Actility
Connecting with intelligence

ThingPark Enterprise All-In-One

Installation, Configuration and Operation Guide for v1.0.1

Content

- Requirements
- Installation and upgrade
- Configuration
  - Base station
  - Node-Red MQTT node
  - Device
- MQTT usage (uplink/downlink)
- Advanced tasks

Hardware Requirements - UFISPACE

- A Ufispace gateway:
  - UFISPACE PICO CELL Enterprise (https://market.thingpark.com/ufispace-enteprise-pico-cell-thingpark-ready-v1-5-indoor-lorawan-gateway.html)
  - Or UFISPACE MACRO CELL v1.5
- Characteristics
  - Processor:
    - Model name : ARMv7 Processor rev 2 (v7l)
    - Hardware : Generic AM33XX (Flattened Device Tree)
  - Disk: 4GB
  - Memory : 500MB

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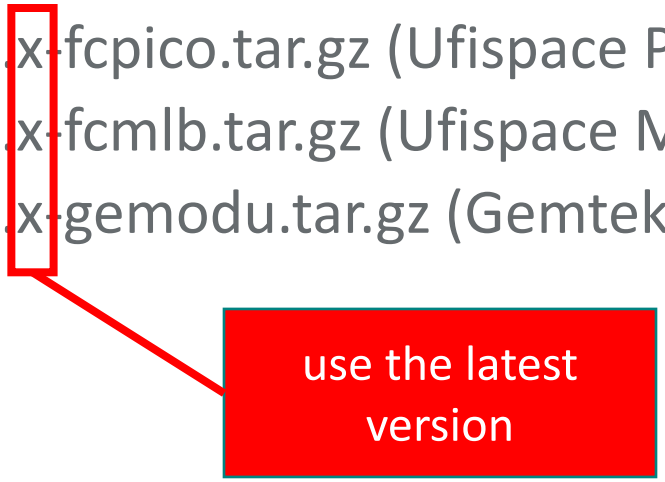
Hardware Requirements - GEMTEK

- A GEMTEK LoRa outdoor micro gateway:
  - https://www.gemteks.com/en/products/lora-iot/gateway#productKkRyJM
- Characteristics
  - Processor :
    - Model name : ARMv7 Processor rev 0 (v7l), Quad Core
    - Hardware : RK30board
  - Disk: 8GB
  - Memory : 1GB

Installation Requirements

- Installation is manual, you need to have SSH access to the Base Station box, and have the root password
- In case of problems, you might have to use an FTDI cable to directly connect on the box
- You need to have at least 500MB free disk space
- You need to have the relevant distribution package for your hardware:
  - rootfs-patch-tao-1.0.x-fcpico.tar.gz (Ufispace PICO)
  - rootfs-patch-tao-1.0.x-fcmlb.tar.gz (Ufispace MACRO V1.5)
  - rootfs-patch-tao-1.0.x-gemodu.tar.gz (Gemtek)



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Installation on UFISPACE PICO/MACRO (1/3)

- Assign BOX_IP variable to your IP box address

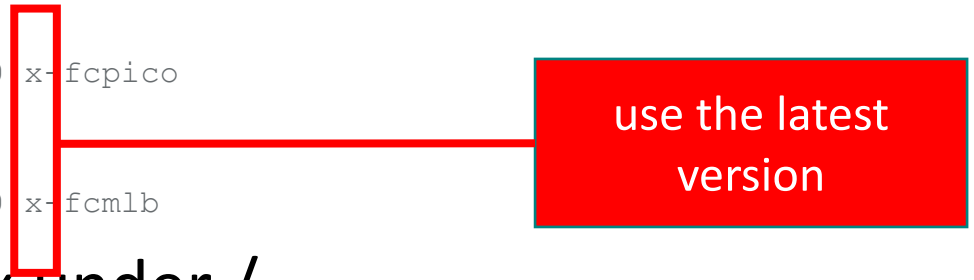
```
export BOX_IP=192.168.1.47
```

- Assign CONF_FINAL_PACKAGE_FILE variable to your package file (without any extension), package file must be on the current folder
  - pico :

```
export CONF_FINAL_PACKAGE_FILE=rootfs-patch-tao-1.0-x-fcpico
```

  - macro :

```
export CONF_FINAL_PACKAGE_FILE=rootfs-patch-tao-1.0-x-fcmlb
```



- Copy the distribution on your box under /

```
scp $CONF_FINAL_PACKAGE_FILE.tar.gz mlbadmin@$BOX_IP:/
```

Installation on UFISPACE PICO/MACRO (2/3)

- Stop services, decompress and install the package

```
ssh mlbadmin@$BOX_IP " \
for svc in lrr lrc tao node-red; do \
  [ -f /etc/init.d/\$svc ] && /etc/init.d/\$svc stop; \
done; \
cd /; \
gunzip $CONF_FINAL_PACKAGE_FILE.tar.gz; \
tar xvf $CONF_FINAL_PACKAGE_FILE.tar; \
rm -f $CONF_FINAL_PACKAGE_FILE.tar; \
/home/actility/tao-system/bootstrap/tao-install.sh; "
```

Installation on UFISPACE PICO/MACRO (3/3)

- At the end, you will get such error messages during firewall startup. They are to be ignored since the IPv6 module is not currently available in Ufispace firmware

```
modprobe: FATAL: Module ip6_tables not found.
ip6tables v1.4.21: can't initialize ip6tables table `filter': Table does not exist (do you need to insmod?)
Perhaps ip6tables or your kernel needs to be upgraded.
modprobe: FATAL: Module ip6_tables not found.
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ip6tables v1.4.21: can't initialize ip6tables table `filter': Table does not exist (do you need to insmod?)
Perhaps ip6tables or your kernel needs to be upgraded.
Could not open socket to kernel: Address family not supported by protocol
```

Installation on GEMTEK (1/2)

- Assign BOX_IP variable to your IP box address

```
export BOX_IP=192.168.1.47
```

- Assign CONF_FINAL_PACKAGE_FILE variable to your package file (without any extension), package file must be on the current folder

```
export CONF_FINAL_PACKAGE_FILE=rootfs-patch-tao-1.0.x-gemodu
```

use the latest version

- Copy the distribution on your box under /

```
scp $CONF_FINAL_PACKAGE_FILE.tar.gz root@$BOX_IP:/
```

- Stop watchdog, decompress, install the package

```
ssh root@$BOX_IP " \
kill \$(pidof kernel_wdg); sleep 2; echo 'V' > /dev/watchdog; \
for svc in lrr lrc tao node-red; do \
  [ -f /etc/init.d/\$svc ] && /etc/init.d/\$svc stop; \
done; \
cd /; \
gunzip $CONF_FINAL_PACKAGE_FILE.tar.gz; \
tar xvf $CONF_FINAL_PACKAGE_FILE.tar; \
rm -f $CONF_FINAL_PACKAGE_FILE.tar; \
/home/actility/tao-system/bootstrap/tao-install.sh "
```

Installation on GEMTEK (2/2)

- At the end, you will get such error messages during firewall startup. They are to be ignored

```
/home/actility/usr/etc/lrr/versions.ini file updated
[OK]
/etc/init.d/firewall: line 124: iptables: command not found
/etc/init.d/firewall: line 125: iptables: command not found
/etc/init.d/firewall: line 128: iptables: command not found
/etc/init.d/firewall: line 129: iptables: command not found
/etc/init.d/firewall: line 136: ip6tables: command not found
/etc/init.d/firewall: line 137: ip6tables: command not found
/etc/init.d/firewall: line 140: ip6tables: command not found
/etc/init.d/firewall: line 141: ip6tables: command not found
```

- Restart the watchdog

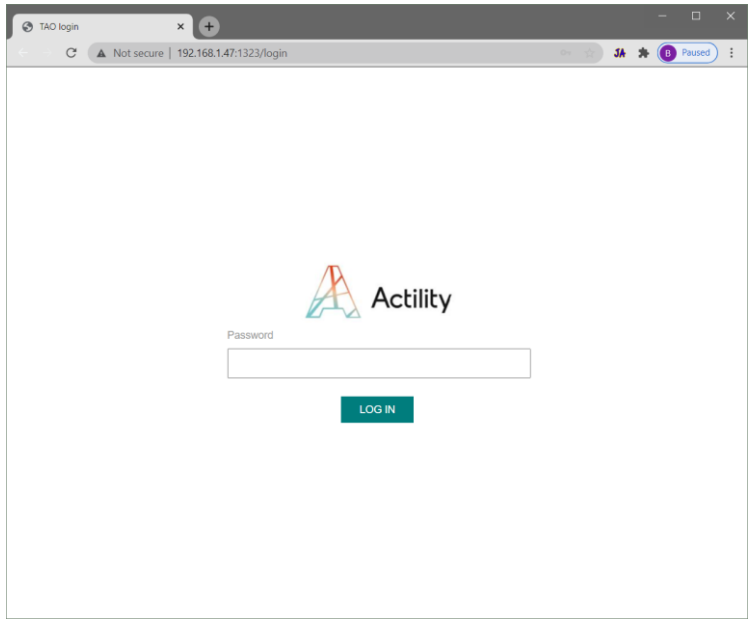
```
ssh root@$BOX_IP "/etc/rc.local </dev/null > /dev/null 2>&1 &"
```

Software upgrade

- For an upgrade, you must follow the same steps as for the installation procedure, but you must reboot the box at the end of the procedure

Login to User Interface (1/2)

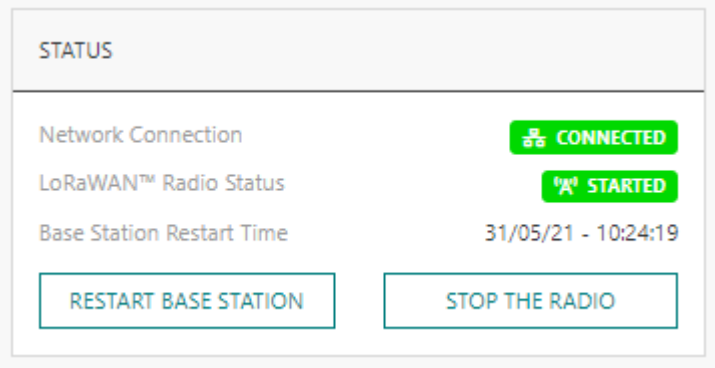
- Connect on the box at the following URL :
  - http://<box ip>:1323



  - Enter password : tao

Login to User Interface (2/2)

- Check that your base station is up and running
  - on the Base Station TAB
    - Network Connection : CONNECTED
    - LoRaWAN Radio Status : STARTED



