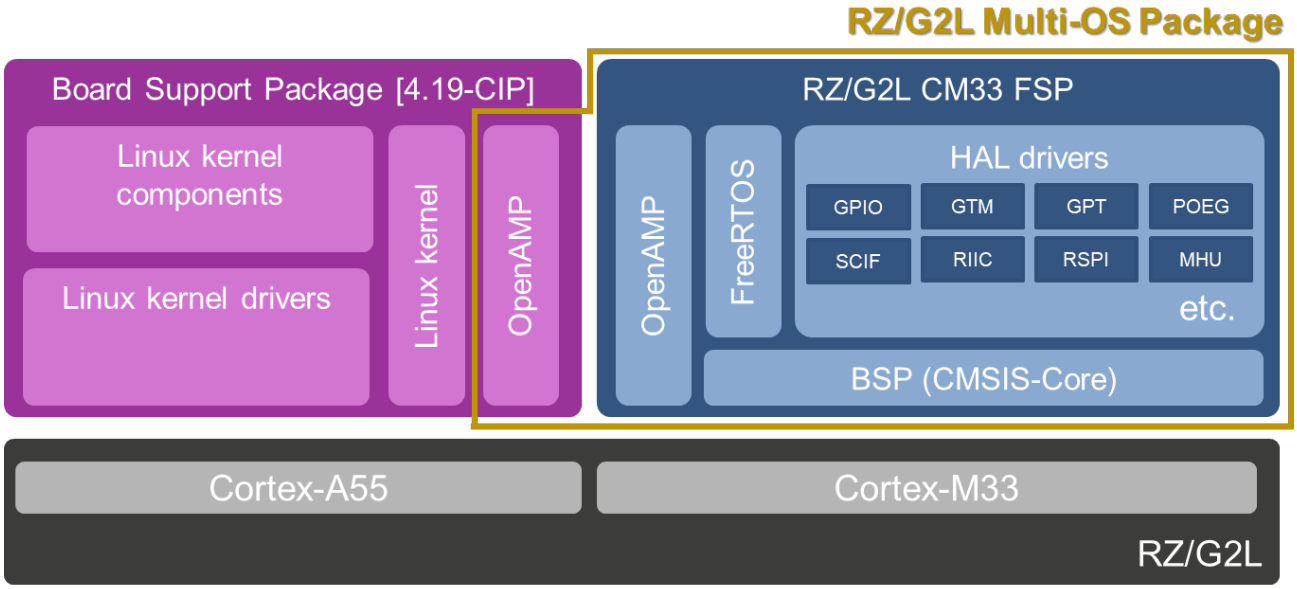
RZ/G2L, RZ/G2LC

Release Note for RZ/G2L Multi-OS Package V1.00

Introduction

This software package provides user with easy way to establish multi-OS (i.e., CIP Linux running on Cortex®-A55 and FreeRTOS running on Cortex-M33) environment and sample program showing how to implement Inter-Processor Communication between those CPU cores.

This package consists of RZ/G2L Cortex-M33 Flexible Software Package (hereinafter referred to as RZ/G2L CM33 FSP) and Inter-Processor Communication Feature Package for RZ/G2L Board Support Package (hereinafter referred to as RZ/G2L BSP).



Here are brief descriptions of each component of RZ/G2 Multi-OS Package:

- RZ/G2L CM33 FSP
  The software package consisting of production ready peripheral drivers, FreeRTOS and portable middleware stacks and the best in-case HAL drivers with low memory footprint.

- OpenAMP
  The framework including the software components needed for Asymmetric Multiprocessing (AMP) systems such as Inter-Processor Communication.

Target Device

RZ/G2L, RZ/G2LC

Contents

1. Specifications

Table 1-1 lists the on-chip peripheral modules to be used in this application.

Table 1-1. Peripheral module used

Peripheral module	Usage
Message Handling Unit (MHU)	Configures Inter-Processor Interrupt.
Serial Communications Interface with FIFO (SCIFA)	Performs standard serial communications sending and receiving console messages.
Interrupt controller (INTC)	Configures interrupt settings; the processor will receive interrupts during buffered serial communications, and in the MHU module when Inter-Processor Interrupt is fired.
Clock Pulse Generator (CPG)	Configures the main CPU clock.
General Purpose Input Output (GPIO)	Configures I/O lines used by serial communications.
General Timer (GTM)	Configures the tick for FreeRTOS.

