

LAN Performance Evaluation Based On Access to Transmission Media

Abstract.—Local Area Network as a computer network on small scale. The limited distance between a room, building, or office. The factor of LAN is performance, where the performance can do by using availability, reliability, response time, and throughput. Its function of it is to know the performance of LAN. Availability, use to measure the time of the network. It's working at all work of the network it is called MTBF and MTTR. Reliability, use to measure the time of the network, which is work to transmit the data and avoid data from errors. Response time, use to measure the time that needs by the data to begin from the computer transmission. The process does in host and time. It's needed to give back the data to the sender. Throughput, use to measure the total data that it's transmitted at a certain time.

Streszczenie. Sieć lokalna jako sieć komputerowa na małą skalę. Ograniczona odległość między pokojem, budynkiem lub biurem. Czynnikiem sieci LAN jest wydajność, gdzie wydajność może być realizowana przy wykorzystaniu dostępności, niezawodności, czasu odpowiedzi i przepustowości. Jego funkcją jest poznanie wydajności sieci LAN. Dostępność, użyj do pomiaru czasu sieci. Działa przy wszystkich pracach sieci o nazwie MTBF i MTTR. Niezawodność, służy do mierzenia czasu sieci, czyli pracy nad przesyłaniem danych i unikaniem błędów danych. Czas odpowiedzi służy do pomiaru czasu potrzebnego na rozpoczęcie transmisji danych przez komputer. Proces odbywa się w gospodarzu i czasie. Jest potrzebny do oddania danych nadawcy. Przepustowość służy do pomiaru całkowitej ilości danych przesyłanych w określonym czasie. **(Ocena wydajności sieci LAN na podstawie dostępu do mediów transmisyjnych)**

Keywords.—LAN, Availability, Reliability, Response Time, Throughput.
Słowa kluczowe: sieć LAN, niezawodność, szybkość transmisji

Introduction

Local Area Network (LAN) is one form of Computer network with a range limited to one room, building, or a certain location.[1] The function of the LAN is to facilitate the user or computer user in communicating and transferring data between one computer to another via the transmission media.[2] The function of the transmission media is not only used to transfer data in the form of text (Text Based) but can also be used to present data in the form of sound (Voice) and images (Image).[3][4][5]

Before the development of LANs, data transmission still uses media such as diskettes, hard disks, optical disks, etc.[6] which are still very simple and very limited in the amount of data to be sent. Since the LAN was developed, many transmission media are used to transfer data, such as UTP cables (Unshielded Twisted Pair) which are widely used for LANs in companies, offices, colleges, and internet cafes, besides that there are also wireless transmission media delivery other Wireless LAN and Bluetooth.[7][8][9]

Like other computer systems, networks on computers can also provide good performance, the effectiveness of computer networks is placed on networks based on network efficiency in sending data to computers.[10] Setting performance on the network is needed to design performance that is on the network.[11][12]

Framework

The framework is a writing plan that contains the outlines of an essay that will be worked on, and is a series of ideas arranged systematically, logically, clearly, structurally, and regularly.

The benefits of the Framework are:

- To guarantee writing is conceptual, comprehensive, and directed
 - To arrange essays regularly
- The essay framework helps the writer to see ideas at a glance so that it can be ascertained whether the composition and interrelationships between the ideas are correct, whether the ideas are well presented, harmonious in the balance

- Makes it easy for writers to create different climaxes
 Each writing is developed towards a certain climax. But before reaching the climax of the entire essay, there are several different parts of the importance of the main climax. Each part also has its climax in its part.
- Avoid making topics twice or more
 It is possible that a part needs to be discussed twice or more, according to the needs of each part of the essay. However, making a topic up to twice or more is unnecessary because it will only bring adverse effects in other parts simply by pointing to that section
- Makes it easy for writers to find help material
 By using the details in the framework of the essay the author will easily search for data or facts to clarify or prove his opinion. Or the data and facts that have been collected will be used in what part of the essay

