ATIM Cloud Wireless

LoRaWAN Gateway
Modbus & MQTT

User Guide

Concerned model:

AGT/INDUS2

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Document version history

Version	Date	Description	Author	Concerned software version
1.0	07/03/2022	Document creation	JA	
1.1	30/03/2022	NTP server time synchronization	JA	
1.2	16/06/2022	WIFI hotspot deactivated	JA	
1.3	19/10/2022	TLS text boxes, power off icon, Modbus reception rates	JA	Modbus app 1.1 Chirpstack 3.14.5

Disclaimer

The information contained in this document is subject to change without warning and does not represent a commitment on the part of ATIM.

Trademarks and copyright

Declaration of compliance

All ACW Atim Cloud Wireless® products comply with the regulatory requirements of the R&TTE Directive (1999/5/EC), article 3:

CE

1 SAFETY (Article 3.1a of the 1999/5/EC Directive)

NF EN60950-1 Ed. 2006/A1:2010/A11:2009/A12:2011 (health)

EN62479: 2010 (power <20mW) or EN62311:2008 (power > 20mW)

2 Electromagnetic Compatibility (Article 3.1b of the 1999/5/EC Directive)

EN 301489-3 v1.4.1, EN 301489-1 V1.9.2

3 Efficient use of the radio frequency spectrum (Art.3.2 of the 1999/5/EC Directive)

ETSI EN300 220-2 v2.4.1 and EN300 220-1 v2.4.1

Environmental recommendations

Respect the temperature ranges for storage and operation of all products. Failing to respect these guidelines could disrupt device operation or damage the equipment.

Follow the instructions and warnings provided below to ensure your own safety and that of the environment and to protect your device from any potential damage.

General hazard *– Failure to follow the instructions presents a risk of equipment damage.*

Electrical hazard *– Failure to follow the instructions presents a risk of electrocution and physical injury.*

WARNING*: do not install this equipment near any source of heat or any source of humidity.*

WARNING*: for your safety, it is essential that this equipment be switched off and disconnected from mains power before carrying out any technical operation on it.*

WARNING*: the safe operation of this product is ensured only when it is operated in accordance with its intended use. Maintenance may only be performed by qualified personnel.*

Waste disposal by users in private households within the European Union. This symbol appears on a product or its packaging to indicate that the product may not be discarded with other household waste. Rather, it is your responsibility to dispose of this product by bringing it to a designated collection point for the recycling of electrical and electronic devices. Collection and recycling waste separately at the time you dispose of it helps to conserve natural resources and ensure a recycling process that respects human health and the environment. For more information on the recycling center closest to your home, contact your closest local government office, your local waste management service or the business from which you purchased the product.

Radio

Modems in the ACW line are radio-communication modems that use the ISM (industrial, scientific and medical) bands, which may be used freely (at no cost and with no authorization required) for industrial, scientific and medical applications.

IMPORTANT NOTE

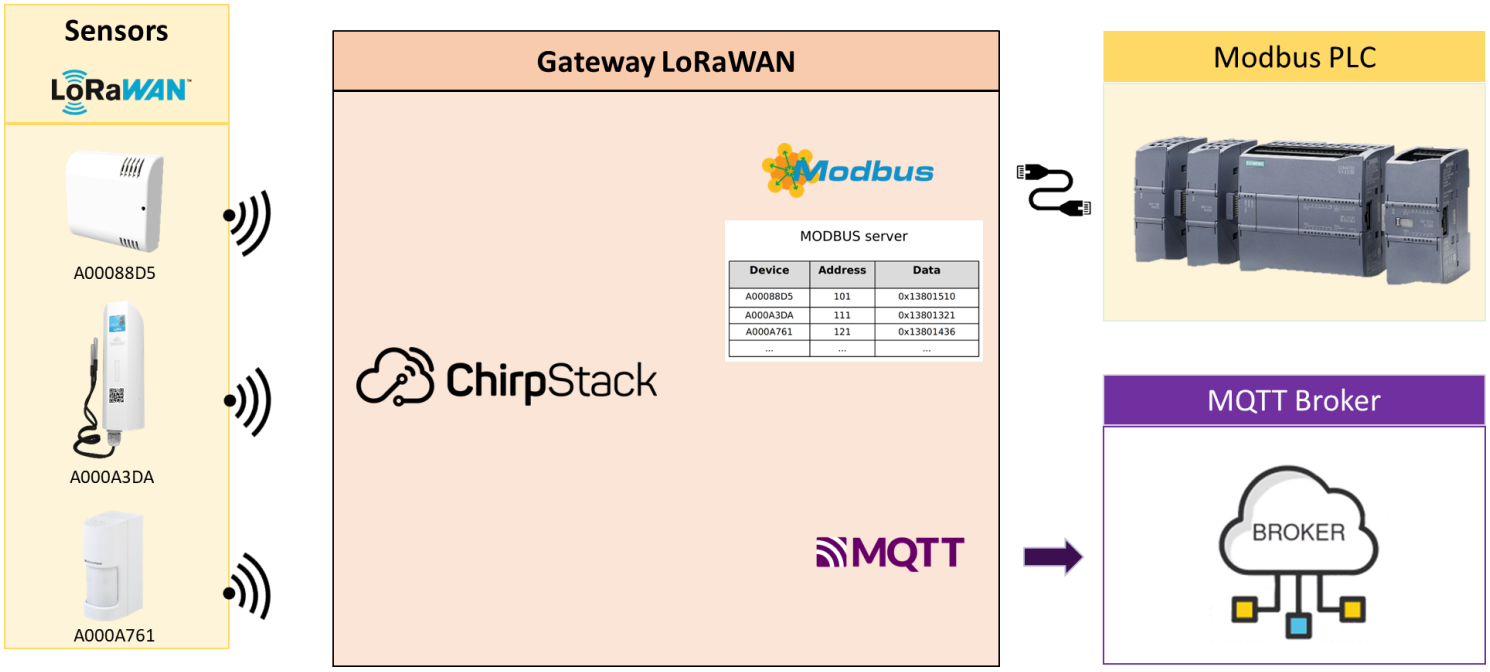
- Basic IT network knowledge is required to set up ATIM LoRaWAN gateways.
- Contact your IT service before installing the gateway.
- Configuration options are explained in this document.
- Further details about Chirpstack network server are available on https://www.chirpstack.io/
- Gateway power supply is 5VDC 2,5A max.
LoRaWAN 868 MHz antenna should be connected to SMA connector before starting the gateway.

Presentation

ATIM 1gate gateway is designed to set up a private LoRaWAN network based on open source Chirpstack server.

Devices' uplink messages can then be forwarded using either:

- MQTT protocol
- MODBUS TCP protocol



When 1gate Gateway is configured in **MQTT** it behaves as a MQTT client and publishes uplink messages to an external MQTT broker.

