

Embedded Coder™ Release Notes

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Embedded Coder™ Release Notes

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Bug Reports

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 <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.

Summary by Version

This table provides quick access to what is new in each version. For clarification, see “Using Release Notes” on page 2.

Version (Release)	New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems
Latest Version V6.1 (R2011b)	Yes Details	Yes Summary	Bug Reports Includes fixes
V6.0 (R2011a)	Yes Details	Yes Summary	Bug Reports Includes fixes

Using Release Notes

Use release notes when upgrading to a newer version to learn about:

- New features
- Changes
- Potential impact on your existing files and practices

Review the release notes for other MathWorks® products required for this product (for example, MATLAB® or Simulink®). Determine if enhancements, bugs, or compatibility considerations in other products impact you.

If you are upgrading from a software version other than the most recent one, review the current release notes and all interim versions. For example, when you upgrade from V1.0 to V1.2, review the release notes for V1.1 and V1.2.

What Is in the Release Notes

New Features and Changes

- New functionality
- Changes to existing functionality

Version Compatibility Considerations

When a new feature or change introduces a reported incompatibility between versions, the **Compatibility Considerations** subsection explains the impact.

Compatibility issues reported after the product release appear under Bug Reports at the MathWorks Web site. Bug fixes can sometimes result in incompatibilities, so review the fixed bugs in Bug Reports for any compatibility impact.

Fixed Bugs and Known Problems

MathWorks offers a user-searchable Bug Reports database so you can view Bug Reports. The development team updates this database at release time and as more information becomes available. Bug Reports include provisions for any known workarounds or file replacements. Information is available for bugs existing in or fixed in Release 14SP2 or later. Information is not available for all bugs in earlier releases.

Access Bug Reports using your MathWorks Account.

Documentation on the MathWorks Web Site

Related documentation is available on mathworks.com for the latest release and for previous releases:

- Latest product documentation
- Archived documentation

Version 6.1 (R2011b) Embedded Coder Software

This table summarizes what is new in Version 6.1 (R2011b):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems
Yes Details below	Yes—Details labeled as Compatibility Considerations , below. See also Summary	Bug Reports Includes fixes

New features and changes introduced in this version are:

- “Static Code Metrics in Code Generation Report” on page 5
- “AUTOSAR Enhancements” on page 5
- “SIL and PIL Enhancements” on page 6
- “Generate Multitasking Code for Concurrent Execution on Multicore Processors” on page 8
- “Changes for Embedded IDEs and Embedded Targets” on page 8
- “Saturation Control of Stateflow Data” on page 11
- “Custom Storage Class Properties for Managing Data Ownership and Definition” on page 12
- “Export Data Declarations to Shared Header File for Code Generation with Model Reference” on page 13
- “Target Function Library Code Replacement Enhancements” on page 13
- “Code Generation Enhancements” on page 15
- “Enhanced Code Generation Optimization Using Minimum and Maximum Values” on page 17
- “New Model Advisor Check for Code Efficiency of Logic Blocks” on page 17
- “Control of Default Case Generation for Switch Statements in Generated Code for Stateflow Charts” on page 18
- “Improvement to Build Process for Conflicting Identifiers” on page 19

- “Update to Code Generation Verification Class `cgv.Config`” on page 20
- “License Names Not Yet Updated for Coder Product Restructuring” on page 20
- “New and Enhanced Demos” on page 21

Static Code Metrics in Code Generation Report

The HTML code generation report now includes a static code metrics report. The static code metrics include: number of source code files, number of lines of code, list of global variables, functions in a call tree format, and the estimated stack size required for a function.

To generate the static code metrics report, on the **Code Generation > Report** pane of the Configuration Parameters dialog box, select the **Static code metrics** parameter and build your model. For more information, see “Analyze Static Code Metrics of the Generated Code”.

AUTOSAR Enhancements

Import and Export of AUTOSAR Sensor/Actuator Components

Embedded Coder™ now supports Sensor/Actuator Software Components. The key difference between a sensor/actuator component and an application component is that a sensor/actuator component can access the I/O hardware abstraction part within the ECU abstraction layer.

This support allows you to import sensor/actuator components, implement and test designs within Simulink, and export sensor/actuator components. For more information, see “Using the Configure AUTOSAR Interface Dialog Box”.

Improved Simulink Library Support for Multiple Runnables

Previously, Embedded Coder did not support the creation of multiple runnables from subsystems with links to Simulink library blocks. For example, you had to disable and break links to library blocks in order to configure and validate the subsystems as AUTOSAR runnables.

Now, the software supports the creation of multiple runnables when:

- The wrapper subsystem (containing function-call subsystems) is a link to a library block
- The function-call subsystems (within the wrapper subsystem) are links to library blocks

For more information, see “Configuring Multiple Runnables” in the Embedded Coder documentation.

AUTOSAR Schema Version 3.2

The software now supports AUTOSAR schema version 3.2 (3.2.1). See “Selecting an AUTOSAR Schema”.

Export AUTOSAR XML as Single File

When you export an AUTOSAR Software Component, you can generate XML as either a set of files (default) or a single file. The latter option is new. For more information, see “Using the Configure AUTOSAR Interface Dialog Box”.

SIL and PIL Enhancements

R2011b supports the following enhancements for software-in-the loop (SIL) and processor-in-the-loop (PIL) simulations.

Code Execution Profiling of Functions in Subsystems and Model Blocks

Previously, you could generate a profile of code execution times only for tasks within your generated code (for example, the step function for a sample rate). Now, you can also produce a profile of code execution times for functions generated from atomic subsystems and model reference hierarchies within the top model. The software places instrumentation probes inside these functions and calculates execution times during a SIL or PIL simulation. At the end of the simulation, you can view an HTML report and analyze execution times within the MATLAB environment:

- The HTML report provides a summary of maximum and average execution times, which allows you to identify code that requires optimization
- The supplied APIs allow you to carry out further analysis of time measurements.

For more information, see “Code Execution Profiling” in the Embedded Coder documentation.

Code Coverage with LDRA Testbed

You can measure code coverage using the LDRA Testbed® from LDRA Software Technology. For more information, see “Code Coverage”.

BitField and GetSet Custom Storage Classes

The software previously did not support the `BitField` and `GetSet` custom storage classes. Now, the software supports these custom storage classes for all types of SIL and PIL simulations, with one limitation. `GetSet` behavior for the SIL block is different from top-model SIL/PIL, Model block SIL/PIL, and PIL block:

- SIL block — The C definitions of the `Get` and `Set` functions that you provide form part of the algorithm under test.
- Other types of SIL/PIL — The SIL/PIL test harness automatically provides C definitions of the `Get` and `Set` functions that are used during SIL/PIL simulations. In addition, the software supports only *scalar* signals, parameters and global data stores.

For more information, see “I/O Support” and “GetSet Custom Storage Class”.

Model Blocks with Variable-Size Signals

You can run Model block SIL and PIL simulations where the Model block contains variable-size signals. On the **Simulation > Configuration Parameters > Model Referencing** pane, in the **Propagate sizes of variable-size signals** field, you must specify `During execution`. See “I/O Support”.

Verification of Generated C++ Code

Previously, support for C++ was restricted to simulations with the SIL block. Now, you can verify generated C++ code using all types of SIL and PIL:

- Top-model
- Model block

- SIL or PIL block

As before, only the SIL block supports C++ encapsulation. See “Configuration Parameters Support”.

Generate Multitasking Code for Concurrent Execution on Multicore Processors

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

See “Configuring Models for Targets with Multicore Processors”.

