

TELIT LUNCH & LEARN

November 22, 2018



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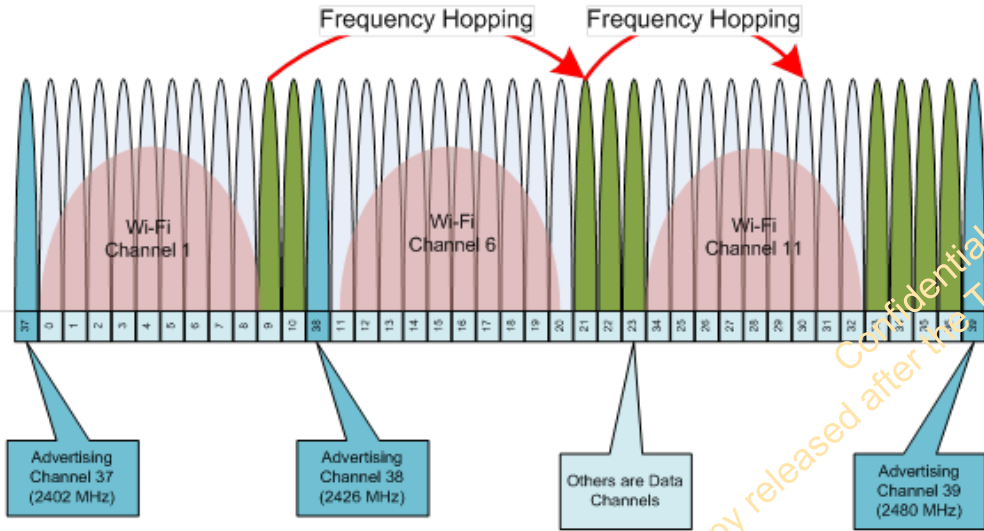
BLE 5, Long-Range, Meshing, and Dual-Band Wi-Fi

What are these and what are they for?

Moshe Yeshurun, *Technical Sales Manager*



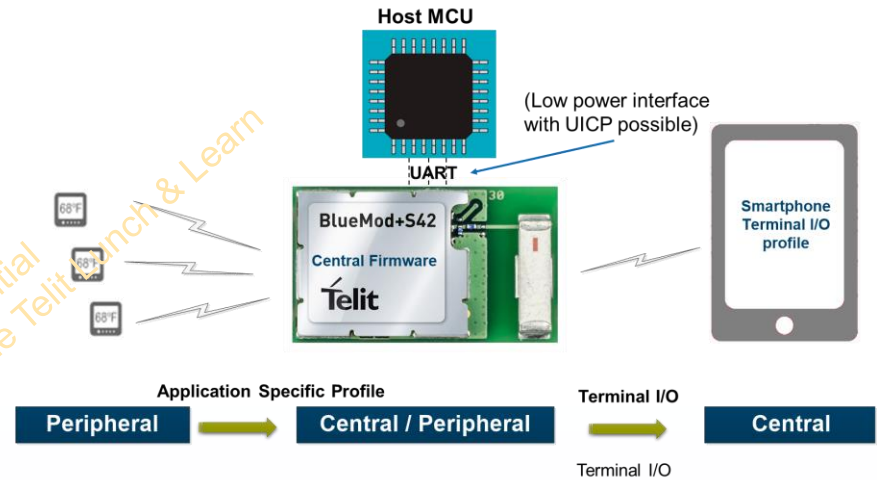
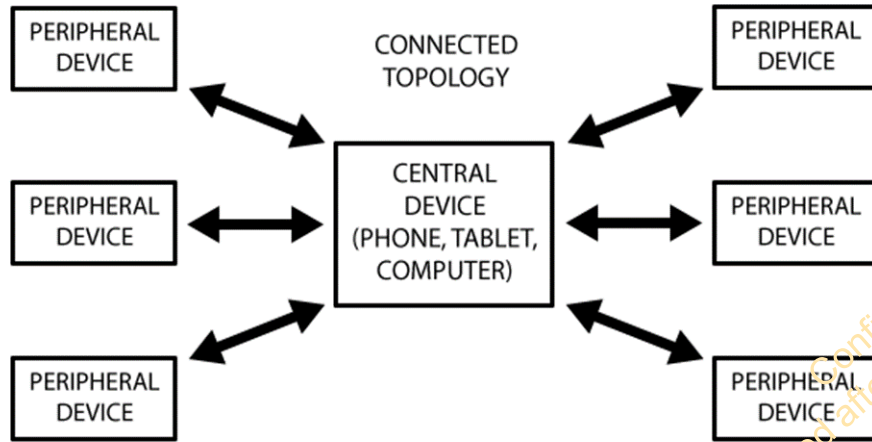
BLE Spectrum and Channels – 2.4GHz