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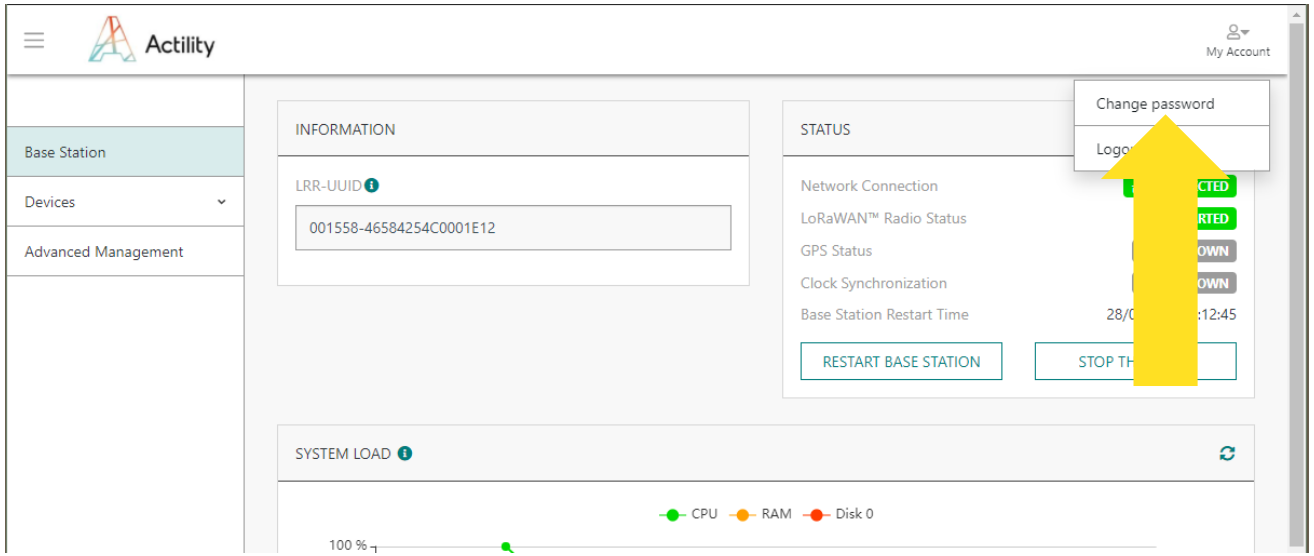
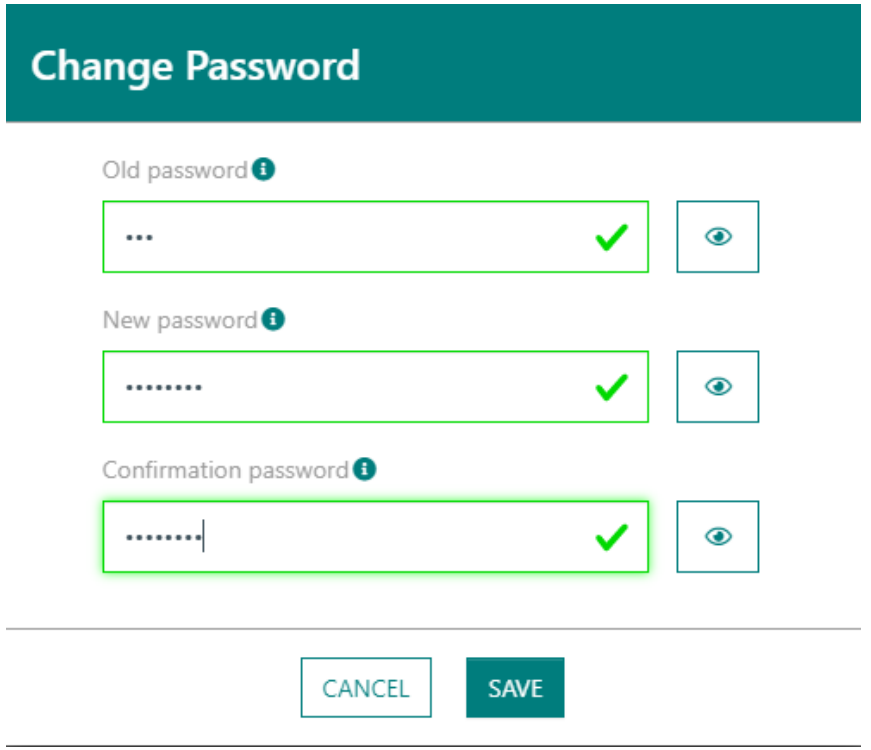
Change your password (1/2)

- For security reason, it is strongly recommended to change the password
  - on the right side, click on My Account and select Change password



Change your password (2/2)

- On the old password field, enter "tao"
- Enter the new password on the
  - new password field
  - confirmation password field
- Click save when finished



- The initial password is "tao"
- On password change, the minimum password length is 8 chars, it must be a standard linux password

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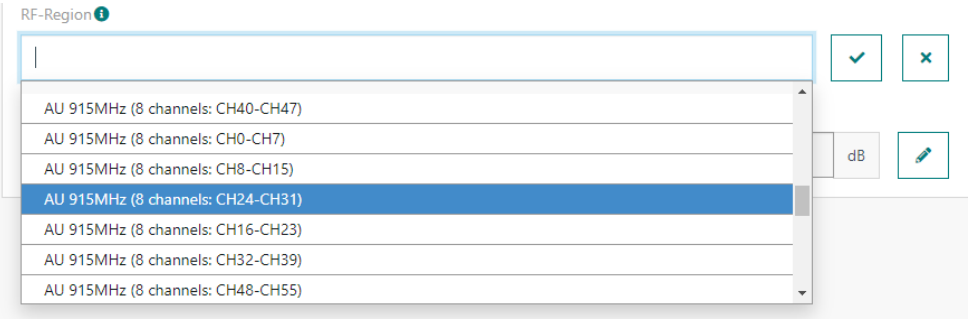
Base station configuration (1/2)

- You can now configure your Base station, return to the "TPE All In One" GUI, and scroll down to the "Configuration" widget:

- You can change the RF-Region settings
  - click on the "PEN" icon
  - in the dropdown, select your new region, and click on the validation icon when finished



  - Wait about 1 minute for the Base Station to reconfigure, you can receive temporary errors during that phase

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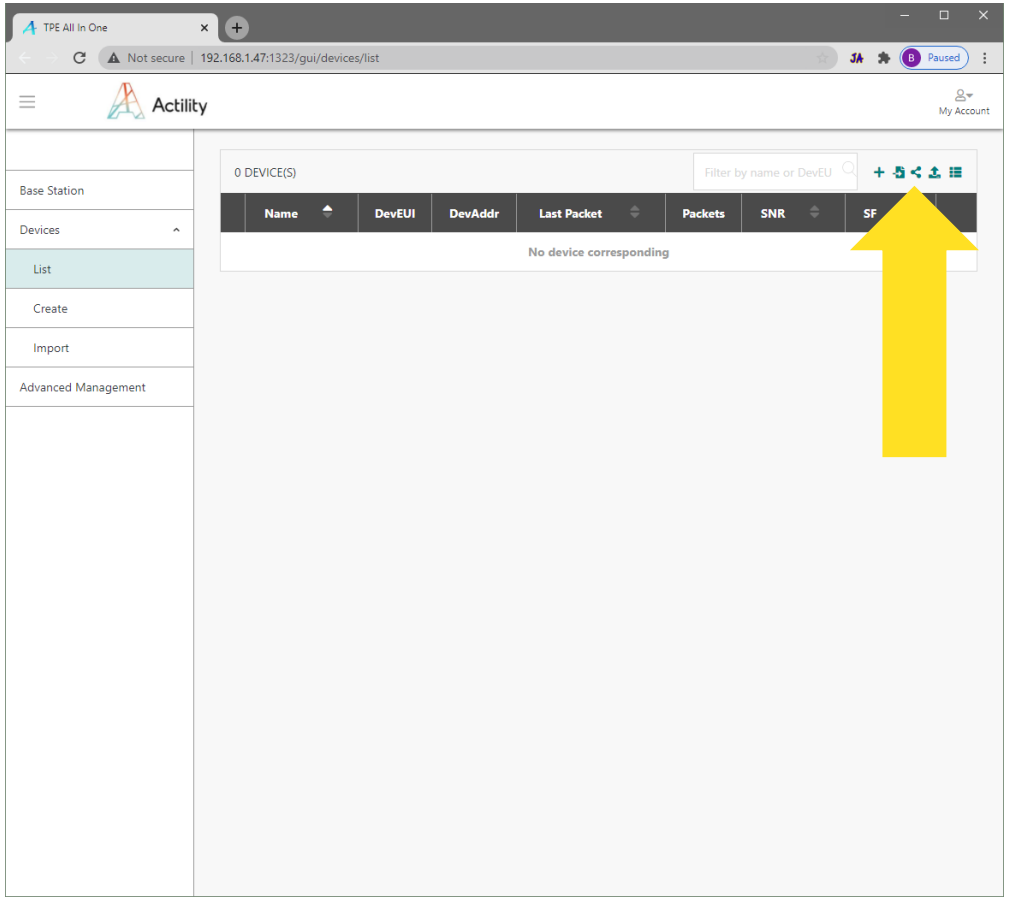
Base station configuration (2/2)

- Set Antenna Gain and Cable loss as per the following table:

	Antenna Gain	Cable loss
Ufispace pico (external antenna)	1.5 dBi	0 dB
Ufispace enterprise (internal antenna)	1.4 dBi	0 dB
Ufispace macro v1.5 & Gemtek outdoor micro	Depends on antenna model	Typically ~ 0.5 dB but depends on installation

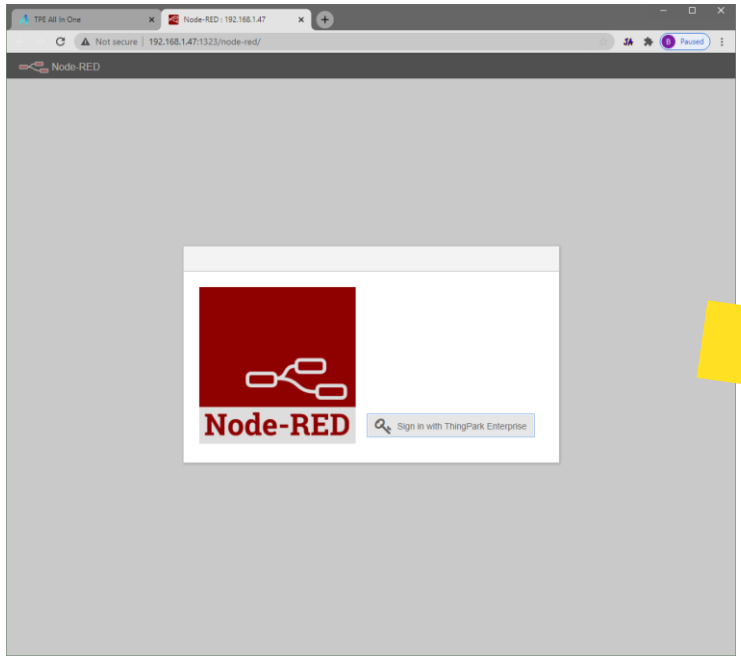
Node-RED : MQTT configuration (1/5)

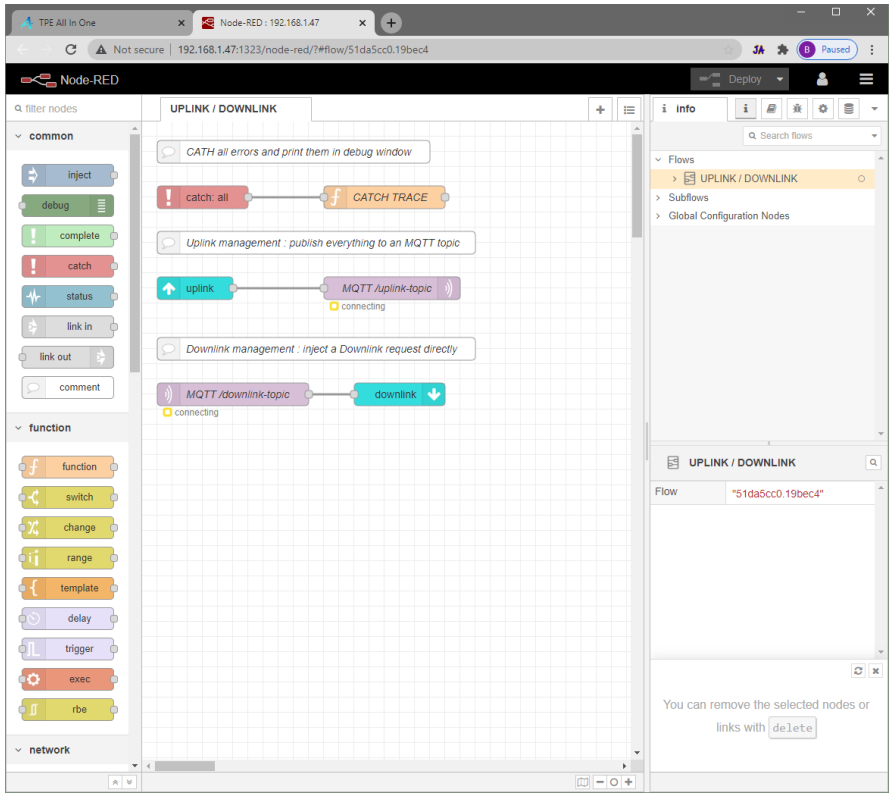
- Connect on node-red to configure the MQTT server :
  - on the Devices / List TAB, click on the node-red icon



