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Optimization of Computer Network Services at Smp Negeri 55 Central Maluku Regency

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A B S T R A C T

This research aims to optimize the computer network services at SMP Negeri 55 Central Maluku Regency, to support the teaching-learning process and administrative activities within the school. The main problems identified include unstable network connectivity, limited infrastructure, and a lack of effective network maintenance and management. The research methods used were observation, interviews, and documentation to gather accurate field data. The analysis results indicate that the existing network does not adequately meet the school's operational needs. Therefore, a network redesign is proposed, including the use of more appropriate hardware, reorganization of cable pathways, and the implementation of network management software. The proposed optimization is expected to result in a more stable, faster, and secure network service. This research provides a practical contribution to improving the quality of information technology services in primary education environments

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INTRODUCTION

The development of information and communication technology (ICT) has had a major impact on various aspects of life, including in the field of education (Julianto et al., 2022). In the current digital era, technology has become the main component in supporting human activities, both in terms of communication, searching for information, and managing complex systems (Arfah et al., 2024). One form of implementation of this development is the use of computer networks, which have become important infrastructure in various agencies, including schools (Jamil, 2022).

Computer network infrastructure has a very vital role in supporting the smooth operation of digital systems in the educational environment. This infrastructure includes hardware such as switches, routers, unshieded twisted pair (UTP cable), and network software that manages data management and connectivity. A well-designed network infrastructure will ensure stable internet access, optimal data transfer speeds, and guaranteed information security (Antoni et al., 2021). In the school context, the existence of reliable network infrastructure is the backbone in supporting technology-based teaching and learning processes, academic administration management, as well as collaborative activities between students and teachers (Arnita & Farid, 2020).

Education is the main foundation in creating quality human resources, therefore, the use of technology in the world of education cannot be avoided, especially in supporting digital-based teaching and learning processes. Schools as educational institutions are required to provide supporting facilities in the form of reliable and stable computer networks, so that learning activities can run effectively and efficiently (Wijaya et al., 2021). Computer networks play an important role in providing internet access, sharing resources, and supporting various academic administration systems.

Optimizing computer network services is an important solution in facing these challenges. Through needs analysis, designing the right topology, and implementing appropriate network devices, schools can improve the quality of connectivity and system work efficiency (Hiswara et al., 2023).

The problem encountered in this research was the limited network equipment, where the school only had one switch to connect the 24 available PC units. As a result, 12 PCs cannot be used due to limited ports available on the switch. This condition causes the use of computer laboratories to be less than optimal, hampers the technology-based learning process, and limits students' access to digital teaching materials.

LITERATURE REVIEW

Computer Network

A computer network is a system consisting of two or more computer devices connected to each other via communication media to share data, information and other resources (Miftahur Rahman et al., 2024).

In the educational environment, computer networks are used to support digital learning activities, internet access, academic data management, and communication between devices (Rahman & Pamungkas, 2024).

Computer networks can be classified based on several factors, including geographic coverage, transmission media, and function. Some common types of computer networks are LAN (Local Area Network), MAN (Metropolitan Area Network), WAN (Wide Area Network), PAN (Personal Area Network), and wireless networks.

Local Area Network (LAN), is a private network within a building measuring up to several kilometers. LANs are often used to connect personal computers and workstations in company offices or factories to share resources (for example printers) and exchange information. According to Prima et al., (2021) that a Local Area Network is a network of several connected computers. Each computer on this network has access to data from other computers. In addition, computers connected on a LAN can play games together, chat with other computer owners, and run hardware such as printers from other computers.

Metropolitan Area Network (MAN) is a larger version of LAN. Usually, MAN uses technology similar to LAN. MAN can include company offices that are adjacent to or part of a city, and can be used for private or public needs. MAN is capable of supporting data and voice, and can even connect to cable television networks.

Wide Area Networks (WAN) have a wide reach, often spanning a country or even a continent. WAN consists of a group of devices whose purpose is to run user application programs. According to Karlinda et al., (2021) that this type of network covers a wider area than the MAN network type. WAN area coverage is able to reach between regions, from different countries. This type of WAN network can be called an internet network or global network because it can cover the entire computer network in the world.

In fact, there are many networks in the world, often using different hardware and software. Individuals connected to a network usually hope to communicate with people on other networks. Such expectations require connections between often incompatible and disparate networks. Generally, to do this, a machine called a gateway is needed to establish the connection and carry out the necessary translations, both in terms of hardware and software. This collection of interconnected networks is called the internet. According to Muzakir & Ulfa, (2019) said that the internet is a global computer network medium with very open access, so guaranteeing the security of users who are directly connected to the internet network is a consequence that must be borne.

Wireless networks are the answer to communication needs that cannot be done via wired networks. For example, someone who wants to get information

or communicate while in a car or airplane, of course needs a wireless network because it is impossible to connect cables in a car or airplane. Currently, wireless networks are widely used by utilizing satellite technology and are able to offer higher access speeds than cable networks.

