



TVWS

AFAS Operation manual

Doc: Runcom AFAS User Operation Manual RN-PMG-011215 V-2.0

About this Document

This document describes the AFAS (Advanced Frequency Allocation Software) element as part of the TV White Space solution, describes the interaction between each element of the entire solution to guaranty proper operation under the FCC requirements and describes in details the command and operation the AFAS unit

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Note: THE AFAS SHALL BE OPERATED ONLY IN CONJUNCTION WITH THE SPECTRUM BRIDGE TVWS DATA BASE, THE RNU-4000TVWS Base Stations (FCC Identifier: XYMBSTVWS-1) AND THE RUNCOM CPE-O-R-WS (FCC Identifier: XYMCPETVWS-1)

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1 Introduction- TVWS Solution

Runcom's TVWS solution is a standard WIMAX 802.16e system which includes adaptations to support the TVWS spectrum and management requirements under FCC Part 15 mandatory requirements.

Runcom's TVWS solution includes all network elements, management element and traffic control to guarantee high quality voice, video and data services over the TVWS spectrum.

The following diagram describes the core network elements, and management resources of the entire WIMAX TVWS solution.

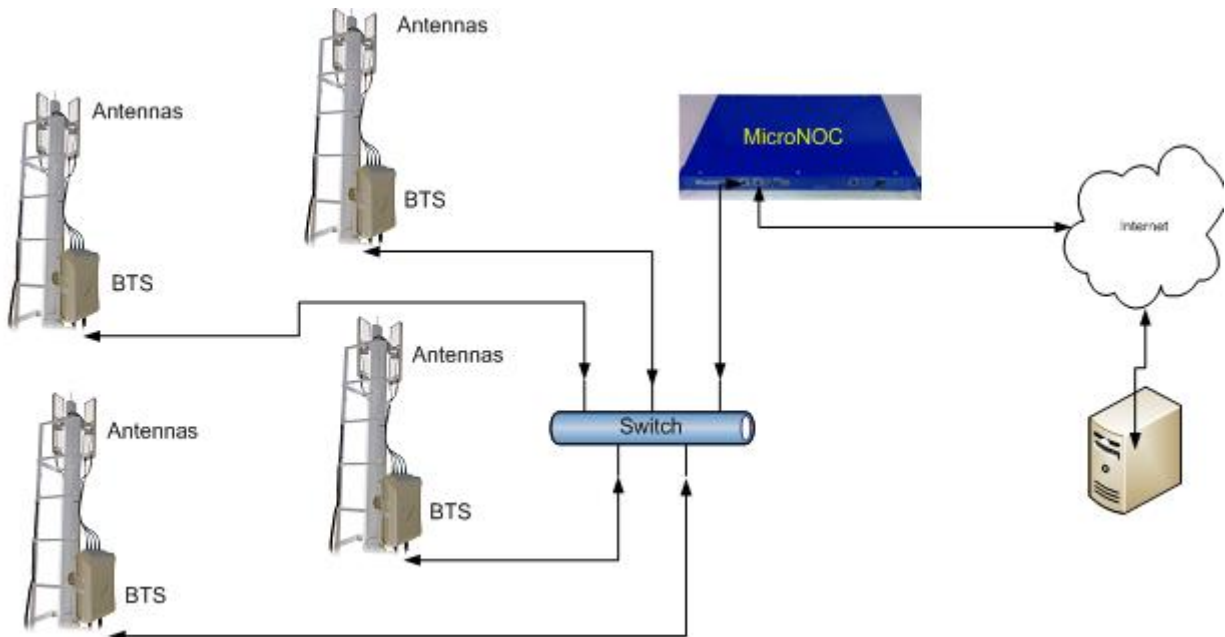


Figure 1: WIMAX TVWS core network diagram

1.1 Solution elements

1.1.1 AFAS

AFAS, Advanced Frequency Allocation Software is a mediation device between authorized FCC TVWS location & frequency database and the base station radio units.

The AFAS allocate frequencies to BTSs according to the BTS location, allowed frequencies, and in the future the algorithm will take into account measured interference parameters. The update cycle is lower than once a day, and it is configurable. Each BTS and CPE is recognized by its MAC address so no mistakes are possible.

The AFAS is a software implemented on Python using Django open source framework and run on a Linux machine using OS Ubuntu version 14.04.

The AFAS requires internet connectivity in order to communicate with Spectrum Bridge TVWS Data Base at least once in 24 hours.

The AFAS communicate with TVWS Data Base using Spectrum Bridge DB client and communicate with Runcom equipment using SNMP V2.

1.1.2 NOC (MicroNOC, Compact NOC)

The xNOC unit is the main network operation controller of any WIMAX 802.16e network. The unit performs the following functions:

- ASM gateway (Access Service Network Gateway). This element enforce all users and WIMAX element network's policies (bandwidth control, total traffic control, AAA profile, scheduling and more)
- DHCP server or mediation device between external DHCP server and the WiMAX elements.
- DNS server or mediation device between external DNS server and the WiMAX elements.
- Basic AAA. If higher level of AAA required the unit can be a mediation device to any AAA server which meet the RADIUS standards

The xNOC units are identical for TVWS and all WIMAX networks, Runcom and non Runcom radio devices.

For more information, commands, services and more please refer to [SG-UM-8500 V13](#) user manual (or later), [SG-1 Vendor-Specific attributes](#) user manual and Runcom's public database.

1.1.3 Base Station

Runcom's base station (BTS) is the center radio point which connects the customers' premises equipment and the users behind it to the core network and the internet. BTS support multiple CPEs (up to 128), mobility, network management (via SNMP V2) and GUI interface. The BTS fully support WiMAX standards with the adaptations needed to comply with the TWVS FCC regulations.

For more information, installation procedures, configuration commands and more please refer to Runcom RNU4000BS User Manual –RN–PMG-230914 V-3.8 user manual.

1.1.4 CPE

The customer premises equipment (CPE) is the unit which connects the users to the internet over the TVWS core network. For information regarding the CPE installation and operation please refer to the CPE-O-R-WS User and Installation Manual (RN–PMG-300516)

2 AFAS – Internal operation

The AFAS unit is a software with access to the internet with permission to access the TVWS database and the NOC.

2.1 Adding new Base Station (BS)

Prior to deployment of new BS, operator needs to update AFAS with the BS information, the expected installation location, the radio capabilities, and the initial frequency which is selected from the database manually and take into account the known interference in that area. After adding is done and the BS is active, the AFAS is automatically submitting a query to TVWS DB for allowed transmission channels for the new BS (double check that all process is working properly).

