page 4-290
“Export CompuMethod Unit References” on page 4-292
“Modify Linear Scaling for SCALE_LINEAR_AND_TEXTTABLE CompuMethod” on page 4-292
“Configure Rational Function CompuMethod for Dual-Scaled Parameter” on page 4-294

Configure AUTOSAR CompuMethod Properties

You can configure AUTOSAR CompuMethod properties in your model, either graphically or programmatically. The CompuMethod properties you can modify include name, category, unit, display format, AUTOSAR package, and Simulink data types.

To configure a CompuMethod using the graphical interface, open AUTOSAR Dictionary and select the **CompuMethods** view. This view displays the modifiable CompuMethods in the model, whether imported from `arxml` code or created in Simulink.



Select a CompuMethod and edit the available fields.

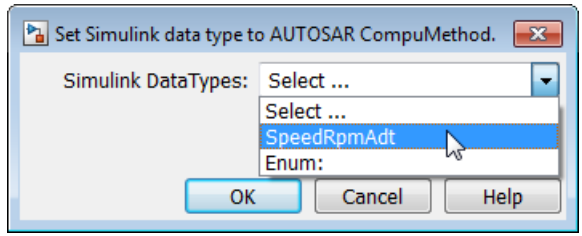
- **Name** — Specify name text
- **Category** — Select `Identical`, `Linear`, `RatFunc`, `TextTable`, or `LinearAndTextTable` (see “CompuMethod Categories for Data Types” on page 2-43)
- **Unit** — Select from units available in the model
- **DisplayFormat** — Optionally specify format to be used by measurement and calibration tools to display the data. Use an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of two characters and maximum precision of one digit. The string produces a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.
- **Package** — Specify path of AUTOSAR package to be generated for CompuMethods
- **Simulink DataTypes** — Specify list of Simulink data types that reference the CompuMethod

To modify the AUTOSAR package for a CompuMethod, you can do either of the following:

- Enter a package path in the **Package** parameter field.

- To open the AUTOSAR Package Browser, click the button to the right of the **Package** field. Use the browser to navigate to an existing package or create and select a package. When you select a package in the browser and click **Apply**, the CompuMethod **Package** parameter value is updated with your selection. For more information about the AUTOSAR Package Browser, see “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85.

To associate a CompuMethod with a Simulink data type used in the model, select a CompuMethod and click the **Add** button to the right of **Simulink DataTypes**. This action opens a dialog box with a list of available data types. In the list of values, select a `Simulink.NumericType` or `Simulink.AliasType`, or enter the name of a Simulink enumerated type. To add the type to the **Simulink DataTypes** list, click **OK**.

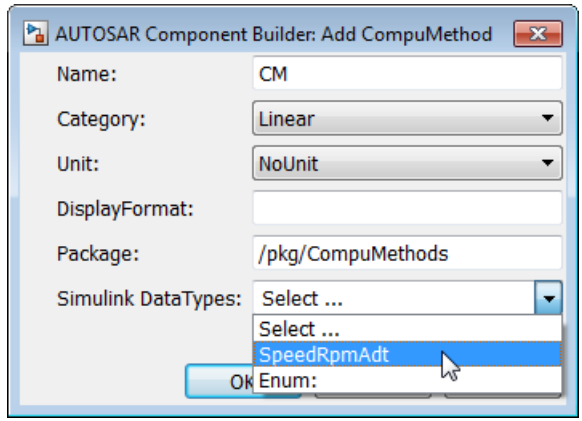


To set the **Simulink DataTypes** property programmatically, open the model and use an AUTOSAR property `set` function call similar to the following:

```
arProps=autosar.api.getAUTOSARProperties('cmSpeed');
set(arProps,'/pkg/CompuMethods/RpmCm','SlDataTypes',{'SpeedRpmAdt'})
sltypes=get(arProps,'/pkg/CompuMethods/RpmCm', 'SlDataTypes')

sltypes =
    'SpeedRpmAdt'
```

Create AUTOSAR CompuMethods

You can create AUTOSAR CompuMethods in your model, either graphically or programmatically. To create an AUTOSAR CompuMethod using the graphical interface, open AUTOSAR Dictionary and select the **CompuMethods** view. To open the Add CompuMethod dialog box, click the **Add** button  . Configure the initial properties for the CompuMethod, such as name, category, unit, display format for calibration, AUTOSAR package to generate, and associated Simulink data type. When you click **OK**, the CompuMethods view in AUTOSAR Dictionary is updated with the new CompuMethod.



When you generate code, the exported `arxml` code contains the CompuMethod definition and references to it.

Configure CompuMethod Direction for Linear Functions

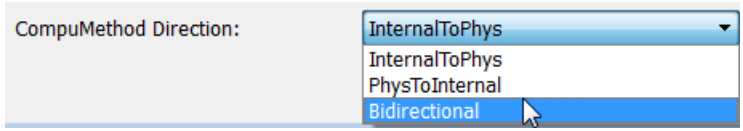
For designs originated in Simulink, you can control properties for an exported `CompuMethod`, including the direction of `CompuMethod` conversion between internal and physical representations of a value. Using either AUTOSAR Dictionary or the AUTOSAR property `set` function, you can specify one of the following `CompuMethod` direction values:

- `InternalToPhys` (default) — Generate `CompuMethod` sections for conversion of internal values into their physical representations.
- `PhysToInternal` — Generate `CompuMethod` sections for conversion of physical values into their internal representations.
- `Bidirectional` — Generate `CompuMethod` sections for both internal-to-physical and physical-to-internal conversion directions.

To specify `CompuMethod` direction in the MATLAB Command Window, use an AUTOSAR property `set` function call similar to the following:

```
open_system('rtwdemo_autosar_multirunnables');
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
set(arProps,'XmlOptions','CompuMethodDirection','Bidirectional');
get(arProps,'XmlOptions','CompuMethodDirection')
```

To specify `CompuMethod` direction in AUTOSAR Dictionary, select **XML Options**. Select a value for parameter **CompuMethod Direction**. Click **Apply**.



When you generate code for your model, the CompuMethods in the exported `arxml` code contain the requested directional sections. For example, here is a CompuMethod generated with the CompuMethod direction set to `Bidirectional`.

```
<COMPU-METHOD UUID="...">
    <SHORT-NAME>COMPU_EngSpdValue</SHORT-NAME>
    <CATEGORY>LINEAR</CATEGORY>
    <COMPU-INTERNAL-TO-PHYS>
    <COMPU-SCALES>
        <COMPU-SCALE>
        <SHORT-LABEL>intToPhys</SHORT-LABEL>
        <LOWER-LIMIT INTERVAL-TYPE="CLOSED">0</LOWER-LIMIT>
        <UPPER-LIMIT INTERVAL-TYPE="CLOSED">24000</UPPER-LIMIT>
        <COMPU-RATIONAL-COEFFS>
            <COMPU-NUMERATOR>
                <V>0</V>
                <V>1</V>
            </COMPU-NUMERATOR>
            <COMPU-DENOMINATOR>
                <V>8</V>
            </COMPU-DENOMINATOR>
        </COMPU-RATIONAL-COEFFS>
        </COMPU-SCALE>
    </COMPU-SCALES>
    </COMPU-INTERNAL-TO-PHYS>
    <COMPU-PHYS-TO-INTERNAL>
    <COMPU-SCALES>
        <COMPU-SCALE>
        <SHORT-LABEL>physToInt</SHORT-LABEL>
        <LOWER-LIMIT INTERVAL-TYPE="CLOSED">0</LOWER-LIMIT>
        <UPPER-LIMIT INTERVAL-TYPE="CLOSED">3000</UPPER-LIMIT>
        <COMPU-RATIONAL-COEFFS>
            <COMPU-NUMERATOR>
                <V>0</V>
                <V>8</V>
            </COMPU-NUMERATOR>
            <COMPU-DENOMINATOR>
                <V>1</V>
            </COMPU-DENOMINATOR>
        </COMPU-RATIONAL-COEFFS>
        </COMPU-SCALE>
    </COMPU-SCALES>
    </COMPU-PHYS-TO-INTERNAL>
</COMPU-METHOD>
```

Note CompuMethods of category TEXTTABLE, which are generated for Boolean or enumerated data types, use only `InternalToPhys`, regardless of the direction parameter setting.

Export CompuMethod Unit References

The `arxml` importer preserves unit and physical dimension information found in imported CompuMethods. The software preserves CompuMethod unit and physical dimension information across round-trips between an AUTOSAR authoring tool (AAT) and Simulink.

For designs originated in Simulink, the exporter generates a unit reference for each `CompuMethod`. By convention, each `CompuMethod` references a unit named `NoUnit`. For example, here is a Boolean data type `CompuMethod` and the unit it references.

```
<COMPU-METHOD UUID="...">
    <SHORT-NAME>COMPU_Boolean</SHORT-NAME>
    <CATEGORY>TEXTTABLE</CATEGORY>
    <UNIT-REF DEST="UNIT">/mymodel_pkg/mymodel_dt/NoUnit</UNIT-REF>
    ...
</COMPU-METHOD>
<UNIT UUID="...">
    <SHORT-NAME>NoUnit</SHORT-NAME>
    <FACTOR-SI-TO-UNIT>1</FACTOR-SI-TO-UNIT>
    <OFFSET-SI-TO-UNIT>0</OFFSET-SI-TO-UNIT>
</UNIT>
```

Providing a unit for each exported `CompuMethod` helps support measurement and calibration tool use of exported AUTOSAR data.

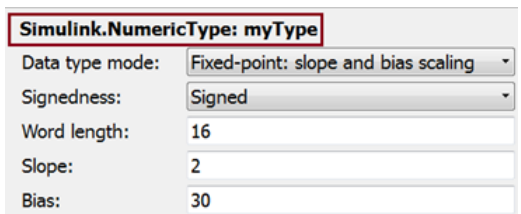
Modify Linear Scaling for SCALE_LINEAR_AND_TEXTTABLE CompuMethod

You can import and export an AUTOSAR CompuMethod that uses LINEAR and TEXTTABLE scaling. Importing application data types that reference CompuMethods of category SCALE_LINEAR_AND_TEXTTABLE creates `Simulink.NumericType` or `Simulink.AliasType` data objects in the Simulink workspace. In Simulink, you can modify the LINEAR scaling for the CompuMethods. The TEXTTABLE scaling is read-only.

For example, here is a CompuMethod with one LINEAR scale and two TEXTTABLE scales.

```
<COMPU-METHOD>
    <SHORT-NAME>COMPU_myType</SHORT-NAME>
    <CATEGORY>SCALE_LINEAR_AND_TEXTTABLE</CATEGORY>
    <COMPU-INTERNAL-TO-PHYS>
        <COMPU-SCALES>
            <COMPU-SCALE>
                <COMPU-RATIONAL-COEFFS>
                    <COMPU-NUMERATOR>
                        <V>30</V>
                        <V>2</V>
                    </COMPU-NUMERATOR>
                    <COMPU-DENOMINATOR>
                        <V>1</V>
                    </COMPU-DENOMINATOR>
                </COMPU-RATIONAL-COEFFS>
            </COMPU-SCALE>
            <COMPU-SCALE>
                <LOWER-LIMIT INTERVAL-TYPE="CLOSED">350</LOWER-LIMIT>
                <UPPER-LIMIT INTERVAL-TYPE="CLOSED">350</UPPER-LIMIT>
                <COMPU-CONST>
                    <VT>SensorError</VT>
                </COMPU-CONST>
            </COMPU-SCALE>
            <COMPU-SCALE>
                <LOWER-LIMIT INTERVAL-TYPE="CLOSED">351</LOWER-LIMIT>
                <UPPER-LIMIT INTERVAL-TYPE="CLOSED">351</UPPER-LIMIT>
                <COMPU-CONST>
                    <VT>SignalNotAvailable</VT>
                </COMPU-CONST>
            </COMPU-SCALE>
        </COMPU-SCALES>
    </COMPU-INTERNAL-TO-PHYS>
</COMPU-METHOD>
```

When you import the CompuMethod into a model, the importer creates a `Simulink.NumericType` with linear scaling. To modify the linear scaling, open the `Simulink.NumericType` data object and modify its fields.



For read-only access to the TEXTTABLE scaling information, use AUTOSAR property `get` function calls similar to the following:

```
>> arProps=autosar.api.getAUTOSARProperties('mySWC');
>> % Get literals for COMPU_myType TEXTTABLE scales
```

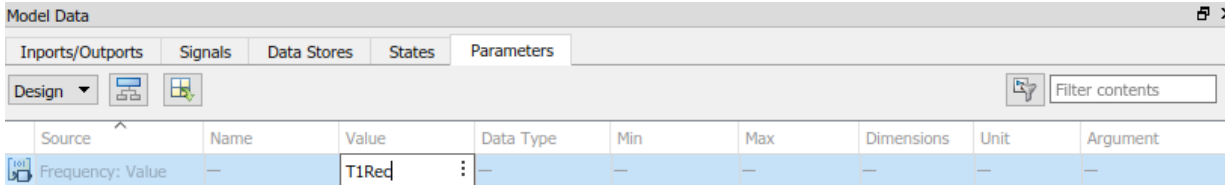
```
>> get(arProps,'/simple_ar_package/simple_ar_dt/COMPU_myType','CellOfEnums')
ans =
    'SensorError'    'SignalNotAvailable'
>> % Get internal values for COMPU_myType TEXTTABLE scales
>> get(arProps,'/simple_ar_package/simple_ar_dt/COMPU_myType','IntValues')
ans =
   350   351
```

Configure Rational Function CompuMethod for Dual-Scaled Parameter

For an AUTOSAR dual-scaled parameter, which stores two scaled values of the same physical value, the software generates the `CompuMethod` category `RAT_FUNC`. The computation method can be a first-order rational function.

To configure and generate a dual-scaled parameter:

1. Open an AUTOSAR model. For the purposes of this example, create a Constant block from which to reference an AUTOSAR dual-scaled parameter. In the model, connect the Constant block to a Simulink outport.
2. Open the Model Data Editor (**View > Model Data Editor**) and select the **Parameters** tab. Find the parameter entry for the Constant block. Use the **Value** column to reference the name of a dual-scaled parameter. This example uses the parameter name `T1Rec`.

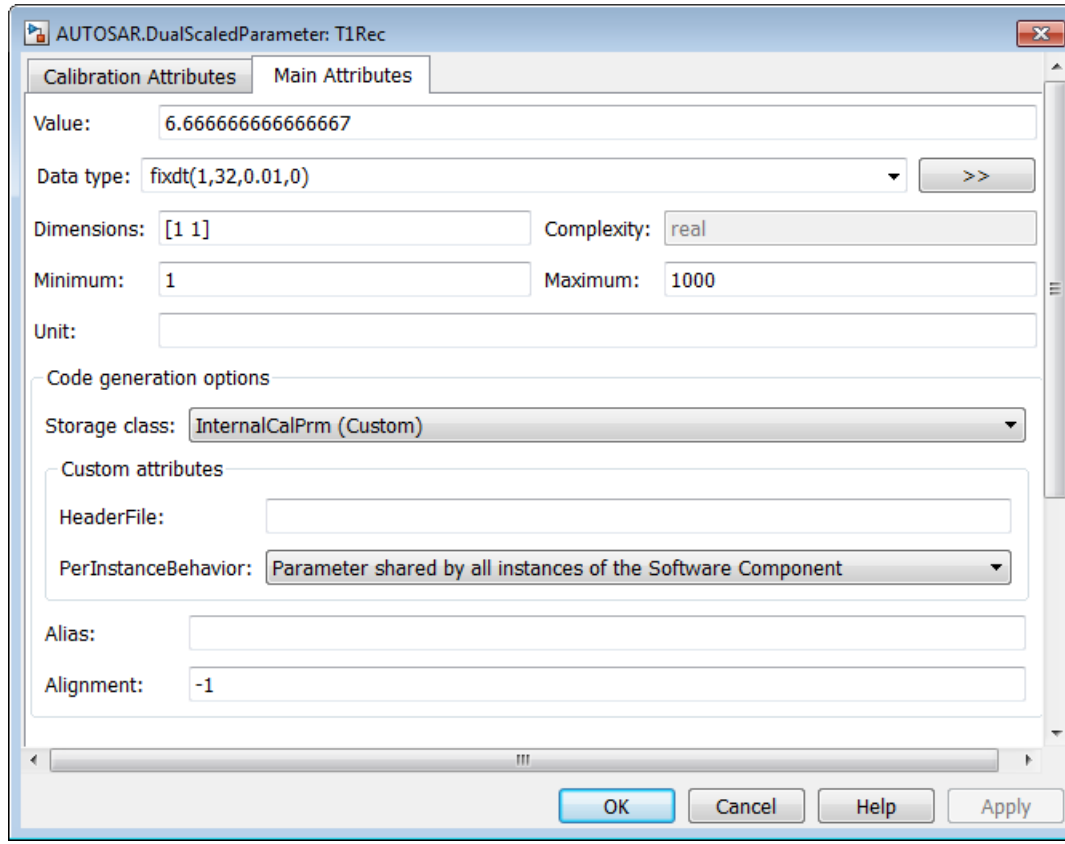


3. Create the `T1Rec` data object. In the Model Data Editor, to the right of the value `T1Rec`, click the action button ⋮ and select **Create**.

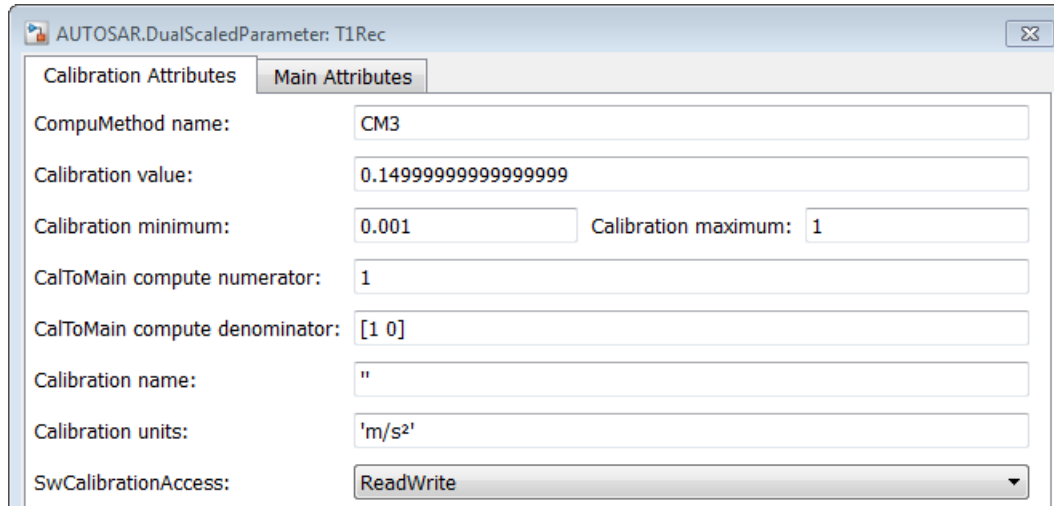
   In the Create New Data dialog box, set **Value** to `AUTOSAR.DualScaledParameter` and click **Create**. An `AUTOSAR.DualScaledParameter` data object appears in the base workspace. The dual-scaled parameter property dialog box opens.
4. Configure the attributes of the dual-scaled parameter `T1Rec`. Execute the following MATLAB code. The code sets up a conversion from an internal calibration time value to a physical frequency (time reciprocal) value.

```
% Conversion from Time to Frequency
% F = 1/T
% In Other Words F = (0*T + 1)/(1*T+0);
T1Rec.CompuMethodName = 'CM3';
T1Rec.DataType ='fixdt(1,32,0.01,0)';
T1Rec.CalToMainCompuNumerator=1;
T1Rec.CalToMainCompuDenominator=[1 0];
T1Rec.CalibrationMin = 0.001;
T1Rec.CalibrationMax = 1.0;
T1Rec.CalibrationValue = 0.1500;
T1Rec.CoderInfo.StorageClass = 'Custom';
T1Rec.CoderInfo.Alias = '';
T1Rec.CoderInfo.CustomStorageClass = 'InternalCalPrm';
T1Rec.CoderInfo.CustomAttributes.PerInstanceBehavior =...
  'Parameter shared by all instances of the Software Component';
T1Rec.Description = '';
% T1Rec.Min = [];
% T1Rec.Max = [];
T1Rec.Unit = '';
T1Rec.CalibrationDocUnits = 'm/s²';
```

5 Inspect the property dialog box for the dual-scaled parameter `T1Rec`. Here are the main attributes set by the MATLAB code.



6 Here are the calibration attributes set by the MATLAB code. The attributes include **CompuMethod name** (`T1Rec.CompuMethodName`), which allows you to specify the name of the AUTOSAR `CompuMethod` for this data type.



7 If `CompuMethod` direction is not already set to bidirectional in the AUTOSAR properties, use AUTOSAR Dictionary, **XML Options** view, to set it.

8 Generate code from the model.

When you generate code from the model, the `arxml` exporter generates a `CompuMethod` of category `RAT_FUNC`.

```
<COMPU-METHOD UUID="...">
    <SHORT-NAME>CM3</SHORT-NAME>
    <CATEGORY>RAT_FUNC</CATEGORY>
    <UNIT-REF DEST="UNIT">/mymodel_pkg/mymodel_dt/m_s_</UNIT-REF>
    <COMPU-INTERNAL-TO-PHYS>
        <COMPU-SCALES>
            <COMPU-SCALE>
                <COMPU-RATIONAL-COEFFS>
                    <COMPU-NUMERATOR>
                        <V>-100</V>
                    </COMPU-NUMERATOR>
                    <COMPU-DENOMINATOR>
                        <V>0</V>
                        <V>-1</V>
                    </COMPU-DENOMINATOR>
                </COMPU-RATIONAL-COEFFS>
            </COMPU-SCALE>
        </COMPU-SCALES>
    </COMPU-INTERNAL-TO-PHYS>
    <COMPU-PHYS-TO-INTERNAL>
        <COMPU-SCALES>
            <COMPU-SCALE>
                <COMPU-RATIONAL-COEFFS>
                    <COMPU-NUMERATOR>
```

```
                        <V>100</V>
                    </COMPU-NUMERATOR>
                    <COMPU-DENOMINATOR>
                        <V>0</V>
                        <V>1</V>
                    </COMPU-DENOMINATOR>
                </COMPU-RATIONAL-COEFFS>
            </COMPU-SCALE>
        </COMPU-SCALES>
    </COMPU-PHYS-TO-INTERNAL>
</COMPU-METHOD>
```

The `CompuMethod` is referenced from the application data type generated for `T1Rec`.

```
<APPLICATION-PRIMITIVE-DATA-TYPE UUID="...">
  <SHORT-NAME>T1Rec_DualScaled</SHORT-NAME>
  <CATEGORY>VALUE</CATEGORY>
  <SW-DATA-DEF-PROPS>
    <SW-DATA-DEF-PROPS-VARIANTS>
      <SW-DATA-DEF-PROPS-CONDITIONAL>
        <SW-CALIBRATION-ACCESS>READ-WRITE</SW-CALIBRATION-ACCESS>
        <COMPU-METHOD-REF DEST="COMPU-METHOD">/mymodel_pkg/mymodel_dt/CM3</COMPU-METHOD-REF>
        <DATA-CONSTR-REF DEST="DATA-CONSTR">/mymodel_pkg/mymodel_dt/ApplDataTypes/
                                    DataConstrs/DC_T1Rec_DualScaled</DATA-CONSTR-REF>
      </SW-DATA-DEF-PROPS-CONDITIONAL>
    </SW-DATA-DEF-PROPS-VARIANTS>
  </SW-DATA-DEF-PROPS>
</APPLICATION-PRIMITIVE-DATA-TYPE>
```

The application data type `T1Rec_DualScaled` is referenced from the parameter data prototype generated for `T1Rec`.

```
<PARAMETER-DATA-PROTOTYPE UUID="...">
  <SHORT-NAME>T1Rec</SHORT-NAME>
  <SW-DATA-DEF-PROPS>
    <SW-DATA-DEF-PROPS-VARIANTS>
      <SW-DATA-DEF-PROPS-CONDITIONAL>
        <SW-CALIBRATION-ACCESS>READ-WRITE</SW-CALIBRATION-ACCESS>
        <SW-IMPL-POLICY>STANDARD</SW-IMPL-POLICY>
      </SW-DATA-DEF-PROPS-CONDITIONAL>
    </SW-DATA-DEF-PROPS-VARIANTS>
  </SW-DATA-DEF-PROPS>
  <TYPE-TREF DEST="APPLICATION-PRIMITIVE-DATA-TYPE">/mymodel_pkg/mymodel_dt/ApplDataTypes/
                                                    T1Rec_DualScaled</TYPE-TREF>
  ...
</PARAMETER-DATA-PROTOTYPE>
```

See Also

`AUTOSAR.DualScaledParameter`

Related Examples

- “Import AUTOSAR Software Component” on page 3-4

- “Configure AUTOSAR Package for Component, Interface, CompuMethod, or SwAddrMethod” on page 4-85
- “Configure AUTOSAR XML Options” on page 4-63
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “CompuMethod Categories for Data Types” on page 2-43
- “AUTOSAR Component Configuration” on page 4-3

Configure AUTOSAR Internal Data Constraints Export

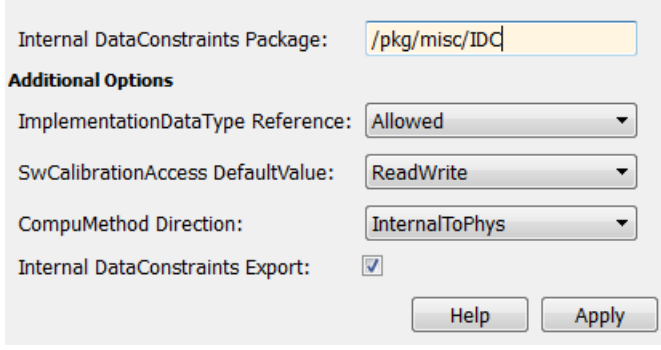
AUTOSAR applications use data constraints to implement limits on data types and provide a controlled range of possible values. Internal data constraints represent minimum and maximum values for implementation data types, reflecting the internal or machine view of the data.

By default, code generation does not export internal data constraint information for AUTOSAR implementation data types in `arxml` code. If you want to force export of internal data constraints for implementation data types, select the XML option **Internal DataConstraints Export**.

If you select **Internal DataConstraints Export**, the exporter generates internal data constraints into an AUTOSAR package with a default name, `DataConstrs`, at a fixed location under the AUTOSAR data type package. Optionally, use the XML option **Internal DataConstraints Package** to specify a different AUTOSAR package name and path.

To configure export of AUTOSAR internal data constraint information in your model:

1. Open AUTOSAR Dictionary. Select **Code > C/C++ Code > Configure AUTOSAR Dictionary**.
2. Select **XML Options**. In the XML options view, under **Additional Options**, select **Internal DataConstraints Export**.
3. Optionally, under **Additional Packages**, enter a package path for **Internal DataConstraints Package**.



4. Build the model and inspect the generated code. Here is an example of an AUTOSAR internal data constraint exported to `arxml` code.

```
<AR-PACKAGE UUID="...">
    <SHORT-NAME>IDC</SHORT-NAME>
    <ELEMENTS>
        ...
        <DATA-CONSTR UUID="...">
            <SHORT-NAME>DC_SInt8</SHORT-NAME>
            <DATA-CONSTR-RULES>
                <DATA-CONSTR-RULE>
                    <INTERNAL-CONSTRS>
                        <LOWER-LIMIT INTERVAL-TYPE="CLOSED">-128</LOWER-LIMIT>
                        <UPPER-LIMIT INTERVAL-TYPE="CLOSED">127</UPPER-LIMIT>
                    </INTERNAL-CONSTRS>
                </DATA-CONSTR-RULE>
            </DATA-CONSTR-RULES>
        </DATA-CONSTR>
    </ELEMENTS>
</AR-PACKAGE>
```

.

See Also

Related Examples

- “Configure AUTOSAR Release 4.x Data Types” on page 4-281
- “Model AUTOSAR Data Types” on page 2-36
- “Generate AUTOSAR C Code and XML Component Descriptions” on page 5-11

More About

- “Release 4.x Data Types” on page 2-39
- “AUTOSAR Component Configuration” on page 4-3

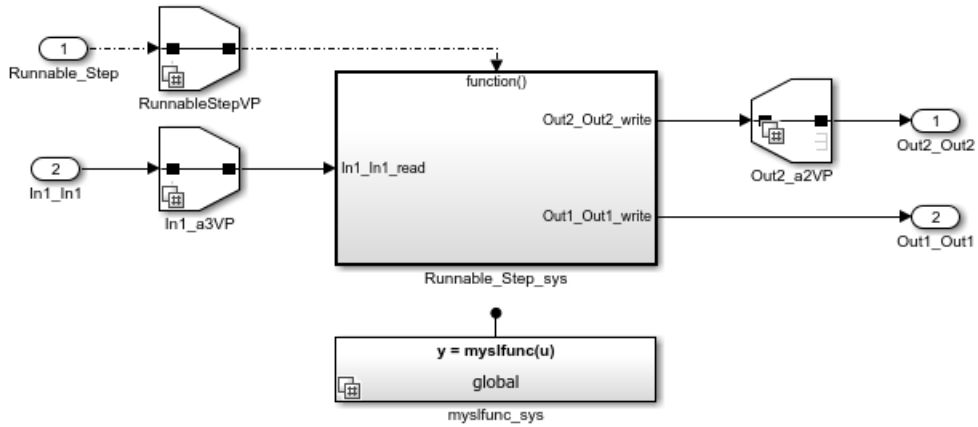
Configure AUTOSAR Variants in Ports and Runnables

AUTOSAR software components can use `VariationPoint` elements to enable or disable AUTOSAR elements, such as ports and runnables, based on defined conditions. In Simulink, you can import AUTOSAR ports and runnables with variation points. Simulink represents the variation points with elements and data objects including:

- `Simulink.Variant` data objects for defining variant condition logic
- `AUTOSAR.Parameter` data objects with storage class `SystemConstant` for representing AUTOSAR system constants
- Variant Sink and Variant Source blocks for propagating variant conditions for the AUTOSAR elements

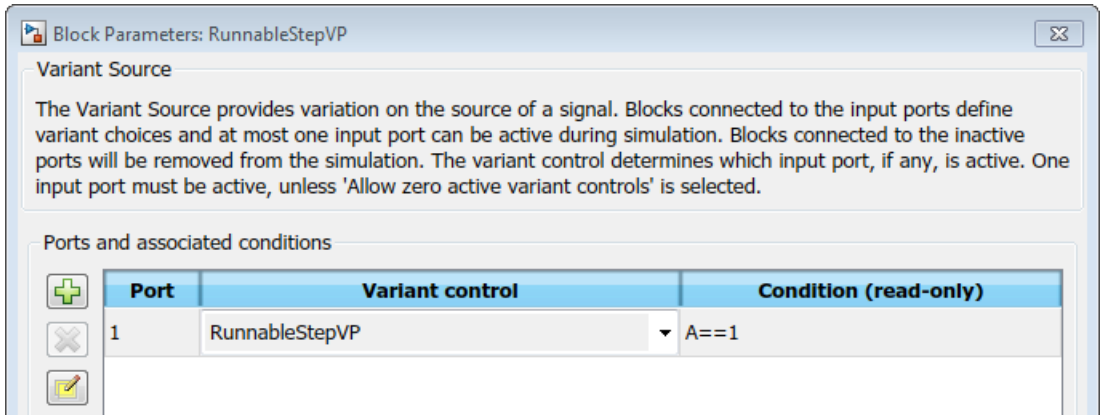
The imported variation points are preserved for export. Before exporting, you can run validation on the AUTOSAR configuration. The validation software verifies that variant conditions on Simulink blocks match the designed behavior from the imported `arxml` code.

For example, here is a model created by importing an AUTOSAR runnable with variation points from an `arxml` file. You can open the model from *`matlabroot`*`/help/toolbox/ecoder/examples/autosar/mAutosarInlineVariant.slx`.

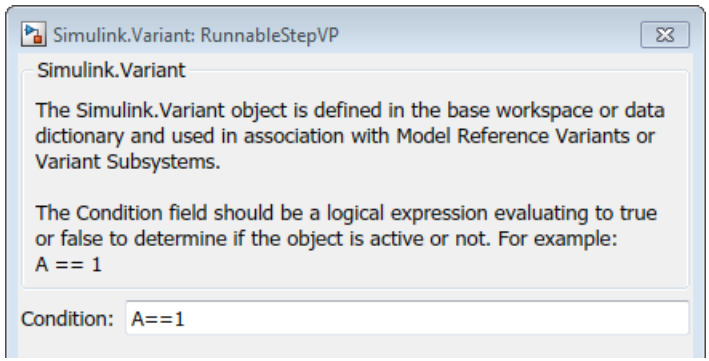


The model contains two Variant Source blocks and one Variant Sink block, which reference `Simulink.Variant` data objects `RunnableStepVP`, `In1_a3VP`, and `Out2_a2VP` in the base workspace. The `Simulink.Variant` data objects reference

`AUTOSAR.Parameter` data object `A`, with storage class `SystemConstant`, representing an AUTOSAR system constant. Here is some of the variant control information for Variant Source block `RunnableStepVP`.



Here is the variant condition expression for `Simulink.Variant` data object `RunnableStepVP`. The expression references AUTOSAR system constant A.



When you build the model, the software exports variation point definitions in `arxml` code.

```
<RUNNABLE-ENTITY ...>
    <SHORT-NAME>Runnable_Step</SHORT-NAME>
...
    <VARIATION-POINT>
        <SHORT-LABEL>RunnableStepVP</SHORT-LABEL>
        <SW-SYSCOND BINDING-TIME="PRE-COMPILE-TIME">
          <SYSC-REF DEST="SW-SYSTEMCONST">
          /mInlineVariant_pkg/mInlineVariant_dt/SystemConstants/A
```

```
          </SYSC-REF>==1
        </SW-SYSCOND>
    </VARIATION-POINT>
</RUNNABLE-ENTITY>
```

For more information, see “Variant Systems” (Embedded Coder) and “Variant Systems” (Simulink) (Simulink).

See Also

`AUTOSAR.Parameter` | `Simulink.Variant` | Variant Sink | Variant Source

Related Examples

- “Model AUTOSAR Variants” on page 2-46

More About

- “Variant Systems”
- “System Constants” on page 2-32

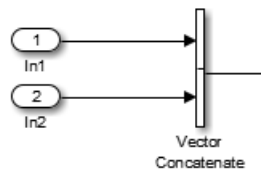
Configure AUTOSAR Variants in Array Sizes

AUTOSAR software components can flexibly specify the dimensions of an AUTOSAR element, such as a port, by using a symbolic reference to a system constant. The system constant defines the array size of the port data type. To model AUTOSAR elements with variant array sizes in Simulink:

- Create blocks that represent AUTOSAR elements.
- To represent array size values, add `AUTOSAR.Parameter` data objects with storage class `SystemConstant`.
- To specify array size for an AUTOSAR element, reference an `AUTOSAR.Parameter` data object.

With variant array sizes, you can modify array size values in system constants between model simulations, without regenerating code for simulation. When you build the model, the generated C and `arxml` code contains symbols corresponding to variant array sizes.

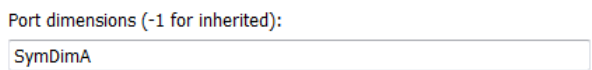
Suppose that you create a Simulink inport `In1` to represent an AUTOSAR receiver port with a variant array size.



To model the AUTOSAR system constant that specifies the dimensions of `In1`, create an `AUTOSAR.Parameter` data object, `SymDimA`, with storage class `SystemConstant`.

```
SymDimA = AUTOSAR.Parameter;
SymDimA.CoderInfo.StorageClass = 'custom';
SymDimA.CoderInfo.CustomStorageClass = 'SystemConstant';
SymDimA.DataType = 'uint8';
SymDimA.Value = 5;
```

In the dialog box for inport block `In1`, enter the parameter name, `SymDimA`, in the **Port dimensions** field.



When you generate code for the model, the name of the system constant, `SymDimA`, appears in C and `arxml` code to represent the variant array size.

Example 4.3. Generated C Code

```
/* SignalConversion: '<Root>/ConcatBufferAtVector ConcatenateIn1' */
  for (i = 0; i < Rte_SysCon_SymDimA; i++) {
    rtb_VectorConcatenate[i] = tmp[i];
```

Example 4.4. Exported `arxml` Code

```
<MAX-NUMBER-OF-ELEMENTS BINDING-TIME="PRE-COMPILE-TIME">
    <SYSC-REF DEST="SW-SYSTEMCONST">/pkg/dt/SC/SymDimA</SYSC-REF>
</MAX-NUMBER-OF-ELEMENTS>
```

See Also

`AUTOSAR.Parameter`

Related Examples

- “Implement Dimension Variants for Array Sizes in Generated Code”
- “Model AUTOSAR Variants” on page 2-46

More About

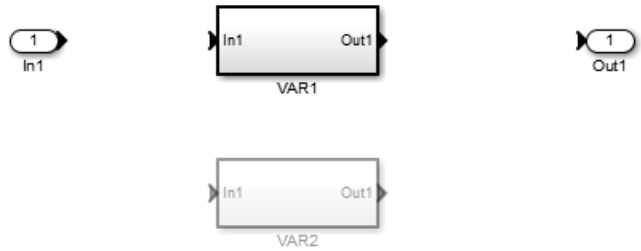
- “System Constants” on page 2-32

Configure AUTOSAR Variants in Runnable Condition Logic

AUTOSAR software components can specify variant condition logic inside a runnable. To model variant condition logic inside an AUTOSAR runnable:

- Use a Variant Subsystem block to represent variant implementations of a subsystem or model.
- Use `AUTOSAR.Parameter` data objects in the base workspace to model AUTOSAR system constants. The system constants represent the condition values that determine the active subsystem or model implementation.
- Use `Simulink.Variant` data objects in the base workspace to define the variant condition logic.

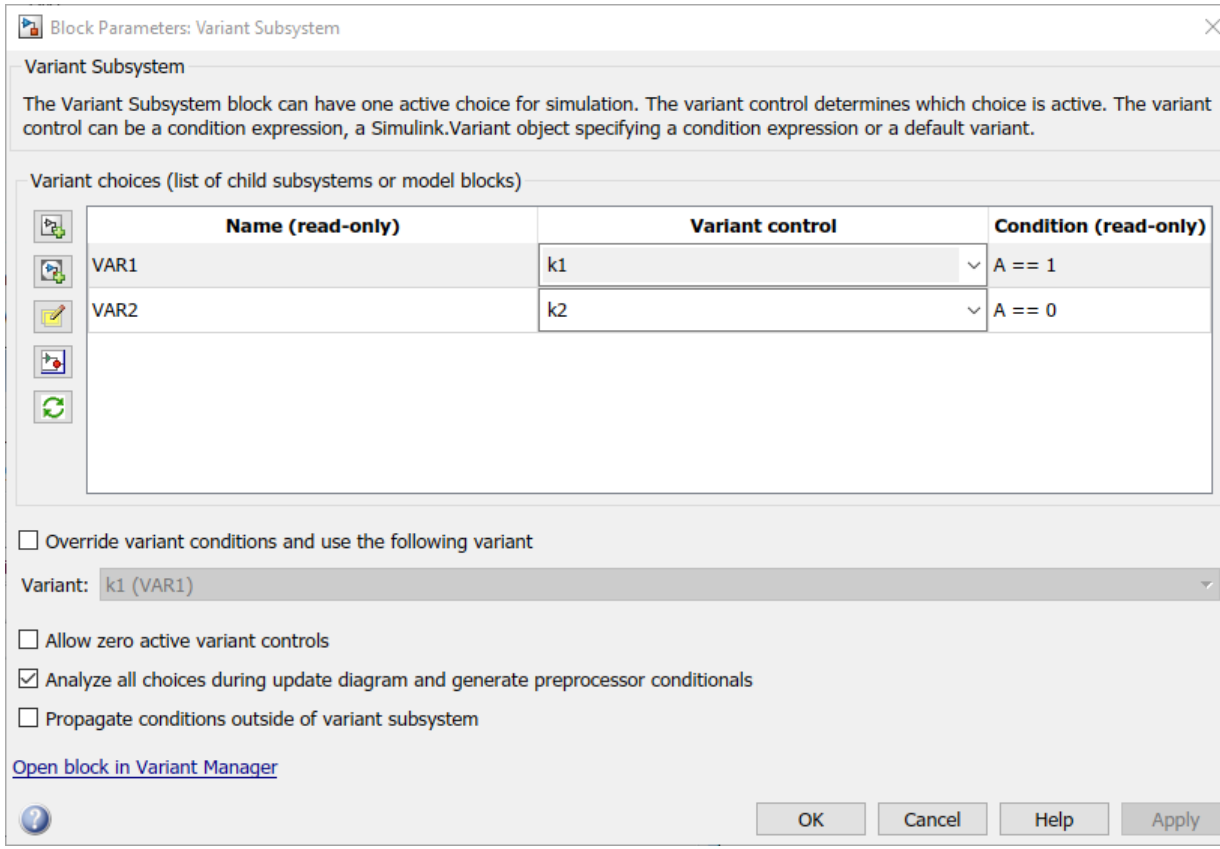
For example, suppose that you implement a Variant Subsystem block. The variant choices are subsystems VAR1 and VAR2. The blocks are not connected because connectivity is determined during simulation, based on the active variant.



