LE910 V2, LE910 Cat1
NCM PROTOCOL
USER GUIDE

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TELIT
TECHNICAL
DOCUMENTATION

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Applicability Table

PRODUCTS

	Platform Version ID[1]	Technology
🟥🟨 LE910 Cat1 SERIES	20	4G
🟥🟨 LE910 V2 SERIES		

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[1] Platform Version ID is a reference used in the document. It defines the different SW versions, e.g. 13 for SW version 13.xx.xxx, 20 for software version 20.xx.xxx, etc.

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1 INTRODUCTION

1.1 Scope

This document provides a guideline to configure a Telit module and the connected PC to run the NCM protocol on the USB port used to connect the devices.

1.2 Audience

This user guide is addressed to those users who need to develop an application running Ethernet frames on the USB port used to connect Telit module and PC.

1.3 Contact Information, Support

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- 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:

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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 LE910 V2 Series AT Command Reference Guide, 80446ST10707A
[2]   LE910 V2 Hardware User Guide, 1vv0301200
[3]   LE910 V2, LE910 Cat1 Ports Arrangements user Guide, 1vv0301252

2 PRELIMINARY INFORMATION

The Network Control Model (NCM) is a protocol by which USB hosts and devices can efficiently exchange Ethernet frames. Ethernet frames may convey IPv4 or IPv6 datagrams that are transported over communication networks. NCM is used with high-speed modules such as LTE.

This guide describes the NCM configuration procedures regarding the:

- modules indicated in the Applicability Table.
- operating systems listed below, that may be run on the DTE (PC) connected to the module.

  - Windows 7, 64-bit

  - Ubuntu 14.04, 64-bit

Once the module and PC are configured to work with the NCM protocol, and the connection between the module and carriers is established, the data exchange occurs like any other network adaptor.

⚠️ Refer to documents [1], [2], and [3] to have information respectively on:
- AT commands syntax and related parameters
- Serial and USB ports
- #PORTCFG configurations, USB driver PIDs, and #USBCFG modes.

---

3 NCM ON WINDOWS 7

3.1 NCM Driver Installation

Telit provides the NCM driver to install on Window-PC. Before installing the new driver, it is suggested to remove the old one, if any. To verify the PIDs of the installed driver refer to document [3].

After driver installation, plug the USB cable in the USB socket of the module. The figures below show an example of USBx/COMx ports mapping. The mapping depends on the Windows-PC configuration. Fig 2 shows the Telit Mobile (NCM1) adapter under the "Network Adapters" folder.

Fig 1: Telit Modules #2 Properties

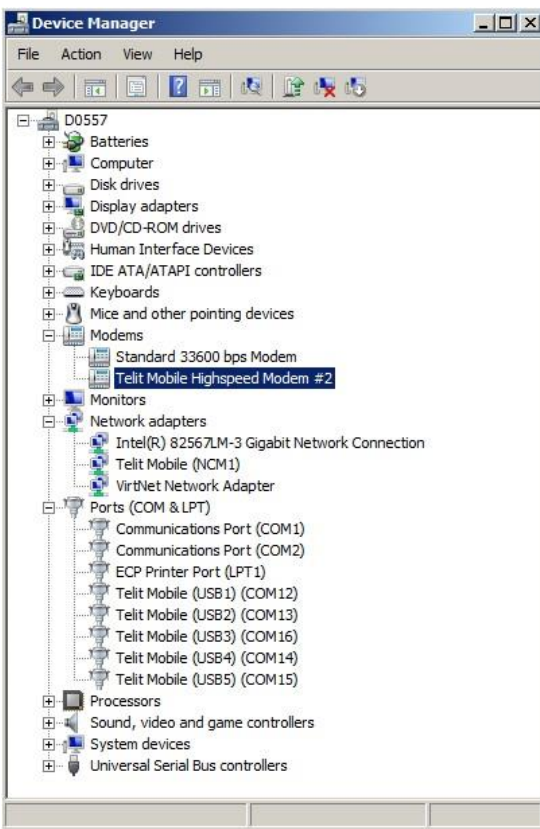Fig 2: Device Manager
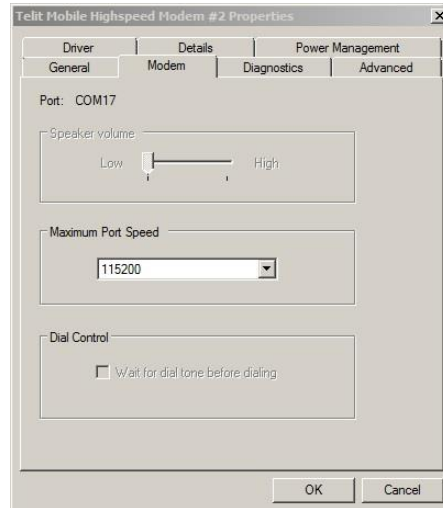
Just stating how the ports map, Telit Mobile Highspeed Modem # 2 is connected to COM17 port, which is mapped to USB0 port, as shown in Fig 2. Tab. 1 summarizes the USBx/COMx mapping.

USB PORTS	VIRTUAL PORTS
USB0	COM17
USB1	COM12
USB2	COM13
USB3	COM16
USB4	COM14
USB5	COM15

Tab 1: USBx/COMx Mapping Table

3.2 IPV4 Protocol

3.2.1 NCM Activation on the Module

Assume that the module is using the default #PORTCFG=0 configuration, and the default #USBCFG=0 mode. Refer to document [2] to have detailed information on available port configurations and modes supporting NCM protocol. Execute the following steps:

- Plug in the USB cable.
- Run the AT Telit Terminal tool on Windows-PC. Connect the module to the COM17 port, which is mapped to the USB0 port.
- Enter the AT#PORTCFG=? Test command.

Test command returns, for each Variant value, a short description on the logical connection regarding physical serial ports/USBx ports and access points (AT parser instances, Trace), see below:

```
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:   not supported by this product
#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
```

NCM protocol can be used on every USBx port connected to an AT parser, in accordance with the current #USBCFG mode. In #PORTCFG=0 configuration, NCM protocol can be used on USB0 or USB3 port, see the response of the Test command. In this example is used COM17, therefore the USB port is USB0, see Tab 1. Telit provides the TMB tool to activate/deactivate easily the NCM protocol, see chapter 5.1.

Check the current #PORTCFG configuration:
AT#PORTCFG?
#PORTCFG: 0,0   ← #PORTCFG=0 is the default configuration.
OK

Check the current #USBCFG configuration mode:
AT#USBCFG?
#USBCFG: 0   ← #USBCFG=0 is the default configuration mode. It supports NCM protocol.

OK

Check if the SIM is inserted and PIN is unlocked
AT+CPIN?
+CPIN: READY
OK

Check on which Network Operator the module is registered.
AT+COPS?
+COPS: 0,0,"network operator",7
OK

Check if the module is GPRS attached.
AT+CGATT?
+CGATT: 1
OK

Set PDP context using, for example, these parameters values: cid = 4, protocol type is "IP", APN is provided by your Network Operator. NCM protocol can be assigned to one of any available cid.

AT+CGDCONT=4,"IP","APN"
OK

Just to be sure to use the module to access the network by means of the USB cable and the carriers, assume that the Windows-PC is not connected to Internet. Its cable is disconnected, and Internet is not accessible.

Left-click on system icon, the PC displays the dialog box below that shows the current network status.
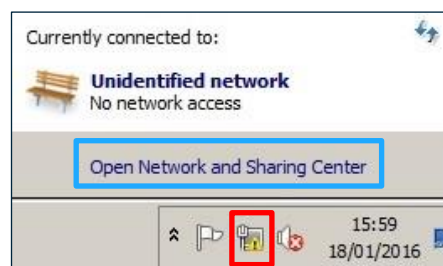
Left-click on "Open Network and Sharing Center", the PC display the following dialog box.

Left-click on "Change adapter settings", the PC displays the following dialog box.
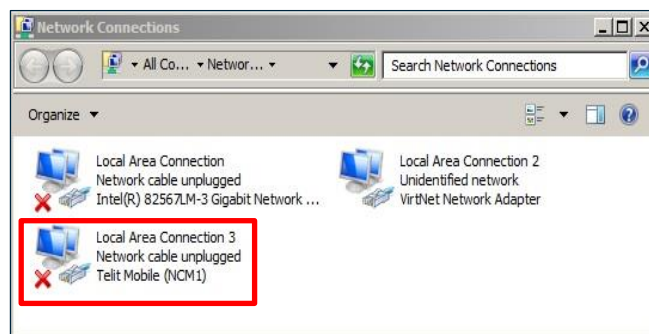
The USB cable is connected, but NCM protocol is not active. Now, you can select one of the following options[2] to perform all the necessary actions to activate the NCM protocol.

