NOT ALL BLUETOOTH IS THE SAME! STANDARDS, APPLICATIONS AND SOLUTIONS EXPLAINED

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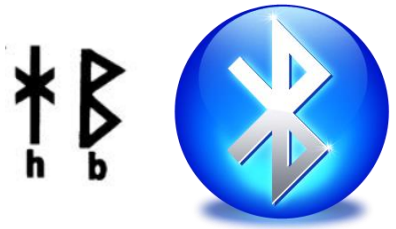
WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

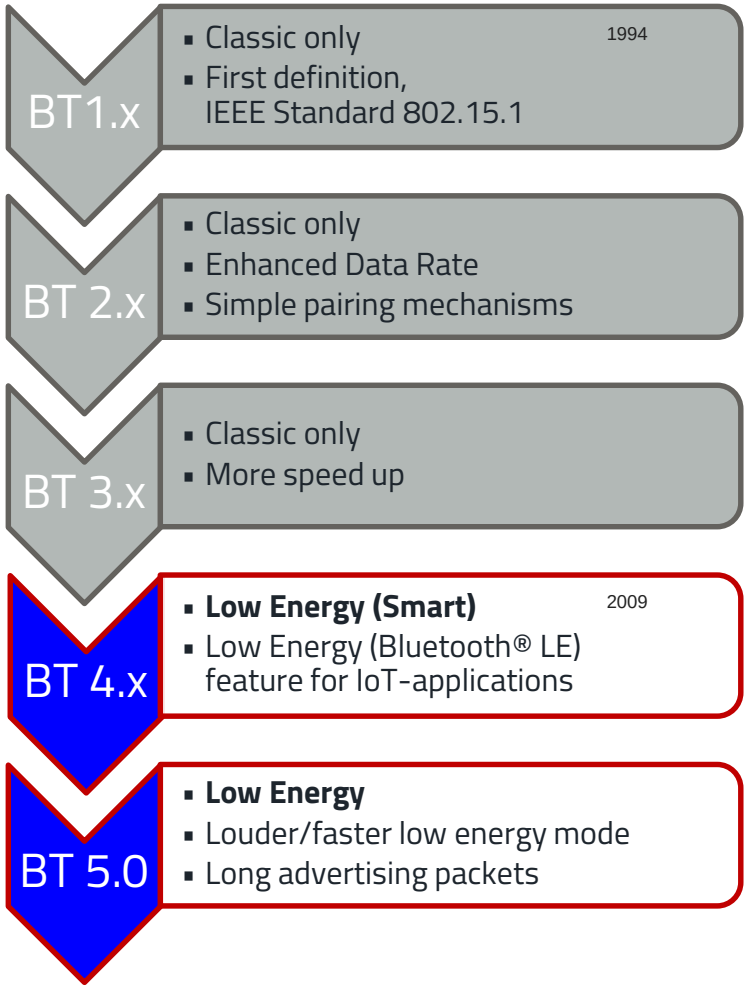
A FOR APPLE… B FOR BLUETOOTH



Named after Harald Bluetooth

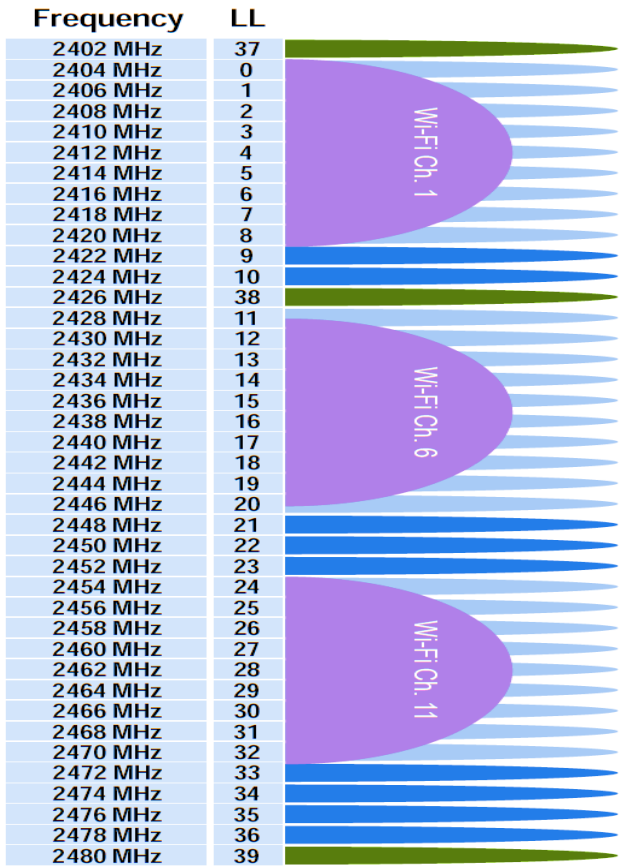
Standardized by the Bluetooth Special Interest Group (SIG) in 1999