Node-RED : MQTT configuration (2/5)

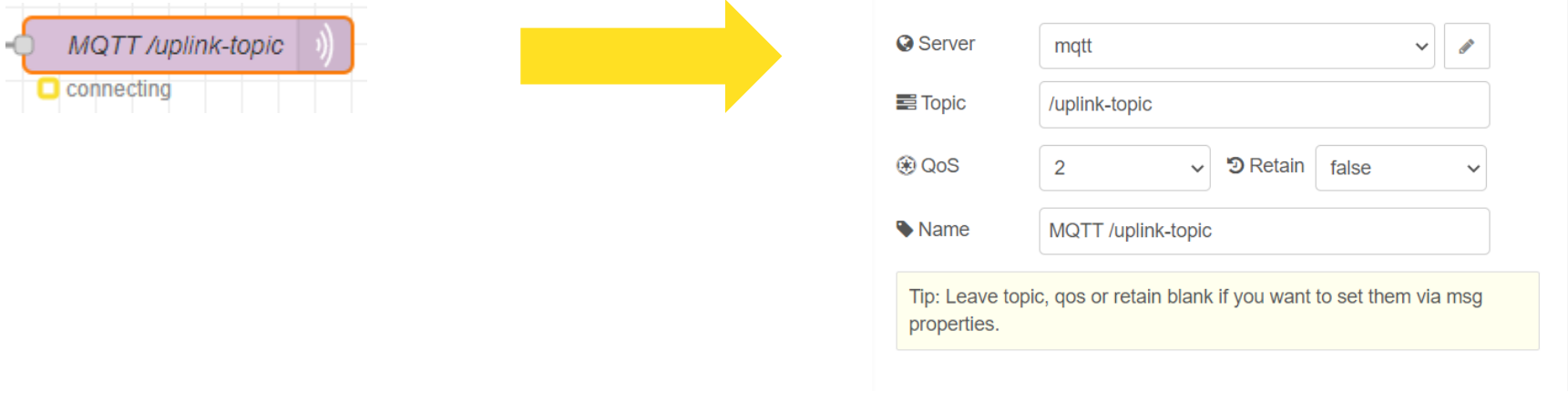
- Click on node-red Sign in button, and eventually sign in again with your password





Node-RED : MQTT configuration (3/5)

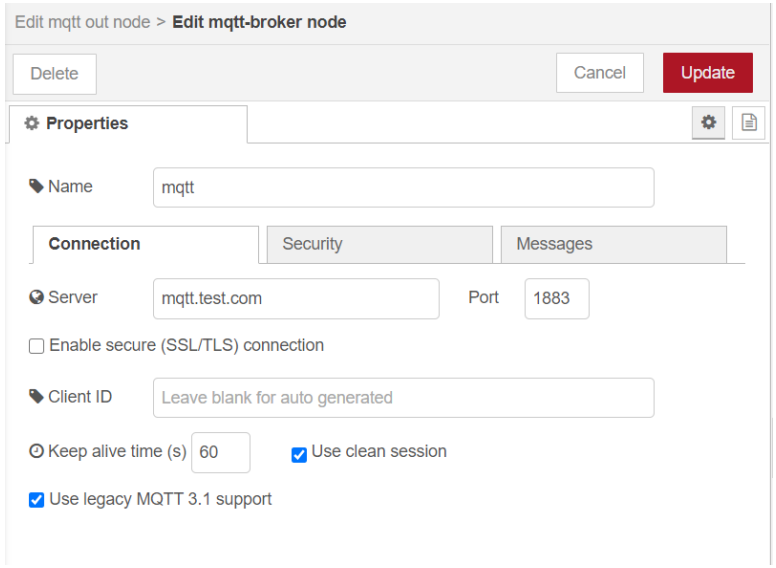
- Double click the "MQTT /uplink-topic" node and configure the MQTT node



- You can change here the standard MQTT settings
  - Topic : the topic where you will receive the uplinks
  - QoS, Retain : standard MQTT attributes
  - Name : the display name of the node

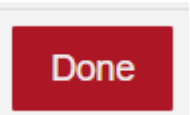
Node-RED : MQTT configuration (4/5)

- Click on the server "pen" icon to configure the MQTT server



- You can change here the main server attributes
  - server address, server security, server secure connection, ...
- You must click "Update" to apply your configuration

- And click also "Done" when you also want to save the MQTT node configuration



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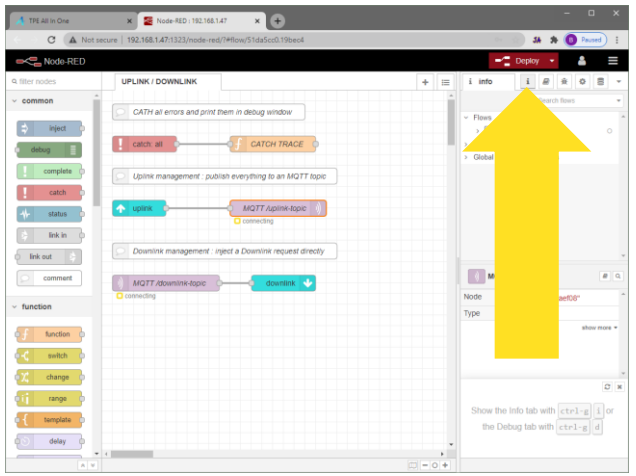
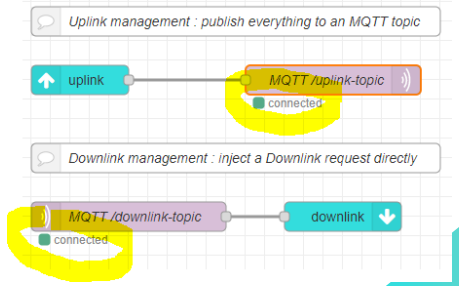
Node-RED : MQTT configuration (5/5)

- Do the Same for the "MQTT /downlink-topic" node, server configuration is global to both nodes
- After you have done all node-red reconfiguration, you must click on "Deploy" to push your new flow on the server



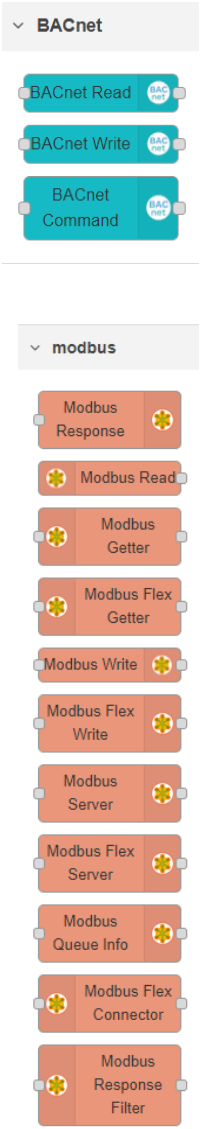
- After few seconds, you should see that your MQTT nodes get connected



Node-RED : BACnet / Modbus

- On node-red, you may use BACnet/IP nodes in your workflows

- And you may also use MODBUS TCP/IP nodes
  - For the Modbus server node, you can only use tcp port 10502 or tcp port 11502 : they are not filtered and therefore can be accessed externally by Application Server



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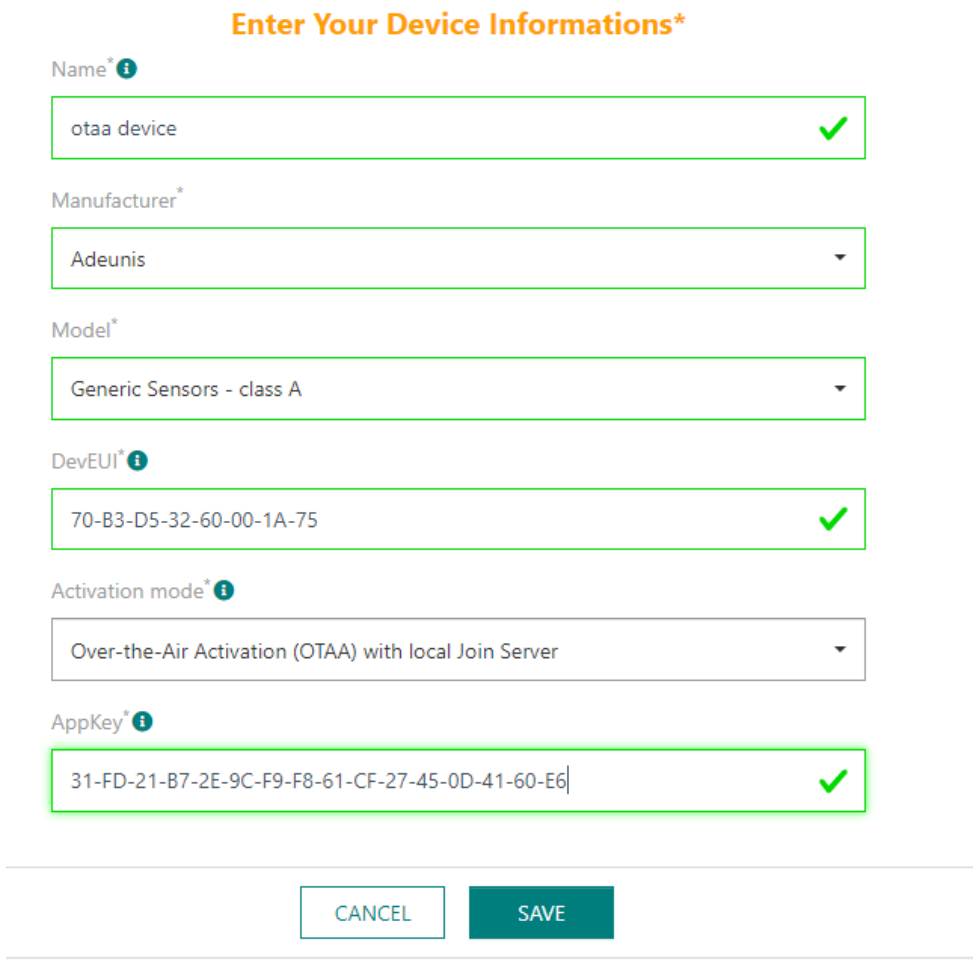
Node-RED : Usage

WARNING :

Use of Node-Red nodes in "server" mode (e.g. modbus server) - with regular polling from external client applications - has not been benchmarked by Actility. Server mode may have negative impacts on TPE-All-in-One performances. Such potential impact on performance remains under the entire responsibility of the TPE Partner.

