

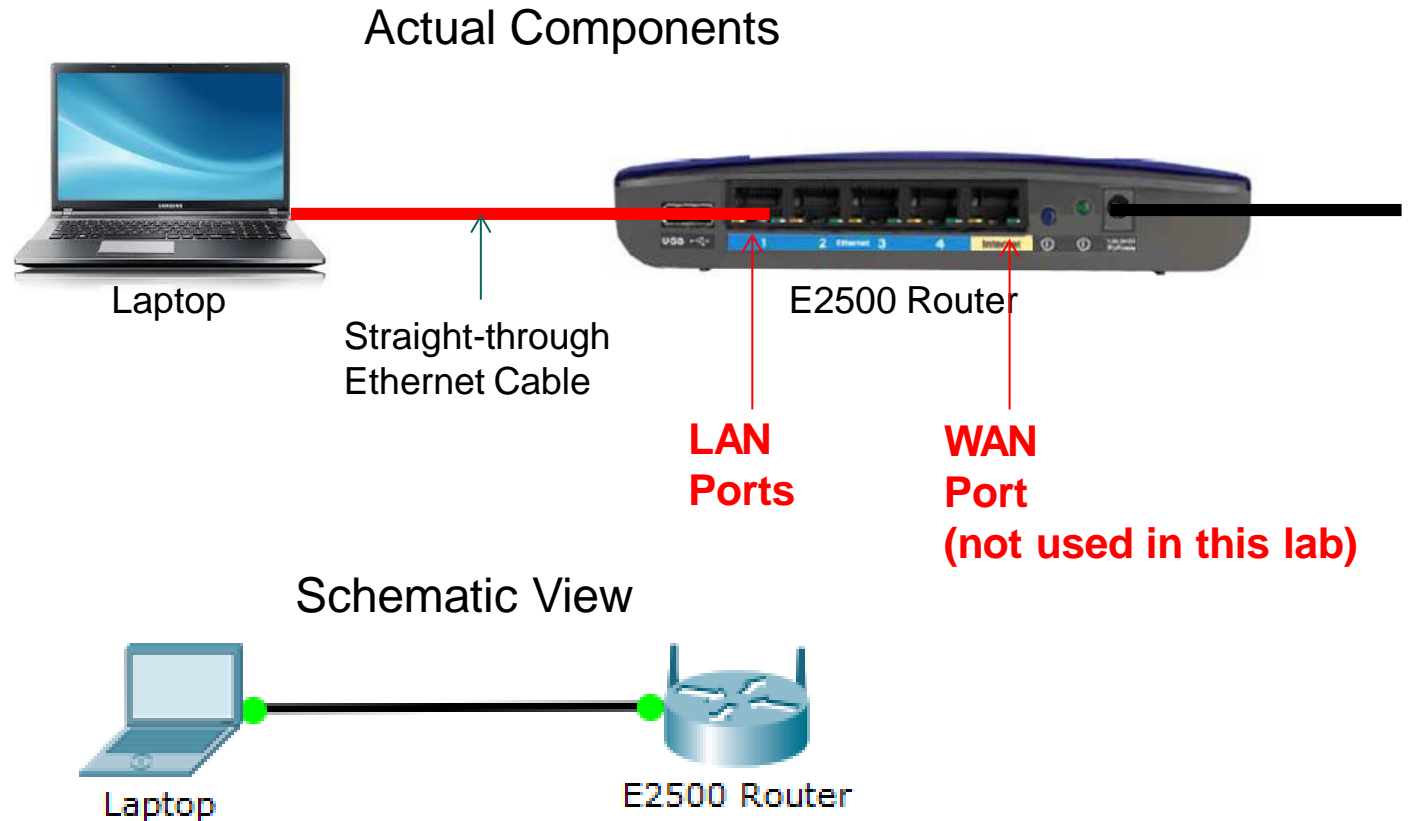
**CST8108:
LAB 2: PREVIEW**

Build and Test an Ethernet Network

- Get to know the **Linksys E2500 router**
- Build and test a **Wired (Ethernet) network** consisting of two nodes
- **Connect your laptop** to the Linksys E2500 router via the devices respective Ethernet ports using a UTP cable
- Configure **static and dynamic IPv4 addresses**
- Learn to use **ipconfig** to determine your IPv4 address
- Learn to use **ping** to test basic network connectivity (Layer 3)
- Learn to use **Wireshark** to capture network traffic



Physical Topology



E2500 Router Information

<http://www.linksys.com/ca/support-article?articleNum=142360>



Internet Protocol

IP = Internet Protocol:

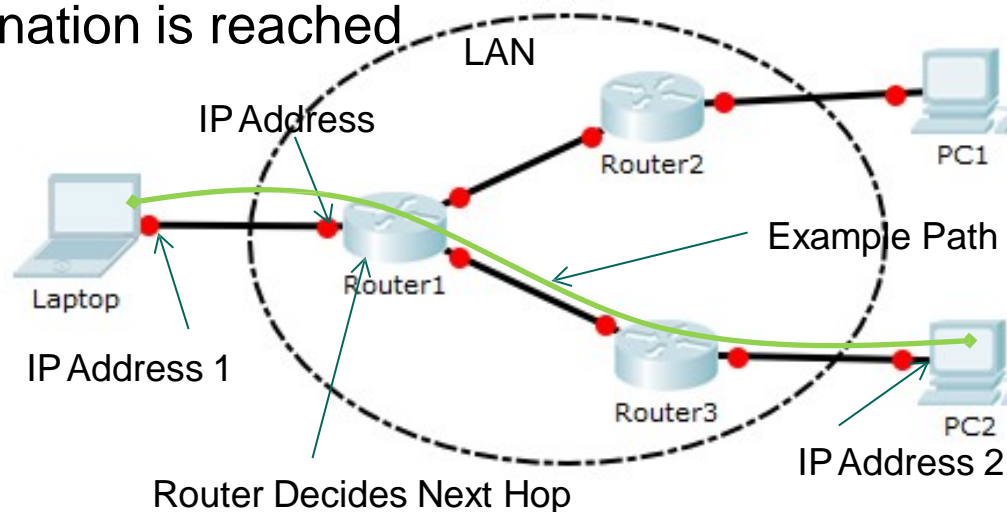
This is a protocol which has rules to forward packets from a source node to a destination node on the Internet.

IP Address:

This is an address assigned to a device interface.

It is used by IP to determine the path to reach the destination.

Each router makes a next-hop decision and forwards the packet until the destination is reached



IP Address

IP Address Length: 32 Binary Digits (bits)
Dotted Decimal Notation

<u>Network Address</u>	<u>Host Address</u>
<u>192</u>	168.1.10

Octet: value between 1-255

This is also called an IPv4 Address.

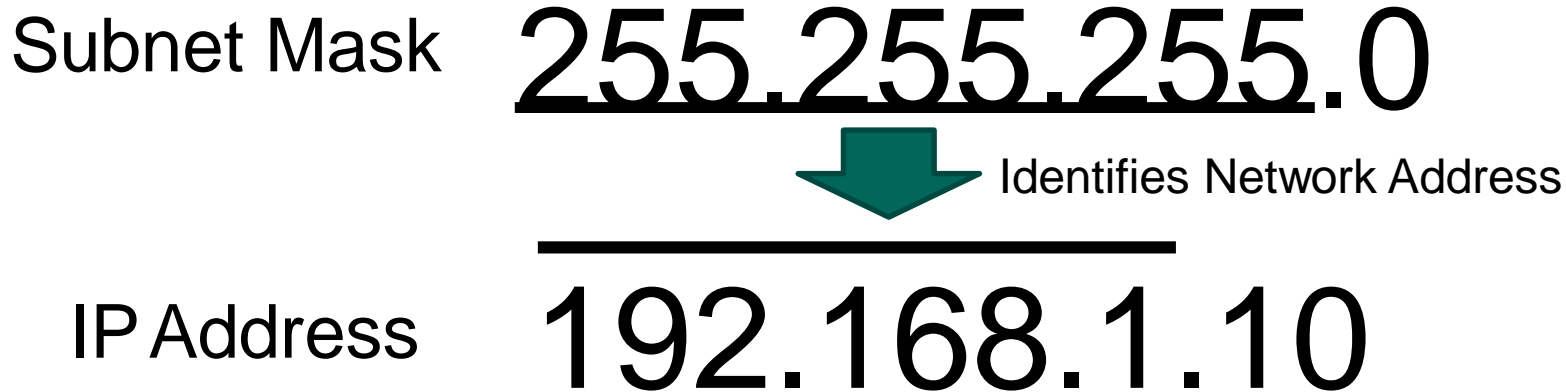
This is based on version 4 of the IP protocol.



IP Subnet Mask

The network address portion is variable.

The Subnet Mask is used to identify which portion of the IP Address forms the Network Address



Special IP Address

This is a special IP address which the interface assigns to it self if:

- a static address was not assigned or
- an address could not be obtained from a DHCP server

