

Peer-to-Peer Lab

BAT-111: Building Automation Systems



This material is based upon work supported by the National Science Foundation Advanced Technical Education grant program, A New Technician Training Program for Advanced Building Technologies, DUE-2000190.

The opinions, findings, and conclusions or recommendations expressed are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Name: _____

Section: _____

Peer-to-Peer Lab

BAT-111: Building Automation Systems

SYNOPSIS

Set up a peer-to-peer network between the laptop and the controller.

OBJECTIVES

Upon completion of this activity the student will be able to:

1. Supply power to the controller.
2. Change the IPv4 address of the laptop.
3. Set up a peer-to-peer network between the laptop and controller.
4. Verify the peer-to-peer network.
5. View the controller's webpage.

PARTS AND EQUIPMENT

- [Contemporary Controls BAScontrol22 or BAScontrol22S](https://www.ccontrols.com/basautomation/bascontrol.htm)
[https://www.ccontrols.com/basautomation/bascontrol.htm]
- Ethernet cable
- Windows Laptop
- Wiring of assorted colors

REFERENCES

- [YouTube - Simple PING commands](https://www.youtube.com/watch?v=KYmtMBsuA50)
[https://www.youtube.com/watch?v=KYmtMBsuA50]
- [YouTube - You MUST know the Ping command!](https://www.youtube.com/watch?v=MCE5ZQcuuVs)
[https://www.youtube.com/watch?v=MCE5ZQcuuVs]

MANUALS

- [Contemporary Controls BAScontrol22 User Manual](https://www.ccontrols.com/pdf/um/UM-BASC22V4.pdf)
[https://www.ccontrols.com/pdf/um/UM-BASC22V4.pdf]

BACKGROUND

We are going to set up a peer-to-peer network between the laptop and controller. These hosts will be connected using one ethernet cable, but we also need to make sure both hosts are on the same local network. When we are saying the same local network, we are not only saying physically connected but they must have the ability to communicate together based upon each of their network configurations.

1.1 - IP address

To send information to a particular device (computer, controller, etc.) on a network there must be a way to uniquely identify that device. An IP address is a unique address for a device on a local network. There are currently two main IP schemes being used on the Internet and they are IPv4 and IPv6.

IPv4

This was the address scheming, which was created in 1978, and it was made up of 32 binary (0 or 1) digits. 32 binary digits allows $2^{32} = 4,294,967,296$ addresses which is over 4 billion addresses.

For a human, reading 32 binary numbers would be tedious and prone to errors in transposing. We use the dotted decimal format to express IPv4 addresses. The dotted decimal format is expressed as four numbers separated by a decimal. The numbers between the decimals are referred to as an octet and can be 0 – 255.

For example, the BAScontrol22 has a default IP address assigned out of the box:

- Binary: 11000000101010000101110001000100
- Dotted decimal: 192.168.92.68

When communicating an IP address, we use the dotted decimal format.

IPv6

Even with over 4 billion IPv4 addresses, the world started running out of IP addresses. There were other design issues addressed in IPv6 as well as the insufficient number of available IP addresses.

There are 128 binary digits in IPv6 address, therefore there are $2^{128} = 3.4 \times 10^{38}$ unique addresses which is approximately 340 trillion trillion trillion IP addresses.

We are going to use IPv4 addressing with our controllers.

1.2 - IP address assignment

An IP address can be assigned locally, or it can get it's IP address from the network.

Static IP address

The device has its IP address set as part of its configuration. A static IP address makes it easy to find a device; however, it just starts using this address regardless of any conflicts with other devices using the same IP address.

Dynamic IP address

When a device comes onto the network using dynamic addressing. It will request an IP address on the network from a DHCP server. The DHCP server will lease out an IP address for a time period referred to as the “lease period”. Peer-to-Peer network

PROCEDURES

Part 1: Wire Terminations

It is important that all conductors are properly terminated.

1.1 - Terminations



A technician should strive that all terminations are reliable and consistent.

Stranded wire

Stranded wire should be twisted so there are no loose wire strands. Loose wire strands can cause an electrical short.

Striped jacket length

Strip the conductor’s jacket such that the jacket will not be under the terminal screw but there will also not be an excessive amount of copper visible.

Excessive exposed copper will be a source for an electrical short. There should just be a hint of copper visible outside of the terminal block and that is to verify the jacket is not under the terminal screw.

Terminal screws

Tighten the terminal screws so the conductor is firmly held in place but do not over tighten them.

