Renesas Synergy™ Platform

Creating a Custom Board Support Package for SSP 1.1.z

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Introduction

This document shows how to use the Custom BSP Creator to create a Board Support Package (BSP). After creating the BSP, you can use this BSP exactly as a BSP provided with a Renesas Synergy kits.

The objective of this document is to demonstrate different approaches of creating a custom BSP for the SSP v1.1.z, which is used in the e^2 studio ISDE (v5.0.0.043) or the IAR Embedded Workbench IDE for Renesas Synergy (v7.40). For more information about what is provided in a BSP, please refer to the *SSP User Manual*.

Prerequisites

As the user of this application note, you are assumed to have some experience with the Synergy SSP v1.1.z, and Renesas e^2 studio ISDE, or the IAR Embedded Workbench IDE for Renesas Synergy.

Required Resources

To perform the procedures described in this application notes, you will need:

- A PC running Microsoft® Windows® 7 or later with the following Renesas software installed:
- e^2 studio ISDE v5.0.0.043, v5.3.1.002
- IAR Embedded Workbench for Renesas Synergy v7.40
- Synergy Software Package (SSP) v1.1.z , SSP v1.2.0
- Synergy Standalone Configurator (SSC) v5.0.0.043.

You can download the required Renesas software from the Renesas Synergy Solutions Gallery (https://www.renesas.com/us/en/products/synergy/gallery.html)

Warning: This document is for legacy support only. New projects should use the most recent version of the SSP and tools, available at https://www.renesas.com/en-us/products/synergy/software.html, which have fully integrated support for creating a custom BSP. BSPs created with this procedure are compatible with SSP v1.2.0 only; they are not compatible with more recent SSP versions ().

Note on SSP Compatibility

Custom BSPs are only verified to work with the SSP version that they were created from. For example, a custom BSP created from SSP v1.0.0 is not verified to work with SSP v1.1.0. A custom BSP *may* be forward compatible, but if it is not compatible, the user will be responsible for manually migrating their custom BSP to the new SSP version.

Contents

1. Migrating an existing BSP Pack based on SSP v1.1.z to SSP 1.2.0

Custom packs cannot be upgraded from one version of SSP to another, so packs for SSP v1.2.0 can only be created using e2 studio v5.3.1.002. This functionality is not available using IAR Embedded Workbench for Renesas Synergy v7.40. Therefore, if your SSP v1.1.z project is using a custom board, you need to re-create the custom board pack in SSP v1.2.0 as described below (even if you're using IAR EW for Synergy as your IDE).
Please refer to the document id (***r11an0071***) at Renesas.com to re-create the BSP pack for SSP 1.2.0 or later

2. Creating a new custom BSP based on SSP 1.1.z

The Custom BSP Creator is a command-line tool for creating a custom BSP for early versions of the SSP, before that functionality was added into e^2 studio and IAR Embedded Workbench for Renesas Synergy. Note that BSPs created with this tool are not compatible with later versions of the SSP.

2.1 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, users develop an application on a Renesas Synergy board and eventually replace the Renesas-provided BSP with a custom BSP matching their custom board.

2.2 What changes with a custom BSP?

Not everything in the BSP changes when you create 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 for 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

