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Application note

Certification of customer products using STM32WB

Introduction

The STM32WB devices are used to design and manufacture applications for Bluetooth® Low Energy (BLE), ZigBee® and Thread.

Methods to build applications for those standards using ST products are described in dedicated application notes, also available on www.st.com.

Formal certifications are required to sell the end products in different markets.

This application note presents an overview of the necessary certifications and gives a guidance to get them. The actual requirements are provided by the certifying bodies.

This application note is valid for STM32WB Series products only.

1 Acronyms and abbreviations

- ATL: Authorized test lab(s) for conduction tests against thread specifications
- BLE: Bluetooth Low Energy
- BQTF: Bluetooth qualified test facility
- BQC: Bluetooth quality consultant
- CSA: Connectivity Standards Alliance (replaces ZigBee Alliance)
- DID: Bluetooth declaration ID
- FFD: Full feature device (ZigBee)
- FTD: Full thread device (opposed to MTD)
- ICS: Implementation conformance statement (Bluetooth Low Energy)
- MTD: Minimum thread device (opposed to FTD)
- PICS: Protocol implementation conformance statements (to be submitted for ZigBee certification)
- PIXIT Protocol implementation eXtra information for testing specification – part of ZigBee PICS
- PTS: Profile tuning suite – test environment for Bluetooth Low Energy qualification available from Launch Studio
- QDID: Bluetooth qualified design ID
- RFD: Reduced feature device (ZigBee)
- SIG: Bluetooth special interest group
- TCRL: Bluetooth test case reference list
- ZCL: ZigBee cluster library
- ZSE: ZigBee smart energy
- ZTT: ZigBee test tool

2 General information

This document applies to the Arm®-based devices.

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

3 Bluetooth Low Energy (BLE)

This chapter describes the qualification processes for Bluetooth Low Energy. There are different cases and the objective is to achieve the qualification for each with minimum cost and effort. It is important to distinguish between the different requirements for qualification.

A company that sells Bluetooth products must be a member of the Bluetooth specific interest group (SIG). An annual membership fee is charged, depending on the kind of membership (associate or adopter) and the annual revenue of the company.

The qualification process for Bluetooth Low Energy products is owned and controlled by the SIG and documented on their website www.bluetooth.com.

In this application note a short summary is presented only to put the ST layer stacks into perspective.

3.1 General description of the qualification process

All products that use Bluetooth technology must complete the product qualification process. It ensures global interoperability and further strengthens the Bluetooth brand (quoted from Bluetooth.com).

All end products, subsystems and components must be submitted for qualification (see Bluetooth.com). In the qualification process there are two paths, one with testing and one without. An end product is qualified without testing if its components have been previously qualified (with testing). In that case, the product receives a Declaration ID (DID) and a list of referenced Qualification Device ID (QDID).

The interface for the qualification process is on launchstudio.bluetooth.com (Launch Studio). A new declaration for an end product or a component is started by giving it a project name. Its features are ticked off on a checklist and constitute the ICS. Existing QDID for re-used components is obtained from the search menu and attached to the project. At this stage there is a consistency check, and all errors must be resolved (for example by adapting the feature list).

The product qualification (with required testing) involves the following steps:

1. Register a project and provide basic information including any existing QDID
2. Select the layers concerning the project
3. Select the relevant ICS
4. Download a test plan and test program to be run in PTS
5. Execute the tests and upload the evidences
6. Submit a detailed product declaration
7. Purchase the declaration ID
8. Make sure all steps are completed, verify the information and submit the product for qualification
9. Sign the declaration

Figure 1. Qualification path with tests

The new product is linked to a current version of the test case reference list (TCRL). A list of necessary tests is obtained from Launch Studio.The evidence that these tests are passed must be uploaded before the qualification process is completed. Some tests are performed at a Bluetooth qualified test facility (BQTF).

