

STM32WB Series BLE interoperability report

Introduction

This document describes tests and results of interoperability of STM32WB55 devices with leading Android™ and iOS™ smartphones.

The testing is performed through two different sessions:

- Basic functional tests such as discovery, connection, GATT procedure
- Application scenarios such as pairing, data transfer measurement (uplink and downlink)



1 Test setup

Table 1. Test setup

Setup Parameter	Description
Mobile phones	Refer to test results
ST device under test	STM32WB55
STM32CubeWB	V1.10.0

Debug traces are enabled in the device under test, and are displayed on a serial console.

Sniffer is launched, air traces are captured and used to measure timings during the different phases (connection, GATT discovery, notification, indication).

Figure 1. Setup overview



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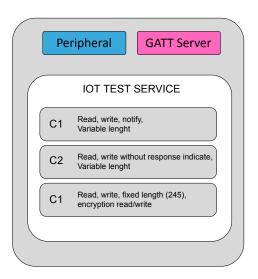


2 Basic functional test cases

2.1 Application of STM32WB Series basic functional test

The test application consists in one service and three characteristics.

Figure 2. BLE IOT test application



2.2 Summary of basic functional tests

Table 2. List of basic functional tests

Test set	Test case	Туре
1	1	BLE scanning, discovery
	1	BLE connection
2	2	GATT (service, characteristic discovery)
3	1	GATT notification Variable length data C1
	1	GATT write/read Variable length data C1: write 1 byte 0xAA, read 0xAA
4	2	GATT write/read Variable length data C1: write 4 bytes 0x55443322, read 0x55443322
5	1	GATT indication Variable length data C2
6	1	GATT read/write without response C2: write 1 byte 0xAA, read 0xAA

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Test set	Test case	Туре
6	2	GATT read/write without response C2: write 4 bytes 0x55443322, read 0x55443322
7	1	GATT read/write with response C3
	1	GAP connection interval change requested by the peripheral Connection interval request: 7.5 ms
	2	GAP connection interval change requested by the peripheral Connection interval request: 20 ms
	3	GAP connection interval change requested by the peripheral Connection interval request: 45 ms
	4	GAP connection interval change requested by the peripheral Connection interval request: 200 ms
8	5	GAP connection interval change requested by the peripheral Connection interval request: 400 ms
	6	GAP connection interval change requested by the peripheral Connection interval request: 600 ms
	7	GAP connection interval change requested by the peripheral Connection interval request: 1000 ms
	8	GAP connection interval change requested by the peripheral Connection interval request: 2000 ms
	9	GAP connection interval change requested by the peripheral Connection interval request: 4000 ms
	1	GAP latency change requested by the peripheral Connection interval request: 48.75 ms, connection latency = 2
	2	 GAP latency change requested by the peripheral Connection interval request: 48.75 ms, connection latency = 4
9	3	GAP latency change requested by the peripheral Connection interval request: 200 ms, connection latency = 2
	4	GAP latency change requested by the peripheral Connection interval request: 200 ms, connection latency = 4
	5	GAP latency change requested by the peripheral Connection interval request: 1000 ms, connection latency = 1

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2.3 Description of basic functional tests

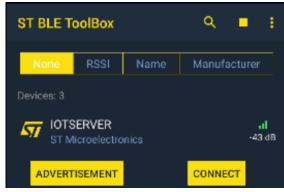
2.3.1 Test 1 – BLE scanning, discovery

STM32WB55 device is the peripheral.

- · Phone scans and finds the device
- Pass if device is found by the phone

Figure 3. Phone scans and finds the device





Smartphone

2.3.2 Test 2-1 – BLE connection

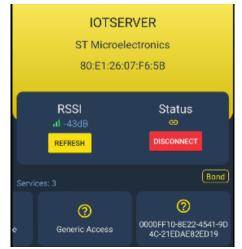
STM32WB55 device is the peripheral.

- Phone scans, connects
- · Pass if phone connects to the device

Figure 4. Phone connects



Smartphone



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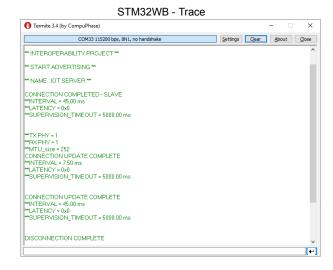


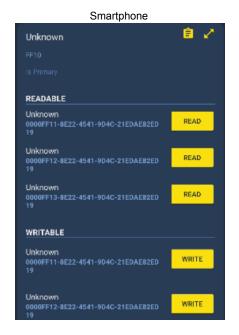
2.3.3 Test 2-2 – GATT, service/characteristics discovery

STM32WB55 device is the peripheral.

- Phone scans, connects, discovers service/characteristic, disconnects
- · Pass if no connection issue and all service/characteristics are discovered by the phone

Figure 5. Phone discovers service, characteristics





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2.3.4 Test 3 – GATT notification

Phone enables the notification on the characteristic which triggers a timer, at timer expiration (1 s) the notification is sent with expected value.

- Length = 1, data=0x55
- Length = 249 (ATT_MTU-3)

Data: Byte0 = Packet sequence number, byte1 = 1,.., byteN = N

Pass if the notification is received with the corresponding length and value.

- Length = 1, data=0x55
- Length = ATT_MTU-3

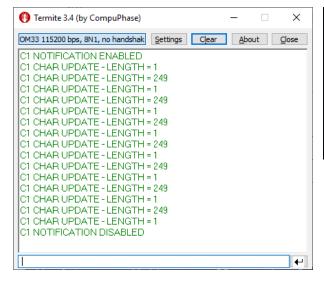
Data: Byte0 = Packet sequence number, byte1 = 1,.., byteN = N

Check no errors on phone, check the air trace and debug trace on device application.

Figure 6. Phone enables the notification

STM32WB - Trace

Smartphone



NOTIFIABLE

Unknown
0000FF11-8E22-4541-904C-21EDAE82ED19

Value
0009-0203-0405-0607-0809-0A08-0C0D-0E0F-1011-1213-14
15-1617-1819-1A1B-1C1D-1E1F-2021-2223-2425-2627-282
9-242B-2C2D-2E2F-3031-3233-3435-3637-3839-3A3B-3C3D-3E3F-4041-4243-4445-4647-4849-4A48-4C4D-4E4F-5051-52
50-5455-5657-5859-5A5B-5C5D-5E5F-6D61-6263-6465-6667
-6869-6A6B-6C6D-6E6F-7071-7273-7475-7677-7879-7A78-...
Updated at 11:54:36

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2.3.5 Test 4-1 – GATT, write/read characteristic (1 byte)

Phone writes a variable length data, reads the written data.

