Installation and Setting Guide for Bridge IEEE802.11ac 20/40/80 MHz

“ This manual is subject to change without prior notice “

SAWWAVE

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FCC Compliance Statement

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC ID: 2AL83PTP-5440

FCC Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 70 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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1. Product

1.1. KEY FEATURES

1.1.1 GENERAL INFORMATION

Antenna	MIMO SOMPA patch
Duplex	TDD (Time Division Duplex)
Radio supported	5.8 GHz band 802.11ac 20/40/80 MHz
Processor	QCA8065
Physical ports	1X10/100/1000 Base T Ethernet Port
Operating temperature	-30°C to 50°C
LED Indicators	Power, LAN, Signal LED1,2

1.1.2 INFORMATION ON POWER

Power over Ethernet	802.3 af/at
Typical operating power	15W

1.2. ETHERTNET Connectors

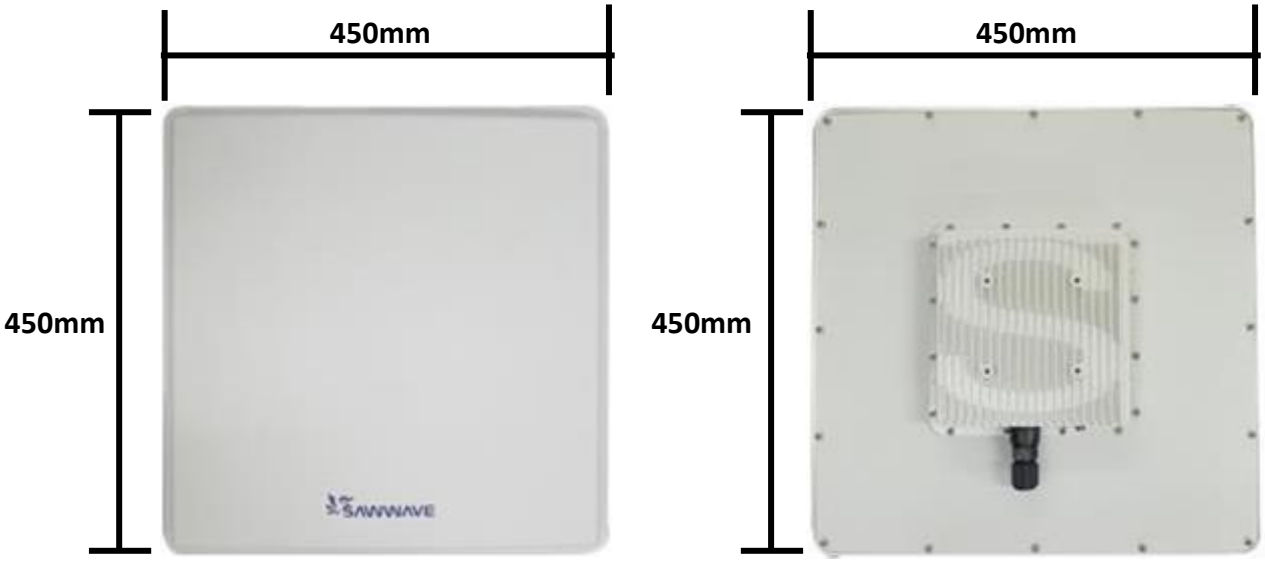
The board contains 1X10/100/1000 Base-T Ethernet Channels. The Ethernet Channels are available through standard 8-pin RJ45 connectors.

Ethernet Connectors signaling is shown below.

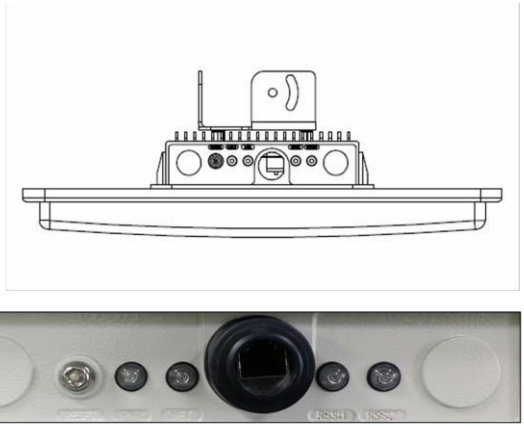
PIN	Signal
1	BI_DA+
2	BI_DA-
3	BI_DB+
4	BI_DC+
5	BI_DC-
6	BI_DB-
7	BI_DD+
8	BI_DD+

1.3. Product Size/ Photo

[Product] 450×450×119mm (W×H×D)



[Frame]



① Reset S/W (security bolt)
② Power LED : green
③ LAN Ethernet LED : yellow
④ WAN port (RJ-45, connect the POE)
⑤ Signal LED : Red

2. Discussion / Due Diligence / Design

2.1 Discussion

Discussion should be made before due diligence to prevent any unexpected field situation which may come during installation.

[Discussion Items]

① Purpose of Installation

② Adequate Address of Point / Detailed information on the installation location, i.e., Height of Tower and Power.
*SAWWAVE equipment has power supply from Power POE which has used AC Power.

③ Discussion on needed building materials which will be needed for installation.
(Assistant Pole. Ground line, UPT cable and so on)

④ Distance between Points / Availability of LOS

⑤ Availability of the 2nd Point in case the Bridge at 1st point can't provide satisfied performance due to unexpected interference.

⑥ Discussion on several field status.

2.2 Due Diligence

Based on the discussion, visit the installation location to check neighboring environment and radio environment. These are needed to prevent any delay during installation.

[Check items during due diligence]

① Height of Tower / Location of Installation / Power / LOS (Line of sight) /
Taking picture of neighboring environment

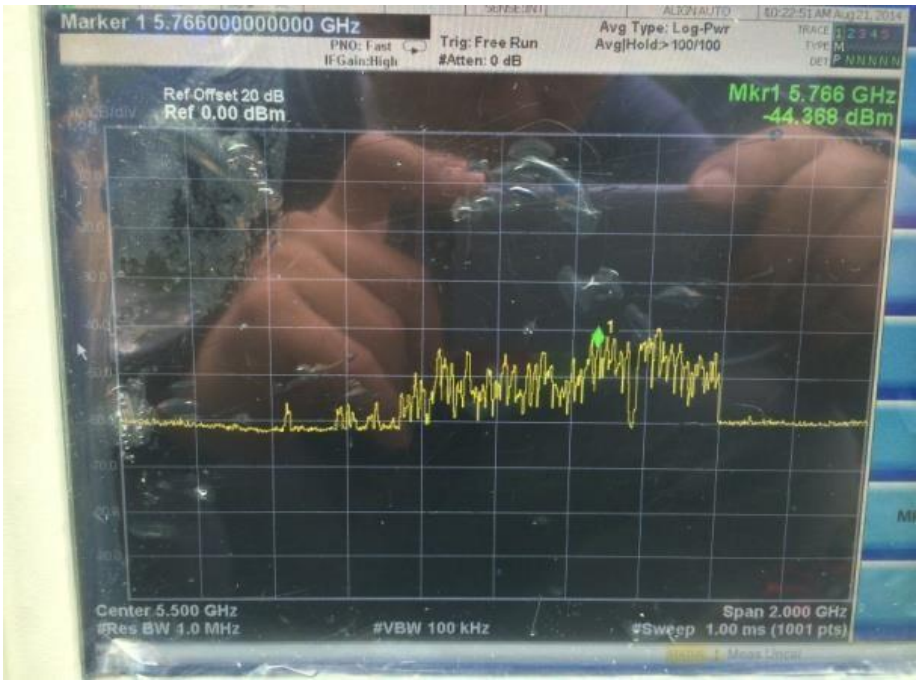
[Method to check radio environment (Interference)]

① Using a wireless LAN Card in a Notebook which has an Insider S/W, scan 5GHz band.

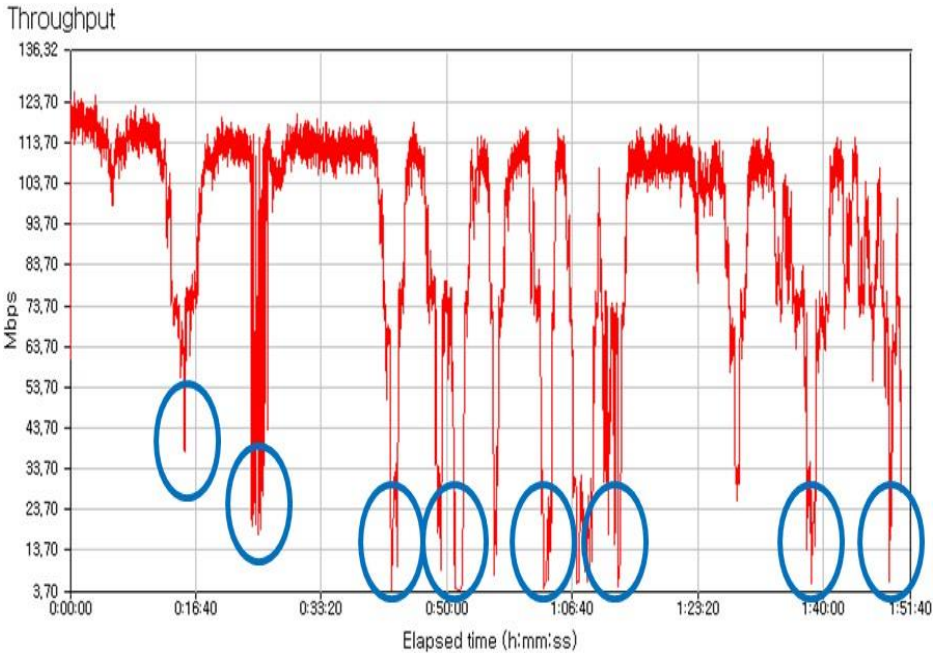
② Using 1 PTP equipment of SAWWAVE_PTP and an Interference Analyzer, scan 5 GHz Band.
(Operating in Access Point Mode)

③ Attach a 5GHz antenna at Spectrum analyzer.

※ Using a Spectrum analyzer is the most accurate method to check radio environment.
Especially, radar signal has provided very strong signal enough to ignore neighboring signals.
But as the radar signal does not have a SSID, it can be checked only by Spectrum analyzer.



<Figure 1. Irregular signal scanned in Spectrum analyzer>



<Figure 2: Irregular signal captured by IxChariot Graph>

2.3 Design

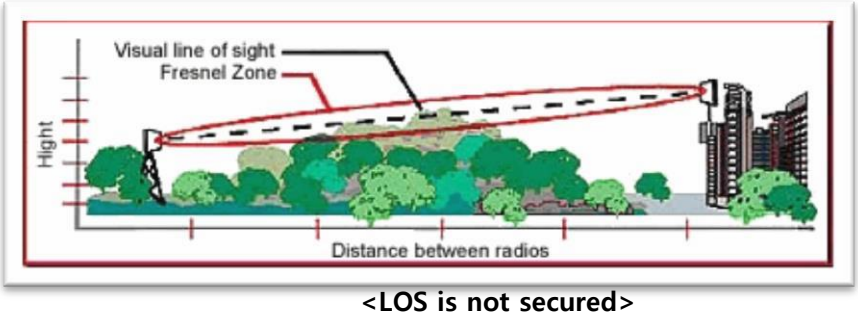
* Consideration for Design

[Fresnel zone]

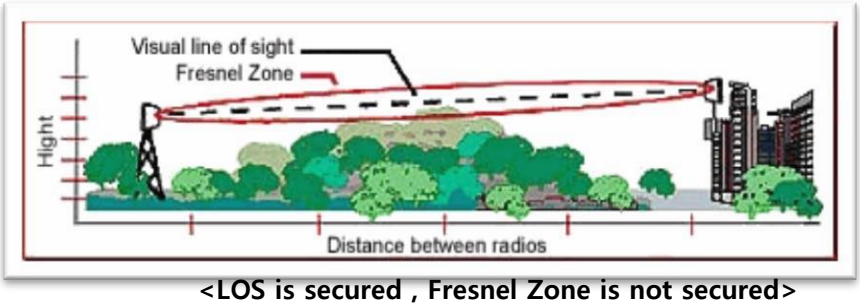
LOS (Line of site) means a visible distance between antennas.