Network Topology

According to Sari et al., (2020) the term network topology refers to the way in which all network points are connected together, while topology basically means shape. When planning a network, the choice of topology is often the most important decision. Networks can be transferred in various topologies. Cost, performance, and reliability levels vary between topologies. Topology according to Nitra & Ryansyah, (2019) is "a way of connecting two computers to form a network known as computer network topology.

The methods currently widely used are bus, token ring and star. The speed of computer network communication will be influenced by the type of topology chosen. Therefore, it is necessary to know the advantages, disadvantages and benefits of each topology based on its characteristics. Network topology describes the way network devices are arranged and connected to each other.

This research uses a star topology, where each computer is connected to a central device (switch) (Rojai Zhofir, 2024). According to Madcoms (2010:5) states that the Star topology is a topology that connects several computers using a device, namely a Hub or Switch, this device functions as a controller of all computers connected to the network.

The advantages of this topology include: ease of installation and maintenance, interference with one cable does not affect the entire network, you can easily add new devices. It can be said that the advantage of this topology is that it makes it easy to identify computers that are experiencing problems, as well as making it easier to add or remove computer units without disturbing others. Apart from that, the level of data security is also better. However, the disadvantages of this type of computer network topology include high installation costs, because it requires a lot of cables and switches or hubs. In addition, network stability is highly dependent on the central terminal, which means that if a switch or hub experiences problems, the entire network will be disrupted.

Network Devices (Switch, Cable, Conector)

Network devices are all hardware components used to connect devices in a network, which allows communication and data exchange between devices. According to (Irsyadi et al., 2024) network devices consist of:

1. Switch: A device that functions to connect several computers in a LAN network. Switches work at the data link layer (Layer 2) and are able to direct data packets specifically to the destination device. In this research, the addition of switches was carried out to overcome the limitations of network ports which previously were only able to serve 12 of the 24 PCs in the laboratory.
2. Unshielded Twisted Pair (UTP cable): This is the most common type of cable used in LAN networks. This cable consists of twisted pairs of copper wires to reduce electromagnetic interference.

3. RJ-45 connector: This is a standard connector used on UTP cables to connect devices to a network. Correct installation of the RJ-45 connector is important to maintain connection stability.

PPDIOO Method

The PPDIOO method is a systematic framework used in planning and implementing computer networks. This method was developed by Cisco Systems and is widely used in network infrastructure development projects because of its structured and comprehensive approach. The PPDIOO method was chosen in this research because it is able to provide a structured and comprehensive approach in the process of designing and managing computer networks. With this method, network development does not only focus on physical development, but also considers long-term evaluation and maintenance aspects (Arrahmani, et al., 2024). PPDIOO is an abbreviation of six main stages, namely:

1. **Prepare**

This stage includes an initial needs assessment, understanding business goals, and preparing a strategic plan for the network technology to be built. The aim is to ensure the organization's readiness to implement network projects, both in terms of human resources, budget and basic infrastructure.

2. **Plan**

This is the stage of detailed needs analysis and designing the network solution that will be implemented. Here, technical requirements, hardware and software, network topology, as well as time and cost estimates are identified.

3. **Design**

At this stage, the network design is created based on the results of the analysis at the planning stage. The design includes physical and logical topology design, IP address scheme, security system, and configuration of the devices to be used. The goal is to create a network blueprint that suits your needs and is ready to be implemented.

4. **Implement**

This stage includes the installation and configuration of network devices based on the design that has been created. Here, cable installation, switch/router settings are carried out, as well as initial testing of connectivity between devices.

5. **Operate**

This is the operational stage of the network system that has been built. The network began to be actively used by users, and system performance was monitored. At this stage all activities are also recorded to ensure the system runs stably and according to its function.

6. **Optimize**

The final stage of the PPDIOO method is optimization, which includes network performance evaluation and continuous improvement. These steps aim to increase network efficiency, prevent disruptions, and extend the service life of the network with proper maintenance.

Wireshark Application

Wireshark is open-source software used to analyze network traffic (Maulana et al., 2021). This application allows users to capture and view data packets that are being transmitted over the network in detail. Wireshark's main functions include:

1. Identify data packets based on protocol
2. Detect network disturbances such as packet loss or delay
3. Analyze network performance based on technical parameters

In this research, Wireshark is used as a tool in testing network quality after implementation.

Quality of Service (QoS)

Quality of Service (QoS) is a parameter used to measure the quality and performance of a network (Arrahmani et al., 2024). The three main components of QoS used in this research are:

1. **Throughput:** The amount of data successfully sent in one unit of time, usually expressed in Mbps. The higher the throughput, the better the network performance.
2. **Delay (Latency):** The time required for a data packet to arrive from the sender to the recipient. Low delay is critical for real-time applications such as video conferencing or online learning.
3. **Packet Loss:** Percentage of data packets lost during transmission. Ideally, packet loss is 0%, because packet loss can cause disruptions such as dropped connections or sound/image disturbances.