HISTORY AND BACKGROUND OF BLUETOOTH



- Bluetooth® versions build on each other
- Bluetooth® classic and Bluetooth® LE are not compatible
- DER (Enhanced Data Rate): Feature for a higher data transfer
- Bluetooth® LE Audio und Bluetooth® LE Mesh are different standards

HISTORY AND BACKGROUND OF BLUETOOTH



Source: http://ftm.futureelectronics.com/2015/04/future-electronics-bluetooth-smart-how-it-operates-and-how-it-may-be-used

- ✓ ISM 2.4GHz, up to 2 mbps GFSK
- ✓ 40 channels sharing Bluetooth® LE, WiFi and Proprietary
- ✓ 3 Advertising + 37 Data channels
- ✓ Advertising channels avoid mainly WiFi Ch. 1, 6 and 11
- ✓ Freq. + Time synchronized during connection
- ✓ Robust w.r.t. disturbances
- ✓ Long sleep periods → good low power capabilities

BLUETOOTH LOW ENERGY

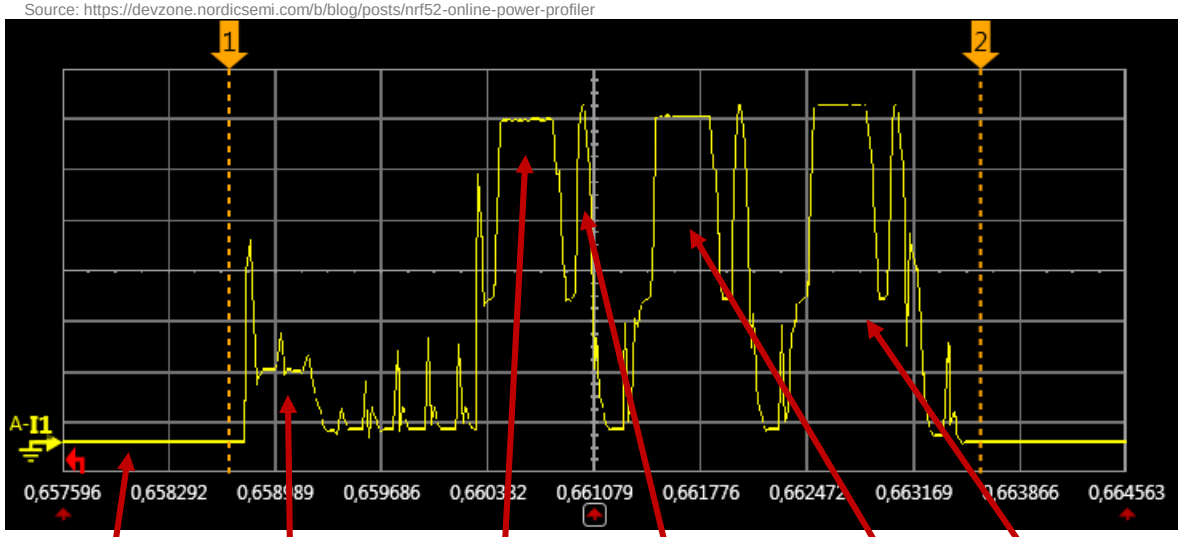
Roles

BLE role	How	Function	Example
Peripheral	Connection based	Provides services and advertises	Sensor or hands-free
Central		Scan advertised packets and initiate a connection	Smart phone
Broadcaster	Connection less	Only transmits advertising events	Sensor beacon
Observer		Only receives advertising events	Beacon receiver

