Throughput Testing with Bluetooth 5 – LE 2M PHY Feature

BL654

Application Note *v2.1*

1 Introduction

Prior to Bluetooth 5, BLE operated on 1 Mbps modulation only. Bluetooth v5 adds support for an optional two Mbps modulation. This feature is known as LE 2M PHY. It allows data to be transmitted at the higher two Mbps symbol rate, which should theoretically double the throughput. However, because the packet format is slightly different, the practical impact is lower than the theoretical double.

Note: The Bluetooth 5 LE 2M PHY feature is relatively new and may take some time before being supported by most silicon and stack vendors.

2 Requirements

- Two Ezurio DVK-BL654
- FTDI USB-to-Serial drivers for DVK-BL654 (found at http://www.ftdichip.com/FTDrivers.htm)
- UwTerminalX v1.10a or later (found at https://github.com/ezurio/UwTerminalX/releases)
- BL654 firmware v29.1.1.0 or later (found in the BL654 Software Downloads tab at https://www.ezurio.com/products/bl654-ble-thread-nfc-modules)
- **$autorun$.2mphy.throughput.central.sb** and **$autorun$.2mphy.throughput.peripheral.sb** *smart*BASIC applications found in https://github.com/LairdCP/BL654-Applications

Note: For the purposes of this document, we assume you have familiarised yourself with compiling/loading *smart*BASIC applications. If not, please visit the BL654 product page. There are several documents available for additional *smart*BASIC support including: *Loading and Running Applications with UwTerminalX*

3 LE 2M PHY Throughput Testing Method

This section describes the method used to test the LE 2M PHY feature throughput:

1. Edit the *$autorun$.2mphy.throughput.central.sb* file and replace `BTAddr` with the `AT I 4` response of the BL654 onto which the peripheral app will be loaded (this is for auto connection).
2. Open two instances of UwTerminalX and uncheck **DTR** on both.
3. Connect the instances of UwTerminalX to each of the DVK-BL654 boards.
4. Reset the BL654 boards by checking and unchecking **BREAK** on both UwTerminalX instances.
5. Flash erase both BL654s using `at&F*`.
6. In the first UwTerminalX window, right click in the window, then select XCompile+Load+Run, and choose the file *$autorun$.2mphy.throughput.central.sb*.
7. In the second UwTerminalX window, right click in the window, then select **XCompile+Load+Run**, and choose the file *$autorun$.2mphy.throughput.peripheral.sb*.
8. On both UwTerminalX instances, switch to the Config tab and set the Baud rate to 1000000.
9. Click **OK**.
10. Check **DTR** on both devices.

11. Reset both devices by checking and unchecking **BREAK**. The devices should auto-connect and the connection messages should be displayed on both.
12. Switch to the Speed Test tab on both UwTerminalX windows.
    a. On the first UwTerminalX window, click **Start Test › Send & Receive test (delay 5 seconds)**.
    b. On the second UwTerminalX window, click **Start Test › Send and receive test**.
    c. After a certain duration (e.g. 2 minutes), stop the test by clicking **Cancel**.

The Received Average(s) should show the throughput of the transmitted data.

4   BL654 Throughput Test Results – Bluetooth 5

4.1   Test Parameters

UART Baud Rate	1000000
Connection Interval	28.75ms
Packet Length	Set to 251 bytes when Data Length Extension is implemented (default is 27).
Attribute MTU	Set to 247 bytes when Data Length Extension is implemented (default is 23).
Attribute Data Length	Set to 244 bytes when Data Length Extension is implemented (default is 20).

4.2   Results

The following table shows the practical and **importantly reliable data** throughput achieved on a BLE link between the two BL654s and Ezurio's *smart*BASIC firmware.

	Throughput Type	Throughput in bps
Standard BLE Throughput	Notifications	~ 64K
	Write without response	~ 64k
	Bidirectional	**~ 128kbps**
LE Data Length Extension and LE 2M PHY	Notifications	~ 500K
	Write without response	~ 500K
	Bidirectional	**~ 1Mbps**

5   Revision History

Version	Date	Notes	Contributor(s)	Approver
1.0	21 June 2018	Initial Release	Youssif M. Saeed	Jonathan Kaye
2.0	15 Apr 2025	Ezurio rebranding	Sue White	Dave Drogowski
2.1	18 Dec 2025	Fixed link to sample applications repo.	Rikki Horrigan	Dave Drogowski

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