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Technical Support

Website

Our website contains much useful information: modules and stand-alone products information, user guides, configuration software and technical documents which can be accessed 24 hours a day.

Email

If you have technical problems or cannot find the required information in the provided documents, contact our Technical Support by email. Use our dedicated email address (arf@adeunis.com) rather than any personal email address of our staff. This makes sure that your request is processed as soon as possible.

Helpful Information when Contacting Technical Support

When contacting Technical Support please have the following information ready:

- Product type (e.g. Wireless M-Bus),
- Firmware version (e.g. V3.03)
- Clear description of your question or the problem
- A short description of the application
- Your complete contact details

Environmental recommendations

All superfluous packaging materials have been eliminated. We have done everything possible to make it easy to separate the packaging into three types of materials: cardboard (box), expanded polystyrene (filler material) and polyethylene (packets, foam protective sheets). Your device is composed of materials that can be recycled and reused if it is dismantled by a specialist company. Please observe local regulations concerning the manner in which waste packaging material, used batteries and your obsolete equipment are disposed of.

Warnings

Valid for the following product: ARFWL55



Read the instructions in the manual



The safety of this product is only guaranteed when it is used in accordance with its purpose. Maintenance should only be carried out by qualified persons.



Please note, do not install the equipment close to a heat source or in damp conditions.



Warning: Do not open the product, risk of electric shock.



Please note: for your own safety, you must ensure that equipment is switched off before carrying out any work on it.

Recommendations regarding use

- Before using the system, check that the power supply voltage shown in the user manual corresponds to your supply. If it doesn't, please consult your supplier.
- Place the device against a flat, firm and stable surface.
- The device must be installed in a location that is sufficiently ventilated so that there is no risk of internal heating and it must not be covered with objects such as newspapers, cloths, curtains, etc.
- The device's aerial must be free and at least 10 cm away from any conducting material.
- The device must never be exposed to heat sources such as heating equipment.
- Do not place the device close to objects with naked flames such as lit candles, blowtorches, etc.
- The device must not be exposed to aggressive chemical agents or solvents likely to damage the plastic or corrode the metal parts.
- Install your device close to its DC power supply.

COMPLIANCE TO FCC US

Important regulatory information FCC ID : U3Z-ARFWL55

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction, may cause harmful interference to radiocommunication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment OFF

and ON, the user is encouraged to try to correct the interference by one or more of the following measures :

- 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.
- Consult the dealer or an experienced radio/TV technician for help.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lower) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be chosen so that the equivalent isotropically radiated power (e.i.r.p.) is not superior than necessary for successful communication.

Cet équipement a été testé et déclaré conforme aux limites d'un appareil numérique de classe B, conformément à la partie 15 des règles de la FCC. Ces limites sont conçues pour fournir une protection raisonnable contre les interférences nuisibles dans une installation résidentielle. Cet équipement génère, utilise et peut émettre de l'énergie radiofréquence et, s'il n'est pas installé et utilisé conformément aux instructions, peut causer des interférences nuisibles aux radiocommunications. Il est cependant toujours possible que des interférences se produisent dans le cadre d'une installation particulière.

Si cet appareil produit des interférences nuisibles à la réception des programmes de radio et de télévision –détectables lors de la mise hors tension ou en tension de l'appareil–l'utilisateur est encouragé à mettre en œuvre une ou plusieurs des mesures suivantes pour remédier à ces interférences :

- Réorienter ou déplacer l'antenne de réception.
- Augmenter la distance entre l'équipement et le récepteur.
- Branchez le matériel à une sortie sur un circuit différent de celui auquel le récepteur est branché.
- Prendre conseil auprès du commerçant ou d'un technicien de radio/TV expérimenté.

Tout changement ou modification non expressément approuvé par la partie responsable des mesures de conformité peut amener l'utilisateur à se voir interdire l'usage de l'appareil.

Cet appareil est limité à l'exploitation des fréquences autorisées Partie 15, et ne peut pas être configuré par des utilisateurs finaux ou des installateurs professionnels à fonctionner en dehors des bandes autorisées.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

WARNING !