QoS parameter measurements were carried out to determine the extent to which network optimization succeeded in improving system performance in the computer laboratory of SMP Negeri 55. According to S. Abdullah et al., (2019) that optimization is the main design of bandwidth optimization, the use of queues with a two-rate system which functions for the lowest bandwidth allocation and the highest bandwidth allocation. This functions when the network is busy, the client will get a bandwidth allocation according to the amount of bandwidth divided equally based on active clients, whereas if the network conditions are very quiet, the client will get the highest bandwidth allocation.

METHODOLOGY

Research Approach

This research uses a quantitative-descriptive approach, where the data collected will be analyzed to describe the impact of implementing the PPDIOO method on computer network performance at SMP Negeri 55 Central Maluku Regency. The purpose of using PPDIOO in computer network design is to provide a systematic and structured framework for planning, designing, implementing, operating and optimizing computer networks at SMP Negeri 55 Central Maluku Regency.

Data Collection Technique

1. **Observation**

The observation method was carried out by directly observing the condition of computer network services at SMP Negeri 55 Central Maluku Regency. This observation aims to see directly the obstacles faced in network infrastructure, such as the hardware used, connectivity conditions, and network use in teaching and learning activities.

2. **Interview**

The interview process is carried out with related individuals, such as school network operators, teachers and other education personnel. The purpose of the interview is to dig up deeper information regarding the problems faced in using computer networks, the need for improved services, as well as proposed solutions that are expected.

3. **Documentation**

Documentation is carried out by collecting various technical and administrative data that supports research. This data includes network device specifications, network topologies that have been implemented, as well as reports regarding problems that have occurred.

Network Development Methods

This research uses the PPDIOO method as a framework for developing computer networks. The PPDIOO method is a systematic approach from Cisco which consists of six main stages, namely:

1. **Plan**

At this stage planning is carried out starting with identifying network needs at SMP Negeri 55 Central Maluku Regency, collecting initial data regarding the condition of the existing network infrastructure, determining the scope and objectives of network optimization.

2. **Prepare**

At this stage, a technical plan is prepared based on the planning results, providing the hardware and software needed for network repairs, preparing human resources or a technical team.

3. **Design**

After preparation, the next stage is designing a new network topology or existing network optimization scheme, designing network segmentation, IP addressing, and network device configuration.

4. **Implement**

Implementation is carried out in accordance with the plans that have been prepared, namely applying the design results to the school network and installing hardware such as switches.

5. **Operate**

After implementation, operations are carried out to ensure the network runs according to design and monitor network performance.

6. **Optimize**

After implementation and operation, network performance evaluation is carried out to measure the effectiveness of the changes implemented. Performance before and after implementation and operation is compared to assess the improvements achieved.

Research Scope

This research focuses on optimizing the computer network at SMP Negeri 55 through the implementation of PPDIOO. This research does not cover server security aspects, or integration with networks outside the scope of SMP Negeri 55. The primary focus is on improving the performance, efficiency and reliability of school local networks.

RESULTS AND DISCUSSION

Initial Network Conditions

According to findings from observations, documentation and interviews conducted at SMP Negeri 55 Central Maluku Regency, several main problems were found in computer network services which had an impact on the effectiveness of teaching and learning activities and school operations. The initial conditions and network constraints identified are as follows:

1. **Wifi Signal is Uneven**

The distribution of WiFi signals in the school environment is uneven. Some rooms such as classrooms and laboratories have difficulty accessing the internet network due to limited access point coverage.

2. **Unstructured Network Topology**

The cable network installation was carried out haphazardly without clear topology planning. This causes difficulties in network management and troubleshooting if interference occurs.

3. **Lack of Supporting Equipment**

The school only has a few basic network devices such as routers and switches, but is not equipped with additional access points, repeaters, or other signal boosting devices that are sufficient to cover the entire school area.

4. **Frequent Connection Problems**

Internet access is often unstable, especially when used simultaneously by many users. Internet speed also decreases drastically during peak hours such as in the morning or when online learning takes place.

5. **Unavailability of Network Documentation**

The school does not yet have network technical documentation that contains information such as topology schemes, IP addressing, device configuration, and network maintenance data. This makes it difficult to process improvements and further development.

6. **Lack of Competent Human Resources in Network Management**

Network management is still handled by school operators who do not have a special background in the field of computer networks. This causes the response to network disturbances to tend to be slow and inaccurate.

Plan

At SMP Negeri 55 Central Maluku Regency there is a computer laboratory containing 24 personal computers and one switch. There are also 13 classrooms, one teacher's room and one principal's room.

1. **Analysis of Network Device Needs**

The findings obtained when the research was carried out were that there were several devices needed by SMP Negeri 55 Central Maluku Regency. From the network topology description, the network devices (hardware and software) needed to design the network circuit are as in table 1 and table 2.

Table 1. Hardware

No	Hardware	Number of Units	Information
1	Switch	1 Pieces	Swicth UnManaged
2	UTP Cable	1 Dos	Straight Cable
3	Conector	1 Dos	Conector Rj45

Table 2. Software

No	Software	Information
1	Packet Tracer	Versi ; 8.2.2
2	Browser	Google Chrome, Mozila firefox, Internet explore
3	Laptops	Windows 10,11 64bit

2. **IP Address**

The network design for SMP Negeri 55 Central Maluku Regency uses Class C IP addresses with details as in table 3 below.

