



RQF LEVEL 4



GENBN401
SOFTWARE
DEVELOPMENT

Basics of Networking

TRAINRE'S MANUAL

October, 2024



BASICS OF NETWORKING

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ACRONYMS

ACL: Access Control List
BGP: Border Gateway Protocol
CIDR: Classless Inter-Domain Routing
DHCP: Dynamic Host Configuration Protocol
DNS: Domain Name System
FTP: File Transfer Protocol
HTTP: Hypertext Transfer Protocol
HTTPS: Hypertext Transfer Protocol Secure
IP: Internet Protocol
ISP: Internet Service Provider
KOICA: Korea International Cooperation Agency
LAN: Local Area Network
MAC: Media Access Control
NAT: Network Address Translation
OSI: Open Systems Interconnection (Model)
PAN: Personal Area Network
PoE: Power over Ethernet
QoS: Quality of Service
RP: Rwanda Polytechnic
RTB: Rwanda TVET Board
SSH: Secure Shell
SSID: Service Set Identifier (Wi-Fi network name)
TCP: Transmission Control Protocol
TQUM: TVET Quality Management
TVET: Technical and Vocational Education and Training
UDP: User Datagram Protocol
VLAN: Virtual Local Area Network
VPN: Virtual Private Network
WAN: Wide Area Network
WLAN: Wireless Local Area Network

INTRODUCTION

This trainer's manual includes all the methodologies required to effectively deliver the module titled "**Basics of Networking.**" Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies.

The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

The trainer's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainer, you will begin by asking questions related to the activities to encourage critical thinking and guide trainees toward real-world applications in the labor market. The manual also outlines essential information such as learning hours, didactic materials, and suggested methodologies.

This manual outlines the procedures and methodologies for guiding trainees through various activities as detailed in their respective trainee manuals. The activities included in this training manual are designed to offer students opportunities for both individual and group work. Upon completing all activities, you will assist trainees in conducting a formative assessment known as the end learning outcome assessment. Ensure that trainees review the key reading and the points to remember section.

MODULE CODE AND TITLE: GENBN401 BASICS OF NETWORKING

Learning Outcome 1: Establish network media connectivity

Learning Outcome 2: Perform Basic Network Configuration

Learning Outcome 3: Maintain Network System

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Indicative contents

1.1 Identification of Network Requirements.

1.2 Termination of Network cables

1.3 Connection of Network Media

Key Competencies for Learning Outcome 1: Establish Network Media Connectivity

Knowledge	Skills	Attitudes
● Description of network requirements ● Identification of tools, materials and equipment ● Description of Network Devices ● Description of Network Services ● Identification of Network media	● Selecting tools, materials and equipment ● Cabling network cables ● Terminating of network cables ● Connecting network media	● Having Curiosity for connecting cables ● Being a Critical Thinker in connecting network media ● Having Attention to connect network media ● Having Adaptability in termination of network cables ● Having Collaborative Spirit in connecting network cable ● Having Ethical Behaviour in network services



Duration: 20 hrs



Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe correctly network concepts and technologies based on network requirements
2. Identify correctly Tools, materials, and equipment based on network requirements.
3. Describe correctly network cables Trunking materials based on network installation
4. Fix correctly network cables Trunking based on network installation.
5. Terminate perfectly Network cables based on network installation.
6. Connect properly Network media based on Network installation.



Resources

Equipment	Tools	Materials
• Computer • Inverter • Switch • Battery • Firewalls • Rack • UPS • Router	• Networking toolkit • Testing tools • Drilling Tools • Simulation tool(Packet tracer, GNS3)	• Internet bundles • Network cables • Electricity • Cable Trunks • Cable connectors • Labelling tags



Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail physical place to be used during network installation.



Indicative content 1.1: Identification of Network Requirements



Duration: 10 hrs



Theoretical Activity 1.1.1: Description of network concepts and technologies



Notes to the trainer:

- Trainer may use small group for describing network concepts and technologies.
- The use of images, videos and illustrations as didactic materials is required.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

- i. What do you understand by the term network?
- ii. What are the network classifications?
- iii. List the benefits of network?
- iv. What are Advantages and Disadvantages of network?
- v. What are the Applications of network?
- vi. List and explain Network technologies.
- vii. Describe Network topology types
- viii. What are Network components?

Step 2: Asks trainees to write answers on provided flipchart/paper.

Step 3: Ask trainees to present the findings.

Step 4: Provide an expert view.

Step 5: Address any questions or concerns.

Step 6: Ask the trainees to read key reading 1.1.1 in the trainee manual.



Points to Remember

- A network consists of two or more computers that are linked in order to share resources.
- Networks can be classified into different categories based on various criteria, including their size, purpose and architecture.

- Networks offer a wide range of benefits like Communication, Data Sharing, Resource Sharing, Flexibility and Mobility and Cost Efficiency.
- Networks offer numerous advantages like Communication, Resource Sharing, Centralized Data Management, Redundancy and Reliability, Global Connectivity etc..
- Disadvantages of Networks are: Security Risks, Complexity, Maintenance Costs, Privacy Concerns, Bandwidth Limitation etc..
- Networks can be applied in Telecommunications, Data Centers, Transportation, Healthcare, Financial Services, Entertainment and Media, Education etc..
- Network technologies encompass a wide range of tools, protocols, hardware, and software.
- Network topologies types are Bus Topology, Star Topology, Ring Topology, Mesh Topology and Tree Topology.
- Network components are classified based on End Devices, Networking Hardware, Network Infrastructure, Networking Software and Protocols.



Theoretical Activity 1.1.2: Identification of network materials, tools and equipment.

Notes to the trainer:

- Trainer may use small groups for describing tools, materials and equipment based on network requirements.
- Avail network tools, materials and equipment or pictures of tools, materials and equipment.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity by asking trainees to answer the following questions:

- Differentiate the term networking tools, equipment and materials used in networking
- Give examples of tools, equipment and materials as used in networking.

Step 2: Ask trainees to present their findings to class.

Step 3: Provides expert view and clarifies ideas by using didactic materials.

Step 4: Address any questions or concerns.

Step 5: Ask the trainees to read key reading 1.1.2 in the trainee manual.



Points to Remember

- In networking, **tools** are software or utilities used for tasks like monitoring, configuration, and troubleshooting, such as network analysers or configuration tools. **Materials** refer to the physical components and resources used in setting up and maintaining networks, like cables, connectors, and network cards. **Equipment** encompasses the larger hardware devices that facilitate network connectivity and communication, including routers, switches, and modems.



Practical Activity 1.1.3: Selection of tools, materials and equipment for network installation



Notes to the trainer

- The trainer may use individual based for Selecting tools, materials and equipment for Network installation
- Avail workshop.
- Avail tools, materials and equipment to be used in activity.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to read the following task:
As a trainee who learned network tools, materials and equipment, you are asked to go in the workshop and select the right tools, material and equipment to be used while installing a Network.
- Step 2:** Explain the task and provide clear work instructions.
- Step 3:** Demonstrate the trainees how to select tools, materials and equipment, explain the steps to perform task.
- Step 4:** Ask trainees to do the task by following the instructions related to the task and monitor the activity.
- Step 5:** Verify whether tools, materials and equipment are correctly selected.
- Step 6:** Ask trainees to read key reading 1.1.3 for more clarification.
- Step 7:** Ask trainees to perform the task provided in application of learning 1.1



Points to Remember

- While selecting materials, tools and equipment for networking installation make sure that you emphasize on the understanding of network design and network components as well as following the steps for selecting tools, materials and equipment.



Application of learning 1.1.

A small company is opening a new office with 15 employees. The company needs a reliable network to support daily operations, including internet access, file sharing, and communication. You are tasked to identify and select the necessary network components to set up network infrastructure.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Network topology is well identified	1.1 Topology type is identified		
		1.2 Topology is selected		
2	Network tools, materials and equipments are well selected	2.1 Cutting tools are selected		
		2.2 Stripping tools are selected		
		2.3 Drilling tools are selected		
		2.4 Fixing tools are selected.		
		2.5 Patching tools are selected		

		2.6 Crimping tools are selected		
		2.7 Testing tools are selected		
		2.8 Materials are selected		
		2.9 Equipment are selected		



Indicative content 1.2: Termination of Network cables



Duration: 5 hrs



Theoretical Activity 1.2.1: Description of network cable installation types



Notes to the trainer:

- Trainer may use small groups to describe network cable installation types.
- Avail of images, videos and illustrations as didactic materials is required.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the following questions:

- i. What are the network cable installation types
- ii. Explain network cable installation types
- iii. Provide the use cases of each cable installation type.

Step 2: Ask learners to Present findings to all class and agree on correct answer.

Step 3: Provide an expert view and relate it to the tasks provided.

Step 4: Address any questions or concerns.

Step 5: Ask the trainees to read key reading 1.2.1. in the trainee manual.



Points to Remember

- Network cables installation types are Open-Wire, Aerial, Above-Grounds Conduits, Underground, Underwater, built in and Semi built in



Theoretical Activity 1.2.2: Description of network cables trunking



Notes to the trainer:

- Trainer may use small groups to describe network cable trunking materials.
- Avail of images, videos and illustrations as didactic materials is required.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the following questions:

- i. What is network cable trunking?
- ii. Describe Network cables Trunking materials
- iii. State the importance of cable trunking in network installation.

Step 2: Ask learners to Present findings to all class and agree on correct answer.

Step 3: Provide expert view and relate it to the tasks provided.

Step 4: Address any questions or concerns.

Step 5: Ask the trainees to read key reading 1.2.2. In the trainee manual.



Points to Remember

- Network cables Trunking materials are Plastic, Wood, and Stainless.
- Network cable trunking refers to the system of channels or conduits used to organize, protect, and route multiple network cables throughout a building or facility.
- Cable trunking is crucial in network installation for several key reasons like: Organization, Protection, and Safety.



Practical Activity 1.2.3 Network cables Trunking



Notes to the trainer

- While delivering this activity individual based can be used for demonstrating how to perform network cable trunking.
- Avail tools, materials, and equipment required to perform trunking
- Avail workplace.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask trainees to read the following task:

According to theoretical activity we have done on 1.2.2. You are asked to make installation of network trunks that will be used to carry cables in the room provided and perform the cables trunking in the network installation provided.

Step 2: Explain the task and provide clear work instructions.

Step 3: Demonstrate how to install cable trunking the given tasks. While demonstrating, explain the installation procedures.

Step 4: Ask trainees to do the task of installing cable trunking and monitor the procedures.

Step 5: Verify whether the installation was well done according to given task.

Step 6: Ask the trainees to read key reading 1.2.3.

