Your First BT Product: BM77

jan. 2016

Agenda

- Fundamental of Bluetooth® Technology
- BM77 PICTAIL & Tools
- Hand on
- BeaconThings
- Q&A

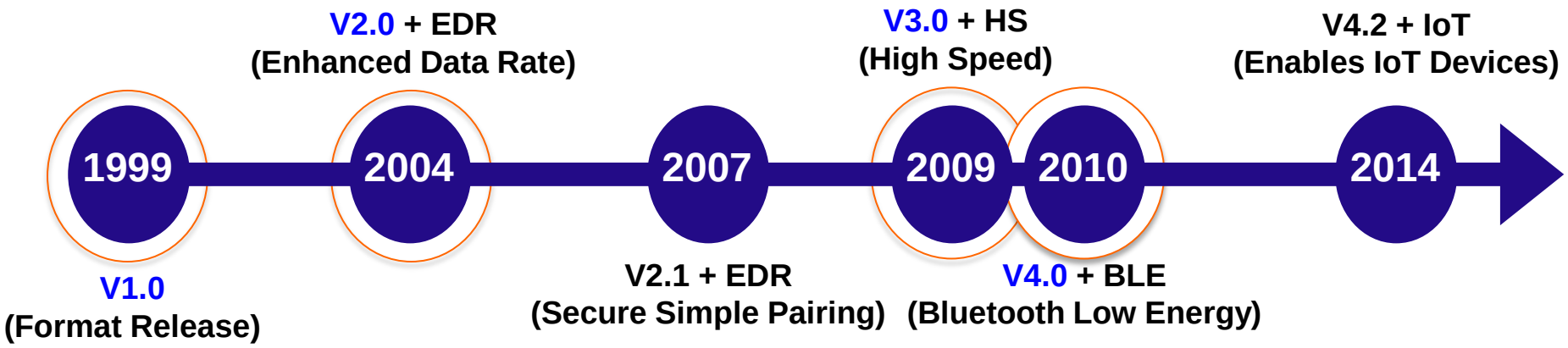
Agenda

- **Fundamental of Bluetooth® Technology**
- **BM77 PICTAIL & Tools**
- **Hand on**
- **BeaconThings**
- **Q&A**

Bluetooth®

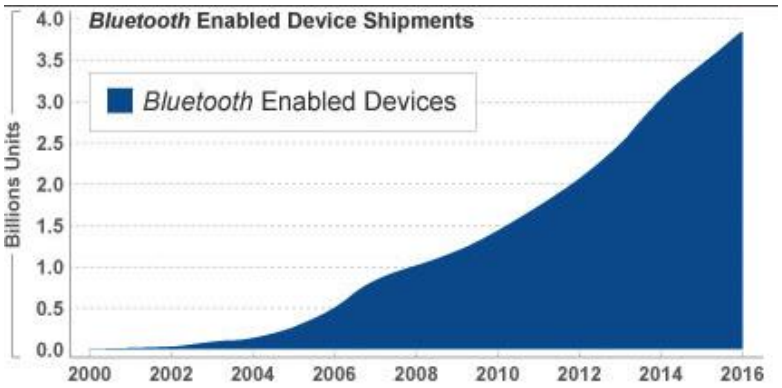
- **Wireless Communication Protocol**
- **An Open Standard**
  - IEEE 802.15.1
  - Bluetooth Core Specification
- **Target Application**
  - Low Power
  - Low Cost
  - Short Range

Milestone

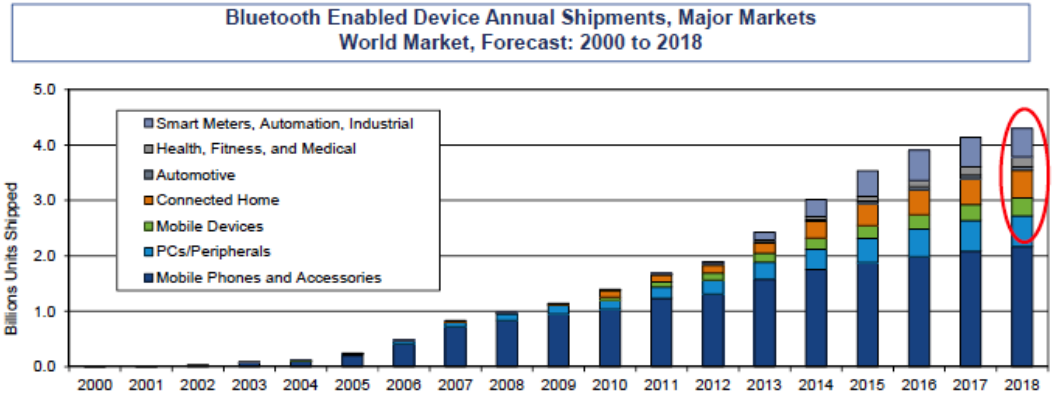

1999
V1.0
(Format Release)
2004
V2.0 + EDR
(Enhanced Data Rate)
2007
V2.1 + EDR
(Secure Simple Pairing)
2009
2010
V3.0 + HS
(High Speed)
V4.0 + BLE
(Bluetooth Low Energy)
2014
V4.2 + IoT
(Enables IoT Devices)

Rise of Bluetooth®

- **Rapid Deployment of Bluetooth**
  - First Killer App is HeadSet (Audio)
  - Next Killer App will be IoT (Data)



Source: Bluetooth SIG



Source: ABI Research

Bluetooth® Fundamental

- **Using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.4835 GHz**
  - Free unlicensed ISM band
- **Frequency Hopping Spread Spectrum (FHSS)**
  - Pseudo-Random Hopping among Channels
  - Noise Rejection
- **Time Division Duplex**
  - 625 us for each time slot
  - Master Initiate Talk, Slave Answers

Bluetooth Radio

- **Operates in the 2.4 GHz ISM band.**

Country	Frequency Range	RF Channels	
Europe and USA	2400 - 2483.5 MHz	2402+k MHz	K=1,2,……78
Spain	2445 - 2475 MHz	2449+k MHz	K=1,2,……22
French	2446.5 - 2483.5 MHz	2454+k MHz	K=1,2,……22

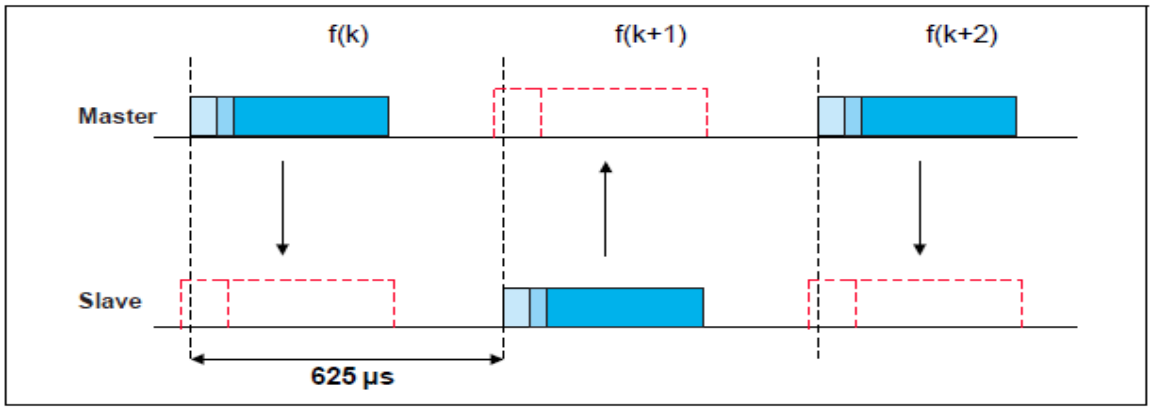
- **Output power**

Power Class	Maximum Output Power	Nominal Output Power	Minimum Output Power
1	100mW(20dBm)	N/A	1mW(0 dBm)
2	2.5mW(4dBm)	1mW(0dBm)	0.25(-6dBm)
3	1mW(0dBm)	N/A	N/A

- **GFSK modulation**

Baseband

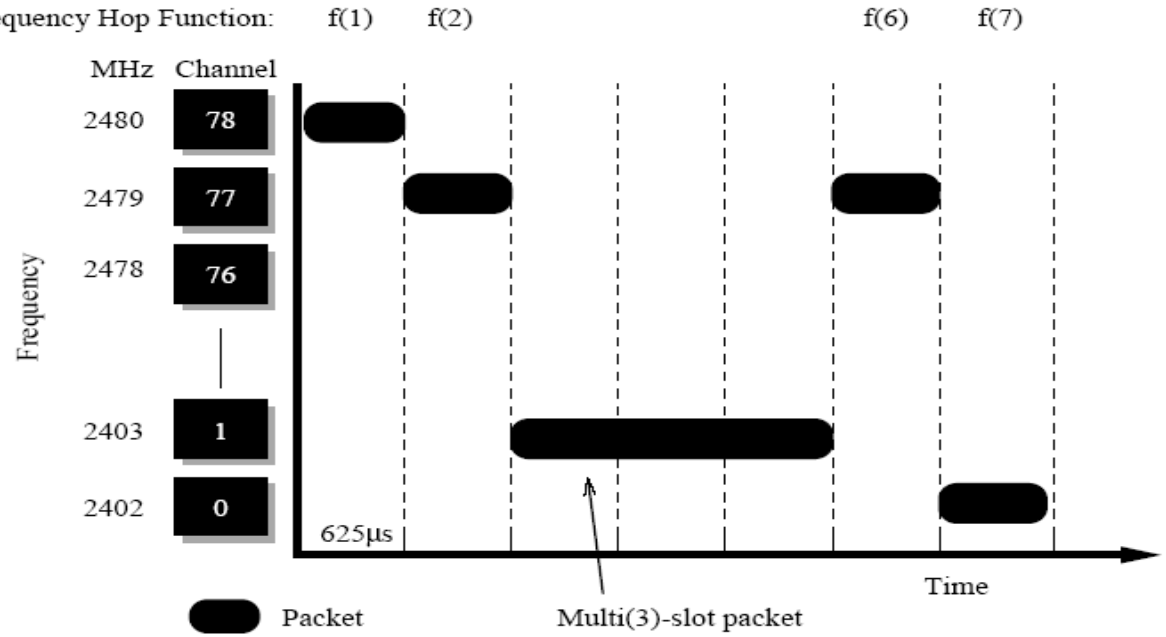
- **Physical channel**
  - TDD (Time Division Duplex)



  - Time slot – 625 us
    - Transmit Max. : 5 time slots
    - Master to Slave data rate 721Kbit/s (1 time slot)
    - Slave to Master 57Kbit/s

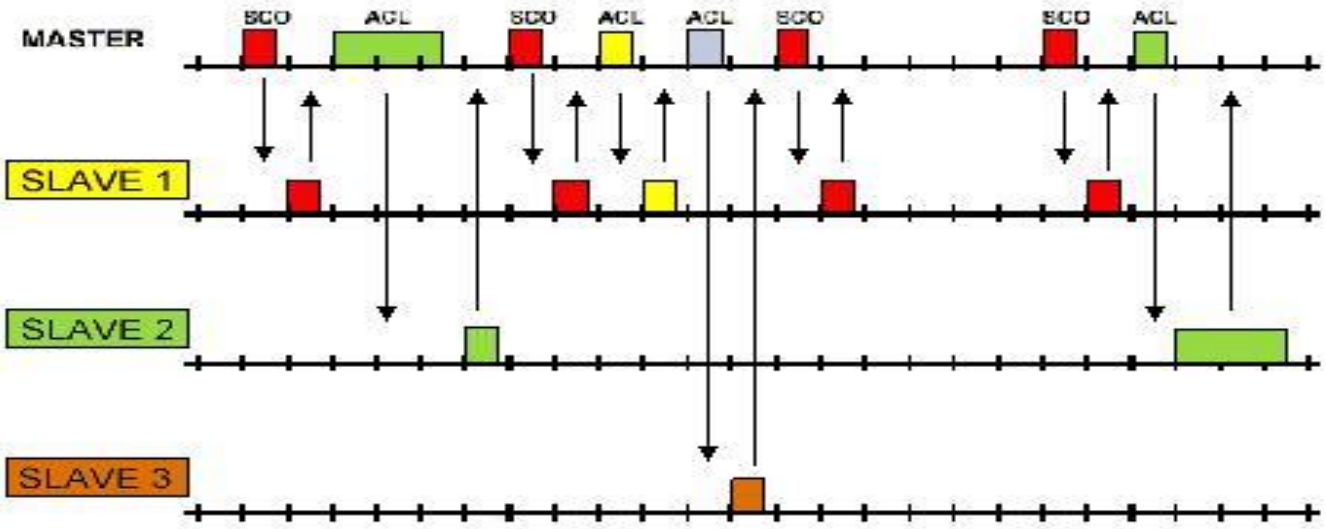
Frequency Hopping

- **Bluetooth channel is represented by a random hopping sequence through the entire 79 RF frequencies**
- **Nominal hopping rate of 1600/s**
- **Channel Spacing is 1 MHz**

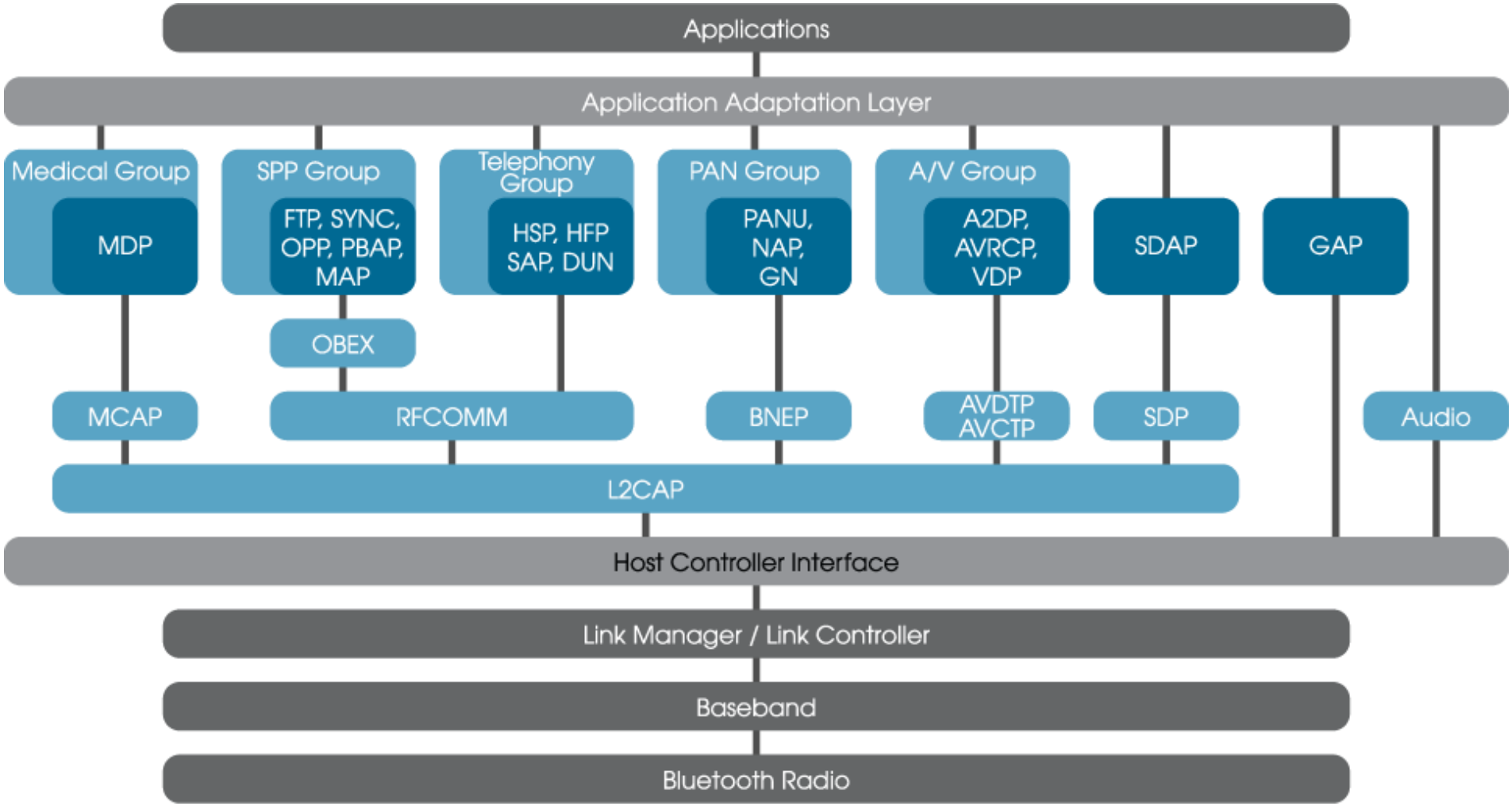


Physical Link

- **Synchronous Connection Oriented (SCO)**
  - Point to Point Full Duplex between Master & Slave.
  - Typically used for voice (CVSD) connection.
  - Time slot on a fixed time interval.
- **Asynchronous Connection Link (ACL)**
  - Typically used for data connection
  - Point to Multipoint connection.
  - Support Symmetric & Asymmetric links.

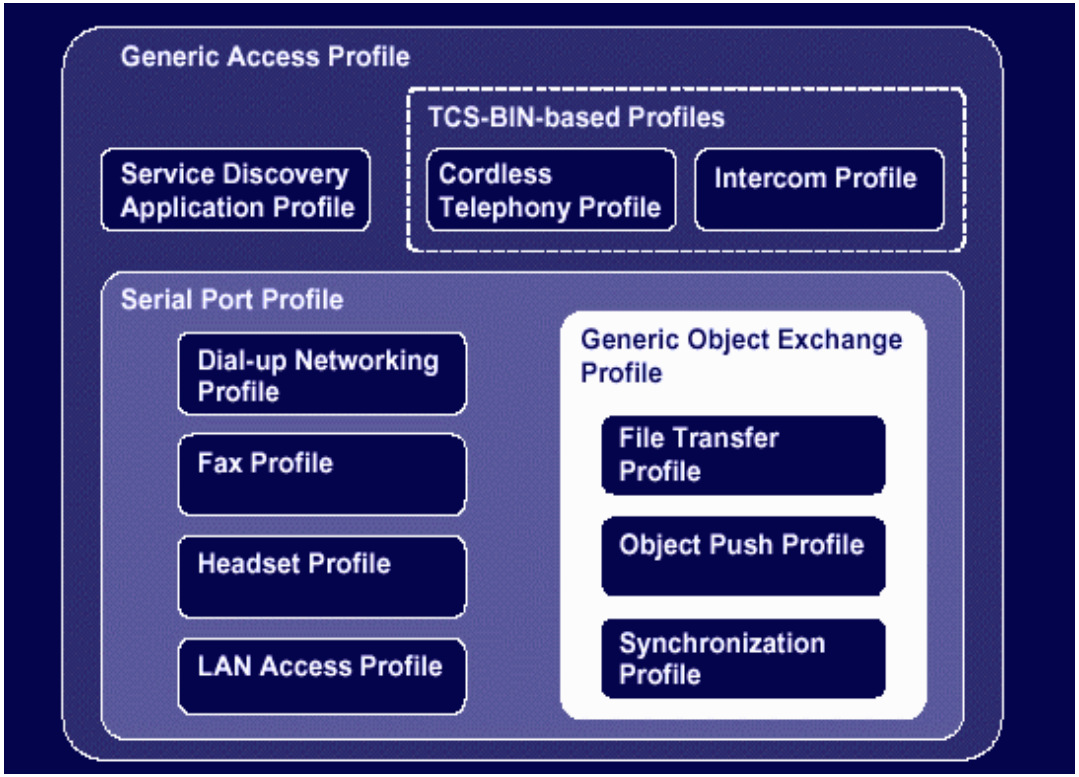


Bluetooth® Stack



Profile

- **Provide interoperability between devices from different manufacturers for specific services and use cases.**



Bluetooth® Profiles

- **Defines application protocol**
  - Both host & client must support the profile
  - Ensures interoperability
- **Not all profiles are equally important**
  - Only a few make up a majority of the opportunity

Handset Profile
Hands Free Profile

Audio/Video Remote Control Profile
Advanced Audio Distribution Profile

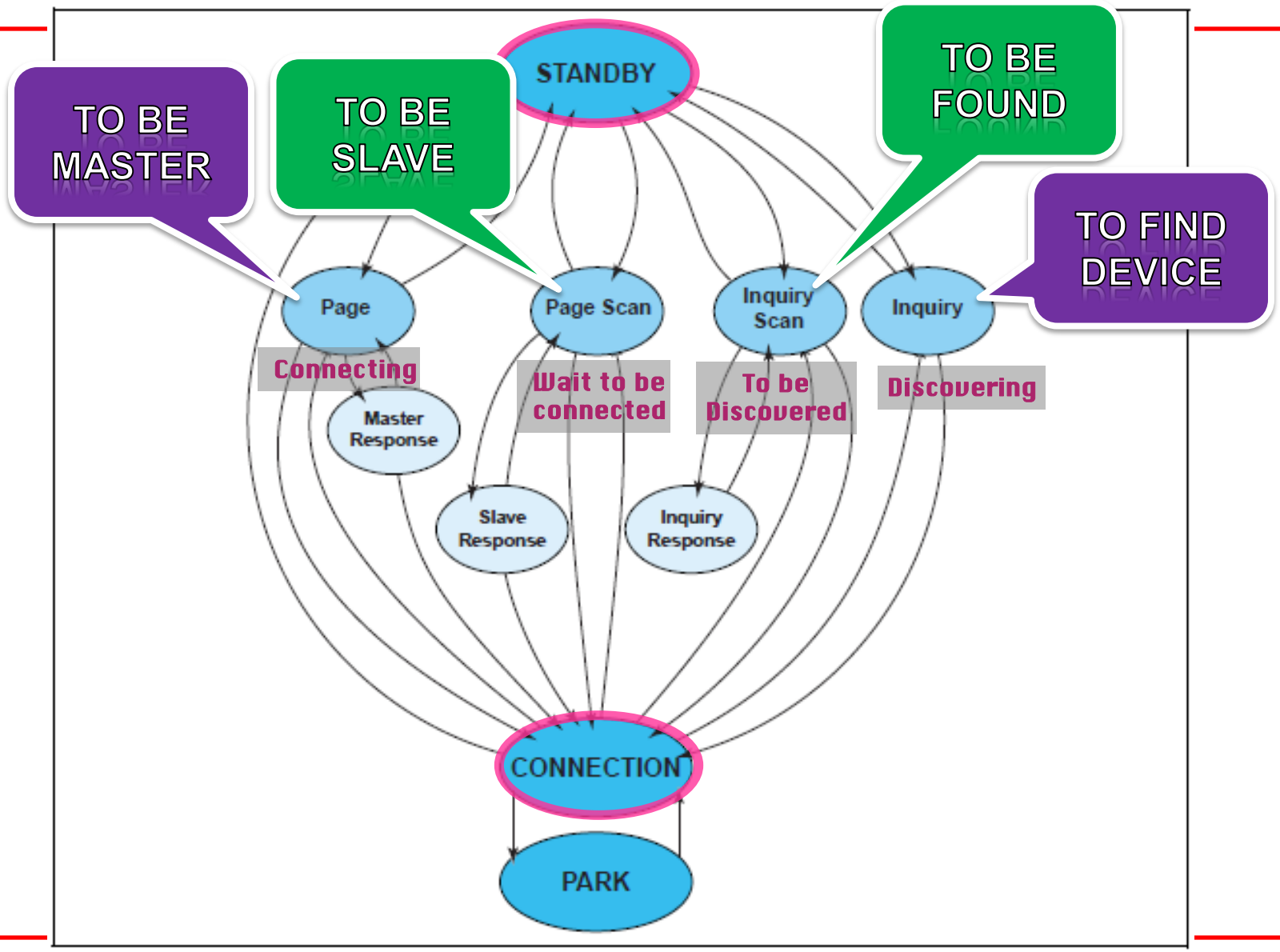
Human Interface Profile

Serial Port Profile

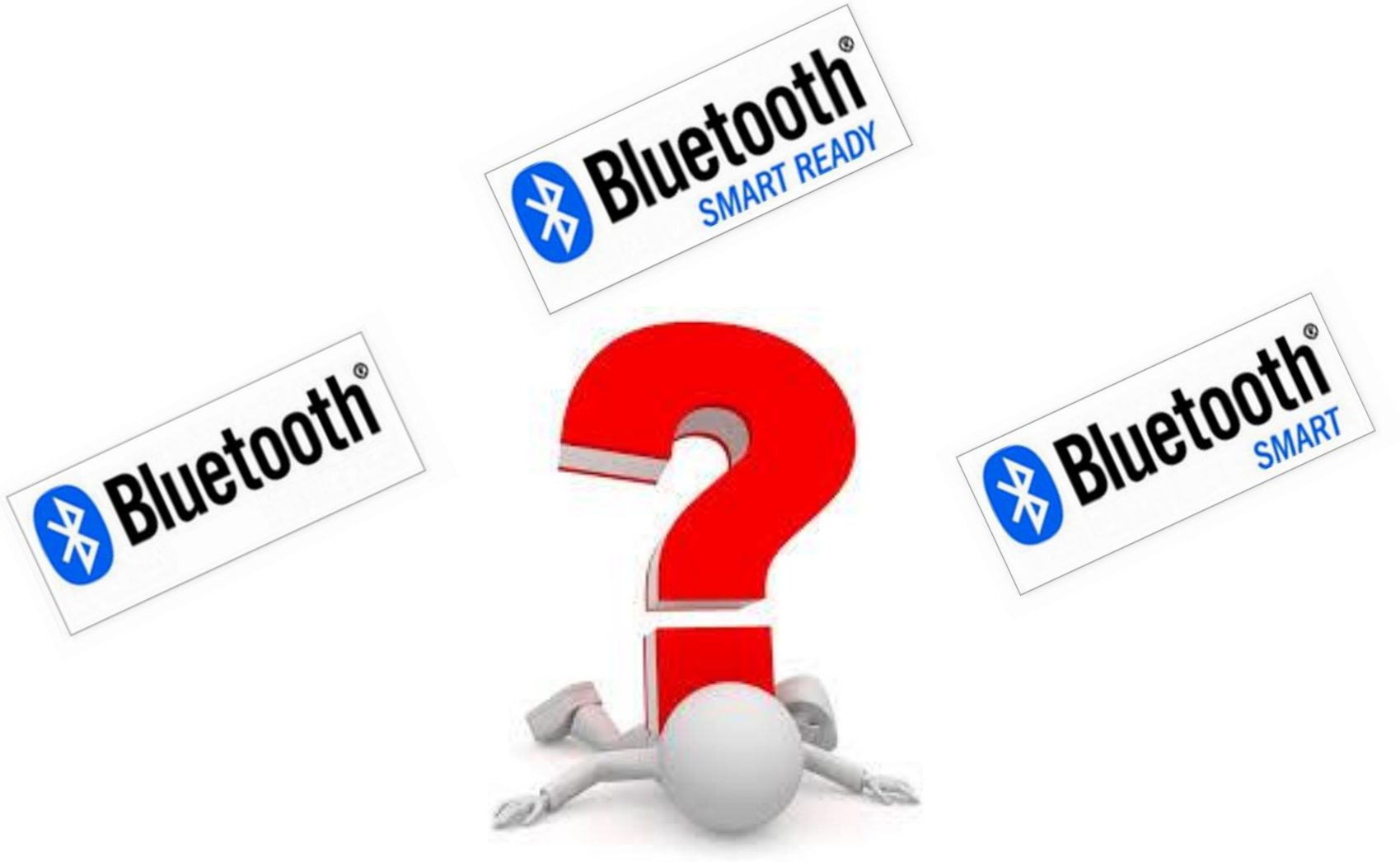
Bluetooth® Profiles

Advanced Audio Distribution Profile (A2DP)
Attribute Profile (ATT)
Audio/Video Remote Control Profile (AVRCP)
Basic Imaging Profile (BIP)
Basic Printing Profile (BPP)
Common ISDN Access Profile (CIP)
Cordless Telephony Profile (CTP)
Device ID Profile (DIP)
Dial-up Networking Profile (DUN)
Fax Profile (FAX)
File Transfer Profile (FTP)
Generic Audio/Video Distribution Profile (GAVDP)
Generic Access Profile (GAP)
Generic Attribute Profile (GATT)
Generic Object Exchange Profile (GOEP)
Hard Copy Cable Replacement Profile (HCRP)
Health Device Profile (HDP)
Hands-Free Profile (HFP)
Human Interface Device Profile (HID)
Headset Profile (HSP)
Intercom Profile (ICP)
LAN Access Profile (LAP)
Message Access Profile (MAP)
OBject EXchange (OBEX)
Object Push Profile (OPP)
Personal Area Networking Profile (PAN)
Phone Book Access Profile (PBAP, PBA)
Proximity Profile (PXP)
Serial Port Profile (SPP)
Service Discovery Application Profile (SDAP)
SIM Access Profile (SAP, SIM, rSAP)
Synchronization Profile (SYNCH)
Synchronization Mark-up Language Profile (SyncML)
Video Distribution Profile (VDP)
Wireless Application Protocol Bearer (WAPB)

