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Analysis of Wifi Signal Distribution and Access Point Placement Using Site Survey and Heatmap Visualization: A Case Study of A Government Office Building

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A B S T R A CT

WiFi networks are an important infrastructure in supporting digital-based administrative and public service activities in government office environments. However, WiFi signal distribution in Manukan Kulon Village is not yet evenly distributed, resulting in several areas with poor signal quality (dead zones) that affect connection stability and employee work effectiveness. This study aims to analyze the distribution and mapping of WiFi signals to determine the most optimal position for Access Points (APs) in the office building. Data collection was carried out using the site survey method with a walk test approach at several predetermined measurement points on the 1st and 2nd floors of the Manukan Kulon Village office building. The measurement process was carried out using the NetSpot and WiFi Analyzer applications to obtain network signal quality data based on the Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR) parameters. The measurement data was then analyzed and visualized in the form of a heat map to illustrate the distribution of WiFi signal strength in each measurement area. The results showed that the placement of access points had a significant effect on the quality and even distribution of WiFi signals in the study area. On the first floor, placing an AP in the Lactation Room resulted in an average RSSI value of -58.83 dBm and an SNR value of 31.17 dB, indicating an improvement in signal quality and a more even network distribution compared to the previous conditions. Meanwhile, on the second floor, placing the AP in the PosKesKel Room resulted in an RSSI value of -54.17 dBm and an SNR value of 35.83 dB, indicating excellent signal quality in that area. Based on these analysis results, this study recommends more optimal Access Point placement positions on each floor to minimize areas with weak signals and improve the stability and quality of the WiFi network in the Manukan Kulon Village environment.

Keywords: WiFi, heatmap, RSSI, SNR, Access Point

1. Introduction

The development of information technology has made computer networks a key infrastructure in supporting work activities, especially in government agencies [1]. One of the most widely used network technologies is Wireless Fidelity (WiFi) because it provides flexible internet access without the use of cables [2]. Optimal utilization of WiFi networks greatly affects the effectiveness of administrative services, internal communication, and the use of digital-based information systems [3].

The Manukan Kulon Village Office was chosen as the object of this study because it is a public service center that relies on WiFi networks to support its digital-based administrative system. In addition, the two-story building structure has the potential to cause differences in WiFi signal distribution quality between floors, requiring special analysis to ensure consistent network quality. However, WiFi networks often face problems such as uneven signal distribution, the emergence of areas with weak signals (dead zones), and connection instability at certain points [4]. These problems are

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generally caused by distance, physical barriers within the building, frequency interference, and suboptimal placement of access points (APs). These conditions can hinder work activities and reduce the quality of public services [5].

To overcome these problems, it is necessary to analyze WiFi signal distribution and mapping to determine the quality of signal coverage in each area. The main parameters used in WiFi signal quality analysis include Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR) [6]. These parameters can be measured using signal mapping applications such as NetSpot and WiFi Analyzer, which are capable of displaying signal distribution in the form of heatmap visualizations, allowing areas with strong, moderate, and weak signals to be clearly identified.

Several previous studies have discussed the analysis and mapping of WiFi networks in educational and public institutions using technical parameters such as Received Signal Strength Indicator (RSSI), Received Signal Level (RSL), and Signal to Interference Ratio (SIR) with the help of NetSpot and WiFi Analyzer applications [7]. The results of these studies show that WiFi signal mapping can help determine the optimal position of Access Points (APs) and reduce areas with weak signals (dead zones) [8]. However, the application of WiFi signal analysis and mapping in the office environment of the sub-district level government is still relatively limited, even though the need for a stable network is increasing in line with the digitization of public services [9]. In addition, most previous studies have not analyzed signal propagation separately on each floor of the building and have not evaluated changes in WiFi signal quality after adjusting or moving the Access Point position. Research related to WiFi signal mapping using heatmap visualization developed independently based on direct measurements in sub-district government office environments is also very limited. Therefore, this study focuses on analyzing and mapping WiFi signal distribution in a two-story government office environment by evaluating changes in signal quality before and after adjusting the Access Point position.

Based on these research gaps, this study contributes by analyzing and mapping the distribution of WiFi signals in a two-story government office environment and comparing the signal quality on each floor before and after adjusting the Access Point position. This approach is expected to provide a more comprehensive picture of WiFi signal distribution patterns and help determine the optimal Access Point position to improve network quality in public service environments [10].

2. Method

This study uses a direct measurement method (site survey) to analyze WiFi signal distribution in the Manukan Kulon neighborhood. Measurements were taken at several points determined based on building plans to obtain comprehensive signal strength data. Data collection was carried out using the NetSpot and WiFi Analyzer applications, utilizing the main parameters of Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR). The measurement data was then analyzed to identify areas with strong, moderate, and weak signals, as well as to detect the existence of dead zones. The results of this analysis were used as a basis for recommending the optimal placement of Access Points (APs) to improve WiFi network quality.

2.1. Location and Research Object

This research was conducted at the Manukan Kulon Village Office, which functions as a center for digital-based administrative and public services. This location was chosen because operational activities in the village environment are highly dependent on the availability of a stable WiFi network to support administrative systems, internal communications, and access to public service applications. The Manukan Kulon Village Office building consists of two floors with several rooms that have different functions, which has the potential to cause variations in the quality of WiFi signal distribution in each area.

The object of research in this study is the WiFi network that operates in the Manukan Kulon Village Office environment, including the Access Point (AP) devices used and the signal coverage

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area on each floor. Signal quality measurements were taken on the first and second floors, taking into account room characteristics, distance from the AP, and physical obstacles such as walls and room partitions that could affect signal propagation. Given the characteristics of the building, the research location was considered representative for analyzing WiFi signal distribution and determining the optimal AP position in a government office environment.

2.2. Research Equipment and Tools

To support the process of measuring and analyzing WiFi signal propagation, this study used several hardware and software devices tailored to the needs of data collection and processing. The list of devices used is presented in Table 1.

Table 1. Research Equipment and Tools

No	Device	Description
1	Access Point	WiFi device used as a signal transmission source at the research location (Indihome ZTE B860H Access Point (dual-band 2.4 GHz and 5 GHz))
2	Laptop	Used as a client device for signal measurement and data processing
3	Wireless Network Adapter	Supports WiFi connectivity on client devices during the measurement process
4	NetSpot	Software for WiFi signal measurement and mapping
5	WiFi Analyzer	Software for WiFi signal quality analysis

2.3. Data Collection Techniques

Data collection techniques in this study were carried out using the walk test method, which is the direct measurement of WiFi signal quality in the study area by walking through each room according to the building plan[11]. Measurements were taken at a number of predetermined points on the 1st and 2nd floors of the Manukan Kulon Village Office to obtain an overview of the overall WiFi signal distribution. The measurement points were determined based on the function of the room, the distance to the Access Point (AP), and environmental conditions that could potentially affect signal propagation.

At each measurement point, the Received Signal Strength Indicator (RSSI) value and noise level were recorded using WiFi network measurement software. The measurement process was carried out more than once at each point to obtain a representative average value and reduce the influence of signal fluctuations. During the data collection process, the WiFi network was active and used during office hours to reflect actual network usage conditions.

The measurement data obtained from the walk test method is then used as a basis for analyzing WiFi signal quality, mapping signal distribution, and identifying areas with strong, moderate, and weak signal quality. This data collection technique allows for the acquisition of accurate information regarding the WiFi network conditions in the research environment.

2.4. Experimental Design

WiFi signal measurements in this study were conducted using the walk test method in the office building area where the research was conducted. This method was carried out by walking to predetermined measurement points to systematically collect network signal quality data. To ensure a structured data collection process, the measurement points were determined based on the division of the measurement area on each floor of the building. Each measurement point was labeled P1, P2, P3, and so on, which were marked on the floor plan as a reference during the data collection process.