In this model:

- `AUTOSAR.Parameter` data object `A` models an AUTOSAR system constant. In the parameter dialog box, **Data type** is set to `uint8`, **Storage class** is set to `SystemConstant`, and **Value** is set to 1.
- `Simulink.Variant` data objects `k1` and `k2` define the variant condition logic, by using system constant `A`. For example, in the `k1` variant dialog box, **Condition** is set to `A == 1`.

You can view their relationship in the Variant Manager or in the Variant Subsystem block dialog box.



When you export `arxml` and C code:

- In the `arxml` code, the variant choices appear as `VARIATION-POINT-PROXY` entries with short-names `k1` and `k2`. `A` appears as a system constant representing the associated conditional value. For example:

```
<VARIATION-POINT-PROXYS>
    <VARIATION-POINT-PROXY UUID="uuidstring">
        <SHORT-NAME>k1</SHORT-NAME>
        <CONDITION-ACCESS BINDING-TIME="PRE-COMPILE-TIME">
          <SYSC-REF DEST="SW-SYSTEMCONST">/basic_pkg/SystemConstants/A</SYSC-REF>
          == 1</CONDITION-ACCESS>
    </VARIATION-POINT-PROXY>
    <VARIATION-POINT-PROXY UUID="uuidstring">
        <SHORT-NAME>k2</SHORT-NAME>
        <CONDITION-ACCESS BINDING-TIME="PRE-COMPILE-TIME">
```

```
            <SYSC-REF DEST="SW-SYSTEMCONST">/basic_pkg/SystemConstants/A</SYSC-REF>
            == 0</CONDITION-ACCESS>
    </VARIATION-POINT-PROXY>
</VARIATION-POINT-PROXYS>
```

- In the RTE compatible C code, short-names `k1` and `k2` are encoded in the names of preprocessor symbols used in the variant condition logic. For example:

```
#if Rte_SysCon_k1
...
#elif Rte_SysCon_k2
...
#endif
```

See Also

`AUTOSAR.Parameter` | `Simulink.Variant` | Variant Subsystem

Related Examples

- “Model AUTOSAR Variants” on page 2-46

More About

- “System Constants” on page 2-32

Control AUTOSAR Variants with Predefined Value Combinations

To define the values that control variation points in an AUTOSAR software component, components use the following AUTOSAR elements:

- `SwSystemconst` — Defines a system constant that serves as an input to control a variation point.
- `SwSystemconstantValueSet` — Specifies a set of system constant values to apply to an AUTOSAR software component.
- `PredefinedVariant` — Describes a combination of system constant values, among potentially multiple valid combinations, to apply to an AUTOSAR software component.

For example, in `arxml` code, you can define `SwSystemconst`s for automobile features, such as `Transmission`, `Headlight`, `Sunroof`, and `Turbocharge`. Then a `PredefinedVariant` can map feature combinations to automobile model variants, such as `Basic`, `Economy`, `Senior`, `Sportive`, and `Junior`.

Suppose that you have an `arxml` specification of an AUTOSAR software component. If the `arxml` files also define a `PredefinedVariant` or `SwSystemconstantValueSet`s for controlling variation points in the component, you can resolve the variation points at model creation time. Specify a `PredefinedVariant` or `SwSystemconstantValueSet`s with which the importer can initialize `SwSystemconst` data.

Typical steps include:

1. Get a list of the `PredefinedVariant`s or `SwSystemconstantValueSet`s defined in the `arxml` file.

```
>> obj = arxml.importer('mySWC.arxml');
>> find(obj,'/','PredefinedVariant','PathType','FullyQualified');
ans =
   '/pkg/body/Variants/Basic'
   '/pkg/body/Variants/Economy'
   '/pkg/body/Variants/Senior'
   '/pkg/body/Variants/Sportive'
   '/pkg/body/Variants/Junior'

>> obj = arxml.importer('mySWC.arxml');
>> find(obj,'/','SystemConstValueSet','PathType','FullyQualified')
ans =
   '/pkg/body/SystemConstantValues/A'
   '/pkg/body/SystemConstantValues/B'
   '/pkg/body/SystemConstantValues/C'
   '/pkg/body/SystemConstantValues/D'
```

2. Create a model from the `arxml` file, and specify a `PredefinedVariant` or one or more `SwSystemconstantValueSet`s.

   This example specifies `PredefinedVariant` Senior, which describes a combination of values for `Transmission`, `Headlight`, `Sunroof`, and `Turbocharge`.

   ```
   >> createComponentAsModel(obj,compNames{1},'ModelPeriodicRunnablesAs','AtomicSubsystem',...
      'PredefinedVariant','/pkg/body/Variants/Senior');
   ```

   This example specifies `SwSystemconstantValueSet`s A and B, which together provide values for `SwSystemconst`s in the AUTOSAR software component.

   ```
   >> createComponentAsModel(obj,compNames{1},'ModelPeriodicRunnablesAs','AtomicSubsystem',...
      'SystemConstValueSets',{'/pkg/body/SystemConstantValues/A','/pkg/body/SystemConstantValues/B'});
   ```

3. During model creation, the `arxml` importer creates `AUTOSAR.Parameter` data objects, with **Storage class** set to `SystemConstant`. The importer initializes the system constant data with values based on the specified `PredefinedVariant` or `SwSystemconstantValueSet`s.

After model creation, you can run simulations and generate code based on the combination of variation point input values that you specified.

In Simulink, you can redefine the `SwSystemconst` data that controls variation points without recreating the model. Call the AUTOSAR property function `createSystemConstants`, and specify a different imported `PredefinedVariant` or a different cell array of `SwSystemconstantValueSet`s. The function creates a set of system constant data objects with the same names as the original objects. You can run simulations and generate code based on the revised combination of variation point input values.

This example creates a set of system constant data objects with names and values based on imported `PredefinedVariant '/pkg/body/Variants/Economy'`.

```
arProps = autosar.api.getAUTOSARProperties(hModel);
createSystemConstants(arProps,'/pkg/body/Variants/Economy');
```

Building the model exports previously imported `PredefinedVariant`s and `SwSystemconstantValueSet`s to `arxml` code.

See Also

Related Examples

- “Model AUTOSAR Variants” on page 2-46
- “Configure AUTOSAR Variants in Ports and Runnables” on page 4-302

More About

- “System Constants” on page 2-32

Configure and Map AUTOSAR Component Programmatically

In Simulink, as an alternative to graphical configuration, you can programmatically configure an AUTOSAR software component. The AUTOSAR property and map functions allow you to get, set, add, and remove the same component properties and mapping information displayed in the AUTOSAR Dictionary and Code Mapping Editor views of the AUTOSAR component model.

In this section...
“AUTOSAR Property and Map Functions” on page 4-313
“Tree View of AUTOSAR Configuration” on page 4-314
“Properties of AUTOSAR Elements” on page 4-315
“Specify AUTOSAR Element Location” on page 4-319

AUTOSAR Property and Map Functions

You can use AUTOSAR property and map functions to programmatically configure the Simulink representation of an AUTOSAR software component. For example:

- Use the AUTOSAR property functions to add AUTOSAR elements, find elements, get and set properties of elements, delete elements, and define `arxml` packaging of elements.
- Use the AUTOSAR map functions to map Simulink model elements to AUTOSAR elements and return AUTOSAR mapping information for model elements.

The AUTOSAR property and map functions also validate syntax and semantics for requested AUTOSAR property and mapping changes.

For a complete list of property and map functions, see the functions listed for “AUTOSAR Component Development”.

For example scripts, see “AUTOSAR Property and Map Function Examples” on page 4-321.

Note For information about functions for creating or importing an AUTOSAR software component, see “AUTOSAR Component Creation”.

Tree View of AUTOSAR Configuration

The following tree view of an AUTOSAR configuration shows the types of AUTOSAR elements to which you can apply AUTOSAR property and map functions. This view corresponds with the AUTOSAR Dictionary tree display, but includes elements that might not be present in every configuration. Names shown in *`italics`* are user-selected.

- AUTOSAR
  - AtomicComponents
    - *`MyComponent`*
      - ReceiverPorts
      - SenderPorts
      - SenderReceiverPorts
      - ModeReceiverPorts
      - ModeSenderPorts
      - ClientPorts
      - ServerPorts
      - NvReceiverPorts
      - NvSenderPorts
      - NvSenderReceiverPorts
      - ParameterReceiverPorts
      - TriggerReceiverPorts
      - Runnables
      - IRV
      - Parameters
  - S-R Interfaces
    - *`SRInterface1`*
      - DataElements
  - M-S Interfaces
    - *`MSInterface1`*

- C-S Interfaces
  - *CSInterface1*
    - Operations
      - *operation1*
        - Arguments
- NV Interfaces
  - *NVInterface1*
    - DataElements
- Parameter Interfaces
  - *ParameterInterface1*
    - DataElements
- Trigger Interfaces
  - *TriggerInterface1*
    - Triggers
- CompuMethods
- XML Options

Properties of AUTOSAR Elements

The following table lists properties that are associated with AUTOSAR elements.

AUTOSAR Element Class	Properties
`AtomicComponent`	• `ReceiverPorts` (add/delete) • `SenderPorts` (add/delete) • `SenderReceiverPorts` (add/delete) • `ModeReceiverPorts` (add/delete) • `ClientPorts` (add/delete) • `ServerPorts` (add/delete) • `NvReceiverPorts` (add/delete) • `NvSenderPorts` (add/delete) • `NvSenderReceiverPorts` (add/delete) • `ParameterReceiverPorts` (add/delete) • `TriggerReceiverPorts` (add/delete) • `Behavior` (add/delete) • `Kind` • `Name`
`ApplicationComponentBehavior`	• `Runnables` (add/delete) • `Events` (add/delete) • `PIM` (add/delete) • `IRV` (add/delete) • `Parameters` (add/delete) • `IncludedDataTypeSets` • `DataTypeMapping` • `Name`

AUTOSAR Element Class	Properties
DataReceiverPort DataSenderPort DataSenderReceiverPort ClientPort ServerPort ModeReceiverPort NvDataReceiverPort NvDataSenderPort NvDataSenderReceiverPort ParameterReceiverPort TriggerReceiverPort	• Interface • Name
Runnable	• symbol • canBeInvokedConcurrently • SwAddrMethod • Name
TimingEvent	• Period • StartOnEvent • DisabledMode • Name
DataReceivedEvent DataReceiveErrorEvent OperationInvokedEvent	• Trigger • StartOnEvent • DisabledMode • Name
ModeSwitchEvent	• Trigger • Activation • StartOnEvent • DisabledMode • Name
InitEvent	• StartOnEvent • Name

AUTOSAR Element Class	Properties
IrvData	• Type • SwAddrMethod • SwCalibrationAccess • DisplayFormat • SwAlignment • Name
ParameterData	• Type • SwAddrMethod • SwCalibrationAccess • DisplayFormat • SwAlignment • Kind • Name
SenderReceiverInterface NvDataInterface ParameterInterface	• DataElements (add/delete) • IsService • Name
FlowData	• Type • SwAddrMethod • SwCalibrationAccess • DisplayFormat • SwAlignment • Name
ModeSwitchInterface	• ModeGroup (add/delete) • IsService • Name
ModeDeclarationGroupElement	• ModeGroup • SwCalibrationAccess • Name

AUTOSAR Element Class	Properties
`ClientServerInterface`	• `Operations` (add/delete) • `IsService` • `Name`
`TriggerInterface`	• `Triggers` (add/delete) • `IsService` • `Name`

Specify AUTOSAR Element Location

The AUTOSAR property functions typically require you to specify the name and location of an element. The location of an AUTOSAR element within a hierarchy of AUTOSAR packages and objects can be uniquely specified using a fully qualified path. A fully qualified path might include a package hierarchy and the element location within the object hierarchy, for example:

```
/pkgLevel1/pkgLevel2/pkgLevel3/grandParentName/parentName/childName
```

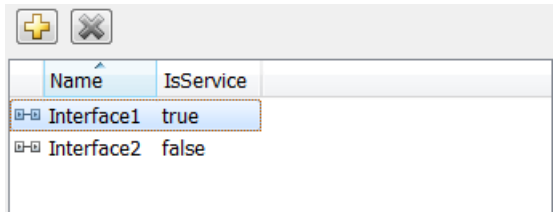
For AUTOSAR property functions other than `addPackageableElement`, you can specify a partially-qualified path that does not include the package hierarchy, for example:

```
grandParentName/parentName/childName
```

The following code sets the `IsService` property for the Sender-Receiver Interface located at path `Interface1` in the example model `rtwdemo_autosar_multirunnables` to `true`. In this case, specifying the name `Interface1` is enough to locate the element.

```
>> arProps = autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
>> set(arProps,'Interface1','IsService',true);
```

Here is the resulting display in the **S-R Interfaces** view in AUTOSAR Dictionary.



If you added a Sender-Receiver Interface to a component package, you would specify a fully qualified path, for example:

```
>> arProps = autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
>> addPackageableElement(arProps,'SenderReceiverInterface','/pkg/if','Interface3',...
   'IsService',true);
```

A potential advantage of using a partially qualified path rather than a fully-qualified path is that it is easier to construct a partially qualified path from looking at the AUTOSAR Dictionary view of the AUTOSAR component. A potential disadvantage is that a partially qualified path could refer to more than one element in the AUTOSAR configuration. For example, the path `s/r` conceivably might designate both a data element of a Sender-Receiver Interface and a runnable of a component. When a conflict occurs, the software displays an error and lists the fully-qualified paths.

Most AUTOSAR elements have properties that are made up of multiple parts (composite). For example, an atomic software component has composite properties such as `ReceiverPorts`, `SenderPorts`, and `InternalBehavior`. For elements that have composite properties that you can manipulate, such as property `ReceiverPorts` of a component, child elements are named and are uniquely defined within the parent element. To locate a child element within a composite property, use the parent element path and the child name, without the property name. For example, if the qualified path of a parent atomic software component is `/A/B/SWC`, and a child receiver port is named `RPort1`, the location of the receiver port is `/A/B/SWC/RPort1`.

AUTOSAR Property and Map Function Examples

After creating a Simulink model representation of an AUTOSAR software component, you refine the AUTOSAR configuration. You can refine the AUTOSAR configuration graphically, using AUTOSAR Dictionary and Code Mapping Editor, or programmatically, using the AUTOSAR property and map functions.

This topic provides examples of using AUTOSAR property and map functions to programmatically refine an AUTOSAR configuration. The examples assume that you have created a Simulink model with an initial AUTOSAR configuration, as described in "AUTOSAR Component Creation". (To graphically refine an AUTOSAR configuration, see "AUTOSAR Component Configuration" on page 4-3.)

Here is representative ordering of programmatic configuration tasks.

1. "Configure AUTOSAR Software Component" on page 4-322
   a. "Configure AUTOSAR Software Component Name and Type" on page 4-322
   b. "Configure AUTOSAR Ports" on page 4-323
   c. "Configure AUTOSAR Runnables and Events" on page 4-327
   d. "Configure AUTOSAR Inter-Runnable Variables" on page 4-332
2. "Configure AUTOSAR Interfaces" on page 4-333
   a. "Configure AUTOSAR Sender-Receiver Interfaces" on page 4-334
   b. "Configure AUTOSAR Client-Server Interfaces" on page 4-335
   c. "Configure AUTOSAR Mode-Switch Interfaces" on page 4-338
3. "Configure AUTOSAR XML Export" on page 4-339

For a list of AUTOSAR property and map functions, see the **Functions** list on the "AUTOSAR Programmatic Interfaces" page.

The examples use a function call format in which a handle to AUTOSAR properties or mapping information is passed as the first call argument:

```
arProps = autosar.api.getAUTOSARProperties(hModel);
swc = get(arProps,'XmlOptions','ComponentQualifiedName');
```

The same calls can be coded in a method call format. The formats are interchangeable. For example:

```
arProps = autosar.api.getAUTOSARProperties(hModel);
swc = arProps.get('XmlOptions','ComponentQualifiedName');
```

While configuring a model for AUTOSAR code generation, use the following functions to update and validate AUTOSAR model configurations:

- `autosar.api.syncModel` — Update Simulink to AUTOSAR mapping of specified model with modifications to Simulink data transfers, entry-point functions, and function callers.
- `autosar.api.validateModel` — Validate AUTOSAR properties and Simulink to AUTOSAR mapping of specified model.

The functions are equivalent to using the **Update** and **Validate** buttons in Code Mapping Editor.

Configure AUTOSAR Software Component

Configure AUTOSAR Software Component Name and Type

This example:

1. Opens a model.
2. Finds AUTOSAR software components.
3. Loops through components and lists property values.
4. Modifies the name and kind properties for a component.

```
% Open model
hModel = 'rtwdemo_autosar_multirunnables';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Find AUTOSAR software components
aswcPaths = find(arProps,[],'AtomicComponent','PathType','FullyQualified');

% Loop through components and list Name and Kind property values
for ii=1:length(aswcPaths)
    aswcPath = aswcPaths{ii};
    swcName = get(arProps,aswcPath,'Name');
    swcKind = get(arProps,aswcPath,'Kind'); % Application, SensorActuator, etc.
```

```
    fprintf('Component %s: Name %s, Kind %s\n',aswcPath,swcName,swcKind);
end
```

```
Component /pkg/swc/ASWC: Name ASWC, Kind Application
```

```
% Modify component Name and Kind
aswcName = 'mySwc';
aswcKind = 'SensorActuator';
set(arProps,aswcPaths{1},'Name',aswcName);
aswcPaths = find(arProps,[],'AtomicComponent','PathType','FullyQualified');
set(arProps,aswcPaths{1},'Kind',aswcKind);
swcName = get(arProps,aswcPaths{1},'Name');
swcKind = get(arProps,aswcPaths{1},'Kind');
fprintf('Component %s: Name %s, Kind %s\n',aswcPaths{1},swcName,swcKind);
```

```
Component /pkg/swc/mySwc: Name mySwc, Kind SensorActuator
```

Configure AUTOSAR Ports

There are three types of AUTOSAR ports:

- `Require` (In)
- `Provide` (Out)
- Combined `Provide-Require` (InOut)

AUTOSAR ports can reference the following kinds of AUTOSAR communication interfaces:

- Sender-Receiver
- Client-Server
- Mode-Switch

The properties and mapping that you can set for an AUTOSAR port vary according to the type of interface it references. These examples show how to use the AUTOSAR property and map functions to configure AUTOSAR ports for each type of interface.

- “Configure and Map Sender-Receiver Ports” on page 4-323
- “Configure Client-Server Ports” on page 4-325
- “Configure and Map Mode Receiver Ports” on page 4-325

Configure and Map Sender-Receiver Ports

This example:

1. Opens a model.
2. Finds AUTOSAR sender or receiver ports.

3 Loops through the ports and lists associated sender-receiver interfaces.

4 Modifies the associated interface for a port.

5 Maps a Simulink inport to an AUTOSAR receiver port.

See also “Configure AUTOSAR Sender-Receiver Interfaces” on page 4-334.

```
% Open model
hModel = 'rtwdemo_autosar_multirunnables';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Find AUTOSAR ports - specify DataReceiverPort, DataSenderPort, or DataSenderReceiverPort
arPortType = 'DataReceiverPort';
aswcPath = find(arProps,[],'AtomicComponent','PathType','FullyQualified');
rPorts=find(arProps,aswcPath{1},arPortType,'PathType','FullyQualified')

rPorts =
    '/pkg/swc/ASWC/RPort'

% Loop through ports and list their associated interfaces
for ii=1:length(rPorts)
    rPort = rPorts{ii};
    portIf = get(arProps,rPort,'Interface');
    fprintf('Port %s has S-R interface %s\n',rPort,portIf);
end

Port /pkg/swc/ASWC/RPort has S-R interface Interface1

% Set Interface property for AUTOSAR port
rPort = '/pkg/swc/ASWC/RPort';
set(arProps,rPort,'Interface','Interface2')
portIf = get(arProps,rPort,'Interface');
fprintf('Port %s has S-R interface %s\n',rPort,portIf);

Port /pkg/swc/ASWC/RPort has S-R interface Interface2

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);

% Get AUTOSAR mapping info for Simulink inport
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'RPort_DE2')

arPortName =
RPort

arDataElementName =
    ''

arDataAccessMode =
ImplicitReceive

% Map Simulink inport to AUTOSAR port, data element, and data access mode
mapInport(slMap,'RPort_DE2','RPort','DE2','ExplicitReceive')
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'RPort_DE2')

arPortName =
RPort

arDataElementName =
```

```
DE2

arDataAccessMode =
ExplicitReceive
```

Configure Client-Server Ports

This example:

1. Opens a model.
2. Finds AUTOSAR client or server ports.
3. Loops through the ports and lists associated client-server interfaces.
4. Modifies the associated interface for a port.

See also “Configure AUTOSAR Client-Server Interfaces” on page 4-335.

```
% Open model
hModel = 'mControllerWithInterface_server';
addpath (fullfile(matlabroot,'/help/toolbox/ecoder/examples/autosar'));
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Find AUTOSAR ports - specify ServerPort or ClientPort
arPortType = 'ServerPort';
aswcPath = find(arProps,[],'AtomicComponent','PathType','FullyQualified');
sPorts=find(arProps,aswcPath{1},arPortType,'PathType','FullyQualified');

% Loop through ports and list their associated interfaces
for ii=1:length(sPorts)
    sPort = sPorts{ii};
    portIf = get(arProps,sPort,'Interface');
    fprintf('Port %s has C-S interface %s\n',sPort,portIf);
end

Port /pkg/swc/SWC_Controller/sPort has C-S interface CsIf1

% Set Interface property for AUTOSAR port
set(arProps,sPorts{1},'Interface','CsIf2')
portIf = get(arProps,sPorts{1},'Interface');
fprintf('Port %s has C-S interface %s\n',sPorts{1},portIf);

Port /pkg/swc/SWC_Controller/sPort has C-S interface CsIf2
```

Configure and Map Mode Receiver Ports

This example:

1. Opens a model.
2. Finds AUTOSAR mode receiver ports.
3. Loops through the ports and lists associated mode-switch interfaces.

4 Modifies the associated interface for a port.

5 Maps a Simulink inport to an AUTOSAR mode receiver port.

See also “Configure AUTOSAR Mode-Switch Interfaces” on page 4-338.

```
% Add path to model and mode definition files and open model
addpath (fullfile(matlabroot,'/help/toolbox/ecoder/examples/autosar'));
hModel = 'mAutosarMsConfigAfter';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Find AUTOSAR mode receiver ports
arPortType = 'ModeReceiverPort';
aswcPath = find(arProps,[],'AtomicComponent','PathType','FullyQualified');
mrPorts=find(arProps,aswcPath{1},arPortType,'PathType','FullyQualified');

% Loop through ports and list their associated interfaces
for ii=1:length(mrPorts)
    mrPort = mrPorts{ii};
    portIf = get(arProps,mrPort,'Interface');
    fprintf('Port %s has M-S interface %s\n',mrPort,portIf);
end

Port /pkg/swc/ASWC/myMRPort has M-S interface myMsIf

% Set Interface property for AUTOSAR port
set(arProps,mrPorts{1},'Interface','MsIf2')
portIf = get(arProps,mrPort,'Interface');
fprintf('Port %s has M-S interface %s\n',mrPorts{1},portIf);

Port /pkg/swc/ASWC/myMRPort has M-S interface MsIf2

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);

% Get AUTOSAR mapping info for Simulink inport
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'MRPort')

arPortName =
    'myMRPort'

arDataElementName =
  0×0 empty char array

arDataAccessMode =
    'ModeReceive'

% Map Simulink inport to AUTOSAR port, mode group, and data access mode
mapInport(slMap,'MRPort','myMRPort','mdgModes','ModeReceive')
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'MRPort')

arPortName =
    'myMRPort'

arDataElementName =
    'mdgModes'

arDataAccessMode =
    'ModeReceive'
```

Configure AUTOSAR Runnables and Events

The behavior of an AUTOSAR software component is implemented by one or more runnables. An AUTOSAR runnable is a schedulable entity that is directly or indirectly scheduled by the underlying AUTOSAR operating system. Each runnable is triggered by RTEEvents, events generated by the AUTOSAR run-time environment (RTE). For each runnable, you configure an event to which it responds. Here are examples of AUTOSAR events to which runnables respond.

- `TimingEvent` — Triggers a periodic runnable.
- `DataReceivedEvent` or `DataReceiveErrorEvent` — Triggers a runnable with a receiver port that is participating in sender-receiver communication.
- `OperationInvokedEvent` — Triggers a runnable with a server port that is participating in client-server communication.
- `ModeSwitchEvent` — Triggers a runnable with a mode receiver port that is participating in mode-switch communication.
- `InitEvent` (AUTOSAR schema 4.1 or higher) — Triggers a runnable that performs component initialization.
- `ExternalTriggerOccurredEvent` — Triggers a runnable with a trigger receiver port that is participating in external trigger event communication.

Configure AUTOSAR TimingEvent for Periodic Runnable

This example:

1. Opens a model.
2. Finds AUTOSAR runnables.
3. Loops through runnables and lists properties.
4. Modifies the name and symbol for an AUTOSAR periodic runnable.
5. Loops through AUTOSAR timing events and lists associated runnables.
6. Renames an AUTOSAR timing event.
7. Maps a Simulink entry-point function to an AUTOSAR periodic runnable.

```
% Open model
hModel = 'rtwdemo_autosar_multirunnables';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Find AUTOSAR runnables
swc = get(arProps,'XmlOptions','ComponentQualifiedName');
ib = get(arProps,swc,'Behavior');
runnables = find(arProps,ib,'Runnable','PathType','FullyQualified');
runnables{2}

ans =
/pkg/swc/ASWC/Behavior/Runnable1

% Loop through runnables and list property values
for ii=1:length(runnables)
    runnable = runnables{ii};
    rnName = get(arProps,runnable,'Name');
    rnSymbol = get(arProps,runnable,'symbol');
    rnCBIC = get(arProps,runnable,'canBeInvokedConcurrently');
    fprintf('Runnable %s: symbol %s, canBeInvokedConcurrently %u\n',...
      rnName,rnSymbol,rnCBIC);
end

Runnable Runnable_Init: symbol Runnable_Init, canBeInvokedConcurrently 0
Runnable Runnable1: symbol Runnable1, canBeInvokedConcurrently 0
Runnable Runnable2: symbol Runnable2, canBeInvokedConcurrently 0
Runnable Runnable3: symbol Runnable3, canBeInvokedConcurrently 0

% Modify Runnable1 name and symbol
set(arProps,runnables{2},'Name','myRunnable','symbol','myAlgorithm');
runnables = find(arProps,ib,'Runnable','PathType','FullyQualified');
rnName = get(arProps,runnables{2},'Name');
rnSymbol = get(arProps,runnables{2},'symbol');
rnCBIC = get(arProps,runnables{2},'canBeInvokedConcurrently');
fprintf('Runnable %s: symbol %s, canBeInvokedConcurrently %u\n',...
  rnName,rnSymbol,rnCBIC);

Runnable myRunnable: symbol myAlgorithm, canBeInvokedConcurrently 0

% Loop through AUTOSAR timing events and list runnable associations
events = find(arProps,ib,'TimingEvent','PathType','FullyQualified');
for ii=1:length(events)
    event = events{ii};
    eventStartOn = get(arProps,event,'StartOnEvent');
    fprintf('AUTOSAR event %s triggers %s\n',event,eventStartOn);
end

AUTOSAR event /pkg/swc/ASWC/Behavior/Event_t_1tic_A triggers ASWC/Behavior/myRunnable
AUTOSAR event /pkg/swc/ASWC/Behavior/Event_t_1tic_B triggers ASWC/Behavior/Runnable2
AUTOSAR event /pkg/swc/ASWC/Behavior/Event_t_10tic triggers ASWC/Behavior/Runnable3

% Modify AUTOSAR event name
set(arProps,events{1},'Name','myEvent');
events = find(arProps,ib,'TimingEvent','PathType','FullyQualified');
eventStartOn = get(arProps,events{1},'StartOnEvent');
fprintf('AUTOSAR event %s triggers %s\n',events{1},eventStartOn);

AUTOSAR event /pkg/swc/ASWC/Behavior/myEvent triggers ASWC/Behavior/myRunnable

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);
```

```
% Map Simulink exported function Runnable1 to renamed AUTOSAR runnable
mapFunction(slMap,'Runnable1','myRunnable');
arRunnableName = getFunction(slMap,'Runnable1')
```

```
arRunnableName =
myRunnable
```

Configure and Map Runnables

This example:

1. Opens a model.
2. Adds AUTOSAR initialization and periodic runnables to the model.
3. Adds a timing event to the periodic runnable.
4. Maps Simulink initialization and step functions to the AUTOSAR runnables.

See also “Configure Events for Runnable Activation” on page 4-329.

```
% Open model
hModel = 'rtwdemo_autosar_counter';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Add AUTOSAR initialization and periodic runnables
initRunnable = 'myInitRunnable';
periodicRunnable = 'myPeriodicRunnable';
swc = get(arProps,'XmlOptions','ComponentQualifiedName')
ib = get(arProps,swc,'Behavior')
add(arProps,ib,'Runnables',initRunnable);
add(arProps,ib,'Runnables',periodicRunnable);

% Add AUTOSAR timing event
eventName = 'myPeriodicEvent';
add(arProps,ib,'Events',eventName,'Category','TimingEvent','Period',1,...
    'StartOnEvent',[ib '/' periodicRunnable]);

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);

% Map AUTOSAR runnables to Simulink initialize and step functions
mapFunction(slMap,'InitializeFunction',initRunnable);
mapFunction(slMap,'StepFunction',periodicRunnable);

% To pass validation, remove redundant initialize and step runnables in AUTOSAR configuration
runnables = get(arProps,ib,'Runnables')
delete(arProps,[ib,'/Runnable_Init']);
delete(arProps,[ib,'/Runnable_Step']);
runnables = get(arProps,ib,'Runnables')
```

Configure Events for Runnable Activation

This example shows the property function syntax for adding an AUTOSAR `TimingEvent`, `DataReceivedEvent`, and `DataReceiveErrorEvent` to a runnable in a model. For a

`DataReceivedEvent` or `DataReceiveErrorEvent`, you specify a trigger. The trigger name includes the name of the AUTOSAR receiver port and data element that receives the event, for example, `'RPort.DE1'`.

For `OperationInvokedEvent` syntax, see “Configure AUTOSAR Client-Server Interfaces” on page 4-335.

For `ModeSwitchEvent` syntax, see “Configure AUTOSAR Mode-Switch Interfaces” on page 4-338.

```
% Open model
hModel = 'rtwdemo_autosar_multirunnables';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Specify AUTOSAR runnable to which to add event
swc = get(arProps,'XmlOptions','ComponentQualifiedName')
ib = get(arProps,swc,'Behavior')
runnables = get(arProps,ib,'Runnables')
runnable = 'Runnable1';

% Add AUTOSAR timing event
timingEventName = 'myTimingEvent';
add(arProps,ib,'Events',timingEventName,'Category','TimingEvent',...
    'Period',1,'StartOnEvent',[ib '/' runnable]);

% Add AUTOSAR data received event
drEventName = 'myDREvent';
add(arProps,ib,'Events',drEventName,'Category','DataReceivedEvent',...
    'Trigger','RPort.DE1','StartOnEvent',[ib '/' runnable]);

% Add AUTOSAR data receive error event
dreEventName = 'myDREEvent';
add(arProps,ib,'Events',dreEventName,'Category','DataReceiveErrorEvent',...
    'Trigger','RPort.DE1','StartOnEvent',[ib '/' runnable]);

% To pass validation, remove redundant timing event in AUTOSAR configuration
events = get(arProps,ib,'Events')
delete(arProps,[ib,'/Event_t_1tic_A'])
events = get(arProps,ib,'Events')
```

Gather Information for AUTOSAR Custom Scheduler Script

This example:

1. Loops through events and runnables in an open model.
2. For each event or runnable, extracts information to use with a custom scheduler.

`hModel` specifies the name of an open AUTOSAR model.

```
% Example of how to extract timing information for runnables
% to prepare for hooking up a custom scheduler
```

```
% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

swc = get(arProps,'XmlOptions','ComponentQualifiedName');

% Get AUTOSAR internal behavior
ib = get(arProps,swc,'Behavior');

% Get AUTOSAR events and runnables
events = get(arProps,ib,'Events');
runnables = get(arProps,ib,'Runnables');

% Loop through events
for ii=1:length(events)
    event = events{ii};
    category = get(arProps,event,'Category');

    switch category
      case 'TimingEvent'
        runnablePath = get(arProps,event,'StartOnEvent');
        period = get(arProps,event,'Period');
        eventName = get(arProps,event,'Name');
        runnableName = get(arProps,runnablePath,'Name');
        fprintf('Event %s triggers runnable %s with period %g\n',eventName,runnableName,period);
      otherwise
        % Not interested in other events
    end
end

% Loop through runnables
for ii=1:length(runnables)
    runnable = runnables{ii};
    runnableName = get(arProps,runnable,'Name');
    runnableSymbol = get(arProps,runnable,'symbol');
    fprintf('Runnable %s has symbol %s\n',runnableName,runnableSymbol);
end
```

Running the example code on the example model `rtwdemo_autosar_multirunnables` generates the following output:

```
Event Event_t_1tic_A triggers runnable Runnable1 with period 1
Event Event_t_1tic_B triggers runnable Runnable2 with period 1
Event Event_t_10tic triggers runnable Runnable3 with period 1
Runnable Runnable_Init has symbol Runnable_Init
Runnable Runnable1 has symbol Runnable1
Runnable Runnable2 has symbol Runnable2
Runnable Runnable3 has symbol Runnable3
```

Running the example code on the example model *`matlabroot`*`/help/toolbox/ecoder/examples/autosar/mMultitasking_4rates.slx` generates the following output:

```
Event Event_Runnable_Step triggers runnable Runnable_Step with period 1
Event Event_Runnable_Step1 triggers runnable Runnable_Step1 with period 2
Event Event_Runnable_Step2 triggers runnable Runnable_Step2 with period 4
Event Event_Runnable_Step3 triggers runnable Runnable_Step3 with period 8
Runnable Runnable_Init has symbol Runnable_Init
Runnable Runnable_Step has symbol Runnable_Step
Runnable Runnable_Step1 has symbol Runnable_Step1
```

```
Runnable Runnable_Step2 has symbol Runnable_Step2
Runnable Runnable_Step3 has symbol Runnable_Step3
```

Configure AUTOSAR Inter-Runnable Variables

In an AUTOSAR software component with multiple runnables, inter-runnable variables (IRVs) are used to communicate data between runnables. In Simulink, you model IRVs using data transfer lines that connect subsystems. In an application with multiple rates, the data transfer lines might include Rate Transition blocks to handle transitions between differing rates.

These examples show how to use the AUTOSAR property and map functions to configure AUTOSAR IRVs without or with rate transitions.

- “Configure Inter-Runnable Variable for Data Transfer Line” on page 4-332
- “Configure Inter-Runnable Variable for Data Transfer with Rate Transition” on page 4-333

Configure Inter-Runnable Variable for Data Transfer Line

This example:

1. Opens a model.
2. Adds an AUTOSAR inter-runnable variable (IRV) to the model.
3. Maps a Simulink data transfer to the IRV.

```
% Open model
hModel = 'rtwdemo_autosar_multirunnables';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Get AUTOSAR internal behavior and add IRV myIrv with SwCalibrationAccess ReadWrite
irvName = 'myIrv';
swCalibValue = 'ReadWrite';
swc = get(arProps,'XmlOptions','ComponentQualifiedName')
ib = get(arProps,swc,'Behavior')
irvs = get(arProps,ib,'IRV')
add(arProps,ib,'IRV',irvName,'SwCalibrationAccess',swCalibValue);
irvs = get(arProps,ib,'IRV')

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);

% Map Simulink signal irv1 to AUTOSAR IRV myIrv with access mode Explicit
irvAccess = 'Explicit';
[arIrvName,arDataAccessMode] = getDataTransfer(slMap,'irv1')
mapDataTransfer(slMap,'irv1',irvName,irvAccess);
[arIrvName,arDataAccessMode] = getDataTransfer(slMap,'irv1')
```

```
% To pass validation, remove redundant IRV in AUTOSAR configuration
irvs = get(arProps,ib,'IRV')
delete(arProps,[ib,'/IRV1'])
irvs = get(arProps,ib,'IRV')
```

Configure Inter-Runnable Variable for Data Transfer with Rate Transition

This example:

1. Opens a model with multiple rates.
2. Adds an AUTOSAR inter-runnable variable (IRV) to the model.
3. Maps a Simulink Rate Transition block to the IRV.

```
% Open model
hModel = 'mMultitasking_4rates';
addpath (fullfile(matlabroot,'/help/toolbox/ecoder/examples/autosar'));
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Get AUTOSAR internal behavior and add IRV myIrv with SwCalibrationAccess ReadWrite
irvName = 'myIrv';
swCalibValue = 'ReadWrite';
swc = get(arProps,'XmlOptions','ComponentQualifiedName')
ib = get(arProps,swc,'Behavior')
irvs = get(arProps,ib,'IRV')
add(arProps,ib,'IRV',irvName,'SwCalibrationAccess',swCalibValue);
irvs = get(arProps,ib,'IRV')

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);

% Map Simulink RT block RateTransition2 to AUTOSAR IRV myIrv with access mode Explicit
irvAccess = 'Explicit';
[arIrvName,arDataAccessMode] = getDataTransfer(slMap,'mMultitasking_4rates/RateTransition2')
mapDataTransfer(slMap,'mMultitasking_4rates/RateTransition2',irvName,irvAccess);
[arIrvName,arDataAccessMode] = getDataTransfer(slMap,'mMultitasking_4rates/RateTransition2')

% To pass validation, remove redundant IRV in AUTOSAR configuration
irvs = get(arProps,ib,'IRV')
delete(arProps,[ib,'/IRV3'])
irvs = get(arProps,ib,'IRV')
```

Configure AUTOSAR Interfaces

AUTOSAR software components can use ports and interfaces to implement the following forms of communication:

- Sender-receiver (S-R)
- Client-server (C-S)
- Mode-switch (M-S) — introduced in AUTOSAR Release 4.0

- Nonvolatile (NV) data — introduced in AUTOSAR Release 4.0

These examples show how to use AUTOSAR property and map functions to configure AUTOSAR ports, interfaces, and related elements for S-R, C-S, and M-S communication. The techniques shown for configuring S-R ports and interfaces also broadly apply to NV communication.

- “Configure AUTOSAR Sender-Receiver Interfaces” on page 4-334
- “Configure AUTOSAR Client-Server Interfaces” on page 4-335
- “Configure AUTOSAR Mode-Switch Interfaces” on page 4-338

Configure AUTOSAR Sender-Receiver Interfaces

- “Configure and Map Sender-Receiver Interface” on page 4-334
- “Configure Sender-Receiver Data Element Properties” on page 4-335

Configure and Map Sender-Receiver Interface

This example:

1. Opens a model.
2. Adds an AUTOSAR sender-receiver interface to the model.
3. Adds data elements.
4. Creates sender and receiver ports.
5. Maps Simulink inports and outports to AUTOSAR receiver and sender ports.

