ADVENTIST UNIVERSITY OF CENTRAL AFRICA

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Student ID: 29061

Course Name: Computer Networks

Assignment Title: Assignment#0

Date: Sep-14-2025

Statement: I confirm that results on this report is my own, and I understand that violating academic and course integrity results punishments.

Table of Contents

Task A – DoD (TCP/IP) vs OSI model

a) DoD (TCP/IP) Model – Four Layer

Application Layer (DoD):

Layer	Responsibilities	Typical Protocols	Example Scenario
Application	Provide user interface	HTTP, HTTPs, DNs	Browser request a website using HTTP
Transport	Ensures end-to-end Communication	TCP,UDP	TCP used for downloading a file reliably
Internet	Logical addressing & routing	IP, ARP,IPv6	Router forward a packets based on destination IP address
Network Access/Link	Frames & MAC addressing	Ethernet, Wi-Fi, ARP	PC send Ethernet frame via switch using MAC address

b) Compare DoD vs OSI – structural & functionality differences

No	OSI 7 Layer	TCP (DoD) 4 Layer	Main Responsibilities
7	Application		App service like HTTP,DNS
6	Presentation	Application	Data format
5	Session		Session Management
4	Transport	Transport	Reliable delivery, error recovery
3	Network	Internet	Routing, IP addressing
2	Data Link	Network Access	MAC addressing, frame delivery
1	Physical		Electrical, media

c) Inclusions per layer

Application:

- DNS resolves domain IP
- HTTP fetches web content

Transport:

- TCP ensures reliable delivery
- UDP used for fast, real –time delivery

Network / Internet:

- IP provides logical addressing
- ARP maps IP -> MAC for delivery

Data Link / Network Access

- Ethernet transmits frames
- Wi-fi sends data wirelessly
- MAC address used for local delivery

d) OSI Model in Depth (7 layers with real-life examples)

No	Layer	Definition	Protocol	Example
7	Application	This is Layer that provide user-level services	HTTP, FTP. DNS	Browser shows web page
6	Presentation	Layer that handles data encoding & encryptions	TLS, compression	HTTP encrypts the page
5	Session	It is layer that start and ends sessions	RDP, NetBIOS	RDP login to remote system
4	Transport	Layer that handles reliable/unreliable delivery	TCP/UDP	TCP download resume after drop
3	Network	Routing across networks	IP, Routers	Router forwards packet to next hop

| 2 | Data Link | MAC & frame delivery | MAC, switches, frames | Switch uses MAC to forward frame |
| 1 | Physical | Media transmission | Wireless, Cables, bits, NICs | Copper cable transmits binary pulses |

Diagram shows how data moves from sender to receiver
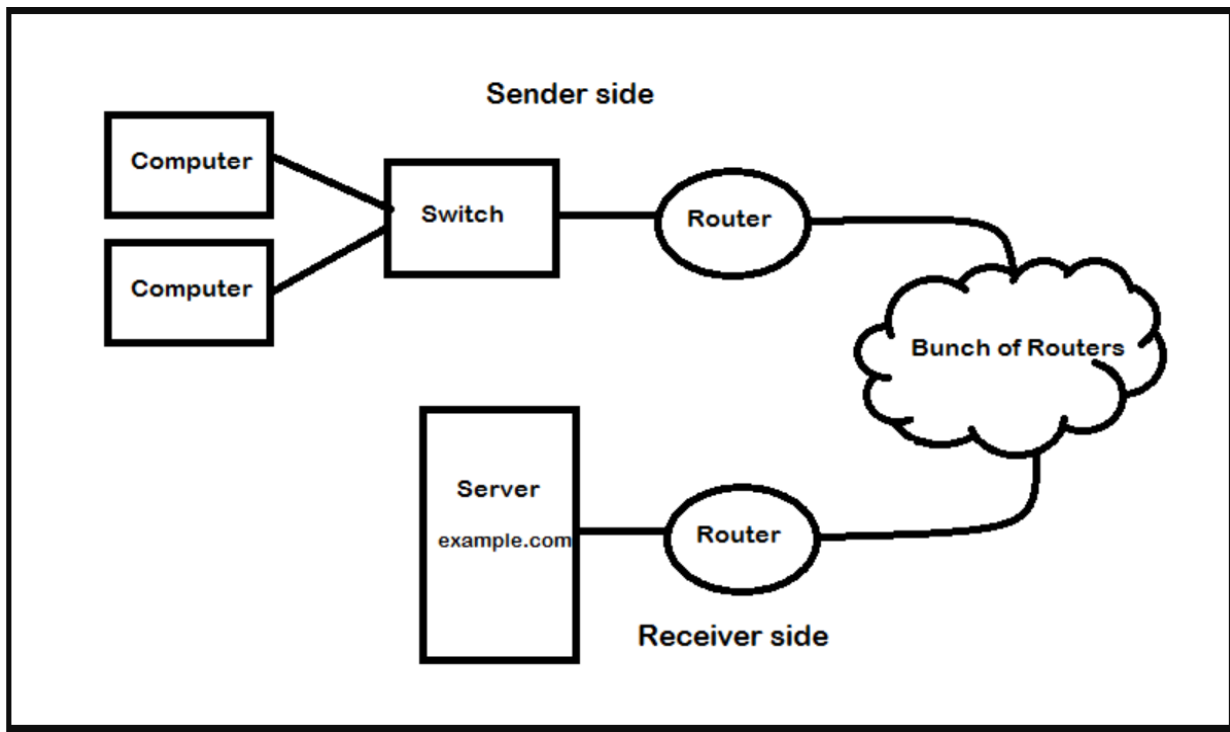
Task B – TCP vs UDP

a) Transmission Control Protocol (TCP)

- Connection (3-way handshake)
- Reliable delivery
- Flow control (sliding window)
- Congestion control (slow start)
- Ordered data transfer

b) User Datagram Protocol (UDP)

- Connectionless
- No retransmission
- Low latency, small overhead
- Stateless, no sequencing

c) TCP vs UDB Table

Feature	Transmission Control (TCP)	User datagram protocol (UDP)
Reliability	Yes	No
Ordering	Yes	No
Overhead	High	Low
Latency	Higher	Low
Use cases	Emails, Web	Streaming, DNS
Handshake	Yes	No
Error handling	Built-in	Handled by application

Task C – Module-by-Module Reflection (17 modules)

Module 1: Communication in a connected world

a) Core Concept

- Network Types
- Data transmission
- Bandwidth and Throughput

b) Observation

In network types, I saw that Internet is not owned by an individual or group, but is worldwide.

