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An Experimental Connectivity Performance of Simple Wireless Mesh Implementation Using Wireless Distribution System (WDS)

Dicky Muhammad [a], Gita Indah Hapsari [b,*], Giva Andriana Mutiara [c]

[a,b,c] *Diploma of Computer Engineering, Telkom University, Bandung, Indonesia*

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ABSTRACT

Today wireless technology grows rapidly, especially in the field of telecommunications and communications. Computer networks now widely utilizes wireless. Wireless Mesh Network is one of the method which is use to communicate computer wirelessly. One important factor in application of wireless network is how to extend wireless signal coverage. Wireless Distribution System is one way to expand the wireless network by mean of wireless interconnection of access point on the network IEEE 8022.11. This study suggests how to build a simple wireless computer network using WDS technology and describes connectivity performance and its signal coverage. The test result of connectivity performance shows that the connectivity between two computers work properly for reliability and multi SSID testing. However, the connectivity was not success in multichannel testing. Furthermore the test result of coverage shows that the range of wireless signal coverage reaches 39 meters with different circumstance room.

* Corresponding author at:
Diploma of Computer Engineering, Telkom University,
Jl. Telekomunikasi No. 1, Terusan Buah Batu, Bandung, 40257
Indonesia.
E-mail address: gitaindahhapsari@tass.telkomuniversity.ac.id

ORCID ID:
Second Author: 0000-0002-9338-0852
Third Author: 0000-0003-4387-6128

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1. Introduction

Advances in wireless technology growing rapidly around the world, especially in the field of telecommunications and data communications. Wide coverage is an important factor in wireless technology. One way to extend the range of the signal is to use WDS technology.

WDS technology is a technology extending wireless network by means of wireless interconnection of access points in the IEEE 802.11 network. With WDS technology, expanded wireless networks using multiple access points without the need for a wired backbone to connect.

Several previous studies discussing the implementation of wireless mesh with WDS. One study on the wireless network using WDS was stated by Babangida Zubaira. In the paper, he developed WDSN (Wireless Distribution System Network) use WDS to demonstrate WLANs, OPNET simulated then measure its performance parameters. The measured parameter is the response time, throughput, and delay [1].

Jutamas Kongtep suggests research in a paper on adaptive frequency hopping scheme for WDS in WLANs. And the result of his research is a signals lingering at predefined frequency for the short period of time in each channel all the time that protects noise with neighbors channels and avoids Intruders roommates Resolves a problem in the general form of WDS is vulnerable considering the attacks or interferences diligence to perpetually use same frequency channel [2].

Another study about WDS presented by Alpatov, et.al about evaluation performance of wireless network for mobile user [3]. Research on Wds for mobile nodes carried by Ridwan Riesta is to implement its WDS bridge mode to support data services on the mobile node [4]. Alif Subardono presented his research in 2011 on performance analysis wireless distribution system configuration star and mesh for hotspot area. In his research it was found that throughput in star configuration is better than mesh configuration [5]. Another research about WDS for hotspot is presented by Wiwin Sulistyo, et.al. research about implementation and analysis of use dd-wrt firmware to establish wireless distribution system network in hotspot network [6]. Deer Li present his research about the performance MPEF-4 AVC video streaming over IEEE. 802.11 WDS [7].

Based on all research explaining above, we present an experimental of simple WDS. The purpose of this research is to build a wireless Mesh Network as simple as connecting the two pieces of the access points. In addition to experiment with performance wireless mesh parameter measurements include reliability, connectivity, connectivity Multichannel Multi SSID and signal range on the system.

2. Theory

2.1. Wireless and Wireless Network Mesh

The wireless network is a wireless network that uses air as the transmission medium to conduct electromagnetic waves [8]. Based on its coverage, there are several type of wireless networks (Figure 1).

1. Wireless Personal Area Network (WPAN) is a wireless network with range of small area for example infrared.
2. Wireless LAN (WLAN) is a wireless coverage larger than WPAN.

3. Wireless MAN (WMAN) is wireless network that connect multiple network WLAN, for example WiMAX.
4. Wireless WAN (WWAN).
5. WWAN is a wireless network that reaches a large area such as connecting headquarters and branches across province.

Wireless mesh network (WMN) is a wireless network consisting of mesh routers and mesh clients. Mesh routers have at least minimal mobility and form the backbone WMN. WMN can be integrated with other networks such as the Internet, cellular, IEEE 802.11, IEEE 802.15, IEEE 802.16, sensor networks and so forth. Figure 1 shows the shape of WMNs [9].

