HUAWEI Module

CMUX Application Guide

Issue 04

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About This Document

Revision History

Document Version	Date	Chapter	Descriptions
01	2014-11-04		Creation
02	2014-11-26	8	Added the description of the MU709 module
03	2015-04-23	1	Updated the scope
04	2015-08-14	1	Added the description of the ME909s series module
		2.1	
		2.2	
		6.1	
		6.2	
		6.3	
		8	

Scope

Huawei Module	Firmware Version
MU509-b	13.815.07.00.00 or latter
MU709s-2	11.651.66.01.00 or latter
MU709s-6	11.651.66.01.00 or latter
ME209u-526	11.535.11.00.00 or latter
ME909s-821	11.613.01.00.00 or latter
ME909s-120	11.613.01.00.00 or latter

Contents

1 Introduction

This document provides readers with necessary information to develop a multiplexing protocol running on their equipment in order to use the CMUX function provided by Huawei modules.

1.1 Audience

This guide is intended for users or integrators interested to implement a multiplexing protocol running on Huawei module.

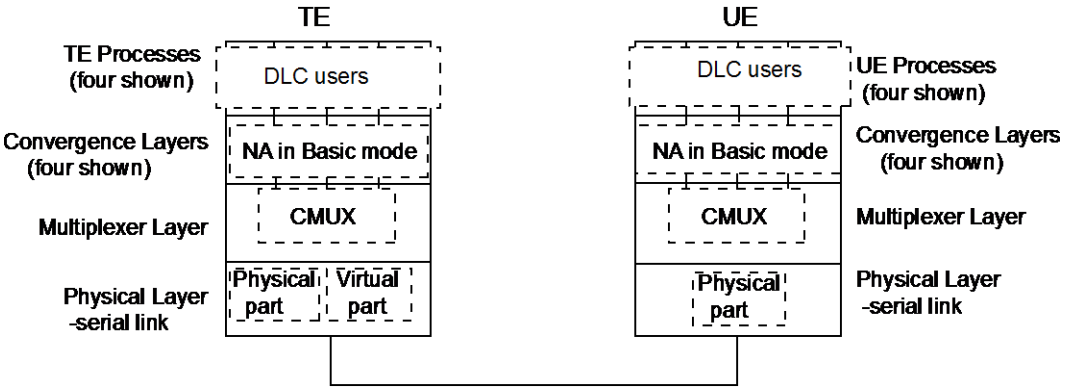
1.2 Related Documents

3GPP TS 27.010 V11.0.0 (2012-09), Release 11

2 Overview

CMUX Library (also referred as CMUX module) is an implementation of the standard 3GPP TS 27.010 V11.0.0 (2012-09). CMUX module along with a serial port emulation module helps providing service to several applications to use their own respective virtual ports, but in essence all data will converge and be transmitted over only one physical serial port. This is very useful in scenarios where there are several applications which intend to use more than one serial port interface, such as SMS, GPRS, voice and GSM, while only one physical port is available to communicate with the Target-platform.

Figure 2-1 General architecture



As shown in Figure 2-1 , CMUX library provides facility for several serial transmissions between TE (the host) and UE (the target) over a single start-stop framed and serial link.

2.1 Implementation Features

Huawei CMUX implementation features currently support the following:

- Operating option: Basic mode
- SABM, DISC, MSC, FCON, FCOFF, DLCPN, TEST_CMD, CLD and UIH frames are supported
- DLCI 0 is control Data Link Connection Identifier (DLCI).

- The MU509-b, MU709s series, ME209u-526 and ME909s series module support four DLCIs (DLCI 1, DLCI 2, DLCI 3 and DLCI 4), and all four DLCIs are AT DLCIs. Only the ME909s series module supports DLCI 5 for eCall AT command.
- User configurable MUX settings
- DLCI PN can be sent but it is not user configurable.

2.2 Key Highlights of Huawei CMUX Application

- **Detailed Log Window:** Log window of the application provides details of the control frames sent and received in Hex and ASCII format and user understandable format leading to:
  - Easier debugging and implementation
  - Easier understanding of CMUX protocol
- **Quick & Advanced DLCI Creation:** DLCI creation can be quickly done through normal DLCI window. Also, application also provides flexibility to send the desired control frames and create DLCI.
- **Configurable MUX Parameters:** MUX parameters such as baud rate, response timer (T2) and retransmission number (N2) can be configured by the user.
  - Baud rates supported are 3000000 bit/s, 1000000 bit/s, 921600 bit/s, 460800 bit/s, 230400 bit/s, 115200 bit/s, 57600 bit/s, 38400 bit/s, 19200 bit/s and 9600 bit/s (The 921600 bit/s and 460800 bit/s are for MU509-b, MU709s series and ME209u-526 module; the 3000000 bit/s and 1000000 bit/s are only for ME909s series module).
  - Response time can be 100 ms to 2.5s. Default value is 900 ms.
  - The stepping time for the response time is 1 ms.
  - Retransmission number can be 0 to 10. Default value is 3.

3 Serial Multiplexer Protocol

This chapter introduces the CMUX protocol and its frame structures.

3.1 CMUX Frames Structures

All the information transmitted between the Huawei module and applications is based on frames that have the following structure.

Figure 3-1 Frame structure for basic option

Flag	Address	Control	Length Indicator	Information	FCS	Flag
1 octet	1 octet	1 octet	1 or 2 octet	Unspecified length but integral number of octets	1 octet	1 octet

MAX FRAME LENGTH

MAX FRAME LENGTH supported is 1540.

The frame structure is composed of an opening and a closing flag, an Address field, a Control field, an Information field and Frame Check Sequence (FCS) field. A length indication field is present in each frame if no transparency mechanism is used for the multiplexing session.

3.1.1 Flag Field

Each frame begins and ends with a flag sequence octet which is defined as a constant bit pattern (0xF9 in Hexadecimal format).

3.1.2 Address Field

The address field consists of a single octet. It contains EA bit, C/R bit and DLCI as shown in Table 3-1 .

Table 3-1 Format of Address Field

Bit No.	1	2	3	4	5	6	7	8
	EA	C/R	DLCI					

- **EA:** It refers extension field. The range of the address field may be extended by use of the EA bit.
  - When the EA bit is set to 1 in an octet, it signifies that this octet is the last octet of the address field.
  - When the EA bit is set to 0, it signifies that another octet of the address field follows.
- **C/R:** It is a command or a response bit. It is used to identify whether a frame is a command or a response. If the application or module sends a command, C/R bit is set to 1; and in case of response, the C/R bit is set to 0. In Huawei CMUX implementation, the initiator is always the application. The table below summarizes the concept.

Initiator	Direction	Responder	C/R value	Command/Response
Application	→	Module	1	Command
Application	←	Module	0	Response
Application	←	Module	1	Command
Application	→	Module	0	Response

- **DLCI**: Data Link Connection Identifier. It is used to identify an individual user information stream as well as to identify connections between TE (the host) and UE (the target). Multiple DLCIs shall be supported but the number is implementation-specific.

3.1.3 Control Field

The content of the control field defines the type of frame. The control fields of the frames used are described in the table below.

Frame Type	Control Octet							
	1	2	3	4	5	6	7	8
SABM	1	1	1	1	P/F	1	0	0
UA	1	1	0	0	P/F	1	1	0
DM	1	1	1	1	P/F	0	0	0
DISC	1	1	0	0	P/F	0	1	0
UIH	1	1	1	1	P/F	1	1	1

- **P/F** stands for Poll/Final bit.

- **SABM (Set Asynchronous Balance Mode)**

  SABM command shall be send by the TE (the host) to the UE (the target) to confirm the acceptance of SABM by transmission of UA response.

- **UA (Unnumbered Acknowledge)**

  The UA response is sent by the module as an acknowledgement that a SABM or DISC command was accepted.

- **DM (Disconnected Mode)**

  In case if the module rejects SABM or DISC command, it will send DM response. For example, if SABM is sent for a DLCI not supported or if a DISC is sent to DLCI address already closed, this frame will be send.

- **DISC (Disconnect)**

  The DISC is used to close a previously established connection. If the application sends a DISC for the DLCI 1 and DLCI 1 is already established, then it will be closed. The module will answer to this command with an UA frame.

- **UIH (Unnumbered Information with Header check)**

  The UIH command/response will be used to send information. For the UIH frame, the FCS will be calculated over only the address, control and length fields. There is no specified response to the UIH command/response.

- **UI (Unnumbered Information)**

  The UI command/response will be used to send information. There is no specified response to the UI command/response. For the UI frame, the FCS shall be calculated over all fields (Address, Control, Length Indicator, and Information). Support of UI frames is optional.

3.1.4 Information Field

The information field is the payload of the frame and carries the user data and any convergence layer information. The field is octet structured .The information field is present in UIH frames. The P/F bit should be set to 0 when this field is sent.

3.1.5 Length Indicator

This field is present only in basic option. It has the following format.

Table 3-2 First byte of length field

Bit No.	1	2	3	4	5	6	7	8
	E/A	L1	L2	L3	L4	L5	L6	L7

The L1 to L7 bits indicate the length of the following data field. The default length is 31 bytes.

According to the rule of ISO/IEC 13239, the range of the length field may be extended by use of the EA bit. When the EA bit is set to 1 in an octet, it is signifies that this octet is the last octet of the length field. When the EA bit is set to 0, it signifies that a second octet of the length field follows. The total length of the length field is in that case 15 bits, L1 to L15.

The second octet of the length field (only present when the EA field in the first byte is set to 0) format is shown in Table 3-3 .

Table 3-3 Second byte of length field

Bit No.	1	2	3	4	5	6	7	8
	L8	L9	L10	L11	L12	L13	L14	L15

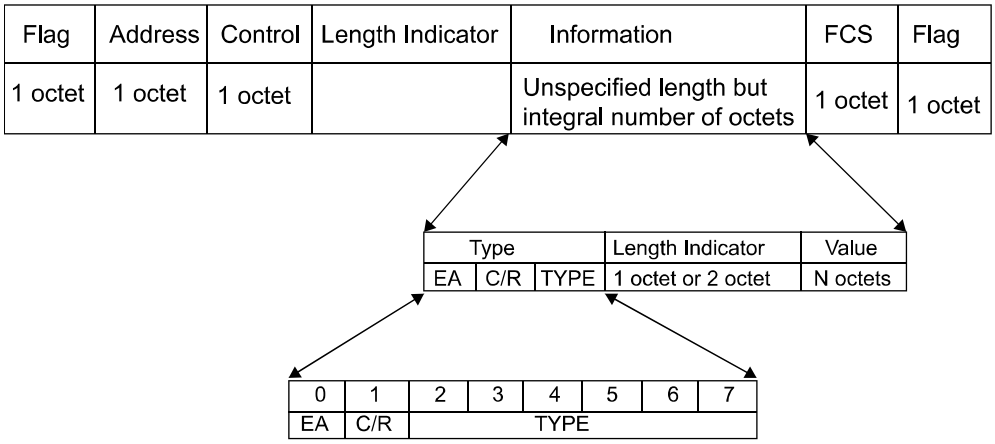
The length field shall always be present, even if the data field is empty.

3.1.6 Frame Check Sequence

The FCS is calculated over the entire frame, but excluding the flags. Only in case of UIH frame, the FCS will not be calculated over the information field. The FCS is the ones complement of the sum (modulo 2) of the remainder of x^k (x7 + x6 + x5 + x4 + x3 + x2 + x1 + 1) divided (modulo 2) by the generator polynomial x8 + x2 + x + 1, where k is the number of bits in the frame.

3.2 UIH Control Channel Frame Coding

Figure 3-2 Detailed figure of information field



Type Octet:

EA: Extension bit. It is always set to 1.

C/R: Identifies whether it is a command or response.

TYPE: Hereafter are listed the UIH Command TYPES.

3.2.1 Multiplexer Close Down

The Multiplexer Close Down (CLD) command is used to reset the link into normal AT command mode without multiplexing.

The multiplexer close down message uses the following type field octet.

Bit No.	1	2	3	4	5	6	7	8
	EA	C/R	0	0	0	0	1	1

The length byte contains the value 0 and there are no value octets.

3.2.2 DLCI Parameter Negotiation

These services are used to negotiate and set parameters for a specific DLCI. This procedure is optional. If this command is not supported, default values are applied to each DLCI.

The DLCI parameter negotiation uses the following type field octet.

Bit No.	1	2	3	4	5	6	7	8
	EA	C/R	0	0	0	0	0	1

3.2.3 Non Supported Command Response (NSC)

This response is sent whenever a command type is not supported by the receiving entity. The length byte contains the value 1 and there is one value octets.

The type field octet has the following format.

Bit No.	1	2	3	4	5	6	7	8
	EA	C/R	0	0	1	0	0	0

The value octet contains the command type of the non-supported command.

The value octet has the following format.

Bit No.	1	2	3	4	5	6	7	8
	EA	C/R	Command type					

The C/R bit (in the value octet above) shall be set to the same value as the C/R bit in the type field octet of the not supported command frame

3.2.4 Modem Status Command (MSC)

This command shall be sent prior to any user data after a creation of a DLCI. This command is only relevant when the basic option is chosen.

Command	Length	DLCI	V2.4 Signal	Break Signals (optional)

The length byte contains the value 2 or 3 and there are 2 or 3 value octets.

The command field octet has the following format.

Bit No.	1	2	3	4	5	6	7	8
	EA	C/R	0	0	0	1	1	1

The DLCI field identifies the specific DLCI to which the command applies. Bit 2 is always set to 1 and the EA bit is set.

Bit No.	1	2	3	4	5	6	7	8
	EA	1	DLCI					

The DLCI field is followed by the control signals field which contains a representation of the state of the signals.

Bit No.	1	2	3	4	5	6	7	8
	EA	FC	RTC	RTR	Reserved 0	Reserved 0	IC	DV

Description of the control signal byte:

- **Bit 1**: The EA bit is set to 1 in the last octet of the sequence; in other octets, EA is set to 0. If only one octet is transmitted, EA is set to 1.
- **Bit 2**: Flow Control (FC). The bit is set to 1 (one) when the device is unable to accept frames.
- **Bit 3**: Ready To Communicate (RTC). The bit is set to 1 when the device is ready to communicate.
- **Bit 4**: Ready To Receive (RTR). The bit is set to 1 when the device is ready to receive data.
- **Bit 5**: Reserved for future use. Set to zero by the sender, ignored by the receiver.
- **Bit 6**: Reserved for future use. Set to zero by the sender, ignored by the receiver.
- **Bit 7**: Incoming call indicator (IC). The bit is set to 1 to indicate an incoming call.
- **Bit 8**: Data Valid (DV). The bit is set to 1 to indicate that valid data is being sent.

3.2.5 Flow Control On Command (FCon)

The flow control command is used to handle the aggregate flow. When either entity is able to receive new information, it transmits this command.

The type field octet has the following format.

Bit No.	1	2	3	4	5	6	7	8
	EA	C/R	0	0	0	1	0	1

3.2.6 Flow Control Off Command (FCoff)

The flow control command is used to handle the aggregate flow. When either entity is not able to receive information, it transmits the FCoff command. The opposite entity is not allowed to transmit frames except on the control channel (DLCI=0).

The type field octet has the following format.

Bit No.	1	2	3	4	5	6	7	8
	EA	C/R	0	0	0	1	1	0

3.2.7 Power Saving Command (PSC)

The power saving control messages use the following type field octet.

Bit No.	1	2	3	4	5	6	7	8
	EA	C/R	0	0	0	0	1	0

If a station wants to enter a low-power state, it transmits a power saving control command; the other station replies with a power saving control response.

3.2.8 Service Negotiation Command (SNC)

This command is used to query and set a specific service on a specific DLCI. It is for instance used to set specific digital voice types.

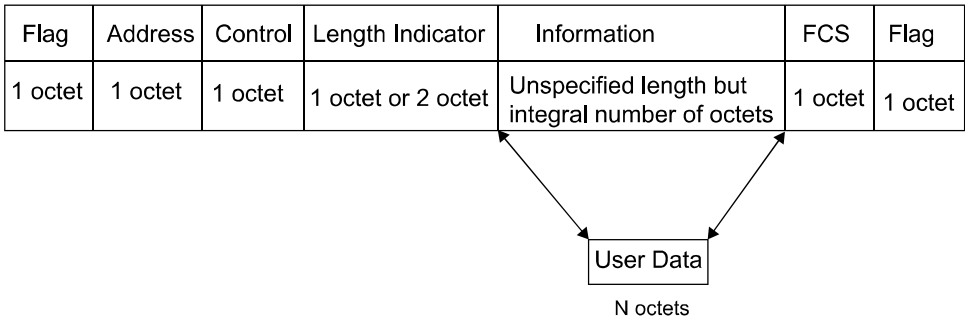
In some situations, it is not very suitable to mix AT commands and raw data on the same DLCI. For those situations, special DLCIs can be established and converted to carry a specific data type. Examples of situation where this is especially useful is for voice transportation, where the AT commands controlling the connection (for instance for multiparty) are transported on one DLCI and voice data carried by another DLCI. If this command is not used, the DLCI is by default set to normal AT command mode. If this command is used, the DLCI indicated in the DLCI octet, is converted to carry the specific data type.

The service negotiation messages use the following format.