Step 7: Ask the trainees to perform the task provided in application of learning 1.6



Points to Remember

- **Trucking Installation steps include** Planning and Preparation, selection of Materials and Tools, Fix or Mounting Trucking and Routing Cables through the trucking.



Theoretical Activity 1.2.4: Description of network cables termination



Notes to the trainer:

- Trainer may use small groups to describe network cable installation types.
- Avail of images, videos and illustrations as didactic materials is required.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the following questions:
- Describe Network cables Termination
- Step 2:** Ask learners to Present findings to all class and agree on correct answer.
- Step 3:** Provide expert view and relate it to the tasks provided.
- Step 4:** Address any questions or concerns.
- Step 5:** Ask the trainees to read key reading 1.2.4 in the trainee manual.



Points to Remember

- Cable termination use in networking are twisted pair cabling, Fiber-optic cabling, coaxial cabling and shielded twisted pair.



Practical Activity 1.2.5: Network cables Termination



Notes to the trainer

- The facilitation of this activity can be individual based; Trainer is supposed to demonstrate how to perform cables termination.
- It is recommended to avail tools, materials and equipments required to perform termination
- Avail workplace.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the following task:

As a trainee who learned cable termination. You are asked to terminate the network cables for 5 computers, 2 printers that will be connected to the office's network switch and patch panel.

Step 2: Explain the task and provide instructions for the task.

Step 3: Demonstrate to the trainees, step by step, how to apply cable termination

Step 4: Ask trainees to perform task by following the instructions.

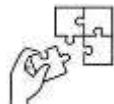
Step 5: Monitor the activity and provide assistance if needed.

Step 6: Ask trainees to read key readings 1.2.4. in the trainee manual.



Points to Remember

- **Cable Terminating:** Cable terminating involves attaching connectors to the ends of network cables, allowing them to be plugged into devices, patch panels, or wall jacks.



Application of learning 1.2.

XYZ complex market would like to install Network in their buildings. You are one of the technician team that is going to install that network, and you are assigned to perform the following tasks:

You are asked to install the network trunking system using above-Grounds Conduits installation type and perform cable termination.

Checklist:

S N	Criteria	Indicators	Observation	
			Yes	No
1	Trunking materials are well installed	1.1 Trunking materials are identified		
		1.2 Trunking materials are selected		
		1.3 Trunking materials are measured.		
		1.4 Trunks are installed		

2	Cable terminating is well implemented.	2.1 Cable termination tools are selected		
		2.2 Cable termination materials are selected		
		2.3 Cables are terminated using connectors		



Indicative content 1.3: Connection of Network Media



Duration: 5 hrs



Theoretical Activity 1.3.1: Description of network media



Notes to the trainer:

- Trainer may use small groups for describing network media
- Avail equipment, tools and materials that will be needed and ensure that are in a good working condition.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask the trainees to do the following questions:

- i. Explain labelling in networking.
- ii. Differentiate Patching and Tagging in networking.
- iii. Explain how to build design in networking media.

Step 2: Asks trainees to write the answers on flipchart/paper.

Step 3: Asks learners to present the answers.

Step 4: Provide a summary view and relate it to the tasks provided.

Step 5: Address any questions or concerns.

Step 6: Ask trainees to read the key reading 1.3.1 in the trainee manual.



Points to Remember

- **Labelling** in Networking refers to the practice of assigning identifiable names or tags to network components, connections, and configurations to facilitate management, troubleshooting, and documentation. This can include: Cable Labelling, Device Labelling, Port Labelling, Patch Panel Labelling.
- **Patching** in networking refers to the physical process of connecting network devices or segments using cables. This step involves creating connections between various network components such as switches, routers, servers, and computers.
- **Tagging** in networking involves adding metadata or identifiers to network packets to manage and differentiate traffic. This metadata helps network devices understand and properly handle the packets based on their tags.

- **Build design** involves creating a detailed plan that covers the network's physical and logical aspects, ensuring that all components work together efficiently and securely. This design serves as a roadmap for the implementation and management of the network, helping to ensure that it meets organizational needs and performance standards.



Practical Activity 1.3.2: Connection of network media



Notes to the trainer

- The trainer may use individual based facilitation to connect network media.
- Avail workplace
- Avail tools, materials and equipment required for network media connection.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask learners to read the task described below:

As a trainee who has recently studied network labeling, patching, tagging, and network design, you are assigned a project to set up a new office network. The office needs a well-organized and functional network to support its daily operations. Your tasks include labeling network components, connecting them using patching and tagging techniques, and providing a comprehensive network build design.

Step 2: Explain the task and provide clear work instructions (Task, Time allocated)

Step 3: Demonstrate how to perform task. While demonstrating, explain the procedures used to perform task.

Step 4: Give other tasks related to the activity and Asks learners to label, patch and tag, then monitor the procedures.

Step 5: Verify whether task has well done according to the procedures

Step 6: Ask trainees to read key reading 1.3.2.

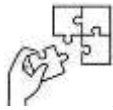
Step 7: Ask trainees to perform the task provided in application of learning 1.3.



Points to Remember

- Labelling steps in network media connection.

- Patching steps in network media connection.
- Tagging steps in network media connection.
- Network Build design steps.



Application of learning 1.3.

A new office is opening near your school, the office needs an installed network for communication. Your task involves labelling all network cables connected to the following components, including the router, switch, computers, and printer, to ensure easy identification and management, then after perform patching and tagging each network connection, using labelled Ethernet cables to connect devices to the switch, and verify that all connections are functional.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Network media Devices are properly Connected	1.1 cables are labeled		
		1.2 Cables are patched		
		1.3 Cables are tagged		



Learning outcome 1 end assessment

Theoretical assessment

1. Which network topology connects all devices to a single central hub?

- a) Star
- b) Ring
- c) Bus
- d) Mesh

Answer: A

2. What type of cable is commonly used for high-speed internet connections and has a high resistance to interference?

- a) Coaxial
- b) Twisted pair
- c) Fiber optic
- d) HDMI

Answer: c

3. Which network device amplifies signals to extend the range of a network?

- a) Switch
- b) Router
- c) Repeater
- d) Hub

Answer: c

4. What is the primary benefit of using fiber optic cables over copper cables?

- a) Higher cost
- b) Higher speed and bandwidth
- c) Shorter distance coverage
- d) Greater electrical interference

Answer: b

5. Which tool is used to remove the insulation from network cables?

- a) Crimping tool
- b) Stripping tool
- c) Cutting tool
- d) Drilling tool

Answer: b

6. In a network, what device is used to connect different network segments and route data between them?

- a) Switch
- b) Router
- c) Repeater
- d) Hub

Answer: b

7. What type of network cabling is suitable for outdoor installations?

- a) Coaxial
- b) Fiber optic
- c) Twisted pair
- d) Coaxial and twisted pair

Answer: b

8. Which network topology requires that each device is connected to exactly two other devices?

- a) Star
- b) Mesh
- c) Ring
- d) Bus

Answer: c

9. Which of the following is a common connector type for twisted pair cables?

- a) RJ45
- b) LC
- c) SC
- d) ST

Answer: A

10. What is the purpose of a network patch panel?

- a) To amplify network signals
- b) To connect and organize cables
- c) To manage network traffic
- d) To provide power to devices

Answer: B

11. Which network topology involves all devices being connected in a straight line?

- a) Star
- b) Mesh
- c) Bus
- d) Ring

Answer: C

12. Which of the following is a disadvantage of a bus topology?

- a) High cost
- b) Difficult to install
- c) If one cable fails, the entire network goes down
- d) High redundancy

Answer: C

13. Which tool is used to test the continuity of network cables?

- a) Crimping tool
- b) Testing tool
- c) Stripping tool
- d) Cutting tool

Answer: B

14. What material is commonly used for trunking in network cable installations?

- a) Wood
- b) Plastic
- c) Metal
- d) Fabric

Answer: B

15. Which type of network cable is best suited for high-speed data transmission over long distances?

- a) Coaxial
- b) Twisted pair
- c) Fiber optic
- d) HDMI

Answer: C

Part 2: Match the network components in column1 with their corresponding function in column2, and write the letter corresponding to the correct function.

Answer	Network Component	Function
...B.....	1. Router	a) Connects and organizes cables
...A.....	2. Patch Panel	b) Routes data between different networks
...D.....	3. Switch	c) Amplifies network signals
...C.....	4. Repeater	d) Connects devices within the same network segment
...E.....	5. Crimping Tool	e) Joins network cables to connectors
...F....	6. Fiber Optic Cable	f) Used for high-speed data transmission
...G.....	7. RJ45 Connector	g) Connects twisted pair cables
...H.....	8. Network Diagram	h) Visual representation of network setup
...E.....	9. Cable Tie	i) Bundles and organizes cables
...J.....	10. Drilling Tool	j) Creates holes for cable routing
		k) Router configuration
		l) Switch management

Part 3: Answer the following questions by using True or False according to the statements

1. Network cables with twisted pair configurations are less susceptible to interference.

Answer: True

2. Fiber optic cables are commonly used for short-distance connections due to their high cost.

Answer: False

3. A network hub operates by sending data to all devices connected to it.

Answer: True

4. A switch can improve network performance by reducing data collisions.

Answer: True

5. Coaxial cables are the most suitable for high-speed internet connections.

Answer: False

6. The RJ45 connector is used for fiber optic cables.

Answer: False

7. Cable ties are used to secure and organize cables.

Answer: True

8. Patching refers to connecting different networks through a patch panel.

Answer: False

9. A UPS provides backup power to network equipment during outages.

Answer: True

10. Tagging is the process of assigning labels to network devices and cables.

Answer: True

11. A router is used to connect different networks and route data between them.

Answer: True

12. Crimping tools are used for testing the continuity of network cables.

Answer: False

13. The main advantage of using coaxial cables is their flexibility and ease of installation.

Answer: False

14. Open-wire network installations are typically used for outdoor aerial connections.

Answer: True

15. Fiber optic cables are resistant to electromagnetic interference.

Answer: True

16. Drilling tools are used to remove insulation from network cables.

Answer: False

17. Network topology refers to the physical or logical layout of a network.

Answer: True

18. A patch panel is used to split a network connection into multiple connections.

Answer: False

19. Network labeling helps in identifying and managing network devices and cables.

Answer: True

20. Plastic trunking materials are less durable than metal trunking materials.

Answer: True

Practical assessment

XYZ Hospital want to install network infrastructure to improve efficiency, patient care, and staff communication. The hospital's operations struggle with communication between staffs and patients. The hospital has hired a professional networking company to implement the installation, ensuring all departments and critical equipment are connected to a secure, high-speed network, with minimal disruption to hospital operations. As one of the technicians from networking company, you are asked to identify and select tools, materials and equipment, install trunks and terminate cables, accordingly, finally connect all the network media for the devices.