Even if there is no obstacle by naked eye, if design/installation are made without considering the Fresnel Zone, amicable communication may not be available.

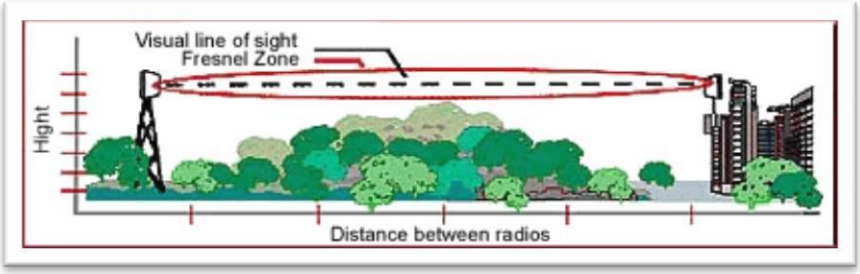
In the first design, after check the LOS, design considering Fresnel Zone should be made. .



<LOS is not secured>



<LOS is secured , Fresnel Zone is not secured>

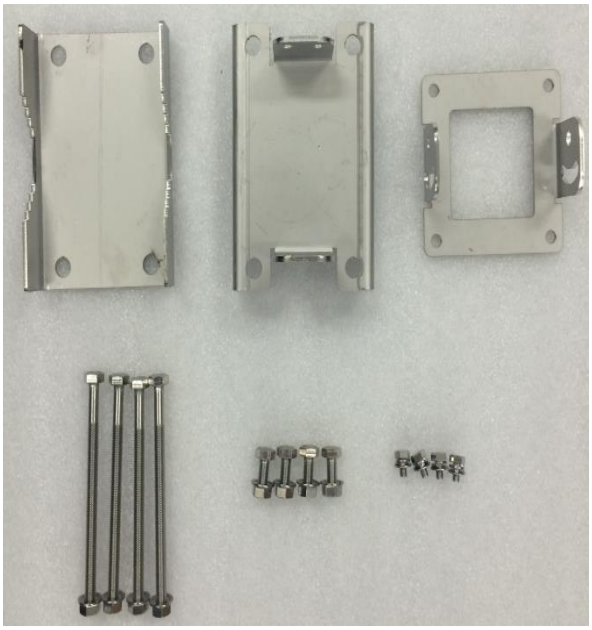


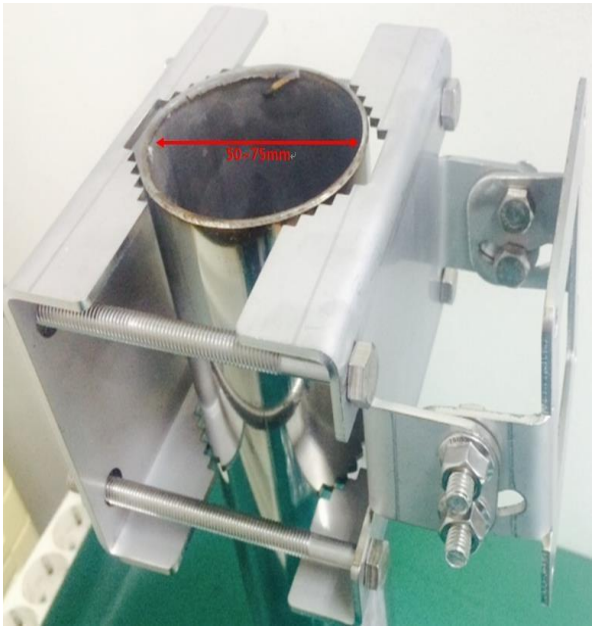
<LOS and Fresnel Zone are secured>

3. Installation

3.1 Bracket

- Install a provided Bracket at Top/Pole (Bracket is provided with the Bridge.)
- SAWWAVE recommends a Bracket to be installed at 50~75mm diameter Pole. Up to 80mm diameter Pole can be supported.
- If a Pole is not proper to use, please install the Bridge using an assistant Pole.
- M6 bolt torque : 49kgf/cm (4.8N/m), M8 bolt torque : 122kgf/cm (11.9N/m)





<Components of Bracket>

<Using incumbent Pole>

<Using an assistant Pole>

3.2 Check points after installation

- Finishing waterproof connector with shrinkable tube.

- Ground

  * Basically install using 4SQ but decides the line for Ground in discussion stage.

- Use outdoor UTP Cable if the equipment is installed at open area.

  If it is not the outdoor UTP Cable, use flexi le Cable not to be damaged

- Install POE inside of Power rack and Outdoor rack as it does not support waterproof.

LED

- Green LED ON : Power on
- Yellow LED ON : Connect the LAN Ethernet
- Red LED 2 : Connect the Link level (RSSI level)

ID : root

P/W : sawwaveap

4. Bridge Setting

4.1 Initial Setting

1) Enter an initial IP address into an Internet Address Window. (http://192.168.1.254)).

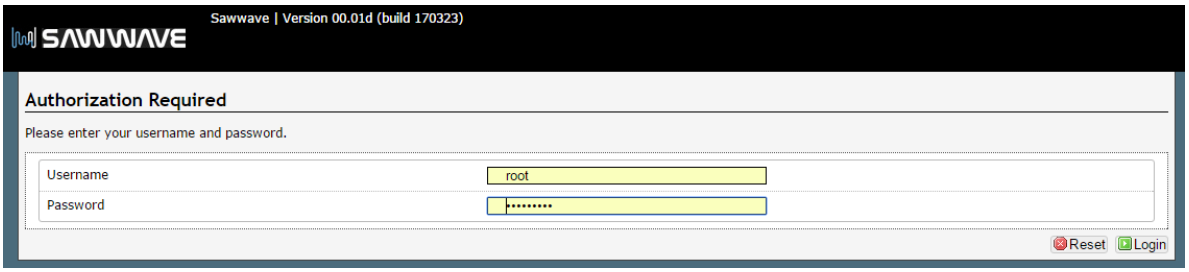
2) Enter both ID and Password.

(The initial IP address is http://192.168.1.254 but as is subject to change depending on environment, it is needed to check the IP address.)

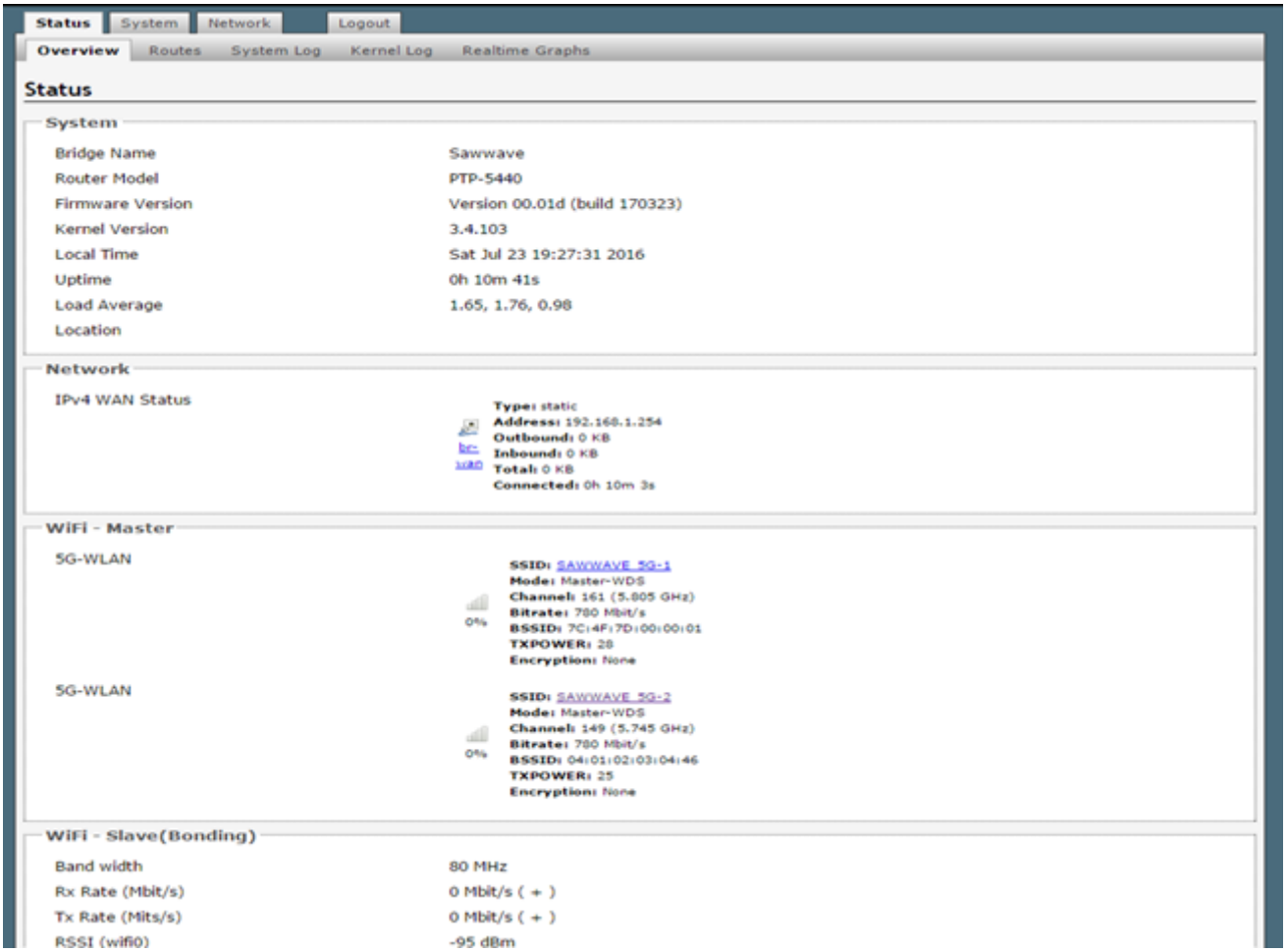
※ PC standard for setting : Over Window 7, Ethernet 1G, CPU over 1GHz(32bit/64bit)

※ Recommend UI Browser : Chrome (Allow all version)

Firmware version : PTP-5440_v00.01d_b170323



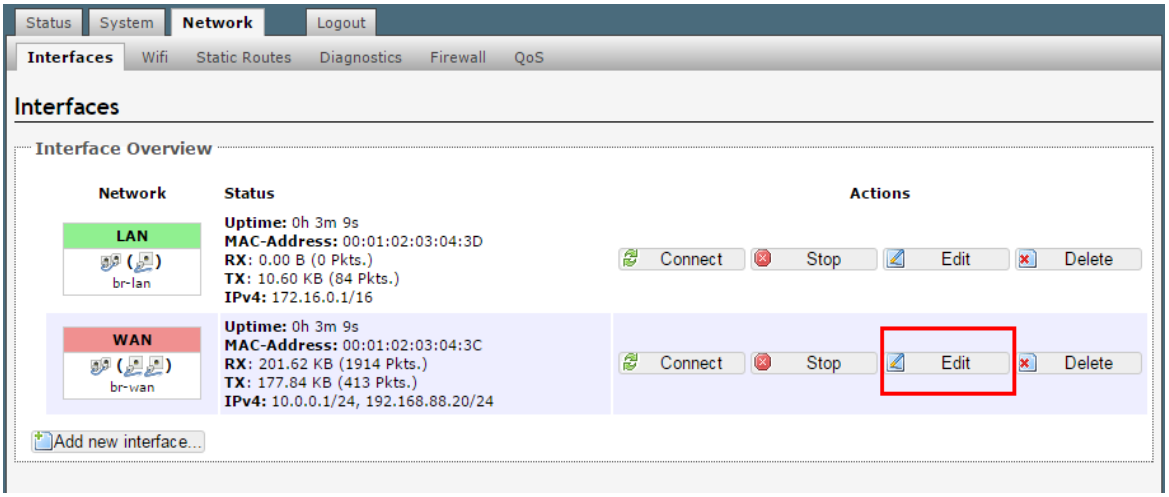
[Figure 1]. login page



[Figure 2]. Status page after Login

4.2 Bridge (Master) Setting

1) Click "Network" in a menu bar and click Edit tab at "Interface Overview" – WAN.

