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Analysis of the Influence of User Distance and Transmission Speed on Data Communication Network Performance

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Abstract: Analysis of the influence of user distance and transmission speed on data communication network performance is a scientific article with the aim of analyzing whether network performance affects user distance and data communication transmission speed. Qualitative method with a phenomenological approach, The phenomenological approach emphasizes the description of the subject's life experience from the participant's own perspective (phenomenology as a social research method). The results of this article are: 1) User distance affects data communication network performance, 2) Transmission speed affects data communication network performance. Apart from these 2 exogenous variables that affect the endogenous variable of signal quality, there are many other factors including LAN networks, communication obstacles, connection stability.

Keywords: User Distance, Transmission Speed, Network Performance, Data Communication.

INTRODUCTION

The development of data communication network technology continues to advance in line with the growing public demand for high-speed digital services, such as video streaming, online conferencing, and the Internet of Things (IoT). Data communication network performance is influenced by various factors, including transmission distance and transmission speed (Bedi & Grover, 2023).

One important factor is transmission distance, which affects signal attenuation, interference, and signal power degradation. The greater the distance between the sending and receiving devices, the lower the received signal quality, resulting in decreased throughput and increased delay (Fitrian et al., 2023). In wireless networks, this phenomenon also leads to reduced download and upload speeds (Garcia & Fraser, 2024).

In addition to distance, transmission speed also plays a crucial role in determining network performance. Transmission speed is influenced by the physical media, bandwidth, and the number of nodes or devices in the network (LearnLearn, n.d.). In ad hoc network research, increasing transmission speed has been shown to increase throughput, but also has the potential to increase delay if not balanced with adequate link capacity (Kabuatila, 2022).

Network performance is generally measured through parameters such as throughput, delay, packet loss, and jitter (Balafif & Qurrata Aini, 2022). Therefore, this study aims to analyze the effect of distance and transmission speed on data communication network performance, with the hope of providing a deeper understanding of the relationship between these parameters in the context of network design optimization.

This study aims to explain the experiences and meanings given to the influence of user distance and transmission speed on data communication network performance. Based on references to the problems described previously, the research questions are as follows:

1. Does user distance affect network performance?
2. Does transmission speed affect network performance?

METHOD

This research uses a qualitative method with a phenomenological approach. This method was chosen because the research objective is to understand real phenomena related to the influence of distance and transmission speed on data communication network performance in an applied context, rather than simply measuring statistical figures. Phenomenology allows researchers to explore the experiences, perceptions, and interactions of users or network devices with the network they use.

The phenomenological approach allows this research to capture the real dynamics of data communication network usage. This method is not limited to quantitative data alone but also takes into account real-world experiences and conditions, making the findings more relevant for effective network design and management.

RESULT AND DISCUSSION

Results

The results of this article based on the background of the problem, objectives, and methods are as follows:

Network Performance

(Fitrian et al., 2023) explains that data communication network performance includes parameters such as throughput, latency, packet loss, and jitter. A decrease in any of these parameters can impact overall network performance, especially in fiber-optic networks.

(Garcia & Fraser, 2024) state that the performance of wireless networks, such as Wi-Fi, is significantly affected by the distance between the device and the access point. The greater the distance, the greater the likelihood of decreased download and upload speeds, as well as increased latency.

(Balafif & Qurrata Aini, 2022) emphasize the importance of network performance analysis using Quality of Service (QoS) methods. QoS helps assess and ensure the quality of service provided by a data communication network, focusing on parameters such as delay, jitter, and packet loss.

Data communication network performance can be measured using several key indicators, namely: (Fitrian et al., 2023)

1) Throughput

Measuring the amount of data successfully transmitted in a given time unit, usually expressed in bits per second (bps).

2) Latency

The time it takes for data to travel from source to destination. High latency can cause delays in communication.

3) Packet Loss

The percentage of data packets lost during transmission. Packet loss can reduce the quality of network service.

4) Jitter

Variation in the arrival time of data packets. High jitter can affect the quality of real-time services such as VoIP and video conferencing.

Network Performance has been widely studied by previous researchers, including: (Rosid, Martanto, & Ali, I., 2023), (Sukendar, T., & Saputro, M, 2019), (Wibawa, M., 2017), (Sugiharto, A., & Alfi, 2018), (Romana et al., 2021), (Anam, K., & Adrian, R., 2017).

