# EC200U&EG915U Series
# MUX Application Note

**LTE Standard Module Series**

Version: 1.1

Date: 2021-08-20

Status: Released

**Our aim is to provide customers with timely and comprehensive service. For any assistance, please contact our company headquarters:**

**Quectel Wireless Solutions Co., Ltd.**
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China
Tel: +86 21 5108 6236
Email: info@quectel.com

**Or our local office. For more information, please visit:**
http://www.quectel.com/support/sales.htm.

**For technical support, or to report documentation errors, please visit:**
http://www.quectel.com/support/technical.htm
Or email to support@quectel.com.

## General Notes

Quectel offers the information as a service to its customers. The information provided is based upon customers' requirements. Quectel makes every effort to ensure the quality of the information it makes available. Quectel does not make any warranty as to the information contained herein, and does not accept any liability for any injury, loss or damage of any kind incurred by use of or reliance upon the information. All information supplied herein is subject to change without prior notice.

## Disclaimer

While Quectel has made efforts to ensure that the functions and features under development are free from errors, it is possible that these functions and features could contain errors, inaccuracies and omissions. Unless otherwise provided by valid agreement, Quectel makes no warranties of any kind, implied or express, with respect to the use of features and functions under development. To the maximum extent permitted by law, Quectel excludes all liability for any loss or damage suffered in connection with the use of the functions and features under development, regardless of whether such loss or damage may have been foreseeable.

## Duty of Confidentiality

The Receiving Party shall keep confidential all documentation and information provided by Quectel, except when the specific permission has been granted by Quectel. The Receiving Party shall not access or use Quectel's documentation and information for any purpose except as expressly provided herein. Furthermore, the Receiving Party shall not disclose any of the Quectel's documentation and information to any third party without the prior written consent by Quectel. For any noncompliance to the above requirements, unauthorized use, or other illegal or malicious use of the documentation and information, Quectel will reserve the right to take legal action.

## Copyright

# About the Document

## Revision History

| Version | Date | Author | Description |
|---|---|---|---|
| - | 2021-04-27 | Joe TU | Creation of the document |
| 1.0 | 2021-06-09 | Joe TU | First official release |
| 1.1 | 2021-08-20 | Joe TU | Added an applicable module series EG915U. |

# Contents

# Table Index

# Figure Index

# 1 Introduction

The document defines Quectel MUX (multiplexer) protocol between UE and TE and provides examples of how to use the MUX function on EC200U and EG915U series modules.

# 2 Overview of MUX Protocol

MUX provides mechanisms for conveying data streams between TE and UE over a single physical port. Quectel MUX protocol creates four virtual channels on one physical port to transmit multiple streams of data simultaneously. It enables the physical port to act like four real physical channels for the application. Every virtual channel supports SMS and PPP dialing, etc.

All data from the application is packed into different frames, and the frames consist of the data and protocol fields which clearly indicate the channel number, length of the information, FCS, and so on. The frames are transmitted as one stream via the serial port. After arriving at the other peer, the data is unpacked as four streams by the MUX protocol stack and transmitted to the application. In addition to the information field, the control signals are also simulated.

Each channel between TE and UE is called a DLC (Data Link Connection) and is established separately and sequentially.

