

Renesas Synergy™

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Creating a Custom Board Support Package

Introduction

The core requirement of every SSP project is the Board Support Package (BSP). This document shows how to use the Custom BSP Creator to create a custom BSP. After creating the BSP, you can use this BSP exactly as a BSP provided with a Renesas Synergy kit.

For more information about what is provided in a BSP please refer to the SSP User's Manual.

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1. BSP Custom Creator Tool

The Custom BSP Creator is a command-line tool for creating a custom BSP that can be used in e² studio.

1.1 Why create a custom BSP?

The BSP is a requirement of every SSP project and Renesas provides BSPs for all Renesas boards. The BSP is responsible for getting the MCU from reset to the main application (the `main()` function). The BSP also provides information to the SSP modules, so that the modules can be automatically configured for your hardware. Typically, you develop an application on a Renesas Synergy board and eventually replace the Renesas provided BSP by a custom BSP matching their custom board.

1.2 What changes with a custom BSP?

Not everything in the BSP changes when creating a custom BSP. The BSP is made up of three folders in its source tree (`synergy/ssp/src/bsp`):

- Board
- cmsis
- mcu

The `cmsis` and `mcu` folders do not need to change when creating a custom BSP. The `cmsis` folder contains the CMSIS-CORE subset of the BSP. The `mcu` folder contains the source that is common to MCU groups. For example, if there are two boards that both use a S7G2 MCU then they share the `mcu/s7g2` source folder.

You will be making changes for the custom BSP in the `board` folder. Each folder in the `board` folder is specific to a particular board. When you make changes for a custom BSP, the tool creates a new folder in the `board` directory that is specific to your custom board.

There are three required files in any board folder:

- `bsp.h`
- `bsp_init.c`
- `bsp_init.h`

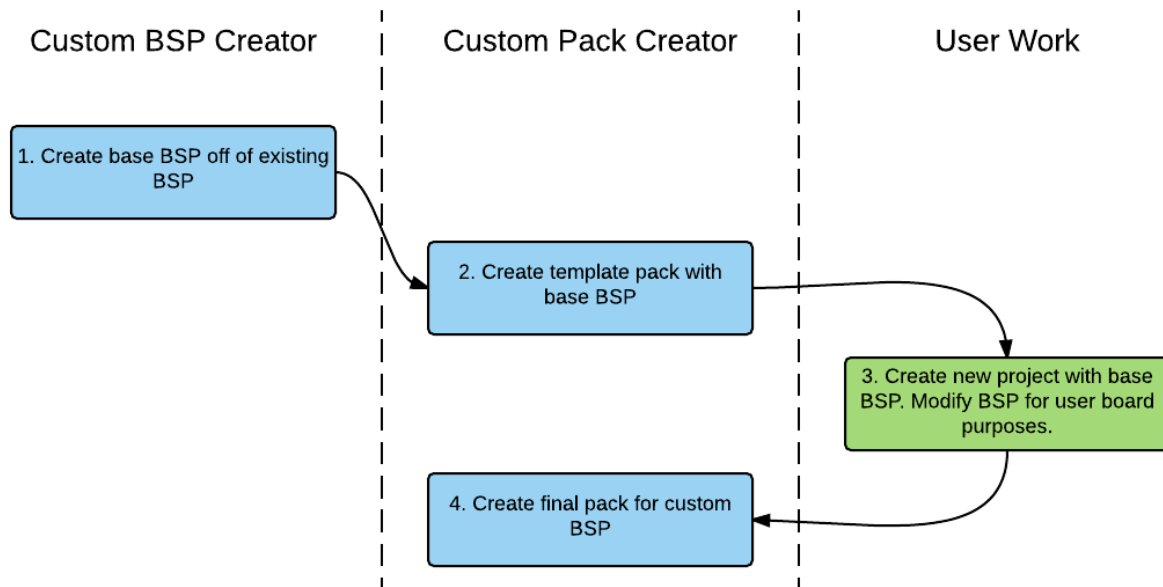
The `bsp.h` header file contains all of the necessary includes and function prototypes needed for this custom BSP. The `bsp_init.c` source file contains code that must be executed before `main()`; and is specific to this board. The code in `bsp_init.c` is called by the core BSP calling the `bsp_init()` function which resides in `bsp_init.c`. The code in the `bsp_init()` function can then call other functions as needed.

