NBX R1000-RF

User Manual

V 2.0

Dan Peleg

10-11-2021

Contents

Figures

Tables

Versions:

Version	Description	Author	Date
2.0	Base 2.0	*	28/11/2021

(15.21) Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

NOTE: 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 instructions, may cause harmful interference to radio communications. 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.

This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

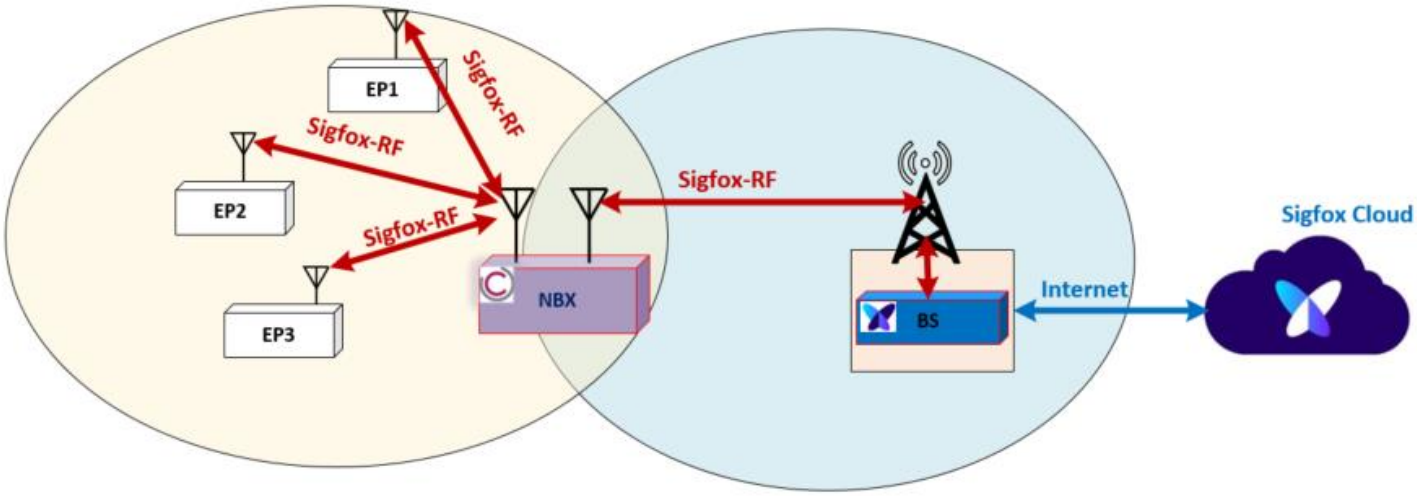
1 Introduction

The ***N**arrow **B**and e**X**tension* (***NBX***) **R1000-RF** is used to extend the Sigfox IoT network coverage by repeating Sigfox messages.

Main features:

- Supports Sigfox message repetition, including UL and DL.
- High capacity: up to 10 Million messages/day, 1000/300 simultaneous UL messages @ 100/600 baud
- Sigfox waveform compliant:
  - Sub GHz ISM (multi region – **RC1** to **RC7**)
  - RX : sensitivity -134dBm @600 baud, -142dBm @100 baud, band >200KHz, Multi carrier
  - TX: Multi carrier
  - Device mode
- Flexible high-performance design:
  - SDR & FPGA SoC
  - Receive diversity (2x Antennas)
- Characteristics:
  - M&C Connectivity: Wi-Fi & Bluetooth (BLE), Ethernet (<100Mbps), USB master (to 4G modem)
  - Power: Passive PoE, 10-48V, <5W (excluding optional USB modem)
  - Physical : IP67 , Outdoor and indoor, -30°C + 55°C, 185x185x57mm

Figure 1: NBX General Application



2 Definitions and Abbreviations

2.1 Definitions

Following terms and definitions apply:

Base-Station (BS): Radio hub which connects endpoints (via RF) to Sigfox cloud (via IP).

Downlink (DL): Unidirectional communication from the BS to the EP.

End-Point (EP): Sigfox capable device.

Narrow Band eXtension (NBX): Narrow-Band message repeater network coverage extension system.

Uplink (UL): Unidirectional communication from the EP to the BS.

2.2 Abbreviations

Following abbreviations apply:

AES	**A**dvanced **E**ncryption **S**tandard
BER	**B**it **E**rror **R**ate
BPSK	**B**inary **P**hase **S**hift **K**eying
BS	**B**ase-**S**tation
CRC	**C**yclic **R**edundancy **C**heck
DL	**D**own**l**ink
ERP	**E**ffective **R**adiated **P**ower
EP	**E**nd-**P**oint
ETSI	**E**uropean **T**elecommunication **S**tandards **I**nstitute
FCC	**F**ederal **C**ommunications **C**ommission
FPGA	**F**ield-**P**rogrammable **G**ate **A**rray
GPS	**G**lobal **P**ositioning **S**ystem
GW	**G**ate-**W**ay
IoT	**I**nternet **o**f **T**hings
IP	**I**nternet **P**rotocol
ITU	**I**nternational **T**elecommunication **U**nion
LAN	**L**ocal **A**rea **N**etwork
LBT	**L**isten **B**efore **T**alk
LPWA	**L**ow **P**ower **W**ide **A**rea
LPWAN	**L**ow **P**ower **W**ide **A**rea **N**etwork
LTE	**L**ong **T**erm **E**volution (4G)
NB-IoT	**N**arrow-**B**and **I**nternet **o**f **T**hings (3GPP LPWAN)
NBN	**N**arrow-**B**and **N**etwork
NBW	**N**arrow-**B**and **W**aveform

NBX	**N**arrow-**B**and e**X**tension
OTA	**O**ver **T**he **A**ir
PAN	**P**rivate **A**rea **N**etwork
PHY	**Phy**sical layer
RX	**R**eceiver
SDR	**S**oftware **D**efined **R**adio
TX	**Transmitter**
UL	**Upl**ink
UNB	**U**ltra-**N**arrow **B**and

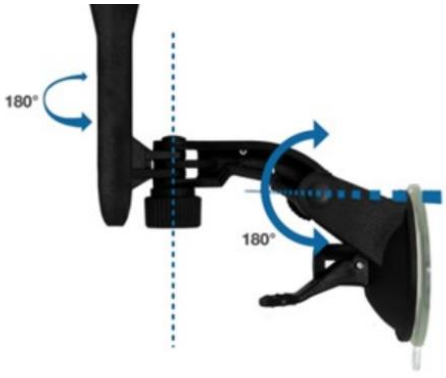
3 Package contents

3.1 Package Contents

- NBX R1000-RF repeater.
- Standard mounting kit.
- RJ-45 extender.
- 2x Antennas.

3.2 Accessories available separately

- Passive PoE injector.
- Tilted pole mounting kit.
- Passive 24V PoE power supply.
- Window mounting kit.
- Various Antennas.



4 Installation

The R1000-RF repeater can be installed indoors or outdoors (IP67).

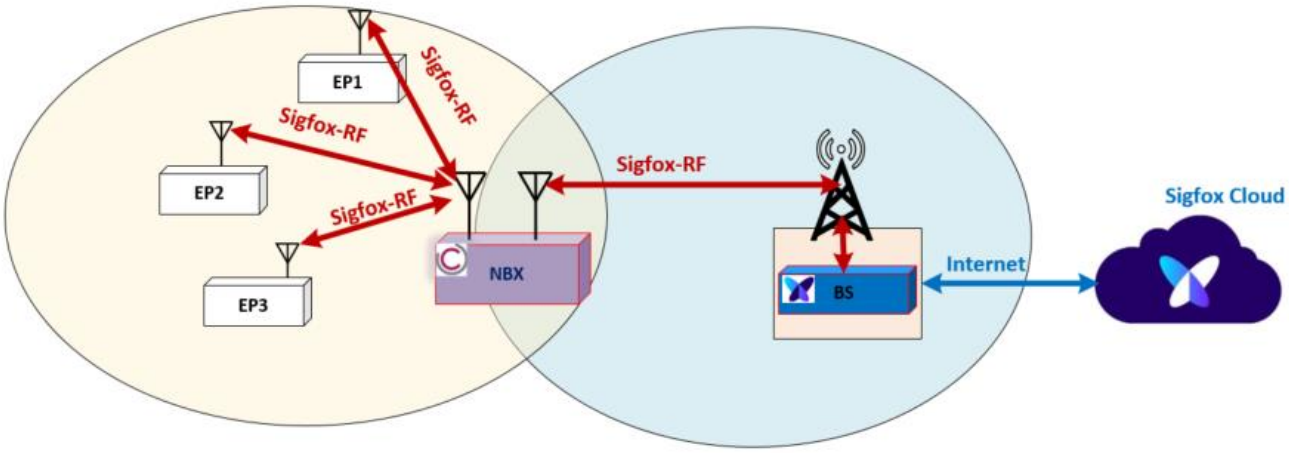
It can be mounted on a tower, pole, wall, window, or any other stable structure.

The main considerations for the choice of the installation location are:

- NBX coverage of the Sigfox devices.
- RF communication with Sigfox Base-station or other NBX repeater (daisy chain).
- Power supply (<5w with 10-48V).

Best practice for RF interference reduction is to place the NBX R1000-RF as far away from other RF equipment and not in direct line of site of cellular antennas.

In general, placement considerations for the NBX repeater are similar to those of the Sigfox base-station with the only difference being the need to be within coverage of one or more Sigfox base-stations (or another NBXs when in daisy chain mode).

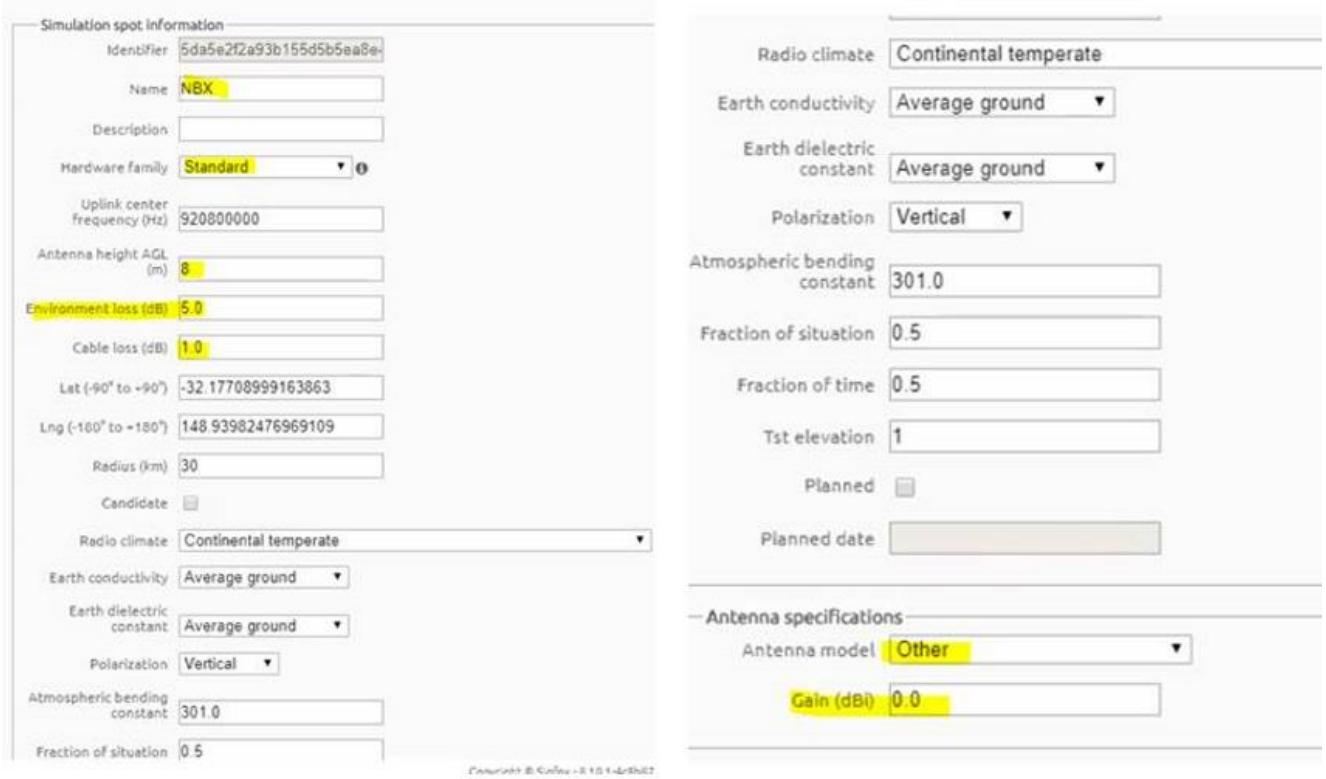


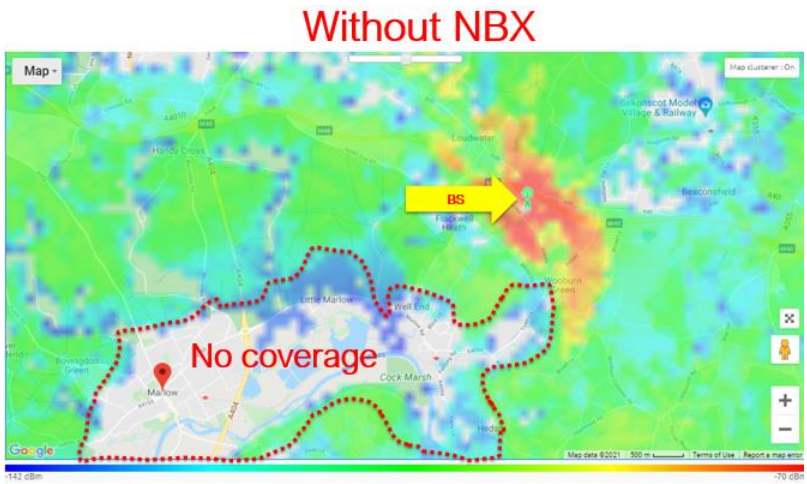
4.1 Radio planning:

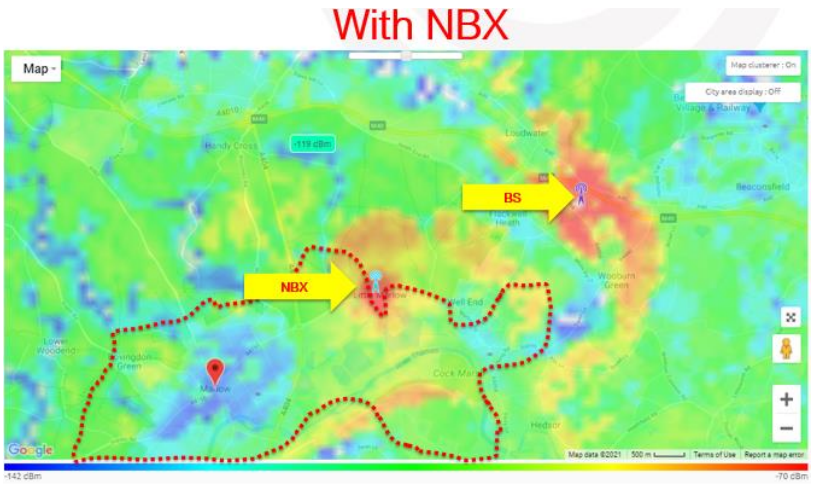
For radio planning, one may use the standard Sigfox tool for a candidate site. If using an external 5dBi antenna, the parameters should be the same as a Sigfox Macro configuration (5dBi antenna + LNA +..).

In the Sigfox backend, make sure that the chosen site is covered by one or more Sigfox BSs an add the NBX as a candidate site to predict coverage. Coverage check can be made with Simple coverage, as there will be a 10+ dB improvement at rooftop level relative to ground level (which the Backend estimates).

Then change the antenna gain by selecting “other” and for **basic** antenna use 0 dBi as a worst case **OR** 5dBi/TBD for **external** antenna you use.



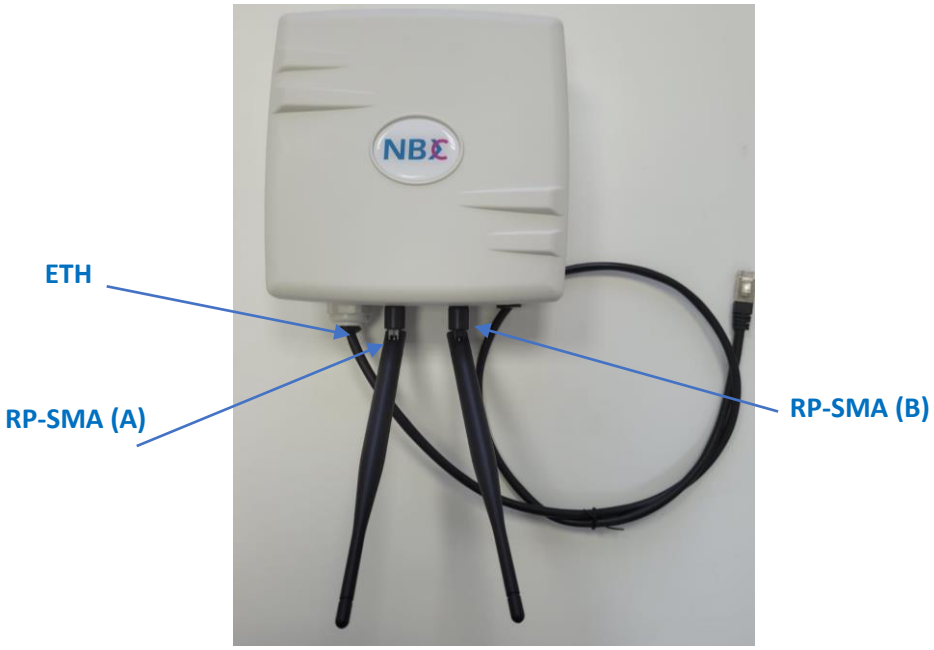




5 Connectivity

5.1 Interfaces

- Waterproof Ethernet (RJ-45) - for power and IP communication
- RP-SMA x2 – for antennas



5.2 Power

The NBX uses passive PoE for supplying power. The power is provided by an AC/DC adapter through a passive PoE DC injector (Pins 4,5 (+) and 7,8 (-)).

Supported voltage range: 10V to 48V DC.

Average R1000-RF power consumption - up to 5Watt (excluding USB modem).

5.3 IP Connectivity

IP connectivity is not mandatory.

The NBX R1000-RF repeater relies on RF communication to one or more BS for its functionality.

IP connectivity is mainly used for expert/technical management, control access and FW upgrades.

IP connectivity options:

- **RJ-45**
- **Wi-Fi/BT**
- **USB dongle**

See section 12.1 for **initial** setup guidelines.

5.3.1 USB Dongle

Following models are supported:

- Huawei E8732/E3372
- Huawei MS2131
- ZTE MF833V
- ZTE MF110
- Onyx Soracom

See section 12.2 for **initial** setup guidelines.

5.4 RF Connectivity

The NBX R1000-RF repeater includes two RP-SMA external antenna ports (A & B).

5.4.1 Antennas

Any antenna with RP-SMA connector can be used. The frequency range should be selected according to the RC zone.

Two 2.15 dBi antennas are supplied with each NBX-R1000-RF unit.

But in some cases, a higher gain antenna can be used.

6 Monitor & Configuration – Web Interface

In general, most configurations are done automatically without any user intervention.

Some of the settings described below are temporary for manual configuration or advanced settings.

There are three levels of user permissions: Super-User, Admin, User.

Possible methods for accessing the NBX R1000-RF are:

- **Web** (over IP).
- **CLI** (over IP).
- **SNMP** (over IP).
- **IoT** (Sigfox messages).
- **Bluetooth** (Using dedicated application).

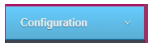
This section will describe the **web** access mode.

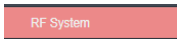
It is recommended to use **Chrome** web-browser.

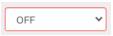
There are special commands and menus which are available only in **expert** mode and are not required for normal operation of the unit.

6.1 Web Interface Convention and Main Menu

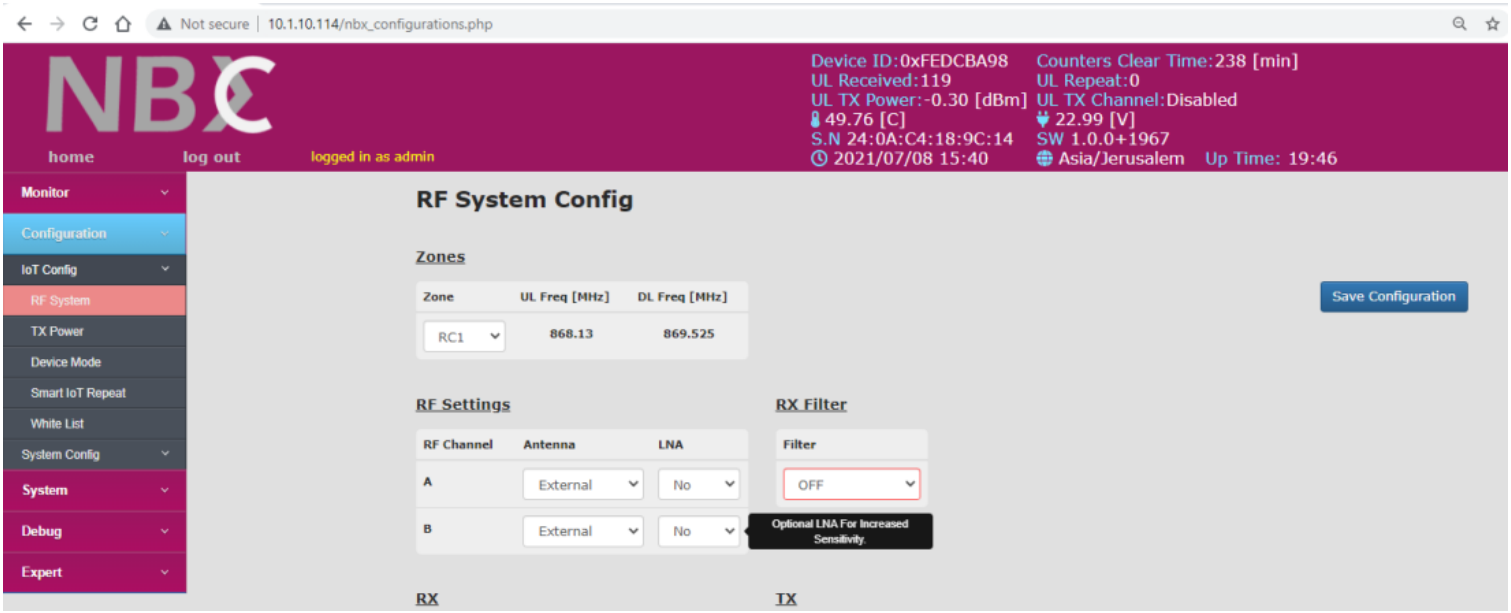
In a typical web page, the following apply:

- **Open sub menu's** – highlighted in blue. 

- **Current page** – highlighted in salmon. 

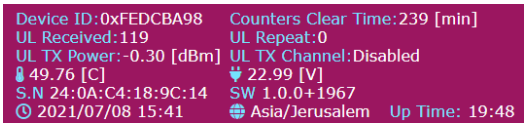
- **Field change before applying** – circled in red. 

- **Tooltip** – white on black 



6.1.1 Dash Board

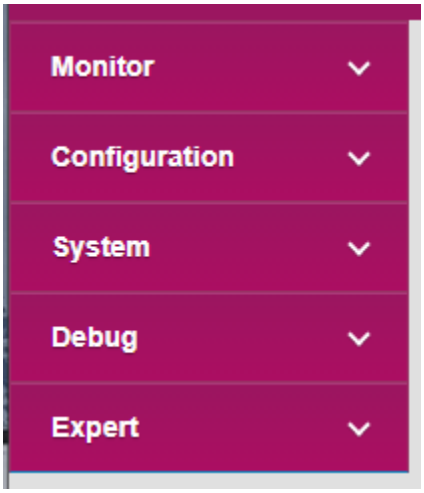
Appeared on the top right corner of the web page.