- BT Classic has 79 1MHz channels
- BLE (Bluetooth Low Energy) has 40 2MHz Channels
- BT/BLE and Wi-Fi 802.11b/g/n share the same spectrum
- BT/BLE use frequency hopping for data channels
- Advertising channels are fixed and in-between Wi-Fi non-overlapping channels (1,6,11)
- Advertisement channels are unidirectional and are used to establish connections
- Data communications use FHSS - Frequency Hopping Spread Spectrum (each piconet hops at 1600 times/sec)

Standard	Theoretical Data Rate	Channel Bandwidth
BT v1.2 ("Classic")	1Mb/s	1MHz
BT v2.1+EDR ("Classic")	3Mb/s	1MHz
BLE 4.0	1Mb/s	2MHz
BLE 5	.125/.5/1/2 Mb/s	2MHz

Bluetooth Connected Topology (Piconet)



BLE devices/modules can be Peripheral only, Peripheral or Central, or Concurrent

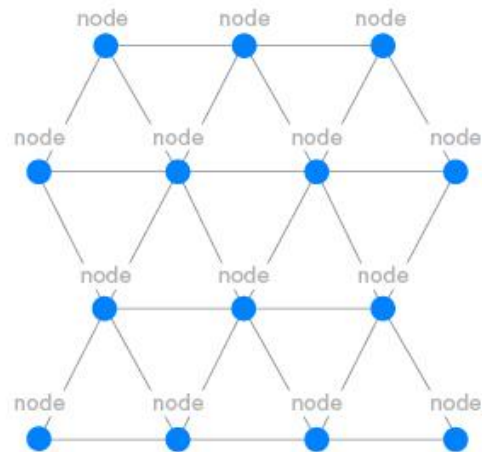
BLE 5

- Increased Bandwidth: Up to 2x bandwidth of Bluetooth 4.2 with Low Energy
 - New 2Mb/s Rate
- Broadcasting channel improvements: 8x the broadcasting message capacity over Bluetooth 4.2
 - Advertising extensions mitigates this potential issue by advertising on the 3 advertising channels as previously, but the data to be sent is on an agreed non-advertising channel
- BLE Long Range
 - Introduced new 125Kb/s and 500Kb/s rates
 - Utilize CRC and forward error correction (FEC)
 - Transmits additional overhead to data to enable finding and correcting errors
 - 500Kb/s rate improves SNR by 6dB with a 2x theoretical range improvement
 - 125Kb/s rate improves SNR by 12dB with a 4x theoretical range improvement
 - Requires hardware/phy change from BLE v4.2

BLE 5 Mesh

- **Low-Power Nodes (sleepers)**
 - Power constrained nodes may use the low-power feature.
 - Low-power nodes (LPNs) work in conjunction with friend nodes
- **Friend Nodes**
 - Friend nodes store incoming messages and security updates destined for LPNs
- **Relay Nodes**
 - Relay nodes receive and retransmit messages
- **Proxy Nodes**
 - Proxy nodes enable transmitting and receiving mesh messages between GATT and Bluetooth mesh nodes