Examples from Renesas Synergy provided boards include initializing external memory, such as SDRAM and QSPI, and defining the LEDs available. The code for initializing SDRAM and QSPI is contained in `bsp_sdram.c` and `bsp_qspi.c` respectively.

There is also an XML file associated with each BSP. This file is used by e² studio to enable configuration of the BSP through the Synergy Configurator inside e² studio. The **BSP**, **Clocks**, and **ICU** tabs are data derived from the information contained in this XML file.

1.3 How does the tool work?

The figure below provides an overview of the steps involved in creating a custom BSP with the Custom BSP Creator. The procedure includes using two executables and following four basic steps.



The first step is to create a base BSP to work from using the Custom BSP Creator executable, **custom_bsp_creator.exe**. In this tool you can pick an existing BSP (for example the DK-S7G2) as a base for the new custom BSP.

Running the tool creates a base BSP. This base BSP exists as a set of files and folders on your PC. To be able to use and configure the base BSP in e² studio, you need to create a new CMSIS Pack in step 2. CMSIS Packs are the mechanism that is used to deliver code inside e² studio.

To create a pack, use the Custom Pack Creator, **custom_pack_creator.exe**. This tool takes the base BSP created in the previous step and packages it, so it can be used in e² studio. One of the options of the tool is to create a template pack. Creating a template pack is required to make changes to the source code later in e² studio.

Normal, non-template packs, do not allow the source code they provide to be modified. If you modify the code, then those modifications are overwritten the next time the project is built. To disable the overwriting feature, you must create a pack that can tell e² studio to allow modifications.

After creating the template pack, you can modify the base BSP in e² studio. At this point the base BSP is still a copy of an existing BSP. The existing BSP must be modified to meet the requirements of your new custom BSP. To do so, you can create a new project in e² studio. Once the project is created, you can modify the BSP through the System Configurator in the same way as editing any other BSP. In addition, you can also add, modify, and remove source code from the BSP as needed. Typical updates to the BSP are:

- Pin configuration
- Stack and heap sizes
- Clock tree configuration
- Additional source in *board* directory to be run before `main()`

After making the changes, you can build and debug the project in e² studio.

Once the custom BSP has been tested and is ready to be finalized, you create the final pack in step 4. This step is essentially the same as step 2 except this time you are creating a standard pack instead of a template pack with the Custom Pack Creator. The BSP in this pack acts like any other BSP provided with a Renesas Synergy kit. Other users of the BSP are able to modify the BSP settings in the Synergy Configurator but are not able to add, remove, or modify source files inside the BSP folder. The pack created from the last step can then be distributed to other team members to be used inside e² studio.

2. Example walkthrough

This section shows how to create an example custom BSP based on the DK-S7G2.

2.1 Step 1: Create a base pack

To create a base pack, follow these steps:

1. From the Windows command prompt, run `custom_bsp_creator.exe -h` to print the command line options for the tool.

Usage: `custom_bsp_creator.exe [options]`

Custom BSP Creator - This script is used to provide a customized BSP based on the user's base board and board name. The custom BSP is generated from a PACK file (eg. To create a board named 'Thunder' based off the S7G2-DK, run the command: `python custom_bsp_creator.exe -p pack_location -b s7g2_dk -n Thunder -# part_number`).