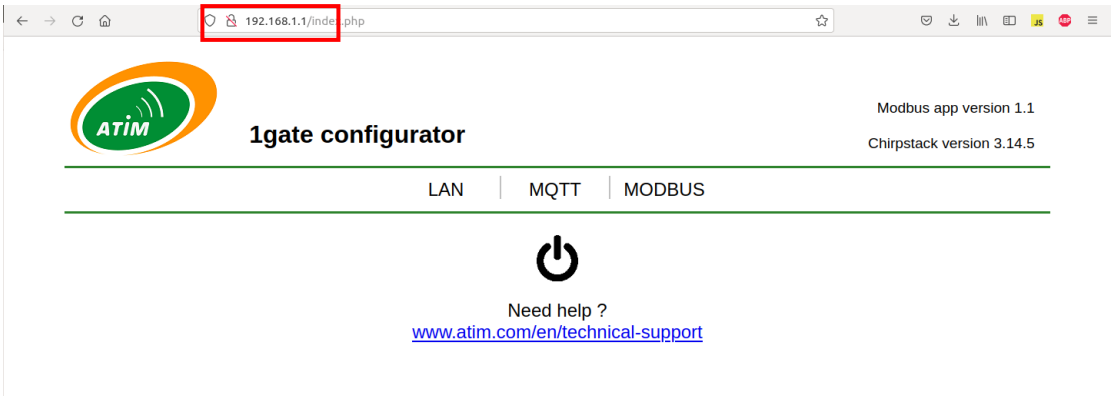
When 1gate gateway is configured in **MODBUS**, it behaves as a MODBUS TCP server (slave) whose registers values can be extracted from external MODBUS master (for example a PLC).

Connection to the gateway

To configure the gateway start connecting an ethernet cable between the gateway and a computer. The computer should automatically connect to local gateway LAN network via DHCP.

CONFIGURATION mode (default)

Once connected, the gateway configuration page can be accessed through a web page using the default IP address: **192.168.1.1**



Configuration changes can be made from this webpage.

Options can be changed with toggle switches and desired fields can be filled before clicking on **OK** button to confirm form changes.

Rebooting the gateway can be necessary after changes, click the **RESTART** button when it appears.

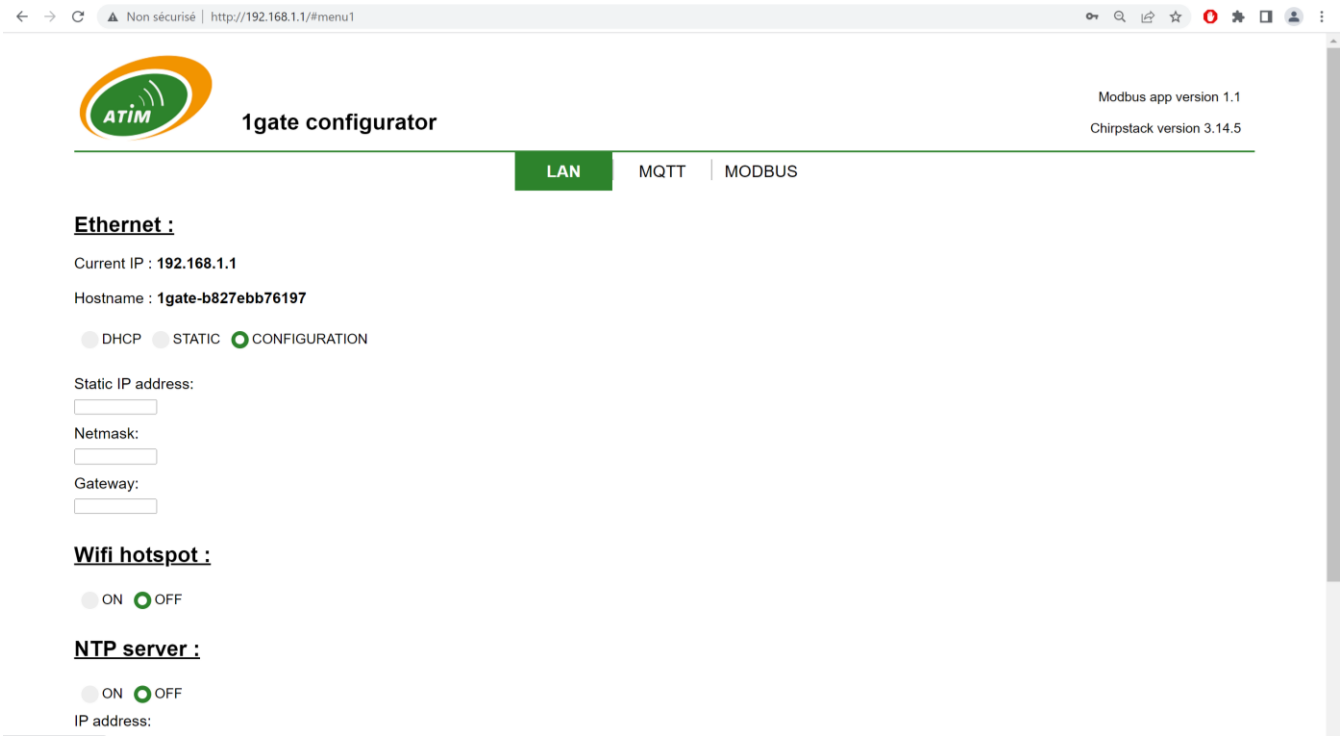
It is also possible to power off the gateway clicking on the ⏻ icon.

IMPORTANT NOTE

In any case gateway should be turned off disconnecting power supply.

a. LAN tab

The LAN (Local Area Network) tab can be used to integrate the gateway in an existing Ethernet network.

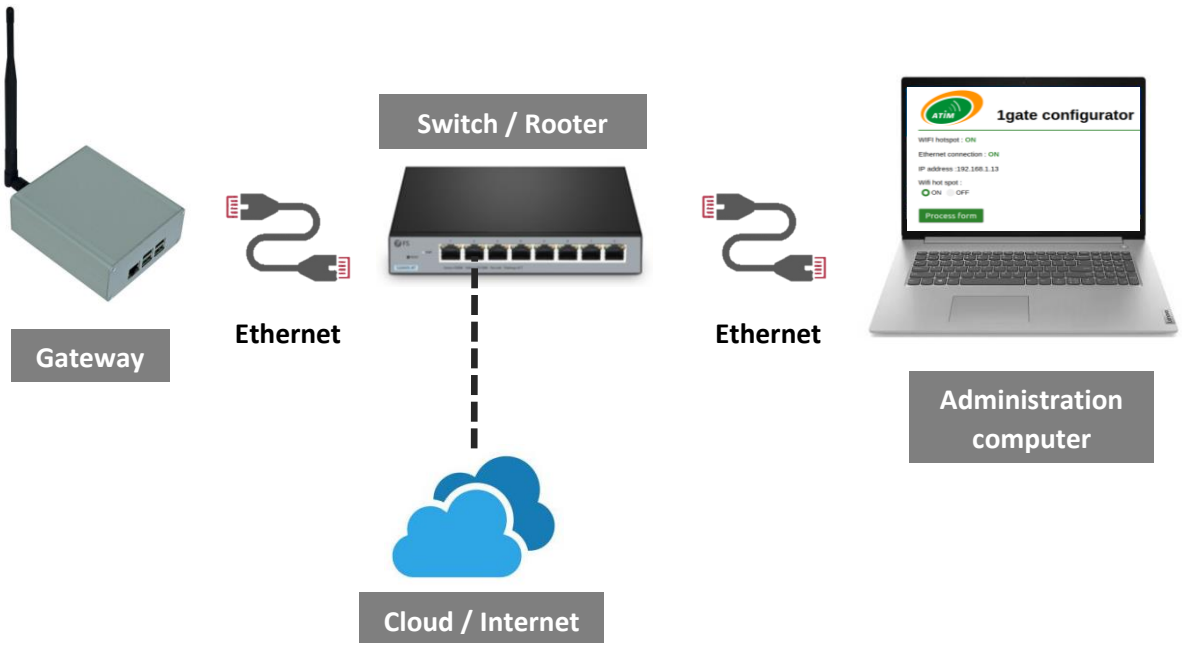


Connecting gateway to an existing ethernet network

Two methods are possible for the gateway to get an IP address: **STATIC** or **DHCP**.

