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Analysis of Semi Parabolic Grid Antenna 2.4 GHz for Wireless LAN Networks

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***Abstract*--Research on analysis Semi Parabolic Grid antenna 2.4 GHz for Wireless LAN networks motivated many ordinary people who do not understand about the use of wireless LAN technology. With this research are expected to help the public in the use of antennas and wireless networking technology Wireless LAN. This research can also be used to become reference in obtaining information about Wireless LAN antenna. This research methodology is experimental. The author made several steps of literature review studies, feasibility studies of site survey and documentation of site survey, analysis which includes analyzing the available networks and analyzes the use of the area and tower, installation, testing and implementation, evaluation, documentation and to compile the final project report book. The author also experienced some constraints in the research, such as distance between of antenna Grid with Access Point, which often have configuration error and the existence of deficiencies found in antenna Grid that makes less link quality. There are several things that affect the quality of the signal emitted by Access Point include: distance and placement of Access Points and Grid antenna, the focal point and the point of the angle between the Grid antenna Access Point, the presence of barriers and the type of Access Point. Link budget and the fade margin is also very influential on the reliability of wireless links. Antenna Semi Parabolic Grid 2.4 GHz can be connected to the Access Point at certain distance with the signal strength is directly proportional to the distance.**

Keywords-Antenna Wireless; Semi Parabolic Grid; Wireless LAN; 2.4 GHz.

I. INTRODUCTION

Wireless LAN technology is increasingly developing along with the times. One tool that can be used for network development is a 2.4 GHz semi parabolic grid antenna. This research has never been done before, so it is very useful to complement previous research related to networks, especially wireless networks. Previous studies include the Vertical Collinear antenna, Satellite dish, Directional Parabolic, Circular Microsite, and Helix.

In this study, several processes were carried out to obtain the desired results, namely arranging a Semi Parabolic Grid antenna, with this antenna, the internet signal was able to be captured properly. Next, do an analysis of the Semi Parabolic 2.4 GHz antenna for Wireless LAN networks. Next, analyze the Semi Parabolic Grid antenna security.

WLAN is a local area network whose transmission media uses radio frequency (RF) and infrared, to provide a network connection to all users in the surrounding area. Area coverage can be spaced from classrooms to all other campuses or offices and different buildings [1].

The disadvantage of this mode is that the computer cannot communicate with computers using cables, besides, the range in this mode is limited to the distance between the two computers [2].

II. PURPOSE

This study aims to design and conduct Semi Parabolic Grid antenna analysis with 2.4 GHz which is used for Wireless LAN networks and will connect the internet network from the Training Center building with the PKSI building at State Islamic University Sunan Kalijaga Yogyakarta.

The results of this study are expected to be used as a first step in the use of wireless antenna technology so that the presence of these antennas can maximize internet usage for the University community

This research can also be used to provide convenience in obtaining information about Wireless LAN antennas.

III. METHODOLOGY

The methodology used in this study is the following steps

A. Literature study

Learn the concepts of the Semi Parabolic Grid antenna system and study the network configuration of Wireless LAN computers. With the literature review method and reading many references from books, the study was carried out by searching data on the internet and reading books about Semi Parabolic Grid antennas.

B. Site survey

Site Survey is a process carried out to map certain locations by determining the placement of wireless devices that are adapted to the nature, interference and radio frequency coverage in order to properly implement wireless networks.

C. Analysis

The analysis carried out is about the available network, and analysis of whether the Wireless LAN network is used inside, outside the room, or both (inside and outside). Such considerations determine whether later it is necessary to provide additional antennas or if necessary provide a tower. If Wireless LAN is used outside the room with a long distance range and there is a lot of interference, it is recommended to use the tower so that the signal can be captured by the antenna properly.

D. Installation and testing

Installing on client computers and server computers and testing Semi Parabolic Grid antennas at the research site, with assistance in the form of laptops / computers and software needed to measure the amount of signal produced by the antenna that has been printed on the laptop/ computer.

