RYZ014 Modules

Data Over UART with PPP

Feature Description

This document describes how to establish a standard PPP connection on the modem interface to perform traffic tests between a RYZ014-based module and a host.

When the PPP connection is up, the module will transmit the IP packet flow from the application to the network. In this mode, the PPP server is running on the module and a PPP client should run on the application side. Linux/Unix and Windows operating systems natively include a PPP protocol stack. For operating systems that do not embed an existing application to set up a PPP connection (such as Android OS), customers will have to develop their own application software to support PPP according to the standard RFC 1661: Point-to-Point Protocol.

In all the examples below, the kit must be connected to a network as a prerequisite. As the PPP connection will be established through UART, the baudrate of the UART must be the one expected by the application.

Note: Please note that in the following examples, the UART baudrate was set to 921600. Please refer to the EVK user manual to get the default baudrate of the UART to be used for PPP connection.

Contents

1. PPP Overview

1.1 PPP Procedure

The following sequence of commands establish and terminate the PPP connection:

AT command	Response	Comment
AT+CFUN=1		
	OK	
	+CEREG:1,”0002”,”01A2 2002”,7	Wait for the CEREG URC showing that the modem is connected to the network
Establish the external network access (PDP context)		
AT+CGDATA=”PPP”,1		Where 1 is the context ID for the external network access. It can be retrieved with the AT+CGDCONT? command. It is 1 for most operators except for Verizon where it is 3.
	CONNECT	If needed, a specific APN for this CID can be set with AT+CGDCONT command.
Instead of using the AT+CGDATA command, it is possible to use the following command :		
ATD*99***1#		1 is the CID
	CONNECT	
At this point, the modem enters data mode and will not answer to AT commands. Every character sent over the UART will be considered as data. Incoming URCs will not be sent to the MCU either.		
In data mode, incoming URC will make the RING0 line toggle. The MCU will then have to suspend the PPP connection with the +++ escape sequence to read the incoming URC.		
[+++]		The +++ command must be sent with a delay not smaller than 1 second before and after the command
	OK	
ATO		After checking the incoming URC, the MCU can resume the PPP session
	CONNECT	
To terminate the PPP session, the MCU should first suspend the PPP connection to exit data mode with +++ escape sequence and then terminate the session with the relevant AT command		
[+++]		The +++ command must be sent with a delay not smaller than 1 second before and after the command
	OK	
ATH		
	OK	The delay to get the OK response can be up to 20 seconds
The PPP session is then terminated		

1.2 PPP and Low Power

When the module enters sleep or deep sleep mode while a PPP connection is open, the PPP connection will be available again when the modem wakes up. No need for the MCU to reestablish the PPP connection.

2. Using a Linux Host

This section illustrates the use of the pppd client. Other PPP clients such as gnome-ppp, kppp, or wvdial, among others can also be used.

Please note that to be able to reach the maximum UL throughput of 1.1Mbps in 3GPP Release 14, it is necessary to change the UART0 baudrate to 1843200 as follows:

```
AT+CFUN=5
AT+SQNHWCFG="uart0","enable",”rtscts”,"1843200“ AT^RESET
```

2.1 Use Case

2.1.1 Preparation

In this example, the Linux host runs Ubuntu 14.04 and the following versions of the tools:

- chat v1.22
- pppd v2.4.5

2.1.2 Configure pppd

The main configuration file is `/etc/ppp/options`.

Please refer to `man pppd` for all details.

Replace the `/etc/ppp/options` file with the contents below for the test:

```
/dev/ttyACM0
921600
nodetach
noauth  l
ocal
noipdefault
defaultroute
usepeerdns
crtscts  lock
debug
dump
-chap  connect "/usr/sbin/chat -t6 -f
/etc/chatscripts/connect"  disconnect "/usr/sbin/chat -t6 -f
/etc/chatscripts/disconnect"
```

In this file, configure:

- The TTY device, which is one of the AT ports of the modem
- The baud rate, which is 921600 in this example but can be 115200 or any other supported baudrate configured on the module
  - The default baud rate of the AT UART terminal can be checked by connecting a UART terminal utility such as Tera Term and running `AT+IPR?`. Make sure to disconnect the UART AT terminal before you attempt to use the COM port for PPP connection
- HW flow control enable with the `crtscts` option
- The scripts for connect and disconnect
- Other options depending on usage

2.1.3 Connect Script

In the options of the configuration file above, the script `/etc/chatscripts/connect` contains the commands sent to the modem to initialize the connection.

Below is an example of this script.

Replace the `/etc/chatscripts/connect` file with the one below for the test.

```
#ABORT "NO CARRIER"
TIMEOUT 30
ABORT ERROR
 "" AT
OK AT+CGDATA="PPP",1
CONNECT ""
```

Note: AT+CGDATA=”PPP”,<cid> where <cid> represents the cid of the PDP context as defined by AT+CGDCONT. Use value 3 for Verizon Wireless testing and 1 for the other networks. The user can check which cid is connected to the network with AT+CGDCONT?.

See also `man chat` for additional information.

2.1.4 Disconnect Script

In the options of the configuration file above, the script `/etc/chatscripts/disconnect` contains the commands sent to the modem to terminate the PPP connection.

Replace the `/etc/chatscripts/disconnect` file with the one below for the test.

```
"" "\d\d\d+++\c"
```

Note: The sequence +++ is used to suspend the PPP session.

2.1.5 Terminate pppd Connection

To terminate the pppd connection, just press **<Ctrl-C>** or kill the pppd process from another terminal as shown below:

```
sudo killall -TERM pppd
```

2.2 Connecting to PPP

Note: Please disconnect the Linux station from the network before the test, to be sure to get the correct default route. Also make sure that AT UART is not in use and disconnected.

When the setup is ready, run the following command to dial-up.

```
sudo pppd
```

After entering the root password, you will see the following log and the PPP connection is established.

```
ydu@ydu-X230:~/tmp/gto$ sudo pppd
[sudo] password for ydu:
pppd options in effect:
debug # (from /etc/ppp/options)
nodetach # (from /etc/ppp/options)
dump # (from /etc/ppp/options)
noauth # (from /etc/ppp/options)
-chap # (from /etc/ppp/options)
/dev/ttyUSB0 # (from /etc/ppp/options)
921600 # (from /etc/ppp/options)
lock # (from /etc/ppp/options)
connect /usr/sbin/chat -t6 -f /etc/chatscripts/connect # (from
/etc/ppp/options)
crtscts # (from /etc/ppp/options)
local # (from /etc/ppp/options)
noipdefault # (from /etc/ppp/options)
defaultroute # (from /etc/ppp/options)
usepeerdns # (from /etc/ppp/options)
Script /usr/sbin/chat -t6 -f /etc/chatscripts/connect finished (pid 7737),
status = 0x0
Serial connection established.
using channel 2
```

```
Using interface ppp0
Connect: ppp0 <--> /dev/ttyUSB0
sent [LCP ConfReq id=0x1 <asyncmap 0x0> <magic 0xa1249984> <pcomp> <accomp>]
rcvd [LCP ConfReq id=0x1 <mru 1280> <asyncmap 0x0> <magic 0xbd59bcce> <pcomp>
<accomp>]
sent [LCP ConfAck id=0x1 <mru 1280> <asyncmap 0x0> <magic 0xbd59bcce> <pcomp>
<accomp>]
rcvd [LCP ConfAck id=0x1 <asyncmap 0x0> <magic 0xa1249984> <pcomp> <accomp>]
sent [CCP ConfReq id=0x1 <deflate 15> <deflate(old#) 15> <bsd v1 15>]
sent [IPCP ConfReq id=0x1 <compress VJ 0f 01> <addr 0.0.0.0> <ms-dns1 0.0.0.0>
<ms-dns2 0.0.0.0>]
rcvd [LCP ProtRej id=0x2 80 fd 01 01 00 0f 1a 04 78 00 18 04 78 00 15 03 2f]
Protocol-Reject for 'Compression Control Protocol' (0x80fd) received
rcvd [IPCP ConfReq id=0x1 <addr 192.168.50.1>]
sent [IPCP ConfAck id=0x1 <addr 192.168.50.1>]
rcvd [IPV6CP ConfReq id=0x1 <addr fe80::51e1:85c6:d330:d689>]
Unsupported protocol 'IPv6 Control Protocol' (0x8057) received
sent [LCP ProtRej id=0x2 80 57 01 01 00 0e 01 0a 51 e1 85 c6 d3 30 d6 89]
rcvd [IPCP ConfRej id=0x1 <compress VJ 0f 01>]
sent [IPCP ConfReq id=0x2 <addr 0.0.0.0> <ms-dns1 0.0.0.0> <ms-dns2 0.0.0.0>]
rcvd [IPCP ConfNak id=0x2 <addr 192.168.6.2> <ms-dns1 172.16.66.1> <ms-dns2
172.16.66.1>]
sent [IPCP ConfReq id=0x3 <addr 192.168.6.2> <ms-dns1 172.16.66.1> <ms-dns2
172.16.66.1>]
rcvd [IPCP ConfAck id=0x3 <addr 192.168.6.2> <ms-dns1 172.16.66.1> <ms-dns2
172.16.66.1>]
local IP address 192.168.6.2
remote IP address 192.168.50.1
primary DNS address 172.16.66.1
secondary DNS address 172.16.66.1
Script /etc/ppp/ip-up started (pid 7751)
Script /etc/ppp/ip-up finished (pid 7751), status = 0x0
```

After the test, you can ping to network (using a different terminal) and access the internet.

2.3 Troubleshooting

The debug option can be used when launching pppd. In that case, pppd will log the contents of all control packets sent or received in a readable form. The packets are logged through syslog with facility `daemon` and level `debug`. This information can be directed to a file by setting up `/etc/syslog.conf` appropriately. Note that if pppd is compiled with extra debugging enabled, it will log messages using facility `local2` instead of `daemon`.

Note that with Ubuntu machines, the `/etc/syslog.conf` file is replaced by `/etc/rsyslog.conf` instead.

3. Using a Windows Host

Please note with a Windows Host, the maximum supported baudrate is 921600, which will not allow the UE to reach the maximum UL throughput of 1.1 Mbps in 3GPP Release 14.

3.1 With sqncom2ppp Tool

This section applies to both Windows 7 and Windows 10.

3.1.1 Modem Interface Creation

A Renesas tool named `sqncom2ppp` can be installed to ease the Windows PPP driver configuration. Get the latest version of `sqncom2ppp` software from Renesas (`com2ppp_setup_1.1-6.exe` for example) and run this application. Click **Next/Finish** on the following windows:

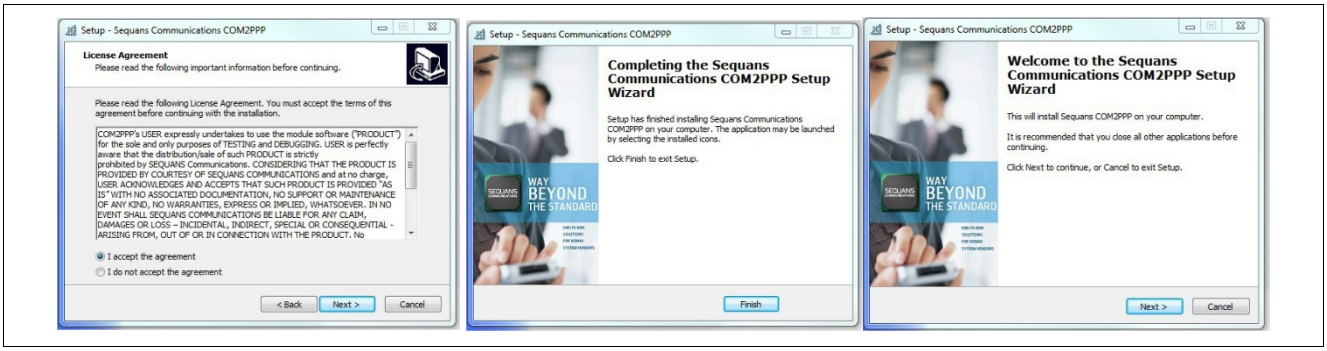

Figure 1. sqncom2ppp Setup

At this stage, `sqncom2ppp` is installed on your PC and can be used to configure PPP driver on Windows.

After completing the `sqncom2ppp` installation, perform the following steps. All these steps are required the first time PPP is used only.

1. Open a CMD command prompt in Windows and run it as administrator
2. Change directory to the default installation directory
   — `C:\Program Files (x86)\Sequans Communications\com2ppp`

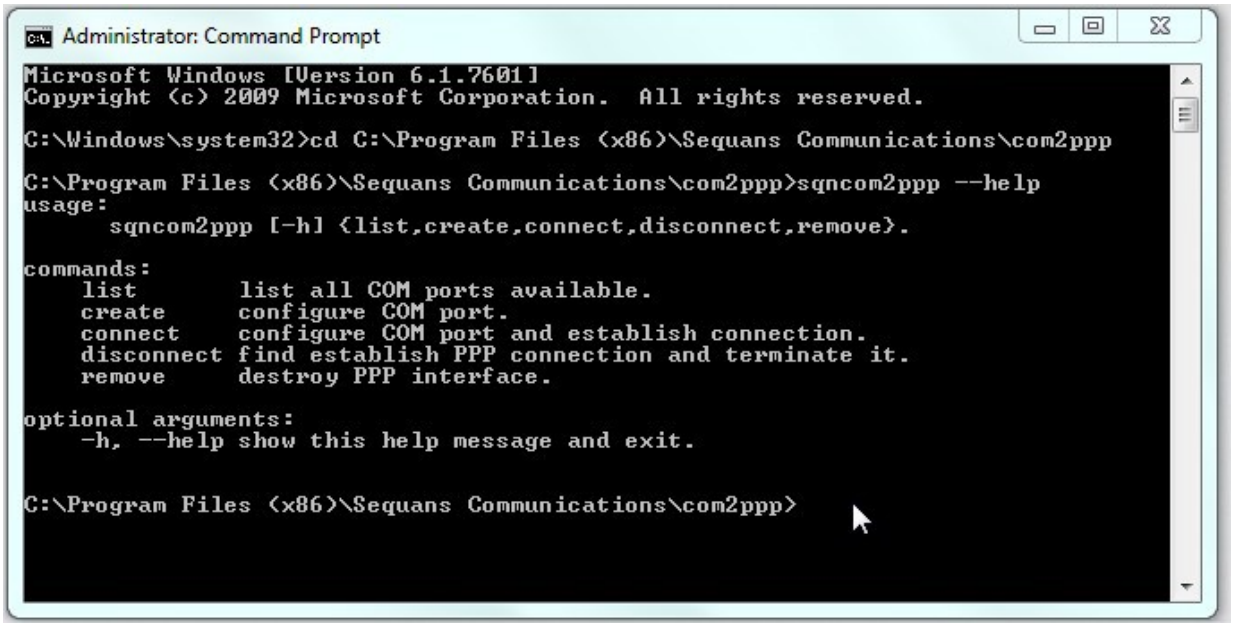

Figure 2. com2ppp Directory

3. From this location you can run the `sqncom2ppp` program.
4. Create the Modem interface, by typing
   `sqncom2ppp create COMxx`
   `COMxx` is one of the COM ports associated to the test kit.
   Please use the UART COM associated to AT Commands or to DCP

3.1.2 Modem Interface Configuration

Configure the Modem interface as follows:

1. Open the Windows control panel, section **Phone and Modem**
2. Click on **Modems** tab
   - The new modem can be seen in the list.
   - Double click on it
3. Then click on **Change Settings**

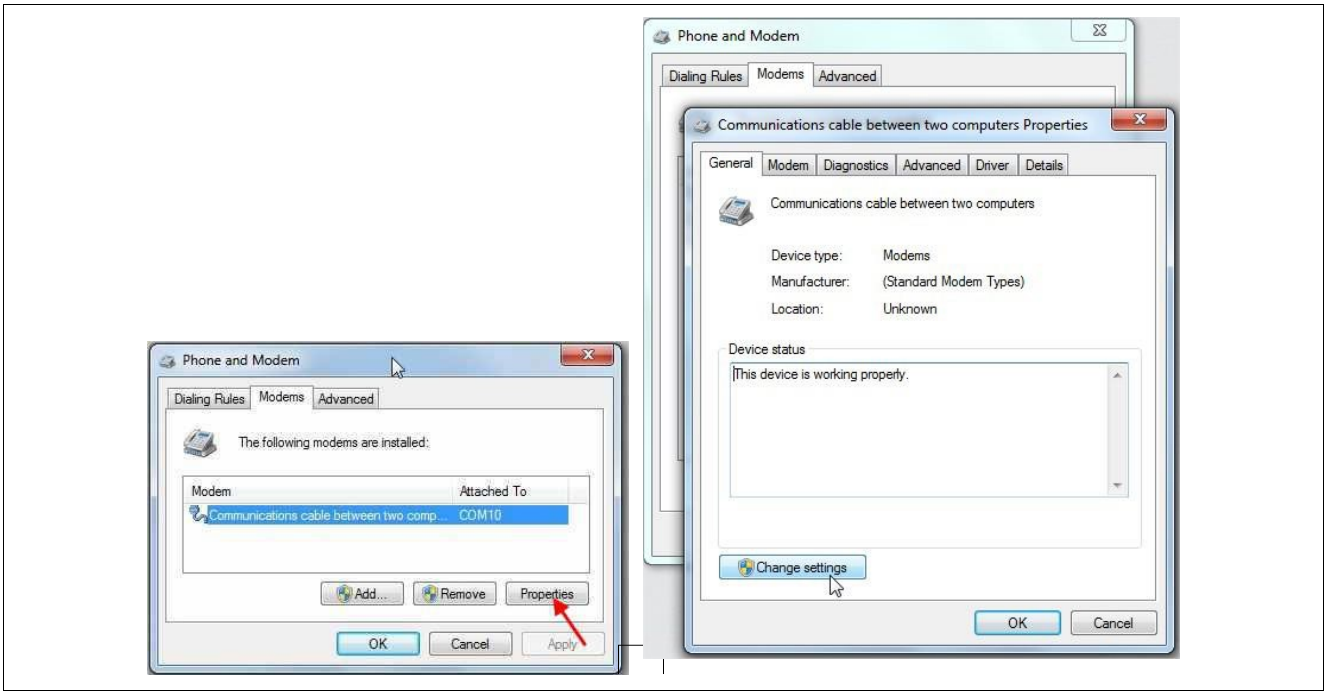

Figure 3. Select New Modem

4. In the Modem tab, set the baud rate of the UART port. It is typically 921600 or 115200
5. The baudrate of the UART can be checked with `AT+IPR?`

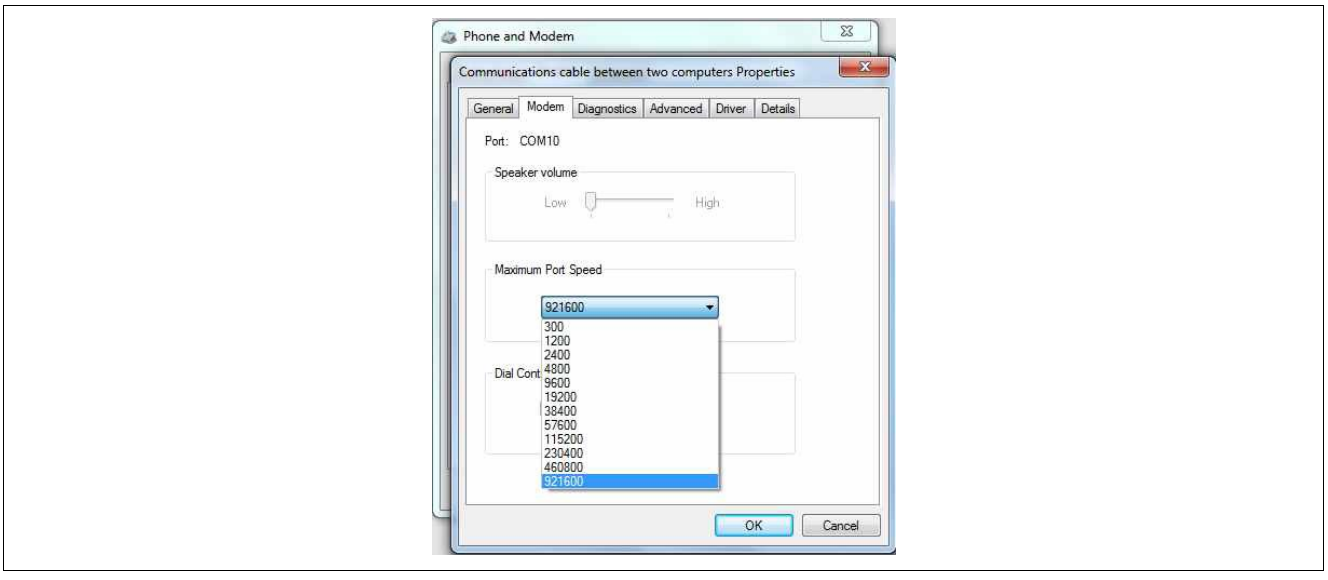

Figure 4. Select Baudrate

At this stage, a **reboot** of the computer is required, in order for those new settings to take effect.