The distance between measurement points was set at approximately 3 to 5 meters, adjusting for the layout of the room and access to the measurement area. This distance was determined in order

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to obtain a representation of the WiFi signal distribution that was evenly distributed throughout the observation area. At each measurement point, the Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR) values were recorded using a wireless network measurement device. Measurements were taken under normal network conditions during working hours with the device placed at a height of approximately 1 meter from the floor. To improve data stability, measurements were taken several times at each point before the values were used for signal quality analysis.

The research location map and measurement point distribution are shown in Figure 1, which indicates the position of the data collection points in the research area.

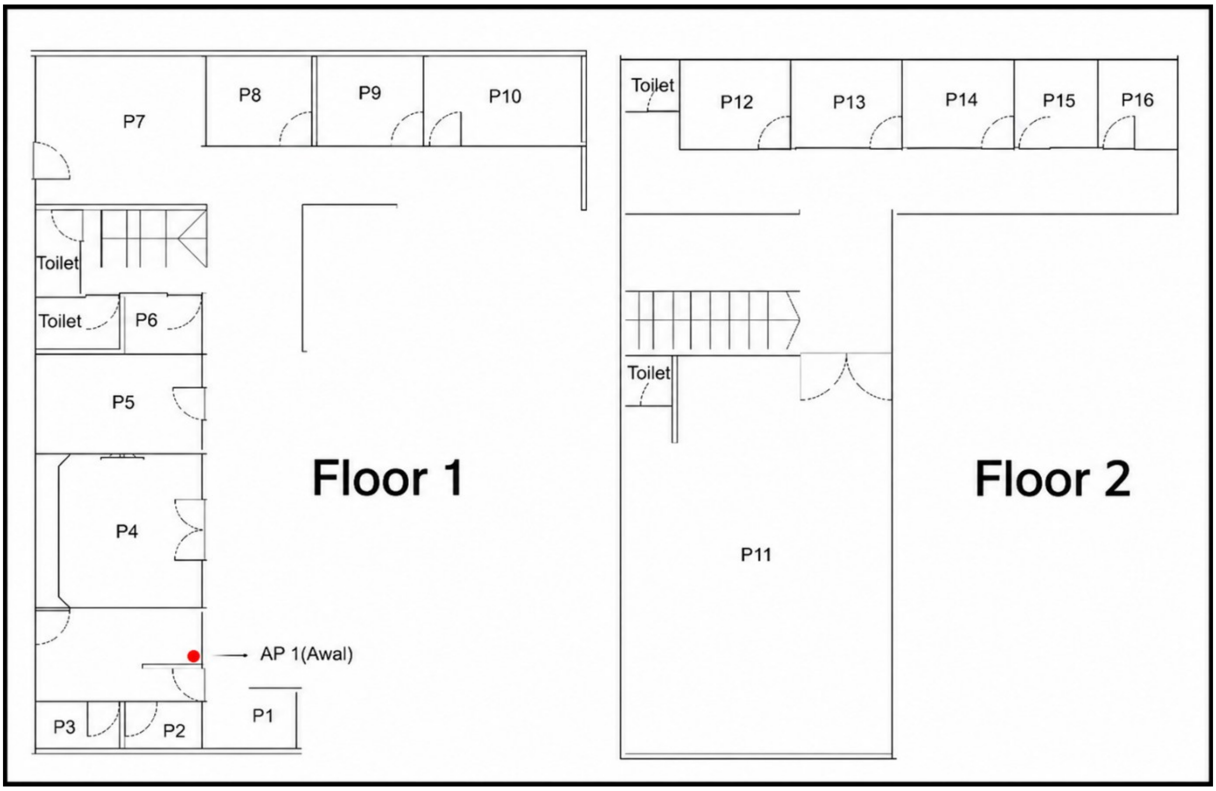

Fig. 1. Experimental Design

Because the distance between measurement points was not entirely uniform due to adjustments made to the room conditions, the distance between points is shown in detail in Table 2 and Table 3.

Table 2. Distance Between Measurement Points on Floor 1

No	Measurement Point	Distance	Measurement Point	Distance
1	P1 – P2		5 Meters	
2	P2 – P3		4 Meters	
3	P3 – P4		8 Meters	
4	P4 – P5		5 Meters	
5	P5 – P6		5 Meters	
6	P6 – P7		10 Meters	
7	P7 – P8		6 Meters	
8	P8 – P9		5 Meters	
9	P9 – P10		6 Meters	

Table 3. Distance Between Measurement Points on Floor 2

No	Measurement Point	Distance	Measurement Point	Distance
1	P10 – P11		15 Meters	

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2	P11 – P12	5 Meters
3	P12 – P13	5 Meters
4	P13 – P14	5 Meters
5	P14 – P15	5 Meters
6	P15 – P16	5 Meters

2.5. Parameter of Signal Quality

Signal quality parameters are used as key indicators in evaluating WiFi network performance at the research location. In this study, WiFi signal quality analysis was conducted using two main parameters, namely Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR). These two parameters were chosen because they are able to represent the strength of the signal received and the level of interference that affects data communication quality on wireless networks.

Received Signal Strength Indicator (RSSI) is a parameter that indicates the strength of the WiFi signal received by the client device, expressed in decibels-milliwatts (dBm). An RSSI value close to zero indicates a stronger signal, while a smaller (negative) RSSI value indicates a decrease in signal strength. The RSSI parameter is used to determine the coverage range of the WiFi signal and identify areas with strong, moderate, or weak signals.

Signal to Noise Ratio (SNR) is the ratio between the strength of the received signal and the level of noise or interference on the communication channel. The SNR value is expressed in decibels (dB), where a higher SNR value indicates better signal quality with low interference levels. The SNR parameter is used to assess the stability and quality of data communication on a WiFi network, especially in areas with potential interference [7].

The simultaneous use of RSSI and SNR parameters allows for a more comprehensive analysis of WiFi signal quality, as it considers not only the strength of the received signal, but also the effect of interference on network quality.

2.6. Signal to Noise Ratio

Signal to Noise Ratio (SNR) is used to determine the ratio between the strength of the received WiFi signal and the level of interference (noise) on the communication channel. The SNR value is an important indicator in assessing the quality and stability of data communication on wireless networks, as it shows the extent to which signals can be received well amid environmental interference [7].

The SNR value is calculated using Equation (1):

$$SNR = RSSI - Noise \tag{1}$$

RSSI = Received Signal Strength Indicator value received by the client device in dBm units, Noise = signal interference level on the communication channel in dBm units.

The SNR value produced from Equation (1) is expressed in decibels (dB). The higher the SNR value, the better the quality of the WiFi signal received and the lower the level of interference. Conversely, a low SNR value indicates that the signal received is increasingly affected by noise, which has the potential to reduce the quality and stability of the network connection.

2.7. Heatmap Visualization

Heatmap visualization is used to visually depict the distribution of WiFi signal quality in the study area. The data obtained from measuring the Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR) values at each measurement point is processed and mapped based on the position of the point on the building plan. This visualization process aims to provide a more intuitive representation of the distribution of WiFi signal strength in each area.

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In heatmap visualization, differences in signal quality are shown through specific color gradations. Areas with good signal quality are displayed in predominantly green, while areas with moderate to weak signal quality are displayed in yellow to red. With this approach, areas with low signal quality or dead zones can be identified more easily and quickly.

The heatmap visualization results are used as an analysis tool to evaluate the effectiveness of Access Point (AP) placement on each floor. By comparing the heatmaps before and after adjusting the AP positions, changes in WiFi signal distribution and signal quality uniformity can be determined. This visualization forms the basis for determining the optimal AP positions to improve the quality and coverage of the WiFi network in the research environment.