Changes for Embedded IDEs and Embedded Targets

- “64-bit Version of Embedded Coder Supports Analog Devices™ VisualDSP++ and Texas Instruments’ Code Composer Studio 3.3 and 4.0” on page 9
- “Support Added for Wind River VxWorks 6.8” on page 9
- “Support Added for Serial Communications Interface with Processor-in-the-loop (PIL) for Texas Instruments™ C28035 and C28335” on page 9
- “New Target Function Library for Intel IPP/SSE (GNU)” on page 10
- “Support Added for Single Instruction Multiple Data (SIMD) with ARM Cortex-A8, ARM Cortex-A9 , and Intel Processors” on page 10
- “Support Removed for Altium TASKING” on page 11
- “Support Removed for Infineon® C166” on page 11
- “Support Ending for Green Hills® MULTI in a Future Release” on page 11
- “Support Ending for Freescale MPC5xx in a Future Release” on page 11

64-bit Version of Embedded Coder Supports Analog Devices VisualDSP++ and Texas Instruments' Code Composer Studio 3.3 and 4.0

Installing MATLAB & Simulink on a 64-bit Windows® computer automatically installs the 64-bit versions of your MathWorks products, including Embedded Coder software. Now, you can use the 64-bit version of Embedded Coder software with the following 32-bit IDEs/tool chains:

- Texas Instruments' Code Composer Studio™ 3.3
- Texas Instruments' Code Composer Studio 4.0
- Analog Devices™ VisualDSP++® 5.0 (update 8)

Previously, you had to install the 32-bit versions of your MathWorks products to use Embedded Coder software with these IDEs.

For more information, see [Embedded Coder — Support for Texas Instruments](#) and [Embedded Coder — Support for Analog Devices](#).

Also, check the [Texas Instruments™](#) and [Analog Devices™](#) Web sites for support information about using their tools on 64-bit Windows platforms.

Support Added for Wind River VxWorks 6.8

You can automatically generate and integrate code with the Wind River® VxWorks 6.8 RTOS using makefiles via the XMakefiles feature. For more information, see “[Choosing an XMakefile Configuration](#)” and “[Working with Wind River VxWorks RTOS](#)”.

Support Added for Serial Communications Interface with Processor-in-the-loop (PIL) for Texas Instruments™ C28035 and C28335

This release adds support for Serial Communication Interface (SCI) communications during processor-in-the-loop (PIL) simulations with Texas Instruments™ C28035 and C28335 microcontrollers. Using SCI for PIL simulations is much faster than using an IDE debugger for PIL.

For more information, see “Serial Communication Interface (SCI) for Texas Instruments C28035 and C28335”, “Example — Performing a Model Block PIL Simulation via SCI Using Makefiles”, and the `fuelsys_pil` demo.

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.

For more information, see “Target Function Library (TFL) and Embedded TargetsDesktop Targets”.

Support Added for Single Instruction Multiple Data (SIMD) with ARM Cortex-A8, ARM Cortex-A9 , and Intel Processors

This release adds support for the Single Instruction Multiple Data (SIMD) capabilities of the ARM® Cortex-A8, ARM Cortex-A9 , and Intel® processors. The use of SIMD instructions increases throughput compared to traditional Single Instruction Single Data (SISD) processing.

The following TFLs (code replacement libraries) optimize generated code for SIMD:

- GCC ARM Cortex-A8 — The GCC compiler and the ARM Cortex-A8 embedded processor
- GCC ARM Cortex-A9 — The GCC compiler and the ARM Cortex-A9 embedded processor
- Intel IPP/SSE (GNU) — The GCC compiler and the Intel Performance Primitives (IPP) and Streaming SIMD Extensions (SSE)

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 SIMD capabilities, enable the corresponding TFLs as described in “Target Function Library (TFL) and Embedded TargetsDesktop Targets”.

Support Removed for Altium TASKING

Support for the Altium® TASKING IDE has been removed from the Embedded Coder product.

Support Removed for Infineon C166

Support for the Infineon® C166® processor family has been removed from the Embedded Coder product.

Support Ending for Green Hills MULTI in a Future Release

Support for the Green Hills® MULTI® IDE will end in a future release of the Embedded Coder product.

Support Ending for Freescale MPC5xx in a Future Release

Support for the Freescale™ MPC5xx processor family will end in a future release of the Embedded Coder product.

Saturation Control of Stateflow Data

A new property for Stateflow® charts, **Saturate on integer overflow**, enables you to control the behavior of data with signed integer types when overflow occurs. This check box appears in the Chart properties dialog box.

Check Box	When to Use This Setting	Overflow Handling	Example of a Result
Selected	Overflow is possible for data in your Stateflow chart and you want explicit saturation protection in the generated code.	Overflows saturate to either the minimum or maximum value that the data type can represent.	An overflow associated with a signed 8-bit integer saturates to -128 or $+127$.
Cleared	You want to optimize efficiency of the generated code.	The behavior depends on the C compiler you use for generating code.	The number 130 does not fit in a signed 8-bit integer and wraps to -126 .

Arithmetic operations in the chart for which you can enable saturation protection are:

- Unary minus: $-a$
- Binary operations: $a + b$, $a - b$, $a * b$, a / b , $a ^ b$
- Assignment operations: $a += b$, $a -= b$, $a *= b$, $a /= b$

For new charts, this check box is selected by default. When you open charts saved in previous releases, the check box is cleared to maintain backward compatibility.

For more information, see “Handling Integer Overflow for Chart Data” in the *Stateflow User’s Guide*.

Custom Storage Class Properties for Managing Data Ownership and Definition

In R2011b, use the **Owner** and **Definition File** properties of custom storage classes to manage the definition and ownership of mpt data objects in generated code.

Previously, you could include the data definitions in generated code but could not specify the model that defined the data. Now, Embedded Coder creates the data definitions in the generated code according to the **Owner** property.

The **Owner** property of a custom storage class specifies the model that owns and defines the data in the generated code. The **Definition File** property specifies a name for the data definition file that Embedded Coder generates.

Compatibility Considerations:

- If your legacy code exports data definitions to generated code and you now specify the **Owner** property, your generated code might have duplicate data definitions. This duplication causes a link error. In this case, remove the data definitions from the legacy code.
- If your legacy code does not export data definitions to generated code and you now specify the **Owner** property, your generated code might not contain data definitions. This mismatch causes a link error. In this case, add the missing data definitions to your legacy code.

Export Data Declarations to Shared Header File for Code Generation with Model Reference

When generating code with model reference, you can export shared data declarations to a specific header file in a shared directory.

Specify a data declaration header file in the following ways:

- For a data object: In the **Code generation** options section of the data object dialog
- For a model: In the **Code Generation > Code Placement** section of the **Configuration Parameters** dialog

Specify the option to use a **Shared location** in the field **Shared code placement** in **Code Generation > Interface** section of the **Configuration Parameters** dialog.

Target Function Library Code Replacement Enhancements

R2011b provides the following enhancements to code replacement using target function libraries (TFLs).

Code Replacement Tool for Creating and Managing TFL Tables

R2011b provides the Code Replacement Tool, which helps you create and manage the code replacement tables that make up a TFL. You can:

- Create a new code replacement table or import existing tables.
- Add, modify, and delete table entries. Each table entry represents a potential code replacement for a single function or operator. You can manage multiple tables together and copy and paste entries between tables.
- Validate correctness of tables and table entries.
- Save code replacement tables as MATLAB files.
- Generate the customization file needed to register your code replacement tables with code generation software.

Each code replacement table contains one or more table entries. Each table entry represents a potential replacement, during code generation, of a single function or operator by a custom implementation. For each table entry, you provide:

- **Mapping Information**, which relates a conceptual view of the function or operator (similar to the Simulink block view of the function or operator) to a custom implementation of that function or operator.
- **Build Information**, which provides any header, source, or link information required for building the custom implementation.

You can open the Code Replacement Tool in the following ways:

- Go to the **Interface** pane of the Configuration Parameters dialog box and click the **Custom** button, which is located to the right of the **Target function library** parameter.
- Use the MATLAB command `crtool`.

