



Republic of Rwanda
Ministry of Education



RTB | RWANDA
TVET BOARD

NETWORKING FUNDAMENTALS

GENNF301

APPLY NETWORKING FUNDAMENTALS

Competence

RQF Level: 3

Learning Hours



Credits: 4

Sector: Technical Services

Trade: Electronics and Telecommunication

Module Type: General

Curriculum: TSVETE4001- TVET Certificate IV in Electronics and Telecommunication

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Purpose statement	This module describes the skills, knowledge and attitude required to Apply Network Fundamentals. At the end of this module, the learners will be able to Identify network concepts, apply network protocols and communications, Apply IP addressing (IPv4&IPv6) and Install Voice over IP phone.				
Learning assumed to be in place	Apply computer skills, Apply digital electronics fundamentals				
Delivery modality	Training delivery		100%	Assessment	
	Theoretical content		30%		
	Practical work:		70%	Formative assessment	50%
	Group project and presentation	20%			
	Individual project /Work	50%			
			Summative Assessment		50%

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria
1. Describe network concepts	1.1. Network technologies are properly identified according to their types.
	1.2. Network topologies are properly identified based on their types.
	1.3. Network devices, components are properly identified according to their functions.
	1.4. Data flow is properly identified based on the network models.
2. Apply network protocols and communications	2.1. Network Protocols are correctly classified according to the network layers.
	2.2. Network standards are appropriately applied according to their layers of application.
	2.3 Network media is appropriately applied according to the network types.
3. Apply IP addressing (IP v4&IPv6)	3.1. IP addresses are correctly classified based on their types.
	3.2. IP addresses are correctly classified based on their versions.
	3.3. IP address structures are appropriately captured based on their versions.

	3.4. IP subnets are appropriately calculated based on the network topology.
	3.5 IP addresses are appropriately assigned according to the network topology.
4. Install VoIP system	4.1 VoIP system installation requirements are properly identified based on Site survey findings
	4.2 VoIP diagram is correctly designed based on VoIP system requirements
	4.3 Tools, materials and equipment are properly selected based on VoIP system requirements
	4.4 VoIP devices are properly connected based on VoIP design and user Manual guideline
	4.5 VoIP server is properly installed based on system requirements
	4.6 Line number is properly configured based on VoIP system design
	4.7 Call manager is properly configured based on VoIP system design
	4.8 VoIP system is correctly tested based on the configured VoIP system

Course content

Learning outcomes	At the end of the module the learner will be able to: 1. Identify network concepts 2. Apply network protocols and communications 3. Apply IP addressing (IPv4) 4. Install Voice over IP
Learning outcome 1: Identify network concepts	Learning hours: 8
Indicative content	

- **Introduction to network**
- **Description of network concepts and technologies**
 - ✓ Network benefits and application of network
 - ✓ Network classifications
 - ❖ By components roles
 - ❖ By geographical area
 - ✓ Network technologies identification
- **Description of Network topology**
 - ✓ Definition of topology
 - ✓ Network topology types and its diagram
 - ❖ Physical
 - ❖ Logical

- **Description of Network components**

- ✓ Media
 - Physical
 - logical
- ✓ data
- ✓ Protocols
- ✓ Devices

- **Classification of network devices**

- ✓ Interconnection devices
- ✓ Access devices
- ✓ End devices

- **Description of network models**

Resources required for the learning outcome	
Equipment	Router, Hubs, Switch, NIC, Computer, Access points, Antenna, Gateways
Materials	Network Cables, internet
Tools	Networking toolkit, simulation tools
Facilitation techniques	<ul style="list-style-type: none"> ▪ Demonstration and simulation ▪ Individual and group work ▪ research
Formative assessment methods / (CAT)	<ul style="list-style-type: none"> ▪ Written assessment ▪ Oral presentation

Equipment	Router, Hubs, Switch, NIC, Computer, Access points, Antenna, Gateways
Materials	Network Cables, internet
Tools	Networking toolkit, simulation tools
Facilitation techniques	<ul style="list-style-type: none"> ▪ Demonstration and simulation ▪ Individual and group work ▪ research
Formative assessment methods / (CAT)	<ul style="list-style-type: none"> ▪ Written assessment ▪ Oral presentation

Learning outcome 2: Apply network protocols and communications	Learning hours: 15
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| **Indicative content** |

- **Description of Network Protocols**
 - ✓ Definition of network protocol
 - ✓ Common network protocols models
 - ⊕ TCP/IP
 - ⊕ UDP
- **Description of Network Media and Transmission**
 - ✓ Major network media types
 - ✓ Baseband and broadband transmission technologies
- **Wireless Transmission Techniques**

Resources required for the indicative content	
Equipment	Router, Hubs, Switch, Computer, Access points, Antenna, Gateways
Materials	Internet bundles
Tools	Simulation tools (Edraw max, cisco packet tracer, GNS 3)
Facilitation techniques	<ul style="list-style-type: none"> ▪ Demonstration and simulation ▪ Individual and group work ▪ Group discussion
Formative assessment methods /(CAT)	<ul style="list-style-type: none"> ▪ Written assessment ▪ Oral presentation

Learning outcome 3: Apply IP addressing (IP v4&IPv6)	Learning hours: 8
Indicative content	
<ul style="list-style-type: none"> • Description of IP addressing concepts <ul style="list-style-type: none"> ✓ IP terminologies ✓ IP addressing classification ✓ IP addresses grouping ✓ IP addressing scheme ✓ IP addressing subnet masks ✓ The prefix length • Identification of IP Addresses types <ul style="list-style-type: none"> ✓ Private ✓ Public ✓ Shared ✓ Dedicated • Application of IPv4 concepts <ul style="list-style-type: none"> ✓ Introduction to IPv4 ✓ Anatomy of IPv4 address 	