- Static addressing : gateway will set a specific IP address, for that **Static IP address**, **Netmask** and **Gateway** fields must be filled before confirming with **OK**.

- DHCP addressing : gateway will automatically get an IP address according to network DHCP server.



STATIC or DHCP modes (default)

Accessing gateway through ethernet network

Once connected to Ethernet network, gateway configuration page can be accessed using either:

- Gateway IP address
- Gateway hostname

Gateway hostname is unique and composed of the **EMAC** address with format below:

1gate-[EMAC address]

NOTE

EMAC is written on gateway label.

To access configuration webpage, open a web browser and enter the URL below: http://1gate-[EMACaddress].local/.

Accessing gateway through WIFI hotspot

When WIFI hotspot option is set, the gateway broadcast a WIFI network.

This network can be used to configure the gateway without connecting to Ethernet network.

To connect to WIFI hotspot use **SSID** and **WPA KEY** written on gateway label.

Once connected to gateway WIFI, the configuration page can be accessed with IP address **192.168.1.1**

IMPORTANT NOTE

Activating WIFI hotspot can result in IP conflicts.

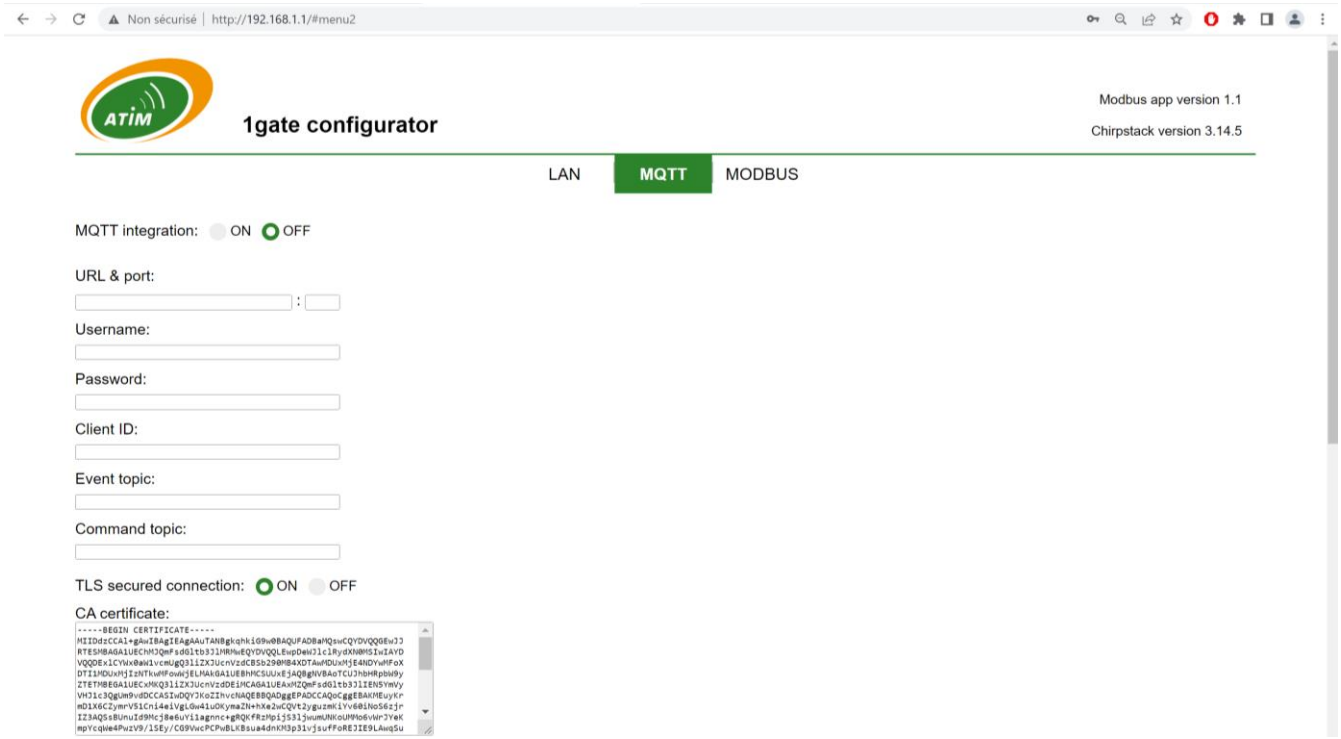
Time synchronization

Gateway time needs to be synchronized.
By default, the gateway will try to get reference time from the internet.

In case there is no internet access from the Ethernet network, an NTP server can be used filling the NTP IP address fields and enabling NTP.

b. MQTT tab

MQTT tab can be used to fill MQTT broker information.



When MQTT integration is ON, then all fields must be filled so that the gateway can connect to remote MQTT broker.

When using TLS secured connection, certificate files can be directly pasted into text boxes.

IMPORTANT NOTE

Before filling MQTT fields please make sure connection to MQTT broker is possible using MQTT emulator (MQTT box, Postman, ….)

c. MODBUS tab

All devices registered and activated in Chirpstack should appear in the MODBUS tab (Provided that device has sent at least one uplink message).

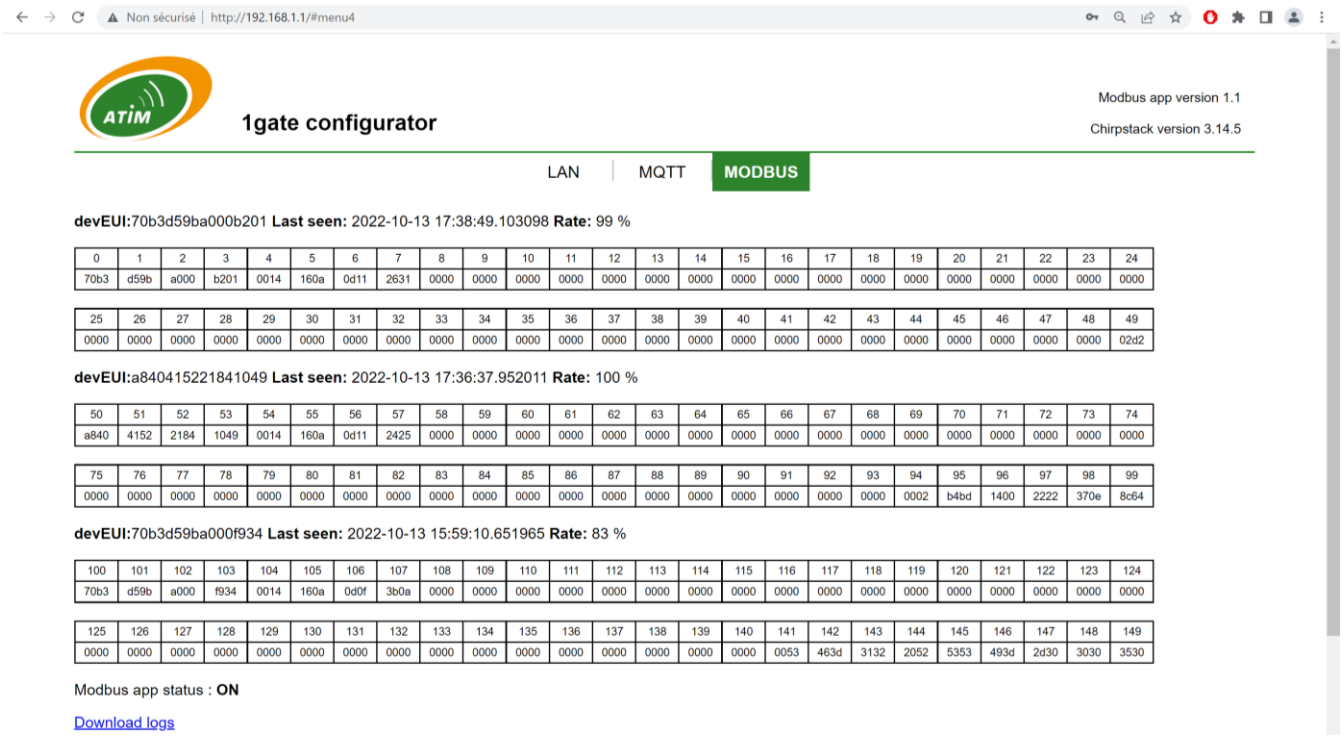
The order in MODBUS tab is defined by the order the devices first sent Uplink messages.