Managed flood-based message relay approach
(multipath, no routing table)



Telit IoT Bluetooth® Application Summary



BL871

- ✓ **Dual Mode** – Bluetooth 4.2 Low Energy and Bluetooth Classic (BR/EDR) capable
- ✓ Networking stack required on Host **(always needs a Host)**
- ✓ Industrial temperature range
- ✓ Telematics
- ✓ Remote sensor hub/gateway
- ✓ Commercial/industrial/medical
- ✓ POS printers/scanners
- ✓ Wireless audio applications
- ✓ Dual mode **(without audio)** host stack available for license from Telit

Software Upgrade to Mesh



BLUEMOD+S50

- ✓ **Single Mode** – Bluetooth 5 low energy
- ✓ NFC pairing, ANT capable
- ✓ Networking stack integrated on module
- ✓ Industrial temperature range
- ✓ Terminal I/O and LUA versions available
- ✓ Interface to Smart Phone & cable replacement
- ✓ Remote sensors or hub/gateway
- ✓ Commercial/industrial/medical



BLUEMOD+S42M

- ✓ **Single Mode** – Bluetooth V4.2 low energy
- ✓ Two versions
 - Low Cost peripheral
 - Peripheral with sensors
- ✓ Bluetooth stack integrated on module
- ✓ Extended Commercial Temperature Range
- ✓ Interface to Smart Phone & cable replacement
- ✓ Consumer products
- ✓ Sensors

BlueMod, BL871 series modules are ideally suited for industrial and commercial applications

Telit IoT BT Module Summary

Feature/Parameter	BL871E2	BlueMod+S50	BlueMod+S42M
Bluetooth Version	Bluetooth v4.2, dual mode	Bluetooth 5, single mode	Bluetooth v4.2, single mode
Bluetooth Classic	BR/EDR, HCI	n/a	n/a
Other Modes/Functions	X	NFC pairing, ANT	3 axis accelerometer, T°/Humidity sensors (optional)
Terminal I/O (concurrent to GATT operations)	Peripheral or Central	Peripheral or Central	Peripheral
Generic GATT Interface	Server or Client	Client	Server
Host Interface	UART	UART	UART
Other Peripherals, I/O	PCM, I ² S	I ² C, SPI, ADC, GPIO	I ² C, SPI,GPIO, ADC
Antenna Option(s)	Integrated	Integrated, Pin	Integrated
Operating Voltage	2.2-4.8V	1.7-3.6V	1.8-3.6V
Temperature Range	-40 - +85°C	-40 - +85°C	-20 - +70°C
Size	9.7 x 10.1 x 2.5mm LCC	17 x 10 x 2.6mm LGA	17 x 10 x 2.6mm LGA
Status	Production	Production	Production

Note: Depends on Host Stack Capabilities

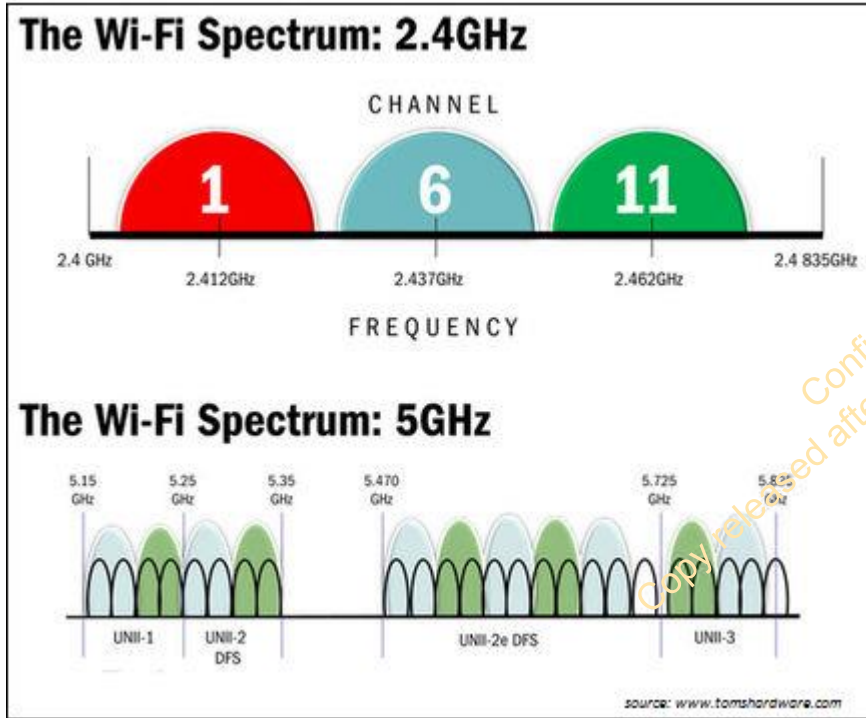
(Nordic nRF52832)