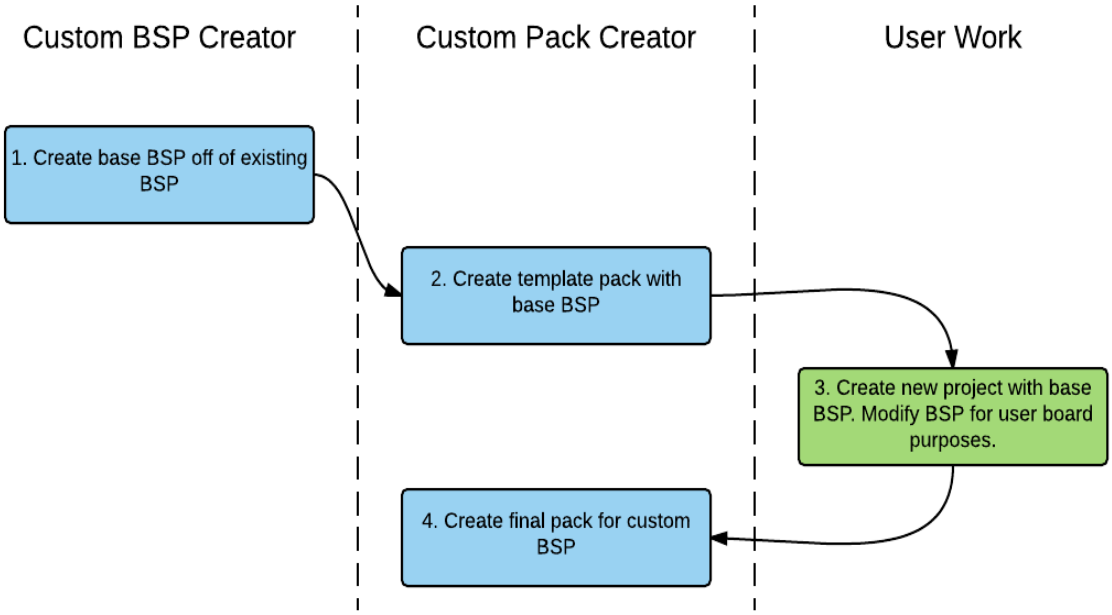
The *bsp.h* header file contains all of the necessary includes and function prototypes needed for this custom BSP. The *bsp_init.c* source file contains code that must be executed before `main()` and is specific to this board. The code in *bsp_init.c* is called when the core BSP executes the `bsp_init()`function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

Examples from boards provided by Renesas Synergy 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 e^2 studio to enable configuration of the BSP through the Synergy Configurator inside e^2 studio. The **BSP**, **Clocks**, and **ICU** tabs are data derived from the information contained in this XML file.

2.3 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.** Using this tool, you can pick an existing BSP (for example, the DK-S7G2) as a base for the new custom BSP.

Running this 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 e^2 studio, you need to create a new CMSIS Pack in step 2. CMSIS Packs are the mechanism that is used to deliver code inside e^2 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 e^2 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 e^2 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 e^2 studio to allow modifications.

After creating the template pack, you can modify the base BSP in e^2 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 e^2 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 e^2 studio.

Once the custom BSP has been tested and is ready to be finalized, you can 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 can modify the BSP settings in the Synergy Configurator but cannot 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 e^2 studio.

3. Example walkthrough

This section shows how to create an example custom BSP based on the DK-S7G2. For illustration purpose, it is assumed that custom_bsp_creator.exe and custom_pack_creator.exe are located under the *<e2 studio_install_directory>\internal\projectgen\arm\Packs* directory. Otherwise, the absolute path of the SSP pack needs to be provided with the –p option when using these executables.

3.1 Step 1: Create a base pack

To create a base pack, follow these steps (the first step and second step are optional and serves as an introduction to the executable):

1. From the Windows command prompt, enter the directory where the custom_bsp_creator.exe is located. Next, run *custom_bsp_creator.exe –h* to print the command line options for the tool.

```
custom_bsp_creator.exe -h
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 'wolfpack' based off the S7G2-DK, run the
command: custom_bsp_creator.exe -p pack_location -b s7g2_dk -n wolfpack
-# part_number -d output
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 wolfpack)
  -# PART_NUMBER, --part=PART_NUMBER
                        Part Number for MCU (eg R7FS7G27H2A01CBD,
                        R7FS3A77C3A01CFB, R7FS124773A01CFM)
  -d GENERATED_BSP_DESTINATION, --dest=GENERATED_BSP_DESTINATON
                        Destination path (eg C:\Users\John\Documents). Default
                        is 'tmp'.
--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. In addition, this example uses SSP1.0.0. User can choose the SSP pack they are using in this command.

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. Note that the users should use a valid C symbol for the board name.
   E. The new BSP is created in the *output* folder using the *-d* option. User can choose any destination folder desired.
   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 -# R7FS7G27H2A01CBD -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
```

3.2 Step 2: Create a template pack

Follow these steps to create a template pack, one that will allow modifications to the BSP source code. Step 1 is optional and serves an introduction to the executable. Creating the template pack involves using the new BSP in e^2 studio:

