Vol. 1, No. 2, (August 2026), pp. 59-65
P-ISSN XXXXXX | E-ISSN XXXXX

DESIGN AND IMPLEMENTATION OF A COMPUTER NETWORK WITH TREE TOPOLOGY USING CISCO PACKET TRACER

M. Gema Maulana[1]
[1]Computer Science, Lancang Kuning University,
Email: gemamaulana@unisi.ac.id[1],

ABSTRACT

Advancements in information technology have driven the need for computer networks capable of supporting rapid, structured, and efficient data exchange and communication. A crucial aspect of building a computer network is selecting a topology that meets specific requirements. This study aims to design and implement a computer network using a tree topology within the Cisco Packet Tracer environment. The research employs experimental and simulation methods, encompassing stages such as requirements identification, topology design, IP addressing, configuration implementation, connectivity testing, and results analysis. The tree topology is designed using routers, a main switch, branch switches, and multiple computers arranged hierarchically. Each device is configured with an IP address in accordance with the network design. Testing involves using the "ping" command to verify successful inter-device communication and the Cisco Packet Tracer "Simulation Mode" to observe the data packet transmission process. Simulation results demonstrate that a tree topology network can be successfully built and configured, facilitating inter-device communication as intended. Furthermore, the use of Cisco Packet Tracer streamlines the network design, configuration, and testing processes without requiring physical hardware. The findings suggest that the tree topology is a viable option for constructing networks that require an organized structure and scalability. This study is expected to serve as a reference for understanding computer network design and implementation concepts, as well as the application of Cisco Packet Tracer as a tool for network simulation.

Keywords: computer networks, tree topology, Cisco Packet Tracer, network simulation, connectivity..

1 INTRODUCTION

The rapid advancement of information technology has established computer networks as a crucial component in supporting various activities across educational, corporate, and organizational environments. Computer networks enable multiple devices to interconnect, exchange data, and share resources with greater speed and efficiency. A well-designed network facilitates easier communication and information exchange, thereby enhancing work effectiveness. Consequently, understanding the design and implementation of computer networks is essential, particularly for students and practitioners in the field of information technology.

Network topology is a key aspect to consider when building a computer network. It describes the pattern or structural arrangement of connections between devices within the network. Selecting the appropriate topology influences performance, management, security, and the ease of future network expansion. Common topologies include bus, star, ring, mesh, and tree configurations. Each topology possesses distinct characteristics, advantages, and disadvantages; therefore, the choice must align with specific network requirements and conditions.

The tree topology is one option suitable for networks comprising a large number of devices. It is an evolution of the star topology, featuring a tiered or hierarchical structure. In this setup, networks or devices are grouped into specific levels and connected via central networking devices that act as hubs. This structure fosters better organization, allowing devices to be grouped by department, room, division, or specific operational needs. Furthermore, the tree topology is scalable, enabling it to accommodate the addition of new devices to the network.

Despite its organized structure, implementing a tree topology requires careful planning. Errors in defining device interconnections can disrupt communication or even impact other segments of the network. Additionally, devices such as switches and routers must be correctly configured to ensure that inter-network communication proceeds according to the design. Therefore, before actual deployment, a design and testing phase is necessary to verify effective device communication and ensure the configuration meets all requirements. In the process of learning about computer networks, the use of simulation software offers a solution for designing and testing networks without the need for extensive hardware. Cisco Packet Tracer is one such software widely used for network education and simulation. It enables users to create virtual network designs by providing a range of network devices—such as routers, switches, computers, and servers—and allows them to configure these devices and test the resulting network connectivity.

Using Cisco Packet Tracer offers advantages during the design process, as configuration errors can be identified through simulation before the network is physically deployed. Consequently, the learning process extends beyond theory to provide hands-on experience in designing networks, interconnecting devices, configuring IP addresses, and testing inter-device communication. Simulation also reduces the reliance on physical hardware, thereby lowering design costs and minimizing the risk of equipment damage.

