



Fixed TVWS Gateway Operation manual

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※ Free service users may not be provided with all services in the manual. In addition, the service can be changed without any special mention due to service improvement

FCC COMPLIANCE STATEMENT

CAUTION: Changes or modifications not expressly approved could void your authority to use this equipment

This device complies with Part 15 of the FCC Rules. Operation 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 §15.105 Information to the user.

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

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

FCC §15.706 Information to the user.

This equipment has been tested and found to comply with the rules for white space devices, pursuant to part 15 of the FCC rules. These rules are designed to provide reasonable protection against harmful interference. 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. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- (1) Reorient or relocate the receiving antenna.
- (2) Increase the separation between the equipment and receiver.
- (3) Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- (4) Consult the manufacturer, dealer or an experienced radio/TV technician for help.

FCC RF Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

Caution: Exposure to Radio Frequency Radiation

To comply with FCC RF exposure compliance requirements, for fixed configurations, a separation distance of at least 30cm must be maintained between the antenna of this device and all persons. This device must not be co-located or operating in conjunction with any other antenna or transmitter.

1. System Introduction

1.1 Service Configure

The service configuration diagram using TVWS Gateway is shown below.

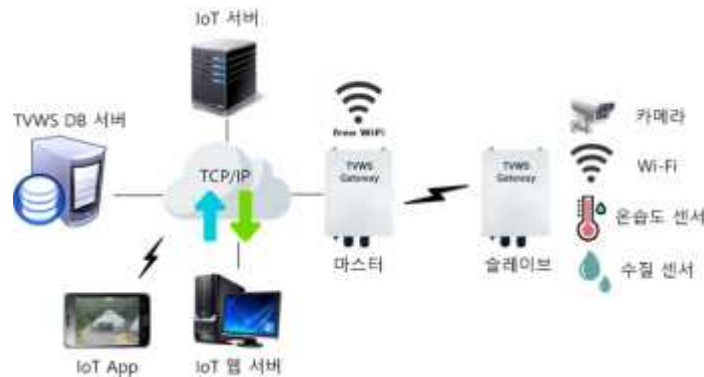


그림 2. TVWS Gateway 서비스 구성도

1) TVWS Internet of Things Advantages

With the rapid activation of the Internet of Things recently, services that require high-speed data communication such as video, Wi-Fi, and IP camera services are rapidly increasing.

Although LTE, which is a wireless communication, is used in rural households, islands, livestock farms, and fish farms, which are difficult to establish wired communication, there is a burden of communication charges.

TVWS eliminates the burden of telecommunications charges in unlicensed bands and saves time and money over wired communication.

2) Configure and leverage TVWS Gateway

The TVWS Gateway consists of master and slave equipment.

Where the master equipment needs to be wired to the TCP/IP network, and slave equipment is installed in an area to supply Internet of Things services, and each device communicates with a wireless TVWS signal.

Wi-Fi can be serviced by the master equipment, and the slave equipment can be serviced by connecting cameras, Wi-Fi, temperature and humidity sensors, and water quality sensors. IoT sensors that can be used by connecting IoT sensors that users want can be used through IoT WEB servers and IoT apps.

1.2 Network Configure

The TVWS Gateway consists of 1:1 connections between one master equipment and one slave equipment. Depending on the service area, 1:N can be configured to connect up to 9 slave equipment to 1 master equipment.

Multiple cameras and NVR can be connected to each slave device, and equipment from other companies can be connected using the following ports.

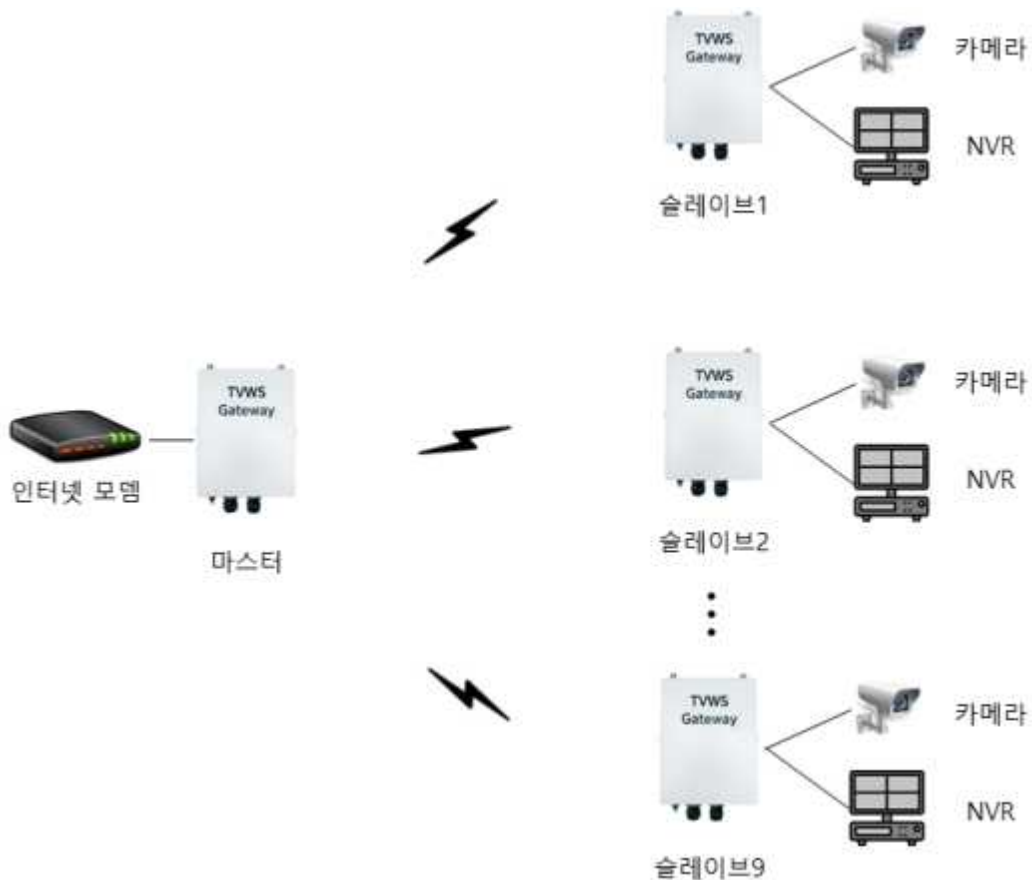


그림 3. TVWS Gateway 망 구성도

A network configuration diagram of the TVWS Gateway master equipment.
Please refer to the example below and check the network configuration as needed.
(Each port can be changed.)

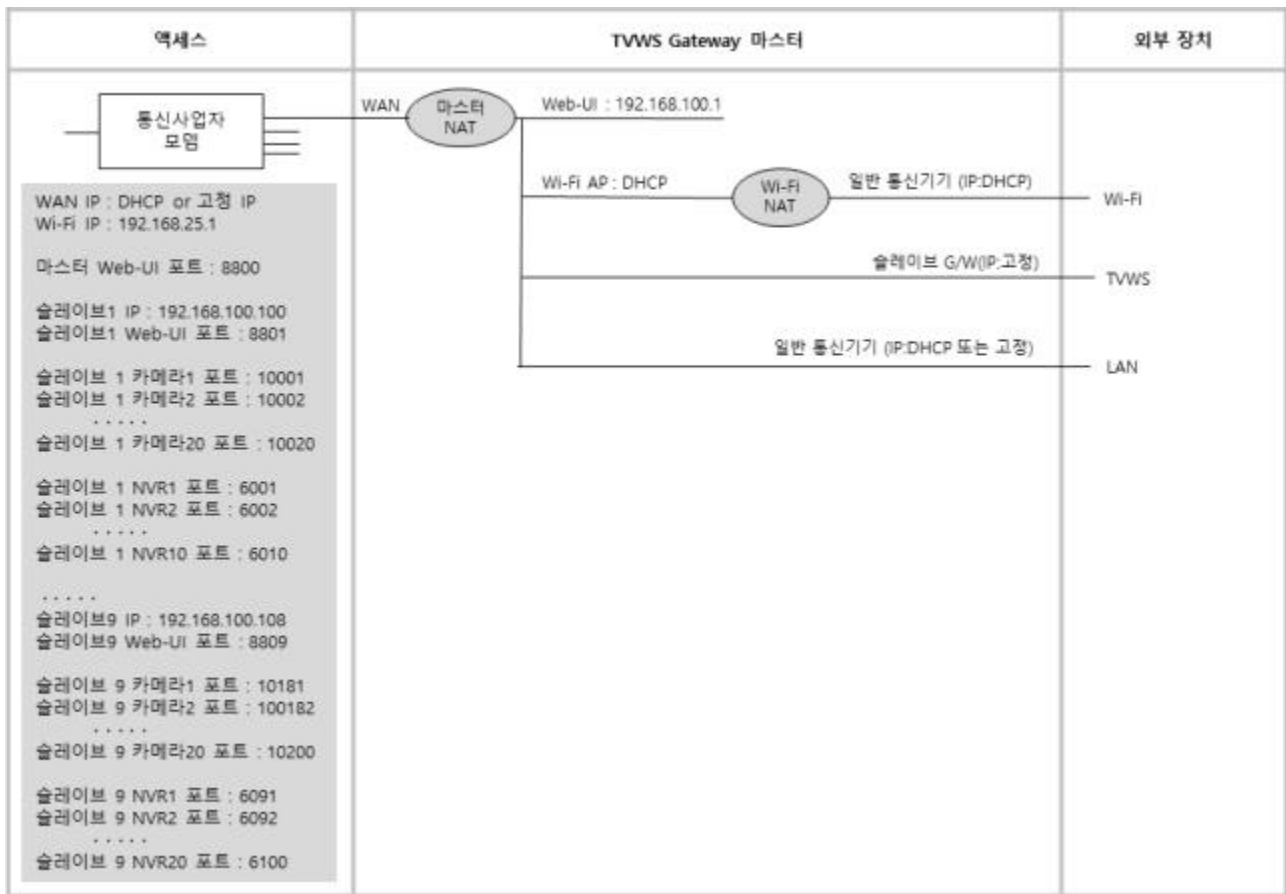


그림 4. TVWS Gateway 마스터 네트워크 구성도

Network configuration diagram of TVWS Gateway slave equipment.

Please refer to the example below and check the network configuration as needed.

To connect equipment other than the equipment provided, refer to the NVR IP and port in the figure below to change the settings of the equipment you want to connect to and connect to the configuration of the slave equipment. (Each port can be changed.)

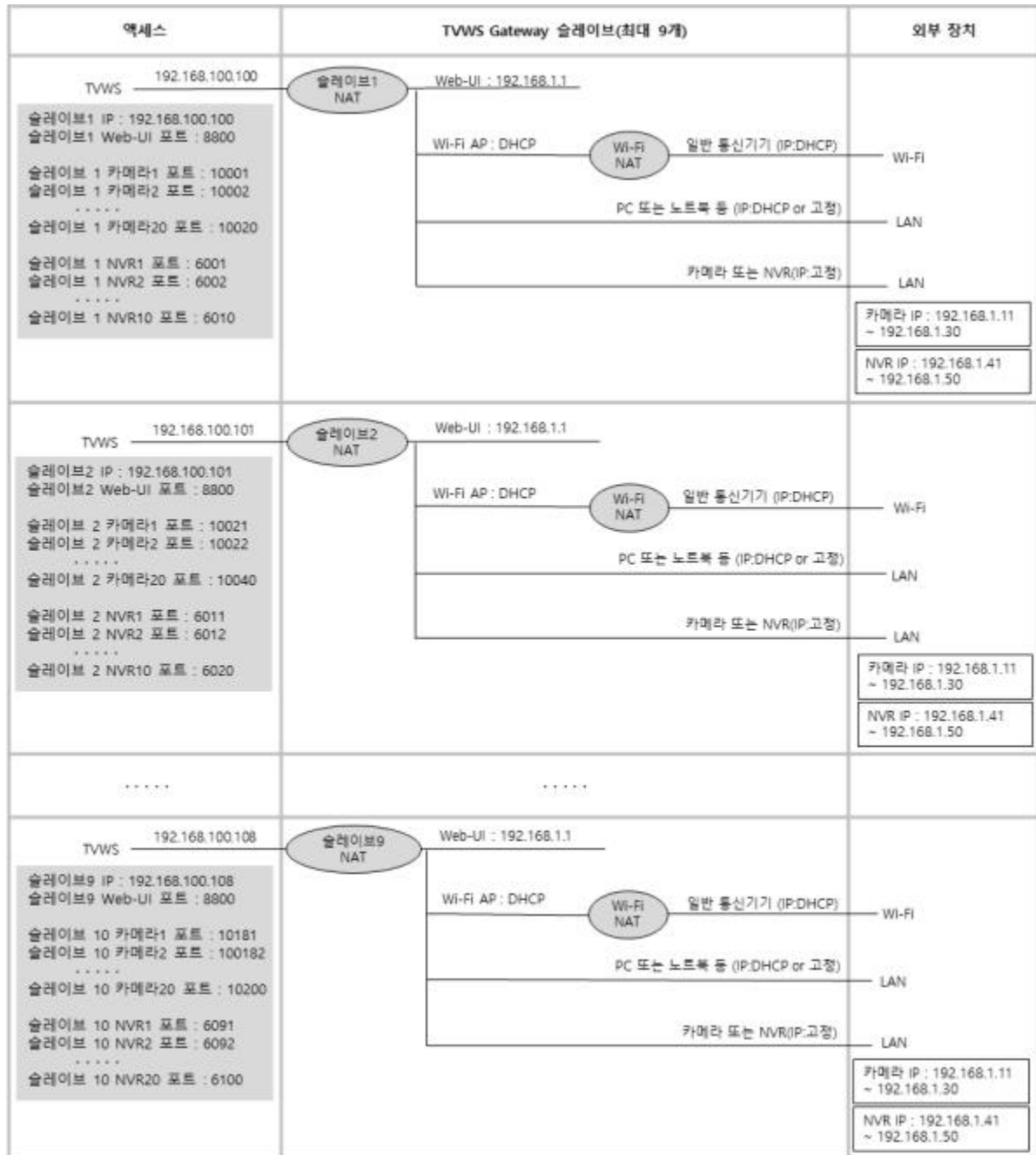


그림 5. TVWS Gateway 슬레이브 네트워크 구성도

1.3 TVWS Gateway

1.3.1 TVWS Gateway Equipment Introduction and Support Capabilities

- Equipment introduction and functionality

- IEEE 802.11af modem support
- Access to the TV White Space database
- WEB UI support
- LOS distance communication greater than 10 km
- Can be installed outdoors (IP65 / -30°C to 60°C)
- Support for bonding of neighboring two channels (6+6MHz)
- Transmit power control function
- Long-range Point-to-Multi Point (PtMP) support
- Wi-Fi(IEEE 802.11n), BLE(v4.1) support
- Remote firmware update support

Precautions

This equipment must be installed by professionals and must comply with the regulations of their country and region. In addition, depending on the surrounding wireless environment, communication between equipment may not be possible without a TVWS available channel.

