REVISIONS			
REV	**DESCRIPTION**	**DATE**	**Engr.**
1.0	Initial Descriptions	10/16/19	EDG
1.1	Updated several sections	10/22/19	EDG
1.2	Updated several sections	11/10/19	EDG
1.3	Updated several sections	12/02/19	EDG
1.4	Add BLE NFC Toolbox sections	10/07/20	YW
1.5	Update BLE NFC Toolbox sections	01/05/21	YW
1.6	Update Appendix for new beacons	04/13/23	YW
1.7	Add Section 4 Beacon Configurator	04/17/23	YW
1.8	Update for Beacon Configurator	11/27/23	YW

MPACT Project: User Guide for Beacon Configurator Toolbox App

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1. Purpose

This document is a User's Guide for MPACT Beacon Configurator Toolbox App. This toolbox runs on Android devices to configure and scan Zebra's standard BLE beacons including the NFC-controlled SB1100. There is a separate User's Guide for MPACT Enhanced BLE Beacons ("Superbeacons") which is not covered in this user's guide.

1.1 Scope

This document will address the usage of each screen in the Beacon Configurator Toolbox. It will go into detail on setting up various parameters that the toolbox can set in each of Zebra's standard BLE Beacons (excluding the Superbeacon). It also will address how various parameters may affect the operation of the beacon and the best way to set these values considering the application the beacons might be deployed.

1.2 BLE and NFC Beacon Overview

Zebra Locationing Solutions deploys BLE and NFC-controlled beacons for various applications. The most com`mon are:

- Waypoint Beacons: These Beacons are used to define a geographical location. One might place a Waypoint Beacon in a patient's room in a hospital at a known location so whenever this beacon is heard by a BLE receiver, the location server will assume that the receiver is in or near the patient's room (i.e. near the waypoint beacon).
- Asset Beacons: Beacons attached to mobile assets such as carts, people, animals, tools, pallets, etc. When the location server receives information regarding these beacons it will use the nearby waypoint beacons or the BLE receiver to determine where the asset is located.

In a warehouse, one might deploy waypoint beacons at the start and end of each isle and maybe more in between. These waypoint beacons may all have the same UUID so that whenever the location server hears a certain UUID, it will treat it as a fixed or waypoint beacon. One might set the major field to be unique for all the waypoint beacons in a certain isle. To conserve battery life, the installer may set the chirp rate to a longer period to reduce the power consumption. The same is true for Asset Beacons. The user might select a different UUID for assets and use the major field to distinguish shopping carts from mobile ladders or pallets or even handle scanners. The user may set the chirp rate for the pallet and ladder to a longer period because these units don't move as often and thus might use a smaller beacon with a smaller battery.

To control these parameters, one must use the Beacon Configurator Toolbox, be near to the desired beacon, to read its current parameter settings, and change those settings if needed.

The following sections will describe in detail how to setup a standard BLE beacon by placing the Beacon in the connect mode and then allowing the Beacon Configurator Toolbox to connect to it to change its parameters. The NFC section shows how to configure the SB1000 type BLE beacons via NFC functions.Beacon Configurator Toolbox User's Guide

2. Beacon Configurator Toolbox User's Guide

This section will describe in detail how to use the Beacon Configurator Toolbox. The toolbox is not distributed as an open application. It is only available for Android and must be downloaded from the Zebra Support website. The screen below shows the how the BLE Toolbox app appears on an Android device once you have downloaded the app.
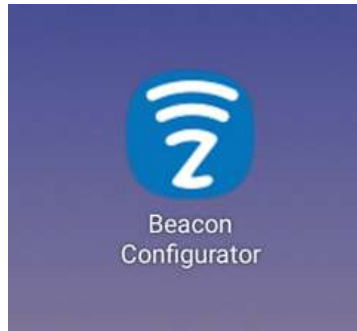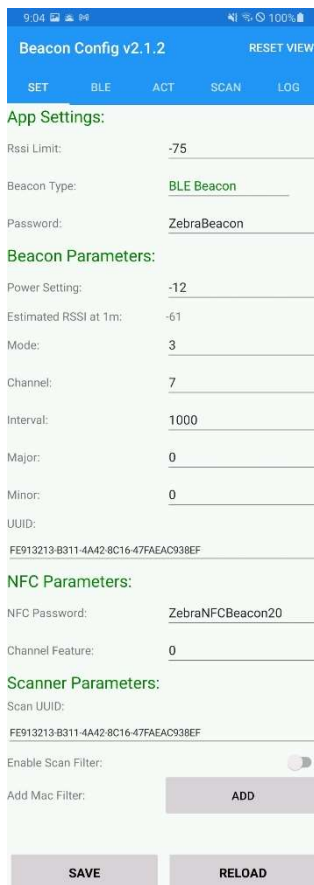

The Beacon Configurator Toolbox App has the following capabilities:

1. Read and Configure BLE Beacons
2. Read and Configure NFC Beacons
3. Perform BLE scanning for surrounding beacons
4. Logging user actions and any errors, on both UI and local file (a running activity log)

2.1 Settings Screen

When the Beacon Configurator Toolbox application is launched, the first window to pop up is the settings menu. This window is shown below.

The top banner shows the version of the Beacon Configurator Toolbox which for this screenshot is v2.1.2. One should occasionally check the Zebra Support website to see if there is a newer version (www.zebra/support). There are four sections in the settings page. Some of these settings are for controlling what the toolbox does and some represent parameters that can be pushed to a beacon. You cannot selectively change a parameter, so if you are changing one or more parameters, you must set the parameters you don't want to change to be the same values as those in the beacon you are updating. In other words, all of the parameters are updated with each configuration. This following section discusses each setting/parameter.

2.1.1 App Settings

This section is the setting for the Beacon Configurator Toolbox.

The "Save Permanent" button can save the current parameter values to the device, so the next time the app is open, these same values are loaded automatically.

The "Reload" button is to load the last saved parameter values.

2.1.1.1 RSSI Limit

This parameter is used by the toolbox to filter from the toolbox beacons that are below a certain RSSI level. This is so that if there are numerous other beacons in the area relative to the toolbox device, the toolbox will only pay attention to beacons whose RSSI is above the value in this field, which in this settings screen shows -75 dBm. Setting this value higher means only beacons closer to the Androind device (i.e. stronger/higher RSSIs) will interact with the application. You use this setting to control only configuring nearby devices.

2.1.1.2 Beacon Type

This parameter is used by the toolbox to configure either BLE beacon or NFC beacon (SB1100 type). It is required that the BLE beacon be put into the connectable mode before configuration so it will interact with the configurator app. The NFC beacon can be configured directly by tapping the Android device to the beacon.

When BLE Beacon mode is selected, two pages are presented: BLE and ACT. The BLE page shows all Zebra BLE beacons meeting the RSSI limits that are also in the connectable mode. When any of the beacons listed is tapped, the ACT page appears with that beacon's info and a list of actions that can be performed with the BLE beacon.