After receiving the TVWS DB response, AFAS will check that the initial frequency is in the allowed list, and in case of reject, it will use the best frequency selection algorithm and will send a set frequency command to the BS followed by start transmission command.

Note: In phase 2 of AFAS development, AFAS will send measurement request to BS in order to verify the freshness of the environment noise levels which are crucial inputs to the channel selection algorithm.

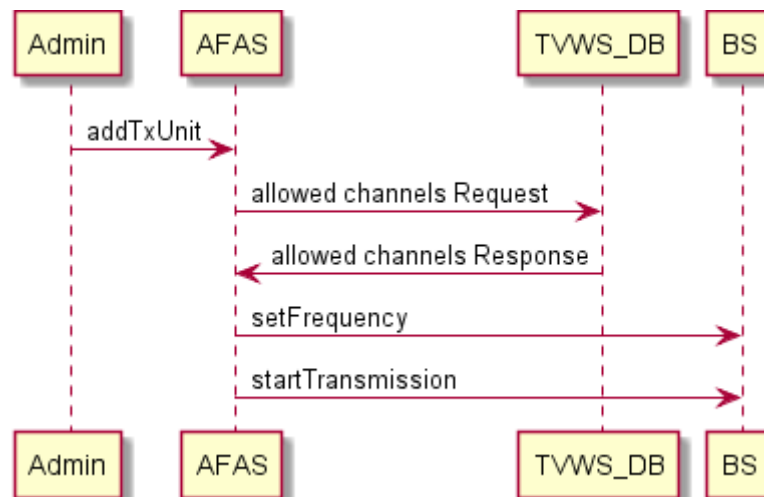


Figure 2 - Adding a new BS to the network

2.2 Adding new CPE

Installation of new CPE or CPE which has moved from its original location, the following actions must be done (Please also refer to the CPE-O-R-WS User and Installation Manual):

1. Register the CPE at the AFAS with the expected location (longitude, altitude, height of the antenna)
2. Select the requested frequency for the CPE (the BTS frequency which this CPE is targeted to connect)
3. The AFAS will check the new CPE TVWS channel allocation (the requested channels) by sending the information to TVWS DB using Spectrum Bridge client.
4. After receiving the response from the Data Base, AFAS will get a list of allowed frequencies for that CPE.
5. AFAS will create an allowed list for the CPE taking into consideration also the available BS in the CPE area, and will update the CPE device.

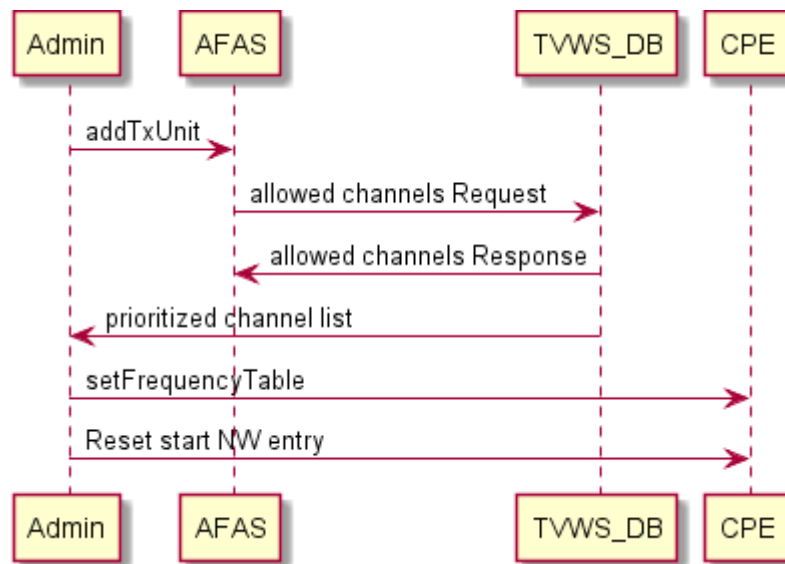


Figure 3 - Adding a new CPE to the network

2.3 Periodic update

Periodic update is the process which must be done at least once every 24 hour. The procedure can be initiated by the system admin using AFAS frontend web interface or by the expiry of a timer using synced tasks in the AFAS management system.

After getting the TVWS DB response, If the response does not have any changes in the TVWS channel availability the AFAS will not do any action to the TVWS system, If the response from the Data Base is different from the previous response AFAS will run a channel allocation algorithm which will allocate a TVWS channel to each BS and a set of allowed frequencies to each CPE