Equipment Specifications

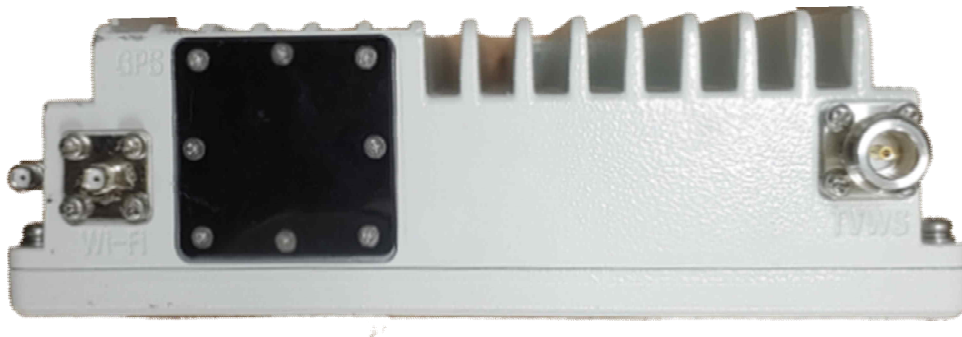
Standards	IEEE 802.11af
Duplex	TDD
Channel bandwidth	6MHz / 12 MHz(Support for bonding of neighboring two channels (6+6MHz))
Operating Frequency	470 – 698MHz
Modulation Method	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
Maximum Data Rate (TCP)	19Mbps @6MHz BW 26Mbps @12MHz BW
Maximum Output Power	27dBm±2dB @6MHz BW 17dB Gain Control @1dB step
TX/RX Carrier	1x1 SISO
Output Spectrum Mask	55dB @C.F±3.0MHz, 6MHz BW
Out of band launch.	≤ -42.8dBm @RBW 100kHz
Receipt Sensitivity	-77dBm @MCS8(256-QAM 3/4) -84dBm @MCS5(64-QAM 2/3) -91dBm @MCS3(16-QAM 1/2) -96dBm @MCS1(QPSK 1/2) -98dBm @MCS0(BPSK 1/2)
Maximum Access Devices	9
GPS	built-in type
Operating Temperature	-30°C ~ 60°C @elevation 0 m
IP Rating	IP65
Electrostatic Discharge	8kV air, 4kV contact
Power Scheme	DC
Operating Voltage	DC 24V
AC Power	AC220V/60Hz
Power Consumption	35W
Size	210mm x 300mm x 85mm
Weight	3.7kg
HOUSING	Die-Cast Aluminum
Installation Method	Wall or Pole ilnstallation
LED	Status LED 4ea
Antenna Port	TVWS ANT Port 1ea (N-Type(F) / 50 ohm) Wi-Fi ANT Port 2ea (RP-SMA-Type(F) / 50 ohm) BLE ANT Port 1ea (RP-SMA-Type(F) / 50 ohm)
Ethernet Ports	RJ45 Connector 2 Port (10/100Base-T) WAN Port, LAN Port
Standard / BW (Wi-Fi)	802.11n / 20MHz
Operating Frequency	2412 ~ 2472MHz (Varies by region/country)

1.3.2 TVWS Gateway Device Components

TVWS Gateway	
AC/DC Converter 220V to 24V	
Patch Anntena (Site Specific Selection)	
Wi-Fi Omni Antenna (Site Specific Selection)	

1.3.3 TVWS Gateway Device Component Description

1) TVWS Gateway Device Top



- TVWS: Port to which TVWS signals are sent and received (Type N connector)
- GPS : GPS built-in to receive location information of equipment
- Wi-Fi: Port where Wi-Fi signals are sent and received (RP-SMA type connector)

2) TVWS Gateway Device Bottom



- DC: DC 24V and RS-485 communication signal connector
- WAN : Ports used as WAN (RJ-45)
- LAN : Port used as LAN (RJ-45)
- BLE: Port that receives BLE signals (RP-SMA type connector)
- LED: LED to check the status of the equipment
 - PWR: Turn on when power is applied to the equipment
 - WAN : Flashes when connecting an Ethernet cable to a WAN
 - LAN : Flashes when connecting an Ethernet cable to a LAN port
 - LINK : Flashing when master equipment and slave equipment communicate

3) AC/DC Converter 220V to 24V



- Rated input voltage: 110 ~ 220 VAC, 50 / 60 Hz
- Rated input current: 1.2 A
- Rated input power: 150W
- Rated output voltage: 24 VDC
- Rated output current: 5.63 A
- Allowed operating temperature: -30°C to 60°C

4) TVWS Patch Antenna



Electrical Specification	
Frequency Range(MHz)	470-698 MHz
Gain(dBi)	8±0.5 dBi
Polarization	Dual Slant V/H
Horizontal Beam width	80±12°
Vertical Beam width	75±12°
Isolation	>25 dB
Front to Back Ratio	>13 dB
VSWR	<2
Maximum Power Per Port	50 W
Impedance	50 Ω
Lighting protection	DC Ground
Mechanical Specification	
Connector	2 x N Female
Height/width/depth	310x310x150 mm
Antenna Weight	2 kg
Radome color	white
Radome material	UV Protection ABS
Operational Temperature	-40°C to +70°C (-32°F to +158°F)
Humidity	ETS 300 019-1-4, EN 302 085 (ANNEX A.1.1)

5) Wi-Fi Omni Antenna



Electrical Specification	
Frequency Range(MHz)	2400 ~ 2483.5 MHz
Band width	83.5 MHz
VSWR	vertical.9 : 1
Gain	5 ± 1 dBi
Impedance	50 Ω
Polarization	Linear
Mechanical Specification	
Antenna Size (Length x Height)	194 x 13 mm
Connector	RP-SMA Male
Radiator Material	Copper
Operation Temperature	-30°C to +70°C
Operation Humidity	10 ~ 90 (%)

2. TVWS WEB UI

2.1 PC Setting

This procedure changes the TCP/IP settings in Windows to allow access to equipment in its initial state.

- 1) Click the Start Windows button and select Windows System > Control Panel.
- 2) Double-click the Network and Sharing Center icon in the Control Panel window.



- 3) Click Change Adapter Settings in the left menu bar.



4) Right-click Ethernet, then select Properties.



5), double-click on Internet Protocol version 4 (ip and tcp).

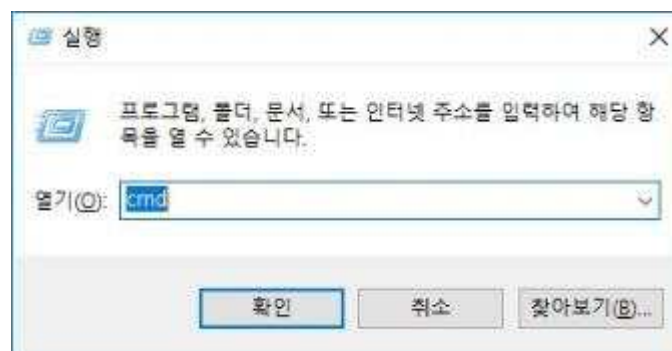


6) Set 'Get IP address automatically' and 'Get DNS server address automatically' as follows, then click the OK button.

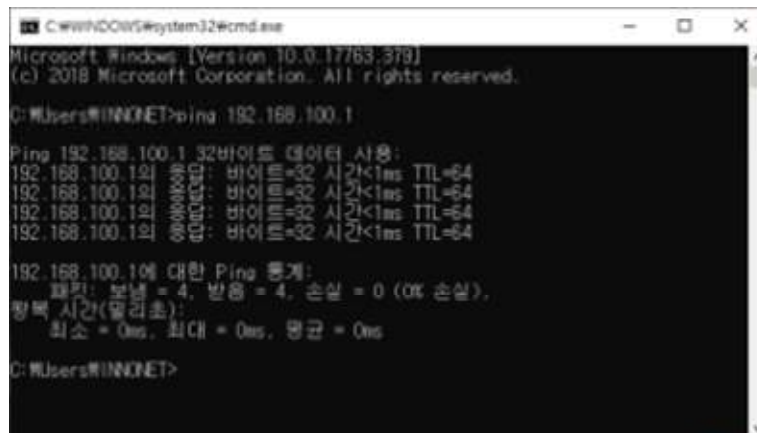


7) In the Ethernet Properties window, also click the OK button.

8) Press the Windows Launcher button, then click the command prompt for the Assistant in all programs to execute it (press the window button and R on the keyboard, enter cmd, and click the OK button).



9) When the PC and master equipment are connected, type 'ping 192.168.100.1', press Enter and check the response message. (Master Equipment LAN Port to Ethernet Cable PC)



```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows [Version 10.0.17763.379]
(c) 2018 Microsoft Corporation. All rights reserved.

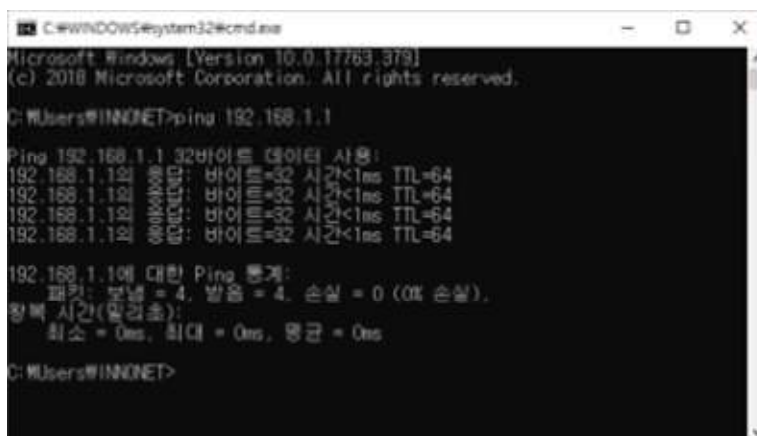
C:\Users\WINNET>ping 192.168.100.1

Ping 192.168.100.1 32바이트 데이터 사용:
192.168.100.1의 응답: 바이트=32 시간<1ms TTL=64
192.168.100.1의 응답: 바이트=32 시간<1ms TTL=64
192.168.100.1의 응답: 바이트=32 시간<1ms TTL=64
192.168.100.1의 응답: 바이트=32 시간<1ms TTL=64

192.168.100.1에 대한 Ping 통계:
패킷: 보낸 = 4, 받음 = 4, 손실 = 0 (0% 손실),
왕복 시간(밀리초):
    최소 = 0ms, 최대 = 0ms, 평균 = 0ms

C:\Users\WINNET>
```

10) When the PC and slave equipment are connected, type 'ping 192.168.1.1', press Enter and check the response message. (LAN port of slave equipment or PoE LAN port to Ethernet cable PC)



```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows [Version 10.0.17763.379]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\WINNET>ping 192.168.1.1

Ping 192.168.1.1 32바이트 데이터 사용:
192.168.1.1의 응답: 바이트=32 시간<1ms TTL=64
192.168.1.1의 응답: 바이트=32 시간<1ms TTL=64
192.168.1.1의 응답: 바이트=32 시간<1ms TTL=64
192.168.1.1의 응답: 바이트=32 시간<1ms TTL=64

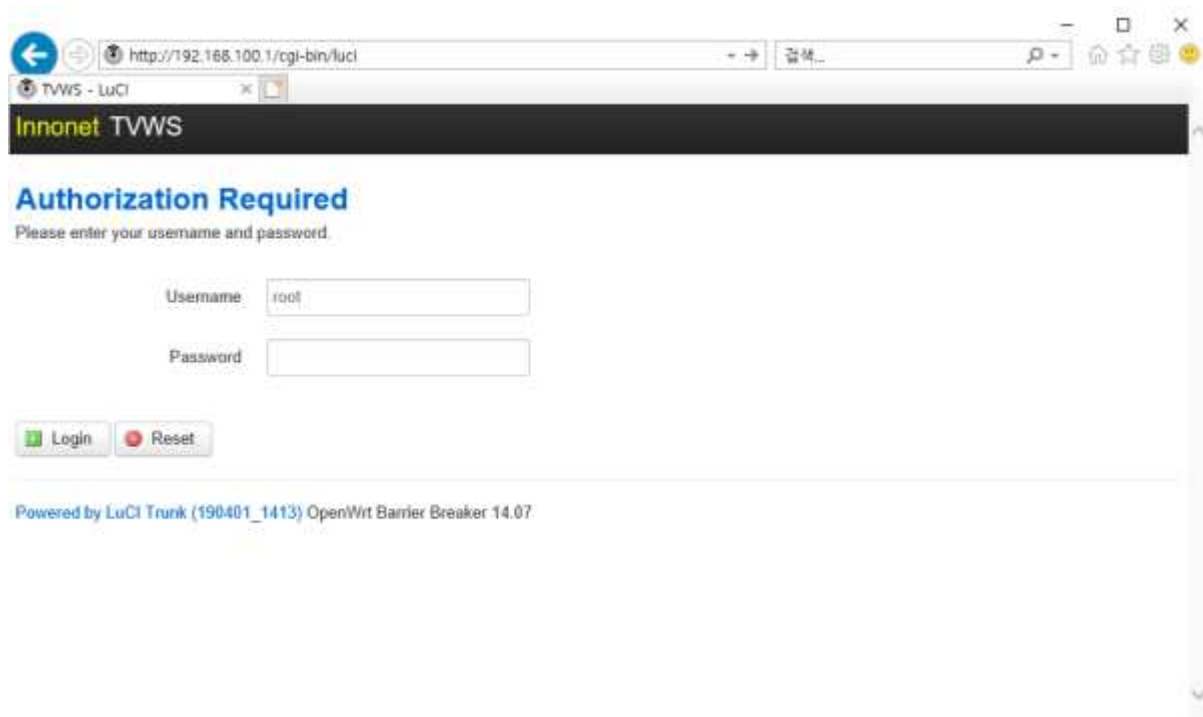
192.168.1.1에 대한 Ping 통계:
패킷: 보낸 = 4, 받음 = 4, 손실 = 0 (0% 손실),
왕복 시간(밀리초):
    최소 = 0ms, 최대 = 0ms, 평균 = 0ms

C:\Users\WINNET>
```

2.2 TVWS WEB UI

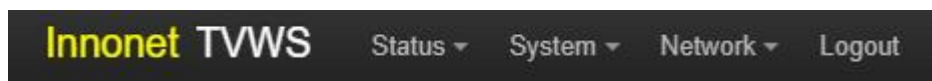
2.2.1 Connection Method

- 1) After confirming that there is no problem with the ping test, enter '192.168.100.1:8800' in the Internet address window to access the WEB page of the master device.
- 2) After confirming that there is no problem with the ping test, enter '192.168.1.1:8800' in the Internet address window to access the WEB page of the slave device.