Options:

```
-h, --help                show this help message and exit
-p PACK_PATH, --pack=PACK_PATH
                           Path to pack which custom BSP will be based upon
-l, --list_boards         Prints list of available base boards
-b BOARD, --base_board=BOARD
                           Board which custom BSP will be based upon (eg s3a7_dk)
-n USER_BOARD_NAME, --name=USER_BOARD_NAME
                           Name of custom board (eg Thunder)
-# PART_NUMBER, --part=PART_NUMBER
                           Part Number for MCU (eg R7FS7G27H2A01CBD,
                           R7FS3A77C3A01CFB)
-d GENERATED_BSP_DESTINATION, --dest=GENERATED_BSP_DESTINATION
                           Destination path (eg C:\Users\John\Documents)
--verbose                 Enable verbose output
```

2. Find the available base BSPs using the `-l` option. A valid pack must be provided using `-p` option. Packs can be found under the `<e2_studio_install_directory>\internal\projectgen\arm\Packs` directory.

```
custom_bsp_creator.exe -l -p Renesas.Synergy.1.0.0.pack
```

```
s3a7_dk
```

```
s3a7_user
```

```
s7g2_dk
```

```
s7g2_pe_hmi1
```

```
s7g2_sk
```

```
s7g2_user
```

Note: This operation will take more than several seconds to complete.

3. Create a custom BSP with the following options:
 - a. As shown previously, use the v1.0.0 pack (`Renesas.Synergy.1.0.0.pack`) for the `-p` option.
 - b. Since we are using the DK-S7G2 for the base BSP, use `s7g2_dk` as the `-b` option.
 - c. The part number of our MCU is the same as the DK-S7G2. Use `R7FS7G27H2A01CBD` for the `-#` option.
 - d. Specify the new board name as `wolfpack` using the `-n` option.
 - e. The new BSP is created in the `output` folder using the `-d` option.

- f. If the `--verbose` option is not used, then no output will be generated. Enable verbose mode for this example.

```
custom_bsp_creator.exe -p Renesas.Synergy.1.0.0.pack -b s7g2_dk -# R7F57G27H2A01CBD -n
wolfpack -d output --verbose
```

Using base pack Renesas.Synergy.1.0.0.pack

Decompressing Base Pack (note: this may take a second)

Pack unzipped

New pack structure used BSP extracted successfully to C:\Workspace\new_bsp\output

2.2 Step 2: Create a template pack

Follow these steps to create a template pack to use the new BSP in e² studio:

1. Use the `custom_pack_creator.exe` to create with the `-h` option to see the command-line options.

```
custom_pack_creator.exe -h
```

Usage: custom_pack_creator.exe [options]

Pack Generator for Custom BSP - This is used to create a custom pack based on a modified bsp which originated from the custom_bsp_creator script. eg) python custom_pack_creator.exe -p CUSTOM_BSP_PATH -n PACK_NAME -v 1.00.00

Options:

-h, --help show this help message and exit

-p CUSTOM_BSP_PATH, --path=CUSTOM_BSP_PATH

Path to Custom BSP (eg C:\CustomBSP"). Folder must contain

'synergy' folder

-n USER_BOARD_NAME, --name=USER_BOARD_NAME

Name of custom board (eg Thunder)

-v PACK_VERSION, --version=PACK_VERSION

Version Number for Generated Pack (eg 1.0.0)

-t, --template Creates a pack with modifiable BSP that can be used

for creating final BSP

-e E2STUDIO_PATH, --e2studio=E2STUDIO_PATH

Path to e2studio (eg

C:\Renesas\synergy_e2_studio)

--verbose Enable verbose output

2. Before continuing make sure that e² studio is not open. If e² studio is open during a new pack generation, the tool may fail since e² studio can have the files open.

