



Low Energy Innovator Suite: Summary Report

XYZ CORPORATION SMART DEVICE

MAY 1, 2015

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1. Overview

The following evaluation includes functional and interoperability testing of the XYZ Corporation Smart Device. Frontline's experienced test engineers and subject matter experts leverage Frontline tools to find critical interoperability issues and help our customers solve them. Over-The-Air (OTA¹) captures give our customers a great view of what is happening in each unique RF environment and Frontline's powerful ComProbe Analysis System will help interpret this data and point the user in the right direction.

This report provides an overview of the BPA Low Energy test tool, as well as examples of the types of data Frontline Services can provide to you.

1. See Appendix 5.1 for a glossary of common acronyms used in this report.

2. Test Bed

The following devices and applications were used in the execution of this report¹:

- ComProbe Bluetooth Low Energy Protocol Analyzer
- ComProbe Analysis System – SW version 14.12.5943.6007
- XYZ Smart Device – SW version 0.1.2.3.4
- Nordic nRF Master Control Panel – SW version 2.1.1

BLE Devices:

Role	Make	Model	SW Version	Inventory #
DUT	Company XYZ	Smart Device	N/A	18-53-001
IOT	Apple	iPhone 4S (A1387)	8.1.2	01-01-006
IOT	Apple	iPhone 6 (A1586)	8.1.3	01-01-038
IOT	HTC	One (PN07200)	5.0.2	01-03-084

1. See Appendix 5.2 for details.

3. Executive Summary of Results

The following section is a high-level summary of testing results based on performance expectations indicated by customer-provided values, industry standards, and protocol standards set forth by the Bluetooth Special Interest Group.

The XYZ Corporation Smart Device and XYZ iOS application operated with each other as expected. The application is purpose built; the DUT is not a generic BLE device and does not work with existing applications other than the XYZ application. The DUT will operate with Apple iOS versions 7.0 or later, there is no Google Android support as of the writing of this document. The DUT did not pair with the HTC One reference device.

The XYZ Corporation Smart Device appears to always be ON and advertising at a constant rate. There is a projected 1 week battery life on a single charge; this number may improve if the advertising scheme is altered in a way that allows the Smart Device to vary advertisement rates based on DUT activity and/or connectivity.

3.1 Application

Application support has been determined as follows:

OS Version	XYZ App	3 rd Party App
iOS 7.x +	YES	N/A
Android 4.3.x +	N/A	Partial

OS 1: Android:

The DUT did not bond with the HTC One reference device. Pairing was rejected by the DUT¹.

Android support is not offered by the XYZ Smart Device.

OS 2: iOS

The iOS application operated as expected without abnormalities. The user interface displayed properly on all interoperability devices.

Data transfer between the Smart Device and XYZ application takes approximately 6 seconds. This becomes an issue if wanting to use the XYZ Smart Device continuously without pause. Due to the 6 second delay, continuous use and feedback is not possible.

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1. See Appendix 5.3: Figure 1 for details.

3.2 Discovered Services

The DUT supports 5 GATT services:

- Short UUID: Generic Access Profile [0x1800]
- Short UUID: Generic Attribute Profile [0x1801]
- Short UUID: Device Information [0x180a]
- Short UUID: Battery Service [0x180f]
- Short UUID: Unknown UUID [0xad04]¹

Short UUID 0xad04 – Unknown 16 bit UUID may be in conflict with future BT SIG defined services.

3.3 Observed Failures

Failure 1: Battery Service Failure

The battery level displayed in the XYZ application² does not match with the level observed in the ComProbe Analysis System OTA³.

In this example, the application (Master) reads the battery level every 30 seconds – it is reporting the battery level at 45% when the OTA shows a battery level of 70%⁴.

