Design and Analysis of QoS Horizontal Handover Wi-Fi 6 Mesh Centralized Control on 4G Network for Video Conference Services

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Abstract: The development of wireless communication technology has resulted in the need for access to information and data services to increase. Network users communicate such as video conferencing not only in one place, but moving around. So we need continuity of communication that is a handover. Video conferencing is a long-distance interactive communication service that is able to bring together two or more people by utilizing broadband internet services. However, problems that arise from the performance of video conferencing are audio and video intermittent and delayed when communication occurs. One solution to overcome this problem is by diverting data traffic on the 4G network through the Wi-Fi network. In addition, to maintain service continuity on the telecommunications network, a reliable handover mechanism is needed. This research will focus on handover analysis to improve the quality of video conference services. The handover method that will be carried out is horizontal handover on the Wi-fi 6 network. OFDMA frequency allocation for Wifi 6 is 2.4 GHz and 5 GHz. The purpose of this research is to find out the use of WLAN 802.11ax network technology with high speed on a mesh topology to see the handover of QOS services on video conferencing over a 4G network. Improvements to the handover mechanism can improve the QoS of video conferencing services. The results of data analysis show that the handover process is able to improve QoS gradually so that QoS returns to normal.

1 INTRODUCTION

Internet connection needs, especially Wi-Fi (Wireless Fidelity) are in great demand by internet service users, because Wi-Fi technology is relatively easy to implement in the work environment and gives users the freedom to access it anytime and anywhere through devices such as notebooks, laptops. or Smart Phones. Wi-Fi users communicate such as video conferencing from place to place, so they only get a relatively small range, so mobile devices will experience handover.

Handoff is the transferring of data from one Wi-Fi network to another Wi-Fi network without disconnecting the previous one till second Wi-Fi network is being connected with device or mobile. Handoffs are basically two types horizontal handoff and vertical handoff. This work is based on the horizontal handoff that transferring of data in same type of networks (Vrushali, 2014)

Handover is the process by which a mobile node (MN) moves from one access point network (AP) to another AP network (foreign network). In general, a handover that only changes the link layer (OSI layer 2) without changing the IP address is called a horizontal handover. For example, when the MN switches to the LAN AP served by the same IP access router. In 802.11 terminology both APs are in the same Extend Service Set (ESS) (I Made Oka Widyantara, 2015)

Video conferencing is a long-distance interactive communication service that is able to bring together two or more people by utilizing broadband internet services (Anggar Wati, 2018). Where this service can send and receive data in the form of audio and video simultaneously or often referred to as a two-way delivery technique. The basic concept of video conferencing is to capture data in the form of sound from a microphone and camera and then convert it into bits of data to be transmitted. This study conducts and analyzes the quality of 4G network services on

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wi-fi 6 by using QoS parameters as the main reference for service quality.

Wi-Fi 6 is the next generation standard in WiFi technology. If you own a VR device, multiple smart home devices, or simply have a large number of devices in your household, then a Wi-Fi 6 router might just be the best WiFi router for you (David Coleman, 2022). Wi-Fi 6 (802.11ax) technology is all about better and more efficient use of the existing radio frequency medium. Higher data rates are not the primary goal of Wi-Fi 6. The goal is better and more efficient 802.11 traffic management (Kshitij Motke, 2019).

The purpose of this research is to design and analyze how the handover process on 4G uses wi-fi 6 mesh topology. With the handover, we can see the effect of QoS parameters on video conference services by measuring signal strength by wi-fi 6 devices. This study conducts and analyzes the quality of 4G network services using QoS parameters as the main reference for service quality.

2 METHODS

In solving a problem, it takes a research method for the achievement of researchers. The research method explains the chronology of the research including how to prepare research materials, research design or design, research procedures (in the form of diagrams), how to test (scenarios) and data collection. This section also explains the theoretical basis of the research. The following figure testing method of QoS Horizontal Handover Wi-Fi 6 on 4G Network in figure 1.

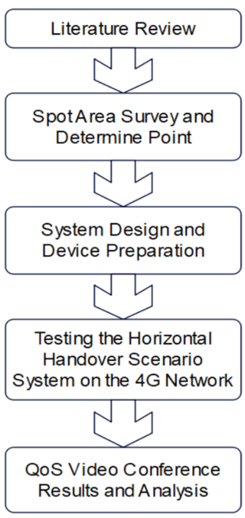

Figure 1: Block diagram of QoS Horizontal Handover Wi-Fi 6 on 4G Network.