If the system is based on already qualified subsystems then a simplified process applies without testing:

1. Register a project and provide basic information including any existing QDID
2. Submit a detailed product declaration
3. Purchase a declaration ID
4. Make sure all steps are completed, verify the information and submit the product to the BQTF for qualification
5. Sign the declaration

A Bluetooth qualification consultant (BQC) is contracted to assess the coherence of the test plan, review the test results before the device is submitted to the BQTF. A list of BQC is available on www.bluetooth.com.

Note: A BQC is recommended, but not required.

Tests on RF-PHY, Link layers and HCI layers must be performed by a BQTF.

Other layers (GAP, GATT, L2CAP, SIG defined profiles, etc) are tested with the Bluetooth profile tuning suite (PTS). Test execution requires a dongle that must be purchased. The PTS and details are available on www.bluetooth.com.

The list of necessary tests depends on the specified features (ICS) and the current TCRL and can be downloaded from Launch Studio.

The tests to be executed are defined by the TCRL. It is best to review them with a BQC.

In addition to the Bluetooth qualification, a regulatory certification is needed. All wireless products sold in any given country (or region) must be compliant with the standards (eg ETSI, ANSI) adopted by that country's authorities (eg FCC). See Regulatory certification for other informations.

3.2 QDID obtained by ST

ST has already obtained QDID for completely functional reference designs and the components are available for reuse by customers.

Customers select the qualification process with required testing. The components with QDID references not more than three years old are taken into account and not everything has to be retested completely.

Following sections list the available QDID at the time of writing. This list evolves over time. Use Launch Studio to find the current list of available QDID with a simple search for *STM32WB*.

3.3 QDID for RF-PHY

ST creates reference designs with STM32WB devices in a variety of packages. These have been RF-PHY qualified and the corresponding QDID are available.

ST recommends to follow guidelines carefully and copy the reference designs as much as possible to minimize the need for tests and design iterations. Each new end product must be tested in its environment and Bluetooth Low Energy qualified. The existing QDID can only be re-used when using a module.

Note: Clients are encouraged to discuss this with the BQTF of their choice and / or with a BQC.

The list of necessary tests for requalification depends on the specified features (ICS) and the current TCRL and can be downloaded from Launch Studio. These tests must be executed by a BQTF.

Table 1. Available QDID for RF-PHY

QDID	Name	Package	Standard
161807	STM32WB55Cx_RF_PHY	QFN 48	BLE5.2 - 2 Mbit/s
162168	STM32WB50Cx_RF_PHY	QFN 48	BLE5.2 - 1 Mbit/s
162170	STM32WB35Cx_RF_PHY	QFN 48	BLE5.2 - 2 Mbit/s
162169	STM32WB30Cx_RF_PHY	QFN 48	BLE5.2 - 1 Mbit/s
127495	STM32WB55Rx_RF_PHY	QFN 68	BLE5.2 - 2 Mbit/s
134665	STM32WB5xVxx_WLCSP100_RF_PHY	CSP 100	BLE5.2 - 2 Mbit/s
161808	STM32WB55Vxx_BGA129_RF_PHY	BGA 129	BLE5.2 - 2 Mbit/s
170767	STM32WB5MMG	Module	BLE5.2 - 2 Mbit/s

Developing a new end product that includes STM32WB5MMG module has several advantages over a design-in with standalone microcontrollers from the STM32WB Series. The development cost is lower, and the time-to-market is significantly shorter. There is no need to re-qualify the RF-PHY and the corresponding QDID can be referenced instead. For Bluetooth Low Energy qualification it is still necessary to submit a product declaration and purchase the declaration ID.

The QDID for RF-PHY are specific for part numbers. If the STM32WB microcontroller is replaced by a different part number, the end product is considered as new, then a requalification of the RF-PHY standard is needed with appropriate testing unless mentioned otherwise in the datasheet. The resulting QDID is referenced in the subsequent product declaration.

3.4 QDID for Bluetooth Low Energy stacks

ST provides the qualified Bluetooth Low Energy software stack, and corresponding QDIDs are available for reference. If the stack is customized, a new qualification is needed. The customer can decide to make changes to the (upper) Bluetooth Low Energy layer but leave the (lower) HCI stack unchanged.

