Study and Analysis of Network Topology Performance Using Wireless Distribution System Technology

Mohammad Faried Rahmat*1, Erfan Rohadi2, Indrazno Sirrjudin3, Farif Chrissandy4

1Information Technology, 2Electrical Engineering, State Polytechnic Of Malang

*efianr@polinema.ac.id, 2mohammad.faried@polinema.ac.id, 3indrazno@polinema.ac.id,
4farif.crissandy@polinema.ac.id

*Corresponding Author

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Abstract. The use of wireless networks has become a trend at this time. However, this can cause several problems in using this technology. One of the problems arising from this technology is the limited signal coverage in a certain place. To solve these problems, Wireless Distribution System technology is an alternative solution that can be done. Wireless Distribution System technology will be applied to each room. In this study, QoS analysis will be used to evaluate throughput performance and response time. The test scenario is performed with 1000 users (simulated) for seven days, four sampling times considering working hours and outside working hours. The analysis results show that with WDS technology, the resulting performance tends to be more stable with a throughput value of 500 KBps and a max response time of 5.5 ms.

Keyword : WDS, Response, Throughput, QoS, Mesh Topology

1 Introduction

The use of wireless networks has become a trend at this time. However, this can cause several problems in using this technology. Most organizations use wireless networks to support existing cable networks. However, in reality, wireless networks still use unshielded twisted pair (UTP) cables as the access point (AP) backbone. [1]. One of the problems that arise from wireless technology is the limited range of wireless signals in a specific place. Wireless network is one of the best alternatives in building a computer network that is practical and flexible and has high mobility [2].

Wire technology is a technique of combining between APs using wireless media in a wireless LAN. WDS allows the interconnection of several AP devices in one area of the wireless network on each AP, at least using only one network cable as a backbone line on the primary AP device. Meanwhile, in other APs, the backbone path comes from the primary AP distributed wirelessly [3]. Wireless Distribution System was proposed as an alternative to improve the electromagnetic occupancy of the spectrum, as each client connects to its access point (AP) [4].

This paper focuses on implementing the Wireless Distribution System with a Mesh topology. The purpose of this implementation is to determine network performance by evaluating the throughput and response parameters. Testing is done by sampling 1000 users (simulation) in 7 days and four times samples considering working hours and outside working hours.

Section 2 presents the state of art of the research. Section 3 displays the system design,
research methodology flow, hardware, and software requirements as well as described in this section. Section 4 presents the results of the performance evaluation with predefined scenarios. The results from the table will be used to compare the QoS parameters and efficiency of each proposed test scenario. Finally, section 5 presents the conclusions of this study.

Wireless Distribution System or also known as Wireless Repeater is a system of developing a wireless network without wires as a means of transmitting data, but the implementation of a wireless route from any AP device, this is different from the implementation in traditional communication networks where the media distribution system uses wired LAN. All base stations in a WDS network must first be configured so that they use the same radio channel, the same encryption mode (no encryption, WEP or WPA), Identifier (SSID) with a different name for each user identity [1]. The Wireless Distribution System enables any AP device to be connected in a wireless environment. By implementing WDS, the connection in the radio network can be expanded again via several APs or BTS without a backbone network.

Figure 1 show a topology of WDS infrastructure is a bit more complicated because each AP must be programmed to only receive the incoming signal from the AP upstream. Therefore, AP2 can only receive signals from AP1. This means that if AP1 is offline, AP2 will not get an Internet signal, so computers in the AP2 range do not get any internet access. What's more, the internet speed was cut in half when the signal was delivered. This means that every computer that gets internet from AP2 receives only half the rate compared to if they get it from AP1.

This could mean that every computer getting Internet access from AP2 receives 1/4 of the actual speed that comes out of the router. This is why the WDS infrastructure can only be configured with no more than five AP units. The WDS infrastructure has no redundancy in participating APs. This means that when one of the Access Point is damaged, the WDS system will have a problem. Offline APs must be replaced or repaired before all downline APs can get a signal [5].