1. See Appendix 5.3: Figure 2 for details.

2. See Appendix 5.3: Figure 3 for details.

3. See Appendix 5.3: Figure 4 for details.
4. Reference OTA Capture File “15_XYZ_01 BAS Failure 1.cfa” for details.

4. Recommendations

The following section includes recommendations for future improvement or development of XYZ Corporation's smart device, based on observed issues, conflicts or failures.

4.1 Recommendation 1: Address Battery Service Failure

- BAS Profile failure has been observed (See Section 3.3)
- Frontline recommends addressing this issue immediately – user experience and data integrity are compromised if this service is reporting incorrectly.

4.2 Recommendation 2: BT SIG qualification

- Frontline can assist XYZ Corporation with Bluetooth SIG compliance as a consultancy service.
- There is a possible conflict with Bluetooth SIG requirements relating to the use of Short UUID 0xad04.

4.3 Recommendation 3: Comprehensive Interoperability Testing

It is recommended that XYZ Corporation partner with Frontline to execute testing against a wider selection of interoperability test devices.

Interoperability testing against a variety of operating systems and chipsets¹ will ensure that consumers of the XYZ Smart Device will maintain a consistent level of performance and user experience across all mobile devices on the market.

1. See Appendix 5.4 for details.

5. Appendix

5.1 Acronyms

- DUT: Device Under Test
- IOT: Interoperability Test Device
- IOP: Interoperability Testing
- BLE: Bluetooth Low Energy (Bluetooth Smart)
- OTA: Over The Air Capture (Sniff trace)
- GATT: Generic Attribute Profile
- BT SIG: Bluetooth Special Interest Group
- QDID: Qualified Design Identification
- UUID: Universally Unique Identifier

5.2 Resources

Frontline Resources

iPhone 4s (A1387)

- Inventory Number - 01-01-006
- iOS 8.1.2 (12B440)

iPhone 6 (A1586)

- Inventory Number - 01-01-038
- iOS 8.1.3 (12B466)

HTC One (PN07200)

- Inventory Number - 01-03-084
- Android 5.0.2

BPA low energy ComProbe

- Inventory Number - 08-04-001

Generic Application: Nordic nRF Master Control Panel (Google Play Store)

Customer Resources

DUT:

- XYZ Company Smart Device
- Inventory Number - 18-53-001
- Weight : 444 g
- Sensor : built in Tri-axial accelerometer
- Battery
 - Lithium Ion Polymer rechargeable battery
 - Charging time 1h via induction charging stand
 - Battery life : approx. 2000 operations, approx. 1 week of standby
- RF Protocol : Bluetooth[™] 4.0 2.4 GHz

XYZ Application:

- XYZ Application by XYZ Company
- Updated: Jan 01, 2015
- Version: 0.1.2.3.4
- Size: 128 MB
- Compatibility: Requires iOS 7.0 or later. Compatible with iPhone 4S, iPhone 5, iPhone 5c, iPhone 5s, iPhone 6, iPhone 6 Plus, iPad Wi-Fi (3rd generation), iPad Wi-Fi + Cellular (3rd generation), iPad Wi-Fi (4th generation), iPad Wi-Fi + Cellular (4th generation), iPad mini Wi-Fi, iPad mini Wi-Fi + Cellular, iPad Air, iPad Air Wi-Fi + Cellular, iPad mini 2, iPad mini 2 Wi-Fi + Cellular, iPad Air 2, iPad Air 2 Wi-Fi + Cellular, iPad mini 3, iPad mini 3 Wi-Fi + Cellular, and iPod touch. This app is optimized for iPhone 5, iPhone 6, and iPhone 6 Plus

5.3 ComProbe/Application Software References

Figure 1: Pairing Failure (OTA of the DUT sending the rejection message)

B...	Frame#	Side	Code	Fram...	Delta	Timestamp	Datasource
	1,253	1	Pairing Request	29		2/12/2015 2:30:29.79479...	0 - Bluetooth low...
	1,256	2	Pairing Failed	24	00:00:00.0...	2/12/2015 2:30:29.84378...	0 - Bluetooth low...
	2,935	1	Pairing Request	29	00:00:18.8...	2/12/2015 2:30:48.71037...	0 - Bluetooth low...
	2,938	2	Pairing Failed	24	00:00:00.0...	2/12/2015 2:30:48.75935...	0 - Bluetooth low...