The MODBUS webpage is convenient to match device devEUI to MODBUS adresses.

For example, below device **70b3d59ba000f934** is registered in addresses from 100 to 149 in MODBUS server.

The **Last seen** field indicates the date of the last uplink message that has been sent by device.

The **Rate** field indicates the percentage of LoRa Uplink message correctly received by the gateway.



0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
70b3	d59b	a000	b201	0014	160a	0d11	2631	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	02d2

50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
a840	4152	2184	1049	0014	160a	0d11	2425	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000

75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0002	b4bd	1400	2222	370e	8c64

100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124
70b3	d59b	a000	f934	0014	160a	0d0f	3b0a	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000

125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149
0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0053	463d	3132	2052	5353	493d	2d30	3030	3530

A low rate can indicate radio issues between a device and the gateway.

The display of the tabs is updated every minutes (Real Modbus tabs are updated instantly at message reception).

MODBUS server

When MODBUS integration is chosen, devices uplink messages are stored in MODBUS registers. The gateway behaves as MODBUS TCP server (slave) and registers can be read from external MODBUS master.

All data is encoded in hexadecimal.

50 registers (100 bytes) are allocated per device and can be divided into three parts:

- 4 registers are allocated to **device EUI**
- 4 registers are allocated to **timestamp**
- 42 registers are allocated to message data **payload**

EXEMPLE

For example, the tab below indicates:

***Device EUI* 70b3d59ba000a761**
***Timestamp* 1416020f090739**
***Data payload* 10cea0cea64**

devEUI:70b3d59ba000a761 **Last seen:** 2022-02-15 09:07:57.610109

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
70b3	d59b	a000	a761	0014	1602	0f09	0739	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	010c	ea0c	ea64

For each part, data is stacked on the right, which implies that lot of registers are set to zero, particularly if payload is short. When a new device is registered and join Chirpstack LoRaWAN server, it will be added to the list automatically.

For example, if three devices have been registered on LoRaWAN network server first, then registers below will be set:
- Registers [0 - 49] allocated to device 1
- Registers [50 - 99] allocated to device 2
- Registers [100 - 149] allocated to device 3

If a device sends various type of message (for example life frames and data frames) no difference can be made, frames are stored in the same registers, which means that earlier frame will erase older one.

a. DevEUI

Device EUI is a unique 8 bytes id that is used to identify a LoRaWAN device.
This id is stored at the beginning of MODBUS registers to make sure device can be identified.

b. Timestamp

4 registers (8 bytes) are allocated to timestamp. Timestamp includes last uplink message date and time.

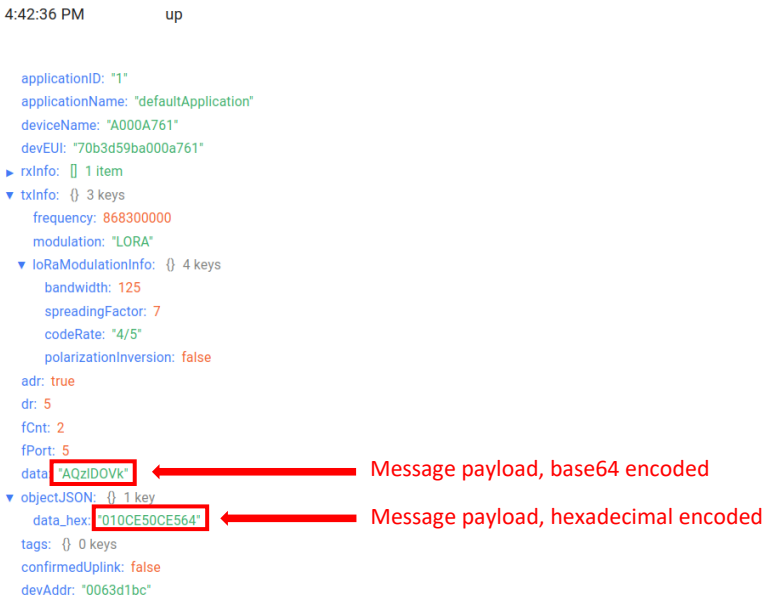
Each byte contains a part of the date/time (i.e. year, month, hour,)
001415070d140014 can be decoded as below:

Register	Byte	Description	Hexadecimal	Decimal
Register 4	Byte 4.1	NC	**00**	-
	Byte 4.2	Century	**14**	20
Register 5	Byte 5.1	Year	**15**	21
	Byte 5.2	Month	**07**	07
Register 6	Byte 6.1	Day	**0d**	13
	Byte 6.2	Hour	**14**	20
Register 7	Byte 7.1	Minute	**00**	00
	Byte 7.2	Second	**14**	20

Decoded timestamp is 2021/07/13 20:00:20.

c. Payload

Remaining 42 registers are allocated to device data payload.
Data payload comes from uplink LoRaWAN message (JSON format) such as below:



Data payload is written in MODBUS registers according to big-endian, starting from the last register allocated or “stacked on the right”.

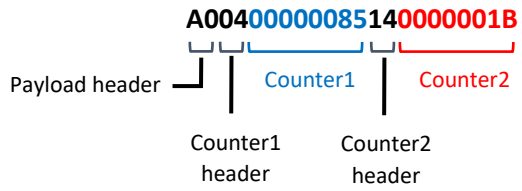
Registers that are not used are left to zero, this way data fields can be read from the same address with a constant length of 42 registers, for example:

- To get device 1 payload consult address 8 hex (8 dec), length 2A hex (42 dec)
- To get device 2 payload consult address 3A hex (58 dec), length 2A hex (42 dec)
- To get device 3 payload consult address 6C hex (108 dec), length 2A hex (42 dec)

Data is encoded in hexadecimal; it contains several information that are relative to the product / device registered. Please see specific product documentation.

