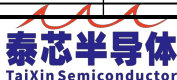





Tektronix AH Bridge User's Manual




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Documents

Confidentiality	A2023-9-7	TaiXin AH Bridge User's Manual		Document	
Level				Number	V1.3.4
Issue Date				Document Version	
Revision Record					
Date	Version	Description Description		Revised by	
2023-9-7	V1.3.4	Add description of automatic trunking;		WHH	
2023-4-10	V1.3.3	Modify footer;		WY	
2022-10-19	V1.3.2	Add description of netat source code;		WY	
2022-4-27	V1.3.1	Add the description of signal lamp display for relay;		WY	
2022-2-18	V1.3.0	Modify the logo;		XYJ	
2021-12-16	V1.2.9	Modify common AT+ commands;		WY	
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2021-6-22	V1.2.4	Description of adding firmware upgrade and relay function		WY	
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2020-11-26	V1.2.0	Update the interface of the new version of the bridge and modify the related description;		WY	
2020-10-19	V1.1.8	Modify the description of signal strength; Add the description of power supply;		WY	
2020-10-10	V1.1.7	Delete tcptest to hit traffic method and replace it with iperf to hit traffic.		XJ	
2020-09-07	V1.1.6	Add solution for unsuccessful pairing; restore factory;		WY	
2020-09-02	V1.1.5	Add the method of obtaining RSSI; add the description of common AT+ commands; Add the description of operating system;		WY	
2020-08-26	V1.1.4	Add the method to locate the problematic device when the communication is not normal.		JHB	
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		method	
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2020-07-28	V1.1.3	Fixed rssi unit error	JHB	
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2020-06-24	V1.1.1	Add the method of testing the flow rate; add the precautions for use; add the common troubleshooting. Add common troubleshooting	ZS	
2020-05-26	V1.1.0	Add a multi-function	JHB	
2020-05-11	V1.0.0	Initial version	JHB	
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1 Program Description

The following is a description of the interfaces and LEDs of the bridge demo:



Figure 1 Interface description

The bridge has the following peripherals:

1. SMA antenna holder.
2. Mode dipswitch to select AP or STA.
3. Pairing key, AP and STA can be pressed at the same time for pairing.
4. Serial print for printing debugging information.
5. RJ45 network port.
6. Debugging interface, for developers only.
7. Power supply holder, support 5V(1A)/12V(500mA) input, note that the USB of computer only has 5V(500mA), which can't supply 5V(500mA), so it can't be used for debugging.
(500mA), the USB of the computer can not afford the power supply of the bridge, please do not use the USB of the computer to supply power. Note: The interface of the old version of the bridge is slightly different, please consult our FEA.

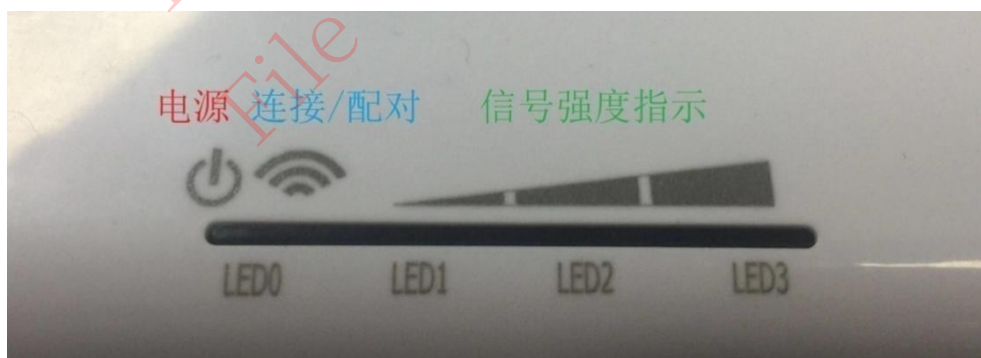


Figure 2 LED Description

Meaning of LEDs:

1. LED0 is the connection status, power indicator. When plugged into the power supply, the red light of LED0 will remain on, the blue light (or green light) of LED0 is always on, which means that the bridge is connected, the blue light (or green light) of LED0 is blinking, which means that the bridge is successfully paired, and the blue light (or green light) of LED0 does not light up, which means that the bridge has been disconnected.
2. LED1~3 represents the wireless signal strength, when all 3 LEDs are on, it means the rssi is greater than -48dBm;
When all 3 LEDs are on, it means rssi is greater than -48dBm; when 2 LEDs (LED1~2) are on, it means rssi is greater than -60dBm and less than -48dBm; when only LED1 is on, it means rssi is greater than -72dBm and less than -60dBm; when all 3 LEDs are not on, but the blue light (or green light) of LED0 stays on, it means rssi is less than -72dBm.
3. When the bridge is connected one-to-many, the signal strength light on the AP side is invalid because the STA may be near or far. You can check the signal indicator of the STA to know the signal condition.

The rssi information can be obtained by viewing the printout as shown below:

```
STA3: 0:22:33:44:12:55  
tx3: mcs=7 bw=8MHz snr=35 cnt=436 agg=9 data=461KB dur=137ms dut=4% cca=2180 ack=428KB(3772) drop=0KB(0) per= 7% d  
rx3: mcs=7 bw=8MHz evm(avg:std)=-29:1 rssi=-49 agc=7773 cnt=308 agg=23 data=11135KB fcsErr=0, freqDev=1791Hz, dur=33
```

Operating System Description:

The bridge is not running linux and does not support linux commands.

The bridge itself is not with IP, it needs to be connected to the device with IP to use, you can understand a pair of connected bridges as a network cable.

