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LE910 V2 SERIES PORTS ARRANGEMENTS

APPLICABILITY TABLE

PRODUCTS

  LE910 V2 SERIES

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1 INTRODUCTION

1.1 Scope

The present document provides a guideline to connect logically the physical serial ports of the module to the services supported by the module itself (GNSS, AppZone, etc.). It is up to the user to configure the module in suitable way to avoid hardware/software resources conflicts. With the generic "ports/services arrangement" expression is intended each possible set of logical connections regarding physical ports and Service Access Points supported by the used module (e.g. AT0, AT1, AT2, etc.).

1.2 Audience

This guide is addressed to the application developers that need to exploit at best the logical connections regarding the physical serial ports and services provided by the used module, without run up against resources contentions among the involved services.

1.3 Contact Information, Support

For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

TS-EMEA@telit.com

TS-AMERICAS@telit.com

TS-APAC@telit.com

Alternatively, use:

<http://www.telit.com/support>

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

<http://www.telit.com>

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.4 Text Conventions



Danger – This information **MUST** be followed or catastrophic equipment failure or bodily injury may occur.



Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.



Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.5 Related Documents

- [1] Telit's CMUX Implementation User Guide, 1vv0300994
- [2] Telit 4G Modules AT Commands Reference Guide, in progress
- [3] LE910 V2 Hardware User Guide, in progress
- [4] NCM Protocol User Guide, 1vv0301246
- [5] Telit's AppZone User Guide, 1vv0301082
- [6] AppZone APIs User Guide, 1vv0301130

2 VIRTUAL SERVICE DEVICE

Before describing the several ports/services arrangements set up by means of the AT#PORTCFG command, it is useful to introduce the Virtual Serial Device (VSD).

VSD is a software layer designed to run on Telit's modules. It manages virtual connections between the physical serial ports, accessible to the user, and the services provided by the module. VSD supports several Service Access Points used as anchorage points for the logical connections. The table below shows the physical and logical objects involved in the connections arrangement: Physical Serial Ports, Services Access Points, Services, and CMUX channels.

Physical Serial Ports	Service Access Points	Services	CMUX Channels
USIF0 USIF1 USBx (USB0÷USB6) ¹	AT0, AT1, AT2 TT	External GNSS Receiver AppZone	CMUX (VC1÷VC4) ²

Tab. 1: Items Connected by means of the VSD

NOTICE: in document [3], USIF0 and USIF1 are called respectively Modem Serial Port1 and Modem Serial Port 2.

Referring to Fig. 1:

the modules provide three AT Commands Parser Instances, which are logically independent and connected to three different Service Access Points; each parser recognizes and executes the AT commands received on its Service Access Point.

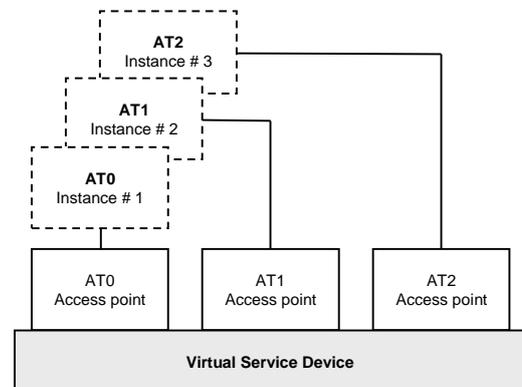


Fig. 1: AT Parser Instances

¹ Seven USB ports (or channels): USB0÷USB6.

² Four CMUX channels: VC1÷VC4, see document [1].

3 PRELIMINARY INFORMATION



It is strongly recommended to use the AT#USBCFG=? and AT#PORTSCFG=? Test commands to have information respectively on the USBx ports configuration modes and ports arrangements provided by the module that you are using. Refer to document [2] to have information on AT commands syntax.

3.1 USB Ports Configuration Modes

Assume that the module is using the factory-setting ports configuration, and the USB cable is connected to the PC, Fig. 2 shows an example of USBx ↔ COMx ports mapping. The mapping depends on the Windows-PC configuration, in this case USB0 port is mapped into COM17 port.

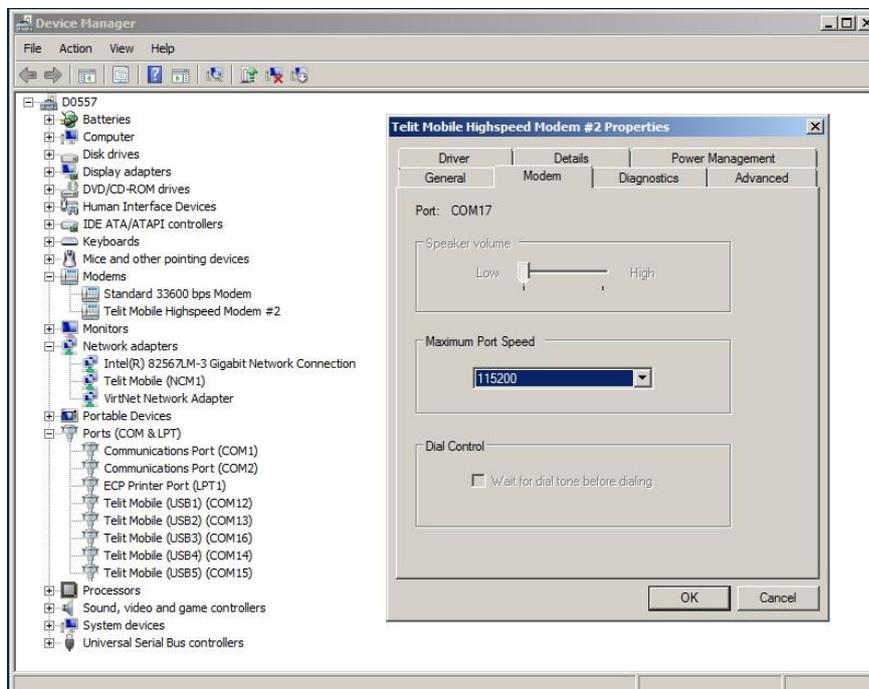


Fig. 2: USBx Ports Mapped into Virtual COMx Ports

Tab. 2 summarizes the mapping shown in Fig. 2.

USBx Ports	COMx Ports
USB0	COM17
USB1	COM12

USB2	COM13
USB3	COM16
USB4	COM14
USB5	COM15

Tab. 2: Mapping Table

Enter the AT#USBCFG=? Test command to check the number of USB ports modes provided by the module.

AT#USBCFG=?

#USBCFG: (0-5) ← the module provides six modes

OK

Check the current mode

AT#USBCFG?

#USBCFG: 0 ← 0 is the factory-setting mode

OK

Tab. 3 describes the USB port configuration for each mode; see also chapter 10.1.

Mode	USB Port Configurations					Description	PID
	ACM	SS	NCM	MBIM	DLINK		
0 (factory-setting)	✓	standard	✓			All USBx ports support ACM subclass, Selective Suspend standard type, and NCM protocol.	0x36
1	Data only	standard			In progress	All USBx ports support ACM subclass in Data only mode, Selective Suspend standard type, and DLink feature (in progress).	0x34
2	✓	standard			In progress	All USBx ports support ACM subclass, Selective Suspend standard type, and DLink feature (in progress).	0x35
3	✓	standard	(✓)	✓		All USBx ports provide ACM subclass, Selective Suspend standard type, and the following feature: USB device starts with MBIM protocol, the host may force the device to use the NCM protocol.	0x32
4	✓	custom	✓			All USBx ports provide ACM subclass, Selective Suspend custom type, and NCM protocol.	0x37
5	✓	custom	(✓)	✓		All USBx ports provide ACM subclass, Selective Suspend custom type, and the following feature: USB device starts with MBIM protocol, the host may force the device to use the NCM protocol.	0x33

Tab. 3: #USBCFG Mode

Telit provides the USB driver to install on the PC-Windows (DTE). With Ubuntu operating systems, the attached USB device works with in-box drivers. See chapter 10.3, and 10.3.1.

Here is a brief description of ACM, SS, NCM, MBIM, DLINK features provided by the different USB ports configuration modes.

➤ ACM (Abstract Control Model)

The USB device (module) implements the Abstract Control Model (ACM) subclass defined in the USB Communication Device Class (CDC) specification. The ACM subclass defines two interfaces, a data interface that consists of two endpoints (bulk in, and bulk out) and a control interface that consists of one interrupt in endpoint. See Tab. 4, and chapter 10.2.

Endpoint	Direction	Type	Description	USB Interfaces
EP1	IN	Interrupt	State notification from device to host	Control interface
EP2	IN	Bulk	Data transfer from device to host	Data Interface
EP3	OUT	Bulk	Data transfer from host to device	

Tab. 4: Endpoints Configuration for ACM

The USB host (PC) reads the current USB device configuration mode using the Device Control Interface EP0. See table below, and chapter 10.2.

Endpoint	Direction	Type	Description	USB Interfaces
EP0	IN/OUT	Control	Standard request, class request	Interface used for controlling the device.

Tab. 5: Endpoints Configuration for Device Control Interface

➤ ACM/Data only

The USB device (module) implements the simplified ACM/DATA only interface (Data interface: bulk in, and bulk out endpoints); see chapter 10.2.

Endpoint	Direction	Type	Description	USB Interfaces
EP2	IN	Bulk	Data transfer from device to host	Data Interface
EP3	OUT	Bulk	Data transfer from host to device	

Tab. 6: Endpoints Configuration for ACM/Data only

➤ SS

Two Selective Suspend types are implemented:

- Custom: the user application sends messages to power off/on the device. The mechanism to use depends on the operating system and the type of device: composite or non-composite.
- Standard: if the host does not send anything to the device for a certain time interval, the device is automatically powered down. The host can resumes the device, or the device can signal a "remote wake up".

➤ NCM (Network Control Model)

NCM is a protocol. The USB host and device (module) can efficiently exchange Ethernet frames using it. Regarding packet format, NCM will use 802.3 frames (i.e. IP packets with Ethernet headers). Refer to document [4] to get information on how activate the NCM protocol.

➤ MBIM (Mobile Broadband Interface Model)

MBIM is a protocol. It provides multiple IP connections over a single USB interface, without the need of 802.3 frames (as was the case with ECM and NCM). MBIM uses raw IP packets (i.e. just IP packets without Ethernet headers).

➤ DLink

It is in progress.

Tab. 7 shows the #USBCFG modes supported by Windows and Ubuntu Operating Systems, see chapter 10.1.

Mode	Windows	Ubuntu
	Telit Driver	in-box Driver
0	✓	✓
1		
2	✓	✓
3	✓	✓
4	✓	✓
5	✓	✓

Tab. 7: #USBCFG Modes & OS

Now we go back to AT commands description.

Enter the following AT commands to change the USB configuration mode.

Set the desired USB mode, for example 5.

AT#USBCFG=5

OK

Check the #USBCFG value.

AT#USBCFG?

#USBCFG: 5

OK

After entering the USB mode, power off/on the module (USB device) to make active the new mode, or enter the AT#REBOOT command.



Chapter 10.1 shows for each USB configuration mode:

- the "Device Manager" screenshot in Windows,
- the information returned by the "dmesg" command in Ubuntu.

3.2 Serial Ports & Service Access Points

Enter the AT#PORTCFG=? Test command to know at which Service Access Point a physical serial port is connected in accordance with the Variant value. The command returns a short description on the logical connection for each Variant value provided by the module.

AT#PORTCFG=?

```
#PORTCFG: Variant=0: AT= USIF0 USB0 USB3; STT (Trace) = USB1
#PORTCFG: Variant=1: not supported by this product
#PORTCFG: Variant=2: not supported by this product
#PORTCFG: Variant=3: AT= USIF0 USIF1 USB0; STT(Trace) = USB1
#PORTCFG: Variant=4: not supported by this product
#PORTCFG: Variant=5: not supported by this product
#PORTCFG: Variant=6: not supported by this product
#PORTCFG: Variant=7: not supported by this product
#PORTCFG: Variant=8: AT= USB0 USB3 USB4; STT(Trace) = USB1
#PORTCFG: Variant=9: not supported by this product
#PORTCFG: Variant=10: not supported by this product
#PORTCFG: Variant=11: AT= USIF0 USB3 USB0; STT(Trace)= USB1; ExtGNSS= USIF1
OK
```

STT is used interchangeably with TTC (Telit Trace Client tool).

Message meaning for each Variant value:

Variant=0:

- USIF0, USB0, and USB3 are connected to AT parsers that are not specified in the message. The following sub-chapters specify the AT parsers, and the other Service Access Points for each Variant value.
- USB1 is connected to the TT Service Access Point.

Variant=8:

- USB0, USB3, USB4 are connected to AT parsers that are not specified in the message. The following sub-chapters specify the AT parsers, and the other Service Access Points for each Variant value.
- USB1 is connected to the TT Service Access Point.

Variant=...

- And so on for each supported Variant value.

The ports arrangement that you set, can be used with one of the six #USBCFG modes. The following table emphasizes that the #PORTCFG assigns a Service Access Point (SAP1, SAP...) to one USBx port, and #USBCFG assigns a "mode" to all USBx ports. Each mode defines a product (USB device) by means of the PID, each product provides different features described in Tab. 3.

USBx Ports	AT#PORTCFG=X					Modes (#USBCFG)					
	SAP1	SAP2	SAP3	SAP...	SAP...	0	1	2	3	4	5
USB0						0x36	0x34	0x35	0x32	0x37	0x33
USB1		✓			✓						
USB2											
USB3				✓							
USB4											
USB5											
USB6	NA										

Tab. 8: #PORTCFG & #USBCFG

4 AT#PORTCFG COMMAND

The AT#PORTCFG command manages several internal ports arrangements by means of its parameter value called 'Variant', refer to document [2]. The tables and figures illustrated on the next pages show the various ports configurations obtained changing the "Variant" value of the command and plugging in/unplugging the USB cable.