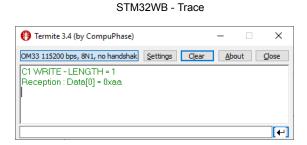
Length = 1, data = 0xAA

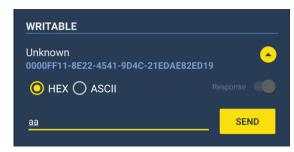
Pass if the read back value equals the written value and if the phone gets:

1 byte read back data 0xAA

Check no errors on phone, check the air trace and debug trace on device application.

Figure 7. Phone writes 1 byte (test 4-1)





Smartphone

2.3.6 Test 4-2 – GATT, write/read characteristic (4 bytes)

Phone writes a variable length data, reads the written data.

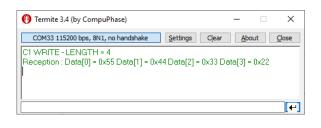
Length = 4, data = 0x55443322

Pass if the read back value equals the written value and if the phone gets:

4 bytes read back data 0x55443322

Check no errors on phone, check the air trace and debug trace on device application.

Figure 8. Phone writes 4 bytes (test 4-2)



STM32WB - Trace

Smartphone



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2.3.7 Test 5 – GATT indication

Phone enables the indication on the characteristic which triggers a timer, at timer expiration the indication is sent with expected value.

- Length = 1
- data = 0x55
- Length = 249 (ATT_MTU-3)

Data: Byte0 = Packet sequence number, byte1 = 1,.., byteN = N

Pass if the indication is received with the corresponding length and value.

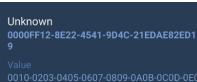
- Length = 1, data = 0x55
- length = ATT_MTU-3

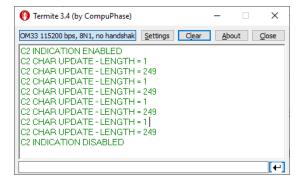
data: Byte0 = Packet sequence number, byte1=1,.., byteN = N

Check no errors on phone, check the air trace and debug trace on device application.

Figure 9. Phone enables the indication

STM32WB - Trace





Value 0010-0203-0405-0607-0809-0A0B-0C0D-0E0F-1011-1213-14 15-1617-1819-1A1B-1C1D-1E1F-2021-2223-2425-2627-282 9-2A2B-2C2D-2E2F-3031-3233-3435-3637-3839-3A3B-3C3D-3E3F-4041-4243-4445-4647-4849-4A4B-4C4D-4E4F-5051-52 53-5455-5657-5859-5A5B-5C5D-5E5F-6061-6263-6465-6667 -6869-6A6B-6C6D-6E6F-7071-7273-7475-7677-7879-7A7B-... Updated at 12:01:26

Smartphone

Indicate

2.3.8 Test 6-1 – GATT, write without response/read characteristic (1 byte)

Phone writes a variable length data, reads the written data

Length = 1, data=0xAA

Pass if the read back value equals the written value and if the phone gets:

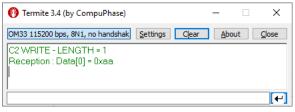
1 byte read back data 0xAA

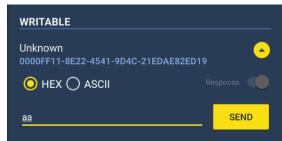
Check no error on phone, check the air trace and debug trace on device application.

Figure 10. Phone writes 1 byte (test 6-1)

STM32WB - Trace







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2.3.9 Test 6-2 – GATT, write without response/read characteristic (4 byte)

Phone writes a variable length data, reads the written data:

Length = 4, data = 0x55443322

Pass if the read back value equals the written value and if the phone gets:

4 bytes read back data 0x55443322

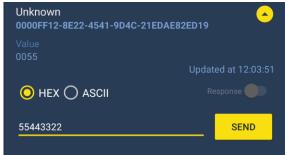
Check no error on phone, check the air trace and debug trace on device application.

Figure 11. Phone writes 4 bytes (test 6-2)

STM32WB - Trace

Smartphone





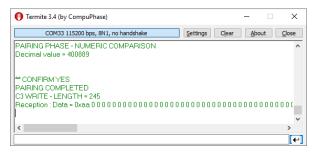
2.3.10 Test 7 – GATT, write/read characteristic encryption permission

The test purpose is to write/read a characteristic with encryption permission needed. With most phones a pop-up appears (see Figure 12) to start the pairing. With some phones, pairing has to be done out of the BLE toolbox application.

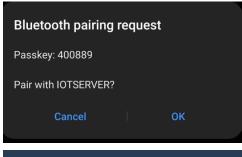
- Phone reads/writes a fixed length value 245
- Pairing done (encrypted link)
- Pass if phone can read/write the characteristic
- Check response in the air trace, no error on phone
- · Check debug trace on device application

Figure 12. Phone writes one byte, encryption needed





Smartphone





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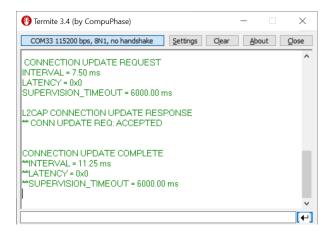
2.3.11 Test 8-1 – L2CAP connection interval request (7.5 ms)

STM32WB55 device is the peripheral.

- Phone scans, connects, discovers service/characteristic
- Peripheral requests a new connection interval (7.5 ms, 20 ms, 45 ms, 200 ms, 400 ms, 1 s, 2 s, 4 s)
- Push SW1 new connection interval requested: 7.5 ms
- Accepted, phone requests 11.5 ms

Figure 13. Peripheral requests connection interval, 7.5 ms

STM32WB - Trace





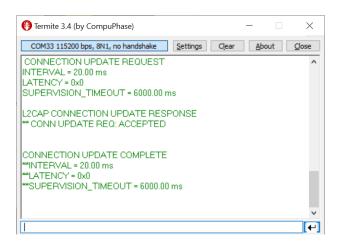
Smartphone

2.3.12 Test 8-2 – L2CAP connection interval request (20 ms)

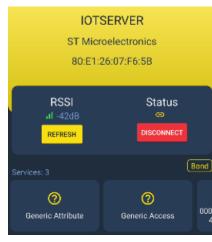
- Push SW1 new connection interval requested: 20 ms
- Accepted, phone requests 20 ms

Figure 14. Peripheral requests connection interval, 20 ms

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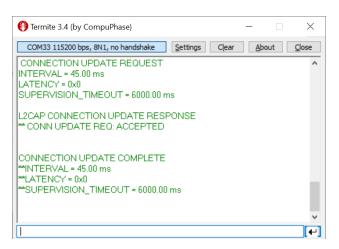


