Link for TASKING®

For Use with Real-Time Workshop®

- Modeling
- Simulation
- Implementation

User's Guide

Version 1

How to Contact The MathWorks:

`www.mathworks.com`	Web
`comp.soft-sys.matlab`	Newsgroup
`www.mathworks.com/contact_TS.html`	Technical Support

`suggest@mathworks.com`	Product enhancement suggestions
`bugs@mathworks.com`	Bug reports
`doc@mathworks.com`	Documentation error reports
`service@mathworks.com`	Order status, license renewals, passcodes
`info@mathworks.com`	Sales, pricing, and general information

508-647-7000 (Phone)

508-647-7001 (Fax)

The MathWorks, Inc.
3 Apple Hill Drive
Natick, MA 01760-2098

For contact information about worldwide offices, see the MathWorks Web site.

Link for TASKING User's Guide

Revision History

May 2006	Online only	New for Version 1.0 (Release 2006a+)

Contents

1 Getting Started

2 Build Process

3 Objects

4 Processor-in-the-Loop (PIL) Cosimulation

5 Tutorials

Index

1

Getting Started

What Is Link for TASKING?

Link for TASKING lets you build, test, and verify automatically generated code using MATLAB®, Simulink®, Real-Time Workshop®, and the TASKING integrated development environment. Link for TASKING makes it easy to verify code executing within the TASKING environment using a test harness model in Simulink. This processor-in-the-loop testing environment uses code automatically generated from Simulink models by Real-Time Workshop Embedded Coder. A wide range of DSPs and 8-, 16- and 32-bit microprocessors and microcontrollers are supported including devices from Infineon, Renesas, and Freescale. Link for TASKING provides customizable templates for configuring hardware variants, automating MISRA C code checking, and controlling the build process.

With Link for TASKING, you can use MATLAB and Simulink to interactively analyze, profile and debug target-specific code execution behavior within TASKING. In this way, Link for TASKING automates deployment of the complete embedded software application and makes it easy for you to assess possible differences between the model simulation and target code execution results.

Features include:

- Automated project-based build process

  Automatically create and build projects for code generated by Real-Time Workshop or Real-Time Workshop Embedded Coder.

- Automated download and debugging

  Rapidly and effortlessly debug generated code in the CrossView Pro debugger, using either the instruction set simulator or real hardware.

- Processor-in-the-loop (PIL) cosimulation

  Use cosimulation techniques to verify generated code running in an instruction set simulator or real target environment.

- Highly customized code generation

  Use Link for TASKING with any Real-Time Workshop System Target File (STF) to generate target-specific and optimized code.

- Highly customized build process

  Support for multiple TASKING Toolsets provides a route to a large number of different target hardware platforms. Further customization is possible by using custom project templates, giving access to all options supported by the TASKING Toolset.

- MATLAB API for TASKING EDE (IDE)

  Automate complex tasks in the TASKING EDE by writing MATLAB scripts to communicate with the EDE.

  For example, you could

  - Automate project creation, including adding source files, include paths, and preprocessor defines.
  - Configure batch building of projects.
  - Launch a debugging session.
  - Execute CodeWright API Library commands.

- MATLAB API for TASKING CrossView Pro (Debugger)

  Automate complex tasks in the TASKING CrossView Pro debugger by writing MATLAB scripts to communicate with CrossView Pro, or debug and analyze interactively in a live MATLAB session.

  For example, you could

  - Automate debugging by executing commands from the powerful CrossView Pro command language.
  - Exchange data between MATLAB and the target running in CrossView Pro.
  - Set breakpoints, step through code, set parameters and retrieve profiling reports

Supported TASKING Toolsets

Link for TASKING includes at least one reference template project for each supported toolset. The reference projects were created for specific versions of each TASKING toolset and were used by The MathWorks for qualification testing. The supported toolset versions are:

- Infineon TriCore: TASKING VX-Toolset for TriCore v2.3 r1
- Infineon C166: TASKING Tools for C166/ST10 v8.6 r1
- Renesas M16C: TASKING Tools for M16C v3.1 r1 patch 2
- ARM: TASKING C Compiler for ARM v1.1 r1
- Freescale DSP563xx: TASKING Tools for DSP563xx v3.5 r3 patch 2
- 8051: TASKING Tools for 8051 v7.1 r3

The Renesas R8C family is supported by the Renesas M16C TASKING Toolset.

The Freescale DSP566xx Family is supported by the Freescale DSP563xx Toolset.

Support for Other Versions

Check the Link for TASKING Product Support page for patches and additional toolchain version information.

For minor release increments it may be sufficient to create new default template projects. To do this, you must first specify the location of your TASKING toolset in the Target Preferences (see “Setting Target Preferences” on page 1-7) then run the `tasking_generate_templates` command. You must specify your configuration description string, e.g.:

```
tasking_generate_templates('C166')
```

or

```
tasking_generate_templates('TriCore')
```

Note Make sure you check the Link for TASKING Product Support page for the latest information about toolchains qualified with the Link for TASKING. You may be able to obtain patches in order to use other toolsets.

Using This Guide

To get started with Link for TASKING:

1. Follow the instructions in “Setting Target Preferences” on page 1-7.
2. Once you have set target preferences, follow the instructions in “Working with Configuration Sets” on page 1-13 to see how to set up configurations using an example model.
3. Try the demos to gain experience using Link for TASKING. Access the demos in one of these ways:
   - Click the link: “Link for TASKING Demos.”
   - Select **Start > Simulink > Link for TASKING > Demos**.
   - Enter `demo('simulink', 'link for tasking')` at the MATLAB command line.
4. See “Link for TASKING Menus” on page 1-18 for a quick guide to the functionality available in the menus, with links to more information.

See the following topics to learn about Link for TASKING features:

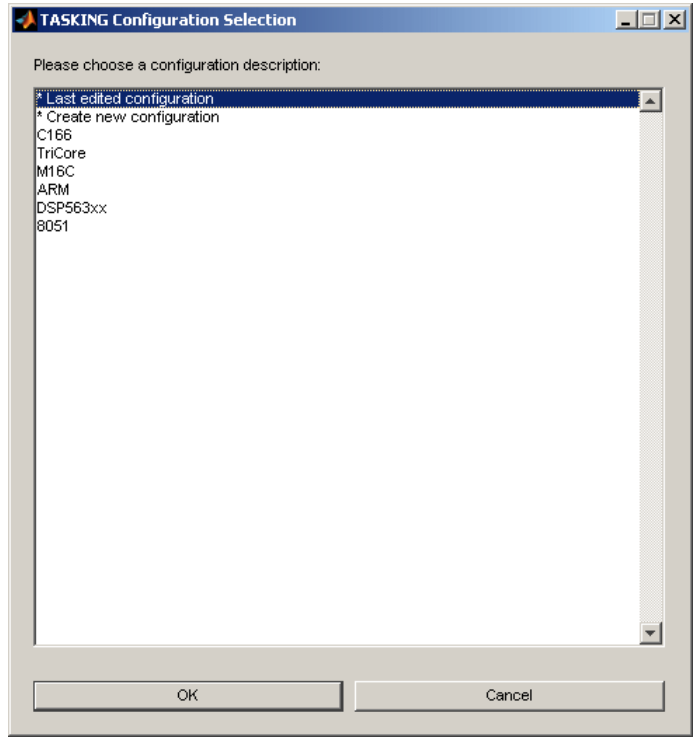
- Chapter 2, “Build Process” explains the Link for TASKING build process.
- Chapter 3, “Objects” explains how to create and use Link for TASKING objects.
- Chapter 4, “Processor-in-the-Loop (PIL) Cosimulation” describes how to use PIL cosimulation.
- Chapter 5, “Tutorials” contains instructions to show you how to create new configurations and template projects, how to use Link for TASKING with existing models, and how to use different build actions.

Setting Target Preferences

You must configure your target preferences to use Link for TASKING.

1 Select **Start > Simulink > Link for TASKING > TASKING Target Preferences**, or enter `tasking_edit_prefs`.

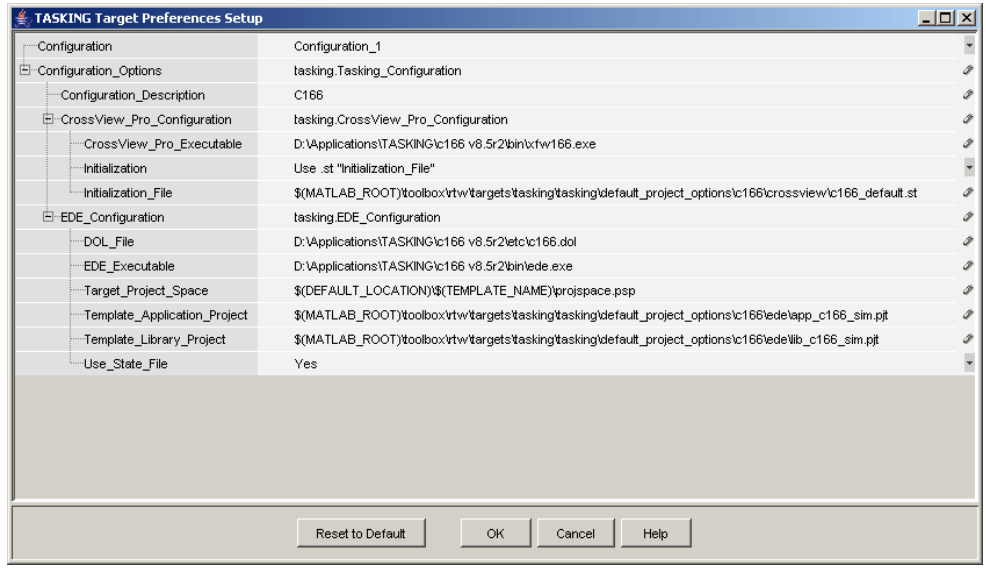
The TASKING Configuration Selection dialog appears.



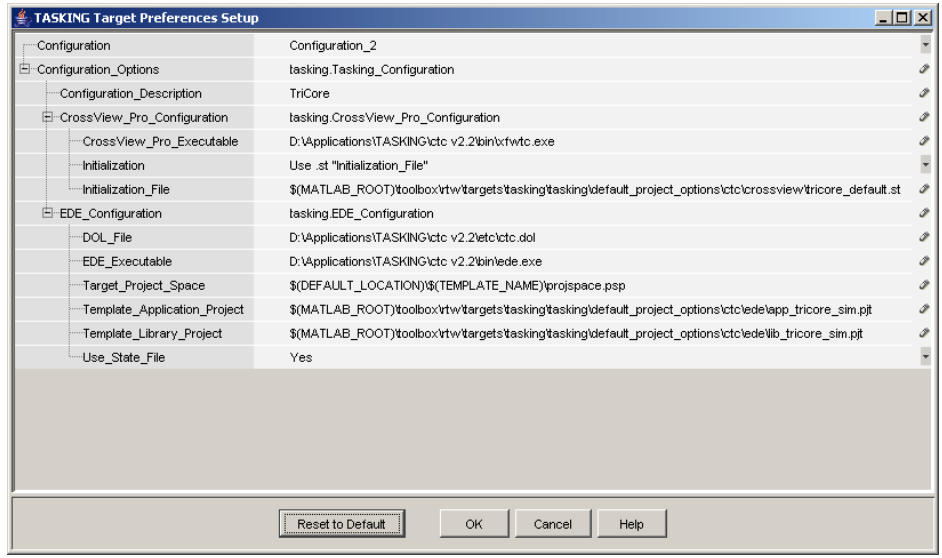
2 Select a predefined configuration from the list that matches your target, or select `Create new configuration` to create a new configuration, and click **OK**. For new configurations, see the tutorial section "Tutorial: Creating a New Configuration" on page 5-6.

The TASKING Target Preferences Setup dialog appears. Here you can configure the location of your toolchain executable and other files.

3 Click the plus to expand `Configuration Options`. Similarly, expand `CrossView_Pro_Configuration` and `EDE_Configuration`, as shown in the example. This example is set up for the Infineon C166 Simulator configuration.



4 Replace the string `<ENTER_TASKING_PATH>` to complete the path to the `CrossView_Pro_Executable`, the `DOL_File`, and the `EDE_Executable`. See the next section, “Target Preference Fields” on page 1-9, for details on each field. The following example is set up for the Infineon TriCore Simulator configuration.



If you have multiple configurations, you have to set them up in your target preferences only once, and then it is simple to switch between them. See the tutorial example “Working with Configuration Sets” on page 1-13.

5 Click **OK** to dismiss the TASKING Target Preferences Setup dialog.

The next section explains each target preference field.

Target Preference Fields

Open the Target Preference Setup dialog by selecting **Start > Simulink > Link for TASKING > TASKING Target Preferences**, or enter `tasking_edit_prefs`.

- `Configuration`

  Select a configuration from the drop-down list. There are preconfigured configurations for

  - C166
  - TriCore
  - M16C

- ARM
- DSP563xx
- 8051

If you have multiple configurations, you have to set them up in your target preferences only once, and then it is simple to switch between them. You can switch between them using this target preference field.