Follow this sequence to make active the entered AT#PORTCFG command:

- Start from the configuration shown in Tab. 9, it is the factory-setting: #PORTCFG=0;
- Enter, for example, the AT#PORTCFG=3 command through USIF0 port, AT0 parser elaborates the just entered command, but no actions are taken;
- Power down the module;
- Power on the module. The AT#PORTCFG=3 command is executed and the ports/services arrangement of Tab. 11 is set. To power off/on the module, you can use the AT#REBOOT command.



The following tables show the use of the TTC trace tools. To have more information contact Telit Technical Support.

4.1 AT#PORTCFG=0

AT#PORTCFG=0 (Factory Setting)					
	AT0	AT1	AT2	TT	/
No USB cable					
USIF0	X				
USIF1					

Tab. 9: #PORTCFG=0, no USB Cable

AT#PORTCFG=0					
	AT0	AT1	AT2	TT	/
USB0		X			
USB1				TTC (Trace)	
USB2					
USB3			X		
USB4					
USB5					
USB6	NA				
USIF0	X				
USIF1					

Tab. 10: #PORTCFG=0, with USB Cable



The USBx port configuration depends on the mode set by means of the AT#USBCFG command. See Tab. 3: #USBCFG Mode.

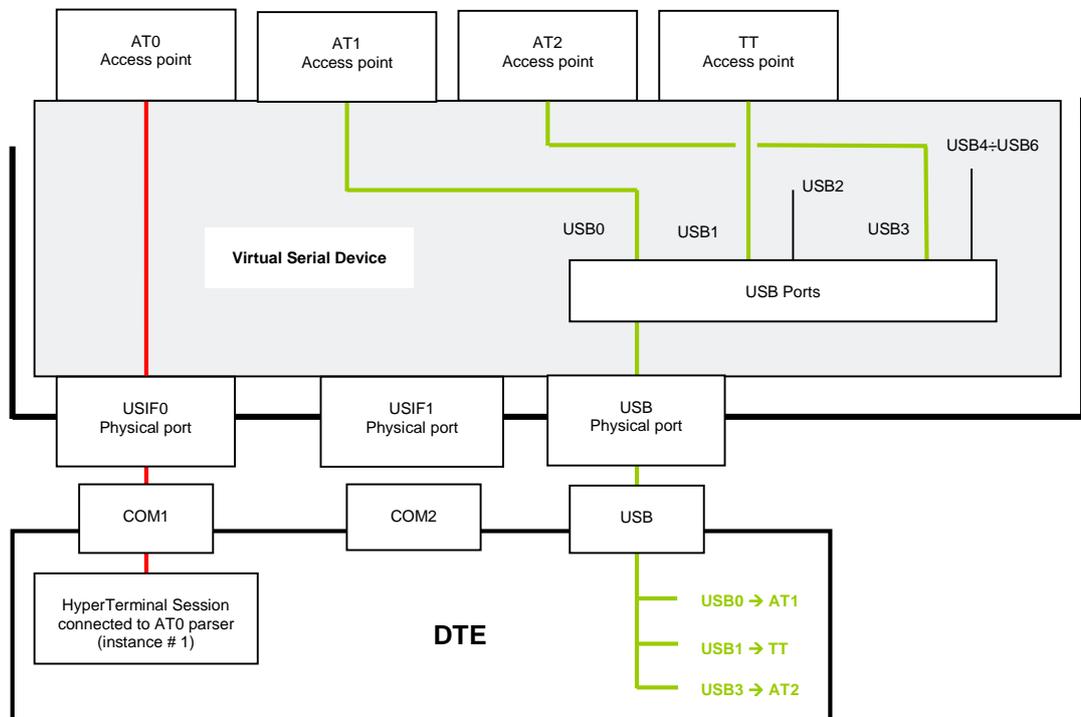


Fig. 3: #PORTCFG=0 + USB Cable

4.2 AT#PORTCFG=3

AT#PORTCFG=3					
	AT0	AT1	AT2	TT	/
No USB cable					
USIF0	X				
USIF1			X		

Tab. 11: #PORTCFG=3, no USB Cable

AT#PORTCFG=3					
	AT0	AT1	AT2	TT	/
USB0		X			
USB1				TTC(Trace)	
USB2					
USB3					
USB4					
USB5					
USB6	NA				
USIF0	X				
USIF1			X		

Tab. 12: #PORTCFG=3, with USB Cable



The USBx port configuration depends on the mode set by means of the AT#USBCFG command. See Tab. 3: #USBCFG Mode.

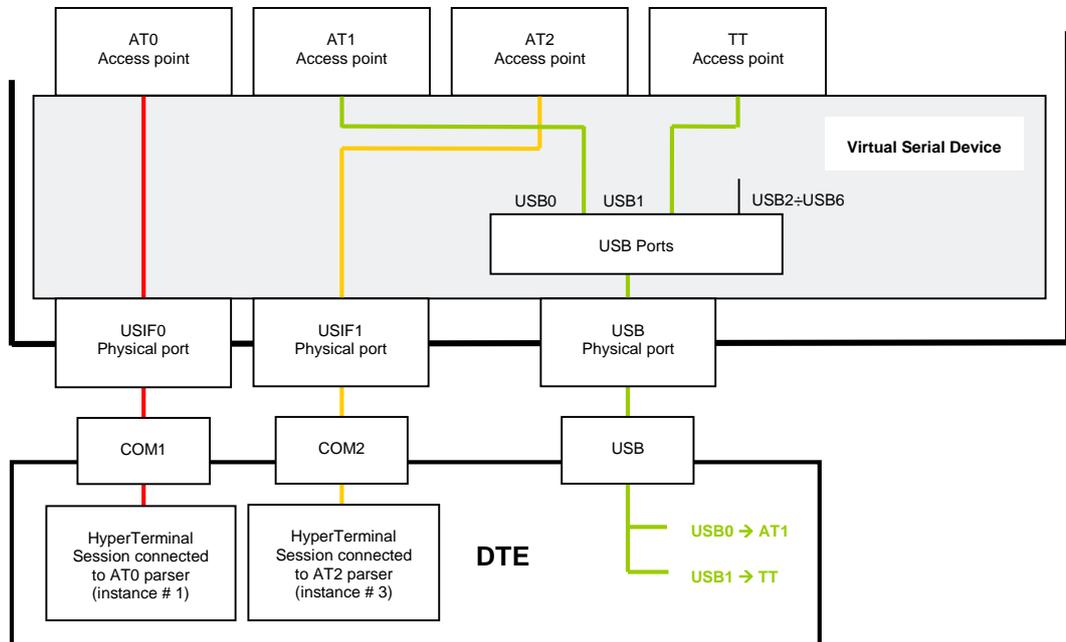


Fig. 4: #PORTCFG=3 + USB Cable

4.3 AT#PORTCFG=8

AT#PORTCFG=8					
	AT0	AT1	AT2	TT	/
NO USB cable					
USIF0					
USIF1					

Tab. 13: #PORTCFG=8, no USB Cable

AT#PORTCFG=8					
	AT0	AT1	AT2	TT	/
USB0	X				
USB1				TTC (Trace)	
USB2					
USB3		X			
USB4			X		
USB5					
USB6	NA				
USIF0					
USIF1					

Tab. 14: #PORTCFG=8, with USB Cable



The USBx port configuration depends on the mode set by means of the AT#USBCFG command. See Tab. 3: #USBCFG Mode.

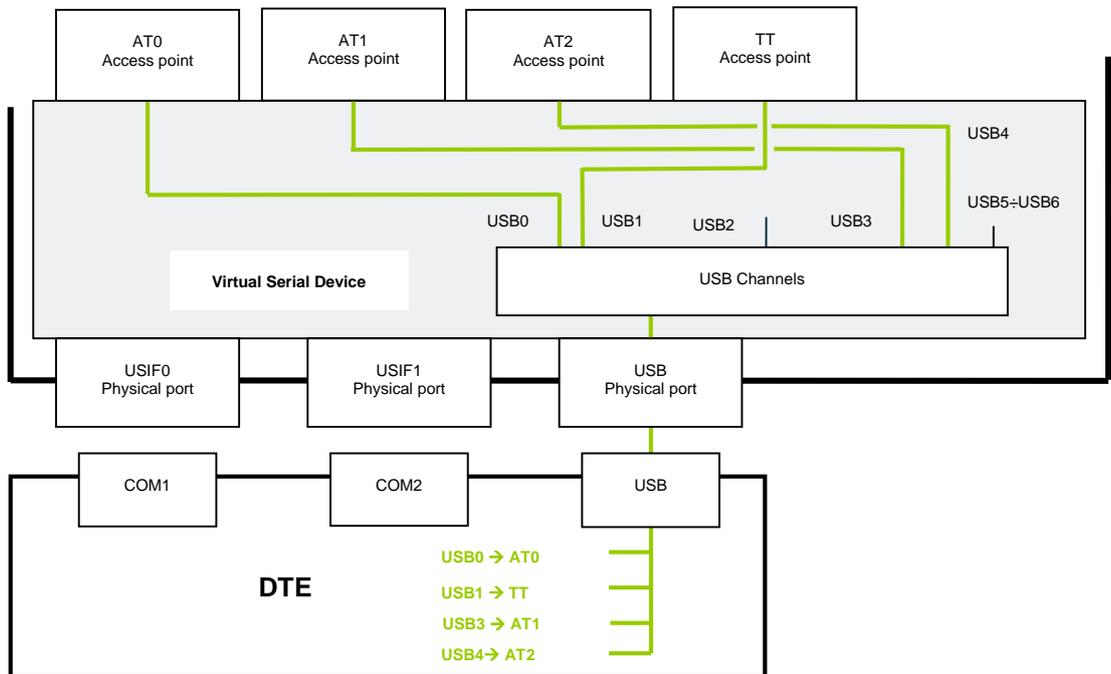


Fig. 5: #PORTCFG=8 USB Cable Only

4.4 AT#PORTCFG=11

AT#PORTCFG=11 is used to connect the module to an external GNSS receiver through USIF1 serial port, see chapter 6.1

AT#PORTCFG=11					
	AT0	AT1	AT2	TT	/
No USB cable					
USIF0	X				
USIF1					Ext. GNSS

Tab. 15: #PORTCFG=11, no USB Cable

AT#PORTCFG=11					
	AT0	AT1	AT2	TT	/
USB0		X			
USB1				TTC (Trace)	
USB2					
USB3			X		
USB4					
USB5					
USB6	NA				
USIF0	X				
USIF1					Ext. GNSS

Tab. 16: #PORTCFG=11, with USB Cable



The USBx port configuration depends on the mode set by means of the AT#USBCFG command. See Tab. 3: #USBCFG Mode.

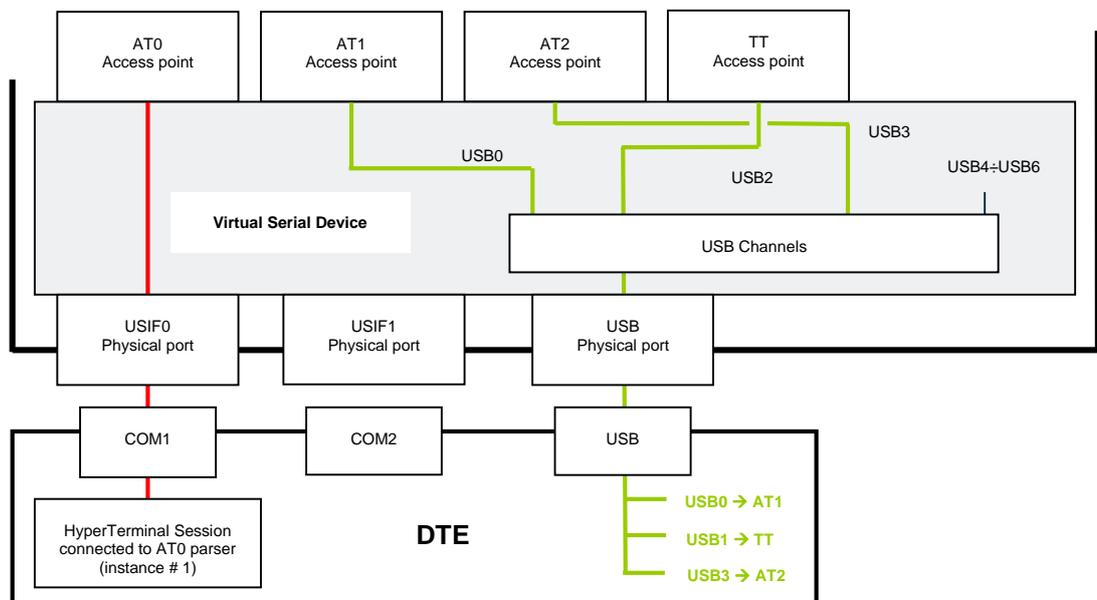


Fig. 6: #PORTCFG=11 + USB Cable

5 CMUX PROTOCOL

This section describes examples of ports/services arrangement using CMUX protocol. If you need to develop a Multiplexing Protocol running on your application processor (for example a user micro-controller), refer to document [1] to get detailed information.

5.1 CMUX Protocol on USIF0 Port

Here is an example of ports/services arrangement based on CMUX protocol running on USIF0 serial port.