User Distance

(Naraswari et al., 2017), The distance between a WiFi user and the access point (AP) affects the received signal strength. The greater the distance between the user's device and the access point (AP), the weaker the received signal, which can reduce the quality of the internet connection. This demonstrates the importance of considering distance when designing a WiFi network to ensure optimal signal quality.

(Sulistyo et al., 2023), the distance between WiFi users is affected by the presence of physical obstructions such as walls and fences. Greater distance from the access point can result in poor WiFi signal coverage, resulting in internet connection interruptions. Adding a signal booster, such as the Mi WiFi Range Extender Pro, can extend signal coverage and address this issue.

User distance indicators according to (Naraswari et al., 2017):

1) Physical Distance between User and Access Point (AP)
   a. Measures how far the user's device is from the AP.
   b. The closer the distance, the higher the received signal strength.
2) Maximum Effective Distance
   a. The maximum distance at which a device can still receive a signal with minimal usable quality.
   b. If the distance exceeds this limit, the connection will weaken or drop.

Distance has been widely studied by previous researchers, including: (Syaljumairi, R., 2021), (Sulistyo et al., 2023), (Naraswari et al., 2017), (TRIHADMOJO, A. I., 2019), (Subchan, M., & Goeritno, A., 2017).

Transmission Speed

According to (Saputra, 2011), transmission speed is the amount of data that can be sent over a communication channel in a given time interval. Factors that influence transmission speed include the type of transmission medium (e.g., copper cable, fiber optic, or radio waves), the distance between devices, signal quality, and the communication protocol used. High transmission speeds allow data to be sent faster, reducing delays and increasing network efficiency, while low speeds can cause delays and service disruptions.

Furthermore, (Firmansyah et al., 2025) emphasize that transmission speed plays a critical role in determining the performance of data communication systems. Inadequate transmission speed can cause network bottlenecks, reduce throughput, and increase the probability of packet loss. This condition is particularly impactful for real-time applications such as video streaming, teleconferencing, or industrial control systems that require rapid response. Therefore, transmission speed is not only a technical parameter but also a critical indicator for assessing network quality of service (QoS).

Transmission speed is also affected by physical environmental conditions, such as device distance, electromagnetic interference, and signal attenuation. Adjusting these factors is necessary to optimize network performance, both in wired (LAN/Fiber) and wireless (WiFi, 4G/5G) networks. Therefore, transmission speed is a key variable that must be

considered in the design, management, and evaluation of data communication networks (Ramadhan, 2023).

Transmission speed can be measured using several key indicators (Saputra, 2011), namely: 1) Data Transmission Rate; 2) Effective Bandwidth; 3) Transmission Time; 4) Transmission Reliability.

Transmission Speed has been widely studied by previous researchers, including: (Ramadhan., & Wahyuningsih, 2023), (Agezi et al., 2022), (Aribowo et al., 2025), (Singh, P., & Sharma, 2023), (Al-Gumaei et al., 2017), (Maeda, K., & Fujita, H., 2018).

Discussion

a) User distance from data communication network performance

The distance between the user and the network access point is a critical factor affecting the performance of a data communications network. The greater the distance between the user's device and the network hub, the lower the received signal strength. According to (Saputra, 2011), this decrease in signal quality reduces data transmission speed and increases the likelihood of packet loss and jitter. Consequently, network performance decreases, resulting in a less than optimal user experience.

Furthermore, greater distance also increases data transmission delays. (Hadiningrum, 2020) explains that in wireless networks, increasing the distance between the user and the access point directly increases latency and packet loss. This is particularly problematic for real-time applications such as video conferencing or VoIP, which require fast and stable network response. Therefore, distance affects not only speed but also overall communication quality.

Performance degradation due to distance has also been observed in certain communications systems. (Basril, 2016) revealed that in an 1800 MHz communications system, downlink data access speeds decreased with increasing distance between the user and the base station. This speed reduction is caused by a weakening of the signal received by the device, resulting in reduced network throughput. These findings indicate that user distance is a critical factor in the design and placement of access points, particularly to ensure stable service quality.

Based on these studies, it can be concluded that the distance between the user and the access point significantly impacts data communication network performance. Distance affects transmission speed, delay, packet loss, and jitter, which collectively determine network service quality. Therefore, proper distance management between the user device and the access point is crucial for maintaining optimal network performance and meeting user needs, both on wireless and wired networks.

