Performance Analysis of CloudLinux-based Web Server at the Embassy of the Kingdom of Morocco in Jakarta

Anggie Pratama Lalengke[1]*, Ida Nurhaida[2]
Computer Science Faculty[1], [2]
Mercu Buana University
Jakarta, Indonesia
41517110092@student.mercubuana.ac.id[1], ida.nurhaida@mercubuana.ac.id[2]

***Abstract*— The rapid development of Information Technology (IT) has made a high availability web server a necessity. CloudLinux is a CentOS-based operating system specifically for the needs of servers with good high availability. This study will implement and analyze a CloudLinux-based web server for the Embassy of the Kingdom of Morocco in Jakarta to replace the current CentOS-based web server that does not meet high availability standards. The research methodology used in this study is the PPDIOO Life-cycle from Cisco. Designing a network according to the customer's needs requires identifying several elements in it, including the goals and constraints faced by the organization. Cisco creates a network life-cycle that can help these problems into six phases: Prepare, Plan, Design, Implement, Operate, and Optimize (PPDIOO). This study aims to determine how well the uptime, response time, and load impact are on the CloudLinux-based web server. The uptime test results on the CloudLinux-based web server have a value of an average of 99.971%. Testing the response time on the CloudLinux-based web server has an average value of 684.75ms (milliseconds). The results of the load impact test on the CloudLinux-based web server using ten virtual users (10VU) has a total value of 7595 requests, load impact using fifteen virtual users (15VU) has a total value of 11315 requests, and finally, load impact using twenty-five virtual users (25VU) has a total value of 18631 requests.**

Keywords*— Web Server, Uptime, Response Time, Load Impact, CloudLinux

I. INTRODUCTION

The development of computer technology is increasing along with the development of human needs in getting information using the internet [1]. Cloud Computing is gaining momentum in the Information Technology (IT) scope as an emerging computing paradigm for managing and delivering services over the internet [2].

In today's cloud computing era, having a server that can work 24 hours, seven days a week, 365 days a year continuously without any constraints is necessary. Of course, according to the Uptime Institute [3], the server must work under a high availability (uptime) standard of 99.9% per month. PERSISMA's servers currently experience uptime problems that do not meet these standards. The problem is downtime for more than 5 hours a month, meaning that PERSISMA's current server uptime is around 99.2%.

PERSISMA (Persaudaran Indonesia Sahara-Morocco) is an organization formed by the Embassy of the Kingdom of Morocco in Jakarta in 2012. This organization has a philosophy of "brotherhood makes us civilized human beings on earth," aiming to be a communication bridge between the two countries, Indonesia and Morocco [4]. Therefore, with the help of current Information Technology (IT), communication and information that exists between Indonesia and Morocco at PERSISMA can run well and be helpful.

CloudLinux is a CentOS-based hosting-oriented Linux distribution [5], [6]. It employs the LVE (Lightweight Virtual Environment) kernel technology, which is similar in some ways to OpenVZ or other OS-based virtualization technologies [6]. CloudLinux continually increases its security, stability, and availability of Linux servers and devices [7]. With CloudLinux, the server will be more stable, and sharing resources is more controlled [8].

The author did not find any related research that discusses CloudLinux-based web servers. However, related research that examines web servers, in general, as a brief literature review in this study we can see in Table 1.

TABLE I. LITERATURE REVIEW

Author (year)	Research Title	Results
Yongquan Yan, Ping Guo, Bin Cheng, Zhigao Zheng (2017)	An experimental case study on the relationship between workload and resource consumption in a commercial web server [9]	A method to quantitatively investigate the relationship between changing workload parameters and resource consumption parameters containing available memory and heap memory in a commercial web server.
Hossein Hadian Jazi, Hugo Gonzalez, Natalia	Detecting HTTP-based Application Layer DoS attacks on Web Servers in	Using real traffic traces of application-level DoS attacks and validated the effectiveness of

