

Comparison Between Performance Of Raspberry Pi 4B And Laptop Computer As a Server

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Abstract - Websites have become common in this modern world, and hosting has become as crucial as the development itself. Thus, here, we will discuss the performance of web servers. One will be the RASPBERRY PI 4B, and the other server is MAC AIR with apple silicon chip and Mac AIR with Intel processor. The objective is to know the feasibility of hosting a website on any of these three servers at your local residence. We used a server benchmarking tool known as apache bench for analyzing the performance. We served static and dynamic websites to achieve more accurate results. The effects were observed after sending 10000 requests with 10 concurrencies, the raspberry pi 4b was able to serve between 400-600 requests per second, mac air intel processor was almost the same, and the mac m1, which is a silicon-based processor was in the range for around 200-400 requests per second. The Raspberry Pi 4B with only its 2 GB RAM and 1.5 GHz processor was able to serve requests very well without any significant effects in temperature. The Mac Air Intel performed the best in terms of concurrent users, and the M1 silicon-based mac was the best in terms of CPU usage as it maintained its CPU usage and did not show any significant fluctuations in any case.

Key Words: Raspberry Pi 4B, server performance, CPU usage, request delay

1. INTRODUCTION

A web server is a computer that stores a web server's software and a website's component files (for example, HTML documents, images, CSS stylesheets, and JavaScript files). A web server connects to the internet and supports physical data interchange with other devices connected to the web. A web server includes several parts that control how web users access hosted files. At a minimum, this is an HTTP server. An HTTP server is software that understands URLs and HTTP (HyperText Transfer Protocol). An HTTP server can be accessed through the domain names of the website it stores, and it delivers the content of these hosted websites to the end-users device.

At the most basic level, whenever a browser needs a file hosted on a web server, the browser requests the file via HTTP. When the request reaches the web server, the HTTP server accepts the request, finds the requested document, and sends it back to the browser, also through HTTP.

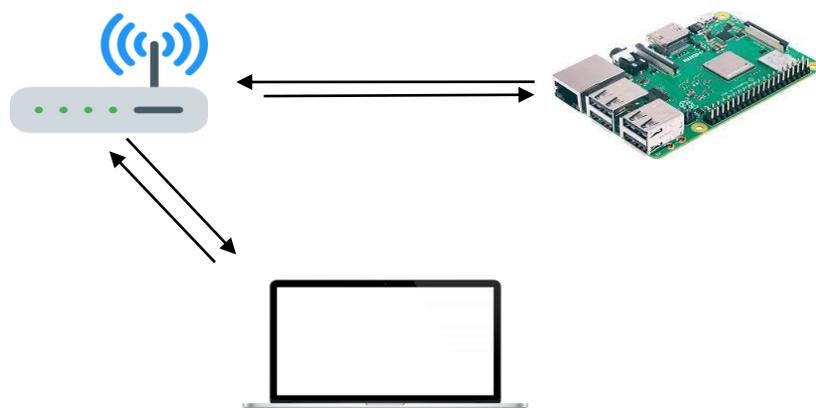


Figure-1: Network Connection of device

2. Purpose

In the advancement of technology, using machines will be standard in the world of servers. Also, It can be assumed that tech-savant people will be more interested in seeing Raspberry Pi's performance as a web server and which web server software gives it better performance.

Raspberry pi is a series of small single-board computers and Debian- based operating system. About 71.1% of websites with this operating system are addressed to host by Unix.

Therefore, to show the precise performance in the study, we will substantially use the high performance of another computer in the process. Thus, the research resolves to show how much performance difference will be between raspberry pi 4b and a typical laptop and how the raspberry pi 4b performs compared to another computer. This study provides the obvious answer to the question and shows raspberry pi 4b as a web server.

3. Background

3.1 RASPBERRY PI

The Raspberry pi is a series of small single-board computers developed in the United Kingdom by the Raspberry pi foundation. The Raspberry Pi project originally leaned towards the promotion of teaching basic computer science in schools in developing countries. The original model became more popular than anticipated, selling outside its target market for uses such as robotics. It is widely used in many areas because of its low cost, modularity, and open design.

Since the launch of the first Raspberry Pi in 2012, there have been several releases of different models.

Model	Raspberry Pi 1	Raspberry Pi 2	Raspberry Pi Zero	Raspberry Pi 3	Raspberry Pi 4	Raspberry Pi Pico
Release	2014	2015	2015	2016	2019	2021

Table-1: Various Models of Raspberry Pi and their release years

3.2 APACHE

The APACHE HTTP server, colloquially called Apache, is a free and open-source cross-platform web server software released under the terms of Apache License 2.0. APACHE is developed and maintained by an open community of developers under the auspices of the Apache Software Foundation. Instead of implementing a single architecture, Apache provides a variety of MultiProcessing Modules, which allow it to run in either a process-based modem, a hybrid mode, or an event-hybrid mode to match the demands of each particular instance.

