

# **Simulink<sup>®</sup> Coder<sup>™</sup> Release Notes**

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*Simulink<sup>®</sup> Coder<sup>™</sup> Release Notes*

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# R2014a

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**Version: 8.6**

**New Features: Yes**

**Bug Fixes: Yes**

## C++ class generation

Beginning in R2014a, you can generate encapsulated C++ class code from GRT-based models, in addition to the previously supported ERT-based models. The following new parameters on the **Code Generation > Interface** pane of the Configuration Parameters dialog box support C++ class code generation:

- **Code interface packaging**
- **Multi-instance code error diagnostic**

The general procedure for generating C++ class interfaces to model code is as follows:

- 1 Select the C++ language for your model.
- 2 Select C++ class code interface packaging for your model.
- 3 Generate model code.
- 4 Examine the C++ class interfaces in the generated files and the HTML code generation report.

For more information, see “Generate C++ Class Interface to Model or Subsystem Code”.

## Simpler behavior for tuning all parameters in referenced models

This release simplifies the way Simulink® considers the `InlineParameters` option when it is set to `Off`. You can perform the following operations:

- Tune all block parameters in your model during simulation, either through the parameters themselves or through the tunable variables that they reference.
- Preserve the mapping between a block parameter and a variable in generated code even when the block parameter does not reference any tunable variables.

- Retain the mapping between tunable workspace variables and variables in generated code, irrespective of the `InlineParameters` setting.
- Set the value of `InlineParameters` to `Off` for model references.

These behaviors are consistent across models containing reusable subsystems and reference models.

The simplified behavior enhances the generated code and provides improved mapping between a block parameter and a variable in generated code.

| Block parameter expression   | Code generated previously   | Code generated in R2014a   |
|--|---|--|
| Expressions referencing global variables (e.g., $K+1$ )  | Variable name is not preserved. Block parameter name is preserved.<br><br><pre>struct Parameters_model_ {   real_T Gain_Gain; // Expression K+1 2.0; } y = model_P.Gain_Gain*u;</pre> | Expression is considered tunable. Variable name is preserved in code and is tunable.<br><br><pre>expression K+1 2.0; y = (K+1)*u;</pre>  |
| Expressions referencing mask parameters for nonreusable subsystems (e.g., $MP*3$ ), the value of $MP$ being a nontunable expression. | Variable name is not preserved. Block parameter name is preserved.<br><br><pre>struct Parameters_model_ {   real_T Gain_Gain; // Expression MP*3 } y = model_P.Gain_Gain*u;</pre>     | Expression is considered tunable. Variable name is substituted by parameter value.<br><br><pre>struct Parameters_model_ {   real_T Subsystem_MP; } y = (model_P.Subsystem_MP * 3) * u;</pre> |
| Expressions referencing model arguments (resp. mask parameters) for referenced models (resp. reusable                                | Variable name is not preserved. Block parameter name is preserved.<br><br><pre>struct Subsystem {</pre>   | Variable name is preserved as an argument name.<br><br><pre> subsystem(y, u, rtp_Arg) {   y = (rtp_Arg+1)*u;</pre>   |

| Block parameter expression | Code generated previously  | Code generated in R2014a |
|----------------------------|--|--------------------------|
| subsystems) (e.g., Arg+1)  | <pre>Gain_Gain; // Expression: } y = model_P.Subsystem1.Gain_Gain*u;</pre> | Arg+1                    |

To revert the behavior of `InlineParameters Off` to what it was in R2013b, run `revertInlineParametersOffToR2013b` at the MATLAB® Command Line. Alternately, add `revertInlineParametersOffToR2013b` to your MATLAB startup function.

After running `revertInlineParametersOffToR2013b`, you cannot undo the change in the same MATLAB session. To return to the `InlineParameters Off` behavior in R2014a, restart MATLAB.

The command `inlineParametersOffRevertedToR2013b` returns a logical true or false to indicate whether the `InlineParameters Off` behavior has been reverted to that in R2013b.

Code generated using the R2013b `InlineParameters Off` behavior is not compatible with the code generated using the R2014a `InlineParameters Off` behavior. Therefore, run `revertInlineParametersOffToR2013b` before code generation.

## Independent configuration selections for standard math and code replacement libraries

**Compatibility Considerations: Yes**

In R2014a, you can independently select and configure standard math and code replacement libraries for code generation with the following changes in the Configuration Parameters dialog box.

- On the top-level **Code Generation** pane, the **Language (TargetLang)** parameter setting determines options that are available for a new **Standard math library** parameter on the **Code Generation > Interface** pane.

- Depending on your **Language** selection, the new **Standard math library** (TargetLangStandard) parameter on the **Code Generation > Interface** pane lists these options.

| <b>Language</b> | <b>Standard Math Libraries</b>                       |
|-----------------|--|
| C               | C89/C90 (ANSI) – default<br>C99 (ISO)                |
| C++             | C89/C90 (ANSI) – default<br>C99 (ISO)<br>C++03 (ISO) |

- On the **Code Generation > Interface** pane, the **Code replacement library** (CodeReplacementLibrary) parameter lists available code replacement libraries. The Simulink Coder™ software filters the list based on compatibility with the **Language** and **Standard math library** settings and on product licensing (for example, Embedded Coder® offers more libraries and the ability to create and use custom code replacement libraries).

For more information, see:

- “Language”
- “Standard math library”
- “Code replacement library”

## Compatibility Considerations

In R2014a, code replacement libraries provided by MathWorks® no longer include standard math libraries.

- When you load a model created with an earlier version:
  - The CodeReplacementLibrary parameter setting remains the same unless previously set to C89/C90 (ANSI), C99 (ISO), C++ (ISO), Intel IPP (ANSI), or Intel IPP (ISO). In these cases, Simulink Coder software sets CodeReplacementLibrary to None or Intel IPP.

- Simulink Coder software sets the new `TargetLangStandard` parameter to C89/C90 (ANSI), C99 (ISO), or C++03 (ISO), depending on the previous `CodeReplacementLibrary` setting.

| If <code>CodeReplacementLibrary</code> was set to   | <code>TargetLangStandard</code> is set to                  |
|---|--|
| C89/C90 (ANSI), C99 (ISO), or C++ (ISO)   | C89/C90 (ANSI), C99 (ISO), or C++03 (ISO), respectively    |
| GNU99 (GNU), Intel IPP (ISO), Intel IPP (GNU), ADI TigerSHARC (Embedded Coder only), or MULTI BF53x (Embedded Coder only) | C99 (ISO)  |
| A custom library (Embedded Coder only), and the corresponding registration file has been loaded in memory                 | A value based on the <code>BaseTfl</code> property setting |
| Any other value   | The default standard math library, C89/C90 (ANSI)          |

- When you select a code replacement library provided by MathWorks after you load a model, the code generator can produce different code than in previous versions depending on the `TargetLangStandard` setting. Verify generated code.
- When you export a model created in R2014a, the Simulink Coder software:
  - Uses the `TargetLangStandard` setting to map to the closest available code replacement library or the default library in the previous version, if `CodeReplacementLibrary` is set to None or Intel IPP.
  - Otherwise, ignores the `TargetLangStandard` parameter.

## Generated code compilation using LCC-64 bit on Windows hosts

You can now use the LCC-win64 compiler, included on Windows® 64-bit platforms, for GRT model builds. If you have an Embedded Coder license, you also can use the compiler for ERT model builds and SIL and PIL mode simulation on Windows hosts.

## Improved code integration of shared utility files

Previously, the code generator created the file `rtw_shared_utils.h` which included header files associated with CRL replacements and Simulink and MATLAB utilities.

In R2014a, code generation no longer creates `rtw_shared_utils.h`. Code generation for a model produces code which directly includes only those header files required for the code. For subsystems, code generation includes only those header files required for the subsystem code. The generated code is more deterministic. You can easily integrate code generated from separate software components.

## Model Architecture and Design

### **Custom post-processing function for protected models**

You can specify a post-processing function for code generated from a protected model using the 'CustomPostProcessingHook' option of the `Simulink.ModelReference.protect` function. You can use this option to run a third-party custom obfuscator on the generated code.

For more information, see “Specify Custom Obfuscator for Protected Model”.

### **Context-sensitive help for the Create Protected Model dialog box**

In R2014a, context-sensitive help (CSH) is available for parameters in the Create Protected Model dialog box.



## Data, Function, and File Definition

### Improved control of C and C++ code interface packaging

**Compatibility Considerations: Yes**

R2014a provides improved control of code interface packaging for generated model code, including nonreusable code, reusable code, and encapsulated C++ class code. To support more robust control of code interface packaging, the following changes were made to the **Code Generation > Interface** pane of the Configuration Parameters dialog box and corresponding command-line model parameters:

- The new model parameter **Code interface packaging** (CodeInterfacePackaging) selects the packaging for the C or C++ code interface generated for your model. The possible values are:
  - Nonreusable function
  - Reusable function
  - C++ class (available if **Language** is set to C++)

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**Note** As described in “C++ class generation” on page 2, C++ class code generation is now available to GRT-based models as well as ERT-based models.

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- The model option **Generate reusable code** (MultiInstanceERTCode) has been removed. Setting the value of **Code interface packaging** to **Reusable function** or **Nonreusable function** is equivalent to selecting or clearing **Generate reusable code** in releases before R2014a.
- The model parameter **Reusable code error diagnostic** has been renamed to **Multi-instance code error diagnostic**. The parameter now supports GRT models and C++ class code generation. For more information, see “Multi-instance code error diagnostic for reusable function code and C++ class code” on page 11.

- Parameters within the **Code interface** subpane have been regrouped and relocated to improve pane navigation and code interface configuration workflows. The following figure shows the **Code interface** subpane when **Code interface packaging** is set to C++ class for an ERT model.

Code interface

Code interface packaging: C++ class Multi-instance code error diagnostic: Error

Classic call interface

Single output/update function  Terminate function required

Generate preprocessor conditionals: Use local settings

Suppress error status in real-time model data structure  Combine signal/state structures

Data Member Visibility/Access Control

Block parameter visibility private Block parameter access None

Internal data visibility private Internal data access None

External I/O access None

Generate destructor  Use operator new for referenced model object registration

Configure C++ Class Interface

## Compatibility Considerations

- For GRT and ERT-based models, selecting the **Language** (TargetLang) value C++ now provides two possible forms of C++ code interface packaging:
  - If you set **Code interface packaging** (CodeInterfacePackaging) to C++ class, the build generates a C++ class interface to model code. The generated interface encapsulates required model data into C++ class attributes and model entry point functions into C++ class methods.
  - If you set **Code interface packaging** to a value other than C++ class, the build generates C++ compatible .cpp files containing model interfaces enclosed within an extern "C" link directive. This behavior is equivalent to code generation with **Language** set to C++ before R2014a.

- A script created before R2014a might select C++ extern "C" code packaging for a model by using `set_param` to set `TargetLang` to C++. Beginning in R2014a, setting `TargetLang` to C++ selects only the C++ language, and does not alter the C++ code interface packaging. To produce the same result as before R2014a, update the script to set both `TargetLang` and `CodeInterfacePackaging`.
- For ERT-based models, the **Language** value C++ (Encapsulated) is no longer available. To configure encapsulated C++ class code generation, set **Language** to C++ and set **Code interface packaging** to C++ class. This pair of settings is equivalent to setting **Language** to C++ (Encapsulated) in releases before R2014a.
- For GRT and ERT-based models, the model option **Generate reusable code** (`MultiInstanceERTCode`) has been removed. Setting the value of **Code interface packaging** to `Reusable function` or `Nonreusable function` is equivalent to selecting or clearing **Generate reusable code** in releases before R2014a.

## Multi-instance code error diagnostic for reusable function code and C++ class code

**Compatibility Considerations: Yes**

The model parameter **Reusable code error diagnostic** has been renamed to **Multi-instance code error diagnostic**. Before R2014a, **Reusable code error diagnostic** applied only to ERT-based models and to reusable function code. Beginning in R2014a, **Multi-instance code error diagnostic** also applies to GRT-based models and to C++ class code.

The **Multi-instance code error diagnostic** parameter specifies the diagnostic action that the build process takes when a model violates strict requirements for generating multi-instance code:

- None — Proceed with build without displaying a diagnostic message.
- Warning — Proceed with build after displaying a warning message.
- Error (default) — Abort build after displaying an error message.

The name of the equivalent command-line parameter, `MultiInstanceErrorCode`, is unchanged.

## Compatibility Considerations

- In releases before R2014a, **Reusable code error diagnostic** did not apply to GRT models. Now, renamed to **Multi-instance code error diagnostic**, the parameter applies to GRT models. Its default value is Error.

If you load a GRT model created before R2014a, for which reusable code generation is selected, by default, code generation now applies strict multi-instance code requirements to the model during code generation, and the build might fail. If the build fails, examine the condition that caused the error message. Decide whether to reset **Multi-instance code error diagnostic** to Warning or None, or leave **Multi-instance code error diagnostic** set to Error and modify the model to remove the condition.