Device configuration (1/2)

- You can now create you first device (OTAA example)
  - On Devices / Create TAB, click save when finished



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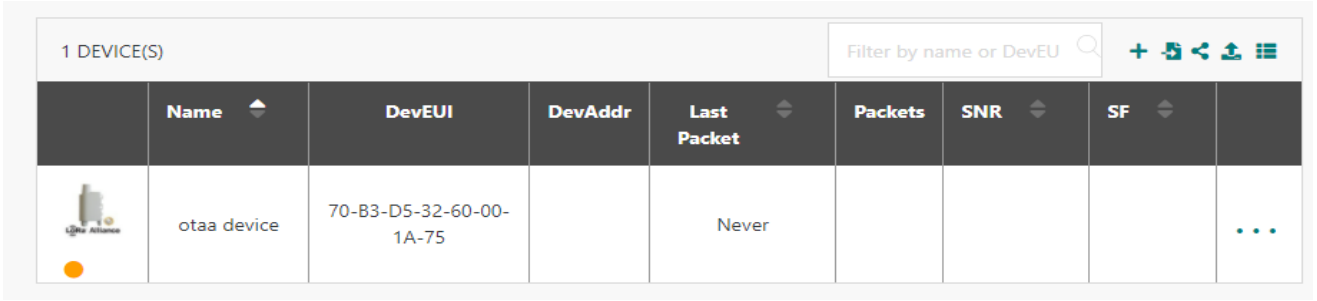
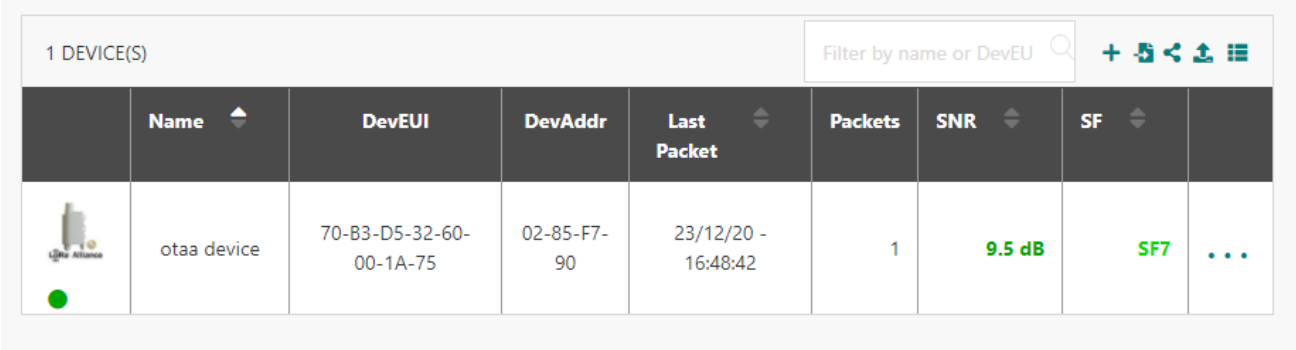
Device configuration (2/2)

- On the Devices / List TAB, your device is created
  - the device is created (orange status)
  - DevEUI is presented
  - DevAddr not yet assigned (OTAA)



- To update the list
  - You can update the list just by changing the screen, all screens are refreshed as soon as they are re-displayed (change form Devices / List to Devices / Create and return to Devices / List)

- You can see that after few uplink packets, your list is updated
  - the device is connected (green status)
  - last packet gets a timestamp
  - DevAddr is assigned (OTAA)
  - Packets represent the uplink counter
  - SNR, SF ...



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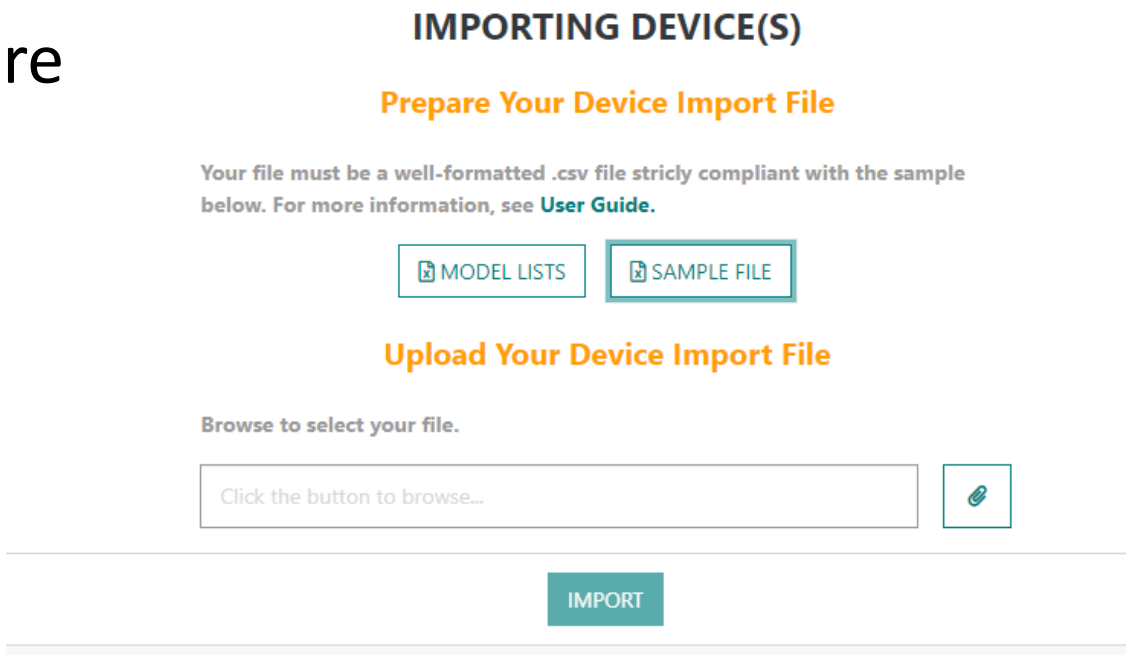
Device configuration / mass import (1/3)

You can also use the mass import feature to import multiple devices in one click



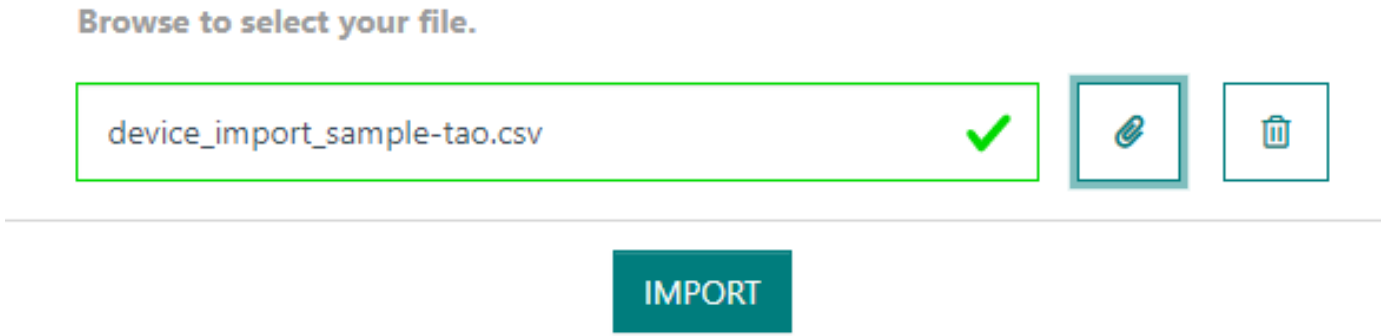
- Follow the "SAMPLE FILE" link to understand the csv format
- Follow the "MODEL LISTS" link to find the "Profile ID" that corresponds to your device profile

Device configuration / mass import (2/3)

- Create a csv (comma separated value) file, you should have something like this at the end (OTAA and ABP device sample) :

```
CREATE_OTAA,70B3D53260001A75,,LORA_GenericA.1.0.2a_ETSI_Rx2-SF12,,31FD21B72E9CF9F861CF27450D4160E6,,device_1
CREATE_ABP,000000000539B181,0539B180,LORA_GenericA.1.0.2c_ETSI,2B7E151628AED2A6ABF7158809CF4F3C,2B7E151628AED2A6ABF7158809CF4F3C,,device_2
```

- Save the file in utf8 format when using a simple text editor
- Click on the  to open the import dialog box and select your file
- Click « Import »



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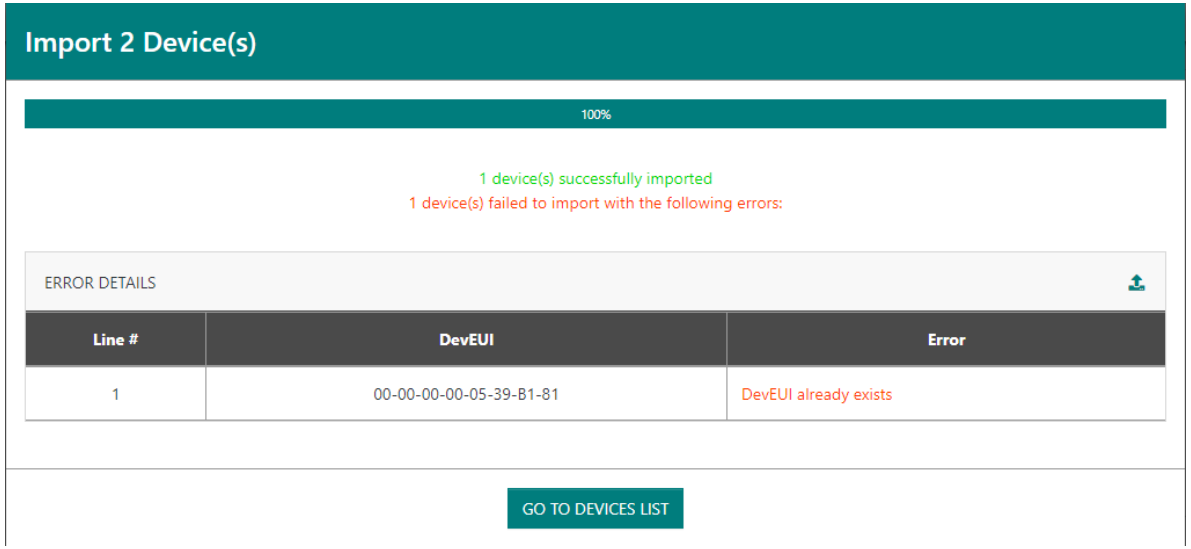
Device configuration / mass import (3/3)

- When everything is done, and you have no error, you can directly return to the device list and start working with your devices
- In case of errors, you get a page that summarizes these errors, ordered by line number



- You can now correct the file, and re-import the corrected devices

MQTT usage : Uplink

- On the MQTT server, you can subscribe to the "/uplink-topic" topic, and verify that you get your packets

```
[root@tools mosquitto]# mosquitto_sub -t /uplink-topic  -h localhost

{"DevEUI_uplink":{"Time":"2020-12-
23T15:51:48.604+00:00","DevEUI":"70B3D53260001A75","FPort":2,"FCntUp":2,"MType":4,"FCntDn":3,"payload
_hex":"cafe","mic_hex":"459b05c6","Lrcid":"0000000F","LrrRSSI":-
58,"LrrSNR":9.75,"SpFact":7,"SubBand":"G2","Channel":"LC5","DevLrrCnt":1,"Lrrid":"FFFFFFFF","Late":0,
"LrrLAT":0,"LrrLON":0,"Lrrs":{"Lrr":[{"Lrrid":"FFFFFFFF","Chain":0,"LrrRSSI":-
58,"LrrSNR":9.75,"LrrESP":-
58.43726}]},"CustomerID":"tao","ModelCfg":"0","InstantPER":0,"MeanPER":0,"DevAddr":"0285F790","TxPowe
r":14,"NbTrans":1,"Frequency":867.3,"DynamicClass":"A"}}

...
```