For more information about creating code replacement tables for TFLs, see “Creating and Managing Code Replacement Tables Using the Code Replacement Tool”.

Ability to Align Data Objects to TFL-Specified Boundaries to Boost Code Performance

R2011b provides the ability to align data objects passed into a TFL replacement function to a specified boundary. This allows you to take advantage of target-specific function implementations that require data to be aligned in order to optimize application performance. To configure data alignment for a function implementation:

- 1 Specify the data alignment requirements in a TFL table entry. Alignment can be specified separately for each implementation function argument or collectively for all function arguments.
- 2 Specify the data alignment capabilities and syntax for one or more compilers, and include the alignment specifications in a TFL registry entry in an `sl_customization.m` or `rtwTargetInfo.m` file.

For more information on specifying data alignment requirements and compiler alignment attributes, see “Configuring Data Alignment for Function Implementations”.

For additional examples of configuring data alignment for function implementations, see the demo `rtwdemo_tfl_script`.

Support for Replacing Element-wise Matrix Multiply

TFLs support several nonscalar operators for replacement with custom library functions in generated model code. R2011b adds support for replacing element-wise matrix multiplication operations (`.*` operator in element-wise mode) with custom implementations. For more information, see “Mapping Nonscalar Operators to Target-Specific Implementations”.

Code Generation Enhancements

Redundant Condition Checks

Multiple checks of the same condition are difficult to avoid in modeling. For example, a common modeling pattern is Switch blocks sharing the same condition check. Previously, the generated code for multiple Switch blocks produced multiple `if` statements.

```
if (cond) {
    true_statement1;
} else {
    false_statement1; }
if (cond) {
    true_statement2;
} else {
    false_statement2;
}
```

In R2011b, the generated code combines these condition checks. For example, the generated code for Switch blocks with a common condition combines these multiple if statements.

```
if (cond) {
    true_statement1;
    true_statement2;
}
else {
    false_statement1;
    false_statement2;
}
```

This optimization reduces code size and execution time. As a result, other optimizations for condition expressions or merged branches are enabled which reduce data copies and RAM usage.

Loop Fusion

R2011b provides more precise data dependency analysis of the data and signals of a nested Simulink bus. This enhancement enables more loop fusion in the generated code which reduces code execution time and ROM, and improves code readability.

Invariant Condition Check Lifting

When a condition check is invariant to the enclosing loop and you specify loops to be unrolled, the code generator lifts the check out of the loop. This enhancement reduces ROM, enables additional optimizations, and improves execution speed and code readability. For more information on loop unrolling, see “Configuring a Loop Unrolling Threshold”.

Parameter Pooling for Stateflow and Interpreted MATLAB Function Blocks

Parameter pooling now occurs for Simulink matrix constants used as Stateflow graphical function arguments. This enhancement reduces RAM and ROM, and improves thread safety.

Readability Improvement for Reusable Subsystem Input and Output

The generated code for reusable subsystem input and output now eliminates redundant operators and unnecessary parentheses. This enhancement improves code readability.

Enhanced Code Generation Optimization Using Minimum and Maximum Values

The **Optimize using specified minimum and maximum values** code generation option now takes into account the minimum and maximum values specified for all `Simulink.Parameter` objects even if the object is part of an expression. For example, consider a Gain block with a gain parameter specified as an expression such as $k1 + 5$, where `k1` is a `Simulink.Parameter` object with `k1.min = -10` and `k1.max = 10`. If minimum and maximum values of the parameter specified in the parameter dialog box are 0 and 20, the range calculated for this parameter expression is 0 to 15.

For more information, see “Optimizing Generated Code Using Specified Minimum and Maximum Values”.

New Model Advisor Check for Code Efficiency of Logic Blocks

The Simulink Model Advisor includes the following new check for code efficiency of logic blocks: “Check output types of logic blocks”. The following blocks in the Simulink Logic and Bit Operations library can use `boolean` or another setting for the output data type:

- Compare To Constant
- Compare To Zero

- Detect Change
- Detect Decrease
- Detect Fall Negative
- Detect Fall Nonpositive
- Detect Increase
- Detect Rise Nonnegative
- Detect Rise Positive
- Interval Test
- Interval Test Dynamic
- Logical Operator
- Relational Operator

Running this Model Advisor check helps you identify logic blocks that do not use `boolean` for the output data type.

For more information about the Model Advisor, see “Consulting the Model Advisor” in the Simulink documentation.

Control of Default Case Generation for Switch Statements in Generated Code for Stateflow Charts

You can specify whether or not to always generate default cases for switch statements in the generated code for Stateflow charts. This optimization works on a per-model basis and applies to the code generated for a state that has multiple substates. Use the following check box on the **Code Generation > Code Style** pane of the Configuration Parameters dialog box:

Code Style

Parentheses level: Nominal (Optimize for readability) ▼

Preserve operand order in expression

Preserve condition expression in if statement

Convert if-else-if-else patterns to switch-case statements

Preserve extern keyword in function declarations

Suppress generation of default cases for Stateflow switch statements if unreachable

Check Box	When to Use This Setting	Format of Switch Statements
Selected	Provide better code coverage by ensuring that every branch in the generated code is falsifiable.	Exclude the default case when it is unreachable.
Cleared	Ensure MISRA C® compliance and provide a fallback in case of RAM corruption.	Always include a default case.

For new models, this check box is cleared by default. When you open models saved in previous releases, the check box is also cleared to maintain backward compatibility.

For more information, see “Code Generation Pane: Code Style” in the *Embedded Coder Reference* documentation.

Improvement to Build Process for Conflicting Identifiers

Previously, if your model contained two referenced models with the same input (or output) port names, the model might not build because of potentially conflicting identifiers. The failure to build happens when the generated identifiers exceed the Maximum identifier length. In R2011b, the build

process is improved to handle more cases when two referenced models have the same input (or output) port names. For more information, see “Model Referencing Considerations”.

Update to Code Generation Verification Class `cgv.Config`

Compatibility Considerations

The Connectivity `cgv.Config` parameter has the following updates:

- `pill` replaces the `custom` value. In R2011b, you can use `custom` without producing a warning or error message.
- The `tasking` value is no longer available. Specifying `tasking` produces an error.

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...
rtwdemo_pmsmfoc_script	Shows how you can perform system-level simulation and algorithmic code generation using Field-Oriented Control for a Permanent Magnet Synchronous Machine
rtwdemo_sil_pil_script	Incorporates code execution profiling
rtwdemo_tfl_script	Shows how you can align nonscalar data passed into a target function library (TFL) code replacement function
fuelsys_pil	Incorporates using serial communication interface to communicate during PIL simulation

Version 6.0 (R2011a) Embedded Coder Software

This table summarizes what is new in Version 6.0 (R2011a):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems
Yes Details below	Yes—Details labeled as Compatibility Considerations , below. See also Summary	Bug Reports Includes fixes

New features and changes introduced in this version are:

- “Coder Product Restructuring” on page 23
- “Data Management Enhancements and Changes” on page 28
- “AUTOSAR Enhancements” on page 31
- “SIL and PIL Enhancements” on page 33
- “Code Generation Enhancements” on page 34
- “Code Generation Verification (CGV) API Updates” on page 36
- “MISRA-C Code Generation Objective” on page 40
- “New Model Advisor Check for Code Efficiency of Lookup Table Blocks” on page 40
- “Enhanced Code Generation Optimization” on page 41
- “Target Function Library Replacement Based on Computation Method for Reciprocal Sqrt, Sine, and Cosine” on page 42
- “Target Function Library Support for abs, min, max, and sign functions” on page 42
- “C++ Encapsulation Allowed for Referenced Models in For Each Subsystems” on page 42
- “Improved Code Generation for Portable Word Sizes” on page 43
- “Improved Comments in the Generated Code” on page 43

