R-Car S4 Series
Guide to Control of RSwitch2 in the R-Car S4

Introduction

Products of the R-Car S4 series incorporate an Arm Cortex-A55, which is suitable for information systems such as multimedia applications.

The products also incorporate an RSwitch2 module for controlling three Ethernet ports.

This application note describes how to set up a system that allows the Cortex-R52 cores to use the Ethernet ports.

Target Board

R-car S4 evaluation board RTP8A779F0ASKB0SC1S or RTP8A779F0ASKB0SB0S

We simply refer to it as "evaluation board" in this document.
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1. Overview

1.1 Content
This document is the installation guide for R-Car S4 GW Ethernet Switch Control Library.
The R-Car S4 GW Ethernet Switch Control Library is included in R-Car S4 BSP.

1.2 Intended readers
This document is intended to help software developers in making use, within their applications.
Readers of this document should have:
- Software programming skills with the C language
- A general understanding of the R-Car S4 GW Ethernet Switch Control Library.

1.3 Reference documents
Please refer the following document in advance.
[2] R-Car S4 Startup Guide (R-Car S4_Startup_Guide_x_x_x.pdf) (*1)
*1) x_x_x: package version
2. Contents of the Sample Program Package

This section describes the contents of the sample program used in this application note.

R-Car S4 GW Ethernet Switch Control Library sample program is included in R-Car S4 BSP.

The following shows the structure of this software.

```
{ install path }¥mcal¥[ version ]
|---docs¥sw¥ethswtcont: Document files
|---sw_src¥cr52_mcal¥rel¥modules¥ethswtcont¥include: Public header files
|---sw_src¥cr52_mcal¥rel¥modules¥ethswtcont¥sample_app: Sample files
|---sw_src¥cr52_mcal¥rel¥modules¥ethswtcont¥src: Source codes and private header files
```

Figure 1  Software Structure

Figure 2  Structure of Folders in the Package
Folder | File | Description
---|---|---
include\rcar-xos\ethswtcont | CDD_Gateway_common.h | It defines the errors and common definition for Gateway SW.
 | CDD_EthSwtCont.h | It defines the Ethernet Switch Control Interface and type definitions. Application which uses Ethernet Switch Control Library must include this file.
src | CDD_EthSwtCont_api.c | It contains API function of Ethernet Switch Control.
 | CDD_EthSwtCont_init.c | It contains initialization as the main function of Ethernet Switch Control.
 | CDD_EthSwtCont_hwctl.c | It contains the process to access Ethernet Switch registers.
 | CDD_EthSwtCont_hwtsn.c | It contains the process to PSFP setting.
 | CDD_EthSwtCont_hwrout.c | It contains the process to update settings.
src\include | CDD_EthSwtCont_api.h | It defines the data used with the multiple modules. It declares prototypes of functions used with the multiple modules.
 | CDD_EthSwtCont_init.h | It defines the data used with the multiple modules. It declares prototypes of functions used with the multiple modules.
 | CDD_EthSwtCont_hwctl.h | It defines the data used with the multiple modules. It declares prototypes of functions used with the multiple modules.
 | CDD_EthSwtCont_hwtsn.h | It defines the data used with the multiple modules. It declares prototypes of functions used with the multiple modules.
 | CDD_EthSwtCont_hwrout.h | It defines the data used with the multiple modules. It declares prototypes of functions used with the multiple modules.
 | CDD_EthSwtCont_common.h | It declares the common definition used in Ethernet Switch Control component.
 | CDD_EthSwtCont_regMFWD.h | They declare the register definition used in Ethernet Switch Control Library.
 | CDD_EthSwtCont_regCOMA.h | 
 | CDD_EthSwtCont_reg.h | 