Table 2. Available QDID for host software stacks

	QDID	Name	Contents	Standard
160726	STM32Cube_WB_BLE_HCI		4.0 HCI – low energy LL	BLE 5.2 - 2 Mbit/s – TCRL 2019-2
160724	STM32Cube_WB_BLE_FULL_STACK STM32Cube_WB_BLE_LIGHT_STACK STM32Cube_WB_BLE_BASIC_STACK		4.0 HCI – low energy LL – ATT –GAP – GATT – L2CAP - SMP	BLE 5.2 - 2 Mbit/s – TCRL 2019-2

In this context, the software is split between the two Arm cores within the STM32WB Series microcontrollers.

In the STM32WB architecture the peripheral processor CPU2 (Cortex®-M0+) is dedicated to the real-time aspects. These are separated from the Bluetooth Low Energy profiles and applications running on the application processor CPU1 (Cortex-M4).

ST provides a qualified full stack running on CPU2 as a single binary file (black box). This stack incorporates the physical 2.4 GHz radio and includes the controller and host layers up to GATT and GAP. This software is already qualified and its QDID can be referenced.

If any customization of the software is required, it is possible to move the host layers to CPU1 and leave the HCI stack on CPU2. The changed layers need to be retested and qualified. Figure 2 and Figure 3 show the stacks and the processors CPU1 and CPU2.

Figure 2. Full stack runs on CPU2

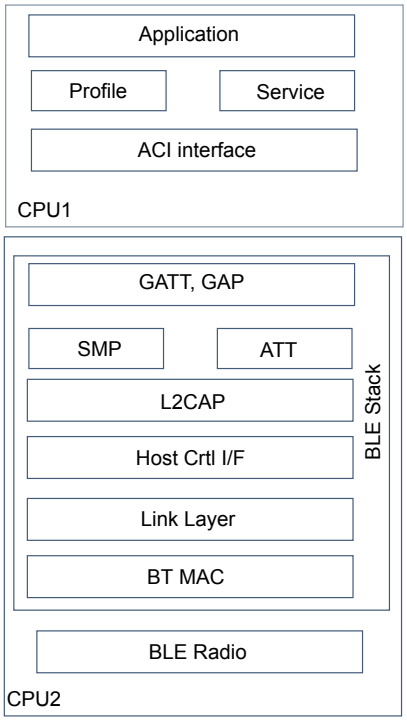
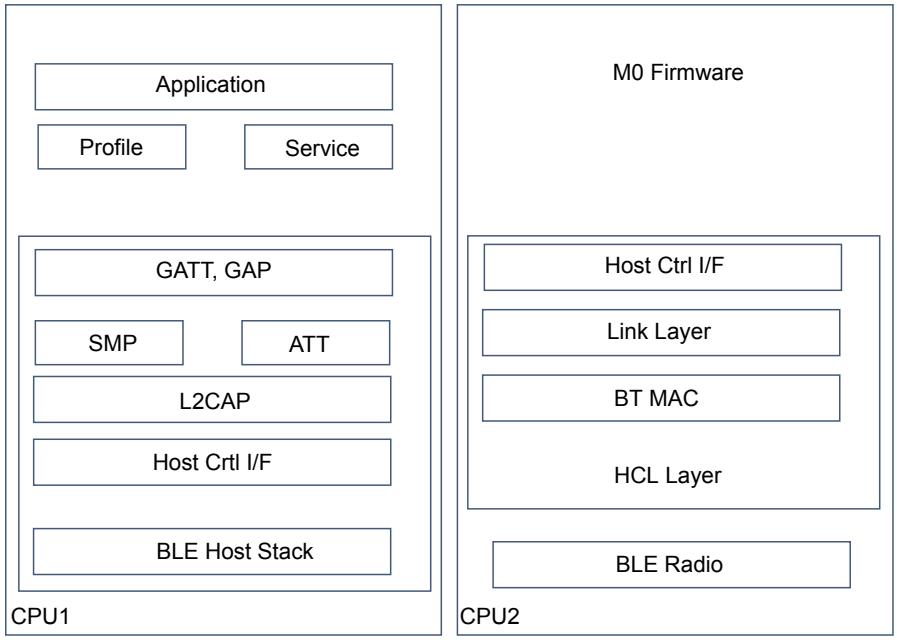


Figure 3. **HCL Layers run on CPU2**



3.5 QDID for profile stacks

ST also supplies software stacks for a large number of profiles. These are primarily intended as templates but are reused and as they are qualified the QDID can be referenced if no changes are made. When packages are upgraded and qualified with more profiles, a new QDID is available from Launch Studio.

