Wireless Network uses RSSI (Received Signal Strength Indication) Mechanism for Smart Office Concept

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2021 4th International Conference of Computer and Informatics Engineering (IC2IE) | 978-1-6654-4288-6/21/$31.00 ©2021 IEEE | DOI: 10.1109/IC2IE53219.2021.9649351

Abstract— The concept of Smart Office has reliable internet network facilities and has the flexibility of access. BYOD (Bring Your Device) is popular, where the user uses many devices connected to the wireless network. Employees need a good wireless connection to support their work. The use of wireless systems in addition to having the flexibility of access, also have infrastructure costs that are far less expensive than ever before using the cable (wired). To support good work use wireless network, this paper use RSSI (Received Signal Strength Indication) which is useful to determine signal user device and synchronized to the wireless device. The research used is PPPDIO (Prepare, Plan, Design, Implement, Operate, and Optimize) method lifecycle. This networking system is expected to meet the needs of the smart office concept.

Keywords—wireless network, received signal strength indication, smart office.

I. INTRODUCTION

Nowadays technology is inseparable from computer networks, its development is growing rapidly in line with the need for the services used. To create an office with the concept of "Smart Office", which is an office that has reliable internet network facilities with cables and without wires with the concept of 1 human 3 devices. BYOD (Bring Your Device) is already popular in the world of work. The accelerating growth of smartphones and mobile devices was propelling wireless communication to evolve toward a higher data rate [1]. The reliable network in question is to allow users to exchange data quickly. The design will place more emphasis on wireless networks because the majority of users will exchange data using laptops, tablets, and smartphones. Smart office-based solutions are information systems to control regular office work [2]. The employee free work anywhere with a centralized control system uses wireless technology. Wireless can be a support to employee free work. The issue is how to design a wireless network to support mobility employees that support smart office concepts. To address this issue, flexible components for radio frequency (RF) wireless communication, such as antennas, transmission lines, high cut-off frequency transistors, inductors, and capacitors have been demonstrated recently [3].

The need for internet networks is very important in ensuring the transportation of corporate data. Therefore, it takes a proper and good network system design. Currently, most companies still use wired access for their employees to work, which causes flexibility and employee mobility to depend heavily on cable connections. Therefore, to meet the need for a good and reliable network, the Smart Office building will build a wireless network system with an RSSI (Received Signal Strength Indication) mechanism. RSSI is usually taken as its true value in Wi-Fi indoor positioning [4].

The use of the RSSI (Received Signal Strength Indication) Mechanism is used to build a wireless network that can fulfill the smart office concept, namely flexibility and mobility access. RSSI needs an access point to broadcast the signal if the use of a single AP to collect data over multiple frequency channels [5]. With the basis of wireless technology that can reduce implementation costs so that it is more efficient and easy to develop. A key factor for the profitability of these networks is using license free bands [6]. The measurement signal strength will increase network performance that is characterized by parameters such as end-to-end delay, total system throughput, bandwidth usage perception, packet loss, user level response, and others [7]. Advantages are enabling the enhanced performance of new fashioned low-cost, low-complex proximity, and forecasts the quality of services [8][9].

From the above problems, the research objective is to design and build a wireless network with the concept of a Hi-Density Smart Office, realize the representative office to improve the productivity and effectiveness of employees [10]. The Hi- Density concept is a reliable wireless concept. In data collection or fact finding in this research, a literature study was used to design the network, interview method with one of the companies for data collection, then analyzed and processed the collected data to get a solution or solution to the existing problem. The background of this research is to provide a reliable wireless network solution to support BYOD every employee device because the smart office concept must be support employees to free work in the office.

II. OVERVIEW

A. Wireless Network

a. WLAN (Wireless Local Area Network)

WLAN often use for wireless communication between an access point (AP) and a station that offers flexible, scalable, and accessible connection services to the Internet. The conditions of network devices and communication links may also be affected by various factors, namely, power shortages, device failures, bandwidth controls by the authorities, and weather changes. To solve the aforementioned problems, we have studied the elastic WLAN system using heterogeneous AP devices [11]. The

position computation perspective of radio-based signaling systems, the known approaches for WLAN positioning are of three main categories: (1) Angle of Arrival (AOA) and related Direction of Arrival (DOA) methods; (2) Time of Arrival (TOA) and related Time Difference of Arrival (TDOA) techniques; and (3) RSS exploitation methods (fingerprinting) [12]. The reason uses WLANis a throughput measurement that calculates the traffic per unit time. It can detect end-to- end quality degradation. Also, the available bandwidth measurements [13].

b. Radio Frequency

RF use was electromagnetic to transmit communication, to design RF need the same frequency, the channel with power-signal interference cancellation using digital and analog techniques. System support WLAN (2.4/5.2/5.8) and 4.9 GHz US public safety [14]. To design with multiple intended RF sources for powering multiple on- and/or in-body sensors with the goals of increasing the system achievable data rate [15].

