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# The Influence of Yagi Antenna Corner Reflector Model Design for Signals

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---------- ***ABSTRACT***----------
*Wireless LAN technology is the best solution in overcoming the problem of signal coverage for remote areas by using a Yagi Antenna with a Corner reflector. In this research, the testing held at a frequency of 2.4 GHz to improve wi-fi reception in the process of receiving wireless USB adapter signals to wi-fi signals. Testing the Corner Antenna of Yagi Reflector held at any distance of 80 meters and 100 meters. The results of measuring the level of acceptability at the Corner Reflector of Yagi Antenna for ten attempts are obtain at an average of -64.75 dBm at a distance of 80 meters and -68.75 dBm at a distance of 100 meters. From the results of the yagi antenna with a reflector in the form of a corner, the gain value of the gain at a distance of 80 meters is 14.1 dBm and at a distance of 100 meters, the best gain value is 34.25 dBm.*
***Keywords****: Yagi Antenna, Reflector Corner, 2.4 Ghz WIFI, Signal Strengthening*
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## I. INTRODUCTION

Wireless telecommunication system is a system that connects two or more devices without using cables, that is, using electromagnetic waves as a means of substituting cables. And a device is needed in the form of an antenna to support communication in a system.

In wireless communication systems the role of antennas is very important, namely to radiate electromagnetic waves. Therefore, a receiver antenna is needed that is able to work as a receiver and release of electromagnetic energy which plays a role in Wi-Fi technology. According to Mudrik Alaydrus (2011: 1). Antennas are components that designed to transmit and receive electromagnetic waves. An antenna as a transmitter (transmitting antenna) is an electromagnetic transducer, which is used to convert a continuous wave in a cable transmission line, into a wave that propagates in free space and as a receiver (receiving antenna) converts a wave of free space into a guided wave.

Yagi antenna is a directional antenna, which is an antenna that can only pick up or receive signals from single direction, namely the front because the antenna side behind the reflector has a smaller gain than in front of the director. With the addition of the reflector model, it will limit the radiation pattern so that it does not widen backward and the beam strength will be amplified in the opposite direction, so that the reflector model that is expected to increase gain is the reflector corner model.

Antenna is one device that converts electrical signals into electromagnetic waves and emits them to free air or conversely captures electromagnetic waves from free air and converts them into electrical signals. Based on this definition, the antenna has 3 main functions, namely:

a) The antenna functions as a converter. It calls as converter because it able to changes the shape of the signal, i.e. from an electrical signal to an electromagnetic signal, or vice versa.
b) The antenna works as a radiator. It is said to be a radiator because this antenna emits electromagnetic waves into the free air next. If instead the antenna receives or opposes the radiation energy of electromagnetic waves from free air, then its function is expressed as a radiator.
c) Antennas function as impedance matching. It is said to be a matching impedance because the antenna will always adjust the system impedance. The system in question is a transmission line and free air. When the antenna is working or operating, the antenna will adjust the channel characteristic impedance with the air characteristic impedance. (Widya, 2015).

In general, the antenna are divide into 2 types, namely: omnidirectional antenna and directional antenna.

a. Omnidirectional antenna is a type of antenna that has a signal transmission pattern in all directions with the same power.

b. Directional antenna is an antenna that emits power in a certain direction. This antenna gain is relatively larger than an omnidirectional antenna.

Yagi antennas are also known as directional radiating antennas and are designed to transmit waves at only one frequency. This antenna consists of driven, reflectors and directors known as elements.

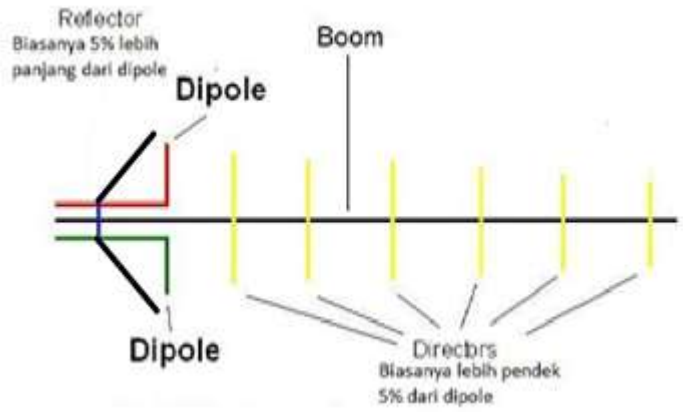


**Figure 1.** Yagi antenna

Source: (Triyadi, 2017)

According to (Widya, 2015) Wireless LAN technology performs the process of sending data using radio frequency as an intermediary medium. This technology is regulated by the same rules as AM / FM radio. The Federal Communications Commission (FCC) is an international organization that regulates the use of wireless LAN devices. On the contrary, IEEE (Institute of Electrical & Electronic Engineers) creates and manages wireless device standardization.

