Post a topic

1. Experimental Purpose

Learn about the STM32-microROS component, access the ROS2 environment, and publish int32 topics.

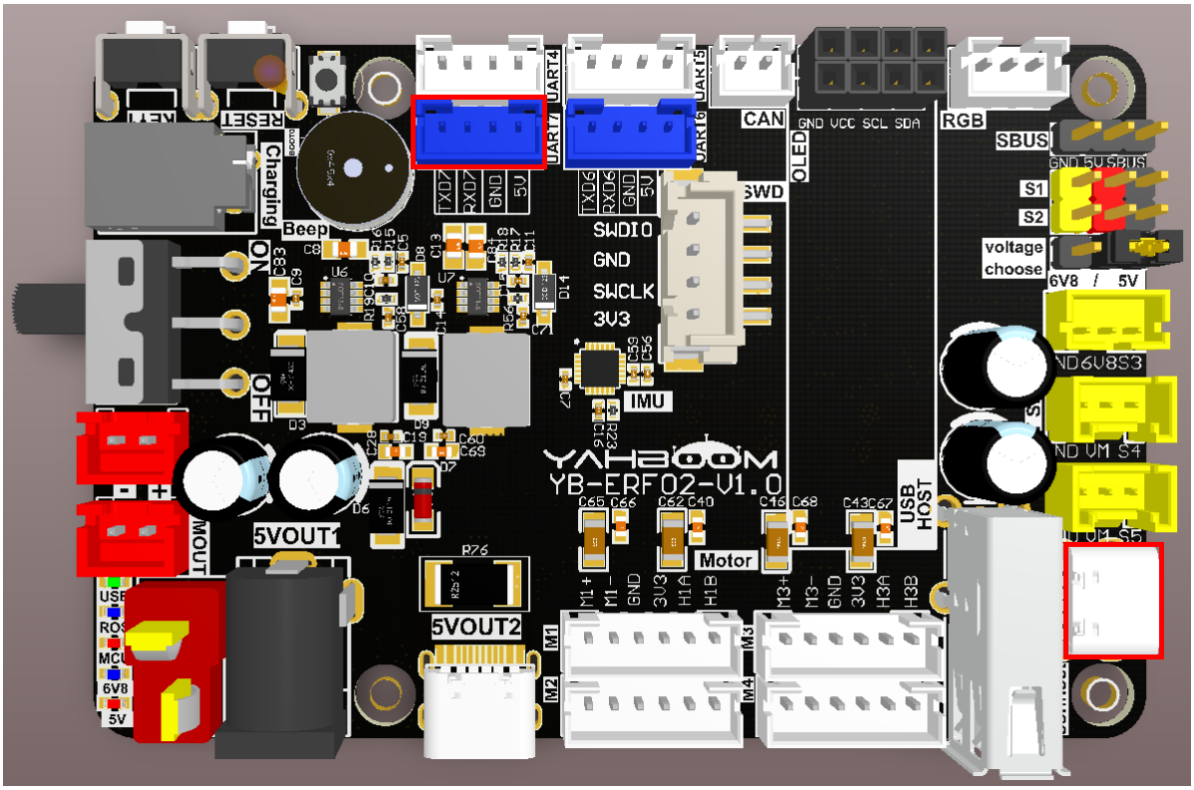
2. Hardware Connection

As shown in the figure below, the STM32 control board integrates the STM32H743 chip and can use the microros framework program.

Please connect the Type-C data cable to the USB port of the main control board and the USB Connect port of the STM32 control board.

If you have a USB-to-serial module such as CH340, you can connect to the serial port assistant to view debugging information.

Since ROS2 requires the Ubuntu environment, it is recommended to install Ubuntu22.04 and ROS2 environment on the main control board.