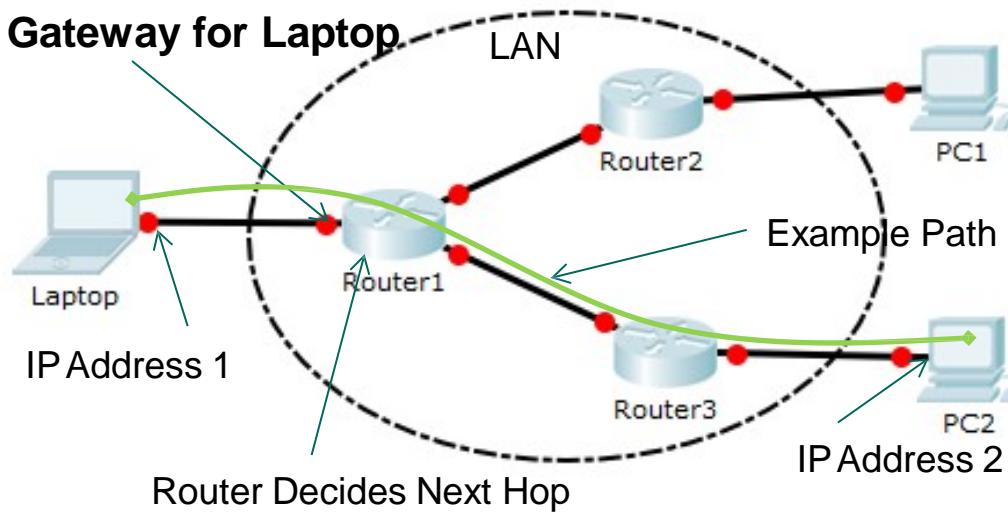
169.254.x.x

This is called a link-local address.



Default Gateway

IP Address &
Default Gateway for Laptop



The default gateway is the IP address of a device's connected router.

It is the next hop IP Address for the device.

The device sends packets to the Default Gateway and the router forwards the packet to the destination.

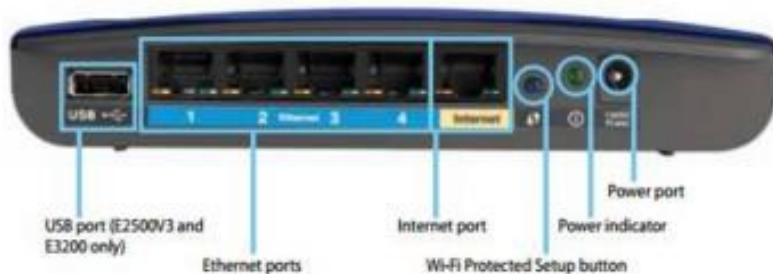


Task 1.4: Reset the Router

Product overview

E900/E1200/E1500/E2500/E3200

Back view



Your router's appearance may vary

- **USB port (E2500V3 and E3200 only)**—To easily share disk storage with other users on your network or on the Internet, connect a USB drive to this port.
- **Ethernet ports**—Connect Ethernet cables (also called network cables) to these Fast Ethernet (10/100, for E900, E1200, E1500 and E2500) or Gigabit (10/100/1000, for E3200) ports, color coded blue, and to other wired Ethernet network devices on your network.
- **Internet port**—Connect an Ethernet cable (also called a network or Internet cable) to this port, color coded yellow, and to your modem.

Wi-Fi Protected Setup™ button—Press this button to easily configure wireless security on Wi-Fi Protected Setup-enabled network devices. For more information, see "Wireless Security" on page 8.

- **Power indicator**—Stays on steadily while power is connected and following a successful Wi-Fi Protected Setup connection. Flashes slowly during bootup, during firmware upgrades, and during a Wi-Fi Protected Setup connection. Flashes quickly when there is a Wi-Fi Protected Setup error.

- **Power**—Connect the included AC power adapter to this port.

CAUTION

Use only the adapter that came with your router.

- **Power button**—Press | (on) to turn on the router.

Bottom view



Your router's appearance may vary

- **Reset button**—Press and hold this button for 5-10 seconds (until the port lights flash at the same time) to reset the router to its factory defaults. You can also restore the defaults using the browser-based utility.

Default Linksys Router Configuration

LINKSYS™ Firmware Version: 3.0.00

Linksys E2500 E2500

Setup

Setup | Wireless | Security | Storage | Access Policy | Applications & Gaming | Administration | Status

Basic Setup | VLAN Setup | IPv6 Setup | DDNS | MAC Address Clone | Advanced Routing

Language
Select your language: English

Internet Setup
Internet Connection Type: Automatic Configuration - DHCP

Optional Settings (required by some Internet Service Providers)

Network Setup
Router Address

DHCP Server Setting

Host Name:

Domain Name:

MTU: Auto Size: 1500

IP Address: 192 . 168 . 1 . 1

Subnet Mask: 255.255.255.0

Router Name: Linksys01278

DHCP Server: ☒ Enabled ☐ Disabled DHCP Reservation

Start IP Address: 192 . 168 . 1 . 100

Maximum Number of Users: 50

IP Address Range: 192 . 168 . 1 . 100 to 149

Client Lease Time: 0 minutes (0 means one day)