Note: Some of the profiles are made available on demand.

Table 3. **Available QDID for profiles**

QDID	Name	Contents	Standard
122688	STM32Cube_FW_WB	Multiprofiles HTP, HTS, DIS, PXP, FMP, IAS, LLS, TPS, HRP, HRS, TIP, CTS, NDCS, RTUS, PASP, PASS, ANS, ANP, BLS, HOGP, HIDS, BAS, SCPS, GLS, RSCS, CSCS, CPS, LNP, LNS, WSS, WSP, BMS, ESS, IPS, AIOS, HPS, OTS	BLE5.0 TCRL2018-1
146387	ST_BLE_MESH	MESH profile	TCRL 2019-1
151209	ST_BLE_MESH	MESH model (client and server)	TCRL 2019-2

Table 4. Profiles included in STM32Cube_FW_WB

AIOS	Automation IO service	**HIDS**	Human interface device service	**OTS**	Object transfer service
ANP	Alert notification profile	**HOGP**	HID (human interface device) over GATT profile	**PASP**	Phone alert status profile
ANS	Alert notification server	**HRP**	Heart rate profile	**PASS**	Phone alert status service
BAS	Battery service	**HRS**	Heart rate sensor	**PXP**	Proximity profile
BLS	Blood pressure sensor	**HTP**	Health thermometer profile	**RSCS**	Running speed and cadence
BMS	Bond management service	**HTS**	Health thermometer sensor	**RTUS**	Reference time update service
CPS	Cycling power	**IAS**	Immediate alert service	**SCPS**	Scan parameters service
CSCS	Cycling speed and cadence	**IPS**	Indoor positioning service	**TIP**	Time profile
CTS	Current time service	**HPS**	HTTP proxy service	**TPS**	Tx power service
DIS	Device information service	**LLS**	Link loss service	**WSS**	Weight scale service
ESS	Environmental sensing service	**LNP**	Location and navigation profile	**WSP**	Weight scale profile
FMP	Find me profile	**LNS**	Location and navigation service	-	
GLS	Glucose sensor	**NDCS**	Next DST change service		

4 ZigBee 3.0

The main driver for the ZigbBee standard is interoperability between devices from multiple vendors. ZigBee certification ensures that devices operate in the same way and work together in a network. The standard and the certification process are owned and maintained by the Connectivity Standards Alliance (formerly ZigBee Alliance). Details on *csa-iot.org*.

Membership is required for the certification of end products. Members get access to the network and help with certification queries.

In addition to the ZigBee certification, a regulatory certification is required. All wireless products sold in any given country (or region) must be compliant with the standards (eg ETSI, ANSI) adopted by that country's authorities (eg FCC). See Section 6 for more additional information.

4.1 General description of the ZigBee certification process

A ZigBee platform/product must be compliant with the IEEE 802.15.4 specfication for the MAC/PHY layer. The ZigBee certification ensures compliance of the ZigBee network protocol stack, the cluster library and the application layer. On top of the ZigBee certification, regulatory certification of the wireless performance is required. Refer to Regulatory certification.

Below is a description of the steps leading to the certification of a ZigBee 3.0 end product.

1. Membership of the ZigBee Alliance

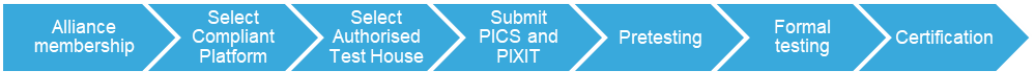
   Any provider of ZigBee products, certified or not, is required to acquire membership. There are different levels of involvement, with corresponding membership fees.
2. Selection of a compliant platform, e.g. STM32WB.