Based on Figure 2, in a mesh WDS network, all APs communicate with each other. When one AP is damaged, the other will take over its role as long as the replacement is within the source signal range. In a certain sense, the WDS mesh network can heal itself. For WDS mesh networks to be effective, it is necessary to add APs in strategic locations to maximize overlapping signals. This is why WDS mesh networks are more potent and more expensive because they need to use more Access Point. When the Access Point is offline, the internet signal flow is redirected.
This is why in mesh Wireless Distribution System networks, AP Mikrotik are placed at a strategic point to maximize route diversion when one or more AP Mikrotik are damaged. Wireless Distribution System creates a wireless backbone between APs on the same wireless network. Wireless Distribution System devices can act as standard APs for wireless devices and bridges that connect AP Mikrotik. Wireless Distribution System with Mesh Topology allows station cycle loops, which means that data will not travel without limits through the network. Networks that join offer fault tolerance so that broken links will not cause network failure. Good channel distribution and several gateways can reduce network traffic load [5].

Mesh Network is a method for connecting multiple nodes of a connected network with a point to point connection. In this topology, many routes function as backup paths when other routes are down. In this topology it also allows users to get a more comprehensive connection range for a connection between nodes in the network.

Mikrotik is a Linux operating system that is intended as a network router and designed to suit all users. Administration can be done through the Windows Application (WinBox). Also, the installation can be done on a standard computer, Personal Computer (PC). Personal Computer will be used as a proxy router does not require a large enough resource for typical use, for example only as a gateway.

2 State Of Art

The State of Art of this study is taken from several examples of previous research as an example of a comparison in conducting this research. The previous works explained that distance and number of obstacles in various network deployment scenarios are different. In each case, QoS parameters are measured and performance is evaluated. The results show that the performance of the wireless distribution system network is the best [6].

In another research explained that The capital cost of implementing mesh networks in enterprises, universities and industries is very low, and compared with other wireless routing protocols, self-organization and low complexity characteristics make it more feasible, 802.11s). Configure the router as required. As mentioned in a document above, it is believed to be easy to implement and easily available on the market [7].

Furthermore, the research explains that Wireless Distribution System (WDS) with a point to multipoint arrange arrangement utilizing 802.11g to point. The consider was conducted in two stages. The primary stage was building a WDS arrange demonstrate utilizing four get to focuses that are associated. The moment one was analyzing WDS organize execution on the server side. Based on the comes about gotten seen throughput on each portion WDS tried in continuous decrease and the most honed happened within the final portion. On the other side, the esteem of jitter expanded from WDS-1 to WDS-2 and WDS-3 in an normal number, as well as the value of parcel misfortune which expanded in a really great category. The comes about gotten show great quality and by and large exceptionally suitable WDS innovation to grow remote get to expand wireless access [8]. And the last research explained that In multiple WDS clusters, a suitable AP partition and a gateway with communication paths in each cluster must be found at the same time to meet all boundary conditions and optimize the objective function. Our algorithm is divided into two stages to meet the requirements. Difficult conditions when optimizing the lens. It can be seen from the research results that the wireless mesh
network infrastructure (WIMNET) includes the NP integrity test of its solution version and its two-stage heuristic algorithm, including the cluster generation phase and the cluster improvement phase. Using the WIMNET simulator for simulation, the performance comparison of the three cases of using and not using our algorithm in two network topologies shows that the performance of our algorithm has improved [9].

3 Design System And Methodology

In this study the system is designed by using a mesh topology. With this topology, each proxy in a network can communicate with each other with clients. The process of sending data on the mesh topology network can be done faster because it can go directly to the destination node without going through other nodes.

