



# Cavli C16QS CMUX

Application Notes

External Release version 1.0

Connect to our website and feel free to contact our technical support team for any assistance.

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## VERSION HISTORY

Version	Edit	Date
1.0	• Initial Version	07-Dec-2023

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# 1 Introduction

This document gives the step-by-step procedure for accessing virtual connection channels on a single physical interface to access the module concurrently using the data link connection (DLC). Each channel between the terminal equipment (TE) and the user equipment (UE) is called a data link connection (DLC). DLC is established separately and sequentially. For example, it is possible to make a PPP connection while accessing the AT command.

The configurable multiplexer (CMUX) protocol architecture is shown here:

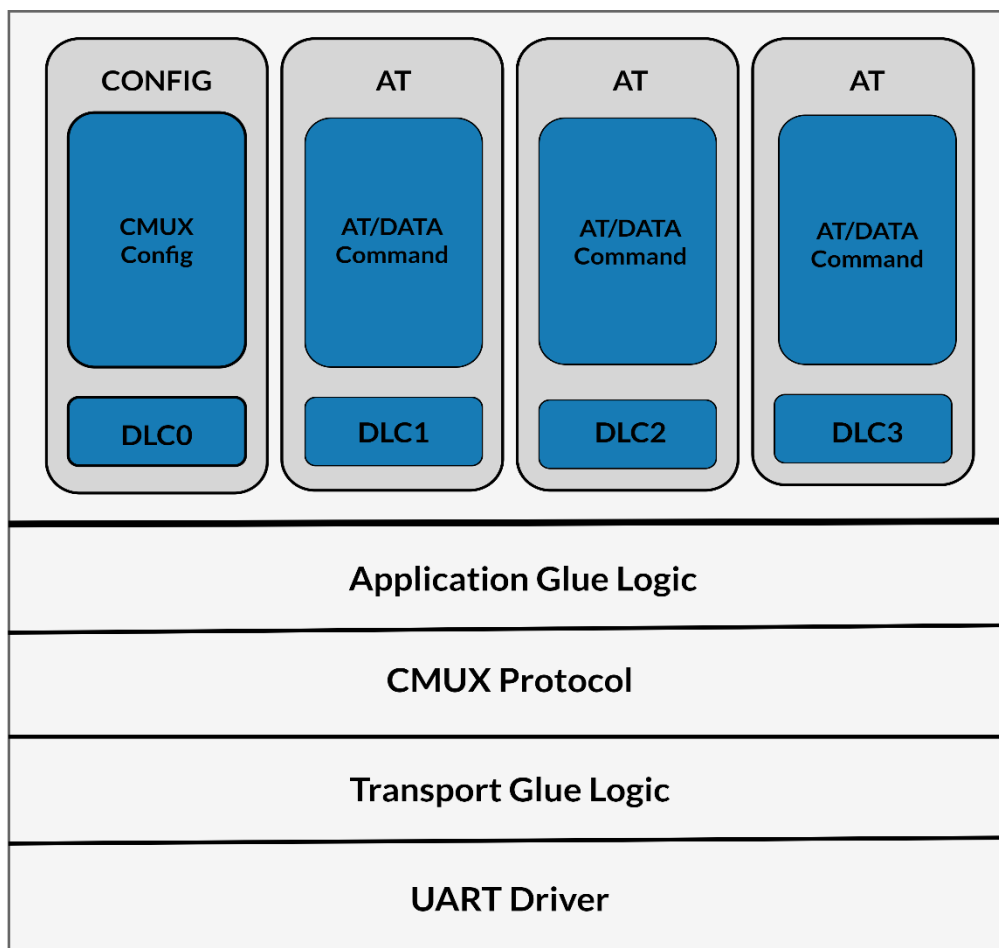


Figure 1 CMUX protocol architecture

C16QS will support the Terminal Equipment to Mobile Station (TE-MS) multiplexer protocol (3GPP TS 27.010) specification.

The multiplexer (mux) supports basic CMUX operation without error recovery method.

The following table lists the CMUX configurations on C16QS:

*Table 1 CMUX Configurations*

	DLC0	DLC1	DLC2	DLC3
Control Channel	✓	×	×	×
AT Command Channel	×	✓	✓	✓
PPP Channel	×	✓	✓	✓
Transparent Channel	×	×	×	×

# 2 CMUX Features and Limitation

## 2.1 C16QS CMUX Supported Features

- ✓ C16QS supports the mux basic option, which is compliant to 3GPP TS 27.010.
- ✓ C16QS supports a maximum of four channels, one (DLC0) is used for the control channel and the other three are used for applications, such as AT command and PPP data.
- ✓ There is no need to use the mux protocol with a USB interface. USB multiplexing capability based on multiple CDCs should be used.
- ✓ The mux is supported only on UART. Only one interface can be used at a time.

C16QS supports three virtual channels or DLCs for the application interface.

- DLC1
- DLC2
- DLC3

By default, all the channels support AT commands and the PPP data channel can be established at any of the channels using AT commands to enable PPP.

## 2.2 C16QS CMUX limitations

The following control messages are not supported on C16QS, although the device may send the reply for the defined messages, but this is not handled at the app or protocol layer.

