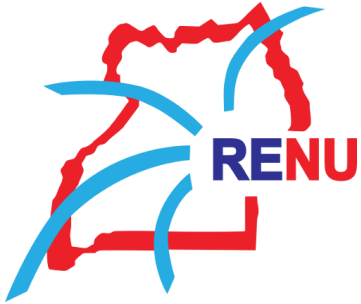

ICT SKILLING FOR SCHOOLS

How Internet Works
&
Introduction to LANs

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Presentation

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Outline

- What is a network?
- How does the Internet work?
- OSI model overview
- Local Area Network Overview

Introduction to Networks

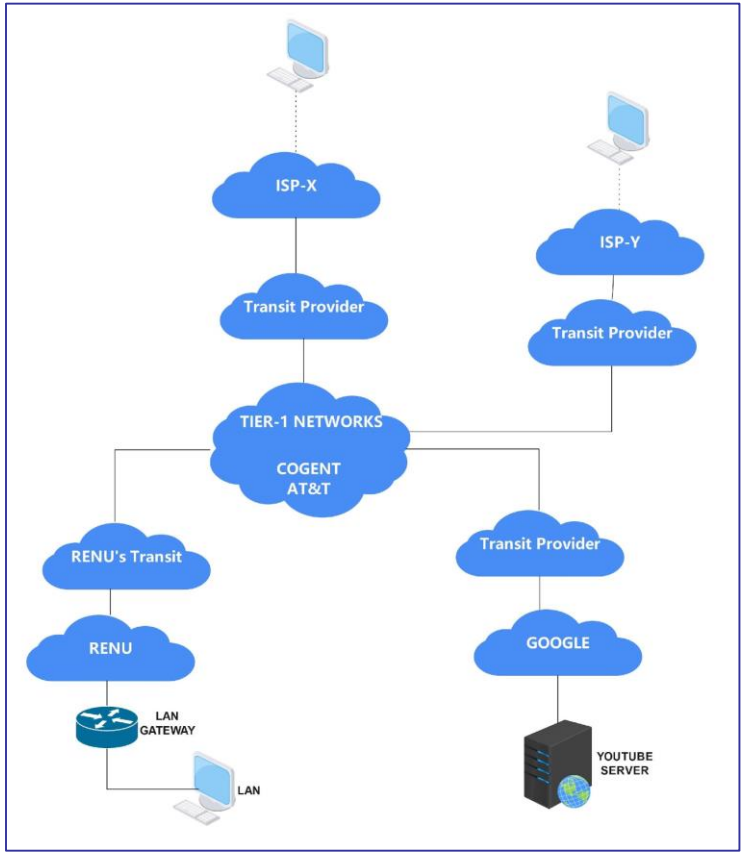
- What?
  - A group of computing devices connected to share resources locally or globally.
- Why?
  - Collaboration
  - Resource sharing
  - Efficient communication
- How?
  - TCP/IP and OSI Models
  - Different Network Devices
  - Connections; Wired or wireless

