Analysis of Wireless Network Range In The Housing And Settlement Office of South Sumatra Province Based on Wifi Area Coverage

Imam Al Akbar[1*]

Abstract

WiFi technology widely used today is based on the IEEE 802.11a/b/g standard, which operates in the 2.4 GHz frequency band. This technology is commonly found in government institutions, private companies, entertainment centers, and educational environments. Wi-Fi (wireless fidelity) has become essential due to the increasing number of modern devices equipped with wireless capability, enabling unrestricted internet access within coverage areas. A field survey conducted at the Housing and Settlement Office of South Sumatra Province revealed that all computers rely on wireless connectivity; however, improper placement of access points has resulted in suboptimal network performance. This study aims to evaluate the range and quality of Wi-Fi signals in the office to improve wireless network accessibility. The research applies an action research methodology consisting of four stages: diagnosis, action planning, action taking, and evaluation. Findings indicate variations in signal strength and channel interference across rooms, highlighting the need for better access point placement and channel configuration.

Keywords

Network coverage, InSSIDer, Wi-Fi area coverage.

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[1*] Universitas Bina Darma, Indonesia, Corresponding email: imamakbar@gmail.com

Introduction

The performance of a network infrastructure plays a critical role in determining the stability, speed, and overall quality of data services within an institution. As digital transformation continues to advance across various sectors, reliable connectivity has become an essential requirement for supporting administrative workflows, communication processes, and information access. Wi-Fi technology, as a wireless communication system, enables users to access network resources without relying on physical cabling. Its effective range is strongly affected by antenna power, building layout, environmental factors, and the presence of physical obstructions such as walls, furniture, and electronic interference.

In this context, the Housing and Settlement Office of South Sumatra Province operates in a multi-room and multi-division environment where connectivity must support diverse activities across administrative, planning, and operational units. The office has implemented several Wi-Fi hotspots to facilitate internet access for employees, administrators, security personnel, and visiting stakeholders. These hotspots are crucial for enabling access to government systems, online correspondence, document processing, and coordination with external agencies. As modern public services increasingly rely on digital workflows, the availability of strong, stable, and well-distributed Wi-Fi becomes indispensable.

To support daily operations, the office utilizes a combination of Local Area Networks (LANs) and wireless access points (APs). Wireless Local Area Networks (WLANs), which utilize radio frequency waves to transmit data, offer convenience and mobility that wired networks cannot provide. WLANs have become a backbone technology for government institutions due to their ability to support flexible workspace arrangements and seamless device connectivity. However, despite their advantages, WLANs are highly sensitive to environmental conditions that may degrade signal quality, such as electromagnetic interference, obstructions, and poor access point placement.

As the demand for reliable wireless coverage increases, network administrators must ensure that every part of the office receives sufficient signal strength to support daily operational activities. Poor Wi-Fi performance can hinder productivity, disrupt communication, and negatively impact service delivery within the institution. Common issues include weak signals in distant rooms, fluctuating speeds, and black spots—areas where no wireless signal is available. Identifying and resolving such issues requires systematic measurement and analysis of Wi-Fi behavior within the building.

This study employs the InSSIDer application, a widely used Wi-Fi analysis tool capable of providing detailed information regarding signal strength, channel distribution, interference levels, and access point performance. Using InSSIDer, measurements are conducted across multiple points within the UPTD office to evaluate the overall coverage pattern of each installed access point. The tool assists in detecting unstable zones, measuring RSSI (Received Signal Strength Indicator) values, and identifying black spot areas that do not receive adequate signal coverage. These measurements form the basis for network optimization efforts aimed at improving wireless performance throughout the office area.

Based on the issues identified, this research is conducted under the title: "Analysis of Wireless Network Range in the Housing and Settlement Office of South Sumatra Province Based on Wi-Fi Area Coverage." The study aims to provide a comprehensive evaluation of

existing wireless infrastructure, identify weaknesses in signal distribution, and present recommendations for improving overall Wi-Fi coverage. The findings are expected to support the institution in enhancing connectivity, increasing work efficiency, and ensuring uninterrupted access to digital services within the office environment.

Methodology

This study employs the Action Research method, a practical and iterative approach widely used to examine and improve organizational processes through cycles of planning, action, observation, and evaluation. Action Research is particularly suitable for identifying real-world technical issues and implementing solutions in operational environments such as office network infrastructures. In the context of this research, Action Research is applied to analyze and optimize Wi-Fi coverage quality within the Housing and Settlement Office of South Sumatra Province.

The research process consists of four structured stages, described as follows:

1. Diagnosis

At the diagnostic stage, the researcher identifies problems related to wireless network coverage, stability, and connectivity across the different rooms and corridors of the building. Initial observations revealed several technical concerns, including weak Wi-Fi signals, intermittent disconnections, channel interference, and black spots where no wireless signal was detected. The diagnosis phase involved interviews with staff, direct network observation, and preliminary walkthrough inspections to understand user experiences and map potential coverage issues. This stage establishes the foundational understanding required for determining appropriate corrective actions.

2. Action Planning

In the action planning stage, a structured plan was developed to conduct a comprehensive signal strength analysis using the InSSIDer application, a tool capable of visualizing signal distribution, channel usage, SSID characteristics, and RSSI (Received Signal Strength Indicator) values. Specific measurement routes were designed to ensure coverage of all workspaces, hallways, and critical areas where Wi-Fi connectivity is essential. Additionally, the researcher prepared documentation templates to record SSID names, frequency bands, channel widths, noise levels, and potential interference from overlapping access points. This stage ensures that data collection is systematic, consistent, and aligned with the objectives of the study.