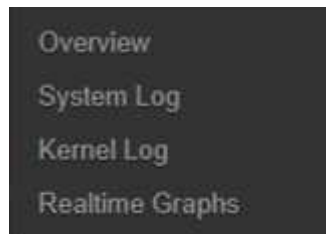
2.2.2 VWS WEB UI Tab

The WEB UI of the TVWS equipment consists of Status, System, Network, Logout.



2.2.3. Status

- Status consists of four tabs.



1) Overview

- The Status Overview of the Equipment is divided into System, Memory, Network, and DHCP Leases.

Status : Displays information about the name of the equipment, model, firmware version, Linux kernel version, synchronized time, equipment running time, and average load amount of equipment.

Status	
System	
Hostname	TWIS
Model	mlk-apoc-demo
Firmware Version	OpenIoT Barrier Breaker 14.07 / LoCI Trunk (210108_1025)
Kernel Version	3.10.14
Local Time	Wed Feb 10 13:38:15 2021
Uptime	3d 10h 36m 35s
Load Average	1.82, 0.76, 0.68

- Memory : Information about the total available memory, free memory, cache, and buffer of the equipment is displayed.

Memory	
Total Available	405912 kB / 514568 kB (94%)
Free	471798 kB / 514568 kB (91%)
Cached	19924 kB / 514568 kB (2%)
Buffered	3290 kB / 514568 kB (0%)

- Network : Network information of the equipment is displayed.

Network

IPv4 WAN Status

 Type: static
 wlan0 Address: 192.168.100.100
 Netmask: 255.255.255.0
 Gateway: 192.168.100.1
 DNS 1: 8.8.8.8
 Connected: 3d 10h 39m 14s

IPv6 WAN Status

 Not connected
 ?

Active Connections

10 / 16384 (0%)

- DHCP Leases : The DHCP information assigned by the equipment is displayed.

DHCP Leases

Hostname	IPv4-Address	MAC-Address	Leasetime remaining
?	192.168.1.127	bc:0f:2b:00:00:8b	7h 20m 19s

DHCPv6 Leases

Hostname	IPv6-Address	DUID	Leasetime remaining
----------	--------------	------	---------------------

There are no active leases.

2) System Log

- You can monitor system logs, which disappear when you reboot the equipment with volatile logs.

System Log

Wed Feb 10 12:52:29 2021	user warm kernel	[294648.372000]	TVWSLINK	TEMPERATURE Normal
Wed Feb 10 12:52:29 2021	user warm kernel	[294648.404000]	TVWSLINK	BATTERY READ (0xFFFF)
Wed Feb 10 12:52:30 2021	user warm kernel	[294648.460000]	TVWSLINK	BATTERY 2nd READ (0xFFFF)
Wed Feb 10 12:52:30 2021	user warm kernel	[294648.532000]	TVWSLINK	WLAN TX POWER (Offset CH 1, Temp 0) Changed (To 16)
Wed Feb 10 12:52:30 2021	user warm kernel	[294648.560000]	TVWSLINK	TSSM READ (00) (255)
Wed Feb 10 12:52:30 2021	user warm kernel	[294648.584000]	Set_TxPower_Proc	KR Bandwidth = 8 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 /
Wed Feb 10 12:52:30 2021	user warm kernel	[294648.644000]	TVWSLINK	STA PROCESS MAIN (PATH=0)
Wed Feb 10 12:52:30 2021	user warm kernel	[294648.676000]	TVWSLINK	STA PROCESS : CONNECTED
Wed Feb 10 12:52:30 2021	user warm kernel	[294648.740000]	TVWSLINK	TSSM Normal
Wed Feb 10 12:52:30 2021	user warm kernel	[294649.424000]	TVWSLINK	HPA(8) : RD 0x0 0x0a 0x50 0x00 0x00 0x20 0x30 0x32 0x3c 0x0 0x0f 0x0f
Wed Feb 10 12:52:31 2021	user warm kernel	[294649.912000]	TVWSWD	UDP received From TVWSLINK (16) 0a 0b 5c 0000 0a 0f 10 11 (61)
Wed Feb 10 12:52:31 2021	user warm kernel	[294650.048000]	TVWSLINK	WLAN TX POWER (Offset CH 1, Temp 0) Changed (To 16)
Wed Feb 10 12:52:31 2021	user warm kernel	[294650.080000]	Set_TxPower_Proc	KR Bandwidth = 8 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 /
Wed Feb 10 12:52:31 2021	user warm kernel	[294650.116000]	TVWSLINK	STA PROCESS MAIN (PATH=0)
Wed Feb 10 12:52:31 2021	user warm kernel	[294650.164000]	TVWSLINK	STA PROCESS : CONNECTED
Wed Feb 10 12:52:32 2021	user warm kernel	[294651.116000]	TVWSLINK	GPS Error in Opening tyUSB0
Wed Feb 10 12:52:33 2021	user warm kernel	[294651.476000]	TVWSLINK	WLAN TX POWER (Offset CH 1, Temp 0) Changed (To 16)
Wed Feb 10 12:52:33 2021	user warm kernel	[294651.520000]	Set_TxPower_Proc	KR Bandwidth = 8 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 /
Wed Feb 10 12:52:33 2021	user warm kernel	[294651.540000]	TVWSLINK	STA PROCESS MAIN (PATH=0)
Wed Feb 10 12:52:33 2021	user warm kernel	[294651.580000]	TVWSLINK	STA PROCESS : CONNECTED
Wed Feb 10 12:52:34 2021	user warm kernel	[294652.520000]	TVWSLINK	HPA(8) : RD 0x1 0x01 0x01 0x01 0x20 0x00 0xa1 0x0a 0x00 0x13 0x00 0x0f 0x0f 0x0f
Wed Feb 10 12:52:34 2021	user warm kernel	[294652.580000]	TVWSLINK	WLAN TX POWER (Offset CH 1, Temp 0) Changed (To 16)
Wed Feb 10 12:52:34 2021	user warm kernel	[294652.624000]	Set_TxPower_Proc	KR Bandwidth = 8 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 /
Wed Feb 10 12:52:34 2021	user warm kernel	[294652.652000]	TVWSLINK	STA PROCESS MAIN (PATH=0)
Wed Feb 10 12:52:34 2021	user warm kernel	[294652.684000]	TVWSLINK	STA PROCESS : CONNECTED
Wed Feb 10 12:52:34 2021	user warm kernel	[294653.192000]	TVWSLINK	BLE Error in Opening tyUSB2
Wed Feb 10 12:52:35 2021	user warm kernel	[294654.172000]	GPS	Upload at 210215-12:52:35
Wed Feb 10 12:52:35 2021	user warm kernel	[294654.360000]	TVWSLINK	WLAN TX POWER (Offset CH 1, Temp 0) Changed (To 16)
Wed Feb 10 12:52:35 2021	user warm kernel	[294654.404000]	Set_TxPower_Proc	KR Bandwidth = 8 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 /
Wed Feb 10 12:52:35 2021	user warm kernel	[294654.432000]	TVWSLINK	STA PROCESS MAIN (PATH=0)
Wed Feb 10 12:52:35 2021	user warm kernel	[294654.460000]	TVWSLINK	STA PROCESS : CONNECTED
Wed Feb 10 12:52:36 2021	user warm kernel	[294654.564000]	TVWSLINK	HPA(8) : Send Request TSSM (12)
Wed Feb 10 12:52:37 2021	user warm kernel	[294655.764000]	TVWSLINK	WLAN TX POWER (Offset CH 1, Temp 0) Changed (To 16)
Wed Feb 10 12:52:37 2021	user warm kernel	[294655.808000]	Set_TxPower_Proc	KR Bandwidth = 8 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 /
Wed Feb 10 12:52:37 2021	user warm kernel	[294655.836000]	TVWSLINK	STA PROCESS MAIN (PATH=0)
Wed Feb 10 12:52:37 2021	user warm kernel	[294655.870000]	TVWSLINK	STA PROCESS : CONNECTED
Wed Feb 10 12:52:37 2021	user warm kernel	[294656.112000]	TVWSLINK	RSCHCK Error in Opening tyUSB1
Wed Feb 10 12:52:38 2021	user warm kernel	[294656.632000]	TVWSLINK	HPA(8) : RD 0x0 0x0a 0x50 0x00 0x00 0x20 0x30 0x32 0x3c 0x34 0x1f 0x0f 0x0f
Wed Feb 10 12:52:38 2021	user warm kernel	[294657.192000]	TVWSLINK	WLAN TX POWER (Offset CH 1, Temp 0) Changed (To 16)
Wed Feb 10 12:52:38 2021	user warm kernel	[294657.236000]	Set_TxPower_Proc	KR Bandwidth = 8 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 /
Wed Feb 10 12:52:38 2021	user warm kernel	[294657.264000]	TVWSLINK	STA PROCESS MAIN (PATH=0)
Wed Feb 10 12:52:38 2021	user warm kernel	[294657.304000]	TVWSLINK	STA PROCESS : CONNECTED
Wed Feb 10 12:52:40 2021	user warm kernel	[294658.644000]	TVWSLINK	UDP : M to S : [IP:192.168.195.1 (4096) Response received (54) 0a 0b 5c 5d
Wed Feb 10 12:52:40 2021	user warm kernel	[294658.704000]	TVWSLINK	HPA(8) : RD 0x1 0x01 0x01 0x01 0x20 0x00 0xa1 0x0a 0x00 0x13 0x00 0x0f 0x0f 0x0f
Wed Feb 10 12:52:40 2021	user warm kernel	[294658.904000]	TVWSLINK	WLAN TX POWER (Offset CH 1, Temp 0) Changed (To 16)
Wed Feb 10 12:52:40 2021	user warm kernel	[294658.948000]	Set_TxPower_Proc	KR Bandwidth = 8 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 /
Wed Feb 10 12:52:40 2021	user warm kernel	[294658.976000]	TVWSLINK	STA PROCESS MAIN (PATH=0)
Wed Feb 10 12:52:40 2021	user warm kernel	[294659.016000]	TVWSLINK	STA PROCESS : CONNECTED
Wed Feb 10 12:52:41 2021	user warm kernel	[294660.040000]	TVWSWD	UDP received From FM10 (307) 30 01 01 01 00 00 00 00 (11)
Wed Feb 10 12:52:41 2021	user warm kernel	[294660.080000]	TVWSWD	FM10 Ping Enabled(2) FailCount 0, 0, 0, 0
Wed Feb 10 12:52:41 2021	user warm kernel	[294660.344000]	TVWSLINK	WLAN TX POWER (Offset CH 1, Temp 0) Changed (To 16)
Wed Feb 10 12:52:41 2021	user warm kernel	[294660.364000]	Set_TxPower_Proc	KR Bandwidth = 8 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 /
Wed Feb 10 12:52:41 2021	user warm kernel	[294660.412000]	TVWSLINK	STA PROCESS MAIN (PATH=0)

3) Kernel Log

- The logs distributed to the console allow you to monitor the debugging logs in the kernel, which disappear when you reboot the equipment with a volatile log.

