Application Note of
IS1678S Bluetooth Controller

ISSC Technologies Corp.

ISSC Technologies Corp.

Content

1. Introduction

This document gives the concepts when considering the application of IS1678S Bluetooth controller on SPP solution. IS1678S is a Bluetooth® controller complies with Bluetooth Core Specification v4.0, which supports BT3.0 BR/EDR and BT4.0 BLE dual mode. IS1678S is designed to connect with MCU through UART interface and several GPIOs. When communicating with the mobile device, IS1678S can auto-detect the standard SPP and MFi protocol and is able to switch between these different types of devices.

The first part of this document illustrates the overview on, and includes the block diagram, pin description, and definition of Bluetooth behavior modes. In Chapter.2, we focus on the UART interface since it is the main communication interface with MCU. In Chapter.3, we illustrate the control method of GPIOs, explain some function parameter related to E2PROM, and give some notes when utilizing BLE application. In the last chapter, we talk about some advanced topics you may be interested in.

1.1. Block Diagram

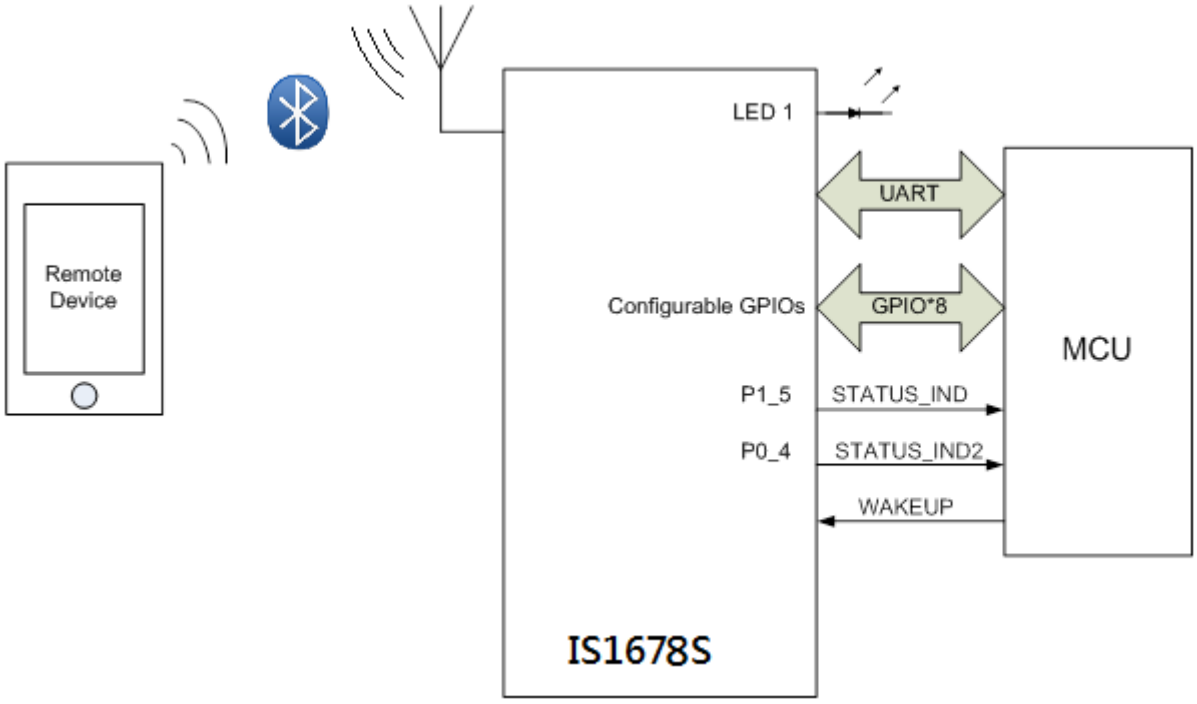


Fig1. IS1678S Block Diagram

1.2. State Machine Configuration

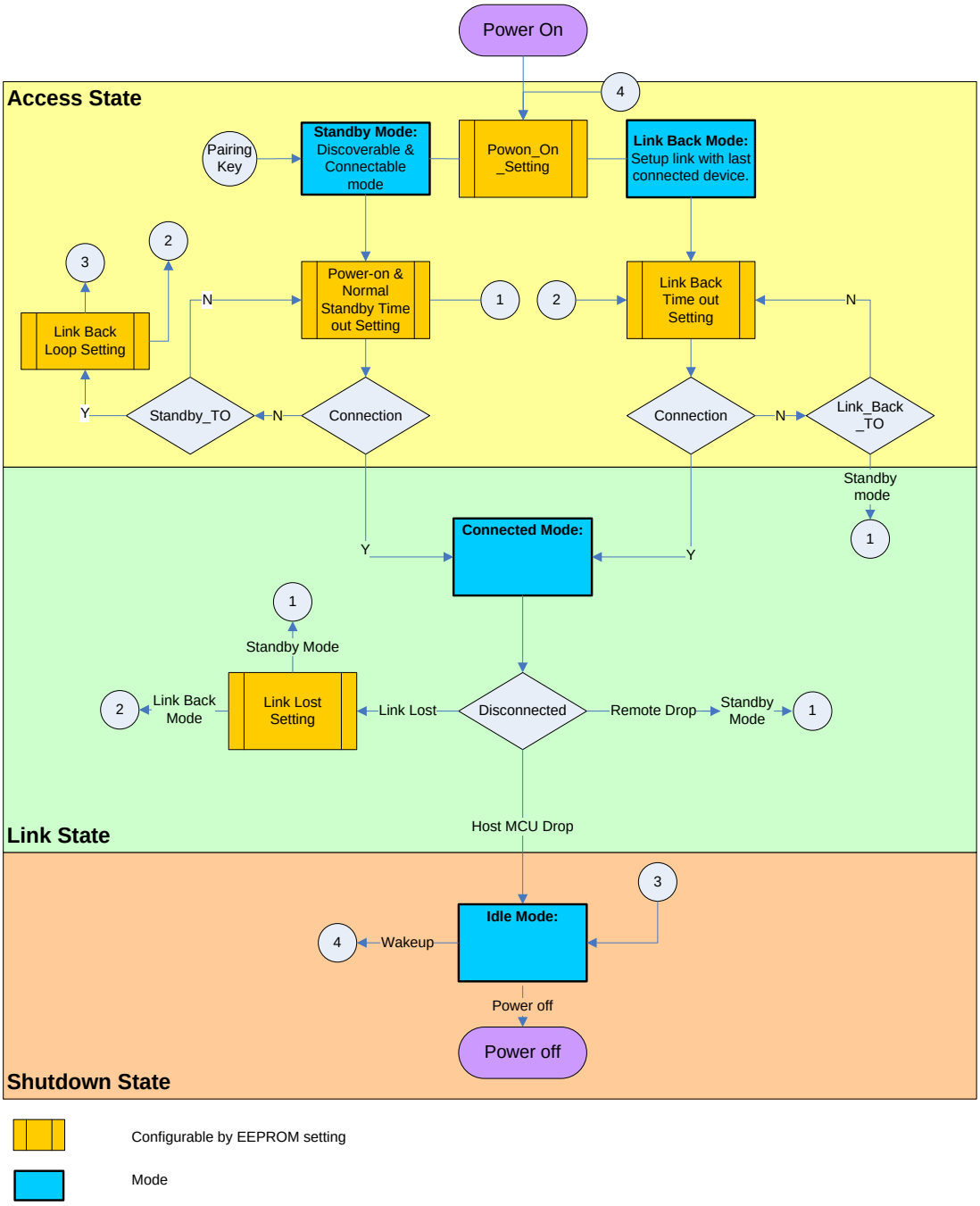


Fig2. IS1678S State Machine Diagram

1.3. State Definition

- **Access State**: is trying to setup Bluetooth Connection.
- **Link State**: is ready to exchange Host MCU UART traffic.
  - SPP: SPP link is established. (For Android 3.0)
  - BLE: BLE link is established and CCCD (Client Characteristic Configuration descriptor) of ISSC_SPP_TX characteristic is enabled. (For iOS/Android BLE)
- **Shut down State**: is shut down after Idle Mode.

1.4. BT Mode Definition

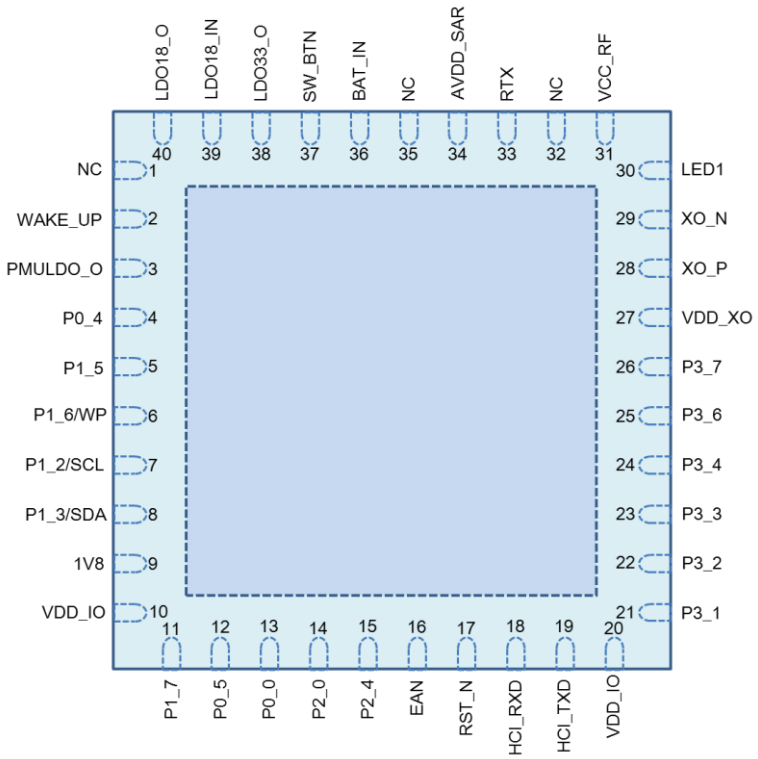
- **Idle Mode**: No any Bluetooth behavior.
- **Standby Mode**: is under Bluetooth discoverable and connectable mode. It can also be paired by another device in this mode.
  - Classic Bluetooth (BR/EDR): Enable the Inquiry Scan and Page Scan in this Mode.
  - Bluetooth Low Energy: Enable the Undirected Advertising in this Mode.
- **Link Back Mode**: tries to connect the last Bluetooth connection. can still be discoverable and connectable mode as an optional configuration.
  - Classic Bluetooth (BR/EDR): Enable Page Procedure to establish Bluetooth Link.
  - Bluetooth Low Energy: Enable Directed Advertising to allow the recorded host to setup Bluetooth Link.
- **Connected Mode**: Bluetooth connection is established successfully
  - Classic Bluetooth (BR/EDR): will use SPP protocol to exchange the application data.
  - Bluetooth Low Energy: will use GATT protocol to exchange the application data.

1.5. Supported Bluetooth Profiles

- Alternative Bluetooth v3.0+EDR and Bluetooth v4.0 Low Energy supported
- Embedded Bluetooth stack profiles included
  - BTv3.0: GAP, SPP, SDP, RFCOMM and L2CAP.
  - BTv4.0: GAP, GATT, ATT, SMP and L2CAP.
- Support iOS Core Bluetooth connection.
- Configurable GAP (General Access Profile) to meet different link establish scenario.
- Support peer to peer connection.

1.6. Pin Assignment

TABLE 2-1: IS1678S PIN DESCRIPTION



pin	Symbol	Type	Description
1	NC	NC	NC
2	WAKEUP	DI	Wakeup from shutdown mode (active low) (internal pull-up)
3	PMULDO_O	Power	Power management unit output. Connect to 1uF (X5R/X7R) capacitor.
4	P0_4	DO	UART_TX_IND: H: IS1678 indicate UART data will be transmitted out after certain timing. (Setting by UI@ “MCU setting”, default wait 5ms) L: Otherwise. STATUS_IND_2: IS1678 State indication , refer to P15
5	P1_5	DO	STATUS_IND_1: Bluetooth link status indication
6	P1_6/WP	DO	EEPROM WP (Do Not Connect)
7	P1_2/SCL	DO	I^2C SCL to EEPROM
8	P1_3/SDA	DIO	I^2C SDA to EEPROM
9	1V8	Power	1v8 input for digital Code power. Connect to 1uF (X5R/X7R) capacitor.
10	VDD_IO	Power	I/O positive supply input. Ensure VDD_IO and MCU I/O voltages are

			compatible. Connect to 1uF (X5R/X7R) capacitor.
11	P1_7	DIO	Configurable Control or Indication pin or UART CTS (input)
12	P0_5	DIO	Configurable Control or Indication pin
13	P0_0	DIO	Configurable Control or Indication pin or UART RTS (output)
14	P2_0	DI	System configuration (internal pull-up)
15	P2_4	DI	System configuration (internal pull-up)
16	EAN	DI	System configuration (internal pull-up) ROM :no connect Flash :must connect 4.7K ohm to GND
17	RST_N	DI	Module reset (active low) (internal pull-up) Apply a pulse of at least 63ns. Connect to 1uF (X5R/X7R) capacitor.
18	HCI_RXD	DI	UART data input
19	HCI_TXD	DO	UART data output
20	VDD_IO	Power	I/O positive supply input. Ensure VDD_IO and MCU I/O voltages are compatible. Connect to 1uF (X5R/X7R) capacitor.
21	P3_1	DIO	Configurable Control or Indication pin (when configured as input: internal pull-up)
22	P3_2	DIO	Configurable Control or Indication pin (when configured as input: internal pull-up)
23	P3_3	DIO	Configurable Control or Indication pin (when configured as input: internal pull-up)
24	P3_4	DIO	Configurable Control or Indication pin (when configured as input: internal pull-up)
25	P3_6	DIO	(Do Not Connect)
26	P3_7	DIO	Configurable Control or Indication pin (when configured as input: internal pull-up)
27	VDD_XO	Power	VDD for RF external 16MHz crystal. Connect to 1uF (X5R/X7R) capacitor.
28	XO_P	AI	Positive node for RF 16MHz crystal input.
29	XO_N	AI	Negative node for RF 16MHz crystal input.
30	LED1	DO	Status LED
31	VCC_RF	Power	Power input for VCO and RF. Connect to 1uF (X5R/X7R) capacitor.
32	NC	NC	NC
33	RTX	AIO	External antenna connection (50 ohm)
34	AVDD_SAR	Power	1v8 input for AVDD_SAR power. Connect to 1uF (X5R/X7R) capacitor.

35	NC	NC	NC
36	BAT_IN	Power	Battery Input. Main positive supply input. Connect to 10uF (X5R/X7R) capacitor.
37	SW_BTN	DI	Software Button H: Power On / L: Power Off
38	LDO33_O	Power	Internal 3.3V LDO regulator output. Connect to 10uF (X5R/X7R) capacitor.
39	LDO18_IN	Power	Internal 1.8V LDO regulator output. connect with LDO33_O
40	LDO18_O	Power	Internal 1.8V LDO regulator output. Connect to 1uF (X5R/X7R) capacitor.
41	EP	Power	Exposed pad as ground

Note 1: Pin type abbreviation: A = Analog, D = Digital, I = Input, O = Output

Definition of Configurable GPIOs:

Item	I/O	Name	Description
1	I	UART_CTS	UART Flow Control set HIGH, to disable TX transmitter. It can only be realized by P1_7.
2	O	UART_RTS:	UART Flow Control goes HIGH to disable host transmitter. Open data session indication- Go Low when APP session is ready. It can only be realized by P0_0.
3	I	Reserved	Reserved
4	I	LINK_DROP	Host_MCU ask to drop SPP link under Link State; One low pulse with 80ms duration low signal to trigger SPP disconnection. Otherwise it will be set as high always.
5	I	UART_RX_IND	L: Inform IS1678 that UART data will be transmitted out after few us. H: Otherwise.
6	I	PAIRING_KEY	
7	O	LOW_BATT_IND	L: Battery voltage is normal. H: Battery voltage is lower than e2prom setting value.
8	O	RSSI_IND	L: Received RF Signal Strength is weak H: Received RF Signal Strength is normal

* I : signal input pin
  O : signal output pin
  P : power pin
  I/O : signal input/output pin
  RP : RF power pin

1.7. BLE Fundamental

When two BTLE devices need to be connected, one is in a central role and the other in a peripheral role. The peripheral advertises its connection status, while the central device starts the connection process. Once connected, either end of the connection can initiate the bond. Once bonded, all security-related keys will be saved and the security process will be waived when reconnecting. The bonded peripheral device can only perform direct advertise; therefore, it is no longer able to connect to devices other than its bonded peer.

Similar to Bluetooth Classic, BTLE uses the concept of profiles to ensure interoperability between different devices. However, unlike Bluetooth Classic, BTLE profiles are a collection of services. All BTLE services are built on top of the Generic Attribute Profile (GATT), where GATT defines the accessibility of attributes, which are called characteristics.
Therefore, the main functionality of BTLE profiles is built around these characteristics. Devices that maintain the value of characteristics in a service are the "server" of the service. Conversely, devices that acquire data from their peer are considered the "client".

Each service and its characteristics are identified by their Universally Unique Identifier (UUID). The UUID can either be short form (16-bit) or long form (128-bit). All Bluetooth SIG adopted services and characteristics have a short UUID, whereas a user-defined private UUID must be in long form.
For information on the Bluetooth SIG adopted services and characteristics, visit the Bluetooth Developer Portal at:
https://developer.bluetooth.org/gatt/profiles/Pages/ProfilesHome.aspx.

2. UART Interface

IS1678S provides UART communication interface with MCU. This chapter describes UART interface and communication protocol between and MCU.

2.1. Pin definition

Name	Pin Define	Type	Description
UART_TX_IND	P0_4	Output	Inform Host MCU that UART data will be transmitted out after few us (Setting by EEPROM, default 5ms)

UART_RX_IND	Configurable	Input	Host MCU inform that UART data will be transmitted out after few us
UART_RTS	P0_0	Output	UART Flow Control High: UART flow stop Low: UART flow Go
UART_CTS	P1_7	Input	UART Flow Control High: UART flow stop Low: UART flow Go
UART_TXD	HCI_TXD	Output	
UART_RXD	HCI_RXD	Input	

2.2. Packet Format

The UART packet format is shown as below diagram.

	HEAD		**MID**	**DATA**	**CRC**
	START	**LENGTH**	**COM/Event.ID**	**COM/Event PARAM**	**CHKSUM**
BYTE NO	0	1 ~ 2	3	4 ~ XX	Length + 3
SIZE (BYTE)	1	2	1	0 ~	1
VALUE	0xAA	1 ~	COMMAND	DATA	CHK SUM
	SINC WORD	Check sum to be calculated			
			TARGET LENGTH		

Check sum rule: Summation of every byte after START WORD(LENGTH, COM.ID, COM PARAM, CHK SUM) is 0xXX00

e.g.

	START	**LENGTH(H)**	**LENGTH(L)**	**ID**	**PARAM**	**CHKSUM**
BYTE NO	0	1	2	3	4	5
VALUE	0xAA	0x00	0x02	0x01	0x00	0xFD

2.3. UART Setting

- UART supports baud rates from 1200 to 921600 bit.
- UART setting can be configured by E2PROM value change.
- System Configure Parameters:

- UART Baud rate setting:
- UART setting: Parity check

2.4. Support HCI UART mode

- Fix baud rate in 115200bps.
- Enter test mode for mass production and system configuration by E2PROM setting.

2.5. UART flow control

- CTS (P17) / RTS (P00) signal flow control scheme.
- UART flow control scheme can be configured by E2PROM setting.
- If UART_CTS sets flow stop while data transmission, will stop transmit, and that won't transmit more than two bytes after flow stop.

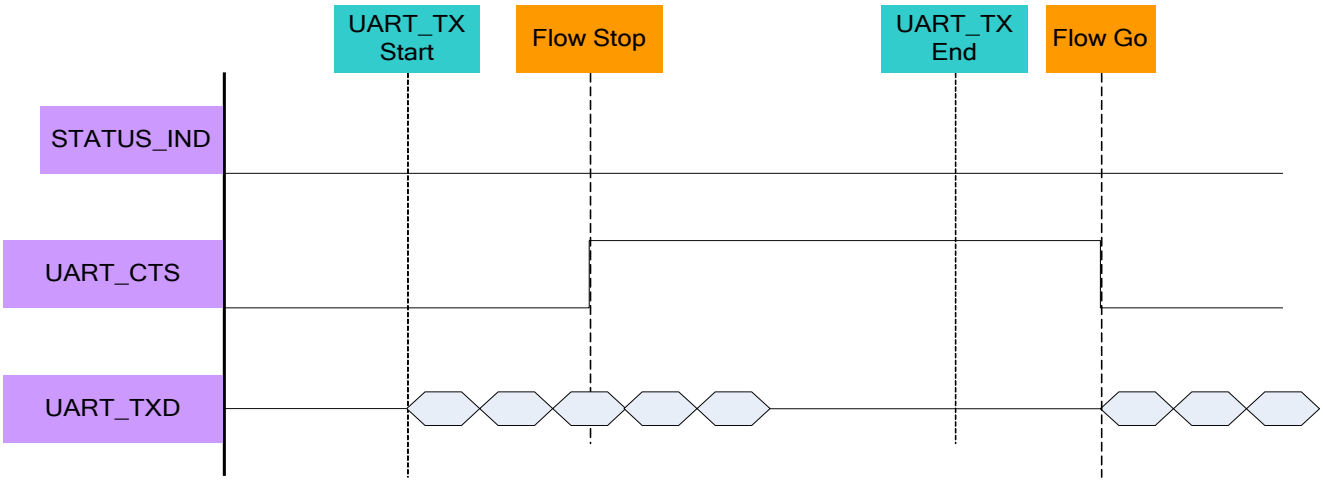


Fig.1. Host_MCU indicate UART flow control timing diagram

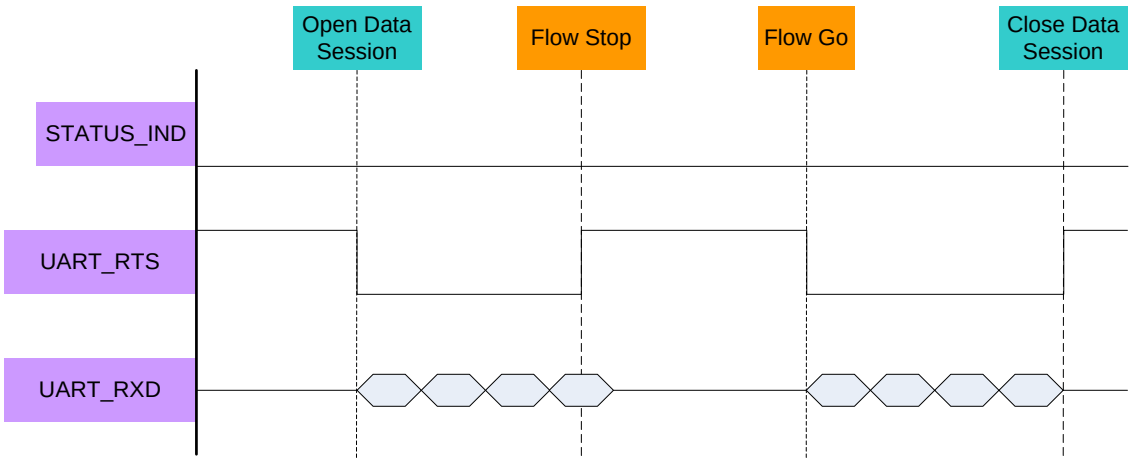
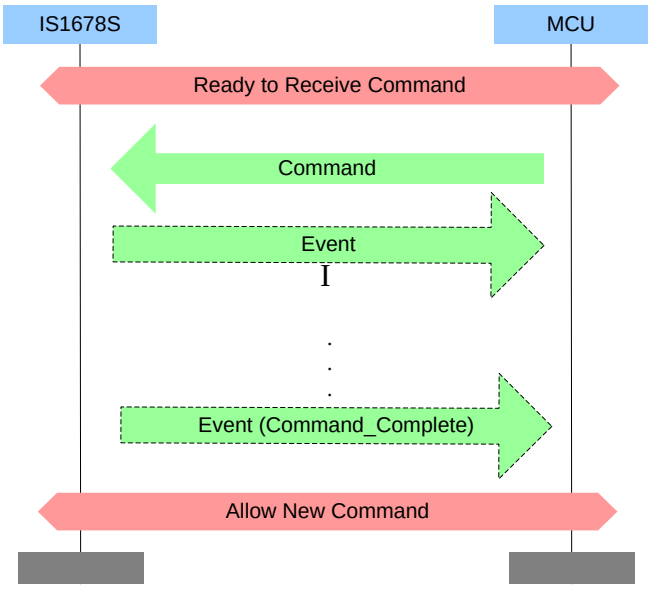


Fig.2 indicate Host_MCU UART flow control timing diagram

2.6. Rules of MCU Command Assign

Most of command request sending by MCU will be replied by “Command_Commplete” event. Another new command request is allowed for MCU by receiving “Command_Complete” event.



There are some exceptions that no Command_Complete event is sent by the IS1678S to indicate that this command has been completed. Following are the exception commands:

- **Read_BM77_Status:**

  The BM77_Status_Report event indicates that this command has been completed.