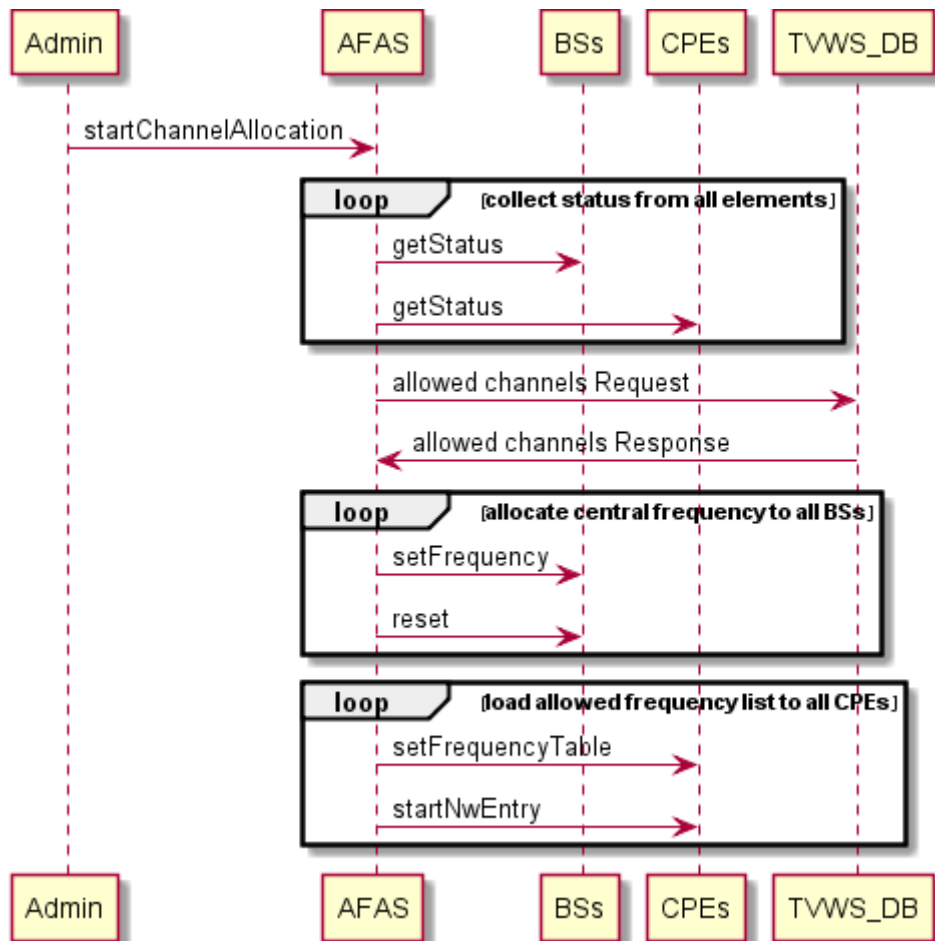


Figure 4 - Periodic channels update

3 AFAS – Configuration

The AFAS GUI is based on WEB pages which are presented by FIREFOX browser. Leafing through pages can be done by double clicking on the selected subject or using the back or next arrows. Returning back to upper hierarchies can be done by double clicking on the name of the directory in the first row as shown in the below figure.

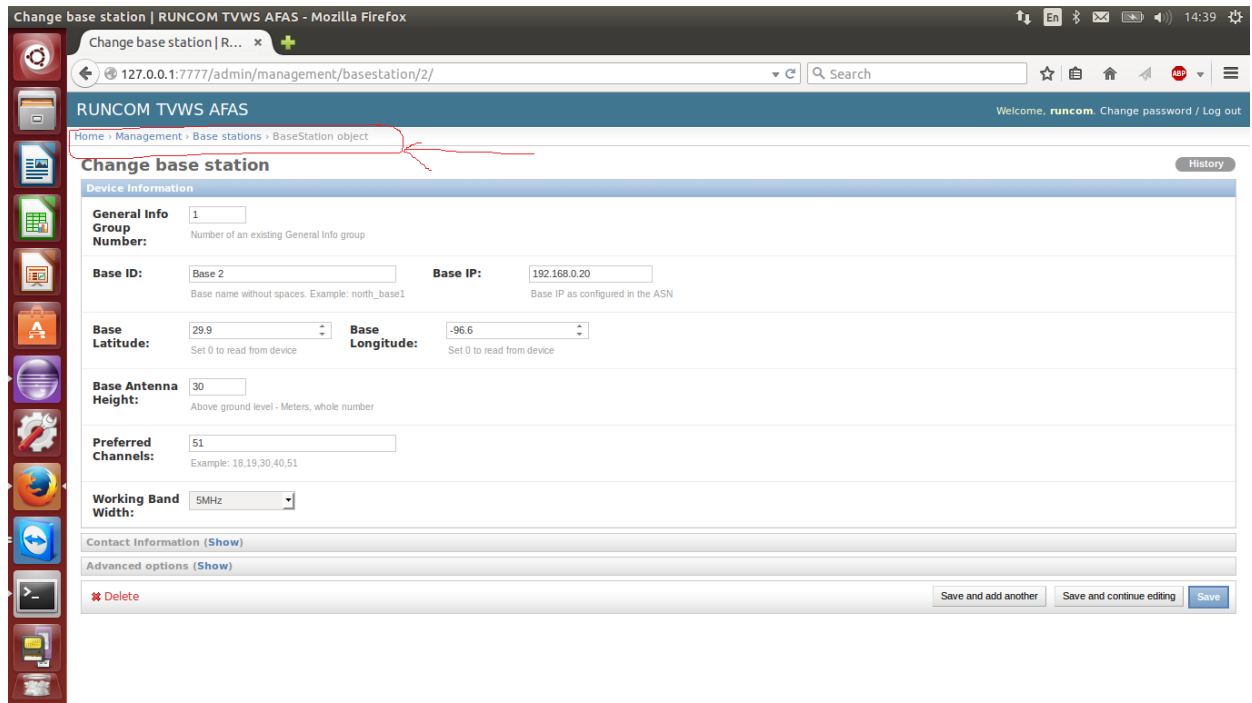


Figure 5: Hierarchy Leafing

3.1 Home page

After turning on the AFAS server the system enters to the HOME page.

The management section is active in this version, and the options to add or change base station.