- **Device ID**: The Sigfox device ID of the unit
- **Counters Clear Time**: time since last clear of the message's counters [**minutes**].
- **UL Received**: How many unique UL messages were received.
- **UL Repeat**: How many UL messages were repeated.
- **UL TX Power** : Uplink transmit power [**dBm**]
- **UL TX Channel** : which channel the UL is being transmitted on (**A/B/Disabled**)
-  : Temperature [°**C**]
-  : Voltage [**V**]
- **S.N.** : Serial number
- **SW :** SW version
-  : Current date/time
-  : Time zone
- **Up Time**: Time since reboot.

6.1.2 Main Menu

Appeared on the left side of the page.



Divided to 5 main areas:

- **Monitor**: Display status information.
- **Configuration**: Configure the unit settings.
- **System**: Various system tasks (e.g. SW upgrade).
- **Debug**: Debug features.
- **Expert**: Advance expert-mode settings (not needed for normal operation).

6.2 Login

After identifying the NBX R1000-RF IP, it can be access via web browser.

Username and password are required.

Default username and password for **S**uper-**U**ser mode are:

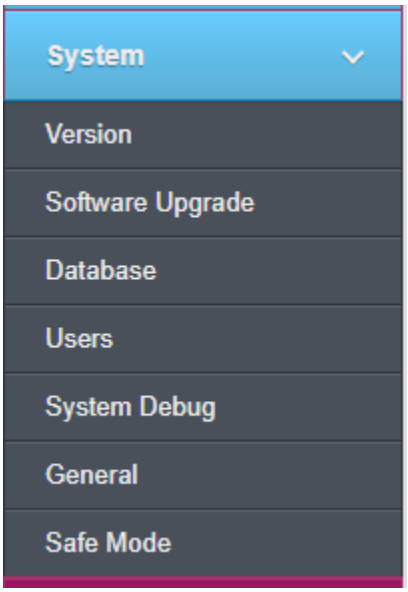
Username: **admin**

Password: **Admin**

The password can be changed.

Login session has a timeout of 15 minutes, after which a logout is automatically performed.

6.3 System



Under ***System*** all users will see the following sections.

System configuration and monitor are under the general "***Monitor***", "***Configuration***" menus.

- ***Version*** – Product versions details.
- ***Software Upgrade*** –SW upgrade operations.
- ***Database*** – Database management.
- ***Users –*** User management.
- ***System Debug –*** Debug files.
- ***General –*** Date/Time, reboot.
- ***Safe Mode –*** Safe mode operation.

6.3.1 Version

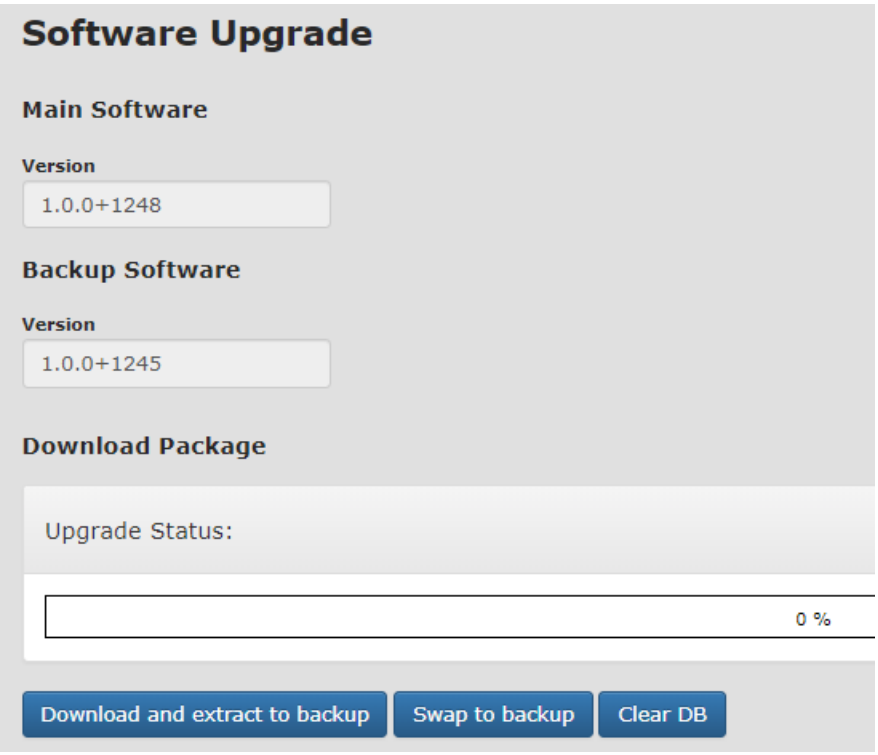
Version

Product	Serial number	HW Version	SW Version	Build Date (D.M.Y)	WiFi/BT SW Version
NBX-R1000RF	24:0a:c4:18:9c:14	5	1.4.0+2007 [20/07/2021-19:36]	15.2.21 | build 1	1.0.6.0

Display the NBX-R1000-RF SW and HW versions and S/N.

- **Product Name**
- **Serial Number**
- **HW Version**
- **SW Version**
- **Build Date**
- **Wi-Fi/BT SW Version**

6.3.2 Software Upgrade



Upgrading the software.

There are two SW versions on the unit: Main and Backup. During SW upgrade process the NBX R1000-RF is downloading and extracting a new SW version, replacing the backup copy.

After the **download and extraction** process is finished, the user can **swap** to the new SW version, which causes the unit to reboot with the new version.

So, the normal process is as follows:

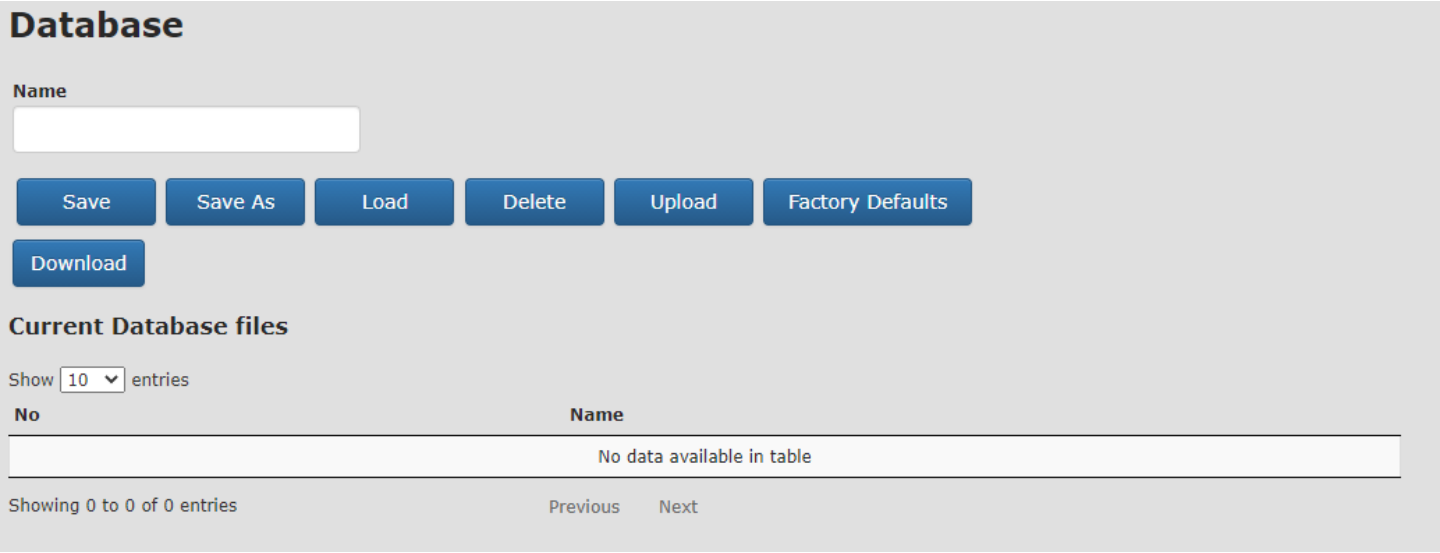
- Download the SW to a local folder accessible by your PC
- Use "***Download and extract to backup***" to select the new SW.
- After the file is extracted and shown in the "Backup Software" , do "***Swap to backup***"
- Then the unit will reboot with the new SW version.

The user can revert to the older version at any time by pressing the "Swap to Backup" button.

If the IP connectivity is slow, then it is recommended to use **tftp** process via **CLI,** instead of **Web** interface**.**

There is also an optional "Clear DB" feature - ***internal use***.

6.3.3 Database



Database is used to store the unit configurations.

Save, download, upload database from/to the NBX.

Save – save the current configuration into the permanent storage (db0.db).

Save As - save the current configuration into specific file given by “Name”.

Load – Activate saved database (the unit will reboot).

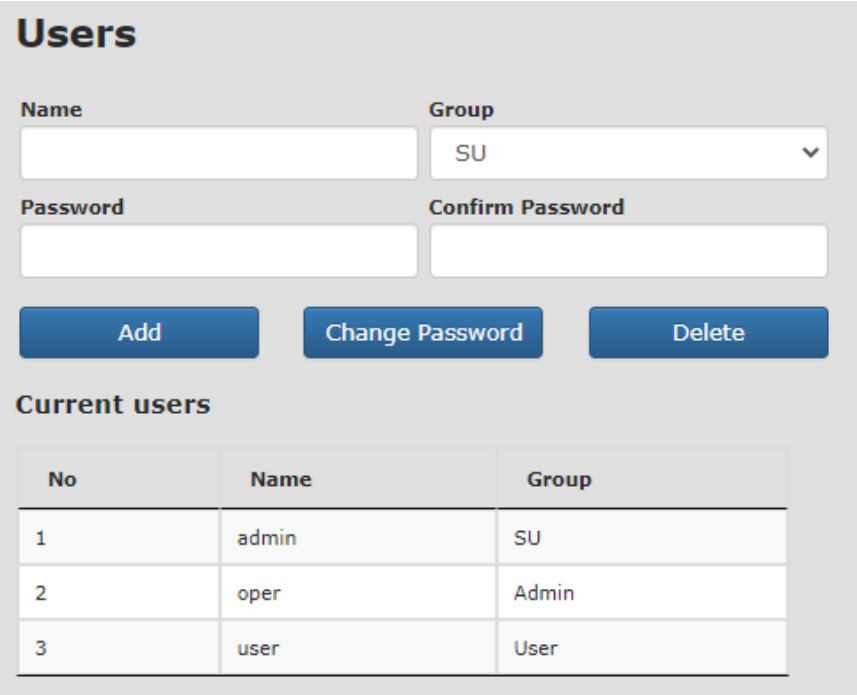
Delete – Delete saved database.

Upload – Upload database from the NBX to the computer.

Factory Defaults – Reset current configuration to factory defaults settings (the unit will reboot).

Download – Download database file from the computer into the NBX (without activation).

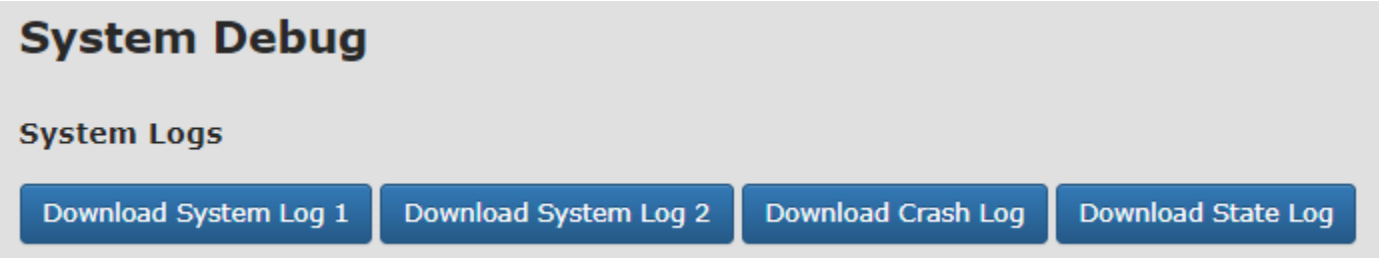
6.3.4 User Management



Managing users.

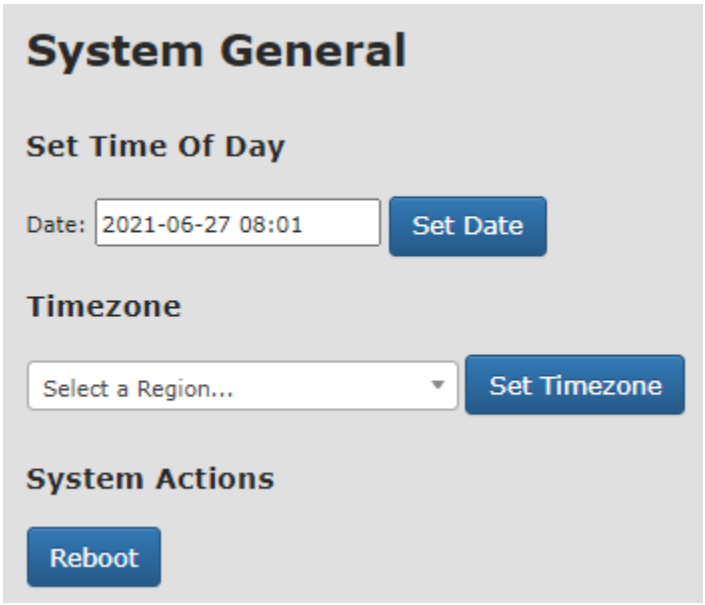
The logged-in user can only change/add users with same or lower level.

6.3.5 System Debug



Download log files from the unit to the PC for debug purpose.

6.3.6 System General



General system functions:

- **Set Time of Day**
- **Select Time zone**
- **Reboot**

6.3.7 Safe Mode

Safe mode can be used during configuration changes. Safe Mode ensures that the communication to the unit is still active following any configuration changes.

The user can configure the timeout period in seconds. The User needs to exit Safe Mode before the timer expires.

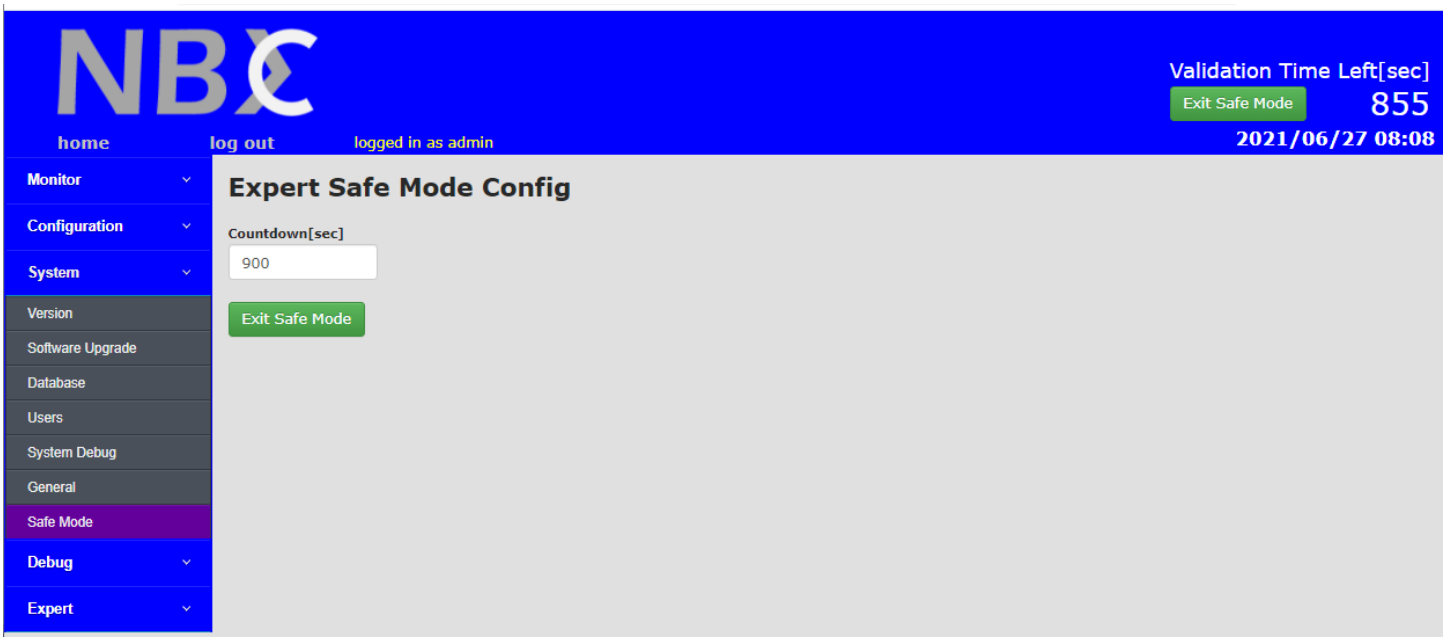
If the user did not exit the safe mode after the configuration and before timer expiry, then the unit will revert to the previous configuration and reboot.

This prevents mistakes in configuration which can disconnect the unit.

When in safe mode, the screen color scheme changes, and there is a countdown timer in the top right corner.

- **Set safe mode time.**
- **Enter safe mode.**

Once activated Exit Safe Mode appears on the following screen.

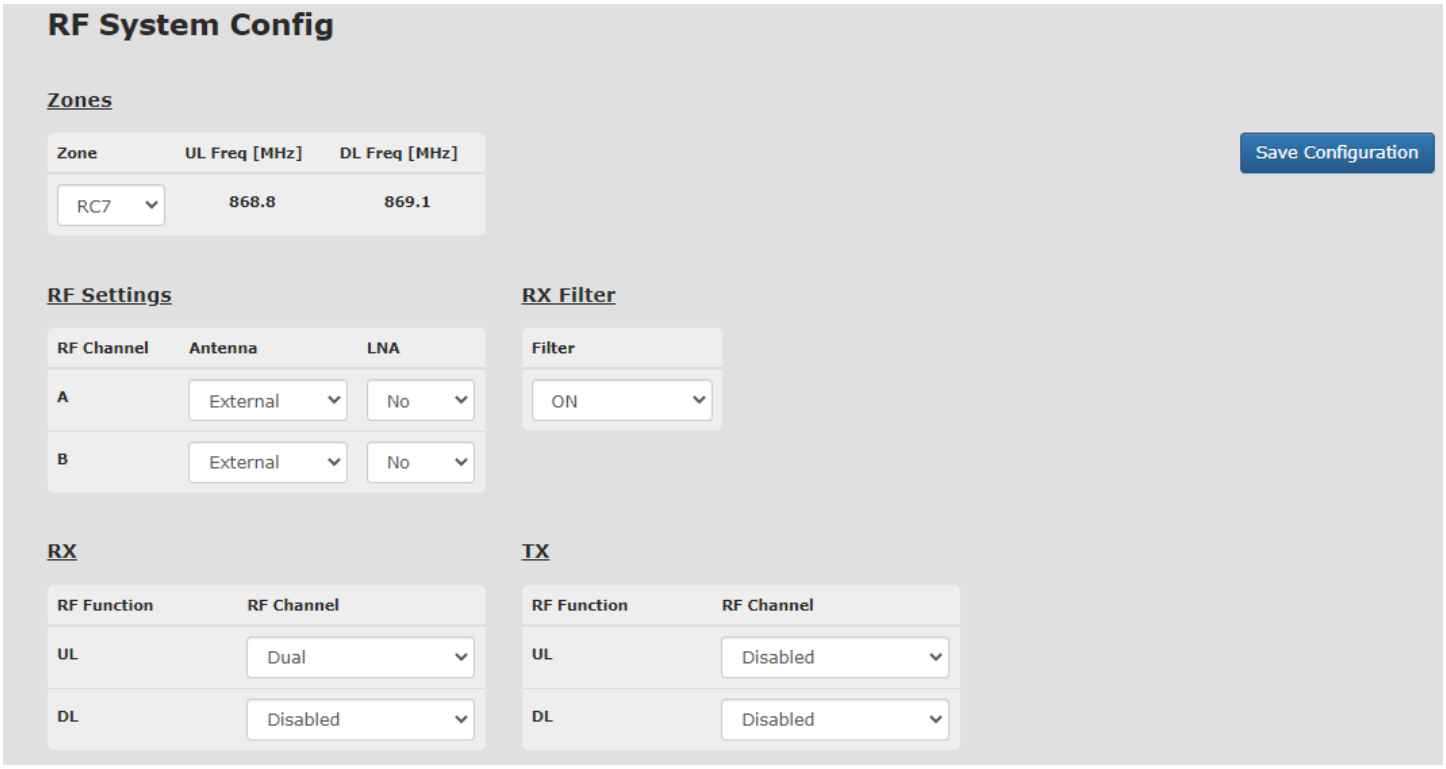


6.4 Configuration

Under ***Configuration*** there are two main sections – ***IoT*** and ***System***:

- ***IoT Config:***
  - ***RF System***– Configure the IoT RF parameters, including filtering and antenna connectivity
  - ***TX Policy*** – UL and DL transmission power levels and UL frames limit
  - ***Device Mode –*** Device mode configuration
  - ***Smart IoT Repeat –*** Smart IoT Repeat (**SIR**) Configuration.
  - ***White List*** – Devices which will be repeated (other device-id's are dropped).
- ***System Config:***
  - ***SNMP –*** SNMP settings
  - ***IP Interfaces –*** IP Interface settings (IP, GW, DHCP…)
  - ***IP Routes –*** IP static routes settings
  - ***IP DNS –*** IP static DNS settings
  - ***IPSec –*** IP VPN settings
  - ***DAS –*** DAS Settings
  - ***IP Ping –*** Ping command
  - ***Wi-Fi –*** Wi-Fi configuration
  - ***Bluetooth –*** Bluetooth configuration
  - ***General –*** system general settings (name, location…)

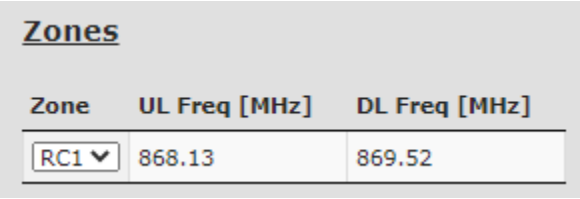
6.4.1 IoT - RF System Configuration



Configure the IoT RF mode and connectivity.

After setting a new configuration, it is necessary to save it.

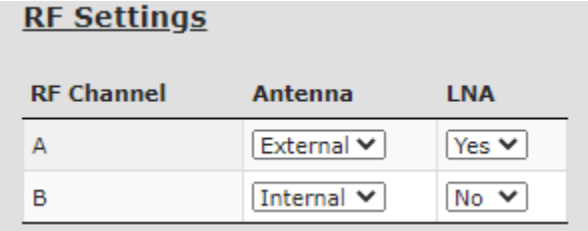
RC zone:



Selects the RC zone : *RC1,RC2…RC7*

The UL and DL center frequencies are specified after selecting the RC. The other characteristics per RC will be implemented (e.g. 100Hz /600Hz baud etc.).

RF setting:

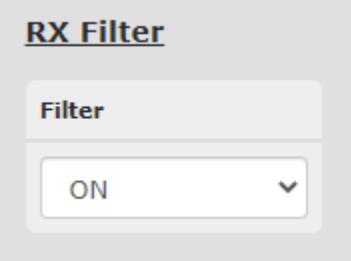


The NBX-R1000-RF includes two RF channels (A&B) with external antennas. Currently, the Internal Connectors are not being used.

Each channel has an optional LNA which can be selected (this is for increased sensitivity).

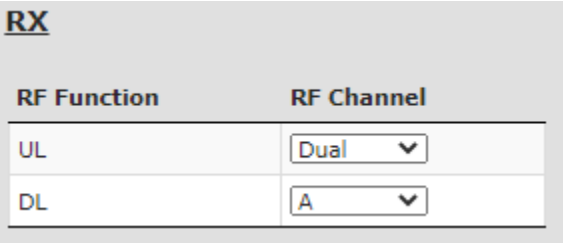
LNA can be turned off if devices are in close proximity to the NBX, e.g. several meters distance from the repeater.

RX Filter:



There are embedded RF filters which can mitigate RF noise in adjacent frequencies (similar to the cavity filter functionality). Normally those filters should be used. Only in an isolated/quite places those filters can be turned off (for having an extra sensitivity).