2.8. Research Stages

The research stages in this study were systematically arranged to describe the flow of the analysis and mapping of WiFi signals as a whole. The flow of the research stages is shown in Figure 2, which illustrates the research process from preparation to determining recommendations for Access Point (AP) placement.

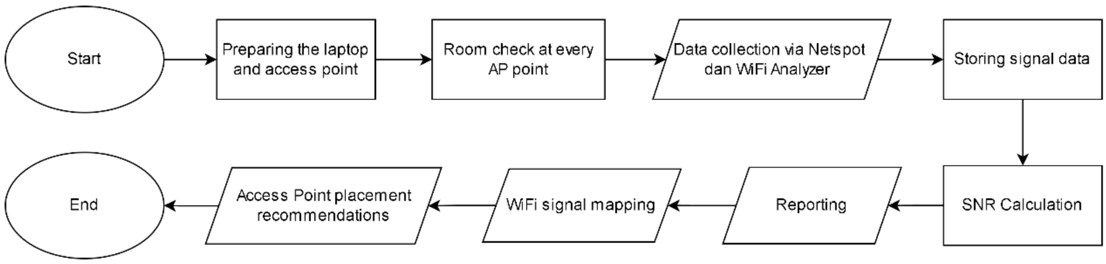

Fig. 2. Research Process Flow

The initial stage of the research began with the preparation of research equipment, which included setting up laptops and WiFi network measurement applications used in the data collection process. This stage aimed to ensure that all equipment and software were ready for use so that the measurement process could run smoothly.

The next stage is to check the room and determine the measurement points in each research area. At this stage, data collection locations are identified based on the floor plans of the 1st and 2nd floors of the Manukan Kulon Village Office in order to obtain an overview of the even distribution of WiFi signals.

After the measurement points were determined, data collection was carried out by directly measuring WiFi signal quality using the NetSpot and WiFi Analyzer applications. Measurements were taken at each observation point to obtain the Received Signal Strength Indicator (RSSI) value and noise level. The measurement data was then stored as signal data to be used in the analysis stage.

The next stage was data processing by calculating the Signal to Noise Ratio (SNR) based on the RSSI and noise data obtained. The SNR calculation results were used to evaluate WiFi signal quality and identify areas with strong, moderate, and weak signal quality.

Next, WiFi signal mapping is carried out in the form of heatmap visualization based on the results of RSSI and SNR analysis. This visualization is used to illustrate the distribution of WiFi signal quality in each measurement area and to evaluate the effectiveness of AP placement.

The final stage of the research is drawing conclusions and compiling recommendations for more optimal Access Point placement. These recommendations are compiled based on the results of the analysis and heatmap visualization to improve the quality, distribution, and stability of the WiFi network in the Manukan Kulon Village area.

3. Results and Discussions

This chapter presents the measurement results, analysis, and discussion related to the distribution and mapping of WiFi signals in the Manukan Kulon Village area. The data presented are

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the results of direct measurements using the Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR) parameters on the 1st and 2nd floors. The discussion focuses on evaluating WiFi signal quality, visualizing signal distribution in the form of a heatmap, and analyzing the effect of Access Point (AP) placement on network distribution and quality.

3.1. Initial Access Point Placement (AP 1) on the 1st Floor

This subsection discusses the results of measurements and analysis of WiFi signal quality on the 1st floor with the Access Point placed in its initial position before the location was changed.

3.1.1. RSSI Measurement Results for AP 1 (Initial) on the 1st Floor

Based on Table 4, the RSSI measurement results for AP 1 on the 1st floor show that several rooms have excellent WiFi signal quality. The Government and Public Services Section Room obtained an average RSSI value of -42 dBm, the Services Room obtained -40.25 dBm, and the PKK Cooperative obtained -50.75 dBm, all of which are classified as very strong. This condition indicates that these rooms receive stable and optimal WiFi signals because they are relatively close to the AP position and have minimal physical obstacles.

Rooms with strong to moderate signal categories include the People's Welfare and Economy Section Room with an average RSSI of -56.25 dBm, the Village Head Room with -60.75 dBm, and the Lactation Room with a value of -62.75 dBm. Meanwhile, several other rooms showed weak signal quality, namely the Kitchen, the Secretary's Room, and the Peace, Order and Development Section Room with average RSSI values ranging from -75 dBm to -76.5 dBm, and the lowest RSSI value was found in the Meeting Room at -78.5 dBm. In general, the RSSI measurement results on the 1st floor show differences in signal strength between rooms, which are influenced by the distance from the AP and the physical condition of the building, so that the WiFi signal distribution is not yet completely even throughout the 1st floor area.

Table 4. RSSI measurement of AP 1 (Initial) on the 1st floor

Room Name	Signal Strength (dBm)				Average	Category
	1	2	3	4		
PKK Cooperative	-49	-50	-51	-53	-50,75	Very Strong
Government and Public Services Section Office	-43	-40	-41	-44	-42	Very Strong
Community Welfare and Economic Affairs Section Office	-55	-57	-54	-59	-56,25	Strong
Service Room	-41	-40	-38	-42	-40,25	Very Strong
Village Head's Office	-61	-60	-59	-63	-60,75	Strong
Lactation Room	-61	-64	-62	-64	-62,75	Moderate
Kitchen	-73	-75	-76	-77	-75,25	Weak
Secretary's Office	-77	-76	-75	-78	-76,5	Weak
Public Order, Security, and Development Section Office	-75	-73	-76	-77	-75,25	Weak
Meeting Room	-76	-79	-81	-78	-78,5	Weak

3.1.2. Analysis of Signal to Noise Ratio (SNR) AP-1 (Initial) on Floor 1

Based on Table 5, the SNR value on Floor 1 shows variations in WiFi signal quality between rooms. The rooms with the highest SNR values are the Service Room and the Government and Public Service Section Room, which indicate excellent signal quality with minimal interference.

Conversely, rooms such as the Meeting Room and the Secretary's Room have lower SNR values, which indicate a decline in signal quality that may be caused by factors such as distance from the AP, physical obstacles, or room conditions.

Table 5. Calculation of SNR AP-1 (Initial) on the 1st Floor

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Room Name	Average RSSI (dBm)	Noise (dBm)	Calculation Process	SNR(dB)	Category
PKK Cooperative	-50,75	-90	-50,75 - (-90)	39,25	Very Good
Government and Public Services Section Office	-42	-90	-42,00 - (-90)	48,00	Very Good
Community Welfare and Economic Affairs Section Office	-56,25	-90	-56,25 - (-90)	33,75	Very Good
Service Room	-40,25	-90	-40,25 - (-90)	49,75	Very Good
Village Head's Office	-60,75	-90	-60,75 - (-90)	29,25	Very Good
Lactation Room	-62,75	-90	-62,75 - (-90)	27,25	Very Good
Kitchen	-75,25	-90	-75,25 - (-90)	14,75	Fair
Secretary's Office	-76,5	-90	-76,50 - (-90)	13,50	Fair
Public Order, Security, and Development Section Office	-75,25	-90	-75,25 - (-90)	14,75	Fair
Meeting Room	-78,5	-90	-78,50 - (-90)	11,50	Fair

3.1.3. Visualization of AP 1 Heatmap (Initial) on Floor 1

Based on the heatmap shown in Figure 3, the area around AP 1 on Floor 1, especially around the Service Room, is dominated by dark green. This condition indicates that rooms close to the AP position receive relatively good WiFi signal strength, so that the network connectivity quality in that area is in the strong category and is able to support service and administrative activities optimally.

Conversely, in rooms that are further away from the AP location or separated by walls and building partitions, there is a change in color to yellow to orange, which indicates a decrease in WiFi signal strength. This decline in signal quality is influenced by the increasing distance from the AP and the presence of physical obstacles that block signal propagation. In general, the Floor 1 heatmap shows that WiFi signal distribution is not yet uniform across the entire area and there are still differences in signal strength between rooms.

