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)

AN5604 - Rev 1 - February 2021
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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).
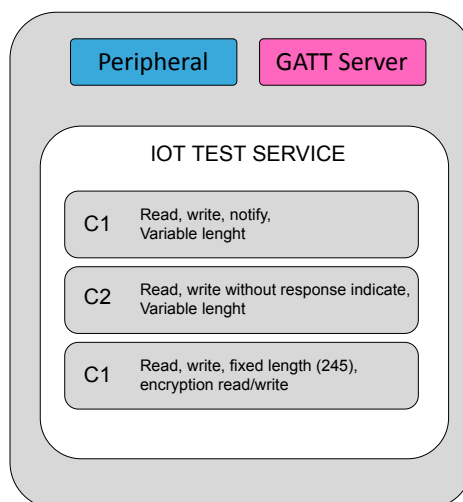
Figure 1. Setup overview

ST BLE toolbox

GATT Client

GATT Server

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	Type
1	1	BLE scanning, discovery
2	1	BLE connection
	2	GATT (service, characteristic discovery)
3	1	GATT notification • Variable length data • C1
4	1	GATT write/read • Variable length data • C1: write 1 byte 0xAA, read 0xAA
	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

| Test set	Test case	Type
6	2	GATT read/write without response • C2: write 4 bytes 0x55443322, read 0x55443322
7	1	GATT read/write with response • C3
8	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
	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
9	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
	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

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

STM32WB -Trace   Smartphone
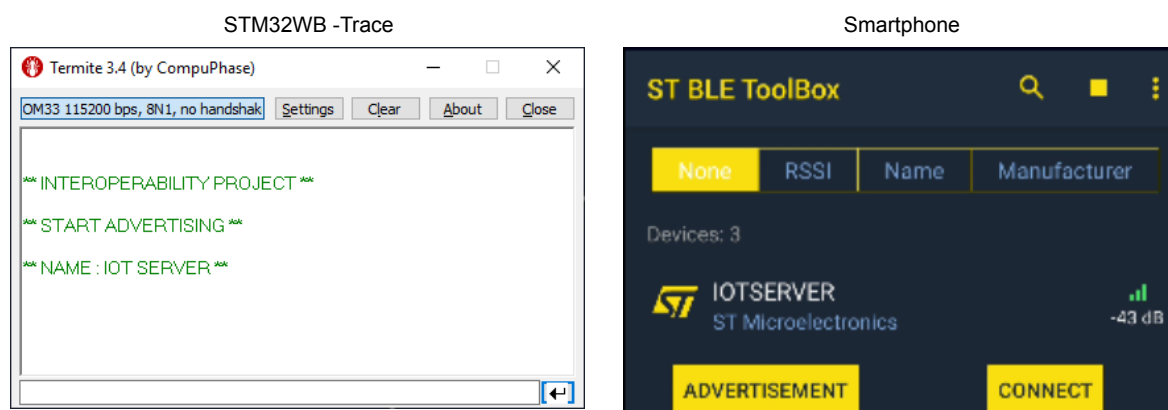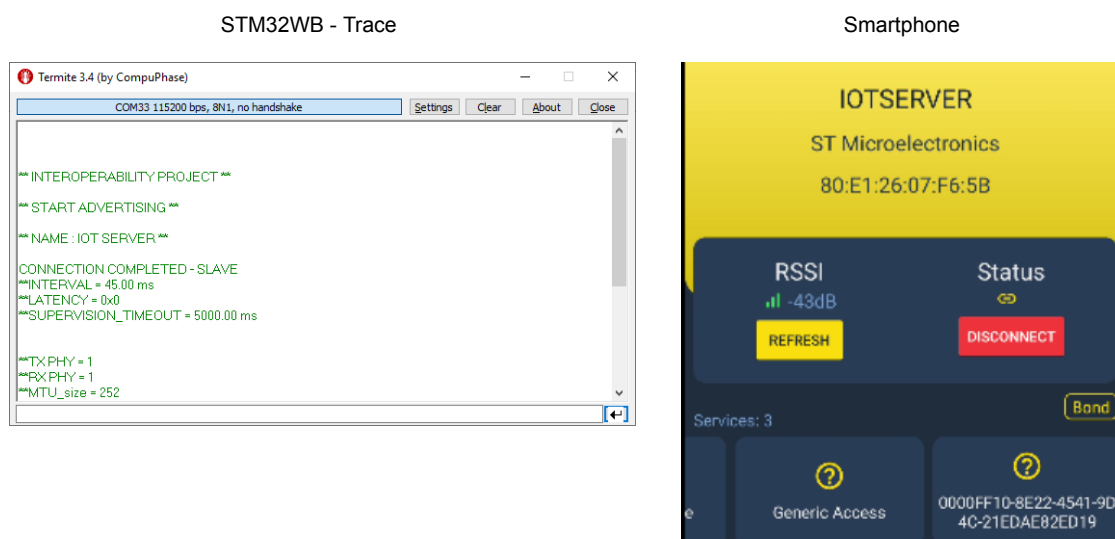

2.3.2 Test 2-1 – BLE connection

STM32WB55 device is the peripheral.

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

Figure 4. Phone connects

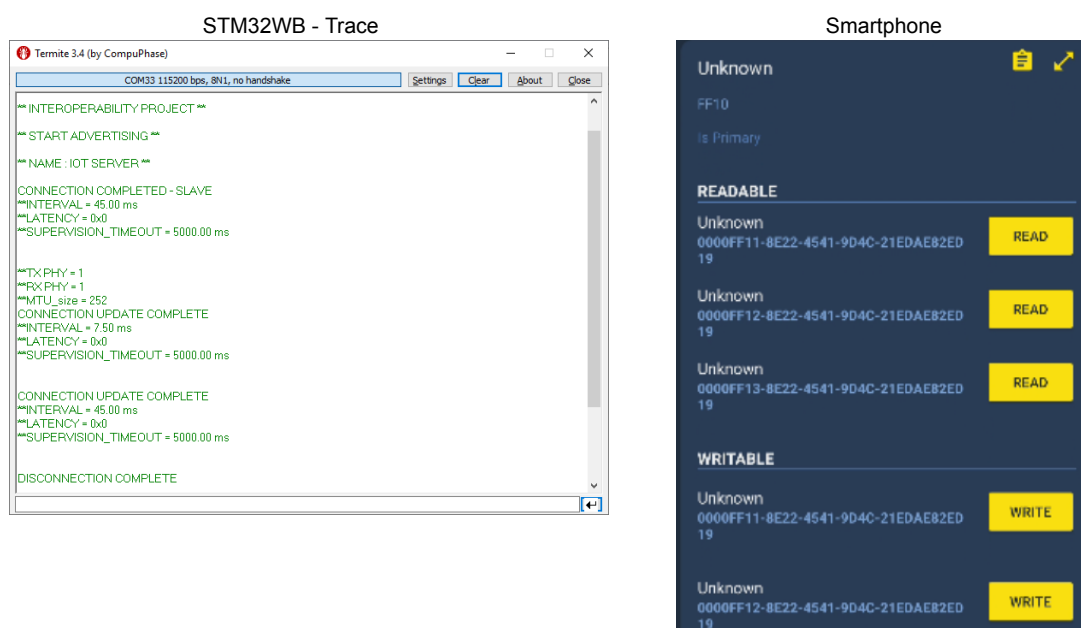STM32WB - Trace   Smartphone

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

STM32WB - Trace

Smartphone

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)

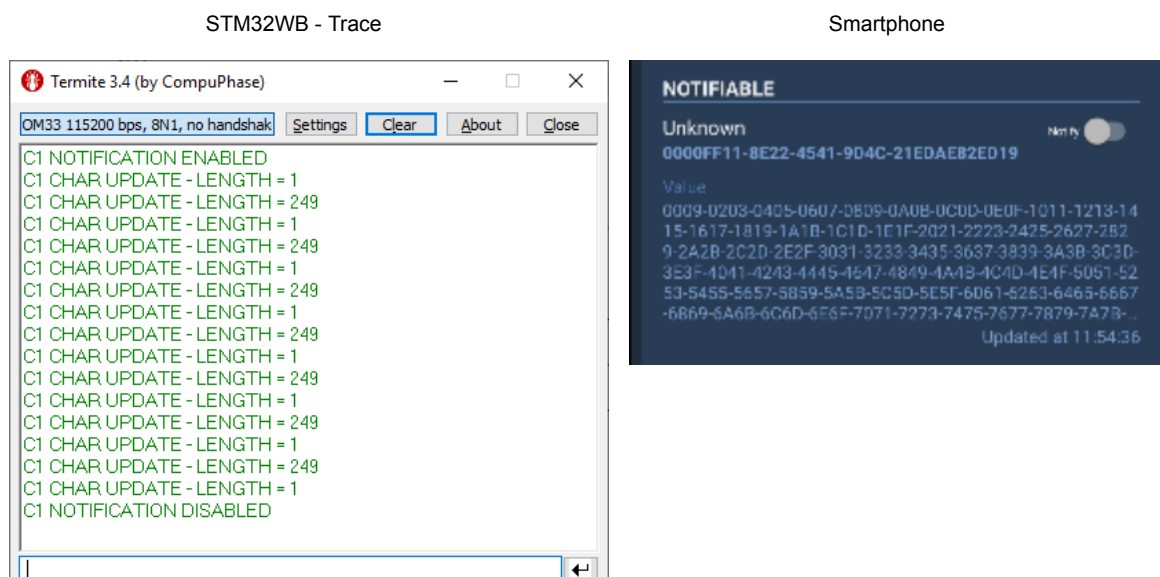Data: Byte0 = Packet sequence number, byte1 = 1,.., byteN = N

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

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

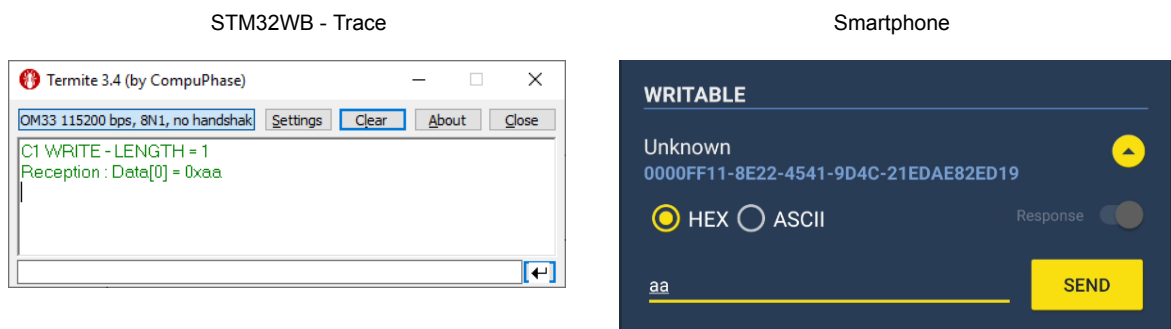Phone writes a variable length data, reads the written data.