3. Create a template pack using the following options:
 - a. The base BSP is located in the *output* folder that was just created. We will provide this path for the *-p* option.
 - b. The board name is *wolfpack* so we will provide that as the *-n* option
 - c. For this example we will set the version using the *-v* option to *1.0.0*
 - d. This is a template pack so we will use the *-t* option
 - e. The path to e² studio will vary based on where you installed it. In this example we will use the e² studio installation located at *C:\Renesas\synergy-e2_studio*. This will be provided as the *-e* option.
 - f. Once again if *--verbose* is not provided then the tool will not output any status. We will provide the *--verbose* option.

```
custom_pack_creator.exe -p output -n wolfpack -v 1.0.0 -t -e C:\Renesas\synergy-e2_studio --verbose
```

```
Removing old release
```

```
Copying files
```

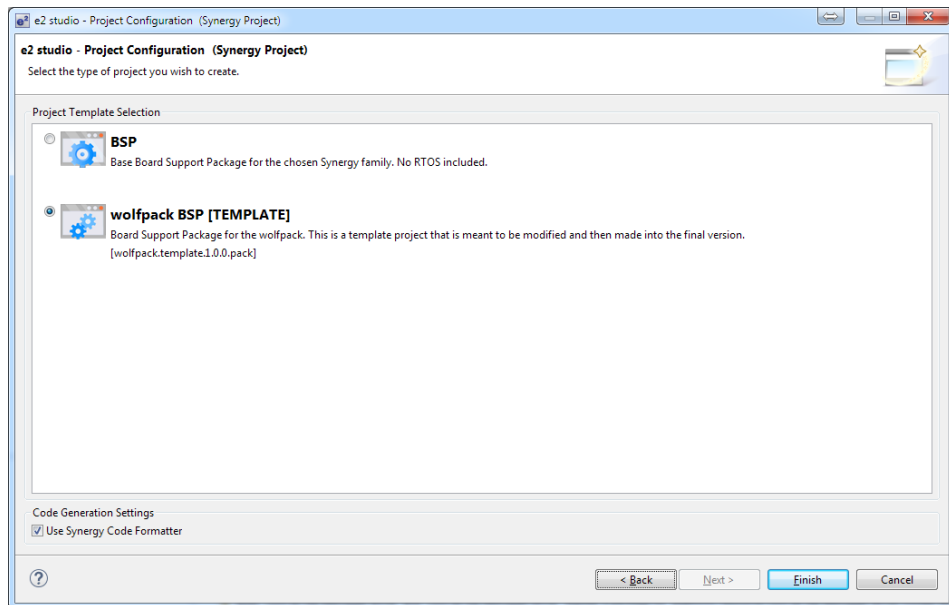
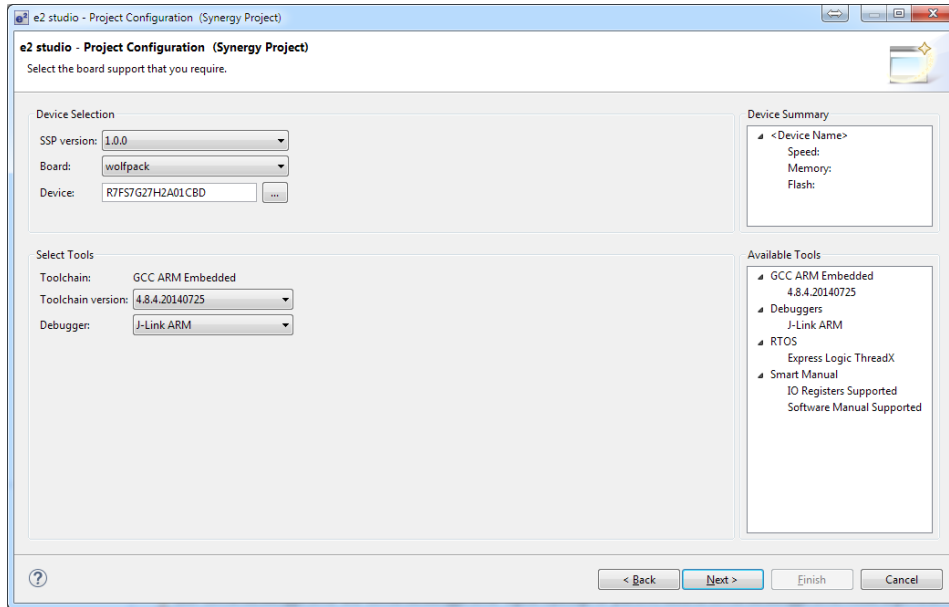
```
Generating .psdc
```