1. Use the *custom_pack_creator.exe* 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)
custom_pack_creator.exe -p CUSTOM_BSP_PATH -n PACK_NAME -v 1.0.0
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. Default is current
                        directory.
  -n USER_BOARD_NAME, --name=USER_BOARD_NAME
                        Name of custom board (eg wolfpack)
  -v PACK_VERSION, --version=PACK_VERSION
                          Version Number for Generated Pack (eg 1.0.0). Default
                        is 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\e2_studio). Default is
                        C:\Renesas\e2_studio.
  --verbose             Enable verbose output
```

2. Before continuing, make sure that e^2 studio is not open. If e^2 studio is open during a new pack generation, the tool may fail since e^2 studio can have the files open.
3. Create a template pack using the following options:
   A. The base BSP is 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 e^2 studio will vary based on where you installed it. In this example, we will use the e^2 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.

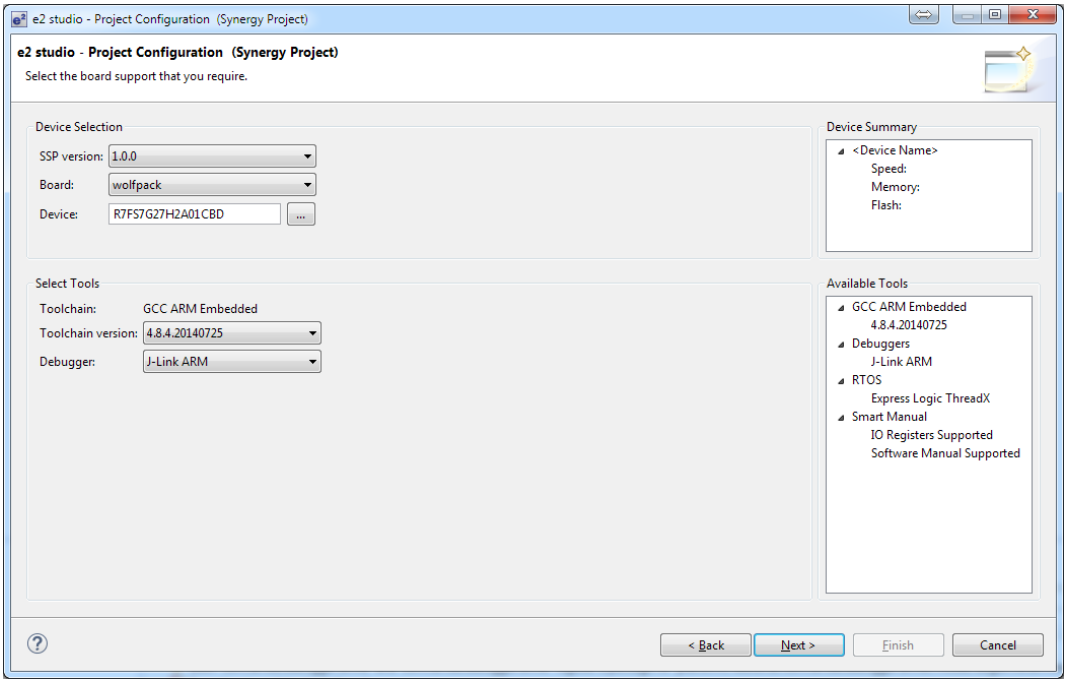
```
custom_pack_creator.exe -p output -n wolfpack -v 1.0.0 -t -e C:\Renesas\synergy-e2_studio --verbose
Removing old release
Copying files
Generating .pdsc
```

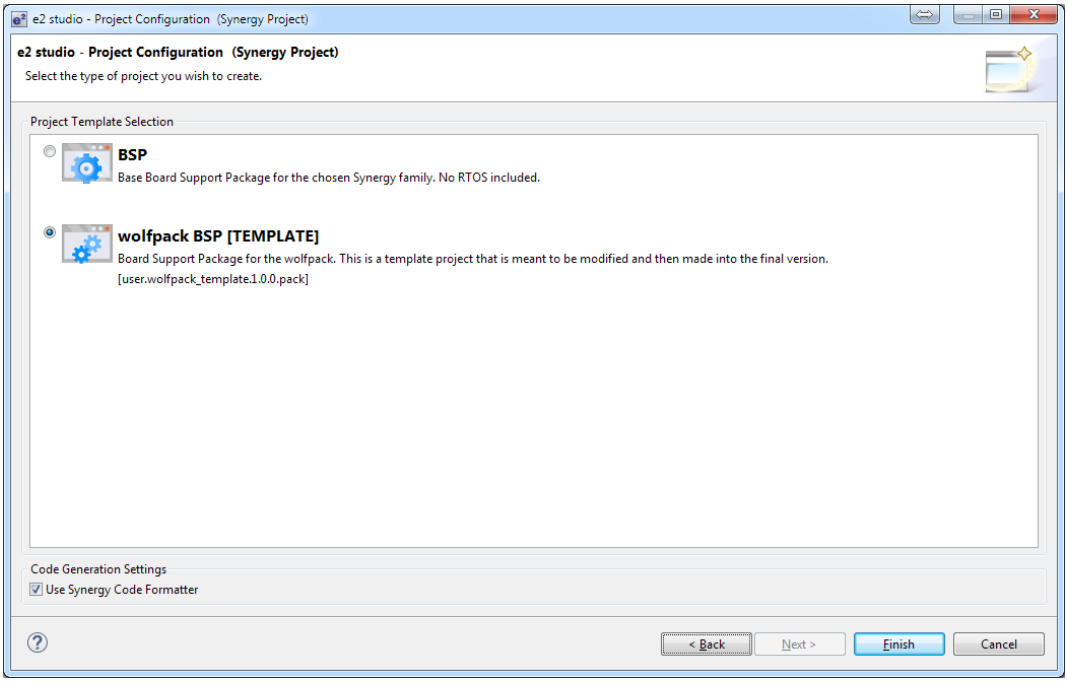
The custom pack has now been created.

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

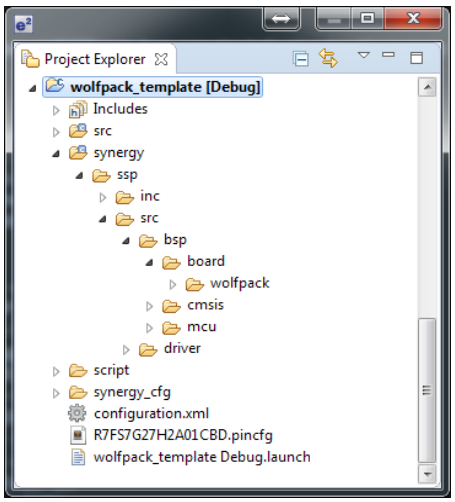
To configure the custom BSP, follow these steps:

1. Start e^2 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.





If you expand the *synergy/ssp/src/bsp/board* directory in the Project Explorer window, you will see your custom board folder.



After the project has been created, e^2 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 e^2 studio.
3. On your PC, navigate to the folder of the project you just created. In this example the folder is *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>user.wolfpack_template.1.0.0.pack</originalPack>
</component>
```