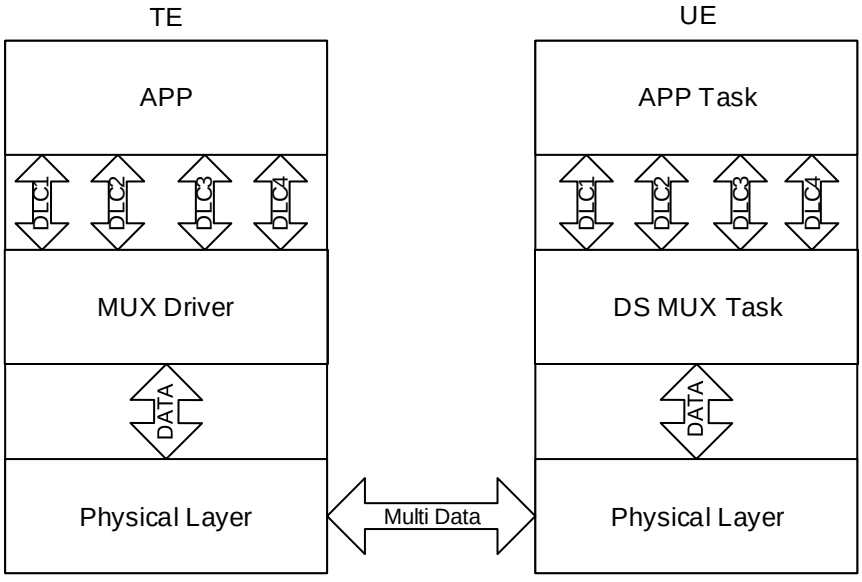


**Figure 1: MUX Architecture**

# 3 MUX AT Command

## 3.1. AT Command Introduction

### 3.1.1. Definitions

- **<CR>** Carriage return character.
- **<LF>** Line feed character.
- **<...>** Parameter name. Angle brackets do not appear on the command line.
- **[...]** Optional parameter of a command or an optional part of TA information response. Square brackets do not appear on the command line. When an optional parameter is not given in a command, the new value equals to its previous value or the default settings, unless otherwise specified.
- **Underline** Default setting of a parameter.

### 3.1.2. AT Command Syntax

All command lines must start with **AT** or **at** and end with **<CR>**. Information responses and result codes always start and end with a carriage return character and a line feed character: **<CR><LF><response><CR><LF>**. In tables presenting commands and responses throughout this document, only the commands and responses are presented, and **<CR>** and **<LF>** are deliberately omitted.

**Table 1: Types of AT Commands**

| Command Type | Syntax | Description |
|---|---|---|
| Test Command | **AT+<cmd>=?** | Test the existence of corresponding Write Command and to return information about the type, value, or range of its parameter. |
| Read Command | **AT+<cmd>?** | Check the current parameter value of a corresponding Write Command. |
| Write Command | **AT+<cmd>=<p1>[,<p2>[,<p3>[...]]]** | Set user-definable parameter value. |
| Execution Command | **AT+<cmd>** | Return a specific information parameter or perform a specific action. |

## 3.2. Declaration of AT Command Examples

The AT command examples in this document are provided to help you familiarize with AT commands and learn how to use them. The examples, however, should not be taken as Quectel's recommendation or suggestions about how you should design a program flow or what status you should set the module into. Sometimes multiple examples may be provided for one AT command. However, this does not mean that there exists a correlation among these examples and that they should be executed in a given sequence.

## 3.3. AT+CMUX Multiplexing Mode

This command enables/disables the multiplexing protocol control channel and sets parameters for the control channel.

| **AT+CMUX Multiplexing Mode** | |
|---|---|
| Test Command<br>**AT+CMUX=?** | Response<br>**+CMUX: (**list of supported **<transparency>**s**),(**list of supported **<subset>**s**),(**range of supported **<port_speed>**s**),(**range of supported **<N1>**s**),(**range of supported **<T1>**s**),(**range of supported **<N2>**s**),(**range of supported **<T2>**s**),(**range of supported **<T3>**s**),(**range of supported **<k>**s**)**<br><br>**OK** |
| Read Command<br>**AT+CMUX?** | Response<br>**+CMUX: <transparency>[,<subset>[,<port_speed>[,<N1>[,<T1>[,<N2>[,<T2>[,<T3>[,<k>]]]]]]]]**<br><br>**OK** |
| Write Command<br>**AT+CMUX=<transparency>[,<subset>[,<port_speed>[,<N1>[,<T1>[,<N2>[,<T2>[,<T3>[,<k>]]]]]]]]** | Response<br>**OK**<br>Or<br>**ERROR**<br><br>If there is an error related to ME functionality:<br>**+CME ERROR: <err>** |
| Maximum Response Time | 300 ms |
| Characteristics | The command takes effect immediately.<br>The configuration is not saved. |

## Parameter

| | |
|---|---|
| **<transparency>** | Integer type. Multiplexer transparency mechanism.<br>0 Basic option |
| **<subset>** | Integer type. Defines the way in which the multiplexer control channel is set up. A virtual channel may subsequently be set up differently but in the absence of any negotiation for the settings of a virtual channel, and it shall be set up according to the control channel **<subset>** setting.<br>0 UIH frame used only |
| **<port_speed>*** | Integer type. Transmission rate of the physical port (not supported currently).<br>1 9600 bit/s<br>2 19200 bit/s<br>3 38400 bit/s<br>4 57600 bit/s<br>5 115200 bit/s<br>6 230400 bit/s<br>7 460800 bit/s<br>8 912600 bit/s |
| **<N1>** | Integer type. Maximum frame size. Range: 1–2048; Default value: 31. |
| **<T1>** | Integer type. Acknowledgement timer, that is, the time UE waits for an acknowledgement before resorting to another action (e.g. transmitting a frame). Range: 1–255; Default value: 10. Unit: ten milliseconds. |
| **<N2>** | Integer type. Maximum number of re-transmissions. Range: 0 – 100; Default value: 3. |
| **<T2>** | Integer type. Response timer for the multiplexer control channel. Range: 2–255; Default value: 30; Unit: ten milliseconds. **<T2>** must be longer than **<T1>**. |
| **<T3>** | Integer type. Wake up response timer. Range: 1–255; Default value: 10; Unit: second. |
| **<k>** | Integer type. Window size. Defines the maximum number of I frames that can be parsed by a DLC. Range: 1–7. Default value: 2. (Not supported currently) |