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MQTT usage : Downlink

- You can also send downlink packets using the "downlink-topic" topic

```
[root@tools mosquitto]# mosquitto_pub -t /downlink-topic -h localhost -m
"{\"DevEUI_downlink\":{\"DevEUI\":\"70B3D53260001A75\",\"FPort\":\"2\",\"Confirmed\":\"1\",\"FlushDow
nlinkQueue\":\"1\",\"payload_hex\": \"1238\"}}"
```

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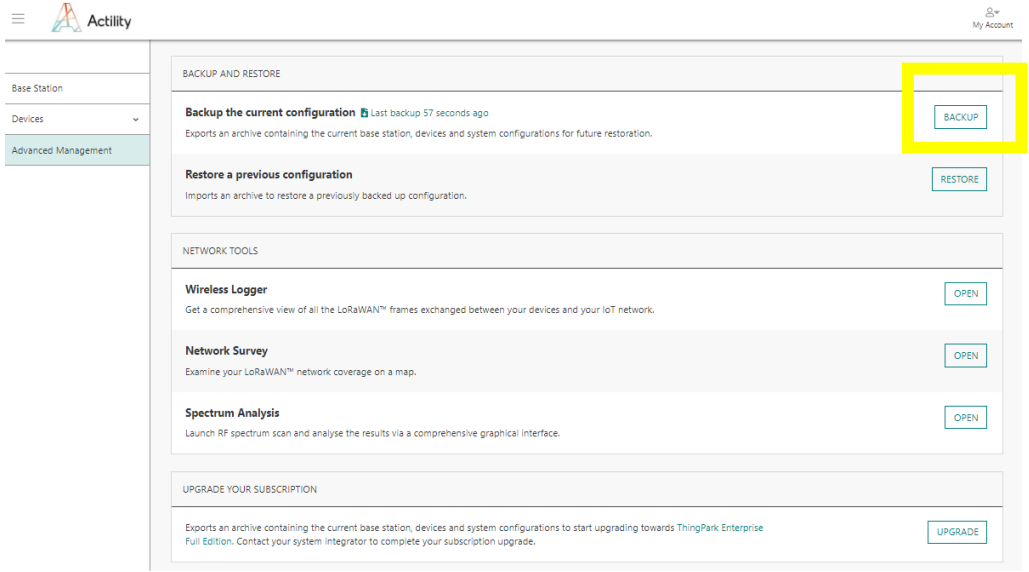
System Backup (1/4)

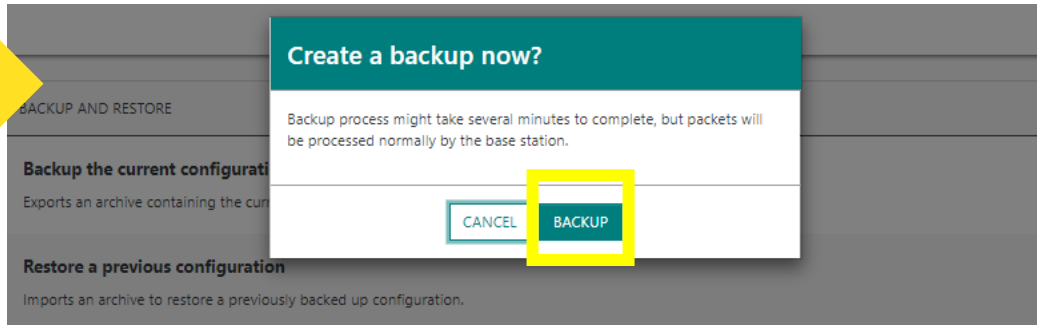
- It is necessary to regularly create a backup archive of your gateway:
  - Before / after node-red flow changes
  - After new device creations
  - Before / after LRR modifications (via Suplog)
  - Before / after system upgrades (upgrade version > 1.0.0), to support potential rollback situations

→ This will ensure that you will be able to restore the gateway if something went wrong

System Backup (2/4)

- To create a backup file :
  - Go to "Advanced Management"
  - Click on the “Backup” button, then click “Backup” again on the popup

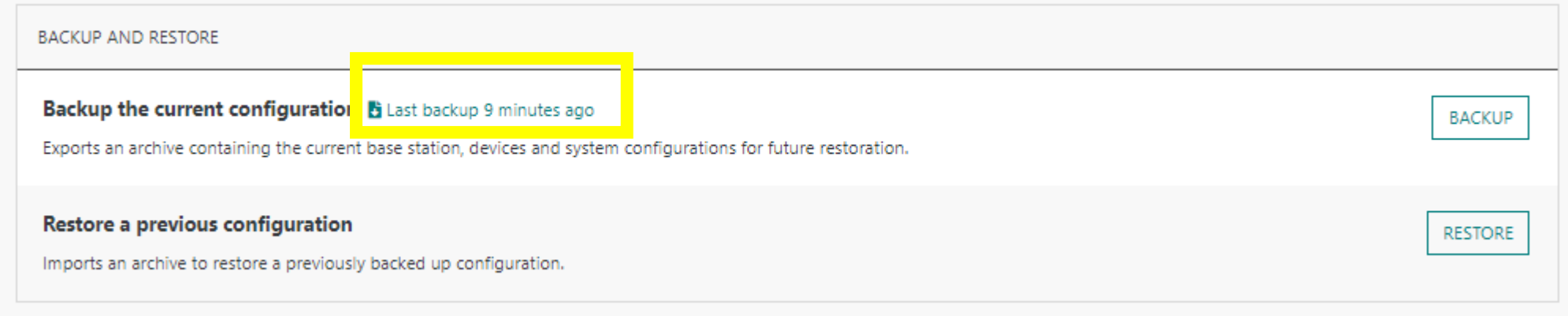




- The backup file is automatically downloaded on your browser

System Backup (3/4)

- After the backup is executed with success, a persistent link is generated :
  - it indicates the age of the last backup
  - it allows you to download the file later-on, but it is highly recommended to save the backup file in an alternative storage location



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System Backup (4/4)

- The backup file consists of :
  - LRC database (FDB_lora)
  - Node-Red data folder (flows, credentials)
  - TPE-All-in-One (TAO) data folder (secret key)
  - A complete LRR backup (specific LRR procedure), including the network configuration changes provided through Suplog
  - TAO release version file

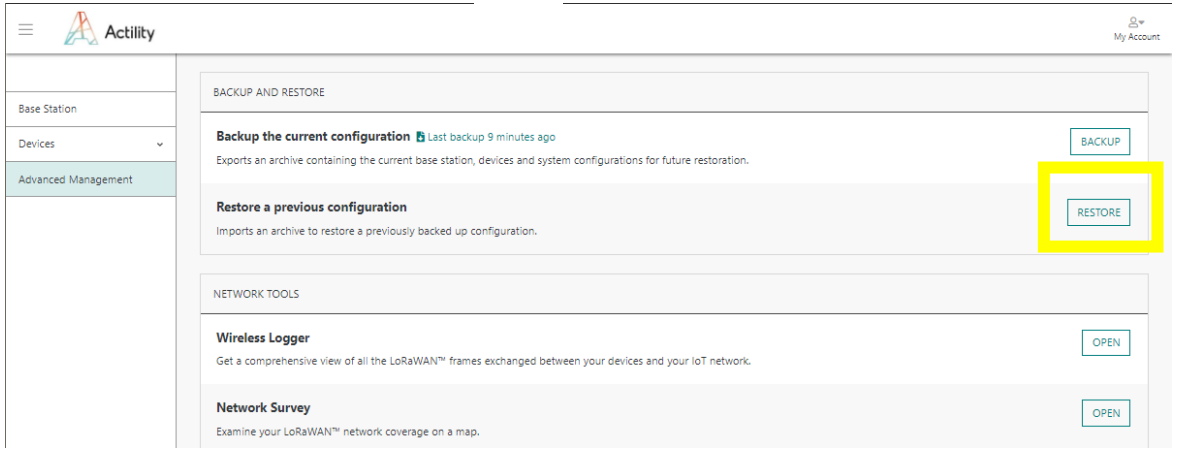
- Note: passwords are not included in the archive

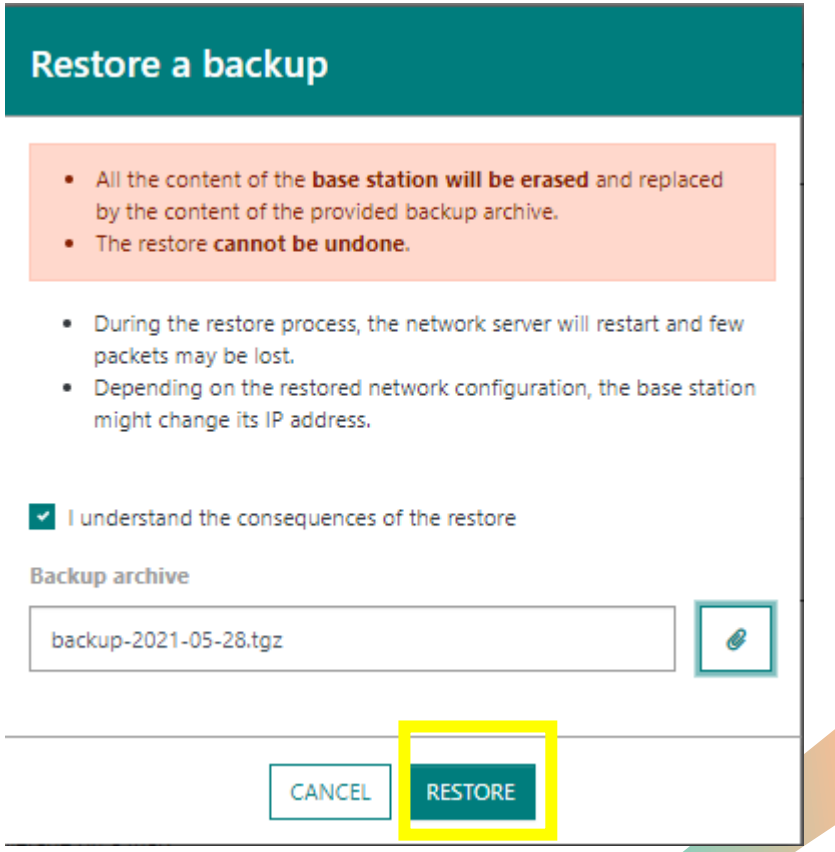
System Restore (1/3)

- Restore can only be executed on the same TAO version and the same hardware model (full restoration of LRR requires the same hardware model)
- It allows you for example to rebuild a gateway after a hardware failure
    1. install the same TAO version on an identical hardware model
    2. restore the archive content on that gateway
- Be careful, as the network configuration is restored, you might lose your gateway, it is then recommended to make sure that the gateway is correctly configured (identically as the backup)
- A full restore duration is around 3mn

System Restore (2/3)

- To restore a backup :
  - Go to "Advanced Management"
  - Click on the Restore button
  - On the popup
    - Click on "I understand the consequences of the restore"
    - Click on the [📎] and pickup you backup file





  - Click “Restore”

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System Restore (3/3)

- During restoration, a waiting screen is displayed, and the GUI is locked

- Any attempt to navigate is blocked, all new login will be redirected to this same page
- After restoration, all required services are restarted and the user can navigate again

Advanced tasks : Services

- TAO is composed of a standard LRR with its standard services, most important one is :
  - /etc/init.d/lrr
- 3 new services are added
  - /etc/init.d/lrc {start|stop|status|restart}
    - LRC server
  - /etc/init.d/tao {start|stop|status|restart}
    - tao server, written in GO, serving the angular GUI
  - /etc/init.d/node-red {start|stop|status|restart}
    - node-red server

Advanced tasks - WARNING

- **Important**
  - It is not allowed to modify any configuration files located under /home/actility/usr/etc... (except for temporary tests)
  - All these modifications will be lost after an upgrade

Advanced tasks : Access to logs (1/3)