- Before R2014a, the setting of the ERT model parameter **Reusable code error diagnostic** was ignored if a model was configured to do all of the following:
  - Generate reusable code.
  - Generate a function to allocate model data for each model instance.
  - Simulate in External mode.

Beginning in R2014a, if a model is configured as described, the setting of the GRT and ERT model parameter **Multi-instance code error diagnostic** is honored. If the diagnostic parameter is set to Error (the default value), a model that built successfully before R2014a might fail to build. If the build fails, examine the condition that caused the error message. Decide whether to reset **Multi-instance code error diagnostic** to Warning or None, or leave **Multi-instance code error diagnostic** set to Error and modify the model to remove the condition.

## Removal of TRUE and FALSE from `rtwtypes.h`

**Compatibility Considerations: Yes**

When the target language is C, `rtwtypes.h` compiles the definitions for `true` and `false` into the code. It no longer defines `TRUE` and `FALSE`.

If you integrate code generated in R2014a with custom code that references `TRUE` and `FALSE`, modify your custom code in one of these ways:

- Define `TRUE` and `FALSE`.

- Change TRUE to true and FALSE to false.
- Change TRUE to 1U and FALSE to 0U.

## Code Generation

### **Optimized inline constant expansion**

In R2014a, the code generator expands inline references to buses, bus arrays, and complex arrays where the elements are all constant and equal. This enhancement improves execution speed and reduces RAM consumption.

### **rtwtypes.h included before tmwtypes.h**

If code generation produces a program file which includes the header files `rtwtypes.h` and `tmwtypes.h`, then code generation includes `rtwtypes.h` first. This file order occurs whether the program file includes the header files directly or indirectly.

When code generation creates `rtwtypes.h`, it includes typedef definitions tailored for the target, using model parameter settings. `rtwtypes.h` is included first so that its target-specific typedef definitions are the definitions used when compiling the code.

### **Constant block output value used when in nonreusable subsystem**

Previously, when you defined a Constant block within a nonreusable subsystem, and then connected a block to the Constant block outside that subsystem, the connected block used the value from the `Value` parameter directly. Now, the connected block uses the output of the Constant block.

Using the Constant block output simplifies mapping from the Subsystem block to its representation in the generated C code.

## Deployment

### **Support for Eclipse IDE and Desktop Targets will be removed**

#### **Compatibility Considerations: Yes**

Simulink Coder support for Eclipse™ IDE will be removed in a future release.

Currently, you can use Simulink Coder support for Eclipse IDE to:

- Build and run generated code on your host desktop computer running Linux® or Windows.
- Generate multitasking code that uses POSIX threads (Pthreads) for concurrent execution.
- Tune parameters on, and monitor data from, an executable running on the target hardware (External mode).
- Perform numeric verification using processor-in-the-loop (PIL) simulation.
- Generate IDE projects and use the Automation Interface API.
- Generate makefile projects using the mingw\_host configuration in XMakefile.
- Use Linux Task and Windows Task blocks

#### **Compatibility Considerations**

There are no recommended alternatives for using Simulink Coder with Eclipse IDE and Desktop Targets.

### **Additional build folder information and protected model support for `RTW.getBuildDir` function**

In 2014a, when you use the `RTW.getBuildDir` function to get build folder information, these new fields are available:

- `ModelRefRelativeRootSimDir` – String specifying the relative root folder for the model reference target simulation folder.
- `ModelRefRelativeRootTgtDir` – String specifying the relative root folder for the model reference target build folder.
- `SharedUtilsSimDir` – String specifying the shared utility folder for simulation.
- `SharedUtilsTgtDir` – String specifying the shared utility folder for code generation.

In addition, the `RTW.getBuildDir` function can return build folder information for protected models.

## **Wind River Tornado (VxWorks 5.x) target to be removed in future release**

**Compatibility Considerations: Yes**

The Wind River® Tornado® (VxWorks® 5.x) target will be removed from Simulink Coder software in a future release. If you generate code using the system target file `tornado.tlc`, the software displays a warning about future removal of the target.

Beginning in R2014a, you can no longer select the system target file `tornado.tlc` for a model using the list of targets in the System Target File Browser. However, you can still specify the Tornado target. Either enter the text `tornado.tlc` in the **System target file** parameter field or, from the MATLAB command line, use the `set_param` command to set the `SystemTargetFile` parameter to `'tornado.tlc'`.

### **Compatibility Considerations**

If you have an Embedded Coder license, you can use the Wind River VxWorks support package. The support package allows you to use the XMakefiles feature to automatically generate and integrate code with VxWorks 6.7, VxWorks 6.8, and VxWorks 6.9. For more information, see [www.mathworks.com/hardware-support/vxworks.html](http://www.mathworks.com/hardware-support/vxworks.html).



## Performance

### To Workspace, Display, and Scope blocks removed by block reduction

When performing block reduction, the code generator can eliminate the Display block when all of the following are true:

- External mode is off. On the **Code Generation > Interface** pane, set **Interface** to None.
- The target is not a simulation target, such as `grt.tlc`, `ert.tlc`, and `autosar.tlc`.

When doing block reduction, the code generator can eliminate the To Workspace and Scope blocks when all of the following are true:

- External mode is off. On the **Code Generation > Interface** pane, set **Interface** to None.
- The system target file is `grt.tlc` or `ert.tlc`.
- MAT-file logging is off. On the **Code Generation > Interface** pane, the **MAT-file logging** check box is cleared.

### Optimized reusable subsystem inputs

When processing the inputs to reusable subsystems, code generation optimizes code reuse and efficiency when you select the input signal. To select the input signal, use a virtual Bus Selector block or a Selector block. This enhancement also improves traceability.

## **Verification**

## 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/](http://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.

### Search R2014a Bug Reports

Known Bugs for Incorrect Code Generation:

[www.mathworks.com/support/bugreports/?product=ALL&release=R2014a&keyword=Incorrect+Code+Generation](http://www.mathworks.com/support/bugreports/?product=ALL&release=R2014a&keyword=Incorrect+Code+Generation)

All Known Bugs for This Product:

[www.mathworks.com/support/bugreports/?release=R2014a&product=RT](http://www.mathworks.com/support/bugreports/?release=R2014a&product=RT)



# R2013b

---

**Version: 8.5**

**New Features: Yes**

**Bug Fixes: Yes**

## Model Architecture and Design

### Multilevel access control when creating password-protected models for IP protection

If you create a protected model, you have the option to specify different passwords to control protected model functionality. The supported types of functionality for password protection are:

- Model viewing
- Simulation
- Code generation

For password-protected models, before using each type of supported functionality, you must enter a password.

To protect your models with passwords, right-click a model reference block, and then select **Subsystem & Model Reference > Create Protected Model for Selected Model Block**. Select the functionality that you want supported inside your protected model. Enter a password for each type of supported functionality. Passwords must be a minimum of four characters. When you are finished creating passwords, click **Create**.

To use the supported functionality of a protected model, you must enter the password. Right-click the protected model shield icon and select **Authorize**. Enter the password, and click **OK**.

### Simulink Coder checks in Model Advisor

You can use the Model Advisor Simulink Coder Checks to verify that your model is configured for code generation. Previously, the checks were available in the Model Advisor Embedded Coder folder.

## Data, Function, and File Definition

### Imported data can be shared

**Compatibility Considerations: Yes**

You can now import header files and use them in the shared utilities folder. Previously, the only imported data types available were those data types exported by a previous model.

Some shared items using imported data types include:

- Reusable library subsystems
- Constants shared across models
- Shared data and Simulink or mpt custom storage classes such as `ExportToFile` and `Volatile`

For more information, see [Incremental Shared Utility Code Generation and Compilation](#).

### Compatibility Considerations

- Previously, you changed imported data types without affecting the shared utilities folder. Now, if you change an imported data type, code generation notifies you that you must clear `slprj` and regenerate code.
- Previously, you created an imported data type with no header file specified. Now, if there is no header file for an imported data type, code generation generates an error.

### Readability improved for constant names

To make constant parameter names more easily readable, code generation uses a macro (`#define`) to create the name when:

- The constant parameter is defined in the shared utilities folder.
- The constant parameter is not in a shared function.

When the constant parameter is used in a shared function, code generation always generates a checksum-based name.

Previously, if a constant parameter definition was generated to the shared location, code generation sometimes used the checksum-based name in nonshared function files.

## Removal of two's complement guard and RTWTYPES\_ID from rtwtypes.h

In 2013b, the following changes have been made to `rtwtypes.h`:

- This code has been removed from `rtwtypes.h`:

```
/*
 * Simulink Coder assumes the code is compiled on a target using a 2's complement
 * representation for signed integer values.
 */
#if ((SCHAR_MIN + 1) != -SCHAR_MAX)
#error "This code must be compiled using a 2's complement representation for signed integer v
#endif
```

Simulink Coder still assumes code is compiled on a target using a two's complement representation for signed integer values.

- The definition of the macro `RTWTYPES_ID` has been removed from `rtwtypes.h`. The definition is no longer referenced from `model_private.h`.

For information about the `rtwtypes.h` file, see [Files and Folders Created by Build Process](#).

## ***MODEL\_M* macro renamed in static main for multi-instance GRT target** Compatibility Considerations: Yes

In R2013a, the static main program module `matlabroot/rtw/c/src/common/rt_malloc_main.c` defined a `MODEL_M` macro for getting the `rtModel` type for the model. R2013b renames the macro to `MODEL_M_TYPE` to resolve a potential naming conflict.



## **Compatibility Considerations**

If you used R2013a materials to develop a custom target based on GRT with model option **Generate reusable code** selected, update your custom static main to use *MODEL\_M\_TYPE* instead of *MODEL\_M* to get the `rtModel` type. You can use the installed static main module *matlabroot/rtw/c/src/common/rt\_malloc\_main.c* as a reference point.

## Code Generation

### Optimized code for long long data type

If your target hardware and your compiler support the C99 long long integer data type, you can select to use this data type for code generation. Using long long results in more efficient generated code that contains fewer cumbersome operations and multiword helper functions. This data type also provides more accurate simulation results for fixed-point and integer simulations. If you are using Microsoft® Windows (64-bit), using long long improves performance for many workflows including using Accelerator mode and working with Stateflow® software.

For more information, see the **Enable long long** and **Number of bits: long long** configuration parameters on the Hardware Implementation Pane.

At the command line, you can use the following new model parameters:

- **ProdLongLongMode**: Specify that your C compiler supports the long long data type. You must set this parameter to 'on' to enable **ProdBitPerLongLong**.
- **ProdBitPerLongLong**: Describes the length in bits of the C long long data type supported by the production hardware.
- **TargetLongLongMode**: Specifies whether your C compiler supports the long long data type. You must set this parameter to 'on' to enable **TargetBitPerLongLong**.
- **TargetBitPerLongLong**: Describes the length in bits of the C long long data type supported by the hardware used to test generated code.

For more information, see Model Parameters.

## **<LEGAL> tokens removed from comments in generated code**

Copyright notice comments in the generated code no longer include a <LEGAL> token. Copyright notices are now bound by COPYRIGHT NOTICE at the top and END at the bottom.

## Deployment

### Compiler toolchain interface for automating code generation builds

**Compatibility Considerations: Yes**

You can configure your model to generate code using **Toolchain settings** instead of **Template makefile** parameters. The software and documentation refer to using these settings as the *toolchain approach*.

The toolchain approach enables you to:

- Select the toolchain a Simulink model uses to build generated code.
- Use custom toolchains that are registered using MATLAB Coder software.
- Select a build configuration such as **Faster Builds**, **Faster Runs**, **Debug**.
- Customize a build configuration, such as setting compiler optimization flags, using **Specify**.
- Use support packages that include custom toolchains.

To use the toolchain approach:

- 1** Open the Configuration Parameters dialog box for Simulink model by pressing **Ctrl+E**.
- 2** In Configuration Parameters, select the **Code Generation** pane.
- 3** Click the **Browse** button for the **System target file** parameter, and select one of the following:
  - `grt.tlc` Generic Real-Time Target (default)
  - `ert.tlc` Embedded Coder (Requires the Embedded Coder product)
  - `ert_shrlib.tlc` Embedded Coder (host-based shared library target) (Requires the Embedded Coder product)

When you use toolchain approach, the following **Toolchain settings** are available:

- **Target hardware** (only with `ert.tlc` Embedded Coder)
- **Toolchain**
- **Build Configuration**

When you use the toolchain approach, the following **Makefile configuration** are unavailable:

- **Generate makefile**
- **Make command**
- **Template makefile**

For more information, see:

- Configure the Build Process
- Custom Toolchain Registration
- Code Generation Pane: General

## Compatibility Considerations

When you open a Simulink model that has **System target file** set to `grt.tlc`, `ert.tlc`, or `ert_shrlib.tlc`, Simulink Coder software automatically updates the model to use the toolchain approach. If the model does not use a default template makefile or configuration settings, Simulink Coder software might not upgrade the model. For more information, see [Upgrade Model to Use Toolchain Approach](#).