- “Replacement Data Types and Simulation Mode for Referenced Models” on page 43
- “Changes for Embedded IDEs and Embedded Targets” on page 43
- “Changes to ver Function Product Arguments” on page 52
- “New and Enhanced Demos” on page 53

Coder Product Restructuring

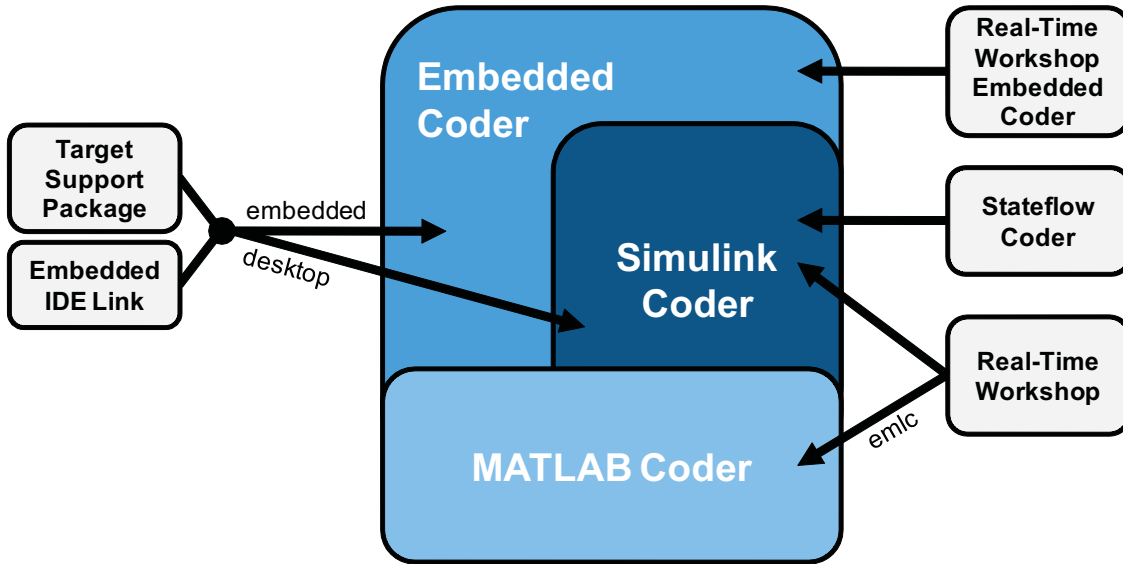
- “Product Restructuring Overview” on page 23
- “Resources for Upgrading from Real-Time Workshop Embedded Coder” on page 24
- “Migration of Embedded MATLAB Coder Features to MATLAB® Coder” on page 25
- “Migration of Embedded IDE Link and Target Support Package Features to Simulink® Coder and Embedded Coder” on page 25
- “Interface Changes Related to Product Restructuring” on page 26
- “Simulink Graphical User Interface Changes” on page 27
- “Compatibility Considerations” on page 28

Product Restructuring Overview

In R2011a, the Embedded Coder product replaces the Real-Time Workshop® Embedded Coder product. Additionally,

- The Simulink Coder product combines and replaces the Real-Time Workshop and Stateflow® Coder™ products
- 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 Embedded IDE Link™ and Target Support Package™ products 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.



Resources for Upgrading from Real-Time Workshop Embedded Coder

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

- “Compatibility Summary for Embedded Coder Software” on page 54 (latest release)
- On the MathWorks web site, in the Archived documentation, select R2010b, and view the following tables, which are provided in the release notes for Real-Time Workshop Embedded Coder: *Compatibility Summary for Real-Time Workshop Embedded Coder Software*:

This table provides 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 and view the corresponding tables for Embedded IDE Link or Target Support Package:
 - *Compatibility Summary for Embedded IDE Link* (R2010b)
 - *Compatibility Summary for Target Support Package* (R2010b)

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 “Generating C/C++ Code from MATLAB Code” in the MATLAB Coder documentation.

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 following table summarizes the transition of the Embedded IDE Link and Target Support Package supported hardware and software 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

Interface Changes Related to Product Restructuring

You will see interface changes as part of restructuring the Coder products.

- 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, changes to code generation related elements
- In error messages, tool tips, demos, and product documentation, references to Real-Time Workshop Embedded Coder, Real-Time Workshop, and Stateflow Coder and related terms are replaced with references to the latest software

Simulink Graphical User Interface Changes

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

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

Compatibility Considerations

In the Help browser **Contents** pane, Embedded Coder is now listed with the products for MATLAB, because Embedded Coder now supports both MATLAB Coder and Simulink Coder workflows.

Data Management Enhancements and Changes

- “Memory Section Enhancements” on page 28
- “No Longer Able to Set RTWInfo or CustomAttributes Property of Simulink Data Objects” on page 29
- “Parts of Data Class Infrastructure No Longer Available” on page 29
- “No Longer Generating Pragma for Data Defined with Built-In Storage Class ExportedGlobal, ImportedExtern, or ImportedExternPointer” on page 30
- “Simulink.CustomParameter and Simulink.CustomSignal Data Classes To Be Deprecated in a Future Release” on page 31

Memory Section Enhancements

- Pragmas are now added to data and function declarations (prior to R2011a they were added to definitions only); at compile time, this makes the compiler aware of memory locations for functions and data, potentially optimizing generated code
- New function category is available for shared utilities on the **Code Generation > Memory Sections** pane: “Shared utility”
- Referenced models can have a memory section that is different from that of the top model for the InitTerm and Execute function categories

No Longer Able to Set RTWInfo or CustomAttributes Property of Simulink Data Objects

You can no longer set the `RTWInfo` or `CustomAttributes` property of a Simulink data object from the MATLAB Command Window or a MATLAB script. Attempts to set these properties generate an error.

Although you cannot set `RTWInfo` or `CustomAttributes`, you can still set subproperties of `RTWInfo` and `CustomAttributes`.

Compatibility Considerations. Operations from the MATLAB Command Window or a MATLAB script, which set the data object property `RTWInfo` or `CustomAttributes`, generate an error.

For example, a MATLAB script might set these properties by copying a data object as shown below:

```
a = Simulink.Parameter;
b = Simulink.Parameter;
b.RTWInfo = a.RTWInfo;
b.RTWInfo.CustomAttributes = a.RTWInfo.CustomAttributes;
.
.
.
```

To copy a data object, use the object's `deepCopy` method.

```
a = Simulink.Parameter;
b = a.deepCopy;
.
.
.
```

Parts of Data Class Infrastructure No Longer Available

Simulink has been generating warnings for usage of the following data class infrastructure features for several releases. As of R2011a, the features are no longer supported.

- Custom storage classes not captured in the custom storage class registration file (`csc_registration`) – *warning displayed since R14SP2*

- Built-in custom data class attributes `BitFieldName` and `FileName+IncludeDelimiter` – *warning displayed since R2008b*

Instead of...	Use...
<code>BitFieldName</code>	<code>StructName</code>
<code>FileName+IncludeDelimiter</code>	<code>HeaderFile</code>

- Initial value of MPT data objects inside `mpt.CustomRTWInfoSignal` – *warning displayed since R2006a*

Compatibility Considerations.

- When you use a removed feature, Simulink now generates an error.
- When loading a MAT-file that uses an unsupported feature, the load operation suppresses the generated error such that it is not visible. In addition, MATLAB silently deletes data that had been associated with the unsupported feature. To prevent loss of data when loading a MAT-file, load and resave the file with R2010b or earlier.

