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Analysis of 5G Network Quality of Service on VoIP Application

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Abstract — Based on the results of the research conducted, it can be concluded that the 5G network at Airport shows excellent performance in supporting the use of VoIP applications such as Instagram, WhatsApp, and Zoom. This is indicated by a consistent category 4 index on all measured parameters, namely throughput, packet loss, delay, and jitter. In terms of throughput, although there are variations between the three apps, all values are still sufficient to support voice and video calls with good quality. In fact, the lower throughput value on the Zoom app does not mean that the video call quality is poor, especially for one-on-one calls or with few participants. Furthermore, the absence of packet loss in all three applications indicates excellent connection stability. This is an important indicator showing that all the data sent and received by the apps made it to their destination without being lost midway, which is essential for ensuring clear voice and video quality. Meanwhile, very low delay and jitter indicate that data transmission is fast and consistent. This is especially important for real-time communications such as video calls, where delays or variations in the arrival time of data packets can disrupt call quality. Overall, the results of this study show that the 5G network at Airport is capable of supporting the use of VoIP applications with good quality. This is an important finding, given the importance of VoIP in everyday life, both for personal and professional communication. Therefore, this research hopes to make an important contribution in understanding and maximizing the potential of 5G network in supporting VoIP communication at Airport.

Keywords: Analysis, Comparison, QoS.

INTRODUCTION

The world's global network certainly already knows what is called the internet. Data, Information, and even Privacy have become an inseparable part of the internet. Accessing the internet, almost the same as browsing the world's information. In this day and age, the internet is no longer an additional need but rather a basic need for entrepreneurs, students, and various parties [1]. People are used to spending most of their time using quotas for social media, such as WhatsApp, Instagram as a social media channel, and also applications such as zoom for study and even online work meetings [2]. Applications that are spread among the community are also very dependent on the internet network. So, without realizing it, the use of the internet is part of our daily lives. Since the Covid-19 pandemic, most people spend their lives on the internet, so Covid-19 has bridged the rapid increase in the use of social media / internet media, the existence of a distance learning system (online) proves that this pandemic focuses on

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shifting learning from conventional to distance or online (in the network) [3]. Due to the impact of the pandemic, the development of telecommunications networks is also accelerating. There is a noticeable growth in wireless networking or commonly known as wireless. 5G is the fifth generation of wireless networks used in Indonesia today, 5G is the fifth generation of wireless cellular technology, which offers higher upload and download speeds, more consistent connections, and increased capacity compared to previous networks. 5G is much faster and more reliable than today's popular 4G networks and has the potential to change the way we use the internet to access apps, social networks, and information. For example, technologies such as self-driving cars, advanced gaming applications, and live streaming media that require highly reliable high-speed data connections will benefit greatly from 5G connectivity [4][5].

The development of digital technology today has a positive impact on life. The existence of the internet makes it easy for us to get information anytime and anywhere. One of the applications of the internet in technological developments is the existence of data transmission technology in various media both radio and television [6]. The development of 5G is expected to improve the quality of service access networks to be more optimal, in addition to the emergence of new mobile applications that are growing so rapidly. Like previous cellular networks, 5G technology uses mobile sites that transmit data via radio waves. Mobile sites connect to the network with wireless technology or a wired connection. 5G technology works by modifying the way data is encoded, significantly increasing the amount of airwaves it can use for operators [7]. Good network quality is certainly a reference for network users for a service, therefore to find out the quality of the 5G network used to access certain online media applications will be measured and analyzed using QoS (Quality of Service). This is an effort to find out whether a provider's performance on streaming services is good or bad [8].

Quality of Service is a method of measuring the quality of a network service and is an attempt to explain the characteristics of a network service. The definition of QoS has many versions and opinions, as expressed by related research, namely QoS is a set of several qualities or properties of services such as: Availability, Security Properties, Response Time, and Throughput. QoS is designed to help end users (clients) become more productive by ensuring that users get reliable performance from network-based applications. QoS refers to a network's ability to provide better service to specific network traffic through different technologies. [9][10][11]. QoS capability refers to the level of speed and reliability of delivering various types of data loads in a communication. Its capability is a collection of several technical quantity parameters, namely: 1). Throughput, which is the speed (rate) of effective data transfer, which is measured in bps. Throughput is the total number of successful packet arrivals observed at the destination during a given time interval divided by the duration of that time interval. 2). Delay is the total time that a packet passes from sender to receiver over the network. The delay from sender to receiver is basically composed of hardware latency, access delay, and transmission delay. The delay most often experienced by passing traffic is transmission delay. 3). Jitter is a variation of end-to-end delay. High levels of jitter in UDP-based applications are an unacceptable situation where the applications are real-time applications, such as audio and video signals. In such cases, Jitter will cause the signal to be distorted, which can be fixed simply by increasing the buffer in the queue. In research conducted by Fahmi, H. et al, 2018 a comparison was made between 3 different providers, with 5 activities, namely downloading, uploading, streaming YouTube videos, playing games, browsing the web. The comparison results are throughput, packet loss, delay, and jitter. Throughput is the time taken by a data packet from the time of transmission by the transmitter until it is received by the receiver, delay/latency is the difference in the arrival time interval between packets at the destination, packet loss is the number of packets lost during the transmission process, jitter is the number of bits received per second through a system or communication medium [12]. In this paper, the author will discuss the quality of service (QoS) analysis of the 5G network in VoIP applications at Airport. This research was conducted during peak hours, namely 2 to 4 pm and using 5G public WIFI. In the context of a significant increase in the use of social media and online applications, as well as the acceleration of telecommunications network development triggered by the pandemic, this study aims to provide a deep understanding. Given the importance of VoIP in everyday life, both for personal and professional communication, this