• 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)

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

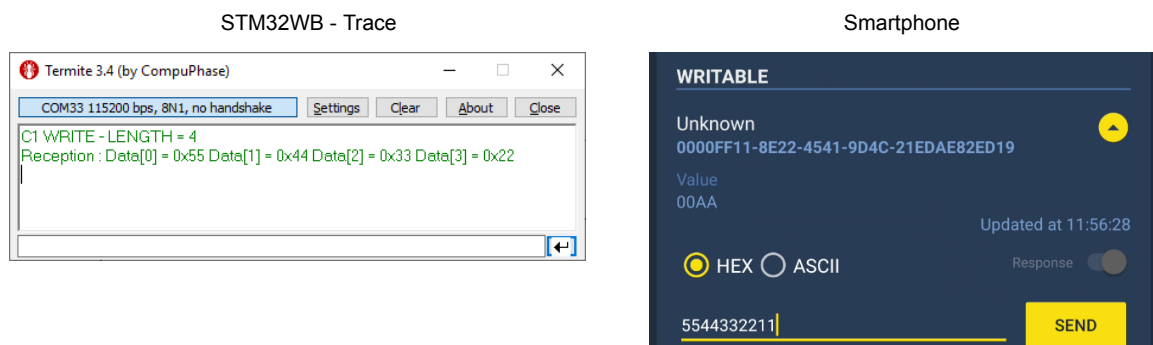Phone writes a variable length data, reads the written data.

• 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)

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)

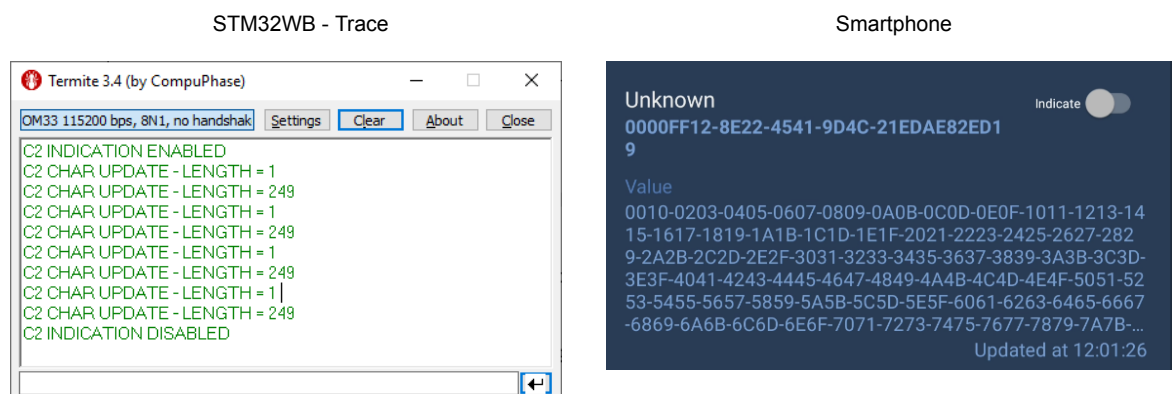Data: Byte0 = Packet sequence number, byte1 = 1,.., byteN = N

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   Smartphone

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

Phone writes a variable length data, reads the written data
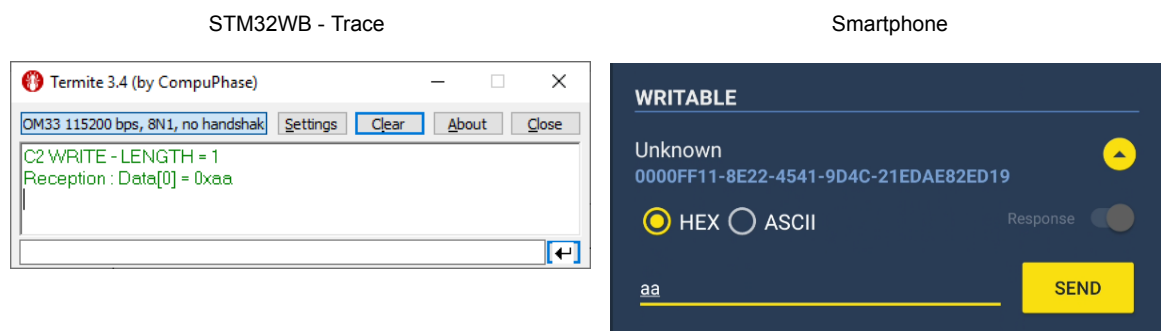
- Length = 1, data=0xAA

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   Smartphone

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

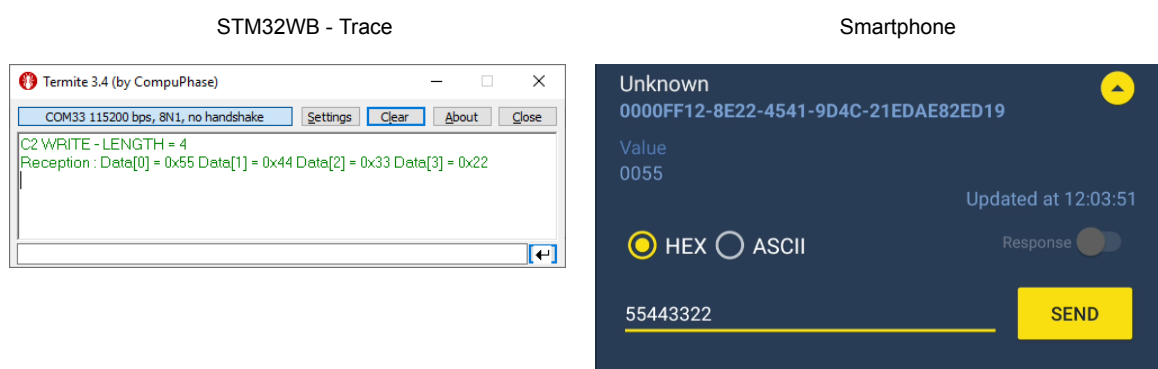Phone writes a variable length data, reads the written data:

•   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

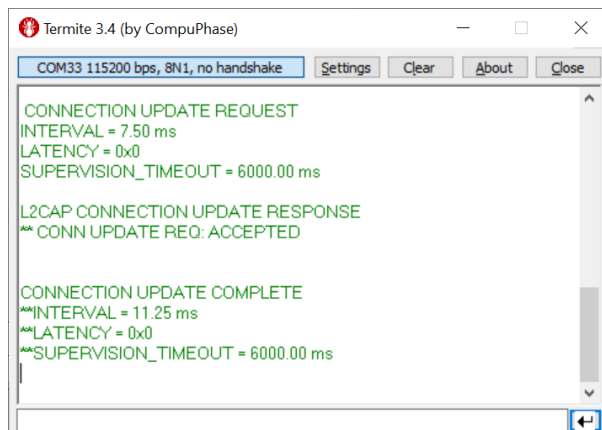STM32WB - Trace   Smartphone
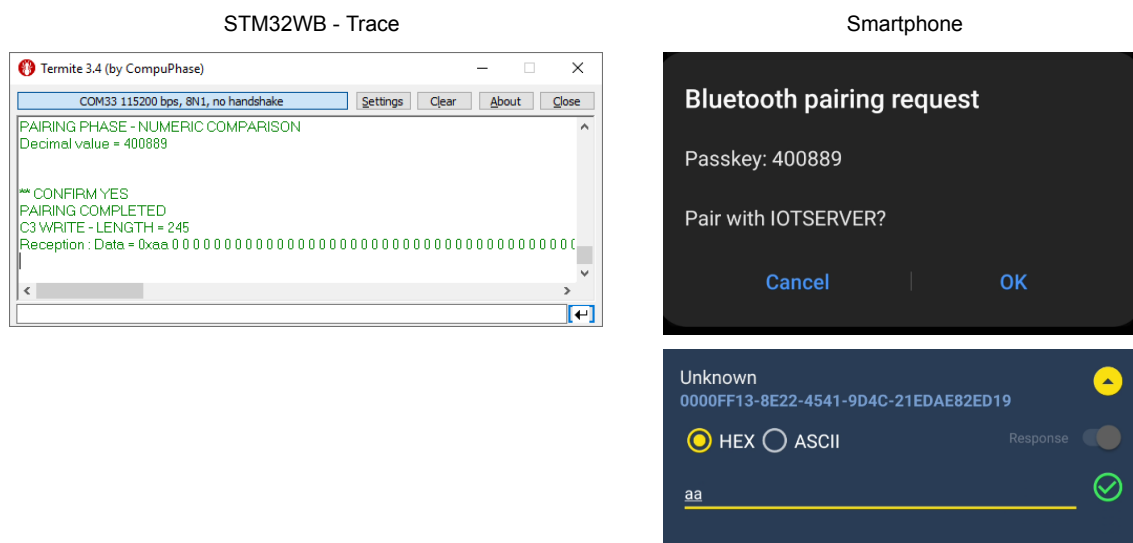
2.3.11 Test 8-1 – L2CAP connection interval request (7.5 ms)
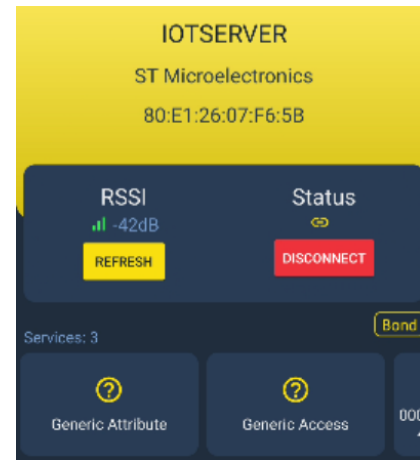
STM32WB55 device is the peripheral.