In data transmission, I saw categories of personal data such as Volunteered data, Observed data, and inferred data

In Bandwidth and Throughput, I saw that bandwidth is measurement of amount of data that flow from one place to another.

While Throughput measures all data being sent and received including latency/delay of data flows from one place to another.

c) Real World example

Transferring file between devices like two phones, then phone A is about to send music file to phone B with specific amount of that file. Bandwidth will track how much amount of file/Kbps is being transferred from A to B in seconds.

d) Key takeaway

- Internet is not physical connection in real world. It is the place people go to find or share information.
- Internet is not owned by an individual or a group. It is worldwide collection of interconnected networks
- Bandwidth is measurement of amount of data flows from one place to another.
- Throughput is measurement of amount of data between one to another including delays.

Module 2: Network Components, Types and Connections

a) Core Concept

- Clients and Servers
- Network Components
- ISP Connectivity Options

b) Observation

In Clients and Servers, I saw that computers connected to a network that participates directly in a network communication are classified as host. The software installed on computer determines which role the computer will plays. Client can work as server and server work as client that called peer-to-peer network.

In Network components, I saw that the network infrastructure has three categories such as End devices, intermediary devices, and network devices.

ISP Connectivity Option, An ISP provides the link between the home network and the internet.

c) Real World example

Network components used in many places such as home, offices, schools, etc. At home I may use my phone, Television, and Router also at office they make network and connect to internet by using network components

d) Key takeaway

- Different between server and client
- Definition of peer-to-peer network
- ISP provides the link between network and the internet
- DSL (Digital Subscriber Line

Module 3: Wireless and Mobile Networks

a) Core Concept

- Wireless Network
- Mobile Devices Connectivity

b) Observation: When a phone call is made, the person who is speaking, the voice is in between the caller and recipient, until it reaches to recipient

Wi-Fi transmitters and receivers are built in our smart phones to enable the our telephone to connect to networks

c) Real World example:

If I call my sister while I'm at Kigali and she is at Bugesera, my voice or her voices moves between our direction until it reaches to her or to me.

Telephones use cellular data to connect to internet and access information or share information by using cellular data.

d) Key takeaway

- Voice moves between direction before it reaches destination when phone call is made.
- Wi-fi transmitters and receivers, helps our telephones to connect to internet
- Cellular data help as to connect to a local network
- Bluetooth helps us to share data in short range
-

Module 4: Build Home Networks

a) Core concept

- Home Network Basics
- Network Technologies in the House Home
- Wireless Standards
- Set up Home Router

b) Observation:

Most home networks consist of at least two separate networks.

Wireless technology is easy and inexpensive to install and one of its advantages is cost saving.

Wireless carry information in electromagnetic waves between devices.

c**) Examples:** Home wireless, school wireless,

d) Key takeaway

- Wireless carry information in electromagnetic waves between devices.
- When setting up wireless router you give it name, know what kind of device to add to network
- and add devices to the router.

Module 5: Communication Principles

a) Core concept

- Communication protocols
- Communication Standards
- Network Communication Models

b) Observation: Communication protocol such as message format, message size, timing that determines the speed, message pattern, encapsulation, encoding.

Network communication models includes protocols that are set of rules that govern communication

Such as Application, transport, internet, and network access.

OSI model layer description: some OSI model are Application, presentation, Session, transport, Network, data link, physical

c) Real World example

- HTTP used to access webpage on the internet
- Ethernet used when set up network especially with wired connection

d) Key takeaway:

- Standards: is set of rules that determines how something must be done.
- TCP/IP protocols
- OSI model

Module 6: Network Media

a) Core concept

- Network media types

b) Observation:

Network media types: Communication transmits across a network on media

Three types of media: Metal wires within cables, Glass or plastic fibers within cables, wireless transmission

c) Real World example

Twisted-pair Cable used to connect PC to Internet by using Ethernet cable

Coaxial Cable used to connect TV

d) Key takeaway

- Common network cables are

    Twisted-pair

    coaxial cable

    Fiber optic

Module 7: The Access Layer

a) Core concept

- Encapsulation and Ethernet Frame
- The Access Layer

b) Observation

Encapsulation and Ethernet Frame: The process of placing one message format inside another message format is called encapsulation

De-encapsulation: is when process reversed by recipient and message is removed from the envelope.

The access layer is the part of network in which people gain access to other host and to shared files and printers

b) Real World example

When Message is being sent from one person to another, that is encapsulation.

c) Key takeaway

- **Encapsulation and Ethernet Frame:** The process of placing one message format inside another message format is called encapsulation
- **De-encapsulation:** is when process reversed by recipient and message is removed from the envelope.
- **The access layer** is the part of network in which people gain access to other host and to shared files and printers

Module 8: The Internet Protocol

a) Core concept

- Purpose of an IPv4
- The IPv4 Address Structure

b) Observation

 The IPv4 address is logical network address to identifier a device that connected to the network.

The IPv4 is made up 32-bit and 32-it divided into 4 octet

Where first 3 octet are Network portion while last octet is identifying a host.

c) Real World example

When a PC that connects to a network like on router, it will have IPv4 address to identify it on that network.

d) Key takeaway

- IPv4 address identify the host on network

- The IPv4 is made up 32-bit

- 32-it divided into 4 octet

Module 9: IPv4 and Network Segmentation

a) Core Concept:

- IPv4 Unicast Broadcast, and Multicast

- Types of IPv4

- Network Segmentation

b) What I observed

Unicast refers to one device that send a message to one devices in one-to-one communication

Broadcast refers to a device sending a message to all the device on a network in one-to all communication

Multicast reduce traffic by allowing a host to send a single packet to a selected set of hosts.

Public IP address, Private IP address, Private IP address, and loopback address are Types of IPv4.

c) Real World example

192.168.0.0/24 is private IP address that used in local network

d) Key takeaway

- **Unicast** refers to one device that send a message to one devices in one-to-one communication

- **Broadcast** refers to a device sending a message to all the device on a network in one-to all communication

- **Multicast** reduce traffic by allowing a host to send a single packet to a selected set of hosts.