Table 3. IP Address

No	Device	IP Address	Information
1	Firewall	192.168.10.2	1 Buah
2	PC Server	192.168.10.1	1 Buah
3	PC Client	192.168.10.5– 192.168.10.28	24 uah

3. **Network Topology Analysis**

At this stage, an analysis is carried out regarding the network scheme or network topology used in the Computer Laboratory so that it will become a reference for creating a system used in the Laboratory of SMP Negeri 55 Central Maluku Regency, as in Figure 1.

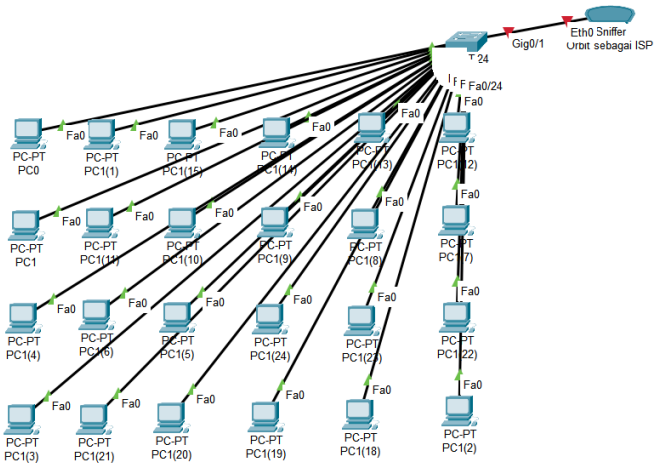


Figure 1. Network Topology SMP Negeri 55 Central Maluku Regency

At this stage the researcher created a series of networks, which will be implemented at SMP Negeri 55 Central Maluku Regency. The network design is quite simple, making it easier for schools or network operators in the implementation process.

Prepare

At this stage, researchers prepared the required hardware as described in Table

1. The equipment prepared included a switch unit as a network distribution center, LAN cables (UTP) for connectivity between devices, and RJ45 connectors to connect cables to network devices. In addition, technical assistance from the Head of the Laboratory takes the form of technical direction and support in the installation process and initial setup of network devices, so that they comply with school standards and needs.

Design

The network topology used in this research is Star Topology with the PPDIOO design method shown in Figure 2.

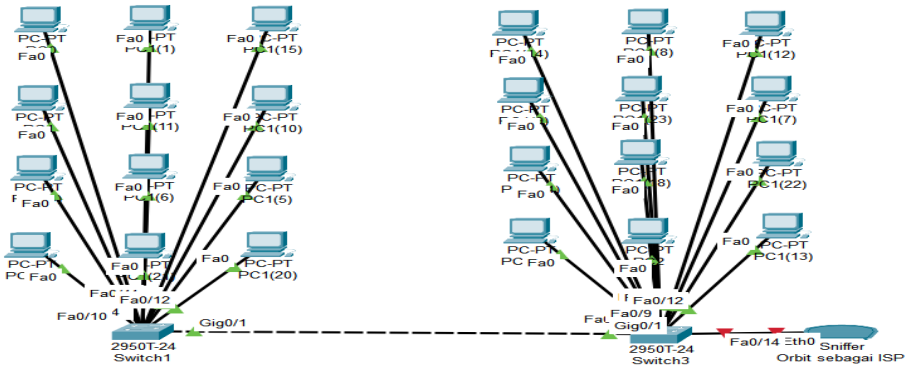


Figure 2. Network Topology Design

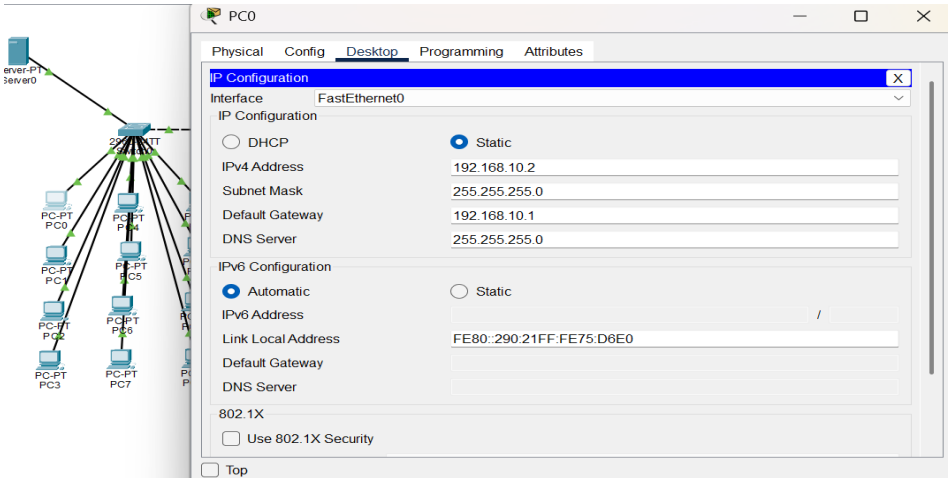
In the Laboratory room of SMP Negeri 55 Central Maluku Regency there are 24 PCs and an internet source which will be connected to a Firewall Filtering device using a Cat 5 cable then connected to a Tp Link switch.

