

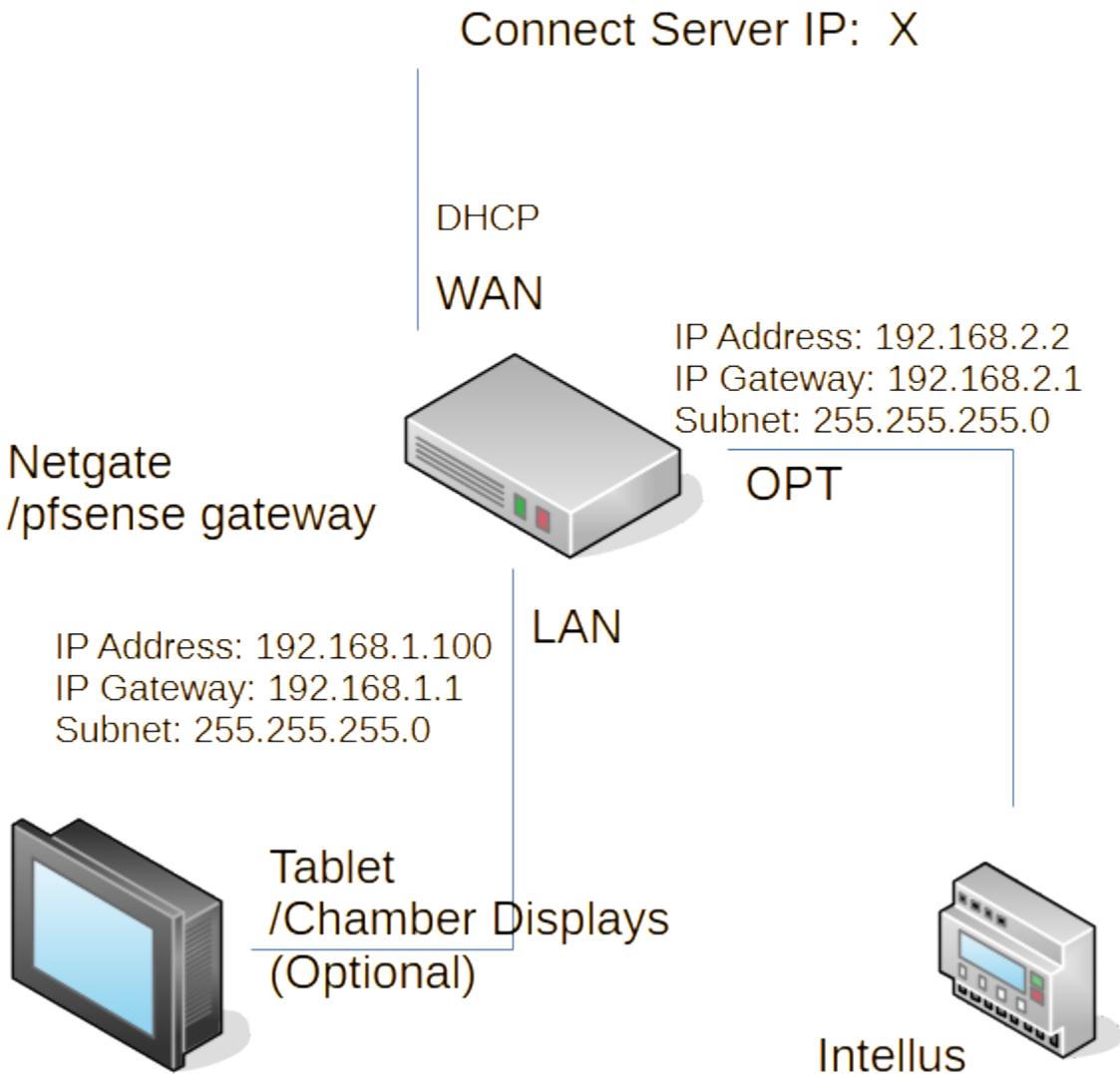
# Intellus Networking Field Guide

As of 2023-05-23 for certain C9 models



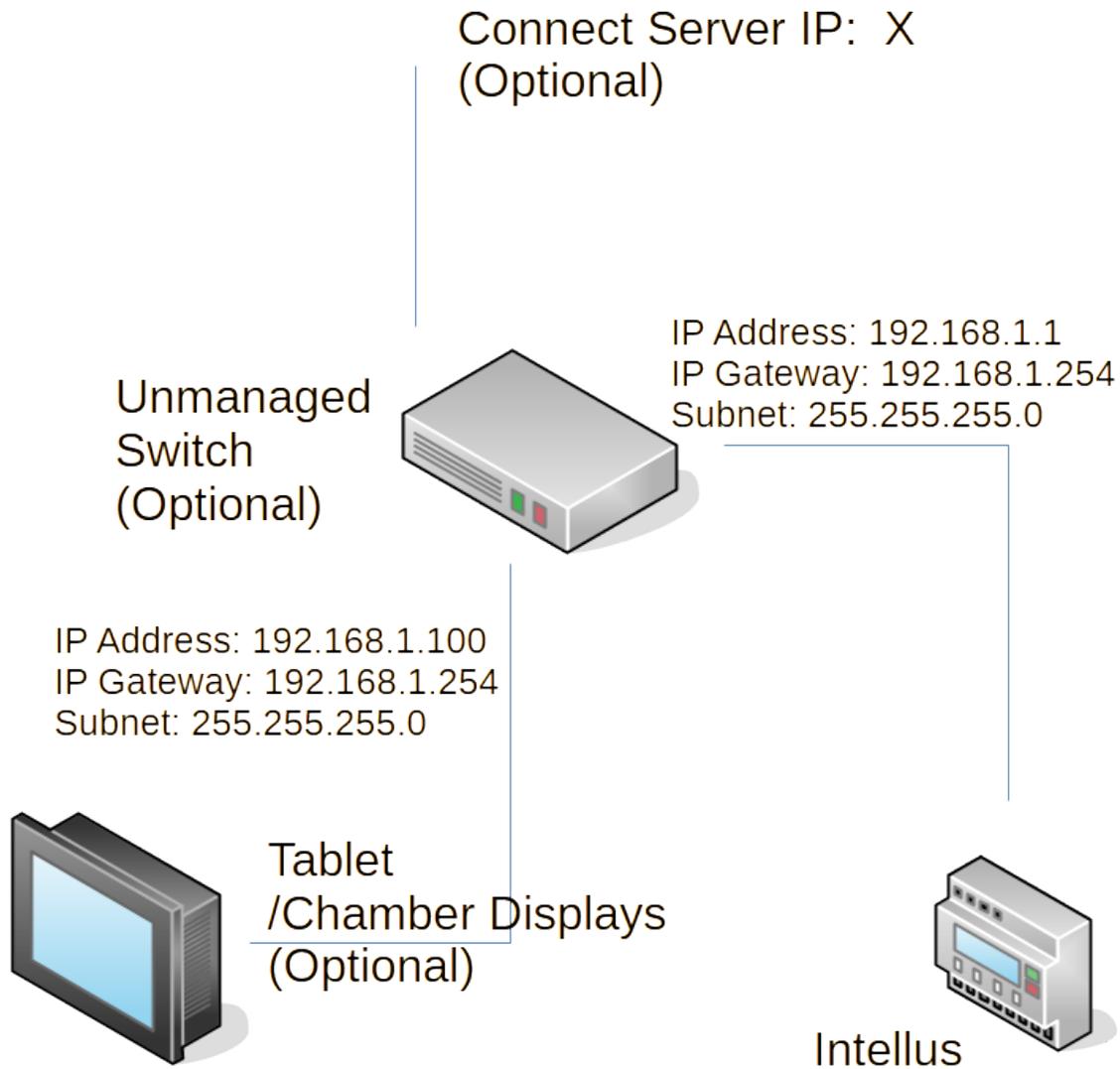
## Preface

Inside certain chambers manufactured after 2022 is a router/gateway device utilizing the pfSense operating system, typically a Netgate [1], which handles many of the auxiliary functions of the chamber system. This includes networking, e-mail, webserver, and routing<sup>1</sup>. The default internal network is configured as follows:



<sup>1</sup> The chamber has a managed router (pfSense) inside, and may require configurations on outbound ports (firewall rules) accordingly.

Chambers manufactured prior to 2022 most likely have the following configuration:



Setting up these chambers is covered in appendices D through G.

Otherwise, the chambers default configuration follows cybersecurity standards NIST 800-53 Rev.5 IA-3 [2] and CIS v8 Devices 1.4 [3] utilizing Dynamic Host Control Protocol (DHCP). Therefore, we recommend users follow this standard first, and ideally to use a DHCP network configuration however to facilitate user needs we've provided different networking configurations. Please identify the network configuration that most closely resembles your on-site network configuration.

