

M3 Lab: Physical Layer

CITA 220: DATA COMM & NETWORK TECH

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2 WINDOWS

2.1 STARTING THE COMMAND PROMPT

Log into a Windows computer. Press the R key while holding down the Windows key (). Type **cmd** and press **Enter**. See Figure 1. The **Command Prompt** program starts. See Figure 2.

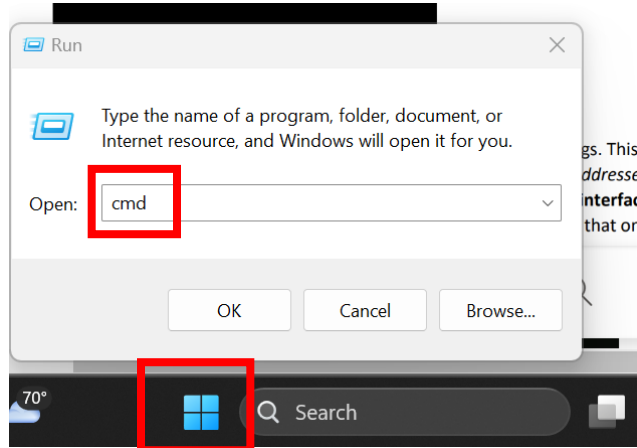


Figure 1. Starting the Command Prompt Program

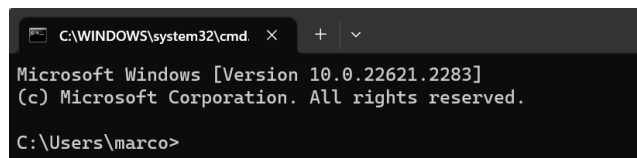


Figure 2. Command Prompt Program

2.2 DISPLAYING THE NETWORK SETTINGS

The **ipconfig** command is used to display the current network settings. This command is typically used with the **/all** switch. See Figure 3. The network settings, such *IP addresses*, *MAC addresses*, and *default gateway addresses*, are grouped into one or more **network interfaces (adapters)**. An interface may be a physical network interface card (NIC) or a virtual interface that only exists in the device's RAM.

```

C:\WINDOWS\system32\cmd. X + v

C:\Users\marco>ipconfig /all

Windows IP Configuration

    Host Name . . . . . : DESKTOP-164LQ8G
    Primary Dns Suffix . . . . . :
    Node Type . . . . . : Hybrid
    IP Routing Enabled. . . . . : No
    WINS Proxy Enabled. . . . . : No

Ethernet adapter Ethernet:

    Connection-specific DNS Suffix  . :
    Description . . . . . : VirtualBox Host-Only Ethernet Adapter
    Physical Address. . . . . : 0A-00-27-00-00-07
    DHCP Enabled. . . . . : No
    Autoconfiguration Enabled . . . . : Yes
    Link-local IPv6 Address . . . . . : fe80::8b74:b43c:5b29:8505%7(Preferred)
    IPv4 Address. . . . . : 192.168.56.1(Preferred)
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . :
    DHCPv6 IAID . . . . . : 654966823
    DHCPv6 Client DUID. . . . . : 00-01-00-01-2A-73-97-C0-70-9C-D1-9F-53-67
    NetBIOS over Tcpip. . . . . : Enabled

Wireless LAN adapter Wi-Fi:

    Connection-specific DNS Suffix  . :
    Description . . . . . : Killer(R) Wi-Fi 6 AX1650w 160MHz Wireless Network Adapter (200D2W)
    Physical Address. . . . . : 70-9C-D1-9F-53-67
    DHCP Enabled. . . . . : Yes
    Autoconfiguration Enabled . . . . : Yes
    Link-local IPv6 Address . . . . . : fe80::cd0c:fa2e:80:9244%21(Preferred)
    IPv4 Address. . . . . : 10.11.65.11(Preferred)
    Subnet Mask . . . . . : 255.255.255.0
    Lease Obtained. . . . . : Tuesday, October 3, 2023 7:36:50 PM
    Lease Expires . . . . . : Friday, October 13, 2023 7:52:53 AM
    Default Gateway . . . . . : 10.11.65.1
    DHCP Server . . . . . : 172.17.112.2
    DHCPv6 IAID . . . . . : 359701713
    DHCPv6 Client DUID. . . . . : 00-01-00-01-2A-73-97-C0-70-9C-D1-9F-53-67
    DNS Servers . . . . . : 8.8.8.8
    . . . . . : 1.1.1.1
    NetBIOS over Tcpip. . . . . : Enabled
  