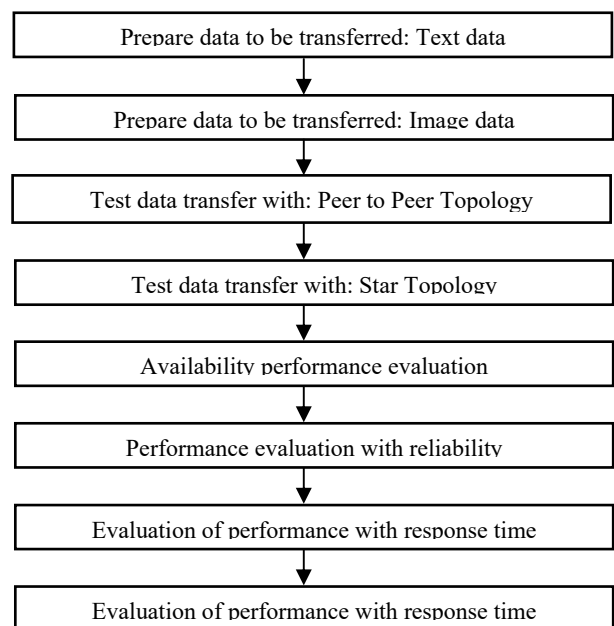


Fig 1. Frame Work

Figure 1 is the Framework or framework used in this study are:

A. Preparing Data To Be Transferred: Text Data

In evaluating LAN performance, data is needed to be transferred between computers using Peer to Peer and Star Topologies. The data used in data transfer is data in the form of text. What is meant by text data is data in the form of letters, numbers or symbols, or a combination of the three. In this study, the test data used is in the .doc format

B. Preparing Data To Be Transferred: Image Data

In evaluating LAN performance, data is needed to be transferred between computers using Peer to Peer and Star Topologies. The data used in data transfer is in the form of images (images). What is meant by image data (image) is data in the form of images or photographs. In this study, the image data used is in the format .jpg.

C. Testing the Data Transfer with Peer to Peer Topology

At this stage, the prepared data is in the form of text and image data transferred from one computer to another using UTP transmission media (Unshielded Twisted Pair) implemented on peer-to-peer topologies.

The trial begins by transferring data to the peer-to-peer topology by using text data in the .doc format with a capacity of 36.5MB. After obtaining the trial results, proceed by transferring image data with the .jpg format with a capacity of 61.9MB.

D. Testing the Transfer of Data with Star Topology

At this stage, the prepared data is in the form of text and image data transferred from one computer to another using UTP transmission media (Unshielded Twisted Pair) implemented in the star topology.

The trial begins by transferring data on the star topology using text data with the .doc format with a capacity of 36.5MB. After obtaining the trial results, proceed by transferring image data with the .jpg format with a capacity of 61.9MB.

E. Evaluation of Performance with Availability

At this stage, evaluate performance with availability. The data transfer results, in the form of text and image data, are entered into the availability formula.

F. Evaluation of Performance with Reliability

At this stage, evaluate performance with reliability. The results of data transfer, in the form of text data and image data, are forced into the reliability formula.

G. Performance Evaluation with Response Time

At this stage, evaluate performance with response time. The results of data transfer, in the form of text data and image data, are forced into the response time formula.

H. Performance Evaluation with Throughput

At this stage, evaluate performance with throughput. The results of data transfer, in the form of text data and image data, are entered into the throughput formula.

Analysis and Results Analysis

After conducting the trial stage of transferring text and image data to peer-to-peer and star topologies, the next step is to evaluate using the criteria of availability, reliability, response time, and throughput.

1. Availability

Availability is used to calculate time working well from all network working times. A good working time is called Uptime or referred to as Mean Time Between Failure (MTBF) and not good working time is called Downtime or referred to as Mean Time to Repair (MTTR). In this study, to be able to know the value of Uptime and Downtime,

monitor the value of Uptime and Downtime by using the CleverEye tool or application. The function of the CleverEye tool for monitoring the network works within a certain period (availability). Using the CleverEye tool will get valid Uptime and Downtime values according to the results of monitoring.

