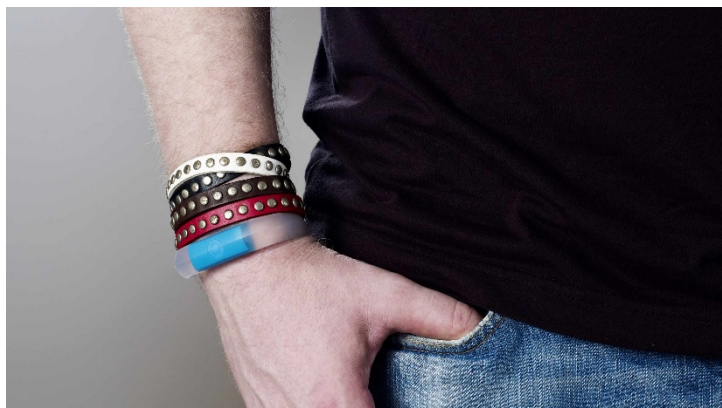


Embrace+ Behavior Understanding and Communication Protocol Definition

Version 3.0

**RKB Global Co. Ltd.
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Version Control

Version Number	Date	Modify By	Introduction
1.0	2013-9-16	Brian	
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1. BEHAVIOR UNDERSTANDING

1.1 EFFECT DEFINITION

Embrace+ is a device to execute a specific led and vibration effect and when it received notification executing effect command from smart phone (iOS6, iOS7, and Andriod) through BLE (Bluetooth Low Energy).

The effect includes two parts. One is led behavior, another one is vibration motor behavior.

Figure 1 shows the final effect regarding to the two LEDs and motor behaviors.

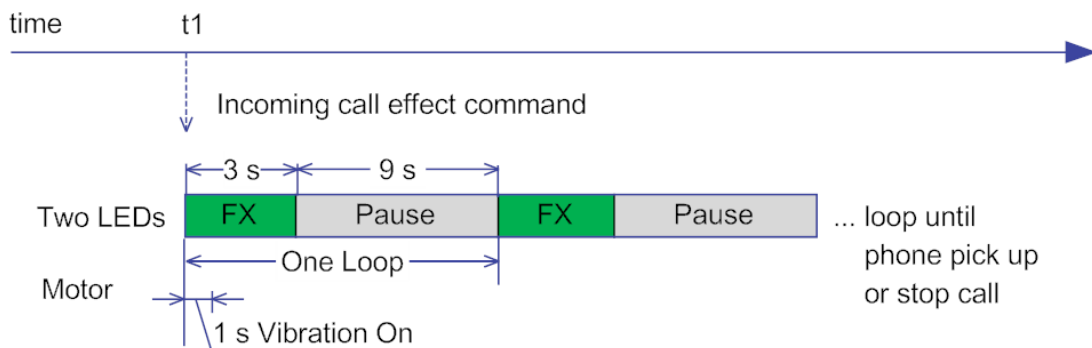


Figure 1 sketch map for example of incoming call final effect

From Figure 1, one led effect loop is made up of two parts, FX and Pause. And for each notification, it may have different loop times. The loop times is decided by phone itself. Please see Section 2 for more information.

1.2 FX EFFECT ATTRIBUTE

FX effect attribute is defined by D-Red (Table 1).

Table 1 Led FX Effect Attribute Definition

Attribute	Lenght	Description
fadeIn	1 Byte	duration of fadeIn (ms * 10)
hold	1 Byte	duration of constant color (ms * 10)
fadeOut	1 Byte	duration of fadeOut (ms * 10)
c1	1 Byte	LED 1 Color from
c2	1 Byte	LED 1 Color to
c3	1 Byte	LED 2 Color from
c4	1 Byte	LED 2 Color to
pause	1 Byte	Pause after effect in 10 ms
FLAGS	1 Byte	0x0 - Random 0: use C1..C4 1: show random colors AND ignore c1..c4
		0x1 - BlackOut 0: hold C2 / C4 color while Pause 1: switch off LED while Pause

