StarFive 赛昉科技

StarFive StarStudio User Guide

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Preface

About this guide and technical support information.

About this document

This document mainly provides the users with the necessary information to use StarFive StarStudio.

StarFive StarStudio provides users an interface to interact with StarFive Bare Metal SDK and StarFive Linux SDK to perform various actions.

This document is intended to help users:

- Use StarFive StarStudio with Linux SDK as described in Using StarFive StarStudio with Linux SDK *(on page 7)*.
- Use StarFive StarStudio with Bare Metal SDK as described in Using StarFive StarStudio with Bare Metal SDK *(on page 18)*.

Revision History

Table 0-1 Revision History

Version	Released	Change Description
0.1	2022/06/16	Preliminary version.
0.2	2022/09/07	Updated the product name.
0.3	2022/10/20	Editorial updates.

Notes and notices

The following notes and notices might appear in this guide:

- **Tip:**
  Suggests how to apply the information in a topic or step.
- **Note:**
  Explains a special case or expands on an important point.
- **Important:**
  Points out critical information concerning a topic or step.
- **CAUTION:**
  Indicates that an action or step can cause loss of data, security problems, or performance issues.
- **Warning:**
  Indicates that an action or step can result in physical harm or cause damage to hardware.

1. Using StarFive StarStudio with Linux SDK

This chapter provides steps to use StarFive StarStudio with Dubhe Linux SDK.

It contains the following procedures:

1. Complete the Prerequisites *(on page 7)*
2. Start Up StarFive StarStudio *(on page 8)*
3. Importing eSDK *(on page 8)*
4. Modifying Packages *(on page 9)*
5. Importing Packages to Project Explorer *(on page 10)*
6. Building Packages and QSPI Image *(on page 11)*
7. Running QEMU *(on page 12)*
8. Flashing Binary into FPGA *(on page 13)*
9. Debugging OpenSBI or Linux Kernel *(on page 14)*

1.1. Prerequisites

Make sure you extract and install both StarFive StarStudio and StarFive Linux eSDK on your host machine before starting up the StarFive StarStudio:

1. Copy the `StarStudio-beta-202206.tar.gz` file into your directory and untar it:

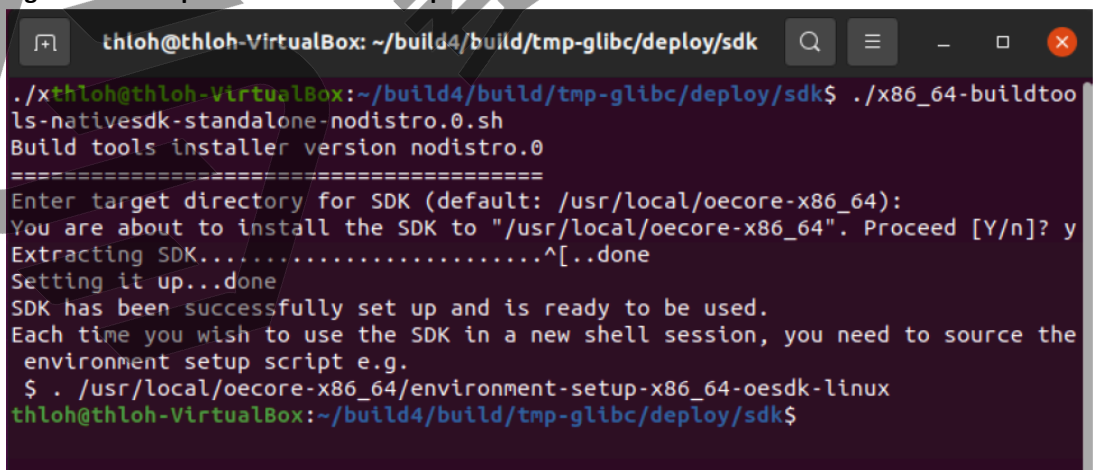
   ```
   $ tar -zxvf StarStudio-beta-202206.tar.gz
   ```

   Result

   The extracted folder is ready to use.

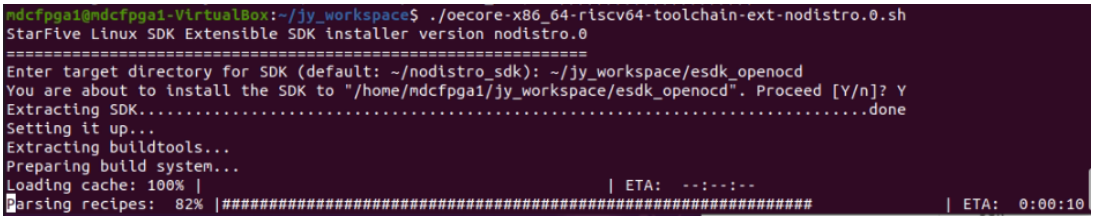
2. Install the Linux eSDK by running the following two scripts:
   - `$ ./x86_64-buildtools-nativesdk-standalone-nodistro.0.sh`

Figure 1-1 Example Command and Output



- `$ ./oecore-x86_64-riscv64-toolchain-ext-nodistro.0.sh`

Figure 1-2 Example Command and Output



1.2. Start Up StarFive StarStudio

To start up the StarFive StarStudio, perform the following steps:

1. Go to the StarFive StarStudio folder and open the executable to open StarFive StarStudio.
2. Select **Workspace** for StarFive StarStudio IDE and click **Launch**.
3. Close the **Welcome** tab.

1.3. Importing eSDK

Perform the following steps to import eSDK:

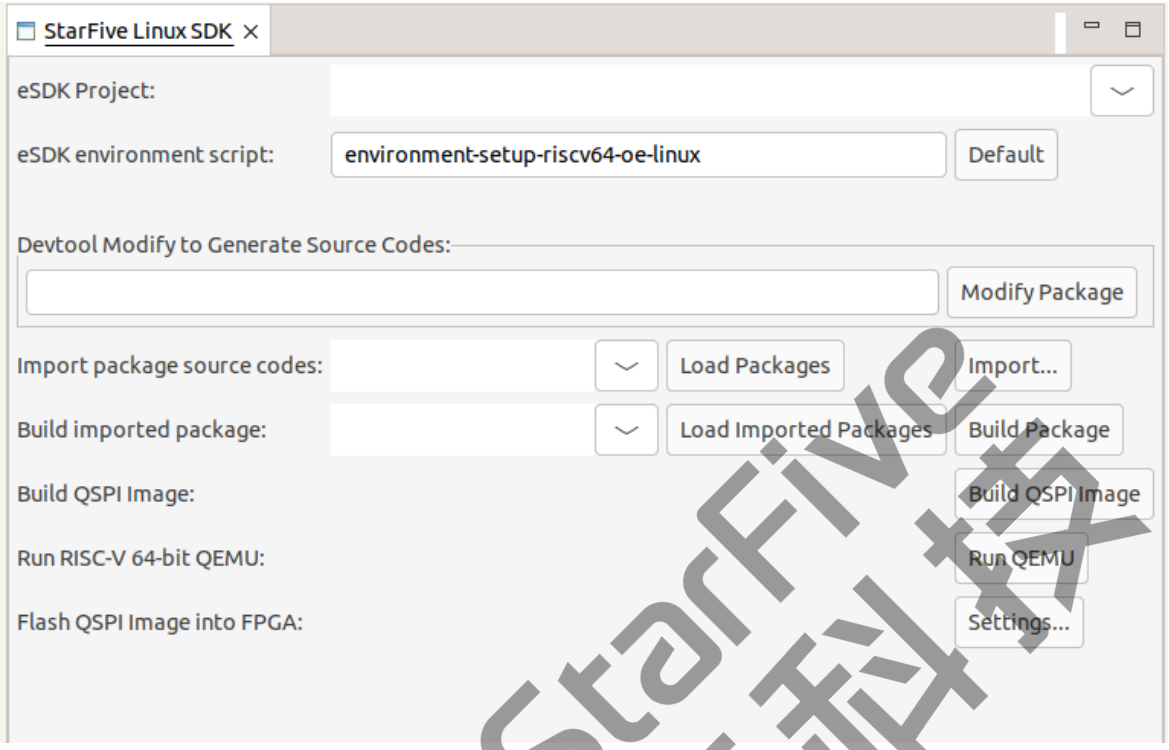
1. Click **Import Projects** under **Project Explorer** on the left side of your StarFive StarStudio workbench.
2. Select **StarFive Dubhe Linux SDK** under the **StarFive** folder from the Import Wizard, and click **Next**.
3. Import StarFive Linux SDK project as prompted:
   - **Project Name**: The project name. For example, `linux_sdk`.
   - **Existing eSDK Location**: The directory of the installed eSDK that you want to import. For example, `/home/jytan/linux_sdk`.
   - **Olimex OpenOCD Config File Location**: The openOCD Confg file location. The default file is `<eSDK>/tmp/deploy/images/starfive-dubhe/olimex-openocd_s5.cfg`.
4. Click **Finish** and the directory of the eSDK will be imported.