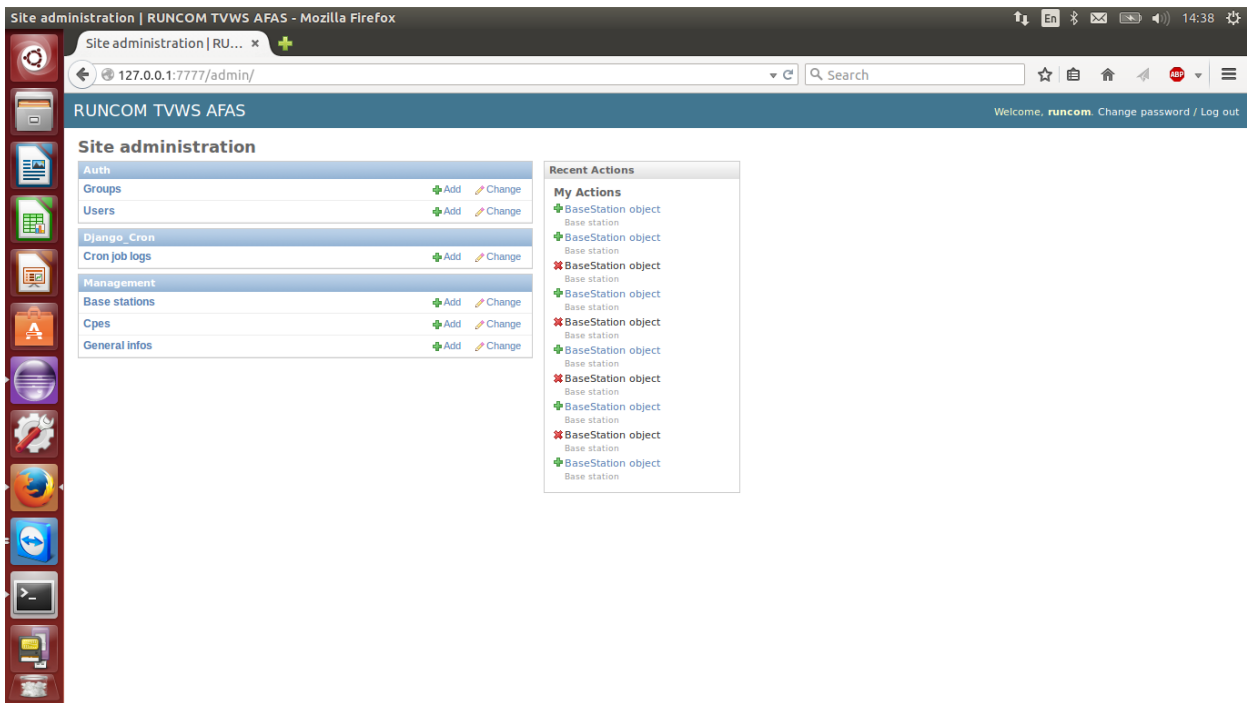


Figure 6: Home page

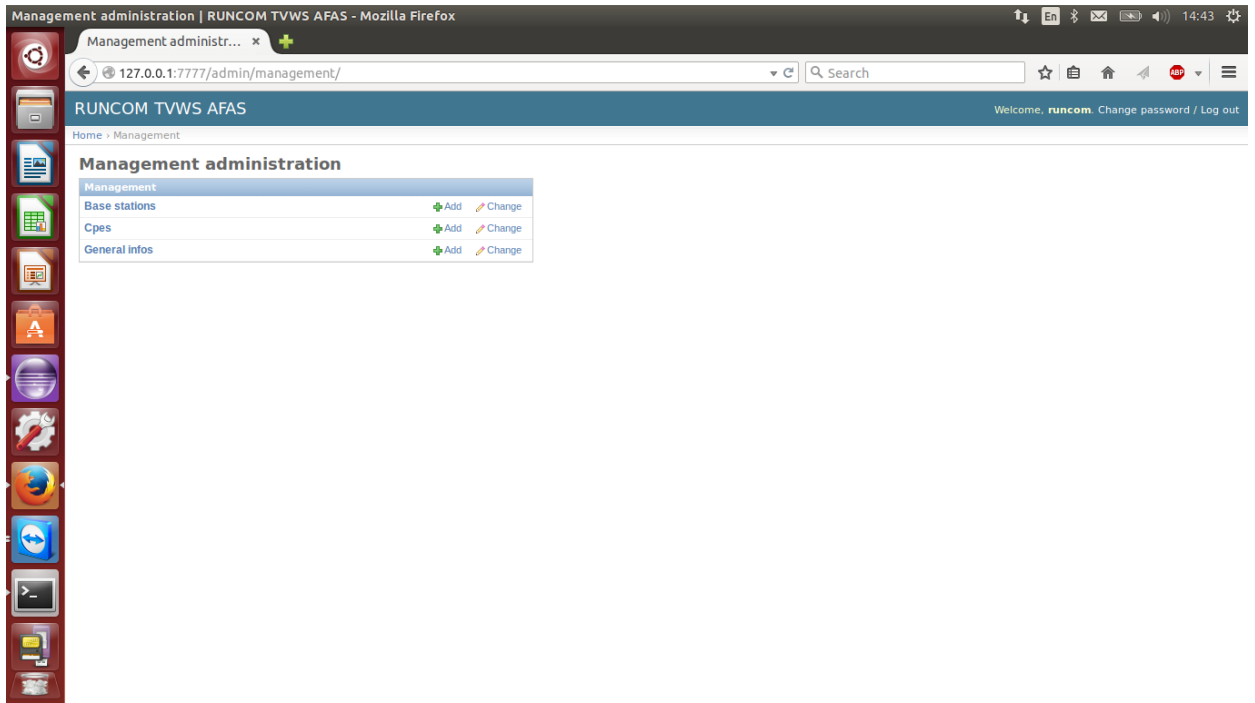


Figure 7: management Administration Page

3.2 Add Base Station

Three options to add base station to be synchronized and operate under the FCC standard:

- From HOME page at the Management/base station row - push the add

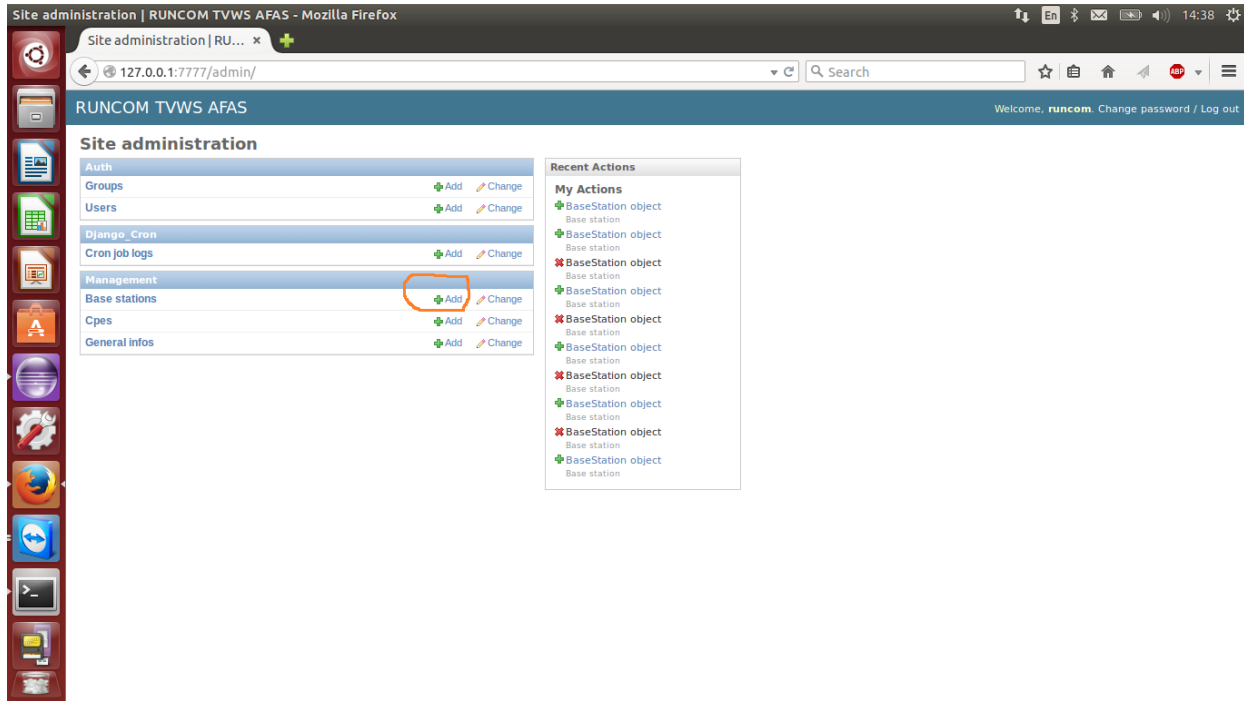


Figure 8: Add Base Station - option 1

- From the management administration page, at the base station row - push the add