3.1.3 Running a Data Session over PPP

In the current example, AT commands are mapped on COM10. The assumption is that the user has already performed all the steps described in previous sections to create the Modem interface and map it on COM10.

Start the terminal process and connect it to COM10.

Then connect the modem to the network with:

`AT+CFUN=1`
Wait for the Kit to connect to the network

`AT+CGDATA="PPP",1`
This will create the PPP connection `AT+CGDATA=”PPP”,<cid>` where `<cid>` is set to 1 by default. To run tests over Verizon Wireless network, cid should be set to 3. The user can check which cid is connected to the network with `AT+CGDCONT?`.

If everything went well, you should get a `CONNECT` answer. Otherwise, the command will return `NO CARRIER`, meaning that something went wrong and it needs to be fixed before moving further. Double check that the modem is correctly attached to the network to make sure that the baudrate matches the one of the module’s UART and reset the module.

Once `CONNECT` is received in response to AT+CGDATA, then disconnect the serial terminal from COM10.

After this step, run the following command from the CMD terminal to establish the PPP connection.

```
sqncom2ppp.exe connect COM10
```

The above command will set up a dial-up connection if not already existing and open it.

If the following error is seen, please check that the COM port configuration is correct, and no other process is using the same COM port. Please also make sure that the PC configuration is correct (refer to section 3.1.2).

Typically, in the example, the COM port used for PPP is the same as the one for the AT command terminal. Omitting to disconnect the terminal will prevent the PPP process from succeeding.

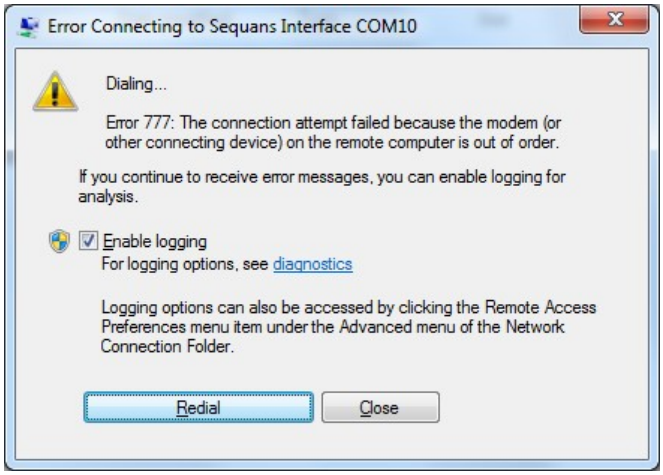

Figure 5. Connection Error

If this step succeeds, the PPP connection will appear among other existing connections, through an `ipconfig` command and is ready for use.

If you want to stop the PPP connection, you should run the following command from the CMD terminal:

```
sqncom2ppp.exe disconnect COM10
```

As long as this PPP interface is not removed, it will be available every time the test kit is connected on this PC. The interface can be deleted using the following command from the CMD terminal:

```
sqncom2ppp.exe remove COM10
```

3.2 Without sqncom2ppp Tool (Windows 10 Host)

If you don't have access to the sqncom2ppp tool, you can configure Windows PPP driver manually as follows. This section applies to a Windows 10 host. Please refer to section 3.3 if you are using a Windows 7 host.