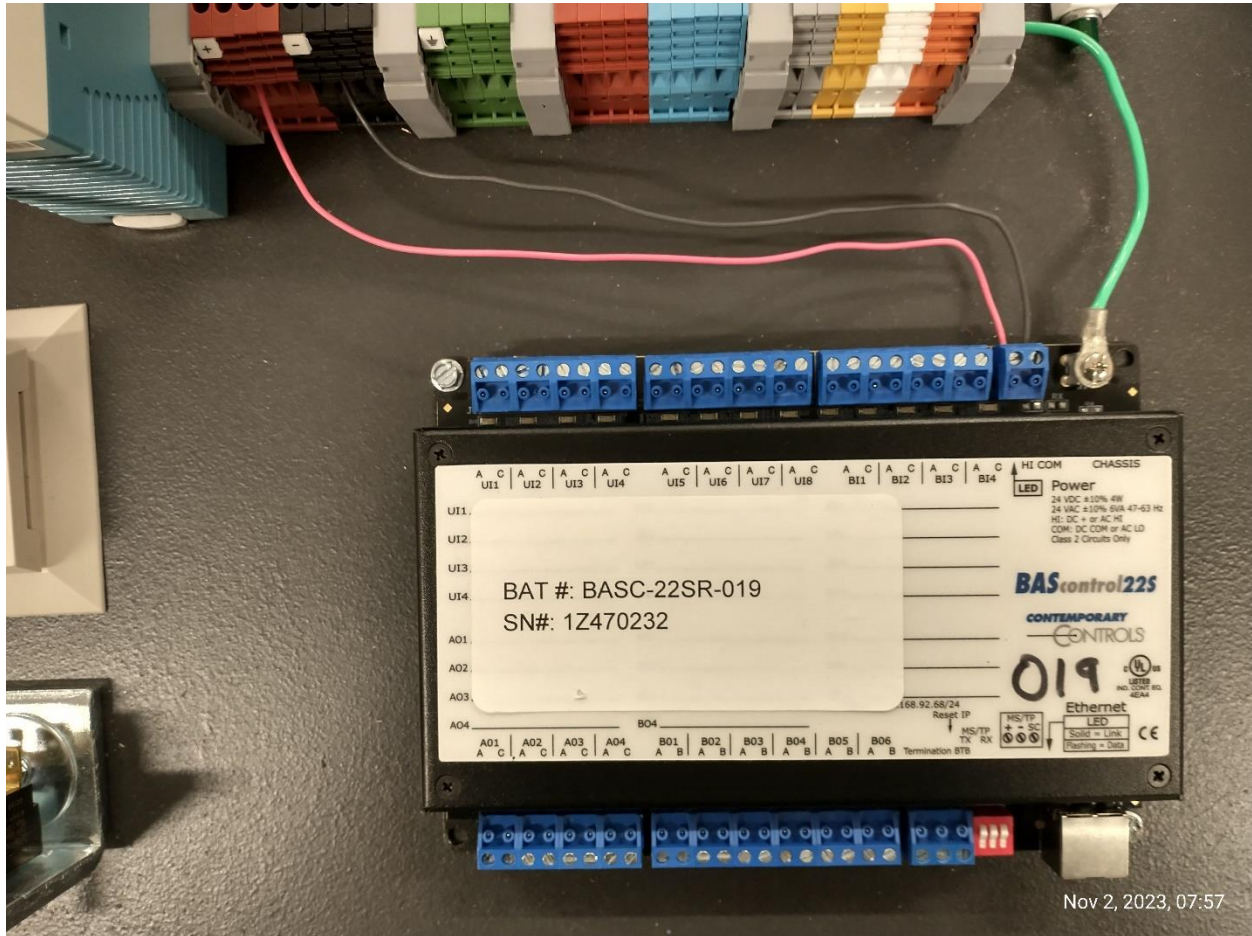
Part 2: Controller

We need to supply power to our controller, and we need to make sure all wire terminations are good.

2.1 - Power wiring

Wire the controller using 24 VDC with the proper color conductors:

- DC+ → Controller HI (red conductor)
- DC- → Controller COM (black conductor)



2.2 - Instructor Review

Have your instructor check your wiring.

Instructor is going to check the following:

1. Correct conductor colors
2. Proper terminations:
 - a. Stray wire strands outside of terminal
 - b. Conductor jacket under the terminal screw
 - c. Excessive exposed copper
 - d. Conductors secured under terminal screw
3. Neat and workmanlike wiring



Stop! Before continuing to the next step, have your instructor inspect your wiring.

If you apply power to the controller or any other device without having the instructor verify the wiring, you will lose points on this lab.