E. Implementation

Implemented the Semi Parabolic Grid 2.4 GHz antenna, and Access Point with the materials and equipment needed to make the antenna. Equipment for implementation, both hardware and software has been mentioned in the previous sub-chapter. In the implementation phase, this refers to the stages of previous research, such as the stages of literature review, feasibility studies and analysis. From the results of documentation in the literature study process, feasibility studies and analyzes are used as material in this implementation stage.

F. Evaluation

Evaluate and conclude the measurement results from the study. At this evaluation stage, it starts from the beginning of the research stage (Literature Study) to the final stage (Testing). The results of the evaluation will be explained in the Discussion and Conclusion chapter.

G. Documentation

In each stage of the research documentation must be carried out so that when the research has been completed it can be reviewed on the stages of research through the documentation.

IV. RESULT AND DISCUSSION

A. Overview of PKSI

The Computer and Information System Center (PKSI) is an institution that is responsible for websites and work units which are included in the scope of the Kusuka Gate, which forms online information offerings from State Islamic University Sunan Kalijaga Yogyakarta.

B. Overview of Training Center

The Training Center (CT) which is now a University Hotel is one of the Business Units developed by State Islamic University Sunan Kalijaga Yogyakarta. This hotel is

located in Sambilegi, Maguwoharjo, Sleman, about 6 kilometers from PKSI.

C. Planning and implementation of WLAN networks

- Location survey
- Select wireless equipment
- Determine the mode
- Consider the real conditions

D. Configuring Access Points

The access point used in writing is TP-LINK 108M Wireless Access mode No: TL-WA601G with the following specifications:

- Standards: IEEE 802.3, 802.3u, 802.11b and 80211g
- Ports: 1 RJ5 supporting ports 10 / 100M Auto-Negotiation and Auto MDI / MDIX.
- Frequency: 24-2.4835 GHz
- Gain: 4 dBi
- Radio Data Rate: 108/54/48/36/24/18/12/9 / Mbps or 11 / 5.5 / 2/1 Mbps (auto rate capable)
- Modes: AP / AP Client / AP + Bridge / Repeater / Universal Repeater
- Modulation: OFDM / DBPSK / DQPSK / CCK
- LEDs: POWER, SYSTEM, LAN, WLAN
- Operating Temp: 0oC-40oC (32oF-104oF)
- Operating Humidity: 10% -95% RH, Non-condensing
- Dimensions (W x D x H): 6.5 x 4.25 x 1.1 in (165 x 108 x 28 mm) (without antenna)
- DHCP server
- Supports WPA
- User friendly installation software
- Configuration can be done via the network using a browser (web based)
- 1 port Ethernet for connection to LAN
- The indicator is an LED light to show power status, WLAN link, System link and LAN link
- Reset button to restore to default settings

E. Grid Antenna and radio link configuration

Grid antenna and radio link device configuration starts from the radio link device settings. The default parameters used in radio link settings include:

- IP address - 192.168.0.22
- Subnet mask - 255.255.255.0
- Gateway - 192.168.0.22
- Primary DHCP Port - Wireless
- Configuration Port - Both (Ethernet & Wireless)
- Administrator Password: public (case sensitive)
- User password: public (case sensitive)
- Authentication type: open key
- WEP keys - None
- WEP Algorithm - Disabled
- ESSID - Any
- BSSID - 0000000000
- Preamble - Long
- Operating Channel: Country specific
- Regulatory Domain: Country specific

F. Client setup

After configuring the Access point, wireless antenna and radio link, the next step is to test the connection to the Access point. Client equipment at this writing are:

- Laptop or computer
- Wireless antenna along with the radio
- Hub or switch
- UTP and RJ-45 cables
- Power cable

The wireless antenna will be the client of the Access point. The wireless antenna will be connected to a hub / switch, and from the hub or switch will be connected via a LAN to several computers.