- ✓ Methods of Assigning IP addresses
 - ✚ Static
 - ✚ Dynamic Automatic
- ✓ Calculation of IP addresses
 - ✚ Binary to decimal conversion
 - ✚ Decimal to binary conversion
 - ✚ Summarization
- Application of IP Configurations
 - ✓ IPv4 Configuration

Resources required for the indicative content

Equipment	Router, Hubs, Switch, Computer, Access points, Gateways
Materials	Cables
Tools	calculators, simulation tools
Facilitation techniques	Individual and group work Practical exercise Individualized Trainer guided Group discussion
Formative assessment methods /(CAT)	Written assessment Performance assessment
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Learning outcome : **Identify network concepts**

Learning hours: 7

Indicative content

- Introduction to VoIP system
 - ✓ Definition
 - ✓ Types and examples

- ✓ Application area/use
- ✓ Benefits
- ✓ Working principle
- ✓ VoIP elements
- ✓ Diagrams
- Identification of VoIP system installation requirements
 - ✓ Evaluation of environment
 - ✚ Physical site survey
 - ✚ System usage
 - ✚ Provide blue print design
 - ✚ Tools
 - ✚ Materials
 - ✚ Equipment
 - ✚ VoIP services
 - ✚ VoIP network
 - ✓ Design of VoIP system diagram
 - ✓ Description of Physical diagram
 - ✓ Description of Logical diagram
 - ✓ Use of design tools

•Selection of VoIP system Tools, materials and equipment

- ✓ **Tools**
 - ✚ Cutting tools
 - ✚ Drilling tools
 - ✚ Fixing tools
 - ✚ Patching tools
 - ✚ Testing tools
- ✓ **Materials**
 - ✚ Connectors
 - ✚ Analog telephone adapter Cable
 - ✚ PoE adapter Patch code Jumper cable
- ✓ **Equipment**
 - ✚ Channel bank Ip phone
 - ✚ Power backup (UPS)

■ IP PBX Server/PBX Server

■ VoIP Router

- Configuration of Router Based VoIP system
 - ✓ VoIP essential router-based configuration Interface
 - ✓ IP default gateway Passwords
 - ✓ Creating VoIP Pool for Voice system
- Configuration of phone line number
 - ✓ Phone directory for IP Phone
 - ✓ E phones
- Configuration of VoIP system Server based (IP PBX/PABX/PBX)
 - ✓ Installation of Server operating system
 - ✓ VoIP users
 - ✓ Frequency for voice
 - ✓ Frame and packet (Voice packet)
 - Layered model
 - Internet protocol
 - Used datagram protocol (UDP)
 - Real time transport protocol (RTP)
 - ✓ Inter PBX circuits
 - ✓ Switch board facilities
 - ✓ Extension facilities
 - ✓ Public exchange services
 - ✓ Alarms
 - ✓ Fuse alarm
 - ✓ Mains fail
 - ✓ Tones
 - ✓ Numbering
 - ✓ Local calls
 - ✓ Outgoing exchange line/Inter PBX calls
 - ✓ Exchange line relay sets

- Testing of VoIP system (Speed, Latency, Jitter, Packet Loss and QoS)
 - ✓ VoIP router based Local calls
 - ✓ VoIP Server based Local calls
 - ✚ Outgoing/External calls
 - ✚ Call routing

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2. D. Bertsekas and R. Gallager. (1992). *Data Networks, 2nd Edition*. Prentice Hall. 7/e, P. P. (n.d.). *Signaling in ATM Networks*. Artech House.
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Glossary

Antenna – A device that converts between radio waves and electrical current.

Anycast address: An IPv6 address that is assigned to a group of interfaces, usually belonging to different nodes. A packet that is sent to an anycast address is routed to the nearest interface having that address.

ARP (Address Resolution Protocol) – The protocol responsible for associating a logical address (often from a Layer-3 protocol) with a physical address (often from a Layer-2 protocol).

bridge – In Ethernet, a Layer-2 legacy networking device replaced almost completely by routers in modern networks. Bridges replaced Layer-1 repeaters for interconnecting separate network cable segments.

host – A networked device with an IP address.

Hub: Ethernet hub is essentially a multiport repeater dealing only with regenerating inbound signals before sending them out all ports simultaneously.

internetwork – A network of networks. An internetwork, or internet for short, is created when two or more autonomous networks are interconnected, usually with one or more Layer-3 devices in between.

node – Any active device anywhere in a network.

optical fiber – A type of cabling media that guides light waves down a core made of glass or plastic.

Private IP: are addresses useful for connecting devices that don't require Internet access, as they are only communicating within a private network.

Public IP: connect private IP addresses to the Internet through an Internet service provider's shared public IP address.

router – A Layer-3 device used in forwarding traffic from one logical segment to another to send the traffic toward the intended recipient. In TCP/IP internetworks, routers are used to forward IP traffic based on reachability information stored in the router's routing table.

server – A device that shares a resource with a client.

Static IP: are IP addresses that never change. These types of addresses are assigned to various network infrastructure devices, such as servers, firewalls, and routers.

subnetting – The act of splitting a larger IP address space into smaller broadcast domains known as subnetworks or subnets .Subnetting is especially necessary with IPv4 to save precious address blocks by splitting them into more appropriately sized segments based on the expected number of hosts present on a given subnet and on any potential future growth of that subnet.

Switch – A Layer-2 device that forwards, filters, or floods frames based on the destination address in the header of the frame.

Topology – The physical or logical layout of a network. Physical topologies describe the observable network. Logical topologies describe the network from a functional viewpoint as if the devices were describing their own view of the layout