Some benefit characteristic of WMN are increased reliability, low installation cost, large coverage area, and automatic network connectivity [10].

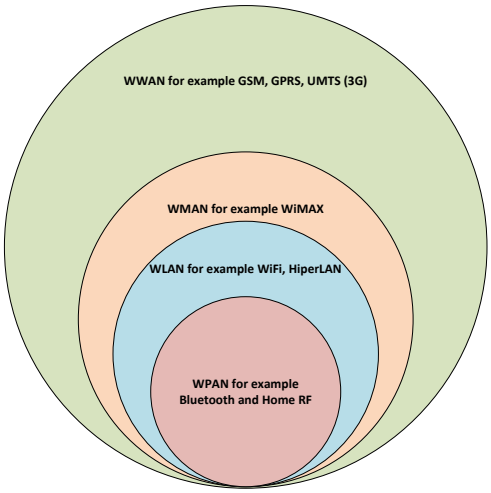

Figure 1 Type of Wireless Network Based on Coverage

2.2. Wireless Distribution System

WDS is a technology extending wireless network without having to build a wired network backbone as the interconnection between the bridges. The example of WDS is shown in Figure 2. Access Point is connected by Mac Address [1].

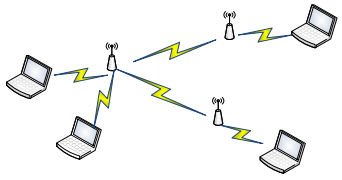

Figure 2 Wireless Distribution System

3. Analysis and Design

To build a Wireless Mesh Network using WDS then the required hardware and software can be showed in Table 1.

Table 1 Hardware and Software

Hardware	Software
Access Point 2 Pieces Linksys WRT54GL v1.1 Two laptops are used for end user	DD-WRT Firmware version 24

Construction of the system is done in stages with the following stages:

1. Configure the network according to the topology as follows in figure 3. Topology used is a simple wireless computer network that consists of 2 pieces of computer and access point as in figure 4.

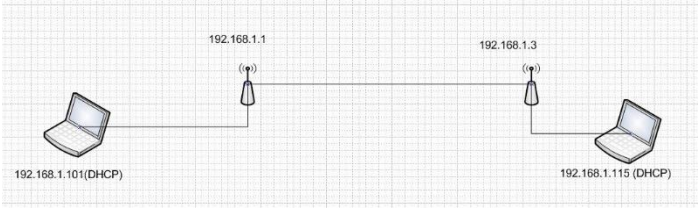

Figure 3 Topology of WDS

2. To install DD-WRT firmware. DD-WRT is a Linux-based firmware for various wireless routers of different brands.
3. Perform wireless mesh configuration with WDS.
4. Perform wireless mesh network connectivity.
5. To test the reliability of wireless mesh.
6. Perform WDS Network Coverage Testing.

4. Implementation and Testing

4.1. Implementation

The results of the analysis and design then implemented physically. After designing the topology to be implemented then perform the installation and configuration of the DD-WRT firmware by entering the username and password as in Figure 4.

Then configure the wireless mesh with WDS. For the selection of the channel using the insider as a helper application to view the wireless channel is in the area to be used. Figure 5 shows that channel 1 will be used to implement this WDS.

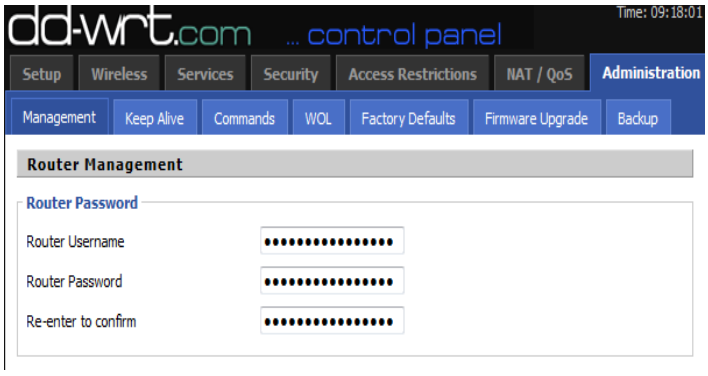

Figure 4 DD-WRT Configuration

Figure 5 DD-WRT Configuration

The next step is to configure the network by entering the IP and DHCP Gateways on the access point 1 and 2. Then select the AP mode and select the channel to be used. In configuration mesh WDS, it must turn off security. Figure 6 and 7 show the configuration of Access Point 1 and Access Point 2.