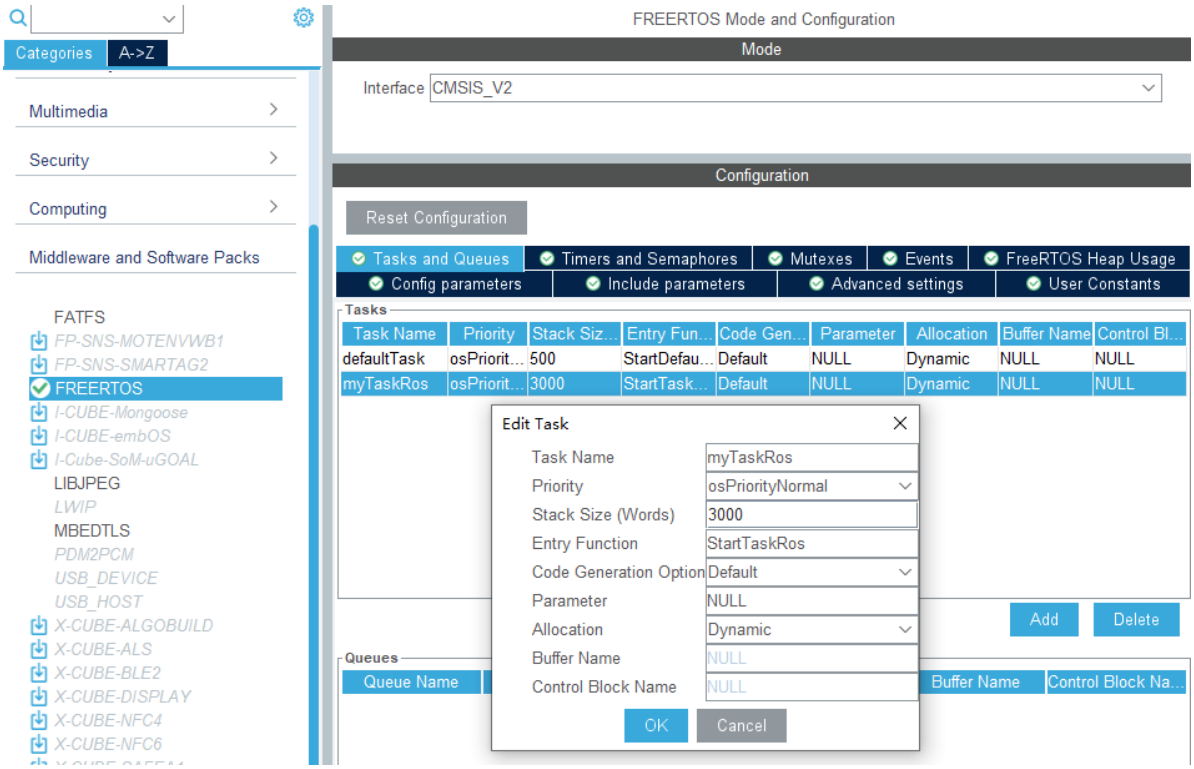
Note: There are many types of main control boards. Here we take the Jetson Orin series main control board as an example, with the default factory image burned.

3. Core code analysis

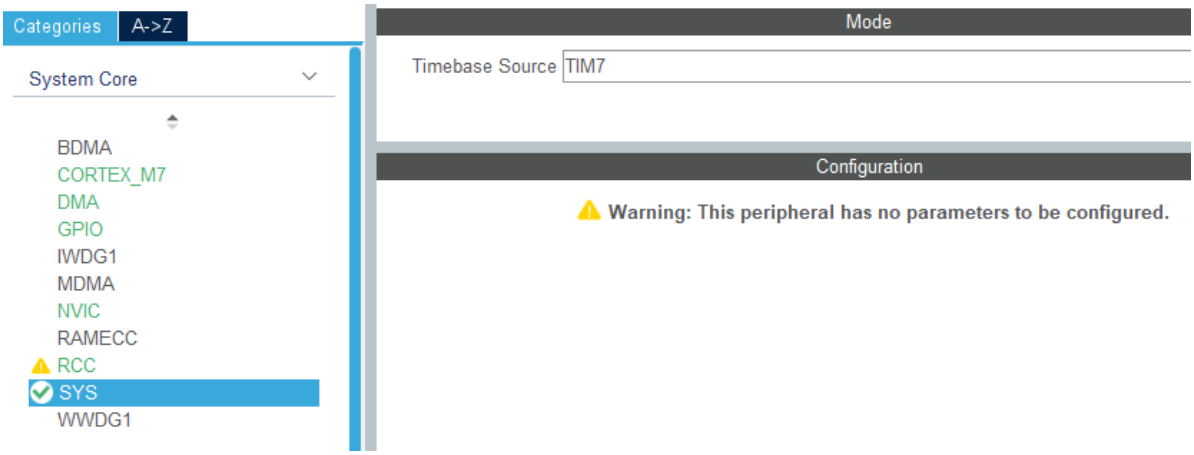
The virtual machine path corresponding to the program source code is:

```
Board_Samples/Microros_Samples/Publisher
```