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2 Instruction

2.1 Pairing method

The following is an example of how to use multiple bridge solution demos:

1. Before powering up, set one of the demos to AP and the others to STA.
 2. Plug in the power supply. At this time, LED0 should light red, which means the power is normal.
 3. Press the pairing button of AP and one of STA, and wait for the blue light of LED0 of both demos to flash, which indicates that the two demos have been paired successfully and can be released. (If the pairing has been done before, you can skip step 3)
 4. Waiting for the light (or green light) of LED0 of the two demos in step 3 to light up indicates that the two demos have established connection, and the bridge can realize the function of Ethernet pass-through;
If the blue light (or green light) of LED0 of the 2 demos does not light up, it indicates that the 2 demos have not established connection or the connection has been disconnected.
 5. If there are more than one bridge solution demo to be connected, repeat steps 3~4.
 6. If the role of the demo has changed, the bridge demo needs to be re-paired to make sure the bridge demo can work normally.
- When step 4 is completed, the bridge demo will save the connection information and will be reconnected after the next re-powering or disconnection.

The status of the light after pairing is shown in Figure 3.



Figure 3 Pairing ok status

2.2 Traffic Test Method

2.2.1 Preparation

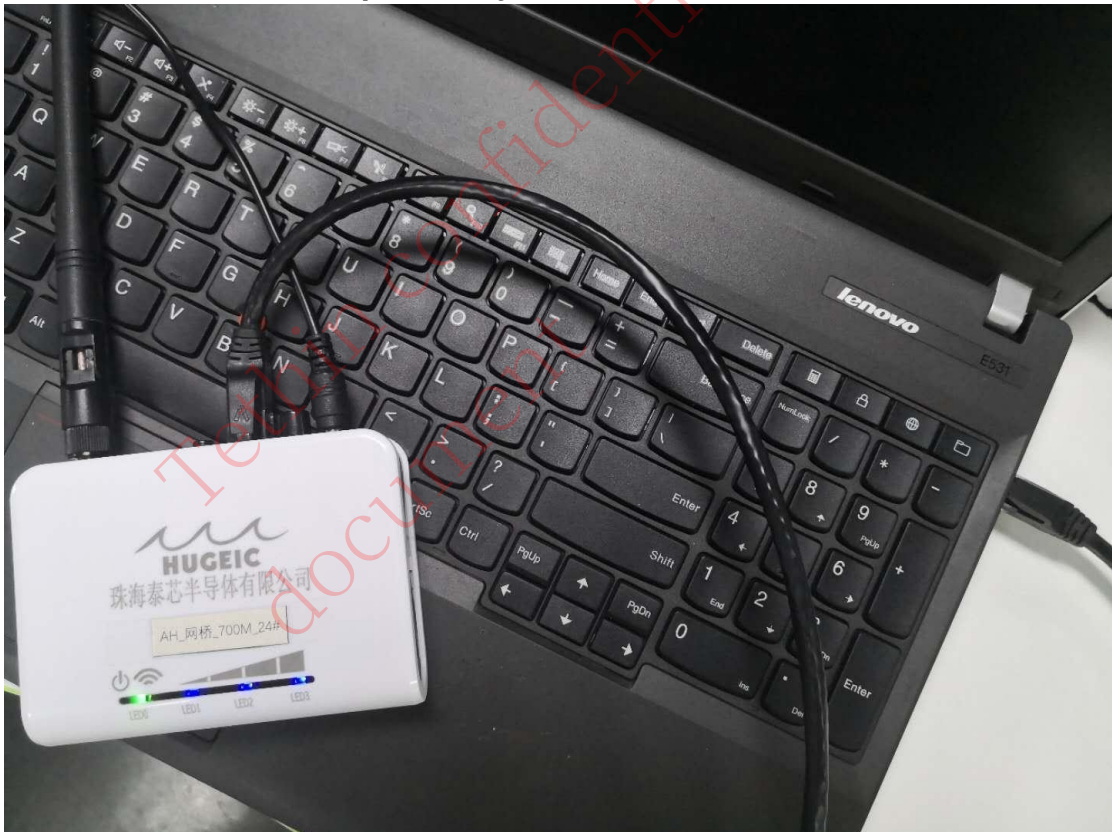
- Two windows computers with wired ports (if there is no wired port, usb adapter can also be used)
- Two network cables
- A pair of successfully paired Tethin bridges according to one section of the pairing method (including host, antenna, 5v power supply)
- jperf (contact FAE of Taixin to provide)

2.2.2 Playing traffic test method

2.2.2.1 Step 1: Connect a computer to the bridge with a network cable.

Connect one computer to the bridge with one cable.

Use a second cable to connect another computer to the bridge.

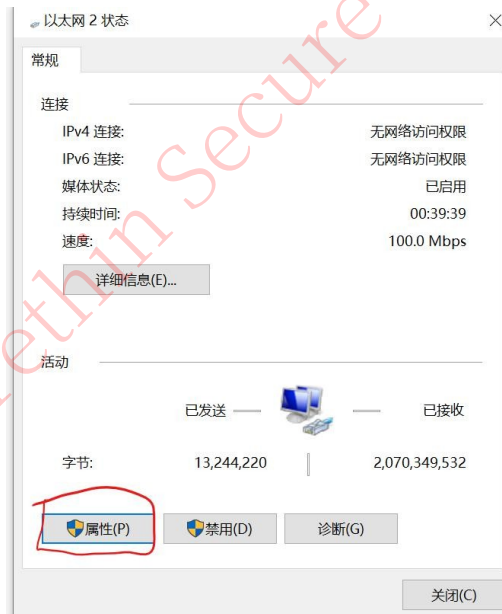


2.2.2.2 Step 2 Configure wired network ip addresses for both computers.

Open the Control Panel\Network and Internet\Network and Sharing Center and click on Ethernet as shown below.