Checklist

SN	Criteria	Indicators	Observation	
			Yes	No
1	Materials, Tools and equipment are well selected	1.1. Network tools are selected		
		1.2. Equipments are selected		
		1.3. Materials are selected		
2	Network cables are properly trunked	2.1. Trunking materials are selected		
		2.2. Trunking materials have been installed.		
		2.3. Cables are laid		
3	Network cables are well terminated	3.2 Installation types selected		
		3.2 Cables are terminated		
4	Network media are properly Connected	4.1 cables are labeled		
		4.2 Cables are tagged		
		4.3 Cables are patched		

END



Further information to the trainer

Books:

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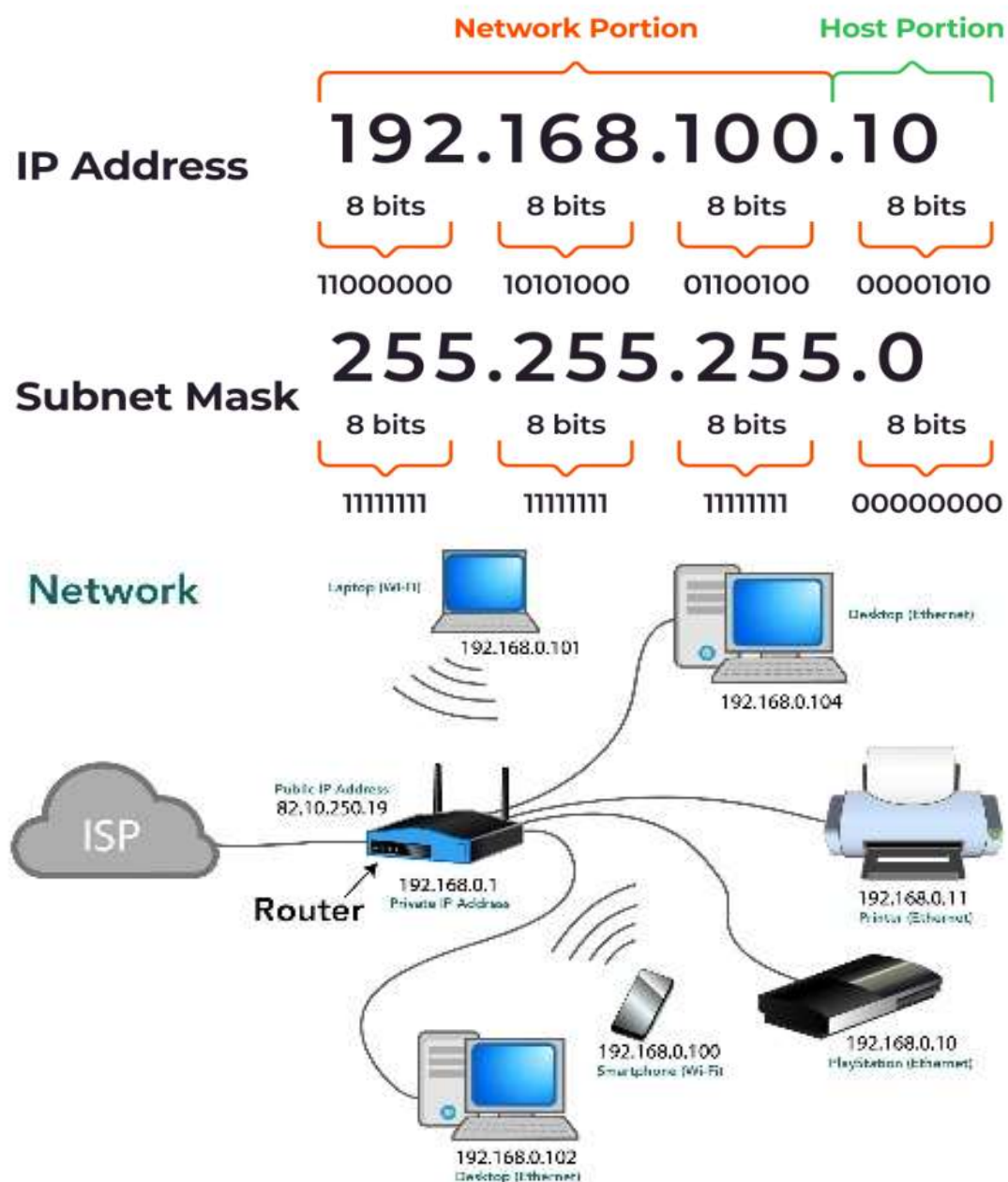
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Learning Outcome 2: Perform Basic Network Configuration.



Indicative contents

- 2.1 Classification of IP Addresses.**
- 2.2 Calculation of IP addresses subnet masks.**
- 2.3 Assigning IP Address.**
- 2.4 Configuration of Basics Network Device.**
- 2.5 Testing network Interconnection.**

Key Competencies for Learning Outcome 2: Perform Basic Network Configuration.

Knowledge	Skills	Attitudes
● Describe IP Addressing ● Identify Principles of subnetting ● Describe basics of network device ● Describe network interconnection testing	● Assign and configure IP addresses on devices ● Configure Network devices ● Perform Subnetting ● Perform network interconnection testing	● Having Curiosity ● Being Patient ● Having Persistence ● Being a Critical Thinker ● Having attention to Detail ● Being adaptive ● Having Ethical Behavior ● Being a Continuous Learner ● Having Empathy ● Having Security Consciousness



Duration: 35 hrs

Learning outcome 2 objectives:



By the end of the learning outcome, the trainees will be able to:

1. Classify accurately the IP Addresses in accordance with network requirements.
2. Calculate precisely the IP address subnet masks based on the network topology.
3. Assign correctly the IP Addresses to devices in accordance with network topology.
4. Configure effectively the basic network devices based on manufactures' guide.
5. Test correctly the network interconnection in accordance with network Functionalities.



Resources

Equipment	Tools	Materials
• Computer • Inverter • Battery • UPS • Router • Switch	• Networking toolkit • Drilling tools • Fixing tool • Testing tools	• Network cables • Connectors • Flexible Cables PIPE • Cables Ties • Cables clips



Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have an installed network to ensure the configuration process.
- Have computers with installed simulation software.



Indicative content 2.1: Classification of IP Addresses



Duration: 7 hrs



Theoretical Activity 2.1.1: Description of IP address configuration



Notes to the trainer:

- Trainer may use small groups for describing IP address configuration
- Avail equipment, tools and materials that will be needed and ensure that are in a good working condition.
- Avail computers with installed simulation software like Packet Tracer.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

- i. Define an IP Address.
- ii. Explain the types of IP Addresses.
- iii. Describe the IP address versions.
- iv. Explain the IP address classes.

Step 2: Asks trainees to write answers on flipchart/paper.

Step 3: Asks learners to discuss the provided answers and choose correct answers.

Step 4: Provide summary view and relate it to the tasks provided.

Step 5: Address any questions or concerns.

Step 6: Ask trainees to read the key reading 2.1.1 in the trainee manual.



Points to Remember

- An IP Address (Internet Protocol Address) is a unique numerical identifier assigned to each device connected to a computer network that uses the Internet Protocol for communication.
- The main types of IP addresses are Private IP Address, Public IP Address, Static IP Address, Dynamic IP Address, Loopback IP Address, Multicast IP Address and Broadcast IP Address.
- IP address versions: There are two main versions of IP (Internet Protocol) addresses in use today: IPv4 and IPv6.

- Identification of IP address classes: IP addresses are divided into five different classes (A, B, C, D, and E) based on the first few bits of the address, which determine the range of the network and host portions.



Practical Activity 2.1.2: Configuration of IP Address



Notes to the trainer

- The trainer may use individual based facilitation to Configure IP Address.
- Avail the required tools (Console cable, Computer with Emulation Software or CISCO Packet tracer).
- Avail installed network for configuration.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask learners to read the task described below:

As a trainee who studied IP address configuration and network setup, you are tasked to configure the IP Addresses of a small office network for a new department. The office consists of four computers, one network printer, switch and a router to manage the internal network. You need to configure the IP addresses for each device, set up the router, and verify that all devices can communicate with each other.

Step 2: Explain the task and provide clear work instructions (Task, Time allocated)

Step 3: Demonstrate how to configure IP addresses. While demonstrating, explain the procedures used to configure IP addresses.

Step 4: Give other tasks related to the activity and Asks learners to configure IP addresses, then monitor the procedures.

Step 5: Verify whether configuration of IP addresses has well done according to the procedures

Step 6: Ask trainees to read key reading 2.1.2.

Step 7: Ask trainees to perform the task provided in application of learning 2.1.



Points to Remember

- **Steps to Configure IP Addresses in Cisco Packet Tracer**

1. Set Up the Network Topology
2. Connect the Devices
3. Configure the Router
4. Configure the Switch (Optional)
5. Configure IP Addresses on PCs
6. Verify Connectivity



Application of learning 2.1.

In ICT Company, a new office is opening with four computers, one network printer, a switch, and a router. As a network technician assigned to this branch, you are tasked with configuring the IP addresses for all network devices. You need to set up the router with the correct IP address scheme, configure each computer and the network printer with appropriate IP addresses, and ensure that all devices are connected through the switch. After configuration, you will need to verify that all devices can communicate with each other and confirm that network services are functioning correctly.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	IP Addresses are well Configured	1.1. Router is assigned the correct IP address scheme		
		1.2. Each computer is configured with an appropriate IP address		
		1.3. Network printer is configured with an appropriate IP address		
		1.4. IP addresses are documented and verified		
2	Devices are well Connected	2.1. All devices are connected through the switch		
		2.2. Connections are tested and verified		
		2.3. Network devices (computers, printer, router) are powered on and checked		
3	Network	3.1. Devices can ping each other successfully		

	Communication is well working	3.2. Internet access is verified on all devices		
		3.3. Printer connectivity is tested from each computer		
4	Documentation is well created	4.1. Network configuration details are documented		
		4.2. Test results are recorded		
		4.3. Any issues encountered and resolved are noted		



Indicative content 2.2: Calculation of IP Addresses Subnet Masks



Duration: 7 hrs



Theoretical Activity 2.2.1: Description of IP address subnet masks



Notes to the trainer:

- Trainer may use small groups for describing IP address subnet masks
- Avail workshop or computer LAB
- Avail equipment, tools and materials that will be needed and ensure that are in a good working condition.
- Avail computers with installed simulation software like Packet Tracer.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the following questions:

- What is subnet masks?
- What are the Benefits of subnetting?
- Discuss on Binary system.
- What are the Types of Subnetting?
- Explain Logical and bitwise Operators.