Bit No.	1	2	3	4	5
	Type field code	Length	DLCI	Service value octet (optional)	Voice codec Value octet (optional)

3.3 UIH Data Channel Frame Coding

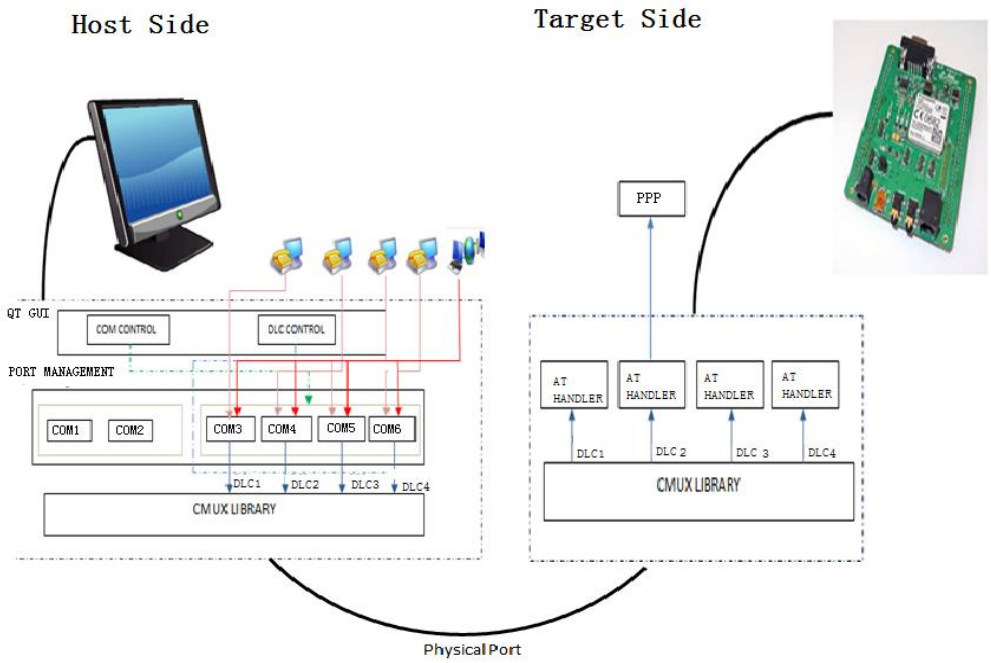
Refer to Figure 3-2 and the figure below. The information field is payload of the frame and carries the user data. The information field exists only for UIH frame type. The P/F bit should be set to value 0 when this field is sent.



As already discussed Length Indicator specifies the length of Information field. The information field consists of the user data. The number of octets occupied is specified by the Length indicator.

4 CMUX Functional Description

This chapter provides the user with functionality details of CMUX.



The host side consists of Huawei CMUX application (QT GUI) and CMUX library. QT GUI consists of mainly 2 modules. They are:

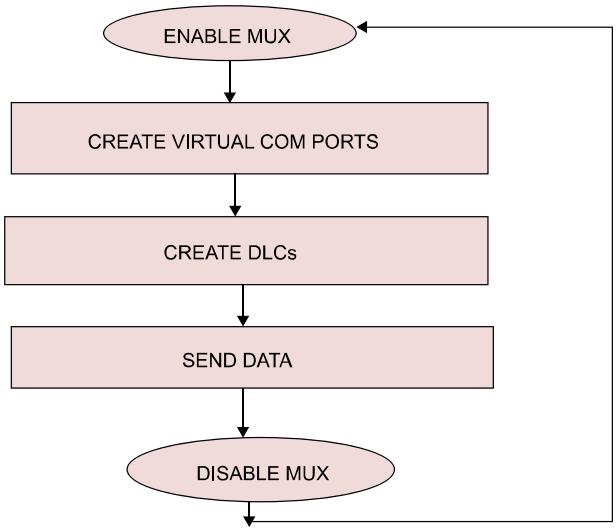
- COM Control helps to create or delete the virtual COM ports.
- DLCI Control helps to keep track which DLCI is mapping to virtual COM port, and DLCI deletion can be done.

Target side also consists of CMUX library. Here DLCIs 1, 2, 3, 4 are mapped to AT command handler. PPP (Dial up) can be activated on any DLCI. The host and the target are connected through the serial cable.

- Once CMUX is enabled, control DLCI (DLC0) can be created; virtual COM ports are created and are mapped to DLCIs; DLCI creation can be done.

- Once DLCI data channel is established, users can transfer the data through either from transfer window in QT GUI or through other applications such as hyper terminal.

Figure 4-1 The CMUX functionality



4.1 Establish CMUX Session

Step 1 First of all, the user application (the host) must force the connected module in multiplexed mode which is done by sending AT+CMUX command and the target (Huawei board) responds with OK.

Step 2 Secondly SABM frame is sent for DLC0 by the host and the target responds with UA frame informing the user that the DLCI is established.

Step 3 DLC0 (control channel) is the first channel established at the initiation of the multiplexer between the TE (the host) and UE (the target) and it has the DLCI value 0.

4.2 Create Virtual COM Port

Virtual COM ports can be created from the Huawei CMUX application and map the virtual COM port (not in use) to the specific DLCI (not established) for DLCI creation.

4.3 Create DLCI

Establishment of a DLCI will be initiated by the TE (the host). TE (the host) wishing to establish a DLCI transmits an SABM frame with the P-bit set to 1. The address field contains the DLCI value associated with the desired connection.

- If UE (the target) is ready to establish the connection, it will reply with a UA frame with the F-bit set to 1.

- If UE (the target) is not ready or unwilling to establish the particular DLCI, it responds with a DM frame.

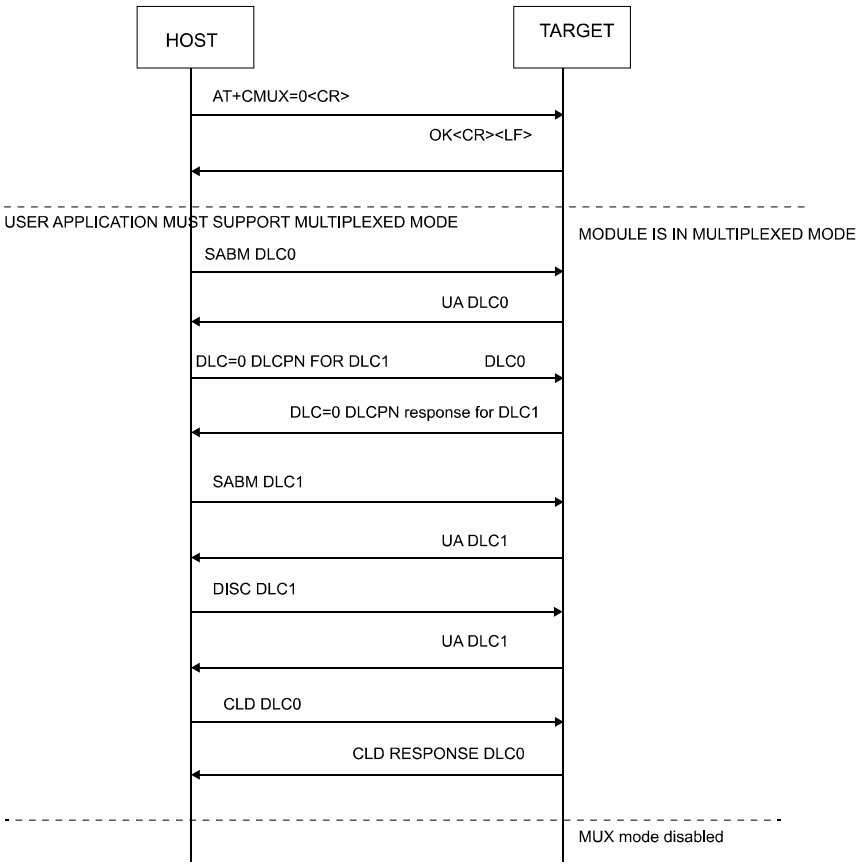
4.4 Send Data

Huawei CMUX data channels (DLCIs) shall be used to transmit user data streams (UIH data) such as AT command data and GPRS data etc., and data channels shall be established only once after control channel (DLCI 0) is established.

4.5 Disable MUX

The release of DLCI will be initiated from TE (the host) by the transmission of a DISC frame with P-bit set to 1.Confirmation of the DLCI release is signaled by UE (the target) sending a UA response frame with F-bit set to 1. Once the DLCI has been released, UE (the target) enters into disconnected mode for that particular DLCI. If UE (the target) receives the DISC command and is already in a disconnected mode, it will send the DM frame to the TE.

Figure 4-2 CMUX Protocol



The table below summarizes the procedure in enabling MUX, creating DLCIs and sending data.

In the following tables, messages in **Red** are sent from TE (the host) to UE (the target); and messages in **Blue** are sent from UE (the target) to TE (the host).

Table 4-1 Procedure and frames during various MUX operations

PROCEDURE	FRAMES
Start or Enable MUX	AT+CMUX 0,0,5,31,10,3,30,10,1
	OK
	SABM, DLCI 0
	UA, DLCI 0
Create virtual COM ports	None
Map COM port to DLCI	DLCI_PN_CMD, DLCI 1
	DLCI_PN_RESP, DLCI 1
	SABM, DLCI 1
	UA, DLCI 1
Send data	UIH_DATA, DLCI 1
	UIH_DATA (with response), DLC1
Disable MUX	DISC, DLCI 1 (say only DLCI 1 is established)
	UA, DLCI 1
	CLD_CMD , DLCI 0
	CLD_RESP, DLCI 0

The frames and the actual frame formats (as hexadecimal) during various CMUX operations are shown as below:

	Flag	Address	Control	Length Indicator	Information	FCS	Flag
SABM, DLCI 0	F9	03	3F	01	-	1C	F9
UA, DLCI 0	F9	03	73	01	-	D7	F9
DLCI_PN_CMD, DLCI1	F9	03	FF	15	83 11 01 00	FB	F9
					01 0A 1F 00		
					03 02		
DLCI_PN_RESP, DLCI 1	F9	03	FF	15	81 11 01 00	FB	F9
					01 0A 1F 00		
					03 02		
SABM, DLCI 1	F9	07	3F	01	-	DE	F9

	Flag	Address	Control	Length Indicator	Information	FCS	Flag
UA, DLCI 1	F9	07	73	01	-	15	F9
FCON CMD, DLC0	F9	03	EF	05	A3 01	F2	F9
FCON_REP, DLC0	F9	03	FF	A1 05	01	E7	F9
FCOFF_CMD, DLC0	F9	03	EF	05	63 01	F2	F9
FCOFF_RESP, DLC0	F9	03	FF	05	C1 01	E7	F9
MSC_CMD, DLCI 1 (XON)	F9	03	EF	09	E3 05 07 0D	FB	F9
MSC_RESP, DLC1 (XON)	F9	03	FF	09	E1 05 07 0D	EE	F9
MSC_CMD, DLCI 1 (XOFF)	F9	03	EF	09	E3 05 07 0F	FB	F9
MSC_RESP, DLC1 (XOFF)	F9	03	FF	09	E1 05 07 0F	EE	F9
DISC, DLC1	F9	07	53	01	-	3F	F9
UA, DLC1	F9	07	73	01	-	15	F9
CLD_CMD, DLC0	F9	03	FF	05	C3 01	E7	F9
CLD_RESP, DLC0	F9	03	FF	05	C1 01	E7	F9

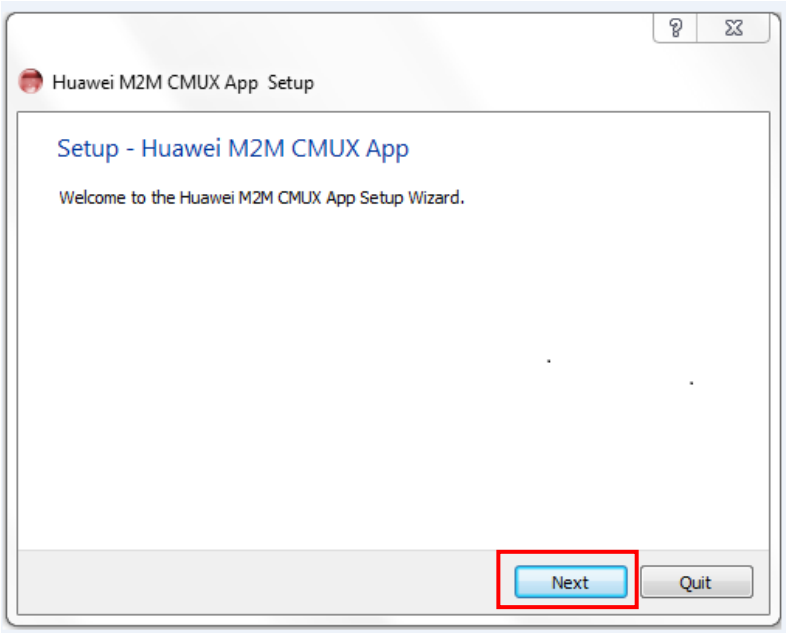
5 Installation Procedures and Requirements

5.1 Install HuaweiCMUXInstaller

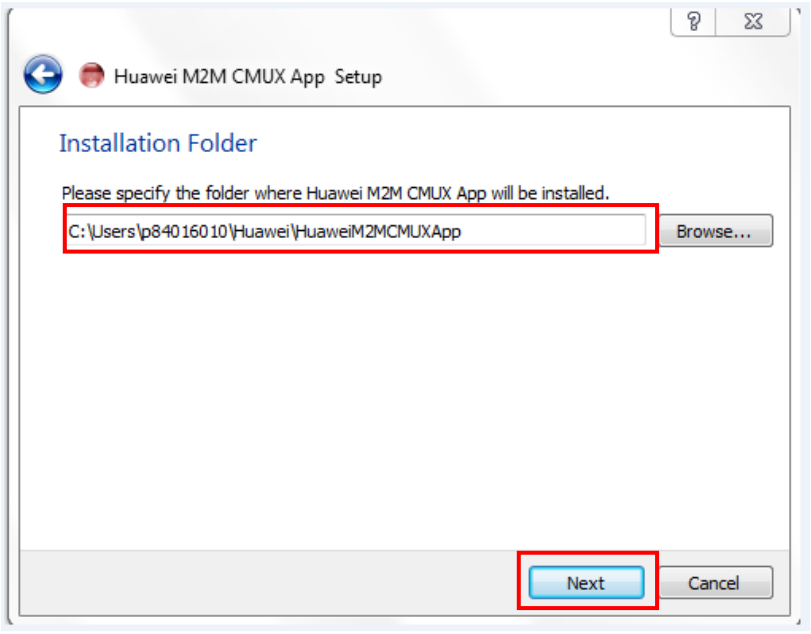
The following steps describe how to install the **Huawei M2M CMUX Application.**

Step 1 Double click the **HuaweiCMUXInstaller.exe**.

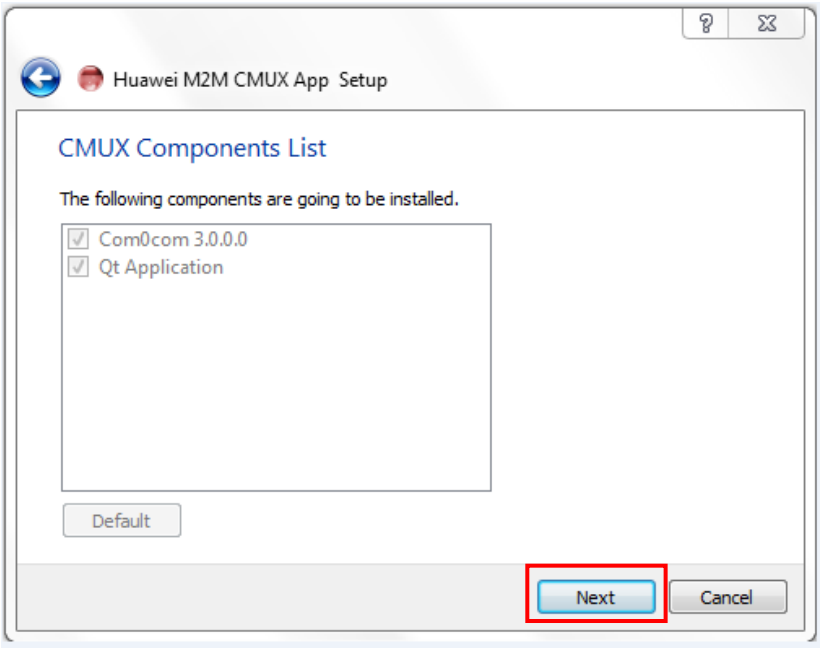
Step 2 The setup welcome window will be dispalyed, and click **Next**.



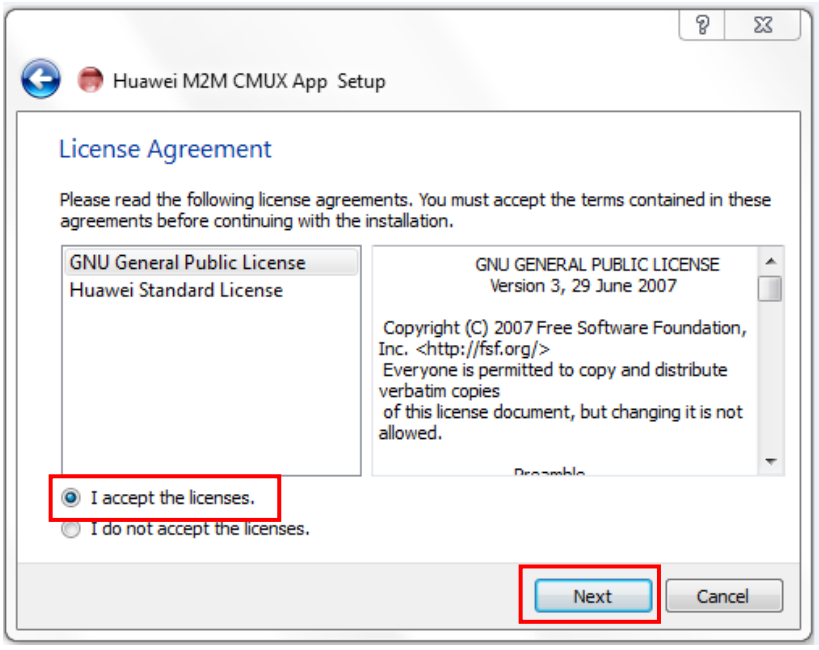
Step 3 Give the installed path and click **Next**.