When the NFC Beacon mode is selected, the NFC page is presented, and a list of available actions for the NFC beacon are shown.

2.1.1.3 Password

This parameter is used by the toolbox to make sure there is no unintended change in the beacon parameters/configuration. The default password is **ZebraBeacon**. Entering the password is required before clicking the Save button or changing any beacon parameters. Once the current settings are saved, user needs to input the password again to change any beacon parameter. It is important to carefully manage this password like any other password using best security practices.

2.1.2 Beacon parameters

This section shows the beacon parameters that can be controlled by both BLE and NFC using this toolbox. These parameters can be pushed to a beacon via BLE or NFC.

2.1.2.1 Power Setting

This parameter is a beacon setting that selects the transmit power the beacon will use to transmit non-connect beacons ("broadcast mode"). Beacons support a range of power settings: most allow the user to set the power from +2 dBm to -21 dBm. This setting represents the TX power at the radio, it does not include any antenna gain and does not

consider any pads in the RF path. This is the RF signal level conducted from the BLE chip. So, if you set the TX power to +2 dBm and the beacon has an antenna gain of -5 dBm and a 10 dB pad, the actual TX power at the antenna is 2 dBm + ant gain (-5dBm) + pad (-10 dBm) = -13dBm: This is essentially the EIRP value. We have provided a table a the end of this guide to show these values are for each beacon type.

2.1.2.2 Estimated RSSI at 1m

This parameter is an estimation of the RSSI at a one (1) meter distance from the beacon. It is calculated based on the power setting, free space path loss and the beacon gain. This is a read-only value. It is not pushed to the beacon during configuration. This value can be used as part of a calculation to determine the distance a receiver is from the beacon.

2.1.2.3 Mode

The beacon software supports two different modes: iBeacon (2), MPact (3). iBeacon mode duplicates the Apple iBeacon packet format. MPact mode is the same as iBeacon except that one byte of the minor field is used to show the battery life. Setting a mode in the beacon must match the mode of the BLE receiver(s) configured to operate in and the Locationing Server. MPACT mode is compatible with iBeacon systems.

2.1.2.4 Channel

This channel variable allows the user to control which RF channels the beacon uses to transmit. This variable can be 0b000 to 0b111 (1-7). Bit zero represents channel 39, bit one represents channel 38 and bit 2 represents channel 37. If the bit is set, the beacon will be sent on that channel. If the bit is cleared, the beacon will not use that channel to send a beacon. Example: 0b010 (2) setting will have beacons only sent on channel 38.

2.1.2.5 Interval

The Interval setting is the time between beacon broadcasts/transmissions in msec. The minimal interval for iBeacon is 100 msec. One second would be 1,000msec. 2,500msec is 2.5 seconds. The max limit on the time is 10,000 msec or 10 seconds. The default value is set based on different beacon types. Shorter intervals consume more battery power than longer intervals.

2.1.2.6 Major

This is a two-byte field that the user can set to whatever is desired. One strategy might be to set this number to the same value for all Waypoint beacons in same area. Or you could set all the waypoint beacons on a given floor to the same value. This is a valuable concept because receivers have filters which allow them to only forward beacons they hear with restricted major fields. In this example the unique major setting for each floor helps receivers from forwarding beacons to the location server that are not on the same floor as

the receivers.

2.1.2.7 Minor

The Minor is the same type of field as the Major. In MPact mode, the Minor can only be set to 0. Some beacons also use the remaining byte in the minor field to transfer channel and version information.

2.1.2.8 UUID

This is a 16-byte field that normally is used to identify the iBeacon format and to associate a beacon with an institution or company like Zebra. There are filtering modes in the receivers and even the SuperBeacon that will use this field to control which beacons are forwarded to the location server. The UUID parameter can be set or modified in the field directly below the UUID variable. Normally the UUID is used to separate asset beacons from Waypoint Beacons. This is helpful for debugging issues with the locationing system.

2.1.3 NFC parameters

This section shows the parameters that is available in the NFC beacon. These parameters can be pushed to a beacon via NFC.

2.1.3.1 NFC Password

This parameter is used by the Toolbox and NFC beacon to encrypt and decrypt data during data exchanging. The default password is **ZebraNFCBeacon20**. It is required for all NFC actions. If the NFC password in the Toolbox does not match with the one in the beacon, NFC actions can not be performed correctly. NFC password can be changed in the NFC beacon. Carefully manage these passwords using best practices to ensure security and privacy.

2.1.3.2 Channel Feature

This channel feature can be set to 0 (disable, default) and 1 (enable). When the channel feature is enabled, the beacon broadcasts different, calibrated, BLE packets for different channels. Based on the channel calibration results, the RSSI at 1 meter values in the BLE packet will be different in different channels. This can be used to get more accurate RF power level determination and this better locate accuracy/precision. The channel index is also included in the BLE packet. Note that using this features increased battery power consumption.

2.1.4 Scanner parameters

This section shows the parameters that are used in the BLE scanner function. These parameters determine how the scanner operates and are not pushed to the beacon during configuration.

2.1.4.1 Scan UUID

This is a 16-byte field that is used to filter the iBeacon / MPact BLE packets. Only BLE packets have the matching UUID that is displayed on the SCAN page will appear in the scanner.

2.1.4.2 Enable Scan Filter

This is a toggle to enable the beacon MAC Filter. If the toggle is enabled, the SCAN page will only show beacons with the desired MAC address(es). See the section 2.1.4.3.

2.1.4.3 Add MAC Filter

User can add desired MAC addresses by clicking the ADD button. From the SCAN page, user can click the displayed beacon to copy its MAC address and then paste in the field. For detailed information, please refer to section 2.5.

2.1.5 Save Permanent and Reload Buttons

These buttons are used to save or recall the saved settings. If you are programming multiple beacons, you can set up all the parameters first and hit the "Save Permanent" button which will save the current values in the toolbox. You can continue to make changes to the settings and for other beacon types. Once you are finished with the minor changes, you can hit the "Reload" button and restore the current settings to those which you saved permanently.