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Stakhanova, Ali A. Ghorbani (2017)	the presence of sampling [10]	detecting DoS attacks based on nonparametric CUSUM algorithm.
Mohamed Escheikh, Kamel Barkaoui, Hana Jouini (2017)	Versatile workload-aware power management performability analysis of server virtualized systems [11]]	A workload-aware PM performability analysis of SVS. This analysis is based on an analytical non-Markovian versatile SVS availability SRN model consisting of two sub-models.
Changsu Kim, Hankil Kim, Jongwon Lee, Hoekyung Jung (2018)	Web Server-based Distributed Machine Socialization System [12]	Comparing and analyzing the existing centralized machine collaboration system and the distributed machine collaboration system, and found that the average response time was reduced from 0.6 seconds to 0.1 seconds, a difference of 0.5 seconds.
Dimara Kusuma Hakim, Dwi Yoga Yulianto, Achmad Fauzan (2019)	Testing Web Server Load Balancing Algorithm Using NGINX [13]	The use of the least connection algorithm for load balancing provides better performance compared to the round-robin algorithm on the speed of website access when there are very many requests from users at the same time.
Albert Yakobus Chandra (2019)	Performance Analysis Between Apache & Nginx Web Server in Handling Client Requests [14]	Nginx has an average request completion time that is faster than Apache. After the testing process, these results were obtained with the number of requests ranging from 100 to 1000000 using the Apache Bench tool.
Kadiyala Ramana, M. Ponnavaikko (2019)	AWSQ: an approximated web server queuing algorithm for heterogeneous web server cluster [15]	A load balancing approach to expand the availability and to decrease the process of overloading of the servers in web server cluster system
Xiuquan Qiao, Hongyi Wanga, Pei Ren, Yukai Tu, Guoshun Nan, Junliang Chen, M. Brian Blake (2020)	Interest packets scheduling and size-based flow control mechanism for content-centric networking web servers [16]	Differentiate the first Interest packets and the subsequent Interest packets based on a novel queuing discipline, and prioritize the subsequent Interest packets of processed services.
Prerna Jain, Yogesh Munjal, Jatin Gera, Dr. Pooja Gupta (2020)	Performance Analysis of Various Server Hosting Techniques [17]	Serverless architecture allows the release of applications and their subsequent versions quickly without worrying about their scalability.

Yan et al. [9] quantitatively investigated the relationship between workload and resource consumption on availably memory and heap memory on a commercial web server using the Regression Trees method. Jazi et al. [10] detecting DOS attacks at the network level and application level on the web server using the Sampling Techniques method. Escheikh et al. [11] analyze Server Virtualized Systems (SVS) performance based on analytical non-Markovian versatile SVS using the Stochastic Modeling method. Kim et al. [12] implement a web server-based Distributed Machine Collaboration System and compare it with the current Centralized Machine Collaboration System to analyze the response time. Hakim et al. [13] using the least connection algorithm for load balancing and comparing it with the round-robin algorithm to determine the response time on the NGINX web server. Chandra [14] uses the Experimental method and compares the Apache web server with the NGINX web server to find a better response time. Ramana and Ponnavaikko [15] conducted experimental investigations and simulations using load balancing algorithms on heterogeneous web servers to determine the drop rate, throughput, and response time with many requests. According to the Shortest-Remaining-Processing-Time (SRPT) scheduling theory, Qiao et al. [16] use Interest packet-based Dynamic Service Request Scheduling to distinguish the first interest packet and the subsequent interest packet on a content-centric networking web server. Jain et al. [17] perform AWS Lambda (serverless platform) analysis to allow the authors to run generic applications in explicit runtime environments using Docker Images installed on Docker-Hub and compare them to other serverless platforms.

The purpose of this research is to implement and analyze a CloudLinux-based web server for the Embassy of the Kingdom of Morocco and determine how good the uptime, response time, and load impact are on a CloudLinux-based web server.

II. Research Methodology

The research methodology used in this research is PPDIOO Life-cycle from Cisco. PPDIOO stands for Prepare, Plan, Design, Implement, Operate, and Optimize [18]. PPDIOO is a Cisco methodology that defines the continuous life-cycle of services required for a network [19]. We can see the flow chart in this study in Figure 1.

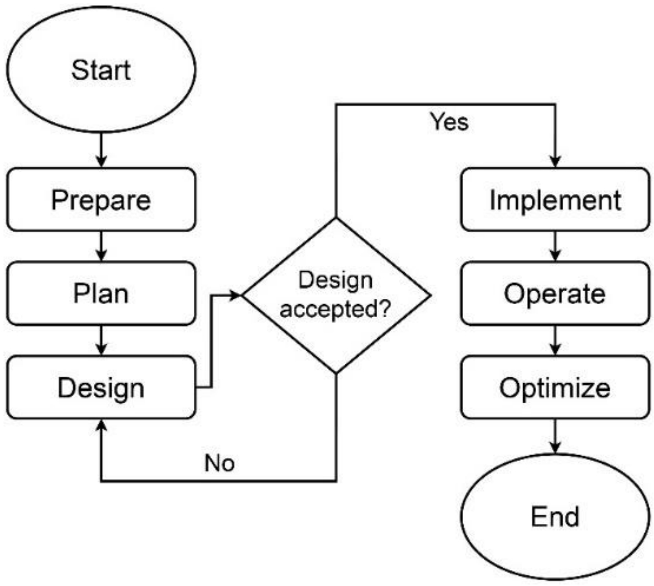

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Fig. 1. Research Methodology