The steps taken in the client setup are as follows:

- Arrange a wireless antenna, radio link, hub / switch, laptop / computer (must be more than one computer) into a LAN network.
- After forming the LAN network, log in to the simple monitor on the radio link.
- In the Site Survey link, select Infrastructure Mode. Click Select from Available Access points and Refresh.
- After refreshing, select ESSID, which corresponds to the Access point that was set before, click 2 times.
- IP address settings on each computer, fill it with IP address Access point, namely 190.10.10.xxx, Subnet mask255.255.255.0, Gateway 190.10.10.1 and DNS server 172.16.4.10. The IP address of each computer must be different, for example if the LAN consists of

2 computers, it can use IP addresses 190.10.10.10 and 190.10.10.11

- After setting the IP address, then enter the browser and a login menu will appear.
- Fill in the login column with the username and password as registered on the Access point.
- The client is connected to the Access point.

G. Perform network testing

After configuring the Access point, the Grid antenna and Link radio and the last one to setup the client, network testing will now be performed. There are several scope of tests carried out by the author.

1) Scope 1

- Access points and their servers, laptops or PCs are used for testing, and Grid antennas are in one room without a barrier.
- Signal strength or Link Quality that can be captured by Grid antennas ranges from 85% to 100%. It can be concluded that the signal quality is very good.
- The distance of the Access point with Grid antenna ranges from 2 to 5 meters
- There has been no interference from other Access points. This means that the Access point signal that can be captured by the Grid antenna is only the Access point TP_LINK-D6D45A (the name of the Access point used in the research process)

2) Scope 2

- Access points and servers, laptops or PCs used for testing, and Grid antennas are not in one room, but they are still in a straight line (without obstructions) between the Access point and the Grid antenna.
- Signal strength or Link Quality that can be captured by Grid antennas ranges from 50% to 85%. It can be concluded that the signal quality is good.
- Distance of Access Points with Grid antennas ranges from 6 to 10 meters.
- Interference from other Access points has been caught, namely the Access point found in PKSI, namely PKSI-UIN Sunan Kalijaga.

3) Scope 3

- Access points and servers, laptops or PCs used for testing, and Grid antennas are in different rooms (Access points are in the research room while Grid antennas are outside the research room). Between the Access point and the antenna, the Grid is not in a straight line, obstructed by the wall, there is interference and hit the corner of the barrier.
- Signal strength or Link Quality that can be captured by Grid antennas ranges from 10% -40%. It can be concluded that signal quality is not good
- The distance of the Access point with Grid antennas ranges from 10 to 15 meters
- Interference from other Access points has been caught, namely the Access point found in PKSI, namely PKSI-UIN Sunan Kalijaga.

4) Scope 4

If the Grid antenna is placed over a distance of 15 meters to a maximum limit of 10 km, with a note that there are no obstacles or interference and are on a parallel line, the signal strength or Link Quality is still capable of reaching 50% - 70%. However, if the Grid access point and antenna are blocked by walls, buildings, or trees, there is interference and are not on a parallel line with a distance of more than 15 meters, we can be sure the signal quality or Link Quality will only reach 7% -15% or not even there is a signal at all (0%). Link Quality can be seen in the simple Monitor Air Bridge software.

From some scope of network testing carried out by the author, there are several things that affect the quality of signals that can be captured by Grid antennas. Things that affect include:

- Judging from the first scope of network testing, the signal quality that can be captured by the Grid antenna is very perfect, which is 100%. In this scope there is no interference, and there is no barrier between the Access point and the Grid antenna with a range of distances of 2 to 5 meters. This means that if the Access point and the Grid antenna are in a straight line in the same space, there is no interference or barrier, we can be sure the signal quality is at the point of perfection.
- While in the second scope of network testing, between the Access point and the Grid antenna is not in one room so there is a distance between the two, which is 6 to 10 meters. Even though it is not in one room, but between the Access point and the Grid antenna it is still in a straight line without any obstacles. In this scope, signal quality begins to decline, from 85% -100% to 50% -85%. This decrease in signal quality is caused by the distance between the Access point and the Grid antenna and the interference from other Access points. The farther the distance of the Access point with the Grid antenna, the signal strength will also decrease.
- In the scope of the three network tests there are three points that cause the signal quality to drop dramatically. These points include:
    - Between the access point and the antenna, the grid is not focused, meaning they are not in a straight line.