How the Internet Works

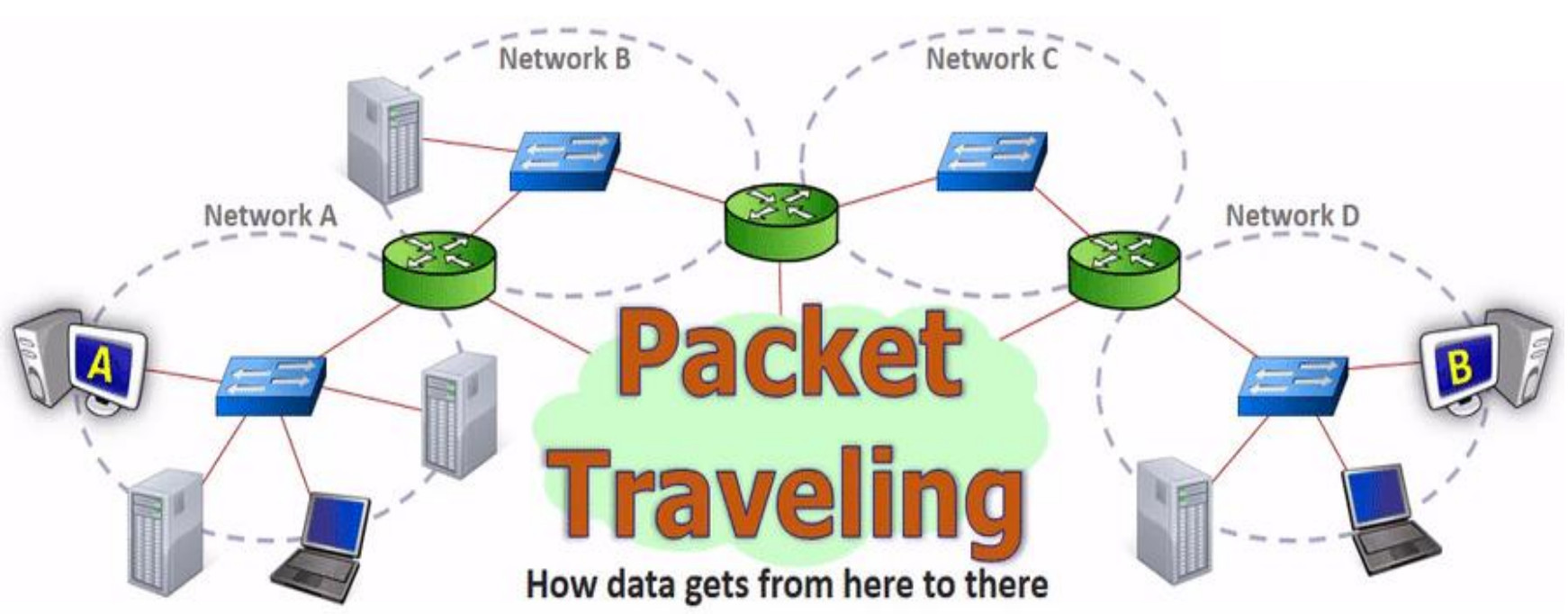
- The Internet: a global network
  A network of networks worldwide.

- Key parts:
  - Servers: Store websites/data.
  - Routers: Guide data.
  - TCP/IP: Rules for data (better understood with OSI layers).

- Example: Accessing YouTube hosted on a google server.