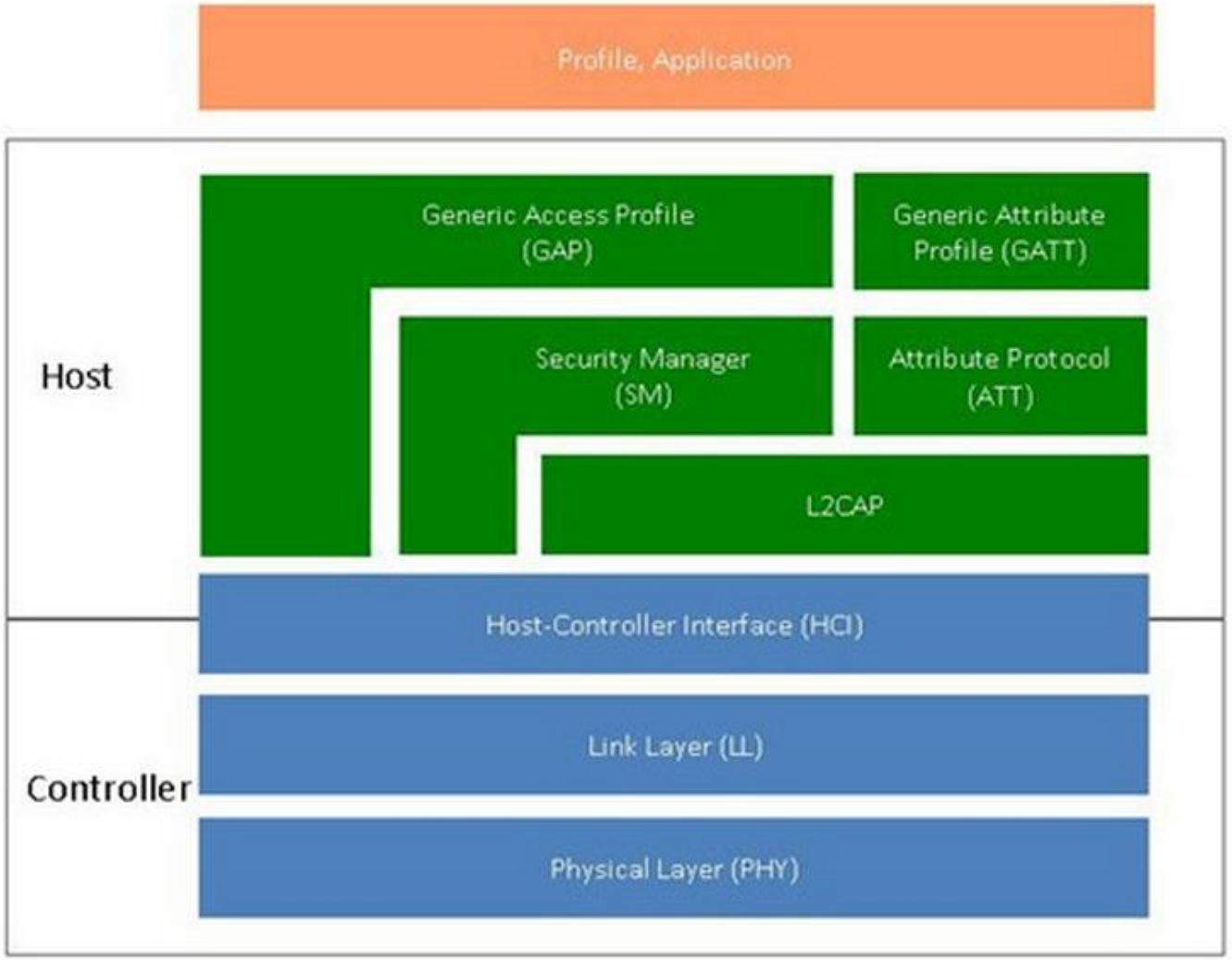
Connection State Machine



Bluetooth Low Energy

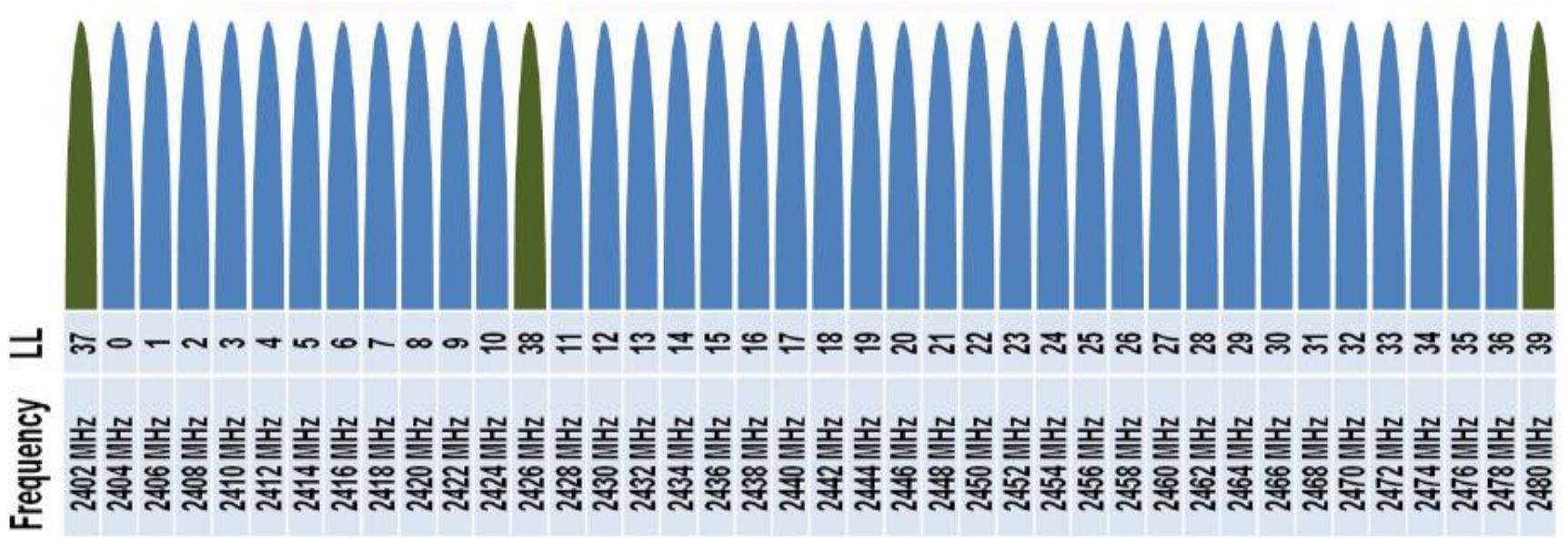


Architecture

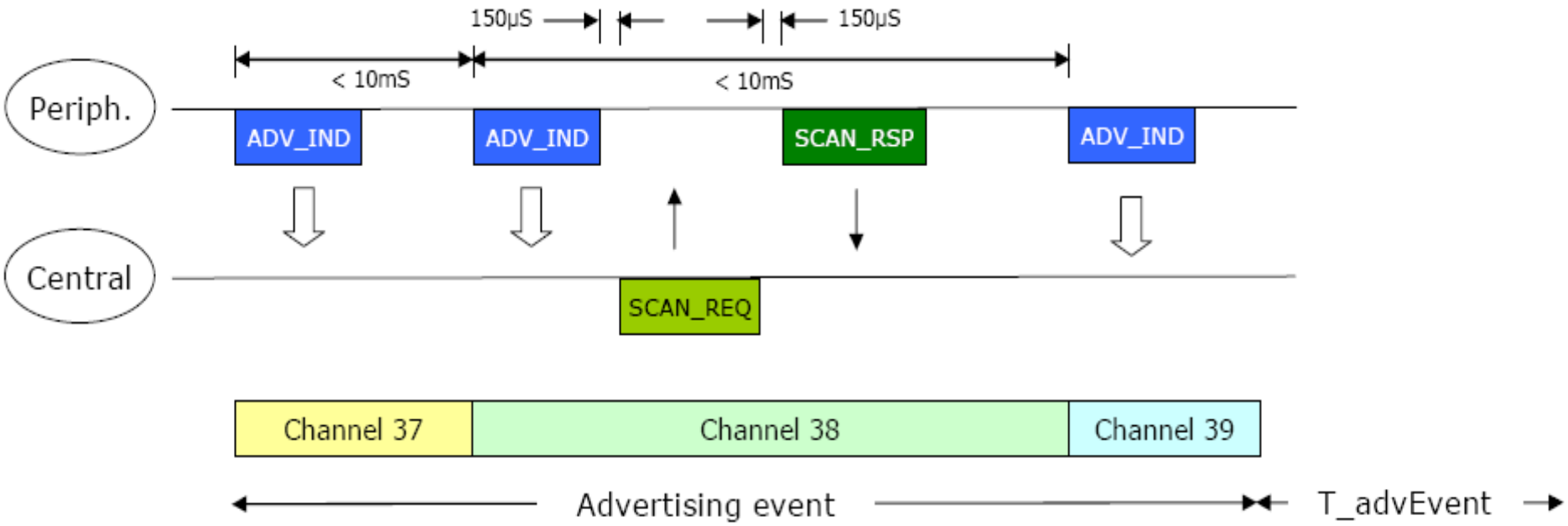


Bluetooth® Low Energy

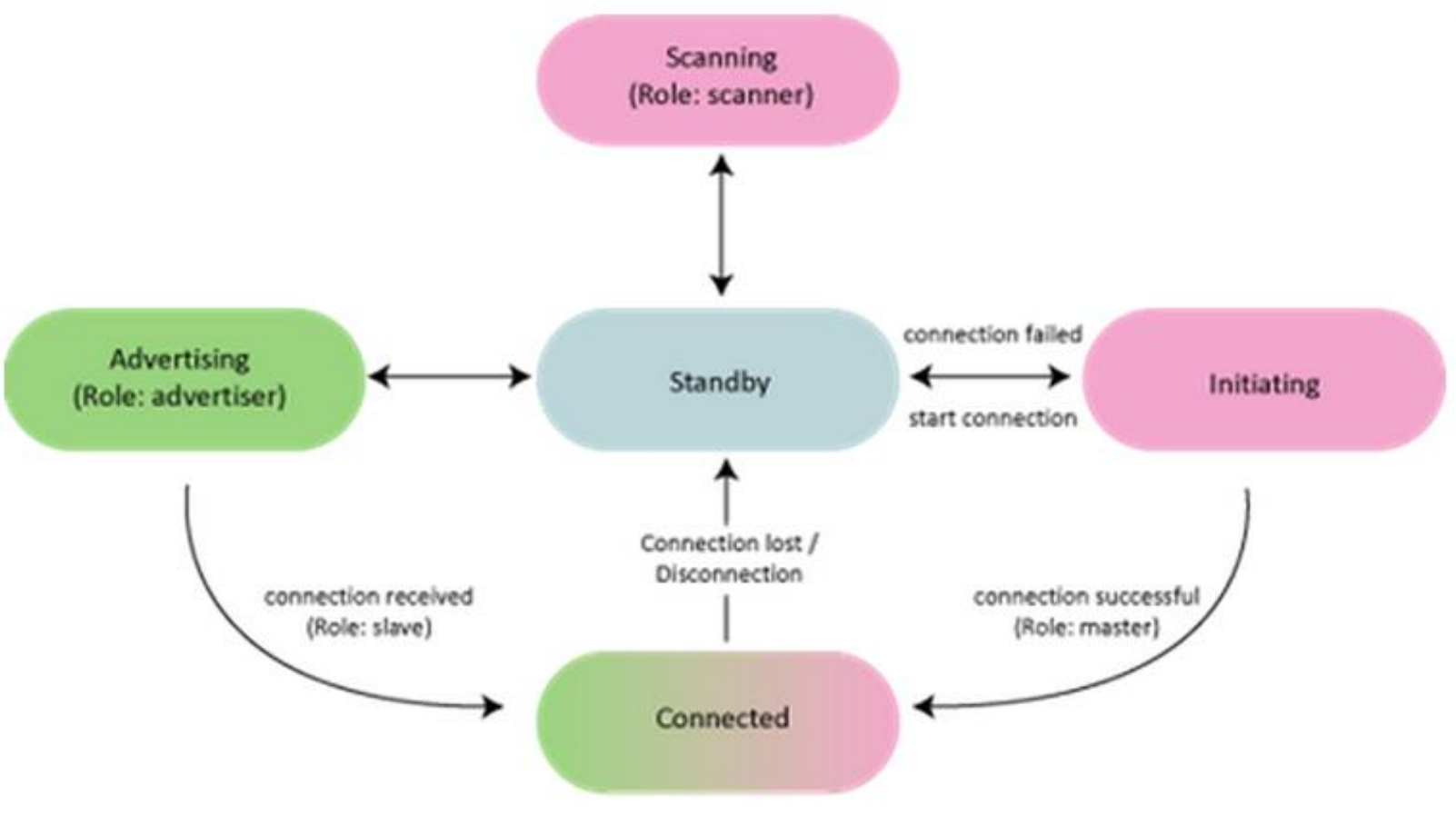
- 40 Channels, 2 MHz Bandwidth
- 2 PDU types – depending on Advertising / Data Channel
- 3 advertising channels and 37 data channels



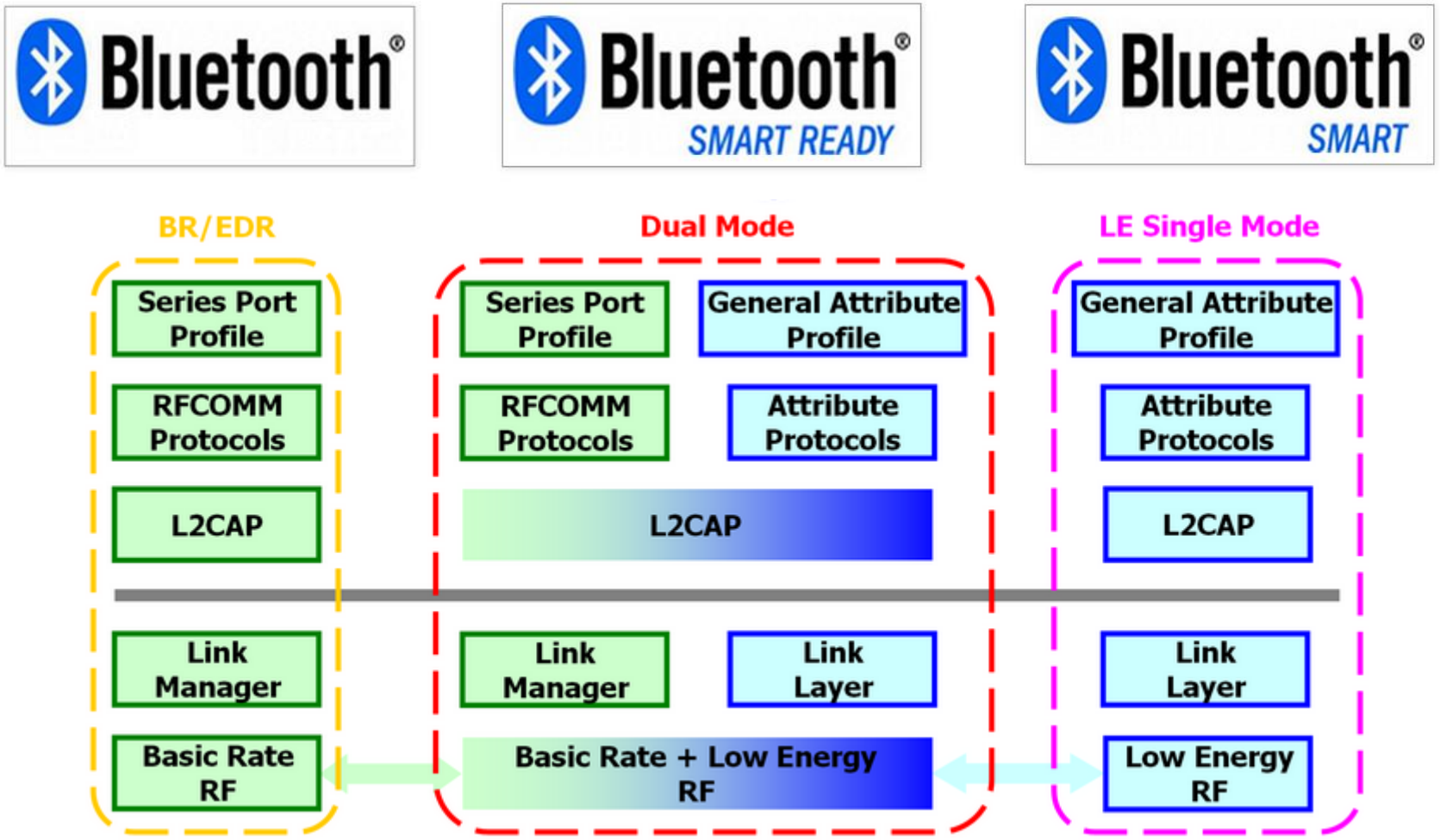
Advertising



Connection State Machine



Bluetooth® Stack

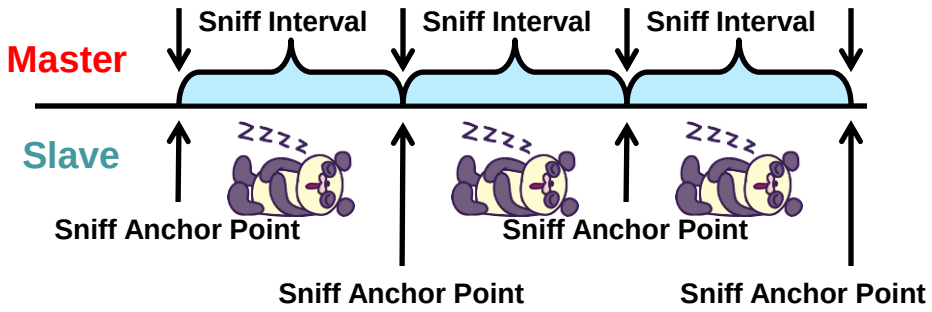


Bluetooth Classic vs BLE

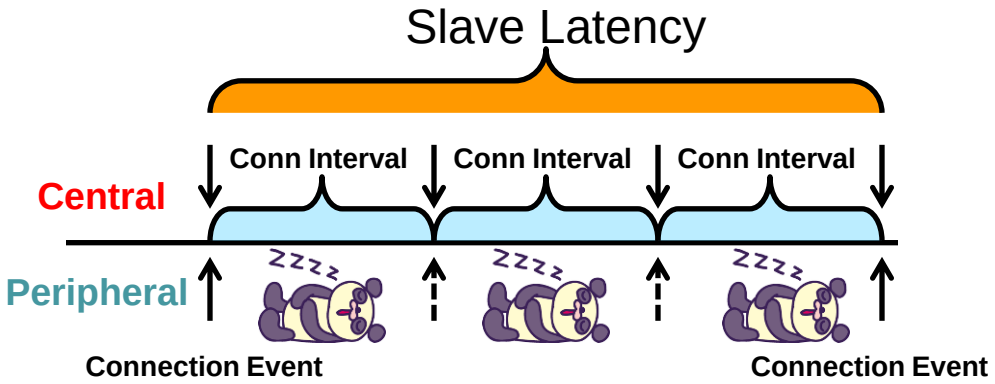
Feature	BR/ EDR	LE	Notes
RF Channels	79	40	**1MHz** Spacing in BT Classic **2MHz** Spacing in LE
Max Tx Power	+20dBm (class 1) +4dBm (class 2)	+10dBm	No “class” Structure **+10**dBm Regulatory Limit
Max Data Rate	2178.1kbps	313kbps	EDR much faster
Connection time	20ms (R0 page scan)	2.5ms	**8**x quicker
Time to send application data	30ms~120ms	3ms	**10**x quicker

Bluetooth Classic vs BLE

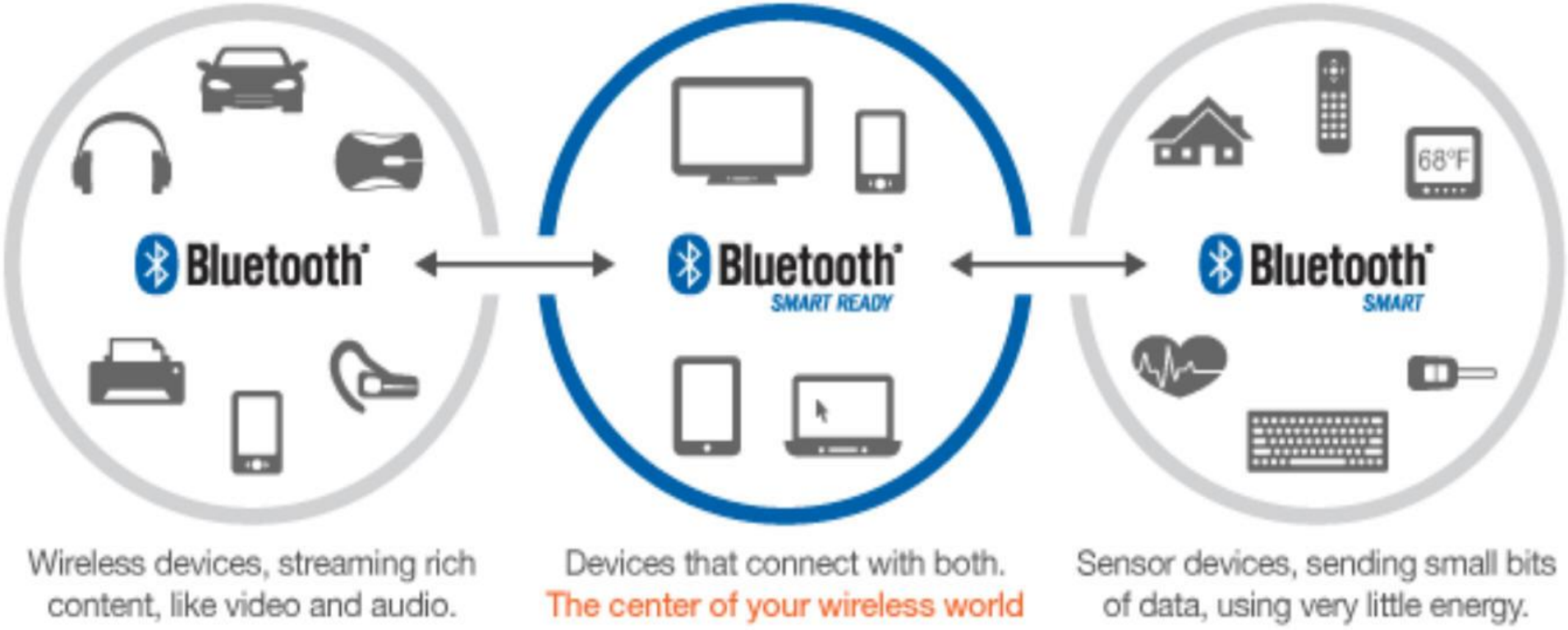
- **BT Classic**
  - Sniff Mode
  - Overhead: > 122 bits



- **BTLE**
  - Forced Sleep Cycles
  - Connection Interval
  - Slave Latency
  - Overhead: 40bits



Depending On Your Product



Agenda

- Fundamental of Bluetooth® Technology
- **BM77 PICTAIL & Tools**
- Hand on
- BeaconThings
- Q&A

Strengths

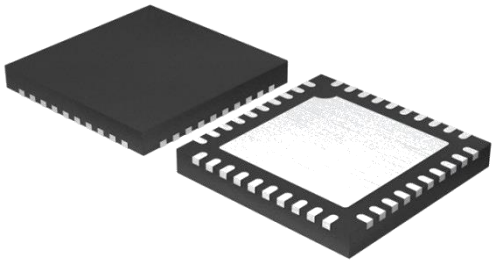
- **Easy to use** (UART transparent)
- **Stable** (High volume production today)
- **Better Interoperability, dual mode**

  (no Need MFi for iOS)
- **BLE > 8KB through**
- **Cost effective** (option)

Bluetooth® 4.0 Dual-Mode Shielded Module
(Part # BM77SPPS3MC2)

