Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 7, Number 2, April 2023
DOI : https://doi.org/10.33395/sinkron.v8i2.12341
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Implementation of IPv6 using 6RD Method on Power Line Communication Network

Yasir Al-Farizi Siregar[1)*], Rahmat Suhatman[2)]
[1,2)]Politeknik Caltex Riau Pekanbaru, Riau, Indonesia
[1)] yasir22trk@mahasiswa.pcr.ac.id [2)] rahmat@pcr.ac.id

Submitted : Apr 7, 2023 | **Accepted** : Apr 29, 2023 | **Published** : May 1, 2023

Abstrak: The development of computer network technology is rapidly advancing in response to society's increasing demand for network services. Currently, the most widely used network protocol is IPv4, but it has some limitations. To address these limitations, a new network protocol, IPv6, has been developed. More and more new network devices are using IPv6 as their IP address, while many existing technologies and internet devices still use IPv4. Therefore, a mechanism is required to transition from IPv4 to IPv6. The 6RD tunneling method is used in Power Line Communication networks to connect two or more network devices using electrical wiring as a data transmission medium. The Power Line is equipped with a charger for a laptop and a drill, creating a load to test the performance of the Quality of Service(QoS) with the throughput parameter. The measured Rerate throughput upload was 11800 Kbit/s without any additional electrical load, 9377.8 Kbit/s with a laptop charger as an additional load, and 6082.2 Kbit/s with a drill as an additional load. The Rerate throughput download was 8098.8 Kbit/s without any additional electrical load, 7782.8 Kbit/s with a laptop charger as an additional load, and 5996 Kbit/s with a laptop charger and a drill as additional loads. With this transition mechanism, IPv4 can communicate with IPv6, allowing for more efficient network communication.

Keyword: 6RD tunneling method, IPv4, IPv6, Power Line Communication Quality of Service (QoS)

INTRODUCTION

Data communication using UTP cable provides better stability and higher throughput compared to signal transmission and simulated transmission channels using cables or power lines with their load characteristics (Rosanto, Satoto, & Rochim, 2009).

The performance of automatic IPv6-in-IPv4 tunneling methods such as 6rd, 6to4, and ISATAP was compared to native IPv6 in streaming audio. It was found that the 6to6 and 6rd methods had a lower performance of 0.16%, while the ISATAP tunneling method had an even lower performance of 0.75%. This was due to the datagram size that had to be received by the host, which reached 1410 bytes, almost reaching the limit that could be transmitted without packet fragmentation. For the 6to4 and 6RD methods, although they had a 20-byte overhead, their performance was better because the datagram was first decapsulated at the host before being sent. although automatic IPv6-in-IPv4 tunneling methods can be used as a transition to IPv6, their performance may not be as good as native IPv6, especially for applications that require high performance such as streaming audio. Therefore, the evaluation of different tunneling methods needs to be carefully considered and the most suitable one should be chosen for specific application needs. (Yoon, Park, Choi, & Kahng, 2012).

Power line networks can be utilized for data transmission with varying range capabilities for LAN and internet applications. The range that can be used for the PLC system cannot be determined

*name of corresponding author

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precisely but based on experiments, it can still be used at distances of 300-400 meters (cable length). The varying range is caused by the varying cable characteristics and the influence of internal channel interference, which is caused by the current flowing through the cable (Suharjo, 2009).

For the transition mechanism of the protocol from IPv4 to IPv6 using the 6rd tunneling mechanism, the applications used for both mechanisms were Winbox and Ubuntu (Muhammad Ikhsan Rivki Azhar, 2019).

LITERATURE REVIEW

When two computers can exchange data/information, they are considered connected. Information can be transmitted in various forms such as text, audio, and video through wired or wireless media. Computer networks allow users to easily share and access files, increasing productivity and collaboration. Knowledge of fundamental network concepts, media, and protocols for data transfer is important for ensuring secure and reliable communication between connected devices. As technology advances, computer networking is becoming increasingly important and in-demand. (Introduction to Computer Networks, Melwan Syafrizal, Andi Offset, Jogja 2005)

Whenever a router receives a packet, it will sort the packet to determine the protocol used, and then the router will forward it to the layer above. The gradual transition phase from IPv4 to IPv6 and the implementation of IPv6 with IPv4 during an unpredictable gap requires a mechanism for IPv4 to IPv6 transition. With this transition, IPv4 will be able to communicate with IPv6. (Ria Puspita Sari, Bagus Arianandhika, Tiyas Agustina, 2014)