There are three frequency bands that can be used freely in the industrial, medical, and scientific worlds, including 900 MHz, 2.4 GHz and 5.2 GHz. Among the three bands, many wireless devices currently use the 2.4 GHz frequency.

IEEE has established a standard protocol that is used on wireless devices, namely:

1. 802.11a, technology uses a 5 GHz frequency and can produce speeds of 54 Mbps.
2. 802.11b, technology uses a 2.4 GHz frequency and has transmission capabilities of up to 11 Mbps.
3. 802.11g, the same technology as 802.11b, uses a 2.4 GHz frequency, and has 54 Mbps transmission capability.
4. 802.11n, a technology that improves the 802.11g standard in terms of the amount of bandwidth and operates 2 frequencies namely 2.4 Ghz and 5 Ghz.
5. 802.11ac, the latest generation of technology supports bandwidth reaching 1300 Mbps at a frequency of 5 Ghz and added 450 Mbps at a frequency of 2.4 Ghz.

## II. RESEARCH METHODS

### 1. Research Materials

The research material is an adequate internet network.

**Tools Used**

**a)** Hardware

- Laptop Acer E5-475G
- Wireless USB Software Adapter

**b)** TP-LINK TL-WN722N USB Wireless LAN Utility is a default application from a wireless USB adapter.

The several uses of the TP-LINK TL-WN722N USB LAN software are as follows:

- There is a signal strength value whose indicator is a percentage (%)
- There is a link quality value whose indicator is a percentage (%)


**Figure 2.** Display of TP-LINK TL-WN722N USB Wireless LAN Utility

## 2. Design of Yagi Antenna

In designing this Yagi antenna, the author made a yagi antenna reflector corner model. Below is a picture of Yagi antenna design reflector corner model:

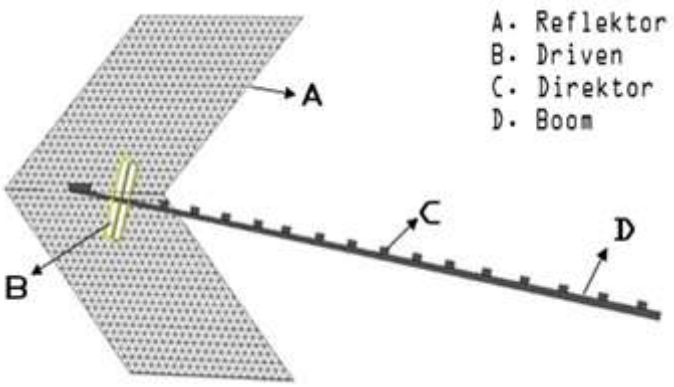


**Figure 3.** Yagi Corner Antenna Design figure 3. is a picture of a yagi corner antenna design that has a right angle with a wire coated as a medium for receiving electromagnetic waves.

- **Antenna Assembly Steps**

➢ **Driven element manufacture**

Cut the copper pipe according to the antenna dimensions obtained from the design process, namely:

$L = 0,5 \times K \times \lambda$
$= 0,5 \times 0.95 \times 0.125$
$= 0,0593$ meter
$= 5,9$ cm

The model used is folded dipole**,** then arch the copper pipe so that it looks like the picture below