- 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

STM32WB - Trace   Smartphone

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
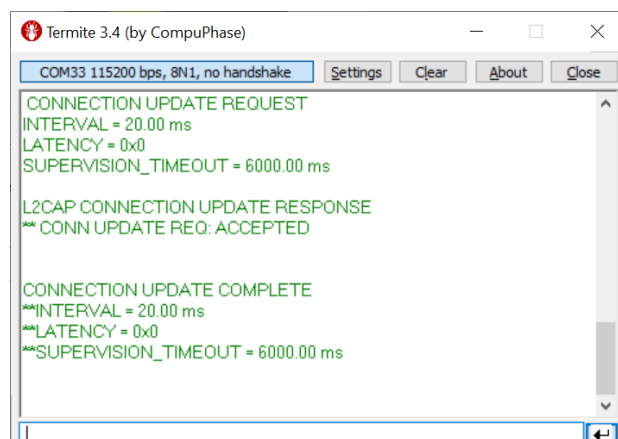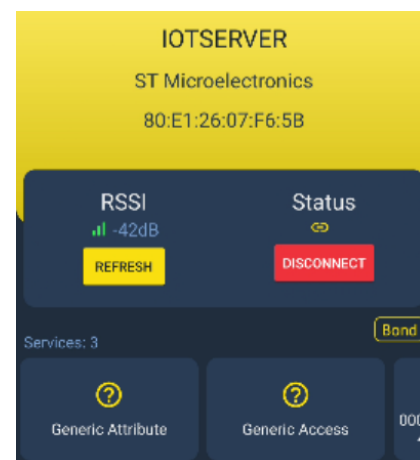

2.3.14 Test 8-4 – L2CAP connection interval request (200 ms)

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

Figure 16. Peripheral requests connection interval, 200 ms

STM32WB - Trace   Smartphone

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

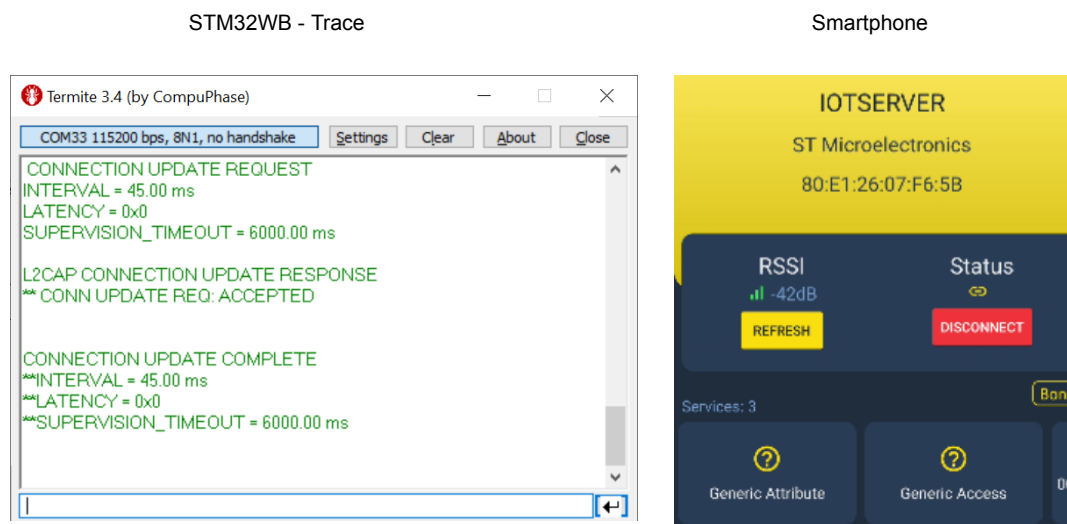**Figure 17. Peripheral requests connection interval, 400 ms**

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

STM32WB - Trace

Smartphone

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
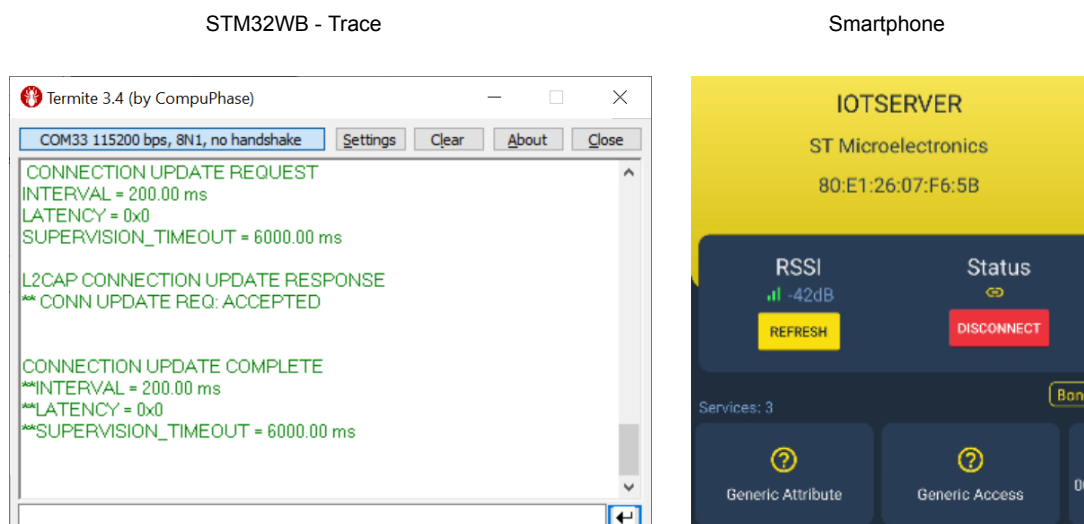
Figure 19. Peripheral requests connection interval, 1000 ms

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
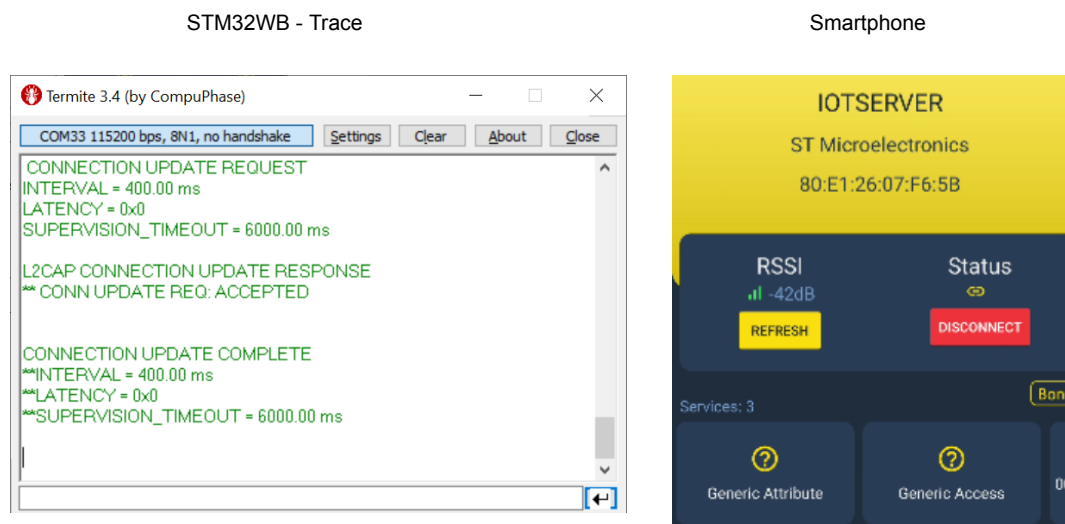
Figure 20. Peripheral requests connection interval, 2000 ms