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## Dynamic Host Control Protocol (DHCP) Configuration

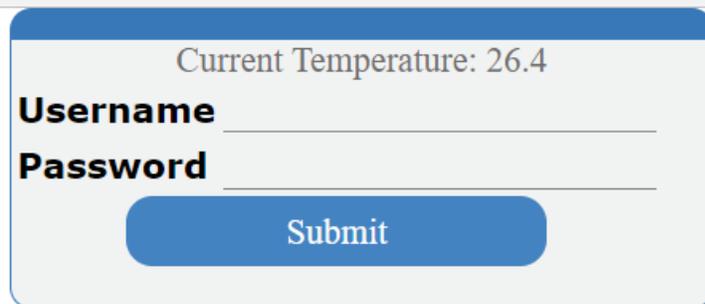
This assumes that you are connecting the chamber to a network that has DHCP on it. Your router or ISP gateway should have DHCP capability. **It is advisable to use this method of connection.**

If you have DHCP on your network, then once you connect the chamber, it should automatically grab an IP address. To see this IP address:

If you have a tablet (C9T), then after a few minutes from when the chamber has started up:

1. Go to the tablet, and tap on the screen to wake it up.
2. Press the circle on the bottom of the screen, this will take you to the desktop if you are still in the Percival app.
3. Press the Chrome icon (  ) on the bottom of the screen.
4. You might get a warning screen, click "Show advanced", and then click the "proceed" link.
5. In Chrome, go to <https://192.168.1.1:8080/index.php> .

192.168.1.1:8080/index.php



Remote Access URL: 10.1.1.18:8443/index.php

Device MAC: f0:ad:4e:2c:79:b1

- 6.
7. Here you can see the IP address grabbed on the network and the MAC Address.

You can then use this IP address and MAC address to set up DHCP reservations.