Telit IoT BT Module Summary - continued

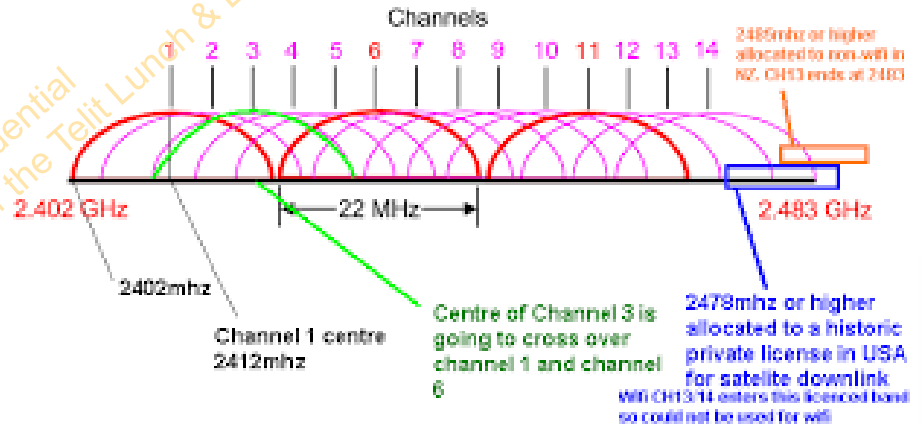
Feature/Parameter	BL871E2	BlueMod+S5 0	BlueMod+S42 M
Number BLE Connections	10	4 (8 later S/W)	1
Application CPU	n/a	ARM® Cortex™-M4F @ 64MHz	ARM®Cortex™-M0 @ 53MHz
RAM	n/a	64K SRAM 512K Flash	80K SRAM 256K Flash
Deep Sleep Current	1µA	1.2µA	0.2µA
3 Channel Advertising Current		13µA	25µA
Rx Sensitivity	-95dBm	-93dBm	-93dBm
Tx Max Output	+12dBm	+5dBm	0dBm
Software Features	Depends on Host Stack	GATT, Terminal I/O, Automation I/O, and LUA	GATT, Terminal I/O
Certifications	CE, FCC, IC	CE, FCC, IC, (TELIC)	SRRC,NCC, CE, (FCC/IC)

Wi-Fi Spectrum and Channels – Single and Dual Band

Wi-Fi 20MHz Channels @ 2.4GHz

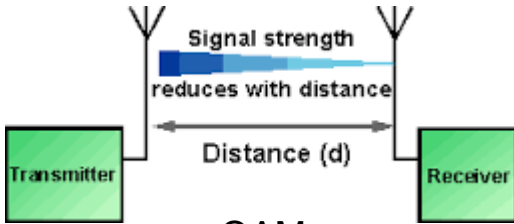


2.4GHz/Single Band Overlapping Channels



Wi-Fi 40,80, and 160MHz Channels @ 5GHz

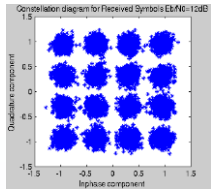
Wi-Fi Standards and Rates



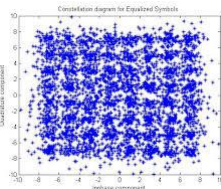
- 5GHz has $\frac{1}{4}$ the range as 2.4GHz (for same signal processing)
- 5GHz is also less able to penetrate walls
- The higher the data rate (fixed bandwidth) the shorter the range (lower sensitivity)