See also “Configure AUTOSAR Runnables and Events” on page 4-327.

```
% Open model
hModel = 'rtwdemo_autosar_multirunnables';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Add AUTOSAR S-R interface
ifName = 'mySrIf';
ifPkg = get(arProps,'XmlOptions','InterfacePackage')
addPackageableElement(arProps,'SenderReceiverInterface',ifPkg,ifName,'IsService',false);
ifPaths=find(arProps,[],'SenderReceiverInterface','PathType','FullyQualified')

% Add AUTOSAR S-R data elements with ReadWrite calibration access
de1 = 'myDE1';
de2 = 'myDE2';
swCalibValue= 'ReadWrite';
add(arProps, [ifPkg '/' ifName],'DataElements',de1,'SwCalibrationAccess',swCalibValue);
add(arProps, [ifPkg '/' ifName],'DataElements',de2,'SwCalibrationAccess',swCalibValue);
```

```
% Add AUTOSAR receiver and sender ports with S-R interface name
rPortName = 'myRPort';
pPortName = 'myPPort';
aswcPath = find(arProps,[],'AtomicComponent','PathType','FullyQualified')
add(arProps,aswcPath{1},'ReceiverPorts',rPortName,'Interface',ifName);
add(arProps,aswcPath{1},'SenderPorts',pPortName,'Interface',ifName);

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);

% Map Simulink inport RPort_DE2 to AUTOSAR receiver port myRPort and data element myDE2
rDataAccessMode = 'ImplicitReceive';
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'RPort_DE2')
mapInport(slMap,'RPort_DE2',rPortName,de2,rDataAccessMode);
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'RPort_DE2')

% Map Simulink outport PPort_DE1 to AUTOSAR sender port myPPort and data element myDE1
sDataAccessMode = 'ImplicitSend';
[arPortName,arDataElementName,arDataAccessMode]=getOutport(slMap,'PPort_DE1')
mapOutport(slMap,'PPort_DE1',pPortName,de1,sDataAccessMode);
[arPortName,arDataElementName,arDataAccessMode]=getOutport(slMap,'PPort_DE1')
```

Configure Sender-Receiver Data Element Properties

This example loops through AUTOSAR sender-receiver (S-R) interfaces and data elements to configure calibration properties for S-R data elements.

```
% Open model
hModel = 'rtwdemo_autosar_multirunnables';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Configure SwCalibrationAccess for AUTOSAR data elements in S-R interfaces
srIfs = find(arProps,[],'SenderReceiverInterface','PathType','FullyQualified')

% Loop through S-R interfaces and get data elements
for i=1:length(srIfs)
    srIf = srIfs{i}
    dataElements = get(arProps,srIf,'DataElements','PathType','FullyQualified')

% Loop through data elements for each S-R interface and set SwCalibrationAccess
    swCalibValue = 'ReadWrite';
    for ii=1:length(dataElements)
        dataElement = dataElements{ii}
        set(arProps,dataElement,'SwCalibrationAccess',swCalibValue)
        get(arProps,dataElement,'SwCalibrationAccess')
    end
end
```

Configure AUTOSAR Client-Server Interfaces

- “Configure Server Properties” on page 4-336
- “Configure Client Properties” on page 4-337

Configure Server Properties

This example:

1. Opens a model.
2. Adds an AUTOSAR client-server interface to the model.
3. Adds an operation.
4. Creates a server port.
5. Creates a server runnable.
6. Maps a Simulink function to the AUTOSAR server runnable.

```
% Open model
hModel = 'mControllerWithInterface_server';
addpath (fullfile(matlabroot,'/help/toolbox/ecoder/examples/autosar'));
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Add AUTOSAR C-S interface
ifName = 'myCsIf';
ifPkg = get(arProps,'XmlOptions','InterfacePackage')
addPackageableElement(arProps,'ClientServerInterface',ifPkg,ifName,'IsService',false);
ifPaths=find(arProps,[],'ClientServerInterface','PathType','FullyQualified')

% Add AUTOSAR operation to C-S interface
csOp = 'readData';
add(arProps, [ifPkg '/' ifName],'Operations',csOp);

% Add AUTOSAR arguments to C-S operation with Direction and SwCalibrationAccess properties
args = {'Op','In'; 'Data','Out'; 'ERR','Out'; 'NegCode','Out'}
swCalibValue = 'ReadOnly';
for i=1:length(args)
    add(arProps,[ifPkg '/' ifName '/' csOp],'Arguments',args{i,1},'Direction',args{i,2},...
        'SwCalibrationAccess',swCalibValue);
end
get(arProps,[ifPkg '/' ifName '/' csOp],'Arguments')

% Add AUTOSAR server port with C-S interface name
sPortName = 'mySPort';
aswcPath = find(arProps,[],'AtomicComponent','PathType','FullyQualified')
add(arProps,aswcPath{1},'ServerPorts',sPortName,'Interface',ifName);

% Add AUTOSAR server runnable with symbol name that matches Simulink function name
serverRunnable = 'Runnable_myReadData';
serverRunnableSymbol = 'readData';
swc = get(arProps,'XmlOptions','ComponentQualifiedName')
ib = get(arProps,swc,'Behavior')
runnables = get(arProps,ib,'Runnables')
% To avoid symbol conflict, remove existing runnable with symbol name readData
delete(arProps,'SWC_Controller/ControllerWithInterface_ar/Runnable_readData')
add(arProps,ib,'Runnables',serverRunnable,'symbol',serverRunnableSymbol);
runnables = get(arProps,ib,'Runnables')

% Add AUTOSAR operation invoked event
```

```
oiEventName = 'Event_myReadData';
add(arProps,ib,'Events',oiEventName,'Category','OperationInvokedEvent',...
    'Trigger','mySPort.readData','StartOnEvent',[ib '/' serverRunnable]);

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);

% Map Simulink function readData to AUTOSAR runnable Runnable_myReadData
mapFunction(slMap,'readData',serverRunnable);
arRunnableName=getFunction(slMap,'readData')
```

Configure Client Properties

This example:

1. Opens a model.
2. Adds an AUTOSAR client-server interface to the model.
3. Adds an operation.
4. Creates a client port.
5. Maps a Simulink function caller to the AUTOSAR client port and operation.

```
% Open model
hModel = 'mControllerWithInterface_client';
addpath (fullfile(matlabroot,'/help/toolbox/ecoder/examples/autosar'));
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Add AUTOSAR C-S interface
ifName = 'myCsIf';
ifPkg = get(arProps,'XmlOptions','InterfacePackage')
addPackageableElement(arProps,'ClientServerInterface',ifPkg,ifName,'IsService',false);
ifPaths=find(arProps,[],'ClientServerInterface','PathType','FullyQualified')

% Add AUTOSAR operation to C-S interface
csOp = 'readData';
add(arProps, [ifPkg '/' ifName],'Operations',csOp);

% Add AUTOSAR arguments to C-S operation with Direction and SwCalibrationAccess properties
args = {'Op','In'; 'Data','Out'; 'ERR','Out'; 'NegCode','Out'}
swCalibValue = 'ReadOnly';
for i=1:length(args)
    add(arProps,[ifPkg '/' ifName '/' csOp],'Arguments',args{i,1},'Direction',args{i,2},...
        'SwCalibrationAccess',swCalibValue);
end
get(arProps,[ifPkg '/' ifName '/' csOp],'Arguments')

% Add AUTOSAR client port with C-S interface name
cPortName = 'myCPort';
aswcPath = find(arProps,[],'AtomicComponent','PathType','FullyQualified')
add(arProps,aswcPath{1},'ClientPorts',cPortName,'Interface',ifName);

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);
```

```
% Map Simulink function caller readData to AUTOSAR client port and operation
[arPort,arOp] = getFunctionCaller(slMap,'readData')
mapFunctionCaller(slMap,'readData',cPortName,csOp);
[arPort,arOp] = getFunctionCaller(slMap,'readData')
```

Configure AUTOSAR Mode-Switch Interfaces

This example:

1. Opens a model.
2. Declares an AUTOSAR mode declaration group.
3. Adds a mode-switch interface to the model.
4. Adds a mode receiver port.
5. Adds a ModeSwitchEvent to a runnable.
6. Maps a Simulink inport to the AUTOSAR mode receiver port and mode group.

```
% Add path to model and mode definition files and open model
addpath (fullfile(matlabroot,'/help/toolbox/ecoder/examples/autosar'));
hModel = 'mAutosarMsConfig';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% File mdgModes.m declares AUTOSAR mode declaration group mdgModes for use with the M-S interface.
% See matlabroot/help/toolbox/ecoder/examples/autosar/mdgModes.m, which must be on the MATLAB path.
% The enumerated mode values are:
%    STARTUP(0)
%    RUN(1)
%    SHUTDOWN(2)
% Separate code, below, defines mode declaration group information for XML export.

% Apply data type mdgModes to Simulink inport MRPort
set_param([hModel,'/MRPort'],'OutDataTypeStr','Enum: mdgModes')
get_param([hModel,'/MRPort'],'OutDataTypeStr')
% Apply data type mdgModes and value STARTUP to Runnable1_subsystem/Enumerated Constant
set_param([hModel,'/Runnable1_subsystem/Enumerated Constant'],'OutDataTypeStr','Enum: mdgModes')
set_param([hModel,'/Runnable1_subsystem/Enumerated Constant'],'Value','mdgModes.STARTUP')

% Add AUTOSAR M-S interface and set its ModeGroup to mdgModes
ifName = 'myMsIf';
modeGroup = 'mdgModes';
ifPkg = get(arProps,'XmlOptions','InterfacePackage')
addPackageableElement(arProps,'ModeSwitchInterface',ifPkg,ifName,'IsService',true);
add(arProps,[ifPkg '/' ifName],'ModeGroup',modeGroup)
ifPaths=find(arProps,[],'ModeSwitchInterface','PathType','FullyQualified')

% Add AUTOSAR mode-receiver port with M-S interface name
mrPortName = 'myMRPort';
aswcPath = find(arProps,[],'AtomicComponent','PathType','FullyQualified')
add(arProps,aswcPath{1},'ModeReceiverPorts',mrPortName,'Interface',ifName);

% Define AUTOSAR ModeSwitchEvent for runnable
msRunnable = 'Runnable1';
msEventName = 'myMSEvent';
```

```
swc = get(arProps,'XmlOptions','ComponentQualifiedName');
ib = get(arProps,swc,'Behavior')
runnables = get(arProps,ib,'Runnables')
add(arProps,ib,'Events',msEventName,'Category','ModeSwitchEvent',...
    'Activation', 'OnTransition', ...
    'StartOnEvent', [ib '/' msRunnable]);
% Separate code, below, sets ModeSwitchEvent port and trigger values.

% To pass validation, remove redundant timing event in AUTOSAR configuration
events = get(arProps,ib,'Events')
delete(arProps,[ib,'/Event_t_1tic_A'])
events = get(arProps,ib,'Events')

% Export mode declaration group information to AUTOSAR data type package in XML
mdgPkg = get(arProps,'XmlOptions','DataTypePackage')
mdgPath = [mdgPkg '/' modeGroup]
initMode = [mdgPath '/STARTUP']
addPackageableElement(arProps,'ModeDeclarationGroup',mdgPkg,modeGroup,'OnTransitionValue',100)
% Add modes to ModeDeclarationGroup and set InitialMode
add(arProps,mdgPath,'Mode','STARTUP','Value',0)
add(arProps,mdgPath,'Mode','RUN','Value',1)
add(arProps,mdgPath,'Mode','SHUTDOWN','Value',2)
set(arProps,mdgPath,'InitialMode',initMode)
% Set ModeGroup for M-S interface
set(arProps,[ifPkg '/' ifName '/' modeGroup],'ModeGroup',mdgPath)

% Set port and trigger for AUTOSAR ModeSwitchEvent
expTrigger = {[mrPortName '.STARTUP'], [mrPortName '.SHUTDOWN']}
set(arProps,[ib '/' msEventName],'Trigger',expTrigger)

% Use AUTOSAR map functions
slMap=autosar.api.getSimulinkMapping(hModel);

% Map Simulink inport MRPort to AUTOSAR mode receiver port myMRPort and mode group mdgModes
msDataAccessMode = 'ModeReceive';
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'MRPort')
mapInport(slMap,'MRPort',mrPortName,modeGroup,msDataAccessMode);
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'MRPort')

% To pass validation, set inport Runnable1 sample time to -1 (inherited)
set_param([hModel,'/Runnable1'],'SampleTime','-1')
```

Configure AUTOSAR XML Export

Configure XML Export Options

This example configures AUTOSAR XML export parameter **Exported XML file packaging** (`ArxmlFilePackaging`).

To configure AUTOSAR package paths, see “Configure AUTOSAR Package Paths” on page 4-340.

```
% Open model
hModel = 'rtwdemo_autosar_counter';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Set exported AUTOSAR XML file packaging to Single file
get(arProps,'XmlOptions','ArxmlFilePackaging')
set(arProps,'XmlOptions','ArxmlFilePackaging','SingleFile');
get(arProps,'XmlOptions','ArxmlFilePackaging')
```

Configure AUTOSAR Package Paths

This example configures an AUTOSAR package path for XML export. For other AUTOSAR package path property names, see “Configure AUTOSAR Packages and Paths” on page 4-90.

To configure other XML export options, see “Configure XML Export Options” on page 4-339.

```
% Open model
hModel = 'rtwdemo_autosar_counter';
open_system(hModel);

% Use AUTOSAR property functions
arProps = autosar.api.getAUTOSARProperties(hModel);

% Specify AUTOSAR application data type package path for XML export
get(arProps,'XmlOptions','ApplicationDataTypePackage')
set(arProps,'XmlOptions','ApplicationDataTypePackage','/rtwdemo_autosar_counter_pkg/ADTs');
get(arProps,'XmlOptions','ApplicationDataTypePackage')
```

See Also

`get` | `set`

Related Examples

- “Configure and Map AUTOSAR Component Programmatically” on page 4-313

More About

- “AUTOSAR Component Configuration” on page 4-3

Limitations and Tips

The following limitations apply to AUTOSAR component development.

In this section...
“AUTOSAR Client Block in Referenced Model” on page 4-341
“Use the Merge Block for Inter-Runnable Variables” on page 4-341

AUTOSAR Client Block in Referenced Model

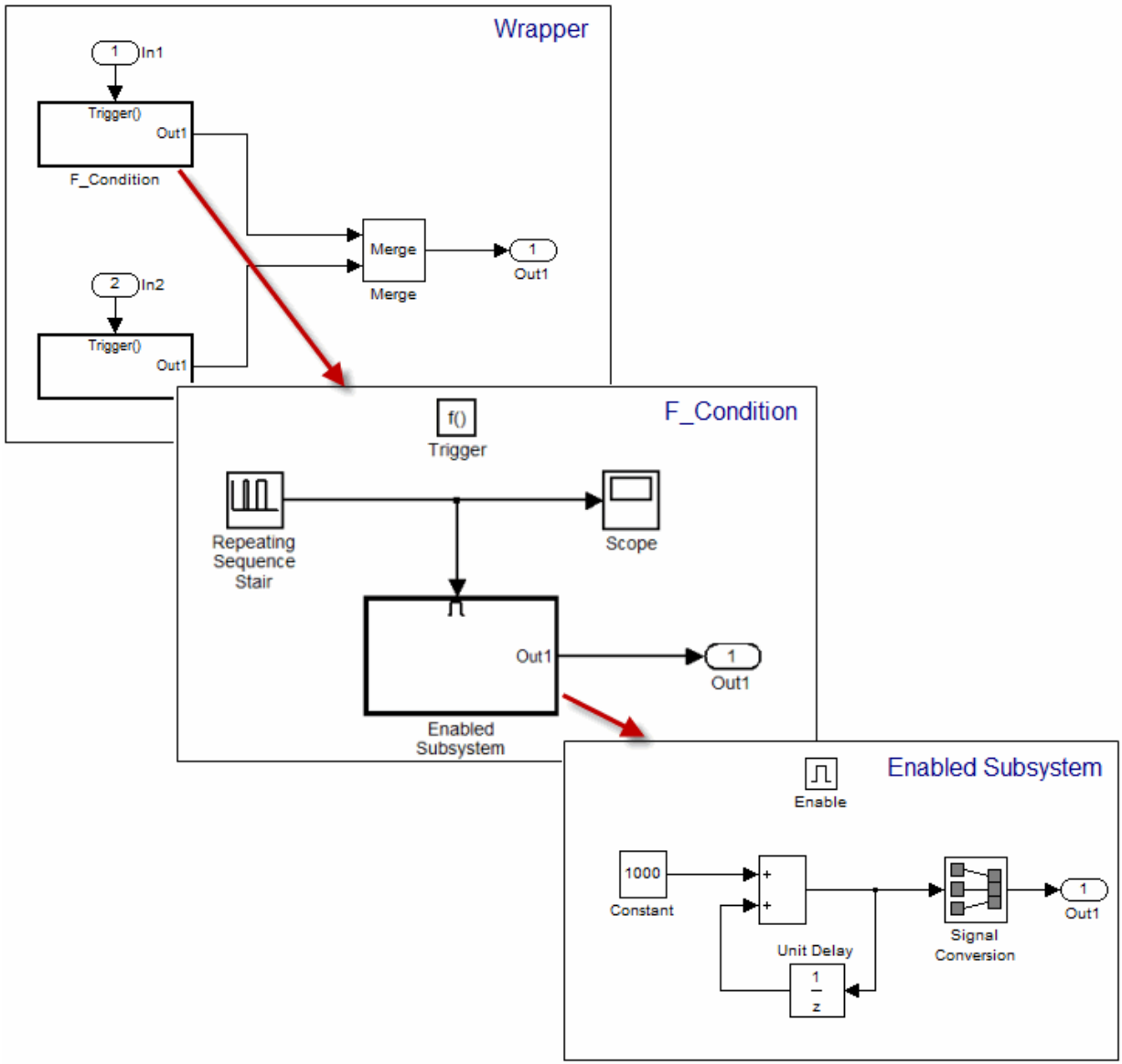
The software does not support the use of an AUTOSAR client block, such as Function Caller or Invoke AUTOSAR Server Operation, in a referenced model.

Use the Merge Block for Inter-Runnable Variables

You can use the Merge block to merge inter-runnable variables. However, you must do the following:

- Connect the output signal of the Merge block to either one root outport or one or more subsystems.
- If the output signal of the Merge block is connected to the inputs of one or more subsystems, assign the same signal name to the Merge block's output and inputs.

In addition, the signal from the function-call subsystem outport that enters a Merge block must not be conditionally computed. Consider the following example.



The output from the subsystem `F_condition` is the conditional output from `Enabled Subsystem`. When you try to validate or build the model, the software generates an error.

If you use an S-Function block instead of the Enabled Subsystem block, the software generates a *warning* when you validate or build the model.

AUTOSAR Code Generation

Getting Started with AUTOSAR Code Generation

Generate AUTOSAR-compliant C code and export AUTOSAR XML (`arxml`) descriptions from a Simulink® model.

Embedded Coder® software supports AUTomotive Open System ARchitecture (AUTOSAR), an open and standardized automotive software architecture. Automobile manufacturers, suppliers, and tool developers jointly develop AUTOSAR components. To develop AUTOSAR components in Simulink, follow this general workflow:

1. Create a Simulink representation of an AUTOSAR component.
2. Develop the component by refining the AUTOSAR configuration and creating algorithmic model content.
3. Generate `arxml` descriptions and algorithmic C code for testing in Simulink or integration into the AUTOSAR Runtime Environment (RTE).

Prerequisites

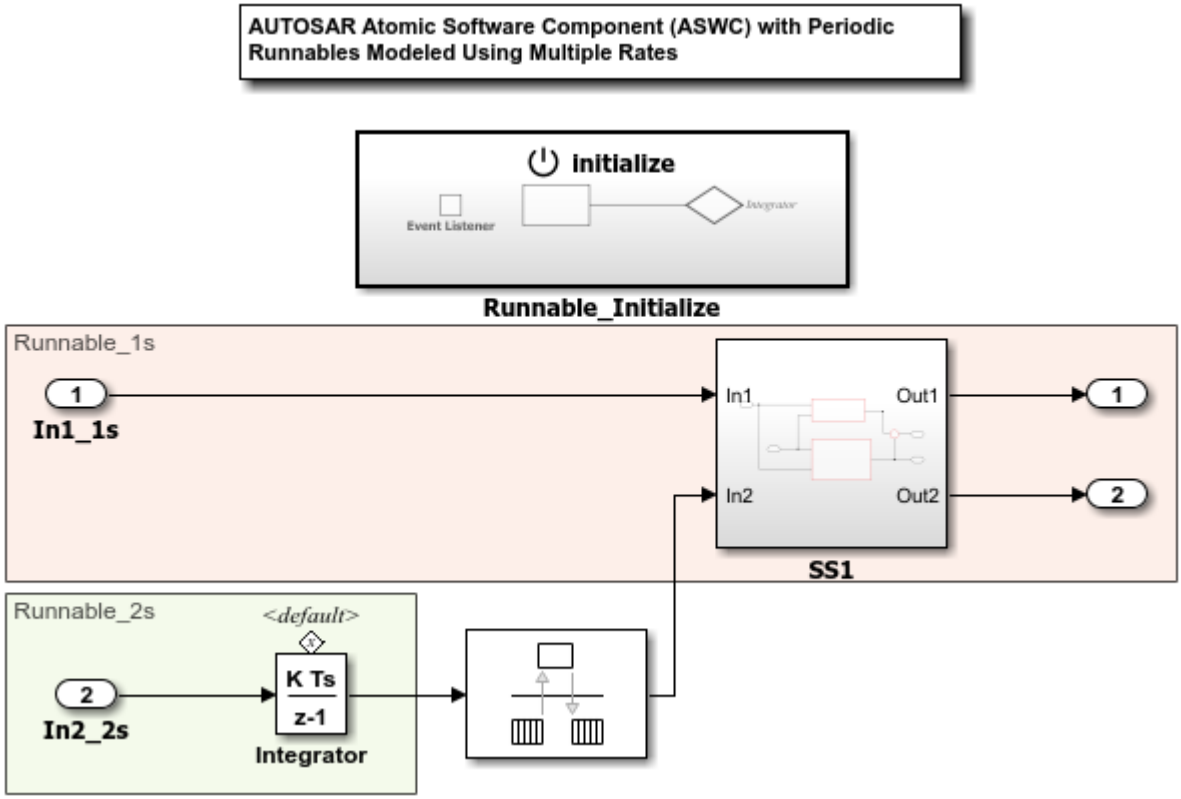
The Embedded Coder Support Package for AUTOSAR Standard is required for working with the model in this example.

- Install the AUTOSAR Standard Support Package
- “Support Package Installation” (MATLAB)

Prepare Model for AUTOSAR Code Generation

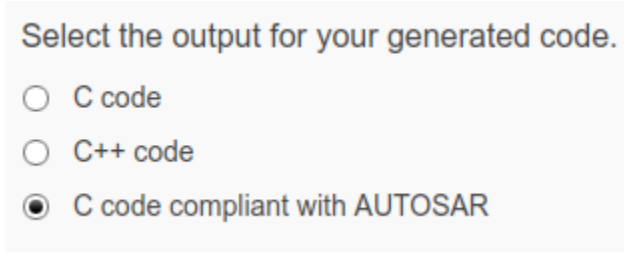
To see the steps for generating AUTOSAR-compliant C code and exporting `arxml` descriptions from an AUTOSAR model, open a model and prepare the model for AUTOSAR code generation.

Open a model from which you want to generate AUTOSAR code and descriptions. The model can be unconfigured or only partially configured for code generation. This example uses demo model `rtwdemo_autosar_swc.`



To prepare the model for AUTOSAR code generation, use Embedded Coder Quick Start. In the model window, click **Code > C/C++ Code > Embedded Coder Quick Start**.

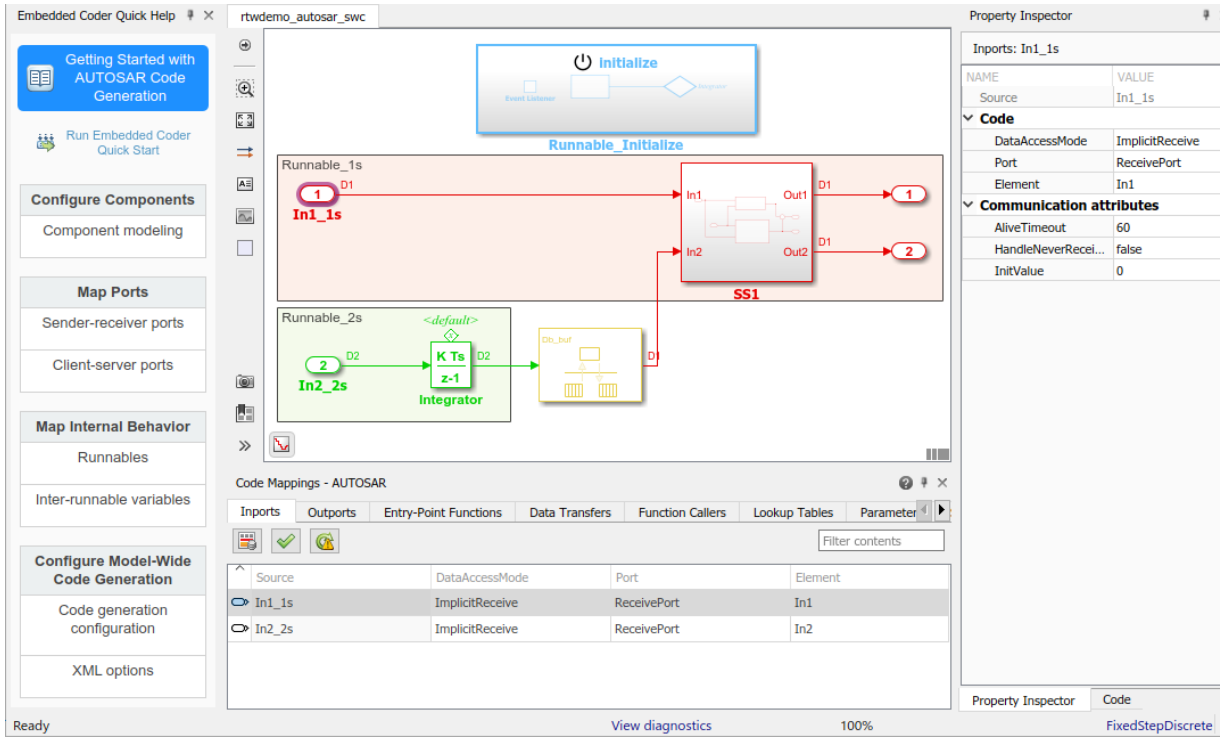
Work through the quick-start procedure. In the Output window, select output option **C code compliant with AUTOSAR**.



The quick-start software takes the following steps to configure an AUTOSAR software component model:

1. Configures code generation settings for the model. If the AUTOSAR target is not already selected, the software sets model configuration parameter **System target file** to `autosar.tlc` and **Generate XML for schema version** to a default schema value.
2. If no AUTOSAR mapping exists, creates a mapped AUTOSAR software component for the model.
3. Performs a model build.

In the last window, when you click **Finish**, your model opens in the AUTOSAR code perspective. AUTOSAR code perspective displays a help panel, a Property Inspector panel, and directly below the model, the Code Mapping Editor.



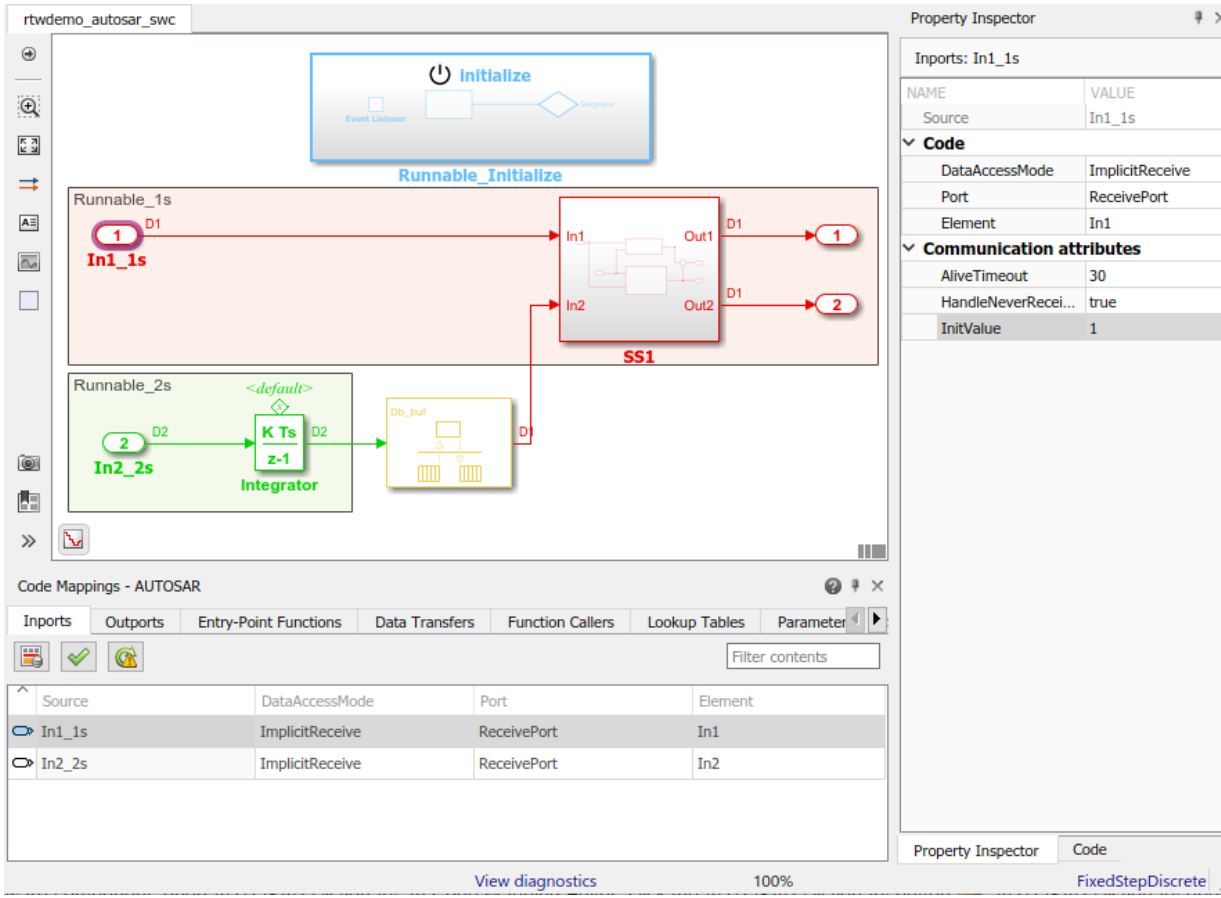
Develop Simulink Representation of AUTOSAR Software Component

After you create an AUTOSAR software component model in Simulink, use the Code Mapping Editor and AUTOSAR Dictionary to further develop the AUTOSAR component. For more information, see “AUTOSAR Component Configuration” on page 4-3.

In a tabbed table format, the Code Mapping Editor displays Simulink model elements, such as inports, outports, entry-point functions, and data transfers. Use the editor to map Simulink model elements to AUTOSAR component elements from a Simulink model perspective. AUTOSAR component elements are defined in the AUTOSAR standard, and include ports, runnable entities, and inter-runnable variables (IRVs).

In the AUTOSAR code perspective view of your model, select the Inports tab of the Code Mapping Editor, and select a model inport. The attributes of the selected inport appear in the Property Inspector panel. This example selects Simulink inport `In1_1s`, which is mapped to AUTOSAR port `ReceivePort` and data element `In1` with data access mode `ImplicitReceive`. In each Code Mapping Editor tab, you can select model elements and modify their AUTOSAR mapping and attributes. Your modifications are reflected in the generated `arxml` descriptions and C code.

If you are using demo model `rtwdemo_autosar_swc` with this example, modify the communication attributes for the mapped Simulink inport `In1_1s`. In the Property Inspector, change the `AliveTimeout` attribute from 60 to 30, change `HandleNeverReceived` from `false` to `true`, and change `InitValue` from 0 to 1.

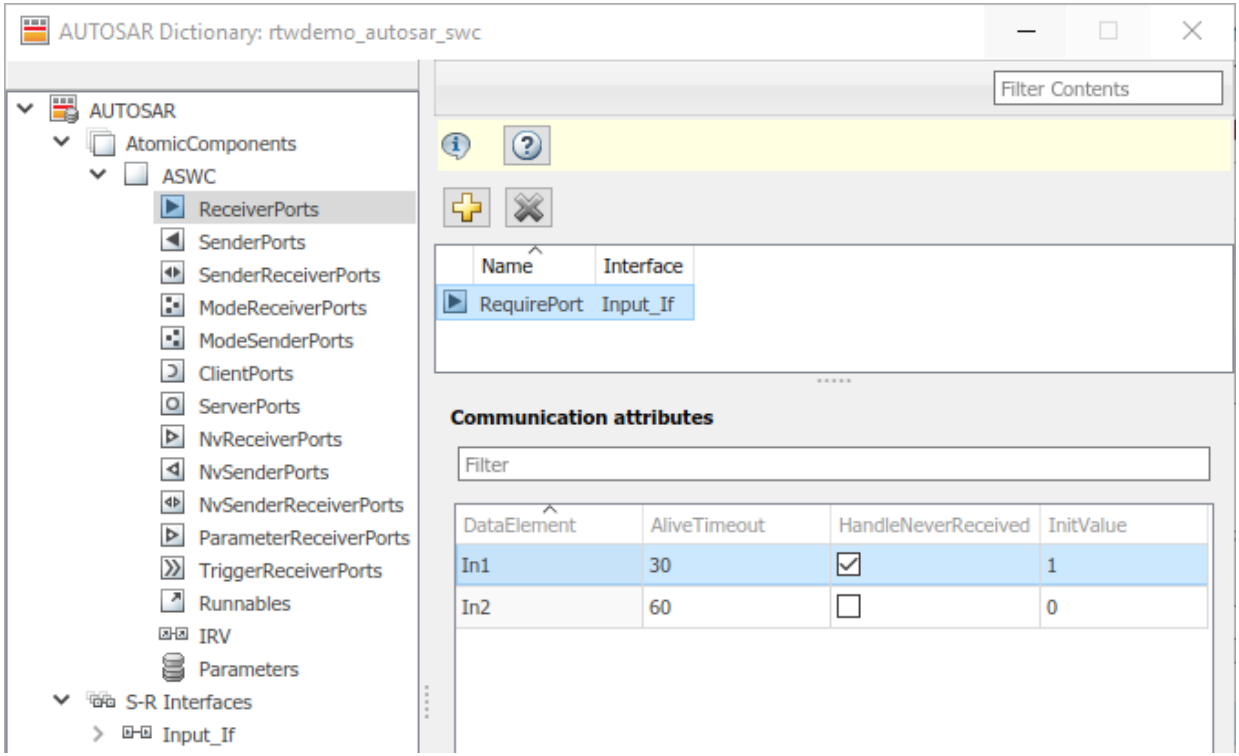


To configure the AUTOSAR properties of the mapped AUTOSAR software component, open AUTOSAR Dictionary. In Code Mapping Editor, click the AUTOSAR Dictionary button, which is the leftmost button. AUTOSAR Dictionary opens in the AUTOSAR view that corresponds to the Simulink element that you last selected and mapped in Code Mapping Editor. If you selected and mapped a Simulink inport, the dictionary opens in ReceiverPorts view and displays the AUTOSAR port to which you mapped the inport.

In a tree format, AUTOSAR Dictionary displays the mapped AUTOSAR component and its elements, communication interfaces, computation methods, software address methods, and XML options. Use the dictionary to configure AUTOSAR elements and properties from an AUTOSAR component perspective.

In the ReceiverPorts view, select the AUTOSAR receiver port to which the Simulink inport was mapped in the Code Mapping Editor. If an AUTOSAR element has additional undisplayed attributes, selecting the element displays them. In each AUTOSAR element view, you can add or rename AUTOSAR elements and modify their displayed properties. Your modifications are reflected in the generated `arxml` descriptions and C code.

If you are using demo model `rtwdemo_autosar_swc` with this example, rename the AUTOSAR receiver port from `ReceivePort` to `RequirePort`. To initiate the edit, click in the **Name** value field.

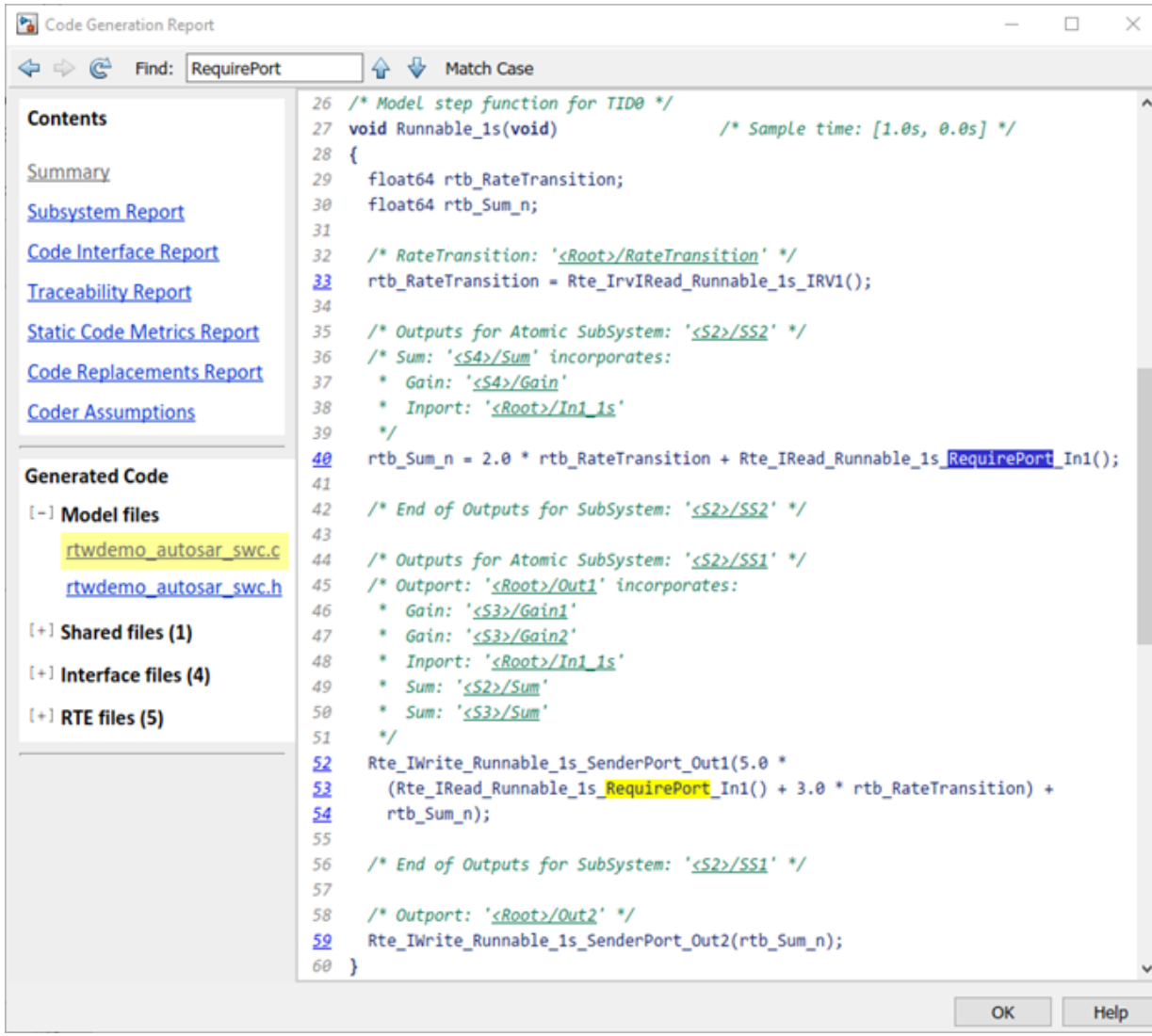


Generate C Code and ARXML Descriptions

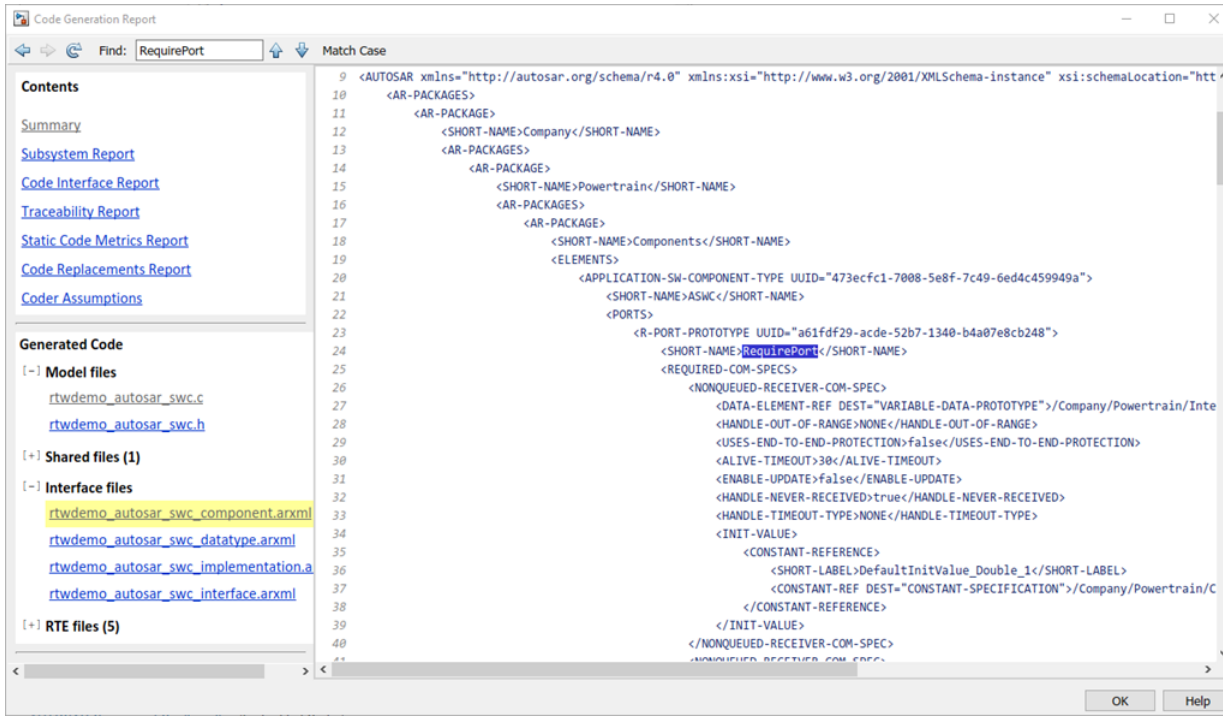
Building the AUTOSAR model generates AUTOSAR-compliant C code and exports `arxml` descriptions. In the model window, press **Ctrl+B**, or click the **Code** menu and select **C/C++ Code > Build Model**.

