

Critical Parameter Analysis of Public WiFi Network Service Quality in Karanganyar Using TIPHON Standards

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ABSTRACT

The study purpose was to identify the critical Quality of Service (QoS) parameters that most affect the quality of public WiFi networks in Karanganyar Regency. The study aimed to evaluate throughput, delay, packet loss, and jitter based on the TIPHON standard. This evaluation helps determine which factors contribute most to service degradation in public WiFi networks. The study also sought to provide recommendations for improving the user experience in high-traffic areas such as Karanganyar Square.

Materials and methods. This study used a descriptive quantitative approach. Data were collected by measuring four QoS parameters: throughput, delay, packet loss, and jitter. Measurements were conducted at four strategic public WiFi locations in Karanganyar Regency. The collected data were analyzed to determine the QoS index and identify which parameters most significantly affect network performance. The TIPHON standard was applied to categorize the quality of each parameter.

Results. The results showed that the overall average QoS index was in the “good” category (index 3). However, two parameters were identified as dominant factors in quality degradation: low throughput and high jitter, both in the moderate category. These issues were most pronounced in locations with high user traffic, particularly Karanganyar Square. The findings indicate that although the network generally meets user expectations, certain conditions can significantly affect performance.

Conclusions. Public WiFi in Karanganyar Regency generally provides good service, but low throughput and high jitter reduce performance in high-traffic areas. Recommendations for improvement include increasing bandwidth capacity and optimizing traffic management to reduce jitter. Implementing these measures can enhance user experience and ensure more reliable network performance.

Keywords: QoS, TIPHON, WiFi Publik, Throughput, Jitter, Karanganyar

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INTRODUCTION

The development of information and communication technology has brought significant changes to various aspects of human life, including the provision of internet services in public spaces. The availability of public Wi-Fi networks in various public facilities such as city parks, town squares, terminals, and public service buildings is one indicator of a region's progress in supporting equitable access to information (Iskandar & Hidayat, 2015; Pranata et al., 2016; Puspitasari, 2011; Santoso et al., 2016). In Karanganyar Regency, an initiative to provide public Wi-Fi was undertaken to support community activities, ranging from entertainment and learning to online administrative services. This service is expected to improve public digital literacy, expand access to information, and encourage digital-based economic activities.

However, the optimal benefits of public Wi-Fi can only be realized if the service quality is adequate. In the context of computer networks, Quality of Service (QoS) refers to a network's ability to provide services according to certain parameters, such as delay, jitter, packet loss, and throughput. These parameters serve as benchmarks for assessing whether a network is capable of delivering a

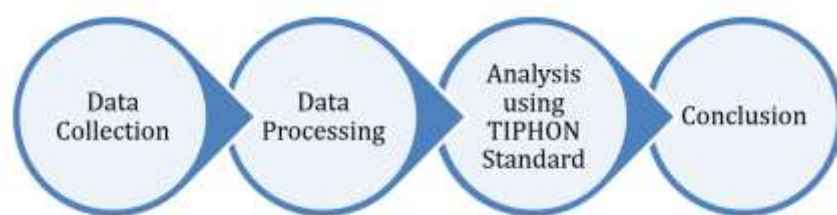
good user experience, especially when used for real-time applications such as video conferencing, voice calls, or media streaming (Silitonga & Morina, 2014; Siyamto, 2018; Siyamto & Saputra, 2019). QoS measurements are crucial for evaluating network performance. One frequently used evaluation method is based on the Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) standard issued by the European Telecommunications Standards Institute (ETSI). The TIPHON standard provides assessment categories for QoS parameters so that evaluation results can be interpreted objectively and measurably. Using this standard, critical parameters that most impact network quality can be identified, allowing service providers to make targeted improvements. Previous research has often focused on comparing performance between locations or between service providers. However, this study focuses on identifying critical parameters that are the dominant factors in service quality degradation. This approach is important because not all QoS parameters have the same impact on user experience. For example, high delays can have a greater impact on voice chat applications, while low throughput is more detrimental to activities such as downloading and uploading files.