Assume that the module is configured as indicated in Tab. 9: #PORTCFG=0 (factory-setting), and no USB cable plugged in. In addition, suppose that the used DTE is a Windows-PC, and Fig. 7 shows its device configuration. Now, run on the DTE the Telit Serial Port MUX application configured as shown in Fig. 8, and connect the MUX application to COM1 port, refer to Fig. 9. When the user starts an application (for example Hyper Terminal) connected to one of the three Virtual Ports (COM20 ÷ COM22), Telit Serial Port MUX application sends automatically the AT+CMUX=0 command to the module and the CMUX protocol is activated.



Fig. 7: Physical COMx Ports

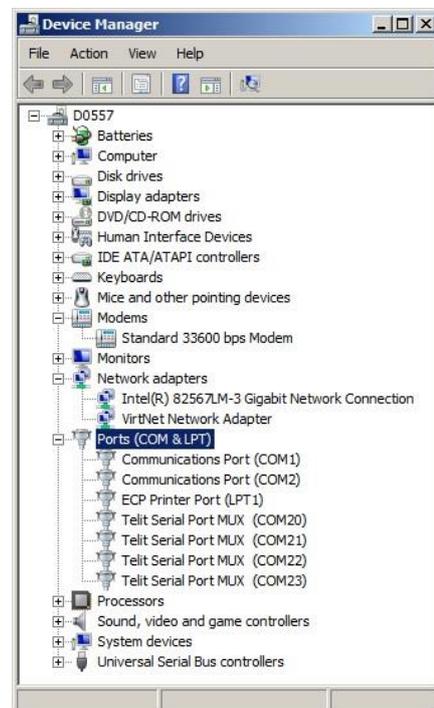


Fig. 8: Virtual Serial Ports of MUX

The configuration of the Telit Serial Port MUX application must avoid virtual serial ports conflict with the physical or virtual serial ports already present on the Windows-PC. The table below summarizes the new configuration.

Module ↔ DTE connection	COMx → VCx	AT0	AT1	AT2	TT
USB not used					
USIF0 ↔ COM1	COM20 → VC1	X			
	COM21 → VC2		X		
	COM22 → VC3			X	
	COM23 → VC4				
USIF1 not used					

Tab. 17: Ports/Services Arrangement with CMUX Connected to USIF0

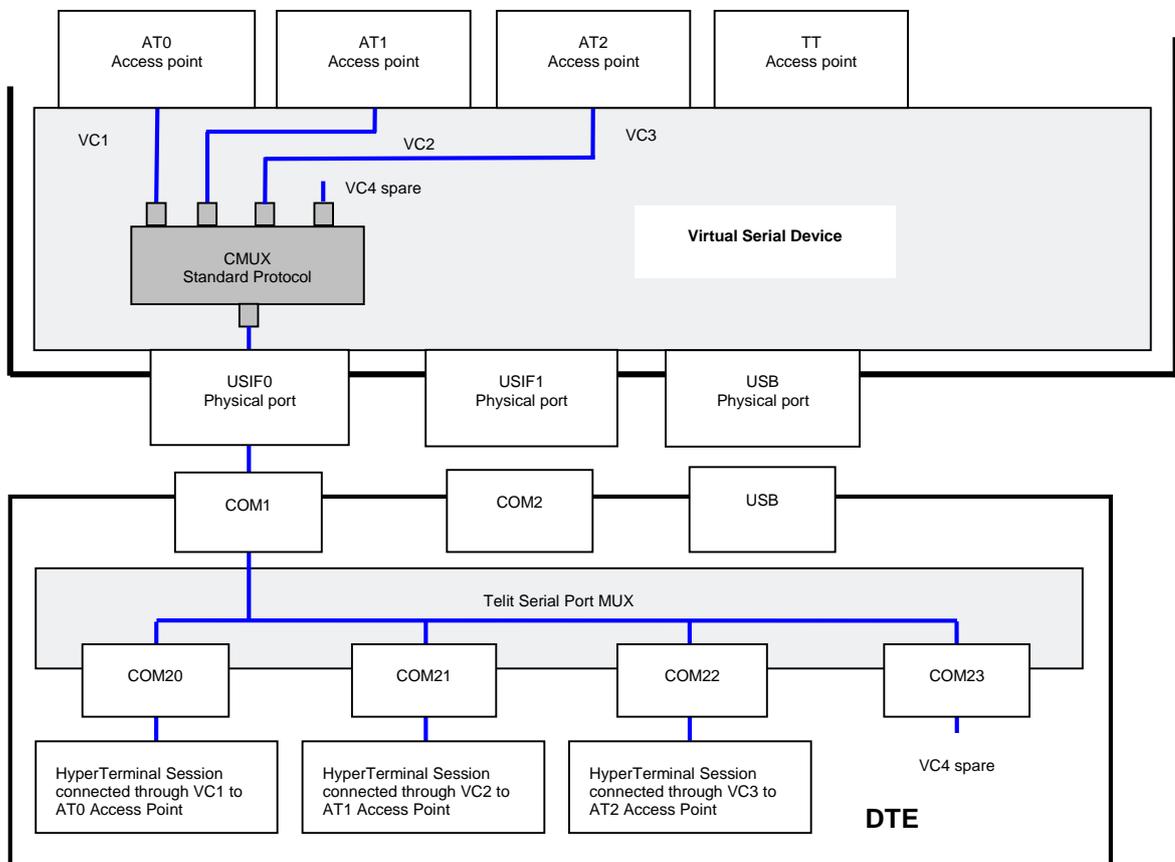


Fig. 9: CMUX Connected to USIF0

5.2 CMUX Protocol on USB3 Port

Here is an example of ports/services arrangement based on CMUX protocol running on USB3 port.

Assume that the module is configured as indicated in Fig. 3: #PORTCFG=0 (factory-setting), and USB cable plugged in. In addition, suppose that the used DTE is a Windows-PC, and Fig. 2 shows its device configuration. Now, run on the DTE the Telit Serial Port MUX application configured as shown in Fig. 10, and connect the MUX application to USB3 port mapped into COM16 virtual port, refer to Fig. 11. When the user starts an application (for example Hyper Terminal) connected to one of the three Virtual Ports (COM20 ÷ COM22), Telit Serial Port MUX application sends automatically the AT+CMUX=0 command to the module and the CMUX protocol is activated.



In the current Windows-PC configuration the USB0 port is mapped into COM17 port, refer to Fig. 10.

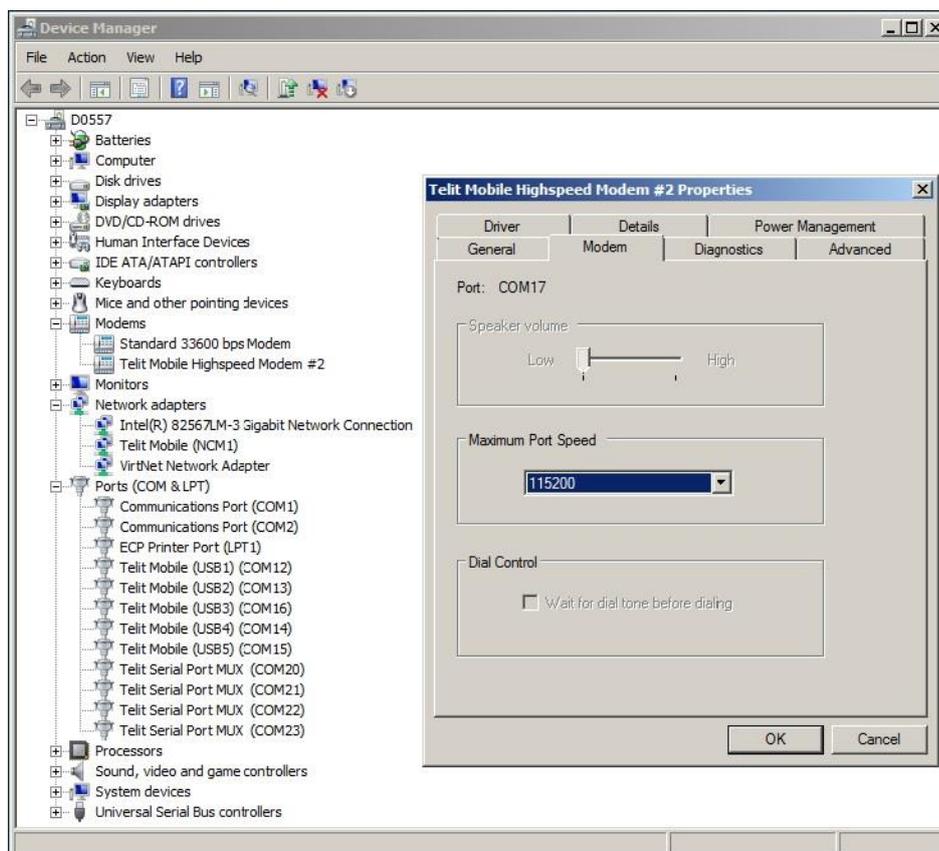


Fig. 10: Virtual Serial Ports of Telit Serial Port MUX

The table below summarizes the new configuration.

Module ↔ DTE connection	USB Ports	USBx → COMx	COMx → VCx	AT0	AT1	AT2	TT	/	
USB ↔ USB	USB0								
	USB1						TTC		
	USB2								
	USB3	COM16	COM20 → VC1	X					
			COM21 → VC2		X				
			COM22 → VC3			X			
			COM23 → VC4						
	USB4								
USB5									
USB6									
USIF0 not used									
USIF1 not used									

Tab. 18: Ports/Services Arrangement with CMUX Connected to USB3 Port

NOTICE: AT0 (instance # 1) is disconnected from USIF0 and connected to VC1/USB3/COM16/COM20.
The TTC tool stays on USB1 port.

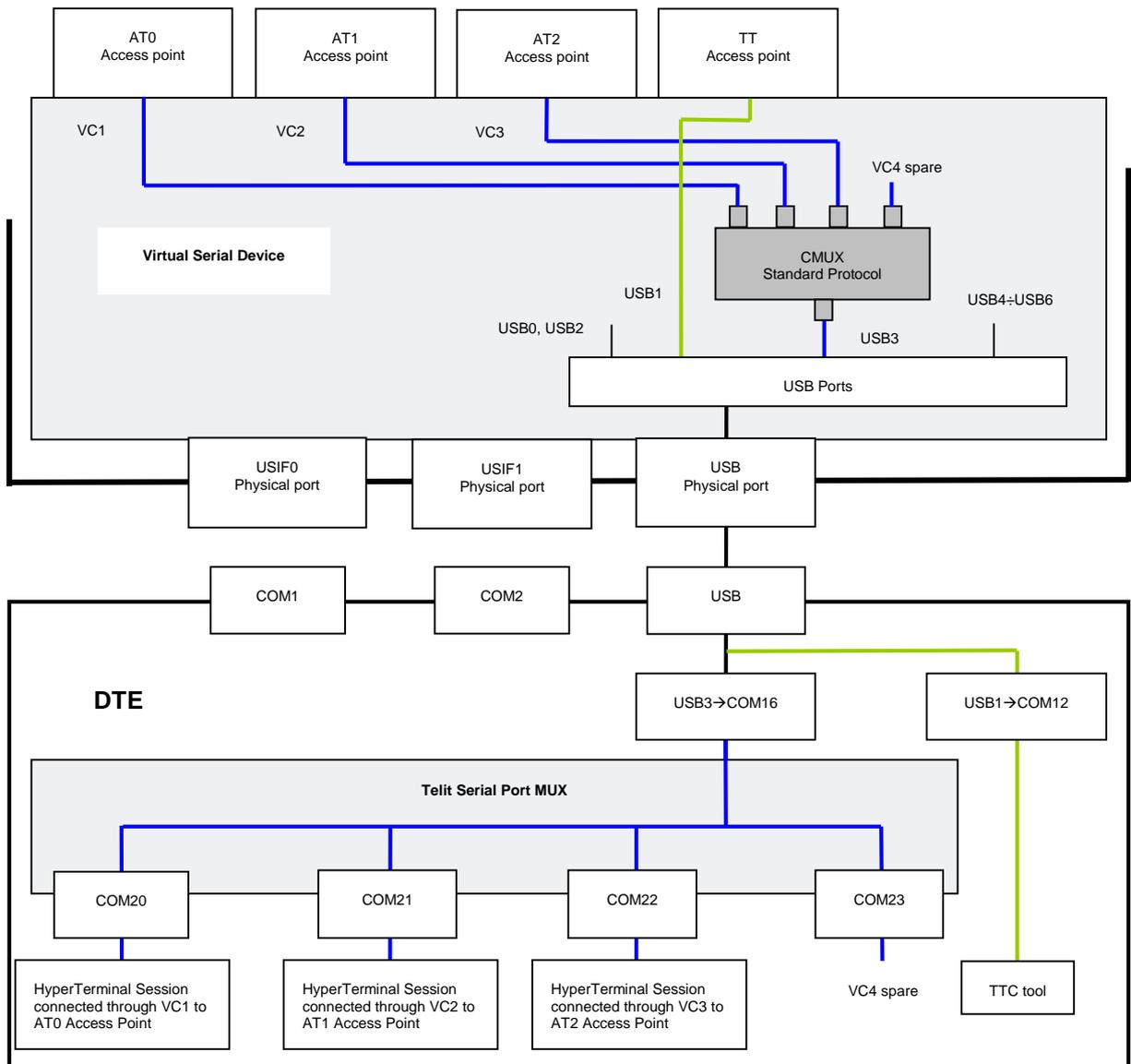


Fig. 11: CMUX Connected to USB3 Port

6 SERVICES

The modules series covered by the present document provide the services indicated in the **SERVICES COEXISTENCE TABLE** of the chapter 9.

As stated in chapter 2, different Service Access Points connect the services to the Virtual Serial Device software layer. This section describes how the user can access the supported service by means of the external physical serial ports, which in their turn are connected to the VSD layer.

