

TECHNICAL NOTE
TN-RF-005

BUILDING A RELIABLE WIFI NETWORK
WITH WILLOW[®] SENSORS



DOCUMENT

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1. TECHNICAL SUPPORT

For general contact, technical support, to report documentation errors and to order manuals, contact **BeanAir Technical Support Center** (BTSC) at:
tech-support@beanair.com

For detailed information about where you can buy the BeanAir equipment/software or for recommendations on accessories and components visit:

www.beanair.com

To register for product news and announcements or for product questions contact BeanAir's Technical Support Center (BTSC).

Our aim is to make this user manual as helpful as possible. Please keep us informed of your comments and suggestions for improvements. BeanAir appreciates feedback from the users.



2. VISUAL SYMBOLS DEFINITION

<i>Symbols</i>	<i>Definition</i>
	<i>Caution or Warning – Alerts the user with important information about BeanAir wireless sensor networks (WSN), if this information is not followed, the equipment /software may fail or malfunction.</i>
	<i>Danger – This information MUST be followed if not you may damage the equipment permanently or bodily injury may occur.</i>
	<i>Tip or Information – Provides advice and suggestions that may be useful when installing BeanAir Wireless Sensor Networks.</i>



3. ACRONYMS AND ABBREVIATIONS

AES	Advanced Encryption Standard
CCA	Clear Channel Assessment
CSMA/CA	Carrier Sense Multiple Access/Collision Avoidance
kSps	Kilo samples per second
LDCDA	Low duty cycle data acquisition
LLC	Logical Link Control
LQI	Link quality indicator
MAC	Media Access Control
PAN	Personal Area Network
PER	Packet error rate
POE	Power Over Ethernet
RF	Radio Frequency
UPS	Uninterruptible power supply
USB OTG	USB On The Go
WDAQ	Wireless DAQ
WSN	Wireless Sensor Networks
WEP	Wired Equivalent Privacy



4. AIM OF THIS DOCUMENT

This document covers the complete process of building a long-range WIFI network for the **BeanDevice®** WILOW® using Ubiquiti M2 WIFI bridge Access point .



5. SOME DEFINITIONS

5.1 WHAT IS AN ACCESS POINT ?

An access point is a station that transmits and receives data , connects users to other users within the network. Each access point can serve multiple users within a defined network area. A small WLAN may only require a single access point.

The number required increases as a function of the number of network users and the physical size of the network.

5.2 WHAT IS WIFI BRIDGE MODE ?

Bridge mode allows two or more wireless Access Points to communicate with each and join their respective local networks together.

Access Point bridging capability can be enabled or disabled through a configuration option. Normally, Access Points in bridging mode discover each other via Media Access Control (MAC) addresses that must be set as configuration parameters.

5.3 WHAT IS VSWR ?

VSWR stands for Voltage Standing Wave Ratio and it is a function of the reflection coefficient, which describes the power reflected from the antenna. The VSWR is always a real and positive number for antennas. The smaller the VSWR is, the better the antenna is matched to the transmission line and the more power is delivered to the antenna. The minimum VSWR is 1.0. In this case, no power is reflected from the antenna, which is ideal.



6. WLAN PLANNING

Initial planning should seek to answer the following questions:

- Total number of users and density (10/100/1000+?)
- Bandwidth requirements of users (file sharing/browsing? 1/2/5/10 Mbps?)
- Growth of WLAN (area/bandwidth/number of users? 1/3/5+ years?)
- Security (open/personal/enterprise? password/hotspot? SSL certificates?)
- Coverage areas (room/building/field/city?)
- Density (sparse/crowded? AP/stations? Number of devices per user?)
- Types of antennas (internal/external? low/hi-gain?)
- Physical location (urban/rural? indoor/outdoor?)
- Band steering (Legacy on 2.4 GHz? N/AC on 5 GHz? 2.4 GHz voice? 5 GHz data?)
- Obstacles (desks/people/trees/signs/doors/walls/windows?)

6.1 WIFI NETWORK ARCHITECTURE

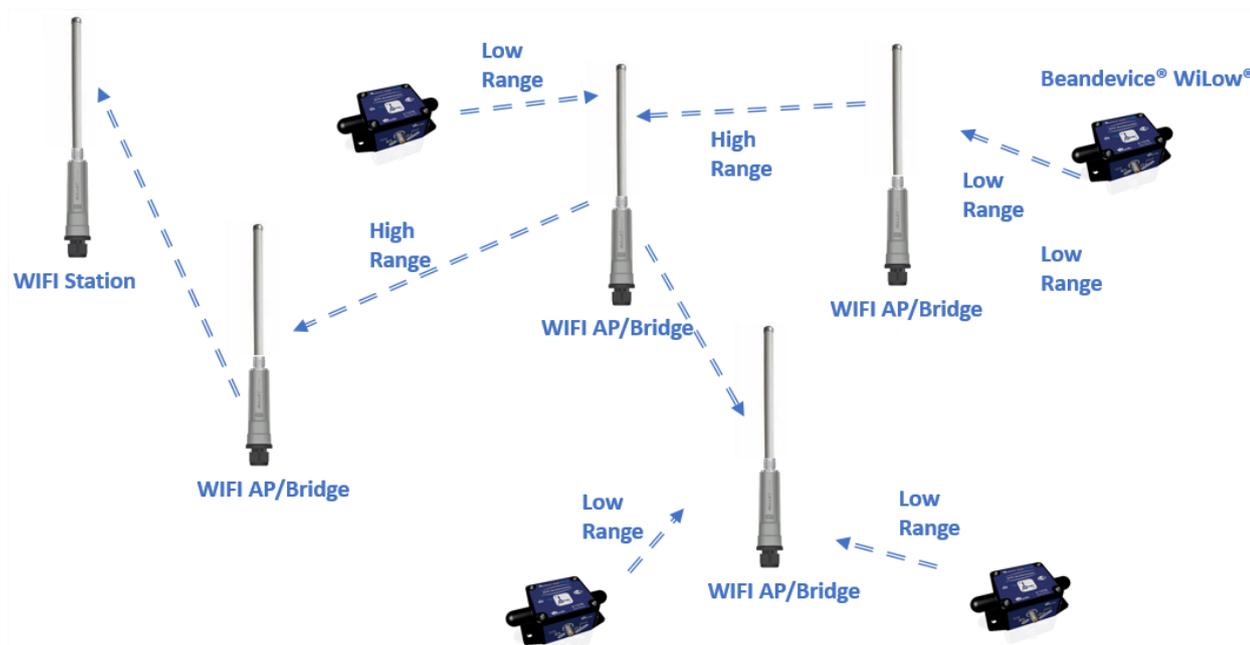


Figure 1: Cluster tree topology



The Cluster tree topology is a special case of combining characteristics of linear bus and star topologies, it consists of groups of star configured WIFI repeaters connected linearly to each other, the drawbacks of this setup is the failure of one station can lead to the failure of a big part of the network, while the large extensibility of the network is the main advantage of this topology.

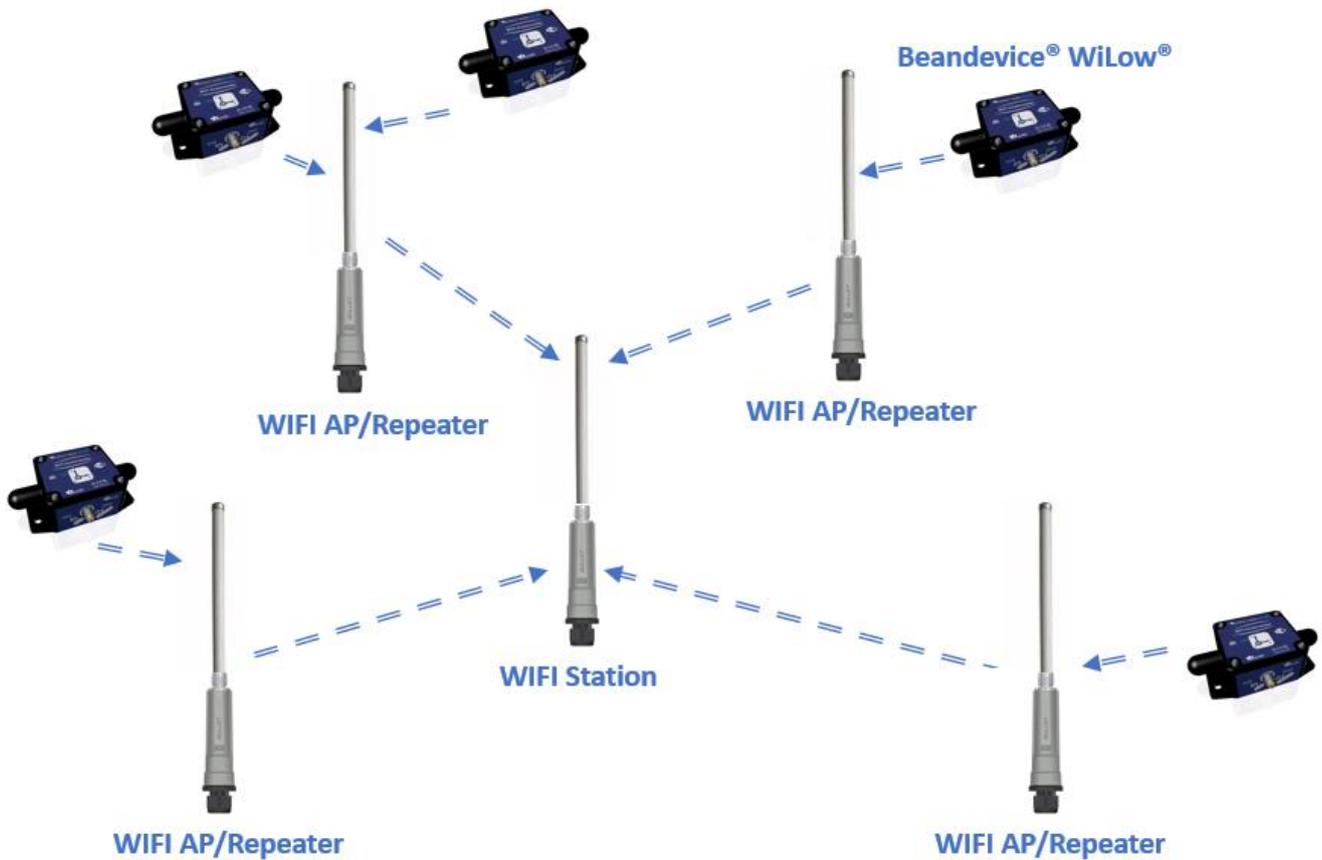


Figure 2:Star topology

The Local Area Network here is using a star topology in which all the WIFI AP/Repeaters are individually connected to a central ubiquity WIFI bridge (Bullet M2) as a coordinator ,the remarkable benefit of a star topology is that when a WIFI repeater fails ,it will only affects its covered area .the downside of a Star topology is the limited number of repeaters we can connect to the central station .



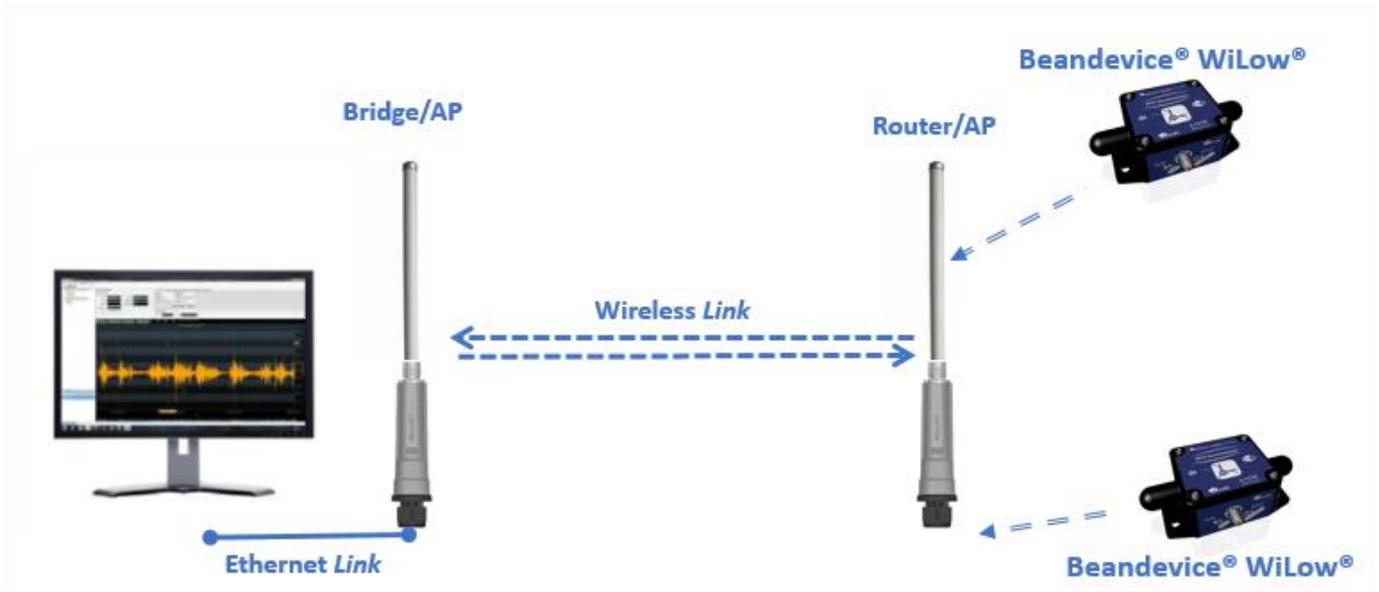


Figure 3: Simple access point

6.2 WIFI EQUIPMENT USED

- BM2HP: WIFI bridge™M2, weatherproof
- BM2-Ti: WIFI bridge™M2 Titanium, with Weatherproof Aluminum Casing
- PICOM2HP: PicoStation M2HP
- 7 dBi high gain Omnidirectional antenna
- BeanDevice® Willow®



**BM2HP****Main features:**

RF Connector Integrated N-type Male Jack (connects directly to antenna)

Enclosure Size 15.2 x 3.7 x 3.1 cm (length, width, height)

Weight 0.18kg

Enclosure Characteristics Outdoor UV Stabilized Plastic

Max Power Consumption 7 Watts 6 Watts

Power Rating Up to 24V

Power Method Passive Power over Ethernet (pairs 4, 5+; 7, 8 return)*

Operating Temperature -40C to 80C

Operating Humidity 5 to 95% Condensing

Shock and Vibration ETSI300-019-1.4

Max Power Consumption 7 Watts





BM2-Ti: Bullet™ M2 Titanium, with Weatherproof Aluminum Casing

Main features:

Dimensions 190 x 46 mm

Weight 196 g

Enclosure Characteristics Powder Coated Aluminum

Antenna Connector N-Type Connector (male)

Power Supply 24V, 0.5A PoE Adapter

Power Method Passive Power over Ethernet (pairs 4, 5+; 7, 8 return)

Max. Power Consumption 7 Watts

Operating Temperature -40 to 80° C

Operating Humidity 5 to 95% Condensing

Modes Station, Access Point, AP Repeater

Services SNMP, DHCP, NAT

Security WEP/WPA/WPA2



High Gain Omnidirectional antenna

Main features:

Frequency range 2400-2500MHz

Gain 7 dBi

VSWR < 1.4

Impedance 50 Ohm

Polarization Vertical

Vertical plane 24°

Horizontal plane 360°

Protection DC Grounded

Dimensions 360mm x 23mm

Weight 0.44 kg

Connector N female



**PICOM2HP**

Main features:

Dimensions 136 x 20 x 39 mm

Weight 0.1 kg

Enclosure Characteristics Outdoor UV Stabilized Plastic

Mounting Wall or Pole Mounting Kit

Antenna Connector External RP-SMA

Antenna

USA: External, 5 dBi Omni Antenna (Included)

EU: External, 2 dBi Omni Antenna (Included)

Operating Frequency 2412-2462 MHz

Range

Indoor: Up to 200 m

Outdoor: Up to 500 m

Max. Power Consumption 8 W

Power Supply (PoE) 15V, 0.8A Power Adapter

Power Method Passive Power over Ethernet (Pairs 4, 5+; 7, 8 Return)

Operating Temperature -20 to 70° C

Operating Humidity 5 to 95% Condensing



7. NETWORK CONFIGURATION

7.1 POWER OVER ETHERNET POWER SUPPLY

Ubiquiti WIFI bridge Access Point is powered by a POE Adapter.