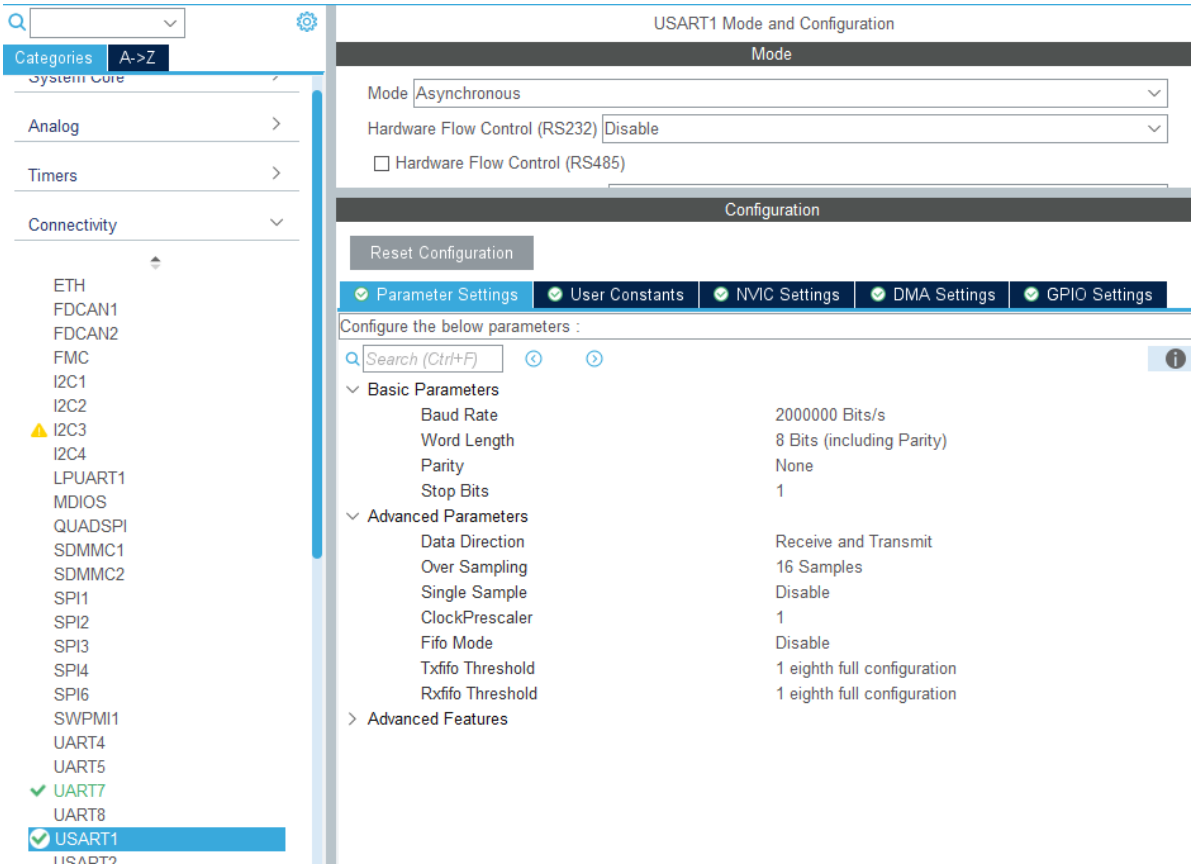
Since microros needs to handle more complex tasks, it is recommended to enable the FREERTOS function of STM32 and create a new microros processing task.

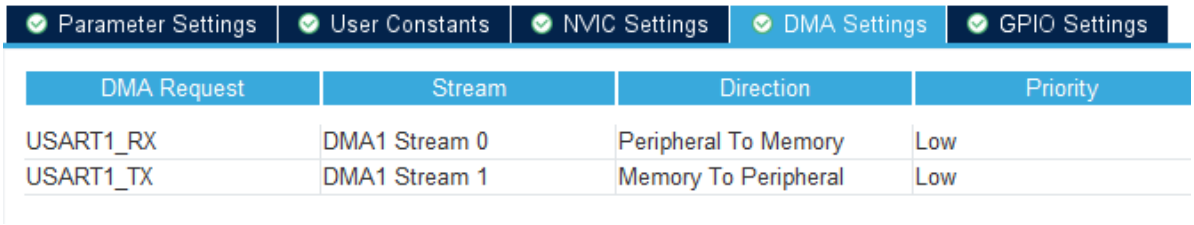


Since the FreeRTOS component is used, in order to avoid warnings, the system basic clock source needs to be replaced with a timer, here it is replaced with timer 7.