- **SPP_Create_Link:**

  The SPP_Connection_Complete event indicates that this connection establishment has been completed. If IS1678S can’t achieve the connection establishment, then the SPP_Connection_Complete event won’t be sent to MCU. MCU can send SPP_Create_Link_Cancel command to stop the action.

- **Reset:**

  MCU can know that the command has been completed by getting BM77_Status_Report event.

- **Disconnect:**

  The Disconnect_Complete event indicates that this command has been completed.

Besides some command request are allowed for MCU without waiting Command_Complete event after last command

request was sending. Those commands are listed as below:

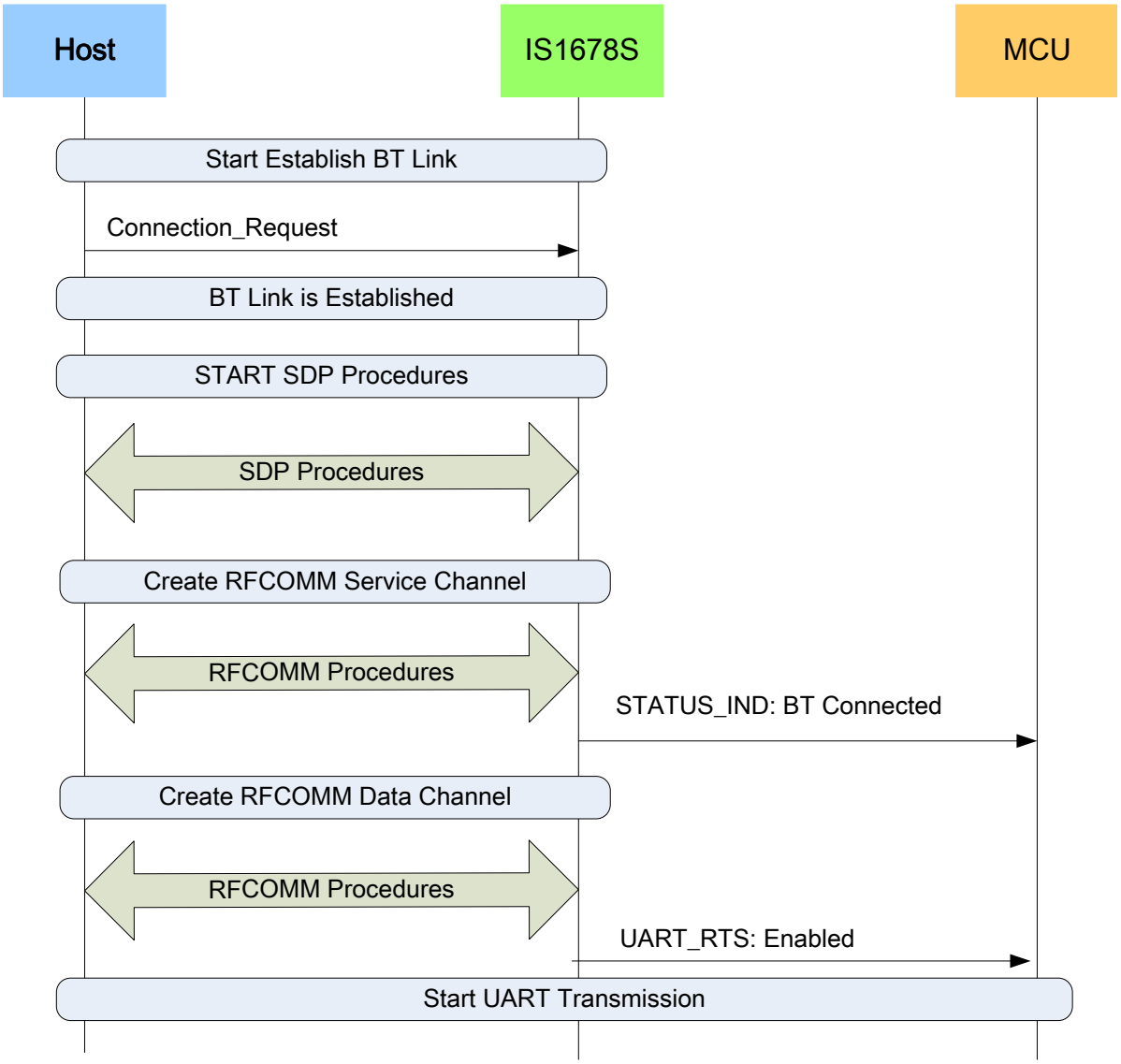
- **SPP_Create_Link_Cancel**
- **Disconnect**
- **Reset**

2.7. The reliable of data transmission

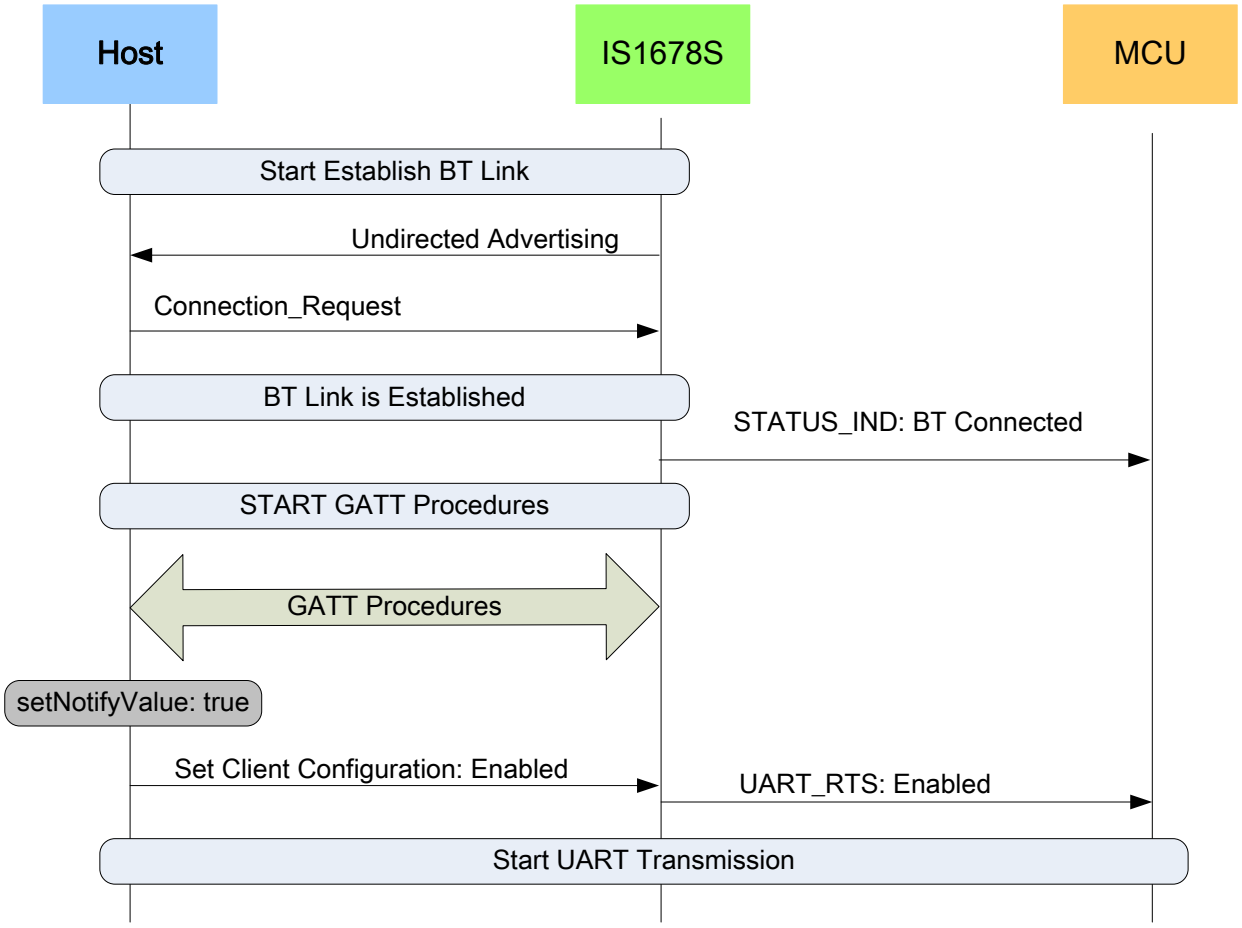
The UART data delivery order is first in, first out. End-to-end delivery of data is normally reliable, but not absolutely guaranteed, so MCU and App protocols must be designed to recover from loss of data.

2.8. Connection Establishment

2.8.1 SPP



2.8.2 iOS CoreBluetooth



2.9. Command Definition

Command Type	Op Code	Command	Return Event	Auto Pattern	Manual Pattern
Common	0x01	Read_Local_Information	Command_Complete	F	
	0x02	Reset		N/A	
	0x03	Read_BM77_Status	BM77_Status_Report	N/A	
	0x05	Into_Power_Down_Mode	Command_Complete	N/A	

	0x07	Read_Device_Name	Command_Complete	F	
	0x08	Write_Device_Name	Command_Complete	F	I
	0x09	Erase_all_Paired_Device_Information	Command_Complete	F	I
	0x0A	Read_Pairing_Mode_Setting	Command_Complete	F	
	0x0B	Write_Pairing_Mode_Setting	Command_Complete	F	I
	0x0C	Read_All_Paired_Device_Information	Command_Complete	F	
	0x0D	Delete_Paired_Device	Command_Complete	F	I
GAP	0x10	Read_RSSI_Value	Command_Complete	N/A	CM
	0x11	Write_Adv_Data	Command_Complete	F	I
	0x12	Write_Scan_Res_Data	Command_Complete	F	I
	0x13	Set_Advertising_Parameter	Command_Complete	F	I
	0x1B	Disconnect	Disconnection_Complete	N/A	CM
	0x1C	Invisible_Setting	Command_Complete	N/A	I
	0x1D	SPP_Create_Link	SPP_Connection_Complete	N/A	I
	0x1E	SPP_Create_Link_Cancel	Command_Complete	N/A	I
	0x1F	Read_Remote_Device_Name	Command_Complete	N/A	CM
SPP/GATT Transparent	0x3a	Send_Transparent_Data	Command_Complete	N/A	CM
Pairing	0x40	Passkey_Entry_Res	Command_Complete	CP	CP
	0x41	User_Confirm_Res	Command_Complete	CP	CP
Common_2	0x50	Read_PIN_Code	Command_Complete	F	I
	0x51	Write_PIN_Code	Command_Complete	F	I
	0x52	Leave_Configure_Mode	Command_Complete	F	N/A

*I: Available in Idle Mode

*CP: Available in Connected Mode with Pairing Procedure.

*F: Available in Configure Mode

*CM: Available in Connected Mode with Manual Pattern

2.10. Common_1 Commands

MCU sends the Common Command to for specific purpose. will reply the Command_Complete event to notify the command process result.

2.10.1 Read_Local_Information (0x01)

Command	Op Code	Command Parameters	Return Parameters

Read_Local_Information	0x01	None	Status, Version, BD_ADDR

Description:

This command is used to read local information of .

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

VERSION: SIZE: 5 BYTES

Value	Parameter Description
0xXXXXXXXXX X	Version information of

BD_ADDR: SIZE: 6 BYTES

Value	Parameter Description
0xXXXXXXXXX XXX	Bluetooth address

[Return to Command Table]

2.10.2 Reset (0x02)

Command	Op Code	Command Parameters	Return Parameters
Reset	0x02	None	Status

Description:

This command is used to reset.

Command Parameters:

None

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.10.3 Read_BM77_Status (0x03)

Command	Op Code	Command Parameters	Return Parameters

Read_BM77_Status	0x03	None

Description:

This command is used to read status of IS17648S . And the status of IS17648S will be informed by "BM77_Status_Report" event.

Command Parameters:

None

Return Parameters:

None

[Return to Command Table]

2.10.4 Into_Power_Down_Mode (0x05)

Command	Op Code	Command Parameters	Return Parameters
Into_Power_Down_Mode	0x05		

Description:

This command is used to drive into power down mode directly. IS17648S will into power down mode after Command_Complete is replied.

This command is valid while IS17648S is in Idle Mode only.

Command Parameters:

None

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.10.5 Read_Device_Name (0x07)

Command	Op Code	Command Parameters	Return Parameters
Read_Device_Name	0x07		Status, Device_Name

Description:

This command is used to read device name of IS17648S.

Command Parameters:

None

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

DEVICE_NAME: SIZE: XX BYTES

Value	Parameter Description
0xXX	Device name of

[Return to Command Table]

2.10.6 Write_Device_Name (0x08)

Command	Op Code	Command Parameters	Return Parameters
Write_Device_Name	0x08	Store_Option,Device_Name	Status

Description:

This command is used to write device name of IS17648S.

Command Parameters:

STORE_OPTION: SIZE: 1 BYTE

Value	Parameter Description
0x00	The change won't store to E2prom
0x01	The change will store to E2prom

DEVICE_NAME: SIZE: XX BYTES

Value	Parameter Description
0xXX	Device name of IS17648S

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.10.7 Erase_All_Paired_Device_Information (0x09)

Command	Op Code	Command Parameters	Return Parameters
Erase_All_Paired_Device_Information	0x09		Status

Description:

This command is used to erase all of the paired device information saved in IS17648S e2prom and it is valid while IS17648S is in Idle Mode only

Command Parameters:

None

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.10.8 Read_Pairing_Mode_Setting (0x0A)

Command	Op Code	Command Parameters	Return Parameters
Read_Pairing_Mode_Setting	0x0A		Status, Pairing_Mode

Description:

This command is used to read pairing mode setting of IS17648S.

Command Parameters:

None

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

PAIRING_MODE: SIZE: 1 BYTE

Value	Parameter Description
0x00	PIN Code Entry
0x01	Just Work
0x02	Passkey_Entry
0x03	User Confirm

[Return to Command Table]

2.10.9 Write_Pairing_Mode_Setting (0x0B)

Command	Op Code	Command Parameters	Return Parameters
Write_Pairing_Mode_Setting	0x0B	Store_Option, Pairing_Mode	Status, Pairing_Mode

Description:

This command is used to write pairing mode setting of IS17648S and it is valid while IS17648S is in Idle Mode only.

Command Parameters:

STORE_OPTION: SIZE: 1 BYTE

Value	Parameter Description
0x00	The change won't store to E2prom
0x01	The change will store to E2prom

PAIRING_MODE: SIZE: 1 BYTE

Value	Parameter Description
0x00	PIN Code Entry
0x01	Just Work
0x02	Passkey_Entry
0x03	User Confirm

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.10.10 Read_All_Paired_Device_Information (0x0C)

Command	Op Code	Command Parameters	Return Parameters
Read_All_Paired_Device_Information	0x0C		Status, Num_Of_Paired_Device, Device_List

Description:

This command is used to read all paired devices information of IS17648S and it is valid while IS17648S is in Idle Mode only.

Command Parameters:

None

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded

0x01 – 0xFF	Command failed. See listing of Error Codes.

NUM_OF_PAIRED_DEVICE: SIZE: 1 BYTE

Value	Parameter Description
0xXX	Number of paired devices

DEVICE_LIST: MAX TO 4 SETS

DEVICE_INDEX: SIZE: 1 BYTE

Value	Parameter Description
0xXX	Paired device index

PRIOROTY: SIZE: 1 BYTE

Value	Parameter Description
0xXX	Link priority(0x01: Latest linked device)

DEVICE_ADDRESS: SIZE: 6 BYTES

Value	Parameter Description
0xXXXXXXXXXXXX	Paired device Bluetooth address

[Return to Command Table]

2.10.11 Delete_Paired_Device (0x0D)

Command	Op Code	Command Parameters	Return Parameters
Delete_Paired_Device	0x0D	Device_Index	Status

Description:

This command is used to delete paired device from IS17648S and it is valid while IS17648S is in Idle Mode only.

Command Parameters:

DEVICE_INDEX: SIZE: 1 BYTE

Value	Parameter Description
0xXX	The range of device index is from 0 to 3.

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.11. GAP Commands

2.11.1 Read_RSSI_Value (0x10)

Command	Op Code	Command Parameters	Return Parameters
Read_RSSI_Value	0x10	Connection_Handle	Status, RSSI_Value

Description:

This command is used to read RSSI value for peer connection.

This command is valid while IS17648S is in Connected Mode only.

Command Parameters:

CONNECTION_HANDLE: SIZE: 2 BYTES

Value	Parameter Description
0xXXXX	Connection Handle

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

RSSI_VALUE: SIZE: 1 BYTE

Value	Parameter Description
0xXX	RSSI Value

[Return to Command Table]

2.11.1 Write_Adv_Data (0x11)

Command	Op Code	Command Parameters	Return Parameters
Write_Adv_Data	0x11	Store_Option, Advertising_Data	Status

Description:

This command is used to update the advertise data.

This command is valid while IS17648S is in Idle Mode only.

* Maximum length of advertising data in IS17648S is 24 bytes

Command Parameters:

STORE_OPTION: SIZE: 1 BYTE

Value	Parameter Description
0x00	The change won't store to E2prom

0x01	The change will store to E2prom

ADVERTISING_DATA SIZE: 1 TO 31 OCTETS

Value	Parameter Description
0xXX	Advertising Data

Return Parameters:

STATUS: SIZE: 1 OCTET

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.11.2 Write_Scan_Res_Data (0x12)

Command	Op Code	Command Parameters	Return Parameters
Write_Scan_Res_Data	0x12	Store_Option, Scan_Res_Data	Status

Description:

This command is used to update the Scan_Res data.

This command is valid while IS17648S is in Idle Mode only.

Command Parameters:

STORE_OPTION: SIZE: 1 BYTE

Value	Parameter Description
0x00	The change won't store to E2prom
0x01	The change will store to E2prom

SCAN_RES_DATA SIZE: 1 TO 31 OCTETS

Value	Parameter Description
0xXX	Scan Response Data

Return Parameters:

STATUS: SIZE: 1 OCTET

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.11.3 Set Advertising Parameter (0x13)

Command	Op Code	Command Parameters	Return Parameters

Advertising_Mode_Setting	0x13	Advertising_Interval Advertising_Type, Direct_Address_Type, Direct_Address,	Status

Description:

This command is used to set advertising parameters and it is valid while BLEDK is in Idle Mode only.

Command Parameters:

ADVERTISING_INTERVAL: SIZE: 2 OCTET

Value	Parameter Description
0xXXXX	Advertising interval for non-directed advertising. Range: 0x0020 to 0x4000 Default: N = 0x0800 (1.28 second) Time = N * 0.625 msec Time Range: 20 ms to 10.24 sec

ADVERTISING_TYPE: SIZE: 1 OCTET

Value	Parameter Description
0x00	Connectable undirected advertising. It is used to make BM77 into standby mode.
0x01	Connectable directed advertising. It is used to make BM77 into link back mode.
0x02	Scannable undirected advertising. It is used to make BLEDK into broadcast mode. And it will reply advertising packet only for the observer passive scanning or active scanning to receive advertising events.
0x03	Non connectable undirected advertising. It is used to make BM77 into broadcast mode.
0x04	Proprietary Beacon Setting

DIRECT_ADDRESS_TYPE: SIZE: 1 OCTET

Value	Parameter Description
0x00	Public Device Address
0x01	Random Device Address

DIRECT_ADDRESS: SIZE: 6 OCTETS

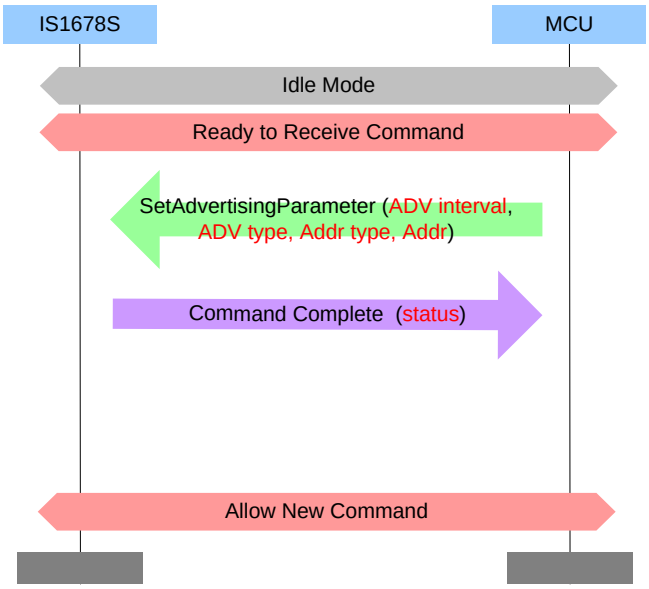
Value	Parameter Description
0xXXXXXXXXXXXX	Public Device Address or Random Device Address of the device to be connected

Return Parameters:

STATUS: SIZE: 1 OCTET

Value	Parameter Description
0x00	Command succeeded

0x01 – 0xFF	Command failed. See listing of Error Codes.



[Return to Command Table]

2.11.4 Disconnect (0x1B)

Command	Op Code	Command Parameters	Return Parameters
Disconnect	0x1B	Reserved	

Description:

This command is used to terminate a connection. And it is valid while IS17648S is in Connected Mode only.

Command Parameters:

RESERVED: SIZE: 1 BYTE

Value	Parameter Description
0x00	Always set this byte to 0

Return Parameters:

None.

Note: No Command_Complete event is sent by the to indicate that this command has been completed. Instead, the Disconnection_Complete event indicates that this command has been completed.

[Return to Command Table]

2.11.5 Invisible_Setting (0x1C)

Command	Op Code	Command Parameters	Return Parameters
Invisible_Setting	0x1C	Mode	Status

Description:

This command is used to configure SPP invisible and it is valid while IS17648S is in Idle Mode only.

Command Parameters:

MODE: SIZE: 1 BYTE

Value	Parameter Description
0x00	Leave Standby Mode
0x01	Enter Standby Mode

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.11.6 SPP_Create_Link (0x1D)

Command	Op Code	Command Parameters	Return Parameters
SPP_Create_Link	0x1D	Device_Index	Status

Description:

This command is used to establish with host and it is valid while IS17648S is in Idle Mode only.

Command Parameters:

DEVICE_INDEX: SIZE: 1 BYTE

Value	Parameter Description
0xXX	The range of device index is from 0 to 3 (Device_Index only valid if paired information exists in). Set this value to 0xff, IS17648S will create link with latest paired device.

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.11.7 SPP_Create_Link_Cancel (0x1E)

Command	Op Code	Command Parameters	Return Parameters
SPP_Create_Link_Cancel	0x1E		Status

Description:

This command is used to cancel the link establishment with host and it is valid while IS17648S is in Link Back

Mode only.

Command Parameters:

NONE

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.11.8 Read_Remote_Device_Name (0x1F)

Command	Op Code	Command Parameters	Return Parameters
Read_Remote_Device_Name	0x1F		Status, Device_Name

Description:

This command is used to read remote device name.

Command Parameters:

NONE

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

DEVICE_NAME: SIZE: XX BYTE

Value	Parameter Description
0xXX	Remote Device Name

[Return to Command Table]

2.12. SPP/GATT Transparent Commands

2.12.1 Send_Transparent_Data (0x3a)

Command	*Op Code*	*Command Parameters*	*Return Parameters*
Send_Transparent_Data	0x3a	Reserved, Transparent_Data	Status

Description:

This command is used to send transparent data by ISSC_TRANS_TX service or SPP profile.

Command Parameters:

RESERVED: SIZE: 1 BYTE

Value	Parameter Description
0x00	Always set this byte to be 0

TRANSPARENT_DATA: SIZE: N BYTES

Value	Parameter Description
0xXX	Transparent_Data. Maximum length of transparent data is 1000 bytes

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.13. Pairing Commands

2.13.1 Passkey_Entry_Res (0x40)

Command	Op Code	Command Parameters	Return Parameters
Passkey_Entry_Res	0x40	Notification_Type, Entered_Passkey	Status

Description:

This command is used to response SSP passkey entry request from .

Command Parameters:

NOTIFICATION_TYPE: SIZE: 1 BYTE

Value	Parameter Description
0x01	Passkey digit entered
0x02	Passkey digit erased
0x03	Passkey cleared
0x04	Passkey entry completed

ENTERED_PASSKEY: SIZE: 1 BYTE

Value	Parameter Description
0xXX	Entered Digital Passkey character. It is valid only while the Notification_type is 0x01. 0x30~0x39: "0" ~"9"

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.13.2 User_Confirm_Res (0x41)

Command	Op Code	Command Parameters	Return Parameters
User_Confirm_Res	0x41	option	Status

Description:

This command is used to response SSP passkey entry request from .

Command Parameters:

NOTIFICATION_TYPE: SIZE: 1 BYTE

Value	Parameter Description
0x00	Entered information is Yes
0x01	Entered information is No

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.14. Common_2_Commands

2.14.1 Read_PIN_Code (0x50)

Command	Op Code	Command Parameters	Return Parameters
Read_PIN_Code	0x50		Status, PIN_Code

Description:

This command is used to read PIN code of .

Command Parameters:

None

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded

0x01 – 0xFF	Command failed. See listing of Error Codes.

PIN_CODE: SIZE: 4 OR 6 BYTES

Value	Parameter Description
0xXX	PIN Code of

[Return to Command Table]

2.14.2 Write_PIN_Code (0x51)

Command	Op Code	Command Parameters	Return Parameters
Write_PIN_Code	0x51	Store_Option, PIN_Code	Status

Description:

This command is used to write PIN code of IS17648S and it is valid while IS17648S is in Idle Mode only.