Example 1

MR4 configured with 2 counters, devEUI **70B3D59BA000C27E** and payload below:



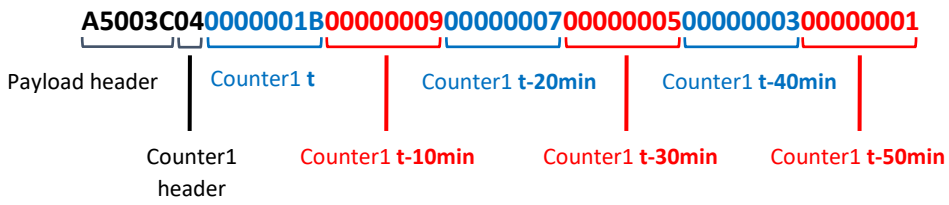
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
70	D5	A0	C2	00	16	12	05	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
B3	9B	00	7E	14	02	0F	2E	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	04	00	85	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	A0	00	00	14	00	1B

To extract counter 1 registers 45, 46 and 47 must be read and then filtered to remove headers.
To extract counter 2 registers 48 and 49 must be read.

Example 2

MR4 configured with 1 counter, datalogging of 6 measurements every 10 minutes, devEUI **70B3D59BA000C27E** and payload below:



0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
70	D5	A0	C2	00	16	12	05	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
B3	9B	00	7E	14	02	0F	2E	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
00	00	00	00	00	00	00	00	00	00	00	00	00	A5	3C	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	04	00	04	00	03	00	1B	00	02	00	08

Example 3

DIND80 frame, devEUI 70B3D59BA000D3EC and payload below:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
70	D5	A0	D3	00	16	12	05	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
B3	9B	00	EC	14	02	0F	2E	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
00	00	00	00	00	00	00	00	FF	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	5E	FF	00	0C	00	0B	00	08	00	06	00	07	00	08	00	06	00	00

To extract counter 1 registers 34 and 35 must be read
To extract counter 2 registers 36 and 37 must be read
...

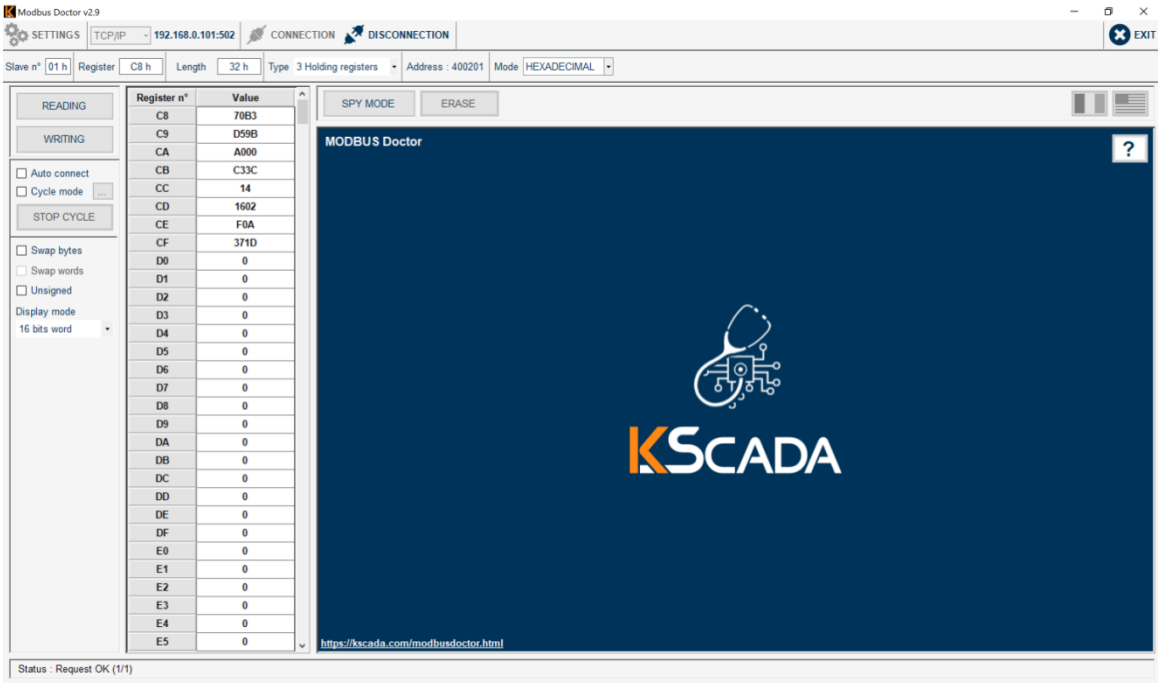
According to product configuration data extraction can require further operations that can be complicated on basic PLCs.

From MODBUS tab it is also possible to **reset** registers: clicking on **Reset table** button deletes the entire table and start allocation from scratch: first device emitting an uplink message will be allocated to registers 0-49, second device to registers 50-99 and so on.

MODBUS webpage also contains a link to **download logs** of MODBUS application for debug purposes.

d. Data extraction

To test MODBUS TCP connection to the gateway, a MODBUS emulator such as Kscada MODBUS DOCTOR can be used.



Please configure:

- **IP address** of the gateway that can be seen in the LAN tab
- **Port** is 502
- **Slave ID** is not specific since MODBUS server should respond to any slave ID
- **Time Out** can be left to 1000
- **Mode** HEXADECIMAL
- **Register**: the address corresponding to the device, for example

  00h (0 dec) for the first device emitting
  32h (50 dec) for the second device emitting
  64h (100 dec) for the third device emitting
  96h (150 dec) for the fourth device emitting ....

- **Length**: 32h (50 in decimal)
- **Type** 3 Holding Registers

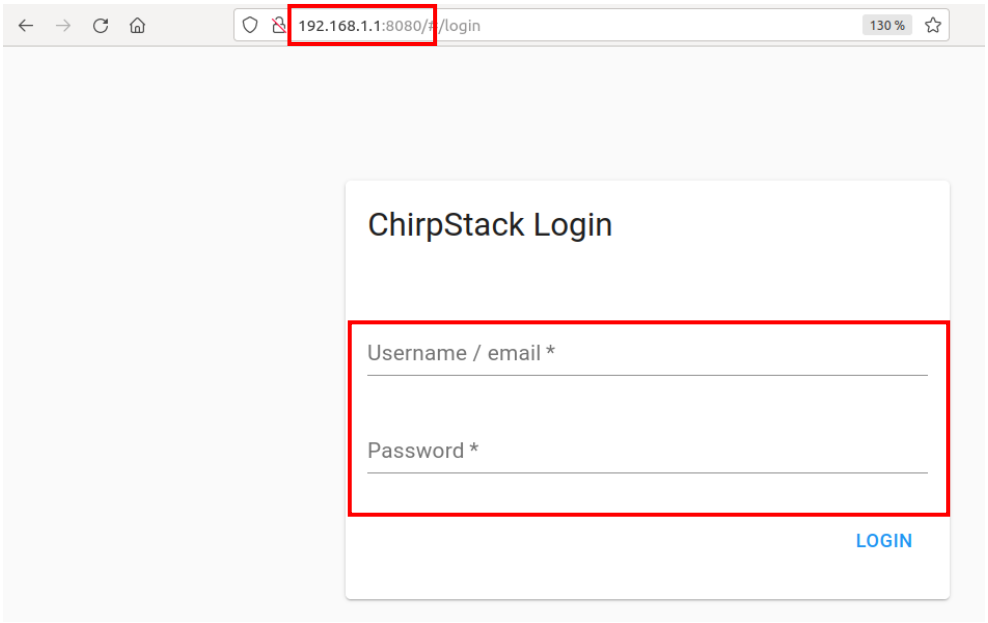
Then click on **CONNECTION**, if connection is successful click on **READING** to get device data.