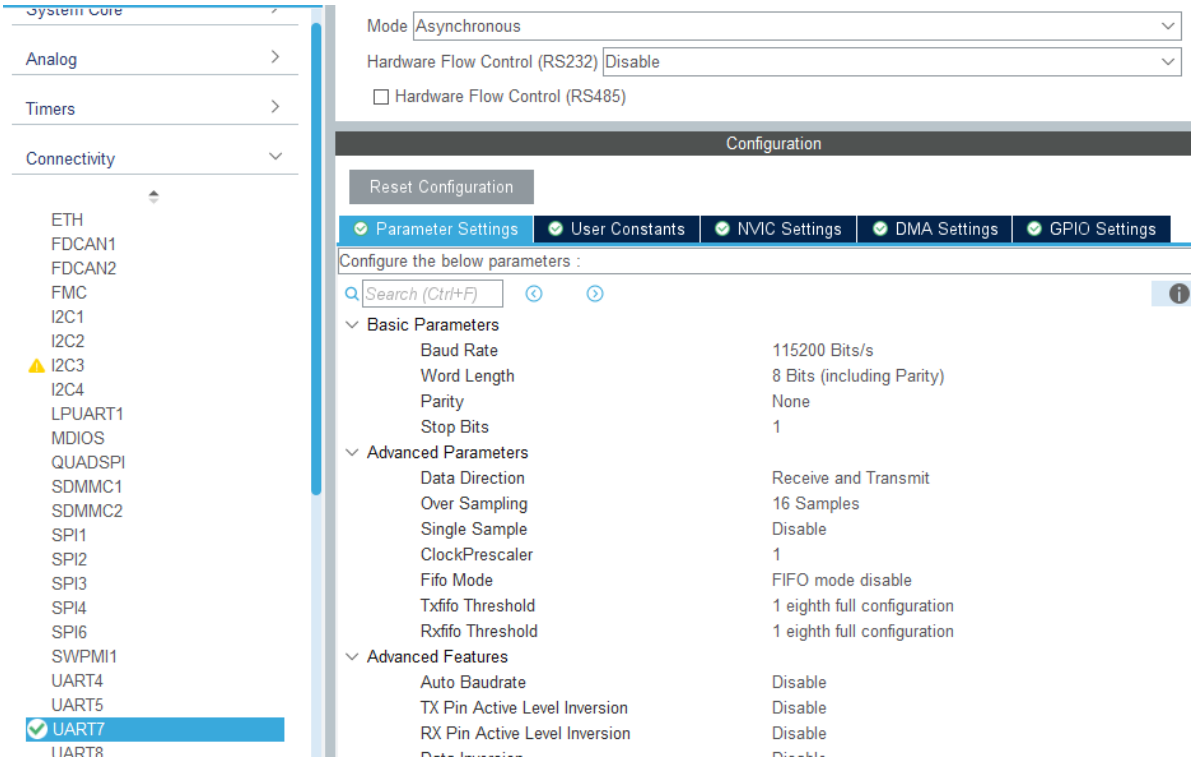


Since Microros needs to transmit a large amount of data, the baud rate is changed to 2Mbps and the DMA channels of TX and RX are enabled.





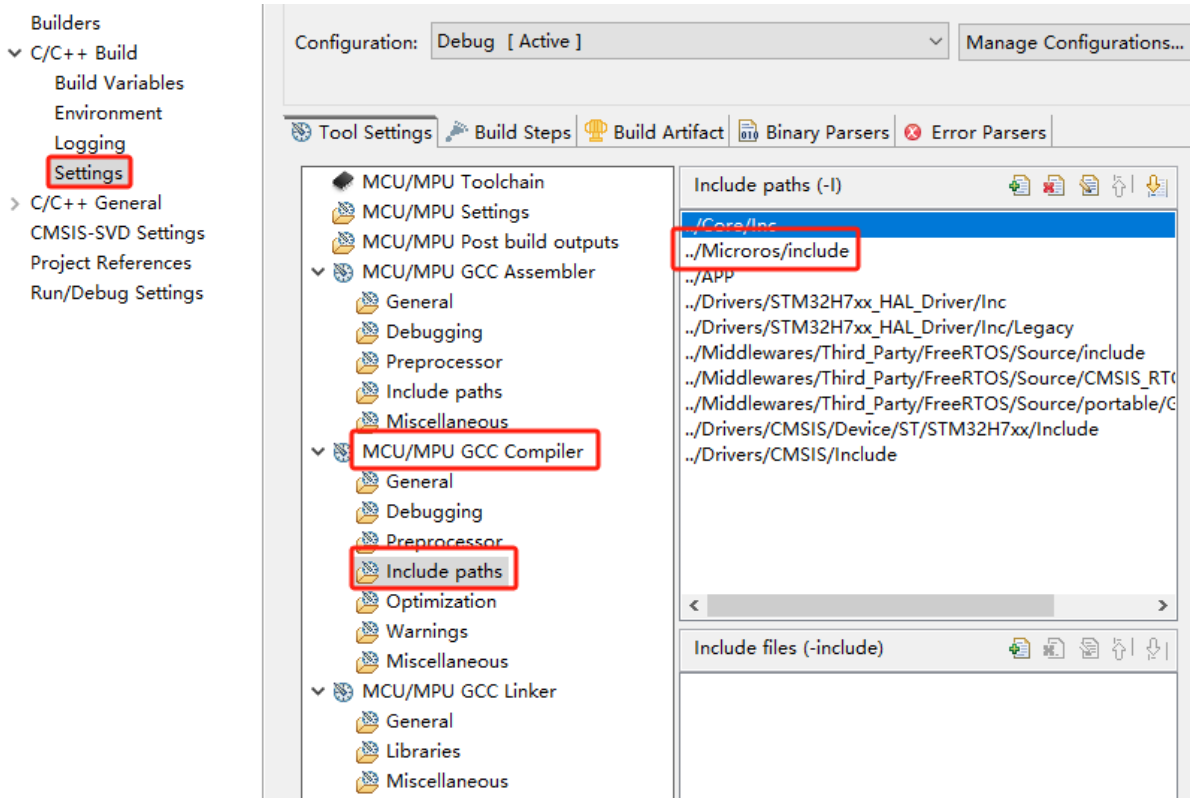
Since serial port 1 is used for Microros communication, the debug information printing is changed to serial port 7. Set the baud rate to 115200, 8-bit data, no parity, and 1 stop bit.