   Making use of certified compliant ZigBee platforms ensures interoperability between products from different vendors, and also backward compatibility with previously installed products.
3. Selection of an authorized test house .

   The list of available test houses is available on the ZigBee alliance website. The companies have all the right equipment and well established test procedures. They can also help in the completion of the documents and assist with the certification.
4. Submission of PICS and PIXIT.

   The protocol implementation conformance statements (PICS) describes the functionality of the submitted device in terms of standardized ZigBee features. Together with the Protocol Implementation eXtra Information for Testing (PIXIT) specifications this is the basis for the test plan for the device.
5. Pretesting with ZTT

   To avoid the delays and cost of multiple iterations with the test house, in-house pre tests can be done before the product is submitted. This requires the setup of one or more test harnesses:
   - The ZigBee test tool (ZTT) software for PC and its license are purchased from the ZigBee website.
   - ZTT dongles (golden devices) are ordered from several sources and require firmware for the configuration.
   - A shield box (Faraday box) to ensure a clean RF environment and a sniffer to verify transmitted packets are also required (the latter comes with the dongle).
6. Formal testing at test house. The test house submits the documents to the CSA:
   a. PICS/PIXIT
   b. Declaration of conformity
   c. Test reports
7. Certification by the CSA



4.2 Certification of ZigBee 3.0 devices

ST supplies two software stacks for ZigBee.

1. `stm32wb5x_ZigBee_FFD_fw.bin`

   The ST ZigBee full feature device (FFD) stack provides support for three basic roles in the network:

   – Coordinator
   – Router
   – End device

2. `stm32wb5x_ZigBee_RFD_fw.bin`

   The reduced feature device (RFD) stack is available for end devices only. This build has a smaller memory footprint and gives the lowest power consumption.

These stacks run on the Cortex-M0+ processor where also the 805.14.2 stack for MAC and PHY is hosted. They are provided as binary files and cannot be modified by the customer.

The STM32WB protocol stacks (ZDO, APS, NWK) are compliant with the ZigBee Pro R22 specification. As such, the STM32WB is a compliant platform. It also supports the green power proxy (GPP) feature from the ZigBee green power specification as shown in Table 5.

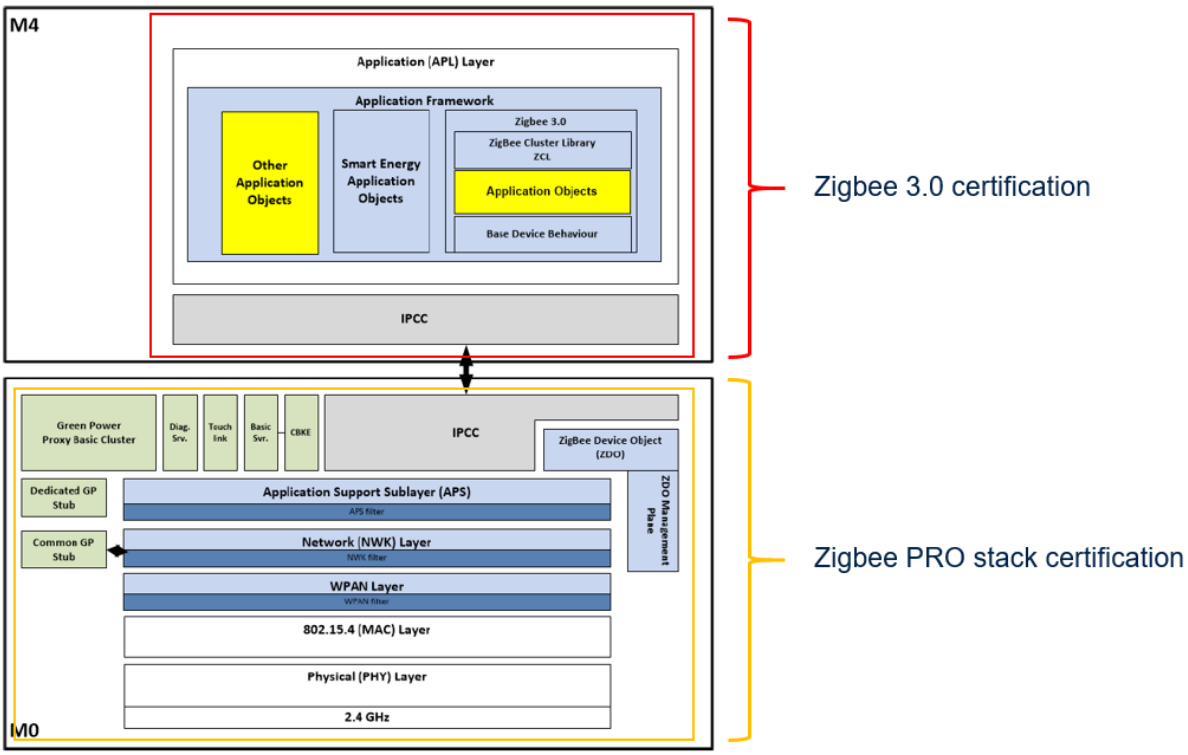
Table 5. Two compliant platforms listed on the CSA website

