Firetide

User Guide
FWB-205
Wireless Bridge

2011-09-25 3.1
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firetide®
Reliable connectivity anywhere™

Caution! Risk of electric shock! Do not open the cover.

Every year, people are killed by touching overhead power lines. Don't be one of them. Do not install where possible contact with power lines can be made. Make sure there is NO possibility that equipment or personnel can come in contact directly or indirectly with power lines.

The horizontal distance from a tower, pole or antenna to the nearest power line should be at least twice the total length of the pole/antenna combination. This will ensure that the pole will not contact power if it falls either during or after installation.

Look over the entire site before beginning any installation and anticipate possible hazards. Never assume anything without checking it out for yourself! Don't take shortcuts!

TO AVOID FALLING, USE SAFE PROCEDURES WHEN WORKING AT HEIGHTS ABOVE GROUND

- Select equipment locations that will allow safe and simple installation.
- Don't work alone. A co-worker can save your life.
- Don't attempt repair work when you are tired. Not only will you be more careless, but your primary safety tool - your brain - will not be operating at full capacity.
- Use approved non-conducting ladders, shoes, and other safety equipment. Make sure all equipment is in good repair.
- If a tower or pole begins falling, don't attempt to catch it. Stand back and let it fall.
- If anything does come in contact with a power line, DON'T TOUCH IT OR ATTEMPT TO MOVE IT. Instead, save your life by calling the power company.
- Don't attempt to erect antennas or towers on windy days.

MAKE SURE ALL TOWERS AND POLES ARE SECURELY GROUNDED, AND ELECTRICAL CABLES CONNECTED TO ANTENNAS HAVE LIGHTNING ARRESTORS. This will help prevent fire damage or human injury in case of lightning, static build-up, or short circuit within equipment connected to the antenna. Be sure that any other equipment connected to Firetide products also have protection.

- The base of the antenna pole or tower must be connected directly to the building protective ground or to one or more approved grounding rods, using 10 AWG ground wire and corrosion-resistant connectors.
- Refer to the National Electrical Code for grounding details.

IF AN ACCIDENT SHOULD OCCUR WITH THE POWER LINES DON'T TOUCH THAT PERSON, OR YOU MAY BE ELECTROCUTED.

- Use a non-conductive dry board, stick, or rope to push or drag them so they no longer are in contact with electrical power.
- Once they are no longer contacting electrical power, administer CPR if you are certified.
- Immediately have someone call for medical help.

Limited End User Product Warranty

Pursuant to all provisions described herein, Firetide hardware products and Firetide antennas are warranted for one (1) year from the date of purchase against defects in the build materials and workmanship. Firetide does not warrant that the Products will meet any requirements or specifications of any End User Customer. This warranty applies to the entire Firetide product, including the AC power adapter.

Pursuant to all provisions described herein, Firetide software products are warranted for ninety (90) days from the date of purchase against defects in the build materials and workmanship. Firetide also warrants that the Software will materially conform to the documentation supplied by Firetide with the Software. In the event that the Software fails to materially conform to the documentation and an authorized Firetide reseller is notified in writing of such failure within the warranty period, Firetide or its reseller shall use commercially reasonable efforts to promptly correct the nonconformity. Firetide does not warrant that the use of the Software will be uninterrupted or error free.

The above warranties are void if the alleged defect cannot be verified by Firetide or if, as determined by Firetide, the product failure was due to tampering, abuse, misuse, accident, shipping, handling, or storage; or if the product has been installed, used, or maintained in a manner not described in the product user manual; or if the product has been altered in any way; or if product serialization has been altered. Any attempt to disassemble or repair the product by anyone other than Firetide immediately voids this warranty.

This warranty applies only to the original End User purchaser of the product and may not be transferred to any other individual or entity.

The foregoing are the exclusive warranties applicable to the product including the software, and the exclusive remedy for defects in the product. Firetide disclaims all other warranties, whether express, implied, statutory or otherwise, including but not limited to implied warranties of merchantability, non-infringement or fitness for a particular purpose. Some laws do not allow the exclusion of implied warranties so to that extent this limitation may not apply to you.

In no event will Firetide be liable for any special, incidental, consequential, punitive or indirect damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or other pecuniary loss) arising out of the use or inability to use the product or the performance, interruption or failure of the product, irrespective of the cause of action, even if Firetide has been advised of the possibility of such damages. Firetide's cumulative liability for all claims arising out of or in connection with this warranty will not exceed the amount paid by the original End User purchaser to purchase the product. The amounts payable for the product are based in part on these limitations and these limitations shall apply notwithstanding the failure of essential purpose of any remedy. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so to that extent the above limitations or exclusions may not apply to you.

By using the product the original End User purchaser agrees to and is bound by these terms and conditions.

In the event that a product fails to meet this warranty and Firetide's authorized reseller is notified in writing of such failure within the warranty period, Firetide shall, at its own discretion, either repair the product or replace it with the same or a functionally-equivalent product free of charge. Replacement products may contain refurbished materials in whole or in part. Firetide will honor this warranty provided the product is returned through an authorized Firetide reseller or dealer with shipping charges prepaid, along with a proof of purchase describing the original purchase date and product serial numbers if applicable. The authorized reseller must acquire a Return Materials Authorization (RMA) number from Firetide prior to returning any product. Firetide does not accept shipments of defective products without shipping charges prepaid.

Please contact your Firetide dealer for instructions on returning defective or damaged products for repair or replacement. Do not return products to Firetide, Inc. Please keep all original packaging materials in the event they are needed to return the product for servicing.

Table of Contents

Chapter 1 Introduction

The FWB-205 provides a point-to-point Ethernet connection between two locations. The devices function as a low-level Ethernet bridge. Ethernet frames sent to a unit at one end are automatically forwarded to the other end, and vice-versa. The system is two-way, half-duplex. Sustained link speeds over 100 Mbps are achievable, and the system will allocate this bandwidth in the two directions dynamcially to meet traffic needs.

FWB-205 configuration is easy; it can be performed with a browser. Under normal circumstances, the two units exchange configuration information automatically.

The FWB-205 Kit is shown in Figure 1. Each kit includes two radio modules, two 19-dBi MIMO antennas, RF cables, two Ethernet PoE injector/powersupplies, two short Ethernet cables, and mounting hardware.