1.1 RZ/G2L reference boards setup

Please refer to RZ/G2L SMARC EVK Start-up Guide.

2. Verified Operation Conditions

Table 2-1. Verified Operating Conditions

Item	Contents
Microprocessor used	RZ/G2L, RZ/G2LC
Integrated Development Environment	e^2 studio 2021-07 or later
C compiler	GNU Arm Embedded 9.2.1 2019q4 Compiler Options (except directory path): • Release -D_RENESAS_RZG_ -mthumb -mcpu=cortex-m33+nodsp+nofp -fdiagnostics-parseable-fixits -O2 -fmessage-length=0 -fsigned-char -ffunction-sections -fdata-sections -Wunused -Wuninitialized -Wall -Wextra -Wmissing-declarations -Wconversion -Wpointer-arith -Wshadow -Wlogical-op -Waggregate-return -Wfloat-equal -Wnull-dereference -g -std=c99 -mcmse • Hardware Debug -D_RENESAS_RZG_ -mthumb -mcpu=cortex-m33+nodsp+nofp -fdiagnostics-parseable-fixits -Og -fmessage-length=0 -fsigned-char -ffunction-sections -fdata-sections -Wunused -Wuninitialized -Wall -Wextra -Wmissing-declarations -Wconversion -Wpointer-arith -Wshadow -Wlogical-op -Waggregate-return -Wfloat-equal -Wnull-dereference -g -std=c99 -mcmse

3. Sample Program Setup

3.1 RZ/G2L Flexible Software Package Setup

Please refer to RZ/G2L Getting Started with Flexible Software Package.

3.2 OpenAMP related stuff Integration to RZ/G2L Board Support Package (BSP)

You need to run the following commands listed below after (3) in the section 3.1 of Release Note for RZ/G2L Board Support Package V1.0.

```
$ cd ~/user_work
$ unzip meta-rzg2l-freertos.zip
$ unzip meta-opemamp.zip
$ cp meta-rzg2l-freertos/docs/sample/conf/minimal/smarc-rzg2l/*.conf \
  build/conf/
$ cd ~/user_work/build
```

Please note that channel 2 of SCIFA won't become available on BSP when OpenAMP related stuff is integrated by following the above procedure. Also, by following the above procedure, u-boot becomes able to access the reserved area in internal RAM. If you would not like to apply this change, please comment out the following line in meta-rzg2l-freertos/conf/layer.conf

```
${LAYERDIR}/recipes-bsp/*/*.bbappend
```

3.3 Deployment of RZ/G2L BSP

First, you need to deploy Linux kernel, device tree and root filesystem referring to the section 3 of RZ/G2L Yocto Recipe Start-Up Guide. Also, you need to extract the modules-smarc-rzg2l.tgz generated in user_work/build/tmp/deploy/images/smarc-rzg2l and copy the extracted files to the 2nd partition of microSD card.

4. Sample Program Invocation

4.1 Hardware setup

1. Connect J-Link to RZ/G2L SMARC EVK. For details, please refer to RZ/G2L Getting Started with Flexible Software Package.
2. Connect Pmod USBUART to the Pmod 1 of SMARC Carrier Board as shown below for securing the console for the program running on CM33:

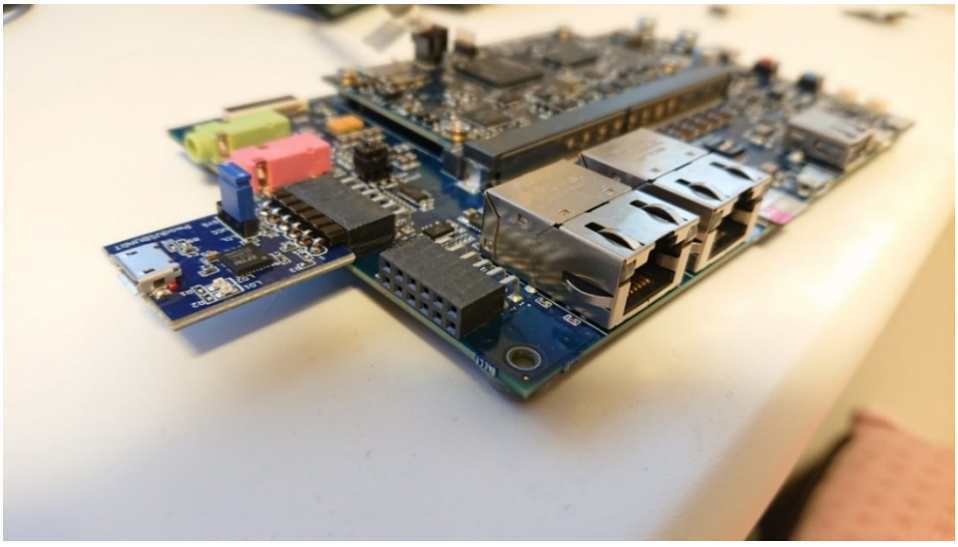


Figure 4-1. Connection between RZ/G2L SMARC EVK and Pmod USBUART

4.2 CM33 Sample Program Setup

Please carry out the following procedures for setting up demo program running on CM33.

1. Extract 01an5869ej0050-rzg2l-cm33-multi-os-pkg.zip on your development PC.
2. Extract rzg2l_cm33_rpmsg_demo.zip there.
3. Open e^2 studio 2021-07 and click File > Import.
4. Double-click General and select Existing Projects into Workspace as shown in Figure 4-2:

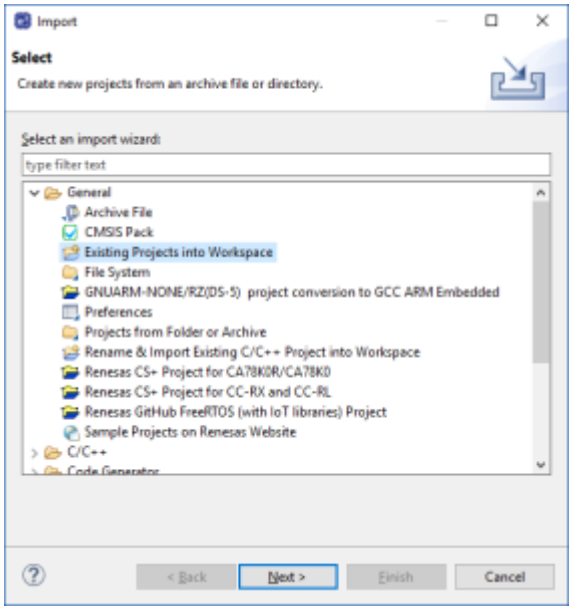


Figure 4-2. Import sample project (1)

5. Input the path to the folder rzg2l_cm33_rpmsg_demo, press Enter key and click Finish button.

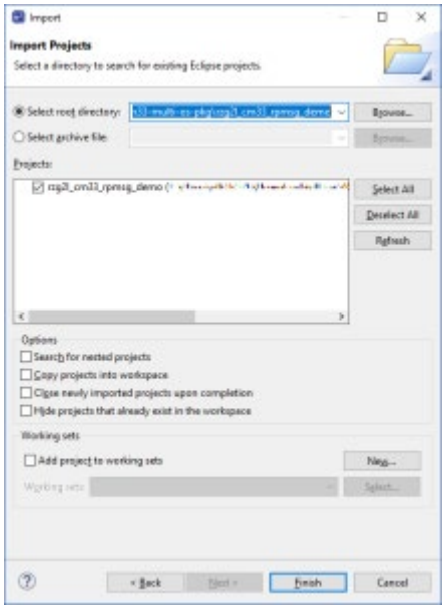


Figure 4-3. Import sample project (2)

6. Build the project from Choose Project > Build Project.
7. If the build is successfully completed, the following files should be generated in Debug and/or Release folder in accordance with the active Build Configuration.
   - rzg2l_cm33_rpmsg_demo.elf
   - rzg2l_cm33_rpmsg_demo_non_secure_code.bin
   - rzg2l_cm33_rpmsg_demo_non_secure_vector.bin
   - rzg2l_cm33_rpmsg_demo_secure_code.bin
   - rzg2l_cm33_rpmsg_demo_secure_vector.bin

4.3 CM33 Sample Program Invocation

4.3.1 CM33 Sample Program Invocation with Segger J-Link

You need to follow the following steps to invocate CM33 sample program with Segger J-Link.

1. Choose rzg2l_cm33_rpmsg_demo Debug_Flat or rzg2l_cm33_rpmsg_demo Release_Flat from the drop-down list indicated by a red arrow in Figure 4-4.