A. Prepare Phase

The preparation stage is the initial stage in this research. At this stage, what is done is to determine the web server requirements used by the Embassy of the Kingdom of Morocco following the organization's finances, select the software to be used, and prepare for configuration.

B. Plan Phase

1) Analysis of the current web server

The author analyzed the current web server used by the Embassy of the Kingdom of Morocco to determine the advantages and disadvantages of existing servers to differentiate the new web server that needs to be made.

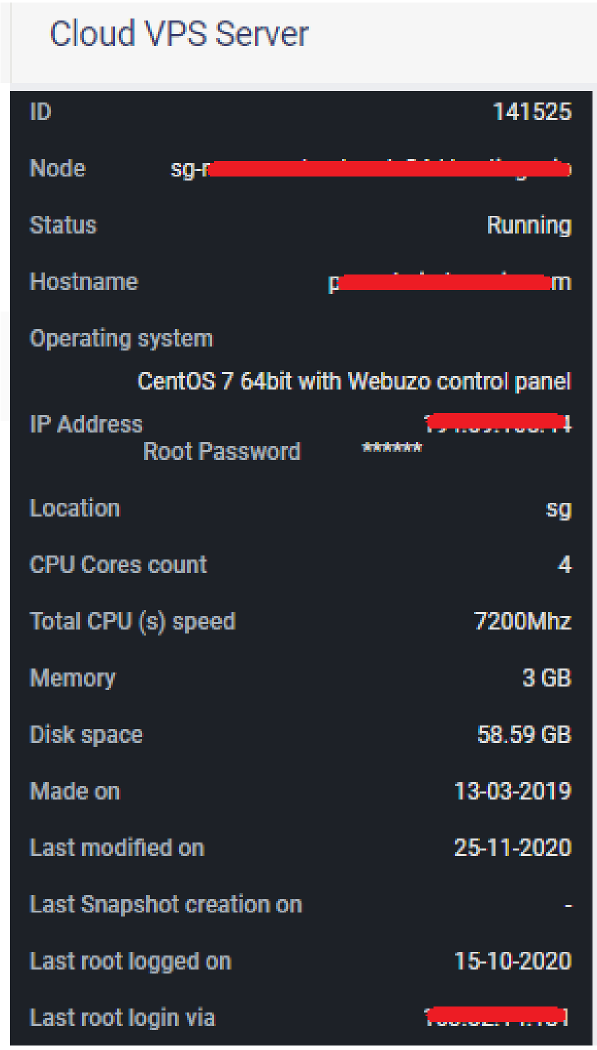

Fig. 2. Current Web Server (CentOS)

In Figure 2, we can see that the current web server used at the Embassy of the Kingdom of Morocco uses a virtual private server located in Singapore with the CentOS 7 64bit operating system and the Webuzo control panel. The CPU on the virtual server is Quad-Core (4 cores) with a speed of 7200Mhz, 3GB of RAM, and 58.59GB (60GB) of Disk Space. The full details of the current web server specifications used by the Embassy of the Kingdom of Morocco can be seen in Table 2.

TABLE II. CURRENT WEB SERVER SPECIFICATIONS

Components	Details
Server Type	Cloud Virtual Private Server
Server Location	Singapore
CPU Count	4 Cores
CPU Speed	7,2 GHz
Memory	3 GB
Disk Space	58.59 GB
Operating System	CentOS 7 64bit
Control Panel	Webuzo (Softaculous)

2) Problem Analysis

Problem analysis is needed to find out what problems occur on the Embassy of the Kingdom of Morocco's current web server and determine the required solution.