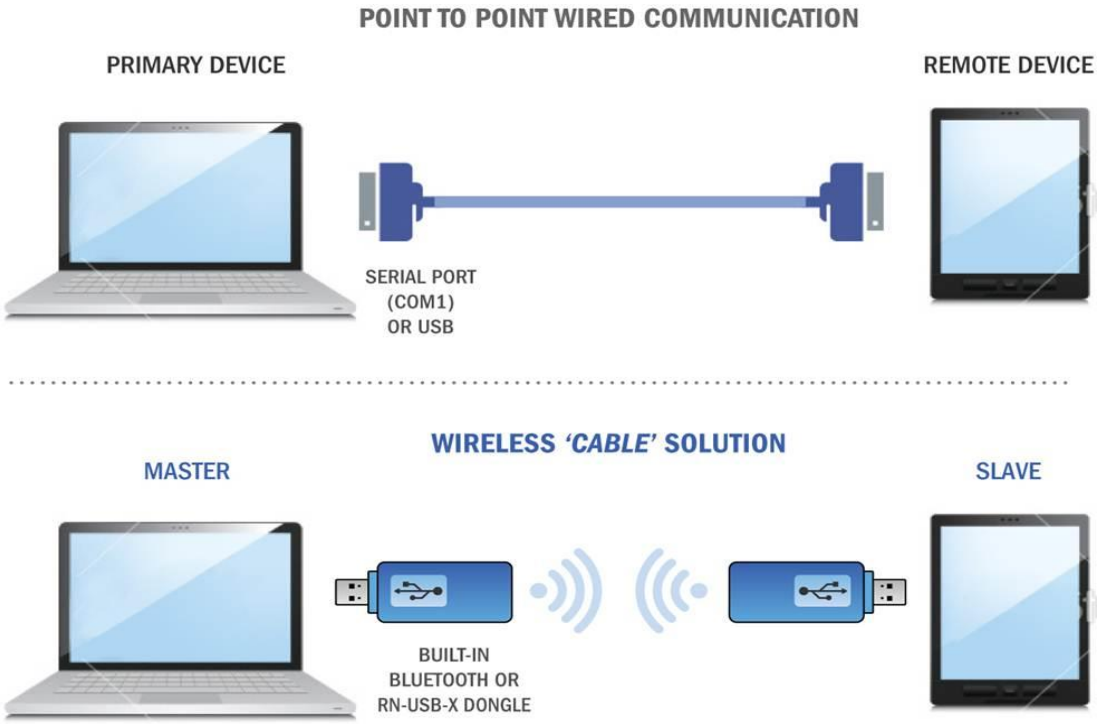
Features/ Specification

- Dual Mode: Classic /EDR, BLE
- Data Transparent/ command
- Hardware Flow Control
- UART，Max Baudrate 921600
- 8 Configurable IOs
- Battery Detect
- RSSI Detect



Serial Port Profiles (SPP)

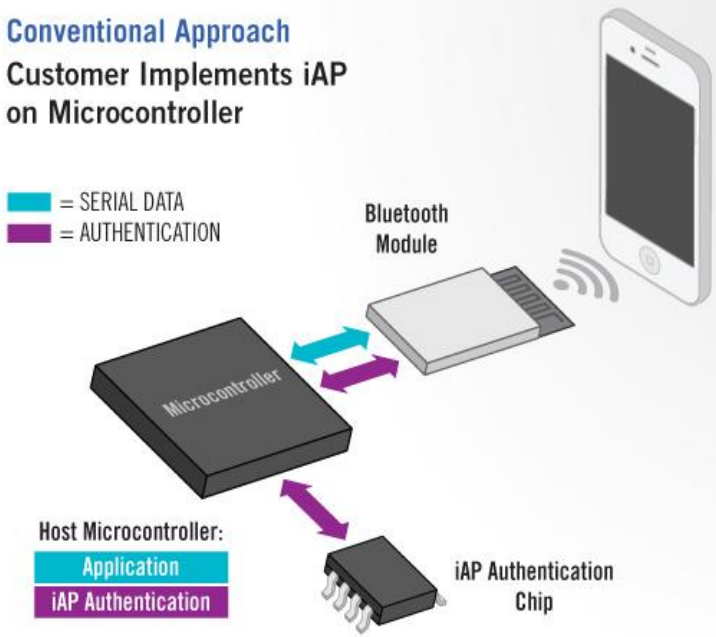
- **Emulates COM Port over Bluetooth®**
  - Cable Replacement Applications
  - Bluetooth driver on host computer creates a virtual COM port after successful pairing
  - When COM port is open the Bluetooth connection to the slave is opened



iAP: Apple Authentication System Architectures

Conventional Approach

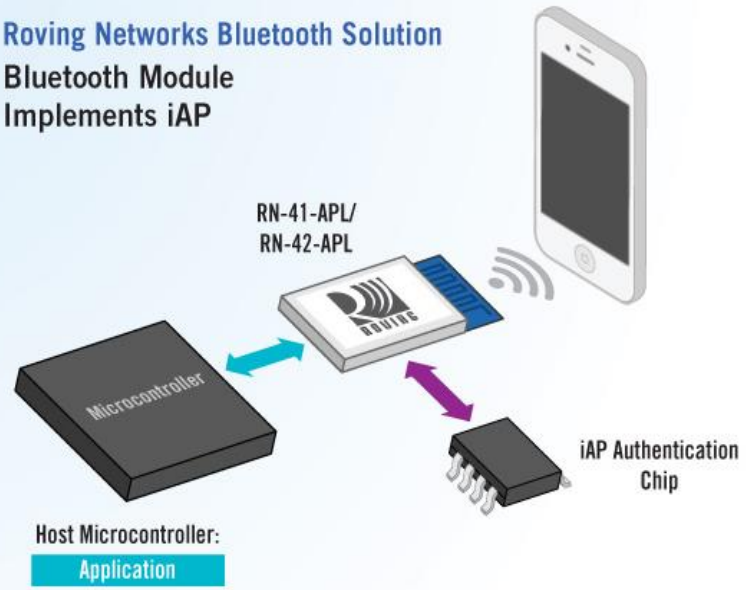
Customer Implements iAP on Microcontroller



- High-end host microcontroller
- Adds complexity to firmware and hardware design
- Longer development cycles and learning curves
- Increases power consumption
- Difficult to port code across microcontroller platforms

Roving Networks Bluetooth Solution

Bluetooth Module Implements iAP

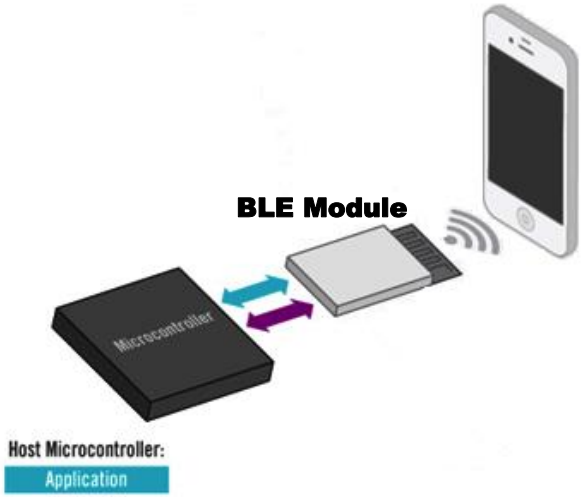


- Low-cost host microcontroller
- Simple host interface
- iAP transparent to user
- Developers focus on their design, not iAP protocols
- Same interface for other smart phones and computing platforms

Apple Friendly: BT Classic vs BLE

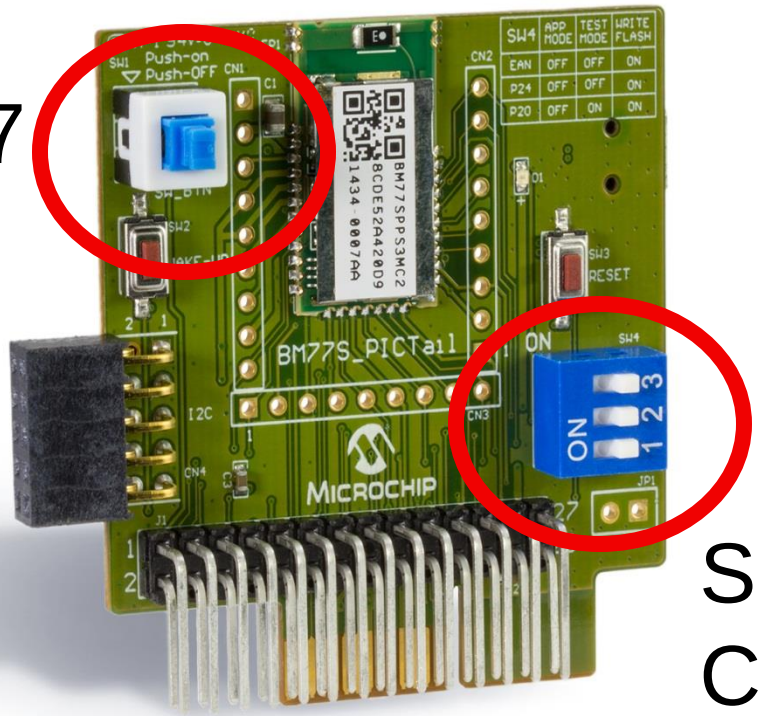
- **BT Classic**
  - MFi Program
  - iAP Protocols

- **BLE**
  - iOS 5 or Later
  - iPhone 4S or later, iPad3 or later
  - Native Support
  - Limited Throughput



BM77 EVB

SW Button:
Power on BM77



BM77 PICtail
(Part # BM-77-PICtail)

Slide Switch:
Change BM77
Mode

Mode Select

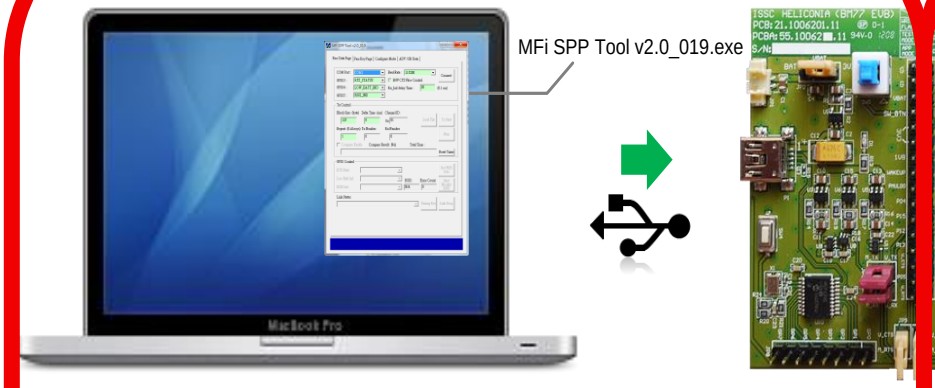
Mode Definitions:

	Switch Number	1	2	3
	**Pin**	P20	P24	EAN
	ON	Low	Low	High
	Function	Test Mode High=Disable/ Application Low=Enable/ Test Mode	Flash Write High=Disable Low=Enable	Boot by Flash or ROM High=ROM Low=Flash

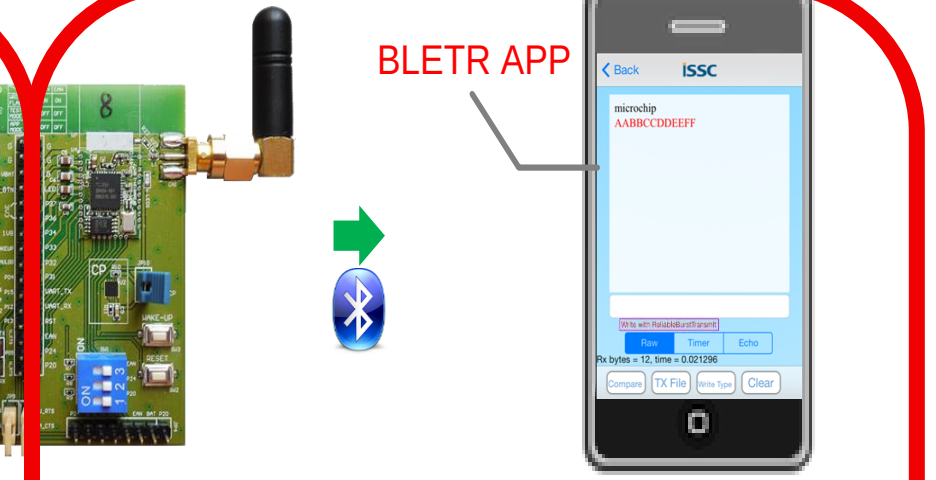
Mode Settings:

Mode	Switch	PIN Definition
Boot Mode (Write Flash)		1: ON (P20: LOW) 2: ON (P24: LOW) 3: ON (EAN: HIGH)
Test Mode (Write EEPROM)		1: ON (P20: LOW) 2: OFF (P24: HIGH) 3: OFF (EAN: LOW)
Application Mode		1: OFF (P20: HIGH) 2: OFF (P24: HIGH) 3: OFF (EAN: LOW)

Developed Environment

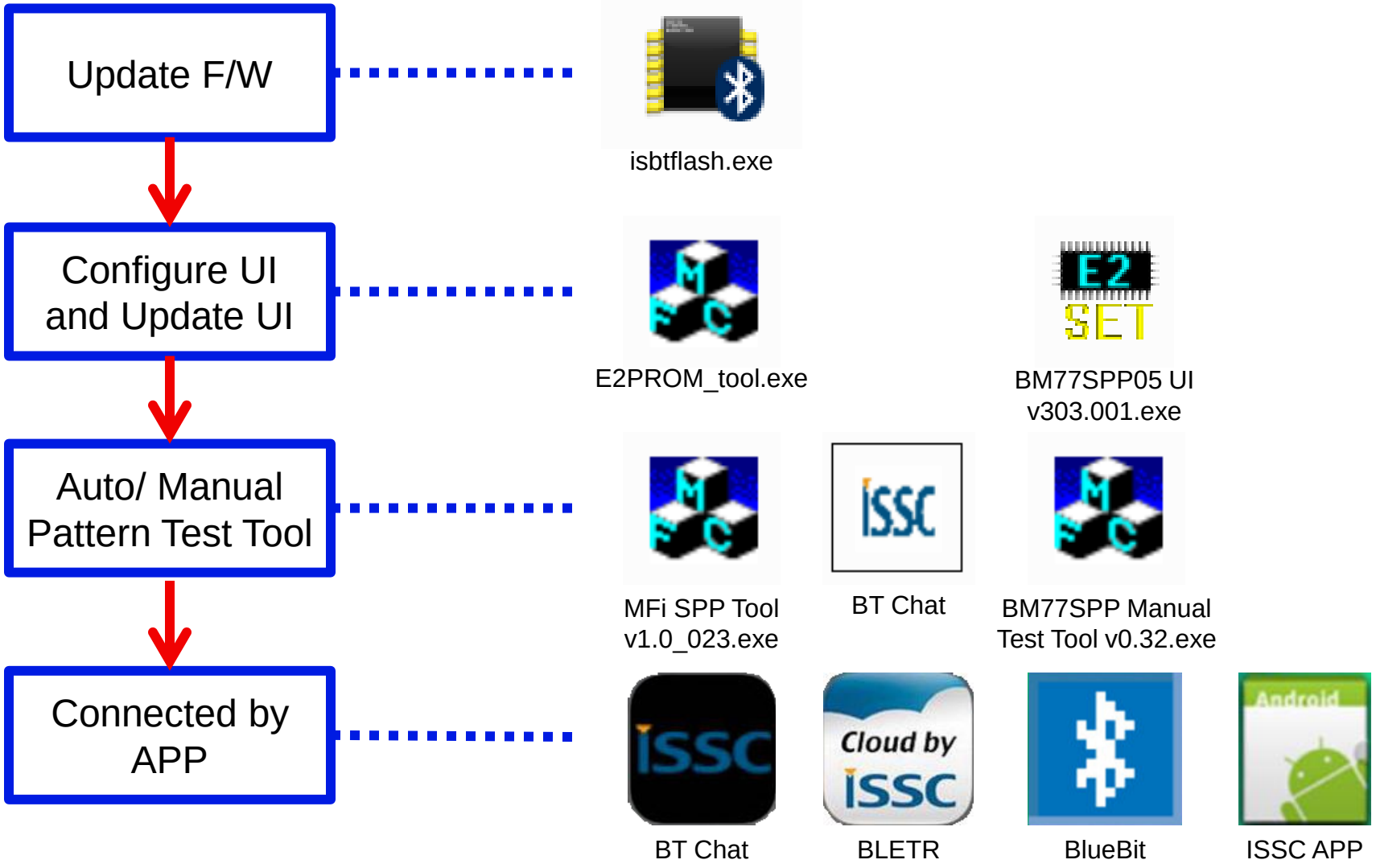


F/W, EEPROM Update
MCU Emulate
Data Exchange



Connect Test
Data Exchange
Throughput Test

Procedure


Update F/W
Configure UI and Update UI
Auto/ Manual Pattern Test Tool
Connected by APP
isbtflash.exe
E2PROM_tool.exe
BM77SPP05 UI v303.001.exe
MFi SPP Tool v1.0_023.exe
BT Chat
BM77SPP Manual Test Tool v0.32.exe
BT Chat
BLETR
BlueBit
ISSC APP

6 Tools and 4 Apps

- **BM77:**
  - Write F/W Tool
  - Write EEPROM Tool
  - UI
- **MCU:**
  - Auto Test Tool
  - BT Chat Tool
  - Manual Test Tool
- **APP:**
  - Android: iSSC APP(Classic), Bluebit (BLE)
  - iOS: BT Chat Tool(Classic), BLETR(BLE)

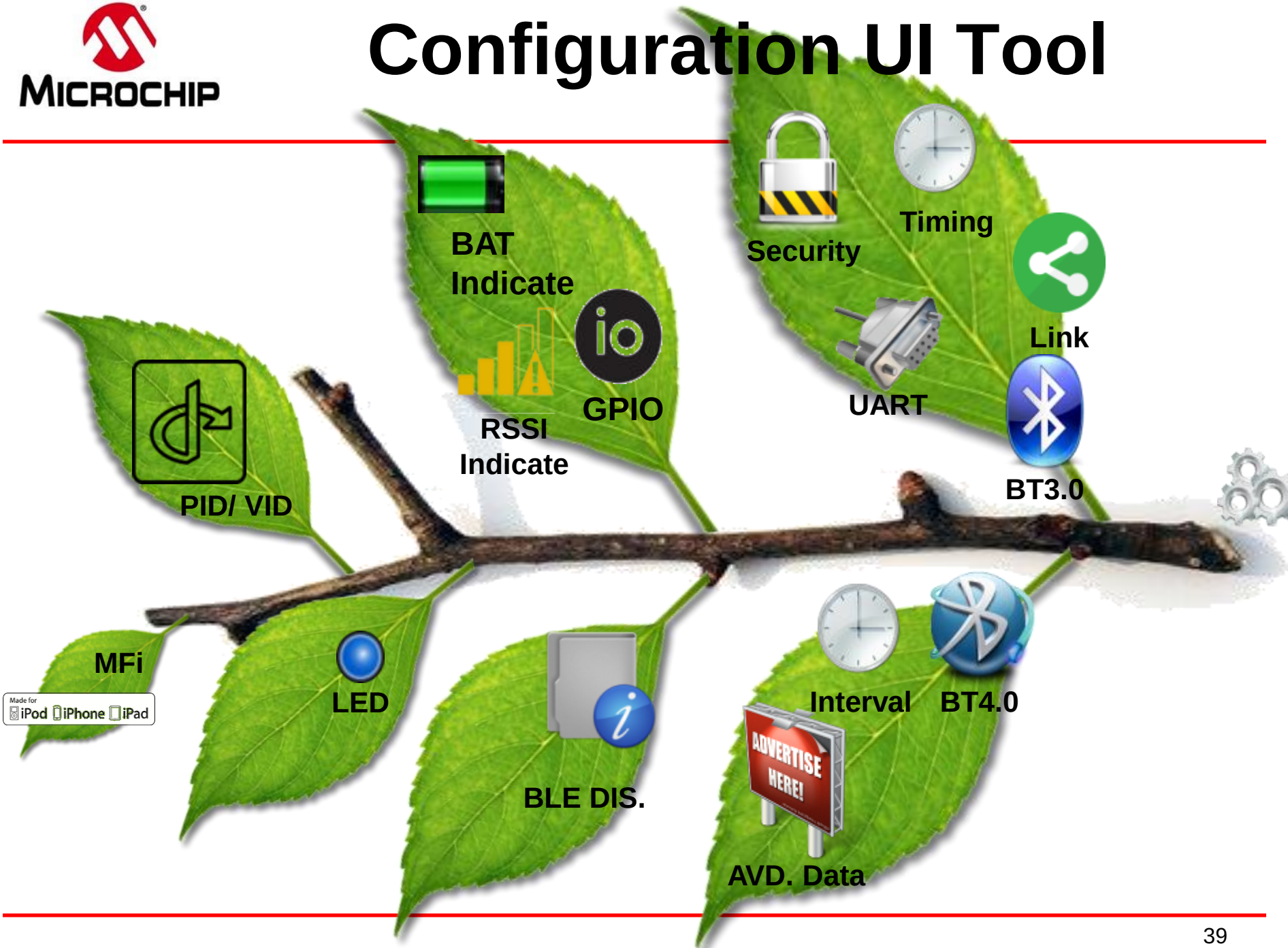
6 Tools and 4 Apps

- **BM77:**
  - **Write F/W Tool** (isbtflash.exe)
  - **Write EEPROM Tool** (E2PROM_tool.exe)
  - **UI Tool** (BM77SPP05 UI v303.001.exe)
- **MCU:**
  - Auto Test Tool (MFi SPP Tool v1.0_023.exe)
  - BT Chat Tool
  - Manual Test Tool (BM77SPP Manual Test Tool v0.32.exe)
- **APP:**
  - Android: **iSSC APP(Classic)**, Bluebit (BLE)
  - iOS: BT Chat Tool(Classic), **BLETR(BLE)**

F/W and Apps

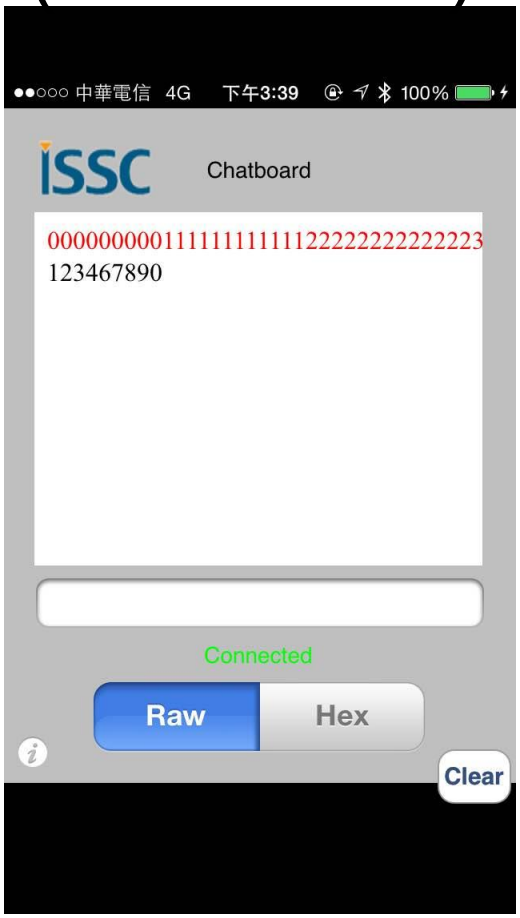
- **F/W Version:**
  - BM77SPP_v1.57_Changeset 916(RC Version)
- **UI Version:**
  - BM77SPP UI v304.003(FW v1.57 RC)
    - BM77SPP03 UI v304.003.exe
- **iOS App: Download from APP Store(search ISSC)**
  - BT Chat, BLETR
- **Android App: Install by apk file**
  - iSSC APP, BlueBit

Configuration UI Tool

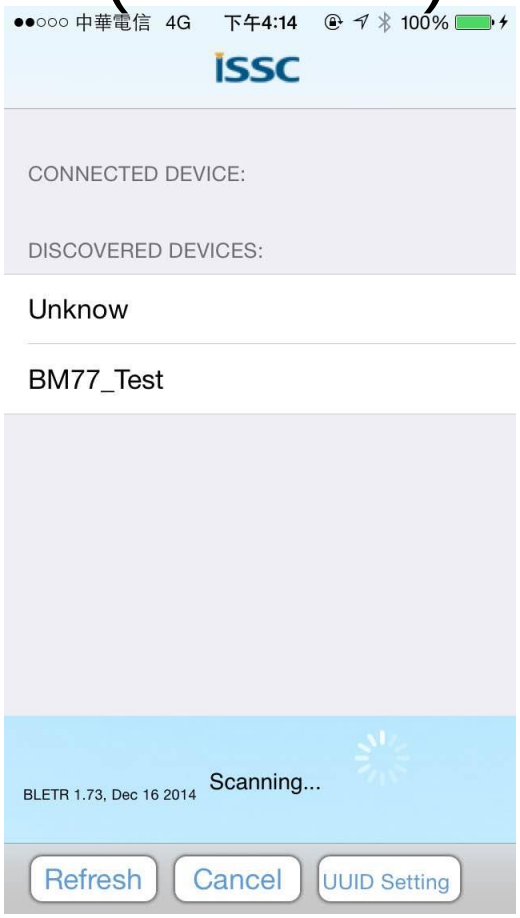


iOS APPs

BT Chat
(For Classic)

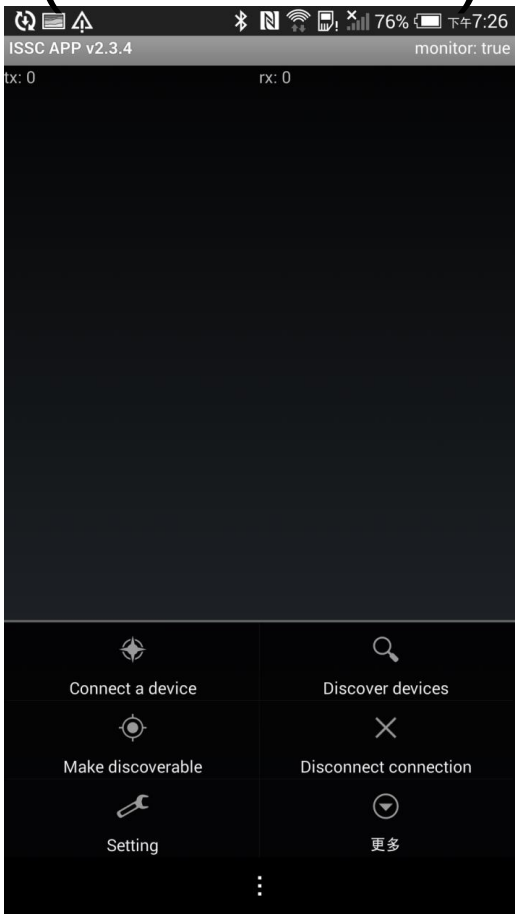


BLETR
(For BLE)