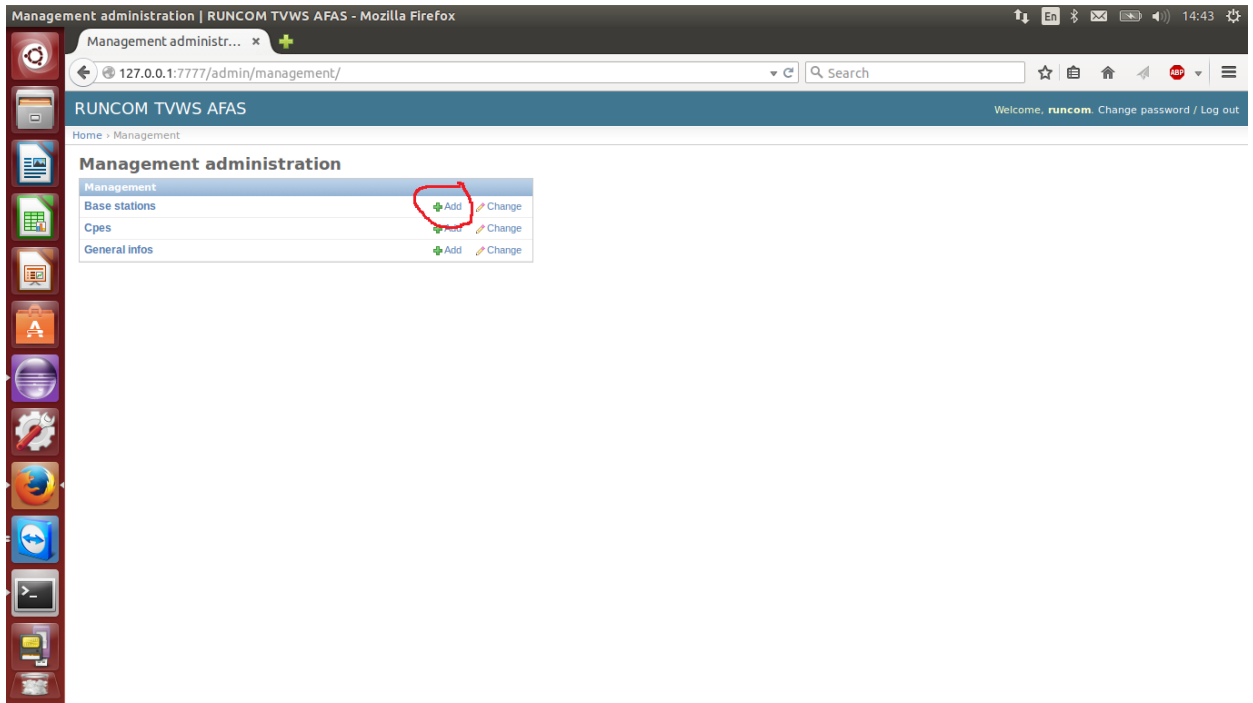


Figure 9: Add Base Station - Option 2

- From the base stations list – push add base station button.

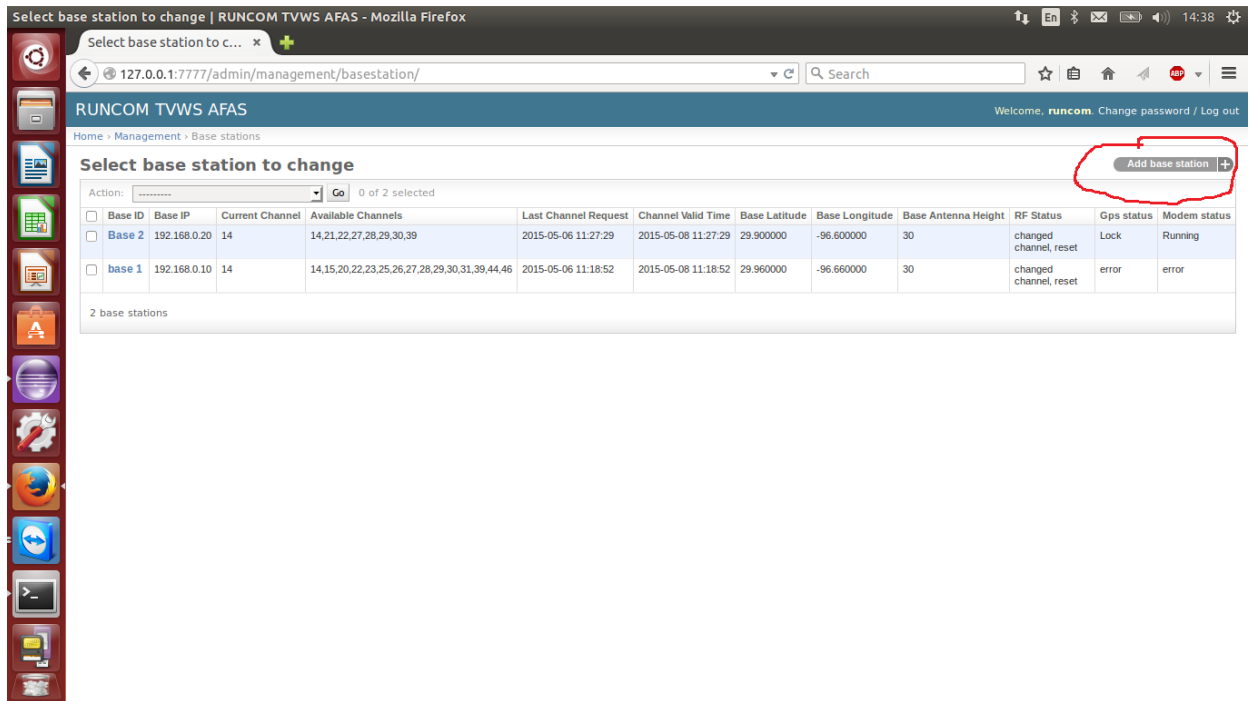


Figure 10: Add Base Station - option 3

After entering to the "add base station" form the following page should be filling with the following information

Figure 11: Add base Station page 1- Device Information

- **Base Station ID** : Logical name of the BS which helps to identify it – use for AFAS only
- **Base Station IP**: the IP address of the base station as presented in the xNOC device
- GIS information: **Base Longitude, Base Latitude** the location of the base station. Keep "0" for automatic update from the BS unit.
- **Base Antenna Height**: the height of the antennas element. If more than one antenna is used, enter the highest antenna parameter.
- **Preferred channel**: During installation it is recommended to measure all possible channels and to use the best. Enter the best first in row, and followed by comma the second best and so on. If "0" is entering the AFAS will use its algorithm to select channel.
- **Channel bandwidth**: It is possible to use single channel or two adjacent channels if found. 5MHz is single 6 MHz channel; 10MHz is two adjacent channels – 12 MHz