No Longer Generating Pragma for Data Defined with Built-In Storage Class `ExportedGlobal`, `ImportedExtern`, or `ImportedExternPointer`

The code generator no longer generates a pragma around definitions or declarations for data that has the following built-in storage classes:

- `ExportedGlobal`
- `ImportedExtern`
- `ImportedExternPointer`

Prior to R2011a, based on model configuration parameters for specifying memory sections and the built-in storage class defined for data, the code generator would do the following:

For Built-In Storage Class...	Generate pragma Around...
ExportedGlobal	Data definition and declaration
ImportedExtern	Data declaration
ImportedExternPointer	Data declaration

The code generator now treats data with these built-in storage classes like custom storage classes with no memory section specified.

Compatibility Considerations. To work around this change, select a custom storage class that uses the memory section of interest for the data.

Simulink.CustomParameter and Simulink.CustomSignal Data Classes To Be Deprecated in a Future Release

In a future release, data classes `Simulink.CustomParameter` and `Simulink.CustomSignal` will no longer be supported because they are equivalent to `Simulink.Parameter` and `Simulink.Signal`.

Compatibility Considerations. If you use the data class `Simulink.CustomParameter` or `Simulink.CustomSignal`, Simulink posts a warning that identifies the class and describes one or more techniques for eliminating it. You can ignore these warnings in R2011a, but consider making the described changes now because the classes will be removed in a future release.

AUTOSAR Enhancements

The following enhancements are available in R2011a.

Calibration Parameters

Previously, the software supported only calibration parameters that were defined by a calibration component. These parameters could be accessed by all AUTOSAR Software Components. The AUTOSAR standard also specifies an internal calibration parameter that is defined and accessed by only one AUTOSAR Software Component. The software now supports:

- AUTOSAR internal calibration parameters, including the import and export of initial values of these parameters.
- A bus object data type (AUTOSAR record type) to import and export both kinds of calibration parameters.

For more information, see “Calibration Parameters” and “Configuring Calibration Parameters” in the Embedded Coder documentation.

Multiple Runnables from Virtual Subsystems

Previously, if a wrapper subsystem had virtual subsystems containing function-call subsystems, you could not export the function-call subsystems as AUTOSAR runnables from the wrapper subsystem level. Now, within a wrapper subsystem, you can group function-call subsystems into virtual subsystems and generate runnables for these function-call subsystems. See “Configuring Multiple Runnables” and “Exporting AUTOSAR Software Component” in the Embedded Coder documentation.

Support for Code Descriptor Elements

The AUTOSAR standard specifies that the XML description of an AUTOSAR Software Component implementation must contain code descriptor elements to describe generated source files and include header files. This feature allows AUTOSAR authoring tools that import software components to automate the building process for source code.

Previously, the software did not generate the software component implementation file (*modelName_implementation.arxml*) with these code descriptor elements. Now, when you build a Simulink model for an AUTOSAR target, the software generates a CODE-DESCRIPTORS element within the SWC_IMPLEMENTATION element. The CODE-DESCRIPTORS element contains XFILE elements that provide descriptions of the generated code.

For example, if you build the model `rtwdemo_autosar_counter`, the generated file `rtwdemo_autosar_counter_implementation.arxml` has the following SWC_IMPLEMENTATION element:

```
....  
<SWC-IMPLEMENTATION>  
  <SHORT-NAME>rtwdemo_autosar_counter</SHORT-NAME>
```

```

<CODE-DESCRIPTORS>
  <CODE>
    <SHORT-NAME>Code</SHORT-NAME>
    <TYPE>SRC</TYPE>
    <XFILES>
      <XFILE>
        <SHORT-NAME>rtwdemo_autosar_counter_c</SHORT-NAME>
        <CATEGORY>GeneratedFile</CATEGORY>
        <URL>rtwdemo_autosar_counter_autosar_rtw\rtwdemo_autosar_counter.c</URL>
        <TOOL>Embedded Coder</TOOL>
        <TOOL-VERSION>5.6</TOOL-VERSION>
      </XFILE>
      <XFILE>
        <SHORT-NAME>rtwdemo_autosar_counter_h</SHORT-NAME>
        <CATEGORY>GeneratedFile</CATEGORY>
        <URL>rtwdemo_autosar_counter_autosar_rtw\rtwdemo_autosar_counter.h</URL>
        <TOOL>Embedded Coder</TOOL>
        <TOOL-VERSION>5.6</TOOL-VERSION>
      </XFILE>
      ...
    </XFILES>
  </CODE>
</CODE-DESCRIPTORS>
<CODE-GENERATOR>Embedded Coder 5.6 (R2011a) 26-Aug-2010</CODE-GENERATOR>
<PROGRAMMING-LANGUAGE>C</PROGRAMMING-LANGUAGE>
</SWC-IMPLEMENTATION>
....

```

SIL and PIL Enhancements

Code Execution Profiling

You can collect execution time measurements in a specified base workspace variable during a software-in-the-loop (SIL) or processor-in-the-loop (PIL) simulation. At the end of the simulation, you can view or analyze the measurements within the MATLAB environment. This feature allows you to collect an execution time profile for each task within your generated code.

The software supports code execution profiling for all types of SIL or PIL simulations except the SIL block.

For more information, see “Code Execution Profiling” in the Embedded Coder documentation.

PIL Block Parameter Tuning

R2011a supports parameter tuning for the PIL block, which allows you to change tunable workspace parameters between or during simulations without regenerating code. This feature also includes support for tunable structure parameters. For more information, see “I/O Support” and “Tunable Parameters and SIL/PIL”.

Top-Model SIL/PIL and PIL Block Parameter Initialization

R2011a supports automatic definition and initialization of parameters with imported storage classes. For more information, see “I/O Support” and “Imported Data Definitions”.

Model Block Parameter Tuning and Model Initialization

Previously, the software did not support the following features for Model block SIL/PIL:

- Simplified initialization mode
- Tunable structure parameters

R2011a now supports these features. For more information, see “Configuration Parameters Support”, “I/O Support”, and “Tunable Parameters and SIL/PIL”.

Code Generation Enhancements

Improved Code for Data Store Memory In-place Assignment

Previously, the generated code for a Data Store Memory block used data copies to perform data store assignments. The generated code now eliminates the data copies and performs an in-place assignment. This improvement generates less code, uses less memory, and provides faster execution.

Improvements to Target Function Library Replacements

Enhancements to Target Function Library Replacements (TFL) include:

- If multiple TFL replacements occur within a function, temporary variables are now reused instead of creating extra temporary variables. This enhancement reduces the stack size during TFL replacement.
- During TFL replacement, if unnecessary temporary variables are introduced when block output is not the returned value of the function but one of the input arguments, code generation now removes the temporary variable. This enhancement improves execution speed and requires less memory.

For more information, see “Introduction to Target Function Libraries”.

Improved Loop Fusion

Code generation now includes the following:

- An improved loop fusion algorithm that reduces data copies. This enhancement decreases stack size, ROM consumption, and code generation time.
- Selectively fuses loops when the loop count is larger than the “Loop unrolling threshold”. In these cases, loop unrolling allows the code generator to perform more optimizations. In addition, the code generator groups the statements together to assign values to the elements of a signal or parameter array, which improves data access and code readability.

Improved Array Indexing

The generated code is optimized for more efficient array indexing. When a complex instruction is used repeatedly in an array index, the instruction is replaced with a temporary variable to perform the calculation more efficiently. This enhancement improves execution speed and reduces code size.

Improvement on Matrix Parameter Pooling

For matrix parameters with the same flattened value, the generated code now pools the matrix parameters even when they have different shapes. This enhancement reduces ROM consumption.

Readability Improvements Involving Data References

For references to the root inport and outport, as well as DWork, unnecessary parentheses are removed from the generated code. This enhancement produces more readable code.