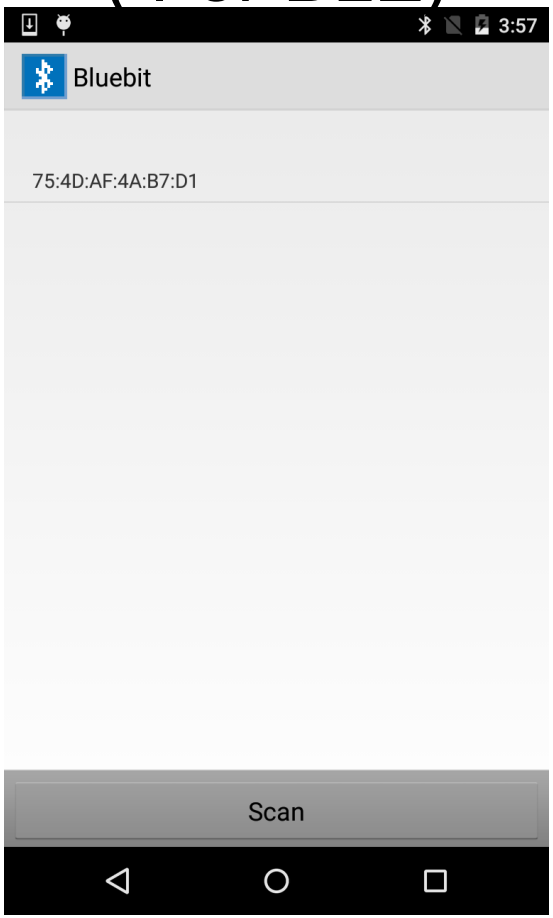


Android APPs

iSSC app
(For Classic)



BlueBit
(For BLE)



OS vs. Solution

Agenda

- Fundamental of Bluetooth® Technology
- BM77 PICTAIL & Tools
- **Hand on**
- BeaconThings
- Q&A

Hand on

- Lab1: Update F/W, configure UI and update UI.
- Lab2: SPP link
- Lab3: BLE link
- Lab4: BM77 connect to another BM77
- Lab5: configure setting under auto pattern
- Lab6: Manual pattern
- Lab7: Test 8 K Bytes/ s throughput

Hand on

- **Lab1: Update F/W, configure UI and update UI.**
- Lab2: SPP link
- Lab3: BLE link
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- Lab6: Manual pattern
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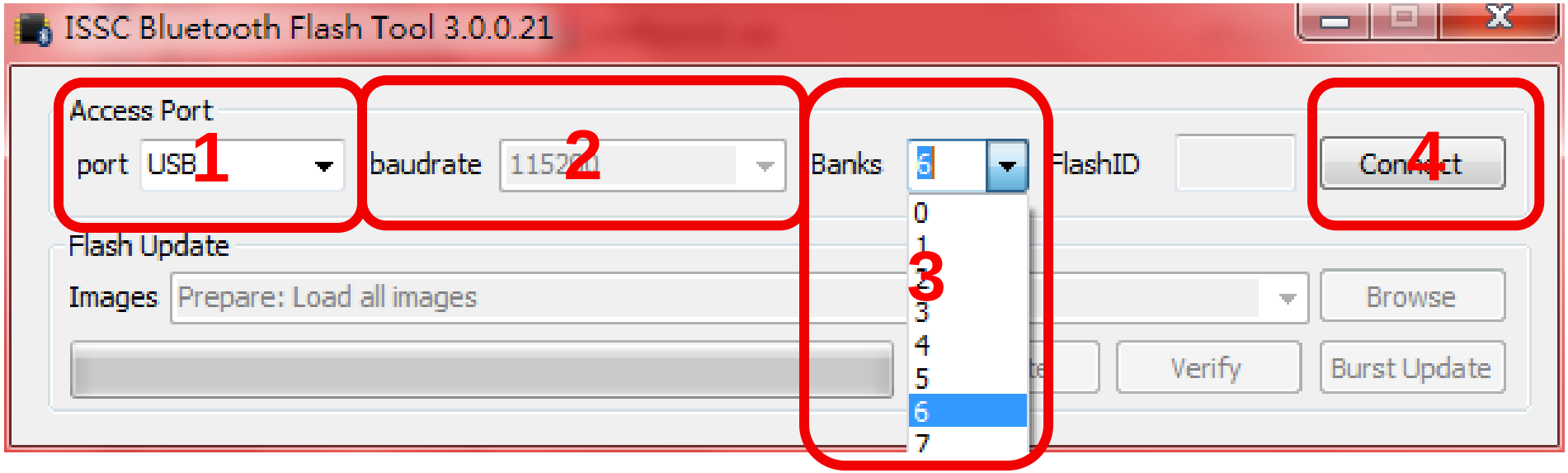
Write F/W Tool



1. Select Com port
2. Select Banks
3. Connect
4. Browse file and include all F/W Banks.
5. Update or Burst Update

Steps

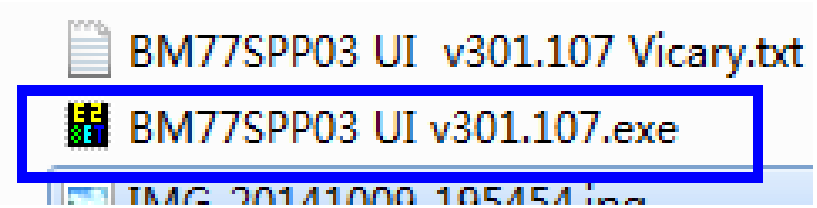
1. Use configuration tool to modify BM77 “**Name Fragment**” and save file.
2. **Backup** and **Update** configuration setting table to BM77
3. Data **transmit/ receive** between BM77 and smart phone

Note: Please modify the name fragment to **BM77_User Name**

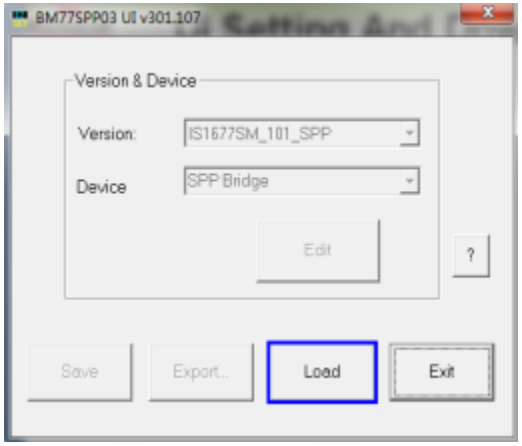
(The users could avoid selecting the wrong device for connection because of the same device name.)

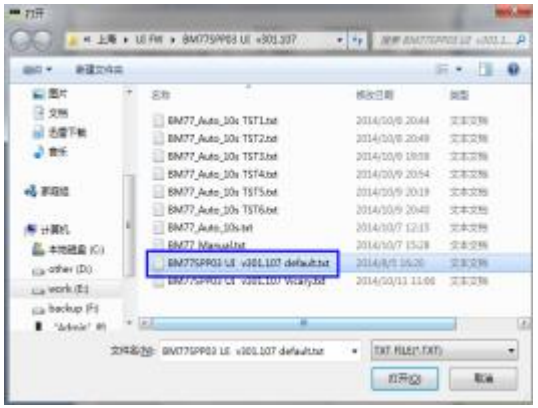
Configure Settings

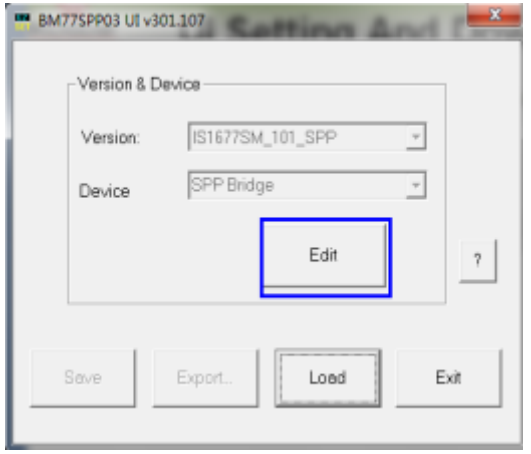
1. Open **the BM77SPP03 UI v301.107.exe** UI Tool



2. Click ”Load” button and select **BM77SPP03 UI v301.107 default.txt;**
   Next click Open;
3. Click “Edit” and enter Edit Page(Next Page)





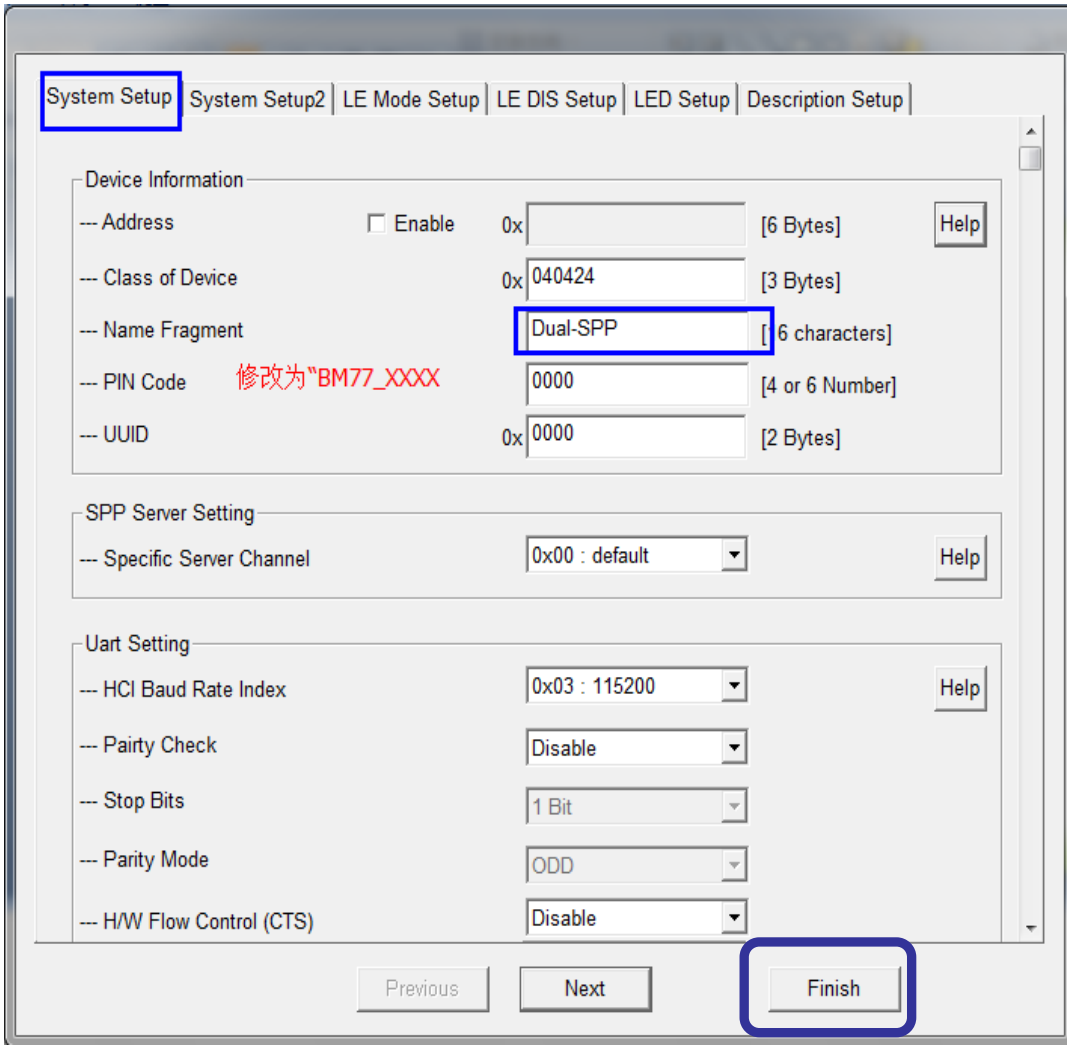


Configure Settings

4, Modify “Name Fragment” as “BM77_XXX” in “System Setup” page.

5, Click “Finish” button to finish configuration editing.

(Next Page)

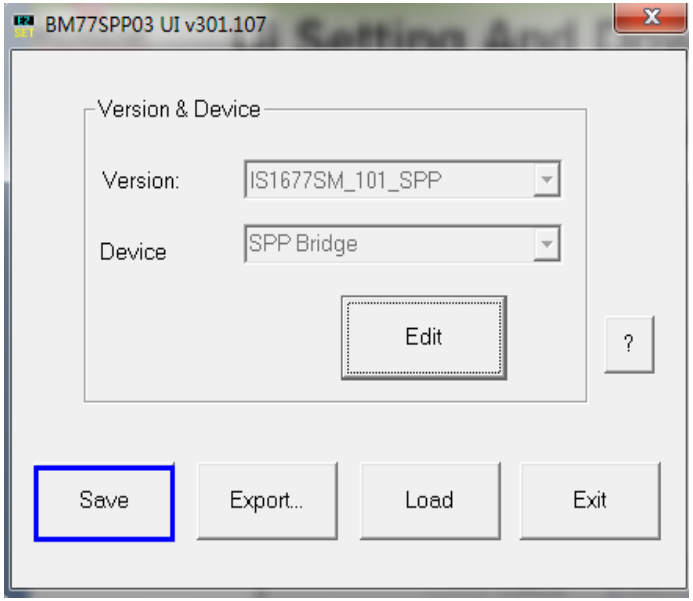


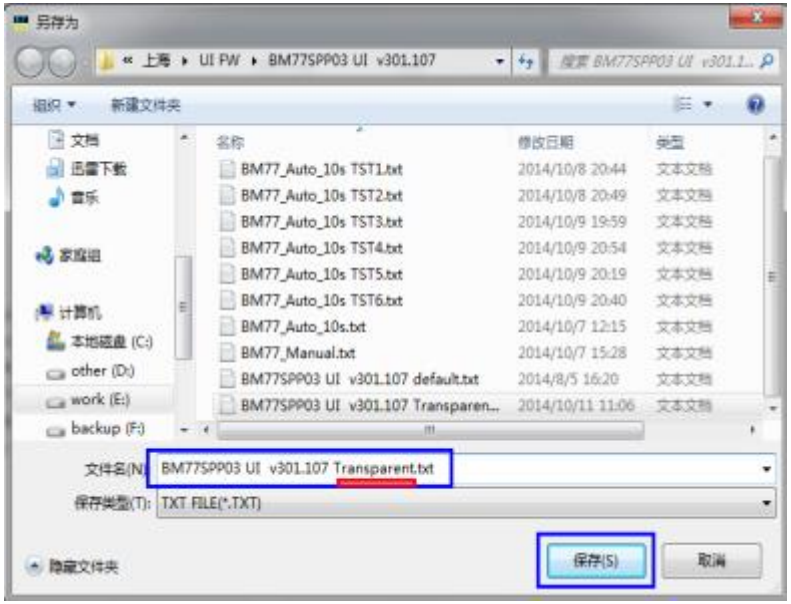
Configure Settings

6, Click “Save” button to save settings.

7, Change file name： **BM77SPP03 UI v301.107 For Transparent.txt**

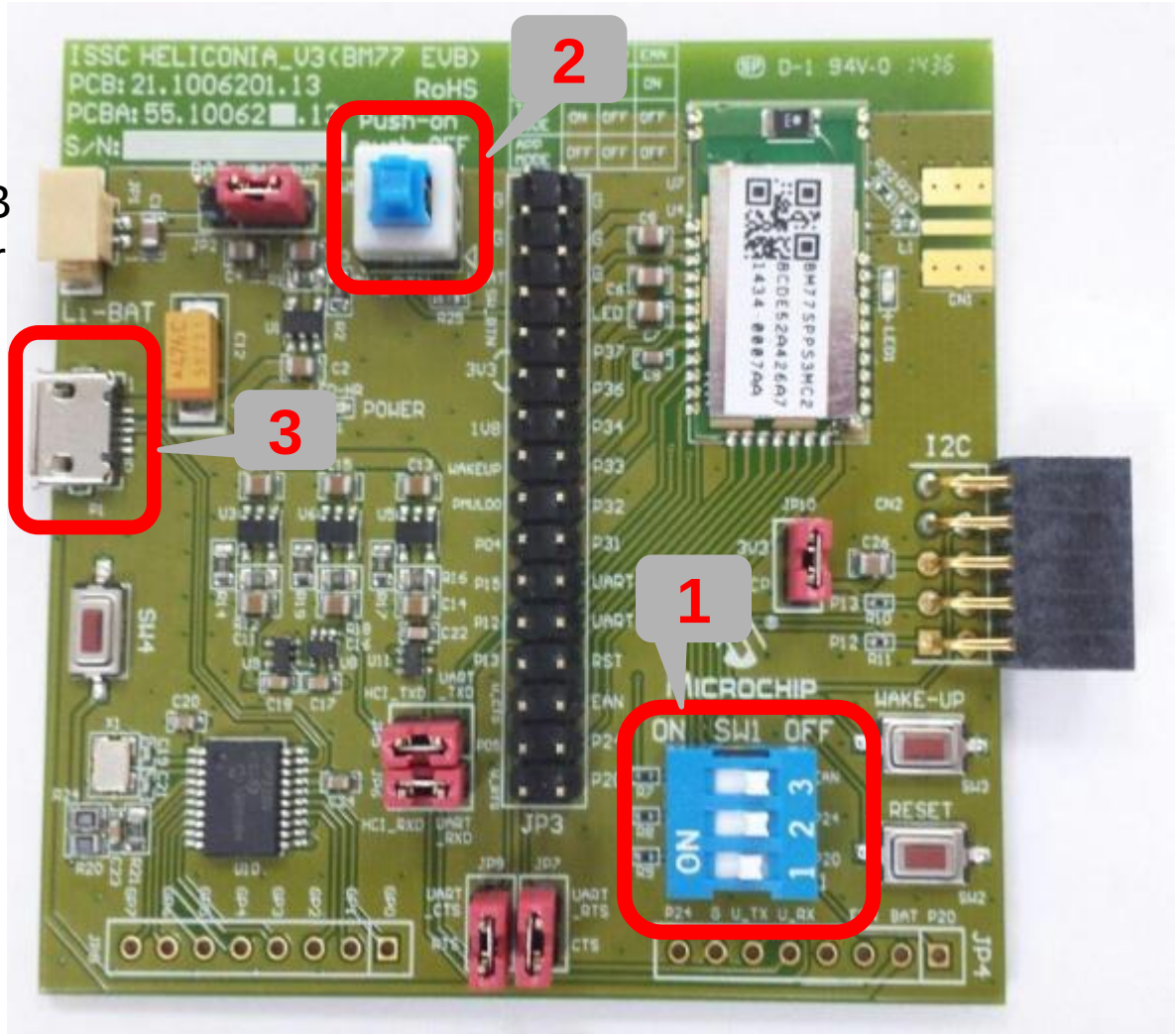
Save it and download this file to EV77 latter.





Update Configuration Table

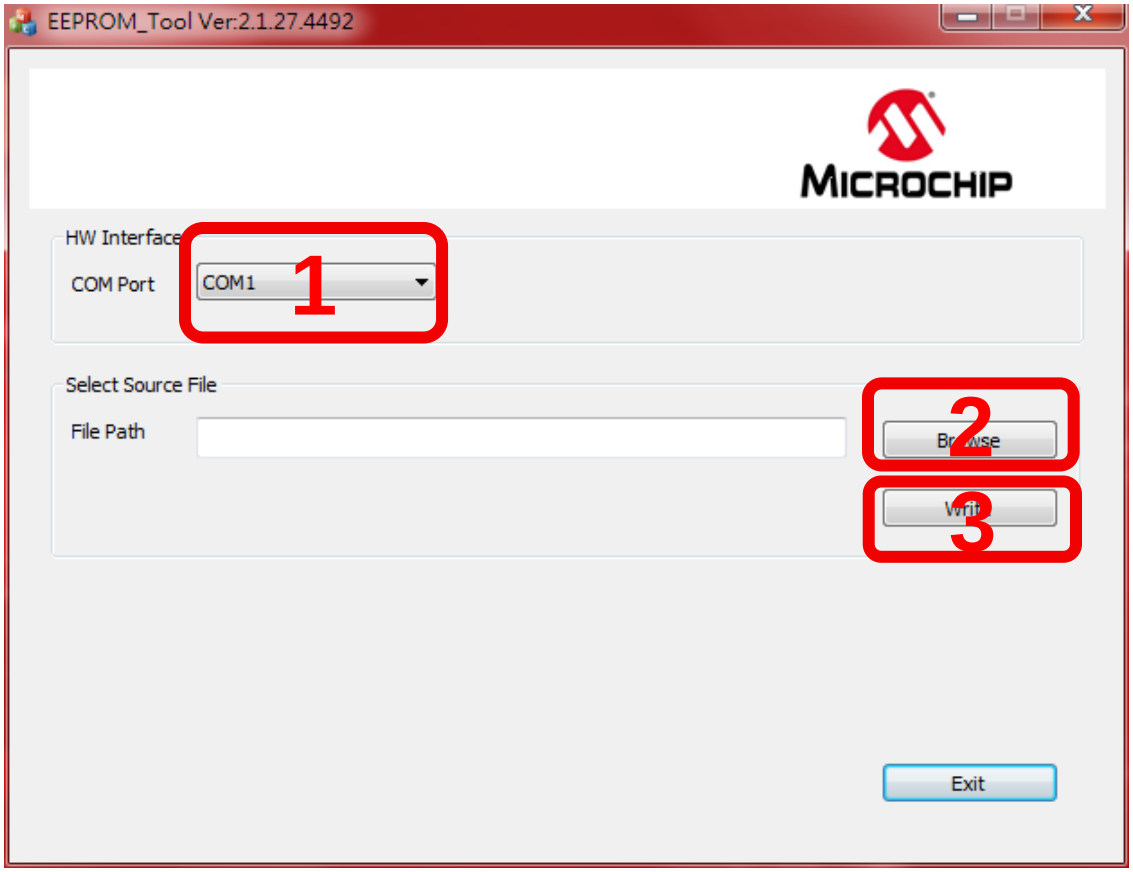
1. Select Mode: Test Mode
2. Press SW_BTN
3. Connect with PC via micro USB Cable and install MCP2200 Driver



SW1 Mode Select

	P20	P24	EAN
Boot Mode	ON	ON	ON
Test Mode	**ON**	**OFF**	**OFF**
APP Mode	OFF	OFF	OFF

Write EEPROM Tool



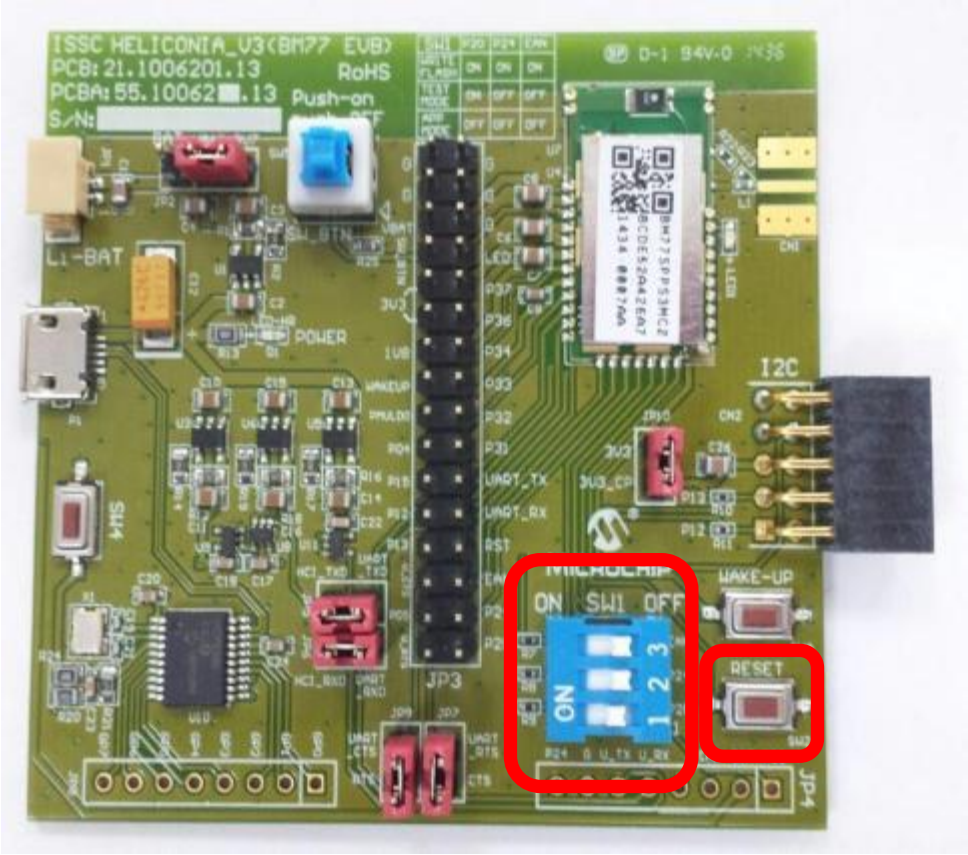
1. Select COM Port and Baudrate
2. Select EEPROM Table File
3. Write EEPROM Table

Hand on

- Lab1: Update F/W, configure UI and update UI.
- **Lab2: SPP link**
- Lab3: BLE link
- Lab4: BM77 connect to another BM77
- Lab5: configure setting under auto pattern
- Lab6: Manual pattern
- Lab7: Test 8 K Bytes/ s throughput

Switch to APP Mode

1. Select Mode： APP Mode；
2. Please Press RESET Button
   And EV77 Will Enter APP Mode;

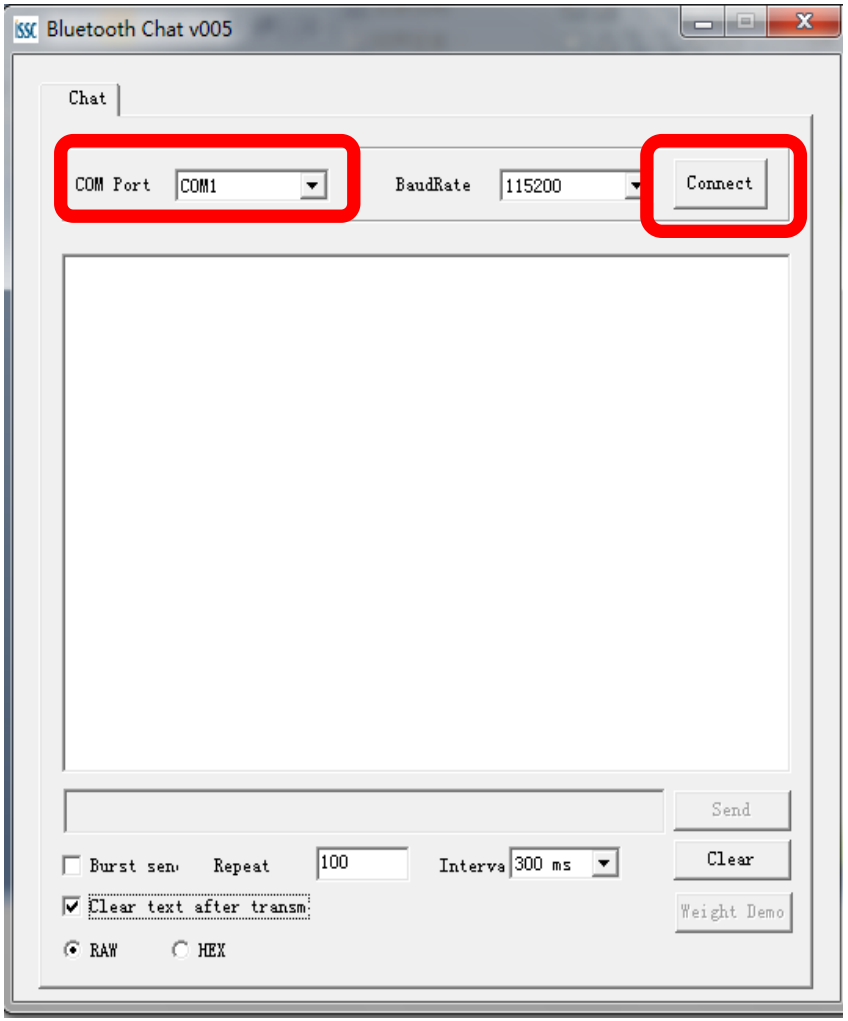


SW1 Mode Select

	P20	P24	EAN
Boot Mode	ON	ON	ON
IBDK Mode	ON	OFF	OFF
APP Mode	**OFF**	**OFF**	**OFF**