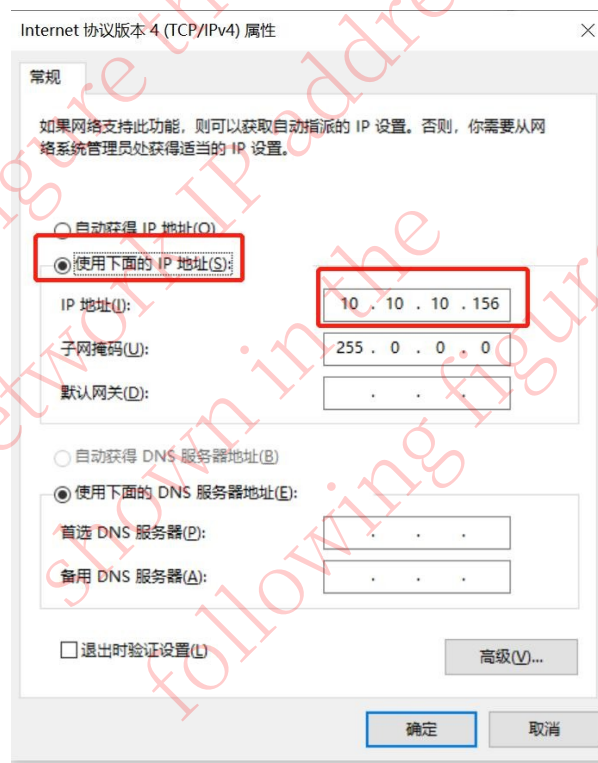
Click on Properties as shown below



Click on the internet protocol version option and click on Properties.



Configure the wired network IP address as shown below, for example, one computer is configured as 10.10.10.156 and the other computer is configured as 10.10.10.123.

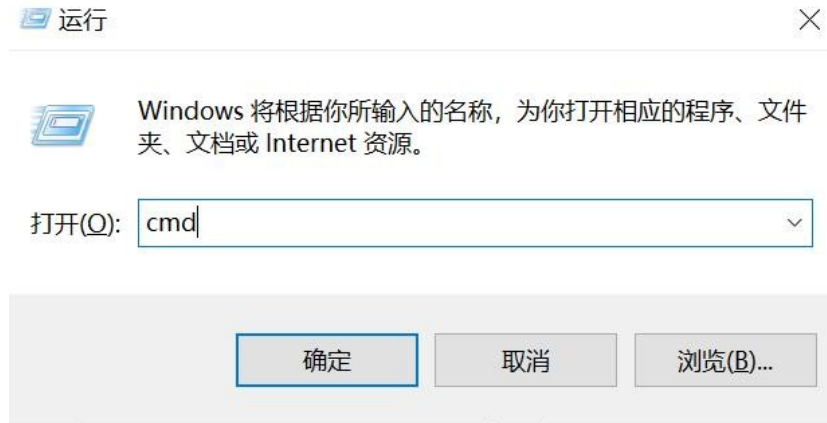


2.2.2.3 Step 3 Temporarily disable the firewall

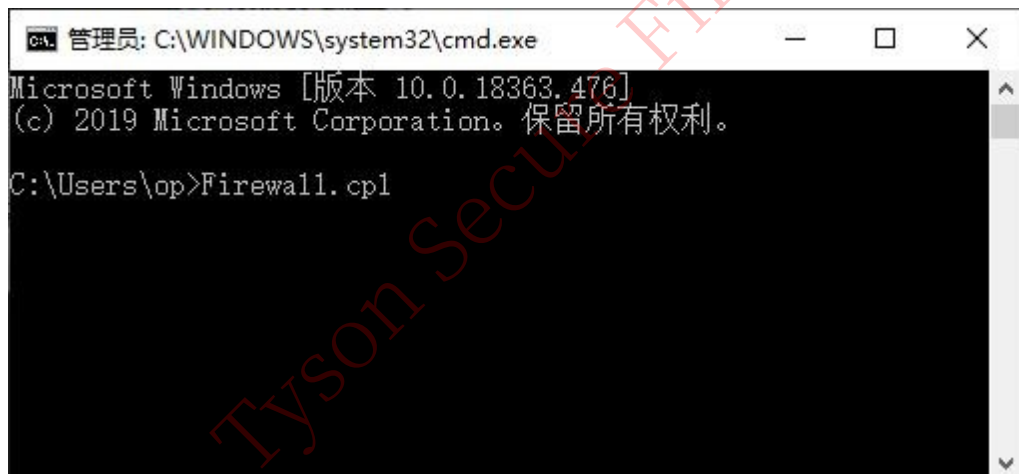
To use iperf as a traffic test method, turn off the firewall, otherwise the traffic test will not work.

Below is only the method to close the firewall that comes with windows, for other security software firewall, please find the method to close it by yourself:

1. Win+R to bring up the run interface, type cmd, and then press enter.



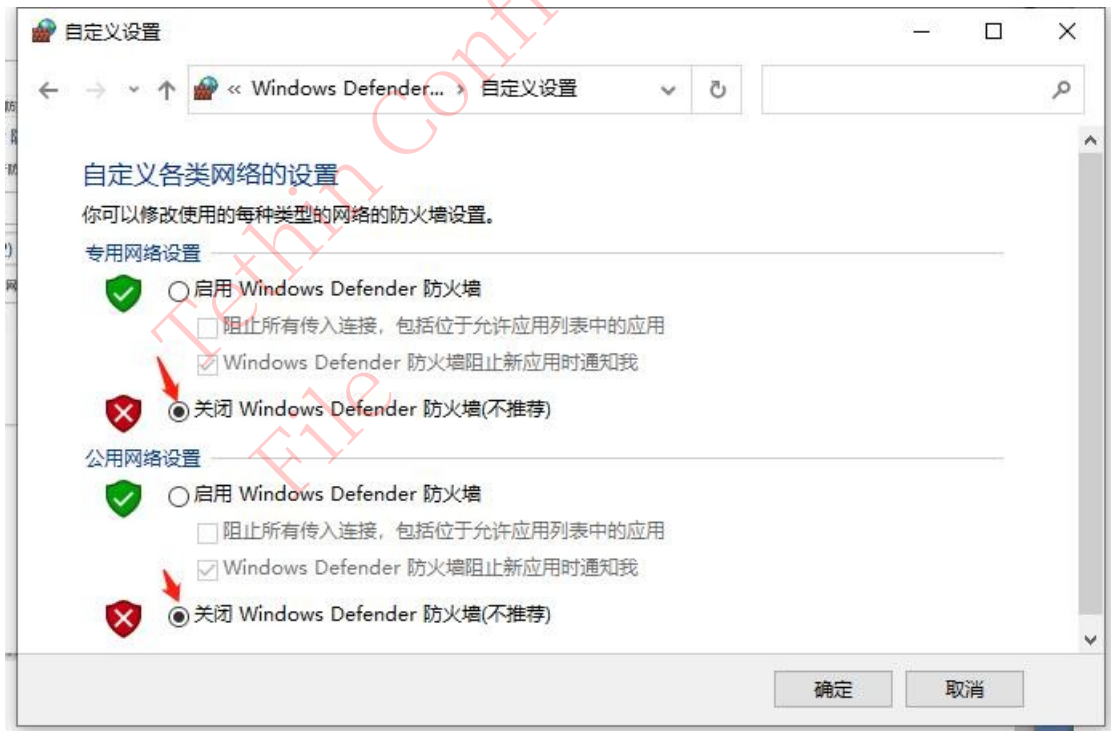
2. In the pop-up cmd interface, type Firewall.cpl, and then press Enter.