Select a free configuration number to set up a new configuration from scratch. See "Tutorial: Creating a New Configuration" on page 5-6.

- `Configuration_Description`

  The title of the configuration. Once created, this title is the name that appears in the TASKING Configuration Description drop-down list in the Configuration Parameters dialog. Edit this field to change the name of the configuration. These names are predefined for the preconfigured configurations. For a new configuration enter a descriptive name (do not include spaces).

- `CrossView_Pro_Executable`

  Enter the full path to your TASKING CrossView Pro installation to replace the string `<ENTER_TASKING_PATH>`. For example, for `Configuration_1` for Infineon C166 Simulator:

  ```
  D:\Applications\TASKING\c166\bin\xfw166.exe
  ```

- `Initialization`

  This setting determines what the CrossView Pro Debugger will execute when it first starts. There are three options.

  - `Use .st Initialization_File` This is the default setting. "`.st`" files are in an internal file format used by The MathWorks to provide initialization options to CrossView Pro during debugger start up. For example, a `.st` file may specify a CrossView Pro configuration file (`.cfg`) and target type for CrossView Pro to use. Each of the option sets shipped with Link for TASKING specifies a corresponding `.st` file. For example, the `c166_sim` option set specifies the `c166_default.st` file, which includes basic initialization commands for the C166 CrossView Pro Simulator. See "Option Sets" on page 1-22 for related information. To customize your CrossView Pro configuration, you should use one of the `.ini` initialization options.

  - `Use .ini Initialization_File` Use this option if you have a custom `.ini` initialization file. The file should be a valid CrossView Pro initialization file for your custom configuration. Refer to your CrossView Pro application documentation for details.
  - `Use CrossView Pro Default .ini File` Use this option if you want to run CrossView Pro Default `.ini` file when launching the CrossView Pro Debugger. When launching CrossView Pro you may be prompted to make configuration selections. Refer to your CrossView Pro application documentation to find the location of this `.ini` file, and for details of CrossView Pro initialization files.

- `Initialization_File`

  Full path of the initialization file corresponding to the `Initialization` field.

- `DOL_File`

  The full path to the TASKING EDE DOL file. For example, the Infineon_C166_Simulator Configuration has the `<ENTER_TASKING PATH>_\etc\c166.dol` as the dol file. You need to replace `<ENTER_TASKING_PATH>` with your real TASKING installation path.

- `EDE_Executable`

  Enter the full path to your TASKING EDE installation to replace the string `<ENTER_TASKING_PATH>`. For example, for `Configuration_1` for Infineon C166 Simulator, enter

  ```
  D:\Applications\TASKING\c166\bin\ede.exe
  ```

- `Target_Project_Space`

  When building models, new projects in the TASKING EDE will be created. These projects will belong to the project space defined in this entry. The default setting is `$(DEFAULT_LOCATION)\$(TEMPLATE_NAME)\projspace.psp`. The code generation process will expand the `$(DEFAULT_LOCATION)` token with the build directory of the model, and the `$(TEMPLATE_NAME)` token with the name of the template application project. It is advisable to keep this default setting unchanged.

- `Template_Application_Project`

  When building a Simulink model with Link for TASKING, the generated projects for your application in the TASKING EDE will have the same project settings as the template application project. This provides a centric place to manage the project options (e.g., compiler settings, linker settings, etc.) your Simulink models use during code generation. You can modify the project settings of the default template projects or create new ones. See "Link for TASKING Menus" on page 1-18 for information on creating or opening template projects, and see "Template Projects" on page 2-5.

- `Template_Library_Project`

  The same as the `Template_Application_Project` field, but this will be applicable for Library projects.

- `Use_State_File`

  Opens the TASKING EDE in its last saved state. For more information, refer to your TASKING EDE documentation.

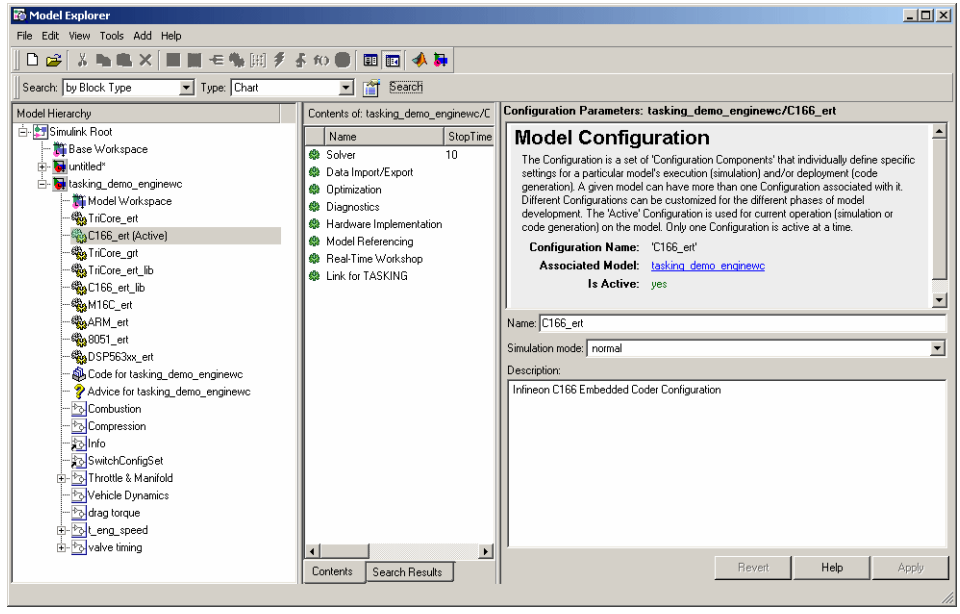
Working with Configuration Sets

Follow the steps in this example to see where to find and change Link for TASKING settings. These steps are described to help you find the settings you need to get started using the demo models. To use the demos, you need to specify your target by working with configuration sets. See “Configuration Sets” in the Simulink documentation for more information.

This example describes how to use Link for TASKING to build a project from a demo model using two different toolchains. The instructions refer to C166 and TriCore TASKING toolchains; adapt the instructions to your toolchain as appropriate.

1. Open the model `tasking_demo_enginewc`.

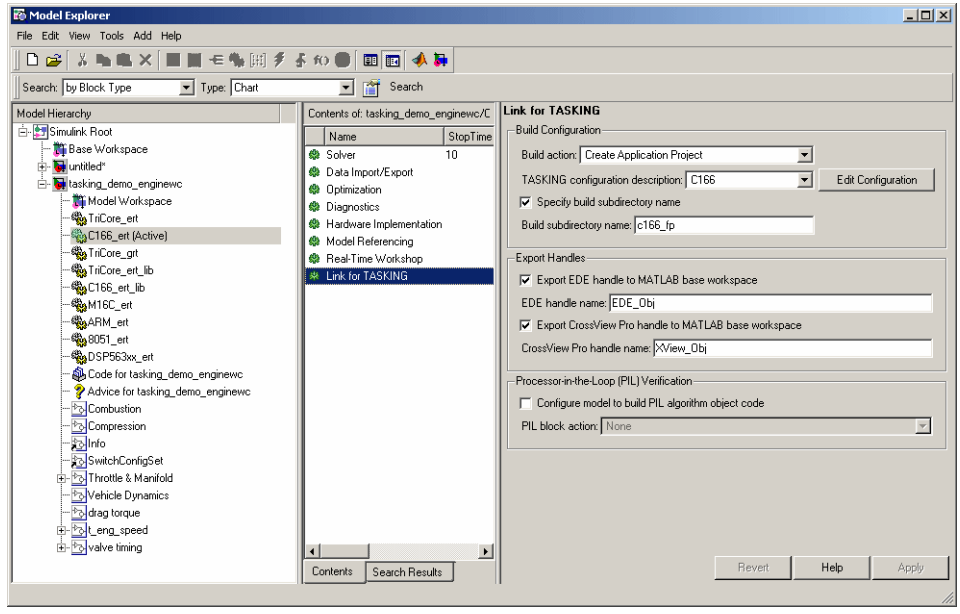
2. Double-click the `Active Configuration Set` block to open the Model Explorer (or select **View > Model Explorer**).



Under `TASKING_demo_enginewc` is a list of configuration sets. The currently selected set is labeled `(Active)`. Inspect the active configuration set.

a The default active configuration set for this model is `C166_ert`. If you want to use a different target, right-click the configuration set that matches your target and select **Activate**.

b Click **Link for TASKING** to see the configuration settings, as shown following.



c The **TASKING configuration description** drop-down list shows all available target preference configurations. Once you have set up target preferences for particular configurations, you can switch between them here (or in the Target Preferences dialog). Click **Edit Configuration** to inspect your current target preferences. Before building, you must replace the string `<ENTER TASKING PATH>` to set up the correct paths to the target preferences `CrossView_Pro_Executable`, the `DOL_File`, and the `EDE_Executable`. See “Setting Target Preferences” on page 1-7.

Click **OK** to dismiss the TASKING Target Preferences Setup dialog.

In the Link for TASKING demos, when you activate a configuration (e.g., `C166_ert`), the appropriate **Tasking configuration description** is automatically selected (e.g., `C166`). You may want to select a different

target preference configuration description, for example if you have set up a custom configuration (e.g., `C167_user_hardware`). For an example, see "Tutorial: Creating a New Configuration" on page 5-6.

See "Link for TASKING Configuration Options" on page 1-24 for information on other Link for TASKING settings in the Configuration Parameters.

d Click **Real-Time Workshop** to see the selected system target file `ert.tlc`.

Note You can use a configuration set specifying any system target file with Link for TASKING.

---

e Click **Hardware Implementation** to see the C166 settings. If you are using a different target, make sure the settings match your device.

f Close the Model Explorer.

3 In the model `tasking_demo_enginewc`, right-click the `t_eng_speed` subsystem and select **Real-Time Workshop > Build Subsystem**. Click **Build** in the dialog to continue.

Watch the output in the MATLAB Command Window as code is generated, your TASKING toolchain EDE is launched and a new project created.

If you have multiple toolchains, you have to set up your target preferences only once, then it is simple to switch between different configurations. For example, to switch configurations from C166 to TriCore targets:

1 In the model `tasking_demo_enginewc`, double-click the `Active Configuration Set` block to open the Model Explorer.

2 Right-click `TriCore_ert` and select **Activate**. Close the Model Explorer.

3 To rebuild the subsystem with the new settings, right-click the `t_eng_speed` subsystem and select **Real-Time Workshop > Build Subsystem**.

Watch the output in the MATLAB Command Window as code is generated, the TASKING C166 EDE is closed, the TASKING TriCore EDE is launched, and the new project created.

You can follow similar steps to specify your target in the demo models. See the "Link for TASKING Demos."

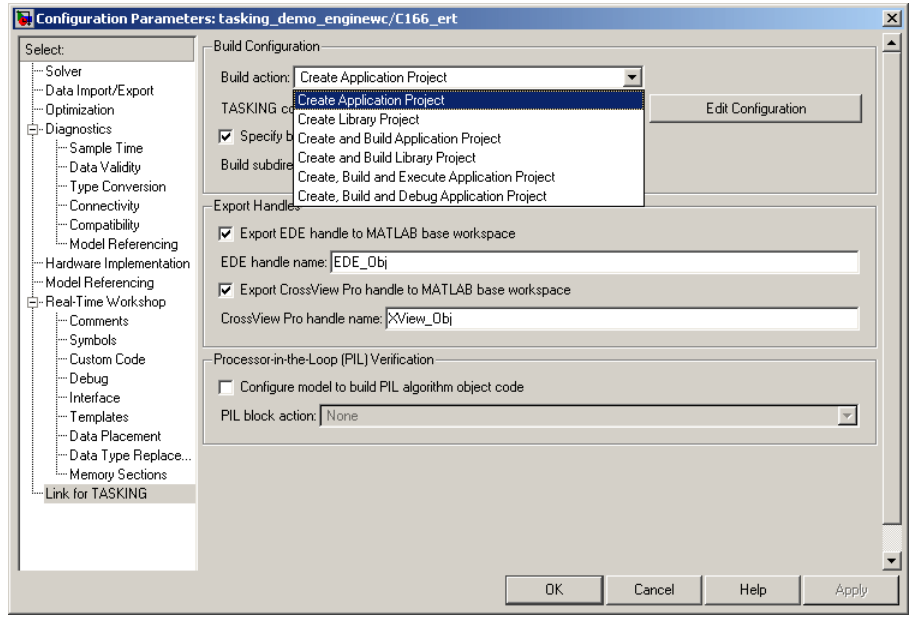
To switch between simulator and hardware implementations for the same target configuration, you can use option sets. See "Option Sets" on page 1-22.

The next section describes using the build action setting in this example.

Setting Build Action

In this example, the project is created but not built in the TASKING EDE. To see this setting,

1. In the model `tasking_demo_enginewc`, select **Simulation > Configuration Parameters**.
2. Click **Link for TASKING** to see the **Build Configuration** parameters.
3. Look at the **Build Action** drop-down list.



Here you can set what action to take after the Real-Time Workshop build process completes. You can create application and library projects in the TASKING EDE and then stop, or you can also choose to build, execute, or debug.