6.1 External GNSS Receiver

The external GNSS receiver is connected to the module through USIF1 serial port.

6.1.1 AT#PORTCFG=11

Tab. 15 shows the starting port configuration of the module: #PORTCFG=11. Now, enable GPS/NMEA sentences through AT\$GPSP=1 and AT\$GPSNMUN=1... commands entered on USIF0 port. AT0 parser executes the AT commands, and after that NMEA sentences and AT commands run across USIF0 port as shown in Fig. 12.

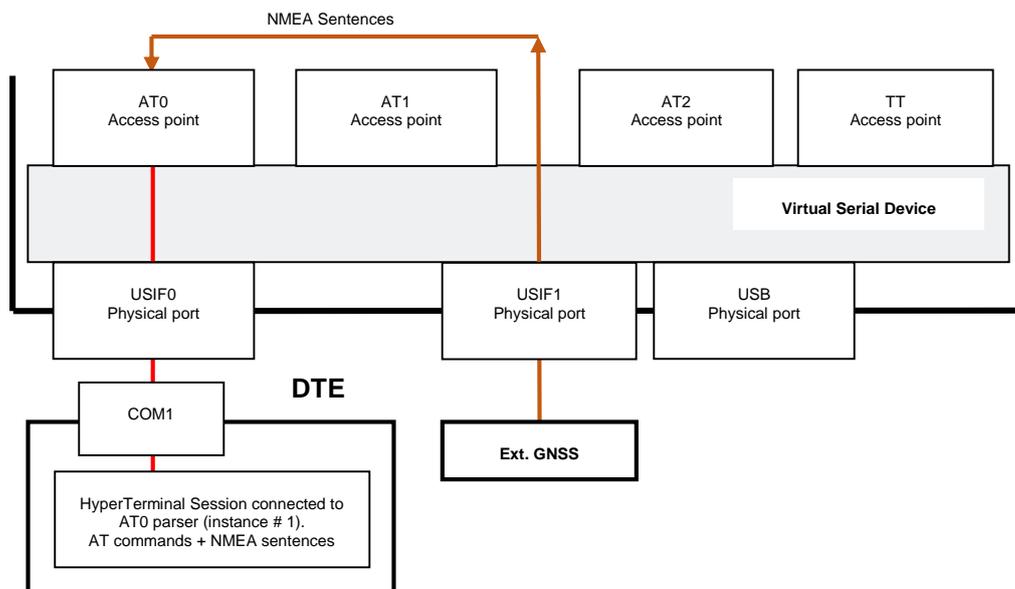


Fig. 12: USIF0 Port Support AT Commands + NMEA Sentences (External GNSS)

6.1.2 AT#PORTCFG=11 + USB

Tab. 16 shows the starting port configuration of the module: #PORTCFG=11+USB. Now, enable GPS/NMEA sentences through AT\$GPSP=1 and AT\$GPSNMUN=1... commands entered, for example, on USB0 port. AT1 parser executes the AT commands, and after that NMEA sentences and AT commands run across USB0 port as shown in Fig. 13.

NOTICE: the user can issue the AT commands through USIF0/AT0, USB0/AT1, or USB3/AT2 port/parser. The NMEA sentences are routed respectively on USIF0, USB0 (as shown by the example), or USB3 port

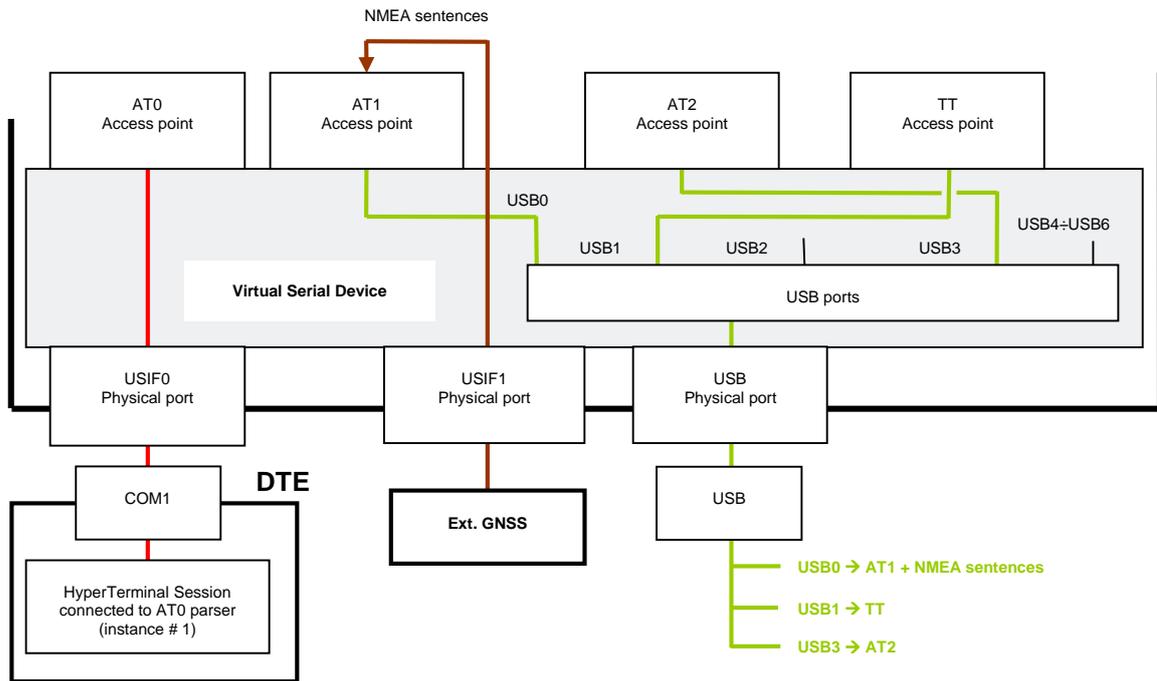


Fig. 13: USB0 Port Support AT Commands + NMEA Sentences (External GNSS)

6.2 AppZone



Refer to documents [5], and [6] to have information on the AppZone layer and its functions (APIs).

6.2.1 USIFx Ports

Example 1

Tab. 9 shows the starting ports configuration of the module: #PORTCFG=0 (factory-setting), no USB cable is connected. For example, run a user AppZone Application that does not use neither serial ports nor any ATx parsers; Fig. 14 shows the resulting ports arrangement.

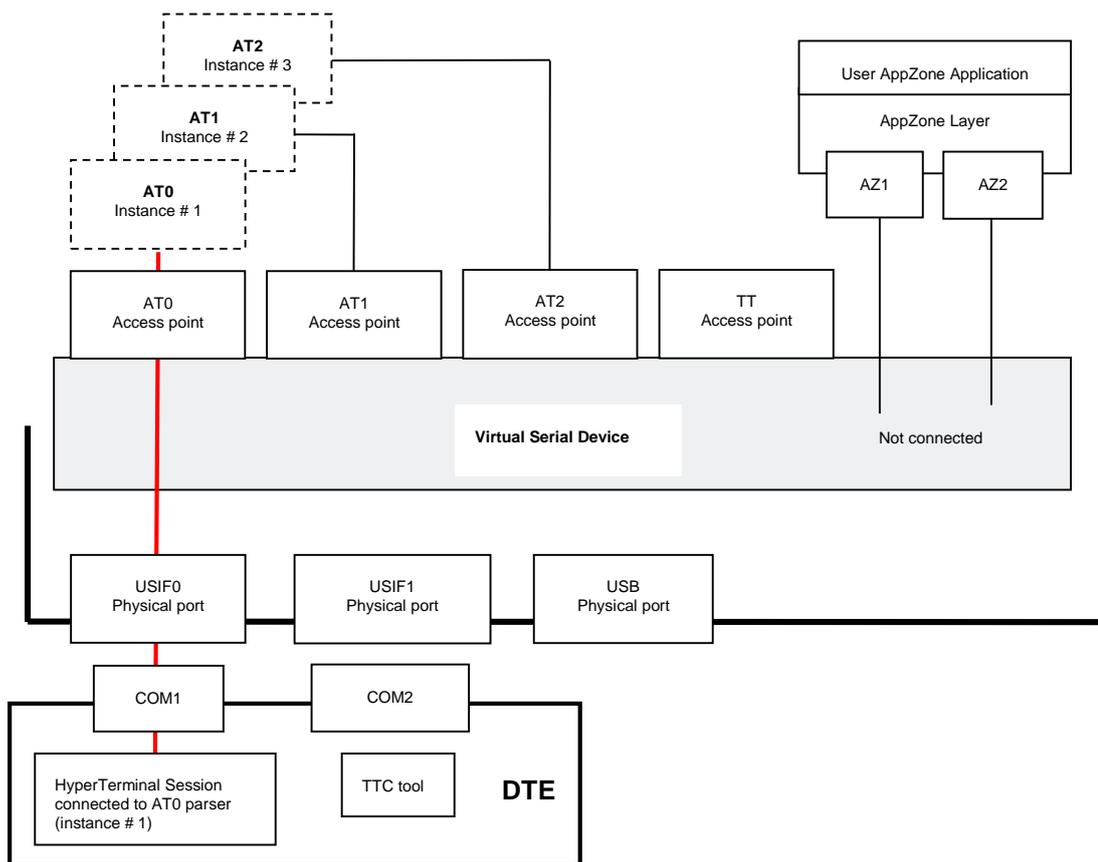


Fig. 14: AppZone Application without Connections

Example 2

Starting from the configuration of the Example 1, use `m2m_os_iat_set_at_command_instance(...)` function to connect logically the AZ1 and AZ2 Service Access Points respectively to AT1 and AT2 parsers, in addition use `PrintToUart(...)` function to use USIF0 port. Fig. 15 shows the resulting ports configuration.

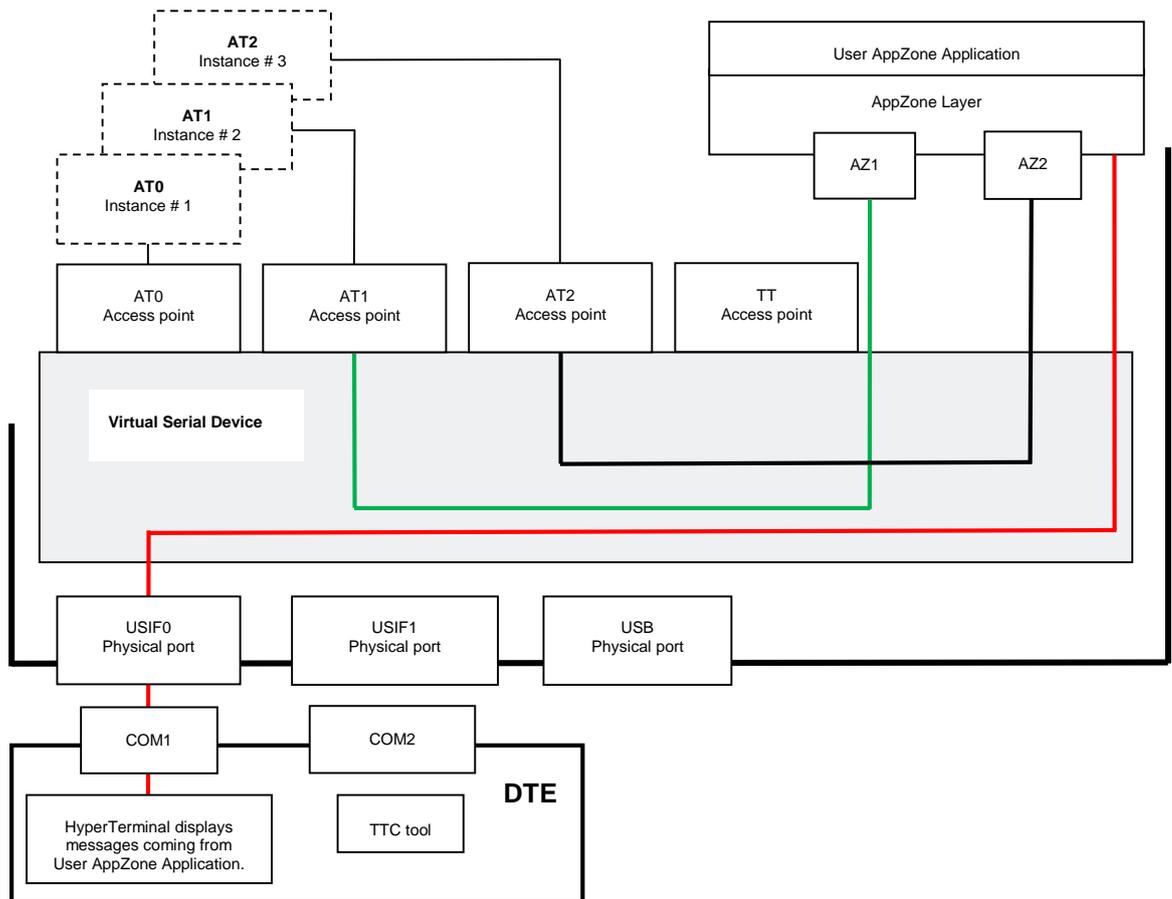


Fig. 15: AppZone Application Connected to AT1, AT2 Parsers, and USIF0 Serial Port

Example 3

Starting from the configuration of the Example 1, use

`m2m_hw_uart_ioctl (uart_fd, M2M_HW_UART_IO_AT_MODE_SET, M2M_HW_UART_IO_AT_MODE_ON)`

API to route data, received from USIF0, to AT1 parser. Fig. 16 shows the resulting ports configuration.