2.2 BLE Beacons Screen

The BLE Beacons screen is shown below. It is only available when the Beacon Type setting is "BLE Beacon". This screen is used to see what beacons have connected to the toolbox. You need to connect to a beacon before you can read or write need parameters.
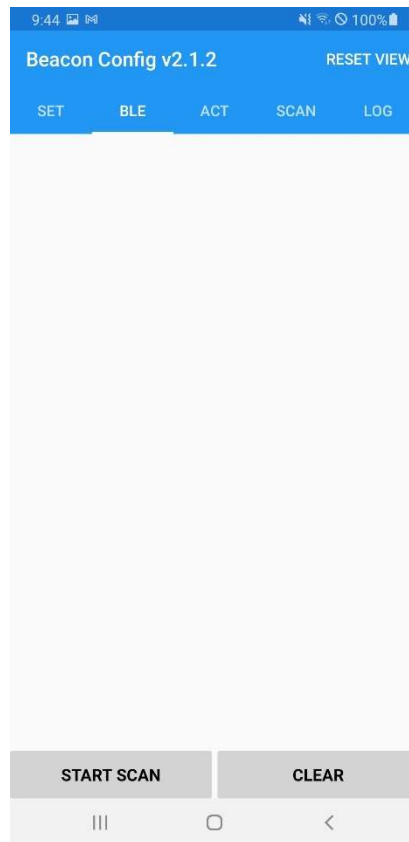

Right now, the screen is blank, the toolbox has not connected with any beacons. The first step to connect the toolbox to a beacon is to start the toolbox scanning.

2.2.1 Scanning

To put the toolbox in connect mode, touch the "Start Scan" button. This puts the toolbox into scan mode looking for a beacon to connect. Next, the user needs to place the beacon in the connect mode. All of our beacons enter the connect mode by holding down the button on the beacon and watching the LED blinking. At first, the LED blinks slowly. Releasing the button during this slow blink period places the beacon back into beaconing mode. After the slow blink is on for about five seconds, as the user continues to hold the button down, the blink rate will change from slow to fast. When this happens, you can remove your finger from the button and the beacon will go into connect mode. When the beacon is in the connect mode and the toolbox is in the scan mode, the toolbox will pair with the beacon.

2.2.2 Connecting the Toolbox to Beacon

The screen shot below shows beacons that are connectable to the toolbox. The MAC addresses of the beacons are shown on the left hand of the "BLE" screen.
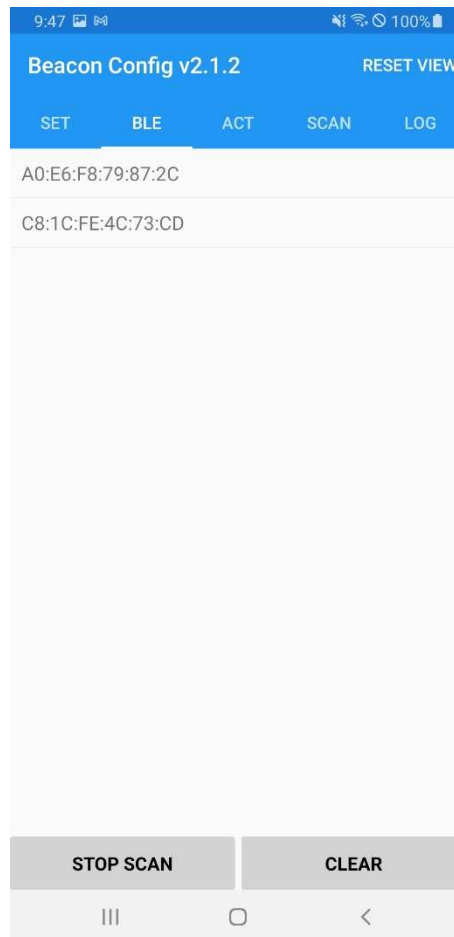
Notice that the "Start Scan" button has changed to "Stop Scan". You can use this to stop the capture process if desired. If not, you can continue to add more beacons to this list by performing the same connect button pushes described in the previous section.

2.2.3 Clear Button

This button can be used to clear the beacon list on the left.

2.2.4 Next Step - Action

You use this step to connect the select beacon to the toolbox prior to reading the contents or writing out new settings to a beacon. Once you find the beacon you want to read or modify, touch the ID on the left part of the screen of the beacon you want to work with, and the toolbox will take you to the "ACT" screen.

2.3 BLE Action Screen

This screen shot shows the BLE Action screen. It is only available when the Beacon Type setting is "BLE Beacon". This is used to read and configure the parameters in a beacon via BLE.
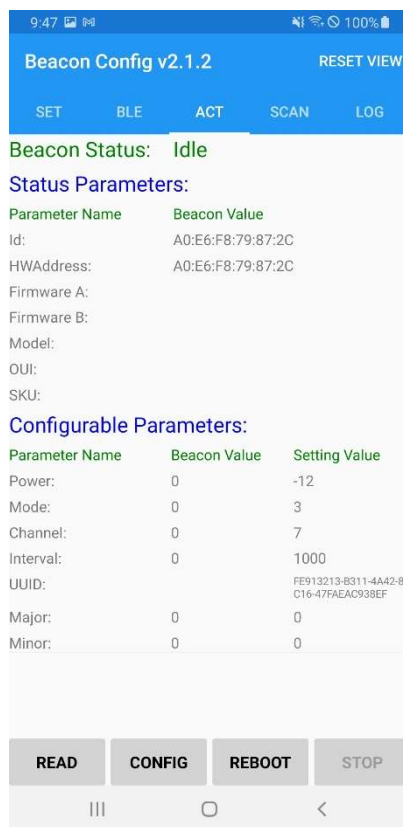
On the left side of this screen, you can see names of various parameters and status indicators. On the bottom banner, you can see the buttons "Read", "Config", "Reboot", and "Stop". Stop is not highlight because the current Beacon Status is "Idle". This button will highlight once one of the functions "Read", "Config" or "Reboot" are invoked. The Setting Value column displays the values that were setup when we started with the Settings screen. These values can be changed by going back to the Settings screen and changing the parameters on that screen.

2.3.1 Read Button

To read the parameters on the selected beacon, the user needs to touch the "Read" button. The screen below shows the results of reading the values from the selected beacon.
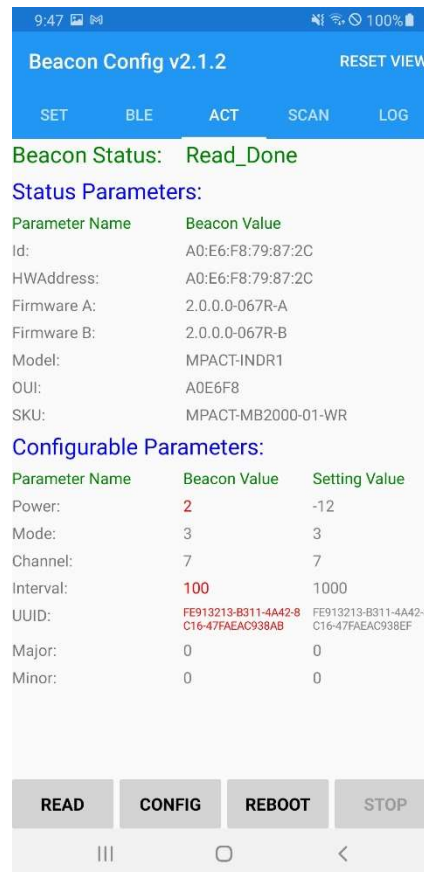
This section will review these columns and what they mean. Notice that after the "Read" was completed, the middle column became filled in and highlighted. The current Beacon Status shows "Read Done". Below the Read Done is the column header Beacon Value. This is separated into two parts, parameters that are fixed or cannot be modified by this screen and another Beacon Value section which has parameters that can be modified by this screen. To the right of this column is the values we initially set in the Setting screen. Notice that the values in red are parameters read from the beacon which do not match the parameters set in the Setting Value column. These beacon parameters will be updated to match those in the Setting Value column when the "Config" button is touched.