3.2.1 Modem Interface Creation

1. Open the device manager, click on **Modems** then **Action→Add legacy hardware**.

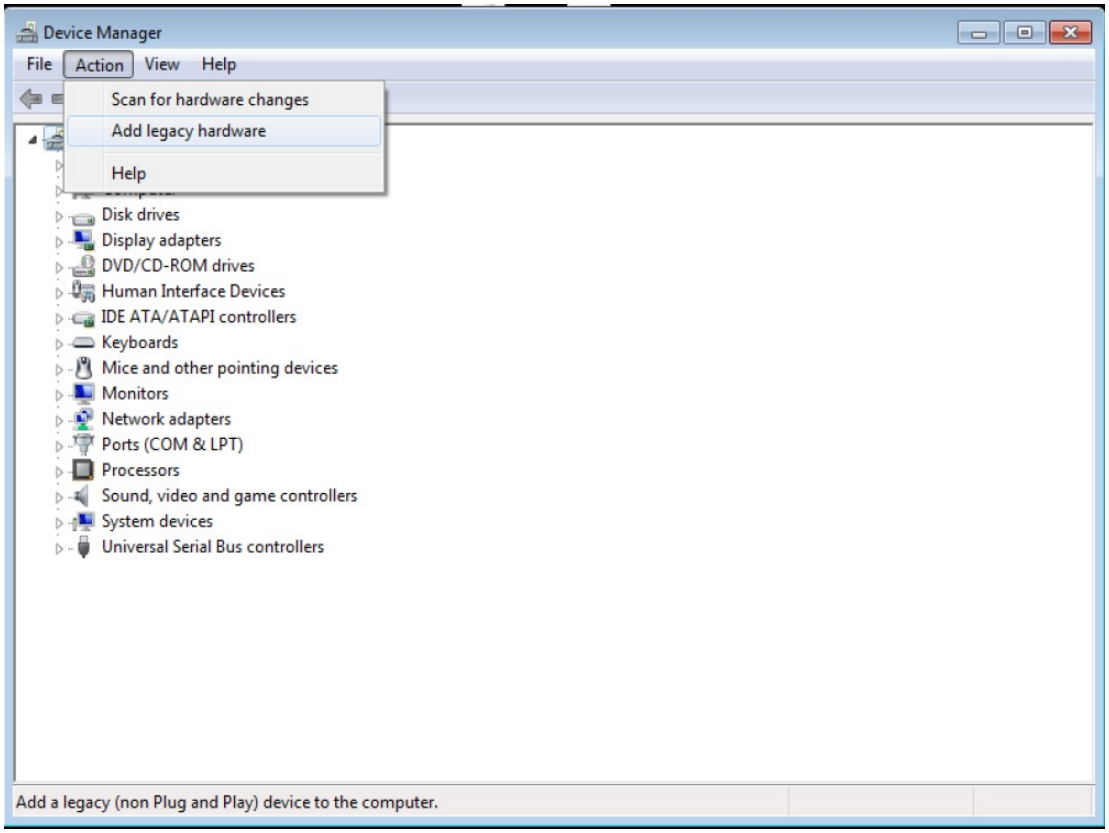

Figure 6. Add Legacy Hardware

2. Click on **Next**.

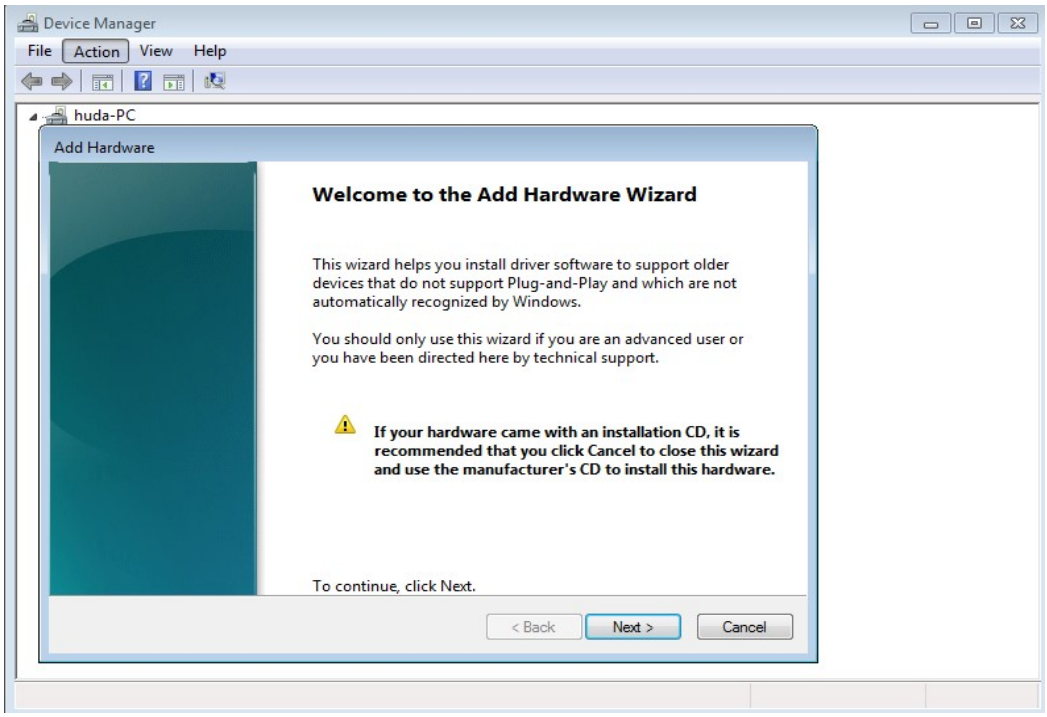

Figure 7. Add Hardware

3. Select **Install the hardware manually**

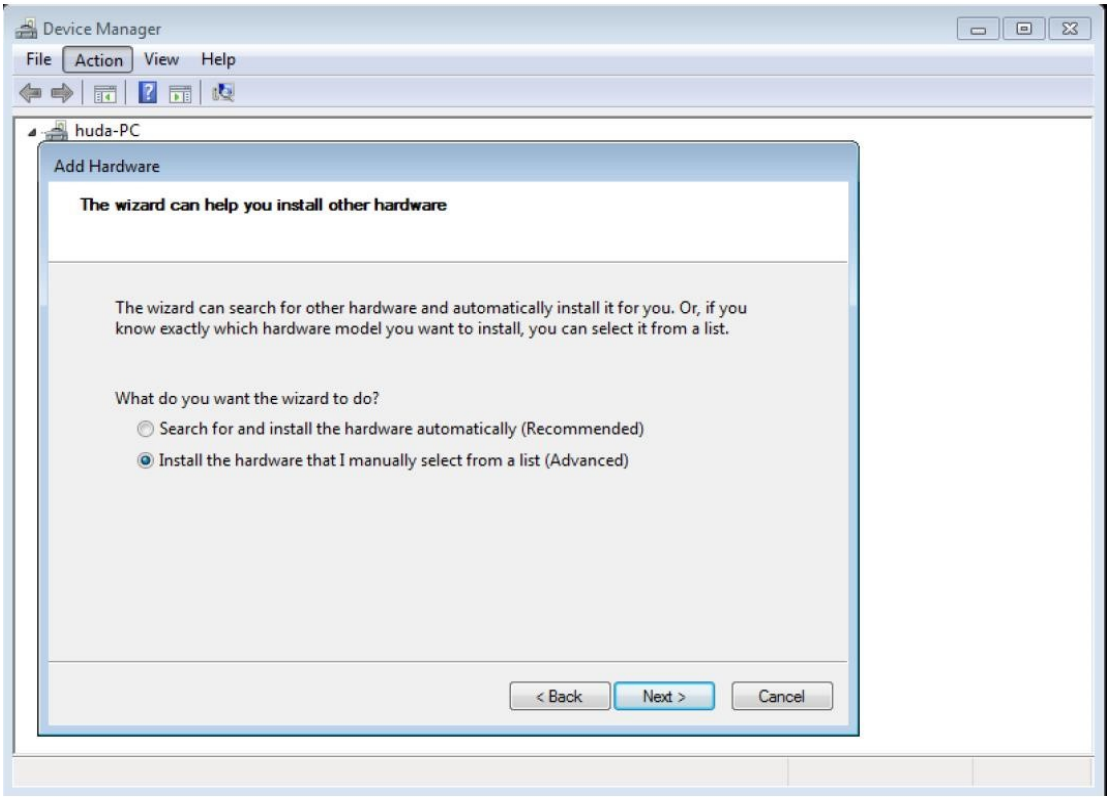

Figure 8. Install Hardware Manually

4. In the list, select **Modem**.

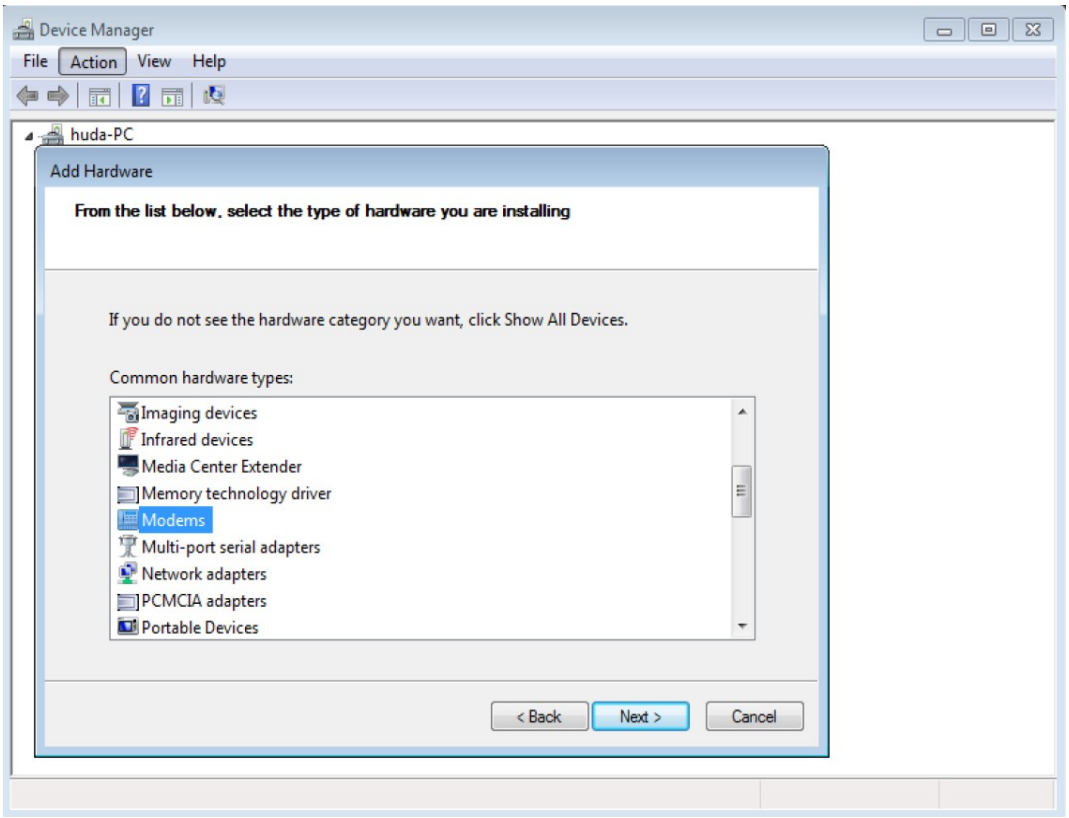

Figure 9. Select Modem

5. Check **Don't detect my modem**.

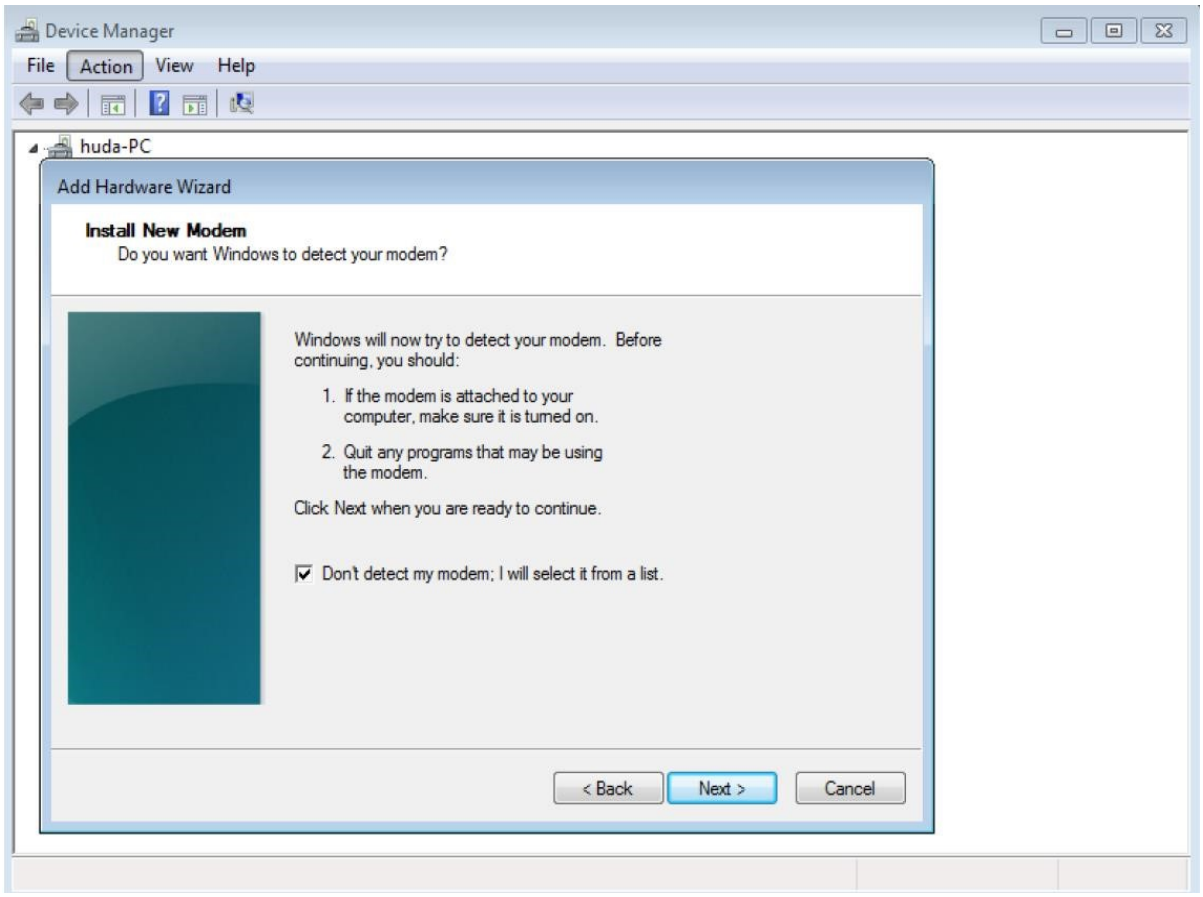

Figure 10. Don’t Detect Modem

6. In the list, select **Communications cable between two computers**.

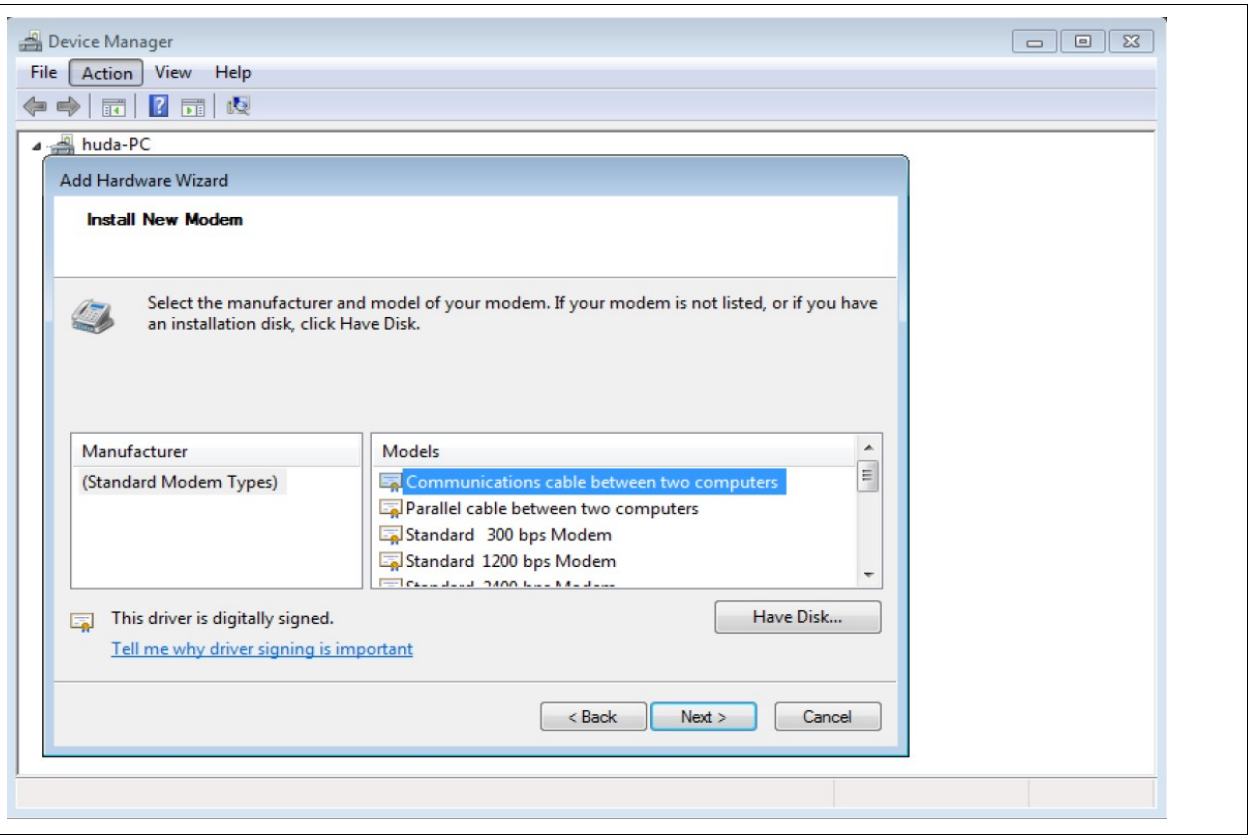

Figure 11. Communications Cable between Two Computers

7. Select the UART COM associated with AT Commands or to the DCP on which PPP connection will take place. Please refer to your Test Kit User Manual. Here, the COM port is COM40.

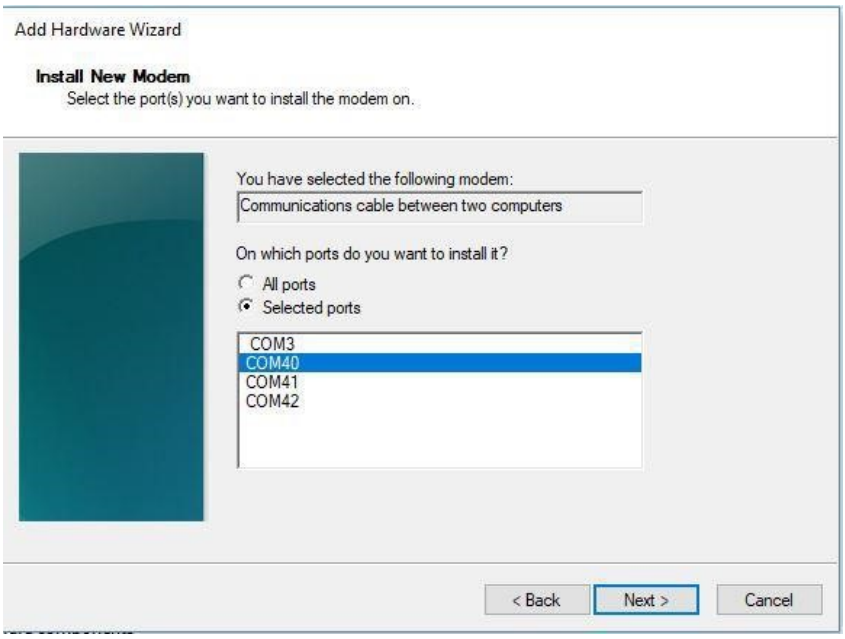

Figure 12. Select Port

8. Click on **Finish**.

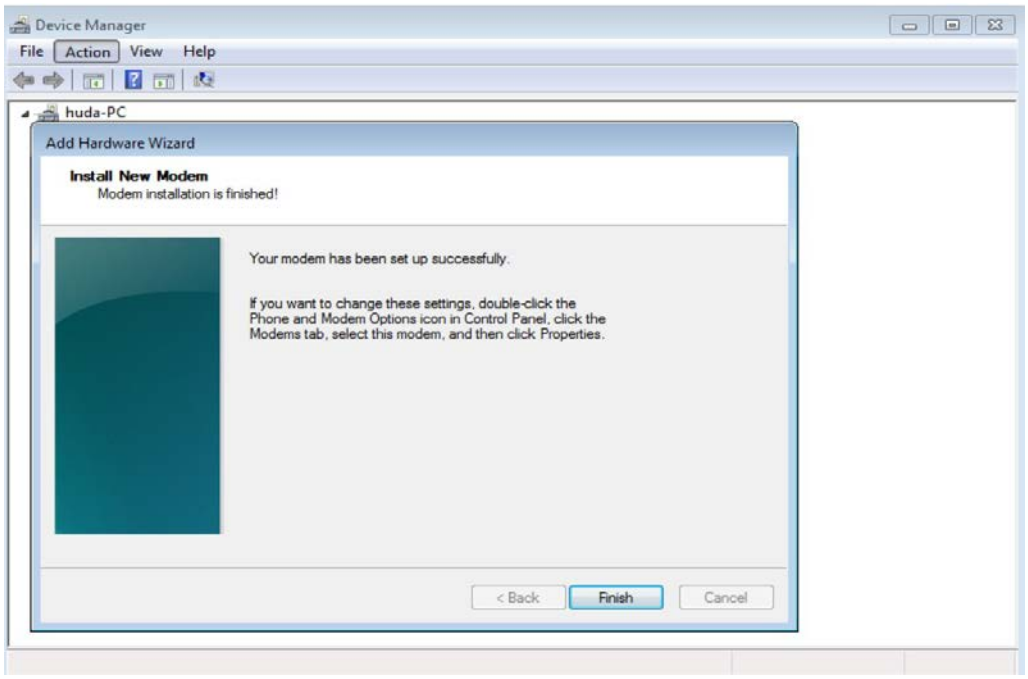

Figure 13. Finish Modem Setup

9. Now in the device manager, under the **Modem** section, you can see the **Communications cable between two computers**.

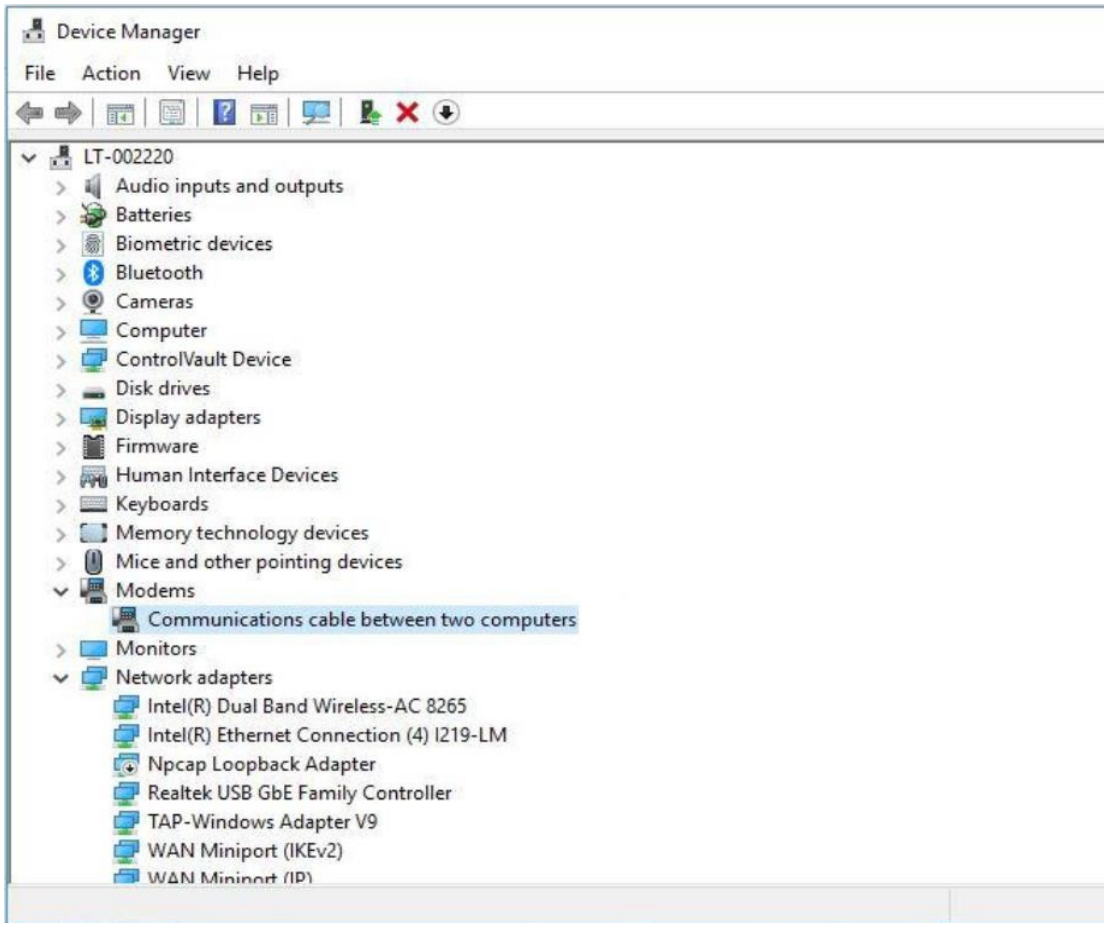

Figure 14. Modem Available

If you have several dial up connections, please delete the old one, or you won't see the new modem device.

3.2.2 Modem Interface Configuration

1. In the device manager, right click on the modem interface and select **Properties**.

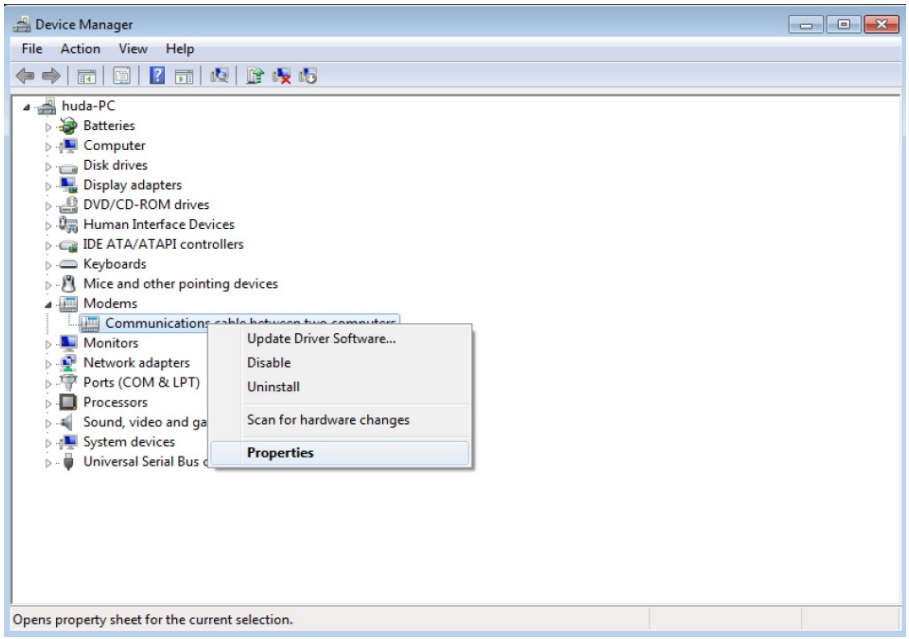

Figure 15. Modem Properties

2. In the tab **Modem** list of baudrates for **Maximum Port Speed**, you will see that the maximum value is 115200. Check that the port corresponds the one you chose. The baudrate to be set is the one of the UART that will be used for the PPP connection. You can refer to your Test Kit User Manual or use `AT+IPR?` to get it.

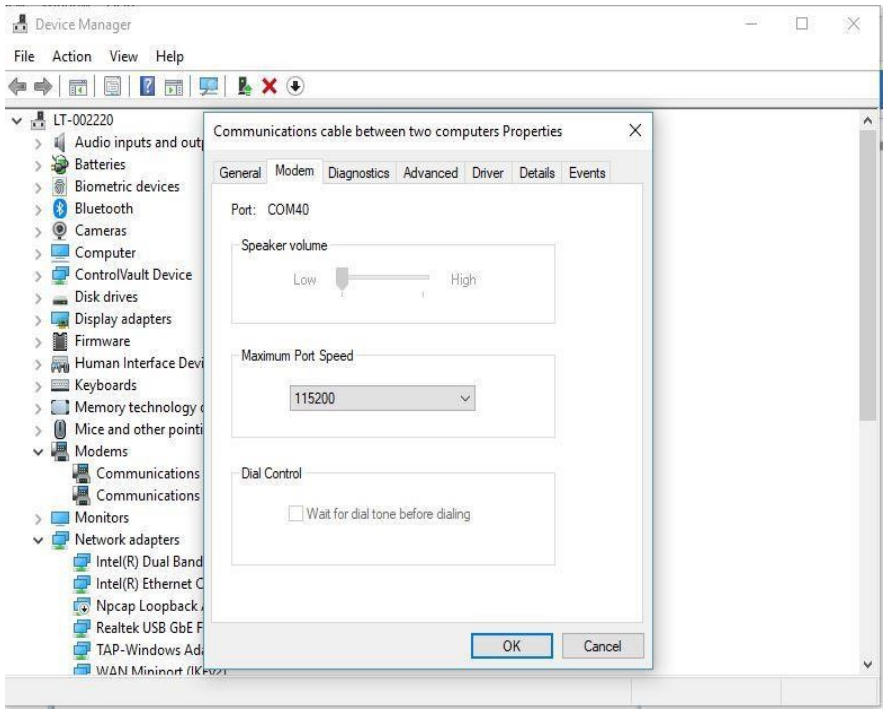

Figure 16. Maximum Port Speed

If you need to set 921600 baudrate, you must modify the base register as follows:

- Close the **Properties** window and start `regedit` as administrator.
- Go into:
  `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Class\{4D36E96D-E325-11CE-BFC1-08002BE10318}\0003`
  Note that the file isn't necessarily named `0003`
- Check that the **AttachedTo** field value matches the UART COM port used when creating the modem (here COM40).

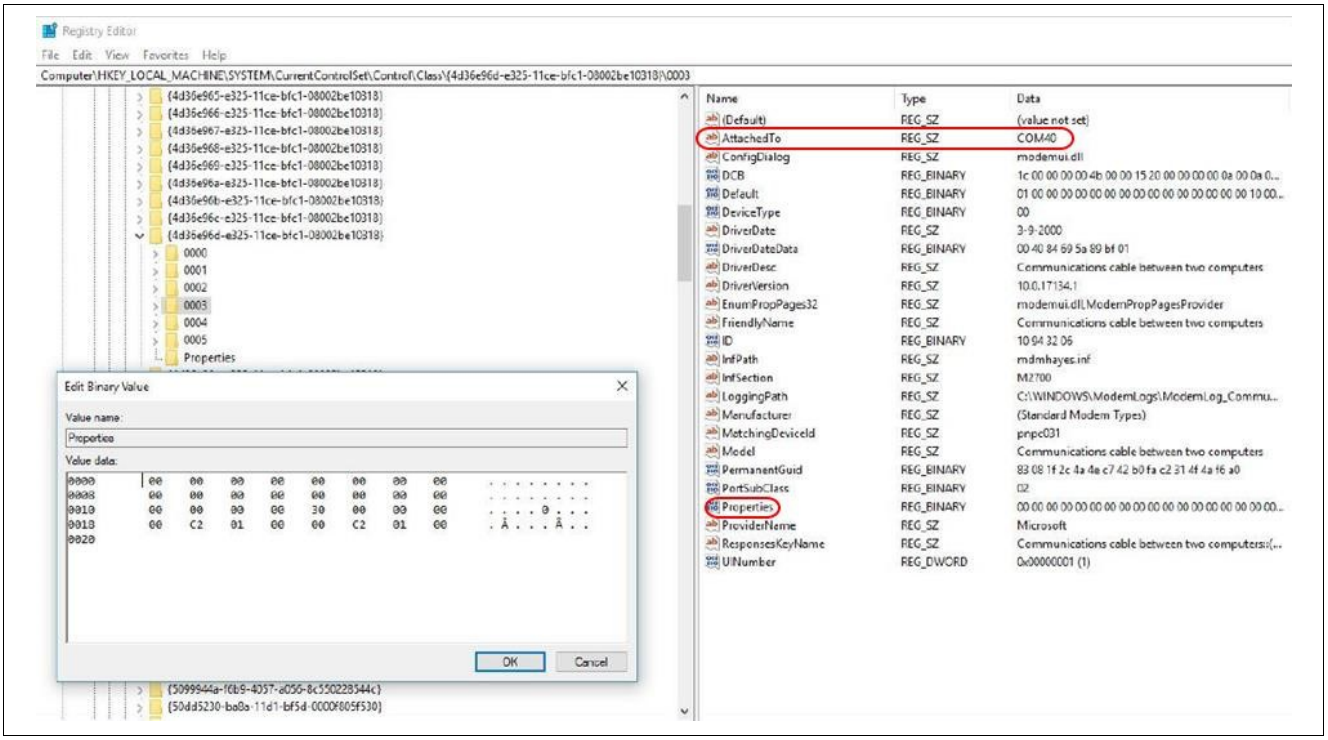

Figure 17. AttachedTo Field

- Right-click on **Properties** and select **Modify Binary Data…**
- Find the first occurrence of 00 C2 01 00 and change it into 00 10 0E 00.