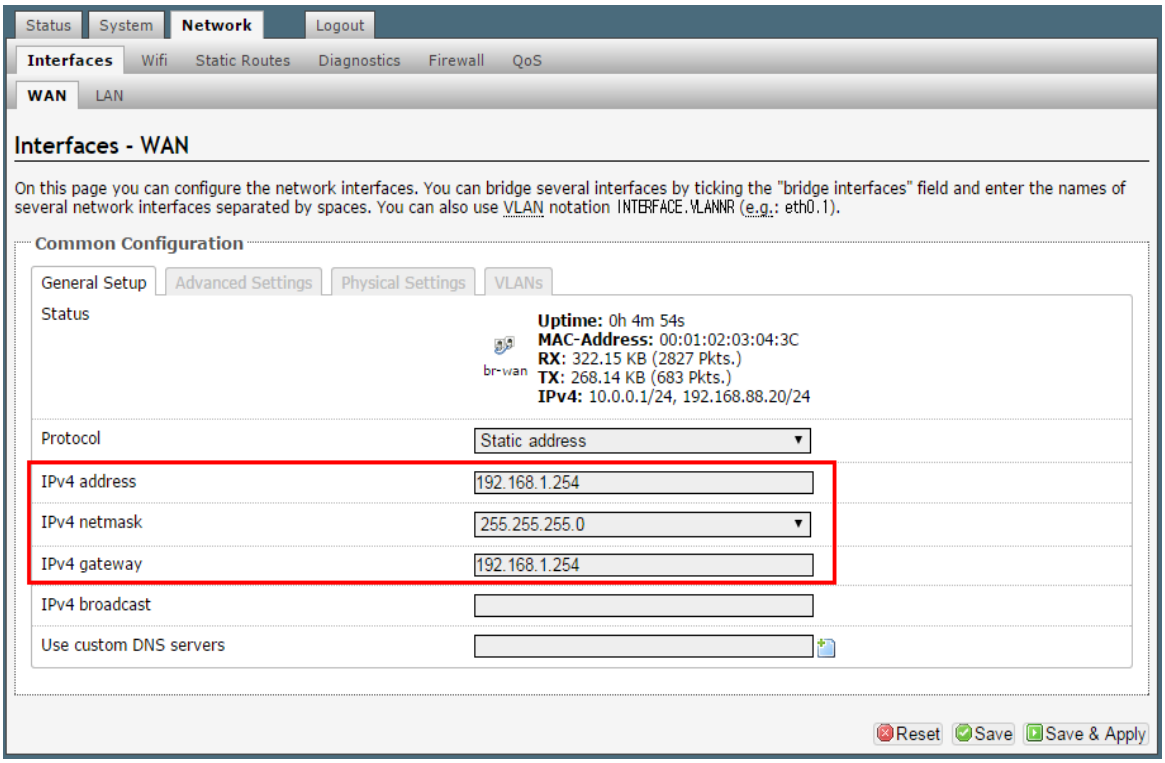


[Figure 3]. Network-Interfaces page

① Set IPv4 address with a desired IP address which will be connected after Bridge setting.

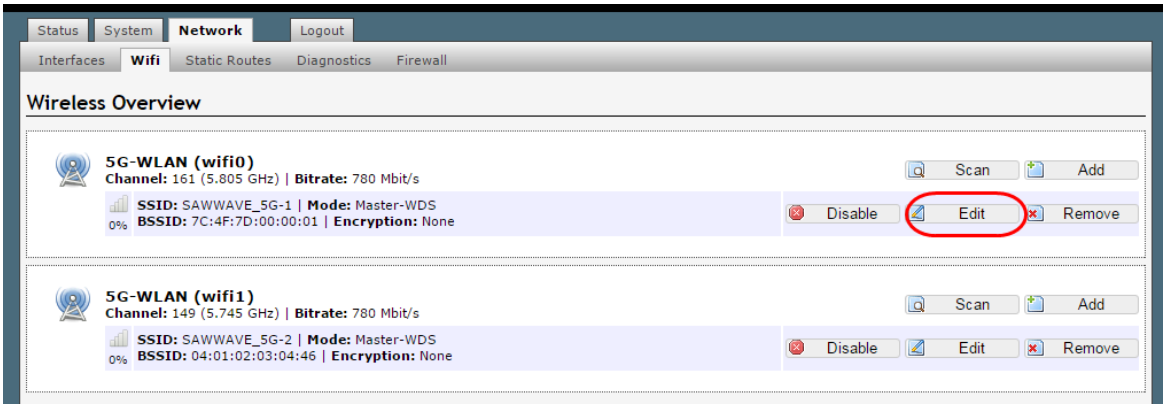
② Select a desired IPv4 netmask

③ Enter a Default gateway at IPv4 gateway.

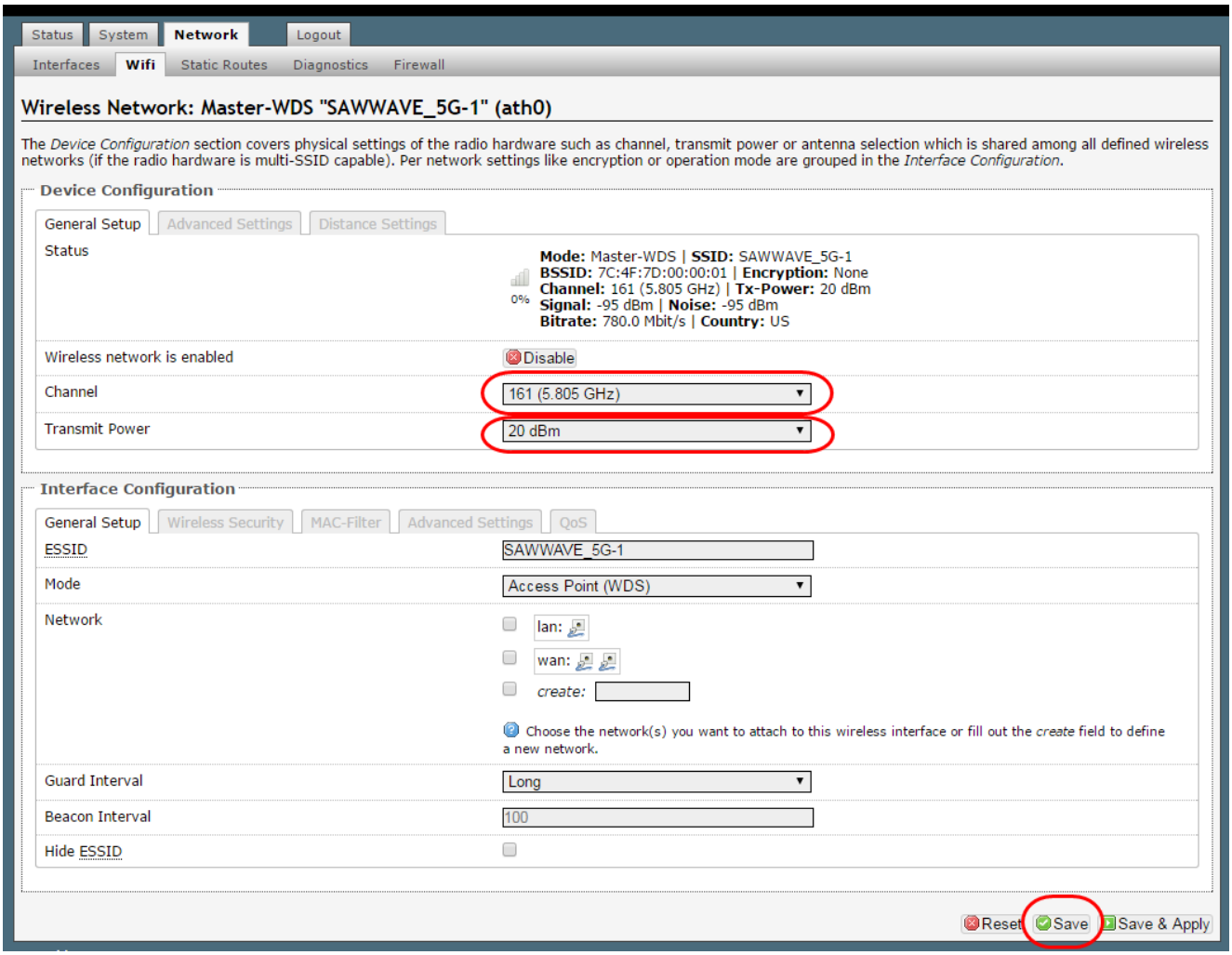


[Figure 4]. Network-Interfaces-wan page

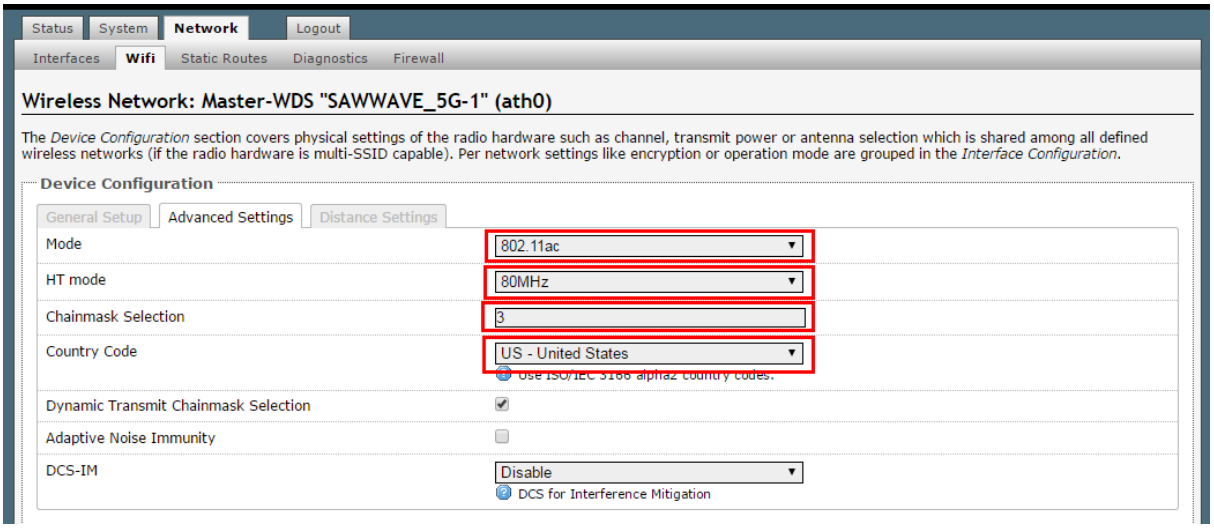
2) Click "Network" at Menu bar and select WiFi tab. **(ath0)**



[Figure 5] Network-wifi page



[Figure 6] Network-wifi-5G General setup



[Figure 7] Network-wifi-5G Advanced Settings

① Set Country Code as a desired one.

Caution!

- Only manufacture is able to select this category. End-user and installer do not select it.
- This category in placed on the market is disabled.

