Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

NITWO401

WIRELESS NETWORK OUTDOOR

Set up Wireless Network Outdoor

Competence

RQF Level: 4

Learning Hours 80

Credits: 8

Sector: ICT and Multimedia

Trade: Networking and Internet Technologies

Module Type: Specific

Curriculum: ICTNIT4001 TVET Certificate IV in Networking and Internet Technologies

1200

Issue Date: September 2023

<table>
<tr><td>Purpose statement</td><td colspan="6">This specific module describes the skills, knowledge and attitude required to setup Wireless Network Outdoor. This module is intended to prepare the learner pursuing TVET Level IV in networking and internet technologies.
At the end of this module the learner will be able to plan wireless network outdoor Installation, Deploy wireless network outdoor and Maintain wireless network outdoor.</td></tr>
<tr><td>Learning assumed to be in place</td><td colspan="6">N/A</td></tr>
<tr><td rowspan="6">Delivery modality</td><td colspan="2">Training delivery</td><td>100%</td><td colspan="2">Assessment</td><td>Total 100%</td></tr>
<tr><td colspan="2">Theoretical content</td><td>30%</td><td rowspan="4">Formative assessment</td><td>30%</td><td rowspan="4">50%</td></tr>
<tr><td colspan="2">Practical work:</td><td rowspan="3">70%</td><td rowspan="3">70%</td></tr>
<tr><td>Group project and presentation</td><td>25%</td></tr>
<tr><td>Individual project /Work</td><td>45%</td></tr>
<tr><td colspan="2"></td><td colspan="2">Summative Assessment</td><td>50%</td></tr>
</table>

Elements of Competence and Performance Criteria

Elements of competency	Performance criteria
1.Plan wireless network outdoor installation	1.1. Network requirements are properly identified based on Site survey findings
	1.2. Materials and equipment are correctly identified based on the site survey findings
	1.3. Wireless network outdoor topology is properly designed based on site survey findings

2.Deploy wireless network outdoor	2.1. Tools, Materials and Equipment are properly selected based on network design
	2.2. Wireless network devices are properly installed according to system design and IEEE 802.11 standards
	2.3. Wireless devices are properly configured according to organization requirements and IEEE 802.11 standards
	2.4. Wireless network outdoor is effectively tested in accordance with network performance
3.Maintain wireless network outdoor	3.1. Wireless network outdoor is regularly monitored in accordance with the network requirements
	3.2. Wireless network outdoor is correctly troubleshot in accordance with the network requirements
	3.3. Wireless network outdoor infrastructure is properly upgraded as per network requirements
	3.4. Wireless network outdoor maintenance is properly documented based on work done

Intended Knowledge,Skills, and Attitude

Knowledge	Skills	Attitude
✓ Describe wireless network outdoor concepts ✓ Identify Materials and Equipment used in wireless network outdoor ✓ Describe topologies that can be used to setup wireless network outdoor	✓ Design wireless network topology ✓ Select tools, Materials and Equipment ✓ Identify wireless network outdoor requirements ✓ Install, configure, and test wireless network devices ✓ Monitor, troubleshoot and upgrade wireless network outdoor ✓ Document wireless network Outdoor ✓ Prepare bill of Quantities	✓ Patience ✓ Environmental Awareness ✓ Effective communication ✓ Self confidence ✓ Adaptability ✓ Safety Awareness

Course content

Learning outcomes	At the end of the module the learner will be able to:
	1. Plan wireless network outdoor installation 2. Deploy wireless network outdoor 3. Maintain wireless network outdoor

Learning outcome 1: Plan wireless network outdoor installation	Learning hours: 20

Indicative content

- **Identification of network requirements.**
  - ✓ Description of wireless network outdoor
  - ✓ Key term of Wireless network outdoor
    - Coverage Area
    - Frequency spectrum
    - Antenna types and Direction
    - Interference Management
  - ✓ Area of application Wireless network outdoor
    - Public Wi-Fi hotspot
    - Smart City infrastructure
    - Wireless Surveillance and Security
    - Remote Connectivity
  - ✓ Environment survey evaluation
    - Physical
    - Analysing existing system
    - Radio frequency site survey
  - ✓ Analyzing site survey findings.
    - Bandwidth
    - Network Coverage
    - Security
    - Scalability
    - Weatherproofing
- **Identification of Materials and Equipment.**
  - ✓ Materials
    - Connectors

- Cable manager (Ties, clips, Sockets)
- Ethernet Cables

✓ Equipment

- Outdoor Access Points
- Antennas
- Wireless Extender
- Power-Over-Ethernet
- Lightning Arrestor
- UPS
- Network switch
- Routers
- Repeater
- Firewall
- Rack mount

✓ Produce bill of quantities

- **Design wireless network topology**

✓ Description of topology

- Network topology types
- Advantages and disadvantages of topology

✓ Selection of designing tools

✓ Draw a Topology Diagram of the wireless network

Resources required for the learning outcome	
Equipment	▪ Access points ▪ Router ▪ Repeater ▪ Wireless Extender ▪ Antennas ▪ Firewall