## Example

```
AT+CMUX=?
+CMUX: (0),(0),(1-8),(1-2048),(1-255),(0-100),(2-255),(1-255),(1-7)

OK
AT+CMUX?
+CMUX: 0,0,5,31,10,3,30,10,2

OK
AT+CMUX=0

OK
```

# 4 MUX Protocol

This chapter explains the technical details of the MUX protocol.

## 4.1. Frame Structure

All information transmitted between the TE and UE is conveyed in frames.

**Table 2: MUX Frame Structure**

| Flag | Address | Control | Length | Information | FCS | Flag |
|---|---|---|---|---|---|---|
| 1 octet | 1 octet | 1 octet | 1–2 octet | Uncertain length | 1 octet | 1 octet |

### 4.1.1. Flag Sequence Field

Each frame begins and ends with a flag sequence octet (0xF9).

### 4.1.2. Address Field

The address field consists of one single octet, including the Data Link Connection Identifier (DLCI), the C/R bit and the address field extension bit as shown in the following table.

**Table 3: Address Field**

| Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8 |
|---|---|---|---|---|---|---|---|
| EA | C/R | DLCI | | | | | |

#### 4.1.2.1. DLCI

The DLCI identifies the virtual channel between TE and UE. The ports are assigned as follows.

**Table 4: Applicable Modules**

| DLCI | Virtual Channel |
|---|---|
| 0 | Reserved to control the channels |
| 1 | Virtual channel 1 |
| 2 | Virtual channel 2 |
| 3 | Virtual channel 3 |
| 4 | Virtual channel 4 |

#### 4.1.2.2. C/R

The C/R (command/response) bit identifies the frame as either a command or a response. TE sends a command to the UE with the C/R bit set to 1, and the UE responses with the C/R bit set to 1. The UE sends a command with the C/R bit set to 0, and the TE responses with the C/R bit set to 0.

**Table 5: C/R Bit Usage**

| Command/Response | Direction | C/R Value |
|---|---|---|
| Command | TE → UE | 1 |
| | UE → TE | 0 |
| Response | UE → TE | 1 |
| | TE → UE | 0 |

The frames sent by the TE have the C/R bit set to 1 and those sent by UE have the C/R bit set to 0.

#### 4.1.2.3. EA

EA bit extends the range of the address field. When the EA bit is set to 1 in an octet, it signifies that this octet is equals to the length field. When the EA bit is set to 0, it signifies that another octet of the address field follows.

**NOTE**

EA is supported being only set to 1 currently.

### 4.1.3. Control Field

The content of the control field defines the type of frame. See ***Chapter 4.2*** for details of the frame types.

**Table 6: Coding of Control Field**

| Frame Type | HEX (P/F=0) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| SABM (Set Asynchronous Balanced Mode) | 0x2F | 1 | 1 | 1 | 1 | P/F | 1 | 0 | 0 | |
| UA (Unnumbered Acknowledgement) | 0x63 | 1 | 1 | 0 | 0 | P/F | 1 | 1 | 0 | |
| DM (Disconnected Mode) | 0x0F | 1 | 1 | 1 | 1 | P/F | 0 | 0 | 0 | |
| DISC (Disconnect) | 0x43 | 1 | 1 | 0 | 0 | P/F | 0 | 1 | 0 | |
| UIH (Unnumbered Information with Header check) | 0xEF | 1 | 1 | 1 | 1 | P/F | 1 | 1 | 1 | |
| UI (Unnumbered Information) | 0x03 | 1 | 1 | 0 | 0 | P/F | 0 | 0 | 0 | Optional |

As Bit 5 of Control field, P/F is the Poll/Final bit. The poll/final (P/F) bit shall serve a function in both command frames and response frames. In command frames, the P/F bit refers to the P bit. The poll (P) bit set to 1 shall be used by one station to solicit (poll) a response or sequence of responses from the other station. In response frames, it is referred to as the F bit. The final (F) bit set to 1 shall be used by a station to indicate the response frame transmitted as the result of a soliciting (poll) command.

