WRAP THOR Bluetooth Modules
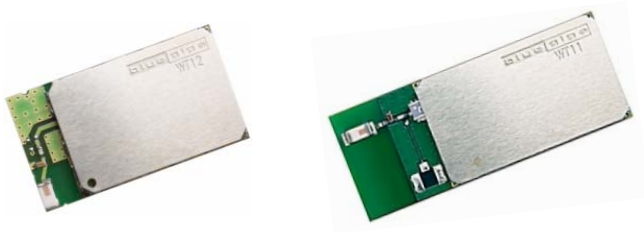
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Topics:

- **Overview**

- **WT12**

- **WT11**

- **WRAP THOR Firmware**

- **Evaluation & Development**

- **Certifications**

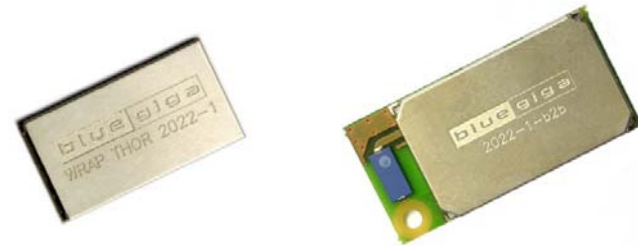- **Comparison**

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Overview:

WT modules

- Bluetooth 2.0 + EDR
- Fully certified (Bluetooth, CE and FCC)
- Range 30-300 meters
- Integrated antenna or U.FL connector
- Pin-to-pin compatible

2022-1 modules

- Bluetooth 1.2
- 2022-1-B2B fully certified
- 2022-1 Certified as component
- Range 100-200 meters
- 2022-1-B2B with integrated antenna
- 2022-1 with RF pin

WT12:

- Surface mount, *Bluetooth*® Class 2 module
- Integrated chip antenna or RF pin
- Supports Enhanced Data Rates (EDR) with data throughput up to 2-3Mbps
- Support for Adaptive Frequency Hopping (AFH) and 802.11 co-existence
- USB version 1.1
- UART with bypass mode
- SPI and 6xGPIO
- 8Mb of flash memory
- Industrial temperature range from -40C to +85C
- RoHS compliant
- Pin-to-Pin compatible with WT11
- Simple iWRAP™ firmware for controlling *Bluetooth*® wireless technology
- HCI firmware or custom applications
- Fully qualified end product - *Bluetooth*® 2.0+EDR, CE and FCC

WT12:

- **Frequency**: 2400MHz - 2483.5MHz

- **Modulation**: GFSK, PI/4DQPSK, 8DPSK

   1, 2, 3 Mbps

- **TX power**: typical +2.5dBm (30m range)

- **Sensitivity**: -80 dB

- **BER**: <0.1%

- **Current consumption**:

  – RX: ~30 mA

  – TX: ~29 mA

  – IDLE: 0.4-1.2 mA

  – Sniff, Park: 2-4 mA

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T E C H N O L O G I E S

WT12:

- **UART interface**

  – 1200bps - 3Mbps

  – Bybass mode

  – H4, H5 and BCSP protocols

  – Flow Control

- **USB interface**

  – Standard USB 2.0 compatible interface (USB slave device)

- **SPI**

  – Dedicated for firmware updates

- **6 x GPIO**

- **PCM for audio applications**

- **Wi-Fi coexistence interface**

  – TDMA

  – FDMA

  – Combination of FDMA & TDMA

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WT11:

- Surface mount, *Bluetooth*® Class 1 module
- Integrated chip antenna or U.FL connector
- Supports Enhanced Data Rates (EDR) with data throughput up to 2-3Mbps
- Support for Adaptive Frequency Hopping (AFH) and 802.11 co-existence
- USB version 1.1
- UART with bypass mode
- SPI and 6xGPIO
- 8Mb of flash memory
- Industrial temperature range from -40C to +85C
- RoHS compliant
- Pin-to-pin compatible with Bluegiga WT11 module
- Simple iWRAP™ firmware for controlling *Bluetooth*® wireless technology
- HCI firmware or custom applications
- Fully qualified end product - *Bluetooth*® 2.0+EDR, CE and FCC