3.3 Devices used in the research

Hardware Specs	Raspberry Pi 4B	MACBook AIR	MACBook AIR
CPU	Arm cortex A-72,1.5GHz	Apple M1	Apple Intel
CPU CORES	4	8	4
CPU CACHES	L2 Cache	L1 and L2 caches	L1 and L2 caches
RAM	2 GB	8 GB	8 GB
Storage	32 GB	256 GB	128 GB
Operating System	Raspbian	MacOS Monterey	MacOS Monterey

Table-2: Hardware Specifications of devices used in the experiment

3.4 Static Website

The static website is made from scratch using HTML, CSS, and Javascript. It is a multiple-page site consisting of Text and Image.

3.5 Apache Bench

Apache bench was used to perform the benchmarking tests and gather information on various parameters of the website. It can be run from the command line, and it is very simple to use. A quick load testing output can be obtained in just one minute. It does not require much familiarity with load and performance testing concepts, so it is suitable for beginners and intermediate users. To use this tool, no complex setup is required. Moreover, it gets installed automatically with the Apache webserver.

4. Scope

The CPU consumption and time taken to answer 10000 requests made by the client of both Raspberry Pi 4B and MacBook air are measured and compared to check the feasibility of both the devices in hosting a website. We also serve static websites to achieve more accurate results. Other than raspberry pi 4B, MacBook air Intel, and apple M1 (silicon), the study will not discuss another device's performance evaluation that is outside the scope.

5. What was measured?

Using the Apache HTTP Server Benchmarking tool, to send the requests, the CPU consumption and time taken for serving 10000 requests was measured. The average time was measured for serving 10000 requests at different levels of concurrency. CPU consumption was measured by sending 10000 requests to the server.

6. Experiment

This experiment is designed to send 10000 requests to the website simultaneously, and this experiment was performed two times to get more accurate results. Then the average of both the results was taken, and a conclusion was given. The requests were made using the Apache Benchmarking tool, and the website was hosted using Apache server. The devices on which the website was hosted were only hosting the website at that instant no other application was open or working in the background. The extra traffic on the router was also blocked, and only the server and the client were the devices allowed on the network. The server hosted the static website with 3 pages using Apache, and the client made the request by using the apache benchmarking tools. The following commands were used to send requests to the server:-

```
ab -n 10000 -c 1 http://ipaddress of website/
```

```
ab -n 10000 -c 10 http://ipaddress of website/
```

```
ab -n 10000 -c 50 http://ipaddress of website/
```

```
ab -n 10000 -c 100 http://ipaddress of website/
```

The CPU usage was measured by using the HTOP command in the terminal. The tests on all devices were made simultaneously to avoid the increase in atmospheric temperature affecting the raspberry pi.

