Virtual Private Network Server and Adblock Server using Raspberry Pi with Parental Control

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Abstract - Technology becomes useful to people, but apart from being useful. It also can become a threat. Virtual Private Network (VPN) is one of the ways to secure and prevent the attack in wireless technology. It is a secure connection so that hackers will not be able to sniff the packet from their victims. In this project, focused on developing an integrated server using Raspberry Pi to host a VPN server, advertisement blocking server, and parental control and to test the security of virtual private network connection and the functionality of advertisement blocking and parental control. On this project, admin can control and monitor their VPN server by itself without worry the data security because only admin can see the data. Besides that, this project will have an advertisement blocking server. Users can access the internet without advertisement. Lastly, parents can block all the websites and pages to control and monitor their children's activities during access to the internet.

Keywords – Virtual Private Network, Advertisement Blocking, Parental Control, Raspberry Pi

I. INTRODUCTION

In recent years, theinternet connection is important. But most of the users are not alert to risk. Users can be attacked by hackers. Especially when they use public Wi-Fi. Some of them that are alert with this issue they might subscribe with an existing Virtual Private Network (VPN). The integrity of the existing Virtual

Private Network (VPN) provider is questionable because the provider can violate, and exploit user's data routed through their network [1]. Practically the free VPN service provider sells user data and user privacy [2].

This project would develop a VPN server using raspberry pi for consumers to control and monitor by itself at home. The VPN server will be more secure because of only admin control and monitor. Other than that, this project would have a feature like an advertisement blocking (AdBlock) and Parenting Control. AdBlock is a software capability for removing or altering online advertisements in a web browser or an application. AdBlock would allow users to prevent page elements such as advertisements from being displayed. On this project using Pi-hole as AdBlock in the raspberry pi.

Parental control is to block unwanted websites. Besides that, this feature can capture useful information, such as what websites they are trying to go and how much data they are trying to pass. This project would use Pi-hole. Following the example. Some components, such as multi-leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

II. RELATED WORK

Eric Jodoin in their research [6] This research paper provides a basic understanding of the VPN configuration requirement using Raspberry Pi and OpenVPN. This research paper has separated into six broad categories that considered three requirements, in terms of cost, simplicity, and compatibility. First is Off the shelf VPN Router, this is a costly approach because router with VPN capabilities are expensive and the current price is $150 or more. The second approach is custom firmware VPN router, this may make it more difficult to discern the root cause of many problems experienced while trying to establish a VPN tunnel. The third approach is windows server, this approach required high-end PC and pricey because the price range from $800 for Windows Server 2012 but this is a good solution for multiple services along with VPN for example as file sharing, backup, and a web server. The fourth approach is SSH Client/ Server, this approach has a problem when the configuration for a client because it complicated and have a problem while traveling is likely, this approach impractical for all user but a savviest mobile user. The fifth approach is Open Source VPN (openwan/ strongwan) this approach can run using Raspberry pi, but this approach has a problem because it forces configuration change and tweaks on both server and client. The complexity and risk of malfunction. The last approach is OpenVPN, which can use minimal hardware like an RPi. This solution required download for both side client and server. Once the server configuration complete. Clients need to load the configuration file. Then, the OpenVPN client takes care of the rest.

Constadinos Lales in their research [7] introduce the advantages of using Raspberry Pi in his project because it is a small credit card-sized computer that includes ports such as HDMI, Ethernet, USB, Audio and many more. The price for RPi is a $35 value project that is worth way more than it cost. This project using OpenVPN for the VPN server and client. This article shows how to access the raspberry pi using SSH (Secure Shell) in putty. SSH is a secure way to remotely connect to a command line. The result for this project is successfully connecting to their home network from burger king through a full tunnel using SSL/TLS protocol.

Nehali Vaka, Vasireddy Rishitha, and Sahithi Chanduptla in their research [8] proposed The Onion Router (TOR) on Raspberry Pi. TOR allows to anonymously use the internet by hiding user identity. This protects a user from any traffic analysis and network spying. The TOR also can encrypt the data in multiple layers and hide the origin of the web pages request. Every packet internet goes through three layers of the relay before reached to the destination. This is an excellent way to gain access to certain websites that are blocked. This project using a small router and portable, it can be connected anywhere adding a secure internet browsing to any destination.

The writer also provides a VPN solution based on cost, simplicity, and compatibility. This paper presents the principles supporting the proposed OpenVPN solution.

III. METHODOLOGY

The most important devices in this project are raspberry pi and router and an important software is OpenVPN and Pi-Hole. Figure 1 shows the network diagram for this project

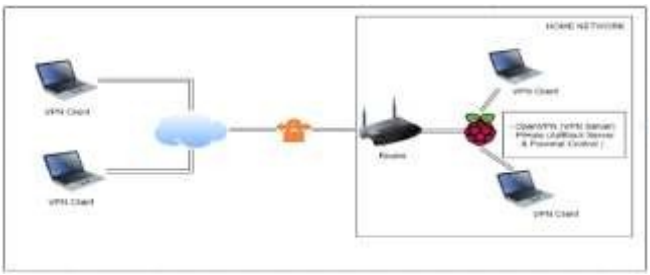

Figure 1 Network Diagram

A. HOW IT WORK?

Figure 2 shows how the process of VPN. After the client device connects to a VPN client, the VPN client connected directly to the VPN server using a VPN tunnel. All the data in the VPN

tunnel are encrypted. VPN Server hides client Ip address from the internet.