Option 1:

Assign NCM protocol to cid=4
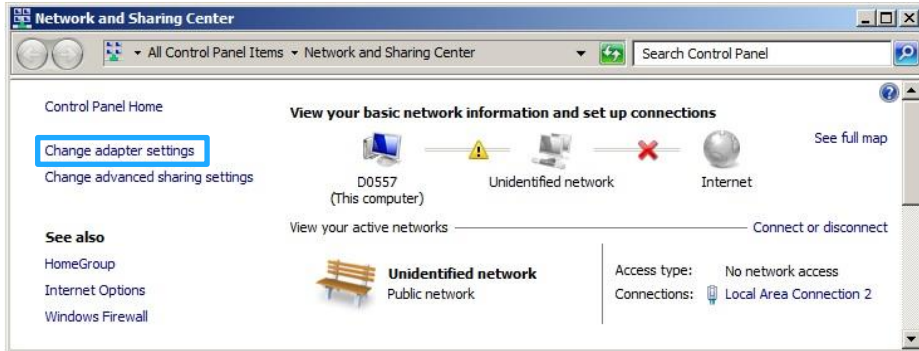**AT#NCM=1,4**
OK

Activate PDP context identified by cid=4
AT+CGACT=1,4
OK

Activate the NCM protocol
AT+CGDATA="M-RAW_IP",4
CONNECT
OK

Option 2:

Assign NCM protocol to cid = 4, activate PDP context and NCM protocol.
AT#NCM=2,4
OK

---

[2] Modules equipped with an old software version, support only the option 1, and do not provide the #NCM command with User Name and Password.

Option 3:

Use this #NCM format when the network requires User Name and Password. Assign NCM protocol to cid = 4, activate PDP context and NCM protocol.
AT#NCM=2,4,0,"User Name", "Password"
OK

Assume that one of the three option has been used. The PC tries the connection, but the Telit Mobile (NCM1) Network Interface is not still set with the right addresses provided by the module. Therefore, after a while the PC shows that the connection is failed by means of the [icon] system icon, left-click on the icon to display the dialog box below.
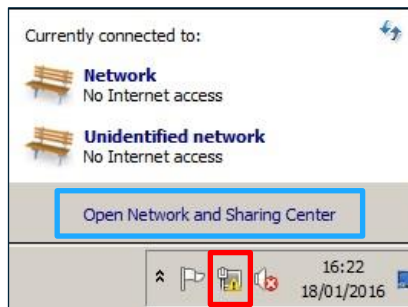
Left-click on "Open Network and Sharing Center", the PC display the following dialog box.
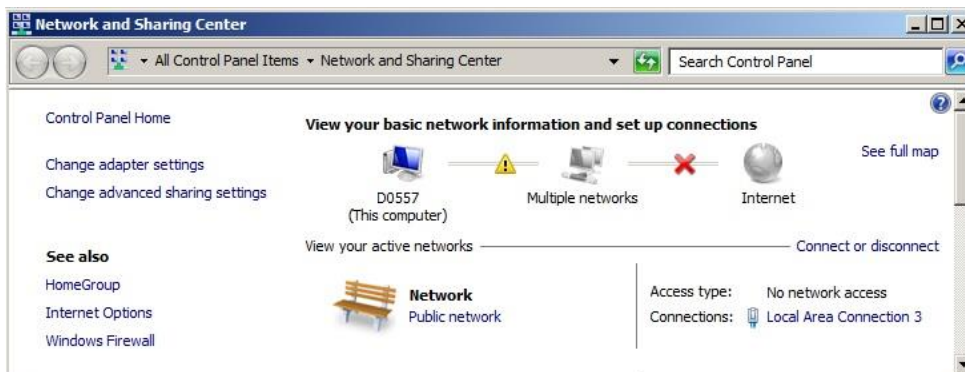
Left-click on "Change adapter settings", the PC displays the following dialog box.
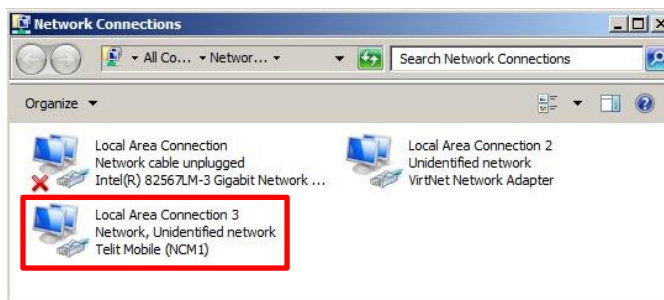
Fig 3: Network Connections

Use the following two commands to get ==IP address==, ==Gateway address==, and ==DNS address==. Type in the commands using <cid>=4 (the same value used with AT+CGDCONT). After getting the addresses use them to configure the Telit Mobile (NCM1) Network Interface, see chapter 3.2.2.

AT+CGPADDR=4
+CGPADDR:
4,
"==10.162.34.196=="   ← IP address
OK

AT+CGCONTRDP=4
+CGCONTRDP:
4,
6,
"string from network",
"==10.162.34.196==.255.0.0.0",   ← IP address
"==10.162.34.197==",   ← Gateway address
"==10.207.43.46==",   ← DNS address
"0.0.0.0",
"0.0.0.0",
"0.0.0.0"
OK

3.2.2   PC Network Interface Configuration

You must configure the network interface.

Referring to Fig 3, select the Telit Mobile (NCM1) and double-click on it. The PC shows the dialog box on the right. Then click on Properties button, the PC displays the dialog box shown in Fig 4.
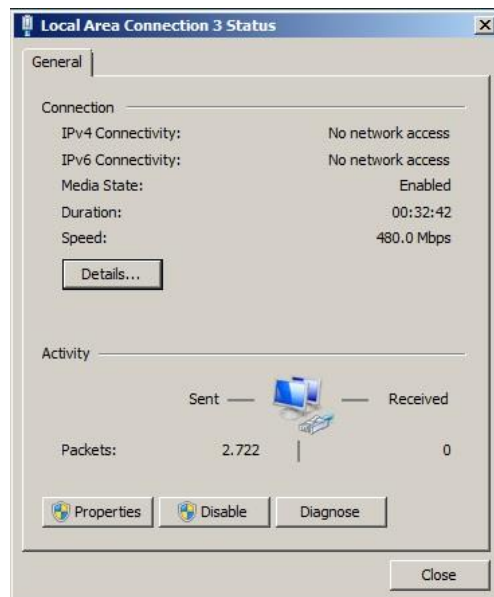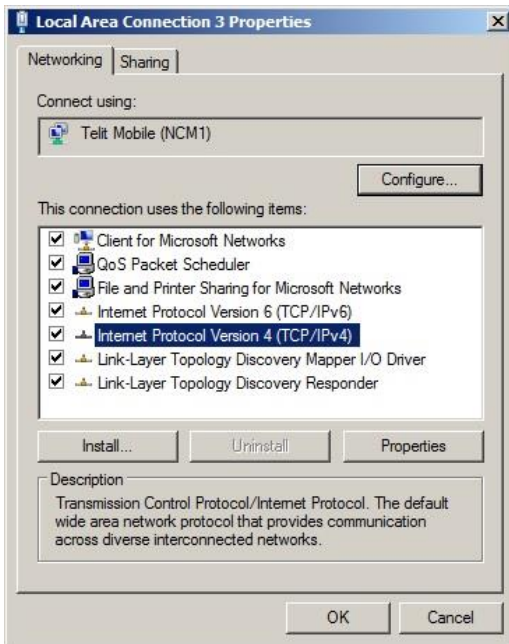
Fig 4: Local Area Connection 3

Referring to

Fig 4: select Internet Protocol Version 4 (TCP/IPv4) and double-click on it.

Refering to Fig 5: set manually the addresses returned by +CGPADDR and +CGCONTRDP commands, see chapter 3.2.1:

- IP address
- Gateway address
- DNS address

After clicking OK button, the PC tries the connection, but the Telit Mobile (NCM1) Network Interface is not still completely configured. Therefore, after a while the PC shows that the connection is failed by means of the system icon.

Open the Command Prompt, and enter the following netsh commands for Interface Internet Protocol version 4 (IPv4), see Fig 6 below.
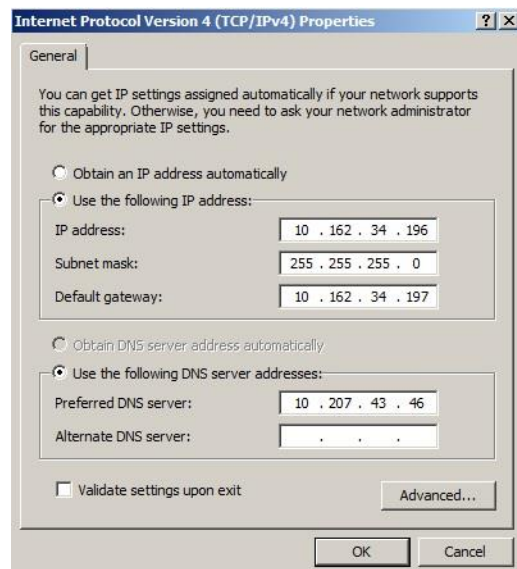
Fig 5: IP Setting

Clear the ARP cache.
netsh interface ip delete arpcache

Specify an entry in the neighbor cache using the following parameters:
- the interface name is that shown in : Local Area Connection 3
- the Gateway address is that returned by +CGCONTRDP command: 10.162.34.197

netsh interface ip add neighbor "Local Area Connection 3" 10.162.34.197 11-22-33-44-55-66