Protocol Details (Left Pane):

- CP #1
 - Channel Index: 15 - 2436 MHz
 - Meets Predefined Filter Criteria for BT low energy devices: No
 - Receive Status: Received without errors
 - Decryption Initiated: No
 - Signal Strength: 3 (weak)
 - PDU Length: 8
- LE PKT:
 - Preamble: 0xaa
 - Access Address: 0xaf9ab5ea
 - CRC: 0x61cd5d
- LE DATA:
 - LLID: Start
 - NESN: 0
 - SN: 1
 - MD: 0
 - Payload Length: 6
- L2CAP:
 - PDU Length: 2
 - Channel ID: 0x0005 (LE Security Manager Protocol)
- SMP:
 - Code: Pairing Failed
 - Reason: Pairing Not Supported

Figure 2: GATT Services in CPAS

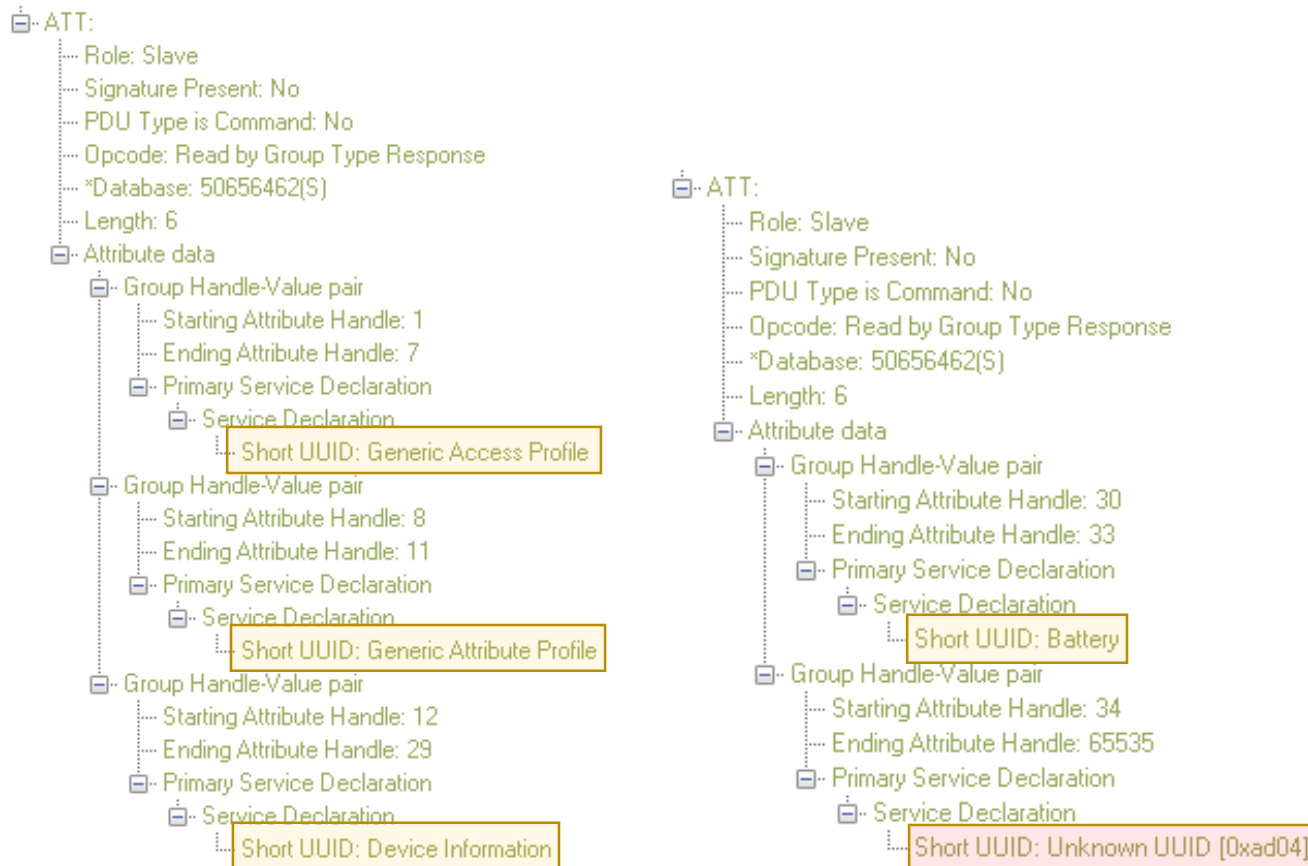


Figure 3: Battery Level in XYZ Application

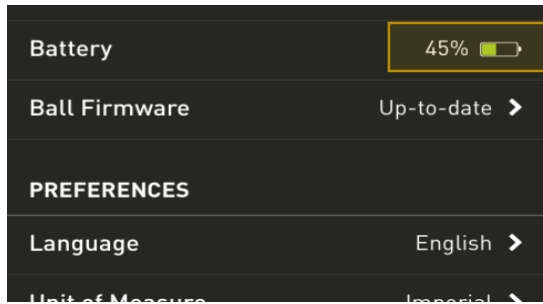


Figure 4: Battery Level in ComProbe Software

Signature Reason No	3,101	Slave	Read Response	54	Unknown UUID (0xad1f)	3
PDU Type is Command: No	3,172	Master	Read Request	32	Battery Level	3
Opcode: Read Response						
*Database: 506555e9(S)	3,175	Slave	Read Response	32	Battery Level	2
*Stored Handle: 32	3,187	Master	Read Request	54	Unknown UUID (0xad1f)	3