6rd tunneling is a transition mechanism used by some service providers to quickly deploy IPv6 to customers using IPv6 on existing IPv4 infrastructure. 6rd tunneling uses the same operating principle as 6to4 tunneling. 6rd tunneling uses different prefixes for each service provider. (Khalid EL Khadiri, 2018)

The maximum speed achieved using this technology is approximately close to the data transmission speed using fiber optic connections, ranging from 256 Kbit/s to 45 Mbit/s. The theoretical distance is up to 300 meters of cable length, but in practice, it is around 100 meters or less. PLC technology promises rapid growth in telecommunications services. It is not a new idea to use communication through power cable networks. PLC technology makes it possible to access data from the internet and telephone communication (Nisma Maulana, 2008)

Quality of Service (QoS) is a performance measurement unit of a transmission system that reflects the quality of transmission and the availability of services. The purpose of QoS is to provide guarantees on the network's ability to deliver services according to pre-estimated results or to meet the needs of various service. The following are the parameters used in evaluating QoS (Wardoyo, S., Ryadi, T., & Fahrizal, R., 2014):

METHOD

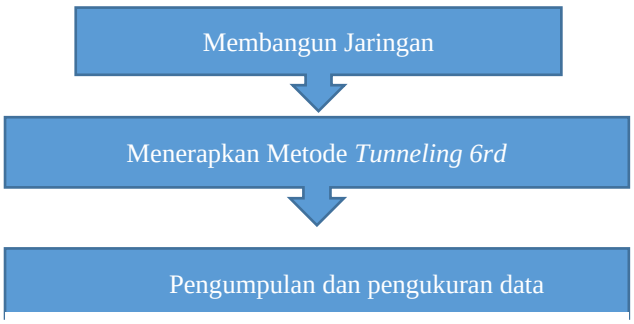

Figure 1.Block Diagram

This is a block diagram that illustrates the stages of the final project design. The first stage involves building a network by creating a tunneling 6rd network topology. The second stage is implementing the tunneling 6rd method. Once the method has been implemented, the final stage is data collection.

In this final project, the author conducted several testing methods as follows:

*name of corresponding author

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1. 6rd Tunneling Testing

Configuring the Server PC to have IPv6 and sending IPv6 to the Client. On the client side, it receives IPv6 and connects to the IPv6 network on the internet. The server uses a public IP provided by the PCR computer center and uses five clients for testing, where the client is given an IP by the server.

2. Power Line Communication Testing

Testing the 6rd Tunneling network using Power Line Communication where the electrical cable is used as the transmission medium for the IPv6 network. This traffic scenario uses a 10-meter long electrical cable, which is the best performing scenario, connected to a switch.

3. Performance Testing

Performance testing was carried out 5 times by downloading and uploading files to the FTP server, then adding additional loads such as laptop chargers and drills to the cable connected to the PLC, and then performing performance testing with 5 trials. This stage is for comparing the performance scenarios. In network testing of the 6rd Tunneling network using Power Line Communication, the FileZilla tool was used to observe QoS parameters. Some of the parameters measured include Throughput, which is the effective data transfer rate measured in bps. Throughput is calculated by dividing the total number of successfully received packets at the destination during a given interval by the duration of that interval. The throughput displayed in this measurement is the data throughput, and the average throughput obtained from 5 trials. Understanding these parameters enables better and more effective network measurement and management.

RESULT

In the previous chapter, a design for tunneling 6rd was presented in the project. As part of the project, data transfer activities, specifically uploading and downloading, were carried out. During these activities, data was collected to determine the throughput values using FileZilla as the upload and download media. As the data transfer was taking place, additional load was applied to the electric current in the Power Line Communication.

Here is the data center network topology that has been built along with the implemented address table in the final project.