For UIH frame, P/F should set to 0.

### 4.1.4. Length Field

**Table 7: The Structure of Length Field**

| Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8 |
|---|---|---|---|---|---|---|---|
| EA | L1 | L2 | L3 | L4 | L5 | L6 | L7 |

The L1 to L7 bits indicate the length of the following data field. The default maximum length is 31 bytes. 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 signifies that this octet is equals to the length field. When the EA bit is set to 0, it signifies that another octet of the address field follows.

| Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8 |
|---|---|---|---|---|---|---|---|
| 0 | L1 | L2 | L3 | L4 | L5 | L6 | L7 |

| Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8 |
|---|---|---|---|---|---|---|---|
| L8 | L9 | L10 | L11 | L12 | L13 | L14 | L15 |

**NOTE**

Even if the data after this byte is empty, the length field should be reserved.

### 4.1.5. Information Field

The information field is valid only when the control field is in UIH frames.

### 4.1.6. FCS Field

FCS checks the address, control, length and information field with CRC. The UIH frame is special that only checks address, control and length fields, which indicates that the information field is not checked. or the check algorithm, see B1–B3 of *3GPP TS 27.010 V13.0.0* for detailed information.

## 4.2. Frame Types

### 4.2.1. SABM

SABM is a command frame and is used to establish DLC between TE and UE. TE initiates the command and UE responds with UA frames.

### 4.2.2. UA

The UA frame is a response to SABM or DISC frame, as illustrated in the following figure.

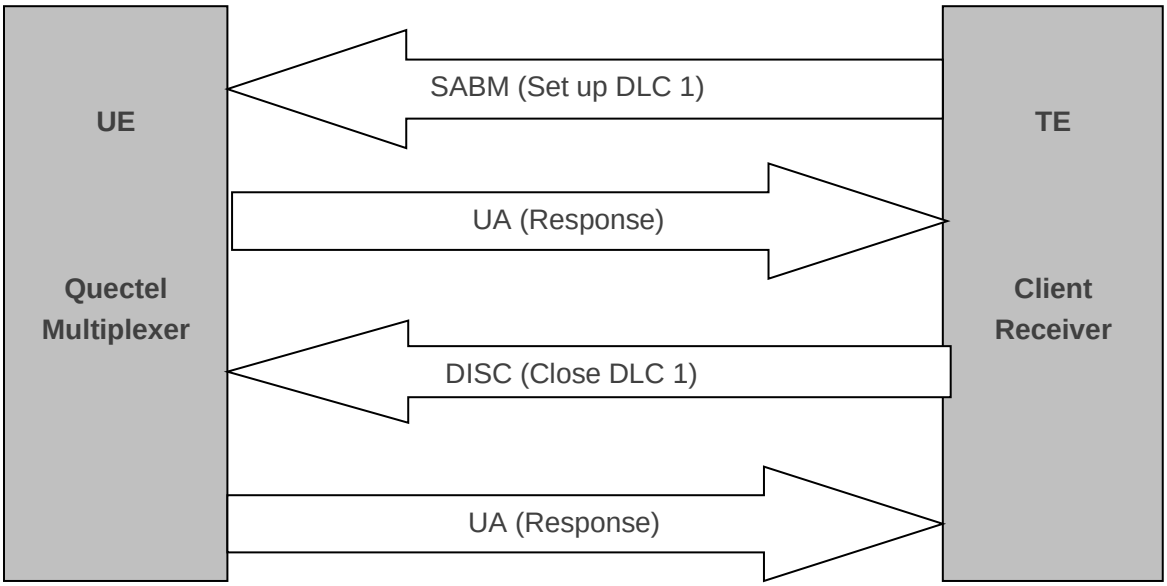


**Figure 2: UA Frame (Response)**

### 4.2.3. DM

The DM response frame reports a status where the station is logically disconnected from the data link. When in disconnected mode, no commands will be accepted until the disconnected mode is terminated by the receipt of a SABM command. If a DISC command is received while in disconnected mode, a DM response will be sent.

### 4.2.4. DISC

DISC is a command frame and is used to close the specific DLC. When the DLCI 0 is closed by the DISC command, all the established DLC channels are closed and the normal AT command mode is restored. The receiving station uses the UA frame to respond as a confirmation of the DISC command.