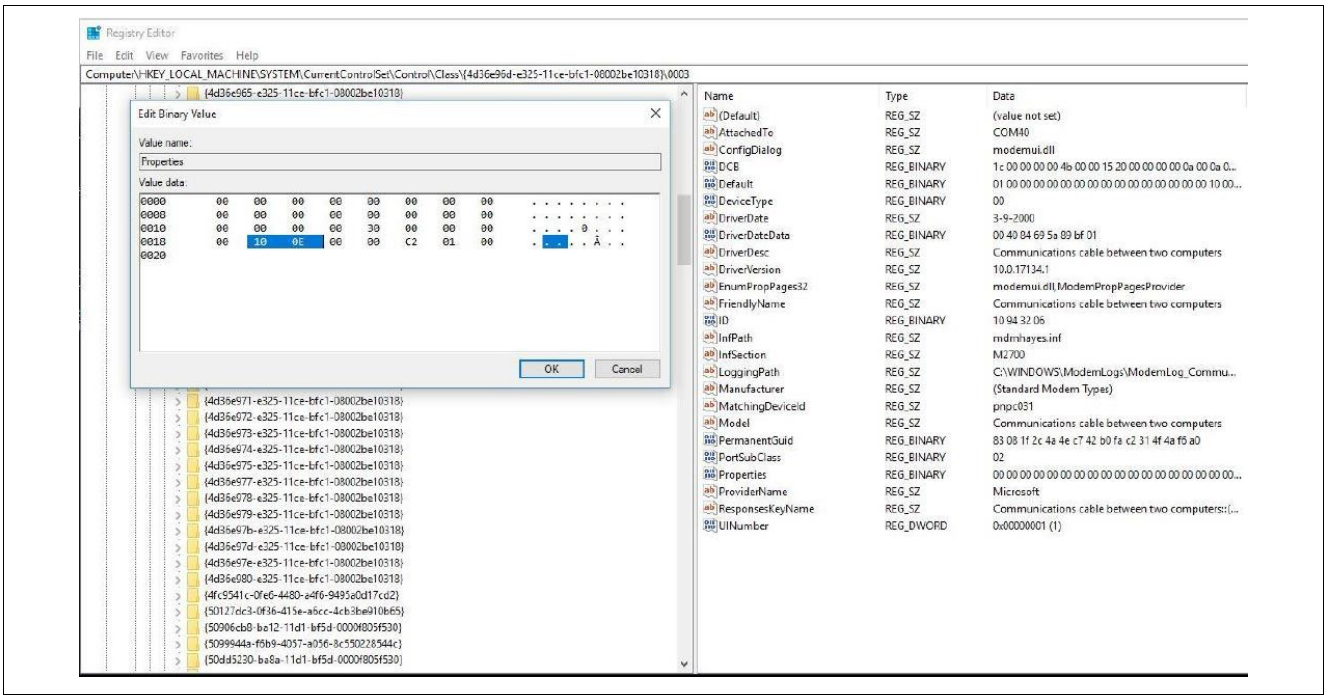

Figure 18. Modify Data

- Close regedit, return in the device manager and re-open the **Properties** window of **Communications cable between two computers**
- Select **921600** as maximum baudrate