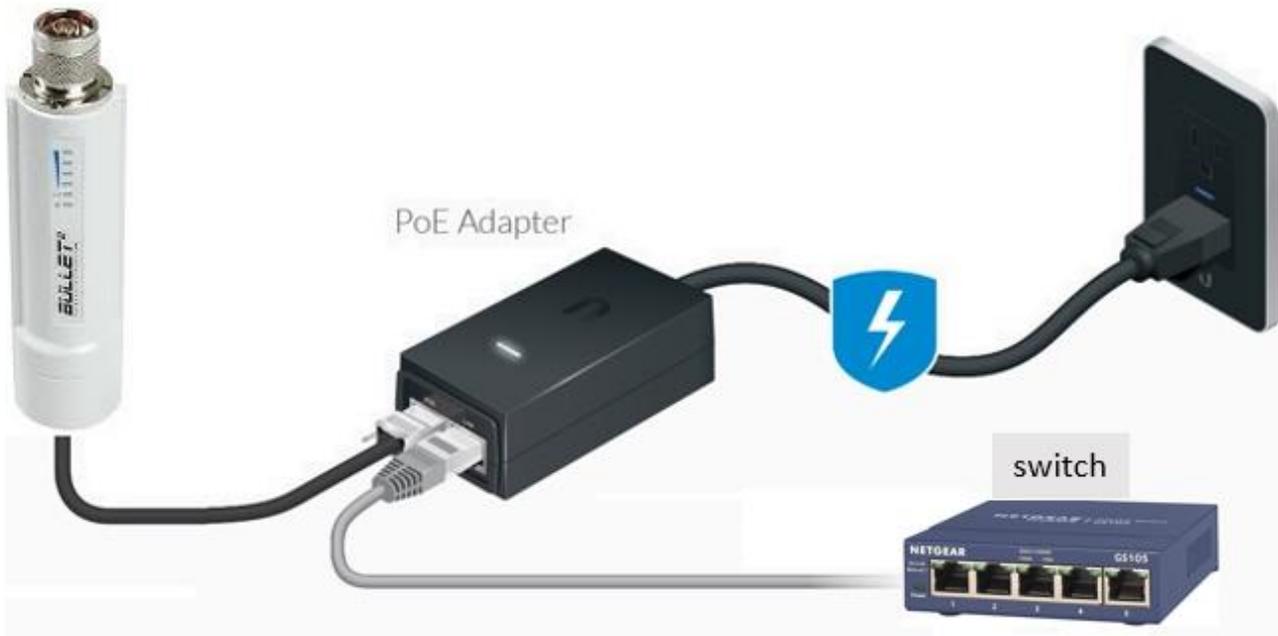


Figure 4: PoE power supply

7.2 CLUSTER-TREE CONFIGURATION

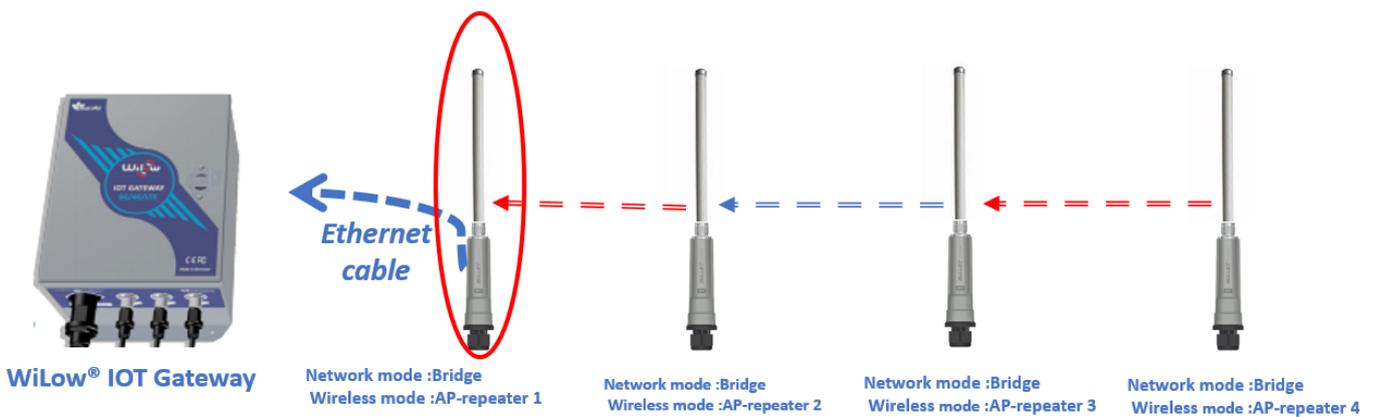


Figure 5: AP 1 configuration



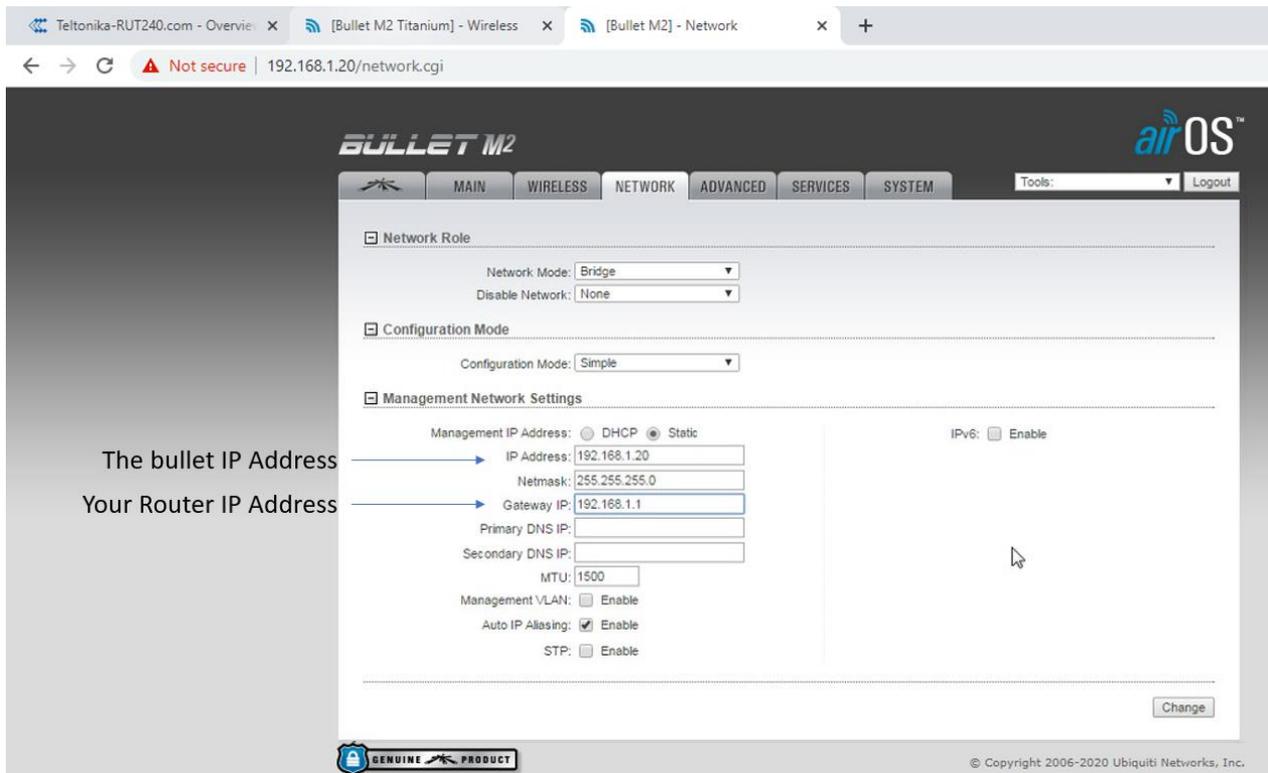
- Ubiquiti AP factory IP Address is [192.168.1.20](#)
- Initial User name : [ubnt](#)
- initial Password:[ubnt](#)



For resetting to factory defaults Press and keep holding the Reset button while the system is already up and running until you see a red LED lighting .

On the network tab:

- Network Mode must be set as bridge
- A static IP address for the AP and the network Gateway IP must be entered (for the Gateway IP settings use your 3G/4G router IP address or your LAN router and make sure that the DHCP option is enabled).



The bullet IP Address
Your Router IP Address

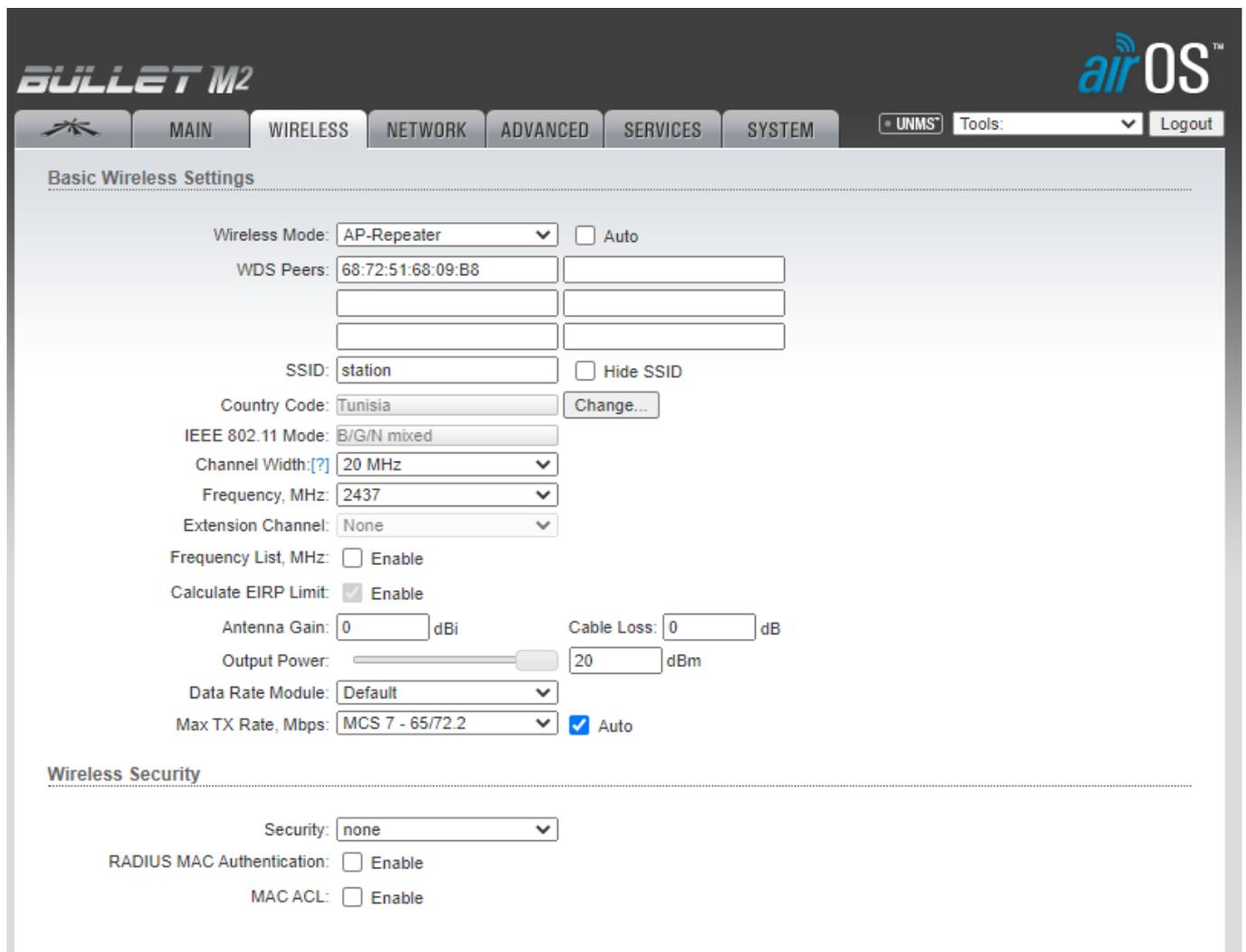


Default Password must be changed to apply configuration changes!



On the wireless tab :

- Chose Wireless Mode as **AP-Repeater**
- On WDS Peers: Use the actual MAC address of the OTHER radio to connect to this Access Point (for Example AA:BB:CC:00:00:03).
- Channel Width: 20 MHz
- For frequency: Choose one from the list:("**Channel 1**" = 2412, "**Channel 6**" = 2437, "**Channel 11**" = 2462)
- Do not use any wireless security.



BULLET M2 airOS™

MAIN WIRELESS NETWORK ADVANCED SERVICES SYSTEM UNMS Tools: Logout

Basic Wireless Settings

Wireless Mode: **AP-Repeater** Auto

WDS Peers:

SSID: Hide SSID

Country Code:

IEEE 802.11 Mode:

Channel Width:[?]

Frequency, MHz:

Extension Channel:

Frequency List, MHz: Enable

Calculate EIRP Limit: Enable

Antenna Gain: dBi Cable Loss: dB

Output Power: dBm

Data Rate Module:

Max TX Rate, Mbps: Auto

Wireless Security

Security:

RADIUS MAC Authentication: Enable

MAC ACL: Enable





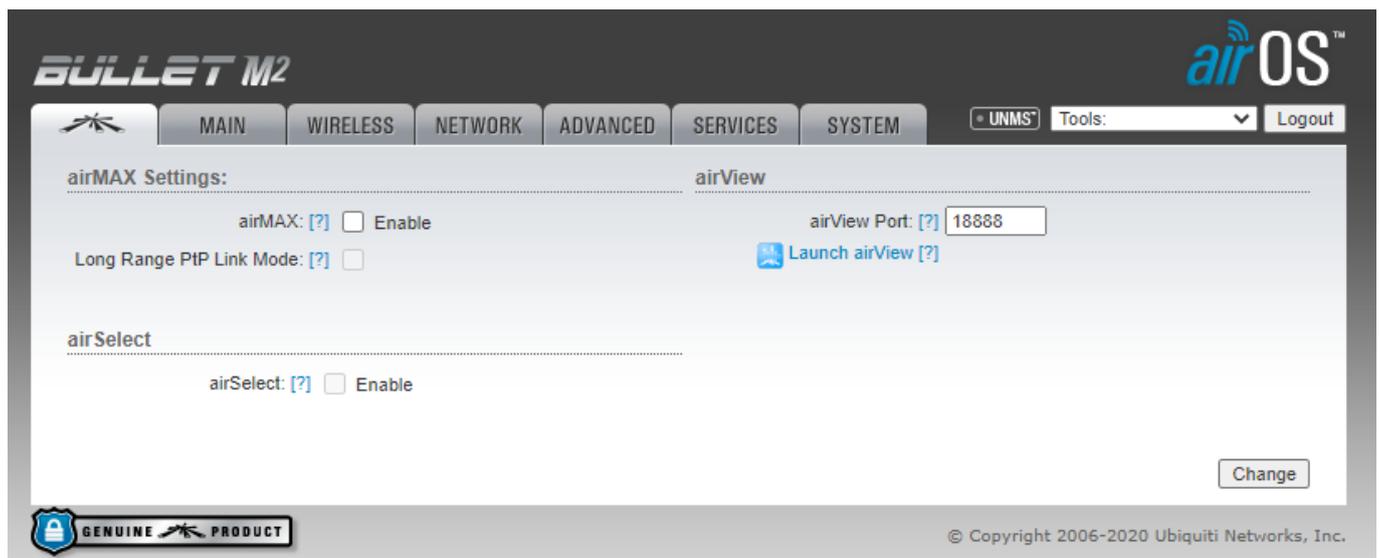
Make sure the AP and all the Stations use the same Channel width(20 MHz) cause standard devices such the BeanDevice will be able to connect by leaving it at the default of 40 MHz those will not be able to connect , same frequency (2437) and use also the same SSID. Otherwise, no connection between AP and Stations can be established.

Based on your country settings those values are used to auto-configure your output.

- **Antenna gain** :enter your antenna gain in dBi and it will calculates the TX power backoff needed to remain in compliance with local regulations. The Antenna Gain setting complements the Cable Loss setting,they both affect the TX power of the device.
- **Cable Loss**: enter your cable loss in dB. cable Loss affects the TX power of the device. In case you have high amounts of cable loss, you may increase the TX power while remaining in compliance with local regulations.
- **Output Power** :Defines the maximum average transmit output power (in dBm) of the device. to specify the output power, use the slider or manually enter the output power value. The transmit power level maximum is limited according to country regulations.



Make sure to disable the Airmax option which is automatically activated while using the AP repeater wireless mode.



The screenshot shows the airOS web interface for a BULLET M2 device. The top navigation bar includes tabs for MAIN, WIRELESS, NETWORK, ADVANCED, SERVICES, and SYSTEM. The current page is the WIRELESS settings page, specifically the airMAX Settings section. Under airMAX Settings, there are two checkboxes: 'airMAX: [?] Enable' (unchecked) and 'Long Range PTP Link Mode: [?] Enable' (unchecked). To the right, there is an 'airView Port: [?] 18888' field and a 'Launch airView [?]' button. Below this is the 'airSelect' section with an 'airSelect: [?] Enable' checkbox (unchecked). A 'Change' button is located at the bottom right of the settings area. The footer of the interface includes a 'GENUINE PRODUCT' logo and a copyright notice: '© Copyright 2006-2020 Ubiquiti Networks, Inc.'