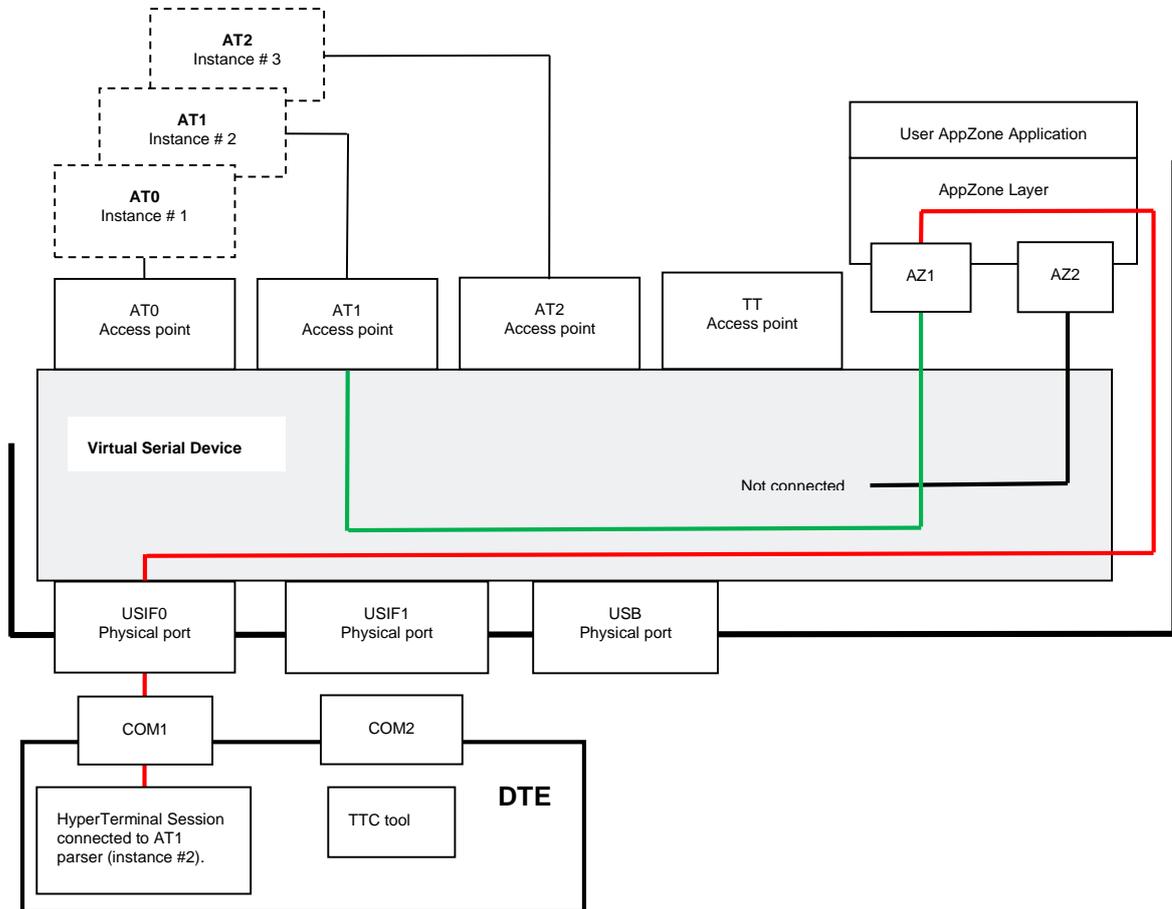


Fig. 16: USIF0 Connected to AT1 Parser through AppZone Layer

6.2.2 USBx Ports

Example 1

Tab. 10 shows the starting ports configuration of the module: #PORTCFG=0 (factory-setting) with USB cable. Out of the six USB ports, only two ports are available for the user AppZone applications: USB0, and USB3. Use:

m2m_hw_usb_open(USB_CH0, handle0) to disconnect USB0 port from AT1 parser, connect it to AppZone layer, and get its handle. When you use **USB_CH0**, the API try to open the USB0 port, and returns the related handle.

m2m_hw_usb_open(USB_CH3, handle3) to disconnect USB3 port from AT2 parser, connect it to AppZone layer, and get its handle. When you use **USB_CH3**, the API try to open the USB3 port, and returns the related handle.

Fig. 17 shows the new configuration.

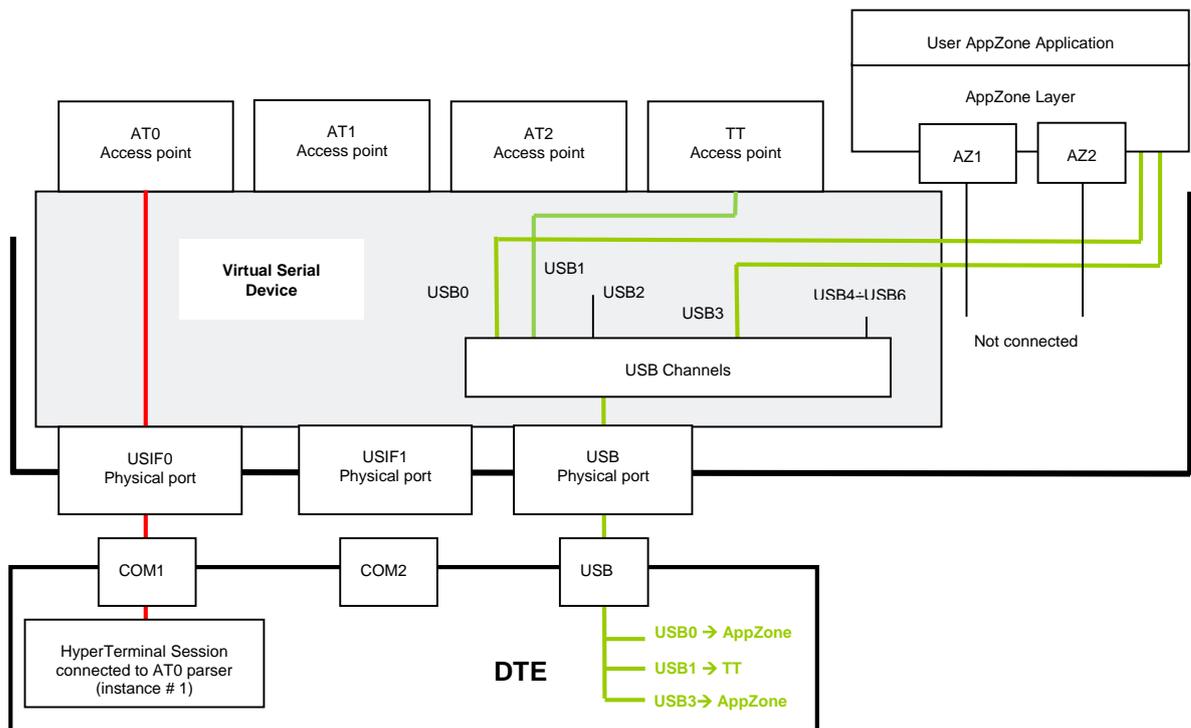


Fig. 17: USB0 and USB3 Ports Available to AppZone Application

Example 2

Tab. 14 shows the starting ports configuration of the module: #PORTCFG=8, with USB cable. Out of the six USB ports, only three ports are available for the user AppZone applications: USB0, USB3, and USB4, USB1 is reserved for TTC. Use:

m2m_hw_usb_open(USB_CH0, handle0) to disconnect USB0 port from AT0 parser, connect it to AppZone layer, and get its handle. When you use **USB_CH0**, the API try to open the USB0 port, and returns the related handle.

m2m_hw_usb_open(USB_CH3, handle3) to disconnect USB3 port from AT1 parser, connect it to AppZone layer, and get its handle. When you use **USB_CH3**, the API try to open the USB0 port, and returns the related handle.

m2m_hw_usb_open(USB_CH4, handle4) to disconnect USB4 port from AT2 parser, connect it to AppZone layer, and get its handle. When you use **USB_CH4**, the API try to open the USB0 port, and returns the related handle.

Fig. 18 shows the new configuration:

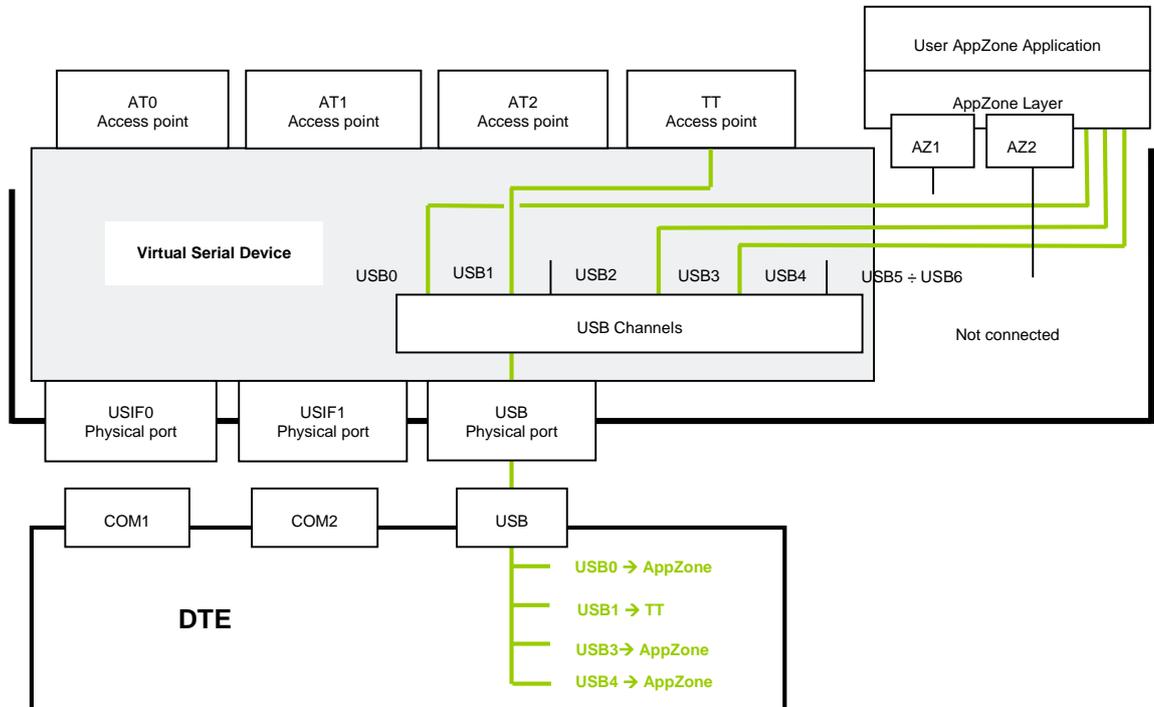


Fig. 18: USB0, USB3, and USB4 Ports Available to AppZone Application

Example 3

Tab. 14 shows the starting ports configuration of the module: #PORTCFG=8, with USB cable.

Use:

`m2m_hw_usb_ioctl(handle4, M2M_USB_AT_MODE_SET, M2M_HW_USB_IO_AT_MODE_ON)`

API to route data received from USB4 port to AT1 parser.

Fig. 19 shows the new configuration.

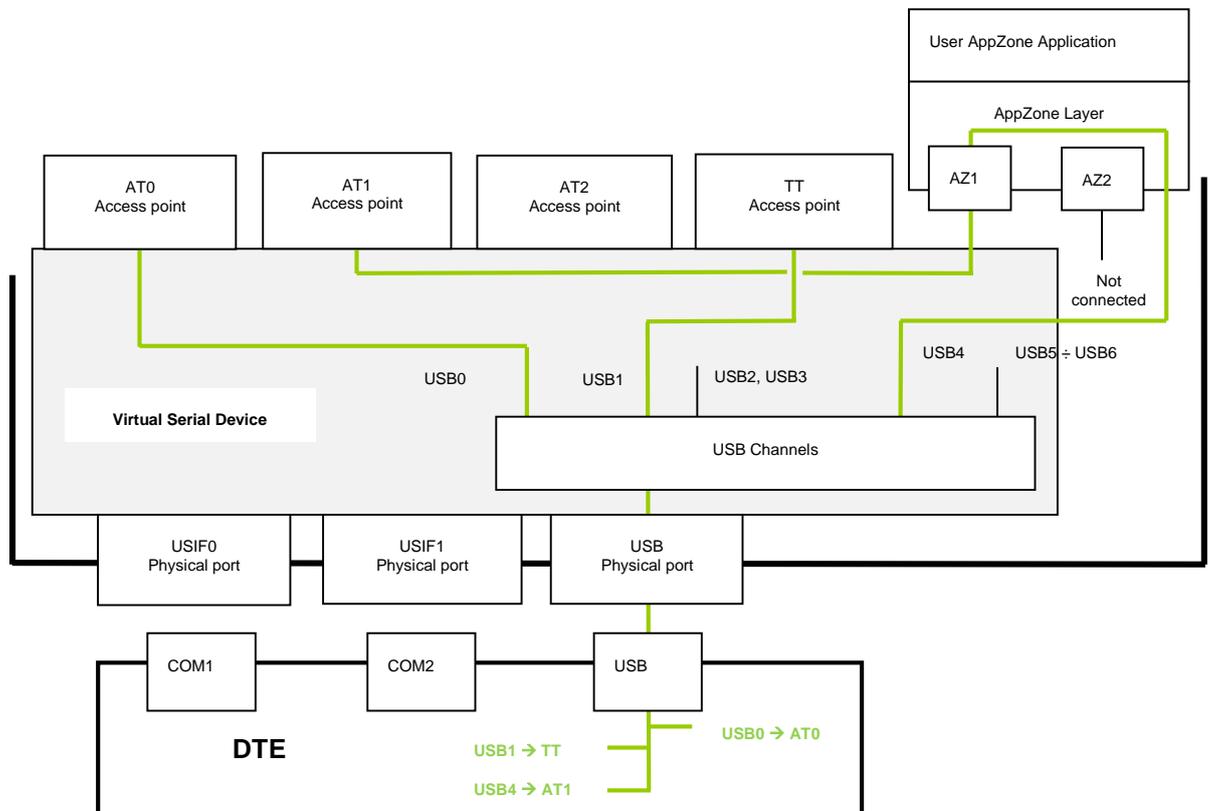


Fig. 19: USB4 Port connected to AT1

Use:

`m2m_hw_usb_read(...)` or `m2m_hw_usb_write(...)` to read or write data from/to USBx ports.