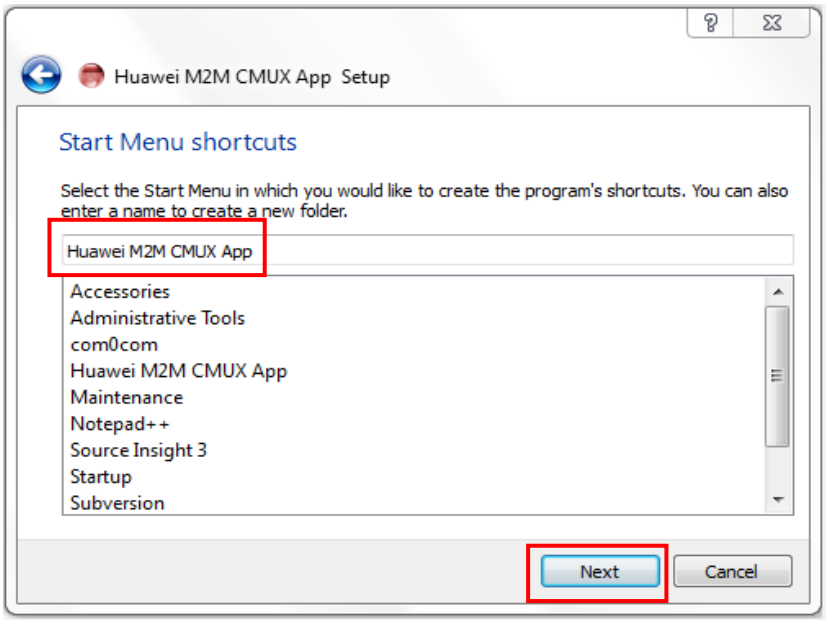
Step 4 **CMUX Componets List** window will be displayed, and click **Next**.



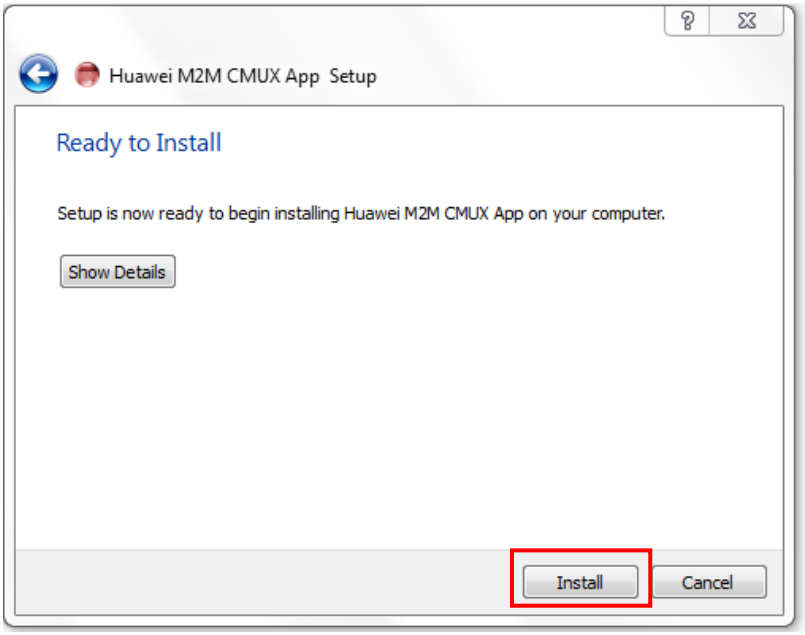
Step 5 Choose **I accept the licenses** and click **Next**.

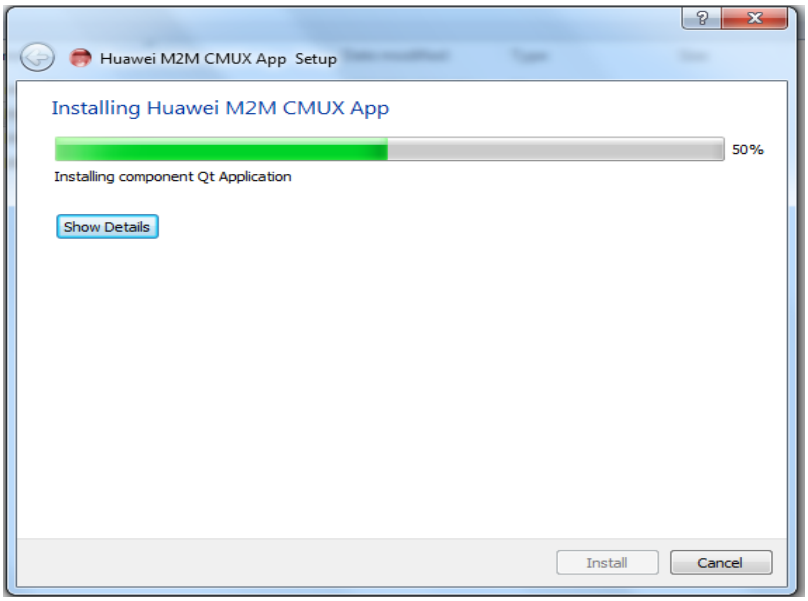


Step 6 **Huawei M2M CMUX App** is the default folder name where the shortcut for the Huawei CMUX Application is created and click **Next**.

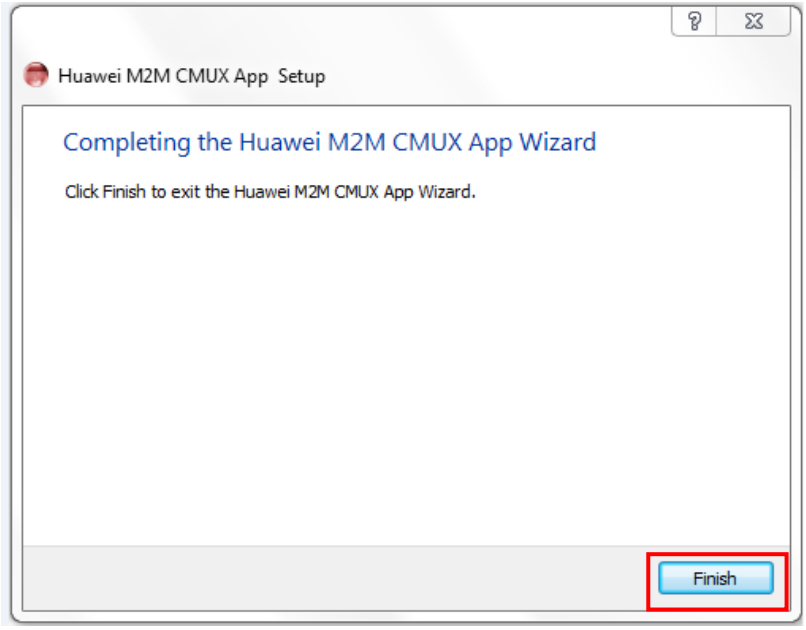


Step 7 Click **Install** to begin installing the Huawei CMUX application.



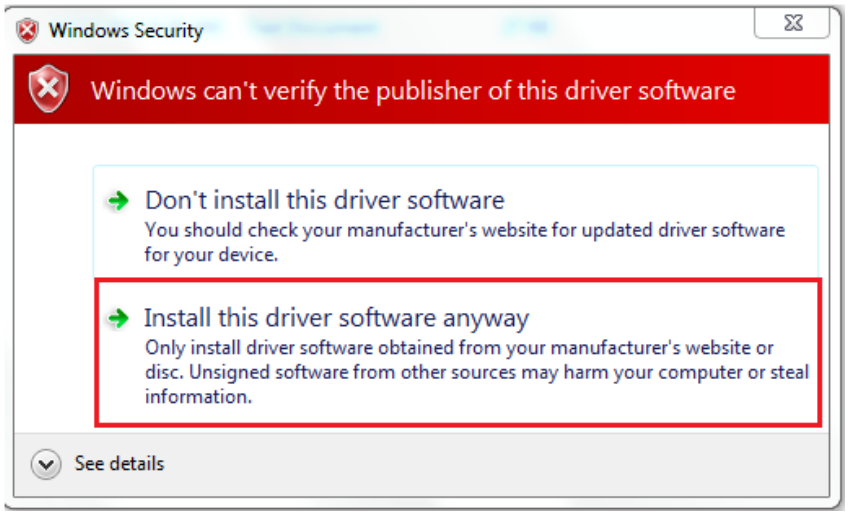


Step 8 After the **Huawei M2M CMUX Application** is completed, click **Finish** to exit the installation wizard.



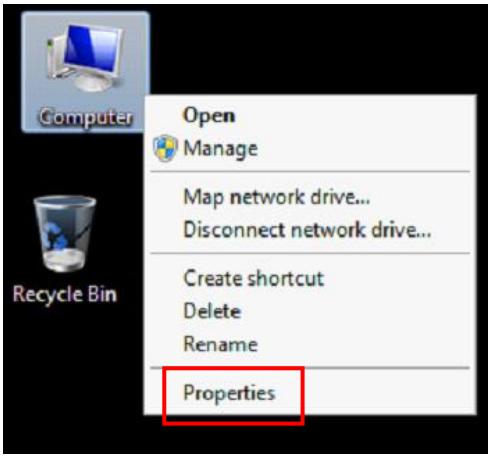
5.2 Create Virtual COM Ports

While creating virtual COM ports through the application for the first time, the following window may appear many times. Select **Install this driver software anyway**.

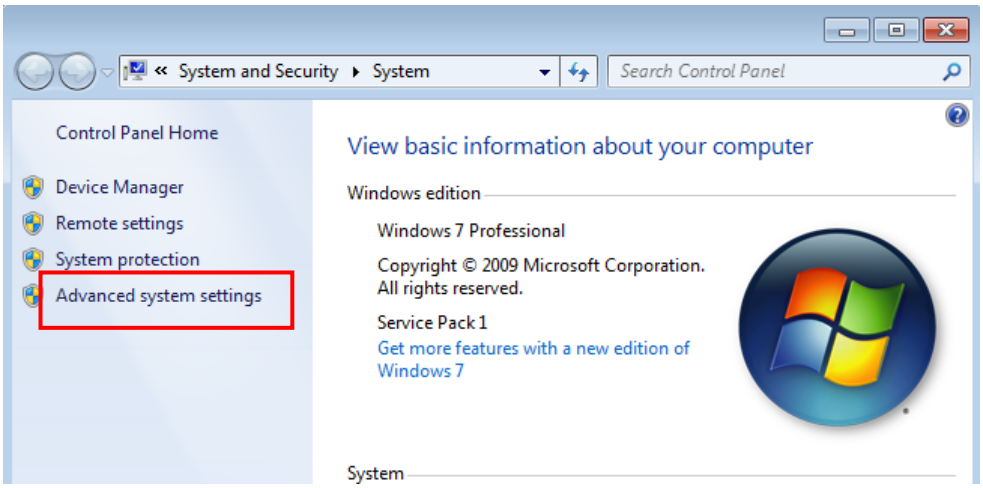


The following steps show how to increase virtual COM ports creation speed through the application.

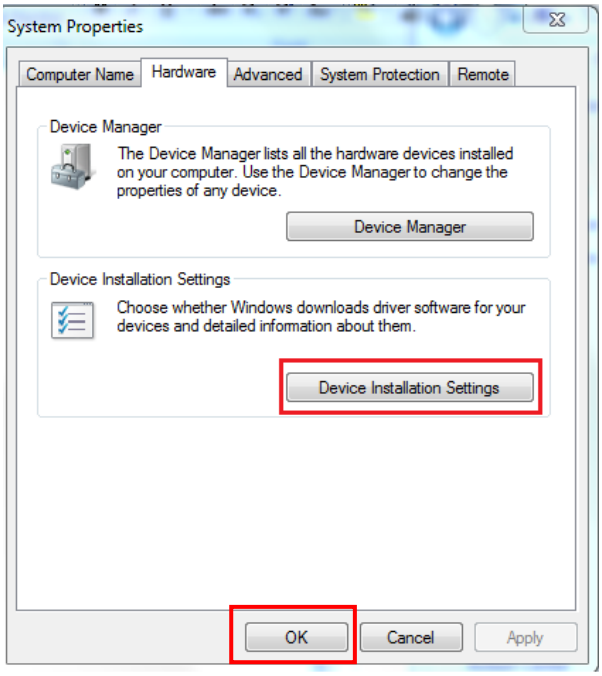
Step 1 Select **Properties** of My Computer.



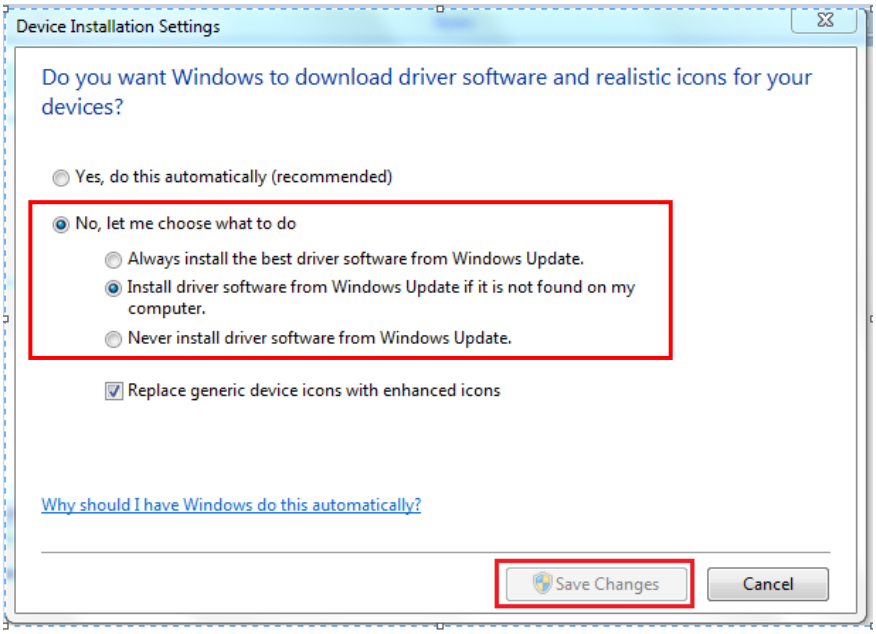
Step 2 Select **Advanced System Settings**, and **System Properties** window will be displayed.



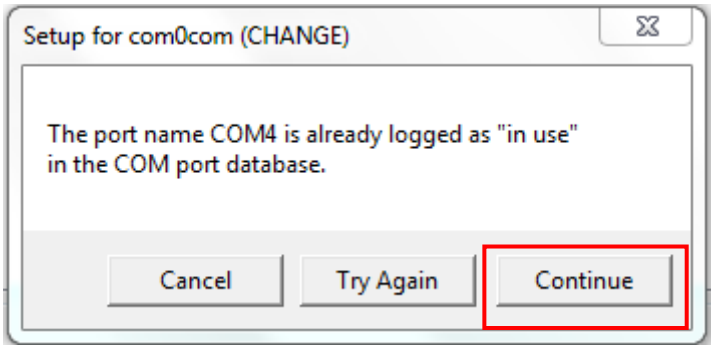
Step 3 Select **Hardware** > **Device Installation Settings,** and click **OK**.



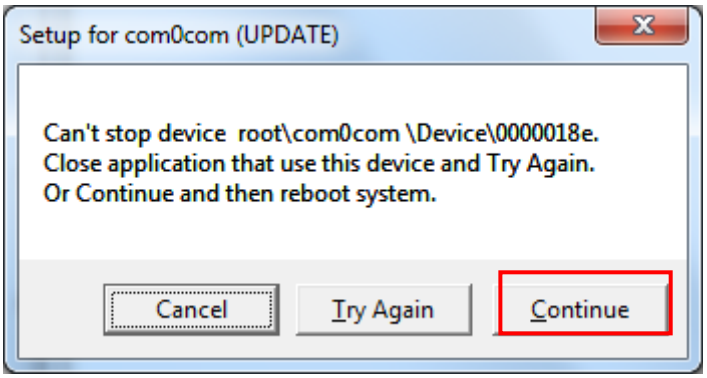
Step 4 Select **No, let me choose what to do**, **Install diver software…** and click **Save Changes**. Restart your system to apply the settings as shown in figure below to avoid COM creation delay.



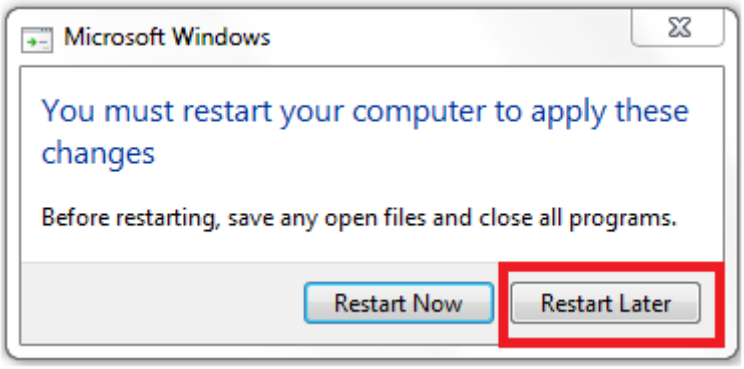
- Sometimes, the following window appears while creating virtual COM ports using application even if COM port is not there in system. Click **Continue** to continue with COM port creation.



- While closing the application, sometimes the following message box may appear. Click **Continue**.



- While creating virtual COM ports through the application, restart message as shown below may come. Select **Restart later**.



6 Guide of Huawei CMUX Application

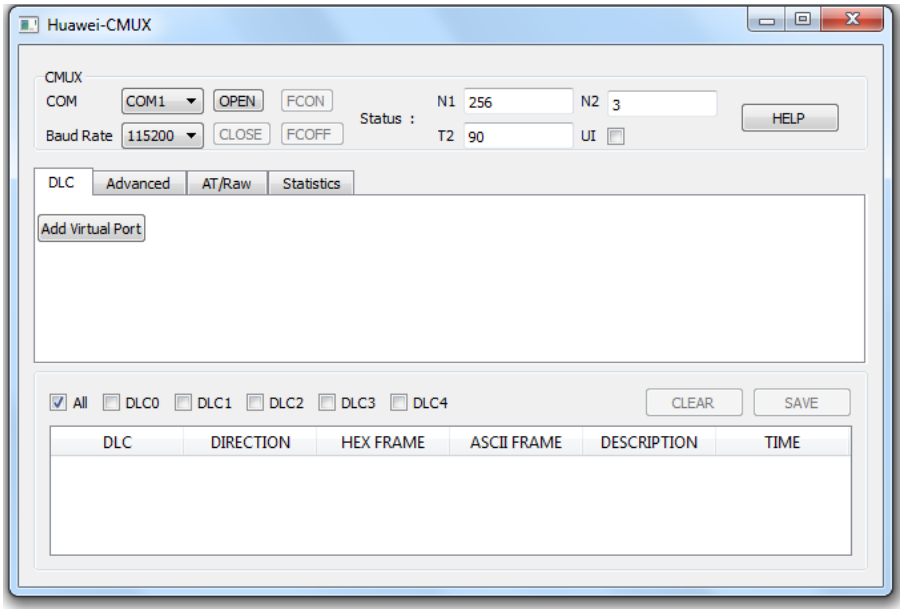
The CMUX application developed by Huawei is used on PC channels existing at the same time on one physical line (serial port). These virtual channels can be used by different PC applications.