Kernel Log

```
[300302.484000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300302.520000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300302.548000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300302.560000] TWWSLINK: STA PROCESS: CONNECTED
[300302.916000] TWWSLINK: GPS Error in Opening ttyUSB0
[300303.000000] TWWSLINK: HPA(0): Send Request TSSI (12)
[300303.920000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300303.964000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300303.992000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300304.032000] TWWSLINK: STA PROCESS: CONNECTED
[300304.268000] TWWSLINK: BLE Error in Opening ttyUSB2
[300304.924000] TWWSLINK: HPA(0): RD:Diff Data 0x50 0x00 0x20 0x30 0x31 0x37 0x10 0x0f
[300305.366000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300305.400000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300305.428000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300305.468000] TWWSLINK: STA PROCESS: CONNECTED
[300307.100000] TWWSLINK: UDP: M to S: IP:192.168.100.1 (4090) Response received (54) 0x0b 0x0d
[300307.400000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300307.452000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300307.480000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300307.520000] TWWSLINK: STA PROCESS: CONNECTED
[300308.004000] TWWSLINK: HPA(0): RD:0x61 0x61 0x61 0x20 0x00 0xa1 0x0a 0x00 0x13 0x00 0x0f 0x0f 0x0f 0x0f 0x74 0x00 0x03 0x01 0x7c 0x0a
[300308.732000] GPS Upload at 210210-14:26:50
[300308.932000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300308.972000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300309.000000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300309.040000] TWWSLINK: STA PROCESS: CONNECTED
[300310.000000] TWWSLINK: HPA(0): Send Request TSSI (12)
[300310.366000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300310.380000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300310.400000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300310.440000] TWWSLINK: STA PROCESS: CONNECTED
[300310.852000] TWWSLINK: RSHECK Error in Opening ttyUSB1
[300311.132000] TWWSLINK: HPA(0): RD:Diff Data 0x50 0x00 0x00 0x31 0x31 0x39 0x36 0x21 0x0f
[300311.776000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300311.820000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300311.848000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300311.880000] TWWSLINK: STA PROCESS: CONNECTED
[300312.944000] TWWSLINK: GPS Error in Opening ttyUSB0
[300313.212000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300313.252000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300313.280000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300313.320000] TWWSLINK: STA PROCESS: CONNECTED
[300314.240000] TWWSLINK: HPA(0): RD:0x61 0x61 0x61 0x20 0x00 0xa1 0x0a 0x00 0x13 0x00 0x0f 0x0f 0x0f 0x0f 0x72 0x00 0x7f 0x00 0x0f 0x0f
[300314.296000] TWWSLINK: BLE Error in Opening ttyUSB2
[300314.644000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300314.684000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300314.712000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300314.752000] TWWSLINK: STA PROCESS: CONNECTED
[300316.004000] TWWSLINK: WLAN0 TX POWER ( Offset CH1, Temp:0 ) Changed ( To 16)
[300316.128000] Set_TxPower_Proc: KR Bandwidth = 0 MHz / Channel = 31 / Tx power = 16 dBm / CH Offset = 2 / (R) = 2
[300316.156000] TWWSLINK: STA PROCESS MAIN (PATH=0)
[300316.196000] TWWSLINK: STA PROCESS: CONNECTED
```

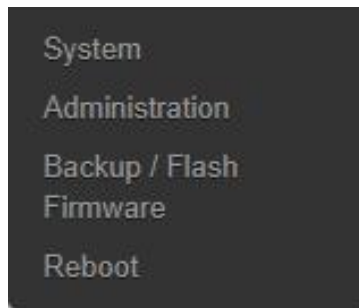
4) Realtime Graphs

- Realtime Graphs displays real-time graphs such as equipment load and traffic. You can select each tab to see the corresponding graph.



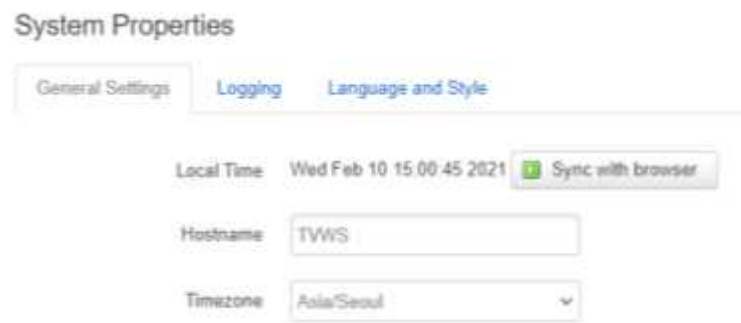
2.2.4. System

- Divided into System, Administration, Backup/Flash Firmware, Reboot



1) System

- System Properties: You can change the time information and log settings of the equipment.
 - Local Time : Check the current equipment setting time. The Sync with browser button allows synchronization with the browser you are connected to.
 - Hostname : You can set the name of the equipment.
 - Timezone : You can set the time zone for the equipment. The initial value is Asia/Seoul.



- Time Synchronization

- Enable NTP Client : Activate the NTP client of the equipment.
- Provide NTP server : Activates the NTP server through the current equipment vision.
- NTP server candidates : Set the list of NTP servers to connect to.



2) Administration

- change the password and remote SSH settings of the Router Password device.

- Password : Enter the password you want to change.
- Confirmation : Enter the password you want to change once more.

Router Password

Changes the administrator password for accessing the device

Password



Confirmation



- SSH Access

- Interface : Set up an interface to allow SSH connections.
- Port : Set the port to use for SSH connections.
- Password authentication : Use the password when accessing SSH.
- Allow root logins with password : Allow root account access when SSH is accessed.
- Gateway ports : Set a port that allows SSH access on the external network.
- SSH-Keys : Set the public key to use for SSH.

SSH Access

Dropbear offers SSH network shell access and an integrated SCP server.

Dropbear Instance

[Delete](#)

Interface

☐ lan 
☐ wan 
☒ unspecified
Listen only on the given interface or, if unspecified, on all

Port

Specifies the listening port of this Dropbear instance.

Password authentication

☒ Allow SSH password authentication

Allow root logins with password

☒ Allow the root user to login with password

Gateway ports

☐ Allow remote hosts to connect to local SSH forwarded ports

[Add](#)

SSH-Keys

Here you can paste public SSH-Keys (one per line) for SSH public-key authentication.

3) Backup / Flash Firmware

- Backup/ Restore You can back up, restore, or update new firmware settings for the equipment.

- Download backup : Download the current settings as a backup file.
- Reset to defaults : Change all settings to preferences.
- Restore backup : Restore settings using the backup file you downloaded.

Backup / Restore

Click "Generate archive" to download a tar archive of the current configuration files. To reset the firmware to its initial state, click "Perform reset" (only possible with squashfs images).

Download backup

[Generate archive](#)

Reset to defaults

[Perform reset](#)

To restore configuration files, you can upload a previously generated backup archive here.

Restore backup

[파일 선택](#) 선택한 파일 업로드

[Upload archive](#)

- Flash new firmware image

- Keep settings : Maintain existing settings after firmware update.
- Image : Select the firmware update file, then click the Flash image button to proceed with the firmware update. Be careful not to lose power during firmware updates. After the firmware update is complete, the equipment will reboot.

Flash new firmware image

Upload a sysupgrade-compatible image here to replace the running firmware. Check "Keep settings" to retain the current configuration (requires an OpenWrt compatible firmware image)

Keep settings: ☒

Image:

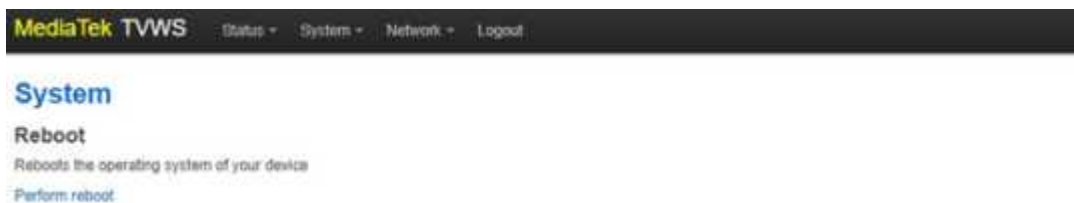
파일 선택

선택된 파일 없음

Flash image...

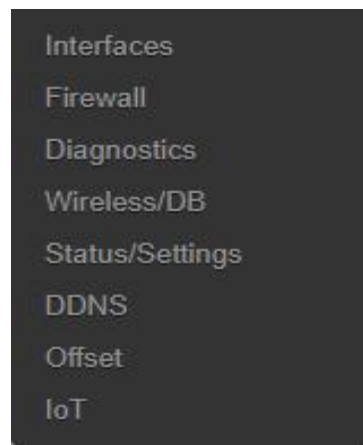
4) Reboot

- You can reboot the equipment remotely. Pressing Perform reboot will reboot the equipment immediately, and will take you to the login page after the operation is complete.



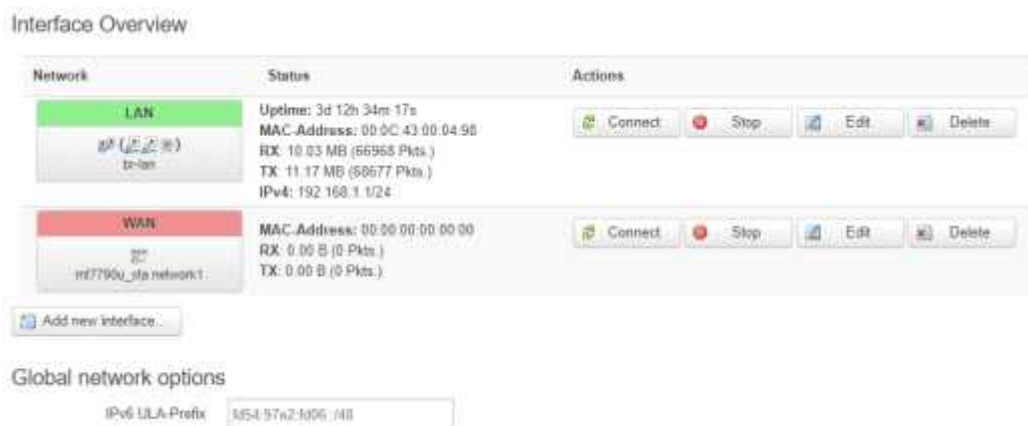
2.2.5. Network

- Interfaces, Firewall, Diagnostics, Wireless/DB, Status/Settings, DDNS, Offset, IoT로 나뉘져 있습니다.



1) Interfaces

- You can set up a network of equipment and assign IPs. The default network is divided into WAN and LAN. The WAN assigns the interface from which the equipment supplies the Internet, and the LAN assigns the interface from which the equipment supplies the Internet. You can set Protocol, IPv4 address, etc. through the LAN and WAN Edit, and you can add any user interface by clicking the Add new interface button.



- Common Configuration – General Setup

- Status : You can check the interface status of the WAN network.
- Protocol : You can apply the protocol to the WAN interface. Use DHCP client for flexible IP assignments and Static address for static IPs.
- When setting the protocol to Static address, you can enter the setting value below.
- IPv4 address : Set the static IP.
- IPv4 netmask : Set up Netmask.
- IPv4 gateway : Set the Gateway IP.

Common Configuration

General Setup Advanced Settings Physical Settings Firewall Settings

Status	 br-lan	Uptime: 3d 12h 43m 27s MAC-Address: 00:0C:43:00:04:98 RX: 10.04 MB (67076 Pkts.) TX: 11.19 MB (68787 Pkts.) IPv4: 192.168.1.1/24
--------	---	--

Protocol	Static address
IPv4 address	192.168.1.1
IPv4 netmask	255.255.255.0
IPv4 gateway	

- IPv4 broadcast : Set the Broadcast IP.
- Use custom DNS servers : Set up a DNS server.
- IPv6 assignment length : Sets the length of Prefix for IPv6.
- IPv6 address : Set an IPv6 address.
- IPv6 gateway : Set the IPv6 gateway address.
- IPv6 routed prefix : Set the IPv6 routed prefix address.

IPv4 broadcast

Use custom DNS servers 

IPv6 assignment length  Assign a part of given length of every public IPv6-prefix to this interface.

IPv6 address

IPv6 gateway

IPv6 routed prefix  Public prefix routed to this device for distribution to clients.

- Common Configuration – Advanced Settings

- Bring up on boot : Set the network to turn on at boot time.
- Use builtin IPv6-management : Enables built-in IPv6 management.
- Override MAC address : Overwrite the MAC address of the network.
- Override MTU : Use the User Settings MTU.
- Use gateway metric : Establish metrics gateway.

Common Configuration

[General Setup](#) [Advanced Settings](#) [Physical Settings](#) [Firewall Settings](#)

Bring up on boot ☒

Use builtin IPv6-management ☒

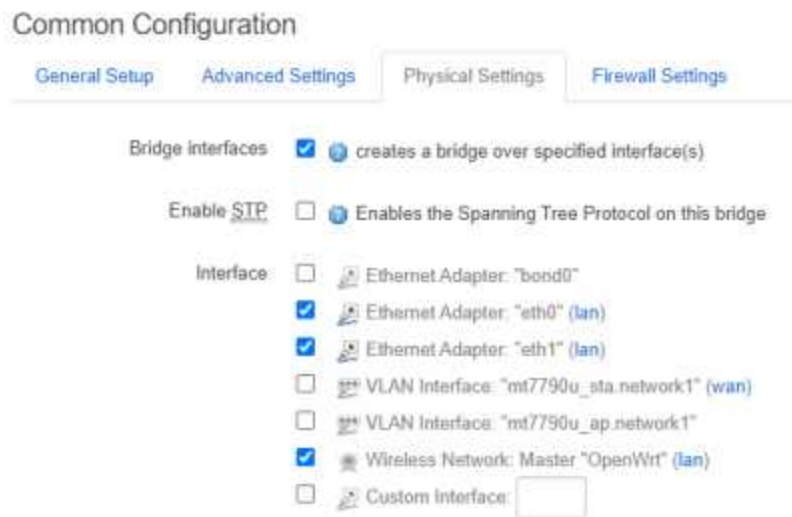
Override MAC address

Override MTU

Use gateway metric

- Common Configuration – Physical Settings

- Bridge Interface : Set the network to a bridge.
- Interface : Assign an interface to the network. For bridge networks, you can select multiple interfaces.



- Common Configuration – Firewall Settings

- Create/Assign firewall-zone : Select firewall rules to apply to your network.



-DHCP Server – General Setup

- Ignore interface : Disable DHCP for the network.
- Start : Sets the starting range of floating IPs allocated by the DHCP server.
- Limit : Set the end range of floating IPs allocated by the DHCP server.
- Leasetime : Set the expiration date of the floating allocation IP.