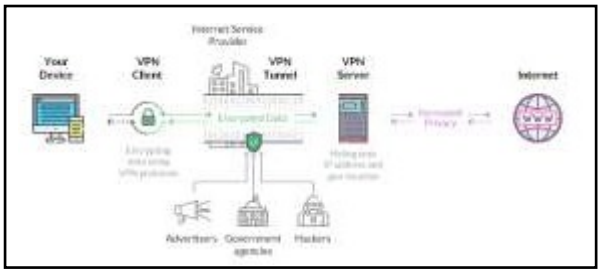

Figure 2 How VPN works

Figure 3 shows how the AdBlock in pi-hole works. All advertisements need to request an IP address from the DNS server. By using this prototype, advertisements need to ask IP address from PiHole. If PiHole detects the request from the advertisement. PiHole replies that IP address 0.0.0.0 to an advertisement, advertisement is not successful to display on the website.

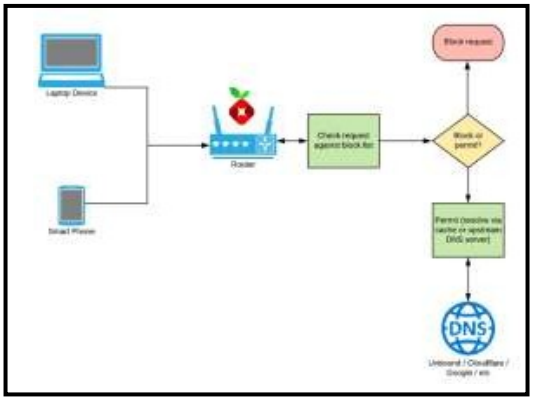

Figure 3 How AdBlock Works

Figure 4 shows how parental control using regex in pi-hole works. Regex works by using a keyword to block a needed website. For example, the user wanted to block a movie website. Users need to enter a keyword “movie” in the regex list. After that, if have any family member want to access a movie website, pi-hole were check the requested website with regex list. If the result matches, the pi-hole has automatically blocked the website. That is how the parental control feature works using regex in pi-hole.

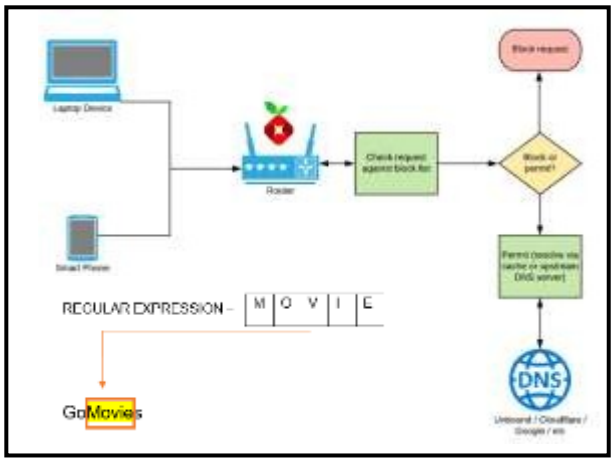

Figure 4 How Parental Control Works

IV. TESTING & DISCUSSION

Figure 5 shows the data in the packet OpenVPN, when the data is encapsulated, the data inside the OpenVPN packet cannot be read and it is gibberish. It proves that the telnet session has been encrypted and secured

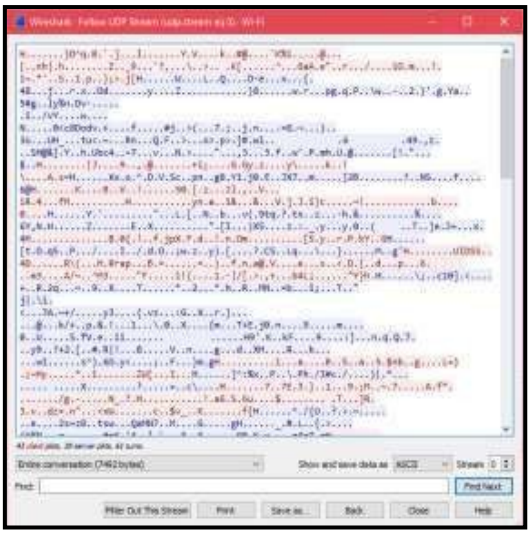

Figure 5 Data in packet OpenVPN

Figure 6 shows the data in the packet telnet, when the data is not encapsulated, the data inside a telnet packet can be read and it is in cleartext. It proves that the telnet session has been not encrypted and secured when the connection not connected to OpenVPN.