After installing Huawei CMUX application on Windows 7 PC, you can click CMUX application shortcut or select it from menu.

6.1 CMUX Application Main Window

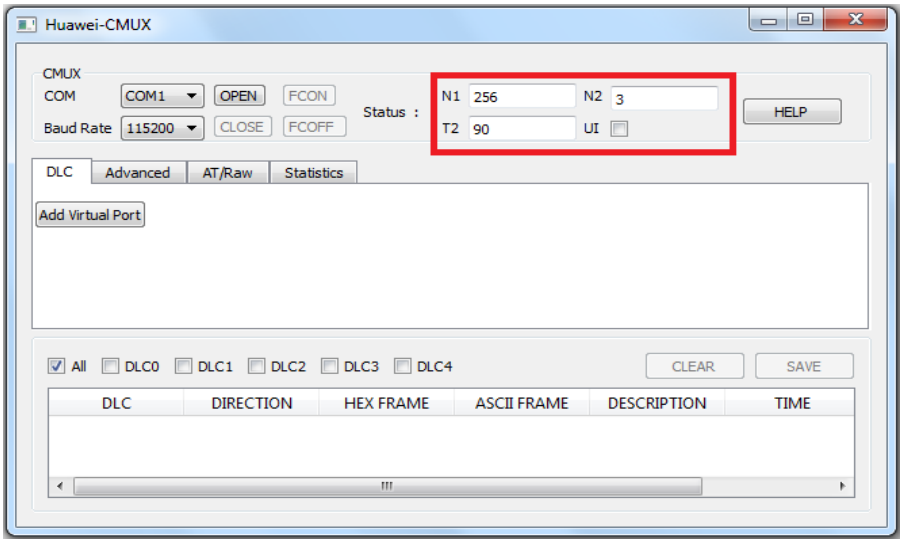
Figure 6-1 is the main window in the application from which all the features can be accessed like setting the CMUX parameters, enabling MUX and DLCI creation etc.

Figure 6-1 Huawei CMUX App Main Window



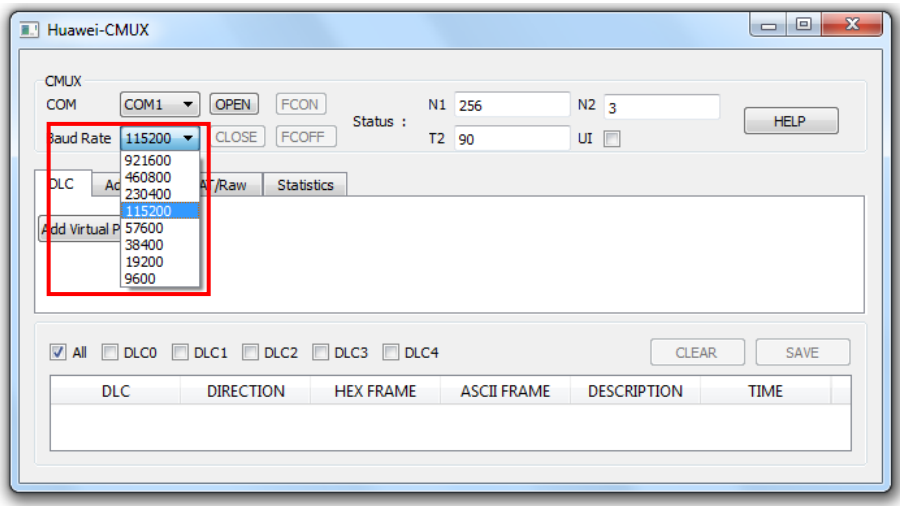
6.1.1 N1, N2 and T2

The maximum frame size (**N1**) can vary from 31 bytes to 1540 bytes. By default it is 256 bytes. The maximum number of retransmission (**N2**) can vary from 0 to 10. The default value is 3. The response timer (**T2**) can vary from 10 ms to 250 ms. The default value is 90 ms.



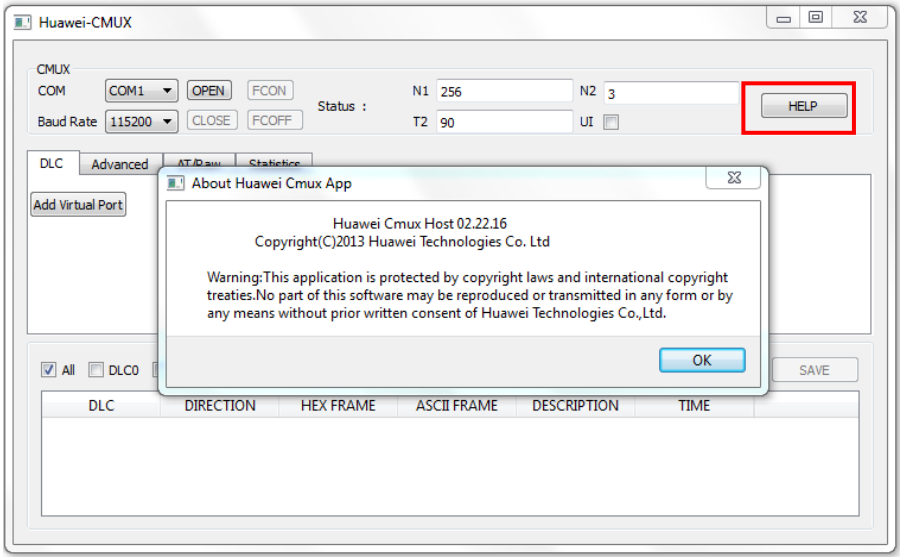
6.1.2 Baud Rates

In the main window, there is a combo box for the baud rates. Baud rates supported are 3000000 bit/s, 1000000 bit/s, 921600 bit/s, 460800 bit/s, 230400 bit/s, 115200 bit/s, 57600 bit/s, 38400 bit/s, 19200 bit/s and 9600 bit/s (**The 921600 bit/s and 460800 bit/s are for MU509-b, MU709s series and ME209u-526 module; the 3000000 bit/s and 1000000 bit/s are only for ME909s series module**). The default value is 115200 bit/s.



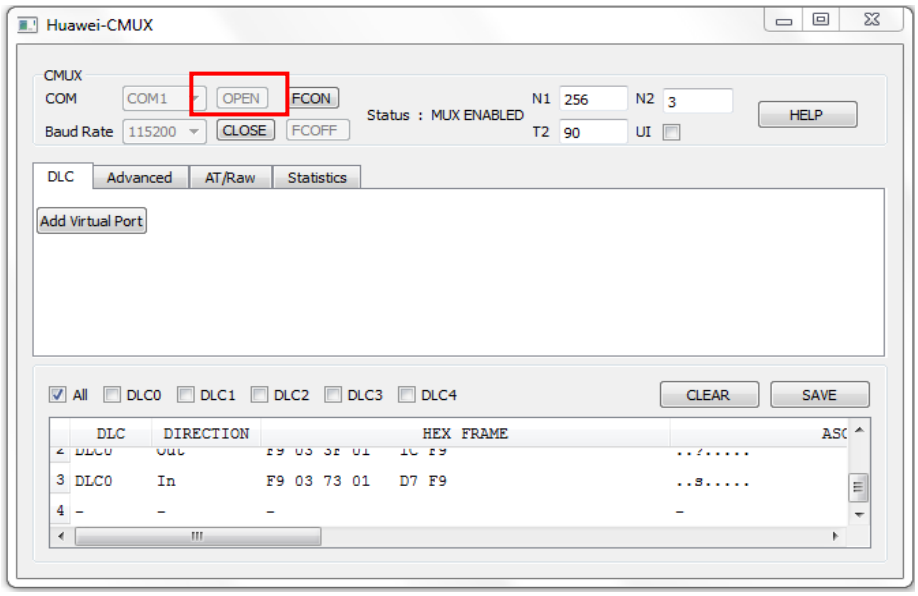
6.1.3 Help Button

After clicking the **HELP**, the **About Huawei CMUX App** window will open which contain the details about the application.

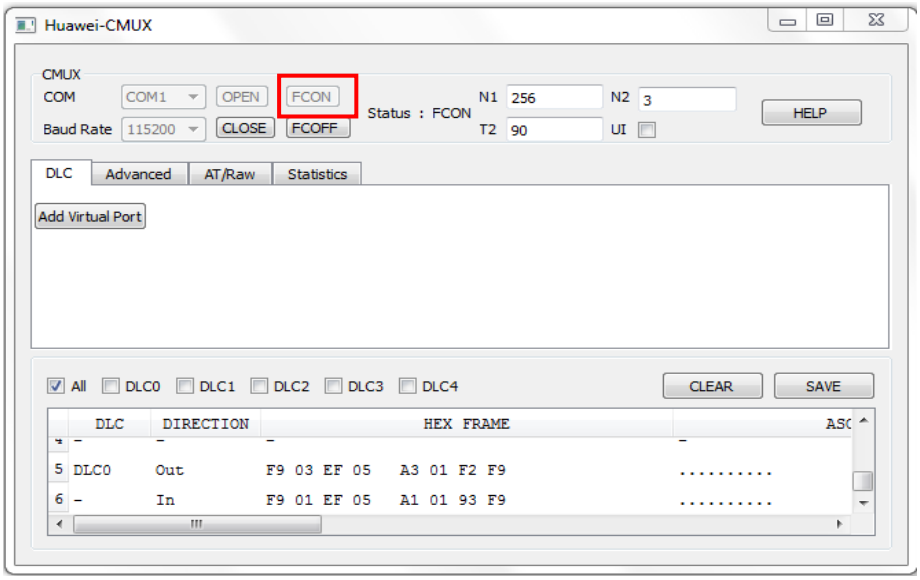


6.1.4 Enable and Disable MUX

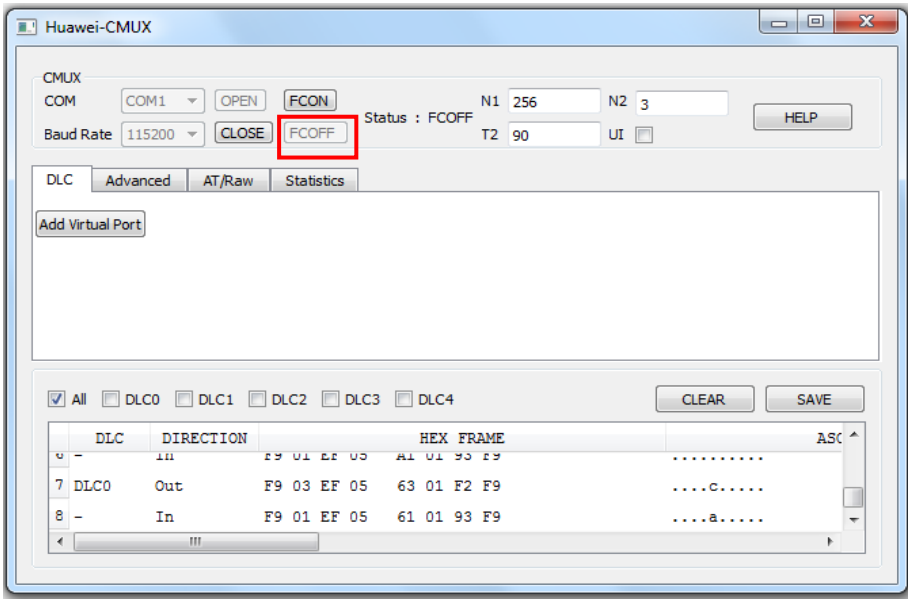
CMUX configuration widget has options to enable and disable MUX as well as has options to send flow control commands. MUX can be enabled on physical port only. To enable the MUX, the user can select the physical comport from the COM combo box at a specific baud rate and set the MUX parameters and then click on **OPEN**, the MUX will get enabled.



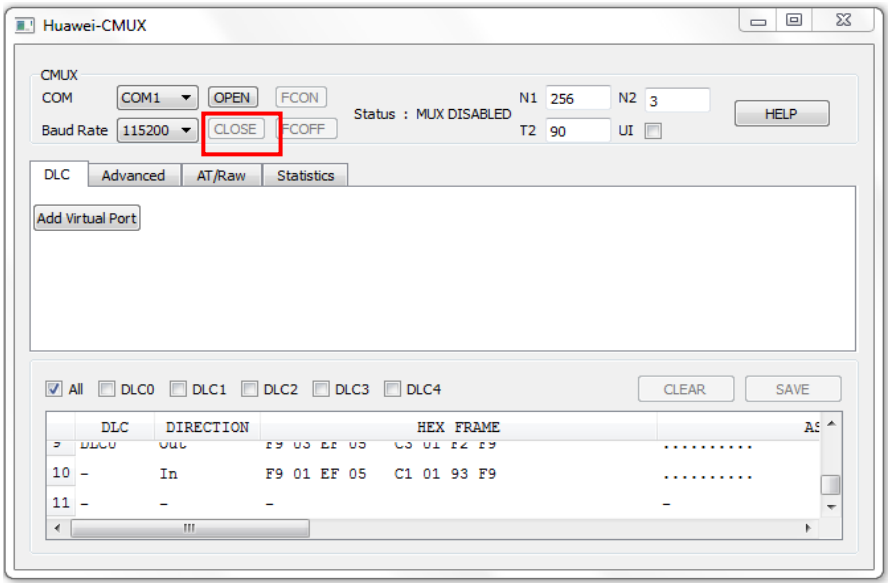
- On clicking the **FCON**, the data frames can be sent and received between both TE (the host) and UE (the target).



- On clicking the **FCOFF**, the data frames cannot be received between the targets.

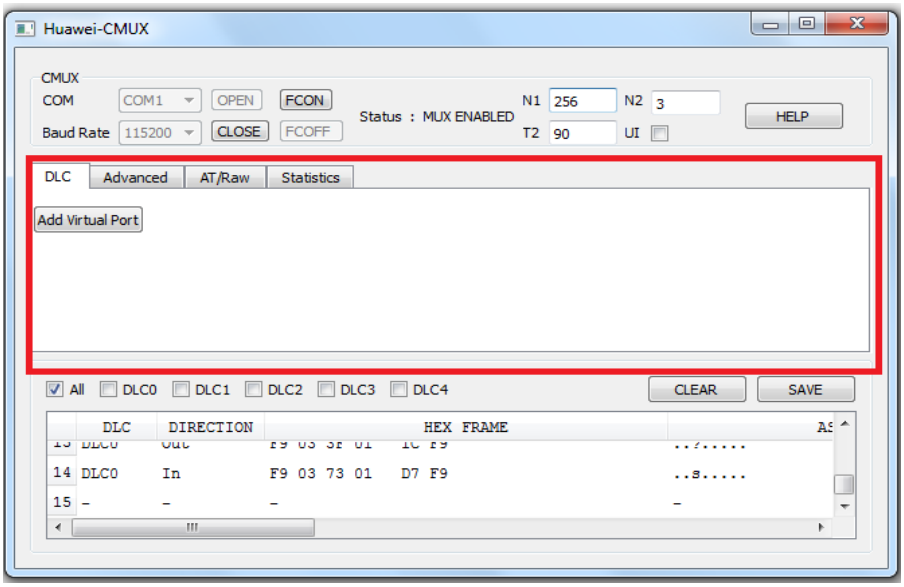


- On clicking the **CLOSE**, the MUX will get disabled.

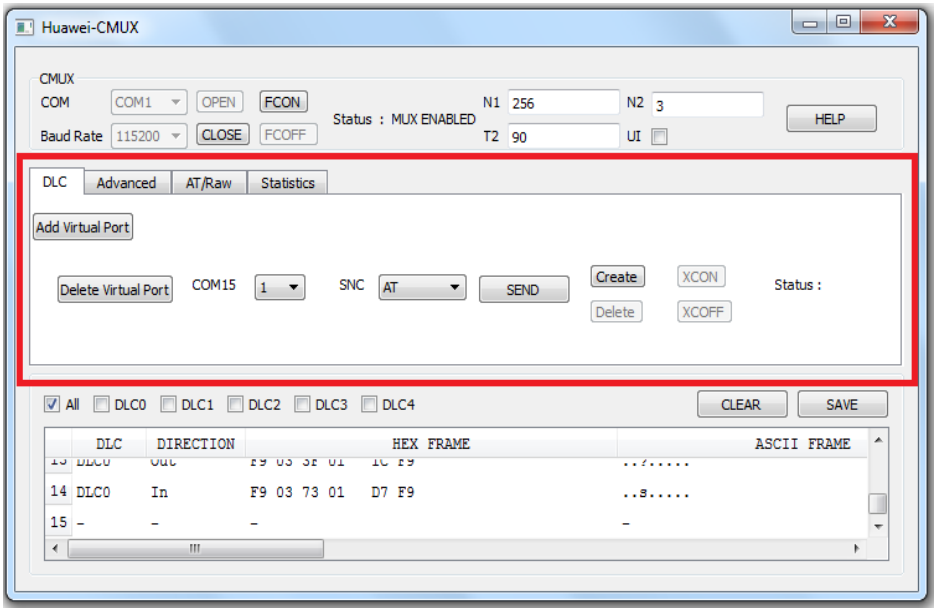


6.2 DLCI Main Window

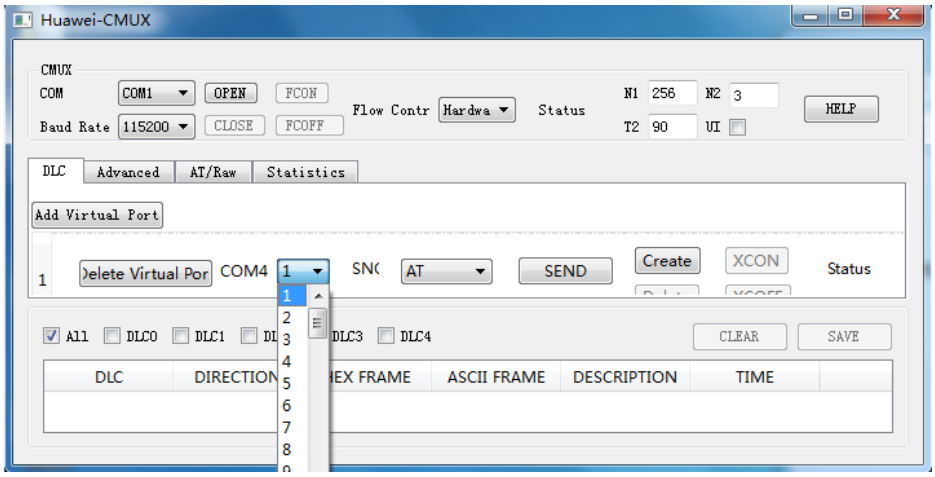
DLCI tab has options to create and delete the virtual ports as well can send the modem status command for the particular DLCIs.