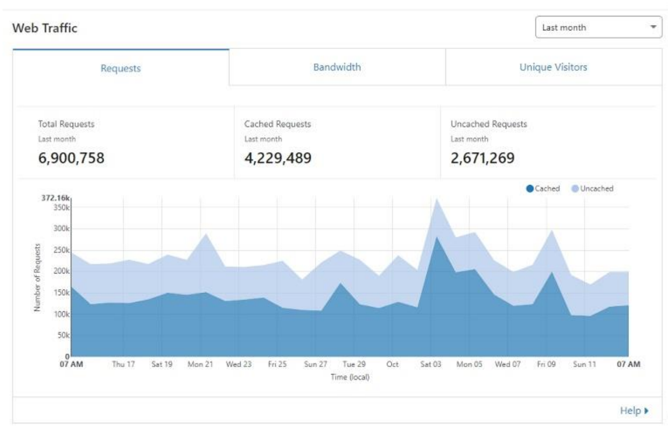

Fig. 3. High Traffic Request

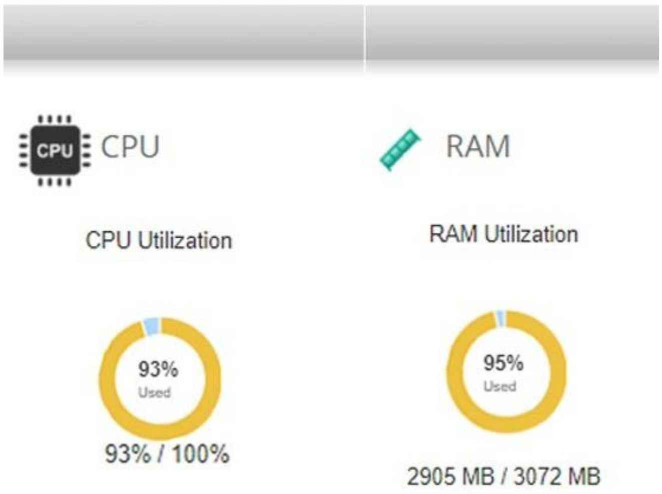

Fig. 4. CPU and RAM Usage (CentOS)

As illustrated in Figure 3, the request traffic to the current web server is close to 7 million requests (6,900,758 requests) per month. Continued in Figure 4 shows that the CPU

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Utilization is very high, reaching 93%, and the total RAM used is also very high, reaching 95% of the total 3 GB of available RAM.

C. Design Phase

In this stage, the author will overview the CloudLinux-based web server to solve the current web server problems at the Embassy of the Kingdom of Morocco. Furthermore, identifying hardware and software requirements, determining hardware and software specifications, the final step at this stage is to create a CloudLinux-based web server and configure it.

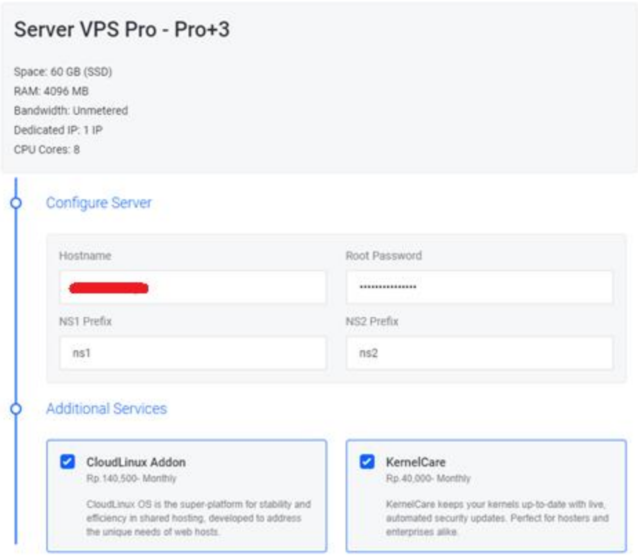

Fig. 5. Web Server Design (CloudLinux)

As illustrated in Figure 5, the web server design plan that the author will design and implement is located in Singapore with the CloudLinux operating system. The CPU used on the web server is Octa-Core (8 cores), 4 GB of RAM, and 60 GB of Disk Space (SSD). For security reasons of the web server, the author adds KernelCare to keep the kernel and security on the web server up-to-date. The full details of the new web server design specifications for the Embassy of the Kingdom of Morocco can be seen in Table 3.

TABLE III. CLOUDLINUX WEB SERVER SPECIFICATIONS

Components	Details
Server Type	Virtual Private Server
Server Location	Singapore
CPU Count	8 Cores
CPU Speed	12,8 GHz
Memory	4 GB
Disk Space	60 GB
Operating System	CloudLinux 7.7
Control Panel	cPanel (WHM)

D. Implement Phase

After the design is accepted by the Embassy of the Kingdom of Morocco, the next step is implementation. Implementation of the web server by migrating all existing data on the old web server to the CloudLinux-based web server that has been made. Then run the web server so that the web server can be used directly by the Embassy of the Kingdom of Morocco, as shown in Figure 6.