Fig 6: netsh and ping Commands

After entering the last netsh interface ip commands, the Window-PC tries again the connection. If the connection is successful, the PC displays the dialog box on the right.
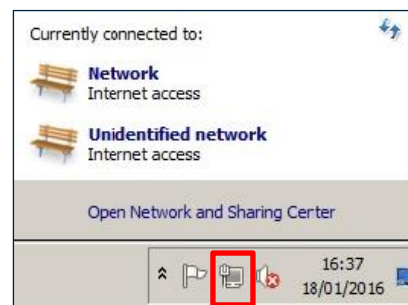
To verify the NCM protocol, run the ping command using the address of an available server (for example, the primary DNS of Google), see Fig 6.
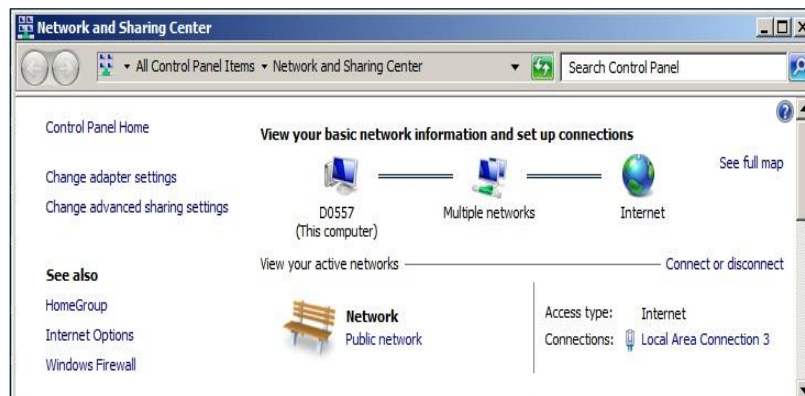
The red **X** indicates that the network cable is disconnected, as assumed in chapter 3.2.1.
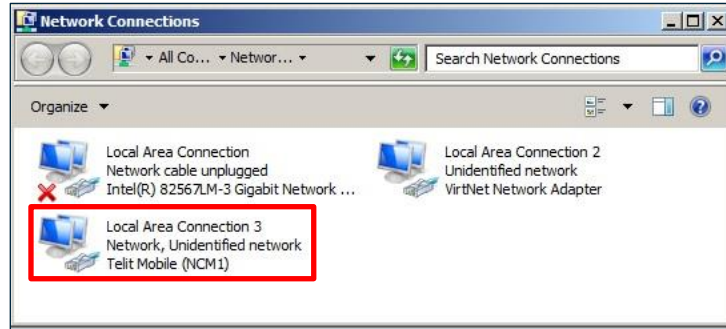
3.2.3 NCM Deactivation

As stated in chapter 3.2.1, the module is using the default #PORTCFG=0 configuration, therefore the available USB port connected to an AT parser are USB0 and USB3. In this example, the NCM protocol was activated on USB0 port.

The AT parser connected to USB0 port is always available, therefore you can continue to issue AT commands on this port regardless if the NCM protocol is activated or not. To deactivate the NCM protocol on the used USB port, enter one of the next AT commands, in accordance with the software version of your module, as stated in chapter 3.2.1.

Option 1:

AT+CGATT=0
OK
NO CARRIER

Option 2:

AT#NCMD=0
OK
NO CARRIER

After entering one of the two commands, the Windows-PC displays the dialog boxes on the right. The NCM protocol is deactivated.
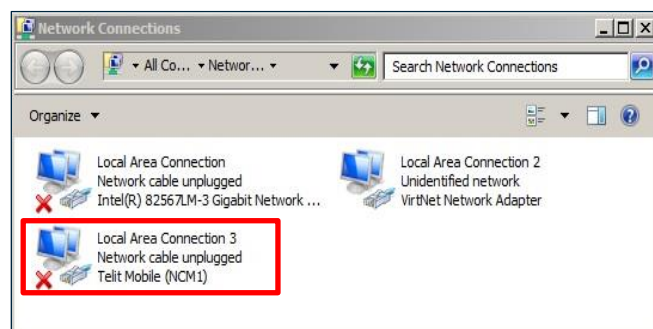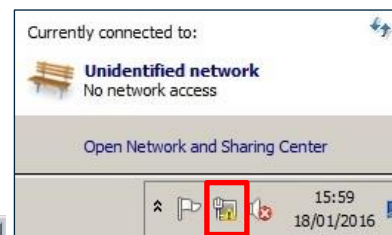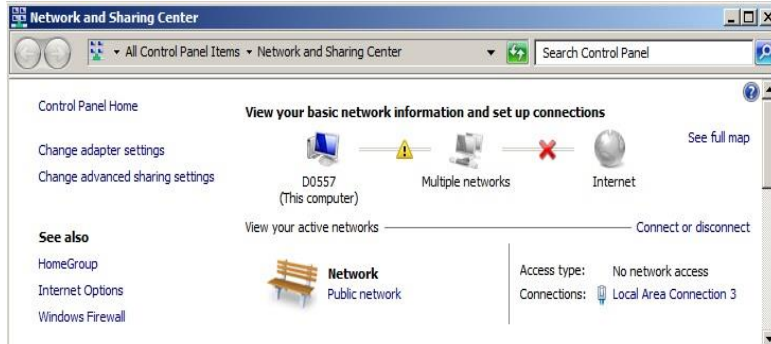
3.3 IPv4/IPv6 Dual Stack

Unlike in IPv4, the network does not assign an IPv6 address to a module. In IPv6 a router advertises an **IPv6 prefix** and each device receiving the advertising packet can choose its own network identifiers (**IPv6 Interface ID**) that are the second part of a full IPv6 address.

Full IPv6 address = **IPv6 prefix** + **IPv6 Interface ID**

To get an IPv6 prefix from the network the module requests an IPv6 or IPv4v6 default bearer. It is also necessary to get an **IPv6 DNS Server address** to perform domain name resolution.

To activate the bearer, the network then assigns an IPv4 address and **IPv6 prefix** and instructs the module to establish an LTE bearer with the suitable message. The message contains the **IPv6 Interface ID** and the **DNS Server IPv6 address**.

3.3.1 NCM Activation on the Module

Check the current #PORTCFG configuration.
AT#PORTCFG?
#PORTCFG: 0,0   ← #PORTCFG=0 is the default configuration.
OK

Check the current #USBCFG configuration mode.
AT#USBCFG?
#USBCFG: 0   ← #USBCFG=0 is the default configuration mode. It supports NCM
protocol.
OK

Configure the PDP context identified by cid=3. "IPV4V6" parameter (Packet Data Protocol type) sets dual stack (the module requests both IPv4 and IPv6 connectivity).
"Access_Point_Name" is the Access Point Name provided by the Network Operator.
AT+CGDCONT=3,"IPV4V6","Access_Point_Name"
OK

Now, you can select one of the following options to perform all the necessary actions to activate the NCM protocol.

Option 1:

Assign NCM protocol to cid=3
AT#NCM=1,3
OK

Activate PDP context identified by cid=3
AT+CGACT=1,3
OK

Select in which format the IPv6 address is displayed.
AT+CGPIAF=1,1,1,1
OK

Activate the NCM protocol
AT+CGDATA="M-RAW_IP",3
CONNECT
OK

Option 2:

Assign NCM protocol to cid = 3, activate PDP context and NCM protocol.
AT#NCM=2,3
OK

Option 3:

Use this #NCM format when the network requires User Name and Password. Assign NCM protocol to cid = 3, activate PDP context and NCM protocol.
AT#NCM=2,3,0,"User Name", "Password"
OK

After using one of the above options, use the following two AT commands to get the information about IP addresses (the items are described on the right side, and underlined with different colors). Type in the commands using cid=3 (the same value used with +CGDCONT).

> The example below was performed with a devices connections configuration using private IP addresses (192.168.X.X). It is highlighted that the same procedure is also valid for a devices connections configuration using public IP addresses.