3. In the pop-up firewall page, click the 'Enable or disable Windows Defender Firewall' option



4. In the pop-up "Customize Settings" page, select "Disable Windows Defender" option, and then click OK.



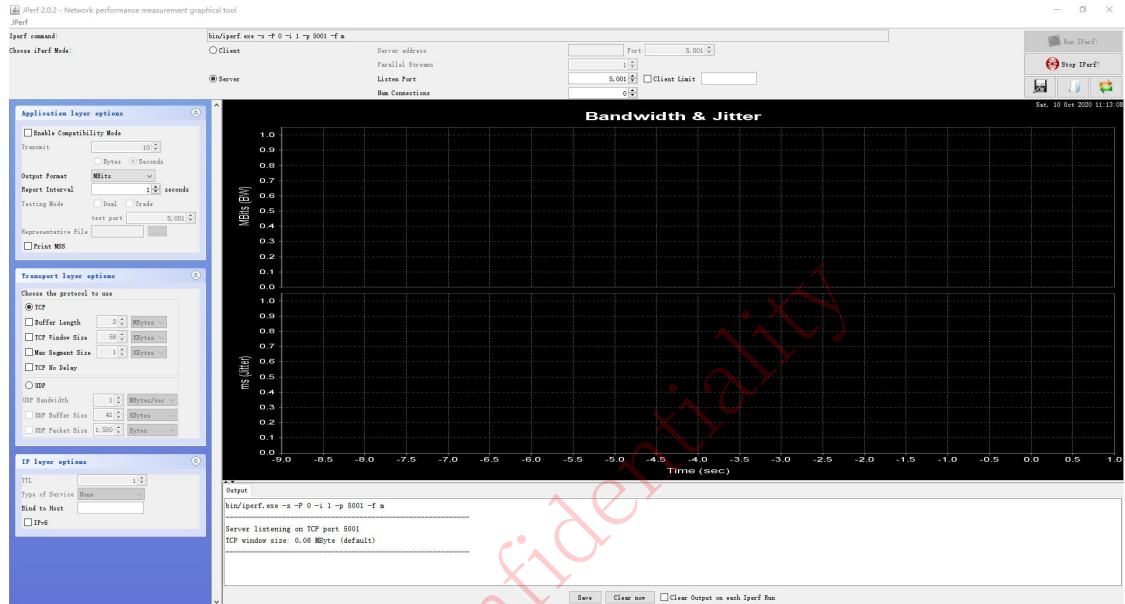
5. Wait for the traffic test to finish, you can turn on the firewall again in the page of Step 4.

2.2.2.4 Step 4 Run iperf to hit the traffic

1. tcp test:

Run iperf on the first computer (ip address is 10.10.10.156, the bridge is in ap mode). transport layer options choose tcp (default is tcp).

Choose iperf mode :server, i.e. as server. Then click run iperf.

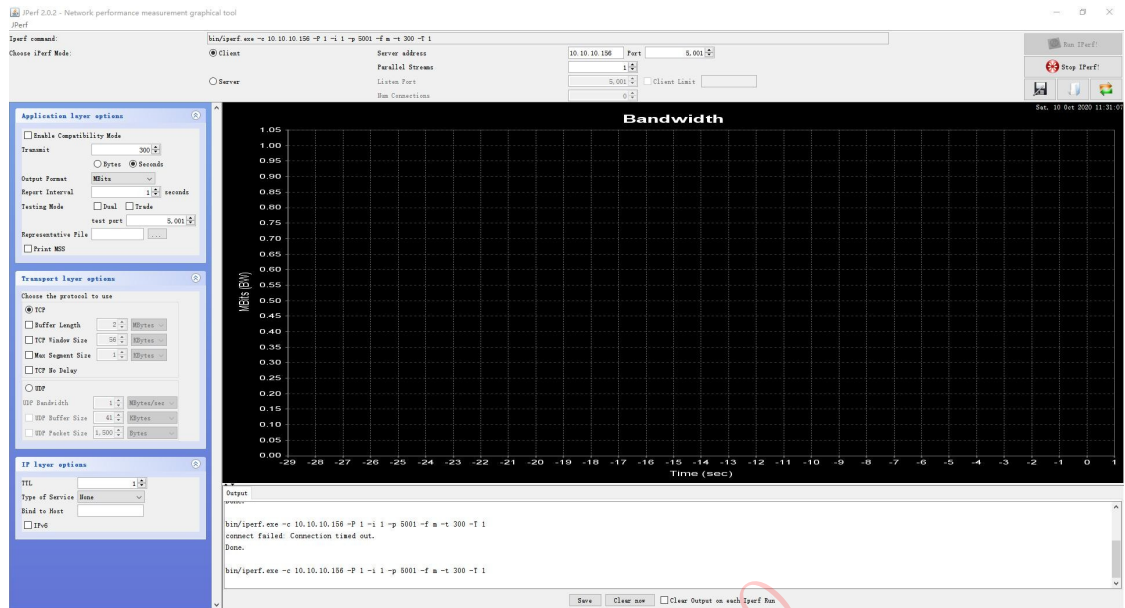


Run iperf on the second computer (ip address 10.10.10.123, bridge is in sta mode). transport layer options choose tcp (default is tcp).

