NUC980 Ethernet Connection via NC-SI

Application Note for 32-bit NuMicro® Family

Document Information

Abstract	This NUC980 Out-of-Band (OOB) module application supplementary document describes how the network interface of the NUC980 series microprocessor connects to the NC-SI (Network Controller Sideband Interface) of the host's network controller to simplify system design.
Apply to	NuMicro® NUC980 series.

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1 Overview

With the independent external network connection of a NUC980 OOB module, when the host or device crashes, the NUC980 Out-of-Band (OOB) module can be the best remote control solution to monitor system status, and remotely turn off or reset the system.

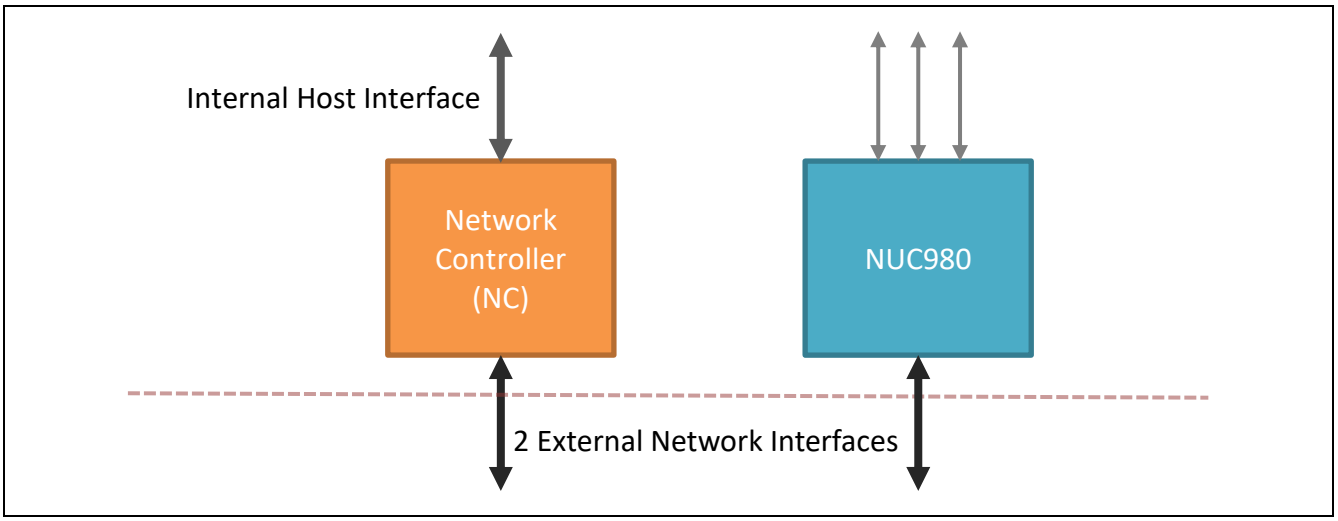


Figure 1-1 System Architecture ***without*** NC-SI

The host for this type of application usually has an Ethernet network. Some Ethernet controllers support the NC-SI (Network Controller Sideband Interface*1) standard defined by DMTF to enable the connection of a baseboard management controller (BMC) to network controller for out-of-band system management. Now the NUC980 series can act as a simplified BMC and its Ethernet network can connect to the NC-SI of the Ethernet controller on the host, so the host only needs one network jack. This saves board space and facilitates network cabling.