Note:
The indexing for the build folder `tmp/` is disabled as the directory is too large.

Result:

You will also be greeted with the StarFive Linux SDK View:

Figure 1-3 StarFive Linux SDK



For instructions to modify the package, see the Modifying Packages *(on page 9)* section.

1.4. Modifying Packages

Perform the following steps to modify the packages:

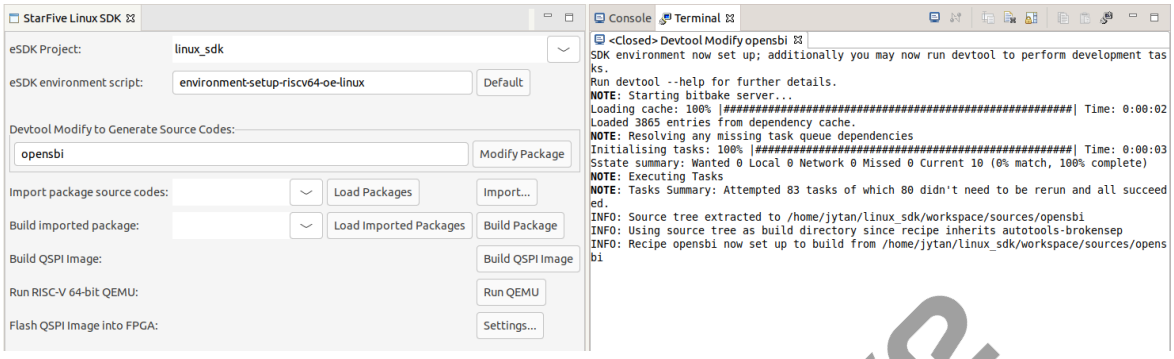
1. On the **StarFive Linux SDK** tab, configure the following:
   - **eSDK Project**: The eSDK project that is imported in Importing eSDK *(on page 8)*. For example, choose **linux_sdk**.
   - **Devtool Modify to Generate Source Codes**: The package that you want to do development on. For example, **opensbi**.

   Note:
   If you want to use command lines to modify packages, refer to the *Developing Applications or Modifying Packages* chapter in the *Dubhe Linux SDK User Guide*.

2. Click **Modify Package**.
   Result:

The package source code is pulled into the workspace directory, and a terminal in StarFive StarStudio will be running the command:

Figure 1-4 Terminal Interface



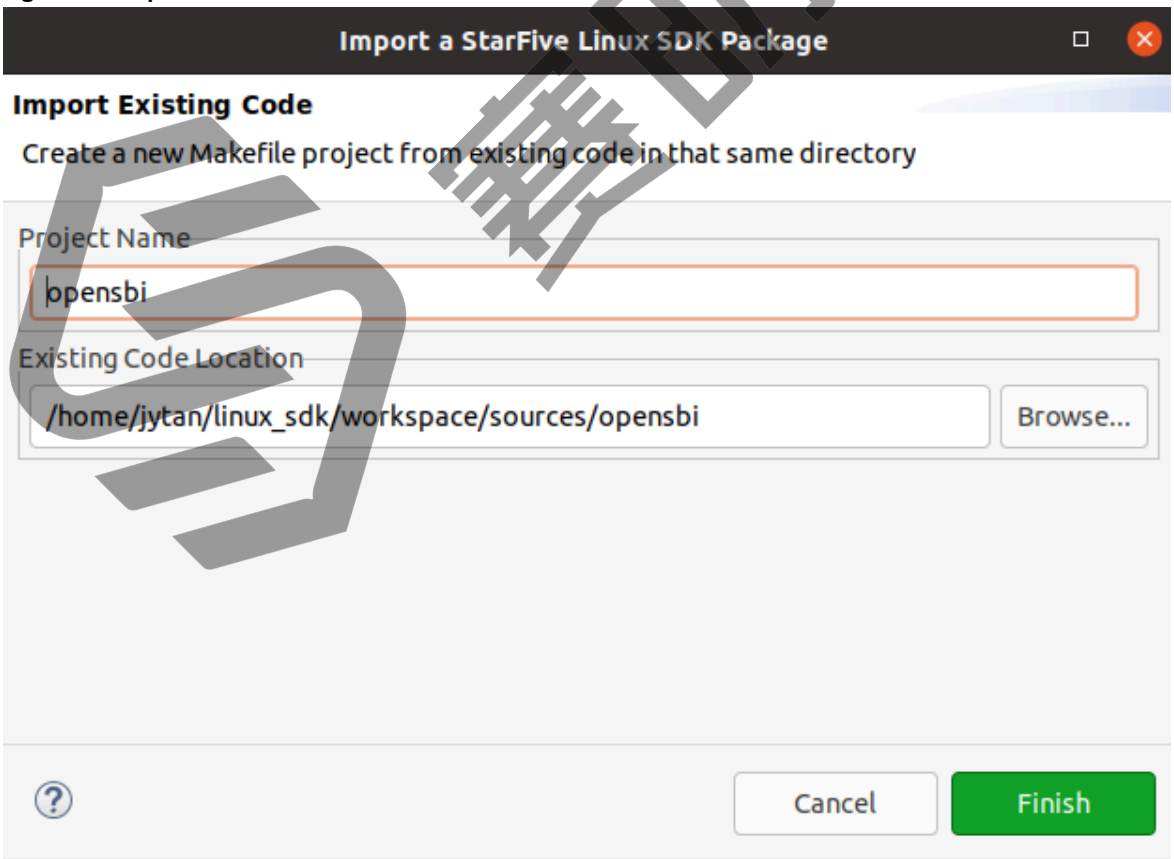
1.5. Importing Packages to Project Explorer

After the modification process is done, you can now import the package into StarFive StarStudio's Project Explorer. To import the opensbi package, perform the following steps:

1. Select the eSDK project under **Import package source codes**, and click **Load Packages** button on the **StarFive Linux SDK** tab to load the packages available.
2. Press the **Import...** button.
   Result:

   you will be directed to a simple import wizard. The data will be auto-populated:

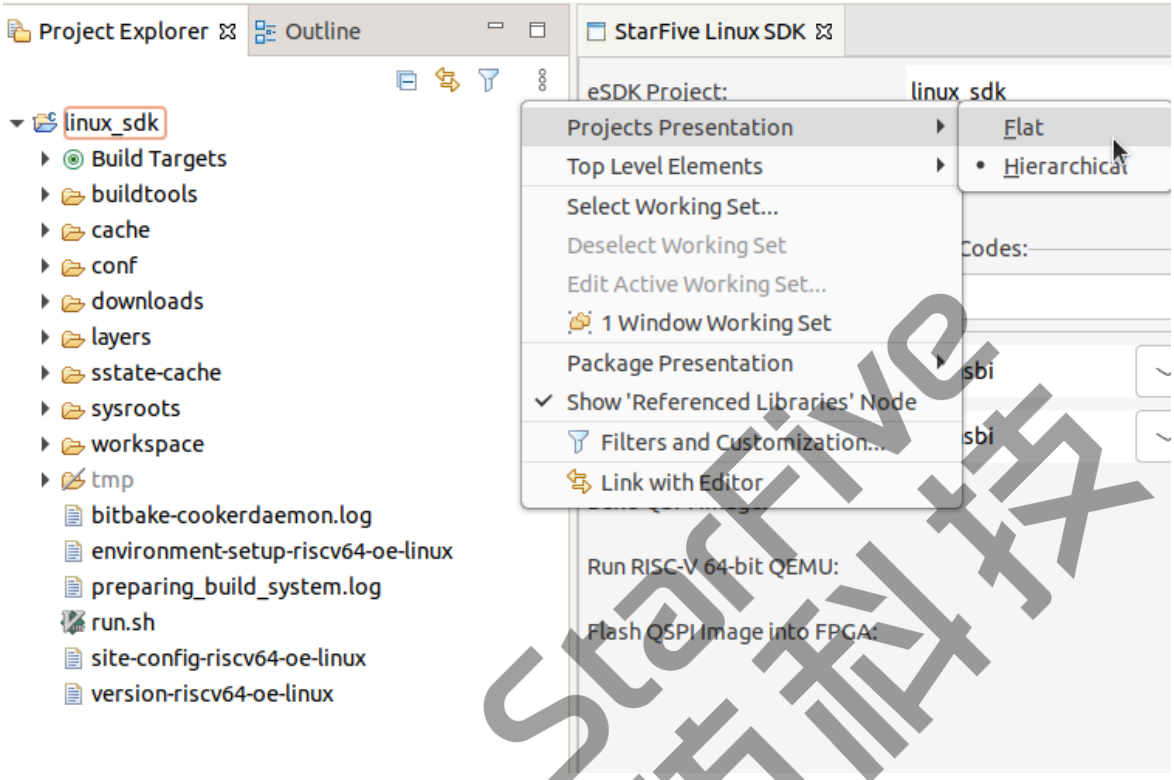
Figure 1-5 Import Wizard



3. Press **Finish** to complete the import package process.

4. (Optional) If the Project Explorer is still the same after you import the packages, you will need to click the settings button on **Project Explorer**, and go to Projects **Presentation** to choose it in a **Flat** mode:

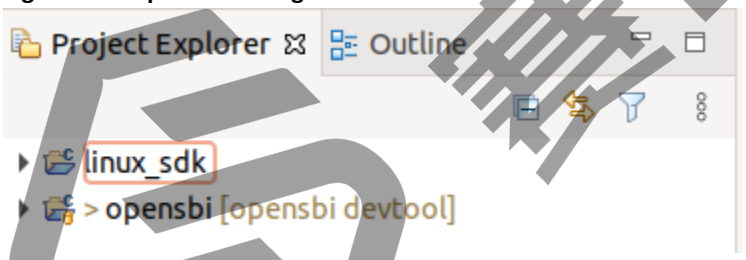
Figure 1-6 Choose Flat Mode



Result:

After choosing the settings, you will now notice that the package imported is in Project Explorer now:

Figure 1-7 Imported Package

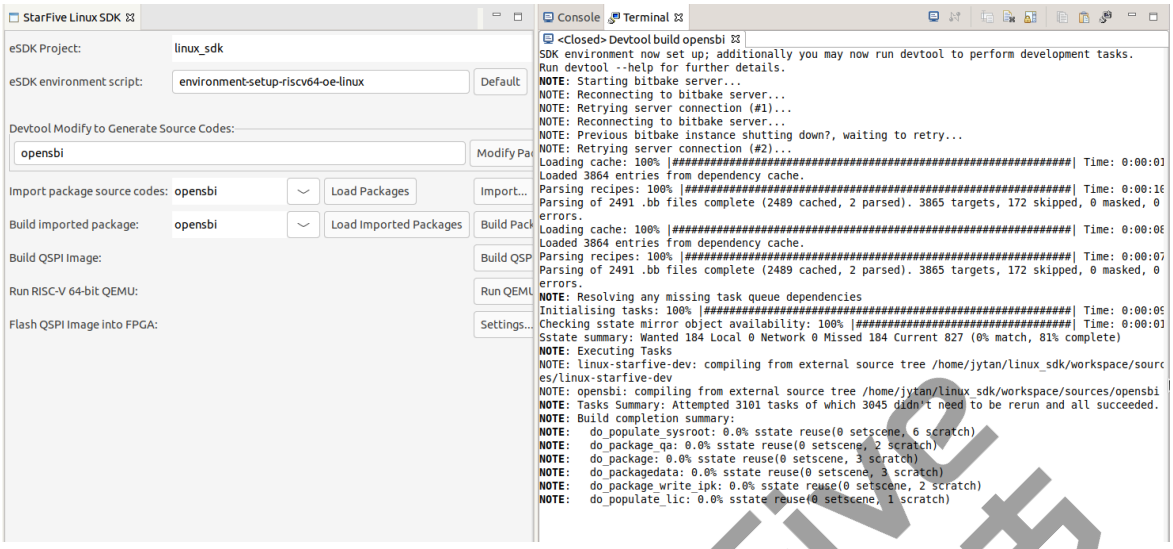


1.6. Building Packages and QSPI Image

After modifying your package's source code, you can now build the package.

1. Click **Build Package** to load the packages available and to build the package.
   Result:

Figure 1-8 Example Output



2. (Optional) Build a new updated QSPI Image by clicking the **Build QSPI Image** button.

Figure 1-9 Build QSPI Image

1.7. Running QEMU

To run a QEMU image, press the **QEMU** button.

The following is the example output:

Figure 1-10 Example Output

1.8. Flashing Binary into FPGA

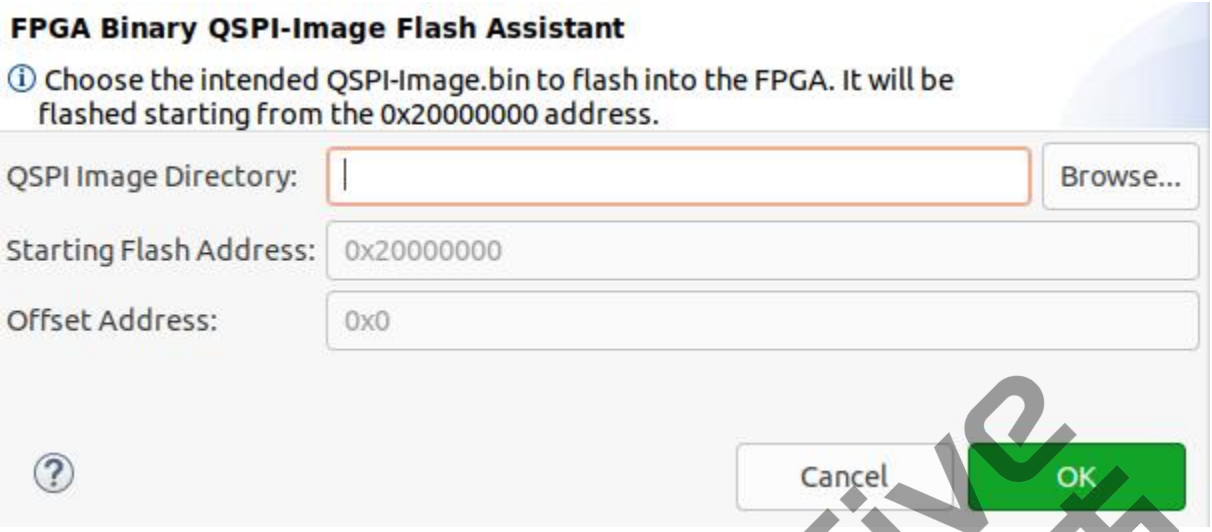
To flash the generated FPGA Binary Image (`QSPI-Image.bin`) into the FPGA, perform the following step:

Press **Settings...** button on the Flash QSPI Image into the FPGA row:

Result:

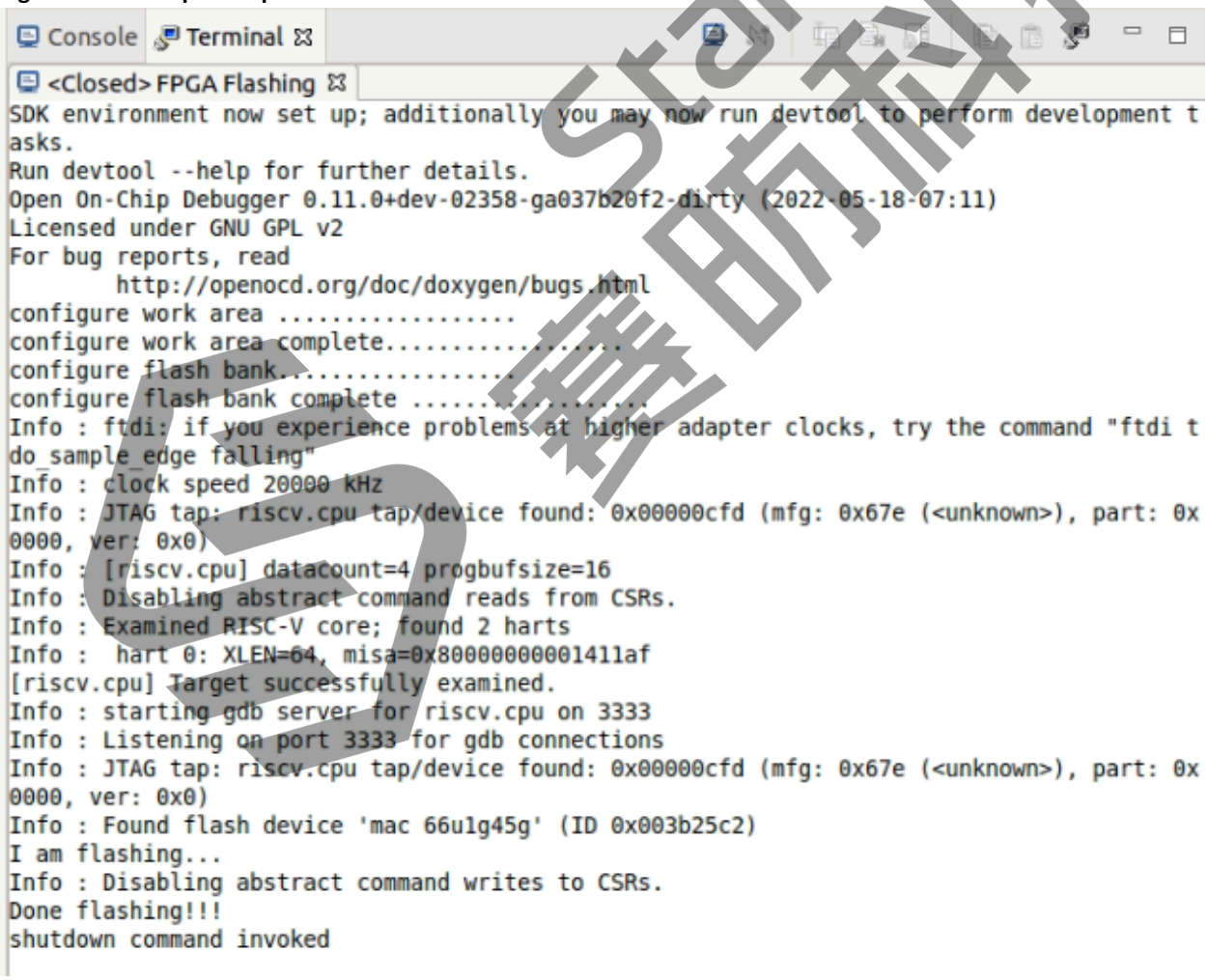
An FPGA Window will pop out:

Figure 1-11 Popup Window



An openocd config file will be generated and it will start to flash the binary image into the FPGA. You will need to wait for a while for the image to be flashed, depending on the size of the binary file.

Figure 1-12 Example Output



1.9. Debugging OpenSBI or Linux Kernel

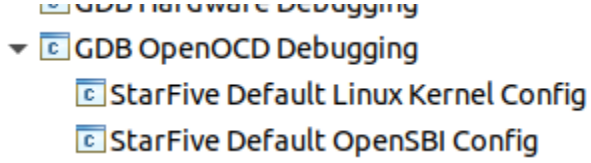
Prerequisite:

The StarFive Linux eSDK project, openSBI or Linux Kernel (`linux-starfive-dev`), is imported into StarFive StarStudio, and two configurations are auto-populated: **openSBI** and **Linux Kernel**:

To debug OpennSBI or Linux Kernel, perform the following steps:

1. Navigate to **Run > Debug Configurations...** and double click **GDB OpenOCD Debugging**. There will be two default configs available:

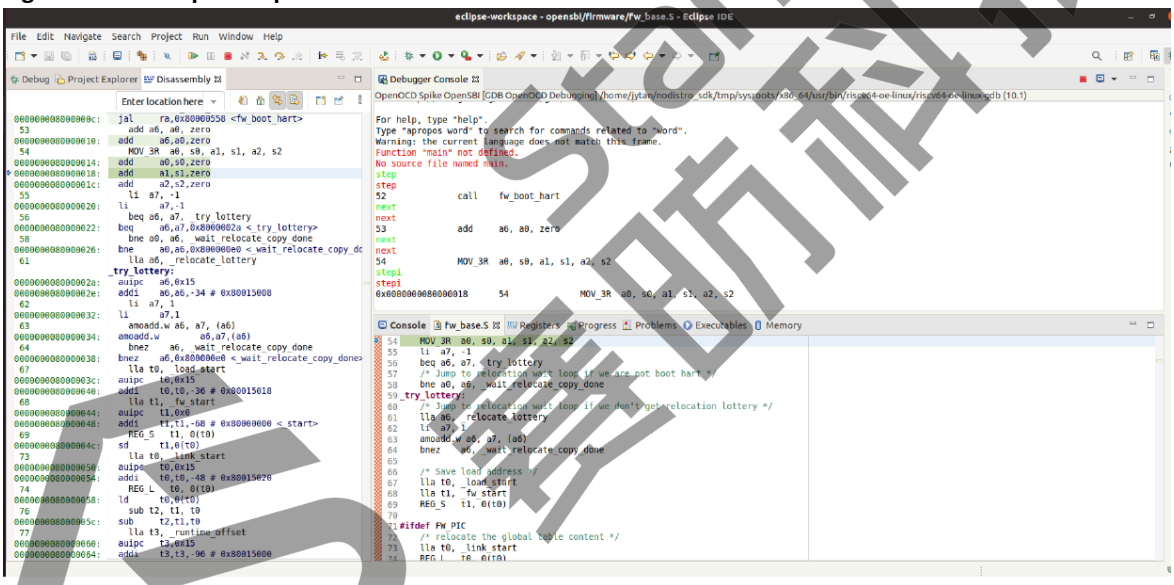
   Figure 1-13 Auto-populated Configuration

2. Choose the configuration (**openSBI** in this example) and press **Debug** to debug with the config.
   Result:

   You can now debug OpenSBI! For a detailed introduction to debugging on StarFive StarStudio, see Debugging on StarFive StarStudio *(on page 24)*.

   Figure 1-14 Example Output

You will need to connect to the FPGA via minicom to view the FPGA's output. For instructions for setting up minicom, see Installing Minicom on Linux to View FPGA Output *(on page 15)*.

1.9.1. Installing Minicom on Linux to View FPGA Output

To connect to the FPGA via minicom to view the FPGA's output, perform the following steps:

1. To install minicom on Linux, run this command:

   ```
   $ sudo apt-get install minicom
   ```

2. You can check which serial port the FTDI USB UART (not the Olimex JTAG) is connected to using the command `$ ls -lR /dev/serial`. Ensure that the FTDI USB UART has the correct serial number for Dubhe (in case you are connecting to more than 1 FTDI UARTs).