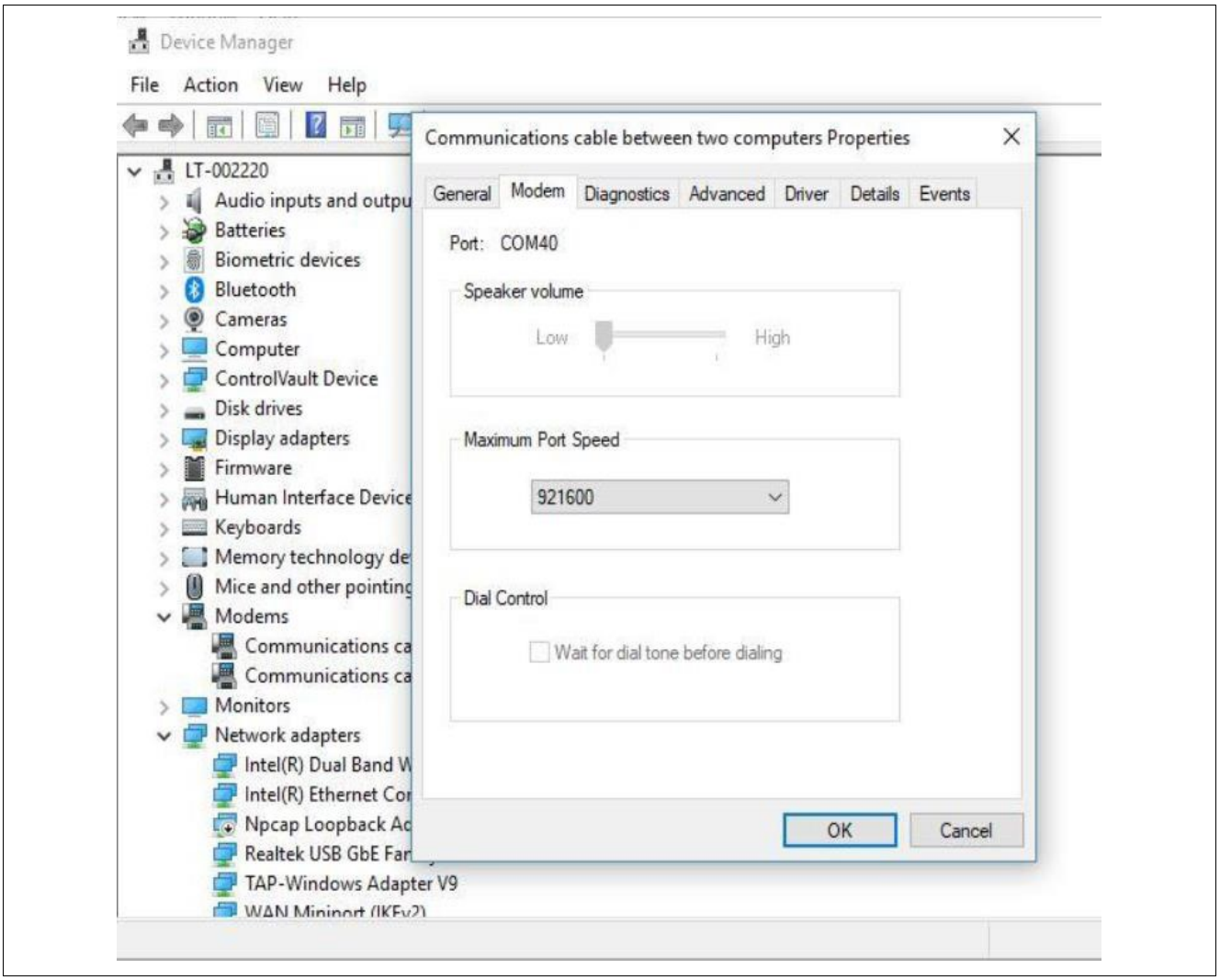

Figure 19. Set 921600 as Maximum Baudrate

3.2.3 Creating a Dial-Up Connection

1. Open the **Network and Sharing Center**

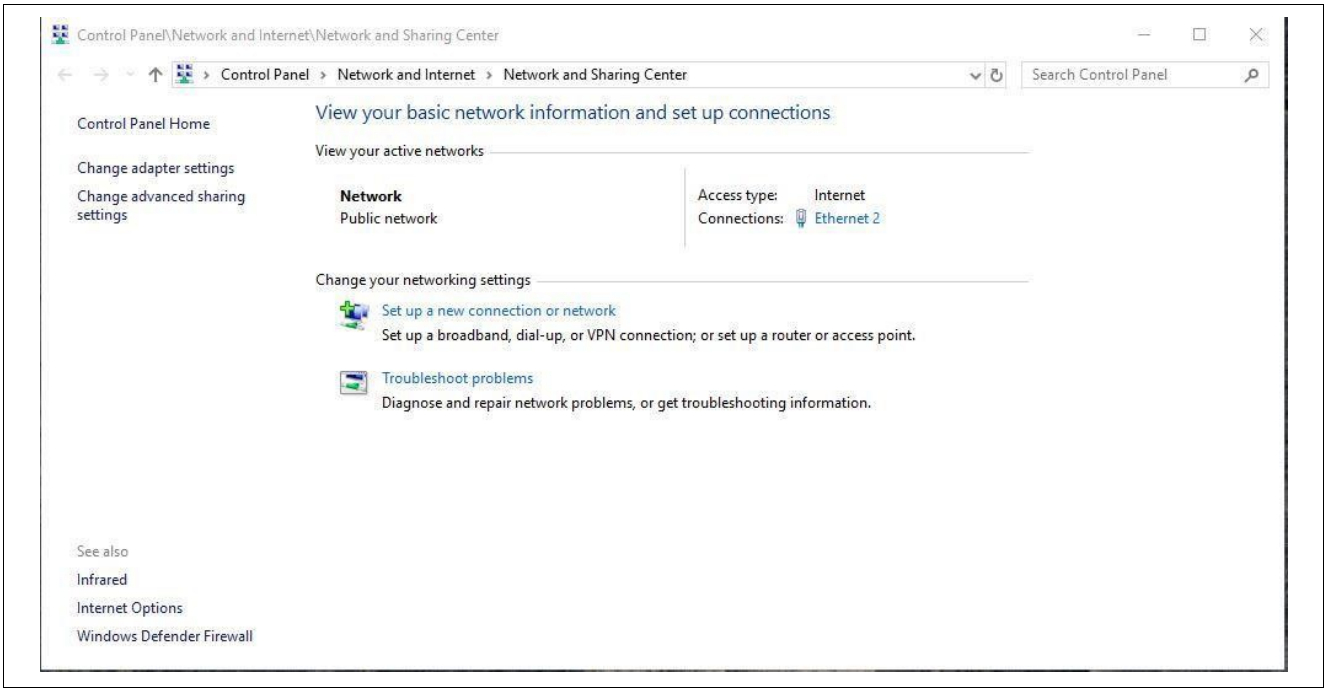

Figure 20. Network and Sharing Center

2. Click on **Connect to a workplace**

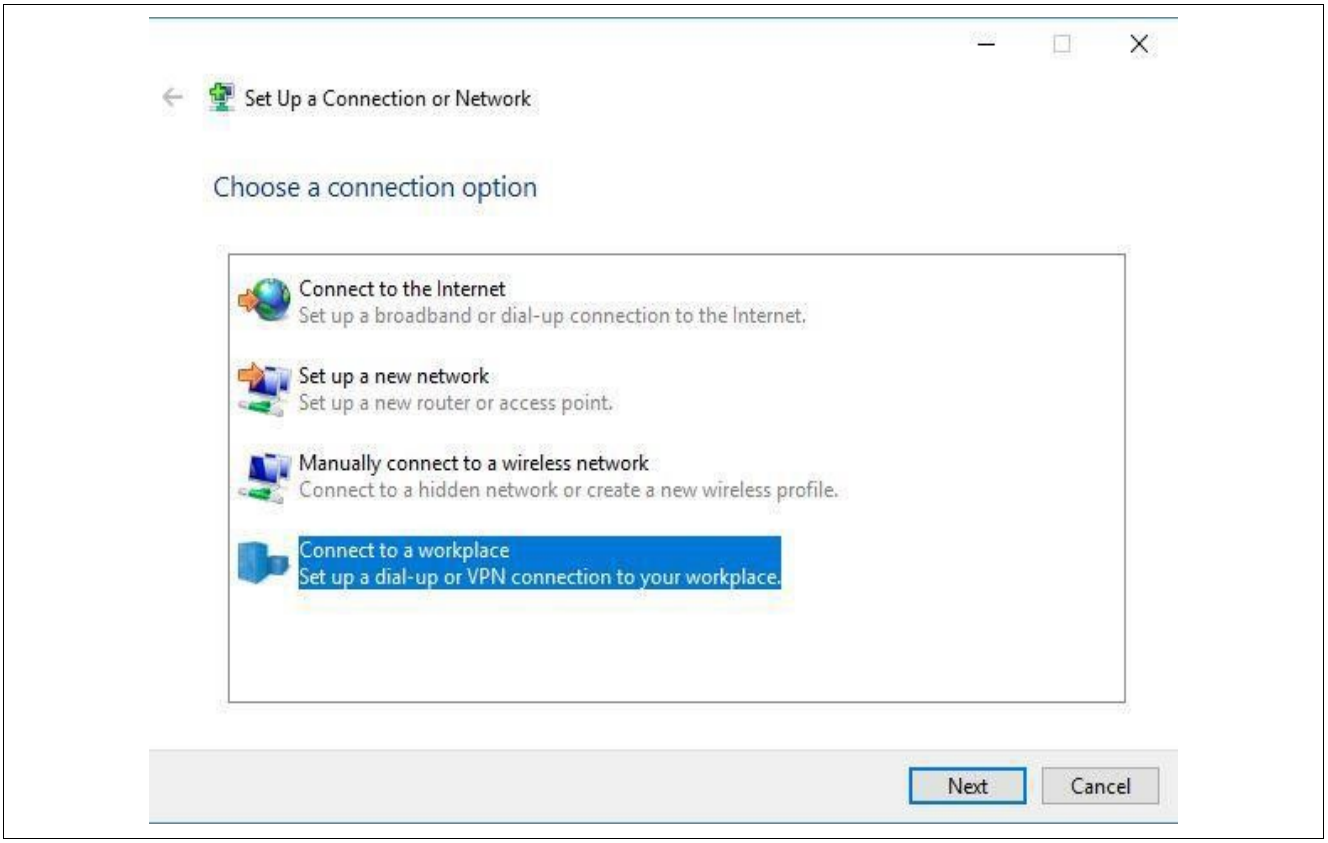

Figure 21. Connect to a Workplace

3. Select **Dial directly**

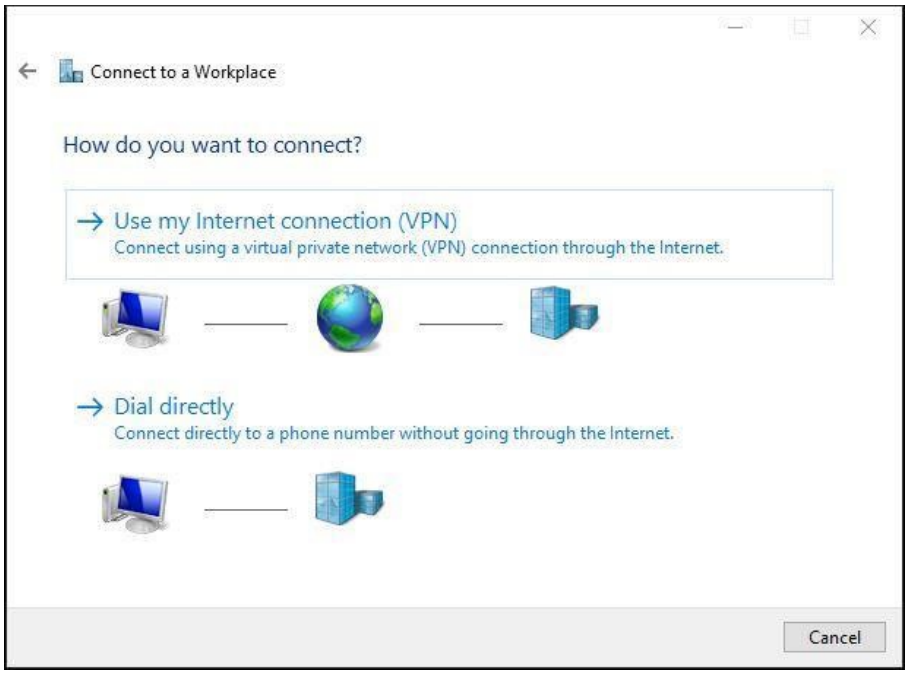

Figure 22. Select Dial Directly

4. Select the modem you created (here: **Communication cable between two computers**)

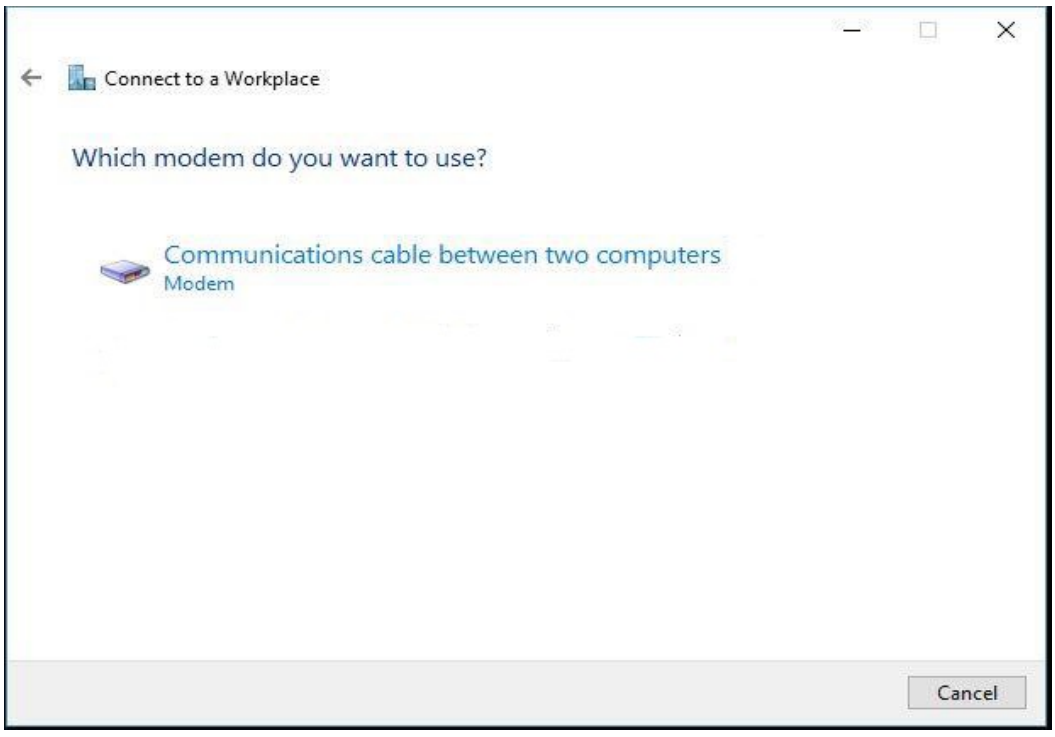

Figure 23. Select Modem

5. Set a dummy number in **Telephone number** and click on **Don’t connect now**. Then click on **Next**

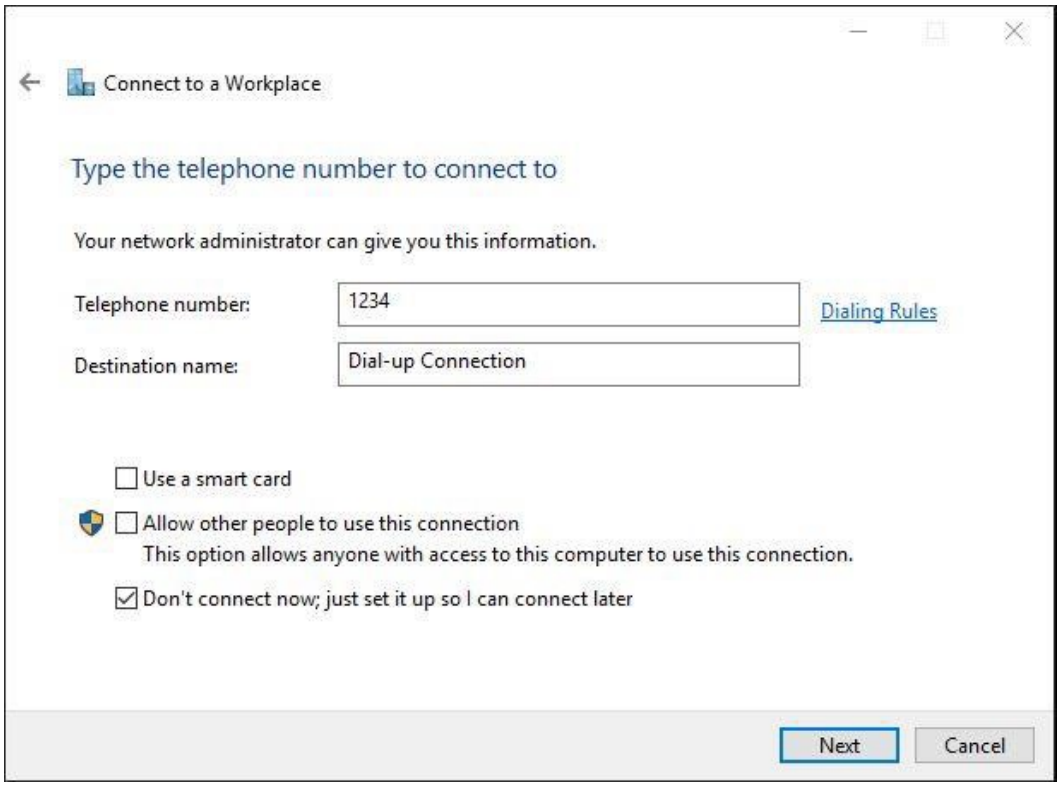

Figure 24. Set Dummy Telephone Number

6. Click on **Create**

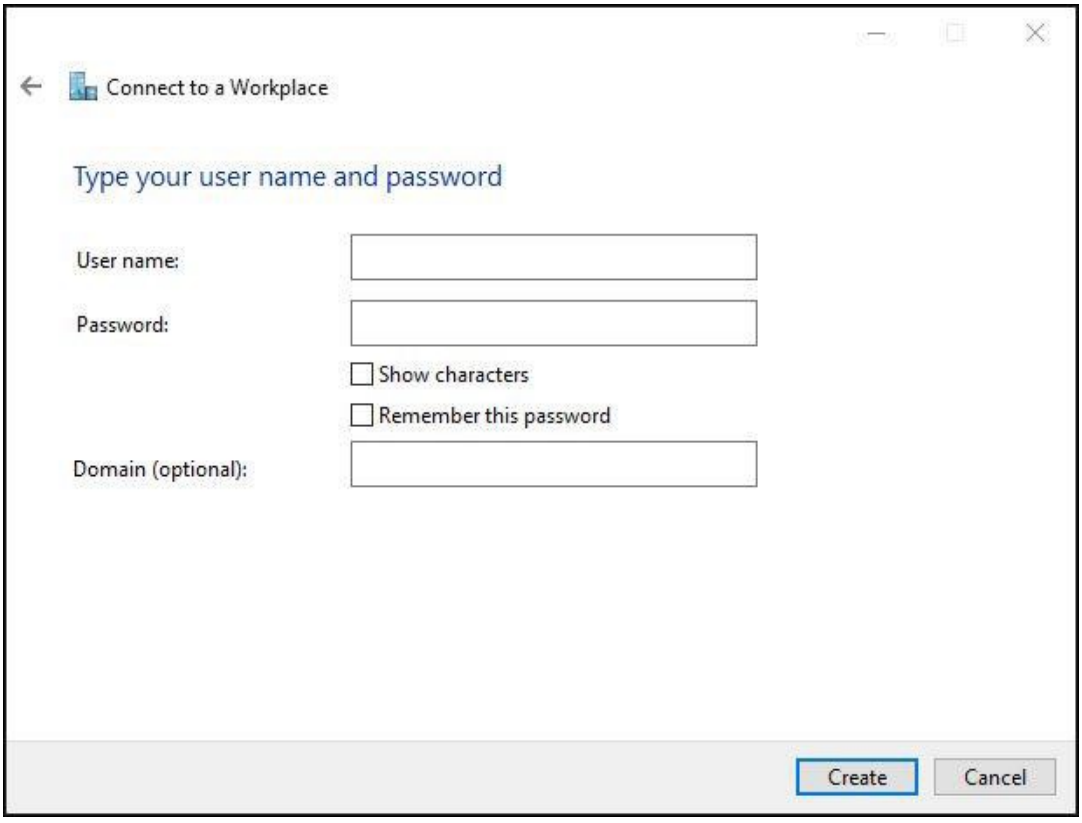

Figure 25. Create Dial Up Connection

7. Return on the **Network and Sharing Center** and click on **Change adapter settings**. You will see your dial up connection created. You can rename it as you wish.

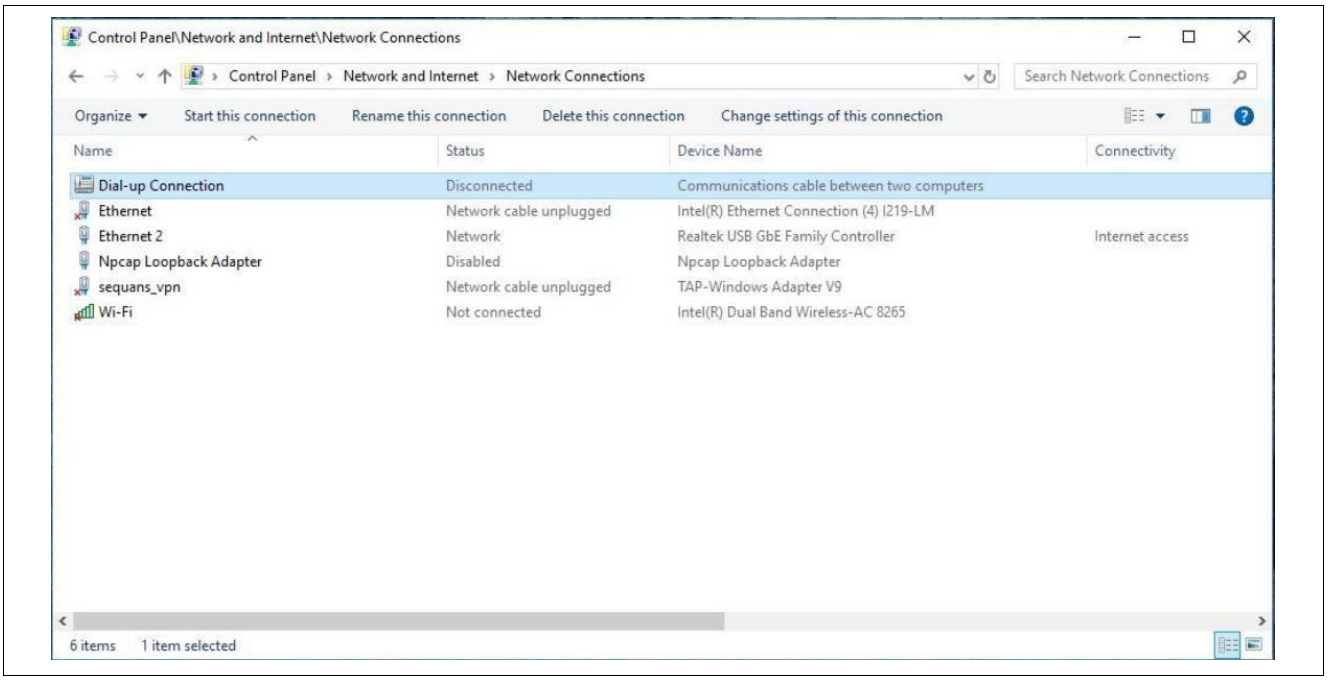

Figure 26. Check Dial Up Connection

8. Right-click on **Properties** and then in **General/Connect** using
   - Click the write link, here **Communication cable between two computers (COM40)** if you created more than one dial-up connection.
   - Click **Configure…** and select **921600** in **Maximum speed (bps)** and then **Ok**. Disable all the hardware features.

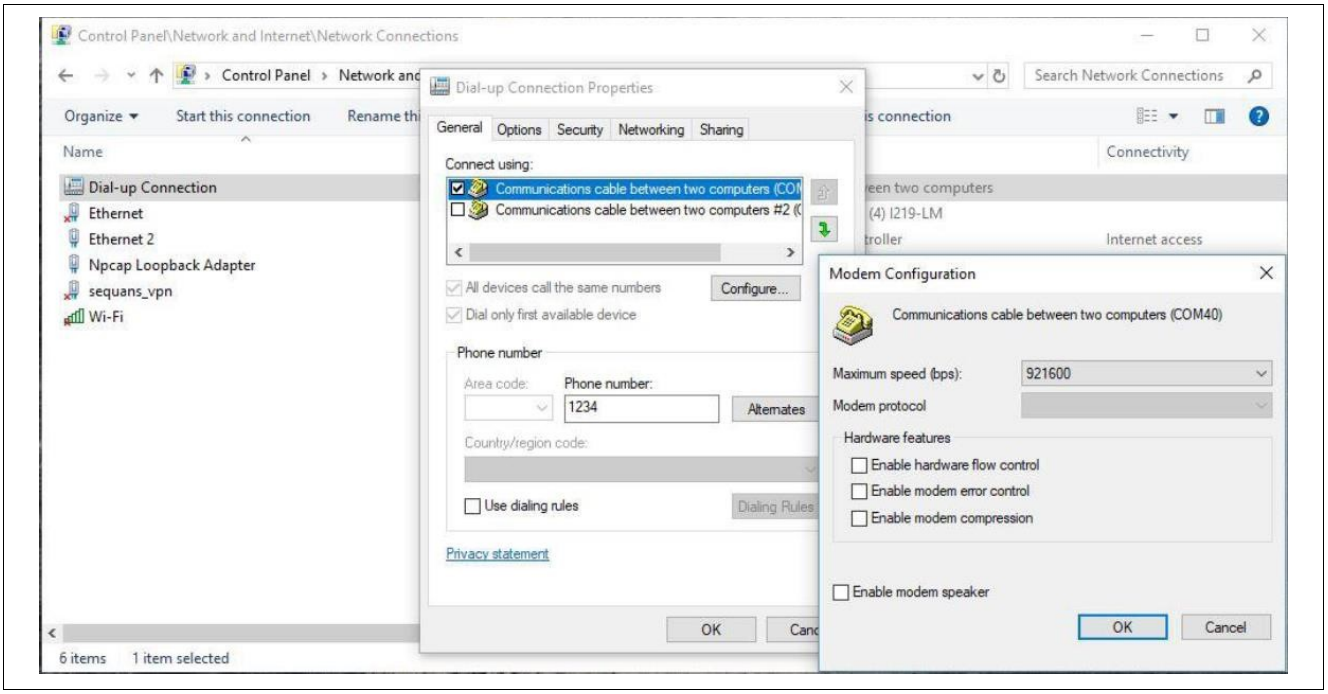

Figure 27. Configure Connection

9. In the **Options** tab, tick only **Display progress while connecting** and set **Idle time before hanging up** to **20 minutes**. Then click **OK**.

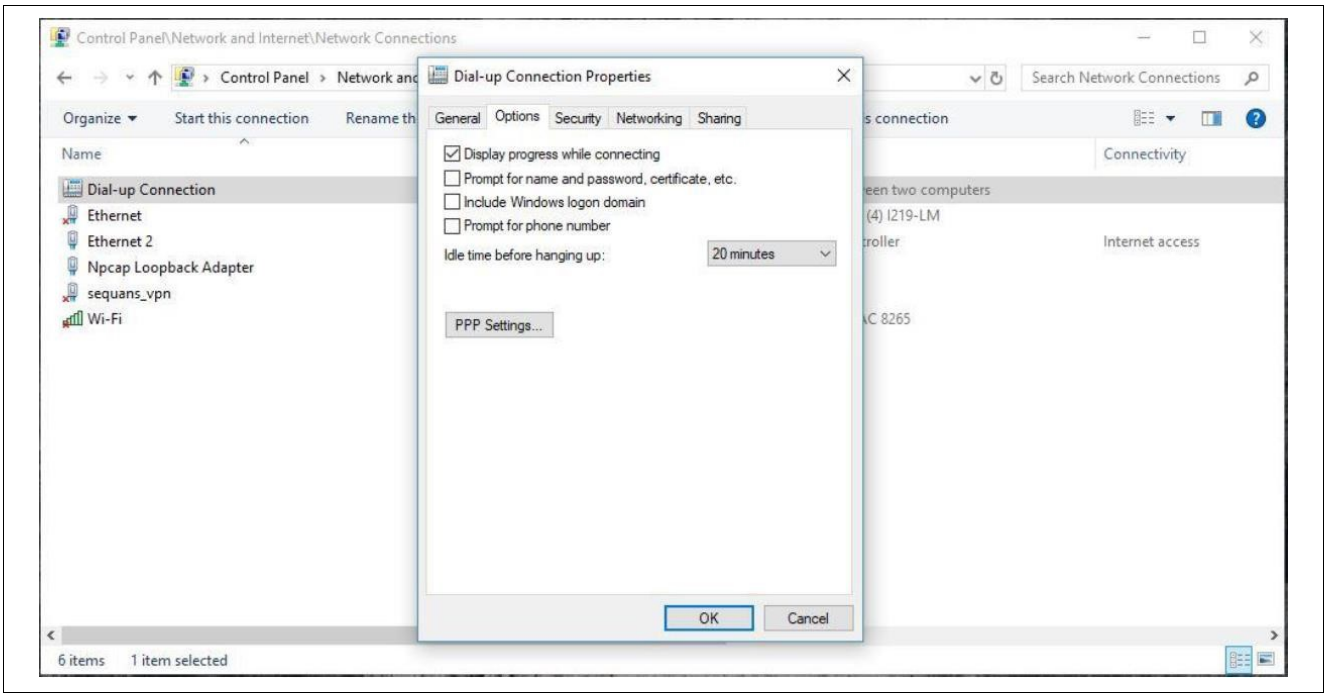

Figure 28. Create Dialup Connection

Note: At this stage, a reboot of the computer is required for those new settings to take effect.

3.2.4 Running a Data Session over PPP

In the current example, AT commands are mapped on COM40. The assumption is that the user already performed all the steps described in previous sections to create the modem interface and map it on COM40.

Start the terminal process and connect it to COM40.

Then connect the modem to the network with:

`AT+CFUN=1`
Wait for the Kit to connect to the network

`AT+CGDATA="PPP",1`
This will create the PPP connection

`AT+CGDATA=”PPP”,<cid>` where`<cid>` represents the cid of the PDP context as defined by `AT+CGDCONT`. Use value 3 for Verizon Wireless testing and 1 for the other networks. The user can check which cid is connected to the network with `AT+CGDCONT?`.

If everything went well, you should get a `CONNECT` answer. Otherwise, the command will return `NO CARRIER`, meaning that something went wrong and it needs to be fixed before moving further. Double check that the modem is correctly attached to the network.

Once `CONNECT` is received in response to `AT+CGDATA`, then disconnect the serial terminal from COM40.

Establish PPP connection as follows.

1. Right click on the **Dial-up Connection** (or whatever the name you gave) in the **Sharing Center** and select **Connect**.