When the build completes, a code generation report opens. Examine the report. Verify that your Code Mapping Editor and AUTOSAR Dictionary changes are reflected in the C code and `arxml` descriptions. For example, use the **Find** field to search for the name of the AUTOSAR receiver port that you modified and renamed.

The generated C code encodes the AUTOSAR receiver port name in AUTOSAR Runtime Environment (RTE) API read calls.



The generated `arxml` description of the AUTOSAR receiver port uses the modified port name and the modified values for port communication attributes `AliveTimeout`, `HandleNeverReceived`, and `InitValue`.



Related Links

- “AUTOSAR Code Generation”
- “AUTOSAR Component Configuration” on page 4-3
- “AUTOSAR”

Generate AUTOSAR C Code and XML Component Descriptions

To generate AUTOSAR-compliant C code and `arxml` component descriptions from a model configured for AUTOSAR:

1. Examine AUTOSAR code generation parameters on the **Code Generation** > **AUTOSAR Code Generation Options** pane of the Configuration Parameters dialog box.
2. Examine AUTOSAR XML export options using AUTOSAR Dictionary or AUTOSAR property functions.
3. Build the model.

This topic explains the AUTOSAR code generation options and their effects on generated `arxml` and C code.

In this section...

Select an AUTOSAR Schema

The software supports the following AUTOSAR schema versions for import and export of `arxml` files and generation of AUTOSAR-compatible C code.

Schema Version Value	Schema Revisions Supported for Import	Export Schema Revision
`4.3` (default)	4.3.0	4.3.0
`4.2`	4.2.1, 4.2.2	4.2.2
`4.1`	4.1.1, 4.1.2, 4.1.3	4.1.3

Schema Version Value	Schema Revisions Supported for Import	Export Schema Revision
`4.0`	4.0.1, 4.0.2, 4.0.3	4.0.3
`3.2`	3.2.1, 3.2.2	3.2.2
`3.1`	3.1.1, 3.1.2, 3.1.3, 3.1.4	3.1.4
`3.0`	3.0.1, 3.0.2, 3.0.3, 3.0.4, 3.0.5, 3.0.6	3.0.2
`2.1`	2.1 (XSD rev 0014, 0015, 0017, 0018)	2.1 (XSD rev 0017)

Selecting the AUTOSAR system target file for your model for the first time sets the schema version parameter to the default value, `4.3`.

When you import `arxml` code into Simulink, the `arxml` importer detects the schema version and sets the schema version parameter in the model. For example, if you import `arxml` code based on schema 4.0 revision 4.0.1, 4.0.2, or 4.0.3, the importer sets the schema version parameter to `4.0`.

When you export your AUTOSAR software component, code generation exports XML that is compliant with the current schema version value. For example, if **Generate XML file for schema version** equals `4.0`, export uses the export schema revision listed above for schema 4.0, that is, revision 4.0.3.

If you need to change the schema version, you must do so before exporting your AUTOSAR software component. To select a schema version, on the **Code Generation** > **AUTOSAR Code Generation Options** pane of the Configuration Parameters dialog box, from the **Generate XML file for schema version** drop-down list, select the schema version that you require.

Note The AUTOSAR model parameters on the **AUTOSAR Code Generation Options** pane must be set to the same values for top and referenced models. This guideline applies to **Generate XML file for schema version**, **Maximum SHORT-NAME length**, **Use AUTOSAR compiler abstraction macros**, and **Support root-level matrix I/O using one-dimensional arrays**.

Specify Maximum SHORT-NAME Length

The AUTOSAR standard specifies that the maximum length of `SHORT-NAME` XML elements is 128 characters, for schema version 4.x or later, or 32 characters, for earlier

schema versions. Even for earlier schema versions, your AUTOSAR authoring tool may support the use of longer `SHORT-NAME` elements, for example, to name ports and interfaces.

Use the **Maximum SHORT-NAME length** parameter to specify a maximum length for `SHORT-NAME` elements exported by the code generator. On the **Code Generation** > **AUTOSAR Code Generation Options** pane of the Configuration Parameters dialog box, in the **Maximum SHORT-NAME length** field, specify a positive number of characters less than or equal to 128. The default is 128 characters.

Configure AUTOSAR Compiler Abstraction Macros

Compilers for 16-bit platforms (for example, Cosmic and Metrowerks for S12X or Tasking for ST10) use special keywords to deal with the limited 16-bit addressing range. The location of data and code beyond the 64k border is selected explicitly by special keywords. However, if such keywords are used directly within the source code, then software must be ported separately for each microcontroller family. That is, the software is not platform-independent.

AUTOSAR specifies C macros to abstract compiler directives (near/far memory calls) in a platform-independent manner. These compiler directives, derived from the 16-bit platforms, enable better code efficiencies for 16-bit micro-controllers without separate porting of source code for each compiler. This approach allows your system integrator, rather than your software component implementer, to choose the location of data and code for each software component.

For more information on AUTOSAR compiler abstraction, see `www.autosar.org`.

To configure AUTOSAR compiler macro generation, in the **Code Generation** > **AUTOSAR Code Generation Options** pane of the Configuration Parameters dialog box, select **Use AUTOSAR compiler abstraction macros**.

When you build the model, the software applies compiler abstraction macros to global data and function definitions in the generated code.

For data, the macros are in the following form:

- `CONST(`*`consttype`*`, `*`memclass`*`) `*`varname`*`;`
- `VAR(`*`type`*`, `*`memclass`*`) `*`varname`*`;`

where

- *consttype* and *type* are data types
- *memclass* is a macro string *SWC*_VAR (*SWC* is the software component identifier)
- *varname* is the variable identifier

For functions (model and subsystem), the macros are in the following form:

- FUNC(*type*, *memclass*) funcname(void)

where

- *type* is the data type of the return argument
- *memclass* is a macro string. This string can be either *SWC*_CODE for runnables (external functions), or *SWC*_CODE_LOCAL for internal functions (*SWC* is the software component identifier).

Example 5.1. Example

If you do *not* select **Use AUTOSAR compiler abstraction macros**, the code generator produces the following code:

```
/* Block signals (auto storage) */
BlockIO rtB;

/* Block states (auto storage) */
D_Work rtDWork;

/* Model step function */
void Runnable_Step(void)
```

However, if you select **Use AUTOSAR compiler abstraction macros**, the code generator produces macros in the code:

```
/* Block signals (auto storage) */
VAR(BlockIO, SWC1_VAR) rtB;

/* Block states (auto storage) */
VAR(D_Work, SWC1_VAR) rtDWork;

/* Model step function */
FUNC(void, SWC1_CODE) Runnable_Step(void)
```

Root-Level Matrix I/O

The software supports matrix I/O at the root-level by generating code that implements matrices as one-dimensional arrays. However, this behavior is not the default. To

configure root-level matrix I/O, on the **Code Generation > AUTOSAR Code Generation Options** pane of the Configuration Parameters dialog box, select **Support root-level matrix I/O using one-dimensional arrays**.

Inspect AUTOSAR XML Options

Examine the XML options that you configured using AUTOSAR Dictionary. If you have not yet configured them, see “Configure AUTOSAR XML Options” on page 4-63.

Generate AUTOSAR C and XML Files

After configuring AUTOSAR code generation and XML options, generate code. To generate C code and export XML descriptions, build the model (**Ctrl+B**).

The build process generates AUTOSAR-compliant C code and AUTOSAR XML descriptions to the model build folder. The following table shows which XML files are generated, based on the value of the **Exported XML file packaging** option configured in AUTOSAR Dictionary.

Exported XML File Packaging Value	Exported File Name	By Default Contains...
`Single file`	*`modelname`*`.arxml`	All AUTOSAR elements.
`Modular`	*`modelname`*`_component.arxml`	Software components, including calibration components. This is the main `arxml` file exported for the Simulink model. In addition to AUTOSAR software components, the file includes elements for which AUTOSAR packages (AR-PACKAGEs) are not configured, and AR-PACKAGEs that do not align with the package paths in the other exported `arxml` files. For more information on AR-PACKAGEs and their location in modular exported `arxml` files, see “Configure AUTOSAR Packages” on page 4-88.
	`modelname``_datatype.arxml`	Data types and related elements.

Exported XML File Packaging Value	Exported File Name	By Default Contains...
	*modelname*_implementation.arxml	Software component implementation.
	*modelname*_interface.arxml	Interfaces, including S-R, C-S, M-S, NV, and other interfaces.
	*modelname*_behavior.arxml	Software component internal behavior (generated only for schema 3.x or earlier).

You can merge the AUTOSAR XML component descriptions back into an AUTOSAR authoring tool. The AUTOSAR component information is partitioned into separate files to facilitate merging. The partitioning attempts to minimize the number of merges that you must do. You do not need to merge the data type file into the authoring tool because data types are usually defined early in the design process. You must, however, merge the internal behavior file because this information is part of the model implementation.

To help support the round trip of AUTOSAR elements between an AAT and the Simulink model-based design environment, the code generator preserves AUTOSAR elements and their UUIDs across `arxml` import and export. For more information, see “Round-Trip Preservation of AUTOSAR XML File Structure and Element Information” on page 3-18.

For an example of how to generate AUTOSAR-compliant C code and export AUTOSAR XML component descriptions from a Simulink model, see “Getting Started with AUTOSAR Code Generation” on page 5-2.

Code Generation with AUTOSAR Library

If your model is configured for AUTOSAR code generation, you can use the AUTOSAR 4.0 code replacement library to produce code that more closely aligns with the AUTOSAR standard. The AUTOSAR 4.0 code replacement library is intended for use with AUTOSAR schema version 4.0 or later.

In this section...

AUTOSAR Code Replacement Library

The AUTOSAR 4.0 code replacement library provides a way for you to customize the C/C++ code generator to produce code that more closely aligns with the AUTOSAR standard. Considering using the library if:

- You want to use service routines provided in the library.
- You have replacement code for the service routines.
- The replacement code follows the AUTOSAR file naming convention that routines for a given specification are in one header file (for example, `Mfl.h` or `Mfx.h`)
- You have a build harness setup that can compile and link the AUTOSAR library with the generated code. For more information about building code for AUTOSAR, see “AUTOSAR Code Generation”.

Note MATLAB and Simulink lookup table indexing differs from AUTOSAR MAP indexing. MATLAB takes the linear algebra approach—row (`u1`) and column (`u2`). AUTOSAR (and ASAM) takes the Cartesian coordinate approach—x-axis (`u2`) and y-axis (`u1`), where `u1` and `u2` are input arguments to Simulink 2-D lookup table blocks. Due to the difference,

the code replacement software transposes the input arguments for AUTOSAR MAP routines.

For more information on code replacement and code replacement libraries, see “What Is Code Replacement?” and “Code Replacement Libraries”.

Supported AUTOSAR Library Routines

To explore the AUTOSAR library routines supported by the AUTOSAR code replacement library, use the **Code Replacement Viewer**. To open the viewer, enter `crviewer` at the command prompt.

For more information, see “Choose a Code Replacement Library”.

Configure Code Generator to Use AUTOSAR Code Replacement Library

To configure the code generator to apply the AUTOSAR code replacement library, select `AUTOSAR 4.0` for the **Code replacement library** model configuration parameter.

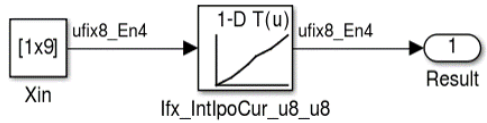
For more information on code replacement and code replacement libraries, see “What Is Code Replacement?” and “Code Replacement Libraries”.

Replace Code with Functions Compatible with AUTOSAR IFL and IFX Library Routines

To replace code generated for Simulink lookup table blocks with functions that are compatible with AUTOSAR floating-point interpolation (IFL) and fixed-point interpolation (IFX) library routines:

1. In your Simulink model, use the Simulink lookup table blocks Interpolation Using Prelookup, Prelookup, and n-D Lookup Table.

   For example:



2. For each lookup table block in the model, use information in “Required Algorithm Property Settings for IFL/IFX Function and Block Mappings” on page 5-19 to configure the block algorithm parameters. Given those parameter settings, the code generator produces code that is compatible with a corresponding AUTOSAR IFX or IFL routine.
3. Configure the model for the code generator to use the AUTOSAR 4.0 code replacement library. In the Configuration Parameters dialog box, select **Code Generation > Interface > Code replacement library > AUTOSAR 4.0**. Alternatively, from the command line or programmatically, use `set_param` to set the `CodeReplacementLibrary` parameter to `'AUTOSAR 4.0'`.
4. Optionally, configure the model for the code generator to produce a code generation report that summarizes which blocks trigger code replacements. In the Configuration Parameters dialog box, in the **Code Generation > Report** pane, select the option **Summarize which blocks triggered code replacements**. Alternatively, from the command line or programmatically, use `set_param` to set the `GenerateCodeReplacementReport` parameter to `'on'`.
5. Generate code.
6. Review the generated code for expected code replacements. For example:

```
for (iU = 0; iU < 9; iU++) {
  /* Lookup_n-D: '<Root>/Ifx_IntIpoCur_u8_u8' incorporates:
   *  Constant: '<Root>/Xin'
   */
  rtb_Ifx_IntIpoCur_u8_u8 = Ifx_IntIpoCur_u8_u8(look01_ConstP.Xin_Value[iU],
    10U, (*Rte_CData_X_array_u8()), (*Rte_CData_Val_array_u8()));

  /* Outport: '<Root>/Result' */
  look01_Y.Result[iU] = rtb_Ifx_IntIpoCur_u8_u8;
}
```

Required Algorithm Property Settings for IFL/IFX Function and Block Mappings

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
`Ifl_DPSearch` Prelookup	**Extrapolation method** `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Linear search` or `Binary search`

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Use last breakpoint for input at or above upper limit `UseLastBreakPoint`	On
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifl_IpoCur` Interpolation Using Prelookup	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Clip`
	Valid index input may reach last index `ValidIndexMayReachLast`	On
	Remove protection against out-of-range index in generated code `RemoveProtectionIndex`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifl_IpoMap` Interpolation Using Prelookup	**Interpolation method** `InterpMethod`	`Linear`

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Extrapolation method `ExtrapMethod`	`Clip`
	Valid index input may reach last index `ValidIndexMayReachLast`	On
	Remove protection against out-of-range index in generated code `RemoveProtectionIndex`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifl_IntIpoCur` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Linear search` or `Binary search`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifl_IntIpoMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Linear search` or `Binary search`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifx_DPSearch` Prelookup	**Extrapolation method** `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Linear search` or `Binary search`
	Use last breakpoint for input at or above upper limit `UseLastBreakPoint`	On

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifx_IpoCur` Interpolation Using Prelookup	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Clip`
	Valid index input may reach last index `ValidIndexMayReachLast`	On
	Remove protection against out-of-range index in generated code `RemoveProtectionIndex`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifx_LkUpCur` Interpolation Using Prelookup	**Interpolation method** `InterpMethod`	`Flat`
	Extrapolation method `ExtrapMethod`	`Clip`

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Remove protection against out-of-range index in generated code `RemoveProtectionIndex`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Valid index input may reach last index `ValidIndexMayReachLast`	On
`Ifx_IpoMap` Interpolation Using Prelookup	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Clip`
	Valid index input may reach last index `ValidIndexMayReachLast`	On
	Remove protection against out-of-range index in generated code `RemoveProtectionIndex`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifx_LkUpMap` Interpolation Using Prelookup	**Interpolation method** `InterpMethod`	`Nearest`

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Extrapolation method `ExtrapMethod`	`Clip`
	Remove protection against out-of-range index in generated code `RemoveProtectionIndex`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Valid index input may reach last index `ValidIndexMayReachLast`	On
`Ifx_LkUpBaseMap` Interpolation Using Prelookup	**Interpolation method** `InterpMethod`	`Flat`
	Extrapolation method `ExtrapMethod`	`Clip`
	Remove protection against out-of-range index in generated code `RemoveProtectionIndex`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Valid index input may reach last index `ValidIndexMayReachLast`	On

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
`Ifx_IntIpoCur` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Linear search` or `Binary search`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifx_IntLkUpCur` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Flat`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Linear search` or `Binary search`
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
`Ifx_IntIpoFixCur` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Evenly spaced points`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Model configuration parameter **Optimization > Default parameter behavior** `DefaultParameterBehavior`	`Inlined`
	Breakpoint data should match power 2 spacing.	
`Ifx_IntLkUpFixCur` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Flat`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Evenly spaced points`
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Model configuration parameter **Optimization > Signals and Parameters > Default parameter behavior** `DefaultParameterBehavior`	`Inlined`
	Breakpoint data must match power 2 spacing.	
`Ifx_IntIpoFixICur` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Linear`

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Evenly spaced points`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Breakpoint data must not match power 2 spacing.	
`Ifx_IntLkUpFixICur` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Flat`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Evenly spaced points`
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Breakpoint data must not match power 2 spacing.	
`Ifx_IntIpoMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Linear search` or `Binary search`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
`Ifx_IntLkUpMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Nearest`

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Linear search` or `Binary search`
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
`Ifx_IntLkUpBaseMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Flat`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Linear search` or `Binary search`
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
`Ifx_IntIpoFixMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Evenly spaced points`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Model configuration parameter **Optimization > Signals and Parameters > Default parameter behavior** `DefaultParameterBehavior`	`Inlined`
	Breakpoint data must match power 2 spacing.	

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
`Ifx_IntLkUpFixMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Nearest`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Evenly spaced points`
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Model configuration parameter **Optimization** > **Signals and Parameters** > **Default parameter behavior** `DefaultParameterBehavior`	`Inlined`
	Breakpoint data must match power 2 spacing.	
`Ifx_IntLkUpFixBaseMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Flat`
	Extrapolation method `ExtrapMethod`	`Clip`

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Index search method `IndexSearchMethod`	`Evenly spaced points`
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Model configuration parameter **Optimization** > **Signals and Parameters** > **Default parameter behavior** `DefaultParameterBehavior`	`Inlined`
	Breakpoint data must match power 2 spacing.	
`Ifx_IntIpoFixIMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Linear`
	Extrapolation method `ExtrapMethod`	`Linear`
	Index search method `IndexSearchMethod`	`Evenly spaced points`

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Breakpoint data must not match power 2 spacing.	
`Ifx_IntLkUpFixIMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Nearest`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Evenly spaced points`
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On

IFL/IFX Function and Block Mapping	Algorithm Property Parameters	Value
	Breakpoint data must not match power 2 spacing.	
`Ifx_IntLkUpFixIBaseMap` n-D Lookup Table	**Interpolation method** `InterpMethod`	`Flat`
	Extrapolation method `ExtrapMethod`	`Clip`
	Index search method `IndexSearchMethod`	`Evenly spaced points`
	Remove protection against out-of-range input in generated code `RemoveProtectionInput`	Off
	Integer rounding mode `RndMeth`	`Round` or `Zero`
	Use last table value for inputs at or above last breakpoint `UseLastTableValue`	On
	Breakpoint data must not match power 2 spacing.	

Code Replacement Checks for AUTOSAR Lookup Table Functions

The following checks occur during the code replacement match process for AUTOSAR lookup table functions:

Function Type	Match Process Checks Whether
n-D lookup	• Input and corresponding breakpoint arguments have the same data type. • Output and the table data argument have the same data type.
Interpolation using prelookup	Output and the table data argument have the same data type.
Prelookup	Input and break point arguments have the same data type.

Verify AUTOSAR C Code with SIL and PIL

You can carry out model-based verification of AUTOSAR software components using software-in-the-loop (SIL) and processor-in-the-loop (PIL) simulations. Use SIL for verification of generated source code on your host computer, and PIL for verification of object code on your production target hardware. For example:

- You can run a top model that is configured for the AUTOSAR system target file (`autosar.tlc`) using the `Software-in-the-Loop (SIL)` and `Processor-in-the-Loop (PIL)` simulation modes.
- You can use Model block SIL or PIL to test AUTOSAR top-model code. In the Model block, set parameter **Code interface** to `Top model`.

For more information, see “Simulation with Top Model” and “Simulation with Model Blocks”.

Note You can create a SIL or PIL block for a component configured for the AUTOSAR system target file. For more information about configuring and running simulations with SIL or PIL blocks, see “Simulation with Blocks From Subsystems”. However, SIL and PIL block verification does not support code generated for Simulink Function and Function Caller blocks, for example, in AUTOSAR client-server configurations.

Import and Simulate AUTOSAR Code from Previous Releases

You can import into the current release AUTOSAR component code that you generated in a previous release. To observe the interaction of code from a previous release with components implemented in the current release, run software-in-the-loop (SIL) or processor-in-the-loop (PIL) simulations with the imported code.

For more information, see:

- “Workflow”
- “Import AUTOSAR Code from Previous Releases”

Limitations and Tips

The following limitations apply to AUTOSAR code generation.

In this section...

Generate Code Only Check Box

If you do not select the **Generate code only** check box, the software produces an error message when you build the model. The message states that you can build an executable with the AUTOSAR system target file only if you:

- Configure the model to create a software-in-the-loop (SIL) or processor-in-the-loop (PIL) block
- Run the model in SIL or PIL simulation mode
- Provide a custom template makefile

AUTOSAR Compiler Abstraction Macros

The software does not generate AUTOSAR compiler abstraction macros for data or functions arising from the following:

- Model blocks
- Stateflow
- MATLAB Coder™
- Shared utility functions
- Custom storage classes
- Local or temporary variables

Relative File Paths in AUTOSAR Code Descriptors (Schema Versions 3.x and Earlier)

When you build a Simulink model for an AUTOSAR system target file, using AUTOSAR schema version 3.x or earlier, the code generator produces a `CODE-DESCRIPTORS` element within the `SWC_IMPLEMENTATION` element. The `CODE-DESCRIPTORS` element contains `XFILE` elements that provide descriptions of the generated code.

For example, if you build the model `rtwdemo_autosar_counter`, the generated file `rtwdemo_autosar_counter_implementation.arxml` has the following `XFILE` element:

```
<XFILE>
  <SHORT-NAME>rtwdemo_autosar_counter_c</SHORT-NAME>
  <CATEGORY>GeneratedFile</CATEGORY>
  <URL>rtwdemo_autosar_counter_autosar_rtw\rtwdemo_autosar_counter.c</URL>
  <TOOL>Embedded Coder</TOOL>
  <TOOL-VERSION>5.6</TOOL-VERSION>
</XFILE>
```

However, the `URL` element does not specify an absolute path. The path is *relative* to the build folder. Therefore, before you use the AUTOSAR XML in a run-time environment to generate code, you must place the XML in the parent folder.

Functions — Alphabetical List

add

Add property to AUTOSAR element

Syntax

```
add(arProps,parentPath,property,name)
add(arProps,parentPath,property,name,childproperty,value)
```

Description

`add(arProps,parentPath,property,name)` adds a composite child element with the specified `name` to the AUTOSAR element at `parentPath`, under the specified `property`.

`add(arProps,parentPath,property,name,childproperty,value)` sets the value of a specified property of the added child property element.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Add Data Element to Sender Interface

Add data element `DE3` to sender interface `Interface1`.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
add(arProps,'Interface1','DataElements','DE3');
get(arProps,'Interface1','DataElements')
```

```
ans =
    'Interface1/DE1'    'Interface1/DE2'    'Interface1/DE3'
```

Add Mode Group to Mode-Switch Interface

Using a fully qualified path, add a mode-switch interface and set the `IsService` property to `true`. Add mode group `mgModes` to the mode-switch interface using the composite property `ModeGroup`.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
addPackageableElement(arProps,'ModeSwitchInterface','/pkg/if','Interface3',...
  'IsService',true);
ifPaths=find(arProps,[],'ModeSwitchInterface','PathType','FullyQualified')
```

```
ifPaths =
    '/pkg/if/Interface3'
```

```
add(arProps,'/pkg/if/Interface3','ModeGroup','mgModes');
```

Input Arguments

`arProps` — AUTOSAR properties information for a model

handle

AUTOSAR properties information for a model, previously returned by *`arProps`* `=` `autosar.api.getAUTOSARProperties(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `arProps`

`parentPath` — Path to a parent AUTOSAR element

character vector | string scalar

Path to a parent AUTOSAR element to which to add a specified child property element.

Example: `'Input'`

`property` — Type of property

character vector | string scalar

Type of property to add, among valid properties for the AUTOSAR element.

Example: `'DataElements'`

`name` — Name of child property element
character vector | string scalar

Name of the child property element to add.

Example: `'DE1'`

`childproperty,value` — Child property and value
name (character vector or string scalar), value

Child property to set, and its value. Table “Properties of AUTOSAR Elements” on page 4-315 lists properties that are associated with AUTOSAR elements.

Example: `'Name','event1'`

See Also

`delete`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

addPackageableElement

Add element to AUTOSAR package in model

Syntax

```
addPackageableElement(arProps,category,package,name)
addPackageableElement(arProps,category,package,name,property,value)
```

Description

`addPackageableElement(arProps,category,package,name)` adds element `name` of the specified `category` to the specified AUTOSAR `package` in a model configured for AUTOSAR.

`addPackageableElement(arProps,category,package,name,property,value)` sets the value of a specified property of the added element.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Add Sender-Receiver Interface to Package and Set IsService Property

Using a fully qualified path, add a sender-receiver interface to an interface package and set the `IsService` property to `true`.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
addPackageableElement(arProps,'SenderReceiverInterface','/pkg/if','Interface3',...
  'IsService',true);
```

```
ifPaths=find(arProps,[],'SenderReceiverInterface',...
  'IsService',true,'PathType','FullyQualified')

ifPaths =
    '/pkg/if/Interface3'
```

Input Arguments

arProps — AUTOSAR properties information for a model

handle

AUTOSAR properties information for a model, previously returned by *`arProps`* = `autosar.api.getAUTOSARProperties(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `arProps`

category — Element category

character vector | string scalar

Category of element to add. Valid category values are `'ClientServerInterface'`, `'DataTypeMappingSet'`, `'ModeDeclarationGroup'`, `'ModeSwitchInterface'`, `'Package'`, `'ParameterComponent'`, `'ParameterInterface'`, `'SenderReceiverInterface'`, `'SwAddrMethod'`, and `'SystemConst'`.

Example: `'SenderReceiverInterface'`

package — Package path

character vector | string scalar

Fully-qualified path to the element package.

Example: `'/pkg/if'`

name — Element name

character vector | string scalar

Name of the element to add.

Example: `'Interface3'`

property,value — Element property and value

name (character vector or string scalar), value

Property/value pairs for setting values of element properties. Table “Properties of AUTOSAR Elements” on page 4-315 lists properties that are associated with AUTOSAR elements.

Example: `'IsService',true`

See Also

`delete`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2014b

arxml.importer

Import AUTOSAR component XML

Description

Use `arxml.importer` functions to import AUTOSAR components into Simulink in a controlled manner. For example, you can parse an AUTOSAR software component description XML file exported by an AUTOSAR authoring tool, and then import the component into a Simulink model. After importing the component, use the Simulink representation of the component for further configuration, algorithm development, C code generation, and `arxml` export.

Note The importer functions require the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Creation

Syntax

```
ar = arxml.importer(filename)
ar = arxml.importer({filename1,filename2,...,filenameN})
```

Description

`ar = arxml.importer(filename)` creates object `ar`, which represents the AUTOSAR information in XML file `filename`.

`ar = arxml.importer({filename1,filename2,...,filenameN})` creates object `ar`, which represents the AUTOSAR information in the specified XML files.

Tip If you enter the `arxml.importer` function call without a terminating semicolon (;), the importer lists the AUTOSAR content of the specified XML file or files. The information includes paths to software components in the AUTOSAR package structure, which you can specify in calls to `createComponentAsModel`, `createCompositionAsModel`, and `createCalibrationComponentObjects`.

Input Arguments

`filename` — AUTOSAR XML filename

character vector | string scalar

Name of XML file containing AUTOSAR information.

Example: `'mySWC.arxml'`

`filename1,filename2,...,filenameN` — AUTOSAR XML filenames

cell array of character vectors | string array

Cell array of names of XML files containing AUTOSAR information.

Example: `{'mySWC.arxml','DataTypes.arxml','MiscDefs.arxml'}`

Object Functions

createCalibrationComponentObjects	Create Simulink calibration objects from AUTOSAR arxml calibration component
createComponentAsModel	Create Simulink representation of AUTOSAR arxml atomic software component
createCompositionAsModel	Create Simulink representation of AUTOSAR arxml software composition
getComponentNames	Get AUTOSAR software component names from arxml files
updateModel	Update AUTOSAR model with arxml changes
updateReferences	Update model with arxml definitions of AUTOSAR reference elements

Examples

Create `arxml.importer` Object from AUTOSAR XML File

Call the `arxml.importer` function to create object `ar`, which represents the AUTOSAR information in XML file `mySWC.arxml`. Use the returned object to import AUTOSAR software component `/pkg/swc` and create an initial Simulink representation of the component.

```
ar = arxml.importer('mySWC.arxml')
createComponentAsModel(ar,'/pkg/swc','ModelPeriodicRunnablesAs','AtomicSubsystem')
```

Create `arxml.importer` Object from Multiple AUTOSAR XML Files

Call the `arxml.importer` function to create object `ar`, which represents the AUTOSAR information in XML files `mySWC.arxml`, `DataTypes.arxml`, and `MiscDefs.arxml`. Use the returned object to import AUTOSAR software component `/pkg/swc` and create an initial Simulink representation of the component.

```
ar = arxml.importer({'mySWC.arxml','DataTypes.arxml','MiscDefs.arxml'})
createComponentAsModel(ar,'/pkg/swc','ModelPeriodicRunnablesAs','AtomicSubsystem')
```

See Also

Topics

“Import AUTOSAR Software Component” on page 3-4
“AUTOSAR arxml Importer” on page 3-2
“Round-Trip Preservation of AUTOSAR XML File Structure and Element Information” on page 3-18
“Import AUTOSAR Software Component Updates” on page 3-11
“Import or Update Shared AUTOSAR Reference Element Definitions” on page 3-29

Introduced in R2008a

autosar.api.create

Create AUTOSAR component for Simulink model

Syntax

```
autosar.api.create(model)
autosar.api.create(model,mode)
```

Description

`autosar.api.create(model)` creates AUTOSAR properties and Simulink to AUTOSAR mapping for `model`.

`autosar.api.create(model,mode)` additionally specifies whether to map model inports and outports with default settings for corresponding AUTOSAR properties.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Create Default AUTOSAR Properties and Mapping

Create AUTOSAR properties and Simulink to AUTOSAR mapping for a model. Map the model inports and outports with default settings for corresponding AUTOSAR properties.

```
rtwdemo_autosar_multirunnables
autosar.api.create('rtwdemo_autosar_multirunnables','default');
```

Input Arguments

`model` — Model for which to create AUTOSAR properties and mapping

handle | character vector | string scalar

Model for which to create AUTOSAR properties and Simulink to AUTOSAR mapping, specified as a handle, character vector, or string scalar representing the model name.

Example: `'my_model'`

`mode` — Whether to map model inports and outports with default settings

`init` (default) | `default`

Specify `default` to map model inports and outports with default settings for corresponding AUTOSAR properties.

Example: `'default'`

See Also

`autosar.api.delete` | `autosar_ui_launch`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

autosar.api.delete

Delete AUTOSAR properties and mapping for Simulink model

Syntax

```
autosar.api.delete(model)
```

Description

`autosar.api.delete(model)` deletes AUTOSAR properties and Simulink to AUTOSAR mapping for `model`. The resulting model does not represent and map an AUTOSAR software component.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Remove AUTOSAR Component Representation from Model

Delete AUTOSAR properties and Simulink to AUTOSAR mapping for a model.

```
open_system('rtwdemo_autosar_counter');
autosar.api.delete('rtwdemo_autosar_counter');
```

Input Arguments

`model` — Model for which to delete AUTOSAR properties and mapping

handle | character vector | string scalar

Model for which to delete AUTOSAR properties and Simulink to AUTOSAR mapping, specified as a handle, character vector, or string scalar representing the model name.

Example: `'my_model'`

See Also

`autosar.api.create`

Topics

“AUTOSAR Component Configuration” on page 4-3

Introduced in R2017b

autosar.api.getAUTOSARProperties

Configure AUTOSAR software component elements and properties

Description

In an AUTOSAR software component model, use AUTOSAR property functions to configure AUTOSAR elements from an AUTOSAR component perspective. You can add AUTOSAR elements, find elements, get and set properties of elements, delete elements, and define `arxml` packaging of elements.

Note The AUTOSAR property functions require the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Creation

Syntax

```
arProps = autosar.api.getAUTOSARProperties(model)
```

Description

`arProps = autosar.api.getAUTOSARProperties(model)` creates object `arProps`, which represents AUTOSAR properties information for `model`. The specified model must be open.

Input Arguments

`model` — AUTOSAR model
handle | character vector | string scalar

Model for which to create AUTOSAR properties object, specified as a handle, character vector, or string scalar representing the model name.

Example: `'my_model'`

Object Functions

add	Add property to AUTOSAR element
addPackageableElement	Add element to AUTOSAR package in model
delete	Delete AUTOSAR element
deleteUnmappedComponents	Delete unmapped AUTOSAR components from model
find	Find AUTOSAR elements
get	Get property of AUTOSAR element
set	Set property of AUTOSAR element

Examples

Create AUTOSAR Properties Object and Set IsService Property

Call the `autosar.api.getAUTOSARProperties` function to create object `arProps`, which represents AUTOSAR properties information for model `rtwdemo_autosar_swc_slfcns`. Use the returned object to set the `IsService` property for client-server interface `CSIf` to `true` (1), indicating that the port interface is used for AUTOSAR services.

```
hModel = 'rtwdemo_autosar_swc_slfcns';
open_system(hModel);
arProps = autosar.api.getAUTOSARProperties(hModel);
set(arProps,'CSIf','IsService',true);
isService = get(arProps,'CSIf','IsService')
```

```
isService =
  logical
   1
```

See Also

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313

“AUTOSAR Property and Map Function Examples” on page 4-321
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

autosar.api.getSimulinkMapping

Map Simulink elements to AUTOSAR elements

Description

In an AUTOSAR software component model, use AUTOSAR map functions to map model elements to AUTOSAR component elements from a Simulink model perspective. For example, you can:

- Map a Simulink inport or outport to an AUTOSAR receiver or sender port and a sender-receiver data element.
- Map a Simulink entry-point function to an AUTOSAR runnable and optional software address methods.
- Map a Simulink data transfer line to an AUTOSAR inter-runnable variable (IRV).
- Map a Simulink function caller to an AUTOSAR client port and a client-server operation.
- Map a Simulink lookup table to an AUTOSAR parameter.
- Map a Simulink model workspace parameter to an AUTOSAR component internal parameter.
- Map a Simulink block signal or state to an AUTOSAR variable.

Note The AUTOSAR map functions require the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Creation

Syntax

```
slMap = autosar.api.getSimulinkMapping(model)
```

Description

`slMap = autosar.api.getSimulinkMapping(model)` creates object `slMap`, which represents AUTOSAR mapping information for `model`. The specified model must be open.

Input Arguments

`model` — AUTOSAR model

handle | character vector | string scalar

Model for which to create AUTOSAR mapping object, specified as a handle, character vector, or string scalar representing the model name.

Example: `'my_model'`

Object Functions

getDataTransfer	Get AUTOSAR mapping information for Simulink data transfer
getFunction	Get AUTOSAR mapping information for Simulink entry-point function
getFunctionCaller	Get AUTOSAR mapping information for Simulink function-caller block
getInport	Get AUTOSAR mapping information for Simulink inport
getLookupTable	Get AUTOSAR mapping information for Simulink lookup table
getOutport	Get AUTOSAR mapping information for Simulink outport
getParameter	Get AUTOSAR mapping information for Simulink model workspace parameter
getSignal	Get AUTOSAR mapping information for Simulink block signal
getState	Get AUTOSAR mapping information for Simulink block state
mapDataTransfer	Map Simulink data transfer to AUTOSAR inter-runnable variable
mapFunction	Map Simulink entry-point function to AUTOSAR runnable and software address methods
mapFunctionCaller	Map Simulink function-caller block to AUTOSAR client port and operation
mapInport	Map Simulink inport to AUTOSAR port
mapLookupTable	Map Simulink lookup table to AUTOSAR parameter
mapOutport	Map Simulink outport to AUTOSAR port
mapParameter	Map Simulink model workspace parameter to AUTOSAR component internal parameter

mapSignal	Map Simulink block signal to AUTOSAR variable
mapState	Map Simulink block state to AUTOSAR variable

Examples

Create AUTOSAR Mapping Object and Map Entry-Point Function to AUTOSAR Runnable

Call the `autosar.api.getSimulinkMapping` function to create object `slMap`, which represents AUTOSAR mapping information for model `rtwdemo_autosar_swc`. Use the returned object to map the Simulink initialize entry-point function to AUTOSAR runnable `Runnable_Init`.

```
hModel = 'rtwdemo_autosar_swc';
open_system(hModel);
slMap = autosar.api.getSimulinkMapping(hModel);
mapFunction(slMap,'InitializeFunction','Runnable_Init');
arRunnableName = getFunction(slMap,'InitializeFunction')
```

```
arRunnableName =
    'Runnable_Init'
```

See Also

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Property and Map Function Examples” on page 4-321
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

autosar.api.syncModel

Update Simulink to AUTOSAR mapping of model with Simulink modifications

Syntax

```
autosar.api.syncModel(model)
```

Description

`autosar.api.syncModel(model)` updates the Simulink to AUTOSAR mapping of `model` with modifications made to Simulink data transfers, entry-point functions, and function callers.

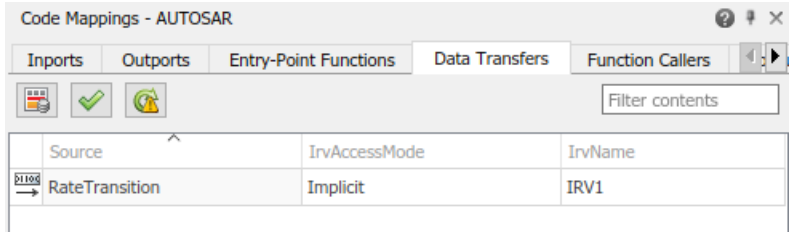
This function is equivalent to using the **Update** button  in the Code Mapping Editor view of an AUTOSAR component model.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

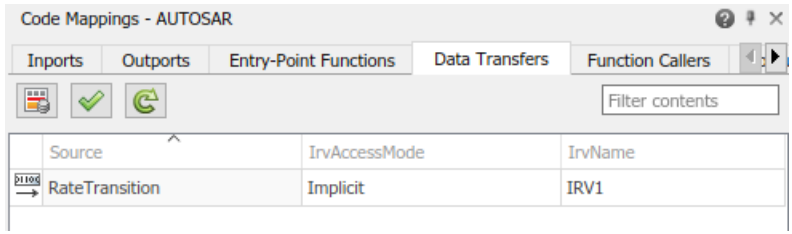
Examples

Update Simulink to AUTOSAR Mapping of Model

When you create or modify an AUTOSAR model, Simulink to AUTOSAR mapping potentially is not current with the model content. For example, the **Update** button in this display indicates that Simulink elements need loading or updating.



This example opens and updates a model. After calling `autosar.api.syncModel`, the Simulink to AUTOSAR mapping reflects the current model content.




```
hModel = 'rtwdemo_autosar_swc';
open_system(hModel);

autosar.api.syncModel(hModel)
```

Input Arguments

`model` — Model to update

handle | character vector | string scalar

Loaded or open model for which to update Simulink to AUTOSAR mapping with model changes, specified as a handle, character vector, or string scalar representing the model name.

Example: `'my_model'`

See Also

`autosar.api.validateModel`

Topics

“AUTOSAR Property and Map Function Examples” on page 4-321
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2016a

autosar.api.validateModel

Validate AUTOSAR properties and mapping of Simulink model

Syntax

```
autosar.api.validateModel(model)
```

Description

`autosar.api.validateModel(model)` validates the AUTOSAR properties and Simulink to AUTOSAR mapping of `model`.

This function is equivalent to using the **Validate** button  in the Code Mapping Editor view of an AUTOSAR component model.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Validate AUTOSAR Properties and Mapping of Model

This example opens a model in which a Simulink inport is not mapped to an AUTOSAR port and data element. Initial validation reports the error and fails. After the inport is mapped, validation succeeds.

