Throughput Testing with Bluetooth 5 – LE 2M PHY Feature

BL652

Method and Results *v1.1*

INTRODUCTION

Prior to Bluetooth 5, BLE operated on 1 Mbps modulation only. Bluetooth v5 adds support for an optional 2 Mbps modulation. This feature is known as LE 2M PHY. It allows data to be transmitted at the higher 2 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 the majority of silicon and stack vendors.

REQUIREMENTS

- Two Laird DVK-BL652 (or equivalent RS-232 to serial connection to the BL652 module)
- FTDI USB-to-Serial drivers for DVK-BL652 (found at http://www.ftdichip.com/FTDrivers.htm) UwTerminalX (version 1.08n or later), provided at https://github.com/LairdCP/UwTerminalX/releases
- BL652 firmware version 28.7.3.0 (or later), found in the BL652 Software Downloads tab at https://www.lairdtech.com/products/bl652-ble-module
- **$autorun$.2mphy.throughput.central.sb** and **$autorun$.2mphy.throughput.peripheral.sb** *smart*BASIC applications found in https://github.com/LairdCP/BL652-Applications/Applications

LE 2M PHY THROUGHPUT TESTING METHOD

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

IMPORTANT!
As of this writing, Android and iOS have not implemented the LE 2M PHY feature and even have limited support for the Bluetooth v4.2 LE Data Length Extension feature. To see the full benefits of LE 2M PHY impact on throughput, two BL652 kits are needed for testing.

To test LE 2M PHY throughput, follow these steps:

1. Open the **$autorun$.2mphy.throughput.central.sb** and replace *BTAddr* with the *ATi 4* response of the BL652 onto which the peripheral app will be loaded (this is for auto connection).
2. Open two instances of UwTerminalX and uncheck **DTR** on both of them.

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3. Reset the BL652s by checking and unchecking **BREAK** on both UwTerminalX instances.
4. Flash erase both BL652s using **at&F***.
5. On the first UwTerminalX window, XCompile+Load+Run **$autorun$.2mphy.throughput.central.sb**.
6. On the second UwTerminalX window, XCompile+Load+Run **$autorun$.2mphy.throughput.peripheral.sb**.
7. On both UwTerminalX instances, switch to the Config tab and set the Baudrate to **1000000**.
8. Click **OK**.
9. Check **DTR** on both devices.
10. Reset both devices by checking and unchecking **BREAK**.
    The devices should auto-connect and the connection messages should be displayed on both.
11. 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.

BL652 Throughput Test Results – Bluetooth 5

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).

Results

The following table shows the practical and **importantly reliable data** throughput achieved on a BLE link between the two BL652s and Laird'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**

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REVISION HISTORY

Version	Date	Notes	Approver
1.0	10 Mar 2017	Initial Release	Jonathan Kaye
1.1	07 Nov 2017	Updated for new production firmware	Youssif M. Saeed

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