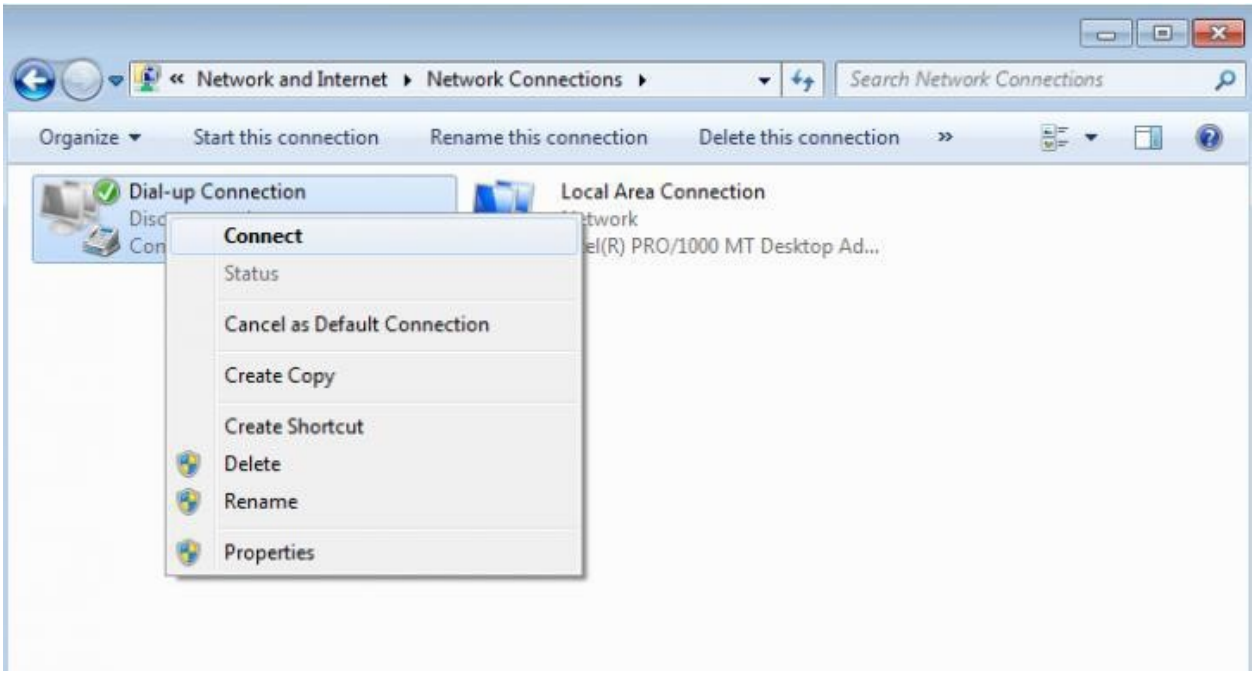

Figure 29. Connect

2. Click on **Dial-up Connection** in the Windows 10 Internet Access popup (here in airplane mode)

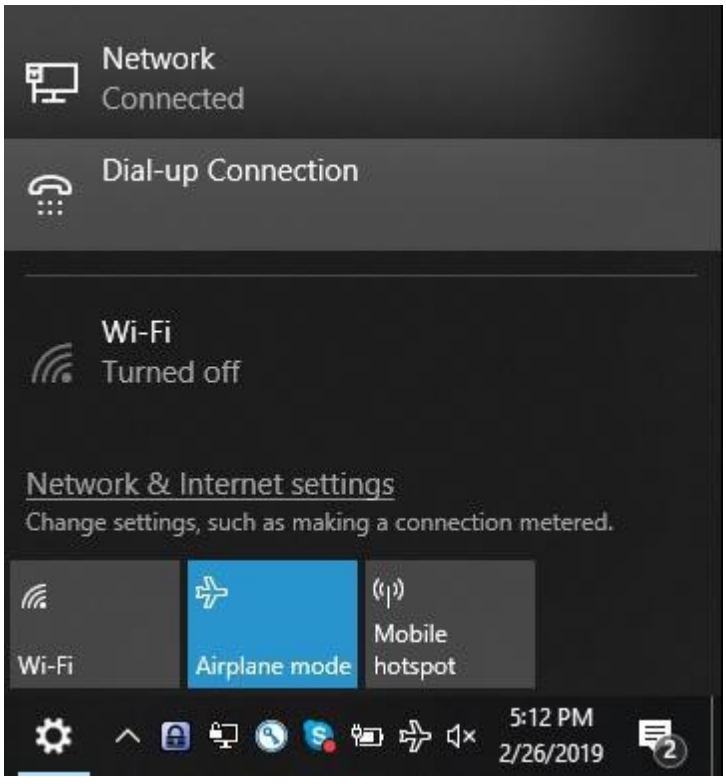

Figure 30. Internet Access

3. Windows 10 interface will show up. Click **Connect**

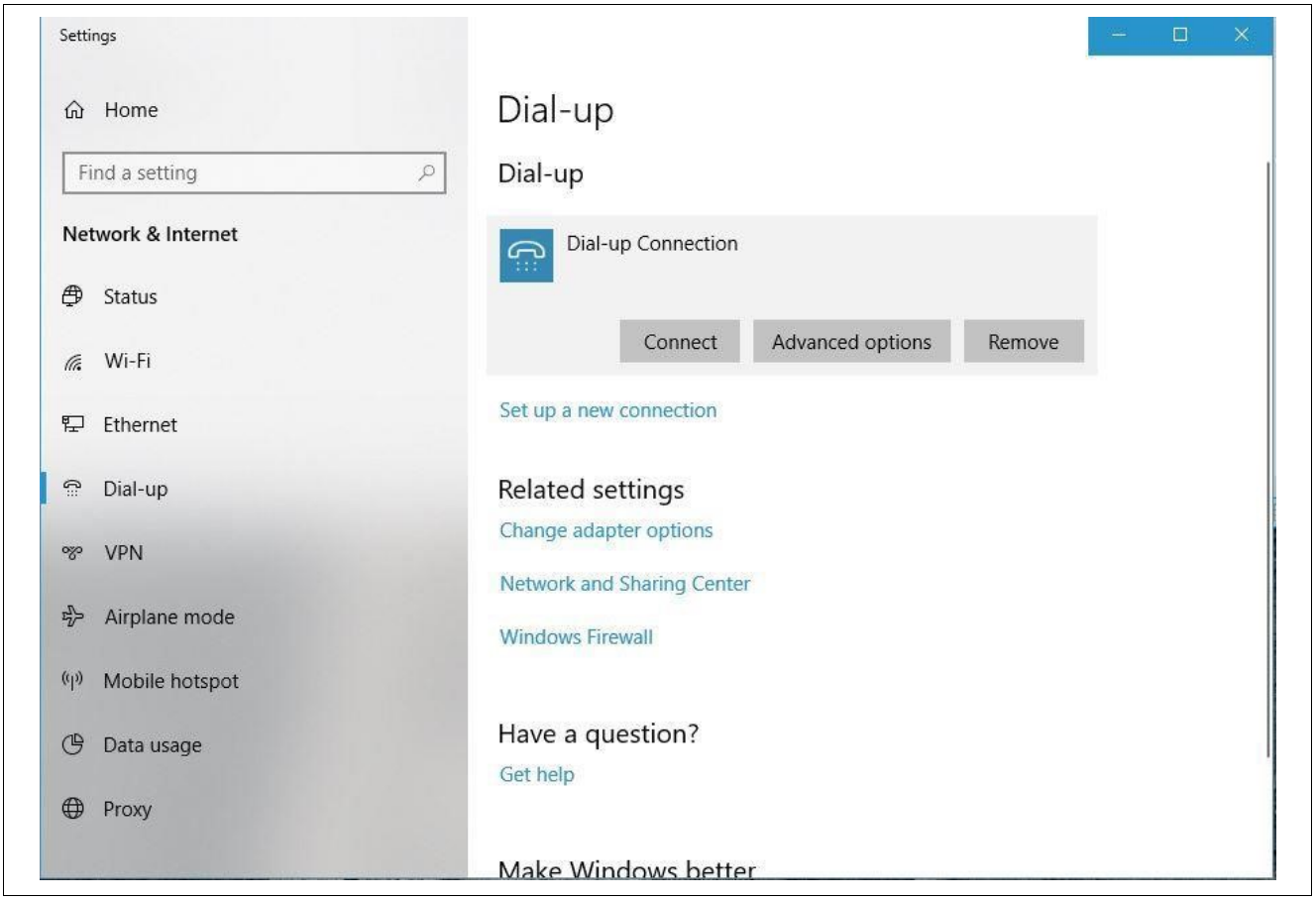

Figure 31. Windows10 Dial Up Interface

A dialog window opens, quickly passes the connection steps until it shows Connected for a few seconds, then it closes itself.

The debug console of test kit shows that PPP connection is established and shows the local and remote IP addresses.

3.2.5 Troubleshooting

If you encounter any issue while setting up the PPP connection, please check the following:

- Check in the device manager that the COM port used for PPP is the right one. It should correspond either to the AT port of the test kit or to the debug port.
- Check that the **Hardware features** are all disabled in the PPP connection properties
  - Make sure that you reboot your laptop after configuring the dial-up connection.
  - Make sure that the COM port used for PPP is not already opened somewhere else
  - Check that the UE is attached and has a valid IP address.
  - Check that the `AT+CGDATA` command was set using the right cid by checking the PDN attached to the network with `AT+CGDCONT?`

3.3 Without sqncom2ppp Tool (Windows 7 Host)

This section describes how to set up a PPP connection using a Windows 7 host if you don't have access to the sqncom2ppp tool. Computer used for testing should have no firewall and user should have administrator rights.

3.3.1 Modem Interface Creation

First associate a dial-up interface with the modem

1. Open the “Phone and Modem” settings panel

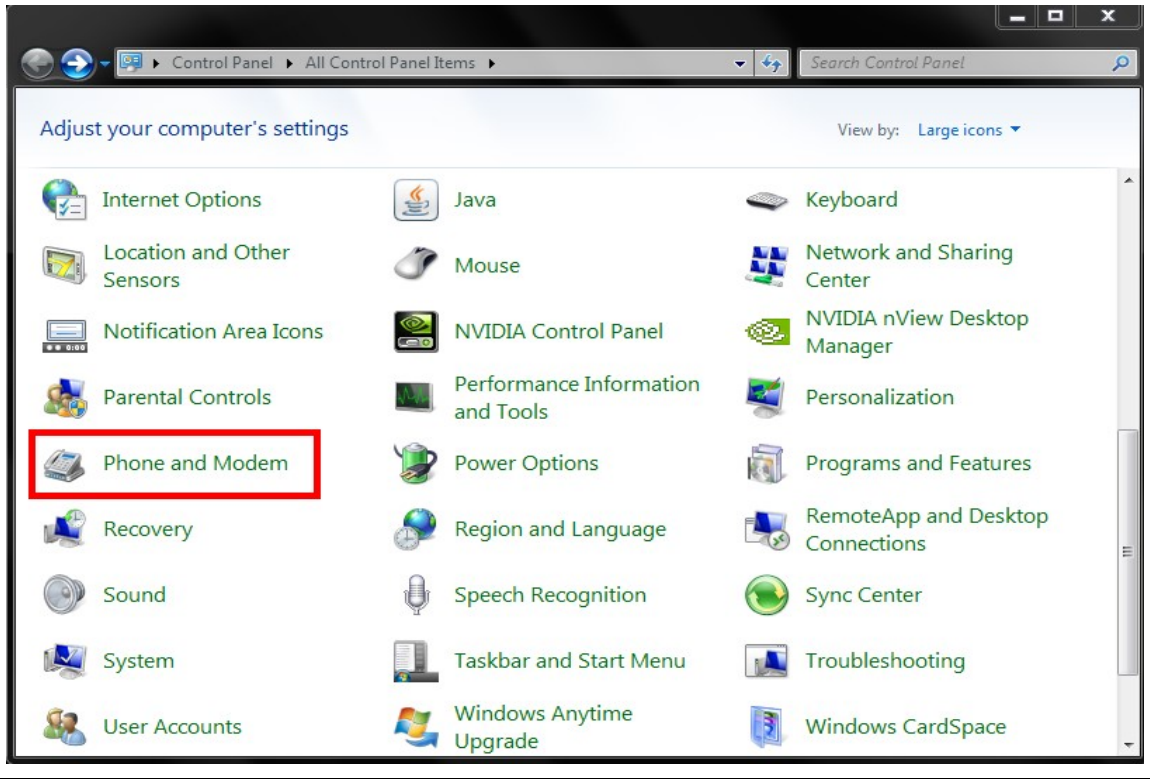

Figure 32. Open Phone and Modem Control Panel

If you see a pop-up window like the following, this is because you need to set some “area zone” the first time you install a dialup modem connection. Just enter **0000** for example and then click **OK**.

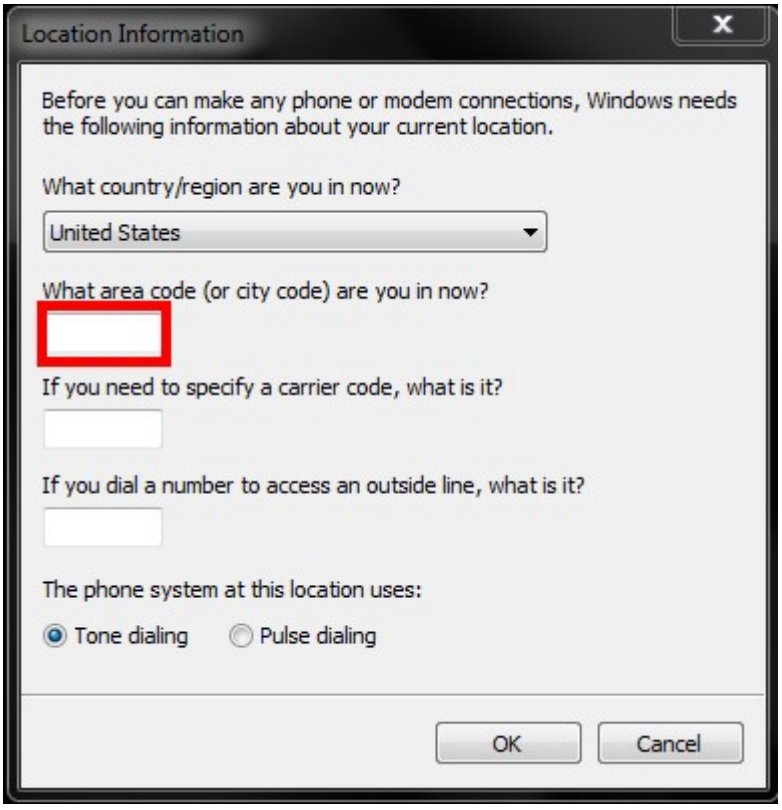

Figure 33. Location Information

2. Choose the **Modems** tab in the next window.

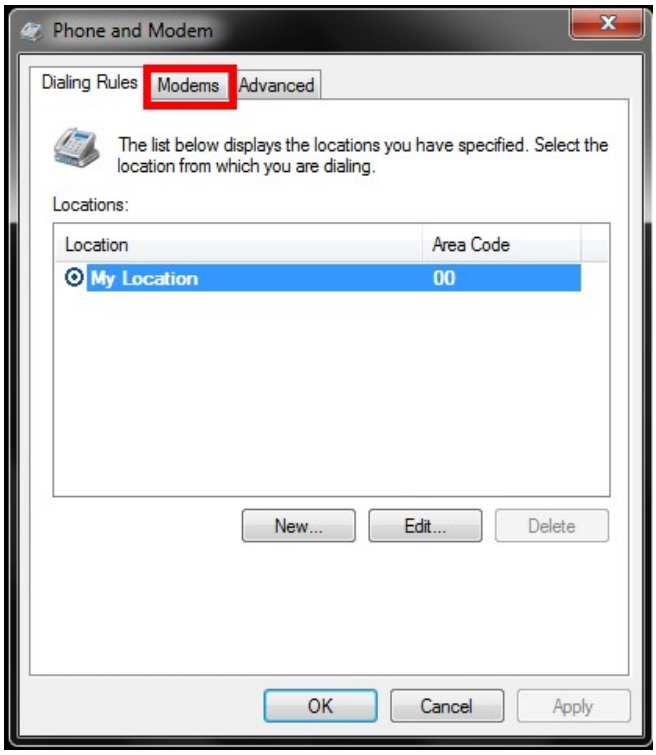

Figure 34. Modem Tab

3. Click on the **Add** button to add a new modem interface. In the new window that pops up, enable the option **Don't detect my modem. I will select it from a list**.

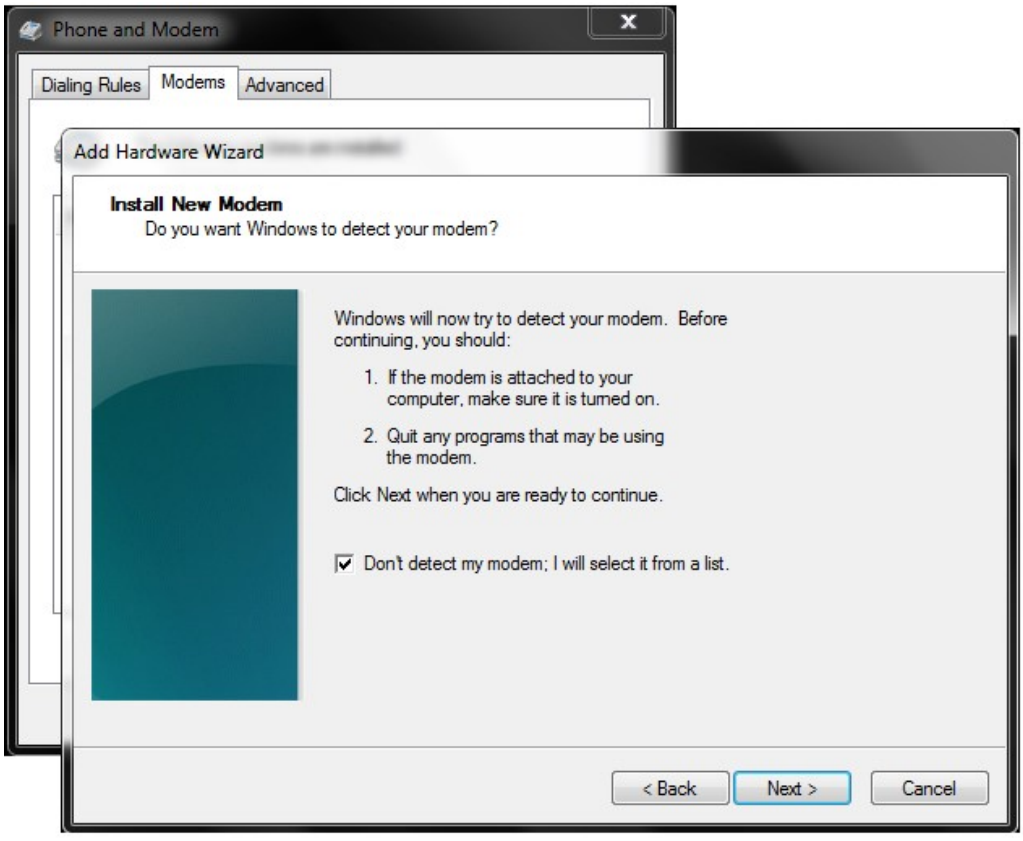

Figure 35. Don't Detect Modem

4. Wait while you see **Retrieving a list of all devices** and a few seconds later a list of modem models appear. Select the **Standard 56000 bps Modem**.

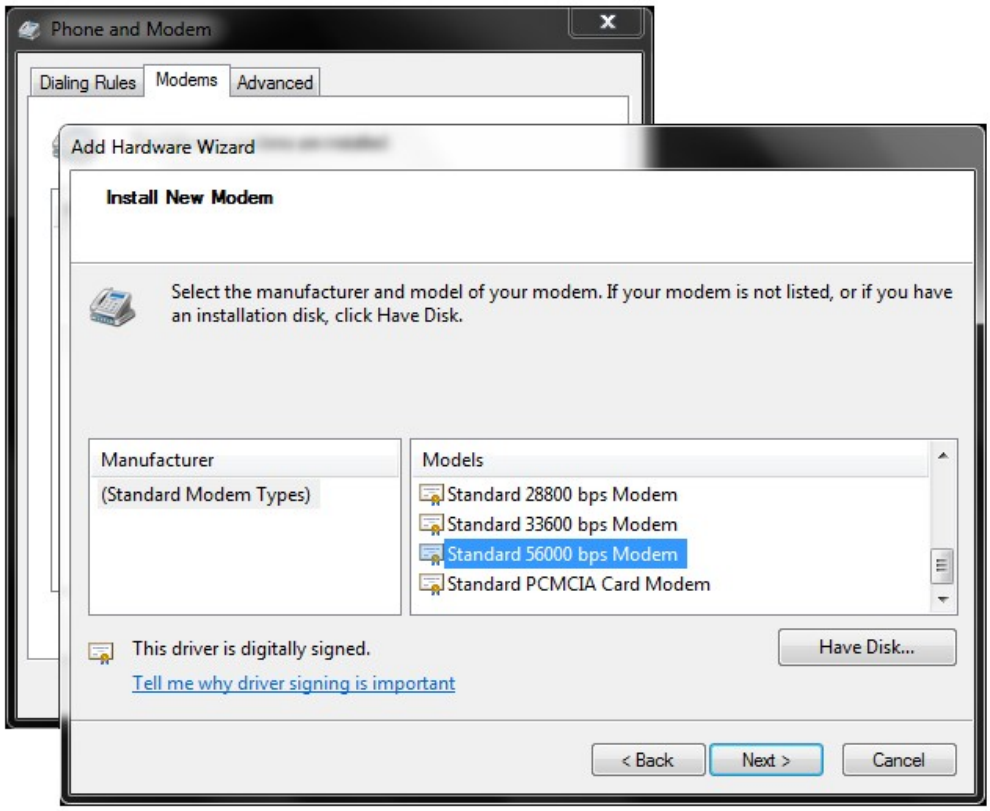

Figure 36. Select Standard 56000 bps Modem

5. In the next window that appears, you need to associate a COM port with the Modem. Please use the UART COM associated with AT Commands or to DCP (refer to your test kit user manual). If you don't see the COM port to be used in the list, make sure that it is not being used by another application.