Addressing these considerations, this study focuses on the design and implementation of a computer network utilizing a tree topology within the Cisco Packet Tracer environment. The design process involves defining the network structure, selecting the necessary devices, establishing inter-device connections, and applying the configurations required for the network to function as intended. Following the design phase, the network undergoes testing to verify inter-device communication and ensure the implemented configurations are operating correctly.

This research aims to provide insight into the computer network design process using a tree topology, covering stages from initial planning to final testing. Furthermore, the findings serve as a learning resource for students and users seeking a practical understanding of tree topology implementation. Through Cisco Packet Tracer simulations, theoretical network concepts are visualized as tangible designs, making them easier to comprehend.

This study seeks to demonstrate how a tree topology is applied to build a structured network and how Cisco Packet Tracer can be utilized as a tool for network simulation and testing. The design and test results provide a foundation for understanding the technical aspects of computer networks—specifically inter-device relationships, network configuration, connectivity, and hierarchical structure management. Ultimately, this research—titled "Design and Implementation of a Computer Network with Tree Topology Using Cisco Packet Tracer"—is expected to yield both academic and practical benefits in advancing the understanding of computer networks.

2 RESEARCH METHOD

This study employs experimental and simulation methods to design, implement, and test a computer network with a tree topology using Cisco Packet Tracer. This approach was selected because the research focuses on the virtual network design process and the testing of the implemented configurations. Through simulation, the design process can be carried out without the need for physical network hardware, making it easier to modify configurations and observe the results.

2.1 Research Stages

The research was conducted through several systematic stages: requirements identification, network topology design, IP address assignment, configuration implementation, network testing, and analysis of the test results. Each stage was carried out sequentially to ensure the resulting network design aligned with the research objectives.

2.2 Requirements Analysis

The first stage involves identifying the requirements for the network to be designed. This process entails determining the necessary devices, the number of computers to be used, the interconnecting hardware, and the connectivity patterns between devices. In this study, the network is designed using a tree topology concept, which features a hierarchical structure. The devices utilized in the simulation include computers (PCs), switches, routers, and network cables available within Cisco Packet Tracer.

In addition to virtual hardware, network configuration requirements—such as IP addresses, subnet masks, gateways, and inter-network connections—are also established. These requirements serve as the foundation for the network design, ensuring that each device can communicate effectively within the defined structure.

2.3 Network Topology Design

Once the network requirements have been determined, the next step is to design a tree topology in Cisco Packet Tracer. The topology is designed hierarchically, utilizing a central device to connect to multiple downstream devices. Switches are used to connect computers within a single network, while routers are employed when inter-network or inter-segment communication is required.

During this stage, devices are placed within the Cisco Packet Tracer workspace and connected using appropriate cabling. The devices are arranged to mirror the actual network setup, ensuring that the connections between them are clearly visible. The design also takes into account the ease of future network expansion should additional devices need to be added.

2.4 IP Address Design

Each device requiring network communication is assigned an IP address based on the established design. IP addressing involves specifying the network address, subnet mask, gateway, and the IP address for each individual device. Using a structured IP addressing scheme aims to prevent address conflicts and simplify device identification.

If the network consists of multiple segments, each segment is assigned a distinct range of IP addresses. This configuration is then applied to the PCs and network devices in use. Once all IP addresses have been assigned, a verification process is conducted to ensure there are no configuration errors.

2.5 Implementation and Configuration

The implementation phase involves applying the network design within Cisco Packet Tracer. Each device is configured according to network requirements. PC configurations include the IP address, subnet mask, and default gateway, while network devices such as routers are configured based on their functions and inter-network relationships.

Configuration is carried out in stages to minimize the likelihood of errors. Once the configuration for a specific network segment is complete, connectivity is verified before proceeding to the next section. This phase aims to ensure that every device has been configured in accordance with the established design.

2.6 Network Testing

Once the implementation process was complete, testing was conducted to determine whether the designed network functioned correctly. Primary testing involved using the `ping` command in Cisco Packet Tracer to verify connectivity between devices.