RX :



Selects which channels will be used for receiving the UL & DL.

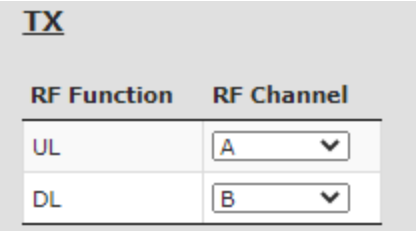
For UL, both channels can be used simultaneously (receive diversity).

For DL, it is normally selected according to the best positioned antenna towards the nearby base-station(s).

UL RF channel options: *A, B, Dual, Disabled*

DL RF channel options: *A, B, Disabled*

TX:



Selects which channel will be used for transmitting for the UL & DL separately.

For UL, it is normally selected according to the best positioned antenna towards the nearby base-station(s).

UL RF channel options: *A, B, Disabled*

DL RF channel options: *A, B, Disabled, Auto* (Auto selects the antenna based on the UL signal quality)

6.4.2 IoT - TX Policy

Selects the transmission power. The R1000-RF uses multi-carrier transmission mode, which enables higher capacity with minimal interference and adheres to the regulations.

The UL power level must be set to balance enough base stations receiving the repeated messages without reaching too many.

UL Tx-power [dBm]: Power per transmitted UL frame. Actual power will be calculated based on multi-carrier scenario.

DL Tx-power [dBm]: DL frame transmitted power. The DL TX power is recommended to be set to 27dBm for the DL link budget to match the UL sensitivity.

Limit UL Max Frames In Block: Allows to limit the maximum UL frames per transmission to a value less or equal to the ***Max UL Frames In Block***). For example, the user can change this value from 12 to 1. In this case if 12 UL frames are received simultaneously, they will be transmitted 1 frame at a time.

Max UL Frames In Block: The maximum number of UL frames, calculated according to the ***UL Tx-power*** (information only).

6.4.3 IoT - Device Mode Configuration

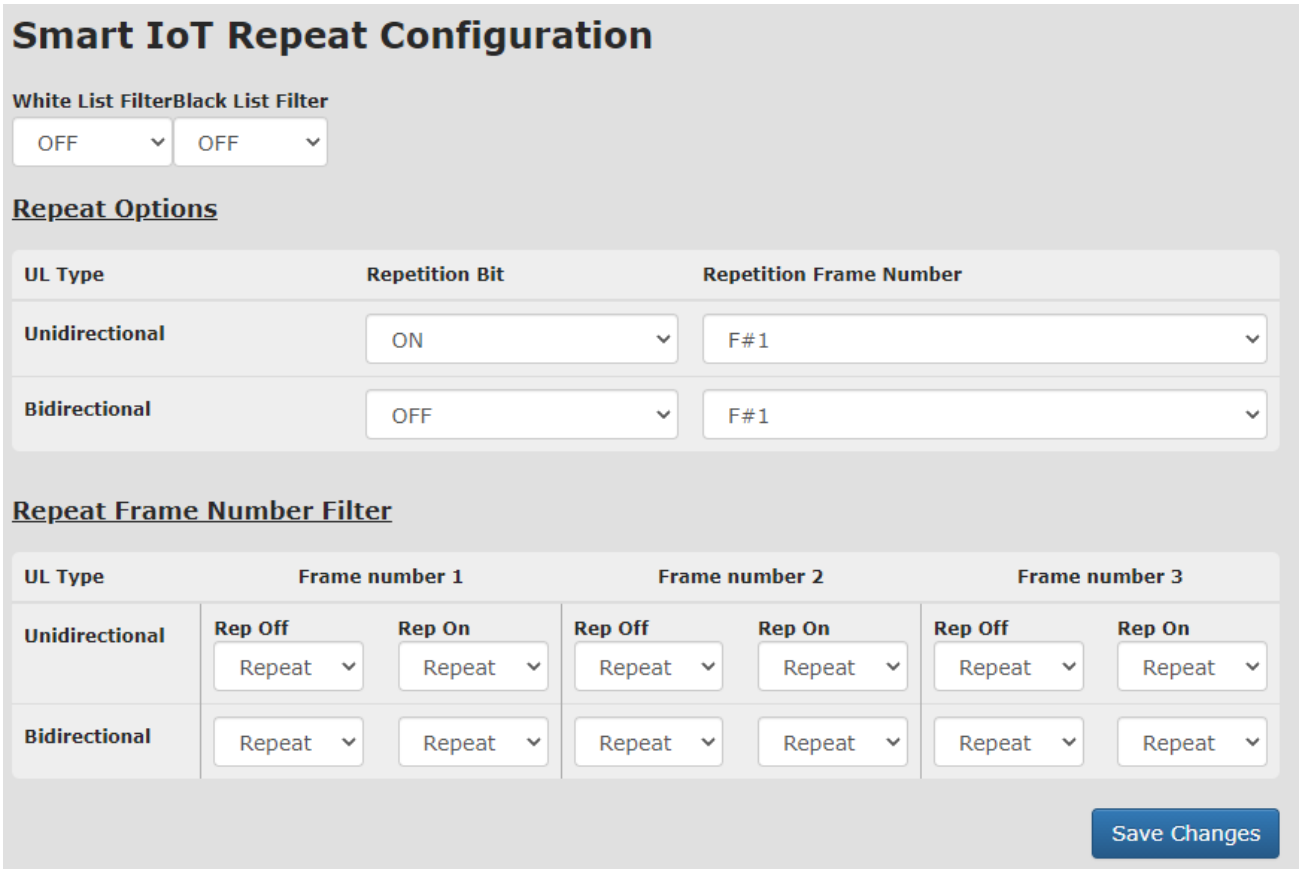
Configure the Device-mode setting:

Note that some of the settings will be configured automatically in a future SW release.

- ***App Sleep Time [sec]*** – Time interval between UL messages generated
- ***Default TX Channel*** – Which **Channel** (**A/B**) to transmit the Device messages
- ***Default TX Antenna*** – Which **Antenna (Internal/External** – only external available**)** to transmit the messages
- ***Symbol Rate*** – What symbol rate (**100/600Hz**) to transmit the Device messages (600Hz is recommended)
- ***Set App Config*** – Change the configuration
- ***TX NBX SFX Message*** – Transmit a device message – used for calibration of the TX power.
- ***Device ID + Message counter*** – Current Device-ID and message counter (information only).

The Device ID and key are unique per NBX unit.

6.4.4 IoT – Smart IoT Repeat (SIR)



Configure the **S**mart **I**oT **R**epeat (**SIR**) setting:

Note that some of the settings will be configured automatically in a future SW release.

The **SIR** functionality minimizes unnecessary repetitions and repeats only the required messages. e.g. in multi hop scenario.

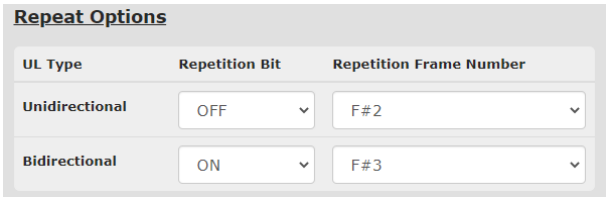
How to repeat the incoming messages:

- **White-list** – enable/disable
- **Black-list** – enable/disable
- **Repeat Options** – Frame number and Repeat Bit selection for repeated messages
- **Repeat Frame Number Filter** – filtering for selecting frames to be repeated .

Repeat options allows selection of the frame number and repeater bit settings for repeated messages.

Use automatic or manual settings.

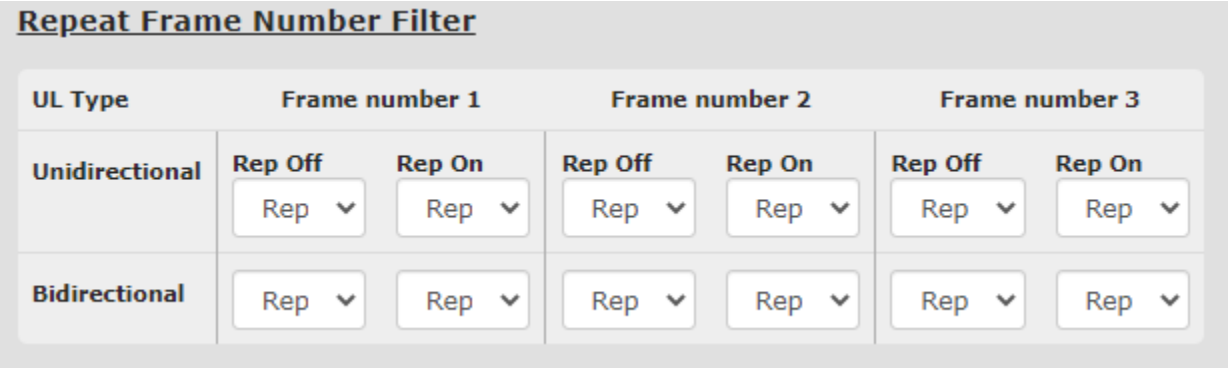
Frame # : 1,2,3,Auto, **Repeater-bit** = On,Off



Selects whether to turn on the repetition bit for UL messages (Sigfox backend will show the message as having been repeated) according to the message type.

The default is to turn it on for unidirectional only. (Currently, the Sigfox backend will not send a DL message to the NBX if the Repeater bit is turned on for bidirectional messages)

Repeat Frame Number Filter



Select which Frames to be repeated according to frame number and repeater bit. This can be used to filter unnecessary frames.

6.4.5 IoT - White List

Devices which will be repeated (other device-id's are dropped – depending on general *SIR* options).

The White-list can be updated manually via the GUI or by loading a text file which contains the device-id's.

- **csv file**: Text files need to include separate line per device-id and assumes hexa-decimal format (can be with or without 0x prefix) lower or uppercase are accepted.
  And indication on enable/disable per device-id (0/1)

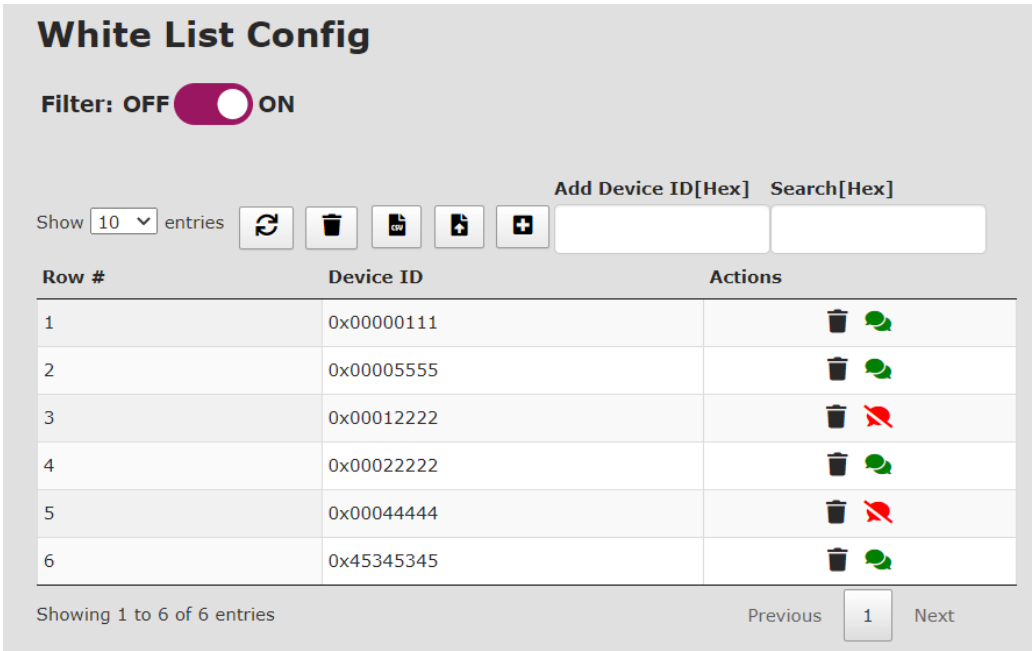
e.g. all the below are valid formats (second dev-id is disabled in the example):

```
0x1234AB   , 1
333aB      , 0
Fe44ba22   , 1
```

- **Web GUI:** The current White-list is displayed and can be changed via the GUI.

Following options supported:

- **Add -** add specific device-id
- **Delete –** delete specific device-id
- **Enable/Block –** Enable or Block specific device-id
- **Search –** all device-id that match the search pattern
- **Upload –** upload csv file
- **Export –** export current white list to csv file



6.4.6 IoT - Black List

Devices which will be blocked (other device-id's are dropped – depending on general *SIR* options).

The Blck-list can be updated manually via the GUI or by loading a text file which contains the device-id's.

- **csv file**: Text files need to include separate line per device-id and assumes hexa-decimal format (can be with or without 0x prefix) lower or uppercase are accepted.
  And indication on enable/disable per device-id (0/1)

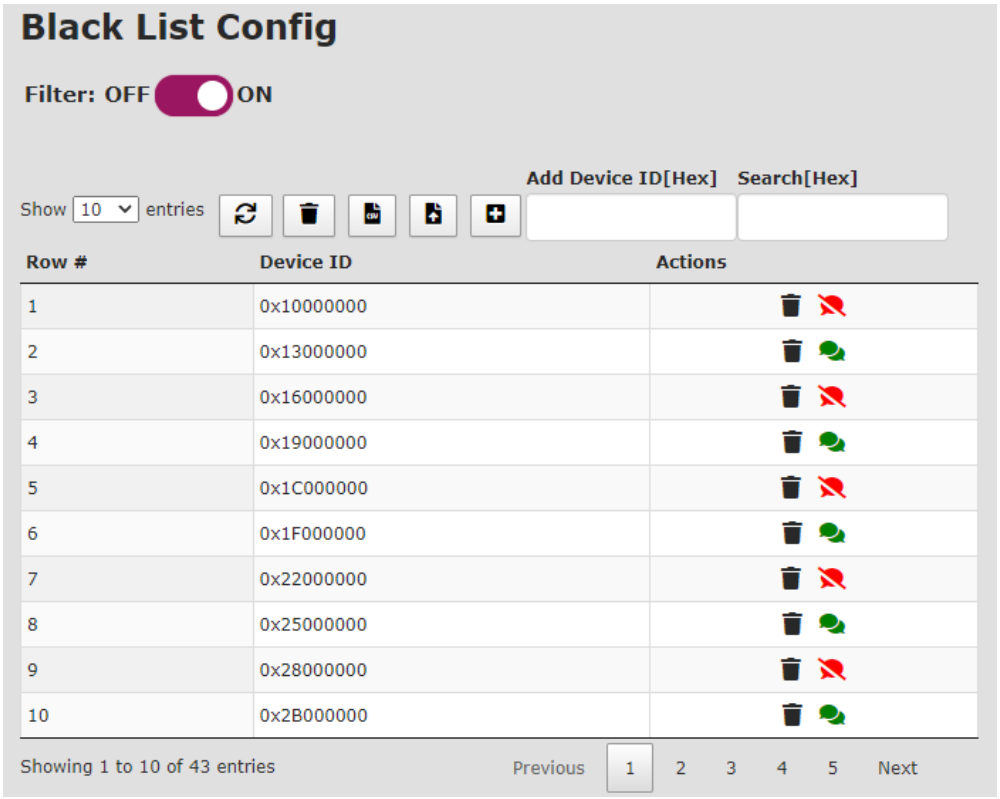
e.g. all the below are valid formats (second dev-id is disabled in the example):

```
0x1234AB   , 1
333aB      , 0
Fe44ba22   , 1
```

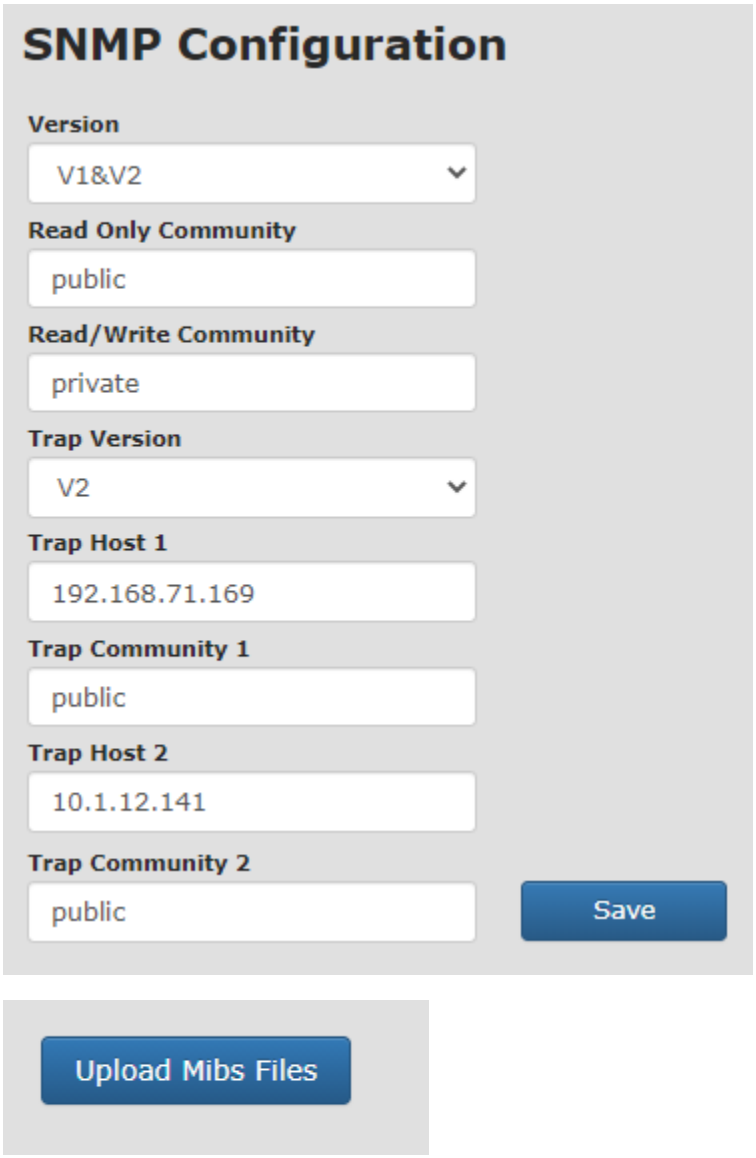
- **Web GUI:** The current Black-list is displayed and can be changed via the GUI.

Following options supported:

- **Add -** add specific device-id
- **Delete –** delete specific device-id
- **Enable/Block –** Enable or Block specific device-id
- **Search –** all device-id that match the search pattern
- **Upload –** upload csv file
- **Export –** export current Black list to csv file



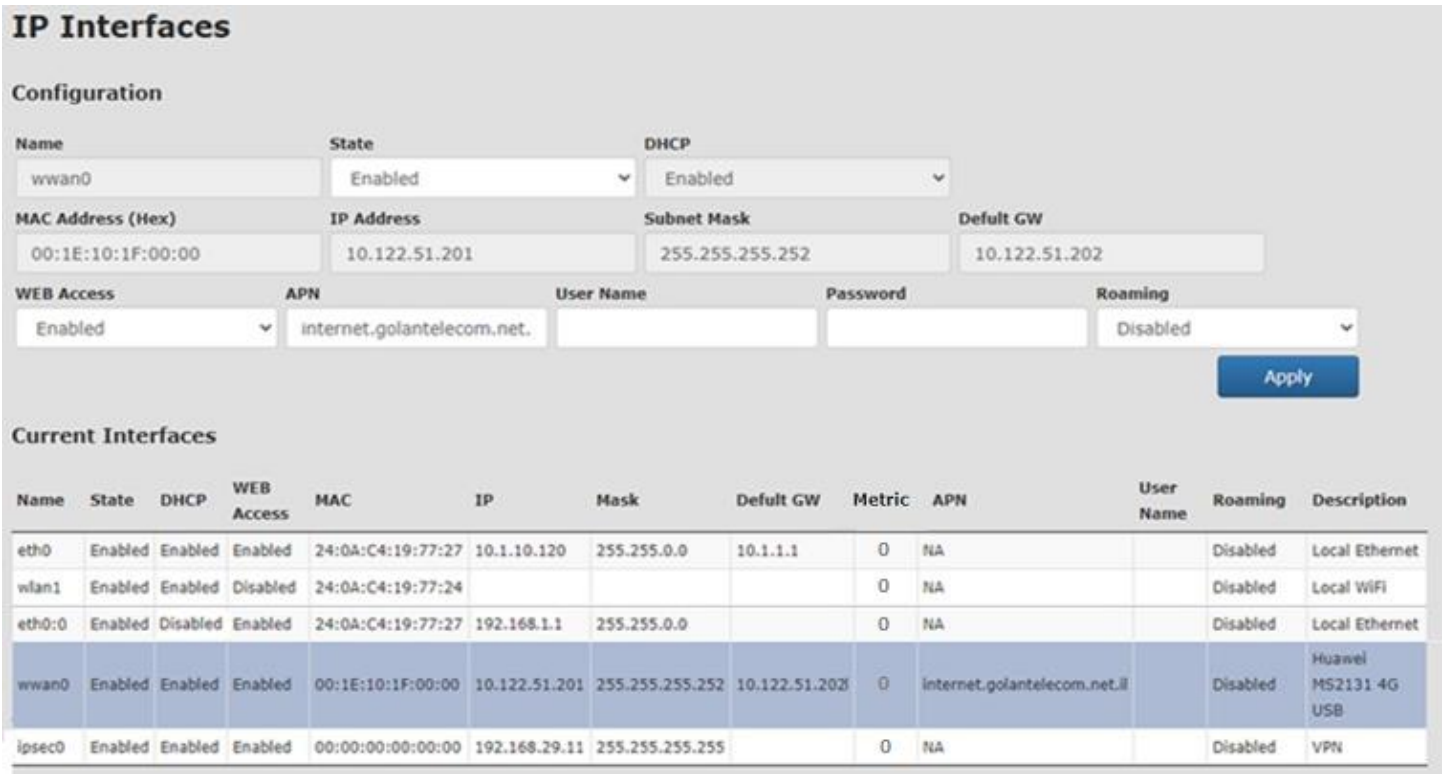
6.4.7 System - SNMP Configuration



Configure the SNMP setting:

- ***Version*** – SNMP version: V1&V2 or V3
- ***Read Only Community*** – Read only community name
- ***Read/Write Community*** – Read/Write community name
- ***Trap version*** – versions - V1 or V2
- ***Trap Host 1*** – IP of trap host 1
- ***Trap Community 1*** – name of trap host 1 community
- ***Trap Host 2*** – IP of trap host 2
- ***Trap Community 2*** – name of trap host 2 community
- ***Upload Mibs Files*** – upload the Mibs file to the local PC

6.4.8 System - IP Interfaces



Display the NBX-R1000-RF IP interfaces settings.