If you choose to build, execute, or debug, CrossView Pro will be launched.

Note the first time you build this model it will take a few minutes to compile the required Real-Time Workshop floating point library. This will not be rebuilt on subsequent builds unless necessary.

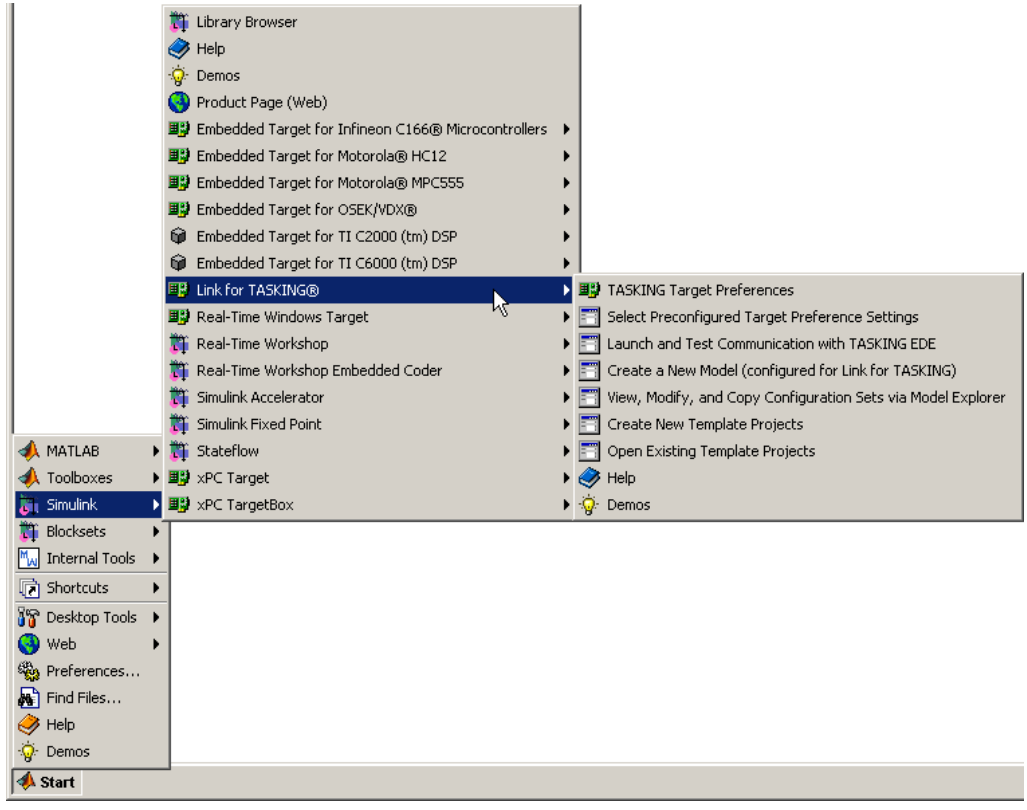
For more information on other build actions, see “Tutorial: Build Actions” on page 5-10.

Link for TASKING Menus

This section describes the menu items, with links to instructions.

Start Menu Items

Common tasks are available in the **Start** menu. Select **Start > Simulink > Link for TASKING** to see the following submenu options.



- **TASKING Target Preferences**

  Opens the TASKING Configuration Selection dialog, and once you have chosen a configuration to match your target (e.g., `TriCore`), you can edit the TASKING Target Preferences Setup dialog. Here you can modify your TASKING preferences configurations. You can also open this dialog from the MATLAB prompt by typing `TASKING_edit_prefs`.

  You must set up your target preferences before you can use Link for TASKING. See “Setting Target Preferences” on page 1-7.

- **Select Preconfigured Target Preference Settings**

  Opens the TASKING Configuration Selection dialog. Choose a configuration to match your target and click **OK**, then you can select a preconfigured option set. Your target preferences are automatically updated according to the option set you select, for example, specifying either hardware or simulator settings. See “Option Sets” on page 1-22.

- **Launch and Test Communication with TASKING EDE**

  Opens the TASKING Configuration Selection dialog. Choose a configuration and click **OK**, and Link for TASKING tests whether MATLAB can communicate successfully with the EDE for the selected configuration. You see messages at the command line to confirm whether communication is successful.

- **Create a New Model (configured for Link for TASKING)**

  Creates a new untitled Simulink model, with Link for TASKING configuration set options already added. You can also configure an existing model by selecting the Simulink model menu item **Tools > Link for TASKING > Add Link for TASKING Configuration to Model**.

- **View, Modify, and Copy Configuration Sets via Model Explorer**

  Opens the Model Explorer where you can edit all configuration sets available for each currently open model.

- **Create New Template Projects**

  The Link for TASKING product ships with preconfigured application and library template projects for the default configurations in the TASKING Preferences. You might, however, create your own template projects (using preconfigured options as a starting point), and use them with any

configuration. See “Tutorial: Creating New Template Projects” on page 5-4 for an example, and “Template Projects” on page 2-5 for more information.

This option opens the TASKING Configuration Selection dialog. Choose a configuration and click **OK**, and Link for TASKING launches the appropriate TASKING EDE and creates new template projects for a specific TASKING configuration. You are prompted to choose a project directory, a template name, and an option set. See “Option Sets” on page 1-22 for more details. `app_template_name.pjt` and `lib_template_name.pjt` are created for the configuration you selected.

- **Open Existing Template Projects**

  Opens the existing application and library template projects in the TASKING EDE for the selected TASKING configuration. You can modify these options; however, it is preferable to do this by first creating new template projects, which avoids overwriting the default template projects. If you modify the default template projects, you can use the following function to recreate the defaults: `tasking_generate_templates`. You must specify your configuration description string, e.g.: `tasking_generate_templates('C166')`.

- **Demos**

  Opens the Link for TASKING Demos page in the Help browser.

Tools Menu Items

In a Simulink model, you can access Link for TASKING items in the **Tools** menu. Select **Tools > Link for TASKING** to see the following submenu items.

- **TASKING Target Preferences**

  As in the **Start** menu, opens the TASKING Configuration Selection dialog, and once you have chosen a configuration, you can edit the TASKING Target Preferences Setup dialog. You must set up your target preferences before you can use Link for TASKING. See “Setting Target Preferences” on page 1-7.

- **Add Link for TASKING Configuration to Model**

  Adds Link for TASKING configuration options to the model configuration parameters.

To see exactly which configuration parameter settings are changed, refer to `tasking_addto_configset.m`. Enter `edit tasking_addto_configset`.

- **Remove Link for TASKING Configuration from Model**

  Removes Link for TASKING configuration options from the model's configuration parameters.

- **Options**

  Opens the Configuration Parameters dialog to show Link for TASKING options. See "Link for TASKING Configuration Options" on page 1-24.

Option Sets

Option sets are preconfigured settings to specify the target configuration for the TASKING tools. For example, once you have set up your target preferences for a Tricore configuration, you can use option sets to switch between using an instruction set simulator configuration, two hardware board configurations, or a simulator with some MISRA-C rule checking.

You can either

- Use option sets to switch between default target configurations, or
- Use option sets when creating new template projects, to set up an initial configuration that you can choose to modify later

See “Tutorial: Using Option Sets” on page 5-2 for instructions.

The following preconfigured option sets are available.

“*” indicates the default in the Target Preferences.

- Infineon TriCore:
  - * `tricore_sim`: Default (TC11IB) instruction set simulator configuration.
  - `tricore_sim_misra`: As `tricore_sim`, but with some example MISRA-C rule checking enabled. See also the TriCore MISRA-C demo example, `tasking_demo_misra.m`, with instructions under Link for TASKING Demos.
  - `tricore_sim_1796b`: Infineon TriCore 1796b hardware configuration.
  - `tricore_sim_1766b`: Infineon TriCore 1766b hardware configuration.
- Infineon C166:
  - * `c166_sim`: Default (C167) instruction set simulator configuration.
  - `c167cs_sim`: Infineon C167CS instruction set simulator configuration.
  - `c167cs_hw`: As c167cs_sim, but targeting hardware rather than simulator.
- Renesas M16C

  - * `m16c_sim`: Default (M30624FGAFP/GP) instruction set simulator configuration.
  - `r8ctiny_sim`: Renesas R8C Tiny (R5F21104FP) instruction set simulator configuration
- Freescale DSP563xx:
  - * `dsp563xx_sim`: DSP563xx Family, 16-bit memory model, instruction set simulator configuration.
  - `dsp566xx_sim`: DSP566xx Family instruction set simulator configuration.
- ARM:
  - * `arm_sim`: Default (ARMv4T) instruction set simulator configuration.
  - `arm_sim_big_endian`: As arm_sim, but in big endian mode.
- 8051:
  - * `i8051_sim`: Default (8051), large memory model, no language extensions, floating point, instruction set simulator configuration.

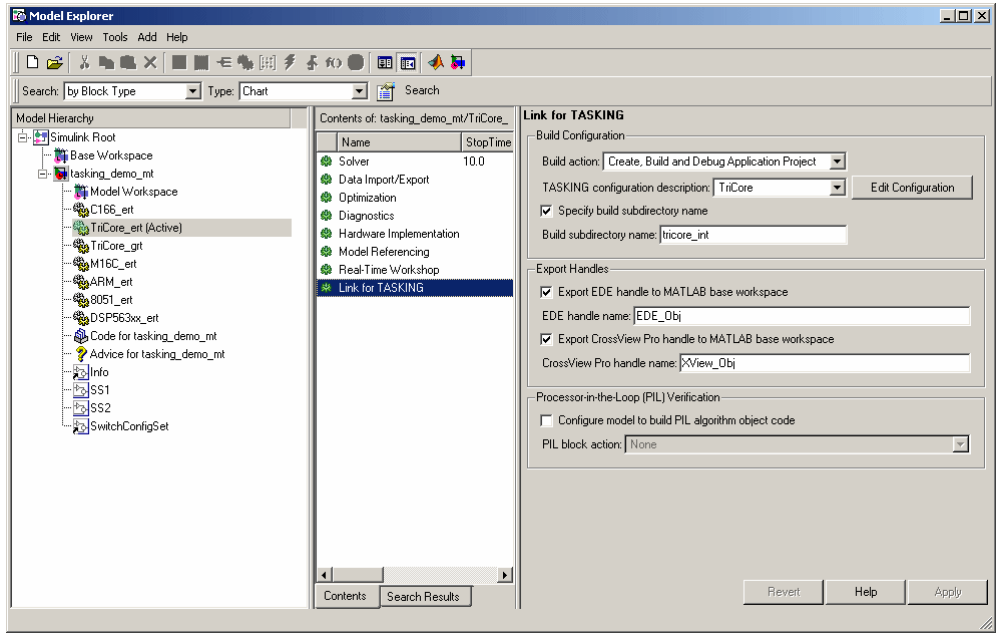
Link for TASKING Configuration Options

Note To add Link for TASKING configuration options to a model, select the menu item **Tools > Link for TASKING > Add Link for TASKING Configuration to Model**.

To see Link for TASKING configuration options, select either

- **Simulation > Configuration Parameters** in a model
- **Tools > Link for TASKING > Options** in a model
- **View > Model Explorer** in a model
- **Start > Simulink > Link for TASKING > View, Modify and Copy Configuration Sets via Model Explorer** in MATLAB

Click Link for TASKING to see the following options.



Under **Build Configuration**

- **Build action**

  Set what action to take after the Real-Time Workshop build process. You can create application and library projects in the TASKING EDE and then stop, or you can also choose to build, execute, or debug. See “Tutorial: Build Actions” on page 5-10 for more details.

- **TASKING configuration description**

  Select target preference configurations here. The names correspond to the `Configuration Description` for each configuration in the TASKING Target Preferences Setup dialog. Click **Edit Configuration** to open the TASKING Target Preferences Setup dialog for the currently selected configuration. See “Working with Configuration Sets” on page 1-13.

- **Specify build subdirectory name**

  Select the check box to specify a subdirectory name and avoid “shared utility function” code generation errors. Prior to code generation, Link for TASKING changes to the specified build subdirectory to avoid conflicts over the “shared utility” location. Clear this check box to use the default Real-Time Workshop build without using a subdirectory — this may result in rebuilding shared libraries unnecessarily. See “Shared Libraries” on page 2-7 and particularly “Supporting Multiple Shared Utility Function Locations: Build Subdirectory Name” on page 2-8 for details.

- **Build subdirectory name**

  Enter a name for the subdirectory in the edit box.

Under **Export Handles**

- **Export EDE handle to MATLAB base workspace**

  Select this check box to export the EDE object handle to the workspace.

- **EDE handle name**

  Enter a MATLAB variable name for the exported handle.

- **Export CrossView Pro handle to MATLAB base workspace**

  Select this check box to export the CrossView Pro object handle to the workspace.

- **CrossView Pro handle name**

  Enter a MATLAB variable name for the exported handle.

See Chapter 3, “Objects” for information on using these object handles.

Under **Processor-in-the-Loop (PIL) Verification**

- **Configure model to build PIL algorithm object code**

  Select this box to build PIL algorithm code.