Code Generation Verification (CGV) API Updates

Support for Adding Multiple Callback Functions

In R2011a, the `cgv.CGV` class includes new methods to add callback functions. These methods replace the `cgv.CGV.addCallback` method which added only a pre-execution callback function. Now, the new methods allow CGV to invoke callback functions at several stages of the `cgv.CGV.run` execution. The new methods are:

- `cgv.CGV.addHeaderReportFcn` adds a callback function invoked before executing any input data in the `cgv.CGV` object.
- `cgv.CGV.addPreExecReportFcn` adds a callback function invoked before executing each input data file in the `cgv.CGV` object.
- `cgv.CGV.addPreExecFcn` adds a callback function invoked before executing each input data file in the `cgv.CGV` object.
- `cgv.CGV.addPostExecReportFcn` adds a callback function invoked after executing each input data file in the `cgv.CGV` object.
- `cgv.CGV.addPostExecFcn` adds a callback function invoked after executing each input data file in the `cgv.CGV` object.
- `cgv.CGV.addTrailerReportFcn` adds a callback function invoked after executing all input data in the `cgv.CGV` object.

New Functionality Added to the `cgv.CGV` Class

The `cgv.CGV` class now includes the following methods:

- `cgv.CGV.activateConfigSet` activates the configuration set of a model.
- `cgv.CGV.addBaseline` adds a file of baseline data for comparison.

- `cgv.CGV.copySetup` creates a copy of a `cgv.CGV` object.
- `cgv.CGV.setMode` specifies the mode of execution (`sim`, `sil`, or `pil`).
- `cgv.CGV.copySetup` returns the status of the execution of the `cgv.CGV` object.

The `cgv.CGV` class now includes the following properties:

- Name
- Description

Compatibility Considerations

Previously, the `cgv.CGV` class included parameters that you set to perform automatic configuration checks of your model. In R2011a, `cgv.CGV` class no longer performs automatic configuration checks. Instead, you can use the `cgv.Config` class to perform a manual configuration check of your model. Before calling `cgv.CGV.run`, MathWorks recommends that you perform a manual configuration check of your model. Otherwise, an error might occur later in the process. For more information, see “Programmatic Code Generation Verification”.

Changes to the `cgv.CGV` class parameters are listed in the following table.

Parameter	What Happens When You Use Parameter?	Use This Parameter Instead	Compatibility Considerations
LogMode removed from <code>cgv.CGV</code>	Errors	LogMode parameter in <code>cgv.Config</code>	To check your model before running CGV, pass the LogMode parameter to the constructor for <code>cgv.Config</code> . Then call the <code>cgv.Config.configModel</code>

Parameter	What Happens When You Use Parameter?	Use This Parameter Instead	Compatibility Considerations
			method to adjust the model configuration.
Processor removed from <code>cgv.CGV</code>	Errors	Processor parameter in <code>cgv.Config</code>	To check your model before running CGV, pass the Processor parameter to the constructor for <code>cgv.Config</code> . Then call the <code>cgv.Config.configModel</code> method to adjust the model configuration.
SaveModel removed from <code>cgv.CGV</code>	Errors	SaveModel parameter in <code>cgv.Config</code>	To check your model before running CGV, pass the SaveModel parameter to the constructor for <code>cgv.Config</code> . Then call the <code>cgv.Config.configModel</code> method to adjust the model configuration.
ConfigModel removed from <code>cgv.CGV</code>	Warns if set to off Errors if set to on	<code>cgv.Config.configModel</code> method	To check your model before running CGV, replace the <code>cgv.CGVConfigModel</code> parameter with a call to the <code>cgv.Config.configModel</code> method

Parameter	What Happens When You Use Parameter?	Use This Parameter Instead	Compatibility Considerations
CheckInterface parameter from <code>cgv.CGV</code>	Warns if set to off Errors if set to on	CheckOutports parameter in <code>cgv.Config</code>	To check your model before running CGV, pass the CheckOutports parameter to the constructor for <code>cgv.Config</code> . Then call the <code>cgv.Config.configModel</code> method to adjust the model configuration.
tasking and custom values removed from the Connectivity parameter of <code>cgv.CGV</code>	Errors	<code>pil</code> , a new value for the <code>cgv.CGV</code> Connectivity parameter	Replace calls to the <code>cgv.CGV</code> constructor using the parameter-value arguments, ('Connectivity', 'tasking') or ('Connectivity', 'custom'), with ('Connectivity', 'pil').

Changes to the `cgv.Config` class parameters are listed in the following table:

Parameter	What Happens When You Use Parameter?	Use This Parameter Instead	Compatibility Considerations
CheckOutports parameter added to <code>cgv.Config</code>	Defaults to on. Compiles the model. Then checks that the model output configuration is compatible with the <code>cgv.CGV</code> object.		If your script fixes errors reported by <code>cgv.Config</code> , you can set <code>CheckOutports</code> to off.
LogMode parameter from <code>cgv.Config</code>	Change in behavior		If you do not give a value for <code>LogMode</code> , no changes are made to the configuration parameters for logging.

MISRA-C Code Generation Objective

The Code Generation Advisor now includes a new objective for MISRA-C:2004 guidelines. To set the new objective, open the Configuration Parameters dialog box and select the **Code Generation** pane. In the Code Generation Advisor section, click the **Set objectives** button to open the Code Generation Advisor dialog box. In the **Available objectives** list, select **MISRA-C:2004 guidelines** and click the select button (arrow pointing right) to move the objective to the **Selected objectives** list. For more information on setting objectives, see “Application Objectives”.

New Model Advisor Check for Code Efficiency of Lookup Table Blocks

The Simulink Model Advisor includes the following new check for code efficiency of lookup table blocks: “Identify lookup table blocks that generate expensive out-of-range checking code”. By default, the following blocks generate code that checks for out-of-range breakpoint inputs:

- 1-D Lookup Table
- 2-D Lookup Table

- n-D Lookup Table
- Prelookup

Similarly, the Interpolation Using Prelookup block generates code that checks for out-of-range index inputs. Running this Model Advisor check helps you identify lookup table blocks that generate out-of-range checking code for breakpoint or index inputs.

For more information about the Model Advisor, see “Consulting the Model Advisor” in the Simulink documentation.

Enhanced Code Generation Optimization

The **Optimize using specified minimum and maximum values** code generation option now takes into account the minimum and maximum values specified for:

- A `Simulink.Parameter` object provided that it is used on its own. It does not use these minimum and maximum values if the object is part of an expression. For example, if a Gain block has a gain parameter specified as `K1`, where `K1` is defined as a `Simulink.Parameter` object in the base workspace, the optimization takes the minimum and maximum values of `K1` into account. However, if the Gain block has a gain parameter of `K1+5` or `K1+K2+K3`, where `K2` and `K3` are also `Simulink.Parameter` objects, the optimization does not use the minimum and maximum values of `K1`, `K2` or `K3`.
- All design ranges specified on block outputs in a conditionally-executed subsystem, except for the block outputs that are directly connected to an Output block.

For more information, see “Optimizing Generated Code Using Specified Minimum and Maximum Values”.

Target Function Library Replacement Based on Computation Method for Reciprocal Sqrt, Sine, and Cosine

Target function libraries (TFLs) now support the ability to control replacement of certain math functions using their computation method as a distinguishing attribute. For example,

- The `rSqrt` block can be configured to use either of two computation methods, `Newton-Raphson` or `Exact`.
- The `Trigonometric Function` block, with **Function** set to `sin` or `cos`, can be configured to use either of two approximation methods, `CORDIC` or `None`.

You can configure TFL table entries to replace these functions for one or all of the available computation methods. For example, you could replace only `Newton-Raphson` instances of the `rSqrt` function.

For more information, see “Replacing Math Functions Based on Computation Method” in the Embedded Coder documentation.

Target Function Library Support for `abs`, `min`, `max`, and `sign` functions

Embedded Coder software now supports target function library customization control for fixed-point `abs`, `min`, `max`, and `sign` functions.

For more information, see “Registering Target Function Libraries”.