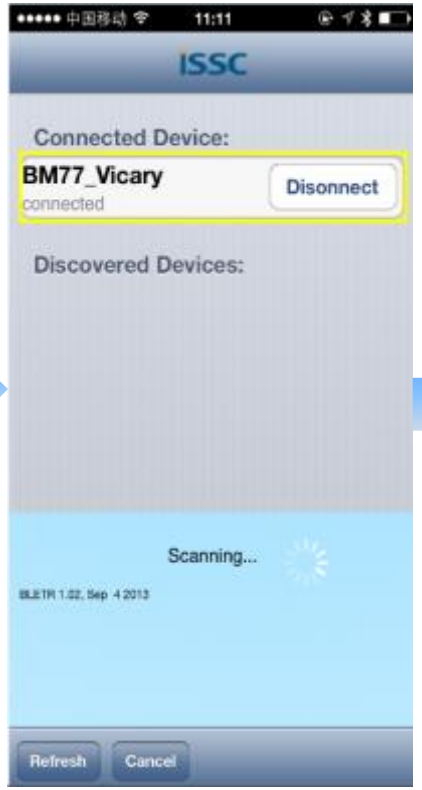
BT Chat Settings

- Open **BT Chat v00x.exe** and select correct Com port number;
- Click connect button



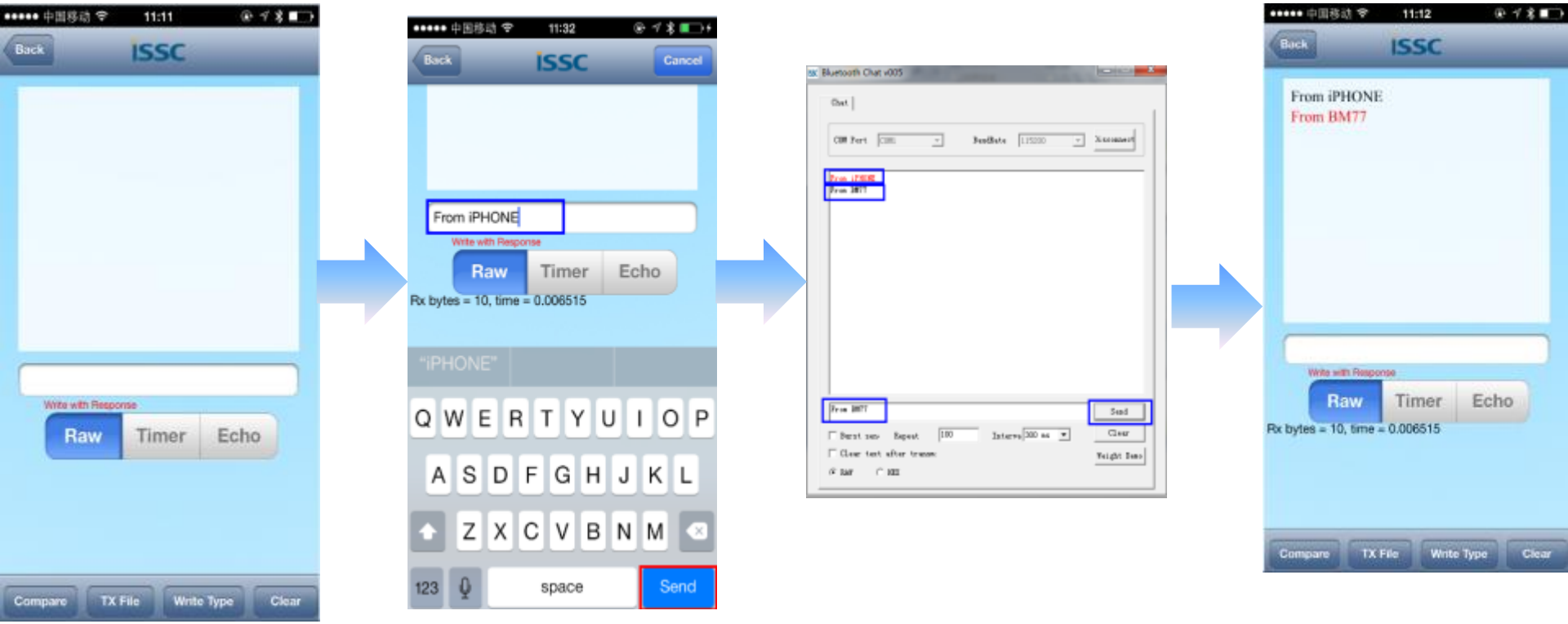
iPhone BT Connection Process

1. Open BLETR and into Scan Windows
2. Click Refresh button and find BM77_xxx
3. Click BM77_xxx and connecting
4. Click Transparent icon (Next Page)



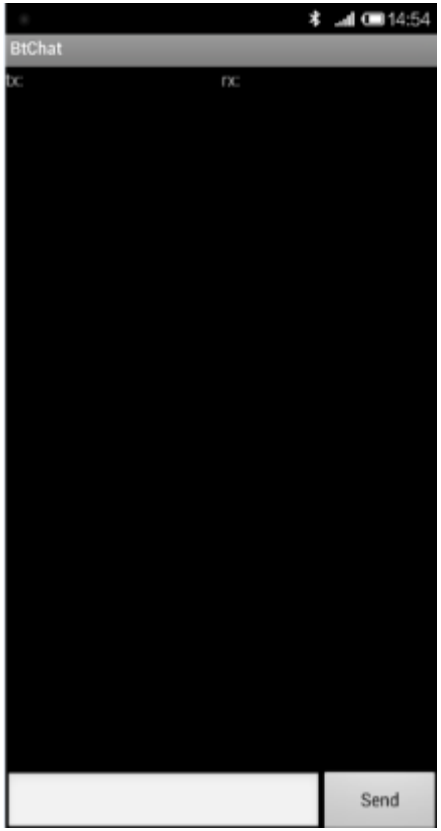
iPhone Transparent Demo

5. You can type some message and then click Send
   The message will show on the Bluetooth Chat window.
6. Vice versa



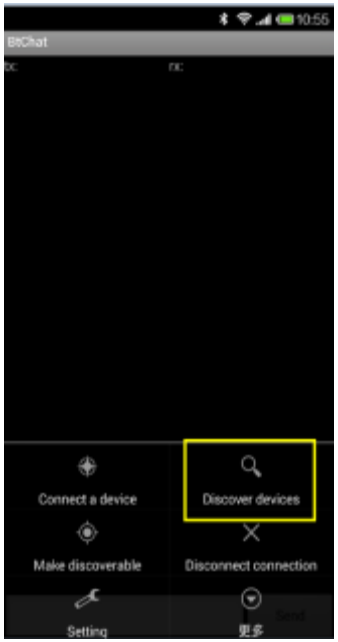
Connect with Android Phone

1. Open The BTChat;



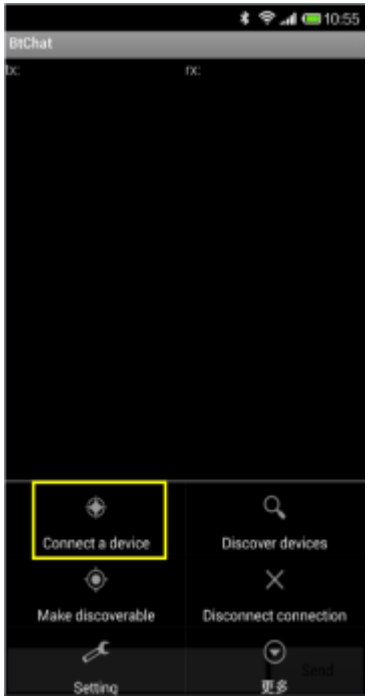
Connect with Android Phone

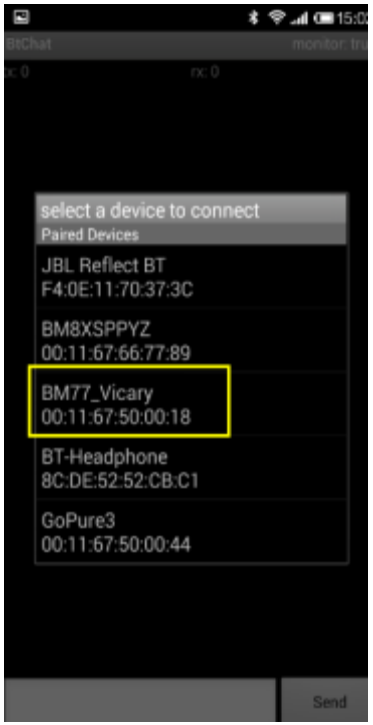
2. Press Menu Button, and tap Discovery devices
3. Find **BM77_XXX**
4. Select BM77_XXX and Paired
   You can see it Under Paired Device Column, You can return to the main interface.

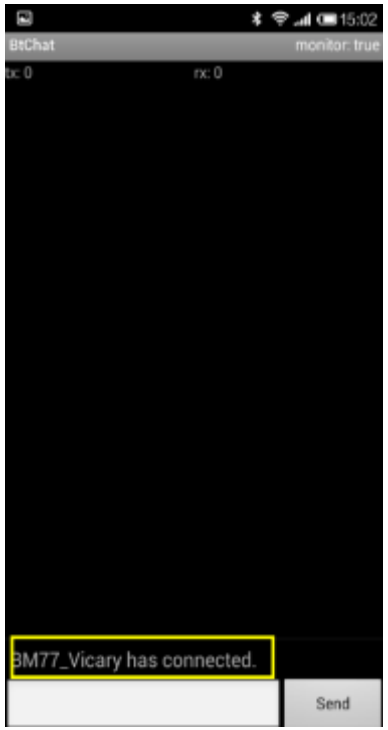


Connect To Android Phone

5. Select Menu and tap Connect a device
6. Select BM77_XXX;
   You can see the message “BM77_XXX has connected”



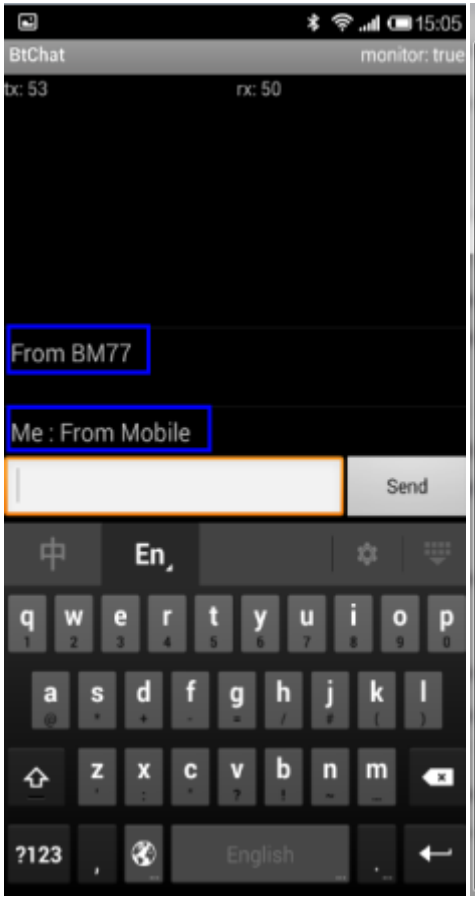




Android PHONE Transparent Demo

Type From BM77 on Bluetooth Chat v005
and Send it, You will see the message display on BTChat APP latter.

Vice versa

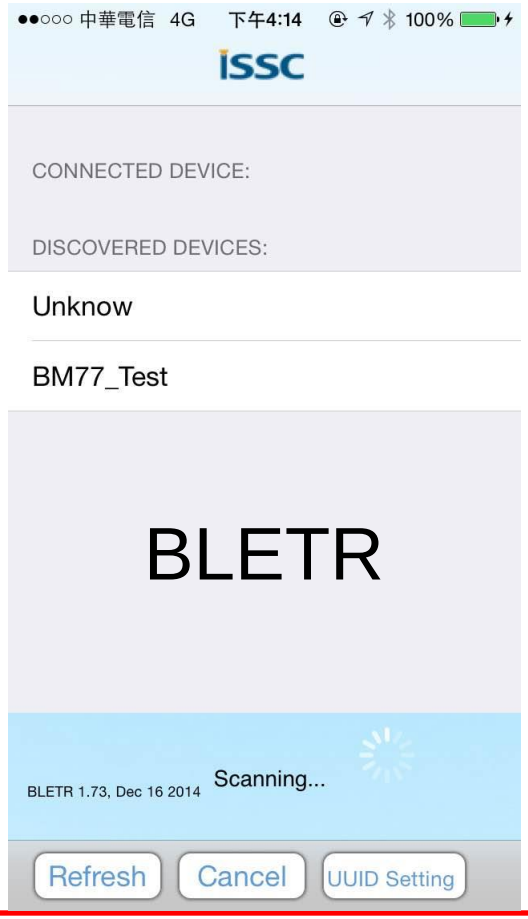


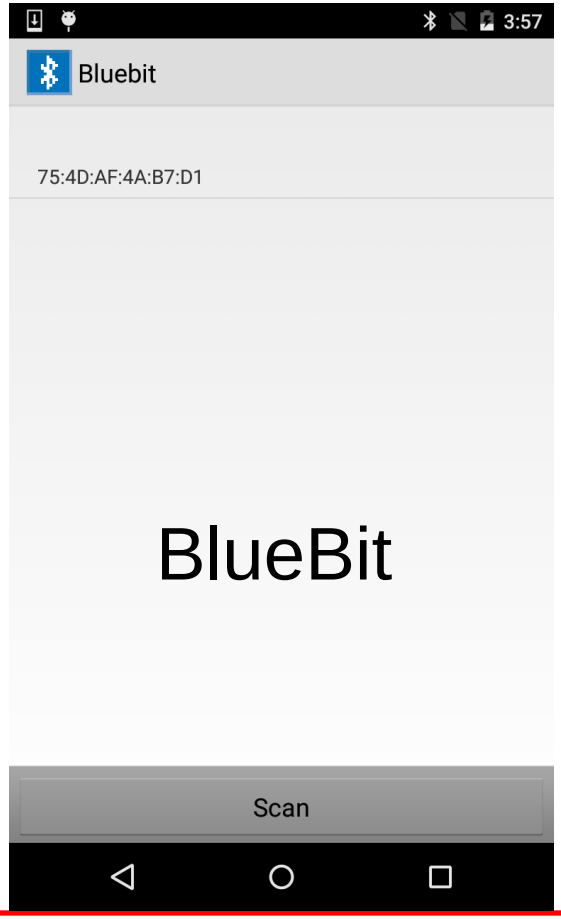
Hand on

- Lab1: Update F/W, configure UI and update UI.
- Lab2: SPP link
- **Lab3: BLE link**
- Lab4: BM77 connect to another BM77
- Lab5: configure setting under auto pattern
- Lab6: Manual pattern
- Lab7: Test 8 K Bytes/ s throughput

Same with Hand on 2

- Search BM77 and connect by app



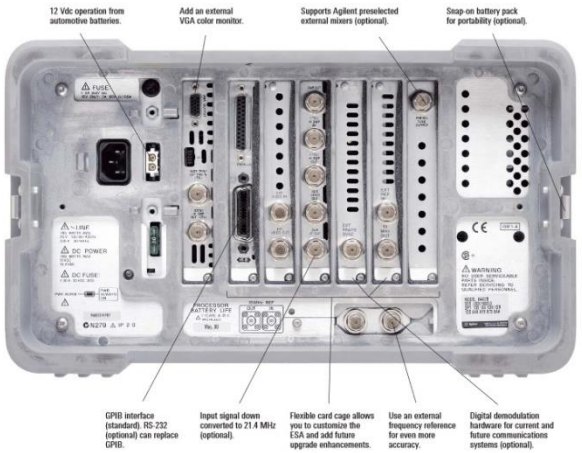


Hand on

- Lab1: Update F/W, configure UI and update UI.
- Lab2: SPP link
- Lab3: BLE link
- **Lab4: BM77 connect to another BM77**
- Lab5: configure setting under auto pattern
- Lab6: Manual pattern
- Lab7: Test 8 K Bytes/ s throughput

Use on:

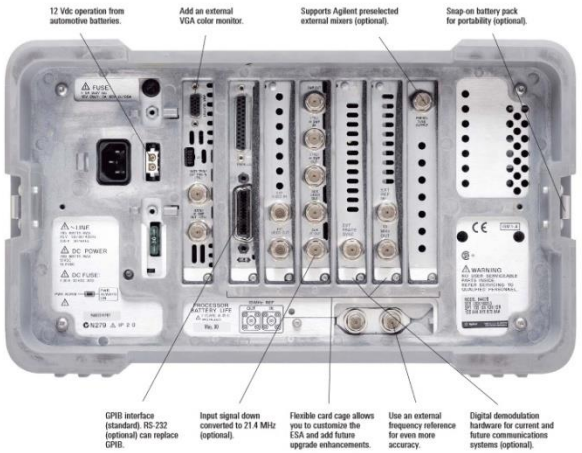
RS232, Cable; Data exchange



Use on:

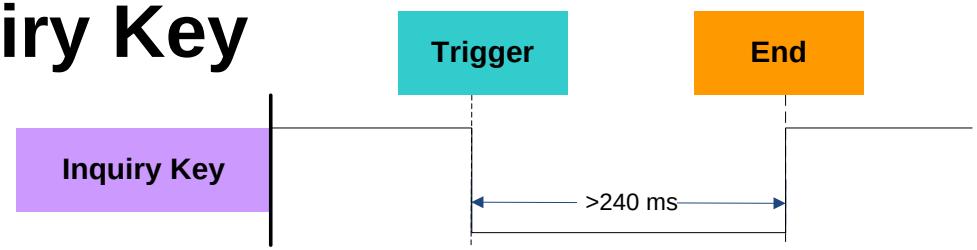
Bluetooth®

RS232, Cable, Data exchange



Proprietary M/ S SPP link

- **Support Proprietary Master/ Slave SPP link setup procedure between both BM77.**
- **Scheme:**
  - Find dedicate peer device by EIR.
    - System Configure Parameters:
      - EIR Manufacture Data (4 bytes)
  - Setup SPP link for both BM77 devices
    - System Configure Parameters: GPIO Configuration
- **Force device into Inquiry Mode by trigger Inquiry Key**

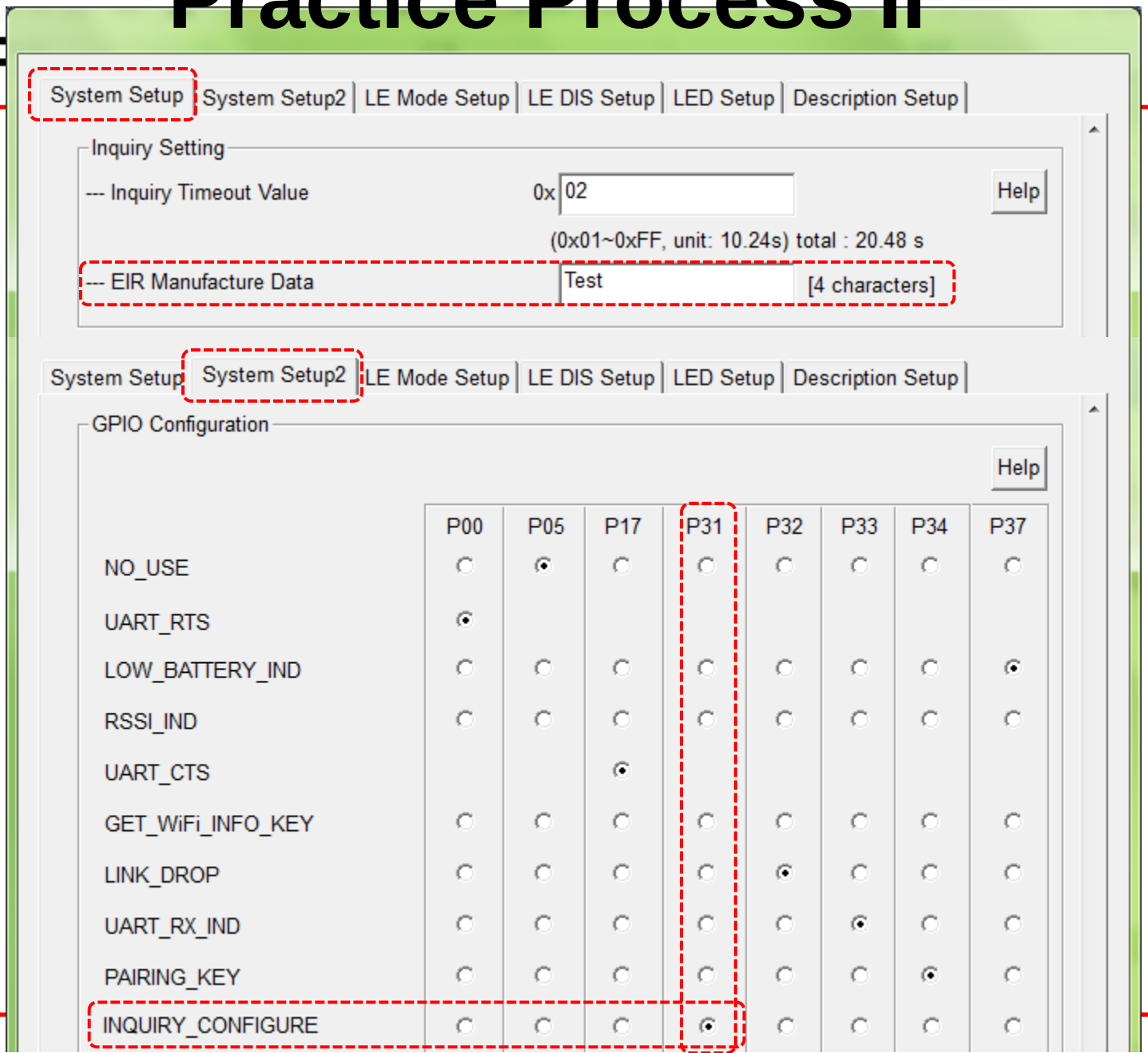


Practice Process I

1. Please change your BM77/ BM78 EIR Data (2Bytes) by air patch dongle
   - Team work(2person/ team),
   - Create a txt file by UI tool, EIR Data change to xxxx. (UI)
   - Check your GPIO Configuration/ Inquire Key is Pxx? (Default P31)
   - Opening Air patch tool on PC/ NB.
   - Power on your Device.
   - Search, Device Name and MAC address.
   - Update UI file
   - P31 short to low > 240 ms,

     BM7x will into Master mode to search same EIR Device.
   - Create link.
   - Using BTChat PC tool, to do Data exchange.
   - Finish, Done, Good Job.