② Set Wireless Profile as 802.11ac – 5 GHz.

③ Set Channel Spectrum Width as 20/40/80 MHz.

④ Set Channel at best optimized frequency depending on site survey result.

⑤ Set Transmit Power as a desired one.

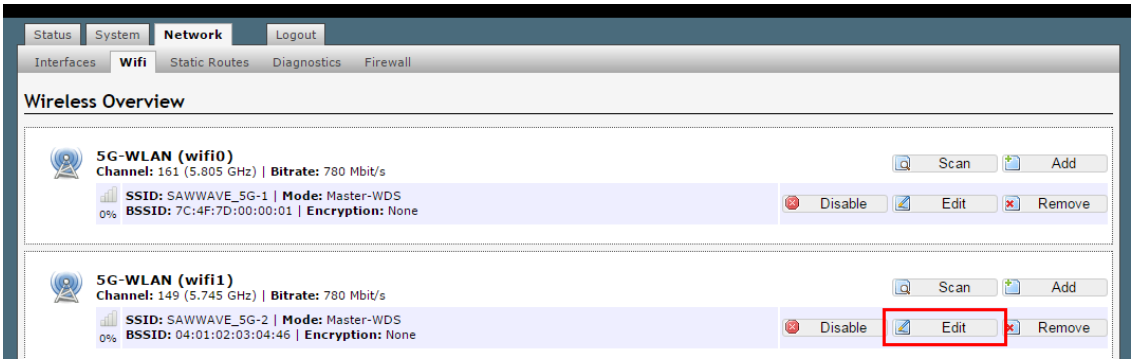
Interface configuration-General Setup

⑥ Set Modes as Access Point (WDS) in case of Master. (For Slave, Station (WDS))

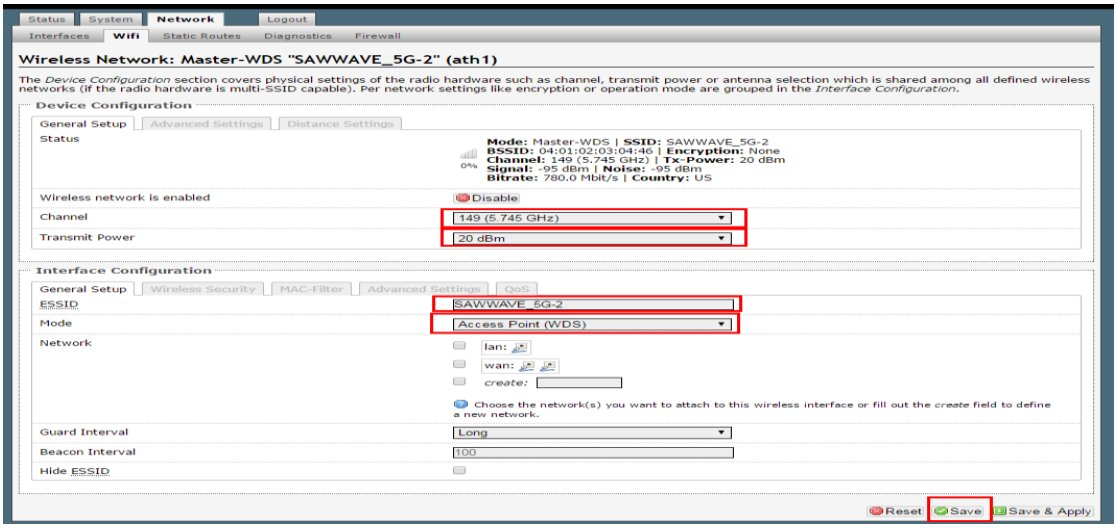
⑦ Enter desired SSID into ESSID.

⑧ Push Save buttons.

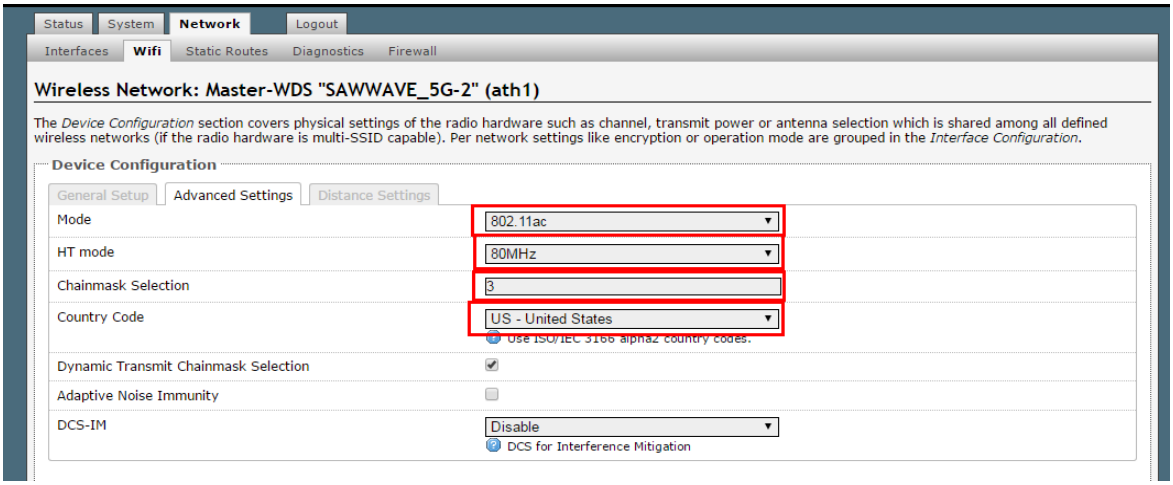
3) Click "Network" at Menu bar and select WiFi tab. **(ath1)**



[Figure8] Network-wifi-5G Edit



[Figure9] Network-wifi-5G General Setup



[Figure10] Network-wifi-5G Advanced Settings

① Set Country Code as a desired one.

Caution!

- Only manufacture is able to select this category. End-user and installer do not select it.
- This category in placed on the market is disabled.

② Set Wireless Profile as 802.11ac – 5 GHz.

③ Set Channel Spectrum Width as 20/40/80 Mhz.

④ Select a channel other than ath0

⑤ Set Transmit Power as a desired one.

Interface configuration-General Setup

⑥ Set Modes as Access Point (WDS) in case of Master. (For Slave, Station (WDS))

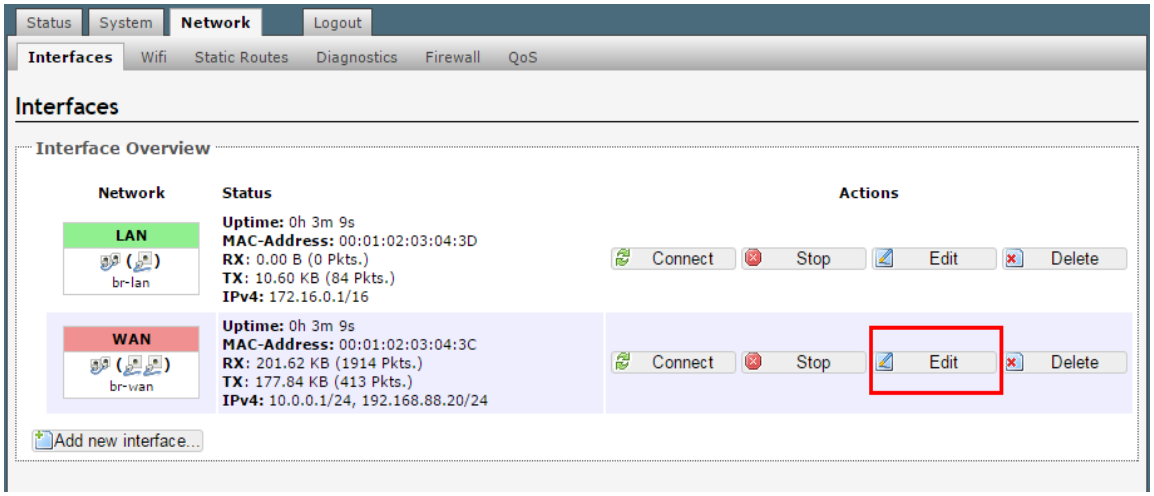
⑦ Enter desired SSID into ESSID. Select the ESSID other than ath0

⑧ Push Save & Apply buttons.

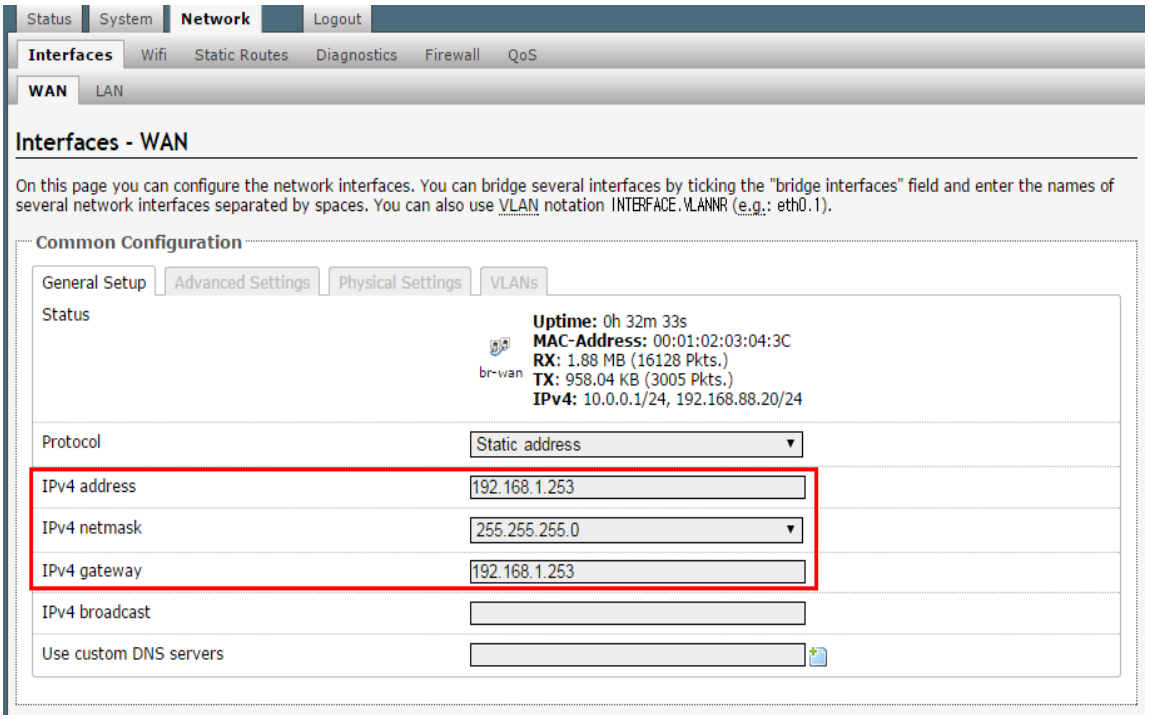
**Setting of Bridge Access Point (Mater) mode is completed.

4.3 Setting of Bridge station (Slave)

1) Click "Network" in a menu bar and click Edit tat at "Interface Overview".