STM32WB - Trace

Smartphone

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

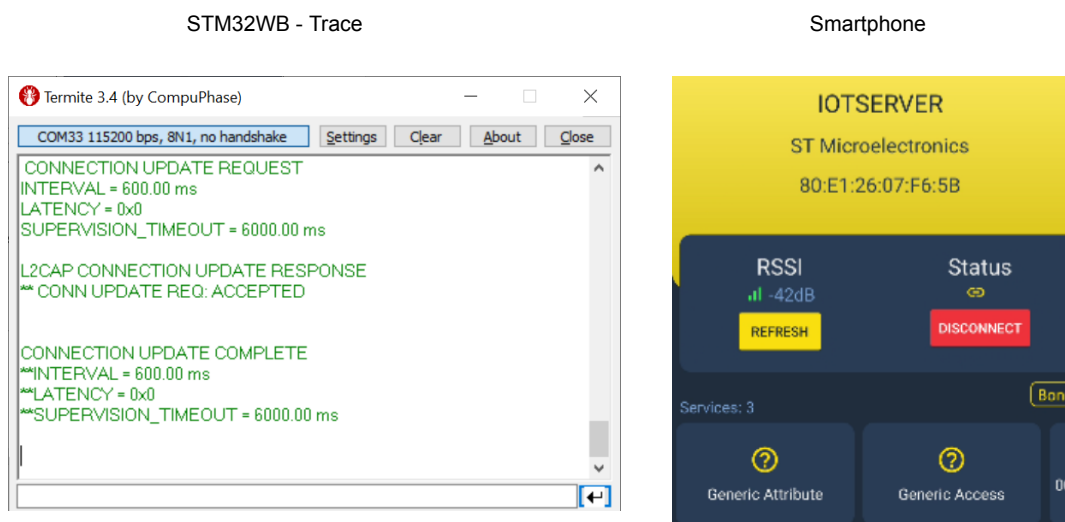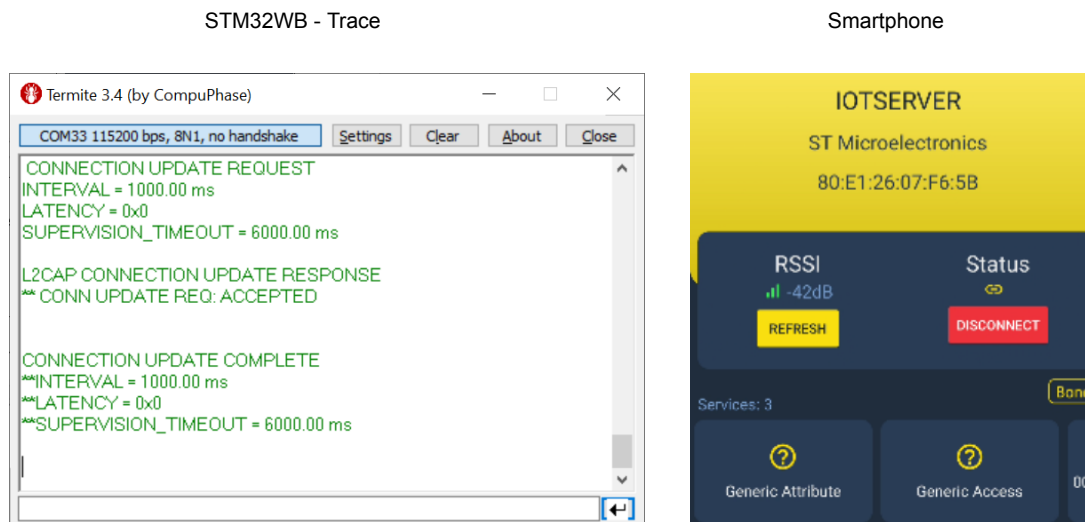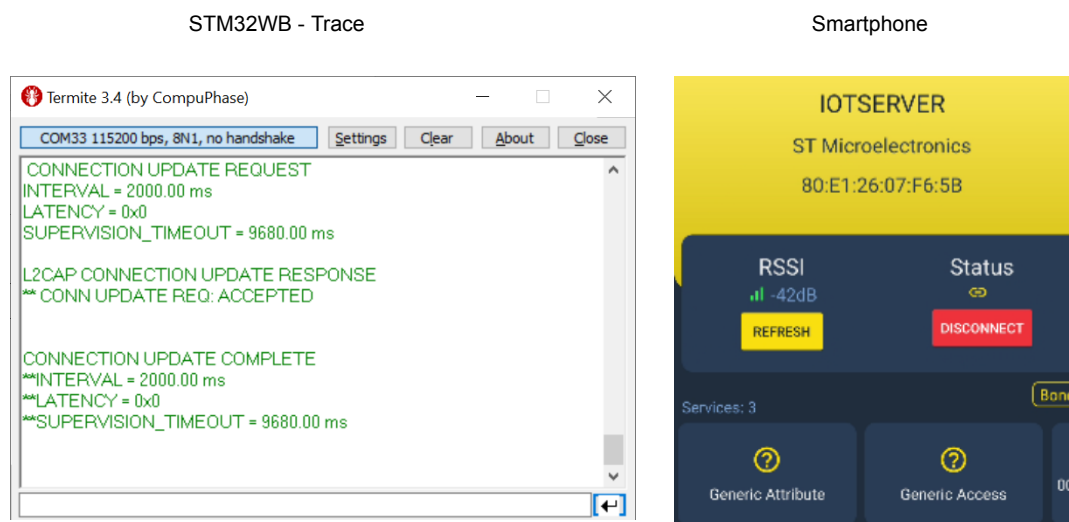**Figure 21. Peripheral requests connection interval, 4000 ms**

STM32WB - Trace   Smartphone
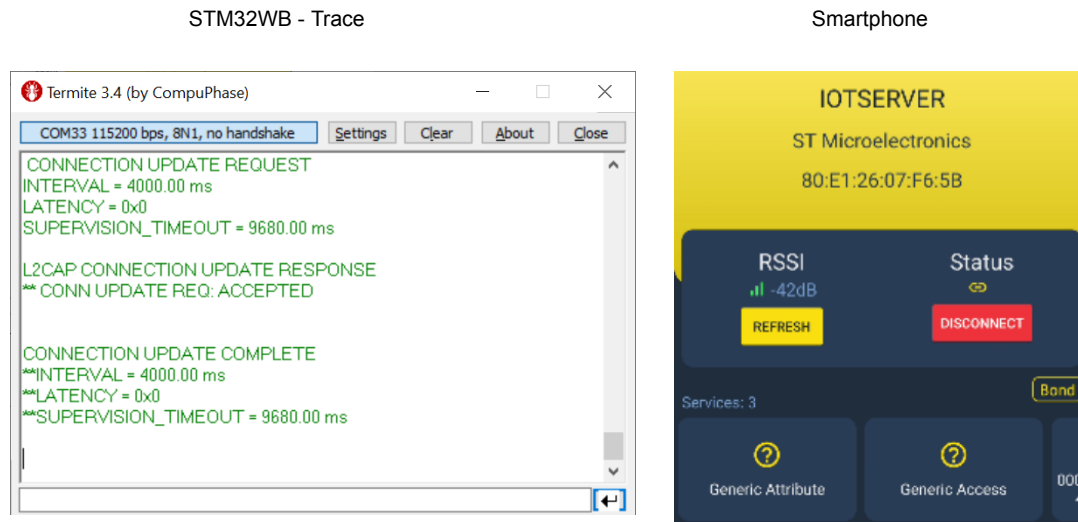
2.3.20 Test 9-1 – L2CAP connection interval, connection latency request (48.75 ms, latency = 2)

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

STM32WB - Trace   Smartphone
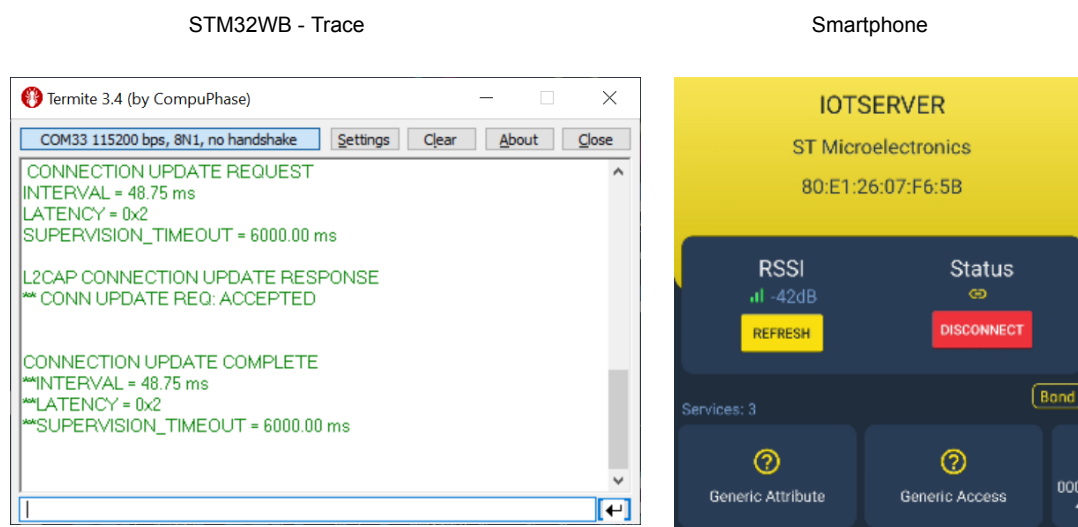
2.3.21 Test 9-2 – L2CAP connection interval, connection latency request (48.75 ms, latency = 4)
- Push SW2 – new connection interval requested: 48.75 ms, latency = 4
- Accepted, phone requests 48.75 ms, latency = 4

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

STM32WB - Trace   Smartphone
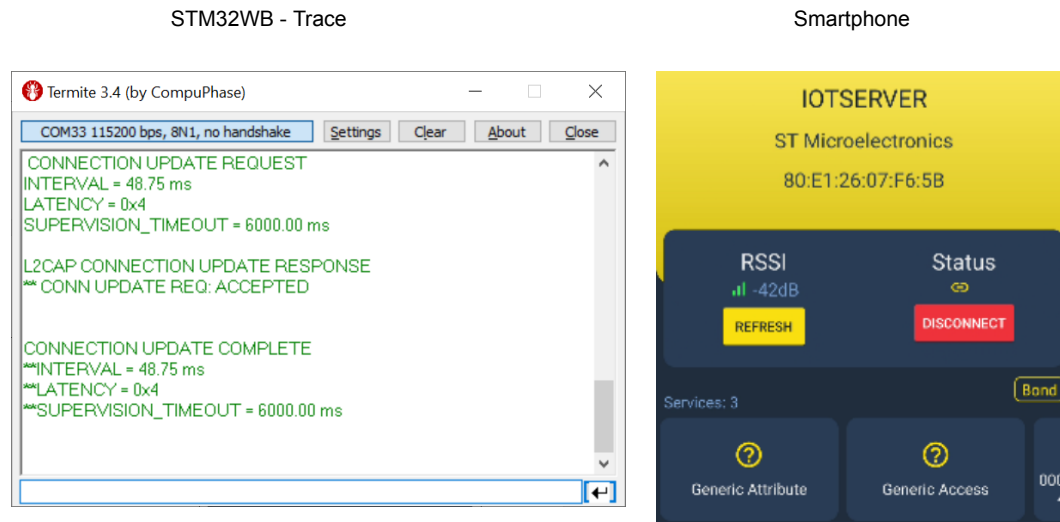
2.3.22 Test 9-3 – L2CAP connection interval, connection latency request (200 ms, latency = 2)
- Push SW2 – new connection interval requested: 200 ms, latency = 2
- Accepted, phone requests 200 ms, latency = 2