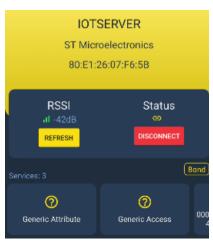
2.3.13 Test 8-3 – L2CAP connection interval request (45 ms)

- Push SW1 new connection interval requested: 45 ms
- Accepted, phone requests 45 ms

Figure 15. Peripheral requests connection interval, 45 ms

STM32WB - Trace





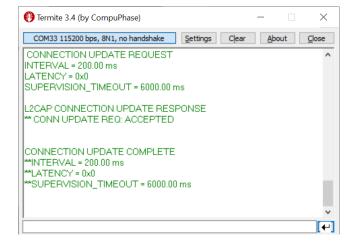
Smartphone

2.3.14 Test 8-4 – L2CAP connection interval request (200 ms)

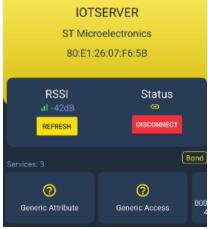
- Push SW1 new connection interval requested: 200 ms
- Accepted, phone requests 200 ms

Figure 16. Peripheral requests connection interval, 200 ms

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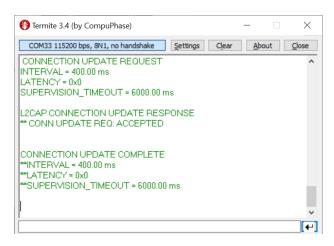


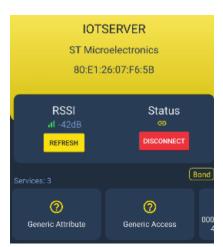
2.3.15 Test 8-5 – L2CAP connection interval request (400 ms)

- Push SW1 new connection interval requested: 400 ms
- Accepted, phone requests 400 ms

Figure 17. Peripheral requests connection interval, 400 ms

STM32WB - Trace





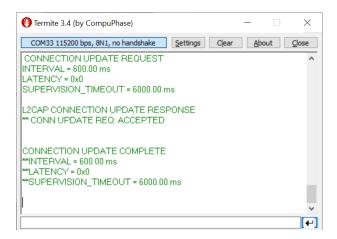
Smartphone

2.3.16 Test 8-6 – L2CAP connection interval request (600 ms)

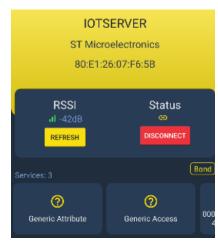
- Push SW1 new connection interval requested: 600 ms
- Accepted, phone requests 600 ms

Figure 18. Peripheral requests connection interval, 600 ms

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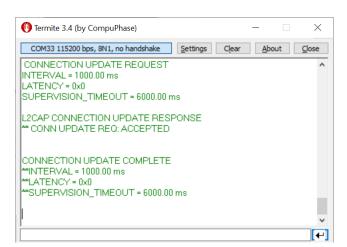


2.3.17 Test 8-7 – L2CAP connection interval request (1000 ms)

- Push SW1 new connection interval requested: 1000 ms
- Accepted, phone requests 1000 ms

Figure 19. Peripheral requests connection interval, 1000 ms

STM32WB - Trace





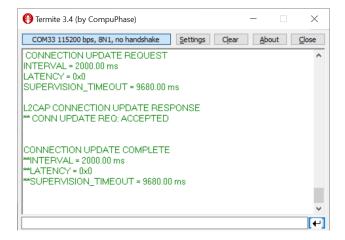
Smartphone

2.3.18 Test 8-8 – L2CAP connection interval request (2000 ms)

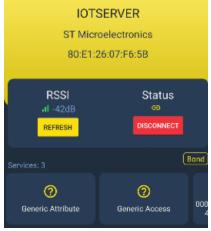
- Push SW1 new connection interval requested: 2000 ms
- Accepted, phone requests 2000 ms

Figure 20. Peripheral requests connection interval, 2000 ms

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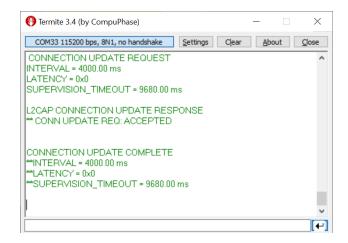
2.3.19 Test 8-9 – L2CAP connection interval request (4000 ms)

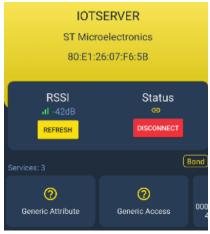
- Push SW1 new connection interval requested: 4000 ms
- Accepted, phone requests 4000 ms

Figure 21. Peripheral requests connection interval, 4000 ms

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Smartphone





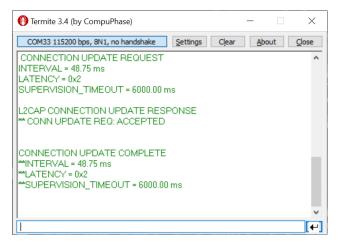
2.3.20 Test 9-1 – L2CAP connection interval, connection latency request (48.75 ms, latency = 2) STM32WB55 device is the peripheral.

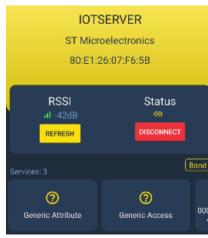
- Phone scans, connects, discovers service/characteristic
- Peripheral requests a new connection interval and new connection latency (48.75 ms, L = 2; 48.75 ms, L = 4; 200 ms, L = 2; 200 ms, L = 4; 1s, L = 1)
- Push SW2 new connection interval requested: 48.75 ms, latency = 2
- Accepted, phone requests 48.75 ms, latency = 2

Figure 22. Peripheral requests connection interval = 48.75 ms, latency = 2

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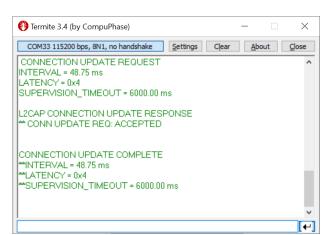


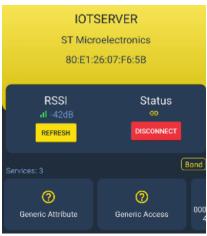
2.3.21 Test 9-2 – L2CAP connection interval, connection latency request (48.75 ms, latency = 4)

- Push SW2 new connection interval requested: 48.75 ms, latency = 4
- Accepted, phone requests 48.75 ms, latency = 4