LoRaWAN server Administration

Chirpstack is an open-source software stack than can be used to set up a local (private) LoRaWAN network.

a. Connection to Chirpstack web page

To access Chirpstack configuration page, open a web browser and enter the IP address of the gateway followed by 8080 port:



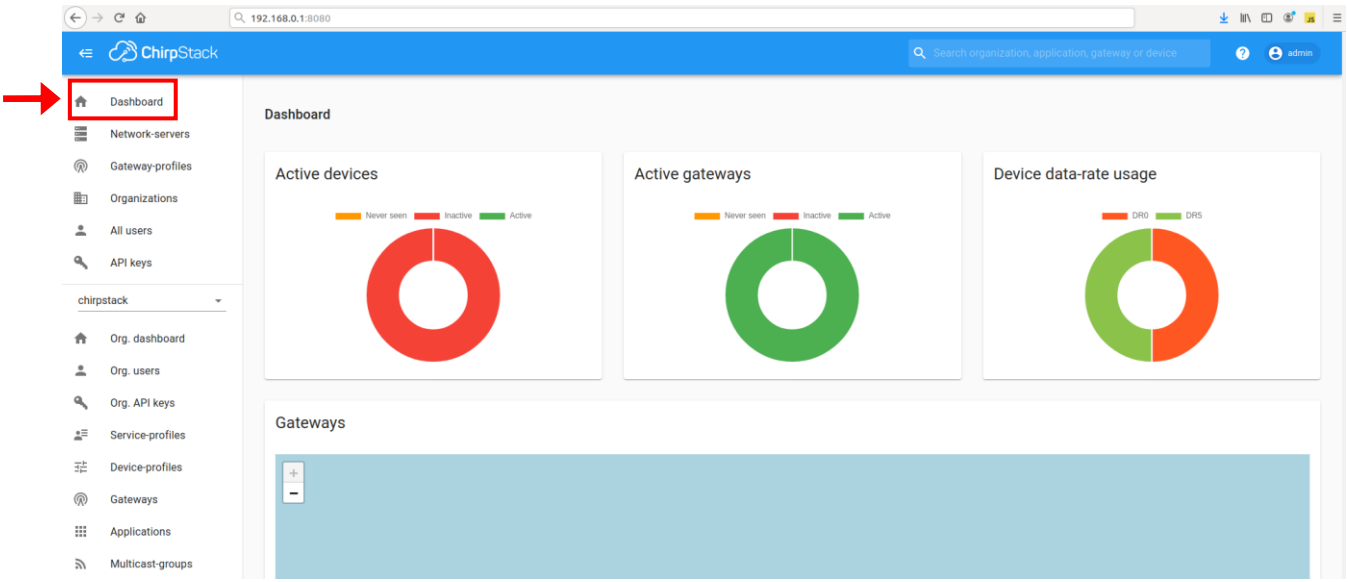
Alternatively, the gateway hostname can be used such as shown previously.

To connect to Chirpstack enter the default IDs below:

- Username/email: **admin**
- Password: **admin**

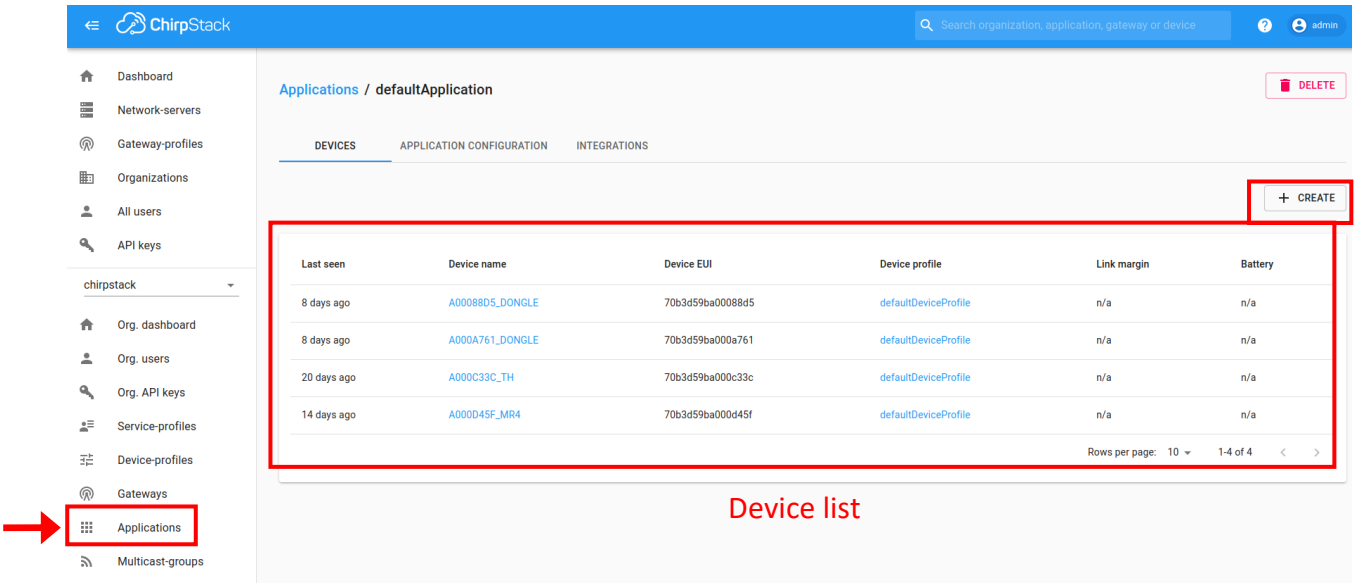
First page is named Dashboard, it shows the activity of the gateway and devices:

Gateway settings can be changed from **Gateway-profiles** tab, such as device settings from **Device-profiles** tab.



b. Device registration

To add devices to LoRaWAN network, select **Applications** tab and then click on **defaultApplication**.



Device list

NOTE

Initially no device should appear in the list.

For security reason, OTAA (Over The Air Activation) method is used to add devices.