The OEM integrators are responsible for ensuring that the end-user has no manual instructions to remove or install module.

The module is limited to OEM installation ONLY

- This device complies with part 15 of the FCC rules and Industry Canada license-exempt RSS standard(s).

Operation is subject to the following two conditions : (1). this device may not cause Harmful interference, and (2).this device must accept any interference received, including interference that may cause undesired operation of the device

Le présent appareil est conforme aux règles de la FCC et CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- 1. l'appareil ne doit pas produire de brouillage ;*
- 2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

ANY CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY ADEUNIS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

Tout changement ou modification non expressément approuvé par la partie responsable des mesures de conformité peut amener l'utilisateur à se voir interdire l'usage de l'appareil.

This equipment complies with FCC's and RSS102's radiation exposure limits set forth for an uncontrolled environment under the following conditions:

- 1. This equipment should be installed and operated such that a minimum separation distance of 20cm is maintained between the radiator (antenna) and user's/nearby person's body at all times.*
- 2. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.*

Cet équipement est conforme aux limites d'expositions de la CNR102 et de la FCC applicables pour un environnement non contrôlé aux conditions suivantes:

- 1. Cet équipement devra être installé et fonctionner de telle manière qu'une distance minimale de séparation de 20 cm soit maintenue entre la partie rayonnante (l'antenne) et l'utilisateur / les personnes à proximité à tout moment.*
- 2. Cet émetteur ne doit pas être co-localisé ou opérer en conjonction avec toute autre antenne ou émetteur.*

The RF module has been certified for mobile and fixed applications. If the module will be used for portable application the device must undergo SAR testing and the following instructions shall be reported on the User Manual:

Le module RF a été certifié pour les applications mobiles et fixes. Si le module est utilisé pour une application portable, l'appareil doit subir un test DAS et les instructions suivantes doivent être consignées dans le manuel de l'utilisateur:

If SAR measurement is not required:

This portable equipment with it's antenna complies with FCC's and RSS102's radiation exposure limits set forth for an uncontrolled environment. To maintain compliance, follow the instructions below :

- 1. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.*
- 2. Avoid direct contact to the antenna, or keep contact to a minimum while using this equipment.*

Si la mesure de DAS n'est pas requise:

Cet équipement portable avec ses antennes est conforme aux limites d'expositions de la FCC et de la CNR102 applicables pour un environnement non contrôlé. Pour maintenir la conformité suivez les instructions ci-dessous:

- 1. Cet émetteur ne doit pas être co-localisé ou opérer en conjonction avec toute autre antenne ou émetteur.*
- 2. Évitez tout contact direct avec l'antenne ou gardez le contact au minimum pendant l'utilisation de cet équipement.*

If SAR measurement is required:

This portable equipment with its antenna complies with FCC's and RSS102's radiation exposure limits set forth for an uncontrolled environment. This equipment has shown compliance with FCC's Specific Absorption Rate (SAR) limits. To maintain compliance, follow the instructions below :

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Si la mesure de DAS est requise:

Cet équipement portable avec ses antennes est conforme aux limites d'expositions de la CNR102 applicables pour un environnement non contrôlé. Cet équipement a démontré la conformité aux limites de Débit d'Absorption Spécifique (DAS). Pour maintenir la conformité suivez les instructions ci-dessous:

1 Cet émetteur ne doit pas être co-localisé ou opérer en conjonction avec toute autre antenne ou émetteur.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication."

Pour réduire le brouillage radioélectrique potentiel causé aux autres utilisateurs, le type d'antenne et son gain doivent être choisis de manière à ce que la puissance rayonnée isotropiquement équivalente (par exemple) ne soit pas supérieure à celle autorisée pour une communication réussie."

this device has been designed to operate with the antenna listed below, and having a maximum gain of 6 dBi. Antennas not included in this list or having a gain greater than 6 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms."