Module 10: IPv6 Addressing Formats and Rules

a) What I observed

IPv6 address are 128 bits in length and written as a string of hexadecimal values

c) Real World example

I a network which using IPv6 address to identify a host, a host will have address in form like this
fe83:253f:adc3:2345:856f:43ac:fc32:2a5f2c

d) Key takeaway

- IPv6 is made up 128 bits in length
- To make IPv6 reduces the numbers of digits,
- Omit leading zero, like 01ab can be represented as 1ab
- Double colon when at least 8 variables continuously are zero

Module 11: Dynamic Addressing with DHCP

a) Core Concept

- Static and Dynamic Addressing
- DHCPv4 Configuration

b) What I observed

- Static Addressing occur when you are addressing manual on a network
- Dynamic Addressing occur when there I server that is providing address to host automatically
- DHCPv4 server, is configured to provide address with a range of IPv4 address can be assigned to DHCP client

c) Real World example

- In a business, server can take static IP address so other hots can access it easily.
- A big organization many hosts uses DHCP server to provide address on each host on the network

e) Key takeaway

- Static Addressing occur when you are addressing manual on a network
- Dynamic Addressing occur when there I server that is providing address to host automatically
- DHCPv4 server, is configured to provide address with a range of IPv4 address can be assigned to DHCP client

Module 12: Gateway to Other Networks

a) Core Concept

- Network Boundaries
- NAT Operation

b) What I observed

Every host on a network must use router as gateway to other networks.

The wireless router acts as DHCP server for all local host attached to it.

Wireless router receives a public address from the ISP which allow it to send and receive packets on the internet.

c) Real World example

In organization with many parts like assistant part, will have their network, and if the assistant network wants to send the packet outside the network like to manager department, it will user router gateway to help get a packet outside the network.

e) Key takeaway

- Every host on a network must use router as gateway to other networks.
- The wireless router acts as DHCP server for all local host attached to it.
- NAT help to move packet outside of the network

Module 13: The ARP Process

a) Core Concept

- MAC and ARP
- Broadcast Containment

b) What I observed

MAC address is a physical address used for NIC-to-NIC communication on the same Ethernet network

IP address is logical address that end-to-end delivery

A message can contain only one MAC address.

ARP used to request and reply the MAC addresses of host on the network

e) Key takeaway

- MAC address is a physical address used for NIC-to-NIC communication on the same Ethernet network
- IP address is logical address that end-to-end delivery
- A message can contain only one MAC address.
- ARP used to request and reply the MAC addresses of host on the network

Module 14: Routing Between Networks

a) Core Concept

- The need for Routing
- The Routing Table
- Create LAN

b) What I observed

- A router is a networking device that connects multiple layer 3, IP networks
- Every port on interface on a router connects to a different local network
- A router forwards a packet to one of two places
- A host is given the IPv4 address of the router through the default gateway

e) Key takeaway

- A router is a networking device that connects multiple layer 3, IP networks
- Every port on interface on a router connects to a different local network
- A router forwards a packet to one of two places
- A host is given the IPv4 address of the router through the default gateway

Module 15: TCP and UDP

a) Core Concept

- TCP and UDP
- Port Numbers

b) What I observed

UDP does not require acknowledgment of receipt. UDP is preferable with applications such as streaming audio and VoIP

TCP packets take a path from the source to the destination. It breaks up a message into small pieces known as a sequence number

When a message is delivered by TCP or UDP, the protocol and services requested are identified by a port and number

Well known ports such as Web server services 80 port, FTP 21 port

c) Real World example

- When a host is requesting web page from a web server, it use port 80 to get the webpage

d) Key takeaway

- UDP is preferable with applications such as streaming audio and VoIP
- TCP breaks up a message into small pieces known as a sequence number

- When a message is delivered by TCP or UDP, the protocol and services requested are identified by a port and number
- Well known ports such as Web server services 80 port, FTP 21 port

Module 16: Application Layer Services

a) Core concept

- The client server Relationship
- Network Application Services
- Domain Name System
- Web Client and Services
- FTP Clients and Services
- Virtual Terminals
- Emil and Messaging

b) Observation

- A server is a host that runs a software application such as Web server, that provide information to other host that are connected to network.
- DNS provides a way for hosts to request the IP address of a specific server.
- FTP provides an easy method to transfer files from one computer to another.
- Telnet is Virtual terminal that provides a standards method of emulating text based terminal services.
- SSH provides the structure for secure remote login and other secure networks
- Mail server receives and store mail for user who have mailbox

C) Key takeaway

- Server runs a software application to provide services to hosts
- DNS help a host to get IP address of server by giving the name of server
- FTP file transfer
- Virtual terminal: Telnet and SSH
- Application protocols used to process email: SMTP, POP3, and IMAP4

Module 17: Network Testing Utilities

a) Core Concept

- Troubleshooting Command

b) What I observed

- **ipconfig** – displays configuration information
- **ping** – tests connection to other IP host
- **tracert** – displays the router taken to destination
- **nslookup** – directly queries the name server for information on a destination domain
- **netsat** – displays network connections

c) Real World example

To test connectivity between two host on a network, use ping command

e) Key takeaway

- ipconfig – displays configuration information
- ping – tests connection to other IP host
- tracert – displays the router taken to destination
- nslookup – directly queries the name server for information on a destination domain
- netsat – displays network connections

Task D – Network Topologies

Bus: A single central cable connects all devices in the network,

Diagram
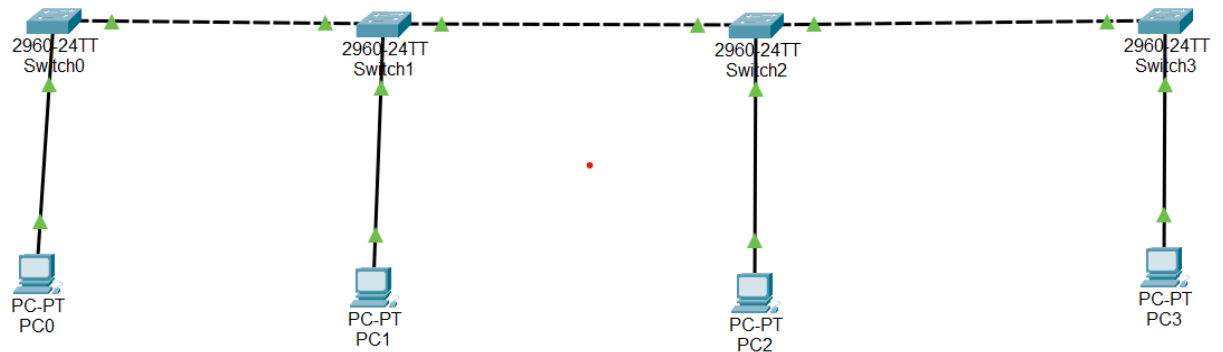
How it operates: All nodes are connected to one shared communication line