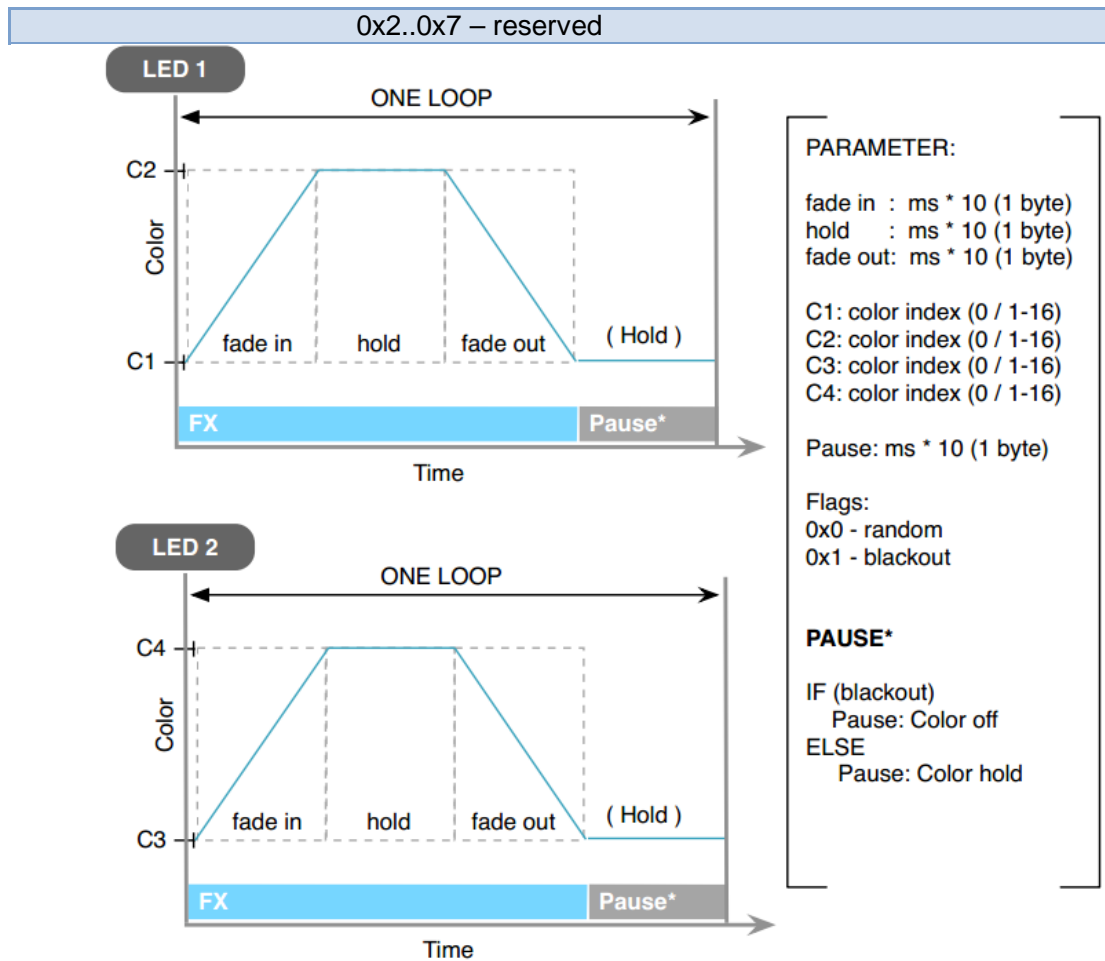


Figure 2 LED Behavior

2. COMMUNICATION PROCEDURE DEFINITION

2.1 BRACELET STATE MACHINE

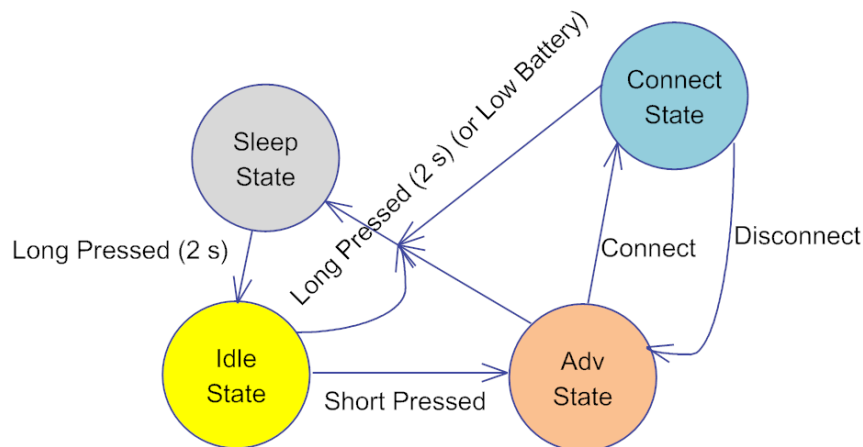


Figure 3 State Diagram

Figure 3 shows bracelet has 4 states. They are Sleep State, Idle state, Adv State, and Connect State. The state transition reasons are as followed:

- 1) Long Pressed (2 s): Press the key on bracelet for 2 seconds.
- 2) Low Battery: Press the key on bracelet for 2 seconds.
- 3) Short Pressed: Short Press the key on bracelet.
- 4) Connect: Received the connect request from phone side.
- 5) Disconnect: Due to out of range or other reason.

On phone side, then it shall scan the device automatically or by manually and if it found a bracelet is advertising, it shall send connect request automatically or manually to the bracelet. Then the advertising bracelet will enter connect state.

How to determine whether an advertising device was an embrace+ bracelet?