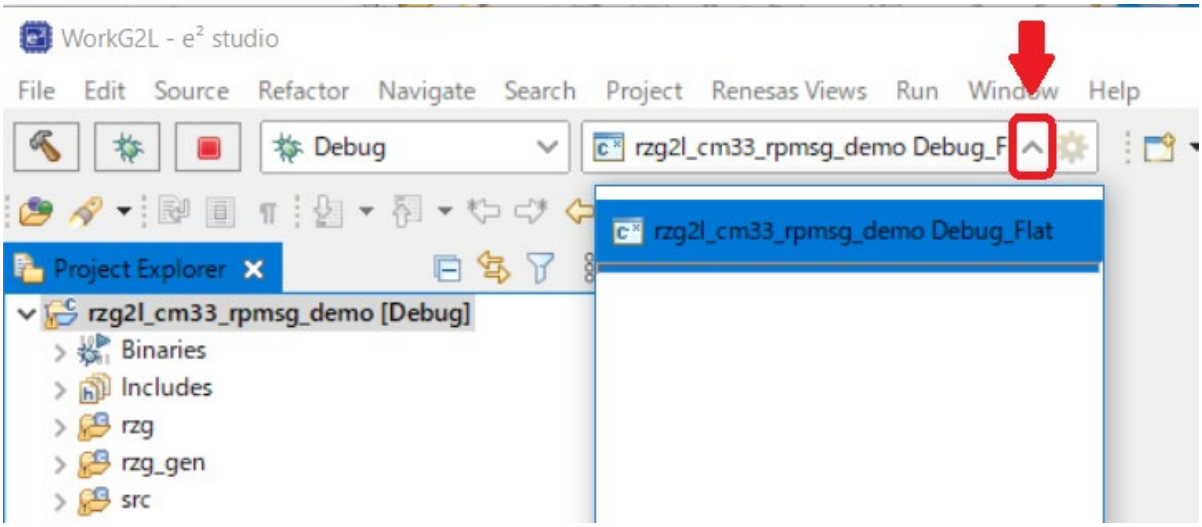


Figure 4-4. Select of Debug Configuration

2. Click the debug button indicated by a red arrow in Figure 4-5.

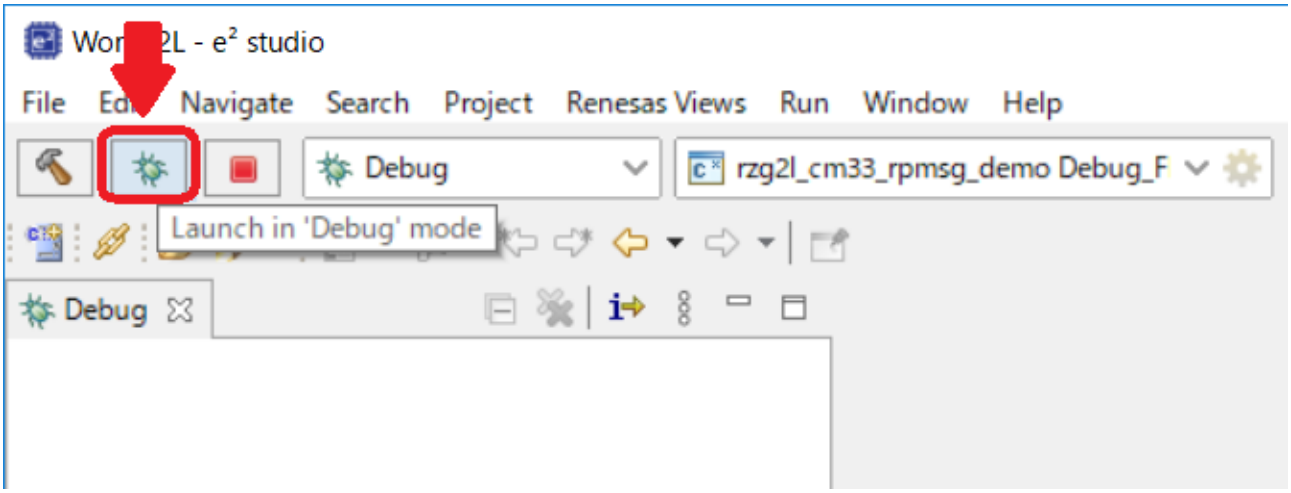


Figure 4-5. Debug Function Launch

If “Confirmation Perspective Switch” window below appears, please press “Switch” to go ahead.