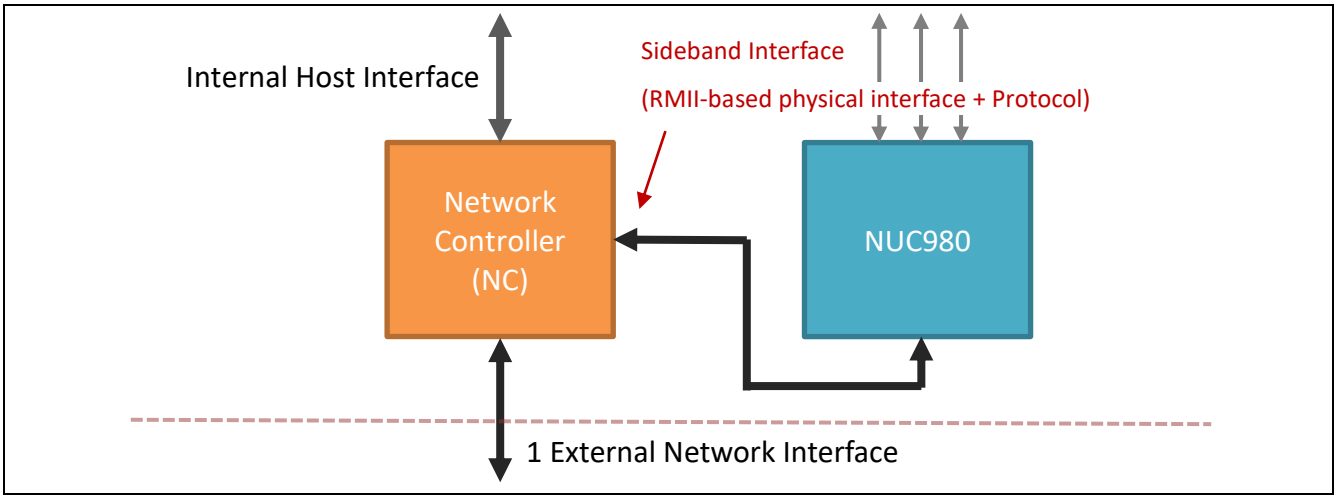


Figure 1-2 System Architecture ***with*** NC-SI

*1 The URL of The Network Controller Sideband Interface (NC-SI) Specification.

2 Hardware and Software Requirements

For the network connection through NC-SI, the required items include:

2.1 Hardware Requirements

- A motherboard has an Ethernet Controller which supports NC-SI

  For example, Intel i210 and i350 Ethernet controllers both support NC-SI. It would be better if its motherboard has a NC-SI connector.

- A NuMaker-RTU-NUC980 (also called Chili) board

  This is the smallest NUC980 evaluation board used for NUC980 OOB solution. It has the RMII connector which is a good way for NC-SI connection. You can download the *NuMaker RTU NUC980 User Manual* from the Nuvoton webpage.

- A Linux PC to build the software

  Or a virtual machine running Linux. The Ubuntu Linux 20.04 LTS is recommended.

2.2 Software Requirements

- Buildroot for NUC980 with Linux v5.10

  Buildroot is the tool to build a complete and bootable Linux environment for embedded system. For NC-SI, it supported in Linux v5 kernel. Please download the Buildroot for NUC980 with Linux v5.10 from the github webpage.

- NuWriter

  The firmware download or program tool for NUC980. It is in the tool directory of NUC980 BSP or can be downloaded from the github webpage.

3 NUC980 and NC-SI Connection

3.1 NC-SI Connection

It is ideal to have an adapter board for the connection between NUC980 and network controller's NC-SI. Figure 3-1 is the reference circuit of the adapter board.