Choose iperf mode :client, i.e. as client. server adress input another computer's ip, i.e. 10.10.10.156. port 5001 is the default port number, just keep the same between server and client.

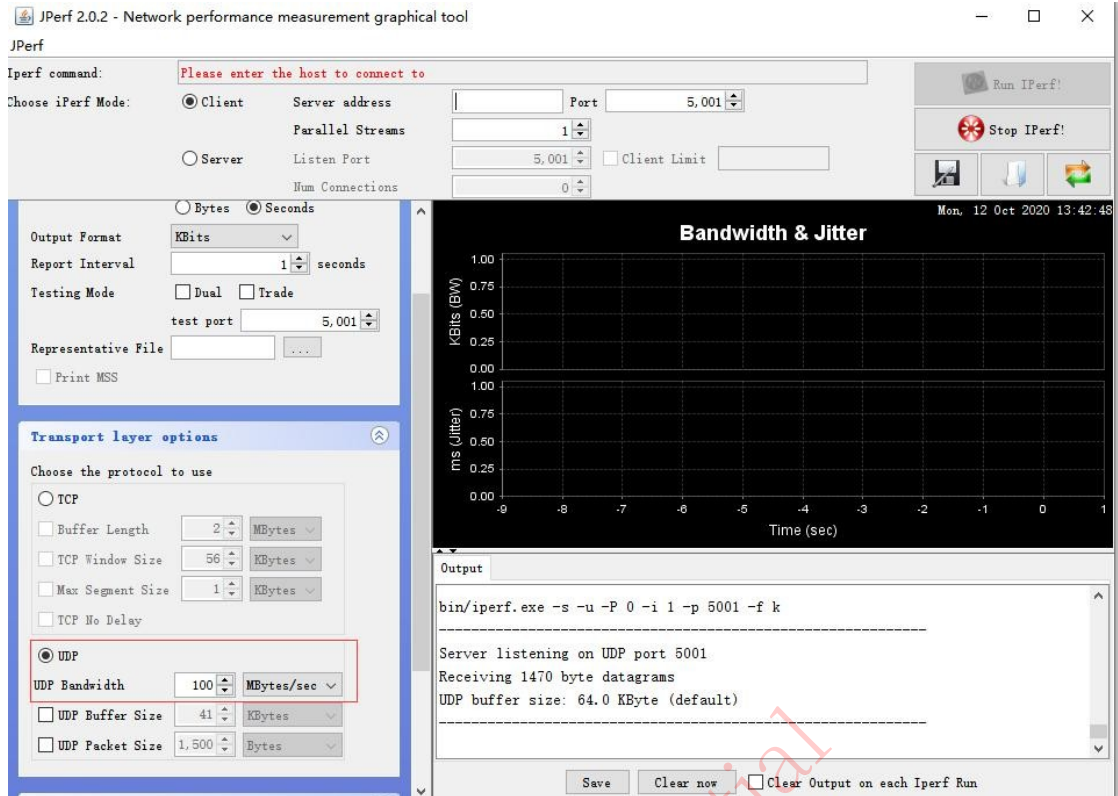
You can modify the traffic test duration (e.g. 600 seconds) in the transmit item of Application layer options. Select the traffic unit (e.g. Mbits) in the output format item.

Then click run iperf.



2. udp test

The steps are the same as for the tcp test, run iperf on the first computer, select udp in the transport layer options. Choose iperf mode :server, i.e. as a server, and click run iperf. Run iperf on the second computer, and choose udp in the transport layer options. Choose iperf mode :client, i.e. as a client, and set the udp bandwidth to udp bandwidth to Enter the ip of the other computer as the server adress. port 5001 is the default port number, keep the server and client the same, and then click run iperf. Observe the traffic data on the server side.



Currently, the bridge is designed to prioritize the traffic from sta to ap direction, if you switch the traffic direction to ap to sta, the traffic will be slightly smaller.

2.2.3 1M Mode Setting

Before snv version 11371, to work in 1M mode, you need to set tx_bw to 1M, bss_bw to 2M, please refer to subsection 2.3.2. After this version, you can set bss_bw=1 directly.

In 1M mode, if you use MCS2/4/0/10, you need to set MTU to 300 byte. ifconfig hg0 mtu 300

ifconfig eth2 mtu 300

2.3 Introduction of Common AT+ Commands

AT+ commands are a set of debugging commands defined by Tektronix AH program, communicating through UART serial port with baud rate of 115200; AT+ is not case-sensitive;

2.3.1 Common commands

1. AT+CHAN_LIST, set the center frequency of working channel, the unit is 100kHz, refer to the module specification for frequency range;
2. AT+BSS_BW, set the bandwidth of the channel in MHz, selectable as 2/ 4/ 8;
3. AT+TX_MCS, set the MCS of transmit signal, the selectable values are 0~7 and 255, if the value is set to 0~7, it means to select a fixed MCS, if the value is set to 255, it means to adjust automatically;
4. AT+SSID, set SSID.

The above commands will be saved when power off.

2.3.2 Example

Test item:

8M bandwidth MCS2, test command sequence:

1. AT+CHAN_LIST=9080,9160,9240 //Set the center frequency as 908M/916M/924M.
2. AT+BSS_BW=8 //Set bw to 8M;
3. AT+TX_MCS=2 //Set tx_mcs to 2;
4. AT+SSID=hgic_ah_test

2.4 Introduction to the net port tool

For the scenarios where the serial port is not convenient to use, Tecent provides two tools based on the network port for customers to configure parameters (netat.exe) and view logs (netlog.exe). Note that both tools can only work after the bridge firmware version 12954. The following describes how to use them.