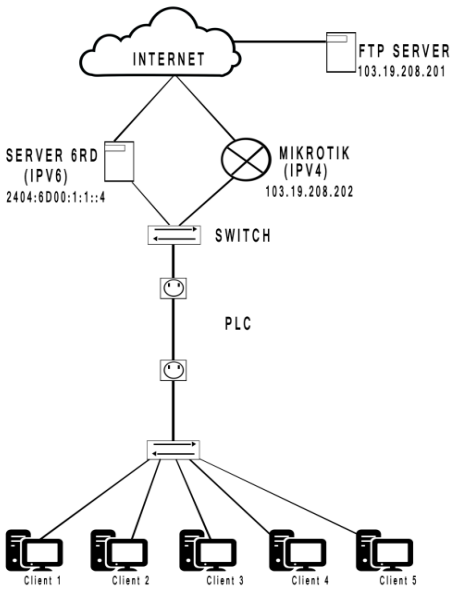

Figure 2. Topology

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The network architecture design that has been built in this final project is a design of the 6rd transition mechanism architecture. In this design, there is a 6rd server which works according IPv6 packets are sent by encapsulating them in IPv4 packets in the 6rd transition mechanism when they reach the 6rd server, it is decapsulated and forwarded as IPv6 traffic. After the client obtains an IPv6 address, it can access the internet through that IPv6 address. The client's IPv6 address is used to access the internet through Power Line Communication via electrical media. This research was conducted using 5 PCs (Personal Computers), 1 Powerline Communication device, 1 router, and 1 server PC.

The Implementation of Tunneling 6rd

In the figure 3, a simple topology of tunneling 6rd is presented. A PC Server Relay is used to distribute IPv6 allocation to clients. The PC server acts as an SP (Service Provider) in distributing the IPv6 allocation.

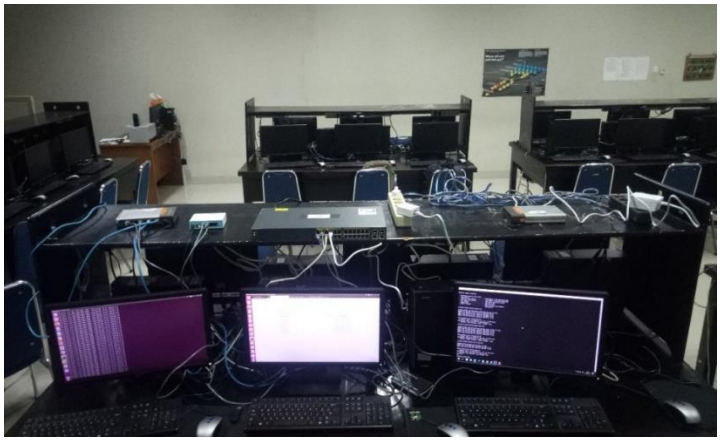

Figure3 Simple Tunneling 6RD Topology

Ping test for Tunneling 6RD Connection

Ping is short for Packet Internet Gropher, which is basically a command to check the response between the client and the target server, and ping is usually used to determine their status, whether normal or not. The way ping works is actually quite simple, where the client sends a packet, and the target server sends a response back to the client device as shown in the picture 4.

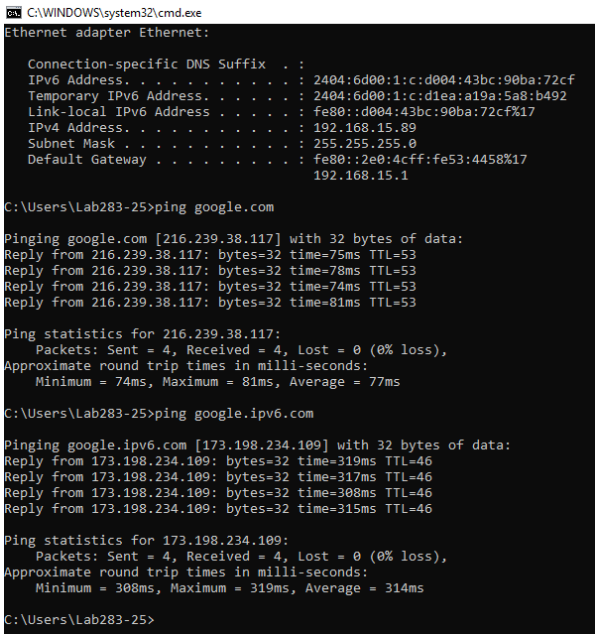

Figure 4. Test ping Tunneling 6RD

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FTP Server

FTP or File Transfer Protocol is an internet protocol that operates in the application layer and functions to exchange data between a client and server in a network. The application used to access FTP Server is FileZilla. The testing was carried out by accessing the FTP server by entering Host = 108.19.208.201, username = yasir, password = **, port = 21 as shown in Figure 5 to perform upload and download activities, and the result was successful.