Command Parameters:

STORE_OPTION: SIZE: 1 BYTE

Value	Parameter Description
0x00	The change won't store to E2prom
0x01	The change will store to E2prom

PIN_CODE: SIZE: 4 OR 6 BYTES

Value	Parameter Description
0xXX	PIN Code of IS17648S

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.14.3 Leave_Configure_Mode (0x52)

Command	Op Code	Command Parameters	Return Parameters
Leave_Configure_ Mode	0x52	Option	Status

Description:

will leave configure mode if "Leave_Configure_Mode" command is received.

Command Parameters:

OPTION: SIZE: 1 BYTE

Value	Parameter Description

0x00	None
0x01	Disable configure mode forever

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded
0x01 – 0xFF	Command failed. See listing of Error Codes.

[Return to Command Table]

2.15. List of Command Status Error Code

Error Code	Description
0x00	Command succeeded
0x01	Unknown Command
0x02	Unknown Connection Identifier
0x03	Hardware Failure
0x05	Authentication Failure
0x06	PIN or Key Missing
0x07	Memory Capacity Exceeded
0x08	Connection Timeout
0x09	Connection Limit Exceeded
0x0B	ACL Connection Already Exists
0x0C	Command Disallowed
0x0D	Connection Rejected due to Limited Resources
0x0E	Connection Rejected Due To Security Reasons
0x0F	Connection Rejected due to Unacceptable BD_ADDR
0x10	Connection Accept Timeout Exceeded
0x11	Unsupported Feature or Parameter Value
0x12	Invalid Command Parameters
0x13	Remote User Terminated Connection
0x14	Remote Device Terminated Connection due to Low Resources
0x15	Remote Device Terminated Connection due to Power Off
0x16	Connection Terminated By Local Host
0x18	Pairing Not Allowed
0x1F	Unspecified Error
0x28	Instant Passed
0x29	Pairing With Unit Key Not Supported
0x2F	Insufficient Security
0x39	Connection Rejected due to No Suitable Channel Found

0x3A	Controller Busy
0x3B	Unacceptable Connection Interval
0x3C	Directed Advertising Timeout
0x3D	Connection Terminated due to MIC Failure
0x3E	Connection Failed to be Established
0x81	Invalid Handle
0x82	Read Not Permitted
0x83	Write Not Permitted
0x84	Invalid PDU
0x85	Insufficient Authentication
0x86	Request Not Supported
0x77	Invalid Offset
0x88	Insufficient Authorization
0x89	Prepare Queue Full
0x8A	Attribute Not Found
0x8B	Attribute Not Long
0x8C	Insufficient Encryption Key Size
0x8D	Invalid Attribute Value Length
0x8E	Unlikely Error
0x8F	Insufficient Encryption
0x90	Unsupported Grout Type
0x91	Insufficient Resources
0xFF	UART_Check_Sum_Error

2.16. Event Definition

Event Type	Op Code	Event
Pairing	0x60	Passkey_Entry_Req
	0x61	Pairing_Complete
	0x62	Passkey_DisplayYesNo_Req
GAP	0x71	LE_Connection_Complete
	0x72	Disonnection_Complete
	0x74	SPP_Connection_Complete
Common	0x80	Command_Complete
	0x81	BM77_Status_Report
	0x8f	Configure_Mode_Status
SPP/GATT Transparent	0x9a	Received_Transparent_Data

2.17. Pairing Event

● Passkey_Entry_Req (0x60)

Event	OpCode	Event Parameters
SSP_Passkey_Entry _Req	0x60	

Description:

This event is used to inform MCU that IS1678S has received Passkey Request.

Event Parameters:

NONE

[Return to Event Table]

● Pairing_Complete (0x61)

Event	OpCode	Event Parameters
Pairing_Complete	0x61	Result

Description:

This event is used to inform MCU that IS1678S pairing process has been finished.

Event Parameters:

RESULT: SIZE: 1 OCTETS

Value	Parameter Description
0x00	Pairing Complete
0x01	Pairing Fail
0x02	Pairing Timeout

[Return to Event Table]

● Passkey_DisplayYexNo_Req (0x62)

Event	OpCode	Event Parameters
SSP_Passkey_Entry _Req	0x62	Displayed_Passkey

Description:

This event is used to inform MCU that IS1678S has received user confirm request.

Event Parameters:

DISPLAYED_PASSKEY: SIZE: 1 OCTETS

Value	Parameter Description

0xXX	Numeric for MCU to display

[Return to Event Table]

2.18 GAP Event

● LE_Connection_Complete (0x71)

Event	OpCode	Event Parameters
LE_Connection _Complete	0x71	Status, Connection_Handle, Role, Peer_Address_Type, Peer_Address, Conn_Interval, Conn_Latency, Supervision_Timeout,

Description:

This event is used to inform MCU that a LE connection has been created.

Event Parameters:

STATUS: SIZE: 1 OCTET

Value	Parameter Description
0x00	Connection successfully completed.
0x01~0xff	Connection failed to complete.

CONNECTION_HANDLE: SIZE: 1 OCTETS

Value	Parameter Description
0xXX	Connection_Handle to be used to identify a connection between two Bluetooth devices

ROLE: SIZE: 1 OCTET

Value	Parameter Description
0x00	Connection is master
0x01	Connection is slave

PEER_ADDRESS_TYPE: SIZE: 1 OCTET

Value	Parameter Description
0x00	Peer is using a Public Device Address
0x01	Peer is using a Random Device Address

PEER_ADDRESS: SIZE: 6 OCTETS

Value	Parameter Description
0xXXXXXXXXXXXX	Public Device Address or Random Device Address of the peer device

CONN_INTERVAL: SIZE: 2 OCTETS

Value	Parameter Description
0xXXXX	Connection interval used on this connection. Range: 0x0006 to 0x0C80 Time = N * 1.25 msec

	Time Range: 7.5 msec to 4000 msec.

CONN_LATENCY: SIZE: 2 OCTETS

Value	Parameter Description
0xXXXX	Connection latency for this connection. Range: 0x0006 to 0x0C80 Time = N * 1.25 msec Time Range: 7.5 msec to 4000 msec.

SUPERVISION_TIMEOUT: SIZE: 2 OCTETS

Value	Parameter Description
0xXXXX	Connection supervision timeout. Range: 0x000A to 0x0C80 Time = N * 10 msec Time Range: 100 msec to 32 seconds

[Return to Event Table]

● Disconnection_Complete (0x72)

Event	OpCode	Event Parameters
Disonnection_Complete	0x72	Connection Handle, Reason

Description:

This event is used to inform that the connection has been terminated.

Event Parameters:

CONNECTION_HANDLE: SIZE: 1 OCTETS

Value	Parameter Description
0xXX	Connection Handle to be used to identify a connection between two Bluetooth devices

REASON: SIZE: 1 OCTET

Value	Parameter Description
0xXX	Disconnection reason. See listing of Error Codes.

[Return to Event Table]

● SPP_Connection_Complete (0x74)

Event	OpCode	Event Parameters
SPP_Connection _Complete	0x74	Status,Connection_Handle, Peer Address

Description:

This event is used to inform MCU that a SPP connection has been created.

Event Parameters:

STATUS: SIZE: 1 OCTET

Value	Parameter Description
0x00	Connection successfully completed.
0x01~0xff	Connection failed to complete.

CONNECTION_HANDLE: SIZE: 1 OCTETS

Value	Parameter Description
0xXX	Connection Handle to be used to identify a connection between two Bluetooth devices

PEER_ADDRESS: SIZE: 6 OCTETS

Value	Parameter Description
0xXXXXXXXXXXXX	Public Device Address or Random Device Address of the peer device

[Return to Event Table]

2.19 Common Event

2.19.1 Command_Complete (0x80)

Event	OpCode	Event Parameters
Command_Complete	0x80	Command_OpCode, Return_Parameters

Description:

This event is used to response of commands.

Event Parameters:

COMMAND_OPCODE: SIZE: 1 OCTET

Value	Parameter Description
0xXX	Opcode of the command which caused this event.

RETURN_PARAMETERS SIZE:

DEPENDS ON COMMAND

Value	Parameter Description
0xXX	Opcode of the command which caused this event.

[Return to Event Table]

2.19.2 BM77_Status_Report (0x81)

Event	OpCode	Event Parameters
BM77_Status_Report	0x81	Status

Description:

This event is used to inform MCU status of IS1678S while status is changed and response of "Read_BM77_Status" command.

Event Parameters:

STATUS: SIZE: 1 OCTET

Value	Parameter Description
0xXX	See listing of BM77 Status.

[Return to Event Table]

2.19.3 Configure_Mode_Status (0x8f)

Event	OpCode	Event Parameters
Configure_Mode_Status	0x8f	Status

Description:

This event is used to inform MCU Configure Mode status of .

Event Parameters:

STATUS: SIZE: 1 OCTET

Value	Parameter Description
0x00	Configure Mode is Disabled.
0x01	Configure Mode is Enabled

[Return to Event Table]

2.20 SPP/GATT Transparent Event

2.20.1 Recieved _Transparent_Data (0x9a)

Event	OpCode	Event Parameters
Received_Transparent_Data	0x9a	Reserved, Transparent_Data

Description:

This event is used to inform MCU that IS1678S has received transparent data by ISSC_TRANS_RX service or SPP profile.

Event Parameters:

RESERVED: SIZE: 1 BYTE

Value	Parameter Description
0x00	Always set this byte to be 0

TRANSPARENT_DATA: SIZE: N OCTETS

Value	Parameter Description
0xXX	Transparent data

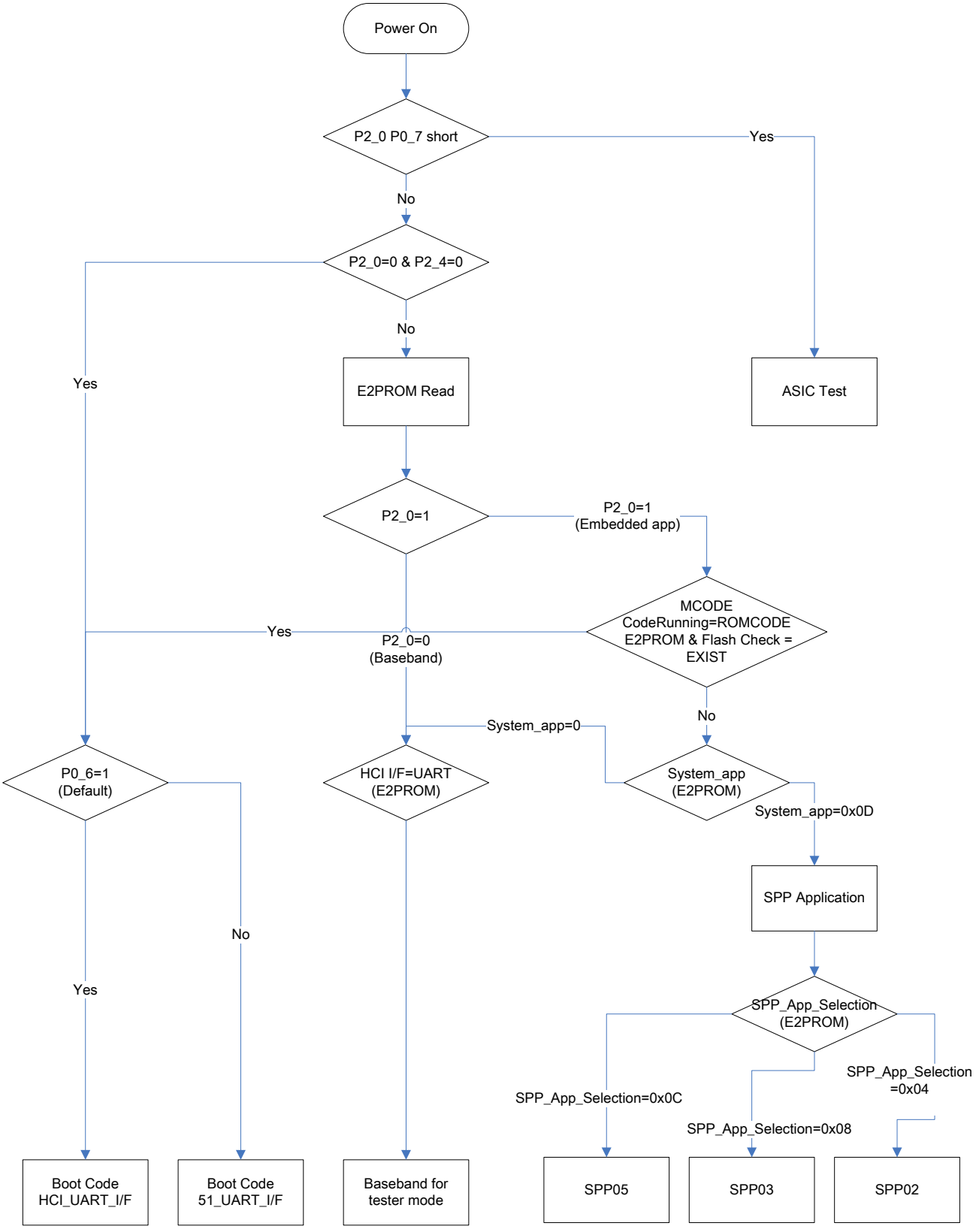
[Return to Event Table]

2.21 List of BT Status

BT Status	Description
0x00	Power On
0x03	Standby Mode
0x04	Link Back Mode
0x07	SPP Connected Mode
0x08	LE Connected Mode
0x09	Idle Mode
0x0a	Shutdown Mode. **BM77** go to power down mode (S2 mode).

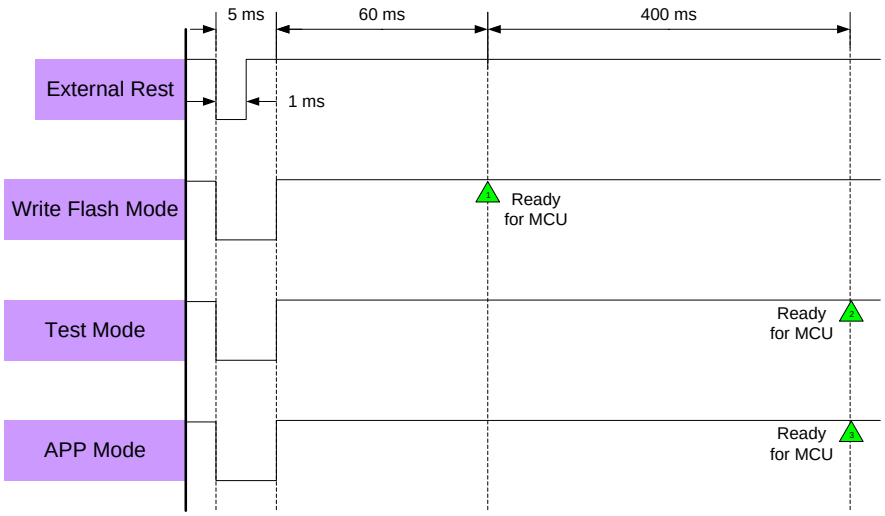
3. GPIO & Other Application

3.1. Flow Chart of System Initialization



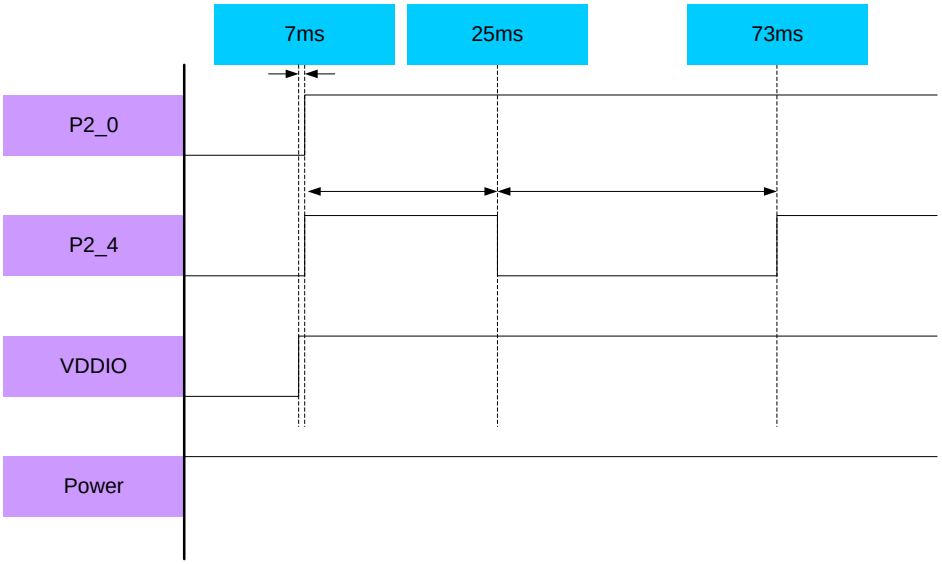
3.2. Power on Timing Sequence

- RST_N



RST_N Timing Diagram

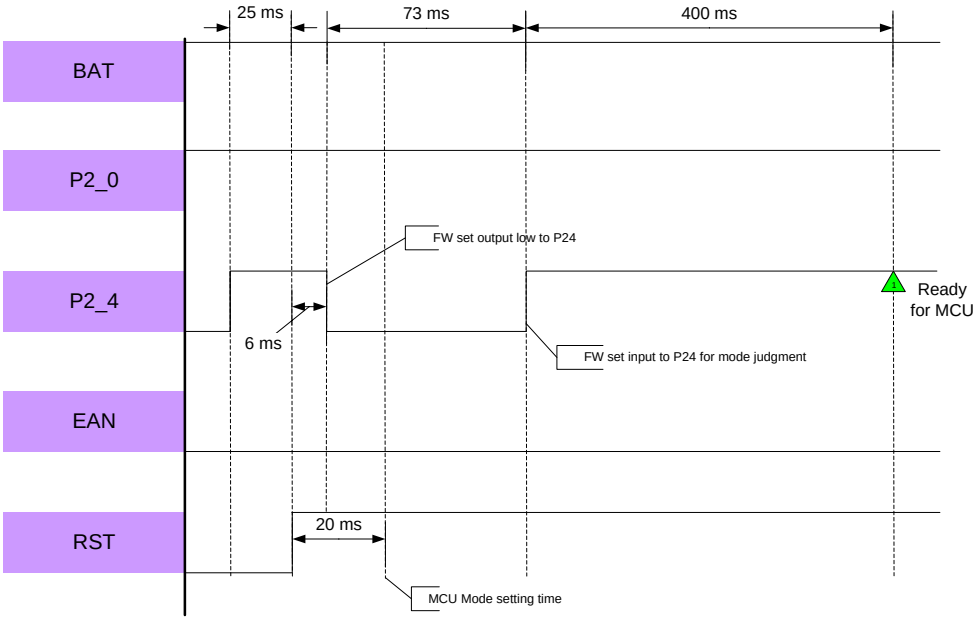
- P2_0/P2_4/VDDIO



P2_0, P2_4, VDDIO Timing Diagram (In APP Mode)

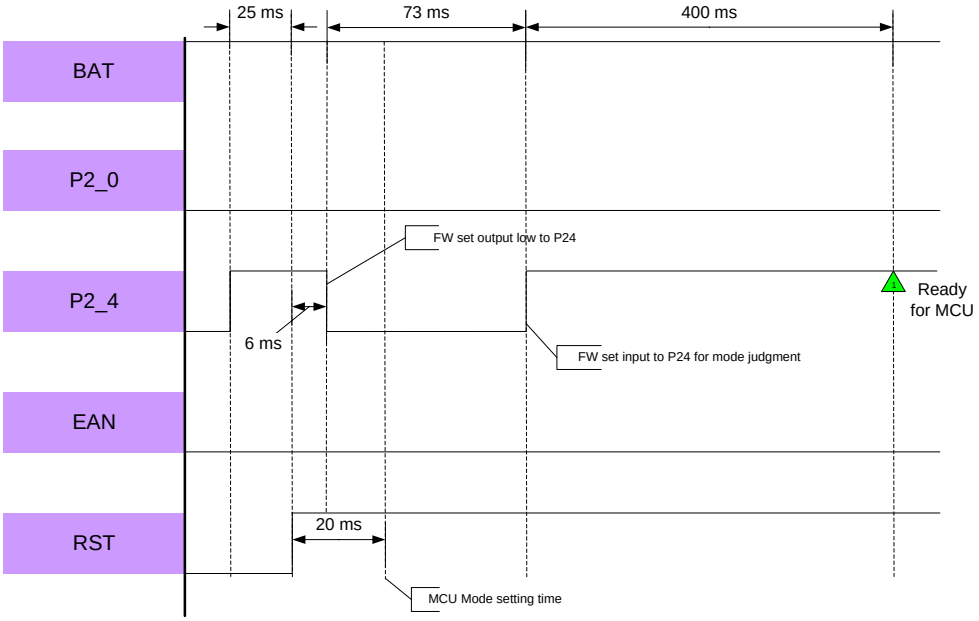
- APP mode

MCU sets P2_0, P2_4 and EAN as input or floating.



APP Mode Timing Diagram

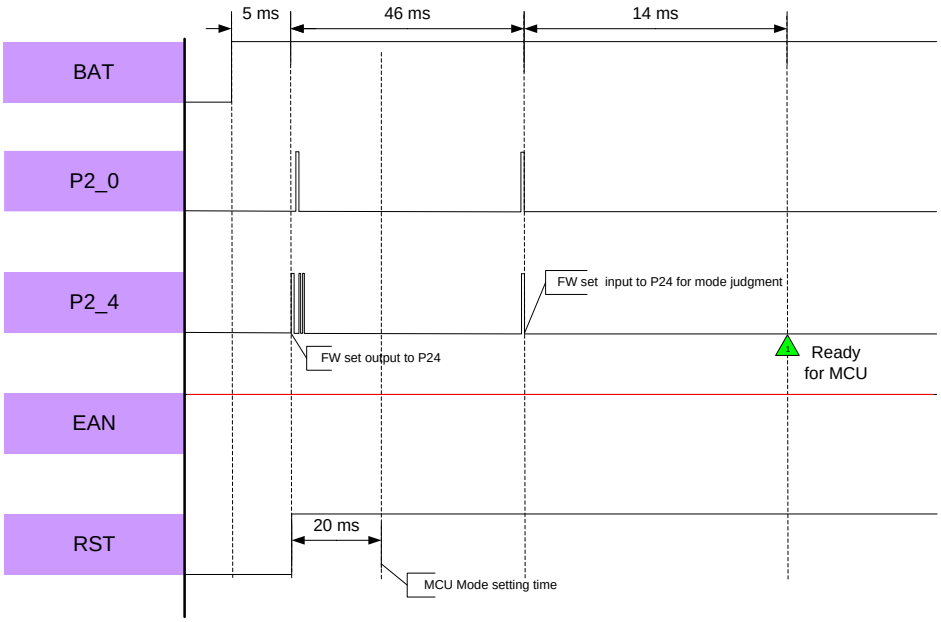
- IBDK mode:
  MCU output low to P2_0, P2_4 and EAN.



IBDK Mode(Test Mode) Timing Diagram

- Boot mode:
  MCU set output low to P2_0 and P2_4

MCU set output high to EAN before BAT power on; Boot by ROM



Boot Mode(Write Flash Mode) Timing Diagram

3.3. Configurable GPIO

GPIO pins P0_0, P0_5, P1_7, P3_1, P3_2, P3_3, P3_4 and P3_7 are configurable control and indication I/O. Control signals are input to the and indication signal s are output from the . Table below shows the configurable I/O pins assignment to control and indication signals.

Please note that UART_RTS can only be assigned to P0_0 and UART_CTS can only be assigned to P1_7 respectively.

	N/C	UART_RTS	UART_CTS	LOW_BATTERY_IND	LINK_QUALITY_IND	DISCONNECT_CONTROL	UART_TX_IND	UART_RX_IND???	DISCOVERY_CONTROL	INQUIRY CONTROL	PROFILE_IND
P0_0		Fixed						?			
P0_5	Default							?			
P1_7			Fixed					?			
P3_1								?		Default	
P3_2						Default		?			
P3_3	Default							?			
P3_4	Default							?			
P3_7				Default				?			