```

Network Interface Name 1

Network Interface Name 2 (Primary Interface)

MAC Address

IP Address

Default Gateway Device Address

Figure 3. The `ipconfig` Command

Although two network interfaces are listed in Figure 3, the second address is the primary interface because the default gateway device address has an IP address (137.37.120.1). Sometimes the output shows more network interfaces with no default gateway IP address. Those interfaces are not primary interfaces.

2.3 IDENTIFYING PHYSICAL LAYER ISSUES

If the computer is on a wired network, unplug the network cable. If the computer is on a wireless network, disconnect it from the network. Reissue the `ipconfig` command. Compare the outputs before

and after the simulated physical layer issue. (Compare Figure 3 and Figure 4.) Note that the **Media State** shows **Media disconnected**. See Figure 4. Reconnect the computer back to the network and re-run the ipconfig command.

```
Wireless LAN adapter Wi-Fi:  
Media State . . . . . : Media disconnected  
Connection-specific DNS Suffix  . :
```

Figure 4. Media Disconnected

3 LINUX

3.1 STARTING THE TERMINAL PROGRAM

Start the CITA 220 virtual machine and log in. Click the **App Button** and type *terminal*. See Figure 5. Click the **Terminal** icon. See Figure 6.

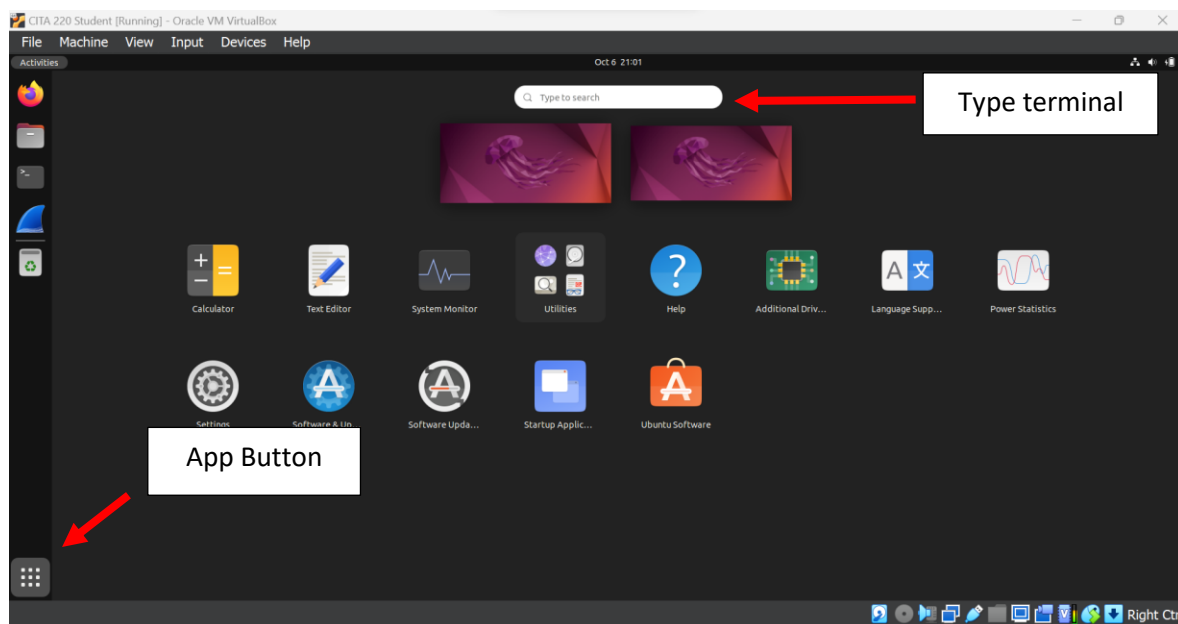