When dual stack capabilities are used, the command returns IPv4 and IPv6 information assigned by the Network Operator.
AT+CGPADDR=3
+CGPADDR:
3,
"192.168.1.31",   ← IPv4 Address
"FE80::1:1:B836:FCF3"   ← PDN IPV6 interface ID
OK

When dual stack capabilities are used, the command returns the following information divided in two groups: one for IPv4, and one for IPv6.
AT+CGCONTRDP=3
+CGCONTRDP:
3,   ← cid identifier
6,   ← bearer identifier
"Access_Point_Name",   ← Access Point Name
"192.168.1.31.255.255.255.0", ← IP Address and subnet mask for IPv4

"192.168.1.32",   ← Gateway Address
"192.168.1.32",   ← DNS primary Address
"192.168.1.42",   ← DNS secondary Address
"0.0.0.0",   ← Primary P-CSCF server Address
"0.0.0.0"   ← Secondary P-CSCF server Address

+CGCONTRDP:
3,
6,
"Access_Point_Name",
"FE80::1:1:B836:FCF3/64",   ← PDN IPV6 interface ID
"..",
"2001:0:0:3::2",   ← IPV6 DNS address
"..",
"..",
".."
OK

3.3.2   PC Network Interfce Configuration (IPv4)

To know the current network status of the PC, left-click on system icon. The PC displays the dialog box on the right side. Left-click on "Open Network and Sharing Center", the PC displays the dialog box below.
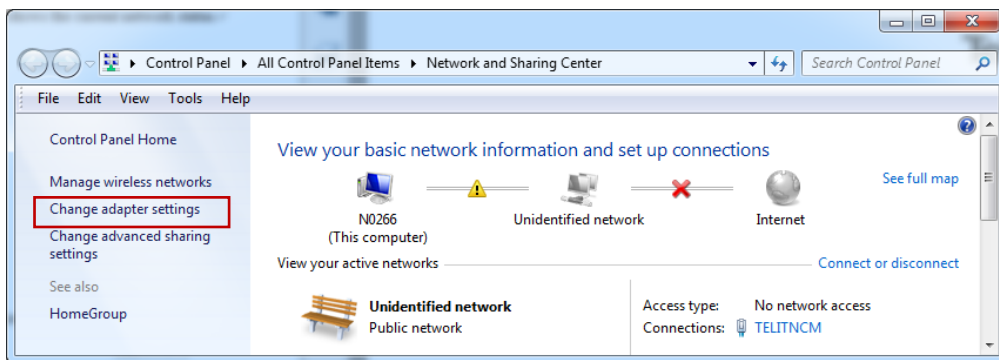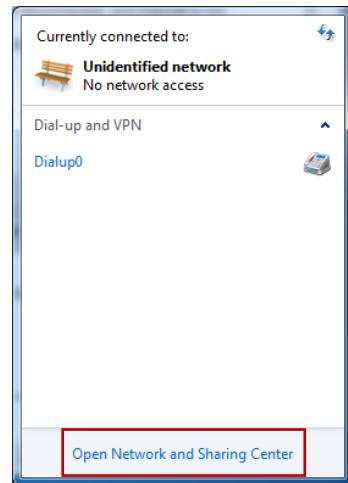
As shown by the dialog box the NCM connection has been named "TELITNCM". Left-click on "Change adapter settings", the PC displays the following dialog box.
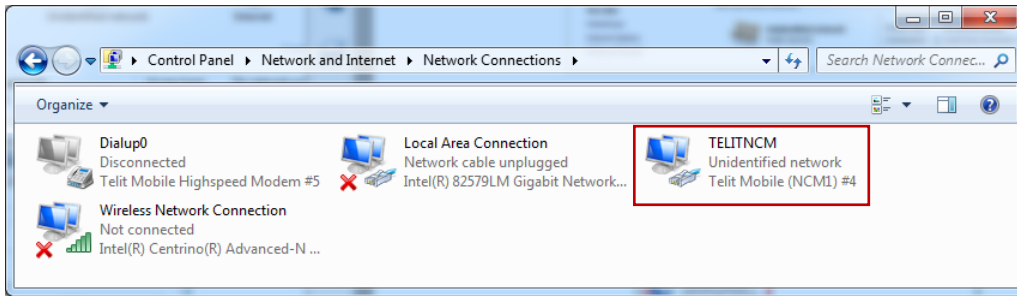
Right-click on "TELITNCM" Unidentified network Telit Mobile (NCM1), and select "Properties". The PC displays the following dialog box shown on right side.

Select "Internet Protocol Version 4 (TCP/IP)", then press the button "Properties", the PC displays the dialog box shown below.

Now, use the IPv4 addresses displayed with **AT+CGPADDR=3** and **AT+CGCONTRDP=3** to configure the Telit Mobile (NCM1) Network Interface.

IP address: 192.168.1.31
Sub net mask   255.255.255.0
Gateway address: 192.168.1.32
DNS address: 192.168.1.42
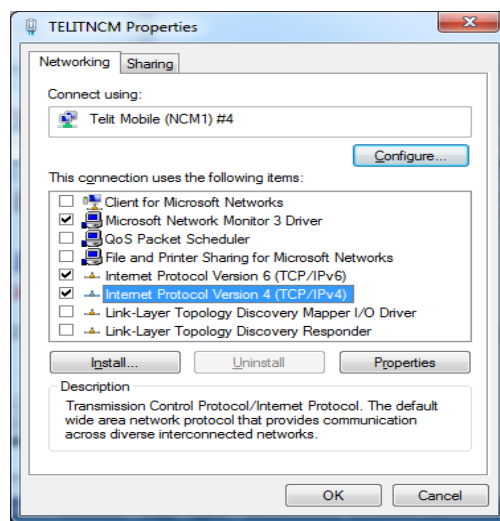
Select "Validate settings upon exit", and press OK. Then, press "Close" on the dialog box below.
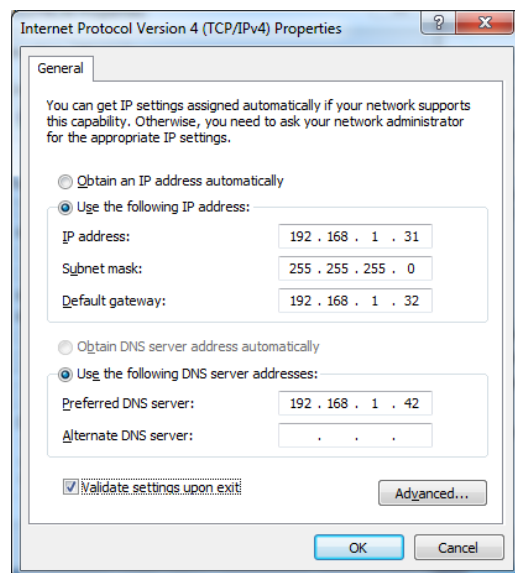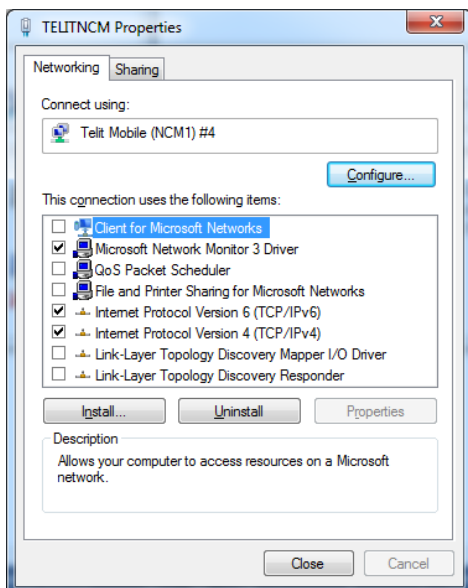
3.3.2.1 Set the IPv4 route table

Right-click on "TELITNCM", then select "Status".
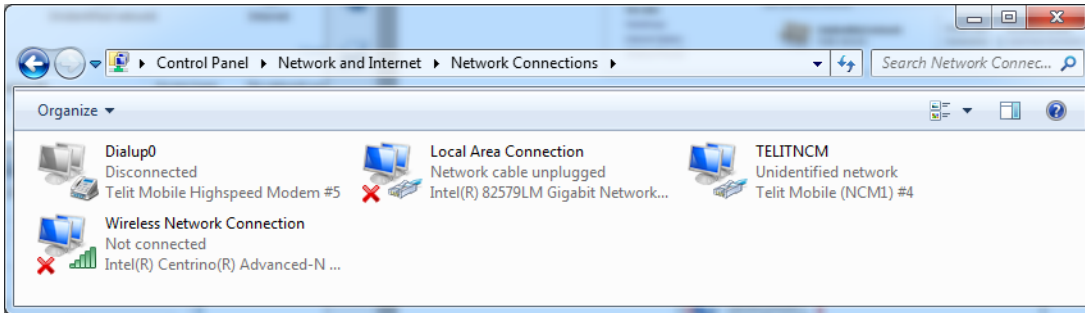
The PC displays the dialog box on the right side.

Right-click on "Details", the PC displays the following dialog box.
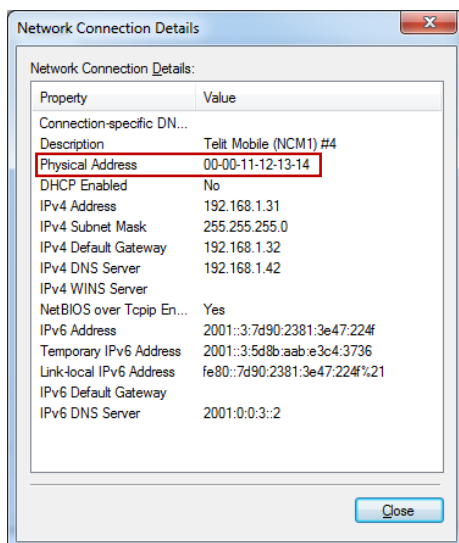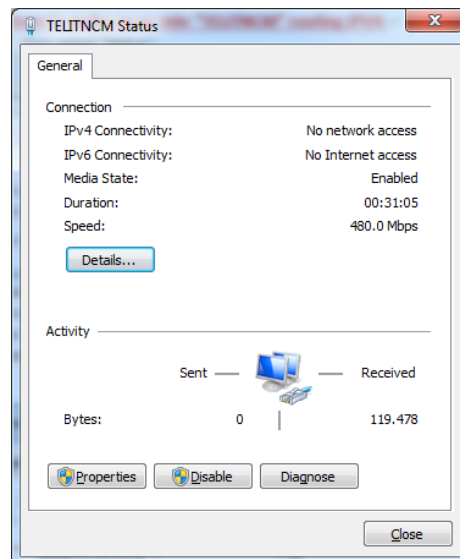
The Physical Address of the NCM adapter is 00-00-11-12-13-14

Now, you should accomplish the following actions.