NOTICE: `m2m_hw_usb_open(...)` returns the control to the calling task only if the USB cable is connected.

7 THE WINNING CONFIGURATION

Here are two examples showing that the last port configuration set by the user overrides the previous one.

There are two ways to change module ports/services arrangement in addition to use AT#PORTCFG command:

- Plug in/out the USB cable;
- Enter the AT+CMUX=0 command.

NOTICE: Telit Serial Port MUX application sends automatically the AT+CMUX=0 command to the module, see chapter 5.

Example 1

Module: Tab. 9: #PORTCFG=0, no USB Cable summarizes module ports configuration.

User action: runs the Telit Serial Port MUX application on Windows-PC; the application connects logically Virtual Ports COM20÷COM23 to COM1.

PC: provides the required Virtual Ports. When the user starts an application (for example Hyper Terminal) connected to one of the three Virtual Ports (the fourth one is spare), Telit Serial Port MUX application sends the AT+CMUX=0 command to the module.

Module: in accordance with the received command, the involved AT Parser starts the CMUX protocol. The module enters the configuration shown on Fig. 9.

User action: now, the user connects USB cable.

Module: enters the configuration shown on Fig. 3: #PORTCFG=0 + USB Cable.

PC: provides seven new virtual “COM” connected logically to the seven USB ports. The CMUX protocol is disabled, and the Telit Serial Port MUX application running on Windows PC is no more connected to the module, it should be closed. COM1 is ready for new applications (e.g. Hyper Terminal).

User action: disconnects USB cable.

Module: enters again the configuration shown in Tab. 9: #PORTCFG=0, no USB Cable.

Example 2

Module: Tab. 9: #PORTCFG=0, no USB Cable summarizes module ports configuration.

User action: connects USB cable.

Module: in accordance with the user action, the module enters the configuration shown in Fig. 3: #PORTCFG=0 + USB Cable

PC: provides seven virtual “COM” required by USB drivers to connect logically the seven USBx ports.

User action: runs the Telit Serial Port MUX application on the Windows PC; the application connects logically Virtual Ports VCOM20 ÷ VCOM23 to USB3→COM16 port.

PC: provides the required Virtual Ports. When the user starts an application (e.g. Hyper Terminal) on a Virtual Ports, Telit Serial Port MUX sends the AT+CMUX=0 command to the module.

Module: in accordance with the received command, the involved AT Parser starts the CMUX protocol. The module enters the configuration shown in Fig. 11

User action: disconnects USB cable.

Module: enters again the configuration shown on Tab. 9: #PORTCFG=0, no USB Cable.

PC: discards the seven virtual “COM” connected logically to the seven USBx ports. The CMUX protocol is disabled, Telit Serial Port MUX application running on Windows PC is no more connected to the module, and it should be closed.

The two examples show that the last required port configuration overrides the previous one.

8 ACRONYMS & ABBREVIATIONS

ACM	Abstract Control Model
API	Application Programming Interface
DTE	Data Terminal Equipment
GNSS	Global Navigation Satellite System
MBIM	Mobile Broadband Interface Model
NA	Not Applicable
NCM	Network Control Model
NMEA	National Marine Electronics Association
PID	Product IDentifier
USIFx	Universal Serial Interface
VSD	Virtual Service Device

9 MODULES & SW VER. TABLE

SOFTWARE VER. TABLE

LE910 V2 Series	SW Versions
LE910-SV V2	20.00.000-B0xx
LE910-AU V2	20.00.100-B0xx
LE910-EU V2	20.00.400-B0xx
LE910-NA V2	20.00.500-B0xx

The table below summarizes the Services provided by the modules, and shows their coexistence. The available Service depends on the software version installed on the modules.

SERVICES COEXISTENCE TABLE

LE910 V2 Series	Services	
	External GNSS	AppZone
LE910-SV V2	✓	✓*
LE910-AU V2	✓	✓*
LE910-EU V2	✓	✓*
LE910-NA V2	✓	✓*

(*): AppZone available on demand on specific part numbers.

10 APPENDIXES

10.1 #USBCFG Modes



If you are using a Windows-PC, before plugging in the USB cable, and issuing the AT commands described in the following chapters, install the USB driver provided by Telit, see chapter 10.3.

10.1.1 #USBCFG=0

Set USB mode 0 (factory-setting).

AT#USBCFG=0

OK

Activate the just set mode

AT#REBOOT

OK

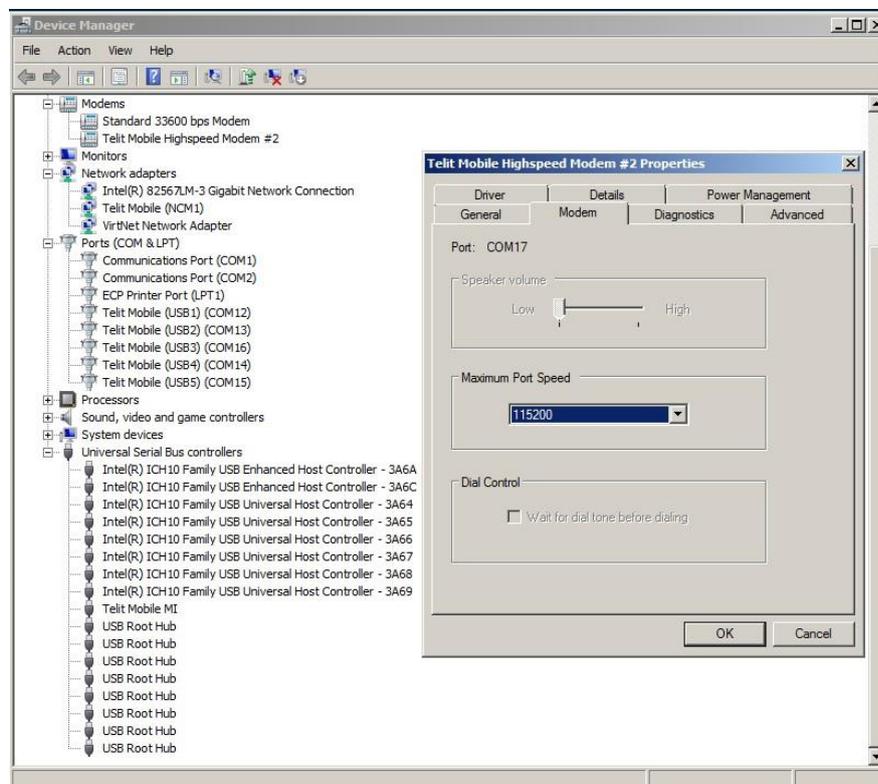
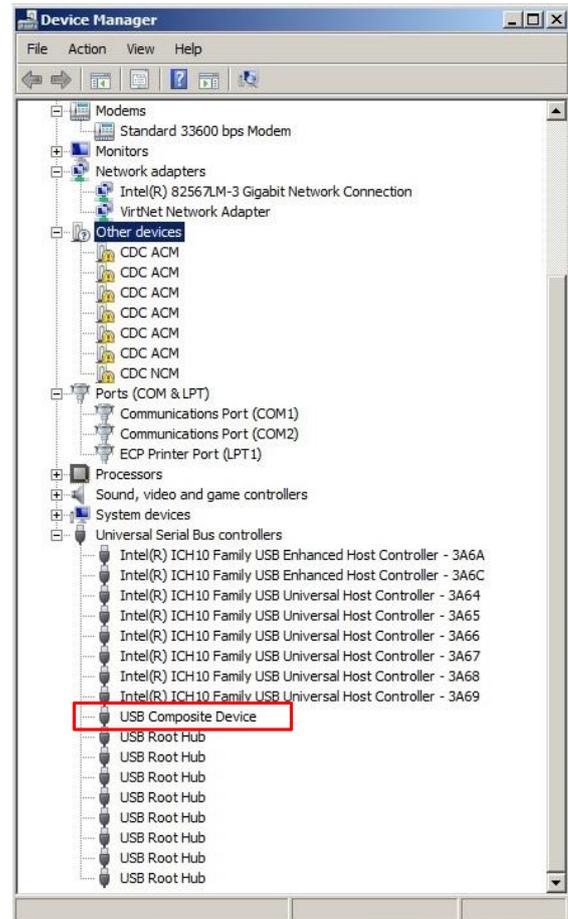


Fig. 20: #USBCFG=0

If the device driver is not installed, and you plug in the USB cable, the "Device Manager" displays the folder "Other devices". See the figure on the right, and compare it with the Tab. 3.



10.1.1.1 Ubuntu

Fig. 21 shows the message returned by the dmesg command when you plug in the USB cable. This OS uses the in-box driver, see Telit idVendor=1bc7, and idProduct=0036 (#USBCFG=0).

```
usb 1-3: New USB device found, idVendor=1bc7, idProduct=0036
usb 1-3: New USB device strings: Mfr=1, Product=2, SerialNumber=3
usb 1-3: Product: FIH7160
usb 1-3: Manufacturer: Telit
usb 1-3: SerialNumber: 351622079900102
cdc_acm 1-3:1.0: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.0: ttyACM0: USB ACM device
cdc_acm 1-3:1.2: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.2: ttyACM1: USB ACM device
cdc_acm 1-3:1.4: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.4: ttyACM2: USB ACM device
cdc_acm 1-3:1.6: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.6: ttyACM3: USB ACM device
cdc_acm 1-3:1.8: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.8: ttyACM4: USB ACM device
cdc_acm 1-3:1.10: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.10: ttyACM5: USB ACM device
cdc_ncm 1-3:1.12: MAC-Address: 00:00:11:12:13:14
cdc_ncm 1-3:1.12: setting rx_max = 16384
cdc_ncm 1-3:1.12 usb0: register 'cdc_ncm' at usb-0000:00:1a:7-3, CDC NCM, 00:00:11:12:13:14
IPv6: ADDRCONF(NETDEV_UP): usb0: link is not ready
```

Fig. 21: #USBCFG=0, Ubuntu

10.1.2 #USBCFG=1



#USBCFG=1 mode in progress.

Set USB mode 1.
AT#USBCFG=1
OK

Activate the just set mode
AT#REBOOT
OK

10.1.3 #USBCFG=2

Set USB mode 2.
AT#USBCFG=2
 OK

Activate the just set mode
AT#REBOOT
 OK

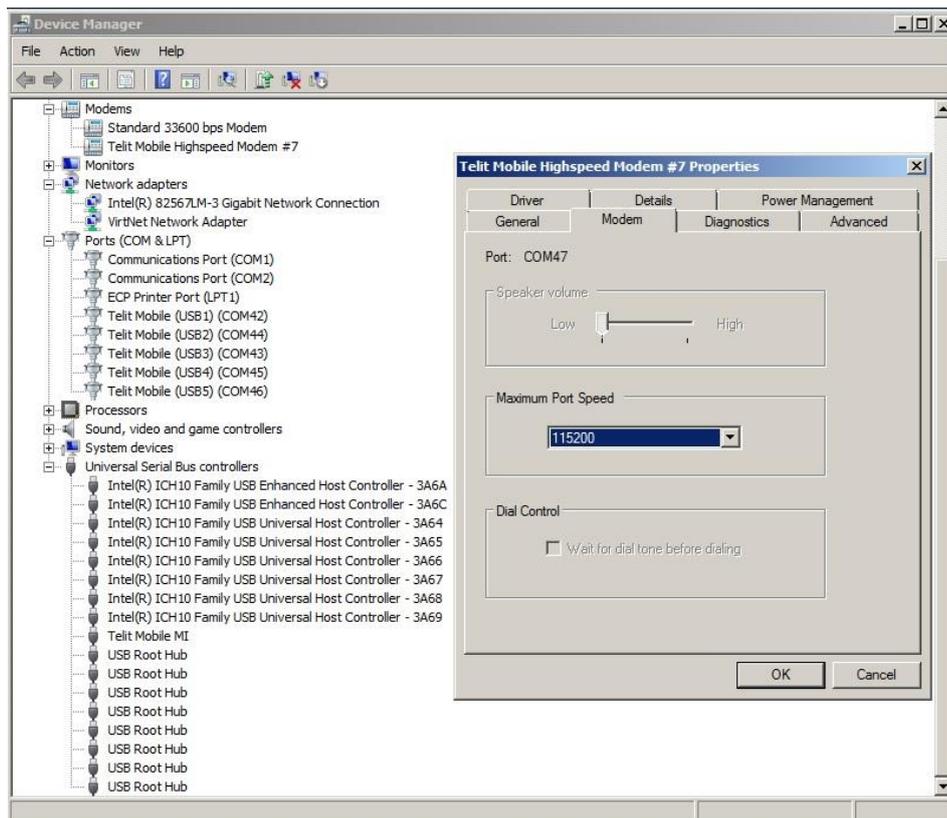
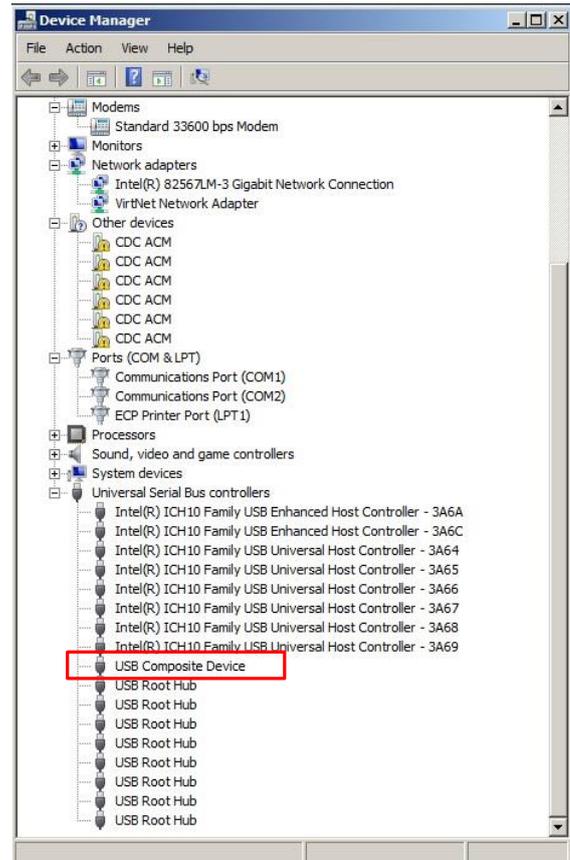


Fig. 22: #USBCFG=2

If the device driver is not installed, and you plug in the USB cable, the "Device Manager" displays the folder "Other devices". See the figure on the right, and compare it with the Tab. 3.