DHCP Server

General Setup **Advanced Settings** IPv6 Settings

Ignore interface ☐ [Disable DHCP for this interface.](#)

Start
[Lowest leased address as offset from the network address.](#)

Limit
[Maximum number of leased addresses.](#)

Leasetime
[Expiry time of leased addresses, minimum is 2 minutes \(2m\).](#)

- DHCP Server – Advanced Settings

- The menu is displayed only when DHCP Server is enabled.
- Dynamic DHCP : Ensure that unregistered clients are also assigned flexible IP.
- Force : Service persists even if another DHCP server is found on the network.
- IPv4-Netmask : Overwrite the Netmask passed to the client.
- DHCP-Option : Sets DHCP-related options.

DHCP Server

General Setup **Advanced Settings** IPv6 Settings

Dynamic DHCP ☒ [Dynamically allocate DHCP addresses for clients. If disabled, only clients having static leases will be served.](#)

Force ☐ [Force DHCP on this network even if another server is detected.](#)

IPv4-Netmask
[Override the netmask sent to clients. Normally it is calculated from the subnet that is served.](#)

DHCP-Options [Define additional DHCP options, for example "6,192.168.2.1,192.168.2.1" which advertises different DNS servers to clients.](#)

- DHCP Server – IPv6 Settings

- Router Advertisement-Service : Set RA Service related options.
- DHCPv6-Service : Set DHCPv6-Service related options.
- NDP-Proxy : Sets NDP-Proxy related options.
- DHCPv6-Mode : Sets DHCPv6-Mode related options.
- Always default router : This setting always notifies you that it is the default router.
- Announced DNS servers : Set up a DNS server.
- Announced DNS domains : Set the DNS domain.

DHCP Server

General Setup

Advanced Settings

IPv6 Settings

Router Advertisement-Service

DHCPv6-Service

NDP-Proxy

DHCPv6-Mode

Always announce default router ☐  Announce as default router even if no public prefix is available.

Announced DNS servers

Announced DNS domains

2) Firewall

can set firewall settings, port forwarding, and rule settings for the equipment.

- General Settings

- Enable SYN-flood protection : Enable the firewall against SYN-Flood attacks.
- Drop invalid packets : No invalid packets are received.
- Input : Set the rules for packets that have the equipment as the destination.
- Output : Set rules for packets sent from the equipment.
- Forward : Set rules for packets passing through the equipment.
- Zones : Set the rules for the preset zone.

[General Settings](#) [Port Forwards](#) [Traffic Rules](#) [Custom Rules](#)

Firewall - Zone Settings

The firewall creates zones over your network interfaces to control network traffic flow.

General Settings

Enable SYN-flood protection ☒

Drop invalid packets ☐

Input

Output

Forward

Zones

Zone ⇒ Forwardings	Input	Output	Forward	Masquerading	MSS clamping	
lan: lan ⇒ wan	accept	accept	accept	☐	☐	Edit Delete
wan: wan ⇒ ACCEPT	accept	accept	accept	☒	☒	Edit Delete

[Add](#)

- Port Forwards

- Allows the user to set up port forwarding for the desired port.
- Name : Rule name
- Protocol : The protocol type to be applied.
- External zone : Zone to be set to the outside (typically wan)
- External port : External Port
- Internal zone : Zone to be set inside (typically lan)
- Internal IP address : Internal IP Address
- Internal port : Internal Port

Firewall - Port Forwards

Port forwarding allows remote computers on the Internet to connect to a specific computer or service within the private LAN.

Port Forwards

Name	Match	Forward to	Enable	Sort
This section contains no values yet				

New port forward:

Name	Protocol	External zone	External port	Internal zone	Internal IP address	Internal port
New port forward	TCP+UDP	wan		lan		

 Add

3) Diagnostics

- Option to self-diagnose network health.

- Ping : Ping can be sent to the entered address to check the network connection with the equipment.
- Traceroute : You can check the path to the entered address and the transfer delay.
- Nslookup : You can check the Name Server information associated with the entered domain.

Diagnostics

Network Utilities

IPv4

Install iputils-traceroute6 for IPv6 traceroute

```
PING openwrt.org (139.59.209.225): 56 data bytes
64 bytes from 139.59.209.225: seq=0 ttl=48 time=268.893 ms
64 bytes from 139.59.209.225: seq=1 ttl=48 time=263.853 ms
64 bytes from 139.59.209.225: seq=2 ttl=48 time=263.211 ms
64 bytes from 139.59.209.225: seq=3 ttl=48 time=263.240 ms
64 bytes from 139.59.209.225: seq=4 ttl=48 time=263.498 ms

--- openwrt.org ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 263.211/264.539/268.893 ms
```

4) Wireless/DB

- Set information necessary for operation such as Mode, MCS, Bandwidth of TVWS.

- General Setup

- Mode : You can set the master and slave modes.
- MCS : You can set a configuration that combines spatial streams, modulation methods, coding rates, etc.
- Bandwidth : You can set the bandwidth.
- Channel Manual Select : You can set the way in which available channels are assigned.
- SSID : You can set the SSID of the equipment.
- TxPower : You can set the output strength of fixed 1W equipment.
- Portable 100mW TxPower : You can set the output strength of mobile 100mW equipment.
- Portable 40mW TxPower : You can set the output strength of mobile 40mW equipment.
- Channel : Channel Manual Select is activated and the channel can be set.

General Setup	
Hardware Type	HIGH_POWER_UHF
Mode	SLAVE
MCS	AUTO
Bandwidth	6MHz
Channel Manual Select	ON
SSID	TVWS
TxPower	25 dBm
Portable 100mW TxPower	14 dBm
Portable 40mW TxPower	14 dBm
Channel	31 (575 MHz)

- NMS Server : You can set the address of the NMS server to which you want to send information about the equipment.
- NMS Report Interval : You can set how often to report to the NMS server.
- Channel Server : You can set whether to use the available channel optimization channel optimization server.
- Channel Server Domain : You can set the domain of the available channel optimization server.
- Channel Server Polling Period : You can set the available channel optimization server registration message transmission frequency.
- Channel Reallocation Polling Period : You can set the available channel optimization server channel reallocation check message sending frequency.
- Slave Location Report Period : (BIS) You can set the slave location information transmission frequency.
- Roaming Table Polling Period : (BIS) You can set how often roaming table request messages are sent.
- Roaming Table Clear : (BIS) You can set roaming table initialization.
- Roaming ID (Bus Line) : (BIS) You can set roaming table route information.

NMS Server	https://220.118.0.113:8443/nms_ct
NMS Report Interval	1 Min
Channel Server	Disable
Channel Server Domain	www.tvws.co.kr
Channel Server Polling Period[min]	1
Channel Reallocation Polling Period[min]	0
Slave Location Report Period[sec]	0
Roaming Table Polling Period[min]	0
Roaming Table Clear	Normal
Roaming ID (Bus Line)	seocho01

- Database stores information to identify users in the RRA prior to being assigned available channels, which should not be modified by users should not be modified by users.

Database

TVWS DB

Domain	tvws.kr
Mobile Slave	Present
Fixed Slave Number	None
DB Access Time	23:55
Tx Power Type	Fixed
Device Type	Fixed
Device Scheme	Manual
Use Device Type Ext	NOT USE
Owner - Full Name	Innonet
Owner - Kind	co
Operator - Full Name	Innonet
Operator - Street	Beobwon-ro 11-gil 7
Operator - Locality	Songpa-gu
Operator - Region	Seoul
Operator - Post Code	05836
Operator - Country	KR
Operator - Tel	02-406-8849
Operator - Email	cs@innonet.net

5) Status/Settings

- TVWS Status

- View the available channels, reception, and output strength of the TVWS.
- TVWS Status : You can check the available channels assigned to the current equipment and the sensitivity of the equipment.
- RSSI Alarm Threshold(Min, Max) : You can set the lowest and highest values of the sensitivity of the alarm (T.D.B.).
- TVWS TSSI : You can check the output value of the equipment.
- TSSI Alarm Threshold(Min, Max) : You can set the lowest and highest values of the output to be alarmed (T.D.B.).
- WiFi#1,2 TSSI : The Wi-Fi output of the machine can be checked (T.D.B.).
- IP Address : You can set the internal IP of the equipment.
- WAN Network Config : Check whether WAN IP has been changed and set.
- TVWS Sleep Mode : You can set the sleep mode of the equipment (T.D.B.).

TVWS STATUS/SETTINGS

Status/Settings

TVWS Status	TVWS Settings	HPA Update
-------------	---------------	------------

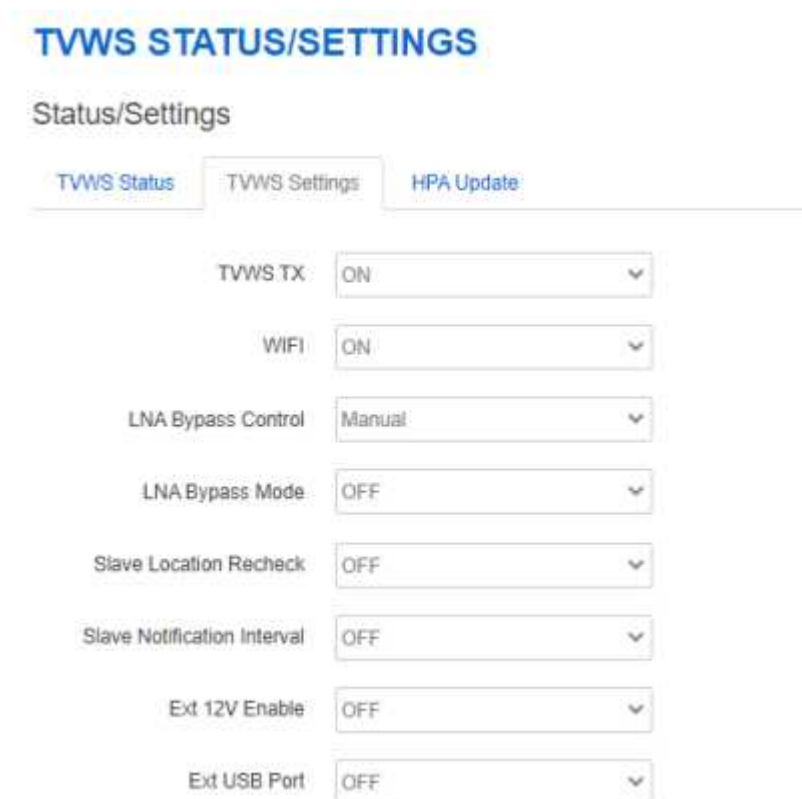
TVWS Status	CH:31 AP:TVWS RSSI:-57
RSSI Alarm Threshold (Min,Max)	-90,-40
TVWS TSSI	23.3
TSSI Alarm Threshold (Min,Max)	5,30
WiFi#1 TSSI	----
WiFi#2 TSSI	----
IP Address	192.168.100.1
WAN Network Config	NOT CHANGED

Sleep Mode Control

TVWS Sleep Mode	OFF
-----------------	-----

- TVWS Settings

- TVWS TX : You can control the output of the equipment.
- WIFI : You can control the WIFI output of the equipment.
- LNA Bypass Control : Depending on TVWS reception, you can control the amplifier that amplifies the signal.
- LNA Bypass Mode : Control the amplifier that amplifies the TVWS signal.
- Slave Location Recheck : Check the location of the cruise ship can be set (T.B.D.).
- Slave Notification Interval : Set the positioning cycle for cruise ships (T.B.D.).
- Ext USB Port : You can control whether or not to use the USB output.



TVWS STATUS/SETTINGS	
Status/Settings	
TVWS Status TVWS Settings HPA Update	
TVWS TX	ON
WIFI	ON
LNA Bypass Control	Manual
LNA Bypass Mode	OFF
Slave Location Recheck	OFF
Slave Notification Interval	OFF
Ext 12V Enable	OFF
Ext USB Port	OFF

- HPA Update
 - Download File Path : You can set the file path for the HPA firmware.
 - HPA1 Status : View firmware information for the HPA.
 - HPA1 F/W : firmware updates can be made by setting it up.

TVWS STATUS/SETTINGS

Status/Settings

TVWS Status	TVWS Settings	HPA Update
Download file path		
http://server/hpamcu303_bxxx.bin		
HPA1 Status		Ver_1.3.00
HPA1 F/W		NORMAL

6) DDNS

- You can set up a domain to access the equipment.

TVWS DDNS

DDNS

TVWS DDNS	
DDNS Domain	1.tvws.co.kr
Update Enable	OFF
DDNS Server	www.tvws.co.kr
Current WAN IP Address	0.0.0.0
DDNS Command Status	---
Connection Status	---

7) Offset

- Adjust the output value by channel by changing the offset of the equipment.

Offset

Offset for Channel & Temperature

ch0x - 6MHz

ch02	ch03	ch04	ch05	ch06	ch07	ch08	ch09
0	0	0	0	0	0	0	0

ch1x - 6MHz

ch10	ch11	ch12	ch13	ch14	ch15	ch16	ch17	ch18	ch19
0	0	0	0	-2	-2	-2	-2	-2	-2

ch2x - 6MHz

ch20	ch21	ch22	ch23	ch24	ch25	ch26	ch27	ch28	ch29
-1	-1	0	-1	0	0	1	2	2	1

ch3x - 6MHz

ch30	ch31	ch32	ch33	ch34	ch35	ch36	ch37	ch38	ch39
1	1	-1	-1	-2	-2	-2	-1	0	1

ch4x - 6MHz

ch40	ch41	ch42	ch43	ch44	ch45	ch46	ch47	ch48	ch49
1	1	0	-1	-2	-2	-2	-1	0	0

8) IoT

- You can set the server to monitor the status of IoT equipment and the frequency to upload.



The image shows a web interface for IoT configuration. At the top, there is a blue 'IoT' logo. Below it, the text 'IoT' is repeated. The main section is titled 'Sensor Status'. It contains two fields: 'Server' with the value 'https://www.tvwsiot.net:8443/iot_ct' and 'IoT Upload Period' with a dropdown menu set to '10 Min'.