Fig. 3. Visualization of Heatmap AP-1 (Initial) on Floor 1

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3.1.4. RSSI Measurement Results for AP-1 (Initial) on Floor 2

Based on Table 6, the WiFi signal quality of AP 1 (initial) on Floor 2 is in the weak to very weak category, with weak RSSI values in the Hall, Warehouse, and Babinsa rooms (−78.5 dBm to −79.5 dBm), and very weak in the Health Post Room and Library Room (−86 dBm to −86.5 dBm). Meanwhile, the PKK Room did not detect a WiFi signal, so it was categorized as N/A, indicating an area without signal coverage (dead zone).

Table 6. RSSI measurements of AP 1 (Initial) on the 2nd Floor

Room Name	Signal Strength (dBm)				Average	Category
	1	2	3	4		
Assembly Hall	-77	-78	-80	-79	-78,5	Weak
PKK Room	0	0	0	0	0	N/A
Community Health Post Room	-84	-86	-88	-87	-86	Very weak
Library	-85	-88	-87	-87	-86,5	Very weak
Military Village Guidance Officer Room	-80	-78	-79	-81	-79,5	Weak
Storage Room	-77	-79	-80	-79	-78,5	Weak

3.1.5. Analysis of Signal to Noise Ratio (SNR) AP 1 (Initial) on the 2nd Floor

Based on Table 7, the results of the SNR AP 1 (initial) calculation on the 2nd floor show that the WiFi signal quality is in the fair to poor category. The Auditorium Room, Babinsa Room, and Warehouse have SNR values in the fair category, while the Poskeskel Room and Library Room show poor SNR values. Meanwhile, the PKK Room has no detectable WiFi signal (N/A), indicating an area without signal coverage due to vertical distance and physical building obstacles.

Table 7. Calculation of SNR AP-1 (Initial) on the 2nd Floor

Room Name	Average RSSI (dBm)	Noise (dBm)	Calculation Process	SNR(dB)	Category
Assembly Hall	-78,5	-90	-78,5 - (-90)	11,5	Fair
PKK Room	0	0	0 - 0	0	N/A
Community Health Post Room	-86	-90	-86 - (-90)	4	Poor
Library	-86,5	-90	-86,5 - (-90)	3,5	Poor
Military Village Guidance Officer Room	-79,5	-90	-79,5 - (-90)	10,5	Fair
Storage Room	-78,5	-90	-78,5 - (-90)	11,5	Fair

3.1.6. Visualization of Heatmap AP-1 (Initial) on the 2nd Floor

Based on Figure 4, the distribution of the WiFi signal from AP-1 (initial) on the 2nd floor is dominated by moderate to weak categories, with moderate signal quality in the Hall and weak signal quality in several rooms such as the Library Room and the Health Center Room. This condition indicates that the placement of the AP on the 1st floor is not yet able to provide optimal signal coverage to the 2nd floor due to the vertical distance and physical barriers of the building, resulting in areas with low signal quality.

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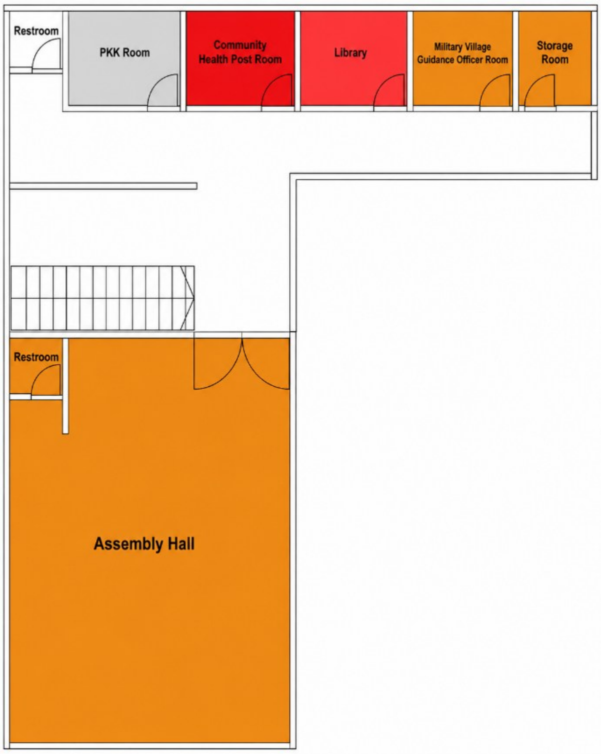

Fig. 4. Visualization of AP 1 (Initial) Heatmap on Floor 2

3.2. Placement of Alternative Access Points on the 1st Floor

This subsection presents the results of WiFi signal quality measurements and analysis on the 1st floor after changing the position of the Access Point in an effort to improve signal distribution and quality.

3.2.1. Measurement and Analysis Results of AP 2 (Lactation Room) on Floor 1

Based on Table 8, the RSSI measurement results of AP 2 on Floor 1 show that the Lactation Room, as the location for placing the AP, has the highest average RSSI value of -49.5 dBm, which is in the very strong category, indicating excellent and stable WiFi signal quality. In addition, most other rooms were in the strong category, such as the PKK Cooperative with an average RSSI of -58.75 dBm, the Government and Public Service Section Room at -56 dBm, the People's Welfare and Economy Section Room at -60.75 dBm, the Service Room at -60 dBm, the Village Head Room at -56.25 dBm, the Secretary Room at -55 dBm, and the Peace, Order, and Development Section Room at -60.25 dBm, indicating relatively good WiFi signal reception that can be used optimally.

Meanwhile, several rooms showed moderate signal quality, namely the Kitchen with an average RSSI value of -70.75 dBm and the Meeting Room with -61 dBm. This condition indicates a decrease in WiFi signal strength due to the greater distance from the AP and the presence of physical barriers such as walls and building partitions. In general, the results of the RSSI measurement of AP 2 on the 1st floor show that the WiFi signal distribution is quite good in most rooms, but there are still some areas with lower signal strength, so the signal distribution is not yet completely even throughout the 1st floor.

Table 8. RSSI measurement of AP 2 (Lactation Room) on the 1st floor

Room Name	Signal Strength (dBm)				Average	Category
	1	2	3	4		
PKK Cooperative	-59	-57	-59	-60	-58,75	Strong

Government and Public Services Section Office	-56	-54	-56	-58	-56	Strong
Community Welfare and Economic Affairs Section Office	-61	-58	-61	-63	-60,75	Strong
Service Room	-60	-61	-60	-59	-60	Strong
Village Head's Office	-57	-56	-57	-55	-56,25	Strong
Lactation Room	-49	-48	-51	-50	-49,5	Very Strong
Kitchen	-74	-69	-73	-67	-70,75	Moderate
Secretary's Office	-55	-53	-55	-57	-55	Strong
Public Order, Security, and Development Section Office	-61	-58	-61	-61	-60,25	Strong
Meeting Room	-61	-59	-61	-63	-61	Moderate

Based on Table 9, the SNR value on the 1st floor shows variations in WiFi signal quality between rooms. The highest SNR value was obtained in the Lactation Room at 40.50 dB, which indicates excellent WiFi signal quality with low interference due to its proximity to the location of the second AP. Conversely, the lowest SNR value was found in the Kitchen at 19.25 dB, which indicates a decrease in WiFi signal quality due to the greater distance from the AP and the presence of physical obstacles in the form of walls and building partitions. In general, the SNR calculation results show that WiFi signal quality tends to decrease with increasing distance and the presence of physical obstacles between the AP and the measurement point.