Company	Platform name	Revision	Firmware version	Hardware version	Feature set	Certificate ID	Certificate data	Product details
STMicroelectronics SAS	STM32WB	2	V.1.6.0 RFD	IC-STM32WB5X Cut2.1	ZigBee PRO compliant platform (2017)	ZIG20037ZCP27258-24	07/16/2020	View
STMicroelectronics SAS	STM32WB	3	V.1.6.0 RFD	IC-STM32WB5X Cut2.1	ZigBee PRO compliant platform (2017), Green power proxy basic	ZIG20037ZCP27258-24	05/28/2020	View

Using ZigBee FFD and RFD stand-alone stacks, ST has obtained a ZigBee 3.0 end product certification based on the STM32WB compliant platform, which has been certified for a significant number of different cluster types listed in the standard.

The application stacks for this products run on Cortex-M4 and are available as sample code from ST.

The PICS for the STM32WB compliant platform are available for reference from the CSA website.



4.3 Certification of smart energy devices

Smart energy devices are deployed to specific markets. These require specific cluster software that must be adapted to requirements dictated by the business practices of the utility company, the network provider infrastructure and national or regional legislation.

ST provides generic cluster templates that must be used to build smart energy applications. The current version of templates is certifiable by the CSA against the ZigBee smart energy ZSE 1.1b (until end 2022) and 1.4 specifications.

4.4 Certification of the physical layer for ZigBee

The IEEE 802.15.4 standard defines the physical layer (PHY) and medium access control (MAC) sublayer specifications for low data rate wireless connectivity with fixed, portable, and moving devices with no battery or very limited battery consumption requirements.

Certification of PHY and MAC layers against this standard is a prerequisite for certification of ZigBee devices.

The ZigBee test specification from the Connectivity Standards Alliance provides a complete description of the standard that the devices must adhere to, and how this is tested. Customers must test their products throughout the design and development phases, and submit the product for formal testing and certification by approved test centers.

ST reference designs have been certified to demonstrate the product capabilities. Nevertheless, the manufacturers of end products are responsible for taking care that their products are adequately certified.

If the customer changes the physical implementation of the radio in the end product, the RF-PHY must be recertified. Based on this certification, the customer gets a new ZigBee Pro compliant platform certificate by similarity. With this new compliant platform, the customer certifies the ZigBee 3.0 end product by following the process described in Section 4.1 .

This also applies even when the STM32WB microcontroller is replaced by a different part number. The RF-PHY needs to be re-certified against the 802.15.4 standard and for the other layers a certification by similarity is requested. If the radio is identical to the ST reference design and the end product uses the certified protocol stacks provided by ST in binary format, the certification process for the end product is straightforward as in Section 4.1 .

STM32WB is selected as compliant platform. The PICS from the ST platform are used as a starting point to fill out the PICS for the end product. Preliminary and formal testing focuses on verifying cluster behavior against ZigBee 3.0 standards.