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

STM32WB - Trace   Smartphone

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

STM32WB - Trace

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

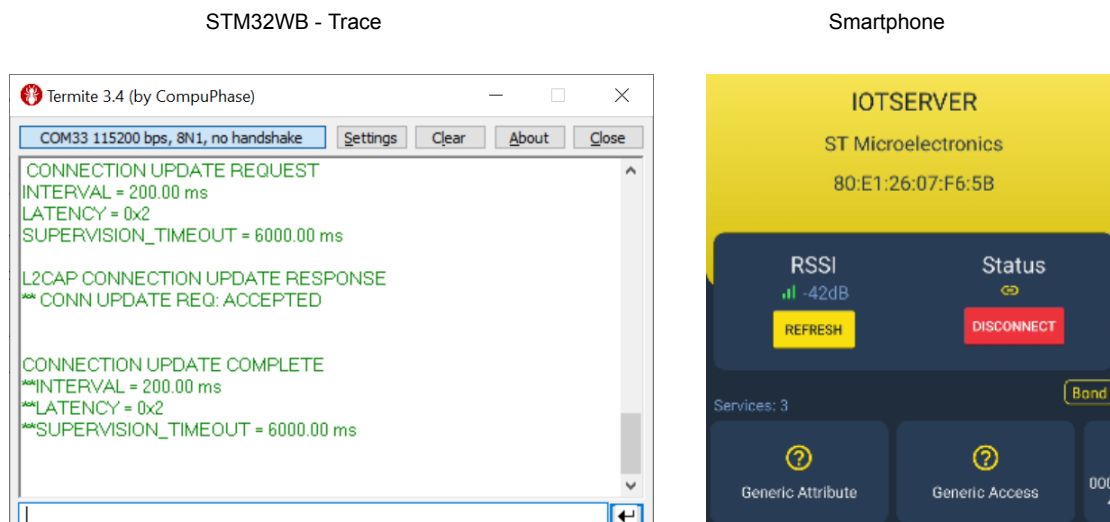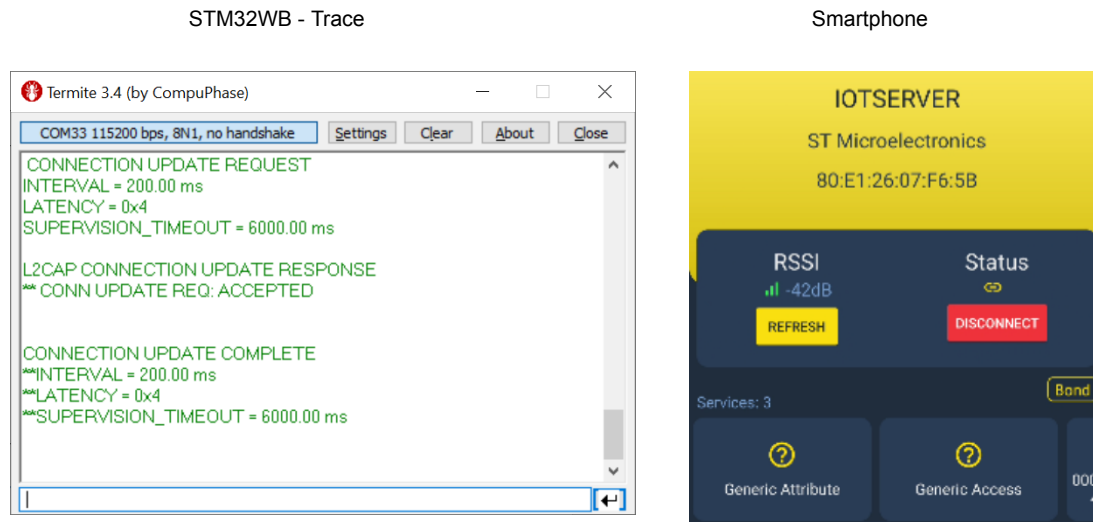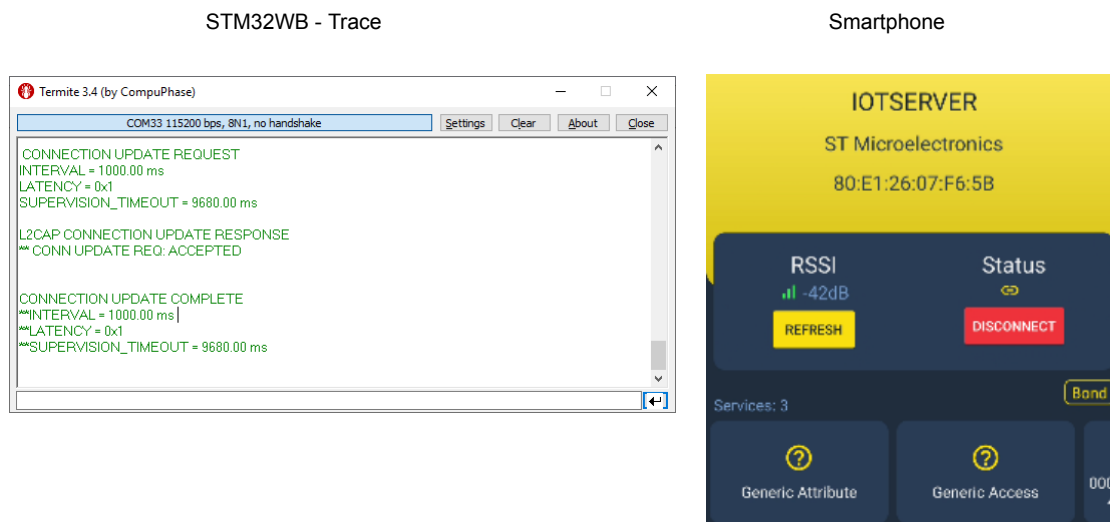**Figure 26. Peripheral requests connection interval equals to 1000 ms, latency equals to 1**

STM32WB - Trace

Smartphone

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]	✓[2]
Apple®	iPhone 8 MQ6V2LL/A	iOS 14.0.1	✓	✓	✓	✓	✓	✓	✓	✓[1]	✓[2]
Apple®	iPhone11	iOS 13.6.1	✓	✓	✓	✓	✓	✓	✓	✓[1]	✓[2]
Apple®	iPhone12	iOS 14.3	✓	✓	✓	✓	✓	✓	✓	✓[1]	✓[2]
Apple®	XR MRYU2VC/A	iOS 14	✓	✓	✓	✓	✓	✓	✓	✓[1]	✓[2]
Apple®	XS MT9H2ZD/A	iOS 13.6.1	✓	✓	✓	✓	✓	✓	✓	✓[1]	✓[2]
Apple®	XS MAX	iOS 14.2	✓	✓	✓	✓	✓	✓	✓	✓[1]	✓[2]
Google®	PIXEL2	R v11 API level 30	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Google®	PIXEL3	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Huawei	Mate 20 LITE	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Huawei	NEXUS 6P	Oreo v8.1.0 API level 27	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Huawei	P10	Nougat v7.0 API level 24	✓	✓	✓	✓	✓	✓	✓	✓	✓
Huawei	P20 ELM-L29	Oreo v8.1.0 API level 27	✓	✓	✓	✓	✓	✓	✓	✓	✓
Huawei	P30 ELE-L29	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Huawei	P Smart+ 2019 POT-LX1T	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
LG	K20	Pie v9 API level 28	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Motorola	Z2	Nougat v7.1.1 API level 25	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
OnePlus	5000	Nougat v7.1.1 API level 25	✓	✓	✓	✓	✓	✓	✓	✓[4]	✓
OnePlus	A6003	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	[4]	✓
OPPO	RX17 PRO CPH1877	Oreo v8.0 API level 26	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Samsung	A41	Q v10	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓

Manufacturer	Model	OS	1	2	3	4	5	6	7	8	9
	SM-A415F	API level 29									
Samsung	A50 SM-A505FN	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	A51	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	GALAXY A5	Oreo v8 API level 25	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	GALAXY S7 SM-G930F	Oreo v8 API level 25	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	GALAXY S8 SM-G950F	Nougat v7 API level 24	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	GALAXY S8 SM-G9500	Nougat V7 API level 24	✓	✓	✓	✓	✓	✓	✓	✓ [4]	✓
Samsung	GALAXY S8+ Chinese model SM-G9550	Nougat V7 API level 24	✓	✓	✓	✓	✓	✓	✓	✓ [4]	✓
Samsung	GALAXY S9 SM-G900	Nougat v7.1.1 API level 25	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	GALAXY S9 SM-G960	Nougat v7.1.1 API level 25	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	GALAXY S10 SM-G730	Pie v9 API level 28	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	GALAXY S10 SM-G973F	Pie v9 API level 28	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	Tab A SM-T510	Q v10 API level 31	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	NOTE 8 SM-N950F	Pie v9 API level 27	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	S6 Edge SM-G925F	Nougat v7 API level 24	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Samsung	S10 SM-G973F	Q v10 API level 30	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Sony	XPERIA10	Pie v9 API level 28	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Sony	XPERIA DOCOMO	Nougat v7.1.1 API level 28	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Sony	XPERIAXZ2	Pie v9 API level 28	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Xiaomi	MI5	Marshmallow API level 27	✓	✓	✓	✓	✓	✓	✓	✓	✓
Xiaomi	MI8	Oreo v8.1.0 API level 27	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓
Xiaomi	MI10	Q v10 API level 23	✓	✓	✓	✓	✓	✓	✓	✓ [3]	✓