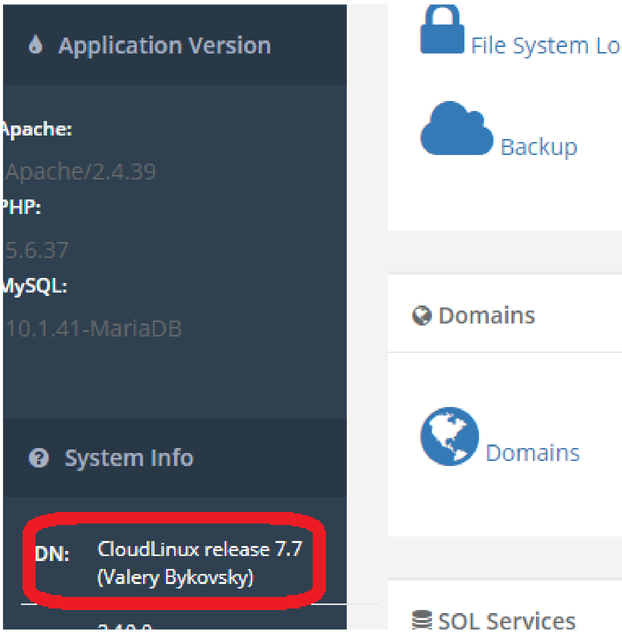

Fig. 6. New Web Server (CloudLinux)

E. Operate Phase

After the implementation phase is complete, then proceed to the web server operational stage. At this stage, the author will carry out a test scenario on the CloudLinux-based web server that has been created. It is aimed to know the uptime, response time, and load impact of the new web server.

F. Optimize Phase

Based on test results conducted a web server in the previous stage, then analyzed the test results. The author will obtain the value of uptime, response time, and load impact at this stage. If the uptime, response time, and load impact values do not meet the standards, then the web server will be optimized so that these values meet the predetermined standards.

III. RESULT AND DISCUSSION

The author realizes that the CPU and Memory on the old web server, CentOS-based web server, is different from the new web server, Cloudlinux-based web server. This difference is due to adjusting to the needs and finances at the Embassy of the Kingdom of Morocco in Jakarta and adjusting to the Prepare Phase, Plan Phase, and Design Phase determined previously. Then, over time, and as users increase, the number of requests on the web server each month increases. The average number of requests on the old web server is only around 6.9 million requests. Currently, the average number of requests is over 10 million requests.

Tests carried out using Site24x7 and LoadImpact K6. The location of the Site24x7 test server is in Seattle, United States, and the LoadImpact K6 test server is in Jakarta, Indonesia. This test is conducted to determine the value of uptime, response time, and load impact of the web server, starting

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from August 2020 to March 2021.

A. Web Server Uptime

Uptime refers to the amount of time the system is available for use as intended, whereas downtime refers to the amount of time the system is stalled, shut down, or otherwise not working as expected. Its uptime measures the percentage of time a server is available [20].

Because servers are critical IT infrastructure components, it makes sense to achieve as close to 100% uptime as possible. In many industries, 99.999% uptime is considered high availability. Server uptime monitoring is the process of determining whether servers' function and availability meet service level agreement (SLA) standard for high availability, which is 99.999% or less. In some cases, server uptime reports are required to demonstrate compliance with its established SLAs [20].

First, the author executed the uptime test on the old web server, CentOS-based web server of the Embassy of the Kingdom of Morocco using Site24x7. This test started from August 2020 to November 2020. The results of the test shown in Figures 7 to 10.