Tests were performed under various conditions, including connections between PCs within the same network, inter-network connections, and connections involving intermediary network devices. Test results were evaluated based on the success or failure of data packet transmission. A successful transmission and receipt of packets indicated a successful connection between devices; conversely, in the event of a failure, the IP address configuration, gateway settings, cabling, and network devices were re-examined.

In addition to the `ping` command, testing could also be performed using the Simulation Mode feature in Cisco Packet Tracer. This feature allows for the observation of the data packet's path from the source device to the destination device. Consequently, the network communication process can be examined in greater detail, aiding in the identification of the specific location of an issue should a communication failure occur.

2.7 Analysis Results

The final stage involves analyzing the test results. Data obtained from the testing process is recorded and compared against the network design objectives. This analysis determines whether the implemented tree topology successfully provides device-to-device connectivity in accordance with the design.

The test results are then used to assess the implementation's success. If all devices communicate as required, the design is deemed successful. However, if issues arise, the configuration is evaluated and adjusted until the network operates correctly.

Overall, the research workflow can be summarized as follows: **requirements identification → topology design → IP addressing design → implementation and configuration → connectivity testing → results analysis**. These stages ensure that the process of designing a computer network with a tree topology using Cisco Packet Tracer is conducted systematically, resulting in a simulated network that meets the research objectives.

3 RESULT AND DISCUSSION

3.1 Network Design Results

Based on the research methodology employed, a computer network design utilizing a tree topology was developed and simulated using Cisco Packet Tracer. The tree topology was selected due to its hierarchical structure, which allows devices to be grouped into distinct sections while maintaining connectivity to a central device.

In the simulation design, the network comprises a router acting as the primary device, a main switch, several branch switches, and a number of computers serving as user devices. The router functions as the network's primary connection point, while the main switch links the central network to the various branch switches. Each branch switch, in turn, connects the computers within its respective network group.

This structure forms a tree-like pattern, featuring a primary device at the top level that branches out to network devices at subsequent levels. The design allows for future expansion—such as the addition of new switches or computers—without requiring alterations to the overall network structure.

In simple terms, the network design can be described as follows:

Router
↓
Switch Main
├── **Branch Switch 1** → PC 1, PC 2, PC 3
├── **Branch Switch Cabang 2** → PC 4, PC 5, PC 6
└── **Branch Switch Cabang 3** → PC 7, PC 8, PC 9

The design serves as a simulation that can be adapted to the number of devices in Cisco Packet Tracer used in the study.

3.2 IP Addressing

To support communication between devices, each computer and network interface is assigned an IP address. The initial simulation utilizes a private network with the address 192.168.10.0/24. The IP address allocation is kept simple to facilitate implementation and verification in Cisco Packet Tracer.

Table 1 below outlines the IP addressing scheme used:

Table 1. IP Addressing

Perangkat	Interface	Alamat IP	Subnet Mask	Gateway
Router	G0/0	192.168.10.1	255.255.255.0	-
PC 1	NIC	192.168.10.2	255.255.255.0	192.168.10.1

PC 2	NIC	192.168.10.3	255.255.255.0	192.168.10.1
PC 3	NIC	192.168.10.4	255.255.255.0	192.168.10.1
PC 4	NIC	192.168.10.5	255.255.255.0	192.168.10.1
PC 5	NIC	192.168.10.6	255.255.255.0	192.168.10.1
PC 6	NIC	192.168.10.7	255.255.255.0	192.168.10.1
PC 7	NIC	192.168.10.8	255.255.255.0	192.168.10.1
PC 8	NIC	192.168.10.9	255.255.255.0	192.168.10.1
PC 9	NIC	192.168.10.10	255.255.255.0	192.168.10.1

3.3 Implementation of Tree Topology

Implementation was carried out by placing routers, switches, and PCs onto the Cisco Packet Tracer workspace. A router was positioned as the primary device connected to a main switch. Subsequently, the main switch was connected to several branch switches, with each branch switch then connected to multiple computers.

Once all devices were in place, they were interconnected using the appropriate cables. Initially, the connections between devices were verified using the connection indicators provided in Cisco Packet Tracer. Upon confirming active connections, IP address configurations were assigned to the devices in accordance with the addressing table.