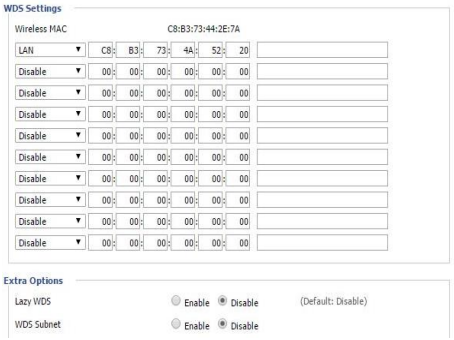

Figure 6 WDS Access Point 1 Configuration

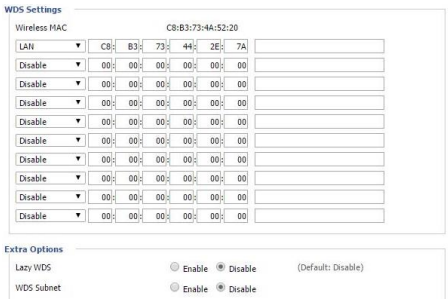

Figure 7 WDS Access Point 2 Configuration

4.2. Testing System

Simple wireless mesh using WDS is tested by these stages:

1. Connectivity Testing,
2. Reliability Testing,
3. Multi SSID Testing,
4. Multichannel Testing,
5. Coverage Testing.

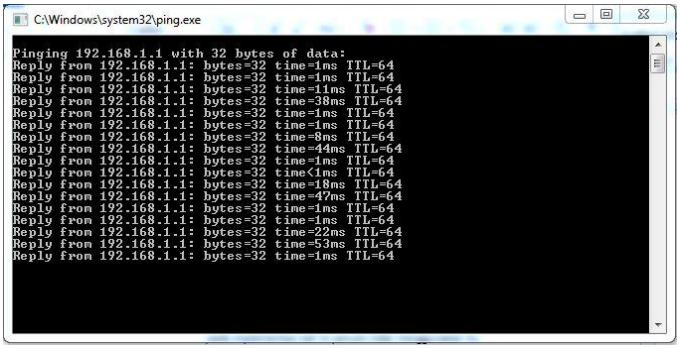

Figure 8 Access Point 1 Connectivity

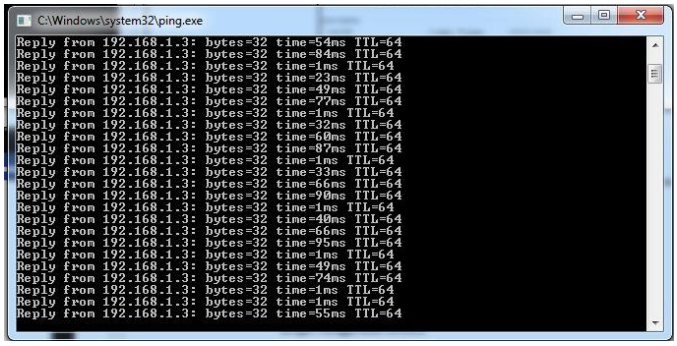

Figure 9 Access Point 2 Connectivity

Testing connectivity between the client and the access point 1 and the access point 2 is done by pinging between client and access point connectivity. The test results are presented in Figure 8 and 9. The results showed that the image of connectivity for successful wireless mesh can be seen from the results of ping to the access point 1 and 2 so that the second access point access point can be connected.

Mesh network reliability testing is done by turning one access point and then try its mesh network. Results of testing the reliability of the mesh network shown in the Figure 10, 11 and 12. The test results showed that the client can not access to the access point 1, but still connected to the access point 2 proves that wireless mesh has good reliability.