Table 9. SNR Calculation for AP 2 (Lactation Room) on the 1st Floor

Room Name	**Average RSSI (dBm)**	**Noise (dBm)**	**Calculation Process**	**SNR(dB)**	**Category**
PKK Cooperative	-58,75	-90	-58,75 - (-90)	31,25	Very Good
Government and Public Services Section Office	-56	-90	-56 - (-90)	34,00	Very Good
Community Welfare and Economic Affairs Section Office	-60,75	-90	-60,75 - (-90)	29,25	Very Good
Service Room	-60	-90	-60 - (-90)	30,00	Very Good
Village Head's Office	-56,25	-90	-56,25 - (-90)	33,75	Very Good
Lactation Room	-49,5	-90	-49,5 - (-90)	40,50	Very Good
Kitchen	-70,75	-90	-70,75 - (-90)	19,25	Good
Secretary's Office	-55	-90	-55 - (-90)	35,00	Very Good
Public Order, Security, and Development Section Office	-60,25	-90	-60,25 - (-90)	29,75	Very Good
Meeting Room	-61	-90	-61 - (-90)	29,00	Very Good

Based on the heat map shown in Figure 5, the area around the Lactation Room, where the second AP is located, is dominated by green. This condition indicates that the room and its surrounding area receive relatively good WiFi signal strength, resulting in strong and stable network connectivity. This is in line with the position of the AP in the Lactation Room, allowing the signal to propagate optimally to the surrounding area.

In areas further away from the Lactation Room, especially rooms separated by walls and building partitions, there is a change in color from green to yellow, indicating a decrease in WiFi signal strength. This decrease is influenced by distance and physical building obstacles, so in general, the heatmap of AP 2 on the 1st floor shows that the WiFi signal distribution is not yet completely even throughout the entire floor area and there are still several rooms with lower signal quality.

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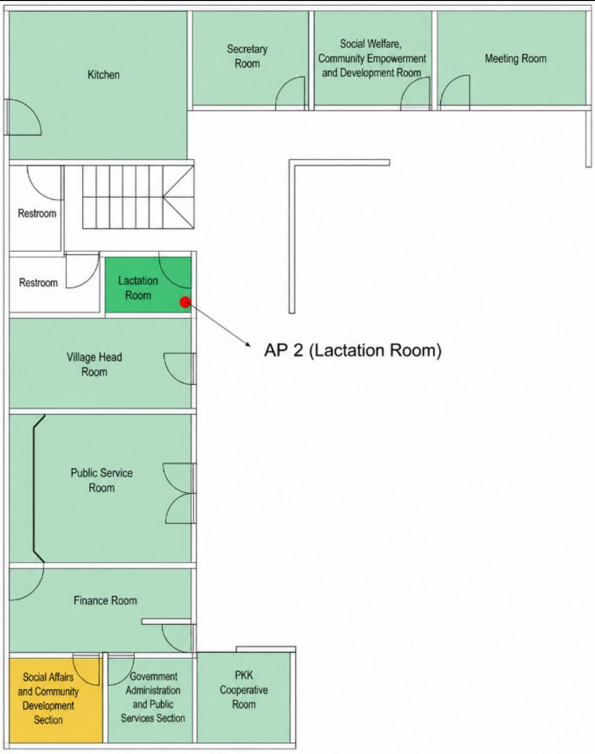

Fig. 5. Visualization of the second AP heatmap (Lactation Room) on the 1st floor

3.2.2. Measurement and Analysis Results of the Third AP (Front of Meeting Room) on the 1st Floor

Based on Table 10, the results of the 3rd AP RSSI measurement on the 1st floor show variations in WiFi signal strength in each room. The Meeting Room has the highest average RSSI value of -47 dBm, which is in the very strong category, indicating excellent signal quality due to its proximity to the AP location. In addition, the Peace, Order and Development Section Room with an average RSSI value of -51.5 dBm and the Secretary's Room with a value of -57.5 dBm are also in the strong category, which indicates relatively stable and optimal signal reception.

Rooms with a moderate signal category include the Service Room with an average RSSI of -70.5 dBm, the Village Head's Room at -69 dBm, the Lactation Room at -68 dBm, and the Kitchen with an average RSSI value of -65.25 dBm. while several other rooms show weak signal quality, namely the PKK Cooperative with an average RSSI of -73.5 dBm, the Government and Public Service Section Room with -79.75 dBm, and the People's Welfare and Economy Section Room with a value of -80.75 dBm. In general, the results of the 3rd AP RSSI measurement on the 1st floor show that the WiFi signal strength tends to decrease with increasing distance from the AP and the presence of physical barriers such as walls and building partitions, so that the distribution of the WiFi signal is not yet completely even throughout the 1st floor area.

Table 10. 3rd AP RSSI measurement (in front of the Meeting Room) on the 1st floor

Room Name	Signal Strength (dBm)				Average	Category
	1	2	3	4		
PKK Cooperative	-75	-73	-74	-72	-73,5	Weak
Government and Public Services Section Office	-81	-79	-78	-81	-79,75	Weak
Community Welfare and Economic Affairs Section Office	-82	-83	-77	-81	-80,75	Weak

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Service Room	-70	-69	-72	-71	-70,5	Moderate
Village Head's Office	-66	-69	-71	-70	-69	Moderate
Lactation Room	-67	-66	-68	-71	-68	Moderate
Kitchen	-61	-64	-66	-70	-65,25	Moderate
Secretary's Office	-56	-58	-59	-57	-57,5	Strong
Public Order, Security, and Development Section Office	-47	-56	-50	-53	-51,5	Strong
Meeting Room	-43	-48	-46	-51	-47	Very Strong

Based on Table 11, the calculation results of the third AP SNR value on the 1st floor show variations in WiFi signal quality between rooms. The highest SNR value was found in the Meeting Room at 43.00 dB, indicating excellent signal quality with low interference due to its proximity to the AP.

Conversely, the lowest SNR value was found in the People's Welfare and Economy Section Room at 9.25 dB, which indicates a decrease in signal quality due to greater distance and physical obstacles in the form of walls and building partitions. In general, these differences in SNR values show that WiFi signal quality tends to decrease with increasing distance and the number of physical obstacles between the AP and the measurement point.

Table 11. SNR calculation for AP 3 (in front of the Meeting Room) on the 1st floor

Room Name	Average RSSI (dBm)	Noise (dBm)	Calculation Process	SNR (dB)	Category
PKK Cooperative	-73,5	-90	-73,5 - (-90)	16,50	Good
Government and Public Services Section Office	-79,75	-90	-79,75 - (-90)	10,25	Fair
Community Welfare and Economic Affairs Section Office	-80,75	-90	-80,75 - (-90)	9,25	Fair
Service Room	-70,5	-90	-70,5 - (-90)	19,50	Good
Village Head's Office	-69	-90	-69 - (-90)	21,00	Good
Lactation Room	-68	-90	-68 - (-90)	22,00	Good
Kitchen	-65,25	-90	-65,25 - (-90)	24,75	Good
Secretary's Office	-57,5	-90	-57,5 - (-90)	32,50	Very Good
Public Order, Security, and Development Section Office	-51,5	-90	-51,5 - (-90)	38,50	Very Good
Meeting Room	-47	-90	-47 - (-90)	43,00	Very Good

Based on the heatmap shown in Figure 6, the area around the Meeting Room and the Peace, Order, and Development Section Room is dominated by green. This condition indicates that the WiFi signal strength in the area adjacent to the position of AP 3 is in the strong and relatively stable category, thus able to support optimal network activity. Meanwhile, several other rooms such as the Secretary's Room, the Village Head's Room, the Service Room, and the Lactation Room are shown in yellow, which indicates that the WiFi signal in these areas is in the moderate category due to the increasing distance from the AP.

At the bottom of the floor plan, specifically the Government and Public Service Section Room and the People's Welfare and Economy Section Room, orange is used to indicate weak WiFi signal quality. This condition is influenced by the considerable distance from the 3rd AP location and the presence of physical barriers in the form of walls and building partitions that obstruct signal propagation. In general, the heatmap of AP 3 on the 1st floor shows that the WiFi signal distribution is not yet completely even, with the best signal quality in the area around the Meeting Room and decreasing in areas further away from the AP.