Implement

After the plan, prepare, design stages have been completed, the next step, namely implementation, is carried out directly in the real environment of SMP Negeri 55 Central Maluku Regency, carried out using QoS (Quality of Service) measurements and network protocol analysis using the Wireshark application.

1. **Simulation Prototyping**

Simulation Prototyping is a simulation step carried out before implementation, so that the goals to be achieved can proceed according to plan.



Gambar 3. Konfigurasi IP Address

Figure 3 shown is the IP address configuration display in the Cisco Packet Tracer application, precisely in the PC0 device configuration section. In this window, the researcher is configuring a static IP on the FastEthernet0 interface. It can be seen that the "Static" option is selected, and the IP Address is set to 192.168.10.2 with a Subnet Mask of 255.255.255.0. Meanwhile, the Default Gateway and DNS Server columns are still left blank or filled with 255.255.255.0, which indicates that this device has not been directed to an external network or does not require access to the internet. At the bottom there are also IPv6 settings, but they are not activated further. This configuration aims to enable PC0 to connect to a local network with a fixed IP address, so that it can be used for communication in network simulations carried out by researchers. The simulation results are as shown in Figure 4 below.

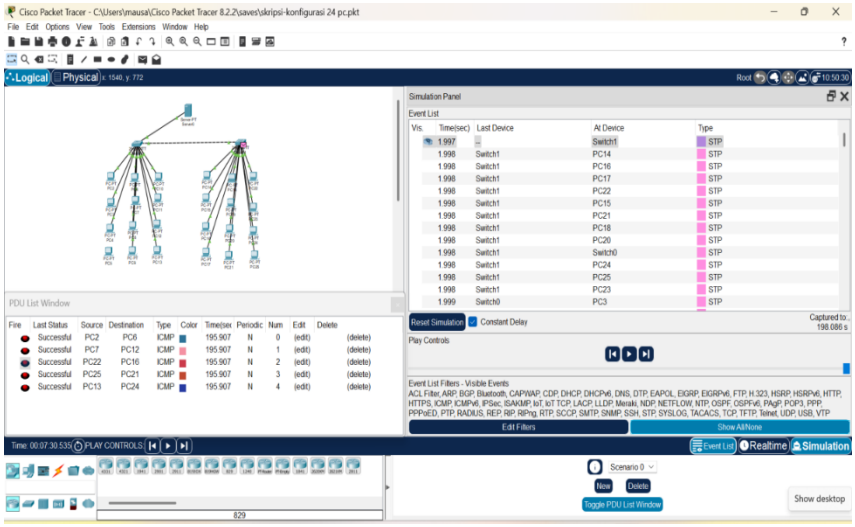


Figure 4. Display of Simulation Results

Figure 4 shows the display of network simulation results in the Cisco Packet Tracer application which is being run by researchers to test the network configuration that has been created. On the left side of the screen you can see the network topology which consists of two switches (Switch0 and Switch1) each of which is connected to several PC devices (PC0 to PC24). Each connection between devices is marked with a green line indicating an active and successful connection. Meanwhile, on the right there is a Simulation Panel panel which displays the Event List—namely a list of events that occur on the network while the simulation is running. Here various protocols such as ARP (Address Resolution Protocol) and ICMP (Internet Control Message Protocol) are recorded which are used between devices to communicate with each other. For example, it can be seen that PC0 is communicating ICMP to PC1, and PC3 is sending ICMP to PC2, indicating that the ping process between devices was successful. This image confirms that the IP address and network topology configuration carried out by researchers has been successful, because data packets can be sent and received between devices without errors. This proves that the network is running well and communication between nodes in the local network is perfectly connected.

2. Quality of Service (QoS)

To measure QoS (Quality of Service), the Wireshark application is used. Wireshark is an open source application that functions as a tool for analyzing network protocols. The following is the main display of the Wireshark application.