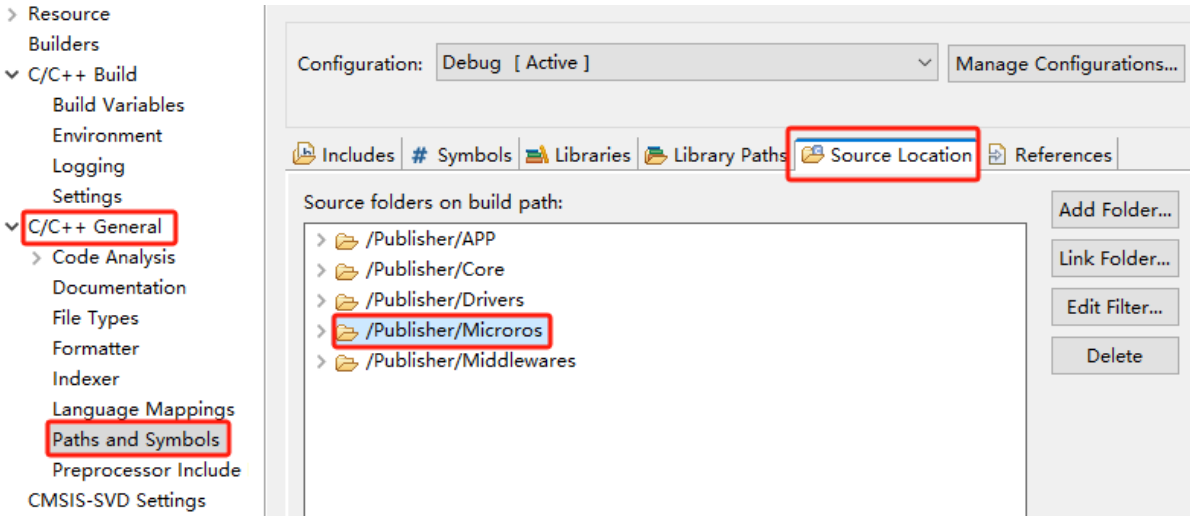
For ease of viewing, the debugging serial port of subsequent microros routines is redefined as serial port 7.

```
int _write(int file, char*p, int len)
{
  HAL_UART_Transmit(&huart7, (uint8_t *)p, len, 0xFF);
  return len;
}
```

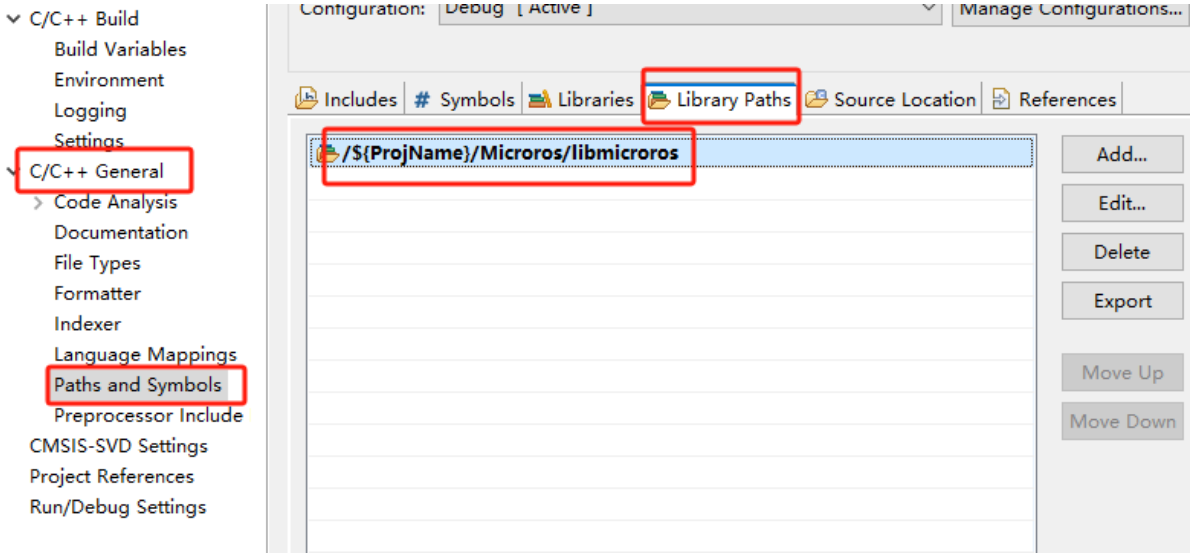
Right-click to open the project properties, then click [Settings]->[MCU/MPU GCC Compiler]->[include paths] to add the microros include directory path, and then click [Apply] to take effect.