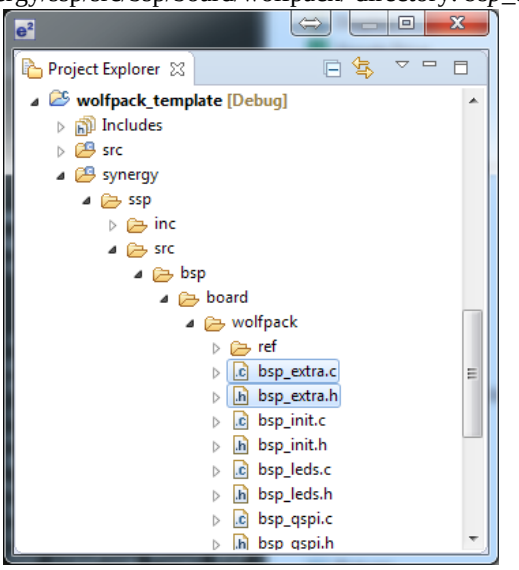
6. Under this <component> element, add the following element: <template>true</template>. Using the example in the previous step the <component> now looks like this:

```
<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>user.wolfpack_template.1.0.0.pack</originalPack>
 <template>true</template>
</component>
```

7. Save the file and close it.
8. Restart e^2 studio and reopen the project you created previously.
   WARNING: If you accidentally create a second component instead of modifying the first one, e^2 studio will crash.