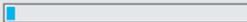
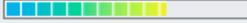


- Main view

BULLET M2 airOS™

MAIN WIRELESS NETWORK ADVANCED SERVICES SYSTEM UNMS Tools: [v] Logout

Status

Device Model: Bullet M2	CPU:  5 %
Device Name: Bullet M2	Memory:  65 %
Network Mode: Bridge	AP MAC: 68:72:51:64:A7:94
Wireless Mode: AP-Repeater	Connections: 0
SSID: station	Noise Floor: -96 dBm
Security: none	Transmit CCQ: -
Version: v6.3.2 (XM)	airMAX: Disabled
Uptime: 00:03:28	UNMS: [?] Disabled
Date: 2020-07-15 17:00:22	
Channel/Frequency: 6 / 2437 MHz	
Channel Width: 20 MHz	
Frequency Band: 2427 - 2447 MHz	
Distance: 0.7 miles (1.1 km)	
TX/RX Chains: 1X1	
TX Power: 20 dBm	
Antenna: Main	
WLAN0 MAC: 68:72:51:64:A7:94	
LAN0 MAC: 68:72:51:65:A7:94	
LAN0: 100Mbps-Full	

Monitor

- Now in the Main page you can see the available stations in range .
- Click on Station MAC address to show all info related to the station

Monitor

[Throughput](#) | [Stations](#) | [Interfaces](#) | [ARP Table](#) | [Bridge Table](#) | [Routes](#) | [Log](#)

Refresh

Station MAC	Device Name	TX Signal, dBm Combined	RX Signal, dBm Combined	Noise, dBm	Latency, ms	Distance, miles	TX/RX, Mbps	CCQ, %	Connection Time	Last IP	Action
28:E0:2C:0C:91:F6	-	-	-41	-82	12	0.7	65 / 65	99	00:00:07	192.168.1.23	kick

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[Bullet M2 Titanium] - Station Info: 28:E0:2C:0C:91:F6 - Google Chrome

Not secure | https://192.168.1.22/stainfo.cgi?ifname=ath0&sta_mac=28:E0:2C:0C:91:F6

Station 28:E0:2C:0C:91:F6 [1]		
Device Name: -	Negotiated Rate	Last Signal, dBm
Connection Time: 00:02:31	MCS0	N/A
RX Signal: -39 dBm	MCS1	N/A
Noise Floor: -83 dBm	MCS2	N/A
Distance: 0.1 miles (0.2 km)	MCS3	N/A
CCQ: 99%	MCS4	N/A
Last IP: 192.168.1.23	MCS5	N/A
TX/RX Rate: 65 Mbps / 65 Mbps	MCS6	N/A
TX/RX Bit Rate: 0.00 bps / 0.00 bps	MCS7	N/A
TX/RX Packets: 94 / 233		
TX/RX Packet Rate, pps: 0 / 0		
Bytes Transmitted: 26528 (26.53 kBytes)		
Bytes Received: 14495 (14.50 kBytes)		

Kick Refresh Close

■ Second Repeater

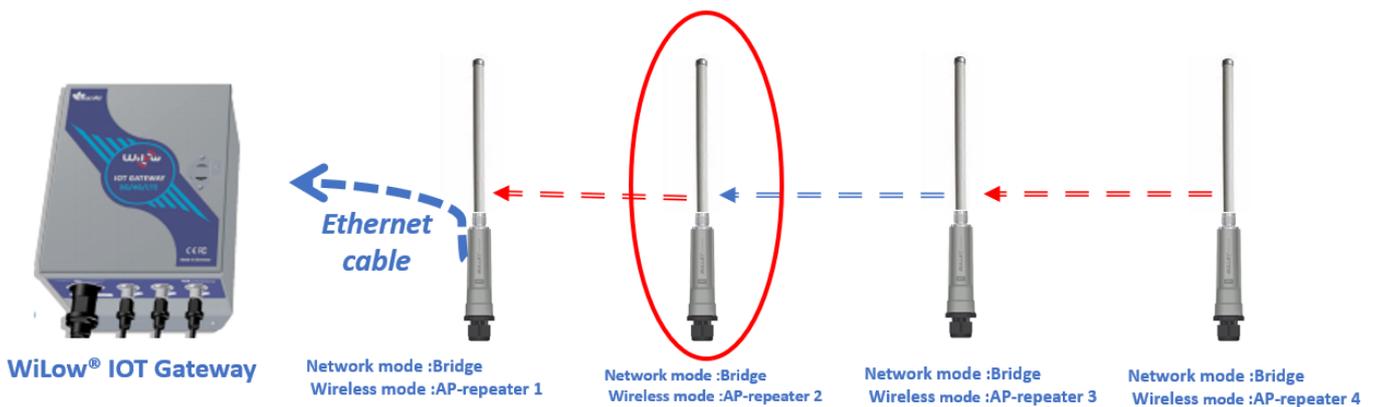


Figure 6: AP2 configuration

In WIFI AP 2 Wireless settings ,both WIFI AP1 and WIFI AP 3 MAC Adress should be entered as WDS peers.



Basic Wireless Settings

Wireless Mode: AP-Repeater Auto

WDS Peers: 68:72:51:64:BB:37 68:72:51:68:0F:4B

Same steps should be followed for the successif AP ,make sure to enter the same frequency, same channel width and the same SSID.

Click on station to check the WIFI bridge connected to this WIFI bridge.

Throughput | [Stations](#) | Interfaces | ARP Table | Bridge Table | Routes | Firewall | Log

Station MAC	Device Name	TX Signal, dBm Combined	RX Signal, dBm Combined	Noise, dBm	Latency, ms	Distance, miles	TX/RX, Mbps	CCQ, %	Connection Time	Last IP	Action
7C:EC:79:F5:9F:4E	-	-	-54	-88	1	0.7	72.222 / 72.222	99	00:34:21	192.168.1.55	kick
18:E8:29:74:1C:E3 (AP-Repeater)	Bullet M2	-29	-23	-88	2	0.7	58.5 / 72.222	59	00:34:19	192.168.1.142	

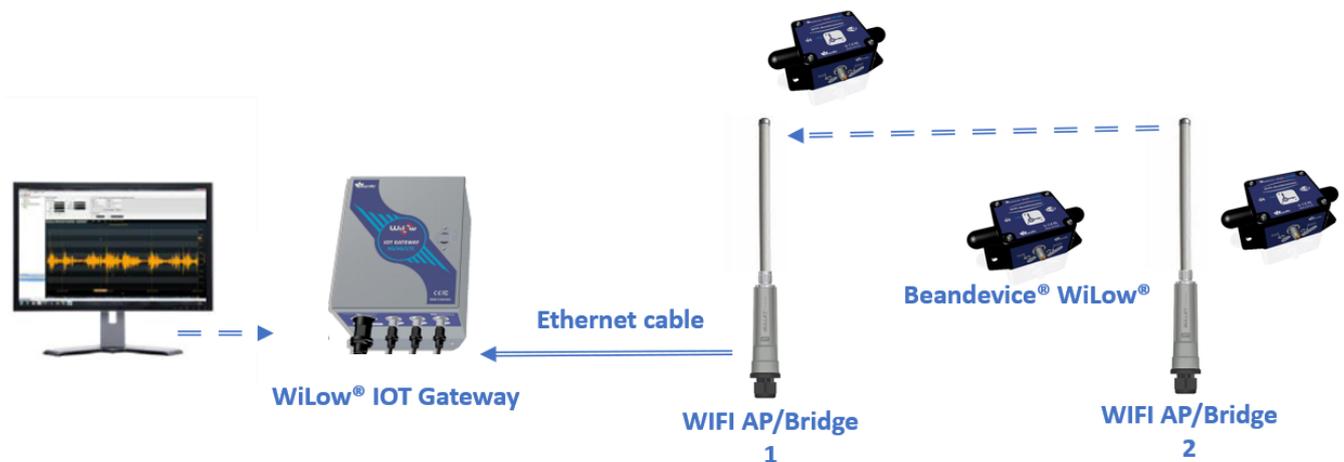


Make sure that each WIFI bridge have the same SSID.



Make sure that the firmware version is the same for all the WIFI bridges.

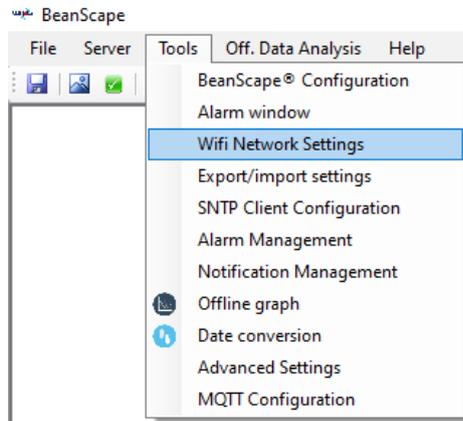
7.3 HOW TO CONFIGURE WILOW® SENSORS



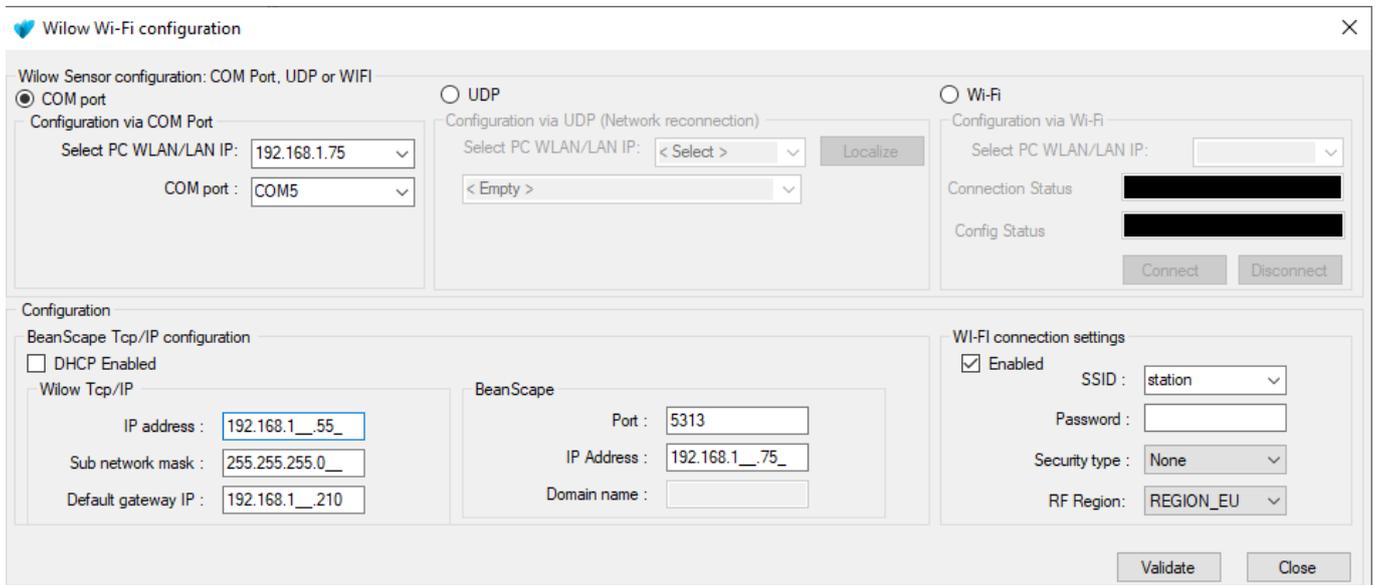
We use BeanScape to Connect each BeanDevice to the closest WIFI AP in the planned network following these steps :



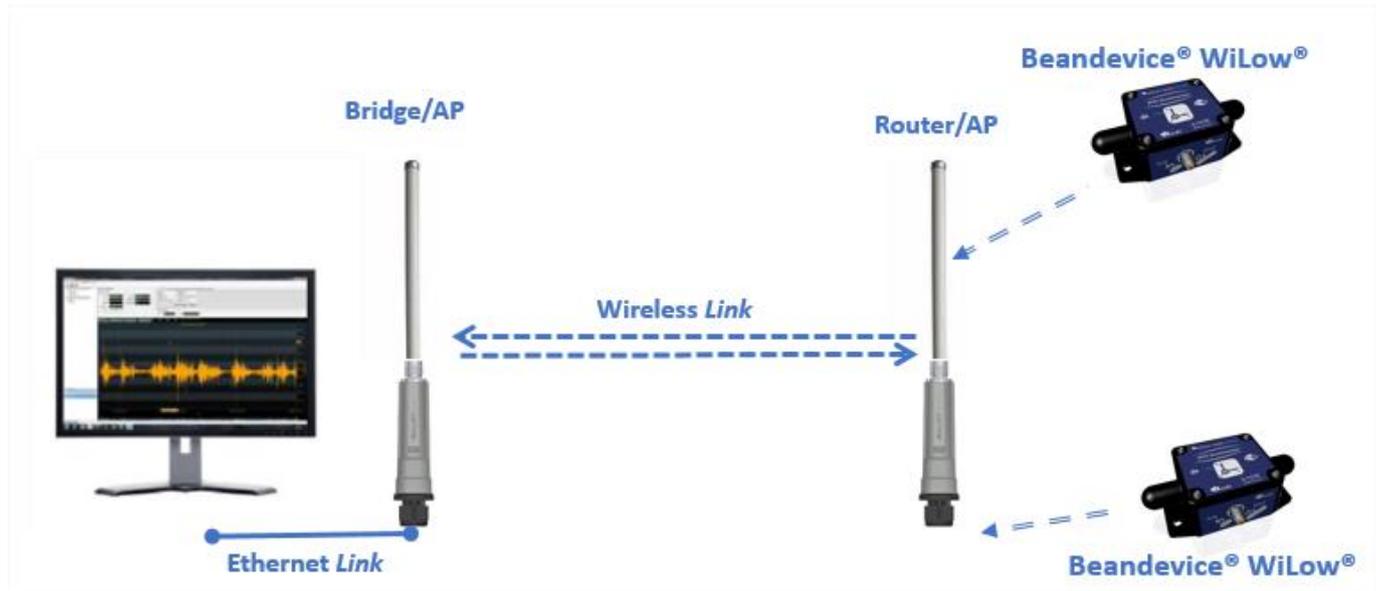
- Power on the BeanDevice WILOW® and select Tools on the BeanScope menu then choose WIFI Network Settings



- Select the Right COM PORT
- Enabling the Wifi Configuration and entering SSID ,Password and selecting WEP as security type
- Uncheck DHCP box to give a static IP tou your BeanDevice®
- Click on valid



7.4 SIMPLE ACCESS POINT CONFIGURATION



With no router present in the network ,one ubiquiti WIFI bridge needs to be configured as router, the other will be a Bridge/access point .