Step 2: Asks trainees to write provided answers on flipchart/paper.

Step 3: Asks learners to discuss the provided answer and choose correct answers.

Step 4: Provide a summary view and relate it to the tasks provided.

Step 5: Address any questions or concerns.

Step 6: Ask trainees to read the key reading 2.2.1 in the trainee manual.



Points to Remember

- A **subnet mask** is a fundamental concept in networking used to divide an IP address into its network and host components. It determines which portion of an IP address identifies the network and which part identifies the individual device (host) within that network.
- A **subnet mask** is a 32-bit address that accompanies an IP address to specify which part of the IP address refers to the network and which part refers to the host within that network. It is used in conjunction with an IP address to create a network segment, making it easier to manage and organize network traffic.

- **Format:** A subnet mask is expressed in the same format as an IP address, consisting of four octets (e.g., 255.255.255.0).
- **Benefits of subnetting** are Improved Network Organization, Enhanced Security, Efficient IP Use, Better Performance, Scalability, Simplified Routing, Effective Troubleshooting and Compliance.
- The binary system is a method of representing numbers using only two digits: 0 and 1. It is the foundation of all digital systems, including computers, where it is used to perform calculations, store data, and manage operations.
- **Types of Subnetting:**
 - ✓ **Fixed-Length Subnet Mask (FLSM):** FLSM is used when each subnet in a network requires the same number of IP addresses.
 - ✓ **Variable-Length Subnet Mask (VLSM):** VLSM allows for different subnet sizes within the same network by using different subnet masks.
- **Logical and Bitwise Operators in Subnetting** are used to perform calculations when subnetting, particularly in determining network and broadcast addresses.
 - ✓ **AND Operator:** The bitwise AND operator is used to calculate the network address by applying the subnet mask to an IP address.
 - ✓ **OR Operator:** The bitwise OR operator is used to calculate the broadcast address.



Practical Activity 2.2.2: Calculating IP address subnet masks



Notes to the trainer

- The trainer may use individual based facilitation for calculating IP address subnet mask.
- Avail the required tools (Console cable, Computer with Emulation Software or CISCO Packet tracer).
- Avail installed network.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask learners to read the task described below:

As a trainee who studied subnet masks concepts, you are tasked to calculate subnet masks of a small office network. The office requires 4 subnets to

accommodate different departments, and each subnet should be able to support up to 20 devices. You have been given the IP address range 192.168.1.0/24 to work with. Your goal is to calculate the appropriate subnet mask to meet these requirements.

Step 2: Explain the task and provide clear work instructions (Task, Time allocated)

Step 3: Demonstrate how to calculate subnet masks. While demonstrating, explain the procedures used to calculate subnet masks.

Step 4: Give other tasks related to the activity and Asks learners to calculate subnet masks, then monitor the procedures.

Step 5: Verify whether calculation of subnet mask has well done according to the procedures

Step 6: Ask trainees to read key reading 2.2.2.

Step 7: Ask trainees to perform the task provided in application of learning 2.2.



Points to Remember

- **Steps to Calculate the Subnet Mask:**

1. Determine the Requirements
2. Identify the IP Address Range
3. Calculate the Number of Required Subnet Bits
4. Determine the Subnet Mask
5. Calculate the Subnet Addresses
6. Identify Usable IP Ranges
7. Verify Network and Broadcast Addresses
8. Document the Subnets
9. Implement and Verify Subnets
10. Review and Adjust as Needed



Application of learning 2.2.

In Musanze District, a small office is expanding and requires a network redesign to accommodate six different departments, each needing its own subnet. As a network trainee who has studied subnet masks, you are assigned to calculate subnet mask for this expansion. You are provided with the IP address range 192.168.1.0/24. Your task is to calculate the appropriate subnet mask that will allow for six subnets, each capable of supporting up to 30 devices. You need to create and configure the subnets, ensuring that each department has its own subnet with the required number of IP addresses. After setting up the subnets, verify that each department's network segment is correctly configured and able to support the devices.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Subnet Mask Calculation is Accurate	1.1. Correct subnet mask is calculated		
		1.2. Subnet mask allows for 6 subnets		
		1.3. Each subnet can support up to 30 devices		
2	Subnets are Properly Configured	2.1. IP address range is correctly divided		
		2.2. Each department has its own subnet		
3	Network Configuration is Verified	3.1. Each subnet is correctly configured		
		3.2. Devices are assigned correct IP addresses		
		3.3. Connectivity between devices is tested		
4	Documentation is Well Done	4.1. Subnet details are recorded		
		4.2. Configuration steps are documented		
		4.3. Verification results are documented		



Indicative content 2.3: Assigning IP Address



Theoretical Activity 2.3.1: Identify IP address assignment



Notes to the trainer:



Duration: 7 hrs

- Trainer may use small groups for describing IP address assignment
- Avail workshop or computer LAB
- Avail equipment, tools and materials that will be needed and ensure that are in a good working condition.
- Avail computers with installed simulation software like Packet Tracer.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the following question:

- i. Differentiate Static, Dynamic and Automatic IP Addresses

Step 2: Asks trainees to write provided answers on flipchart/paper.

Step 3: Asks learners to discuss the provided answer and choose correct answers.

Step 4: Provide a summary view and relate it to the tasks provided.

Step 5: Address any questions or concerns.

Step 6: Ask trainees to read the key reading 2.3.1 in the trainee manual.



Points to Remember

- **Static IP Address** is a fixed, manually assigned IP address that remains constant over time. It does not change unless manually reconfigured.
- **Dynamic IP Address** is assigned automatically by a DHCP (Dynamic Host Configuration Protocol) server from a pool of available addresses. It can change over time based on lease duration and server configuration.
- **Automatic IP Address** are assigned using a protocol such as Automatic Private IP Addressing (APIPA) when a DHCP server is unavailable. These addresses are typically in the range of 169.254.x.x.



Practical Activity 2.3.2: Assigning IP Address



Notes to the trainer

- The trainer may use individual based facilitation for Configuring Static, dynamic and automatic IP Address.
- Avail the required tools (Console cable, Computer with Emulation Software or CISCO Packet tracer).
- Avail computers with installed simulation software like Packet Tracer.
- Avail an installed network to be used during configuration.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the topic and ask learners to read the task described below:
As a networking student who has studied various IP address configurations, you are tasked with setting up a network for a small office. The network needs to support a shared printer with a static IP address, several office computers using dynamic IP addresses, and temporary devices that may rely on automatic IP addressing if the DHCP server is unavailable.
- Step 2:** Explain the task and provide clear work instructions (Task, Time allocated)
- Step 3:** Demonstrate how to assign static, dynamic and automatic IP addresses to network devices. While demonstrating, explain the procedures used to assign IP addresses.
- Step 4:** Give other tasks related to the activity and Asks learners to assign IP addresses, then monitor the procedures.
- Step 5:** Verify whether configuration of IP addresses has well done according to the procedures
- Step 6:** Ask trainees to read key reading 2.3.2.
- Step 7:** Ask trainees to perform the task provided in application of learning 2.3.



Points to Remember

- Steps for configuring static, dynamic, and automatic IP addresses in a network:

1. Assign a Static IP Address

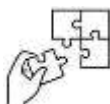
- ✓ Identify Device
- ✓ Choose IP Address
- ✓ Access Device Settings
- ✓ Configure IP Address
- ✓ Save and Apply Settings
- ✓ Verify Connectivity

2. Configure Dynamic IP Addressing

- ✓ Set Up DHCP Server
- ✓ Define DHCP Scope
- ✓ Connect Devices
- ✓ Verify IP Assignment

3. Manage Automatic IP Addressing

- ✓ Prepare for Temporary Network
- ✓ Connect Temporary Devices
- ✓ Verify APIPA
- ✓ Monitor for DHCP Availability



Application of learning 2.3.

In Musanze District, a new smart office building has been established for the district's administrative functions. As a network technician responsible for setting up the network, you are tasked with assigning IP addresses to various devices within the office. The office network includes:

- **Five computers** for staff members.
- **Two network printers.**
- **A Wi-Fi router** providing wireless access to visitors and mobile devices.

Your task is to assign IP addresses to these devices using static for 2 printers and 5 desktop computers of staff members, dynamic (DHCP) for staff telephones and their personal computer (laptops), and provide automatic IP configurations that can be used when DHCP server is down.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	IP Addresses are well assigned	1.1. Static IP addresses are assigned to 2 network printers		
		1.2. Static IP addresses are assigned to 5 desktop computers		
		1.3. DHCP is set up for staff telephones and personal computers		
		1.4. Automatic IP configuration is available for DHCP server failure		
2	IP Address Configuration are well verified	2.1. IP addresses for network printers are verified		
		2.2. IP addresses for desktop computers are verified		
		2.3. DHCP settings are tested and confirmed		
		2.4. Automatic IP configuration is tested for reliability		
3	Connectivity is well tested	3.1. Network printers are reachable from staff computers		
		3.2. Staff telephones and personal computers connect to the network		
		3.3. Wi-Fi router provides internet access to mobile devices		
4	Documentation and Backup are well created	4.1. IP address assignments are documented		
		4.2. DHCP and automatic IP configuration settings are recorded		
		4.3. Any issues encountered and resolutions are noted		



Indicative content 2.4: Configuration of Basics Network Device.



Duration: 7 hrs



Theoretical Activity 2.4.1: Describing Basics of network device



Notes to the trainer:

- Trainer may small groups for describing the Basics of network device
- Avail workshop or computer LAB
- Avail equipment, tools and materials that will be needed and ensure that are in a good working condition.
- Avail computers with installed simulation software like Packet Tracer.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the following questions:

- i. Explain Device Configuration Modes.
- ii. What is Host name in networking?
- iii. What is Banner message?
- iv. What is the meaning of Reload Device in networking?

Step 2: Asks trainees to write provided answers on flipchart/paper.

Step 3: Asks learners to discuss the provided answer and choose correct answers.

Step 4: Provide a summary view and relate it to the tasks provided.

Step 5: Address any questions or concerns.

Step 6: Ask trainees to read the key reading 2.4.1 in the trainee manual.



Points to Remember

- **Device Configuration Modes**

Device configuration modes refer to the different states or environments a networking device (such as a router, switch, or firewall) can be in when you're setting it up or managing it. Each mode allows you to perform specific types of configuration tasks.