First, enter Command prompt.

Flush the entire Address Resolution Protocol (ARP) cache on your PC. As soon as network connections are made, the ARP cache will begin to repopulate.
netsh interface ip delete arpcache

Display all ARP entries.
arp –a

Display ipv4 neighbor cache entries of the "TELITNCM" interface.
netsh interface ipv4 show neighbor "TELITNCM"

```
Interface 21: TELITNCM
Internet Address                       Physical Address    Type
-----------------------------------    -----------------   -----------
192.168.1.32                           00-00-00-00-00-00   Unreachable
192.168.1.42                           Unreachable          Unreachable
192.168.1.255                          ff-ff-ff-ff-ff-ff   Permanent
224.0.0.22                             01-00-5e-00-00-16   Permanent
224.0.0.252                            01-00-5e-00-00-fc   Permanent
```

Add the correct IPv4 neighbor for "TELITNCM" interface:
netsh interface ip add neighbor "TELITNCM" 192.168.1.32 00-00-11-12-13-14
netsh interface ip add neighbor "TELITNCM" 192.168.1.42 00-00-11-12-13-14

Display neighbor cache entries of the "TELITNCM" interface.
netsh interface ipv4 show neighbor "TELITNCM"

```
Interface 21: TELITNCM
Internet Address                       Physical Address    Type
-----------------------------------    -----------------   -----------
192.168.1.32                           00-00-11-12-13-14   Permanent
192.168.1.42                           00-00-11-12-13-14   Permanent
192.168.1.255                          ff-ff-ff-ff-ff-ff   Permanent
224.0.0.22                             01-00-5e-00-00-16   Permanent
224.0.0.252                            01-00-5e-00-00-fc   Permanent
```

Display information about IP addresses and default gateways on "TELITNCM" interface. The right IPv4 and IPv4 Default Gateway addresses that must be used are respectively underlined in yellow and green.
netsh interface ipv4 show address "TELITNCM"

```
Configuration for interface "TELITNCM"
        DHCP enabled:           No
        IP Address:             192.168.1.31
        Subnet Prefix:          192.168.1.0/24 (mask 255.255.255.0)
        Default Gateway:        192.168.1.32
        Gateway Metric:         256
        InterfaceMetric:        10
```

Displays route table entries
netsh interface ipv4 show route

Publish	Type	Met	Prefix	Idx	Gateway/Interface Name
No	Manual	256	0.0.0.0/0	21	192.168.1.32
No	Manual	256	127.0.0.0/8	1	Loopback Pseudo-Interface 1
No	Manual	256	127.0.0.1/32	1	Loopback Pseudo-Interface 1
No	Manual	256	127.255.255.255/32	1	Loopback Pseudo-Interface 1
No	Manual	256	192.168.1.0/24	21	TELITNCM
No	Manual	256	192.168.1.31/32	21	TELITNCM
No	Manual	256	192.168.1.255/32	21	TELITNCM
No	Manual	256	224.0.0.0/4	1	Loopback Pseudo-Interface 1
No	Manual	256	224.0.0.0/4	11	Local Area Connection
No	Manual	256	224.0.0.0/4	23	Local Area Connection* 11
No	Manual	256	224.0.0.0/4	21	TELITNCM
No	Manual	256	224.0.0.0/4	12	Wireless Network Connection
No	Manual	256	255.255.255.255/32	1	Loopback Pseudo-Interface 1
No	Manual	256	255.255.255.255/32	11	Local Area Connection
No	Manual	256	255.255.255.255/32	23	Local Area Connection* 11
No	Manual	256	255.255.255.255/32	21	TELITNCM
No	Manual	256	255.255.255.255/32	12	Wireless Network Connection

Delete the IPv4 routes that have no meaning.
netsh interface ipv4 delete route 255.255.255.255/32 21
netsh interface ipv4 delete route 192.168.1.255/32 21
netsh interface ipv4 delete route 224.0.0.0/4 21
netsh interface ipv4 delete route 192.168.1.0/24 21

Displays route table entries
netsh interface ipv4 show route

Publish	Type	Met	Prefix	Idx	Gateway/Interface Name
No	Manual	256	0.0.0.0/0	21	192.168.1.32
No	Manual	256	127.0.0.0/8	1	Loopback Pseudo-Interface 1
No	Manual	256	127.0.0.1/32	1	Loopback Pseudo-Interface 1
No	Manual	256	127.255.255.255/32	1	Loopback Pseudo-Interface 1
No	Manual	256	192.168.1.31/32	21	TELITNCM
No	Manual	256	224.0.0.0/4	1	Loopback Pseudo-Interface 1
No	Manual	256	224.0.0.0/4	11	Local Area Connection
No	Manual	256	224.0.0.0/4	23	Local Area Connection* 11
No	Manual	256	224.0.0.0/4	12	Wireless Network Connection
No	Manual	256	255.255.255.255/32	1	Loopback Pseudo-Interface 1
No	Manual	256	255.255.255.255/32	11	Local Area Connection
No	Manual	256	255.255.255.255/32	23	Local Area Connection* 11
No	Manual	256	255.255.255.255/32	12	Wireless Network Connection

A simple test: ping the Gateway
ping 192.168.1.32

Pinging 192.168.1.32 with 32 bytes of data:
Reply from 192.168.1.32: bytes=32 time=15ms TTL=128
Reply from 192.168.1.32: bytes=32 time=14ms TTL=128
Reply from 192.168.1.32: bytes=32 time=14ms TTL=128
Reply from 192.168.1.32: bytes=32 time=16ms TTL=128

Ping statistics for 192.168.1.32:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 14ms, Maximum = 16ms, Average = 14ms

3.3.3   PC Network Interface Configuration (IPv6)

Enter this dialog box as shown at the beginning of the chapter 3.2.2.
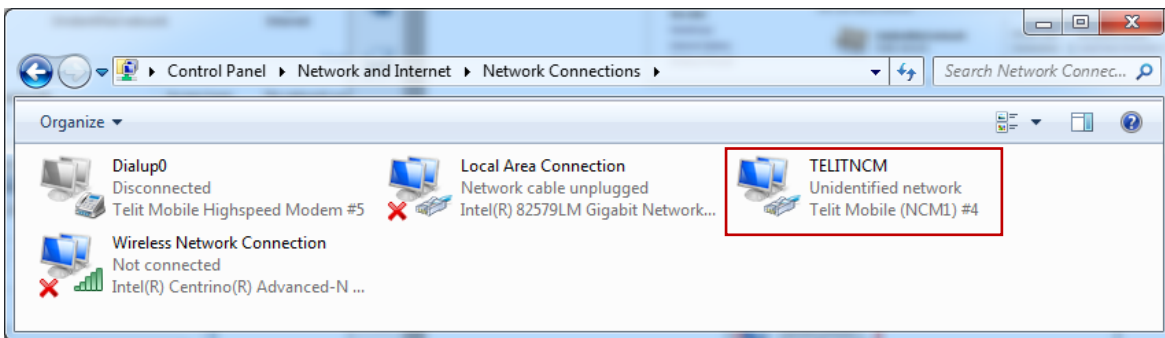
Right-click on "TELITNCM", then select "Status", the PC displays the dialog box on the right side. Press "Details" button, the PC displays the dialog box below.
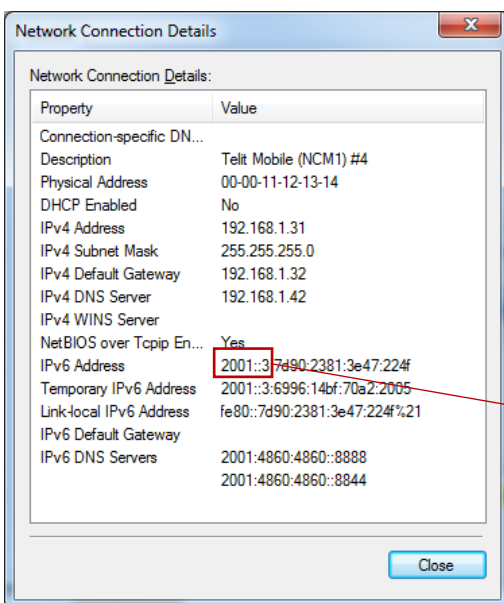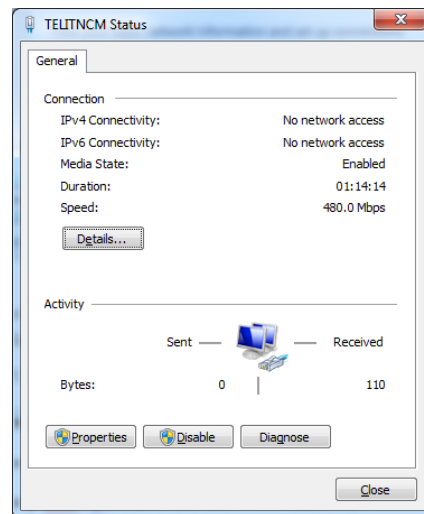
This is IPV6 PREFIX from network Routing Advertisement

Using the information returned by the **AT+CGPADDR** and **AT+CGCONTRDP** commands, it is possible to build the IPv6 address and the IPv6 Gateway address.