B. IEEE 802 Standart

The IEEE 802.11 standard is commonly used for Wi-Fi communications [16], use to evolving for more than two decades offering higher data rate services and introducing various options to support varying QoS requirements of different user applications [17]. Preamble manipulation has been done successfully on low data rate WLANs operating in the 2.4GHz band. The effectiveness of preamble manipulation on WLANs operated in 5GHz, e.g., IEEE 802.11a and IEEE 802.11ac were examined for the first time [18]. In 802.11ac, as this technique is highly simplified and also standardized, it is foreseen as a major contributor in improving performance [19].

C. Network Device

In this paper need more network device to support RSSI mechanism, such as :

- WLC (Wireless LAN Controller) Cisco
  Cisco WLAN controller is responsible for system wide security, scalability, control, and reliability that is required to build a secure enterprise level wireless network [20]. WLAN Cisco supports providing 802.11 wireless standards.
  - Switch Cisco
    A switch is useful to split broadcast domain based on OSI layer 2 functions because smart office design for enterprise companies.
  - Router Cisco
    A router is useful to send the packet from source to destination with many routing protocols based on OSI layer 3 functions.
  - Access Point
    AP is a wireless network that provides an additional degree of freedom in terms of mobility in the system design [21].

D. RSSI (Received Signal Strength Indication)

A standard model for indoor localization has not been developed due to obstacles, our layouts, and reactions of signals that can occur [21]. Some of the most common models that are used in localization systems are Angle of Arrival (AoA), Time of Arrival (ToA), Time Difference of Arrival (TDoA), and Received Signal Strength Indicator (RSSI) [9].

RSSI is used to measure the signal strength indicator received by a wireless device. RSSI-based methods compute the absolute position or relative distance according to the average RSSI values [22]. RSSI methods triangulate the location of the device based on a propagation distance calculation from multiple APs [23].

II. MODEL SYSTEM

This research uses the PPDIOO method lifecycle but in the implementation, several PPDIOO methods will be developed following this research.

- A survey, at this stage, is carried out using data collection methods, namely interviews with sources to find out the location and problems that occur at the current office to obtain accurate data.
- Network analysis, at this stage, ongoing network analysis is carried out by understanding the network topology, devices, and software being used.
- Formulation of the problem, this stage will be carried out after analyzing a system that is running, it will get data that supports research and from these data, we can formulate a problem that is being experienced.
- Problem Solution, at this stage, provides a solution to the problem by creating a new network design to overcome existing problems.
- Network Design, after doing the analysis, will be known the deficiencies that exist in the running system. Therefore, a new topology design will be carried out to overcome the deficiencies in the system.
- Trials, at this stage, tests are carried out on simulators or simulations to find out whether the new network design can solve the problems that occur.
- Test results, at this stage, it is carried out after being sure of the results of the test and it turns out that it is following the expectation, it will get results in the form of network load balancing with two ISPs using the failover technique.

In this research, the first thing to do is to analyze the company's needs by direct interviews with users. After getting the needs, the system design is carried out by looking for information about the device to be designed. Each device has a different configuration, therefore configuration is collected. After collecting the configuration, the system will be tested by configuring the devices that are already available. The last process is to implement. The five stages are interconnected. Therefore, if one stage changes it will affect the other stages. The concept of a smart office is appropriate for high-rise buildings with high employee mobility, there are several basic concepts of using a smart office in this research, namely:

- Wireless, supports employees with flexible connections. The flexibility in question is that every

connected employee no longer needs to use wired media but has replaced wireless media. Not dependent on wired media.
- Paperless, maximizing digital data to manage information.
- Seamless, which means free work. Employees do not need to know, but a system that knows it, every employee is free to do work anywhere in an office building, but the system can find out where the employee is currently working. Topology model design uses the Cisco platform that to support RSSI and network enterprise.

The system model used is to change the design of a computer network that still uses wired media with wireless media. At this time some are already using wireless but the type of security is still using WPA-PSK and the like, which is easy to do as a threat from outside parties. Along with technological developments, currently, one employee can have more than one device, namely laptops, smartphones, and tablets. If all of these devices are connected to one access point, it can be a burden to work on the access point. Wireless media will be the primary access for all employees access. Here is the topology that used in the research.