BLUETOOTH LOW ENERGY

Advertising

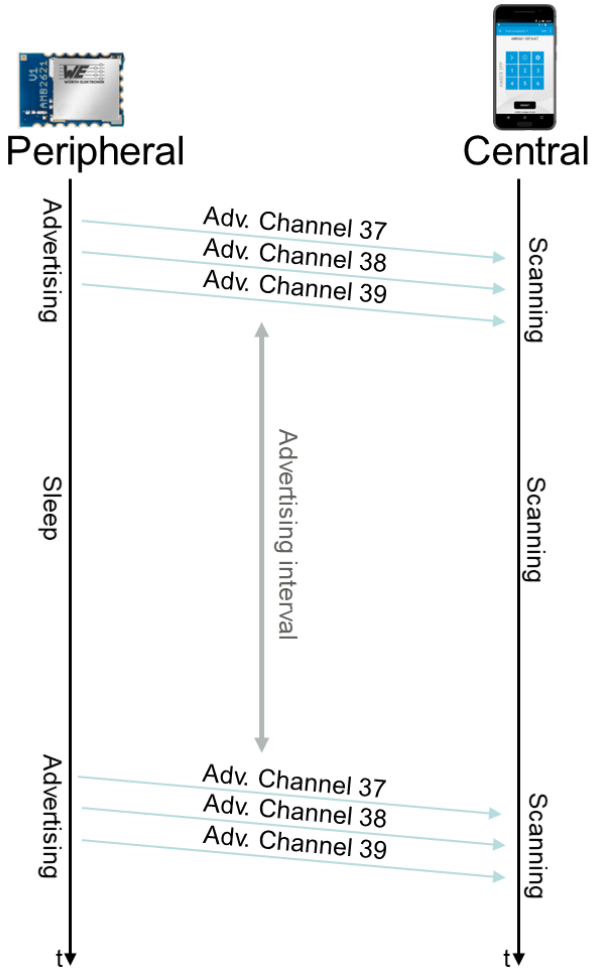
Source: https://devzone.nordicsemi.com/b/blog/posts/nrf52-online-power-profiler



PERIPHERAL advertises on 3 primary advertising channels (37, 38, 39)

Connection: *"Hello, who wants to connect to me?"*

Beacon: *" You cannot connect, but I have some beacon data for you"*



BLUETOOTH LOW ENERGY

Connection setup

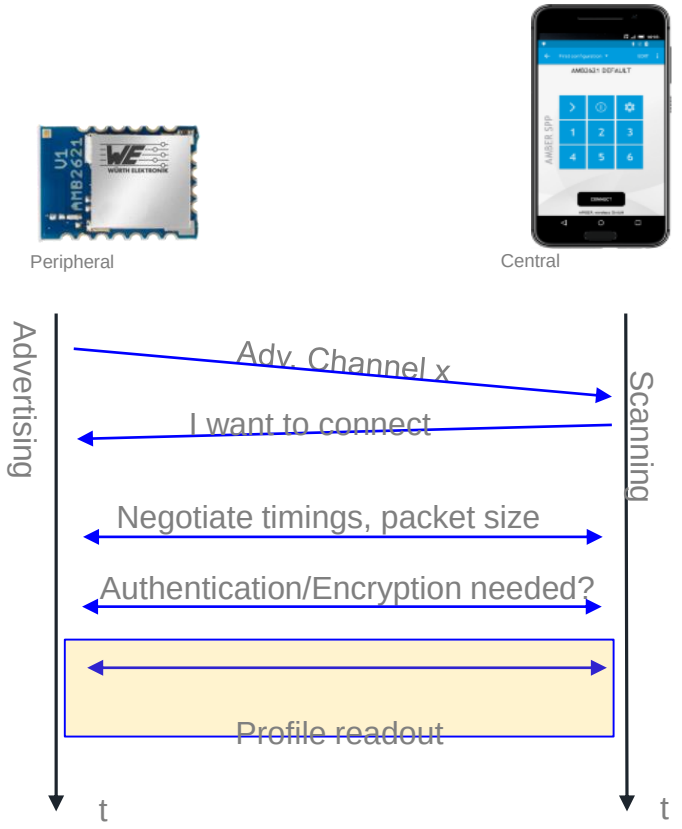
1. CENTRAL scans & connects as soon as it receives advertising packet. It reads profile of the peripheral to know how to communicate.