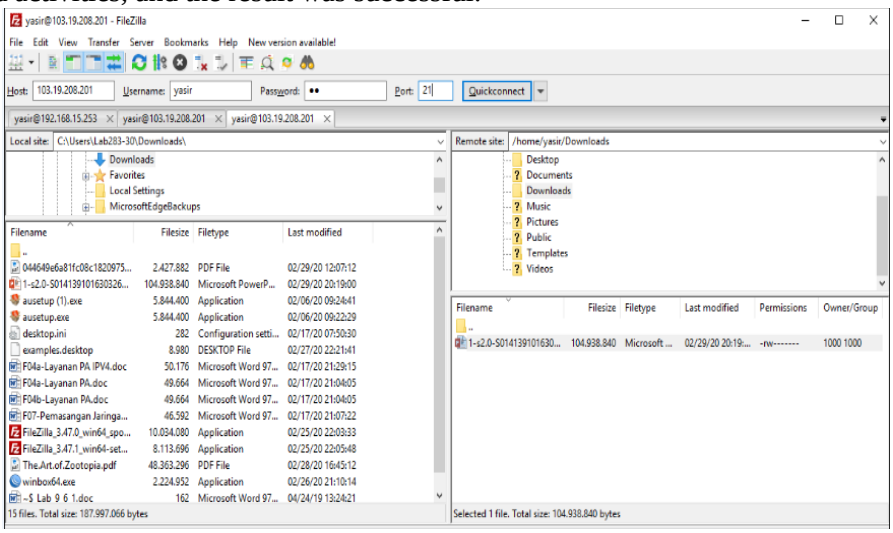

Figure 5. FTP

Performance Testing of Tunneling 6RD

Throughput

Throughput is the actual bandwidth measured at a certain time for a specific condition. QoS (Quality of Service) performance to see QoS parameters on the internet network using the 6rd method on a Power Line Communication-based network by adding an electrical load in the form of a Laptop charger and Drill on the Power Line Communication. When the client accesses the FTP Server and performs the upload and download process with a file size of 100 Mb, the measured parameter is throughput. The test is conducted 5 times, with an electrical load givwhich are different in each testing trial. The measurement of Throughput value can be done through the statistics menu on Wireshark.

Table 1. Testing Data of Throughput without Electrical Load

Pengujian	*Troughput (Kbit/s)*	
	Upload	Download
1	11000	7852
2	13000	12000
3	11000	8002
4	12000	10000
5	12000	11000
Jumlah	590000	40449
Rata-rata	11800	8089,8

"In Table 1, it shows the test results without adding any electrical load with an average upload speed of 11800 Kbit/s and a download speed of 8089.8 Kbit/s."

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Table 2. Test Data for Throughput with Laptop Chargers.

Pengujian	*Troughput (Kbit/s)*	
	Upload	Download
1	5887	4919
2	12000	9012
3	8002	7049
4	10000	8162
5	11000	9772
Jumlah	46889	38914
Rata-rata	9377,8	7782,8

In Table 2 the test was conducted to observe the effect of adding an electrical load in the form of a Laptop Charger on the average throughput. The results show an average upload speed of 9377.8 Kbit/s and a download speed of 7782.8 Kbit/s.

Table 3. Test Data for Throughput with Laptop Charger and Drill.

Pengujian	*Troughput (Kbit/s)*	
	Upload	Download
1	5355	2974
2	5299	4429
3	4141	5266
4	12000	8676
5	3613	8635
Jumlah	30411	29980
Rata-rata	6082,2	5996

In Table 3. the test was conducted to observe the effect of adding electrical loads in the form of a Laptop Charger and a Drill on the average throughput. The results show an average upload speed of 6082.2 Kbit/s and a download speed of 5996 Kbit/s.