### 4.2.5. UIH

The UIH frame is used to transmit data or UIH MUX command control message and is identified with address field. If the address field is set to DLCI 0, it indicates that this frame is used to transmit UIH control messages; otherwise, it indicates that this frame transmits data. The UIH frame does not check the information field.

## 4.3. UIH MUX Control Message

The UIH MUX control message is transmitted through the DLCI 0 channel. The messages should exist in pairs, that is, a command message and a response message. The command and response are determined according to the C/R bit of the following type fields. Message format is as follows.

### 4.3.1. UIH MUX Control Message Format

The format of UIH MUX control message format is as follows:

**Table 8: UIH MUX Control Message Format**

| Flag | Address | Control | Length | Information | FCS | Flag |
|---|---|---|---|---|---|---|
| 1 octet | 1 octet | 1 octet | 1/2octet | Multiple octets | 1 octet | 1 octet |

**Table 9: UIH MUX Control Message Information Field**

| Type | Length | Value 1 | Value 2 | … | Value n |
|---|---|---|---|---|---|

Each box in this table above represents a field of minimum size per octet.

#### 4.3.1.1. Type Field

The type field octet has the following format:

**Table 10: Message Format – Type Field**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| EA | C/R | T1 | T2 | T3 | T4 | T5 | T6 |

The EA bit is an extension bit and is set to 1 in the last octet of the sequence. In other octets, EA is set to 0. In Quectel MUX protocol, only one octet is transmitted so EA is always set to 1.

The C/R bit indicates whether the message is a command or a response.

The T bits indicate the type coding. Each command has a unique pattern of bit sequence. This means that a single-octet type field can encode 63 different message types. Only single octet message types are defined in this document.

**NOTE**

When a UIH frame is on the DLCI 0, there are two C/R bits. The settings of the C/R in the address field is detailed in ***Chapter 4.1.2***.

#### 4.3.1.2. Length Field

The length field octet has the following structure:

**Table 11: Message Format – Length Field**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| EA | L1 | L2 | L3 | L4 | L6 | L6 | L7 |

The EA bit is an extension bit. It is set to 1 in the last octet of the sequence. In other octets EA is set to 0.

The L bits define the length of the value octets that follows. L1 is the LSB.

#### 4.3.1.3. Value Field

The contents of the value octets are defined for each message type in ***Chapter 4.3.2***.

### 4.3.2. MUX Close Down (CLD)

The MUX close down command is used to reset the link to the normal AT command mode. The multiplexer closes down messages use the following type field octet:

**Table 12: MUX Close-down Message – Type Field Format**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| EA | C/R | 0 | 0 | 0 | 0 | 1 | 1 |

The length byte in CLD message frame is 0. It has no value octet.

### 4.3.3. Test Command (Test)

The test command is used to test the link between TE and UE. The format of the type field byte is as follows:

**Table 13: Test Command – Type Field Format**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| EA | C/R | 0 | 0 | 0 | 1 | 0 | 0 |

The length byte indicates the length of the subsequent value field. The content of the value range is arbitrary, and the other station should return the same content.

## 4.4. UIH Data Channel

User data is transmitted through DLCI 1~DLCI 4 channels, and the frame format is as follows:

**Table 14: UIH Data Frame Structure**

| Flag | Address | Control | Length | Information | FCS | Flag |
|---|---|---|---|---|---|---|
| 1 octet | 1 octet | 1 octet | 1–2 octet | Multiple octets | 1 octet | 1 octet |

The information field is used to transmit user data, and FCS only checks the address, control, and length fields.

## 4.5. Procedures

### 4.5.1. Lunch MUX

The activation of MUX needs to be triggered by sending **AT+CMUX** to the UE on a physical AT channel. If you need to switch the rate, the rate of the main serial channel needs to be modified through **AT+IPR** first. For detailed information about AT commands, see ***document [1]***.

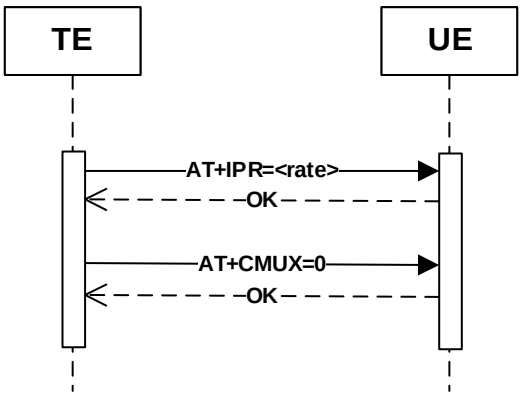


**Figure 1: Enable MUX**

### 4.5.2. Establish DLC

Currently the module supports one control channel (DLCI 0) and four effective DLC channels.