[Figure 11] Network Interfaces page



[Figure 12]. Network-Interfaces-Wan page

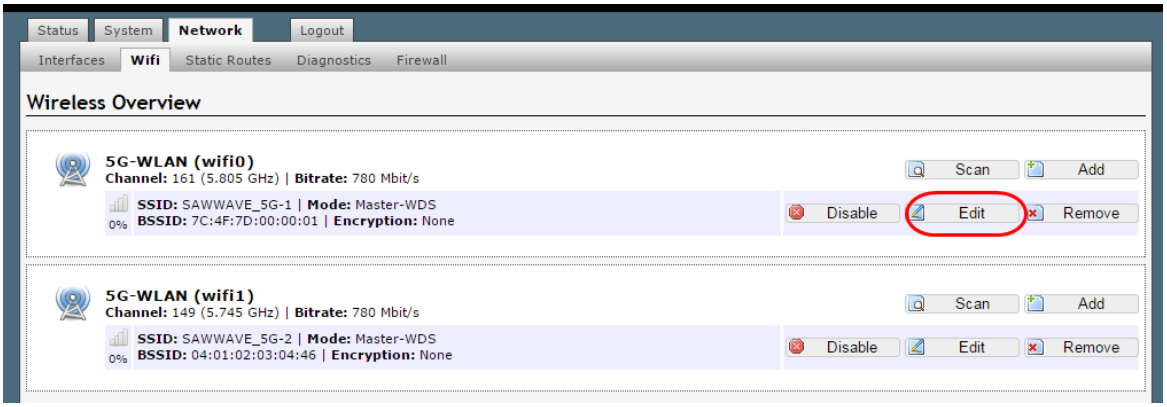
① Set IPv4 address with a desired IP address which is different from Mast Bridge's IP address

② Select a desired IPv4 netmask..

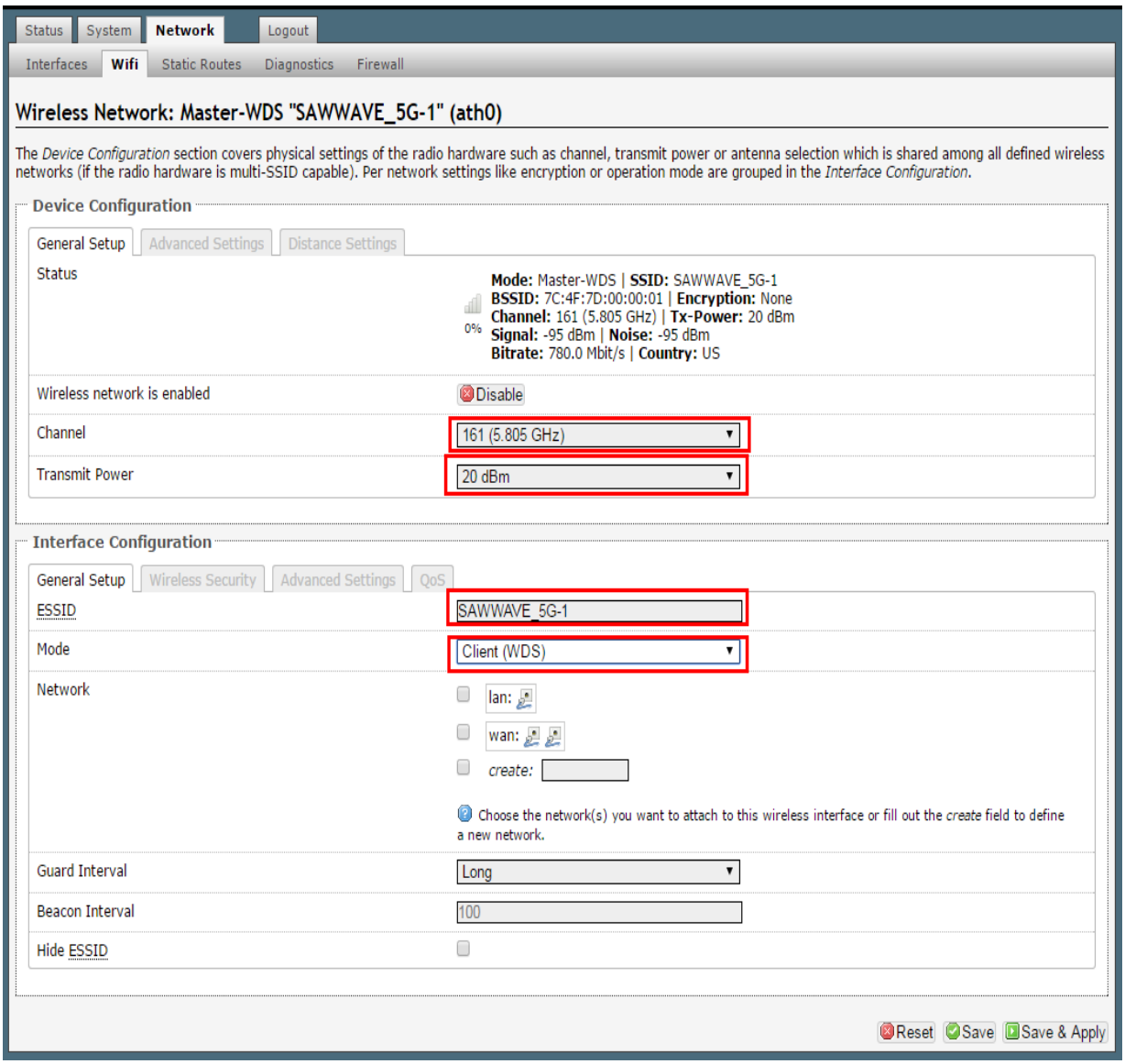
③ Enter a Default gateway at IPv4 gateway.

※ Comparing with Master Bridge, makes the same setting except IP address.

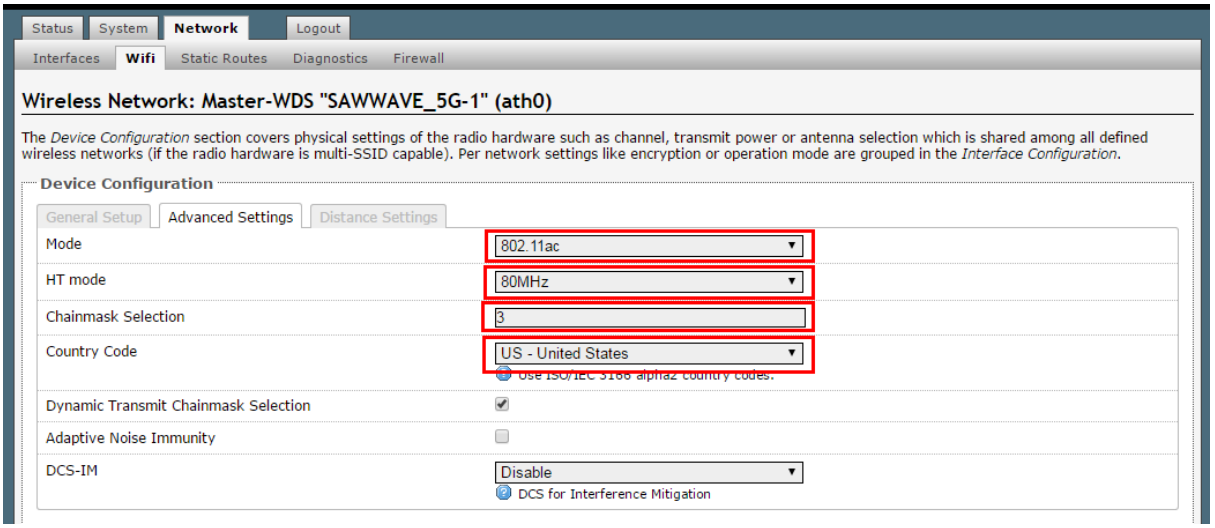
2) Click "Network" at Menu bar and select WiFi tab. **(ath0)**



[picture 13] Network-wifi page



[Figure 14] Network-wifi-5G General Setup



[Figure 15] Network-wifi-5G Advanced Setting

① Set Country Code as a desired one.

Caution!

- Only manufacture is able to select this category. End-user and installer do not select it.
- This category in placed on the market is disabled.

② Set Wireless Profile as 802.11ac – 5 GHz.

③ Set Channel Spectrum Width as 20/40/80 Mhz..

④ Set Channel with a frequency which is same from that of Master Bridge.

⑤ Set Transmit Power as a desired one.

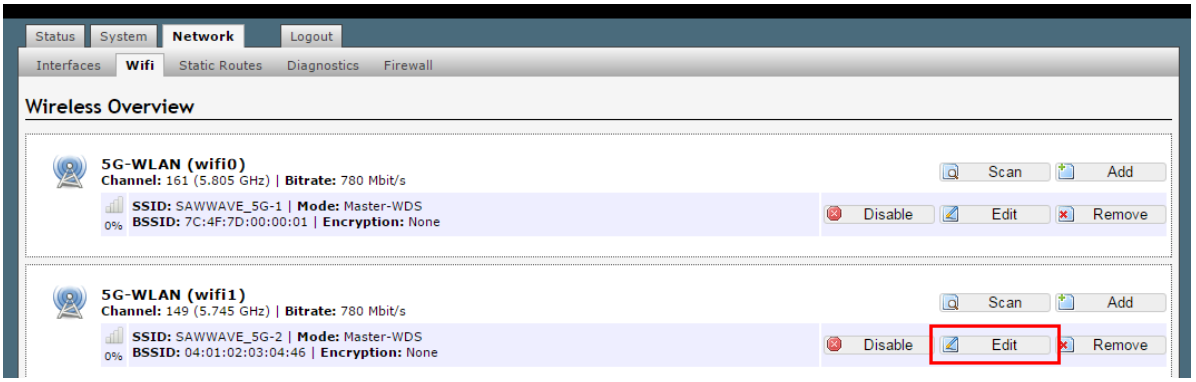
Interface configuration-General Setup

⑥ Set Modes as Station (WDS) in case of Slave. (For Master, Access Point (WDS))

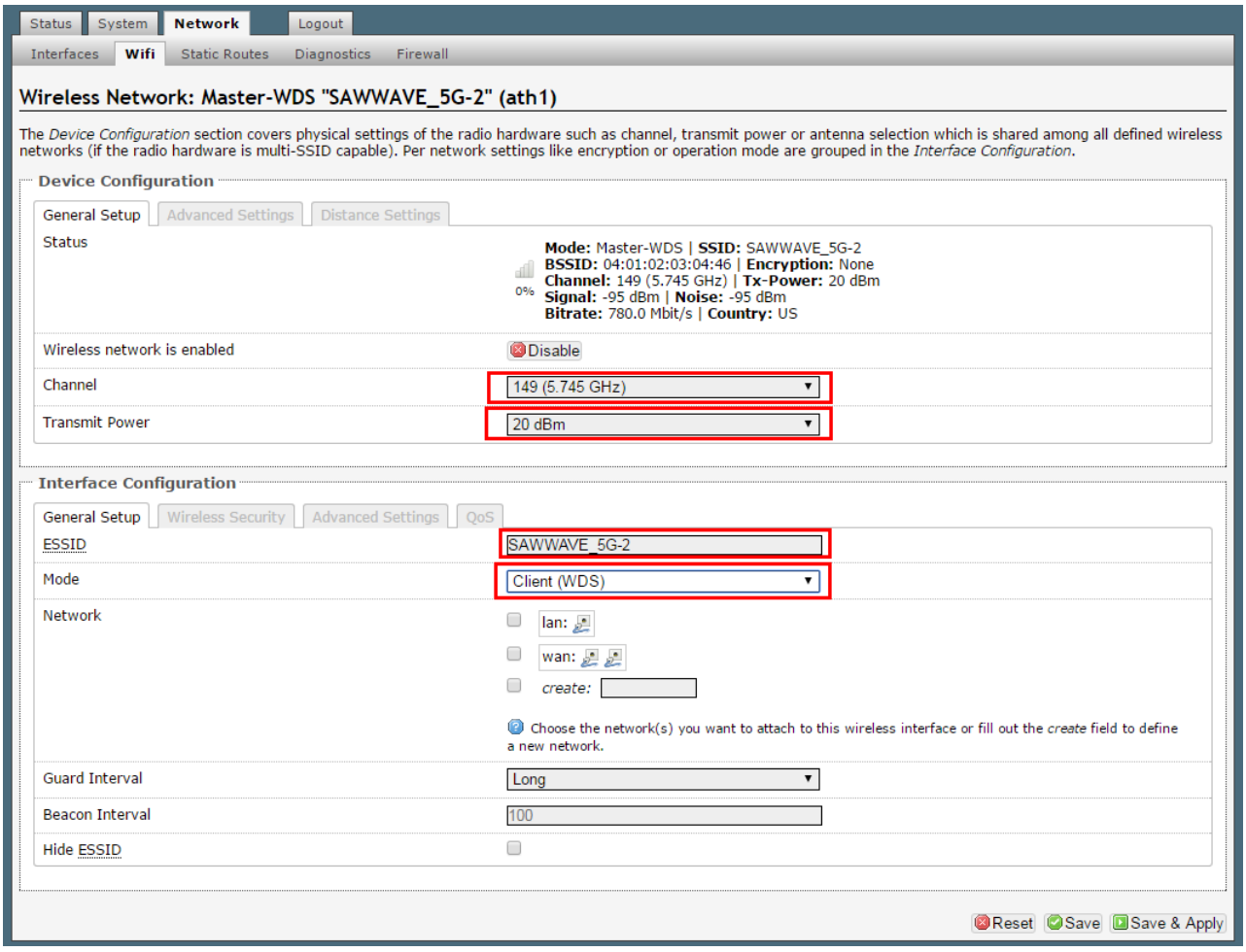
⑦ Enter desired SSID into ESSID, which is the same SSID of Master Bridge.