When a device scanned by phone, then it can read its advertising data. And if the advertising data contains 16-bit Service UUID = 0xFFC0, then the advertising device is a bracelet.

2.2 SERVICE REQUIREMENTS ON BRACELET

See Figure for Service Requirement and GAP Role Requirement.

Embrace+ Bracelet shall support both GATT Client and GATT Server, and GAP Peripheral. As GATT Server, it shall support DIS (Device Information Service), and BRS (Bracelet Service). When taken as GATT Client, the peer device must be iOS 7.

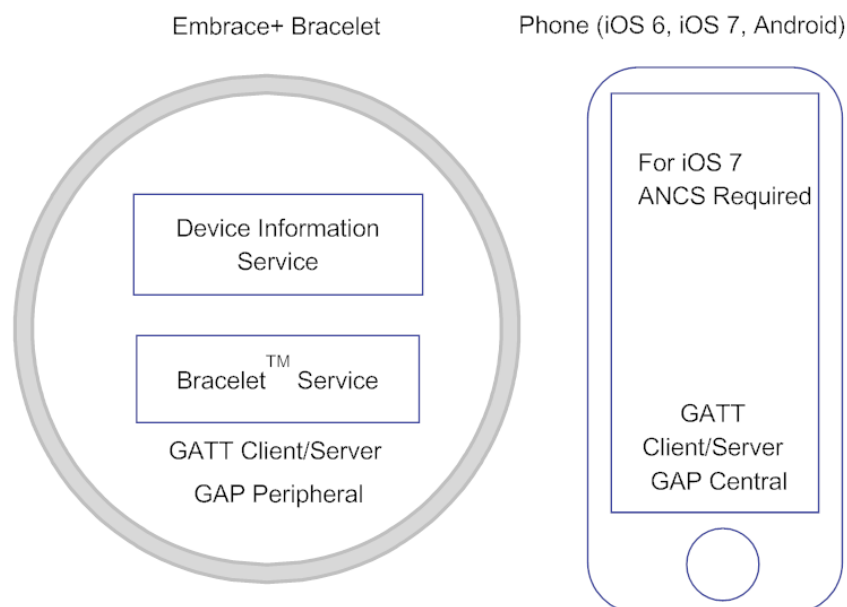


Figure 4 Service and GAP Role Requirement on Bracelet and Phone

On phone side, if the OS is iOS6, then it shall be a GATT Client and GAP Central, whereas the GATT server does need. For iOS7, both GATT Client and GATT Server shall support, and GAP Central is mandatory. For Android phone, just the GATT Client and GAP Central are needed.