```
hModel = 'autosar_model_with_unmapped_port';
load_system(hModel);

% Initial validation fails
try
    autosar.api.validateModel(hModel)
catch validationErr
```

```
    throw(validationErr)
end
```

```
Block 'autosar_model_with_unmapped_port/Input' is not mapped to an AUTOSAR port element.
```

```
% Map the unmapped port
slMap=autosar.api.getSimulinkMapping(hModel);
mapInport(slMap,'Input','Input','Input','ImplicitReceive');

% Second validation succeeds
autosar.api.validateModel(hModel)
```

Input Arguments

`model` — Model to validate

handle | character vector | string scalar

Loaded or open model for which to validate AUTOSAR properties and Simulink to AUTOSAR mapping, specified as a handle, character vector, or string scalar representing the model name.

Example: `'my_model'`

See Also

`autosar.api.syncModel`

Topics

“AUTOSAR Property and Map Function Examples” on page 4-321
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2016a

AUTOSAR.DualScaledParameter class

Package: AUTOSAR

Specify computation method, calibration value, data type, and other properties of AUTOSAR dual-scaled parameter

Description

This class extends the `AUTOSAR.Parameter` class so that you can define an object that stores two scaled values of the same physical value. For example, for temperature measurement, you can store a Fahrenheit scale and a Celsius scale with conversion defined by a computation method that you provide. Given one scaled value, the `AUTOSAR.DualScaledParameter` can compute the other scaled value using the computation method.

A dual-scaled parameter has:

- A calibration value. The value that you prefer to use.
- A main value. The real-world value that Simulink uses.
- An internal stored integer value. The value that is used in the embedded code.

You can use `AUTOSAR.DualScaledParameter` objects in your model for both simulation and code generation. The parameter computes the internal value before code generation via the computation method. This offline computation results in leaner generated code.

If you provide the calibration value, the parameter computes the main value using the computation method. This method can be a first-order rational function.

$$y = \frac{ax + b}{cx + d}$$

- `x` is the calibration value.
- `y` is the main value.
- `a` and `b` are the coefficients of the CalToMain compute numerator.
- `c` and `d` are the coefficients of the CalToMain compute denominator.

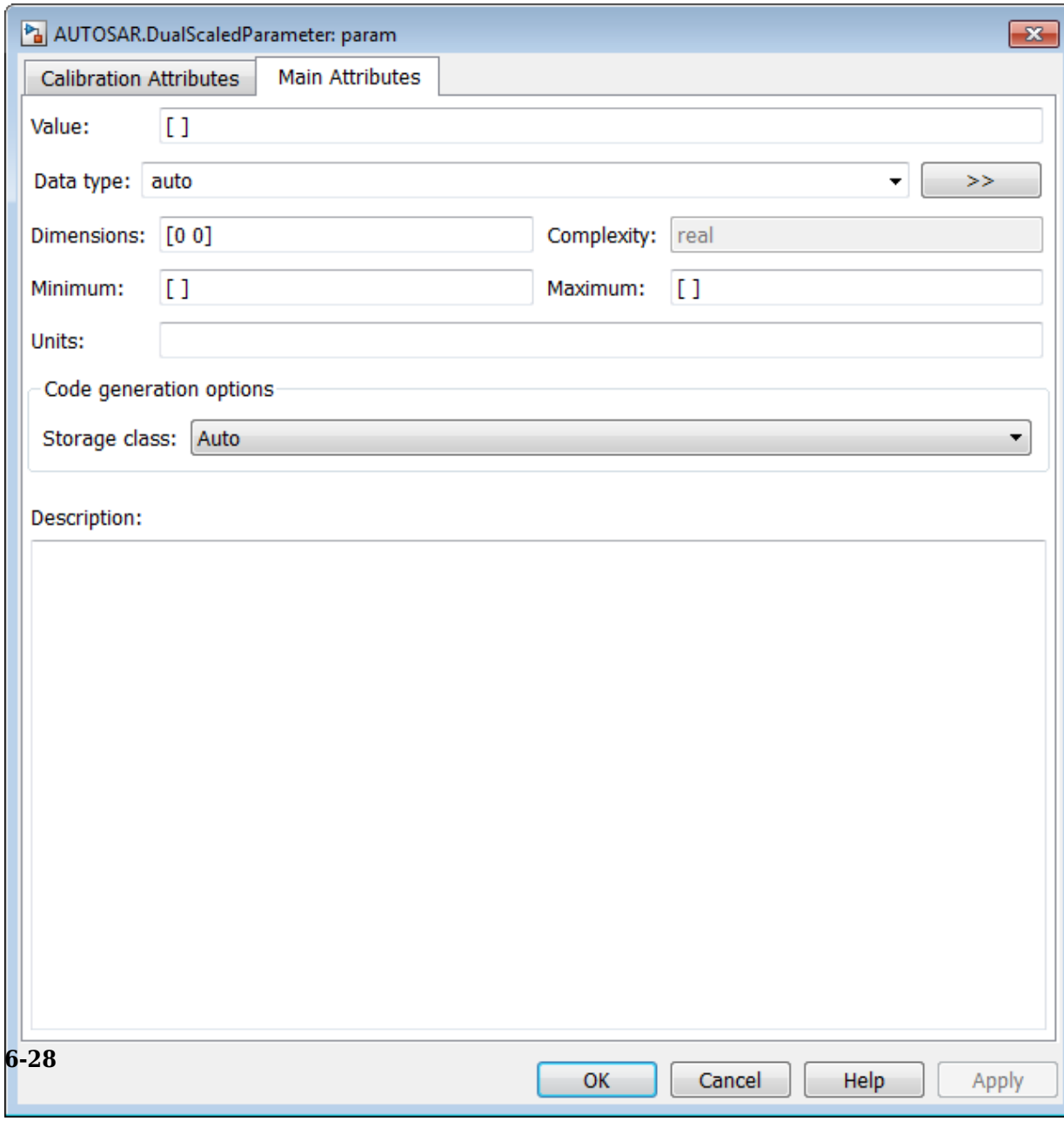
If you provide the calibration minimum and maximum values, the parameter computes minimum and maximum values of the main value. Simulink performs range checking of parameter values. The software alerts you when the parameter object value lies outside a range that corresponds to its specified minimum and maximum values and data type.

You can use the AUTOSAR.DualScaledParameter dialog box to define an `AUTOSAR.DualScaledParameter` object. To open the dialog box:

1. In the Model Explorer, select the base workspace or a model workspace and select **Add** > **Add Custom**.
2. In the Model Explorer — Select Object dialog box, set **Object class** to `AUTOSAR.DualScaledParameter`.

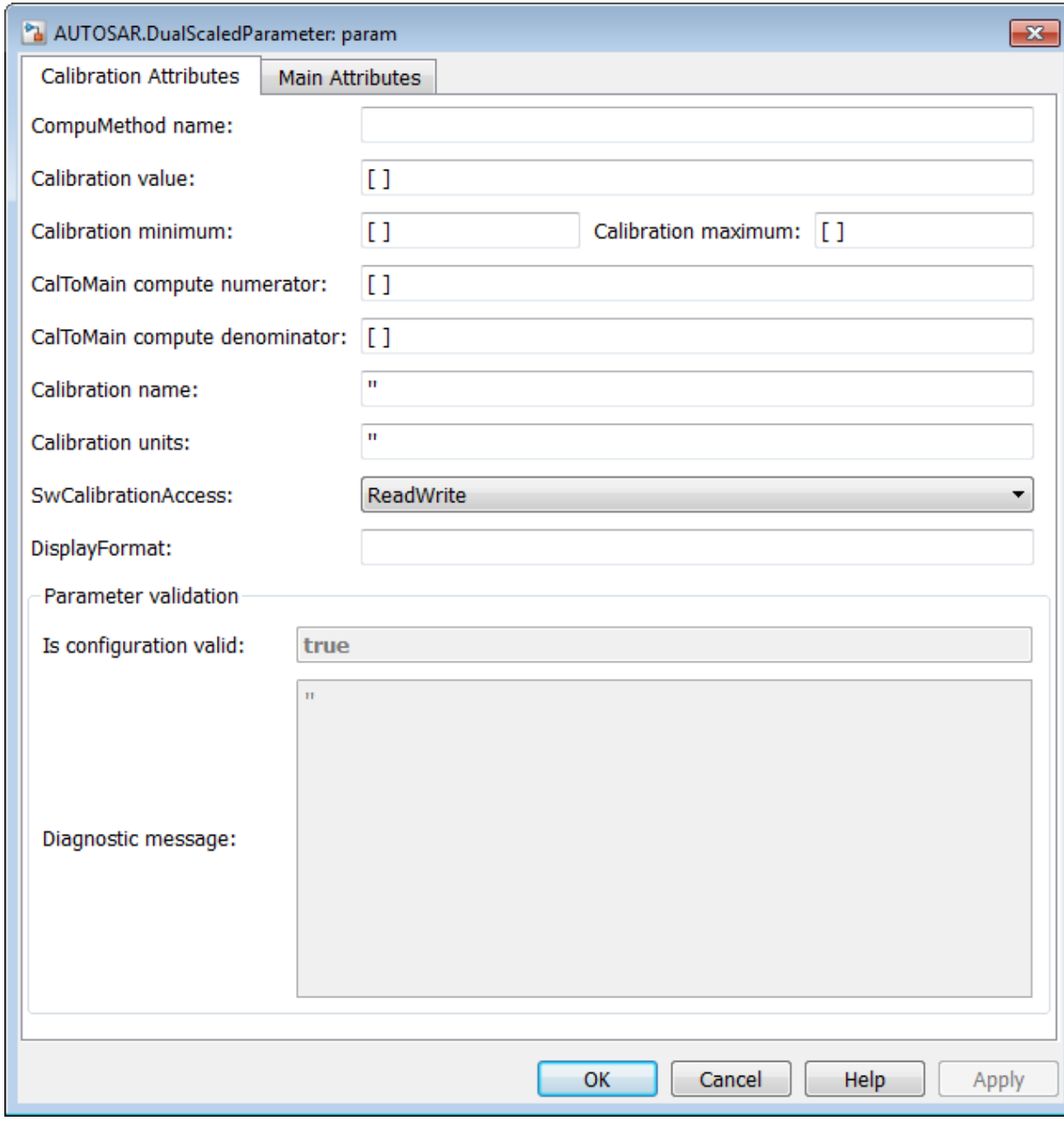
Property Dialog Box

Main Attributes Tab



This tab shows the properties inherited from the `AUTOSAR.Parameter` class. For more information, see `AUTOSAR.Parameter`.

Calibration Attributes Tab



CompuMethod name

Name of the AUTOSAR computation method (`CompuMethod`) to generate for the parameter in `arxml` code. For an AUTOSAR dual-scaled parameter, the code generator produces the `CompuMethod` category RAT_FUNC. For an example, see “Configure Rational Function CompuMethod for Dual-Scaled Parameter” on page 4-294.

Calibration value

Calibration value of the parameter. The value that you prefer to use. The default value is `[]` (unspecified). Specify a finite, real, double value.

Before specifying **Calibration value**, you must specify **CalToMain numerator** and **CalToMain denominator** to define the computation method. The parameter uses the computation method and the calibration value to calculate the real-world value that Simulink uses.

Calibration minimum

Minimum value for the calibration parameter. The default value is `[]` (unspecified). Specify a finite, real, double scalar value.

Before specifying **Calibration minimum**, you must specify **CalToMain numerator** and **CalToMain denominator** to define the computation method. The parameter uses the computation method and the calibration minimum value to calculate the minimum or maximum value that Simulink uses. A first order rational function is strictly monotonic, either increasing or decreasing. If it is increasing, setting the calibration minimum sets the main minimum value. If it is decreasing, setting the calibration minimum sets the main maximum.

If the parameter value is less than the minimum value or if the minimum value is outside the range of the parameter data type, Simulink generates a warning. In these cases, when updating the diagram or starting a simulation, Simulink generates an error.

Calibration maximum

Maximum value for the calibration parameter can have. The default value is `[]` (unspecified). Specify a finite, real double scalar value.

Before specifying **Calibration maximum**, you must specify **CalToMain numerator** and **CalToMain denominator** to define the computation method. The parameter uses the computation method and the calibration maximum value to calculate the corresponding maximum or minimum value that Simulink uses. A first order rational function is strictly monotonic, either increasing or decreasing. If it is increasing,

setting the calibration maximum sets the main maximum value. If it is decreasing, setting the calibration maximum sets the main minimum.

If the parameter value is less than the minimum value or if the minimum value is outside the range of the parameter data type, Simulink generates a warning. In these cases, when updating the diagram or starting a simulation, Simulink generates an error.

CalToMain compute numerator

Specify the numerator coefficients `a` and `b` of the first-order linear equation:

$$y = \frac{ax + b}{cx + d}$$

The default value is `[]` (unspecified). Specify finite, real double scalar values for `a` and `b`. For example, `[1 1]` or, for reciprocal scaling, `1`.

Once you have applied **CalToMain compute numerator**, you cannot change it.

CalToMain compute denominator

Specify the denominator coefficients `c` and `c` of the first-order linear equation:

$$y = \frac{ax + b}{cx + d}$$

The default value is `[]` (unspecified). Specify finite, real, double scalar values for `c` and `d`. For example, `[1 1]`.

Once you have applied **CalToMain compute denominator**, you cannot change it.

Calibration name

Specify the name of the calibration parameter. The default value is `''`. Specify a text value, for example, `'T1'`.

Calibration units

Specify the measurement units for this calibration value. This field is intended for use in documenting this parameter. The default value is `''`. Specify a text value, for example, `'Seconds'`.

SwCalibrationAccess

Specify measurement and calibration tool access to the calibration parameter. The valid values are:

- `ReadOnly` — Data element appears in the generated description file with read access only.
- `ReadWrite` — Data element appears in the generated description file with both read and write access.
- `NotAccessible` — Data element does not appear in the generated description file and is not accessible with measurement and calibration tools.

The default value is `ReadWrite`.

DisplayFormat

Optionally specify the format to be used by measurement and calibration tools to display the data. If you specify a display format, exporting `arxml` code generates a corresponding DISPLAY-FORMAT specification.

Use an ANSI C `printf` format specifier string, which has the following general form:

```
%[flags][width][.precision]type
```

For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.

Is configuration valid

Simulink indicates whether the configuration is valid. The default value is `true`. If Simulink detects an issue with the configuration, it sets this field to `false` and provides information in the **Diagnostic message** field. You cannot set this field.

Diagnostic message

If you specify invalid parameter settings, Simulink displays a message in this field. Use the diagnostic information to help you fix an invalid configuration issue. You cannot set this field.

Properties

Name	Access	Description
`CompuMethodName`	`RW`	Name of AUTOSAR `CompuMethod` to generate for this parameter in `arxml` code. (See “Calibration Attributes Tab” on page 6-30 > **CompuMethod name**.)
`CalibrationValue`	`RW`	Calibration value of this parameter. (See “Calibration Attributes Tab” on page 6-30 > **Calibration value**.)
`CalibrationMin`	`RW`	Calibration minimum value of this parameter. (See “Calibration Attributes Tab” on page 6-30 > **Calibration minimum**.)
`CalibrationMax`	`RW`	Calibration maximum value of this parameter. (See “Calibration Attributes Tab” on page 6-30 > **Calibration maximum**.)
`CalToMainCompuNumerator`	`RW`	Numerator coefficients of the computation method. (See “Calibration Attributes Tab” on page 6-30 > **CalToMain compute numerator**.) Once you have applied `CalToMainCompuNumerator`, you cannot change it.
`CalToMainCompuDenominator`	`RW`	Denominator coefficients of the computation method. (See “Calibration Attributes Tab” on page 6-30 > **CalToMain compute denominator**.) Once you have applied `CalToMainCompuDenominator`, you cannot change it.
`CalibrationName`	`RW`	Name of the calibration parameter. (See “Calibration Attributes Tab” on page 6-30 > **Calibration name**.)
`CalibrationDocUnits`	`RW`	Measurement units for this calibration parameter's value. (See “Calibration Attributes Tab” on page 6-30 > **Calibration units**.)

Name	Access	Description
`SwCalibrationAccess`	`RW`	Measurement and calibration tool access to the calibration parameter — `ReadOnly`, `ReadWrite`, or `NotAccessible`. (See "Calibration Attributes Tab" on page 6-30 > **SwCalibrationAccess**.)
`DisplayFormat`	`RW`	Format to be used by measurement and calibration tools to display the data. Format specifier uses the general form `%[flags] [width][.precision]type` — for example, `%2.1d` to produce 12.2. (See "Calibration Attributes Tab" on page 6-30 > **DisplayFormat**.)
`IsConfigurationValid`	`RO`	Information about validity of configuration. (See "Calibration Attributes Tab" on page 6-30 > **Is configuration valid**.)
`DiagnosticMessage`	`RO`	If the configuration is invalid, diagnostic information to help you fix the issue. (See "Calibration Attributes Tab" on page 6-30 > **Diagnostic message**.)

Examples

Create and Update a Dual-Scaled Parameter

Create an `AUTOSAR.DualScaledParameter` object that stores a value as both time and frequency.

```
T1Rec = AUTOSAR.DualScaledParameter;
```

Set the computation method.

```
T1Rec.CalToMainCompuNumerator = [1];
T1Rec.CalToMainCompuDenominator = [1 0];
```

This computation method specifies that the value used by Simulink is the reciprocal of the value that you want to use.

Set the value that you want to see.

```
T1Rec.CalibrationValue = 1/7

T1Rec =

  DualScaledParameter with properties:

             CompuMethodName: ''
            CalibrationValue: 0.1429
              CalibrationMin: []
              CalibrationMax: []
      CalToMainCompuNumerator: 1
    CalToMainCompuDenominator: [1 0]
             CalibrationName: ''
          CalibrationDocUnits: ''
         IsConfigurationValid: 1
            DiagnosticMessage: ''
          SwCalibrationAccess: 'ReadWrite'
                DisplayFormat: ''
                        Value: 7
                   CoderInfo: [1x1 Simulink.CoderInfo]
                 Description: ''
                    DataType: 'auto'
                         Min: []
                         Max: []
                        Unit: ''
                  Complexity: 'real'
                  Dimensions: [1 1]
```

The `AUTOSAR.DualScaledParameter` calculates `T1Rec.Value` which is the value that Simulink uses. `T1Rec.CalibrationValue` is `1/7`, so `T1Rec.Value` is `7`.

Name this value and specify the units.

```
T1Rec.CalibrationName = 'T1';
T1Rec.CalibrationDocUnits = 'Seconds';
```

Set calibration minimum and maximum values.

```
T1Rec.CalibrationMin = 0.001;
T1Rec.CalibrationMax = 1;
```

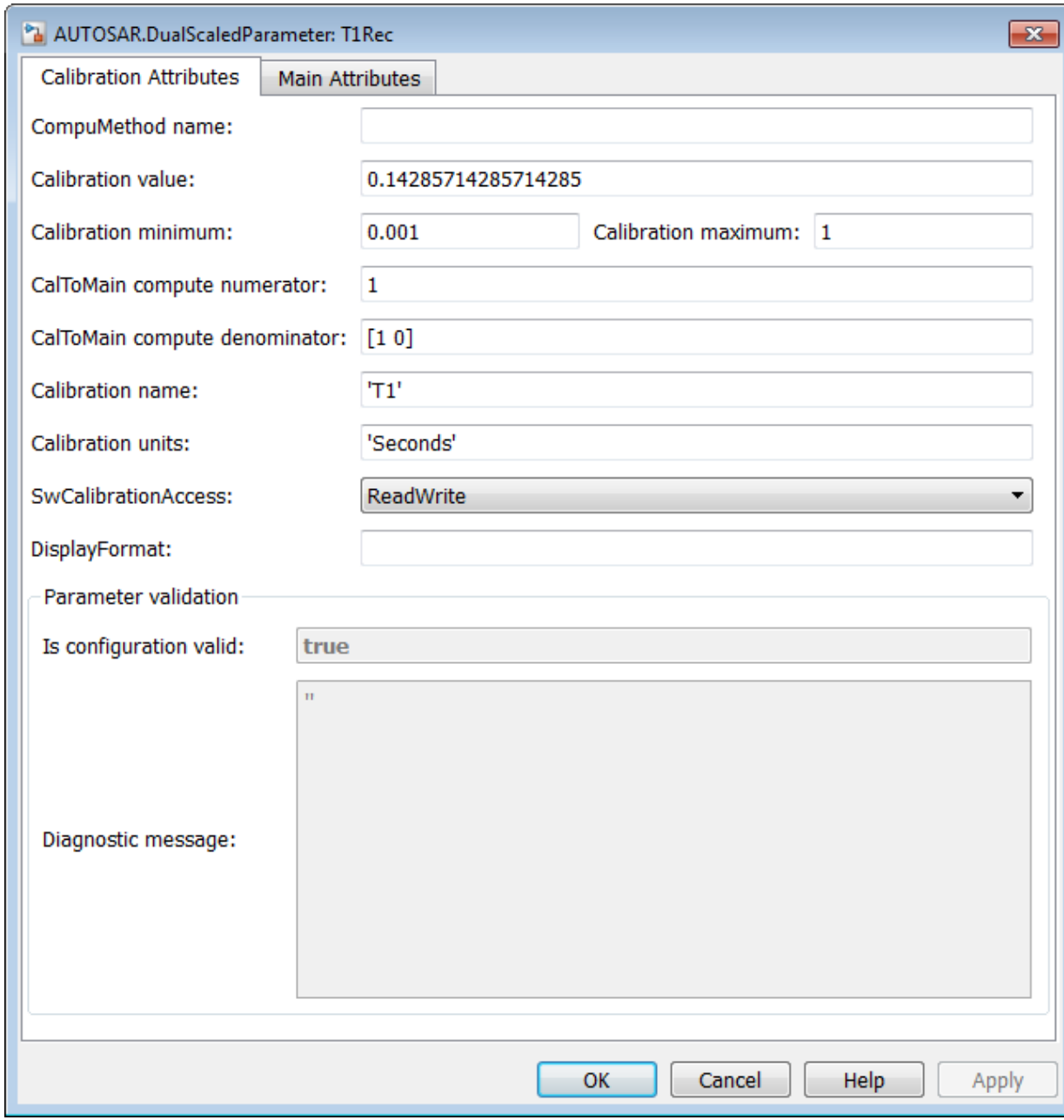
If you specify a value outside this allowable range, Simulink generates a warning.

Specify the units that Simulink uses.

```
T1Rec.Unit = 'Hz';
```

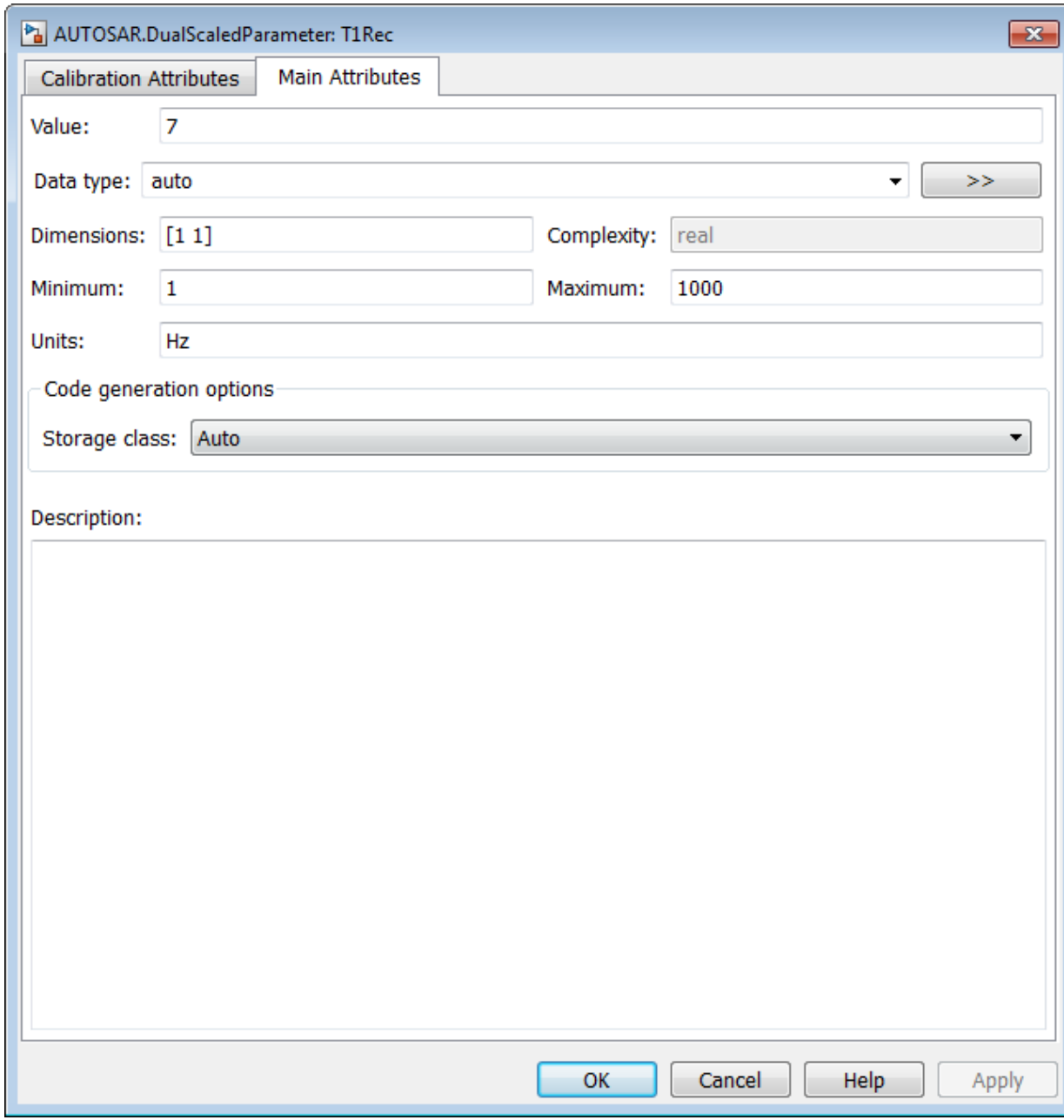
Open the AUTOSAR.DualScaledParameter dialog box.

```
open T1Rec
```


AUTOSAR.DualScaledParameter: T1Rec
Calibration Attributes
Main Attributes
CompuMethod name:
Calibration value:
0.14285714285714285
Calibration minimum:
0.001
Calibration maximum:
1
CalToMain compute numerator:
1
CalToMain compute denominator:
[1 0]
Calibration name:
'T1'
Calibration units:
'Seconds'
SwCalibrationAccess:
ReadWrite
DisplayFormat:
Parameter validation
Is configuration valid:
true
Diagnostic message:
''
OK
Cancel
Help
Apply

The **Calibration Attributes** tab displays the calibration value and the computation method that you specified.

In the dialog box, click the **Main Attributes** tab.


AUTOSAR.DualScaledParameter: T1Rec
Calibration Attributes
Main Attributes
Value:
7
Data type:
auto
>>
Dimensions:
[1 1]
Complexity:
real
Minimum:
1
Maximum:
1000
Units:
Hz
Code generation options
Storage class:
Auto
Description:
OK
Cancel
Help
Apply

This tab displays information about the value used by Simulink.

Configure arxml Settings

Create a dual-scaled parameter. Configure its storage class so that when you generate code, the exported `arxml` code includes the dual-scaled parameter.

Create a dual-scaled parameter.

```
T1Rec = AUTOSAR.DualScaledParameter;
T1Rec.CalToMainCompuNumerator = [1];
T1Rec.CalToMainCompuDenominator = [1 0];
T1Rec.CalibrationValue = 1/7;
T1Rec.CalibrationName = 'T1';
T1Rec.CalibrationDocUnits = 'Seconds';
T1Rec.CalibrationMin = 0.001;
T1Rec.CalibrationMax = 1
```

```
T1Rec =

  DualScaledParameter with properties:

             CompuMethodName: ''
            CalibrationValue: 0.1429
              CalibrationMin: 1.0000e-03
              CalibrationMax: 1
      CalToMainCompuNumerator: 1
    CalToMainCompuDenominator: [1 0]
             CalibrationName: 'T1'
          CalibrationDocUnits: 'Seconds'
         IsConfigurationValid: 1
            DiagnosticMessage: ''
          SwCalibrationAccess: 'ReadWrite'
                DisplayFormat: ''
                        Value: 7
                    CoderInfo: [1x1 Simulink.CoderInfo]
                  Description: ''
                     DataType: 'auto'
                          Min: 1
                          Max: 1000
                         Unit: ''
                   Complexity: 'real'
                   Dimensions: [1 1]
```

Set the storage class of the parameter so that the generated `arxml` code includes the parameter.

```
T1Rec.CoderInfo.StorageClass = 'Custom';
T1Rec.CoderInfo.CustomStorageClass = 'InternalCalPrm';
```

You can now use the parameter in a Simulink model. If you configure the model for AUTOSAR, when you generate code for the model, the code generator produces `arxml` code that contains information about the dual-scaled parameter.

See Also

Classes
`AUTOSAR.Parameter`

Topics

Class Attributes (MATLAB)
Property Attributes (MATLAB)

AUTOSAR.Parameter

Specify value, data type, code generation options, other properties of parameter

Description

With this class, you can create workspace objects for modeling AUTOSAR calibration parameters. You can create an `AUTOSAR.Parameter` object in the base MATLAB workspace.

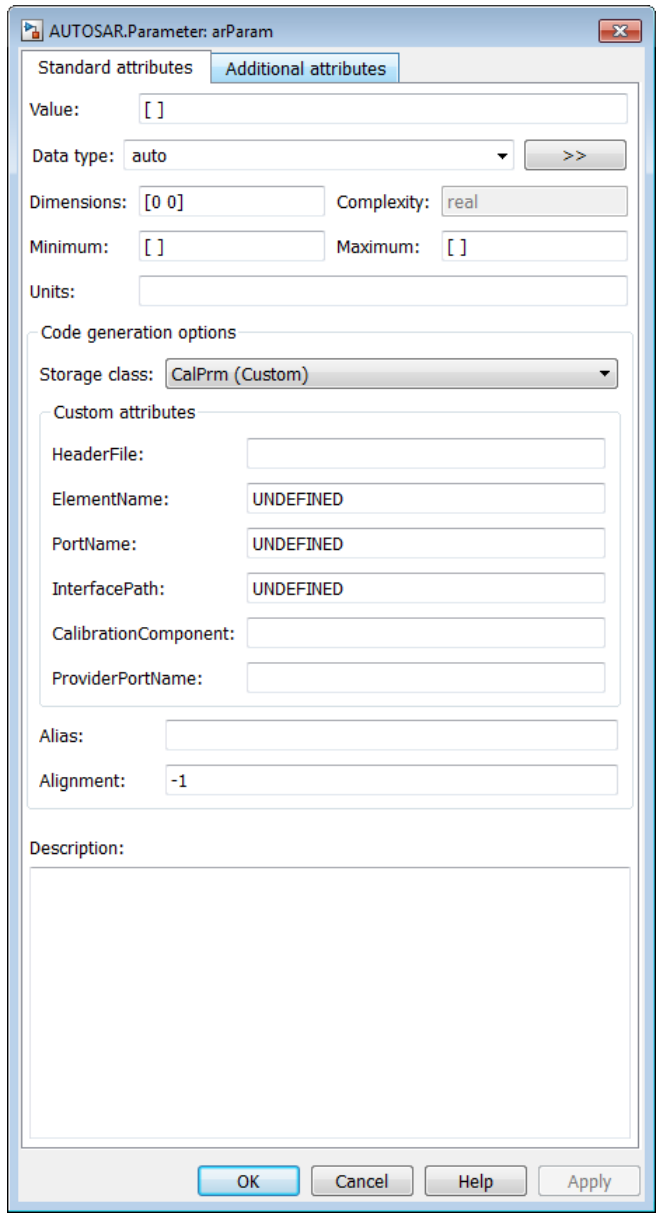
This class extends the `Simulink.Parameter` class. With parameter objects, you can specify the value of a parameter and other information about the parameter, such as its purpose, its dimensions, or its minimum and maximum values. Some Simulink products use this information, for example, to determine whether the parameter is tunable (see “Tune and Experiment with Block Parameter Values” (Simulink)).

Simulink performs range checking of parameter values. The software alerts you when the parameter object value lies outside a range that corresponds to its specified minimum and maximum values and data type. For more information, see the `Simulink.Parameter` reference page.

You can use the AUTOSAR.Parameter dialog box to define an `AUTOSAR.Parameter` object. To open the dialog box:

1. In Model Explorer, select the base workspace. Select **Add** > **Add Custom**.
2. In the Model Explorer - Select Object dialog box, set **Object class** to `AUTOSAR.Parameter`. Optionally, you can modify the default object name. Click **OK**.

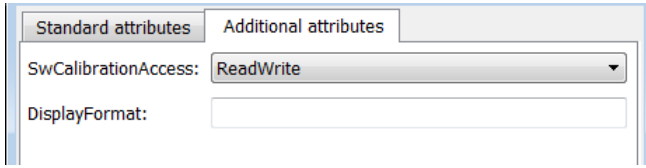
Property Dialog Box



The `Simulink.Parameter` reference page describes the parameter attributes in detail. The `AUTOSAR.Parameter` class extends the `Simulink.Parameter` class with the following additional selections for the **Storage class** attribute:

- `CalPrm (Custom)` — Calibration parameters belong to a calibration component, which can be accessed by multiple AUTOSAR software components. Selecting this storage class enables the custom attributes **HeaderFile**, **ElementName**, **PortName**, **InterfacePath**, **CalibrationComponent**, and **ProviderPortName**.
  - **HeaderFile** allows you to optionally specify the name of the AUTOSAR software component header file that declares the calibration parameter.
  - **ElementName**, **PortName**, and **InterfacePath** allow you to associate the calibration parameter with a specific AUTOSAR element, AUTOSAR port, and AUTOSAR interface. Specify an element name, a port name, and an interface path. For example, element `K`, port `rCounter`, and interface `rCounter/CalibrationComponents/counter_if`.
  - **CalibrationComponent** and **ProviderPortName** allow you to configure the calibration parameter to be exported in an AUTOSAR calibration component (`ParameterSwComponent`). Calibration parameters exported in a calibration component can be accessed by multiple AUTOSAR software components, using the calibration component name and associated provider port name. **CalibrationComponent** specifies the qualified name of the calibration component to be exported, and **ProviderPortName** specifies the short name of the associated provider port. For example, calibration component `/CalibrationComponents/counter_swc/counter` and provider port `pCounter`.
- `InternalCalPrm (Custom)` — Internal calibration parameters are defined and accessed by only one AUTOSAR software component. Selecting this storage class enables the custom attributes **HeaderFile** and **PerInstanceBehavior**.
  - **HeaderFile** allows you to optionally specify the name of the AUTOSAR software component header file that declares the calibration parameter.
  - **PerInstanceBehavior** allows you to specify `Parameter shared by all instances of the Software Component` or `Each instance of the Software Component has its own copy of the parameter`.
- `SystemConstant (Custom)` — Allows you to control the storage of a systemwide constant in generated code.

The `AUTOSAR.Parameter` class also provides the following attributes, which are independent of storage class, on the **Additional attributes** tab:



- **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as `NotAccessible`, `ReadOnly`, or `ReadWrite`.
- **DisplayFormat** allows you to specify the format to be used by measurement and calibration tools to display the data. If you specify a display format, exporting `arxml` code generates a corresponding DISPLAY-FORMAT specification. Use an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.

For more information, see:

- “Create Tunable Calibration Parameter in the Generated Code”
- “Model AUTOSAR Calibration Parameters and Lookup Tables” on page 2-26
- “Configure AUTOSAR Internal Calibration Parameters” on page 4-212
- “Configure AUTOSAR Calibration Component” on page 4-216
- “Variants in Runnable Condition Logic” on page 2-48
- “Configure AUTOSAR Variants in Runnable Condition Logic” on page 4-307
- “Configure AUTOSAR Data for Measurement and Calibration” on page 4-236

See Also

- `Simulink.Parameter`
- `AUTOSAR.DualScaledParameter`
- `AUTOSAR4.Parameter`

Introduced in R2013b

AUTOSAR.Signal

Specify data type, code generation options, other attributes of signal

Description

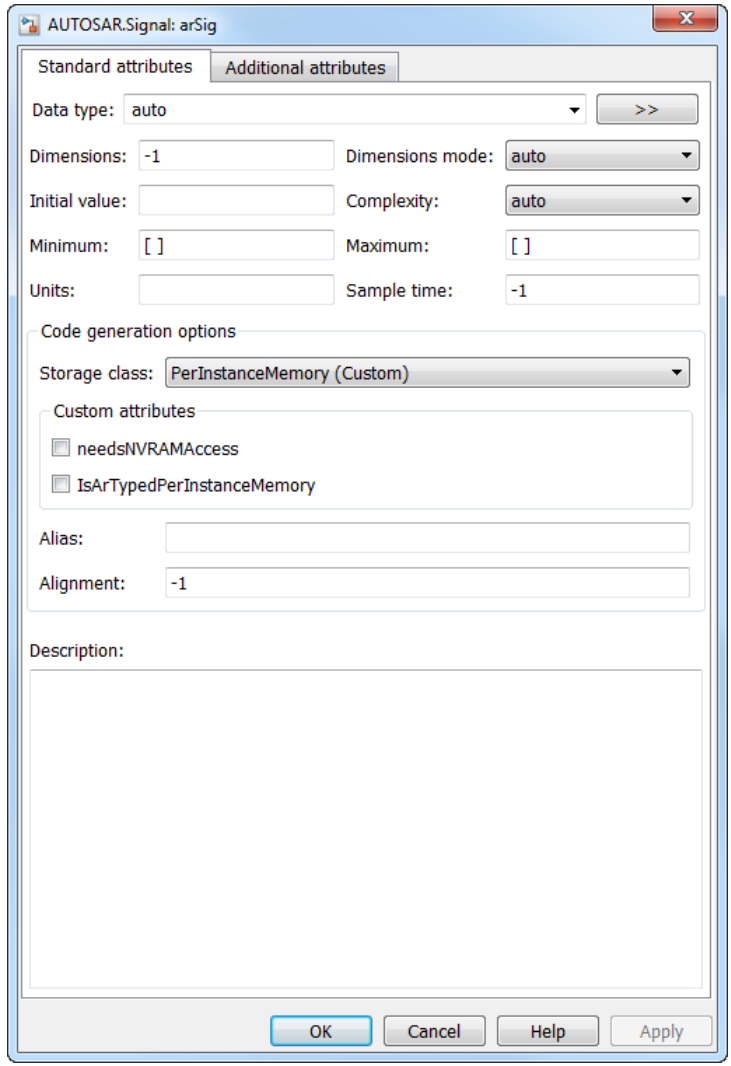
With this class, you can create workspace objects for modeling per-instance memory for AUTOSAR runnables. You can create an `AUTOSAR.Signal` object in the base MATLAB workspace.

This class extends the `Simulink.Signal` class. With signal objects, you can assign or validate the attributes of a signal or discrete state, such as its data type, numeric type, dimensions, and so on. For more information, see the `Simulink.Signal` reference page.

You can use the AUTOSAR.Signal dialog box to define an `AUTOSAR.Signal` object. To open the dialog box:

1. In Model Explorer, select the base workspace. Select **Add** > **Add Custom**.
2. In the Model Explorer - Select Object dialog box, set **Object class** to `AUTOSAR.Signal`. Optionally, you can modify the default object name. Click **OK**.

Property Dialog Box

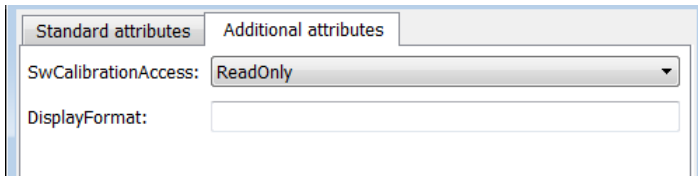


The `Simulink.Signal` reference page describes the signal attributes in detail. The `AUTOSAR.Signal` class extends the `Simulink.Signal` class with the following additional selection for the **Storage class** attribute:

- `PerInstanceMemory (Custom)` — AUTOSAR per-instance memory is instance-specific global memory within an AUTOSAR software component. An AUTOSAR run-time environment generator allocates this memory and provides an API through which you access this memory. Selecting this storage class enables the custom attributes **needsNVRAMAccess** and **IsArTypedPerInstanceMemory**.

  - **needsNVRAMAccess** allows you to specify whether the AUTOSAR signal needs access to nonvolatile RAM on a processor. Depending on the AUTOSAR schema selected for your model, this setting potentially impacts the XML output for your model.
  - **IsArTypedPerInstanceMemory** allows you to specify whether to use AUTOSAR-typed per-instance memory (introduced in AUTOSAR schema version 4.0), rather than C-typed per-instance memory.

The `AUTOSAR.Signal` class also provides the following attributes, which are independent of storage class, on the **Additional attributes** tab:



- **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as `NotAccessible`, `ReadOnly`, or `ReadWrite`.
- **DisplayFormat** allows you to specify the format to be used by measurement and calibration tools to display the data. If you specify a display format, exporting `arxml` code generates a corresponding DISPLAY-FORMAT specification. Use an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.

After you create an `AUTOSAR.Signal` object, you can reference it in a Data Store Memory block. For more information, see

- “Per-Instance Memory” on page 2-33
- “Configure AUTOSAR Per-Instance Memory” on page 4-270
- “Configure AUTOSAR Data for Measurement and Calibration” on page 4-236

See Also

- Data Store Memory
- `Simulink.Signal`
- `AUTOSAR4.Signal`

Introduced in R2013b

autosar_ui_close

Close AUTOSAR Dictionary dialog box

Syntax

```
autosar_ui_close(model)
```

Description

`autosar_ui_close(model)` closes the AUTOSAR Dictionary dialog box for the specified open model.

Examples

Close AUTOSAR Dictionary Dialog Box for Example Model

Open the AUTOSAR Dictionary dialog box with settings for an AUTOSAR example model, and then close the dialog box.