Practice Process II



Hand on

- Lab1: Update F/W, configure UI and update UI.
- Lab2: SPP link
- Lab3: BLE link
- Lab4: BM77 connect to another BM77
- **Lab5: configure setting under auto pattern**
- Lab6: Manual pattern
- Lab7: Test 8 K Bytes/ s throughput

Auto Pattern & Manual Pattern

Transparent Pipe

(Auto Pattern)

1 2 3 4 5

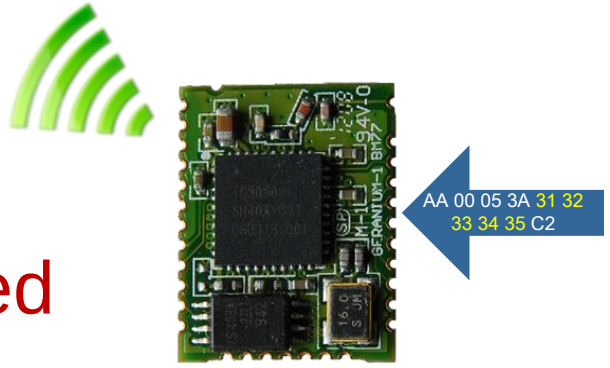
31 32 33 34 35

Easy to use

Protocol Pipe

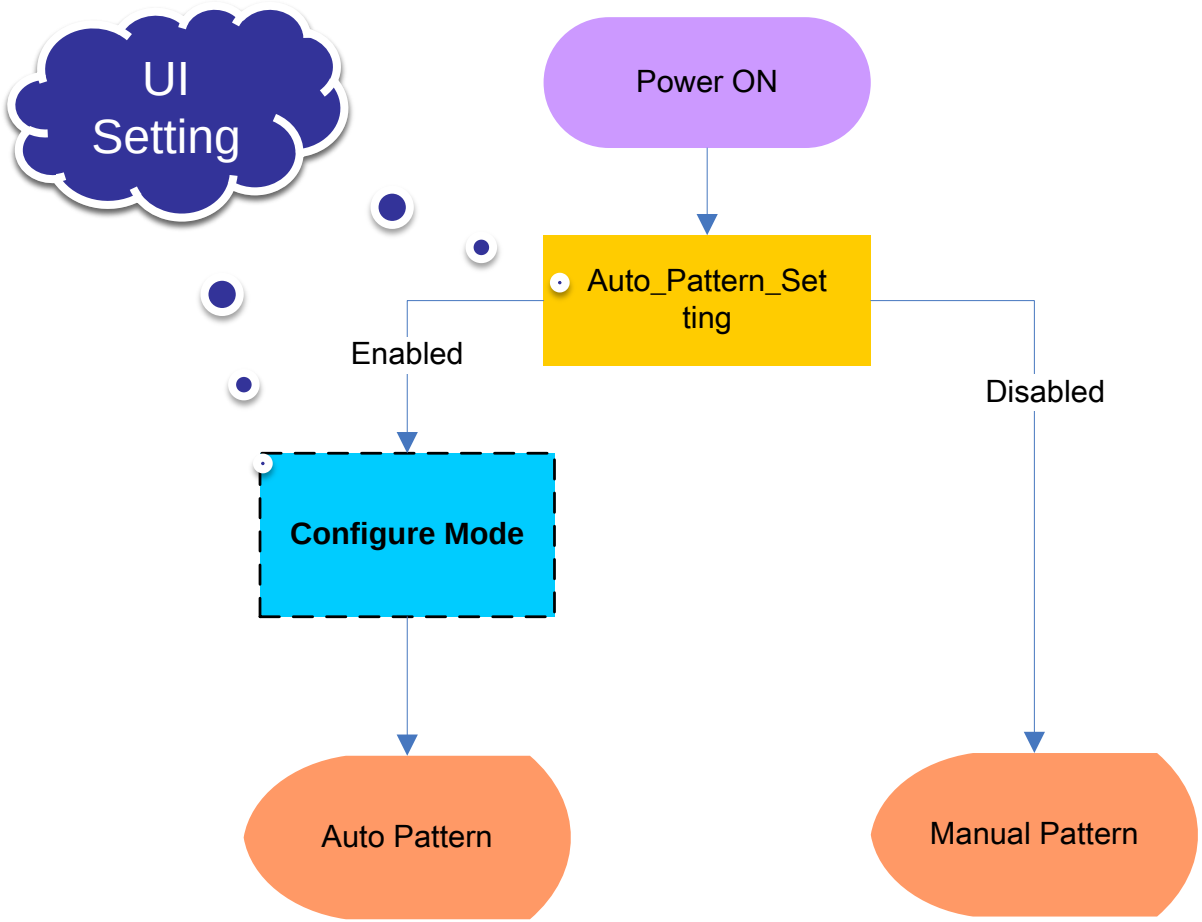
(Manual Pattern)

Need different Bluetooth behavior that auto pattern dose not support

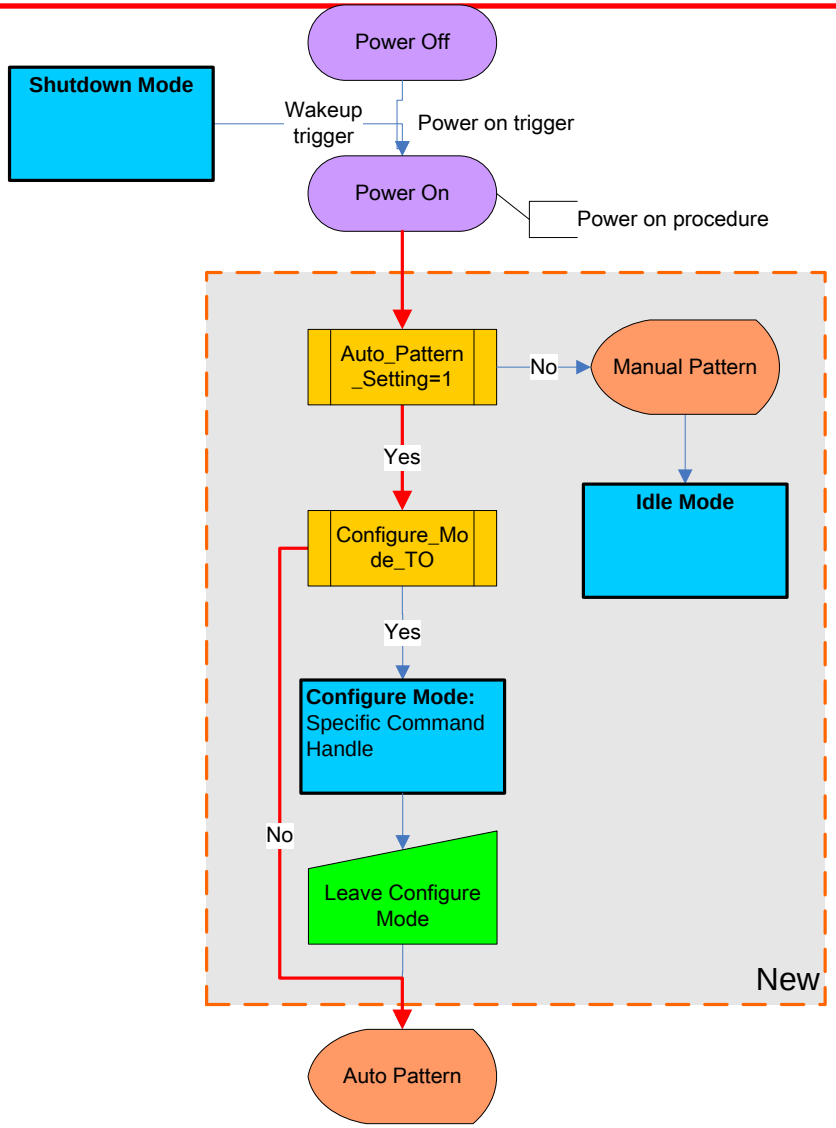


Behavior was controlled By MCU

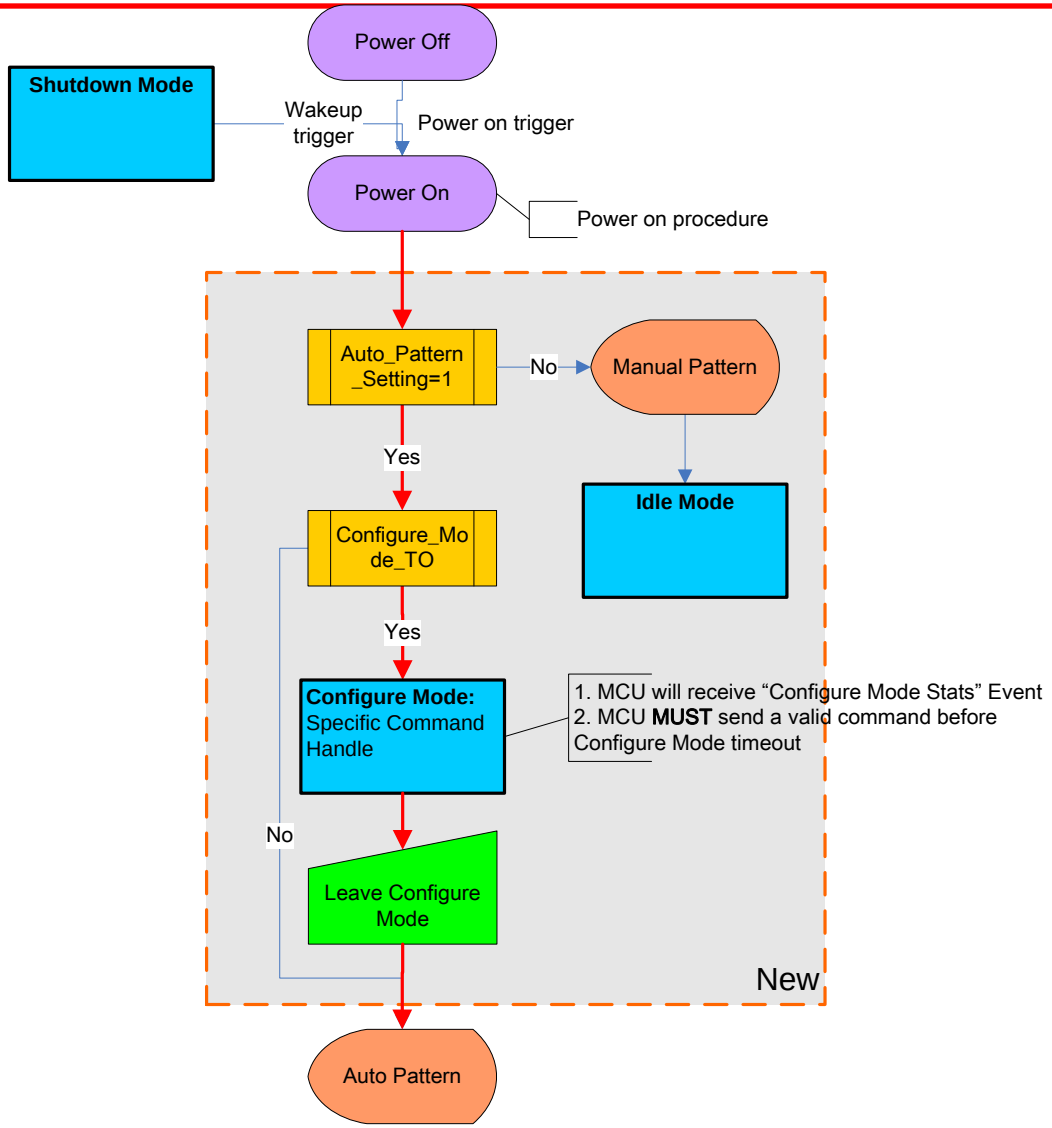
Pattern Configuration



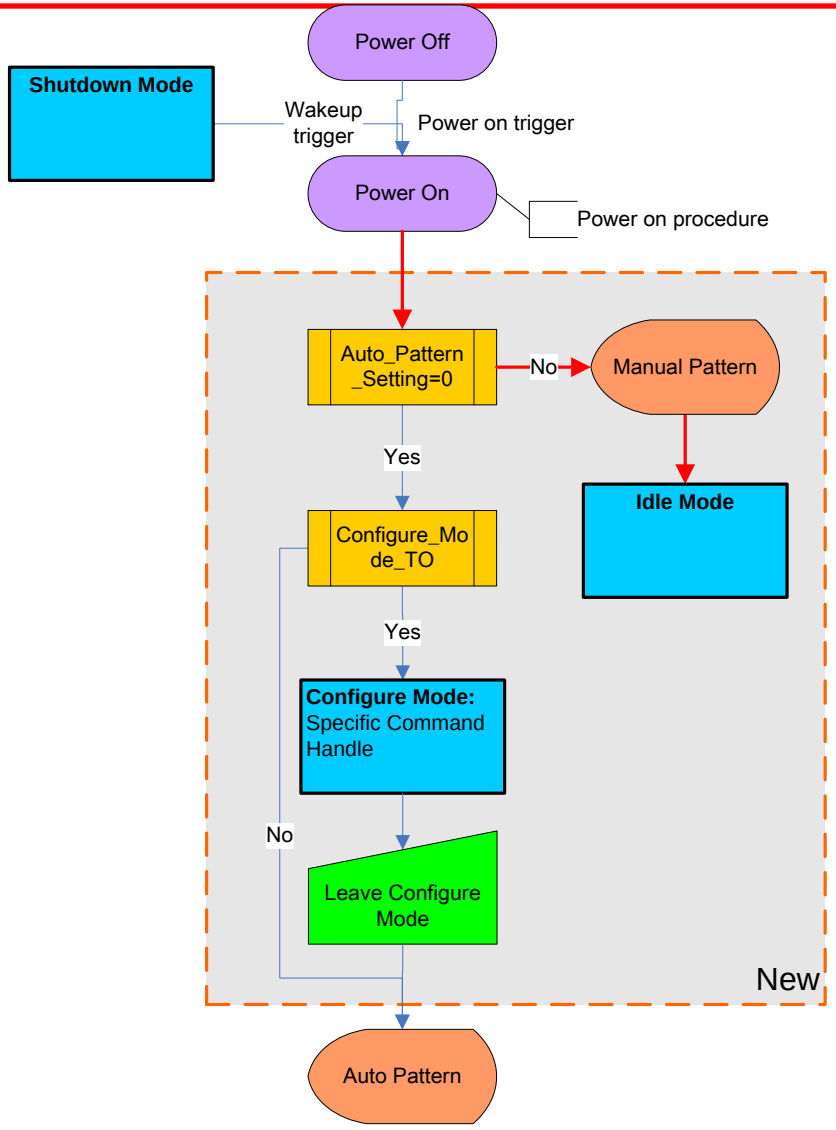
Auto Pattern w/o Configure Mode



Auto Pattern w/ Configure Mode



Manual Pattern



Hand on

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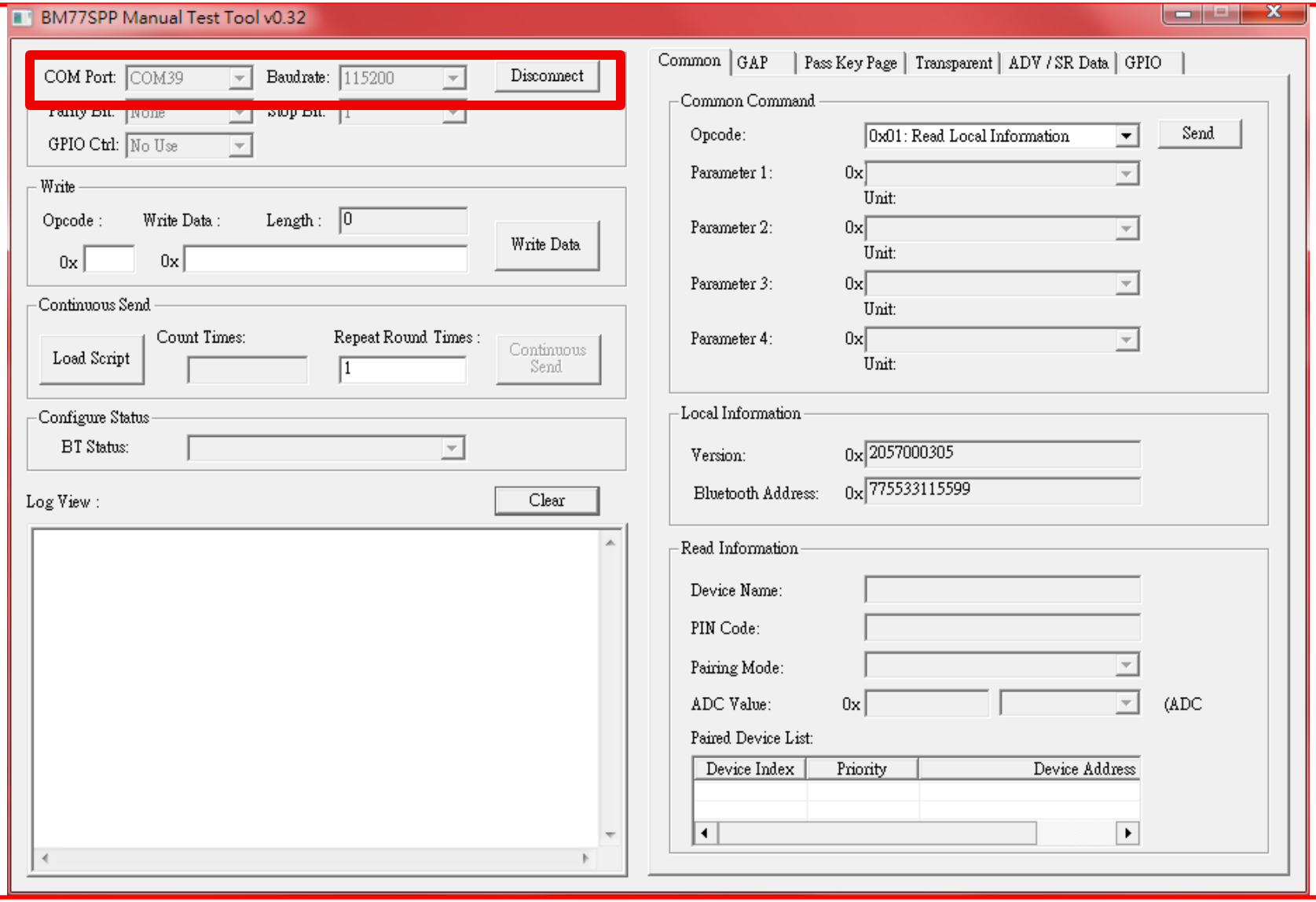
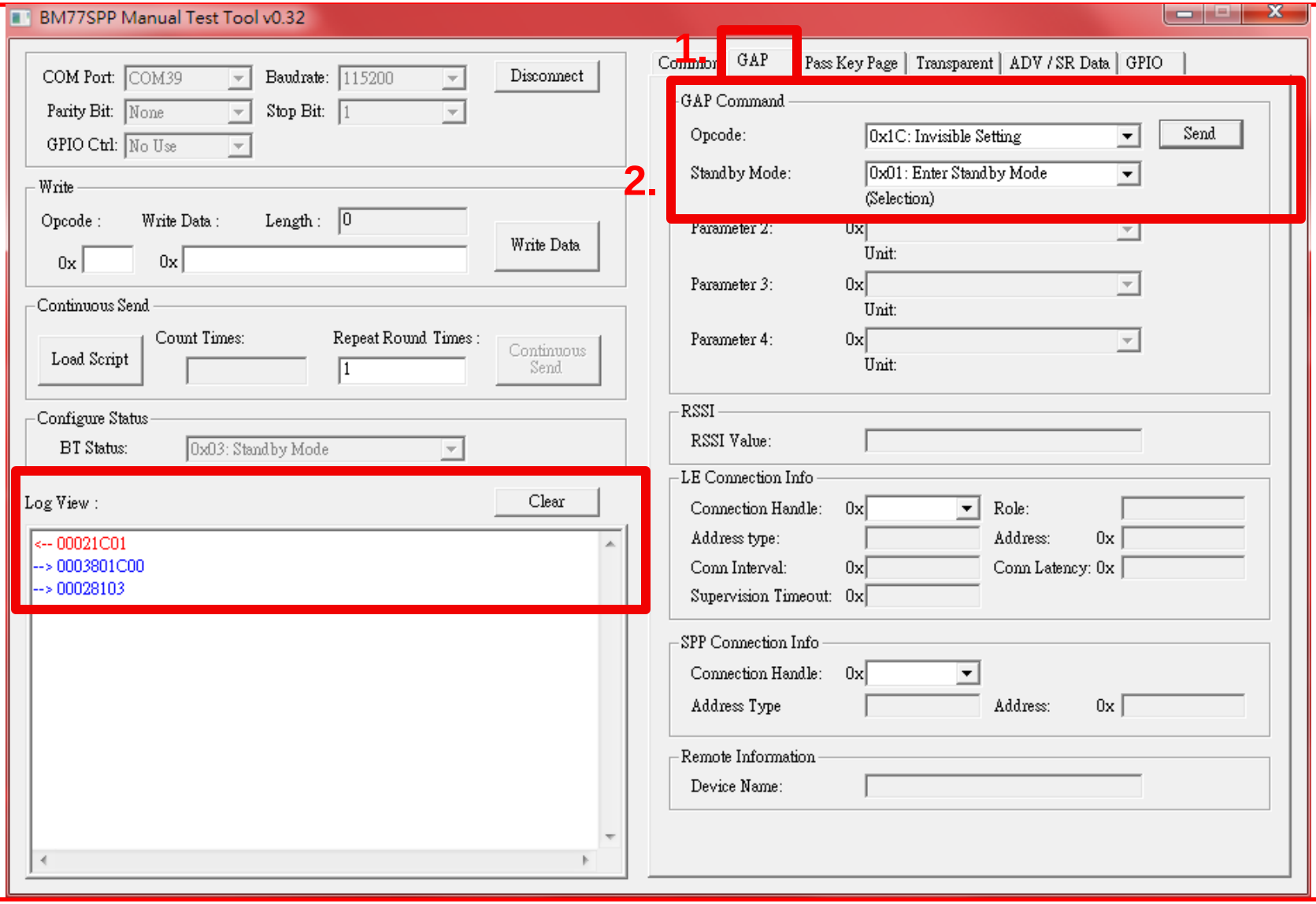
- **Lab6: Manual pattern**
- Lab7: Test 8 K Bytes/ s throughput