Adeunis	0 dBi+/-1dBgain	PCB Antennas
---------	-----------------	--------------

Cet appareil a été conçu pour fonctionner avec les antennes répertoriées ci-dessous et avec un gain maximal de 6 dBi. Les antennes ne figurant pas dans cette liste ou ayant un gain supérieur à 6 dBi sont strictement interdites d'utilisation avec cet appareil. L'impédance d'antenne requise est de 50 ohms"

Antenne PCB Adeunis 0 dBi +/- 1dBgain

OEM Installation and Compliance Labeling

The ARF52840 module is labeled with its own FCC ID number, and, if the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed transmitter module.

This exterior label can use wording such as the following:

"Contains Transmitter Module	Contains FCC ID: U3Z-ARFWL55
------------------------------	------------------------------

"This device complies with Part 15 of the FCC's and RSS's Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation."

(When the device is so small or for such use that it is not practicable to place the statement specified above on it, the information required shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed.)

Installation OEM et étiquetage de conformité

Le module ARF52840 est étiqueté avec son propre numéro d'identification FCC. Si l'ID FCC n'est pas visible lorsque le module est installé dans un autre périphérique, l'extérieur du périphérique sur lequel il est installé doit également afficher une étiquette faisant référence au module.

Cette étiquette extérieure peut utiliser les libellés suivants:

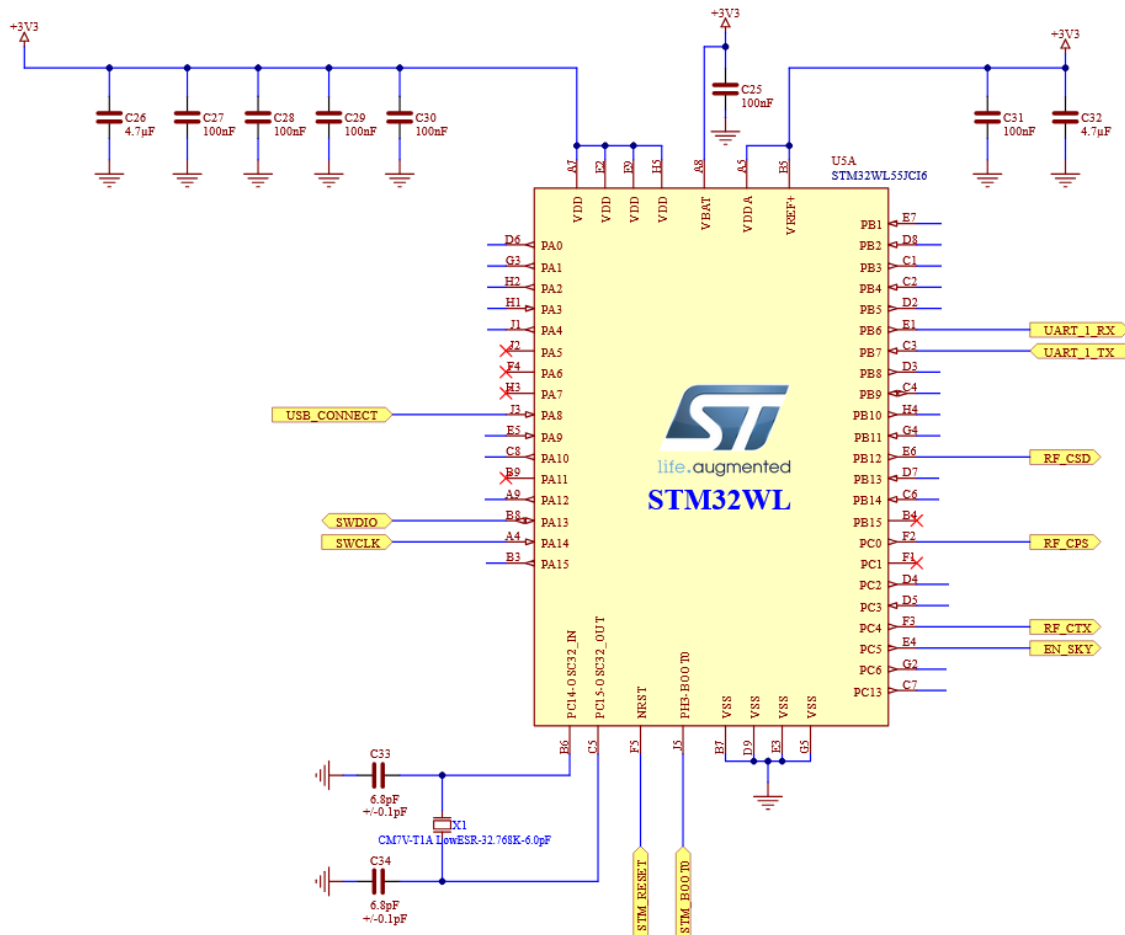
“Contains Transmitter Module” Contient le FCC ID: U3Z-ARFWL55