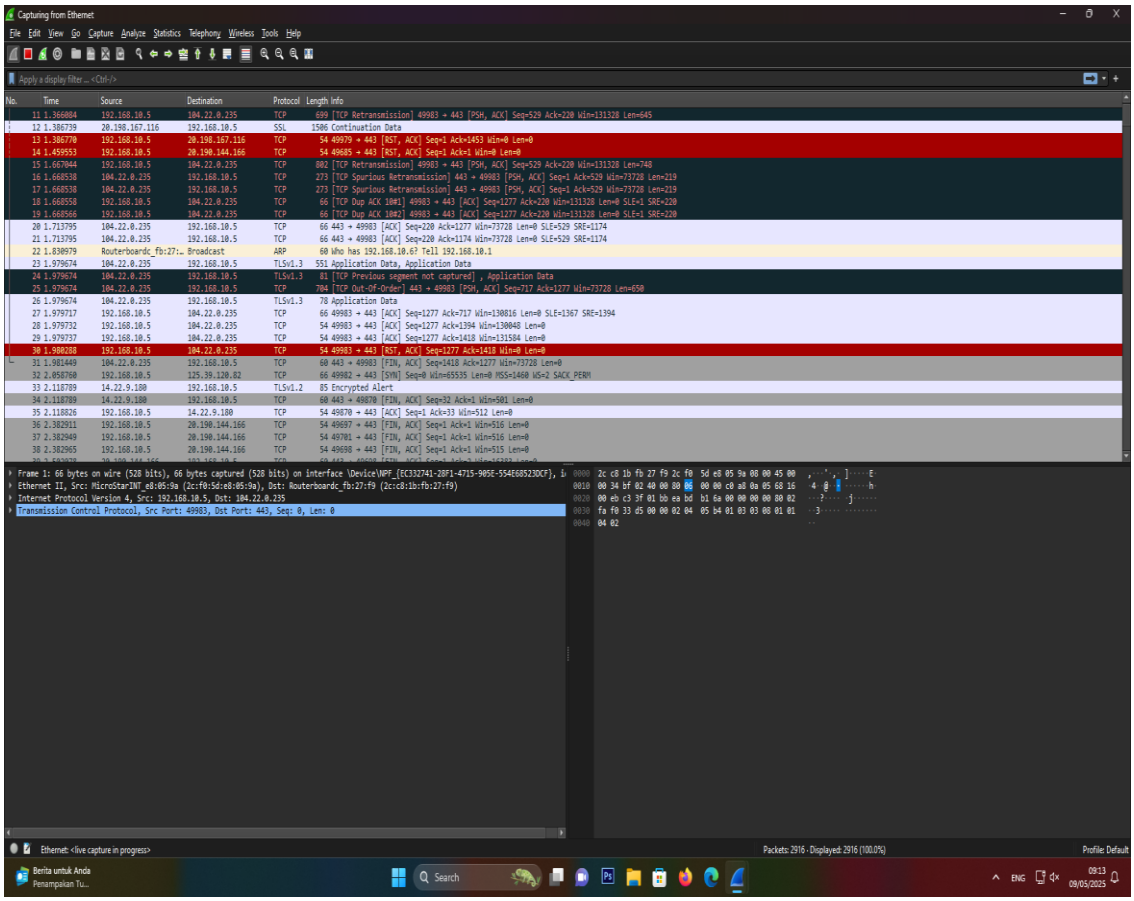


Figure 5. Wireshark display

The main function of Wireshark is to analyze information passing through transmission channels and present the obtained data in detail. In this study, the data capture process will be carried out using Wireshark. After the packets have been successfully captured via Wireshark, the next step is to carry out statistical analysis of the packets. The service quality (Qos) indicators that will be used as a benchmark for Qos values on each network are Delay, Throughput, and Packages.

3. Measurement of Throughput values

The following are the results of measuring the throughput value. From the data obtained, the average value for Download was recorded at 3.5 Mbps and the average for Upload was 2.5 Mbps.

Table 4. Throughput Value in QoS Measurement

1	2.53 Mbps	1.71 Mbps
2	3.38 Mbps	1.72 Mbps
3	3.67 Mbps	1.88 Mbps
4	2.79 Mbps	2.27 Mbps
5	3.91 Mbps	1.75 Mbps
6	3.76 Mbps	2.20 Mbps
7	3.32 Mbps	1.86 Mbps
Average	3.5 Mbps	2.5 Mbps

4.Delay Value Measurement

In the table below there are measurement results of the Delay value. From measuring the Delay value, an average of 0.66854 was obtained.

Table 5. Delay Values in QoS Measurements

Measurement	Delay
1	2.7503
2	1.2681
3	1.4913
4	0.109
5	0.0507
6	0.0201
7	0.6763
8	0.2497
9	0.0001
10	0.0698
Average	0.66854

5.Packet Loss Value Neasurement

In the table below there are measurement results of the Packet Loss value. From measuring the Packet Loss value, an average of 0 was obtained.

Table 6. Packet Loss Values in QoS Measurements

Pengujian	Packet Loss
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
Average	0

Operate

At the operational stage, researchers carry out monitoring, which is an important step in the PPDIOO (Plan, Prepare, Design, Implement, Operate, Optimize) method which aims to ensure that the network that has been implemented runs stably, efficiently and in accordance with planning. The test is carried out using Speedtest. This testing stage after changes are made, the Administrator usually carries out a bandwidth test using speedtest by opening the link www.speedtest.net with a browser application such as Google Chrome. The test results are as in Figure 6.