The common device configuration modes, particularly in the context of Cisco networking devices are:

1. User EXEC Mode
 2. Privileged EXEC Mode
 3. Global Configuration Mode
 4. Interface Configuration Mode
 5. Line Configuration Mode
 6. VLAN Configuration Mode
 7. Router Configuration Mode
 8. ROMMON Mode
- **Key elements in configuration of network devices** are hostname, banner messages, device passwords, configure ports, configure devices password, saving configurations and reloading devices.



Practical Activity 2.4.2: Configuring Basic network devices



Notes to the trainer

- The trainer may use individual based facilitation for configuring basics of network devices
- Avail Network devices in place and computers with Terminal Emulation software.
- Avail an installed network.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask learners to read the task described below:

As a trainee who has recently learned about network basic device configuration, you are asked to set up a small office network of IT lab using three network switches. Your task is to configure each switch by assigning a unique hostname (Switch-1, Switch-2, Switch-3) for easy identification, setting up a banner message (Unauthorized access to Switch-1,2,3 is prohibited) to display a warning against unauthorized access, and configuring all the passwords required (e.g for one switch: c0ns0le1, vtypass1, enablepass1) to secure access to the switches. You also need to enable and configure the necessary ports on each switch to connect computers and other devices. Additionally, you must save the configurations on all switches

to ensure they are retained after a reboot, and then perform a reload of each switch to apply and verify the settings. The task must be performed using Cisco Packet tracer

Step 2: Explain the task and provide clear work instructions (Task, Time allocated)

Step 3: Demonstrate how to configure basics network device. While demonstrating, explain the procedures used to configure basics network device.

Step 4: Give other tasks related to the activity and Asks learners to configure basics network device, then monitor the procedures.

Step 5: Verify whether configuration of basics network device has well done according to the procedures

Step 6: Ask trainees to read key reading 2.4.2.

Step 7: Ask trainees to perform the task provided in application of learning 2.4.



Points to Remember

- **Device Configuration steps specifically using a Cisco Packet Tracer:**

1. Access the Switch
2. Configure the Hostname
3. Set Banner Message
4. Configure Device Passwords
5. Configure IP Address on the Management Interface
6. Save the Configuration
7. Reload the Switch



Application of learning 2.4.

In Kigali City, a new training center has been established to provide networking and IT courses. As part of the initial setup, you, a network technician, are tasked with configuring the network devices in the training lab. The lab consists of three Cisco switches that need to be properly configured to ensure secure and efficient network operation.

Your tasks include setting up the hostname for each switch, configuring a banner message to display important information when users log in, setting passwords for secure access, configuring the necessary ports, and saving the configurations to ensure they persist after a reboot. Additionally, you need to perform a device reload to verify that the configurations have been saved successfully.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Hostname is well Configured	1.1. Hostname is set for each of the three Cisco switches		
2	Banner Message is well Configured	2.1. Banner message is configured and displayed on login		
3	Password is well Configured	3.1. Console password is set		
		3.2. Enable password is set		
		3.3. VTY (Telnet/SSH) password is set		
4	Port are well Configured	4.1. Necessary ports are configured		
		4.2. Ports are assigned to the correct VLANs (if applicable)		
5	Configuration Saving are well done.	5.1. Configuration is saved using write memory or copy running-config startup-config		
6	Device Reload is well done	6.1. Device is reloaded to verify configuration persistence		
		6.2. Post-reload verification shows correct configuration		
7	Documentation is well done	7.1. Configuration details are documented		
		7.2. Any issues encountered and resolutions are noted		



Indicative content 2.5: Testing network Interconnection



Duration: 7 hrs



Theoretical Activity 2.5.1: Description of network Interconnection testing.



Notes to the trainer:

- The trainer may use small groups for describing network interconnection Testing.
- Avail workshop or computer LAB
- Avail equipment, tools and materials that will be needed and ensure that are in a good working condition.
- Avail computers with installed simulation software like Packet Tracer.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to perform the task described below:
Answer the following questions regards to the topic.
- i. Explain physical testing in networking.
 - ii. Explain what unit testing is in the context of networking.
 - iii. Discuss Network Integration Testing.
- Step 2:** Ask trainees to present the answers to trainer and to whole class.
- Step 3:** Provide the expert view and more clarifications to the trainees.
- Step 4:** Ask them to Read the key readings 2.5.1 in trainee's manual.



Points to Remember

- **Physical Testing:** In networking, physical testing involves evaluating the hardware components of a network, such as routers, switches, cables, and other network devices, to ensure they operate correctly and meet required specifications.
- **Unit testing:** in the context of Networking imply testing individual components of software or hardware which operate within that Network.

- **Integration Testing** involves testing the combined parts of a network system and ensuring that they function correctly when they interact with each other.



Practical Activity 2.5.2: Testing network interconnection.



Notes to the trainer

- The trainer may use individual-based facilitation for testing network interconnection.
- Avail testing tools and other required tools (Console cable, Computer with Emulation Software)
- Avail an installed network to be used during installation.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to read the task described below:

As network Technician, install a small local area network or use the one installed during previous activities and apply physical, unity testing and integration testing.

Step 2: Explain the task and provide clear work instructions (Task, Time allocated)

Step 3: Demonstrate how to perform network interconnection testing. While demonstrating, explain the procedures used to perform physical, unit and integration testing.

Step 4: Give other tasks related to the activity and Asks learners to perform physical, unit and integration testing, then monitor the procedures.

Step 5: Verify whether physical, unit and integration testing has well done according to the procedures

Step 6: Ask trainees to read key reading 2.5.2.

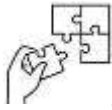
Step 7: Ask trainees to perform the task provided in application of learning 2.5.



Points to Remember

- **Steps of Physical Testing:** Focuses on checking the physical network components (e.g., cables, hardware) for correct installation and performance.
- **Steps of Unit Testing:** Involves verifying individual network configurations or services to ensure they function as expected in isolation.

- **Steps of Integration Testing:** Tests the interaction and performance of combined network components to ensure they work together seamlessly and meet overall network requirements.



Application of learning 2.5.

In Kigali City, the Training Center has recently completed the installation of its new network infrastructure. As a trainee who has studied network testing methodologies, you are now tasked with ensuring that the network is functioning correctly by performing three key types of tests: physical testing, unit testing, and integration testing.

Your objective is to verify that all network components, including switches, routers, cables, and connected devices, are working properly and that the network as a whole is performing as expected.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Physical Testing is well done	1.1. All network cables are properly connected		
		1.2. Cables are securely terminated and organized		
		1.3. Network devices (switches, routers) are powered on and operational		
		1.4. No physical damage to cables or equipment		
2	Unit Testing is well done	2.1. Each network device is tested individually		
		2.2. Switches are checked for correct port functionality		
		2.3. Routers are tested for proper routing functions		
		2.4. Connected devices (computers, printers) are checked for network connectivity		
3	Integration Testing is well done	3.1. All network components work together as expected		
		3.2. Data flow between devices is tested		

		3.3. End-to-end connectivity is verified		
		3.4. Network performance metrics meet expectations		
		3.5. Network services (e.g., file sharing, printing) are functioning correctly		
4	Documentation and Reporting are well done	4.1. Test results are documented		
		4.2. Any issues identified and resolutions are recorded		
		4.3. Summary report of testing outcomes is prepared		



Learning outcome 2 end assessment

Theoretical assessment

Part 1: Choose the correct answer.

1. What is the primary purpose of an IP address?

- a) To provide security for data transmission
- b) To identify devices on a network
- c) To control data flow
- d) To encrypt data packets

Answer: B

2. Which of the following is a characteristic of a static IP address?

- a) It is assigned automatically by a DHCP server
- b) It changes frequently based on network conditions
- c) It remains constant unless manually changed
- d) It is used only for temporary connections

Answer: C

3. What is the primary difference between IPv4 and IPv6?

- a) IPv4 uses 128-bit addresses, while IPv6 uses 32-bit addresses
- b) IPv4 addresses are written in hexadecimal, while IPv6 addresses are written in binary
- c) IPv4 addresses are 32-bit, while IPv6 addresses are 128-bit
- d) IPv4 is designed for wireless networks, while IPv6 is for wired networks

Answer: C

4. Which class of IP addresses is typically used for multicast groups?

- a) Class A
- b) Class B
- c) Class C
- d) Class D

Answer: D

5. In subnetting, what does the subnet mask 255.255.255.0 indicate?

- a) The first 8 bits are the network portion
- b) The first 16 bits are the network portion
- c) The first 24 bits are the network portion
- d) The entire address is used for the host portion

Answer: C

6. Which of the following is a benefit of subnetting?

- a) Increases the available IP address space
- b) Reduces network traffic by limiting broadcast domains
- c) Automatically assigns IP addresses to devices
- d) Enhances data encryption for secure communication

Answer: A

7. Which binary number corresponds to the decimal number 192?

- a) 11000000
- b) 10101010
- c) 11110000
- d) 10000000

8. Which type of subnetting is used to allocate IP addresses to subnets of varying sizes?

- a) Fixed-Length Subnet Mask (FLSM)
- b) Variable-Length Subnet Mask (VLSM)
- c) Classless Inter-Domain Routing (CIDR)
- d) Automatic Subnet Mask Allocation (ASMA)

Answer: B

9. Which logical operator is used to determine the network address in subnetting?

- a) OR
- b) AND
- c) XOR
- d) NOT

Answer: B

10. What is the role of a DHCP server in assigning IP addresses?

- a) To manually assign IP addresses to devices
- b) To automatically allocate IP addresses within a network
- c) To restrict IP address allocation to specific devices
- d) To encrypt IP addresses for secure communication

Answer: B

11. Which command is used to set a hostname on a Cisco switch?

- a) switch-hostname
- b) Hostname
- c) set hostname
- d) name-switch

Answer: B

12. What is the purpose of a banner message on a network device?

- a) To configure device passwords
- b) To display a message when a user logs in
- c) To reload the device with new configurations
- d) To save the current configuration

Answer: B

13. Which of the following is NOT a device configuration mode in Cisco networking?

- a) User EXEC mode
- b) Privileged EXEC mode
- c) Interface configuration mode
- d) Host configuration mode

Answer: D

14. What is the purpose of saving a network device's configuration?

- a) To apply temporary settings
- b) To ensure the configuration is retained after a reboot
- c) To reset the device to factory settings
- d) To delete all current settings

Answer: B

15. Which type of testing verifies that all network components work together as intended?

- a) Physical Testing
- b) Unit Testing
- c) Integration Testing
- d) Functional Testing

Answer: C

Part 2: Match the terms on the left with the correct descriptions on the right by writing the number corresponding to the correct description.