Ce dispositif est conforme aux règles de la FCC part 15 et à la norme CNR-210 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes : (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement. In the latter case, a copy of these instructions must be included in the application for equipment authorization.

Toute formulation similaire exprimant le même sens peut être utilisée. Le bénéficiaire peut soit fournir une telle étiquette, dont un exemple doit être inclus dans la demande d'autorisation d'équipement, soit fournir des instructions adéquates ainsi que le module qui explique cette exigence. Dans ce dernier cas, une copie de ces instructions doit être incluse dans la demande d'autorisation d'équipement

1 Hardware pinout



2 Specification ARFWL55

Parameter	Value
Power supply	1.8 - 3.6 V
Stand by consumption	3µA
TX consumption	87mA
RX consumption	4.82mA
Operational T°C	-40 / +85°C
RF output Power	20dbm(100mW)
Sensitivity	-148dBm
Frequency channels	ISM band 902-928MHz, AU915, AS923

UART setting	Default Value
Baud rate	115200
Data bits	8
Parity	None
Stop Bits	1
Flow Control	Disabled

3 AT commands

The module can be controlled by AT commands through UART

Command	Description
+++	Enter in commande mode
ATT10	- CW generation (continuous) using the values defined in the registers below. - Generation is continuous: no ON/OFF period (like ATT11) - Use "ESC" to exit test mode <u>Command :</u> ATT10 <u>Response :</u> O BEGIN TX FREQ: 868000000 PWR: 14 PA: OFF OFFSET: 0
ATT12	- Permanent modulated carrier using the values defined in the registers below. - Use "ESC" to exit test mode <u>Command :</u> ATT12 <u>Response :</u> O BEGIN TX FREQ: 868000000 PWR: 14 PA: OFF OFFSET: 0
ATT15	- Pulsed modulated carrier (FCC mode): transmits a payload ranging from 1 to 64 hexadecimal characters in LoRa mode. - Use "ESC" to exit test mode. - The SF used will be the default SF depending on the region (SFmax per region: SF12 in the EU, S10: US915, etc.). <u>Command :</u> <u>Lora [US/AU] :</u> ATT15 [SYNC] [PWR] [NB] [PAYLOAD][PA][MODE]

	<u>Example :</u> ATT15 34C194C1 20 99 123! 0 1
ATT16	- Frame reception (LoRa or FSK mode depending on the registers below). It returns the Data, RSSI level and SNR for each received frame. This command is used in response to ATT12, ATT13 or ATT15 (modulated carrier). - Use "ESC" to exit test mode. <u>Commande :</u> ATT16 <u>Réponse :</u> O BEGIN RX FREQ 868000000 SF 12

4 Firmware implementation

The firmware has been developed by following the ST application note : [How to build a LoRa® application with STM32CubeWL - Application note](#)

4.1 DUAL CORE MANAGEMENT(RTU)

The STM32WL5x devices embed two Cortex:

- Cortex-M4 (named CPU1)
- Cortex-M0+ (named CPU2)

In the dual-core applications, the application part mapped on CPU1 is separated from the stack and firmware low layers mapped on CPU2.