Use SABM to establish DLC channel. After entering MUX through executing the configuration command of **AT+CMUX**, the MUX control channel (DLCI 0) is first established by sending a SABM frame, and the UE will respond to the message through a UA message. SABM frames are also sent to establish other DLC channels.

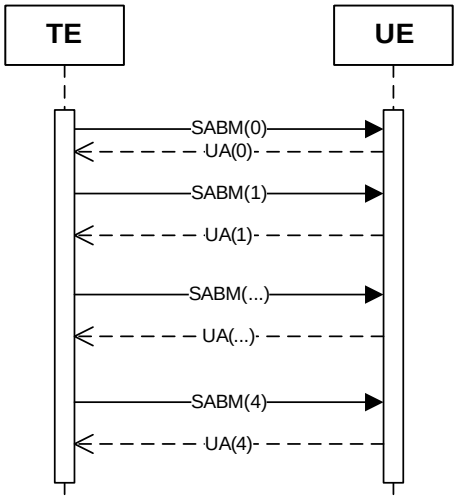


**Figure 2: Establish DLC**

### 4.5.3. Transmit Data

When the DLC connection is established, user data is transmitted through the UIH data channel.

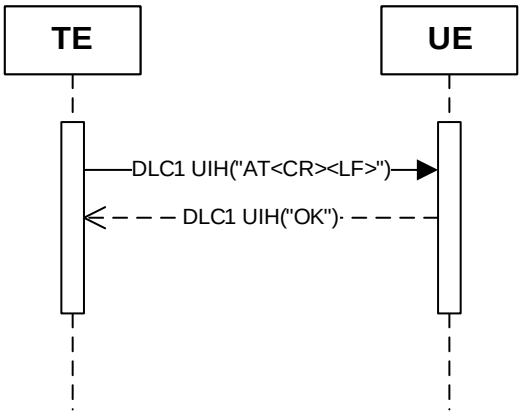


**Figure 3: Transmit Data**

### 4.5.4. Release DLC

The DLC channel is released through DISC command, and the UE responds to the command through the UA.

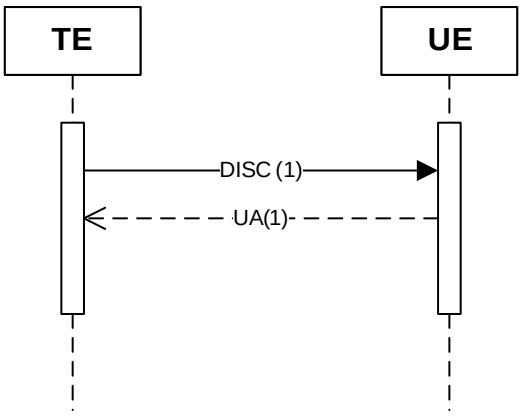


**Figure 4: Release DLC**

**NOTE**

Sending DISC command on DLCI 0 channel is equivalent to sending CLD command, see ***Chapter 4.5.5*** for details.

### 4.5.5. Disable MUX

Disable the MUX function through the CLD command and restore the serial port to the normal AT channel.

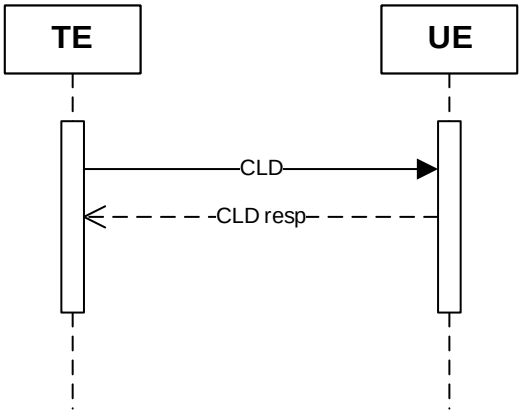


**Figure 5: Disable MUX**

# 5 Examples

## 5.1. Samples for Frame Structure

**Sample 1: SABM frame to open DLCI 0**

| Flag | Address Field | Control Field | Length Field | FCS | Flag |
|---|---|---|---|---|---|
| F9 | 03 | 3F | 01 | 1C | F9 |
| Header | DLCI 0 | SABM Frame | 0, No Information Field | | Tail |