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WT11:

- **Frequency**:   2400MHz - 2483.5MHz

- **Modulation**:   GFSK, PI/4DQPSK, 8DPSK

    1, 2, 3 Mbps

- **TX power**:   typical +17dBm (200-300m range)

- **Sensitivity**:   -80 dB

- **BER**:   <0.1%

- **Current consumption**:

    – RX: ~55 mA

    – TX: ~54 mA

    – IDLE: 0.4-1.2 mA

    – Sniff, Park: 2-4 mA

WT11:

- **UART interface**

  – 1200bps - 3Mbps

  – Bybass mode

  – H4, H5 and BCSP protocols

  – Flow Control

- **USB interface**

  – Standard USB 2.0 compatible interface (USB slave device)

- **SPI**

  – Dedicated for firmware updates

- **6 x GPIO + 1 x 8-bit A/D**

- **PCM for audio applications**

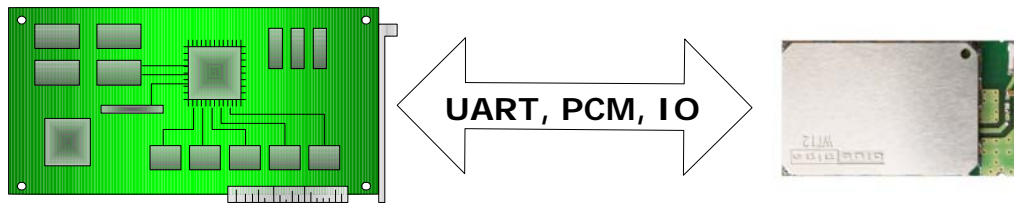- **Wi-Fi coexistence interface**

  – TDMA

  – FDMA

  – Combination of FDMA & TDMA

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Firmware Overview

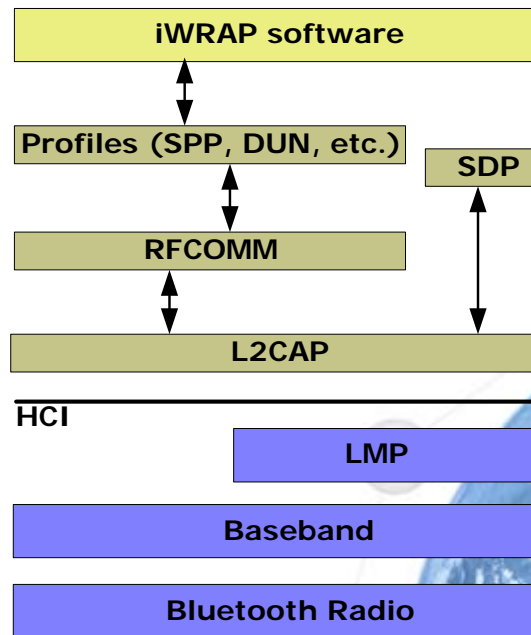| iWRAP	HCI	Custom	Windows stacks
• Easy-to-use modem like firmware • Operated with simple ASCII commands • Provides access to most commons Bluetooth functions • Can be configured to operate autonomously • Combined with MCU offers a platform to create sophisticated applications	• A low level firmware • Offers a stadard Bluetooth HCI command interface • Provides acces to all Bluetooth functions • Requires a host system that implemetns the Bluetooth upper stack • More powerfull than iWRAP but requires more development	• WRAP THOR modules have an internal RISC processor • Enables creating a custom firmware • Simple application functionality can be embedded into the module. For example simple data processing/routing or automated network setup • Requires the BlueLab SDK	• Bluetooth upper stack for Windows based operating sytems • Provides a GUI for controllong the Bluetooth functions • For applications offers simple data access methods like: Virtual COM ports, TCP/IP and Windows audio • Ideal to be used with WT12 or WT11 with HCI firmware

WRAP THOR Firmware: iWRAP

- iWRAP enables users to access Bluetooth functionality with simple ASCII commands delivered to the module over serial interface - it's just like a Bluetooth modem.