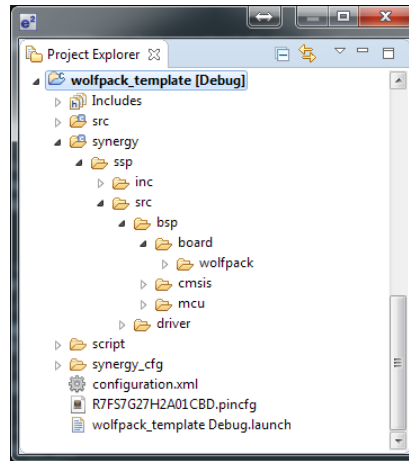
The custom pack has now been created.

2.3 Step 3: Create a new project for the BSP and modify the BSP

To configure the custom BSP follow these steps:

1. Start e² studio and create a new project based on this BSP. The ISDE project configurator shows the BSP template you created as selectable Board option in the Project Configuration and Project Template Selection windows.





After the project has been created, e² studio must be configured to treat the BSP module as a template module. Only perform this step when working with template pack BSPs.

2. Close e² studio.
3. On your PC, navigate to the folder of the project you just created. In this example the folder was *C:\Workspace\wolfpack_template*.
4. Open the *configuration.xml* file in a text editor.
5. Find the `<component>` element that relates to the BSP. It is the only element with its *class* attribute set to "BSP". Below is the `<component>` for this example.

```
<component apiversion="" class="BSP" condition="" group="USER" subgroup="wolfpack" variant=""
  vendor="Renesas" version="1.0.0">
  <description>[TEMPLATE] Board Support Package for wolfpack</description>
  <originalPack>wolfpack.template.1.0.0.pack</originalPack>
</component>
```

6. Under the `<component>` element add the following element: `<template>true</template>`. Using the example in the previous step the `<component>` now looks like this:

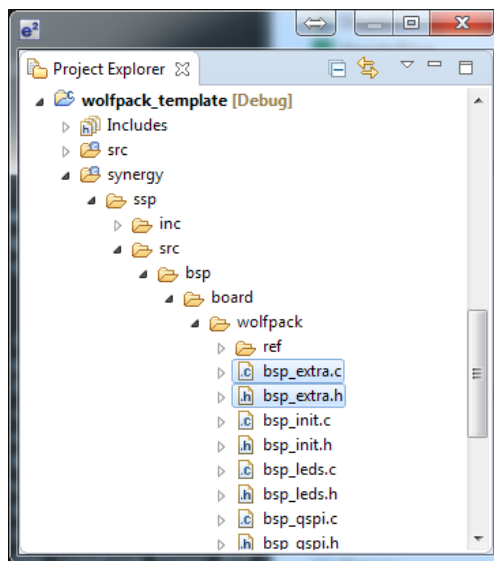
```
<component apiversion="" class="BSP" condition="" group="USER" subgroup="wolfpack" variant=""
  vendor="Renesas" version="1.0.0">
  <description>[TEMPLATE] Board Support Package for wolfpack</description>
  <originalPack>wolfpack.template.1.0.0.pack</originalPack>
  <template>true</template>
</component>
```

7. Save the file and close it.
8. Restart e² studio and reopen the project you created previously.

WARNING: If you accidentally create a second component instead of modifying the first one, e² studio will crash.