DIS on bracelet can provide the phone its information about software, hardware, manufactory, etc.

Bracelet service is defined based on GATT standard. Its definition can satisfy to deliver the iOS6/7 notification event back to the background app. And it can also receive the effect from iOS6/7 and Android phone. See section 2.3 for more information.

2.3 DEFAULT EFFECT CONFIGURATION

Table 2 is the bracelet service defined by BDE to satisfy default effect configuration and send effect executing command configuration.

Table 2 Bracelet Service Definition

Service	Characteristic
Bracelet Service (UUID = 0xFFC0)	Peer OS Information (UUID = 0xFFC1) Property: Write
	Heart Beat (UUID = 0xFFC2) Property: Notify
	Upload Event (UUID = 0xFFC3) Property: Notify
	Effect Command (UUID = 0xFFC4) Property: Write
	Update Configuration (UUID = 0xFFC5) Property: Read,Write

FOUR characteristics defined in Table 2. They are:

1) Peer OS Information Characteristic

This characteristic responds for the phone's OS information collection. At the beginning of connection state, phone shall obtain its OS version and name and then write that information to *Peer OS Information* Characteristic.

The value for this characteristic is just null terminated string. The maximum length for the string is 20 characters (include the null character).

For iOS6, the value shall be "iOS6", and the length is 5 bytes.

For iOS7, the value shall be "iOS7", and the length is 5 bytes.

For Android, the value shall be "Android", and the length is 9 bytes.

2) Heart Beat Characteristic

The heart beat characteristic is used to send heart PDU to the phone to give its background app the chance to keep running. When phone becoming connected state and after it complete the services and characteristics discovery procedure, it shall enable *Heart Beat* Characteristic notification first. When *Heart Beat* Characteristic notification enabled, brace will start to send notification with one byte value = 0x01 to phone.

If app on phone side can keep running at background, then this notification enable procedure can be ignored.

From the BDE experiences, app keep running at background:

iOS6 need Heart Beat mechanism.

iOS7 need Heart Beat mechanism.

Android may not need.

3) Upload Event Characteristic

Upload Event is served for sending the iOS6/7 Notification Event back to the background app. When ANCS on Phone side send some iOS Notification to bracelet, the bracelet will send some relative information about the Notification to the background app through this characteristic.

The value for this characteristic is a null terminated string.

4) Effect Command.

The effect command characteristic is used for phone to send its wanted effect on bracelet. After received the command, bracelet will execute it by setting some specific LEDs effect and vibration effect.

The format for this characteristic is shown in Figure .

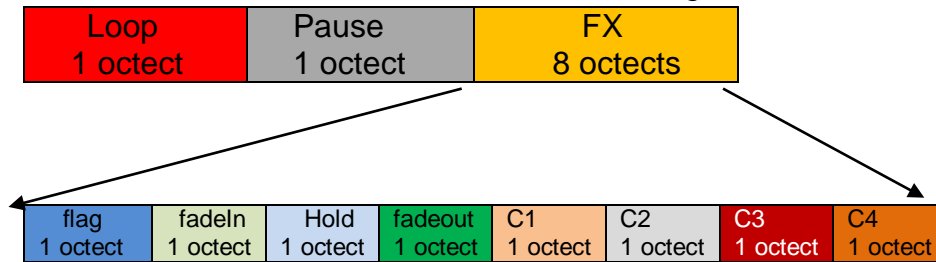


Figure 5 Effect Command characteristic value format

b7~b2 of flag field is reserved.

b1 of flag indicates the Random value

b0 of flag indicates the BlackOut value

Loop Times indicates effect timers

Pause indicates duration of pause (ms * 10)

fadeIn indicates duration of fadeIn (ms * 10)

Hold indicates duration of constant color (ms * 10)

fadeOut indicates duration of fadeOut (ms * 10)

C1 indicates LED 1, Color Index (0 / 1..16) 0 = no color

C2 indicates LED 1, Color Index (0 / 1..16) 0 = no color

C3 indicates LED 2, Color Index (0 / 1..16) 0 = no color

C4 indicates LED 2, Color Index (0 / 1..16) 0 = no color

cX (*X* = 1, 2, 3, 4) is a color index.