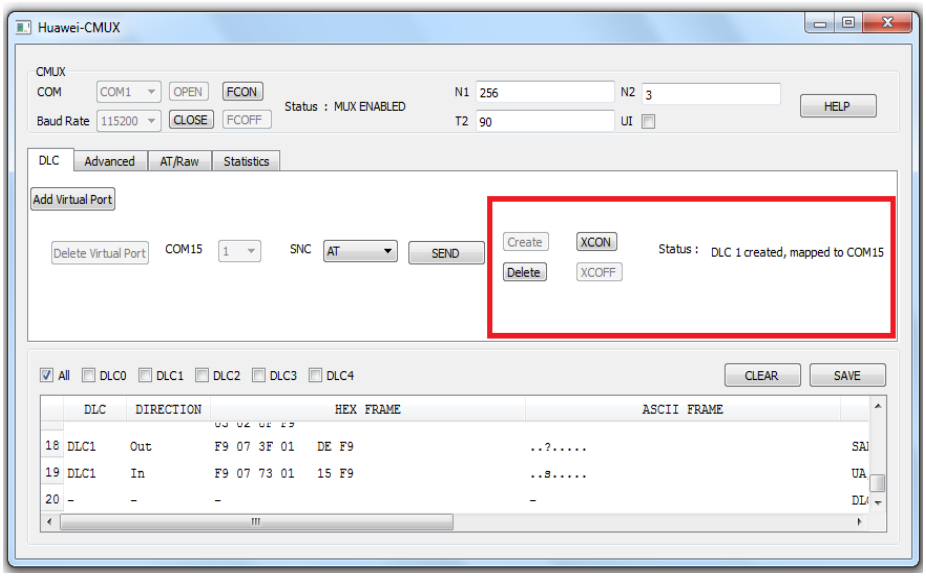


- On clicking the **Add Virtual Port**, the virtual ports will get added to the window.

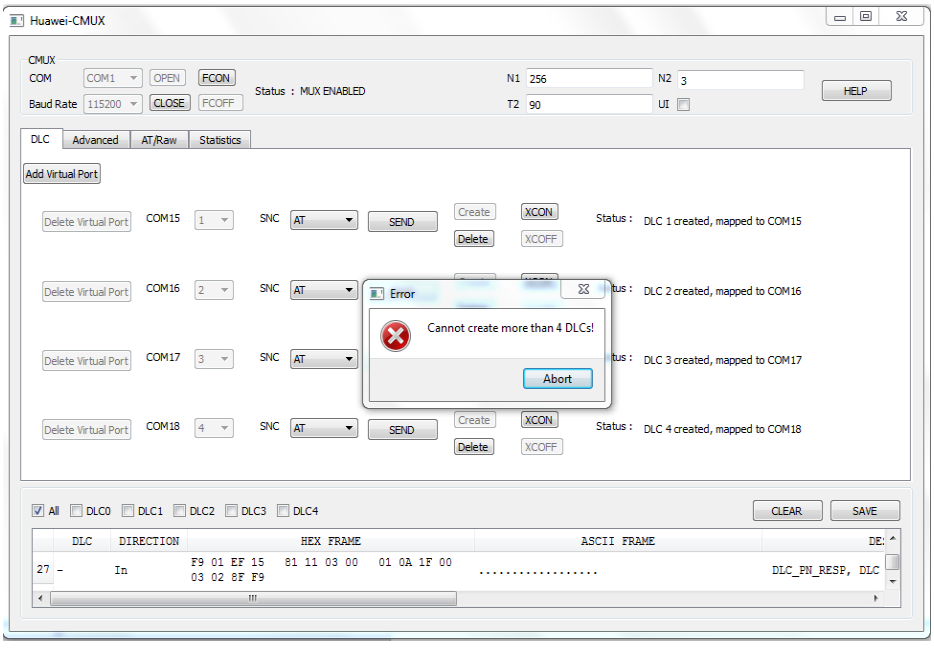


- **Create** is used for creating the DLCIs.

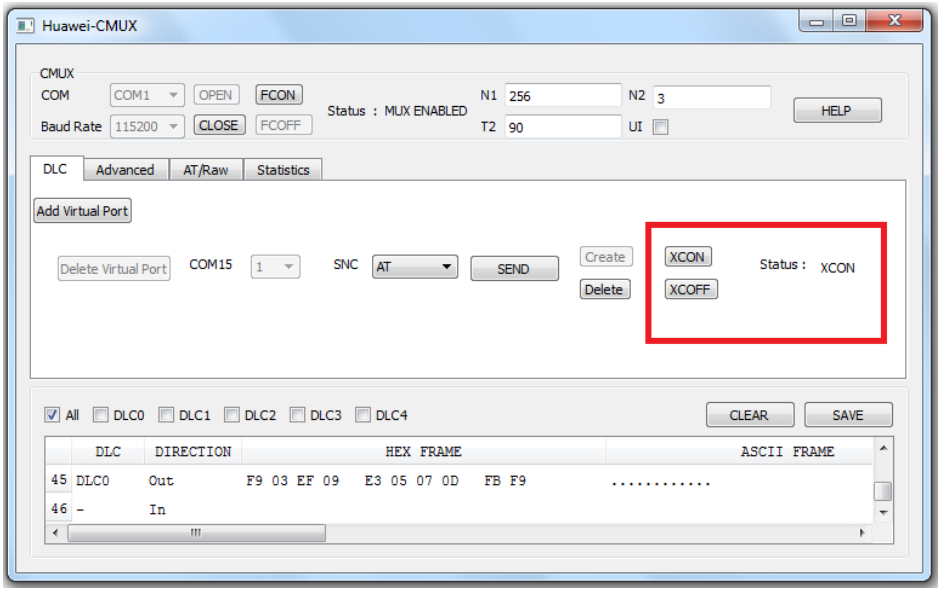




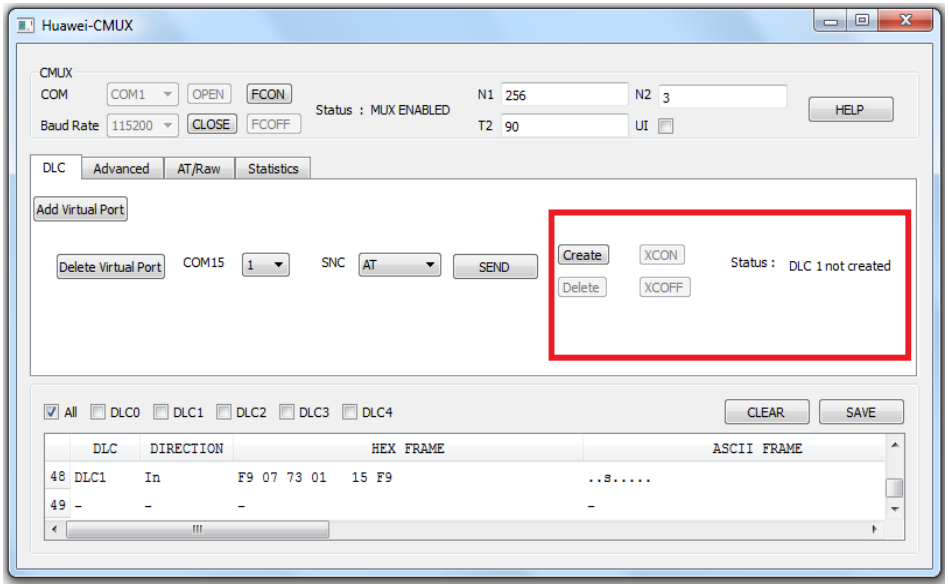
- The **Add Virtual Port** can add only 4 DLCIs at a time. If it is clicked four more or than four times, it will give an error message as **Cannot create more than 4 DLCIs**.



- On clicking **XCON**, the data frames can be sent and received by the host and target for the particular DLCI. In this example, this modem status command (**XCON**) will take place for DLC1.



- **Delete** is used to delete the mapped DLCI.

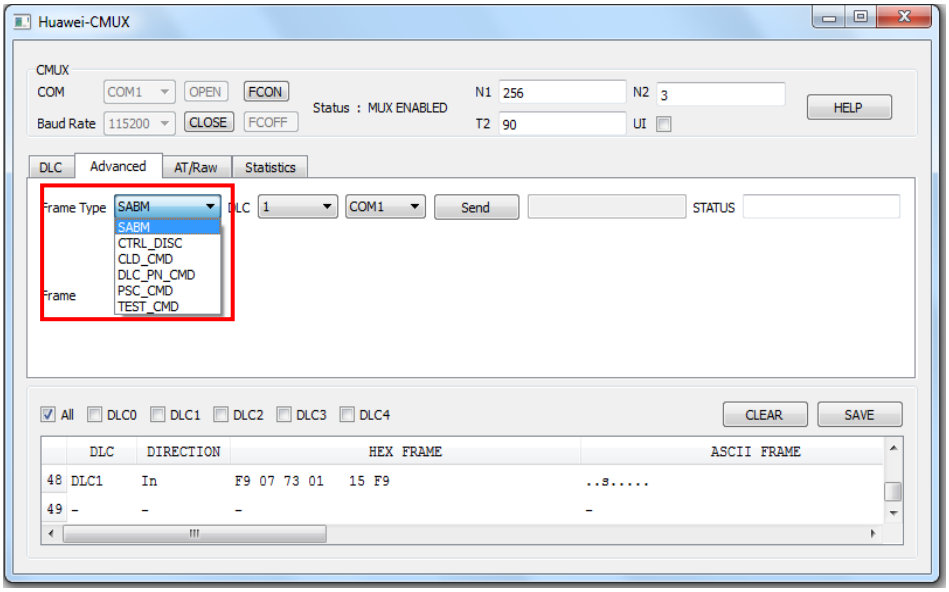


6.3 Advanced Main Window

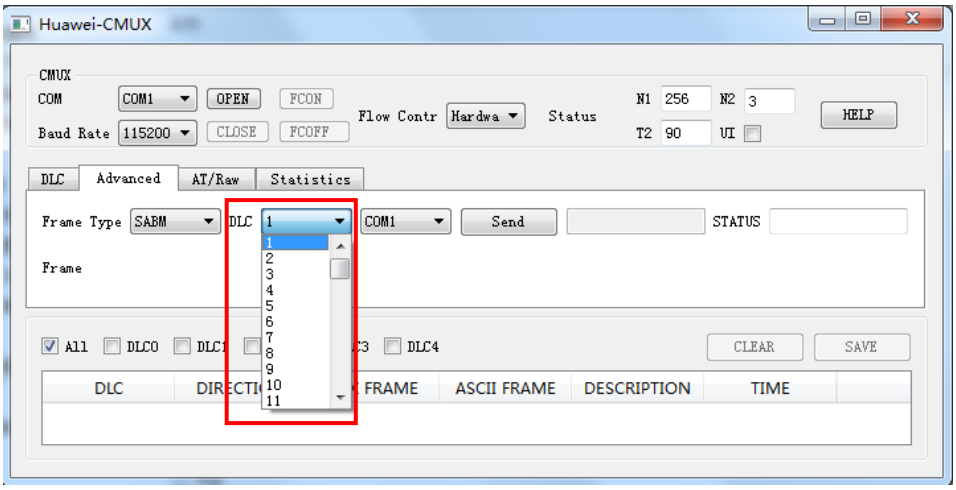
Advanced tab is used to send the control frames.

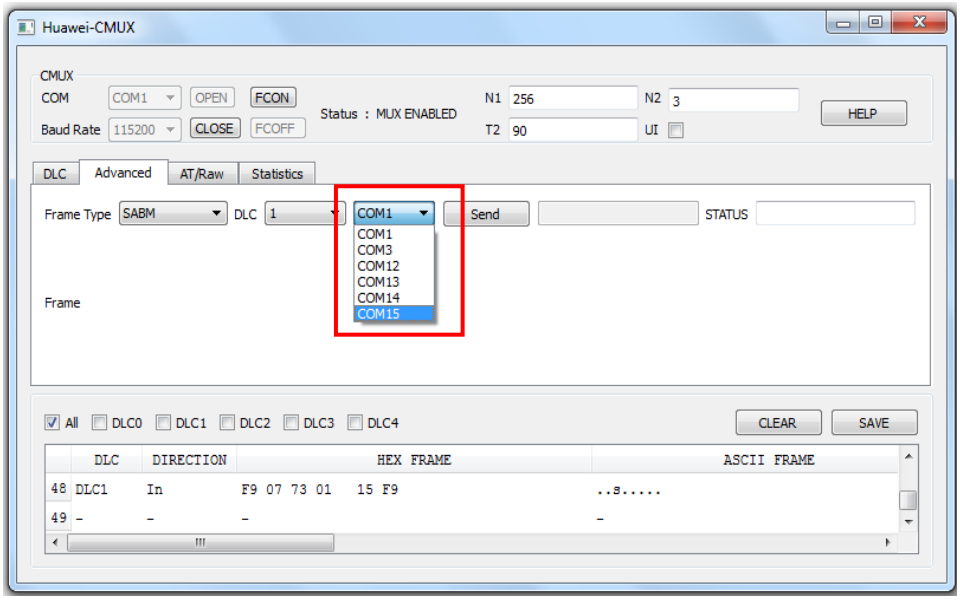
6.3.1 Create DLCI from Advanced Window

Step 1 Select **SABM** from **Frame Type** combo box.



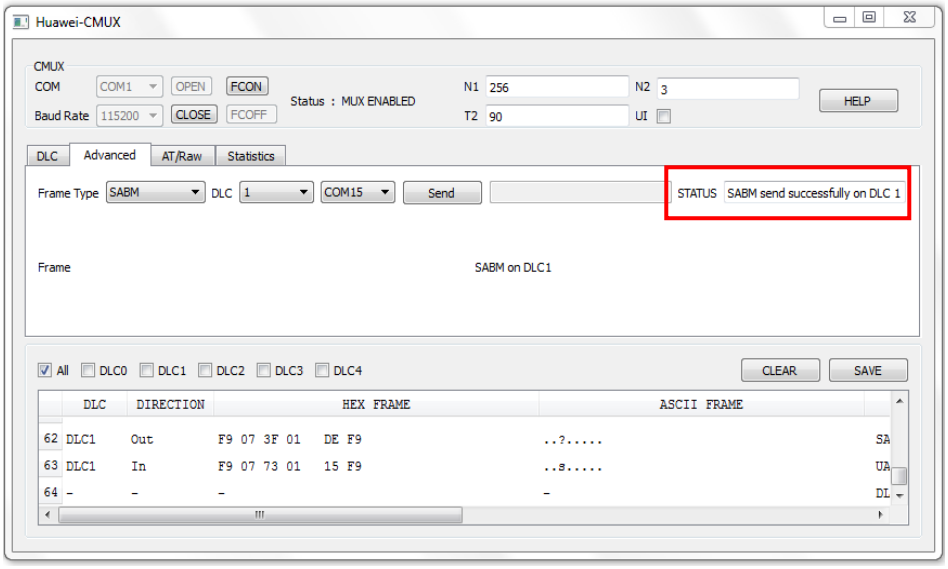
Step 2 Select DLCI number (say 1) from the **DLC** Identifier combo box and virtual COM port (say **COM15**) from **COM** combo box. **STATUS** will show whether the DLCI is already mapped to another COM or vice versa.





Step 3 Select **Send** to send the frame.

Now DLCI creation is done. If the DLCI is already created, sending SABM will fail.



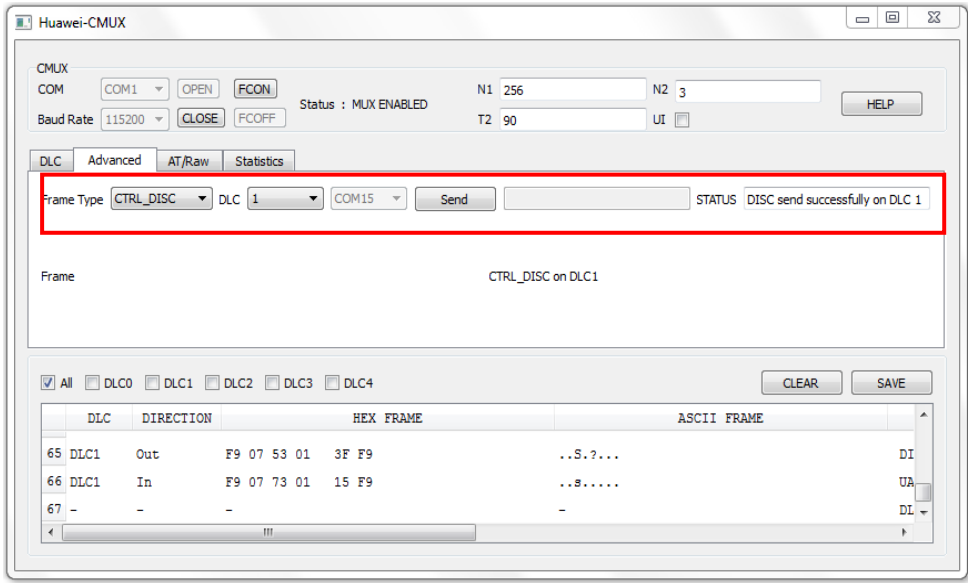
6.3.2 Delete DLCI from Advanced Window

Step 1 Select **CTRL_DISC** from the **Frame Type** combo box.