Manufacturer	Model	OS	1	2	3	4	5	6	7	8	9
Xiaomi	MI MIX3	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Xiaomi	REDMI M2004J19AG	Q v10 API level 30	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Xiaomi	REDMI NOTE 8 M1908C3JG	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓
Xiaomi	REDMI NOTE 8 PRO	Q v10 API level 29	✓	✓	✓	✓	✓	✓	✓	✓[3]	✓

1. *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.*

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
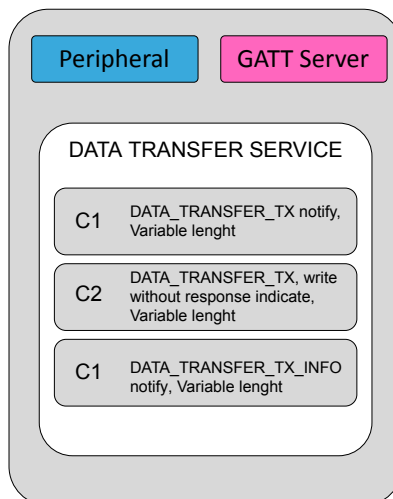
3.2 Summary of data throughput application tests

Table 4. List of data throughput application tests

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

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

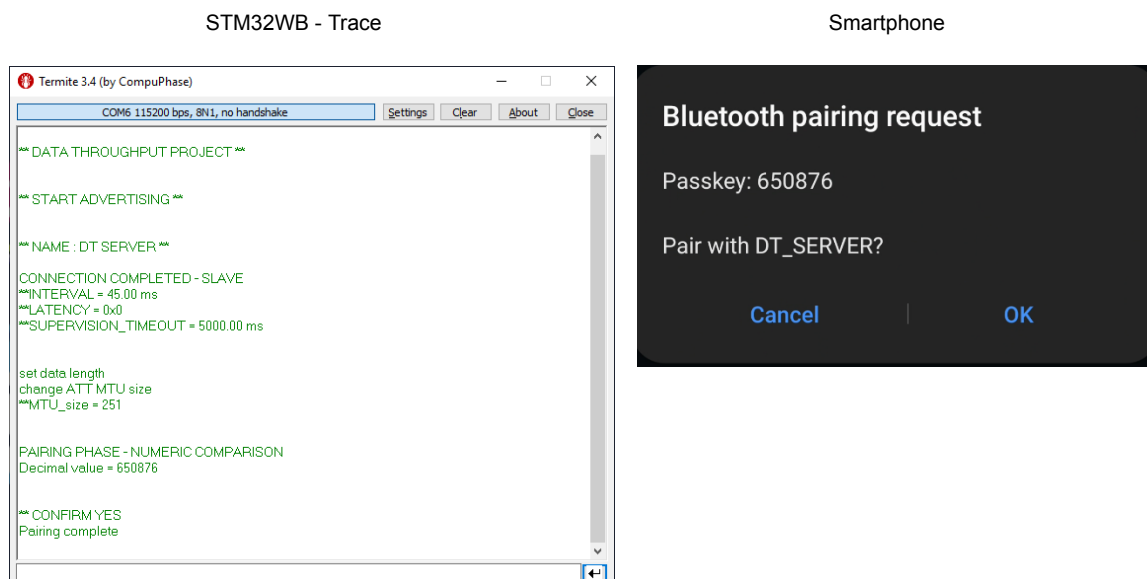**Figure 28. Phone scans, connects, discovers service and characteristics**

STM32WB - Trace   Smartphone
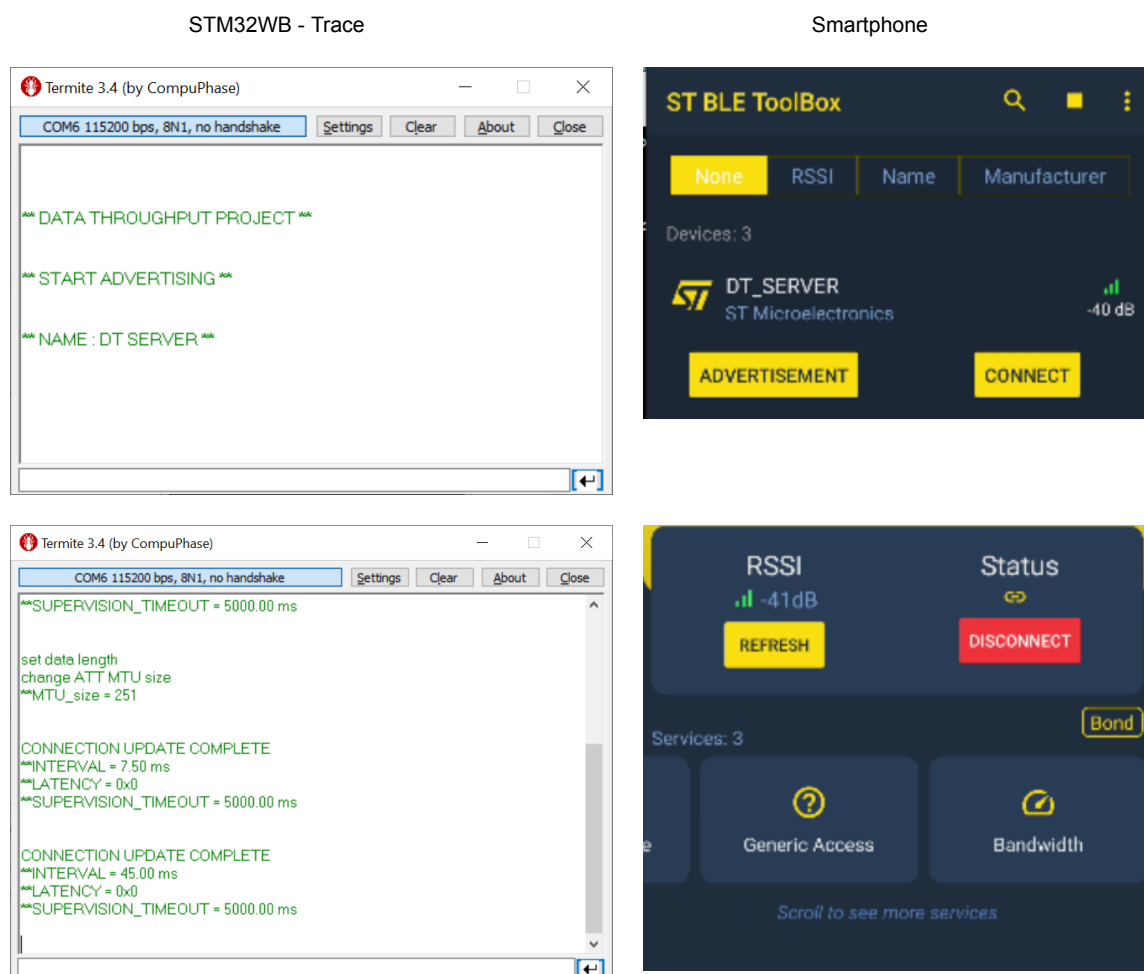
3.3.2 Scenario 2-1 – GAP security – Pairing requested by the phone

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

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
- 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

STM32WB - Trace   Smartphone
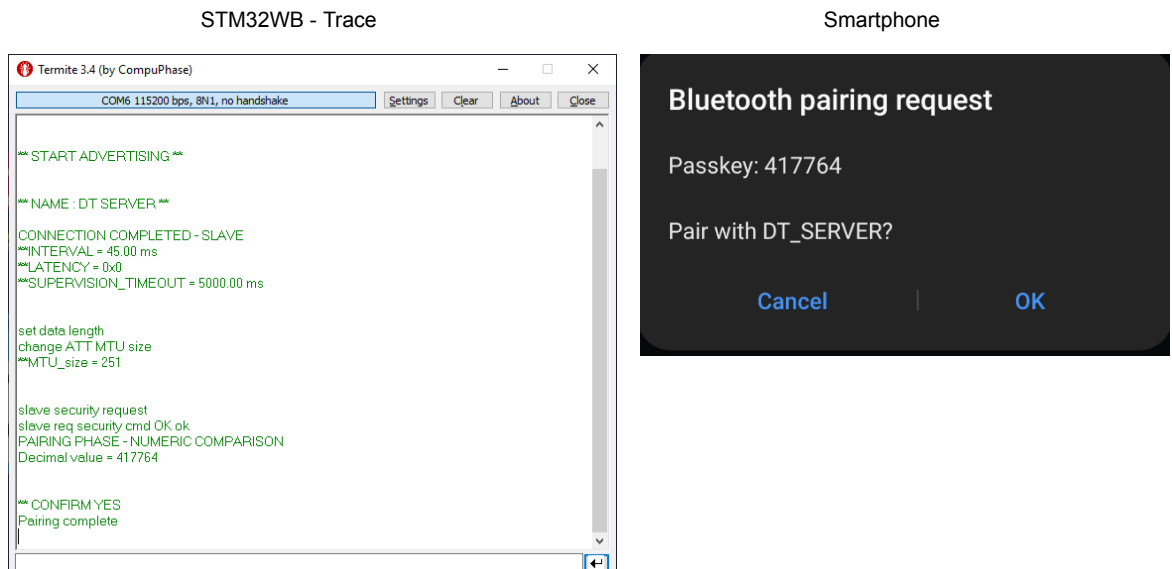
Note: *The database can be deleted on phone using "delete bond". Delete database is a local action.*