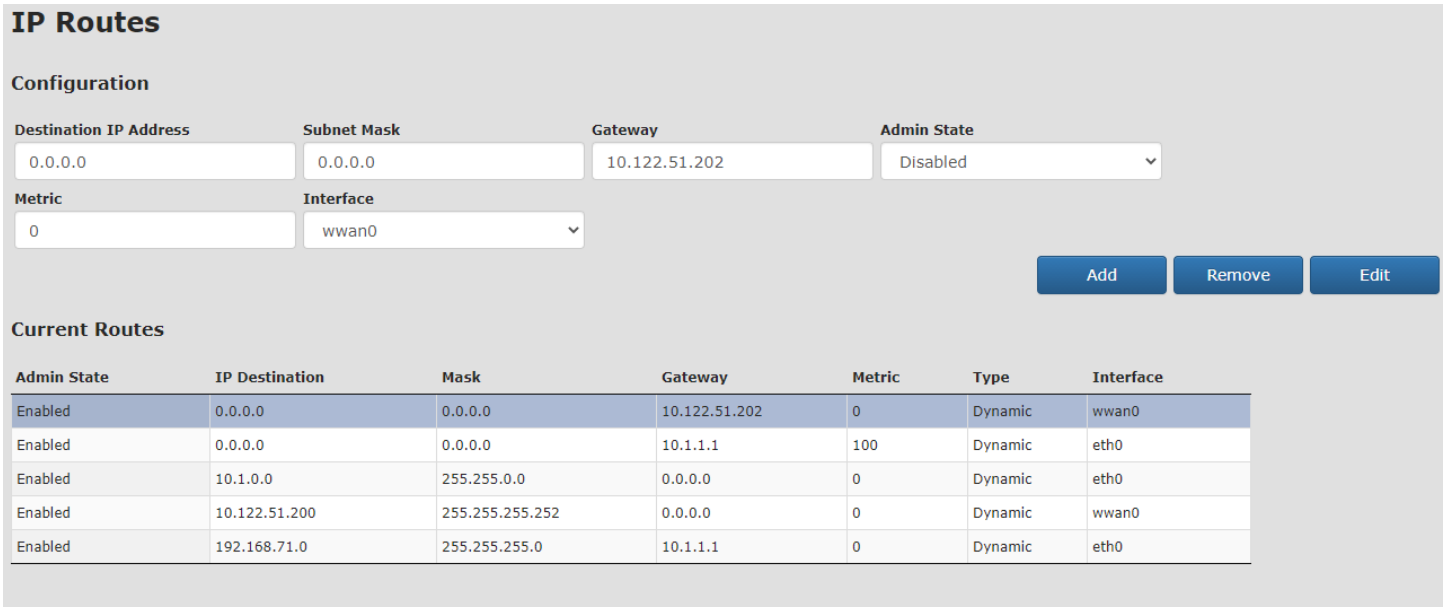
- **Name**: The name of the interface
- **Status**: Enabled/disabled
- **DHCP**: Enabled/disabled. If disabled, the interface is in STATIC IP mode.
- **MAC**: MAC address
- **IP Address**
- **Subnet Mask**
- **Default GW**
- **Metric:** To set interface precedence.
- **WEB Access:** Enabled/disabled. If disabled, the GUI will not be available.
- **APN:** Only for PPP 3G/4G interface
- **User Name:** Only for PPP 3G/4G interface
- **Password:** Only for PPP 3G/4G interface
- **Roaming:** Only for 3G/4G interface

Both ETH0 and ETH0:0 linked to the RF-45 interface.

By default, ETH0 is set to DHCP and ETH0:0 is set to STATIC IP 192.168.1.1 / MASK 255.255.255.0.

If ETH0 is set to STATIC, ETH0:0 is disabled.

6.4.9 System – IP Routes



Displays the NBX current routing table and allows insertion/deletion of static routes.

Admin State – Enable/Disable this route.

IP Destination – IP network address.

Mask – IP network subnet mask.

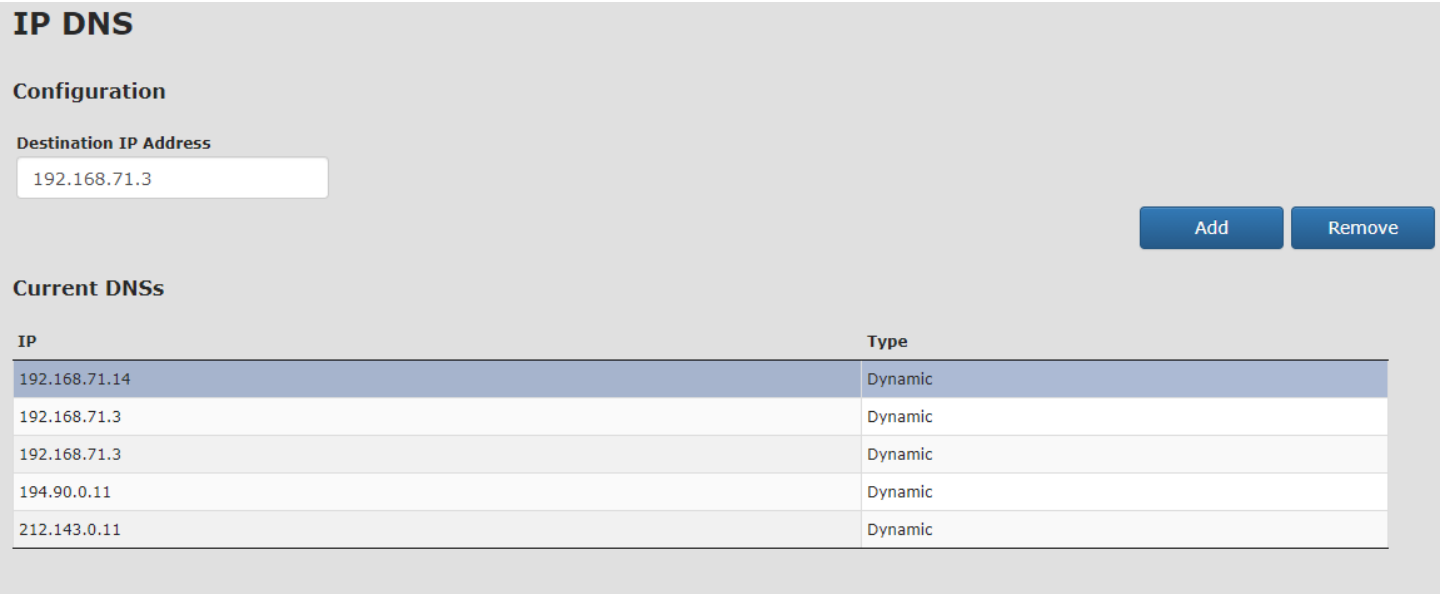
Gateway – IP router address for this network.

Metric – Metric of this route for priorities in case of multiple routes.

Type – Connection type (Dynamic / persistent).

Interface – The interface which the route relates to.

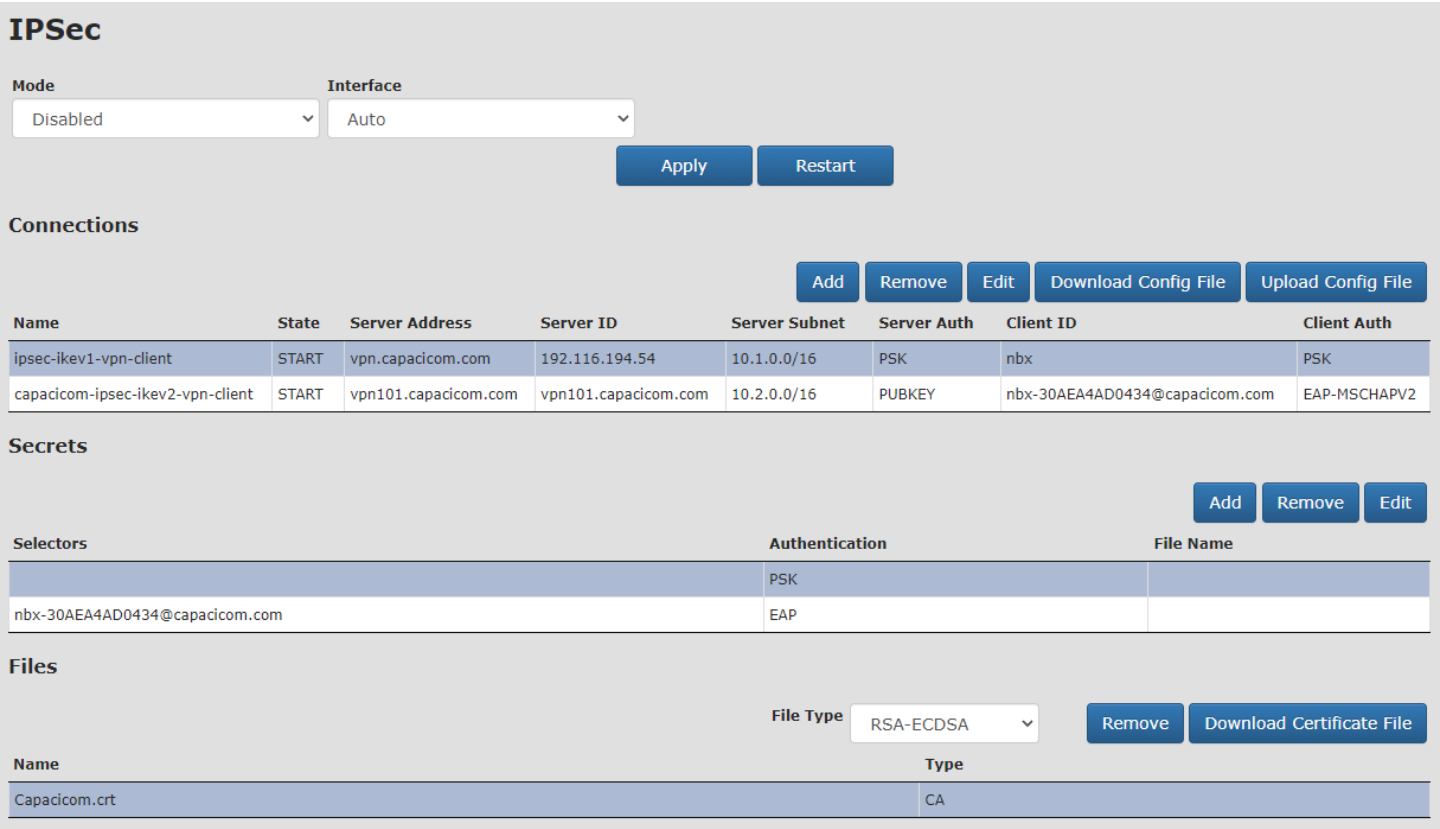
6.4.10 System – IP DNS



Display the current domain name servers and allows to adding or removing static DNS.

Destination IP address – IP address of the DNS.

6.4.11 System – IPSec



IPSEC – Configure a secure IPSec VPN tunnel.

Mode – Enable / disable all IPSEC tunnels.

Interface – Select on which IP interface the IPSEC will be initialize. AUTO for the IPSEC to initialize on the first available interface that allows an internet connection, otherwise will try to initialize only on the selected interface.

Restart – Manually restart the IPSEC tunnels and try to reconnect.

Connections – Define the IPsec connection settings

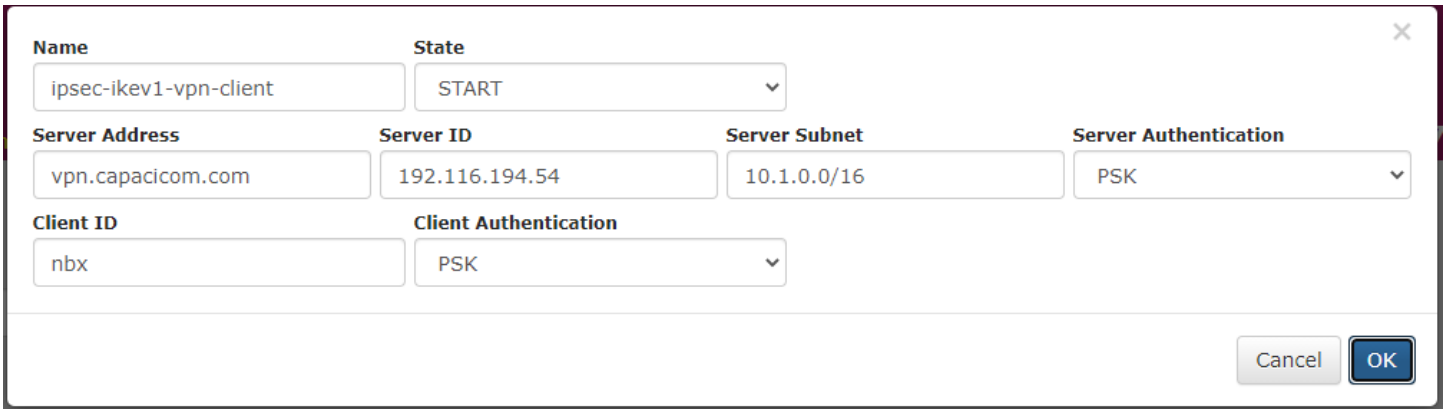
Add – Add a new connection to the list.

Remove – Remove a connection from the list.

Edit – Edit an existing connection.

Download Config File – Download a pre-configured connection setup from the PC to the NBX.

Upload Config File – Upload the existing connections from the NBX to the PC.



Name – The name of the connection

State – Add - loads a connection without starting it.

Route - loads a connection and installs kernel traps. If traffic is detected, a connection is established.

Ignore - ignores the connection.

Start - loads a connection and brings it up immediately.

Server Address – the other VPN endpoint address. IP or fully-qualified domain name (FQDN).

Server ID – ID of the other VPN endpoint, used also for authentication. Can be an IP address, a fully-qualified domain name, an email address or a Distinguished Name for which the ID type is determined automatically and the string is converted to the appropriate encoding.

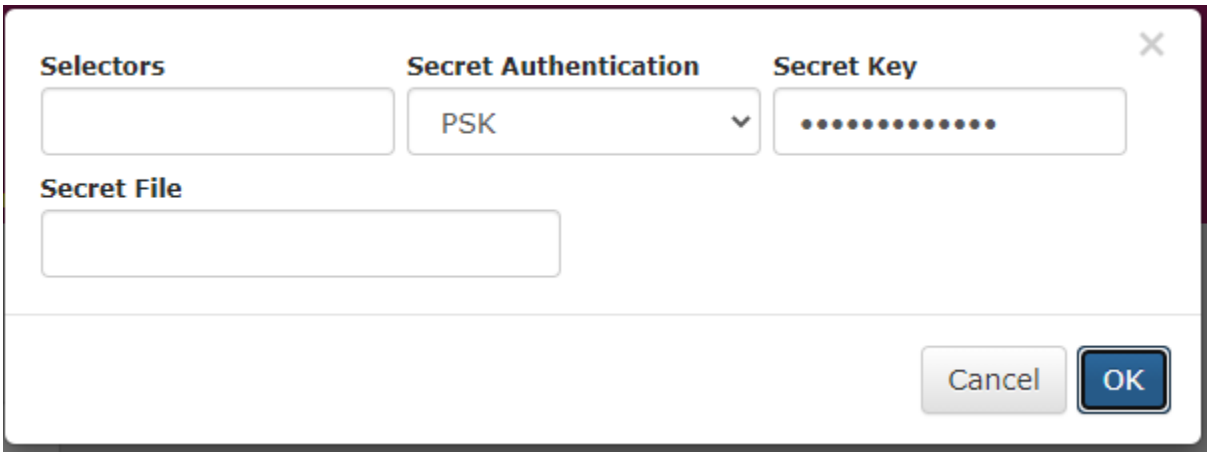
Server Subnet - network/netmask of the other VPN endpoint.

Server Authentication - Authentication method require from the other VPN endpoint.

Client ID - ID of the NBX.

Client Authentication - Authentication method use locally.

Secrets – Defines the VPN secrets.



Selectors - A selector is an IP address, a Fully Qualified Domain Name, user@FQDN, %any or %any6.

Secret Authentication - type of the secret:

RSA - defines an RSA private key.

ECDSA - defines an ECDSA private key.

P12 - defines a PKCS#12 container.

PSK - defines a pre-shared key.

EAP - defines EAP credentials.

NTLM - defines NTLM credentials.

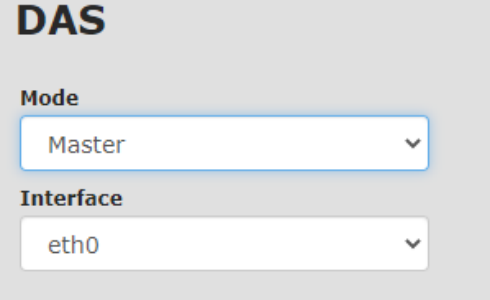
XAUTH - defines XAUTH credentials.

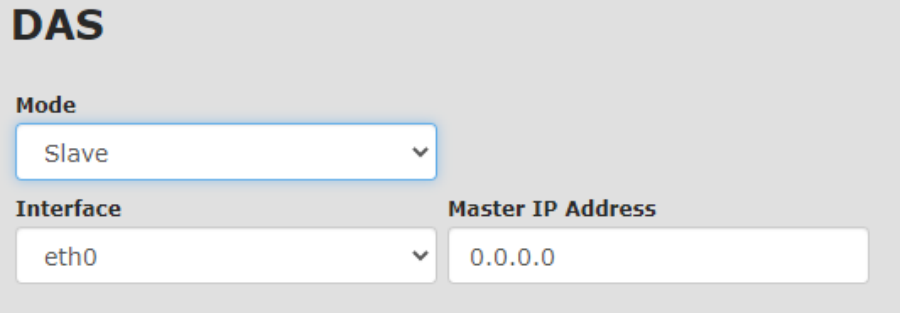
Secret Key – Password to use with the Key.

Secret File – Secret File used with the Key – the file should download using the “Download certificate file” button with the current type.

Files – Enable downloading or removing of a certificate file according to the type selected.

6.4.12 DAS





DAS –Allows multiple NBXs to work together, connected via IP, where the Master, in addition to operating as a repeater, is also responsible relaying messages to/from Sigfox base stations and the Slaves communicate with the devices.

Disabled – Disable DAS.

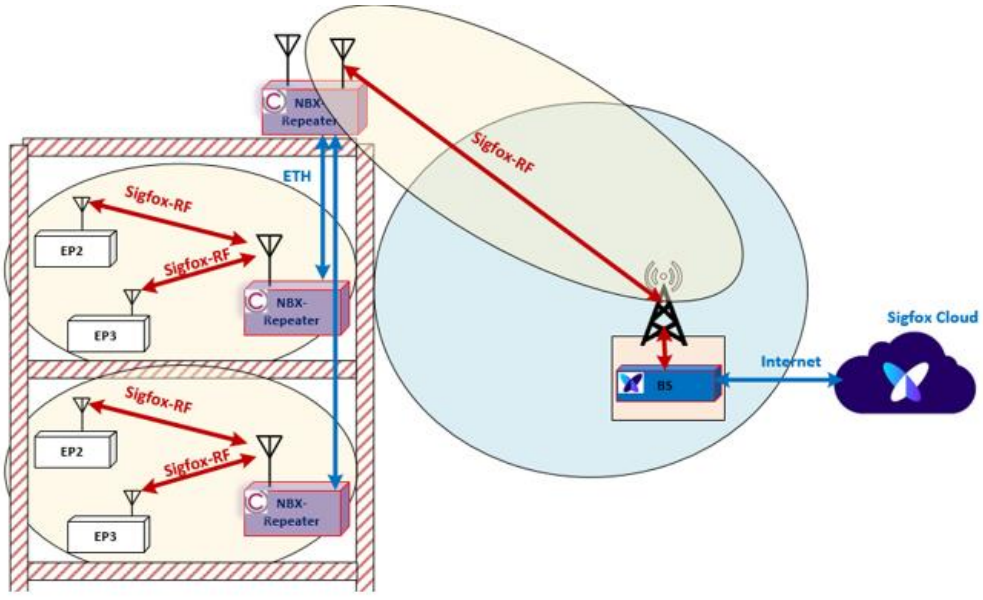
Slave Mode – All Sigfox uplink messages received by RF from Sigfox devices will be sent over IP to the MASTER. Downlink messages coming from the MASTER over IP will be sent by RF to the devices.

Master Mode – Uplink messages received over IP from the SLAVE will be sent by RF to the base station. RF downlink messages received from the base station and associate with a device that located behind the SLAVE will be send over IP.

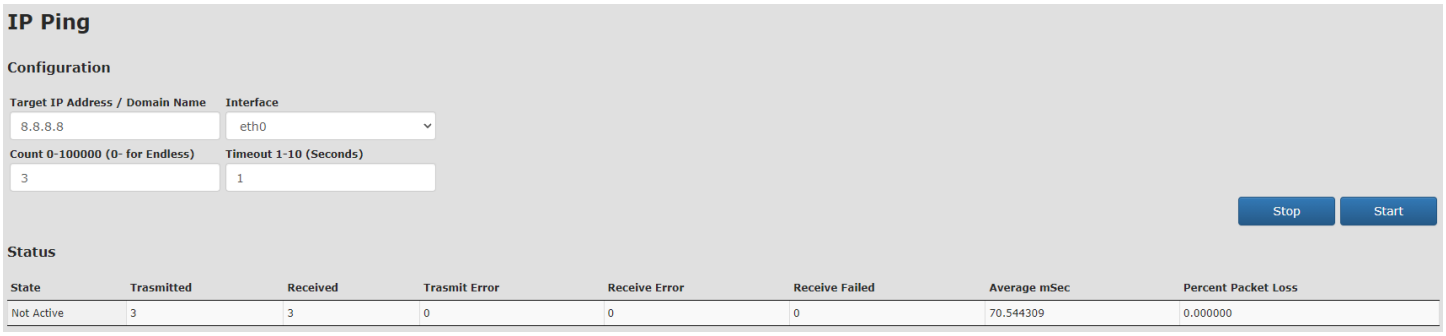
Slave can have only one master.

Master can have up to 10 slaves.

To switch between MASTER and SLAVE modes, <u>you must first change the Mode to Disabled</u>.



6.4.13 System – IP Ping

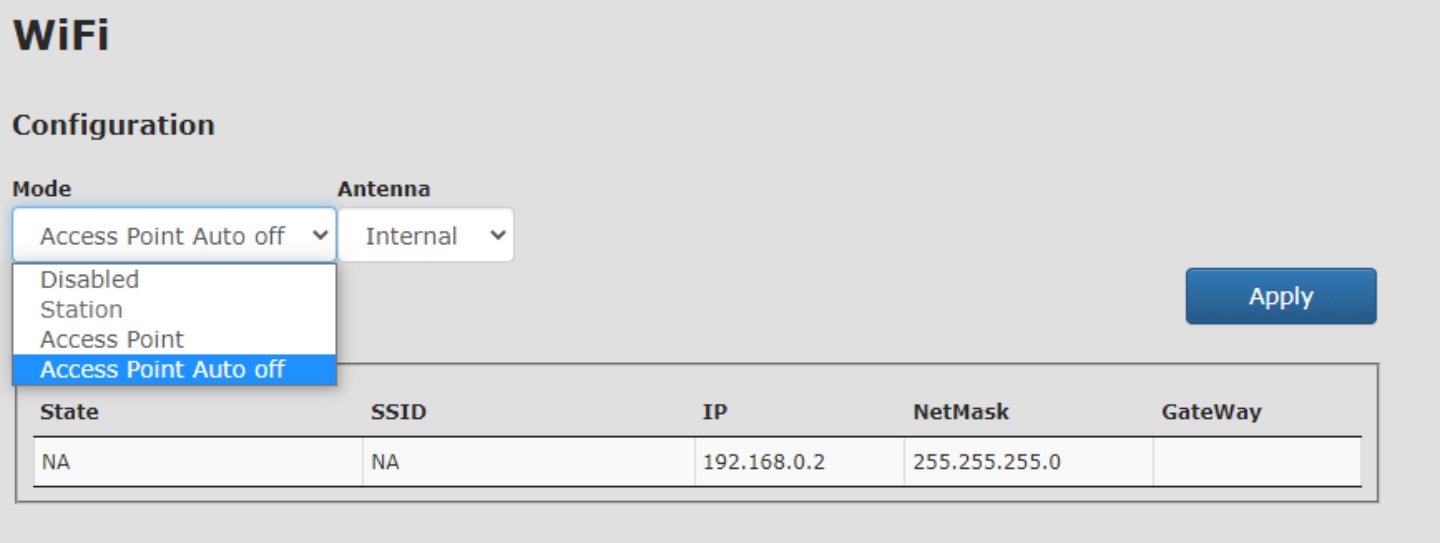


Ping an IP address:

- **Target Ip Address / Domain name**: The IP address / Domain name to ping.
- **Interface**: The IP interface from which the Ping will be send. Use **Auto** to try all interfaces.
- **Count 0-100000 (0 – for endless)**: Set the number of pings to be sent or 0 for endless pings.
- **Timeout 1-10 (Seconds)**: Set the ping timeout.
- **Start**: Start pinging.
- **Stop**: Stop pinging.

Status: Display the current pinging status and statistics.