In the next step, make modifications to the BSP to simulate the customization process. As previously mentioned, in most cases, the modification included pin configuration, stack and heap size, clock tree configuration and any additional source in board directory that needs to run before main.

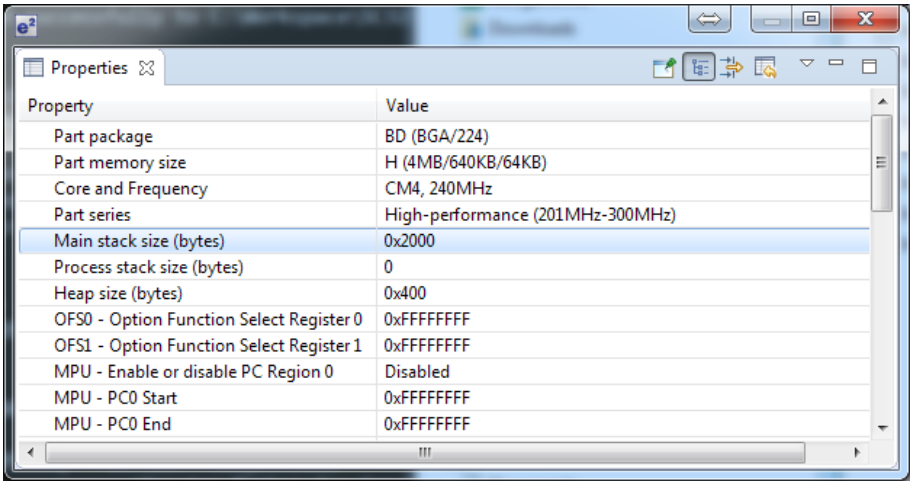
9. Add two empty files to the synergy/ssp/src/bsp/board/wolfpack/ directory: *bsp_extra.c* and *bsp_extra.h*.



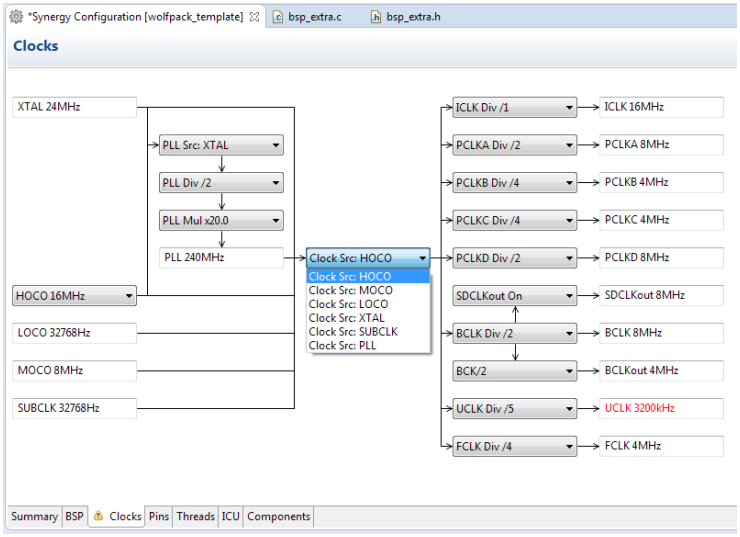
These two files are used to test the creation of the final non-template pack.

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

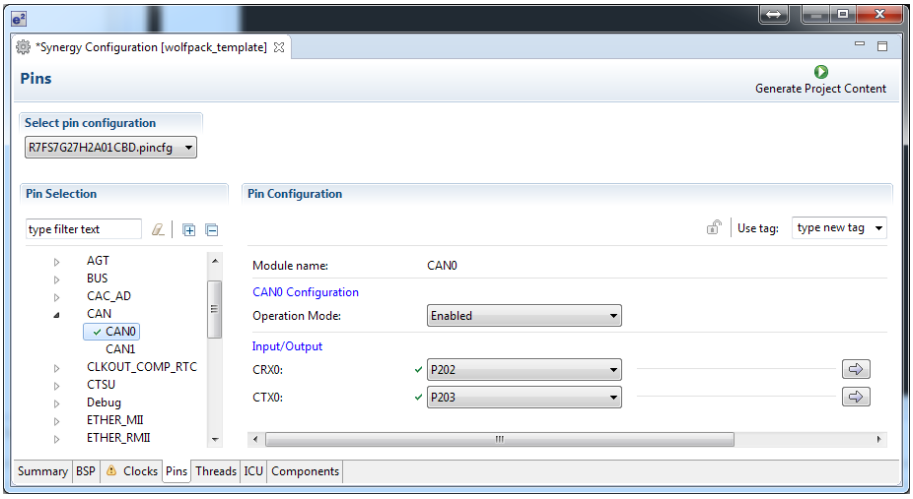
- In **Properties** window of the **BSP** tab, change the Main Stack size to *0x2000*. In your application, you may need a different Main Stack size