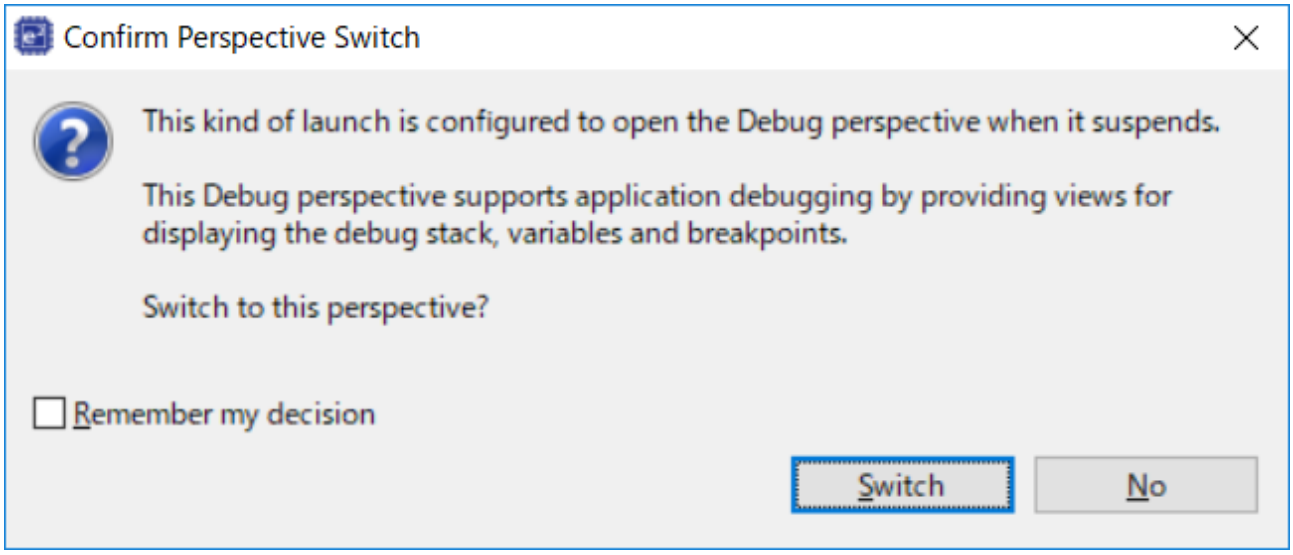


Figure 4-6. Confirmation window to open the Debug perspective

3. When the debug perspective is opened, Program Counter (PC) should be located at the top of Warm_Reset_S function. Then, you need to press the button indicated by a red arrow in Figure 4-7.

