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Ministry of Education

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**lT infrastructure Management PROJECT:**

Design and configure dynamic routing (RIP and OSPF) for non-profit educational organization

Using the simulator tool (Cisco Packet Tracer)

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**1.0 Introduction**

A network is a collection of computers, servers, mainframes, network devices, or other devices connected to allow data sharing. An example of a network is the Internet, which connects millions of people all over the world. The main task of a network is to provide participants with a single platformfor exchangingdataand sharing resources.]1[ To successfully send and receive information, devices on both sides of a communication exchange must accept and follow protocol conventions. Without protocols, devices would not know how to engage with each other and function ]2[. Therefore, to facilitate the communication, OSPF protocol will be used in designing the network organization allowing each router to choose the best routes table based on the learned LSDB information. Another protocol which it will be used is the RIP protocol that will route the data packets by finding the best hop count which will help in improving the efficiency of the network]3[. In this project we aim on designing and configuring a network for a nonprofit educational organization that contains three interactive halls offering all the essential tools a student can use from PCs to Printers and Laptops.

**2.0 Methodology**

The main goals of this project:

- Designing and configuring two network models for that has several non-profit educational that provide many interactive rooms for creative learning. The organization has branches located in different areas.

- Simulating network models to observe how the performance varies from the OSPF network to the RIP network.

- calculate the packets lost in each protocol using the simulating tool (Cisco Packet Tracer).

2.1 Packet Tracer

Packet Tracer is virtual networking simulation software developed by Cisco, to learn and understand various concepts in computer networks. Networking devices appear in packet tracer as they look and a student can interact with various networking devices, by customizing the configurations, by turning them on and off etc. Packet Tracer is teaching and learning software and a tool, easy to work with, thus after working with virtual environment. [4]

2.2 Packet loss

Packet loss is caused due to poor signal strength at destination due to natural or human-made interference, system noise, hardware failure and software corruption and many more.

Packet loss can be caused by

several possibilities, including:

1. Traffic overload in the network.

2. Collision in the network

3. Error that occurs on physical media [5]

Calculation of packet loss = (Packet data send - Packet data revived / Packet data send)\* 100

# **3.0 Designing network model**

Diagram, map

Description automatically generated

Figure: 1 Network Simulation

After the topology was designed, the 12 routers were enabled and assigned to it Ip addresses. The protocols (RIP and OSPF) configuration was assigned to the model one at a time to be able to compare and evaluate the performance.