The IPV6 address is formed by:

- IPV6 PREFIX + PDN IPV6 interface ID = 2001::3:1:1:B836:FCF3

The IPV6 Gateway address is formed by:

- IPV6 PREFIX + PDN IPV6 interface ID changing last 2 digits in 01. In this case the result is this: 2001::3:1:1:B836:FC01, so the IPv6 Gateway address is 2001::3:1:1:B836:FC01

This addresses are used to configure the Telit Mobile (NCM1) Network Interface. To make this, left-click on "TELITNCM" Unidentified network Telit Mobile (NCM1), and select "properties". The PC displays the dialog box on the right side.

Select Internet Protocol Version 6 (TCP/IP), then press the button "Properties", the PC displays the dialog box. to configure the TELITNCM network interface, enter the IPv6 addresses build before.

IP address: 2001::3:1:1:B836:FCF3
Gateway address: 2001::3:1:1:B836:FC01
DNS address: 2001:0:0:3::2

Select "Validate settings upon exit", and press OK. Then, press "Close" on the dialog box on the left.
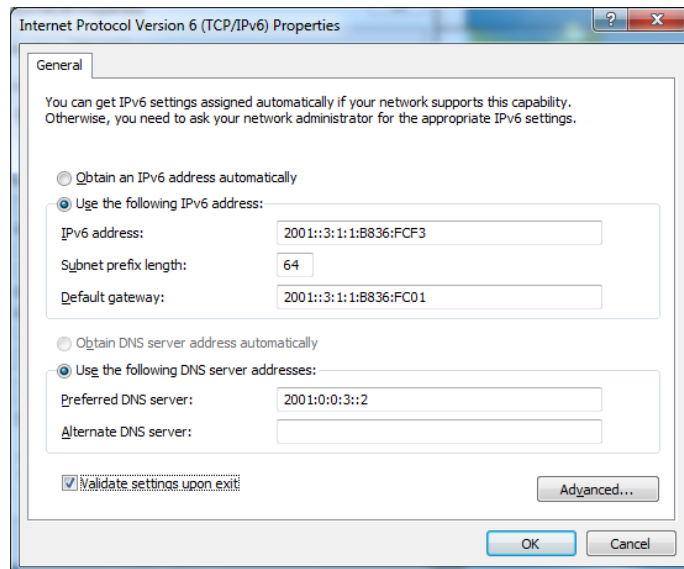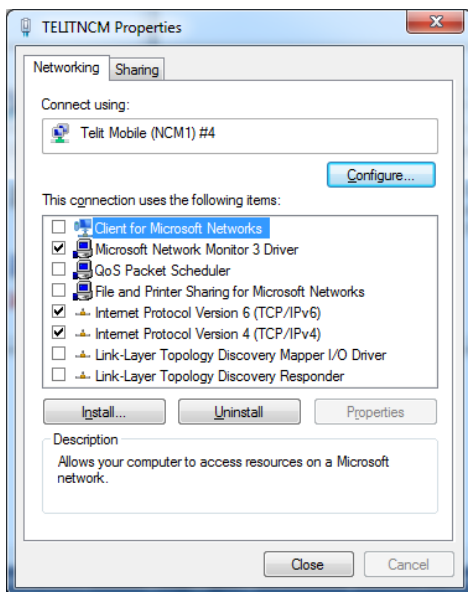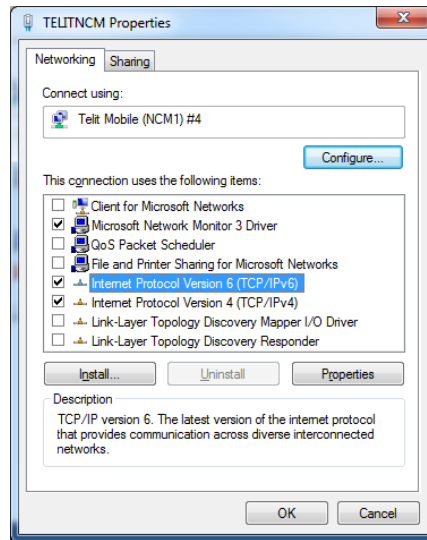
3.3.3.1 Set the IPv6 route table

Now, you should accomplish the following actions:

First, enter Command prompt.

Display IPv6 neighbor cache entries of the "TELITNCM" interface.
netsh interface ipv6 show neighbor "TELITNCM"

```
Interface 21: TELITNCM
Internet Address                            Physical Address   Type
-------------------------------------------  ----------------   -----------
2001:0:0:3::2                                Unreachable        Unreachable
2001::3:1:1:b836:fc01                        Unreachable        Incomplete
ff02::1                                      33-33-00-00-00-01  Permanent
ff02::2                                      33-33-00-00-00-02  Permanent
ff02::16                                     33-33-00-00-00-16  Permanent
ff02::1:3                                    33-33-00-01-00-03  Permanent
ff02::1:ff00:1                               33-33-ff-00-00-01  Permanent
ff02::1:ff00:2                               33-33-ff-00-00-02  Permanent
ff02::1:ff36:fc01                            33-33-ff-36-fc-01  Permanent
ff02::1:ff36:fcf3                            33-33-ff-36-fc-f3  Permanent
ff02::1:ff47:224f                            33-33-ff-47-22-4f  Permanent
ff02::1:ff73:da57                            33-33-ff-73-da-57  Permanent
```

Add the correct IPv6 neighbor for "TELITNCM" interface:
netsh interface ipv6 add neighbor "TELITNCM" 2001:0:0:3:1:1:b836:fc01 00-00-11-12-13-14
netsh interface ipv6 add neighbor "TELITNCM" 2001:0:0:3::2 00-00-11-12-13-14

Display neighbor cache entries of the "TELITNCM" interface.
netsh interface ipv6 show neighbor "TELITNCM"

```
Internet Address                            Physical Address   Type
-------------------------------------------  ----------------   -----------
2001:0:0:3::2                                00-00-11-12-13-14  Permanent
2001::3:1:1:b836:fc01                        00-00-11-12-13-14  Permanent
ff02::1                                      33-33-00-00-00-01  Permanent
ff02::2                                      33-33-00-00-00-02  Permanent
ff02::16                                     33-33-00-00-00-16  Permanent
ff02::1:3                                    33-33-00-01-00-03  Permanent
ff02::1:ff00:1                               33-33-ff-00-00-01  Permanent
ff02::1:ff00:2                               33-33-ff-00-00-02  Permanent
ff02::1:ff36:fc01                            33-33-ff-36-fc-01  Permanent
ff02::1:ff36:fcf3                            33-33-ff-36-fc-f3  Permanent
ff02::1:ff47:224f                            33-33-ff-47-22-4f  Permanent
ff02::1:ff73:da57                            33-33-ff-73-da-57  Permanent
```

Display information about IP addresses. The right IPv6 address is the yellow one.
netsh interface ipv6 show address "TELITNCM"

Address 2001::3:1:1:b836:fcf3 Parameters

Interface Luid	TELITNCM
Scope Id	0.0
Valid Lifetime	infinite
Preferred Lifetime	infinite
DAD State	Preferred
Address Type	Manual
Skip as Source	false

Address 2001::3:7d90:2381:3e47:224f Parameters

Interface Luid	TELITNCM
Scope Id	0.0
Valid Lifetime	29d22h55m26s
Preferred Lifetime	6d22h55m26s
DAD State	Preferred
Address Type	Public
Skip as Source	false

Address 2001::3:ed2a:8f8f:e673:da57 Parameters

Interface Luid	TELITNCM
Scope Id	0.0
Valid Lifetime	6d22h55m26s
Preferred Lifetime	22h55m26s
DAD State	Preferred
Address Type	Temporary
Skip as Source	false

Address fe80::7d90:2381:3e47:224f%21 Parameters

Interface Luid	TELITNCM
Scope Id	0.21
Valid Lifetime	infinite
Preferred Lifetime	infinite
DAD State	Preferred
Address Type	Other
Skip as Source	false

Delete the IPv6 addresses that have no meaning.
netsh interface ipv6 DELE address "TELITNCM" 2001::3:7d90:2381:3e47:224f
netsh interface ipv6 DELE address "TELITNCM" 2001::3:ed2a:8f8f:e673:da57
netsh interface ipv6 DELE address "TELITNCM" fe80::7d90:2381:3e47:224f

Display information about IP addresses. The right IPv6 address is the yellow one.
netsh interface ipv6 show address "TELITNCM"

Address 2001::3:1:1:b836:fcf3 Parameters

Interface Luid   TELITNCM
Scope Id   0.0
Valid Lifetime   infinite
Preferred Lifetime infinite
DAD State   Preferred
Address Type   Manual
Skip as Source   false