Access to your Ubiquiti WIFI bridge (to be connected to the PC using Ethernet cable) configuration interface by entering its IP address on your navigator

On the wireless tab:

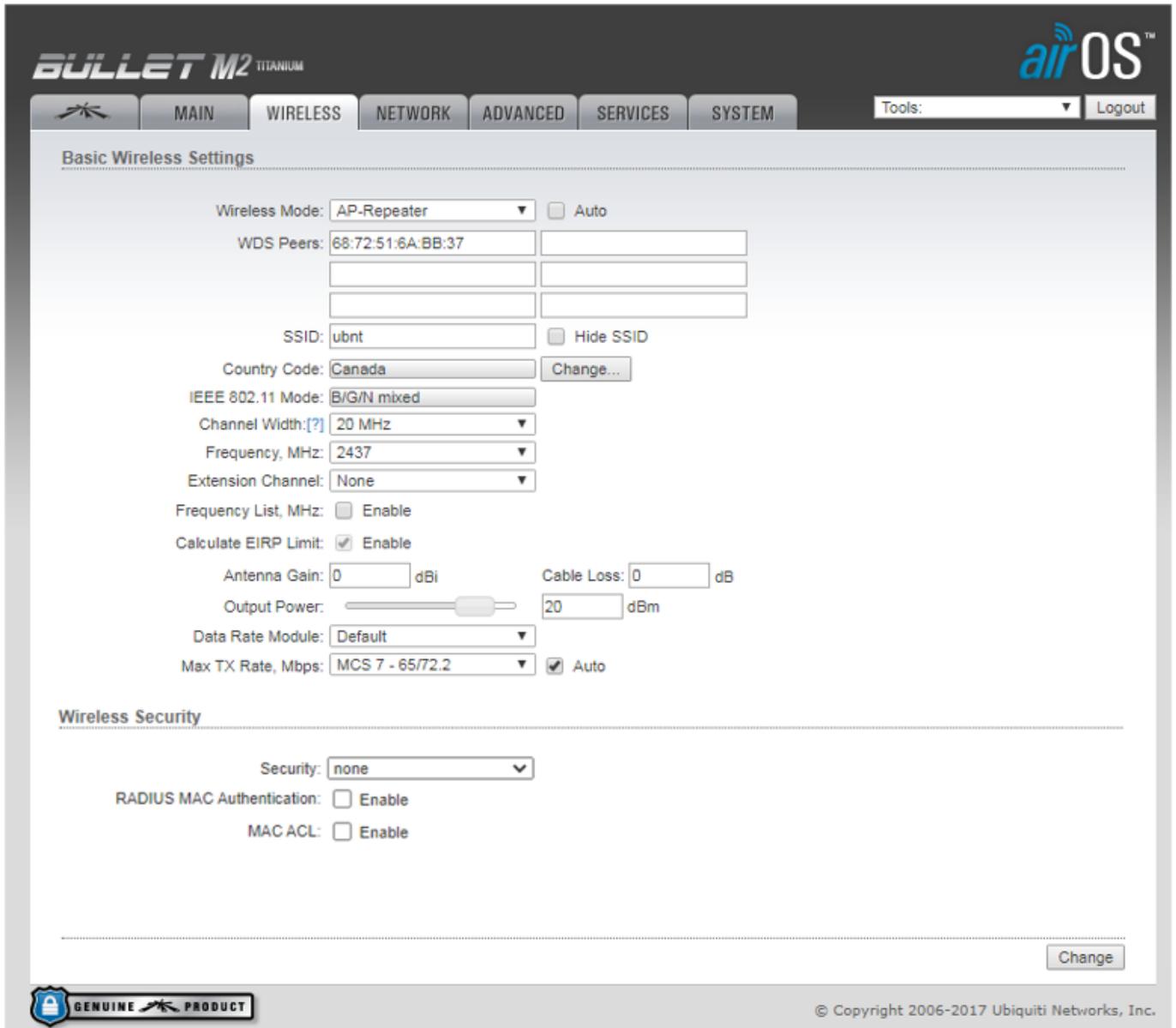
- Wireless Mode must be set as AP-Repeater
- Enter MAC ID of the other WIFI bridge in the WDS Peers
- Enter SSID
- Enter your country Code
- Set Channel width at 20 MHz
- Select the best available Frequency or set it as auto



Find more how to select the best available frequency [click here](#)

Standard Wi-Fi devices only operate in 20MHz channel width.





BULLET M2 TITANIUM airOS™

MAIN WIRELESS NETWORK ADVANCED SERVICES SYSTEM Tools: [v] Logout

Basic Wireless Settings

Wireless Mode: AP-Repeater Auto

WDS Peers: 68:72:51:6A:BB:37

SSID: ubnt Hide SSID

Country Code: Canada

IEEE 802.11 Mode: B/G/N mixed

Channel Width: [?] 20 MHz

Frequency, MHz: 2437

Extension Channel: None

Frequency List, MHz: Enable

Calculate EIRP Limit: Enable

Antenna Gain: 0 dBi Cable Loss: 0 dB

Output Power: 20 dBm

Data Rate Module: Default

Max TX Rate, Mbps: MCS 7 - 65/72.2 Auto

Wireless Security

Security: none

RADIUS MAC Authentication: Enable

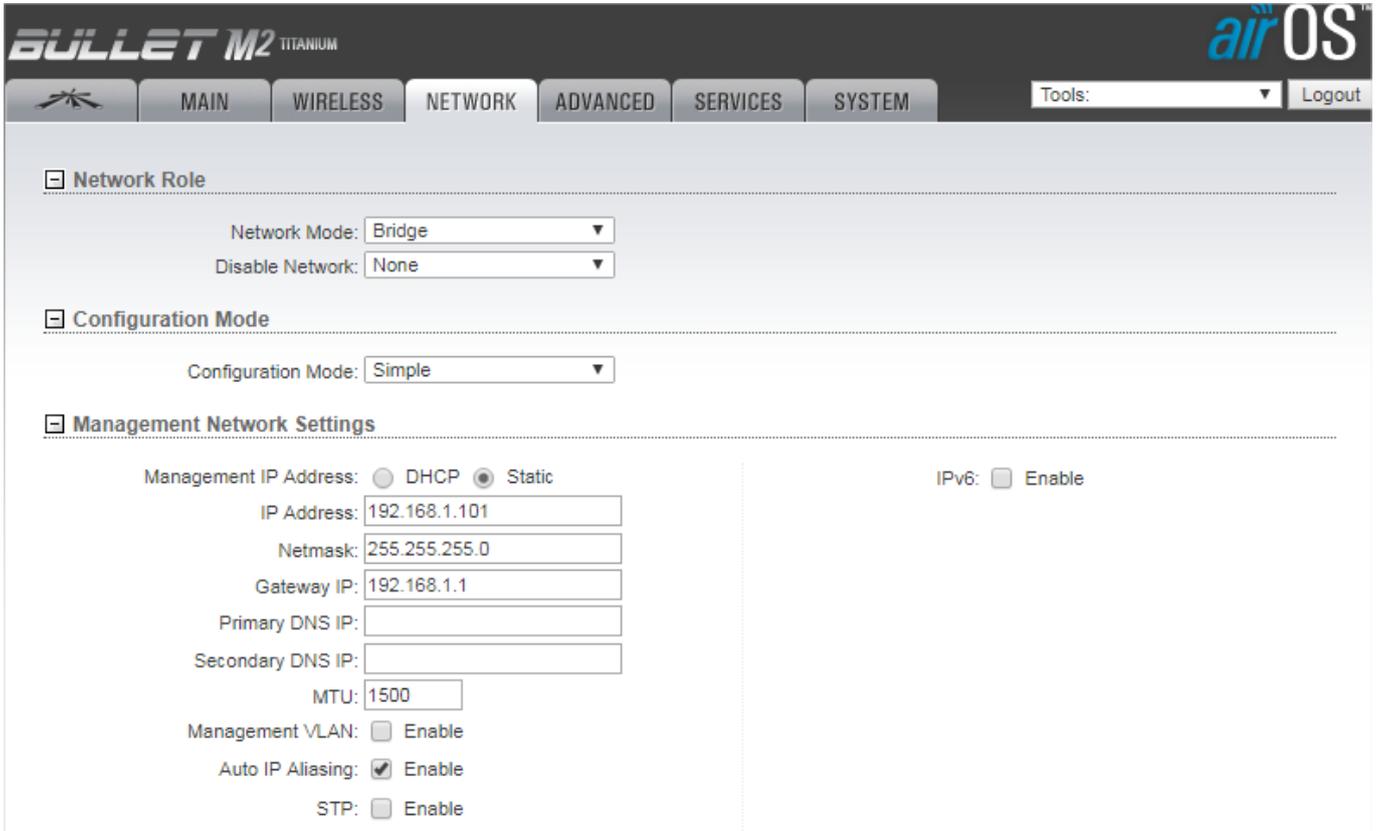
MAC ACL: Enable

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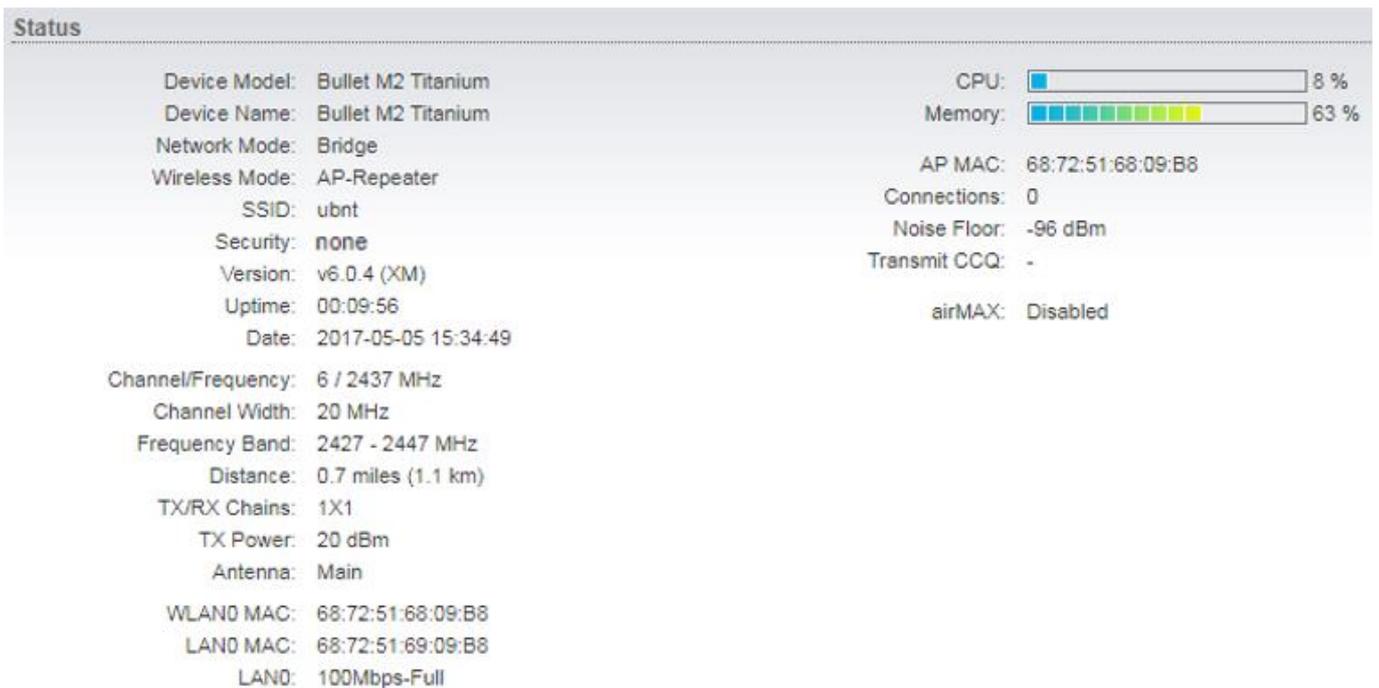
On the network tab :

- Set the Network Mode to Bridge and configuration Mode to Simple
- Set the IP Address to static
- Enter a static IP Address
- Set the Gateway IP to 192.168.1.1(address of the other WIFI bridge to be configured as router)



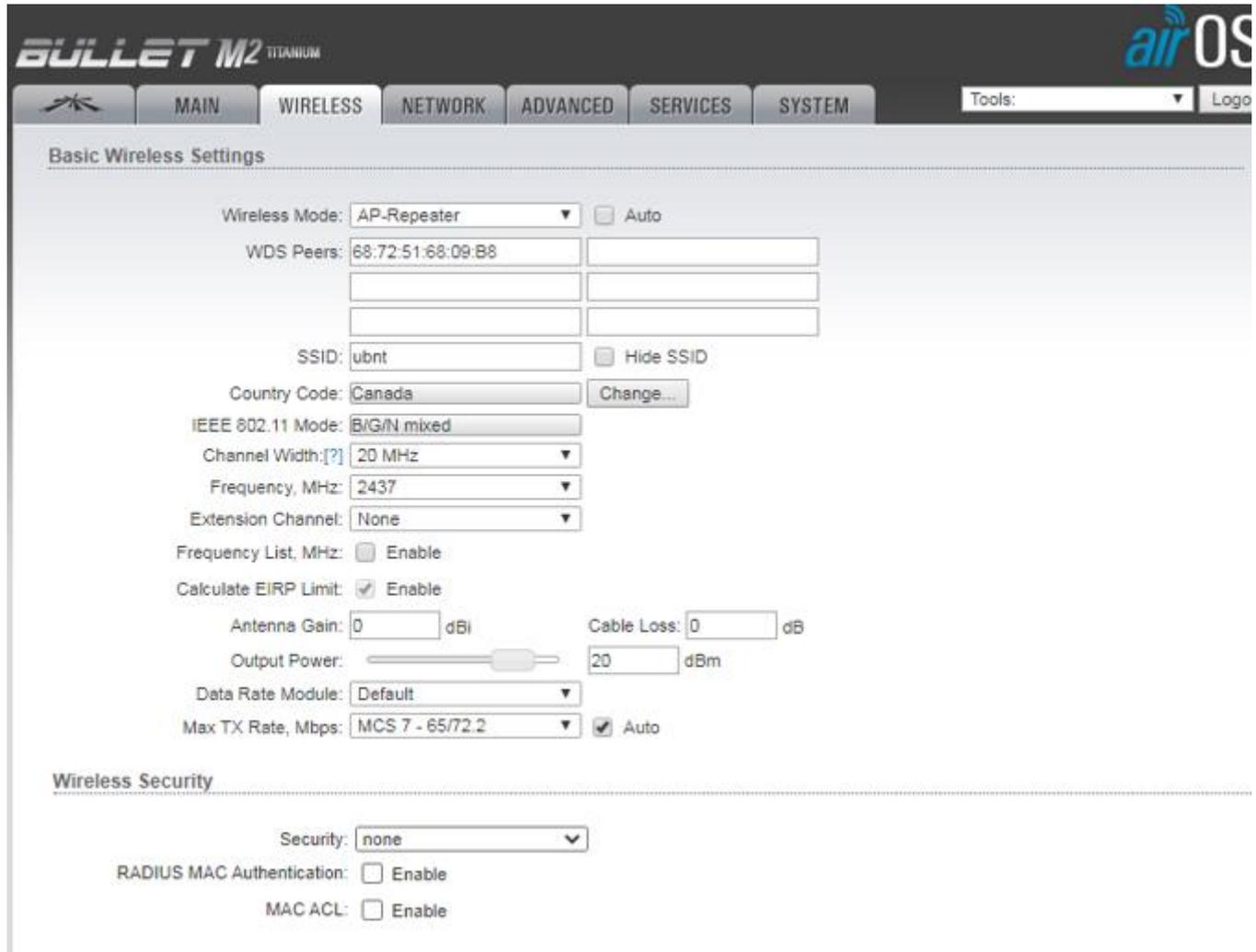


The status of the WIFI bridge will look like that :



In the other ubiquiti WIFI bridge configuration interface and in the Wireless tab :

- Set wireless mode as AP-Repeater
- Enter the same SSID and country code
- Set channel width to 20 MHz and select the best available Frequency