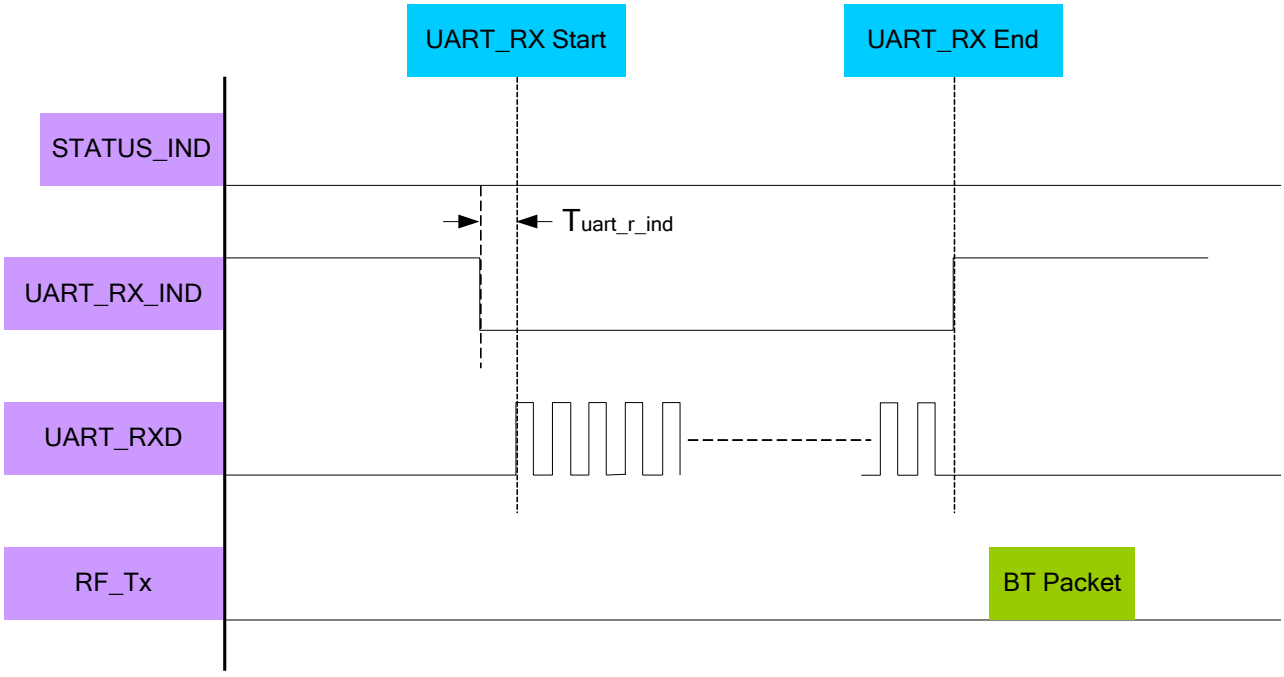
P1_5 and P0_4 are dedicated I/O assigned to “Status Indicator 1 and 2”. Together they provide status information of IS1678S to the MCU as the table shown below.

P1_5/STATUS_IND_1	P0_4/STATUS_IND_2	Indication

H	H	Power default / Shutdown state
H	L	Access state
L	H	Link state (UART data transmitted)
L	L	Link state (NO UART data transmitted)

3.4. Low Power Mode Connection

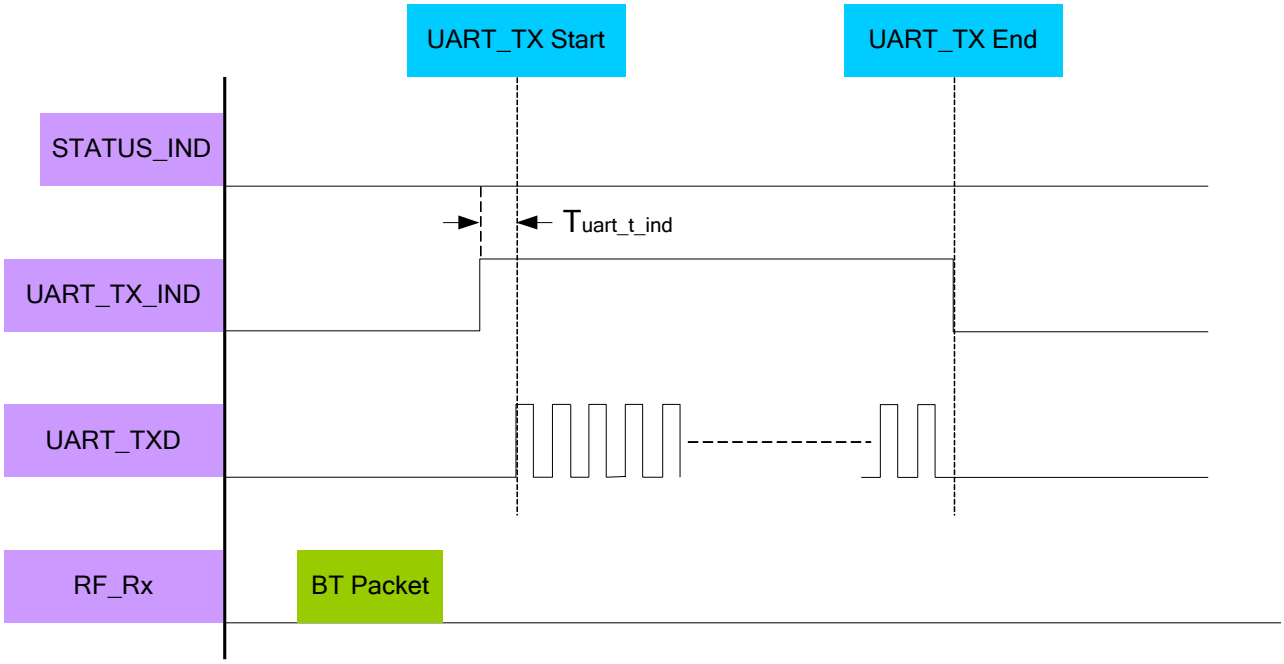
- Optional feature for continuous Bluetooth connection.
- Bluetooth Sniff mode supported and configurable Sniff mode parameters by E2PROM setting.
- Configurable Bluetooth Low Energy Connection parameters.
- For Bluetooth 3.0, in order to enter low power mode, Sniff interval and UART RX_IND (default setting PIN: P3_3 in EEPROM) should be enabled by E2PROM setting.
- For Bluetooth 4.0, UART RX_IND should be enabled by E2PROM setting to enter low power mode.
- Fig.2 shows the related timing (Bluetooth 3.0 and 4.0 UART data transmission), when UART RX_IND function is enabled.



* $T_{uart\_r\_ind}$: > 2ms

Fig1. Host_MCU indicate UART data timing diagram

- Fig.3 shows the related timing, when indicates HOST MCU UART data transmission. This function works under both Bluetooth 3.0 and 4.0 modes. If MCU doesn't need UART_TX_IND, please keeps this pin (P0_4) floating.



*** Tuart_t_ind: by E2PROM setting (Default 5ms)**

Fig2. Indicate Host_MCU UART data timing diagram

3.5. Other Utility features

- State indication by P1_5 (STATUS_IND) and P0_4 (STATUS_IND_2).

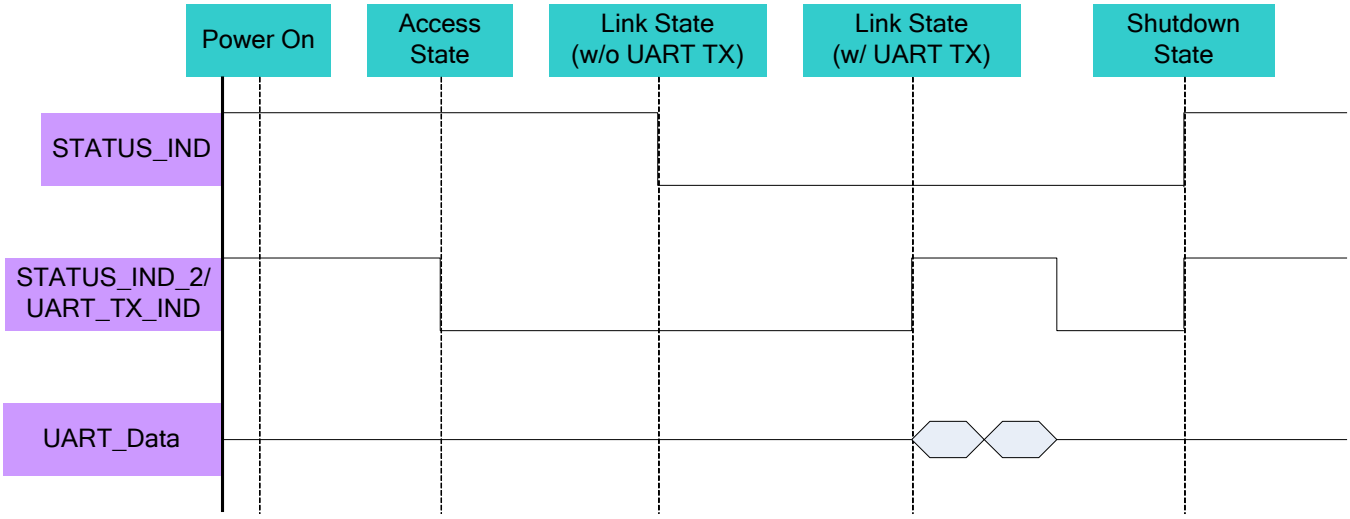
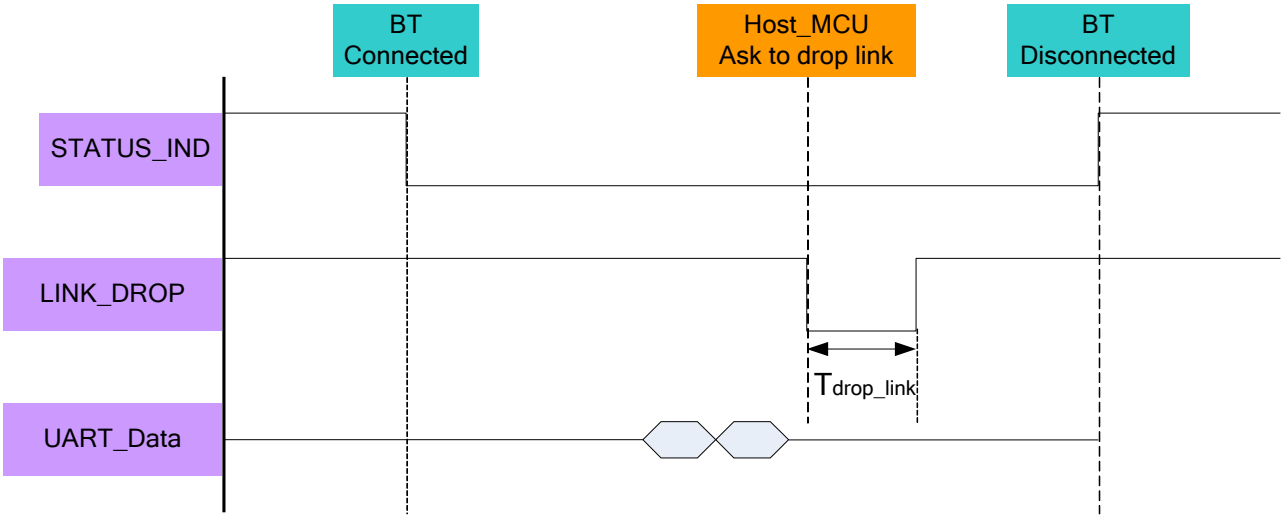


Fig3. State shown by STATUS_IND Pin status

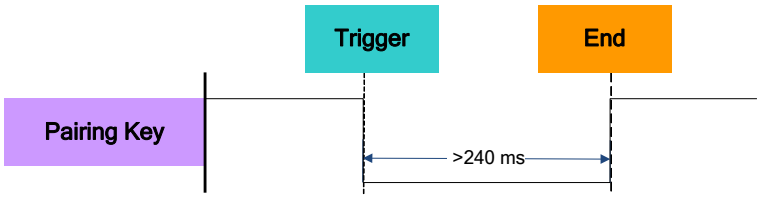
- Drop Bluetooth connection by LINK_DROP control.



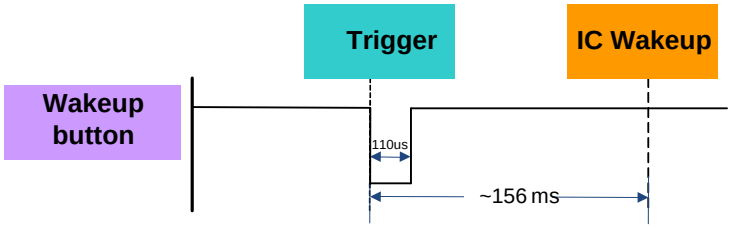
* **T_{drop_link}: >10ms.**

Fig4. Host_MCU ask to drop link timing diagram

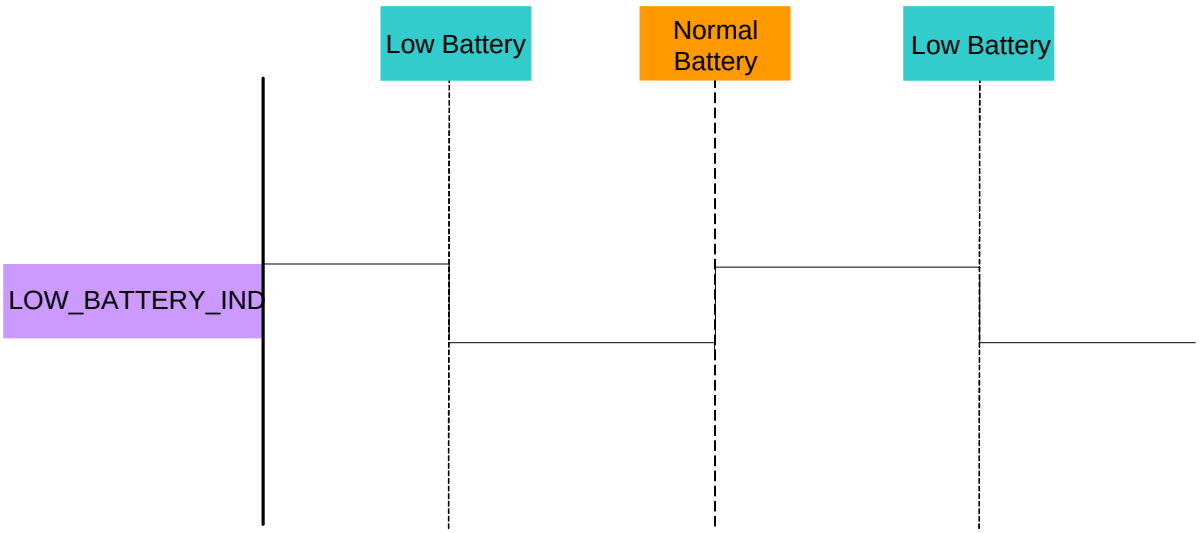
- Force device into Standby Mode by trigger Pairing Key (Condition: pull low over 240ms)



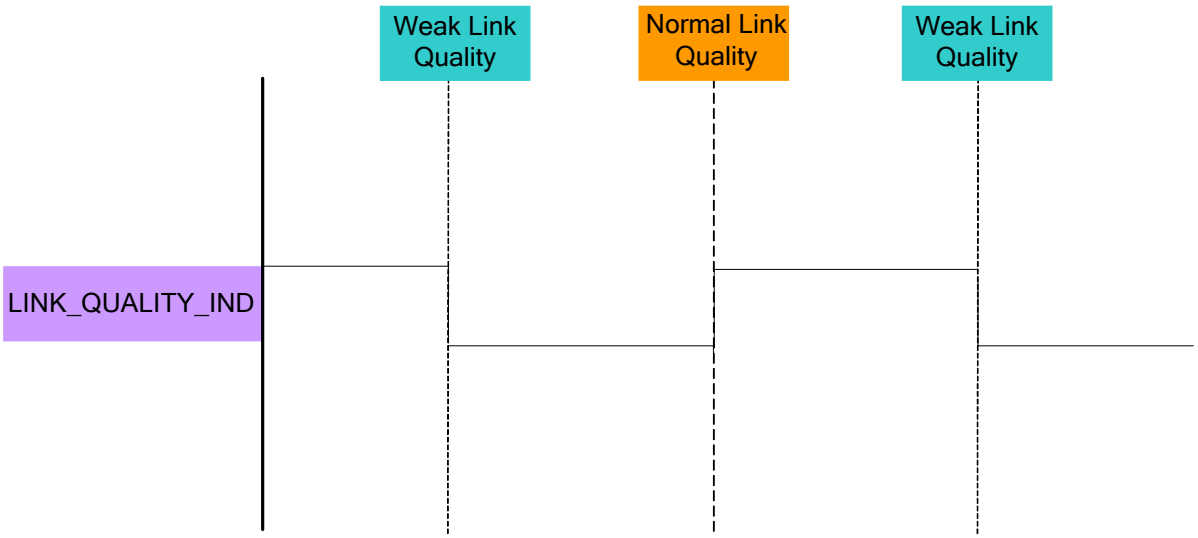
- Resume from Shutdown State by WAKEUP low active control.



- Low battery indication by LOW_BATTERY_IND.



◆ Weak link quality indication by WEAK_LINK_QUALITY_IND

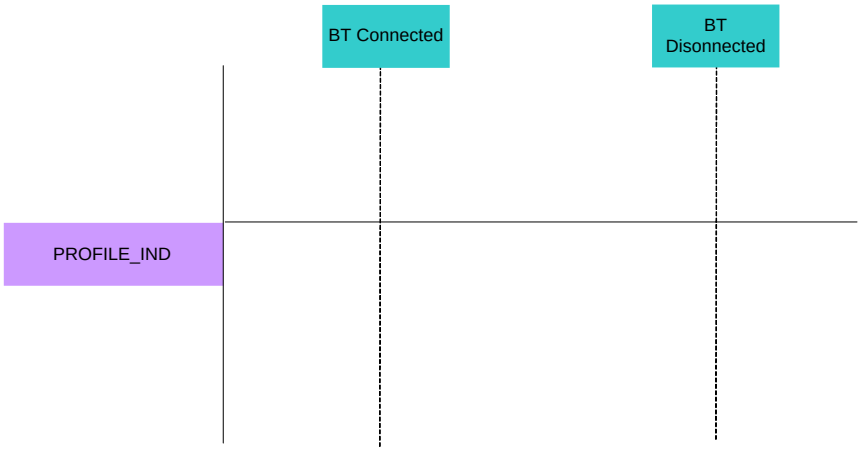


3.6. Profile Indication

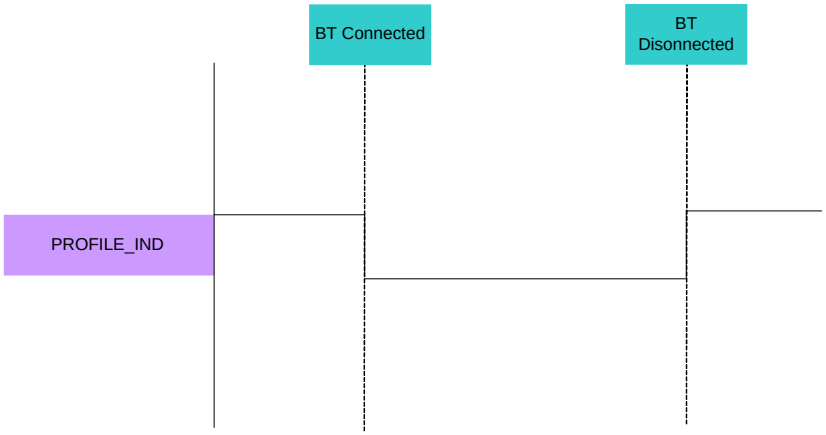
Profile indication (Configurable GPIO) can be configured by E2PROM. It is used for BT connection indication. If the link is established under BR/EDR, PROFILE_IND outputs as HIGH. Otherwise if the link is established under BLE, PROFILE_IND

outputs as LOW. It is valid only when the BT is connected (Link State).