- **PIL block action**

  Select one of the following PIL block actions

  - `Create PIL block, then build and download PIL application`

    Select this option to automatically build and download the PIL application after creating the PIL block. This is the default when you select the option to configure the model for PIL.

  - `Create PIL block`

    Choose this to create the PIL block and then stop without building. You can build manually from the PIL block.

  - `None`

    Choose this to avoid creating a PIL block, for instance if you have already built a PIL block and do not want to repeat the action.

    See Chapter 4, “Processor-in-the-Loop (PIL) Cosimulation” for more information on using PIL settings.

Known Limitations and Tips

The following issues are known limitations with Link for TASKING, with suggestions for workarounds where possible.

Build Process

EDE is slow, unresponsive or crashes

Tool Suites: All

Problem: Under certain circumstances the TASKING EDE may become slow, unresponsive, or even terminate with virtual memory problems. This is an open issue with the TASKING EDE.

Workaround:

- Close the EDE and try building the model again, and/or
- Try deleting the symbol database file, `cwright.sbl`, which can be found in the EDE_Executable directory ($TASKINGRootDir\bin)

Signal Processing Blockset Library Build Failures

The following problems have been found with Signal Processing Blockset ("`DSP lib`") library builds:

- With Renesas M16C, building the Signal Processing Blockset library with floating point support enabled results in the following error:

  ```
  TASKING program builder v3.1r1 Build 076 SN 00100552
  Assembling qrdc_z_rt.src asm16c E219:
  ["qrdc_z_rt.src" 1692] expression out of range
  (0 and FF hexadecimal)wmk:
  *** action exited with value 1.
  ```

  This is a known bug with the Renesas 16C compiler. Workaround: Disable floating point support in the model.

- With 8051, when trying to build DSP libraries, you may see the following errors with floating- and fixed-point versions:

```
 TASKING program builder v7.1r3 Build 076 SN 00123456
Compiling g711_enc_a_sat_rt.c
cc51 S533: D:\work_dirs\tasking_bugs\8051_fixed_point_dsplib\
g711_enc_a_sat_rt.c: line 34: assertion failed - please report
wmk: *** action exited with value 2.
wmk: "g711_enc_a_sat_rt.src" removed.

TASKING program builder v7.1r3 Build 076 SN 00123456
Compiling burg_a_c_rt.c
wmk: *** action exited with value -1073741571.
wmk: "burg_a_c_rt.src" removed.
```

This is a known bug with the 8051 compiler. Workaround: none.

- With ARM, when trying to build DSP libraries, you may see the following errors with floating- and fixed-point versions:

```
TASKING program builder v1.1r1 Build 078 SN 00123456
Compiling "..\..\..\..\..\..\aetargets with spaces\matlab\
toolbox\rtw\dspblks\c\dspendian\is_little_endian_rt.c"
carm S917: internal consistency check failed - please report
wmk: *** action exited with value 1.

TASKING program builder v1.1r1 Build 078 SN 00123456
Compiling "..\..\..\..\..\..\aetargets with spaces\matlab\
toolbox\rtw\dspblks\c\dspendian\is_little_endian_rt.c"
carm S917: internal consistency check failed - please report
wmk: *** action exited with value 1.
```

This is a known bug with the ARM compiler. Workaround: none.

Model Reference is not supported

Tool Suites: All

Problem: Model reference is not yet supported by Link for TASKING. An informative error is provided.

Workaround: None.

Real-Time Workshop "grt.tlc"-based targets are only supported for 32-bit targets

Tool Suites: Infineon C166, Renesas M16C, 8051, DSP563xx

Real-Time Workshop "grt.tlc"-based targets are not supported for non–32-bit targets. If you use an unsupported combination you see an error of this form:

```
Error using ==> RTW.makertw.PCGHook
Error encountered while executing PostCodeGenCommand:
Error using ==> tasking_post_code_gen_hook>i_processBuildArgs
This model requires support for non-finite floating point values
 ("rt_nonfinite.c").
"rt_nonfinite.c" only compiles on targets with at least a 32-bit
word size.
However, this target has a word size of only: 16 bits.
To avoid this error you can switch to an ERT-based target and
uncheck "non-finite numbers" in the RTW Interface configuration
settings, however you will not be able to use non-finite
floating point values in the model.
```

Workaround: Use a Real-Time Workshop "ert.tlc"-based target.

Memory Block Freed Twice Error

Occasionally, when the Link for TASKING is creating projects in the TASKING EDE, the following error appears: `Memory block freed twice`. This is a known bug in the TASKING EDE.

To work around the problem, click **OK** in the error dialog, and the code generation process will continue as normal.

8051 EDE cannot compile files with long names

If you encounter this problem you will see error messages like the following:

```
Assembling tasking_fuel_controller_ert_rtw_pil_cstart.src
asm51 E001: tasking_fuel_controller_ert_rtw_pil_cstart.src: line 1:
syntax error
wmk: *** action exited with value 1.
```

This indicates that the full path of the model or subsystem you are trying to build is too long. Consider moving the model to a shorter directory name, or renaming the model/subsystem to use shorter names.

8051 Compiler Bug: Assertion Failure

When building 8051 projects you may see the following error:

```
TASKING program builder v7.1r3 Build 076 SN 00123456

Compiling compilerassertion.c

cc51 S518: D:\Applications\tasking\8051\v7.1r3\examples\banksw\
compilerassertion.c: line 23: assertion failed - please report

wmk: *** action exited with value 2.

wmk: "compilerassertion.src" removed.
```

This is a known bug with the 8051 compiler. Workaround: none

8051 8-bit code generation problem for signals with large dimensions

Problem: Real-Time Workshop defines the "int_T" datatype as an 8-bit integer datatype on the 8051 architecture. In the generated code, "int_T" is often used as a loop index variable. For signals with large dimensions (>127), the required number of iterations of loops in the generated code is correspondingly large, and this results in overflowing of the loop index variable. This overflow can lead to infinite loops during execution of the generated code, and results in timeout errors during PIL cosimulation.

Workaround: On the 8051 platform, do not use signals that require loop index variables to represent values larger than 127 in the generated code.

ARM GRT Build Failure

With ARM, when building with the `grt` system target file, you may see the following error:

```
TASKING program builder v1.1r1 Build 078 SN 00123456
```

```
Compiling "..\..\slprj\grt\_sharedutils\rt_nonfinite.c"
carm S917: internal consistency check failed - please report
wmk: *** action exited with value 1.
```

This is a known bug with the ARM compiler. Workaround: none.

DSP563xx Toolset Support Limitations

Some limitations should be noted for the DSP563xx Toolset.

- Only 16-bit mode for the DSP563xx Family is supported. As for other 16-bit targets, Real-Time Workshop “grt.tlc”-based targets are not supported; for this toolset the "GRT Compatible Call interface" option in the Real-Time Workshop Interface settings is also not supported. This is due to the non-standard size of single- and double-precision floating-point datatypes on this architecture (`tmwtypes.h` will not compile)
- The DSP5600x Toolset is NOT supported because none of the processors supported by this toolset have 16-bit memory models.
- PIL is not supported for the DSP563xx Toolset owing to the fact that it is a word addressable architecture and this is not yet supported by PIL. Only byte addressable architectures are supported.
- Both 16-bit memory models of the DSP563xx Family produce watch errors (wrong values displayed) in CrossView Pro owing to a bug in the TASKING toolset. CrossView Pro does not know that the datatype sizes should be different according to the selected memory model. Note: this does not affect the DSP566xx Family.

“Create, Build and Execute Application Project” Build Action fails

Tool Suites: Renesas M16C

Problem: Executing the application project, rather than debugging (via “Create, Build and Debug Application Project) does not work correctly, because the CrossView Pro Simulator does not know the start address when debugging information is not loaded. The application does not execute.

Workaround: Once CrossView Pro has launched,

1. Stop execution by clicking the Halt button
2. Execute the following command in the CrossView Pro command window to determine the application entry point stored at location 0xfffffc

   ```
   *((unsigned long *)0xfffffc)/x
   ```

   Example output for this command is:

   ```
   0xfffffc = 0x000d0000
   ```

3. Change the execution position to the application entry point by executing the "gi" command, using the output of the previous command. For example, `0xd0000 gi`
4. Resume execution by clicking the Run/Continue button.

Alternatively, use the “Create, Build and Debug Application Project” build action.

Processor-in-the-Loop (PIL)

TASKING TriCore 1766B PIL Limitation

The demo "tasking_demo_pil_toplevel_testharness" does not work correctly for PIL, due to a TASKING bug relating to setting breakpoints. The PIL application does not download correctly in CrossView Pro and causes a 60 second pause in MATLAB before the following error occurs:

```
Error using ==> tasking.xviewapi.executeAndWait
Command "s", sequence number 14, timed out after 60 seconds.
```

Other PIL demos like `tasking_demo_pil_library_testharness` and `tasking_demo_autotrans` do work correctly. However, customers’ PIL models on this platform may run into the same issue.

8051 link order bug can cause PIL application failure

When building PIL applications for 8051 you may see linker warnings like the following.

```
link51 W001: unresolved external symbol
 '_?BINARYSEARCH_S16', module t_fuelsys.obj
link51 W001: unresolved external symbol
'_?DotProduct_s32s16', module t_fuelsys.obj
link51 W001: unresolved external symbol
 '_?INTERPOLATE_S16_S16_SAT', module t_fuelsys.obj
```

If this happens an error will be reported by the PIL block during cosimulation.

Workaround: if you encounter this you can contact TASKING for a patch to make it possible to use the multipass option to rescan multiple libraries.

8051 PIL timeout errors

See limitation and workaround details in “8051 8-bit code generation problem for signals with large dimensions” on page 1-30.

Support for Buses / Mux Signals at boundary

Problem: Buses / Mux Signals are not supported at the PIL component boundary

Workaround: None.

Signals with Custom Storage Classes are not supported at the PIL component boundary

Problem: As title. Workaround: None. However, note that the standard non-custom storage classes, like ExportedGlobal, are supported.

Continuous sample times not supported

Continuous sample times are not supported by PIL. If you encounter this you see the following error:

```
??? Processor-in-the-Loop (PIL) does not support continuous
time. Please uncheck "continuous time" in the RTW Interface
```

```
configuration set options or disable PIL.
```

Workaround: none. You must use discrete sample times.

Real-Time Workshop "grt.tlc"-based targets are not supported for PIL

Problem: As title.

Workaround: Use a Real-Time Workshop "ert.tlc"-based target.

Enabled / Triggered subsystems are not supported

Problem: As title.

Workaround: None.

Warnings caused by infinite sample times

When some of the PIL algorithm's inputs and/or outputs have infinite sample times the following warning may occur when using the corresponding PIL block:

```
Warning: Inconsistent sample times.
Sample time of signal ([1.#INF, 0]) driving input port 1
of 'pil_inf_input_tasking/Subsystem' differs from the expected
sample time at this input port ([1, 0]).
```

These warnings occur because the PIL block uses the discrete sample times associated with the PIL algorithm code rather than the corresponding infinite sample times associated with the PIL algorithm model. This warning can be ignored and no differences between simulation and PIL cosimulation results are known to occur.

Workaround: Do not use signals with infinite sample times at the PIL algorithm boundary.

No support for TASKING feature "treat double as float"

You can enable the feature in a TASKING project to treat the double precision floating point datatype "double" as the single precision floating point datatype

"float". Usually, this means that double precision floating point datatypes are represented in 4 bytes rather than 8 bytes.

PIL always assumes that the "double" datatype is represented normally. If you enable the 'treat double as float' override, PIL will not be able to correctly transfer "double" datatypes between host and target, and cosimulation errors will occur. Note that the default templates that ship with Link for TASKING do not enable the override.

Workarounds:

- Do not use the option to treat “double” as “float”. In this case, double precision floating point values are represented normally.
- Use the "single" datatype in Simulink rather than "double". In this case, the option to treat “double” as “float” will have no effect on PIL, because no "double" datatypes will be used.

TASKING optimization settings may cause incorrect cosimulation results

Sometimes you may observe differences between simulation and PIL cosimulation results. The code compiled and running in the TASKING environment may not always behave correctly, even when the generated code is correct. One cause of this, particularly with the TriCore toolset, is the compiler optimization configuration used to build the generated code.

Workaround: If you see differences between simulation and PIL cosimulation results, try setting the compiler optimization settings in the template projects to either `No optimization`, `Debug purpose`, or a similar equivalent for your TASKING toolset. Then, build the PIL algorithm and PIL application again and try repeating the cosimulation.

To create new template projects and modify their project settings see “Tutorial: Creating New Template Projects” on page 5-4.

2

Build Process

Build Process Overview

The Link for TASKING provides a customized build process that is designed to work with the highly customized code generation process provided by Real-Time Workshop.

To explain the separation of duties between Real-Time Workshop and Link for TASKING, the following sections elaborate on the terms “code generation process” and “build process”.

Code Generation Process

The code generation process is performed by the Real-Time Workshop family of products and is the process of translating a Simulink model into C code.

Customized code generation, perhaps to create target-specific device drivers or target-optimized code, is often a key requirement for users wishing to generate code from Simulink models.