Karanganyar Regency, as one of the regions seeking to provide public Wi-Fi services, needs clear evaluation data regarding the factors determining network quality. Without measurable evaluation, network quality improvement efforts can be haphazard and ineffective. By analyzing the most critical QoS parameters, improvement recommendations can be focused on the technical aspects that truly impact user experience (Ulya, 2011; Ulya, 202; Wanto et al., 2017)

Therefore, this study aims to analyze the QoS parameters of public Wi-Fi networks in Karanganyar using the TIPHON standard and identify those that most impact service quality. The results of this study are expected to provide a basis for network managers and local governments in developing service improvement strategies, ensuring that public Wi-Fi can function optimally as a means of supporting community digital activities. Furthermore, the findings of this study can contribute to academic research in the field of network management and measuring internet service performance in public facilities.

METHOD

This study uses a descriptive quantitative approach to analyze the quality of service (QoS) of public WiFi networks in the Karanganyar area based on the Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) standard. The data used in this study are the results of QoS parameter measurements previously obtained through field tests at several public facilities, such as city parks, town squares, and community service areas.



Picture 1. Research Stages

Research Stages

1. Data Collection

The QoS data used includes four main parameters: delay, jitter, throughput, and packet loss. This data is obtained from direct measurements using a network testing application (e.g., Wireshark, iPerf, or similar applications) during an active connection. Each parameter is recorded in multiple measurements to obtain representative values.

2. Data Processing

The collected data is processed by calculating the average, maximum, and minimum values for each parameter. In addition, the standard deviation is calculated to measure network quality stability.

3. Analysis

Based on TIPHON Standards Each parameter is compared against the quality of service categories according to TIPHON, which divides quality into four categories: excellent, good, moderate, and

poor. This analysis aims to determine which parameters have the lowest performance and are the dominant factors contributing to network quality degradation.

4. Conclusion

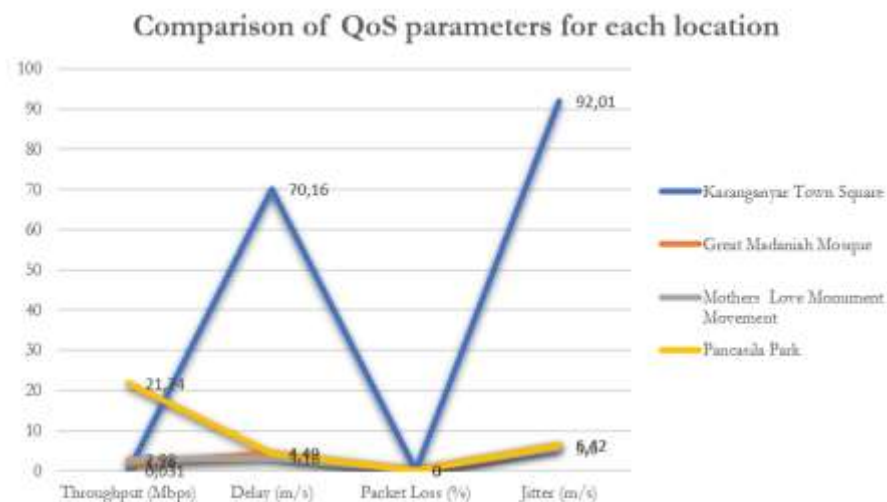
Drawing The analysis results are used to identify critical parameters that require special attention from public Wi-Fi service providers. Conclusions and recommendations for improvement are developed to help improve network quality. This method allows the research to remain valid even though it only uses readily available QoS data, because the analysis focuses on quantitative evaluation and interpretation based on the international TIPHON standard.