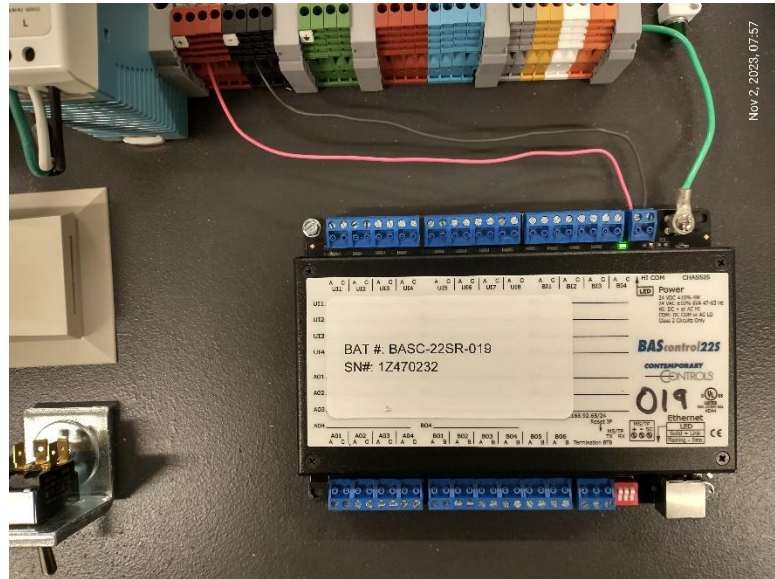
This rule is also for all future labs.

2.3 - Power Controller

Turn on the power to the controller.

As the controller starts up, LEDs illuminate a startup sequence showing that the controller is booting up.

Once the controller has successfully booted up, the LED light near the controller's power terminal blocks should be illuminated.



Is the controller's power LED light illuminated? _____

- If you answered No, troubleshoot the issue.

Part 3: Peer-to-peer network

Our simple P2P network is going to be a laptop and controller connected with an ethernet cable.

3.1 - Ethernet

Connect the controller and laptop together with the ethernet cable. Make sure the RJ-45 connectors are properly inserted into the ethernet ports.

3.2 - Controller IPv4 address

In our simple P2P network, the controller is going to use its default IPv4 settings.

The default BAScontrol22 network address:

- BAScontrol22 controller
 - IP address: 192.168.92.68
 - Subnet mask: 255.255.255.0

The subnet mask must match all our devices on the same local network.

What is the default IP address of the BAScontrol22? _____

3.3 - Connectivity

The laptop and controller will not be able to communicate, until we change the IPv4 address of the laptop to be in the same local network as the controller.

Part 4: Laptop network settings

We are going to use the default IPv4 settings for the controller and change the IPv4 address of our laptop to be in the same local network.

4.1 - Laptop IP address

We need to configure our laptop to be in the same local network as our controller.

More than likely, our laptop is set up to automatically get its IP address dynamically from the network using DHCP. We need to set our laptop's IP address statically so that it is on the same local network as our controller. The IP address must be different for each host (laptop or controller), but it will have the same subnet mask.

Since this is a simple P2P network, we need to choose an IP address for our laptop that does not conflict with our controller.

We are going to choose the following settings for our laptop:

- Laptop
 - IP address: 192.168.92.20
 - Subnet mask: 255.255.255.0
 - Default gateway: 192.168.92.1

What are you going to change your laptop's IP address to? _____



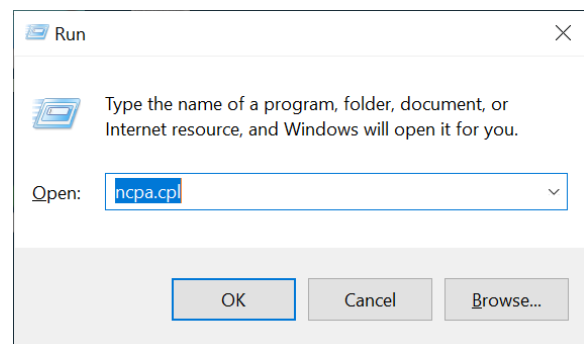
The IP address for our laptop does not have to be 192.168.92.20. According to the subnet mask, the first three octets must be the same, however, the last octet can be between 0 and 255. We should not use 0, 1, & 255 due to networking and we should not use 68 as that would set the IP address for the laptop to the same as the controller and that would not work.

4.2 - Change laptop IP address

We are going to change the laptop's IP address via the Network Connections settings.

Open Windows Network Connections

Open a run prompt with **Win+R**. In the Open command, type "ncpa.cpl" and click "OK". This will open the Network Connections window. There will be one or more network connections listed. We want to change the IPv4 address of the ethernet connection that is going to be connected to the controller.