BULLET M2 TITANIUM air OS

MAIN WIRELESS NETWORK ADVANCED SERVICES SYSTEM Tools: Logo

Basic Wireless Settings

Wireless Mode: AP-Repeater Auto

WDS Peers: 68:72:51:68:09:B8

SSID: ubnt Hide SSID

Country Code: Canada

IEEE 802.11 Mode: B/G/N mixed

Channel Width: [?] 20 MHz

Frequency, MHz: 2437

Extension Channel: None

Frequency List, MHz: Enable

Calculate EIRP Limit: Enable

Antenna Gain: 0 dBi Cable Loss: 0 dB

Output Power: dBm

Data Rate Module: Default

Max TX Rate, Mbps: MCS 7 - 65/72.2 Auto

Wireless Security

Security: none

RADIUS MAC Authentication: Enable

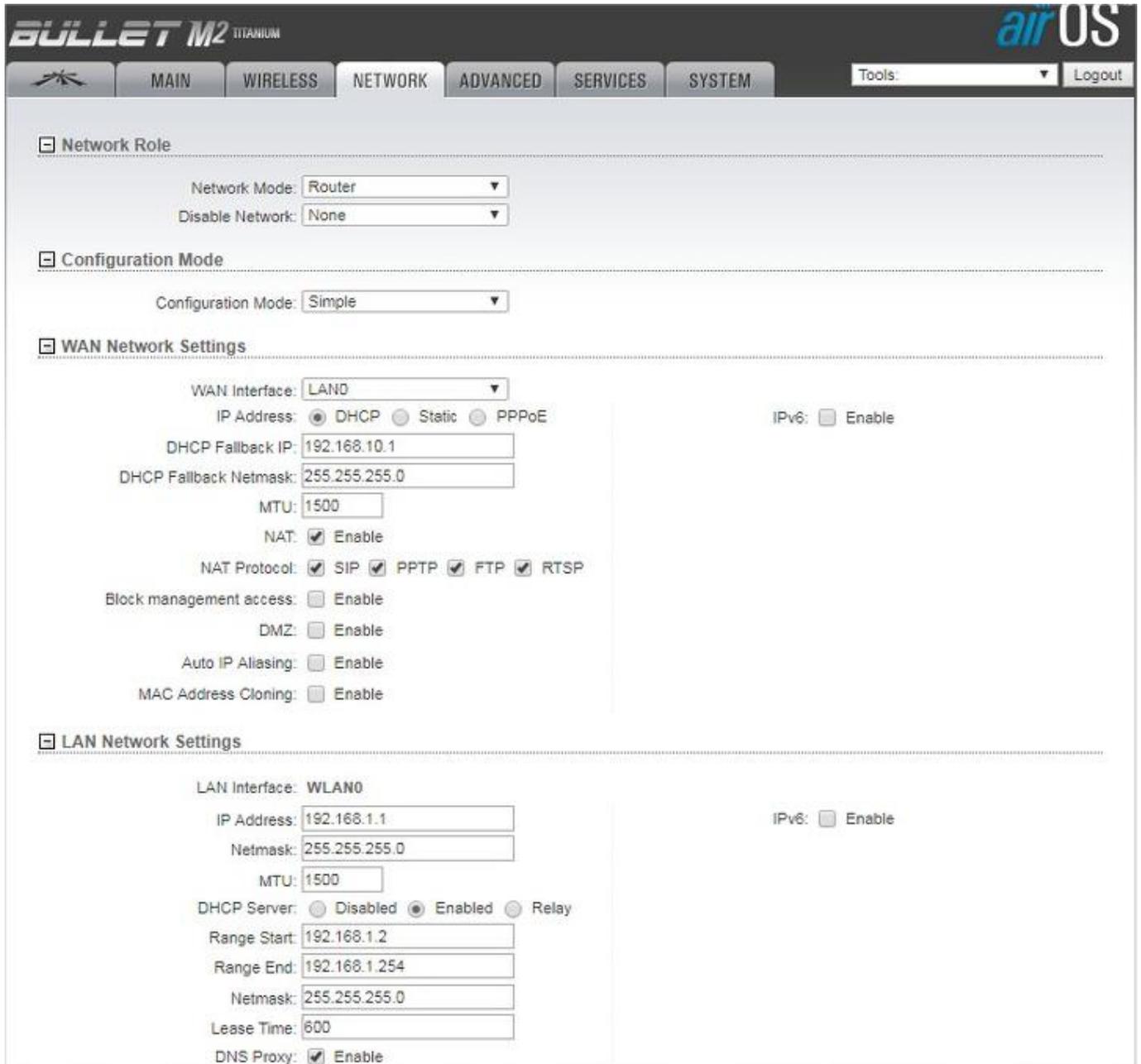
MAC ACL: Enable

In the Network tab :

- Select Network Mode as Router
- Configuration Mode to Simple
- Select LAN0 as WAN Interface
- Check DHCP for IP Address



- Enter 192.168.10.1 in DHCP Fallback IP and 255.255.255.0 its Netmask
- In LAN network setting enter 192.168.1.1 as IP Address and 255.255.255.0 it Netmask
- Range start from 192.168.1.2 and ends at 192.168.1.254 with Netmask 255.255.255.0



BULLET M2 TITANIUM **airOS**

MAIN WIRELESS NETWORK ADVANCED SERVICES SYSTEM Tools: Logout

Network Role

Network Mode: Router
Disable Network: None

Configuration Mode

Configuration Mode: Simple

WAN Network Settings

WAN Interface: LAN0
IP Address: DHCP Static PPPoE IPv6: Enable
DHCP Fallback IP: 192.168.10.1
DHCP Fallback Netmask: 255.255.255.0
MTU: 1500
NAT: Enable
NAT Protocol: SIP PPTP FTP RTSP
Block management access: Enable
DMZ: Enable
Auto IP Aliasing: Enable
MAC Address Cloning: Enable

LAN Network Settings

LAN Interface: WLAN0
IP Address: 192.168.1.1 IPv6: Enable
Netmask: 255.255.255.0
MTU: 1500
DHCP Server: Disabled Enabled Relay
Range Start: 192.168.1.2
Range End: 192.168.1.254
Netmask: 255.255.255.0
Lease Time: 600
DNS Proxy: Enable

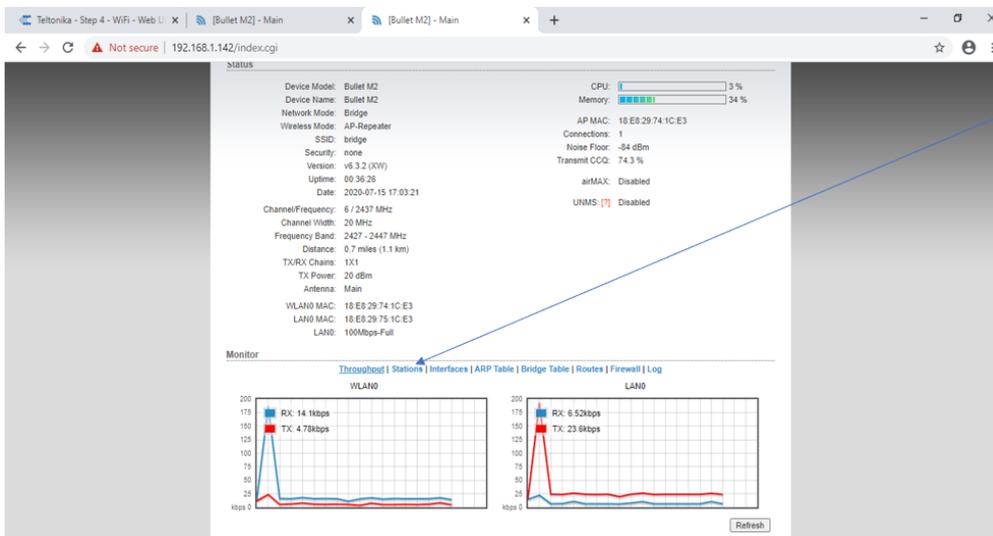


8. MONITORING SITE CHECK LIST

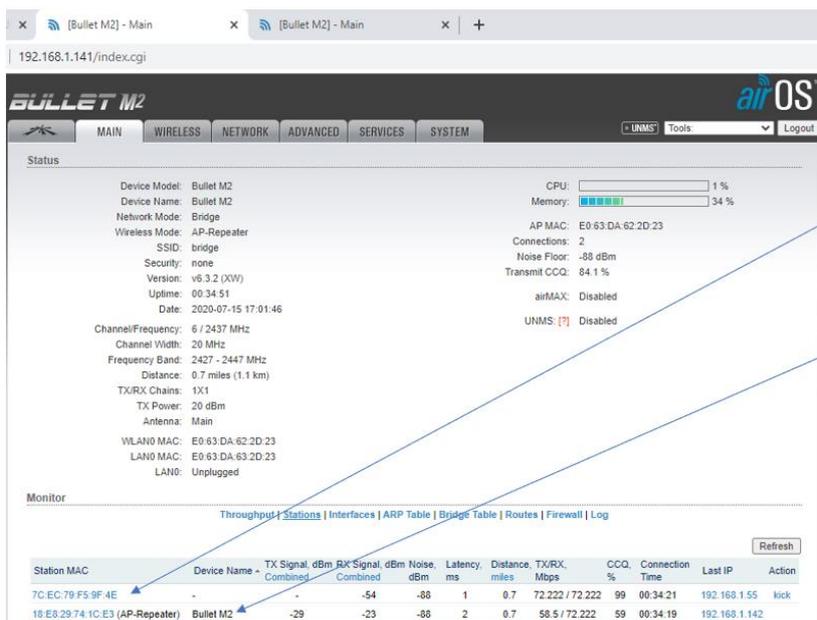
After setting up the system on the monitoring site, you need to make sure that the system is working properly.

We advice you to:

- **Get an access to all the WIFI Bridge Dashboard:** by entering each WIFI bridge IP address in browser the search bar you should have an access to the Dashbord of all the WIFI bridges which are constructing the WIFI bridge.
- **On the WIFI bridge Main menu click on Station:** Check the bridge connectivity and the devices traffic click on station then all the linked devices will be displayed with their corresponding IP addresses and MAC IDs.



Click on Station to check the WIFI devices connected to this WIFI Bridge.



BeanDevice Wilow MAC ID

Connection to WIFI Bridge

- **Ping the WIFI devices**



Use the command prompt (CMD command line) to ping all the available WIFI devices (WIFI bridges/BeanDevices)
Write ping then the corresponding IP address and press Enter

```
Command Prompt - ping 192.168.1.141
Wireless LAN adapter Local Area Connection* 11:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 12:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix  . :

Wireless LAN adapter Wi-Fi:
Connection-specific DNS Suffix  . : lan
Link-local IPv6 Address . . . . . : fe80::702c:9866:748a:20ba%19
IPv4 Address. . . . . : 192.168.1.232
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1

Ethernet adapter Bluetooth Network Connection:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix  . :

C:\Users\BeanairGmbH>ping 192.168.1.141

Pinging 192.168.1.141 with 32 bytes of data:
Reply from 192.168.1.141: bytes=32 time=510ms TTL=64
Reply from 192.168.1.141: bytes=32 time=3ms TTL=64
Reply from 192.168.1.141: bytes=32 time=3ms TTL=64
```

Pinging WIFI Bridge 1

```
Command Prompt - ping 192.168.1.141
Wireless LAN adapter Local Area Connection* 11:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 12:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix  . :

Wireless LAN adapter Wi-Fi:
Connection-specific DNS Suffix  . : lan
Link-local IPv6 Address . . . . . : fe80::702c:9866:748a:20ba%19
IPv4 Address. . . . . : 192.168.1.232
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1

Ethernet adapter Bluetooth Network Connection:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix  . :

C:\Users\BeanairGmbH>ping 192.168.1.141

Pinging 192.168.1.141 with 32 bytes of data:
Reply from 192.168.1.141: bytes=32 time=510ms TTL=64
Reply from 192.168.1.141: bytes=32 time=3ms TTL=64
Reply from 192.168.1.141: bytes=32 time=3ms TTL=64
```

Pinging Router

```
Command Prompt
Approximate round trip times in milli-seconds:
Minimum = 3ms, Maximum = 510ms, Average = 129ms

C:\Users\BeanairGmbH>ping 192.168.1.142

Pinging 192.168.1.142 with 32 bytes of data:
Reply from 192.168.1.142: bytes=32 time=5ms TTL=64

Ping statistics for 192.168.1.142:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 5ms, Maximum = 5ms, Average = 5ms

C:\Users\BeanairGmbH>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time=5ms TTL=64

Ping statistics for 192.168.1.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 5ms, Maximum = 5ms, Average = 5ms

C:\Users\BeanairGmbH>
```

Pinging WIFI Bridge 2

```
Command Prompt
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix  . :

C:\Users\BeanairGmbH>ping 192.168.1.141

Pinging 192.168.1.141 with 32 bytes of data:
Reply from 192.168.1.141: bytes=32 time=510ms TTL=64
Reply from 192.168.1.141: bytes=32 time=3ms TTL=64
Reply from 192.168.1.141: bytes=32 time=3ms TTL=64

Ping statistics for 192.168.1.141:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 3ms, Maximum = 510ms, Average = 129ms

C:\Users\BeanairGmbH>ping 192.168.1.142

Pinging 192.168.1.142 with 32 bytes of data:
Reply from 192.168.1.142: bytes=32 time=5ms TTL=64

Ping statistics for 192.168.1.142:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 5ms, Maximum = 5ms, Average = 5ms
```

Pinging your BeanDevice® Wilow

```
Command Prompt
Approximate round trip times in milli-seconds:
Minimum = 3ms, Maximum = 510ms, Average = 129ms

C:\Users\BeanairGmbH>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time=5ms TTL=64

Ping statistics for 192.168.1.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 5ms, Maximum = 5ms, Average = 5ms

C:\Users\BeanairGmbH>ping 192.168.1.55

Pinging 192.168.1.55 with 32 bytes of data:
Reply from 192.168.1.55: bytes=32 time=100ms TTL=128
Reply from 192.168.1.55: bytes=32 time=150ms TTL=128
Reply from 192.168.1.55: bytes=32 time=50ms TTL=128
Reply from 192.168.1.55: bytes=32 time=72ms TTL=128

Ping statistics for 192.168.1.55:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 50ms, Maximum = 150ms, Average = 90ms

C:\Users\BeanairGmbH>
```



- **Use the advanced Wifi diagnostic tools to discover and track the traffic in the network** (See section 9 for further details)

To get more details about the bridge status, use the Ubiquity discovery tool within you can have an idea about the firmware version, product name and the IP address for each product.

Use the **AirView Spectrum Analyser** to see different activity on the different frequency range, most used channel with all the details.

The last option is the Site survey, you can use this option to see all the available wireless networks that exist on your monitoring site with the used channels.



The Air Spectrum Analyzer tool is acting as a network mode like the Access point/ AP Repeater mode. By using it, the WIFI Bridge will switch between two different modes and the link connectivity with the bridge will be broken just in the usage duration of the tool and by closing the corresponding window the WIFI bridge will restore the connection with the bridge again.

- **[Check the BeanDevice dashboard](#)**

Lastly check the BeanDevice® profile to see the corresponding SSID on which the BeanDevice is connected, the IP address and the network quality indicator.



When the wireless link is broken between the BeanDevice® and the WIFI Bridge on which it's connected to, the roaming start to work in this case and the BeanDevice will switch to connect to a new WIFI Bridge providing a better LQI/RSSI .



The roaming process is instant when the BeanDevice® is working in active mode. If the BeanDevice® is working in battery saver power mode (sleep power mode), and it loses the connection to the WIFI bridge you can not see the Beandevicé® status on the stations information (on the WIFI bridge Dashboard info) as this is based on a ping processing, and the device is almost in sleep mode and will not answer to the pinging, so the BeanDevice® needs to reach its listening cycle to reconnect again to another WIFI Bridge based on the roaming process which takes time and the process is a little bit slower comparing when the BeanDevice® is in active mode.

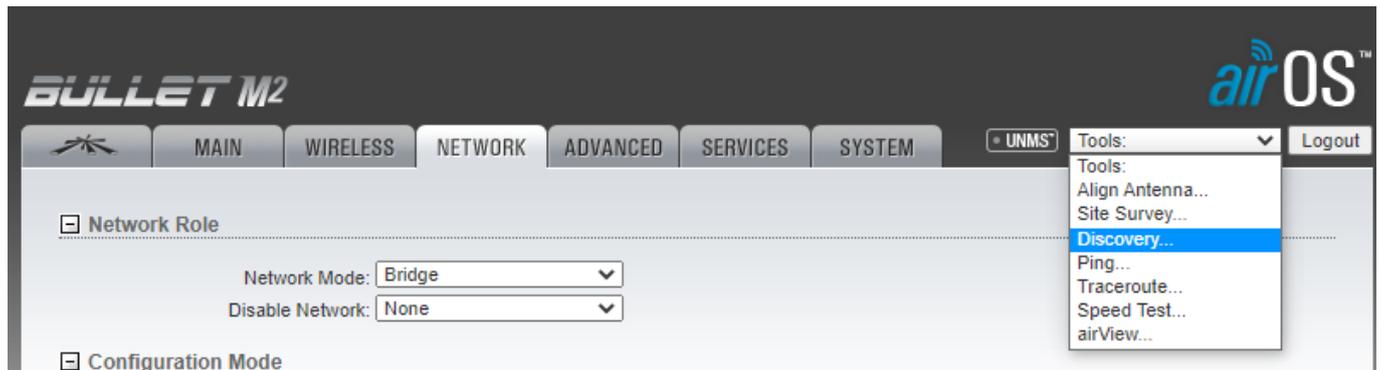


9. WIFI DIAGNOSTIC TOOLS

9.1 UBIQUITI DISCOVERY TOOL

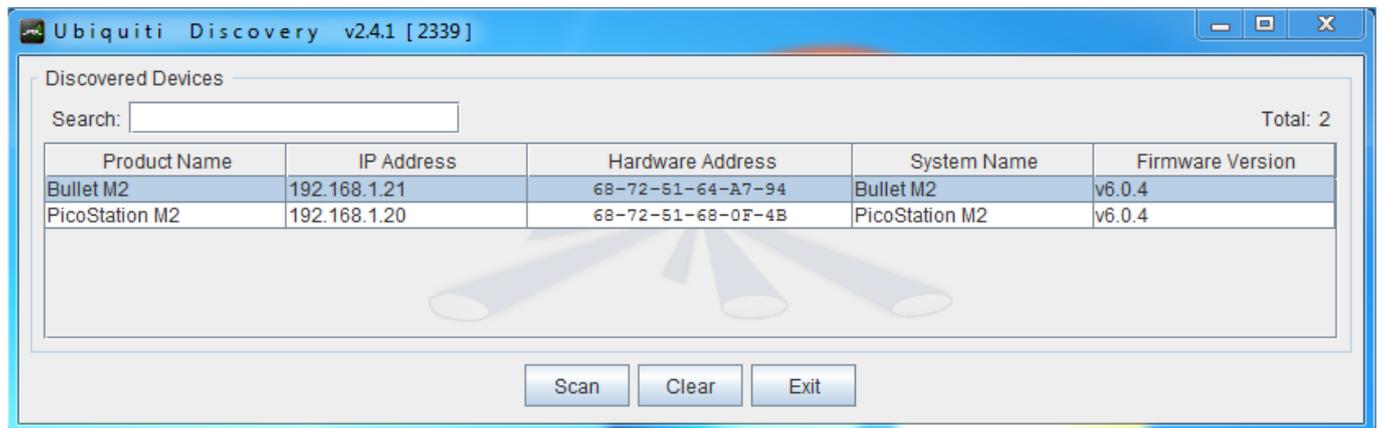
Ubiquiti discovery tool is used to scan the network for ubiquiti connected devices .