2. Reliability

Reliability is used to calculate network time that works in delivering data, no errors occur during the process of data transfer. Reliability values can be obtained after transferring text and image data.

3. Response Time

Response Time is used to measure the time taken from data starting to move from the delivery computer, the process carried out in the host, and the time needed to return the data to the host. The value of response time is obtained after transferring text and image data.

4. Throughput

Throughput is used to measure the total amount of data that is transmitted for a certain time by taking the estimated delivery back. The throughput value is obtained after transferring text and image data

Results

At this stage, data that has been prepared in the form of text and image data (image) is transferred from one computer to another computer, for the stages:

1. Peer to Peer Topology:

The first step is to transfer data to peer-to-peer topologies. This trial was carried out in 10 hours (600 minutes), using 2 (two) computer units consisting of 1 (one) server and 1 (one) client. The computer specifications used are as follows:

a. Computer Server:

- 1) Processor Intel Pentium Dual-Core 2.20 GHz
- 2) RAM 2 GB
- 3) Hard Drive 320 GB

b. Computer Client :

- 1) Processor Intel Pentium Dual-Core 2.20 GHz
- 2) RAM 1 GB
- 3) Hard Drive 320 GB

c. UTP cable with speed 10 Base5 Cat 5

The results of the data transfer trial can be seen in table 1.

Table 1. First Phase Trial of Topology Peer To Peer

The First Stage		
Type Data	Capacity Data	Timespan What is needed in Data Transfer
Text data in .doc format	36.5 Mb 38,283,264 Byte 306266112 Bit	4 Second
Bit damage when transferring text data	1.5 Mb 1536 Kbyte 1572864 Byte 12582912 Bit	
Image data in .jpg format	61,9 Mb 63385,6 Kbyte 64906854,4 Byte 519254835,2 Bit	8 Second
Bit damage when transferring image data	2.5 Mb 2560 Kbyte 2621440 Byte 20971520 Bit	

Information :

- In the trial of transferring text data with a capacity of 36.5MB, it takes 4 seconds.
- During the process of transferring the text data, a bit error occurred at 12582912 Bit. See the bit error (bit error) can be done by running the Ping 192.168.0 command? or right-clicking the text data and selecting properties
- In the trial transfer of image data (image) with a capacity of 61.9 Mb it takes a time (period) of 8 seconds.
- During the process of transferring image data (image) takes place a bit damage (bit error) of 20971520 Bit. See the bit error (bit error) can be done by running the Ping 192.168.0 command? or right-clicking the text data and selecting properties.

Star Topology

The next stage (second stage) is to test the transfer of data in the star topology. This trial was carried out in 10 hours (600 minutes), using 3 (three) computer units consisting of 1 (one) server and 2 (two) clients. The computer specifications used are as follows:

- Computer Server :
 - Processor Intel Pentium Dual-Core 2.20 GHz
 - RAM 2 GB
 - Hard Drive 320 GB
- Client 1 :
 - Processor Intel Pentium Dual-Core 2.20 GHz
 - RAM 1 GB
 - Hard Drive 320 GB
- Client 2 :
 - Processor Intel Pentium Dual-Core 2.20 GHz
 - RAM 1 GB
 - Hard Drive 320 GB
- UTP cable with speed 10 Base5 Cat 5
- Switch 8 Port D-Link 10/100

The results of the data transfer trial can be seen in table 2.