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Fig. 6. Visualization of the 3rd AP Heatmap (Front of Meeting Room) on the 1st Floor

3.3. Placement of Alternative Access Points on the 2nd Floor

This subsection discusses the results of WiFi signal quality measurements and analysis on the 2nd floor with two different Access Point placement scenarios.

3.3.1. Measurement and Analysis Results of AP 1 (Auditorium Room) on the 2nd Floor

Based on Table 12, the results of the RSSI measurement of AP 1 on the 2nd floor show variations in WiFi signal strength in each room. The Hall Room, where the AP is located, has an average RSSI value of -49.25 dBm, which is classified as very strong, indicating excellent and stable WiFi signal quality in the area around the AP. In addition, the PKK Room and PosKesKel Room have average RSSI values of -58 dBm and -59.25 dBm, respectively, which are in the strong category, indicating that the WiFi signal can still be received well in rooms that are relatively close to the AP location.

Meanwhile, the Library Room shows an average RSSI value of -62.5 dBm, which is in the moderate category, indicating a decrease in signal strength due to distance and possible physical obstacles in the building. The rooms with the lowest signal quality were the Babinsa Room and the Warehouse, with average RSSI values of -78.5 dBm and -73.25 dBm, respectively, which are categorized as weak. In general, the results of the RSSI measurement of AP 1 on the 2nd floor show that the WiFi signal strength tends to decrease with increasing distance from the AP and the presence of physical obstacles, so that the distribution of the WiFi signal on the 2nd floor is not yet completely even.

Table 12. RSSI measurement of AP 1 (Hall Room) on the 2nd floor

Room Name	Signal Strength (dBm)				Average	Category
	1	2	3	4		
Assembly Hall	-49	-47	-53	-48	-49,25	Very Strong
PKK Room	-59	-58	-58	-57	-58	Strong
Community Health Post Room	-64	-60	-54	-59	-59,25	Strong

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Library	-64	-62	-63	-61	-62,5	Moderate
Military Village Guidance Officer Room	-74	-80	-81	-79	-78,5	Weak
Storage Room	-72	-72	-74	-75	-73,25	Weak

Based on Table 13, the SNR value on the 2nd floor shows variations in WiFi signal quality between rooms. The Hall Room has the highest SNR value of 40.75 dB, which indicates excellent signal quality with a low level of interference due to its location close to the initial position of the AP. The PKK Room and PosKesKel Room have SNR values of 32.00 dB and 30.75 dB, respectively, which indicate that the WiFi signal quality is in the excellent category. In contrast, the Babinsa Room has the lowest SNR value of 11.50 dB, followed by the Warehouse with a value of 16.75 dB, indicating a decline in WiFi signal quality due to the greater distance from the AP and the presence of physical obstacles in the form of walls and building partitions. In general, the SNR calculation results on the 2nd floor show that WiFi signal quality tends to decrease with increasing distance and physical obstacles between the AP and the measurement point.

Table 13. SNR calculation for AP 1 (Hall Room) on the 2nd floor

Room Name	**Noise (dBm)**	**Calculation Process**	**SNR(dB)**	**Average**	**Category**
Assembly Hall	-49,25	-90	-49,25 - (-90)	40,75	Very Good
PKK Room	-58	-90	-58 - (-90)	32,00	Very Good
Community Health Post Room	-59,25	-90	-59,25 - (-90)	30,75	Very Good
Library	-62,5	-90	-62,5 - (-90)	27,50	Very Good
Military Village Guidance Officer Room	-78,5	-90	-78,5 - (-90)	11,50	Fair
Storage Room	-73,25	-90	-73,25 - (-90)	16,75	Good

Based on the heatmap shown in Figure 7, the Hall area, which is the location of AP 1 on the 2nd floor, is dominated by green. This condition indicates that the WiFi signal strength in the Hall area is strong and relatively stable, because the AP is located directly inside the room so that signal propagation can optimally reach the surrounding area. Apart from the Hall, several adjacent rooms such as the PKK Room and the PosKesKel Room are displayed in light green, which indicates that the WiFi signal is still in the fairly good category despite experiencing a slight decline due to distance and structural barriers.

Conversely, rooms that are further away from AP location 1, such as the Library Room, Babinsa Room, and Warehouse, are shown in yellow to orange. This indicates that the WiFi signal strength in these areas is in the moderate to weak category. This decline in signal quality is influenced by the increasing distance from the Hall Room and the presence of physical obstacles in the form of walls and building partitions. In general, the AP 1 heatmap on the 2nd floor shows that the WiFi signal quality is optimal in the Hall area and gradually decreases in rooms that are further away from the AP.

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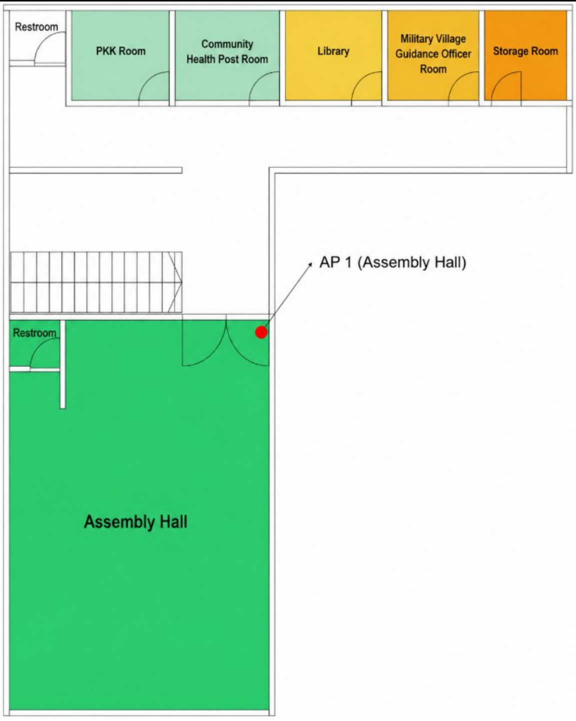

Fig. 7. Visualization of Heatmap AP 1 (Hall Room) on the 2nd Floor

3.3.2. Measurement Results and Analysis of AP 2 (Front of PosKesKel Room) on the 2nd Floor

Based on Table 14, the results of the RSSI measurement of AP 2 on the 2nd floor show variations in WiFi signal strength in each room. The PosKesKel Room has the highest average RSSI value of -44.25 dBm, which is in the very strong category, indicating excellent signal quality because the room is the location of the AP. In addition, the PKK Room, Library Room, Babinsa Room, and Hall also show average RSSI values in the strong category, with values ranging from -51 dBm to -55.75 dBm, indicating that the WiFi signal is still well received and relatively stable in these rooms.

Meanwhile, the Warehouse has the lowest average RSSI value of -67.75 dBm, which is in the moderate category, indicating a decrease in WiFi signal strength. This decrease is influenced by the greater distance from the AP position and the possibility of physical obstacles in the form of walls and building partitions. In general, the results of the second AP RSSI measurement on the 2nd floor show that the WiFi signal distribution is quite good in the area around the PosKesKel Room, but decreases in rooms that are further away from the AP.