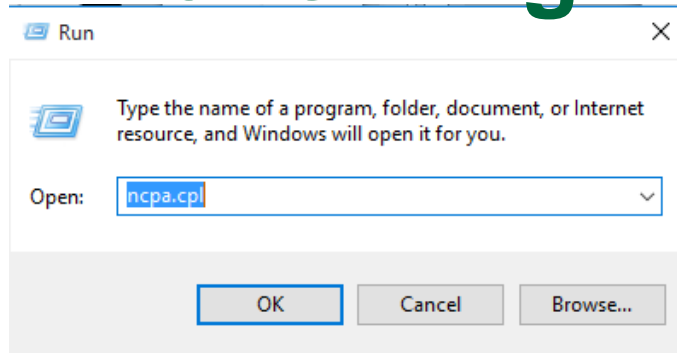
WAN Interface
IP Configuration

LAN Interface:
IP Address → PCs
Default Gateway

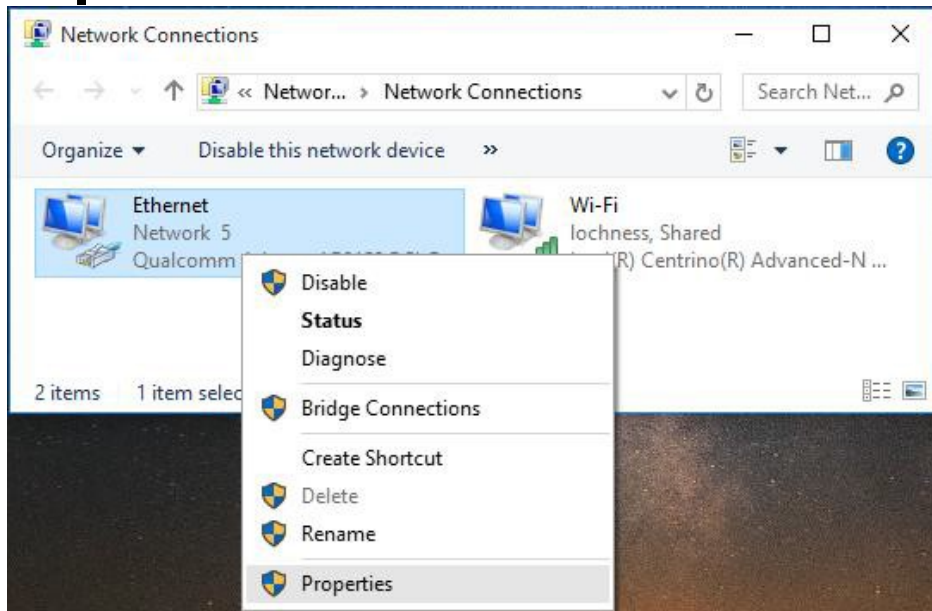
DHCP Server:
Provides IP Addresses to
PCs

Task 1.5: Configure DHCP

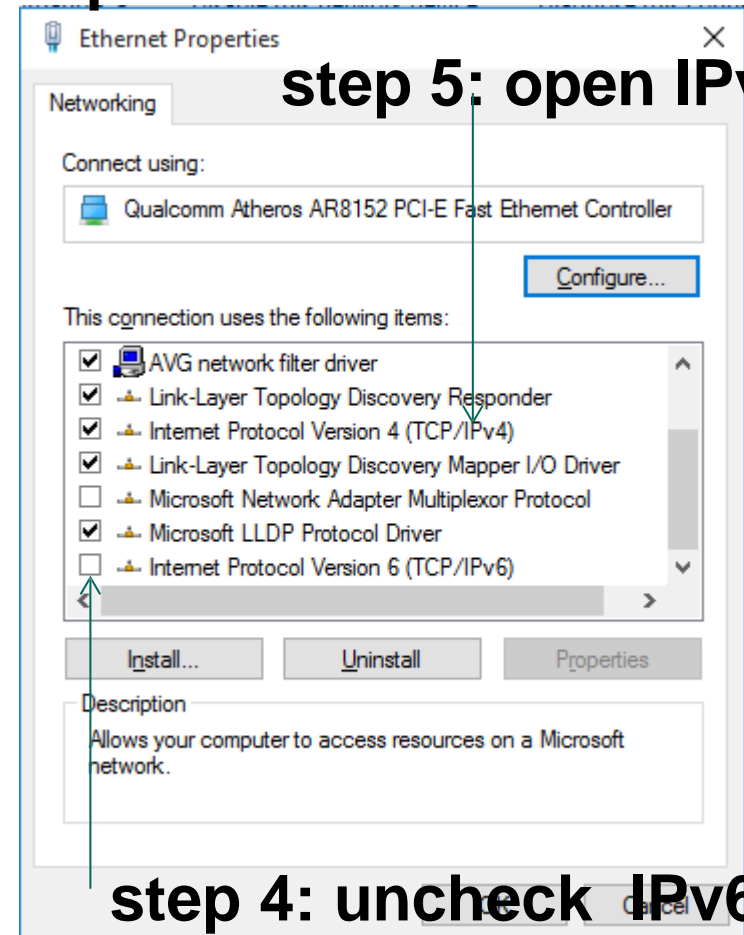
step 1



step 2



step 3



step 5: open IPv4

step 4: uncheck IPv6



Task 1.5: Configure DHCP - 2

step 6
Use DHCP
Server

Internet Protocol Version 4 (TCP/IPv4) Properties

General Alternate Configuration

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

☒ Obtain an IP address automatically

☐ Use the following IP address:

IP address:

Subnet mask:

Default gateway:

☒ Obtain DNS server address automatically

☐ Use the following DNS server addresses:

Preferred DNS server:

Alternate DNS server:

☐ Validate settings upon exit

Advanced...