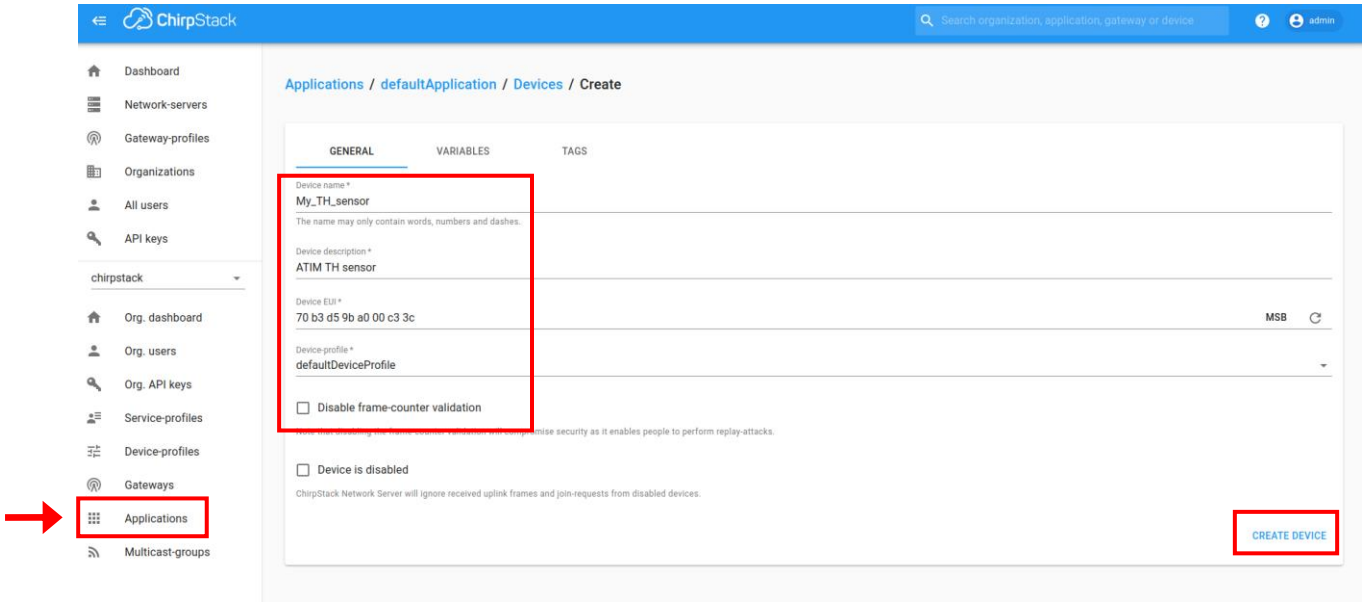
Two IDs are necessary for that:

- A 8 bytes **device EUI**
- The 16 bytes **application key** attached to the devEUI

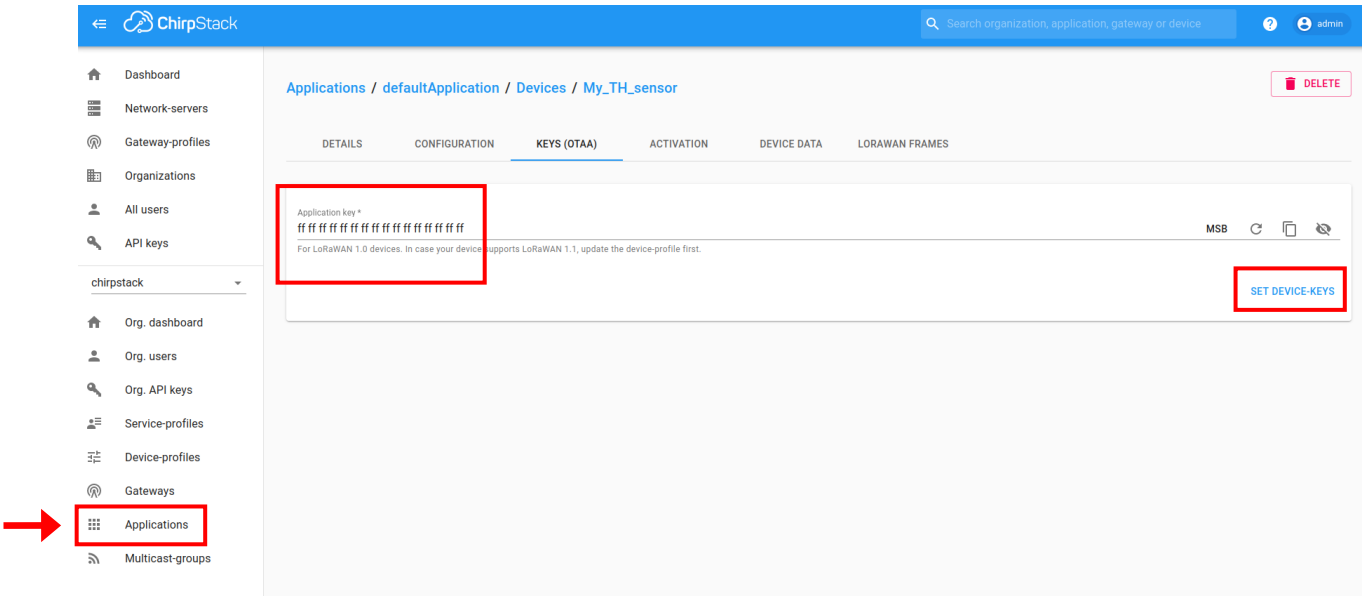
To add a device, click on **+CREATE**

In the **GENERAL** tab enter the device **name** and **description** and the **Device EUI**

Then select **defaultDeviceProfile** and confirm clicking on **CREATE DEVICE**

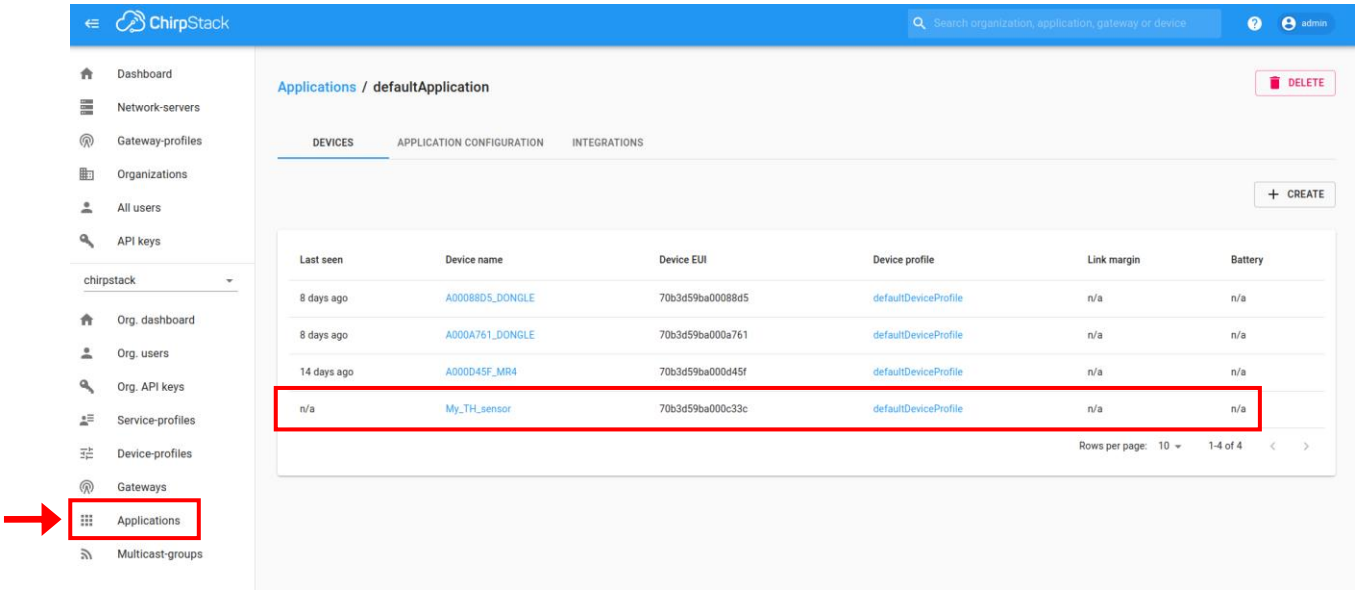


In the next page complete **Application Key** field and confirm clicking on **SET DEVICE-KEYS**