## Log data on Linux-based target hardware

With Linux-based target hardware for the Simulink “Run on Target Hardware” feature, you can log data from a model to a MAT-file, and then pull that data into MATLAB for analysis.

This capability:

- Works with Raspberry Pi™, BeagleBoard, Gumstix® Overo®, and PandaBoard hardware.

- Enables you to log real-time data from signals attached to scopes, root-level I/O ports, or To Workspace blocks.
- Saves the logged data to MAT-files on the target hardware.
- Enables you to use SSH to transfer MAT-files to your host computer.

For more information, see [Log Data on Linux-based Target Hardware and Target Hardware](#)

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**Note** This feature requires a Simulink Coder license.

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## Performance

### Reduced data copies for bus signals with global storage

Data copies are reduced when subsystem outputs are global and packed into a bus through a bus creator block. This enhancement improves execution speed and reduces RAM consumption.

For this optimization your model requires all of the following conditions:

- Set subsystem **Function packaging** parameter to **Inline** or **Nonreusable**.
- The signal property for output signal cannot be **Testpoint**.
- The subsystem must have a single destination.
- For a conditionally executed subsystem's properties, set the output, when disabled, to **held**.

Previously, code generation might produce extra data copies for bus signals with global storage.

## Customization

### Support for user-authored MATLAB system objects

Simulink Coder supports code generation for the MATLAB System block, which allows you to include a System object™ in your Simulink model. This capability is useful for including algorithms. For more information, see System Object Integration.

### TLC Options removed from Configuration Parameters dialog box

The model parameter **TLC options** has been removed from the **Code Generation** pane of the Configuration Parameters dialog box. However, at the MATLAB command line, you can still use the `set_param` command to set the equivalent command-line parameter `TLCOptions`. For more information, see Specify TLC Options and Configure TLC.



## 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/](http://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.

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### Search R2013b Bug Reports

Known Bugs for Incorrect Code Generation:

[www.mathworks.com/support/bugreports/?product=ALL&release=R2013b&keyword=Incorrect+Code+Generation](http://www.mathworks.com/support/bugreports/?product=ALL&release=R2013b&keyword=Incorrect+Code+Generation)

All Known Bugs for This Product:

[www.mathworks.com/support/bugreports/?release=R2013b&product=RT](http://www.mathworks.com/support/bugreports/?release=R2013b&product=RT)



# R2013a

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**Version: 8.4**

**New Features: Yes**

**Bug Fixes: Yes**

## Data, Function, and File Definition

### Optimized interfaces for Simulink functions called in Stateflow

Previously, when subsystem input and output signals were used inside a Stateflow chart, the generated code for the input and output signals was copied into global variables. In R2013a, when the Subsystem block parameter Function packaging is set to `InLine`, the subsystem inputs and outputs called within a Stateflow chart are now local variables. This optimization improves execution speed and memory usage.

### Shortened system-generated identifier names

For GRT targets, the length of the system-generated identifier names are shortened to allow for more space for the user-specified components of the generated identifier names. The name changes provide a more consistent and predictable naming system that uses camel case, no underscores or plurals, and consistent abbreviations for both a type and a variable.

The default for the system-generated identifiers per model are changed.

| Before R2013a       | In R2013a | Type                        |
|---------------------|-----------|-----------------------------|
| BlockIO, B          | B         | Type                        |
| ExternalInputs      | ExtU      | Type                        |
| ExternalInputSizes  | ExtUSize  | Type                        |
| ExternalOutputs     | ExtY      | Type                        |
| ExternalOutputSizes | ExtYSize  | Type                        |
| Parameters          | P         | Type                        |
| ConstBlockIO        | ConstB    | Const Type                  |
| MachineLocalData    | MachLocal | Const Type                  |
| ConstParam, ConstP  | ConstP    | Const Type, Global Variable |

| <b>Before R2013a</b>               | <b>In R2013a</b> | <b>Type</b>                 |
|------------------------------------|------------------|-----------------------------|
| ConstParamWithInit, ConstWithInitP | ConstInitP       | Const Type, Global Variable |
| D_Work, DWork                      | DW               | Type, Global Variable       |
| MassMatrixGlobal                   | MassMatrix       | Type, Global Variable       |
| PrevZCSigStates, PrevZCSigState    | PrevZCX          | Type, Global Variable       |
| ContinuousStates, X                | X                | Type, Global Variable       |
| StateDisabled, Xdis                | XDis             | Type, Global Variable       |
| StateDerivatives, Xdot             | XDot             | Type, Global Variable       |
| ZCSignalValues, ZCSignalValues     | ZCV              | Type, Global Variable       |
| DefaultParameters                  | DefaultP         | Global Variable             |
| GlobalTID                          | GlobalTID        | Global Variable             |
| InvariantSignals                   | Invariant        | Global Variable             |
| Machine                            | MachLocal        | Global Variable             |
| NSTAGES                            | NSTAGES          | Global Variable             |
| Object                             | Obj              | Global Variable             |
| TimingBridge                       | TimingBrdg       | Global Variable             |
| U                                  | U                | Global Variable             |
| USize                              | USize            | Global Variable             |
| Y                                  | Y                | Global Variable             |
| YSize                              | YSize            | Global Variable             |

The default for the system-generated identifiers names per referenced model or reusable subsystem are changed.

| <b>Before R2013a</b> | <b>In R2013a</b> | <b>Type</b>           |
|----------------------|------------------|-----------------------|
| rtB, B               | B                | Type, Global Variable |
| rtC, C               | ConstB           | Type, Global Variable |

| <b>Before R2013a</b>           | <b>In R2013a</b> | <b>Type</b>           |
|--------------------------------|------------------|-----------------------|
| rtDW, DW                       | DW               | Type, Global Variable |
| rtMdlrefDWork ,<br>MdlrefDWork | MdlRefDW         | Type, Global Variable |
| rtP, P                         | P                | Type, Global Variable |
| rtRTM, RTM                     | RTM              | Type, Global Variable |
| rtX, X                         | X                | Type, Global Variable |
| rtXdis, Xdis                   | XDis             | Type, Global Variable |
| rtXdot, Xdot                   | XDot             | Type, Global Variable |
| rtZCE, ZCE                     | ZCE              | Type, Global Variable |
| rtZCSV, ZCSV                   | ZCV              | Type, Global Variable |

For more information, see Construction of Generated Identifiers.

## Code Generation

### Shared utility name consistency across builds with maximum identifier length control

In R2013a, shared utility names remain consistent in the generated code across multiple builds of your model. In addition, shared utility names now comply with the **Maximum identifier length** parameter specified on the **Code Generation > Symbols** pane in the Configuration Parameters dialog box. The **Maximum identifier length** parameter does not apply to fixed-point and DSP utilities.

### Code Generation Advisor available on menu bar

To launch the Code Generation Advisor, on the model menu bar, select **Code > C/C++ Code > Code Generation Advisor**. Alternatively, the Code Generation Advisor remains available in the Configuration Parameters dialog box, on the **Code Generation** pane.

For information about using the Code Generation Advisor to configure your model to meet specific code generation objectives, see:

- Application Objectives in Simulink Coder
- Application Objectives in Embedded Coder

### Code generation build when reusable library subsystem link status changes

Shared functions for a reusable library subsystem are generated only for resolved library links. If you enable or disable a library link for a reusable subsystem, and then build your model, new code is generated.

## **Protected models usable in model reference hierarchies**

Previously, you could not protect a model and use it in a model reference hierarchy.

In R2013a, you can use protected models in a model reference hierarchy. In addition, R2013a includes enhancements to the programmatic interface as well as the dialog for model protection.

To learn more about changes to the programmatic interface, see `Simulink.ModelReference.protect` and to view the changes to the model protection dialog, see [Create a Protected Model](#).



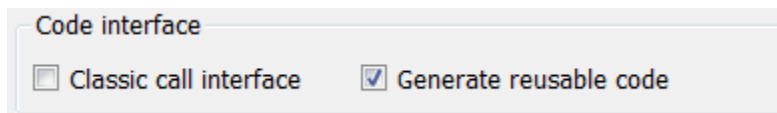
## Deployment

### Simplified multi-instance code with support for referenced models

R2013a provides simplified multi-instance code deployment for GRT targets with support for referenced models.

In previous releases, to generate reentrant, reusable code with dynamic allocation of per-instance model data, you had to select a specialized target, `grt_malloc.tlc`, for the model. If you selected the GRT malloc target for a model, you could not include referenced models in your model design.

Beginning in R2013a, you can generate reentrant, reusable code for a GRT model by selecting the model configuration option **Generate reusable code**, which is located on the **Code Generation > Interface** pane of the Configuration Parameters dialog box.



When you select **Generate reusable code** for a GRT model, the build process generates reusable, multi-instance code that is reentrant, as follows:

- The generated `model.c` source file contains an allocation function that dynamically allocates model data for each instance of the model.
- The generated code passes the real-time model data structure in, by reference, as an argument to `model_step` and the other model entry point functions.
- The real-time model data structure is exported with the `model.h` header file.

With the new GRT model option **Generate reusable code**, you can generate and deploy multi-instance code for your model without selecting a specialized target, and you can include referenced models in your model design.

---

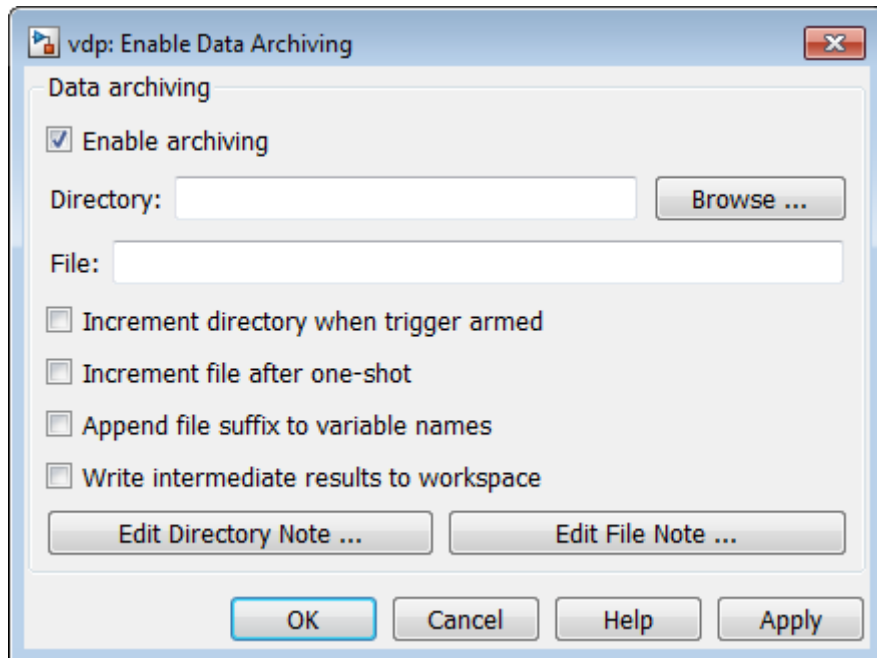
**Note** Use of the `grt_malloc.tlc` target is no longer recommended. For more information, see “GRT malloc target to be removed in future release” on page 45.

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## External mode control panel improvements and C API access

### Improved External mode graphical controls

External mode dialog boxes are now consistent with other Simulink dialog boxes, with improved layout, ability to resize, and consistent sets of buttons. The improved dialog boxes include the **External Mode Control Panel** and the subsidiary dialog boxes that you can open from it, **External Signal & Triggering** and **Enable Data Archiving**. Here is the improved **Enable Data Archiving** dialog box.



To view the improved External mode dialog boxes, open a model and select **Code > External Mode Control Panel**.