Figure 23. Peripheral requests connection interval = 48.75 ms, latency = 4

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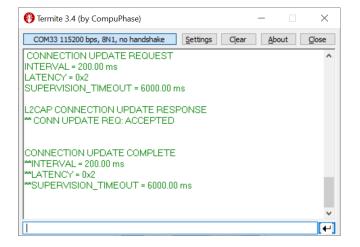
Smartphone

2.3.22 Test 9-3 – L2CAP connection interval, connection latency request (200 ms, latency = 2)

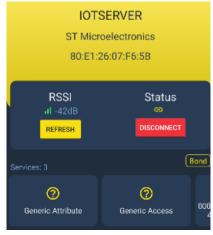
- Push SW2 new connection interval requested: 200 ms, latency = 2
- Accepted, phone requests 200 ms, latency = 2

Figure 24. Peripheral requests connection interval = 200 ms, latency = 2

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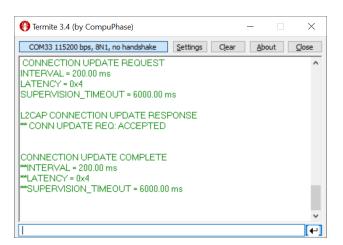


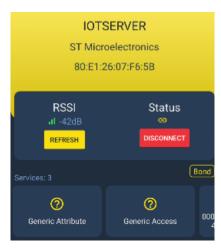
2.3.23 Test 9-4 – L2CAP connection interval, latency request (200 ms, latency = 4)

- Push SW2 new connection interval requested: 200 ms, latency = 4
- Accepted, phone requests 200 ms, latency = 4

Figure 25. Peripheral requests connection interval = 200 ms, latency = 4

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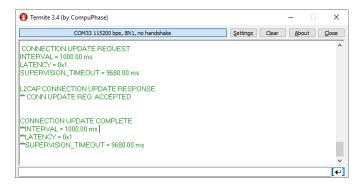
Smartphone

2.3.24 Test 9-5 – L2CAP connection interval, latency request (1000 ms, latency = 1)

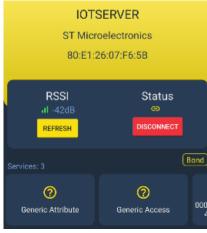
- Push SW2 new connection interval requested: 1000 ms, latency = 1
- Accepted, phone requests 1000 ms, latency = 1

Figure 26. Peripheral requests connection interval equals to 1000 ms, latency equals to 1

STM32WB - Trace



Smartphone



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2.4 Results of basic functional tests

Table 3. Results of basic functional tests

Manufacturer	Model	os	1	2	3	4	5	6	7	8	9
Apple [®]	iPhone 7 MN8X2ZD/A	iOS 13.7	1	1	1	1	1	1	1	√ (1)	√ ⁽²⁾
Apple [®]	iPhone 8 MQ6V2LL/A	iOS 14.0.1	1	1	1	1	1	1	1	√ (1)	√ ⁽²⁾
Apple [®]	iPhone11	iOS 13.6.1	1	1	1	1	1	1	1	√ (1)	√ (2)
Apple [®]	iPhone12	iOS 14.3	1	1	1	1	1	1	1	√ (1)	√ ⁽²⁾
Apple [®]	XR MRYU2VC/A	iOS 14	1	1	1	1	1	1	1	√ (1)	√ (2)
Apple [®]	XS MT9H2ZD/A	iOS 13.6.1	1	1	1	1	1	1	1	√ (1)	√ (2)
Apple [®]	XS MAX	iOS 14.2	1	1	1	1	1	1	1	√ (1)	√ (2)
Google [®]	PIXEL2	R v11 API level 30	1	1	1	1	1	1	1	√ (3)	1
Google [®]	PIXEL3	Q v10 API level 29	1	1	1	1	1	1	1	√ (3)	1
Huawei	Mate 20 LITE	Q v10 API level 29	1	1	1	1	1	1	1	√ (3)	1
Huawei	NEXUS 6P	Oreo v8.1.0 API level 27	1	1	1	1	1	1	1	√ (3)	1
Huawei	P10	Nougat v7.0 API level 24	1	1	1	1	1	1	1	1	1
Huawei	P20 ELM-L29	Oreo v8.1.0 API level 27	1	1	1	1	1	1	1	1	1
Huawei	P30 ELE-L29	Q v10 API level 29	1	1	1	1	1	1	1	√ (3)	1
Huawei	P Smart+ 2019 POT-LX1T	Q v10 API level 29	1	1	1	1	1	1	1	√ (3)	1
LG	K20	Pie v9 API level 28	1	1	1	1	1	1	1	√ (3)	1
Motorola	Z 2	Nougat v7.1.1 API level 25	1	1	1	1	1	1	1	√ (3)	1
OnePlus	5000	Nougat v7.1.1 API level 25	1	1	1	1	1	1	1	√ (4)	1
OnePlus	A6003	Q v10 API level 29	1	1	1	1	1	1	1	(4)	1
OPPO	RX17 PRO CPH1877	Oreo v8.0 API level 26	1	1	1	1	1	1	1	√ (3)	1
Samsung	A41	Q v10	1	1	1	1	1	1	1	√ (3)	1