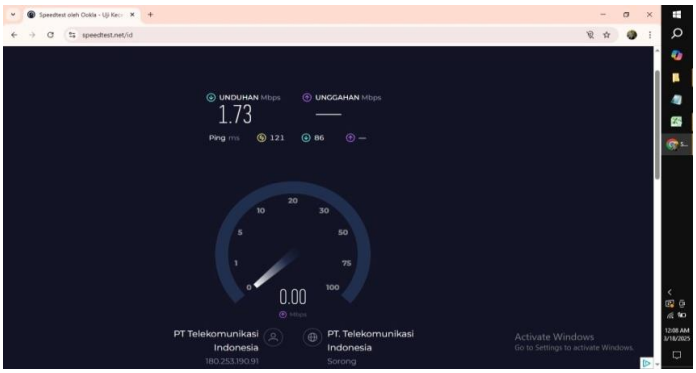


Figure 6. Before (Speedtest)

Figure 6 shows the ongoing network testing process using Speedtest. At this stage, the system calculates the Internet connection speed by measuring network speed time.

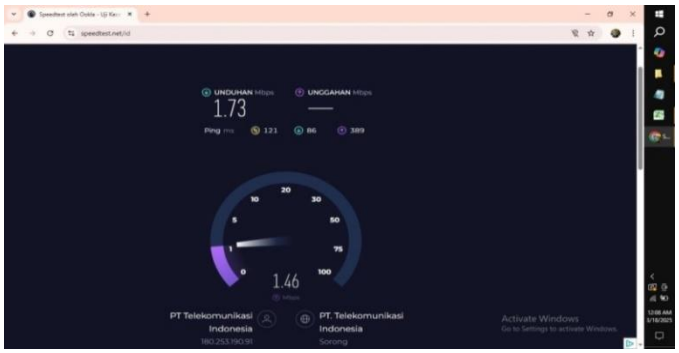


Figure 7. After (Speedtest)

Figure 7 shows the results of network testing before optimization. In this image it can be seen that the download and upload speeds are at a relatively low level, and the ping value is quite high. This condition shows that the network infrastructure is still less than optimal, which is most likely caused by limited devices such as switches and uneven network distribution, so that only some computers have a stable connection.

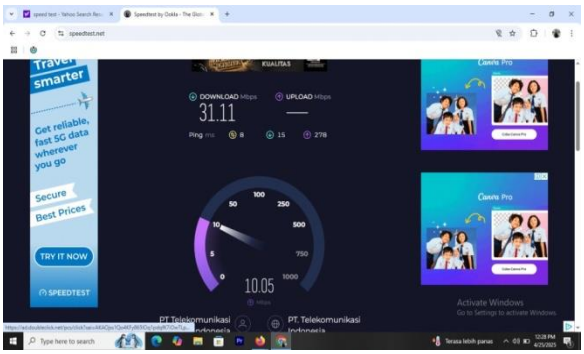


Figure 8. After (Speedtest)

Test results show a significant increase in download and upload speeds, as well as lower ping values compared to before. This change shows that network improvements have succeeded in improving the quality of the internet connection in the computer laboratory of SMP Negeri 55 Central Maluku Regency, thereby supporting digital learning activities more effectively.

Optimize

The optimization stage is the final step in the computer network improvement process which aims to maintain and improve network performance after implementation and testing. Based on the results of the analysis and improvements that have been carried out at SMP Negeri 55 Central Maluku Regency, several optimization steps have been prepared so that the network can work more efficiently, stably and sustainably in supporting learning activities. Optimization steps taken include:

1. **Network Topology Rearrangement**

After it was discovered that the previous topology was inefficient and resulted in uneven signal distribution, the network was reorganized using a star topology approach which allows centralized control and more stable data distribution. This reduces network conflicts and speeds up the data transfer process between devices.

2.**Improved Network Device Quality**

Optimization is carried out by replacing old network devices such as switches.

3. **IP Address Management and Network Segmentation**

The IP assignment system which was previously done manually and irregularly was optimized using structured static and dynamic IP addressing. In addition, network segmentation is carried out so that data traffic can be better managed and reduce the occurrence of IP conflicts.

4. **Implementation of a Network Monitoring System**

To maintain network performance on an ongoing basis, researchers use network monitoring software such as Wireshark. This tool helps in detecting interference, monitoring user activity, and evaluating network speed and stability periodically.

5. **Evaluation of Results**

From the evaluation carried out, it can be concluded that the computer network optimization process has had a significant impact on improving the quality of network services at SMP Negeri 55 Central Maluku Regency. The network becomes more stable, fast and reliable in supporting learning and administration activities.

CONCLUSION AND RECOMMENDATION

Network conditions before optimization showed various problems, such as unstable connections, low internet access speeds, and uneven bandwidth distribution. This has an impact on the effectiveness of the teaching and learning process that uses information technology. The network optimization process is carried out through several stages, namely analyzing network needs, planning a more efficient network topology, adding hardware. The results of the optimization show a significant increase in network performance. Internet access has become more stable and evenly distributed throughout the school area. In addition, digital-based school administration and learning processes have become more efficient. To improve the quality of computer network services, it is recommended that network monitoring and maintenance be carried out regularly to ensure its stability and reliability.

FUTHER STUDY

There are limitations in this research which focuses on speed, so it is necessary to carry out further research by considering other variables such as computer network security, in order to perfect this research and increase insight for readers.