From the WIFI Bridge dashboard, at the top left click on Tools then Discovery.



The screenshot shows the Ubiquiti airOS interface. The top navigation bar includes tabs for MAIN, WIRELESS, NETWORK, ADVANCED, SERVICES, and SYSTEM. A dropdown menu is open under the 'Tools' button, listing options: Tools, Align Antenna..., Site Survey..., Discovery... (highlighted), Ping..., Traceroute..., Speed Test..., and airView... The main content area shows 'Network Role' settings with 'Network Mode' set to 'Bridge' and 'Disable Network' set to 'None'.

New windows will pop up



The screenshot shows the Ubiquiti Discovery v2.4.1 [2339] window. It displays a table of discovered devices with the following data:

Product Name	IP Address	Hardware Address	System Name	Firmware Version
Bullet M2	192.168.1.21	68-72-51-64-A7-94	Bullet M2	v6.0.4
PicoStation M2	192.168.1.20	68-72-51-68-0F-4B	PicoStation M2	v6.0.4

Buttons for 'Scan', 'Clear', and 'Exit' are visible at the bottom of the window.

From this tool you can check the Wifi bridges firmware version and IP addresses.



The WIFI bridges should be shared the same firmware version otherwise the system will not work properly.



The WIFI bridges IP addresses should be different from each other to avoid IP conflict.



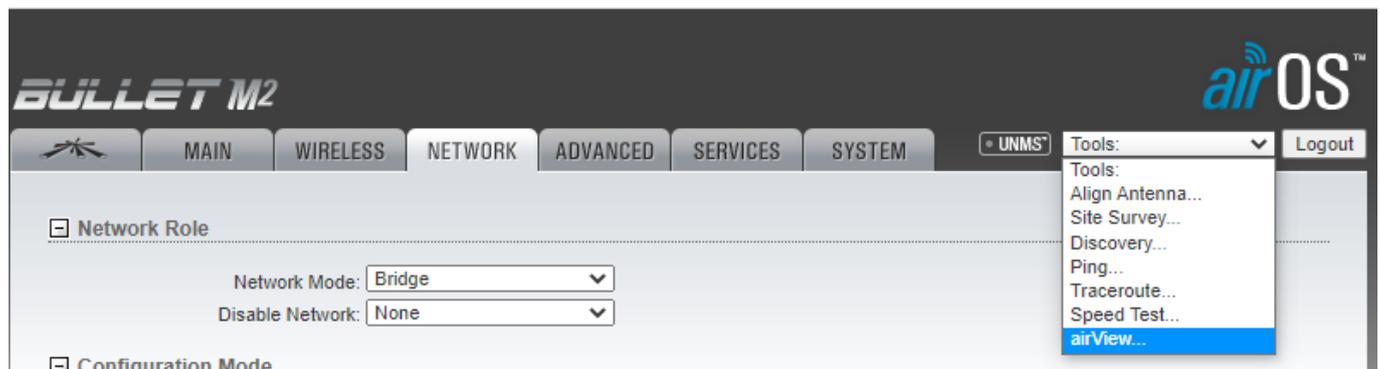
9.2 AIROS TOOLS

AirOS is the configuration interface for Ubiquiti products and it provides a very powerful features including:

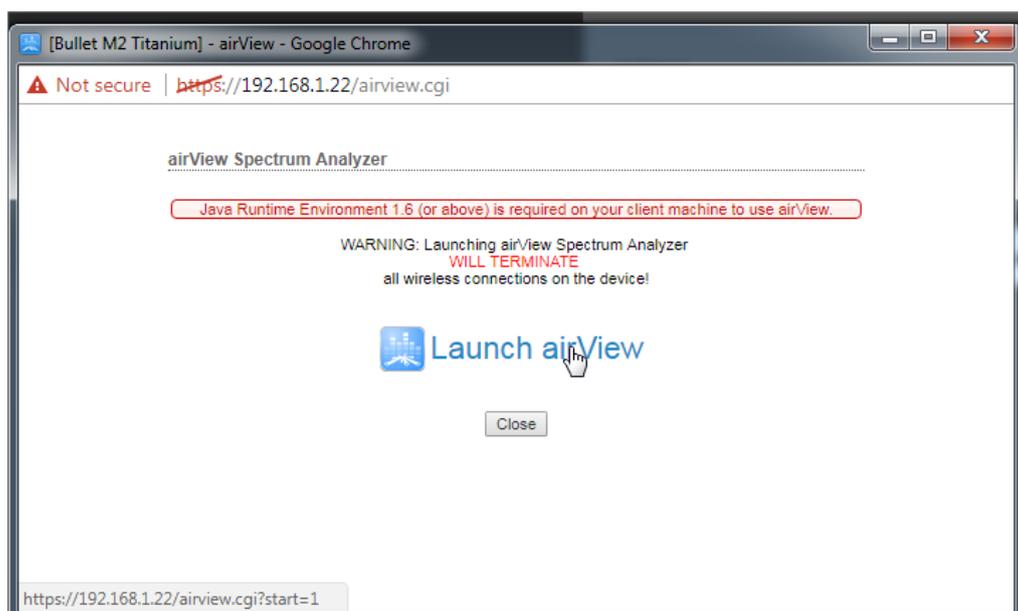
- **AirView Spectrum Analyzer**

WIFI Signal level can be predicted and planned based on the transmit power, antenna gain, distance, and frequency band. However, the problem with unlicensed wireless bands (2.4 GHz, 5 GHz, etc.) is that noise cannot be predicted, and clean spectrum is not guaranteed on any certain frequencies therefore ,this utility will help you determine the best channel configuration for your wireless network by conducting a site survey or spectrum analysis at the installation site of the wireless equipment , integrated on all Ubiquiti Networks products, airView™ provides powerful spectrum analyzer functionality, removing the need to rent or purchase additional equipment for doing site surveys.

- To access the airView utility, login to the device by entering your device's IP address in your Web Brower's address bar.
- Go into the "Tools" menu and select "airView".



The screenshot shows the airOS web interface for a BULLET M2 device. The top navigation bar includes tabs for MAIN, WIRELESS, NETWORK, ADVANCED, SERVICES, and SYSTEM. A dropdown menu is open under the 'Tools' button, listing options: Align Antenna..., Site Survey..., Discovery..., Ping..., Traceroute..., Speed Test..., and airView... (highlighted in blue). The main content area shows the 'Network Role' section with 'Network Mode' set to 'Bridge' and 'Disable Network' set to 'None'.



The screenshot shows a web browser window displaying the airView Spectrum Analyzer interface. The address bar shows the URL <https://192.168.1.22/airview.cgi>. The page title is "airView Spectrum Analyzer". A red warning message states: "Java Runtime Environment 1.6 (or above) is required on your client machine to use airView." Below this, a warning message reads: "WARNING: Launching airView Spectrum Analyzer WILL TERMINATE all wireless connections on the device!". A large blue button labeled "Launch airView" is visible, along with a "Close" button. The browser's address bar at the bottom shows <https://192.168.1.22/airview.cgi?start=1>.



- A Pop-up window will appear, it alerts that when launching airView, all wireless connections will be terminated for as long as the program runs. To agree, press the “Launch airView” button.

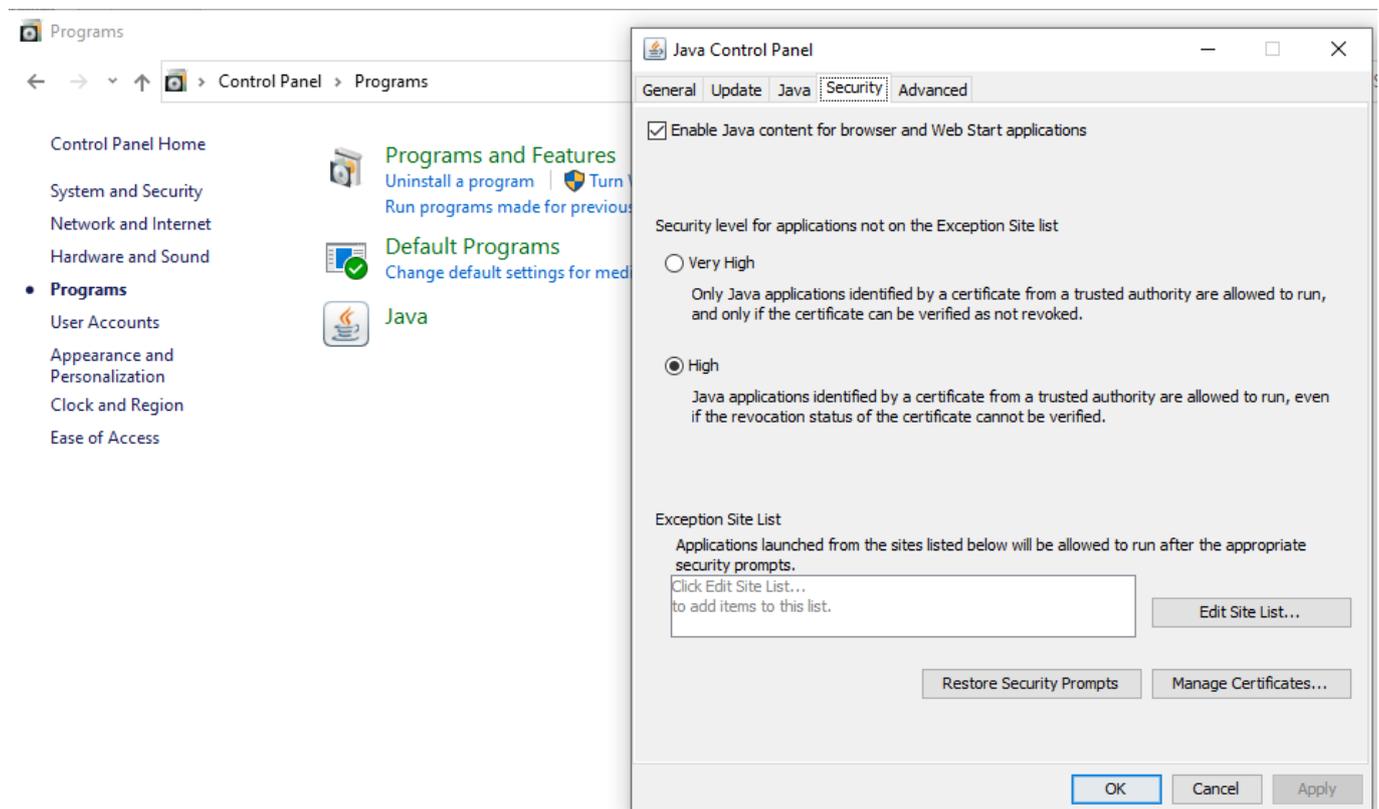


It's not recommended to run airView in Access Points with stations associated, because all your clients will be disconnected for as long as airView is running.

- Install Java environment on your pc then run “airview.jnlp” file.

Add the website IP address displayed on the Security warning message, to Java exception list to avoid that the browser blocks the communication

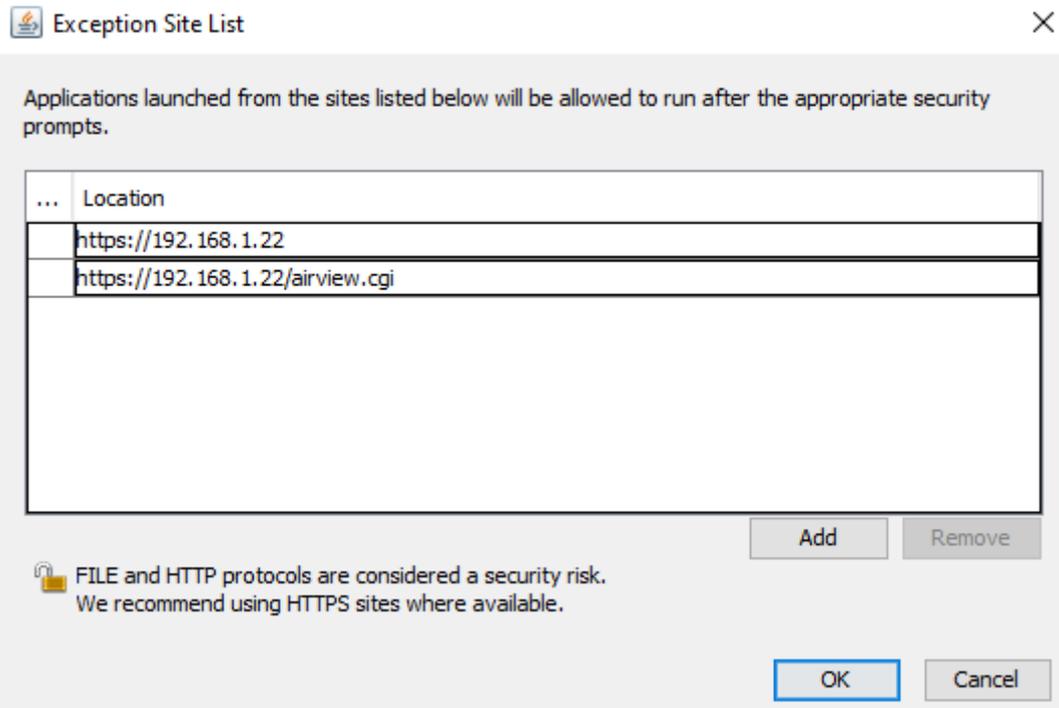
To add an exception list in Java go to **Control Panel → Programs → Java → Security**



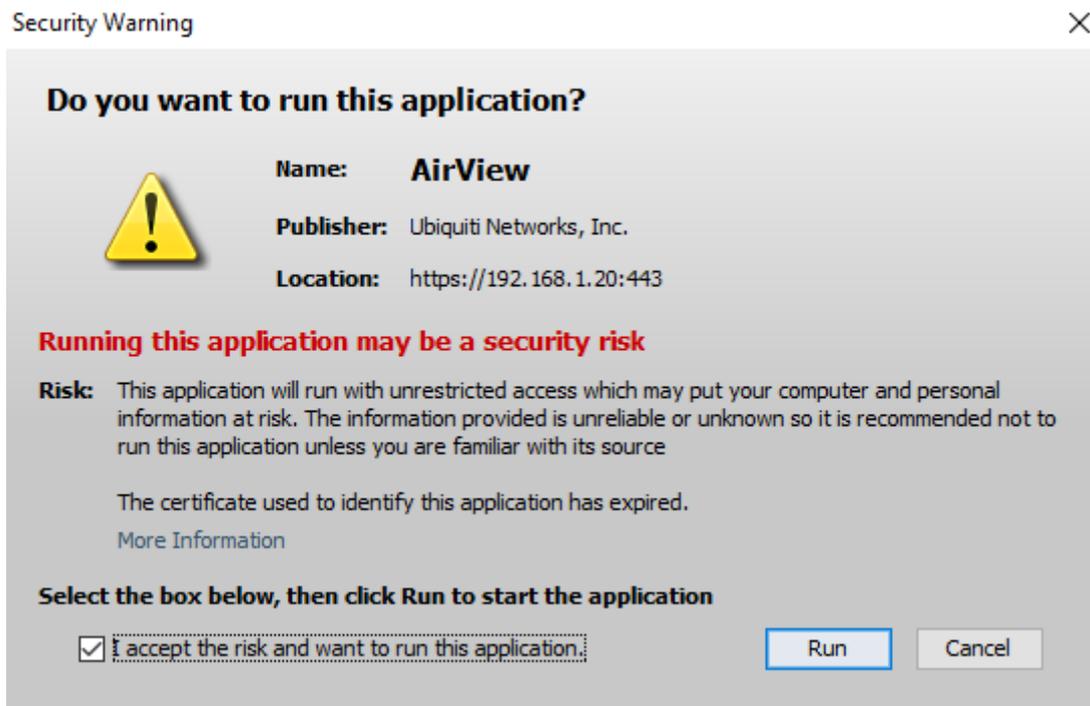
Select **High** option then click on **Edit list site** then **add** the application web address and the bridge IP address.