Displays route table entries.
netsh interface ipv6 show route

Publish	Type	Met	Prefix	Idx	Gateway/Interface Name
No	Manual	256	::/0	21	2001::3:1:1:b836:fc01
No	Manual	256	::1/128	1	Loopback Pseudo-Interface 1
No	Manual	8	2001:0:0:3::/64	21	TELITNCM
No	Manual	256	2001::3:1:1:b836:fcf3/128	21	TELITNCM
No	Manual	256	fe80::/64	20	Teredo Tunneling Pseudo-Interface
No	Manual	256	fe80::/64	11	Local Area Connection
No	Manual	256	fe80::/64	23	Local Area Connection* 11
No	Manual	256	fe80::/64	12	Wireless Network Connection
No	Manual	256	fe80::e0:0:0:0/128	20	Teredo Tunneling Pseudo-Interface
No	Manual	256	fe80::1966:9ab6:814:5f3b/128	11	Local Area Connection
No	Manual	256	fe80::3956:e189:9265:5164/128	12	Wireless Network Connection
No	Manual	256	fe80::c88e:c663:4dff:caf4/128	23	Local Area Connection* 11
No	Manual	256	ff00::/8	1	Loopback Pseudo-Interface 1
No	Manual	256	ff00::/8	20	Teredo Tunneling Pseudo-Interface
No	Manual	256	ff00::/8	11	Local Area Connection
No	Manual	256	ff00::/8	23	Local Area Connection* 11
No	Manual	256	ff00::/8	21	TELITNCM
No	Manual	256	ff00::/8	12	Wireless Network Connection

Delete the IPv6 routes that have no meaning.
netsh interface ipv6 delete route ff00::/8 21
netsh interface ipv6 delete route 2001:0:0:3:: 21

Add route.
netsh interface ipv6 add route 2001:0:0:3::2/128 21
netsh interface ipv6 add route ::/0 "TELITNCM" 2001:0:0:3:1:1:b836:fc01

Displays route table entries.
netsh interface ipv6 show route

```
Publish  Type     Met  Prefix                         Idx  Gateway/Interface Name
-------  -------  ---  ----------------------         ---  -----------------------
No       Manual   256  ::/0                            21  2001::3:1:1:b836:fc01
No       Manual   256  ::1/128                          1  Loopback Pseudo-Interface 1
No       Manual     8  2001:0:0:3::2/128               21  TELITNCM
No       Manual   256  2001::3:1:1:b836:fcf3/128       21  TELITNCM
No       Manual   256  fe80::/64                       20  Teredo Tunneling Pseudo-Interface
No       Manual   256  fe80::/64                       11  Local Area Connection
No       Manual   256  fe80::/64                       23  Local Area Connection* 11
No       Manual   256  fe80::/64                       12  Wireless Network Connection
No       Manual   256  fe80::e0:0:0:0/128              20  Teredo Tunneling Pseudo-Interface
No       Manual   256  fe80::1966:9ab6:814:5f3b/128    11  Local Area Connection
No       Manual   256  fe80::3956:e189:9265:5164/128   12  Wireless Network Connection
No       Manual   256  fe80::c88e:c663:4dff:caf4/128   23  Local Area Connection* 11
No       Manual   256  ff00::/8                         1  Loopback Pseudo-Interface 1
No       Manual   256  ff00::/8                        20  Teredo Tunneling Pseudo-Interface
No       Manual   256  ff00::/8                        11  Local Area Connection
No       Manual   256  ff00::/8                        23  Local Area Connection* 11
No       Manual   256  ff00::/8                        12  Wireless Network Connection
```

Optional operations to make only if there was a wrong:

- IPv6 address:
  netsh interface ipv6 set address "TELITNCM" 2001:0:0:3:1:1:b836:fcf3

- IPv6 gateway address:
  netsh interface ipv6 add route ::/0 "TELITNCM" 2001:0:0:3:1:1:b836:fc01

- DNS IPv6 address:
  netsh interface ipv6 set address "TELITNCM" 2001:0:0:3::2/64

- Link-Local address:
  netsh interface ipv6 delete route ::/0 "TELITNCM" fe80::3:ff:fe00:1

A simple test: ping the DNS
ping 2001:0:0:3::2

Pinging 2001:0:0:3::2 with 32 bytes of data:
Reply from 2001:0:0:3::2: time=33ms
Reply from 2001:0:0:3::2: time=14ms
Reply from 2001:0:0:3::2: time=14ms
Reply from 2001:0:0:3::2: time=16ms

Ping statistics for 2001:0:0:3::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 14ms, Maximum = 33ms, Average = 19ms

Network connection details of "TELITNCM" may be like those shown on the right side.

For reset all settings at the end of NCM operations:

netsh winsock reset

netsh interface ipv4 reset

netsh interface ipv6 reset

ipconfig /flushdns

Network Connection Details

Network Connection Details:

Property	Value
Connection-specific DN...	
Description	Telit Mobile (NCM1) #4
Physical Address	00-00-11-12-13-14
DHCP Enabled	No
IPv4 Address	192.168.1.31
IPv4 Subnet Mask	255.255.255.0
IPv4 Default Gateway	192.168.1.32
IPv4 DNS Server	192.168.1.42
IPv4 WINS Server	
NetBIOS over Tcpip En...	Yes
IPv6 Address	2001::3:1:1:b836:fcf3
IPv6 Default Gateway	2001::3:1:1:b836:fc01
IPv6 DNS Server	2001:0:0:3::2

Close

4 NCM ON UBUNTU

4.1 Preliminary Check

First, the OS should detect the connected module as NCM device. To force this check, you create a file named **cdc_ncm.conf** in the folder **/etc/modprobe.d/** and insert the following line: **options cdc_ncm prefer_mbim=N**.

Assume that the module is using the default #PORTCFG=0 configuration and #USBCFG=0 mode. Refer to document [2] to have information on the available #PORTCFG configuration and #USBCFG modes.

Reboot the Ubuntu-PC, and plug the USB cable in. Use the **dmesg** command to check if the module is recognized as a NCM device. The command response should contain something that looks like the following:

dmesg

```
[  510.764017] usb 1-3: new high-speed USB device number 7 using ehci-pci
[  515.907764] usb 1-3: New USB device found, idVendor=1bc7, idProduct=0036
[  515.907769] usb 1-3: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[  515.907772] usb 1-3: Product: FIH7160
[  515.907775] usb 1-3: Manufacturer: Telit
[  515.907777] usb 1-3: SerialNumber: 351622079900102
[  515.946172] cdc_acm 1-3:1.0: This device cannot do calls on its own. It is not a modem.
[  515.946240] cdc_acm 1-3:1.0: ttyACM0: USB ACM device
[  515.947784] cdc_acm 1-3:1.2: This device cannot do calls on its own. It is not a modem.
[  515.947845] cdc_acm 1-3:1.2: ttyACM1: USB ACM device
[  515.949159] cdc_acm 1-3:1.4: This device cannot do calls on its own. It is not a modem.
[  515.949224] cdc_acm 1-3:1.4: ttyACM2: USB ACM device
[  515.950912] cdc_acm 1-3:1.6: This device cannot do calls on its own. It is not a modem.
[  515.950979] cdc_acm 1-3:1.6: ttyACM3: USB ACM device
[  515.952409] cdc_acm 1-3:1.8: This device cannot do calls on its own. It is not a modem.
[  515.952480] cdc_acm 1-3:1.8: ttyACM4: USB ACM device
[  515.954035] cdc_acm 1-3:1.10: This device cannot do calls on its own. It is not a modem.
[  515.954103] cdc_acm 1-3:1.10: ttyACM5: USB ACM device
[  515.960140] cdc_ncm 1-3:1.12: MAC-Address: 00:00:11:12:13:14
[  515.960144] cdc_ncm 1-3:1.12: setting rx_max = 16384
[  515.960782] 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
```

The command response shows that Ubuntu, when connected to the module, maps automatically ttyACMx into USBx as summarized in the table below.

tty device on Ubuntu	USB ports on module
ttyACM0	USB0
ttyACM1	USB1
ttyACM2	USB2
ttyACM3	USB3
ttyACM4	USB4
ttyACM5	USB5

Tab 2: ttyACMx/USBx

In addition, the command response shows:

- the name of NCM interface: usb0.
- idProduct=0036, it identifies the #USBCFG=0 mode, refer to document [3].

Just to be sure to use the module to access the Network by means of the USB cable and the carriers, click on ◇ button and disable the Networking connected to the Ethernet cable.

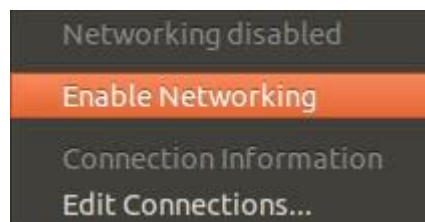The following Ubuntu dialog box shows that the Networking is disabled.

Fig 7: Networking Disabled

Use the **ifcongif** command to display the status of the currently active network interfaces.