Figure 1-15 Example Output

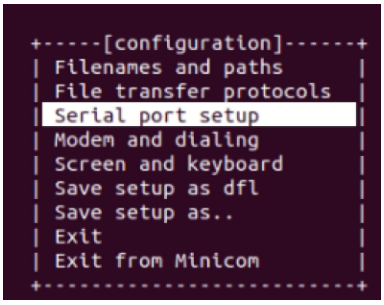
3. Execute the following command to set up minicom:

```
$ sudo minicom -s
```

Result:

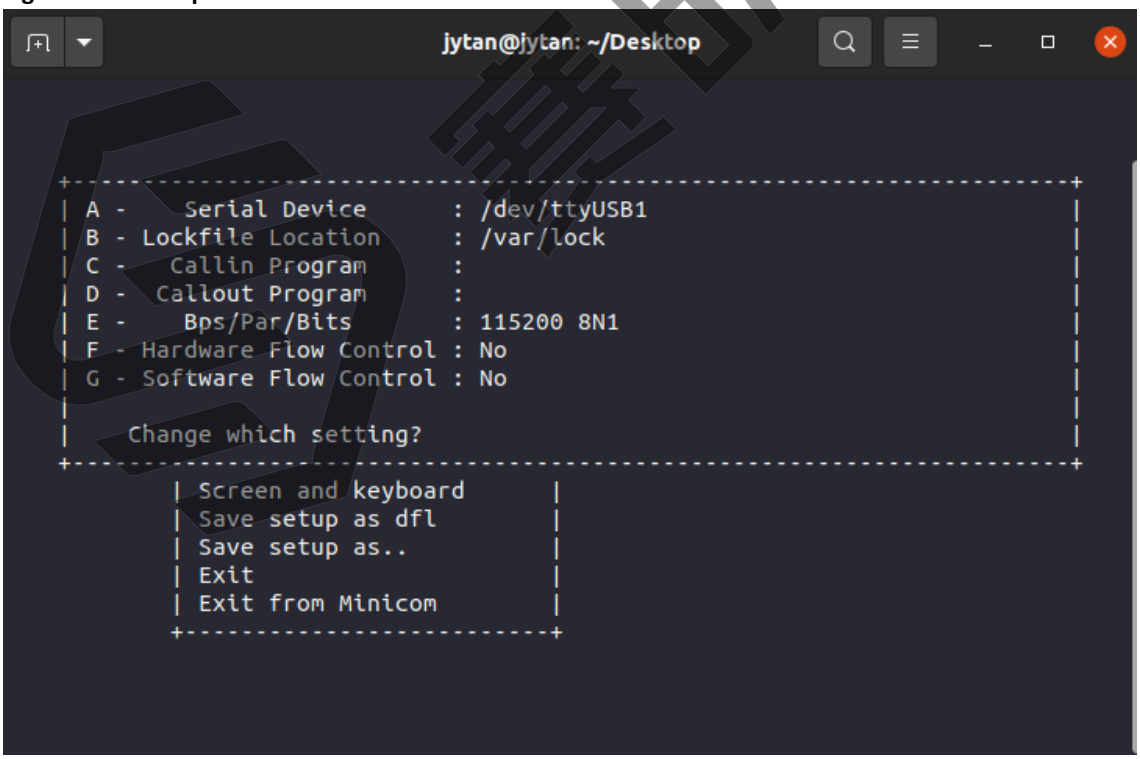
You will be brought to an interface shown below:

Figure 1-16 Example Output



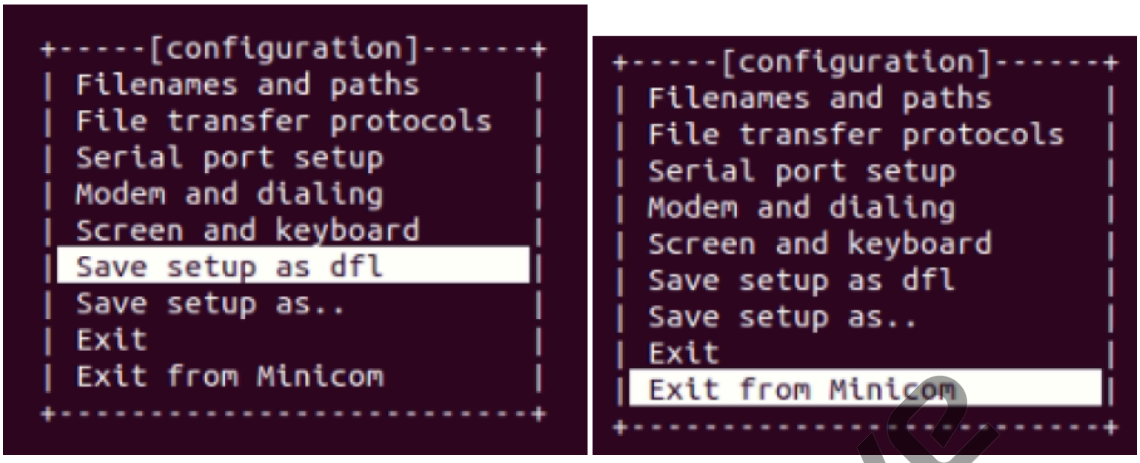
4. Go to **Serial port setup** and press A. Change the serial device to the port that the FTDI is connected to (for example: /dev/ttyUSB1). Press Enter after typing the serial port name, and type F to set the **Hardware Flow Control** to **No**. Ensure that the baud rate in **E** is **115200.**

Figure 1-17 Example Interface



5. Go to **Save setup as dfl** and press `Enter` to save the configuration. Then, go down to Exit from Minicom to exit.

Figure 1-18 Example Baud Rate



6. After successfully saving the configuration, you can now use this command in the terminal to get access to the FTDI USB port:

```
$ sudo minicom
```

Figure 1-19 Example Output

After successfully saving the configuration, you can now use this command in the terminal to get access to the FTDI USB port:

```
$ sudo minicom
```

2. Using StarFive StarStudio with Bare Metal SDK

This chapter provides steps to use StarFive StarStudio with Dubhe Bare Metal SDK.

It contains the following procedures:

1. Complete Prerequisites *(on page 18)*
2. Start Up StarFive StarStudio *(on page 8)*
3. Importing StarFive Bare Metal SDK *(on page 18)*
4. Building and Cleaning Program *(on page 19)*
5. Adding New Compile Program *(on page 20)*
6. Debugging with Single Core or Multi Cores *(on page 22)*

2.1. Prerequisites

Make sure you perform the following steps before starting up the StarFive StarStudio:

1. Extracted StarFive StarStudio on your host machine.
2. Copy the `StarStudio-beta-202206.tar.gz` file into your directory and untar it:

   ```
   $ tar -zxvf StarStudio-beta-202206.tar.gz
   ```

   Result

   The extracted folder is ready to use.
3. Extracted and installed StarFive Bare Metal SDK on your host machine.
4. Have a pre-built StarFive bare metal toolchain on your host machine.

   Note:
   To obtain Bare Metal SDK and toolchain files, please refer to the *Dubhe Bare Metal SDK User Guide* for the relevant links and steps to install.

2.2. Start Up StarFive StarStudio

To start up the StarFive StarStudio, perform the following steps:

1. Go to the StarFive StarStudio folder and open the executable to open StarFive StarStudio.
2. Select **Workspace** for StarFive StarStudio IDE and click **Launch**.
3. Close the **Welcome** tab.