10.1.3.1 Ubuntu

Fig. 23 shows the message returned by the dmesg command when you plug in the USB cable. This OS uses the in-box driver, see Telit idVendor=1bc7, and idProduct=0035 (#USBCFG=2).

```
usb 1-3: New USB device found, idVendor=1bc7, idProduct=0035
usb 1-3: New USB device strings: Mfr=1, Product=2, SerialNumber=3
usb 1-3: Product: FIH7160
usb 1-3: Manufacturer: Telit
usb 1-3: SerialNumber: 351622079900102
cdc_acm 1-3:1.0: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.0: ttyACM0: USB ACM device
cdc_acm 1-3:1.2: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.2: ttyACM1: USB ACM device
cdc_acm 1-3:1.4: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.4: ttyACM2: USB ACM device
cdc_acm 1-3:1.6: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.6: ttyACM3: USB ACM device
cdc_acm 1-3:1.8: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.8: ttyACM4: USB ACM device
cdc_acm 1-3:1.10: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.10: ttyACM5: USB ACM device
```

Fig. 23: #USBCFG=2, Ubuntu

10.1.4 #USBCFG=3

Set USB mode 3.
AT#USBCFG=3
 OK

Activate the just set mode
AT#REBOOT
 OK

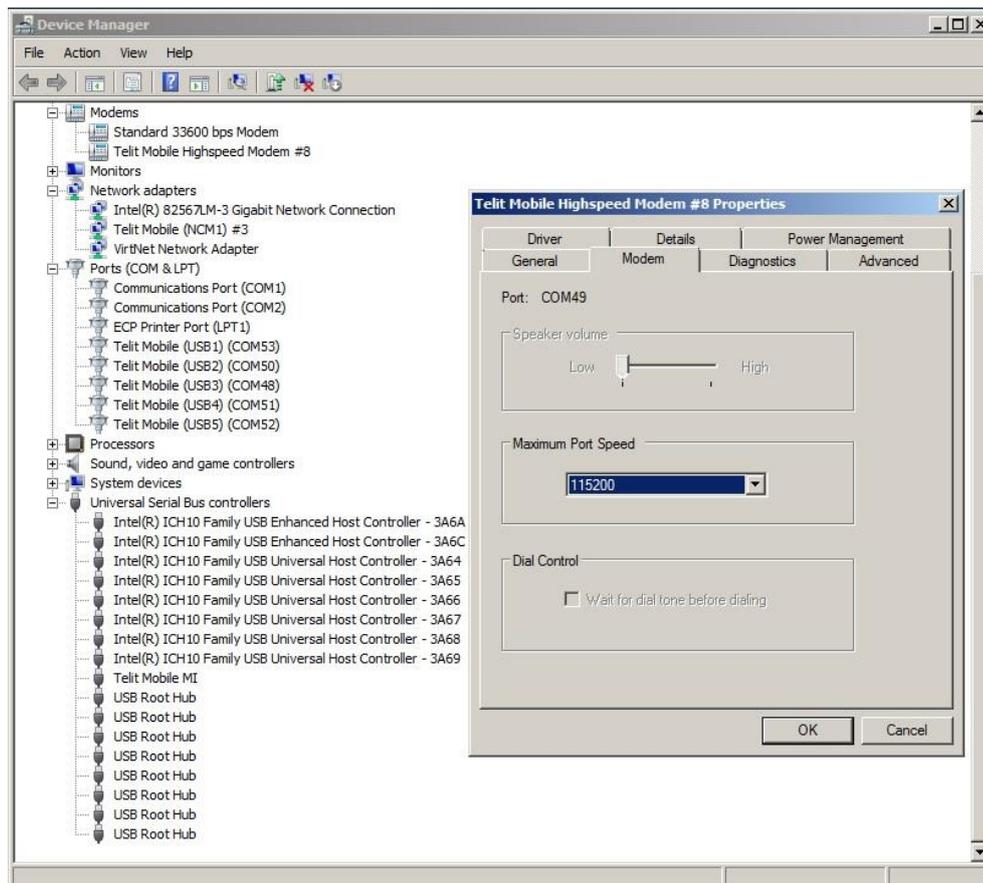
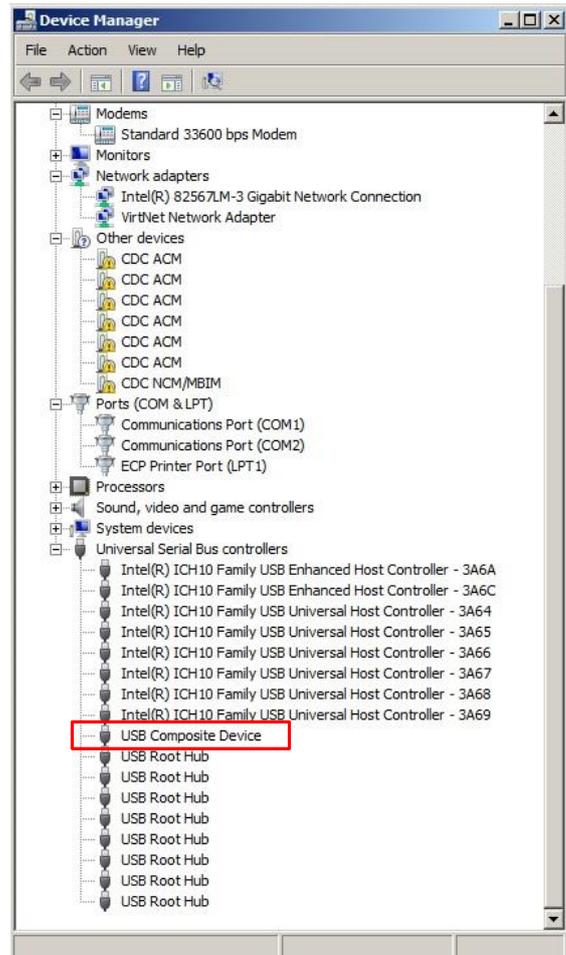


Fig. 24: #USBCFG=3

If the device driver is not installed, and you plug in the USB cable, the "Device Manager" displays the folder "Other devices". See the figure on the right, and compare it with the Tab. 3.



10.1.4.1 Ubuntu

Fig. 25 shows the message returned by the dmesg command when you plug in the USB cable. This OS uses the in-box driver, see Telit idVendor=1bc7, and idProduct=0032 (#USBCFG=3).

```

usb 1-3: New USB device found, idVendor=1bc7, idProduct=0032
usb 1-3: New USB device strings: Mfr=1, Product=2, SerialNumber=3
usb 1-3: Product: FIH7160
usb 1-3: Manufacturer: Telit
usb 1-3: SerialNumber: 351622079900102
cdc_acm 1-3:1.0: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.0: ttyACM0: USB ACM device
cdc_acm 1-3:1.2: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.2: ttyACM1: USB ACM device
cdc_acm 1-3:1.4: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.4: ttyACM2: USB ACM device
cdc_acm 1-3:1.6: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.6: ttyACM3: USB ACM device
cdc_acm 1-3:1.8: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.8: ttyACM4: USB ACM device
cdc_acm 1-3:1.10: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.10: ttyACM5: USB ACM device
cdc_mbim 1-3:1.12: setting rx_max = 16384
cdc_mbim 1-3:1.12: cdc-wdm0: USB WDM device
cdc_mbim 1-3:1.12 wwan0: register 'cdc_mbim' at usb-0000:00:1a.7-3, CDC MBIM, ee:a7:2d:7f:ce:7d

```

Fig. 25: #USBCFG=3, Ubuntu

10.1.5 #USBCFG=4

Set USB mode 4.
AT#USBCFG=4
 OK

Activate the just set mode
AT#REBOOT
 OK

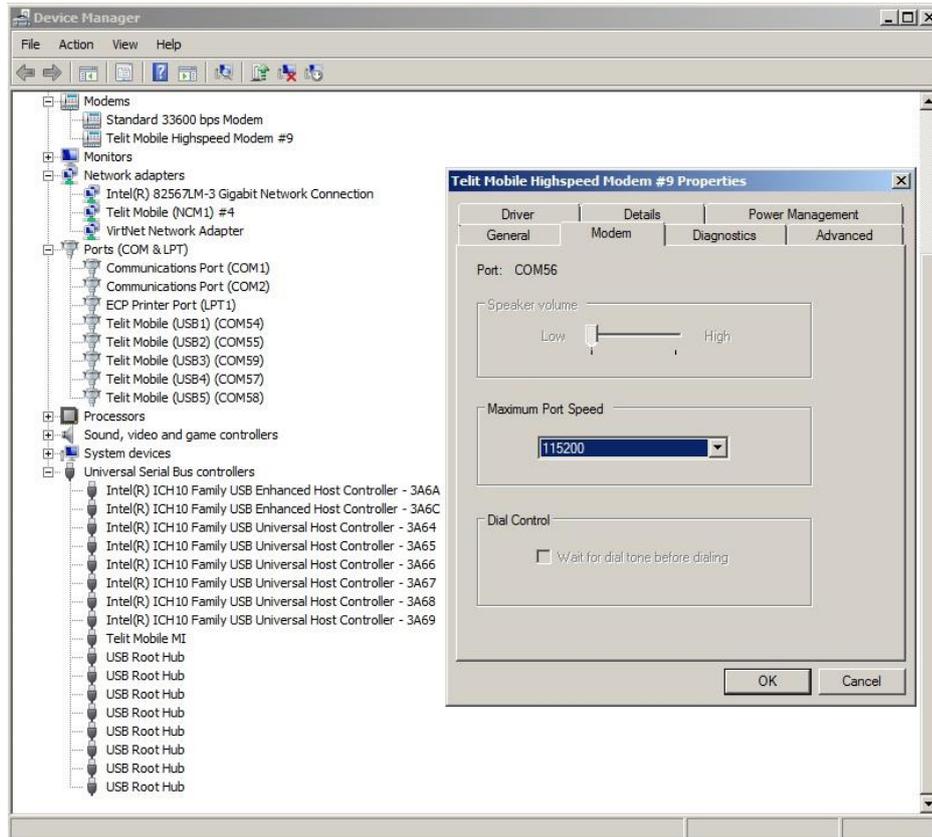
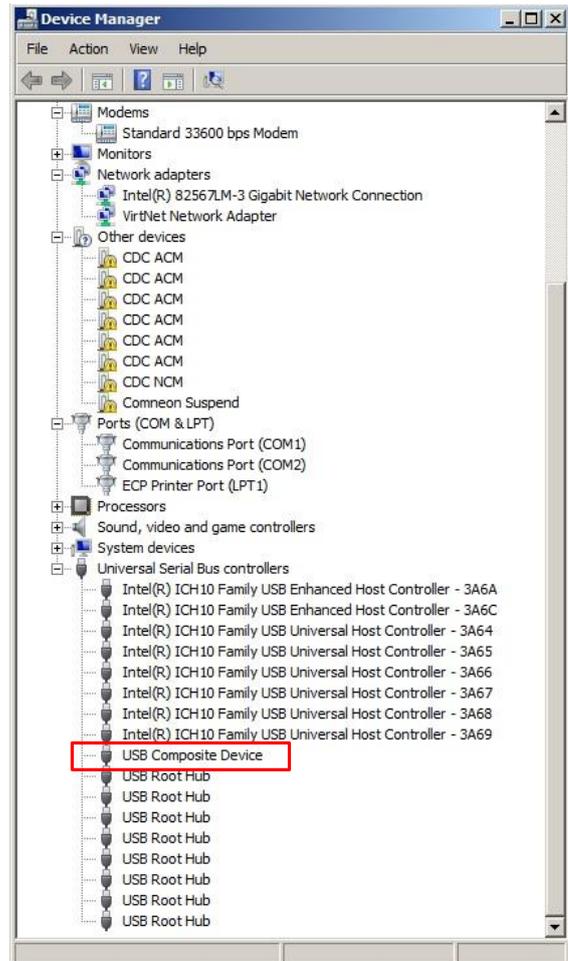


Fig. 26: #USBCFG=4

If the device driver is not installed, and you plug in the USB cable, the "Device Manager" displays the folder "Other devices". See the figure on the right, and compare it with the Tab. 3.