6.4.14 System – Wi-Fi

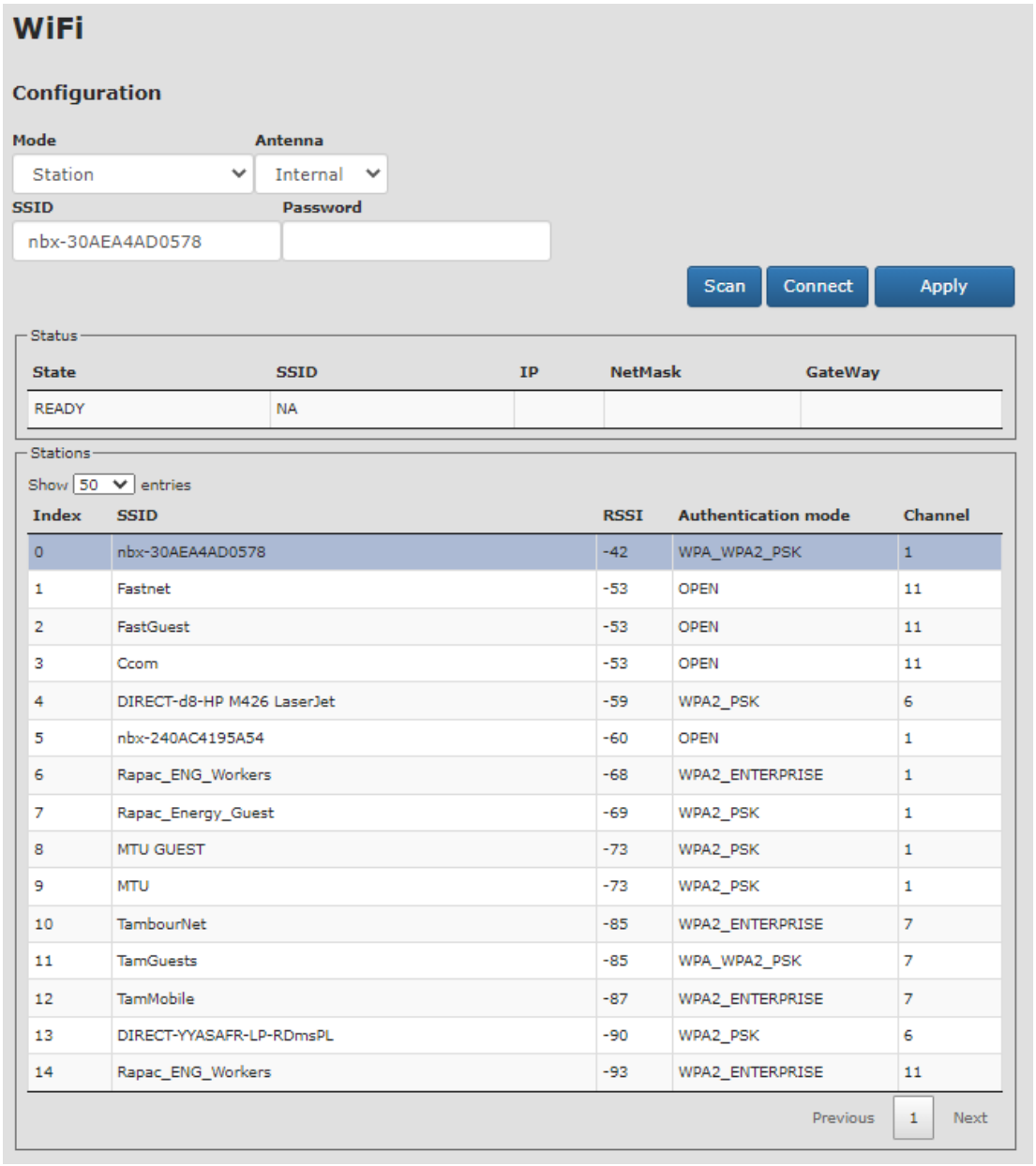


Configure Wi-Fi interface :

- **Disabled**: Disable the Wi-Fi.
- **Station**: The NBX is in station mode – connecting to available access points.
- **Access Point**: The NBX is in Access Point mode

Access Point Auto off: The NBX is in Access Point mode when powered up. After 15 minutes, the AP turns off automatically until the unit is again powered on. This feature allows the use of Wi-Fi for the initial configuration, or for on-site configuration. Change to any other mode to disable this mode. To switch between Station / Access Point / Access Point Auto off modes, you must first change the Mode to Disabled.

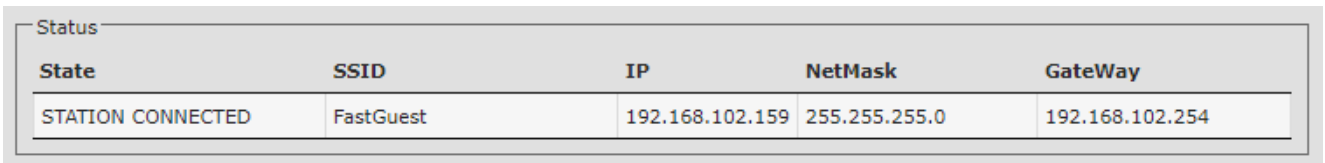
6.4.14.1 System - Wi-Fi – Station



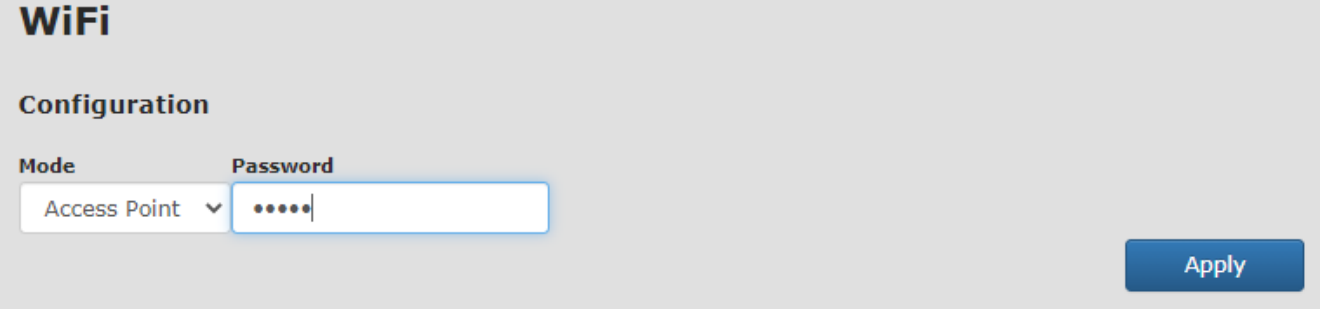
Scan for available access points → press Scan.

To connect: *Select* the desired access point from the list → provide *password* → press *Connect or alternatively enter the SSID and Password manually and press Connect.*

After connecting to the AP, an IP will be provided.



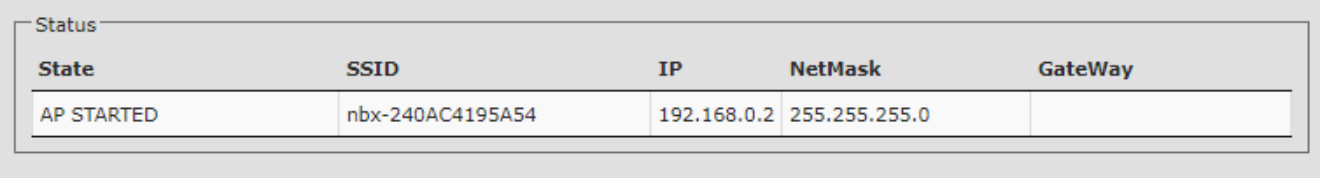
6.4.14.2 System - Wi-Fi – Access Point



To enable: Select *Access Point* mode → provide *password* (optional) → *Apply*

After enabling the access point, it provides the details of the SSID and the user may connect to it from an external device,

The IP Address to connect to the NBX via the AP is listed (192.168.0.2)

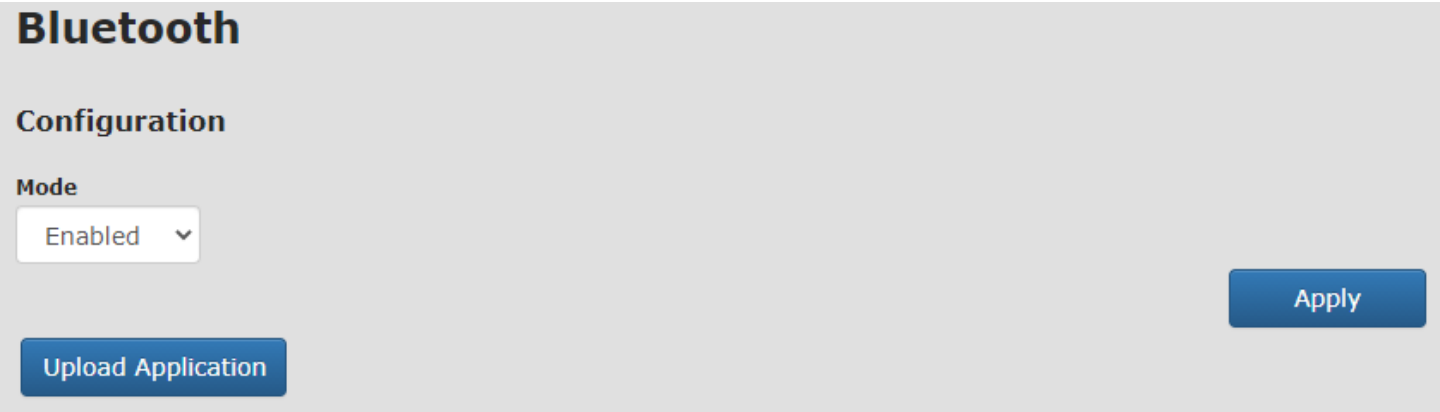


6.4.14.3 System - Wi-Fi – Access Point Auto off

Same as 6.4.12.2 (Access Point), but with 15 minutes timeout after power-on / reboot, after which the AP will be automatically disabled until the next power up.

Default password: **12345678**

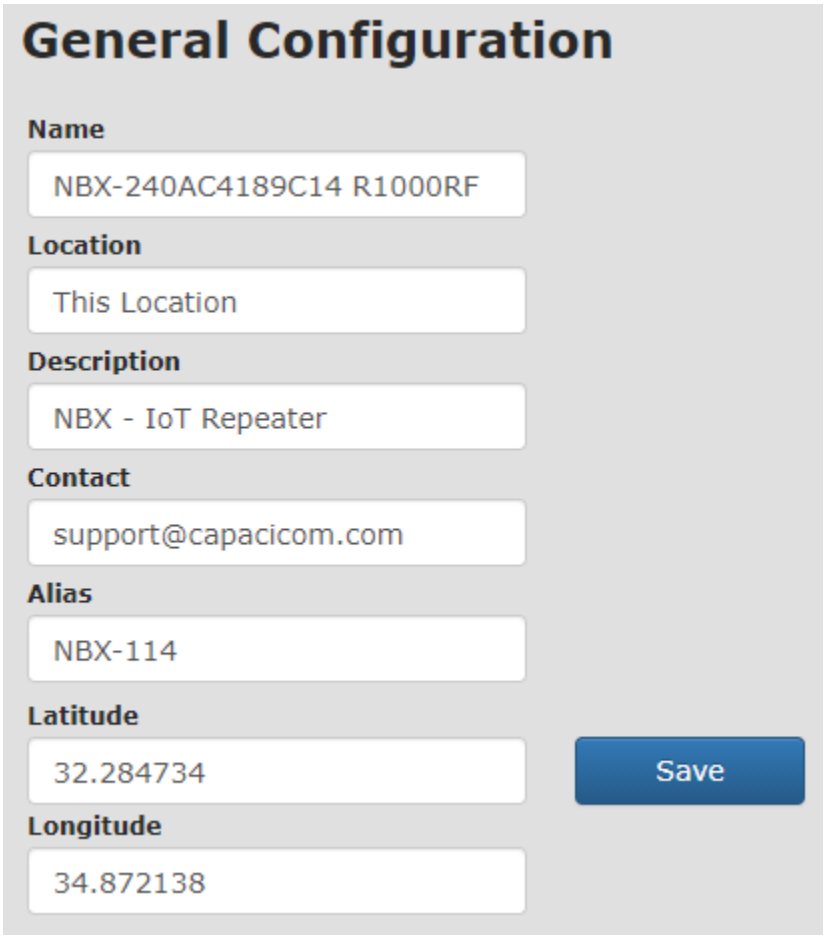
6.4.15 System - Bluetooth



Configure Bluetooth interface :

- **Mode**: Enable/Disable.
- **Upload Application**: Upload the Android APK application from the NBX to the PC. This application can be installed on any Android machine to control & manage the NBX via BT.

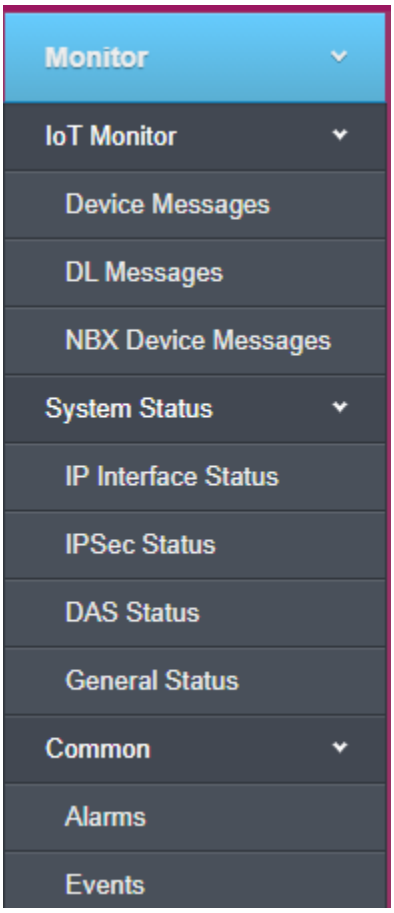
6.4.16 System – General Configuration



General configuration to be read by SNMP and other control tools:

- **Name**: The name of the unit
- **Location**: Text describing the location
- **Description**: Description of the unit
- **Contact:** Support email contact
- **Alias:** An alias name for the unit. Will be displayed in the browser tab and CLI prompt.
- **Latitude:** The geo-location latitude value in a range of -90 - +90 degrees.
- **Longitude:** The geo-location longitude value in a range of -180 - +180 degrees.

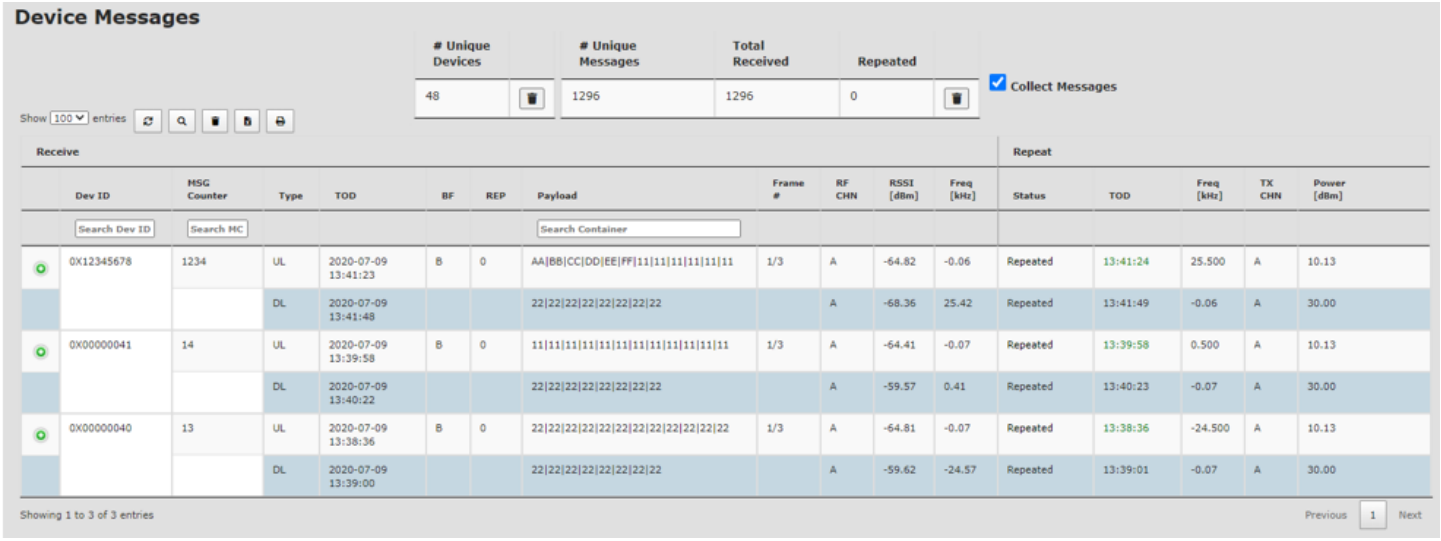
6.5 Monitor



Under ***Monitor*** there are two main sections – ***IoT*** and ***System***:

- ***IoT Monitor:***
  - ***Device Messages*** – Displays UL messages received and repeated by the unit as well as DL messages received and associated to UL frames received
  - ***DL Messages*** – display all DL frames received, including those which not associated with a corresponding UL.
  - ***NBX Device Messages*** – Self Messages generated from/to the NBX unit
- ***System Status:***
  - ***IP Interface Status –****Statistics of the IP interfaces*
  - ***IPSEC Status*** *– Status of the IPSEC VPNs*
  - ***DAS Status –*** *Statistics of the DAS messages*
  - ***General Status*** *– General Status (temperature, Voltage…)*
- ***Common:***
  - ***Alarms –*** *Current Alarms*
  - ***Events –*** *Events log*

6.5.1 IoT - Device Messages



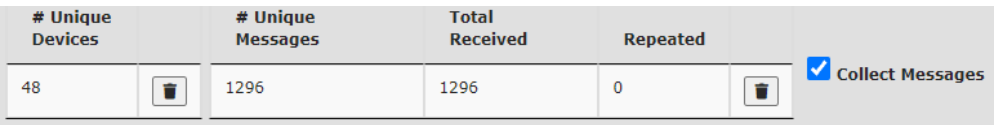
Displaying the messages received and repeated by the unit (**including associated DL** messages).

All the relevant information for each unique message is displayed:

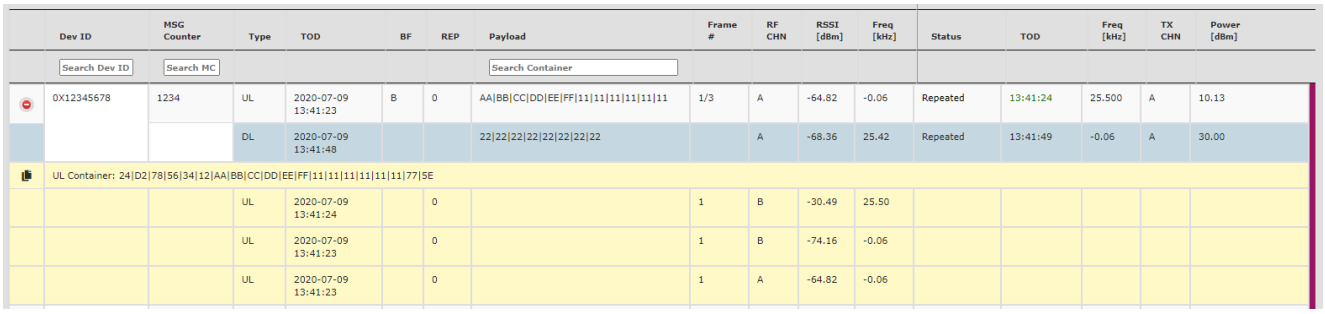
- ***Receive***
  - ***Dev-ID***: Device ID (can ***search*** for specific device-ID's)
  - ***MSG Counter***: Message counter (can ***search*** for specific MC's)
  - ***Type***: UL, UL100 or DL (UL100 are UL messages at 100Hz Baud)
  - ***TOD***: Time of Day
  - ***BF***: **B**i-directional or **U**ni-directional mode (ACK or not)
  - ***REP***: Repetition bit on (1) / off (0)
  - ***Payload:*** payload data (can ***search*** for specific data) – available in **Expert mode** only
  - ***Frame #*** : how many frames out of the 3 were received
  - ***RF CHN*** : The strongest RSSI frame, RF channel (A or B)
  - ***RSSI[dBm]*** : The strongest RSSI frame
  - ***Freq.[kHz]*** : The strongest RSSI frame, frequency (relative to the central band).
- **Repeat**
  - ***Status***: the status of the repetition: Repeated, pending, …
  - ***TOD***: Time of Day of the transmitted
  - ***Freq***.: transmitted frequency (relative to the central band – N.B. it is different for both UL and DL).
  - ***TX Channel*** – Which channel the message was repeated from
  - ***Power[dBm]*** : Transmitted power

DL messages are placed below the associated UL message which triggered it.

Collect Messages– Enable/disable message collection mechanism.



Detailed message information: can be displayed when clicking on the message (+):

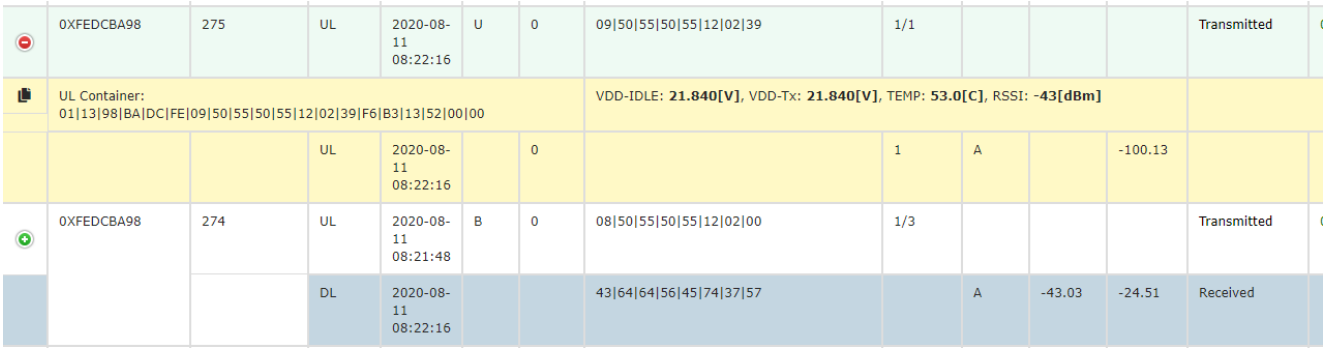


	Dev ID	MSG Counter	Type	TOD	BF	REP	Payload	Frame #	RF CHN	RSSI [dBm]	Freq [kHz]	Status	TOD	Freq [kHz]	TX CHN	Power [dBm]
	Search Dev ID	Search MC					Search Container									
	0X12345678	1234	UL	2020-07-09 13:41:23	B	0	AA|BB|CC|DD|EE|FF|11|11|11|11|11|11	1/3	A	-64.82	-0.06	Repeated	13:41:24	25.500	A	10.13
			DL	2020-07-09 13:41:48			22|22|22|22|22|22|22|22		A	-68.36	25.42	Repeated	13:41:49	-0.06	A	30.00
	UL Container: 24|D2|78|56|34|12|AA|BB|CC|DD|EE|FF|11|11|11|11|11|11|77|5E															
			UL	2020-07-09 13:41:24		0		1	B	-30.49	25.50					
			UL	2020-07-09 13:41:23		0		1	B	-74.16	-0.06					
			UL	2020-07-09 13:41:23		0		1	A	-64.82	-0.06					

All the related information details of each frame are displayed.

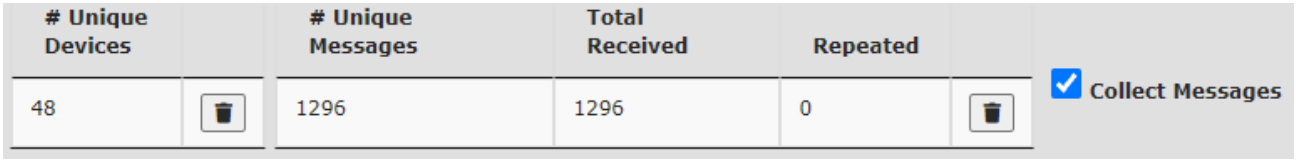
OOB/Control message information: detailed the Sigfox control message information.

VDD-Idle, VDD-TX, Temperature, RSSI.