Table 2 Second Phase Trial of Star Topology

Second Stage		
Type Data	Capacity Data	Timespan What is needed in Data Transfer
Text data in .doc format	36.5 Mb 37376 Kbyte 38273024 Byte 306184192 Bit	7 Second
Bit damage when transferring text data	2,1 Mb 21504 Kbyte 22020096 Byte 176061768 Bit	
Image data in .jpg format	61,9 Mb 63385,6 Kbyte 64906854 Byte 519254835,2 Bit	15 Second
Bit damage when transferring image data	3,7 Mb 3788,8 Kbyte 3879731,2 Byte 31037849,6 Bit	

Information :

- In a trial of transferring text data with a capacity of 36.5MB, it takes (7 seconds) time.
- During the process of transferring the text data there is a bit error of 176061768 Bit. See the bit error (bit error) can be done by running the Ping 192.168.0 command? or right-clicking the text data and selecting properties

- In the trial transfer of image data (image) with a capacity of 61.9 Mb it takes a time (period) of 15 seconds.
- During the process of transferring image data (image) takes place a bit damage (bit error) of 31037849.6 Bit. See the bit error (bit error) can be done by running the Ping 192.168.0 command? or right-clicking the text data and selecting properties.

Availability

To obtain availability value, data transfer and monitoring availability are first performed. Monitoring availability can be done in 2 ways, namely:

- Manual
The manual method here is that the network admin monitors network activity working within a certain period, for example, 5 hours, 10 hours, or 24 hours.
- CleverEye Tool
The clever eye tool is an application that serves to evaluate LAN performance in terms of availability and response time. In the study, the authors used the CleverEyes Tool. The CleverEye Tool will display a graph of availability changes every 3 hours. The CleverEye tool will produce valid Uptime and Downtime values, this is very different from the manual method.

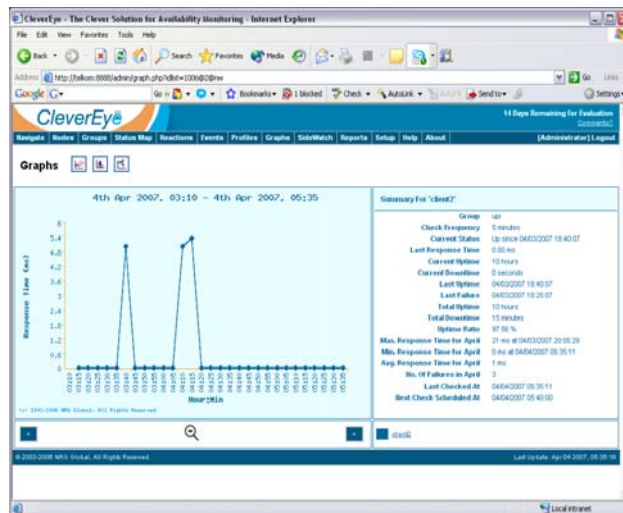


Fig 2. The Process of Monitoring Availability in topology Peer To Peer

Caption 2:

In the CleverEye tool window, you can see the availability monitoring process, such as:

- Current Status: Up since 04/03/2007 18: 40/07, indicates the date and time of the beginning of the availability monitoring process.
- Total Uptime: 10 hours, showing the length of time (hours) of the monitoring process availability.
- Total Downtime: 15 minutes, indicating the length of time (minutes) of the availability monitoring process.
- Last Update: Apr 04, 2007, 05:35:18, shows the time of the last data update carried out during the monitoring process.

From the results of monitoring availability using the CleverEye Tool, it can be seen that the result of Uptime is 10 hours (600 minutes) and Downtime is 15 minutes. The results of Uptime and Downtime are then calculated using the formula:

$$= \frac{600}{(600+15)} \times 100\% \times 100\%$$

$$= \frac{600}{6015}$$

$$= 97,5 \%$$

Reliability

From the results of data transfer using a peer-to-peer topology, followed by evaluating the results of data transfer by entering the value or the results of data transfer using reliability.

Peer to peer topology

Text data type with a capacity of 36.5MB (306266112 Bit)

$$= \frac{306266112}{4} = 76566528$$

$$= 0,041$$

$$= 4,1 \%$$

Image data type with a capacity of 61.9MB (519254835.2 Bit)

$$= \frac{519254835,2}{8} = 64906854,4$$

$$= 0,040$$

$$= 4 \%$$

Response Time

From the results of data transfer using a peer-to-peer topology, proceed with evaluating the results of the data transfer by entering the value or using the response time.