study will focus on analyzing the performance of 5G networks available to the public at Airport in supporting VoIP applications such as Instagram, WhatsApp, and Zoom. Through measurement and analysis of throughput, packet loss, delay, and jitter, this study hopes to provide a better understanding of how the 5G network at Airport can support VoIP use and how this can affect the user experience. Thus, this research hopes to make an important contribution in understanding and maximizing the potential of 5G networks in supporting VoIP communication at Airport. Research conducted using a free application that can be downloaded freely. The application used by researchers is Wireshark. Wireshark is an open source application that functions to analyze network performance and control data traffic on managed networks. This application is very useful for analyzing various types of packet information in various different protocols, making it very easy to troubleshoot. QoS testing was conducted using an Acer Nitro 5 AN515-56 laptop. This laptop has a 2.6GHz Quad-Core Intel Core i5-11300H Processor with Turbo Boost up to 4.4GHz, 8GB DDR4 ram, 512GB PCIe NVMe SSD storage, and connectivity using WIFI 6 (802.11ax). The device that the researcher uses is considered sufficient in terms of processor devices is the reason researchers use only one device and are easy to move.

METHOD

QoS measurement can be done according to the following steps: a) Read the evaluation document to find problems that can be researched. b) Prepare a laptop containing the Wireshark application as a QoS parameter meter, WhatsApp, Instagram, and zoom applications as video call applications to be measured, as well as Telecommunication providers as translators of 5G services used. c) Measure QoS parameters for 3 streaming applications using the Wireshark application. d) Record the results of QoS parameters for each streaming application measured. e) Enter the results of the QoS parameters to be displayed in tables and graphs. Record the QoS parameter results for each streaming application measured. e) Enter the QoS parameter results to be displayed in tables and graphs. Summarize the results of QoS parameters with quality assessment according to TIPHON standards and draw conclusions. The quality of service measurement is done with a video of about 160 seconds. The reason we use a 160-second time limit is that it is considered sufficient to get an overview of QoS. This can help identify problems that arise in a relatively short time. Quality of service measurements were conducted in Pekanbaru, Riau during the daytime. The QoS parameter results were obtained using the following equations [13]. TIPHON (Telecommunications and Internet Protocol Harmonization Over Networks) is an industry forum established in 1996 to integrate telecommunications and Internet Protocol (IP) networks in order to provide better quality of service for users. The organization consists of companies, telecommunications operators, research institutions, and universities from around the world. Its goal is to develop technical specifications and standards that can be used to integrate telecommunications and IP networks, as well as facilitate coordination between parties involved in the development of related technologies [14]. This chapter discusses the methodology used in this research, specifically in analyzing the quality of service (QoS) of 5G networks in VoIP applications. One important aspect in this analysis is the use of several formulas that help us measure and evaluate network performance. To measure the quality of service on 5G networks with throughput can be determined using equation 1, The formula used is also obtained from related references [15].

$$\text{Throughput} = \frac{\text{Amount of Data Sent}}{Data\ Transmission\ Time} \quad (1)$$

Where; X and Y values are known, packet loss is calculated as equation (2),

$$\text{Packet Loss} = \frac{(X-Y)}{X} * 100\ \% \quad (2)$$

After funded all packet data, average delay is determinedusing the following equation (3),

$$\text{Average Delay} = \frac{\text{Total Delay}}{Total\ Packet\ Data\ Received} \quad (3)$$

and average jitter determined using the following equation(4),

$$\text{Average Jitter} = \frac{\text{Total Jitter}}{Total\ Packet\ Data\ Received} \quad (4)$$

After calculating throughput, packet loss, delay, and jitter with predetermined formulas, the next step in this research is to classify the category index based on the TIPHON (Telecommunications and Internet Protocol Harmonization Over Networks) standard. The TIPHON standard, developed by the European Telecommunications Standards Institute (ETSI), is used as a framework in this research to ensure the quality and interoperability of VoIP services. By using the TIPHON standard in category index classification, this research can provide an accurate picture of the quality of 5G networks in supporting VoIP applications and ensure that the analysis results are in accordance with recognized industry standards.