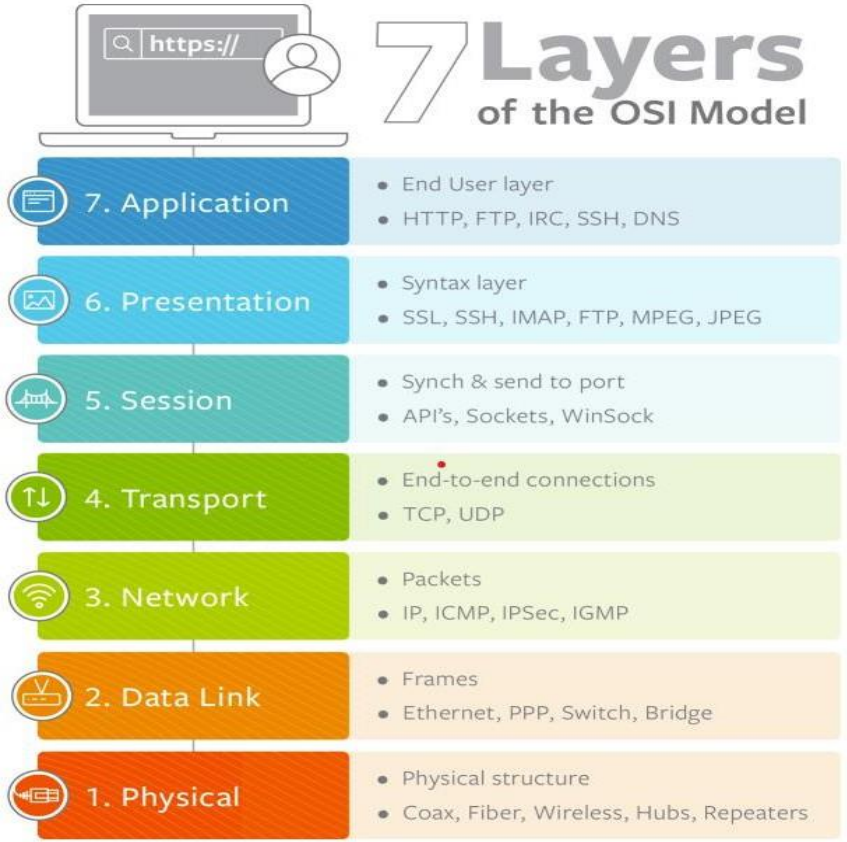


How the Internet Works



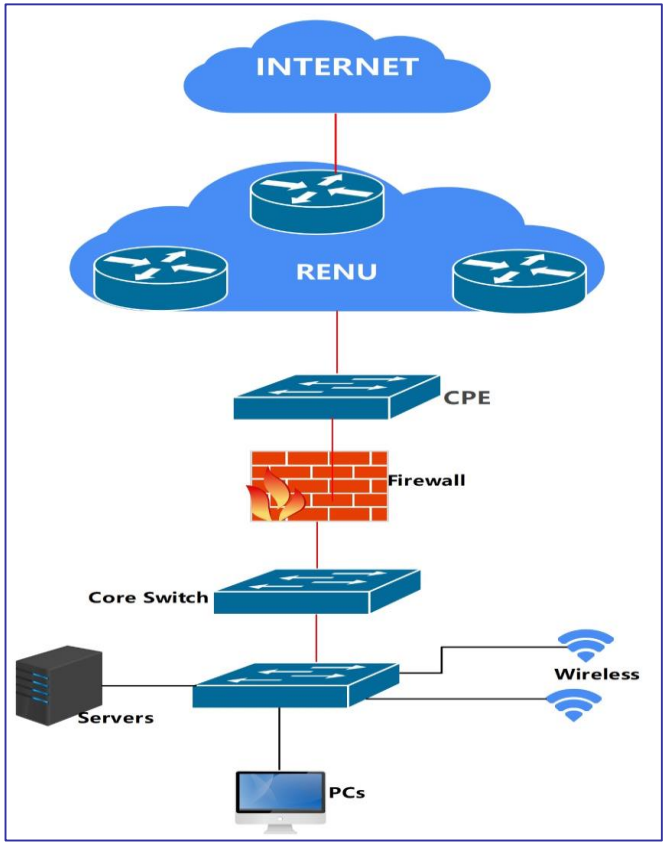
Why the OSI model

- Foundation for the Internet
  - 7 layers - describing information flow on a network.
  - Each layer relies on the ones below it.
  - Focus – **Layers 1, 2, 3.**
- Universal set of rules
  - Allowing for interoperability between **multiple vendor equipment**.
  - Makes troubleshooting systematic and easier.



Local Area Network

- A collection of devices connected together in one physical location.
- Cable or Wireless connections.
- Cable –Ethernet, Optical Fiber, Serial.
- Wireless (WLAN) – WiFi, Microwave links.
- Devices – Routers, switches, Firewalls, servers, access points.



Common Network Devices

1. Router

- A layer 3 network device that routes and forwards data packets between computer networks.
- Uses IP addresses.
- Does NAT

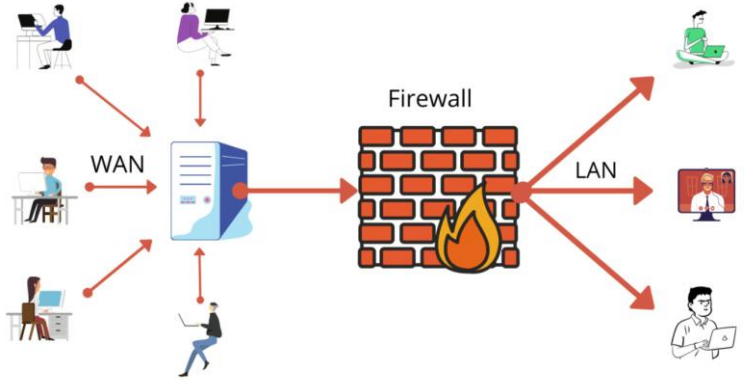
2. Switch

- Connects devices on a computer network.
- Can be managed or unmanaged
- Can be Layer 2 or Layer 3.
- Layer 2 – uses MAC addresses.
- Layer 3 – Has IP functionality such as basic routing.

Common Network Devices

3. Firewall

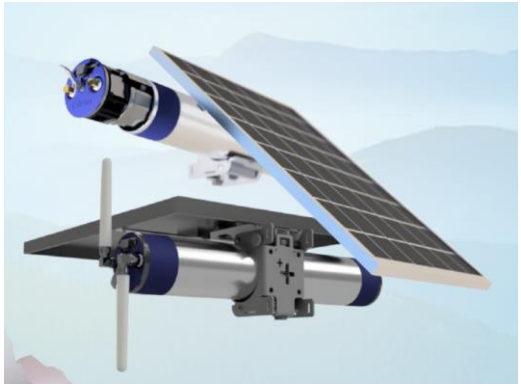
- A firewall acts as a security barrier between trusted internal and untrusted external networks.
- Controls traffic based on predefined rules to block unauthorized access and cyber threats



Common Network Devices

4. Access Points

- Creates a WLAN
- Allows Wi-Fi devices to connect to a LAN.
- Typically connected to LAN through ethernet.
- Outdoor or Indoor.
- Layer 2 device.