Peer to peer topology

Text data type with a capacity of 36.5MB (306266112Bit)

$$= 3 + 1,70 + 10$$

$$= 14,7 \text{ Second}$$

Information :

- Value 3, is movement from terminal to host using TCP / IP protocol where TCP / IP protocol sends: 1 = IP Address, 2 = Subnet mask and 3 = Gateway.
- Value 1.70, is the speed or specification of the server computer.
- Value 10, is the speed of the 10BaseT UTP cable.

Image data type with a capacity of 61.9MB (519782312 Bit)

Response Time = Time of movement from terminal to host + processing time that occurs at the host + return time to the terminal

$$= 3 + 1,70 + 10$$

$$= 14,7 \text{ Second}$$

Information :

- a) Value 3, is movement from terminal to host using TCP / IP protocol where TCP / IP protocol sends: 1 = IP Address, 2 = Subnet mask and 3 = Gateway.
- b) Value 1.70, is the speed or specification of the server computer.
- c) Value 10, is the speed of the 10BaseT UTP cable.

Throughput

From the results of data transfer using a peer-to-peer topology, followed by evaluating the results of the data transfer by entering values or results using throughput.

Peer to peer topology

Text data type with a capacity of 36.5MB (306266112 Bit)

$$= \frac{306266112}{4} = 76566528$$

$$= 76566528 \text{ Bit per second}$$

Image data type with a capacity of 61.9MB (519254835.2 Bit)

$$= \frac{519254835,2}{8} = 64906854,4$$

$$= 64906854,4 \text{ Bit per second}$$

Availability

To obtain availability value, data transfer and monitoring availability are first performed. Monitoring availability can be done in 2 ways, namely:

- Manual
The manual method here is that the network admin monitors network activity working within a certain period, for example, 5 hours, 10 hours, or 24 hours.
- CleverEye Tool
The clever eye tool is an application that serves to evaluate LAN performance in terms of availability and response time. In the study, the authors used the CleverEyes Tool. The CleverEye Tool will display a graph of availability changes every 3 hours. The CleverEye tool will produce valid Uptime and Downtime values, this is very different from the manual method.

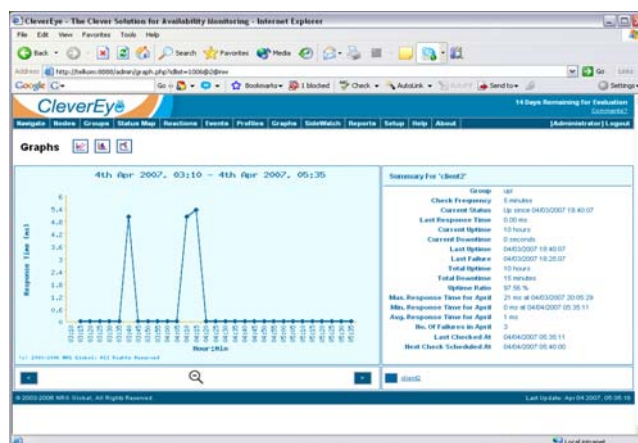


Fig 3. Process of Monitoring Availability in Star Topology

Caption 3:

In the CleverEye tool window, you can see the availability monitoring process, such as:

- Current Status: Up since 04/03/2007 18: 40/07, indicates the date and time of the beginning of the availability monitoring process.
- Total Uptime: 10 hours, showing the length of time (hours) of the monitoring process availability.
- Total Downtime: 15 minutes, indicating the length of time (minutes) of the availability monitoring process.
- Last Update: Apr 04, 2007, 05:35:18, shows the time of the last data update carried out during the monitoring process.