- iWRAP implemements the whole Bluetooth stack so the user can only focus on the application level development.

- With iWRAP software you have several implementation options:
  - iWRAP can be configured to operate autonomously - just like a Bluetooth cable replacer
  - To create sophisticated applications - a host system can be used to control iWRAP with ASCII commands
  - The GPIO interface in WT12 module can be used to connect host and iWRAP
  - For audio applications PCM interface can be used to connect to PCM codec

- iWRAP supports following Bluetooth profiles: GAP, SDP, SPP, DUN, OPP, Headset, Hands-Free and Audio Gateway

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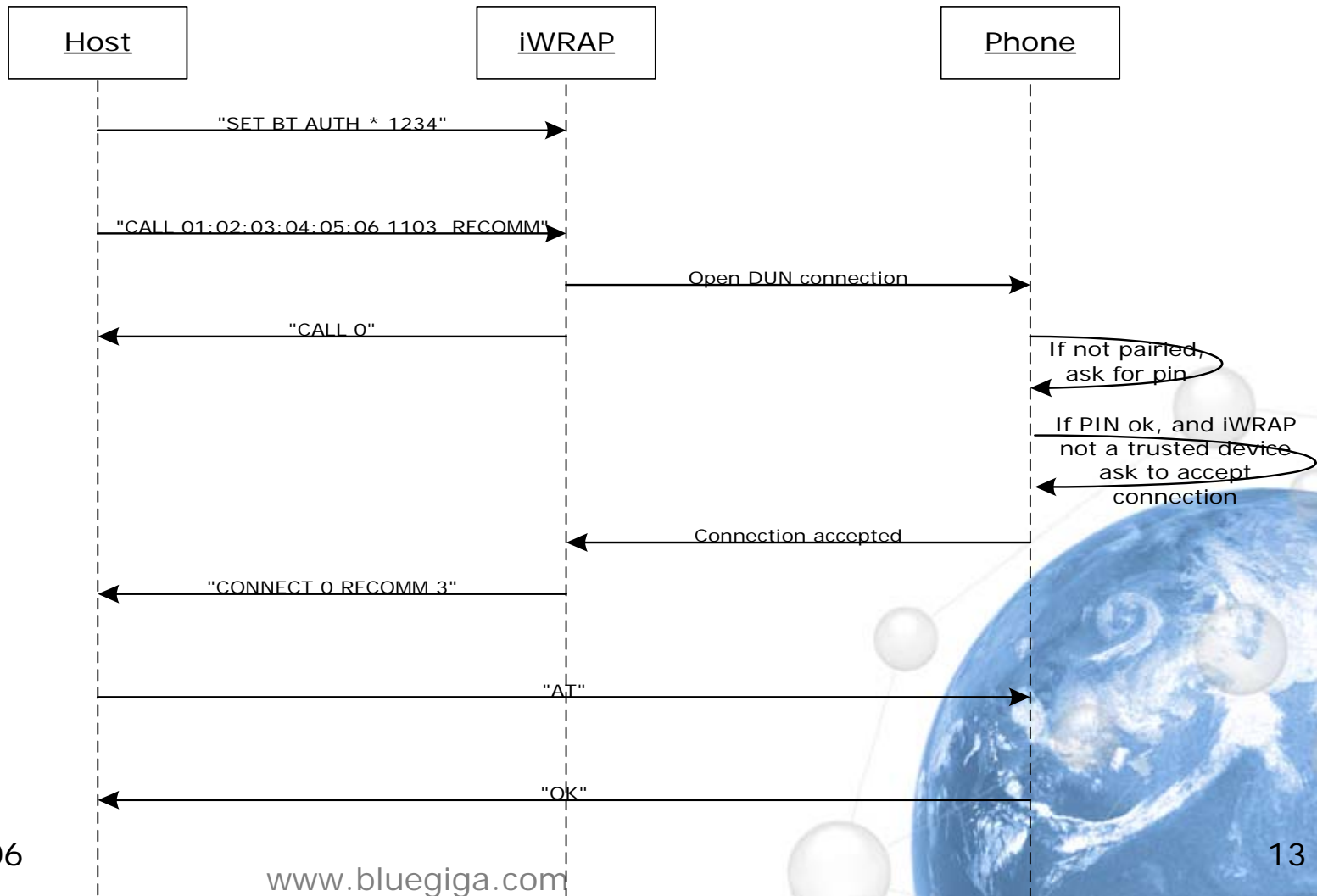# WRAP THOR Firmware: iWRAP