Real-Time Workshop and Real-Time Workshop Embedded Coder provide a variety of mechanisms for users to customize the code generation process. For example, the standard code generation process, using the regular system target files (like `grt.tlc` and `ert.tlc`) can be customized by making changes to the model’s configuration parameters. Alternatively, for an even greater level of customization, including the ability to define custom Real-Time Workshop options, you can use a user created system target file.

The demos that come with Link for TASKING make use of the first type of customization described above. That is, the standard code generation process has been tailored for the appropriate target platform simply by changing the model’s configuration parameters.

Of course, for greater flexibility, you should use a custom system target file. For further details on customizing the code generation process, see the Real-Time Workshop and Real-Time Workshop Embedded Coder documentation.

Build Process

The build process is performed by Link for TASKING and is the process of taking the C code produced by the code generation process and building (assembling, compiling, and linking) it for the target platform.

A customized build process, perhaps to use optimized compiler and linker settings, or perhaps to produce a MISRA compliance report, is often a key requirement for users wishing to build code produced from Simulink models.

Link for TASKING provides access to the full build process customization capabilities of the TASKING tools by allowing the user to set up the exact required configuration in TASKING. Link for TASKING then uses this configuration as a template for the build process.

Memory Placement Example

As an example, to consolidate the descriptions above, consider the common task of placing program data into a particular area of memory on a target platform.

Usually, this is achieved by using compiler-specific notations (like #pragmas) to define special “memory sections” and to assign data definitions to those sections. Additionally, a linker command file defines the different available “memory regions” on the target, and where in these regions the different memory sections should be located.

Splitting this task between the processes of code generation and building could be done as follows:

1. Customized code generation defines memory sections and assigns data.
2. Customized build process defines memory regions and assigns memory sections.

Project-Based Build Process

The Link for TASKING build process automatically creates TASKING EDE projects representing the application and libraries to be built.

A Real-Time Workshop application usually consists of some application code that makes references to modules that are part of libraries like the Real-Time Workshop library. Another common library is the Signal Processing Blockset library, used with the Signal Processing Blockset.

Link for TASKING creates separate projects for the main application code and each required library. The required libraries are included in the main application projects as subprojects.

Although the build process is project-based, underlying the projects are "makefiles" that can be used independently of the EDE. For an example of how to obtain the appropriate make command, see the demo instructions in `tasking_demo_objects.m` .

Target Project Space

Link for TASKING places projects in a project space known as the *target project space*. The location of the target project space is controlled by the `Target_Project_Space` setting in the Target Preferences, and usually depends on the name of the template application project (see `$(TEMPLATE_NAME)` token) that triggered the build process, as well as the current directory at the time the build process is invoked (see `$(DEFAULT_LOCATION)` token).

Template Projects

Template projects are regular TASKING EDE projects that are used by Link for TASKING to allow customization of the build process. Template projects are tied to particular TASKING Configurations as set up in the Target Preferences.

There are two types of template projects: application, and library template projects.

The application template project is used as the template for application projects and the library template project is used as the template for library projects.

Relocation of Template Projects

During the build process, the template project is copied to a target project location, and is then populated with the information relating to how to build the generated code.

Therefore, the project options of the template project become the project options of the target project, and hence the build process is customized according to the template project.

On subsequent build processes, Link for TASKING determines whether the template project has been updated since it was last copied to the target project location. If it has, then the target project is updated with a new copy of the template project. Otherwise, the target project is not updated from the template project.

Note Project options should be updated in the template project and not in the target project.

How the Build Process Modifies the Relocated Template Project

The Link for TASKING build process determines if any changes (preprocessor defines, include paths and source files) to the target project are required to

build the code associated with a particular model, and will update the target project only if required. Thus, unnecessary project rebuilding is avoided.

Any source files and include paths in the template project will always be maintained in the target project. This is useful for keeping startup code that is automatically generated by the EDE, and also the include path to the compiler's standard header files.

Preprocessor defines in the template project are not maintained in the target project and will be overwritten with preprocessor defines associated with the model during the build process.

Shared Libraries

Link for TASKING models that share the same target project space share required libraries such as the Real-Time Workshop library. This means that a library is only built the first time a model that requires it is built.

The advantages of this shared library approach are

- No unnecessary per-model building of libraries; models with similar library requirements (e.g., integer code only) can share libraries.
- Libraries are built with the project options specified in the corresponding template project.
- Multiple sets of libraries, each with custom model and/or project options, can coexist.

Utility Function Generation: Shared Location

The above shared library approach uses the Real-Time Workshop "Utility Function Generation" feature.

By setting utility function generation to use a shared location, rather than the model-specific default, you can ensure that the library projects created have no dependence on model-specific generated code. This feature is the key to allowing library projects to be shared between models.

As an example, consider the generated header file, `rtwtypes.h`, that contains the set of Real-Time Workshop data types available for compiling code modules, including any libraries.

With the utility function generation set to the default, individual `rtwtypes.h` files are generated into each code generation directory. Therefore, there would be multiple definitions of `rtwtypes.h` for a library shared between these models. The problem is, how can one of these `rtwtypes.h` files be chosen to build the library?

Setting the utility function generation to use a shared location provides a solution. In this case, a single `rtwtypes.h` file is generated into a directory shared between a set of models. This single file can be used to build the library without any dependence on the model-specific generated code.

Supporting Multiple Shared Utility Function Locations: Build Subdirectory Name

The approach outlined above works well for a single set of models that have the same shared utility requirements.

However, what happens if you have two sets of models, each set with different shared utility requirements?

Normally, the Real-Time Workshop code generation process uses the current working directory as the location for generated files. In this location, it supports only a single shared utilities directory for each system target file. Therefore, it is possible for conflicts over the contents of the shared utility directory to occur.

For example, this would occur if the Hardware Implementation settings were different for two models using the same system target file. If the standard `grt.tlc` or `ert.tlc` code generation process is customized by changing configuration set parameters, this is a highly likely situation.

Another common example of this conflict, for two models sharing the same system target file, would be if one model was configured to support floating-point numbers and the other was configured to support integer code only.

To work around this problem, Link for TASKING provides the “Specify Build Subdirectory Name” and “Build Subdirectory Name” settings.

During a Link for TASKING build, if the **Specify Build Subdirectory Name** check box is enabled then the name specified in the **Build Subdirectory Name** setting is used as the name of a directory to change to from the current working directory location. If this directory does not exist, it is created automatically.

Therefore, specifying the same build subdirectory name for a similar set of models allows them to generate code into their own working directory, avoiding conflict with other models, while still allowing a shared utilities directory.

At the end of the build process, the original working directory is restored.

This feature of Link for TASKING removes the need for the user to manually manage changing directories to avoid shared utility directory conflicts.

See the demo models for examples of using this setting: Link for TASKING Demos.

Build Process — Directory Structure

The following table shows the typical directories that are created, relative to the current working directory, during the Real-Time Workshop code generation process and Link for TASKING build process. Library files are specific to library builds.

Note If the Link for TASKING Build Subdirectory option is being used, then the directories in the table are relative to the build subdirectory.

Directory	Contents
`$(TEMPLATE_NAME)\pjt_$(CODEGEN)`	Main application project: `$(CODEGEN).pjt` and associated files (only for application builds).
`$(TEMPLATE_NAME)\pjt_exp_-$(CODEGEN)`	Main library project: `exp_$(CODEGEN).pjt` and associated files (only for library builds).
`$(TEMPLATE_NAME)\pjt_rtwlib` (if required)	Real-Time Workshop library project: `rtwlib.pjt` and associated files.
`$(TEMPLATE_NAME)\pjt_rtwshared` (if required)	Shared utilities library project: `rtwshared.pjt` and associated files.
Key	
`$(CODEGEN)`	Real-Time Workshop code generation directory name
`$(TEMPLATE_NAME)`	Token expanded from the name of the template application project in the target preferences. If the project name is prefixed with "`user_`" this is removed. `$(CONFIG_DESC)` is a valid alternative, which expands to the name of the TASKING configuration decription.

See the next section, “Command Line Project Information” on page 2-11, for details about finding file names, paths and other build information.

Command Line Project Information

When you build an application you can see information containing links at the MATLAB command line. You can use these links to get further details such as paths to projects, preprocessor defines, include paths, added files and their locations.

An example output is shown below.

```
### Building the PIL Application...
### Updating EDE projects according to BuildInfo object.
Please wait...
Creating project: t_shift_alg_ert_rtw_pil.pjt
Updating preprocessor defines in project:
t_shift_alg_ert_rtw_pil.pjt
Updating include paths in project:
t_shift_alg_ert_rtw_pil.pjt
Adding source files to project:
t_shift_alg_ert_rtw_pil.pjt
```

You can click the hyperlinks within these messages to get more information. The build messages are more readable with this information hidden, and the links provide access when you require more details.

Click the project file name (e.g., `t_shift_alg_ert_rtw_pil.pjt`) to see the full path to the project being built, like the following example.

```
Project path: D:\MATLAB\\work\tricore_fp\tricore_sim\
pjt_t_shift_alg_ert_rtw_pil\t_shift_alg_ert_rtw_pil.pjt
```

Click `preprocessor defines` to see a list of preprocessor defines like the following.

```
t_shift_alg_ert_rtw_pil.pjt preprocessor defines:

ADD_MDL_NAME_TO_GLOBALS=1
INTEGER_CODE=0
```

```
MAT_FILE=0
MODEL=t_shift_alg
MT=0
MULTI_INSTANCE_CODE=0
NCSTATES=0
NUMST=1
ONESTEPFCN=1
TERMFCN=1
TID01EQ=0
```

Click `include paths` to see a list of include paths like the following.

```
t_shift_alg_ert_rtw_pil.pjt include paths:

$(PRODDIR)\include
D:\MATLAB\work\tricore_fp\t_shift_alg_ert_rtw
D:\MATLAB\work\tricore_fp
D:\MATLAB\matlab\toolbox\rtw\targets\tasking\taskingdemos
D:\MATLAB\matlab\extern\include
D:\MATLAB\matlab\simulink\include
D:\MATLAB\matlab\rtw\c\src
D:\MATLAB\matlab\rtw\c\libsrc
D:\MATLAB\matlab\rtw\c\ert
D:\MATLAB\work\tricore_fp\slprj\ert\_sharedutils
D:\MATLAB\matlab\toolbox\rtw\targets\tasking\tasking\pil
D:\MATLAB\work\tricore_fp\t_shift_alg_ert_rtw_pil
```

Click `source files` to see a list of files added and their full paths.

```
t_shift_alg_ert_rtw_pil.pjt added files:

D:\MATLAB\toolbox\rtw\targets\tasking\tasking\pil\
pil_interface.h
D:\MATLAB\toolbox\rtw\targets\tasking\tasking\pil\
pil_interface_common.h
D:\MATLAB\toolbox\rtw\targets\tasking\tasking\pil\
pil_interface_lib.c
D:\MATLAB\toolbox\rtw\targets\tasking\tasking\pil\
pil_interface_lib.h
D:\MATLAB\toolbox\rtw\targets\tasking\tasking\
```

```
tasking_pil_main.c
D:\MATLAB\work\tricore_fp\t_shift_alg_ert_rtw_pil\
pil_interface.c
D:\MATLAB\work\tricore_fp\t_shift_alg_ert_rtw_pil\
pil_interface_data.h
D:\MATLAB\work\tricore_fp\tricore_sim\
pjt_exp_t_shift_alg_ert_rtw\exp_t_shift_alg_ert_rtw.pjt
D:\MATLAB\work\tricore_fp\tricore_sim\pjt_rtwlib\rtwlib.pjt
```

3

Objects

Objects for Link for TASKING

Link for TASKING uses object-oriented programming techniques and requires a basic knowledge of some object-oriented terminology. Some fundamental terms are described below.

- Object — Something you can operate on. An object is an instance of a class, created by calling the class constructor.
- Class — A class defines the properties and methods common to all objects of the class.
- Constructor — A function that creates an object, based on the class definition, and initializes it.
- Method — An operation on an object, defined as part of the class definition.
- Property — Part of an object, treated as a variable at times, that is defined as part of the class definition.
- Handle — A mechanism to access any object that Link for TASKING creates. Used in this guide to refer to the object. Often the handle is the name you assign when you create the object.

The following sections describe how to use and get help for Link for TASKING objects. See “Objects Demo Example” on page 3-7 for an example demonstrating some basic capabilities of Link for TASKING objects.

Classes

The following table shows the different classes that are provided with Link for TASKING.

Class	Description
`tasking.edeapi`	Represents the TASKING EDE.
`tasking.edeprojectspace`	Represents a project space in the TASKING EDE.
`tasking.edeproject`	Represents a project in the TASKING EDE.
`tasking.xviewapi`	Represents the TASKING CrossView Pro debugger.
`tasking.Tasking_Configuration`	Property of a `tasking.edeapi` class representing TASKING configuration details.
`tasking.EDE_Configuration`	Property of a `tasking.tasking_Configuration` representing EDE configuration details.
`tasking.CrossView_Pro_Configuration`	Property of a `tasking.tasking_Configuration` representing CrossView Pro configuration details.