NOTE: The FWB-205 and its two 19 dBi panel antennas are intended for fixed (non-mobile), point-to-point applications only. Any other use is prohibited.

Figure 1. FWB-205 Kit Contents

1.1 Planning Your Installation

You must set the units up on the bench and perform several initial configuration steps prior to installing the units in the field. Basic configuration parameters include:

- IP addresses
- Country code
- Radio channels

These must be set prior to field deployment. The configuration parameters can be modified later, if desired. Many system designers choose to set all configuration parameters on the bench, prior to field deployment. Refer to “Chapter 2 Initial Setup for the FWB-205” on page 6 for basic setup information. Refer to “Chapter 3 Radio and System Settings” on page 9 for complete software configuration information.

Note that is is not necessary to connect the antennas when performing basic bench configuration. The units will establish a radio connection without antennas when in close proximity.

1.1.1 Field Installation

After basic software configuration is complete, the units can be deployed in the field. Installation requires these tools:

- 1/2-inch open-end wrench
- 7/16-in open-end wrench
- 3/8-inch open-end wrench
- Phillips screwdriver
- Channel-lock or slip-joint pliers
- RJ-45 crimping tool and male plug
- Waterproofing tape or mastic for RF connections.

The assembly must be grounded. If the mast is not already properly grounded, you will need appropriate grounding hardware. Consult local codes.

Refer to “Chapter 4 Antenna Installation” on page 14 for complete installation instructions.

Chapter 2 Initial Setup for the FWB-205

2.1 Initial Setup & Login

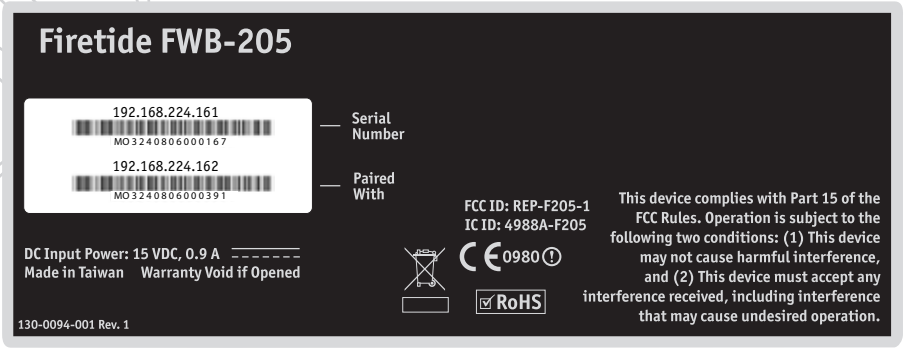
The FWB-205 nodes are sold in pairs. and each pair has been programmed at the factory to work with each other. Installation of the nodes should only be done by qualified and experienced personnel. Outdoor installation involves many safety hazards, including electrocution, lightning strikes, and falls. Please be careful.

In all cases, test and configure the nodes before mounting it on the pole or mast. Set the two nodes up on the bench and apply power. Wait about 1-2 minutes for the nodes to boot up and establish a radio connection. The LEDs should look like Figure 2, with both LEDs a steady green color. If the nodes are not able to establish a connection, the '5G' LED will blink. Proceed anyway.

Figure 2. LED Pattern for Normal Operation

Each unit has a label, as shown, which identifies the unit and its partner. (The label is on the bottom of the unit. You will need to remove the mounting plate to see the label. Use a Philips screwdriver.) FWB nodes are paired, or "married", at the factory. Within each pair, the unit with the lower serial number is assigned IP address 192.168.224.161, and the unit with the higher serial number is assigned IP address 192.168.224.162. Configure your computer to have an IP address on the subnet 192.168.224.0/24. Using a CAT-5 cable, onnect your computer to the power insertion unit which feeds the lower-numbered member of the pair.

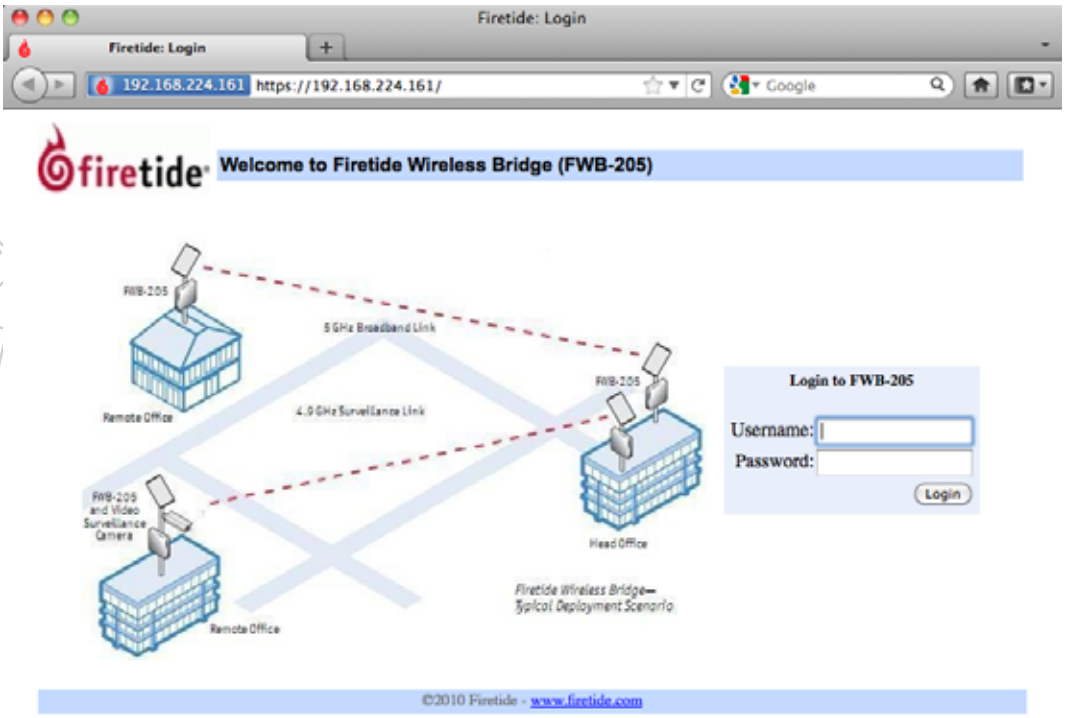
Figure 3. FWB-205 Label



Using an RJ-45 CAT5 cable (not supplied), connect your computer to the unit labeled with the 192.168.224.161 IP address. Point the browser at **https**://192.168.224.161. Note: use a secure web connection (**https)** not a conventional connection (http). A website security certificate warning may occur; ignore it for now. If possible, do NOT add the certificate to your browser's list of trusted certificates; this will prevent you from logging into the second node in the pair, should that be necessary.