About color index definition, see Table 3 for detailed information.

Table 3 Color Index Definition

Index	Color	Index	Color
0	Transparent	9	Yellow
1	White	10	Green – Acid
2	Silver	11	Green
3	Pink – Light	12	Orange
4	Pink	13	Gold
5	Purple	14	Blue – Sky
6	Pink – Red	15	Blue – Light
7	Red	16	Blue
8	Red – Blood	NC	

5) Update Configuration

This characteristic is used by iOS7 to update the default configuration that defines the behavior when the Effect Command is not received on time to bracelet. But if the Effect Command is received on time, the bracelet behaves reference to the Effect Command. If the Effect Command is received out of time, the bracelet only behaves reference to the configuration and doesn't care the command.

The format for this characteristic is shown in following figure.

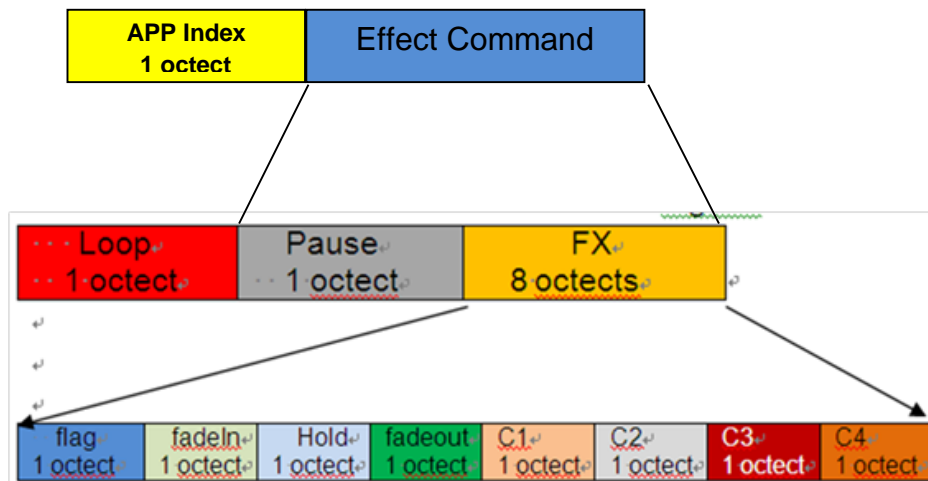
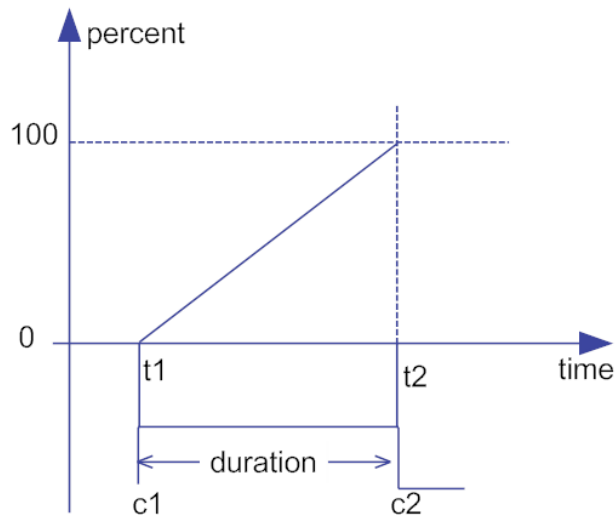


Table4 APP Index Definition

APP	Index
Incoming caller ID Incoming call	0x01
SMS	0x02
iMessage	0x03
Email (Gmail or any IMAP email account)	0x04
Calendar Reminder	0x05
Facebook	0x06
Twitter	0x07
Instagram	0x08
Tumblr	0x09
Skype	0x0A
LinkedIn	0x0B
Reserve	0x0C-0xFF