Answer	Term	Description
...2....	A. Class A IP Address	1. Provides automatic IP addresses within a network
.....5.....	B. VLSM	2. Used to uniquely identify a device on a network
.....10.....	C. Binary System	3. The subnet mask divides a network into subnets
.....1.....	D. Dynamic IP Address	4. Assigns a fixed IP address manually
.....4.....	E. Static IP Address	5. Used to create subnets of different sizes

.....6.....	F. IPv4	6. Uses 32-bit addresses for IP networking
.....7.....	G. IPv6	7. Uses 128-bit addresses for IP networking
.....3.....	H. Subnet Mask	8. Used to calculate network and broadcast addresses
.....9....	I. Integration Testing	9. Network testing involving the entire system
.....8.....	J. Logical AND Operator	10. The base-2 number system used in networking
.....	k. Hexadecimal system	
.....	l. Class B IP address	

Part 3: Answer the following questions by using True or False according to the system.

1. Class B IP addresses have a default subnet mask of 255.255.0.0.

Answer: True

2. Static IP addresses are assigned automatically by a DHCP server.

Answer: False

3. IPv6 addresses are written in hexadecimal format.

Answer: True

4. A subnet mask of 255.255.255.240 allows for 14 usable host addresses.

Answer: True

5. Subnetting reduces the number of available IP addresses in a network.

Answer: False

6. The binary equivalent of the decimal number 128 is 10000000.

Answer: True

7. CIDR allows for more flexible IP address allocation than traditional subnetting.

Answer: True

8. A logical OR operation is used to calculate network addresses.

Answer: False

9. Automatic IP address assignment can occur without a DHCP server.

Answer: False

10. The hostname of a network device must be unique within the network.

Answer: True

11. A banner message is optional but recommended for providing login information.

Answer: True

12. Reloading a device will erase all saved configurations.

Answer: False

13. Device passwords are set to control access to a network device's configuration.

Answer: True

14. A switch's port configuration determines how devices connect to the network.

Answer: True

15. Saving the configuration ensures it is retained after the device is powered off.

Answer: True

16. Physical testing checks the logical configuration of network devices.

Answer: False

17. Unit testing involves testing individual components of the network in isolation.

Answer: True

18. Integration testing is only performed after all network devices have been installed.

Answer: True

19. A Class C IP address has a default subnet mask of 255.255.255.0.

Answer: True

20. Bitwise operators are not used in network subnetting calculations.

Answer: False

Practical assessment

You are a network technician assigned to a newly established office branch in Musanze District. The office consists of four computers, one network printer, a switch, and a router. Your task is to design and implement the network, ensuring proper IP addressing, subnetting, and configuration of all network devices. After setting up the network, you will conduct testing to verify that all components are functioning correctly.

Tasks:

- You have been allocated the IP address range 192.168.10.0/24. The office has four departments, each requiring its subnet. The IP address scheme must allow for future expansion, so plan your subnets accordingly.
- Calculate the appropriate subnet masks and assign IP addresses to each department, ensuring that each subnet can support at least 30 devices.
- Assign static IP addresses to the computers and network printer within each subnet.
- Configure the router with the correct IP address scheme and ensure it manages the internal network effectively.
- Assign appropriate hostnames to the router and switch. For example, use OfficeRouter and OfficeSwitch.
- Configure a banner message on the router and switch to display a welcome message and a warning that unauthorized access is prohibited.
- Configure the switch ports to connect the four computers and the network printer.
- Set up strong passwords for accessing the router and switch to secure the network devices.
- Perform physical testing to ensure all devices are connected correctly and powered on.
- Conduct unit testing by verifying the configuration and operation of each individual network device (computers, network printer, router, switch).
- Perform integration testing by ensuring that all network components (computers, printer, router, switch) communicate effectively with each other.
- Test connectivity between subnets and verify that network services such as file sharing and printing are functioning correctly.
- Configure DHCP on the router to assign IP addresses dynamically to any additional devices that might be connected to the network in the future.
- Verify that the dynamic IP assignment works correctly by connecting a new device to the network and confirming it receives an IP address automatically.

- Document the IP address scheme, subnet calculations, and configuration settings for all network devices.

Checklist

SN	Criteria	Indicators	Yes	No
1	IP Addresses are well Planed	1.1. IP address range 192.168.10.0/24 is allocated		
		1.2. Subnets for four departments are designed		
		1.3. Subnet masks calculated for at least 30 devices per subnet		
		1.4. IP addresses are assigned to each department's subnet		
2	Static IP Addresses are well assigned	2.1. Static IP addresses assigned to computers		
		2.2. Static IP address assigned to network printer		
3	Router is well configured	3.1. Router configured with correct IP address scheme		
		3.2. Router is managing the internal network effectively		
		3.3. DHCP configured on router for future devices		
		3.4. Dynamic IP assignment verified with new device		
4	Switch and Router are well configured	4.1. Hostnames set to Office Router and Office Switch		
		4.2. Banner message configured on router and switch		
		4.3. Strong passwords set for router and switch access		
		4.4. Switch ports configured to connect devices		
5	Physical Testing is well performed	5.1. All devices are connected correctly		
		5.2. Devices are powered on and operational		

6	Unit Testing is well performed	6.1. Configuration and operation of each device verified		
		6.2. Individual device functionality confirmed		
7	Integration Testing is well performed	7.1. All network components communicate effectively		
		7.2. Connectivity between subnets verified		
		7.3. Network services (file sharing, printing) functioning correctly		
8	Documentation is well done	8.1. IP address scheme documented		
		8.2. Subnet calculations documented		
		8.3. Configuration settings for all devices documented		

END



Further information to the trainer

Books:

Burgess, M. (2016). *Network troubleshooting: A practical guide*. London: Addison-Wesley.

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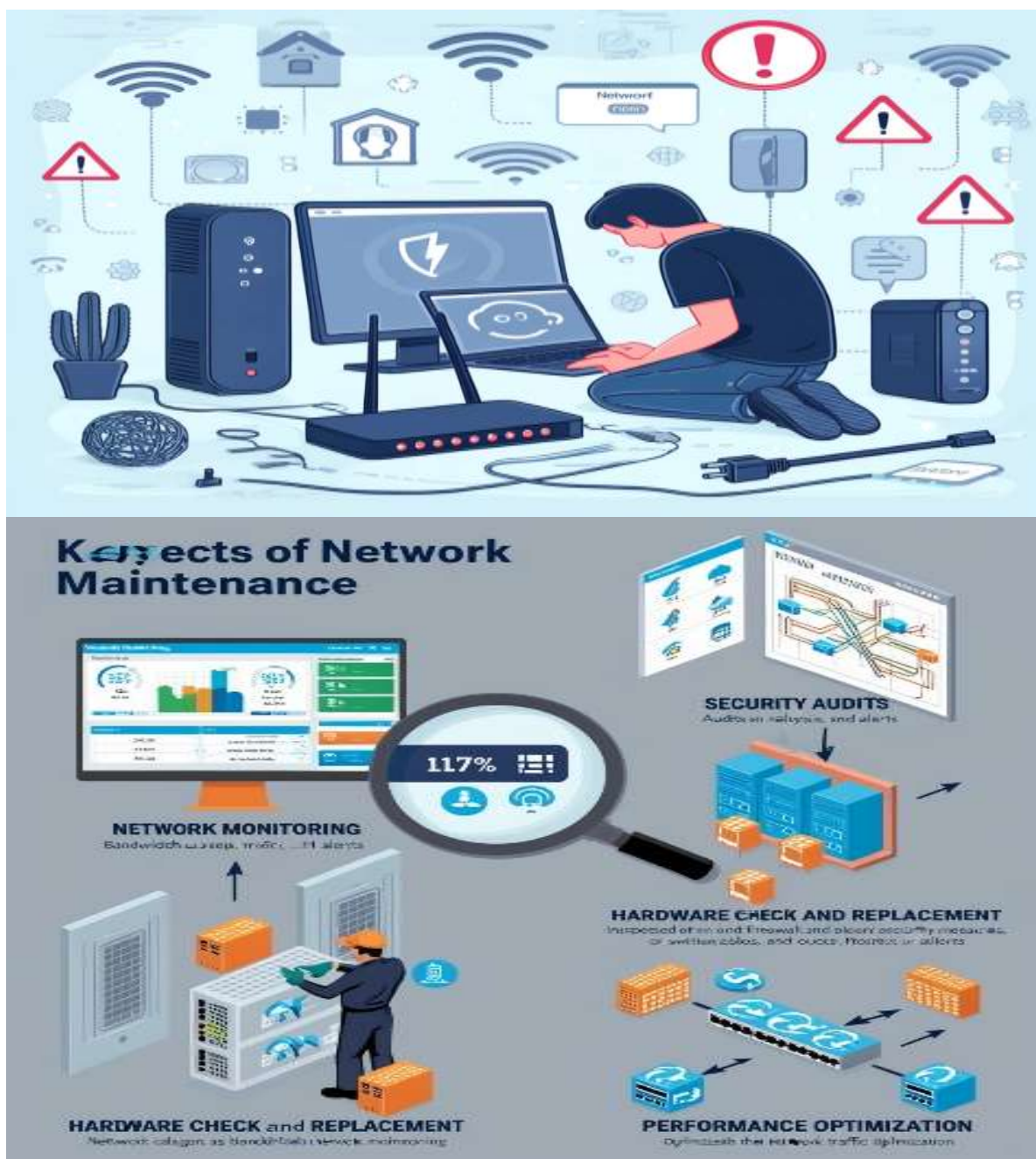
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Learning Outcome 3: Maintain Network System



Indicative contents

3.1 Performing preventive maintenance

3.2 Performing corrective maintenance.

3.3 Troubleshooting network

3.4 Elaboration of maintenance report

Key Competencies for Learning Outcome 3: Maintain Network system

Knowledge	Skills	Attitudes
• Description of preventive maintenance in network system • Description of corrective maintenance in network system • Introduction to troubleshooting network • Description of maintenance report	• Performing preventive maintenance • Performing corrective maintenance • Troubleshooting network system • Elaborating maintenance report	• Being a Critical Thinker in troubleshooting • Having Curiosity for preventive maintenance • Having Adaptability in corrective maintenance • Having Collaborative Spirit for elaboration of maintenance report



Duration: 15 hrs



Learning outcome 3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Perform properly Preventive maintenance as per manufacturer's guidelines.
2. Perform properly Corrective Maintenance based on problems
3. Check properly network protection measures in accordance with the installation design.
4. Handle properly network issues-based system diagnosis.
5. Elaborate efficiently maintenance report based on network status.