Network Connections

Look through all the connections/adaptors and make sure you are going to change the correct ethernet connection for your ethernet port. The ethernet connection will not necessarily look exactly like the screen shot example.

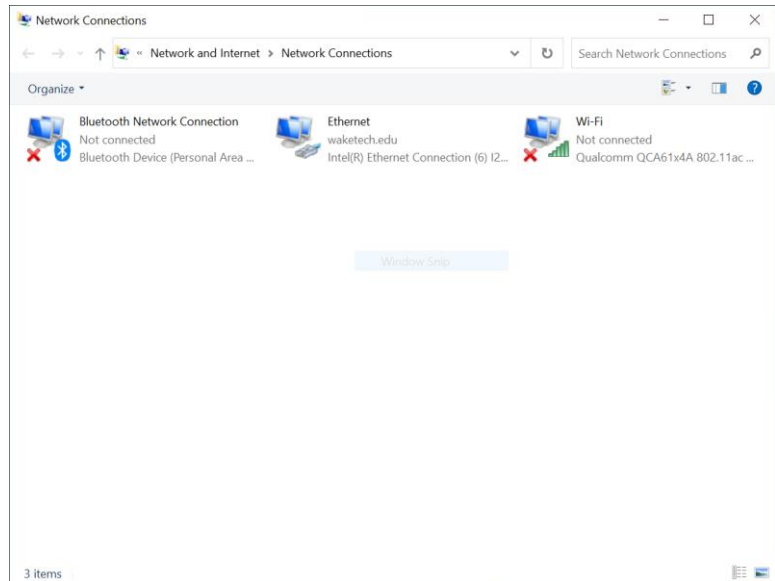
You can exclude some of the network connections that are obviously not ethernet by looking at the name and description.

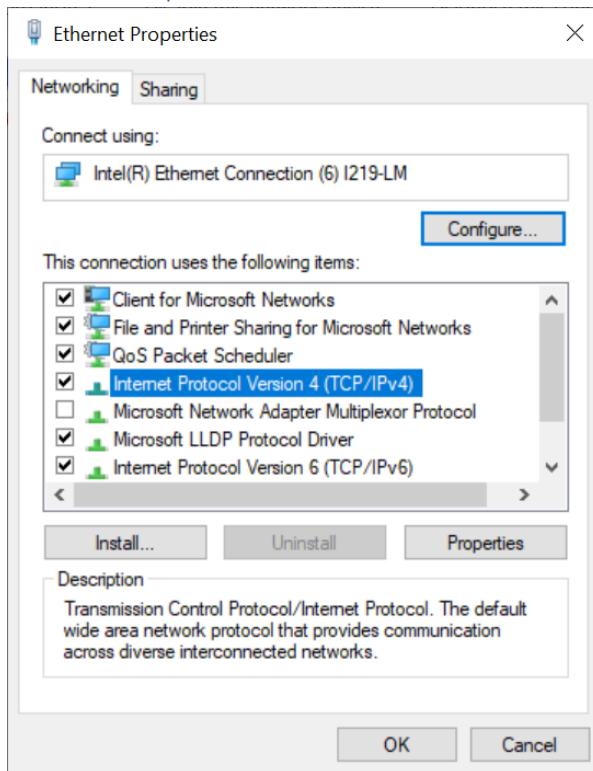
Connections which can be **excluded** may have the following words:

- Wi-Fi
- Bluetooth
- VPN
- Virtual

What is the name of the ethernet adaptor on your laptop? _____

Right-click the ethernet network connection and select “Properties.”



Ethernet Properties

Select “Internet Protocol Version 4 (TCP/IPv4)” and click the “Properties” button.

IPv4 properties

More than likely your laptop is set to get it's IP address dynamically using DHCP from the network.

Most client devices such as laptops, desktop computers, phones connect to the network and request an IP address via DHCP.

The setting "Obtain an IP address automatically" means that the laptop is configured to use DHCP to dynamically get it's IP address. This means the IP address is assigned to you from the network.

Servers (web, email, ftp, etc.), tend to have static IP addresses/

Edit IPv4 properties

We need to change the IP address of our laptop to a static IP address so that it is on the same network as our controller.