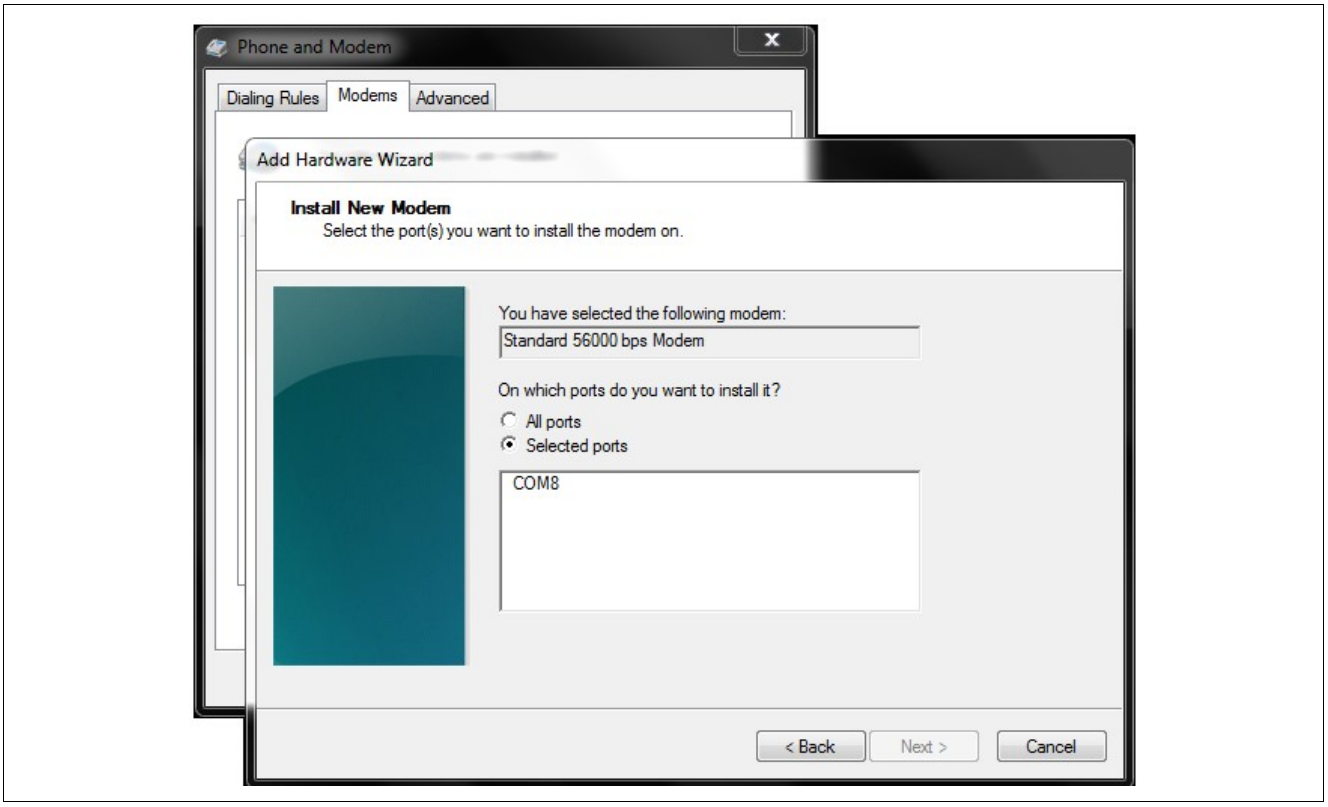

Figure 37. Associate COM Port with Modem

6. Click on **Next** to finish the installation of the modem device.

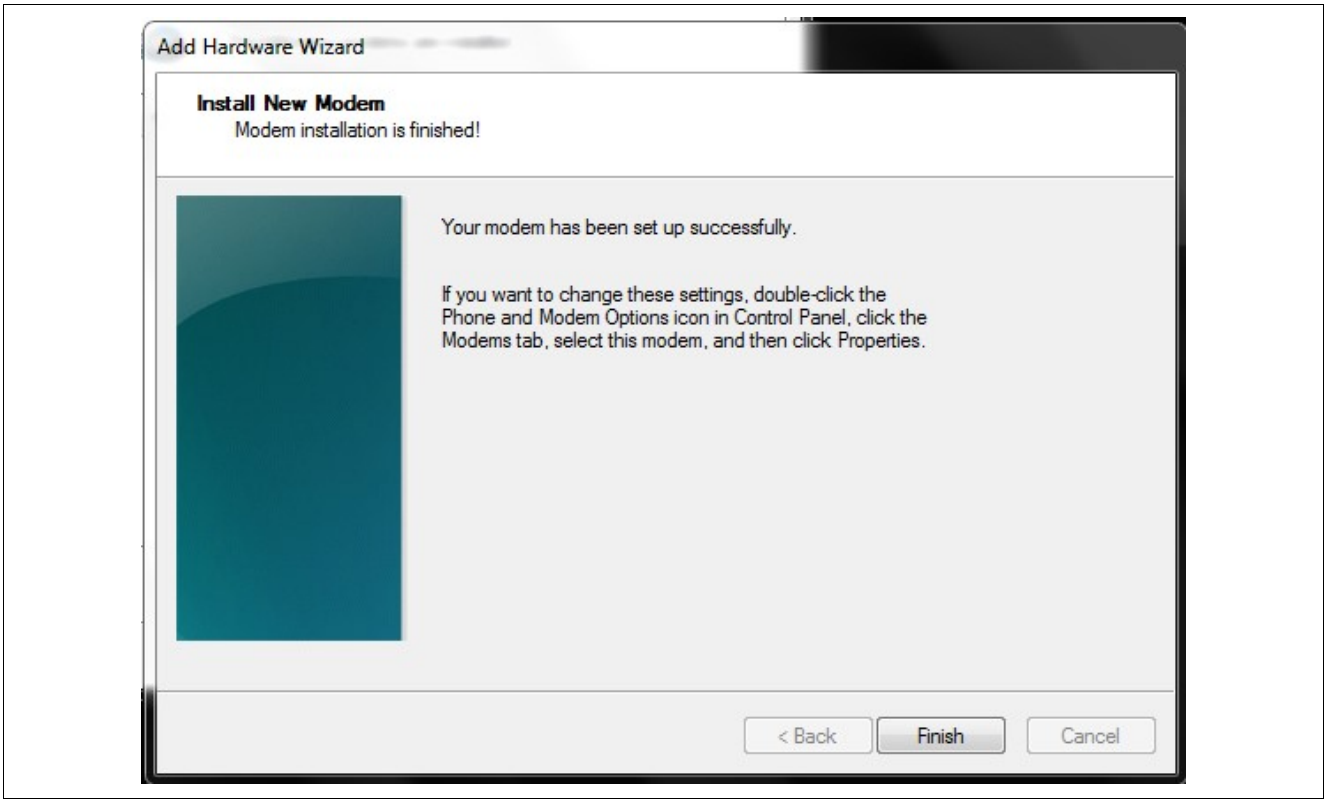

Figure 38. Finish Installation

7. A new modem device associated to the COM port has been created

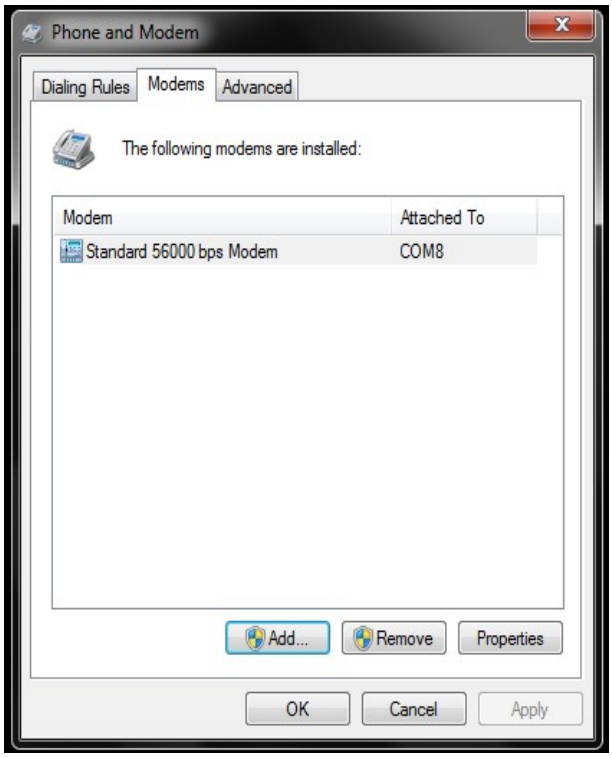

Figure 39. Modem Installed

3.3.2 Modem Interface Configuration

1. Configure the Modem interface as follows
   - Open the Windows control panel **Phone and Modem** section
   - Click on the **Modems** tab
     - The new modem can be seen in the list.
     - Double-click on it
     - Then click on **Change Settings**

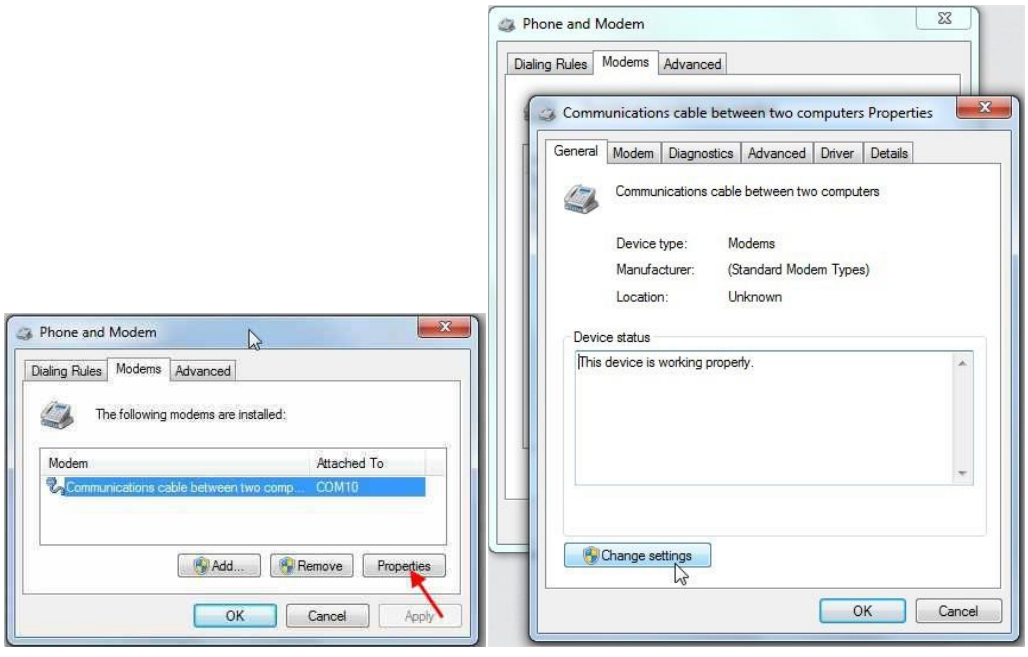

Figure 40. Change Modem Settings

- In the **Modem** tab, set the baud rate of the UART port
- The baudrate of the UART can be checked with AT+IPR?

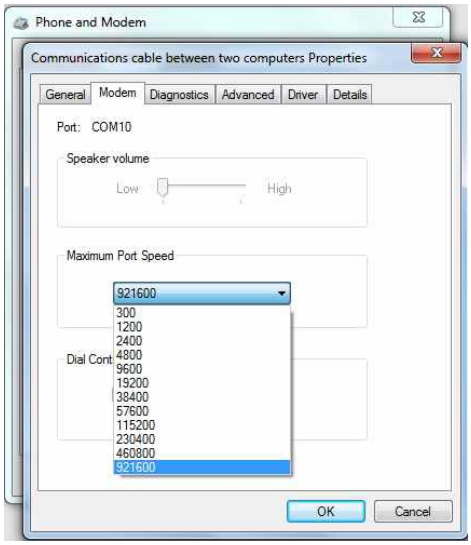

Figure 41. Set Baudrate

Note: At this stage, a reboot of the computer is required, in order for those new settings to take effect.

2. Check modem configuration
   - Open the Windows control panel, **Network and Sharing Center** section
   - Click on **Change adapter settings** on the left
   - Select the right connection (**Sequans Interface COM##**) and click on **Change settings of this connection** from the menu above, then **Configure**

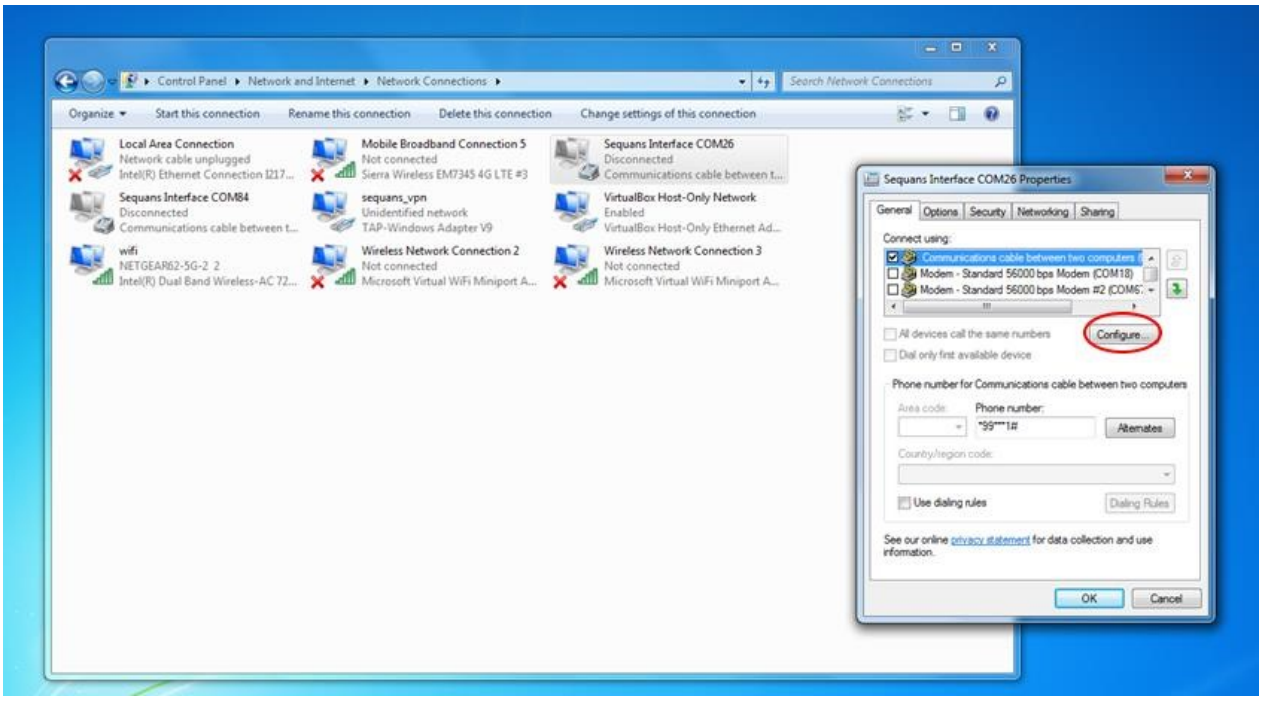

Figure 42. Modem Configuration

— Check that the speed is correct, and that HW flow control is enabled

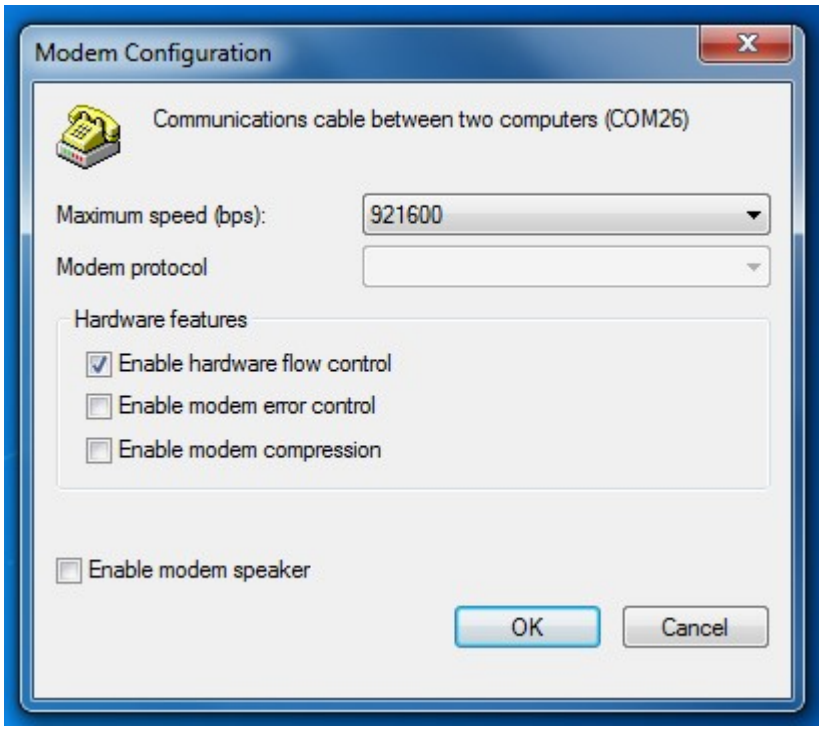

Figure 43. Check Modem Speed and Hardware Flow Control

3.3.3 Running a Data Session over PPP

In the current example, AT commands are mapped on COM10. Assumption is made that the user already performed all the steps described in previous sections to create the modem interface and map it on COM10.

Start the terminal process and connect it to COM10.

Then connect the modem to the network with:

`AT+CFUN=1`
Wait for the Kit to connect to the network

`AT+CGDATA="PPP",1`
This will create the PPP connection

`AT+CGDATA=”PPP”,<cid>` where `<cid>` is set to 1 by default. To run tests over Verizon Wireless network, cid should be set to 3. The user can check which cid is connected to the network with `AT+CGDCONT?`.

If everything went well, you should get a `CONNECT` answer. Otherwise, the command will return `NO CARRIER`, meaning that something went wrong and it needs to be fixed before moving further. Double check that the modem is correctly attached to the network.

Once `CONNECT` is received in response to `AT+CGDATA`, then disconnect the serial terminal from COM10.