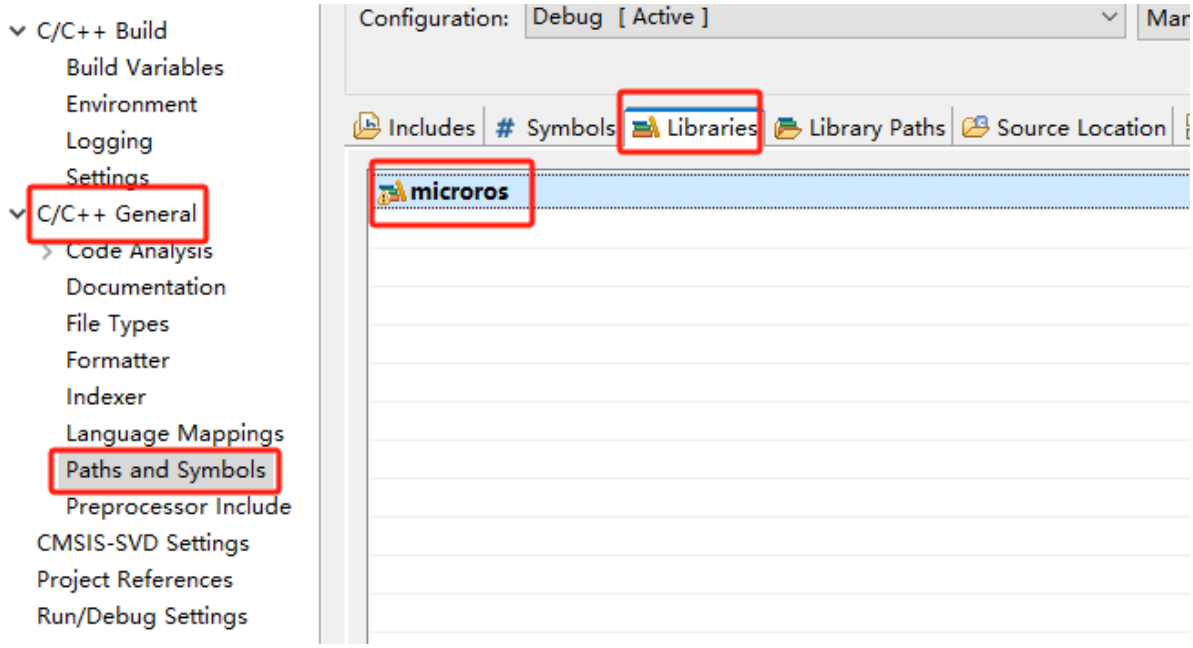
Add the microros folder as the project source code path.



Import the microros library path



Link the microros library file to the project. Make sure the name matches the libmicroros.a static library file name (excluding the prefix and suffix "microros").



Initialize the configuration of microROS. The default value of ros2_domain_id is 30, which is consistent with the factory image configuration. If the DOMAINID of the ROS2 environment is changed to another value, the ros2_domain_id variable must also be changed to the same value for normal communication.

```
    allocator = rcl_get_default_allocator();
    rcl_init_options_t init_options = rcl_get_zero_initialized_init_options();
    RCCHECK(rcl_init_options_init(&init_options, allocator));
    RCCHECK(rcl_init_options_set_domain_id(&init_options, ros2_domain_id));
    rmw_init_options_t *rmw_options =
rcl_init_options_get_rmw_init_options(&init_options);
```

Set the microros communication serial port and specify it as serial port 1.

```
int32_t set_microros_serial_transports_with_options(rmw_init_options_t *
rmw_options)
{
    int32_t ret = 0;
    ret = rmw_uros_options_set_custom_transport(
```

```
        true,
        (void *) &huart1,
        cubemx_transport_open,
        cubemx_transport_close,
        cubemx_transport_write,
        cubemx_transport_read,
        rmw_options
    );
    return ret;
}
```

Set the method for requesting memory in the Microros system.

```
int set_microros_freeRTOS_allocator(void)
{
    rcl_allocator_t freeRTOS_allocator =
rcutils_get_zero_initialized_allocator();
    freeRTOS_allocator.allocate = microros_allocate;
    freeRTOS_allocator.deallocate = microros_deallocate;
    freeRTOS_allocator.reallocate = microros_reallocate;
    freeRTOS_allocator.zero_allocate = microros_zero_allocate;
    if (!rcutils_set_default_allocator(&freeRTOS_allocator)) {
        printf("Error on default allocators (line %d)\n", __LINE__);
        return -1;
    }
    return 0;
}
```

Try to connect to the proxy. Only proceed to the next step if the connection is successful. If the connection to the proxy fails, it will remain in the connecting state. In this case, you need to enable the proxy script on the control panel to connect.

```
while (1)
    {
        osDelay(500);
        state = rclc_support_init_with_options(&support, 0, NULL, &init_options,
&allocator);
        if (state == RCL_RET_OK) break;
        printf("Reconnecting agent...\n");
    }
```