2. Connection? (Phase 1)
   - Timings and maximum transmission unit (MTU) negotiation

3. Authentication, encryption and bonding (Phase 2)
   Bonding = Saving of the pairing data for fast re-connection

4. Profile readout (Phase 3)

5. Data transmission (Phase 4)

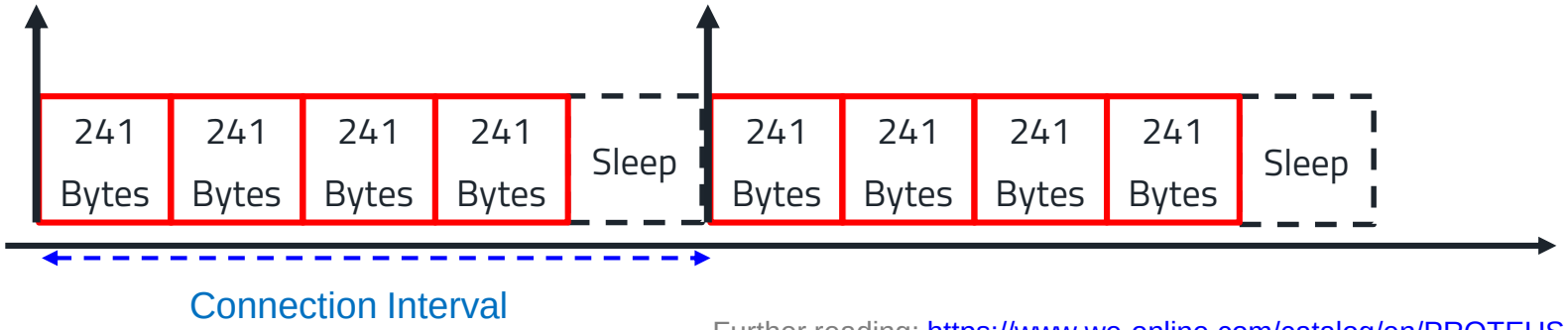


BLUETOOTH LOW ENERGY 5.0

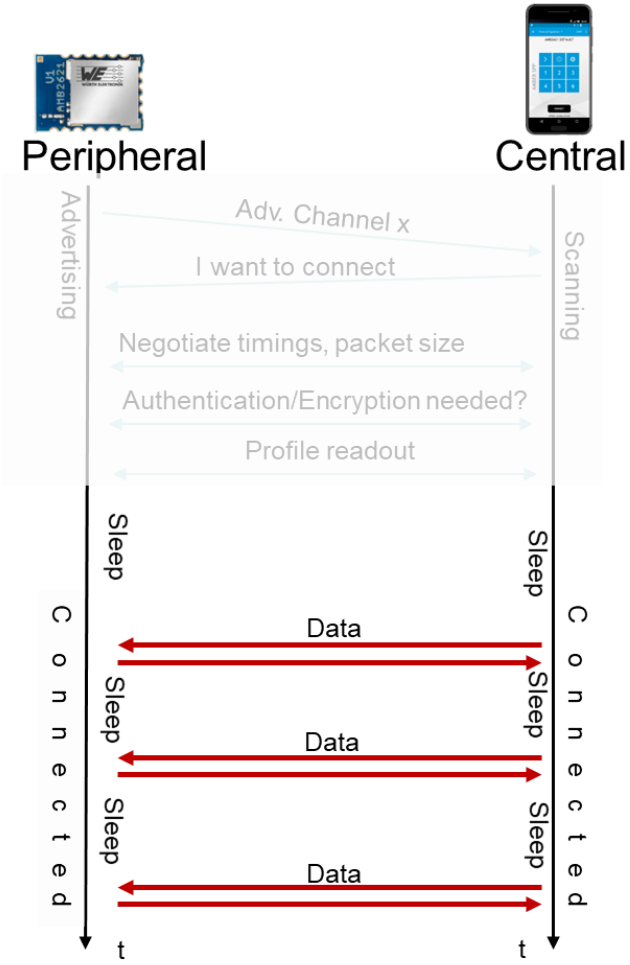
Data transmission

- ✓ Time synchronized data transmission during open connection
- ✓ Data transmission & reception only in predefined time slots → connection interval
- ✓ Sleeps in between to save energy
- ✓ Throughput: 23 – 247 Bytes per connection interval
- ✓ Example: 100 ms connection interval, 247 Bytes MTU ⟶ 2.47 kB/s