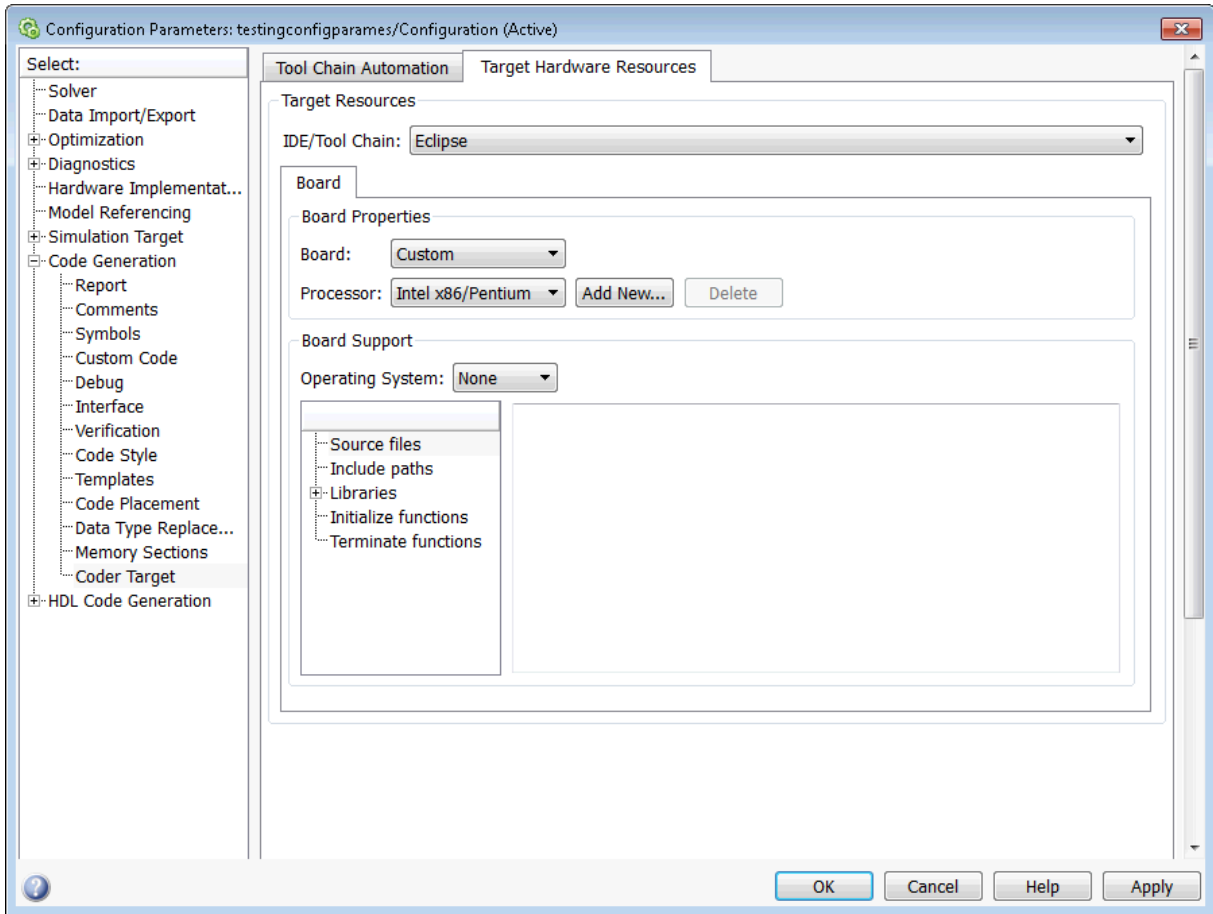
### **C API access from External mode simulations**

In previous releases, the External mode and C API data interfaces for model code were mutually exclusive. Beginning in R2013a, you can generate code for your model with both the External mode and C API interfaces enabled. Custom code now can access C API data structures during an External mode simulation.

For more information, see [Generate External Mode and C API Data Interfaces](#).

## **Hardware configuration relocation from Target Preferences block to Configuration Parameters dialog**

The contents of the Target Preferences block have been relocated to the new **Target Hardware Resources** tab on the Coder Target pane in the Configuration Parameters dialog box.



The Target Preferences block has been removed from the Desktop Targets block library.

If you open a model that contains a Target Preferences block, a warning instructs you that the block is optional and can be removed from your model.

Opening the Target Preferences block automatically displays the **Target Hardware Resources** tab.

For instructions on how to use **Target Hardware Resources** to build and run a model on desktop system, see Model Setup.

For information about specific parameters and settings, see Code Generation: Coder Target Pane.

## Support ending for Eclipse IDE in a future release

Support for the Eclipse IDE will end in a future release of the Embedded Coder and Simulink Coder products.

## GRT malloc target to be removed in future release

**Compatibility Considerations: Yes**

The GRT malloc target will be removed from Simulink Coder software in a future release.

Beginning in R2013a, you can no longer select the system target file `grt_malloc.tlc` for a model using the list of targets in the System Target File Browser. However, you can still specify the GRT malloc target. Either enter the text `grt_malloc.tlc` in the **System target file** parameter field or use the `set_param` command to set the `SystemTargetFile` parameter from the MATLAB command line.

## Compatibility Considerations

If you are using the system target file `grt_malloc.tlc` to generate reentrant code with dynamic memory allocation, switch to using `grt.tlc` with the model configuration option **Generate reusable code**. As described in “Simplified multi-instance code with support for referenced models” on page 41, the **Generate reusable code** option offers several advantages over the GRT malloc target, including a simple multi-instance call interface and support for model reference hierarchies. For more information, see the help for **Generate reusable code**.

## Customization

### **MakeRTWSettingsObject model parameter removed**

**Compatibility Considerations: Yes**

In R2013a, the model parameter `MakeRTWSettingsObject` has been removed from the software. Before R2013a, custom target authors used `MakeRTWSettingsObject` in build hook functions to get the value of the current build folder path during the model build process.

### **Compatibility Considerations**

If your `STF_make_rtw_hook` function uses the model parameter `MakeRTWSettingsObject` in a `get_param` function call, you must update the MATLAB code to use a different function call. For example, your hook function might contain code similar to the following.

```
makertwObj = get_param(gcs, 'MakeRTWSettingsObject');  
buildDirPath = getfield(makertwObj, 'BuildDirectory');
```

In R2013a, you can replace the above code with the following code, which returns the current build folder path.

```
buildDirPath = rtwprivate('get_makertwsettings', gcs, 'BuildDirectory');
```

For more information about build hook functions, see [Customize Build Process with STF\\_make\\_rtw\\_hook File](#).

## Check bug reports for issues and fixes

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Known Bugs for Incorrect Code Generation:

[www.mathworks.com/support/bugreports/?product=ALL&release=R2013a&keyword=Incorrect+Code+Generation](http://www.mathworks.com/support/bugreports/?product=ALL&release=R2013a&keyword=Incorrect+Code+Generation)

All Known Bugs for This Product:

[www.mathworks.com/support/bugreports/?release=R2013a&product=RT](http://www.mathworks.com/support/bugreports/?release=R2013a&product=RT)





# R2012b

---

**Version: 8.3**

**New Features: Yes**

**Bug Fixes: Yes**

## Unified and simplified code interface for ERT and GRT targets

**Compatibility Considerations: Yes**

Previously, Simulink Coder software provided a static main program for GRT-based targets, *matlabroot/rtw/c/grt/grt\_main.c*, that was distinct from the static main program that Embedded Coder software provided for ERT-based targets, *matlabroot/rtw/c/ert/ert\_main.c*.

Beginning in R2012b, Simulink Coder software provides a unified static main program for both GRT- and ERT-based targets:

```
matlabroot/rtw/c/src/common/rt_main.c
```

Generated code for GRT-based models is simplified and more consistent with generated code for ERT-based models. As a result, GRT- and ERT-based models can now use a common static main program. The benefits for GRT-based models include:

- The generated `rtModel` structure has a minimal number of fields.
- Unused macros no longer appear in the generated code.
- Multitasking behavior is consistent between GRT and ERT generated code.

---

**Note**

- If you are using the pre-R2012a GRT call interface (by selecting the model option **Classic call interface**) with a static main program, use the static main program *matlabroot/rtw/c/grt/classic\_main.c* as a reference point.
  - The previous GRT and ERT static main program files, *matlabroot/rtw/c/grt/grt\_main.c* and *matlabroot/rtw/c/ert/ert\_main.c*, have been removed from the software and are replaced by the new simplified and classic static main program files, *matlabroot/rtw/c/src/common/rt\_main.c* and *matlabroot/rtw/c/grt/classic\_main.c*.
  - The generated main program file for ERT targets is still named *ert\_main.c/cpp*.
  - If you have an Embedded Coder license, see also External mode support for ERT targets with static main in the Embedded Coder release notes.
- 

**Compatibility Considerations**

If you use a GRT-based target with a static main program, and if you configure your models with the simplified call interface that was made available to GRT targets in R2012a (that is, you do not use the model option **Classic call interface**), you must update your static main program to be compatible with the R2012b static main changes. Use the code in *matlabroot/rtw/c/src/common/rt\_main.c* as an example. The following sections outline some of the key changes to look for.

**Error status handling**

In R2012a, GRT targets using the simplified call interface handled stop simulation requests (during MAT-file logging or External mode simulation) differently from ERT targets using the simplified call interface:

- For ERT targets, a stop simulation request caused the error status to be set to `Simulation finished`. The main program (*ert\_main.c*) treated

this error status as a non-error, while treating all other non-NULL status values as errors.

- For GRT targets, a stop simulation request did not cause the error status to be set (it remained NULL). The main program treated all non-NULL status values as errors.

Beginning in R2012b, the error status handling for GRT targets using the simplified call interface has been changed to match ERT targets using the simplified interface.

### **Unused macros**

In R2012a, GRT targets using the simplified call interface generated macros differently from ERT targets using the simplified call interface:

- For ERT targets, the build process did not generate macros if they were not used in the generated code.
- For GRT targets, the build process unconditionally generated several macros that were not used in generated code.

Beginning in R2012b, the build process no longer unconditionally generates unused macros for GRT targets using the simplified call interface. The macros affected include:

- `rtm*` macros for accessing unused fields of the `rtModel` structure, such as `ModelPtrs`, `StepSize`, `ChildSfunction`, `TPtr`, and `TaskTime`
- `IsSampleHit`

### **Multitasking functions**

In R2012a, GRT targets using the simplified call interface generated functions for multitasking differently from ERT targets using the simplified call interface:

- For ERT targets, the build process never generated the `rt_SimUpdateDiscreteEvents` function and, by default, never generated the `rate_monotonic_scheduler` function. (The `rate_monotonic_scheduler` function is for MathWorks internal use only.)

- For GRT targets, the build process generated the functions `rt_SimUpdateDiscreteEvents` and `rate_monotonic_scheduler` for multitasking.

Beginning in R2012b, the build process no longer generates the multitasking functions `rt_SimUpdateDiscreteEvents` and `rate_monotonic_scheduler` for GRT targets using the simplified call interface.

## Convenient packNGo dialog for packaging generated code and artifacts

R2012b adds model configuration parameters for packaging generated code and artifacts as part of a model build. The following new parameters are located on the **Code Generation** pane of the Configuration Parameters dialog box:

- **Package code and artifacts** (`PackageGeneratedCodeAndArtifacts`) — Specify whether to automatically package generated code and artifacts for relocation.
- **Zip file name** (`PackageName`) — Specify the name of the `.zip` file in which to package generated code and artifacts for relocation.

If you select **Package code and artifacts**, the build process runs the `packNGo` function after code generation to package generated code and artifacts for relocation. Selecting **Package code and artifacts** also enables the **Zip file name** parameter for specifying a `.zip` file name. The default file name is `model.zip`. (*model* represents the name of the top model for which code is being generated.)

For more information, see [Relocate Code to Another Development Environment](#).

## Reusable code for subsystems shared by referenced models

In R2012b, you can configure a subsystem that is shared across referenced models to generate code to the shared utilities folder. Code generation creates

a standalone function in the shared utilities folder that can be called by the generated code of multiple referenced models.

To generate a single function for a reusable subsystem, the subsystem must be an active link to a subsystem in a library. For more information, see [Code Reuse For Subsystems Shared Across Referenced Models](#).

## **Code generation for protected models for accelerated simulations and host targets**

A protected model can include the generated code of the model. To create a protected model, right-click the referenced model and select **Subsystem & Model Reference > Create Protected Model for Selected Block** to open the Create Protected Model dialog box. You can select options that:

- Include the generated C code of the referenced model.
- Obfuscate the generated code.
- Create a protected model report.

You can then package the protected model, generated code, and protected model report for a third party to use for accelerated simulations and code generation. In R2012b, the file extension for protected models is `.slxp` (instead of the `.mdl` extension in previous releases).

For more information, see [Protect a Referenced Model and Package a Protected Model](#).

## **Reduction of data copies with buses and more efficient for-loops in generated code**

### **Reduction of cyclomatic complexity with virtual bus expansion**

In R2012b, code generation reduces cyclomatic complexity introduced by virtual bus expansion. This enhancement improves execution speed, reduces code size, and enables additional optimizations that reduce data copies and RAM consumption.

## Simplifying for loop control statements

Improvements to for loops in the generated code include lifting invariance out of the for loop header and simplifying complex control statements in the for loop header. This enhancement improves execution speed and the readability of the generated code.

## Unified rtiostream serial and TCP/IP target connectivity for all host platforms

Beginning in R2012b, Simulink Coder software provides unified rtiostream serial and TCP/IP target connectivity for all host platforms. Specifically, R2012b extends rtiostream serial connectivity to Linux and Macintosh host platforms; previously, only Windows host platforms were supported.

If you have implemented rtiostream serial connectivity for your embedded target environment, you can use rtiostream serial communication on any valid host to connect a Simulink model to your embedded target, using External mode or processor-in-the-loop (PIL) simulation.