Fig. 1 explains the topology above uses one internet source and several hardware devices to support a Smart Office implementation. The use of wireless technology uses radio frequency management to support the RSSI mechanism. In radio frequency regulations must use the same frequency but different channels to expand the bandwidth on the wireless network. In concept, the location of the WLAN device will determine the RSSI of the signal emitted by the access point, when the receiving device receives a signal from a different

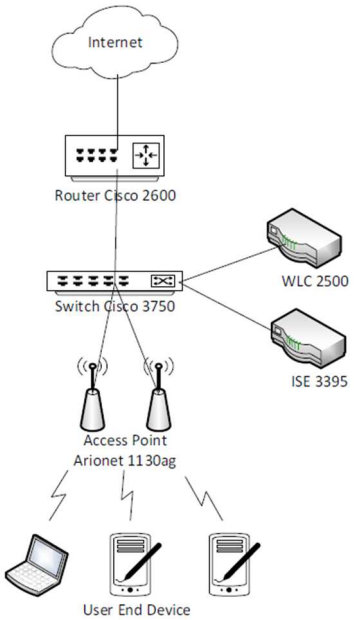

Fig. 1. Topology

channel, it is necessary to calculate the time difference. The time required must be proportional to the transmitter and receiver transmission lines. RSSI is correct for up to three receivers and a large enough distance to precision the received signal.

RSSI mechanism settings can be implemented on a WLAN (Wireless LAN Controller). By measuring radio signal strength, packet transmission can be done optimally by wireless devices and other access points. The access point will send a packet to WLC with RSSI information to ensure that the access point is connected. RSSI is used for indoor wireless designs that are small from interference. RSSI can be developed into a big office or smart office with manage location access points, regulation, and radio frequency.

Routers have a function as forwarding packets that are requested by users to the internet, in addition to IP addressing to all devices connected to one network. A switch is useful as a breaker of broadcast domains by maximizing the VLAN function for the management of connected users. With WLC technology support that can set up to 1500 access points, but in this research using WLC 2500 series that can set 75 access points and 1000 clients.

III. EXPERIMENT

Experiments were carried out about design VLAN to manage the broadcast domain that used each floor. WLC has another function to implement the RSSI mechanism, range, and manage radio frequency based on the frequency and bandwidth channel. In this experiment VLAN 10 and 20 use 5GHz with D- ZONE SSID. D-ZONE is used for employee intranet networks that can support employee mobility, by using 5GHz frequency which each user gets a bandwidth of 5Mbps. To support RSSI on the computer network must manage wireless standards to allow connection and avoid interference. Mapping frequency with WLC to access point.

Cisco Aironet 1130AG supports the CAPWAP protocol to set access points to WLC based on distance. In general, to map channels using channels that are small distance to avoid interference such as interference, glass, walls, doors, and others that can reduce the quality of wireless networks. The experiment for this research used the wireless standard 802.11ac with a frequency of 5GHz which has a range of distance up to 115 meters. Here is a mapping access point based on the channel to support RSSI.

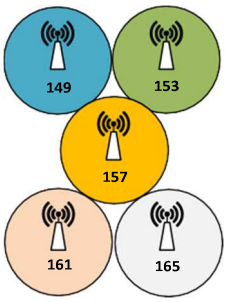

Fig.2. Mapping Access Point

In Fig. 2 describe 149, 153, 157, 161, and 165 channel on 5 GHz regulation that supports RSSI mechanism. The mechanism can't use the same channel between an access point and must arrange distance between access points. The use of many 5GHz frequencies aims to increase the higher

data transfer speed, in the case of 5GHz frequencies following the regulation of IEEE 802.11a or IEEE 802.11ac which supports speeds of up to 1Gbps. By regulation, the use of access points has been waived usage permits.

Before configuring WLC, the administrator must the regional settings to be used are US and China. Region US because it uses US and China channels because the AP used comes from China, aims to allow AP to join WLC. The next step configures WLC as a controlled access point that manages VLAN, WLAN, SSID, security, IP, a frequency that supports RSSI, load balancing, QoS, and users that connect to SSID, as in the Fig. 3.

Fig.3. Mapping WLAN

Fig. 3 is configured mapping WLAN based on the first requirement. This paper focuses on D-ZONE WLAN to AP implement, as in Fig. 4.