Note to Firefox users: Firefox will require you to add the certificate in order to proceeds. If you need to connect to the other node, you must delete the certificate and re-start Firefox.

You will be asked for a login and password; the defaults are **admin** and **firetide**. You should change these when you configure the FWB units.



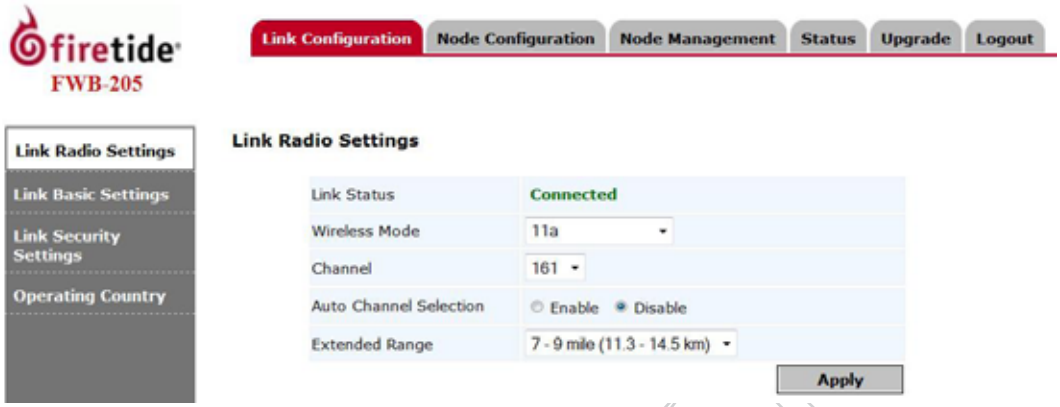
Operating Country

Some Firetide FWB-205 nodes require that you enter the country of operation to ensure compliance with the channel limitations, indoor/outdoor restrictions, and license requirements of your region. Selecting a country other than where you are using the device may result in illegal operation and may cause harmful interference to other systems. The node will reboot after you click Apply to set the country code.

Link Radio Settings

The **Link Status** field, under the **Link Configuration** tab, shows whether or not the two nodes connected.

It also shows the radio channel setting.



If the two nodes did not connect with each other, you must connect your PC to the second node and point your browser at https://192.168.224.162. Log in as before, and set the second node's country code. Make sure the second node's radio settings match the settings of the first node. The nodes should connect. If they do not, contact Firetide Customer Support.

Extended Range can be set from 0 to 9 miles (0 to 14.5 km). Increasing the range setting does not actually increase the range or power of the radios. Rather, it affects the timing of pauses between packets. Longer links require longer pauses. Set this parameter to be greater than the path length. A too-short setting will result in frequent collisions and reduced throughput.

Click **Apply** to save settings.

If you wish to configure other settings on the nodes before deployment, proceed to the next chapter.

Chapter 3 Radio and System Settings

Radio and System settings include Link Configuration (RF settings), Node Configuration (IP and network settings), Node Management Settings, Node Status, and Firmware Upgrade commands.

3.1 Link Configuration

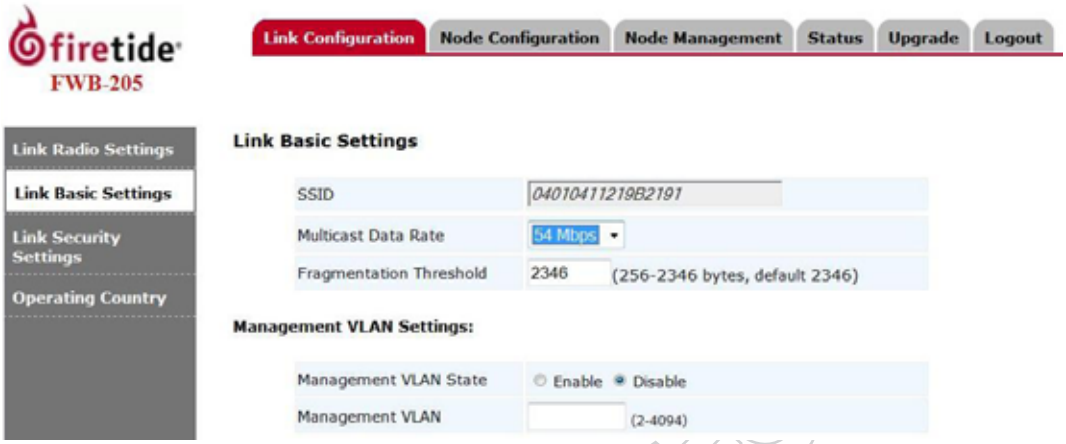
Link Basic Settings

Link Basic Settings include Multicast Data Rate, Fragmentation Threshold, and Management VLAN Settings.

The multicast data rate can be set from 1 Mbps up to 54 Mbps. Per the original 802.11 standard, many WiFi systems automaticlly slow down when sending multicast traffic, to maximize the likelihood of all recipients receiving the signal. In a point-to-point configuration this is not necessary, thus a setting of 54 Mbps is recommended.

The fragmentation threshold is generally best left at the default setting of 2346.

Management VLAN status can be enabled or disabled. If you are unsure, leave it disabled. If enabled, select the appropriate management VLAN number. Click Apply to save settings.



Link Security Settings

Link Security Settings provide support for encryption. The default is Enabled, WPA2-PSK.