2.3.2 ID

This is a random number which the beacon has.

2.3.3 HW Address

This is the last three bytes of the MAC_ID. This beacon MAC_ID is B0:91:22:F0:19:E8.

2.3.4 Firmware A, Firmware B

There are two firmware images in the Beacon, an A image and a B image. This shows the version of each of these images.

2.3.5 Model Number

This is the model number of the Beacon which is "MPACT-INDR1. This is how the beacon is registered regarding Zebra's regulatory certifications.

### 2.3.6 OUI – Organization Unique Identifier

This is the first 3 bytes of the MAC_ID. This block of MAC_IDs were issued to Texas Instruments who design the BLE chip we are using. This beacon MAC_ID is A0:E6:F8:79:87:2C.

2.3.7 SKU – Zebra's Part Number

This field contains the Zebra part number for this beacon. There are many SKUs for this style of beacon but all of them share the same model number. The SKU difference can be in the software, the pad installed on the beacon or the logo or all three.

2.3.8 Config Button

The "Config" button is used to push the parameters shown in the Setting Value column on the right. When you invoke the "Config" command, the screen will be as shown below.
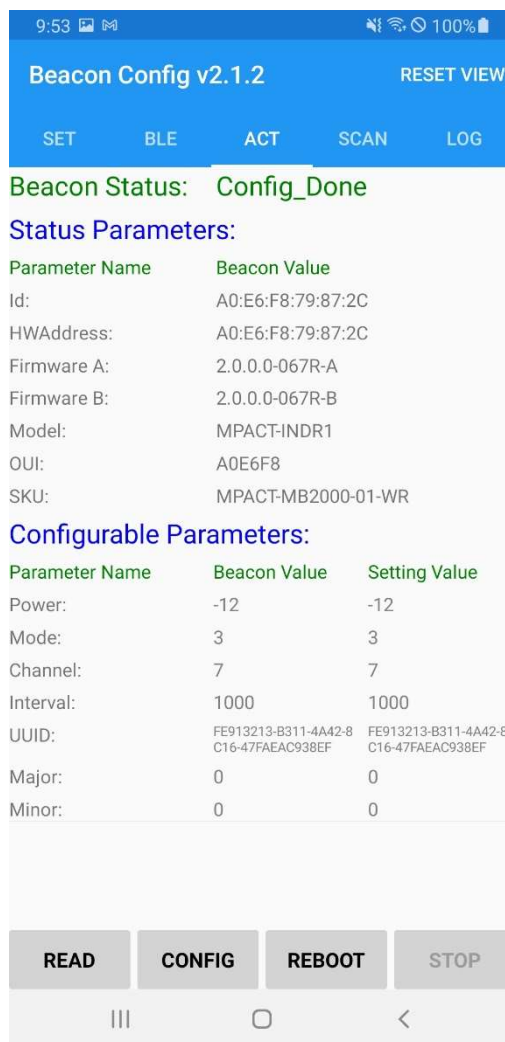

Notice the Beacon Status changes to "Config_Done". Also note that the values in the Beacon Value column now match the values in the Setting Value column. The toolbox will reboot the beacon after it has completed the configuration operation on the beacon. This places the beacon back into the beacon mode. You will need to go back to the scan "Beacons" screen to re-connect to the beacon and place the beacon back into the connect mode.

2.3.9 Reboot Command

This button will reboot the beacon shown on the screen. Once the beacon reboots, it will come up in the beaconing mode. You will need to go back to the scan "Beacons" screen to re-connect to the beacon and place the beacon back into the connect mode if you wish

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to update the Beacon settings.
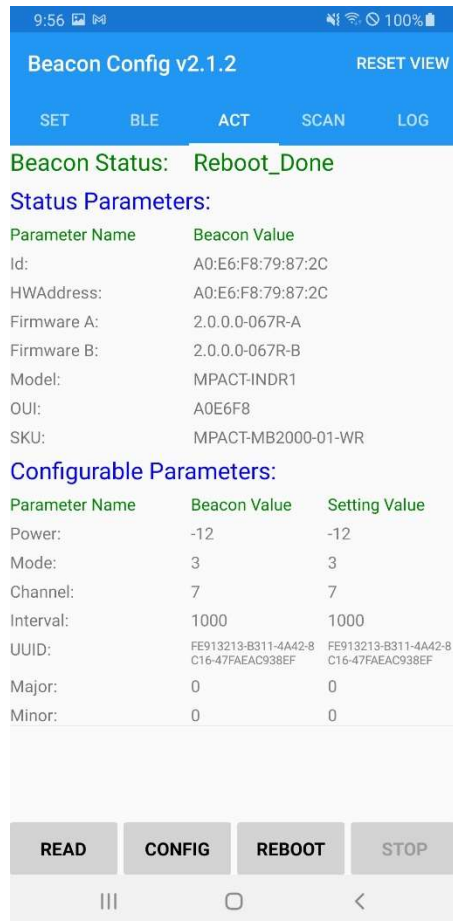
2.4 NFC Screen

This screen shot shows the NFC screen. It is only available when the Beacon Type setting is "NFC Beacon". This is used to read and configure the parameters in a beacon via NFC.

The default NFC screen is empty display without reading any NFC beacon.

On the bottom banner, you can see the buttons "Rd Parm" (Read Parameters), "Cfg Parm" (Config Parameters), "Rd Pw" (Read Password), "Cfg Pw" (Config Password), "BDcast"(Broadcast), "Sleep", "Clear" and "Stop". Stop is not highlighted because there is no NFC action started. This button will highlight once one of the functions is invoked.
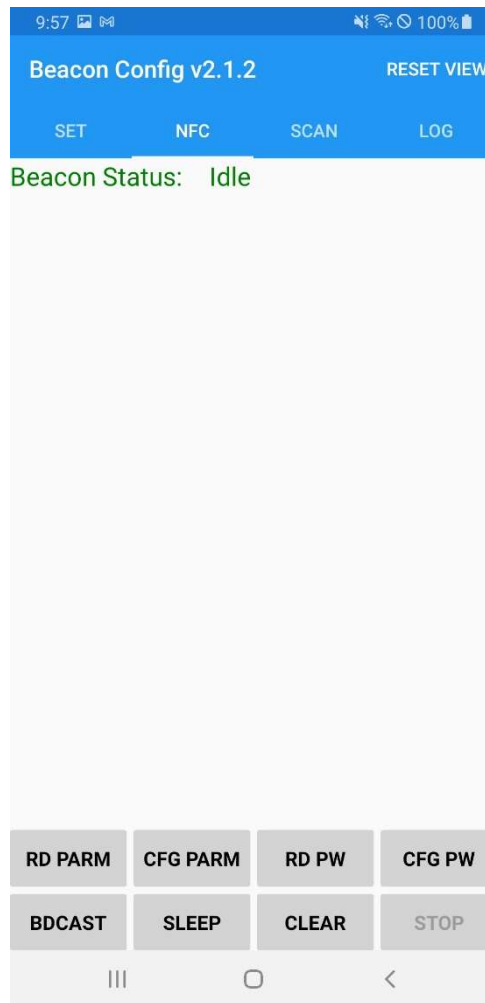
2.4.1 Read Parameter Button