QAM

(Quadrature Amplitude Modulation)



16-QAM

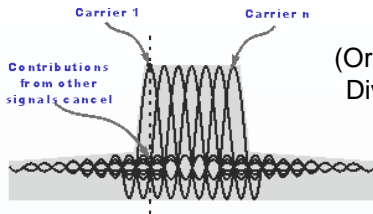


64-QAM

(more bits/second)

OFDM

(Orthogonal Frequency Division Multiplexing)



Standard	Frequency	Theoretical Data Rate	Channel Bandwidth
802.11a	5GHz	DSSS 6-54Mb/s	20MHz
802.11b	2.4GHz	1-11Mb/s	22MHz
802.11g	2.4GHz	6-54Mb/s	20MHz
802.11n	2.4GHz	6.5-72Mb/s	20MHz
802.11n	5GHz	13.5-150Mb/s	40MHz
802.11ac	5GHz	29.3Mb/s-433Mb/s	80MHz
802.11ac	5GHz	58.5-866.7Mb/s	160MHz

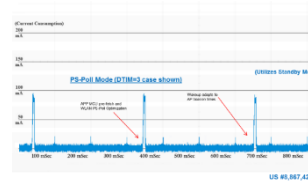
256-QAM

Wi-Fi Configurations and Modes



STA (Station)

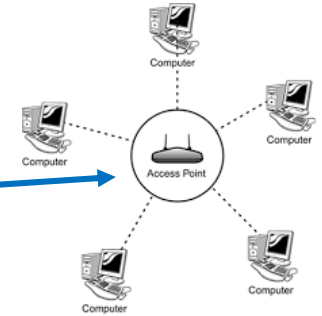
- Sleeps
- Checks beacons (PS-Polling)
- Sleeps again if no data



AP (access point)

- Always on
- Sends out beacons (typically every 100ms)
- Buffer data for stations
- Sets/determines the Wi-Fi channel
- Provides Open, WPA/2 Personal or Enterprise security

Wi-Fi Star Network



(Stations)

Group Member
(ie a station)



Group Member



Wi-Fi Direct



Group Owner (ie AP)

Telit IoT Wi-Fi Application Summary

Production, Available Modules

Single Band

- ✓ Low Power (sleeps very well)
- ✓ Good Range
- ✓ Cost effective
- ✓ Cloud ready – homekit, AWS-IoT, deviceWISE
- ✓ A lot of stack content and value
- ✓ 30Mb/s UDP throughput

- **Standalone and cellular solution companions**
- **Pair up with Telit LE910C1 (Cat1) and ME910 (CatM1/NB-IoT)**

Small Size & Low Power



- b/g/n Single Band

GS2200M

- ✓ Battery powered sensors (secure web clients)
- ✓ Smart locks, access control
- ✓ Ultra low power video
- ✓ Ultra Low power networking for Host MCU's (via AT Commands)
- ✓ HomeKit, AWS-IOT, deviceWISE support

Cost Effective & Line Powered



- b/g/n Single Band

GS2101M

- ✓ Smart energy, lighting and appliances
- ✓ Always connected devices and video (PS Polling)
- ✓ IoT bridge
- ✓ Industrial Applications – Pumps, etc
- ✓ Networking for Host MCU's (via AT Commands)
- ✓ HomeKit, AWS-IOT, deviceWISE support