RESULT AND DISCUSSION

In this chapter, we delve into an in-depth exploration of the results derived from measuring and analysing the Quality of Service (QoS) of 5G networks on Voice over IP (VoIP) applications, specifically focusing on popular platforms such as Zoom, WhatsApp, and Instagram. These results are meticulously obtained by using Wireshark, a widely recognized and used network protocol analyser that allows us to view the finer details of network activities.

The data that has been gathered will be presented in a comprehensive manner using tables to make it easier to understand the complex details. This visual representation of data not only simplifies the complex details but also provides a clear overview of the 5G network performance metrics on these VoIP applications. Furthermore, the analysis of the data will be conducted based on the TIPHON (Telecommunications and Internet Protocol Harmonization Over Networks) standard, a benchmark created by the European Telecommunications Standards Institute (ETSI). This standard provides a robust framework for evaluating the QoS of VoIP services, ensuring that the analysis is both reliable and consistent with industry standards. By calculating and understanding the value of each QoS parameter, we aim to provide a comprehensive overview of how 5G networks influence the quality of service on VoIP applications. This discussion is intended to shed light on the intricacies of 5G network performance, and how it impacts the everyday use of VoIP applications, ultimately providing insights that could guide future network development and optimization strategies. As an example, we will show how these calculations are performed on the Zoom application. Throughput = 3.3 Mbps; Packet Loss = 0%; Average Delay = 5.4 ms; Average Jitter = 0,020726 ms.

In the context of video calls via the Zoom app or VoIP on the 5G network at the airport, the data obtained shows good connection quality. With a throughput of 3.3 Mbps, although lower than the maximum potential of the 5G network, this is still sufficient to make video calls with good quality. In addition, the absence of packet loss indicates excellent connection stability, which is important for ensuring clear voice and video quality. The average delay of 5.4 ms and jitter of 0.020726 ms, both very low, show that data transmission is fast and consistent, which is important for real-time communication such as video calls. Therefore, based on these data, it can be concluded that the quality of video calls over the 5G network at Airport should be excellent. The low throughput of the 5G network when making Zoom video calls at airports can be affected by several factors. First, the number of users connected simultaneously at the

airport may affect the network speed, even though 5G networks are designed to handle multiple users. Second, distance and physical obstacles, such as buildings or other objects, can affect network speed, given that 5G networks use higher frequencies with shorter coverage. Third, signal quality, which can be affected by factors such as weather, building conditions, and interference from other devices, can also affect network speed. Lastly, apps like Instagram may have speed limits to ensure consistent quality across different network types and conditions, so while the network may be capable of higher speeds, apps may not always utilize these full speeds. The quality of the can be influenced by the device in use. Network performance is influenced by various factors, including connectivity technology, memory capacity, and processor type. Faster data processing is made possible by a strong processor, which also makes it easier for services and apps to function. For intensive operations like streaming videos or playing online games, a large memory capacity of the device is vital because it allows the device to manage more data at once. Technology for connectivity is also crucial. When comparing devices that only support earlier standards to those that support the newest standards, like 5G or Wi-Fi 6, the latter often have reduced latency and can attain faster speeds. Additionally, better and more steady signals can be received by devices that enable technologies like MIMO (Multiple Input Multiple Output) or have high-quality antennas. Although the device being used can have an impact on network quality, a number of other factors also come into play, including the state of the network itself, the device's location, and the quantity of other users on the same network. The device being used has an impact on network quality in addition to external elements including signal quality, distance, physical barriers, and user count. In this context, the Acer Nitro 5 AN515-56 laptop used has an Intel Core i5-11300H Quad-Core 2.6GHz processor with Turbo Boost up to 4.4GHz that enables fast data processing, 8GB DDR4 RAM that enables efficient multitasking, and 512GB PCIe NVMe SSD storage that enables fast data access. Additionally, the laptop uses WIFI 6 (802.11ax) connectivity, which is designed to work well in environments with many connected devices and can provide higher speeds and lower latency compared to previous WIFI versions. However, additional variables like the distance from the router, the quantity of other devices connected to the network, and interference from other devices can also have an impact on the quality of the WIFI connection. Thus, despite the laptop's impressive specifications, a number of factors may still have an impact on the network quality.

