Nucleus USB Ethernet Communication Class Driver
A White Paper

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This white paper introduces the Nucleus USB Ethernet Communication class driver. Nucleus USB Ethernet Communication class driver has support for both host and function. Nucleus USB Host Ethernet Communication class driver can be used as an embedded host class driver to support Ethernet communication devices with the Nucleus USB Host stack. Nucleus USB Function Ethernet Communication class driver can be used as an embedded function class driver to create USB Ethernet peripherals with the Nucleus USB Function stack.

Scope

Nucleus USB Host Ethernet Communication class driver provides the facility to embedded host system that can access USB-enabled peripheral devices like Ethernet adapters, cable modems and DSL modems. The class driver provides generic APIs for transferring data to and receiving data from the USB-enabled Ethernet devices.

Nucleus USB Function Ethernet Communication class driver adds the Ethernet connectivity to USB peripheral devices that can provide an Ethernet connection to the host through USB. These devices can work up to 100 Mbps Ethernet when using with the USB 2.0. Nucleus USB Function Ethernet Communication class driver can primarily be used for creating the USB Ethernet adapters, cable modems, set-top boxes and resident gateways, etc.

Nucleus USB Ethernet and USB Specification

Nucleus USB Ethernet devices are compliant to USB Class Definitions for Communication Devices (CDC) which can be used for implementing telephony devices like modems, ISDN adapters and networking devices like USB Ethernet adapters, ATM adapters, etc.

USB reserves a class code f 0x02 for communication devices while subclass code determines its device model.
- 01h Direct Line Control Model
- 02h Abstract Control Model
- 03h Telephone Control Model
- 04h Multi-Channel Control Model
- 05h CAPI Control Model
- 06h Ethernet Networking Control Model
- 07h ATM Networking Control Model

There is a single protocol code of 0x00 defined for communication class devices. Other values are either reserved or not used.

Nucleus USB Ethernet Communication class driver is implemented based on the Ethernet Networking Control Model (ECM) subclass.

Nucleus USB Ethernet Communication class driver supports the following two separate standards for Ethernet Communication devices.

- CDC Ethernet: This standard is compliant to Ethernet Networking Control Model subclass defined in the USB Class definition for the Communication Devices. This standard is supported mostly in non-Microsoft platforms like Linux and MacOS.
- Remote NDIS (RNDIS): This standard is defined by Microsoft and supported on all Microsoft's platforms, Windows 2000 and onwards. This standard is implemented using the abstract control model subclass defined in the USB class definition for communication devices with the vendor-specific protocol field. Nucleus RNDIS driver supports all of the mandatory OIDs defined in the MSDN library by the Microsoft.

Note: The RNDIS is only supported on the Nucleus USB Function Ethernet Communication class driver and is not supported on the Nucleus USB Host Ethernet Communication class driver.

Architecture

The Nucleus USB Ethernet Communication class driver is a fast, small, portable and modularized solution. The Nucleus USB Ethernet Communication class driver is implemented in two layers. The first layer is communication base class driver. This module will be common for all communication devices like Ethernet adapters and modems. The second layer is the user driver. This layer is responsible for implementing the subclass-specific functionality in the communication devices. The CDC Ethernet driver is implemented using the Nucleus USB Communication base class driver and Ethernet user driver. The RNDIS driver is implemented using the Nucleus USB Communication base class driver and RNDIS user driver. The Nucleus USB Ethernet Communication class driver contains a module which is based on code. Selections can be made between different device models through defines. The model-specific part contains routines for model-specific requests as well as other routines to inquire about the device characteristics. Remaining protocol specific (like RNDIS or CDC Ethernet) code is implemented in the user driver.

The Nucleus USB Ethernet Communication class driver is written in C and is portable to any USB hardware platforms.

Nucleus USB Ethernet and Nucleus NET

Nucleus USB Ethernet Communication class driver can easily be integrated with any TCP/IP stack. By doing so, it will work like an Ethernet hardware driver for the TCP/IP stack. As a result, the Nucleus USB Host Ethernet Communication class driver can take the packets from network stack and transmits them to the network, and the Nucleus USB Function Ethernet Communication class driver can pass the received frames from network to the host. Integration layer is provided for both CDC Ethernet and RNDIS driver with the Nucleus NET (Nucleus TCP/IP stack). Additionally, Nucleus USB Host Ethernet Communication class driver can work with Nucleus NET and Nucleus PPPoE to take advantage of a USB connection to the Internet.

Technical Fact Sheet

Nucleus USB Ethernet Communication function class driver is implemented in the following modules.

- Communication class driver (common for all communication products)
- Ethernet user driver (specific to CDC Ethernet)
- RNDIS user driver (specific to RNDIS)

Following table gives the ROM and RAM requirement for all three modules. It assumes that the driver's functions code is placed in ROM and driver's dispatch table, control block and other data is placed in RAM. This also contains the stack requirement for demo task for CDC Ethernet and RNDIS.

Tool Set	RealView tools Ver. 2.0.1	Hitachi SH tools Ver 7.1.02
Function Side		
Communication class ROM	5784 bytes	6720 bytes
Communication class RAM	3912 bytes	3912 bytes
Ethernet user ROM	3284 bytes	3800 bytes
Ethernet user RAM	3612 bytes	3612 bytes
RNDIS user ROM	6808 bytes	8292 bytes
RNDIS user RAM	3656 bytes	3656 bytes
Ethernet demo stack	256 bytes	232 bytes
RNDIS demo stack	256 bytes	232 bytes
Host Side		
Communication class ROM	8268 bytes	9028 bytes
Communication class RAM	260 bytes	260 bytes
CDC Ethernet user ROM	1188 bytes	1280 bytes
CDC Ethernet user RAM	268 bytes	268 bytes
CDC Ethernet demo stack	140 bytes	140 bytes

Related documents

USB Class Definitions for Communication Devices
Version 1.1
January 19, 1999
This document is available from the USB Implementation Forum Web site at
http://www.usb.org/developers/devclass_docs/usbcdc11.pdf

The Remote NDIS standard was developed by the Microsoft Corporation. This standard is available from the MSDN library online at
http://msdn.microsoft.com/library/en-us/network/hh/network/netremote_357362f9-684d-4447-87a5-8397517f7d15.xml.asp

Nucleus USB
http://www.acceleratedtechnology.com/embedded/nuc_usb.html