---

**Note** Simulink Coder software provides rtiostream serial and TCP/IP target connectivity for all host platforms. If required, you can implement custom rtiostream connectivity—for example, to support a communication protocol other than serial or TCP/IP—for both the host platform and the embedded target environment.

---

## Constant parameters generated as individual constants to shared location

Previously, constant parameters were generated to a model-specific structure, rtConstP, in the *model\_data.c* file. If constant parameters are part of a model reference hierarchy or the model configuration parameter **Shared code placement** is set to `Shared location`, they are generated to a shared location. In R2012b, shared constant parameters are generated as individual constants to the *const\_params.c* file in the *\_sharedutils* folder. This code generation improvement generates less code and allows for subsystem code

reuse across models. For more information, see Shared Constant Parameters for Code Reuse.

## Code efficiency enhancements

The following code generation enhancements improve the efficiency of the generated code by:

- Removing a root-level outport data copy in the generated code when data is from a Stateflow chart. This enhancement reduces RAM and ROM consumption and improves execution speed.
- Removing a data copy for masked subsystems when a parameter is a matrix data type. This enhancement reduces RAM and ROM consumption and improves execution speed.
- Removing a limitation where the joint presence of initial value and function prototype control prevent removal of the root-level outport data copy in the generated code. The outport data copy is removed when the initial value is zero. This enhancement reduces RAM and ROM consumption and improves execution speed.
- Removing an unnecessary global variable generated by a For Each Subsystem or as a result from the selected configuration parameter **Pack Boolean data into bitfields**. In R2012b, the variable is removed from the global block structure which reduces global RAM.

## Optimized code generation of Delay block

In R2011b, a new Delay block replaced the Integer Delay block. The Delay block now supports optimized code generation.

## Search improvements in code generation report

Searching text in the code generation report highlights results and then scrolls to the first result. Press **Enter** to scroll through the subsequent search results. If the search returns no results, the background of the search box is highlighted red.



## GRT template makefile change for MAT-file logging support

### Compatibility Considerations: Yes

In R2012b, the template makefiles (TMFs) for GRT-based targets have been updated to better support the **MAT-file logging** (MatFileLogging) model option, which was added to the **Interface** pane of the Configuration Parameters dialog box for GRT targets in R2010b.

### Compatibility Considerations

If you authored a TMF for a GRT-based target, you should update your TMF to better support the **MAT-file logging** option. If **MAT-file logging** is selected for a GRT model, your existing TMF will continue to work. But if **MAT-file logging** is cleared, compilation of the model code will fail unless your TMF is updated.

To update your TMF, do the following:

- 1 Add a makefile variable token for MAT-file logging to the TMF:

```
MAT_FILE      = |>MAT_FILE<|
```

- 2 Use this variable to create a -D define that is part of the compiler invocation. For example

```
CPP_REQ_DEFINES = -DMODEL=$(MODEL) -DRT -DNUMST=$(NUMST) \
                  -DTID01EQ=$(TID01EQ) -DNCSTATES=$(NCSTATES) -DUNIX \
                  -DMT=$(MULTITASKING) -DHAVESTDIO -DMAT_FILE=$(MAT_FILE)
```

For examples of this update, see the GRT-based TMFs provided with Simulink Coder, located at *matlabroot/rtw/c/grt/grt\_\*.tmf*.

## Change for blocks that use TLC custom code functions in multirate subsystems

### Compatibility Considerations: Yes

In earlier releases, blocks could use the TLC functions `LibSystem*CustomCode` to register custom code to be placed inside the gcd rate of a multirate

subsystem. Beginning in R2012b, blocks that register custom code for this purpose must additionally register use of custom code with the Simulink software, using the `SimStruct` macro `ssSetUsingTLCCustomCodeFunctions`. Registering allows the Simulink engine to perform necessary adjustments to handle multiple rates for subsystems with custom code. Code generation will generate an error if all of the following conditions are true:

- An S-function uses `LibSystem*CustomCode` functions without registering their use to Simulink.
- The S-function is placed in a multirate subsystem.
- No nonvirtual block in the subsystem has a sample time equal to the gcd of the sample times in the system.

## Compatibility Considerations

If you authored a block that uses any of the TLC `LibSystem*CustomCode` functions to register custom code to be placed inside multirate subsystem functions, the block now must register custom code use with the Simulink software. Modify the `mdlInitializeSizes` code in the block to call the `ssSetUsingTLCCustomCodeFunctions` macro, as shown below:

```
ssSetUsingTLCCustomCodeFunctions (S, 1);
```

## Model `rtwdemo_f14` removed from software

**Compatibility Considerations: Yes**

In R2012b, the example model `rtwdemo_f14` has been removed from the Simulink Coder software.

## Compatibility Considerations

If you need an example model with similar content, open the Simulink example model `sldemo_f14` and configure it with a fixed-step solver. If you need an example GRT model that is configured for code generation, see the Simulink Coder models in the `rtwdemos` list.

## 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/](http://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.

### Search R2012b Bug Reports

Known Bugs for Incorrect Code Generation:

[www.mathworks.com/support/bugreports/?product=ALL&release=R2012b&keyword=Incorrect+Code+Generation](http://www.mathworks.com/support/bugreports/?product=ALL&release=R2012b&keyword=Incorrect+Code+Generation)

All Known Bugs for This Product:

[www.mathworks.com/support/bugreports/?release=R2012b&product=RT](http://www.mathworks.com/support/bugreports/?release=R2012b&product=RT)



# R2012a

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**Version: 8.2**

**New Features: Yes**

**Bug Fixes: Yes**

## Simplified Call Interface for Generated Code

In previous releases, GRT and GRT-based targets generated code with a GRT-specific call interface, using the model entry functions `model`, `MdlInitializeSizes`, `MdlInitializeSampleTimes`, `MdlStart`, `MdlOutputs`, `MdlUpdate`, and `MdlTerminate`. ERT and ERT derived targets, by default, generated code with a simplified call interface, using the model entry functions `model_initialize`, `model_step`, and `model_terminate`. (Additionally, model options could be applied to customize the simplified call interface, such as clearing **Single output/update function** or **Terminate function required**.)

In R2012a, GRT targets can now generate code with the same simplified call interface as ERT targets. This simplifies the task of interacting with the generated code. Target authors can author simpler `main.c` or `.cpp` programs for GRT targets. Also, it is no longer required to author different main programs for GRT and ERT targets.

To preserve compatibility with models, GRT-based custom targets, and GRT main modules created in earlier releases, R2012a provides the model option **Classic call interface** (`GRTInterface`), which is located on the **Code Generation > Interface** pane of the Configuration Parameters dialog box. If you select **Classic call interface**, code generation generates model function calls compatible with the main program module of the GRT target in models created before R2012a. If you clear the **Classic call interface** option, code generation generates the simplified call interface.

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**Note**

- The **Classic call interface** (GRTInterface) option is available for both GRT-based and ERT-based models. For Embedded Coder users, it replaces the ERT model option **GRT-compatible call interface** (GRTInterface).
  - For new GRT and ERT models, the **Classic call interface** option is cleared by default. New models use the simplified call interface.
  - For GRT models created before R2012a, **Classic call interface** is selected by default. Existing GRT models can continue to use the pre-R2012a GRT-specific call interface.
- 

## Incremental Code Generation for Top-Level Models

R2012a provides the ability to omit unnecessary code regeneration from top model builds, allowing top models to be built incrementally. This can significantly reduce model build times.

Previously, each model build fully regenerated and compiled the top model code. Beginning in R2012a, the build process checks the structural checksum of the model to determine whether changes to the model require code regeneration. If code regeneration is required, the build process fully regenerates and compiles the model code, in the manner of earlier releases. However, if the generated code is found to be current with respect to the model, the build process does the following:

- 1** Skips model code regeneration.
- 2** Still calls build process hooks, including *STF\_make\_rtw\_hook* functions and the post code generation command.
- 3** Reruns the makefile to make sure external dependencies are recompiled and relinked.

Additionally, command-line options exist for controlling or overriding the new build behavior. For more information, see [Control Regeneration of Top Model Code](#).

## Minimal Header File Dependencies with packNGo Function

The packNGo function, which packages model code files in a zip file for relocation, now by default includes only the minimal header files required in the zip file. The packNGo function now runs a preprocessor to determine the minimal header files required to build the code. Previously, packNGo included all header files found on the include path.

To revert to the behavior of previous releases, you can use the following form of the function:

```
>> packNGo(buildInfo,{'minimalHeaders',false})
```

## ASAP2 Enhancements for Model Referencing and Structured Data

### Ability to Merge ASAP2 Files Generated for Top and Referenced Models

R2012a provides the ability to merge ASAP2 files generated for top and referenced models into a single ASAP2 file. To merge ASAP2 files for a given model, use the function `rtw.asap2MergeMdlRefs`, which has the following syntax:

```
[status,info]=rtw.asap2MergeMdlRefs(topModelName,asap2FileName)
```

For more information, see [Merge ASAP2 Files Generated for Top and Referenced Models](#)

### ASAP2 File Generation for Test Pointed Signals and States

ASAP2 file generation has been enhanced to generate ASAP2 MEASUREMENT records for the following data, without the need to resolve them to Simulink data objects:

- Test-pointed Simulink signals, usable inside reusable subsystems
- Test pointed Stateflow states, allowing you to monitor which state is active during real-time testing



- Test-pointed Stateflow local data
- Root-level inports and outports

Options to control ASAP2 record generation for structured data are defined in `matlabroot/toolbox/rtw/targets/asap2/asap2/user/asap2setup.tlc`:

- `ASAP2EnableTestPoints` enables or disables record generation for test pointed Simulink signals, test pointed Stateflow states, and test-pointed Stateflow local data (enabled by default)
- `ASAP2EnableRootLevelIO` enables or disables record generation for root-level inports and outports (disabled by default)

For more information, see [Customize an ASAP2 File](#).

### **ASAP2 File Generation for Tunable Structure Parameters**

ASAP2 file generation has been enhanced to generate ASAP2 CHARACTERISTIC records for tunable structure parameters. This allows you to tune structure parameters with ASAP2 tools and potentially manage large parameter sets.

For more information, see [Customize an ASAP2 File](#).

## **Serial External Mode Communication Using `rtiostream` API**

In R2012a, you can create a serial transport layer for Simulink external mode communication using the `rtiostream` API. For more information, see [Create a Transport Layer for External Communication](#).

### **Improved Data Transfer in External Mode Communication**

In Simulink External mode communication, the `rt_OneStep` function runs in the foreground and the `while` loop of the main function runs in the background. See [Real-Time Single-Tasking Systems](#). Previously, with code generated for GRT and Embedded Coder bareboard ERT targets, data

transfer between host and server was performed by functions within the model step function in `rt_OneStep`. The data transfer between host and server (in the foreground) would slow down model execution, potentially impairing real-time performance.

Now, the function that is responsible for data transfer between host and server (`rtExtModeOneStep`) is inserted in the `while` loop of the main function. As the execution of the `while` loop in the main function is a background task, real-time performance potentially is enhanced.

## Changes for Desktop IDEs and Desktop Targets

- “Support Added for GCC 4.4 on Host Computers Running Linux with Eclipse IDE” on page 66
- “Limitation: Parallel Builds Not Supported for Desktop Targets” on page 66

### Support Added for GCC 4.4 on Host Computers Running Linux with Eclipse IDE

Simulink Coder software now supports GCC 4.4 on host computers running Linux with Eclipse IDE. This support is on both 32-bit and 64-bit host Linux platforms.

If you were using an earlier version of GCC on Linux with Eclipse, upgrade to GCC 4.4.

### Limitation: Parallel Builds Not Supported for Desktop Targets

The Simulink Coder product provides an API for MATLAB Distributed Computing Server™ and Parallel Computing Toolbox™ products. The API allows these products to perform parallel builds that reduce build time for referenced models. However, the API does not support parallel builds for models whose **System target file** parameter is set to `idelink_ert.tlc` or `idelink_grt.tlc`. Thus, you cannot perform parallel builds for Desktop Targets.

## Code Generation Report Enhancements

### Post-build Report Generation

In previous releases, if you did not configure your model to create a code generation report, you had to build your model again to open the code generation report. You can now generate a code generation report after the code generation process completes without building your model again. This option is available on the model diagram **Tools** menu. After building your model, select **Tools > Code Generation > Code Generation Report > Open Model Report**. You can also open a code generation report after building a subsystem. For more information on creating and opening the code generation report, see [Generate an HTML Code Generation Report](#).

### Generate Code Generation Report Programmatically

At the MATLAB command line, you can generate, open, and close an HTML Code Generation Report with the following functions:

- `coder.report.generate` generates the code generation report for the specified model.
- `coder.report.open` opens an existing code generation report.
- `coder.report.close` closes the code generation report.