Using Objects

The topics in this section are:

Creating an Object

To find out how to create an object of a particular class you can use the `tasking_help` function to find help for the constructor. At the MATLAB command prompt, enter

```
tasking_help <classname>.<constructorname>
```

For example, for the `tasking.edeapi` class, enter

```
tasking_help tasking.edeapi.edeapi
```

Or, for the `tasking.edeprojectspace` class, enter

```
tasking_help tasking.edeprojectspace.edeprojectspace
```

Follow these steps to create example objects.

1. To create a `tasking.edeapi` object, you call the constructor as follows:

   ```
   Ede = tasking.edeapi
   ```

   The name on the left side of the "=" could be any valid MATLAB identifier and is the handle to the object.

   You must choose a configuration, then communication is tested with the TASKING EDE. At the command line you see the configuration target preferences.

2. To create a `tasking.edeprojectspace` object, you call the constructor as follows

   ```
   tasking.edeprojectspace(projspace, edeapi)
   ```

   Where `projspace` is the absolute path of the TASKING Project Space this object will relate to, and `edeapi` is a `tasking.edeapi` object, as shown in the following example.

   ```
    ps = tasking.edeprojectspace('D:\MATLAB\work\
   myprojspace.psp', Ede)
   ```

3. To create a `tasking.edeproject` object, you call the constructor as follows

   ```
   tasking.edeproject(proj, edeprojspace)
   ```

   Where `proj` is the absolute path of the TASKING Project this object will relate to, and `edeapiprojspace` is a `tasking.edeprojectspace` object, as shown in the following example.

   ```
   proj = tasking.edeproject('D:\MATLAB\work\myproj.pjt', ps)
   ```

4. To create a `tasking.xviewapi` object, you call the constructor as follows

   ```
   xv = tasking.xviewapi
   ```

   You must choose a configuration, then communication is tested with CrossView Pro. At the command line you see the configuration target preferences.

Determining the Available Methods for a Class

Once you have created an object, you can find the available methods by running the "methods" function.

1. For example, to find the methods available on the `tasking.edeapi` object created above (in "Creating an Object" on page 3-4), enter `methods(Ede)`.
2. To find the methods available on the `tasking.edeprojectspace` object created above, enter `methods(ps)`
3. To find the methods available on the `tasking.edeproject` object created above, enter `methods(proj)`
4. To find the methods available on the `tasking.xviewapi` object created above, enter `methods(xv)`

To see the methods available, refer to the tables in "List of Methods" on page 3-8.

Obtaining Help for a Class Method

To get help for a class method, you can use the `tasking_help` function.

For example, to find out more about the `getProject` method of the `tasking.edeapi` class, you could enter the following command:

```
tasking_help tasking.edeapi.getProject
```

MATLAB returns the following output:

```
GETPROJECT - get the active Project in the EDE
project = getProject
project: edeproject object representing the active Project
 in the EDE
project will be empty if there is no open project
```

To see the methods available, refer to the tables in "List of Methods" on page 3-8.

Calling a Method

Once you know the details of a class method, you can call it using dot (.) notation.

For example, to get a `tasking.edeproject` object representing the active project, run the following command:

```
project = Ede.getProject
```

Determining the Available Properties for a Class

Once you have created an object, you can find the available properties by running the `get` function.

For example, to find the properties available on the `tasking.edeapi` object created above, enter

```
get(Ede)
```

Accessing a Property

You can access a property of a class using dot (.) notation.

For example, to get the "configuration" property of the `tasking.edeapi` object created above, enter:

```
config = Ede.configuration
tasking.Tasking_Configuration (handle)
      Configuration_Description: 'C166'
              EDE_Configuration: [1x1 tasking.EDE_Configuration]
    CrossView_Pro_Configuration: [1x1 tasking.CrossView_Pro_
Configuration]
```

Objects Demo Example

For hands-on experience you can work through the demo example, `tasking_demo_objects.m`, found under Link for TASKING Demos.

This example provides step-by-step instructions for using Link for TASKING objects to communicate with the TASKING EDE and CrossView Pro debugger from the MATLAB command line. This illustrates using objects during the process of building and debugging projects.

List of Methods

See the following tables for lists of available methods:

The public methods are shown in the tables (methods beginning with "p" or "p_" are private methods and should not be used).

Methods for Class tasking.edeapi

Methods for class tasking.edeapi	
closeIDE	getOptionSetNames
disp	getProject
display	getProjectSpace
edeapi	getTargetProject
exec	getToolchainInfo
execApiMacro	newProject
execRetNumeric	newProjectSpace
execRetString	newProjectTemplates
getCreatedEDEProcess	newProjectTemplatesViaUI
getOptionSet	newTempProjectSpaceIfNoneOpen
open	processTemplateProject
openProjectTemplates	validateToolchainDirectory
pwd	

Methods for Class tasking.edeprojectspace

Methods for class tasking.edeprojectspace	
add	deleteParentDir
getEDE	isopen
checkValid	disp
getOriginalPath	new
checkValidProject	display
getPath	open
close	edeprojectspace
isequal	remove

Methods for Class tasking.edeproject

Methods for class tasking.edeproject		
add	getEDE	isopen
build	getFiles	new
checkValid	getHyperlink	open
close	getIncludes	rebuild
debug	getMakeCmd	remove
disp	getOriginalPath	run
display	getPath	setCDefines
edeproject	getProjectSpace	setIncludes
getBuildOutput	getTarget	setPerformToolchainNameCheck
getCDefines	hasFile	
getDir	isequal	

Methods for Class tasking.xviewapi

Methods for class tasking.xviewapi	
addBreakpointCallback	getEventReporting
getFunctionConfiguration	debug
disp	halt
removeBreakpointCallbacks	display
isRunning	setEventReporting
downloadAndRun	execute
xviewapi	executeAndWait
getCommandResponse	

4

Processor-in-the-Loop (PIL) Cosimulation

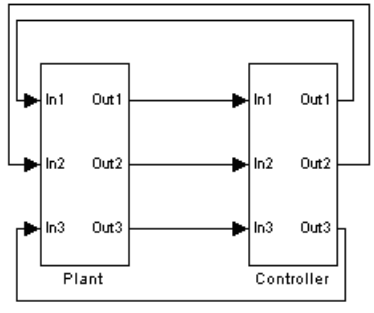
Overview of PIL Cosimulation

The Link for TASKING supports processor-in-the-loop (PIL) cosimulation, a technique that is designed to help you evaluate how well a candidate algorithm (e.g., a control system) operates on the actual target processor selected for the application.

During the Real-Time Workshop Embedded Coder code generation process, a PIL block can be created by Link for TASKING from one of several Simulink components including a model, a subsystem in a model, or subsystem in a library. You then place the generated PIL block inside a Simulink model that serves as the test harness, and run tests to evaluate the target-specific code execution behavior.

Why Use Cosimulation?

PIL cosimulation is particularly useful for simulating, testing, and validating a controller algorithm in a system comprising a plant and a controller. In classic closed-loop simulation, Simulink and Stateflow® model such a system as two subsystems and the signals transmitted between them, as shown in this block diagram.



Your starting point in developing a plant/controller system is to model the system as two subsystems in closed-loop simulation. As your design progresses, you can use Simulink external mode with standard Real-Time

Workshop targets (such as GRT or ERT) to help you model the control system separately from the plant.

However, these simulation techniques do not help you to account for restrictions and requirements imposed by the hardware (e.g., limited memory resources, or behavior of target-specific optimized code). When you finally reach the stage of deploying controller code on the target hardware, you may need to make extensive adjustments to the controller system. Once these adjustments are made, your deployed system may diverge significantly from the original model. Such discrepancies can create difficulties if you need to return to the original model and change it.

PIL cosimulation addresses these issues by providing an intermediate stage between simulation and deployment. The term "cosimulation" reflects a division of labor in which Simulink models the plant, while code generated from the controller subsystem runs on the actual target hardware. In a PIL cosimulation, the target processor participates fully in the simulation loop — hence the term "*processor-in-the-loop*."

Definitions

PIL Algorithm

This is the algorithmic code (e.g., the control algorithm) to be tested during the PIL cosimulation. The PIL algorithm resides in compiled object form to allow verification at the object level.

PIL Application

This is the executable application to be run on the target platform. The PIL application is created by linking the PIL algorithm object code with some wrapper code (or "test harness") that provides an execution framework that interfaces to the PIL algorithm.

The wrapper code includes the `string.h` header file so that the `memcpy` function is available to the PIL application. The PIL application uses `memcpy` to facilitate data exchange between Simulink and the cosimulation target. NOTE: Whether the PIL algorithm code under test uses `string.h` is independent of the use of `string.h` by the wrapper code, and is entirely dependent on the implementation of the algorithm in the generated code.

How Cosimulation Works

In a PIL cosimulation, Real-Time Workshop generates efficient code for the PIL algorithm. This code runs (in simulated time) on a target platform. The plant model remains in Simulink without the use of code generation.

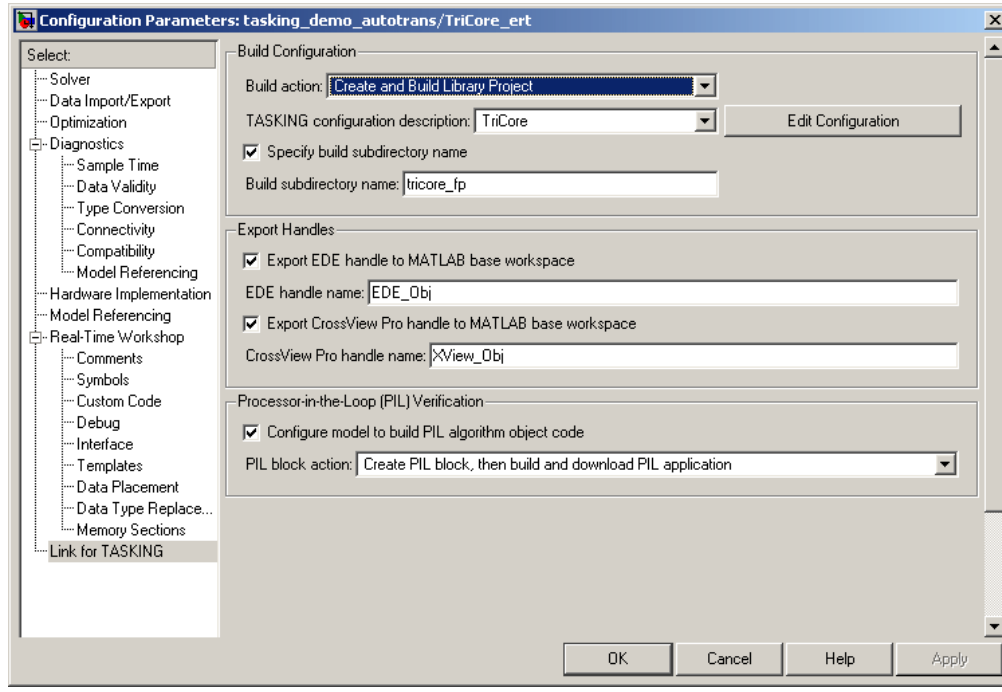
During PIL cosimulation, Simulink simulates the plant model for one sample interval and exports the output signals (Yout of the plant) to the target platform via the CrossView Pro debugger. When the target platform receives signals from the plant model, it executes the PIL algorithm for one sample step. The PIL algorithm returns its output signals (Yout of the algorithm) computed during this step to Simulink, via the CrossView Pro debugger. At this point, one sample cycle of the simulation is complete and the plant model proceeds to the next sample interval. The process repeats and the simulation progresses.

PIL tests do not run in real time. After each sample period, the tests halts to ensure that all data has been exchanged between the Simulink test harness and object code. You can then check functional differences between the model and generated code. During a PIL test, you can use the TASKING debugger to set breakpoints, step through the code, and watch variables.

After the test, Link for TASKING returns execution profiling and code coverage reports to MATLAB for your review. See “Coverage and Profiling Reports” on page 4-12 for more information.

Creating a PIL Block

The PIL settings can be found in the Configuration Parameters dialog under the Link for TASKING settings.



Under **Processor-in-the-Loop (PIL) Verification**

- **Configure model to build PIL algorithm object code**

  Select this box to create PIL algorithm object code as part of the Real-Time Workshop code generation process.

- **PIL block action**

  Select one of the following PIL block actions

  - `Create PIL block, then build and download PIL application`

Select this option to automatically build and download the PIL application after creating the PIL block. This is the default when you select the option to configure the model for PIL.

- `Create PIL block`

  Choose this to create the PIL block and then stop without building. You can build manually from the PIL block.

- `None`

  Choose this to avoid creating a PIL block, for instance if you have already built a PIL block and do not want to repeat the action.

Once you have created and built a PIL block, you can

- copy it into your model to replace the original subsystem (save the original subsystem in a different model so it can be restored), or
- add it to your model to compare with the original subsystem during cosimulation.