3.3.3.1 Creating a Dial-up Connection

1. From the **Network settings** panel, choose **Setup a new connection or network**.

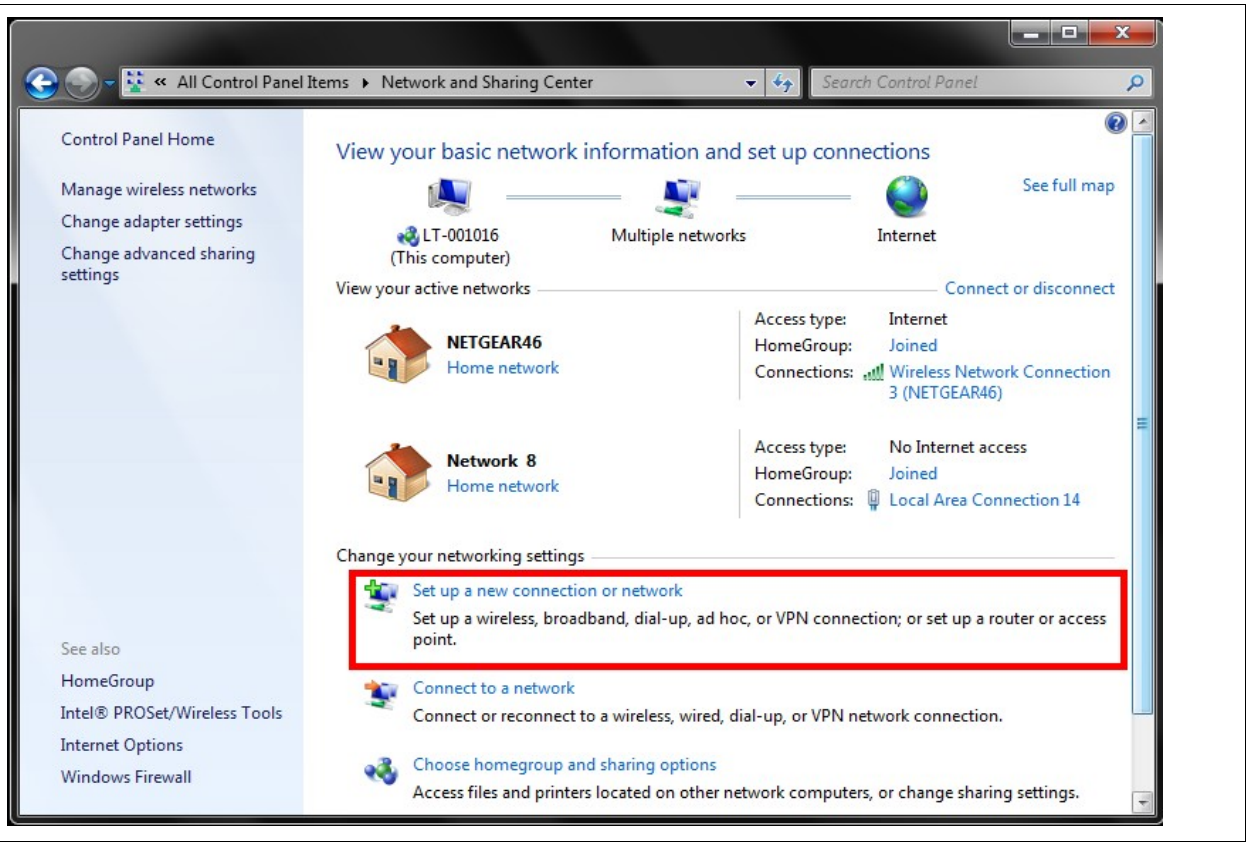

Figure 44. Set Up New Connection

2. Then choose **Set up a dial-up connection**.

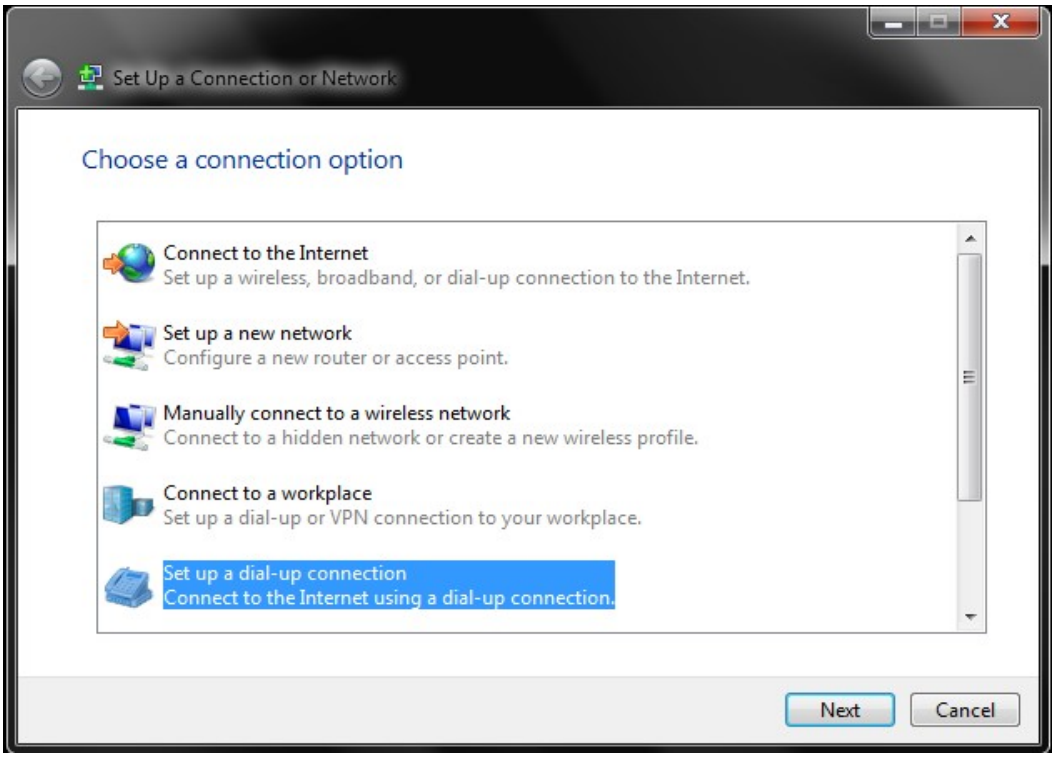

Figure 45. Set Up a Dial-Up Connection

3. Enter `*00#` as the **Dial-up phone number** and then click on **Connect**.

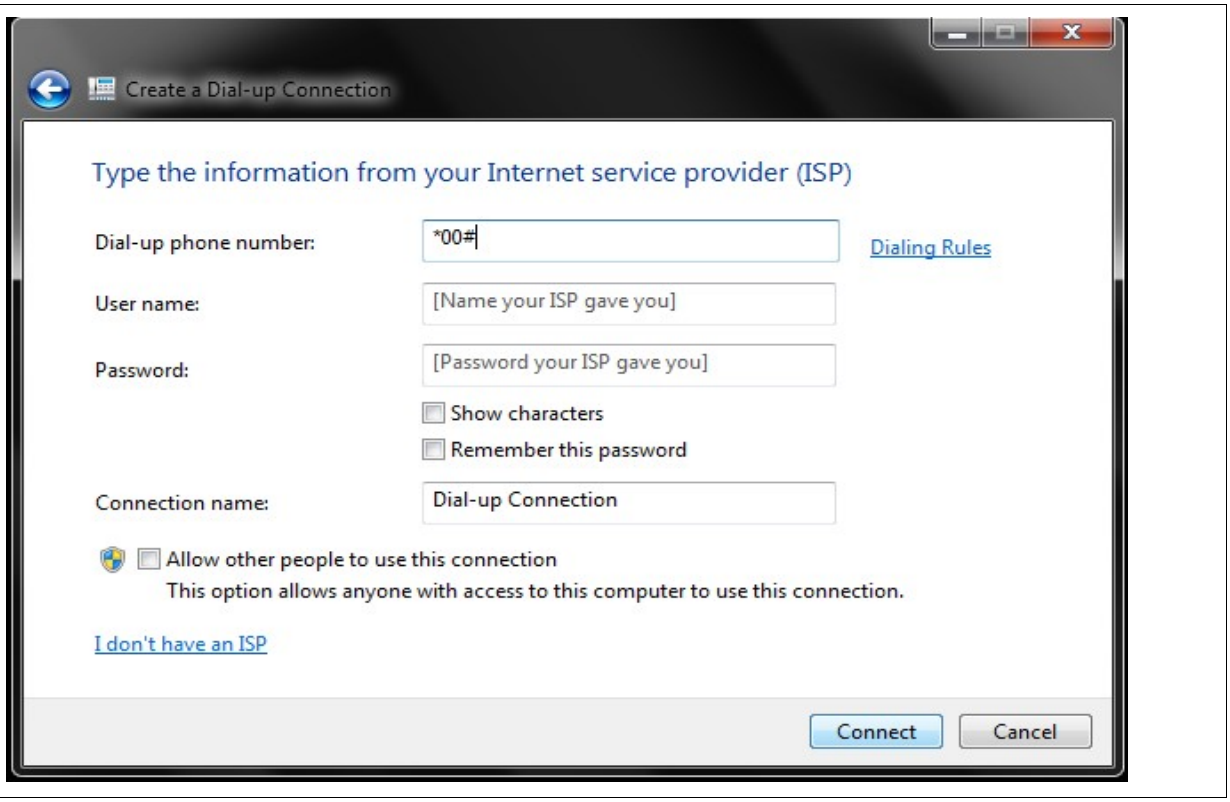

Figure 46. Enter Phone Number

4. Windows will immediately try to open the dial-up connection

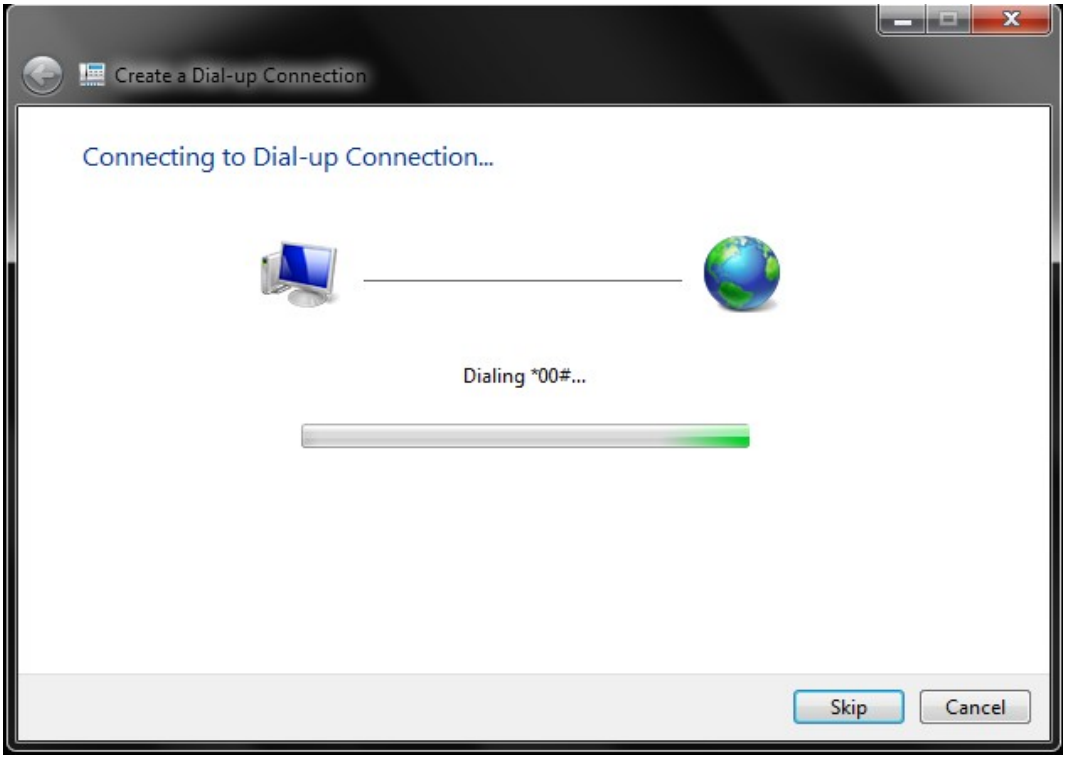

Figure 47. Opening Dial-Up Connection

3.3.3.2 Opening Dial-up Connection

1. From the Windows **Control Panel**, open the **Network and Sharing Center** settings and choose **Change adapter settings**. Right-click on the icon of the **Dial-up Connection** and choose **Connect**.

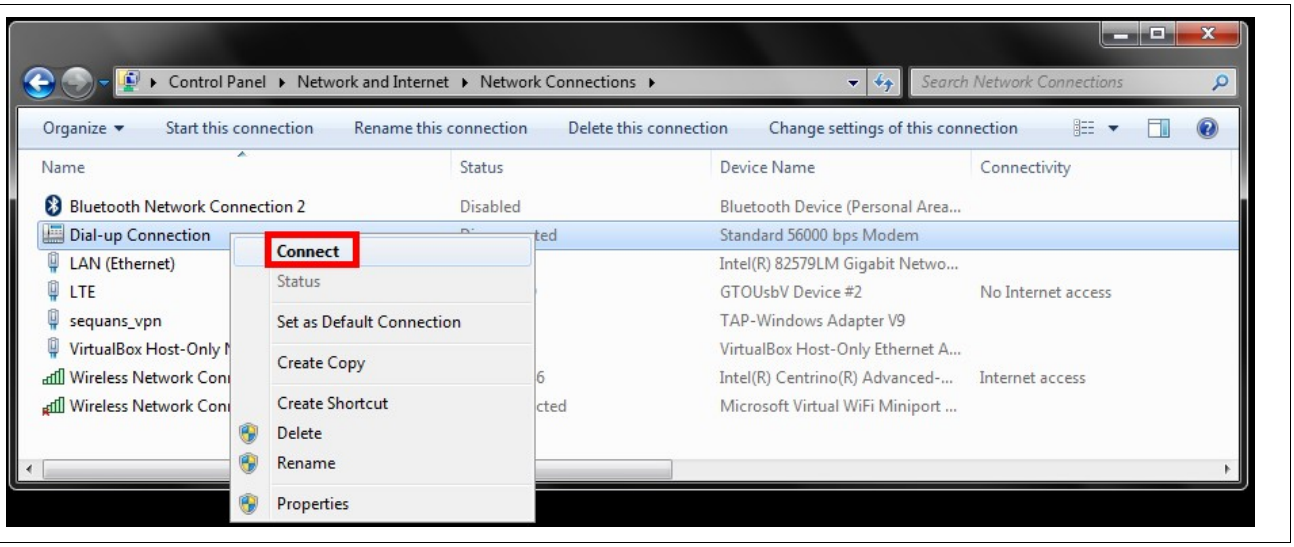

Figure 48. Connect

2. In the new window that pops up, click on **Dial**. You don't need to enter anything in the user name/password fields.

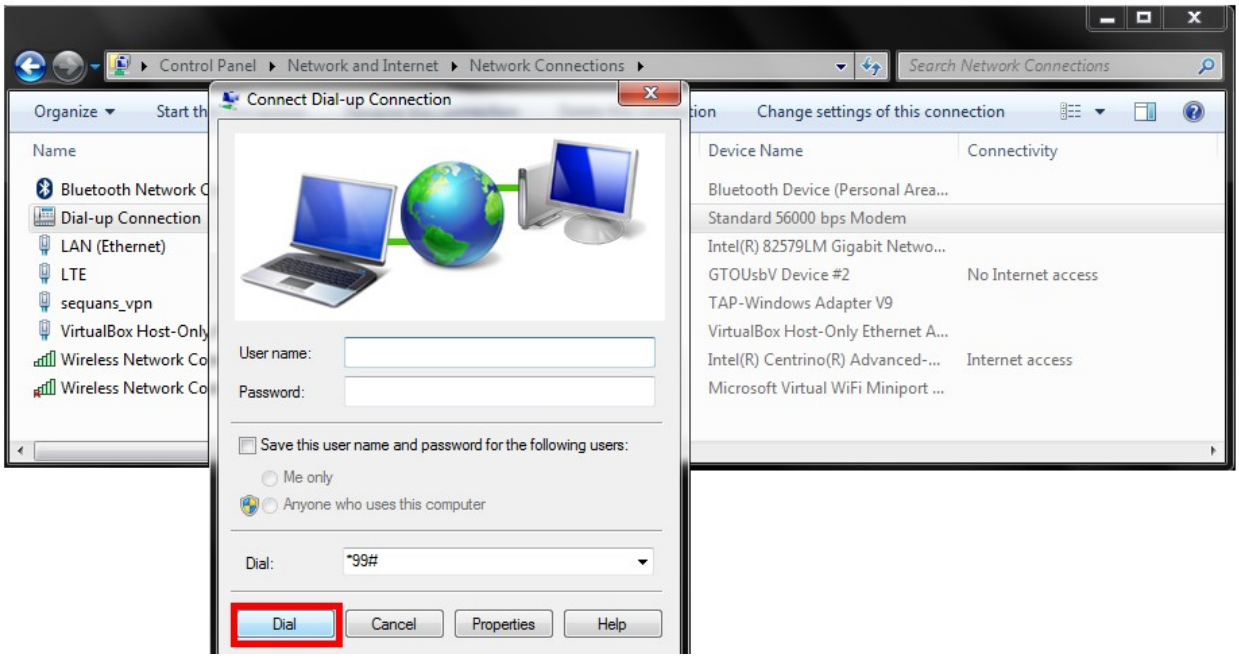

Figure 49. Dial

3. Once the connection is established, you can right-click on the icon for **Dial-up Connection** and choose **Status** for checking connection parameters after clicking on **Details** (IP address and so on).

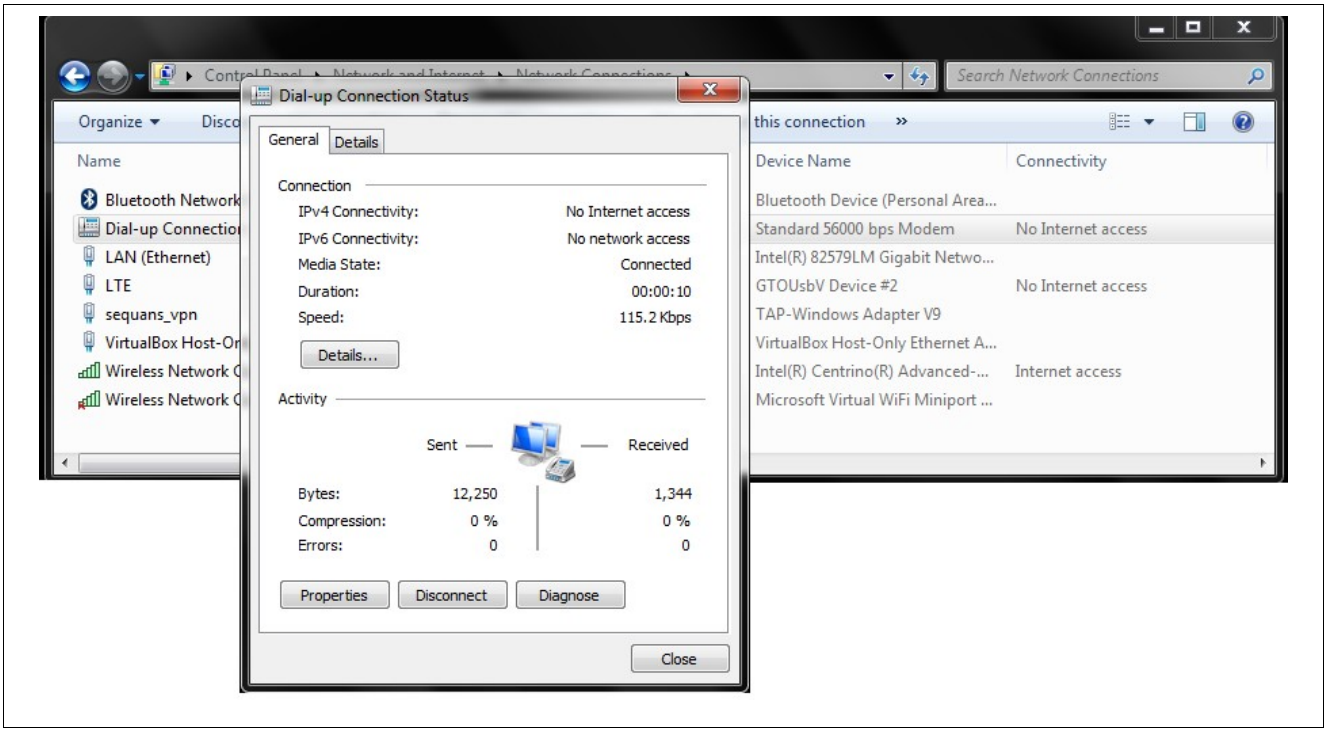

Figure 50. Check Parameters

3.3.3.3 Closing Dial-up Connection

Right-click on the icon of the **Dial-up Connection** and choose **Disconnect**.

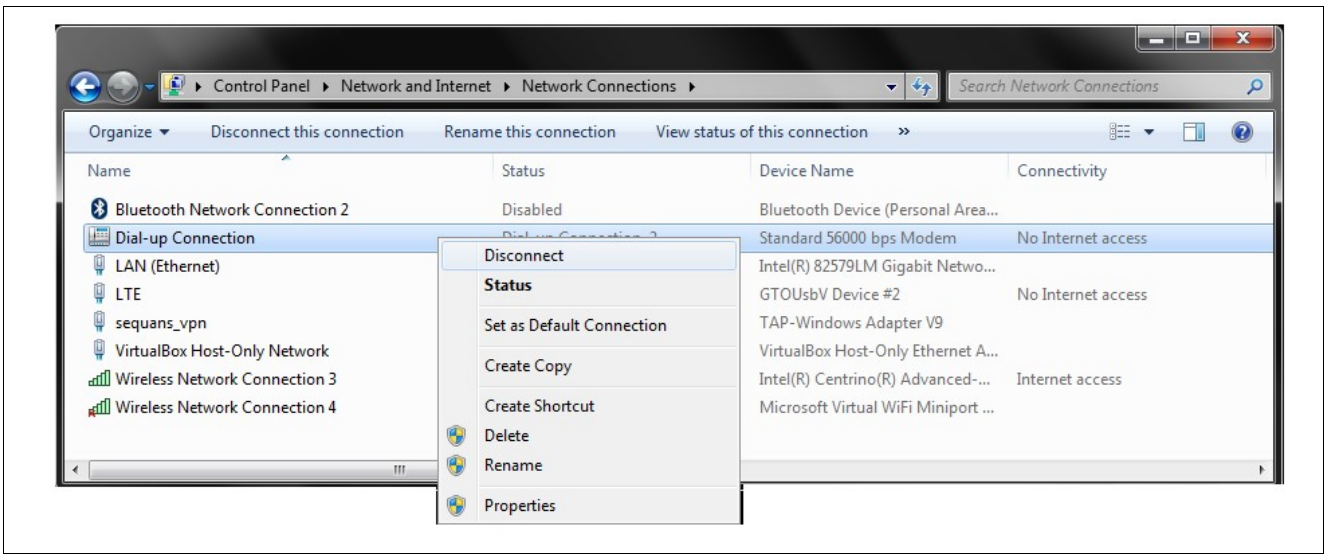

Figure 51. Disconnect

Revision History

Rev.	Date	Description	
		Page	Summary
Rev.1.00	Dec.9.20	-	Initial release
Rev.1.40	Mar.23.22	-	Added PPP Overview section. Other minor changes.
Rev.1.41	Mar. 30.22	6 17	Removed extraneous text from code sample. Fixed the example filename to match Figure 17.

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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