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anufacturer	Model	os	1	1 2		4	5	6	7	8	۶
	SM-A415F	API level 29									
0	A50	Q v10							,	4 (2)	
Samsung	SM-A505FN	API level 29	1	1	1	1	1	1	1	√ (3)	•
		Q v10									
Samsung	A51	API level 29	1	1	1	1	1	1	1	√ (3)	١,
		Oreo v8									
Samsung	GALAXY A5	API level 25	1	1	1	1	1	1	1	√ (3)	,
	CALAVV 07										
Samsung	GALAXY S7 SM-G930F	Oreo v8 API level 25	1	1	1	1	1	1	1	√ (3)	,
		API level 25									
Samsung	GALAXY S8	Nougat v7 API level 24	1	1	1	1	1	1	1	√ (3)	,
-	SM-G950F										
Samsung	GALAXY S8	Nougat V7	/	/	/	/	/	1	/	√ (4)	١,
Cambang	SM-G9500	API level 24		ľ	,	,	•	•	•	•	'
	GALAXY S8+	November 1/7									
Samsung	Chinese model	Nougat V7	1	1	1	1	1	1	1	√ (4)	
	SM-G9550	API level 24									
	GALAXY S9	Nougat v7.1.1									
Samsung	SM-G900	API level 25	1	1	1	1	1	1	1	√ (3)	١,
	GALAXY S9	Nougat v7.1.1									
Samsung	SM-G960	API level 25	1	1	1	1	1	1	1	√ (3)	
	GALAXY S10	Al Flevel 25									
Samsung		Pie v9 API level 28	1	1	1	1	1	1	1	√ (3)	
	SM-G730										
Samsung	GALAXY S10	Pie v9 API level 28	1	1	1	1	1	1	1	√ (3)	١,
-	SM-G973F										
Samsung	Tab A	Q v10	/	1	1	1	1	1	/	√ (3)	Ι,
	SM-T510	API level 31					ľ			_	
Comouna	NOTE 8	Pie v9 API level 27	/	1	/	1	/	1	/	√ (3)	١,
Samsung	SM-N950F	Pie v9 API ievei 27		•	•	•	•	•	•	7 (0)	'
	S6 Edge	Nougat v7				_				- (0)	
Samsung	SM-G925F	API level 24	1	1	1	1	1	1	1	√ (3)	
	S10	Q v10									
Samsung	SM-G973F	API level 30	1	1	1	1	1	1	1	√ (3)	
Sony	XPERIA10	Pie v9 API level 28	/	1	1	1	1	1	1	√ (3)	
July	AI LIMATO		-	"	'	"	'	"	–	V (-/	_
Sony	XPERIA DOCOMO	Nougat v7.1.1	1	1	1	1	1	1	1	√ (3)	
		API level 28									
Sony	XPERIAXZ2	Pie v9 API level 28	1	1	1	1	1	1	1	√ (3)	
Xiaomi	MI5	Marshmallow	/	1	1	./	1	1	1	1	
ΛιαΟΙΙΙΙ	UIIO	API level 27		•	"	1	1	•	*	•	'
\(\text{\tin}\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\tint{\text{\tin}\text{\texi\tint{\text{\text{\text{\text{\text{\text{\text{\tin}}\\ \tittt{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\texi}\text{\text{\text{\text{\text{\texi}\tint{\text{\text{\text{\texi}\text{\text{\texi}\tint{\text{\texi}\tint{\text{\texi}\tilitht{\text{\texi}\tint{\texit{\texi}\titt{\titil\titt{\titil\titt{\titil\titt{\tii}\tint{\texit{\texi}\tit	142	Oreo v8.1.0								4(0)	
Xiaomi	MI8	API level 27	1	1	1	1	1	1	1	√ (3)	,
		Q v10									
Xiaomi	MI10	API level 23	1	1	1	1	1	1	1	√ (3)	Ι,

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Manufacturer	Model	os	1	2	3	4	5	6	7	8	9
Xiaomi	MI MIX3	Q v10							/	√ (3)	/
Alaomi	IVII IVIIAS	API level 29	1	, ,	•	•	1	1	•	7 (3)	
Vinceni	REDMI	Q v10			,		,	,	,	√ (3)	
Xiaomi	M2004J19AG	API level 30	•	•	•	1	1	1	1	(3)	1
V::	REDMI NOTE 8	Q v10			,		,	,	,	√ (3)	
Xiaomi	M1908C3JG	API level 29	•	•	•	1	1	1	1	(3)	1
Viaomi	REDMI NOTE 8 PRO	Q v10	/	,	,	,	,	,	,	(3)	/
Xiaomi	KEDIVII NOTE 8 PRO	API level 29		'	1	1	•	/	1	√ (3)	

- If requested connection interval < 30 ms, phone updates with a connection interval around 30 ms (26.25 ms or 30 ms).
 Other requests are accepted and answered with few differences.
- 2. L2CAP request with connection interval equals to 1 s and latency > 0 is not accepted.
- 3. If requested connection interval equals to 7.5 ms, phone updates with 11.25 ms.
- 4. If requested connection interval equals to 7.5 ms, phone's response is failed but test can continue.

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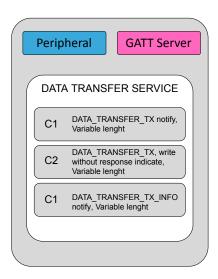


3 Specific scenario test cases

3.1 STM32WB Series data throughput application

The application used for the following scenario is part of ST project delivery: BLE_Data_Throughput

Figure 27. BLE_Data_Throughput application



3.2 Summary of data throughput application tests

Table 4. List of data throughput application tests

Test set	Test case Type					
1	1	BLE connection, GATT (service, characteristic discovery)				
1 (GAP security – requested by the phone				
2 2		GAP security – requested by STM32WB55 device				
3	1	Data throughput download (GATT notification) PHY 1 M				
3	2	Data throughput download (GATT notification) PHY 2 M				
1		Data throughput upload (GATT write) PHY 1 M				
4	2	Data throughput upload (GATT write) PHY 2 M				

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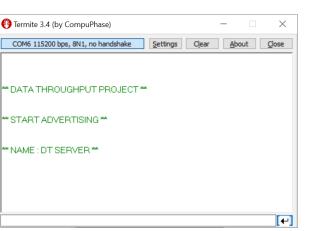
3.3 Description of data throughput application tests

3.3.1 Scenario 1 – BLE scanning, connection, service/characteristic discovery STM32WB55 device is the peripheral.

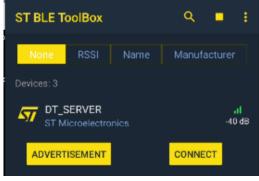
- Phone connects, discovers service/characteristic, disconnects
- Pass if no connection issue and all service/characteristics are discovered by the phone

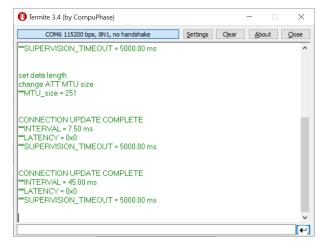
Figure 28. Phone scans, connects, discovers service and characteristics

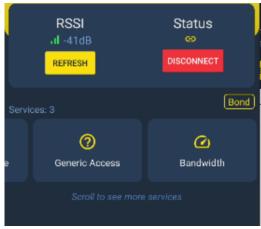
STM32WB - Trace



Smartphone







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3.3.2 Scenario 2-1 – GAP security – Pairing requested by the phone

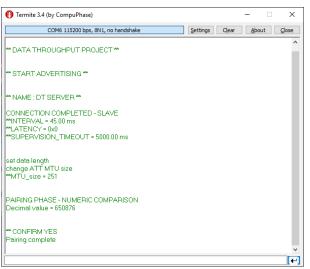
STM32WB55 device is in advertising.

STM32WB55 device can support legacy pairing or secure connection. The used method depends on the phone.