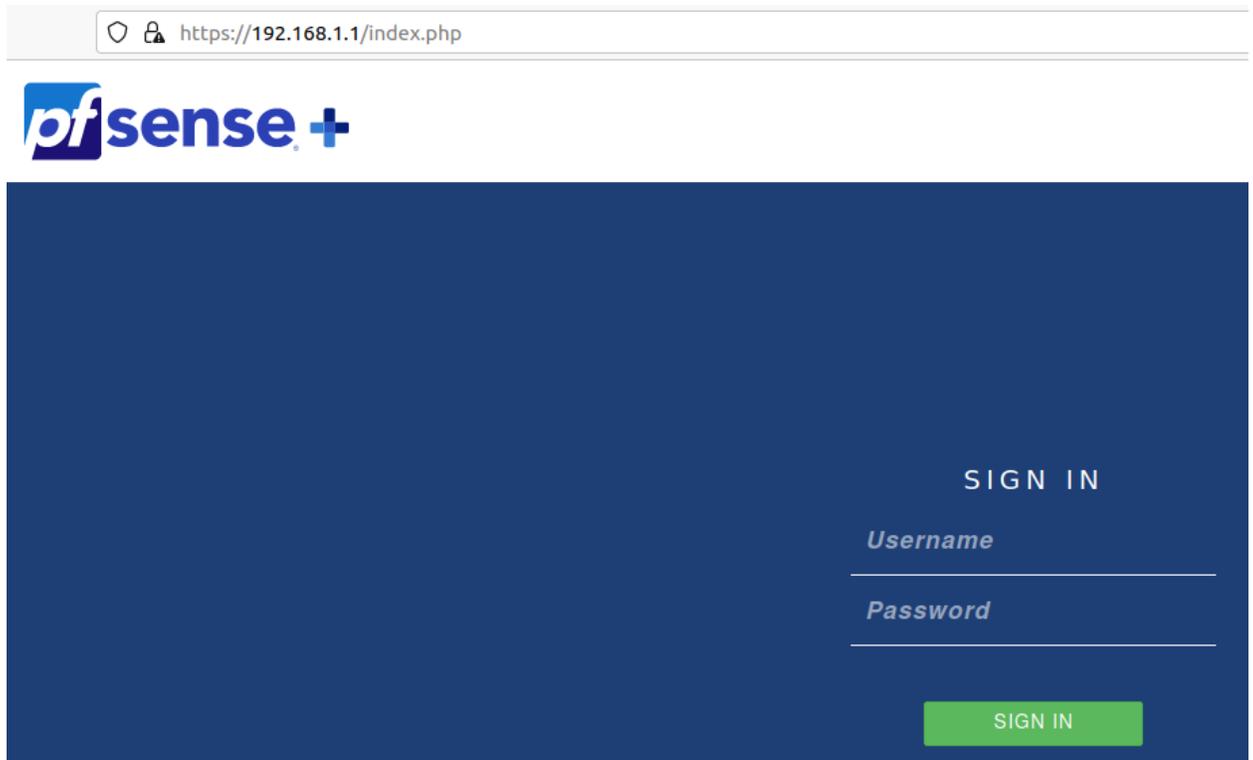
If you do not have a tablet (C9), you can either see the device on the network together with its remote IP address by checking your DHCP server logs, or using a network discovery tool like Nmap, or you can open up the front control panel, and connect into the LAN port (the center RJ45 jack) of the pfsense device using a laptop, and setting your laptop's adaptor settings to an IP address of 192.168.1.100, gateway of 192.168.1.1, and subnet of 255.255.255.0. After this, by going to <https://192.168.1.1:8080/index.php> in a browser you should be able to see the same page above, which will display the remote access URL and MAC address.

If you need to get a new address, simply restart the chamber.

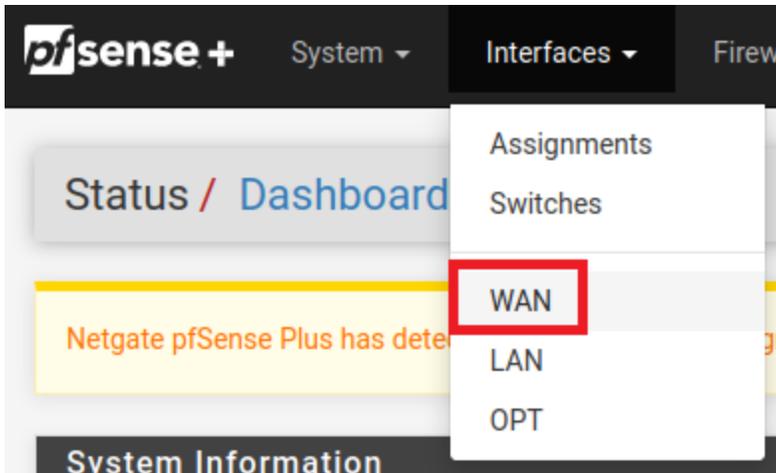
## Fixed IP address

If you wish to use a fixed IP address for routing reasons, it is still advisable to leave the device in DHCP, as you can instead make a DHCP reservation using the device's MAC address, or ideally to make an internal domain name if your network allows it. This will allow the device to automatically connect, register to the network, and follow current IT standards. Otherwise, please follow these steps:

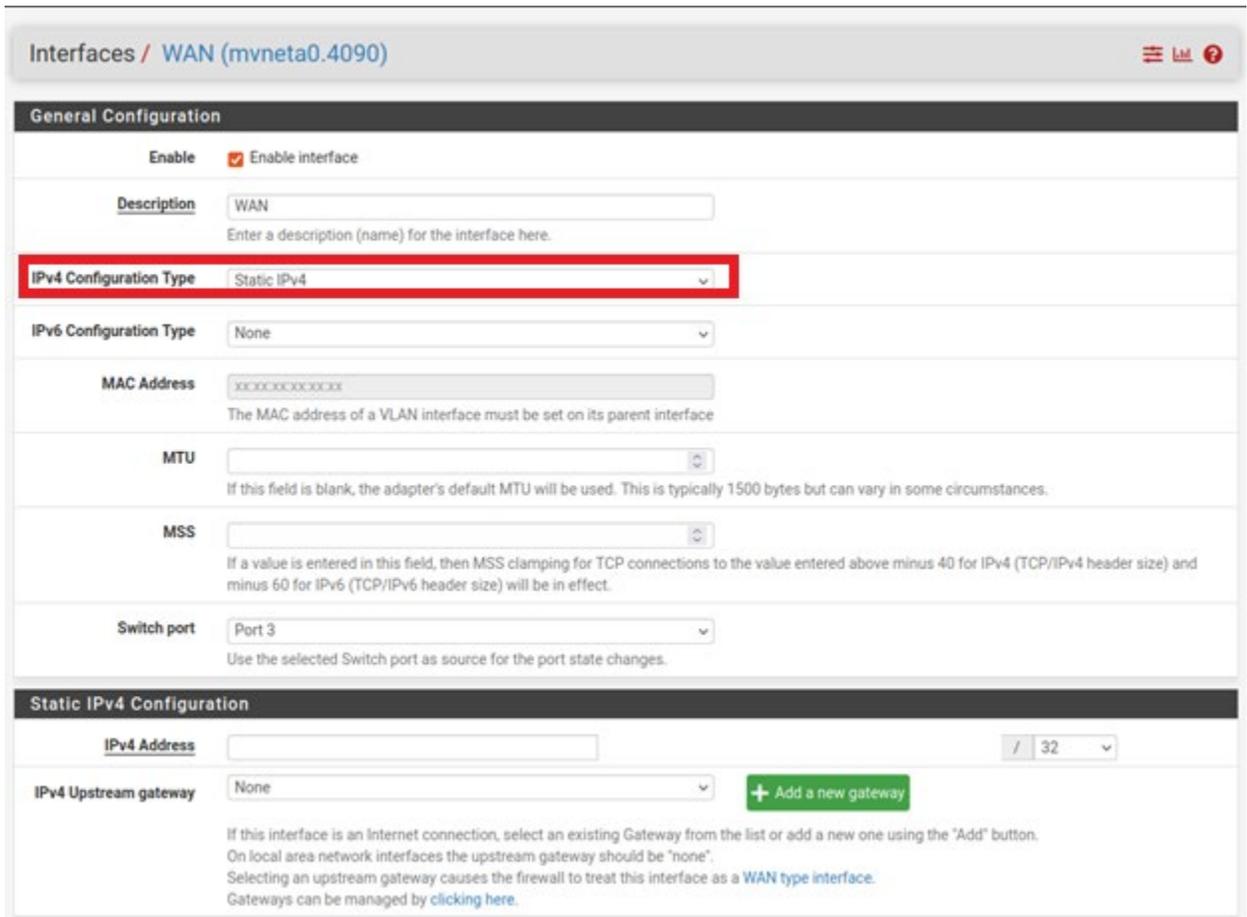
1. Bring up Chrome on the tablet.
2. Go to <https://192.168.1.1> . You should see the following:



3. The default credentials are admin/Percival1! . As a backup, it should be labeled on the Netgate in the control. Alternatively, if you reboot the Netgate from a fresh stock, it may reset its default credentials as admin/pfsense .
4. Click on Interfaces→WAN on the top bar of the Dashboard:



5. Next, change IPv4 Configuration Type to Static IPv4, and you should see the Static IPv4 Configuration appear below:

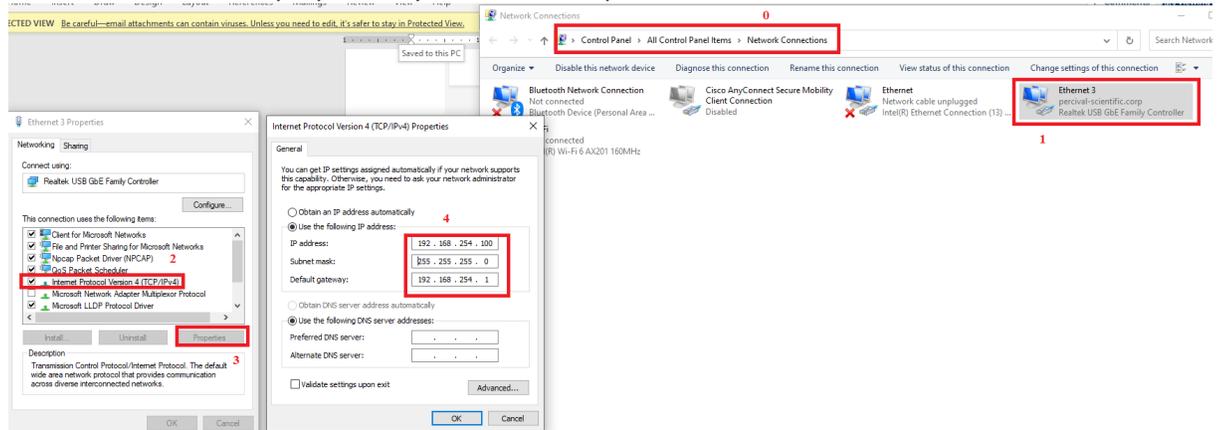


6. Here you can denote the IPv4 Address of the chamber/Netgate, Subnet (denoted as /X under a dropdown as opposed to IP address), and Gateway. When you are done, hit save:

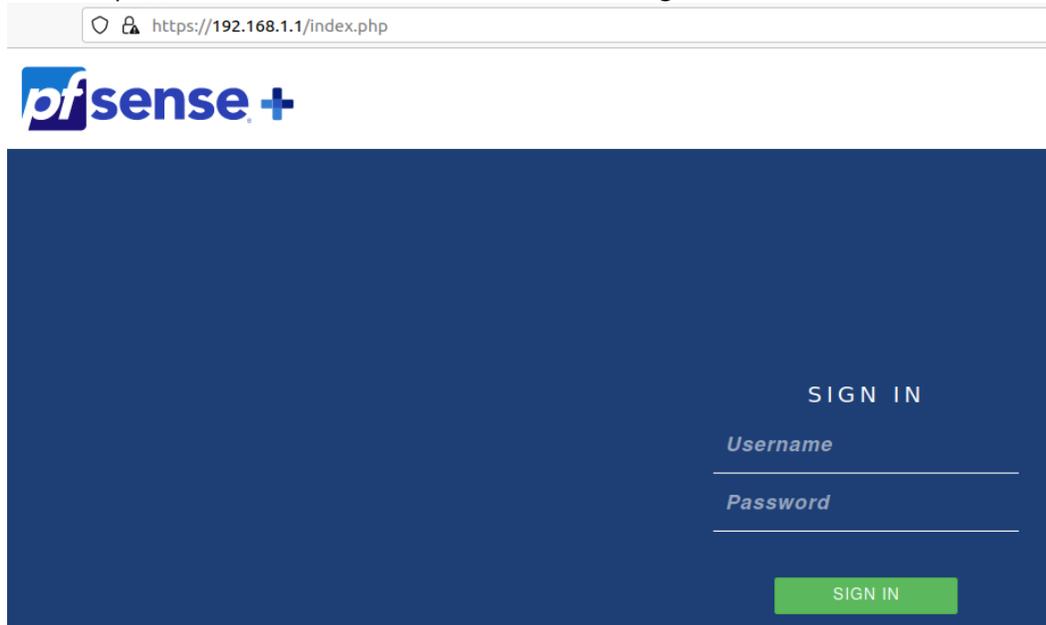


## Direct Access

If you wish to connect one PC or laptop directly to a chamber, please follow these instructions.