```
open_system('rtwdemo_autosar_swc')
autosar_ui_launch('rtwdemo_autosar_swc')
autosar_ui_close('rtwdemo_autosar_swc')
```

Input Arguments

`model` — Model for which to close the AUTOSAR Dictionary dialog box

handle | character vector | string scalar

Model for which to close the AUTOSAR Dictionary dialog box, specified as a handle, character vector, or string scalar representing the model name.

Example: `'rtwdemo_autosar_swc'`

See Also

`autosar.api.create` | `autosar_ui_launch`

Topics

“AUTOSAR Component Configuration” on page 4-3

Introduced in R2014b

autosar_ui_launch

Open AUTOSAR Dictionary dialog box

Syntax

```
autosar_ui_launch(model)
```

Description

`autosar_ui_launch(model)` opens the AUTOSAR Dictionary dialog box with settings for the specified open model.

Note Configuring an AUTOSAR component requires an Embedded Coder license. If Embedded Coder is not licensed, the AUTOSAR Dictionary dialog box runs in read-only mode.

Examples

Open AUTOSAR Dictionary Dialog Box for Example Model

Open the AUTOSAR Dictionary dialog box with settings for an AUTOSAR example model.

```
open_system('rtwdemo_autosar_swc')
autosar_ui_launch('rtwdemo_autosar_swc')
```

Input Arguments

`model` — Model for which to open the AUTOSAR Dictionary dialog box

handle | character vector | string scalar

Model for which to open the AUTOSAR Dictionary dialog box, specified as a handle, character vector, or string scalar representing the model name.

Example: `'rtwdemo_autosar_swc'`

See Also

`autosar.api.create` | `autosar_ui_close`

Topics

“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

AUTOSAR4.Parameter

Specify value, data type, code generation options, other properties of parameter

Description

With this class, you can create workspace objects for mapping internal global parameters to AUTOSAR memory sections. You can create an `AUTOSAR4.Parameter` object in the base MATLAB workspace.

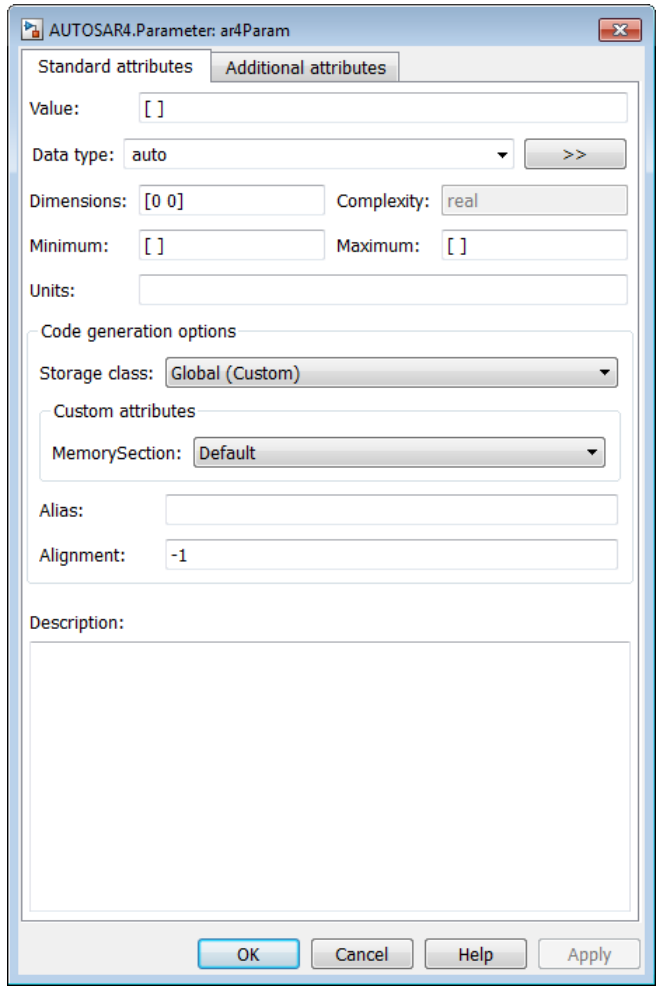
This class extends the `Simulink.Parameter` class. With parameter objects, you can specify the value of a parameter and other information about the parameter, such as its purpose, its dimensions, or its minimum and maximum values. Some Simulink products use this information, for example, to determine whether the parameter is tunable (see “Tune and Experiment with Block Parameter Values” (Simulink)).

Simulink performs range checking of parameter values. The software alerts you when the parameter object value lies outside a range that corresponds to its specified minimum and maximum values and data type. For more information, see the `Simulink.Parameter` reference page.

You can use the AUTOSAR4.Parameter dialog box to define an `AUTOSAR4.Parameter` object. To open the dialog box:

1. In Model Explorer, select the base workspace. Select **Add** > **Add Custom**.
2. In the Model Explorer - Select Object dialog box, set **Object class** to `AUTOSAR4.Parameter`. Optionally, you can modify the default object name. Click **OK**.

Property Dialog Box

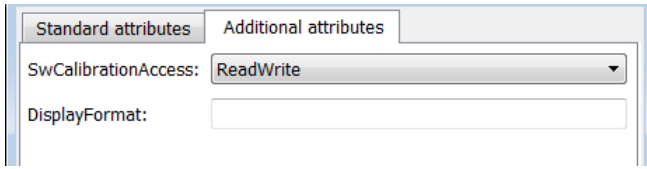


The `Simulink.Parameter` reference page describes the parameter attributes in detail. The `AUTOSAR4.Parameter` class extends the `Simulink.Parameter` class with the following additional selection for the **Storage class** attribute:

- `Global (Custom)` — Allows you to map internal global parameters to AUTOSAR memory sections. Selecting this storage class enables the custom attribute **MemorySection**.

  MemorySection allows you to explicitly select AUTOSAR memory section `VAR`, `CAL`, `CONST`, `VOLATILE`, or `CONST_VOLATILE`, or accept the `Default`.

The `AUTOSAR4.Parameter` class also provides the following attributes, which are independent of storage class, on the **Additional attributes** tab:



- **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as `NotAccessible`, `ReadOnly`, or `ReadWrite`.
- **DisplayFormat** allows you to specify the format to be used by measurement and calibration tools to display the data. If you specify a display format, exporting `arxml` code generates a corresponding DISPLAY-FORMAT specification. Use an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.

For more information, see

- “Static and Constant Memory” on page 2-34
- “Configure AUTOSAR Static Memory” on page 4-275
- “Configure AUTOSAR Data for Measurement and Calibration” on page 4-236

See Also

- `Simulink.Parameter`
- `AUTOSAR.Parameter`
- `AUTOSAR.DualScaledParameter`

Introduced in R2014a

AUTOSAR4.Signal

Specify data type, code generation options, other attributes of signal

Description

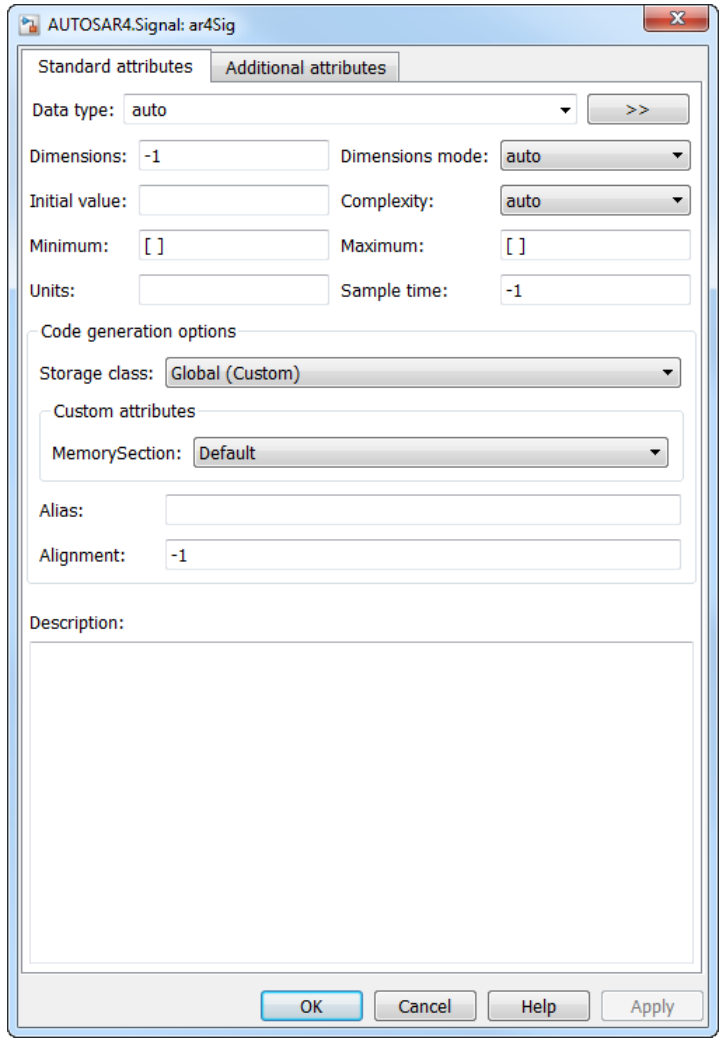
With this class, you can create workspace objects for mapping internal global signals to AUTOSAR memory sections. You can create an `AUTOSAR4.Signal` object in the base MATLAB workspace.

This class extends the `Simulink.Signal` class. With signal objects, you can assign or validate the attributes of a signal or discrete state, such as its data type, numeric type, dimensions, and so on. For more information, see the `Simulink.Signal` reference page.

You can use the AUTOSAR4.Signal dialog box to define an `AUTOSAR4.Signal` object. To open the dialog box:

1. In Model Explorer, select the base workspace. Select **Add** > **Add Custom**.
2. In the Model Explorer - Select Object dialog box, set **Object class** to `AUTOSAR4.Signal`. Optionally, you can modify the default object name. Click **OK**.

Property Dialog Box

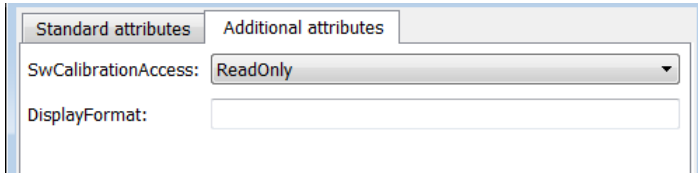


The `Simulink.Signal` reference page describes the signal attributes in detail. The `AUTOSAR4.Signal` class extends the `Simulink.Signal` class with the following additional selection for the **Storage class** attribute:

- `Global (Custom)` — Allows you to map internal global signals to AUTOSAR memory sections. Selecting this storage class enables the custom attribute **MemorySection**.

  MemorySection allows you to explicitly select AUTOSAR memory section `VAR`, `CAL`, `CONST`, `VOLATILE`, or `CONST_VOLATILE`, or accept the `Default`.

The `AUTOSAR4.Signal` class also provides the following attributes, which are independent of storage class, on the **Additional attributes** tab:



- **SwCalibrationAccess** allows you to specify measurement and calibration software access to the data as `NotAccessible`, `ReadOnly`, or `ReadWrite`.
- **DisplayFormat** allows you to specify the format to be used by measurement and calibration tools to display the data. If you specify a display format, exporting `arxml` code generates a corresponding DISPLAY-FORMAT specification. Use an ANSI C `printf` format specifier string. For example, `%2.1d` specifies a signed decimal number, with a minimum width of 2 characters and a maximum precision of 1 digit, producing a displayed value such as 12.2. For more information about constructing a format specifier string, see “Configure DisplayFormat” on page 4-240.

For more information, see

- “Static and Constant Memory” on page 2-34
- “Configure AUTOSAR Static Memory” on page 4-275
- “Configure AUTOSAR Data for Measurement and Calibration” on page 4-236

See Also

- `Simulink.Signal`
- `AUTOSAR.Signal`

Introduced in R2014a

createCalibrationComponentObjects

Package: arxml

Create Simulink calibration objects from AUTOSAR `arxml` calibration component

Syntax

```
createCalibrationComponentObjects(ar,ComponentName)
sts = createCalibrationComponentObjects(ar,ComponentName,Name,Value)
```

Description

`createCalibrationComponentObjects(ar,ComponentName)` imports calibration parameters from AUTOSAR calibration component `ComponentName` in the AUTOSAR XML file or files represented by `arxml.importer` object `ar`. The importer creates corresponding Simulink data objects in the MATLAB base workspace or a Simulink data dictionary. You can then assign the data objects to block parameters in your Simulink model.

`sts = createCalibrationComponentObjects(ar,ComponentName,Name,Value)` specifies additional options for Simulink calibration data object creation with one or more `Name,Value` pair arguments.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Create Calibration Data Objects in MATLAB Base Workspace

Import calibration parameters from an AUTOSAR calibration component and create corresponding Simulink data objects in the MATLAB base workspace.

```
ar = arxml.importer('mySWC.arxml')
createCalibrationComponentObjects(ar,'/ComponentType/MyCalibComp1')
```

Create Calibration Data Objects in Simulink Data Dictionary

Import calibration parameters from an AUTOSAR calibration component and create corresponding Simulink data objects in Simulink data dictionary `ardata.sldd`.

```
ar = arxml.importer('mySWC.arxml')
createCalibrationComponentObjects(ar,'/ComponentType/MyCalibComp1','DataDictionary','ardata.sldd')
```

Input Arguments

`ar` — `arxml.importer` object

object

AUTOSAR information previously imported from XML files, specified as an `arxml.importer` object.

`ComponentName` — Component path

character vector | string scalar

Absolute short-name path of the calibration parameter component.

Example: `'/MyComponent/MyCalibComp1'`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'DataDictionary','ardata.sldd'` directs the importer to use a data dictionary.

`DataDictionary` — Simulink data dictionary
character vector | string scalar

Simulink data dictionary into which to import data objects corresponding to AUTOSAR data types in the XML file. If the specified dictionary does not already exist, the importer creates it. The model is then associated with that data dictionary.

Example: `'DataDictionary','ardata.sldd'`

Output Arguments

`sts` — Success or failure
true or false

Variable that returns true if the import is successful. Otherwise, returns false.

Tip

If you enter the `arxml.importer` object function call without a terminating semicolon (;), the importer lists the AUTOSAR content of the specified XML file or files. The information includes paths to software components in the AUTOSAR package structure, which you can specify in calls to `createComponentAsModel` and `createCalibrationComponentObjects`.

See Also

`arxml.importer`

Topics

“Import AUTOSAR Software Component” on page 3-4
“AUTOSAR arxml Importer” on page 3-2
“Control AUTOSAR Variants with Predefined Value Combinations” on page 4-310

Introduced in R2008b

createComponentAsModel

Package: arxml

Create Simulink representation of AUTOSAR `arxml` atomic software component

Syntax

```
createComponentAsModel(ar,ComponentName)
[mdl, sts] = createComponentAsModel(ar,ComponentName,Name,Value)
```

Description

`createComponentAsModel(ar,ComponentName)` creates a Simulink model corresponding to AUTOSAR atomic software component `ComponentName`. The component description is part of AUTOSAR information previously imported from AUTOSAR XML files, which is represented by `arxml.importer` object `ar`.The importer creates an initial Simulink representation of the imported AUTOSAR component, with an initial, default mapping of Simulink model elements to AUTOSAR component elements. The initial representation provides a starting point for further AUTOSAR configuration and Model-Based Design. For more information, see “AUTOSAR arxml Importer” on page 3-2.

The initial representation of AUTOSAR component behavior in the created model depends on the XML description:

- If the XML description of the component does not describe component behavior, the importer creates a model with a default representation of AUTOSAR runnables and ports.
- If the XML description of the component describes component behavior, the importer creates a model based on AUTOSAR elements that are accessed in the component.

  For example, AUTOSAR ports must be accessed by runnables in order to generate the corresponding Simulink elements. If a sender-receiver or client-server port in XML code is not accessed by a runnable, the importer does not create the corresponding inports, outports, or Simulink functions.

`[mdl, sts] = createComponentAsModel(ar,ComponentName,Name,Value)` specifies additional options for Simulink model creation with one or more `Name,Value` pair arguments.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Import AUTOSAR Component and Model Periodic Runnables as Atomic Subsystems

Import AUTOSAR software component `/pkg/swc` from XML file `mySWC.arxml` and create an initial Simulink representation of the component. Model AUTOSAR periodic runnables as atomic subsystems with periodic rates.

```
ar = arxml.importer('mySWC.arxml')
createComponentAsModel(ar,'/pkg/swc','ModelPeriodicRunnablesAs','AtomicSubsystem')
```

Import AUTOSAR Component and Model Periodic Runnables as Function-Call Subsystems

Import AUTOSAR software component `/pkg/swc` from XML file `mySWC.arxml` and create an initial Simulink representation of the component. Model AUTOSAR periodic runnables as function-call subsystems with periodic rates.

```
ar = arxml.importer('mySWC.arxml')
createComponentAsModel(ar,'/pkg/swc','ModelPeriodicRunnablesAs','FunctionCallSubsystem')
```

Import AUTOSAR Component and Use Data Dictionary

Import AUTOSAR software component `/pkg/swc` from XML file `mySWC.arxml` and create an initial Simulink representation of the component. Place Simulink data objects corresponding to AUTOSAR data types into data dictionary `ardata.sldd`.

```
ar = arxml.importer('mySWC.arxml')
createComponentAsModel(ar,'/pkg/swc','ModelPeriodicRunnablesAs','AtomicSubsystem',...
  'DataDictionary','ardata.sldd')
```

Import AUTOSAR Component and Designate Initialization Runnable

Import AUTOSAR software component `/pkg/swc` from XML file `mySWC.arxml` and create an initial Simulink representation of the component. Configure AUTOSAR runnable `Runnable_Init` as the initialization runnable for the component.

```
ar = arxml.importer('mySWC.arxml')
createComponentAsModel(ar,'/pkg/swc','ModelPeriodicRunnablesAs','AtomicSubsystem',...
  'InitializationRunnable','Runnable_Init')
```

Import AUTOSAR Component and Use `PredefinedVariant` to Resolve Variation Points

Import AUTOSAR software component `/pkg/swc` from XML file `mySWC.arxml` and create an initial Simulink representation of the component. Use `PredefinedVariant` Senior to resolve variation points in the component at model creation time.

```
ar = arxml.importer('mySWC.arxml')
createComponentAsModel(ar,'/pkg/swc','ModelPeriodicRunnablesAs','AtomicSubsystem',...
  'PredefinedVariant','/pkg/body/Variants/Senior');
```

Import AUTOSAR Component and Use `SwSystemconstantValueSets` to Resolve Variation Points

Import AUTOSAR software component `/pkg/swc` from XML file `mySWC.arxml` and create an initial Simulink representation of the component. Use `SwSystemconstantValueSets` A and B to resolve variation points in the component at model creation time.

```
ar = arxml.importer('mySWC.arxml')
createComponentAsModel(ar,'/pkg/swc','ModelPeriodicRunnablesAs','AtomicSubsystem',...
  'SystemConstValueSets',{'/pkg/body/SystemConstantValues/A','/pkg/body/SystemConstantValues/B'});
```

Input Arguments

`ar` — `arxml.importer` object
object

AUTOSAR information previously imported from XML files, specified as an `arxml.importer` object.

`ComponentName` — Component path
character vector | string scalar

Absolute short-name path of the atomic software component.

Example: `'/Company/Powertrain/Components/ASWC'`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'ModelPeriodicRunnablesAs','AtomicSubsystem'` directs the importer to model AUTOSAR periodic runnables as atomic subsystems with periodic rates.

`DataDictionary` — Simulink data dictionary
character vector | string scalar

Simulink data dictionary into which to import data objects corresponding to AUTOSAR data types in the XML file. If the specified dictionary does not already exist, the importer creates it. The model is then associated with that data dictionary.

Example: `'DataDictionary','ardata.sldd'`

`InitializationRunnable` — Initialization runnable
character vector | string scalar

Name of an existing AUTOSAR runnable to select as the initialization runnable for the component.

Example: `'InitializationRunnable','Runnable_Init'`

`ModelPeriodicRunnablesAs` — Subsystem type for periodic runnables
`'AtomicSubsystem'` (default) | `'FunctionCallSubsystem'` | `'Auto'`

By default, `createComponentAsModel` imports AUTOSAR periodic runnables found in `arxml` files and models them as atomic subsystems with periodic rates. If conditions prevent use of atomic subsystems, the importer throws an error.

To model periodic runnables as function-call subsystems with periodic rates, specify `FunctionCallSubsystem`.

If you specify `Auto`, the importer attempts to model periodic runnables as atomic subsystems. If conditions prevent use of atomic subsystems, the importer models periodic runnables as function-call subsystems.

For more information, see “Import AUTOSAR Software Component with Multiple Runnables” on page 3-8.

Example: `'ModelPeriodicRunnablesAs','AtomicSubsystem'`

Data Types: `char`

`PredefinedVariant` — Path to AUTOSAR predefined variant
character vector | string scalar

Path to a `PredefinedVariant` defined in the AUTOSAR XML file. A `PredefinedVariant` describes a combination of system constant values among potentially multiple valid combinations to apply to an AUTOSAR software component. Use this property to resolve variation points in the AUTOSAR software component at model creation time. If specified, the importer uses the `PredefinedVariant` to initialize `SwSystemconst` data that serves as input to control variation points.

For more information, see “Control AUTOSAR Variants with Predefined Value Combinations” on page 4-310.

Example: `'PredefinedVariant','/pkg/body/Variants/Senior'`

`SystemConstValueSets` — Paths to one or more AUTOSAR system constant value sets
cell array of character vectors | string array

Paths to one or more `SystemConstValueSet`s defined in the AUTOSAR XML file. A `SystemConstValueSet` specifies a set of system constant values to apply to an AUTOSAR software component. Use this property to resolve variation points in the AUTOSAR software component at model creation time. If specified, the importer uses the `SystemConstValueSet`s to initialize `SwSystemconst` data that serves as input to control variation points.

For more information, see “Control AUTOSAR Variants with Predefined Value Combinations” on page 4-310.

Example: `'SystemConstValueSets','{'/pkg/body/SystemConstantValues/A','/pkg/body/SystemConstantValues/B'}'`

Output Arguments

`mdl` — Model handle
handle

Variable that returns a handle to created model.

`sts` — Success or failure
true or false

Variable that returns true if the import is successful. Otherwise, returns false.

Tips

- If you enter the `arxml.importer` object function call without a terminating semicolon (;), the importer lists the AUTOSAR content of the specified XML file or files. The information includes paths to software components in the AUTOSAR package structure, which you can specify in calls to `createComponentAsModel`, `createCompositionAsModel`, and `createCalibrationComponentObjects`.
- When importing an AUTOSAR software component into a model, it is recommended that you explicitly specify the `ModelPeriodicRunnablesAs` property. This property determines how the importer models AUTOSAR periodic runnables in the created model. See the property description under “Name-Value Pair Arguments” on page 6-68.

See Also

`arxml.importer`

Topics

“Import AUTOSAR Software Component” on page 3-4
“Import AUTOSAR Component to Simulink” (Embedded Coder Support Package for AUTOSAR Standard)
“AUTOSAR arxml Importer” on page 3-2
“Control AUTOSAR Variants with Predefined Value Combinations” on page 4-310

Introduced in R2008a

createCompositionAsModel

Package: arxml

Create Simulink representation of AUTOSAR `arxml` software composition

Syntax

```
createCompositionAsModel(ar,CompositionName)
[mdl, sts] = createCompositionAsModel(ar,CompositionName,Name,Value)
```

Description

`createCompositionAsModel(ar,CompositionName)` creates a Simulink model corresponding to AUTOSAR software composition `CompositionName`. The composition description is part of AUTOSAR information previously imported from AUTOSAR XML files, which is represented by `arxml.importer` object `ar`.The importer creates an initial Simulink representation of the imported AUTOSAR composition. The initial representation provides a starting point for further AUTOSAR configuration and Model-Based Design. For more information, see “AUTOSAR arxml Importer” on page 3-2.

`[mdl, sts] = createCompositionAsModel(ar,CompositionName,Name,Value)` specifies additional options for Simulink model creation with one or more `Name,Value` pair arguments.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Import AUTOSAR Composition

Import AUTOSAR software composition `/pkg/rootComposition` from XML file `mySWCs.arxml` and create an initial Simulink representation of the composition.

```
ar = arxml.importer('mySWCs.arxml')
createCompositionAsModel(ar,'/pkg/rootComposition')
```

Import AUTOSAR Composition and Include Existing Component Models

Import AUTOSAR software composition `/pkg/rootComposition` from XML file `mySWCs.arxml` and create an initial Simulink representation of the composition. For components `mySwc1` and `mySwc2` contained within the composition, use existing Simulink component models rather than creating new ones.

```
ar = arxml.importer('mySWCs.arxml')
createCompositionAsModel(ar,'/pkg/rootComposition','ComponentModels',{'mySwc1','mySwc2'})
```

Import AUTOSAR Composition and Use Data Dictionary

Import AUTOSAR software composition `/pkg/rootComposition` from XML file `mySWCs.arxml` and create an initial Simulink representation of the composition. Place Simulink data objects corresponding to AUTOSAR data types into data dictionary `ardata.sldd`.

```
ar = arxml.importer('mySWCs.arxml')
createCompositionAsModel(ar,'/pkg/rootComposition','DataDictionary','ardata.sldd')
```

Import AUTOSAR Composition and Model Periodic Runnables as Function-Call Subsystems

Import AUTOSAR software composition `/pkg/rootComposition` from XML file `mySWCs.arxml` and create an initial Simulink representation of the composition. Model AUTOSAR periodic runnables as function-call subsystems with periodic rates.

```
ar = arxml.importer('mySWCs.arxml')
createCompositionAsModel(ar,'/pkg/rootComposition',...
  'ModelPeriodicRunnablesAs','FunctionCallSubsystem')
```

Import AUTOSAR Composition and Use `PredefinedVariant` to Resolve Variation Points

Import AUTOSAR software composition `/pkg/rootComposition` from XML file `mySWCs.arxml` and create an initial Simulink representation of the composition. Use `PredefinedVariant` Senior to resolve variation points in components at model creation time.

```
ar = arxml.importer('mySWCs.arxml')
createCompositionAsModel(ar,'/pkg/rootComposition',...
  'PredefinedVariant','/pkg/body/Variants/Senior');
```

Import AUTOSAR Composition and Use `SwSystemconstantValueSets` to Resolve Variation Points

Import AUTOSAR software composition `/pkg/rootComposition` from XML file `mySWCs.arxml` and create an initial Simulink representation of the composition. Use `SwSystemconstantValueSets` A and B to resolve variation points in components at model creation time.

```
ar = arxml.importer('mySWCs.arxml')
createCompositionAsModel(ar,'/pkg/rootComposition',...
  'SystemConstValueSets',{'/pkg/body/SystemConstantValues/A','/pkg/body/SystemConstantValues/B'});
```

Input Arguments

`ar` — `arxml.importer` object
object

AUTOSAR information previously imported from XML files, specified as an `arxml.importer` object.

`CompositionName` — Composition path
character vector | string scalar

Absolute short-name path of the software composition.

Example: `'/Company/Powertrain/Components/RootComposition'`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes.

You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'ModelPeriodicRunnablesAs','AtomicSubsystem'` directs the importer to model AUTOSAR periodic runnables as atomic subsystems with periodic rates.

`ComponentModels` — Simulink component models
cell array of character vectors | string array

Names of existing atomic software component models to use when creating a Simulink representation of the composition. The function incorporates the specified existing component models in the composition model instead of creating new ones.

Example: `'ComponentModels',{'mySwc1','mySwc2'}`

`DataDictionary` — Simulink data dictionary
character vector | string scalar

Simulink data dictionary into which to import data objects corresponding to AUTOSAR data types in the XML file. If the specified dictionary does not already exist, the importer creates it. The model is then associated with that data dictionary.

Example: `'DataDictionary','ardata.sldd'`

`ModelPeriodicRunnablesAs` — Subsystem type for periodic runnables
`'Auto'` (default) | `'AtomicSubsystem'` | `'FunctionCallSubsystem'`

By default, `createCompositionAsModel` imports AUTOSAR periodic runnables found in `arxml` files and attempts to model them as atomic subsystems with periodic rates. If conditions prevent use of atomic subsystems, the function models the periodic runnables as function-call subsystems with periodic rates.

To model periodic runnables only as atomic subsystems, specify `AtomicSubsystem`. If conditions prevent use of atomic subsystems, the function throws an error.

To model periodic runnables only as function-call subsystems, specify `FunctionCallSubsystem`.

For more information, see “Import AUTOSAR Software Component with Multiple Runnables” on page 3-8.

Example: `'ModelPeriodicRunnablesAs','AtomicSubsystem'`

Data Types: `char`

`PredefinedVariant` — Path to AUTOSAR predefined variant
character vector | string scalar

Path to a `PredefinedVariant` defined in the AUTOSAR XML file. A `PredefinedVariant` describes a combination of system constant values among potentially multiple valid combinations to apply to AUTOSAR software components. Use this property to resolve variation points in AUTOSAR software components at model creation time. If specified, the importer uses the `PredefinedVariant` to initialize `SwSystemconst` data that serves as input to control variation points.

For more information, see “Control AUTOSAR Variants with Predefined Value Combinations” on page 4-310.

Example: `'PredefinedVariant','/pkg/body/Variants/Senior'`

`SystemConstValueSets` — Paths to one or more AUTOSAR system constant value sets
cell array of character vectors | string array

Paths to one or more `SystemConstValueSets` defined in the AUTOSAR XML file. A `SystemConstValueSet` specifies a set of system constant values to apply to AUTOSAR software components. Use this property to resolve variation points in AUTOSAR software components at model creation time. If specified, the importer uses the `SystemConstValueSets` to initialize `SwSystemconst` data that serves as input to control variation points.

For more information, see “Control AUTOSAR Variants with Predefined Value Combinations” on page 4-310.

Example: `'SystemConstValueSets','{'/pkg/body/SystemConstantValues/A','/pkg/body/SystemConstantValues/B'}'`

Output Arguments

`mdl` — Model handle
handle

Variable that returns a handle to created model.

`sts` — Success or failure
true or false

Variable that returns true if the import is successful. Otherwise, returns false.

Tip

If you enter the `arxml.importer` object function call without a terminating semicolon (;), the importer lists the AUTOSAR content of the specified XML file or files. The information includes paths to software components in the AUTOSAR package structure, which you can specify in calls to `createCompositionAsModel`, `createComponentAsModel`, and `createCalibrationComponentObjects`.

See Also

`arxml.importer`

Topics

"Import AUTOSAR Software Component" on page 3-4
"Import AUTOSAR Composition to Simulink" (Embedded Coder Support Package for AUTOSAR Standard)
"AUTOSAR arxml Importer" on page 3-2
"Control AUTOSAR Variants with Predefined Value Combinations" on page 4-310

Introduced in R2017b

delete

Delete AUTOSAR element

Syntax

`delete(arProps,elementPath)`

Description

`delete(arProps,elementPath)` deletes the AUTOSAR element at `elementPath`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Delete Sender-Receiver Interface

Delete the sender-receiver interface `Interface1` from the AUTOSAR configuration for a model.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
ifPaths=find(arProps,[],'SenderReceiverInterface','PathType','FullyQualified')
```

```
ifPaths =
    '/pkg/if/Interface1'    '/pkg/if/Interface2'
```

```
delete(arProps,'Interface1');
ifPaths=find(arProps,[],'SenderReceiverInterface','PathType','FullyQualified')
```

```
ifPaths =
    '/pkg/if/Interface2'
```

Input Arguments

`arProps` — AUTOSAR properties information for a model

handle

AUTOSAR properties information for a model, previously returned by *`arProps`* = `autosar.api.getAUTOSARProperties(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `arProps`

`elementPath` — Path to AUTOSAR element

character vector | string scalar

Path to the AUTOSAR element to delete.

Example: `'Input'`

See Also

add

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

deleteUnmappedComponents

Delete unmapped AUTOSAR components from model

Syntax

```
deleteUnmappedComponents(arProps)
```

Description

`deleteUnmappedComponents(arProps)` deletes atomic software components that are not mapped to the model. Use this to remove unused imported components that you do not want preserved in the model and exported in `arxml` code. This function does not remove calibration components.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Remove Unmapped Atomic Software Components From AUTOSAR Model

After importing AUTOSAR information from `arxml` files and configuring a model for AUTOSAR, remove atomic software components that were imported but are not mapped to the model. This prevents unmapped components from being exported back to `arxml`.

```
arProps=autosar.api.getAUTOSARProperties('my_autosar_model');
deleteUnmappedComponents(arProps);
```

Input Arguments

arProps — AUTOSAR properties information for a model

handle

AUTOSAR properties information for a model, previously returned by *`arProps`* = `autosar.api.getAUTOSARProperties(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `arProps`

See Also

`arxml.importer`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“Import AUTOSAR Software Component” on page 3-4
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2014b

find

Find AUTOSAR elements

Syntax

```
paths=find(arProps,rootPath,category)
paths=find(arProps,rootPath,category,'PathType',value)
paths=find(arProps,rootPath,category,property,value)
```

Description

`paths=find(arProps,rootPath,category)` returns `paths` to AUTOSAR elements matching `category`, starting at path `rootPath`.

`paths=find(arProps,rootPath,category,'PathType',value)` specifies whether the returned `paths` are fully qualified or partially qualified.

`paths=find(arProps,rootPath,category,property,value)` specifies a constraining value on a property of the specified `category` of elements, narrowing the search.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Find Sender-Receiver Interfaces That Are Not Services

For a model, find sender-receiver interfaces for which the property `IsService` is `false` and return fully qualified paths.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
ifPaths=find(arProps,[],'SenderReceiverInterface',...
  'IsService',false,'PathType','FullyQualified')

ifPaths =
  1×2 cell array
    {'/pkg/if/Interface1'}    {'/pkg/if/Interface2'}
```

Find Mode-Switch Interface Paths

For a model, add a mode-switch interface and then use `find` to list paths for mode-switch interfaces in the model.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
addPackageableElement(arProps,'ModeSwitchInterface','/pkg/if','Interface3',...
  'IsService',true);
ifPaths=find(arProps,[],'ModeSwitchInterface','PathType','FullyQualified')

ifPaths =
  1×1 cell array
    {'/pkg/if/Interface3'}
```

Input Arguments

`arProps` — AUTOSAR properties information for a model

handle

AUTOSAR properties information for a model, previously returned by *`arProps`* `= autosar.api.getAUTOSARProperties(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `arProps`

`rootPath` — Starting point of the search

character vector | string scalar | `[ ]`

Path specifying the starting point at which to look for the specified type of AUTOSAR elements. `[ ]` indicates the root of the component.

Example: `[ ]`

`category` — Type of AUTOSAR element

character vector | string scalar

Type of AUTOSAR element for which to return paths.

Example: `'SenderReceiverInterface'`

`'PathType',value` — Whether the returned paths are fully qualified or partially qualified
`'PartiallyQualified'` (default) | `'FullyQualified'`

Specify `FullyQualified` to return fully qualified paths.

Example: `'PathType','FullyQualified'`

`property,value` — Property and value
name (character vector or string scalar), value

Valid property of the specified category of elements, and a value to match for that property in the search. Table “Properties of AUTOSAR Elements” on page 4-315 lists properties that are associated with AUTOSAR elements.

Example: `'IsService',true`

Output Arguments

`paths` — Paths to AUTOSAR elements
cell array of character vectors

Variable that returns paths to AUTOSAR elements.

Example: `ifPaths`

See Also

`add` | `delete` | `get` | `set`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

get

Get property of AUTOSAR element

Syntax

```
pValue=get(arProps,elementPath,property)
```

Description

`pValue=get(arProps,elementPath,property)` returns the value of the property of the AUTOSAR element at `elementPath`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get Value of IsService Property of Sender-Receiver Interface

For a model, get the value of the `IsService` property for the sender-receiver interface `Interface1`. The variable `IsService` returns `false` (0), indicating that the sender-receiver interface is not a service.

```
rtwdemo_autosar_multirunnables
arProps=autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
isService=get(arProps,'Interface1','IsService')
```

```
isService =
     0
```

Input Arguments

`arProps` — AUTOSAR properties information for a model

handle

AUTOSAR properties information for a model, previously returned by *`arProps`* `= autosar.api.getAUTOSARProperties(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `arProps`

`elementPath` — Path to AUTOSAR element

character vector | string scalar

Path to the AUTOSAR element for which to return the value of a property.

Example: `'Input'`

`property` — Type of property

character vector | string scalar

Type of property to add for which to return a value, among valid properties for the AUTOSAR element.

Example: `'IsService'`

Output Arguments

`pValue` — Property value or path

value of property | path to composite property or property that references other properties

Variable that returns the value of the specified AUTOSAR property. For composite properties or properties that reference other properties, the return value is the path to the property.

Example: `ifPaths`

See Also

`set`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

getComponentNames

Package: arxml

Get AUTOSAR software component names from `arxml` files

Syntax

```
names = getComponentNames(ar)
names = getComponentNames(ar,compKind)
```

Description

`names = getComponentNames(ar)` returns the names of AUTOSAR software components found in the XML files associated with `arxml.importer` object `ar`. By default, the function returns the names of atomic software components, including application, sensor/actuator, complex device driver, ECU abstraction, and service proxy software components.

`names = getComponentNames(ar,compKind)` uses the `compKind` argument to specify the type of software component to return. You can narrow the search to a specific type of atomic software component, such as `'Application'` or `'SensorActuator'`, or specify a nonatomic component, such as `'Composition'` or `'Parameter'`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Atomic Software Component Names from `arxml` Files

Get the names of AUTOSAR atomic software components present in `arxml` files.

```
addpath(fullfile(autosarroot,'autosar_examples','ThrottlePositionControlSystem','arxml'));
ar = arxml.importer('ThrottlePositionControlComposition.arxml');
names = getComponentNames(ar)
```

```
names =
  5x1 cell array
    {'/Company/Components/Controller'                    }
    {'/Company/Components/ThrottlePositionMonitor'       }
    {'/Company/Components/AccelerationPedalPositionSensor'}
    {'/Company/Components/ThrottlePositionActuator'      }
    {'/Company/Components/ThrottlePositionSensor'        }
```

Get AUTOSAR Sensor-Actuator Software Component Names from `arxml` Files

Get the names of AUTOSAR sensor-actuator software components present in `arxml` files.

```
addpath(fullfile(autosarroot,'autosar_examples','ThrottlePositionControlSystem','arxml'));
ar = arxml.importer('ThrottlePositionControlComposition.arxml');
names = getComponentNames(ar,'SensorActuator')
```

```
names =
  3x1 cell array
    {'/Company/Components/AccelerationPedalPositionSensor'}
    {'/Company/Components/ThrottlePositionActuator'      }
    {'/Company/Components/ThrottlePositionSensor'        }
```

Input Arguments

`ar` — `arxml.importer` object

object

AUTOSAR information previously imported from XML files, specified as an `arxml.importer` object.

`compKind` — Component type

`'Atomic'` (default) | `'Application'` | `'ComplexDeviceDriver'` | `'Composition'` | `'EcuAbstraction'` | `'Parameter'` | `'SensorActuator'` | `'ServiceProxy'`

Type of software component to return.

Output Argument

`names` — Names array
cell array of character vectors

Variable that returns an array of component names. Each array element is the absolute short-name path of an AUTOSAR software component.

Example: `{'/pkg/swc/tpSensor','/pkg/swc/tpActuator'}`

See Also

`arxml.importer`

Topics

“Import AUTOSAR Software Component” on page 3-4
“AUTOSAR arxml Importer” on page 3-2

Introduced in R2008a

getDataTransfer

Get AUTOSAR mapping information for Simulink data transfer

Syntax

```
[arIrvName,arDataAccessMode]=getDataTransfer(slMap,slDataTransfer)
```

Description

`[arIrvName,arDataAccessMode]=getDataTransfer(slMap,slDataTransfer)` returns the values of the AUTOSAR inter-runnable variable `arIrvName` and AUTOSAR data access mode `arDataAccessMode` that are mapped to Simulink data transfer line or Rate Transition block `slDataTransfer`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Mapping Information for Simulink Data Transfer Line

Get AUTOSAR mapping information for a data transfer line in the example model `rtwdemo_autosar_multirunnables`. The model has data transfer lines named `irv1`, `irv2`, `irv3`, and `irv4`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
[arIrvName,arDataAccessMode]=getDataTransfer(slMap,'irv4')
```

```
arIrvName =
    'IRV4'
```

```
arDataAccessMode =
    'Implicit'
```

Get AUTOSAR Mapping Information for Rate Transition Block

Get AUTOSAR mapping information for a Rate Transition block in the example model `mMultitasking_4rates`. The model has Rate Transition blocks named `RateTransition`, `RateTransition1`, and `RateTransition2`, which are located at the top level of the model.