5 Thread

Thread is an IP-based wireless networking protocol. It allows home products to connect to a low-power wireless mesh network.

The Thread group is a no-profit organization responsible for the market education around the Thread networking protocol and certification of Thread products.

Thread has a certification program and relies on third-party testing to verify quality, security and interoperability. Certified Thread products are bear the Thread logo to help consumers identify them on the market. (www.threadgroup.org).

Certification indicates to customers that the product is fully Thread compliant, and that it works with other Thread products. Product certification is required to ship the OpenThread-based product and to state that the product supports the Thread.

The Thread group test houses are already familiar with OpenThread as a reference stack. This permits to reduce certification time and cost.

Certification testing is done with the GRL Thread Test Harness (available for download from graniteriverlabs.com). It is recommend running and passing all certification tests in a local setup prior to submission to the Thread group. (http://www.openthread.io)

All wireless products sold in a country (or region) must be compliant with the standards (eg ETSI, ANSI) adopted by that country's authorities (eg FCC). For more information see: Section 6 .

5.1 General description of the Thread certification process

The Thread certification is described as a process with the following steps.

1. Join the Thread group by becoming a member.
   There are different levels of membership with different price tags.
   See www.threadgroup.org for details.
2. Select an Authorized Test Lab (ATL) where the product is tested.
   A list of ATL and contacts is available on threadgroup.org
   The ATL have access to the Thread test harness software and reference devices.
   These are also available for members who want to take preliminary tests.
3. Submit an application for certification to the Thread group.
   This step decides if the product is a component or an end product.
   The selection of tests to be performed is defined at this stage.
4. Submit the product to the ATL for testing. The ATL shares the test results with the Thread group.
5. When testing is finished, the Thread group reviews the results. It grants product certification or ask for more details.

5.2 Thread certification with ST layer stacks

STM32WB is certified by Thread group for two devices with different node types:

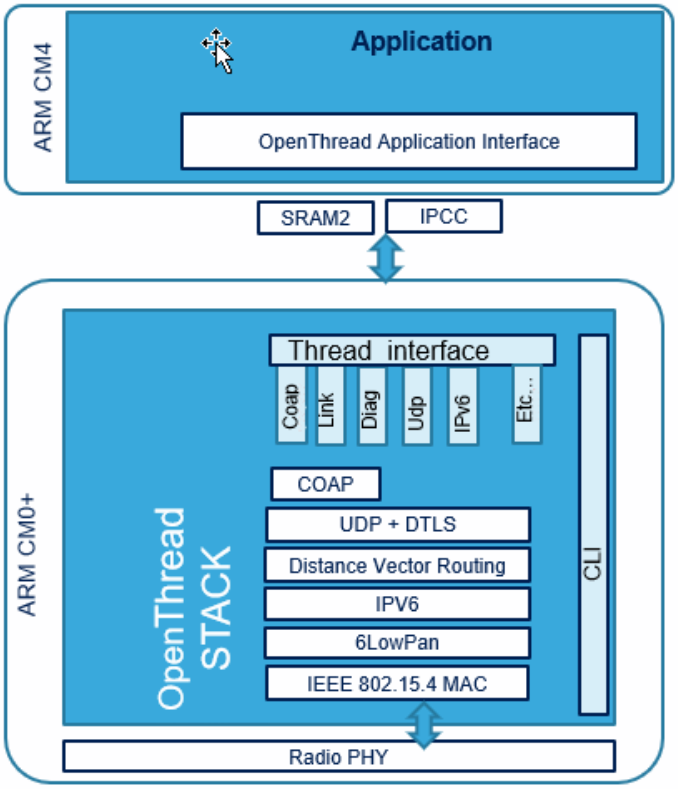
- Full Thread Device (FTD)
  - On-mesh commissioner
  - Full end device
  - Minimal end device
  - Sleepy end device
- Minimum Thread Device (MTD)
  - Minimal end device
  - Sleepy end device

These are the corresponding software stacks:

- `stm32wb5x_Thread_FTD_fw.bin`
- `stm32wb5x_Thread_MTD_fw.bin`

End products using the STM32WB are certified by Inheritance. If the Thread system (combination of Thread software and hardware) is unchanged, there is no need to run again the certification tests. However, the maker/seller of the end product must apply and pay for Thread group membership as well as a one time administration fee for each certification.