C++ Encapsulation Allowed for Referenced Models in For Each Subsystems

In previous releases, due to a code generation limitation, code could not be generated for a `For Each Subsystem` block under the following conditions:

- The `For Each Subsystem` block directly or indirectly contains a `Model` block.
- The `Model` block references a model for which C++ encapsulation is selected.

R2011a removes this limitation. You can now generate code for a `For Each Subsystem` in which a referenced model uses C++ encapsulation.

Improved Code Generation for Portable Word Sizes

In the software-in-the-loop (SIL) simulation work flow, the model option **Enable portable word sizes** allows you to take code intended for a specific target platform and compile and run the same code on a MATLAB host platform that uses different processor word sizes. R2011a enhances the code generated for portable word sizes by inserting explicit casts to help protect against integral promotion differences and other behavior differences between host and target. This potentially can reduce the incidence of numerical differences due to host/target behavior differences. For more information, see “Configuring Hardware Implementation Settings for SIL” and “Portable Word Sizes Limitations” in the Embedded Coder documentation.

Improved Comments in the Generated Code

R2011a provides improvements to comment generation for better readability and understanding of the generated code. Specifically, comments are located closer to the referring code and more accurately reflect the intent of the code. An end comment is now included at the end of a control flow block of code. For information on customizing comments in the generated code, see “Configuring Code Comments in Embedded System Code”.

Replacement Data Types and Simulation Mode for Referenced Models

To replace built-in data type names with user-defined data type names in the generated code for a referenced model, you must set the **Simulation mode** parameter for the Model block to one of the following:

- Normal
- Software-in-the-loop (SIL)
- Processor-in-the-loop (PIL)

For more information, see “Data Types” and “Referenced Model Simulation Modes” in the Simulink documentation.

Changes for Embedded IDEs and Embedded Targets

- “Feature Support for Embedded IDEs and Embedded Targets” on page 44

- “Execution Profiling during PIL Simulation” on page 45
- “Location of Blocks for Embedded Targets” on page 45
- “Location of Demos for Embedded IDEs and Embedded Targets” on page 47
- “Multicore Deployment with Rate-Based Multithreading” on page 48
- “Windows-Based Code Generation and Remote Build On Linux Target (BeagleBoard)” on page 48
- “Changes to Frame-Based Processing” on page 48
- “New Support for Analog Devices Blackfin BF50x and BF51x Processors” on page 50
- “Generate Optimized Fixed-Point Code for ARM Cortex-M3, Cortex-A8, and Cortex-A9 Processors” on page 50
- “Support for Versions 5.0.6 and 5.1.6 of Green Hills® MULTI” on page 50
- “Support for Texas Instruments Delfino C2834x Processors” on page 51
- “Ending Support for Altium TASKING in a Future Release” on page 52
- “Ending Support for Freescale MPC5xx in a Future Release” on page 52
- “Ending Support for Infineon® C166 in a Future Release” on page 52
- “Removed Methods and Arguments” on page 52

Feature Support for Embedded IDEs and Embedded Targets

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

- Automation Interface
- Processor-in-the-Loop (PIL) Simulation
- Execution Profiling
- Execution Profiling during PIL Simulation
- Stack Profiler
- External Mode
- Schedulers and Timing

- Makefile Generation (XMakefile)
- Target Function Library (TFL) Optimization
- Multicore Deployment for Rate Based Multithreading

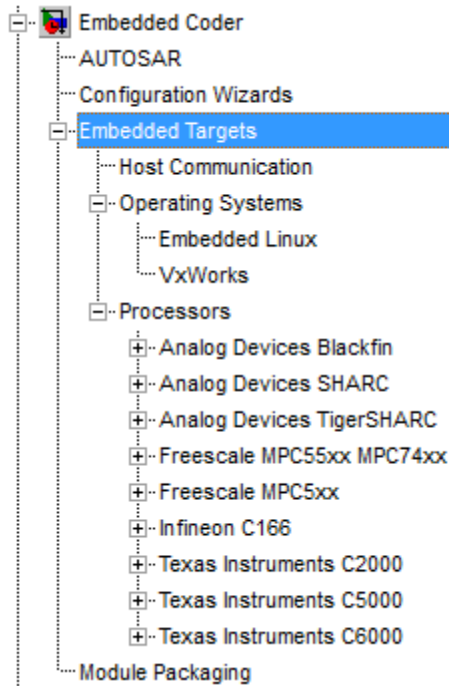
Note You can only use these features in the 32-bit version of your MathWorks products. To use these features on 64-bit hardware, install and run the 32-bit versions of your MathWorks products.

Execution Profiling during PIL Simulation

During Processor-in-the-loop (PIL) simulation, you can profile synchronous tasks in code running on the target. For more information, see [Execution Profiling during PIL Simulation](#)

Location of Blocks for Embedded Targets

Blocks from the former Target Support Package product and Embedded IDE Link product now reside under Embedded Coder in the Embedded Targets block library, as shown.



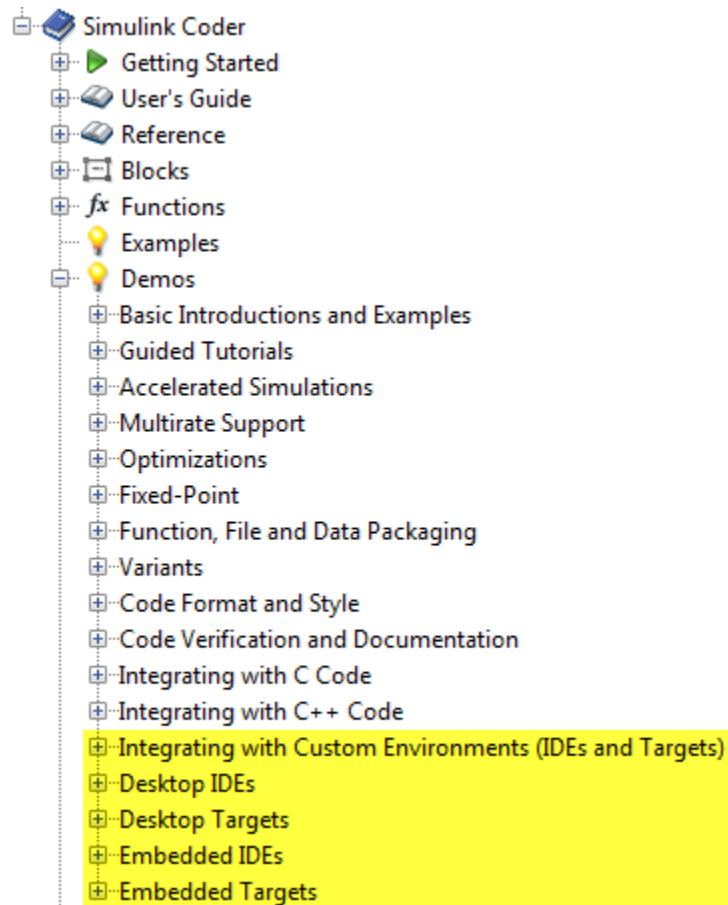
Embedded Targets includes the following types of blocks:

- Host Communication
- Operating Systems
 - Embedded Linux
 - VxWorks
- Processors
 - Analog Devices Blackfin
 - Analog Devices™ SHARC®
 - Analog Devices™ TigerSHARC®
 - Freescale MPC55xx MPC74xx
 - Freescale MPC5xx
 - Infineon C166

- Texas Instruments C2000
- Texas Instruments C5000
- Texas Instruments C6000

Location of Demos for Embedded IDEs and Embedded 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 Embedded Linux and

VxWorks. This feature improves performance by taking advantage of multicore hardware resources.

Also see the “Running Target Applications on Multicore Processors” user’s guide topic.

Windows-Based Code Generation and Remote Build On Linux Target (BeagleBoard)

You can generate a makefile project on a Windows host machine, transfer the makefile project to an remote target running Linux, such as a BeagleBoard, and then build the executable on the remote target.