Real World uses and examples

Advantages

- Simple and inexpensive layout
- Requires less cable than star or mesh
- Easy to extend with minima changes

Disadvantages

- If the main cable fails, the whole network fails
- Limited scalability and speed
- Difficulty to troubleshoot

Recommendation: Only use in very small or temporary setups.

Ring: Each device connects exactly two others, forming a ring

Diagram
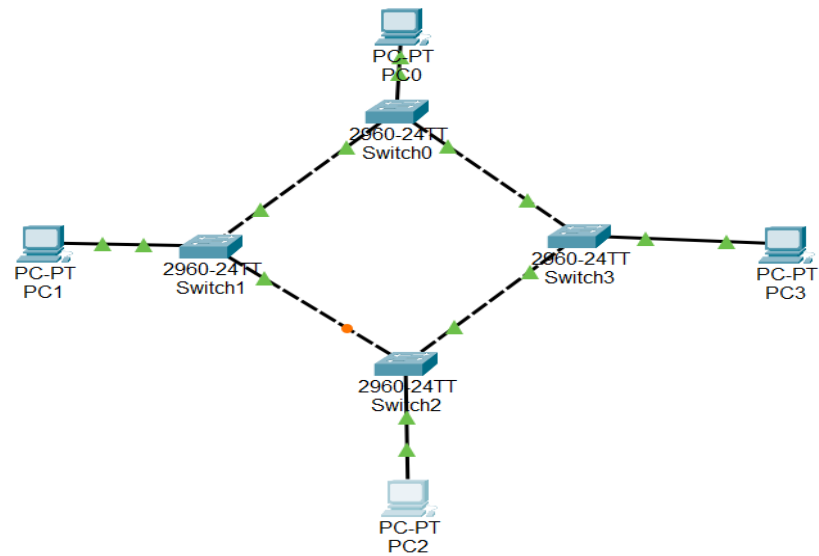
How it operates: Data passes from one device to the next, unit it reaches its destination

Advantages

- Equal access for all nodes
- Predictable performance under load
- Can prevent collisions

Disadvantages

- A single point of failure
- Difficulty to add/remove nodes
- Higher latency with more devices

Observation

Recommendation: Best for telecom using fiber ring for high redundancy

Mesh: Devices are interconnected, allowing multiple paths between any two devices.

Diagram
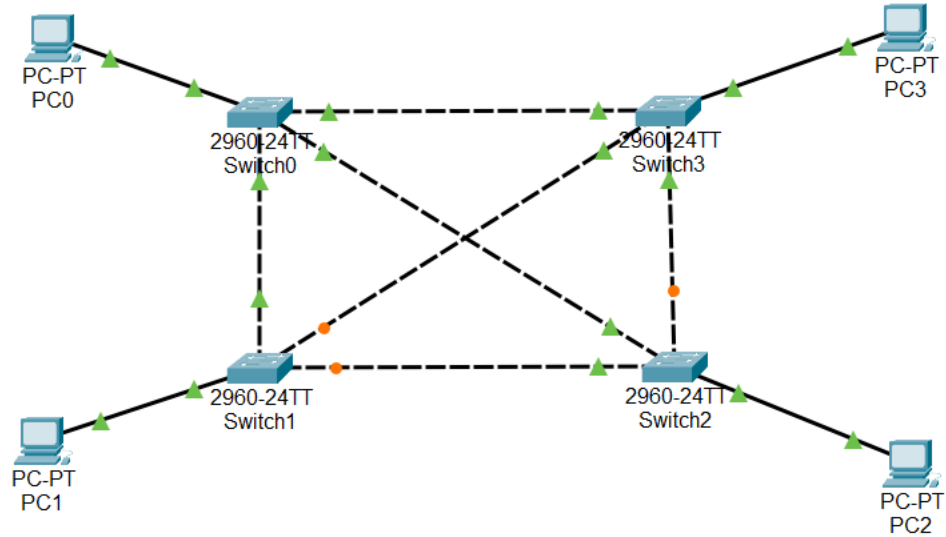
Two types of mesh

Full-mesh: Every node connected to every other.

Partial-mesh: Some nodes have multiple connections, other fewer

How it operates: Multiple links ensure continuous communication even if one link fails

Real World uses and example: ISP, data centers, and cloud providers use mesh for resilience

Advantages

- High Fault tolerance
- Multiple redundancy paths
- Supports heavy traffic well

Disadvantages

- Complex and expensive
- Requires lots of cabling and configuration
- Harder to manage and scale in physical networks

Star: All devices connect to a central hub/switch

Diagram
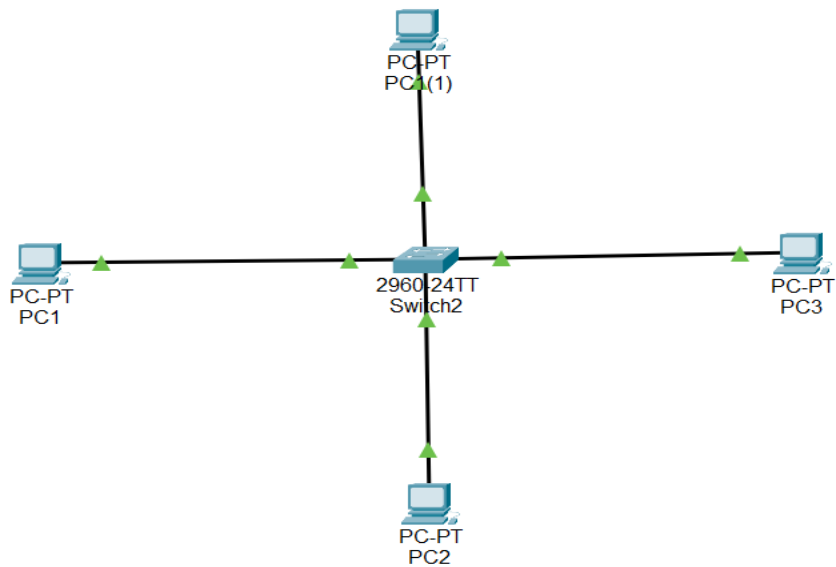
How it operates: Devices send data to central node, it forwards to destination.