From the results of monitoring availability using the CleverEye Tool, it can be seen that the result of Uptime is 10 hours (600 minutes) and Downtime is 15 minutes. The results of Uptime and Downtime are then calculated using the formula:

$$= \frac{600}{(600+15)} \times 100\%$$

$$= \frac{600}{615} \times 100\%$$

$$= 97,5 \%$$

Reliability

From the results of data transfer using the star topology, followed by evaluating the results of the data transfer by entering values or using reliability.

Star topology

Text data type with a capacity of 36.5MB (306184192 Bit)

$$= \frac{306184192}{4} = 76546048$$

$$\begin{aligned}
 &= \frac{306184192}{519254835,2} \\
 &= 0.575 \\
 &= 57,5 \%
 \end{aligned}$$

Type of image data with capacity 61,9 MB (519254835,2 Bit)

$$\begin{aligned}
 &= \frac{31037849,6}{519254835,2} \\
 &= 0.059 \\
 &= 5,9 \%
 \end{aligned}$$

Response Time

From the results of data transfer using the star topology, followed by evaluating the results of the data transfer by entering a value or using the response time.

Star topology

Text data type with a capacity of 36.5MB (519254835.2 Bit)

$$\begin{aligned}
 &= 3 + 2,8 + 10 \\
 &= 15,8 \text{ Second}
 \end{aligned}$$

Information :

- a) Value 3, is movement from terminal to host using TCP / IP protocol where TCP / IP protocol sends: 1 = IP Address, 2 = Subnet mask and 3 = Gateway.
- b) Value 2.8, is the speed or specification of the server computer.
- c) Value 10, is the speed of the 10BaseT UTP cable.

Image data type with a capacity of 61.9MB (519254835.2 Bit)

$$\begin{aligned}
 &= 3 + 2,8 + 10 \\
 &= 15,8 \text{ Second}
 \end{aligned}$$

Throughput

From the results of data transfer using the star topology, followed by evaluating the results of data transfer by entering values or using results throughput.

Star topology

Text data type with a capacity of 36.5MB (306184192 Bit)

$$\begin{aligned}
 &= \frac{306184192}{7} \\
 &= 43740598,857 \text{ Bit per second}
 \end{aligned}$$

Type of image data with capacity 61,9 MB (519254835,2 Bit)

$$\begin{aligned}
 &= \frac{519254835,2}{15} \\
 &= 34616989,013 \text{ Bit per second}
 \end{aligned}$$

From the results of data transfer and calculation using the criteria of availability, reliability, response time, and throughput, the results are obtained in table 3 and table 4.

Table 3 LAN Performance Evaluation Results Peer To Peer Topology

A. Peer to Peer Topology			
Text Data	Results	Image Data	Results
Availability	97,5 %	Availability	97,5 %
Reliability	4,1 %	Reliability	4 %
Response Time	14,7 Second	Response Time	14,7 Second
Throughput	76566528 Bps	Throughput	64906854, 4 Bps

Description of Table 3:

- a) From the results of the trial transfer of text and image (image) data on the peer to peer topology can be seen the difference in results between:
- b) Availability of text data and image data is of the same value.
- c) Reliability of text data has a greater value than image data (image).

- d) Response time of text data and image data (image) is worth the same result.
- e) Text data throughput is smaller than the image data (image).

Table 4 LAN Performance Evaluation Results Star Topology

B. Star Topology			
Text Data	Results	Image Data	Results
Availability	97,5 %	Availability	97,5 %
Reliability	57,5 %	Reliability	5,9 %
Response Time	15,8 Second	Response Time	15,8 Second
Throughput	43740598,85 7 Bps	Throughput	3461698 9,13 Bps

Description of Table 4:

From the results of the trial transfer of text and image (image) data on the peer to peer, topology can be seen in the difference in results between:

- a) Availability of text data and image data is of the same value.
- b) Reliability of text data has a greater value than image data (image).
- c) Response time of text data and image data (image) is worth the same result.
- d) Text data throughput is smaller than the image data (image).