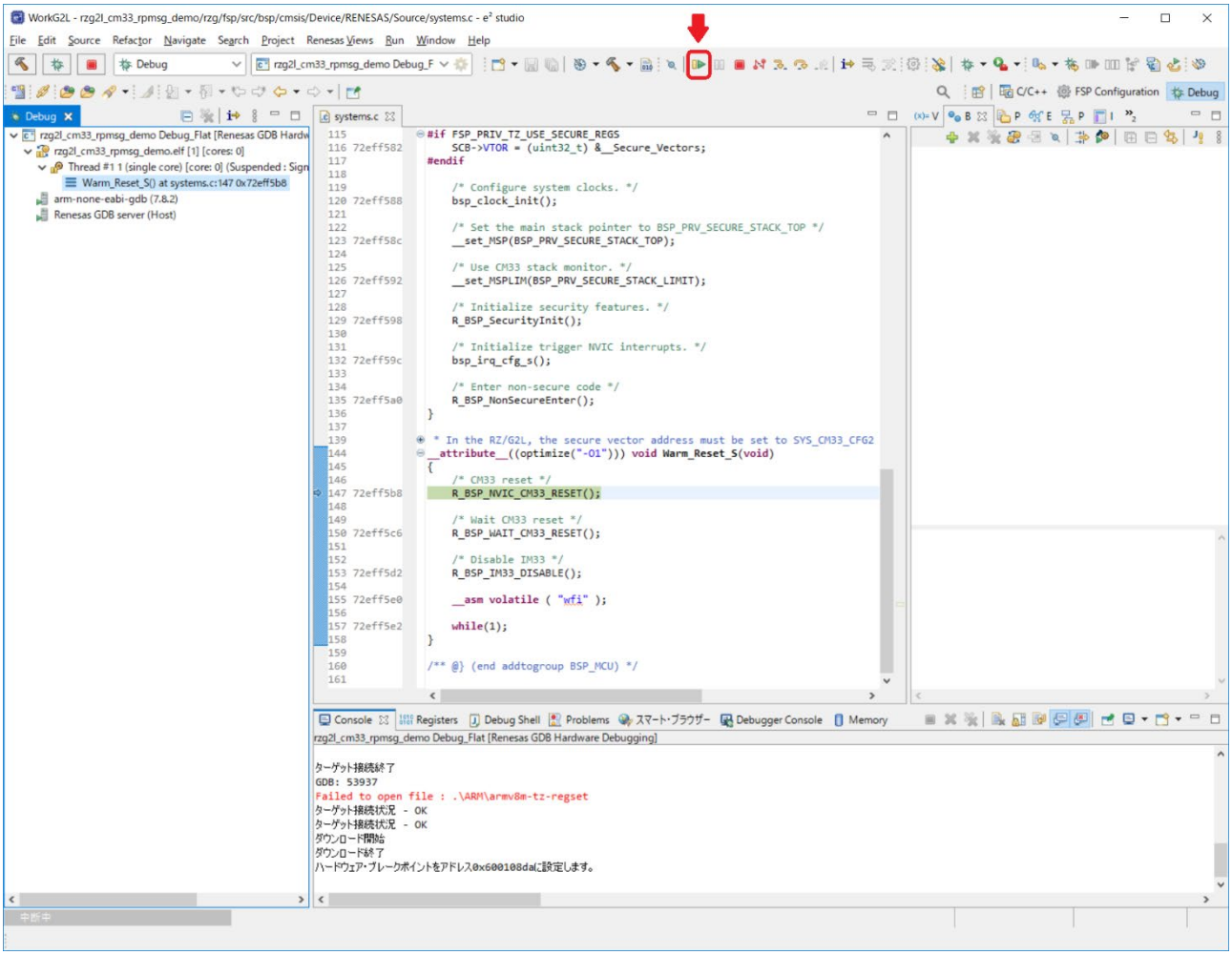


Figure 4-7. How to start to debug sample program (1)