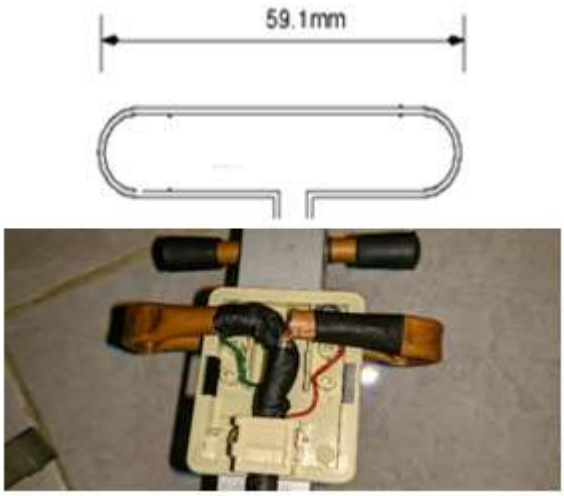


**Figure 4.** Elemen Driven

- **Making Director Elements**

Just like making a driven element, the director's element also uses copper pipes. The length of the director can be determined by:

$$L_{director} = L_{driven} - 5\% (L_{driven})$$
$$= 5{,}9 - 5\% (5{,}9)$$
$$= 5{,}9 - 0{,}295$$
$$= 5{,}6 \text{ cm}$$

$L_{director}$ = length of director
$L_{driven}$ = length of driven

**Figure 5.** Direktor's element

- **BOOM Processing**

Cut the aluminum rod 54 cm long, then use the drill hole with a distance of 2 cm then enter the driven element and the director as shown below.

**Figure 6.** The process of making Boom

**4. Measurement Data Collection**

Retrieving measurement data based on testing is shown in Figure 11.


**Figure 7.** Yagi Antenna Testing Scheme

Source: TP-LINK TL-WN722N USB Wireless LAN Utility software

**Figure 8.** Data Collection Process

Figure 8. is a data retrieval process using TP-LINK TL-WN722N USB Wireless LAN Utility Software. This test is done when the laptop is connected to "Access Point". All required parameters will be proven by screenshots using this software.

## III. RESULT AND ANALYSIS

**1. Calculation of Transmission Power and Antenna Receipt at a Distance of 80 Meters**

In testing the Yagi antenna this different reflector corner model will be calculated ten times, to determine the value of transmit power and receiving power as follows:

$$P_R = P_T - L_T + G_T - L + G_R - L_R$$
$$= 4 - 1 + 3 - 78{,}06 + 3 - 3{,}125$$
$$= -72{,}18 \text{ dBm}$$

After calculation, the value of the received power is -72.18 dBm. To facilitate reading the data, Table1 is created.

**Table 1.** Power Calculation and Measurement Accept at a distance of 80 meters

| Antenna Type | Power Receive Calculation (dBm) | Measurement Receipt (dbm) | Color Indicator |
|---|---|---|---|
| *Omni* | -72,18 dBm | -75,85 | *Good* |
| *Yagi Corner* | | -64,75 | *Excellent* |

Source: Processed Data

**2. Calculation of Transmission Power and Antenna Receipt at a Distance of 100 Meters**

**Table 2.** Power calculations and measurementsAccept at a distance of 100 meters

| Antenna Type | Power Receive Calculation (dBm) | Measurement Receipt (dbm) | Color Indicator |
|---|---|---|---|
| Omni | -74,1 dBm | Not Detected | *Poor* |
| *Yagi Corner* | | -68,75 | *Excellent* |

Source: Processed Data

**3. Strengthening (Gain)**

**Table 3.** Recapitulation of Calculations Strengthening (Gain).

| No | *Yagi* Antenna | Range | |
|---|---|---|---|
| | | 80 meter | 100 meter |
| 1 | *Yagi Corner* | 14,1 dBm | 34,25 dBm |

Source: Processed Data

Then, Figure 9 and Figure 10 made as a graph of the results of tests that have been carried out so that it is clear that changes in the signal strength and gain of each antenna at different distances.