- Select "Use the following IP address:"
 - IP address: 192.168.92.20
 - Subnet mask: 255.255.255.0
 - Default gateway: 192.168.92.1
- Select "Use the following DNS server addresses:"
 - Preferred DNS server: 8.8.8.8
 - Alternate DNS server: 8.8.4.4

4.3 - Verify IPv4 properties

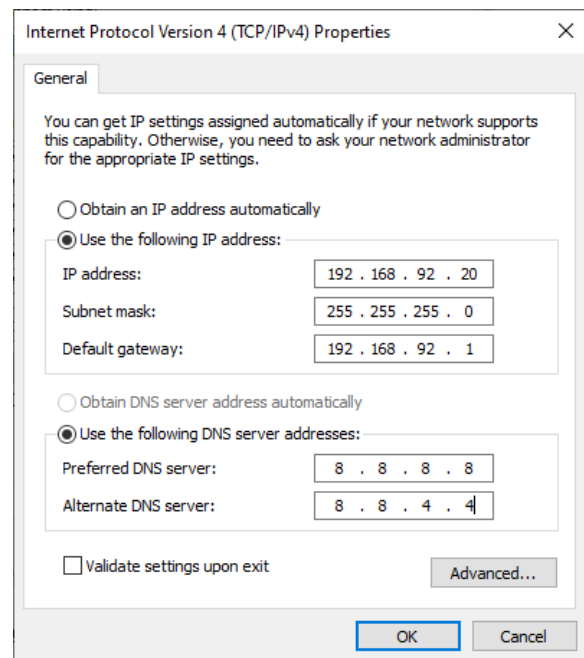
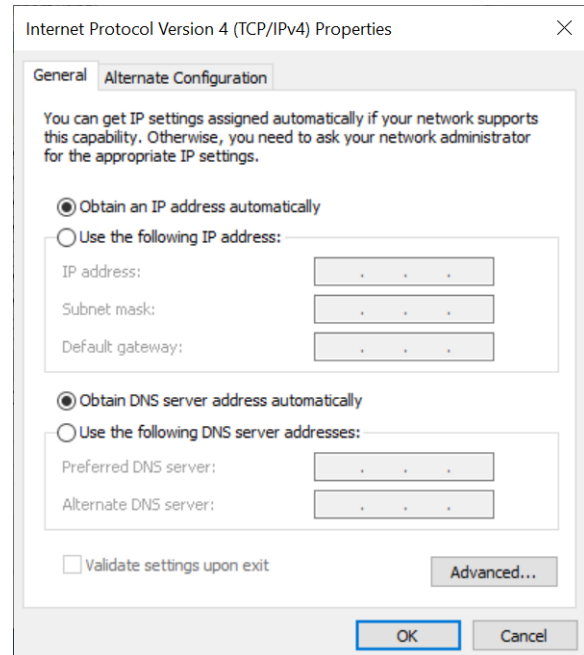
Before closing out the Properties window, verify all configuration on the IPv4 properties page.

4.4 - Close windows

Click "OK" to close the IPv4 properties page.

Click "Close" to close the ethernet properties.

Close the Network Connections page.



Part 5: Verify laptop IP address


A dos command (cmd) window is a window where users type in a command and the results scroll in the space of that window.

There are dos commands that can supply information about our laptop's network configuration.

We are going to use the "ipconfig" command.

5.1 - Open a command prompt

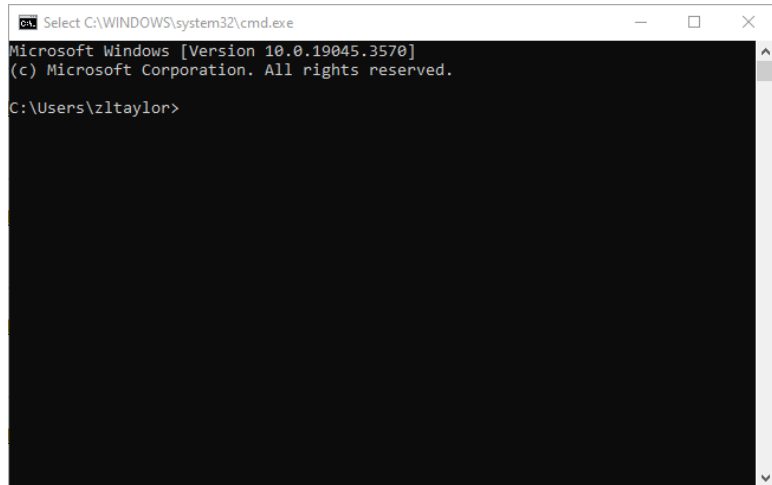
We are going to use the dos command "ipconfig" to verify the IPv4 changes we made on our laptop.

Open a run prompt (-R) and type "cmd" and click "OK."