- Multiplexer timers and retransmission (T1, T2, T3, and N2, see 3GPP TS 27.010) are not supported.
- Parameter negotiation (PN) command
- Flow control on (FC-on)
- Flow control off (FC-off) command



- Remote port negotiation (RPN) command
- Remote line status (RLS) command
- Service negotiation (SNC) command
- Software flow control (X-On/X-Off) on the DLCs is not supported and should be disabled
- Multiplexer power control and wake-up mechanism via the power-saving control (PSC) command is not supported.

## NOTE

- AT UART port is used for the mux interface, which is enabled by using a AT+CMUX command.
- By default, mux supports 115200 bits/sec baud rate. However, the baud rate of the C16QS can be changed by using the baud rate set command AT+CBST.
- Only one PPP session shall be used at any of the channels.
- For all details about command parameters, frame format, and other details, see **3GPP TS 27.010**.

## 3 Configuring CMUX Functionality

### 3.1 Procedures for Configuring CMUX Functionality



- AT command with SABM CMUX frame should be used for configuring CMUX functionality
- AT Commands should be in hexadecimal format frame and print will also be in hexadecimal format frame.

**Step 1:** To start the CMUX function once the system boots up, send the AT+CMUX=1 AT command followed by the SABM CMUX frame.

Description	SABM frame from the host	UA frame from the device
Enable the CMUX functionality	41 54 2B 43 4D 55 58 3D 31 0D 0A	<b>Success:</b> 0D 0A 4F 4B 0D 0A  <b>Fail:</b> 0D 0A 45 52 52 4F 52 0D 0A

**Step 2:** After enabling the CMUX function, Create an CMUX session by AT command followed by the SABM CMUX frame.

Description	SABM frame from the host	UA frame from the device
Establishing a CMUX session	F9 03 3F 01 1C F9	<b>Success:</b> F9 03 73 01 D7 F9

		<b>Fail:</b> 0D 0A 45 52 52 4F 52 0D 0A
--	--	--

**Step 3:** Send an Open DLC frame AT command to open required DLC channel after the session has been created.

Description	Open DLC1 request from the host	Open DLC ACK from the device
Open dlc1 CMUX channel	F9 07 3F 01 DE F9 F9	<b>Success:</b> F9 07 3F 01 DE F9 F9 07 EF 27 0D 0A 52 44 59 0D 0A 0D 0A 2B 41 54 52 45 41 44 59 0D 0A EB F9  <b>Fail:</b> 0D 0A 45 52 52 4F 52 0D 0A

 **NOTE**

- Different AT commands with DLC frame are used for opening DLC1, DLC2, DLC3 channels.

**Step 4:** Send AT command over DLC1

**Example**

AT command request on DLC1:  
 F9 07 EF 0B 61 74 69 0D 0A DA F9

AT reply on DLC1:

F9 07 EF 05 0D 0A 30 F9 F9 07 EF 39 0D 0A 4D 61 6E 75 66 61 63 74 75 72 65 72 3A 20 43 61 76 6C 69 20 49 6E 63 2E 0D 0A 1D F9 F9 07 EF 27 4D 6F 64 65 6C 20 4E 61 6D 65 3A 20 43 31 36 51 53 0D 0A EB F9 F9 07 EF 45 44 65 73 63 72 69 70 74 69 6F 6E 3A 20 4C 54 45 20 43 41 54 31 2E 62 69 73 20 4D 6F 64 75 6C 65 0D 0A 40 F9 F9 07 EF 35 46 69 72 6D 77 61 72 65 20 52 65 6C 65 61 73 65 3A 20 56 31 2E 34 2E 34 0D 0A 14 F9 F9 07 EF 2F 49 4D 45 49 3A 20 33 35

```

38 37 37 33 34 30 30 30 35 35 39 36 38 0D 0A E5 F9 F9 07 EF 37 53 65 72 69 61 6C 20 4E 75 6D
62 65 72 3A 20 51 43 4C 43 31 35 35 39 36 42 0D 0A F7 F9 F9 07 EF 45 48 57 20 56 65 72 73 69
6F 6E 3A 20 43 31 36 51 53 5F 48 57 5F 56 32 2E 32 31 28 32 37 31 31 29 0D 0A 40 F9 F9 07 EF
39 50 61 72 74 20 4E 75 6D 62 65 72 3A 20 43 31 36 51 53 2D 4E 41 2D 47 4E 41 4E 0D 0A 1D
F9 F9 07 EF 2D 42 75 69 6C 64 20 44 61 74 65 3A 20 32 30 32 33 31 32 30 36 0D 0A 06 F9 F9
07 EF 0D 0D 0A 4F 4B 0D 0A 3E F9
  
```

**Step 5:** For Closing the **dlc1** port after sending the AT command

Description	DISC message from the host	UA from the device
Close dlc1 CMUX channel	F9 07 53 01 3F F9	<b>Success:</b> F9 07 53 01 3F F9  <b>Fail:</b> 0D 0A 45 52 52 4F 52 0D 0A

**Step 6:** For Closing the CMUX Session

Description	DM frame from the host	UA from the device
Closing the CMUX Session	F9 03 EF 05 C3 01 F2 F9	<b>Success:</b> F9 03 EF 05 C3 C3 F2 F9  <b>Fail:</b> 0D 0A 45 52 52 4F 52 0D 0A

# 4 Appendix

## 4.1 Abbreviations

Table 2 Abbreviations

Abbreviations	Full Name
CMUX	Configurable multiplexer
DLC	Data link connection
SABM	Set asynchronous balanced mode
UA	Unnumbered acknowledgment
UIH	Unnumbered information with header check
DM	Device management
DISC	Disconnect