Figure 5. Searching for the Terminal Program

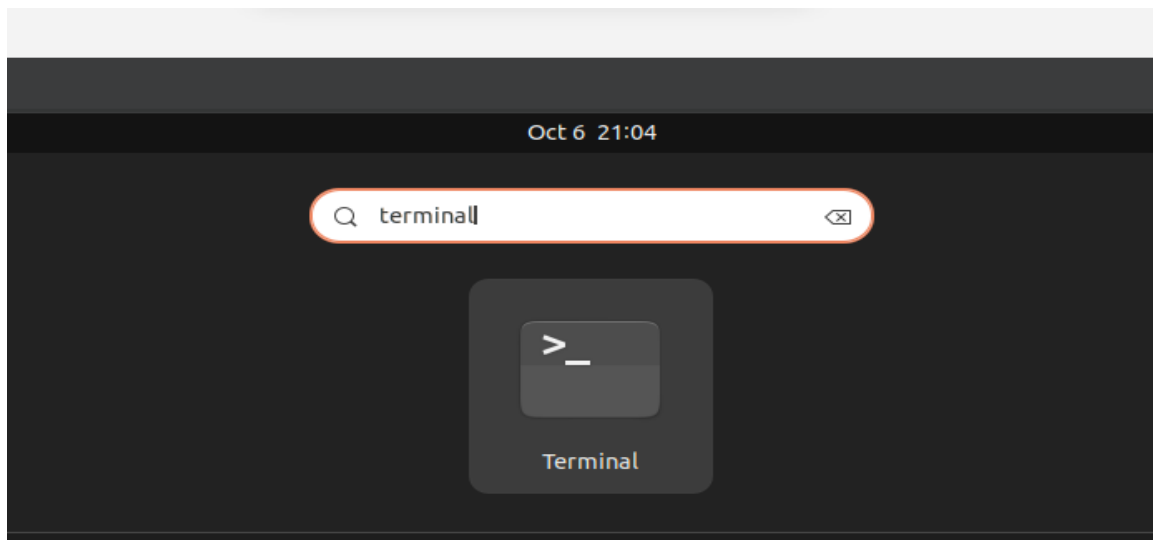


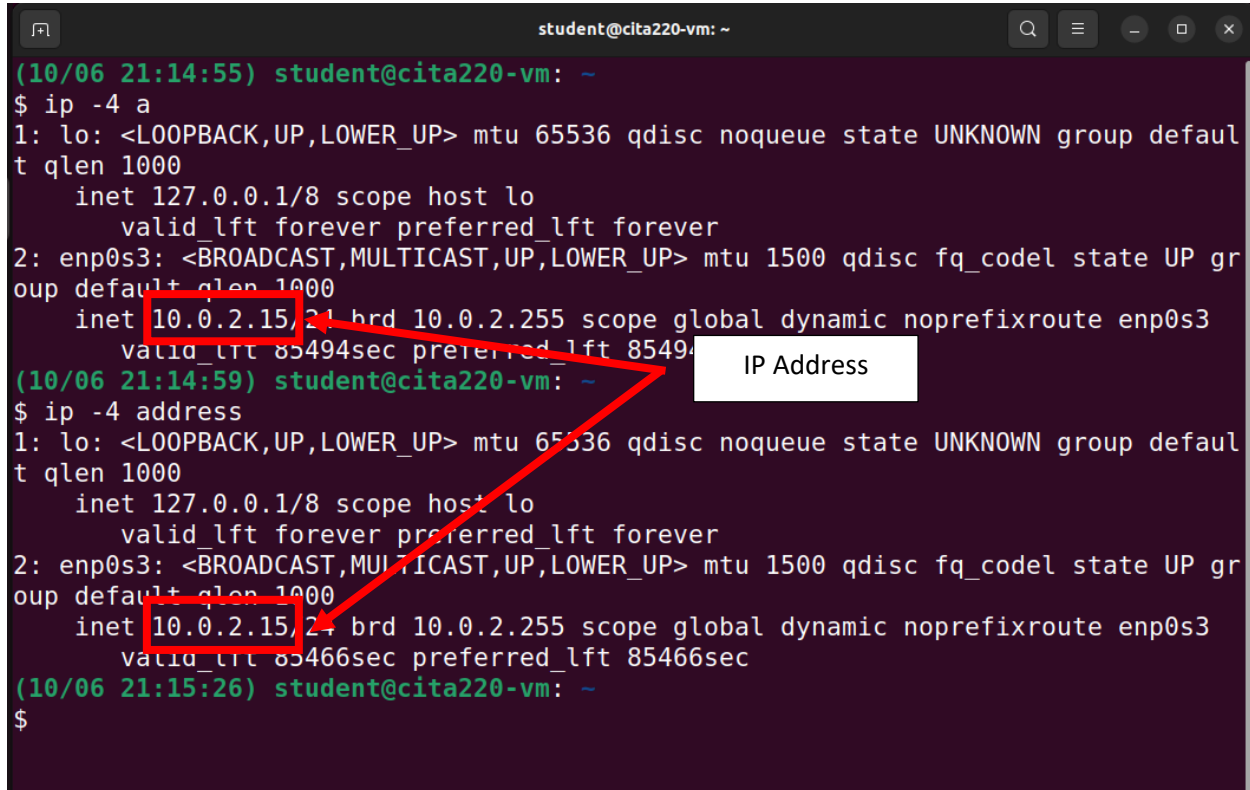
Figure 6. Starting the Terminal Program

3.2 DISPLAYING THE NETWORK SETTINGS

The **ifconfig** and **ip** commands identify the system's network settings. The **ifconfig** command is the older command, and more systems encourage users to use the **ip** command. The **ip** command is typically used with the **-4 a (-4 address)** command arguments. See Figure 7 and Figure 8.

A screenshot of a terminal window. The prompt is 'student@cita220-vm: ~'. The command 'ifconfig' has been executed. The output shows details for the 'enp0s3' interface, including its flags, MTU, IP address (10.0.2.15), netmask (255.255.255.0), broadcast address (10.0.2.255), and various statistics. The IP address '10.0.2.15' is highlighted with a red rectangular box. A white callout box with the text 'IP Address' has an arrow pointing to the highlighted IP address. Below the 'enp0s3' output, the output for the 'lo' (loopback) interface is also visible. The terminal window has a title bar with standard window controls and a search icon.

Figure 7. The **ifconfig** Command



```
(10/06 21:14:55) student@cita220-vm: ~
$ ip -4 a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
        valid_lft 85494sec preferred_lft 85494sec