2.2.6. Logout

- Log out the WEB page of the equipment.



2.3 Wi-Fi Setting

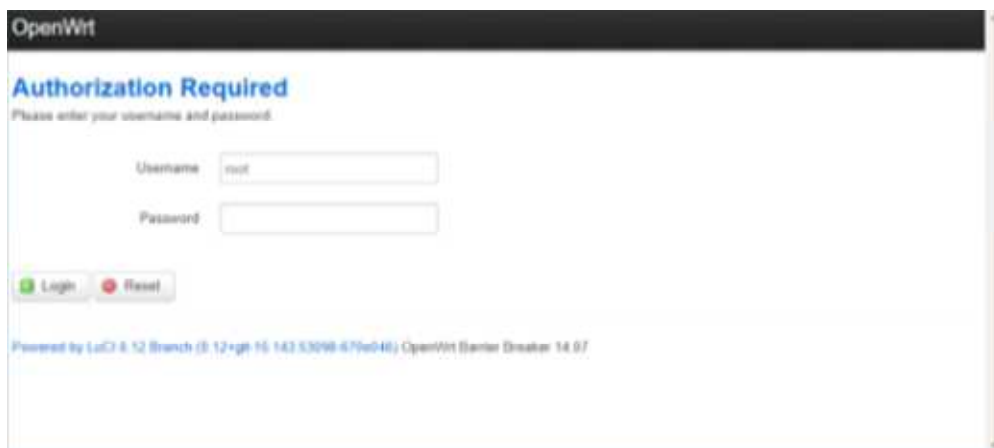
You can access the Wi-Fi WEB page to change your password settings. The Wi-Fi WEB setting screen requires wireless connection with the Wi-Fi, laptop, and mobile phone of the TVWS equipment to use the WEB page.

1) Use your laptop or mobile phone to find and connect Wi-Fi of your backpack Wi-Fi.

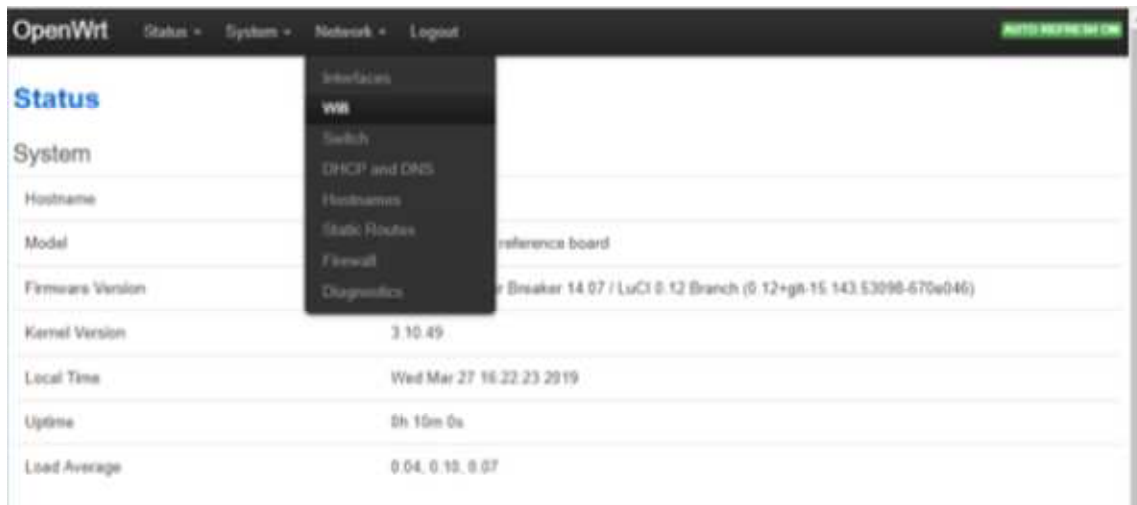


2) Open the WEB browser, type the IP (192.168.25.1) of the Wi-Fi WEB page in the address bar, type Password, and press Enter to access the WEB page.

(ID= root / Password= fts)



3) On the Network tab at the top of the Wi-Fi WEB UI, select Wifi.



4) In the Wireless Overview, view the SSID, verify that the Wi-Fi signal you connected to is correct, and click the edit you marked.



5) Select the Wireless Security tab in the Interface Configuration at the bottom to select the WPA2-PSK and set the desired password for the key. Click the green arrow on the right side of the key to see the password you are typing. Click the Save & Apply button to apply the settings.

OpenWrt Status System Network Logout

Wireless Network: Master "TVWS-WIFI-TEST" (wlan0)

The Device Configuration section covers physical settings of the radio hardware such as channel, transmit power or antenna selection which are shared among all defined wireless networks (if the radio hardware is multi-SSID capable). For network settings like encryption or operation mode are grouped in the Interface Configuration.

Device Configuration

General Setup **Advanced Settings**

Status: Mode: Master | SSID: TVWS-WIFI-TEST
BSSID: BC:0F:28:00:00:A5 | Encryption: None
Channel: 1 (2.412 GHz) | Tx Power: 5 dBm
Signal: -71 dBm | Noise: -95 dBm
Bitrate: 21.7 Mbit/s | Country: KR

Wireless network is enabled

Channel: 1 (2.412 GHz)

Transmit Power: 5 dBm (3 mW)

Interface Configuration

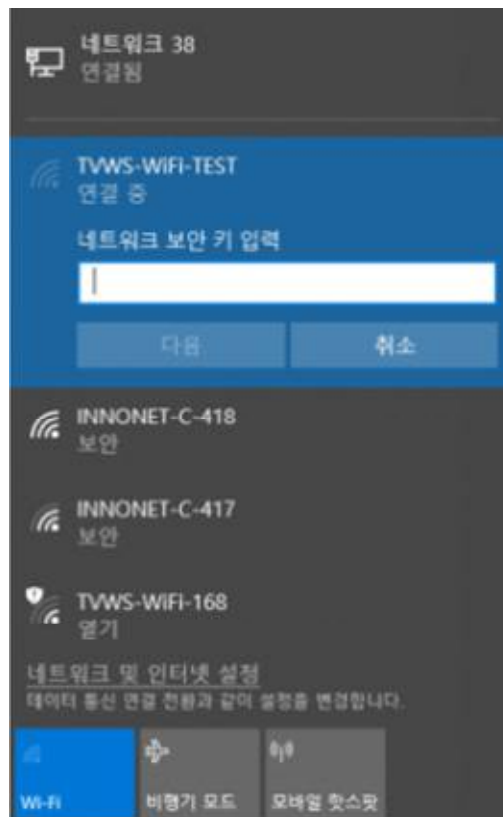
General Setup **Wireless Security** MAC Filter

Encryption: WPA2-PSK

Cipher: auto

Key:

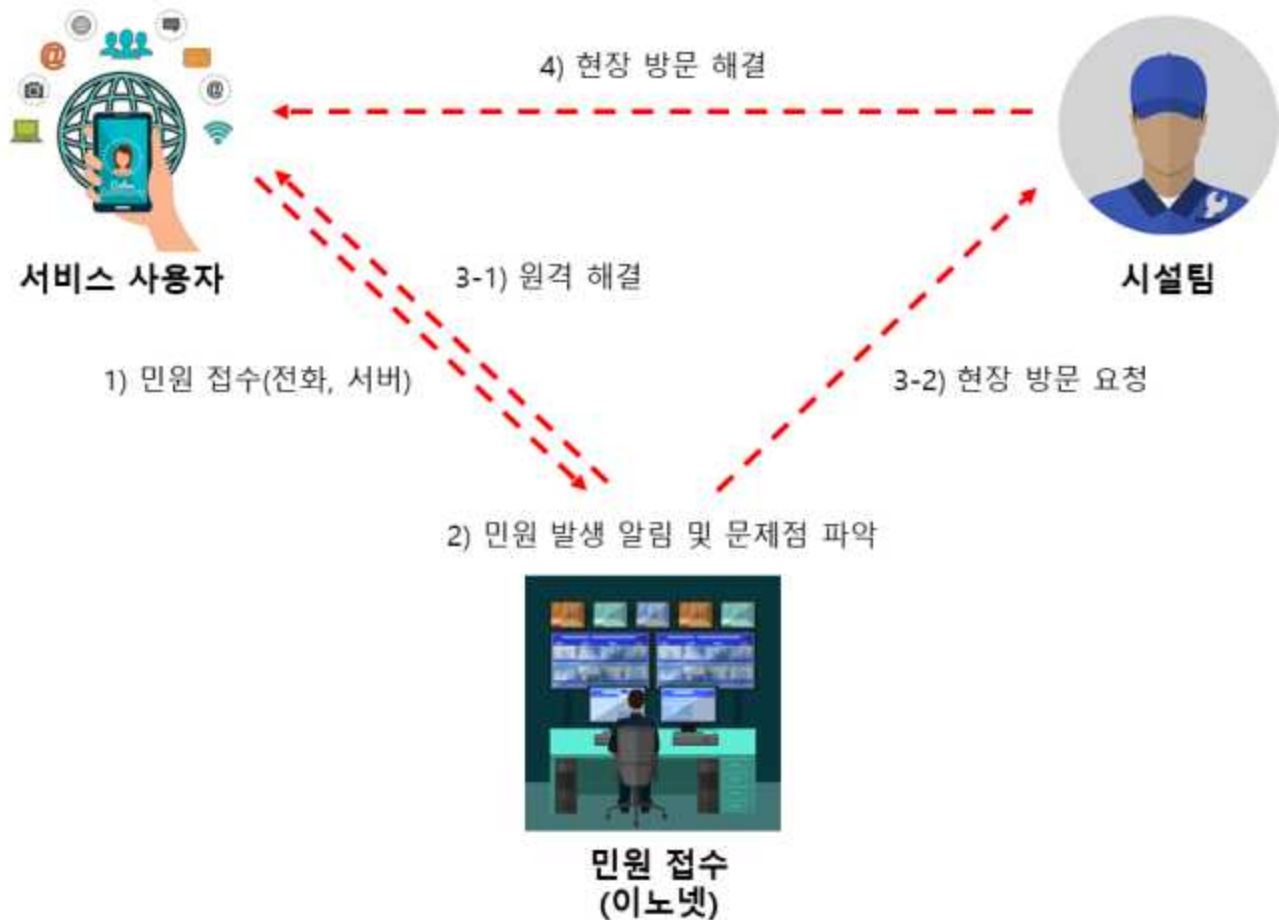
6) If you try to connect the Wi-Fi of your backpack Wi-Fi using your laptop or mobile phone again, and you are prompted for a password, enter the password you set to connect.



3. Maintenance

3.1 Maintenance System

Maintenance is carried out with the following system.



- 1) A service user reports a complaint due to an inconvenience while using the service.
- 2) When a complaint is received, it notifies the occurrence of a complaint and identifies the problem.
- 3) If it can be resolved remotely, support it remotely to resolve complaints.
- 4) If you need to visit the site, ask the facility team to visit the site.
- 5) The facility team visits the site to resolve the complaint.

3.2 Failure Check and Action

If you experience any inconvenience while using the service, please check the following situations first.

If you are not aware of any inconvenience after checking the following clarification and confirmation, please contact A/S at 070-7734-9970.

1) In case the master equipment does not have Wi-Fi

- Verify that your Internet modem is functioning normally.
- Ensure that the Power and WAN LEDs of the master equipment are illuminated.
- Under Master Equipment, check for Wi-Fi signals. (The Wi-Fi signal may be weak or not catchable indoors.)

2) In the case that the Wi-Fi of the slave equipment

- Ensure that the power and link LEDs of the slave equipment are illuminated.
- Under Slave Equipment, check for Wi-Fi signals. (The Wi-Fi signal may be weak or not catchable indoors.)

3) If the camera connected to the slave equipment does not come out

- Ensure that the camera power (12V or 24V) is supplied to the power box.
- Ensure that the LAN port of the slave equipment and the LAN port of the camera are connected.
- Make sure that the camera's connection ports are intact.
- Connect to the slave equipment and ping test with the camera to check for abnormalities.

3.3 How to Verify Equipment Operation

Before installing the Equipment, you should check and follow the instructions below.

(1) Height above average terrain (HAAT). Below 602 MHz, antenna shall not exceed 250 meters or 500 meters in less congested areas.

All other bands not to exceeds 250 meters.

The HAAT is calculated by the White Space database (§73.684(d)).

For HAAT greater than 250 meters the following A-F procedures below are required:

(2) The installing party must contact a White Space database, identify all TV broadcast station contours that would be potentially affected by operation at the planned HAAT and EIRP.

(3) Notification -The installing party must notify each of these licensees and provide geographic coordinates, relevant technical parameters and contact information.