Real World uses and examples

Advantages

- Easy to manage
- Simple to add/remove devices
- Centralized monitoring

Disadvantages

- Central device is a single point of failure
- High cable use
- Not cost-effective for large areas

Hybrid: A combination of two or more topologies

Diagram
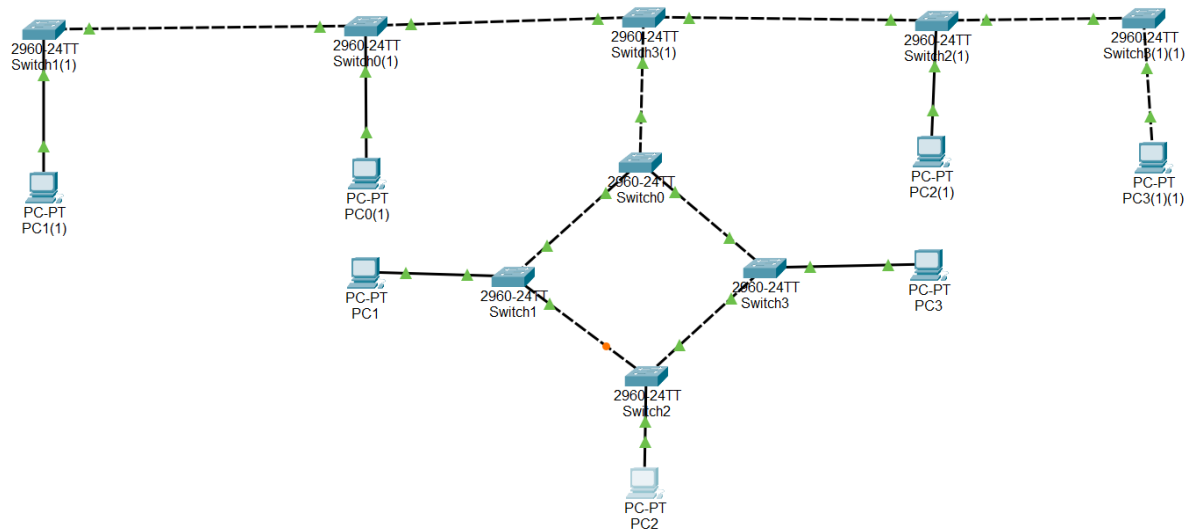
How it operates: Different segments use topologies suited to their purpose.

Advantages

- Flexible and scalable.
- Can optimize cost and performance per segments
- Fault isolation possible in segments

Disadvantages

- Design can be complex
- Troubleshooting requires understanding of multiple topologies
- May be costlier to maintain that pure designs