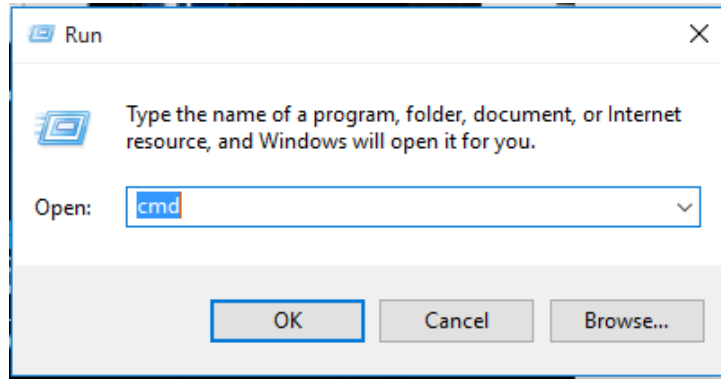
OK Cancel

Task 2
Enter Static
IP Address Info.

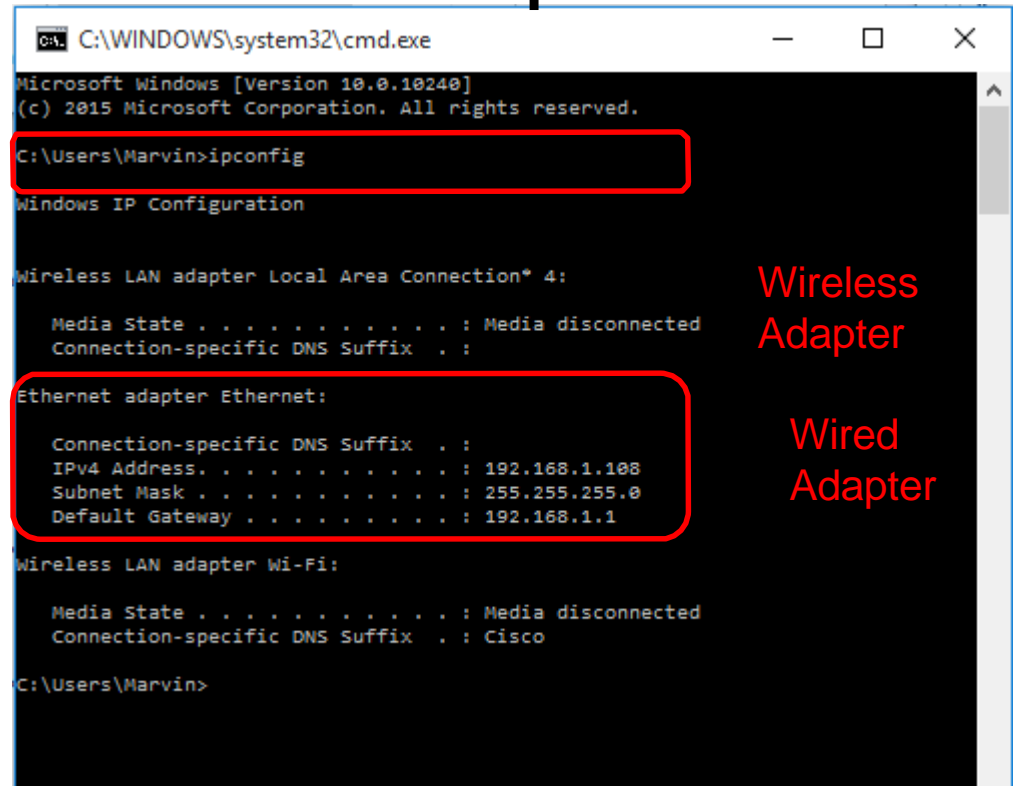


Task 1.8: Show PC's IP Configuration

Command Prompt Window



step 1

A screenshot of a Windows Command Prompt window. The title bar shows 'C:\WINDOWS\system32\cmd.exe'. The window content shows the output of the 'ipconfig' command. The output is as follows:

```
Microsoft Windows [Version 10.0.10240]
(c) 2015 Microsoft Corporation. All rights reserved.

C:\Users\Marvin>ipconfig

Windows IP Configuration

Wireless LAN adapter Local Area Connection* 4:

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

Ethernet adapter Ethernet:

    Connection-specific DNS Suffix  . :
    IPv4 Address. . . . . : 192.168.1.108
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1

Wireless LAN adapter Wi-Fi:

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

C:\Users\Marvin>
```

Red boxes highlight the command 'ipconfig' and the Ethernet adapter information. Red text labels 'Wireless Adapter' and 'Wired Adapter' are placed to the right of the corresponding sections.