A. Literature Review

The literature review stages are taken from journals about Wi-fi 6, handover, Quality of Service, and 2.4 GHz and 5 GHz frequencies. The Handover Scenario Model on the 4G network is applied by the Horizontal Handover standard. Horizontal handover is based between wifi nodes using a mesh topology.

B. Spot Area Survey and Determine Point

Determine service area for wi-fi 6 network planning and analyze 4G network handover. Determining the location and placing the access point aims to limit the data that will be used on wi-fi 6.

C. Handover Design For Wi-Fi 6 Network

Simulation system design and device preparation for Wi-fi 6 network. This stage will use 3 (three) units of Wi-fi Router 6, namely: 1 (one) unit of Wi-Fi Dongle 6 Client, 1 (one) unit of Laptop, 1 (one) unit of 4G modem. The application used is the Video Conference application, namely Zoom. Device Configuration has also been set in this stage indoor/outdoor. Each router is connected via wifi 6 with a mesh topology. For completeness of the model, see figure 3.

D. Handover System Testing and QoS Analysis for Video Conference

The horizontal handover stage begins with measuring the signal strength or RSSI (Receive Signal Strength Indicator) of the access point (AP) using a wifi dongle 6 with the condition of the video conference application being active, checking the ping test, and using wireshark for data packets. The QoS parameters observed in this study are delay, throughput and packet loss.

2.1 Wi-Fi 6 (802.11ax)

Wi Fi 6 is the name of IEEE 802.11ax, as defined in the naming conventions released by the Wi Fi Alliance for IEEE 802.11 standards. The Wi Fi Alliance is a commercial organization that promotes and markets 802.11 standards as well as certifies interoperability of 802.11 products worldwide. Through rigorous testing, it checks the interoperability of products with other Wi-Fi certified products in various configurations. Its members include most producers of 802.11 equipment and some carriers, who are permitted to use the Wi-Fi trademark owned by the Wi-Fi Alliance to brand their certified products. In 2018, the Wi Fi Alliance decided to make WLAN standards easier to understand and remember. To this end, the organization renamed the standards in a manner similar to the different generations of mobile communications, which are called 3G, 4G, and 5G. Earlier 802.11 versions were also renamed in retrospect to align with this new naming convention, as shown in Figure 2 (Xia Zhou, 2022).

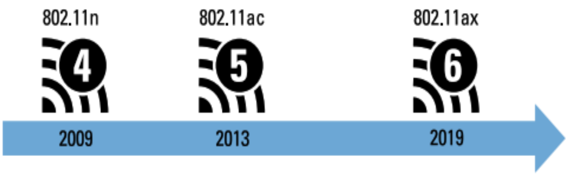

Figure 2: Generations of Wi-Fi (Kshitij Motke, 2019).

2.2 Handover Mechanism on Wi-Fi 6 Networks

The need for mobility that has a wider range, creates problems in the limited coverage area of the AP. This problem is solved by installing several APs at certain points with the aim of increasing the access range for wireless devices. Because a wireless device can only be connected to an AP, it is necessary to transfer the connection between a wireless device and a new AP in its coverage area. This process is known as handover. In its implementation, the handover procedure is distinguished on the connectivity hierarchy, namely fast handover, horizontal handover, and vertical handover.

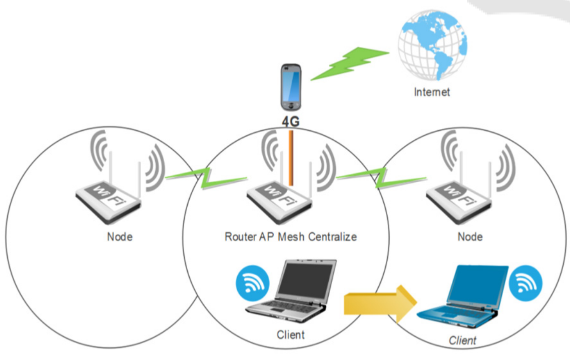

Figure 3: Horizontal Handover.