1. change the adaptor settings on the PC. **Suggestion: use no gateway, subnet 255.255.255.0, and IP address 192.168.254.100.**
2. Change the WAN port to a fixed IP address operating on the same gateway of your PC like follows:
  - a. Bring up Chrome on the tablet.
  - b. Go to <https://192.168.1.1> . You should see the following:



- c. Click on Interfaces→WAN on the top bar of the Dashboard.

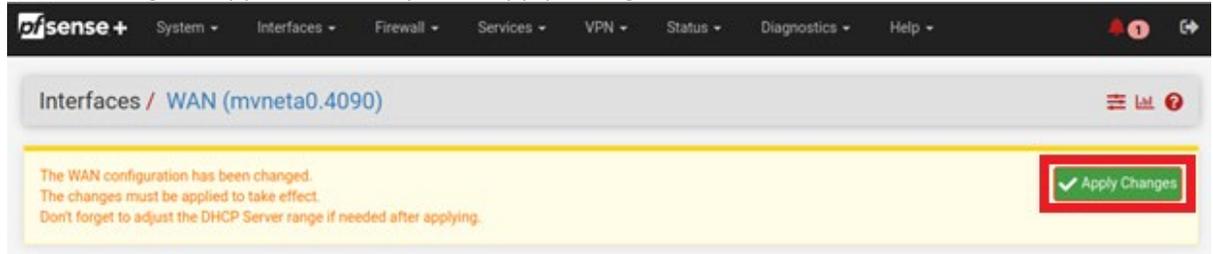
- d. Next, change IPv4 Configuration Type to Static IPv4, and you should see the Static IPv4 Configuration appear below:

The screenshot shows the configuration page for the WAN interface (mvneta0.4090). The 'General Configuration' section is active, and the 'IPv4 Configuration Type' dropdown is highlighted with a red box and set to 'Static IPv4'. Other fields include 'Description' (WAN), 'IPv6 Configuration Type' (None), 'MAC Address' (xxxxxxxxxxxx), 'MTU' (1500), 'MSS' (blank), and 'Switch port' (Port 3). Below this, the 'Static IPv4 Configuration' section is visible, showing 'IPv4 Address' and 'IPv4 Upstream gateway' (None) fields.

- e. Here you can denote the IPv4 Address of the chamber/Netgate, Subnet (denoted as /X under a dropdown as opposed to IP address), and Gateway. **Suggestion: use no gateway, subnet 255.255.255.0, and IPv4 address of 192.168.254.2.** When you are done, hit save:

The screenshot shows the 'Static IPv4 Configuration' section with the 'IPv4 Address' field highlighted by a red box. The 'IPv4 Upstream gateway' dropdown is also highlighted with a red box and set to 'None'. Below this, the 'Reserved Networks' section is visible, with checkboxes for 'Block private networks and loopback addresses' and 'Block bogon networks'. A 'Save' button is located at the bottom of the page.

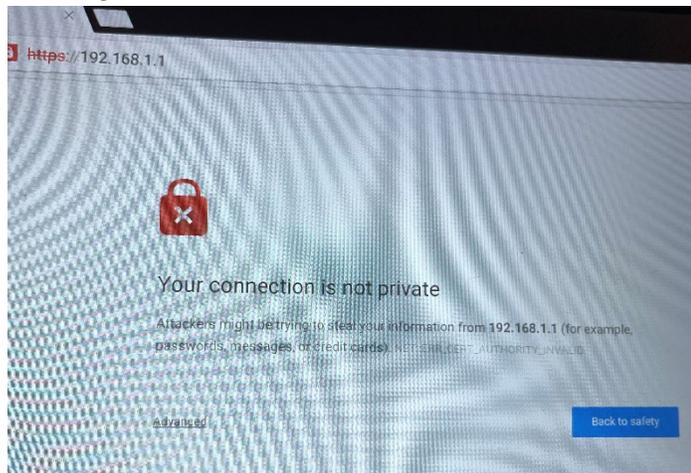
- f. A new dialog will appear at the top. Hit “Apply Changes.”



3. Once this is done, then you should be able to go to <https://192.168.254.2:8443/index.php> on the laptop to access the new webpages, <https://192.168.254.2> to access the old in case of C9 if they still exist.

## Appendix A: Retrofitting Chamber with Netgate

1. Press ENTER+UP on the Intellus, and type in the 1111 code using the PROGRAM and UP keys.
2. Set the IP Mode to Fixed, Fixed IP Address to 192.168.002.002, Fixed IP Subnet to 255.255.255.000, and Fixed IP Gateway to 192.168.002.001. (the tablet should have an IP/Gateway/Subnet of 192.168.1.100/192.168.1.1/255.255.255.0)
3. Press PROGRAM twice, and then press the DIAGNOSTICS key on the Intellus.
4. Repeatedly press the UP key until you see the MAC Address.
5. Record the MAC Address.
6. Make sure the NetGate has stopped blinking—this may take up to five minutes from starting up the chamber.
7. On the tablet, click on the gear icon, go to Ethernet, and click the “DHCP” icon. When it asks for a username/password, don’t input anything and just click “OK.” Then, turn the Ethernet connection off and then back on. You should see the tablet grab the gateway address as 192.168.1.1. Should this not work, default back to a “Fixed” and use 192.168.1.100/192.168.1.1/255.255.255.0 .
8. On the tablet, click on the router link, or navigate to a Chrome browser and type in either <https://192.168.1.1> (the https is necessary!) or 192.168.2.1.
9. You might get a warning screen, click “Show advanced”, and then click the “proceed” link.