Transmission Media

1. Ethernet cable - Copper cores.

- Standardisations: CAT 6>CAT 5E>CAT 5
- Connector – RJ45 – into ethernet port.

2. Optical fiber cable/ patch cord

- Optical fiber core.
- Connectors – LC (Into SFP), SC, and FC
- Types – LC-LC, LC-SC, LC-FC

3. Console cable – connects to the console port to access the device.

Network Terminologies

1. IP Addresses

- A numerical layer 3 address that identifies a device and the network to which it is connected. eg. V4 - **137.63.189.3/24**. V6 – **2c0f:f6d0:2b:13::/64**.

- Prefix length -identifies a network address, and number of usable host addresses.

➢ Private IPs Vs Public IPs
➢ NAT- types of NAT
➢ Drawbacks of NAT

Network Terminologies

2. IPV6.

- Why IPv6
- How to identify IPv6

3. MAC Address - A unique layer 2 address that identifies devices network devices.

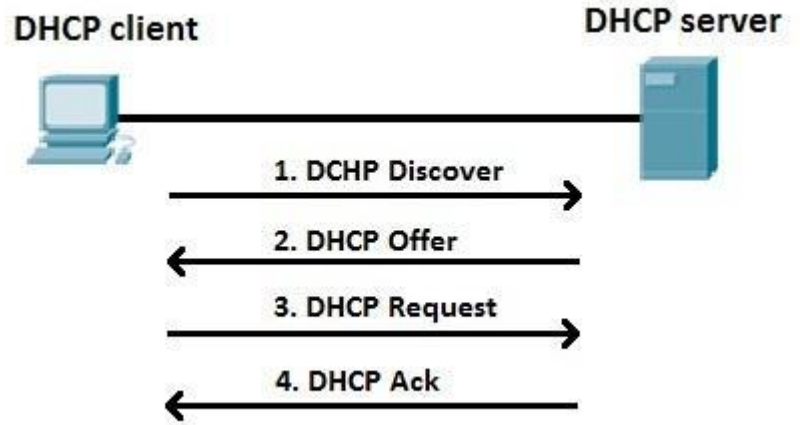
- Assigned to Network Interface Card (NIC) – Identifies device + Vendor eg. **28:b8:29:43:29:93**.

Network Terminologies

4. DHCP

- A system that automatically assigns a unique IP address to each device on a network.

- A device may fail to get an IP (**169.254.x.x/16**) due to;
  - A weak Wi-Fi signal
  - Network cable problems
  - DHCP server malfunctioning
  - Static IP address configuration
  - No available IP addresses

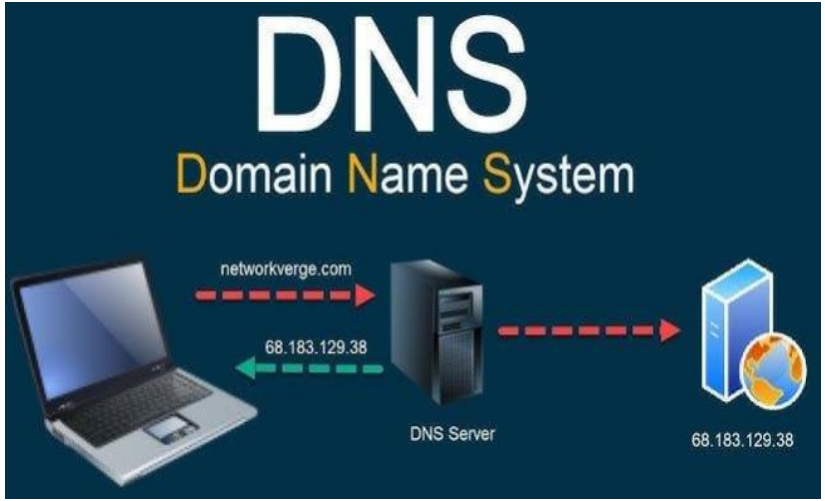


Network Terminologies

5. DNS

- DNS translates domain names into IP addresses, allowing users to access websites without typing numeric addresses.