After connecting to the proxy, create the node "YB_Example_Node" where ros2_namespace is empty by default, indicating the namespace of the node.

```
printf("Start YB_Example_Node\n");

    node = rcl_get_zero_initialized_node();
    RCCHECK(rclc_node_init_default(&node, "YB_Example_Node",
(char*)ros2_namespace, &support));
```

Create a publisher "int32_publisher" and specify that the publisher's information is of type std_msgs/msg/Int32.

```
RCCHECK(rclc_publisher_init_default(
        &publisher,
        &node,
        ROSIDL_GET_MSG_TYPE_SUPPORT(std_msgs, msg, Int32),
        "int32_publisher"));
```

Create a publisher timer with a publishing frequency of 1HZ.

```
#define PUBLISHER_TIMEOUT (1000)
RCCHECK(rclc_timer_init_default(
        &publisher_timer,
        &support,
        RCL_MS_TO_NS(PUBLISHER_TIMEOUT),
        publisher_callback));
```

Create an executor, where the executor_count parameter is the number of executors controlled by the executor, which must be greater than or equal to the sum of the number of subscribers and publishers added to the executor. Add the publisher's timer to the executor.

```
printf("executor_count:%d\n", executor_count);
    executor = rclc_executor_get_zero_initialized_executor();
    RCCHECK(rclc_executor_init(&executor, &support.context, executor_count,
&allocator));

    // Add a timer to the executor
    RCCHECK(rclc_executor_add_timer(&executor, &publisher_timer));
```

The function of publishing information is executed in the publisher timer callback. In order to facilitate viewing, the current value of msg.data is printed. After the publishing is completed, msg.data is automatically increased by 1.

```
void publisher_callback(rcl_timer_t *timer, int64_t last_call_time)
{
    RCLC_UNUSED(last_call_time);
    if (timer != NULL)
    {
        printf("Publishing: %d\n", (int) msg.data);
        RCSOFTCHECK(rcl_publish(&publisher, &msg, NULL));
        msg.data++;
    }
}
```

The node and topic are processed, and the power LED_MCU indicator is on. Call rclc_executor_spin_some in the loop to make Microros work normally.

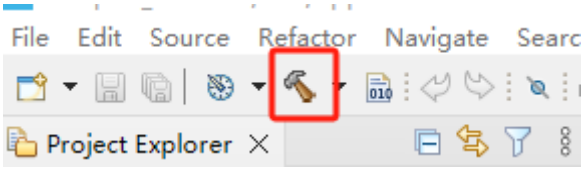
```
LED_ROS_ON();
    uint32_t lastWakeTime = xTaskGetTickCount();
    while (ros_error < 3)
    {
        rclc_executor_spin_some(&executor, RCL_MS_TO_NS(ROS2_SPIN_TIMEOUT_MS));
        vTaskDelayUntil(&lastWakeTime, 10);
        // vTaskDelay(pdMS_TO_TICKS(100));
    }
```

If the agent is disconnected or the topic is abnormal, the system will automatically restart the microcontroller.

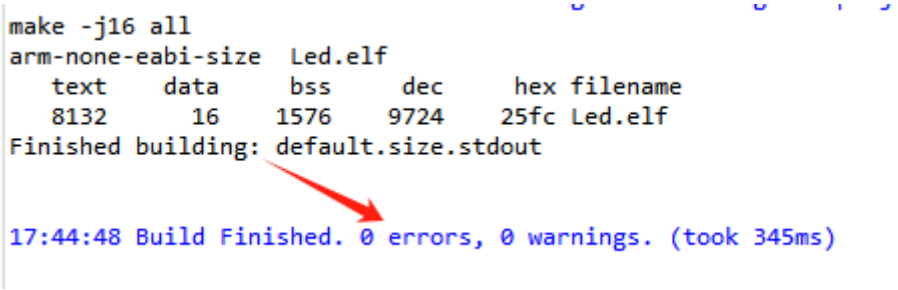
```
printf("ROS Task End\n");
    printf("Restart System!!!\n");
    vTaskDelay(pdMS_TO_TICKS(10));
    HAL_NVIC_SystemReset();
```

4. Compile, download and burn firmware

Select the project to be compiled in the file management interface of STM32CUBEIDE and click the compile button on the toolbar to start compiling.



If there are no errors or warnings, the compilation is complete.



Since the Type-C communication serial port used by the microros agent is multiplexed with the burning serial port, it is recommended to use the STlink tool to burn the firmware.

If you are using the serial port to burn, you need to first plug the Type-C data cable into the computer's USB port, enter the serial port download mode, burn the firmware, and then plug it back into the USB port of the main control board.