(10/06 21:14:59) student@cita220-vm: ~
$ ip -4 address
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
        valid_lft 85466sec preferred_lft 85466sec
(10/06 21:15:26) student@cita220-vm: ~
$
```

Figure 8. The `ip` Command

3.3 OBTAINING OTHER PHYSICAL LAYER INFORMATION

The **ethtool** command shows more physical layer information about network adapters. It shows the supported link modes, the current bandwidth, the duplex state, the link state, and other information.

```
(10/06 21:22:48) student@cita220-vm: ~
$ sudo ethtool enp0s3
[sudo] password for student:
Settings for enp0s3:
Supported ports: [ TP ]
Supported link modes:   10baseT/Half 10baseT/Full
                        100baseT/Half 100baseT/Full
                        1000baseT/Full
Supported pause frame use: No
Supports auto-negotiation: Yes
Supported FEC modes: Not reported
Advertised link modes:  10baseT/Half 10baseT/Full
                        100baseT/Half 100baseT/Full
                        1000baseT/Full
Advertised pause frame use: No
Advertised auto-negotiation: Yes
Advertised FEC modes: Not reported
Speed: 1000Mb/s
Duplex: Full
Auto-negotiation: on
Port: Twisted Pair
PHYAD: 0
Transceiver: internal
MDI-X: off (auto)
Supports Wake-on: umbg
Wake-on: d
Current message level: 0x00000007 (7)
                        drv probe link
Link detected: yes
```