C:\WINDOWS\system32\cmd.exe

Microsoft Windows [Version 10.0.10240]
(c) 2015 Microsoft Corporation. All rights reserved.

C:\Users\Marvin>ipconfig

Windows IP Configuration

Wireless LAN adapter Local Area Connection* 4:

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

Wireless Adapter

Ethernet adapter Ethernet:

Connection-specific DNS Suffix . :
IPv4 Address. : 192.168.1.108
Subnet Mask : 255.255.255.0
Default Gateway : 192.168.1.1

Wired Adapter

Wireless LAN adapter Wi-Fi:

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

C:\Users\Marvin>

step 2:

Enter “ipconfig”

to see IP information for each interface



Extended ipconfig Command

Command: **ipconfig /all**

- Shows more information
- Info Includes:
 - Physical Address
 - IP Address
 - Subnet Mask
 - DHCP Server
 - DHCP Lease
 - DNS Address
- The purpose of these fields will be covered later in the course.

```
C:\Users\Marvin>ipconfig /all

Windows IP Configuration

Host Name . . . . . : labpc
Primary Dns Suffix . . . . . :
Node Type . . . . . : Hybrid
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No

Wireless LAN adapter Local Area Connection* 4:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
Description . . . . . : Microsoft Hosted Network Virtual Adapter #2
Physical Address. . . . . : 00-23-14-46-5D-35
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes

Ethernet adapter Ethernet:

Connection-specific DNS Suffix . :
Description . . . . . : Qualcomm Atheros AR8152 PCI-E Fast Ethernet
Physical Address. . . . . : 00-26-6C-4A-2C-71
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes
IPv4 Address. . . . . : 192.168.1.108(Preferred)
Subnet Mask . . . . . : 255.255.255.0
Lease Obtained. . . . . : Tuesday, January 12, 2016 9:29:12 PM
Lease Expires . . . . . : Friday, January 15, 2016 12:06:58 PM
Default Gateway . . . . . : 192.168.1.1
DHCP Server . . . . . : 192.168.1.1
DNS Servers . . . . . : 192.168.1.1
NetBIOS over Tcpip. . . . . : Enabled

Wireless LAN adapter Wi-Fi:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . : Cisco
Description . . . . . : Intel(R) Centrino(R) Advanced-N 6200 AGN
Physical Address. . . . . : 00-23-14-46-5D-34
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes

C:\Users\Marvin>
```



Task 1.11 ICMP and Ping (Echo)

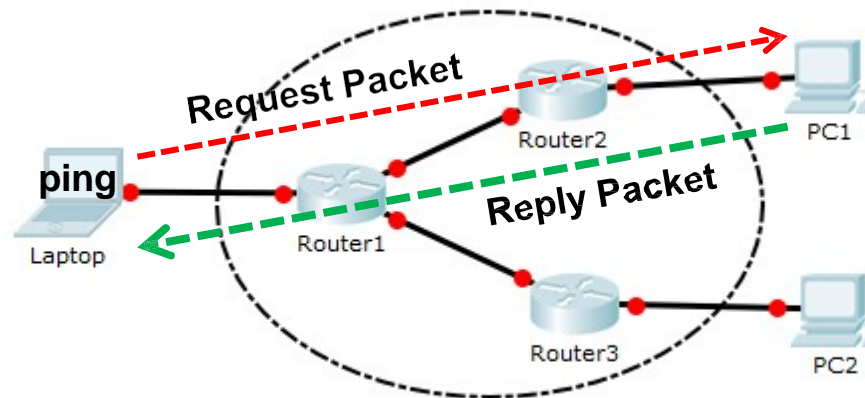
ICMP – Internet Control Message Protocol

An extension of the IP Protocol which includes utilities to facilitate and troubleshoot packet forwarding.

Ping

An ICMP troubleshooting utility to test connectivity.

1. Source device sends an request packet to a destination interface
2. Destination interface responds with a reply packet
3. If the Sender gets the reply, then IP layer connectivity is verified