To read the parameters on the selected beacon, the user needs to touch the "Rd Parm" button. The Beacon Status shows "Read Done". The screen below shows the results of reading the values from the selected beacon.
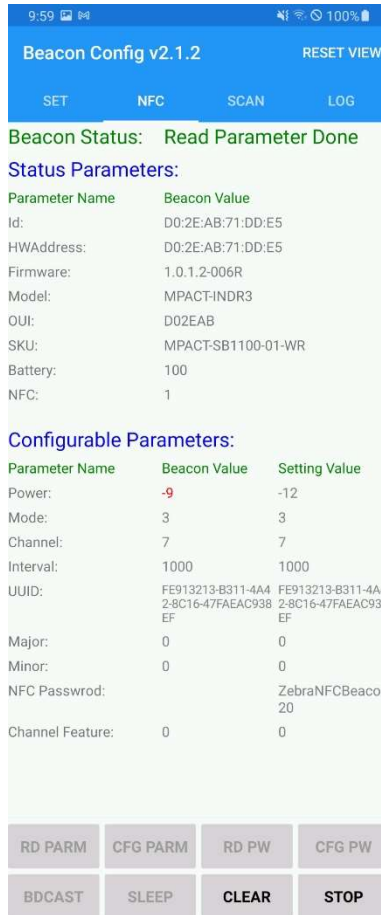
On the left side of the screen, you can see names of various parameters and status indicators. "Status Parameters" shows read-only parameters of the beacon. "Configurable Parameters" means changeable parameters.

For the "Configurable Parameters" part, the "Setting Value" column displays the values that were setup when we started with the Settings screen. These values can be changed by going back to the Settings screen and changing the parameters on that screen.

The parameter values under column "Beacon Value" are displayed in red when they are different with the values under column "Setting Value". After configuring and reading again, the colors will be changed to gray as others.

For Status Parameter ID, HW Address, Firmware A, Firmware B, Model, OUI, SKU, please refer to section 2.3.2 to 2.3.7.

Battery: Remaining percent of the current battery

NFC: NFC hardware is ready.

2.4.2 Config Parameter Button

To configure the parameters on the selected beacon, the user needs to touch the "Cfg

Parm" button. The Beacon Status shows "Config Parameter Done". The toolbox will reboot the beacon after it has completed the configuration operation on the beacon. This places the beacon back into the beaconing mode.

The screen on left shows the results of configuring the values to the selected beacon. The screen on right shows the results after reading parameter again.
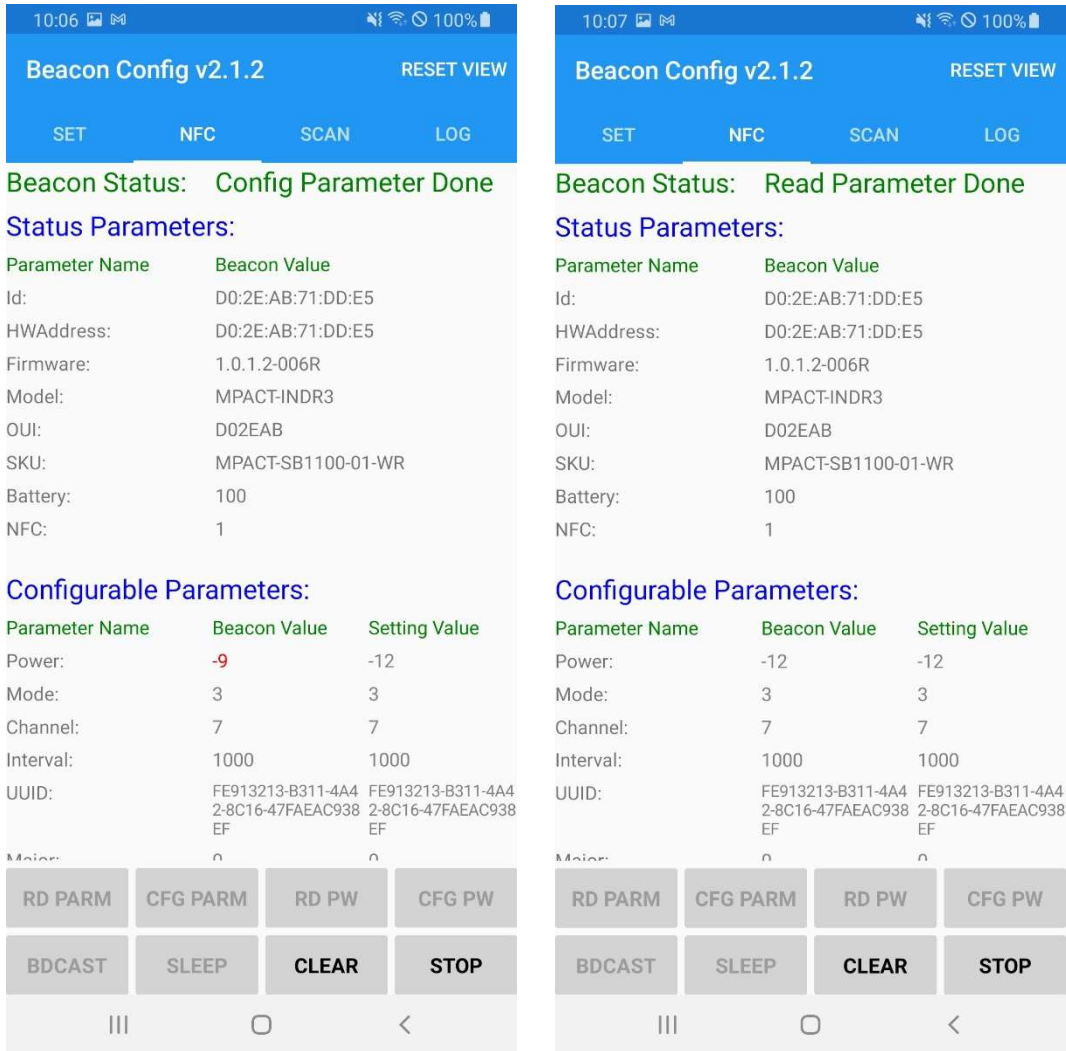

2.4.3 Read Password Button

To read the password on the selected beacon, the user needs to touch the "Rd Pw" button. The Beacon Status shows "Read Done". The screen below shows the results of reading the password from the selected beacon. The "NFC Password" row is updated. As it is different with the current settings, its value is displayed in red.