2.4.1 Netat.exe

Use netat.exe when you need to configure the bridge parameters with AT+ commands.

Connect the bridge device and PC with a cable, double click to run, input the IP address of PC, it will show the mac of the connected device.

If only one device is connected, it will auto select device 1.

```
select ipaddr for bind:10.10.10.151
----- Discover 1 Device -----
1: fa-de-09-8a-9b-38
>:auto select device 1
```

If there are several devices connected through the switch, you can select the device by inputting the number

```
1>:
----- Discover 3 Device -----
1: f6-de-09-9b-a7-60
2: f6-de-09-60-96-60
3: f6-de-09-99-6f-60

1>:2
select device 2

2>:3
select device 3
```

显示识别了3台设备

默认选择第一台设备。输入数字可以切换选择其他设备

After selecting device, input AT command, then AT command will be executed, the usage is the same as serial port.

If you need the source code of netat for linux integration, please contact FAE to get it. [libnetat](#).

2.4.2 Netlog.exe

If you need to check the debug logs of the bridge with a network cable, you can use netlog.exe.

Connect the bridge device and PC with a network cable, double click and run netlog.exe, input the IP address of PC, it will print the log automatically, it will only show the log of the device connected by the network cable, be careful not to connect more than one device with the switch when you use it.

2.5 Firmware Upgrade Function

Old firmware version (before SVN 10000) needs to be upgraded by OTA tool, please consult FAE for details;

For new version firmware (SVN after 10000), besides OTA tool, you can also use UART to upgrade.

(at+fwupg), please consult FAE for details.

2.6 Relay Function Description

The bridge relay function is supported after firmware version 1.3.4.x. The relay node is in APSTA mode. The relay node is in APSTA mode. The number of relay levels is limited to one, when relaying one level, the traffic will be reduced by half, and the delay will be doubled, for example, under 8M bandwidth, when relaying one level, the peak traffic will only be about 8Mbps.

Note that the pairing and role buttons of the repeater node are invalid.

2.6.1 Configuration of Relay Network

2.6.1.1 Role Configuration

1, AP and STA nodes are recommended to use the Role button to select the role:

2, the role key of the repeater node is invalid, you can only use the serial port AT+ command to select the role:

AT+MODE=APSTA.

2.6.1.2 SSID Configuration

In the bridge network without relay node, the pairing between AP and STA can be realized by pressing the pairing key; in the bridge network with relay node, the pairing can be realized only by configuring SSID, the setting method is as follows:

1, AP: set SSID, for example, AT+SSID=AH_AP;

2,Relay: set R_SSID to connect with the previous node (i.e. AP), for example, AT+R_SSID=AH_AP; set SSID to connect with the next node (i.e. STA), for example, AT+SSID=AH_REPEATER; 3,STA: set SSID to connect with the next node (i.e. STA), for example, AT+SSID=AH_REPEATER.

3,STA: set SSID to connect with the relay node, e.g. AT+SSID=AH_REPEATER.

2.6.1.3 Key Setting

If encryption is not enabled, AT+KEYMGMT=NONE, you can not set the key;

If encryption is turned on, AT+KEYMGMT=WPA-PSK, the key (64 hex characters) should be set for each node, please refer to AT Command Development Guide:

1, AP: set PSK, the command is AT+PSK=xxx1 (a 64 hex character);

2,Relay: set R_PSK to connect with the previous node (i.e. AP), for example, AT+R_PSK=xxx1; set PSK to connect with the next node (i.e. STA), for example, AT+PSK=xxx2 (another 64 hex characters).

3,STA: set PSK to be used to connect with the relay node, e.g. AT+PSK=xxx2.

2.6.2 Signal indicator of relay network

In relay mode, STA signal light shows the signal strength to the relay, and the relay shows the signal strength to the AP. If the AP is connected to only one relay, the signal strength of the relay is displayed, if the AP is connected to two devices then all signal lights are on.

2.7 Roaming Function Description

Firmware version 1.3.4.x supports the bridge roaming function.

2.7.1 Roaming Configuration

2.7.1.1 SSID Configuration

The SSIDs of the APs in the roaming network can be set according to full word matching or fuzzy matching.

Full character matching: All APs' SSIDs are set to the same SSID, the length of SSID is not limited, no more than 32 characters, and the STA is also set to this SSID.

Fuzzy Matching: The last 3 characters of SSID of different APs are different, the total length of SSID should be more than 8 characters, which consists of a common string (at the beginning of SSID) and a 3-character ID (at the end of the string). For example, if the common string is HUGE_IC_AH, then you can set the SSID of AP1 to HUGE_IC_AH001, the SSID of AP2 to HUGE_IC_AH002, and the SSID of the STA should be set to be the same as the SSID of one of the APs.

2.7.1.2 Key Setting

It is recommended to turn on encryption (AT+KEYMGMT=WPA-PSK).

The keys of all APs and STAs in the roaming network should be set to be the same. Example:

```
AT+PSK=baa58569a9edd7c3a55e446bc658ef76a7173d023d256786832474d737756a82
```

Please refer to the AT Instruction Development Guide.

2.7.1.3 Roaming Mode Enable

STA node needs to enable roaming mode (AT+ROAM=1).

2.8 Auto Relay Function Description

Auto Relay is realized by using Relay+Roaming function, that is, except AP node, all other nodes are configured as Relay, and Roaming function is turned on, then it can automatically realize that the remote node is relayed to the AP through other nodes, and there is no need to fix a certain node as a relay node.