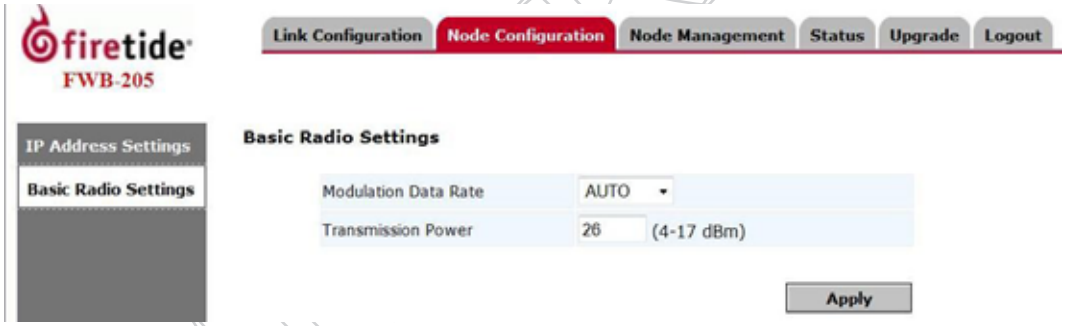
3.2 Node Configuration

IP Address Settings

Enter the node IP address, IP Net Mask, and Gateway IP address. Click Apply to save settings.

Basic Radio Settings

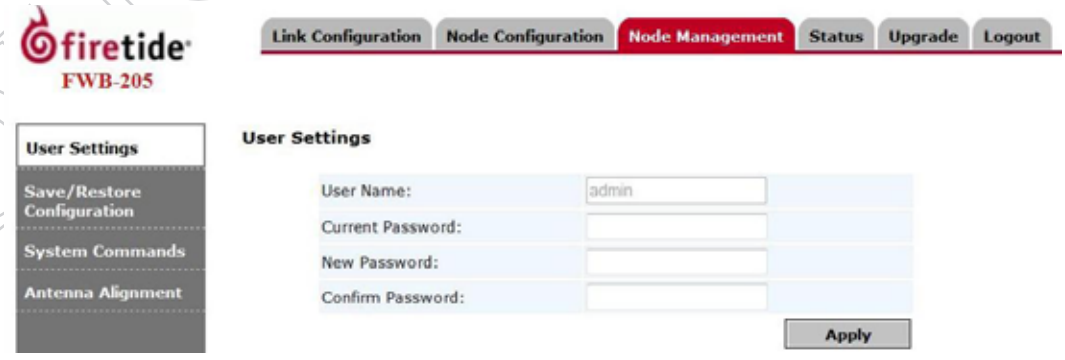
Node settings for Modulation Data Rate & Transmission Power can be set. Click Apply to save settings.



3.3 Node Management

User Settings - Changing the Password

Configure users with node management privileges here by adding & changing User Name and Password.



Save/Restore Configuration

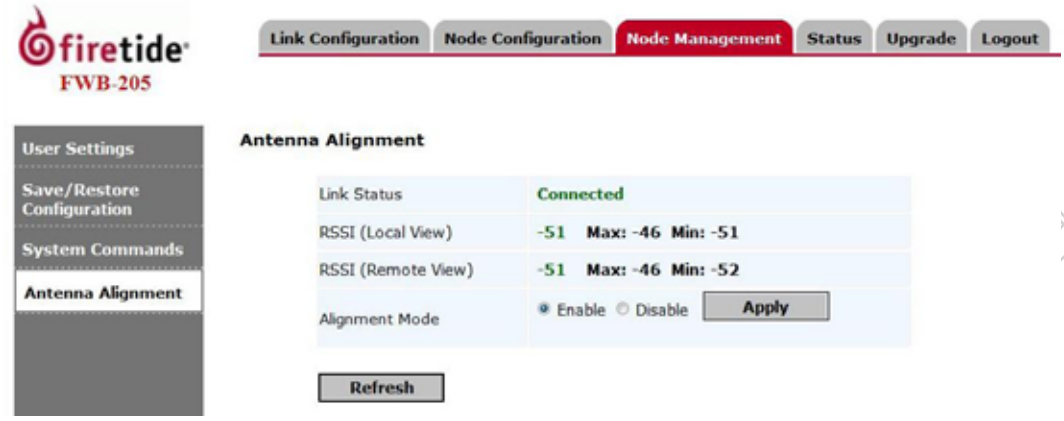
You can save the current link configuration as a file, then restore the settings later.

System Commands

System Commands let you reboot the node or perform a factory reset. Note that a factory reset will re-enable the antenna alignment tool, and require you to re-specify the country code.

Antenna Alignment

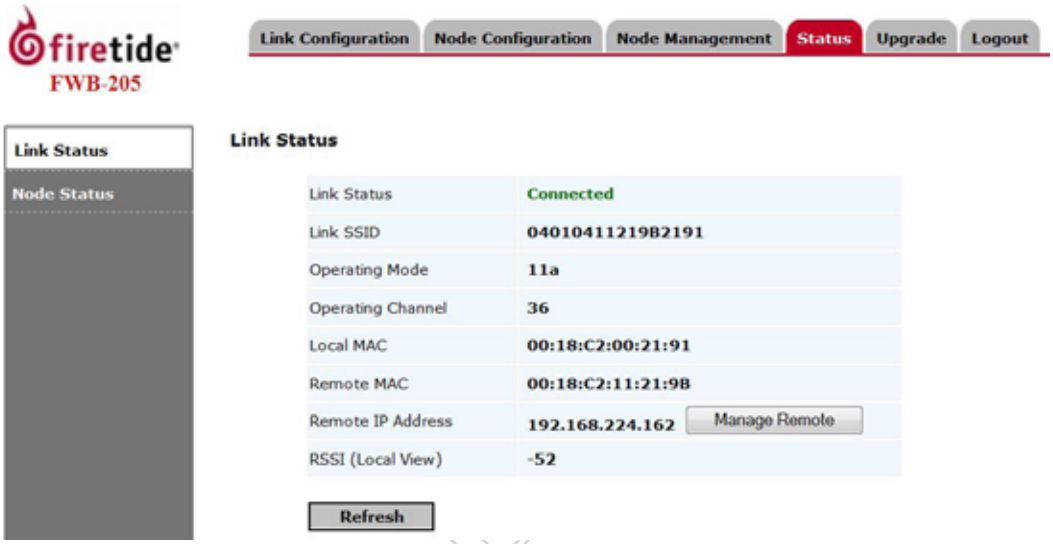
Antenna alignment settings are available here. Alignment is on by default. To insure maximum performance, turn off the alignment feature after alignment is complete.