Step 2 Select **DLCI** number (say 1) from the **DLC** Identifier combo box and corresponding virtual COM port from **COM** combo box.

Step 3 Click **Send** to send the frame.

This will delete the created DLCI. If the DLCI that is to be deleted is not created, then an error message will come.



6.3.3 Send Test Commands from Advanced Window

Step 1 Select **TEST_CMD** from the **Frame Type** combo box.

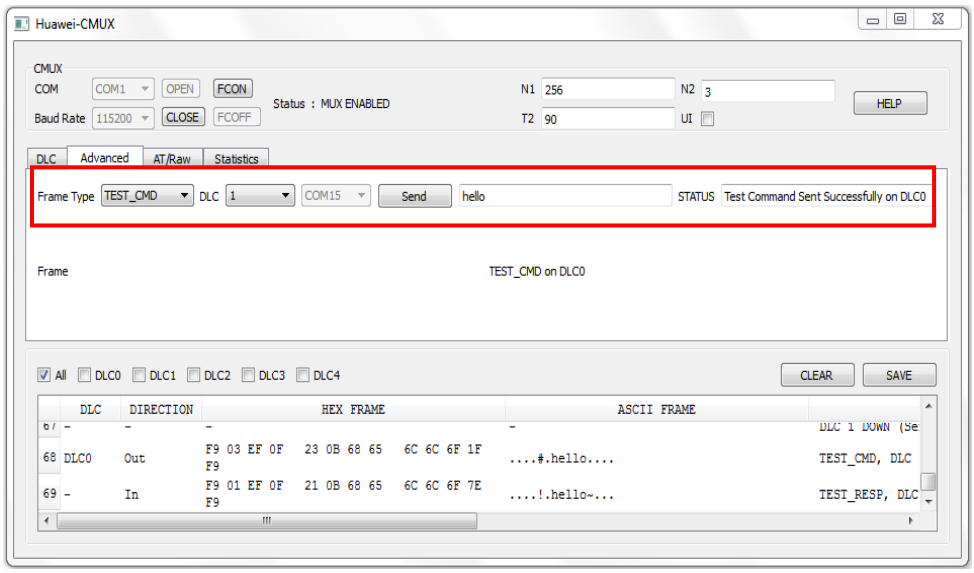
Step 2 Enter the message to be send.

Step 3 Click **Send** to send the frame.

NOTE

If data length is less than 127, then data length must be less than frame length (N1) –2 and if the data length is greater than 127, then data length must be less than frame length (N1) –3.

This will send the message. If the user tries to send empty message or the message size greater than the maximum frame size (**N1**), then an error message will come.

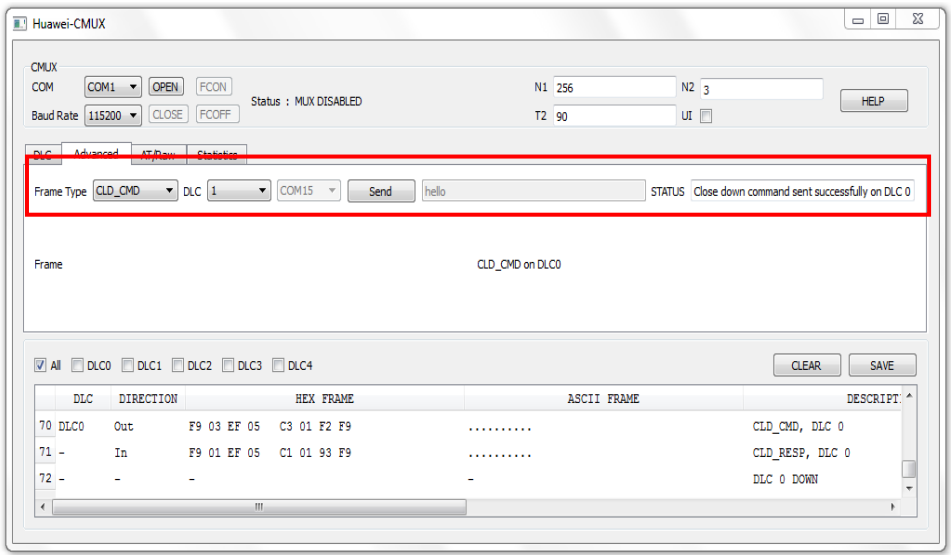


6.3.4 Close down the CMUX from Advanced Window

Step 1 Select **CLD_CMD** from the **Frame Type** combo box .

Step 2 Click **Send** to send the frame.

This will disable the CMUX.



6.4 AT/Raw Main Window

AT/Raw tab is used to send the AT commands in ASCII and Hex format for a particular DLCI.

Step 1 Select the created DLCI on which you want to send the AT commands.

Step 2 Select the AT commands from the **AT** combo box.

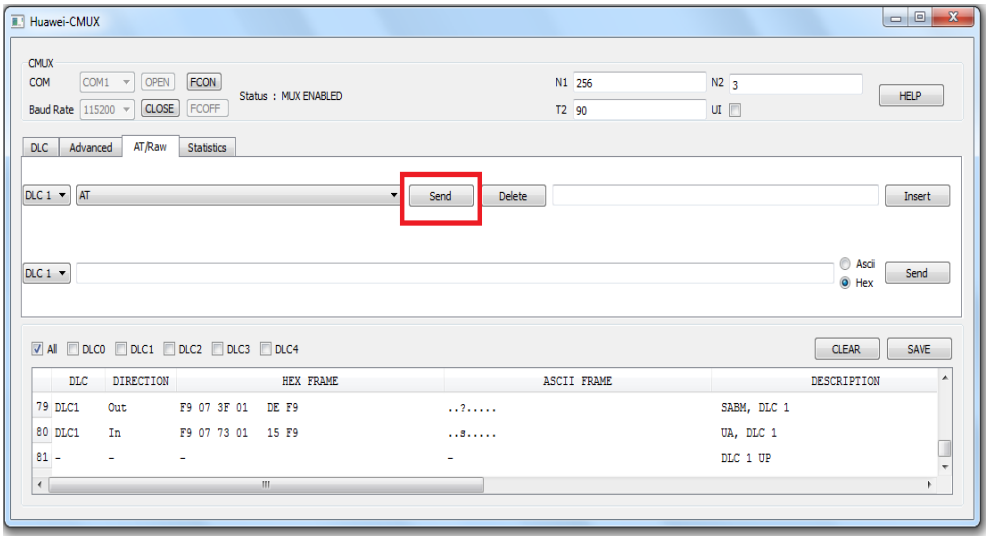
New AT commands can be added in the **AT** combo box through the line edit by clicking **Insert**.

Step 3 Click **Send** to send the AT command.

We can also send the AT commands in **Ascii** and **HEX** form by selecting the Radio box and then click **Send** to send the command.

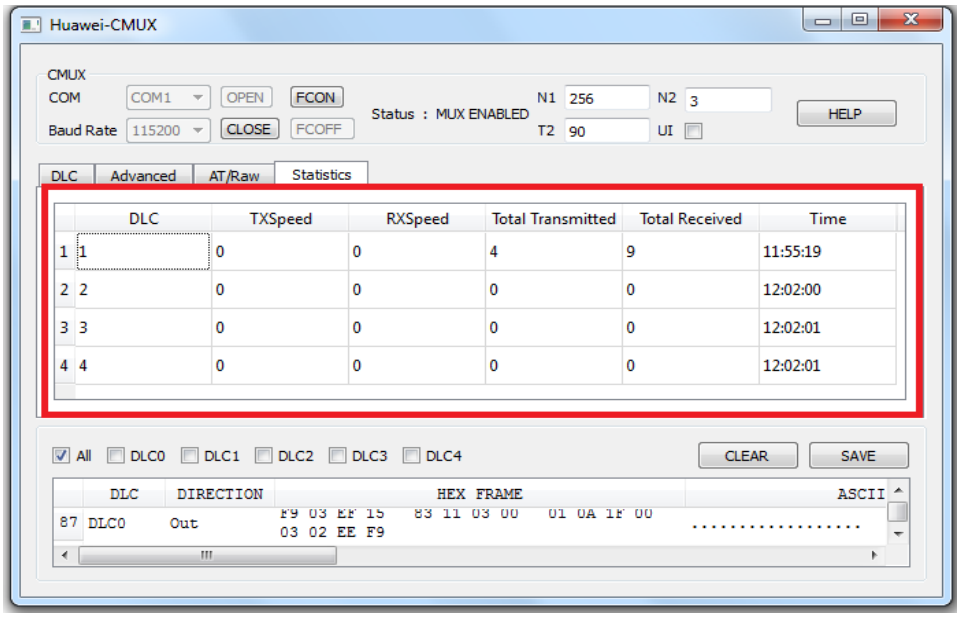
The **Insert** is used to insert the new AT commands in the **AT** combo box.

The **Delete** is used to delete the existing AT commands present in the AT combo box.



6.5 Statistics Application Main Window

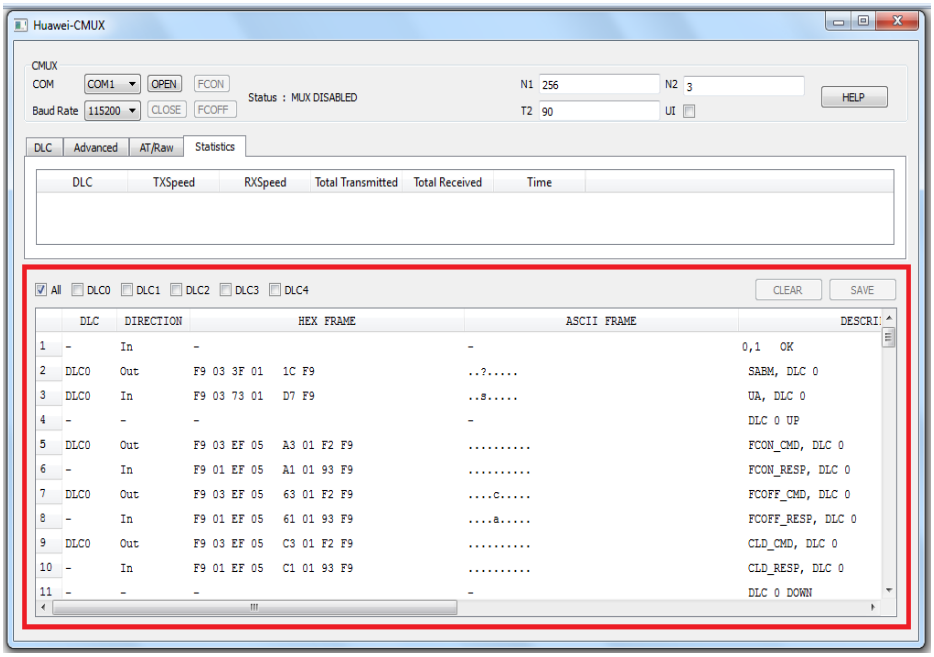
Statistics tab is used to show the created DLCI with the time duration when it is created.



6.6 Log Window

Log window shows frames sent by the host (TE) and the target (UE) in Both Hex and ASCII format with the time duration. There are checkboxes for DLCIs, if the user wants to see only the frames sent on DLCI 0 then by checking DLCI 0, the user can see the frames sent on DLCI 0 only. It is the same with DLC1, DLC2, DLC3, and

DLC4. If the user wants to see all the frames sent then by checking the ALL checkbox, the user can see all the frames. The log window can also be saved and cleared by clicking the **SAVE** and **CLEAR** respectively.



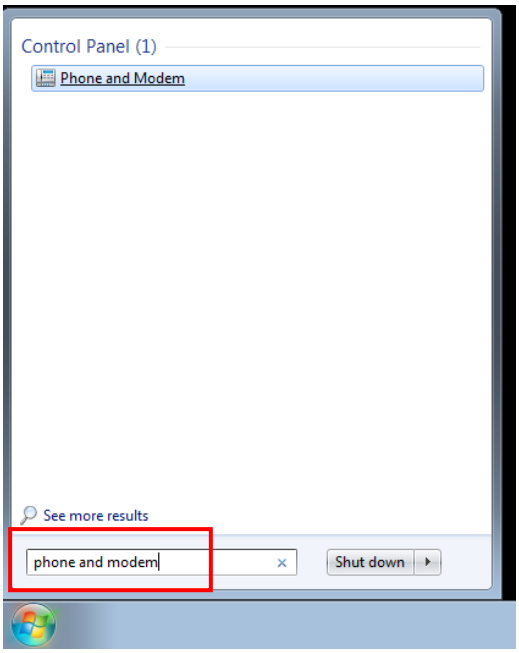
7 How to Use Windows Dialer

The following steps describe how to create dialer in windows (to use the virtual port as the modem port) for M2M project.

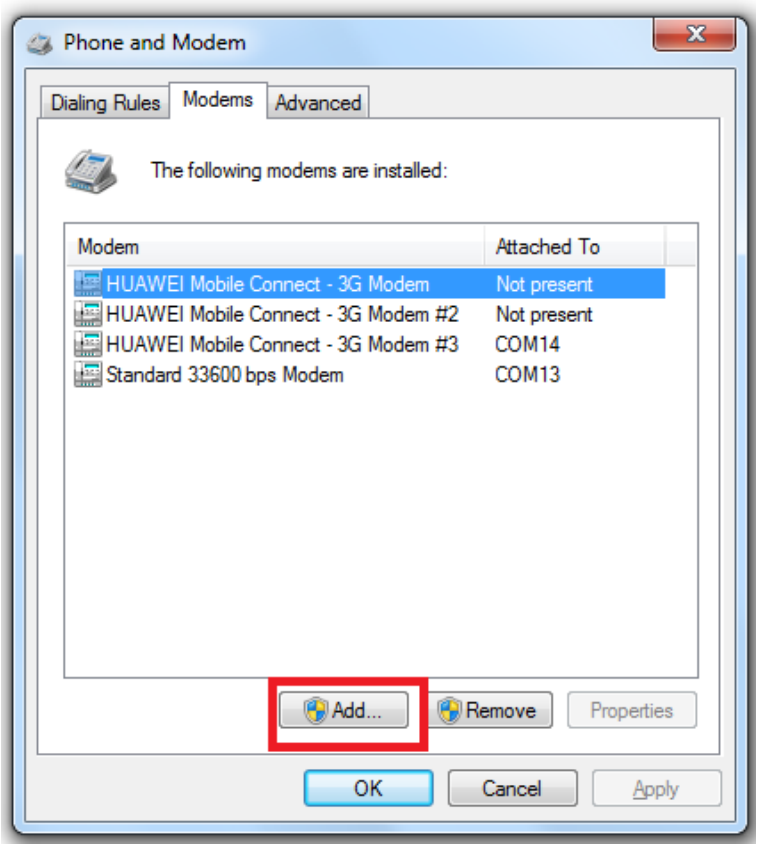
7.1 Create the Virtual Ports

Step 1 Create the virtual ports using Com0com software.

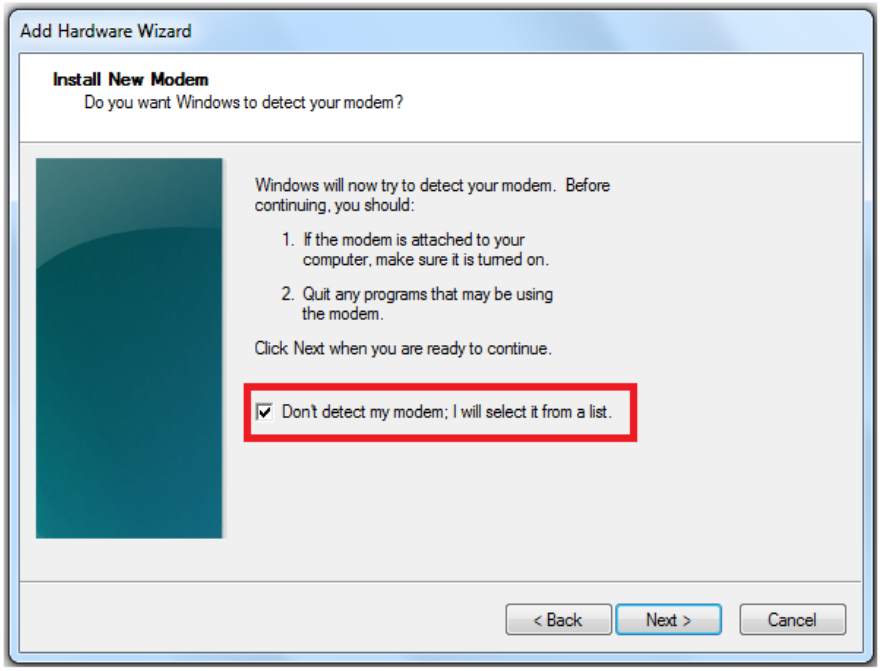
Step 2 In **Start** menu dialog box, input **phone and modem**.