*Stored Attribute Type: Battery Level	3,190	Slave	Read Response	54	Unknown UUID (0xad1f)	3
Battery Level	3,275	Master	Read Request	54	Unknown UUID (0xad1f)	3
Battery Level %: 70	3,281	Slave	Read Response	54	Unknown UUID (0xad1f)	3

5.4 Recommended Future Interoperability Test Devices Table

Recommended Interoperability Test Devices				
01-01-003	Apple	iPhone 4 A1332	01 Phone	7.1.2
01-01-005	Apple	iPhone 4 MC676LL	01 Phone	7.0.3
01-01-006	Apple	iPhone 4S A1387	01 Phone	8.1.3
01-01-008	Apple	iPhone 4S A1387	01 Phone	8.2
01-01-019	Apple	iPhone 4S A1387	01 Phone	7.0.2
01-01-036	Apple	iPhone 5 A1428	01 Phone	8.1.2
01-01-017	Apple	iPhone 5 A1428	01 Phone	8.1.3
01-01-018	Apple	iPhone 5 A1429	01 Phone	8.3
01-01-024	Apple	iPhone 5S A1533	01 Phone	8.1.3
01-01-030	Apple	iPhone 5S A1533	01 Phone	8.2
01-01-031	Apple	iPhone 5S A1533	01 Phone	7.0.3
01-01-025	Apple	iPhone 5C A1532	01 Phone	8.2
01-01-040	Apple	iPhone 6 (A1549)	01 Phone	8.2
01-01-044	Apple	iPhone 6 (A1549)	01 Phone	8.3
01-01-042	Apple	iPhone 6+ (A1524)	01 Phone	8.1.2
01-01-041	Apple	iPhone 6+ (A1522)	01 Phone	8.2
01-01-045	Apple	iPhone 6+ (A1522)	01 Phone	8.3