3.4 Status

3.5 Link Status

Link Status is displayed here. Click Refresh to see the current status. Link status includes current radio operating mode, RF channel, node MAC addresses, and IP addresses. The Manage Remote button lets you connect to and manage the remote node, as long as the RF link is up.



3.6 Node Status

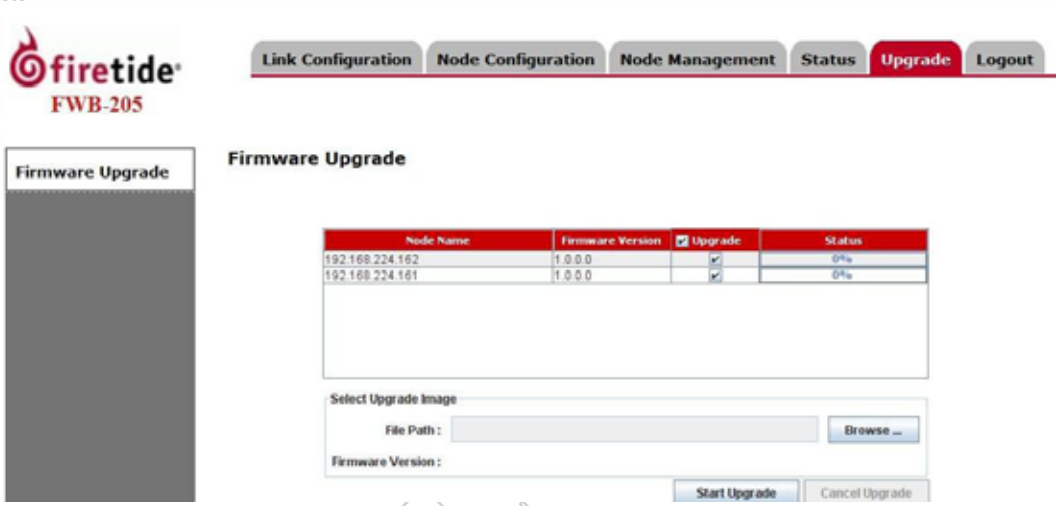
Node Status is displayed here. Click Refresh to see the current status.

3.7 Upgrade

3.8 Firmware Upgrade

In order to upgrade firmware, you must have Java installed on your PC. When you begin this process, the Java applet will take a moment to load.

Browse to select upgrade image. Click Start Upgrade to begin. Once started the upgrade can be cancelled by clicking Cancel Upgrade.



3.9 Logout

Select the Logout tab to exit from the session.

Chapter 4 Antenna Installation

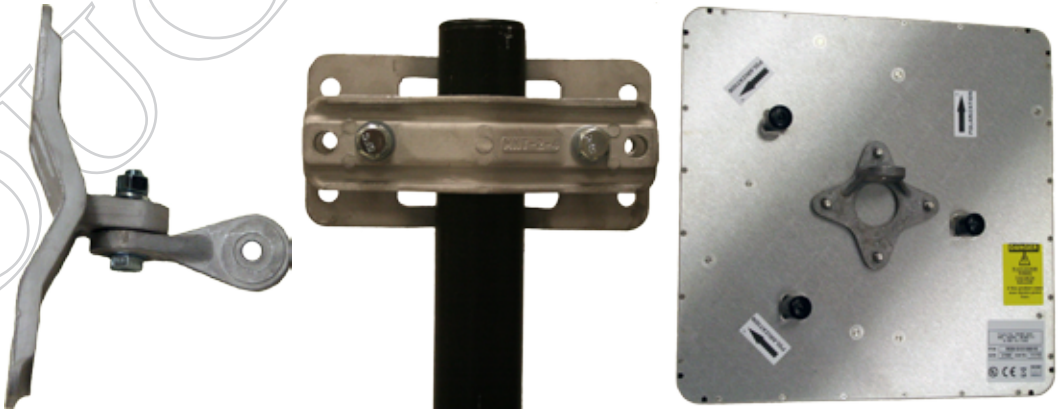
The FWB-205 Kit and its two 19 dBi antennas are intended for fixed, point-to-point applications only. Any other use is prohibited. Antenna(s) for the FWB-205 outdoor unit must be installed by a qualified professional. Operation of the unit with non-approved antennas is a violation of U.S. FCC Rules, Part 15.203(c), Code of Federal Regulations, Title 47.

The FWB-205 units have three antenna connectors for each radio. Each FWB-205 unit should be installed with its antenna on a sturdy pole or mast. It does not matter whether you install the antenna first or the radio unit first. In all cases, antennas should be installed by a qualified professional. Outdoor installations MUST have code-approved grounding and lightning-protection systems.

An assembled and mounted antenna is shown in Figure 4. The mounting systems consists of a pole clamp assembly, a pivot link, and an antenna bracket. These are shown in Figure 5.

Figure 4. Mounted Antenna

Figure 5. Pivot Link; Pole Clamp Assembly; Antenna Bracket



Begin assembly by attaching the pivot link to the pole clamp assembly, as shown at left in Figure 5. Use a flat washer under the bolt head, and under the nut use a flat washer and lock washer.