10. You should see the following login screen:

**SIGN IN**

*Username*

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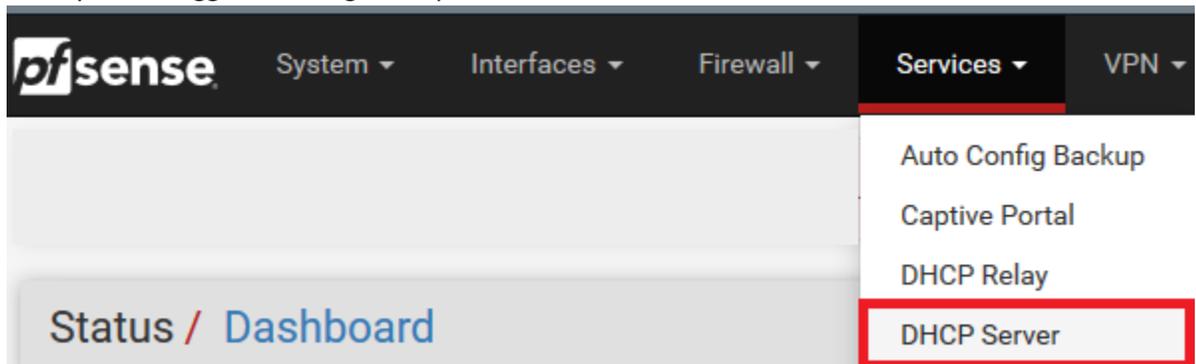
*Password*

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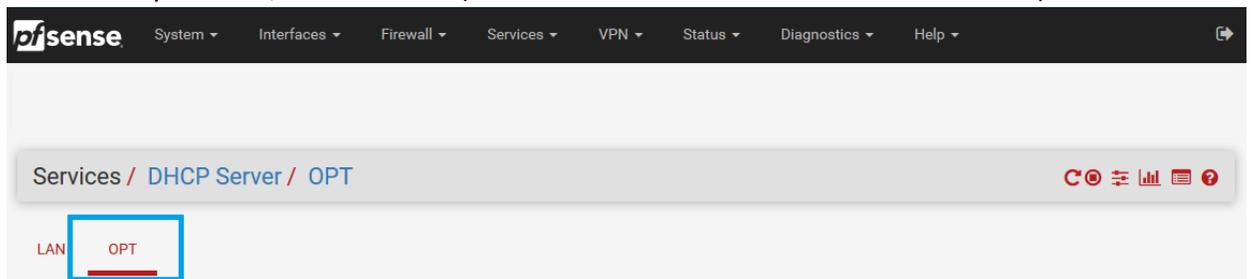
**SIGN IN**

pfSense is developed and maintained by Netgate. © ESF 2004 - 2020 [View license](#).

11. For the username type in “admin” and for the password, type in the code printed on the box, **Percival1!** .
12. Once you are logged in, along the top bar click “Services” and then “DHCP Server”



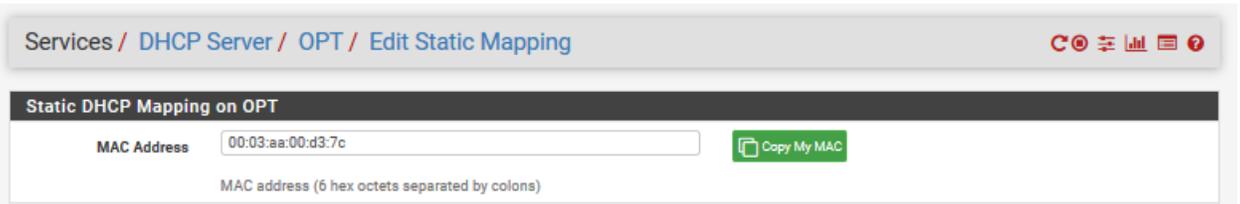
13. If not already selected, click on “OPT” (which indicates the connection to the controller)



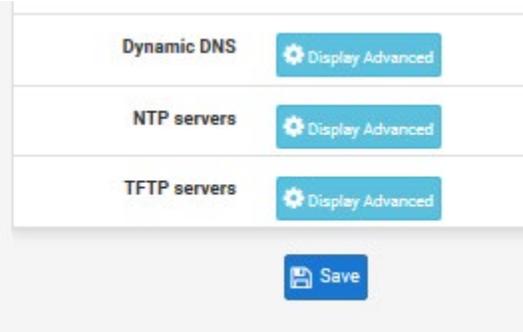
14. Scroll down and don't touch anything in between. At the bottom of this page, click the blue pencil icon



15. Edit the MAC Address to the MAC Address that you wrote down in step 3. Be sure that there is a colon every two characters.



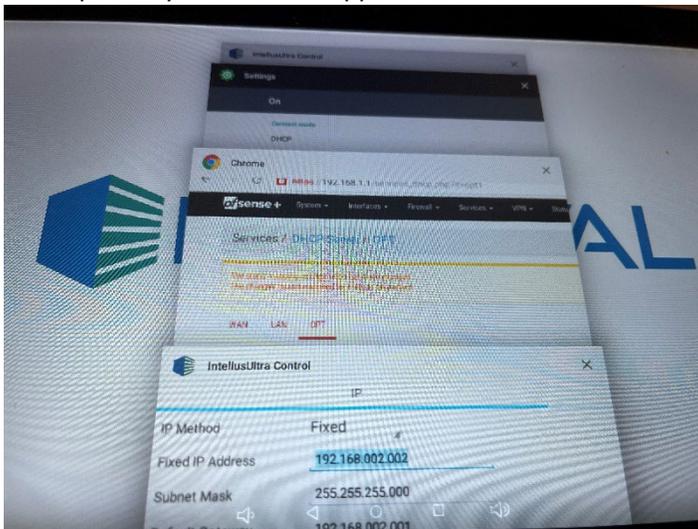
16. At the bottom of the page, click "Save"



17. After clicking save, click the green "Apply Changes" button with the checkmark.

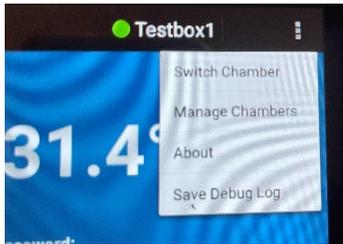


18. Restart the chamber. It may take up to five minutes for the NetGate to start.
19. The latest version of the tablet apk (any 2022 and later version) should automatically reconnect without needing to restart the app, but keep in mind that because the tablet starts up faster than the Netgate you might need to wait a couple minutes.
20. If not, or if the tablet still reads N/A. Just click somewhere into the screen. Then click the square for the open apps.
21. Swipe away the Percival app to close it.