Task E – Installation evidence

Packet Tracer
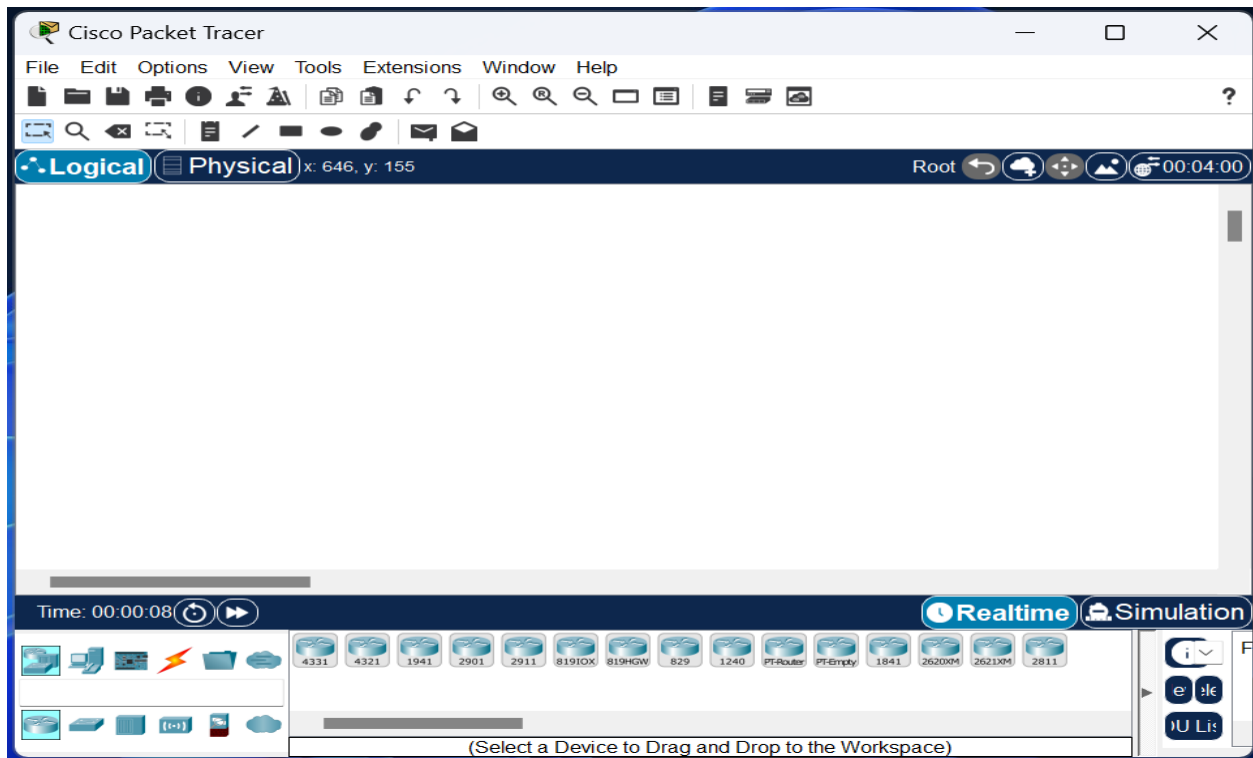
Virtual-Box
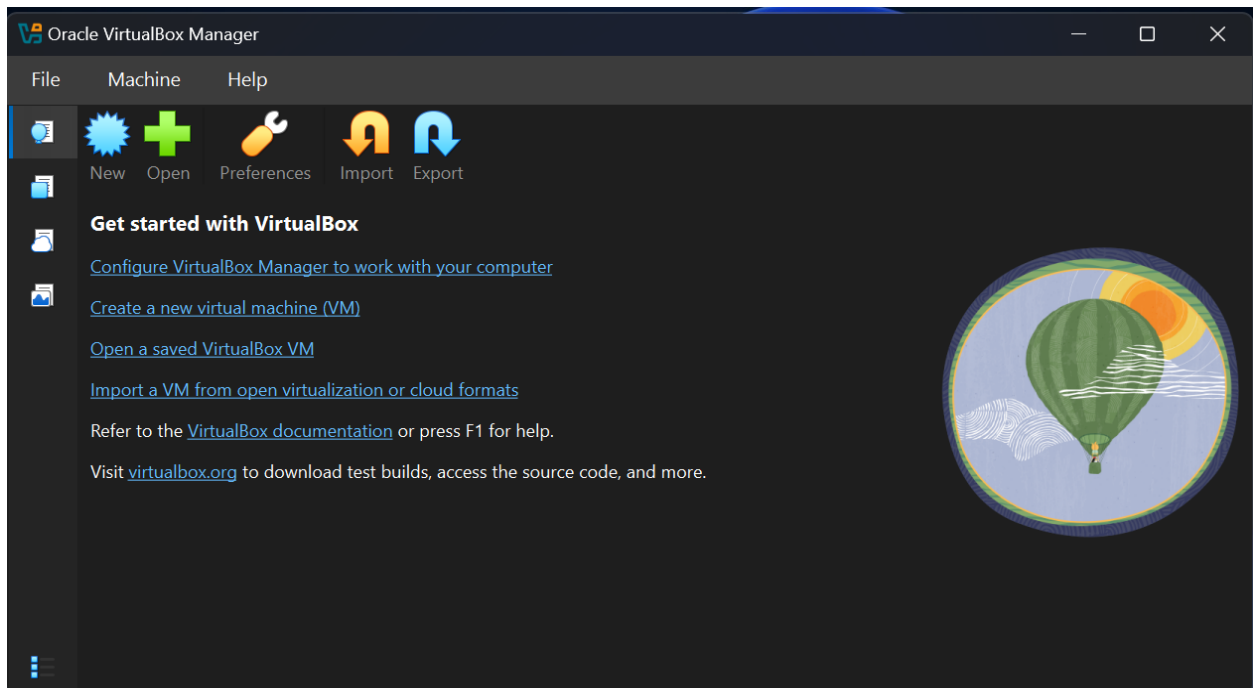
VMware Workstation Player / Pro
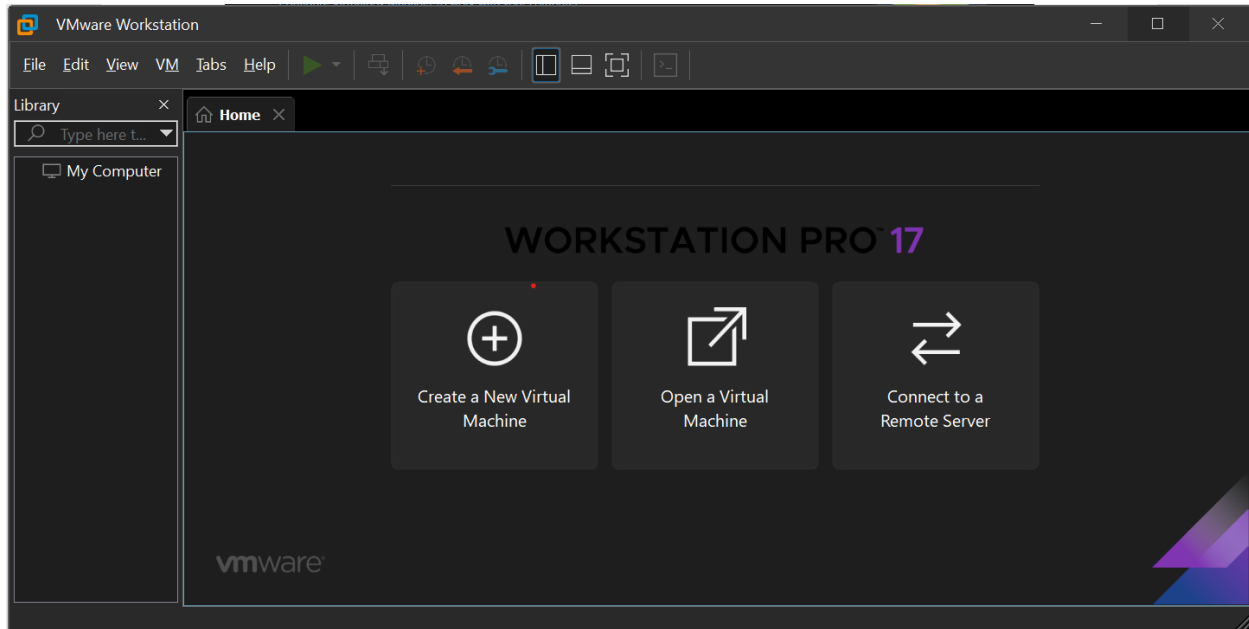
EVE-NG installation using VMware workstation