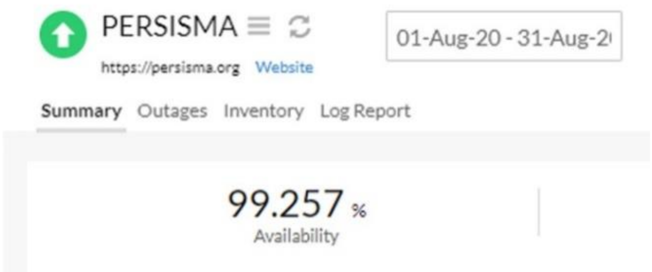

Fig. 7. Uptime Result on August 2020 (CentOS)

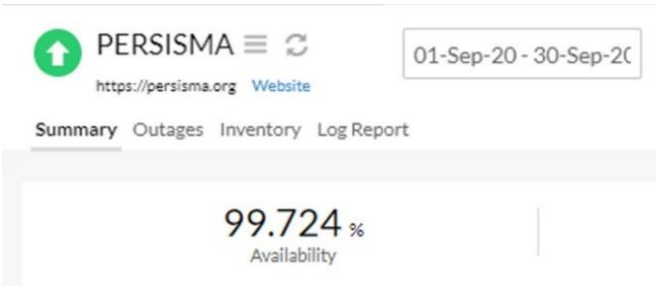

Fig. 8. Uptime Result on September 2020 (CentOS)

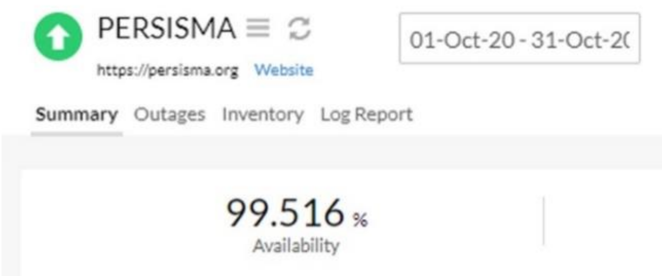

Fig. 9. Uptime Result on October 2020 (CentOS)

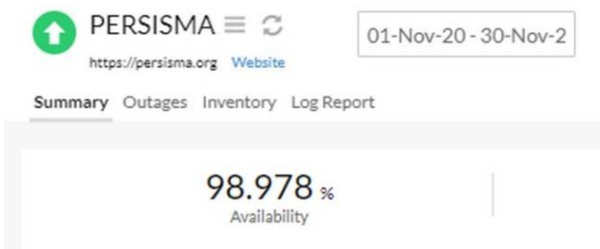

Fig. 10. Uptime Result on November 2020 (CentOS)

After testing the old web server, the author continued testing on a new web server, CloudLinux-based web server. This test started from December 2020 to March 2021. The results of the test shown in Figures 11 to 14.

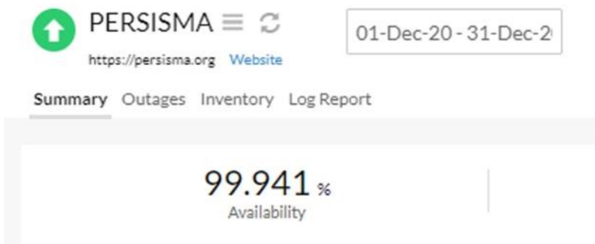

Fig. 11. Uptime Result on December 2020 (CloudLinux)

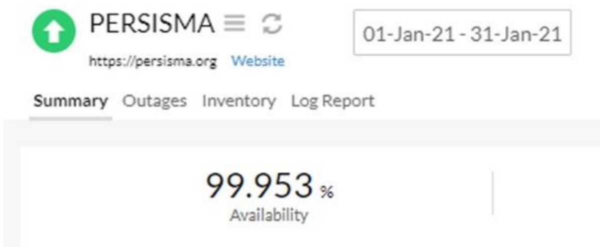

Fig. 12. Uptime Result on January 2021 (CloudLinux)

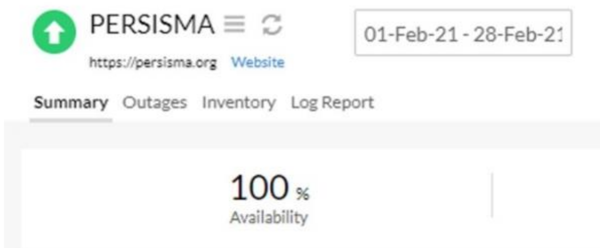

Fig. 13. Uptime Result on February 2021 (CloudLinux)

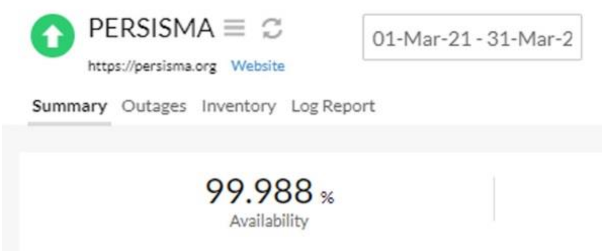

Fig. 14. Uptime Result on March 2021 (CloudLinux)