	▪ PoE ▪ Switch ▪ Rack amount ▪ Computer ▪ UPS ▪ Lightning Arrestor
Materials	▪ Connector ▪ Network Cables ▪ Cable ties ▪ Screws ▪ Internet Bundles ▪ Nails
Tools	▪ Edrawmax ▪ Draw.io ▪ Cisco packet tracer ▪ Lucidchart
Facilitation techniques or Learning activity	▪ Individual and Work group ▪ Practical exercise ▪ Group discussion
Formative assessment methods /(CAT)	▪ Written assessment ▪ Oral assessment ▪ Performance assessment
Learning outcome 2: Deploy wireless network outdoor	**Learning hours: 40**
Indicative content	
• **Selection of tools, Materials and Equipment** ✓ Tools Cutting Tools	

- Patching tools
- Crimping tools
- Drilling tools
- Testing tools
- Fixing tools

✓ Materials

- Internet bundles
- Ethernet Cables
- Connectors
- Cable manager (Ties, clips, Sockets)

✓ Equipment

- Outdoor Access Points
- Antennas
- Power-Over-Ethernet
- Lightning Arrestor
- UPS
- Wireless extender
- bridge
- Network switch
- Routers
- Repeater
- Nano station
- Firewall
- Rack amount

- **Installation of wireless network devices**

✓ Description of wireless standards

- IEEE802.11a
- IEEE802.11b

- IEEE802.11n
- IEEE802.11ac
- IEEE802.11ax

✓ Wireless Network Outdoor-Specific Features

- Point-to-Point (PtP) Bridging
- Point-to-Multipoint (PtMP) Bridging
- Wireless Mesh Networking
- Outdoor Antenna Alignment
- Long-Range Considerations
- Quality of Service (QoS)

✓ Mount network equipment

✓ Cabling

- Cable color coding
- Cable termination
- Cable testing

✓ Connecting devices

- **Configuration of wireless devices**

✓ Access points settings

✓ DHCP

✓ DNS

✓ NAT

✓ VPN

✓ Content filtering

✓ Quality of service

✓ Logging and reporting

✓ Wireless extender

✓ Firewall

- ✓ Proxy server

- **Testing of deployed wireless network outdoor**
  - ✓ Connectivity
  - ✓ Security
  - ✓ Performance

Resources required for the indicative content	
Equipment	▪ Access points ▪ Router ▪ Wireless Extender ▪ Firewall ▪ PoE ▪ Switch ▪ Rack amount ▪ Computer ▪ UPS ▪ Server ▪ Personal Protective Equipment (PPE)
Materials	▪ Connector(RJ45) ▪ Cables (CAT6) ▪ Cable ties ▪ Screws ▪ Internet Bundles ▪ Nails ▪ Electricity
Tools	▪ Ladder ▪ Drilling machine ▪ Tape Measure ▪ Hummer

	▪ Networking tool Kit ▪ Cable tester ▪ clipping tools ▪ Cisco packet tracer ▪ Edrawmax ▪ GSN3 ▪ Wireshark ▪ Solar Wind network performance ▪ Wi-Fi Analyser(insider, NetSpot) ▪ PRTG Network Monitor ▪ Wi-Spy Spectrum Analyze ▪ PingPlotter ▪ Heat Mapping Software(Ekahau HeatMapper, VisiWave Site Survey)
Facilitation techniques or Learning activity	▪ Individual and Work group ▪ Practical exercise ▪ Group discussion
Formative assessment methods /(CAT)	▪ Written assessment ▪ Oral assessment ▪ Performance assessment ▪ Project based assessment

Learning outcome 3: Maintain wireless network outdoor	**Learning hours: 20**
Indicative content	
• **Monitoring wireless network Outdoor** ✓ Monitoring metrics Signal Strength (Bandwidth and Latency) Signal to noise Ratio	

- Data throughput
- Jitter
- Packet Loss and Re-transmissions

✓ Monitoring Tools

- Wireshark
- Solar Winds Network Performance
- Wi-Fi Analyzer

✓ Access points controllers

- **Troubleshooting wireless network Outdoor**

✓ Check Hardware

✓ Physical inspection

- Antenna Alignment
- Cables Integrity
- Power issues

✓ Environment Factors

✓ Check software

- Firmware updates
- Configurations Review

✓ Diagnosing commands

- **Upgrading wireless network Outdoor**

✓ Factors of upgrading

✓ Steps of upgrading

- **Document wireless network Outdoor**

✓ Technical reports

✓ Technical journal

Resources required for the indicative content	
Equipment	▪ Access points

	▪ Router ▪ Wireless Extender ▪ Firewall ▪ PoE ▪ Switch ▪ UPS
Materials	▪ Connector (RJ45) ▪ Cable ties ▪ Screws ▪ Internet Bundles ▪ Nails ▪ Network cables.
Tools	▪ Ladder ▪ Drilling machine ▪ Tape Measure ▪ Hummer ▪ Networking tool Kit ▪ Cable tester ▪ Clipping tools ▪ Cisco packet tracer ▪ Edrawmax ▪ GSN3 ▪ Wireshark ▪ Solar Wind network performance ▪ Wi-Fi Analyser(insider, NetSpot) ▪ PRTG Network Monitor ▪ Wi-Spy Spectrum Analyze ▪ PingPlotter