This research is in line with research conducted by: (Hadiningrum, 2020), (Basril, 2016), (Saputra, 2011), (Syaljumairi, R., 2021), (Sulistyo et al., 2023), (Naraswari et al., 2017), (Trihadmojo, A. I., 2019), (Subchan, M., & Goeritno, A., 2017), (Rosid, Martanto, & Ali, I., 2023), (Sukendar, T., & Saputro, M, 2019), (Wibawa, M., 2017), (Sugiharto, A., & Alfi, 2018), (Romana et al., 2021), (Anam, K., & Adrian, R., 2017).

b) Transmission speed on data communication network performance

Transmission speed is one of the main factors determining the performance of a data communications network. According to (Saputra, 2011), transmission speed is the rate at which data is sent from sender to receiver in a given unit of time. The higher the available transmission speed, the faster data can be sent, thereby increasing network throughput and reducing latency. This directly impacts network efficiency and user experience, especially in applications that require fast data transfer, such as video streaming and real-time systems.

Furthermore, (Firmansyah et al., 2025) explain that low transmission speed can act as a bottleneck in the network, causing reduced throughput and increased likelihood of packet loss. Inadequate transmission speed will cause data to accumulate on the network, increasing delays and degrading service quality. This phenomenon is particularly evident in networks with many users or high traffic, where the limited transmission rate cannot meet the simultaneous data transfer demand.

(Ramadhan, 2023) adds that transmission speed is also influenced by environmental factors and the quality of the transmission media. For example, in fiber optic networks, high transmission speeds can be achieved with minimal signal attenuation, while in wireless networks, interference and user distance can limit effective speeds. Therefore, transmission speed is determined not only by device capabilities but also by the physical conditions and configuration of the existing network.

Based on these studies, it can be concluded that transmission speed has a significant impact on data communication network performance. Transmission speed affects key parameters such as throughput, delay, and packet loss, which determine the quality of network service. Therefore, optimal transmission speed management is crucial to maintaining stable network performance and meeting user needs, both on wired and wireless networks.

This research is in line with research conducted by: (Ramadhan, 2023), (Firmansyah et al., 2025), (Saputra, 2011), (Rosid, Martanto, & Ali, I., 2023), (Sukendar, T., & Saputro, M, 2019), (Wibawa, M., 2017), (Sugiharto, A., & Alfi, 2018), (Romana et al., 2021), (Anam, K., & Adrian, R., 2017), (Ramadhan., & Wahyuningsih, 2023), (Agezi et al., 2022), (Aribowo et al., 2025), (Singh, P., & Sharma, 2023), (Al-Gumaei et al., 2017), (Maeda, K., & Fujita, H., 2018).

Conceptual Framework

Based on the formulation of the problem, theoretical studies, relevant previous research and discussion of the influence between variables, the framework for thinking in this article is obtained as below.

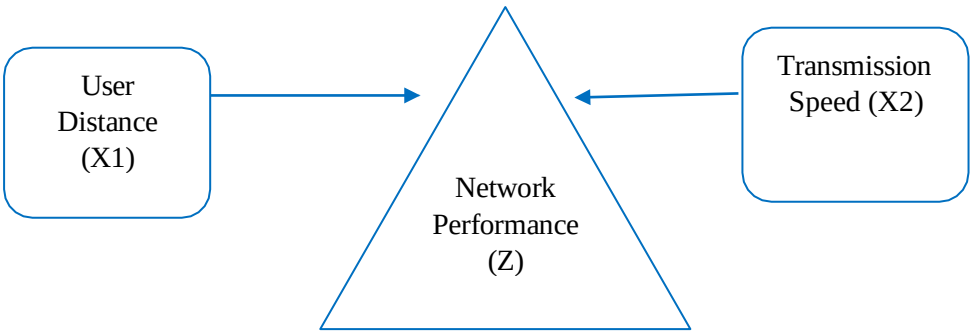


Figure 1. Conceptual Framework

And there are many other factors that influence network performance (Z), including:

a) LAN Network : (Sukendar., & Saputro, 2019), (Sandova., & Prihantoro, 2021), (Rizky et al., 2020), (Nugroho et al., 2018), (Hasanah et al., 2014).
b) Network Obstacles : (Alfi, I., & Saputro, 2018), (Nurdianti, S., 2014), (Yudhistira & Trihastuti, 2023), (Aisyah, S., 2021).
c) Connection Stability : (Saputra et al., 2024), (Praditya, M. F., & Arifin, 2025), (Muryanto et al., 2025).

CONCLUSION

This study aims to determine whether user distance and transmission speed affect the performance of data communication networks. Based on the article's questions, the

following conclusions can be drawn from this study: 1) User distance affects the performance of data communication networks, 2) Transmission speed affects the performance of data communication networks.

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