In a dual-core proposed model, two separated binaries are generated: CPU1 binary is placed at 0x0800 0000 and CPU2 binary is placed at 0x0802 0000.

4.2 LoRaWAN stack description

- Middleware:

– LoRaWAN containing:

- LoRaWAN layer
- LoRa utilities
- LoRa software crypto engine
- LoRa state machine

– SubGHz_Phy layer middleware containing the radio and radio_driver interfaces

- LoRaWAN applications:

– LoRaWAN_AT_Slave (DualCore)

- SubGHz_Phy application:

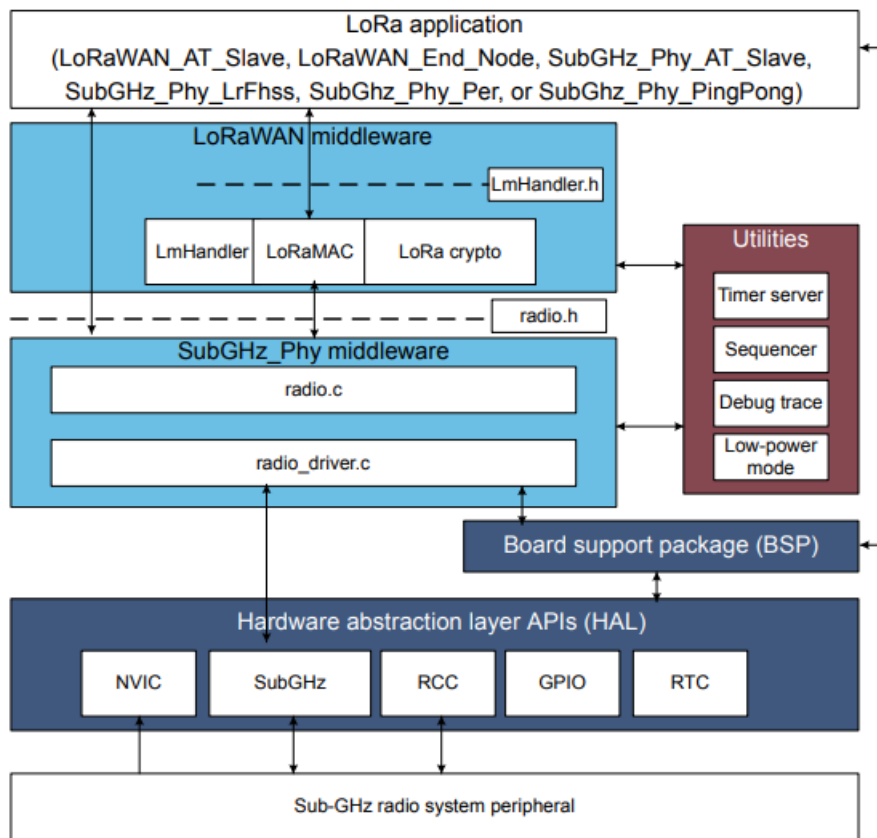
– SubGHz_Phy_PingPong (SingleCore and DualCore)

- SubGHz_Phy_Per (SingleCore)
- SubGHz_Phy_AT_Slave (SingleCore)
- SubGHz_Phy_LrFhss (SingleCore)

In addition, this application provides an efficient system integration with the following:

- a sequencer to execute the tasks in background and to enter low-power mode when there is no activity
- a timer server to provide virtual timers running on RTC (in Stop and Standby modes) to the application.