```
open_system(fullfile(matlabroot,'/help/toolbox/ecoder/examples/autosar/mMultitasking_4rates'))
slMap=autosar.api.getSimulinkMapping('mMultitasking_4rates');
[arIrvName,arDataAccessMode]=getDataTransfer(slMap,'mMultitasking_4rates/RateTransition')
```

```
arIrvName =
    'IRV1'
arDataAccessMode =
    'Implicit'
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slDataTransfer` — Simulink data transfer line name or Rate Transition full block path

character vector | string scalar

Name of the Simulink data transfer line or full block path to the Rate Transition block for which to return AUTOSAR mapping information.

Example: `'irv4'`

Example: `'myModel/RateTransition2'`

Output Arguments

`arIrvName` — Name of AUTOSAR inter-runnable variable
character vector

Variable that returns the name of AUTOSAR inter-runnable variable mapped to the specified Simulink data transfer.

Example: `arIrvName`

`arDataAccessMode` — Value of AUTOSAR data access mode
character vector

Variable that returns the value of the AUTOSAR data access mode mapped to the specified Simulink data transfer. The value is `Implicit` or `Explicit`.

Example: `arDataAcessMode`

See Also

`mapDataTransfer`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

getFunction

Get AUTOSAR mapping information for Simulink entry-point function

Syntax

```
arRunnableName = getFunction(slMap,slFcnName)
[arRunnableName,arRunnableSwAddrMethod,arInternalDataSwAddrMethod] =
getFunction(slMap,slFcnName)
```

Description

`arRunnableName = getFunction(slMap,slFcnName)` returns the name of the AUTOSAR runnable `arRunnableName` mapped to Simulink entry-point function `slFcnName`.

`[arRunnableName,arRunnableSwAddrMethod,arInternalDataSwAddrMethod] = getFunction(slMap,slFcnName)` returns the names of function and internal data software address methods (`SwAddrMethods`) defined for the mapped AUTOSAR runnable. If a `SwAddrMethod` is not defined, the function returns `'<None>'`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Runnable Name for Simulink Entry-Point Function

Get the name of the AUTOSAR runnable mapped to a Simulink entry point function in the example model `rtwdemo_autosar_swc`. The model has an initialize entry-point function named `Runnable_Init` and rate-based entry-point functions named `Runnable_1s` and `Runnable_2s`.

```
open_system('rtwdemo_autosar_swc')
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_swc');
arRunnableName=getFunction(slMap,'InitializeFunction')
```

```
arRunnableName =
    'Runnable_Init'
```

Get AUTOSAR SwAddrMethod Names for Simulink Entry-Point Function

Get AUTOSAR SwAddrMethod names for a Simulink entry point function in the example model rtwdemo_autosar_counter. The model has a rate-based entry-point step function.

```
open_system('rtwdemo_autosar_counter')

% Add SwAddrMethods myCODE and myVAR to the AUTOSAR component
arProps = autosar.api.getAUTOSARProperties('rtwdemo_autosar_counter');
addPackageableElement(arProps,'SwAddrMethod',...
    '/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods','myCODE',...
    'SectionType','Code')
swAddrPaths = find(arProps,[],'SwAddrMethod','PathType','FullyQualified',...
    'SectionType','Code')
addPackageableElement(arProps,'SwAddrMethod',...
    '/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods','myVAR',...
    'SectionType','Var')
swAddrPaths = find(arProps,[],'SwAddrMethod','PathType','FullyQualified',...
    'SectionType','Var')

% Set code generation parameter for runnable internal data SwAddrMethods
set_param('rtwdemo_autosar_counter','GroupInternalDataByFunction','on')

% Map step runnable function and internal data to myCODE and myVAR SwAddrMethods
slMap = autosar.api.getSimulinkMapping('rtwdemo_autosar_counter');
mapFunction(slMap,'StepFunction','Runnable_Step',...
    'SwAddrMethod','myCODE','SwAddrMethodForInternalData','myVAR')

% Return AUTOSAR mapping information for step function
[arRunnableName,arRunnableSwAddrMethod,arInternalDataSwAddrMethod] = ...
    getFunction(slMap,'StepFunction')
```

```
swAddrPaths =
    {'/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods/myCODE'}

swAddrPaths =
    {'/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods/myVAR'}

arRunnableName =
    'Runnable_Step'

arRunnableSwAddrMethod =
    'myCODE'
```

```
arInternalDataSwAddrMethod =
    'myVAR'
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slFcnName` — Name of Simulink entry point function

character vector | string scalar

Name of the Simulink entry point function for which to return AUTOSAR mapping information, specified as follows:

- For an initialize function, `'InitializeFunction'`.
- For a reset function, a model-wide reset event name. For example, `'reset'`.
- For a terminate function, `'TerminateFunction'`.
- For a rate-based function, `'StepFunction'` for the base-rate task or `'StepFunction`*`N`*`'` for a subrate task, where *`N`* is the task identifier.
- For an exported function, `'`*`FunctionCallName`*`'`, where *`FunctionCallName`* is the name of the Inport block that drives the control port of the function-call subsystem. For example, `'Trigger_1s'` in example model `rtwdemo_autosar_swc_slfcns` or `'FunctionTrigger'` in example model `rtwdemo_autosar_swc_fcncalls`.
- For a global Simulink function in a client-server configuration, `'`*`SlFunctionName`*`'`, where*`SlFunctionName`* is the name of a Simulink function for which Trigger block parameter **Function visibility** is set to `global`. For example, `'readData'` in the example model used in “Configure AUTOSAR Server” on page 4-144.

Example: `'StepFunction2'`

Output Arguments

`arRunnableName` — Name of AUTOSAR runnable
character vector

Variable that returns the name of the AUTOSAR runnable mapped to the specified Simulink entry-point function.

Example: `arRunnableName`

`arRunnableSwAddrMethod` — Name of function `SwAddrMethod`
character vector

Variable that returns the name of the `SwAddrMethod` defined for the AUTOSAR runnable function.

Example: `arRunnableSwAddrMethod`

`arInternalDataSwAddrMethod` — Name of internal data `SwAddrMethod`
character vector

Variable that returns the name of the `SwAddrMethod` defined for the AUTOSAR runnable internal data.

Example: `arInternalDataSwAddrMethod`

See Also

`mapFunction`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

getFunctionCaller

Get AUTOSAR mapping information for Simulink function-caller block

Syntax

```
[arPortName,arOperationName] = getFunctionCaller(slMap,slFcnName)
```

Description

`[arPortName,arOperationName] = getFunctionCaller(slMap,slFcnName)` returns the value of the AUTOSAR client port `arPortName` and AUTOSAR operation `arOperationName` mapped to the Simulink function caller block for Simulink function `slFcnName`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons** > **Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Mapping Information for Function Caller Block

Get AUTOSAR mapping information for a function-caller block in a model in which AUTOSAR client function invocation is being modeled. The model has a function-caller block for Simulink function `readData`.

```
open_system('mControllerWithInterface_client')
slMapC = autosar.api.getSimulinkMapping('mControllerWithInterface_client');
mapFunctionCaller(slMapC,'readData','cPort','readData');
[arPort,arOp] = getFunctionCaller(slMapC,'readData')
```

```
arPort =
cPort
```

```
arOp =
readData
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slFcnName` — Name of Simulink function

character vector | string scalar

Name of the Simulink function for the function-caller block for which to return AUTOSAR mapping information.

Example: `'readData'`

Output Arguments

`arPortName` — Name of AUTOSAR client port

character vector

Variable that returns the name of the AUTOSAR client port mapped to the specified function-caller block.

Example: `arPort`

`arOperationName` — Name of AUTOSAR operation

character vector

Variable that returns the name of the AUTOSAR operation mapped to the specified function-caller block.

Example: `arOp`

See Also

`mapFunctionCaller`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2014b

getInport

Get AUTOSAR mapping information for Simulink inport

Syntax

```
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,
slPortName)
```

Description

`[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap, slPortName)` returns the values of the AUTOSAR port `arPortName`, AUTOSAR data element `arDataElementName`, and AUTOSAR data access mode `arDataAccessMode` mapped to Simulink inport `slPortName`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Mapping Information for Model Inport

Get AUTOSAR mapping information for a model inport in the example model `rtwdemo_autosar_multirunnable`. The model has an inport named `RPort_DE1`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'RPort_DE1')
```

```
arPortName =
RPort

arDataElementName =
```

```
DE1

arDataAccessMode =
ImplicitReceive
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slPortName` — Name of model inport

character vector | string scalar

Name of the model inport for which to return AUTOSAR mapping information.

Example: `'Input'`

Output Arguments

`arPortName` — Name of AUTOSAR port

character vector

Variable that returns the name of the AUTOSAR port mapped to the specified Simulink inport.

Example: `arPortName`

`arDataElementName` — Name of AUTOSAR data element

character vector

Variable that returns the name of the AUTOSAR data element mapped to the specified Simulink inport.

Example: `arDataElementName`

`arDataAccessMode` — Value of AUTOSAR data access mode
character vector

Variable that returns the value of the AUTOSAR data access mode mapped to the specified Simulink inport. The value can be `ImplicitReceive`, `ExplicitReceive`, `QueuedExplicitReceive`, `ErrorStatus`, `ModeReceive`, `IsUpdated`, `EndToEndRead`, or `ExplicitReceiveByVal`

Example: `arDataAccessMode`

See Also

`mapInport`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

getLookupTable

Get AUTOSAR mapping information for Simulink lookup table

Syntax

```
[arParameterAccessMode,arPortName,arParameterData]=getLookupTable(
slMap,slParam)
```

Description

`[arParameterAccessMode,arPortName,arParameterData]=getLookupTable(slMap,slParam)` returns the values of the AUTOSAR parameter access mode `arParameterAccessMode`, AUTOSAR parameter receiver port `arPortName`, and AUTOSAR parameter data item `arParameterData` mapped to Simulink lookup table `slParam`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons** > **Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Mapping Information for Simulink Lookup Tables

Get AUTOSAR mapping information for Simulink lookup tables. The model has lookup tables named `L_4x6_single` and `L_4_single`.

- Simulink lookup table `L_4x6_single` is mapped to AUTOSAR parameter data item `L_4x6_single_ar`, which the AUTOSAR software component defines and accesses internally. (The parameter is not associated with a port-based parameter interface.) Parameter `L_4x6_single_ar` uses `Shared` parameter access mode.

- Simulink lookup table `L_4_single` is mapped to AUTOSAR parameter data item `prmDE1`, which is a data element associated with AUTOSAR parameter receiver port `prmRPort1`. Parameter `prmDE1` uses `PortParameter` parameter access mode.

```
open_system('mySWC')
slMap=autosar.api.getSimulinkMapping('mySWC');
[arParameterAccessMode,arPortName,arParameterData]=getLookupTable(slMap,'L_4x6_single')

arParameterAccessmode =
Shared

arPortName =
''

arParameterData =
L_4x6_single_ar

[arParameterAccessMode,arPortName,arParameterData]=getLookupTable(slMap,'L_4_single')

arParameterAccessmode =
PortParameter

arPortName =
prmRPort1

arParameterData =
prmDE1
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slParam` — Name of Simulink lookup table

character vector | string scalar

Name of the Simulink lookup table for which to return AUTOSAR mapping information.

Example: `'L_4x6_single'`

Output Arguments

`arParameterAccessMode` — Value of AUTOSAR parameter access mode
character vector

Variable that returns the value of the AUTOSAR parameter access mode mapped to the specified Simulink lookup table. The value can be `PortParameter`, `Shared`, `PerInstance`, or `Const`.

Example: `arParameterAccessMode`

`arPortName` — Name of AUTOSAR port
character vector

Variable that returns the name of the AUTOSAR parameter receiver port mapped to the specified Simulink lookup table. If the parameter returned by `arParameterData` is internal to the AUTOSAR software component, and not associated with a port-based parameter interface, `arPortName` returns an empty character vector.

Example: `arPortName`

`arParameterData` — Name of AUTOSAR parameter data item
character vector

Variable that returns the name of the AUTOSAR parameter data item mapped to the specified Simulink lookup table. The parameter can be internal to the AUTOSAR software component or associated with a port-based parameter interface.

Example: `arParameterData`

See Also

`mapLookupTable`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2016b

getOutport

Get AUTOSAR mapping information for Simulink outport

Syntax

```
[arPortName,arDataElementName,arDataAccessMode]=getOutport(slMap,
slPortName)
```

Description

`[arPortName,arDataElementName,arDataAccessMode]=getOutport(slMap, slPortName)` returns the values of the AUTOSAR provider port `arPortName`, AUTOSAR data element `arDataElementName`, and AUTOSAR data access mode `arDataAccessMode` mapped to Simulink outport `slPortName`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons** > **Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Mapping Information for Model Outport

Get AUTOSAR mapping information for a model outport in the example model `rtwdemo_autosar_multirunnables`. The model has an outport named `PPort_DE1`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
[arPortName,arDataElementName,arDataAccessMode]=getOutport(slMap,'PPort_DE1')
```

```
arPortName =
PPort

arDataElementName =
```

```
DE1

arDataAccessMode =
ImplicitSend
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slPortName` — Name of model outport

character vector | string scalar

Name of the model outport for which to return AUTOSAR mapping information.

Example: `'Output'`

Output Arguments

`arPortName` — Name of AUTOSAR port

character vector

Variable that returns the name of the AUTOSAR port mapped to the specified Simulink outport.

Example: `arPortName`

`arDataElementName` — Name of AUTOSAR data element

character vector

Variable that returns the name of the AUTOSAR data element mapped to the specified Simulink outport.

Example: `arDataElementName`

`arDataAccessMode` — Value of AUTOSAR data access mode
character vector

Variable that returns the value of the AUTOSAR data access mode mapped to the specified Simulink outport. The value can be `ImplicitSend`, `ImplicitSendByRef`, `ExplicitSend`, `EndToEndWrite`, or `ModeSend`.

Example: `arDataAcessMode`

See Also

`mapOutport`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

getParameter

Get AUTOSAR mapping information for Simulink model workspace parameter

Syntax

```
arValue=getParameter(slMap,slParameter)
arValue=getParameter(slMap,slParameter,arProperty)
```

Description

`arValue=getParameter(slMap,slParameter)` returns the type of AUTOSAR parameter mapped to Simulink model workspace parameter `slParameter`. AUTOSAR parameter types include `SharedParameter` and `ConstantMemory`.

`arValue=getParameter(slMap,slParameter,arProperty)` returns the value of property `arProperty` for the AUTOSAR parameter to which model workspace parameter `slParameter` is mapped.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Mapping Information for Simulink Model Workspace Parameters

Get AUTOSAR mapping and property information for Simulink model workspace parameters K and INC in model `mTest`.

```
slMap = autosar.api.getSimulinkMapping('mTest');

mapParameter(slMap,'K','SharedParameter')
```

```
arMappedTo = getParameter(slMap,'K')
arValue = getParameter(slMap,'K','SwCalibrationAccess')

mapParameter(slMap,'INC','ConstantMemory','SwCalibrationAccess','ReadOnly')
arMappedTo = getParameter(slMap,'INC')
arValue = getParameter(slMap,'INC','SwCalibrationAccess')

arMappedTo =
    'SharedParameter'

arValue =
    'ReadWrite'

arMappedTo =
    'ConstantMemory'

arValue =
    'ReadOnly'
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slParameter` — Simulink model workspace parameter

character vector | string scalar

Name of Simulink model workspace parameter for which to return AUTOSAR mapping information.

Example: `'INC'`

`arProperty` — AUTOSAR property

character vector | string scalar

Name of AUTOSAR parameter property. Valid property names include `SwAddrMethod`, `SwCalibrationAccess`, and `DisplayFormat`. For `ConstantMemory`, you can also specify C type qualifier properties `IsConst`, `IsVolatile`, or `Qualifier` (AUTOSAR additional native type qualifier). For property descriptions, see `mapParameter`.

Example: `'SwCalibrationAccess'`

Output Arguments

`arValue` — Value of AUTOSAR parameter type or property
character vector

Variable that returns either the type of the mapped AUTOSAR component internal parameter or the value of a parameter property.

Example: `arValue`

See Also

`mapParameter`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2018b

getSignal

Get AUTOSAR mapping information for Simulink block signal

Syntax

```
arValue=getSignal(slMap,slPortHandle)
arValue=getSignal(slMap,slPortHandle,arProperty)
```

Description

`arValue=getSignal(slMap,slPortHandle)` returns the type of AUTOSAR variable mapped to the named or test-pointed Simulink block signal associated with outport port handle `slPortHandle`. AUTOSAR variable types include `ArTypedPerInstanceMemory` and `StaticMemory`.

`arValue=getSignal(slMap,slPortHandle,arProperty)` returns the value of property `arProperty` for the AUTOSAR variable to which the Simulink block signal is mapped.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Mapping Information for Simulink Block Signals

Get AUTOSAR mapping and property information for the Simulink block signals for blocks `RelOpt` and `Sum` in example model `rtwdemo_autosar_counter`.

```
open_system('rtwdemo_autosar_counter');
slMap = autosar.api.getSimulinkMapping('rtwdemo_autosar_counter');
```

```
portHandles = get_param('rtwdemo_autosar_counter/RelOpt','portHandles');
outportHandle = portHandles.Outport;
mapSignal(slMap,outportHandle,'StaticMemory')
arMappedTo = getSignal(slMap,outportHandle)
arValue = getSignal(slMap,outportHandle,'SwCalibrationAccess')

portHandles = get_param('rtwdemo_autosar_counter/Sum','portHandles');
outportHandle = portHandles.Outport;
mapSignal(slMap,outportHandle,'ArTypedPerInstanceMemory',...
    'SwCalibrationAccess','ReadWrite')
arMappedTo = getSignal(slMap,outportHandle)
arValue = getSignal(slMap,outportHandle,'SwCalibrationAccess')

arMappedTo =
    'StaticMemory'

arValue =
    'ReadOnly'

arMappedTo =
    'ArTypedPerInstanceMemory'

arValue =
    'ReadWrite'
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slPortHandle` — Simulink outport port handle for a block signal

handle

Outport port handle for a named or test-pointed Simulink block signal for which to return AUTOSAR mapping information. Use MATLAB commands to construct the outport port handle. For example, for a Relational Operator block named `RelOpt`:

```
portHandles = get_param('rtwdemo_autosar_counter/RelOpt','portHandles');
outportHandle = portHandles.Outport;
```

Example: `outportHandle`

`arProperty` — AUTOSAR property
character vector | string scalar

Name of AUTOSAR variable property. Valid property names include `ShortName`, `SwAddrMethod`, `SwCalibrationAccess`, and `DisplayFormat`. For `StaticMemory`, you can also specify C type qualifier properties `IsVolatile` or `Qualifier` (AUTOSAR additional native type qualifier). For property descriptions, see `mapSignal`.

Example: `'SwCalibrationAccess'`

Output Arguments

`arValue` — Value of AUTOSAR variable type or property
character vector

Variable that returns either the type of the mapped AUTOSAR variable or the value of a variable property.

Example: `arValue`

See Also

`mapSignal`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2018b

getState

Get AUTOSAR mapping information for Simulink block state

Syntax

```
arValue=getState(slMap,slStateOwnerBlock)
arValue=getState(slMap,slStateOwnerBlock,slState)
arValue=getState(slMap,slStateOwnerBlock,slState,arProperty)
```

Description

`arValue=getState(slMap,slStateOwnerBlock)` returns the type of AUTOSAR variable mapped to the Simulink block state associated with state owner block `slStateOwnerBlock`. AUTOSAR variable types include `ArTypedPerInstanceMemory` and `StaticMemory`.

`arValue=getState(slMap,slStateOwnerBlock,slState)` returns the type of AUTOSAR variable mapped to Simulink state `slState` associated with state owner block `slStateOwnerBlock`. Specify a nonempty `slState` argument only for blocks with multiple states.

`arValue=getState(slMap,slStateOwnerBlock,slState,arProperty)` returns the value of property `arProperty` for the AUTOSAR variable to which the Simulink block state is mapped.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Get AUTOSAR Mapping Information for Simulink Block State

Get AUTOSAR mapping and property information for the Simulink block state for Unit Delay block X in example model `rtwdemo_autosar_counter`. The state owner block has one state.

```
open_system('rtwdemo_autosar_counter');
slMap = autosar.api.getSimulinkMapping('rtwdemo_autosar_counter');

mapState(slMap,'rtwdemo_autosar_counter/X','','ArTypedPerInstanceMemory',...
    'SwCalibrationAccess','ReadWrite')
arMappedTo = getState(slMap,'rtwdemo_autosar_counter/X')
arValue = getState(slMap,'rtwdemo_autosar_counter/X','','SwCalibrationAccess')
```

```
arMappedTo =
    'ArTypedPerInstanceMemory'

arValue =
    'ReadWrite'
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slStateOwnerBlock` — Simulink state owner block handle or path

handle | character vector | string scalar

Handle or path to Simulink state owner block for which to return AUTOSAR mapping information.

Example: `'rtwdemo_autosar_counter/X'`

`slState` — Simulink state

character vector | string scalar

Name of Simulink state associated with state owner block `slStateOwnerBlock`. Specify a nonempty state name only for blocks with multiple states. If `slState` is empty, the function returns mapping information for the first state in the block.

Example: `''`

`arProperty` — AUTOSAR property
character vector | string scalar

Name of AUTOSAR variable property. Valid property names include `ShortName`, `SwAddrMethod`, `SwCalibrationAccess`, and `DisplayFormat`. For `StaticMemory`, you can also specify C type qualifier properties `IsVolatile` or `Qualifier` (AUTOSAR additional native type qualifier). For property descriptions, see `mapState`.

Example: `'SwCalibrationAccess'`

Output Arguments

`arValue` — Value of AUTOSAR variable type or property
character vector

Variable that returns either the type of the mapped AUTOSAR variable or the value of a variable property.

Example: `arValue`

See Also

`mapState`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2018b

mapDataTransfer

Map Simulink data transfer to AUTOSAR inter-runnable variable

Syntax

```
mapDataTransfer(slMap,slDataTransfer,arIrvName,arDataAccessMode)
```

Description

`mapDataTransfer(slMap,slDataTransfer,arIrvName,arDataAccessMode)` maps the Simulink data transfer line or Rate Transition block `slDataTransfer` to AUTOSAR inter-runnable variable `arIrvName` and AUTOSAR data access mode `arDataAccessMode`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set AUTOSAR Mapping Information for Simulink Data Transfer Line

Set AUTOSAR mapping information for a data transfer line in the example model `rtwdemo_autosar_multirunnables`. The model has data transfer lines named `irv1`, `irv2`, `irv3`, and `irv4`. This example changes the AUTOSAR data access mode for `irv4` from `Implicit` to `Explicit`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
mapDataTransfer(slMap,'irv4','IRV4','Explicit');
[arIrvName,arDataAccessMode]=getDataTransfer(slMap,'irv4')

arIrvName =
IRV4
```

```
arDataAccessMode =
Explicit
```

Set AUTOSAR Mapping Information for Rate Transition Block

Set AUTOSAR mapping information for a Rate Transition block in the example model `mMultitasking_4rates`. The model has Rate Transition blocks named `RateTransition`, `RateTransition1`, and `RateTransition2`, which are located at the top level of the model. This example changes the AUTOSAR data access mode for `RateTransition` from `Implicit` to `Explicit`.

```
open_system(fullfile(matlabroot,'/help/toolbox/ecoder/examples/autosar/mMultitasking_4rates'))
slMap=autosar.api.getSimulinkMapping('mMultitasking_4rates');
mapDataTransfer(slMap,'mMultitasking_4rates/RateTransition','IRV1','Explicit');
[arIrvName,arDataAccessMode]=getDataTransfer(slMap,'mMultitasking_4rates/RateTransition')

arIrvName =
IRV1

arDataAccessMode =
Explicit
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* `= autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slDataTransfer` — Simulink data transfer line name or Rate Transition full block path

character vector | string scalar

Name of the Simulink data transfer line or full block path to the Rate Transition block for which to set AUTOSAR mapping information.

Example: `'irv4'`

Example: `'myModel/RateTransition2'`

`arIrvName` — Name of AUTOSAR inter-runnable variable
character vector | string scalar

Name of the AUTOSAR inter-runnable variable to which to map the specified Simulink data transfer.

Example: `'IRV4'`

`arDataAccessMode` — Value of AUTOSAR data access mode
character vector | string scalar

Value of the AUTOSAR data access mode to which to map the specified Simulink data transfer. The value can be `Implicit` or `Explicit`.

Example: `'Explicit'`

See Also

`getDataTransfer`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

mapFunction

Map Simulink entry-point function to AUTOSAR runnable and software address methods

Syntax

```
mapFunction(slMap,slFcnName,arRunnableName)
mapFunction(slMap,slFcnName,arRunnableName,Name,Value)
```

Description

`mapFunction(slMap,slFcnName,arRunnableName)` maps Simulink entry-point function `slFcnName` to AUTOSAR runnable `arRunnableName`.

`mapFunction(slMap,slFcnName,arRunnableName,Name,Value)` specifies additional properties for the AUTOSAR runnable by using one or more `Name,Value` pair arguments. You can specify software address methods (`SwAddrMethods`) for runnable function code and internal data.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set AUTOSAR Mapping Information for Simulink Entry-Point Function

Set AUTOSAR mapping information for a Simulink entry point function in the example model `rtwdemo_autosar_swc`. The model has an initialize entry-point function named `Runnable_Init` and rate-based entry-point functions named `Runnable_1s` and `Runnable_2s`.

```
open_system('rtwdemo_autosar_swc')
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_swc');
```

```
mapFunction(slMap,'InitializeFunction','Runnable_Init');
arRunnableName=getFunction(slMap,'InitializeFunction')
```

```
arRunnableName =
    'Runnable_Init'
```

Set AUTOSAR SwAddrMethods for Simulink Entry-Point Function

Set AUTOSAR SwAddrMethods for a Simulink entry point function in the example model `rtwdemo_autosar_counter`. The model has a rate-based entry-point step function.

```
open_system('rtwdemo_autosar_counter')

% Add SwAddrMethods myCODE and myVAR to the AUTOSAR component
arProps = autosar.api.getAUTOSARProperties('rtwdemo_autosar_counter');
addPackageableElement(arProps,'SwAddrMethod',...
    '/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods','myCODE',...
    'SectionType','Code')
swAddrPaths = find(arProps,[],'SwAddrMethod','PathType','FullyQualified',...
    'SectionType','Code')
addPackageableElement(arProps,'SwAddrMethod',...
    '/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods','myVAR',...
    'SectionType','Var')
swAddrPaths = find(arProps,[],'SwAddrMethod','PathType','FullyQualified',...
    'SectionType','Var')

% Set code generation parameter for runnable internal data SwAddrMethods
set_param('rtwdemo_autosar_counter','GroupInternalDataByFunction','on')

% Map step runnable function and internal data to myCODE and myVAR SwAddrMethods
slMap = autosar.api.getSimulinkMapping('rtwdemo_autosar_counter');
mapFunction(slMap,'StepFunction','Runnable_Step',...
    'SwAddrMethod','myCODE','SwAddrMethodForInternalData','myVAR')

% Return AUTOSAR mapping information for step function
[arRunnableName,arRunnableSwAddrMethod,arInternalDataSwAddrMethod] = ...
    getFunction(slMap,'StepFunction')
```

```
swAddrPaths =
    {'/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods/myCODE'}

swAddrPaths =
    {'/rtwdemo_autosar_counter_pkg/rtwdemo_autosar_counter_dt/SwAddrMethods/myVAR'}

arRunnableName =
    'Runnable_Step'

arRunnableSwAddrMethod =
    'myCODE'
```

```
arInternalDataSwAddrMethod =
    'myVAR'
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slFcnName` — Name of Simulink entry point function

character vector | string scalar

Name of the Simulink entry point function for which to set AUTOSAR mapping information, specified as follows.

- For an initialize function, `'InitializeFunction'`.
- For a reset function, a model-wide reset event name. For example, `'reset'`.
- For a terminate function, `'TerminateFunction'`.
- For a rate-based function, `'StepFunction'` for the base-rate task or `'StepFunction`*`N`*`'` for a subrate task, where *`N`* is the task identifier.
- For an exported function, `'`*`FunctionCallName`*`'`, where *`FunctionCallName`* is the name of the Inport block that drives the control port of the function-call subsystem. For example, `'Trigger_1s'` in example model `rtwdemo_autosar_swc_slfcns` or `'FunctionTrigger'` in example model `rtwdemo_autosar_swc_fcncalls`.
- For a global Simulink function in a client-server configuration, `'`*`SlFunctionName`*`'`, where*`SlFunctionName`* is the name of a Simulink function for which Trigger block parameter **Function visibility** is set to `global`. For example, `'readData'` in the example model used in “Configure AUTOSAR Server” on page 4-144.

Example: `'StepFunction2'`

`arRunnableName` — Name of AUTOSAR runnable

character vector | string scalar

Name of AUTOSAR runnable to which to map the specified Simulink entry-point function.

Example: `'Runnable2'`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'SwAddrMethod','CODE'` specifies `SwAddrMethod` `CODE` for an AUTOSAR runnable function.

`SwAddrMethod` — Name of function `SwAddrMethod`
character vector | string scalar

Specify a `SwAddrMethod` name that is valid for the AUTOSAR function. Code generation uses the `SwAddrMethod` name to group AUTOSAR runnable functions in a memory section. For a list of valid `SwAddrMethod` values for the function, see the Code Mapping Editor, **Entry-Point Functions** tab. For more information, see “Configure SwAddrMethod” on page 4-243.

Example: `'SwAddrMethod','CODE'`

`SwAddrMethodForInternalData` — Name of internal data `SwAddrMethod`
character vector | string scalar

Specify a `SwAddrMethod` name that is valid for the AUTOSAR internal data. Code generation uses the `SwAddrMethod` name to group AUTOSAR runnable internal data in a memory section. For a list of valid `SwAddrMethod` values for the internal data, see the Code Mapping Editor, **Entry-Point Functions** tab. For more information, see “Configure SwAddrMethod” on page 4-243.

Code generation for runnable internal data `SwAddrMethod`s requires setting the model configuration option **Code Generation** > **Interface** > **Generate separate internal data per entry-point function** (`GroupInternalDataByFunction`) to `on`.

Example: `'SwAddrMethodForInternalData','VAR'`

See Also

`getFunction`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

mapFunctionCaller

Map Simulink function-caller block to AUTOSAR client port and operation

Syntax

```
mapFunctionCaller(slMap,slFcnName,arPortName,arOperationName)
```

Description

`mapFunctionCaller(slMap,slFcnName,arPortName,arOperationName)` maps the Simulink function-caller block for Simulink function `slFcnName` to AUTOSAR client port `arPortName` and AUTOSAR operation `arOperationName`.

If your model has multiple callers of Simulink function `slFcnName`, this function maps all of them to the AUTOSAR client port and operation.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set AUTOSAR Mapping Information for Function Caller Block

Set AUTOSAR mapping information for a function-caller block in a model in which AUTOSAR client function invocation is being modeled. The model has a function-caller block for Simulink function `readData`.

```
open_system('mControllerWithInterface_client')
slMapC = autosar.api.getSimulinkMapping('mControllerWithInterface_client');
mapFunctionCaller(slMapC,'readData','cPort','readData');
[arPort,arOp] = getFunctionCaller(slMapC,'readData')
```

```
arPort =
cPort

arOp =
readData
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slFcnName` — Name of Simulink function

character vector | string scalar

Name of the Simulink function for the function-caller block for which to set AUTOSAR mapping information.

Example: `'readData'`

`arPortName` — Name of AUTOSAR client port

character vector | string scalar

Name of the AUTOSAR client port to which to map the specified function-caller block.

Example: `'cPort'`

`arOperationName` — Name of AUTOSAR operation

character vector | string scalar

Name of the AUTOSAR operation to which to map the specified function-caller block.

Example: `'readData'`

See Also

`getFunctionCaller`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2014b

mapInport

Map Simulink inport to AUTOSAR port

Syntax

```
mapInport(slMap,slPortName,arPortName,arDataElementName,
arDataAccessMode)
```

Description

`mapInport(slMap,slPortName,arPortName,arDataElementName, arDataAccessMode)` maps the Simulink inport `slPortName` to the AUTOSAR data element `arDataElementName` at AUTOSAR receiver port `arPortName`. The AUTOSAR data access mode for the receiver port is set to `arDataAccessMode`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set AUTOSAR Mapping Information for Model Inport

Set AUTOSAR mapping information for a model inport in the example model `rtwdemo_autosar_multirunnables`. The model has an inport named `RPort_DE1`. This example changes the AUTOSAR data access mode for `RPort_DE1` from `ImplicitReceive` to `ExplicitReceive`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
mapInport(slMap,'RPort_DE1','RPort','DE1','ExplicitReceive');
[arPortName,arDataElementName,arDataAccessMode]=getInport(slMap,'RPort_DE1')
```

```
arPortName =
RPort

arDataElementName =
DE1

arDataAccessMode =
ExplicitReceive
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slPortName` — Name of model inport

character vector | string scalar

Name of the model inport for which to set AUTOSAR mapping information.

Example: `'Input'`

`arPortName` — Name of AUTOSAR port

character vector | string scalar

Name of the AUTOSAR port to which to map the specified Simulink inport.

Example: `'Input'`

`arDataElementName` — Name of AUTOSAR data element

character vector | string scalar

Name of the AUTOSAR data element to which to map the specified Simulink inport.

Example: `'Input'`

`arDataAccessMode` — Value of AUTOSAR data access mode

character vector | string scalar

Value of the AUTOSAR data access mode to which to map the specified Simulink inport. The value can be `ImplicitReceive`, `ExplicitReceive`, `QueuedExplicitReceive`,

`ErrorStatus`, `ModeReceive`, `IsUpdated`, `EndToEndRead`, or `ExplicitReceiveByVal`.

Example: `'ExplicitReceive'`

See Also

`getInport`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

mapLookupTable

Map Simulink lookup table to AUTOSAR parameter

Syntax

```
mapLookupTable(slMap,slParam,arParameterAccessMode,arPortName,
arParameterData)
```

Description

`mapLookupTable(slMap,slParam,arParameterAccessMode,arPortName,
arParameterData)` maps the Simulink lookup table `slParam` to the AUTOSAR parameter data item `arParameterData` and, if defined, AUTOSAR parameter receiver port `arPortName`. The AUTOSAR parameter access mode for the parameter is set to `arParameterAccessMode`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set AUTOSAR Mapping Information for Simulink Lookup Tables

Set AUTOSAR mapping information for Simulink lookup tables. The model has lookup tables named `L_4x6_single` and `L_4_single`. This example:

- Maps Simulink lookup table `L_4x6_single` to AUTOSAR parameter data item `L_4x6_single_ar`, which the AUTOSAR software component defines and accesses internally. (The parameter is not associated with a port-based parameter interface.) Parameter `L_4x6_single_ar` uses `Shared` parameter access mode.

- Maps Simulink lookup table `L_4_single` to AUTOSAR parameter data item `prmDE1`, which is a data element associated with AUTOSAR parameter receiver port `prmRPort1`. Parameter `prmDE1` uses `PortParameter` parameter access mode.

```
open_system('mySWC')
slMap=autosar.api.getSimulinkMapping('mySWC');
mapLookupTable(slMap,'L_4x6_single','Shared','','L_4x6_single_ar');
[arParameterAccessMode,arPortName,arParameterData]=getLookupTable(slMap,'L_4x6_single')

arParameterAccessmode =
Shared

arPortName =
''

arParameterData =
L_4x6_single_ar

mapLookupTable(slMap,'L_4_single','PortParameter','prmRPort1','prmDE1');
[arParameterAccessMode,arPortName,arParameterData]=getLookupTable(slMap,'L_4_single')

arParameterAccessmode =
PortParameter

arPortName =
prmRPort1

arParameterData =
prmDE1
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slParam` — Name of Simulink lookup table

character vector | string scalar

Name of the Simulink lookup table for which to set AUTOSAR mapping information.

Example: `'L_4x6_single'`

`arParameterAccessMode` — Value of AUTOSAR parameter access mode
character vector | string scalar

Value of the AUTOSAR parameter access mode to which to map the specified Simulink lookup table. The value can be `PortParameter`, `Shared`, `PerInstance`, or `Const`.

Example: `'Shared'`

`arPortName` — Name of AUTOSAR port
character vector | string scalar

Name of the AUTOSAR parameter receiver port to which to map the specified Simulink lookup table. If the parameter is internal to the AUTOSAR software component, and not associated with a port-based parameter interface, specify `''`.

Example: `'PrmRPort1'`

`arParameterData` — Name of AUTOSAR parameter data item
character vector | string scalar

Name of the AUTOSAR parameter data item to which to map the specified Simulink lookup table. The parameter can be internal to the AUTOSAR software component or associated with a port-based parameter interface.

Example: `'prmDE1'`

See Also

`getLookupTable`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2016b

mapOutport

Map Simulink outport to AUTOSAR port

Syntax

```
mapOutport(slMap,slPortName,arPortName,arDataElementName,
arDataAccessMode)
```

Description

`mapOutport(slMap,slPortName,arPortName,arDataElementName, arDataAccessMode)` maps the Simulink outport `slPortName` to the AUTOSAR data element `arDataElementName` at AUTOSAR provider port `arPortName`. The AUTOSAR data access mode for the provider port is set to `arDataAccessMode`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set AUTOSAR Mapping Information for Model Outport

Set AUTOSAR mapping information for a model outport in the example model `rtwdemo_autosar_multirunnables`. The model has an outport named `PPort_DE1`. This example changes the AUTOSAR data access mode for `PPort_DE1` from `ImplicitSend` to `ExplicitSend`.

```
rtwdemo_autosar_multirunnables
slMap=autosar.api.getSimulinkMapping('rtwdemo_autosar_multirunnables');
mapOutport(slMap,'PPort_DE1','PPort','DE1','ExplicitSend');
[arPortName,arDataElementName,arDataAccessMode]=getOutport(slMap,'PPort_DE1')
```

```
arPortName =
PPort

arDataElementName =
DE1

arDataAccessMode =
ExplicitSend
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slPortName` — Name of model outport

character vector | string scalar

Name of the model outport for which to set AUTOSAR mapping information.

Example: `'Output'`

`arPortName` — Name of AUTOSAR port

character vector | string scalar

Name of the AUTOSAR port to which to map the specified Simulink outport.

Example: `'Output'`

`arDataElementName` — Name of AUTOSAR data element

character vector | string scalar

Name of the AUTOSAR data element to which to map the specified Simulink outport.

Example: `'Output'`

`arDataAccessMode` — Value of AUTOSAR data access mode

character vector | string scalar

Value of the AUTOSAR data access mode to which to map the specified Simulink outport. The value can be `ImplicitSend`, `ImplicitSendByRef`, `ExplicitSend`, `EndToEndWrite`, or `ModeSend`.

Example: `'ExplicitSend'`

See Also

`getOutport`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

mapParameter

Map Simulink model workspace parameter to AUTOSAR component internal parameter

Syntax

```
mapParameter(slMap,slParameter,arParamType)
mapParameter(slMap,slParameter,arParamType,Name,Value)
```

Description

`mapParameter(slMap,slParameter,arParamType)` maps the Simulink model workspace parameter `slParameter` to an AUTOSAR parameter of type `arParamType` for AUTOSAR run-time calibration. AUTOSAR parameter types include `SharedParameter` and `ConstantMemory`.