5.2 - ipconfig

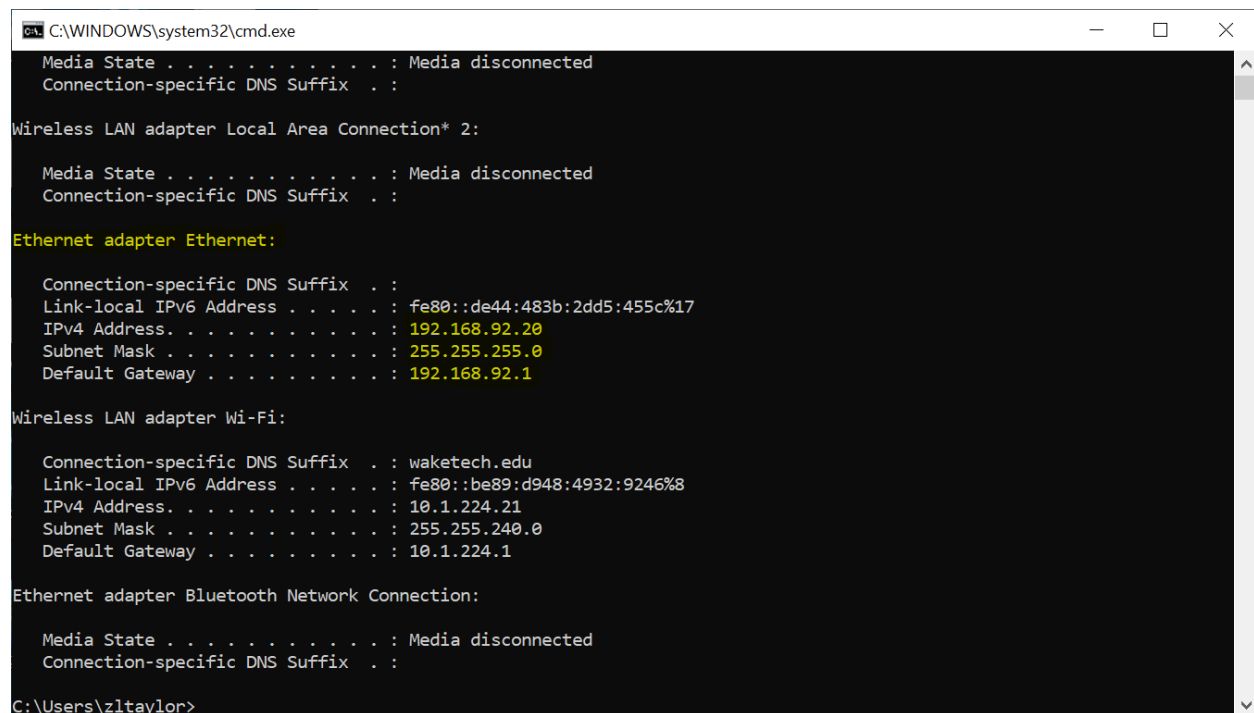
The dos command "ipconfig" is used to display information about the laptop's network configuration.

From the command prompt, type "ipconfig" and click the Enter button.



```
Microsoft Windows [Version 10.0.19045.3570]
(c) Microsoft Corporation. All rights reserved.

C:\Users\zltaylor>
```



```
C:\WINDOWS\system32\cmd.exe
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :

Wireless LAN adapter Local Area Connection* 2:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :

Ethernet adapter Ethernet:

Connection-specific DNS Suffix . :
Link-local IPv6 Address . . . . . : fe80::de44:483b:2dd5:455c%17
IPv4 Address. . . . . : 192.168.92.20
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.92.1

Wireless LAN adapter Wi-Fi:

Connection-specific DNS Suffix . : waketech.edu
Link-local IPv6 Address . . . . . : fe80::be89:d948:4932:9246%8
IPv4 Address. . . . . : 10.1.224.21
Subnet Mask . . . . . : 255.255.240.0
Default Gateway . . . . . : 10.1.224.1

Ethernet adapter Bluetooth Network Connection:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :

C:\Users\zltaylor>
```

While your output may be different, you should be able to find the configuration settings for your ethernet adaptor that you set previously.



Make sure you are looking at the ethernet adaptor that you edited previously. You might have to scroll through the window to find your adaptor.

For the ethernet adaptor:

What is the IPv4 Address? _____

What is the Subnet Mask? _____

What is the Default Gateway? _____

Are these entered all correct as entered? _____

- If you answered No, go back and change the IPv4 settings to the correct network adaptor and then reverify by running ipconfig again.

Part 6: Check connectivity to the controller

We have verified the IP settings on our adaptor and now we need to check connectivity to our controller.

6.1 - ping

The dos “ping” command is a TCP/IP command used to troubleshoot connectivity.

The simplest usage of the ping is with just one parameter which is the IP address of the destination you are trying to reach. The ping command sends a request to that destination IP and then waits a brief period for a response. By default, the ping command will send out 4 requests and detail the status.