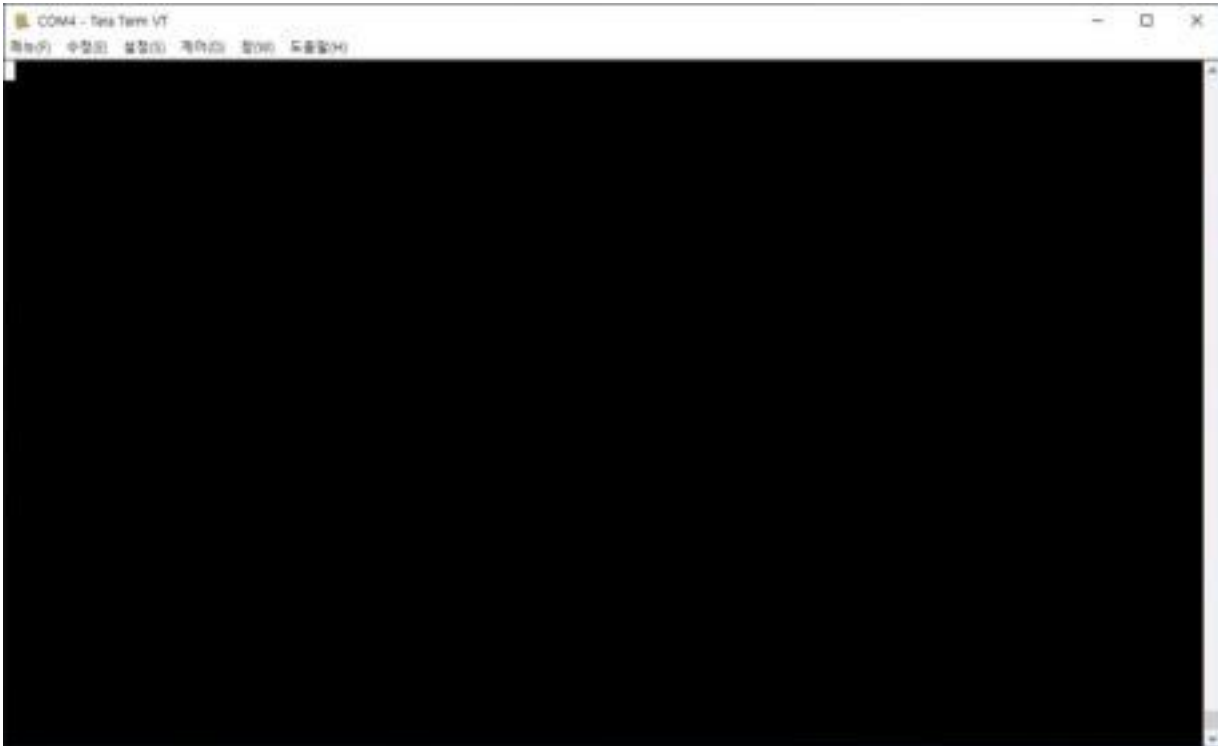
(4) Start operations, No earlier than four calendar days after the notification in paragraph (g)(1)(ii)(B) above

(5) Upon request, the installing party must provide affected licensee the time periods of operations.

(6) Conduct a new notification if increasing its power level, moving more than 100 meters horizontally from its location, or making an increase in the HAAT or EIRP that results in an increase in the minimum required separation distances from co-channel or adjacent channel TV station contours.

(7) All notifications required by this section must be in written form (including email). To be kept by the White Space device operator for its records and supplied to the Commission upon request.

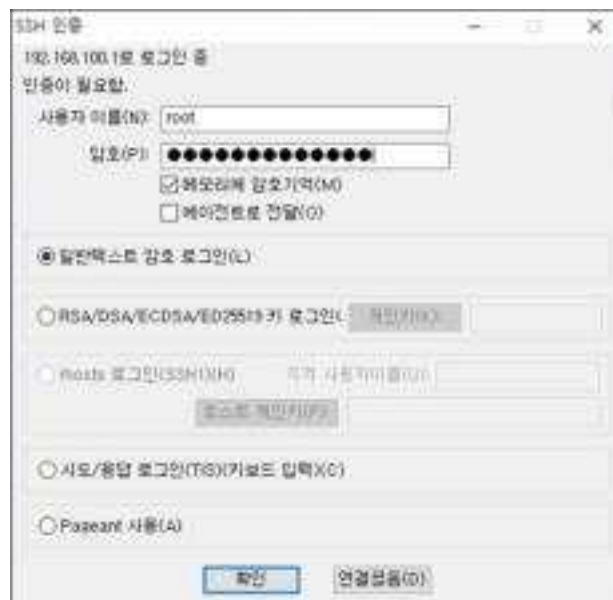
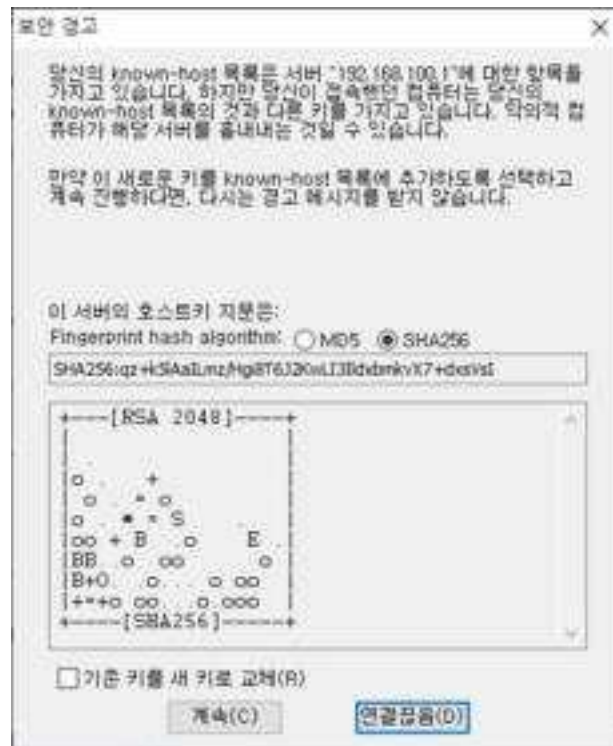
You can check the operation of the equipment using the Terra Term program.



From the menu bar at the top, select Menu, and select New Link.

The master enters IP 192.168.100.1, service SSH, TCP port 2249.

The Slave enters IP 192.168.1.1, service SSH, TCP port 2249.



3.3.1 IP Verification of Equipment

Type 'ifconfig'

The master displays 192.168.100.1 in br-lan, and the slave displays 192.168.1.1. When DHCP is assigned to the WAN port of the master, eth1 displays the IP. (ex: 192.168.1.155)

```
root@RVHS:~#  
root@RVHS:~# ifconfig  
br-lan: Link encap:Ethernet HWaddr 00:0C:43:06:10:8A  
        inet addr:192.168.100.1 Bcast:192.168.100.255 Mask:255.255.255.0  
        inet6 addr: fe80::20c:43ff:fe06:1a8a/64 Scope:Link  
        UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
        RX packets:22744 errors:0 dropped:0 overruns:0 frame:0  
        TX packets:21926 errors:0 dropped:0 overruns:0 carrier:0  
        collisions:0 txqueuelen:0  
        RX bytes:1670132 (1.5 MiB) TX bytes:1780445 (1.7 MiB)  
  
eth0: Link encap:Ethernet HWaddr 00:0C:43:06:10:8A  
        UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
        RX packets:23274 errors:0 dropped:21 overruns:0 frame:0  
        TX packets:22060 errors:0 dropped:0 overruns:0 carrier:0  
        collisions:0 txqueuelen:1000  
        RX bytes:2077226 (1.9 MiB) TX bytes:1802366 (1.7 MiB)  
        Interrupt:3  
  
eth1: Link encap:Ethernet HWaddr 00:0C:43:06:10:89  
        inet addr:192.168.1.155 Bcast:192.168.1.255 Mask:255.255.255.0  
        inet6 addr: fe80::20c:43ff:fe06:1a89/64 Scope:Link  
        UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
        RX packets:44010 errors:0 dropped:0 overruns:0 frame:0  
        TX packets:120560 errors:0 dropped:0 overruns:0 carrier:0  
        collisions:0 txqueuelen:1000  
        RX bytes:3723056 (3.5 MiB) TX bytes:10531096 (10.0 MiB)  
  
lo: Link encap:Local Loopback  
     inet addr:127.0.0.1 Mask:255.0.0.0  
     inet6 addr: ::1/128 Scope:Host  
     UP LOOPBACK RUNNING MTU:65536 Metric:1  
     RX packets:42017 errors:0 dropped:0 overruns:0 frame:0  
     TX packets:42017 errors:0 dropped:0 overruns:0 carrier:0  
     collisions:0 txqueuelen:0  
     RX bytes:2900000 (2.7 MiB) TX bytes:2900000 (2.7 MiB)  
  
wlan0: Link encap:Ethernet HWaddr 00:0C:43:D0:C0:03  
        inet6 addr: fe80::20c:43ff:fed0:cb03/64 Scope:Link  
        UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
        RX packets:0 errors:0 dropped:0 overruns:0 frame:0  
        TX packets:0 errors:0 dropped:0 overruns:0 carrier:0  
        collisions:0 txqueuelen:1000  
        RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)  
  
root@RVHS:~#
```

```

root@TVMS: ~#
root@TVMS: ~# ifconfig
br-lan Link encap:Ethernet HWaddr 00:0C:43:06:1A:88
      inet addr:192.168.1.1 Bcast:192.168.1.255 Mask:255.255.255.0
      inet6 addr: fe80::20c:43ff:fe06:1a88/64 Scope:Link
      UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
      RX packets:154959 errors:0 dropped:0 overruns:0 frame:0
      TX packets:68469 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:0
      RX bytes:10559130 (10.0 MiB) TX bytes:5652525 (5.3 MiB)

eth0 Link encap:Ethernet HWaddr 00:0C:43:06:1A:88
      UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
      RX packets:155301 errors:0 dropped:0 overruns:0 frame:0
      TX packets:68836 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:1000
      RX bytes:12721044 (12.1 MiB) TX bytes:5715890 (5.4 MiB)
      Interrupt:3

eth1 Link encap:Ethernet HWaddr 00:0C:43:06:1A:87
      UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
      RX packets:355 errors:0 dropped:4 overruns:0 frame:0
      TX packets:201 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:1000
      RX bytes:65725 (64.1 KiB) TX bytes:24974 (24.3 KiB)

lo Link encap:Local Loopback
      inet addr:127.0.0.1 Mask:255.0.0.0
      inet6 addr: ::1/128 Scope:Host
      UP LOOPBACK RUNNING MTU:65536 Metric:1
      RX packets:44595 errors:0 dropped:0 overruns:0 frame:0
      TX packets:44595 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:0
      RX bytes:3029624 (2.8 MiB) TX bytes:3029624 (2.8 MiB)

wlan0 Link encap:Ethernet HWaddr 00:0C:43:00:99:E4
      inet6 addr: fe80::20c:43ff:fe0a:99e4/64 Scope:Link
      UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
      RX packets:0 errors:0 dropped:0 overruns:0 frame:0
      TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:1000
      RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)

root@TVMS: ~#

```

3.3.2 Checking the mode of the equipment and TVWS SSID

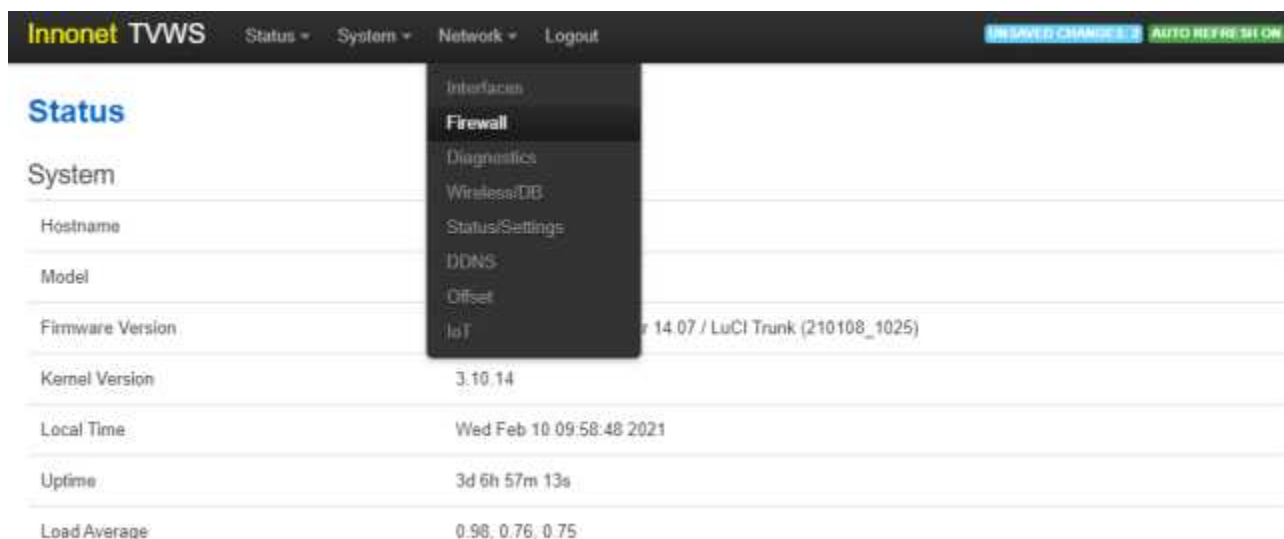
Type 'iwconfig'

```
root@TVWS:~#  
root@TVWS:~# iwconfig  
lo        no wireless extensions.  
  
eth1      no wireless extensions.  
  
wlan0     RTWIFI SoftAP  ESSID:"TVWS-M1"  
          Mode:Managed Channel=14 Access Point: 00:0C:43:D0:CB:03  
          Bit Rate=26 Mb/s  
          Link Quality=10/100 Signal level:0 dBm Noise level:0 dBm  
          Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0  
          Tx excessive retries:0 Invalid misc:0 Missed beacon:0  
  
eth0      no wireless extensions.  
  
br-lan    no wireless extensions.  
  
bond0     no wireless extensions.  
  
root@TVWS:~#
```

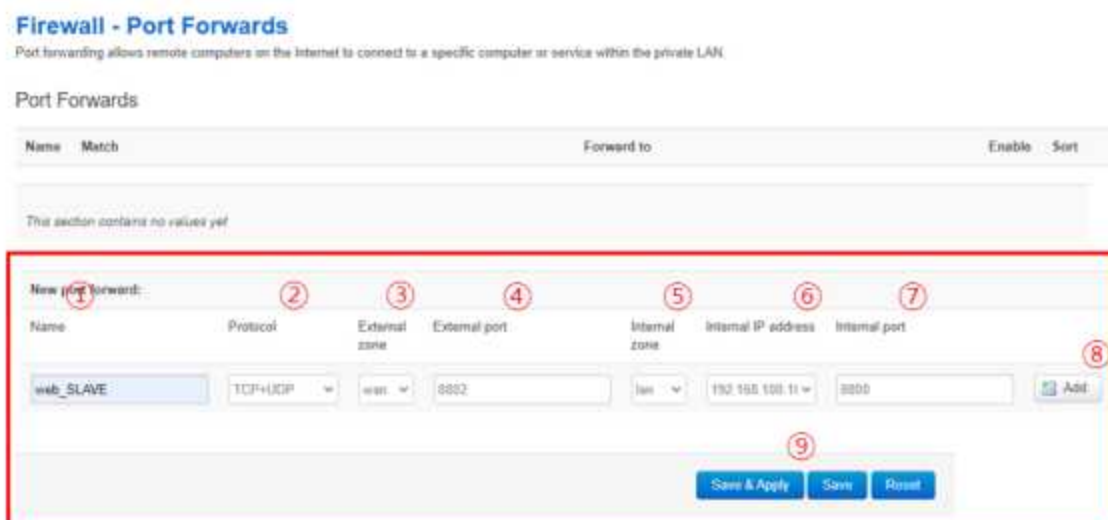
```
root@TVWS:~#  
root@TVWS:~# iwconfig  
lo        no wireless extensions.  
  
eth1      no wireless extensions.  
  
wlan0     Ralink STA  ESSID:"TVWS"  
          Mode:Auto Frequency=2.484 GHz Access Point: Not-Associated  
          Bit Rate:1 Mb/s  
          RTS thr:off Fragment thr:off  
          Encryption key:off  
          Link Quality=10/100 Signal level:0 dBm Noise level:0 dBm  
          Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0  
          Tx excessive retries:0 Invalid misc:0 Missed beacon:0  
  
eth0      no wireless extensions.  
  
br-lan    no wireless extensions.  
  
bond0     no wireless extensions.  
  
root@TVWS:~#
```

3.3.3 Verify and Modify Port Forwarding Table (Master Equipment)

In the WEB UI of the master appliance, select from the Parent Network tab -> Firewall -> Port Forward.