Changes to Frame-Based Processing

Signal processing applications often process sequential samples of data at once as a group, rather than one sample at a time. MathWorks documentation refers to the former as *frame-based processing* and the latter as *sample-based processing*. A *frame* is a collection of samples of data, sequential in time. To perform frame-based processing in MathWorks products, you must have a DSP System Toolbox™ license.

Historically, Simulink-family products that can perform frame-based processing propagate frame-based signals throughout a model. The frame status is an attribute of the signals in a model, just as data type and dimensions are attributes of a signal. The Simulink engine propagates the frame attribute of a signal with a frame bit, which can either be on or off. When the frame bit is on, Simulink interprets the signal as frame-based, and displays it as a double line, rather than as a single line.

Beginning in R2010b, MathWorks started to change the handling of frame-based processing significantly. In the future, signal attributes will not include frame status. Instead, individual blocks will control whether they treat data inputs as frames or as samples.

To transition to this new paradigm, blocks that can perform sample- and frame-based processing contain a new **Input processing** parameter that specifies the appropriate processing behavior. You can set **Input processing** to Columns as channels (frame based) or Elements as channels (sample based). The third option, Inherited (this choice will be removed - see release notes), is a temporary selection. This third option helps you migrate your existing models from the old paradigm to the new paradigm.

In R2011a, the following Embedded Coder blocks received a new **Input processing** parameter:

- C62X Real Forward Lattice All-Pole IIR
- C62X Complex FIR
- C62X General Real FIR
- C62X Real IIR
- C64X Real Forward Lattice All-Pole IIR

Compatibility Considerations. When you load an existing model in R2011a, blocks with the new **Input processing** parameter shows a setting of Inherited (this choice will be removed - see release notes). This setting enables your existing models to work as expected until you upgrade them. Upgrade your models as soon as possible.

To upgrade your existing models, use the `slupdate` function. This function detects all blocks that have **Input processing** set to Inherited (this choice will be removed - see release notes). The function asks you whether to upgrade each block. If you select yes, the function detects the status of the frame bit on the input port of the block. If the frame bit is 1 (frames), the function sets the **Input processing** parameter to Columns as channels (frame based). If the bit is 0 (samples), the function sets the parameter to Elements as channels (sample based).

A future release will remove the frame bit and the Inherited (this choice will be removed - see release notes) option. At that time, if you have not updated the model, the software automatically sets the **Input processing** parameter. The software uses the library default setting of the block to select either Columns as channels (frame based) or Elements as

channels (sample based). If the library default setting does not match the parameter setting in your model, your model will produce unexpected results. Additionally, after the removal of the frame bit, you will no longer be able to upgrade your models using the `slupdate` function. Therefore, upgrade your existing modes using `slupdate` as soon as possible.

New Support for Analog Devices Blackfin BF50x and BF51x Processors

You can now generate code for the following embedded processors when you use Embedded Coder software:

- BF504
- BF504F
- BF506F
- BF512
- BF514
- BF516
- BF518

Generate Optimized Fixed-Point Code for ARM Cortex-M3, Cortex-A8, and Cortex-A9 Processors

You can use new Target Function Libraries (TFLs) to generate efficient fixed-point code for the ARM Cortex-M3, Cortex-A8, and Cortex-A9 processors. These TFLs include GCC compiler extensions and intrinsic functions that optimize the code Embedded Coder generates for these processors.

Support for Versions 5.0.6 and 5.1.6 of Green Hills MULTI

Support for Green Hills MULTI software now includes versions 5.0.6 and 5.1.6. For additional information about supported versions, see the Support for Green Hills MULTI topic online.

Support for Texas Instruments Delfino C2834x Processors

You can now generate code for the following embedded processors when you use Embedded Coder software with Texas Instruments Code Composer Studio™ software:

- C28341
- C28342
- C28343
- C28344
- C28345
- C28346

The new “C2834x (c2834xlib)” block library contains the following blocks:

- C2000 CAN Calibration Protocol
- C280x/C2802x/C2803x/C28x3x/c2834x GPIO Digital Input
- C280x/C2802x/C2803x/C28x3x/c2834x GPIO Digital Output
- C280x/C2802x/C2803x/C28x3x/C2834x I2C Receive
- C280x/C2802x/C2803x/C28x3x/C2834x I2C Transmit
- C280x/C2802x/C2803x/C28x3x/c2834x SCI Receive
- C280x/C2802x/C2803x/C28x3x/c2834x SCI Transmit
- C280x/C2802x/C2803x/C28x3x/c2834x SPI Receive
- C280x/C2802x/C2803x/C28x3x/c2834x SPI Transmit
- C280x/C2802x/C2803x/C28x3x/c2834x Software Interrupt Trigger
- C28x Watchdog
- C280x/C2803x/C28x3x/c2834x eCAN Receive
- C280x/C2803x/C28x3x/c2834x eCAN Transmit
- C280x/C2802x/C2803x/C28x3x/c2834x eCAP
- C280x/C2802x/C2803x/C28x3x/c2834x ePWM
- C280x/C2803x/C28x3x/c2834x eQEP

Ending Support for Altium TASKING in a Future Release

Support for the Altium TASKING IDE will end in a future release of the Embedded Coder product.

Ending Support for Freescale MPC5xx in a Future Release

Support for the Freescale MPC5xx processor family will end in a future release of the Embedded Coder product.

Ending Support for Infineon C166 in a Future Release

Support for the Infineon C166 processor family will end in a future release of the Embedded Coder product.

Removed Methods and Arguments

Deprecated the `type` property for the Code Composer Studio IDE object. For example, entering the following text generates an error message:

```
infolist = IDE_Obj.list(type)
```

Changes to ver Function Product Arguments

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

- The new argument `'embeddedcoder'` returns information about the installed version of the Embedded Coder product.
- The argument `'ecoder'`, which previously returned information about the installed version of the Real-Time Workshop® Embedded 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 `'ecoder'` argument, update the script appropriately. For example, you can update the `ver` call to use the `'embeddedcoder'` argument.

New and Enhanced Demos

The following demos have been added in R2011a:

Demo...	Shows How You Can...
coderdemo_tfl	Use target function libraries (TFLs) to replace operators and functions in code generated by MATLAB Coder.
rtwdemo_code_coverage_script	Generate model coverage and code coverage reports, and use these reports to compare model coverage and code coverage results for any part of a model.
rtwdemo_pmsmfoc_script	Perform system-level simulation and algorithmic code generation using Field-Oriented Control for a Permanent Magnet Synchronous Machine.

The following demos have been enhanced in R2011a:

Demo...	Now...
vipstabilize_fixpt_beagleboard	Uses the new Video Capture block to simulate or capture a video input signal in the Video Stabilization demo.

Compatibility Summary for Embedded Coder Software

This table summarizes new features and changes that might cause incompatibilities when you upgrade from an earlier version, or when you use files on multiple versions. Details are provided in the description of the new feature or change.

Version (Release)	New Features and Changes with Version Compatibility Impact
<p>Latest Version V6.1 (R2011b)</p>	<p>See the Compatibility Considerations subheading for each of these new features or changes:</p> <ul style="list-style-type: none"> • “Custom Storage Class Properties for Managing Data Ownership and Definition” on page 12 • “Update to Code Generation Verification Class <code>cgv.Config</code>” on page 20
<p>V6.0 (R2011a)</p>	<p>See the Compatibility Considerations subheading for each of these new features or changes:</p> <ul style="list-style-type: none"> • Code Generation Verification classes, <code>cgv.CGV</code> and <code>cgv.Config</code> • “Changes to <code>ver</code> Function Product Arguments” on page 52 • “Changes to Frame-Based Processing” on page 48 • “Coder Product Restructuring” on page 23