### Searching in the Code Generation Report

You can now search within the code generation report using a search box in the navigation section. After entering text in the search box, the current page scrolls to the first match and highlights all of the matches on the page. To access the **Search** text box, press **Ctrl-F**.

### New Reserved Keywords for Code Generation

The Simulink Coder software includes the following reserved keywords to the Simulink Coder Code Generation keywords list. For more information, see [Reserved Keywords](#).

|                       |                  |                       |                  |
|-----------------------|------------------|-----------------------|------------------|
| ERT                   | LINK_DATA_STREAM | NUMST                 | RT_MALLOC        |
| HAVESTDIO             | MODEL            | PROFILING_ENABLED     | TID01EQ          |
| INTEGER_CODE          | MT               | PROFILING_NUM_SAMPLES | USE_RTMODEL      |
| LINK_DATA_BUFFER_SIZE | NCSTATES         | RT                    | VCAST_FLUSH_DATA |

## Improved MAT-File Logging

R2012a enhances Simulink Coder MAT-file logging to allow logging of multiple data points per time step, by reallocating buffer memory during target execution. Generated code logging results now match simulation results for blocks executing multiple times per step, such as blocks in an iterator subsystem. Previously, code generation issued a warning that the logged results for blocks executing in an iterator subsystem might not match the results from simulation.

## **rtwdemo\_f14 Being Removed in a Future Release** Compatibility Considerations: Yes

The demo model `rtwdemo_f14` will be removed in a future release of Simulink Coder software.

### Compatibility Considerations

In R2012a, you can still open `rtwdemo_f14` by entering `rtwdemo_f14` in the MATLAB Command Window. Going forward, transition to using `f14`, `sldemo_f14`, or a Simulink Coder model in the `rtwdemos` list.

## New and Enhanced Demos

The following demos have been enhanced in R2012a:

| <b>Demo...</b>            | <b>Now...</b>   |
|---------------------------|---|
| rtwdemo_asap2             | <ul style="list-style-type: none"><li>• Illustrates ASAP2 file generation for test pointed signals and states.</li><li>• Shows how to generate a single ASAP2 file from files for top and referenced models.</li><li>• Generates STD_AXIS and FIX_AXIS descriptions for lookup table breakpoints.</li></ul> |
| rtwdemo_configuration_set | Shows how to use the Code Generation Advisor and the <code>Simulink.ConfigSet</code> <code>saveAs</code> method.  |

## 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/](http://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.

### Search R2012a Bug Reports

Known Bugs for Incorrect Code Generation:

[www.mathworks.com/support/bugreports/?product=ALL&release=R2012a&keyword=Incorrect+Code+Generation](http://www.mathworks.com/support/bugreports/?product=ALL&release=R2012a&keyword=Incorrect+Code+Generation)

All Known Bugs for This Product:

[www.mathworks.com/support/bugreports/?release=R2012a&product=RT](http://www.mathworks.com/support/bugreports/?release=R2012a&product=RT)

# R2011b

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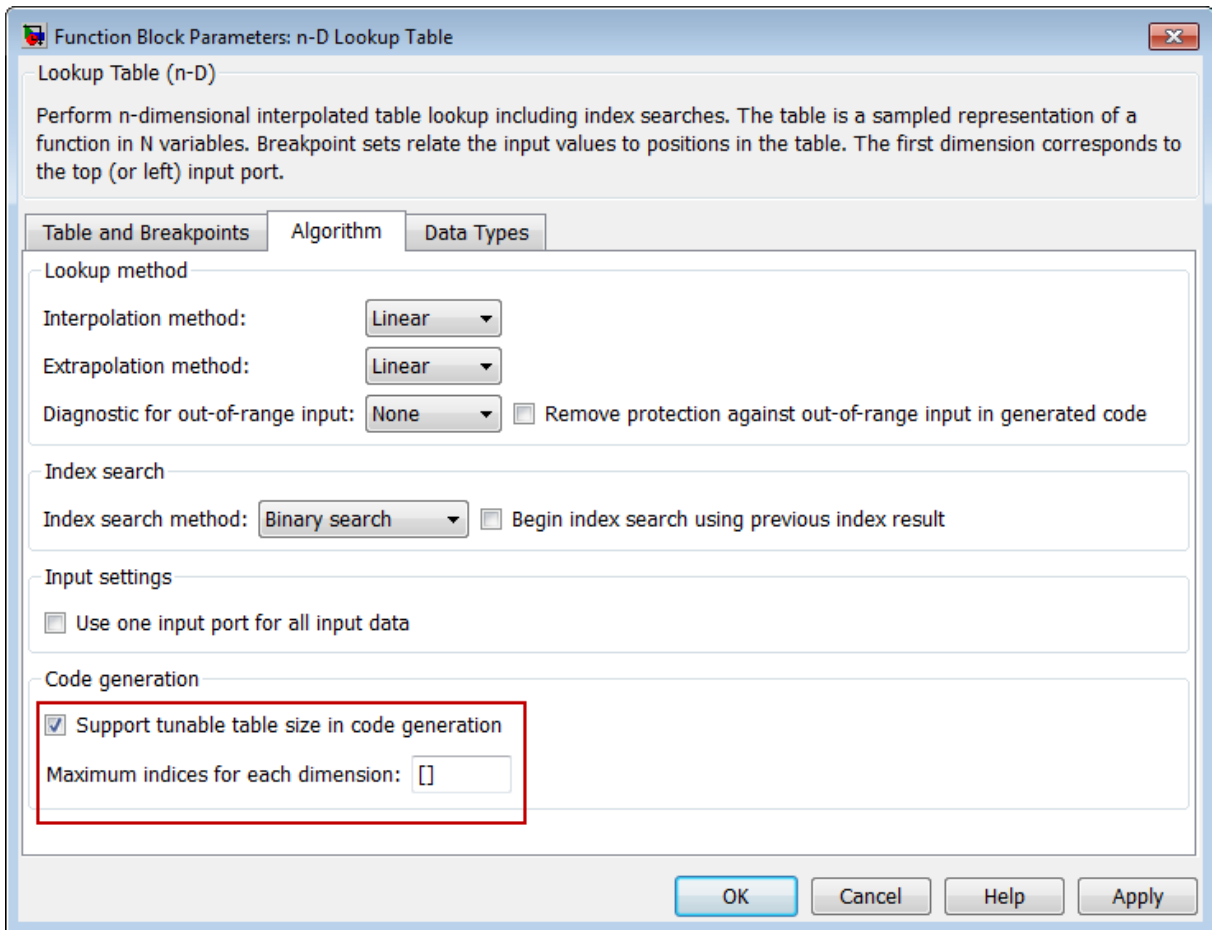
**Version: 8.1**

**New Features: Yes**

**Bug Fixes: Yes**

## n-D Lookup Table Block Supports Tunable Table Size

The n-D Lookup Table block provides new parameters for specifying a tunable table size in the generated code.



This enhancement enables you to change the size and values of your lookup table and breakpoint data without regenerating or recompiling the code.



## Complex Output Support in Generated Code for the Trigonometric Function Block

In previous releases, the imaginary part of a complex output signal was always zero in the generated code for the Trigonometric Function block. In R2011b, this limitation no longer exists. Code that you generate for a function in this block now supports complex outputs.

## Code Optimizations for the Combinatorial Logic Block

The Simulink Coder build process uses a new technique to provide more efficient code for the Combinatorial Logic block.

Benefits include:

- Reuse of variables
- Dead code elimination
- Constant folding
- Expression folding

For example, in previous releases, temporary buffers were created to carry concatenated signals for this block. In R2011b, the build process eliminates unnecessary temporary buffers and writes the concatenated signal to the downstream global buffer directly. This enhancement reduces the stack size and improves code execution speed.

## Code Optimizations for the Product Block

**Compatibility Considerations: Yes**

The Simulink Coder build process provides more efficient code for matrix inverse and division operations in the Product block. The following summary describes the benefits and when each benefit is available:

| <b>Benefit</b>                | <b>Small matrices<br/>(2-by-2 to<br/>5-by-5)</b> | <b>Medium<br/>matrices<br/>(6-by-6 to<br/>20-by-20)</b> | <b>Large matrices<br/>(larger than<br/>20-by-20)</b> |
|-------------------------------|--|---|--|
| Faster code execution time    | Yes, much faster                                 | No, slightly slower                                     | Yes, faster  |
| Reduced ROM and RAM usage     | Yes, for real values                             | Yes, for real values                                    | Yes, for real values                                 |
| Reuse of variables            | Yes  | Yes   | Yes  |
| Dead code elimination         | Yes  | Yes   | Yes  |
| Constant folding              | Yes  | Yes   | Yes  |
| Expression folding            | Yes  | Yes   | Yes  |
| Consistency with MATLAB Coder | Yes  | Yes   | Yes  |

## Compatibility Considerations

In the following cases, the generated code might regress from previous releases:

- The ROM and RAM usage increase for complex input data types.
- For blocks configured with 3 or more inputs of different dimensions, the code might include an extra buffer to store temporary variables for intermediate results.

## Enhanced MISRA C Code Generation Support for Stateflow Charts

In previous releases, the code generated to check whether or not a state in a Stateflow chart was active included a line that looked something like this:

```
if (mdl_state_check_er_DWork.is_active_c1_md1_state_c == 0)
```

In R2011b, that line has been modified to:

```
if (mdl_state_check_er_DWork.is_active_c1_mdl_state_c == 0U)
```

This enhancement supports MISRA C® 2004, rule 10.1.

## Change for Constant Sample Time Signals in Generated Code

**Compatibility Considerations: Yes**

In previous releases, constant sample time signals were initialized even if the **Data Initialization** field of their custom storage class was set to None.

In R2011b, constant sample time signals using a custom storage class for which the **Data Initialization** field is set to None will not be initialized for non-conditionally executed systems in generated code.

### Compatibility Considerations

If you use such constant time signals, you will notice that they are not initialized in the generated code in R2011b. To enable their initialization, change the setting of the **Data Initialization** field of their custom storage class from None to another value.

## New Code Generation Advisor Objective for GRT Targets

In R2011b, `Execution efficiency` is now available as a Code Generation Advisor objective for models with generic real-time (GRT) targets. You can use this objective to achieve faster code execution times for your models. For more information, see `Application Objectives`.

## Improved Integer and Fixed-Point Saturating Cast

Simulink Coder software now eliminates more dead branches in both integer and fixed-point saturation code.

## **Generate Multitasking Code for Concurrent Execution on Multicore Processors**

The Simulink Coder product extends the concurrent execution modeling capability of the Simulink product. With Simulink Coder, you can generate multitasking code that uses POSIX threads (Pthreads) or Windows threads for concurrent execution on multicore processors running Linux, Mac OS X, or Windows.

See [Configuring Models for Targets with Multicore Processors](#).

## **Changes for Desktop IDEs and Desktop Targets**

- “New Target Function Library for Intel IPP/SSE (GNU)” on page 76
- “Support Added for Single Instruction Multiple Data (SIMD) with Intel Processors” on page 76

### **New Target Function Library for Intel IPP/SSE (GNU)**

This release adds a new Target Function Library (TFL), Intel IPP/SSE (GNU), for the GCC compiler. This library includes the Intel Performance Primitives (IPP) and Streaming SIMD Extensions (SSE) code replacements.

### **Support Added for Single Instruction Multiple Data (SIMD) with Intel Processors**

This release adds support for the SIMD capabilities of the Intel® processors. The use of SIMD instructions increases throughput compared to traditional Single Instruction Single Data (SISD) processing.

The Intel IPP/SSE (GNU) TFL (code replacement library) optimizes generated code for SIMD.

The performance of the SIMD-enabled executable depends on several factors, including:

- Processor architecture of the target
- Optimized library support for the target

- The type and number of TFL replacements in the generated algorithmic code

Evaluate the performance of your application before and after using the TFL.

To use the SIMD capabilities with GCC and Intel processors, enable the Intel IPP/SSE (GNU) TFL. See Code Replacement Library (CRL).

## Reserved Keyword `UNUSED_PARAMETER`

The Simulink Coder software adds the `UNUSED_PARAMETER` macro to the reserved keywords list for code generation. To view the complete list, see Reserved Keywords. In R2011b, code generation now defines `UNUSED_PARAMETER` in `rt_defines.h`. Previously, it was defined in `model_private.h`.

## Target API for Verifying MATLAB® Distributed Computing Server™ (MDCS) Worker Configuration for Parallel Builds

R2010b added the ability to use remote workers in MDCS configurations for parallel builds of model reference hierarchies. This introduced the possibility that parallel workers might have different configurations, some of which might not be compatible with a specific Simulink Coder target build. For example, the required compiler might not be installed on a worker system.

R2011b provides a programming interface that target authors can use to automatically check the configuration of parallel workers and, if the parallel workers are not set up as required, take action, such as throwing an error or reverting to sequential builds. For more information, see Support Model Referencing in the Simulink Coder documentation.