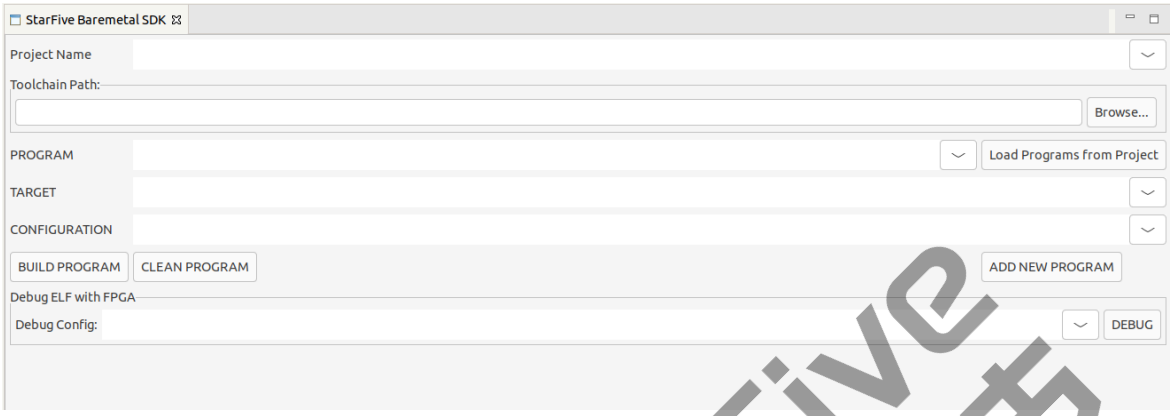
2.3. Importing StarFive Bare Metal SDK

1. Click **Import Projects** in Project Explorer on the left side of your StarFive StarStudio workbench:
2. Select **StarFive Dubhe Baremetal SDK** under the **StarFive** folder from the Import Wizard, and click **Next**:
3. Choose your existing Bare Metal SDK:
4. Import the Bare Metal SDK project as prompted:
   - **Project Name**: The project name. For example, `bare-metal-sdk2`.
   - **Existing SDK Location**: The directory of the existing bare metal that you want to import. For example, `/home/jytan/Desktop/baremetal/SDK/20220513/bare-metal-sdk`.

5. Click **Finish** and the files and directory of the SDK will be imported.
   Result:

   You will be greeted with the StarFive Bare Metal SDK view:

   Figure 2-1 StarFive Baremetal SDK View



Note:
You can also re-open the Baremetal view by going to **Window > Show View > StarFive Baremetal SDK**:

6. To start compiling programs for Dubhe, you will need to fill in the **Project Name** and the**Toolchain Path** (Fill in with the pre-built bare metal toolchain) on the StarFive Bare Metal SDK view.

2.4. Building and Cleaning Program

This section provides steps to build and clean the program:

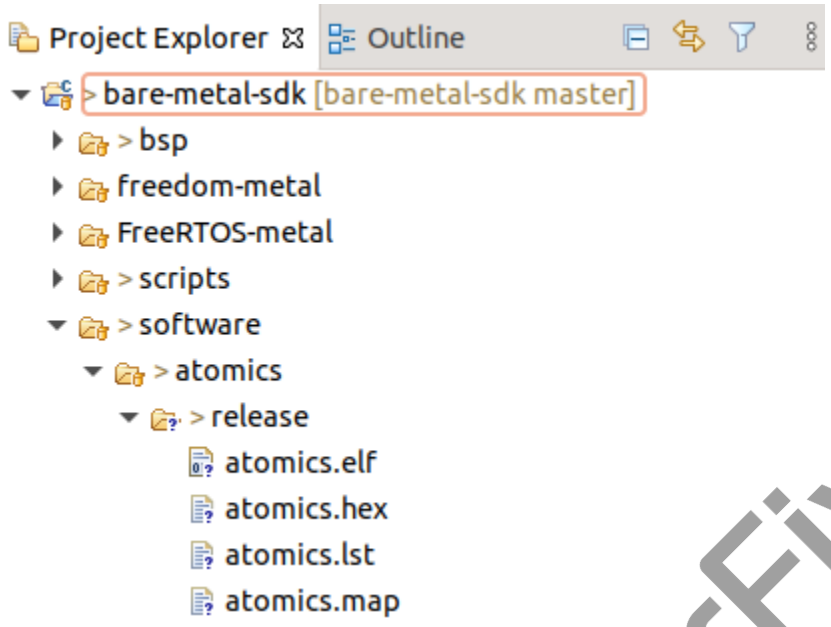
1. Choose the **PROGRAM**, and click **Load Programs from Project** so that it will load the programs located in the directory `<baremetal_SDK>/software`.
2. Choose the **Target** and **Configuration** for compiling, and click **BUILD PROGRAM** to build the program with the selected toolchain.
   Result:

   After the program is built, you will see an output in the **Console** View:

   Figure 2-2 Build Program Output

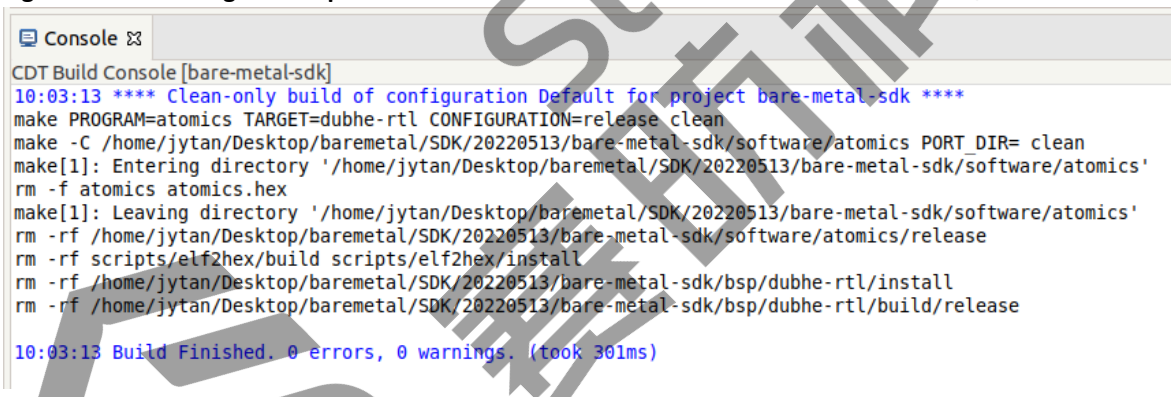
3. Locate the build outputs in the directory `<baremetal_SDK>/software/<program>/<config>` after the build is finished:

Figure 2-3 Example Build Outputs



4. (Optional) You can also click **CLEAN PROGRAM** to remove the program build directory from the Baremetal SDK folder.
   Result:

Figure 2-4 Clean Program Output

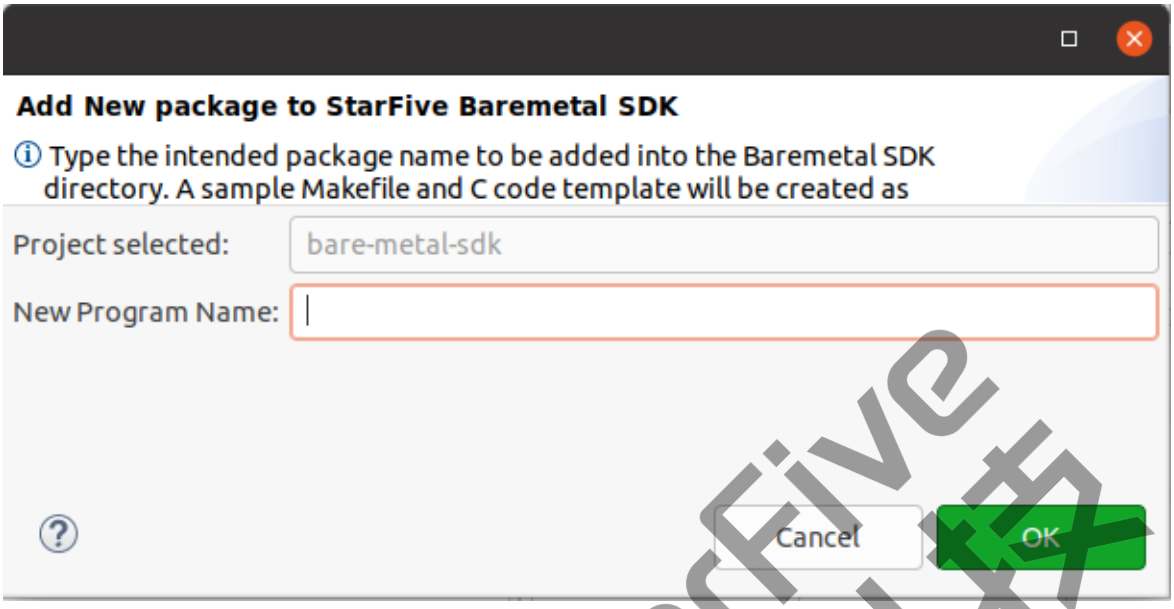


2.5. Adding New Compile Program

You can also add a new program via StarFive StarStudio plugin.