- Change the system clock source (*Clock Src*) to the HOCO. In your application, you should choose whichever clock is suitable for you.



- Enable the CAN0 pins in the Pin Configurator using the **Peripherals** view. This is an example for configuring a peripheral in the customer BSP package.



11. Save the changes by clicking the **Generate Project** button and build the project. The final, customized BSP has been created. Now we need to put it in a final pack.

3.4 Step 4: Create the final pack

You can now create a final, non-template pack with the Custom Pack Creator. Remember to close e^2 studio before performing this step. Go through the previous steps with the following differences:

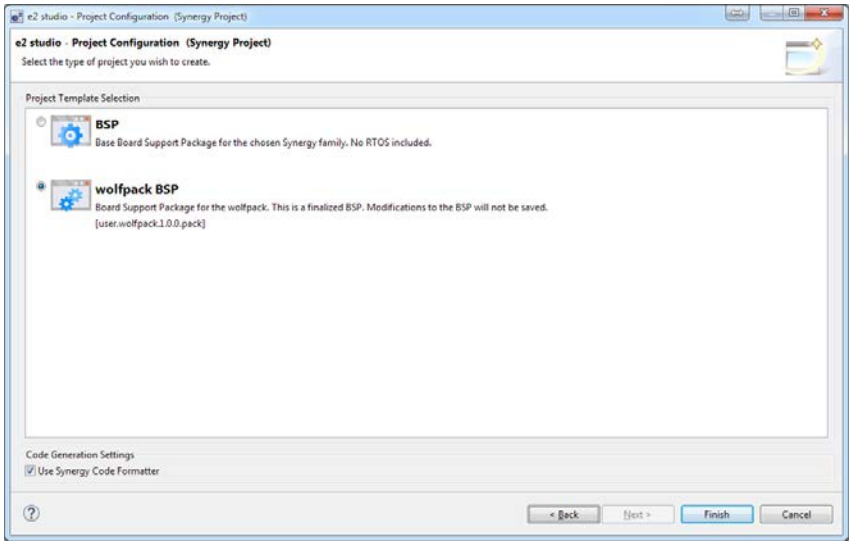
- The path to the custom BSP is now below the root of the project you created in earlier steps. For this example, we will assume the project was created under *C:\Workspace\wolfpack_template* and there is a *synergy* directory under this folder. Notice that there must be a *synergy* directory in the 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 .pdsc
```

Before using the final template, remove the template pack from e^2 studio:

Navigate to *<e2 studio_install_directory>\internal\projectgen\arm\Packs* and delete the template pack or move it outside of the e^2 studio directory. For this example, the name of the template pack is *user.wolfpack_template.1.0.0.pack.*

Open up e^2 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 a 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 *user.wolfpack.1.0.0.pack*.

Website and Support

Visit the following vanity URLs to learn about key elements of the Synergy Platform, download components and related documentation, and get support.

Synergy Software	renesassynergy.com/software
Synergy Software Package	renesassynergy.com/ssp
Software add-ons	renesassynergy.com/addons
Software glossary	renesassynergy.com/softwareglossary
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Revision History

Rev.	Date	Description	
		Page	Summary
1.0	Oct 12, 2015	-	Initial Version
1.01	Oct 16, 2015	All	Minor editorial updates
1.02	Jan 12, 2016	12	Support URL updated.
1.03	Mar 17, 2016	-	Minor typos fixed. Updates based on latest pack creator.
1.04	Sep 29, 2016	1 12	Title format changed. Support URLs updated.
1.05	Sep 10, 2018	All	Added section 1, added review comments, made editorial updates.
1.06	Oct 16, 2018	3	Document id describing in section 1 changed.

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