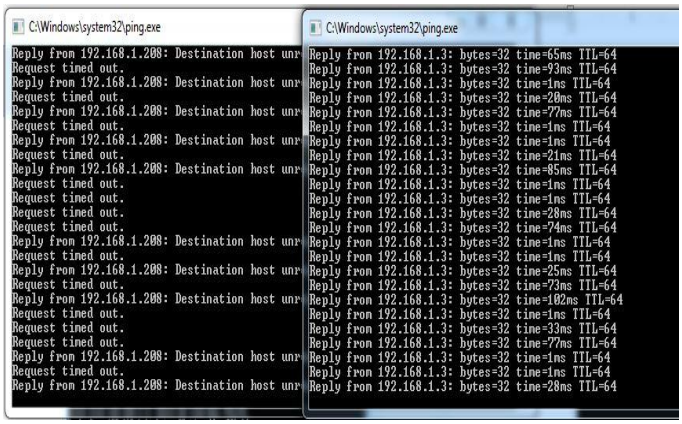

Figure 10 Access Point Reliability Test

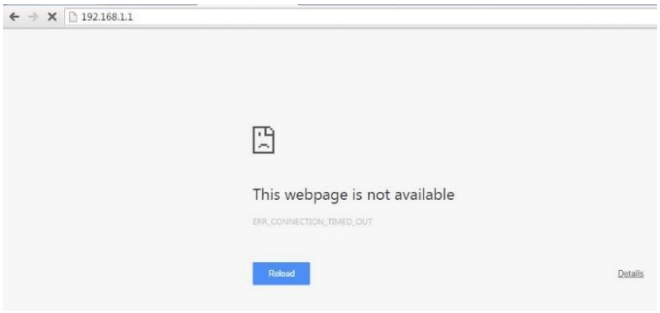

Figure 11 Access Point 1 Accessible

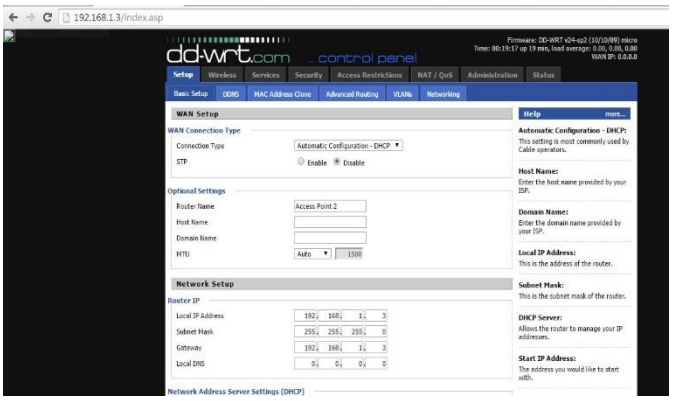

Figure 12 Access Point 2 Accessible

Testing wireless mesh connectivity with multi SSID is done by adding one new SSID on both the access point and client enter a new SSID and try the connectivity. Results of testing multi SSID shown in the Figure 13 and 14. The test results show both the access point and create a new SSID second access point can be connected.

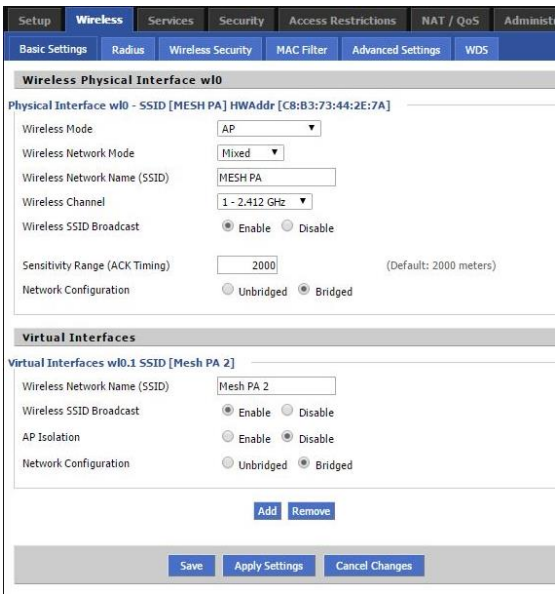

Figure 13 Creating New SSID

Figure 14 New SSID Connection

Testing connectivity with multi-channel wireless mesh done by replacing the channel on one of the access point and test the connectivity. Results of testing multi SSID contained in the Figure 15, 16, 17, 18 and 19. In this test, a second access point has different channels so that both the access point can't connect to each other even if WDS is already in the configuration.