Figure 31. Phone deletes its database

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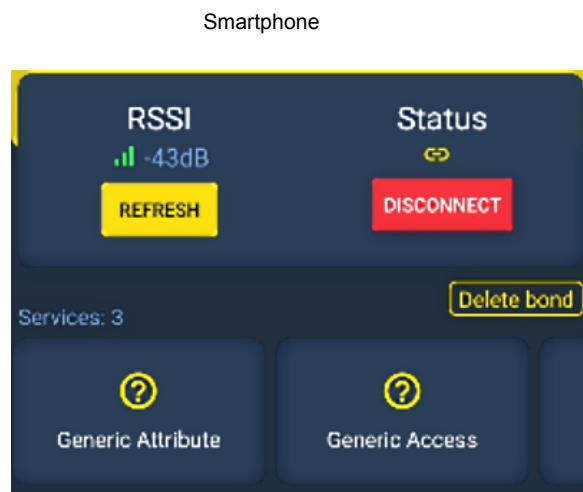
Note: *The database can be deleted on STM32WB55 device after disconnection, using SW3-long push (more than 1 s). Delete database is a local action.*

Figure 32. STM32WB55 device deletes its database

STM32WB - Trace
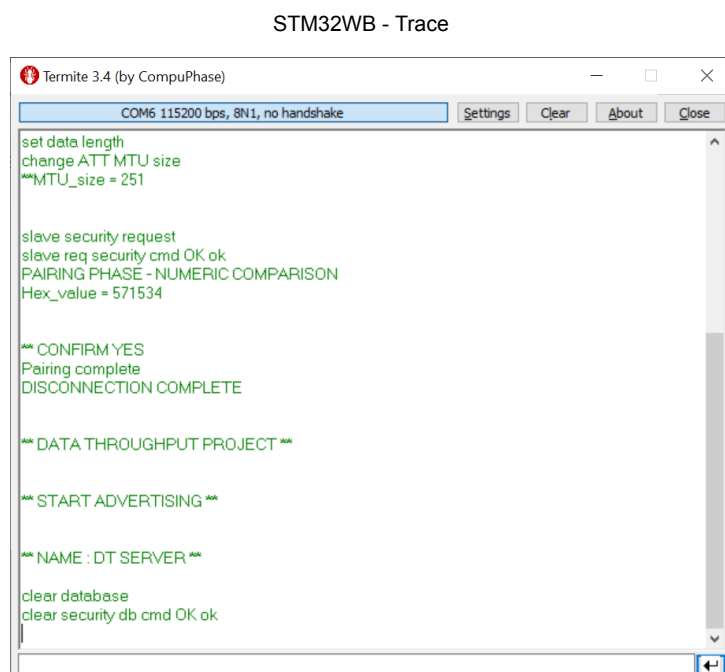
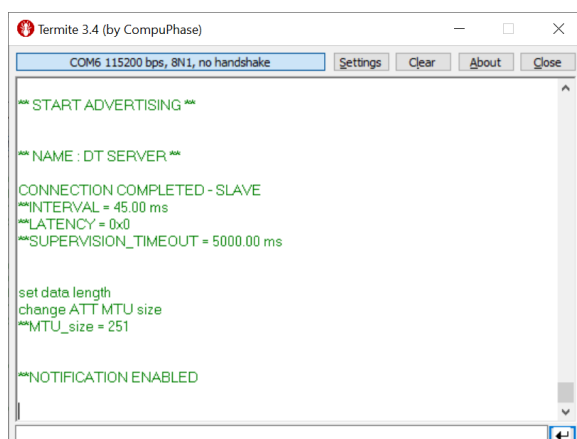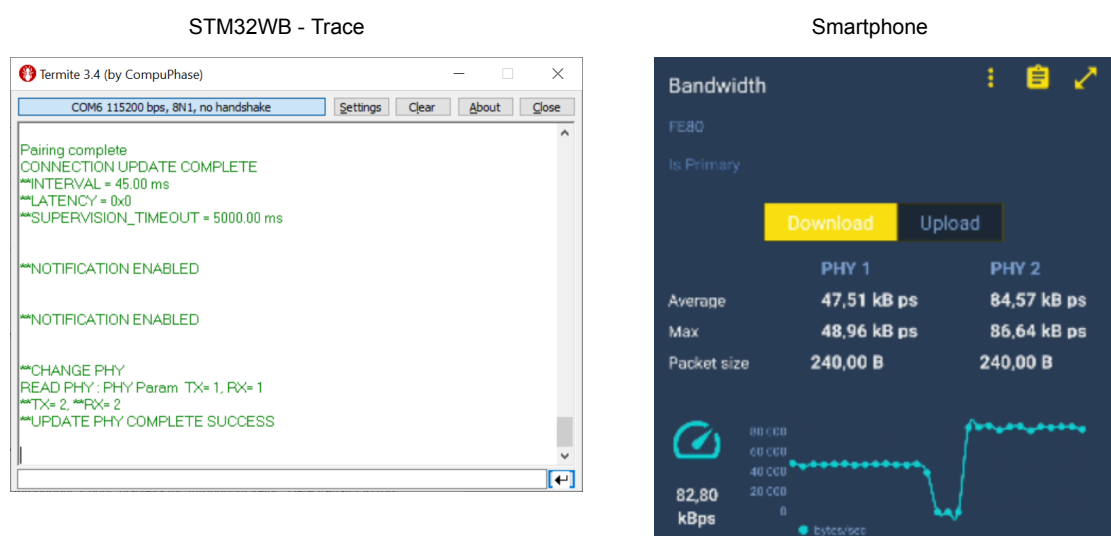### 3.3.4 Scenario 3-1 – Data throughput downlink 1 M

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

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

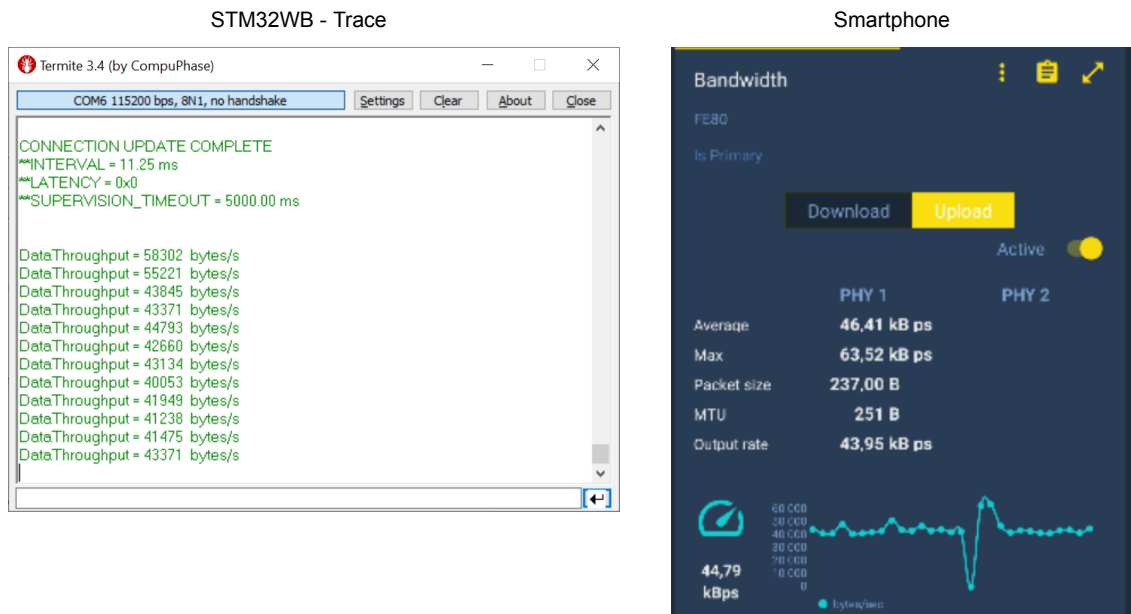STM32WB - Trace   Smartphone

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**

STM32WB - Trace   Smartphone

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
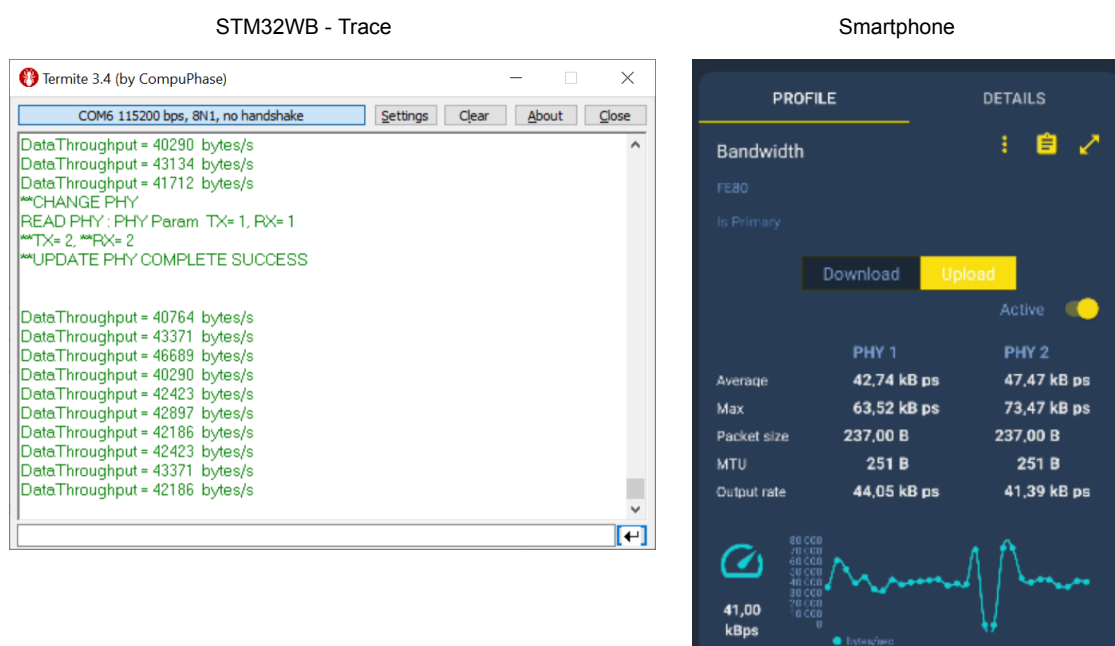
3.4 Results of data throughput application tests