Figure 3. Static LoRa architecture

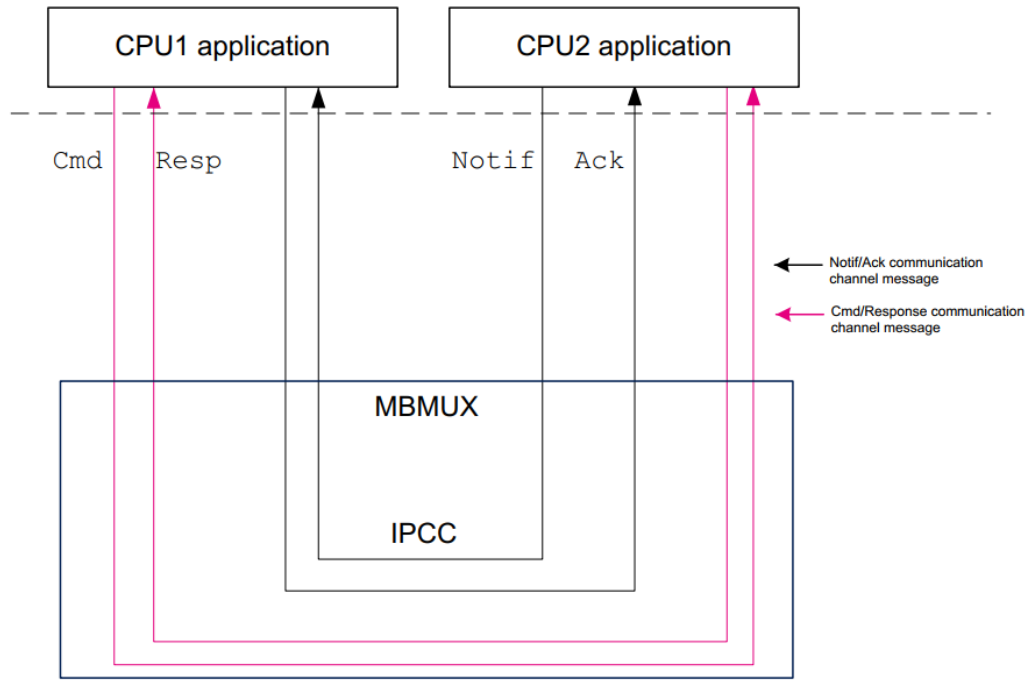


4.3 Mailbox mechanism

The mailbox is a service implementing a way to exchange data between the two processors. As shown in the figure below, the mailbox is built over two resources:

- **IPCC**: This hardware peripheral is used to trigger an interrupt to the remote CPU, and to receive an interrupt when it has completed the notification. The IPCC is highly configurable and each interrupt notification may be disabled/enabled. There is no memory management inside the IPCC.
- **Intercore memory**: This shared memory can be read/written by both CPUs. It is used to store all buffers that contain the data to be exchanged between the two CPUs.

Figure 11. Mailbox messages through MBMUX and IPCC channels



5 Channel description

The 915 MHz ISM Band SHALL be divided into the following channel plans.

- Upstream – 64 channels numbered 0 to 63 utilizing LoRa 125 kHz BW varying from DR0 to DR3, using coding rate 4/5, starting at 902.3 MHz and incrementing linearly by 200 kHz to 914.9 MHz
- Upstream – 8 channels numbered 64 to 71 utilizing LoRa 500 kHz BW at DR4 starting at 903.0 MHz and incrementing linearly by 1.6 MHz to 914.2 MHz
- Downstream – 8 channels numbered 0 to 7 utilizing LoRa 500 kHz BW at DR8 to DR13, starting at 923.3 MHz and incrementing linearly by 600 kHz to 927.5 MHz

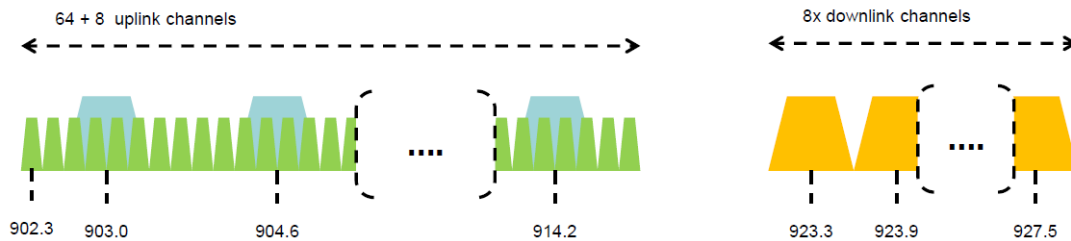


Figure 1: US902-928 channel frequencies

The AU ISM Band SHALL be divided into the following channel plans.