2.4.4 Config Password Button

To configure the parameters on the selected beacon, the user needs to touch the "Cfg Pw" button. The Beacon Status shows "Config Password Done". The toolbox will reboot the beacon after it has completed the configuration operation on the beacon. This places the beacon back into the beaconing mode.

The screen on left shows the results of configuring the password to the selected beacon. The screen on right shows the results after reading password again.
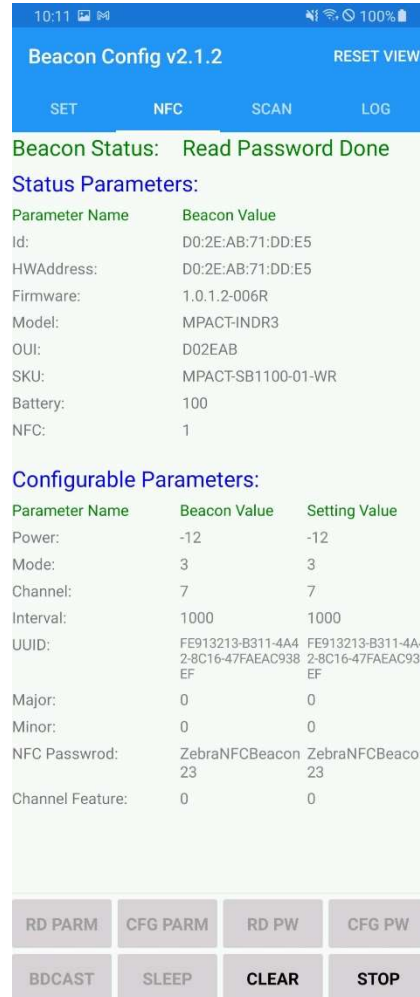
2.4.5 Broadcast Button

This button will reboot the selected beacon into the beaconing mode.

2.4.6 Sleep Button

This button will put the selected beacon into sleep mode. The beacon stops broadcasting and go into low power mode. The beacon will blink twice to acknowledge the action.

2.4.7 Clear Button

This button will clear the selected beacon on UI.

Note: even if there is no beacon displayed on UI, user can still configure parameters and password from the current settings to an NFC beacon by a NFC action.

2.5 BLE Scanning Screen

The BLE Scanner essentially uses the Androind BLE receiver to capture BLE beacon broadcasts and then for those meeting the scanner parameters display them in an activity window. On the Settings page, there is a section named "Scanner Parameters". The parameter "Scan UUID" is used to filter the beacon with interest.

Note:
User needs to stop the BLE scanning on the "BLE Beacons" screen before performing BLE scanning on this page. The "Scan UUID" can be different with the "UUID" under the "Beacon Parameters" section. The Androind BLE radio must be fully enabled.

There are 2 modes for the BLE scanning:
1. Scan MAC Filter is disabled, which is the default setting.
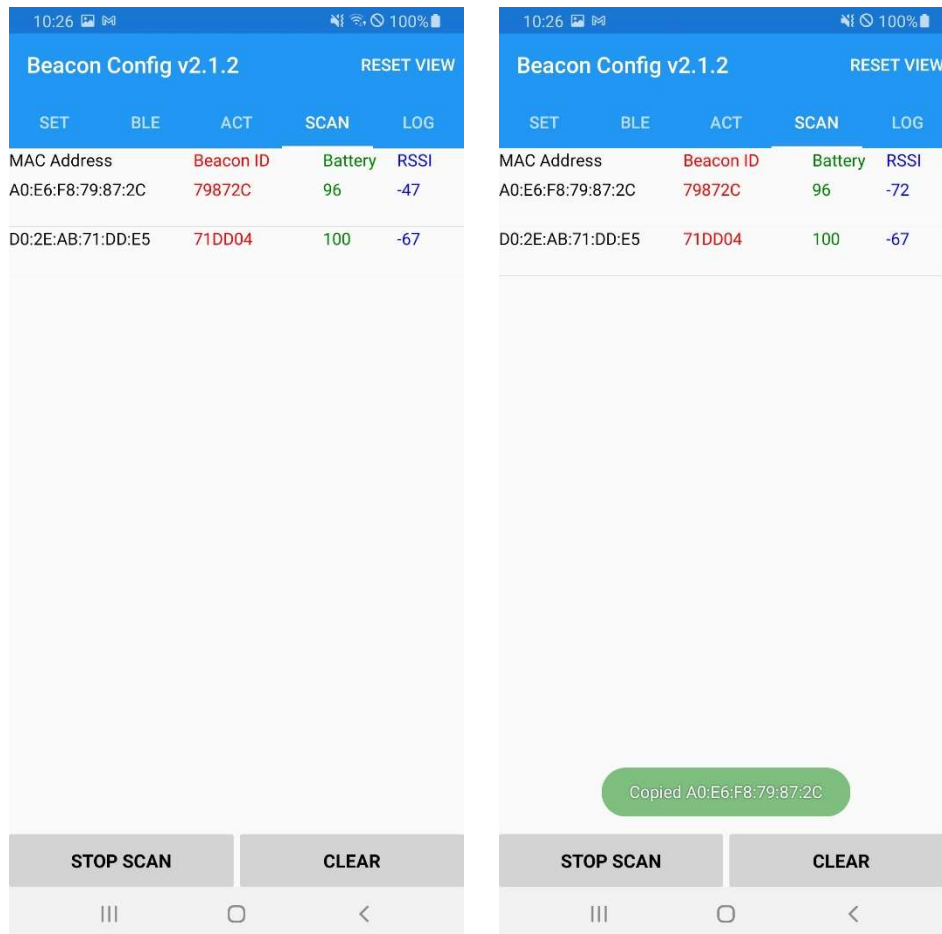2. Scan MAC Filter is enabled.
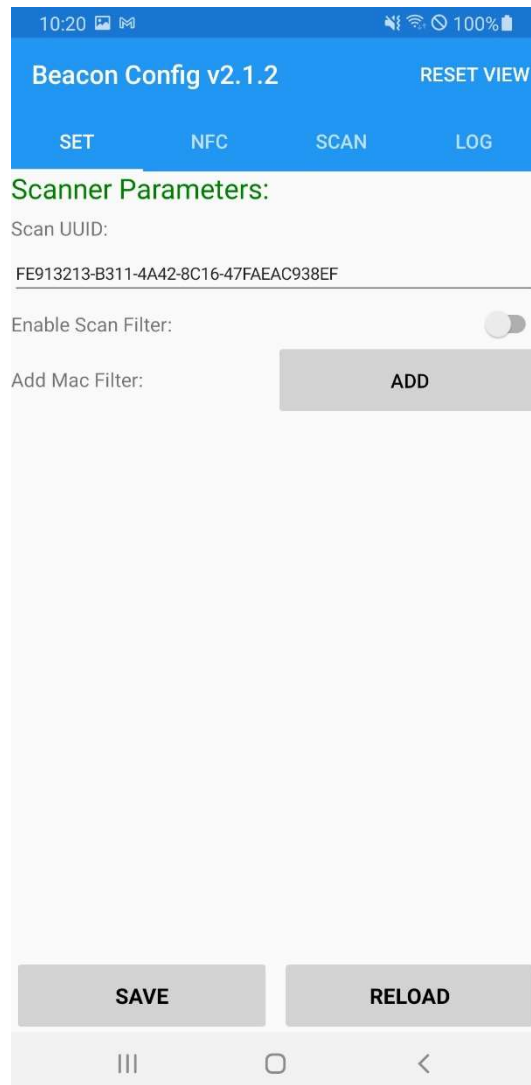
2.5.1 Scan without MAC Filter