22. Wait the 5 min and then start the Percival App anew.
23. If you connect the tablet the first time, you will have to set up the chamber first in the tablet.

24. Go to the 3 dots in the right corner and select “Manage Chambers”



25. Type Add and give the chamber a new name. Type will be Ethernet

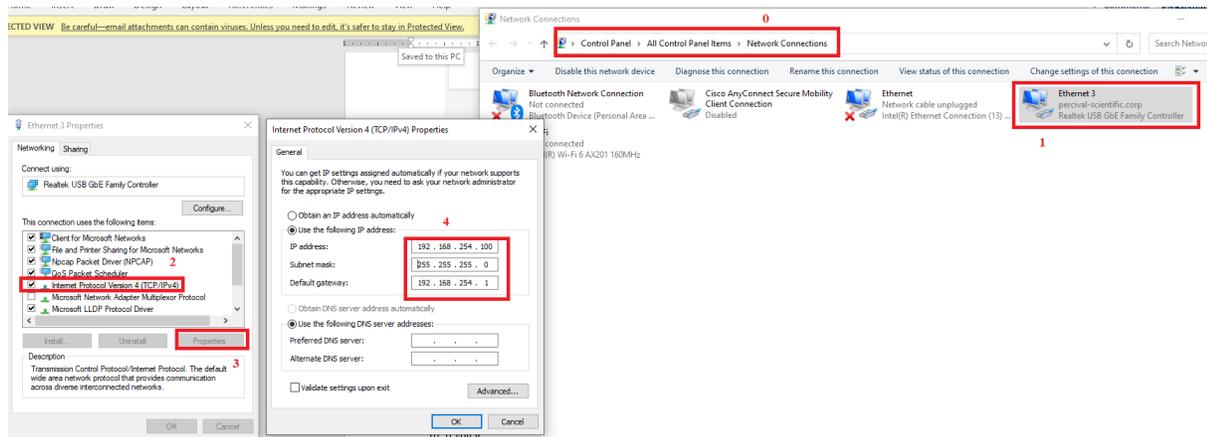
26. Type in the IP Address 192.168.1.1. (This is the IP of the NetGate)

27. Type on “Activate” – Tablet will prepare for new controller and re-open the App.

28. If not, or if the tablet still reads NA, exit the app and go to the gear icon and then Ethernet. If you do not see that it has grabbed an address on the Ethernet page, turn the connection toggle on this page off and on again. After this, exit this page and restart the app.

## Appendix B: Installer Network Verification

1. Disconnect the cable between Netgate and the tablet, and connect it to a laptop (so the laptop is connected to the LAN port on the Netgate)
2. change the adaptor settings on your laptop to gateway 192.168.1.1, subnet 255.255.255.0, and IP address 192.168.1.99.



3. Then going to <https://192.168.1.1:8080/index.php> should bring up a website.

## Appendix C: Setting Up Percival Connect

Once the chamber has been placed on the network (as in, the remote website can be viewed), then connections with Percival Connect can be established. For convenience, some short instructions are given here, but please see the Percival Connect or tablet manual.

but this can be accomplished one of two ways:

On the tablet

1. Login
2. Bring up the left-hand side menu
3. Press Settings->Cloud/IP settings
4. Go to the "Cloud" tab.
5. Change the "Cloud Server IP" to the PC or domain name running Percival Connect on your network.
6. Make sure that the Customer ID matches your user ID in Connect (the default Customer ID is 541B31C7 )
7. Change "Connection Enabled" to "Yes."
8. Press "Save" in the top right of the page.

On the remote webpages

1. Login (the default password is admin/percival-scientific )



2. Go to "Information"
3. Make sure that the "Connect IP String" matches your PC or domain name that's running Percival Connect on your network.
4. Make sure that the Customer ID matches your user ID in Connect (the default Customer ID is 541B31C7 )
5. Press "Change Connect"

Connect IP String	10.1.1.240
Port	61614
SSL Enabled	True
Customer ID	541B31C7

**Change Connect**

**Please be sure that no firewall on your network is inadvertently blocking traffic on port 61614 between any of your chambers and Connect.**

## Appendix D: IP Address Table Reference

Networking Config w/NetGate			
	Intellus	Tablet/Android	App
Type	Fixed	Fixed	Ethernet or Wireless
IP Address	192.168.2.2	192.168.1.100	192.168.1.1
IP Gateway	192.168.2.1	192.168.1.1	N/A
IP Subnet	255.255.255.0	255.255.255.0	N/A
Webpage on PC	https://Fixed or WAN Address:8443/index.php		
Webpage on Tablet	https://192.168.1.1:8080/index.php		

Networking Config w/o NetGate			
	Intellus	Tablet/Android	App
Type	Fixed	Fixed	Ethernet or Wireless
IP Address	192.168.1.1	192.168.1.100	192.168.1.1
IP Gateway	192.168.1.254	192.168.1.254	N/A
IP Subnet	255.255.255.0	255.255.255.0	N/A
Webpage on PC	N/A		
Webpage on Tablet	N/A		

Networking Config Chamber to PC Direct		
	Netgate	PC
Type	Fixed	Fixed
IP Address	192.168.254.2	192.168.254.100
IP Gateway	None/192.168.254.1	None/192.168.254.1
IP Subnet	255.255.255.0	255.255.255.0
Webpage Link on PC	https://192.168.254.2:8443/index.php	
Webpage Link on Tablet	https://192.168.1.1:8080/index.php	

Laptop to Tablet cable	
	Laptop
Type	Fixed
IP Address	192.168.1.99
IP Gateway	192.168.1.1
IP Subnet	255.255.255.0
Webpage Link	https://192.168.1.1:8080/index.php

## Appendix E: IP Settings on the Controller

For convenience, instructions are placed here to manually change networking information on the controller, but please see the Intellus Ultra manual.