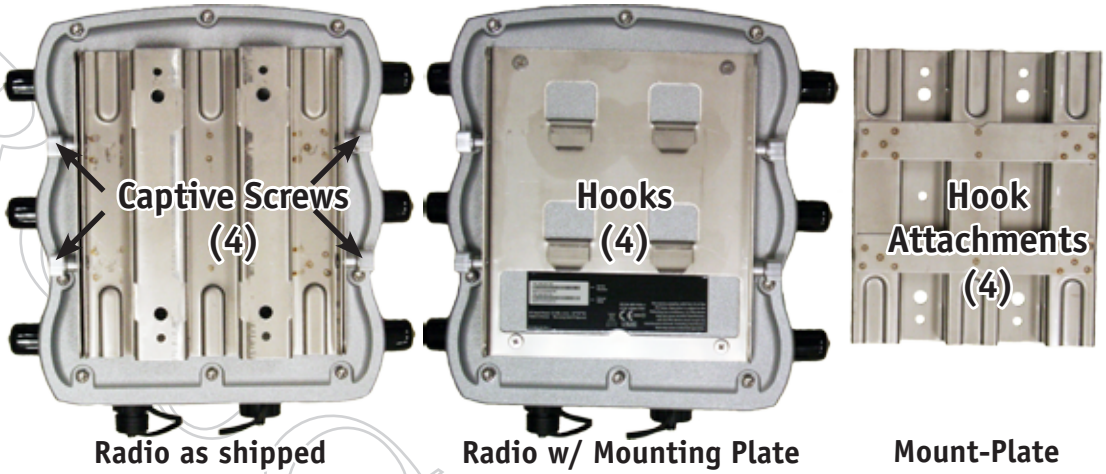
Next, attach the pole clamp assembly to the pole, as shown at center in Figure 5. Again, use a flat washer under the bolt heads, and under the nuts use a flat washer and lock washer.

Mount the antenna bracket to the antenna such that the mounting lug is horizontal when the top of the antenna is up, as shown at right in Figure 5. Antenna polarizations must match between the two ends of a link.

Installing the Radio Unit

The radio unit mounts with a two-piece mounting assembly. One half of the assembly is permanently attached to a pole or wall; the second half, on the radio itself, hooks over the first.

Figure 6. Two-Piece Radio Mounting Plate Assembly



The FWB-205 is shipped with a two-piece mounting plate already attached, as shown. Loosen the four fasteners, two on each side, to remove the hook-attachment plate. The captive screws are tight; you will need a Phillips screwdriver, or channel-lock or slip-joint pliers.

Attach two U-bolt assemblies to the mounting pole, as shown in Figure 7. The U-bolts are large enough to accomodate large poles; if you are mounitng on a smaller-diameter pole, you must either cut the U-bolts to length or use four additional spacer nutes, as shown at right in Figure 7.

Figure 7. U-Bolt Attachment to Pole, Spacer Nuts on U-Bolts

Now you can hang the radio unit on the bracket, and tighten the four captive screws.

Connecting the Antennas

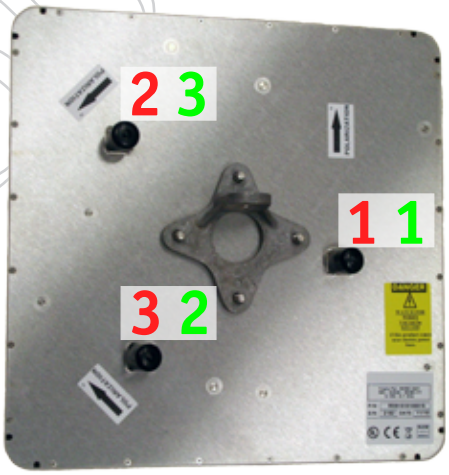
Connect the radio unit to the antenna using the supplied cables. The cables are equipped with lightning-arrestor units, and should be installed with the arrrestors connected to the radio unit, not the antennas. This is shown at left in Figure 8.

Figure 8. Cable-to-Radio Connections; Completed Installation

Cable connection pattern is critical. You must use the Radio 2 antenna connectors; these are on the right side of the unit when viewed from the front. The panel antennas included with the FWB-205 are 'handed'; the individual antenna connections on the radio unit must be connected to the antenna in a specific way, and it is slightly different on each end of the link.

On one end of the link, connect the three antenna leads as shown in red. On the other end, connect them as shown in green. Note that this reverses connections 2 and 3; this preserves matching antenna polarization

Figure 9. Antenna Connections



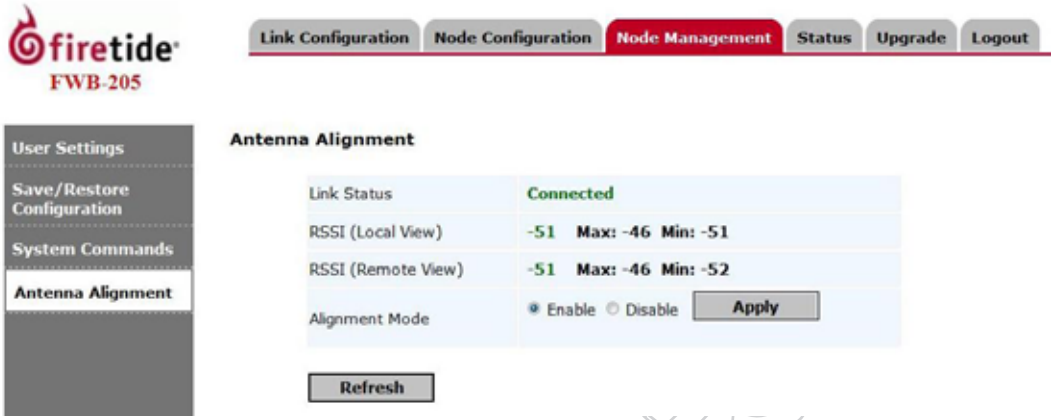
Next, fabricate a weatherproof Ethernet connector. Thread the cable as shown, and then attach it to the FWB-205 radio unit.

Figure 10. Ethernet Cable Fabrication

Antenna Alignment

After physical installation, the antennas should be aligned. You and a co-worker will need to work together; one at each end. Log into the FWB-205 pair and bring up the alignment screen, as shown.

Alignment is on by default. To insure maximum performance, turn off the alignment feature after alignment is complete.



Refer to “Chapter 3 Radio and System Settings” on page 9 for other software configuration options.