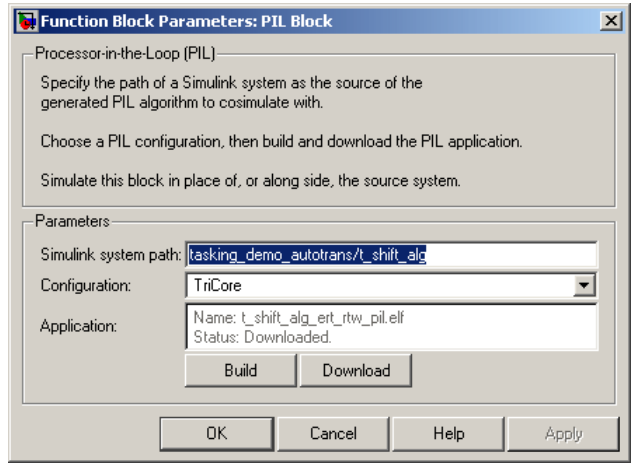
See “Building, Running, and Debugging PIL Applications” on page 4-10 for more details.

The PIL Cosimulation Block

The PIL cosimulation block is the Simulink block interface to PIL. The Simulink inputs and outputs of the PIL cosimulation block are configured to match the input and output specification of the PIL algorithm.

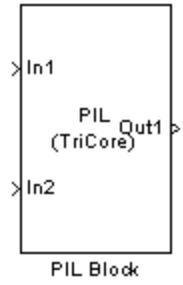
The block is a basic building block that allows you to:

- Select a PIL algorithm
- Choose a PIL configuration
- Build and download a PIL application
- Run a PIL cosimulation



See the next section, “Building, Running, and Debugging PIL Applications” on page 4-10 for instructions for using the PIL block.

The PIL block takes the same shape and signal names as the parent subsystem, like the following example. This is convenient for copying the PIL block into the model to replace the original subsystem for cosimulation.



Link for TASKING creates PIL blocks with both the "Simulink system path" and "Configuration" properties automatically configured. These parameters are described below.

Simulink system path — Allows you to select a PIL algorithm. You specify the path of a Simulink system (model or subsystem) as the source of the generated PIL algorithm to use for cosimulation.

Note: The Simulink system path is the full path to the system and "/" must be escaped to "//". For example, a subsystem named "fuel/sys" inside a model named "tasking_demo_fuelsys" would have the escaped system path:

```
tasking_demo_fuelsys/fuel//sys
```

Note that the correct system path can be obtained by clicking on the system and then running the `gcb` command. In this example,

```
>> gcb
ans =
tasking_demo_fuelsys/fuel//sys
```

Configuration — Allows you to specify a PIL configuration to use for building the PIL application and running the subsequent cosimulation. The available configurations correspond to the TASKING configuration descriptions in the Target Preferences.

Some guidelines on choosing a valid configuration:

1. The configuration must generate debugging information because Link for TASKING requires this in order to communicate with the PIL application.

2. The configuration must be compatible with the TASKING configuration description that was used to build the PIL algorithm. The fact that these two configurations need not match exactly allows the flexibility for the PIL algorithm to be compiled as if for a production environment, for example, without generating debugging information. However, care must be taken to ensure that the configurations are compatible in terms of linking, otherwise build errors will occur when building the PIL application. In many cases, it is appropriate to use exactly the same configuration for building both the PIL algorithm and PIL application and therefore no errors can ever occur owing to incompatibilities between configurations.

Building, Running, and Debugging PIL Applications

This section includes the following topics:

Building and Downloading PIL Applications

Once you have created a PIL block, you must build and download it before you can use it for cosimulation. You can use the **PIL Block Action** setting in the Configuration Parameters to automatically build and download the PIL application after the PIL block is created. If you choose not to do this, you can use the PIL block to do this manually. To do this,

1. Double-click the PIL block to open the mask.
2. Click **Build**. Wait until the **Application** name in the mask is updated and you see the 'build complete' message.
3. Click **Download**.
4. Wait until the output in the MATLAB command window stops and you see the 'download complete' message in the PIL block, then click **OK** to close the block mask.

The PIL Application is now ready. To cosimulate with it, you must copy the PIL block into your model, either to replace the original subsystem or in addition to it for comparison. Click **Start Simulation** to run a PIL cosimulation.

See the Link for TASKING demo models for examples with instructions to enable you to build and download PIL blocks and use them in cosimulation.

PIL Debugging

Prior to PIL cosimulation you can use the CrossView Pro debugger to set breakpoints, so that you can step through the code and watch variables during

cosimulation. To do this, you must set breakpoints in CrossView Pro prior to starting the cosimulation as follows:

1. Once the build process completes, a minimized CrossView Pro window should appear on your Windows Start menu. Maximize the CrossView Pro window.
2. In CrossView Pro, select **File > Open Source** and choose a source file to open. A typical choice would be to open the main generated file associated with the algorithm, eg. *`model`*`.c`.
3. Choose a location in the file to set a breakpoint and click the "breakpoint" button to the left of the line. A typical location for setting a breakpoint in the *`model`*`.c` file would be one of the `step` functions.

Note You can set multiple breakpoints in multiple files if you wish.

---

4. To add a variable to the watch, double-click the variable, and then click **Add Watch** in the Expression Evaluation window. A typical variable to add to the watch would be either the external inputs or external outputs structures which usually represent all of the inputs and outputs of the algorithm.
5. Start the PIL cosimulation in Simulink. When the breakpoint is hit, Simulink will pause. CrossView Pro will be available for debugging, and watch variables will be updated. You can step through the code, set more breakpoints, and analyze data.
6. When you've finished debugging, you can continue running by clicking the "play" button in CrossView Pro. This will allow the PIL cosimulation to continue. If you left the breakpoint in place then the cosimulation stops at that point again. To return to uninterrupted cosimulation, remove breakpoints.

Warning **Never remove the PIL synchronization breakpoint (usually set on the `pilaction` function). This breakpoint is used to maintain synchronization between Simulink and CrossView Pro.**

As an alternative to manual configuration in CrossView Pro, you can obtain a handle to the `tasking.xviewapi` object associated with a PIL block by using the `tasking_pil_crossview_handle` command as follows:

```
crossview = tasking_pil_crossview_handle(block)
```

where `block` is the full Simulink system path to the PIL block. You can use `gcb` to obtain the system path after clicking on the PIL block.

This handle can be used prior to PIL cosimulation to configure breakpoints, etc., by using the CrossView Pro command language. Note: this handle should not be used during PIL cosimulation.

Coverage and Profiling Reports

Once you have downloaded the PIL application and run a cosimulation, you can view reports in MATLAB. The reports available depend on the target configuration. For example, for C166 Simulator you can view C code coverage, profiling and cumulative profiling reports. Messages at the command line detail which reports are available with hyperlinks. An example follows:

```
PIL reports available from CrossView Pro for block: fuelsys
Coverage ("covinfo"):  Yes (pil_coverage_report)
Profiling ("proinfo"): Yes (pil_profiling_report)
Cumulative profiling ("cproinfo"):  Yes
(pil_cumulative_profiling_report)
```

Click the variable name hyperlinks (e.g., `pil_coverage_report`) to view the reports, like the following two examples.

```
pil_coverage_report =

Module:   ..\..\fuelsys0_ert_rtw_pil\pil_interface.c    81%
 Function: pilInitialize                          77%
 Function: initUDataProcessing                    76%
 Function: processUData                          100%
 Function: checkDataProcessingComplete           100%
 Function: pilStep                                71%
 Function: initYDataProcessing                    76%
 Function: processYData                          100%
 Function: pilTerminate                           75%
```

```
Module:   ..\..\..\..\..\..\aetargets with spaces\matlab\
toolbox\rtw\targets\tasking\tasking\pil\
pil_interface_lib.c    90%
 Function: getNextSymbol                      100%
 Function: processData                         90%
 Function: resetLibSymbolState                100%
 Function: checkDataProcessing                 78%
Module:   ..\..\..\..\..\..\aetargets with spaces\matlab\
toolbox\rtw\targets\tasking\tasking\tasking_pil_main.c    72%
 Function: singleshotStep                      97%
 Function: taskingStep                         75%
 Function: taskingProcessUData                 95%
 Function: taskingProcessYData                 95%
 Function: pilaction                           39%
 Function: main                                80%
Module:   ..\..\fuelsys0_ert_rtw\fuelsys0.c    42%
 Function: Sens_Failure_Counter                13%
 Function: Fueling_Mode                        16%
 Function: Init_controllogic                  100%
 Function: controllogic                        48%
 Function: fuelsys0_step                       45%
 Function: fuelsys0_initialize                100%
 Function: fuelsys0_terminate                 100%
Module:   MEMCPY_C                           100%
Module:   MEMSET_C                           100%
Module:   CPNNW                               50%
Module:   MUL                                  0%
Module:   ..\..\slprj\ert\_sharedutils\
binarysearch_s16.c    89%
 Function: BINARYSEARCH_S16                    89%
Module:   ..\..\slprj\ert\_sharedutils\
dotproduct_s32s16.c     0%
 Function: DotProduct_s32s16                    0%
Module:   ..\..\slprj\ert\_sharedutils\
interpolate_even_s16_s16_sat.c     0%
 Function: INTERPOLATE_EVEN_S16_S16_SAT         0%
Module:   ..\..\slprj\ert\_sharedutils\
interpolate_s16_s16_sat.c    56%
 Function: INTERPOLATE_S16_S16_SAT             56%
Module:   ..\..\slprj\ert\_sharedutils\
```

```
look2d_s16_s16_s16_sat.c   100%
 Function: Look2D_S16_S16_S16_SAT             100%
Module:   ..\..\slprj\ert\_sharedutils\
div_s32_sat_floor.c    67%
 Function: div_s32_sat_floor                   67%
Module:   ..\..\slprj\ert\_sharedutils\
fix2fix_s16_s32_sat.c    75%
 Function: FIX2FIX_S16_S32_SAT                 75%
Module:   UDIL                                29%
Module:   UMOL                                24%
Module:   fuelsys0_ert_rtw_pil                 0%
Module:   CSTART                               0%
Module:   ..\..\fuelsys0_ert_rtw\fuelsys0_data.c     0%

pil_profiling_report =

Total Execution Time:   473348
                                           Cycles %Cycles
Function: pilInitialize                        18 0.004%
Function: initUDataProcessing                2828 0.597%
Function: processUData                       1616 0.341%
Function: checkDataProcessingComplete        2020 0.427%
Function: pilStep                            2626 0.555%
Function: initYDataProcessing                2828 0.597%
Function: processYData                       1616 0.341%
Function: pilTerminate                         16 0.003%
Function: getNextSymbol                     37370 7.895%
Function: processData                       61610 13.02%
Function: resetLibSymbolState                2828 0.597%
Function: checkDataProcessing                8080 1.707%
Function: singleshotStep                    15150 3.201%
Function: taskingStep                        1616 0.341%
Function: taskingProcessUData                9898 2.091%
Function: taskingProcessYData                9898 2.091%
Function: pilaction                          5716 1.208%
Function: main                               1886 0.398%
Function: Sens_Failure_Counter               3000 0.634%
Function: Fueling_Mode                       8800 1.859%
Function: Init_controllogic                    62 0.013%
Function: controllogic                      17366 3.669%
```

```
Function: fuelsys0_step                          66864 14.13%
Function: fuelsys0_initialize                       54 0.011%
Function: fuelsys0_terminate                         4 0.001%
Function: BINARYSEARCH_S16                       41002 8.662%
Function: DotProduct_s32s16                          0 0.000%
Function: INTERPOLATE_EVEN_S16_S16_SAT               0 0.000%
Function: INTERPOLATE_S16_S16_SAT                28678 6.059%
Function: Look2D_S16_S16_S16_SAT                 32320 6.828%
Function: div_s32_sat_floor                      31782 6.714%
Function: FIX2FIX_S16_S32_SAT                     4980 1.052%
Module:   MEMCPY_C                               23230 4.908%
Module:   MEMSET_C                                 536 0.113%
Module:   CPNNW                                  22624 4.780%
Module:   MUL                                        0 0.000%
Module:   UDIL                                   10624 2.244%
Module:   UMOL                                   10292 2.174%
Module:   fuelsys0_ert_rtw_pil                       0 0.000%
Module:   CSTART                                     0 0.000%
147:    switch(tasking_pil_main_action) {
```

For cumulative profiling, command line messages like the following will inform you that you must configure CrossView Pro to specify which functions to collect data for. Select **Tools > Cumulative Profiling Setup**, then run the cosimulation again to get the report.

```
NOTE: Cumulative profiling requires manual setup in
CrossView Pro.
See Tools->Cumulative Profiling Setup
DO NOT add function, pilaction, to the list of functions
to profile.
You must then run the PIL simulation again
to generate the report.

pil_cumulative_profiling_report =

CrossView Cumulative Profiling Report
-------------------------------------
Total Execution Time:  3790326
Function                              Calls    Recursive
Min.Time   Max.Time   Avg.Time   Total Time %Time
```

For information on build messages containing links at the command line, see “Command Line Project Information” on page 2-11.

5

Tutorials

Tutorial: Using Option Sets (p. 5-2)	How to use option sets to switch between preconfigured project settings.
Tutorial: Creating New Template Projects (p. 5-4)	Steps for creating new template projects.
Tutorial: Configuring an Existing Model for Link for TASKING (p. 5-8)	An example showing how to configure an existing model for Link for TASKING.
Tutorial: Build Actions (p. 5-10)	How to use different build actions with Link for TASKING.