- All logs are stored in a tmpfs in-memory space
  - log storage root path :
    - ufispace : /var/volatile/log
    - gemtek : /dev/shm/log
  - for each service, a dedicated folder is created
    - < log storage root path> /_LRCLOG
    - < log storage root path> /_LRRLOG
    - < log storage root path> /_NODEREDLOG
    - < log storage root path> /_TAOLOG
- This is achieved through links (ufispace example)

```
am335x-evm:/# ls -l /home/actility/var/log/
lrwxrwxrwx   1 root    root         25 Jan  5 11:36 lrc -> /var/volatile/log/_LRCLOG
lrwxrwxrwx   1 root    root         25 Jan  5 11:36 lrr -> /var/volatile/log/_LRRLOG
lrwxrwxrwx   1 root    root         29 Jan  5 11:36 node-red -> /var/volatile/log/_NODEREDLOG
lrwxrwxrwx   1 root    root         25 Jan  5 11:36 tao -> /var/volatile/log/_TAOLOG
```

Advanced tasks : Access to logs (2/3)

- tmpfs space
  - ufispace PICO/MACRO : 100 MB
  - gemtek : 500 MB
- Log levels are kept very low
  - LRR (/home/actility/usr/etc/lrr/lrr.ini) :
    - level=1, debug=1, size=10000000 (10MB)
  - LRC (/home/actility/usr/etc/lrc/lrc.ini) :
    - level=1, debug=1, size=10000000 (10 MB)
  - TAO (/home/actility/usr/etc/tao/configs/tao_server_config.yaml) :
    - level: WARN, maxSize=10 #megabytes
  - node-red : (/home/actility/usr/etc/node-red/settings.js) :
    - level : 'error', size=10000000 (10 MB)

Advanced tasks : Access to logs (3/3)

- Log level modification
  - For lrr, tao, node-red, you must connect on the base station, and modify the configuration files and then, restart the corresponding service
  - For lrc, you can do the same or dynamically througth a telnet admin session (telnet 0 2009)

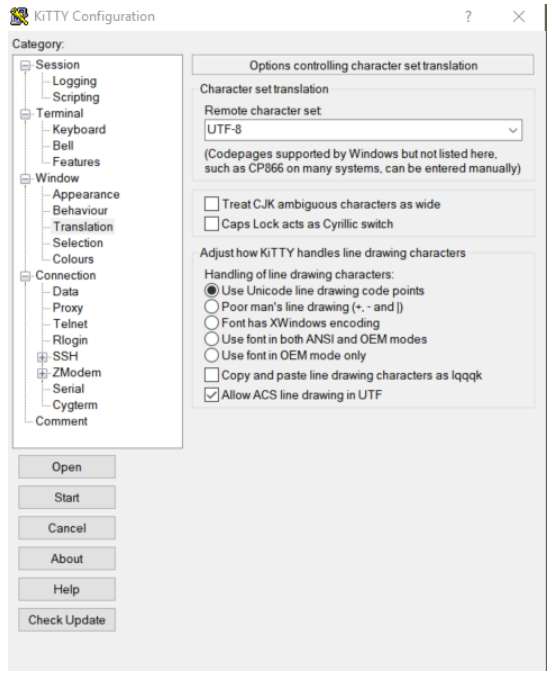
- All logs are stored in memory, they are copied on disk every day in /home/actility/traces

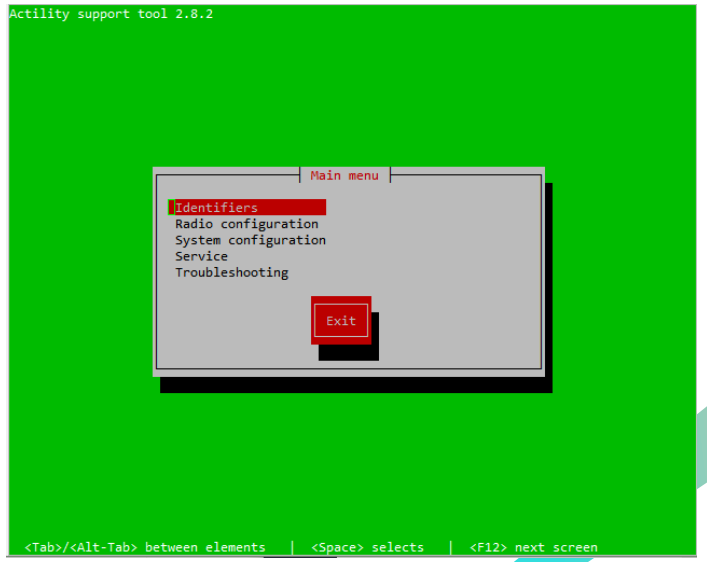
Advanced tasks – Suplog (1/2)

- Preliminary : for putty users, you must configure "Allow ACS line drawing in UTF" to get nice rendering
- Connect on suplog using ssh (password is the one you use to connect on tao)

```
ssh support@$BOX_IP
```

- To navigate inside the tool :
  - <tab>, <arrow right> : move to action buttons, then return to the initial position, navigate inside forms
  - <arrow up> / <arrow down> : change position in menus, navigate inside forms
  - <enter> : select a menu item, validate an action
  - <space> : activate/deactivate a choice inside forms





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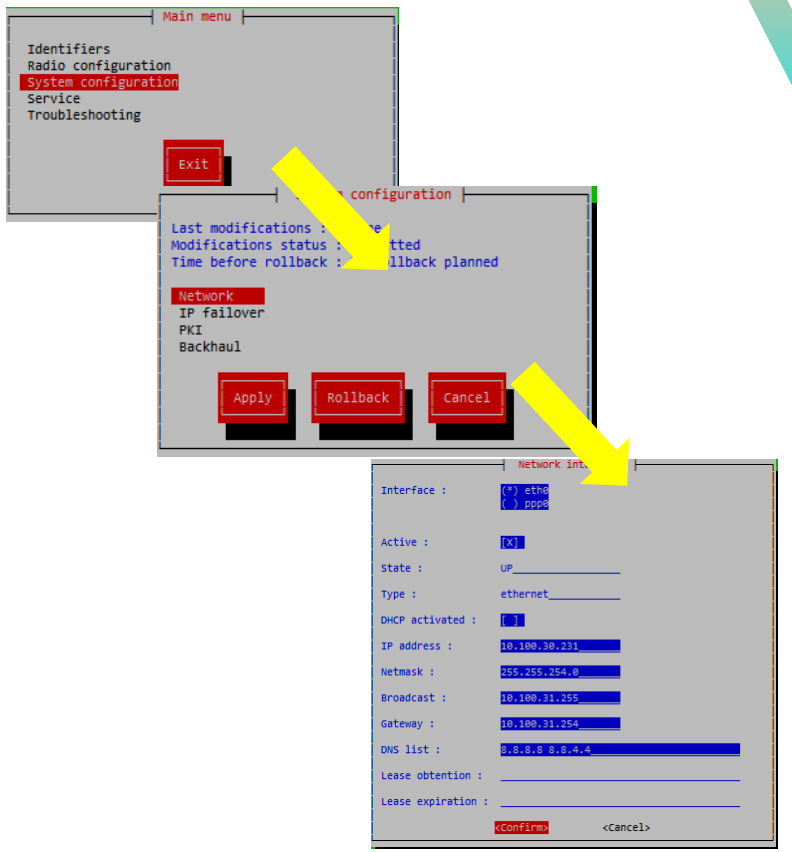
Advanced tasks – Suplog (2/2)

- Warning : some menu configurations are not supported or irrelevant in TPE All In One context :
  - Identifiers
  - Radio configuration
  - System configuration / PKI
  - System configuration / Backhaul
  - Service
  - Troubleshooting

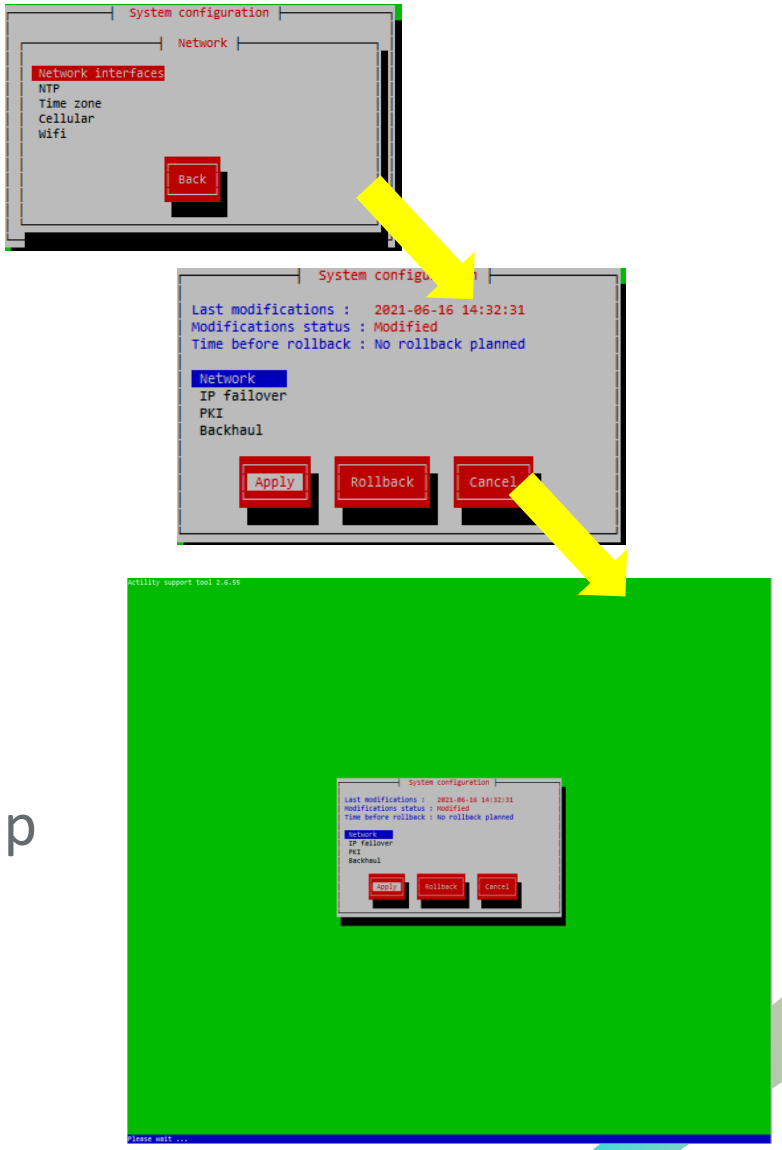
Suplog DHCP -> Static IP (1/3)

- The gateway is originally configured for ethernet with DHCP, follow these steps to configure a fix IP address
  - select System configuration, press <enter>
  - select Network, press <enter>
  - select Network interfaces, press <enter>
  - you can then configure your interface settings, use <tab> to navigate through the fields
    - Active, should have an [X]
    - DHCP activated, should be deactivated : [ ]
    - IP address, Netmask, Broadcast, Gateway, DNS list must be configured
    - Move to the Confirm button, Press <Enter>



Suplog DHCP -> Static IP (2/3)

- select Back button, press <enter>
- select Apply, press <enter>
- you are now invited to wait, the gateway is now reconfiguring everything, but as you have changed the ip address, your console is no more on the right location