Chapter 5 Technical Information

5.1 FWB-205 Specifications

Wireless Interface

Model	Use
FWB-205	Outdoor, Worldwide, Radio 2: 5 GHz

Bands	Frequency (GHz)	Restrictions
802.11a 802.11n	5.15-5.25 5.25-5.35 5.725-5.825	
	4.9-5.090 4.94-4.990	Japan only US Public Safety
	5.470-5.725	ETSI 301.893, U-NII

Bands (GHz)	Max TX Power
802.11a 5.725-5.825 UNII-3	20 dBm
802.11n	
5.725-5.825 UNII-3	20 dBm
5.470-5.735 UNII	20 dBm
5.25-5.36 UNII-2	20 dBm
5.15-5.25 UNII-1	17 dBm

Supported Data Rates & Standards

- 802.11a 6/9/12/18/24/36/48/54Mbps
- 802.11a Capable of switching to 1/4 and 1/2 rates for 4.940 – 4.990 GHz Public Safety Band
- 802.11g 6/9/12/18/24/36/48/54Mbps
- 802.11n 6.5/13/19.5/26/65/130 (20MHz LGB)
  7.2/14.4/21.7/28.9/72.2/144 (20MHz SGB)
  13.5/27/40.5/54/135/270 (40MHz LGB)
  15/30/45/60/150/300 (40MHz SGB)
- Network Standards: IEEE 802.11a/d/e/f/h/i/n
- Security: WPA; 64/128/256 w/TKIP, AES

Power

- 48 VDC via DC connecter or 802.3af PoE

Environmental

- Humidity (non-condensing): 10% to 90%
- Storage humidity (non-condensing): 5% to 95%
- Maximum altitude 15,000 feet (4600 meters)

Network Port

- One 10/100/1000 Mbps Ethernet port with weatherproof connector
- IEEE 802.3, 802.3u compliant
- CSMA/CD 10/100/1000 autosense

Enclosure

- Cast aluminum NEMA-4X/IP66 enclosure
- Six N-type antenna connectors
- Weatherproof 48VDC power connector
- Weight: 3.75 lbs (1.7 Kg) with bracket
- Dimensions: 8.2" x 8.6" x 2" (205 x 214 x 100 mm)

Security, Authentication and Encryption

- 802.11i, WPA2
- 40-bit, 104-bit WEP keys
- SSID suppression

Management and Configuration

- Built-in web-based management
- Remote firmware upgrade

Network Ports

- One 10/100/1000 autosense Base-T port
- IEEE 802.3,802.3 at based PoE

5.2 Reset Procedure

Firetide FWB-205s may be reset to factory parameters. This is useful when returning a unit from field service or in recovering a unit you cannot communicate with. You will need a long, thin shaft to reach the reset button, because the switch is recessed approximately 35 mm (1-3/8 in) inside the unit.

1. Apply power and wait for the unit to fully boot. This takes 60 to 90 seconds.
2. Remove the Phillips screw covering the reset port. It is near the Ethernet connector.
3. Insert a drill bit or similar object about 3 mm (1/8 in) and at least 37 mm (1-1/2 in) long directly into the hole. The tool must be perpendicular to the face of the node.
4. Push the reset button. You will feel a slight 'click'; if you don't, you missed. Hold the button for 15 seconds, then wait for the units to reboot before attempting to connect or removing power.

When a unit has been reset, it forgets the country code setting and operates at low power until the country code is re-established. Units that are already installed in the field are unlikely to communicate with each other after reset, due to the low power setting. You must connect to each unit in turn and set the country code.

5.3 Regulatory Notices

FCC Part 15 Note

These devices comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

FCC Class B Notice

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 Radiation Exposure

To ensure compliance with the FCC's RF exposure limits, the antenna used for this transmitter must be installed to provide a separation distance of at least 76 cm from all persons and must not be co-located or operated in conjunction with any other antenna or transmitter. Installers and end users must follow these installation instructions.

Modifications

Any modifications made to this device that are not approved by Firetide, Inc. may void the authority granted to the user by the FCC to operate this equipment.

Installation

The FWB-205 Kit and its two 19 dBi antennas are intended for fixed, point-to-point applications only. Any other use is prohibited. Antenna(s) for the FWB-205 outdoor unit must be installed by a qualified professional. Operation of the unit with non-approved antennas is a violation of U.S. FCC Rules, Part 15.203(c), Code of Federal Regulations, Title 47.

Canadian Compliance Statement

This Class B Digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations. Cet appareil numerique de la classe B respecte les exigences du Reglement sur le material broilleur du Canada.

FWB-205 devices are certified to the requirements of RSS-210 for 2.4 GHz spread spectrum devices. The use of this device in a system operating either partially or completely outdoors may require the user to obtain a license for the system according to the Canadian regulations. For further information, contact your local Industry Canada office.

NCC Statement

一、經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

二、低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。

前項合法通信，指依電信法規定作業之無線電通信。

低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設 備之干擾。

FCC DFS Rules

This explains how to correctly configure DFS channels so as to maintain compliance with FCC regulations and guidelines. DFS operation can only be enabled and configured by a DFS-qualified professional installer. Contact Firetide for details. All DFS-listed channels must comply with basic DFS rules, including channel avoidance when radar signals are detected.

Channels 120, 124, and 128 have been removed from DFS service completely. **These channels must not be used in the US anywhere, at any time**. They do not appear in channel listing in any Firetide product, and are only listed here for historical reference.

Channels 116 and 132 may only be used when certain special rules have been followed. The channels can only be used if either of the following two conditions are met:

- The transmitting antenna is more than 35 km from all TDWR stations;

OR

- The TDWR is operating on a frequency more than 30 MHz different than the equipment.

DFS Rules

Distance

You must determine if there are any transmitting elements (i.e., any Firetide product) within 35 km of any TDWR system. If there are, you should register the installation.

Registration

A voluntary WISPA-sponsored database has been developed that allows registration of devices within 35 km of any TDWR location (see http://www.spectrumbridge.com/udia/home.aspx). This database is used by government agencies to expedite resolution of any interference with TDWRs.

Channel Avoidance

When a radar signature is detected on a channel, transmitters must stop using that channel. The channel delection lets you configure the channels to which the system can switch, and the channels which must be avoided.