In this mode, the scanner only uses the Scan UUID to filter beacons.

The app will show all the surrounding beacons that are broadcasting with the UUID.

User may click any beacon on the UI and its MAC address is copied.

2.5.2 Scan with MAC Filter

In this mode, the scanner filters beacons with UUID and MAC address list.

The copied MAC address from the Scan page can be used in the Mac Filter section of the Settings page.

User can tap the "Add" button, a MAC address field appears. User can then long press in the MAC address field to paste the copied MAC address. Or user may choose to manually add or edit the field. User can add more MAC addresses by tapping the Add button. User can delete the specific MAC address field by tapping the "-" sign in front of each field.

User also needs to turn on "Enable Scan Filter" option to enable the MAC Filter feature. User can turn this option off while keeping all the MAC address fields for later usage.
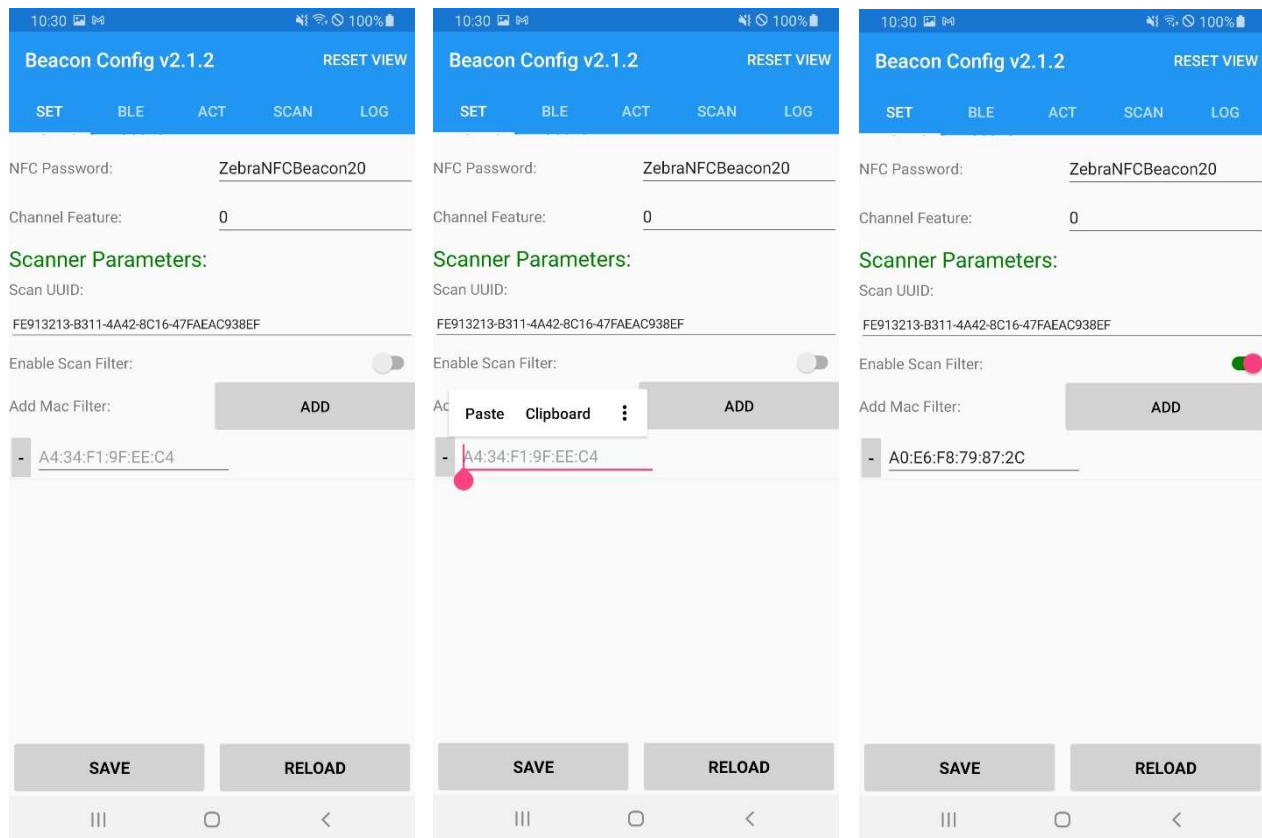
The image below shows the scan results with the MAC filter on:
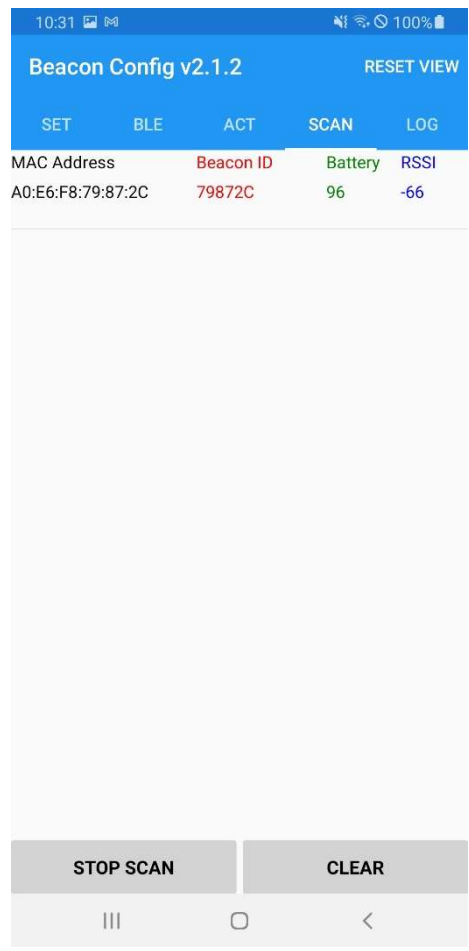
2.6 Logging Screen

Activity Log file and Log UI page capture and present records of all major app activity and actions. They can be used to verify the actions and results and are a record of activity.