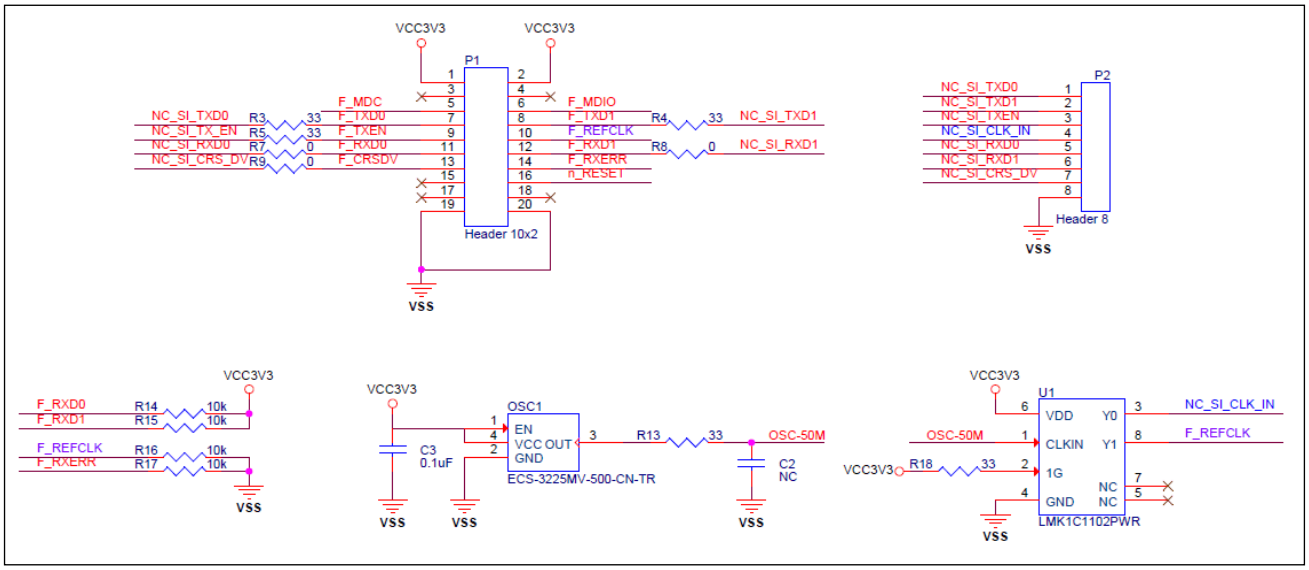


Figure 3-1 Reference Circuit of Adapter Board

In Figure 3-1, **P1** is a 2.54mm pitch dual row female header connector for NUC980 Chili board. **P2** is the connector for network controller's NC-SI. If host motherboard cannot provide a 50 MHz clock, an oscillator (**OSC1**) is required to generate the clock. The oscillator may not have enough power to drive both NUC980 RMII and Ethernet controller's NC-SI, so as to add the 2-channel output buffer (**U1**) to feed the clock to both sides.

3.2 Code Build

1. In Linux PC, get the Buildroot for NUC980.

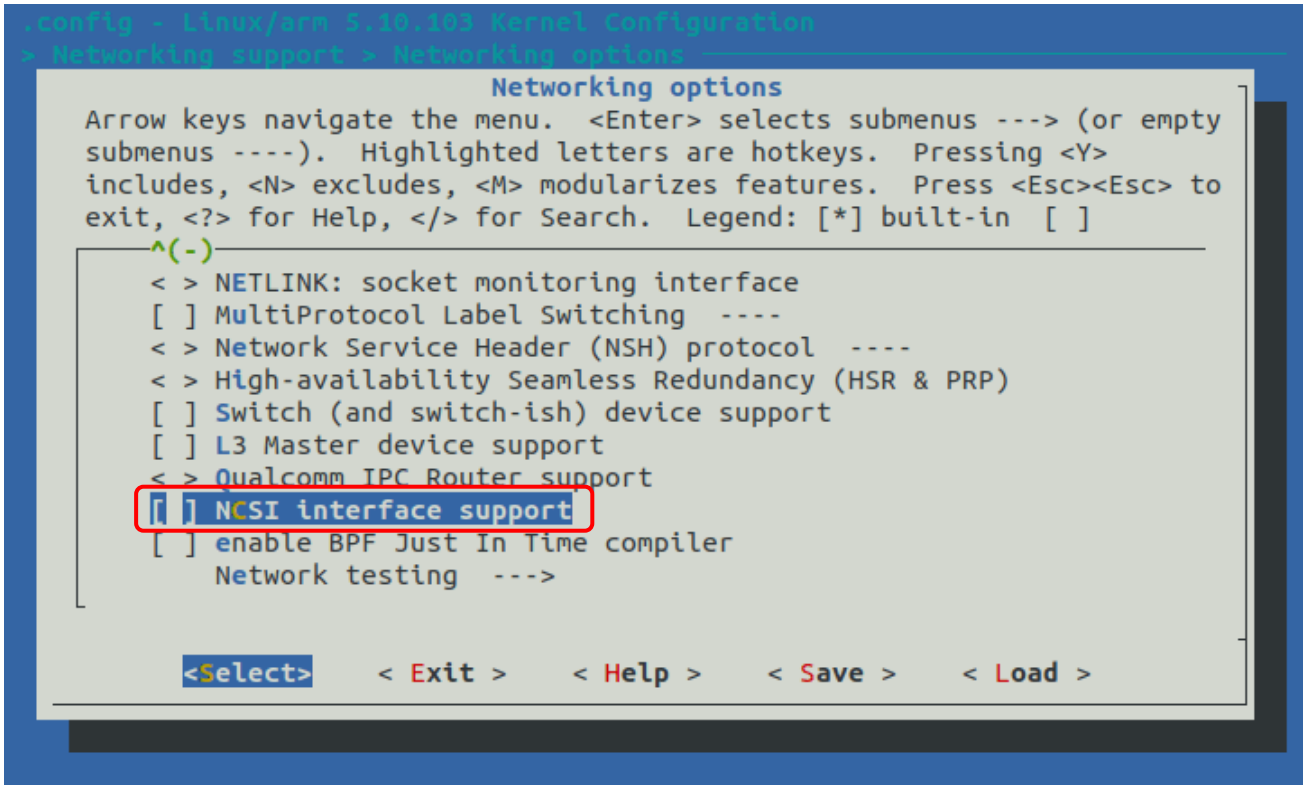
```
$ git clone https://github.com/OpenNuvoton/MA35D1_Buildroot
$ cd MA35D1_Buildroot
$ make nuvoton_nuc980_chili_defconfig
```