Write the information you want to add sequentially in the Newport forward column, add it, and reboot the equipment.



- | | |
|--|--------------------------|
| ① Name of device and settings to be port forward | ⑤ Internal network |
| ② Protocol method | ⑥ Address of Internal IP |
| ③ External network | ⑦ Internal Port Settings |
| ④ External Port Settings | ⑧ Added |
| | ⑨ Save & Apply |

3.3.4 Verify and modify port forwarding tables (slave equipment)

Because TVWS G/W does not support NAT features, slave equipment also requires port forwarding.

On the slave appliance, type 'ls' to verify that portconfig exists and enter 'vi /etc/config/portconfig'

You can see that 80 ports of Camera 1 IP 192.168.1.108 are port-forwarded to 10001. 554 port is 20001 port and you can see that it is port forwarding.

To modify port forwarding, press the 'i' key to convert to the input state of the vi editor, press the 'esc' key to release the input state, and type ':wq' to save and exit the editor. If you have nothing to modify or want to leave the editor, type 'q!' and it will leave without saving it.



```
root@TVWS:~#  
root@TVWS:~# ls  
blecheck          rebootCount        setfile.nco        tmscheck  
bonding           rebootInterval     setfile            tmswd  
config_tvws_hak   modules            reboot_system      ver  
daccess.lua       nms.lua            roomatchdog        wdiogfile  
gps               notify.lua          roomingtable.csv   showpro  
gps.sh            pingcheck           sensor              status  
lua               portconfig          setfile            tmpcheck  
iot.lua  
root@TVWS:~# vi /etc/config/portconfig  
root@TVWS:~#
```

```

SLAVE SYSTEM
# USER NAT PORT FORWARD CONFIGURATION

# IP CAM 1
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 10001 -j DNAT --to 192.168.1.108:80
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 20001 -j DNAT --to 192.168.1.108:554

# IP CAM 2
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 10002 -j DNAT --to 192.168.1.109:80
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 20002 -j DNAT --to 192.168.1.109:554

# IP CAM 3
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 10003 -j DNAT --to 192.168.1.110:80
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 20003 -j DNAT --to 192.168.1.110:554

# IP CAM 4
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 10004 -j DNAT --to 192.168.1.111:80
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 20004 -j DNAT --to 192.168.1.111:554

# IP CAM 5
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 10005 -j DNAT --to 192.168.1.112:80
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 20005 -j DNAT --to 192.168.1.112:554

# IP CAM 6
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 10006 -j DNAT --to 192.168.1.113:80
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 20006 -j DNAT --to 192.168.1.113:554

# IP CAM 7
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 10007 -j DNAT --to 192.168.1.114:80
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 20007 -j DNAT --to 192.168.1.114:554

# IP CAM 8
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 10008 -j DNAT --to 192.168.1.115:80
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 20008 -j DNAT --to 192.168.1.115:554

# WiFi Web
iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 9000 -j DNAT --to 192.168.1.127:80

- /etc/config/portconfig 1/37 2%

```

3.3.5 Check equipment rssi – iwpriv wlan. entering zero British stat

To check the RSSI and MCS of the equipment, enter 'iwpriv wlan0 stat'.

```
root@IVWS:~#  
root@IVWS:~#  
root@IVWS:~# iwpriv wlan0 stat  
wlan0      stat:  
Tx success          = 1024  
Tx fail count       = 3431, PER=77.0%  
Rx success          = 17027  
Rx with CRC         = 77704, PER=82.0%  
Rx with PhyErr      = 0  
Rx with PlcpErr     = 0  
Rx drop due to out of resource = 0  
Rx duplicate frame  = 0  
False CCA           = 0  
RSSI                = -60 0 0  
Last TX Rate        = MCS9, 20M, SGI, CCK  
Last RX Rate        = MCS9, 40M, SGI, CCK  
TX AGG Range 1 (1)  = 4126  
TX AGG Range 2 (2~5) = 221  
TX AGG Range 3 (6~15) = 1  
TX AGG Range 4 (>15) = 0  
AMPDU Tx success    = 1018  
AMPDU Tx fail count = 3637, PER=78.1%
```

```
root@IVWS:~# iwpriv wlan0 stat  
wlan0      stat:  
Tx success          = 1327  
Tx fail count       = 11326, PER=89.5%  
Rx success          = 7741  
Rx with CRC         = 24979, PER=76.3%  
Rx drop due to out of resource = 0  
Rx duplicate frame  = 0  
False CCA           = 0  
RSSI                = -45 -99 -99  
Last TX Rate        = MCS8, 20M, SGI, CCK  
Last RX Rate        = MCS7, 40M, SGI, CCK  
TX AGG Range 1 (1)  = 9542  
TX AGG Range 2 (2~5) = 2525  
TX AGG Range 3 (6~15) = 52  
TX AGG Range 4 (>15) = 0  
AMPDU Tx success    = 1330  
AMPDU Tx fail count = 14590, PER=91.6%  
SNR-A               = 0  
SNR-B (if available) = 0  
WpaSupplicantUP     = 1
```

3.3.6 Verify Equipment Throughput

iperf requires a server and a client. Entering 'iperf -s -i1' means that the equipment entered will become the iperf server and display the value every second. By typing 'iperf -c 192.168.100.1 -i1', it means that the equipment entered will become an iperf client and display what was sent to the server IP 192.168.100.1 every second. By default, the appliance is supposed to run the iperf server process, so you only need to enter the client. You can enter 'ps' to verify that the 'iperf -s' process is working.

```
152 root      0 SsN  (load)
153 root      0 SsN  (lsmotifg_nark)
154 root      0 SsN  (cngotel)
157 root      0 SsN  (deterugl)
158 root      0 SsN  (kueker/2:11)
159 root      0 SsN  (kueker/3:11)
160 root      0 SsN  (kueker/1:11)
170 root      0 SsN  (kueker/2:10)
180 root      0 SsN  (jffn2_gcd_nob)
184 root      0 SsN  (kueker/2:2)
185 root      0 SsN  (kueker/3:2)
476 root      0 SsN  /sbin/dmcc
479 root      768 S  /sbin/askinst: 11561 /bin/ash --login
600 root      0 SsN  (bus01)
875 root     1004 S  /sbin/lopd -S 2048
936 root     1240 S  /usr/sbin/odhcpd
141 root      0 SsN  (kueker/0:2)
148 root      0 SsN  (kueker/1:2)
1810 root     1140 S  /usr/sbin/dmccbear -F -F /var/run/dmccbear.1.pid -p 2240 -k 300
1852 root     1532 S  /usr/sbin/udhrpd -f -k /var -r TMS -u /cpi-bin -u /dbs -t 60 -t 30 -k 20 -k 1 -k 100 -k -p 0.5,0.5,0000 -p (111)db
1880 root     1492 S  /usr/sbin/ntpd -n -p 0.openurl.pool.ntp.org -p 1.openurl.pool.ntp.org -p 2.openurl.pool.ntp.org -p 3.openurl.pool.ntp.org
1881 root      0 SsN  (kueker/0:2)
1887 root     1790 S  /bin/trueink
1898 root     1268 S  /bin/trueink
1899 root     1204 S  iperf -s
1899 root     768 S  watchdog
1899 root      0 SsN  (kueker/0:10)
1899 root      0 SsN  (kueker/1:10)
1899 root     1600 S  /sbin/netifd
1899 root      0 SsN  (RtcpTimeTask)
1899 root      0 SsN  (RtcpCmdTask)
1899 root      0 SsN  (RtcpTimeTask)
1899 root     1400 S  odhcp -p /var/run/odhcp-eth0.pid -u /lib/netifd/dhcp.script -f -t 0 -i eth0 -c
1899 root     1400 S  /usr/sbin/dmcc -F /var/etc/dmcc.conf -k
1899 root     1500 S  curl -s -u /dev/null -R POST -k https://192.168.1.1:2244/dmcc_ota_root -H Content-Type: application/json -H Accept: */*
1899 root     1216 S  /usr/sbin/dmccbear -F -F /var/run/dmccbear.1.pid -p 2240 -k 300
1899 root     1496 S  ash
1899 root     1492 S  ps
root@T88: ~
```

```

Rx duplicate frame          = 0
False CCA                  = 0
RSSI                       = -60 0 0
Last TX Rate               = MCS9, 20M, SGI, CCK
Last RX Rate               = MCS9, 40M, SGI, CCK
TX AGG Range 1 (1)        = 4126
TX AGG Range 2 (2~5)      = 221
TX AGG Range 3 (6~15)     = 1
TX AGG Range 4 (>15)      = 0
AMPDU Tx success          = 1018
AMPDU Tx fail count       = 3637, PER=78.1%

root@TVWS:~#
root@TVWS:~#
root@TVWS:~#
root@TVWS:~#
root@TVWS:~# iperf -c 192.168.100.100 -i1
-----
Client connecting to 192.168.100.100, TCP port 5001
TCP window size: 20.7 KByte (default)
-----
[  3] local 192.168.100.1 port 48448 connected with 192.168.100.100 port 5001
[ ID] Interval           Transfer     Bandwidth
[  3] 0.0- 1.0 sec      256 KBytes  2.10 Mbits/sec
[  3] 1.0- 2.0 sec      768 KBytes  6.29 Mbits/sec
[  3] 2.0- 3.0 sec      1.63 MBytes 13.6 Mbits/sec
[  3] 3.0- 4.0 sec      1.25 MBytes 10.5 Mbits/sec
[  3] 4.0- 5.0 sec      1.13 MBytes  9.44 Mbits/sec
[  3] 5.0- 6.0 sec      1.50 MBytes 12.6 Mbits/sec
[  3] 6.0- 7.0 sec      1.75 MBytes 14.7 Mbits/sec
[  3] 7.0- 8.0 sec      768 KBytes  6.29 Mbits/sec
[  3] 8.0- 9.0 sec      2.00 MBytes 16.8 Mbits/sec
[  3] 9.0-10.0 sec      1.13 MBytes  9.44 Mbits/sec
[  3] 10.0-10.2 sec     12.3 MBytes 10.1 Mbits/sec
root@TVWS:~#

```

```

Rx duplicate frame          = 0
False CCA                  = 0
RSSI                       = -45 -99 -99
Last TX Rate               = MCS8, 20M, SGI, CCK
Last RX Rate               = MCS7, 40M, SGI, CCK
TX AGG Range 1 (1)        = 9542
TX AGG Range 2 (2~5)      = 2525
TX AGG Range 3 (6~15)     = 52
TX AGG Range 4 (>15)      = 0
AMPDU Tx success          = 1330
AMPDU Tx fail count       = 14590, PER=91.6%
SNR-B                      = 0
SNR-B (if available)      = 0

MpaSupplicantUP            = 1

root@TVWS:~#
root@TVWS:~#
root@TVWS:~# iperf -c 192.168.100.1 -i1
-----
Client connecting to 192.168.100.1, TCP port 5001
TCP window size: 20.7 KByte (default)
-----
[  3] local 192.168.100.100 port 41169 connected with 192.168.100.1 port 5001
[ ID] Interval           Transfer     Bandwidth
[  3] 0.0- 1.0 sec      512 KBytes  4.19 Mbits/sec
[  3] 1.0- 2.0 sec      1.00 MBytes  8.39 Mbits/sec
[  3] 2.0- 3.0 sec      1.13 MBytes  9.44 Mbits/sec
[  3] 3.0- 4.0 sec      1.13 MBytes  9.44 Mbits/sec
[  3] 4.0- 5.0 sec      1.00 MBytes  8.39 Mbits/sec
[  3] 5.0- 6.0 sec      1.25 MBytes 10.5 Mbits/sec
[  3] 6.0- 7.0 sec      1.13 MBytes  9.44 Mbits/sec
[  3] 7.0- 8.0 sec      1.38 MBytes 11.5 Mbits/sec
[  3] 8.0- 9.0 sec      1.13 MBytes  9.44 Mbits/sec
[  3] 9.0-10.0 sec      1.38 MBytes 11.5 Mbits/sec
[  3] 10.0-10.1 sec     11.1 MBytes  9.21 Mbits/sec
root@TVWS:~#

```