	0XFEDCBA98	275	UL	2020-08-11 08:22:16	U	0	09|50|55|50|55|12|02|39	1/1				Transmitted	
	UL Container: 01|13|98|BA|DC|FE|09|50|55|50|55|12|02|39|F6|B3|13|52|00|00						VDD-IDLE: **21.840[V]**, VDD-Tx: **21.840[V]**, TEMP: **53.0[C]**, RSSI: **-43[dBm]**						
			UL	2020-08-11 08:22:16		0		1	A		-100.13		
	0XFEDCBA98	274	UL	2020-08-11 08:21:48	B	0	08|50|55|50|55|12|02|00	1/3				Transmitted	
			DL	2020-08-11 08:22:16			43|64|64|56|45|74|37|57		A	-43.03	-24.51	Received	

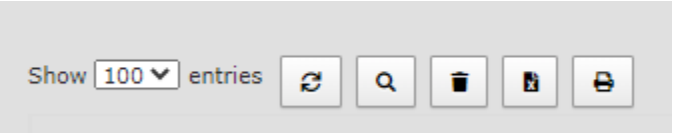
Statistics: displays the overall messages statistics. How many were received and how many were repeated.



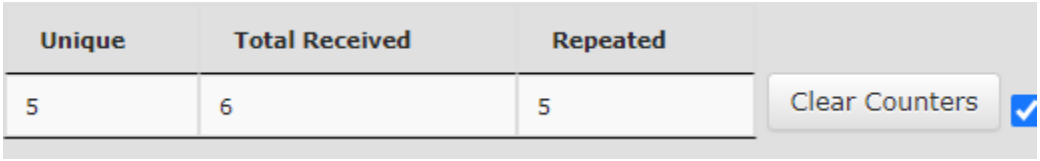
# Unique Devices		# Unique Messages	Total Received	Repeated		
48		1296	1296	0		Collect Messages

- ***# Unique Devices***: Number of unique device-id's
- ***# Unique Messages***: Message counter
- ***Total Received :*** How many messages were received
- ***Repeated :*** Total messages repeated

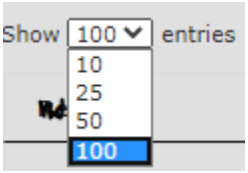
Actions:



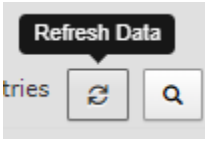
- ***Clear counters***: Clear the statistics.



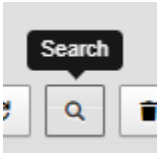
- ***Show*** : display 10,25,50 or 100 entries



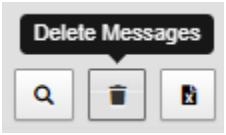
- ***Refresh***: refresh the message monitor



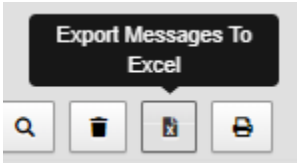
- ***Search***: Search according to search criteria in other fields



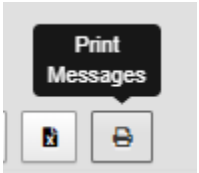
- ***Delete***: clear all the messages



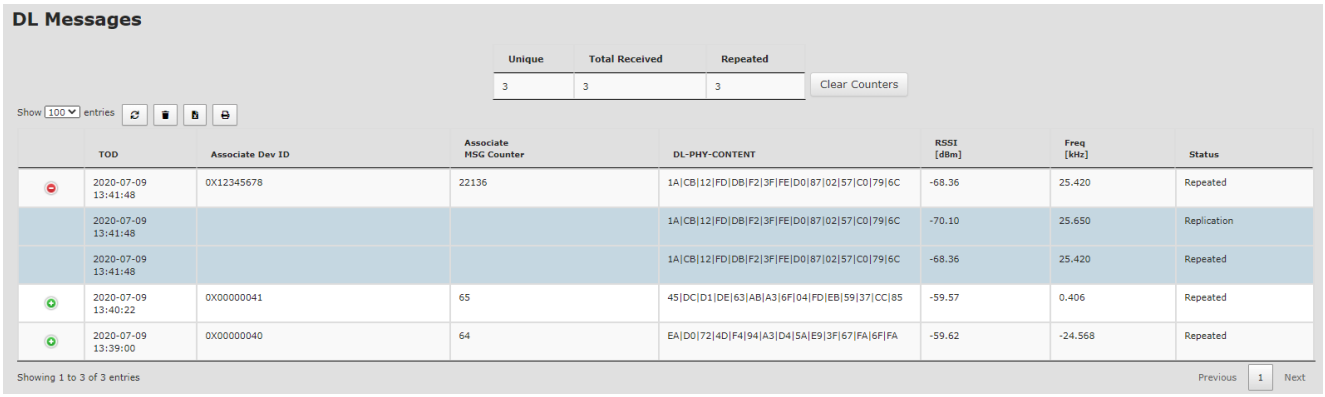
- ***Export***: export the messages displayed to Excel file



- ***Print***: Print the displayed messages



6.5.2 IoT - DL Messages



Displays all DL received frames, including ones which not associated with UL repeated by the unit.

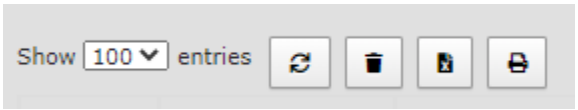
For each unique message all the relevant information is displayed:

- ***TOD***: Time of Day
- ***For associated messages***:
  - ***Dev-ID***: Device ID
  - ***MSG Counter***: Message counter
  - ***DL-PHY-Content***
  - ***RSSI[dBm]*** : The strongest RSSI frame, RSSI
  - ***Freq***.[kHz] : The strongest RSSI frame, frequency (relative the central band).
  - ***Status***: Confirmation if it was repeated.

Detailed message information: Displays more details when clicking on the message (+).

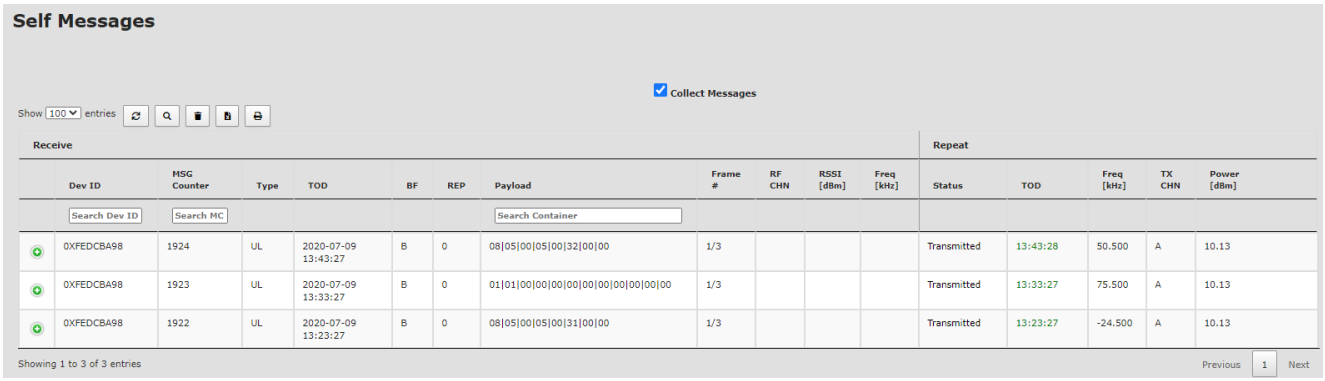
Actions:

Similar to Device messages screen.



- ***Clear counters***: Clear the statistics.
- ***Show***: display 10,25,50 or 100 entries
- ***Refresh***: refresh the message monitor
- ***Delete***: clear all the messages
- ***Export***: export the messages displayed to Excel file
- ***Print***: Print the displayed messages

6.5.3 IoT - NBX Device Messages

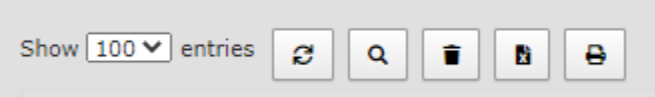


Display NBX Device Messages created by the unit.

Similar fields as in Device messages screen.

Actions:

Like Device messages screen.



- ***Clear counters***: Clear the statistics.
- ***Show***: display 10,25,50 or 100 entries
- ***Refresh***: refresh the message monitor
- ***Search***: Search according to search criteria in other fields
- ***Delete***: clear all the messages
- ***Export***: export the messages displayed to Excel file
- ***Print***: Print the displayed messages

6.5.4 System – IP Interface Status

IP Interfaces Status

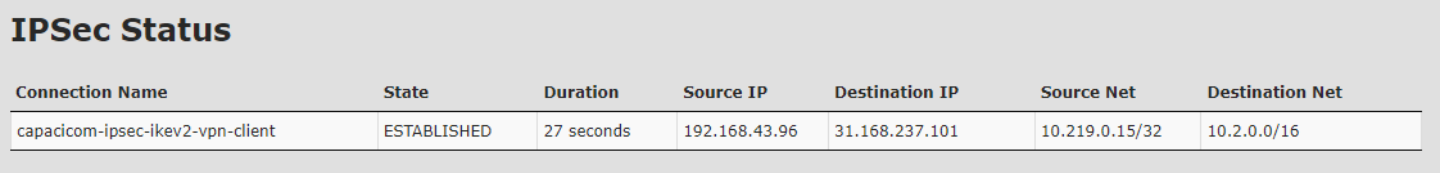
	Name	State	DHCP	WEB Access	MAC	IP	Mask	Defult GW	RX Packets	TX Packets	RX Bytes	TX Bytes	Description
	eth0	Enabled	Enabled	Enabled	30:AE:A4:AC:FB:3F	192.168.128.14	255.255.255.0	192.168.128.1	47592	40133	6943650	6383944	Local Ethernet
	wlan1	Enabled	Enabled	Enabled	30:AE:A4:AC:FB:3C	192.168.30.2	255.255.255.0		0	60	0	11248	Local WiFi
	wwan0	Enabled	Enabled	Enabled	00:1E:10:1F:00:00	10.45.149.76	255.255.255.248	10.45.149.73	5062	5910	476133	1284570	Huawei MS2131 4G USB
	eth0:0	Enabled	Disabled	Enabled	30:AE:A4:AC:FB:3F	192.168.1.1	255.255.255.0						Local Ethernet
	ipsec0	Enabled	Enabled	Enabled	00:00:00:00:00:00	10.219.0.31	255.255.255.255		0	15	0	720	VPN

USB 4G/3G Status

Name	RSSI	BER	System Service	Service Domain	Roaming	System Mode	SIM Card	Sub Mode	Network Mode	Network Access	Network Name	Connection State
wwan0	-101	NA	Valid	PS+CS	No	WCDMA	Valid	HSDPA	Auto-Manual	UTRAN GSM-w/EGPRS	YES OPTUS	Connected

Display the NBX-R1000-RF IP interfaces and USB Dongle, status and statistics.

6.5.5 System – IPSEC Status



IPSec Status

Connection Name	State	Duration	Source IP	Destination IP	Source Net	Destination Net
capacicom-ipsec-ikev2-vpn-client	ESTABLISHED	27 seconds	192.168.43.96	31.168.237.101	10.219.0.15/32	10.2.0.0/16

Display the status of IPSEC VPN in NBX-R1000-RF.

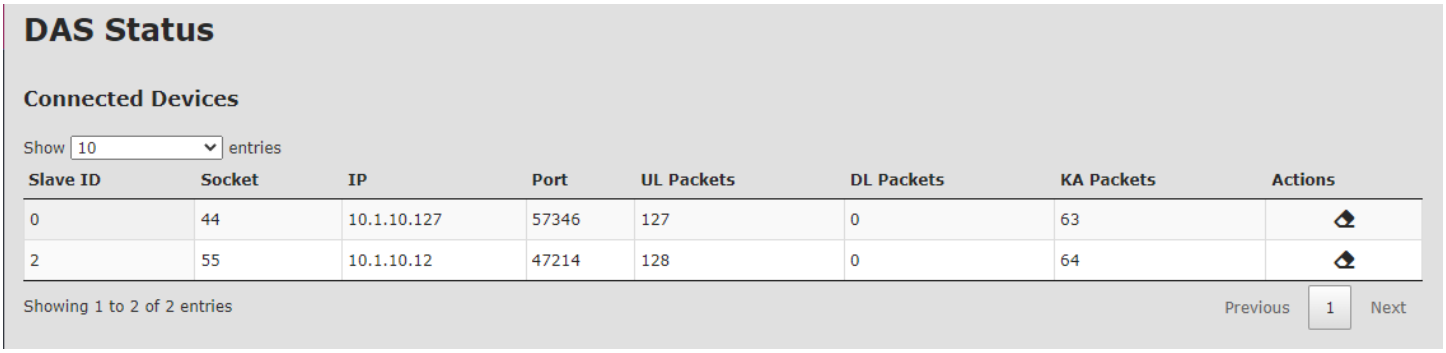
- **Name**
- **State**
- **Duration**
- **Source IP**
- **Destination IP**
- **Source Net**
- **Destination Net**

6.5.6 System – DAS Status

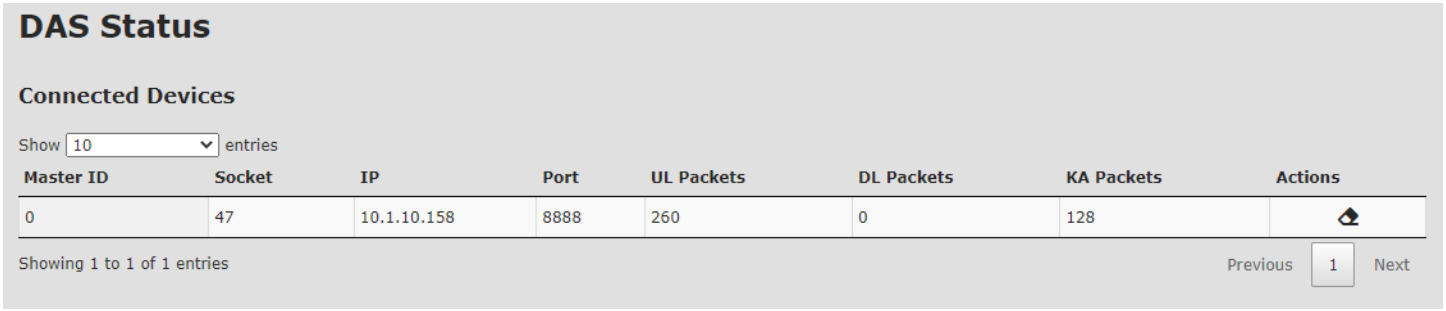
Display the NBX-R1000-RF IPSec status and statistics. The Status info depends on DAS setting, **Master/Slave/None**

- **Slave/Master ID** – Which Master/Slave ID
- **Socket**
- **IP** – IP Address
- **Port** – IP port
- **UL Packets** – number of UL packets
- **DL Packets** – number of DL packets
- **KA Packets** – number of Keep Alive packets
- **Actions** – Clear counters

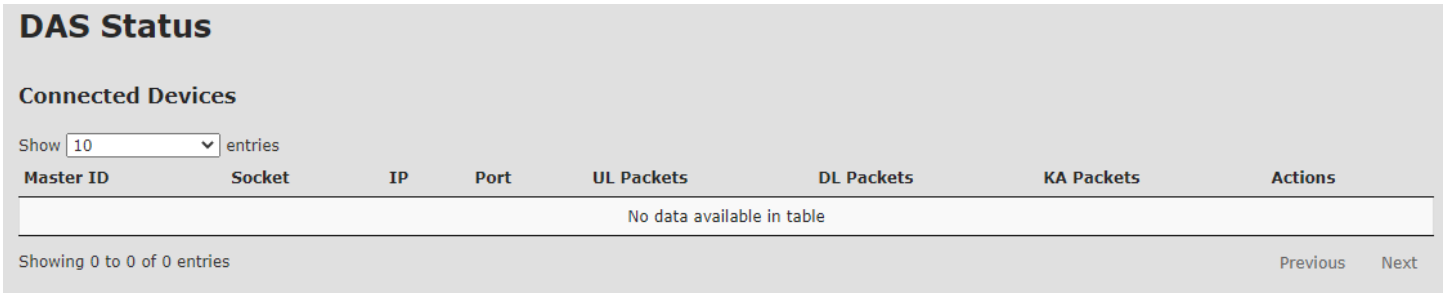
Master:



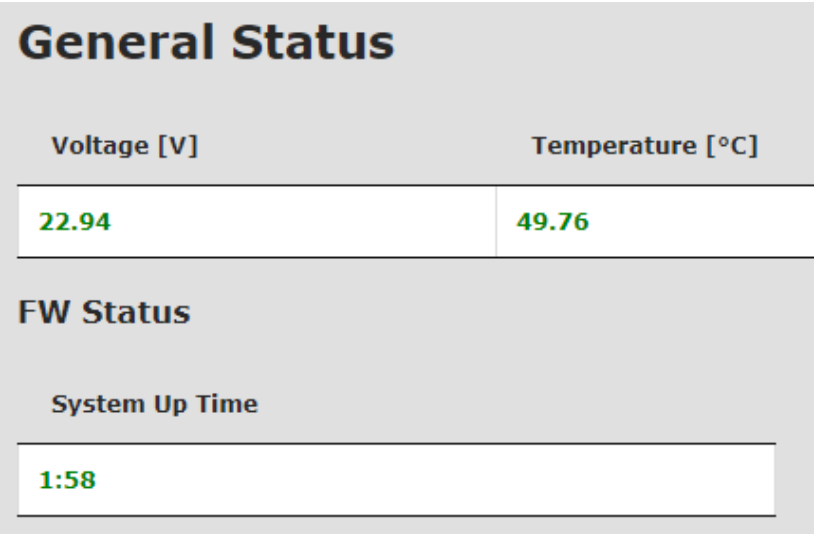
Slave:



None:



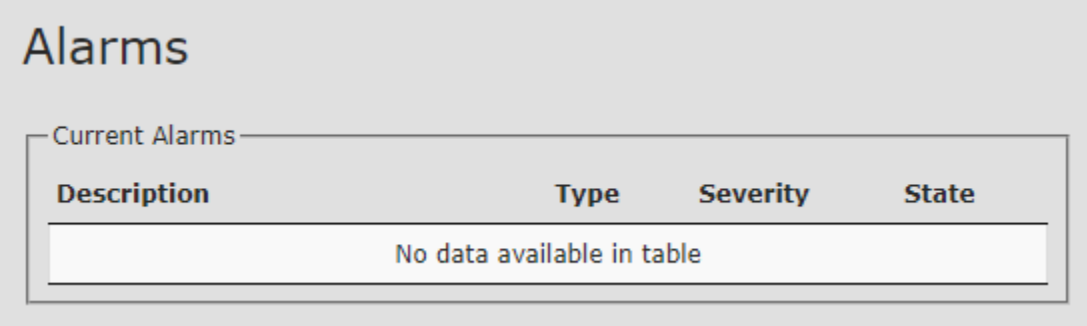
6.5.7 System – General Status



Display the NBX-R1000-RF general status:

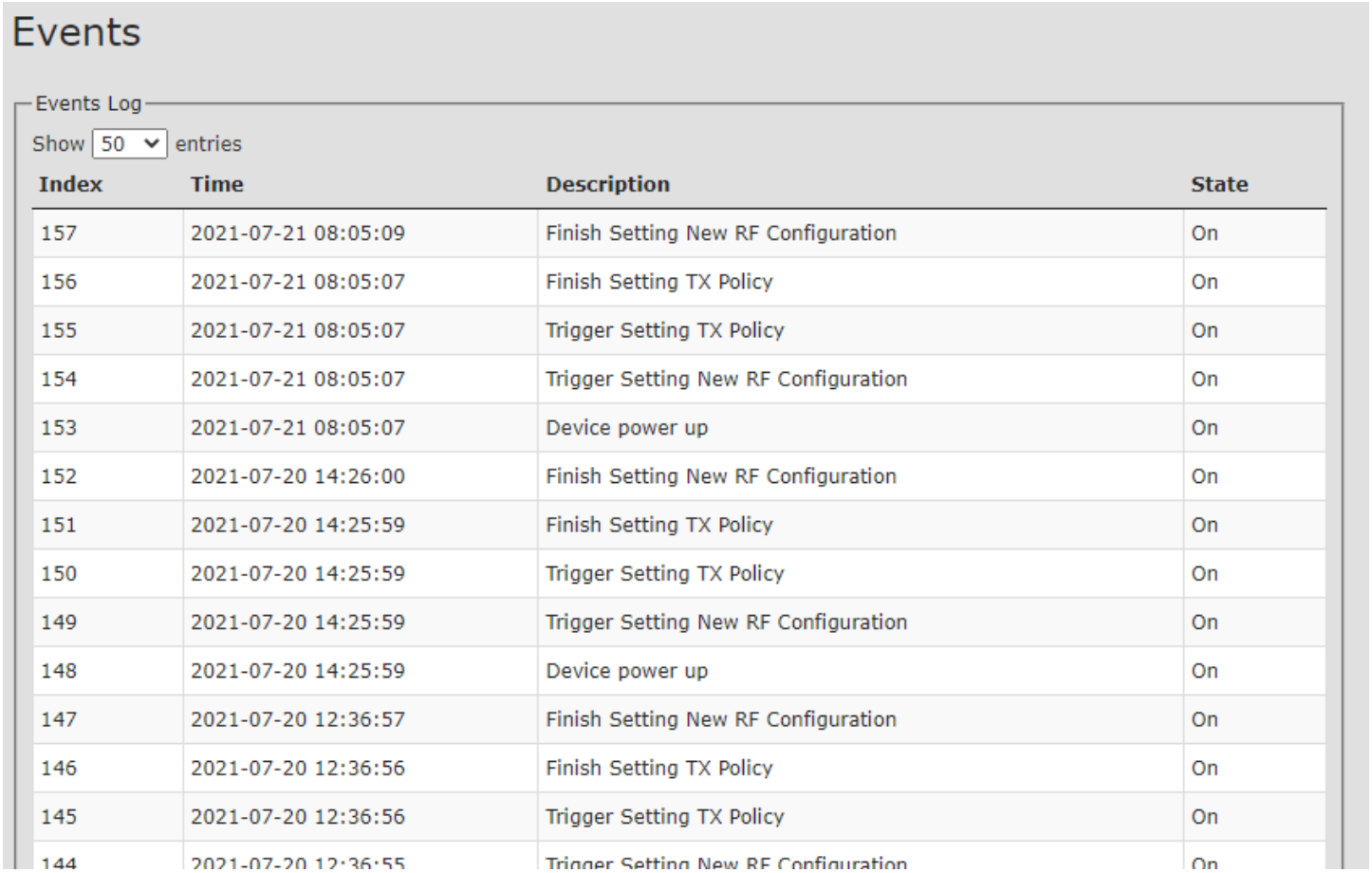
- **Voltage** [V] – Input Voltage [Volt]
- **Temperature** (SDR chip Temperature) [^{o}C]
- **System up Time** – time elapsed since system boot

6.5.8 Common – Alarms



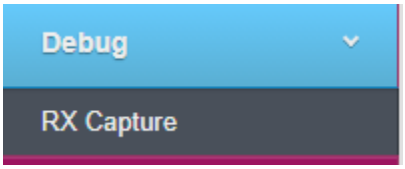
Display the NBX-R1000-RF Alarms.

6.5.9 Common – Events



Displays events on the NBX-R1000-RF.