UART, PCM, IO

Application

iWRAP software

Profiles (SPP, DUN, etc.)

SDP

RFCOMM

Bluetooth stack

L2CAP

HCI

LMP

Baseband

Bluetooth Radio

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WRAP THOR Firmware: iWRAP

Host	iWRAP	Phone

Host → iWRAP: "SET BT AUTH * 1234"

Host → iWRAP: "CALL 01:02:03:04:05:06 1103 RFCOMM"

iWRAP → Phone: Open DUN connection

iWRAP → Host: "CALL 0"

If not paired, ask for pin

If PIN ok, and iWRAP not a trusted device, ask to accept connection

Phone → iWRAP: Connection accepted

iWRAP → Host: "CONNECT 0 RFCOMM 3"

Host → Phone: "AT"

Phone → Host: "OK"
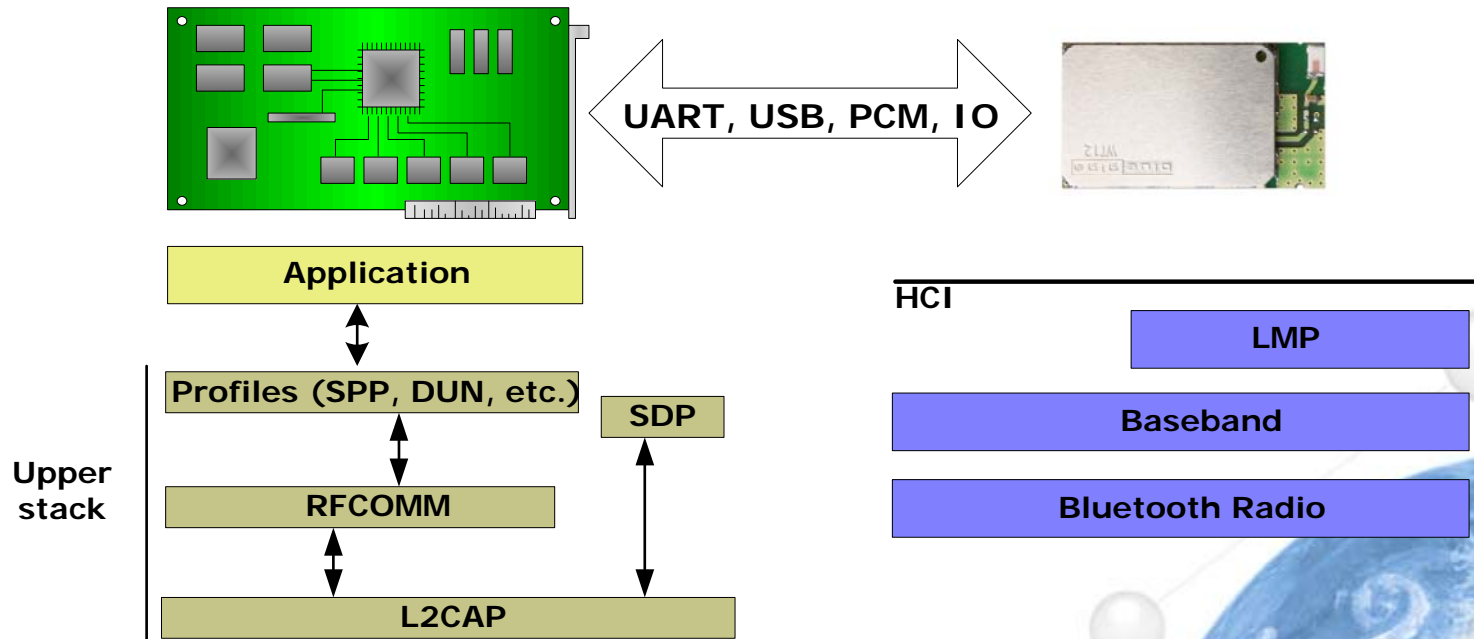
WRAP THOR Firmware: HCI