## 3.1 Addressing table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Device** | **Interface** | **IP address** | **Subnet Mask** | **Default Gateway** | |
| **R1** | **S0/1/1 (DCE)** | **14.0.0.1** | **255.0.0.0** | | **N/A** |
| **S0/0/1** | **10.0.0.1** | **255.0.0.0** | | **N/A** |
| **S0/1/0** | **11.0.0.1** | **255.0.0.0** | | **N/A** |
| **R2** | **G0/0** | **192.168.1.1** | **255.255.255.0** | | **N/A** |
| **S0/0/0 (DCE)** | **13.0.0.2** | **255.0.0.0** | | **N/A** |
| **S0/0/1 (DCE)** | **10.0.02** | **255.0.0.0** | | **N/A** |
| **R3** | **S0/0/0** | **13.0.0.1** | **255.0.0.0** | | **N/A** |
| **G0/0** | **192.168.2.1** | **255.255.255.0** | | **N/A** |
| **S0/0/1** | **12.0.0.2** | **255.0.0.0** | | **N/A** |
| **R4** | **S0/1/0 (DCE)** | **11.0.0.2** | **255.0.0.0** | | **N/A** |
| **S0/0/0 (DCE)** | **12.0.0.1** | **255.0.0.0** | | **N/A** |
| **G0/0** | **192.168.3.1** | **255.255.255.0** | | **N/A** |
| **R5** | **S0/0/0** | **14.0.0.2** | **255.0.0.0** | | **N/A** |
| **S0/0/1** | **15.0.0.1** | **255.0.0.0** | | **N/A** |
| **S0/1/0** | **17.0.0.1** | **255.0.0.0** | | **N/A** |
| **S0/1/1 (DCE)** | **19.0.0.1** | **255.0.0.0** | | **N/A** |
| **R6** | **S0/0/0 (DCE)** | **16.0.0.1** | **255.0.0.0** | | **N/A** |
| **S0/0/1 (DCE)** | **15.0.0.2** | **255.0.0.0** | | **N/A** |
| **G0/0** | **194.168.1.1** | **255.255.255.0** | | **N/A** |
| **R7** | **S0/0/0** | **16.0.0.2** | **255.0.0.0** | | **N/A** |
| **S0/0/1** | **18.0.0.1** | **255.0.0.0** | | **N/A** |
| **G0/0** | **194.168.2.1** | **255.255.255.0** | | **N/A** |
| **R8** | **S0/0/0 (DCE)** | **18.0.0.2** | **255.0.0.0** | | **N/A** |
| **S0/1/0 (DCE)** | **17.0.0.2** | **255.0.0.0** | | **N/A** |
| **G0/0** | **194.168.3.1** | **255.255.255.0** | | **N/A** |
| **G0/1** | **194.168.4.1** | **255.255.255.0** | | **N/A** |
| **R9** | **S0/0/1** | **20.0.0.1** | **255.0.0.0** | | **N/A** |
| **S0/1/1** | **21.0.0.1** | **255.0.0.0** | | **N/A** |
| **S0/1/0** | **19.0.0.2** | **255.0.0.0** | | **N/A** |
| **R10** | **S0/0/0 (DCE)** | **20.0.0.2** | **255.0.0.0** | | **N/A** |
| **S0/0/1** | **23.0.0.1** | **255.0.0.0** | | **N/A** |
| **G0/0** | **195.168.1.1** | **255.255.255.0** | | **N/A** |
| **R11** | **S0/0/0 (DCE)** | **23.0.0.2** | **255.0.0.0** | | **N/A** |
| **S0/0/1** | **22.0.0.2** | **255.0.0.0** | | **N/A** |
| **G0/0** | **195.168.2.1** | **255.255.255.0** | | **N/A** |
| **G0/1** | **195.168.3.1** | **255.255.255.0** | | **N/A** |
| **R12** | **S0/0/0 (DCE)** | **22.0.0.1** | **255.0.0.0** | | **N/A** |
| **S0/1/0 (DCE)** | **21.0.0.2** | **255.0.0.0** | | **N/A** |
| **G0/0** | **195.168.4.1** | **255.255.255.0** | | **N/A** |
| **S1** | **N/A** | **VLAN** | **N/A** | | **N/A** |
| **S2** | **N/A** | **VLAN** | **N/A** | | **N/A** |
| **S3** | **N/A** | **VLAN** | **N/A** | | **N/A** |
| **S4** | **N/A** | **VLAN** | **N/A** | | **N/A** |
| **S5** | **N/A** | **VLAN** | **N/A** | | **N/A** |
| **PC - A** | **Fa/0** | **192.168.1.2** | **255.255.255.0** | | **192.168.1.1** |
| **Laptop - A** | **Fa/0** | **192.168.1.3** | **255.255.255.0** | | **192.168.1.1** |
| **PC - B** | **Fa/0** | **192.168.2.2** | **255.255.255.0** | | **192.168.2.1** |
| **Printer - A** | **Fa/0** | **194.168.2.3** | **255.255.255.0** | | **192.168.2.1** |
| **Laptop - B** | **Fa/0** | **192.168.3.2** | **255.255.255.0** | | **192.168.3.1** |
| **Printer - B** | **Fa/0** | **194.168.3.3** | **255.255.255.0** | | **192.168.3.1** |
| **PC - C** | **Fa/0** | **192.168.3.4** | **255.255.255.0** | | **192.168.3.1** |
| **PC - D** | **Fa/0** | **192.168.1.2** | **255.255.255.0** | | **192.168.1.1** |
| **Printer - C** | **Fa/0** | **194.168.1.3** | **255.255.255.0** | | **192.168.1.1** |
| **PC – E** | **Fa/0** | **194.168.2.2** | **255.255.255.0** | | **194.168.2.1** |
| **Laptop – C** | **Fa/0** | **194.168.2.3** | **255.255.255.0** | | **194.168.2.1** |
| **PC – F** | **Fa/0** | **194.168.3.3** | **255.255.255.0** | | **194.168.3.1** |
| **PC – G** | **Fa/0** | **194.168.4.4** | **255.255.255.0** | | **194.168.4.1** |
| **PC - H** | **Fa/0** | **194.168.1.2** | **255.255.255.0** | | **194.168.1.1** |
| **PC – K** | **Fa/0** | **194.168.1.3** | **255.255.255.0** | | **194.168.1.1** |
| **Laptop – D** | **Fa/0** | **195.168.2.2** | **255.255.255.0** | | **195.168.2.1** |
| **PC – L** | **Fa/0** | **195.168.3.3** | **255.255.255.0** | | **195.168.3.1** |
| **Laptop – E** | **Fa/0** | **195.168.4.2** | **255.255.255.0** | | **195.168.4.1** |
| **Printer - D** | **Fa/0** | **194.168.4.4** | **255.255.255.0** | | **194.168.4.1** |