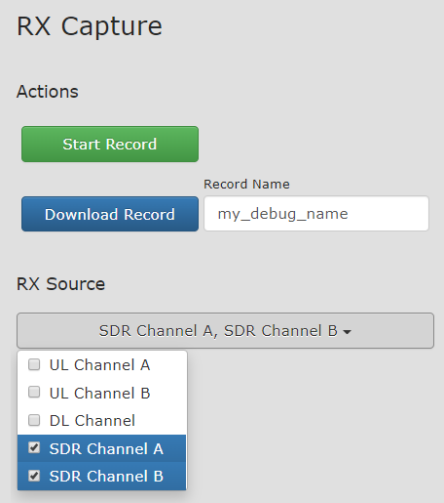
6.6 Debug



Under ***Debug*** there are the following sections:

- ***RX Capture*** – Captures the raw RF samples and analyzes the spectrum
- ***Additional*** – *available only in Expert mode*

6.6.1 RX Capture

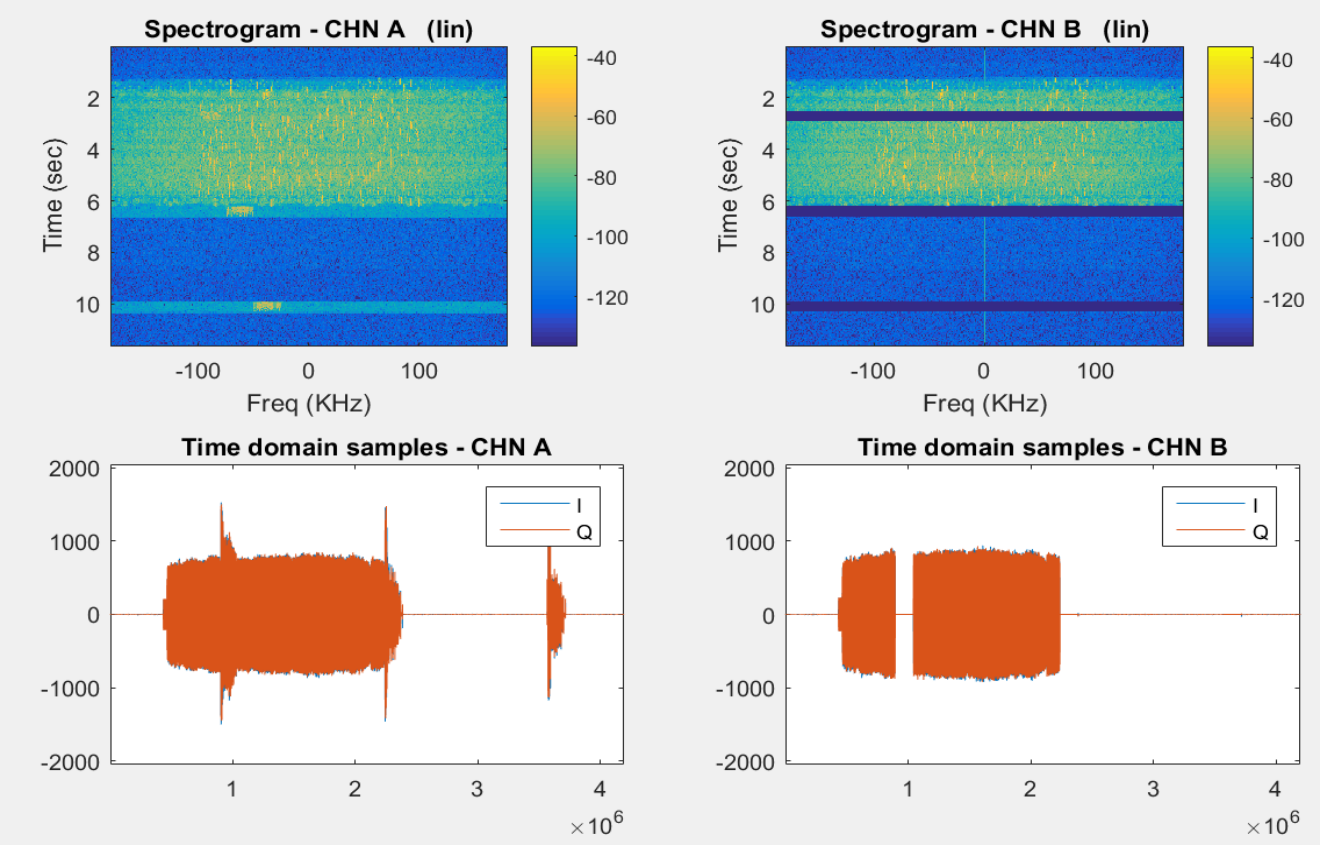


RX Source: Captures samples from the RF channel chosen for offline analysis. Either the entire band (SDR: UL+DL) or for each channel narrow band (UL-A, UL-B, DL).

Start Record/Stop Record: Starts and stops the recording of the chosen band(s). Can capture up to: 10 or 20 seconds for single/dual channel mode or 1 or 2 seconds for the entire band.

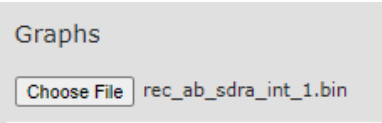
Download Record: Downloads the file. File name can be selected - every new capture, increase the name number suffix (#).

Choose a File: Select a previously recorded file to show the analysis. Embedded analysis tool included in the "RX Capture" page. Data can also be analyzed offline by expert tools. e.g.:



6.6.1.1 RX Capture - Analysis

Upload the captured data by selecting the file:



UL and DL captures occupy 360KHz around the RC zone central frequencies. 192KHz is Sigfox usable band.

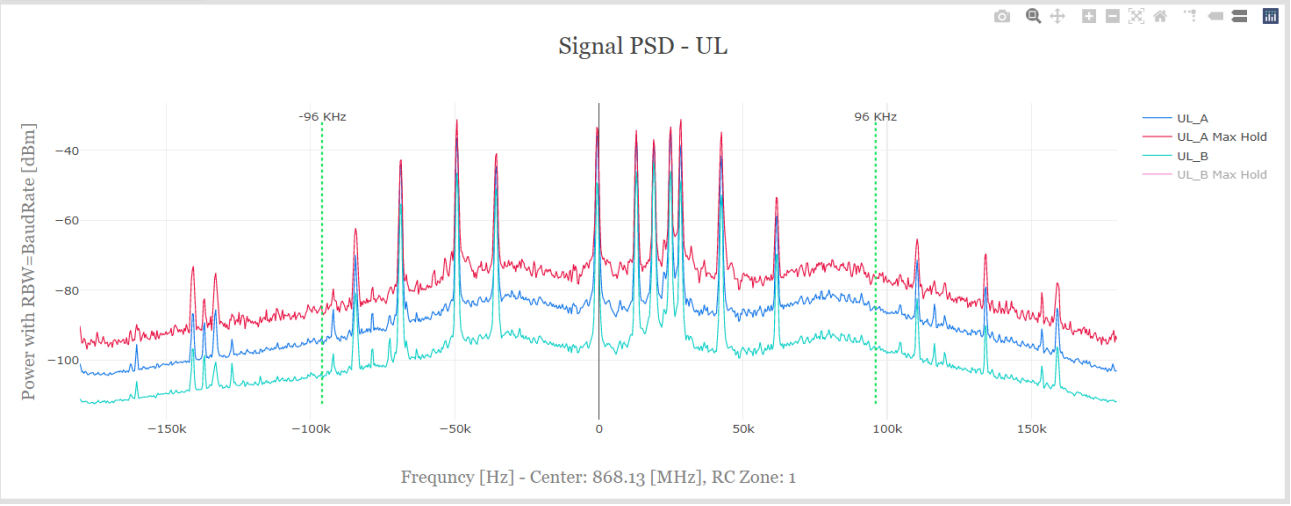
SDR captures occupy 5.7MHz around the mid. Frequency between UL and DL, so, it displays both bands.

There are several analysis options (pressing on the legend turn on/off the display) :

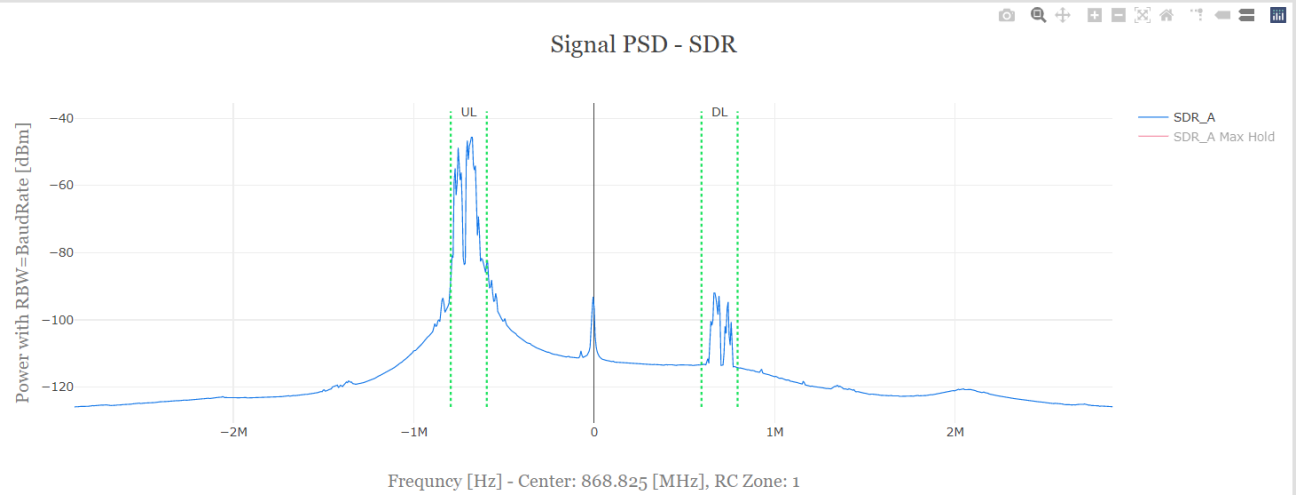
- Average PSD (Power Spectral Density)
- Max-Hold PSD
- Spectrogram (freq. over time)

The limits and frequencies are displayed according to the current selected RF configuration of the unit. E.g.:

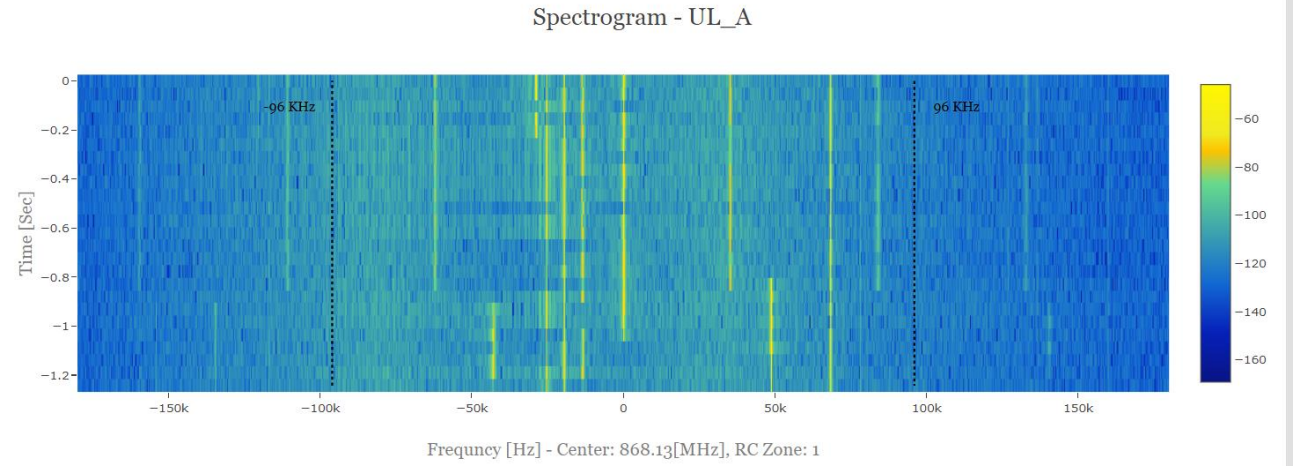
Hide Power/Frequency UL



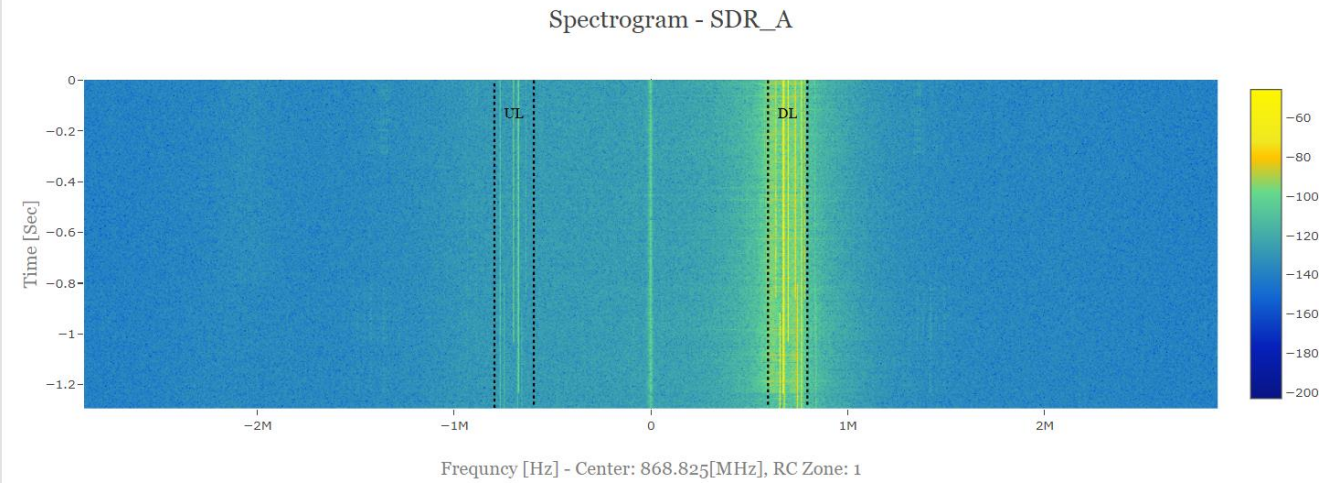
Hide Power/Frequency SDR



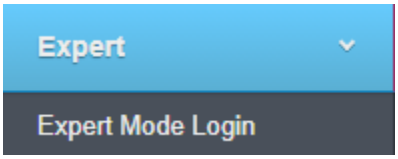
Hide Spectogram UL_A



Hide Spectogram SDR_A

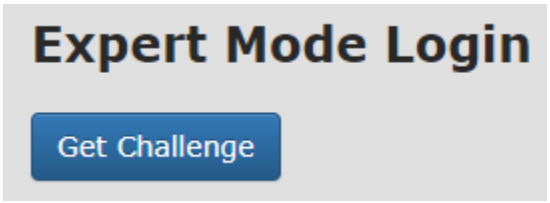


6.7 Expert



Under ***Expert*** there are the additional sections which are for “expert” user (**Super-User** group) and ***internal*** use:

Need to login first:



Each time a different challenge is generated to login.

7 Monitor & Configuration– CLI

This section will describe some **BASIC** **CLI** access mode. A more detailed reference manual can be used.

7.1 General - CLI

After identifying the NBX R1000-RF IP Address, it can be access via SSH using standard tools, e.g. putty).

After login, there are 3 main functionalities:

- **Debug** – special debug instructions {internal use}
- **Enable** – Configure various setting in the device.
- **Show** – display current status of the device

In addition, there are **global** CLI commands:

- **?** – display help (at any stage of the CLI – even during command entry)
- **Exit –** exit one level up
- **Help –** display help
- **History –** display current session CLI history
- **Logout –** Logout from the CLI session
- **Top –** Return to default mode

```
!         Comments
debug     Change to the debug mode
enable    Turn on privileged commands
exit      Exit from the CLI
help      Display an overview of the CLI syntax
history   Display the current session's command line history
logout    Logout of the current CLI session
show      Change to the show mode
top       Return to the default mode
```

Menu commands are indicated by **(M)**. At each hierarchy the current location is in the command prefix.

e.g. in the **enable** menu :

#

? →

…
```
configure   (M)Enter configuration mode
```
…

in the sub menu **enable>config>system>general**

```
(config-system-general)#
```

7.2 Login - CLI

Need to provide user-name and password.

```
login as: admin
admin@10.1.12.12's password:****

*****************************************
*         Capacicom NBX CLI               *
*                                          *
*      WARNING: Authorized Access Only     *
*****************************************

Welcome admin it is Thu Jan  1 00:02:22 UTC 1970
>
```

7.3 System - CLI

Under ***System*** all users will see the following sections.

System configuration and monitor are under the general "***Monitor***", "***Configuration***" menus.

- ***Version*** - SW and HW version, S/N
- ***Software Upgrade*** – SW upgrade
- ***Database*** – Database management
- ***Users –*** User management
- ***System Debug –*** log files for debug
- ***General –*** reboot
- ***Safe Mode –*** Safe mode

7.3.1 Version

Display the NBX-R1000-RF SW and HW versions and S/N.

```
> show system serial_number
24:0a:c4:19:77:24
> show system hw_version
5
> show system version
1.0.0+1836
> show system esp_version
software version: 1.0.5.0
> show system all
Temperature: 48.812817
Voltage: 22.608000
Product: NBX-R1000RF
Serial Number: 24:0a:c4:19:77:24
System HW Version: 5
System Version: 1.0.0+1836 [25/05/2021-16:13]
System Version Backup: 1.0.0-local+1822 [04/05/2021-15:06]
Build Date (D.M.Y): 15.2.21 | Build: 1
ESP software version: 0.0.0.0
```

7.3.2 Software Upgrade

Need to have a **tftp server** to access the SW package.

First need to download and extract (in the enable-system menu):

```
(system)# software_upgrade < Software.tar.gz file> < tftp file server IP> <server type>
```

e.g.

```
(system)# software_upgrade sw.package.iot_nbx_40MHz.1.0.0+1351.tar.gz 10.1.1.2 tftp
```

Afterwards, need to swap to backup:

```
(system)# swap_software
```

8 Monitor & Configuration– SNMP

Following are the SNMP settings and commands. The IP address and the general settings. Need to be known in order to access the unit.

SWNMP discovery tool can be used. See section

8.1 SNMP General Configuration

Before starting to work with the unit via SNMP, it needs to be configured according to your NMS requirements.

Configuring the SNMP setting:

- ***Version*** – SNMP version: V1&V2 or V3
- ***Read Only Community*** – Read only community name
- ***Read/Write Community*** – Read/Write community name
- ***Trap version*** – versions - V1 or V2
- ***Trap Host 1*** – IP of trap host 1
- ***Trap Community 1*** – name of trap host 1 community
- ***Trap Host 2*** – IP of trap host 2
- ***Trap Community 2*** – name of trap host 2 community

8.2 SNMP Commands (MIB)

MIB files are delivered with the SW version. There are 3 NBX specific command files:

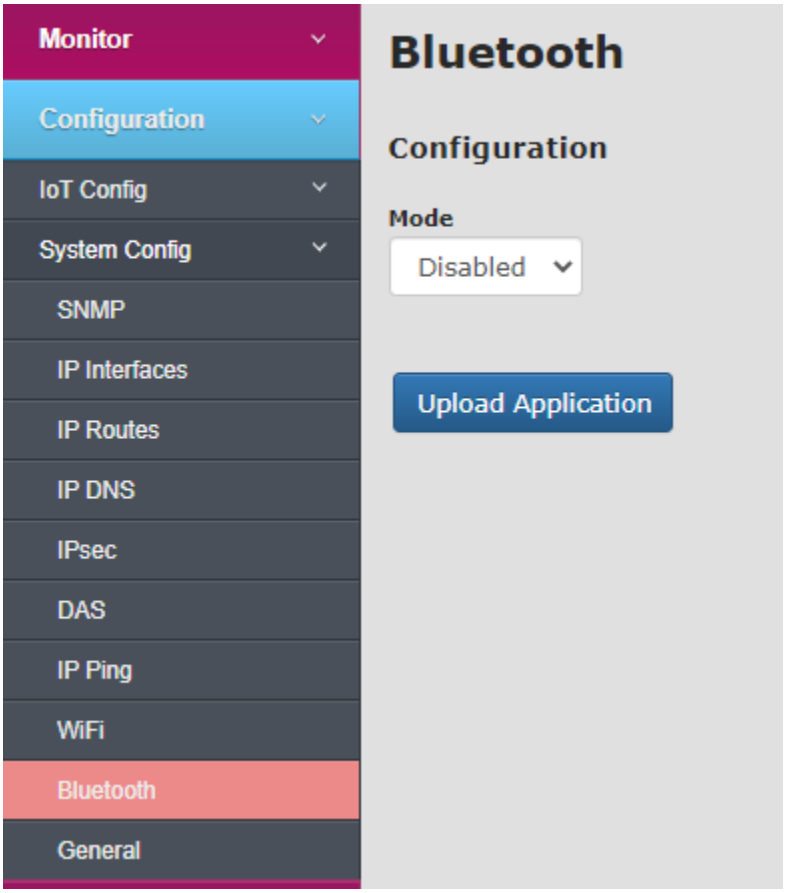
- **CAPACICOM-COMMON.mib** – basic capacicom product commands (e.g., Software upgrade)
- **CAPACICOM-NBX.mib** - specific NBX R1000-RF commands (e.g., IoT RF settings)
- **CAPACICOM-ROOT.mib** – link to the global mib tree

Detailed commands are described within the mib files.

9 Monitor & Configuration – Bluetooth

To configure and monitor the device through Bluetooth you need first to install the application (nbx.apk) on Android device.

The application can be uploaded directly from the NBX under the Configuration→System Config → Bluetooth menu.

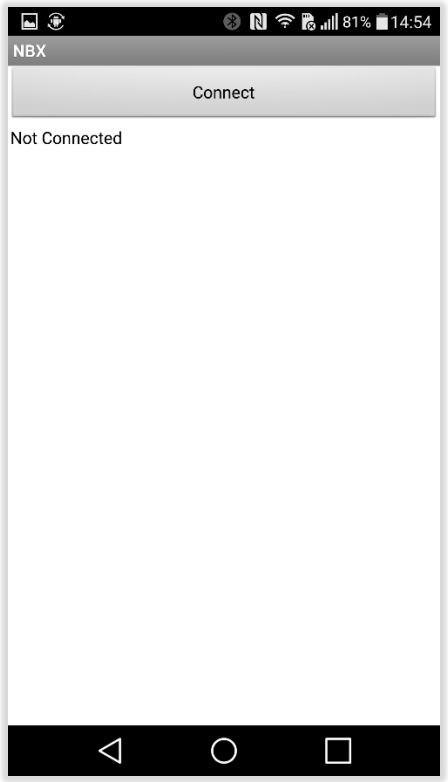


Download the application file (nbx.apk) to your Android device.

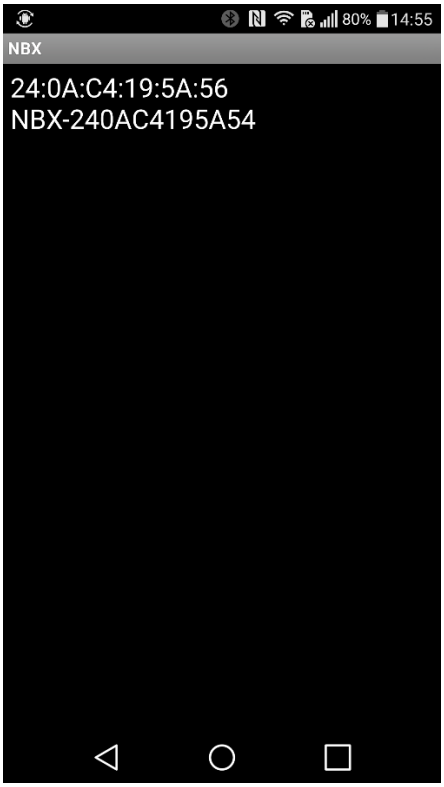
Open the file and accept installing an application from unknown source.

In your Android Bluetooth Settings menu on your device, activate the search and find the NBX device (named: NBX-<serial-number>), select it to pair the two together.