After finishing click on OK.

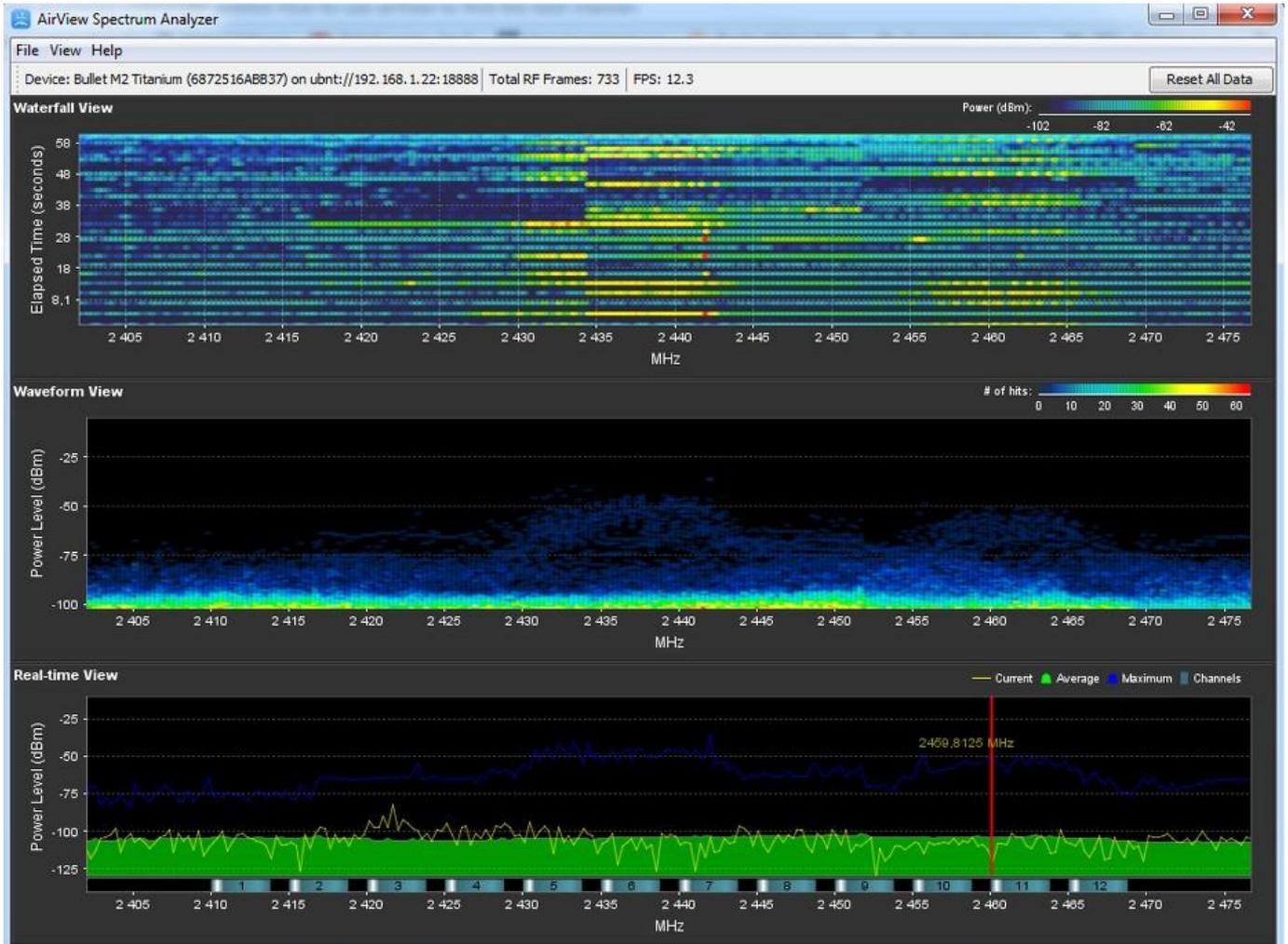




- Now Launch the Airview application and click continue when the security warning message is displayed, then check the checkbox and click on **Run**



- Inside airView, you have the following Views:
 - a) Waterfall View or Channel Usage view
 - b) Waveform View
 - c) Real-time View



Waterfall chart: This is a time-based graph showing the aggregate energy collected over time for each frequency while airView has been running. The color of energy designates its amplitude: colder colors stand for lower energy levels (with blue representing the lowest levels) at that frequency bin, whereas warmer colors (like yellow, orange or red) mean higher energy levels at that frequency bin.

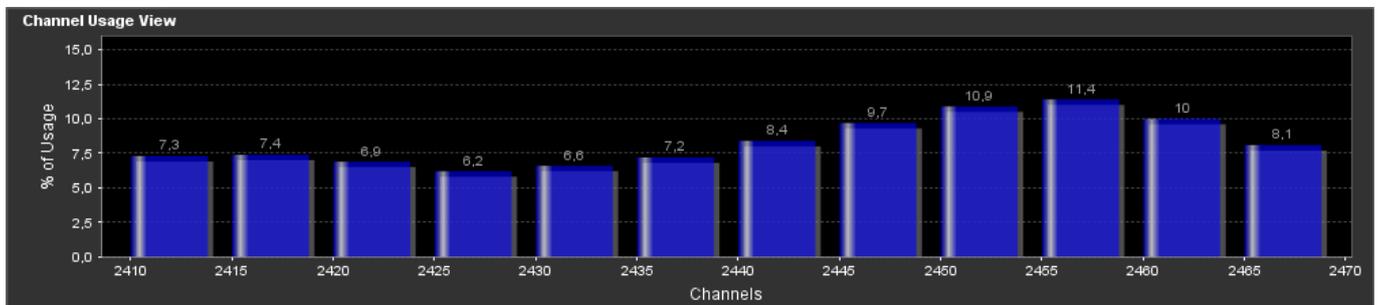
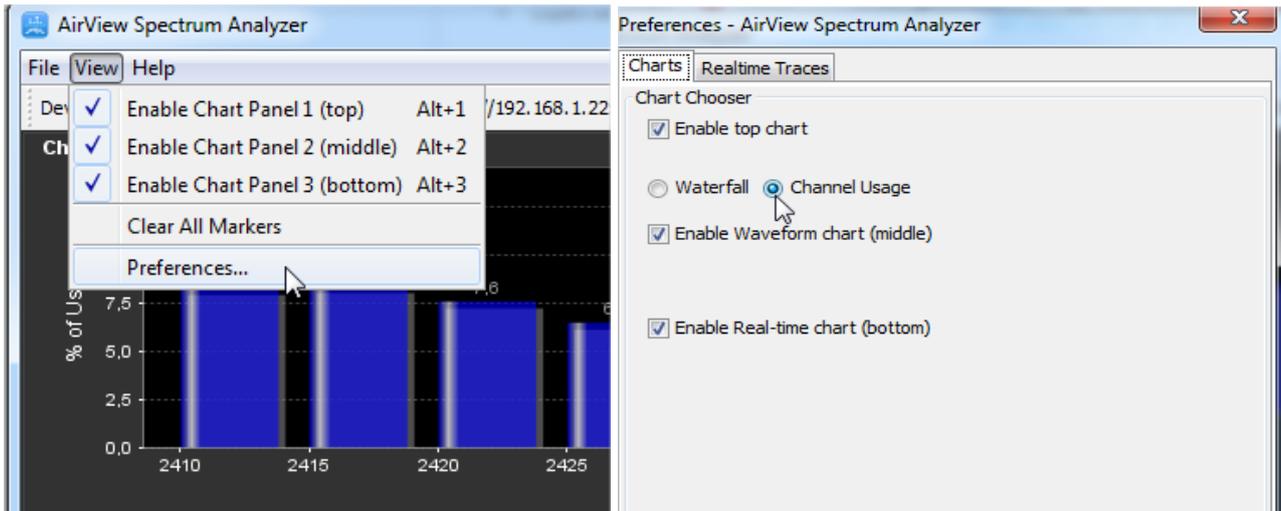
The Waterfall View's legend (top-right corner) provides a numerical guide associating the various colors to power levels (dBm). The low end of that legend (left) is always adjusted to the calculated noise floor, and the high end (right) is set to the highest detected power level since the start of the session.



Channel Usage chart: In this graph, each 2.4GHz Wi-Fi channel is represented by a bar displaying a percentage showing the relative "crowdedness" of that specific channel. This percentage is calculated by analyzing both the popularity and the strength of RF energy in that channel since the start of an airView session.

To enable Channel usage view:

Click on view → Preferences → check channel usage



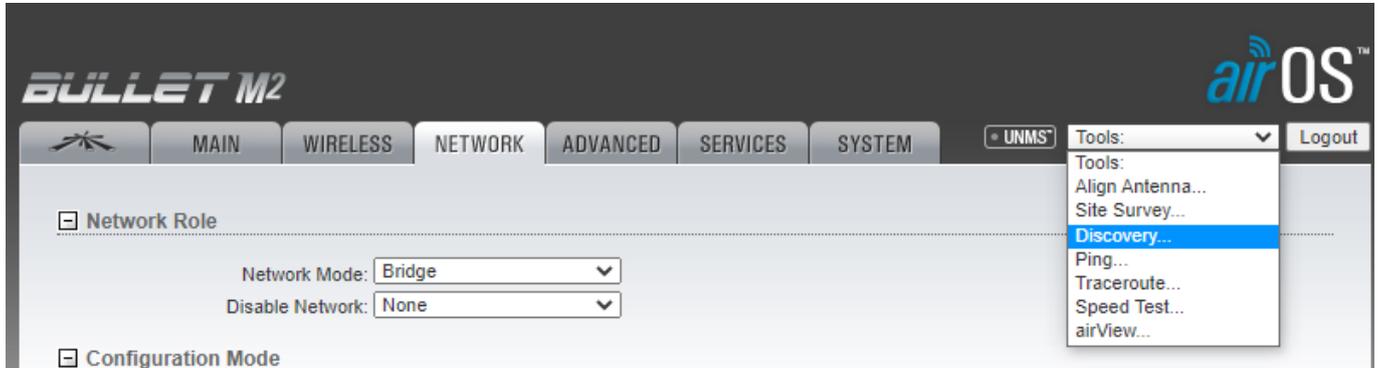
Waveform chart: Like the Waterfall chart, this is a time based graph showing the aggregate energy collected for each frequency over time while airView has been running. The color of the energy designates its amplitude: colder colors stand for lower energy levels (with blue representing the lowest levels) at that frequency bin, whereas warmer colors (like yellow, orange or red) mean higher energy levels at that frequency bin.

Real-time chart: this graph displays a traditional Spectrum Analyzer in which energy (in dBm) is shown in real time as a function of frequency. There are three traces in this view: Max Hold - this trace will update and hold maximum power levels across the frequency since the start of an airView session. Average - shows the running average energy across frequency. Real-time - shows the real-time energy seen by the airView device as a function of frequency.



- **Device Discovery:**

The Device Discovery tool searches for all Ubiquiti devices on your network.



The screenshot shows the airOS web interface for a BULLET M2 device. The 'Tools' dropdown menu is open, and 'Discovery...' is selected. The interface includes navigation tabs (MAIN, WIRELESS, NETWORK, ADVANCED, SERVICES, SYSTEM) and a 'Logout' button. The 'Network Role' section shows 'Network Mode' set to 'Bridge' and 'Disable Network' set to 'None'.



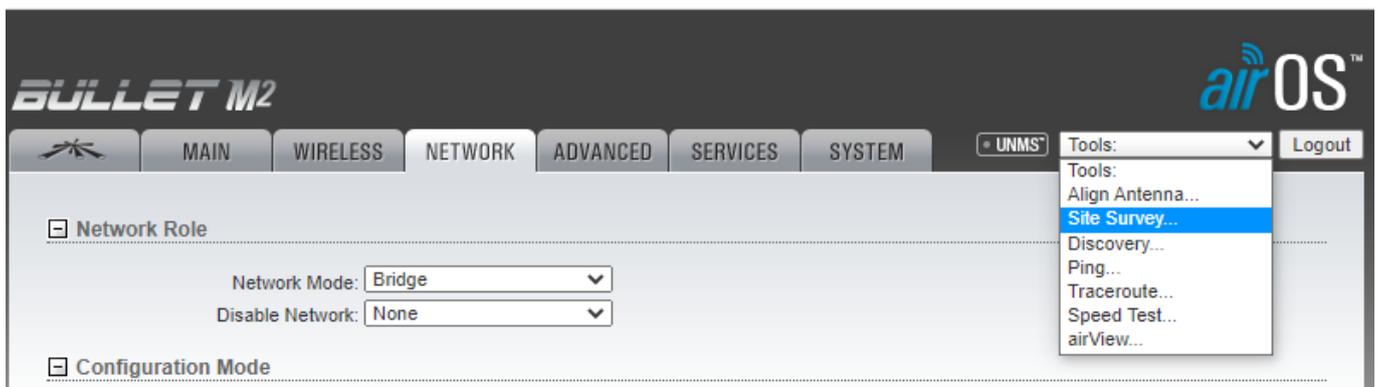
The screenshot shows the 'Device Discovery' results page in a browser window. The URL is <https://192.168.1.22/discovery.cgi>. The page displays a table with one entry:

MAC Address	Device Name	Mode	SSID	Product	Firmware	IP Address
68:72:51:6A:BB:37	Bullet M2 Titanium	AP	ubnt	Bullet M2 Titanium	v6.0.6	192.168.1.22

Below the table, it says 'Showing 1 to 1 of 1 entries' and includes navigation arrows. A 'Scan' button is visible at the bottom right.

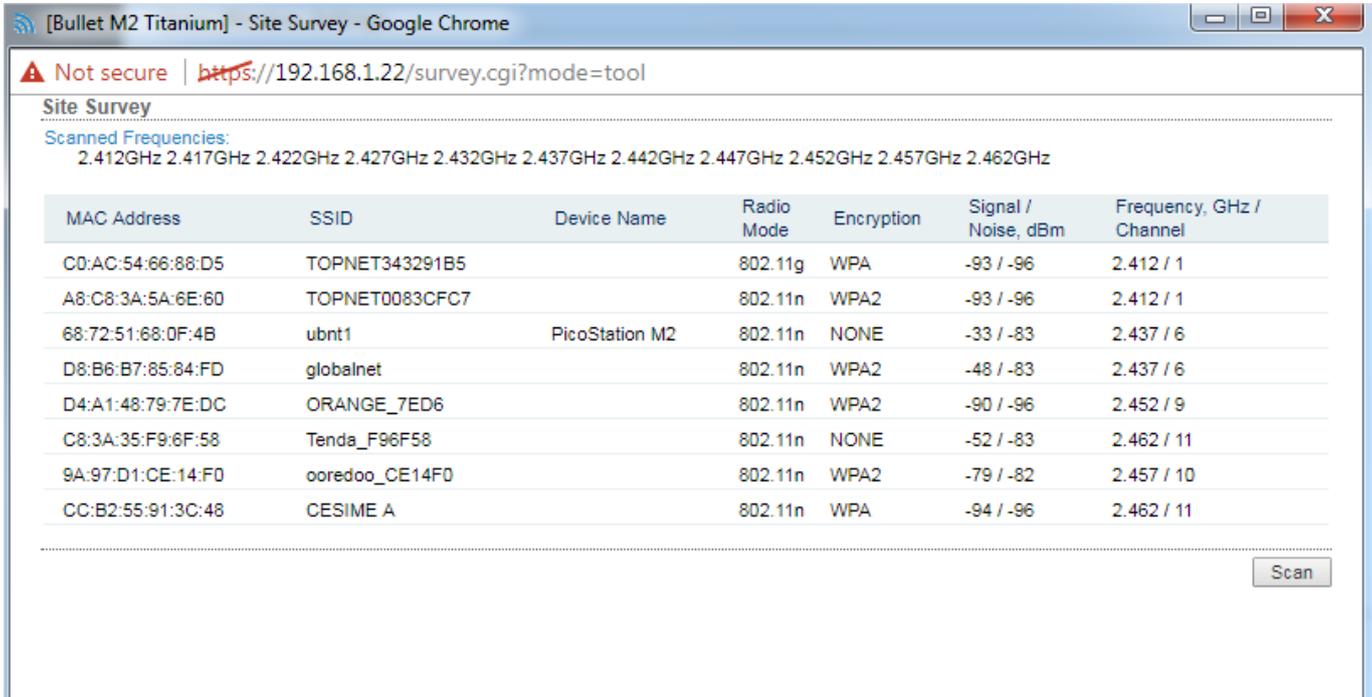
- **Site Survey:**

The Site Survey tool searches for wireless networks in range on all supported frequencies.