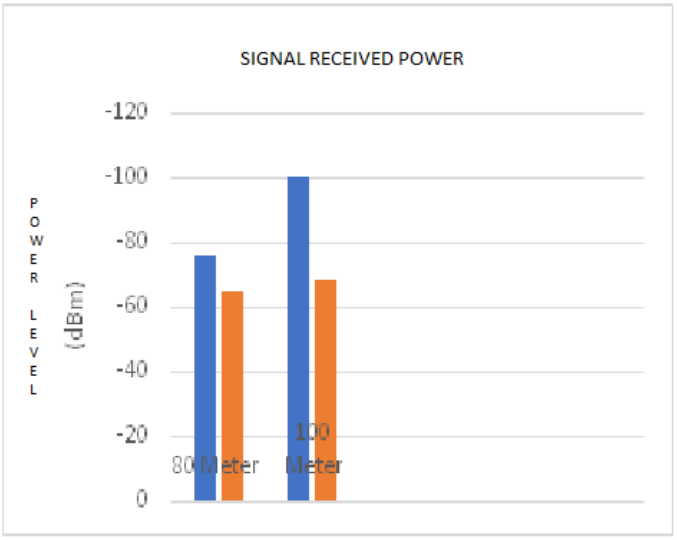


**Figure 9.** Graph of Value Measurement Results Receive Power Level
Source: Processed Data

From Figure 9. The graph above can be seen for the value of the acceptability level which has the best signal strength level for a distance of 80 meters is the Yagi Corner antenna of -64.75 dBm and at a distance of 100 meters Yagi Corner antenna with an average value of - 68.75 dBm. This statement has been proven in the results of testing in the field.

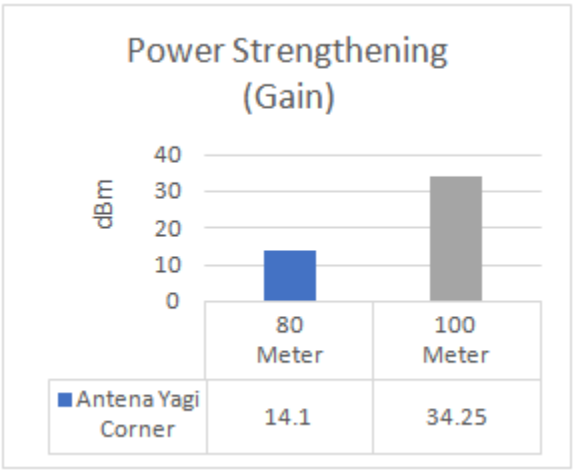


**Figure 10.** Graph of Power Strengthening (Gain) based on Calculation Result
Source: Processed Data

Figure 10. The graph of the calculation of power gain (gain) shows that the gain value on the Yagi antenna is quite good. Thus, Yagi antenna has an appreciable reinforcement value that is at a distance of 80 meters has a gain value of 14.1 dBm and at a distance of 100 meters has a gain value of 34.25 dBm. Based on the graph the results of the above test can be seen which have the best signal strength and gain in the Yagi Corner antenna. Both of these graphs show that the Yagi antenna with this reflector corner model has been able to increase the value of the receiving power level on a wireless USB adapter that works on the 2.4 GHz frequency.

## IV. CONCLUSION AND RECOMMENDATIONS

### A. Conclusion

**a)** Calculation and measurement of acceptability level values using Omni antenna at a distance of 80 meters, the calculation of -72.18 dBm is obtained and at a distance of 100 meters a calculation of -74.1 dBm is obtained. The measurement results at a distance of 80 meters are obtained with an average level of receiving power of -75.85 dbm in the category of good signal quality (Good), and for longer distances of 100 meters wireless USB adapter TP-LINK WN722N has been unable to connect on the access point.

**b)** Results of measurement of wireless USB adapter using Yagi Reflector Corner antenna of -64.75 dBm signal quality is very good (Excellent).

**c)** Measurement of the received power level at a distance of 100 meters TP-LINK WN722N wireless USB adapter that uses a Yagi Reflector Corner antenna of -68.75 dbm.

**d)** Based on the results of the average measurement of reception at a distance of 80 meters using the Omni Antenna with the default USB USB adapter and the Yagi Antenna with the Reflector Corner model proven by TP-LINK TL-WN722N softwares the USB Wireless LAN Utility gets gain on the Yagi antenna Corner of 14.1 dBm.

**e)** On the results of testing with the TP-LINK TL-WN722N USB Wireless LAN Utility software at a distance of 100 meters, gain gain, Yagi Reflector Corner antenna antenna is 34.25 dBm.

**f)** From the measurement and testing results it can be seen that the Yagi antenna with this reflector corner model is functioning properly, indicated by the magnitude of the gain for the 80 meter distance of 14.1 dBm and for the 100 meter distance the best value is found in Yagi Corner antenna is 34.25 dBm..

**B. Suggestion**

a) In the next development, the research can be carried out by changing the size of the reflector material so that it can improve the gain of power (gain) even better.

b) Further research can be done by giving the obstacle at a distance to determine the change in signal strength

c) Check, treatment and maintenance are needed to get a longer use on this antenna.

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