AirPrime RC76xx

USB Driver Developer's Guide

SIERRA WIRELESS®

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Revision History

Revision number	Release date	Changes
1.0	December 26, 2019	Creation
2.0	January 06, 2020	Modified data tranfer rates and standard USB power management under USB Standards Compliance.
2.1	January 10, 2020	Removed “Figure 2-1 on page reference” under Supported Interfaces — Service Descriptions
2.2	February 3, 2020	Removed Apple-related trademarks.

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1: Introduction

Purpose of this Guide

This guide is intended for use when designing host drivers for AirPrime RC76xx modules and describes the following information:

- Services (protocols) available over the USB connection
- Physical USB interface (device and endpoint descriptors)

Related documents

Industry/other documents

Related and supporting documents include:

[1] Terminal Equipment to User Equipment (TE-UE) multiplexer protocol (Release 6)
Website: www.3gpp.org

[2] Universal Serial Bus Specification, Rev 2.0
Website: www.usb.org

2: USB Architecture

This chapter describes the RC76xx driver architecture for data transfer, and its physical USB interfaces.

USB Standards Compliance

RC76xx devices comply with USB 2.0 standards, including the following:

- USB slave only
- USB 2.0 (backwards compatible with USB 1.1)
- High-speed 480 Mb/s, full-speed 12 Mb/s, and low-speed 1.5 Mb/s data transfer rates
- Standard USB flow control
- Standard USB power management — USB slave device enters into suspend mode via the USB Host BUS suspend request.

For consistency across module types, Sierra Wireless modules employ a static Interface numbering strategy for enabled (concurrent) interfaces, whereas the USB 2.0 specification dynamically numbers interfaces based on the number of enabled interfaces.

USB Endpoints

USB endpoints are uniquely addressable portions of a USB device used to transfer information between the host and module. Each defined endpoint is a unidirectional link from the modem to the host (Input) or from the host to the modem (Output).

Note: The logical endpoint numbers in this guide are used for ease of reading; developers must use the actual, physical endpoints when developing USB drivers

Supported Interfaces—Service Descriptions

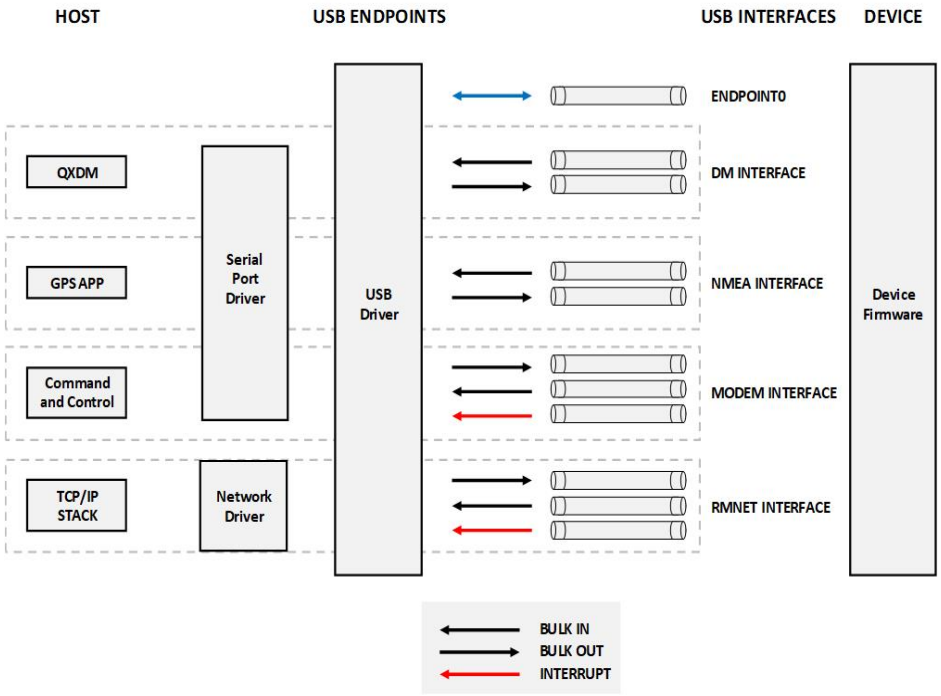
The following services are available over the supported interfaces:

- DIAG (DM) — Diagnostic (or DM) interface intended for use with Qualcomm tools, such as QXDM, during product development.
- NMEA — Provides external application with standard NMEA messages.
- MODEM/AT — Main command & control interface and supports Data calls. Note that AT commands cannot be used while a PPP session is established (the session must be terminated).
- RMNET — Intended for wireless data transfer between host and wireless network through device modem stack.

Each physical endpoint is defined in USB descriptors and is referred to in this document by a logical endpoint number (for example, endpoint ‘2’) and direction (IN or OUT). Where bidirectional communication is required for a specific data service, two endpoints are used. These endpoints use the same logical endpoint number. For example, where endpoints 2-IN and 2-OUT are used for bidirectional transfer of

NMEA between the host and module, these endpoints have the same logical endpoint number (2) but different physical endpoint numbers (IN is 0x82 and OUT is 0x02).

Figure 2-1: USB Endpoints and Interfaces Diagram



Descriptors

This section describes the supported interfaces, including the descriptor of each interface and supported interface set of each USB PID.

USB Interfaces

The RC76xx supports following interfaces:

- DIAG
- NMEA
- MODEM
- RMNET

Different USB PIDs support different sets of USB interfaces as shown in the table below.

Table 2-1: Device Field Identifiers and Values

Interface Index	Endpoint Number	Service Name	USB PID (0x68C0)	Notes
0	1 IN, 1 OUT	DIAG	Yes	FW download, proivsioning, modern logging
2	1 IN, 1 OUT	NMEA	Yes	GNSS sentences
3	2 IN, 1 OUT	MODEM	Yes	AT port
8	2 IN, 1 OUT	RMNET	Yes	Programmatic control and status / WWAN data

Descriptors of PID 0x68C0

The following table provides the USB descriptors of PID 0x68C0.

Table 2-2: Descriptor Identifiers and Values for PID 0x68C0

Descriptor	Field Identifier	Value
Device Descriptor	bLength	0x12
	bDescriptorType	0x01
	bcdUSB	0x0200 (USB spec version 2)
	bDeviceClass	0x00
	bDeviceSubClass	0x00
	bDeviceProtocol	0x00
	bMaxPacketSize0	0x40 (Max packet size for endpoint 0 = 64)
	idVendor	0x1199 (Sierra Wireless Inc.)
	idProduct	0x68C0
	bcdDevice	0x0000 (May change in future firmware releases)
	iManufacturer	0x03 (Sierra Wireless, Incorporated)
	iProduct	0x02 (RC76xx)
	iSerialNumber	0x04
	bNumConfigurations	0x01
Configuration Descriptor (Index 0x00)	bLength	0x09
	bDescriptorType	0x02
	wTotalLength	0x0073 (Length varies depending on number of interfaces and endpoints)
	bNumInterfaces	0x04 (Number of interfaces varies depending on provisioning, and use of !USBCOMP to enable/ disable interfaces.)
	bConfigurationValue	0x01
	iConfiguration	0x01
	bmAttributes	0xE0
	MaxPower	0xFA

Table 2-2: Descriptor Identifiers and Values for PID 0x68C0

Descriptor	Field Identifier	Value
Interface Descriptor (Number 0x00) DIAG	bLength	0x09
	bDescriptorType	0x04
	bInterfaceNumber	0x00
	bAlternateSetting	0x00
	bNumEndpoints	0x02
	bInterfaceClass	0xFF (vendor-specific device class)
	bInterfaceSubClass	0xFF (vendor-specific device subclass)
	bInterfaceProtocol	0xFF
	iInterface	0x00
Endpoint Descriptor (0x81)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x81
	bmAttributes	0x02 (Transfer Type: Bulk)
	wMaxPacketSize	0x0200 - Must be high speed device
	bInterval	0x00
Endpoint Descriptor (0x01)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x01 (OUT)
	bmAttributes	0x02 (Transfer Type: Bulk)
	wMaxPacketSize	0x0200 - Must be high speed device
	bInterval	0x00