Width:

Contact Information [Hide](#)

Contact City:
Leave blank to read from General Info group

Contact Country:
Leave blank to read from General Info group

Contact Email:
Leave blank to read from General Info group

Contact Name:
Leave blank to read from General Info group

Contact Phone:
Leave blank to read from General Info group

Contact State:
Leave blank to read from General Info group

Contact Street:
Leave blank to read from General Info group

Contact Zip:
Leave blank to read from General Info group

Country Code:
Leave blank to read from General Info group

Device Owner:
Leave blank to read from General Info group

Figure 12: Add Base Station page 2 – Contact Information

The contact information page includes the information of the person (or officer in duty) which in-charge on the site, and is authorized and capable to perform maintenance, site ON and OFF, etc.

If fields in the web page are left blank, the information will be added automatically from the group information which this site is connected.

The screenshot shows a web browser window with the following content:

- Browser title: Add base station | RUNCOM TVWS AFAS - Mozilla Firefox
- Address bar: 127.0.0.1:7777/admin/management/basestation/add/
- Form fields:
 - Contact Zip:
 - Country Code:
 - Device Owner:
 - Advanced options: **Hide**
 - Time Zone:
 - Data Base Host Address:
 - Data Base Host Port Number:
 - Data Base Regulatory Domain:
 - Base Fcc ID:
 - Base Serial Number:
 - Base Rf map:
 - Device Type:
- Buttons: Save and add another, Save and continue editing, Save

Figure 13: Add Base Station page 3 – Advanced Information

The advanced option web page includes information on the database which this device gets the operation authorization frequencies. Blank fields are automatically updated from the group information.

- **Time Zone:** indicates the time zone where the BS is operation. The time zone should be winter time zone all year.
- **Data Base Host Address:** IP address of the server from which the authorized frequencies are downloaded. Currently Runcom is using SpectrumBridge database only. In the future additional databases will be available.
- **Data Base Host Port Number:** the port number which is open for access to the database.
- **Data Base Regulatory ID:** "US" for United States.
- **Base FCC ID:** the FCC authorization ID as received after passing the tests.
- **Base Station Serial Number:** the serial number of the unit.
- **Device type:** fixed (the only option for BS units)

3.3 View Registered Base Stations

From the HOME page, push the Base Station button and enter into the base station page

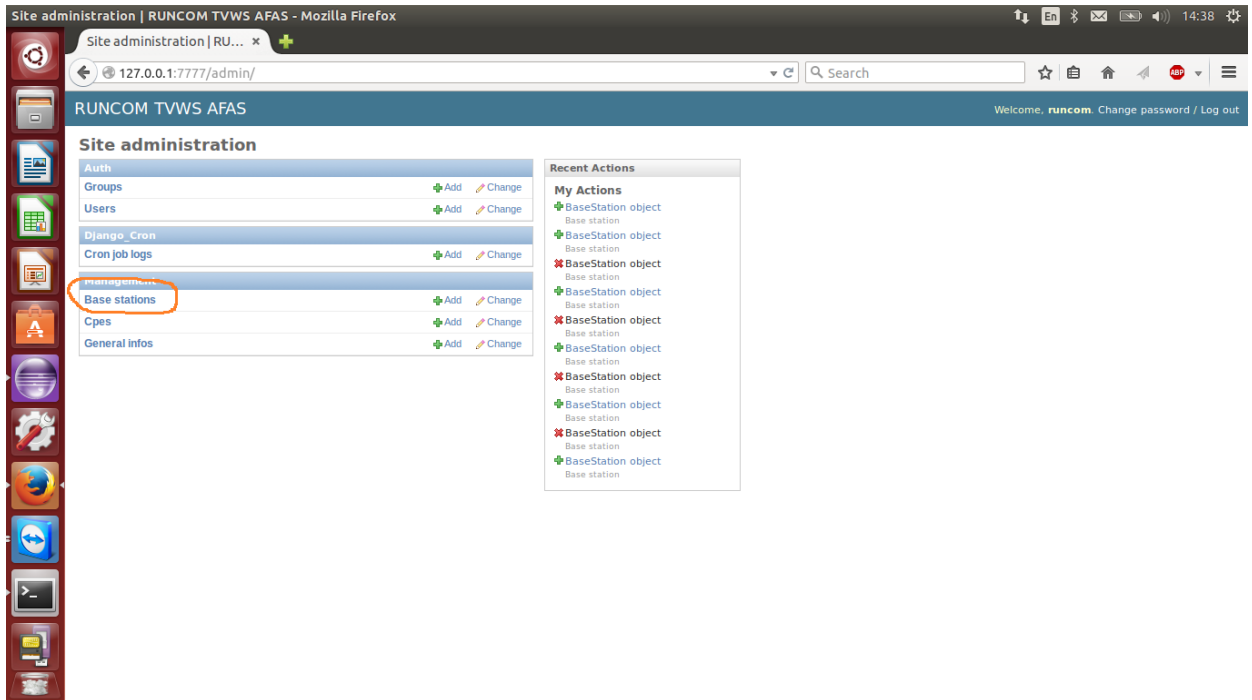


Figure 14: Base Station Page Selection

The following web page shows all registered base stations, their authorization status, GIS information and operation status

The screenshot shows a web browser window with the URL `127.0.0.1:7777/admin/management/basestation/`. The page title is "Select base station to change" and the header includes "RUNCOM TVWS AFAS" and "Welcome, runcom. Change password / Log out". The main content area is titled "Select base station to change" and contains a table with the following data:

Base ID	Base IP	Current Channel	Available Channels	Last Channel Request	Channel Valid Time	Base Latitude	Base Longitude	Base Antenna Height	RF Status	Gps status	Modem status
Base 2	192.168.0.20	14	14,21,22,27,28,29,30,39	2015-05-06 11:27:29	2015-05-08 11:27:29	29.900000	-96.600000	30	changed channel, reset	Lock	Running
base 1	192.168.0.10	14	14,15,20,22,23,25,26,27,28,29,30,31,39,44,46	2015-05-06 11:18:52	2015-05-08 11:18:52	29.960000	-96.660000	30	changed channel, reset	error	error

Below the table, it indicates "2 base stations".