⑧ Push Save buttons

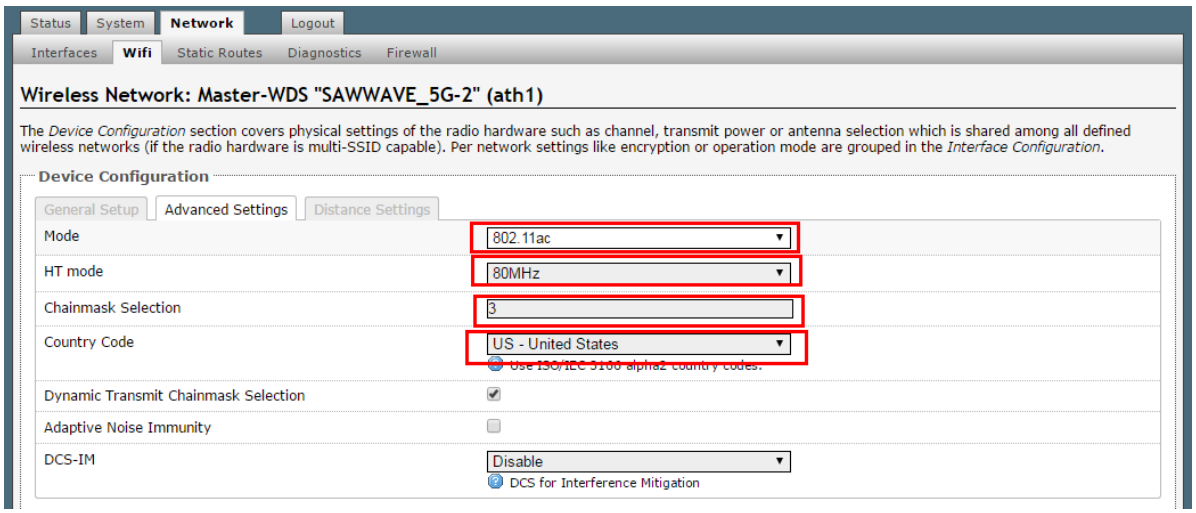
3) Click "Network" at Menu bar and select WiFi tab. **(ath1)**



[picture 16] Network-wifi page



[Figure 17] Network-wifi-5G General Setup



[Figure 18] Network-wifi-5G Advanced Setting

① Set Country Code as a desired one.

Caution!

- Only manufacture is able to select this category. End-user and installer do not select it.
- This category in placed on the market is disabled.

② Set Wireless Profile as 802.11ac – 5 GHz.

③ Set Channel Spectrum Width as 20/40/80 Mhz..

④ Set Channel with a frequency which is same from that of Master Bridge..

⑤ Set Transmit Power as a desired one.

Interface configuration-General Setup

⑥ Set Modes as Station (WDS) in case of Slave. (For Master, Access Point (WDS))

⑦ Enter desired SSID into ESSID, which is the same SSID of Master Brdige.

⑧ Push Save& Apply buttons

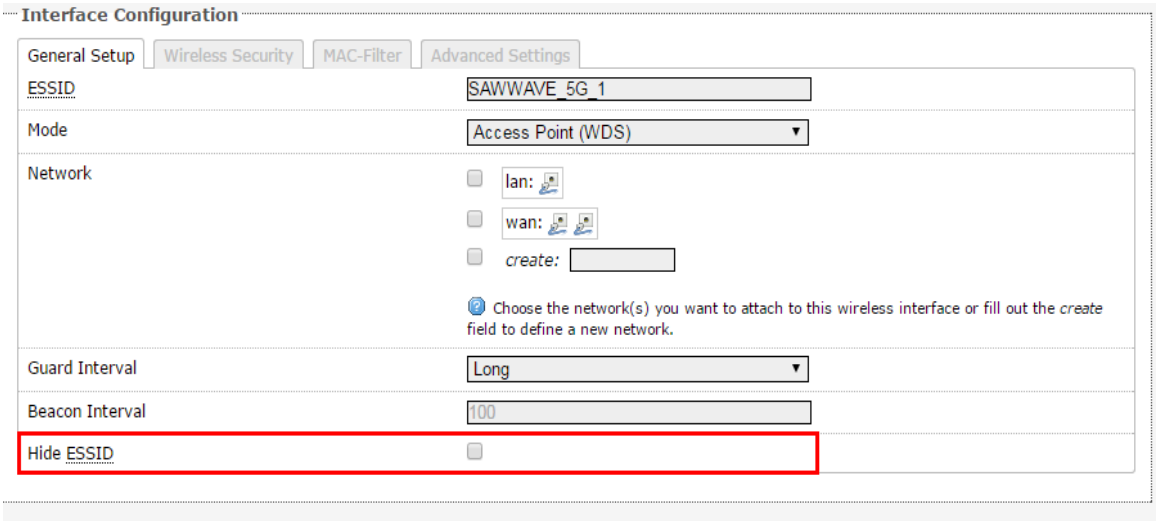
**Setting of Bridge Access Point (Slave) mode is completed.

4.4 Security

4.41 SSID Hide

① Push Network-wifi-5G_Edit tab of GUI whose equipment is designed for Access Point WDS (Master Bridge).

② If Hide SSID of Interface Configuration tab is activated, SSID is hidden and it is not available to search SSID of concerned Bridge at cellular phone.



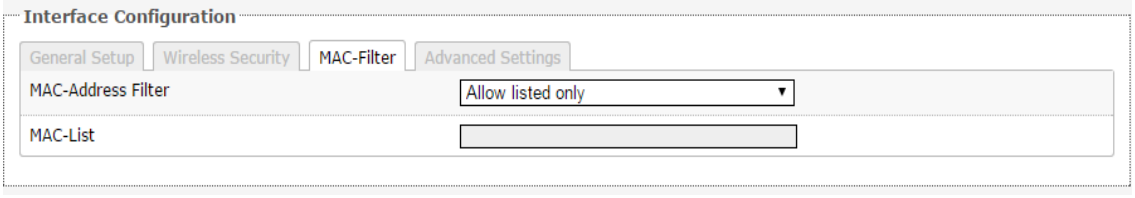
[Figure 19] Hide ESSID

4.4.2 Mac Filter

① Push Network-wifi-5G_Edit tab of GUI whose equipment is designed for Access Point WDS (Master Bridge).

② Push MAC-Filter tab of Interface Configuration tab.

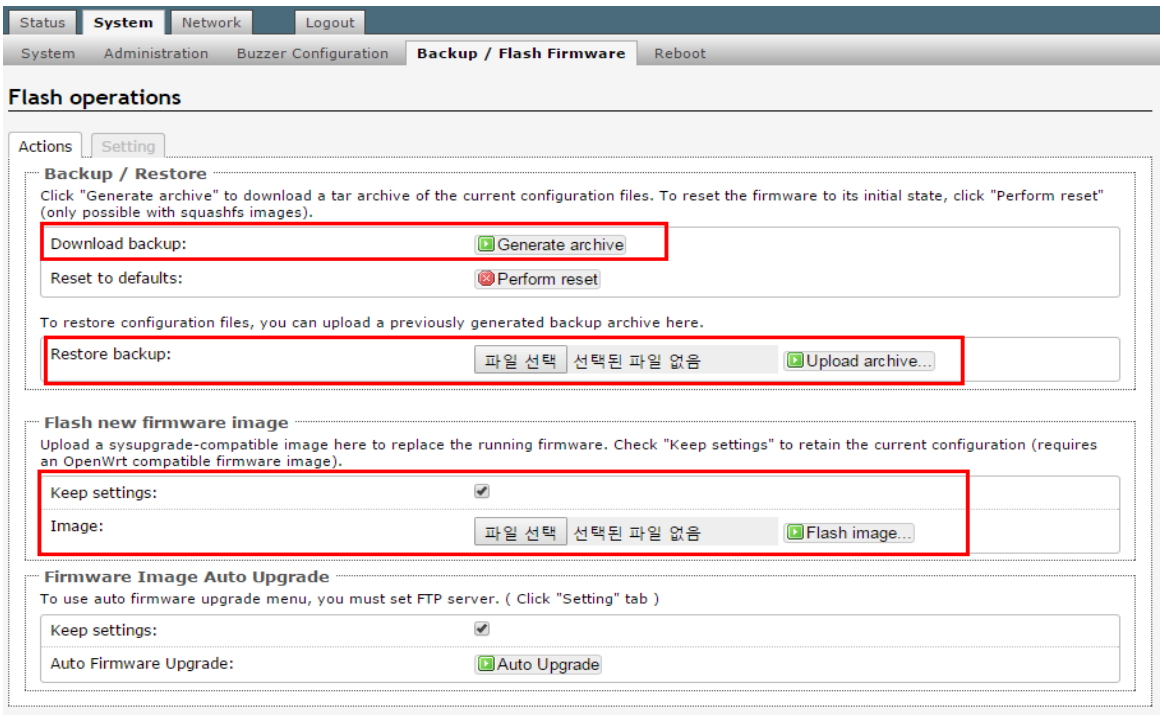
③ Enter corresponding MAC-address after selecting Allow listed only mode at MAC-Address Filter.



[Figure 20] MAC-Filter

4.5 Firmware Backup and Upload

1) Click "System" at Menu bar and select Backup / Flash Firmware tab.