<table>
<thead>
<tr>
<th>Folder</th>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sample_app</td>
<td>build_EthSwtCont_Sample.bat</td>
<td>Batch file to build sample application.</td>
</tr>
<tr>
<td>sample_app\src</td>
<td>CDD_EthSwtCont_Sample.c</td>
<td>They contain sample functions to use the API of Ethernet Switch Control Library.</td>
</tr>
<tr>
<td></td>
<td>CDD_EthSwtCont_Sample_Cfg.c</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDD_Gateway_Sample_log.c</td>
<td>They contain sample functions to use scif.</td>
</tr>
<tr>
<td></td>
<td>CDD_Gateway_Sample_scif.c</td>
<td></td>
</tr>
<tr>
<td>sample_app\src\include</td>
<td>CDD_EthSwtCont_Sample.h</td>
<td>It defines the data used with the multiple modules. It declares prototypes of functions used with the multiple modules.</td>
</tr>
<tr>
<td></td>
<td>CDD_EthSwtCont_Sample_Cfg.h</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDD_Gateway_Sample_log.h</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDD_Gateway_Sample_scif.h</td>
<td></td>
</tr>
<tr>
<td>sample_app\make</td>
<td>renesas_ethswtcont_check.mak</td>
<td>Makefile of Ethernet Switch Control Library.</td>
</tr>
<tr>
<td></td>
<td>renesas_ethswtcont_defs.mak</td>
<td></td>
</tr>
<tr>
<td></td>
<td>renesas_ethswtcont_rules.mak</td>
<td></td>
</tr>
<tr>
<td>sample_app\tool</td>
<td>GatewaySettingTool_EthSwtCont.xlsm</td>
<td>Setting tool to generate the configuration to be set to the argument of R_EthSwtCont_Init API.</td>
</tr>
<tr>
<td>sample_app\MCAL\src</td>
<td>App_ETH_Common_RSW2_Sample.c</td>
<td>C source file to replace file in MCAL package to build sample application.</td>
</tr>
<tr>
<td></td>
<td>EthIf_Cbk.c</td>
<td></td>
</tr>
<tr>
<td>sample_app\MCAL\make</td>
<td>App_ETH_Common_Sample.mak</td>
<td>Makefile to replace file in MCAL package to build sample application.</td>
</tr>
<tr>
<td>sample_app\MCAL\config</td>
<td>App_ETH_S4_RSW2_Sample.arxml</td>
<td>Configuration file to replace file in MCAL package to build sample application.</td>
</tr>
</tbody>
</table>
3. Environment for Confirming Operation

The following lists the items of the operating environment in which operation of the sample program was confirmed.

Table 1 Operating Environment

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU (CR52)</td>
<td>Arm Cortex-R52 (CR52) incorporated in the R-Car S4.</td>
</tr>
<tr>
<td>Evaluation board</td>
<td>R-Car S4 evaluation board</td>
</tr>
<tr>
<td>Boot loader</td>
<td>ICUMXA Loader Rev.0.5.0</td>
</tr>
<tr>
<td>MCAL</td>
<td>MCAL SDK V3.6.0</td>
</tr>
</tbody>
</table>

3.1 Preparation for Ethernet Switch Control Sample software

This sample software is dependent on the R-Car S4/CR52 MCAL package. A detailed description on software structure, build environment, used compiler, debugger and evaluation board can be found in the Reference documents [2] (R-Car S4 Startup Guide). Thereby the general structure is described in chapter “1.1 S4 Software Overview” and the build process of this software package is outlined in chapter “5.2 gateway-cdd(comm2)”. In order to load and execute the resulting image, a debugger is needed as explained in chapter “4.4 How to run application with debugger for CR52”.

3.1.1 Preparation for Ethernet Adaptor Setting

In order to check the operation of this sample software, prepare equipment that can check the transmission and reception of Ethernet. In the setup described here, a host PC with two separated Ethernet adaptors is used to test the roundtrip transfer through the ethernet switch on the evaluation board. The Ethernet adaptors are referred as USB-Ethernet Adaptor in Figure 2.1 and Figure 2.2. Such an adaptor should at least support link speed of 1 Gbps.
The Sample software outputs the conversion results via HSCIF0.

The connection location of the USB cable changes depending on the type of evaluation board.

The following shows the connections between the evaluation board and PCs including the PC for the use of a serial terminal.

**Figure 3** Connections between the Evaluation Board and PCs (In case of S4 A0/B0 1st board)

**Figure 4** Connections between the Evaluation Board and PCs (In case of S4 A0/B0 1st board)
The following shows the IP addresses and MAC Address
For the MAC address of the USB-Ethernet adapter, replace it with the MAC address changed in the procedure described in [2] Chapter “5.2.3.1 Ethernet Switch Control Library”.
4. Execute Sample software

4.1 Overview

The MCAL sample application included in the Ethernet Switch Control Library has the following functions.
- Initialize Ethernet Switch Control Library by calling Ethernet Switch Control Sample software function.
- Initialize MCAL ETH Driver.
- Send a ping frame to the USB-Ethernet adapter and CA55 core.
- Print the received ARP, Ping, IPv4 frames.
- Print MAC address learning results.

4.2 Ethernet Switch Control Sample software

This section describes the details of Ethernet Switch Control Sample software. The function EthSwtCont_Sample_Init() is the entry point for this application. It calls the function R_EthSwtCont_Init() internally to initialize the settings for Ethernet Switch. For this example, the Ethernet Switch settings are based on the source file CDD_EthSwtCont_SampleCfg.c. The provided CDD_EthSwtCont_SampleCfg.c contains following the settings. You can create your own configuration with help of the ‘Gateway setting tool’ introduced in chapter 4.3. The routing setting shows in Table 4-1 and Table 4-2.