![Fig. 3 Design System WDS](image)

The system designed must have capabilities that can meet system requirements. For this reason, an analysis of the needs of wireless network systems is needed to use Wireless Distribution System. After the analysis of system requirements is carried out, the results are obtained that the system requirements related to hardware and tools are the main needs that must be prepared. The needs of hardware and tools can be seen in Table 1.

| Hardware       | Qty | Detail               |
|----------------|-----|----------------------|
| Mikrotik RB750 | 2   | Mikrotik RB750       |
| Server         | 1   | Server Intel Xeon    |
| UTP Cable      | 2   | Belden US Cat6e      |
| Connector      | 4   | Connector RJ45 + Jacket |

The reasons for choosing hardware and tools in Table 1, apart from being needed to support wireless networks using Wireless Distribution System, are other reasons:

1. The use of a firewall router aims to enable segmentation of IP addresses, wireless distribution system feature, routing, and packet filtering and to make the network safe from attackers.
2. The server acts as a web content service provider

This research methodology has been carried out in accordance with the Fishbone diagram flow shown in Figure 4 below.
4 Result And Discussion

This section discusses about the result of Implementation Wireless Distribution System. In the previous research related to WDS test results based on distance testing with the QoS parameter is presented [6]. In this Study scenario test on Wireless Distribution System is carried out by sampling 1000 users (simulated) in 7 days, and four times in data sampling with consideration of working hours and outside working hours. The parameter for QoS are throughput and Response time. For application test using Web Server Stress Tool.

| Time | Monday Average | Tuesday Average | Wednesday Average | Thursday Average | Friday Average | Saturday Average | Sunday Average |
|------|----------------|----------------|------------------|-----------------|---------------|-----------------|----------------|
| I: 6.10 | 455.99 | 462 | 444.29 | 385 | 405.66 | 530 | 503.38 | 438 | 537.38 | 330 | 699 | 490 | 782 | 530 |
| II: 10.00 | 405 | 506 | 545 | 478 | 546 | 531 | 664 | 419 | 431 | 548 | 346 | 659 | 553 | 730 | 735 | 541 |
| III: 11.00 | 476.63 | 448 | 401.19 | 315 | 503.61 | 416 | 428.75 | 500 | 604.68 | 502 | 474.41 | 443 | 760.94 | 410 |
| IV: 16.00 | 489.37 | 598 | 501.86 | 310 | 525.87 | 431 | 506.71 | 452 | 523.79 | 452 | 534.23 | 461 | 723.29 | 383 |
| V: 21.00 | 432.37 | 253 | 400.26 | 440 | 442.02 | 431 | 400.26 | 431 | 442.71 | 513 | 403.42 | 523 | 735.79 | 384 |

The results from Web Server Stress Tool test as shown in table 3. In this scenario, the results of the response time are carried out with four sampling times with consideration of working time and outside working hours.

| Time | Monday Average | Tuesday Average | Wednesday Average | Thursday Average | Friday Average | Saturday Average | Sunday Average |
|------|----------------|----------------|------------------|-----------------|---------------|-----------------|----------------|
| I: 6.10 | 561 | 5057 | 5291 | 4804 | 5194 | 4379 | 4934 |
| II: 10.00 | 5393 | 5408 | 5442 | 5345 | 5349 | 5350 | 5476 |
| III: 13.00 | 6099 | 5383 | 5868 | 4561 | 5578 | 6119 | 4080 |
| IV: 16.00 | 5012 | 6276 | 5455 | 5276 | 5455 | 6450 | 5516 |
| V: 21.00 | 5812 | 5415 | 5417 | 5415 | 5345 | 5359 | 5217 |

The average throughput values are shown in Figure 5. Average Throughput Testing is done using a Web Server Stress Tool apps with testing for seven days with four sampling times.
The number of users tested is 1000 users (Simulation). As shown in Figure 5, the throughput measurement results involve 2 AP Mikrotik that function together as a Wireless Distribution System network. According to the results of the test scenario, the average performance value shows a stable trend in the range of 500 kbps every day at 6:00 am.

![Fig 5. Average Throughput](image)

![Fig 6. Simulation Result with Parameter Response Time](image)

The response time results in Figure 6 show that if you apply the WDS system, the response time is obtained with an average max of 5.5 ms. These results indicate that the Wireless Distribution System network with Mesh Topology has better performance. In general, it can be used as an alternative to expanding Wireless Access.

5 Conclusion
This research has shown performance evaluation based on throughput and response time of a mesh topology wireless distribution system. The results obtained show that the quality is good and it is means the propose system with Wireless Distribution System technology is promising for expanding Wireless Access System.
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