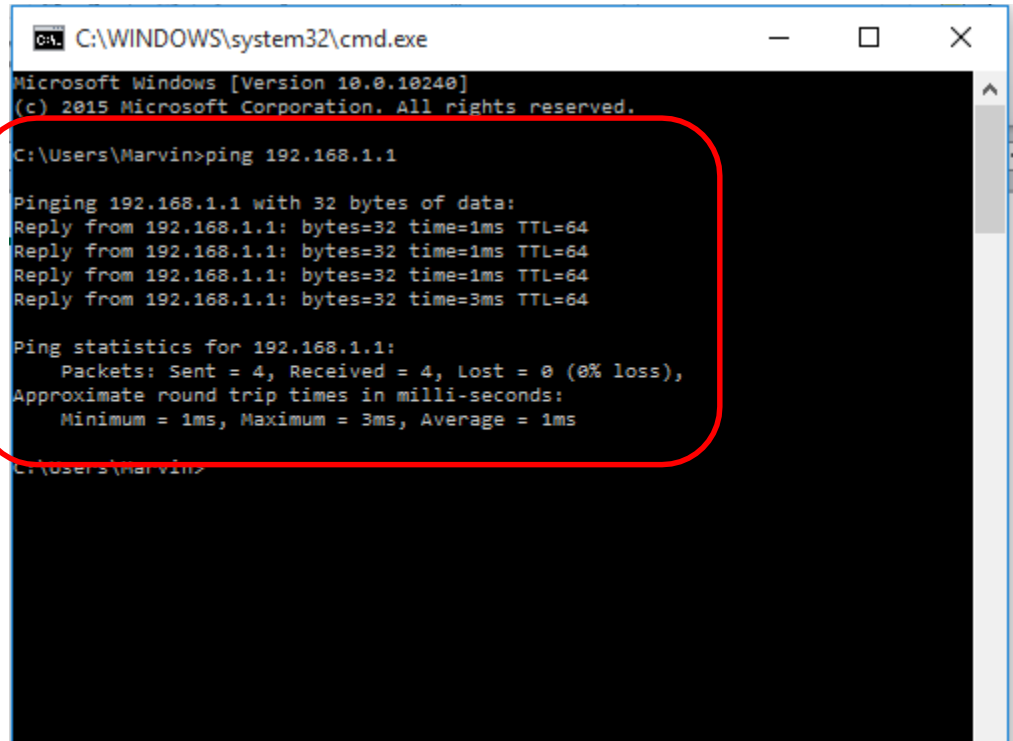
Task 1.11 ICMP and Ping

Basic Ping Command for your PC:

ping a.b.c.d where a.b.c.d is the IP Address

Pinging the Router Gateway

- Ping utility sends 4 ping packets
- Replies are shown
- Ping statistics are shown

A screenshot of a Windows Command Prompt window titled "C:\WINDOWS\system32\cmd.exe". The window shows the output of the command "ping 192.168.1.1". The output includes four individual replies and a summary of ping statistics. A red rounded rectangle highlights the replies and statistics section.

```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows [Version 10.0.10240]
(c) 2015 Microsoft Corporation. All rights reserved.

C:\Users\Marvin>ping 192.168.1.1

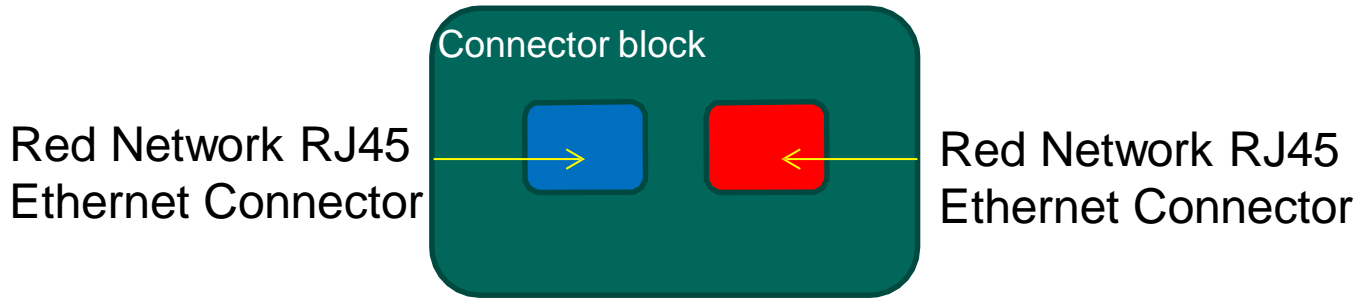
Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Reply from 192.168.1.1: bytes=32 time=3ms TTL=64

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 3ms, Average = 1ms

C:\Users\Marvin>
```



Task 3: Blue and Red Networks



Each desk has a network connector block with two network connections.

Blue Network:


College network with access to the Public Internet

Red Network:










Network that simulates the equipment at an Internet Service Provider. It includes several servers.




Task 4.2 Wireshark Interface Setup


**WIRESHARK**

The World's Most Popular Network Protocol Analyzer
Version 2.0.1 (v2.0.1-0-g59ea380 from master-2.0)

Capture	Files	Online
<div>Interface List Live list of the capture interfaces (counts incoming packets)</div> <div>Start Choose one or more interfaces to capture from, then Start</div> <div> Ethernet</div> <div>Capture Options Start a capture with detailed options</div>	<div>Open Open a previously captured file</div> <div>Open Recent:</div> <div>Sample Captures A rich assortment of example capture files on the wiki</div>	<div>Website Visit the project's website</div> <div>User's Guide The User's Guide (online version)</div> <div>Security Work with Wireshark as securely as possible</div>

Capture Help

**How to Capture**
Step by step to a successful capture setup

**Network Media**
Specific information for capturing on: Ethernet, WLAN, ...

If you installed Wireshark 2.01, then launch Wireshark Legacy



Task 4.2 Wireshark Interface Setup

Go to “Capture > Options” Tab, Click “Close” at bottom when complete.