FINDING AND DISCUSSION

Quality of Service (QoS) on public Wi-Fi networks is crucial to ensuring an optimal user experience, especially in strategic locations that are centers of community activity. The TIPHON (Telecommunications and Internet Protocol Harmonization Over Networks) standard provides an objective benchmark for assessing network performance based on four key parameters: Throughput, Delay, Packet Loss, and Jitter. This study compared measurement results at four public locations in Karanganyar: Karanganyar Town Square, the Madaniyah Grand Mosque, the Mothers Love Movement Monument, and Pancasila Park. The measurement data used are as follows:

Table 1. Recapitulation of QoS parameters for each location

Location		Throughput (Mbps)	Delay (ms)	Packet Loss (%)	Jitter (ms)
Karanganyar Square	Town	0,031	70,16	0	92,01
Madaniyah Mosque	Grand	1,74	4,49	0	6,42
Mothers Love Movement Monument		2,98	3,16	0	5,60
Pancasila Park		21,74	4,49	0	6,42



Picture 2. QoS parameter comparison chart

Throughput Parameter Analysis

Throughput describes the actual data transfer speed that users can experience when accessing the network. Based on the TIPHON standard, high throughput indicates sufficient network capacity to support activities such as video streaming, video calls, and large file downloads. The measurement results show significant differences between locations. Pancasila Park ranked highest with a throughput of 21.74 Mbps, practically allowing users to carry out various online activities smoothly, even for multiple users simultaneously. This value indicates that the network infrastructure at Pancasila Park is likely equipped with large bandwidth, good traffic management, and adequate

network devices to optimally distribute internet capacity. In second place, the Mothers Love Movement Monument recorded a throughput of 2.98 Mbps. While significantly lower than Pancasila Park, this speed is still adequate for standard usage such as browsing, email, and HD-quality video playback. Madaniyah Grand Mosque ranked slightly lower with 1.74 Mbps, which is still sufficient for text-based communication and voice calls, but begins to feel limited when used for high-quality video streaming or online conferencing. A very different situation was observed at Karanganyar Town Square, which only had a throughput of 0.031 Mbps, or approximately 31 Kbps. This value barely allows for modern online activities, even simply opening a simple web page. This condition indicates a serious network capacity issue, whether due to very limited bandwidth, high user load, or other technical disruptions. From TIPHON's perspective, this throughput value falls far below satisfactory. The extreme differences between locations indicate that factors such as internet service capacity, network configuration, and user usage levels at each location significantly impact throughput performance. Practically speaking, locations like Pancasila Park demonstrate that with proper infrastructure management, public Wi-Fi services can achieve excellent quality.

Delay Parameter Analysis

Delay, or latency, is the time it takes for data to travel from source to destination. In the context of TIPHON, low delay values are highly desirable, especially for real-time applications such as video calls or online gaming. The measurement results show that the Mothers Love Movement Monument had the lowest delay of 3.16 ms, followed by the Great Mosque of Madaniyah and Pancasila Park, both at 4.49 ms. These values are very low and considered excellent by TIPHON, as they are well below the 150 ms threshold for real-time applications. Users in these locations will experience fast network response, with minimal wait times when sending or receiving data. In contrast, Karanganyar Square had a delay of 70.16 ms. While this value is still below TIPHON's tolerance limit, in practice, delays this high can begin to be felt in real-time applications that require fast synchronization, such as online games or interactive video conferencing. Interestingly, the delay at Town Square was not as high as anticipated, given its very low throughput. This may indicate that the limitations at that location are more due to low bandwidth capacity than latency issues. The combination of low delay and high throughput, as found at Pancasila Park, is ideal. However, when throughput is low, such as at Town Square, even a moderate delay is insufficient to ensure a good user experience.

Packet Loss Parameter Analysis

Packet loss is the percentage of data packets lost en route from source to destination. Packet loss can cause significant disruption to service quality, particularly for real-time applications. The TIPHON standard stipulates that the ideal packet loss value is 0%, meaning no data packets are lost.

In this study, all locations demonstrated 0% packet loss, meaning the networks at all four locations were able to transmit data with full integrity without any loss. Technically, this is a good achievement, demonstrating that despite significant differences in throughput and delay, data transmission quality was maintained. These results indicate that the primary issue at some locations, such as Karanganyar Town Square, did not stem from packet loss, but rather from network capacity and congestion levels that limited data transfer speeds. The absence of packet loss also indicates that the network hardware and protocol configurations at all locations were adequate to maintain data transmission stability.