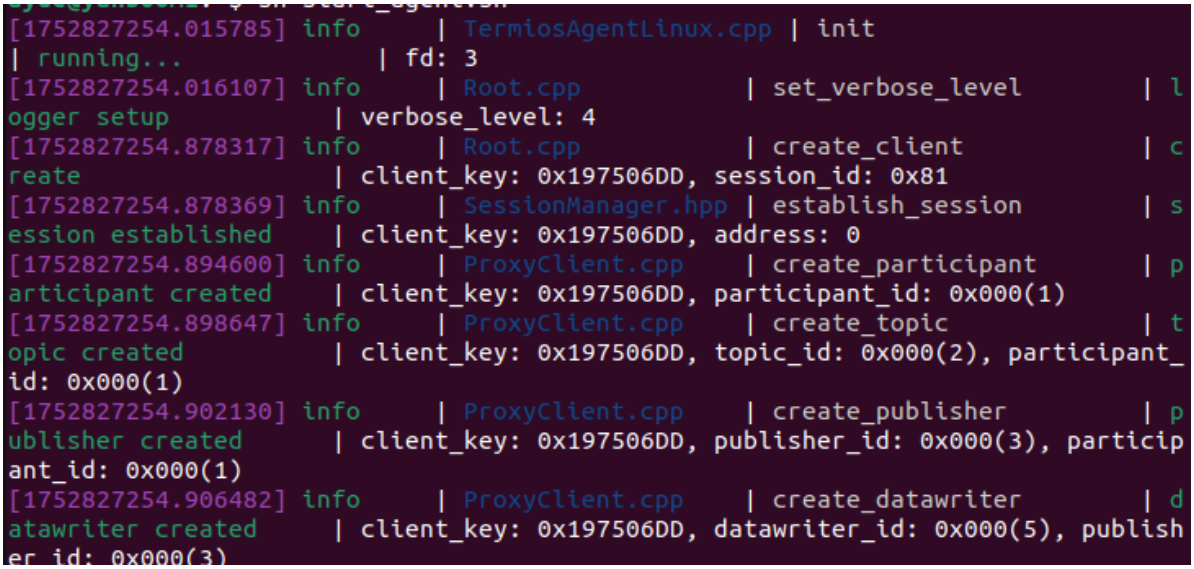
5. Experimental Results

The MCU_LED light flashes every 200 milliseconds.

If the proxy is not enabled on the main control board terminal, enter the following command to enable it. If the proxy is already enabled, disable it and then re-enable it.

```
sh ~/start_agent.sh
```

After the connection is successful, a node and a publisher are created.



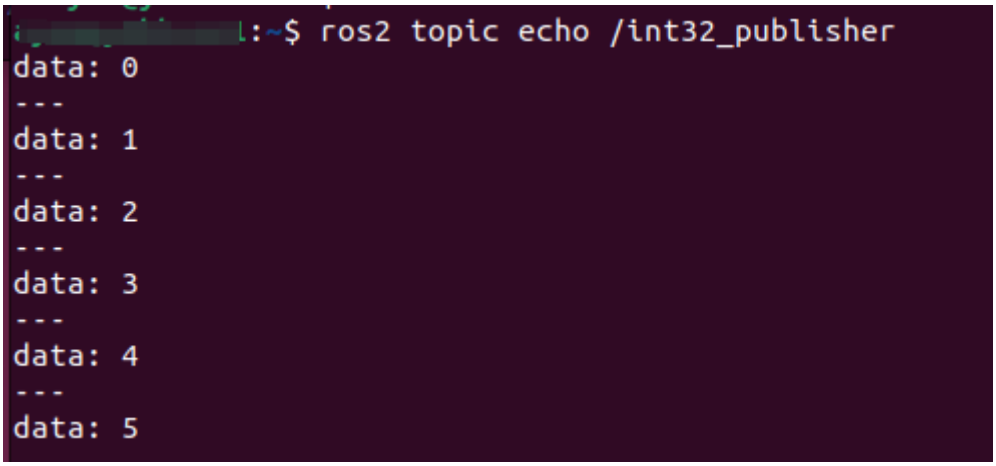
At this point, you can open another terminal in the virtual machine/computer to view the /YB_Example_Node node.

```
ros2 node list
ros2 node info /YB_Example_Node
```

Subscribe to data from the /int32_publisher topic

```
ros2 topic echo /int32_publisher
```

Press Ctrl+C to end the command.



Check the frequency of the /int32_publisher topic. A frequency of about 1 Hz is normal.

```
ros2 topic hz /int32_publisher
```

Press Ctrl+C to end the command.

```
[redacted]:~$ ros2 topic hz /int32_publisher
average rate: 1.000
        min: 1.000s max: 1.000s std dev: 0.00010s window: 2
average rate: 1.000
        min: 1.000s max: 1.000s std dev: 0.00009s window: 4
average rate: 1.000
        min: 1.000s max: 1.000s std dev: 0.00009s window: 6
average rate: 1.000
        min: 1.000s max: 1.000s std dev: 0.00010s window: 7
```