The image shows the Wireshark 'Capture Options' dialog box. A red arrow points to the 'Ethernet' interface in the list, labeled 'step 1'. A red box contains the following instructions:

1. Select Ethernet Interface
2. Double Left Click to Open Options
3. Set Buffer Size to 2 megabytes

Red arrows point from the instructions to the 'Buffer size' field in the 'Edit Interface Settings' sub-dialog, labeled 'steps 2,3'. The 'Close' button in the sub-dialog is circled with a dashed blue line.

Wireshark: Capture Options

Capture	Interface	Link-layer header	Prom. Mode	Snaplen [B]	Buffer [MiB]	Capture Filter
<input checked="" type="checkbox"/>	Ethernet 192.168.1.108	Ethernet	enabled	262144	2	

☒ Capture on all interfaces Manage Interfaces...

☒ Use promiscuous mode on all interfaces

☐ Capture on interface: Compile selected BPFs

File: Browse...

☐ Use multiple files ☒ Use pcap-ng format

☒ Next file every 1 megabyte(s)

☐ Next file every 1 minute(s)

☐ Ring buffer with 2 files

Stop Capture Automatically After...

☐ 1 packet(s) ☐ 1 megabyte(s)

☐ 1 file(s) ☐ 1 minute(s)

Help

Edit Interface Settings

Capture

Interface: Ethernet

IP address: 192.168.1.108

Link-layer header type: Ethernet

☒ Capture packets in promiscuous mode

☐ Limit each packet to 262144 bytes

Buffer size: 2 mebibyte(s)

Capture Filter: Compile BPF

Help OK Cancel

Close

Task 4.3 Packet Capture

Procedure:

1. Open the Command Prompt
2. Start Packet Capture: “Capture > Start” Tab
3. Issue ping command
4. When ping is complete, stop packet capture:
Capture > Stop



Task 4.3: Packet Capture

*Ethernet [Wireshark 2.0.1 (v2.0.1-0-g59ea380 from master-2.0)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: Expression... Clear Apply Save

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.108	192.168.1.1	ICMP	74	Echo (ping) request id=0x0001, seq=526/3586, ttl=128 (no response found!)
2	0.010420	192.168.1.1	192.168.1.108	ICMP	74	Echo (ping) reply id=0x0001, seq=526/3586, ttl=64 (request in 1)
3	1.008740	192.168.1.108	192.168.1.1	ICMP	74	Echo (ping) request id=0x0001, seq=527/3842, ttl=128 (reply in 4)
4	1.010408	192.168.1.1	192.168.1.108	ICMP	74	Echo (ping) reply id=0x0001, seq=527/3842, ttl=64 (request in 3)
5	2.016665	192.168.1.108	192.168.1.1	ICMP	74	Echo (ping) request id=0x0001, seq=528/4098, ttl=128 (no response found!)
6	2.020396	192.168.1.1	192.168.1.108	ICMP	74	Echo (ping) reply id=0x0001, seq=528/4098, ttl=64 (request in 5)
7	3.024574	192.168.1.108	192.168.1.1	ICMP	74	Echo (ping) request id=0x0001, seq=529/4354, ttl=128 (reply in 8)
8	3.030518	192.168.1.1	192.168.1.108	ICMP	74	Echo (ping) reply id=0x0001, seq=529/4354, ttl=64 (request in 7)
9	8.004648	Inventec_4a:2c:71	BelkinIn_2c:e0:16	ARP	42	who has 192.168.1.1? Tell 192.168.1.108

Frame 2: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface 0

Ethernet II, Src: BelkinIn_2c:e0:16 (c0:56:27:2c:e0:16), Dst: Inventec_4a:2c:71 (00:26:6c:4a:2c:71)

Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.1.108

Internet Control Message Protocol

Type: 0 (Echo (ping) reply)
Code: 0
Checksum: 0x534d [correct]
Identifier (BE): 1 (0x0001)
Identifier (LE): 256 (0x0100)
Sequence number (BE): 526 (0x020e)
Sequence number (LE): 3586 (0x0e02)
[\[Request frame: 1\]](#)
[Response time: 10.420 ms]

Data (32 bytes)

0000	00 26 6c 4a 2c 71 c0 56 27 2c e0 16 08 00 45 00	.&]J,q.V ',....E.
0010	00 3c 4a 3a 00 00 40 01 ac c9 c0 a8 01 01 c0 a8	.<J:..@.
0020	01 6c 00 00 53 4d 00 01 02 0e 61 62 63 64 65 66	.l..SM.. ..abcdef
0030	67 68 69 6a 6b 6c 6d 6e 6f 70 71 72 73 74 75 76	ghijklmn opqrstuv
0040	77 61 62 63 64 65 66 67 68 69	wabcdefg hi

END