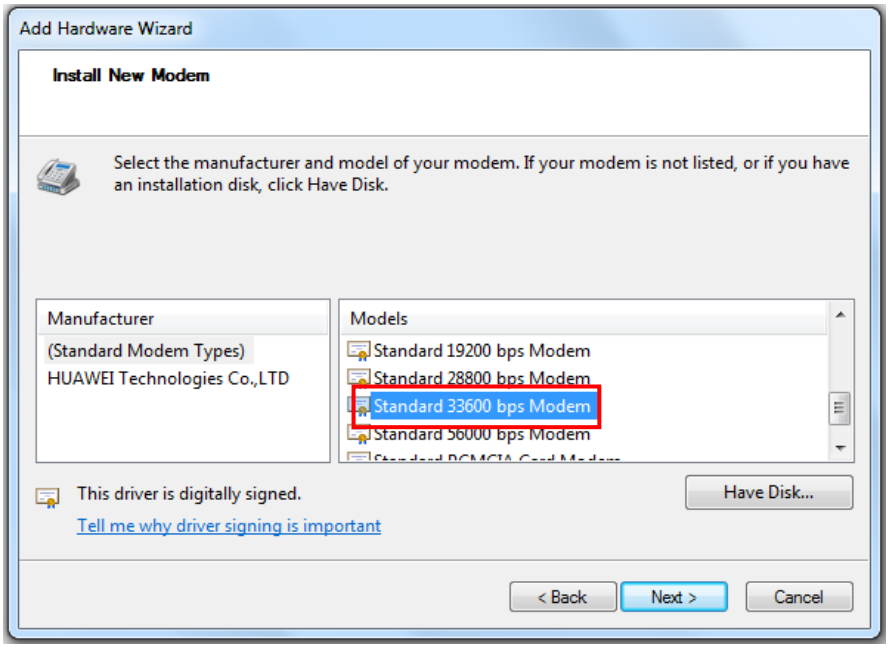
Step 3 Click **Modems** tag and then click **Add**.



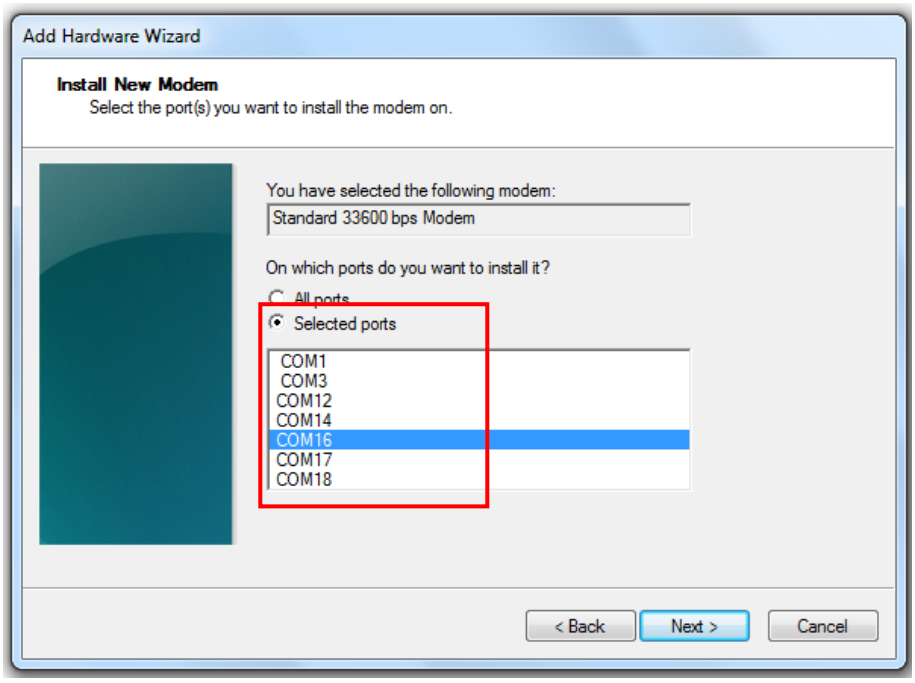
Step 4 Select the mark option and then click **Next**.



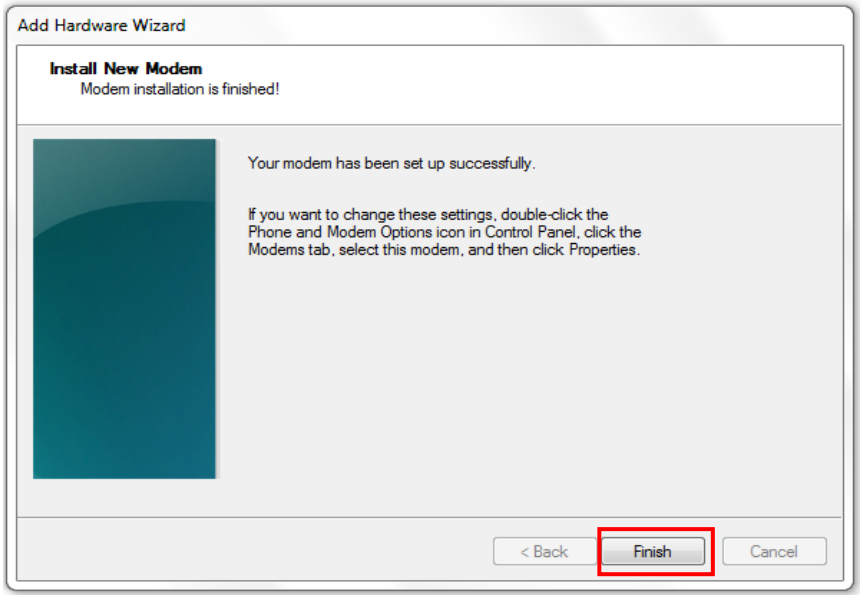
Step 5 Wait till it retrieves all the available configurations, and then select the type of the modem and click **Next**.



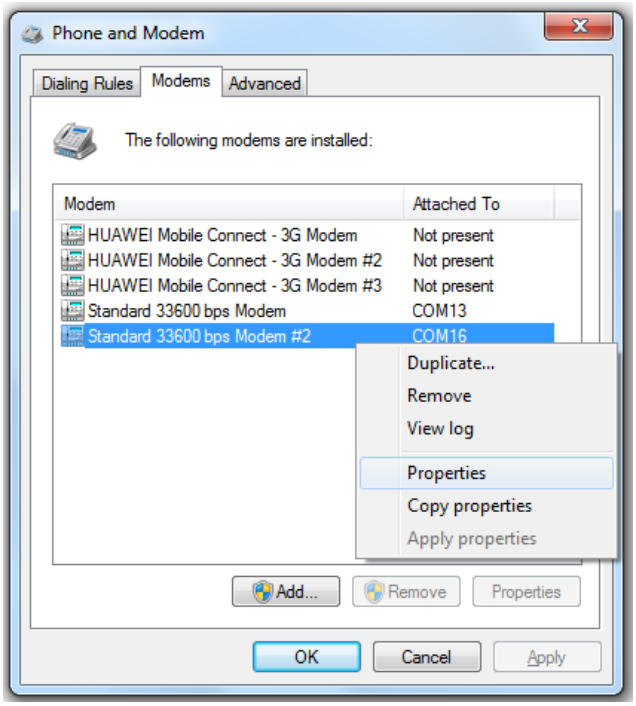
Step 6 Select the modem port on which the modem has to be configured. And click **Next**.



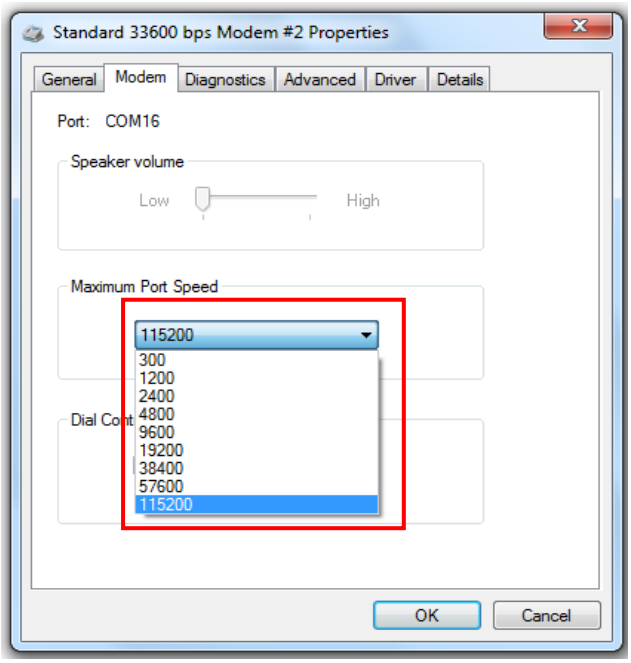
Step 7 Final page of configuration, click **Finish** to create new modem.



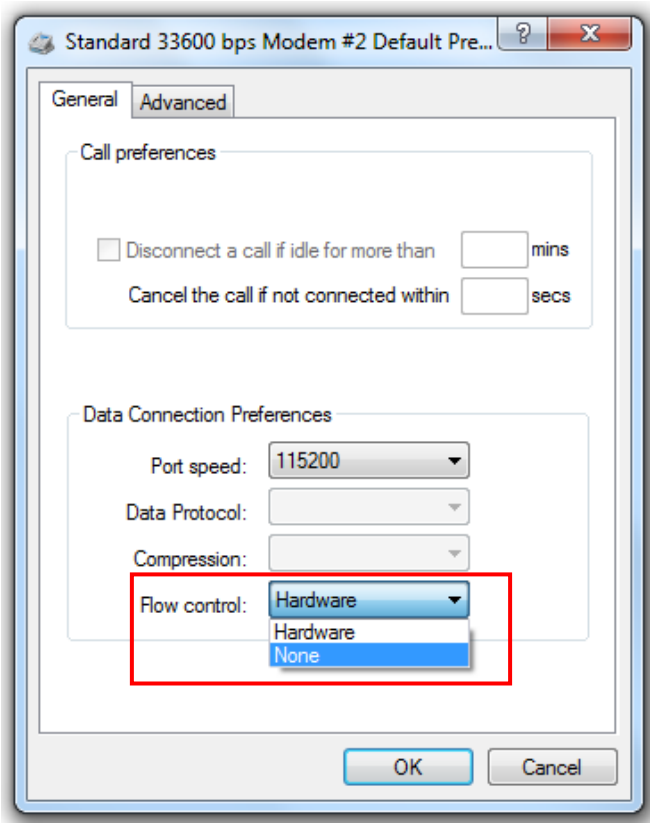
Step 8 Change the **Properties** of the modem.



Step 9 Configure the speed of the modem to **115200**. And click **OK**.

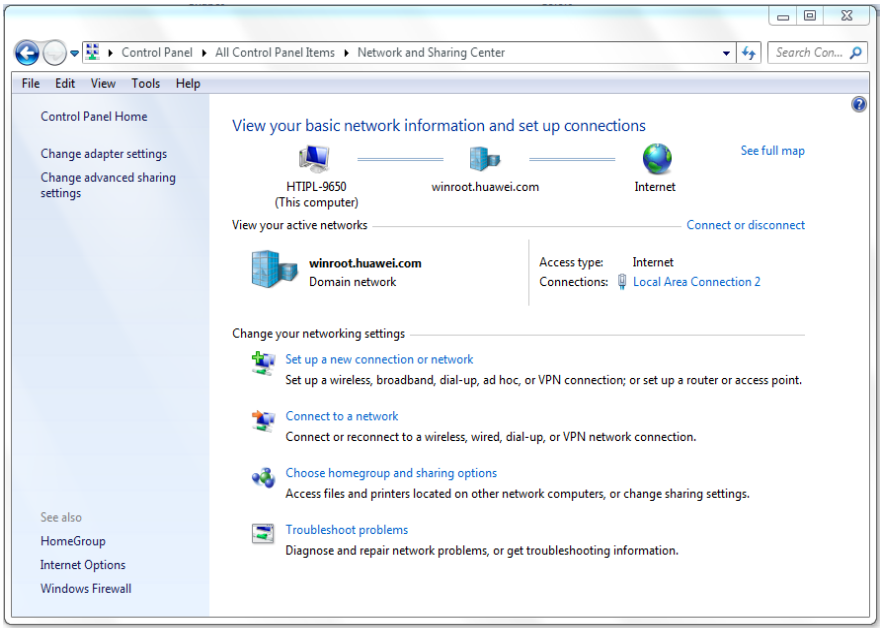


Step 10 Click **Advanced** tag and choose **Flow control** in **Data Connection Preferences** as **None**. And click **OK**.

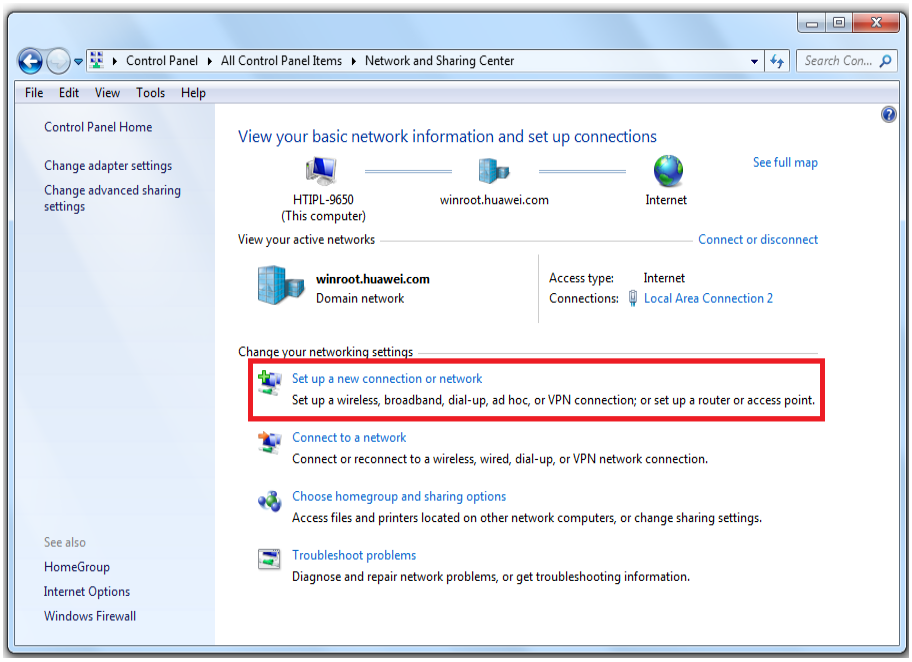


Step 11 Click **OK** on the all windows opened.

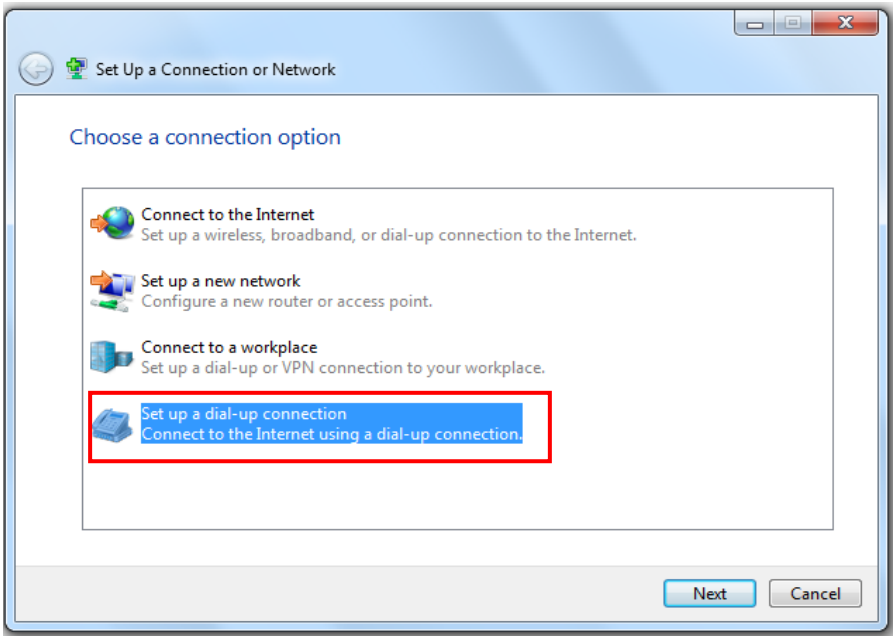
Step 12 Setup a dialer from **Control Panel** > **Network and Internet** > **Network Sharing Center**.



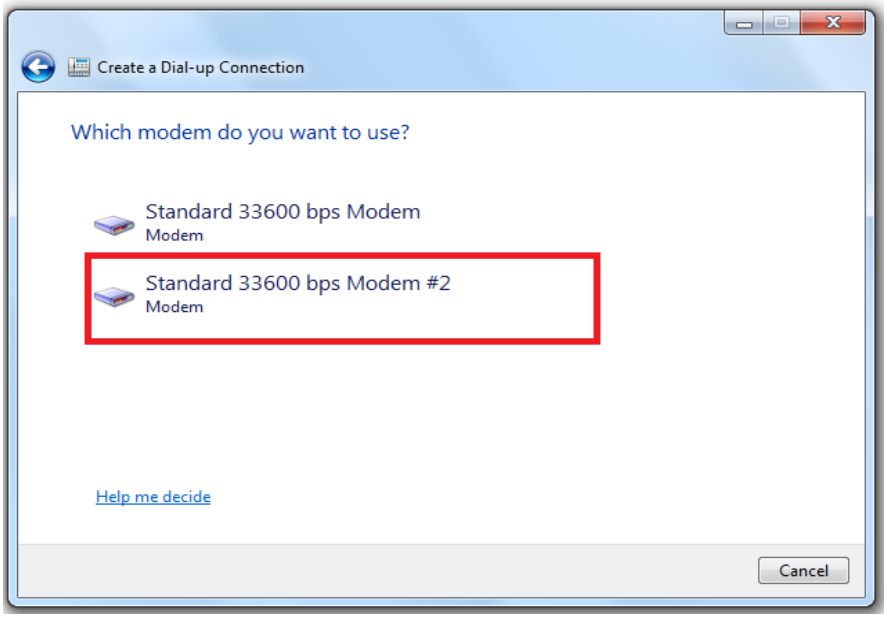
Step 13 Click on **Set up a new connection or network**.