Table 14. Second AP RSSI measurement (PosKesKel Room) on the 2nd floor

Room Name	Signal Strength (dBm)				Average	Category
	1	2	3	4		
Assembly Hall	-50	-54	-60	-59	-55,75	Strong
PKK Room	-59	-53	-40	-52	-51	Strong
Community Health Post Room	-55	-46	-40	-36	-44,25	Very Strong
Library	-52	-54	-52	-58	-54	Strong
Military Village Guidance Officer Room	-52	-56	-50	-51	-52,25	Strong
Storage Room	-59	-61	-73	-78	-67,75	Moderate

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Based on Table 15, the SNR value of the second AP on the 2nd floor shows variations in WiFi signal quality between rooms. The PosKesKel room has the highest SNR value of 45.75 dB, which indicates excellent WiFi signal quality with low interference. The PKK Room and Babinsa Room have SNR values of 39.00 dB and 37.75 dB, respectively, indicating that the WiFi signal quality is in the very good and stable category. Furthermore, the Library Room and Hall Room have SNR values of 36.00 dB and 34.25 dB, which are still in the very good category despite showing a decline in signal quality compared to rooms closer to the AP.

Meanwhile, the Warehouse Room has the lowest SNR value of 22.25 dB, which indicates lower signal quality due to the greater distance from the AP and the presence of physical barriers in the form of walls and building partitions. In general, the SNR calculation results show that the quality of the WiFi signal from AP 2 on the 2nd floor tends to decrease with increasing distance from the AP location and the environmental conditions of the room.

Table 15. SNR Calculation for AP 2 on the 2nd Floor (PosKesKel Room)

Room Name	Average RSSI (dBm)	Noise (dBm)	Calculation Process	SNR(dB)	Category
Assembly Hall	-55,75	-90	-55,75 - (-90)	34,25	Very Good
PKK Room	-51	-90	-51 - (-90)	39,00	Very Good
Community Health Post Room	-44,25	-90	-44,25 - (-90)	45,75	Very Good
Library	-54	-90	-54 - (-90)	36,00	Very Good
Military Village Guidance Officer Room	-52,25	-90	-52,25 - (-90)	37,75	Very Good
Storage Room	-67,75	-90	-67,75 - (-90)	22,25	Good

Based on the heatmap shown in Figure 8, the area around the PosKesKel Room as the location for the second AP on the 2nd floor is dominated by dark green and light green colors. Dark green indicates a very strong WiFi signal, while light green indicates a strong signal, which means that the area around the PosKesKel Room receives a very good and relatively stable WiFi signal. The PKK Room and Library Room also show light green, which indicates that the signal strength in those rooms is still in the strong category even though they are slightly further away from the AP.

Conversely, in rooms that are farther from the AP, such as the Babinsa Room and the Warehouse, the color changes to yellow. This color indicates that the WiFi signal quality in these areas is in the moderate category due to the influence of distance and physical obstacles in the form of building walls. In general, the second AP heatmap on the 2nd floor shows that the WiFi signal distribution is quite good in the area around the PosKesKel Room, but the quality decreases in rooms that are farther away from the AP.

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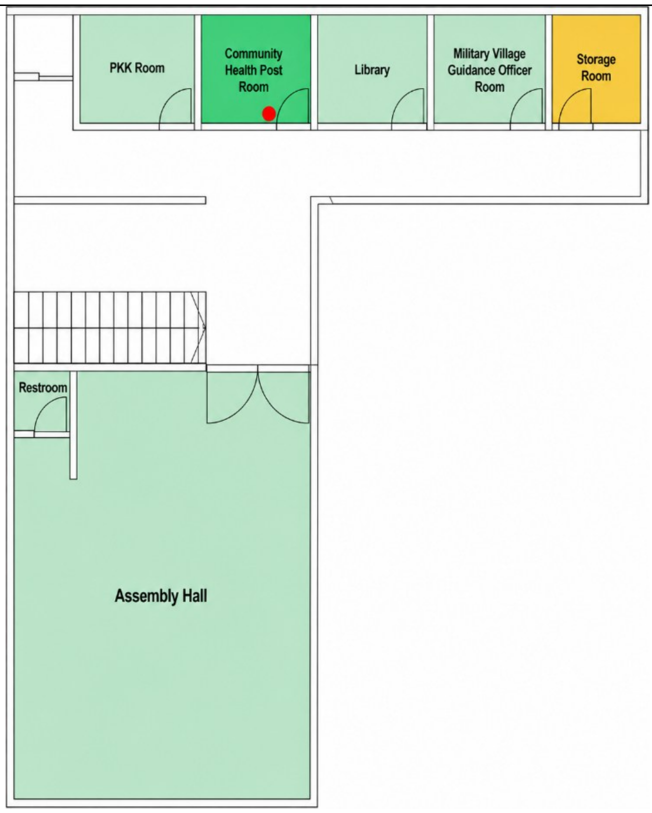

Fig. 8. Visualization of the 2nd AP Heatmap (PosKesKel Room) on the 2nd Floor

3.4. Statistical Analysis of RSSI and SNR Values

To provide a more measurable evaluation of WiFi signal quality in the research area, a statistical analysis of the RSSI and SNR data obtained from all measurement points was performed. This analysis includes the minimum, maximum, and average values of each parameter. The results of the RSSI value statistical calculations are shown in Table 16.

Table 16. RSSI Value Statistics

No	Parameter	Value
1	Minimum RSSI	-78 dBm
2	Maximum RSSI	-52 dBm
3	Average RSSI	-63 dBm

In addition to the analysis of RSSI, a statistical analysis was also performed on the Signal to Noise Ratio (SNR) values obtained during the measurement process. The results of the SNR value statistical calculations are shown in Table 17.

Table 17. SNR Value Statistics

No	Parameter	Value
1	Minimum SNR	15 dB
2	Maximum SNR	32 dB
3	Average SNR	24 dB

To improve the accuracy of the analysis, statistical calculations were performed on the RSSI and SNR data obtained at each measurement point. This analysis included the minimum, maximum, and average values of each parameter. In addition, a comparison was made between

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several Access Point placement scenarios to determine the position that produced the most optimal signal quality in the study area.

3.5. Comparison Analysis of Access Point Placement

To evaluate the effectiveness of Access Point placement in the research area, a comparative analysis was conducted on the signal quality produced from several Access Point placement scenarios. This analysis was carried out by comparing the RSSI and SNR values obtained in each measurement scenario. The results of the signal quality comparison based on the Access Point position are shown in Table 18.

Table 18. SNR Value Statistics

No	AP Scenario	Average RSSI	Average SNR
1	Minimum SNR	-65 dBm	22 dB
2	Maximum SNR	-58 dBm	27 dB

A comparison analysis of Access Point (AP) placement was conducted to evaluate the effectiveness of each AP position in producing optimal WiFi signal quality on the 1st and 2nd floors. The comparison was made based on the average Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR) values obtained from the measurement results in each AP placement scenario.

Table 19. Comparison of RSSI Values Based on Access Point Position

Floor	AP Position	Average RSSI
1	AP 1 (Initial)	-61,83
	AP 2 (Lactation Room)	-58,83
	AP 3 (In Front of the Meeting Room)	-66,28
2	AP 1 (Assembly Hall)	-63,46
	AP 2 (Community Health Post Room)	-54,17

Based on Table 19, on the 1st floor, the placement of AP 2 in the Lactation Room resulted in the highest average RSSI value of -58.83 dBm compared to AP 1 in its initial position of -61.83 dBm and AP 3 in front of the Meeting Room of -66.28 dBm. An RSSI value closer to 0 indicates a better signal strength, so it can be concluded that the placement of the AP in the Lactation Room provides a more optimal and even signal quality on the 1st floor. Meanwhile, the placement of the 3rd AP in front of the Meeting Room produced the lowest RSSI value, which indicates a weakening of the signal due to the distance and physical barriers between rooms.

On the 2nd floor, the placement of the second AP in front of the PosKesKel Room showed the best performance with an average RSSI value of -54.17 dBm, which was better than the placement of the first AP in the Hall Room, which had an average RSSI value of -63.46 dBm. This difference shows that a more central AP position with fewer physical obstacles affects the improvement in WiFi signal reception quality.