Example



Further reading: https://www.we-online.com/catalog/en/PROTEUS-III

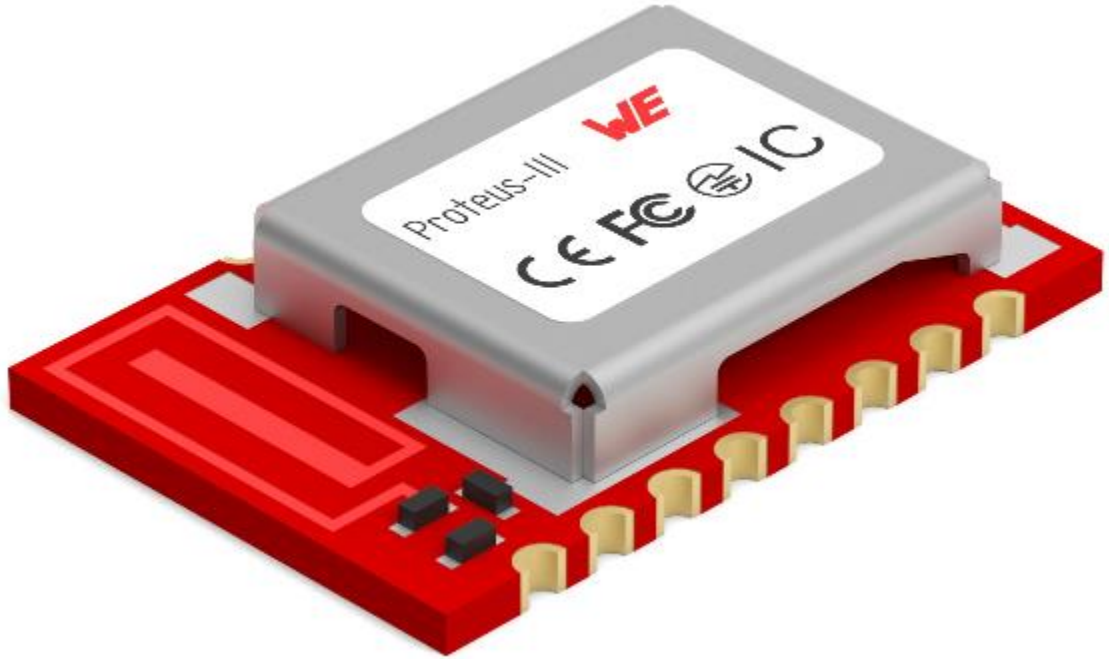


FIRMWARE OPTIONS

FIRMWARE

Standard Firmware

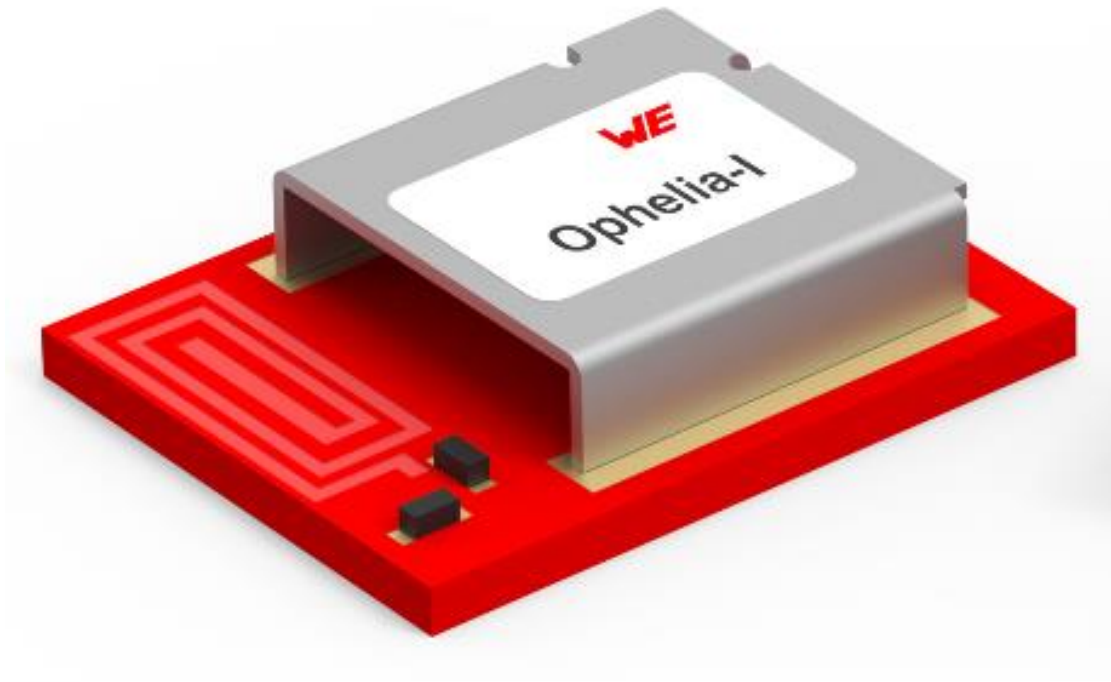
- Standard Firmware
  - RF module has a standard firmware
  - RF module is certified
  - RF module is subject to further firmware development
  - RF module has a standard part number
  - 100% verified, electrical tested and validated
  - Update functionality given (UART, FOTA…)