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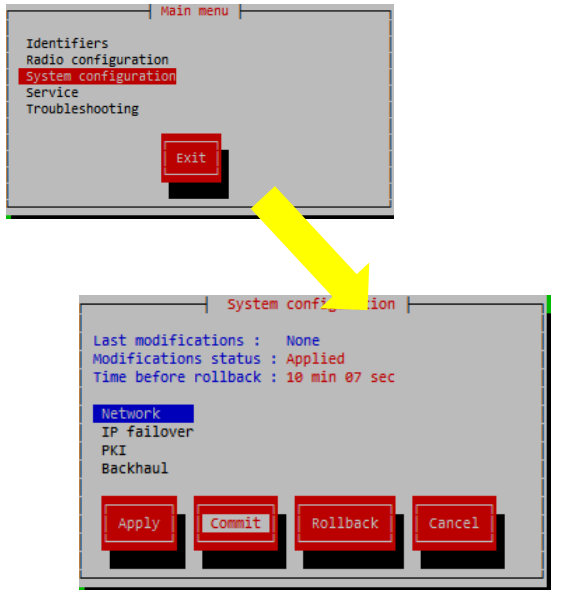
Suplog DHCP -> Static IP (3/3)

- After the configuration is applied, you must wait around 1 minute before connecting to the new IP address (you will not be able to commit the configuration before this delay), you also have 15 minutes to commit your changes, if you don't commit, the configuration will be automatically rolled back
  - connect a new suplog session to the new IP address
  - select System configuration, press <enter>
  - select the Commit button, press <enter>

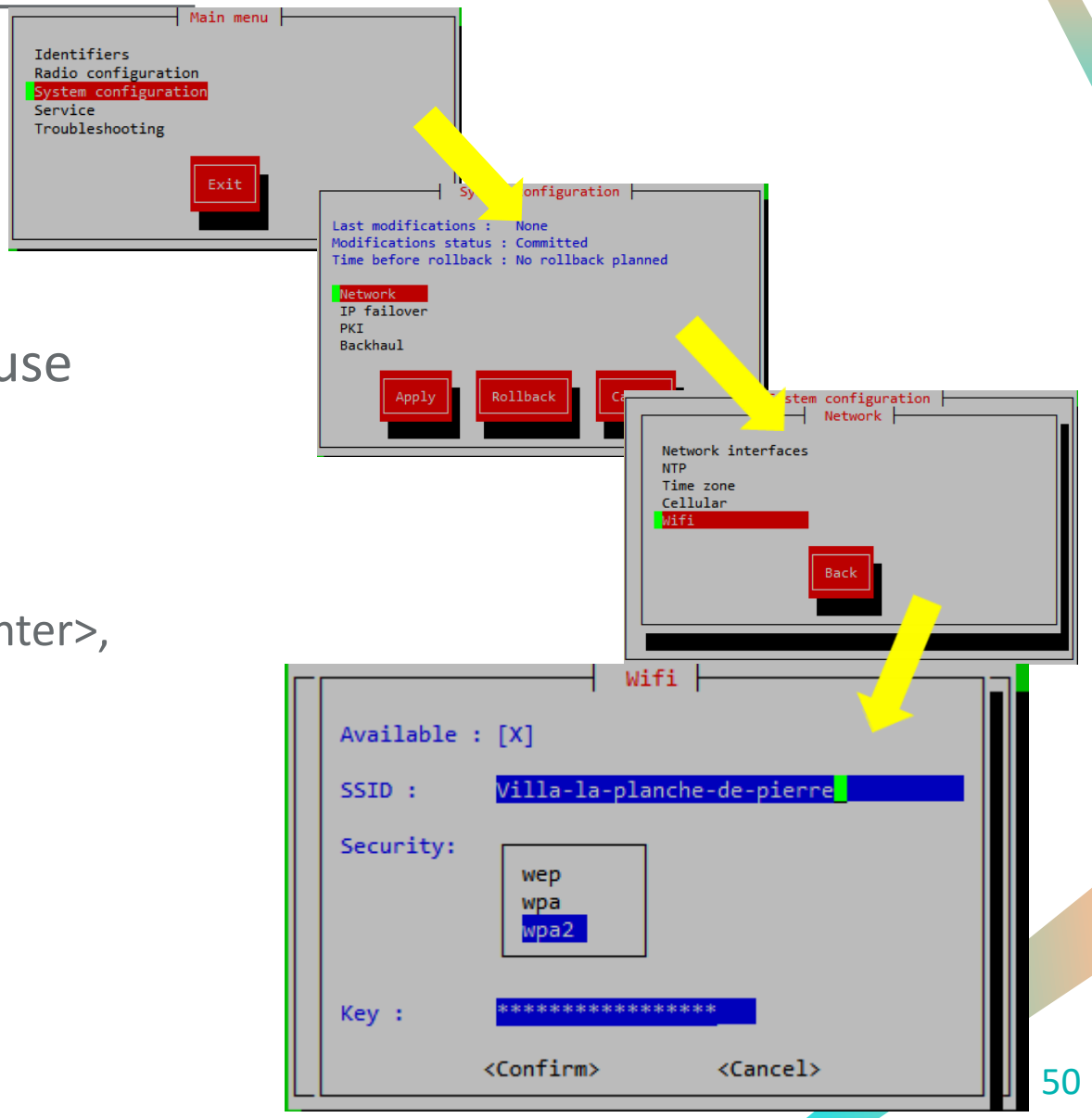


Suplog Eth -> WiFi mode [PICO] (1/6)

- The gateway is originally configured for ethernet with DHCP, follow these steps to configure the WiFi mode instead of ethernet
- Five steps are required
  - Configure your WiFi credentials
  - Deactivate eth0
  - Activate wlan0
  - Apply the configuration
  - Commit the configuration

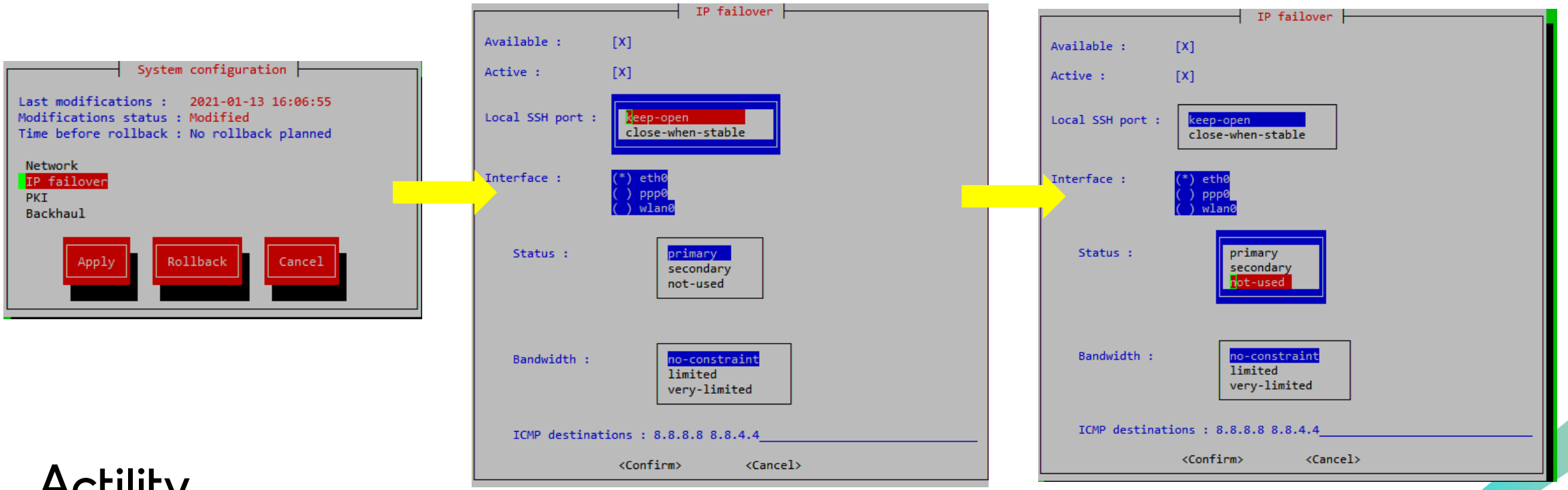
Suplog Eth -> WiFi mode [PICO] (2/6)

- Step 1/5 : enter your WiFi credentials
  - select System configuration, press <enter>
  - select Network, press <enter>
  - select WiFi, press <enter>
  - you can then configure your WiFi settings, use <tab> to navigate through the fields
    - Available, should have an [X]
    - SSID, enter your SSID
    - Security, enter your security algorithm, press <enter>, when finished to validate your choice
    - Key, enter your security key, press <enter>,
    - Confirm, press <enter>
  - Select Back button to return to the System configuration



Suplog Eth -> WiFi mode [PICO] (3/6)

- Step 2/5 : deactivate eth0
  - select IP failover, press <enter>
  - Interface should be (*) eth0
  - move to Status, select not-used and press <enter>
  - stay on this form for the next step !



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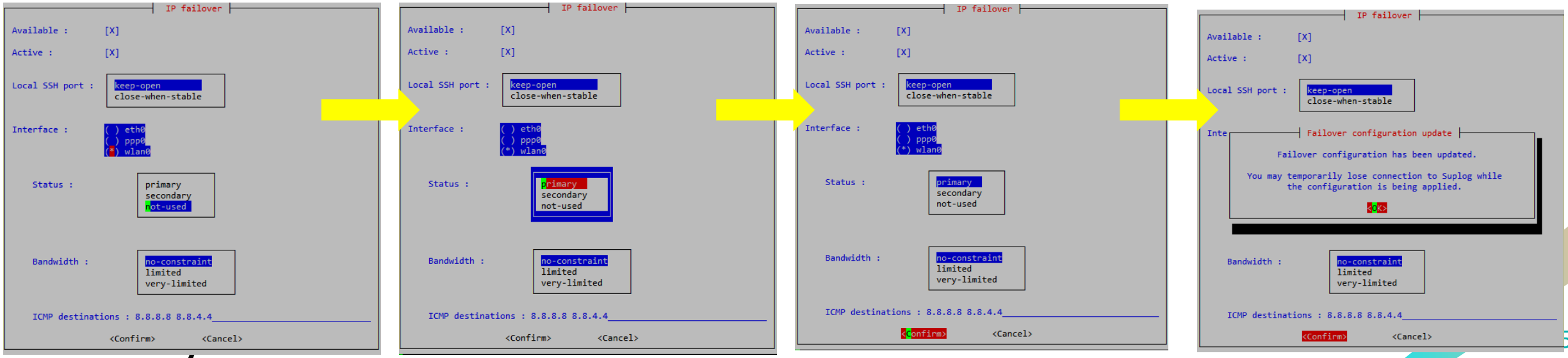
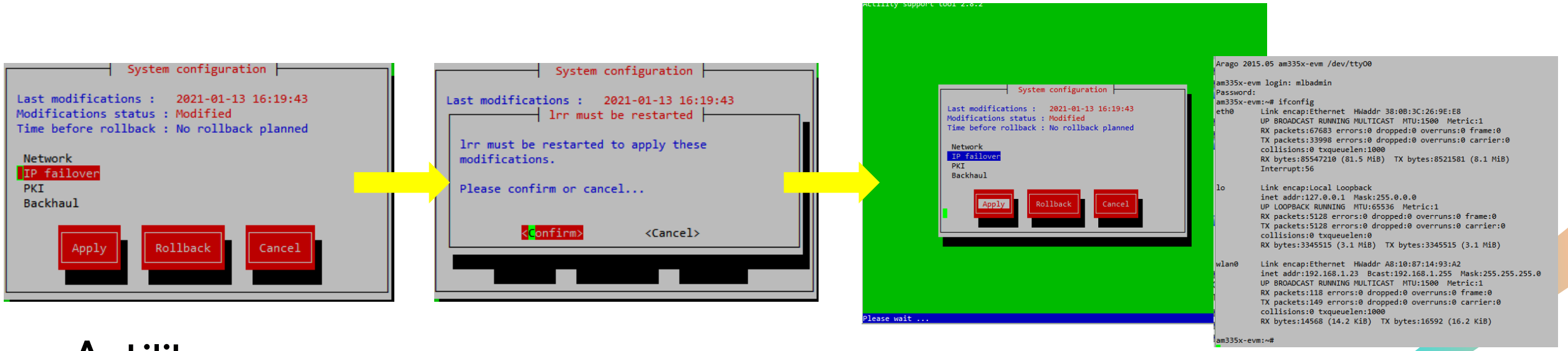
Suplog Eth -> WiFi mode [PICO] (4/6)