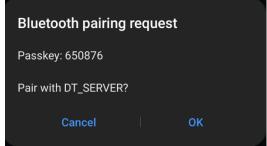
- Phone scans, connects, discovers service/characteristic
- The phone starts the pairing/bonding sequence
- Pass if after connection, pairing initiated by the phone is successful

Figure 29. Phone requests pairing

STM32WB - Trace



Smartphone



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3.3.3 Scenario 2-2 – GAP security – Pairing requested by the STM32WB55 device

STM32WB55 device is in advertising.

STM32WB55 device can support legacy pairing or secure connection. The used method depends on the phone.

• Phone scans, connects, discovers service/characteristic

STM32WB - Trace

- The STM32WB55 device starts the pairing/bonding sequence
- Pass if after connection, pairing initiated by the phone is successful

Figure 30. STM32WB55 device requests pairing

Termite 3.4 (by CompuPhase)

COM6 115200 bps, 8N1, no handshake

Settings

Clear About Gose

START ADVERTISING **

*** NAME: DT SERVER **

CONNECTION COMPLETED - SLAVE

***INTERVAL = 45.00 ms

***LATENCY = 0.00

**SUPERVISION_TIMEOUT = 5000.00 ms

set data length change ATT MTU size

**MTU_size = 251

slave security request slave req security cmd OK ok PAIRING PHASE - NUMERIC COMPARISON Decimal value = 417764

*** CONFIRM YES
Pairing complete

Bluetooth pairing request

Passkey: 417764

Smartphone

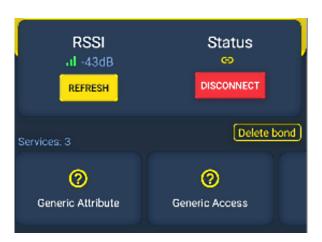
Pair with DT_SERVER?

Cancel OK

Note: The database can be deleted on phone using "delete bond". Delete database is a local action.

Figure 31. Phone deletes its database

Smartphone



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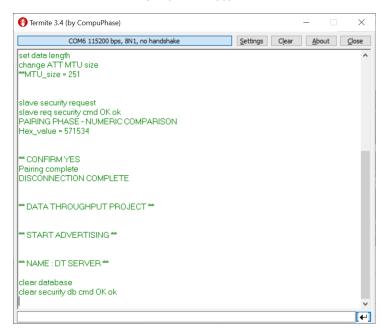


Note:

The database can be deleted on STM32WB55 device after disconnection, using SW3-long push (more than 1 s). Delete database is a local action.

Figure 32. STM32WB55 device deletes its database

STM32WB - Trace



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3.3.4 Scenario 3-1 – Data throughput downlink 1 M

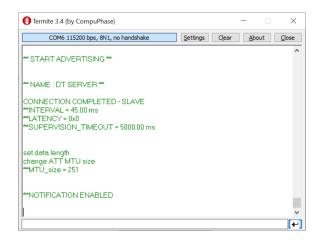
STM32WB55 device is the peripheral.

- · Phone scans, connects, discovers service/characteristic, enables the notification
- Push SW1 notification is sent from STM32WB55 device
- Throughput is calculated on the phone

Pass if all service and characteristics are discovered and the throughput value is displayed

Figure 33. STM32WB55 device sends data to the phone at PHY = 1 M

STM32WB - Trace



Smartphone



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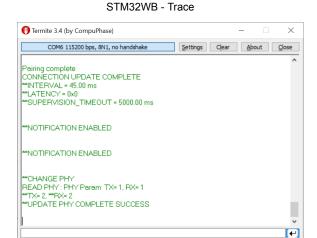
3.3.5 Scenario 3-2 – Data throughput downlink 2 M

STM32WB55 device is the peripheral.

- · Phone scans, connects, discovers service/characteristic, enables the notification
- Push SW1: notification are sent from STM32WB55 device
- Push SW2, check the phone supports PHY 2 M
- Throughput is calculated on the phone

Pass if all service and characteristics are discovered and the throughput value is displayed.

Figure 34. STM32WB55 device sends data to the phone at PHY = 2 M



Smartphone



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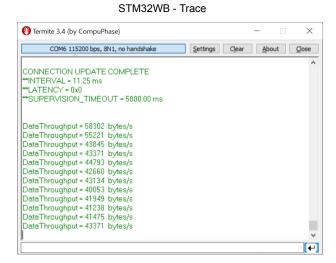
3.3.6 Scenario 4-1 – Data throughput uplink 1 M

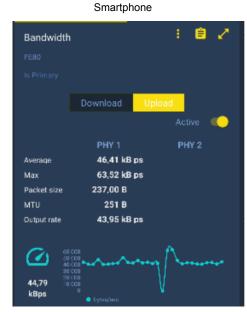
STM32WB55 device is in advertising.

- · Phone scans, connects, discovers service/characteristic, enables the notification (not used in this case)
- Select uplink box on phone application. Write data started from the phone
- Throughput is calculated on device and sent to the phone through a notification. The value is displayed on phone

Pass if all service and characteristics are discovered and the throughput value is displayed.

Figure 35. Phone sends data to STM32WB55 device at PHY = 1 M





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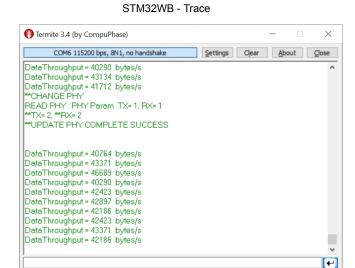
3.3.7 Scenario 4-2 – Data throughput uplink 2 M

STM32WB55 device is in advertising.

- · Phone scans, connects, discovers service/characteristic, enables the notification (not used in this case)
- Select uplink box on phone application. Write data started from the phone
- Push SW2, check the phone supports PHY 2 M
- Throughput is calculated on device and sent to the phone through a notification. The value is displayed on phone.

Pass if all service and characteristics are discovered and the throughput value is displayed.