Table 1. Throughput Of Each Streaming Application

	Throughput (kbps)	Index Category
Instagram	363.762	4
WhatsApp	108.690	4
Zoom	3263	4

Instagram, WhatsApp, and Zoom have significant variations in throughput. Instagram, with a throughput of 363,762 kbps, performed well, enough to support voice and video calls with adequate quality. WhatsApp, despite having a lower throughput of 108,690 kbps, can still function well for video calls. Meanwhile, Zoom, with a throughput of 3,263 kbps, which is much lower compared to the other two apps, may experience quality degradation in video calls, especially in group calls with multiple participants or high-resolution videos. However, for one-on-one video calls or those with few participants, Zoom should still be able to function well. Keep in mind that the throughput required by each application will largely depend on the type and volume of data being transmitted.

Table 2. Packet Loss each Streaming Application

	Packet Loss (%)	Index Category
Instagram	0%	4
WhatsApp	0%	4
Zoom	0%	4

Instagram, WhatsApp, and Zoom had no packet loss on all three apps. The absence of packet loss indicates that all data sent and received by these apps made it to their destination without being lost midway, which is important for ensuring good voice and video call quality. The category 4 index for all three apps indicates that the network quality for all three apps is in the same category. Overall, the absence of packet loss in all three applications indicates that your 5G network is functioning properly and can support VoIP usage with good quality.

Table 3. Delay each Streaming Application.

	Delay (ms)	Index Category
Instagram	0.002866601	4
WhatsApp	0.007302721	4
Zoom	0.054695074	4

Instagram, WhatsApp, and Zoom have very low delays on all three apps. Instagram, with a delay of 0.002866601 ms, and WhatsApp, with a delay of 0.007302721 ms, showed excellent performance with little to no latency in data transmission, which is important for ensuring good voice and video call quality, as well as for uploading and downloading media content smoothly. Meanwhile, Zoom, with a delay of 0.054695074 ms, although slightly higher, is still considered low and should not significantly affect call quality. The category 4 index for all three apps indicates that the network quality for all three apps is in the same category. Overall, this low delay indicates that your 5G network is functioning well and can support VoIP usage with good quality.

Table 4. Average Jitter each Streaming Application

	Average Jitter (ms)	Index Category
Instagram	0.00000217874	4
WhatsApp	0.000000223877	4
Zoom	0.000020726	4

Instagram, WhatsApp, and Zoom for VoIP usage, had very low average jitter across the three applications. Instagram, with an average jitter of 0.00000217874 ms, and WhatsApp, with an average jitter of 0.000000223877 ms, showed excellent performance with minimal variation in data packet arrival times, which is important for ensuring good voice and video call quality. Meanwhile, Zoom, with an average jitter of 0.000020726 ms, although slightly higher, is still considered low and should not significantly affect call quality. The category 4 index for all three apps indicates that the network quality for all three apps is in the same category. Overall, this low average jitter indicates that your 5G network is functioning well and can support VoIP usage with good quality.

Table 5. The Final of QOS Measurement.

Index	Instagram	WhatsApp	Zoom
Throughput	4	4	4
Packet Loss	4	4	4
Delay	4	4	4
Jitter	4	4	4
Total	4	4	4

In testing the 5G network on Instagram, WhatsApp, and Zoom apps for VoIP usage, there was a consistent category 4 index on all parameters, namely throughput, packet loss, delay, and jitter. This category 4 index indicates excellent performance with minimal variation in data packet arrival time, which is important for ensuring good voice and video call quality, and for uploading and downloading media content smoothly. While factors such as network speed, number of users, and signal quality can affect these results, the total index of 4 for all three apps shows that the network quality for all three apps is in the same category. Overall, this category 4 index indicates that your 5G network is functioning well and can support VoIP usage with good quality.

CONCLUSION

Based on the results of the research conducted, it can be concluded that the 5G network at Airport shows excellent performance in supporting the use of VoIP applications such as Instagram, WhatsApp, and Zoom. This is indicated by a consistent category 4 index on all parameters measured, namely throughput, packet loss, delay, and jitter. In terms of throughput, although there are variations between the three applications, all these values are still enough to support voice and video calls with good quality. In fact, lower throughput values on the Zoom app do not mean that video call quality is poor, especially for one-on-one calls or with few participants. For video calls in zoom meetings, researchers did not focus on video, because when zooming, researchers turned off the camera. Furthermore, the absence of packet loss in all three applications indicates excellent connection stability. This is an important indicator showing that all the data sent and received by the apps made it to their destination without being lost midway, which is essential for ensuring clear voice and video quality. Meanwhile, very low delay and jitter indicate that data transmission is fast and consistent. This is especially important for real-time communications such as video calls, where delays or variations in the arrival time of data packets can disrupt call quality. Overall, the results of this study show that the 5G network at Airport is capable of supporting the use of VoIP applications with good quality. This is an important finding, given the importance of VoIP in everyday life, both for personal and professional communication. Therefore, this research hopes to make an important contribution in understanding and maximizing the potential of 5G network in supporting VoIP communication at Airport.

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