`mapParameter(slMap,slParameter,arParamType,Name,Value)` specifies additional properties for an AUTOSAR `SharedParameter` or `ConstantMemory` parameter by using one or more `Name,Value` pair arguments.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set AUTOSAR Mapping Information for Simulink Model Workspace Parameters

Set AUTOSAR mapping and property information for Simulink model workspace parameters K and INC in model `mTest`.

```
slMap = autosar.api.getSimulinkMapping('mTest');
```

```
mapParameter(slMap,'K','SharedParameter')
arMappedTo = getParameter(slMap,'K')
arValue = getParameter(slMap,'K','SwCalibrationAccess')

mapParameter(slMap,'INC','ConstantMemory','SwCalibrationAccess','ReadOnly')
arMappedTo = getParameter(slMap,'INC')
arValue = getParameter(slMap,'INC','SwCalibrationAccess')

arMappedTo =
    'SharedParameter'

arValue =
    'ReadWrite'

arMappedTo =
    'ConstantMemory'

arValue =
    'ReadOnly'
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slParameter` — Name of Simulink model workspace parameter

character vector | string scalar

Name of the Simulink model workspace parameter for which to set AUTOSAR mapping information.

Example: `'INC'`

`arParamType` — Type of AUTOSAR parameter

character vector | string scalar

Type of AUTOSAR component internal parameter to which to map the specified Simulink model workspace parameter. Valid AUTOSAR parameter types include `SharedParameter`, `ConstantMemory`, and `Auto`. To accept software mapping defaults, specify `Auto`.

Example: `'SharedParameter'`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'SwCalibrationAccess','ReadOnly'` specifies read-only access to the parameter for run-time calibration.

`DisplayFormat` — Calibration display format
character vector | string scalar

Specify display format for the AUTOSAR parameter. AUTOSAR display format specifications control the width and precision display for measurement and calibration data. For more information, see “Configure DisplayFormat” on page 4-240.

Example: `'DisplayFormat','%2.6f'`

`IsConst` — C `const` type qualifier flag (`ConstantMemory` only)
boolean

Specify whether to include C type qualifier `const` in generated code for the AUTOSAR parameter.

Example: `'IsConst',true`

`IsVolatile` — C `volatile` type qualifier flag (`ConstantMemory` only)
boolean

Specify whether to include C type qualifier `volatile` in generated code for the AUTOSAR parameter.

Example: `'IsVolatile',true`

`Qualifier` — C `AdditionalNativeTypeQualifier` flag (`ConstantMemory` only)
character vector | string scalar

Optionally specify an AUTOSAR additional native type qualifier to include in generated code for the AUTOSAR parameter.

Example: `'Qualifier','test_qualifier'`

`SwAddrMethod` — Name of parameter `SwAddrMethod`
character vector | string scalar

Specify a `SwAddrMethod` name that is valid for the AUTOSAR parameter. Code generation uses the `SwAddrMethod` name to group AUTOSAR parameters in a memory section for access by measurement and calibration tools. For a list of valid `SwAddrMethod` values for the parameter, see the Code Mapping Editor, **Parameters** tab. For more information, see “Configure SwAddrMethod” on page 4-243.

Example: `'SwAddrMethod','CONST'`

`SwCalibrationAccess` — Calibration access mode
character vector | string scalar

Specify how measurement and calibration tools can access the AUTOSAR parameter. Valid access values include `ReadOnly`, `ReadWrite`, and `NotAccessible`. For more information, see “Configure SwCalibrationAccess” on page 4-237.

Example: `'SwCalibrationAccess','ReadOnly'`

See Also
`getParameter`

Topics
“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2018b

mapSignal

Map Simulink block signal to AUTOSAR variable

Syntax

```
mapSignal(slMap,slPortHandle,arVarType)
mapSignal(slMap,slPortHandle,arVarType,Name,Value)
```

Description

`mapSignal(slMap,slPortHandle,arVarType)` maps the named or test-pointed Simulink block signal associated with outport port handle `slPortHandle` to an AUTOSAR variable of type `arVarType` for AUTOSAR run-time calibration. AUTOSAR variable types include `ArTypedPerInstanceMemory` and `StaticMemory`.

`mapSignal(slMap,slPortHandle,arVarType,Name,Value)` specifies additional properties for an AUTOSAR `ArTypedPerInstanceMemory` or `StaticMemory` variable by using one or more `Name,Value` pair arguments.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set AUTOSAR Mapping Information for Simulink Block Signals

Set AUTOSAR mapping and property information for the Simulink block signals for blocks `RelOpt` and `Sum` in example model `rtwdemo_autosar_counter`.

```
open_system('rtwdemo_autosar_counter');
slMap = autosar.api.getSimulinkMapping('rtwdemo_autosar_counter');
```

```
portHandles = get_param('rtwdemo_autosar_counter/RelOpt','portHandles');
outportHandle = portHandles.Outport;
mapSignal(slMap,outportHandle,'StaticMemory')
arMappedTo = getSignal(slMap,outportHandle)
arValue = getSignal(slMap,outportHandle,'SwCalibrationAccess')

portHandles = get_param('rtwdemo_autosar_counter/Sum','portHandles');
outportHandle = portHandles.Outport;
mapSignal(slMap,outportHandle,'ArTypedPerInstanceMemory',...
    'SwCalibrationAccess','ReadWrite')
arMappedTo = getSignal(slMap,outportHandle)
arValue = getSignal(slMap,outportHandle,'SwCalibrationAccess')

arMappedTo =
    'StaticMemory'

arValue =
    'ReadOnly'

arMappedTo =
    'ArTypedPerInstanceMemory'

arValue =
    'ReadWrite'
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slPortHandle` — Simulink outport port handle for a block signal

handle

Outport port handle for a named or test-pointed Simulink block signal for which to set AUTOSAR mapping information. Use MATLAB commands to construct the outport port handle. For example, for a Relational Operator block named `RelOpt`:

```
portHandles = get_param('rtwdemo_autosar_counter/RelOpt','portHandles');
outportHandle = portHandles.Outport;
```

Example: `outportHandle`

`arVarType` — Type of AUTOSAR variable
character vector | string scalar

Type of AUTOSAR variable to which to map the specified Simulink block signal. Valid AUTOSAR variable types include `ArTypedPerInstanceMemory`, `StaticMemory`, and `Auto`. To accept software mapping defaults, specify `Auto`.

Example: `'StaticMemory'`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'SwCalibrationAccess','ReadWrite'` specifies read-write access to the variable for run-time calibration.

`DisplayFormat` — Calibration display format
character vector | string scalar

Specify display format for the AUTOSAR variable. AUTOSAR display format specifications control the width and precision display for measurement and calibration data. For more information, see “Configure DisplayFormat” on page 4-240.

Example: `'DisplayFormat','%2.6f'`

`IsVolatile` — C `volatile` type qualifier flag (`StaticMemory` only)
boolean

Specify whether to include C type qualifier `volatile` in generated code for the AUTOSAR variable.

Example: `'IsVolatile',true`

`Qualifier` — C `AdditionalNativeTypeQualifier` flag (`StaticMemory` only)
character vector | string scalar

Optionally specify an AUTOSAR additional native type qualifier to include in generated code for the AUTOSAR variable.

Example: `'Qualifier','test_qualifier'`

`ShortName` — Variable short name
character vector | string scalar

Specify short name for the AUTOSAR variable. If unspecified, `arxml` export automatically generates a short name, which can differ from the signal name.

Example: `'ShortName','SM_equal_to_count'`

`SwAddrMethod` — Name of variable `SwAddrMethod`
character vector | string scalar

Specify a `SwAddrMethod` name that is valid for the AUTOSAR variable. Code generation uses the `SwAddrMethod` name to group AUTOSAR variables in a memory section for access by measurement and calibration tools. For a list of valid `SwAddrMethod` values for the variable, see the Code Mapping Editor, **Signals** tab. For more information, see “Configure SwAddrMethod” on page 4-243.

Example: `'SwAddrMethod','VAR'`

`SwCalibrationAccess` — Calibration access mode
character vector | string scalar

Specify how measurement and calibration tools can access the AUTOSAR variable. Valid access values include `ReadOnly`, `ReadWrite`, and `NotAccessible`. For more information, see “Configure SwCalibrationAccess” on page 4-237.

Example: `'SwCalibrationAccess','ReadWrite'`

See Also
`getSignal`

Topics
“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2018b

mapState

Map Simulink block state to AUTOSAR variable

Syntax

```
mapState(slMap,slStateOwnerBlock,'',arVarType)
mapState(slMap,slStateOwnerBlock,slState,arVarType)
mapState(slMap,slStateOwnerBlock,slState,arVarType,Name,Value)
```

Description

`mapState(slMap,slStateOwnerBlock,'',arVarType)` maps the Simulink block state associated with state owner block `slStateOwnerBlock` to an AUTOSAR variable of type `arVarType` for AUTOSAR run-time calibration. AUTOSAR variable types include `ArTypedPerInstanceMemory` and `StaticMemory`.

`mapState(slMap,slStateOwnerBlock,slState,arVarType)` maps Simulink block state `slState` associated with state owner block `slStateOwnerBlock` to an AUTOSAR variable of type `arVarType`. Specify a nonempty `slState` argument only for blocks with multiple states.

`mapState(slMap,slStateOwnerBlock,slState,arVarType,Name,Value)` specifies additional properties for an AUTOSAR `ArTypedPerInstanceMemory` or `StaticMemory` variable by using one or more `Name,Value` pair arguments.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set AUTOSAR Mapping Information for Simulink Block State

Set AUTOSAR mapping and property information for the Simulink block state for Unit Delay block X in example model `rtwdemo_autosar_counter`. The state owner block has one state.

```
open_system('rtwdemo_autosar_counter');
slMap = autosar.api.getSimulinkMapping('rtwdemo_autosar_counter');

mapState(slMap,'rtwdemo_autosar_counter/X','','ArTypedPerInstanceMemory',...
    'SwCalibrationAccess','ReadWrite')
arMappedTo = getState(slMap,'rtwdemo_autosar_counter/X')
arValue = getState(slMap,'rtwdemo_autosar_counter/X','','SwCalibrationAccess')
```

```
arMappedTo =
    'ArTypedPerInstanceMemory'

arValue =
    'ReadWrite'
```

Input Arguments

`slMap` — Simulink to AUTOSAR mapping information for a model

handle

Simulink to AUTOSAR mapping information for a model, previously returned by *`slMap`* = `autosar.api.getSimulinkMapping(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `slMap`

`slStateOwnerBlock` — Simulink state owner block handle or path

handle | character vector | string scalar

Handle or path to Simulink state owner block for which to set AUTOSAR mapping information.

Example: `'rtwdemo_autosar_counter/X'`

`slState` — Simulink state

character vector | string scalar

Name of Simulink state associated with state owner block `slStateOwnerBlock`. Specify a nonempty state name only for blocks with multiple states. If `slState` is empty, the function sets mapping information for the first state in the block.

Example: `''`

`arVarType` — Type of AUTOSAR variable
character vector | string scalar

Type of AUTOSAR variable to which to map the specified Simulink block state. Valid AUTOSAR variable types include `ArTypedPerInstanceMemory`, `StaticMemory`, and `Auto`. To accept software mapping defaults, specify `Auto`.

Example: `'ArTypedPerInstanceMemory'`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'SwCalibrationAccess','ReadWrite'` specifies read-write access to the variable for run-time calibration.

`DisplayFormat` — Calibration display format
character vector | string scalar

Specify display format for the AUTOSAR variable. AUTOSAR display format specifications control the width and precision display for measurement and calibration data. For more information, see “Configure DisplayFormat” on page 4-240.

Example: `'DisplayFormat','%2.6f'`

`IsVolatile` — C `volatile` type qualifier flag (`StaticMemory` only)
boolean

Specify whether to include C type qualifier `volatile` in generated code for the AUTOSAR variable.

Example: `'IsVolatile',true`

`Qualifier` — C `AdditionalNativeTypeQualifier` flag (`StaticMemory` only)
character vector | string scalar

Optionally specify an AUTOSAR additional native type qualifier to include in generated code for the AUTOSAR variable.

Example: `'Qualifier','test_qualifier'`

`ShortName` — Variable short name
character vector | string scalar

Specify short name for the AUTOSAR variable. If unspecified, `arxml` export automatically generates a short name, which is based on the state name if one exists. If the state is unnamed, the generated short name can differ from the block name.

Example: `'ShortName','PIM_X'`

`SwAddrMethod` — Name of variable `SwAddrMethod`
character vector | string scalar

Specify a `SwAddrMethod` name that is valid for the AUTOSAR variable. Code generation uses the `SwAddrMethod` name to group AUTOSAR variables in a memory section for access by measurement and calibration tools. For a list of valid `SwAddrMethod` values for the variable, see the Code Mapping Editor, **States** tab. For more information, see “Configure SwAddrMethod” on page 4-243.

Example: `'SwAddrMethod','VAR'`

`SwCalibrationAccess` — Calibration access mode
character vector | string scalar

Specify how measurement and calibration tools can access the AUTOSAR variable. Valid access values include `ReadOnly`, `ReadWrite`, and `NotAccessible`. For more information, see “Configure SwCalibrationAccess” on page 4-237.

Example: `'SwCalibrationAccess','ReadWrite'`

See Also

`getState`

Topics

“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2018b

set

Set property of AUTOSAR element

Syntax

```
set(arProps,elementPath,property,value)
```

Description

`set(arProps,elementPath,property,value)` sets the specified `property` of the AUTOSAR element at `elementPath` to `value`. For properties that reference other elements, `value` is s path. To set XML packaging options, specify `elementPath` as `XmlOptions`.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Set IsService Property for Sender-Receiver Interface

For an AUTOSAR model, set the `IsService` property for sender-receiver interface `Interface1` to `true` (1), indicating that the port interface is used for AUTOSAR services.

```
rtwdemo_autosar_multirunnables
arProps = autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
set(arProps,'Interface1','IsService',true);
isService = get(arProps,'Interface1','IsService')
```

```
isService =
     1
```

Set Runnable Symbol Name

For an AUTOSAR model, set the `symbol` property for runnable `Runnable1` to `test_symbol`.

```
rtwdemo_autosar_multirunnables
arProps = autosar.api.getAUTOSARProperties('rtwdemo_autosar_multirunnables');
compQName = get(arProps,'XmlOptions','ComponentQualifiedName');
runnables = find(arProps,compQName,'Runnable','PathType','FullyQualified');
runnables(2)

ans =
    '/pkg/swc/ASWC/Behavior/Runnable1'

get(arProps,runnables{2},'symbol')

ans =
Runnable1

set(arProps,runnables{2},'symbol','test_symbol')
get(arProps,runnables{2},'symbol')

ans =
test_symbol
```

Input Arguments

`arProps` — AUTOSAR properties information for a model

handle

AUTOSAR properties information for a model, previously returned by *`arProps`* `= autosar.api.getAUTOSARProperties(`*`model`*`)`. *`model`* is a handle, character vector, or string scalar representing the model name.

Example: `arProps`

`elementPath` — Path to an AUTOSAR element

character vector | string scalar

Path to an AUTOSAR element for which to set a property. To set XML packaging options, specify `XmlOptions`,

Example: `'Input'`

`property` — Type of property

character vector | string scalar

Type of property for which to specify a value, among valid properties for the AUTOSAR element.

Example: `'IsService'`

`value` — Value of property
value of property | path to composite property or property that references other properties

Value to set for the specified property. For properties that reference other elements, specify a path.

Example: `true`

See Also
`get`

Topics
“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2013b

updateModel

Package: arxml

Update AUTOSAR model with `arxml` changes

Syntax

```
updateModel(ar,modelname)
```

Description

`updateModel(ar,modelname)` updates the specified open model with changes detected in the XML files associated with `arxml.importer` object `ar`. The update generates and opens a report that details the updates applied to the model, and required changes that were not made automatically. The XML files must contain the AUTOSAR software component mapped by the model.

Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Example

Update Model with AUTOSAR `arxml` Changes

Update model `mySWC` with the AUTOSAR `arxml` changes described in `updatedSWC.arxml` and open an update report.

```
open_system('mySWC')
ar = arxml.importer('updatedSWC.arxml');
updateModel(ar,'mySWC');
```

```
### Updating model mySWC
### Saving original model as mySWC_backup.slx
### Creating HTML report mySWC_update_report.html
```

Input Arguments

`ar` — `arxml.importer` object
object

AUTOSAR information previously imported from XML files, specified as an `arxml.importer` object.

`modelname` — Model name
character vector | string scalar

Name of an open model to be updated with changes in the XML files associated with an `arxml.importer` object.

Example: `'mySWC'`

See Also

`arxml.importer`

Topics

"Import AUTOSAR Component to Simulink" (Embedded Coder Support Package for AUTOSAR Standard)
"Import AUTOSAR Composition to Simulink" (Embedded Coder Support Package for AUTOSAR Standard)
"Import AUTOSAR Software Component" on page 3-4
"AUTOSAR arxml Importer" on page 3-2
"Import AUTOSAR Software Component Updates" on page 3-11

Introduced in R2014a

updateReferences

Package: arxml

Update model with `arxml` definitions of AUTOSAR reference elements

Syntax

```
updateReferences(ar,modelname)
updateReferences(ar,modelname,Name,Value)
```

Description

`updateReferences(ar,modelname)` updates the specified open model with AUTOSAR reference elements in the XML files associated with `arxml.importer` object `ar`. Reference elements are definitions of packageable AUTOSAR elements that multiple components and services can share. The update operation generates a report that details the elements added to the model. On a read-only basis, the model can reference the imported elements. Model builds export the references to AUTOSAR software component `arxml` files.

If you do not specify `Name,Value` argument pairs, the function imports all supported reference element definitions found in the XML files, except `ApplicationDataType` elements. Import of `ApplicationDataType` elements must be explicitly requested.

For a list of supported AUTOSAR reference elements, see “Import or Update Shared AUTOSAR Reference Element Definitions” on page 3-29.

`updateReferences(ar,modelname,Name,Value)` updates the specified open model with AUTOSAR reference elements, using a `Name,Value` argument pair to specify a specific element category, package, or path.

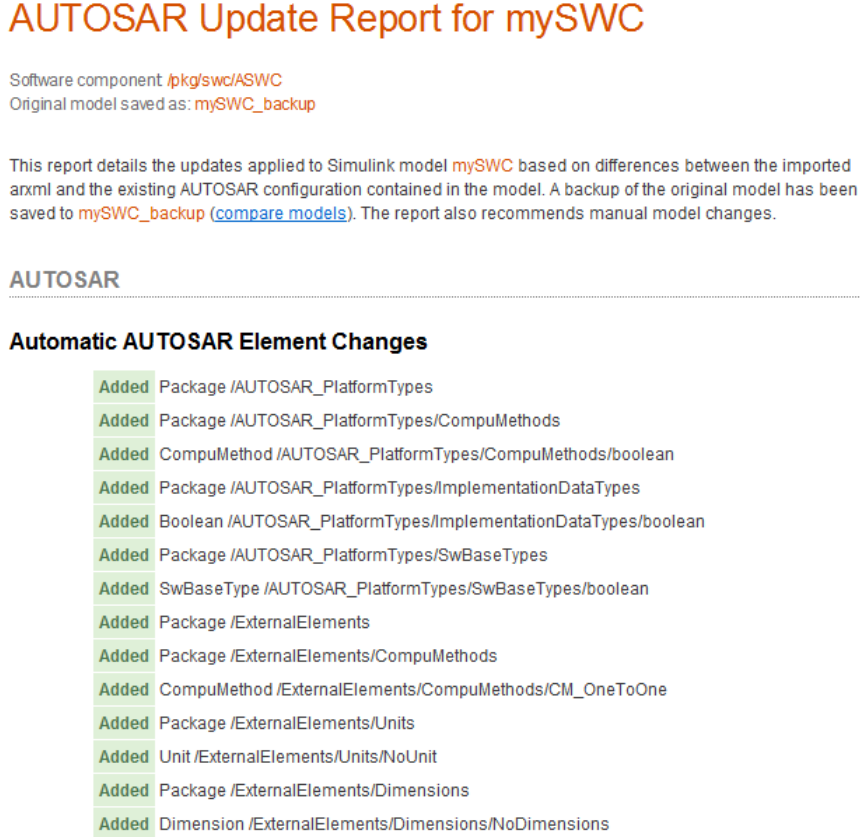
Note This function requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Examples

Update Model with AUTOSAR Reference Elements

Update model `mySWC` with AUTOSAR reference elements described in `ExternalElements.arxml` and generate an update report.

```
open_system('mySWC')
ar = arxml.importer('ExternalElements.arxml');
updateReferences(ar,'mySWC');

### Updating references in model mySWC
### Saving original model as mySWC_backup.slx
### Creating HTML report mySWC_update_report.html
```



AUTOSAR Update Report for mySWC

Software component /pkg/swc/ASWC
Original model saved as: mySWC_backup

This report details the updates applied to Simulink model mySWC based on differences between the imported arxml and the existing AUTOSAR configuration contained in the model. A backup of the original model has been saved to mySWC_backup (compare models). The report also recommends manual model changes.

AUTOSAR

Automatic AUTOSAR Element Changes

Added	Package /AUTOSAR_PlatformTypes
Added	Package /AUTOSAR_PlatformTypes/CompuMethods
Added	CompuMethod /AUTOSAR_PlatformTypes/CompuMethods/boolean
Added	Package /AUTOSAR_PlatformTypes/ImplementationDataTypes
Added	Boolean /AUTOSAR_PlatformTypes/ImplementationDataTypes/boolean
Added	Package /AUTOSAR_PlatformTypes/SwBaseTypes
Added	SwBaseType /AUTOSAR_PlatformTypes/SwBaseTypes/boolean
Added	Package /ExternalElements
Added	Package /ExternalElements/CompuMethods
Added	CompuMethod /ExternalElements/CompuMethods/CM_OneToOne
Added	Package /ExternalElements/Units
Added	Unit /ExternalElements/Units/NoUnit
Added	Package /ExternalElements/Dimensions
Added	Dimension /ExternalElements/Dimensions/NoDimensions

Update Model with Specific AUTOSAR Reference Elements

Update model `mySWC` with two AUTOSAR reference elements, specified by root paths `/ExternalElements/CompuMethods/RpmCm` and `/AUTOSAR_PlatformTypes/ImplementationDataTypes/uint16`.

```
open_system('mySWC')
ar = arxml.importer('ExternalElements.arxml');
updateReferences(ar,'mySWC','RootPath',{'/ExternalElements/CompuMethods/RpmCm',...
                          '/AUTOSAR_PlatformTypes/ImplementationDataTypes/uint16'});
```

Update Model with AUTOSAR Reference Elements From a Specific Package

Update model `mySWC` with AUTOSAR reference elements from package `/AUTOSAR_PlatformTypes/CompuMethods`.

```
open_system('mySWC')
ar = arxml.importer('ExternalElements.arxml');
updateReferences(ar,'mySWC','Package',{'/AUTOSAR_PlatformTypes/CompuMethods'});
```

Update Model with AUTOSAR Reference Elements From a Specific Category

Update model `mySWC` with AUTOSAR reference elements of category `ImplementationDataType`. Importing `ImplementationDataType` elements also imports dependent elements, such as `SwBaseType` elements.

```
open_system('mySWC')
ar = arxml.importer('ExternalElements.arxml');
updateReferences(ar,'mySWC','Category',{'ImplementationDataType'});
```

Update Model with AUTOSAR Application Data Type Reference Elements

Update model `mySWC` with AUTOSAR reference elements of category `ApplicationDataType`. Importing `ApplicationDataType` elements requires specifying a path to an associated AUTOSAR data type mapping set, using a **DataTypeMappingSet** argument.

`ApplicationDataType` elements must be explicitly requested using `Name,Value` arguments such as **RootPath** or **Category**.These calls combine **DataTypeMappingSet** with other `Name,Value` arguments.

```
open_system('mySWC')
ar = arxml.importer('ExternalElements.arxml');

% Specify ADT RootPath and DataTypeMappingSet
updateReferences(ar,'mySWC','RootPath',{'/pkg/ApplicationDataTypes/AppType1'},...
    'DataTypeMappingSet', {'/AUTOSAR_PlatformTypes/DataTypeMappingSets/MapSet1'};

% Specify ADT Category and DataTypeMappingSet
updateReferences(ar,'mySWC','Category',{'ApplicationDataType'},...
  'DataTypeMappingSet', {'/AUTOSAR_PlatformTypes/DataTypeMappingSets/Mapet1'});
```

Input Arguments

`ar` — `arxml.importer` object

object

AUTOSAR information previously imported from XML files, specified as an `arxml.importer` object.

`modelname` — Model name

character vector | string scalar

Name of the open model to be updated with definitions of AUTOSAR reference elements in the XML files associated with an `arxml.importer` object.

Example: `'mySWC'`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'Category',{'ImplementationDataType'}` directs the importer to update a model with AUTOSAR reference elements of category `ImplementationDataType`.

`Category` — AUTOSAR element categories

cell array of character vectors | string array

One or more AUTOSAR element categories from which to import reference elements.

Example: `'Category',{'ImplementationDataType'}`

`Package` — AUTOSAR element packages
cell array of character vectors | string array

Paths to one or more AUTOSAR element packages from which to import reference elements.

Example: `'Package',{'/AUTOSAR_PlatformTypes/CompuMethods'}`

To refine a category or package import, you can specify both a category and a package from which to import reference elements. For example:

```
'Category',{'ImplementationDataType'}, ...
'Package',{'/AUTOSAR_PlatformTypes/ImplementationDataTypes'}
```

`RootPath` — AUTOSAR reference elements
cell array of character vectors | string array

Root paths to one or more specific AUTOSAR reference elements to import.

Example: `'RootPath',{'/ExternalElements/CMs/RpmCm','/AUTOSAR_PlatformTypes/IDTs/uint16'}`

`DataTypeMappingSet` — AUTOSAR data type mapping sets
cell array of character vectors | string array

Paths to one or more AUTOSAR data type mapping sets associated with application data type reference elements. This argument is required when importing application data type reference elements.

Example: `{'/AUTOSAR_PlatformTypes/DataTypeMappingSets/MapSet1'}`

See Also

`arxml.importer`

Topics

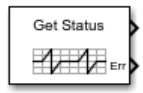
“Import AUTOSAR Software Component” on page 3-4
“AUTOSAR arxml Importer” on page 3-2
“Import or Update Shared AUTOSAR Reference Element Definitions” on page 3-29

Introduced in R2016b

Blocks — Alphabetical List

DiagnosticInfoCaller

Call AUTOSAR Diagnostic Event Manager (Dem) service interface `DiagnosticInfo`



Library

Embedded Coder Support Package for AUTOSAR / Basic Software / Diagnostic Event Manager (Dem)

Description

Call AUTOSAR Dem service interface `DiagnosticInfo` using a specified operation.

Note This block requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Parameters

Client port name

Name of the client port used by the AUTOSAR software component for the function call, set to `DiagnosticInfo` by default.

Operation

Name of an operation defined by the AUTOSAR standard for the Dem service interface `DiagnosticInfo`:

- `GetEventStatus` (default)
- `GetEventFailed`

- `GetEventTested`
- `GetDTCOfEvent`
- `GetFaultDetectionCounter`
- `GetEventExtendedDataRecord`
- `GetEventFreezeFrameData`

Data type for DTCFormat (`GetDTCOfEvent` only)

Name of a data type that defines Dem format type values for the function input `DTCFormat`. By default, the data type is set to `Enum: Dem_DTCFormatType`. For more information about format type values, see the AUTOSAR standard *Specification of Diagnostic Event Manager*.

Sample time

Block sample time, set to -1 (inherited) by default.

See Also

DiagnosticMonitorCaller

Diagnostic Service Component

Related Examples

“Configure Calls to AUTOSAR Diagnostic Event Manager Service” on page 4-192

“Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207

“Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard)

Introduced in R2016b

DiagnosticMonitorCaller

Call AUTOSAR Diagnostic Event Manager (Dem) service interface `DiagnosticMonitor`

Library

Embedded Coder Support Package for AUTOSAR / Basic Software / Diagnostic Event Manager (Dem)

Description

Call AUTOSAR Dem service interface `DiagnosticMonitor` using a specified operation.

Note This block requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Parameters

Client port name

Name of the client port used by the AUTOSAR software component for the function call, set to `DiagnosticMonitor` by default.

Operation

Name of an operation defined by the AUTOSAR standard for the Dem service interface `DiagnosticMonitor`:

- `SetEventStatus` (default)
- `ResetEventStatus`

- `PrestoreFreezeFrame`
- `ClearPrestoredFreezeFrame`
- `SetEventDisabled`

Data type for EventStatus (`SetEventStatus` only)

Name of a data type that defines Dem event status values for the function input `EventStatus`. By default, the data type is set to `Enum: Dem_EventStatusType`. For more information about event status values, see the AUTOSAR standard *Specification of Diagnostic Event Manager*.

Sample time

Block sample time, set to -1 (inherited) by default.

See Also

DiagnosticInfoCaller

Diagnostic Service Component

Related Examples

“Configure Calls to AUTOSAR Diagnostic Event Manager Service” on page 4-192

“Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207

“Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard)

Introduced in R2016b

Diagnostic Service Component

Configure AUTOSAR Diagnostic Services and Runtime Environment (RTE) for emulation

Library

Embedded Coder Support Package for AUTOSAR / Basic Software / Diagnostic Event Manager (Dem)

Description

The Diagnostic Service Component block provides reference implementations of Diagnostic Event Manager (Dem) services supported by AUTOSAR Basic Software (BSW) caller blocks. When coupled with Dem caller blocks, the reference implementations allow you to configure and run system- or composition-level simulations of AUTOSAR Dem service calls.

The block has prepopulated parameters, including **Counter-Based Debouncing** parameters and RTE parameters. Examine the parameter settings and consider if modifications are required, based on how you are using the Dem service operations.

Note This block requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

The **Counter-Based Debouncing** parameters control the counter-based debounce algorithm provided by the Dem service reference implementations. During multiple simulation runs, you can tune event step size and threshold parameters and observe the effects.

Debouncing provides a means to determine when a monitored event is regarded as passed or failed. The software maintains a counter for each event ID. When PREFAIL events arrive, the software increments the event ID counter by a fixed step value. When PREPASS events arrive, the software decrements the event ID counter by a fixed step value. When a counter reaches a lower or upper threshold, the event is considered passed or failed.

In the Dem reference implementations, the step size and threshold parameters apply globally to event IDs, not to individual IDs.

Parameters

Increment step size

Specify a fixed-step value, 1 to 32767, by which to increment a Dem event ID counter when PREFAIL events arrive.

Decrement step size

Specify a fixed-step value, 1 to 32767, by which to decrement a Dem event ID counter when PREPASS events arrive.

Failed threshold

Specify a Dem event ID counter threshold value, 1 to 32767, to represent failed status.

Passed threshold

Specify a Dem event ID counter threshold value, -32768 to -1, to represent passed status.

Event ID

The RTE tab table lists component client ports and their mapping to Dem service event IDs. Each row in the table represents a call into Dem services from a Basic Software caller block. Calls that act on the same event should use the same event ID. Check the event ID mappings. For an example of mapping Dem client ports to shared event IDs, see “Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard).

See Also

DiagnosticInfoCaller

DiagnosticMonitorCaller

Related Examples

“Configure Calls to AUTOSAR Diagnostic Event Manager Service” on page 4-192

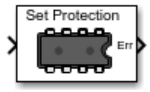
“Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207

“Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard)

Introduced in R2017b

NvMAdminCaller

Call AUTOSAR NVRAM Manager (NvM) service interface `NvMAdmin`



Library

Embedded Coder Support Package for AUTOSAR / Basic Software / NVRAM Manager (NvM)

Description

Call AUTOSAR NvM service interface `NvMAdmin` using a specified operation.

Note This block requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Parameters

Client port name

Name of the client port used by the AUTOSAR software component for the function call, set to `NvMAdmin` by default.

Operation

Name of an operation defined by the AUTOSAR standard for the NvM service interface `NvMAdmin`. One operation is supported: `SetBlockProtection`.

Sample time

Block sample time, set to -1 (inherited) by default.

See Also

NvMServiceCaller

NVRAM Service Component

Related Examples

“Configure Calls to AUTOSAR NVRAM Manager Service” on page 4-199

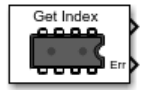
“Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207

“Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard)

Introduced in R2016b

NvMServiceCaller

Call AUTOSAR NVRAM Manager (NvM) service interface `NvMService`



Library

Embedded Coder Support Package for AUTOSAR / Basic Software / NVRAM Manager (NvM)

Description

Call AUTOSAR NvM service interface `NvMService` using a specified operation.

Note This block requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Parameters

Client port name

Name of the client port used by the AUTOSAR software component for the function call, set to `NvMService` by default.

Operation

Name of an operation defined by the AUTOSAR standard for the NvM service interface `NvMService`:

- `GetDataIndex` (default)
- `GetErrorStatus`

- `EraseNvBlock`
- `InvalidateNvBlock`
- `ReadBlock`
- `RestoreBlockDefaults`
- `SetDataIndex`
- `SetRamBlockStatus`
- `WriteBlock`

Argument specification (`ReadBlock`, `RestoreBlockDefaults`, and `WriteBlock` only)

MATLAB expression that specifies data type and dimensions for data to be read or written by the operation. The default expression is `uint8(1)`. For examples, see "Argument Specification for Simulink Function Blocks" (Simulink).

Sample time

Block sample time, set to -1 (inherited) by default.

See Also

NvMAdminCaller

NVRAM Service Component

Related Examples

"Configure Calls to AUTOSAR NVRAM Manager Service" on page 4-199

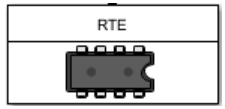
"Configure AUTOSAR Basic Software Service Implementations for Simulation" on page 4-207

"Simulate AUTOSAR Basic Software Services and Runtime Environment" (Embedded Coder Support Package for AUTOSAR Standard)

Introduced in R2016b

NVRAM Service Component

Configure AUTOSAR NVRAM Services and Runtime Environment (RTE) for emulation



Library

Embedded Coder Support Package for AUTOSAR / Basic Software / NVRAM Manager (NvM)

Description

The NVRAM Service Component block provides reference implementations of NVRAM Manager (NvM) services supported by AUTOSAR Basic Software (BSW) caller blocks. When coupled with NvM caller blocks, the reference implementations allow you to configure and run system- or composition-level simulations of AUTOSAR NvM service calls.

The block has prepopulated parameters, including **NVRAM Properties** parameters and RTE parameters. Examine the parameter settings and consider if modifications are required, based on how you are using the NvM service operations.

Note This block requires the Embedded Coder Support Package for AUTOSAR Standard. You install support packages from the MATLAB **Add-Ons** menu. Select **Add-Ons > Get Hardware Support Packages**. For more information, see “Install Support Package for AUTOSAR Standard” on page 1-3.

Parameters

Maximum number of memory blocks

Specify the maximum number of memory blocks to use in NvM service operations.

Block ID

The RTE tab table lists component client ports and their mapping to NvM service block IDs. Each row in the table represents a call into NvM services from a Basic Software caller block. Calls that act on the same NvM block should use the same block ID. Check the block ID mappings.

See Also

NvMAdminCaller

NvMServiceCaller

Related Examples

“Configure Calls to AUTOSAR NVRAM Manager Service” on page 4-199

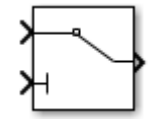
“Configure AUTOSAR Basic Software Service Implementations for Simulation” on page 4-207

“Simulate AUTOSAR Basic Software Services and Runtime Environment” (Embedded Coder Support Package for AUTOSAR Standard)

Introduced in R2017b

Signal Invalidation

Control AUTOSAR root outport data element invalidation
Library: Embedded Coder / AUTOSAR



Description

Relay the first input, a data value, to the output, based on the value of the second input, an invalidation control flag.

If the input data value is valid (invalidation control flag is `false`), the software relays the input data value to the output.

If the input data value is invalid (invalidation control flag is `true`), the resulting action is determined by the value of the block parameter **Signal invalidation policy**:

- `Keep` - Replace the input data value with the last valid signal value.
- `Replace` - Replace the input data value with the value of the block parameter **Initial value**.
- `DontInvalidate` - Do not replace the input data value.

This block must be connected directly to a root outport block. It cannot be used within a reusable subsystem.

Ports

Input

`Port_1` — Input data value

numeric value

Input data value to be relayed if valid.

Example: 4

Data Types: `single` | `double` | `base integer` | `Boolean` | `fixed point` | `enumerated` | `bus`

`Port_2` — Invalidation control flag
`true` | `false`

The invalidation control flag determines whether the input data value is valid and can be relayed (`false`), or is invalid and must be handled based on an invalidation policy (`true`).

Example: `false`

Data Types: `Boolean`

Output

`Port_1` — Output data value
numeric value

Output data value produced by the combination of the input data value and the invalidation control flag.

Data Types: `single` | `double` | `base integer` | `Boolean` | `fixed point` | `enumerated` | `bus`

Parameters

`Signal invalidation policy` — Invalidation policy
`Keep` (default) | `Replace` | `DontInvalidate`

Specify an AUTOSAR data element invalidation policy, which determines how an invalid data element is handled.

`Initial value` — Data element initial value
0 (default) | numeric value

Specify a data element initial value. If the input data value is flagged as invalid, and if the **Signal invalidation policy** is `Replace`, the software replaces the input data value with the specified initial value.

See Also

Topics

“Configure AUTOSAR Sender-Receiver Data Invalidation” on page 4-106

Introduced in R2015b

Tools — Alphabetical List

Code Mapping Editor

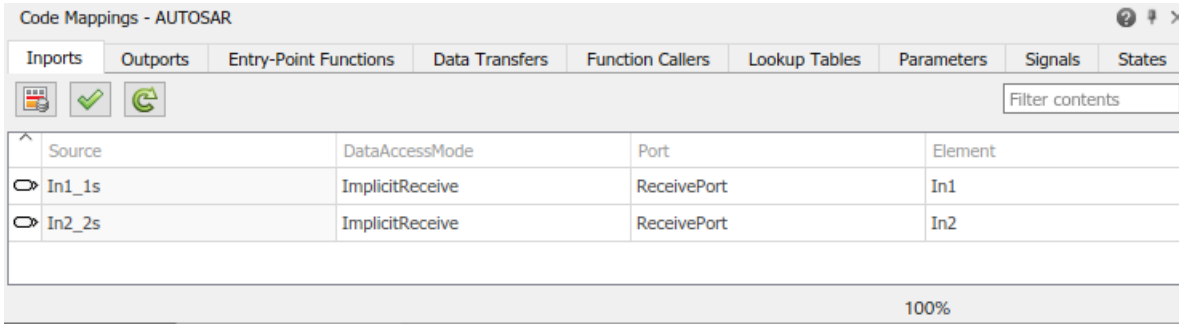
Map AUTOSAR elements for code generation

Description

Code Mapping Editor is a graphical interface for mapping AUTOSAR elements for code generation. Map Simulink model elements such as inports, outports, entry-point functions, and data transfers to AUTOSAR component elements such as receiver ports, sender ports, runnables, and inter-runnable variables.

Using a tabbed table format, Code Mapping Editor displays model inports, outports, entry-point functions, data transfers, function callers, lookup tables, model workspace parameters, block signals, and block states. Use this view to map model elements to AUTOSAR component elements from a Simulink model perspective. The mappings that you configure are reflected in generated AUTOSAR-compliant C code and exported `arxml` descriptions.

For more information, see “Map AUTOSAR Elements for Code Generation” on page 4-68.



Code Mapping Editor provides in-canvas access to AUTOSAR mapping information, with batch editing, element filtering, easy navigation to model elements and AUTOSAR properties, and model element traceability. As you progressively configure the model representation of the AUTOSAR component, you can apply these Code Mapping Editor controls:

- **Filter contents** field – Selectively display some elements, while omitting others, in the current view.

- **AUTOSAR Dictionary** button  – Switch from the Code Mapping Editor view of a Simulink element to the AUTOSAR Dictionary view of the corresponding AUTOSAR element.
- **Validate** button  – Validate the AUTOSAR component configuration.
- **Update** button  – Update the Simulink to AUTOSAR mapping of the model to reflect model changes, such as adding, changing, or removing Simulink data transfers, entry-point functions, and function callers.

Open the Code Mapping Editor

- If your model already has a mapped AUTOSAR software component, in the model window, do one of the following:
  - Select **Code > C/C++ Code > Configure Model in Code Perspective**
  - Click the perspective control in the lower-right corner and select **Code**.

  The model opens in the AUTOSAR code perspective, which includes Code Mapping Editor.
- If your model does not have a mapped AUTOSAR component, use Embedded Coder Quick Start.
  1. Select **Code > C/C++ Code > Embedded Coder Quick Start**.
  2. As you work through the quick-start procedure, in the Output window, select output option **C code compliant with AUTOSAR**.
  3. When you click **Finish**, the model opens in the AUTOSAR code perspective, which includes Code Mapping Editor.

Examples

Map Model Elements to AUTOSAR Component Elements

Navigate Code Mapping Editor tabs to perform these actions:

- “Map Inports and Outports to AUTOSAR Sender-Receiver Ports” on page 4-70

- “Map Entry-Point Functions to AUTOSAR Runnables” on page 4-73
- “Map Data Transfers to AUTOSAR Inter-Runnable Variables” on page 4-75
- “Map Function Callers to AUTOSAR Client-Server Ports and Operations” on page 4-72
- “Map Base Workspace Lookup Table Objects to AUTOSAR Parameters” on page 4-75
- “Map Model Workspace Parameters to AUTOSAR Component Internal Parameters” on page 4-77
- “Map Block Signals and States to AUTOSAR Variables” on page 4-80

See Also

Topics

“Map AUTOSAR Elements for Code Generation” on page 4-68
“Configure AUTOSAR Elements and Properties” on page 4-7
“Configure and Map AUTOSAR Component Programmatically” on page 4-313
“AUTOSAR Component Configuration” on page 4-3

Introduced in R2018a