[Figure 21] Backup and Upload Page

4.5.1 Firmware Backup : Save the setting state of Bridge.

1) Push the Generate archive at Down load backup of Backup / Restore tab
2) Push the save(S)
3) Creation the backup-oooo(host name)-2000-00-00(current date).tar.gz file

4.5.2 Backup file upload : Upload the setting state of backup bridge

1) Push the 찾아보기 at Restore backup of Backup / Restore tab
2) search the backup file and then open(o)
3) Push the Upload archive

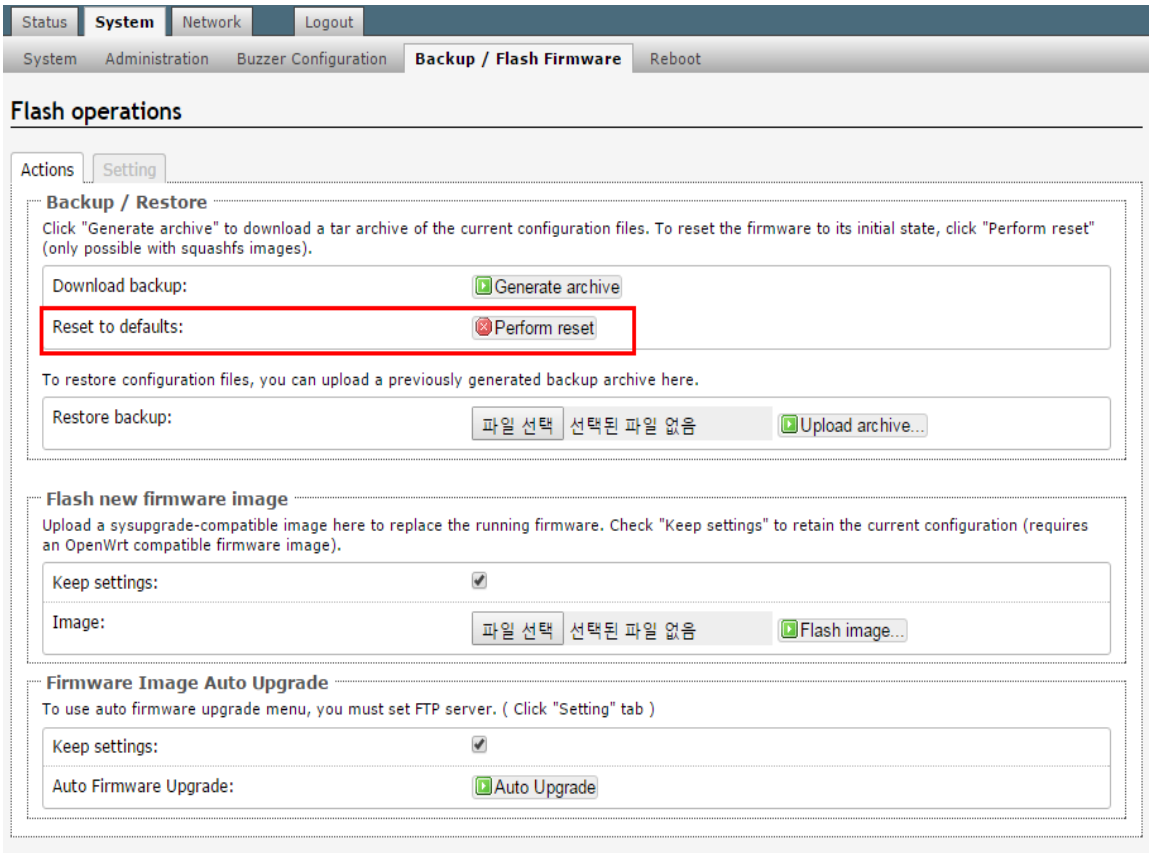
4.5.3 New firmware upload : version upgrade

1) push the 찾아보기 at Flash new firmware tab
   (check the version of current firmware at Flash new firmware tab)
2) search the new firmware file and then open(o)
3) Push the Flash firmware
   ※ If you check the Keep settings of Flash new firmware tab, will be setting with same IP of before firmware.

4.6 Factory reset

1) Click "System" at Menu bar and select Backup / Flash Firmware tab.

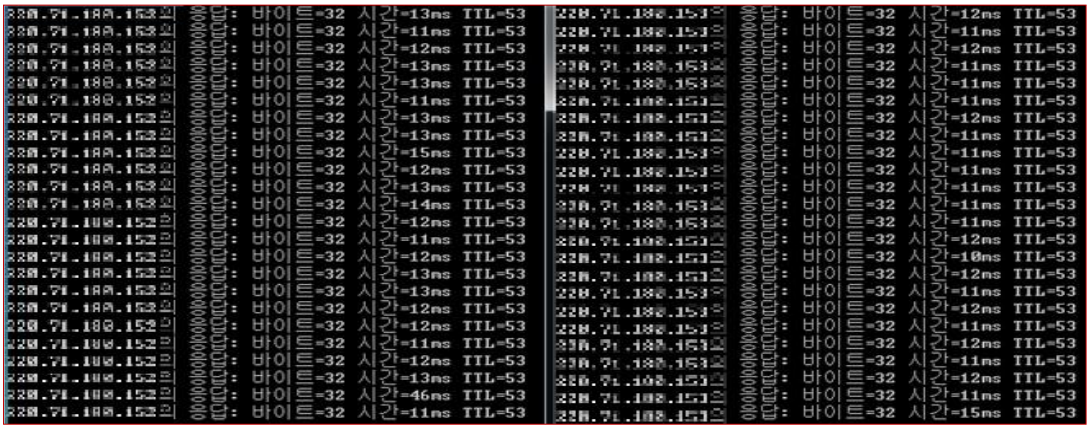
2) Push Perform reset at Reset to defaults of backup / Restore tab



[Figure 22] Factory reset

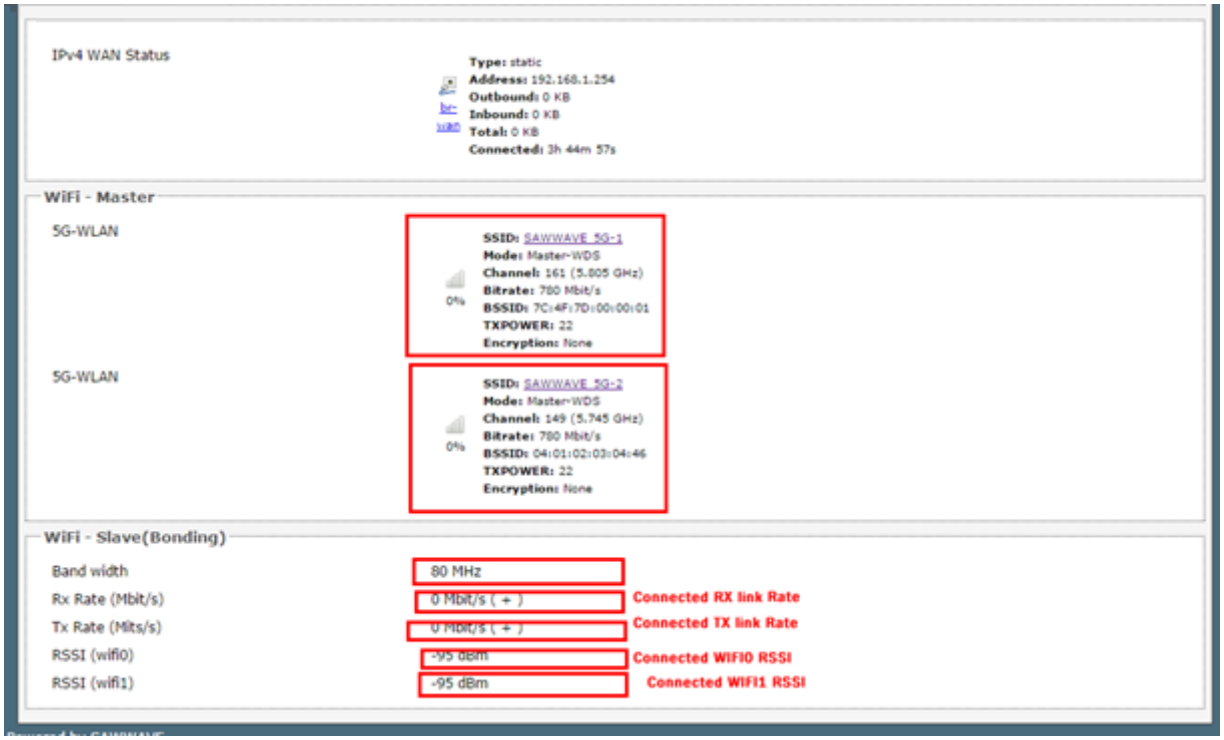
4.7 Method to check Bridge Link

① To check Bridge Link is made, send Ping to corresponding **Bridge**..
(Below is an example to help customers' understanding)



[Figure 23] ping check

② Push **Status** tab after accessing GUI whose equipment is designed for **Access Point WDS (Master).**



[Figure 24] Status Window for Master and Slave

4.8 Methods to check to give best optimized Performance after Bridge Link

① Check whether the Link of Bridge is made normally.

② Push **Status** tab after accessing GUI whose equipment is designed for **Access Point WDS.(Master Bridge)**

③ Calibrate the angle in Statuses of Access Point WDS and Station WDS in a notebook. (It means that Strength of Rx. signal is getting better as long as the value of RSSI closes to -40~-60dBm.)

④ Check whether Tx Rate/Rx Rate values are maintained at 866.7Mbps for 80MHz Bandwidth after setting best RSSI.

5. Bridge Link Budget (RSSI)

5.1 RSSI per distance.

Standard model : PTP-5440

Distance (Km)	Theory RSSI (dBm)
5	-55
10	-61
15	-64
20	-67
25	-69

5.2 RSSI (Signal Level) Formula

$$20 \times \log\left(\frac{3 \times 10^8}{4 \times \pi \times r \times f}\right) + P_o +$$

f : Frequency

r : distance

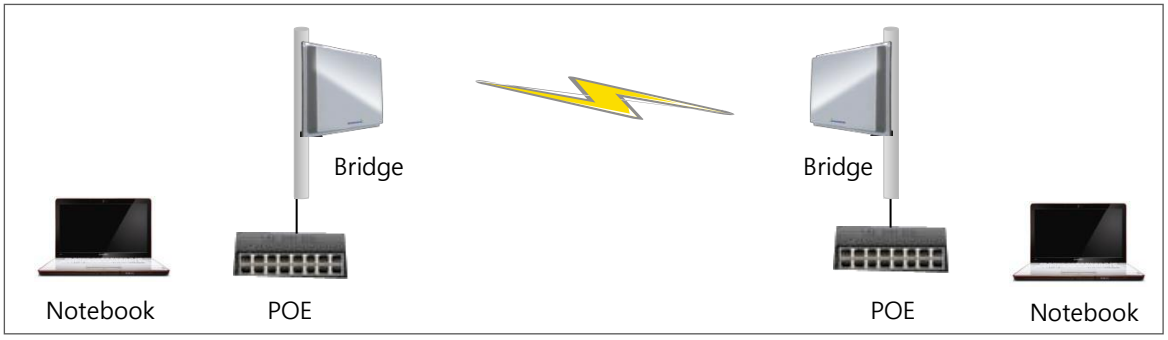
P_o : TX Power

P_i : RX Ant. gain

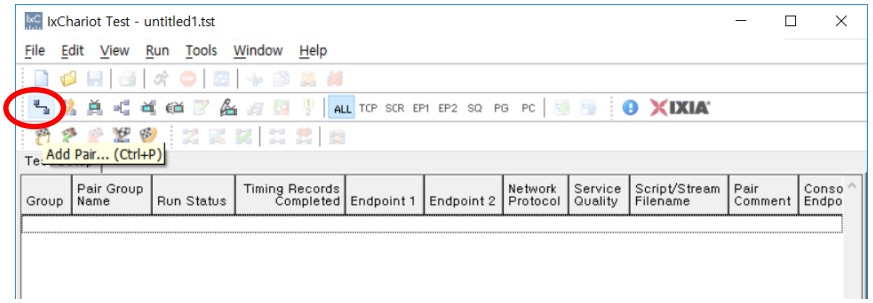
P_r : Tx Ant. Gain

6. Bridge performance test using an IxChariot

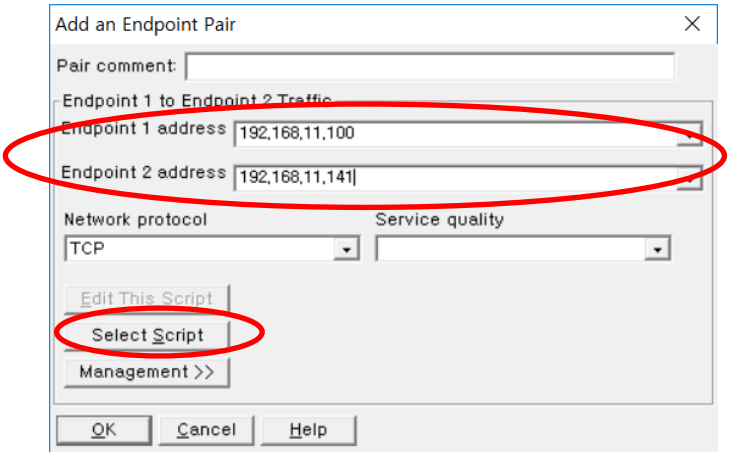
6.1 Test configuration



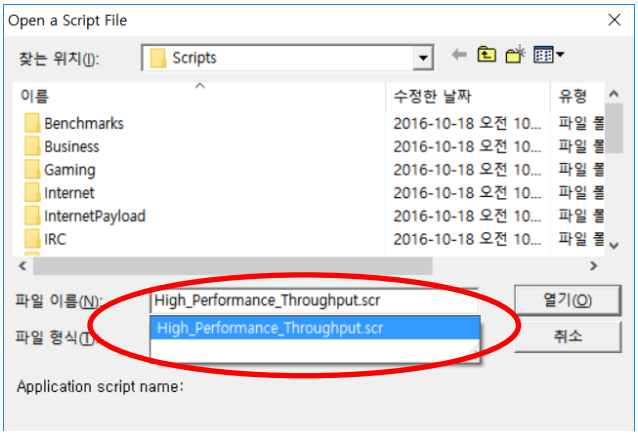
1. Change the IP address of the Notebook at both ends to not the same IP address in the same band as the Wireless Bridge.
2. Execute IxChariot program
3. Click Add Pair…. Icon