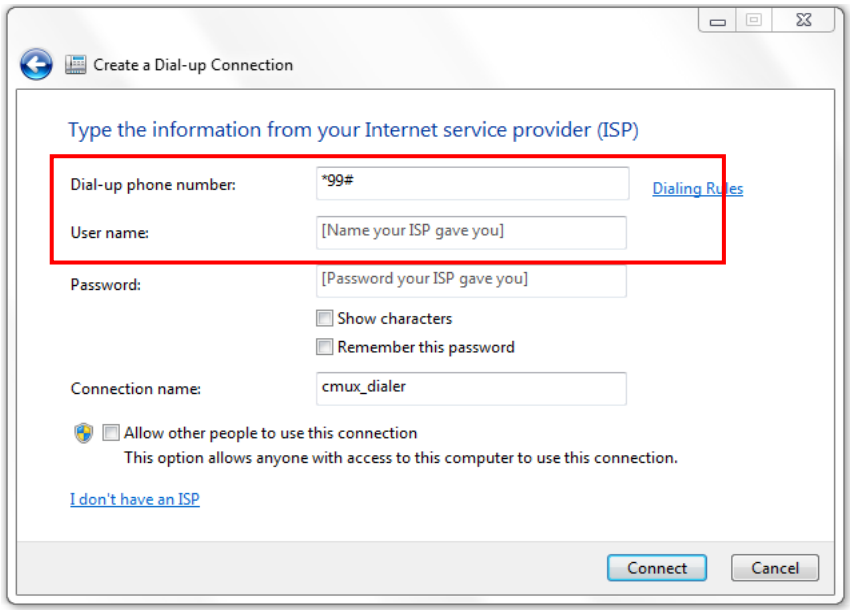
Step 14 Click **Set up a dial-up connection** and click **Next**.



Step 15 Then select the created modem from the list.



Step 16 Give the **Dial-up number** as ***99#** and the dialer name of user choice, and click **Connect**.



Step 17 Now start MUX on the target. Then create the DLCI on the port where the dial has to be done.

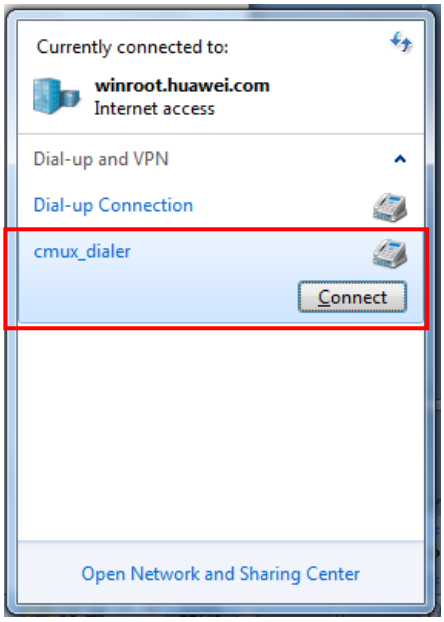
Open the hyper terminal on that port and initialize the APN. For example, if dialing has to be done on COM2, create DLCI on the COM2, and then open COM2 in hyper terminal and initialize the APN. If Airtel SIM is in use, then give the initialize the APN for Airtel.

AT+CGDCONT=1,"IP","www.airtelgprs.com"

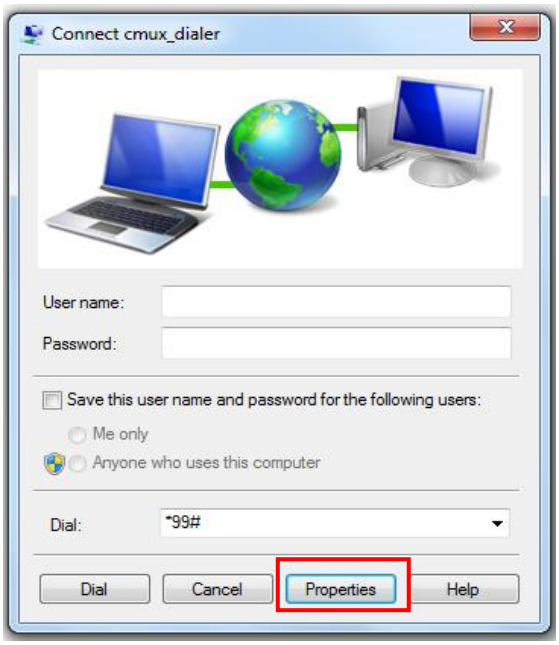
7.2 Disconnect the Hyper Terminal

Then disconnect the hyper terminal. Now follow the steps below.

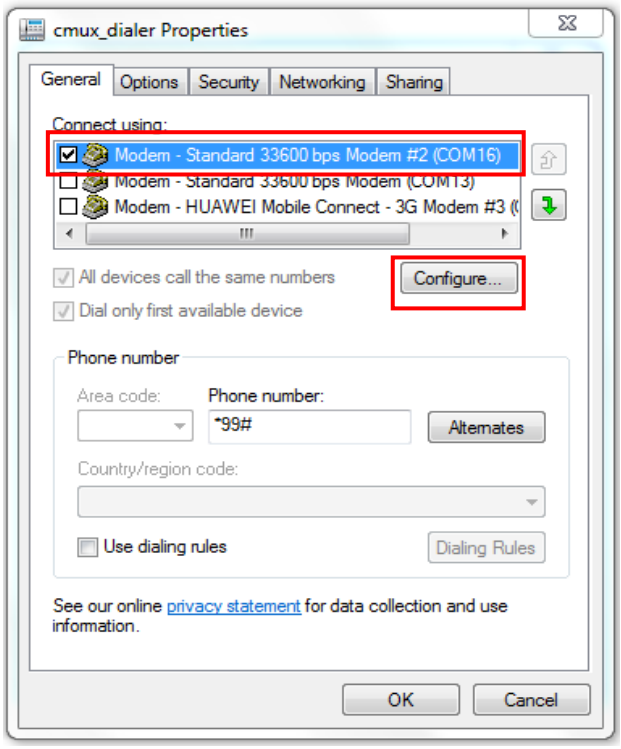
Step 1 Select the dialer **cmux_dialer** from the toolbar. Click **Connect**.



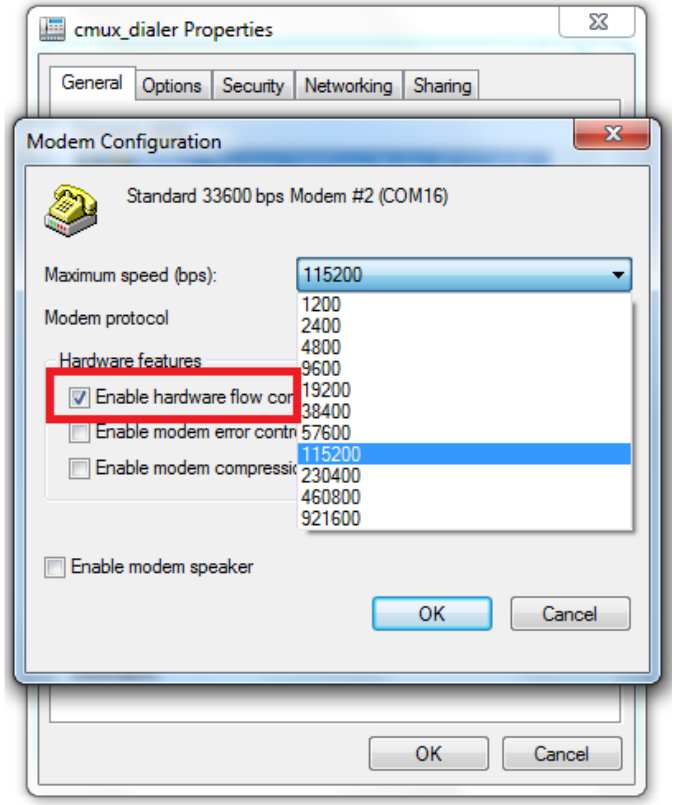
Step 2 Select **Properties** of the dialer.



Step 3 Select the modem from the list (if more than one modems are configured). Click **Configure**.

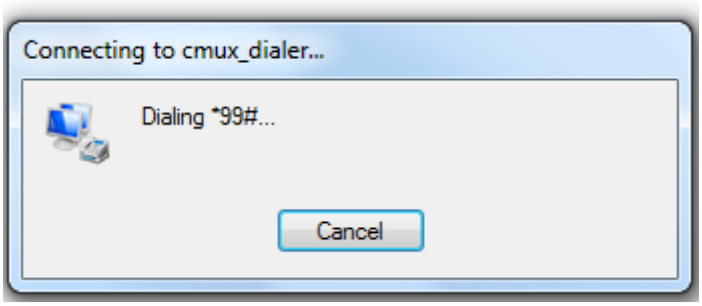


Step 4 Select the speed as **115200** and select the **Enable hardware flow** and click **OK**.



Step 5 Click **OK** on the remaining windows opened.

Step 6 Click **Dial**.



8 Summary and Recommendations

The user protocol application shall remember:

- Huawei module supports the CMUX basic option and UIH frames. The serial port must be configured as: 8 data bits, no parity, 1 stop bit and no flow control.

NOTE

The 909s series module enables CMUX mode only when the hardware flow control is enabled. The hardware flow control is enabled with the CMUX APP.

While creating DLCIs, make sure only virtual COM ports created through the application are used. It will be useful if you make a list of virtual ports created by other applications other than the ones created by the Huawei CMUX app.

- Speeds supported are: 3000000 bit/s, 1000000 bit/s, 921600 bit/s, 460800 bit/s, 230400 bit/s, 115200 bit/s, 57600 bit/s, 38400 bit/s, 19200 bit/s and 9600 bit/s (**The 921600 bit/s and 460800 bit/s are for MU509-b, MU709s series and ME209u-526 module; the 3000000 bit/s and 1000000 bit/s are only for ME909s series module**).
- When an asynchronous AT command, such as **AT+COPS=?**, is executed in a DLC channel, AT commands executed in other DLC channels are cached. Responses to those cached commands are returned only after the response to the asynchronous AT command is returned. Each DLC channel can have only one cached AT command. (**Applies to MU709 series module and ME909s series**)

NOTE

Speeds are supported through "IPR" setting.

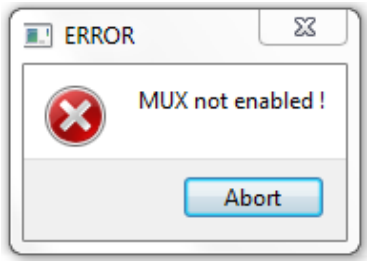
Limitations:

- The UIH data cannot be shown in log window because during PPP or bulk download, it affects the CMUX performance and makes slow down.
- We cannot release the ports when It is selected to send the message since all the tabs are in the same window and we have provided option to select the VSP in 2 places in AT/RAW window. Hence until the App is closed the VSP will not get released. Only possible thing is directly send the AT command from other Tools or only send the AT commands from AT/RAW window
- The virtual ports opened in the SSCOM will always write at the speed on which the MUX is enabled.
- Suppose if the MUX is enabled with the baud rate 9600 and the virtual ports are opened at the speed of 115200, it will write at the speed of 9600 only.

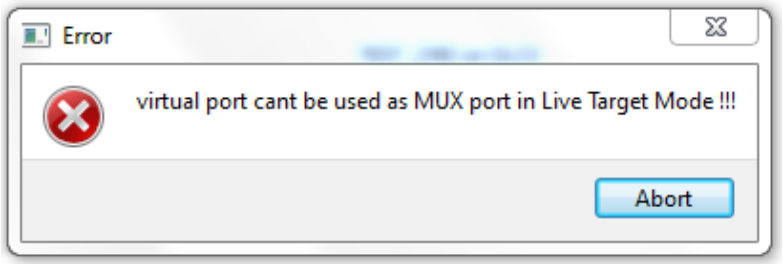
- If the data length and the data length size in the CMUX frame are in mismatch, then some of the upcoming frames might get affected (the number of frames affected depends on the frame size of the MUX session)
- CSD feature is not supported over CMUX.
- The local upgrade is not supported in the CMUX mode.(**Applies to MU709 series module and ME909s series**)
- The AT commands, such as: AT+IPR, AT&C, AT&D, AT&S, AT+IFC, AT+ICF, ATZ and AT&F are not effective, and they only return OK in the CMUX mode. (**Applies to MU709 series module and ME909s series**)

9 FAQ

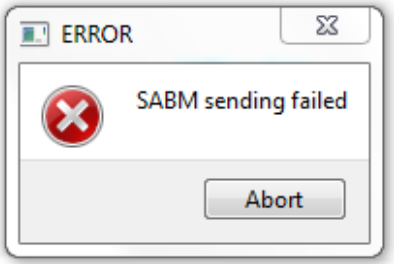
- FAQ 1: If you try to perform any operation from **Advanced** window when the MUX is not enabled, the following error message will be shown.



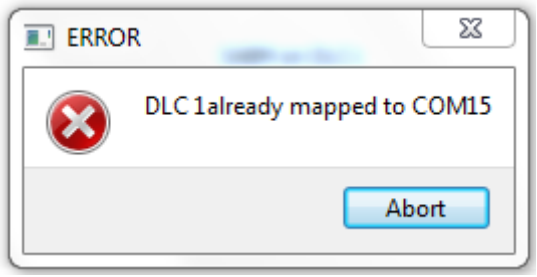
- FAQ 2: If MUX enabling is tried on virtual port, the following error message will be shown.



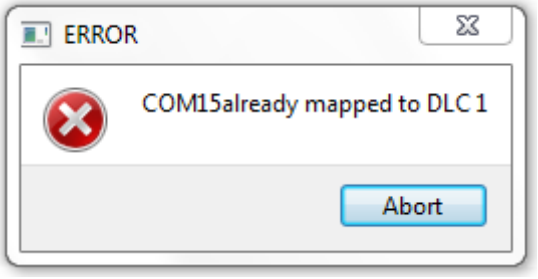
- FAQ 3: If **SABM** frame is tried to send again on an already created DLCI, the following error message will be shown.



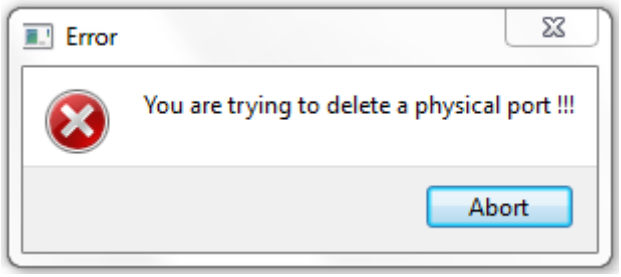
- FAQ 4: If already created DLCI is tried to be mapped to another COM, the following error message will be shown.



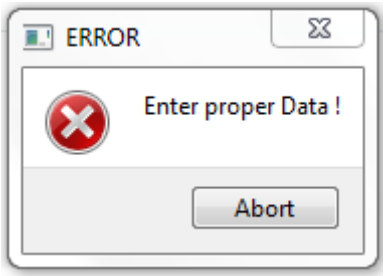
- FAQ 5: If already mapped COM port is tried to be mapped to another DLCI, the following error message will be shown.



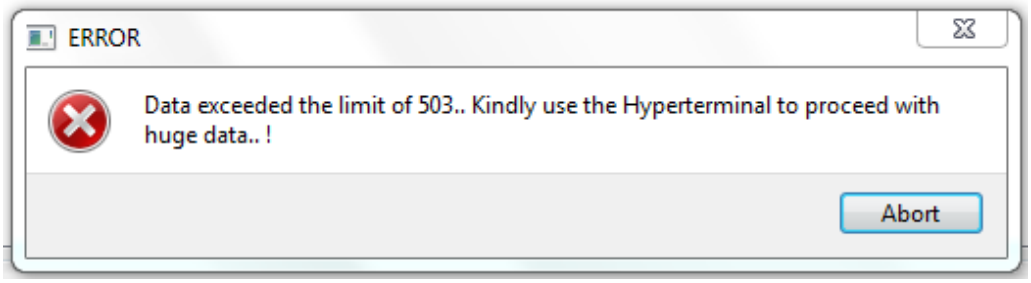
- FAQ 6: If DLCI is tried to be created on a physical port, the following error message will be shown.



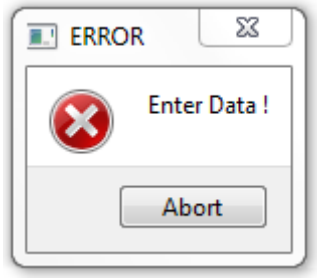
- FAQ 7: When you want to send data in Hex format, make sure you enter data in the following format as shown in this eg: A4 B3… 07 DE. Otherwise the following error message will be shown.



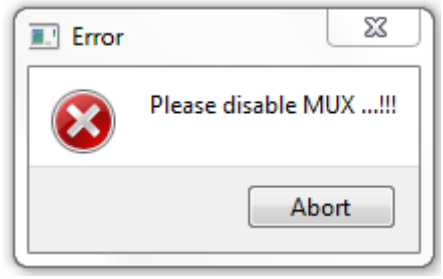
- FAQ 8: When you try to send large data through Huawei CMUX Application, the following error will be shown. In such situations, use application like hyperterminal to send large data.



- FAQ 9: When you try to perform **TEST_CMD** with no data, the following error will be shown.



- FAQ 10: When you try to close the application and the MUX is not disabled, the following error will be shown.



- FAQ 11: When you try to delete virtual COM port which is in use, restart option may come. Make sure that applications using that COM is closed before trying to delete it from Huawei CMUX Application.

10 Abbreviations

Abbreviations	Full spelling
3GPP	3rd Generation Partnership Project
CLD_CMD	Close Down Command
CLD_RESP	Close Down Response
DISC	Disconnect Command
DLCI	Data Link Connection Identifier
DLCI_PN_CMD	DLCI Parameter Negotiation Command
DLCI_PN_RESP	DLCI Parameter Negotiation Response
DM	Disconnected Mode
ERM	Error-Recovery Mode
FCS	Frame Check Sequence
MSC	Modem Status Command
NSC	Non Supported Command
PSC	Power Saving Control
SABM	Set Asynchronous Balanced Mode
TE	Terminal Equipment
TS	Technical Specification
UA	Unnumbered Acknowledgement
UE	User Equipment
UI	Unnumbered Information
UIH	Unnumbered Information with Header check