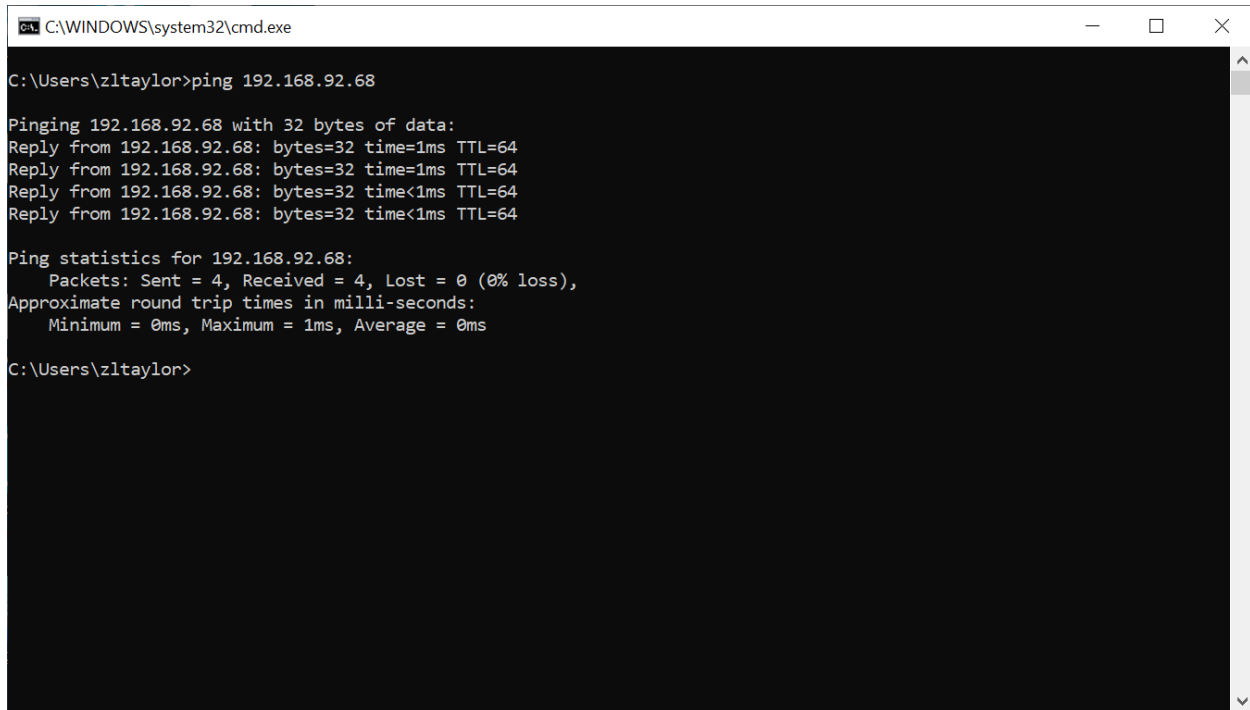


Every device on your peer-to-peer network must have a unique IPv4 address and be on the same network. You have been changing the IPv4 address on your laptop to be on the same network as your controller.

What is the IP address of your laptop? _____

What is the IP address of the controller? _____

We are going to see if we can ping our controller. From the dos prompt, type “ping” then followed by the IP address of the controller.



```
C:\WINDOWS\system32\cmd.exe
C:\Users\zltaylor>ping 192.168.92.68

Pinging 192.168.92.68 with 32 bytes of data:
Reply from 192.168.92.68: bytes=32 time=1ms TTL=64
Reply from 192.168.92.68: bytes=32 time=1ms TTL=64
Reply from 192.168.92.68: bytes=32 time<1ms TTL=64
Reply from 192.168.92.68: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.92.68:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\Users\zltaylor>
```

If you do not receive a proper response, you need to diagnose the connection to the controller.

What is the average round trip time? _____

You may not get the first reply, but if you get the other three replies that is fine. If you do not get any of the replies, you will need to troubleshoot your connection to the controller.

Part 7: BAScontrol22

The controller hosts a webpage that allows you to change the controller's configuration as well as view, edit, and override the controller's IO.

The goal of this lab is to correctly configure a peer-to-peer network to communicate with the controller. We will get familiar with the features of the controller in our next lab.