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DISCUSSIONS

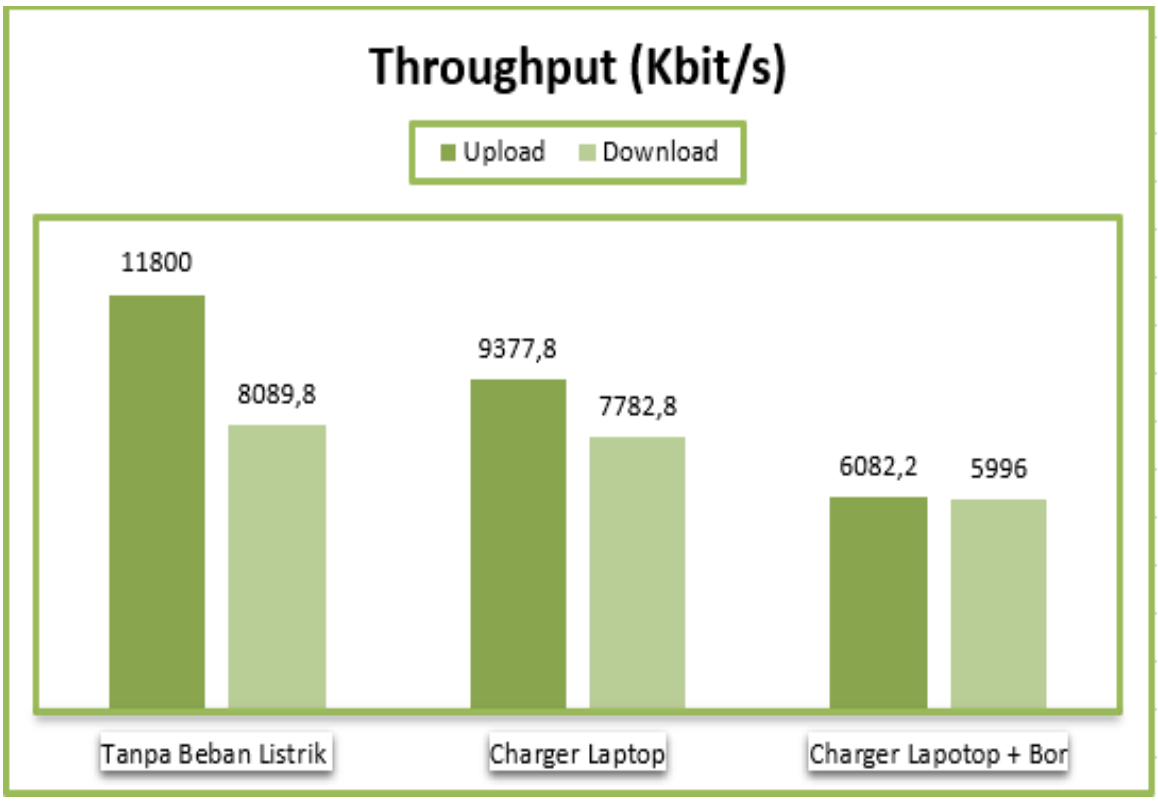

Figure 6. The average throughput.

By observing the throughput parameters during client's upload and download on an FTP server as shown in Figure 6, where the rerate download throughput without additional electrical load is 8098.8 kbit/s and the rerate upload throughput is 11800 kbit/s. The rerate download throughput with an additional electrical load in the form of a laptop charger is 9377.8 kbit/s, and the rerate upload throughput is 7782.8 kbit/s. The rerate download throughput with an additional electrical load in the form of a drill is 6082.2 kbit/s, and the rerate upload throughput is 5996 kbit/s. From the data in Figure 6, it can be concluded that the greater the electrical load connected to the Power Line Communication (PLC), the smaller the throughput and the slower the data transmission to the destination. Conversely, the fewer or no electrical loads connected to the PLC, the larger the throughput, and the faster the data transmission to the destination.

CONCLUSION

In 6rd tunneling, QoS performance has been compared by observing the parameter of throughput when the client uploads and downloads a file of 100MB on an FTP server. The rerate throughput download without additional electrical load is 8098.8 kbit/s and the rerate throughput upload is 11800 kbit/s. The rerate throughput download with electrical load in the form of an additional laptop charger is 9377.8 kbit/s and the rerate throughput upload is 7782.8kbit/s. The rerate throughput download with electrical load in the form of a drill is 6082.2 kbit/s and the rerate throughput upload is 5996 kbit/s. From the data in Figure 4.4, it can be concluded that the greater the electrical load given to Power Line Communication, the smaller the throughput and the slower the data sent to the destination. Conversely, the smaller or no load connected to PLC (Power Line Communication), the greater the throughput and the faster the data sent to the destination.

*name of corresponding author

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*name of corresponding author