	▪ Heat Mapping Software(Ekahau HeatMapper, VisiWave Site Survey)
Facilitation techniques or Learning activity	▪ Individual and Work group ▪ Practical exercise ▪ Group discussion
Formative assessment methods /(CAT)	▪ Written assessment ▪ Oral assessment ▪ Performance assessment

Integrated/Summative assessment

Integrated situation

X&Z University with 400 students and 60 staffs located in Rwanda southern Province in Muhanga District.it has four departments (HR, Finance, IT department, Lecturer) located in different blocks where HR is in Block1, Finance is in Block 2, IT department is in Block 3 and Lecturer is in block 4 where all Staffs need internet access in order to perform daily activities. Due to the increase of technology in education, students are required to access all academic resources via university website. However, X&Z University has a problem of network that help students and Staff to have internet access. Therefore, the administration is looking for an IT Technician who can set up the X&Z wireless network outdoor to provide high speed internet access to the large number of Students, The network should have bandwidth of 80MHZ and frequency of 5GHz, network range is 240m radius from the source , Staff and students must have different network name and password, Student are not allowed to access YouTube via university wireless, Network should assign address dynamically and the number of Users for students access the network should not exceeds 400. Provided that all the required devices are available.

Based on the mentioned information, you are required to:

- ✓ Prepare the network requirements for university
- ✓ Design the network
- ✓ Set SSID as Z&W and Password: Z&W2023@! For staffs
- ✓ Set SSID as Student and Password: W2023#* For student only
- ✓ Ensure that the network is maintained

The task should be accomplished in 4 hours and the network document should be submitted to the IT department.

Resources	
Tools	**Hardware:** ▪ Ladder ▪ Drilling machine ▪ Tape Measure

	▪ Hummer ▪ Networking tool Kit ▪ Cable tester ▪ Crippling tools. **Software:** ▪ Cisco packet tracer ▪ Edrawmax ▪ GSN3 ▪ Wireshark ▪ SolarWind network performance ▪ Wi-Fi Analyser
Equipment	▪ Access points ▪ Router ▪ Wireless Extender ▪ Firewall ▪ PoE ▪ Switch ▪ Rack amount ▪ Computer.
Materials/ Consumables	▪ Connector (RJ45) ▪ Cables (CAT6) ▪ Cable ties ▪ Screws

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
	Materials and equipment are correctly identified	Materials are identified			3

Plan wireless network outdoor installation **(20%)**	based on the site survey findings	Equipment are identified			3
	Wireless network outdoor topology is properly designed based on site survey findings	Topology is well selected			4
		designing tools are selected			5
		Topology is designed			5
Deploy wireless network outdoor **(50%)**	Tools, Materials and Equipment are properly selected based on design	Tools are selected			2
		Materials are selected			2
		Equipment are selected			2
	Wireless network devices are properly installed according to system design and IEEE 802.11 standards	Wireless standard is selected			4
		Rack Amount is fixed			3
		Access point is fixed			3
		Router is fixed			3
		Wireless extender is fixed			3
		Cables are tested			3
		Network devices are connected			7
		Default credentials changed			3
		SSID is set			3
		Password is set			3
		Security mode is selected			3

		Connection is success			3
		Firewall is configured			3
Maintain wireless network outdoor (30%)	Wireless network outdoor is regularly monitored in accordance with the network requirements	Network Devices are monitored			2
		Monitoring tools are selected			2
		Access point controller is used			3
	Wireless network outdoor is correctly troubleshoot in accordance with the network requirements	Hardware is troubleshot			5
		Software is troubleshot			5
		Diagnosing tools is used			3
	Wireless network outdoor maintenance is properly documented based on work done	Technical report is documented			5
		Technical journal is documented			5
Total marks					**100**
Percentage Weightage					**100%**
Minimum Passing line % (Aggregate): 70%					

References

1. Abdelrahman, M. B., & Mustafa. (2015). A Comparison between IEEE 802.11a, b, g, n and ac Standards.

2. CreativeCommonsAttribution-ShareAlike. (2020). Configure Access point -Wireless networking in the developing world third edition.

3. K. Sharma, N. Dhir, “A study of wireless networks: WLANs, WPANs, WMANs, and WWANs with comparison”, International Journal of Computer Science and Information Technologies, vol. 5 (6), pp. 7810-7813, 2014.