Raspberry Pi Home Tool

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Abstract

- The Raspberry Pi is a powerful single board computer that, when paired with Raspbian OS, becomes a lightweight system perfectly suited for running in a home-lab environment with networking modules. On the Pi device, the applications Pi-Hole will be configured to increase the level of network security for devices on a local network.
- Pi-Hole allows the Pi device to act as a recursive DNS server, which filters incoming network traffic of any unwanted advertisements and potentially harmful elements before it reaches the target device. It also has the potential to increase perceived network speeds depending on the amount of traffic blocked upon request of a webpage.

Introduction & Research Question

Introduction

- The Raspberry Pi, when used with Pi-Hole, becomes a powerful and lightweight tool that allows users to increase the security of their home network at a low upfront cost of less than 100 USD. It fits in the palm of your hand and provides 24/7 protections on the network, and can further be used in conjunction with other linux compatible applications to add multiple layers of security and network monitoring.
- Pi-Hole also features an interactive web admin GUI, which can be accessed through a browser on the local network by pointing it at the address which the Pi device is present. Depending on a router's settings a static IP address can be assigned to the Pi device, which increases the ease of use for users and makes the device relatively maintenance-less.

Research Question

- Does the security of a network increase with the application of a home DNS server capable of blocking ad-focused malware and misinformation? Does implementing Pi-Hole affect network performance?

Hypothesis

- Adding the Pi-Hole server to a local network will increase the network security by blocking unwanted network traffic from reaching local devices, and it will also have a negligible affect on network speeds because of how lightweight the program is.

Research Design & Data Collection

- Pi Hole conveniently has an interactive web admin GUI, which allows multiple datapoints to be easily measured on one page. The most used function on this dashboard is the query log, which outputs the requests that pass through the domain server in a neat fashion. With information such as the connected device's IP address and requested website's address, an administrator can easily tell if unwanted traffic slipped through the blacklist and take action to block that domain.
- The speed of my home network is measured by the average of 5 Speedtest.net queries before/after I set Pi-Hole as my DNS on my desktop connected via Ethernet.
- To determine how effective Pi-Hole is on a home network, the values to consider would be the Total Number of Queries, Number of Queries Blocked, Before/After Network Speed Results

Results

Total Number of Queries = 24,803
Number of Queries Blocked = 2,310
Device Duration (at the time of recording) = 72hr39min
Speedtest.net Results without Pi-Hole = 473.11Mbps Down / 22.51 Mbps Up
Speedtest.net Results with Pi-Hole = 484.51Mbps Down / 23.70Mbps Up

2.4% Increase in Download Speeds
5.3% Increase in Upload Speeds
9.31% of Total Queries were Blocked

Conclusions

- Pi-Hole is an application capable of blocking unwanted traffic from reaching devices on a local network. In doing so, it lessens the overall load from the router-to-internet communications and results in a slight increase in network speeds of 2.4% download and 5.3% upload. Despite the difference not seeming significant on paper, the true value of Pi-Hole can be appreciated when spending time browsing on the web and using a computer hands-on while it is connected to the Pi-Hole DNS. Not having to worry about my network resources being used to project unnecessary adware results in a better user experience, as my webpages are no longer cluttered with advertisements, and I can view my content without distractions.