Resources

Equipment	Tools	Materials
• Computer • Router • battery • Visual Equipment	• Network Toolkit • Testing tools	• Cables and accessories • Electricity • Internet bundles • Power Extension



Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Prepare workshop as learning place.
- Have an installed and working Network.



Indicative content 3.1: Perform Preventive Maintenance



Duration: 4 hrs



Theoretical Activity 3.1.1: Description of hardware and software Preventive maintenance



Notes to the trainer:

- Trainer may use small groups for Describing hardware and software Preventive maintenance.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the following questions:

- i. Differentiating hardware and software preventive maintenance.
- ii. What are examples of hardware preventive maintenance in networking?
- iii. What are examples of software preventive maintenance in networking?

Step 2: Asks trainees to write answers on provided flipchart/paper.

Step 3: Ask trainees to discuss the provided answers and choose correct answers.

Step 4: Provide a summary view and relate it to the tasks provided.

Step 5: Address any questions or concerns.

Step 6: Ask trainees to read key readings 3.1.1 in their manual.



Points to Remember

- Hardware preventive maintenance is crucial for ensuring that network equipment remains reliable and performs optimally
- Software preventive maintenance in networking involves a series of ongoing tasks designed to ensure that network software and systems remain secure, up-to-date, and perform efficiently.
- Hardware preventive measures examples are dust removal, port and connector cleaning, cable management etc..
- Software preventive measures examples are regular change of network device credentials, network monitoring software licensing and application, updating and upgrading network monitoring software and device firmware etc.



Practical Activity 3.1.2: Implementation of network hardware and software preventive measures



Notes to the trainer

- The trainer may use individual based facilitation techniques for Setting and Implementing network hardware and software preventive measures
- Avail Installed and working Network.



Key steps:

While delivering this activity, pass through the following steps:

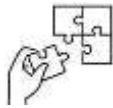
- Step 1:** Introduce the activity and ask trainees to read the task described below:
As IT, you are requested to perform Preventive Maintenance on a Small Office Network include cleaning network devices, updating firmware, and checking environmental conditions.
- Step 2:** Explain the task and provide clear instructions
- Step 3:** Demonstrate how to perform preventive measures based on the type of problem. While demonstrating, explain the criteria used for perform.
- Step 4:** Ask trainees to do the task by following the given instructions.
- Step 5:** Assist trainees in performing preventive maintenance.
- Step 6:** Provide more explanations where is necessary.
- Step 7:** Verify whether preventive measures are correctly performed.
- Step 8:** Ask trainees to read key reading 3.1.2



Points to Remember

Steps for Cleaning Network Devices and configure firmware

1. Power Down the Devices>Gather Cleaning Supplies>Remove External Dust and Debris>Clean Internal Components>Clean Connectors and Ports>Reassemble and Power On>Review Documentation>Backup Configuration>Download Firmware>Prepare the Device>Access Device Management Interface>Upload Firmware>Monitor the Update>Verify Update>Restore Configuration (if needed)>Document the Update>Schedule Regular Updates



Application of learning 3.1.

ABC School has a growing number of students and staff, and their network infrastructure is becoming strained. The school's IT department has identified issues with network performance and security, including slow internet speeds and occasional unauthorized access attempts. To address these concerns, the school decides to bring in a Network Technician to perform preventive maintenance and upgrades.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Preventive Measures are well set	1.1 Regular Cleaning is Scheduled		
		1.2 Physical Equipment Condition is checked		
		1.3 All physical connections Inspected and secured		
		1.4 Environment Condition is Checked		
		1.5 Network Device Firmware is Updated		
		1.6 Network Device Credentials is Changed		
		1.7 Network Monitoring Software Licensing/Application is Reviewed		
		1.8 Network Monitoring Software Updated		



Indicative content 3.2: Performing Corrective Maintenance



Duration: 3 hrs



Theoretical Activity 3.2.1: Description of Corrective maintenance



Notes to the trainer:

- Trainer may use small groups for describing corrective maintenance
- Avail testing tools.
- Avail installed and working network.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the following questions:

- Identify common network problems and their causes.

Step 2: Asks trainees to write answers on provided flipchart/paper.

Step 3: Ask trainees to present the provided answers and choose correct answers.

Step 4: Provide a summary view and relate it to the tasks provided.

Step 5: Address any questions or concerns.

Step 6: Ask trainees to read key readings 3.2.1 in their manual.



Points to Remember

- **Corrective maintenance:** Corrective maintenance focuses on fixing issues that have already occurred, with the aim of restoring the network to its normal functioning state.
- **Common network problems and their causes**
 - Slow Network Performance
 - Cause: high network traffic.
 - Network Connectivity Issues
 - Cause: IP address conflicts
 - Security Breaches
 - Cause: Weak.
 - High Packet Loss

- Cause: Poor cabling, overloaded network devices



Practical Activity 3.2.2: Performing corrective maintenance



Notes to the trainer

- The trainer may use individual based facilitation techniques for Troubleshooting and resolving a network problem.
- Avail diagnostic tools
- Installed network in previous activities may be used.
- Avail Network simulation software (e.g.Cisco Packet Tracer)



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity by asking trainees to read the task described below:
You are tasked with setting up a small office network for a new department in your company. The network consists of a router, a switch, and eight client computers. The network is used for accessing shared files, communicating via email, and connecting to the internet. By using packet tracer. Configure the network devices with appropriate IP addresses, subnet masks, and default gateways. Verify that all client computers can successfully ping the router and access the internet.
- ✓ Randomly :(1) disable a network connection, such as a cable or a network interface card, on one of the client computers. (2) Set incorrect router settings.
 - ✓ Observe the network behaviours and identify the symptoms of the malfunction.
 - ✓ Document the observed symptoms and the affected client computer.
- Step 2:** Ask trainees to perform task and provide instructions for the task.
- Step 3:** Demonstrate how to Use network diagnostic tools, Check the network status indicators and explain how to Verify that the network issue has been resolved
- Step 4:** Ask trainees to carry out the activity mentioned above and facilitate the process by offering assistance as needed.
- Step 5:** Assist trainees in performing corrective maintenance
- Step 6:** Provide more explanations where is necessary.
- Step 7:** Verify whether corrective measures are correctly performed.

Step 8: Ask trainees to read key readings 3.2.2 in their manuals



Points to Remember

Key Aspects of network Corrective Maintenance

- Identification of Issues
- Planning and Scheduling
- Repair or Replacement
- Testing and verification
- Documentation
- Follow-Up



Application of learning 3.2.

XYZ Company experiences frequent network slowdowns, particularly during peak business hours. The IT team identifies the problem as an overloaded network switch that is dropping packets due to high traffic. To resolve the issue, they replace the switch with a higher-capacity model and reconfigure the network to balance the load. After implementation, the network performance improves, and the IT team sets up monitoring to ensure the problem doesn't recur.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Identification of Network Issues is well done	1.1. Network slowdowns identified during peak hours		
		1.2. High packet loss detected due to overloaded switch		
2	Evaluation of Network Equipment	2.1. Assessment of switch capacity and performance		
		2.2. Decision to replace the switch based on traffic analysis		
3	Implementation of Upgraded Equipment	3.1. Replacement of the switch with a higher-capacity model		
		3.2. Correct installation and configuration of the new switch		



Indicative content 3.3: Troubleshooting Network



Duration: 6 hrs



Theoretical Activity 3.3.1: Identification of network problems and solutions



Notes to the trainer:

Trainer may use small groups for Describing network functionality checking



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
- Identify the main troubleshooting process in networking
 - Explain the main troubleshooting process in networking.
 - Identify the common problems found in networking
- Step 2:** Asks trainees to write answers on provided flipchart/paper.
- Step 3:** Ask trainees to discuss the provided answers and choose correct answers.
- Step 4:** Provide a summary view and relate it to the tasks provided.
- Step 5:** Address any questions or concerns.
- Step 6:** Ask trainees to read key readings 3.3.1 in their manual.



Points to Remember

Troubleshooting a network is the process of identifying, diagnosing, and resolving issues that are affecting the network's performance or functionality.

Troubleshooting process

1. Identify the Problem
2. Define the Scope of the Problem
3. Establish a Theory of Probable Cause
4. Test the Theory to Determine Cause
5. Establish an Action Plan
6. Implement the Solution
7. Verify the Solution
8. Document the Problem and Solution
9. Monitor for Recurrence

Common problem found in networking

1. Hardware-Related Issues
2. Software-Related Issues
3. Connectivity Problems
4. Authentication and Access Issues



Practical Activity 3.3.2: Checking network functionalities



Notes to the trainer

- The trainer may use individual based facilitation techniques for Troubleshooting and resolving a network problem
- Installed network in previous activities may be used.
- Avail network functionalities testing tools



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity by asking trainees to read the task described below:

According to the key readings in trainee's manual you are asked to set up a network with a router, switch, and multiple client computers. Configure the devices with correct IP settings and confirm all clients can ping the router and access the internet. Next, inspect and resolve any physical cable or device issues. Verify network components' functionality by updating firmware, and ensure all software, including security patches, is up-to-date.

Step 2: Ask trainees to perform task and provide instructions

Step 3: Demonstrate how you can check network functionalities basing on type of problem

Step 4: Ask trainees to carry out the activity mentioned above and facilitate the process by offering assistance as needed.

Step 5: Assist trainees in checking network functionalities

Step 6: Provide more explanations where is necessary.

Step 7: Verify whether checking network functionalities are correctly performed.

Step 8: Ask trainees to read key readings 3.3.2 in their manuals



Points to Remember

Troubleshooting a network is the process of identifying, diagnosing, and resolving issues that are affecting the network's performance or functionality.

Follow the following steps for effective check and maintain the functionalities of your network, ensuring a reliable and efficient network environment.

- Identify the Problem
- Establish a Theory of Probable Cause
- Test the Theory to Determine the Cause
- Plan of Action
- Implement the Solution
- Verify Full System Functionality
- Document Findings and Actions



Application of learning 3.3.

You are a member of the IT team at a small office where employees are experiencing frequent network disruptions and slow internet speeds. Your assignment is to investigate and fix these issues by inspecting both physical connections and device configurations. Start by checking cables and network hardware for faults, then move on to diagnosing software issues, such as outdated firmware or misconfigured settings. Ensure that all systems are up-to-date and functioning properly.