FIRMWARE

Build Your Own Firmware

- Build Your Own Firmware (BYOF)
  - RF module comes without a standard firmware
  - RF module has a standard part number
  - 100% electrical testing under customer request
  - SDKs available for development of own firmware



FIRMWARE

Customized Firmware

- Customized firmware
  - RF module comes with a customized firmware
  - RF module has a unique part number
  - 100% electrical testing under customer request
  - Firmware can be uploaded in our production process → RF module is ready to use

WHY BUILD YOUR OWN FIRMWARE IS 2ND BEST CHOICE

Customized Firmware

	WÜRTH ELEKTRONIK „OFF THE SHELF“ MODULE	BUILD YOUR OWN DEVICE/FIRMWARE
Fixed Costs		
Module buying price	€€	€
Hardware development		€
Firmware development		€€
Required measurement equipment		€€
Variable & fix costs		
Certifications, conformity, declaration	€	€€
Opportunity costs		
Delayed market entry		€

APPLICATIONS

APPLICATIONS

Examples

- Mobile phone connects to coffee machine and checks the amount of beans/water and the configured boiling temperature
- Customer beacon transmission, e.g. advertising of a marketing URL in case a smartphone comes in the range of a sales booth
- Module to module or mobile phone data streaming of performance data of a bike gear
- Module to module or smartphone data streaming of recorded data like machine performance data
- High range data transmission e.g. agriculture environment or huge industry halls
- Remote control of the connected periphery via GPIO and PWM, e.g. control on/off switch of a machine and PWM driven signals

WE BLUETOOTH PORTFOLIO

WE BLUETOOTH PORTFOLIO

From ... to

				
	Proteus-e	**Proteus-I**	**Proteus-II**	**Proteus-III**
Order Code (PCB Antenna)	2612011024000*	2608011024000	2608011024010	2611011024000*
Order Code (RF-Pad)		2608011124000	2608011124010	
Chipset	nRF52805	nRf52832		nRf52840
Bluetooth® Standard	5.1	4.2	5.0	5.1
Output Power [dBm]		4		8
Power Consumption Rx [mA]	6.8	5.4		7.7
Power Consumption Tx [mA]	9.3	7.5		18.9
Power Consumption Sleep [µA]	0.3	0.4		0.4
Supply Voltage min - max [V]	1.8 - 3.6			
op. Temp [°C]	-40 ... +85			
Max Datarate [Mbps]	2	1	2	2
Payload [byte]	243	243	964	964
measured Throughput [kbps]	100	80	257	343
Antenna (PCB, RF-Pad, SAS*)	SAS*	PCB / RF-Pad		SAS*
Long range Mode		-		✔
LoS Range (Int / ext. Antenna) [m]	30 / 350	50 / 100		100 / 400
LoS Test Conditions	2 m height, Two-ray ground-reflection, TX and RX antenna gain = 0 dB			
Interface	UART			
SPP-like Profile	✔	✔	✔	✔
USB-Radio Stick	-	-	✔	✔
FOTA	-	✔	✔	✔
Additional GPIO	2	-	-	6
Certification	CE, FCC, IC, TELEC			

* SmartAntennaSelection

WE BLUETOOTH PORTFOLIO

- Build-Your-Own-Firmware → Ophelia-I

- Combined module: Proprietary + Bluetooth → Setebos-I

Questions

& Answers

We are here for you now!
Ask us directly via our chat or via E-Mail.

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