4. The program should stop at the top of main function. Thus, please click the same button as the previous step.

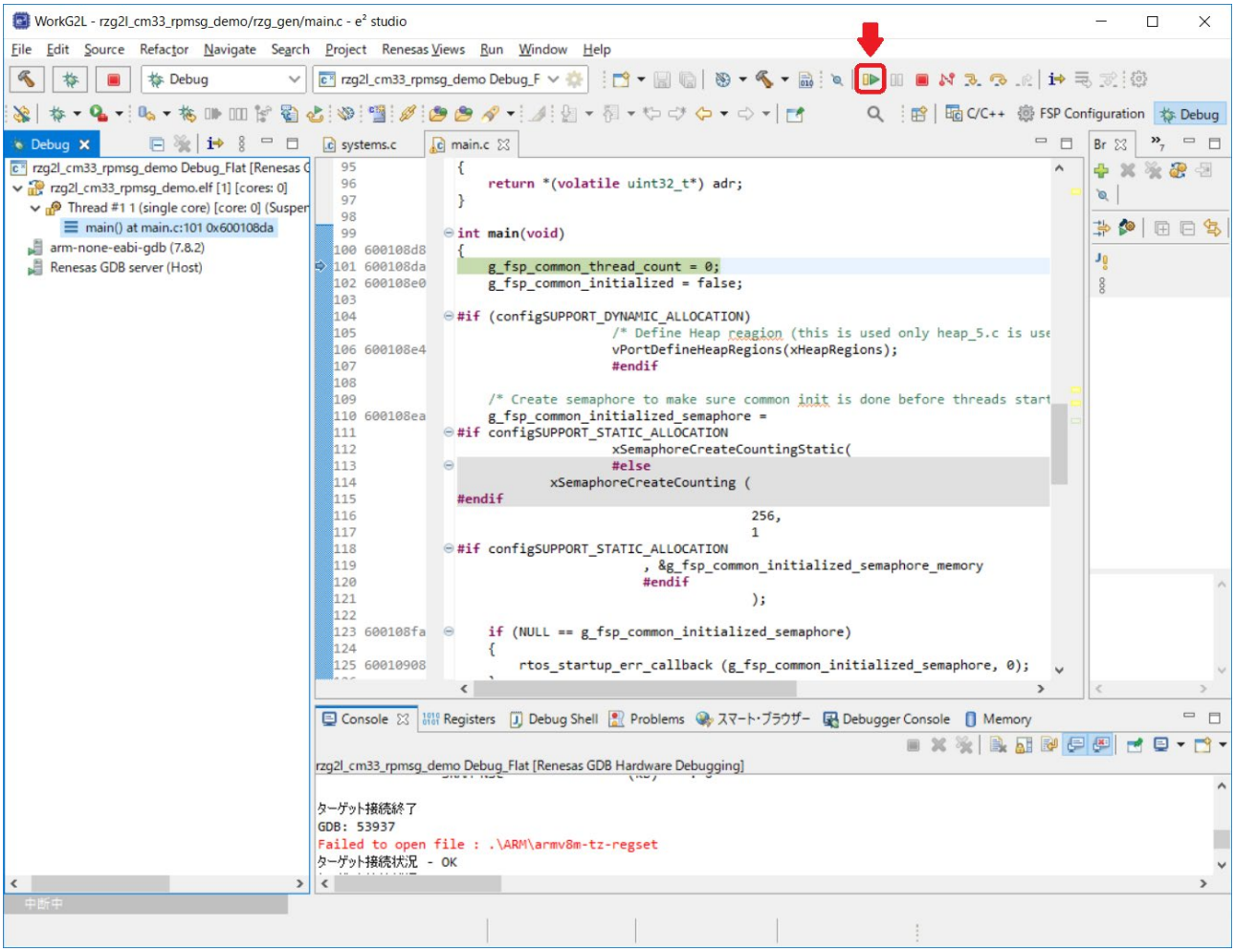


Figure 4-8. How to start to debug sample program (2)

5. Now that CM33 sample program has been started, the following message is shown on the console connected to Pmod USBUART:

```
Successfully probed IPI device
Successfully open uio device: 42F00000.rsctbl.
Successfully added memory device 42F00000.rsctbl.
Successfully open uio device: 43000000.vring-ctl0.
Successfully added memory device 43000000.vring-ctl0.
Successfully open uio device: 43200000.vring-shm0.
Successfully added memory device 43200000.vring-shm0.
Initialize remoteproc successfully.
creating remoteproc virtio
initializing rpmsg vdev
```

At this point of time, CM33 program is waiting for the establishment of rpmsg channel between CM33 and CA55.

4.3.2 CM33 Sample Program Invocation with u-boot

You can invoke CM33 sample program from u-boot by following the procedure described below:

1. Copy rzg2l_cm33_rpmsg_demo_secure_code.bin, rzg2l_cm33_rpmsg_demo_secure_vector.bin, rzg2l_cm33_rpmsg_demo_non_secure_code.bin and rzg2l_cm33_rpmsg_demo_non_secure_vector.bin generated at 7 of section 4.2 to microSD card.
2. Insert the microSD card into CN10 of SMARC carrier board.
3. Turn on SMARC EVK by pressing reset button (i.e., SW14)
4. You should now see the following message in the console connected to CN14 of SMARC carrier board:

```
U-boot 2020.10 (Mar 25 2021 - 08:20:26 +0000)

CPU: Renesas Electronics E rev 9.7
Model: smarc-rzg2l
DRAM: 1.9GiB
MMC: sh-sdhi: 0, sh-sdhi: 1
Loading Environment from MMC... OK
In: serial@1004b800
Out: serial@1004b800
Err: serial@1004b800
Net: No ethernet found.
Hit any key to stop autoboot: 0
=>
```

   Then, you need to hit any key to stop autoboot within 3 sec.

5. Load the binary files listed in 1. from microSD card to RAM by executing the commands below on the console:

```
dcache off
mmc dev 1
fatload mmc 1:N 0x0001FF80 rzg2l_cm33_rpmsg_demo_secure_vector.bin
fatload mmc 1:N 0x42EFF440 rzg2l_cm33_rpmsg_demo_secure_code.bin
fatload mmc 1:N 0x00010000 rzg2l_cm33_rpmsg_demo_non_secure_vector.bin
fatload mmc 1:N 0x40010000 rzg2l_cm33_rpmsg_demo_non_secure_code.bin
cm33 start_debug 0x1001FF80 0x00010000
dcache on
```

   Here, N denotes the partition number in which you stored those binaries.