Figure 9. The ethtool Command

3.4 IDENTIFYING PHYSICAL LAYER ISSUES

Click the **Devices** menu. (See Figure 10). Click **Network** and **Connect Network Adapter** to simulate a network cable disconnection issue. Re-execute the `ifconfig`, the `ip`, and the `ethtool` commands, and compare the outputs before and after the simulated issue. (Compare Figure 7 and Figure 11. Compare Figure 8 and Figure 12. Compare Figure 9 and Figure 13.) Go back to the Devices menu and restore the network connection. Re-execute the `ifconfig`, the `ip`, and the `ethtool` commands to make sure the simulated physical layer is resolved.

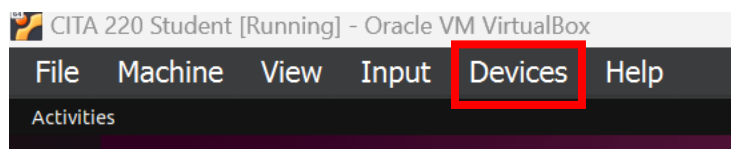
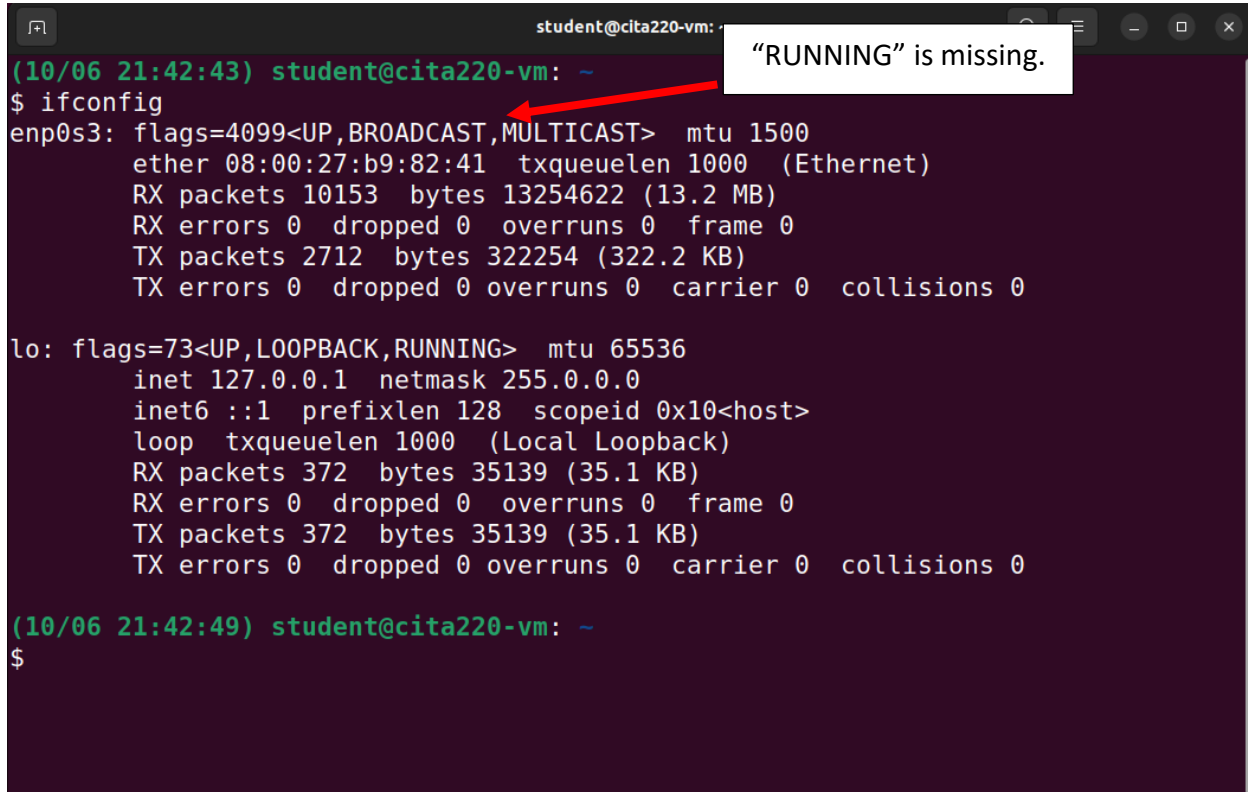