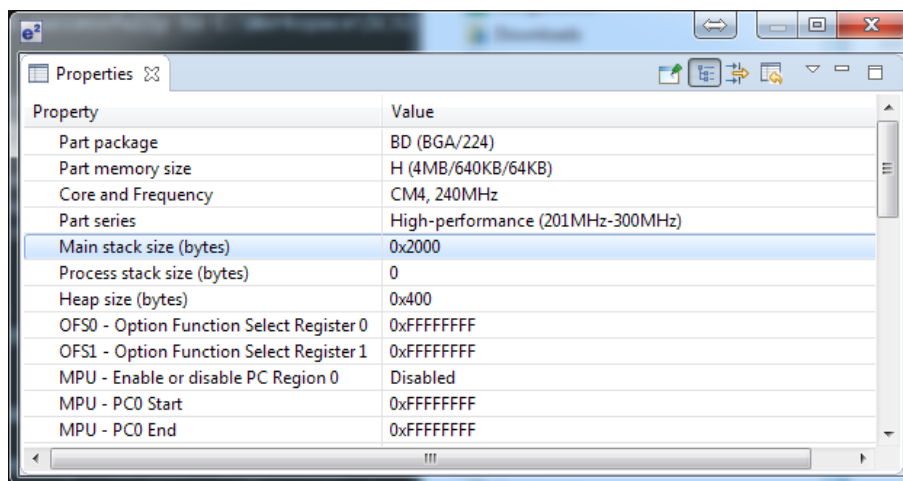
In the next step, make modifications to the BSP to simulate the customization process.

9. Add two empty files to the `synergy/ssp/src/bsp/board/wolfpack/` directory: `bsp_extra.c` and `bsp_extra.h`.

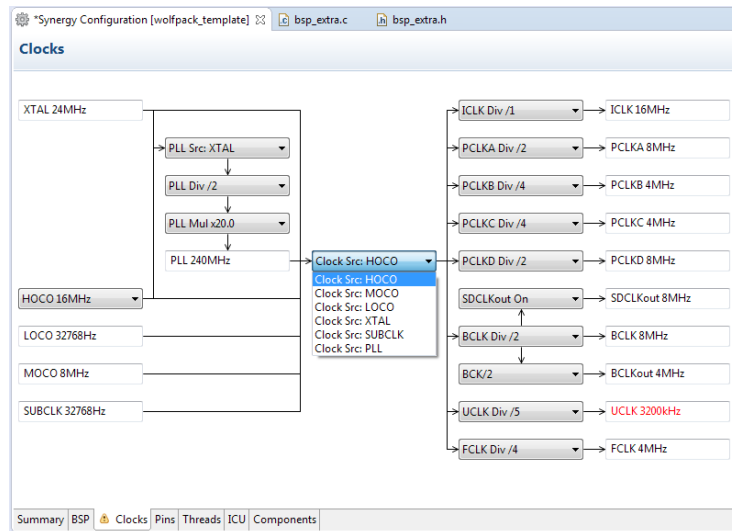


10. Open the Synergy Configurator and make the following changes:

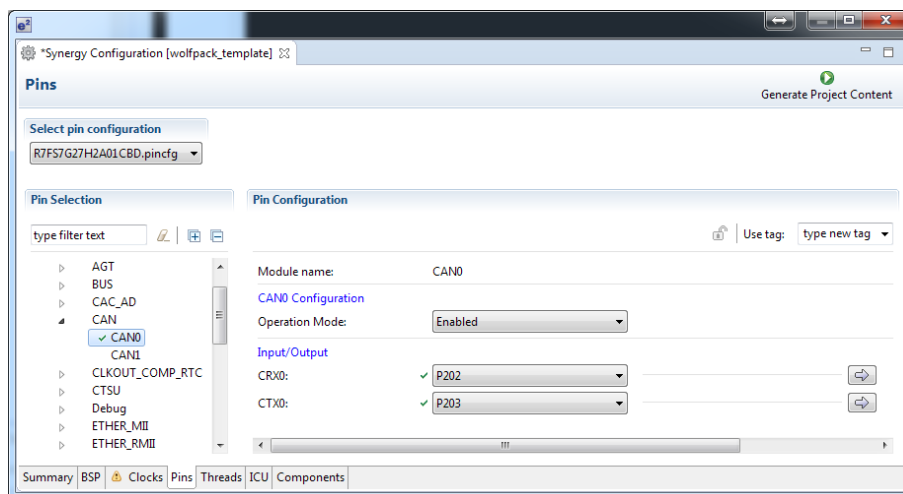
- In **Properties** window of the **BSP** tab, change the Main Stack size to `0x2000`.