- HCI is a low level firmware implementing only lower levels of the Bluetooth protocol stack up to the standard *Host Controller Interface* (HCI)

- With HCI firmware the host system needs to implement the rest of the Bluetooth stack (so called upper Bluetooth stack)

- This requires, of course, more resources from the host system, but the advantage is better performance than with iWRAP firmware

  – Usually more profiles can be supported
  – Faster data rate
  – More connections
  – Lower response times

- **Remember**:

  – iWRAP runs on a 16-bit microprocessor, where as the host processor can be an ARM7 or 4GHz 64-bit Intel Pentium.

  – However the host processor can also be a low end PIC processor!

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WRAP THOR Firmware: HCI

UART, USB, PCM, IO

Application

Profiles (SPP, DUN, etc.)

SDP

Upper stack

RFCOMM

L2CAP

HCI

LMP

Baseband

Bluetooth Radio

WRAP THOR Firmware: Windows Stacks

- **IVT Bluesoleil Stack**
  - A Bluetooth upper stack for Windows Operating Systems
  - Can be purchased together with WT modules
  - Supported Bluetooth profiles: PAN, SPP, DUN, LAP, FTP, HID, HCRP, OPP, SYNC, FAX, Headset, AV, BIP, GAP and SDAP

- **Toshiba Bluetooth Stack**
  - An alternative Windows stack
  - Supported Bluetooth profiles: DUN, FAX, LAP, SPP, HID, HCRP, FTP, OPP, HSP, PAN, BIP, A2DP, AVRCP and GAVDP

- **Windows SDK also available for both stacks**

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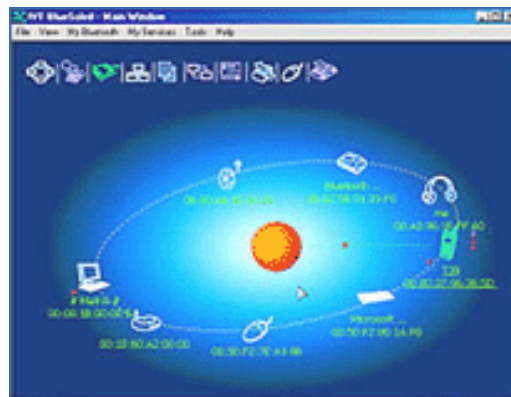
Evaluation & Development

- **PCB with integrated WT11 or WT12 module**

    - Full RS-232 interface (1Mbps)

    - USB interface

    - SPI

    - All I/O signals

    - DTR and Reset switches

    - PCM codec and microphone + speaker connection

- **Three different evaluation kits available:**

    - For WT12 module   (code: EKWT12-A)
    - For WT11-A module   (code: EKWT11-A)
    - For WT11-E module   (code: EKWT11-E)

- **Package contains:**

    - 2 x WT12 / WT11 Evaluation Boards

    - On-board Installation Kit

    - Documentation

    - Software

    - Design references (BOM, schematics, gerber)

    - Access to Bluegiga Tech-forum

    - With WT11-E: Antenna + U.FL to SMA cable

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Evaluation & Development

- **There is a 16-bit RISC processor inside WRAP THOR modules**
  - Can run custom software (like iWRAP for example)