Figure 10. VirtualBox Devices Menu

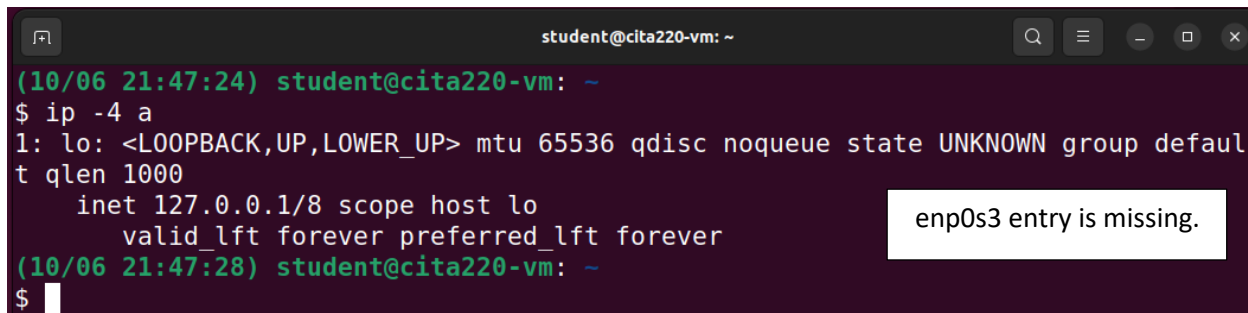


```
(10/06 21:42:43) student@cita220-vm: ~
$ ifconfig
enp0s3: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
        ether 08:00:27:b9:82:41 txqueuelen 1000 (Ethernet)
        RX packets 10153 bytes 13254622 (13.2 MB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 2712 bytes 322254 (322.2 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 372 bytes 35139 (35.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 372 bytes 35139 (35.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

(10/06 21:42:49) student@cita220-vm: ~
$
```

Figure 11. The `ifconfig` Command Output after a Simulated Issue



```
(10/06 21:47:24) student@cita220-vm: ~
$ ip -4 a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
(10/06 21:47:28) student@cita220-vm: ~
$
```

Figure 12. The `ip` Command Output after a Simulated Issue

```
(10/06 21:49:47) student@cita220-vm: ~
$ sudo ethtool enp0s3
[sudo] password for student:
Settings for enp0s3:
    Supported ports: [ TP ]
    Supported link modes:   10baseT/Half 10baseT/Full
                           100baseT/Half 100baseT/Full
                           1000baseT/Full

    Supported pause frame use: No
    Supports auto-negotiation: Yes
    Supported FEC modes: Not reported
    Advertised link modes:  10baseT/Half 10baseT/Full
                           100baseT/Half 100baseT/Full
                           1000baseT/Full

    Advertised pause frame use: No
    Advertised auto-negotiation: Yes
    Advertised FEC modes: Not reported
    Speed: Unknown!
    Duplex: Unknown! (255)
    Auto-negotiation: on
    Port: Twisted Pair
    PHYAD: 0
    Transceiver: internal
    MDI-X: Unknown (auto)
    Supports Wake-on: umbg
    Wake-on: d
    Current message level: 0x00000007 (7)
                           drv probe link
    Link detected: no
(10/06 21:50:22) student@cita220-vm: ~
```

Figure 13. The ethtool Command Output after a Simulated Issue