- Without DNS, users would need to remember complex numerical IP addresses for every website they visit.



Network Performance

Bandwidth

- Network bandwidth defines how much data can possibly travel in a network in a period of time.
- Measured in Mbps.
- Analogy - Bandwidth (Water pipe); Data (Water)
    - The bigger the pipe, the more water can flow through in a given amount of time.

Latency - Speed at which data travels across the network to its destination and back to the source.

Common Network Bottlenecks

- ✔ **Slow and Unreliable Connectivity**
  - Outdated routers, switches, and access points.
- ✔ **Inadequate Bandwidth**
  - As number of devices and high-bandwidth applications increases, the internet bandwidth needs to be upgraded proportionally.
- ✔ **Unreliable Power**
- ✔ **DNS Issues**
- ✔ **Packet Loss**
- ✔ **Security Threats**

How to spot Bottlenecks

- Monitor Internet Speeds Regularly
- Track User Complaints
- Ping and Traceroute Tools
- Power Monitoring - frequent outages or unstable power affecting network uptime.
- Test DNS Resolution Times
- Observe Traffic Patterns

Recommended Network Design Practices

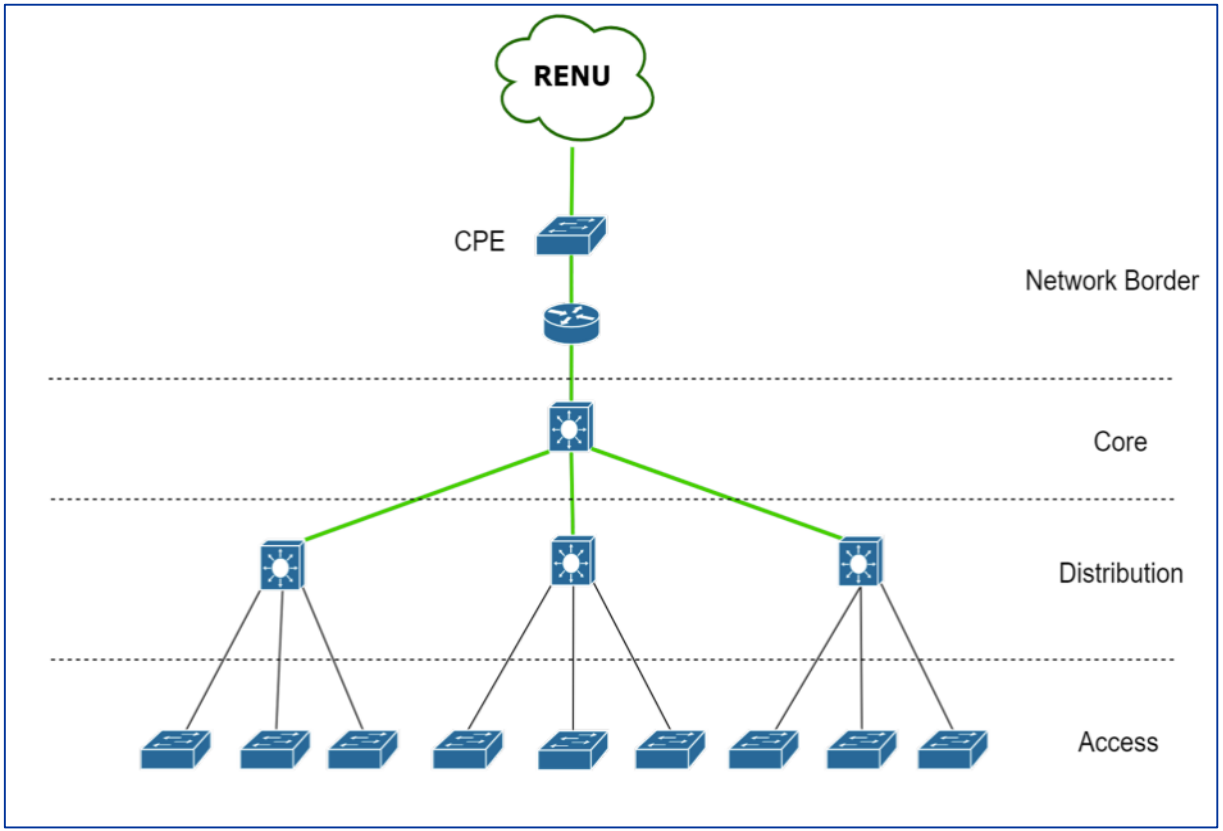
Hierarchical network design model

Using a hierarchical network design model that consists of three layers: core, distribution and access with separation of functions.