- BT connection is established under BR/EDR

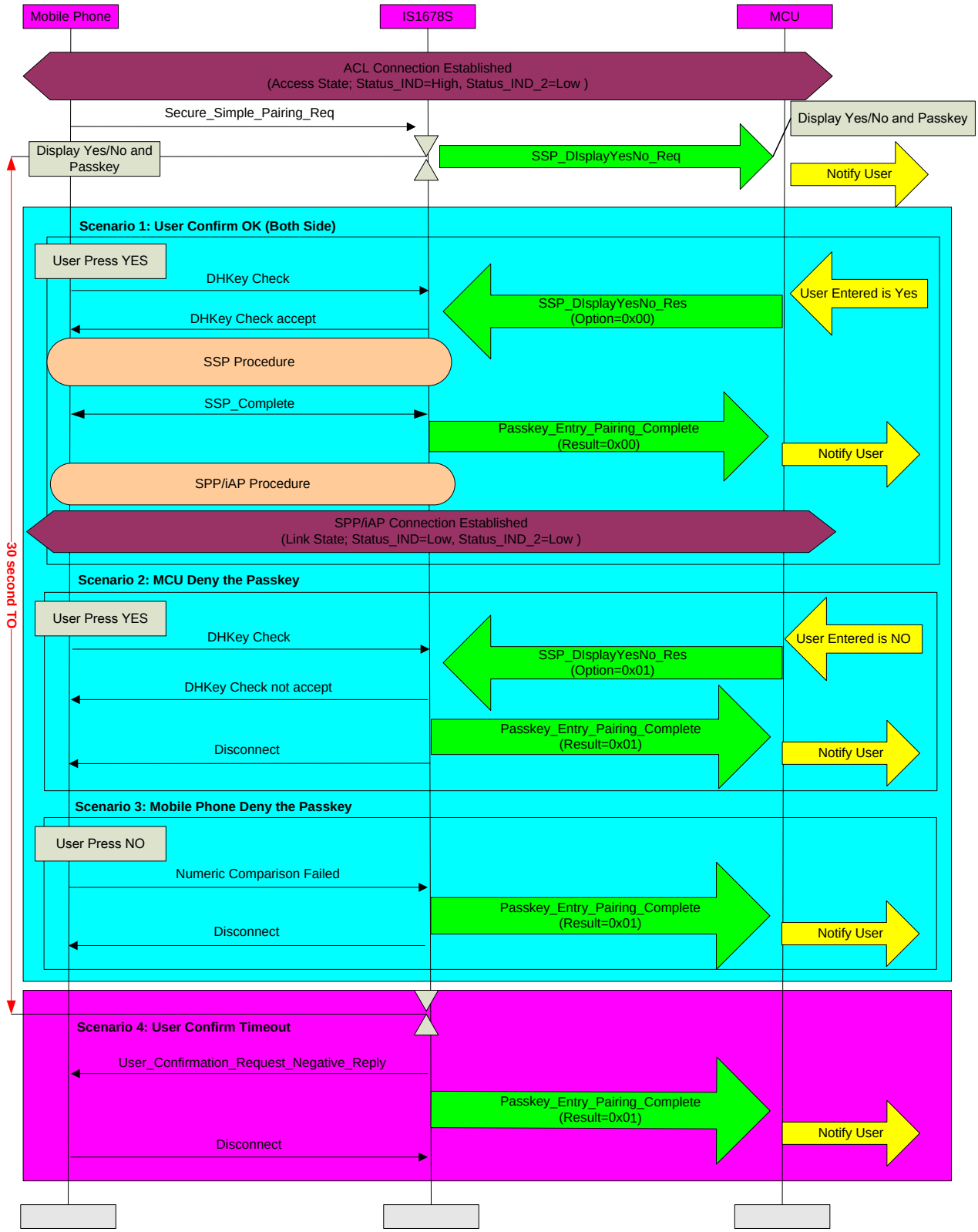


- BT connection is established under BLE

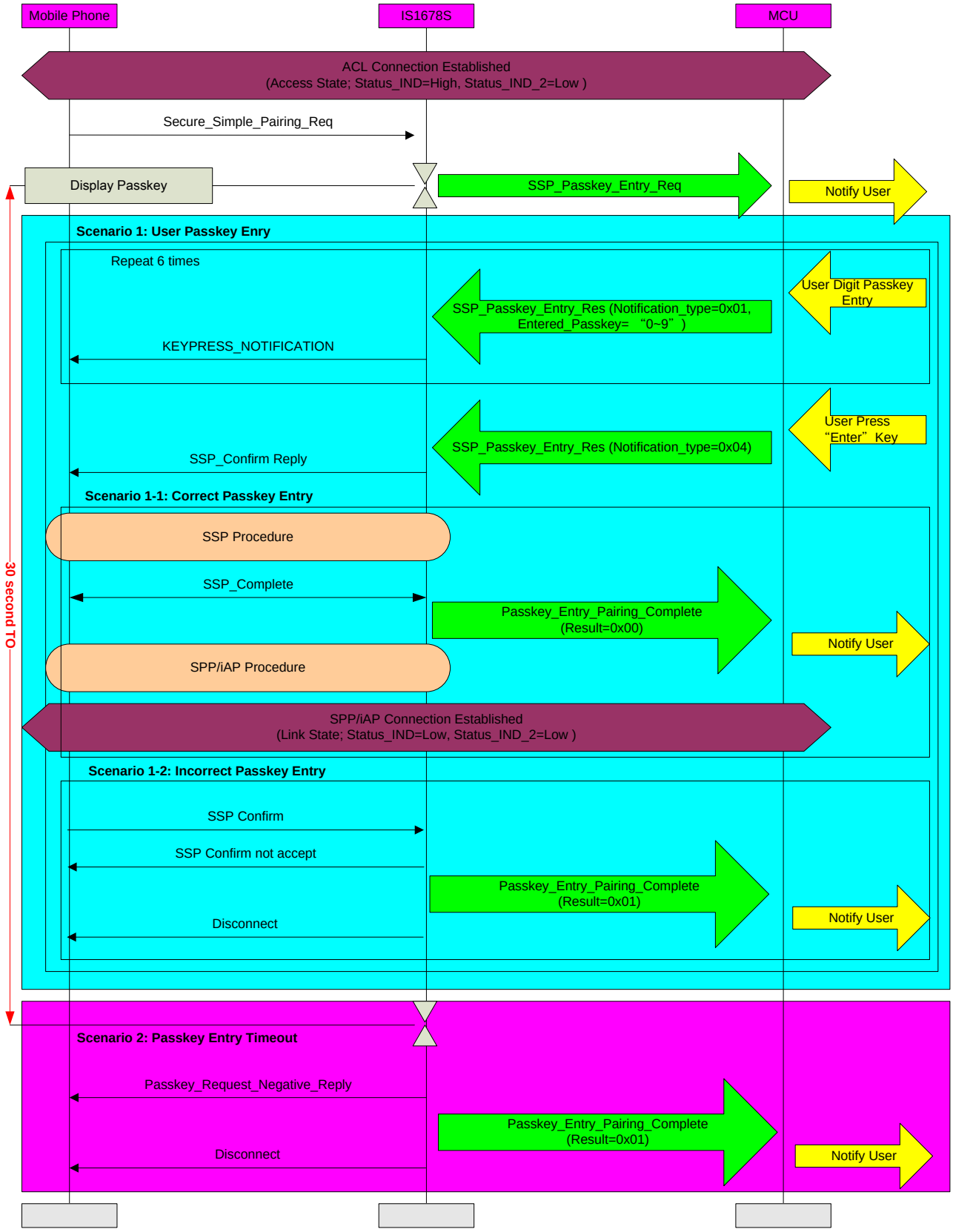


3.7. Security MSC

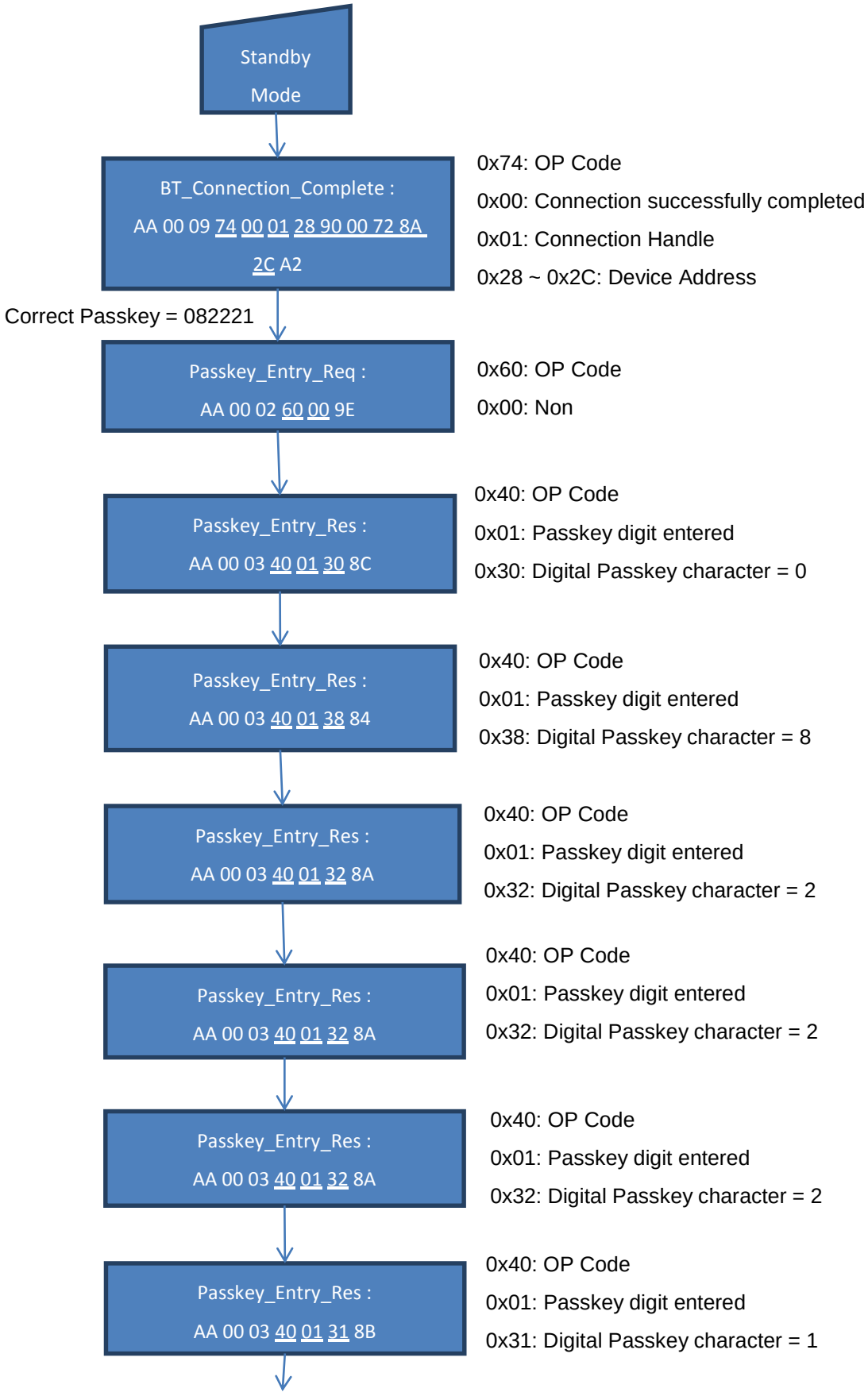
3.8.1 SPP Pairing (User Confirm)

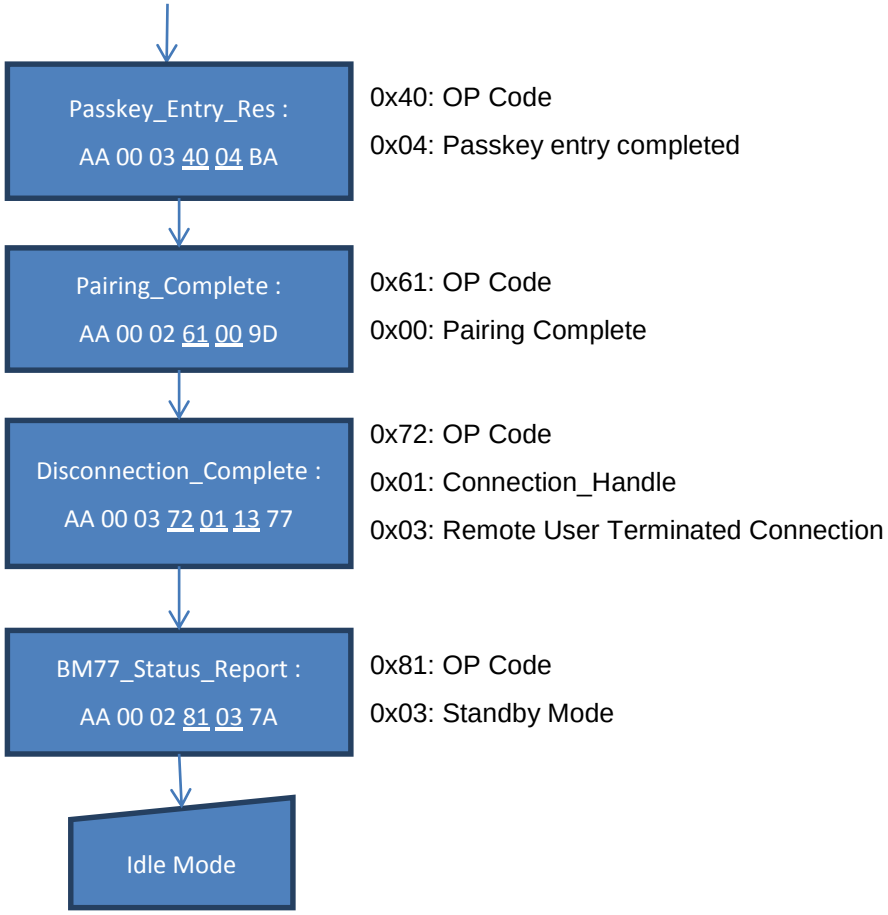


3.8.2 SPP Pairing (Passkey Entry)

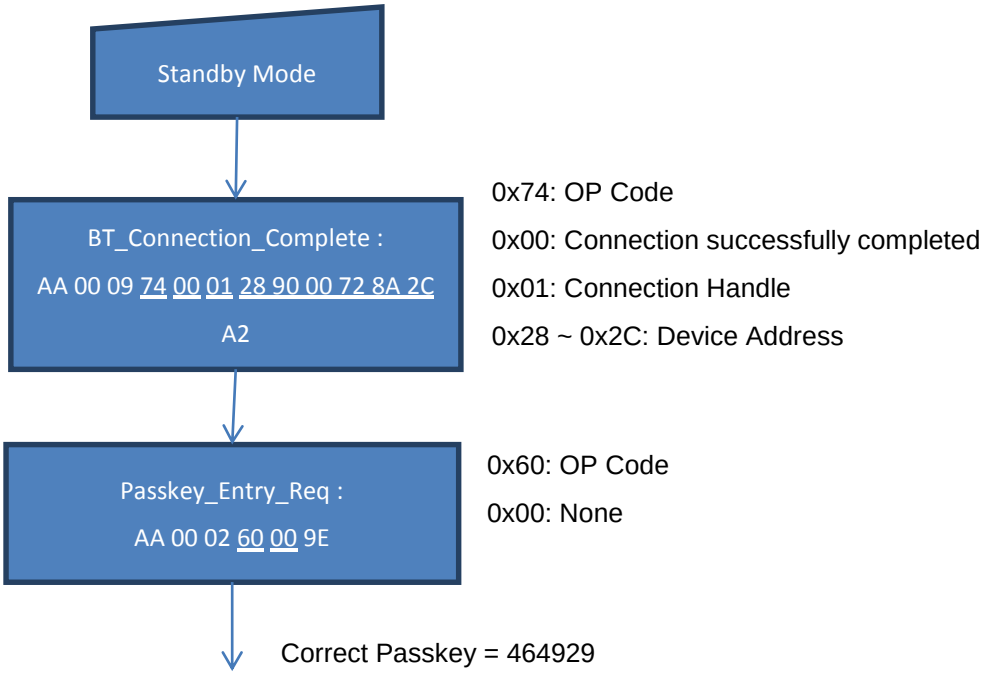


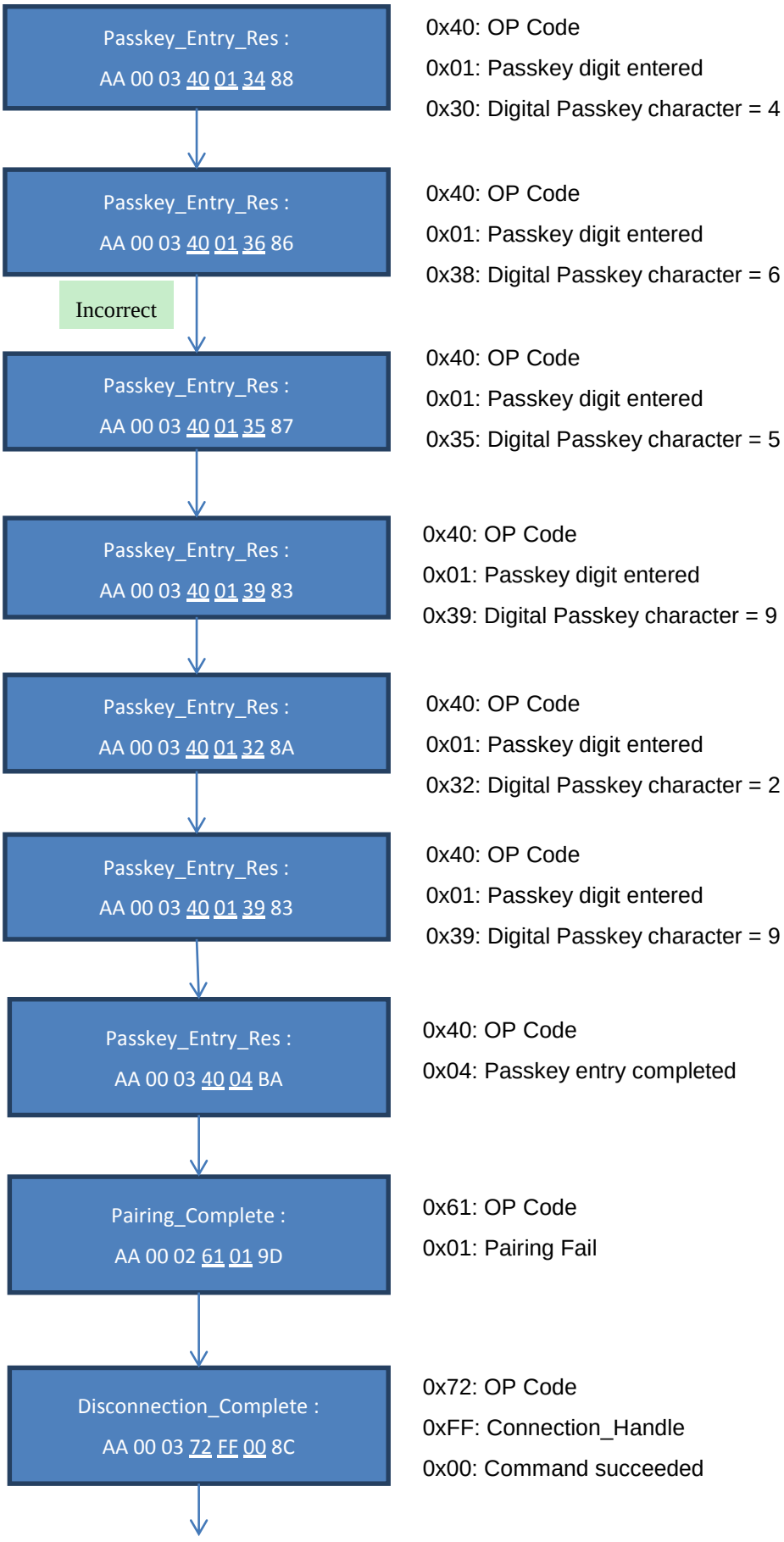
3.8.3 Correct Passkey Entry Procedure

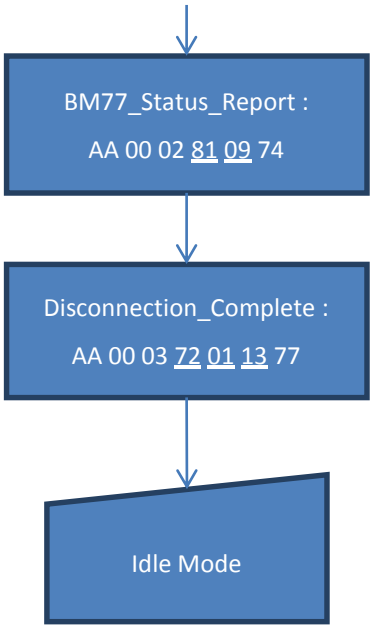




3.8.4 Incorrect Passkey Entry Procedure



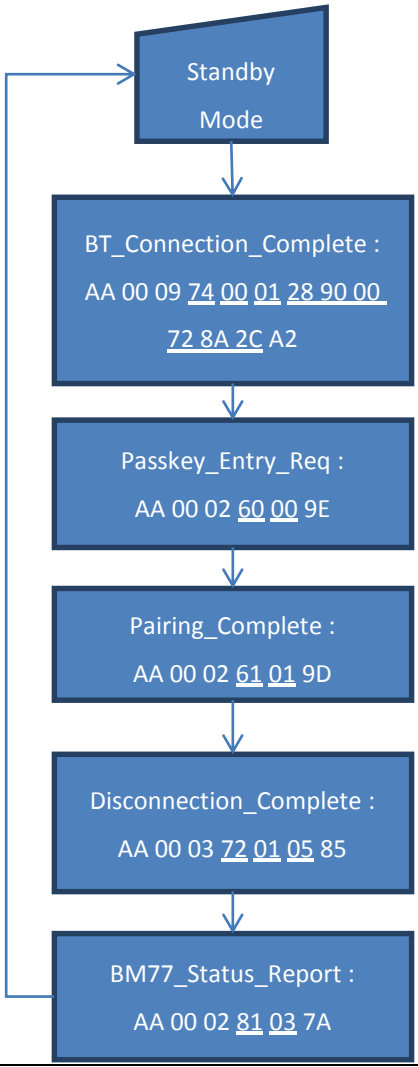

Passkey_Entry_Res :
AA 00 03 40 01 34 88
0x40: OP Code
0x01: Passkey digit entered
0x30: Digital Passkey character = 4
Passkey_Entry_Res :
AA 00 03 40 01 36 86
0x40: OP Code
0x01: Passkey digit entered
0x38: Digital Passkey character = 6
Incorrect
Passkey_Entry_Res :
AA 00 03 40 01 35 87
0x40: OP Code
0x01: Passkey digit entered
0x35: Digital Passkey character = 5
Passkey_Entry_Res :
AA 00 03 40 01 39 83
0x40: OP Code
0x01: Passkey digit entered
0x39: Digital Passkey character = 9
Passkey_Entry_Res :
AA 00 03 40 01 32 8A
0x40: OP Code
0x01: Passkey digit entered
0x32: Digital Passkey character = 2
Passkey_Entry_Res :
AA 00 03 40 01 39 83
0x40: OP Code
0x01: Passkey digit entered
0x39: Digital Passkey character = 9
Passkey_Entry_Res :
AA 00 03 40 04 BA
0x40: OP Code
0x04: Passkey entry completed
Pairing_Complete :
AA 00 02 61 01 9D
0x61: OP Code
0x01: Pairing Fail
Disconnection_Complete :
AA 00 03 72 FF 00 8C
0x72: OP Code
0xFF: Connection_Handle
0x00: Command succeeded



0x81: OP Code
0x09: Idle Mode

0x72: OP Code
0x01: Connection_Handle
0x13: Remote User Terminated Connection

3.8.5 Timeout Passkey Entry Procedure



0x74: OP Code
0x00: Connection successfully completed
0x01: Connection Handle
0x28 ~ 0x2C: Device Address

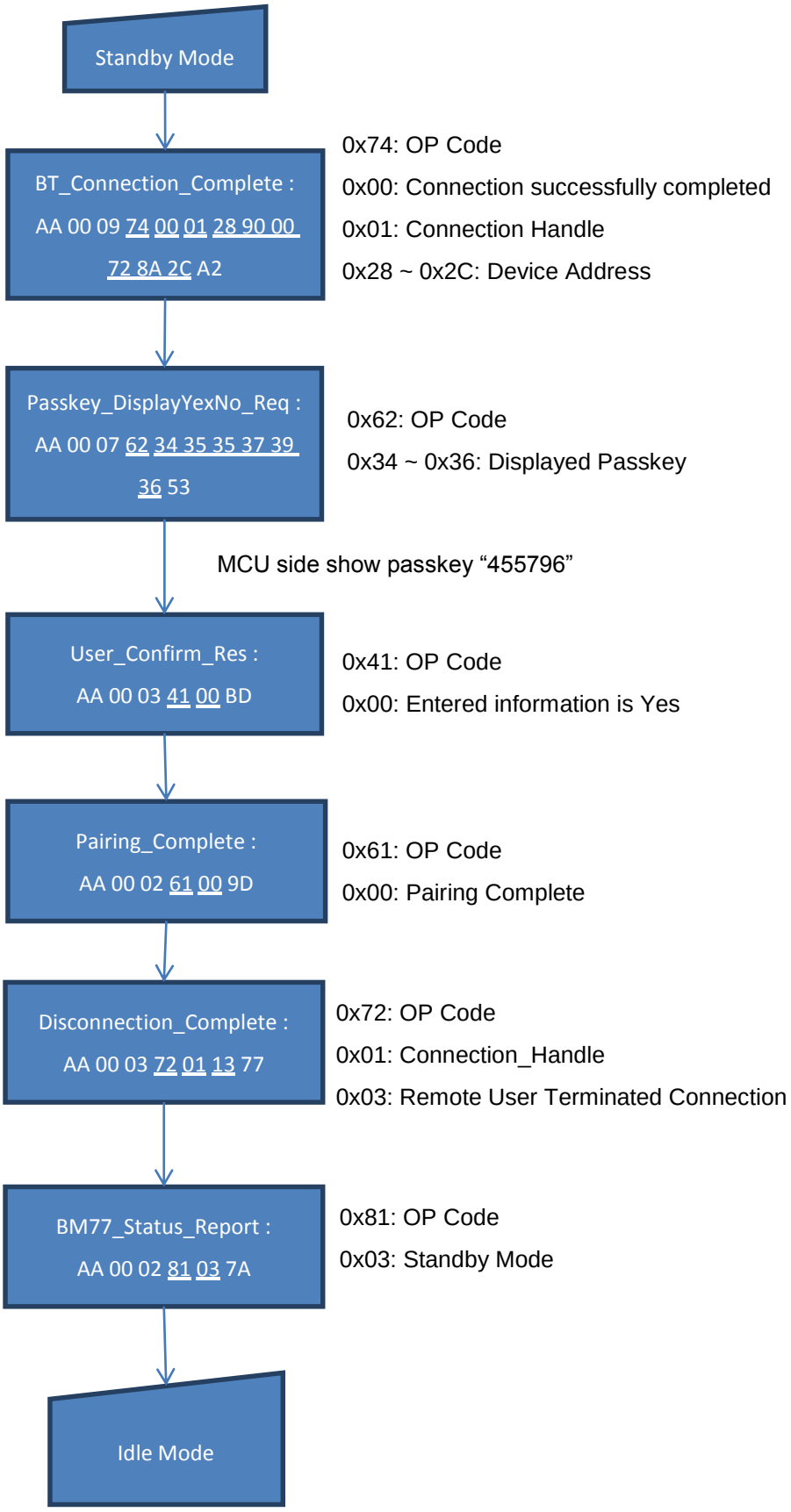
0x60: OP Code
0x00: None

0x61: OP Code
0x01: Pairing Fail

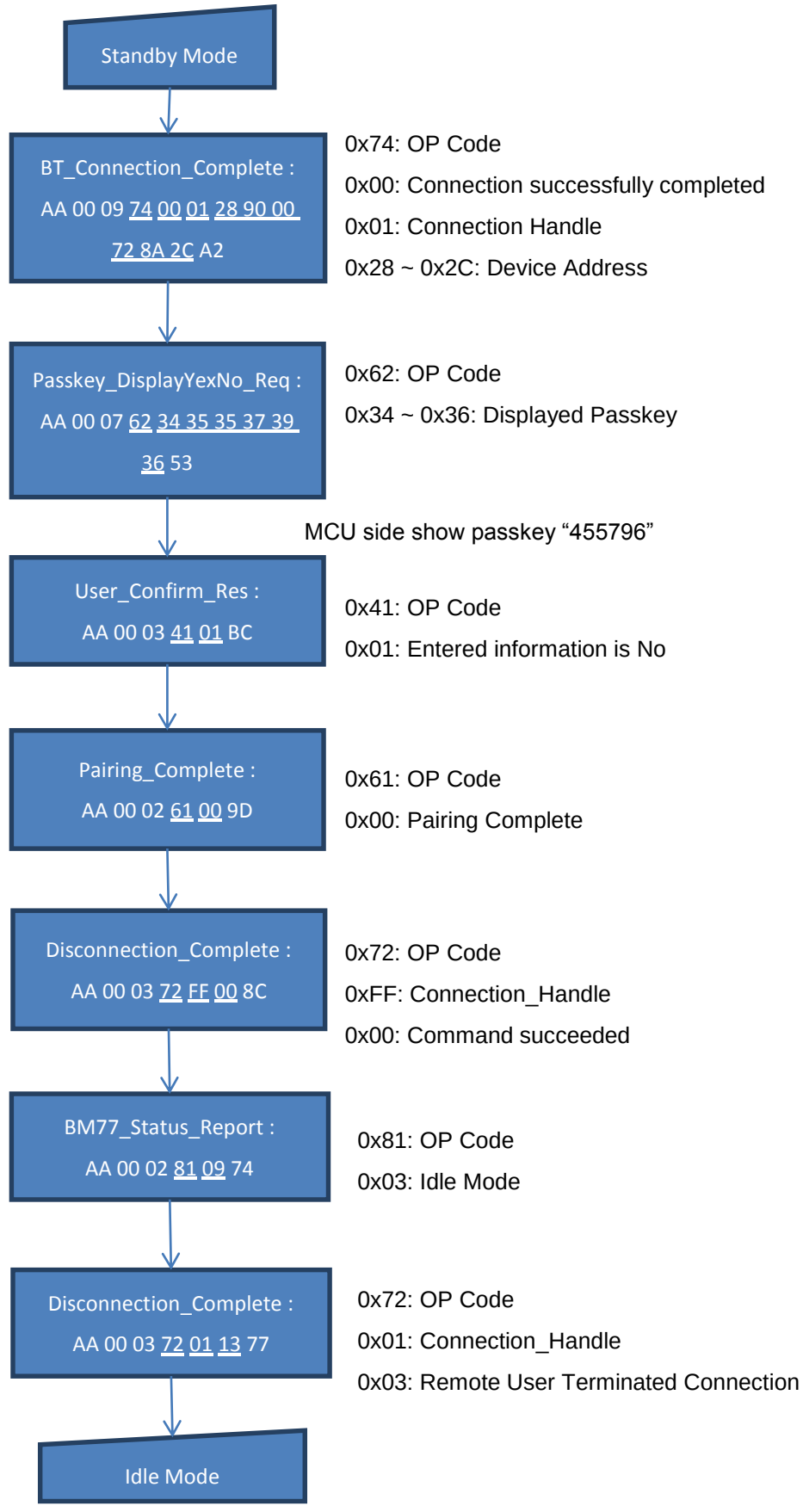
0x72: OP Code
0x01: Connection_Handle
0x05: Authentication Failure