- **BlueLab Professional Software Development Kit (SDK) is available for this purpose**
  - Enables creating of new Bluetooth profiles
  - Custom applications for data processing, I/O, SPI, I2C functionality

- **Programming language is C and applications work on top of RFCOMM layer**

- **Comes with a smart Windows based IDE**
 - Documentation
  - Example Applications

Certifications

- **WT12 / WT11 are Bluetooth "End Product" certified with iWRAP firmware**

  – If the customer does not modify the hardware or software, there is no need to do any additional Bluetooth certification

  – Customers can use Bluetooth logo and name in their product and marketing (free Bluetooth SIG membership required)

- **With HCI firmware, the software part is not does not full fill the requiremnt of end product certification**

  – Upper stack needs to be certified as well

  – The whole system still needs to be Bluetooth listed
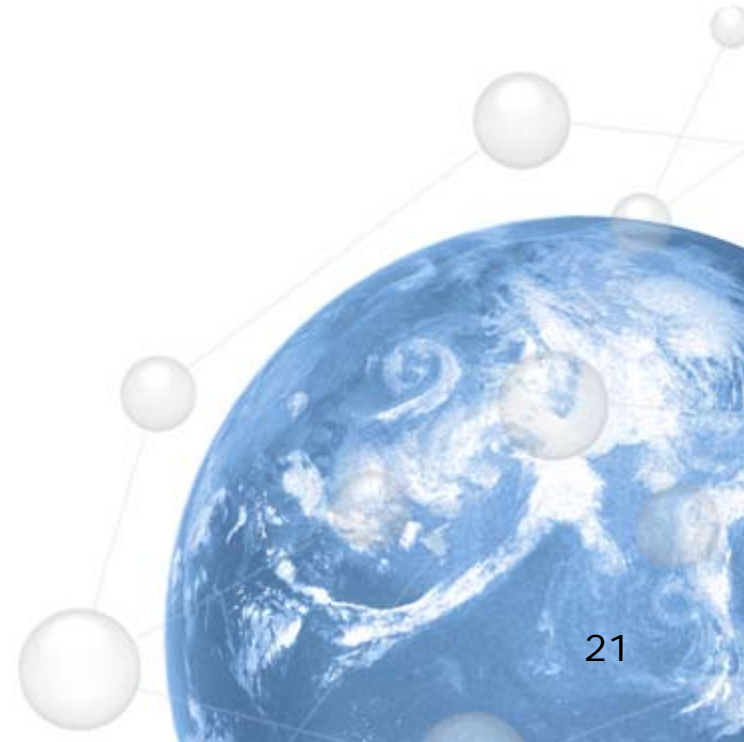
Certifications

- **FCC**

  – WT12 / WT11 comply with the requirements set by ANSI C63.4 and FCC Part 15

- **Limitations:**
  – Reorient or relocate the receiving antenna.
  – Increase the separation between the equipment and receiver.
  – Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
  – This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

- **You also must understand:**

  – This device may not cause interference and
  – This device must accept any interference, including interference that may cause undesired operation of the device.

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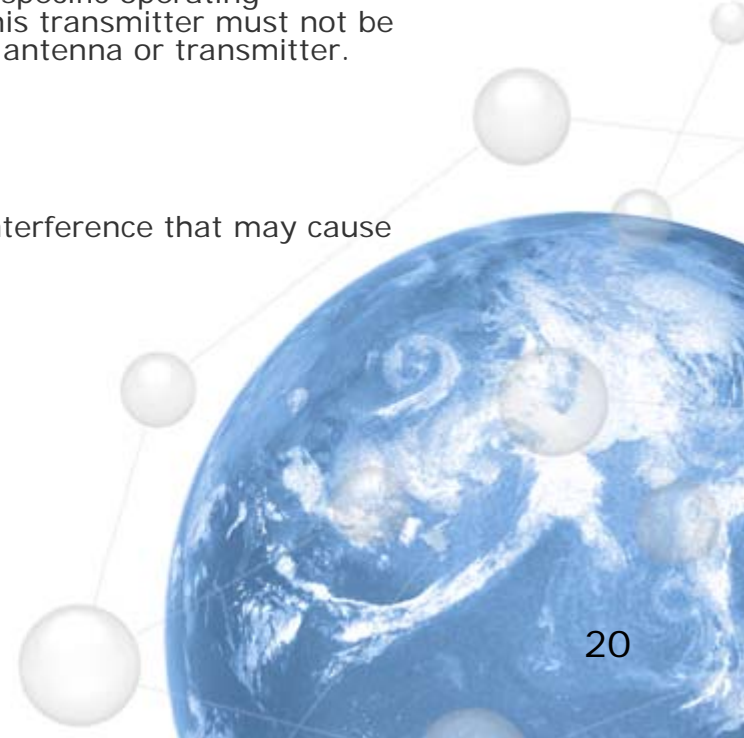
Certifications