1. Choose the project and click **Add New Program** in the Baremetal View and a pop up will appear:

Figure 2-5 Example Pop Up



2. Enter the project name, for example, `testing666` in **New Program Name**, and press **OK**.

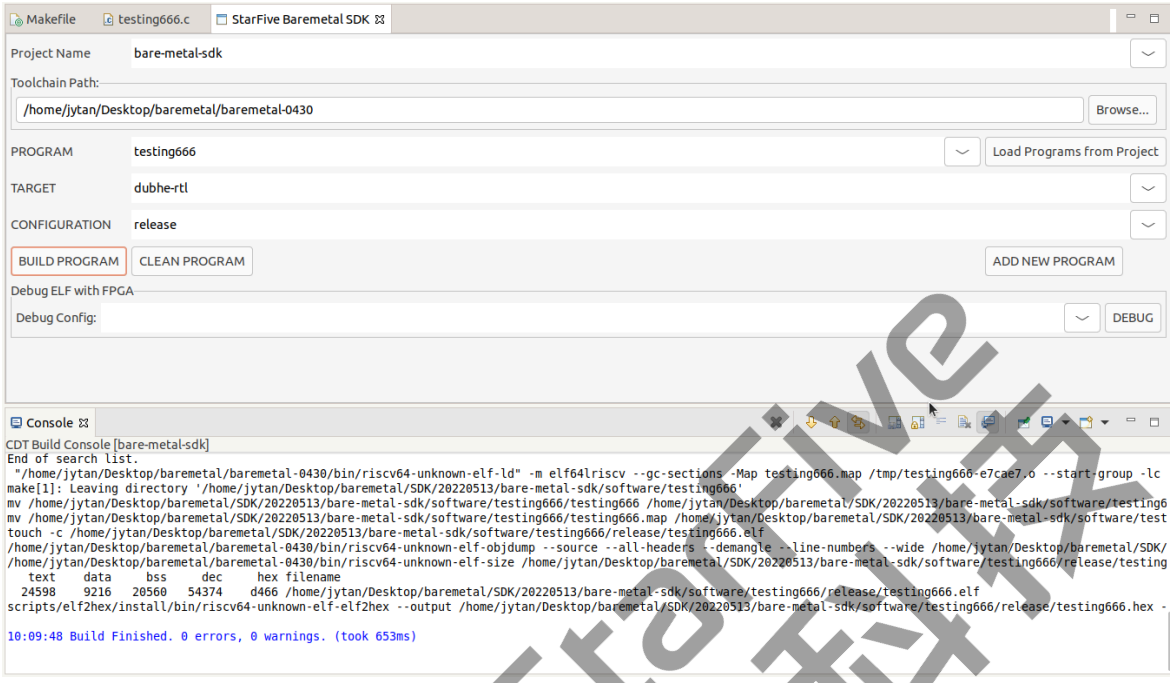
Result:

A new folder will be created in the Bare Metal SDK, with sample templates of a Makefile and a template C file:

Figure 2-6 Example Output

3. You can edit the C file and Makefile to any code for development, and the program can also be built via the StarFive Baremetal SDK View:

Figure 2-8 Example Interface



2.6. Debugging with Single Core or Multi Cores

Prerequisite:

Use the debug function, make sure the followings are completed:

- The bare metal SDK is imported as described in Importing StarFive Bare Metal SDK *(on page 18)*.
- The minicom is installed as described in Installing Minicom on Linux to View FPGA Output *(on page 15)*.

This section provides steps to debug with single core or multi cores.

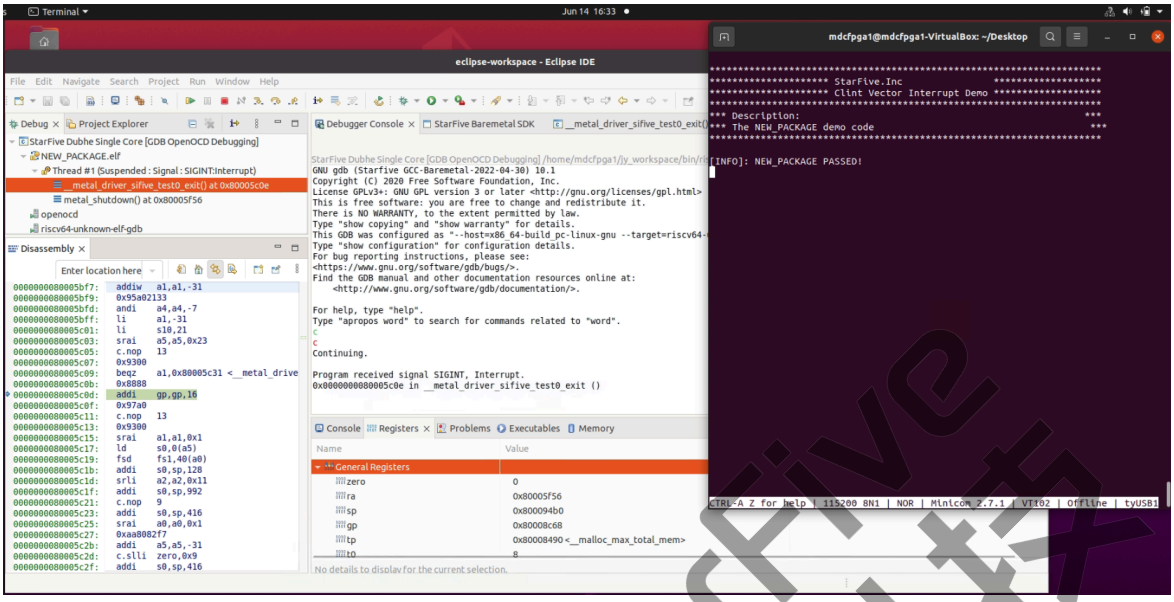
1. Navigate to the **Debug Config** under **Debug ELF with FPGA** on the **StarFive Baremetal SDK** view, and select **Single Core** or **Dual Core**.
2. Launch minicom to show output from FPGA, click **Debug** and openOCD will launch to connect with the FPGA.

   Note:
   You will need to open a Debugger Console (**Window > Show View > Debugger Console**) to send commands on GDB for debugging.

3. Click **DEBUG**.

Result:

Figure 2-9 Example Output



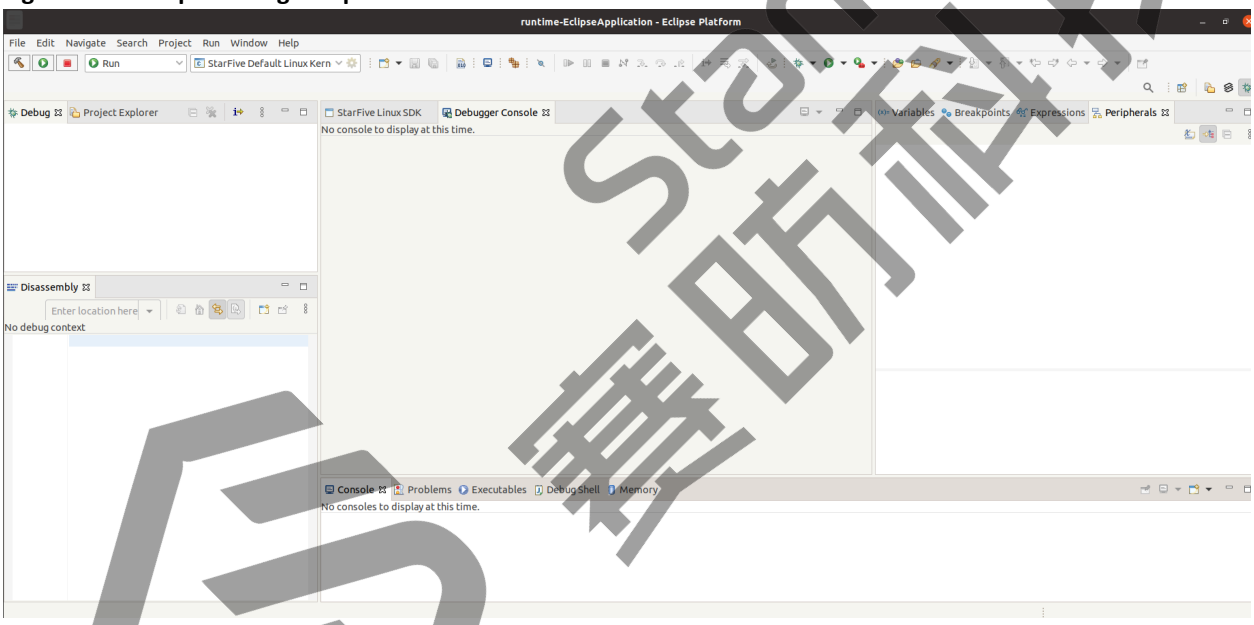
3. Debugging on StarFive StarStudio

When debugging on StarFive StarStudio IDE, a lot of useful tools or views can assist you to debug more efficiently and effectively. This chapter will introduce the Debug perspective and various views that are useful when debugging.