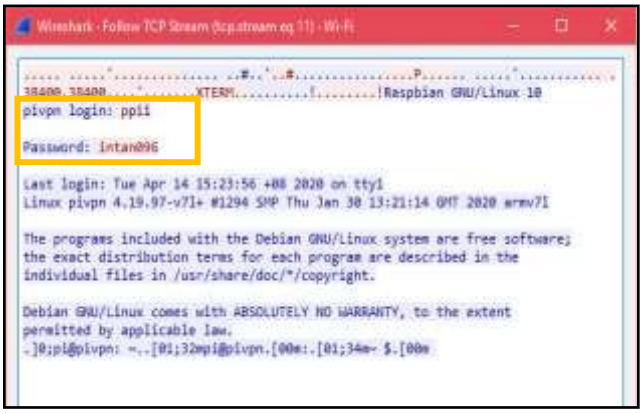

Figure 6 Data in the packet telnet

Next, browse to any website and an advertisement can be seen on that website. Figure 7 shows an example of a website that has an advertisement.

Figure 7 Advertisement on Website

In this situation, an advertisement can be seen on the website. This is because the device is not connected to the OpenVPN which hosts the PiHole. The device did not have any ad-blocking tools installed to it, hence all kinds of advertisements can be seen.

Figure 8 shows that no advertisement was shown on the website. This proved that the PiHole that acts as the AdBlocker was functioning as expected.

Figure 8 Websites Without Advertisement

In this situation, when the device is not connected to the OpenVPN the browser can access the website gomovies freely. This is because the DNS request was successful to translate the URL to an IP address. The DNS server when not connected to the OpenVPN. Figure 9 shows an interface of gomovies.

Figure 9 Interface Gomovies Website

The second scenario is the device connected to OpenVPN that is a host of Pi-hole. Next, the browser will connect to the same website as previously to test the functionality of the blocking website that acts as a parental control for this project. Figure 10 shows that the gomovies website was not

shown on the website. This proved that the blocking website that acts as the parental control was functioning.

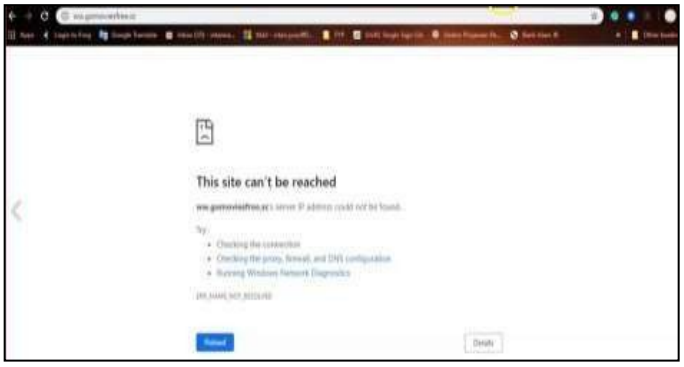

Figure 10 Gomovies Website

In testing, we simulated two connections in the environment in which one was connected to Raspberry Pi and can access all features that implement no it, and the other one was not connected with Raspberry Pi. Table 1 shows the result in terms of three functions.

Table 1 Comparison Functionality

Functionality	Connected	Not connected
Security Connection	Yes	No
AdBlock	Yes	No
Parental Control	Yes	No

The prototype successfully provides a 3 in 1 feature to the users. Whenever user connected to the prototype via OpenVPN, they can access to PiHole which provide advertisement blocking and parental control features.

V. CONCLUSION

Wireless technology is one of the technologies that can easily be hacked since it involves open to any connection. In order to protect from those attacks, a user needs their private session each time when using public Wi-Fi or an unsecured connection. This project provides a solution for consumers to have their VPN server installed in a cheap microcomputer which is Raspberry Pi with full control of the device. Besides, the Raspberry Pi also hosts one more server which is Pi-hole server. This server provides adblocking and parental control services.

REFERENCES

[1] Demoro, J. “Nothing in life is ever truly free”. 2019.

[2] Ola, J,“Privacy Violations by free VPN service providers”, 2018.

[3] FreeCodeCamp.org, “How to run your own OpenVPN server on a Raspberry Pi”, 2018

[4] TehGM, Phillips, A., Elias, J., Mark, Alex, Adi, Burt, P. J., “How to turn your Raspberry Pi into a VPN Server using Pi VPN” , 2019.

[5] Dayz. (n.d.). ,”How to turn your Raspberry Pi into a Home VPN Server”, 2018

[6] Lales, C., & Carranza, A. , “Using the Raspberry Pi to establish a Virtual Private Network(VPN) connection to a Home Network”, 2013.

[7] Jodoin, E., “Information Security Reading Room SOHO Remote Access VPN. Easy as Pie, Raspberry Pi”, 2019.

[8] Vaka, N., Rishitha, V., & Chandupatla, S, ”Anonymous Browsing with Rasberry Pi VPN / TOR Router”, 2018 pp 549-553.

[9] Bate, A., Wilson, B., Sierakowski, R., PcMac, Craig, Lutz Merten, “Block ads at home using Pi-hole and a Raspberry Pi”, 2018.