Figure 36. Phone sends data to STM32WB55 device at PHY = 2 M



Smartphone



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3.4 Results of data throughput application tests

Table 5. Results of data throughput application tests

Manufacturer	Model	os	S1	S2	S3-download (kbytes/s)	S4-upload (kbytes/s)
	iPhone 7	100.40.7		1	1 M - 22.11	1 M - 21.8
Apple [®]	MN8X2ZD/A	iOS 13.7	1	SC	2 M - 28.31	2 M - 30.87
A 1 ®	iPhone 8	:00.44.0.4	,	1	1 M - 24	1 M - 23
Apple [®]	MQ6V2LL/A	iOS 14.0.1	1	SC	2 M - 38	2 M - 39
Annia®	iPhone 11	iOC 12 6 1	,	1	1 M - 15	1 M - 15
Apple®	iPhone 11	iOS 13.6.1	1	SC	2 M - 40	2 M - 39
Apple [®]	iPhone 12	iOS 14.3	1	1	1 M - 23.2	1 M - 23.4
Apple	IFHORE 12	103 14.3	•	SC	2 M - 40	2 M - 39
Apple [®]	XR	iOS 14	1	1	1 M - 24	1 M - 23
Apple	MRYU2VC/A	103 14	•	SC	2 M - 40	2 M - 38
Apple [®]	XS	iOS 13.6.1	1	1	1 M - 24	1 M - 23
Apple	MT9H2ZD/A	100 10.0.1	•	SC	2 M - 40	2 M - 40
Apple [®]	XS MAX	iOS 14.2	1	1	1 M - 24	1 M - 23
Apple	AS WAX	103 14.2	•	SC	2 M - 38	2 M - 39
Google®	PIXEL 2	R v11	/	1	1 M - 48.73	1 M - 49.30
Google	I IXEE Z	API level 30	Ľ	SC	2 M - 85.90	2 M - 85.20
Google [®]	PIXEL 3	Q v10	/	1	1 M - 48.7	1 M - 42
Google	TIXEL 3	API level 29	Ť	SC	2 M - 75	2 M - 75
Huawei	MATE 20 LITE	Q v10	/	1	1 M - 22.3	1 M - 8
ridawci	WATE 20 LITE	API level 29	Ľ	SC	2 M - not supported	2 M - not supported
Huawei	NEXUS 6P	Oreo v8.1.0	/	1	1 M - 20	1 M - 42
ridawei	NEXOU 01	API level 27	Ů	SC	2 M - not supported	2 M - not supported
Huawei	P10	Nougat v7	1	1	1 M - 30	1 M - 30
ridawei	1 10	API level 24	ľ	SC	2 M - 32	2 M - 31
Huawei	P20	Oreo v8.1.0	1	1	1 M - 19	1 M - 31
ridawci	ELM-L29	API level 27	Ľ	SC ⁽²⁾	2 M - 32	2 M - 31
Huawei	P30	Q v10	1	✓	1 M - 60	1 M - 47
ridawei	ELE-L29	API level 29	Ů	SC	2 M - 105	2 M - 78
Huawei	P Smart+ 2019	Q v10	1	1	1 M - 16	1 M - 2.6
ridawei	POT-LX1T	API level 29	ľ	SC	2 M - not supported	2 M - not supported
1.0	1400	Pie v9		1	1 M - 2	1 M - 0.87
LG	K20	API level 28	1	SC	2 M - not supported	2 M - not supported
		Nougat v7.1.1		1	1 M - 7.2	1 M - 7.2
Motorola	Z2	API level 25	1	sc	2 M - not supported	2 M - not supported
		Nougat v7.1.1		1	1 M - 48	1 M - 48
OnePlus	5000	API level 25	/	SC ⁽²⁾	2 M - 90	2 M - 46
		Q v10	<u> </u>	/	1 M - 62.2	1 M - 62.7
OnePlus	A6003	API level 29	1	SC ⁽²⁾	2 M - 85.2	2 M - 84

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Manufacturer	Model	os	S1	S2	S3-download (kbytes/s)	S4-upload (kbytes/s)
0000	RX17 PRO	Oreo v8.1.0	,	1	1 M - 47	1 M - 42
OPPO	CPH1877	API level 27	1	SC	2 M - 84	2 M - 61
Comouna	A41	Q v10		1	1 M - 43	1 M - 70
Samsung	SM-A415F	API level 30	1	SC	2 M - 74	2 M - 74
Comouna	A50	Q v10	,	1	1 M - 47	1 M - 46
Samsung	SM-A505FN	API level 30	1	SC	2 M - 85	2 M - 46
Sameuna	A51	Q v10	/	1	1 M - 43.10	1 M - 46.10
Samsung	AST	API level 29	•	SC	2 M - 77.75	2 M - 47.20
Samsung	GALAXY A5	Oreo v8	1	1	1 M - 35	1 M - 28
Samsung	SM-A520F	API level 25	•	sc	2 M - not supported	2 M - not supported
0	GALAXY S7	Oreo v8	,	1	1 M - 24.02	1 M - 23.79
Samsung	SM-G930F	API level 25	1	SC	2 M - not supported	2 M - not supported
0	GALAXY S8	Nougat v7		1	1 M - 69	1 M - 42
Samsung	SM-G950F	API level 24	1	SC	2 M - 74	2 M - 46
	GALAXY S8	Nougat V7		1	1 M - 93	1 M - 48
Samsung	SM-G9500	API level 24	1	SC	2 M - 150	2 M - 48
	GALAXY S8+					
Samsung	Chinese model	Nougat V7	1	✓	1 M - 93	1 M - 51
	SM-G9550	API level 24		SC	2 M - 164	2 M - 50
0	GALAXY S9	Nougat v7.1.1		1	1 M - 93	1 M - 42
Samsung	SM-G900	API level 25	1	SC	2 M - 166	2 M - 76
0	GALAXY S9	Nougat v7.1.1		1	1 M - 93	1 M - 42
Samsung	SM-G960	API level 25	1	SC	2 M - 167	2 M - 57
0	GALAXY S10	Pie v9		1	1 M - 93	1 M - 42
Samsung	SM-G730	API level 28	1	SC	2 M - 167	2 M - 76
	GALAXY S10	Pie v9		1	1 M - 93	1 M - 43
Samsung	SM-G973F	API level 28	1	SC	2 M - 167	2 M - 76
	Tab A	Q v10		1	1 M - 37.6	1 M - 48.2
Samsung	SM-T510	API level 29	1	SC ⁽²⁾	2 M - 64.8	2 M - 57.2
_	NOTE 8	Pie v9		1	1 M - 86.6	1 M - 35.15
Samsung	SM-N950F	API level 27	1	SC	2 M - 156.25	2 M - 37.1
_		Nougat v7		1	1 M - 2.48	1 M - 2
Samsung	S6Edge	API level 24	1	SC	2 M - not supported	2 M - not supported
_		Q v10		1	1 M - 91.7	1 M - 46.18
Samsung	S10	API level 30	1	SC	2 M - 162.3	2 M - 79
_	.,	Pie v9		1	1 M - 49.15	1 M - 48.21
Sony	XPERIA10	API level 28	1	SC	2 M - 86.11	2 M - 75.29
	VD=0:	Nougat v7.1.1		1	1 M - 42	1 M - 38
Sony	XPERIA DOCOMO	API level 25	1	SC	2 M - 86	2 M - 52
	VD=	Pie v9	<u> </u>	1	1 M - 49.3	1 M - 8.7
Sony	XPERIAXZ2		1	SC	2 M - 145.5	2 M - 8.6
	=		<u> </u>	1	1 M - 29.8	1 M - 31.5
Xiaomi	MI5	Marshmallow	1	SC	2 M - not supported	2 M - not supported