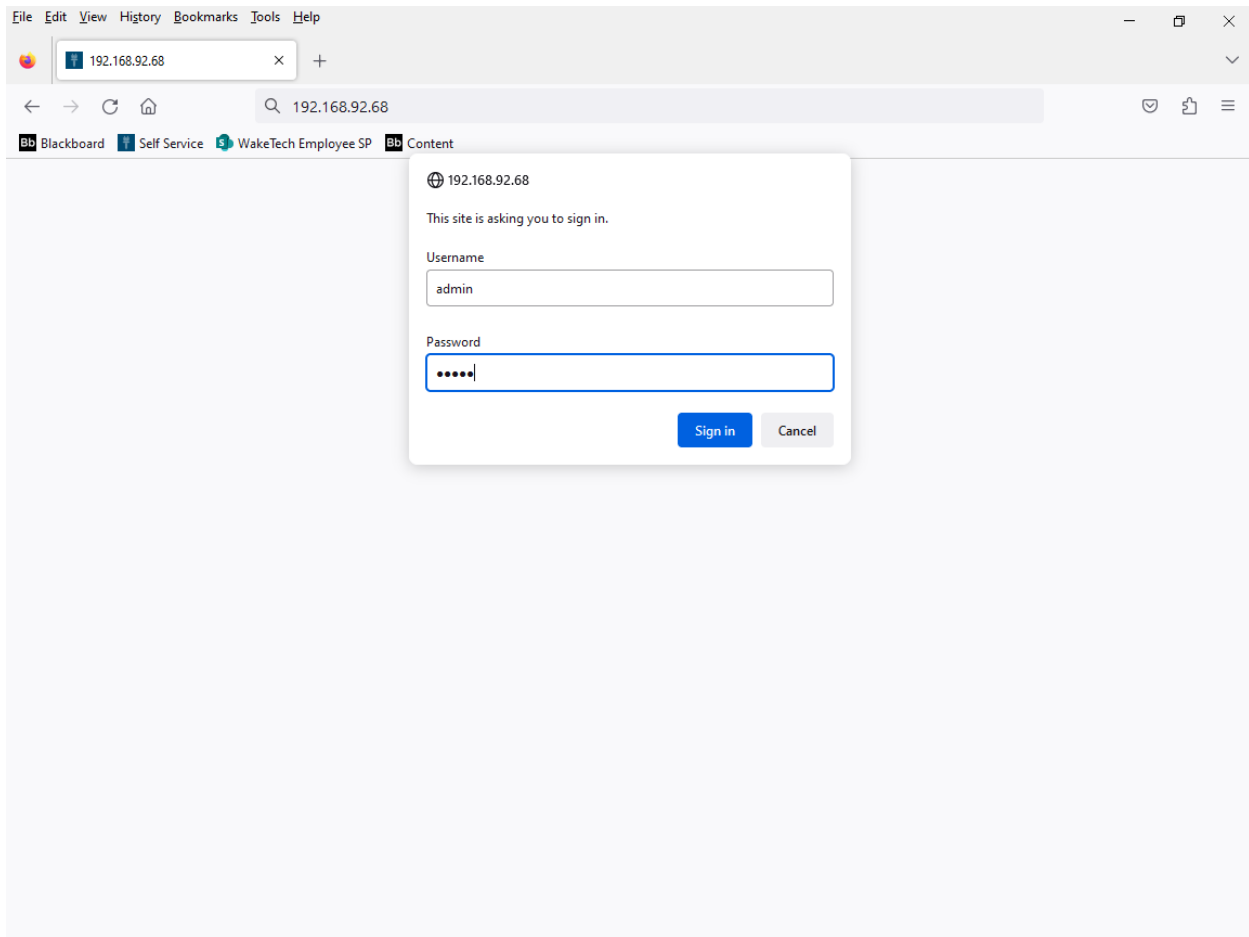
7.1 - Controller's webpage

What is the laptop's IP address? _____

What is the controller's IP address? _____

We are going to use a web browser to access the BAScontrol22. Open a browser window and enter the controller's IP address into the address field.

7.2 - User authentication



Credentials are used to make sure only authorized users are allowed access. Each user account has different permissions on what that user is allowed to do.

The BAScontrol22 has two default users:

- admin
- user

We are going to use the admin user. Use the following credentials to logon the BAScontrol22 web page.

- Username: admin
- Password: admin

7.3 - BAScontrol22

Once you can view the BAScontrol22 web page, you have successfully set up a peer-to-peer (P2P) network between your laptop and the BAScontrol22.

What is the firmware revision found at the bottom of the webpage? _____

Part 8: Instructor Verification

Demonstrate to your instructor that you have successfully set up a peer-to-peer network.

Part 9: Tear-down



When disassembling your work, make sure there is no power to the controller or any other device.

When removing conductors from the terminal blocks, unscrew them enough so you can gently remove the wires. Do not forcefully yank the wires out as this will damage the terminals.

After removing a conductor, please make sure the screw is seated in the threads by tightening the screw two turns.