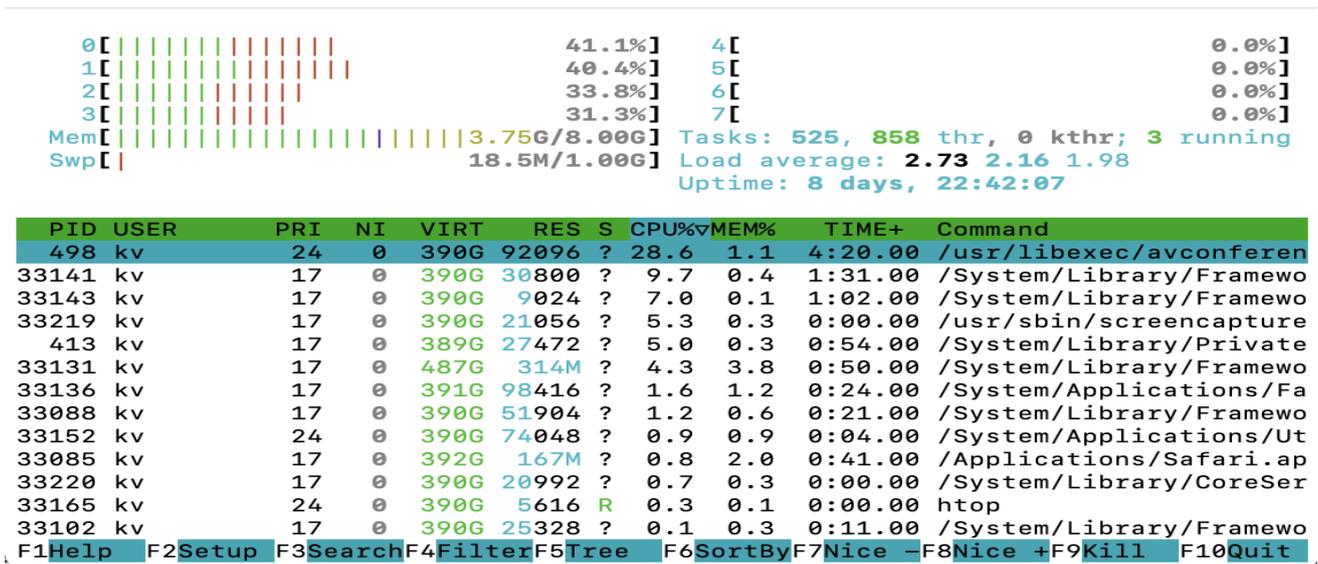


Figure-2: CPU Consumption using Htop

7. CPU consumption analysis of Static website

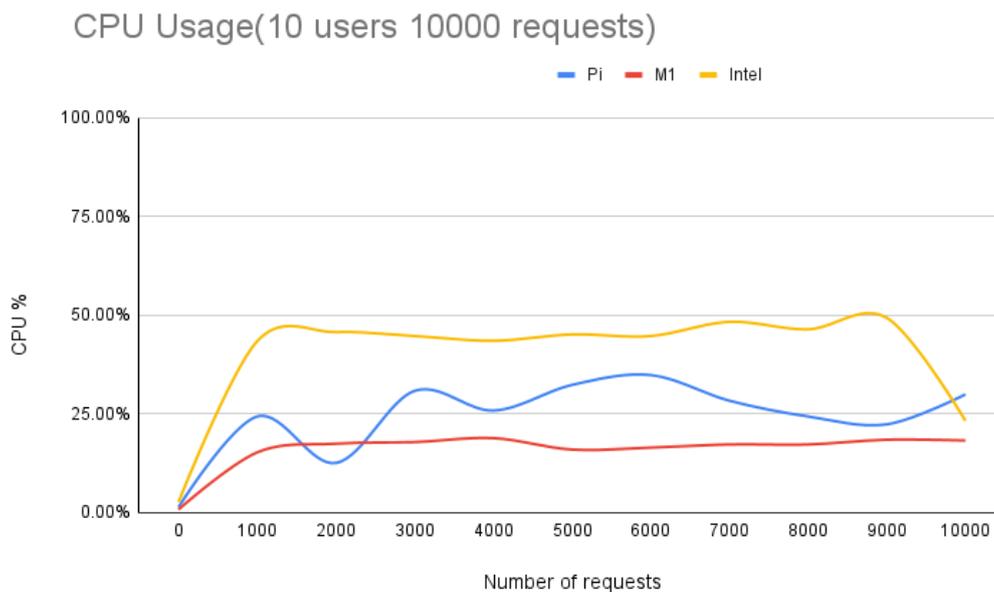


Figure-3: CPU consumption analysis of Static website

The above chart shows the comparison of CPU usage at different numbers of requests of all the servers used in the research.

8. Average served per second for different concurrencies



Figure-4: Average served per second for different concurrencies

The above chart represents the difference between requests served per second on different servers at 10000 requests and various concurrency.

9. Time Taken for testing of static website

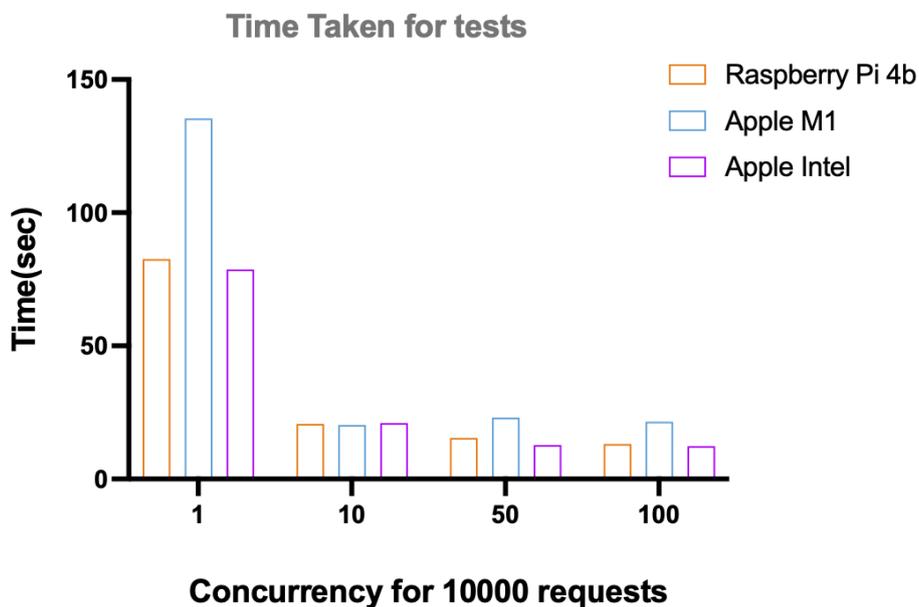


Figure-5: Time Taken for testing of static website

The above graph shows a comparison between time taken to complete 10000 requests at different concurrency on all three servers used in the research for static website.

10. CONCLUSION

The Raspberry Pi 4B, with only its 2 GB Ram and 1.5 GHz processor was able to serve requests very well without any significant effects in temperature. The Mac Air Intel performed the best in terms of concurrent users, and the M1 silicon-based mac was the best in terms of CPU usage as it maintained its CPU usage and did not show any significant fluctuations in any case.

11. FUTURE WORK

From the thesis, we found the performance comparison and consumption of the CPU and response time of both raspberry pi 4B and mac air with apple silicon. In the future, we are interested in examining the other aspects and testing the devices. Due to the advancement in technology, when a new raspberry pi is released, it will be fascinating to see the new model and perform the tests to measure its feasibility.

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