2. Now, the Buildroot with Linux v5.10 has been configured for NUC980 Chili board. Then enable the support of NC-SI.

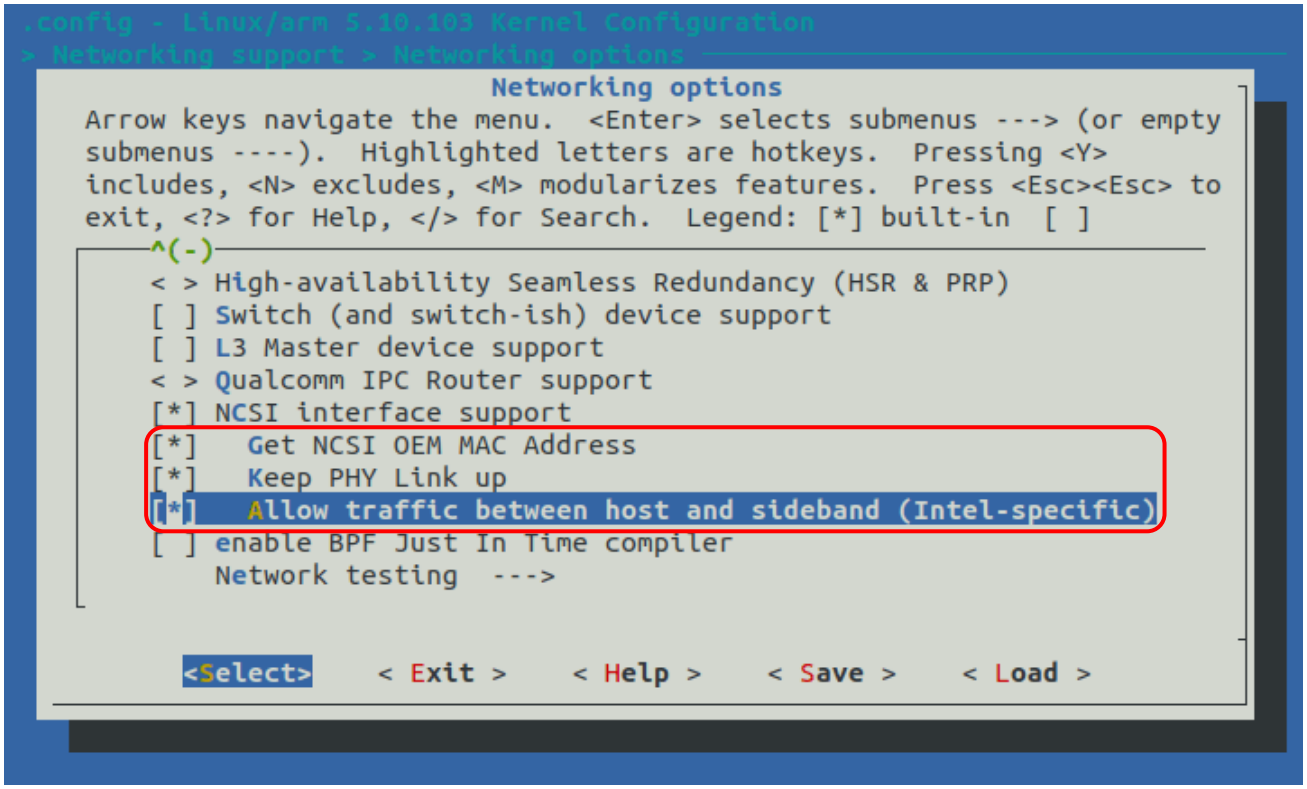
```
$ make linux-menuconfig
```

3. When the menu appears, select "Networking support" -> "Networking options", then find

the “NCSI interface support”.



Press **space bar** or **Y** to enable to “**NCSI interface support**”, and also enable “**Get NCSI OEM MAC Address**” and “**Keep PHY Link up**”. If the network controller is Intel and host wants to connect to NUC980, enable the “**Allow traffic between host and sideband (Intel-specific)**”.



Then click "**< Save >**" to save the configuration.

4. The NUC980 has two EMACs, EMAC0 and EMAC1. The NUC980 Chili board uses EMAC1. Edit the dts file to enable NC-SI feature on the specified EMAC.

```
$ vi output/build/linux-custom/arch/arm/boot/dts/nuc980-chill.dts
```

Add the red box as shown below to EMAC1, then save it.

```
…
$ make
                        status = "disabled";
                };
                emac1@b0022000 {
                        use-ncsi;
                        status = "okay";
                };
…
```

5. Build the firmware image for NUC980 Chili board.

6. After building is completed, please refer to *NUC980 NuWriter User Manual* or NUC980 OOB to program the firmware image to NUC980 Chili board.

Connect with a network cable, boot the NUC980 Chili board, and the Ethernet port should work well. The network connection goes through NC-SI to an outside server.

4 Conclusion

Using the NC-SI feature can save the board size and reduce the amount of network jacks to facilitate network cabling. This document provides steps to guide you how to use NC-SI, and provide frequently encountered questions and answers to save your development time. Please refer to Chapter 5 for Frequently Asked Questions (FAQ).

5 Appendix

5.1 Frequently Asked Questions (FAQ)

1. **Can NUC980 Ethernet work through NC-SI when system is turned off?**