This implementation resulted in a more organized network structure, as computers were grouped according to their respective branch switches. Consequently, a fault in a single computer would not immediately cause a disconnection of the entire network. However, a failure in the main switch or a higher-level device could disrupt the downstream segments of the network.

3.4 Connection Testing

Testing was conducted to determine whether each device could communicate with the others. The tests utilized the `ping` command via the Command Prompt on the Cisco Packet Tracer PCs.

The first test involved PC 1 and PC 2, which are connected to the same branch switch. The results showed that packets could be sent from PC 1 to PC 2 and that a response was received from the destination device. This indicates that the IP address configuration and local network connectivity are functioning correctly.

Subsequent testing involved PCs connected to different branch switches—for example, PC 1 and PC 4. This test aimed to verify whether communication between different network segments could occur within the tree topology structure. If the network configuration is correct, the destination device will respond to the ping request.

The test results are presented in Table 2 below:

Tabel 2 Results Testing

No	Source Device	Destination Device	Results	Description
1	PC 1	PC 2	Success	Connected
2	PC 1	PC 3	Success	Connected
3	PC 1	PC 4	Success	Connected
4	PC 2	PC 5	Success	Connected
5	PC 3	PC 6	Success	Connected
6	PC 4	PC 7	Success	Connected
7	PC 5	PC 8	Success	Connected
8	PC 6	PC 9	Success	Connected

3.5 Discussion

Simulation results indicate that implementing a tree topology using Cisco Packet Tracer allows for the construction of a computer network with an organized structure. Grouping computers based on branch switches makes the network easier to understand and manage. This hierarchical structure also illustrates how a network with a large number of devices can be built systematically.

Connectivity testing—specifically successful communication between devices—demonstrates that the IP address configuration and device interconnections align with the design. Using the "ping" command serves as a simple method to verify that a source device can reach a destination device.

Cisco Packet Tracer also facilitates the design and testing processes. Configuration errors can be corrected immediately without the need for physical network hardware. Furthermore, the simulation allows for the observation of data communication, helping to visualize how data packets travel from one device to another.

Tree topologies offer advantages regarding network management and scalability. Additional computers can be connected to available switches, and branch switches can be expanded as the number of devices grows. This structure provides greater flexibility compared to networks where all devices connect directly to a single central point.

However, a tree topology relies heavily on devices at higher levels of the hierarchy. The main switch (or central device) plays a critical role by linking various network branches. If the main device fails, communication across the branches dependent on it may be disrupted. Consequently, real-world implementation requires proper management, maintenance, and redundancy planning to ensure the network remains operational during a failure.

Overall, the simulation results demonstrate that designing a tree-topology network in Cisco Packet Tracer effectively illustrates a hierarchical network structure. The simulation also highlights that successful network communication depends heavily on the accuracy of the topology design, IP address configuration, device interconnections, and connectivity testing. Thus, Cisco Packet Tracer serves as a valuable simulation tool for designing, implementing, and evaluating computer networks prior to physical deployment.

4 CONCLUSION

Based on the design, implementation, and testing conducted, it can be concluded that a computer network using a tree topology can be effectively designed and simulated using Cisco Packet Tracer. The tree topology features a hierarchical structure that allows network devices to be grouped into sections, thereby making network management and expansion more structured.

Network implementation involved connecting routers, a main switch, branch switches, and computers according to the established design. Assigning IP addresses to each device enabled inter-device communication to function in accordance with network requirements. Connectivity testing using the ping command demonstrated that communication between devices within the network is successful when IP addresses, subnet masks, gateways, and inter-device connections are correctly configured.

The use of Cisco Packet Tracer also facilitates the design and testing processes, as the network can be created virtually without the need for physical hardware. Configuration errors can be identified and rectified before the network is deployed in a real-world environment. Furthermore, simulations aid in understanding the relationships between devices and the data transmission processes within the network.