Table 5. Results of data throughput application tests

Manufacturer	Model	OS	S1	S2	S3-download (kbytes/s)	S4-upload (kbytes/s)
Apple®	iPhone 7 MN8X2ZD/A	iOS 13.7	✓	✓ SC	1 M - 22.11 2 M - 28.31	1 M - 21.8 2 M - 30.87
Apple®	iPhone 8 MQ6V2LL/A	iOS 14.0.1	✓	✓ SC	1 M - 24 2 M - 38	1 M - 23 2 M - 39
Apple®	iPhone 11	iOS 13.6.1	✓	✓ SC	1 M - 15 2 M - 40	1 M - 15 2 M - 39
Apple®	iPhone 12	iOS 14.3	✓	✓ SC	1 M - 23.2 2 M - 40	1 M - 23.4 2 M - 39
Apple®	XR MRYU2VC/A	iOS 14	✓	✓ SC	1 M - 24 2 M - 40	1 M - 23 2 M - 38
Apple®	XS MT9H2ZD/A	iOS 13.6.1	✓	✓ SC	1 M - 24 2 M - 40	1 M - 23 2 M - 40
Apple®	XS MAX	iOS 14.2	✓	✓ SC	1 M - 24 2 M - 38	1 M - 23 2 M - 39
Google®	PIXEL 2	R v11 API level 30	✓	✓ SC	1 M - 48.73 2 M - 85.90	1 M - 49.30 2 M - 85.20
Google®	PIXEL 3	Q v10 API level 29	✓	✓ SC	1 M - 48.7 2 M - 75	1 M - 42 2 M - 75
Huawei	MATE 20 LITE	Q v10 API level 29	✓	✓ SC	1 M - 22.3 2 M - not supported	1 M - 8 2 M - not supported
Huawei	NEXUS 6P	Oreo v8.1.0 API level 27	✓	✓ SC	1 M - 20 2 M - not supported	1 M - 42 2 M - not supported
Huawei	P10	Nougat v7 API level 24	✓	✓ SC	1 M - 30 2 M - 32	1 M - 30 2 M - 31
Huawei	P20 ELM-L29	Oreo v8.1.0 API level 27	✓	✓ SC[2]	1 M - 19 2 M - 32	1 M - 31 2 M - 31
Huawei	P30 ELE-L29	Q v10 API level 29	✓	✓ SC	1 M - 60 2 M - 105	1 M - 47 2 M - 78
Huawei	P Smart+ 2019 POT-LX1T	Q v10 API level 29	✓	✓ SC	1 M - 16 2 M - not supported	1 M - 2.6 2 M - not supported
LG	K20	Pie v9 API level 28	✓	✓ SC	1 M - 2 2 M - not supported	1 M - 0.87 2 M - not supported
Motorola	Z2	Nougat v7.1.1 API level 25	✓	✓ SC	1 M - 7.2 2 M - not supported	1 M - 7.2 2 M - not supported
OnePlus	5000	Nougat v7.1.1 API level 25	✓	✓ SC[2]	1 M - 48 2 M - 90	1 M - 48 2 M - 46
OnePlus	A6003	Q v10 API level 29	✓	✓ SC[2]	1 M - 62.2 2 M - 85.2	1 M - 62.7 2 M - 84

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

Manufacturer	Model	OS	S1	S2	S3-download (kbytes/s)	S4-upload (kbytes/s)
		API level 27				
Xiaomi	MI 8	Oreo v8.1.0 API level 27	✓	✓ SC[2]	1 M - 43 2 M - 85	1 M - 42 2 M - 74
Xiaomi	MI10 M2001J2G	Q v10 API level 29	✓	✓ SC	1 M - 72 2 M - 138	1 M - 55 2 M - 55
Xiaomi	MI MIX3	Q v10 API level 29	✓	✓ SC	1 M - 47.1 2 M - 82.5	1 M - 43 2 M - 80
Xiaomi	REDMI M2004J19AG	Q v10 API level 29	✓	✓ SC	1 M - 73 2 M - 75	1 M - 27 2 M - 39
Xiaomi	REDMI NOTE 8	Q v10 API level 29	✓	✓ SC	1 M - 45 2 M - not supported	1 M - 16 2 M - not supported
Xiaomi	REDMI NOTE 8 PRO	Q v10 API level 29	✓	✓ SC	1 M - 73.4 2 M - 127.7	1 M - 27.1 2 M - 40.6

1. *SC stay for secure connection*
2. *Peripheral security request not supported by the phone.*

4 Analysis

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

SUPPLIER	MODEL	1M_	2M_
XIAOMI			
	MI MIX3	47.1	82.5
	MI10 M2001J2G	72	139
	MI8	43	85
	REDMI M2004J19AG	73	75
	REDMI NOTE 8 M1908C3JG	45.21	0
	REDMI NOTE 8 PRO	73.4	127.7
	MI5 MXB48T	29.85	0
SONY			
	XPERIA DOCOMO SO-04J	42.1	86.2
	XPERIA 10 I4113	49.15	86.11
	XPERIA XZ2 H8266	48.51	86.75
SAMSUNG			
	GALAXY S10 SM G730 Chinese model	93.5	167.6
	GALAXY S10 UE Model SM-G973F	93.4	167.5
	GALAXY S7 SM-G930F	24.02	0
	GALAXY S8 NXP CLF+eSE SM-G9500	93.84	150.75
	GALAXY S8+ Chinese model SM-G9550	93.71	164.45
	GALAXY S9 G900 LAT Model NXP CLF	93.8	166.75
	GALAXY S9 SM-G960 UE Model	93.2	167.3
	NOTE 8 SM-N950F	86.06	156.25
	S10 SM-G973F	91.7	162.3
	S6 Edge SM-G925F	2.48	0
	A41 SM-A415F	43	74
	A50 SM-A505FN	47	85
	A51 SM-A515F	43.1	77.75
	TAB A	37.69	64.88
	GALAXY A5 SM-A520F	35	0
	GALAXY S8 SM-950F	69.3	74.7
OPPO			
	RX17 PRO CPH1877	47.4	84.2
ONE +			
	A5000	48	90
	ONE + 6 A6003	62.22	85.22
MOTOTROLA			
	Z2 PLAY Dual XT1710-09	7.26	0
LG			
	K20 X120EMW	2.05	0
HUAWEI			
	NEXUS 6P	19.9	0
	P10	30	32
	P20 - EML L29	19	32
	P Smart+ 2019 POT-LX1T	16	0
	P 30 ELE-L29	60	105
	MATE 20 LITE	22.3	0
GOOGLE			
	PIXEL 2	48.73	85.9
	PIXEL 3 2018	48.7	75.3
APPLE			
	IPHONE 7 MN8X2ZD/A	22.11	28.31
	IPHONE 8 MQ6V2LL/A	24	38.3
	IPHONE 11 MWLT2CN/A	15.8	40.03
	XR MRYU2VC/A	24	40.06
	XS MT9H2ZD/A	24	40.02
	XS MAX MT522ZD/A	24.05	38.2
	12	23.2	39.68

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

DATA THROUGHPUT UPLOAD 1M/ 2M			
SUPPLIER	MODEL	1M_	2M_
XIAOMI			
	MI MIX3	43	80
	MI10M2001J2G	55	55
	MI8	42	74
	REDMI M2004J19AG	27	39
	REDMI NOTE 8 M1908C3JG	16.75	0
	REDMI NOTE 8 PRO	27.11	0
	MI5 MXB48T	31.5	0
SONY			
	XPERIA DOCOMO SO-04J	38.2	52.2
	XPERIA 10 I4113	48.21	75.29
	XPERIA XZ2 H8266	48.51	86.75
SAMSUNG			
	GALAXY S10 SM G730 Chinese model	42.6	76.7
	GALAXY S10 UE Model SM-G973F	43.3	76.2
	GALAXY S7 SM-G930F	23.79	0
	GALAXY S8 NXP CLF+eSE SM-G9500	48.72	48.98
	GALAXY S8+ Chinese model SM-G9550	51.32	50.2
	GALAXY S9 G900 LAT Model NXP CLF	42.8	76.2
	GALAXY S9 SM-G960 UE Model	42.66	57.4
	NOTE 8 SM-N950F	35.15	37.1
	S10 SM-G973F	46.18	79
	S6 Edge SM-G925F	2	0
	A41 SM-A415F	70	74
	A50 SM-A505FN	46	46
	A51 SM-A515F	46.1	47.2
	TAB A	48.28	57.26
	GALAXY A5 SM-A520F	28	0
	GALAXY S8 SM-950F	42.4	46.4
OPPO			
	RX17 PRO CPH1877	42.8	61.2
ONE +			
	A5000	48	46
	ONE + 6 A6003	62.75	84.14
MOTOROLA			
	Z2 PLAY Dual XT1710-09	7.23	0
LG			
	K20 X120EMW	0.87	0
HUAWEI			
	NEXUS 6P	42.02	0
	P Smart+ 2019 POT-LX1T	2.6	0
	P10	30	31
	P20 - EML L29	31	31
	P 30 ELE-L29	47	78
	MATE 20 LITE	8.08	0
GOOGLE			
	PIXEL 2	49.3	85.2
	PIXEL 3 2018	42.4	74.6
APPLE			
	IPHONE 11 MWLT2CN/A	15.7	39.15
	IPHONE 7 MN8X2ZD/A	21.8	30.87
	IPHONE 8 MQ6V2LL/A	23	39.95
	XR MRYU2VC/A	23	38.85
	XS MT9H2ZD/A	23	40.1
	XS MAX MT522ZD/A	23.4	39.26
	12	23.4	39.02

DATA THROUGHPUT_UPLOAD PHY 1M/2M

Figure 39. Connection interval and supervision timeout summary

Revision history

Table 6. Document revision history

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

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IMPORTANT NOTICE – PLEASE READ CAREFULLY