25
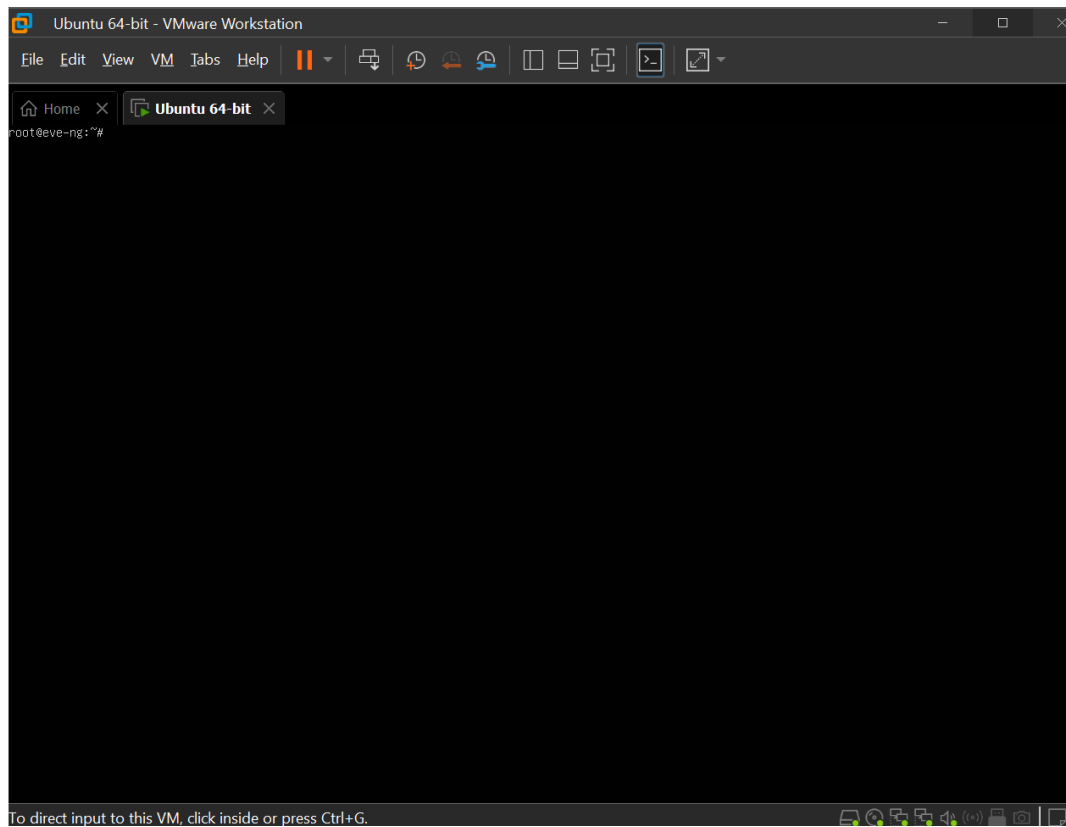
Router and Switches in EVE-NG

.
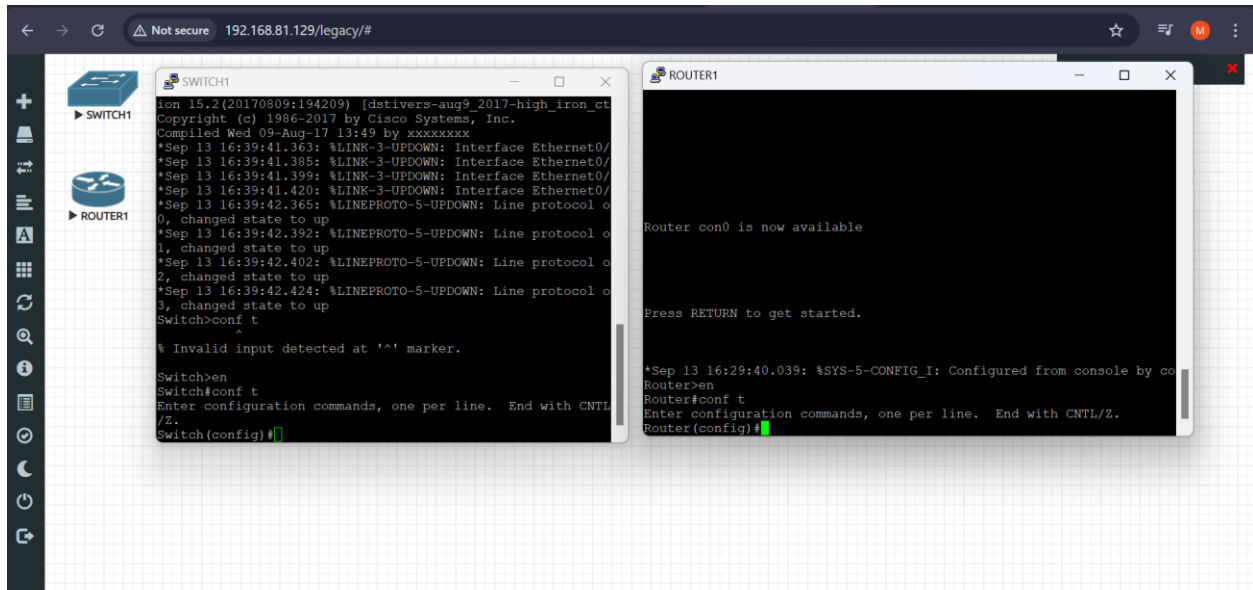
Computer Networking Basics Course Enrollment on Canvas