2.4 COLOR CHANGE EFFECT METHOD



$$C_{current} = \begin{pmatrix} r1 \\ g1 \\ b1 \end{pmatrix} * (1 - percent) + \begin{pmatrix} r2 \\ g2 \\ b2 \end{pmatrix} * percent$$

Figure6 Formula of color change rule

Figure shows the BDE understanding about how to implement the color change effect. Percent is zero at t1 (Completely c1 color), 100 at t2 (Completely c2 color). And the relationship between percent and time is linear.

2.5 SPECIFIC COMMUNICATION DEFINITION

The communication can be divided into three phases, see Figure . And the first 2 phases are mandatory for iOS 7. For iOS 6 and Android, just phase 2 and phase 3 are needed.

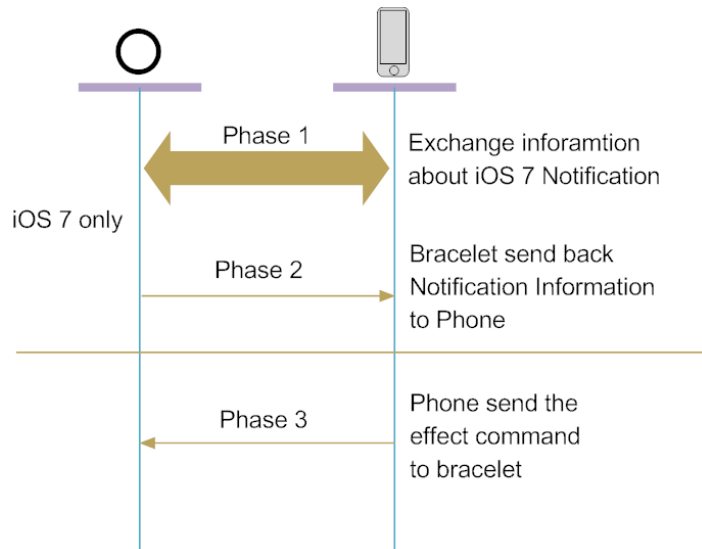


Figure 7 Three phases Flowchart

For iOS7, phase 1 is a procedure to exchange command and data between bracelet and iOS7 system. During this duration, the iOS7 app may need to keep silence in background. If iOS7 has generated a new Notification, then after completed this procedure the specific Notification Event has been gotten by bracelet. Bracelet will send the Event back to the iOS7 app through Phase 2.

Phase 1 will automatically complete, so the app in iOS7 does not know whether there was an activated communication.

Phase 2 is designed to send the Notification Event gotten in phase 1 to iOS7's background app. The air data format obeys the definition osBRS. Upload Event Characteristic Value. See section 2.3Default Effect Configuration.

Phase 1 and Phase 2 are a procedure to help iOS7 to know what new Notification generated.

When phone app knows there is new notification generated, it should get to know what the event is. iOS7 knows the event under the help of phase 1 and phase 2. However iOS6 and Android can know the new event directly. The two systems do not need phase 1 and phase 2 to get the Notification Event.

Phase 3 is used on phone side to send effect command by using the format of Effect Command Characteristic Format. See section 2.3 Default Effect Configuration for more information.

3 REFERENCE

- [1] Bluetooth 4.0 Core Specification.
- [2] Device Information Service Specification Adopted Version 1.0.
- [3] EMBRACE-Specification V2, RKB Global Co. Ltd.

4 APPENDIX

APP ID List

App Name	APP ID
Incoming caller ID	com.apple.mobilephone
SMS	com.apple.MobileSMS
Email	com.apple.mobilemail
Calendar Reminder	com.apple.mobilecal
Facebook	com.facebook.Facebook
Twitter	com.atebits.Tweetie2
Tumblr	com.tumblr.tumblr
Skype	com.skype.tomskype
Instagram	com.burbn.instagram
LinkedIn	com.linkedin.Linkedin