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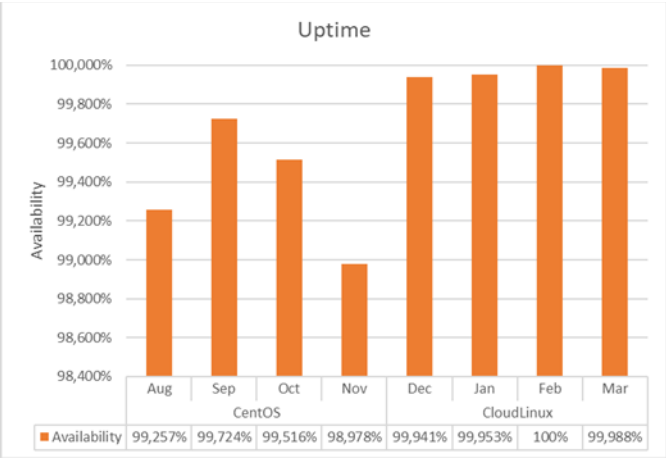

Fig. 15. Uptime Chart (Higher is better)

As seen in Figure 15, CentOS-based web server, from August 2020 to November 2020, the average uptime is 99.369%. After using the CloudLinux-based web server from December 2020 to March 2021, the average uptime increased to 99.971%. A good standard of uptime, according to the Uptime Institute, is around 99.9%.

B. Web Server Response Time

The response time is the most crucial factor determining user experiences in the service provision model involving server clusters [21]. The amount of time required to load an HTML document from a server so that the client can begin rendering the page is referred to as server response time. The HTML document will take longer to load if the server response time is slow. If the HTML document is not loaded, the browser will not know what other resources are needed to display the page correctly [22].

If the web server has a good response time, the webpage will appear to load almost instantly. The page will take longer to load without it, negatively impacting the user experience and, ultimately, search engine rankings [23].

After completing the uptime testing, followed by testing the response time on the old web server, CentOS-based web server, which started from August 2020 to November 2020. The results of the test shown in Figures 16 to 19.

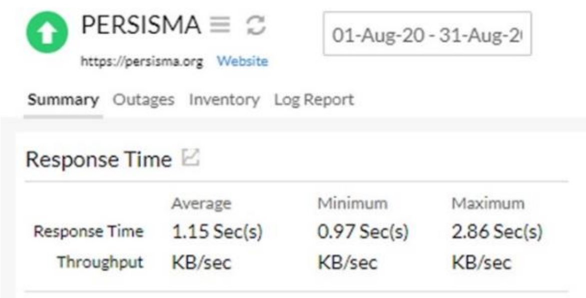

Fig. 16. Response Time Result on August 2020 (CentOS)

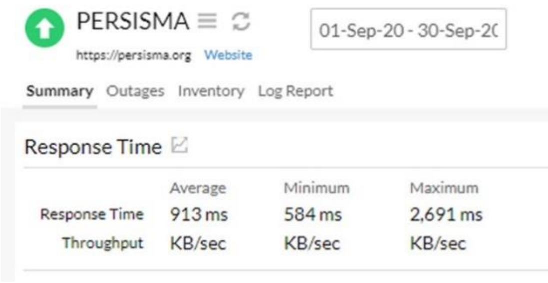

Fig. 17. Response Time Result on September 2020 (CentOS)

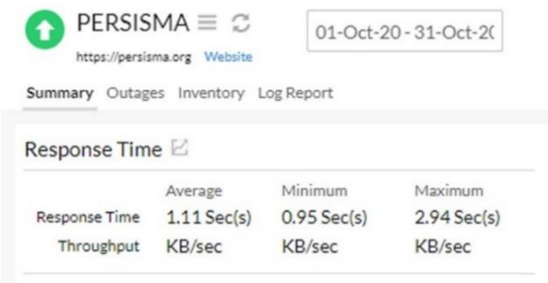

Fig. 18. Response Time Result on October 2020 (CentOS)

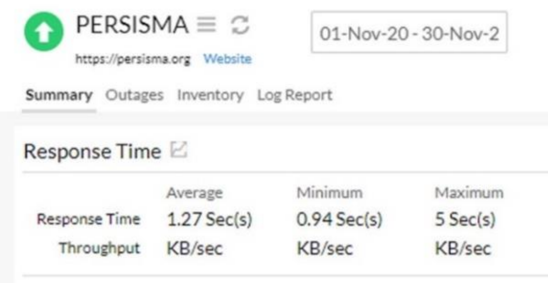

Fig. 19. Response Time Result on November 2020 (CentOS)