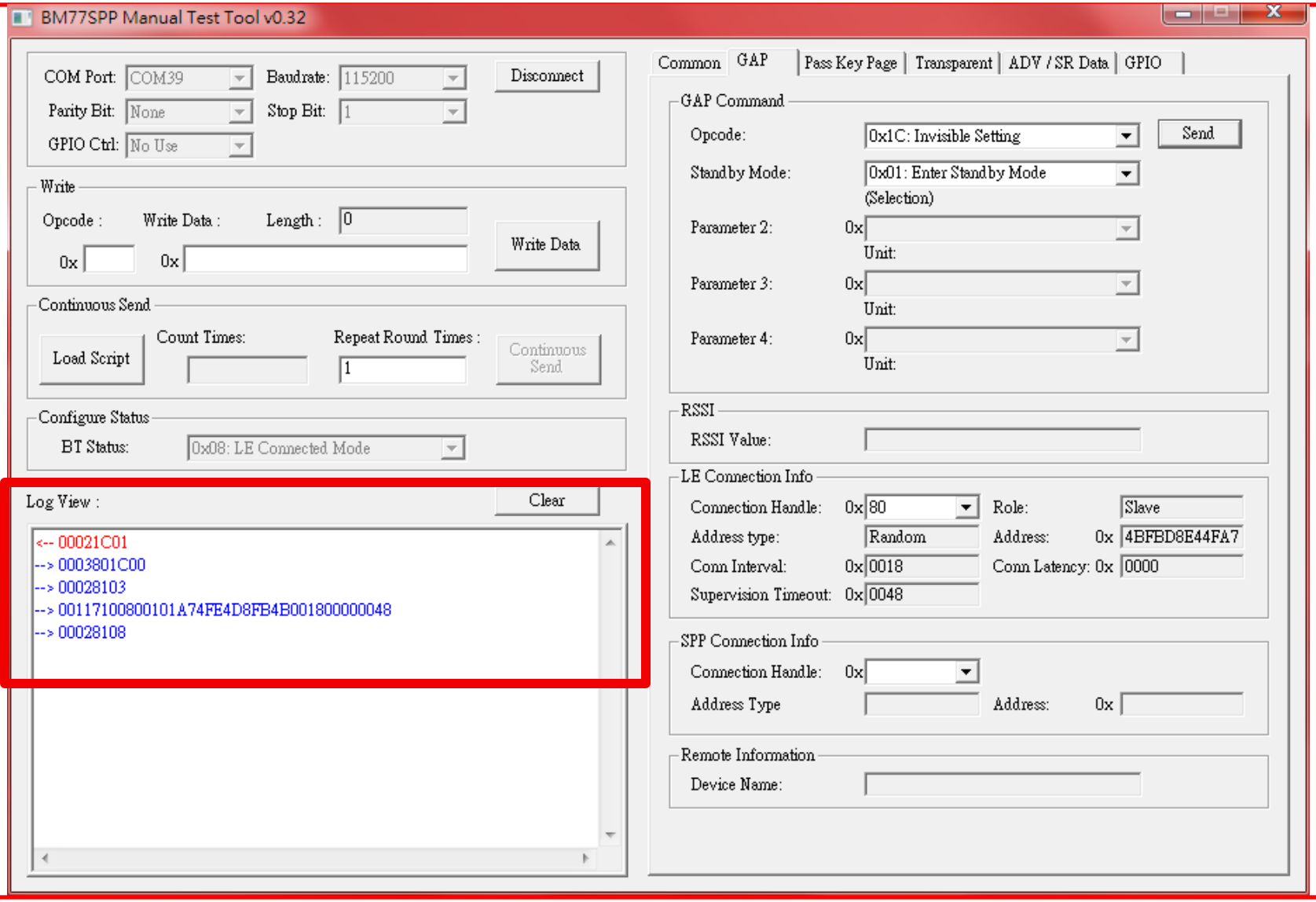
Connect to Manual Test Tool



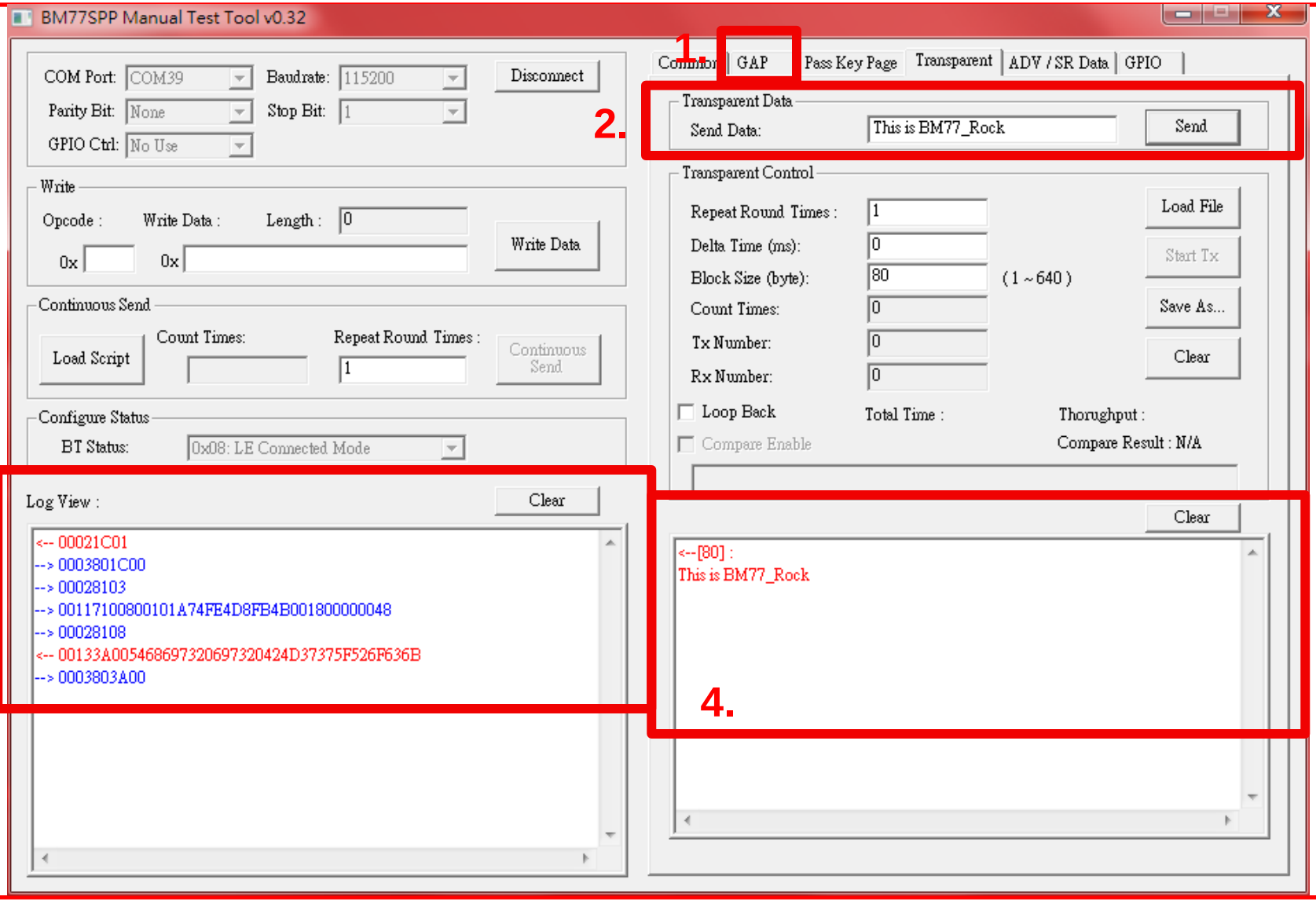
Enter Standby Mode



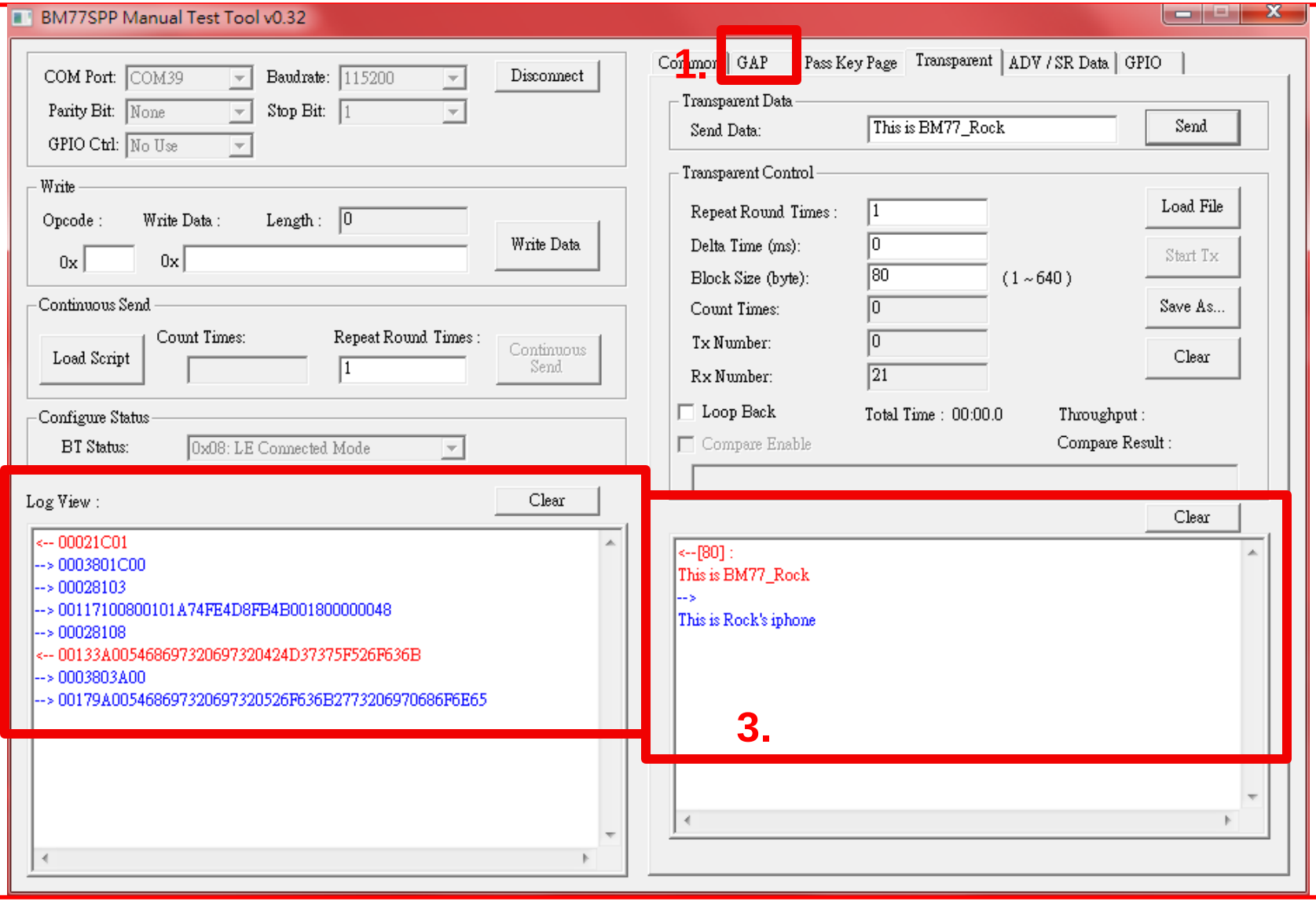
Connected by APP



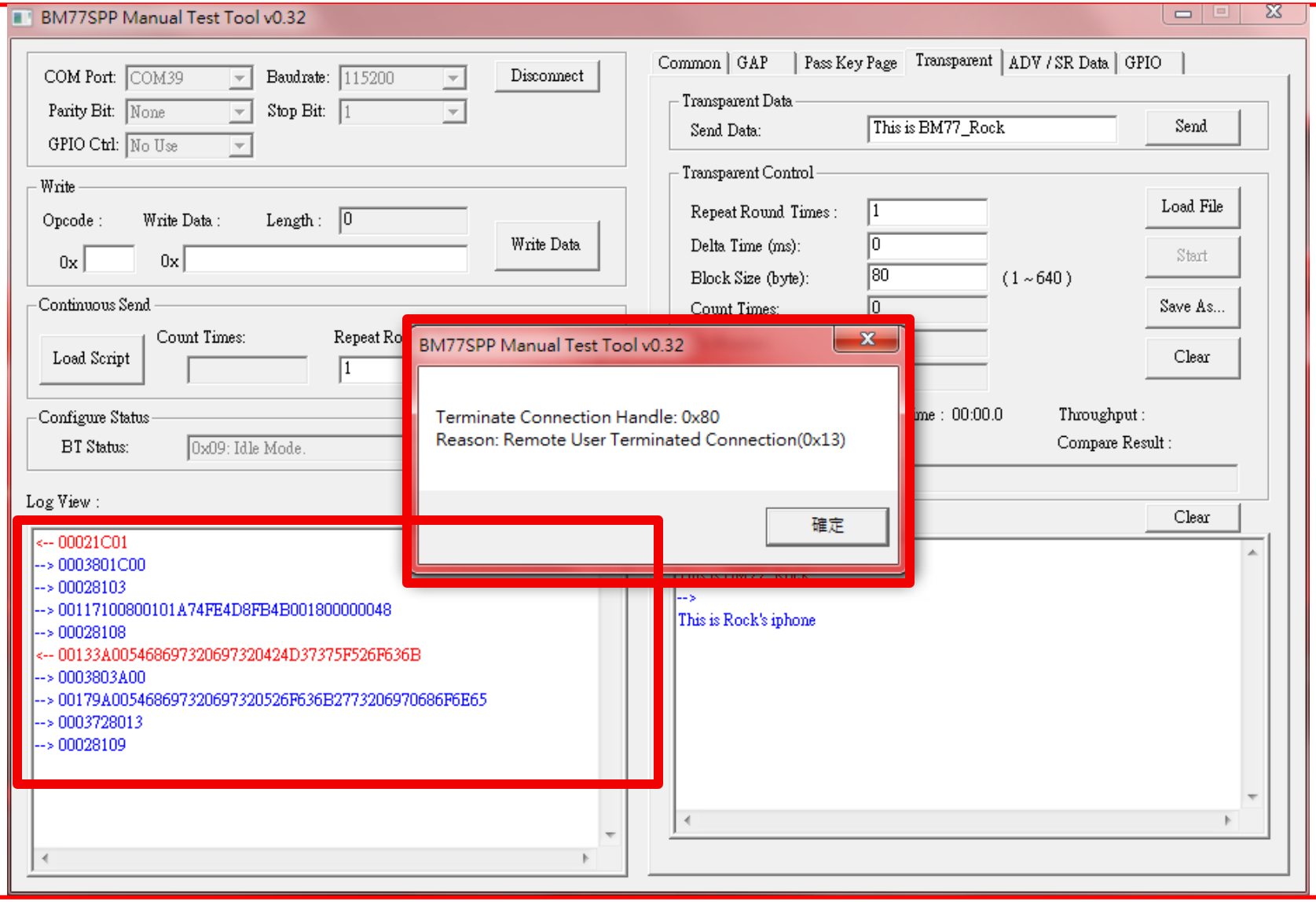
Data Transmitted From BM77



Data Received From APP



Disconnection



Hand on

- Lab1: Update F/W, configure UI and update UI.
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- Lab3: BLE link
- Lab4: BM77 connect to another BM77
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- Lab6: Manual pattern
- **Lab7: Test 8 K Bytes/ s throughput**

Agenda

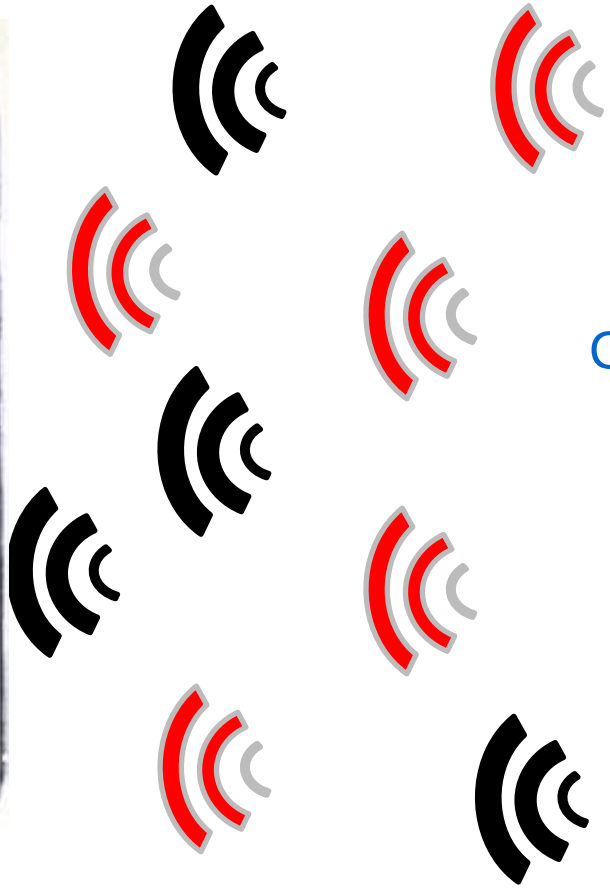
- Fundamental of Bluetooth® Technology
- BM77 PICTAIL & Tools
- Hand on
- **BeaconThings**
- Q&A

BeaconThings ®

1. **Auto Connection/ Control Appcessory**

2. **Data to Cloud Easily (No need open App)**

BeaconThings®



Connectable
ADV

Beacon
ADV

POS

Agenda

- Fundamental of Bluetooth® Technology
- BM77 PICTAIL & Tools
- Hand on
- BeaconThings
- **Q&A**

How to Identify?

- IS1677SM
- IS1678S
- IS1678SM
- IS1870SF
- IS1871SF

Differentiation

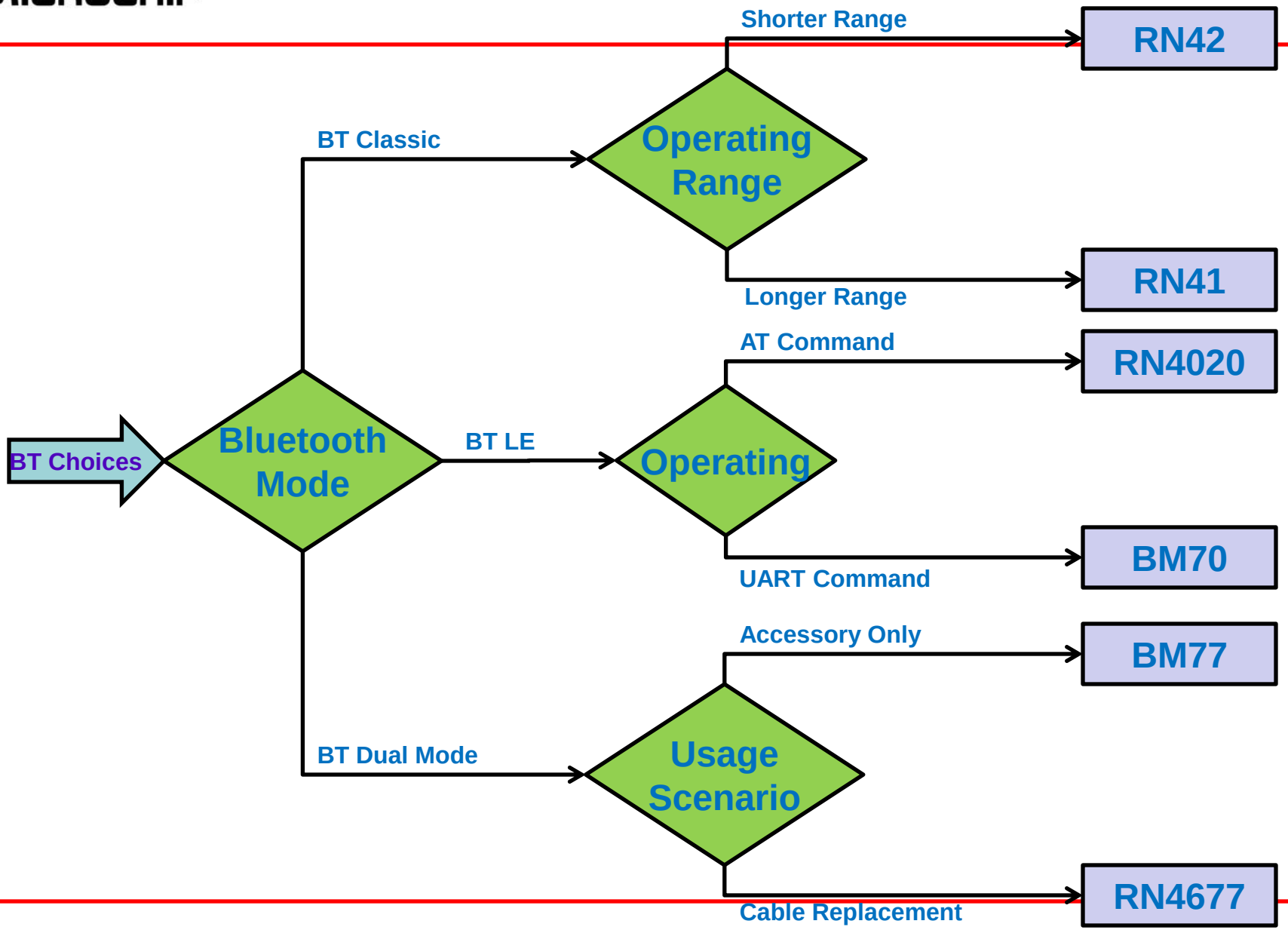
	IS1678S -151	IS1678SM	IS1870SF
Available	Bluetooth **4.0** BeaconThing® ROM base iAP1 Patch Updatable	Bluetooth **4.2** BeaconThing® Parallel Flash iAP**2**	Bluetooth **4.2** BeaconThing® e-Flash
Under Development		Master Mode WeChat AirSync Ali-Beacon Multi-link SDK OTA	Master Mode WeChat AirSync Ali-Beacon Multi-link SDK OTA

Microchip's Bluetooth® Portfolio

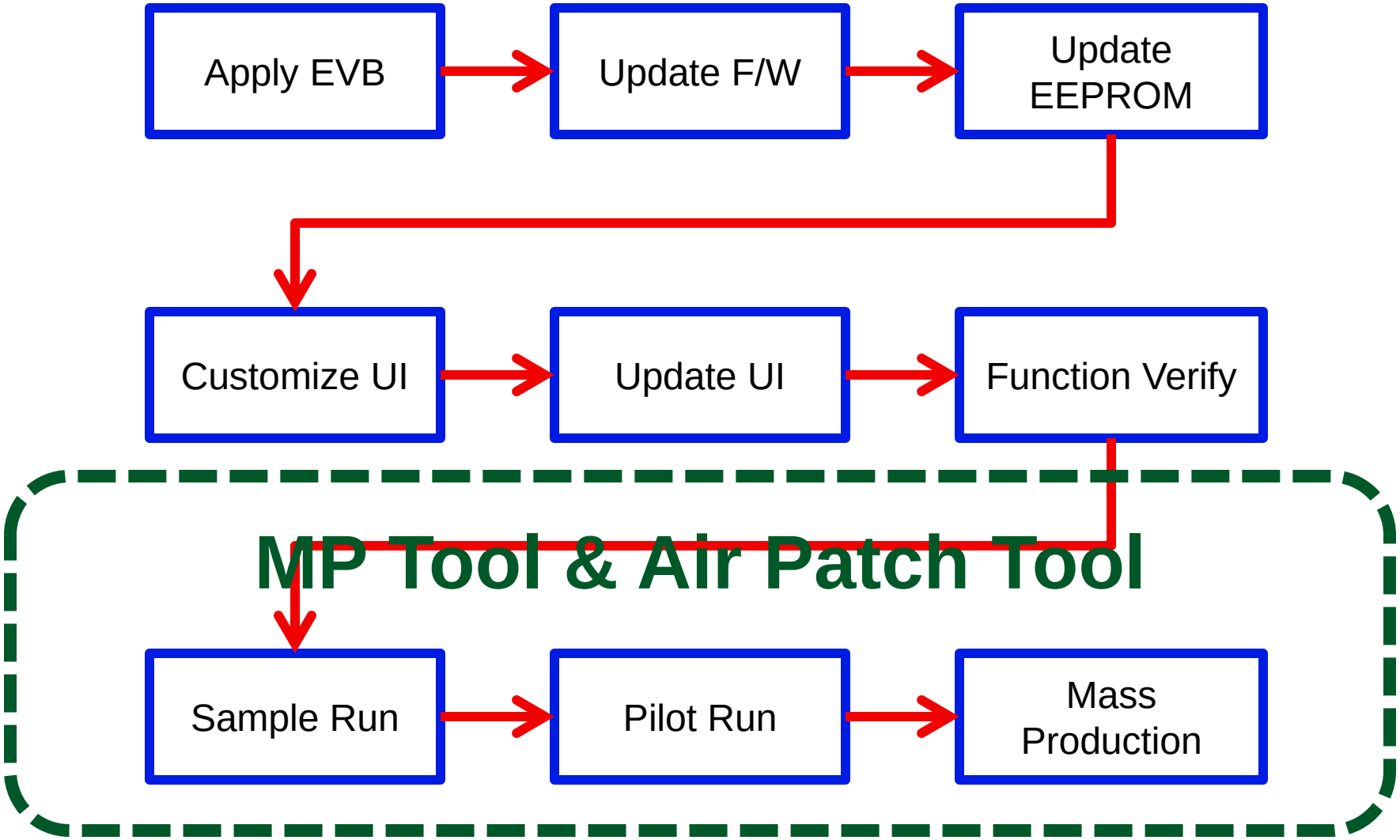


	RN41 / 41N	RN42 / RN42N	RN4020	BM77	RN4677
Type	Class 1 Bluetooth 2.1	Class 2 Bluetooth 2.1	Bluetooth 4.1	BT Dual Mode	BT Dual Mode
Interfaces	UART		UART Analog,PWM,I2C	UART	
Profiles	SPP, HID, iAP, HCI		GATT, Health, Fitness, Proximity, etc.; Custom data	SPP, iAP, GATT, Custom data	SPP, iAP, GATT, Custom data
Control	ASCII Command Set			Limited Control	ASCII Command Set
Power	3.3 VDC				
Size (mm)	13.4 x 25.8 x 2.0		11.5 x 19.5 x2.5	22 x 12 x 2.4	
Certifications	BT SIG / FCC / CE / ICS				

Choosing a Bluetooth® Data Module



Process


Apply EVB
Update F/W
Update EEPROM
Customize UI
Update UI
Function Verify
MP Tool & Air Patch Tool
Sample Run
Pilot Run
Mass Production

Mass Production Tool

Desk Top

USB

Test Fixture
With *Victoria* V2.15

RF Cable

RF Cable

Without RF Instrument,
Using GU

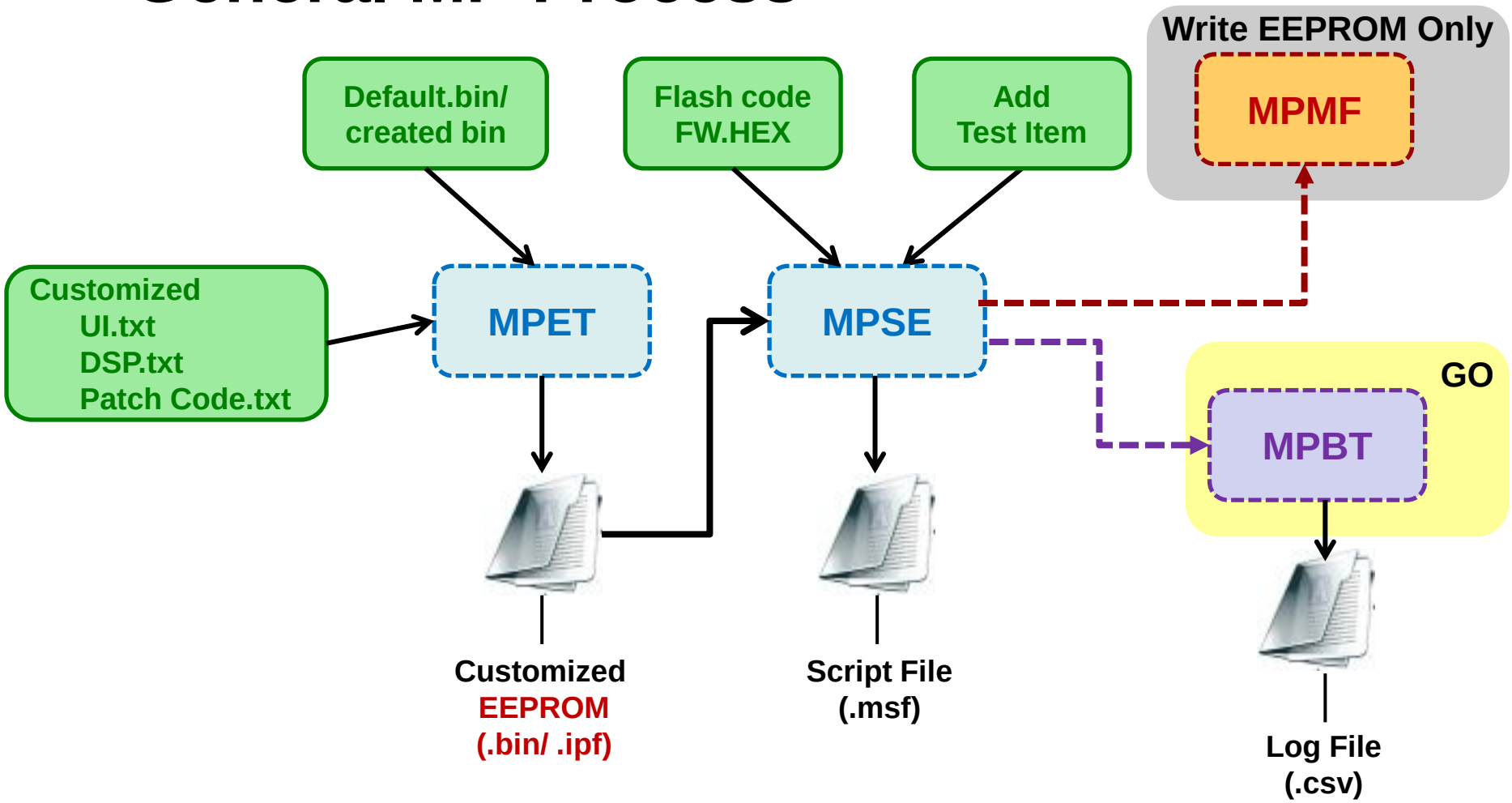
Anritsu MT8852

Agilent N4010A

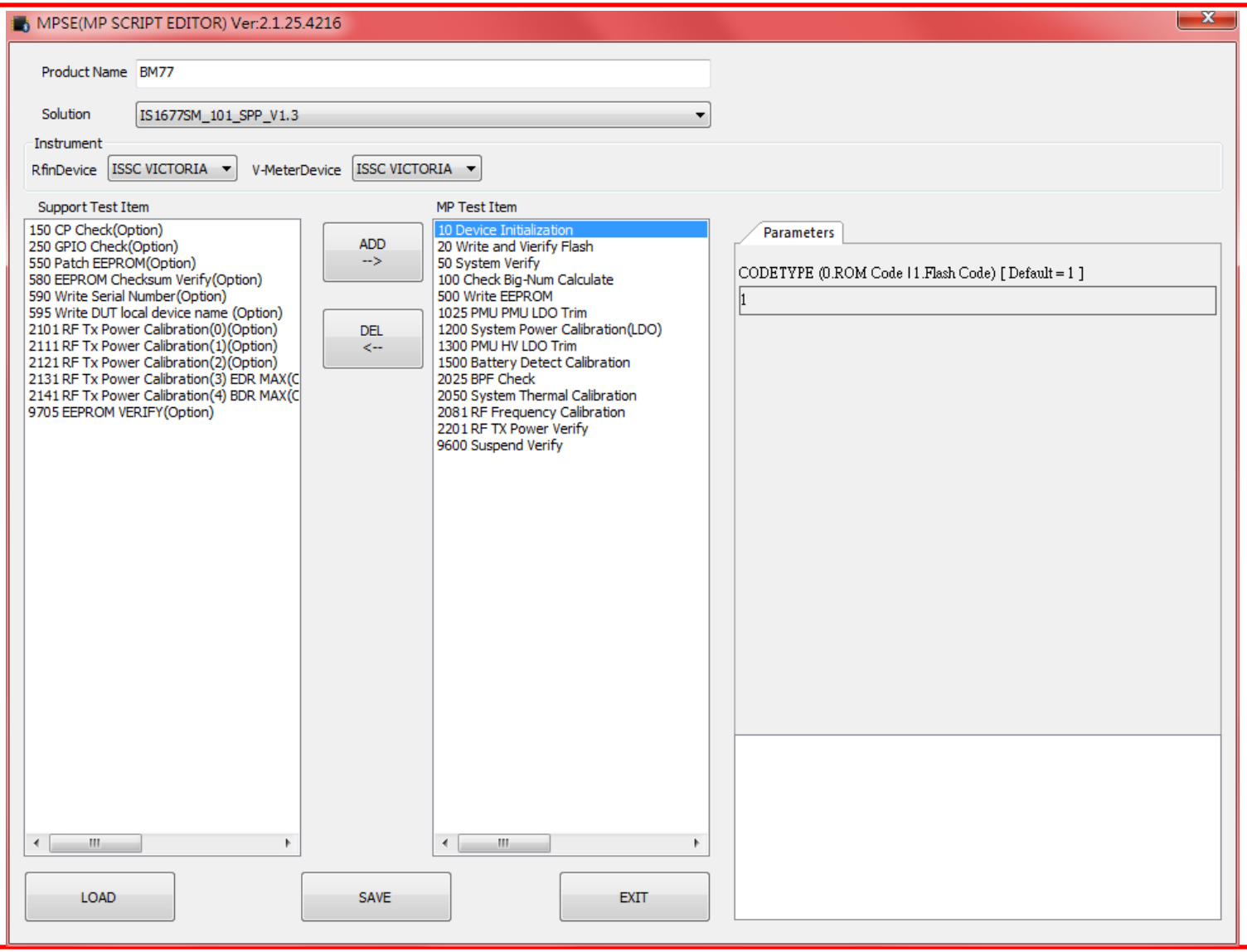
IQView (RF only)