Figure 15: Registered Base Stations Information

- **Base ID:** the BS unique identifier.
- **Base IP:** Base Station IP address.
- **Current Channel:** the channel which the AFAS selected for the BTS from the allowed channel list for this Base Station
- **Available channels:** The list of available channels for that GIS information and Base station ID as received from the FCC database.
- **Last Channel Request:** the date and time for the last AFAS request.
- **Channel Valid Time:** the expiration time if no renew is performed.
- GIS information: **Base Latitude, Base Longitude, Antenna height.**
- **RF Status:** the last action on the RF module in the BS.
- **GPS Status:** GPS lock status.
- **Modem Status:** shows if the base station is active (Running), standby, down or faulty (error).

3.4 View / Change Base Stations Information

By clicking on the **Base ID** field in figure 16, the base station entire information is presented. Information can be changed, or the base station can be deleted from the database.

The screenshot displays a web browser window with the URL `127.0.0.1:7777/admin/management/basestation/2/`. The page title is "Change base station | RUNCOM TVWS AFAS - Mozilla Firefox". The main content area is titled "Change base station" and contains a "Device Information" section. The form fields are as follows:

Device Information	
General Info Group Number:	<input type="text" value="1"/> <small>Number of an existing General Info group</small>
Base ID:	<input type="text" value="Base 2"/> <small>Base name without spaces. Example: north_base1</small>
Base IP:	<input type="text" value="192.168.0.20"/> <small>Base IP as configured in the ASN</small>
Base Latitude:	<input type="text" value="29.9"/> <small>Set 0 to read from device</small>
Base Longitude:	<input type="text" value="-96.6"/> <small>Set 0 to read from device</small>
Base Antenna Height:	<input type="text" value="30"/> <small>Above ground level - Meters, whole number</small>
Preferred Channels:	<input type="text" value="51"/> <small>Example: 18,19,30,40,51</small>
Working Band Width:	<input type="text" value="5MHz"/>

Below the form, there are sections for "Contact Information (Show)" and "Advanced options (Show)". At the bottom, there are three buttons: "Delete" (with a red asterisk icon), "Save and add another", and "Save and continue editing". A "Save" button is also visible at the bottom right.

Figure 16: Base Station Information page 1- Device Information

This page includes the device static and operation information. The **Preferred Channel** is the field which expected to change manually. After installation the preferred channel (from the allowed list) should be selected for the best RF operation.

Change base station | RUNCOM TVWS AFAS - Mozilla Firefox

Change base station | R... x

127.0.0.1:7777/admin/management/basestation/2/

Width:

Contact Information (Hide)

Contact City:
Leave blank to read from General Info group

Contact Country:
Leave blank to read from General Info group

Contact Email:
Leave blank to read from General Info group

Contact Name:
Leave blank to read from General Info group

Contact Phone:
Leave blank to read from General Info group

Contact State:
Leave blank to read from General Info group

Contact Street:
Leave blank to read from General Info group

Contact Zip:
Leave blank to read from General Info group

Country Code:
Leave blank to read from General Info group

Device Owner:
Leave blank to read from General Info group

Figure 17: Base Station Information page 2 – Contact Information

The contact information tab includes the current contact information, as defined in the installation or in the last update. It should be used in case that the device need maintenance of repair.

The screenshot shows a web browser window with the URL `127.0.0.1:7777/admin/management/basestation/2/`. The page is titled "Change base station | R..." and contains a form for configuring a base station. The "Advanced options" tab is active, showing the following fields:

- Contact Zip:
- Country Code:
- Device Owner:
- Time Zone:
- Data Base Host Address:
- Data Base Host Port Number:
- Data Base Regulatory Domain:
- Base Fcc ID: Base Serial Number:
- Base Rf map: Device Type:

At the bottom of the form, there are buttons for "Delete", "Save and add another", "Save and continue editing", and "Save".

Figure 18: Base Station Information page 2 – Advanced options

The advance option tab includes information on the allocating frequencies source database, and FCC device operation approval. Any change in this information must be done carefully. Wrong information will cause the base station to stop it service and shut down.

4 AFAS – Connection Status

AFAS internet connectivity is important to keep the TVWS WIMAX network in normal and healthy conditions. The internet connectivity is required to support two major functions:

- Connection to the FCC frequencies allocation database (currently supported by Spectrum Bridge)
- Connection to the base stations via the NOC.

4.1 FCC Database connection lost

If connection between AFAS and the FCC database is lost, during the next refresh information cycle, the AFAS will notify the operator (on screen) for each base station separately, that the connection to the TVWS database is not available.

The screenshot shows the 'Select base station to change' page in the RUNCOM TVWS AFAS web interface. The table below displays the status of a single base station:

Base ID	Base IP	Current Channel	Available Channels	Last Channel Request	Channel Valid Time	Base Latitude	Base Longitude	Base Antenna Height	RF Status	Gps status	Modem status
base 1	192.168.0.10	14	0	no communication to TVWS-DB	2015-04-28 14:15:42	29.960000	-96.660000	30	changed channel, reset	Lock	Running

The 'Last Channel Request' column for the first base station (base 1) contains the message 'no communication to TVWS-DB', which is circled in red. A TeamViewer session window is visible in the bottom right corner.

Figure 19: No Connection to DataBase

After validity expiration of the database the following message is published and the base station informed to stop service and shut transmission down till further action. Figure 21 shows the status

The screenshot shows a web browser window with the URL `127.0.0.1:6688/admin/management/basestation/`. The page title is "Select base station to change | RUNCOM TVWS AFAS". The interface includes a navigation menu on the left and a main content area with the heading "Select base station to change". Below the heading is a table with the following columns: Base ID, Base IP, Current Channel, Available Channels, Last Channel Request, Channel Valid Time, Base Latitude, Base Longitude, Base Antenna Height, RF Status, Gps status, and Modem status. The table contains one row for "base 1" with the following values: Base IP: 192.168.0.10, Current Channel: 14, Available Channels: 0, Last Channel Request: Communication Timeout expired BS will be disconnected at 24:00, Channel Valid Time: 2015-04-29 06:21:14, Base Latitude: 29.960000, Base Longitude: -96.660000, Base Antenna Height: 30, RF Status: changed channel, reset, Gps status: Lock, and Modem status: Running. A red circle highlights the "Last Channel Request" cell.

Base ID	Base IP	Current Channel	Available Channels	Last Channel Request	Channel Valid Time	Base Latitude	Base Longitude	Base Antenna Height	RF Status	Gps status	Modem status
base 1	192.168.0.10	14	0	Communication Timeout expired BS will be disconnected at 24:00	2015-04-29 06:21:14	29.960000	-96.660000	30	changed channel, reset	Lock	Running

Figure 20: Database validity expired

5 Adding CPE to the AFAS

To add a CPE in the AFAS open the “Site administration” page in the AFAS and Choose CPE as shown in Figure 21 below.