This model provides;

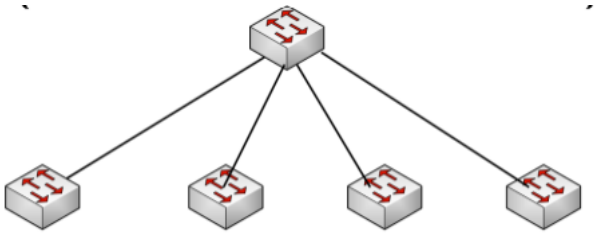
- Modularity
- Resilience
- Flexibility
- Scalability

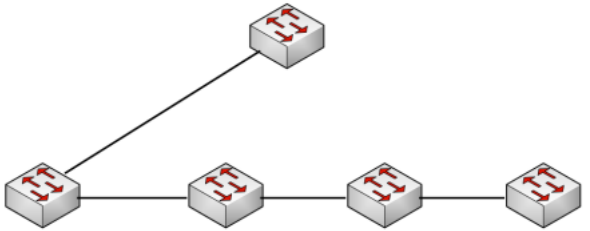
Recommended Network Design



Recommended Network Design Practices

- ✔ Minimize number of network devices in the path
- ✔ Build hub and spoke (sometimes called star) networks
- ✔ Not daisy chained (sometimes called cascaded) networks





Practical Session

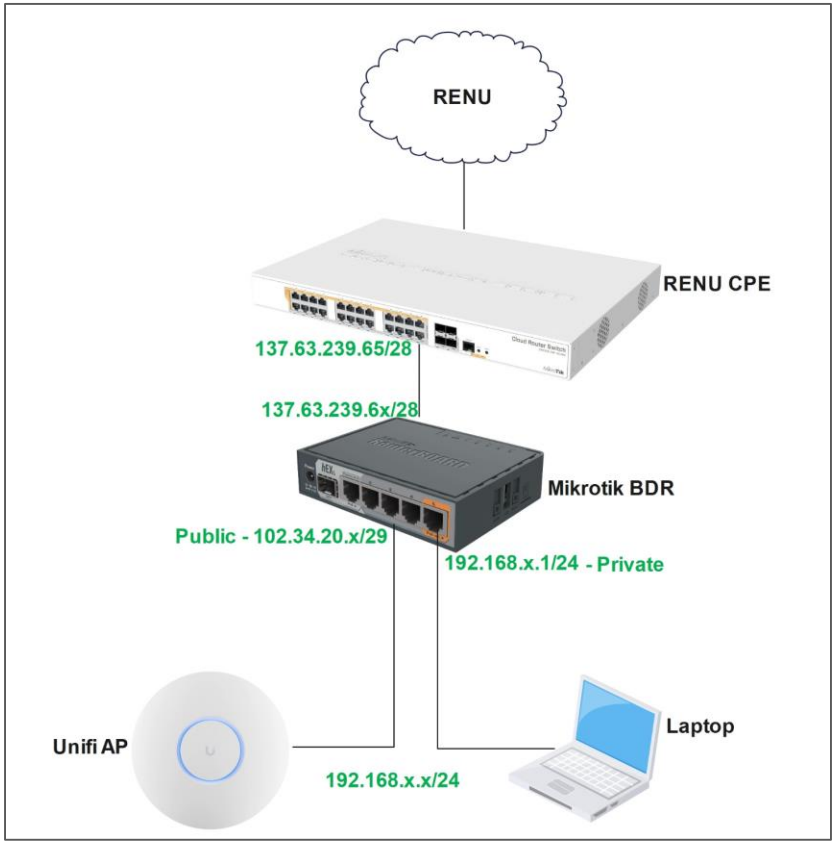
Necessary Equipment

- A Mikrotik heX Router
- A Unifi U6 Access point
- Ethernet Cables
- A computer

Guidelines

- Form 6 groups
- Each group will have access to a Mikrotik router, Unifi AP, and some Ethernet cables
- Follow the documentation provided to complete the setup

Lab Topology



IP Requirements

1. P2P to CPE: 137.63.239.48/29
    - ❖ Gateway: 137.63.239.65
    - ❖ BDR IP: 137.63.239.6x

1. Private Subnet: 192.168.x.0/24

1. Public Subnet: 102.34.20.x/29

THANK YOU