Telit IoT Wi-Fi Application Summary

Modules in Development

MCU & Cellular



- a/b/g/n Dual Band
- **11ac**
- BT/BLE 4.2
- BT Audio

- AT commands to LE910C4/C1
- **WE866C3 adds hotspot capability**

WE866C3

- ✓ Networking stack always on Host
- ✓ Linux/Android **Host MCU Companion**
- ✓ LE910C4/C1 **LTE Cellular Companion**
- ✓ SDIO interface, high throughput applications (**200Mb/s**)
- ✓ Security panels including video
- ✓ Video bridges/gateways
- ✓ Pocket/mobile routers
- ✓ Medical devices – ultrasound, patient monitoring, EKG/ECG
- ✓ Telematics
- ✓ Remote sensor hub/gateway

Standalone Dual Band, Dual Mod



- a/b/g/n Dual Band
- **BLE 5.0**

WE866E4

- ✓ 1080p60, 4K HD Cameras
- ✓ POS scanners and printers
- ✓ Medical devices
- ✓ Smart buildings, Smart energy
- ✓ Industrial applications
- ✓ BLE sensor bridge/gateway
- ✓ Dual band networking for Host MCU's (via AT Commands)
- ✓ HomeKit, AWS-IOT, deviceWISE support

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Telit IoT Wi-Fi Module Summary

Feature/Parameter	WE866C3	GS2200M	GS2101M	WE866E4
Single Band 802.11b/g/n	✓	✓	✓	✓
Dual Band 802.11 a/b/g/n	✓	X	X	✓
802.11ac	✓	X	X	X
BT/BLE	BT/BLE 4.2	X	X	BLE 5.0
Companion/Standalone (AT Commands)	High Speed Companion	Both	Both	Both
Wi-Fi Interface	SDIO	SPI/UART/ SDIO	SPI/UART SDIO	SPI/UART SDIO
Peripherals, I/O	SDIO	2x SPI (master/slave), 2x UART, SDIO, GPIO, PWM, I2C, I2S, ADC (16bit), JTAG	2x SPI (master/slave), 2x UART, SDIO, GPIO, PWM, I2C, Sigma Delta ADC (16bit), JTAG	UART, SPI (master/slave), SDIO2.0, I2C, I2S, GPIO, ADC (12Bit), PWM, JTAG
Antenna Options	Pin, Integrated	u.fl, Integrated	u.fl, Integrated	Dual Pin
Temperature Range	-30 - +85°C	-40 - +70°C	-40 - +85°C	-40 - +85°C
Size	13 x15mm LGA	13.5 x 17.9 x 2.2mm	18 x 25 x 2.7mm	15 x 19mm LGA
Status	Samples	Production	Production	Development

Telit IoT Wi-Fi Module Summary - continued

Feature/Parameter	WE866C3	GS2200M	GS2101M	WE866E4
AP Mode, STA Mode	✓	✓	✓	✓
Concurrent AP/STA Mode	✓	✓	✓	
AP Stations	10	16	16	10
Wi-Fi Personal and Enterprise Security	✓	✓		✓
Application CPU	n/a	ARM CM3	ARM CM3	ARM CM4F
Application Security	n/a	TLS 1.2	TLS 1.2	TLS 1.2
UDP Throughput	200Mb/s	30mb/s	30mb/s	30mb/s
Tx Output at 1Mb/s	19dBm	15dBm	16dBm	19dBm
Software Features	WLAN (companion)	REST, CoAP, MQTT, Websockets, Discovery, JSON, XML, HomeKit	REST, CoAP, MQTT, Websockets, Discovery, JSON, XML, HomeKit	REST, CoAP, MQTT, Websockets, Discovery, JSON, XML, HomeKit
Certifications	In development, samples available	CE, FCC, IC, RED, TELEC, Wi-Fi	CE, FCC, IC, RED, TELEC, KCC(MIE), Wi-Fi	In development

A woman with long brown hair is looking at a tablet computer. She is wearing a dark patterned top. The background is a blurred city street at night with bokeh lights. A yellow speech bubble contains the text "Thank you!".

Thank you!

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