   The network controller on the motherboard still needs power to work. If NC-SI is used, make sure power is supplied to the network controller and NUC980.

2. **NC-SI seems not stable when jumping wire between NUC980 RMII and network controller.**

   Because of high frequency signals, please shorten wires. If you use a 50 MHz oscillator, it is recommended to add a buffer. Please refer to the reference circuit of adapter board in this document.

3. **Can host and NUC980 communicate with each other via the network?**

   For Intel Ethernet controller, please also enable the “Allow traffic between host and sideband (Intel-specific)” in Linux kernel configuration of NUC980 Buildroot.

4. **Host can connect to server but NUC980 still cannot connect to the server.**

   Normally, if NC-SI is not used by default, the Ethernet controller (e.g. Intel i210) configuration is turned off. Please refer to Ethernet controller document to enable the NC-SI feature.

5. **When using ‘ifconfig’ to turn off Ethernet on NUC980, Ethernet cannot be turned on anymore.**

   There is no Ethernet PHY for NUC980 when connecting to NC-SI, and no PHY response when Ethernet is turned on. Always keep NUC980 Ethernet enabled after booting.

6. **NUC980 has two EMAC. How to select one of the EMAC to connect to NC-SI?**

   The dts file in “output/build/linux-custom/arm/boot/dts/” should be modified. Also add ‘use-ncsi;’ to the specified EMAC.

7. **Why RX-ERR pin is pull-down with 10 Kohm resistor directly?**

   Since the sideband interface of Intel i210 network controller does not have RX-ERR wiring, the NUC980 RMII RX-ERR pin needs be pull-down to avoid the floating state in schematics design.

8. **The message in booting log appears: nuc980-emac1 b0022000.emac1 eth0: NCSI: No channel found to configure!**

   Failed to configure pass-through mode. Please check RMII pins wiring between the NUC980 and network controller or related clock-buffer circuit.

Revision History

Date	Revision	Description
2023.02.15	1.00	Initial version.

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