In this study using Horizontal Handover. Horizontal Handover As shown in Figure 3, horizontal handover changes only at the link layer (OSI layer 2), so there is no change in the IP address. Based on Figure 3 above, when the MN moves to a wireless LAN access point served by the same IP access router. In 802.11ax terminology both access points are in the same Extend Service Set (ESS). Handover that only changes the link layer (OSI layer 2) without changing the IP address.

2.3 Design Implementation Horizontal Handover on Wi-Fi 6 Network

Analysis of the effect of Wi-fi 6 handover on QoS will be tested on video conferencing services. Video conference services or online lectures use zoom, where video conferencing is a media to help in learning. The quality of horizontal handovers reviewed is based on delay time, response time, and throughput. The Qos value is obtained from the "server" the first time it sends the packet, that is, when a video conference playback request is made starting from the first second, until the last packet is sent, which is when the video is finished so that the video can be displayed entirely on the video conference service.

A. Scenario I

As shown in Figure 4, this scenario aims to determine the effect of horizontal handover on the existing Wi-Fi 6 network. The existing network is a previously installed Wi-Fi 6 network.

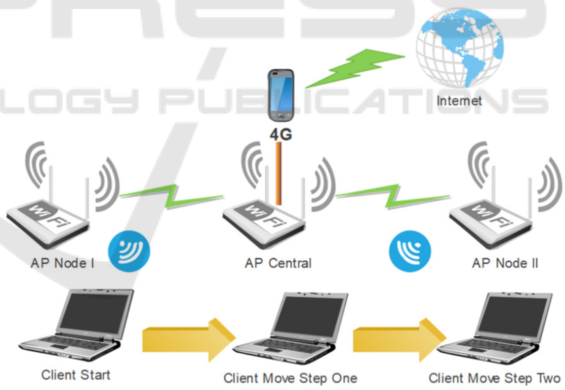

Figure 4: Handover Design for Scenario I.

B. Scenario II

This scenario aims to determine the effect of horizontal handover on an ad-hoc Wi-Fi 6 network. The network used in this test is a new 6 mesh Wi-Fi access point network. As in Figure 5, the client moves from access point A to access point B by conducting video conference.

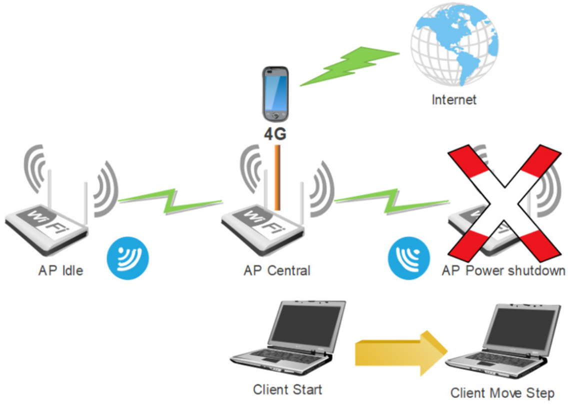

Figure 5: Handover Design for Scenario II.

3 RESULT

The results of measuring signal strength or RSSI mapping measurement in determining the QoS value, scenario 1 between station (mesh controller) Asus TUF AX3000 4-antenna with node 1 Asus RT-AX56u 2-antenna with a height of 5 m (Floor-2) and node 2 Asus AX RT-Ax 55 with 4-antenna on the AP using the feature on the Asus-WRT v3.0 OS, namely AiMesh for controllers, horizontal handover will switch AP access if the client side is at the RSSI value of -70, to RSSI -40 there is a request for a SYN signal from the client to the host, after moving the AP from the station (STA) to node 1, and from node 1 to node 2 are shown in figure 6.

Figure 6: RSSI Handover Scenario.

The latency generated is above 50 ms, because it uses a 4G network, for QoS control the ping value is obtained during the walktest and video conference handover process as shown in Figure 7.

For BSS (Basic Service Set) Colouring inference between signals at 2.4 GHz and 5 GHz on wi-fi 6 only the Ax mode in this study. Shown in Figure 8.