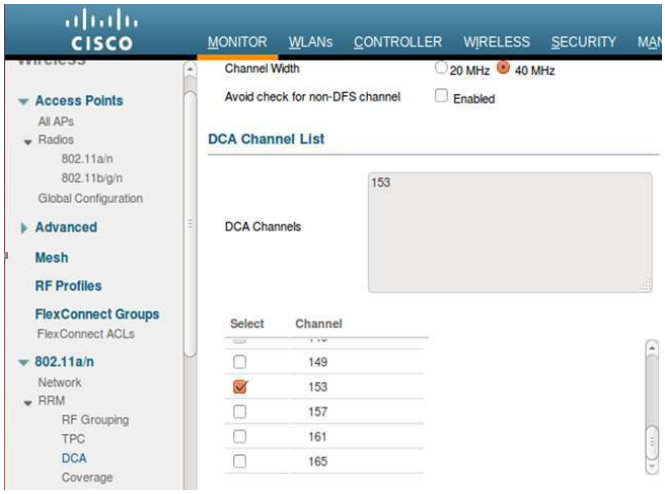

Fig.4. Mapping Frequency RSSI

Fig.5. Manage Frequency AP to WLC

In Fig. 4 describes the security arrangement will be done the design of the floor plan by the region and channel previously determined, namely the US region with channels 149, 153, 157, 161, and 165. In the implementation using channel 153 on one AP. Settings between access points can use the same frequency but must use different channels to avoid interference. As can be seen in Fig.2 has been done mapping channel so that there is no interference. Now set up frequency AP connect to WLC.

In Fig.5 is capture already done for mapping frequency to support RSSI and next must be configured based on fig.2. The session must status AP is UP, which indicates that the AP is already directly connected to the WLC. Here is a flowing design to use the wireless network at a smart office.

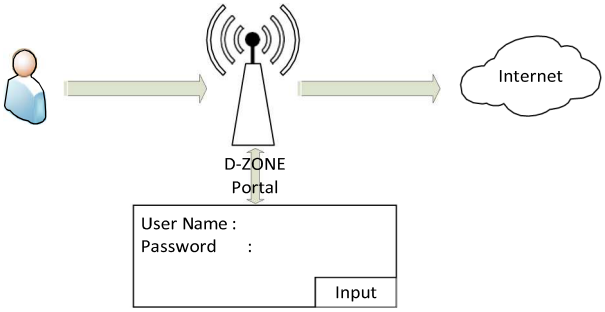

Fig.6. Workflow WLAN

In Fig. 6 explain workflow when the employee needs internet access from WLAN. The employee must be input the user and password to the portal. The portal aims to support the security of WLAN. The testing frequency RSSI that already configured in Fig. 4.

Fig.7. Wireless Channel Analyzer

In Fig. 7 there are 10 SSID that use 153 frequency channels and must check in-depth to ensure frequency channels have for WLAN D-ZONE. Yellow when indicating the device is connected to the D-ZONE SSID WLAN. The blue color indicates that the WLAN SSID D-ZONE has a frequency of 5.0 GHz. To ensure strength frequency must be tested, as in the Fig. 8.

Fig.8. Testing Channel RSSI

In Fig. 8 WLAN D-ZONE already running with a 153 frequency channel with attenuation -54. By using WLAN produces a network with high mobility where WLAN allows users to access information in real-time as long as it is within the reach of WLAN, thus improving the quality of service and productivity that is not obtained by using a regular LAN network. Wherever the user is, he can always connect to the internet. This will thus support faster voice, data, and information communication. Using a wireless network then generates a network with flexibility access and Hi-Density Access by the concept of the smart office. Using login authentication can guarantee the security of the company's network because it is logged in using a registered user account.

IV. CONCLUSION

This paper presents a WLAN with RSSI method that uses the cisco platform to support smart office concepts. The purpose of the scheme is to support mobility employee wiggle room in work. One of the uses of WLC serves to support the security system because in the office many employees are connected to a network and then how the network provider must maintain data transactions. With the web login method, the user will feel more secure because not just any user can access it. RSSI process is divided into signal strength, which is average dB on channel and distance. Experiments are conducted by using Router, Switch, Wireless LAN Controller, Aironet (Cisco Access Point). Experiment results show channel 153 has -54 strength and can't overlap with another access point channel.

With WLC the administrator can be modified frequency and channel based on the results of checking. The use of the RSSI mechanism aims to measure the signal strength of access points with a large number, as well as frequency settings can be maximized to produce better network quality. Advantages of wireless technology to support the concept of a smart office that can support network access flexibility so as not to limit employee's wiggle room in work. RSSI mechanism will be more optimal when using many Aironet access points.

The concept of a smart office is to convince employees to work with high mobility, meaning that they can work not only in the room but in other rooms. The use of RSSI is very influential to support the high mobility of employees in the office. The use of an office network is indispensable for accessing corporate data that can only be accessed internally. To ensure RSSI that support to smart office concept must be tested with many access points and users.

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