- Change the system clock source (*Clock Src*) to the HOCO.



- Enable the CAN0 pins in the Pin Configurator using the **Peripherals** view.



11. Save the changes by clicking the **Generate Project** button and build the project.

The final, customized BSP has been created.

2.4 Step 4: Create the final pack

You can now create a final, non-template, pack with the Custom Pack Creator. Remember to close e² studio before performing this step. Go through the previous steps previous steps with the following differences:

- The path to the custom BSP is now the root of the project you created in earlier steps. For this example we will assume the project was created under *C:\Workspace\wolfpack_template*. There must be a *synergy* directory in the path that is given to the tool.
- Since this pack will not be a template we will remove the *-t* option that we used previously.

```
custom_pack_creator.exe -p C:\Workspace\wolfpack_template -n wolfpack -v 1.0.0
-e C:\Renesas\synergy-e2_studio --verbose
```

Removing old release

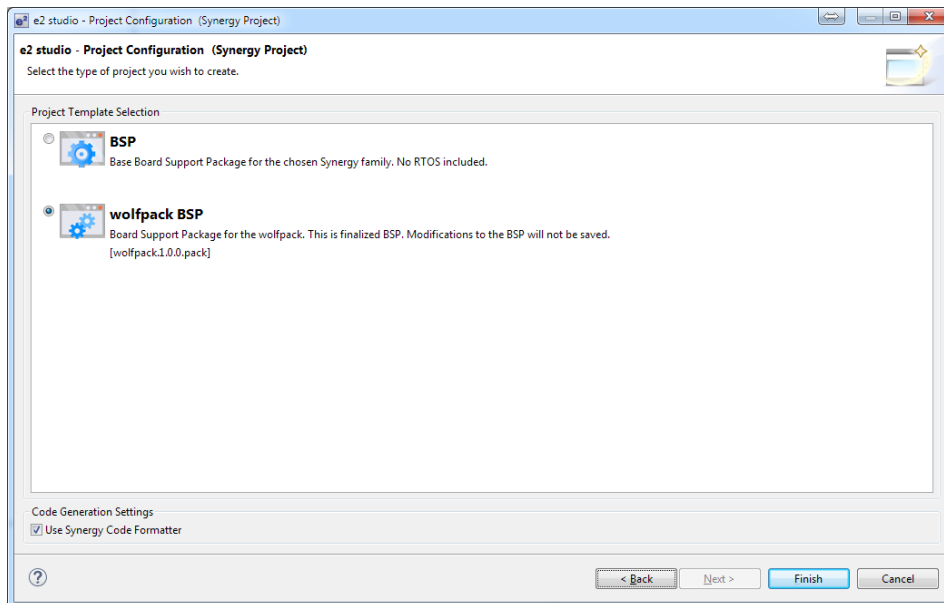
Copying files

Generating .psdc </code></pre>

Before using the final template, remove the template pack from e² studio:

Navigate to <e2_studio_install_directory>\internal\projectgen\arm\Packs and delete the template pack or move it outside of the e² studio directory. For this example the name of the pack is *wolfpack.template.1.0.0.pack*.

Open up e² studio and create a new project based on the new custom board.



Once the project has been created, verify that the changes made to the template are still in the new project.

To verify that this is the final pack, delete the *bsp_extra.c* and *bsp_extra.h* files in the *synergy/ssp/src/bsp/board/wolfpack/* directory. After deleting the files, build the project and verify that the files are brought back into the project.

You have now created a custom BSP. To share this BSP, you can distribute the newly created pack in the <e2_studio_install_directory>\internal\projectgen\arm\Packs directory. For this example, the name of the final pack is *wolfpack.1.0.0.pack*.

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Support: <https://synergygallery.renesas.com/support>

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1.01	October 16, 2015	All	Minor editorial updates
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