3.1. Debug Perspective

During debugging, you can open the **Debug Perspective** on StarFive StarStudio to have a more productive view as shown in the following figure.

Figure 3-1 Example Debug Perspective



To open the **Debug Perspective**:

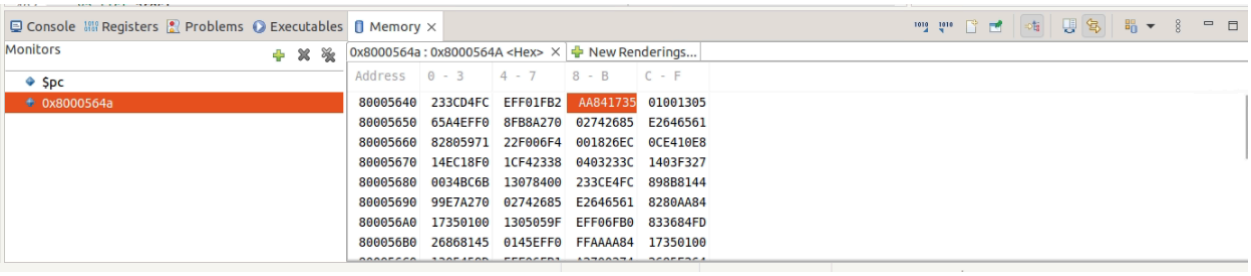
1. Go to **Window > Perspective > Open Perspective > Other... > Debug**
2. (Optional) If you still need some useful Views such as Disassembly View, you can go to **Window > Show View** to open the view that is needed.

3.2. Memory View

The **Memory** view in the **Debug** perspective enables users to monitor and modify the process memory. The process memory is presented as memory monitors, and users can specify the base address or location of each memory monitor.

You can add or remove memory monitors in the **Memory** view, and each memory monitor can display the memory content in different data formats such as hexadecimal or ascii.

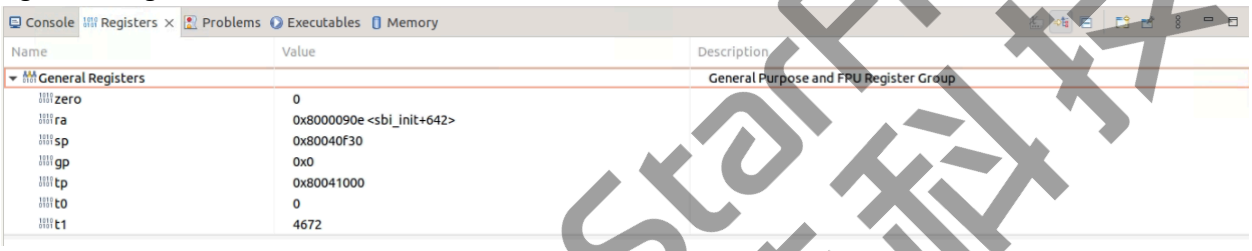
Figure 3-2 Memory View



3.3. Registers View

StarFive StarStudio comes with a **Registers** view, that enables users to view the info of general-purpose registers for the target while debugging. Register values that have been changed would also be highlighted in the **Registers** view when the program stops. Users can also modify or assign the memory values of the target via **Registers** view.

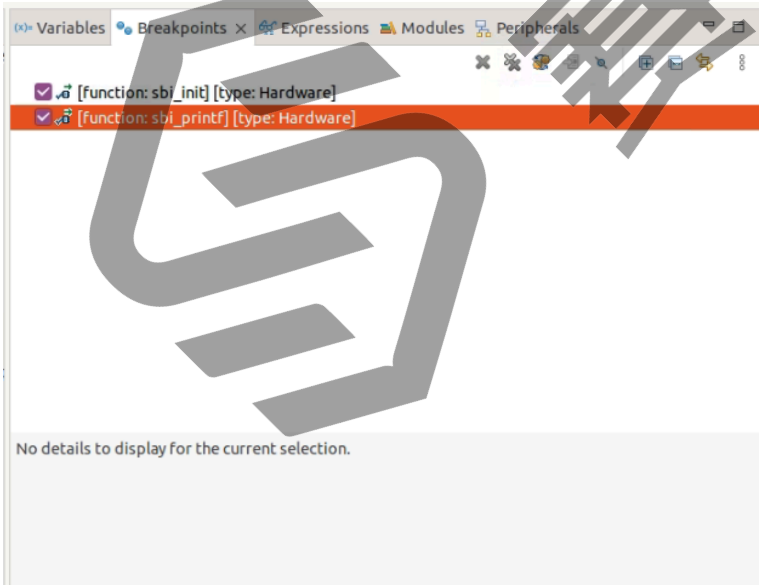
Figure 3-3 Registers View



3.4. Setting Breakpoint

Users can set breakpoint during debugging.

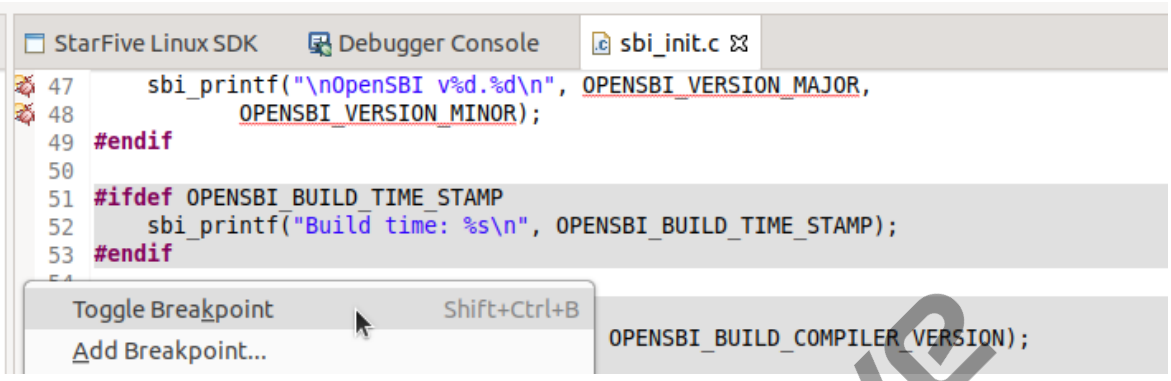
Figure 3-4 Breakpoints View



Users can view, delete, or deactivate breakpoints and modify breakpoint properties with the **Breakpoints** view in StarFive StarStudio. For users to set a breakpoint, users can either:

- Right click in the left margin in the editor View and select **Toggle Breakpoint**. Double clicking the left margin of the line works too:

Figure 3-5 Toggle Breakpoint



- Alternatively, users can also set breakpoints during debugging. Via the debugger console, the user can set either a hardware breakpoint (**hbreak**) or a software breakpoint (**break**).

Figure 3-6 Debugger Console

3.5. Disassembly View

The **Disassembly** view allows users to view the disassembled code during the stepping of code while debugging. The current executed assembly code will be indicated by an arrow marker and highlighted in the view.

Figure 3-7 Disassembly View