Thus, designing a network with a tree topology using Cisco Packet Tracer serves as an effective solution for learning about and simulating structured computer network implementation. The results of this study can also provide a foundation for developing more complex networks by increasing the number of devices, segmenting the network into subnets or VLANs, and implementing advanced security and network management configurations.

REFERENCE

[1] Nazwa Amelia Purnama, Muhammad Dicky Saputra, Gilang Nur Rosyid, Paul Manurung,

and Didik Aribowo, "Komunikasi Data Menggunkan Topologi Tree," *Uranus J. Ilm. Tek. Elektro, Sains dan Inform.*, vol. 2, no. 2, pp. 01–06, 2024, doi: 10.61132/uranus.v2i2.95.

[2] M. Firmansyah, "Design of Computer Network Infrastructure with Wired and Wireless Transmission Media Using Cisco Packet Tracer," *MALCOM Indones. J. Mach. Learn. Comput. Sci.*, vol. 4, no. 7, pp. 1063–1071, 2024, [Online]. Available: https://doi.org/10.57152/malcom.v4i3.1420

[3] S. M. S, D. Sukma, and H. Permana, "Jurnal Informasi , Teknologi , Rancangan Jaringan Komputer di SMK : Studi Implementasi Menggunakan Cisco Packet Tracer," *JITES Vol. 3 No. 2 J.*, vol. 3, no. 2, pp. 46–51, 2024.

[4] S. Hotmariana and Y. Syafitri, "Analisis Dan Perancangan Infrastruktur Jaringan Komputer Menggunakan Metode NDLC (Network Development Life Cycle) Studi Kasus : SMP Negeri 34 Bandar Lampung," *J. Teknol. dan Inform.*, vol. 5, no. 2, pp. 2745–8911, 2024.

[5] Susilawati, "Perancangan Jaringan Pada Client Server Menggunakan Aplikasi Cisco Packet Tracer," vol. 2, 2024.

[6] J. I. Teknik *et al.*, "Perancangan Jaringan Lan Di Sekolah Menggunakan Cisco Packet Tracer Dan Protocol Routing OSPF," vol. 3, no. 4, pp. 242–248, 2024.

[7] M. G. Seftian, M. Wildan, and D. Pratama, "Perancangan Jaringan LAN dengan Server Cloud Storage: Studi Kasus Menggunakan Cisco Packet Tracer," *J. Sist. Informasi, Manaj. dan Teknol. Inf.*, vol. 3, no. 1, pp. 54–63, 2025, doi: 10.33020/jsimtek.v3i1.804.

[8] N. P. S. Sari, E. D. Muhti, A. Masa, S. Salmiah, and Sriwijanaka, "Perancangan Jaringan Komputer Menggunakan Cosco Packet Tracer Pada Kantor Pemerintahan Di Wilayah Kecamatan Anggeraja Kabupaten Enrekang," *J. LOGITECH Log. Technol.*, vol. 8, no. 1, pp. 45–52, 2025, doi: 10.64109/1vxj9e78.

[9] K. S. Syamsul Bahri, "Perancangan Dan Desain Jaringan Lan Menggunakan Cisco Packet Tracer Untuk Kelas X Di Smk 1 Pasundan Kota Serang," *J. Pendidik. Integr. J. Pendidik.*, vol. 6, no. 3, pp. 438–448, 2025.

[10] A. Harmain, M. Guntara, and I. Gusti Ayu Diah Gita Kartika Santi, "Simulasi Topologi Jaringan Berbasis ACL Menggunakan Cisco Packet Tracer," *Pros. Semin. Nas. CORISINDO 2025*, vol. 1, no. 1, pp. 223–230, 2025.

[11] R. Jhon *et al.*, "Analisis Perbandingan Routing Ospf Single Area Dan Multi Area Menggunakan Cisco Packet Tracer," vol. 11, no. 2, 2025.

[12] A. M. Purnama, I. M. Harahab, and N. Jarti, "Implementasi Monitoring Jaringan Komputer Menggunakan Cisco Paket Tracer ," *J. Tambora*, vol. 9, no. 3, pp. 47–51, 2025, [Online]. Available: https://doi.org/10.36761/suffix