On the Log UI page, the message in red means there is some error/or item to note.

Notes:

1. User can copy out the permanent log from the Android device:
   - \Download\BeaconConfigurator.csv

2. User can clear logs in the app

   - The permanent log file won't be deleted.
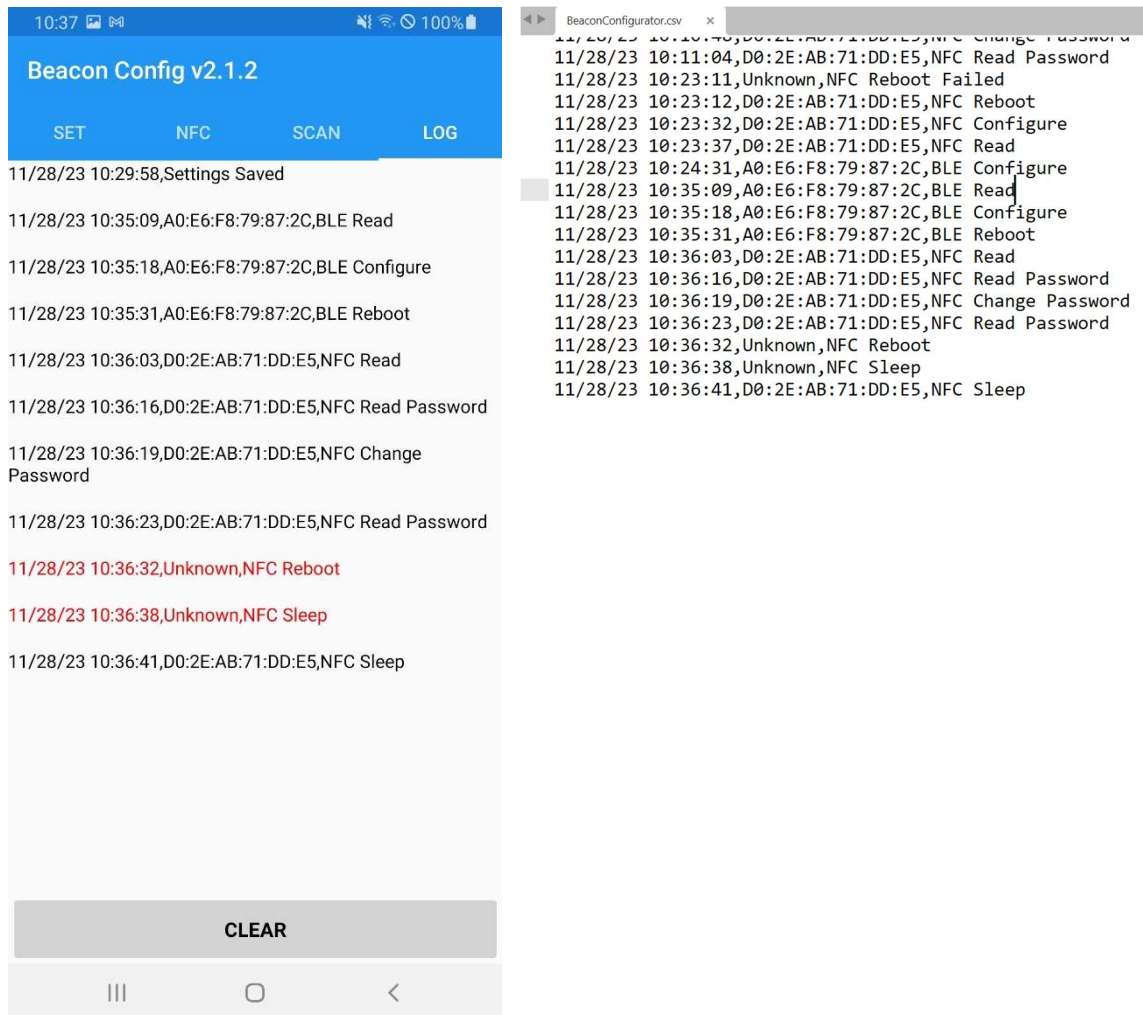
Appendix

Below are important parameters for each current Zebra Beacon SKUs.

Name	SKU	Antenna Type	Antenna Gain (dBm)	Pad (dBm)	RSSI at 1m power@ -21	RSSI at 1m power @ -5	UUID Last 4 Bytes	Default Chirp (ms)	BLE Power Default (dBm)	BLE EIRP Default (dBm)	BLE Power Min (dBm)	BLE Power Max (dBm)
Negril (ASSET)	GE-MB1000-01-WR	omni	1	-10	-78	-62	38EF	2000	-12	-21	-21	2
Montego (Indoor GE)	GE-MB2001-01-WR	Patch	-5	-20	-93	-77	38EF	200	-13	-38	-21	2
Outdoor GE	GE-MB4000-01-WR	Down (red)	-4.8	-10	-81	-65	38EF	200	-13	-27.8	-21	5
Negril MPact (ASSET)	MPACT-MB1000-01-WR	omni	1	-10	-78	-62	38DB	1000	-12	-21	-21	2
Indoor	MPACT-MB2000-01-WR	Patch	-5	0	-73	-57	38DB	100	-21	-26	-21	2
Indoor	MPACT-MB2001-01-WR	Patch	-5	-20	-93	-77	38DB	100	-11	-36	-21	2
Outdoor UPS	MPACT-MB4000-01-WR	Down (red) Patch	-4.8	-10	-81	-65	38DB	200	-13	-27.8	-21	5
Outdoor UPS	MPACT-MB4001-01-WR	Side (Black) Patch	-4.8	-10	-81	-65	38DB	200	-13	-27.8	-21	5

USB_US Only	MPACT-MB3000-01-WR	omni	-5.2	-10	-83	-67	38DB	100	-13	-28.2	-21	0
USB Beacon	MPACT-MB3100-01-WR	omni	-5.2	-10	-83	-67	38DB	100	-13	-28.2	-21	0
USB Hub	MPACT-MB3200-01-WR	omni	-5.2	-10	-83	-67	38DB	100	-13	-28.2	-21	0
Negril MPact Refurbished (ASSET)	MPACT-MB1001-01-U	omni	1	-10	-78	-62	38EF	2000	-12	-21	-21	2
Negril Renesas (ASSET)	MPACT-MB1101-01-WR	omni	-1	-16	-71.2	-56.2	38EF	2000	-13.5	-29.5	-19.5	2.5
Negril NFC (ASSET)	MPACT-SB1100-01-WR	omni	1	-10	-78	-62	38CC	2000	-12	-21	-21	2
SuperBeacon Two-Streams	MPACT-SB2100-01-WR	Patch	-5	0	-66	-51	38EF	1000	2	-3	-21	2