Ch.	Center Freq.	Distance Determination	Registration	Channel Avoidance	TDWR Restrictions
52	5260	Yes	If > 35 km	Yes	No
56	5280	Yes	If > 35 km	Yes	No
60	5300	Yes	If > 35 km	Yes	No
64	5320	Yes	If > 35 km	Yes	No
100	5500	Yes	If > 35 km	Yes	No
104	5520	Yes	If > 35 km	Yes	No
108	5540	Yes	If > 35 km	Yes	No
112	5560	Yes	If > 35 km	Yes	No
116	5580	Yes	If > 35 km	Yes	Yes
120	5600	Banned			
124	5620	Banned			
128	5640	Banned			
132	5660	Yes	If > 35 km	Yes	Yes
136	5680	Yes	If > 35 km	Yes	No
140	5700	Yes	If > 35 km	Yes	No

TABLE 2.1 TDWR INSTALLATIONS

This list is current as of August 2011. Elevation and antenna height shown in feet. Refer to www.fcc.gov for the most current version.

TDWR-Restricted Additional Requirements

Terminal Doppler Weather Radar systems operate in the 5600 MHz band, and must be kept free of interference from all other types of equipment. For this reason, the FCC has removed channels 120, 124, and 128 (5600-5640) from service, and placed additional restrictions on channels 116 (5580 MHz) and 132 (5660 MHz).

If you are within 35 km of a TDWR, you may not operate on any channel that is within 30 MHz of the listed TDWR frequency. In some instances it is possible that a device may be within 35 km of multiple TDWRs. In this case the device must ensure that it avoids operation within 30 MHz for each of the TDWRs. This requirement applies even if the master is outside the 35 km radius but communicates with outdoor clients which may be within the 35 km radius of the TDWRs.

The requirement for ensuring 30 MHz frequency separation is based on the best information available to date. If interference is not eliminated, a distance limitation based on line-of-sight from TDWR will need to be used. In addition, devices with bandwidths over 20 MHz may require greater frequency separation.

Table 2.2 DFS Channels

This table shows channels defined as DFS. They are color-coded based on the applicable rule set.

Specific rules for each of the four compliance requirements are explained on the following page.

ST	City	Longitude	Latitude	Frequency	Elev	Ht
AZ	Phoenix	W 112 09 46	N 33 25 14	5610 MHz	1024	64
CO	Denver	W 104 31 35	N 39 43 39	5615 MHz	5643	64
FL	Ft Lauderdale	W 080 20 39	N 26 08 36	5645 MHz	7	113
FL	Miami	W 080 29 28	N 25 45 27	5605 MHz	10	113
FL	Orlando	W 081 19 33	N 28 20 37	5640 MHz	72	97
FL	Tampa	W 082 31 04	N 27 51 35	5620 MHz	14	80
FL	West Palm Beach	W 080 16 23	N 26 41 17	5615 MHz	20	113
GA	Atlanta	W 084 15 44	N 33 38 48	5615 MHz	962	113
IL	Mccook	W 087 51 31	N 41 47 50	5615 MHz	646	97
IL	Crestwood	W 087 43 47	N 41 39 05	5645 MHz	663	113
IN	Indianapolis	W 086 26 08	N 39 38 14	5605 MHz	751	97
KS	Wichita	W 097 26 13	N 37 30 26	5603 MHz	1270	80
KY	Covington-Cincinnati	W 084 34 48	N 38 53 53	5610 MHz	942	97
KY	Louisville	W 085 36 38	N 38 02 45	5646 MHz	617	113
LA	New Orleans	W 090 24 11	N 30 01 18	5645 MHz	2	97
MA	Boston	W 070 56 01	N 42 09 30	5610 MHz	151	113
MD	Brandywine	W 076 50 42	N 38 41 43	5635 MHz	233	113
MD	Benfield	W 076 37 48	N 39 05 23	5645 MHz	184	113
MD	Clinton	W 076 57 43	N 38 45 32	5615 MHz	249	97
MI	Detroit	W 083 30 54	N 42 06 40	5615 MHz	656	113
MN	Minneapolis	W 092 55 58	N 44 52 17	5610 MHz	1040	80
MO	Kansas City	W 094 44 31	N 39 29 55	5605 MHz	1040	64
MO	Saint Louis	W 090 29 21	N 38 48 20	5610 MHz	551	97
MS	Desoto County	W 089 59 33	N 34 53 45	5610 MHz	371	113
NC	Charlotte	W 080 53 06	N 35 20 14	5608 MHz	757	113
NC	Raleigh Durham	W 078 41 50	N 36 00 07	5647 MHz	400	113
NJ	Woodbridge	W 074 16 13	N 40 35 37	5620 MHz	19	113
NJ	Pennsauken	W 075 04 12	N 39 56 57	5610 MHz	39	113
NV	Las Vegas	W 115 00 26	N 36 08 37	5645 MHz	1995	64
NY	Floyd Bennett Field	W 073 52 49	N 40 35 20	5647 MHz	8	97
OH	Dayton	W 084 07 23	N 40 01 19	5640 MHz	922	97
OH	Cleveland	W 082 00 28	N 41 17 23	5645 MHz	817	113
OH	Columbus	W 082 42 55	N 40 00 20	5605 MHz	1037	113
OK	Aero. Ctr TDWR #1	W 097 37 31	N 35 24 19	5610 MHz	1285	80
OK	Aero. Ctr TDWR #2	W 097 37 43	N 35 23 34	5620 MHz	1293	97
OK	Tulsa	W 095 49 34	N 36 04 14	5605 MHz	712	113
OK	Oklahoma City	W 097 30 36	N 35 16 34	5603 MHz	1195	64
PA	Hanover	W 080 29 10	N 40 30 05	5615 MHz	1266	113
PR	San Juan	W 066 10 46	N 18 28 26	5610 MHz	59	113
TN	Nashville	W 086 39 42	N 35 58 47	5605 MHz	722	97
TX	Houston Intercontl	W 095 34 01	N 30 03 54	5605 MHz	154	97
TX	Pearland	W 095 14 30	N 29 30 59	5645 MHz	36	80
TX	Dallas Love Field	W 096 58 06	N 32 55 33	5608 MHz	541	80
TX	Lewisville DFW	W 096 55 05	N 33 03 53	5640 MHz	554	31
UT	Salt Lake City	W 111 55 47	N 40 58 02	5610 MHz	4219	80
VA	Leesburg	W 077 31 46	N 39 05 02	5605 MHz	361	113
WI	Milwaukee	W 088 02 47	N 42 49 10	5603 MHz	820	113

Latitude and Longitude based on NAD83 datum.

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