Table 20. Comparison of SNR Values Based on Access Point Position

Floor	AP Position	Average SNR
1	AP 1 (Initial)	28,17
	AP 2 (Lactation Room)	31,17
	AP 3 (In Front of the Meeting Room)	23,72
2	AP 1 (Assembly Hall)	26,54

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Floor	AP Position	Average SNR
	AP 2 (Community Health Post Room)	35,83

Furthermore, based on Table 20, the comparison of average SNR values reinforces the RSSI analysis results. On the 1st floor, the placement of the 2nd AP in the Lactation Room produced the highest average SNR value of 31.17 dB, indicating good signal quality with a relatively low level of interference. Conversely, the third AP in front of the Meeting Room had the lowest SNR value of 23.72 dB, indicating suboptimal signal quality due to interference and environmental obstacles.

On the 2nd floor, the placement of AP 2 in front of the PosKesKel Room produced the highest average SNR value of 35.83 dB, which was much better than AP 1 in the Hall Room, which had an average SNR value of 26.54 dB. A high SNR value indicates that the WiFi signal received is more stable and has a better signal-to-noise ratio, thus supporting a more optimal connection quality.

3.6. WiFi Signal Quality Distribution

In addition to statistical analysis of RSSI and SNR values, an analysis of WiFi signal quality distribution was also conducted at all measurement points. This analysis aims to determine the distribution of signal quality received in the study area based on signal strength categories obtained from RSSI measurement results. The RSSI signal quality classification in this study refers to wireless network signal strength categories commonly used to evaluate WiFi connectivity quality. These categories are shown in Table 21.

Table 21. RSSI Signal Quality Classification

No	RSSI Range	Category
1	≥ -50	Verry Strong
2	-60 < RSSI < -50	Strong
3	-70 < RSSI ≤ -60	Moderate
4	-80 < RSSI ≤ -70	Weak
5	≤ -80	Verry Weak / (N/A)

In addition to using the RSSI parameter, WiFi network quality is also analyzed using the Signal to Noise Ratio (SNR), which shows the ratio between signal strength and noise levels on the network. A higher SNR value indicates a better and more stable network connection quality. The classification of signal quality based on SNR values is shown in Table 22.

Table 22. SNR Signal Quality Classification

No	RSSI Range	Category
1	SNR ≥ -50	Verry Good
2	15 ≤ SNR < 25	Good
3	5 ≤ SNR < 15	Fair
4	SNR < 5	Poor

Based on this classification, an analysis was conducted on the distribution of WiFi signal quality at all measurement points determined in the study area. The results of the signal quality distribution are shown in Table 23.

Table 23. Signal Quality Distribution at Measurement Points

No	Signal Category	Number of Points
1	Verry Strong	7
2	Strong	16
3	Moderate	8
4	Weak	12

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5	Verry Weak / (N/A)	3

3.7. Analysis of Environmental Factors Affecting Signal Propagation

WiFi signal propagation in indoor environments is greatly affected by various environmental factors such as distance from the access point, building materials, room structure, and interference from other wireless devices. At the research location, several rooms were separated by concrete walls and office partitions, which could cause signal attenuation. In addition, differences in floor structure between the two floors of the building also had the potential to affect the distribution of WiFi signals received by user devices.

Based on the measurement results obtained, areas with lower RSSI and SNR values were generally located further away from the Access Point or blocked by several room partitions. This condition shows that physical barriers such as walls and furniture can affect the wireless signal propagation process, thereby reducing the signal strength received at certain measurement points.

3.8. Comparison with Previous Research

To provide a more comprehensive understanding of the research results obtained, a comparison was made with several previous studies that discussed WiFi network optimization using the RSSI measurement method and heatmap visualization. Several previous studies have shown that WiFi signal quality in indoor environments is greatly influenced by the distance between user devices and access points, as well as physical obstacles such as walls and room partitions. The results of this study are in line with previous studies which show that the greater the distance between the device and the Access Point, the lower the RSSI value received.

In addition, research on WiFi signal mapping using the site survey method also shows that signal distribution in multi-story buildings often experiences variations in signal quality due to differences in room layout and building structure. The measurement results in this study also show a similar pattern, where several measurement points have lower RSSI values due to physical obstacles and greater distance from the Access Point. Thus, the results of this study reinforce the findings of previous studies that proper placement of Access Points and mapping of signal distribution using the site survey method and heatmap visualization can help optimize WiFi network quality in office environments.

3.9. Discussion of Research Results

The network quality evaluation in this study was conducted by analyzing the Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR) parameters obtained from each measurement point. RSSI is used to indicate the strength of the WiFi signal received by the user's device, while SNR describes the ratio between signal strength and noise level on the network. These two parameters provide an overview of signal range quality and connection stability in the study area.

Based on the measurement results obtained, the RSSI and SNR values at each observation point showed variations influenced by several factors, such as distance from the Access Point, the presence of physical barriers such as walls and furniture, and the surrounding network environment conditions. Through analysis of these two parameters, the distribution of WiFi signal quality can be identified more clearly, both in areas with strong signals and in areas with relatively weaker signals.

Although the RSSI and SNR parameters have provided a fairly representative picture of the quality of WiFi signal distribution in the study area, a more comprehensive evaluation of network performance can also involve additional parameters such as throughput, latency, and packet loss. These parameters can provide further information regarding data transfer speed, network response time, and the level of data packet loss during the communication process. Therefore, further research may consider the use of these additional parameters to obtain a more comprehensive analysis of network performance.

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3.10. Analysis of Environmental Factors Affecting Signal Propagation

WiFi signal propagation in indoor environments is greatly influenced by various environmental factors such as distance from the access point, building materials, room structure, and interference from other wireless devices. At the research site, several rooms were separated by concrete walls and office partitions, which could cause signal attenuation. In addition, differences in floor structure in two-story buildings also have the potential to affect the distribution of WiFi signals received by user devices.

Based on the measurement results obtained, areas with lower RSSI and SNR values are generally located further away from the Access Point or blocked by several room partitions. This condition shows that physical obstacles such as walls and room furniture can affect the wireless signal propagation process, thereby reducing the signal strength received at certain measurement points.

Building materials such as concrete walls, glass, and room partitions are known to cause WiFi signal attenuation because the radio waves emitted by the Access Point must pass through various physical obstacles before reaching the user's device.

4. Conclusion

This study analyzed and mapped the distribution of WiFi signals in the two-story Manukan Kulon Village Office building using the walk test site survey method. Network quality was evaluated by analyzing the Received Signal Strength Indicator (RSSI) and Signal to Noise Ratio (SNR) parameters, which were then visualized in the form of a heat map to illustrate the distribution of WiFi signals in each measurement area. The results showed that the position of the Access Point had a significant effect on the quality and even distribution of WiFi signals. On the first floor, the placement of the Access Point in the Lactation Room resulted in an average RSSI value of -58.83 dBm and an SNR of 31.17 dB, while on the second floor, the placement of the Access Point in the PosKesKel Room resulted in an RSSI value of -54.17 dBm and an SNR of 35.83 dB. These results indicate that more optimal placement of access points can improve signal quality and reduce areas with weak signals in an office environment. The contribution of this study lies in the application of WiFi signal distribution mapping analysis in a two-story government office environment by comparing signal quality conditions before and after adjusting the position of the access points. This approach provides a more comprehensive picture of WiFi signal distribution patterns and can be used as a reference in the process of optimizing Access Point placement in similar work environments. However, this study still has several limitations, including network quality evaluation that only uses RSSI and SNR parameters without involving other network performance metrics such as throughput, latency, and packet loss. In addition, measurements were taken under specific network conditions, so variations in network usage conditions have not been fully analyzed. Therefore, further research could consider the use of additional parameters and conduct a more comprehensive network optimization analysis to obtain a more thorough evaluation of WiFi network performance.

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