Table 4-1 MAC Table setting

<table>
<thead>
<tr>
<th>Destination MAC address</th>
<th>Output Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>74:90:50:00:00:03</td>
<td>GWCA0</td>
</tr>
<tr>
<td>74:90:50:00:00:00</td>
<td>GWCA1</td>
</tr>
<tr>
<td>FF:FF:FF:FF:FF:FF:FF</td>
<td>All ports except input port</td>
</tr>
</tbody>
</table>

Note: In this sample, HW learning function of MAC Table is enabled. R-Switch2 automatically learns the MAC address of the connected terminal and registers it in the MAC Table.

Table 2-2 Port forwarding setting

<table>
<thead>
<tr>
<th>Input Port</th>
<th>Output Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWCA0</td>
<td>TSN0</td>
</tr>
<tr>
<td>TSN0/1/2</td>
<td>GWCA0</td>
</tr>
</tbody>
</table>

Note: Since this sample application displays the Ethernet frame reception log, the logs may not match exactly.

After running the program on the debugger, the following log shown below is output on the serial console.

```
PROGRAM START
[ETH] Loopback: OFF
[ETH] Gateway: ON
[RESULT]<OK> R_EthSwtCont_Init() Return value: 0
[MCAL] Eth_Init() Start

(Omitted)

[MCAL] Initialization End
Communication is now possible
```
4.3 MAC Table Search

The console displays the MAC table search results for the MAC address set in Chapter 4.2. If the Search Result is 0, the MAC address is registered in the MAC table.

---
MAC Table Search Start: 7490, 50000003
Search Result: 0
Collision Number: 0
Learn Disable: 1
Dynamic Entry: 0
Security Level: 1
Destination Source Lock Vector: 1f
Source Source Lock Vector: 1f
CPU Sub-Destination(GNCAO): 18
CPU Sub-Destination(GNCA1): 0
Destination Vector: 8
Internal Priority Value: 0
Internal Priority Update: 0
Ethernet Mirroring Enable: 0
CPU Mirroring Enable: 0
---
MAC Table Search Start: 7490, 50000000
Search Result: 0
Collision Number: 0
Learn Disable: 1
Dynamic Entry: 0
Security Level: 1
Destination Source Lock Vector: 1f
Source Source Lock Vector: 1f
CPU Sub-Destination(GNCAO): 0
CPU Sub-Destination(GNCA1): 0
Destination Vector: 10
Internal Priority Value: 0
Internal Priority Update: 0
Ethernet Mirroring Enable: 0
CPU Mirroring Enable: 0
4.4 Communication confirmation by Ping

By sending a ping from the host PC via the first USB-Ethernet Adaptor connected to port 0 of the evaluation board, you can confirm the correct operation of the switch sample software. If the ping is received and replied by the host PC via the 2nd USB-Ethernet Adaptor connected to port 1 of the evaluation board, the setup works correctly. The output of such an operation is shown below.

```
C:\Users > ping 192.168.0.2
-S 192.168.0.1
Pinging 192.168.0.2 from 192.168.0.1 with 32 bytes of data:
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.0.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
  Minimum = 0ms, Maximum = 0ms, Average = 0ms
```
This sample application sends a ping to the IP address of the USB-Ethernet adapter and the CA55 core shown in Figure 4.1. The console displays the sample application ping transmission result. If you see the following log, it means that the sample application sent a ping request, the USB-Ethernet adapter returned a ping response, and the sample application received the ping response.

When using the Ethernet Switch in cooperation with the CA55 core application described in [2] Appendix A, this sample application will receive a ping response from the Linux BSP.

![Diagram of sample application operation]

**Figure 4.1 Sample application operation**

```
[MCAL][T_x] Send PING frame(Ctrl[Idx=3]): Dst=90:96:F3:4A:1C:35, IP=192.168.0.1
[MCAL][RxCallback] Ctrl[Idx=3, FrameType=0800, IsBroadcast=0, PhysAddPtr=90:96:F3:4A:1C:35
  => Receive IPv4 packet(Ctrl[Idx=3]) Src=192.168.0.1 Dst=192.168.0.100
  => ICMP echo reply
```
4.5 Gateway Setting Tool (Excel)

This section describes Gateway Setting Tool. (¥sample_app¥Tool¥GatewaySettingTool_EthSwtCont.xlsm)

Gateway Setting Tool (Excel) can generate configuration C source file. Add a configuration to each cell and press the generate button. This outputs the C source file. Please refer to "Guide" sheet in Gateway Setting Tool for details of the tool.

It can be used by replacing file CDD_EthSwtCont_SampleCfg.c with the generated C source file. Afterwards recompilation of the code is needed.

# Revision History

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Page</th>
<th>Description</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Nov.18, 2022</td>
<td>All pages</td>
<td>Initial version</td>
<td></td>
</tr>
</tbody>
</table>
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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.

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   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 $V_{IL} \text{ (Max.)}$ and $V_{IH} \text{ (Min.)}$ 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 $V_{IL} \text{ (Max.)}$ and $V_{IH} \text{ (Min.)}$.

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