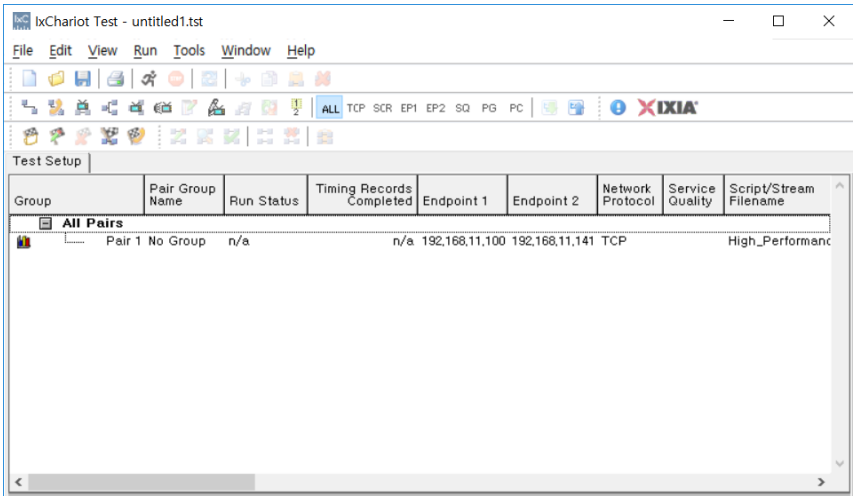
4. In the window created after clicking, enter the IP address of the notebook connected to the Access Point (WDS) into thr Endpoint 1 address , and the IP address of the notebook connected to the station (WDS) into the Endpoint 2 address.



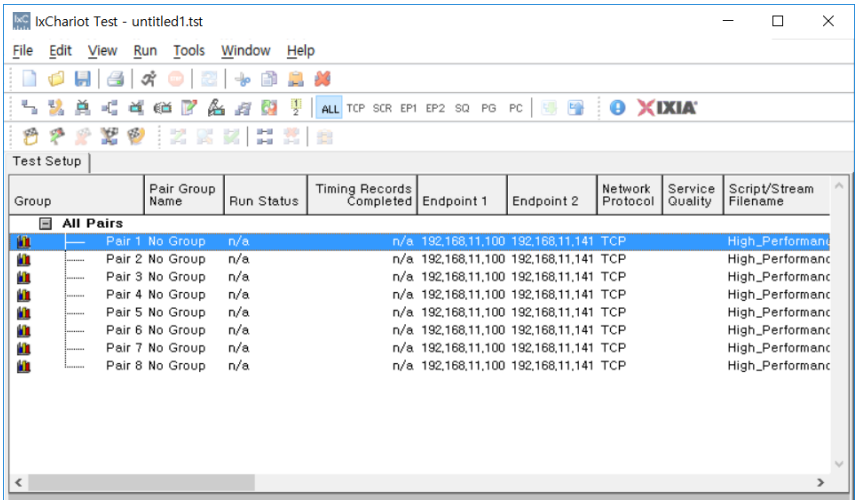
5. Click “Select Script” key.



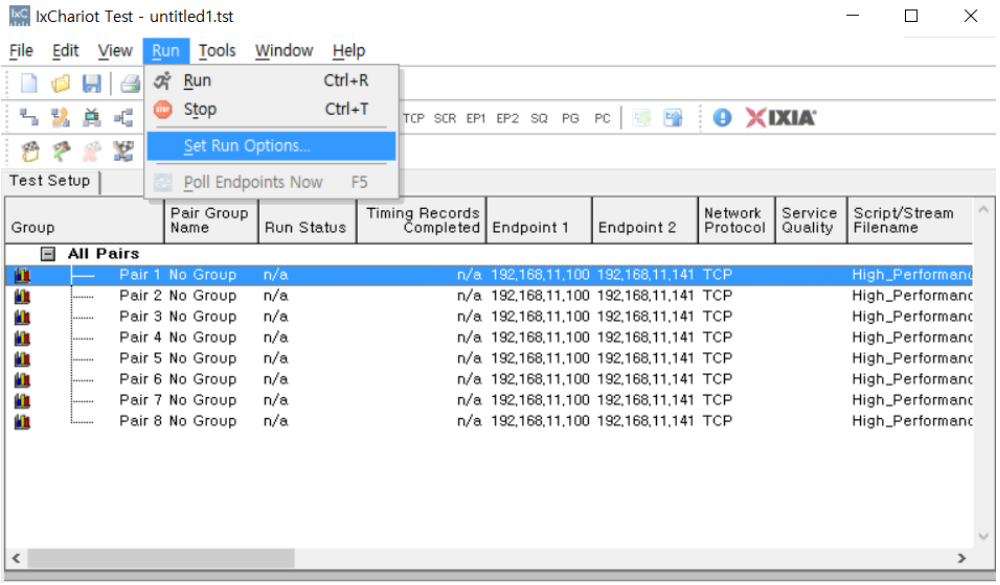
6. Select "High_Performance_Throughput.scr " and click "열기(open)" button
7. Click "OK" button in "Add an Endpoint Pair" window.
8. Confirm that Pair 1 is created as shown below.



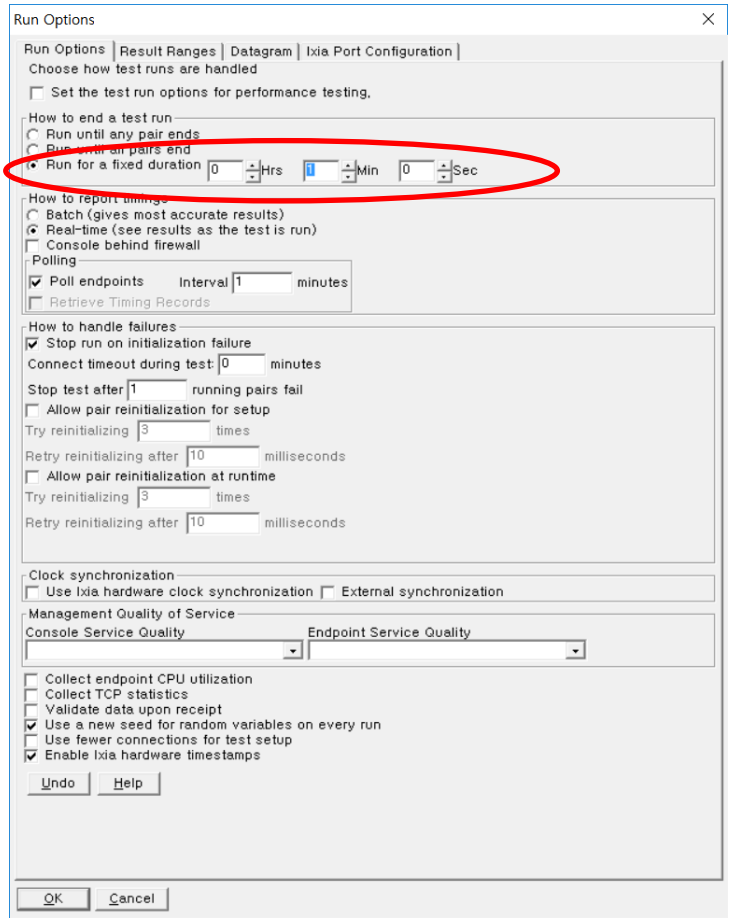
9. Copy and paste the corresponding Pair 1 to create a total of 8 pairs.



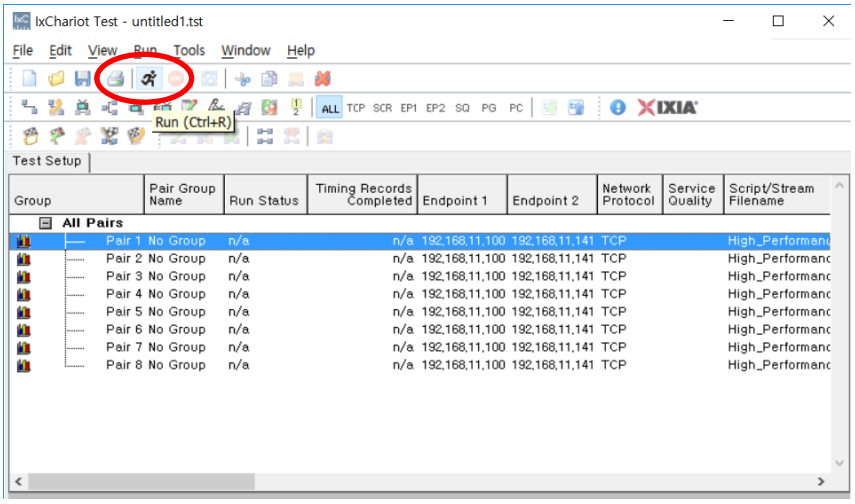
10. Click Run->SetRunOptions



11. When the Run Option window appears, select Run for fixed duration, specify the test time and press Ok



12. Then click on the run icon (RUN) to start the throughput measurement.


IxChariot Test - untitled1.tst
File Edit View Run Tools Window Help
Run (Ctrl+R)
ALL TCP SCR EP1 EP2 SQ PG PC
IXIA
Test Setup
Group
Pair Group Name
Run Status
Timing Records Completed
Endpoint 1
Endpoint 2
Network Protocol
Service Quality
Script/Stream Filename
All Pairs
Pair 1 No Group n/a n/a 192.168.11.100 192.168.11.141 TCP High_Performanc
Pair 2 No Group n/a n/a 192.168.11.100 192.168.11.141 TCP High_Performanc
Pair 3 No Group n/a n/a 192.168.11.100 192.168.11.141 TCP High_Performanc
Pair 4 No Group n/a n/a 192.168.11.100 192.168.11.141 TCP High_Performanc
Pair 5 No Group n/a n/a 192.168.11.100 192.168.11.141 TCP High_Performanc
Pair 6 No Group n/a n/a 192.168.11.100 192.168.11.141 TCP High_Performanc
Pair 7 No Group n/a n/a 192.168.11.100 192.168.11.141 TCP High_Performanc
Pair 8 No Group n/a n/a 192.168.11.100 192.168.11.141 TCP High_Performanc