Process

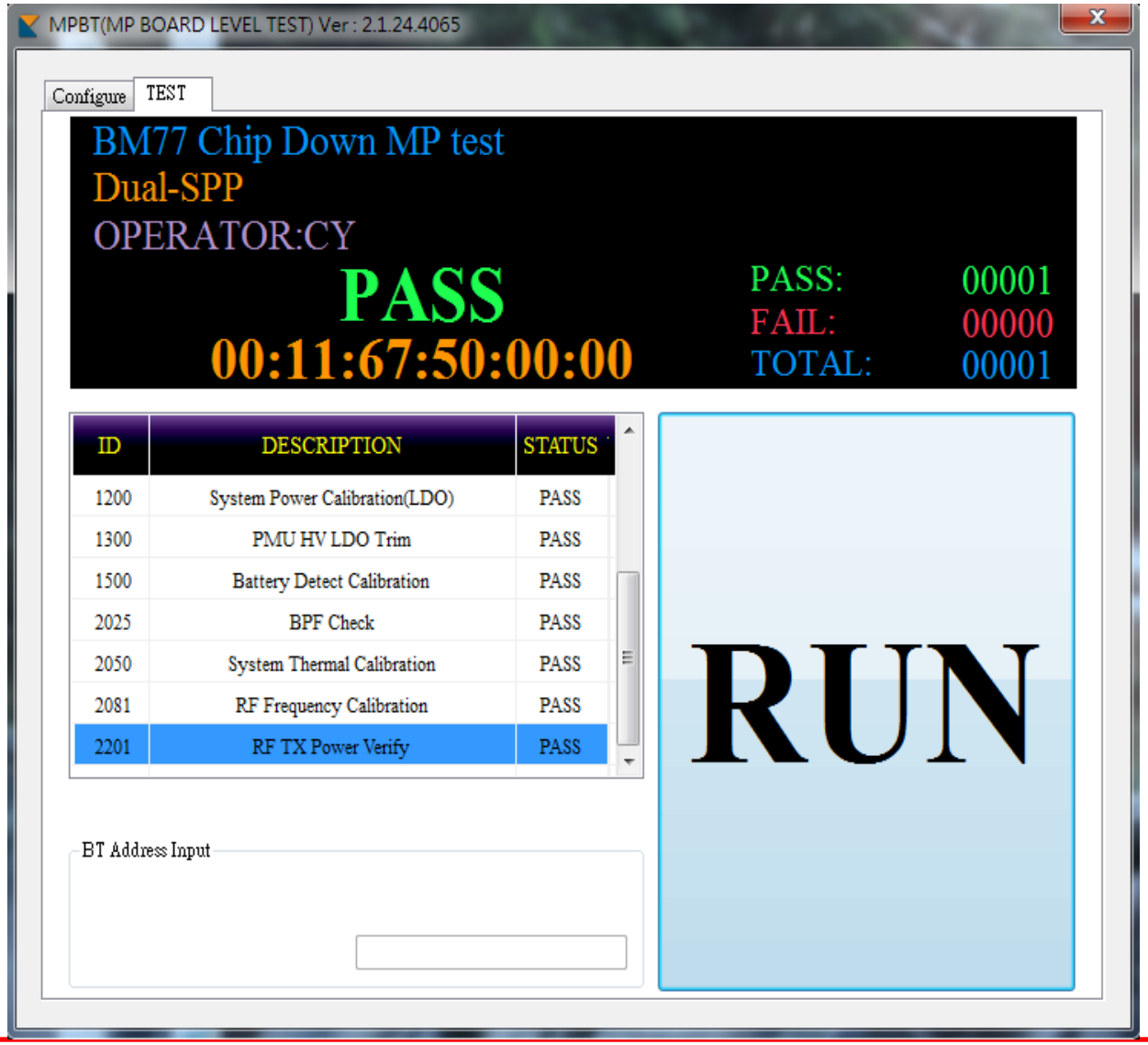
- General MP Process



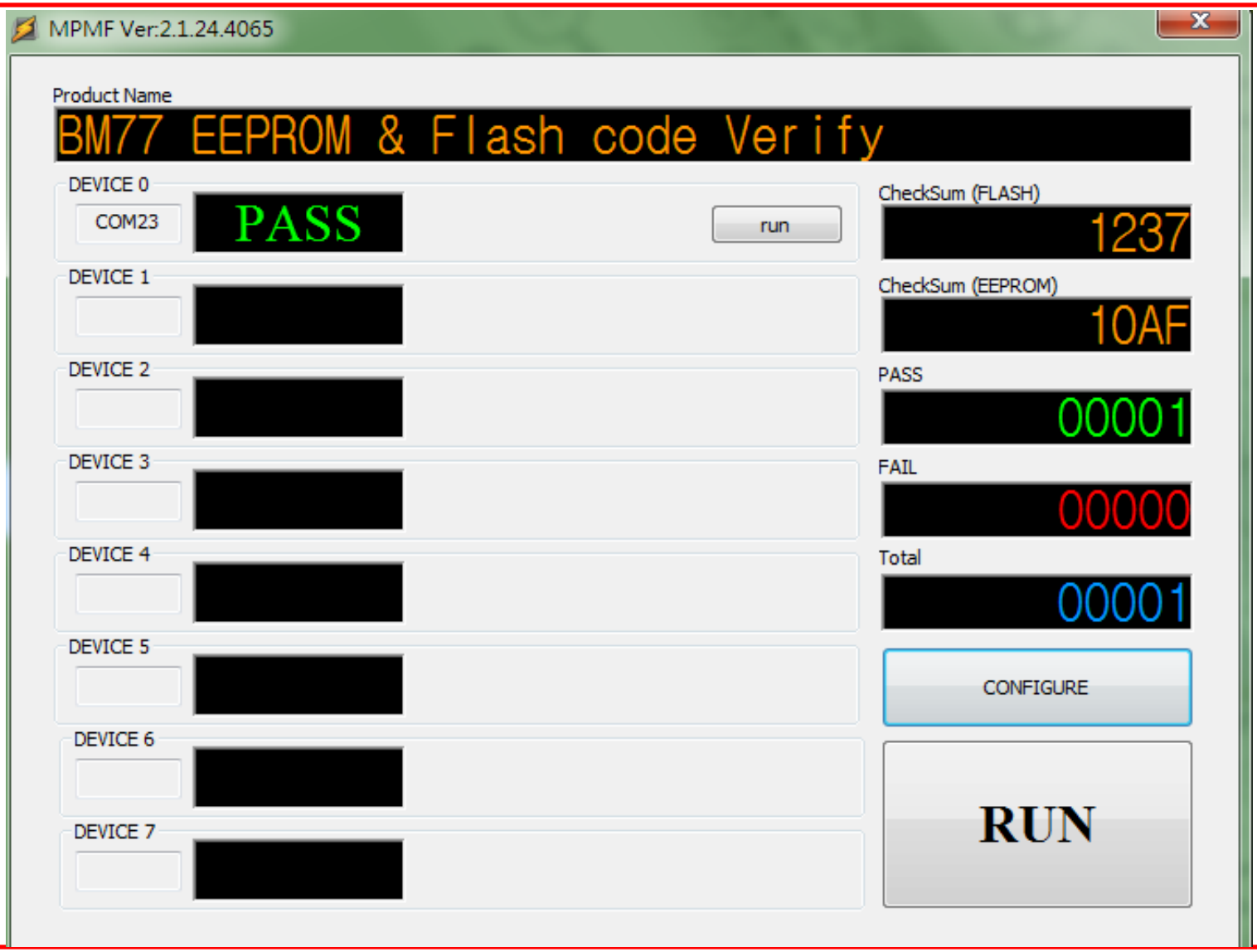
MPSE


MPSE(MP SCRIPT EDITOR) Ver:2.1.25.4216
Product Name
BM77
Solution
IS1677SM_101_SPP_V1.3
Instrument
RfinDevice
ISSC VICTORIA
V-MeterDevice
ISSC VICTORIA
Support Test Item
150 CP Check(Option)
250 GPIO Check(Option)
550 Patch EEPROM(Option)
580 EEPROM Checksum Verify(Option)
590 Write Serial Number(Option)
595 Write DUT local device name (Option)
2101 RF Tx Power Calibration(0)(Option)
2111 RF Tx Power Calibration(1)(Option)
2121 RF Tx Power Calibration(2)(Option)
2131 RF Tx Power Calibration(3) EDR MAX(C
2141 RF Tx Power Calibration(4) BDR MAX(C
9705 EEPROM VERIFY(Option)
ADD
-->
DEL
<--
MP Test Item
10 Device Initialization
20 Write and Vierify Flash
50 System Verify
100 Check Big-Num Calculate
500 Write EEPROM
1025 PMU PMU LDO Trim
1200 System Power Calibration(LDO)
1300 PMU HV LDO Trim
1500 Battery Detect Calibration
2025 BPF Check
2050 System Thermal Calibration
2081 RF Frequency Calibration
2201 RF TX Power Verify
9600 Suspend Verify
Parameters
CODETYPE (0.ROM Code I1.Flash Code) [Default = 1]
1
LOAD
SAVE
EXIT

MPBT


MPBT(MP BOARD LEVEL TEST) Ver : 2.1.24.4065
Configure
TEST
BM77 Chip Down MP test
Dual-SPP
OPERATOR:CY
PASS
00:11:67:50:00:00
PASS: 00001
FAIL: 00000
TOTAL: 00001
ID
DESCRIPTION
STATUS
1200 System Power Calibration(LDO) PASS
1300 PMU HV LDO Trim PASS
1500 Battery Detect Calibration PASS
2025 BPF Check PASS
2050 System Thermal Calibration PASS
2081 RF Frequency Calibration PASS
2201 RF TX Power Verify PASS
RUN
BT Address Input

MPMF


MPMF Ver:2.1.24.4065
Product Name
BM77 EEPROM & Flash code Verify
DEVICE 0
COM23
PASS
run
DEVICE 1
DEVICE 2
DEVICE 3
DEVICE 4
DEVICE 5
DEVICE 6
DEVICE 7
CheckSum (FLASH)
1237
CheckSum (EEPROM)
10AF
PASS
00001
FAIL
00000
Total
00001
CONFIGURE
RUN

Air Patch Tool

- By Air
- Using PC instead of phone/ tablet
- No pairing records left after testing

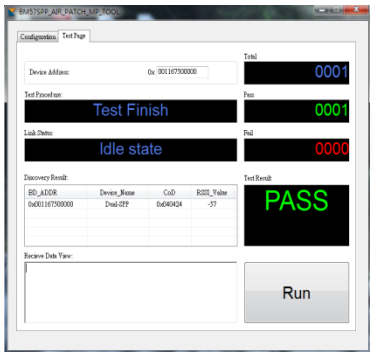
Air Patch **Dongle**

BM77 is Dual Mode

- **2 Scenarios**
  - Bluetooth 3.0 (BT Classic)
  - Bluetooth 4.0 (BLE)

Scenario 1 - BT3.0

2 Air Patch **MP Tool (MPAP)** for **BT classic**



MCP2200 USB-UART Driver

MPAP_LOG_20140728_190258.csv

Finish Good

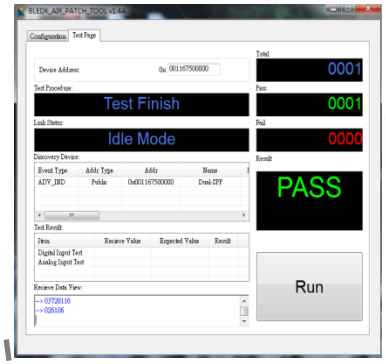
1

BT classic
Air Patch **Dongle**

- ***Function Tested***
  - ***Write/ Verify*** EEPROM
  - ***Send/ Receive*** Data
  - GPIO Control ***Test***

Scenario 2 – BT4.0

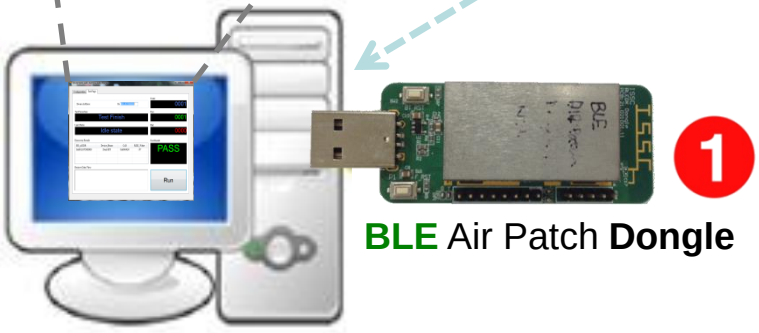
2 Air Patch **MP Tool (MPAP)** for **BLE**



MCP2200 USB-UART Driver

MPAP_LOG_20140729_112818.csv

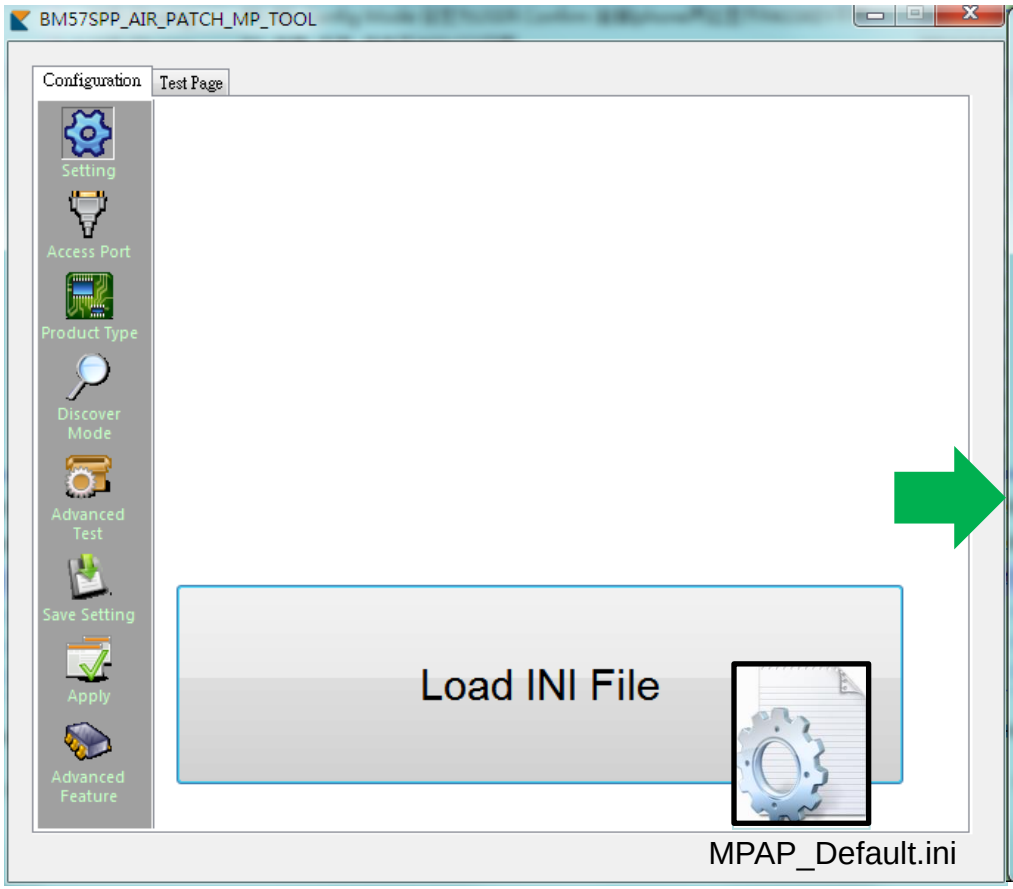
Finish Good

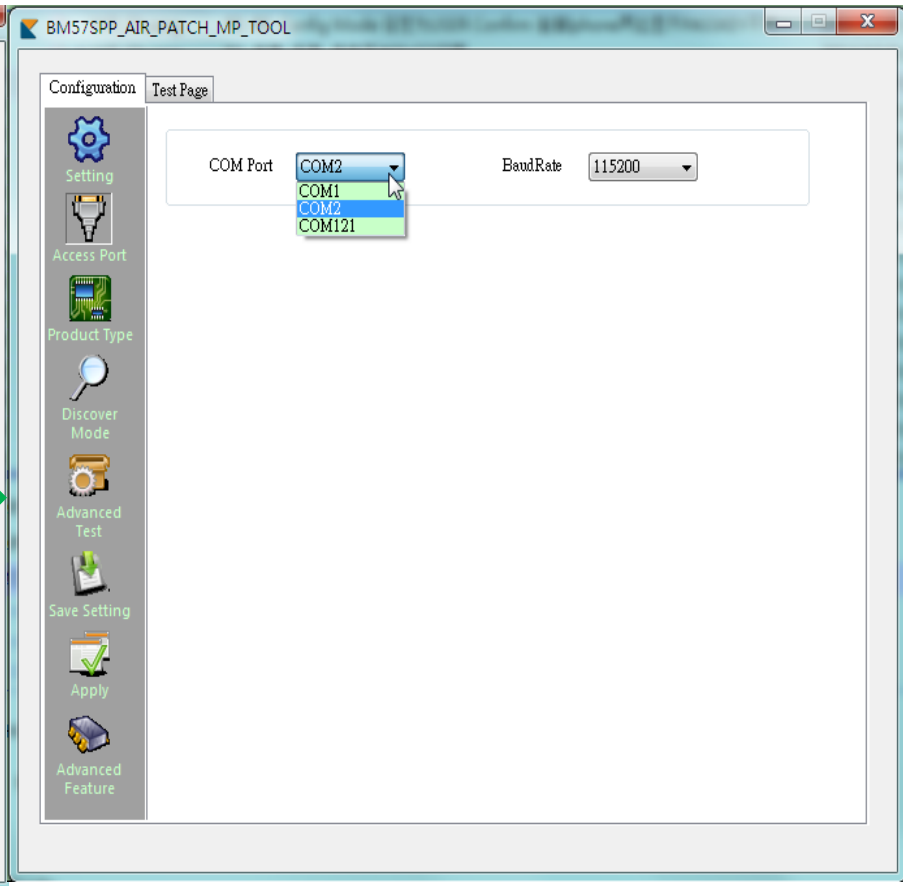


1 **BLE** Air Patch **Dongle**

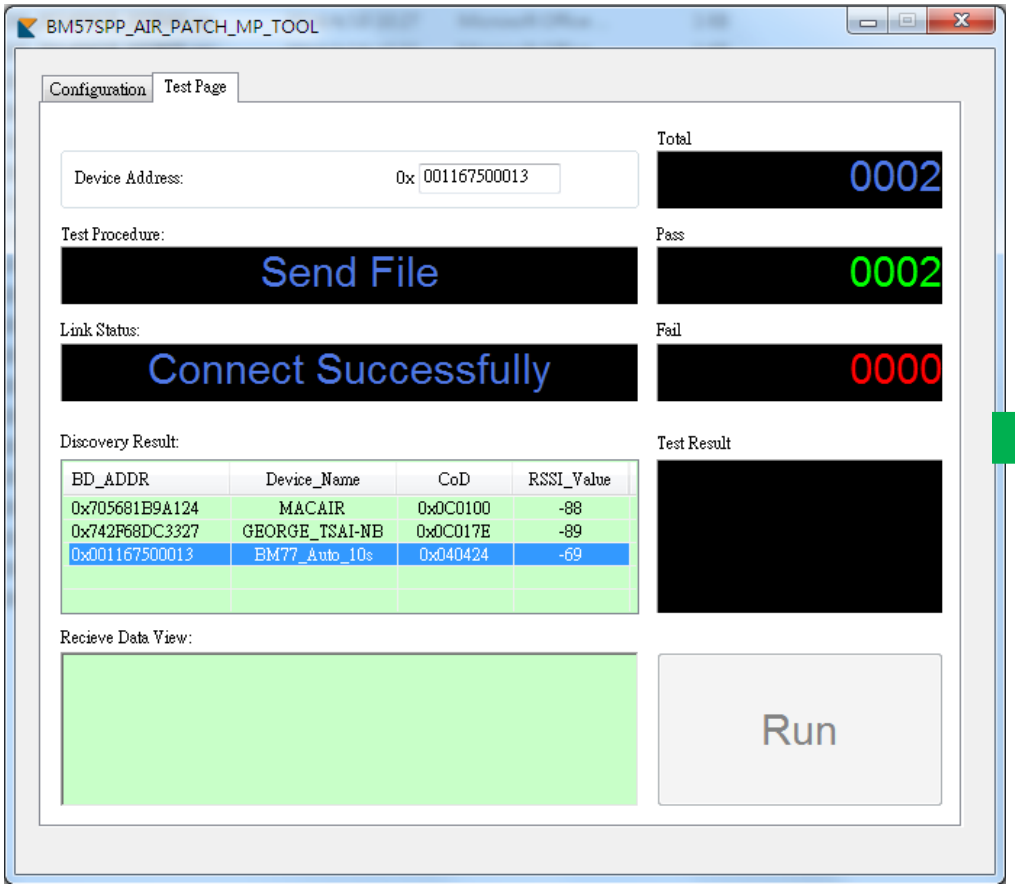
- ***Function Tested***
  - ***Write/ Verify*** EEPROM
  - ***Send/ Receive*** Data
  - GPIO Control ***Test***

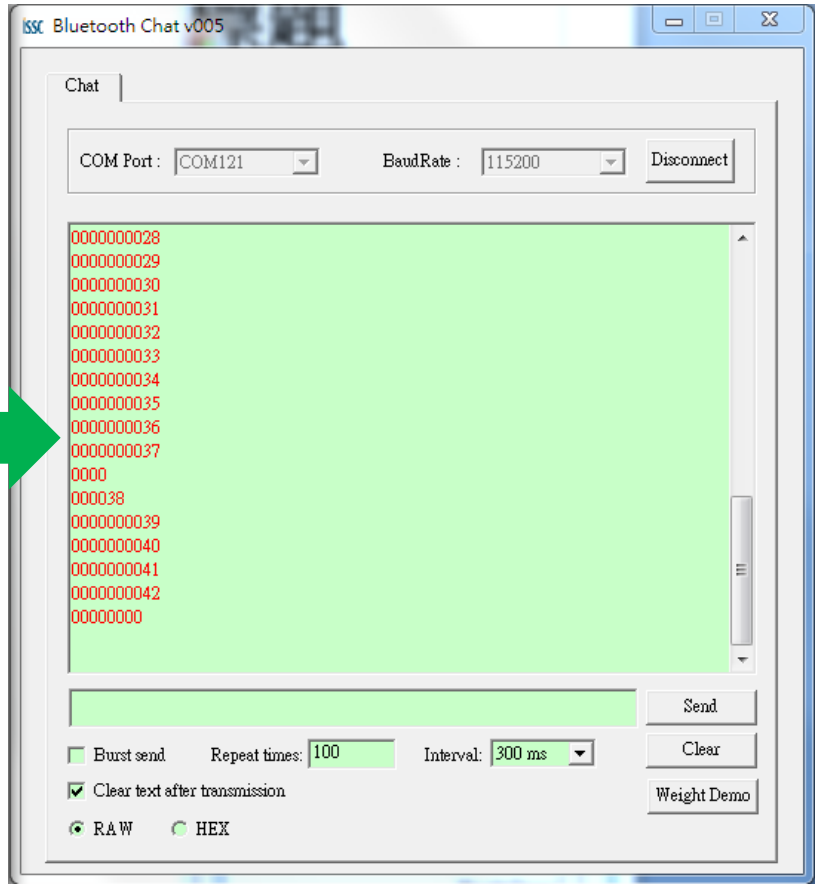
Operation of MPAP tool (BT3.0)



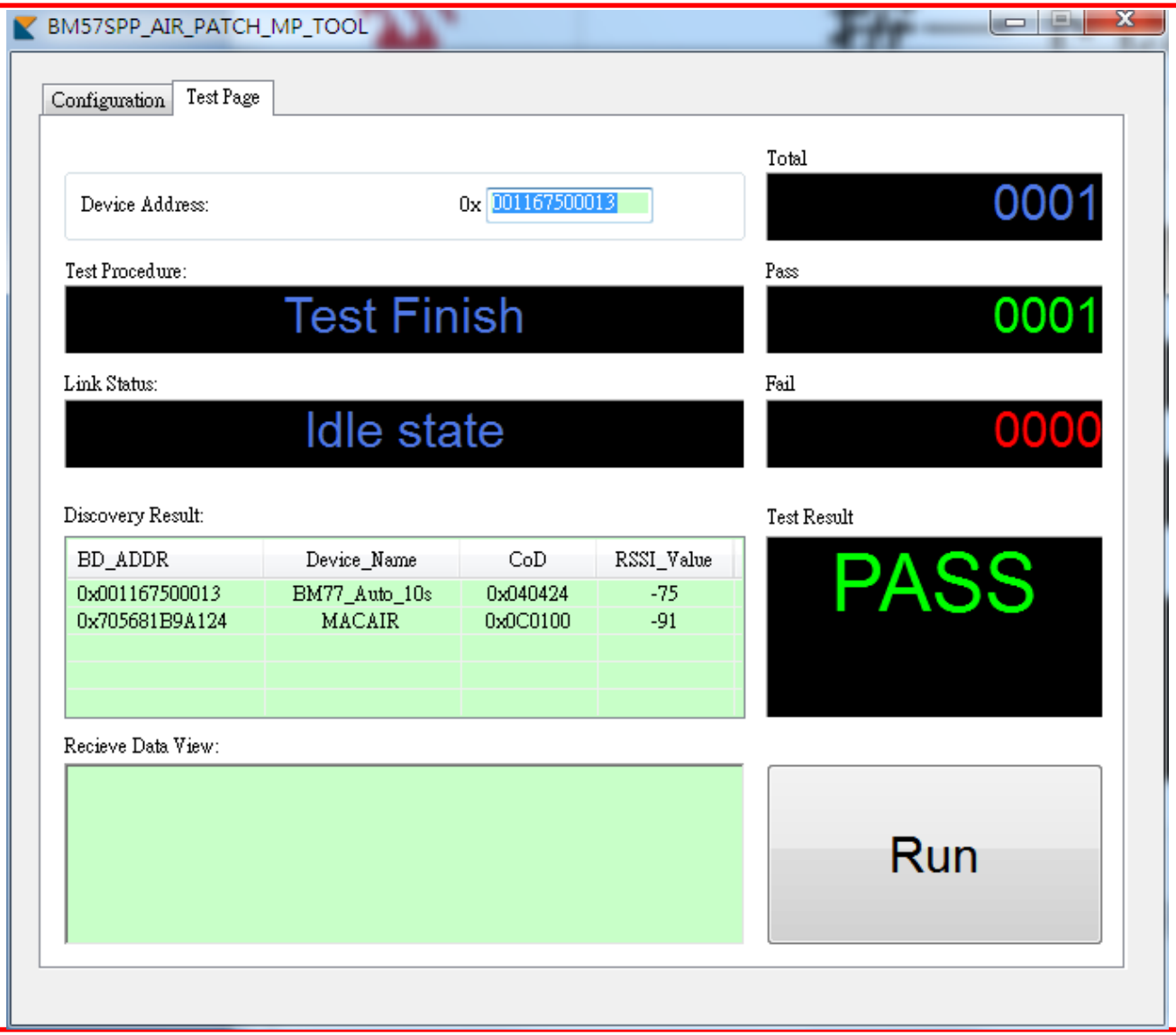


Operation of MPAP tool (BT3.0)





PASS


BM57SPP_AIR_PATCH_MP_TOOL
Configuration
Test Page
Device Address:
0x 001167500013
Total
0001
Test Procedure:
Test Finish
Pass
0001
Link Status:
Idle state
Fail
0000
Discovery Result:
BD_ADDR
Device_Name
CoD
RSSI_Value
0x001167500013
BM77_Auto_10s
0x040424
-75
0x705681B9A124
MACAIR
0x0C0100
-91
Test Result
PASS
Recieve Data View:
Run

Thank you