2.8.1 Configuration of Auto Relay

2.8.1.1 Configuration of SSID

In order to automatically roam and switch to the relay device according to the distance, it is recommended to set the SSID to the same SSID with an unlimited length of no more than 32 characters. The setting method is as follows:

AP: Set SSID, for example, AT+SSID=HUGE_IC_AH001;

Relay 1: Set R_SSID is used to connect with the previous node (i.e., AP), e.g. AP), e.g.

```
AT+R_SSID=HUGE_IC_AH001
```

AT+R_SSID=HUGE_IC_AH001; set SSID to connect with the next level node (i.e. Relay 2), for example: AT+SSID=HUGE_IC_AH001;

Relay 2: set R_SSID to connect with the next level node (i.e. relay 1), e.g. AT+R_SSID=HUGE_IC_AH001; set SSID to connect with the next level node (i.e. relay n-1), e.g. AT+SSID=HUGE_IC_AH001;

Relay n: set SSID to connect with relay n-1, for example, AT+R_SSID=HUGE_IC_AH001;

2.8.1.2 Key Configuration

It is recommended to turn on encryption (AT+KEYMGMT=WPA-PSK) and set the key to be the same for all APs and APSTAs. Example:

AT+PSK=baa58569a9edd7c3a55e446bc658ef76a7173d023d256786832474d737

756a82 Refer to the AT Instruction Development Guide for details.

If encryption is turned off (AT+KEYMGMT=NONE) all devices are required to have encryption turned off.

2.8.1.3 Configuration of Roaming

Roaming mode needs to be enabled for all relay devices (AT+ROAM=1).

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3 Precautions for use

3.1 Precautions for installation location

- It is recommended to use a bracket to elevate the bridge to more than 1.5 meters, in order to eliminate the interference of the antenna propagation route caused by the movement of people;
- Do not place the bridge too close to the wall, it will affect the performance of the antenna;
- Some antennas do not support bending, if the antenna is labeled "Do not bend", do not bend it.
- Do not place the bridge too close to the wall, it is recommended to keep the distance more than 1 meter to prevent the signal from being too strong.



The reason why the bridge needs to be placed at a distance is that the 900mhz/700mhz radio Fresnel zone is relatively small compared to the 2.4Ghz Fresnel zone.

2.4Ghz Fresnel zone is higher. The following figure shows a comparison of 700mhz and 2.4Ghz Fresnel zone calculations.

中国移动4G
下午4:47
菲涅尔区在线计算|无线传输损耗计...

中国移动4G
下午4:48
菲涅尔区在线计算|无线传输损耗计...

菲涅尔区图示:

菲涅尔区图示:

频率: 700 兆赫兹 (MHz)
距离: 0.5 千米(Km)

清空 计算

菲涅尔区半径: 7.32 米(m)
天线最小高度: 障碍物高度 + 5.86 米 (m)

频率: 2400 兆赫兹 (MHz)
距离: 0.5 千米(Km)

清空 计算

菲涅尔区半径: 3.95 米(m)
天线最小高度: 障碍物高度 + 3.16 米 (m)

Fresnel zone calculation link <https://lunaw.cn/wifical/?from=groupmessage>

3.2 Power Supply Considerations

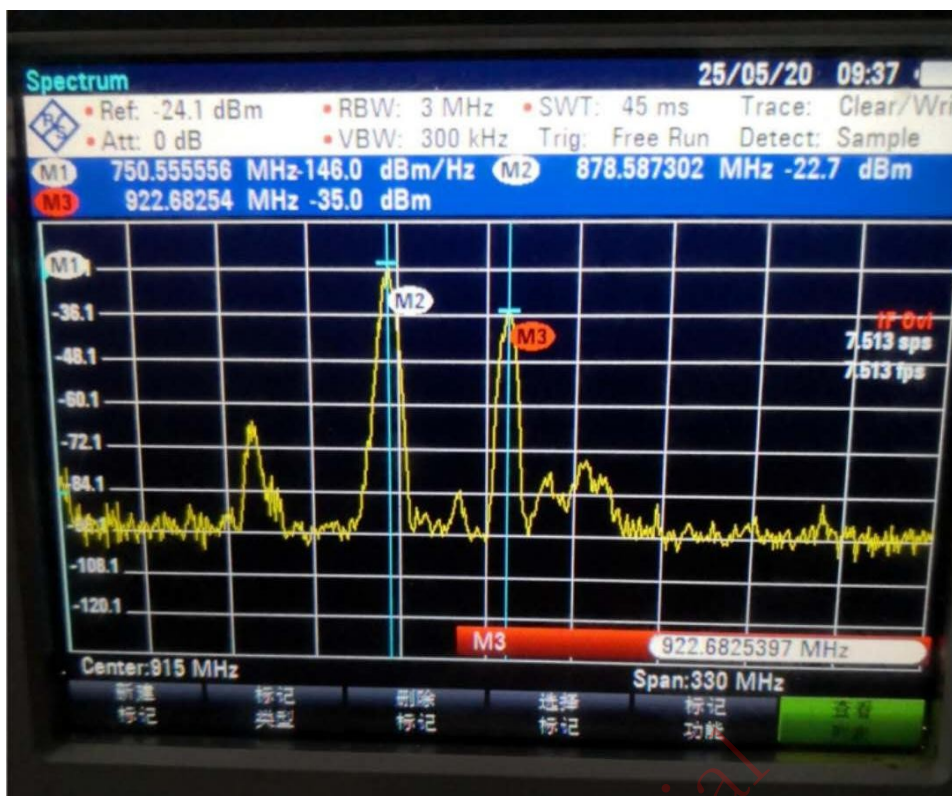
The bridge supports 5v and 12v power supply.

The resistance of the power supply line should be less than 0.2 ohm, in short, the thicker the better, too thin power supply line may lead to too large a voltage drop and cause the bridge to work abnormally.

Please note that the USB of your computer is only 5V (500mA), which can't supply the power of the bridge, please don't use the USB of your computer to supply the power.

3.3 Avoiding Interference

Communication performance can also be seriously affected if high power interference signals are present in the test environment. If you have a spectrum analyzer, please measure the condition of the empty port at the working frequency of 700~1000mhz. The following figure shows the situation where there is obvious high-power interference near 900mhz, using a portable spectrum analyzer.



4 Common Troubleshooting

4.1 Unable to pair

Check if the mode key (see the physical picture of the bridge solution demo in Chapter 1) is correct, the correct method is that one and only one bridge should be in AP mode, the remaining one or more bridges should be in STA mode.