10.1.5.1 Ubuntu

Fig. 27 shows the message returned by the dmesg command when you plug in the USB cable. This OS uses the in-box driver, see Telit idVendor=1bc7, and idProduct=0037 (#USBCFG=4).

```

usb 1-3: New USB device found, idVendor=1bc7, idProduct=0037
usb 1-3: New USB device strings: Mfr=1, Product=2, SerialNumber=3
usb 1-3: Product: FIH7160
usb 1-3: Manufacturer: Telit
usb 1-3: SerialNumber: 351622079900102
cdc_acm 1-3:1.0: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.0: ttyACM0: USB ACM device
cdc_acm 1-3:1.2: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.2: ttyACM1: USB ACM device
cdc_acm 1-3:1.4: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.4: ttyACM2: USB ACM device
cdc_acm 1-3:1.6: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.6: ttyACM3: USB ACM device
cdc_acm 1-3:1.8: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.8: ttyACM4: USB ACM device
cdc_acm 1-3:1.10: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.10: ttyACM5: USB ACM device
cdc_ncm 1-3:1.13: MAC-Address: 00:00:11:12:13:14
cdc_ncm 1-3:1.13: setting rx_max = 16384
cdc_ncm 1-3:1.13 usb0: register 'cdc_ncm' at usb-0000:00:1a:7-3, CDC NCM, 00:00:11:12:13:14
IPv6: ADDRCONF(NETDEV_UP): usb0: link is not ready

```

Fig. 27: #USBCFG=4, Ubuntu

10.1.6 #USBCFG=5

Set USB mode 5.
AT#USBCFG=5
 OK

Activate the just set mode
AT#REBOOT
 OK

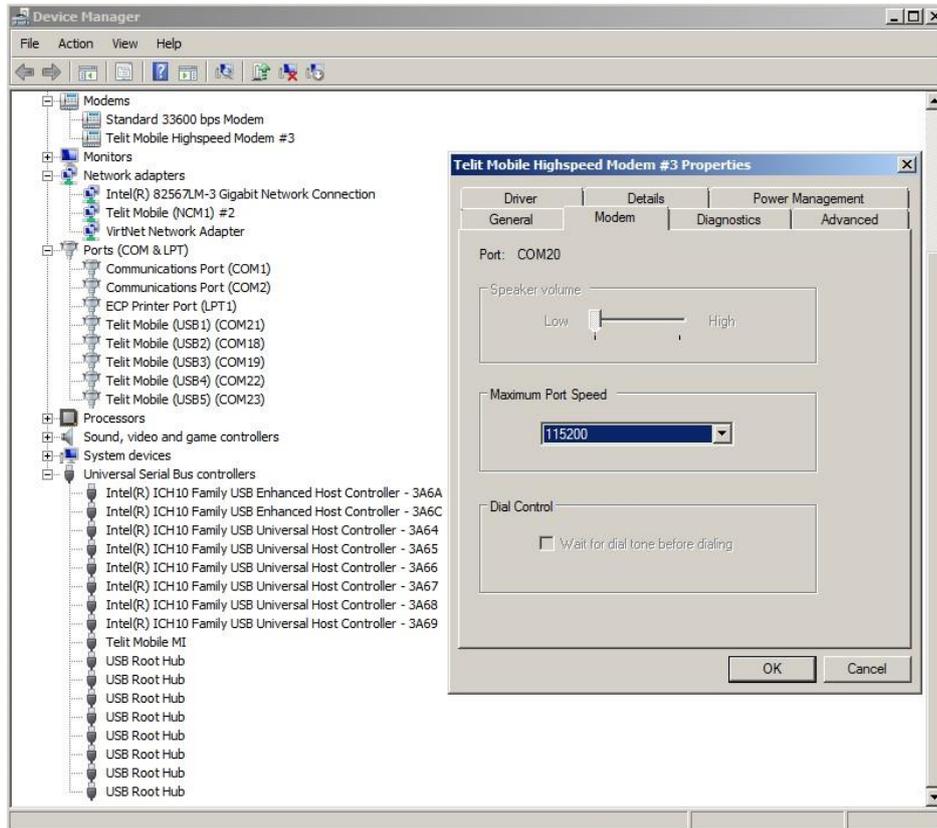
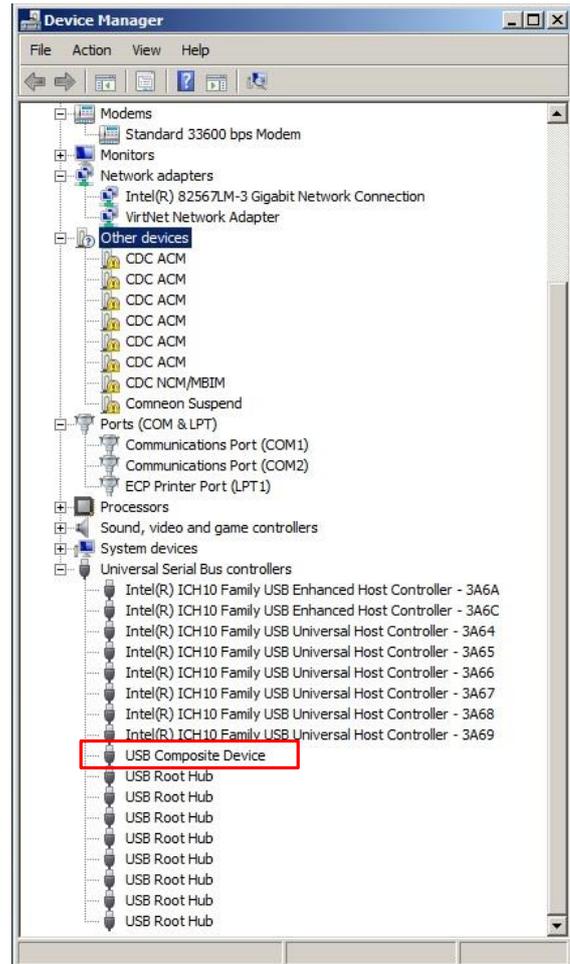


Fig. 28: #USBCFG=5

If the device driver is not installed, and you plug in the USB cable, the "Device Manager" displays the folder "Other devices". See the figure on the right, and compare it with the Tab. 3.



10.1.6.1 Ubuntu

Fig. 29 shows the message returned by the dmesg command when you plug in the USB cable. This OS uses the in-box driver, see Telit idVendor=1bc7, and idProduct=0033 (#USBCFG=5).

```
usb 1-3: New USB device found, idVendor=1bc7, idProduct=0033
usb 1-3: New USB device strings: Mfr=1, Product=2, SerialNumber=3
usb 1-3: Product: FIH7160
usb 1-3: Manufacturer: Telit
usb 1-3: SerialNumber: 351622079900102
cdc_acm 1-3:1.0: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.0: ttyACM0: USB ACM device
cdc_acm 1-3:1.2: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.2: ttyACM1: USB ACM device
cdc_acm 1-3:1.4: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.4: ttyACM2: USB ACM device
cdc_acm 1-3:1.6: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.6: ttyACM3: USB ACM device
cdc_acm 1-3:1.8: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.8: ttyACM4: USB ACM device
cdc_acm 1-3:1.10: This device cannot do calls on its own. It is not a modem.
cdc_acm 1-3:1.10: ttyACM5: USB ACM device
cdc_mbim 1-3:1.13: setting rx_max = 16384
cdc_mbim 1-3:1.13: cdc-wdm0: USB WDM device
cdc_mbim 1-3:1.13 wwan0: register 'cdc_mbim' at usb-0000:00:1a.7-3, CDC MBIM, ee:a7:2d:7f:ce:7d
```

Fig. 29: #USBCFG=5, Ubuntu

10.2 USB Interfaces & Endpoints

The target of this chapter is to provide a short overview of USB interfaces and endpoints.

Referring to Fig. 30.

Endpoints

Each USB device has a number of endpoints. Each endpoint is a source or sink of data. In general, a device can have up to 16 out and 16 in endpoints. Out always means from host (for example, Windows-PC) to device (module). In always means from device to host.

Endpoint 0 is a special case, which is a combination of endpoint 0 out and endpoint 0 in (EP0), and is used for controlling the device.

Pipe

A logical data connection between the host and a particular endpoint.

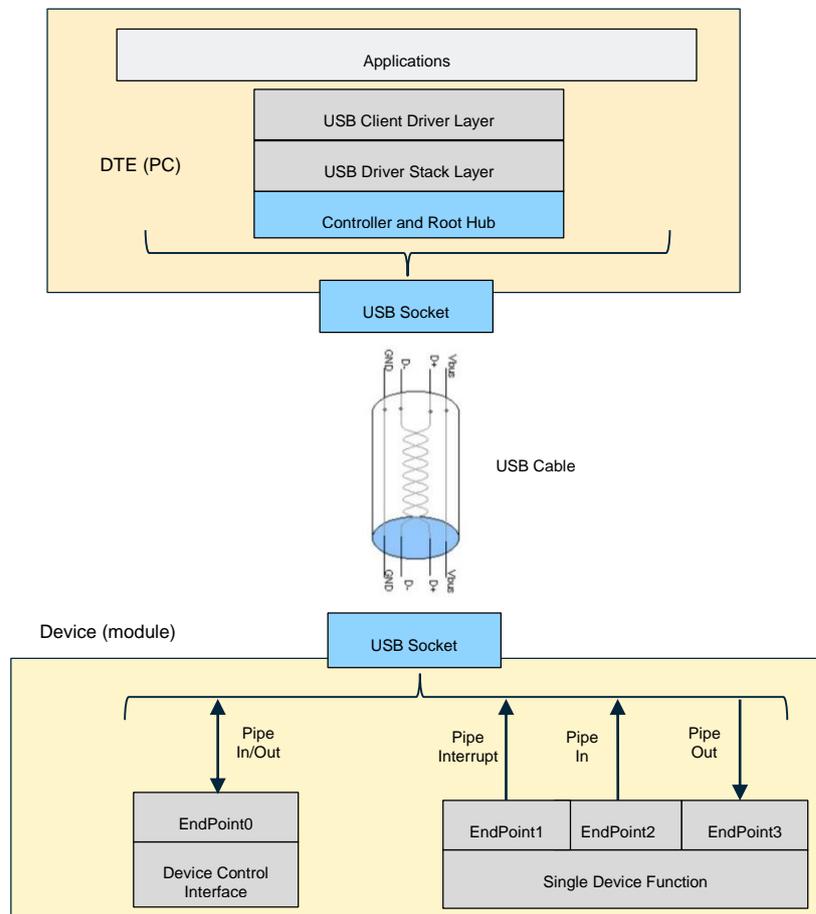


Fig. 30: USB Interfaces & Endpoints

10.3 USB Driver

Telit provides the USB driver to install on Windows-PC. Before installing the driver, it is suggested to remove the old one, if present. To verify if the right USB driver has been installed check its Vendor Identifier and the Product Identifier by means of the Windows Device Manager, see the screenshot below.

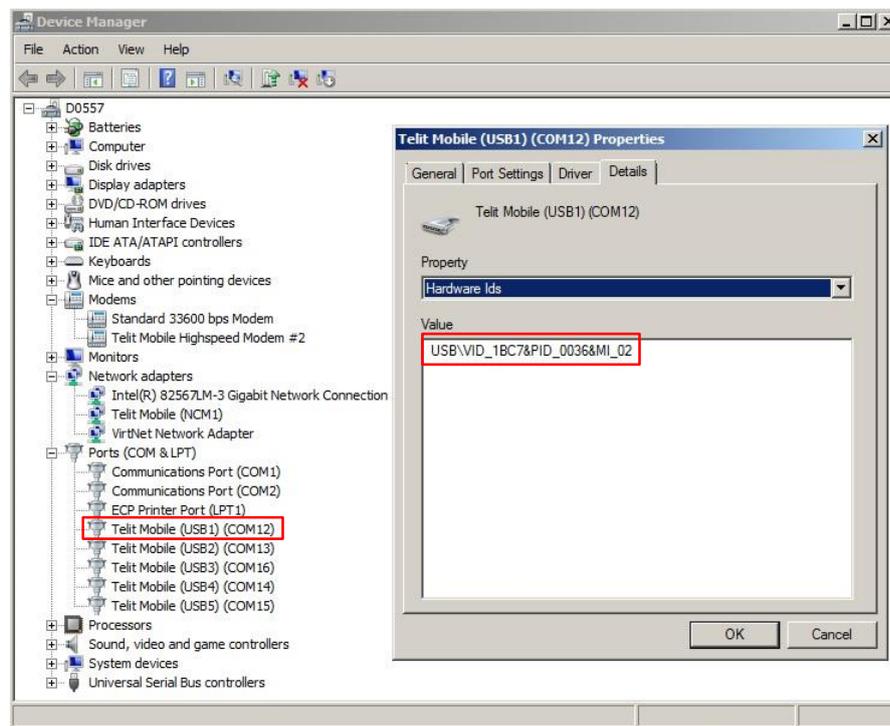


Fig. 31: Vendor Identifier & Product Identifier

- Telit Vendor Identifier is 1BC7.
- Product Identifier depends on the #USBCGF mode, refer to Tab. 3

10.3.1 Ubuntu

With Ubuntu, the USB device (module) uses the in-box drivers. It means that no Telit's USB driver is needed. To get Telit Vendor Identifier and Product Identifier in Ubuntu environment use the command `dmesg` as shown in sub-chapters of the chapter 10.1. To have more information refer to document [4].

11 DOCUMENT HISTORY

Revision	Date	Changes
0	2016-02-10	First issue