Jitter Parameter Analysis

Jitter is the variation in delay between received data packets and is critical to the stability of real-time communications. High jitter can cause audio dropouts, video freezes, or disrupted data synchronization. Measurements showed that Karanganyar Square had the highest jitter at 92.01 ms, which far exceeds TIPHON's tolerance limit for real-time communications (typically below 30 ms). Jitter this high would be highly disruptive to the user experience, especially during video calls or online gaming. This value is also consistent with very low throughput at these locations, indicating severe network instability. On the other hand, the Monument to the Loving Mother Movement had the lowest jitter at 5.60 ms, followed by the Madaniyah Grand Mosque and Pancasila Park, which both recorded 6.42 ms. These values are in the very good category, indicating that real-time

communications at these locations can proceed smoothly without significant disruption due to delay fluctuations.

Implications of the Research Findings

The results of this study provide a comprehensive overview of the quality of public Wi-Fi network services in Karanganyar, which can serve as an important basis for policymakers, public facility managers, and internet service providers. The significant differences found between locations in terms of throughput, delay, and jitter parameters indicate that network quality is not evenly distributed. Locations with high throughput, such as Pancasila Park, show significant potential as centers for internet-based activities, while locations with low throughput, such as Karanganyar Town Square, require special attention to increase network capacity. Practical implications: local governments can prioritize infrastructure improvements in low-quality areas through device upgrades, additional access points, and network configuration optimization. For service providers, these results can serve as benchmarks for evaluating performance and ensuring that services meet TIPHON standards, thereby maintaining user satisfaction. Furthermore, these findings also have socio-economic implications. A well-equipped and reliable public network has the potential to encourage the growth of digital MSMEs, increase access to online education, and strengthen the smart city ecosystem. Therefore, improving the quality of public internet services is not only a technical issue, but also part of a technology-based regional development strategy.

CONCLUSIONS

Based on the research and analysis of Quality of Service (QoS) parameters of public WiFi networks in Karanganyar using the TIPHON standard, several important conclusions can be drawn. Overall, the average service quality of public WiFi in the studied locations was categorized as “good” (QoS index 3), which means that in general the network is able to support basic online activities for the community. However, the study also identified two critical parameters that significantly affect user experience. The first is low throughput, particularly at Karanganyar Town Square, where the measured value was only 0.031 Mbps. This condition makes it difficult for users to perform activities such as browsing, streaming, or video conferencing. The second is high jitter, which reached 92.01 ms at the same location, leading to instability in real-time applications such as online meetings or gaming.

In contrast, other parameters showed more stable performance. Delay values, ranging from 3.16 to 70.16 ms, were still within the “good” category according to TIPHON standards. Packet loss was recorded at 0% in all locations, indicating that data transmission was reliable and free from significant losses. These results highlight that throughput and jitter are the most critical determinants of service degradation, while delay and packet loss did not present major issues in this study.

Another important finding is the variation in quality between different WiFi locations. Sites with adequate bandwidth capacity and better traffic management, such as Pancasila Park, provided optimal network performance. On the other hand, locations with high user density and limited infrastructure, such as Karanganyar Town Square, experienced poorer service quality. Overall, the study confirms that throughput and jitter are the dominant factors influencing the effectiveness of public WiFi services in Karanganyar.

Recommendations

To improve the quality of public WiFi services in Karanganyar, several recommendations can be implemented. First, increasing bandwidth capacity is essential, especially in high-traffic areas such as Karanganyar Town Square, to ensure smoother access for various online activities. Second, optimization of network traffic management should be applied through techniques such as Quality of Service (QoS) scheduling and traffic prioritization for real-time applications, in order to reduce jitter and maintain stable connections during peak hours. Third, the addition of more access points in crowded areas can help prevent network congestion and improve signal distribution. Fourth, regular maintenance and upgrading of network equipment—including routers, switches, and antennas—are needed to sustain high throughput and minimize jitter. Fifth, periodic monitoring using TIPHON standards should be conducted to evaluate service quality continuously and to

address potential issues before they disrupt user activities. Finally, as part of the Smart City initiative, the government is encouraged to strategically expand public WiFi services to other areas, while consistently applying QoS-based evaluations to ensure equitable internet access that supports educational, social, and economic development.

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