If the pairing network is unable to restore the factory settings (using the factory restore function of the OTA tool) and then pair again. Note that after restoring the factory settings, any previously maintained pairing information is lost.

4.2 Reboot repeatedly

Check whether the bridge power supply voltage is normal, for example, whether the power supply wire is too thin and the voltage drop is too large.

4.3 Abnormally low flow rate

Please refer to the section on usage precautions.

4.4 The demo fails to connect after reboot after switching roles.

Our bridge demo supports working mode (AP/STA) hot-switching. When the role of the bridge demo is switched, the bridge automatically reboots.

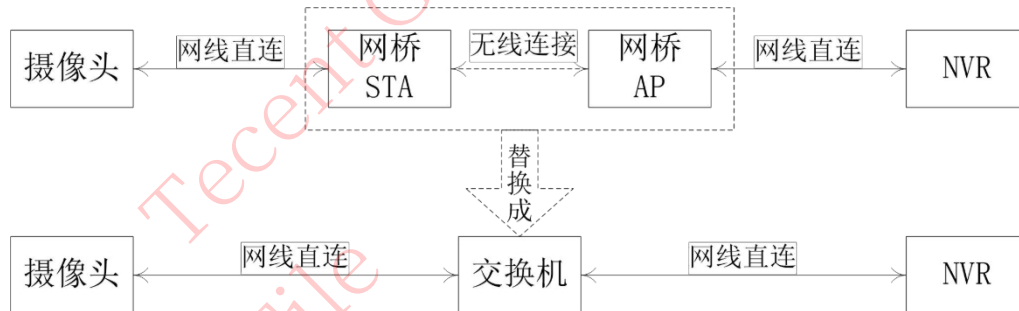
It is important to note that if the bridge demo has been paired with more than 1 other bridge demo, the bridge demo will only reconnect to the saved bridge demo after switching roles (the bridge demo after switching actually initiates the reconnection, but not necessarily the bridge demo that the client thinks it is). (the switching bridge demo actually initiates a callback, but not necessarily to the bridge demo that the client thinks it is).

Therefore, we require the demo to be re-paired after switching roles to ensure that the bridge works properly afterwards.

4.5 Bridge shows connected but not communicating properly

If you encounter this problem, you can follow the steps below to locate the problem:

1. First, determine whether the Ethernet connection is normal. If the LED of the RJ45 of the bridge does not light up, it means the Ethernet connection is not normal, you can try to replace the network cable, or check whether the device connected to the bridge is normal.
2. The Ethernet connection is normal, but the communication is not normal. In this case, you can replace the bridge with a switch to locate what went wrong:
 - a) Determine the conditions that reproduce the problem. For example, the order of powering up the bridge and the connected devices, the order of unplugging the network cable, etc.
 - b) Our bridges are essentially switches that transmit data with a delay, so you can use a switch to replace the bridge and determine where the problem is. Here we recommend using a pure pass-through switch (such as Mercury's SG105M switch). The following figure shows how to replace a bridge with a switch, taking NVR and camera as an example:



- c) After completing the replacement of the bridge with a switch, use step a to reproduce the problem conditions (such as the power-up sequence of the switch and connected devices, and the unplugging and plugging sequence of the bridge, etc.), and observe whether there are still communication irregularities. If the communication problem still occurs after using the switch, it means that the problem is not with the bridge, but with the devices connected to the bridge. On the contrary, the problem occurs

It is a bridge, at this point you need to contact our FAE.

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Appendix

A Reference Traffic Indicator

A.1 Through-floor test

Test location: Tecent office building. One bridge is fixed in the stairwell of the 1st floor, and the other one is mobile.

900M拉距离.xlsx - Microsoft Excel

	A	B	C	D	E	F	G	H	I
1									
2	楼层	evm	tx mcs	rx mcs	bgrssi	rssi	平均流量 (KB/s)		
3	2楼	-30	7	7	-97	-37~-38	1858	备注: 频点890MHz	
4	3楼	-28~-30	7	6~7	-98~-99	-52~-57	1679		
5	4楼	-21~-24	3~4	4~5	-97	-65~-67	1030		
6	5楼	-9~-12	0	0	-99	-86	169	备注: 不稳定	
7									

700M网桥拉距离.xlsx - Microsoft Excel

	A	B	C	D	E	F	G	H	I
1									
2	位置	evm	tx mcs	rx mcs	bgrssi	rssi	平均流量 (KB/s)		
3	2楼	-28~-30	7	7	-97	-35~-38	1907		
4	3楼	-30	7	7	-97	-48~-49	1914		
5	4楼电梯门口	-6~-14	0~2	0~1	-94	-72~-80	296		
6	4楼楼梯间 稍微 远离墙角	-21~-22	6~7	4~5	-96~-97	-68~-69	1785		
7	4楼楼梯间 墙角	-18~-14	1~2	0~1	-97	-77~-80	589		
8	5楼	-10~-12	0~1	0~1	-97	-79~-82	448		
9	5楼电梯门口							备注: 几乎无流量, 经常断线	
10	3楼办公桌	-12~-13	1~3	0~1	-95	-73~-74	731	备注: 只统计在我自己座位上的数据	
11									

A.2

Straight line distance (m)	evm	tx mcs	rx mcs	bgrssi	rssi	Average traffic (KB/s)	Frequency (MHz)
300	-28~-29	6~7	6~7	-95~-97	-95~-97 -59~-61	1849	890
600	-19	1	1~3	-95~-96	-68~-69	After the slave side is raised, there are 630KB/s	906

1200	-20~-21	0~1	1~4	-94~-95	-65~-67	After the slave side is raised, there are 808KB/s, and after the slave side is lowered, there are about 500KB/s	906
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Special note: The distance test was conducted on the Qi'ao Bridge, the 300m and 600m locations are located on the bridge, and the 1200m location is where the ap and sta can be across the sea. Therefore, the test shows that the flow rate at 1200m may be higher than that at 600m.

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