0x81: OP Code
0x03: Standby Mode

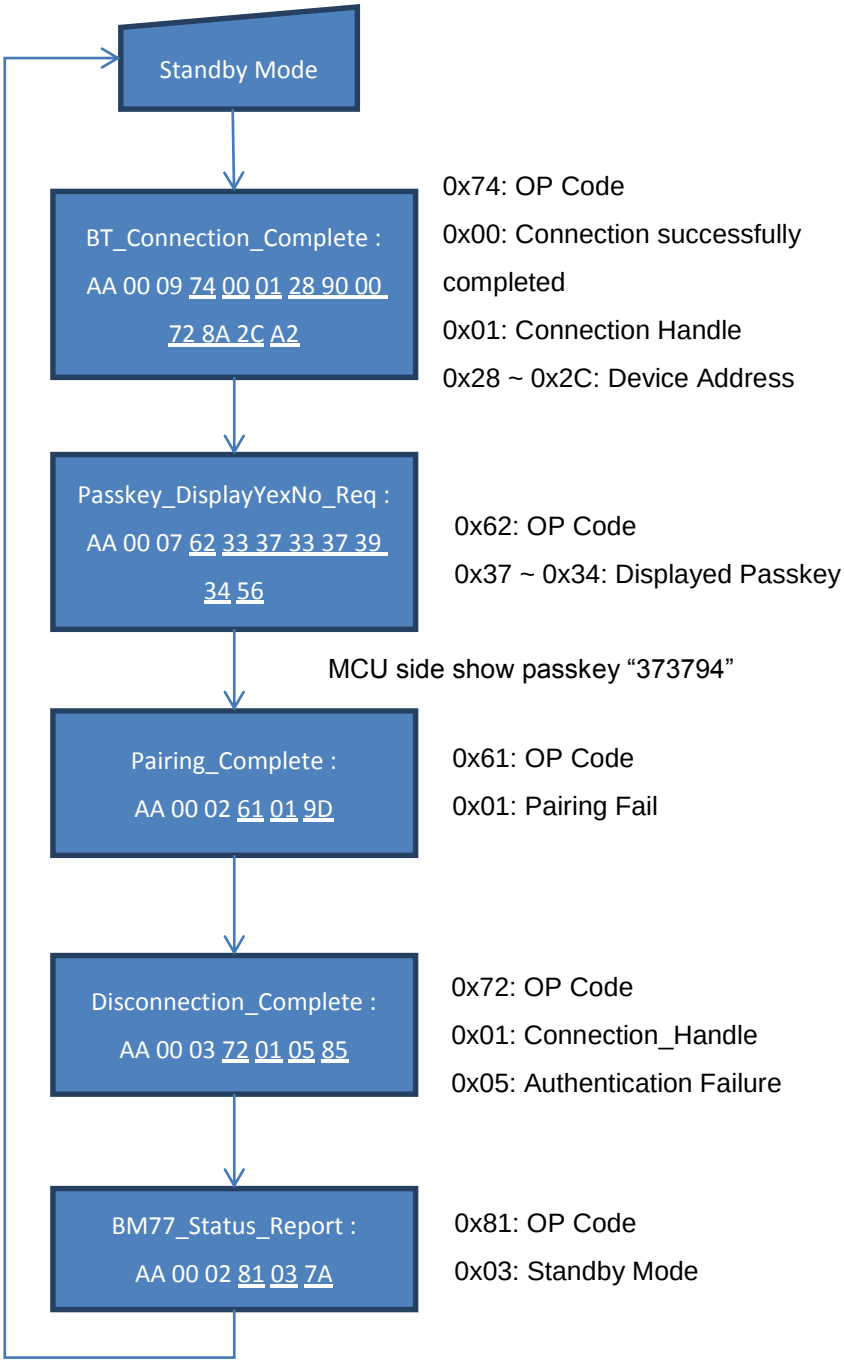
3.8.6 Passkey Confirm Pass Procedure



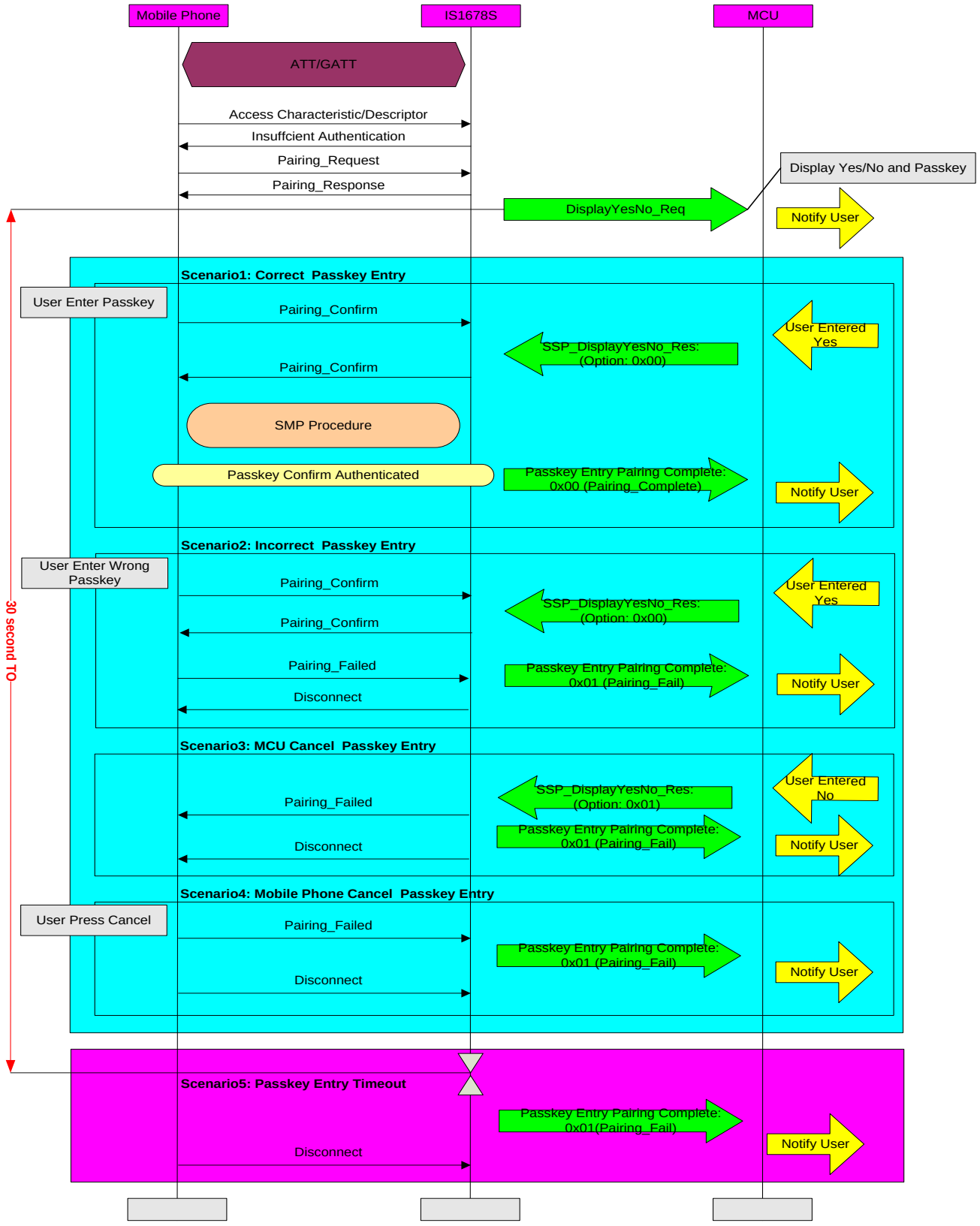
3.8.7 Passkey Confirm Denied Procedure



3.8.8 Passkey Confirm Timeout Procedure

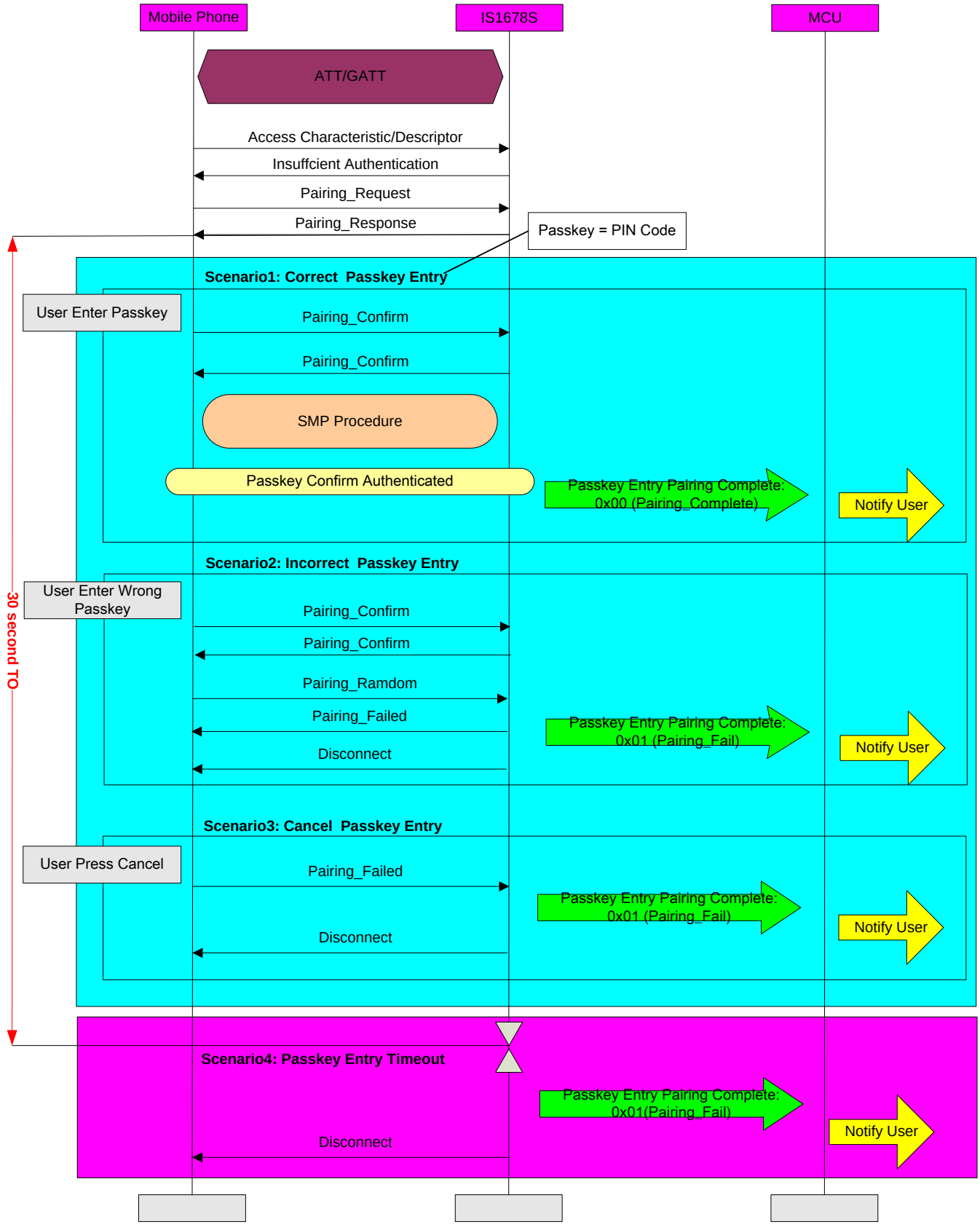


3.8.9 BLE SMP[1] (Passkey Confirm)

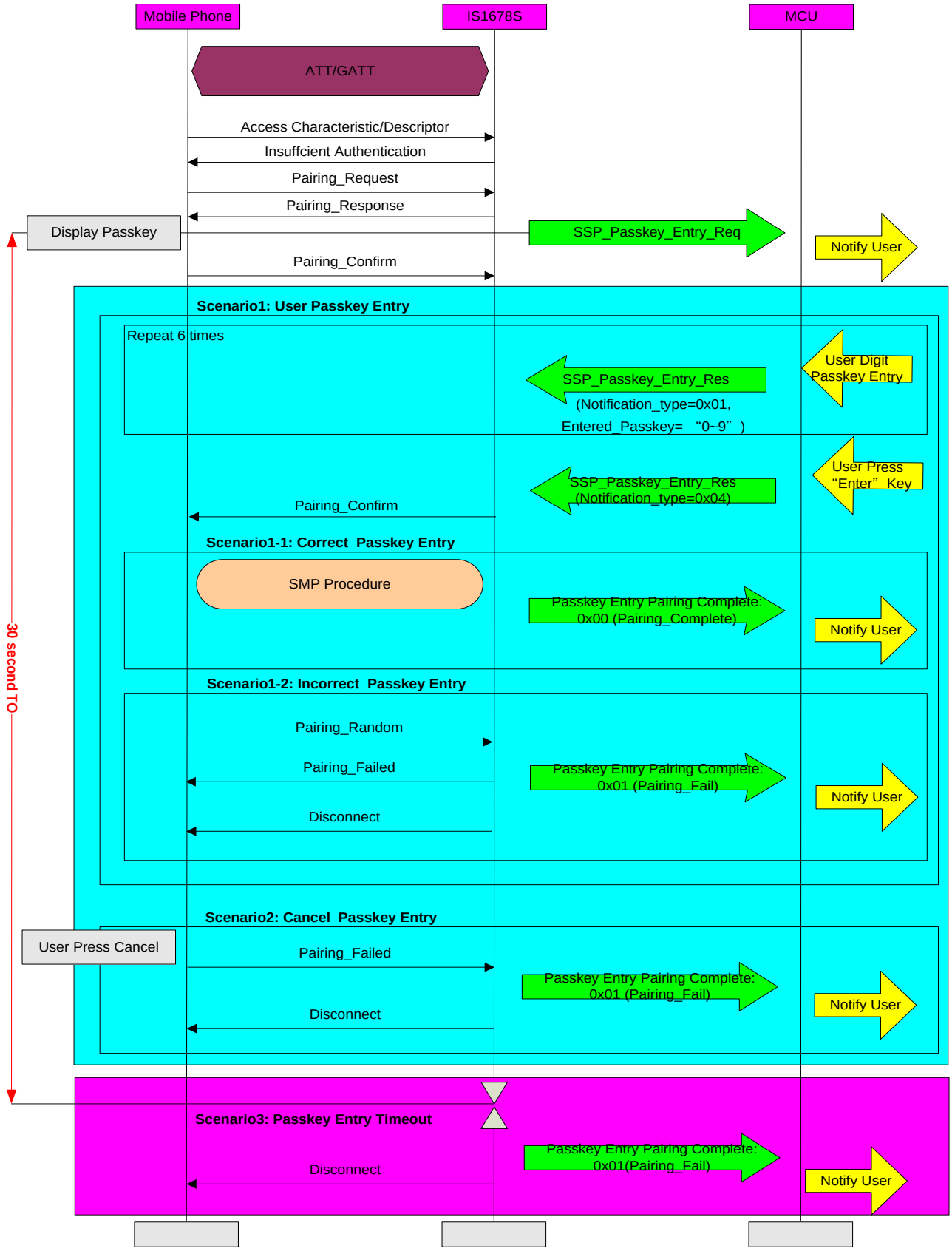


1: Security manager protocol (SMP)

3.8.10 BLE SMP (Passkey Confirm “refer to pin code”- by UI setting)

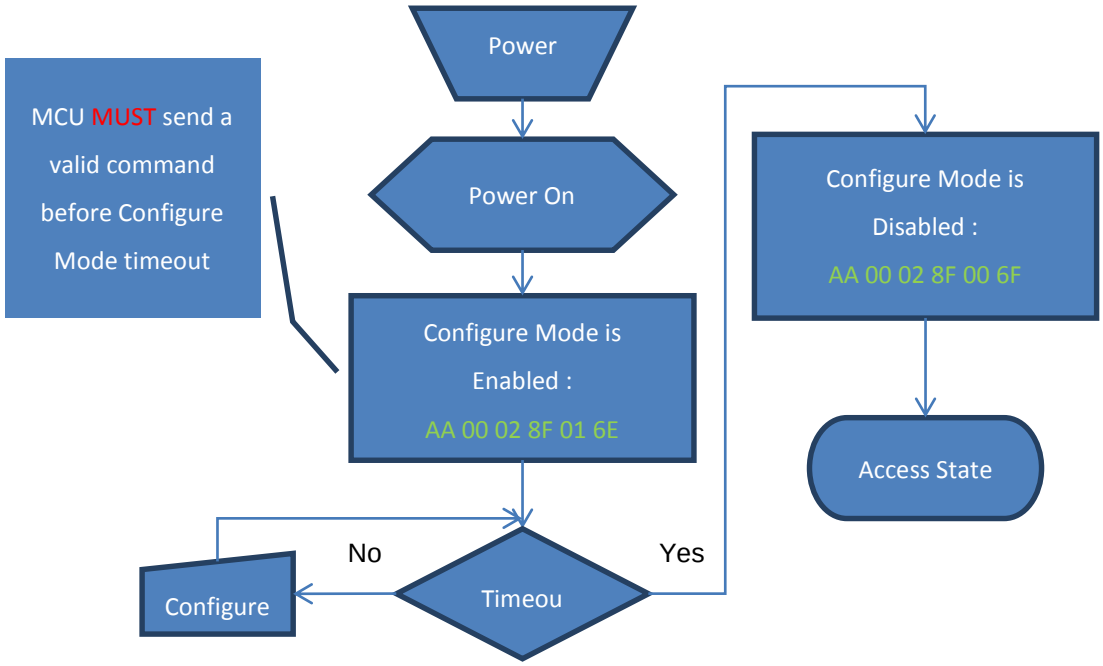


3.8.11 BLE SMP (Passkey Entry)

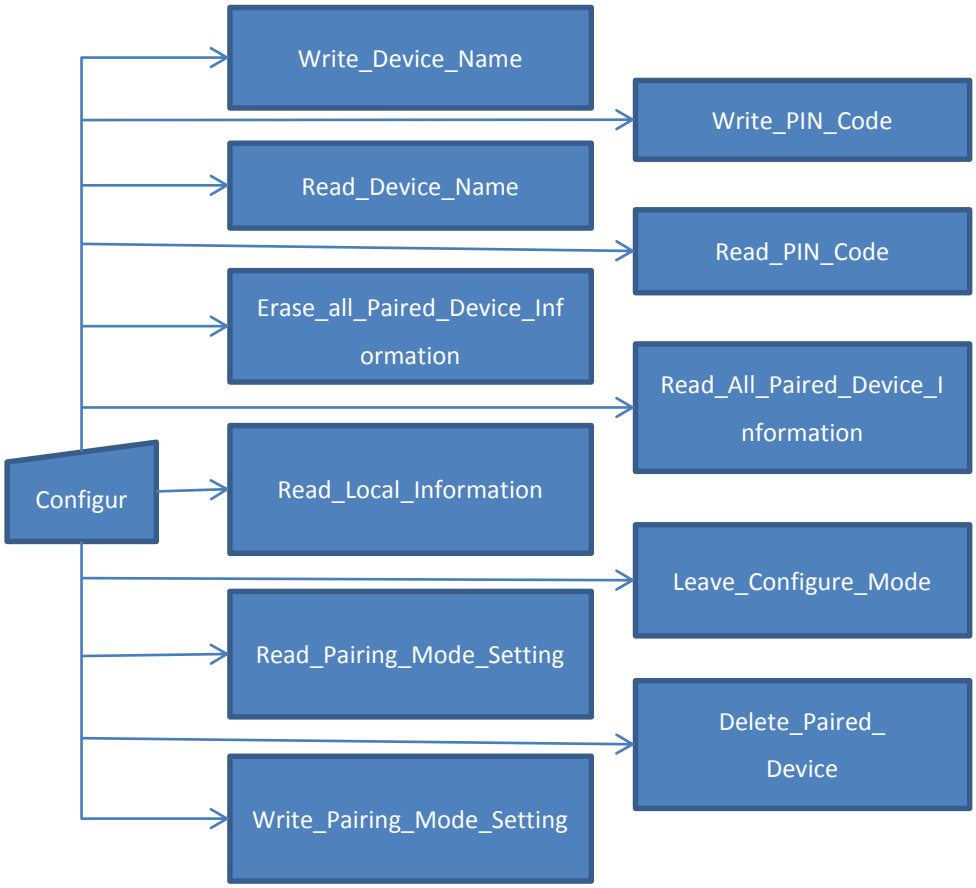


3.9. Standard Operating Procedure

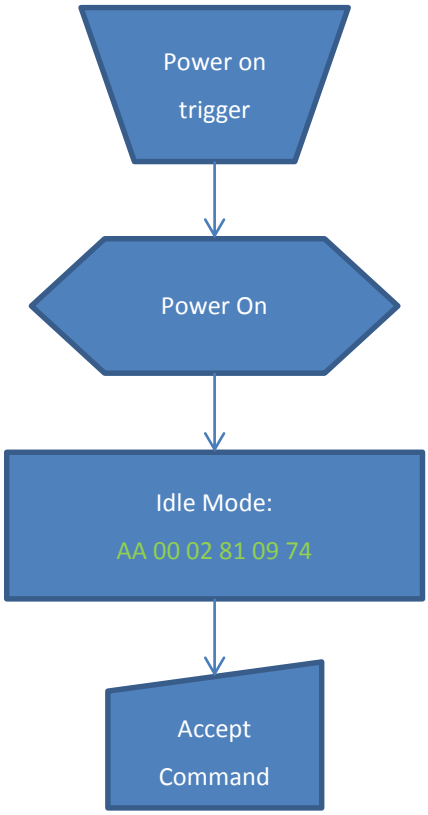
3.10.2 Auto pattern w/ Configure Mode



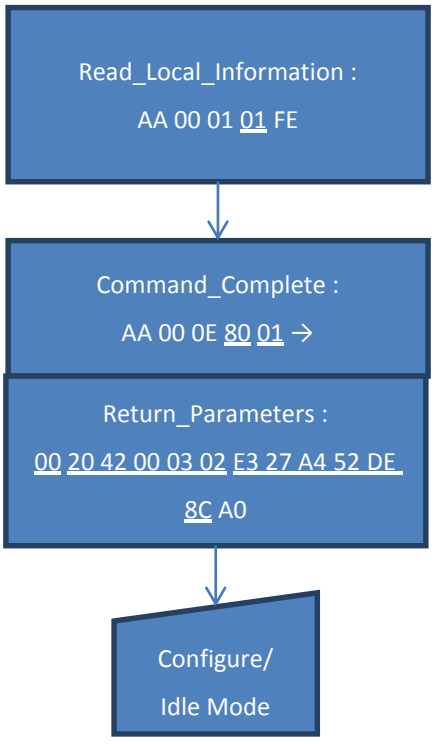
3.10.2 Configure Mode



3.10.2 Manual pattern



3.10.2 Read_Local_Information



0x01: OP Code

0x80: OP Code

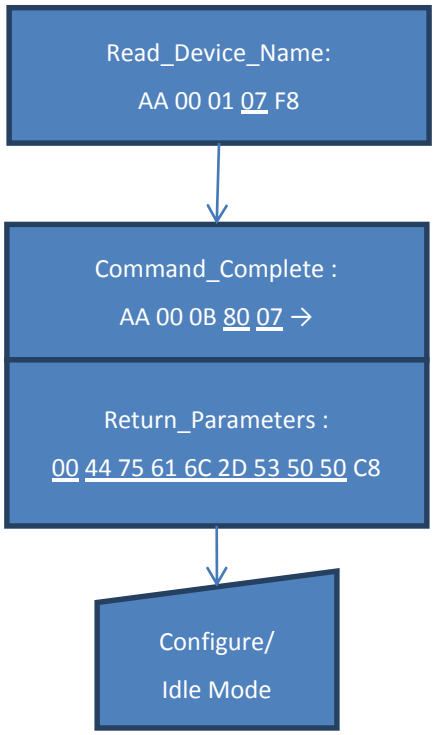
0x01: The command which caused this event.

0x00: Command succeeded

0x20 ~ 0x02: Version = 0x2042000302

0xE3 ~ 0x8C: Bluetooth address = 0x8CDE52A427E3

3.10.2 Read_Device_Name



0x07: OP Code

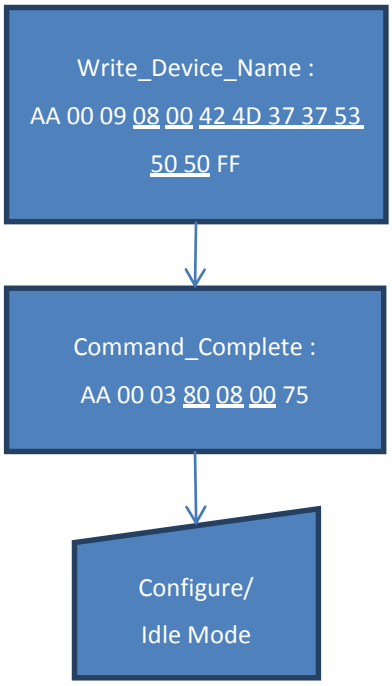
0x80: OP Code

0x07: The command which caused this event.