- Step 3/5 : activate wlan0
  - move to Interface, and select wlan0 (<space>)
  - Interface should be (*) wlan0
  - move to Status, select primary and press <enter>
  - move to Confirm, press <enter>
  - on the OK button, press <enter>
  - you are now back to the System configuration menu



Suplog Eth -> WiFi mode [PICO] (5/6)

- Step 4/5 : apply your configuration
  - move to Apply, and press <enter>
  - press <enter> on the Confirm button
  - Please wait, you will now loose your network connection, you need to find the WIFI address
  - After the configuration is applied, you have 15 minutes to commit your changes, if you don't commit, the configuration will be automatically rolled back



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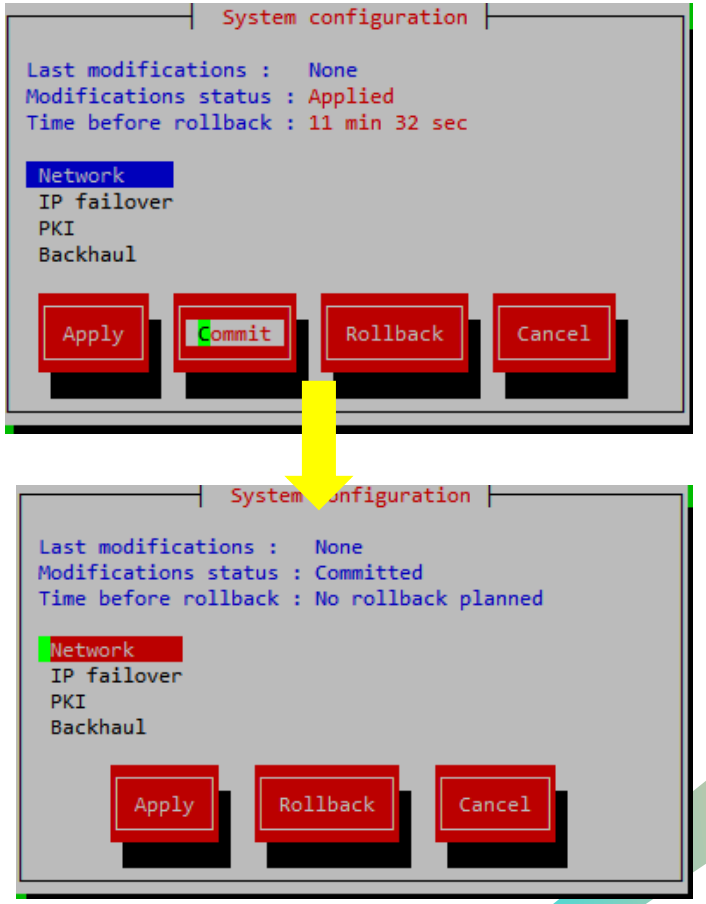
Suplog Eth -> WiFi mode [PICO] (6/6)

- Step 5/5 : commit your configuration
  - See next slide

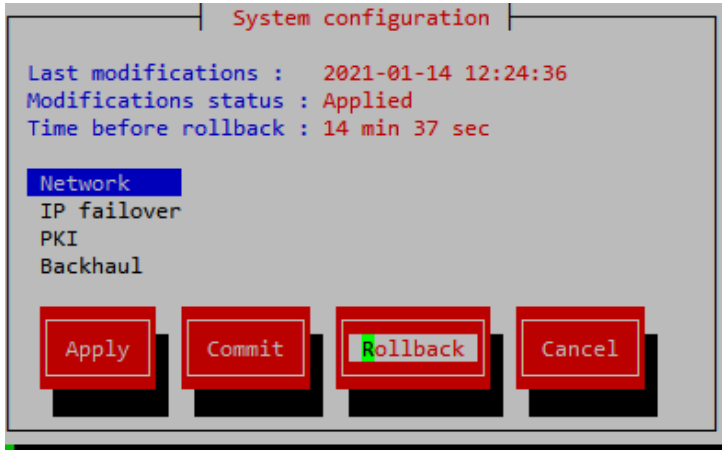
Suplog - Commit configuration

- Every time you apply a new configuration, ThingPark All In One will keep this configuration for 15 minutes, and will automatically roll back if you don't commit your changes
- you have to commit the configuration to keep it permanently
  - you must return to the System configuration menu
  - Modification Status should be : Applied
  - Time before rollback is also displayed
  - You now have to select Commit and press <enter>
  - The screen will change to reflect the new Modification Status : Committed



Suplog - Restore configuration

- If you want to restore your previous configuration manually rather than waiting for the automatic rollback
  - select System configuration, press <enter>
  - Modification Status should be : Applied
  - Time before rollback is displayed
  - Select Rollback and press <enter>
- Note : Once a configuration is committed, it cannot be rolled back



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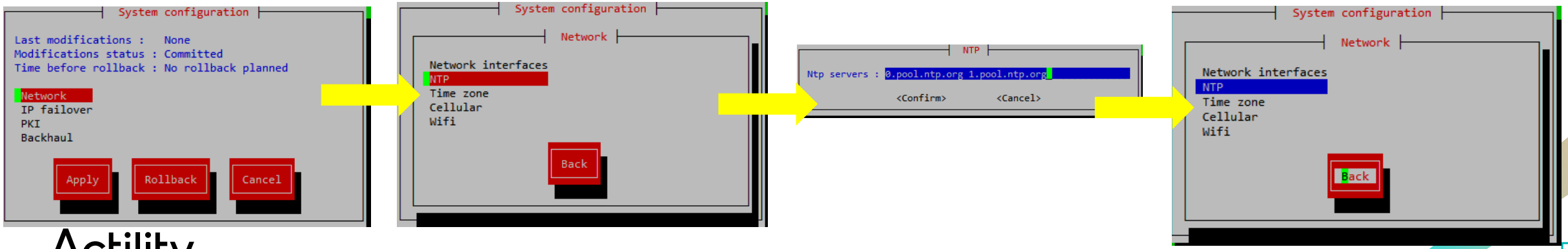
Suplog - Change NTP Servers

- If you want to change your NTP servers
  - Select System configuration, press <enter>
  - Select Network and press <enter>
  - Select NTP and press <enter>
  - Change the NTP servers list
  - Move to Confirm, press <enter>
  - Move to Back, press <enter>
  - Move to Apply, press <enter>
  - After reconfiguration, commit your configuration, see Suplog - Commit configuration



Advanced tasks - Direct access to Node-Red flow

- In case you encounter issues with Node-Red configuration, making Node-Red UI unreachable (e.g. infinite loop that consume all node CPU) and you have no backup file
  - You may directly connect on the box using the node-red user (password is the one you use to connect on tao)
    - `ssh node-red@$BOX_IP`
  - Enter the node-red-data folder
    - `cd /home/actility/node-red-data/`
  - You can edit flows.json and correct the file
  - You can now kill -9 the node-red process, it will be automatically restarted, take care to only kill the "node-red" process

```
am335x-evm:~$ ps | grep node-red
3768 root      1464 S    {S99node-red} /bin/sh /etc/rc5.d/S99node-red _respawnService
3822 node-red  2600 S    su -c /opt/node/bin/node /home/actility/node-red/node_modules/node-red/red.js --settings /home/actility/usr/etc/node-red/settings.js node-red
3838 node-red  131m S    node-red
```

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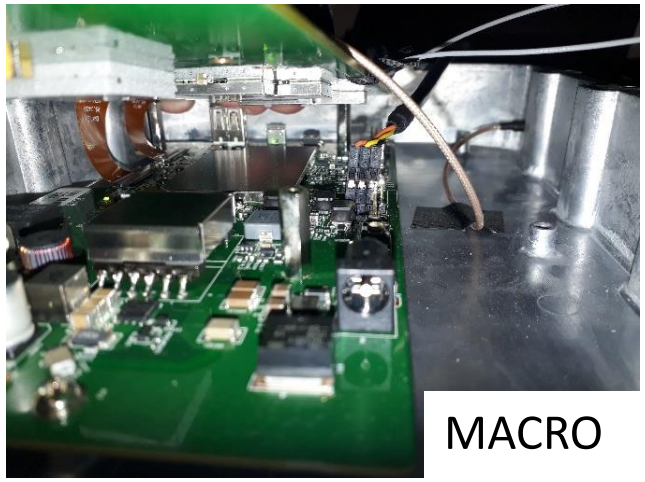
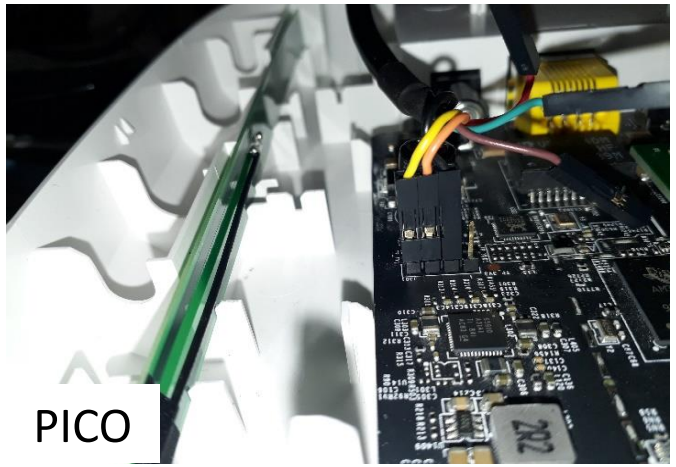
Advanced tasks – Access via serial port

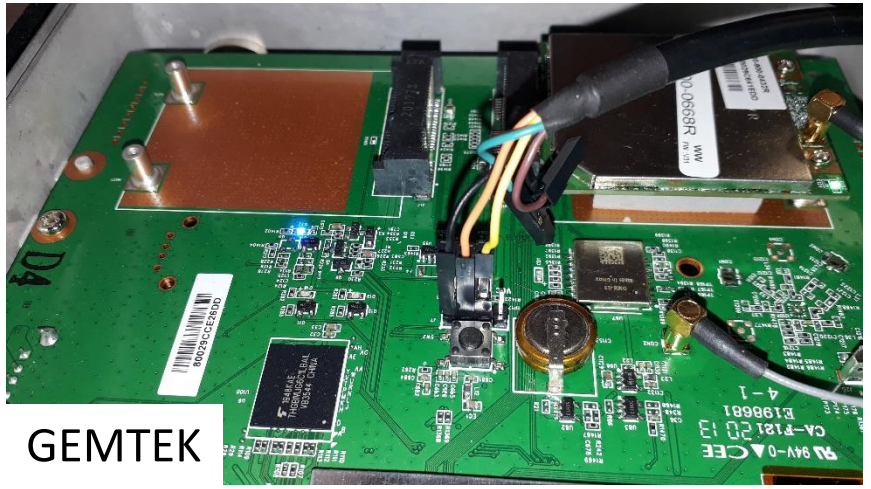
- You may connect to the serial port using an FTDI cable
  - black : GND
  - yellow : TX
  - orange : RX
  - Speed (baud): 115200, Data bits: 8, Stop bits: 1, Parity: None, Flow control: XON/XOFF



MACRO



PICO



GEMTEK

THANK YOU

Actility