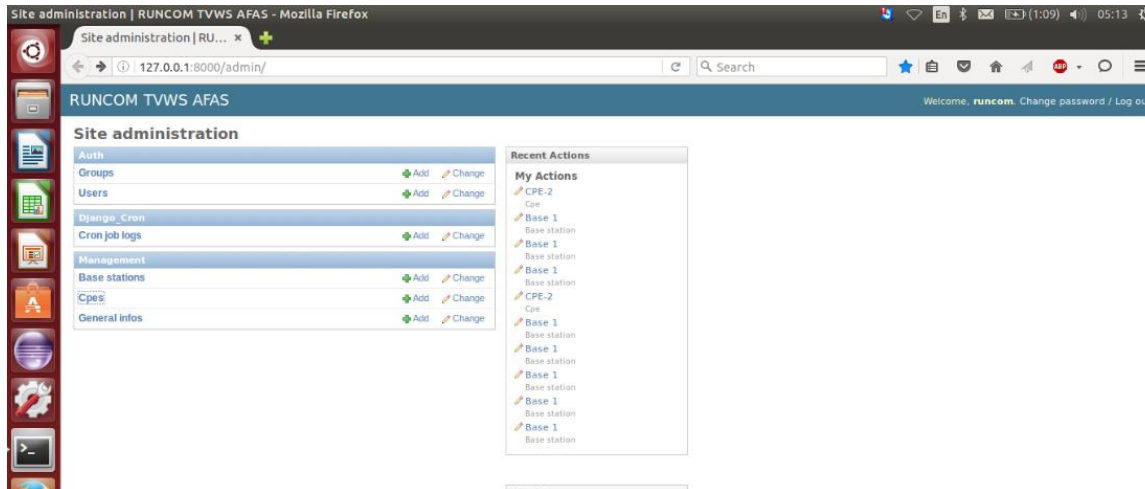


Figure 21: AFAS Site administration page

The AFAS SW will open the “Select CPE” page, on this page click the “Add cpe” option as shown in figure 22 below.

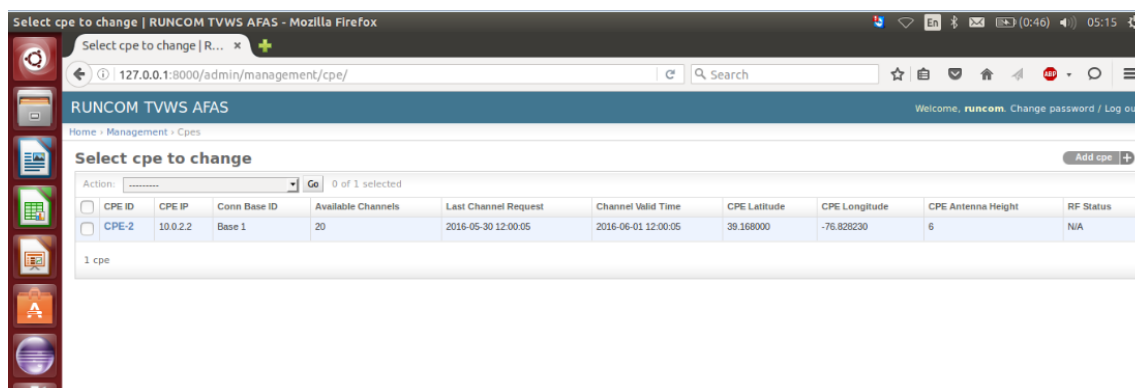


Figure 22: AFAS Select CPE page

On the “Add cpe” page fill the CPE ID, CPE IP, CPE Latitude and Longitude, the Connecting Base ID, The CPE antenna Height, MAC ID and save it as shown in Figure 23 below:

NOTE: Each CPE MAC ID will have one set of location data (Latitude, Longitude and Antenna Height) associated to it at the AFAS

The screenshot shows the 'Add cpe' configuration page in the AFAS web interface. The page is titled 'Add cpe' and is part of the 'RUNCOM TVWS AFAS' management system. The browser address bar shows the URL '127.0.0.1:8000/admin/management/cpe/add/'. The page contains several input fields for configuring a new CPE device:

- General Info Group Number:** A text input field with a small 'x' icon.
- CPE ID:** A text input field with a note: 'CPE name without spaces. Example: north_base1'.
- CPE IP:** A text input field with a note: 'CPE IP as configured in the ASN/DHCP'.
- CPE Latitude:** A text input field with a note: 'Latitude coordinate'.
- CPE Longitude:** A text input field with a note: 'Longitude coordinate'.
- Conn Base ID:** A dropdown menu with a plus icon.
- CPE Antenna Height:** A text input field with a value of '30' and a note: 'Above ground level - Meters, whole number'.
- Preferred Channels:** A text input field with a value of '0' and a note: 'Example: 18,19,30,40,51'.
- Available Channels:** A text input field with a value of '0'.
- Refresh In:** A text input field with a value of '0'.

Figure 23: AFAS CPE configuration page

After completion of entering the information in the "Add cpe page" click the "Channel request to select Devices" and press "Go" and the AFAS will ask for channels from the Data Base as shown in Figure 24 below.

The screenshot shows the 'Select cpe to change' page in the AFAS web interface. The page is titled 'Select cpe to change' and is part of the 'RUNCOM TVWS AFAS' management system. The page displays a table with the following columns:

- CPE ID
- CPE IP
- Conn Base ID
- Available Channels
- Last Channel Request
- Channel Valid Time
- CPE Latitude
- CPE Longitude
- CPE Antenna Height
- RF Status

A single row is visible in the table:

CPE ID	CPE IP	Conn Base ID	Available Channels	Last Channel Request	Channel Valid Time	CPE Latitude	CPE Longitude	CPE Antenna Height	RF Status
CPE-2	10.0.2.2	Base	14,21,22,23,24,25,26,31,32,33,34,35,40,41,50	22:46:18 06/05/16	22:46:18 06/07/16	37.526000	-86.705000	6	N/A

The page also includes an 'Action:' dropdown menu and a 'Go' button. The status '0 of 1 selected' is displayed. A '1 cpe' summary is shown at the bottom of the table.

Figure 24: AFAS CPE available channels request

After receiving the available channels from the Data Base, AFAS will load the allowed channels to the CPE and the CPE will establish the link with the Base Station in one of the allowed channels.