Ifconfig

```
lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:281 errors:0 dropped:0 overruns:0 frame:0
          TX packets:281 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:21279 (21.2 KB)  TX bytes:21279 (21.2 KB)
```

This command response shows that only the loopback interface is active. It is used for diagnostics and troubleshooting, and to connect to servers running on the local machine (local host).

Use the next command to display all interfaces, which are currently available, even if down.

ifconfig –a

```
eth1    Link encap:Ethernet  HWaddr 00:1e:4f:db:2d:26
        BROADCAST MULTICAST  MTU:1500  Metric:1
        RX packets:0 errors:0 dropped:0 overruns:0 frame:0
        TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
        Interrupt:21 Memory:fe9e0000-fea00000
```

```
lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:281 errors:0 dropped:0 overruns:0 frame:0
          TX packets:281 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:21279 (21.2 KB)  TX bytes:21279 (21.2 KB)

usb0   Link encap:Ethernet  HWaddr 00:00:11:12:13:14
          BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
```

This command response shows that usb0 is the name of NCM interface, as stated before.

To send manually AT commands to the module, as shown in the next paragraph, you may use the serial terminal emulation minicom. To install it use the following command:

sudo apt-get install minicom

Assume that the module is using the default #PORTCFG=0 configuration. Enter one of the following commands to use USB0 or USB3 port of the module, refer to Tab 2.

sudo minicom –D /dev/ttyACM0

sudo minicom –D /dev/ttyACM3

4.2 NCM Activation on the Module

Assume that the module is using the default #PORTCFG=0 configuration, and the default #USBCFG=0 mode. Refer to document [2] to have detailed information on available port configurations and modes supporting NCM protocol. Execute the following steps:

- USB cable is already plugged in, see previous chapter.
- Run the minicom serial terminal emulation connected to the USB0 port of the module (/dev/ttyACM0 on Ubuntu side), see previous chapter.
- Enter the AT#PORTCFG=? Test command. If the entered command is not echoed, enter the ATE1 command to enable the echo.

Test command returns, for each Variant value, a short description on the logical connection regarding physical serial ports/USBx ports and access points (AT parser instances, Trace), see below:

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:   not supported by this product
#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

NCM protocol can be used on every USBx port connected to an AT parser, in accordance with the current #USBCFG mode. In #PORTCFG=0 configuration, NCM protocol can be used on USB0 or USB3 port, see the response of the Test command. In this example is used /dev/ttyACM0, therefore the used USB port is USB0, refer to Tab 2.

Check the current #PORTCFG configuration:
AT#PORTCFG?
#PORTCFG: 0,0   ← #PORTCFG=0 is the default configuration.
OK

Check the current #USBCFG configuration mode:
AT#USBCFG?
#USBCFG: 0   ← #USBCFG=0 is the default configuration mode.
OK

Check if the SIM is inserted and PIN is unlocked
AT+CPIN?
+CPIN: READY
OK

Check on which Network Operator the module is registered.
AT+COPS?
+COPS: 0,0,"network operator",7
OK

Check if the module is GPRS attached.
AT+CGATT?
+CGATT: 1
OK

Set PDP context using, for example, these parameters values: cid = 4, protocol type is "IP", APN is provided by your Network Operator. NCM protocol can be assigned to one of any available cid.
AT+CGDCONT=4,"IP","APN"
OK

NCM protocol is not active. Now, you can select one of the following options[3] to perform all the necessary actions to activate the NCM protocol.

Option 1:

Assign NCM protocol to cid=4
AT#NCM=1,4
OK

Activate PDP context identified by cid=4
AT+CGACT=1,4
OK

Activate the NCM protocol
AT+CGDATA="M-RAW_IP",4
CONNECT
OK

Option 2:

Assign NCM protocol to cid = 4, activate PDP context and NCM protocol.
AT#NCM=2,4
OK

Option 3:

---

[3] Modules equipped with an old software version, support only the option 1, and do not provide the #NCM command with User Name and Password.

Use this #NCM format when the network requires User Name and Password. Assign NCM protocol to cid = 4, activate PDP context and NCM protocol.
AT#NCM=2,4,0,"User Name", "Password"
OK

The NCM Network Interface of the Ubuntu-PC is not still configured with the addresses provided by the module. Use the following two commands to get IP address, Gateway address, and DNS address. Type in the commands using <cid>=4 (the same value used with +CGDCONT). After getting the addresses use them to configure the NCM Network Interface, see chapter 4.3.

AT+CGPADDR=4
+CGPADDR:
4,
"10.162.34.196"   ← IP address
OK

AT+CGCONTRDP=4
+CGCONTRDP:
4,
6,
"string from network",
"10.162.34.196.255.0.0.0",   ← IP address
"10.162.34.197",   ← Gateway address
"10.207.43.46",   ← DNS address
"0.0.0.0",
"0.0.0.0",
"0.0.0.0"
OK

4.3   PC Network Interface Configuration

Configure the usb0 network interface using the addresses returned by the +CGPADDR and +CGCONTRDP commands, see chapter 4.2.

- IP address
- Gateway address
- DNS address

sudo ifconfig usb0 10.162.34.196 netmask 255.255.255.0 up

sudo route add default gw 10.162.34.197

sudo arp -s 10.162.34.197 11:22:33:44:55:66

Now, the interface can carry on traffic. Check it using **ping** command with the IP address of the primary DNS of Google.

ping 8.8.8.8

To use URL instead of IP addresses the DNS must be configured; modify the file **/etc/resolv.conf** adding the line **nameserver 10.207.43.46** at the end of the file.

An alternative DNS could be the secondary DNS of Google: 8.8.4.4

4.4   NCM Deactivation

As stated in chapter 4.2, the module is using the default #PORTCFG=0 configuration, therefore the available USBs ports connected to an AT parser are USB0 and USB3. In this example, the NCM protocol was activated on USB0 port.

The AT parser connected to USB0 port is always available, therefore you can continue to issue AT commands on this port, regardless if the NCM protocol is activated or not. Referring to the two options below, to deactivate the NCM protocol use the option 2, it does not matter the command sequence you used to activate the protocol, see chapter 4.2.

Option 1:

AT+CGATT=0
OK
NO CARRIER

Option 2:

AT#NCMD=0
OK
NO CARRIER

You can deactivate the NCM protocol entering the following command in Ubuntu-PC.
sudo ifconfig usb0 down

5 APPENDIXES

5.1 TMB Tool

Telit provides the TMB tool that furnishes a simple interface to activate/deactivate the NCM protocol in Windows environment. Before running the tool[4] , verify if the:

- current port configuration is #PORTCFG=0 (default);
- mode is #USBCFG=0 (default);
- USB3 port is available.

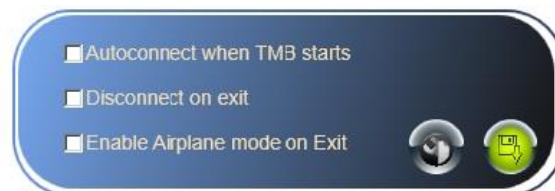The Fig 8 shows how the Telit Mobile Broadband tool appears on the display.

Fig 8: TMB Tool

Push SIM Management button, the following dialog box is displayed.

Push Configuration button, the following dialog box is displayed.

---

[4] It is suggested to install NET Framework 4.5 or later.

Push   Network Setting button, the following dialog box is displayed.

The APN is connected to the selected CID. The Packet Data Protocol type is always set to "IP". See AT command AT#CGDCONT, refer to document [1].

Right-click on the TMB window, the following information is displayed.

Push   Connect button, the following dialog box is displayed. The NCM protocol activation is successfully performed.
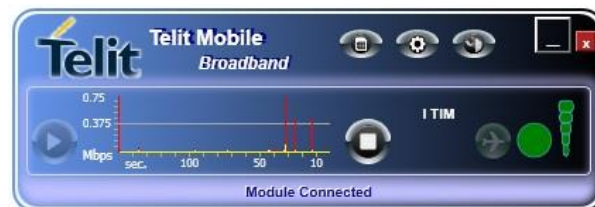
6 GLOSSARY AND ACRONYMS

	Description
APN	Access Point Name
ARP	Address Resolution Protocol
CID	PDP Context IDentifier
DNS	Domain Name Server
DTE	Data Terminal Equipment
FW	FirmWare
LTE	Long Term Evolution
MBIM	Mobile Broadband Interface Model
NCM	Network Control Model
PDP	Packet Data Protocol
PID	Product IDentifier
PIN	Personal Identification Number
TMB	Telit Mobile Broadband
URL	Uniform Resource Locator

7 DOCUMENT HISTORY

Revision	Date	Changes
0	2016-02-02	First issue
1	2016-03-16	Added: Description of the AT#NCM command with User Name and Password.
2	2016-10-14	Updated: Chapter: 1.5 Related Documents Removed: Chapter: 6 Modules & SW Ver. Tables
3	2016-11-29	Fulfilled some missing references.
4	2017-10-23	Adopted new template. Added: The Platform Version ID in the Applicability Table, and the LE910 Cat1 series. Section IPv4/IPv6 Dual Stack. Changed: The document title into: LE910 V2, LE910 Cat1 NCM Protocol User Guide. Updated: Chapter: 1.5 Releted Documents

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