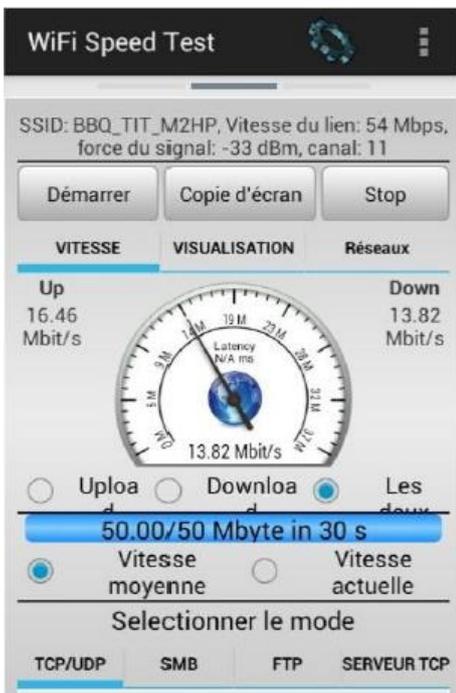
The screenshot shows the airOS web interface for a BULLET M2 device. The 'Tools' dropdown menu is open, and 'Site Survey...' is selected. The interface includes navigation tabs (MAIN, WIRELESS, NETWORK, ADVANCED, SERVICES, SYSTEM) and a 'Logout' button. The 'Network Role' section shows 'Network Mode' set to 'Bridge' and 'Disable Network' set to 'None'.





This tool helps you to discover the interference between the networks.

9.3 WIFI SPEED TEST



WiFi speed test is used for testing the Performance of the network .



10.FIRMWARE UPDATE

To update the WIFI bridge firmware you need to download the latest firmware from the Ubiquiti website on the links below

For the WIFI bridge BM2HP

https://www.ui.com/download/airmax-m/WIFI_bridgem/bm2hp

For the WIFI bridge BM2-Ti

https://www.ui.com/download/airmax-m/WIFI_bridgem/bm2-ti

once you download the new firmware go to the WIFI bridge main page and click on system, under firmware update section click on browse to locate the new firmware file then select the file and click open.

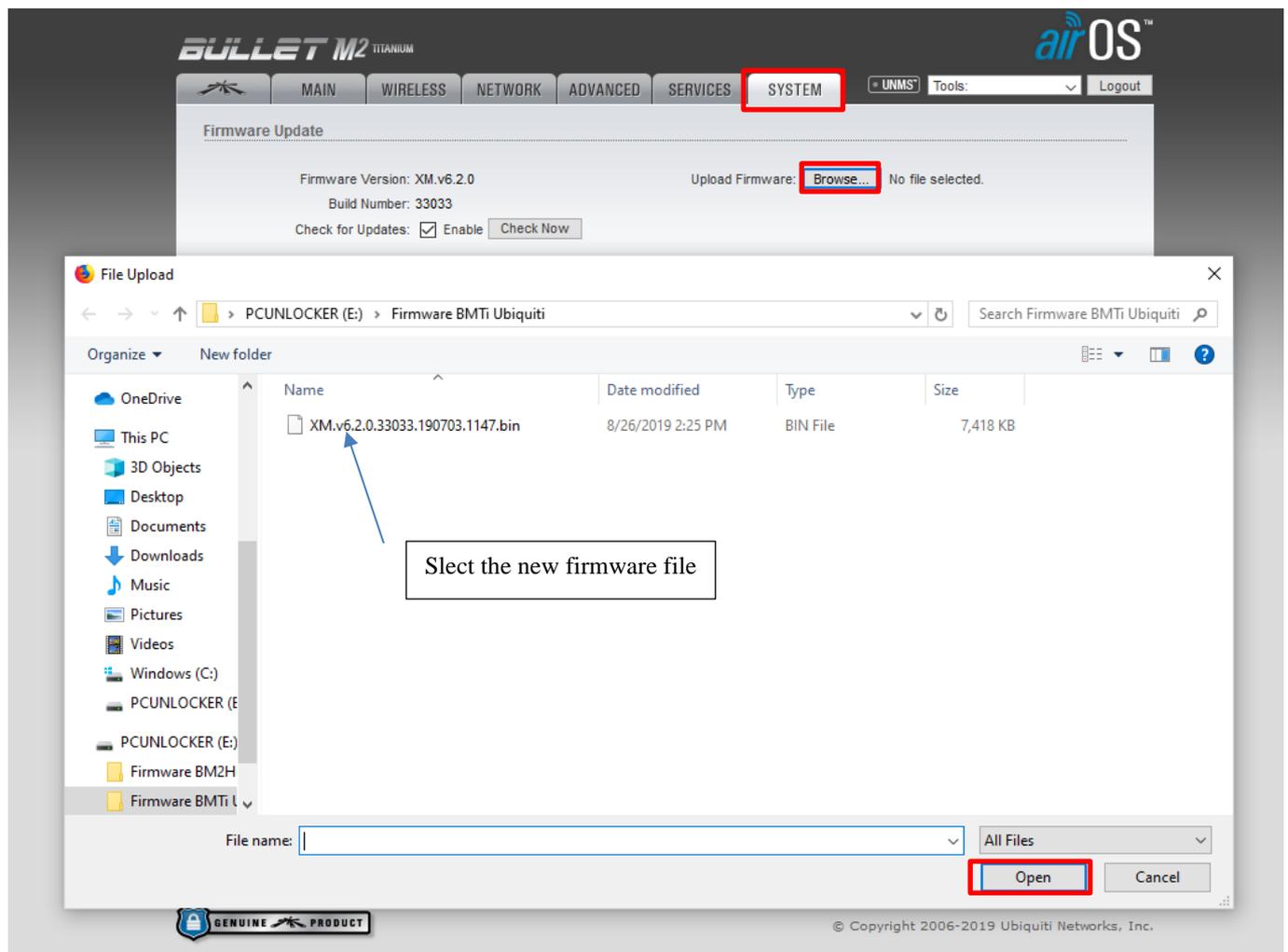


Figure 7: slect the new firmware file



Click upload to upload the new firmware to the device and when the upload firmware version is displayed click update to confirm.

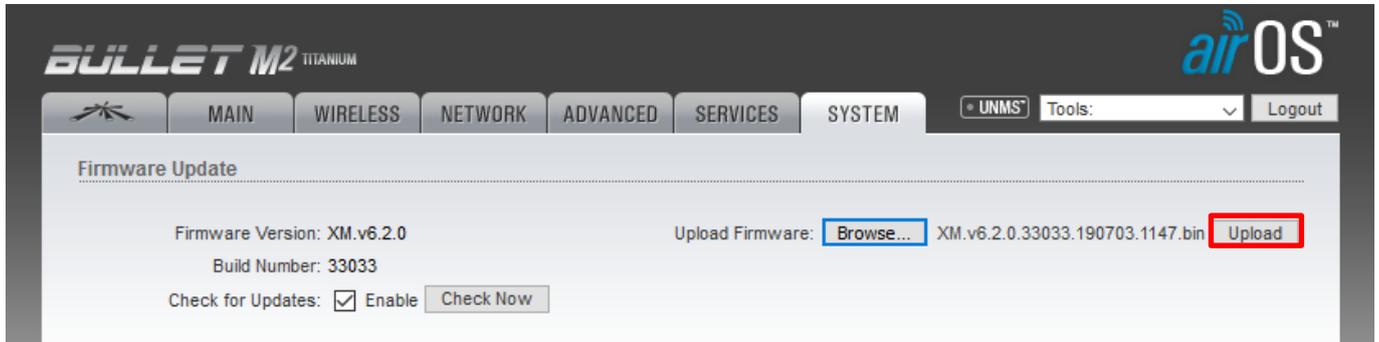


Figure 8: upload the new firmware

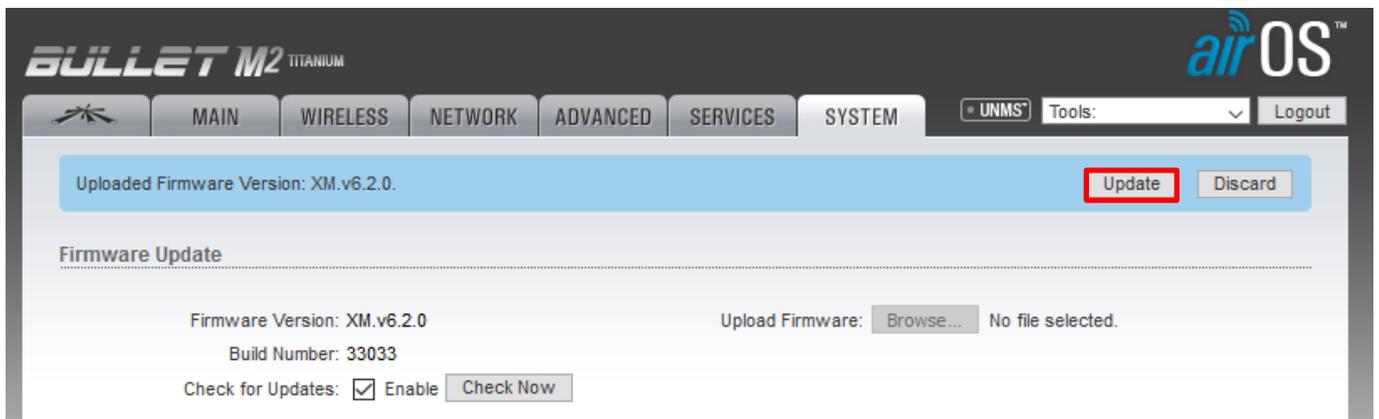


Figure 9: update the device



Do not power off, do not reboot, and do not disconnect the device from the power supply during the firmware update process as these actions will damage the device.



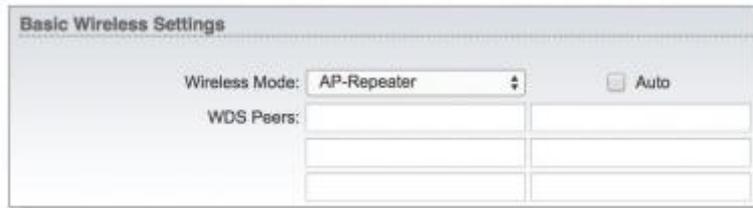
We recommend that you back up your current system configuration before updating the firmware.



11. APPENDICES

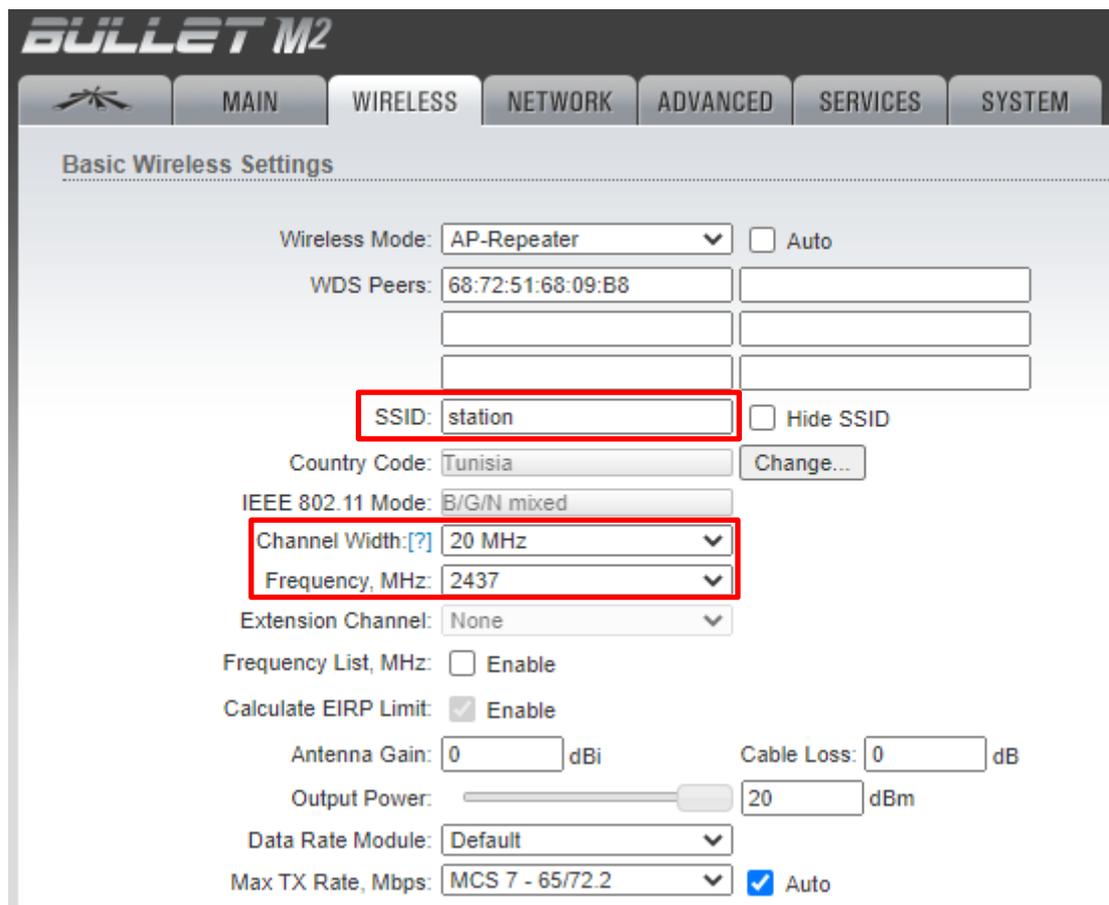
Using the AP-Repeater wireless mode you need to respect all the following instructions

1. Uncheck the Auto box for the WDS peers and enter the corresponding WIFI bridge MAC ID's



The screenshot shows the 'Basic Wireless Settings' form. The 'Wireless Mode' is set to 'AP-Repeater'. The 'Auto' checkbox is unchecked. The 'WDS Peers' section has three empty input fields.

2. Do not enter the WIFI bridge MAC ID itself, which currently configure in the WDS peers.
3. Choose the channel width 20MHz and the 2437MHz frequency and make sure to enter the same channel width and frequency for all the repeaters.
4. Make sure to use the same SSID for all the repeaters



The screenshot shows the 'BULLET M2' web interface for 'Basic Wireless Settings'. The 'Wireless Mode' is 'AP-Repeater' and 'Auto' is unchecked. The 'WDS Peers' field contains '68:72:51:68:09:B8'. The 'SSID' field is 'station' and 'Hide SSID' is unchecked. The 'Country Code' is 'Tunisia'. The 'IEEE 802.11 Mode' is 'B/G/N mixed'. The 'Channel Width' is '20 MHz' and the 'Frequency' is '2437', both highlighted with red boxes. The 'Extension Channel' is 'None'. 'Frequency List, MHz' is unchecked. 'Calculate EIRP Limit' is checked. 'Antenna Gain' is '0 dBi' and 'Cable Loss' is '0 dB'. 'Output Power' is '20 dBm'. 'Data Rate Module' is 'Default'. 'Max TX Rate, Mbps' is 'MCS 7 - 65/72.2' and 'Auto' is checked.



5. Don't use any wireless security for all the repeaters.

Wireless Security

Security:

6. Disable the DHCP server on the WIFI bridge and gives to it a static IP address not used by another device.

Management Network Settings

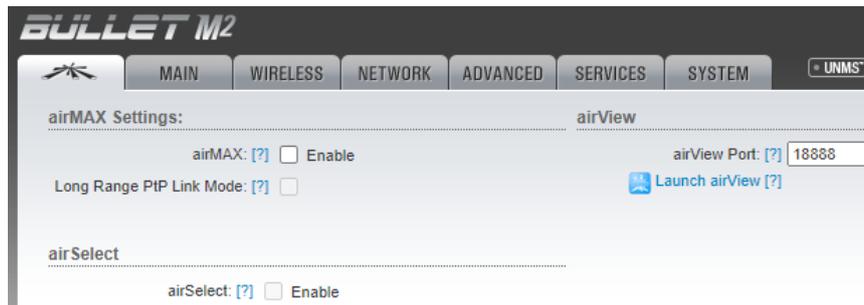
Management IP Address: DHCP Static

IP Address:

Netmask:

Gateway IP:

7. Enter your 3G/4G router IP Address or your router IP Adress, and make sure that the DHCP server is enabled, in the Gateway IP settings.
8. Make sure to disable the airMAX option.



The screenshot shows the configuration page for a BULLET M2 device. The 'WIRELESS' tab is selected. Under 'airMAX Settings', the 'airMAX' checkbox is unchecked. Under 'airView', the 'airView Port' is set to 18888 and the 'Launch airView' button is visible. Under 'airSelect', the 'airSelect' checkbox is unchecked.

9. Make sure that all the repeater have the same firmware version.
10. Make sure to switch off the first WIFI bridge while configuring the second one.