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Manufacturer	Model	os	S1	S2	S3-download (kbytes/s)	S4-upload (kbytes/s)
		API level 27				
Xiaomi	MI 8	Oreo v8.1.0	/	1	1 M - 43	1 M - 42
AldUIII	IVII O	API level 27	•	SC ⁽²⁾	2 M - 85	2 M - 74
Xiaomi	MI10	Q v10	,	1	1 M - 72	1 M - 55
Alaoitii	M2001J2G	API level 29	rel 29		2 M - 138	2 M - 55
Xiaomi	MI MIX3	Q v10	1	1	1 M - 47.1	1 M - 43
Alaomi	IVII IVIIAS	API level 29	•	sc	2 M - 82.5	2 M - 80
Xiaomi	REDMI	Q v10	1	1	1 M - 73	1 M - 27
Alaoitii	M2004J19AG	API level 29	•	sc	2 M - 75	2 M - 39
Xiaomi	REDMI NOTE 8	Q v10	1	1	1 M - 45	1 M - 16
Alaoitii	REDIVIT NOTE 6	API level 29	•	sc	2 M - not supported	2 M - not supported
Xiaomi	REDMI NOTE 8 PRO	Q v10	/	1	1 M - 73.4	1 M - 27.1
AldOITII	REDIVII NOTE 8 PRO	API level 29	'	sc	2 M - 127.7	2 M - 40.6

^{1.} SC stay for secure connection

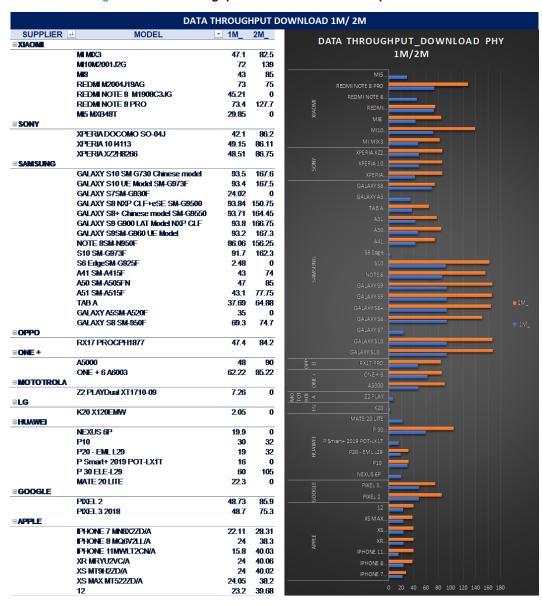
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^{2.} Peripheral security request not supported by the phone.



4 Analysis

Figure 37. Data throughput download 1 M and 2 M performances



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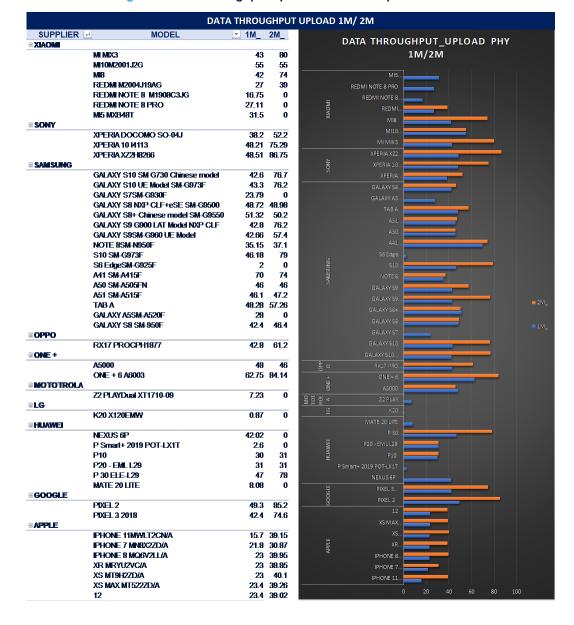


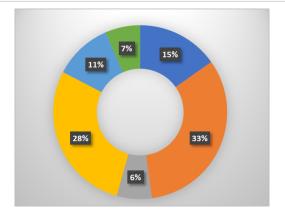
Figure 38. Data throughput upload 1 M and 2 M performances

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■ INTERVAL_ (ms) ■ SUP TIME OUT_ x10² (ms) 250 200 150 100 50 11... NS.... 0 ONE + 6... GALAXY S10... NOTE 8.. GALAXY A5.. Z2 PLAY.. S6 Edge.. XPERIA.. MI10.. PIXEL 3... P20 - EML L29 XPERIA XZ2. P Smart+ POT-LX1T MATE 20 LITE A51. GALAXY S8... REDMI NOTE 8 PRO

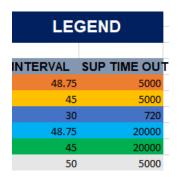
SAMSUNG

Figure 39. Connection interval and supervision timeout summary



GOOGLE HUAWEI MOGORONIEROPPO

APPLE



SONY

XIAOMI

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Revision history

Table 6. Document revision history

Date	Version	Changes
02-Feb-2021	1	Initial release.

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1	Test	setup.	2
2	Basi	c functi	onal test cases3
	2.1	Applica	ation of STM32WB Series basic functional test
	2.2	Summa	ary of basic functional tests
	2.3	Descrip	otion of basic functional tests
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		2.3.2	Test 2-1 – BLE connection
		2.3.3	Test 2-2 – GATT, service/characteristics discovery
		2.3.4	Test 3 – GATT notification
		2.3.5	Test 4-1 – GATT, write/read characteristic (1 byte)
		2.3.6	Test 4-2 – GATT, write/read characteristic (4 bytes)
		2.3.7	Test 5 – GATT indication
		2.3.8	Test 6-1 – GATT, write without response/read characteristic (1 byte)
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		2.3.10	Test 7 – GATT, write/read characteristic encryption permission
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		2.3.13	Test 8-3 – L2CAP connection interval request (45 ms)
		2.3.14	Test 8-4 – L2CAP connection interval request (200 ms)
		2.3.15	Test 8-5 – L2CAP connection interval request (400 ms)
		2.3.16	Test 8-6 – L2CAP connection interval request (600 ms)
		2.3.17	Test 8-7 – L2CAP connection interval request (1000 ms)
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