Tutorial: Using Option Sets

Option sets are preconfigured settings to specify the target configuration for the TASKING tools. You use option sets to apply EDE project settings (e.g., compiler and linker settings, hardware or simulator) that you can then modify if you choose. For example, once you have set up your target preferences for a Tricore configuration, you can use option sets to switch between using an instruction set simulator configuration, two hardware board configurations, or a simulator with some MISRA-C rule checking.

To choose an option set:

1. Select **Start > Simulink > Link for TASKING > Select Preconfigured Target Preference Settings**.

   The TASKING Configuration Selection dialog appears.

2. Select a target configuration (e.g., `C166`, `TriCore`) from the list in the dialog, and click **OK**.

   The Option Set Selection dialog appears.

3. Select an option set. The list items are specific to the configuration you selected; the available option sets are listed in “Option Sets” on page 1-22. Click **OK**.

   Your target preferences are automatically updated according to the option set you select, and command line messages inform you the following target preferences have changed:

   - `EDE_Configuration`

     `Template_Application_Project`: Set to default template application project relating to the option set.

     `Template_Library_Project`: Set to default template library project relating to the option set.

   - `CrossView_Pro_Configuration`

     `Initialization_File`: Set to CrossView Pro (`.st`) initialization file relating to the option set.

Now, when you build any model configured for the same target (e.g., `TriCore`), these project settings will be used. To switch to a different option set, repeat the steps above.

You can also use option sets to set up an initial configuration when creating new template projects — see “Tutorial: Creating New Template Projects” on page 5-4.

Tutorial: Creating New Template Projects

In this tutorial, you create new template projects for a target configuration, and set up options such as simulator or hardware implementation, compiler and linker settings, MISRA-C rule checking, or any other project options. Every time you build a model for the selected target configuration, the project options you have set up in the new template projects will be used.

To create custom application and library template projects:

1. Select **Start > Simulink > Link for TASKING > Create New Template Projects**.

2. When prompted to select a configuration, select your target (e.g., `TriCore`) and click **OK**.

   Your target preferences for the location of your TASKING installation must be set up for the target configuration you choose (see "Setting Target Preferences" on page 1-7). Make sure the fields are filled in for this configuration (except the Application and Library Template Projects fields, and CrossView Initialization field, as this will be done automatically in the steps below). If your target preferences are set up correctly, your TASKING EDE launches when you click **OK**.

3. When prompted by dialogs, choose a location for the template projects, and enter the template name.

4. When prompted, choose an option set. These specify options specific to your target, such as whether you want to use simulator or hardware. You can use these to set up an initial configuration to modify later. See "Option Sets" on page 1-22 for more information and a list of available option sets.

   You now have custom template projects for this new configuration. The EDE project settings associated with the option set are applied to the new template projects. Your target preferences are automatically updated according to the option set you select. Messages at the command line inform you the following target preferences have changed:

   - EDE_Configuration

     `Template_Application_Project`: Set to new template application project configured by the option set.

`Template_Library_Project`: Set to new template library project configured by the option set.

- CrossView_Pro_Configuration

  `Initialization_File`: Set to CrossView Pro (`.st`) initialization file configured by the option set.

Note You can always choose a preconfigured option set to return to the default settings (using the **Start** menu option **Select Preconfigured Target Preference Settings**).

Next, you will modify the compiler settings for these new template projects.

5 To modify the template projects, you need to open them in the TASKING EDE:

   a Select **Start > Simulink > Link for TASKING > Open Existing Template Projects**.

   b When prompted to select a configuration, select the same target for which you created new template projects, and click **OK**.

   c The template projects should now be open in the EDE. Right-click the project in the TASKING EDE, and select **Project Options**. You can now modify the project options (compiler settings, linker settings, etc.).

   d When done, you can close the template projects in the TASKING EDE.

6 To modify your CrossView Pro configuration you need to specify a `.ini` file in the `Initialization_File` Target Preference field. See `Initialization` in the section “Target Preference Fields” on page 1-9.

7 You are now ready to use the configuration. Open any Simulink model that is configured with Link for TASKING (`tasking_demo_fuelsys`, for example).

8 Select **Simulation > Configuration Parameters**. The Configuration Parameters dialog opens.

9 Select **Link for TASKING** on the left side panel. When you select your target in the **TASKING Configuration Description** menu, the template projects you have set up will be used.

See "Template Projects" on page 2-5 for details about how Link for TASKING uses template projects during the build process.

You may want to create a new configuration to use with new template projects. See the next section for details.

Tutorial: Creating a New Configuration

You can customize the default Target Preference configurations by choosing from the preconfigured options sets, or by creating new template projects.

However, it may be useful to create a new Target Preference configuration if you want to switch between them in the **TASKING Configuration Description** menu. For example, if your target is TriCore, you could set up a new configuration called `TriCore_user` to specify hardware settings for your target; then you can easily switch between `TriCore` (the default instruction set simulator configuration) and `TriCore_user` using the **TASKING Configuration Description** menu in your model's Configuration Parameters dialog.

In this tutorial, you create a new TASKING configuration and save it in the TASKING target preferences. You can then use your new configuration in any Simulink model that is configured with Link for TASKING by selecting it in the **TASKING Configuration Description** menu.

To create a new configuration:

1 From the MATLAB **Start** menu select **Simulink > Link for TASKING > TASKING Target Preferences**.

2 Select `Create new Configuration` and click **OK**.

3 Expand `Configuration_Options`.

4 Type `Tutorial` in the **Configuration_Description** field.

5 Fill in the rest of the fields for this configuration. See “Setting Target Preferences” on page 1-7 to set these fields properly.

   a You must specify the location of your toolset, by filling in the path to the `CrossView_Pro_Executable`, the `DOL_File`, and the `EDE_Executable`.

   b You can set up the template projects and CrossView initialization fields automatically in one of two ways:

   - You can use the **Start** menu option **Select Preconfigured Target Preference Settings**. See “Tutorial: Using Option Sets” on page 5-2 for instructions.
   - You can create new template projects for this configuration. See “Tutorial: Creating New Template Projects” on page 5-4.

   If you are going to use either of these options you can leave the template projects and CrossView initialization fields blank, as they will be filled in automatically when you follow the steps in using option sets or creating new template projects.

   Click **OK** to close and save your target preferences.

6 Once saved, you can use the new `Tutorial` configuration in any model that is configured with Link for TASKING. For example, open any of the Link for TASKING demo models (such as `tasking_demo_fuelsys`).

7 Select **Simulation > Configuration Parameters**. The Configuration Parameters dialog opens.

8 Select **Link for TASKING** on the left side panel. Click the **TASKING Configuration Description** menu, and notice that the `Tutorial` configuration now appears in the list.

Tutorial: Configuring an Existing Model for Link for TASKING

In this tutorial, you configure an existing fixed-point model and build it with Link for TASKING.

1. At the MATLAB command prompt, type `rtwdemo_fixptdiv` to open a fixed-point demo model.
2. Switch the model to use Real-Time Workshop Embedded Coder. Select **Simulation > Configuration Parameters**, and click **Real-Time Workshop**.
3. Click **Browse** and select `ert.tc` (first item in the list). Click **OK**.
4. Add the Link for TASKING configuration set to the model as follows: Select **Tools > Link for TASKING > Add Link for TASKING Configuration to Model**.
5. Open the Configuration Parameters dialog again (from the **Simulation** menu), and observe the Link for TASKING configuration set added to the model. Select **Link for TASKING** from the left panel:
   a. Set the **Build Action** to `Create and Build Application Project`.
   b. Select the **TASKING Configuration Description** to match your target.
   c. Select the check box option to **Specify Build Subdirectory Name**, and type `<target>_int` in the **Build Subdirectory Name** field. Replace the string `<target>` with your real target, e.g., `c166_int`.
   d. Under the Real-Time Workshop options, select **Interface** and clear the check box for **floating-point numbers** support under **Software environment**, since this model is fixed point. This instructs Real-Time Workshop to avoid building the floating-point version of the `rtwlib` library.
   e. Under **Real-Time Workshop**, select **Hardware Implementation**, and select your device type. See the demo models for examples. Some devices use custom settings, others have preconfigured configurations, for example:
      - For C166 platforms, select Infineon C16x, XC16x.

- For TriCore platforms, select Infineon TriCore.
- For ARM platforms, select ARM 7/8/9.

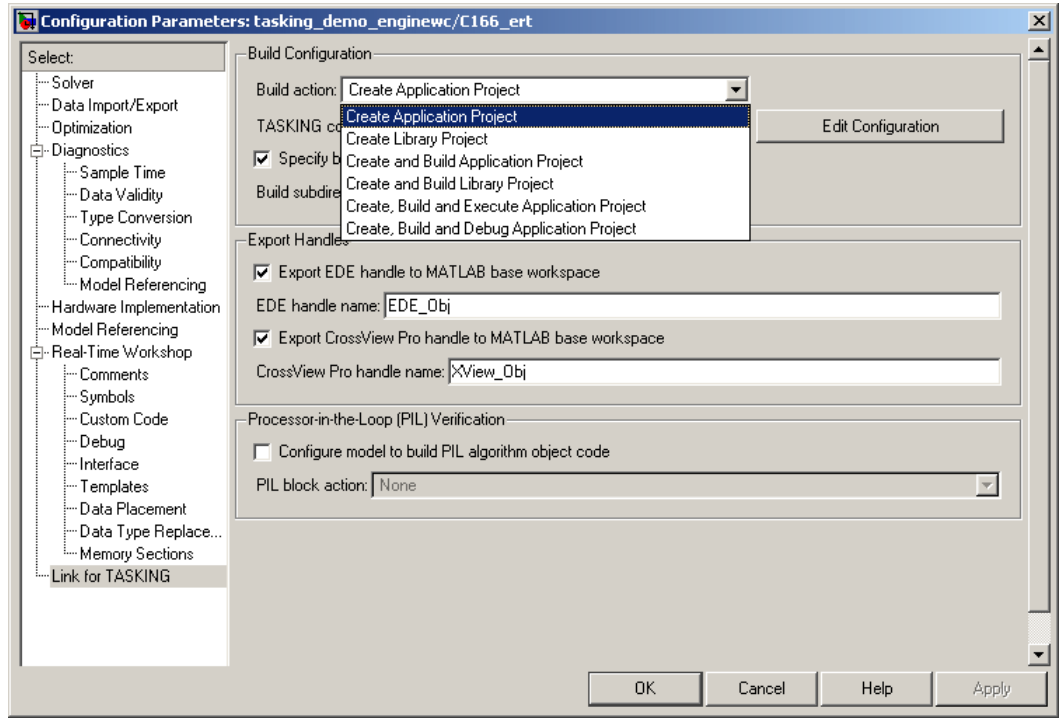
You are now ready to build the model. Press **Ctrl+B** or select **Tools > Real-Time Workshop > Build Model**.

Tutorial: Build Actions

Models configured with Link for TASKING have a build action setting that instructs Real-Time Workshop to perform different actions when the model is built. The following example explains what you can do by setting the build action.

Open any model configured with Link for TASKING (example, demo model `tasking_demo_fuelsys`).

Select **Simulation > Configuration Parameters**, and click the **Link for TASKING** configuration set. Under **Build Configuration**, the **Build Action** list has six different settings:



- `Create Application Project`

  Generates code for the model or subsystem, creates a TASKING application project for the selected TASKING configuration, connects to the TASKING EDE, and opens the application project (in addition to the required Real-Time Workshop and DSP Library projects, if required) in the TASKING EDE. This option does not build or execute the application.

  An `EDE_Obj` object handle is exported to the MATLAB workspace (if this option is selected). This object allows you to interact with the TASKING EDE from MATLAB. For more information, see the section on using object handles, Chapter 3, "Objects".

Note To manually build the generated project in the TASKING EDE, right click on the application project (starts with the same name as the model name), and select **Build**.

- `Create Library Project`

  Performs the same actions as `Create Application Project`, but this option archives the generated code into a library in TASKING. No `main.c` file is generated.

- `Create and Build Application Project`

  Performs the same actions as `Create Application Project`, but also instructs TASKING to build the application project.

Note To manually debug the executable from the application project, click the Debug Application icon in the TASKING EDE.

- `Create and Build Library Project`

  Performs the same actions as `Create Library Project`, but also instructs TASKING to build the Library project.

- `Create, Build and Execute Application Project`

  Performs the same actions as `Create and Build Application Project` and also downloads the executable file to your CrossView Target and runs

the executable. No debugging information is downloaded into the target with this option.

A CrossView Pro object handle is exported to the MATLAB workspace (if this option is selected). This object allows you to interact with the CrossView Pro debugger from MATLAB. For more information, see the section on using object handles, Chapter 3, “Objects”.

- `Create, Build and Debug Application Project`

  Performs the same actions as `Create, Build and Execute Application Project` but also downloads debugging information to the target. This option behaves the same way as the Debug Application icon in the TASKING EDE.

Index

L