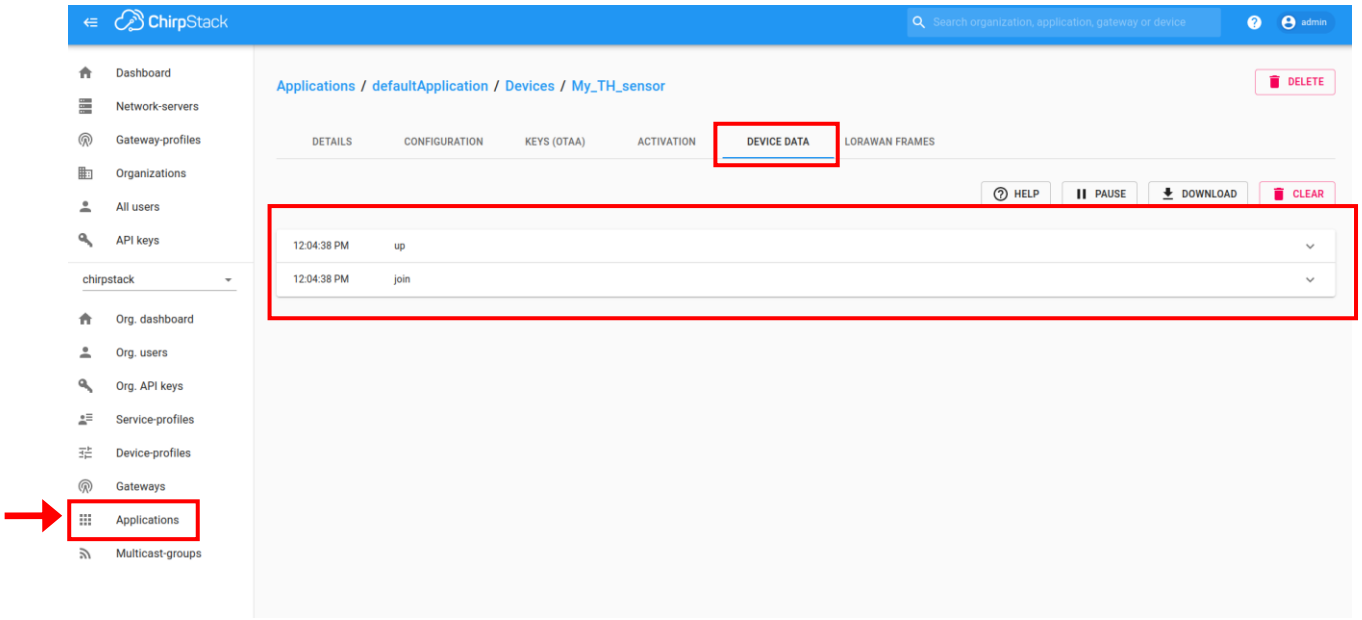


c. Device commissioning

Once device has been registered it should appear on **defaultApplication** page.
Click on its name to access device information

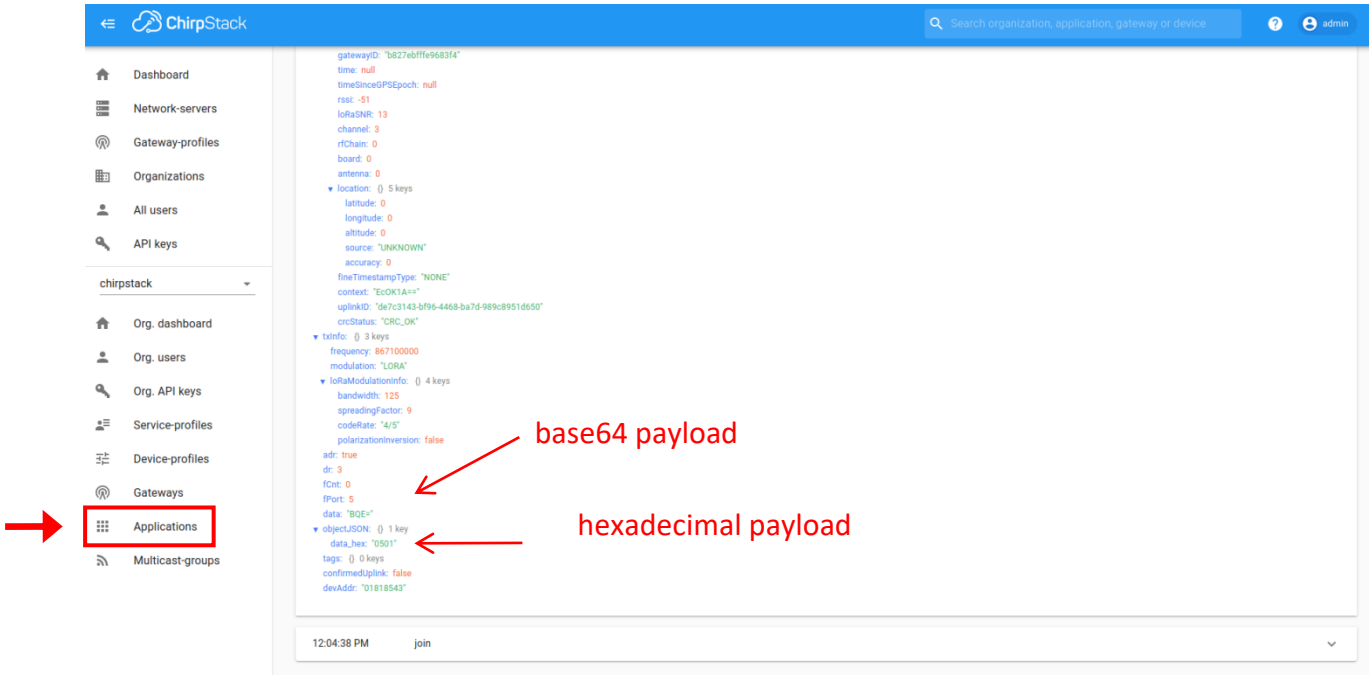


Device activity can be seen from **DEVICE DATA** tab:



Diverse events can be seen for debug and commissioning purposes:

- **join**: device join request to connect to gateway network
- **up**: uplink message, all fields can be seen clicking on the event
- **txack**: acknowledgment made next to a downlink message
- **ack**: message acknowledgement
- **status**: status frame made by the gateway regularly
- **error**



Data payloads and certain IDs are encoded in base64 by default in Chirpstack.
However hexadecimal encoded payload is displayed under the **data_hex** field.

NOTE

It is also possible to register devices using ABP method, however it is necessary to create a new device-profile to do so.

DEVICE DATA list is not saved, and only real time events can be seen.

Technical support

For any further information or technical question, you can open a ticket on our technical support dedicated webpage.

IMPORTANT NOTE

ATIM provides you with a gateway but not the driver's license that goes with it, you must learn how to use and program it.

- For technical questions concerning the Packet Forwarder: https://github.com/Lora-net/packet_forwarder

- For technical questions concerning the integrated Network Server: https://www.chirpstack.io/