0x00: Command succeeded

0x44 ~ 0x50: Device Name = Dual-SPP

3.10.2 Write_Device_Name



0x08: OP Code

0x00: The change won't store to EEPROM *0x42 ~ 0x50:

New Device Name = BM77SPP

0x80: OP Code

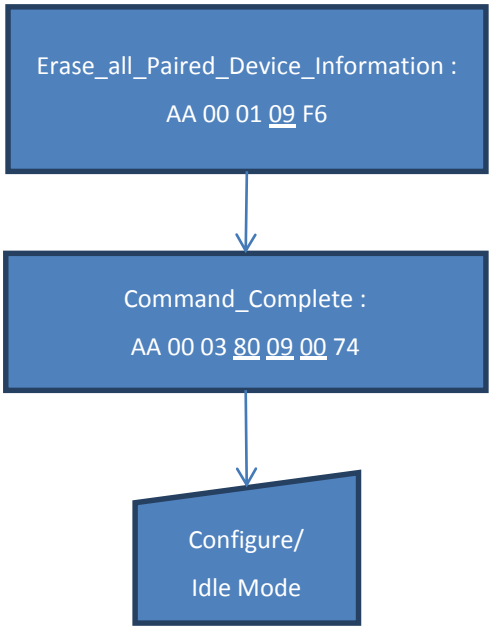
0x08: The command which caused this event.

0x00: Command succeeded

* 0x01: The change will store to EEPROM.

Reset change won't be clear.

3.10.2 Erase_all_Paired_Device_Information



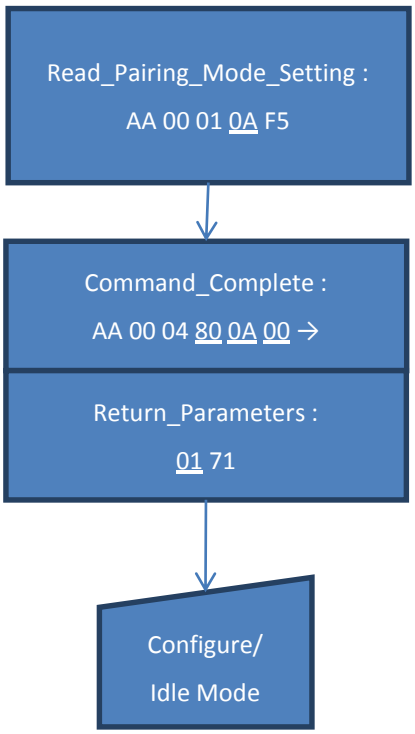
0x09: OP Code

0x80: OP Code

0x09: The command which caused this event.

0x00: Command succeeded

3.10.2 Read_Pairing_Mode_Setting



0x0A: OP Code

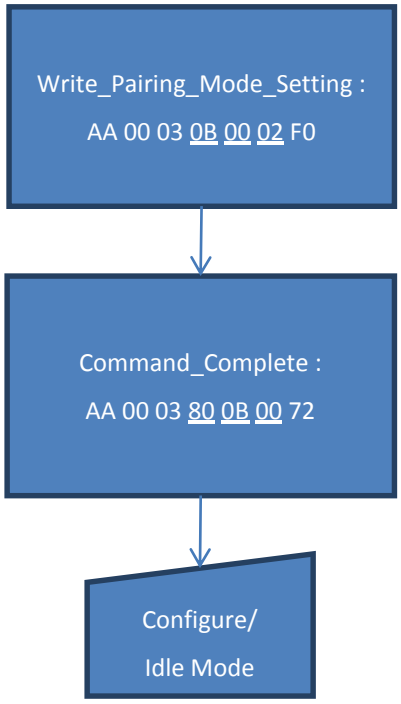
0x80: OP Code

0x0A: The command which caused this event.

0x00: Command succeeded

0x01: Pairing Mode = Just Work

3.10.2 Write_Pairing_Mode_Setting



0x0B: OP Code

0x00: The change won't store to EEPROM *

0x02: Pairing Mode = Passkey Entry **

0x80: OP Code

0x0B: The command which caused this event.

0x00: Command succeeded

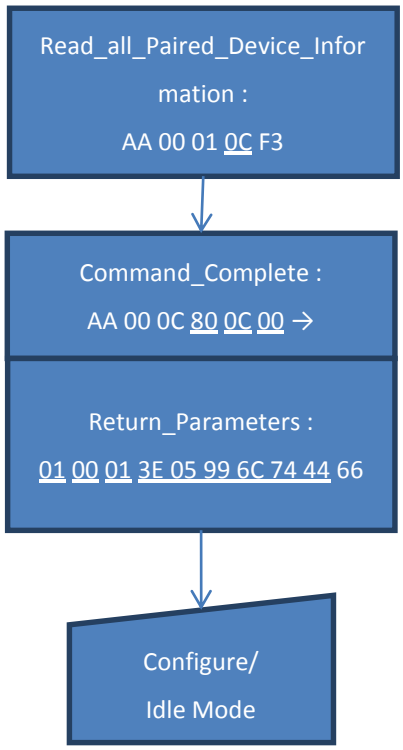
* 0x01: The change will store to EEPROM.
Reset the change won't be clear.

** 0x00: Disable SSP

0x01: Just Work

0x03: User Confirm

3.10.2 Read_all_Paired_Device_Information



0x0C: OP Code

0x80: OP Code

0x0C: The command which caused this event.

0x00: Command succeeded

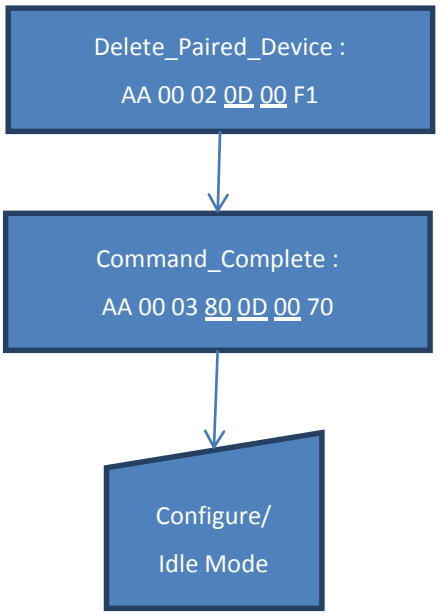
0x01: Number of paired devices

0x00: Paired device index

0x01: Link priority

0x3E ~ 0x44: Paired device Bluetooth address (e.g.)

3.10.2 Delete_Paired_Deviceg



0x0D: OP Code

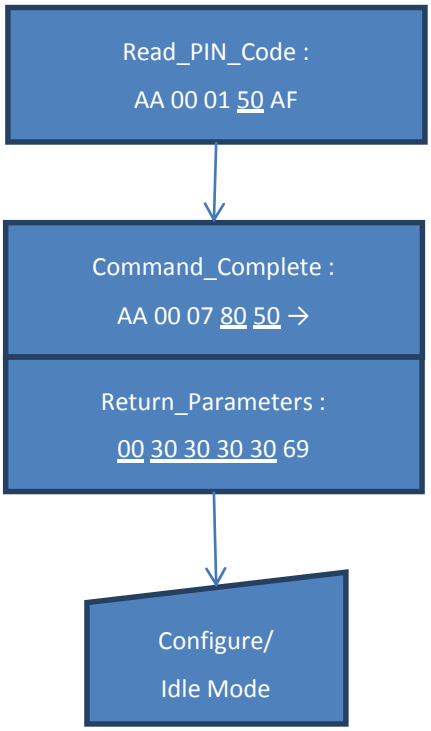
0x00: Device index

0x80: OP Code

0x0D: The command which caused this event.

0x00: Command succeeded

3.10.2 Read_PIN_Code



0x50: OP Code

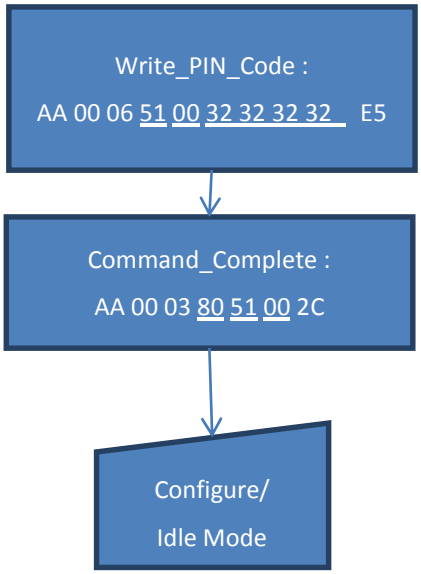
0x80: OP Code

0x50: The command which caused this event.

0x00: Command succeeded

0x30 ~ 0x30: PIN Code = 0000

3.10.2 Write_PIN_Code



0x51: OP Code

0x00: The change won't store to EEPROM *

0x32 ~ 0x32: New PIN Code = 2222 (e.g.)

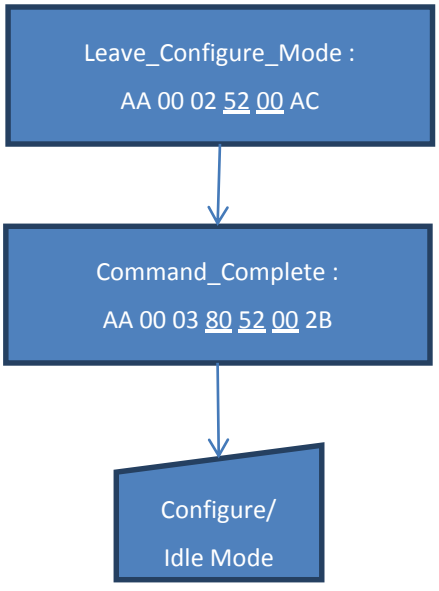
0x80: OP Code

0x51: The command which caused this event.

0x00: Command succeeded

* 0x01: The change will store to EEPROM.
Then reset the change won't be clear.

3.10.2 Leave_Configure_Mode



0x52: OP Code

0x00: None *

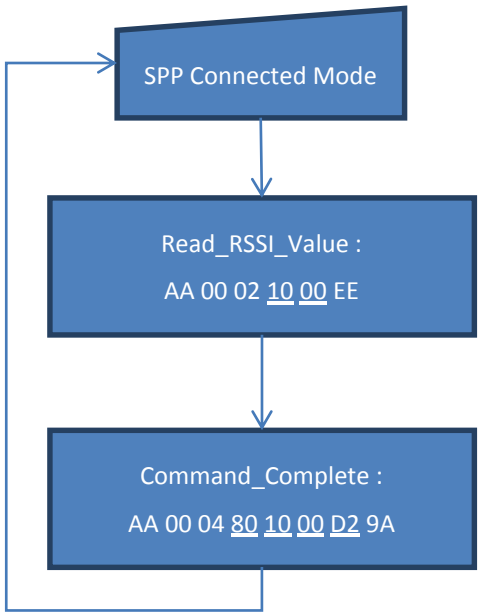
0x80: OP Code

0x51: The command which caused this event.

0x00: Command succeeded

* 0x01: Disable configure mode forever

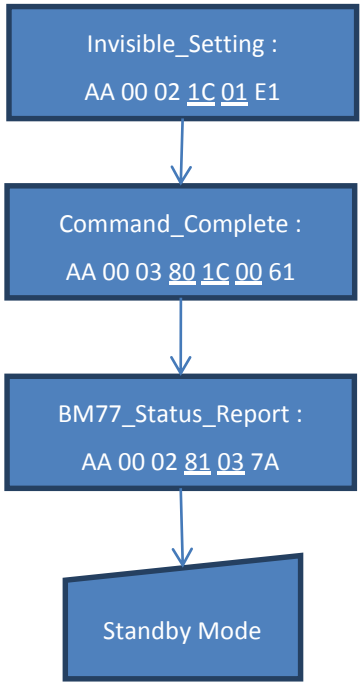
3.10.2 Read_RSSI_Value



0x10: OP Code
0x00: Connection Handle

0x80: OP Code
0x10: The command which caused this event.
0x00: Command succeeded
0xD2: RSSI Value

3.10.2 Invisible_Setting (1)

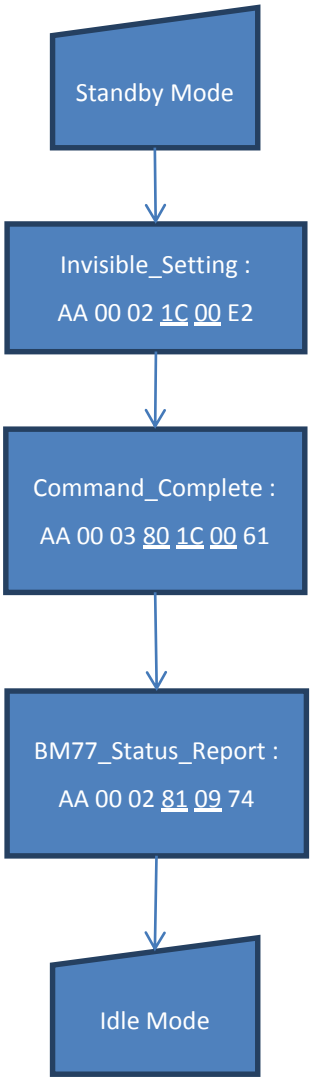


0x1C: OP Code
0x01: Enter Standby Mode

0x80: OP Code
0x1C: The command which caused this event.
0x00: Command succeeded

0x81: OP Code
0x03: Standby Mode

3.10.2 Invisible_Setting (2)



0x1C: OP Code

0x00: Leave Standby Mode

0x80: OP Code

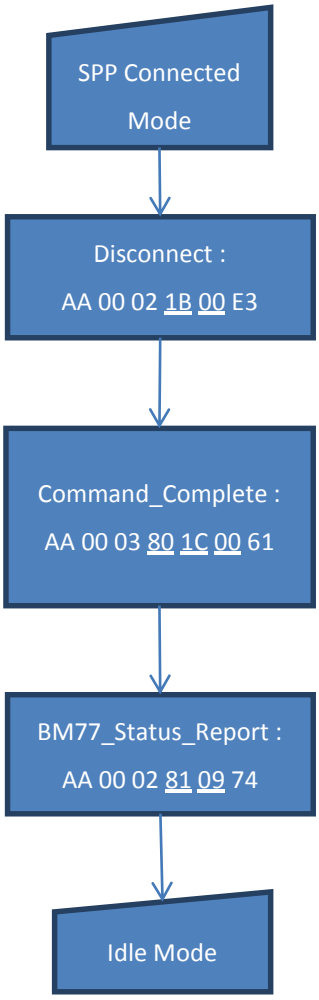
0x1C: The command which caused this event.

0x00: Command succeeded

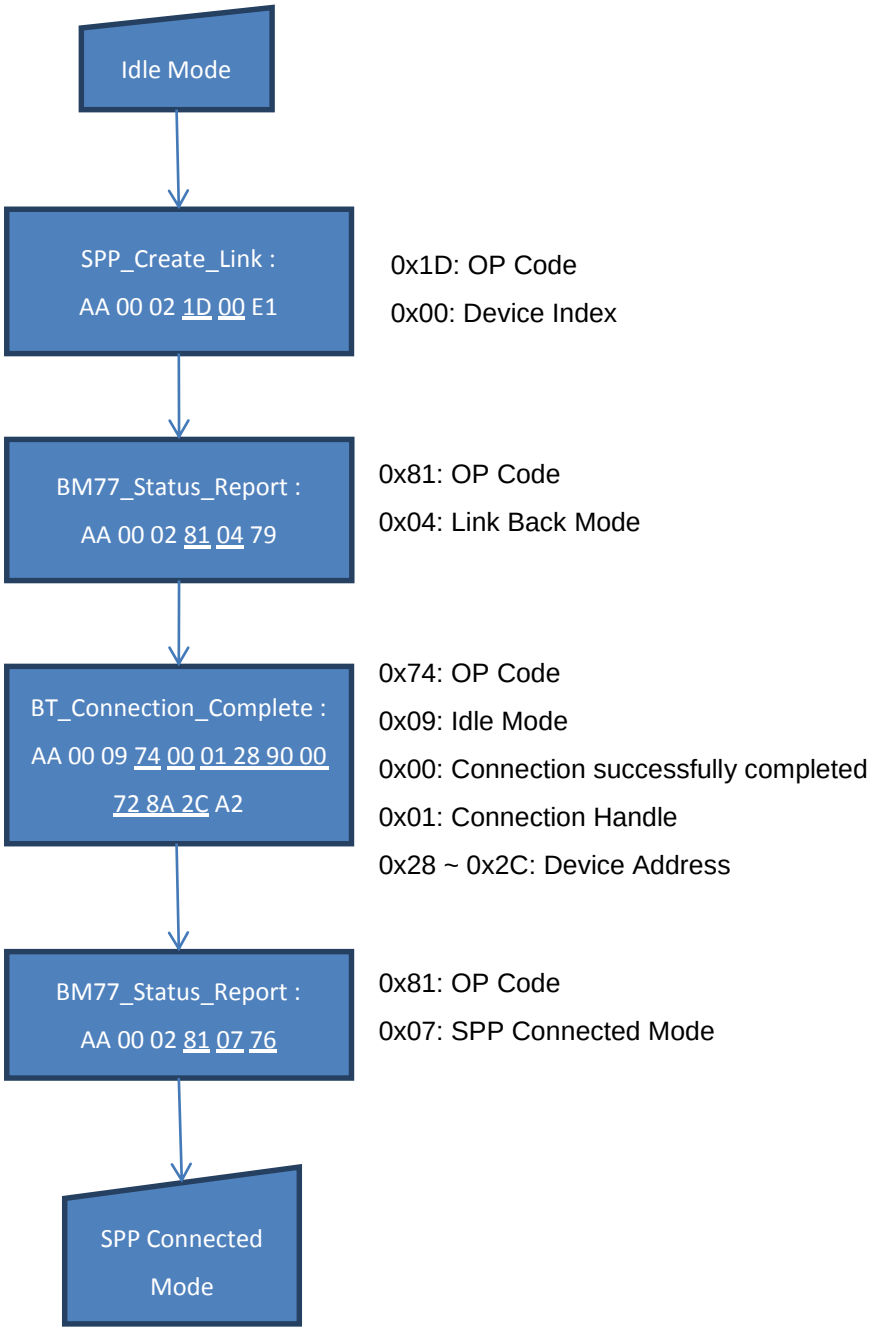
0x81: OP Code

0x09: Idle Mode

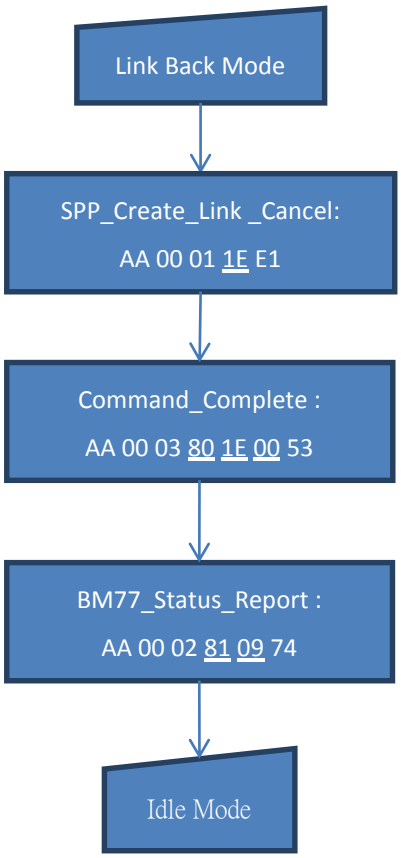
3.10.2 Disconnect



3.10.2 SPP_Create_Link



3.10.2 SPP_Create_Link_Cancel

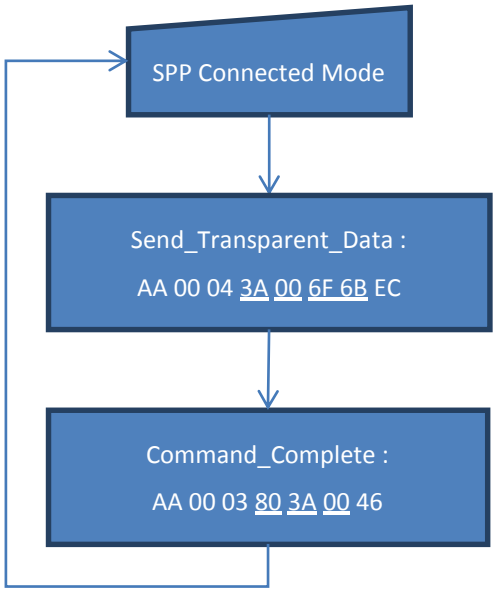


0x1E: OP Code
0xE1: CRC

0x80: OP Code
0x1E: The command which caused this event
0x00: Command succeeded

0x81: OP Code
0x09: Idle Mode

3.10.2 Send_Transparent_Data

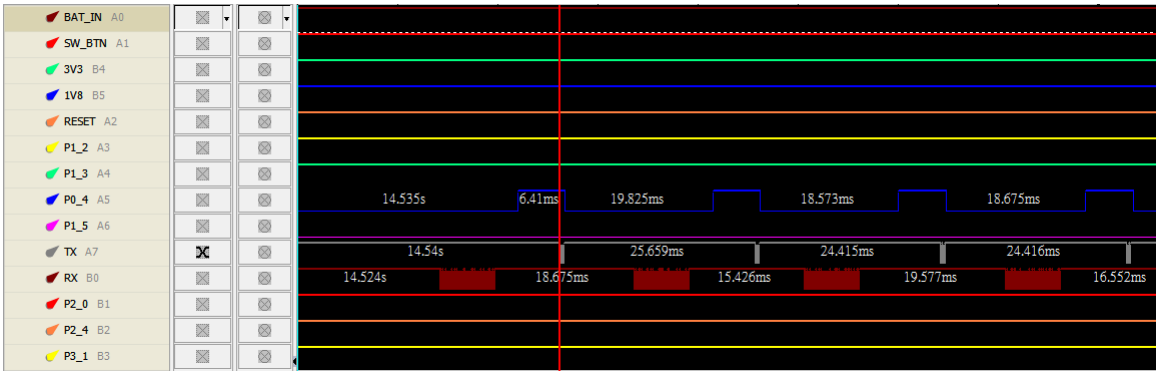


0x3A: OP Code
0x00: Reserved
0x6F ~ 0x6B: Transparent Data

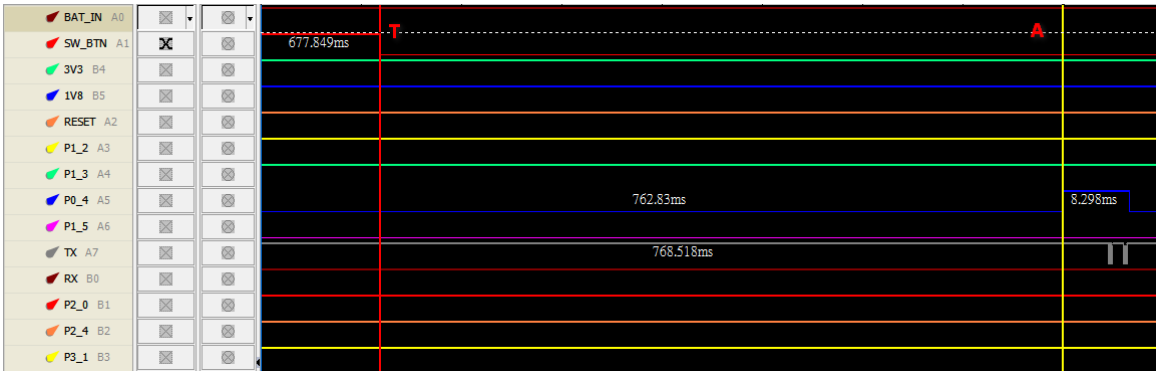
0x80: OP Code
0x3A: The command which caused this event
0x00: Command succeeded

3.10. Timing Diagram

3.10.2 Manual Pattern Transmit



3.10.2 Manual Pattern in Soft Power Down



T – A: 85ms

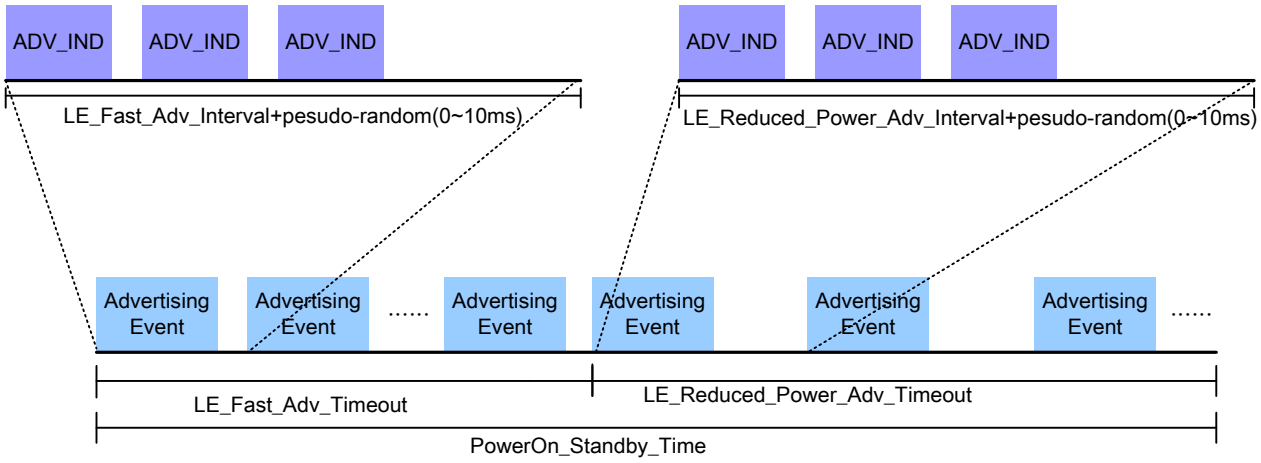
4. Advanced Topic

4.9. BLE Standby & Link Back Explanation:

The advertising interval and time to perform advertising can be configured with consideration for user expectations of connection establishment time.