  - Placement of Access points with Grid antennas with distances that are more distant compared to the first scope and scope of both network testing.
  - There has been interference from other Access points other than the Access point used in the study

- In the last scope, the point is that the Grid antenna can reach maximum signal strength as long as it meets 3 criteria, namely there is no interference, the Access point and antenna are in a straight line and the last is no barrier. In addition, the distance factor also affects signal strength.
- The type of access point also greatly affects signal strength. Famous Access point brands certainly have better quality than Access points that are not yet well-known. There are some disadvantages of Grid antennas found in the process of testing the network.

H. Access Point and Semi Parabolic Grid Antenna Installation

Whereas the installation of the Semi Parabolic Grid Antenna is done in steps like the following:

- Microwave Antennas Parabolic and Loop Grids and Yagi types need to be assembled because they consist of a number of components, different from the types of Patch Panel, Panel Sector or Omni Directional.
- Assemble the antenna according to the instructions (manual) and construction drawings included.
- Tighten all nuts and bolts including connectors and especially reflectors.
- Microwave Antennas are very sensitive to changes in focus, so when the antenna assembly looks as well as possible the focus of the horn reflector (driven antenna), a slight change in focus will have broad effects such as changes in gain (db) of the antenna.
- Some Parabolic Grid antenna types have an extender rod that can change the location of the reflector's focus to the horn so that the required gain can be set.
- Installing pipes in accordance with the specified location during the site survey.
- Check all cable connections and connectors including lightning protection if available.
- Install the antenna neatly and correctly, aim it using a compass and GPS according to the location of BTS on the map.
- Install the cable and trim it temporarily, do not let the weight of the cable become the load of the connector connection and interfere with the pointing and position of the antenna.
- In installing cables in the tower / pipe, do not have a potential bending position into the accumulation of rainwater, in such a way that free rain water falls down.

I. Security features

In this study, there are several points of security features that are applied to Access points, including:

- Use a username and password when configuring Access points using a web browser. This is done so that the Access point configuration can only be done by an administrator who knows the Access point username and password.
- In the Wireless Security feature contained in the Access point there are several options, namely by using WEP, WPA / WPA2, WPA-PSK / WPA2-PSK. Because security on the radio link uses WEP on key 4 in 128 bits, security in the Access point also uses WEP on key 4 at 128 bits.
- Change the SSID that is on the Access point, because only the client has the right SSID that can communicate with the Access point.
- Activate the Wireless MAC Address filtering feature. Although in terms of scalability this is not effective because the Access point also has limited space to accommodate a number of MAC addresses that must be filtered.
- The server used in the Access point also uses security, such as registering a user using a password, so that only users who have registered their MAC Address and IP address can access the Access point.

V. CONCLUSION

Some conclusions can be drawn from research on the use of Semi Parabolic Antennas on the 2.4 GHz Grid for Wireless LAN networks, including:

There are several things that affect the quality of signals emitted by an Access point that can be captured by Grid antennas, including:

- Distance and placement between Access points and Grid antennas
- There is interference from other Access points
- Type or brand of Access point
- The focus point and placement point between the Access point and the Grid antenna
- There is no barrier between the Access point and the Grid antenna.
- Link budget and fade margin

The Semi Parabolic Grid 2.4 GHz antenna compared to other wireless antennas has an excess range that is in a vertical position and a large beam in a horizontal position. In

terms of the Semi Parabolic Grid antenna prices are cheaper compared to other types of satellite dish antenna. The use of servers on the Access point is more focused on the internet network security in State Islamic University Sunan Kalijaga. This needs to be done by the author because the internet network in the UIN is prone to frequent bandwidth theft. The use of the GRE protocol is part of point security.

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