**Sample 2: SABM frame to open DLCI 1**

| Flag | Address Field | Control Field | Length Field | FCS | Flag |
|---|---|---|---|---|---|
| F9 | 03 | 3F | 01 | 1C | F9 |
| Header | DLCI 1 | SABM Frame | 0, No Information Field | Check | Tail |

**Sample 3: UIH frame to transmit the AT command string "ATI<CR>"**

| Flag | Address Field | Control Field | Length Field | Information Field | FCS | Flag |
|---|---|---|---|---|---|---|
| F9 | 05 | EF | 09 | 41 54 49 0D | 58 | F9 |
| Header | DLCI 1 | UIH Frame | 4 | AT command string **"ATI<CR>"** | | Tail |

## 5.2. Establish Channels

**Step 1: Launch MUX**

| No. | Step | Data Direction | Hex | Comment |
|---|---|---|---|---|
| 1 | TE launches UE MUX function via AT command | TE → UE | 41 54 2B 43 4D 55 58 3D 30 0D 0D 0A | **AT+CMUX=0<CR><LF>** |
| | UE sends a response | TE ← UE | 4F 4B 0D 0A | **OK<CR><LF>** |

**Step 2: Establish DLCI 0**

| No. | Step | Data Direction | Hex | Comment |
|---|---|---|---|---|
| 1 | TE requests to establish control channel DLCI 0 by sending SABM frame | TE → UE | F9 03 3F 01 1C F9 | SABM Frame |
| | UE replies with the UA response | TE ← UE | F9 03 73 01 D7 F9 | UA Frame |

**Step 3: Establish DLCI 1–4**

| No. | Step | Data Direction | Hex | Comment |
|---|---|---|---|---|
| 1 | TE requests to establish DLCI 1 by sending SABM frame | TE → UE | F9 07 3F 01 DE F9 | SABM Frame |
| | UE replies with the DM response | TE ← UE | F9 07 73 01 15 F9 | UA Frame |
| 2 | TE requests to establish DLCI 2 by sending SABM frame | TE → UE | F9 0B 3F 01 59 F9 | SABM Frame |
| | UE replies with the UA response | TE ← UE | F9 0B 73 01 92 F9 | UA Frame |
| 3 | Frame transmission on DLCI 3 and DLCI 4 are the same as above (DLCI 1 and DLCI 2). | | | |

## 5.3. Frame Transmission

After the control channel and data channels are established, TE and UE can transmit data to each other through UIH frames.

**Frame Transmission:**

| No. | Step | Direction | Hex | Comment |
|---|---|---|---|---|
| 1 | TE sends the AT command string **"ATI<CR>"** on DLCI 1 | TE → UE | F9 07 EF 09 41 54 49 0D 39 F9 | UIH Frame |
| | UE replies with a response on DLCI 1 | TE ← UE | F9 05 EF 09 41 54 49 0D 58 F9 F9 05 EF 3F 0D 0A 51 75 65 63 74 65 6C 0D 0A 45 43 32 30 30 55 0D 0A 52 65 76 69 73 69 6F 6E 3A 20 45 43 98 F9 F9 05 EF 39 32 30 30 55 43 4E 41 41 52 30 32 41 30 31 4D 30 38 5F 42 45 54 41 30 33 32 32 0D 0A 7C F9 F9 05 EF 0D 0D 0A 4F 4B 0D 0A 5F F9 | UIH Frame |
| 2 | TE sends the AT command string "**AT<CR>**" on DLCI 2 | TE → UE | F9 0B EF 07 41 54 0D 54 F9 | UIH Frame |
| | UE replies with a response on DLCI 2 | TE ← UE | F9 09 EF 07 41 54 0D 35 F9 F9 09 EF 0D 0D 0A 4F 4B 0D 0A D8 F9 | UIH Frame |
| 3 | Frame transmission on DLCI 3 and DLCI 4 are the same as above (DLCI 1 and DLCI 2). | | | |

## 5.4. Synchronization and Loss of Synchronization

The data in the DLC channel needs to comply with the protocol format of MUX. When the data in the channel does not comply with the protocol format, the channel may lose synchronization. At this time, no response will be got by sending any data to the channel. When the channel loses synchronization, data will gradually accumulate in the channel. When the data volume reaches a certain amount, the channel will clear the blocked data to clean the channel, and then UE and TE can communicate normally.