Once pairing is finished, open the application, you should get the following screen:

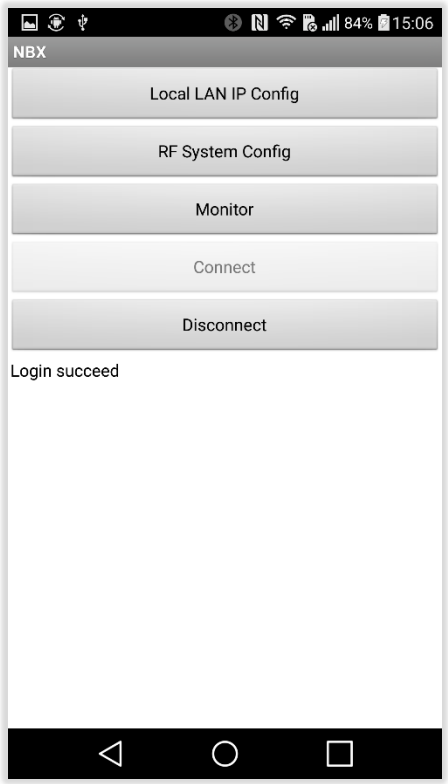


Press connect and select the NBX from the list:



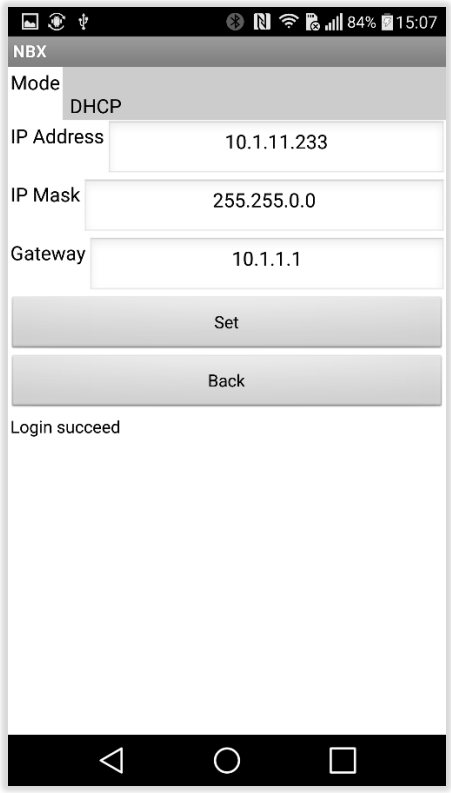
You should get the login screen:

Enter username and password and press “Login”, if user authenticated succeed you should get the main menu screen:

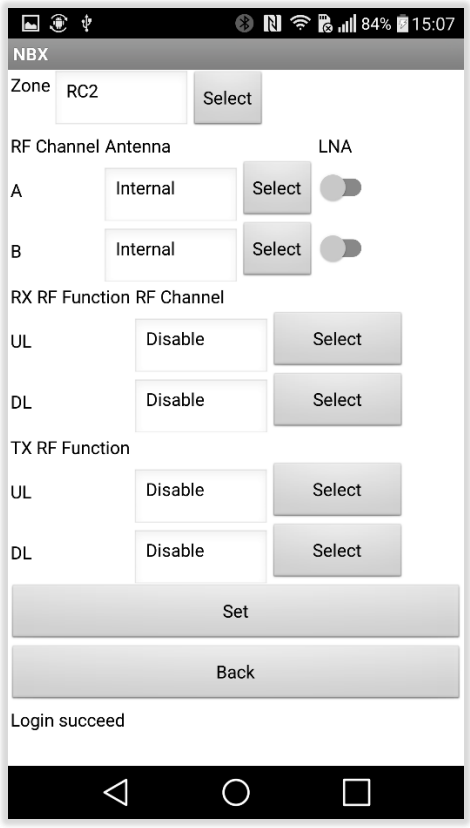


Depending on your selection you will get one of the following screens:

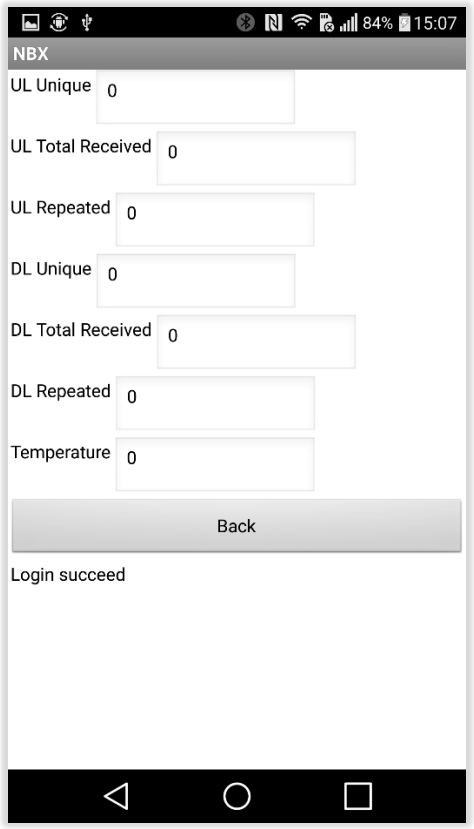
Monitor and configure IP settings:



RF Settings:



Monitoring:



10 Monitor & Configuration – IoT - Sigfox Protocol

The NBX R1000-RF is also a Sigfox device which can be access over the Sigfox network

10.1 NBX Device Mode - General Configuration

The NBX unit can immediately be accessed over Sigfox network as a device without specific configuration.

Expert mode enables additional settings to the default configuration.

- ***App Mode*** – Private, Public or Test mode – encryption key used.
- ***Auth Layer*** – Disabled, Active – Message authentication state.
- ***Reset MC*** – Reset the message counter.
- ***Test Key*** – Set the test key to be used.
- ***Set Test Key*** – Change the test-key according to the Test Key field.
- ***Message Type*** – Set the control message to be sent via the TX NBX SFX Message button.
- ***Download Device Key*** – Download an encrypted device KEY/ID from PC to NBX (need reboot to activate).
- ***Set App Config*** – Save the new configuration.

The Device ID and key are unique per NBX unit.

This will be provided for production units.

10.2 NBX Device Mode - General Flow

The NBX sends periodic status UL messages, indicating the unit status (power, repeated messages, etc.). The user can reply with a DL message with specific command, e.g., change configuration, send advance status etc.

The DL message will reconfigure NBX unit accordingly.

An application server can be used to manage all the repeaters in the network.

Any change to the RF configuration will put the unit in safe mode until an acknowledge is sent.

10.3 NBX Device Mode – Messages

Detailed message types and information are outlined in a separate document.

11 Specifications

The following are the NBX-R1000-RF specifications

Table 1 NBX specifications

Radio - IoT	
Standard	Sigfox UNB Protocol – All regions (100bps and 600 bps)
Operational Frequencies	865 MHz to 928 MHz (depend on country/regulations)
Receiver Sensitivity	-140dBm @ 100bps / -134dBm @ 600bps
Receiver Throughput	1000 @100bps /300 @600bps simultaneous messages (10 M/day)
Max output Power	27 dBm (depend on country/regulations)
RF channels	2 simultaneous RX/TX channels
Antennas	2 x External
Interfaces/Connectivity	
Ethernet	1 x RJ45 (10/100BaseT)
EXT Antennas	2 x RP-SMA
Cellular	1 x USB dongle (internal)
Wi-Fi/BT	1 x Wi-Fi/BT internal antenna
Power	
Power input	Passive PoE, 10 – 48 V
Power Consumption	<5W typical
Mechanical	
Casing (W x H x D)	185 x 185 x 57 mm
Weight	540 gr
Mounting options	Wall, Window, Pole, Desk mounts
Environmental	
Operating Temperature	-30 to +55^{0}C
Protection	IP67
Compliance	
Safety	EN 60950-22, IEC 60950-22; EN 62368-1, IEC 62368-1
Radio	EN 300 220-2 ; EN 300 220-1 ; FCC part 15.247 ; ARIB STD-T108, ETSI-300-328 (Wi-Fi / BT)
EMC	EN 301 489-3; EN 301 489-1 FCC Part 15 B; FCC 15.207 and FCC 15.209

12 Appendix

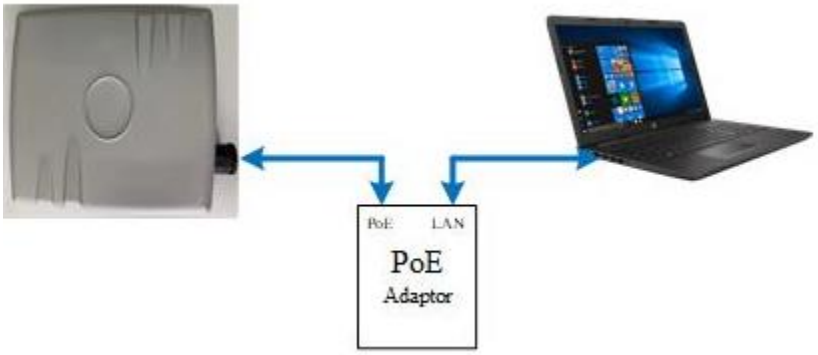
12.1 Initial IP Connectivity Setup

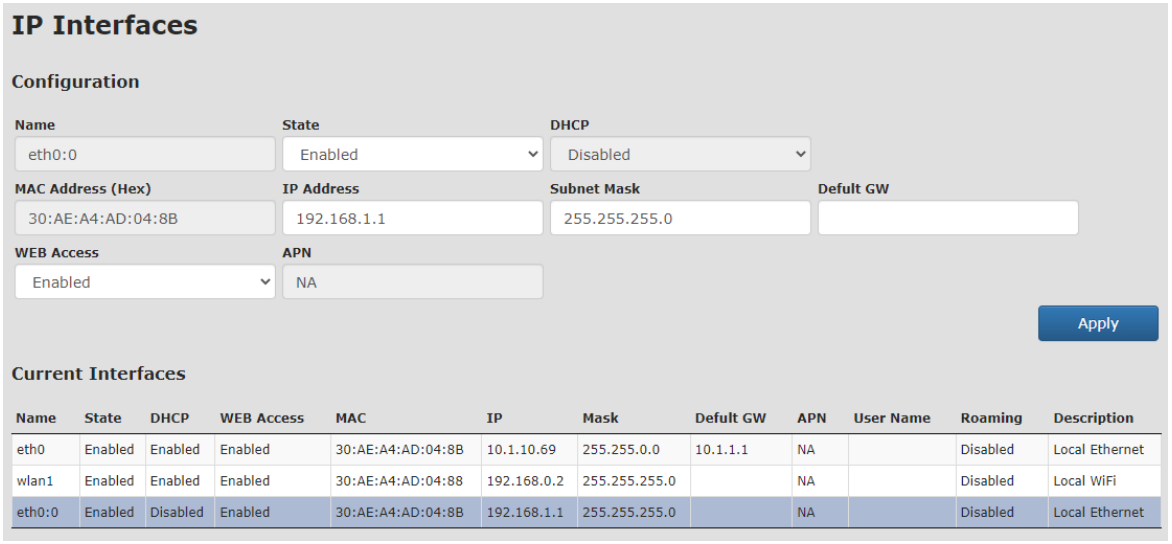
IP connectivity uses port **80** for WEB GUI and port **22** for **SSH CLI**. Make sure that the network defined policies are not blocking these ports.

In addition, a VPN may be set to secure the unit access.

IP connectivity to the unit can be obtain by the following guidelines:

12.1.1 RJ-45 IP port





Both ETH0 and ETH0:0 linked to the RJ-45 interface.

By default, ETH0 is set to DHCP and ETH0:0 is set to STATIC IP 192.168.1.1 / MASK 255.255.255.0.

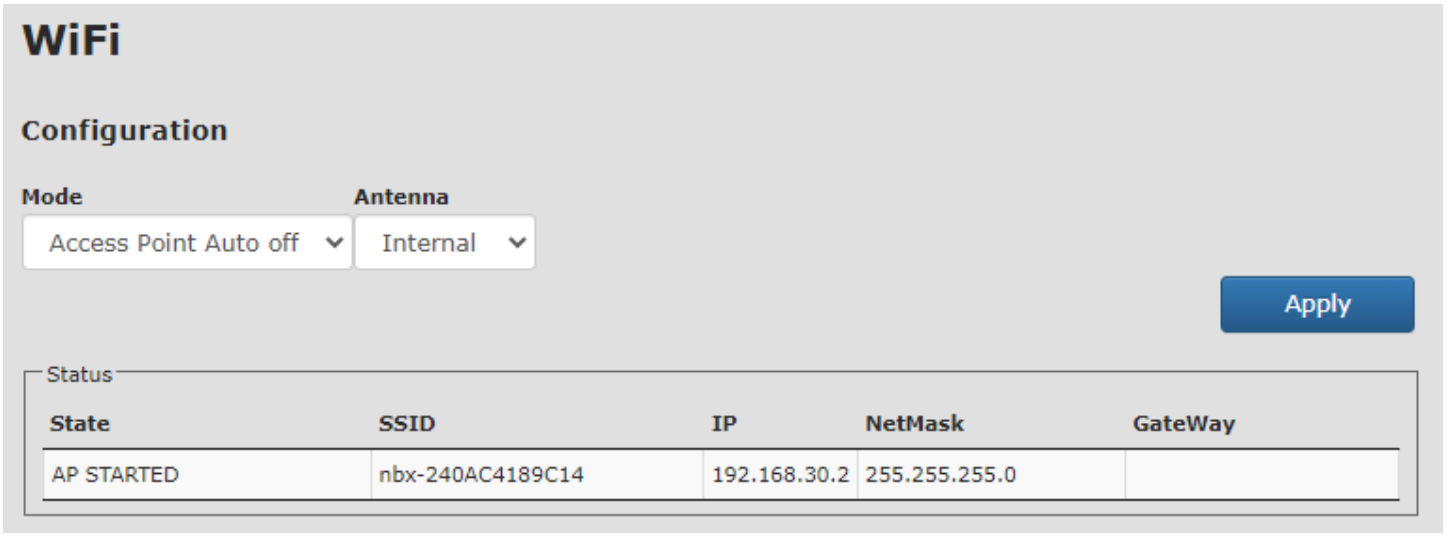
If connected to a switch or directly to a PC / LAPTOP, then the PC / LAPTOP should be set to STATIC IP in the 192.168.1.XXX subnet (XXX value in the range of 2 to 254). Then enter the 192.168.1.1 address to a chrome browser to open the GUI login page, or open SSH terminal with these IP.

If connected to a network which has a DHCP server, the unit will automatically allot an IP address to ETH0. Obtain the allotted IP address and enter it to the browser to open the GUI login page, or open SSH terminal with these IP.

12.1.1.1 DNS

If you have a DNS with multicast DNS protocol enabled, you can access the NBX by its name “nbx-<serial-number>”, e.g., nbx-30AEA4AD0488.
The NBX name can be obtain from the DNS server, or by concatenating the “nbx-“ with the serial number found on the sticker.
Enter the unit name to a chrome browser to access the unit login page.

12.1.2 Wi-Fi interface



By default, the unit arrives from the factory with Wi-Fi in “**Access Point Auto off**” mode in which the AP is enabled for 15 minutes each time the unit is powered-on or rebooted, to allow the user an “on-the-fly” connection, to be able to modify the unit settings. Unless the mode is changed each time the unit is powered-on or rebooted the 15 minutes time-out will be available. To obtain a quick connection:

1. Make sure you LAPTOP / mobile phone Wi-Fi interface is enabled.
2. Obtain the unit serial-number from the sticker.
3. Scan the Wi-Fi APs and locate the one with SSID corresponding to the serial-number.
4. Connect to the unit SSID.
5. Use the connection properties to get the unit AP IP address (usually **192.168.30.2**).
6. default password is: **12345678**
7. Open a chrome browser and enter the IP to access the GUI login page, or open SSH terminal with these IP.
8. To keep the Wi-Fi AP constant enter the SYSTEM-CONFIG > Wi-Fi page and change the mode to Access Point.

12.2 Cellular USB Dongle Setup

This guide describes the steps that are needed to connect and manage the Cellular USB Dongle.

It is used to connect the NBX-R1000-RF to the cellular network.

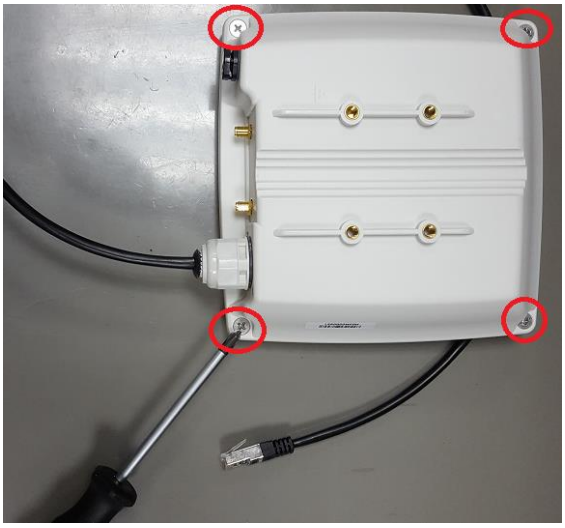
Following models are supported:

- Huawei E8732/E3372
- Huawei MS2131
- ZTE MF833V
- ZTE MF110

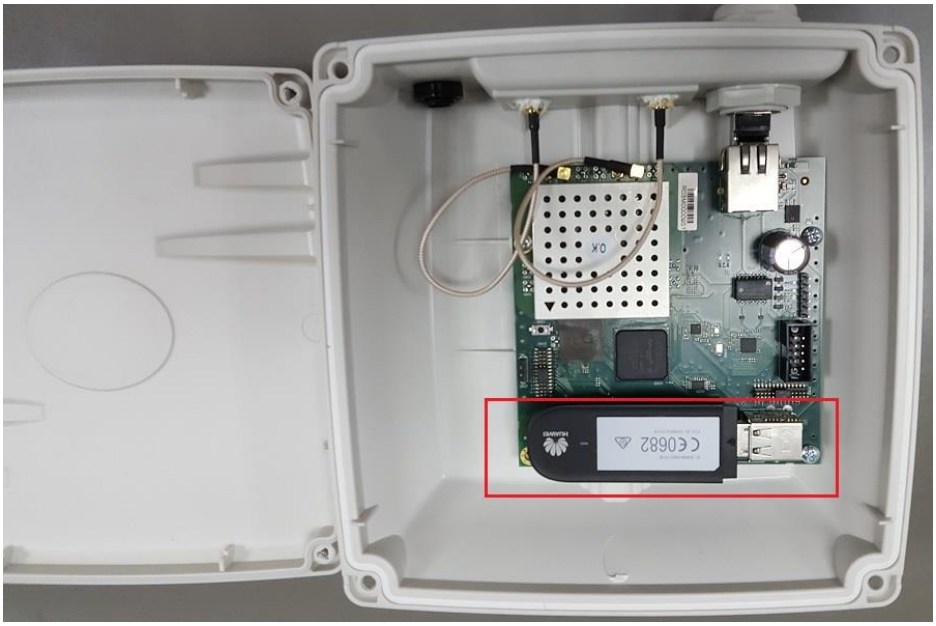
12.2.1 Cellular USB Dongle Installation

- Obtain a USB Cellular Dongle. Below is an example of a Huawei dongle. Make sure the SIM card plugged in.

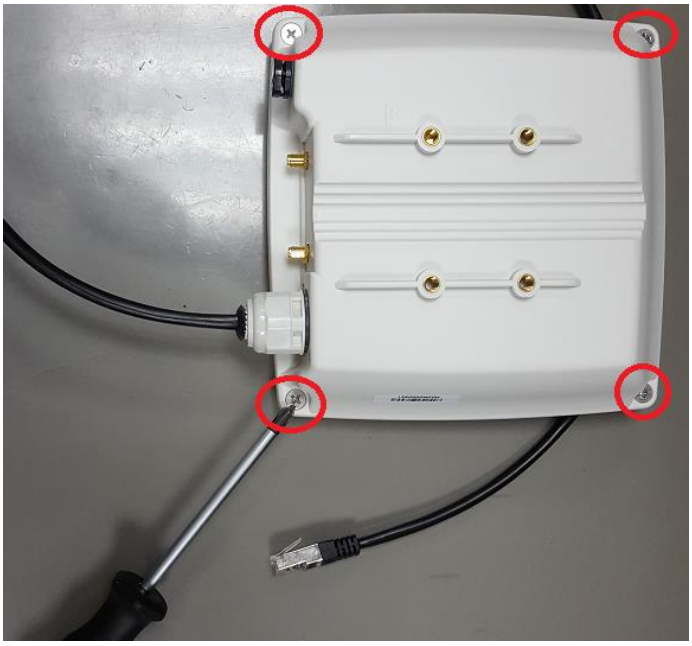
- Open the NBX cover by unscrewing the 4 screws.



- Connect the dongle to the NBX upper USB port.



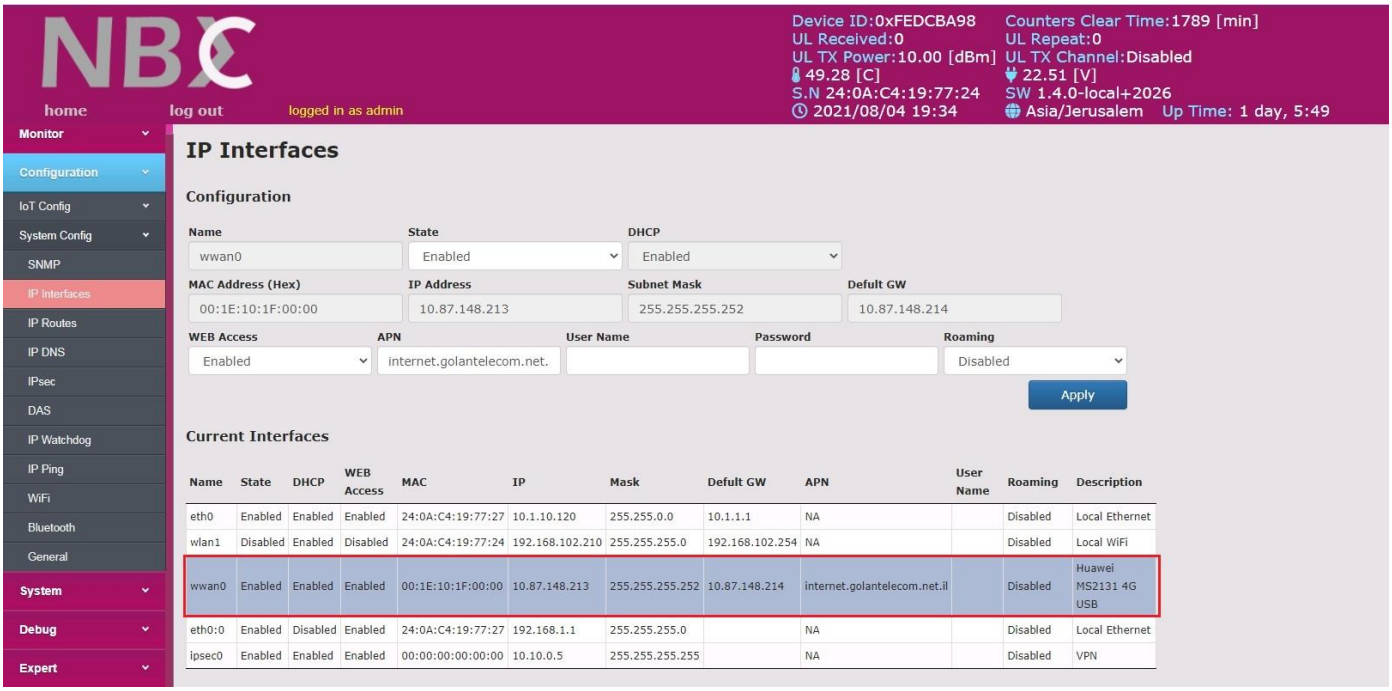
- Close the NBX cover by screwing the 4 screws.



- Power up the NBX.

12.2.2 USB Dongle Parameters Setup

- From the Chrome browser, type in the NBX IP to open the NBX GUI.
- Go to **CONFIGURATION** > **SYSTEM-CONFIG** > **IP-INTERFACES** page.
- In the Current-Interfaces table, select the **wwan0** interface and type in the Configuration fields type in the **APN**, **User**, **Password**, and press **Apply**.
- Wait for the dongle (**wwan0**) to get an IP connection as seen in the below example.
  Note that if it is a **PPP** connection, the interface name will display **PPP**. If the dongle is a HiLink type, the APN information must be populated in the Dongle from a laptop and the Dongle will show up as ETH1 with an IP address given by the Dongle's DHCP server



12.2.3 USB Dongle Status Monitoring

- In the NBX GUI, go to **MONITOR** > **SYSTEM-STATUS** > **IP-INTERFACE-STATUS** page.
- Verify that the dongle is connected and there is TX/RX traffic.
- In the USB 4G/3G status table, verify the dongle PHY status (RSSI, MODE, etc).