- Standby: Undirected Advertising

  The interval values “LE_Fast_Adv_Interval” is designed to attempt fast connection during the limited time “LE_Fast_Adv_Timeout”. If a connection is not established within that time, the interval value “LE_Reduced_Power_Adv_Interval” is designed to reduce power consumption for devices that continues to advertise.

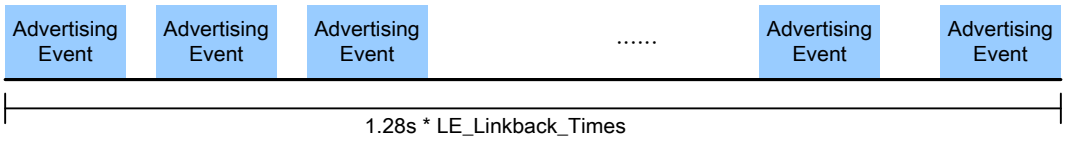


- Link Back: Directed Advertising

  For dedicate central BD_ADDR.

  Two cases can execute Link Back:

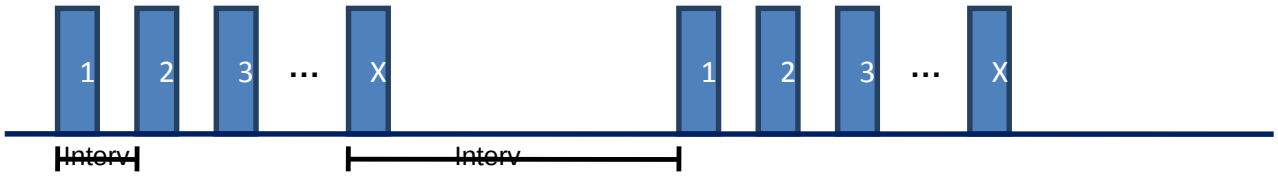
  - Central BD_ADDR is Public Address
  - Central BD_ADDR is Non-Resolvable Address and the address will be written in the reconnection address characteristic in Peripheral.



4.10. BLE Packet Divider

E2PROM Setting: Check_RX_Data_Interval Max: 160ms (Unit: 0.625ms)

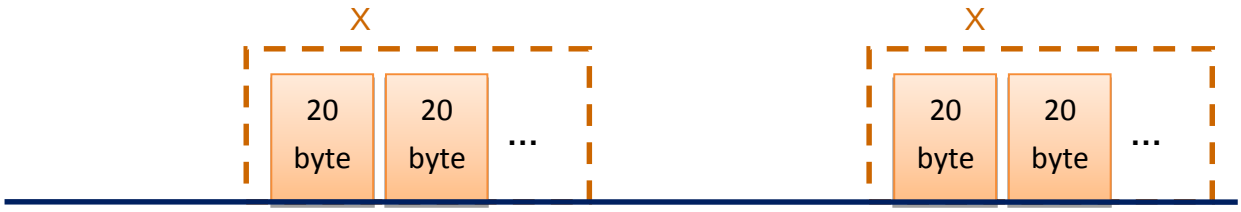
UART RX Packet



Interval<Check RX Data Int Interval>Check RX Data Inter

X<=20 BLE RF Packet

X>20 BLE RF Packet



4.11. BLE supports passkey entry and user confirm for pairing process

	PAIRING_REQUEST_ENABLE/ GATT_TABLE_PERMISSION_ENABLE
ENABLE_PASSKEY_ENTRY=1	iocapability: KeyboardDisplay MITM: Yes Authenticated
ENABLE_USER_CONFIRM=1	iocapability: DisplayYesNo MITM: Yes Authenticated
ENABLE_PASSKEY_ENTRY=0 **ENABLE_USER_CONFIRM=0**	iocapability: NoInputOutput MITM: No Unauthenticated

4.12. BLE throughput enhancement

Use proprietary protocol to increase BLE RX throughput by adding a new command "Read_MTU_Size_And_Enable_Credit_Ctrl" of air patch characteristic.

Read_MTU_Size_And_Enable_Credit_Ctrl (0x24)

Command	ID	Command Parameters	Return Parameters
Read_MTU_Size_And_Enable_ Credit_Ctrl	0x24	None	Status, ID, Max_MTU, Credit

Return Parameters:

STATUS: SIZE: 1 BYTE

Value	Parameter Description
0x00	Command succeeded

ID: SIZE: 1 BYTE

Value	Parameter Description
0x24	Returned Command ID is Read_MTU_Size_And_Enable_Credit_Ctrl

MAX_MTU: SIZE: 2 BYTE

Value	Parameter Description

0xXXXX	Maximum transmission MTU

CREDIT: SIZE: 1 BYTE

Value	Parameter Description
0xXX	Credit Number

4.13. BLE Random Device Address Notification

A device in Central may support the privacy feature by use of the non-resolvable address or the reconnection address as the device address. When a Central connects to privacy enabled Peripheral with the reconnection address characteristic, the Central shall write a new reconnect address in the reconnection address characteristic in the Peripheral. In iOS5 and above design, iDevice will uses the non-resolvable address and won't write reconnection address in the reconnection address characteristic in. So IS1678S won't enter link back mode while the last connected devices are iDevices.

4.14. BLE Connection Parameter Update Explanation:

LE Slave can request a set of new connection parameters by sending Connection Parameter Update Request to LE Master. LE Master may accept the requested parameters and deliver the requested parameters to its Controller or reject the request. The actual connection parameters are determined by LE Master. And iPhone4s will refer LE_Connection_Interval_Max as the connection interval.

There are four parameters need to be configured if connection parameters need to be updated.

- LE_Connection_Interval_Min
- LE_Connection_Interval_Max
- LE_Slave_Latency
- LE_Supervision_Timeout

Following are the example of the connection parameters and maximum throughput

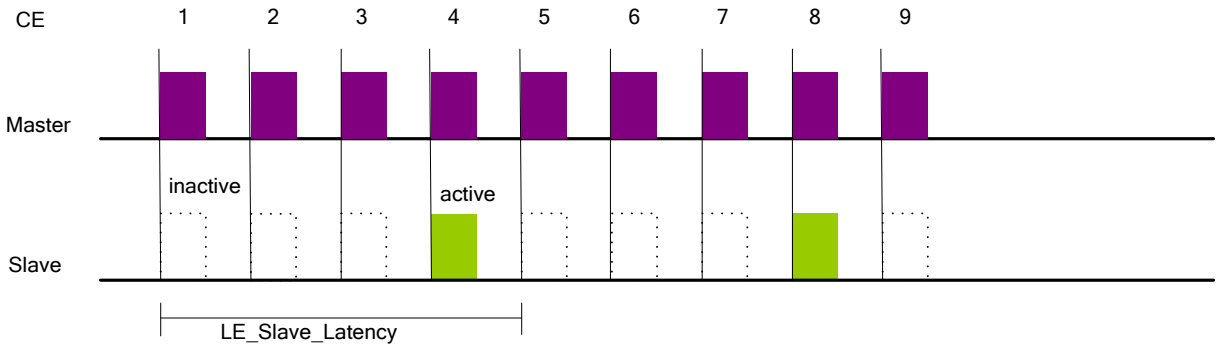
LE_Connection_Interval_Min (Unit: 1.25 ms)	LE_Connection_Interval_Max (Unit: 1.25 ms)	LE_Slave_Latency	LE_Supervision_Timeout (Unit: 10 ms)	Maximum Throughput (to iDevice)
0x0008	0x0010	0x0004	0x0200	1K *4 bytes/sec
0x0008	0x0030	0x0004	0x0200	320 *4 bytes/sec
0x0008	0x0190	0x0002	0x0200	40 * 4 bytes/sec (Default setting)

4.15. BLE_Slave_Latency Explanation:

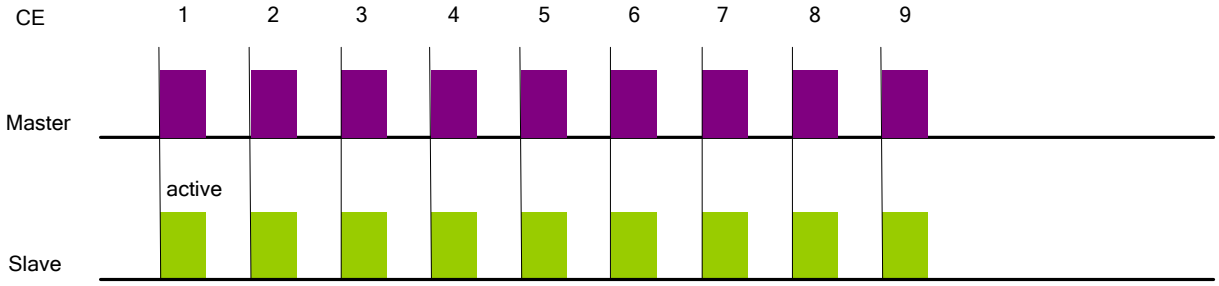
Slave latency allows a slave to use a reduced number of connection events. The LE_Slave_Latency parameter defines the number of consecutive connection events that the slave device is not required to listen for the master.

For example of LE_Slave_Latency = 0x0003:

- Case 1: No data traffic between Master and Slave:



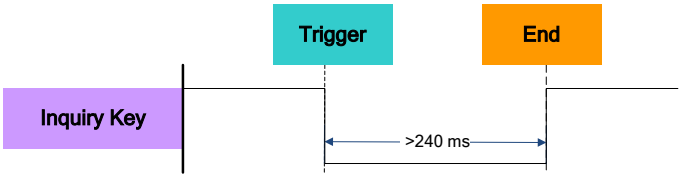
- Case 2: With data traffic between Master and Slave:



4.16. Support Proprietary Master/Slave SPP link setup procedure

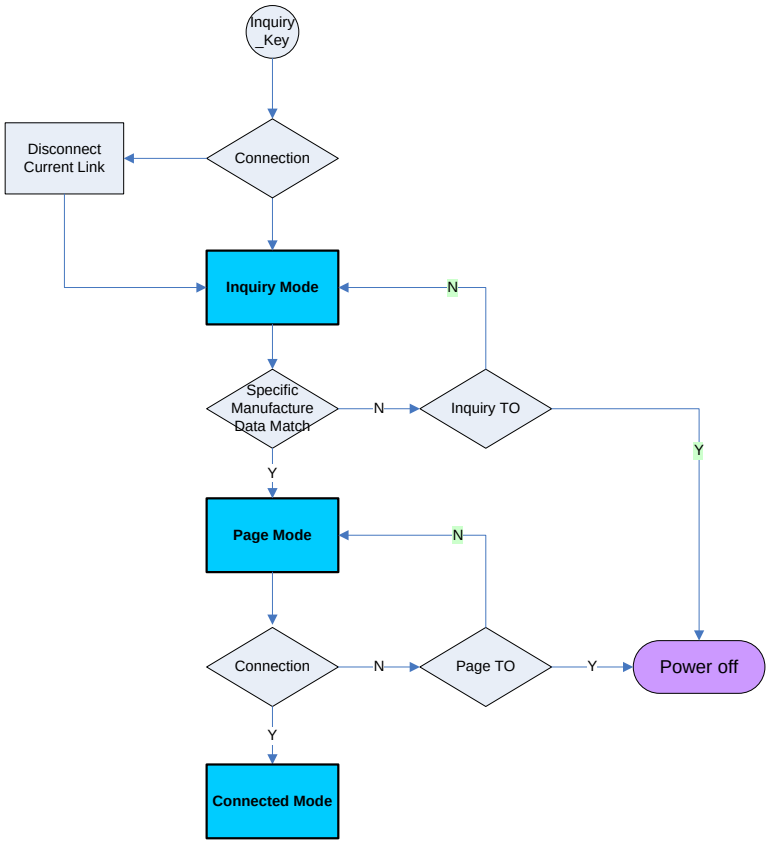
- Scheme:
  - Find dedicate peer device by EIR.
  - Setup SPP link for both devices.

- Force device into Inquiry Mode by trigger Inquiry Key (Condition: pull low over 240ms)



- System Configure Parameters:
  - GPIO Configuration
  - EIR Manufacture Data
  - Inquiry Timeout

- Inquiry State Machine:



***Note**: Pairing procedure won't be executed under this condition. And the linked device won't be recorded.

4.17. Add two customization characteristics in DIS

Both of the characteristics UUID and characteristics can be configured by E2prom setting. And the format of characteristic UUID is 16-bit, max length of characteristic value is 16 bytes.

4.18. Add customization Service and characteristic

The customization service UUID and characteristic UUID can be configured by E2prom setting. The format of this service and characteristics are 128-bit.

There's only one proprietary service can be used at the same time. If the 128-bit customization service is enabled, then the 16-bit customization service and ISSC transparent service will be disabled.

4.19. ISSC Proprietary Service and Specific Service

All ISSC Proprietary Service and characteristic UUIDs are defined by ISSC, and those are used as 16 bytes format. Besides ISSC Proprietary Service, also provides Specific Service for customization. The specific service and characteristic UUIDs can be configured by E2PROM. The Specific Service UUIDs are used as 2 bytes format. And there's only one transparent instance exists at the same time. If Specific Service is assigned, ISSC Proprietary transparent characteristics will be disabled.

4.20. Definition of ISSC Proprietary Service

- ISSC Proprietary Service

UUID: 49535343-FE7D-4AE5-8FA9-9FAFD205E455

Summary: The ISSC_PROPRIETAYR_SERVICE service is used for ISSC proprietary service.

Service Characteristics:

<table>
<tr><th>Overview</th><th>Properties</th><th>Security</th><th>Descriptors</th></tr>
<tr>
<td>Name:
ISSC_TRANS_TX</td>
<td>
<table>
<tr><th>Property</th><th>Requirement</th></tr>
<tr><td>Read</td><td>Excluded</td></tr>
<tr><td>Write</td><td>Excluded</td></tr>
<tr><td>WriteWithoutResponse</td><td>Excluded</td></tr>
<tr><td>SignedWrite</td><td>Excluded</td></tr>
<tr><td>Notify</td><td>Mandatory</td></tr>
<tr><td>Indicate</td><td>Excluded</td></tr>
<tr><td>WritableAuxiliaries</td><td>Excluded</td></tr>
<tr><td>Broadcast</td><td>Excluded</td></tr>
</table>
</td>
<td>None</td>
<td>
<table>
<tr><th>Overview</th><th>Permissions</th></tr>
<tr><td>Name:
Client
Characteristic
Configuration</td><td>
<table>
<tr><th>Permission</th><th>Requirement</th></tr>
<tr><td>Read</td><td>Mandatory</td></tr>
<tr><td>Write</td><td>Mandatory</td></tr>
</table>
</td></tr>
<tr><td></td><td></td></tr>
</table>
</td>
</tr>
<tr>
<td>Name:
ISSC_TRANS_RX</td>
<td>
<table>
<tr><th>Property</th><th>Requirement</th></tr>
<tr><td>Read</td><td>Excluded</td></tr>
<tr><td>Write</td><td>Mandatory</td></tr>
<tr><td>WriteWithoutResponse</td><td>Mandatory</td></tr>
<tr><td>SignedWrite</td><td>Excluded</td></tr>
<tr><td>Notify</td><td>Excluded</td></tr>
<tr><td>Indicate</td><td>Excluded</td></tr>
<tr><td>WritableAuxiliaries</td><td>Excluded</td></tr>
<tr><td>Broadcast</td><td>Excluded</td></tr>
</table>
</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Name:
ISSC_UPDATE_CONNECTION_PARAMETER</td>
<td>
<table>
<tr><th>Property</th><th>Requirement</th></tr>
<tr><td>Read</td><td>Mandatory</td></tr>
<tr><td>Write</td><td>Mandatory</td></tr>
<tr><td>WriteWithoutResponse</td><td>Excluded</td></tr>
<tr><td>SignedWrite</td><td>Excluded</td></tr>
<tr><td>Notify</td><td>Excluded</td></tr>
<tr><td>Indicate</td><td>Excluded</td></tr>
<tr><td>WritableAuxiliaries</td><td>Excluded</td></tr>
</table>
</td>
<td>None</td>
<td>None</td>
</tr>
</table>

<table>
<tr><td></td><td><table><tr><td>Broadcast</td><td>Excluded</td></tr></table></td><td></td><td></td></tr>
<tr><td>Name:
ISSC_AIR_PATCH</td><td><table><tr><th>Property</th><th>Requirement</th></tr><tr><td>Read</td><td>Excluded</td></tr><tr><td>Write</td><td>Mandatory</td></tr><tr><td>WriteWithoutResponse</td><td>Excluded</td></tr><tr><td>SignedWrite</td><td>Excluded</td></tr><tr><td>Notify</td><td>Mandatory</td></tr><tr><td>Indicate</td><td>Excluded</td></tr><tr><td>WritableAuxiliaries</td><td>Excluded</td></tr><tr><td>Broadcast</td><td>Excluded</td></tr></table></td><td>None</td><td><table><tr><th>Overview</th><th>Permissions</th></tr><tr><td>Name:
Client Characteristic
Configuration</td><td><table><tr><th>Permission</th><th>Requirement</th></tr><tr><td>Read</td><td>Mandatory</td></tr><tr><td>Write</td><td>Mandatory</td></tr></table></td></tr><tr><td></td><td></td></tr></table></td></tr>
</table>

4.21. ISSC Proprietary Characteristics

- ISSC_TRANS_TX

UUID: 49535343-1E4D-4BD9-BA61-23C647249616

Summary: The ISSC_TRANS_TX characteristic is used for UART or SPI transparent TX path.

Value Fields:

Names	Field Requirement	Format	Minimum Value	Maximum Value	Additional Information
Trans TX	Mandatory	Unit8[]	N/A	N/A	None

- ISSC_TRANS_RX

UUID: 49535343-8841-43F4-A8D4-ECBE34729BB3

Summary: The ISSC_TRANS_RX characteristic is used for UART or SPI transparent RX path.

Value Fields:

Names	Field Requirement	Format	Minimum Value	Maximum Value	Additional Information
Trans RX	Mandatory	Unit8[]	N/A	N/A	None

- ISSC_UPDATE_CONNECTION_PARAMETER

UUID: 49535343-6DAA-4D02-ABF6-19569ACA69FE

Summary: The ISSC_UPDATE_CONNECTION_PARAMETER characteristic is used to change connection parameters.

Value Fields:

Names	Field Requirement	Format	Minimum Value	Maximum Value	Additional Information

Status	Mandatory	Unit8	N/A	N/A	Enumerations Key: 0 — Value: Update Finish Key: 1 — Value: Update In Progress Key: 2 - 255 — Value: Reserved
Interval Min	Mandatory	Unit16	N/A	N/A	None
Interval Max	Mandatory	Unit16	N/A	N/A	None
Slave Latency	Mandatory	Unit16	N/A	N/A	None
Timeout Multiplier	Mandatory	Unit16	N/A	N/A	None

- ISSC_AIR_PATCH

UUID: 49535343-ACA3-481C-91EC-D85E28A60318

Summary: The ISSC_AIR_PATCH characteristic is used for air patch vendor commands.

Value Fields:

Write Path Field

Names	Field Requirement	Format	Minimum Value	Maximum Value	Additional Information
Command ID	Mandatory	Unit8	N/A	N/A	Refers to ISSC BT4.0 Functional Tester doc.
Command Parameters	Mandatory	Unit8[]	N/A	N/A	Refers to ISSC BT4.0 Functional Tester doc.

Notify Path Field

Names	Field Requirement	Format	Minimum Value	Maximum Value	Additional Information
Status	Mandatory	Unit8	N/A	N/A	Refers to ISSC BT4.0 Functional Tester doc.
Return ID	Mandatory	Unit8	N/A	N/A	Refers to ISSC BT4.0 Functional Tester doc.
Return Parameter	Mandatory	Unit8[]	N/A	N/A	Refers to ISSC BT4.0 Functional Tester doc.

4.22. Definition of Specific Service

- Specific Service

UUID: Configured by E2PROM

Summary: The Specific service is used for specific UART transparent service.

Service Characteristics:

<table>
<tr><th>Overview</th><th>Properties</th><th>Security</th><th>Descriptors</th></tr>
<tr>
<td>Name:
TRANS_TX</td>
<td>
<table>
<tr><th>Property</th><th>Requirement</th></tr>
<tr><td>Read</td><td>Excluded</td></tr>
<tr><td>Write</td><td>Excluded</td></tr>
<tr><td>WriteWithoutResponse</td><td>Excluded</td></tr>
<tr><td>SignedWrite</td><td>Excluded</td></tr>
<tr><td>Notify</td><td>Mandatory</td></tr>
<tr><td>Indicate</td><td>Excluded</td></tr>
<tr><td>WritableAuxiliaries</td><td>Excluded</td></tr>
<tr><td>Broadcast</td><td>Excluded</td></tr>
</table>
</td>
<td>None</td>
<td>
<table>
<tr><th>Overview</th><th>Permissions</th></tr>
<tr><td>Name:
Client Characteristic Configuration</td><td>
<table>
<tr><th>Permission</th><th>Requirement</th></tr>
<tr><td>Read</td><td>Mandatory</td></tr>
<tr><td>Write</td><td>Mandatory</td></tr>
</table>
</td></tr>
<tr><td></td><td></td></tr>
</table>
</td>
</tr>
<tr>
<td>Name:
TRANS_RX</td>
<td>
<table>
<tr><th>Property</th><th>Requirement</th></tr>
<tr><td>Read</td><td>Excluded</td></tr>
<tr><td>Write</td><td>Mandatory</td></tr>
<tr><td>WriteWithoutResponse</td><td>Mandatory</td></tr>
<tr><td>SignedWrite</td><td>Excluded</td></tr>
<tr><td>Notify</td><td>Excluded</td></tr>
<tr><td>Indicate</td><td>Excluded</td></tr>
<tr><td>WritableAuxiliaries</td><td>Excluded</td></tr>
<tr><td>Broadcast</td><td>Excluded</td></tr>
</table>
</td>
<td>None</td>
<td>None</td>
</tr>
</table>

4.23. Specific Service Characteristics

- TRANS_TX

UUID: Configured by E2PROM

Summary: The TRANS_TX characteristic is used for UART transparent TX path.

Value Fields:

Names	Field Requirement	Format	Minimum Value	Maximum Value	Additional Information
Trans TX	Mandatory	Unit8[]	N/A	N/A	None

- TRANS_RX

UUID: Configured by E2PROM

Summary: The TRANS_RX characteristic is used for UART transparent RX path.

Value Fields:

Names	Field Requirement	Format	Minimum Value	Maximum Value	Additional Information
Trans RX	Mandatory	Unit8[]	N/A	N/A	None

Appendix: Security Maps

Command	UI Setting	SPP	BLE[#1]
1. **Write Pairing Mode** : Just Work 2. **Write Pairing Mode** : Disable SSP + UI Setting - BT3.0 Security(Disable SSP)	**Pairing Method**: Just Work **BT3.0 Security Mode**: Disable SSP	Disable SSP	Just Work
1. **Write Pairing Mode** : Passkey Entry 2. **Write Pairing Mode** : Disable SSP + UI Setting - BT3.0 Security(Disable SSP)	**Pairing Method**:Passkey Entry **BT3.0 Security Mode**: Disable SSP	Disable SSP	Passkey Entry
1. **Write Pairing Mode** : User Confirm 2. **Write Pairing Mode** : Disable SSP + UI Setting - BT3.0 Security(Disable SSP)	**Pairing Method**: User Confirm **BT3.0 Security Mode**: Disable SSP	Disable SSP	User Confirm
1. **Write Pairing Mode** : Just Work 2. **Write Pairing Mode** : Disable SSP + UI Setting - BT3.0 Security Mode(SM3)	**Pairing Method**: Just Work **BT3.0 Security Mode**: SM3[#2]	SM3	Just Work
1. **Write Pairing Mode** : Passkey Entry 2. **Write Pairing Mode** : Disable SSP + UI Setting - BT3.0 Security Mode(SM3)	**Pairing Method**:Passkey Entry **BT3.0 Security Mode**: SM3	SM3	Passkey Entry
1. **Write Pairing Mode** : User Confirm 2. **Write Pairing Mode** : Disable SSP + UI Setting - BT3.0 Security Mode(SM3)	**Pairing Method**: User Confirm **BT3.0 Security Mode**: SM3	SM3	User Confirm
Write Pairing Mode : Just Work	**Pairing Method**: Just Work **BT3.0 Security Mode**: SM4	Just Work	Just Work
Write Pairing Mode : Passkey Entry	**Pairing Method**: Passkey Entry **BT3.0 Security Mode**: SM4	Passkey Entry	Passkey Entry
Write Pairing Mode : User Confirm	**Pairing Method**: User Confirm **BT3.0 Security Mode**: SM4	User Confirm	User Confirm

1: This column available if BLE Security set to enabled (UI Setting)

2: UI Setting Only (IS1678SPP UI v100.106)

Reversion History

Date	Revision Content	Version
2015/04/08	Preliminary Version	0.1