- **CE**

    – ETSI EN 300 328-1 v1.3.1 (2001-12)

    – ETSI EN 300 328-2 v1.2.1 (2001-12)

    – EN 301 489-17, v1.2.1

    – EN 55022: Cont contucted. (Class B)

    – EN 55022: Radiated (Class B)

    – EN 301 489-17 v1.2.1

    – EN 61000-4-2 (1995): ESD

    – EN 61000-4-´3 (1996): EM Radiated field of RF

Certification Overview

Bluetooth HW	Bluetooth SW	Bluetooth listing	CE	FCC
· HW part of WT12 and WT11 tested / certified - No need to do anything unless something is changed	· iWRAP fully certified – no need to do anything · HCI partially certified · If upper stack is certified, only listing needed (IVT, Toshiba) · If upper stack is not certified, testing and listing is needed · Custom software needs to be tested and listed	· WT12 / WT11 listed as end products with iWRAP firmware – no need to do anything · HCI / custom firmware will need listing	· WT12 / WT11 have been been tested according to the ETSI standards mentioned earlier · Testing is needed only if some other standards need to be supported	· WT12 / WT11 FCC certified · Testing is only needed if FCC rules violated. For example other radio product used in the same design

- Bluetooth listing fee: $10000
- Profile (SW) testing: $1000-4000 / profile
- Full CE testing: $4000-7000
- Full FCC testing: $3000-5000

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Module Comparison

Feature	WT11	WT12	2022-1	2022-1-B2B
Bluetooth specification	2.0+EDR	2.0+EDR	1.2	1.2
Bluetooth class	1	2	1	1
Antenna	Internal or U.FL	Internal, PIN	PIN	Internal
Temperature range	-40° to +85°	-40° to +85°	-40° to +85°	-40° to +85°
Maximum troughput	2,2Mbps	2,2Mbps	723kbps	723kbps
Integration	Surface mount	Surface mount	Surface mount	AMP connector
Interfaces	UART, USB, SPI, PCM, 6xGPIO,1xAIO	UART, USB, SPI, PCM, 6xGPIO	UART, USB, SPI, PCM, 6xGPIO	UART, USB, SPI, PCM, 6xGPIO
Power supply	Regulated 3.3V	Regulated 3.3V	Regulated 3.3V	Regulated 3.3V or 5-9V unregulated
AFH supported	Yes	Yes	Yes	Yes
802.11 Co-existence	Yes	Yes	No	No
Memory	48Kb RAM, 8Mb Flash	48Kb RAM, 8Mb Flash	32Kb RAM, 8Mb Flash	32Kb RAM, 8Mb Flash
Chip	BlueCore-04	BlueCore-04	BlueCore-02	BlueCore-02
Certifications	Bluetooth, CE, FCC	Bluetooth, CE, FCC	Bluetooth, CE	Bluetooth, CE, FCC
Can host applications	Yes	Yes	Yes	Yes
Software	iWRAP, HCI, Custom	iWRAP, HCI, Custom	iWRAP, HCI, Custom	iWRAP, HCI, Custom

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