CheckList:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Physical Inspection is well done	Cables is Checked Replace any faulty		
		Cable Connections is Tested		
		Network Hardware is Inspected		
		Environment Condition is Checked		
2	Network Hardware Diagnosis is well done	Network Devices are Rebooted		
		Port Status is Checked		
		Switch and Router Configuration is Verified		
3	Software Diagnosis is well performed	Update Firmware is done		
		Device Configurations is Checked		



Indicative Content 3.4: Elaboration of Maintenance Report



Duration: 2 hrs



Theoretical Activity 3.4.1: Description of maintenance report



Notes to the trainer:

- Trainer may use small groups for describing maintenance report



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the task and ask trainees to answer the following questions:

- What is maintenance report
- What is the primary purpose of a maintenance report?
- Who is the typical target audience for a maintenance report?
- Name the essential components/elements of a maintenance report.

Step 2: Ask trainees to discuss about the provided questions

Step 3: Ask trainees to present their findings to the class

Step 4: Provide expert view for presented content

Step 5: Address any questions or concerns

Step 6: Ask trainees to read key readings 3.4.1 in trainee manual



Points to Remember

- A maintenance report is a detailed document outlining the maintenance activities performed on a specific asset or equipment during a particular period.
- The primary purpose of a maintenance report is to document the condition of equipment or systems before, during, and after maintenance, as well as the work performed and its outcome.
- The typical target audience for a maintenance report includes clients, management, technicians, and other relevant stakeholders.
- There are three key elements typically included in a maintenance report are:
 - Client Information:** Details about the client or organization where the maintenance was performed, including contact information and specific location.

- b. **Status before Maintenance:** A description of the equipment or system's condition before maintenance, highlighting any issues or faults observed.
- c. **Implementation of Solution:** A detailed account of the steps taken to resolve the issues, including the methods used and any challenges encountered.



Practical Activity 3.4.2: Elaborating Maintenance report



Notes to the trainer

- The trainer may use individual based facilitation techniques for Elaborating Maintenance report
- Installed network in previous activities may be used.
- Prepare a sample of maintenance report that trainees will refer to while working on activity



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the topic and ask trainees to read the task described below:
Inspect network hardware for wear and performance issues, documenting any anomalies or potential failures. Verify software updates and patches are current to ensure system security and stability. Provide recommendations for necessary repairs or upgrades based on findings.
- Step 2:** Ask trainees perform the task mentioned above and facilitate the process by offering assistance as needed.
- Step 3:** Assist trainees in elaborating maintenance report
- Step 4:** Provide more explanations where is necessary.
- Step 5:** Verify whether elaborating maintenance report are correctly performed.
- Step 6:** Ask trainees to read key readings 3.4.2 in their Manual



Points to Remember

- Detailed maintenance report would serve as a valuable tool for the IT department to improve network reliability and performance, as well as to communicate effectively with management and staff about the state of the network.

- **The maintenance report would include:**

- ✓ Date and time of the maintenance activity
- ✓ Summary of the issues reported by employees
- ✓ Detailed description of the investigation process
- ✓ Actions taken to resolve the issues (e.g., replacement of the switch, reconfiguration)
- ✓ Performance metrics before and after the maintenance (e.g., speed tests, connectivity stability)
- ✓ Recommendations for future monitoring or upgrades (e.g., considering a network assessment or additional hardware)
- ✓ Any observed trends or recurring issues that may need further attention



Application of learning 3.4.

You are a member of the IT team at a small office where employees are experiencing frequent network disruptions and slow internet speeds. Your assignment is to investigate and fix these issues by inspecting both physical connections and device configurations. Start by checking cables and network hardware for faults, then move on to diagnosing software issues, such as outdated firmware or misconfigured settings. Ensure that all systems are up-to-date and functioning properly. Finally, document the troubleshooting steps and solutions for future reference.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Physical Inspection is well done	1.1 Cables is Checked Replace any faulty		
		1.2 Cable Connections is Testedd		
		1.3 Network Hardware is Inspected		
		1.4 Environment Condition is Checked		
2	Network Hardware Diagnosis is well done	2.1 Network Devices are Rebooted		
		2.2Port Status is Checked		
		2.3 Switch and Router Configuration is Verified		
3	Software Diagnosis is well performed	3.1 Update Firmware is done		
		3.2 Device Configurations is Checked		
4	Report of the work is well done	4.1 Record all identified issues and the steps taken to resolve them is done.		
		4.2 Reflect any changes made to the		

		network configuration in the office network diagram is done		
--	--	--	--	--

END



Learning outcome 3 end assessment

Theological assessment

Part1: Multiple-Choice Questions: Select the correct answer

1. **Which of the following is a common practice in hardware preventive maintenance for network equipment?**

- A) Updating firmware regularly
- B) Installing antivirus software
- C) Cleaning dust from hardware components
- D) Configuring network security settings

Answer: C

2. **What is the primary purpose of software preventive maintenance in a network environment?**

- A) To increase the physical lifespan of devices
- B) To prevent hardware failures
- C) To enhance software performance and security
- D) To reduce the need for hardware upgrades

Answer: C

3. **Which tool is most commonly used to check the integrity of network cables during preventive maintenance?**

- A) MultiMate
- B) Cable tester
- C) Network analyser
- D) Packet sniffer

Answer: B

3. **During preventive maintenance, why is it important to keep firmware up to date on network devices?**

- A) To ensure compatibility with older software
- B) To avoid overheating of hardware components
- C) To prevent unauthorized physical access to devices
- D) To patch security vulnerabilities and improve device performance

Answer: D

4. **What should be done before performing any hardware preventive maintenance on network equipment?**

- A) Disconnect the device from the network
- B) Update the operating system
- C) Back up the current configuration
- D) Install a new antivirus program

Answer: C

Part2: Match the statements in column A with its corresponding Answers in column B.

Column A	Column B
1. What maintenance activity involves cleaning physical equipment?	A. Schedule regular cleaning
2. Which task includes updating network device credentials as part of preventive maintenance?	B. Setting of preventive measures
3. What activity focuses on troubleshooting network configurations?	C. Check physical equipment condition
4. When should the condition of the network environment be checked?	D. Check environment condition
5. What task involves the replacement of damaged hardware components?	E. Regular change of network device credentials
6. Which task involves licensing network monitoring software?	F. Network monitoring software licensing
7. Which preventive task involves setting up preventive measures?	G. Updating and upgrading network monitoring software
8. Which task involves regularly updating network monitoring software?	H. Identification of common problems and their causes
9. What corrective task involves repairing damaged equipment?	I. Repair/Replace damaged equipment
10. Which task checks the status of network devices?	J. Troubleshoot network configuration
11. What maintenance activity is required to update network configurations?	K. Check network status
12. Which task involves identifying common problems and their causes?	L. Update network configuration
13. What activity requires regular updating of firmware on network devices?	M. Troubleshooting network
14. Which task involves checking the physical condition of equipment?	N. Repair/Replace damaged equipment
15. Which corrective task involves troubleshooting network issues?	O. Updating and upgrading device firmware

Answers

Column A	Column B
1	A
2	B
3	B
4	A
5	B
6	A
7	B
8	A

Part3: Answer true or false questions related to corrective maintenance in networking.

1. Corrective maintenance involves making changes to a network configuration after a failure or problem has been identified. **T**
2. Corrective maintenance in networking is only performed on software components, not hardware. **F**
3. Replacing a faulty network switch with a new one is an example of corrective maintenance. **T**
4. Corrective maintenance is typically performed on a scheduled basis, even if no issues are present. **F**
5. The primary goal of corrective maintenance is to restore network functionality after a disruption. **T**
6. Corrective maintenance should always be documented to ensure a record of what was done and why. **T**
7. Updating antivirus software to protect against new threats is considered corrective maintenance. **F**
8. Corrective maintenance is only necessary when a complete network failure occurs. **F**

Part4:

1. What are the three main ways of reporting the outcome of a network maintenance activity?

Answers:

1. **Oral Reporting:** Presenting the maintenance results verbally, often in meetings or briefings.
 2. **Written Reporting:** Documenting the maintenance activities and outcomes in a written report, which can be shared as a document or email.
 3. **Video Documentation:** Creating a video that visually explains the maintenance process, showing the steps taken and the results achieved
2. Why is it important to include the tools, materials, and equipment used in a maintenance report?

Answers:

- **Accountability:** It provides a clear record of what was used during maintenance, ensuring that all necessary resources were appropriately utilized.
- **Future Reference:** It helps in future maintenance tasks by detailing what tools and materials were effective in resolving specific issues.
- **Budgeting and Inventory Management:** It assists in tracking the use of materials and equipment, which is crucial for budgeting and maintaining inventory levels

Practical assessment

ABC Corp., a mid-sized business, has been experiencing intermittent connectivity issues, slow network speeds, and frequent downtime. The network infrastructure includes multiple switches, routers, firewalls, and access points supporting both wired and wireless connections across several floors. The IT team is tasked with diagnosing and resolving these issues to ensure long-term network stability.

Checklist:

SN	Criteria	Indicators	Observation	
			Yes	No
1	Identification of Network Issues is well performed	1.1 Reports of intermittent connectivity from various departments is done		
		1.2 Slow network speeds observed, especially during peak hours is done		
		1.3 Network logs showing frequent downtime or packet loss is done		
2	Diagnostic and Troubleshooting is well performed	2.1 Comprehensive network device assessment (switches, routers, firewalls, access points) is done		
		2.2 Identification of faulty hardware or misconfigured settings is done		
		2.3 Utilization of network monitoring tools to locate bottlenecks and high-traffic zones is done		
3	Corrective Maintenance Actions is well done	3.1 Replacement or repair of faulty hardware (e.g., switches, routers) is done		
		3.2 Reconfiguration of network		

		devices for optimal performance is done		
4	Network Reconfiguration is well performed	4.1 Post-maintenance testing to ensure issues are fully resolved		
		4.2 Redistribution of network traffic to balance the load across devices		
		4.3 Update and enforcement of security protocols on firewalls and access points		
		Validation that all devices are correctly configured and functioning properly		
5	Performance Monitoring and Follow-Up is well done	5.1 Continuous monitoring setup to track network performance is done		
		5.2 Regular analysis of network performance data to detect recurring issues is done		
		5.3 Scheduled periodic audits and testing to ensure ongoing network stability is done		
6	Preventive Maintenance Planning is well done	6.1 Development of a preventive maintenance schedule, including regular hardware checks and firmware updates is done		
		6.2 Implementation of early detection protocols for potential network issues is done		
		6.3 Documentation of maintenance activities for future reference is done		
7	User Feedback and Reporting is well done	7.1 Collection of user feedback to assess satisfaction with network improvements is done		
		7.2 Compilation of a detailed report covering issues, corrective actions, and results		

		is done		
		7.3Presentation of the report to stakeholders to ensure transparency and inform future decisions is done		



Further information to the trainer

Books:

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