For more information about parallel builds, see Reduce Build Time for Referenced Models in the Simulink Coder documentation.

## License Names Not Yet Updated for Coder Product Restructuring

The Simulink Coder and Embedded Coder license name strings stored in `license.dat` and returned by the `license ('inuse')` function have not yet been updated for the R2011a coder product restructuring. Specifically, the `license ('inuse')` function continues to return `'real-time_workshop'` for Simulink Coder and `'rtw_embedded_coder'` for Embedded Coder, as shown below:

```
>> license('inuse')
matlab
matlab_coder
real-time_workshop
rtw_embedded_coder
simulink
>>
```

The license name strings intentionally were not changed, in order to avoid license management complications in situations where Release 2011a or higher is used alongside a preR2011a release in a common operating environment. MathWorks plans to address this issue in a future release.

For more information about using the function, see the `license` documentation.

## New and Enhanced Demos

The following demos have been enhanced in R2011b:

| Demo...                             | Now...  |
|-------------------------------------|---|
| <code>rtwdemo_pmsmfoc_script</code> | Shows how you can perform system-level simulation and algorithmic code generation using Field-Oriented Control for a Permanent Magnet Synchronous Machine |

## 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/](http://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.

### Search R2011b Bug Reports

Known Bugs for Incorrect Code Generation:

[www.mathworks.com/support/bugreports/?product=ALL&release=R2011b&keyword=Incorrect+Code+Generation](http://www.mathworks.com/support/bugreports/?product=ALL&release=R2011b&keyword=Incorrect+Code+Generation)

All Known Bugs for This Product:

[www.mathworks.com/support/bugreports/?release=R2011b&product=RT](http://www.mathworks.com/support/bugreports/?release=R2011b&product=RT)





# R2011a

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**Version: 8.0**

**New Features: Yes**

**Bug Fixes: Yes**

## Coder Product Restructuring

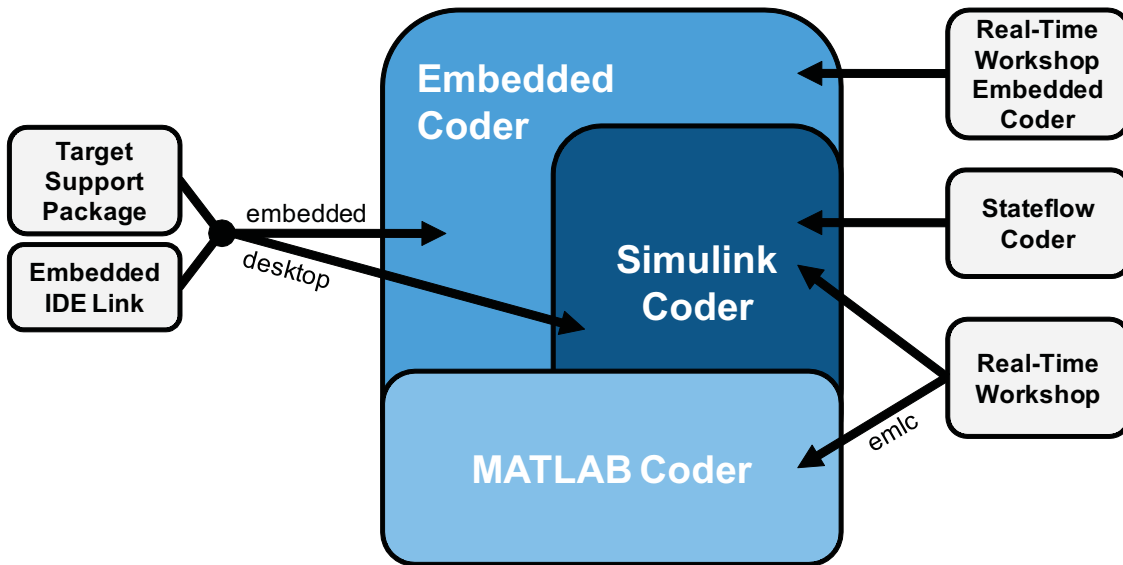
- “Product Restructuring Overview” on page 82
- “Resources for Upgrading from Real-Time Workshop or Stateflow® Coder™” on page 83
- “Migration of Embedded MATLAB Coder Features to MATLAB® Coder™” on page 84
- “Migration of Embedded IDE Link and Target Support Package Features to Simulink® Coder™ and Embedded Coder” on page 84
- “User Interface Changes Related to Product Restructuring” on page 85
- “Simulink Graphical User Interface Changes” on page 86

## Product Restructuring Overview

In R2011a, the Simulink Coder product combines and replaces the Real-Time Workshop® and Stateflow Coder products. Additionally,

- The Real-Time Workshop facility for converting MATLAB code to C/C++ code, formerly referred to as Embedded MATLAB® Coder, has migrated to the new MATLAB Coder product.
- The previously existing products Embedded IDE Link™ and Target Support Package™ have been integrated into the new Simulink Coder and Embedded Coder products.

The following figure shows the R2011a transitions for C/C++ code generation related products, from the R2010b products to the new MATLAB Coder, Simulink Coder, and Embedded Coder products.



The following sections address topics related to the product restructuring.

### Resources for Upgrading from Real-Time Workshop or Stateflow Coder

If you are upgrading to Simulink Coder from Real-Time Workshop or Stateflow Coder, review information about compatibility and upgrade issues at the following locations:

- *Release Notes for Simulink Coder* (latest release), “Compatibility Summary” section
- In the Archived documentation on the MathWorks web site, select R2010b, and view the following tables, which are provided in the release notes for Real-Time Workshop and Stateflow Coder:
  - *Compatibility Summary for Real-Time Workshop Software*
  - *Compatibility Summary for Stateflow and Stateflow Coder Software*

These tables provide compatibility information for releases up through R2010b.

- If you use the Embedded IDE Link or Target Support Package capabilities that now are integrated into Simulink Coder and Embedded Coder, go to the Archived documentation, select R2010b, and view the corresponding tables for each product:
  - *Compatibility Summary for Embedded IDE Link*
  - *Compatibility Summary for Target Support Package*

You can also refer to the rest of the archived documentation, including release notes, for the Real-Time Workshop, Stateflow Coder, Embedded IDE Link, and Target Support Package products.

### **Migration of Embedded MATLAB Coder Features to MATLAB Coder**

In R2011a, the MATLAB Coder function `codegen` replaces the Real-Time Workshop function `emlc`. The `emlc` function still works in R2011a but generates a warning, and will be removed in a future release. For more information, see *Migrating from Real-Time Workshop emlc Function in the MATLAB Coder release notes*.

### **Migration of Embedded IDE Link and Target Support Package Features to Simulink Coder and Embedded Coder**

In R2011a, the capabilities formerly provided by the Embedded IDE Link and Target Support Package products have been integrated into Simulink Coder and Embedded Coder. The follow table summarizes the transition of the Embedded IDE Link and Target Support Package hardware and software support into coder products.

| Former Product         | Supported Hardware and Software          | Simulink Coder | Embedded Coder |
|------------------------|--|----------------|----------------|
| Embedded IDE Link      | Altium® TASKING                          |                | x              |
|                        | Analog Devices™ VisualDSP++®             |                | x              |
|                        | Eclipse IDE                              | x              | x              |
|                        | Green Hills® MULTI®                      |                | x              |
|                        | Texas Instruments™ Code Composer Studio™ |                | x              |
| Target Support Package | Analog Devices Blackfin®                 |                | x              |
|                        | ARM®                                     |                | x              |
|                        | Freescale™ MPC5xx                        |                | x              |
|                        | Infineon® C166®                          |                | x              |
|                        | Texas Instruments C2000™                 |                | x              |
|                        | Texas Instruments C5000™                 |                | x              |
|                        | Texas Instruments C6000™                 |                | x              |
|                        | Linux OS                                 | x              | x              |
|                        | Windows OS                               | x              |                |
|                        | VxWorks RTOS                             |                | x              |

### User Interface Changes Related to Product Restructuring

Some user interface changes were made as part of merging the Real-Time Workshop and Stateflow Coder products into Simulink Coder. They include:

- Changes to code generation related elements in the Simulink Configuration Parameters dialog box

- Changes to code generation related elements in Simulink menus
- Changes to code generation related elements in Simulink blocks, including block parameters and dialog boxes, and block libraries
- References to Real-Time Workshop and Stateflow Coder and related terms in error messages, tool tips, demos, and product documentation replaced with references to the latest software

### Simulink Graphical User Interface Changes

| Where...                            | Previously...  | Now...   |
|-------------------------------------|--|--|
| Configuration Parameters dialog box | <b>Real-Time Workshop</b> pane   | <b>Code Generation</b> pane  |
| Model diagram window                | <b>Tools &gt; Real-Time Workshop</b>   | <b>Tools &gt; Code Generation</b>  |
| Subsystem context menu              | <b>Real-Time Workshop</b>  | <b>Code Generation</b>   |
| Subsystem Parameters dialog box     | Following parameters on main pane: <ul style="list-style-type: none"> <li>• <b>Real-Time Workshop system code</b></li> <li>• <b>Real-Time Workshop function name options</b></li> <li>• <b>Real-Time Workshop function name</b></li> <li>• <b>Real-Time Workshop file name options</b></li> <li>• <b>Real-Time Workshop</b></li> </ul> | On new <b>Code Generation</b> pane and renamed: <ul style="list-style-type: none"> <li>• <b>Function packaging</b></li> <li>• <b>Function name options</b></li> <li>• <b>Function name</b></li> <li>• <b>File name options</b></li> <li>• <b>File name (no extension)</b></li> </ul> |

| Where... | Previously...            | Now... |
|----------|--------------------------|--------|
|          | file name (no extension) |        |

## Changes for Desktop IDEs and Desktop Targets

- “Feature Support for Desktop IDEs and Desktop Targets” on page 87
- “Location of Blocks for Desktop Targets” on page 87
- “Location of Demos for Desktop IDEs and Desktop Targets” on page 88
- “Multicore Deployment with Rate Based Multithreading” on page 89

### Feature Support for Desktop IDEs and Desktop Targets

The Simulink Coder software provides the following features as implemented in the former Target Support Package and Embedded IDE Link products:

- Automation Interface
- External Mode
- Multicore Deployment with Rate Based Multithreading
- Makefile Generation (XMakefile)

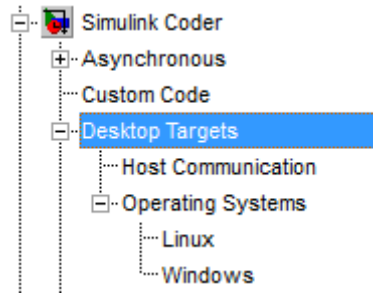
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**Note** You can only use these features in the 32-bit version of your MathWorks products. To use these features on 64-bit hardware, install and run the 32-bit versions of your MathWorks products.

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### Location of Blocks for Desktop Targets

Blocks from the former Target Support Package product and Embedded IDE Link product are now located in Simulink Coder under Desktop Targets.



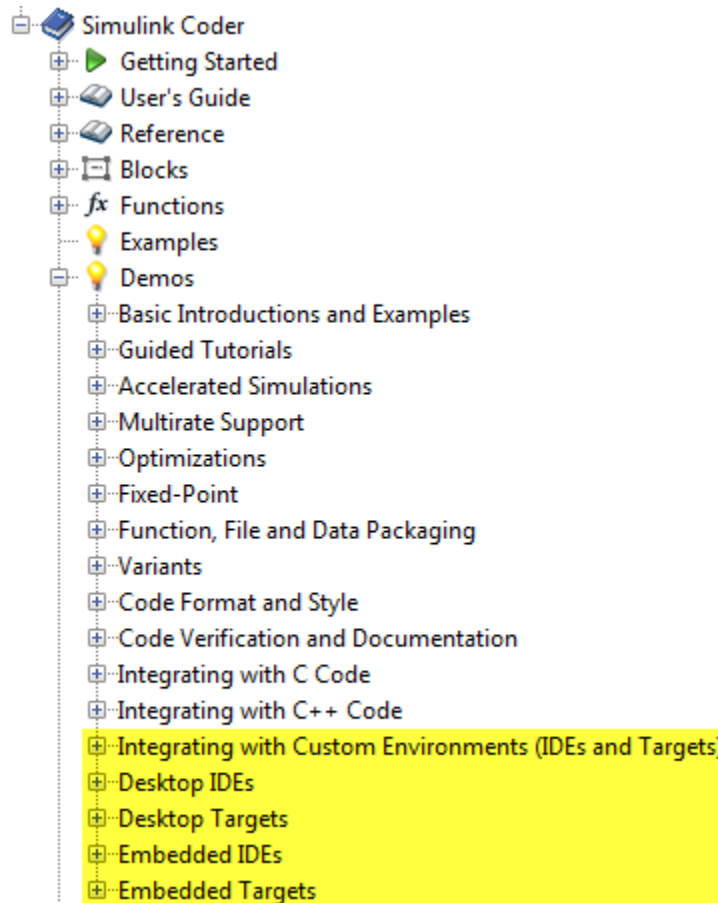
Desktop Targets includes the following types of blocks:

- Host Communication
- Operating Systems
  - Linux
  - Windows

### **Location of Demos for Desktop IDEs and Desktop Targets**

Demos from the former Target Support Package product and Embedded IDE Link product now reside under Simulink Coder product help. Click the expandable links, as shown.