Table 1: Addressing table

### 3.2 Configuration Routing RIP

This configuration has been done inside all the 12 routers to enable the RIP protocol

Router(config)#router rip

Router(config-router)#network 10.0.0.0

Router(config-router)#network 11.0.0.0

Router(config-router)#network 12.0.0.0

Router(config-router)#network 13.0.0.0

Router(config-router)#network 192.168.1.0

Router(config-router)#network 192.168.2.0

Router(config-router)#network 192.168.3.0

Router(config-router)#network 14.0.0.0

Router(config-router)#network 15.0.0.0

Router(config-router)#network 16.0.0.0

Router(config-router)#network 17.0.0.0

Router(config-router)#network 18.0.0.0

Router(config-router)#network 19.0.0.0

Router(config-router)#network 20.0.0.0

Router(config-router)#network 21.0.0.0

Router(config-router)#network 22.0.0.0

Router(config-router)#network 23.0.0.0

Router(config-router)#network 194.168.1.0

Router(config-router)#network 194.168.2.0

Router(config-router)#network 194.168.3.0

Router(config-router)#network 194.168.4.0

Router(config-router)#network 19.0.0.0

Router(config-router)#network 20.0.0.0

Router(config-router)#network 21.0.0.0

Router(config-router)#network 22.0.0.0

Router(config-router)#network 23.0.0.0

Router(config-router)#network 195.168.1.0

Router(config-router)#network 195.168.2.0

Router(config-router)#network 195.168.3.0

Router(config-router)#network 195.168.4.0

Router(config-router)#exit

### 3.3 Configuration Routing OSPF

Router(config)#router ospf 1

Router(config-router)#network 192.168.1.1 0.0.0.255 area 0

Router(config-router)#network 13.0.0.0 0.255.255.255 area 0

Router(config-router)#network 10.0.0.0 0.255.255.255 area 0

Router(config-router)#network 11.0.0.0 0.255.255.255 area 0

Router(config-router)#network 14.0.0.0 0.255.255.255 area 0

Router(config-router)#network 13.0.0.0 0.255.255.255 area 0

Router(config-router)#network 12.0.0.0 0.255.255.255 area 0

Router(config-router)#network 192.168.2.1 0.0.0.255 area 0

Router(config-router)#network 192.168.3.1 0.0.0.255 area 0

Router(config-router)#network 15.0.0.0 0.255.255.255 area 0

Router(config-router)#network 17.0.0.0 0.255.255.255 area 0

Router(config-router)#network 19.0.0.0 0.255.255.255 area 0

Router(config-router)#network 16.0.0.0 0.255.255.255 area 0

Router(config-router)#network 194.168.1.1 0.0.0.255 area 0

Router(config-router)#network 18.0.0.0 0.255.255.255 area 0

Router(config-router)#network 17.0.0.0 0.255.255.255 area 0

Router(config-router)#network 19.0.0.0 0.255.255.255 area 0

Router(config-router)#network 20.0.0.0 0.255.255.255 area 0

Router(config-router)#network 21.0.0.0 0.255.255.255 area 0

Router(config-router)#network 23.0.0.0 0.255.255.255 area 0

Router(config-router)#network 195.168.1.1 0.0.0.255 area 0

Router(config-router)#network 22.0.0.0 0.255.255.255 area 0

Router(config-router)#network 195.168.4.1 0.0.0.255 area 0

# **4.0 Result and Discussion**

Packet loss: Packet loss occurs when one or more transmitted data packets fail to arrive at their destination the causes of packet loss:

Network congestion

Network hardware

Software bugs

Security breaches

The percentage packet loss equation:

Percentage of packet loss

PING command in command prompt is used to show the details of the packet loss.

*RIP*: 24 packets were sent from one device to another. 21 packets were received which mean 3 packets were loss.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Packet loss % | received | sent | Receiver | sender | No. |
| 25% | 3 | 4 | PC - D | PC - A | 1 |
| 25% | 3 | 4 | PC - E | Laptop-D | 2 |
| 0% | 4 | 4 | PC - B | PC - A | 3 |
| 25% | 3 | 4 | PC - L | PC - C | 4 |
| 0% | 4 | 4 | PC - D | PC- E | 5 |
| 0% | 4 | 4 | PC - H | PC- L | 6 |

Table 2: packet loss of RIP

*OSPF*: 24 packets are sent from one device to another. The packet range percentage was between 0 – 25%. The total of the received packet is 23 packets.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Packet loss % | received | sent | Receiver | sender | No. |
| 0% | 4 | 4 | Laptop-B | PC-A | 1 |
| 0% | 4 | 4 | PC- D | Laptop-C | 2 |
| 0% | 4 | 4 | PC-K | PC-L | 3 |
| 0% | 4 | 4 | Laptop-C | PC-H | 4 |
| 0% | 4 | 4 | Laptop-C | PC-K | 5 |
| 25% | 3 | 4 | Laptop-E | PC-L | 6 |

Table 3: packet loss of OSPF

Cisco packet tracer performance evaluation: the goal of performance evaluation is to offer a popular concept of the effectiveness by comparing between tow protocols to find the performance of packet tracer. Includes three factors for the performance evaluation:

Central processing unit (CPU) utilization.

Memory usage.

Execution time.

CPU utilization: CPU utilization refers to a computer's usage of processing resources, or the amount of work handled by a CPU. Actual CPU utilization varies depending on the amount and type of managed computing tasks.in the RIP protocol was the CPU utilization about 79%, and in the OSPF protocol was 42%.

Figure: 2 CPU utilization of RIP, OSPF

Memory usage: displays the amount of memory available on your system, as well as the memory currently in use. In the RIP protocol the memory usage was 88%. In the OSPF protocol the memory usage was 83%.

Figure 3: memory usage of RIP, OSPF

Discussion: according to the result above. Each protocol differs from the others protocol in the number of packet loss. In figure 1 the CPU utilization was shown, and the RIP protocol was higher than the OSPF protocol. In figure 2 the memory usage was shown, and the RIP protocol was higher than the OSPF protocol.in table 1 shown the packet loss for the RIP protocol. 3 out of 6 devices loss their packets.3 packets has been loss and 75% packet loss. In table 2 shown the packet loss for the OSPF protocol. 1 out of 6 devices loss their packets. 1 packet has been loss and 25% packet lost. Based on the previous conclusion, I think that OSPF protocol is better than the RIP protocol.

# **5.0 Conclusion**

In this project, we used Packet Tracer as our tool to analyze and compare the performance of two dynamic routing protocols which is: RIP and OSPF. We implemented a hybrid topologies to examine the performance of each routing protocol in our nonprofit organization. Furthermore, in order to be able to compare the performance of the protocols, we collected the packet loss of both protocols and considered the CPU utilization. In conclusion, based on our result we confirmed that OSPF is the best choice for our network topology implemented as it has less packet loss and low CPU utilization compared to the RIP protocol. As for the RIP protocol it mostly 25% of lost packet and it has high CPU utilization which affect the performance of the workstation.

# **6.0 Reference**

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