1. On the IntellusUltraConnect controller, hold both the ENTER and UP keys simultaneously for approximately four seconds.
2. The controller will prompt the user to enter the security level password. The default password is '1111'. If the first character of the password is not flashing, press the ENTER key.
3. Use the UP and DOWN keys as necessary to change characters. Press the PROGRAM key to advance to the next character. You may repeatedly press the PROGRAM key to scroll through and review the password. Pressing the PROGRAM key at the last character will cause the character selection to wrap around. 4) Press the ENTER key when the password '1111' has been successfully entered.
4. Press the DOWN key repeatedly until "IP Address Mode" appears in the display.
5. Press the ENTER key.
6. Use the UP or DOWN keys as necessary to select the desired IP address mode, then press the ENTER key again. Refer to the section titled IP Address Mode below for more information.
7. Press and release the DOWN key.
8. The user will be prompted to enter the fixed IP address. A unique IP address must be entered into the controller if the selected IP Address Mode "Fixed". It is highly recommended that a unique, fixed IP address be entered, even if the intended IP Address Mode is "DHCP/Fixed". The fixed address will be used if a DHCP server cannot be found when the IP address mode is set to "DHCP/Fixed".
9. To enter the fixed IP, press the ENTER key.
10. Use the UP or DOWN keys as necessary to change each character of the IP address. Press the PROGRAM key to advance to the next character. Repeatedly press the PROGRAM key to advance to the next character. Pressing the PROGRAM key while on the last character, will increment the active character field back to the first character.
11. Press the ENTER key when the IP address has been entered.
12. Press and release the DOWN key.
13. "Fixed IP Subnet" should appear in the display. This is the subnet mask entry for the controller. Press the ENTER key.
14. Use the UP or DOWN keys as necessary to change each character of the subnet mask. Press the PROGRAM key to advance to the next character. Repeatedly press the PROGRAM key to advance to the next character. Pressing the PROGRAM key while on the last character will increment the active character field back to the first character.
15. Press the ENTER key when the subnet mask has been entered.
16. Press and release the DOWN key.
17. "Fixed IP Gateway" should appear in the display. This is the default gateway entry for the controller. Press the ENTER key.
18. Use the UP or DOWN keys as necessary to change each character of the gateway address. Press the PROGRAM key to advance to the next character. Repeatedly press the PROGRAM key to advance to the next character. Pressing the PROGRAM key while on the last character will increment the active field back to the first character.

19. Press the ENTER key when the gateway address has been entered.
20. Hold both the ENTER and UP keys simultaneously for approximately four seconds to return to the main status menu.
21. Cycle power to the chamber (turn chamber power off then on again). The controller will begin to use the assigned network settings after restarting.

## Appendix F: IP Settings on the Tablet

If you see a USB cord emerging from the tablet and connected to the chamber, then this section is not necessary. For convenience, instructions are placed here to manually change networking information on the tablet.

1. Tap on the screen to wake it up, if necessary.
2. Press the circle on the bottom of the screen, and then to the side of screen to return to the home screen.
3. You should see a green gear icon, click it.
4. Click on "Ethernet"
5. In this menu, you can set the IP address, gateway, subnet, and DNS servers for the tablet. In the top right is a radio button that you can use to turn the tablet's connection on and off again.
6. To go back to the Percival app, press the circle on the bottom of the circle, and then to the side to return to the home screen. You should see a hexagon of the Percival logo, click it to return to the chamber app.

## Appendix G: IP Settings on the Percival App

For convenience, instructions are placed here to manually update any changes in the networking information for the Percival app. If you ever see an “N/A” on the front screen, then please check this section.

1. In the Percival app on the tablet, click the three dots in the upper right-hand portion of the screen.
2. Click “Manage chambers.”
3. You should see one default connection, if you do not, click “Add,” otherwise click “Edit.”
4. You should not need to change the chamber name, nor the connection type (leave it as “Ethernet,” if you see “Wifi” this is a typo that has been fixed in later versions of the app, which you can get along with installation instructions at <https://percivalconnect.com> ), so click “Next” past these questions.
5. Make sure the IP address either matches the IP Gateway of the LAN port of the pfsense device (since by default the pfsense device is configured to proxy data to the Intellus), or in the case where you do not have such a device, the IP address of the controller directly.

## Appendix H: General Troubleshooting Tips

- If you still face connectivity issues, please be sure to restart the chamber and upstream switch (if possible or relevant) to reset any network caches.
- It will take up to 5 minutes, till the NETGATE starts
- If you wish to perform any more complicated network functionality—changing default firewall rules for security reasons, changing traffic rules, and more complex networking configurations, then please see the complete manual.
- In all cases, the tablet/LAN should be running on the 192.168.1.1 gateway, and the Intellus/OPT off of the 192.168.2.2 Gateway, because there's a proxy setup to airgap the Intellus (this is the requirement we're facing by IT networks that's the reason for this setup).
- If you ever see the Percival app display "N/A," please see appendix G.
- If you ever see the remote webpages display a "0.0.0.0" remote address, then this means that there was an error in establishing the connection on the WAN port.
- Refer to the complete Netgate manual if you have any particular firewall, VLAN, logging, identification, port opening, etc. that you may need to do for your network.

## References

- [1] R. C. LLC, "Security Gateway Manual," 22 May 2023. [Online]. Available: <https://docs.netgate.com/manuals/pfsense/en/latest/sg-1100-security-gateway-manual.pdf>.
- [2] NIST, "NVL Publications," September 2020. [Online]. Available: <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-53r5.pdf>.
- [3] C. f. I. Security, "CIS Critical Security Controls Version 8," May 2021. [Online]. Available: <https://www.cisecurity.org/controls/v8>.