- Upstream – 64 channels numbered 0 to 63 utilizing LoRa 125 kHz BW varying from DR0 to DR5, using coding rate 4/5, starting at 915.2 MHz and incrementing linearly by 200 kHz to 927.8 MHz
- Upstream – 8 channels numbered 64 to 71 utilizing LoRa 500 kHz BW at DR6 starting at 915.9 MHz and incrementing linearly by 1.6 MHz to 927.1 MHz
- Downstream – 8 channels numbered 0 to 7 utilizing LoRa 500 kHz BW at DR8 to DR13) starting at 923.3 MHz and incrementing linearly by 600 kHz to 927.5 MHz

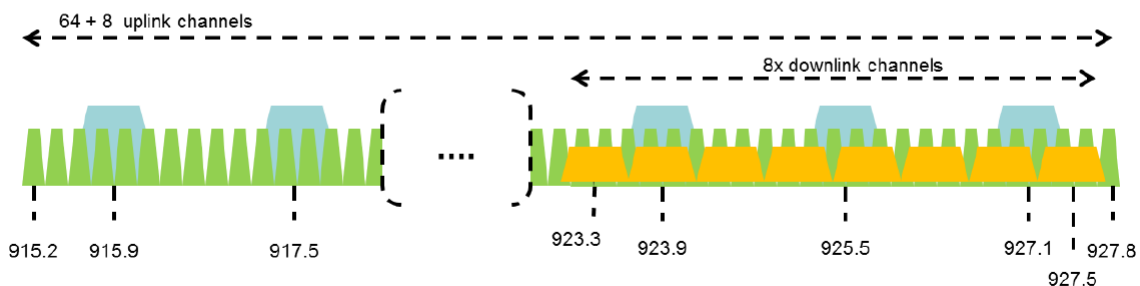


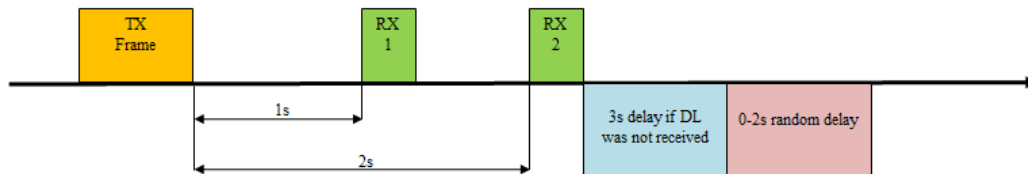
Figure 2: AU915-928 channel frequencies

The AS ISM Band:

Modulation	Bandwidth (KHz)	Channel Frequency (MHz)	Nb Channels
LoRa	125	923,2	2
		923,4	

6 Module operation

Different use cases can be expressed. In any case if the payload is at the maximum (see. Maximum payload size) the frame duration never exceeds 400ms. The following diagram shows a simplified description of a LoRa cycle.



The channel selection is managed by embedded software (with a LoraWAN Stack) which controls and respects the frequency hopping described in section 3. The module can operate in confirmed and in unconfirmed mode. In any case, there is always one frame sent by the module during a transmission.

As the module is LoraWAN protocol certified, it covers the LoraWAN Specification and regional parameters.

The module supports much functionality such as data cryptography, timing management to open receive Windows, frequency channel hopping, data rate adaptation and max payload handling. The transmission power, channel frequency plan and data rate can be changed by a remote LoraWAN gateway located in the same range. The module can refuse any of those parameters if there are not compliant with LoraWAN protocol and not respecting FCC requirements.

The module supports two main activation methods: Over-The-Air Activation (OTAA) and Activation-By-Personalized (ABP). During OTAA mode, the module has two phases of operation: a join phase and a data transmission phase. In ABP there is no Join phase, the module sends data directly.

Below we give some examples about how the two phases operate taking into account the channel plan (presented in section 4) that we be used for each region US 902-928, AU 915 and AS 923.