**Synchronization and Loss of Synchronization:**

| No. | Step | Data Direction | Hex | Comment |
|---|---|---|---|---|
| 1 | TE sends the AT command string **"ATI<CR>"** on DLCI 1 | TE → UE | F9 07 EF 09 41 54 49 0D 39 F9 | UIH Frame |
| | UE replies with a response on DLCI 1 | TE ← UE | F9 05 EF 09 41 54 49 0D 58 F9 F9 05 EF 3F 0D 0A 51 75 65 63 74 65 6C 0D 0A 45 43 32 30 | UIH Frame |

| | | | |
|---|---|---|---|
| | | | 30 55 0D 0A 52 65 76 69 73 69 6F 6E 3A 20 45 43 98 F9 F9 05 EF 39 32 30 30 55 43 4E 41 41 52 30 32 41 30 31 4D 30 38 5F 42 45 54 41 30 33 32 32 0D 0A 7C F9 F9 05 EF 0D 0D 0A 4F 4B 0D 0A 5F F9 |
| 2 | TE sends out-of-order data | TE → UE | 12 F9 12 12 12 F9 F9 |
| | After that, the UE has no response, and all DLC channels are blocked | TE ← UE | |
| 3 | TE continuously sends the AT command string **"ATI<CR>"** on DLCI 1 | | F9 07 EF 09 41 54 49 0D 39 F9 |
| | When the blocked data is cleared, UE and TE can communicate normally | TE → UE | F9 05 EF 09 41 54 49 0D 58 F9 F9 05 EF 3F 0D 0A 51 75 65 63 74 65 6C 0D 0A 45 43 32 30 30 55 0D 0A 52 65 76 69 73 69 6F 6E 3A 20 45 43 98 F9 F9 05 EF 39 32 30 30 55 43 4E 41 41 52 30 32 41 30 31 4D 30 38 5F 42 45 54 41 30 33 32 32 0D 0A 7C F9 F9 05 EF 0D 0D 0A 4F 4B 0D 0A 5F F9 |

## 5.5. Disable MUX

**Disablement Procedures:**

| No. | Step | Data Direction | Hex | Comment |
|---|---|---|---|---|
| 1 | TE sends DISC frame to request for closing down DLCI 1 | TE → UE | F9 07 53 01 3F F9 | DISC frame |
| | UE replies with the UA frame to accept the request | TE ← UE | F9 07 73 01 15 F9 | UA frame |
| 2 | TE sends DISC frame to request for closing down DLCI 2 | TE → UE | F9 0B 53 01 B8 F9 | DISC frame |
| | UE replies with the UA frame to accept the request | TE ← UE | F9 0B 73 01 92 F9 | UA frame |
| 3 | TE sends DISC frame to request for closing down DLCI 3 | TE → UE | F9 0F 53 01 7A F9 | DISC frame |

| | | | | |
|---|---|---|---|---|
| | UE replies with the UA frame to accept the request | TE ← UE | F9 0F 73 01 50 F9 | UA frame |
| 4 | TE sends DISC frame to request for closing down DLCI 4 | TE → UE | F9 13 53 01 77 F9 | DISC frame |
| | UE replies with the UA frame to accept the request | TE ← UE | F9 13 73 01 5D F9 | UA frame |
| 5 | TE sends CLD message frame to request for closing down multiplexer on DLCI 0 | TE → UE | F9 03 EF 05 C3 01 F2 F9 | UIH control message frame |
| | UE replies with the UA frame to accept the request | TE ← UE | F9 01 EF 05 C1 01 93 F9 | UIH control message frame |

# 6 Appendix References

**Table 15: Related Documents**

| Document Name |
| --- |
| [1] Quectel_EC200U&EG915U_Series_AT_Commands_Manual |

**Table 16: Terms and Abbreviations**

| Abbreviation | Description |
| --- | --- |
| CLD | Multiplexer Close Down |
| C/R | Command/Response |
| CRC | Cyclic Redundancy Check |
| DCE | Data Communications Equipment |
| DISC | Disconnect |
| DLC | Data Link Connection |
| DLCI | Data Link Connection Identifier |
| DM | Disconnected Mode |
| EA | Extended Address |
| FCS | Frame Check Sequence |
| ME | Mobile Equipment |
| P/F | Poll/Final |
| PPP | Point-to-Point Protocol |
| SABM | Set Asynchronous Balanced Mode |
| SMS | Short Message Service |

| | |
|---|---|
| TA | Terminal Adapter |
| TE | Terminal Equipment |
| UA | Unnumbered Acknowledgement |
| UE | User Equipment |
| UI | Unnumbered Information |
| UIH | Unnumbered Information with Header Check |