## Multicore Deployment with Rate Based Multithreading

You can deploy rate-based multithreading applications to multicore processors running Windows and Linux. This feature potentially improves performance by taking advantage of multicore hardware resources.

Also see the Running Target Applications on Multicore Processors user's guide topic.

## Code Optimizations for Discrete State-Space Block, Product Block, and MinMax Block

The Simulink Coder build process uses a new technique to provide more efficient code for the following blocks:

- Discrete State-Space
- Product (element-wise matrix operations)

Benefits include:

- Reuse of variables
- Dead code elimination
- Constant folding
- Expression folding

For example, in previous releases, temporary buffers were created to carry concatenated signals for these blocks. In R2011a, the build process eliminates unnecessary temporary buffers and writes the concatenated signal to the downstream global buffer directly. This enhancement reduces the stack size and improves code execution speed.

The build process also provides more efficient code for the MinMax block. In R2011a, expression folding is enhanced with several local optimizations that enable more aggressive folding. This enhancement improves code efficiency for foldable matrix operations.

## Ability to Share User-Defined Data Types Across Models

In previous releases, user-defined data types that were shared among multiple models generated duplicate type definitions in the `model_types.h` file for each model. R2011a provides the ability to generate user-defined data type definitions into a header file that can be shared across multiple models, removing the need for duplicate copies of the data type definitions. User-defined data types that you can set up in a shared header file include:

- Simulink data type objects that you instantiate from the classes `Simulink.AliasType`, `Simulink.Bus`, `Simulink.NumericType`, and `Simulink.StructType`
- Enumeration types that you define in MATLAB code

For more information, see [Share User-Defined Data Types Across Models in the Simulink Coder documentation](#).

## C API Provides Access to Root-Level Inputs and Outputs

The C API now provides programmatic access to root-level inputs and outputs. This allows you to log and monitor the root-level inputs and outputs of a model while you run the code generated for the model. To generate C API code for accessing root-level inputs and outputs at run time, select the model option **Generate C API for: root-level I/O**.

Macros for accessing C API generated structures are located in `matlabroot/rtw/c/src/rtw_capi.h` and `matlabroot/rtw/c/src/rtw_modelmap.h`, where `matlabroot` represents your MATLAB installation root.

For more information, see [Generate C API for: root-level I/O and Data Interchange Using the C API in the Simulink Coder documentation](#).

## ASAP2 File Generation Supports Standard Axis Format for Lookup Tables

In previous releases, ASAP2 file generation for lookup table blocks supported the Fix Axis and Common Axis formats, but not the Standard Axis format, a format in which axis points are global in code but not shared among tables. R2011a adds support for Standard Axis format.

For more information, see [Define ASAP2 Information for Lookup Tables in the Simulink Coder documentation](#).

## **ASAP2 File Generation Enhancements for Computation Methods**

### **Custom Names for Computation Methods**

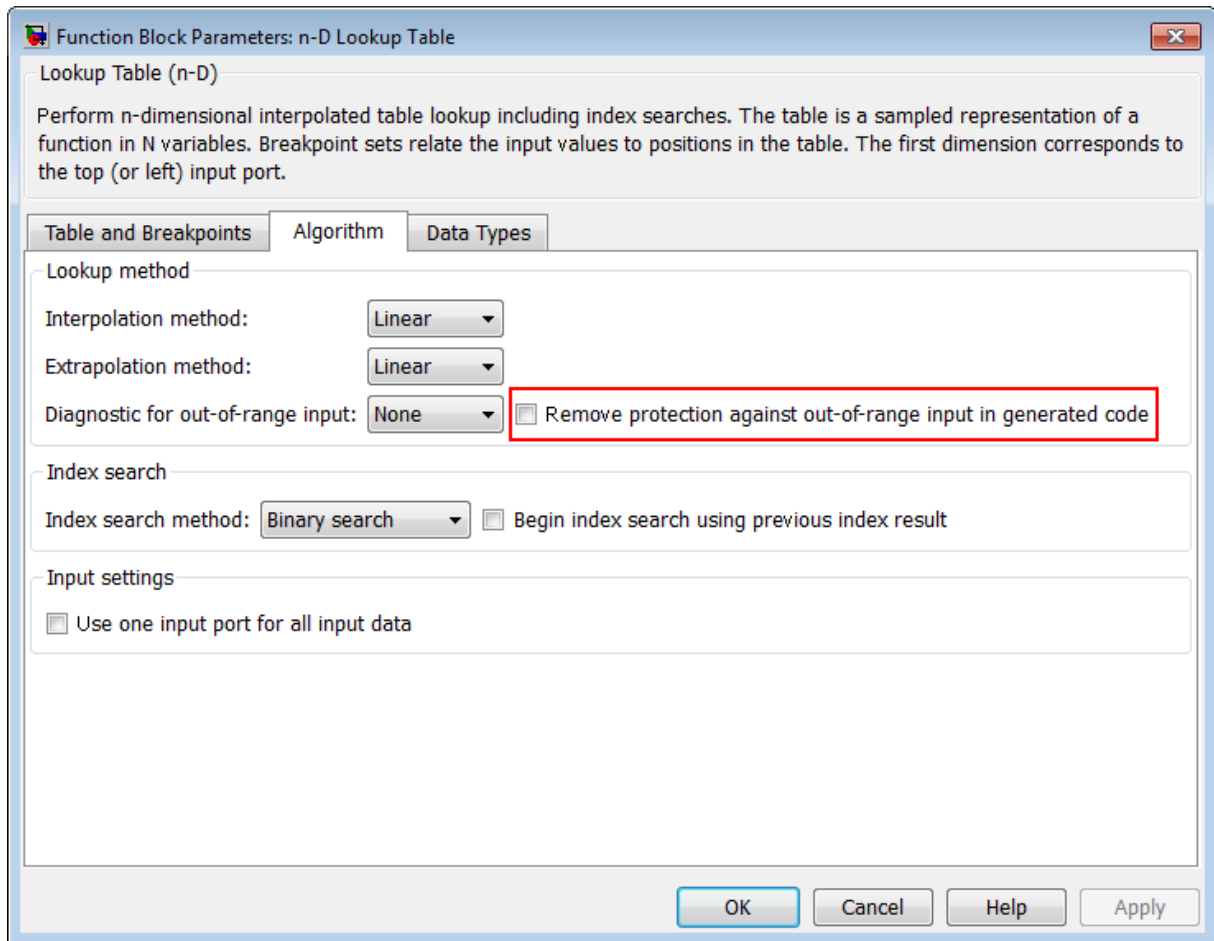
In generated ASAP2 files, computation methods translate the electronic control unit (ECU) internal representation of measurement and calibration quantities into a physical model oriented representation. R2011a adds the MATLAB function `getCompuMethodName`, which you can use to customize the names of computation methods. You can provide names that are more intuitive, enhancing ASAP2 file readability, or names that meet organizational requirements. For more information, see *Customize Computation Method Names* in the Simulink Coder documentation.

### **Ability to Suppress Computation Methods for FIX\_AXIS When Not Required**

Versions 1.51 and later of the ASAP2 specification state that for certain cases of lookup table axis descriptions (integer data type and no doc units), a computation method is not required and the Conversion Method parameter must be set to the value `NO_COMPU_METHOD`. Beginning in R2011a, you can control whether or not computation methods are suppressed when not required, using the Target Language Compiler (TLC) option `ASAP2GenNoCompuMethod`. For more information, see *Suppress Computation Methods for FIX\_AXIS* in the Simulink Coder documentation.

### **Lookup Table Block Option to Remove Input Range Checks in Generated Code**

When the breakpoint input to a Prelookup, 1-D Lookup Table, 2-D Lookup Table, or n-D Lookup Table block always falls within the range of valid breakpoint values, you can disable range checking in the generated code. By selecting **Remove protection against out-of-range input in generated code** on the block dialog box, your code can be more efficient.



## Reentrant Code Generation for Stateflow Charts That Use Events

When you generate code for Stateflow charts that use events, the code does not use a global variable to keep track of the currently active event. Elimination of this global variable enables the code to be reentrant, which allows you to:

- Deploy your code in multithreading environments

- Share the same algorithm with different persistent data
- Compile code that uses function variables that are too large to fit on the stack

In previous releases, reentrant code generation was not possible for charts that used events.

## **Redundant Check Code Removed for Stateflow Charts That Use Temporal Operators**

When you generate code for Stateflow charts that use temporal operators, the code excludes redundant checks for `tick` events and input events that are always true. This enhancement enables the code to be more efficient and applies to temporal operators `after`, `before`, `at`, `every`, and `temporalCount`.

In previous releases, the code generated for a temporal logic expression such as `after(x,tick)` would check for two conditions:

```
(event == tick) && (counter > x)
```

In R2011a, the code generated for `after(x,tick)` checks only for when the temporal counter exceeds `x`:

```
(counter > x)
```

This enhancement does not apply when a chart with multiple input events has super-step semantics enabled.

## **Support for Multiple Asynchronous Function Calls Into a Model Block**

Simulink and Simulink Coder software now support multiple asynchronous function calls into a Model block. This capability relies in part on the new Asynchronous Task Specification block.

The Asynchronous Task Specification block, in combination with a root-level Inport block, allows you to specify an asynchronous function-call input to a Model block. After placing this block at the output port of each root-level

Inport block that outputs a function-call signal, select **Output function call** on the **Signal Attributes** pane of the Inport block. The Inport block then accepts function-call signals. You can use Asynchronous Task Specification blocks to specify parameters for the asynchronous task associated with the respective Inport blocks.

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**Note** Use the new function call API, `LibBlockExecuteFcnCall`, to make function calls from an asynchronous source block to reference model destination blocks.

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**Note** The demo model `rtwdemo_async_md1reftop` shows how you can simulate and generate code for asynchronous events on a real-time multitasking system, using asynchronous function calls as Model block inputs.

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## Changes to ver Function Product Arguments

**Compatibility Considerations: Yes**

The following changes have been made to ver function arguments related to code generation products:

- The new argument `'simulinkcoder'` returns information about the installed version of the Simulink Coder product.
- The argument `'rtw'` works but now returns information about Simulink Coder instead of Real-Time Workshop. The software also displays the following message:

```
Warning: Support for ver('rtw') will be removed in a future release.  
Use ver('simulinkcoder') instead.
```

- The argument `'coder'`, which previously returned information about the installed version of the Stateflow Coder product, no longer works. The software displays a “not found” warning.

For more information about using the function, see the ver documentation.

## Compatibility Considerations

If a script calls the `ver` function with the `'rtw'` argument or the `'coder'` argument, update the script appropriately. For example, you can update the `ver` call to use the `'simulinkcoder'` argument, or remove the `ver` call.

## Updates to Target Language Compiler (TLC) Semantics and Diagnostic Information

Updates to TLC simplifies semantics and produces diagnostic information when using the scope resolution operator (`::`) and built-in function `EXISTS(::)`.

- If `var` can not be resolved in global scope, `::var` errors out
- If `var` can only be resolved in local scope, `EXISTS(::var)` returns false
- Diagnostic information highlights problematic TLC coding

For more information, see [Introducing the Target Language Compiler](#).

## Change to Terminate Function for a Target Language Compiler (TLC) Block Implementation

Previously, the code generator attempted to execute the `Terminate` function from the TLC implementation of a block, even if the function did not exist. Now, the code generator only attempts to execute a `Terminate` function if it is defined in the TLC implementation of a block. In the case where the TLC implementation of a block includes a secondary TLC file, which includes a `Terminate` function, that `Terminate` function no longer executes.

## New and Enhanced Demos

The following demos have been added in R2011a:



| <b>Demo...</b>         | <b>Shows How You Can...</b>   |
|------------------------|---|
| rtwdemo_async_mdleftop | Simulate and generate code for asynchronous events on a real-time multitasking system, using asynchronous function calls as Model block inputs. |

The following demos have been enhanced in R2011a:

| <b>Demo...</b>  | <b>Now...</b>  |
|---|--|
| vipstabilize_fixpt_beagleboard<br>videostabilization_host_temp1 | Use the new Video Capture block to simulate or capture a video input signal in the Video Stabilization demo. |

## Check bug reports for issues and fixes

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All Known Bugs for This Product:

[www.mathworks.com/support/bugreports/?release=R2011a&product=RT](http://www.mathworks.com/support/bugreports/?release=R2011a&product=RT)