

ICT SKILLING FOR SCHOOLS

How the 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 of networks worldwide.
- Key parts:
 - Servers: Store websites/data.
 - Routers and Switches: Guide data.
 - TCP/IP: Rules for data (better understood with the 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 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.



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- 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



2. IPV6.

- Why IPv6
- How to identify IPv6
- 3. MAC Address A unique layer 2 address that identifies network devices.
 - Assigned to Network Interface Card (NIC) Identifies device + Vendor, eg, 28:b8:29:43:29:93.



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





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





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IP Requirements

- 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



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