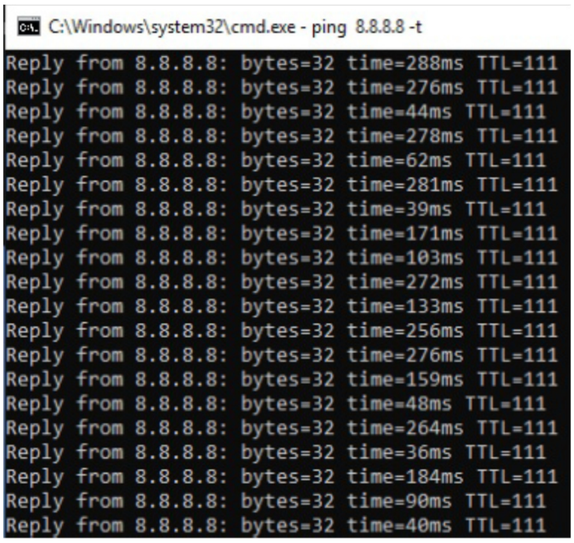

Figure 7: Ping QoS Video Conference without lag.

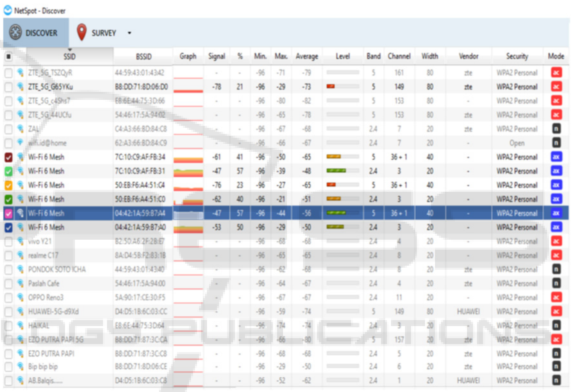

Figure 8: Scanning Wi-Fi.

While scenario 2, on node 1 the power adapter is shutdown, causing no handover (hang) process to occur, then QoS automatically becomes non-existent due to RTO (Request Time Out) same no internet Network, seen in the wireshark application package. with the condition that the RSSI client has approached the AP station with a walktest.

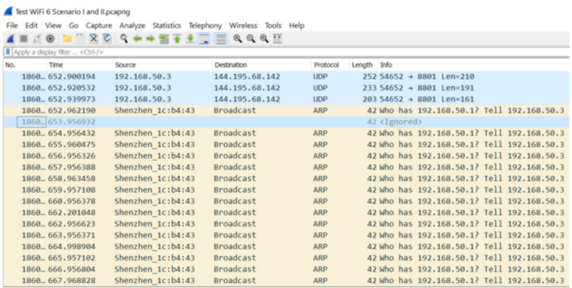

Figure 9: Failure Handover (RTO).

Monitoring process is also seen using a LAN cable, there is a fairly large 4G signal jitter between the AP station and the Smartphone modem, so that the QoS factor decreases in video conferencce communication services between uploads and downloads for 2-way communication needs. but the stability of the video conference remains stable because the average jitter is 40 ms on figure 10.

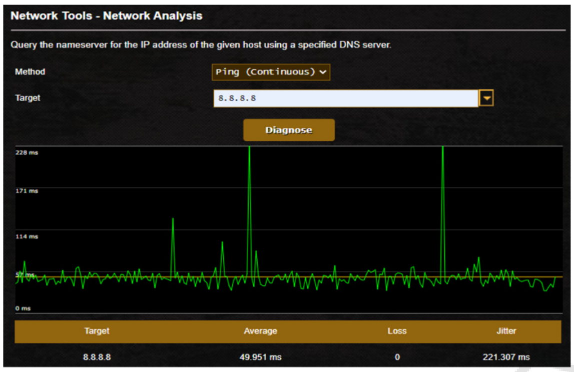

Figure 10: Ratio Ping and Jitter on Graph.

4 CONCLUSIONS

The conclusion that has been obtained is that in the normal scenario, the handover process runs normally, but the failed handover condition occurs when one of the AP nodes fails. One possible factor is that the mesh control feature on the router's OS is unstable.the next possibility is that the USB network card wi-fi 6 client does not match the AP device, this is no comparison with devices that have embedded wi-fi 6 on laptops and smartphone clients.

based on the typhoon standard, the average jitter is 0 to 75 ms its good, while for normal latency it is very good (< 150 ms), but when the handover shift becomes good (< 300 ms), the influence of brick obstacles becomes a barrier in the signal transmission pure without LAN cable backhaul. For Throughput and Packet loss which are read in the very good category Wireshark application.

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