Figure 4. Thread stack running on Cortex-M0+ and Cortex-M4 processors



5.3 Certification of the physical layer for Thread

The IEEE 802.15.4 standard defines the physical layer (PHY) and medium access control (MAC) sublayer specifications for low data rate wireless connectivity with fixed, portable, and moving devices with no battery or very limited battery consumption requirements.

Certification of PHY layers against this standard is an assumption for certification of Thread devices.

For own designs, even matching closely the ST reference design, the customer gets the RF-PHY certification against the 802.15.4 standard. This also applies to redesigns of existing, already certified end products. If the radio is modified, or the microcontroller is replaced by another part number, the RF-PHY must be recertified.

Once the RF-PHY certification is obtained, the end product is submitted for certification by similarity, if no changes have been made to the software stack.

6 Regulatory certification

To limit noise and interference of RF devices, regulations are enforced by committees in various countries and regions around the world. These concern all end products using components or modules of the STM32WB Series. All products must be certified, thus ensuring to be in accordance with the regulations for the region where they are sold.

6.1 General description of the certification processes

USA, Canada and Japan issue a certification after submission of an application. Typically, the manufacturer contracts an accredited test lab to perfom the tests, and submits the test reports with the application.

In Europe, manufacturers go through a self-certification process. The tests are done in a test lab, or in-house if the company has adequate knowledge and resources. The test reports are stored and are produced when needed, for example in the context of an audit. The company then issues a declaration of compliance.

In both cases, it is common practice to carry out tests and measurements during the design stages. For the final certifying tests, the production version of the product must be submitted because any changes to housing, PCB or firmware invalidate the certification.

6.2 Regulatory certification of devices using STM32WB components

ST gets certifications for their boards with STM32WB for the major sales regions, typically the USA and Canada, Europe, China, Japan and Korea. The exact list of regions varies by product and evolves over time.

The corresponding certifications are listed in the respective datasheets.

When not available from www.st.com, the certificates and test reports are obtained from ST sales offices.

Customers are responsible for obtaining the appropriate certifications for the regions in which they sell their products. While the final product is very similar to the ST reference design, small differences in firmware, component procurement, PCB implementation, connections and housing can have a significant impact on RF behavior profiles.

A particular case is the STM32WB5MMG module in which the request of a complete recertification depends on the regional standards and the end product itself.

6.3 Some regional standards and certification bodies

Table 6. Regional standards and certification bodies

USA		FCC - Federal Communications Commission	www.fcc.gov
Canada		ISED – Innovation, Science and Economic Development Canada	http://www.ic.gc.ca
Europe	RED - Radio Equipment Directive	European Community	https://ec.europa.eu
Japan	JRL - Japan Radio Law	MIC – Ministry of Internal Affairs and Communications	https://www.tele.soumu.go.jp
China	SRRC – State Radio Regulation	State Radio Regulation Centre	http://www.srrc.org.cn/

7 FAQ

The table below gives an indication of fees to be paid to the certifying bodies (as per July 15th 2021). The amounts listed are for the lowest level that allows product certification. They are subject to change by the organisations. The costs of testing depends on the test facility as well as the effort involved. The test time is counted in weeks and the cost is several thousands dollars per week.

	Bluetooth	ZigBee	Thread
Cost of membership (minimum)	No annual fee for adopter membership	7000 $ for adopter level membership	5000 $ for implementer level membership
Fee for qualification/ certification	8000 $ declaration fee	3000 $ to certify a new product (as of July 15th 2021)	750 $ administration fee per product application
Cost of testing	Contract with BQTF	Contract wth authorized test house	Contract with ATL

Revision history

Table 7. **Document revision history**

Date	Version	Changes
03-Nov-2021	1	Initial release.

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