Figure 15 Access Point 1 Accessible Multi SSID

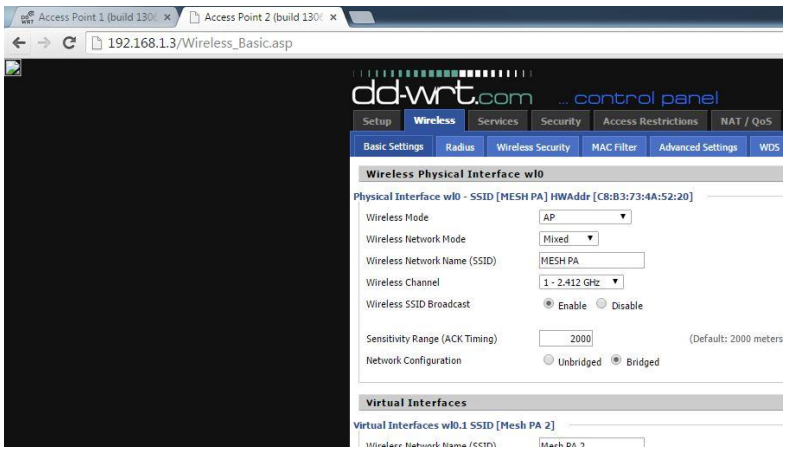

Figure 16 Access Point 2 Accessible Multi SSID

Figure 17 Channel Selection on Access Point 1

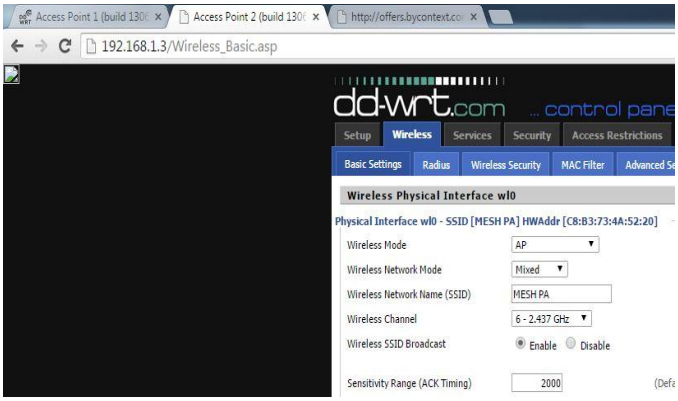

Figure 18 Make Channel 6 at Access Point 2

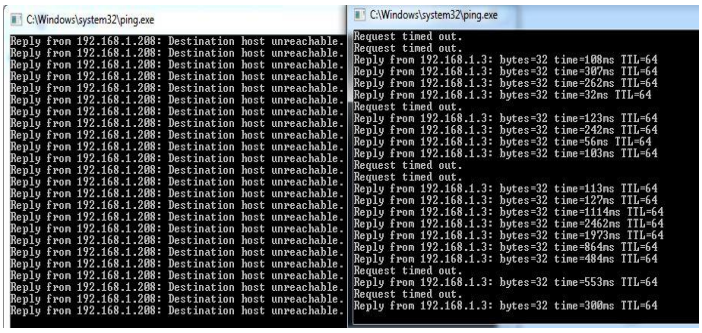

Figure 19 Test Result of Multichannel Connection

Testing wireless mesh measurement range is done by testing the connectivity and change the placement position between the access point and client. Change of position is based on the distance and space. Results of testing wireless mesh range shown in the Table 2. The results of the testing range wireless mesh can be seen that the largest range of WDS that is as far as 39 meters.

Table 2 Test Result of Wireless Coverage

Connectivity between AP 1 and API 2	Position of AP 1 and API 2	Distance between AP 1 and 2
Connectivity work properly	Access Point 1 and Access Point 2 in same Room	< 3 m
Connectivity work properly	Access Point 1 and Access Point 2 in same Room	< 10 m

Connectivity between AP 1 and API 2	Position of AP 1 and API 2	Distance between AP 1 and 2
Connectivity work properly	Access Point 1 and Access Point 2 in same Room	< 20 m
Connectivity work properly	Access Point 1 and Access Point 2 in different Room	< 5 m
Connectivity work properly	Access Point 1 and Access Point 2 in different Room	<10 m
Connectivity work properly	Access Point 1 and Access Point 2 in different Room	<20 m
Connectivity work properly	Access Point 1 and Access Point 2 in different Room	< 30 m
Connectivity work properly	Access Point 1 and Access Point 2 in different Room	< 39 m
Connectivity Bad	Access Point 1 and Access Point 2 in different Room	> 39 m

5. Result

The connectivity of simple wireless mesh network using WDS can work properly by using single SSID and Multi SSID but the connectivity cannot work properly on different channel. The signal range wireless mesh network using WDS can reach 39 meters with the position of each access point is located in a different room.

In the future, this research can be done on more complex configuration of WDS with different topologies with performance measurements on each topology. Performance measurement can be made on the throughput of each topology and compare the result.

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