Availability Chart

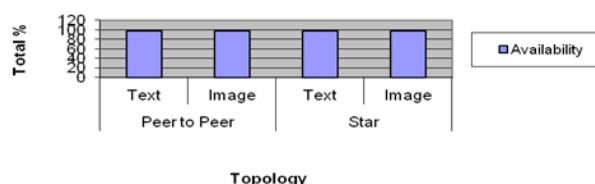


Fig 4. Graph Comparison of Availability of Topology of Peer to Peer and Star

Figure 4, the difference in availability performance between text data and image data (image) in the peer-to-peer topology and star topology. The value (%) between availability that occurs in the peer-to-peer topology and the star topology has the same availability value, which is worth 97.5%. This shows that for the same 10 hours there is uptime and downtime.

Reliability Chart

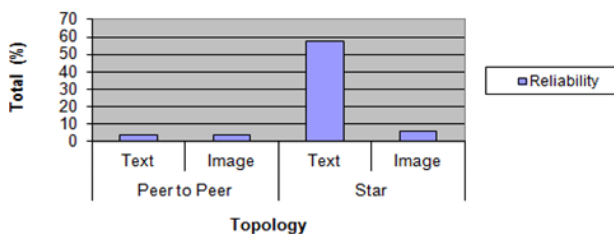


Figure 5 Graph Comparison of Reliability in Peer To Peer and Star Topologies

In Figure 5, there are differences in reliability performance between peer-to-peer topologies and star topologies. The value (%) between reliability that occurs in text data and image data (image) in the peer-to-peer topology and star topology has different reliability values.

Response Time Chart

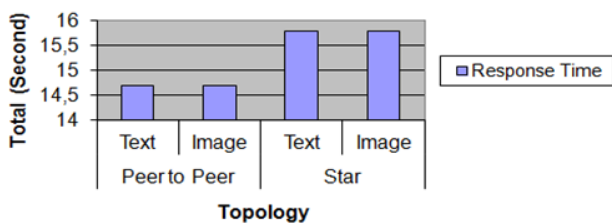


Fig 6 Graph Comparison of Response Time in Peer To Peer and Star Topologies

In Figure 6, the difference in response time performance between text data and image data (image) in the peer-to-peer topology and star topology. The value (second) between response time in the peer-to-peer topology with the star is very different.

Throughput Chart

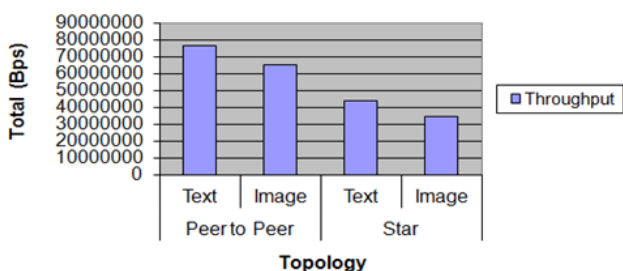


Figure 7 Throughput Comparison Chart of Peer To Peer and Star

In Figure 7, there are differences in throughput performance between text data and image data (image) in the peer-to-peer topology and star topology. The value (Bps) between peer-to-peer and star topologies is very different, especially in text and image data. Text data shows a high-value graph, while image data shows a graph of value less below the graph of the text data value.

Conclusion

1. Transfer of text data and transfer of image data (image) to the peer-to-peer topology in getting a quite different period, where the period of text data is faster than the image data (image).
2. Transfer of text data and transfer of image data (image) to the star topology in getting a quite different

period, where the period of text data is faster than the image data (image).

3. Availability value if it shows that it is getting smaller or not at all, the LAN performance will be better. To get a value (%) availability, a tool that can monitor the availability of LAN is needed, namely CleverEye.
4. Reliability value, if it shows higher the LAN performance will be better.
5. Value of response time, if it shows smaller, the LAN performance will be better. Nilai *throughput*, apabila menunjukkan semakin tinggi maka performansi LAN akan semakin baik.

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