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REFERENCES

Antoni, D., Herdiansyah, M. I., Akbar, M., & Sumitro, A. (2021). Pengembangan Infrastruktur Jaringan Untuk Meningkatkan Pelayanan Publik di Kota Palembang. Jurnal Media Informatika Budidarma, 5(4), 1652. https://doi.org/10.30865/mib.v5i4.3318

Arfah, F., Pananrangi, A. R., & Bahri, S. (2024). Optimization of Administrative Services in the Financial Department of the Transportation Agency of Sinjai Regency. 2(2), 97–103. https://doi.org/10.35965/pja.v2i2.5147

Arnita, A., & Farid, M. (2020). Implementasi Jaringan Virtual Private Network Dengan Teknologi Multi Protocol Label Switching (MPLS). JRTI (Jurnal Riset Tindakan Indonesia), 5(2), 28–40.

Arrahmani, F. H., (2024). Optimasi Topologi Jaringan Untuk Meningkatkan Ketahanan Jaringan dan Mitigasi Kemacetan Pada Jaringan PT XYZ. 11(4), 4287–4291.

Arsanto, A. T. (2022). Optimalisasi Firewall Pada Sistem Jaringan Komputer Kantor. Cyber-Techn, 16(01), 62–71.

Firmansyah, Purnama, R. A., & Astuti, R. D. (2021). Optimalisasi Keamanan Wireless.. 15(1), 25–33.

Hiswara, I., Khoiriyah, K., & Febriyanto, D. (2023). Perancangan Jaringan LAN SMK Al-Khairiyah 2 Dengan Menggunakan Metode OSPF. JEIS : Jurnal Elektro dan Informatika Swadharma, 3(1), 58–66. https://doi.org/10.56486/jeis.vol3no1.302

Irsyadi, F. Y., Utomo, I. C., Rahman, A. A., Kojyro, H. D., Mursetyani, D., Putri, S. Q. A., Atmadja, S. M., & Syafi'uddin, M. W. (2024). Optimalisasi Sistem Jaringan Informasi Pada MIM Taraman Sragen. Abdi Teknoyasa, 5(1), 276–281. https://doi.org/10.23917/abditeknoyasa.v5i1.5139

Jamil, J. (2022). Optimalisasi Layanan Tutorial Online dan Aksesibilitas Terhadap Kepuasan Bantuan Belajar Online Mahasiswa UT. Jurnal Studi Guru dan Pembelajaran, 5(1), 141–150. https://doi.org/10.30605/jsgp.5.1.2022.1714

Julianto, B., Nugroho, K., & Saifullah, D. F. N. M. (2022). Optimalisasi Jaringan Komputer Tanpa Harddisk (Diskless) Pada Laboratorium Jaringan AKN Pacitan. Journal of Electrical, Electronic, Mechanical, Informatic and Social Applied Science, 1(1), 1–9. https://doi.org/10.58991/eemisas.v1i1.3

Maulana, A. R., Walidainy, H., Irhamsyah, M., Fathurrahman, F., & Bintang, A. (2021). Analisis Quality of Service (QoS) Jaringan Internet Pada Website E-Learning Univiersitas Syiah Kuala Berbasis Wireshark. Jurnal Komputer, Informasi Teknologi, dan Elektro, 6(2), 27–30. https://doi.org/10.24815/kitektro.v6i2.22284

Miftahur Rahman, Moh. Miftahur Rahman, & Moh. (2024). Implementasi Manajemen Bandwidth Simple Queue Sebagai Optimalisasi Layanan Jaringan Internet Warga Menggunakan Metode NDLC. Jurnal CoSciTech (Computer Science and Information Technology), 5(1), 27–35. https://doi.org/10.37859/coscitech.v5i1.6899

Muzakir, A., & Ulfa, M. (2019). Analisis Kinerja Packet Filtering Berbasis Mikrotik Routerboard Pada Sistem Keamanan Jaringan. 10 (1), 15–20.

Prima, J., et al., "Penerapan Metode Service Quality Dalam Analisis Persepsi Konsumen Pada Pelayanan Pemesanan Barang E-Commerce di Universitas Prima Indonesia," vol. 5, no. 2, 2022.

Rahman, T., & Pamungkas, E. T. (2024). Optimalisasi Jaringan Komputer Di Smk Travina Prima Dengan Implementasi Intervlan, VLSM, DAN HSRP. JIKA (Jurnal Informatika), 8(4), 438–447.

Rojai Zhofir, (2024). Analisis Pengaruh Topologi Jaringan Terhadap Kecepatan Data. 26–31.

Wijaya, C., Aspriyono, H., & Al Akbar, A. (2021). Pengembangan Infrastruktur Jaringan Berbasis Nirkabel Ke Jaringan Berteknologi GPEN (Gigabit Passive Ethernet Network) di Kampus IAIN Bengkulu. Jurnal Amplifier : Jurnal Ilmiah Bidang Teknik Elektro dan Komputer, 11(1), 14–21. https://doi.org/10.33369/jamplifier.v11i1.16064