6. Now that CM33 program has been started to run. With respect to the behavior of sample program, please see 4.5.

4.4 CA55 Sample Program Invocation

You need to follow the procedure shown below to invoke CA55 sample program running on Linux.

1. Boot up Linux by executing the following command on u-boot:

```
run bootcmd
```

2. Login as “root”

```
smarc-rzg2l login: root
```

3. Update Linux module dependencies by executing the “depmod” command.

```
root@smarc-rzg2l:~# depmod
```

Please note that you need to execute this command at the time of first login.

4. Run CA55 sample program by executing the following command on Linux.

```
root@smarc-rzg2l:~# rpmsg_sample_client 0
```

5. Then, you can see the following message on the console relative to CN14 of SMARC carrier board. Be sure that you invoke CM33 program in advance.

```
Successfully probed IPI device
metal: info:      metal_uio_dev_open: No IRQ for device 42f00000.rsctbl.
Successfully open uio device: 42f00000.rsctbl.
Successfully added memory device 42f00000.rsctbl.
metal: info:      metal_uio_dev_open: No IRQ for device 43000000.vring-ctl0.
Successfully open uio device: 43000000.vring-ctl0.
Successfully added memory device 43000000.vring-ctl0.
metal: info:      metal_uio_dev_open: No IRQ for device 43200000.vring-shm0.
Successfully open uio device: 43200000.vring-shm0.
Successfully added memory device 43200000.vring-shm0.
metal: info:      metal_uio_dev_open: No IRQ for device 42f01000.mhu-shm.
Successfully open uio device: 42f01000.mhu-shm.
Successfully added memory device 42f01000.mhu-shm.
Initialize remoteproc successfully.
creating remoteproc virtio
initializing rpmsg shared buffer pool
initializing rpmsg vdev
```

Please note that, the communication with CM33 is started immediately after that. For details, please refer to section 4.5.

4.5 Overview of Sample Program Behavior

The behavior of sample program is as follows:

1. Wait until a communication channel between CA55 and CM33 is established.
2. Once the communication channel is established, CA55 sample program starts to send the message to CM33 with incrementing its size from the minimum value 17 to the maximum value 488. At that time, the message like the following should be shown in the console connected to CN14 of SMARC carrier board:

```
Sending payload number 148 of size 165
```

3. When CM33 receives the message sent from CA55, the echo reply is sent back to CA55.
4. When CA55 receives the echo reply, the message below should be displayed in the console connected to CN14 of SMARC carrier board:

```
echo test: sent : 165
 received payload number 148 of size 165
```

5. After the message which has 488 bytes sized payload is sent from CA55 to CM33 and CM33 sends back the echo reply, the message for terminating the communication channel is sent from CA55 to CM33.

Then, CA55 and CM33 sample programs output the following log messages to the corresponding consoles respectively when receiving the termination message.

- Termination message on CA55 side

```
**********************************
Test Results: Error count = 0
**********************************
Quitting application .. Echo test end
Stopping application...
```

- Termination message on CM33 side

```
De-initializating remoteproc
```

Then, CM33 side re-waits for the establishment of connection channel. You can see the following log on the console a short time later:

```
creating remoteproc virtio
initializing rpmsg vdev
```

5. Reference Documents

- R01AN5924: RZ/G2L Getting Started with Flexible Software Package
  The latest version can be downloaded from Renesas Electronics website.
- R01US0471: Release note for RZ/G2L Board Support Package
  The latest version can be downloaded from Renesas Electronics website.
- R01US0473: RZ/G2L Yocto Recipe Start-up Guide
  The latest version can be downloaded from Renesas Electronics website.
- R01US0472: RZ/G2L Board Support Package Version 1.0 Component list
  The latest version can be downloaded from Renesas Electronics website.
- R01TU0338: RZ/G2L SMARC EVK Start-up Guide
  The latest version can be downloaded from Renesas Electronics website.

Revision History

Rev.	Date	Description	
		Page	Summary
1.0	Jul.30.21	-	First edition issued.

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

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1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses
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