3. Action Taking

The action-taking stage involves performing the actual measurements across the building using the InSSIDer tool. The researcher conducted a walktest, walking through predefined measurement routes while continuously capturing signal strength readings from each access point. Data such as SSID visibility, channel allocation, RSSI values, and signal fluctuations were recorded in real time. Measurements were taken at varying distances and in rooms with different structural layouts to analyze the impact of walls, furniture, and electronic interference on signal propagation. The results provide a comprehensive overview of wireless network performance under real operational conditions.

4. Evaluation

The evaluation stage involves analyzing the collected data to assess overall wireless network performance. Indicators such as RSSI values, channel overlap, signal stability, and coverage gaps were examined to determine the effectiveness of current access point placement. The evaluation process identifies problem areas that require immediate improvement—such as relocating access points, adjusting channel configurations, or adding additional APs to eliminate black spots. Based on this assessment, the researcher formulates targeted recommendations aimed at optimizing Wi-Fi coverage, reducing interference, and enhancing connectivity across the entire building.

Field Survey Implementation

A detailed field survey was conducted throughout all operational rooms and corridors on each floor of the building. Despite all computers relying on wireless connectivity, the placement of existing access points was found to be inconsistent and suboptimal, leading to weak signal distribution and frequent channel overlap. These conditions significantly degrade network performance, causing slow speeds and unstable connections during daily activities. The findings from the survey serve as essential input for determining corrective strategies in the action research cycle.

Results

Action Taking

During the action-taking stage, RSSI (Received Signal Strength Indicator) measurements were performed using the InSSIDer software. The building contains 13 rooms, of which 9 have dedicated access points, while 4 depend on signals from adjacent rooms.

Table 1. Room Names and SSIDs

No.	Room Name	Wi-Fi Name (SSID)
1	Finance Room	Keuangan
2	Bankim Division	Bangkim
3	Housing Division	Bidang Perumahan
4	Operational Room	Rahasia
5	Head of Office / Secretary	KADIS–SEKDIS PERKIM SUMSEL
6	Head of UPTD Room	Ruang Kepala UPTD
7	Meeting Room (1st Floor)	UPTD Ruang Rapat Lantai 1
8	Planning Room	Perencanaan
9	Official Meeting Room	Official

Measurements were performed at an 8-meter distance from each access point.

Table 2. Wi-Fi Signal Strength Measurements

SSID	RSSI (dBm)	Channel	Security	MAC Address
Keuangan	-58	6	WPA2-Personal	56:16:51:8E:E8:47
Official	-47	12	WPA2-Personal	56:16:51:83:6A:36
Bangkim	-59	14	WPA2-Personal	54:16:51:F3:69:CA
Rahasia	-45	9	WPA2-Personal	56:16:51:83:3F:56
Ruang Rapat Lt. 1	-41	3	WPA2-Personal	56:16:51:83:6A:42
Perencanaan	-59	3	WPA2-Personal	56:16:51:84:24:32
Kepala UPTD	-71	8	WPA2-Personal	56:16:51:83:6A:2
KADIS–SEKDIS PERKIM SUMSEL	-61	11+7	WPA2-Personal	24:D3:F2:E6:1D:D0
Bidang Perumahan	-34	2	WPA2-Personal	56:16:51:88:83:9E

Most access points produced signal levels categorized as Excellent or Good, except for areas with physical obstructions.

Discussion

The analysis focused on determining whether neighboring Wi-Fi access points experienced channel overlap, which can lead to interference and reduced performance. The results are shown below.

Table 3. Channel Overlap Analysis

SSID & Channel	Distance (m)	Adjacent SSID & Channel	Overlap
Keuangan (6)	8	None	No Overlap
Official (12)	8	Rahasia (9)	Overlap
Bangkim (14)	8	Keuangan (6)	No Overlap
Rahasia (9)	8	Official (12)	Overlap

SSID & Channel	Distance (m)	Adjacent SSID & Channel	Overlap
Rapat Lt. 1 (3)	8	Kepala UPTD (8)	Overlap
Perencanaan (3)	8	None	No Overlap
Kepala UPTD (8)	8	Rapat Lt. 1 (3)	Overlap
KADIS–SEKDIS (11)	8	Rahasia (9), Official (12)	Overlap
Bidang Perumahan (2)	8	Perencanaan (3)	Overlap

Channel overlap occurs when access points operate within adjacent frequency ranges. To minimize interference, a separation of at least five channel values is recommended. The overlapping channels identified include:

- Official (12) with Rahasia (9)
- Ruang Rapat Lt. 1 (3) with Ruang Kepala UPTD (8)
- KADIS–SEKDIS (11) with Rahasia (9) and Official (12)
- Bidang Perumahan (2) with Perencanaan (3)

These overlaps contribute to interference, decreased throughput, and unstable connectivity.

Conclusion and Recommendations

The study produced the following conclusions: Wi-Fi signal measurements were conducted in all rooms equipped with access points. Coverage varied according to room size and physical structure.Most access points exhibited Excellent signal quality due to minimal obstructions.Several rooms including the staffing room, SPAMPLP room, the second-floor UPTD staff room, and the PBL area still experience weak connectivity due to walls and other obstructions.Multiple access points were found to operate on overlapping channels, resulting in interference. Channel realignment is recommended to improve performance.

Disclosure Statement

The authors declare no conflict of interest related to this study.

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Biographical Notes

IMAM AL AKBAR is student at the computer networking and wireless communication at Universitas Bina Darma. His research interests include WLAN optimization, network security, and applied wireless technologies in governmental institutions.