Table 2-2: Descriptor Identifiers and Values for PID 0x68C0

Descriptor	Field Identifier	Value
Interface Descriptor (Number 0x02) NMEA	bLength	0x09
	bDescriptorType	0x04
	bInterfaceNumber	0x02
	bAlternateSetting	0x00
	bNumEndpoints	0x02
	bInterfaceClass	0xFF (vendor-specific device class)
	bInterfaceSubClass	0xFF (vendor-specific device subclass)
	bInterfaceProtocol	0xFF
	iInterface	0x00
Endpoint Descriptor (0x82)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x82 (ep #, IN)
	bmAttributes	0x02 (Transfer Type: Bulk)
	wMaxPacketSize	0x0200 - Must be high speed device
	bInterval	0x00
Endpoint Descriptor (0x02)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x02 (ep #, OUT)
	bmAttributes	0x02 (Transfer Type: Bulk)
	wMaxPacketSize	0x0200
	bInterval	0x00

Table 2-2: Descriptor Identifiers and Values for PID 0x68C0

Descriptor	Field Identifier	Value
Interface Descriptor (Number 0x03) MODEM	bLength	0x09
	bDescriptorType	0x04
	bInterfaceNumber	0x03
	bAlternateSetting	0x00
	bNumEndpoints	0x03 (Number of endpoints used by this interface is 3, excluding endpoint 0.)
	bInterfaceClass	0xFF (vendor-specific device class)
	bInterfaceSubClass	0xFF (vendor-specific device subclass)
	bInterfaceProtocol	0xFF
	iInterface	0x00
Endpoint Descriptor (0x83)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x83 (ep #, IN)
	bmAttributes	0x03 (Transfer Type: Bulk)
	wMaxPacketSize	0x0040
	bInterval	0x05
Endpoint Descriptor (0x84)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x84 (ep #, IN)
	bmAttributes	0x02(Transfer Type: Interrupt)
	wMaxPacketSize	0x0200
	bInterval	0x00
Endpoint Descriptor (0x03)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x03 (ep #, OUT)
	bmAttributes	0x02 (Transfer Type: Bulk)
	wMaxPacketSize	0x0200 - Must be high speed device
	bInterval	0x00

Table 2-2: Descriptor Identifiers and Values for PID 0x68C0

Descriptor	Field Identifier	Value
Interface Descriptor (Number 0x08) RMNET	bLength	0x09
	bDescriptorType	0x04
	bInterfaceNumber	0x08
	bAlternateSetting	0x00
	bNumEndpoints	0x03 (Number of endpoints used by this interface is 3, excluding endpoint 0.)
	bInterfaceClass	0xFF (vendor-specific device class)
	bInterfaceSubClass	0xFF (vendor-specific device subclass)
	bInterfaceProtocol	0xFF
	iInterface	0x00
Endpoint Descriptor (0x85)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x85 (ep #, IN)
	bmAttributes	0x03 (Transfer Type: Bulk)
	wMaxPacketSize	0x0040
	bInterval	0x05
Endpoint Descriptor (0x86)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x86 (ep #, IN)
	bmAttributes	0x02 (Transfer Type: Interrupt)
	wMaxPacketSize	0x0200
	bInterval	0x00
Endpoint Descriptor (0x04)	bLength	0x07
	bDescriptorType	0x05
	bEndpointAddress	0x04 (ep #, OUT)
	bmAttributes	0x02 (Transfer Type: Bulk)
	wMaxPacketSize	0x0200 - Must be high speed device
	bInterval	0x00