Canvas Profile

Joseph Mutangana (29061) > Settings

Joseph Mutangana (29061)'s Settings

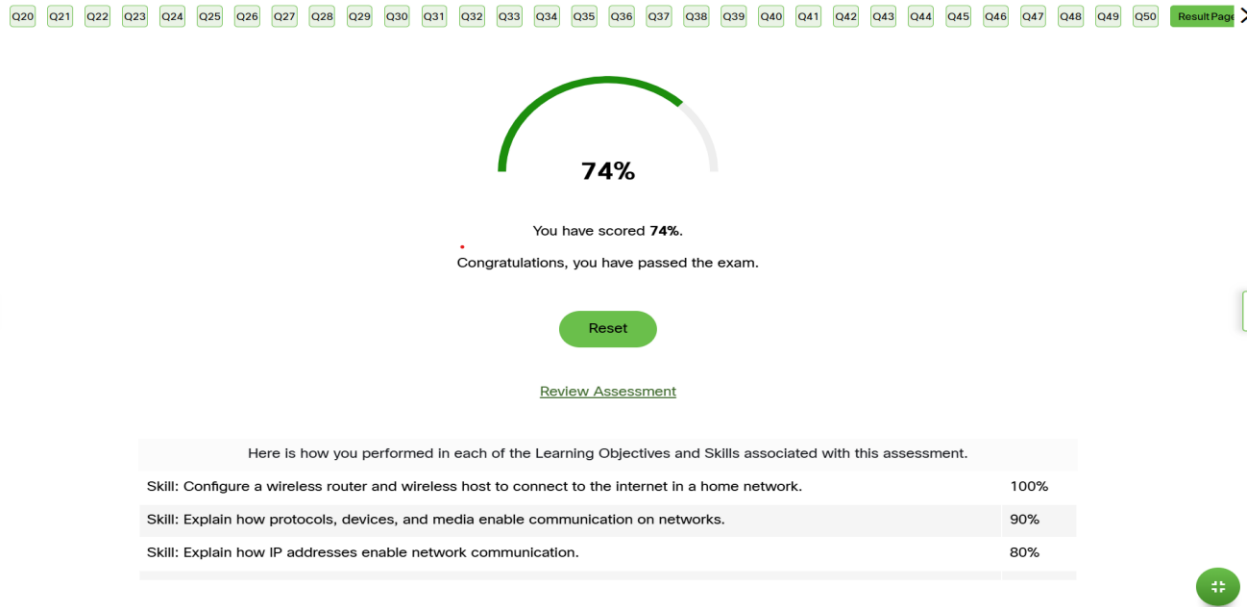|	
Full Name:*	Joseph Mutangana (29061)
	This name will be used for grading.
Display Name:	Joseph Mutangana (29061)
	People will see this name in discussions, messages and comments.
Sortable Name:	(29061), Joseph Mutangana
	This name appears in sorted lists.
Pronouns:	None
	This pronoun will appear after your name when enabled
Language:	System Default (English (United States))
Time Zone:	Harare

Maintenance windows: 1st and 3rd Thursday of the month from 9:05am to 11:05am (Thursday from 7:05am to 9:05am UTC)
Next window: Thu Sep 18, 2025 from 9:05am to 11:05am

Account
Dashboard
Courses
Calendar
Inbox
History
Help

Task F - Networking Basic course evidence

Course completion/grade page

Direct Link of Networking Basics Badge on Cledly

Networking Basics badge on Linkedin
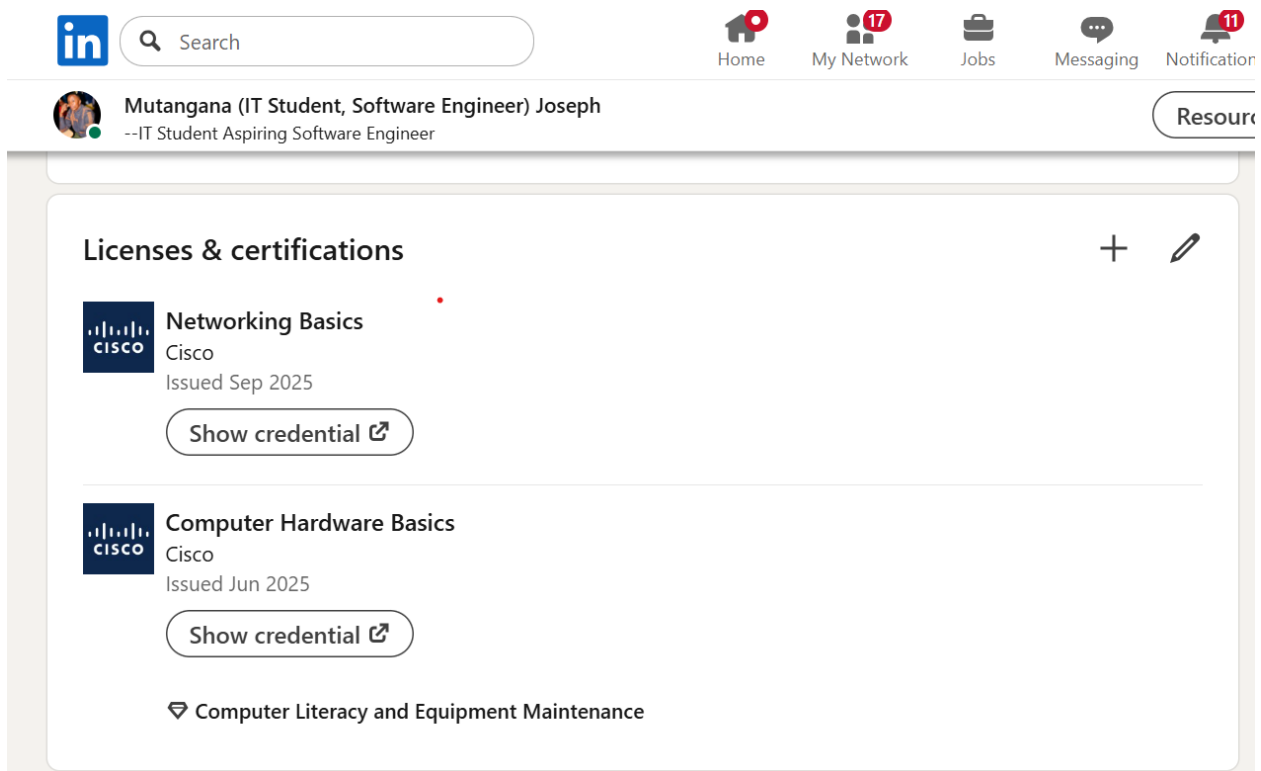
Task G – Agreements & Commitment Plan

- I, Joseph MUTANGANA – 29061, commit to attend classes, participate actively, follow instructor directions, and complete assignments on time.
- I will maintain academic integrity: submit original work, cite sources, and avoid plagiarism.
- I will avoid distractions in class (like using phone or any unrelated activities).
- I understand consequences for violations (grade penalties, academic review) and accept them.

Date: 14/09/2025   **Signature:**

Appendices

https://www.netacad.com/courses/networking-basics?courseLang=en-US

https://access.redhat.com/downloads/content/rhel

https://www.eve-ng.net/index.php/download/

https://www.virtualbox.org/wiki/Downloads

https://www.netacad.com/courses/packet-tracer

https://support.broadcom.com/group/ecx/productdownloads?subfamily=VMware%20Workstation%20Pro&freeDownloads=true

https://www.microsoft.com/en-us/download/details.aspx?id=23163

https://drive.google.com/drive/folders/1BXlAGxgTpcqxMHntGga48h8Ohf3H9JY9