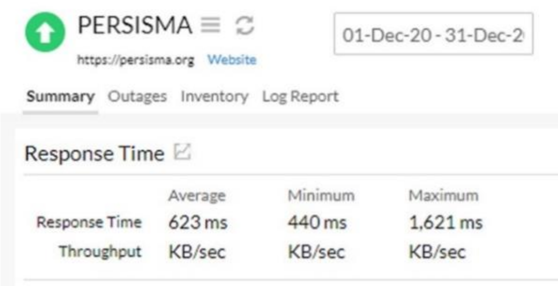

Fig. 20. Response Time Result on December 2020 (CloudLinux)

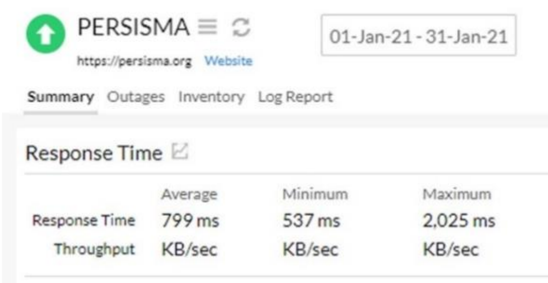

Fig. 21. Response Time Result on January 2021 (CloudLinux)

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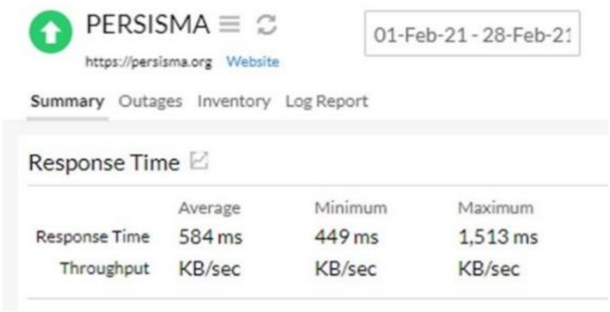

Fig. 22. Response Time Result on February 2021 (CloudLinux)

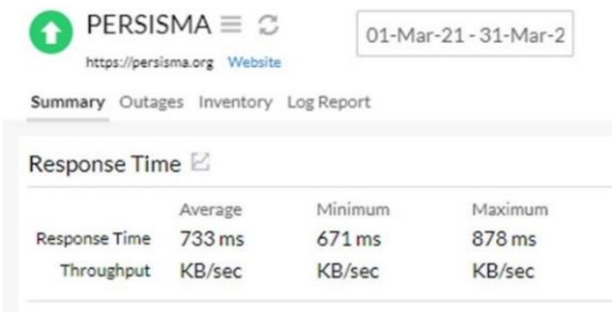

Fig. 23. Response Time Result on March 2021 (CloudLinux)

As shown in Figures 20 to 23, the author continued testing the response time on the new web server, CloudLinux-based web server. This test started from December 2020 to March 2021.

Time to First Byte (TTFB) is a unit used to measure server response time. The time it takes between the HTTP client making a request and receiving the first byte of data is calculated by TTFB [23]. The time is measured in milliseconds, as illustrated in Figure 24.

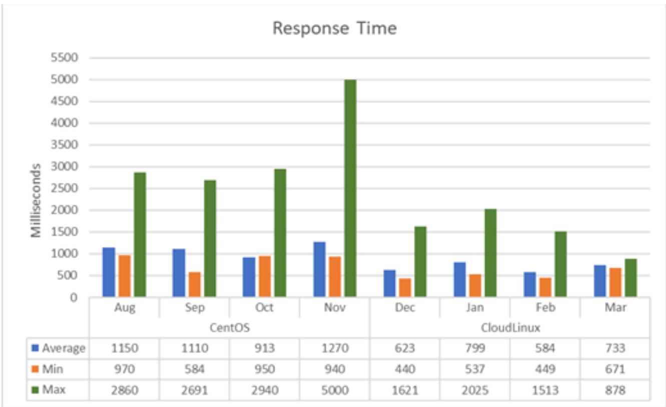

Fig. 24. Response Time Chart (Lower is better)

What constitutes a good, bad, and acceptable TTFB varies. Here are some general rules, (1) quicker than 100ms is excellent. (2) 100–200ms is good. Google PageSpeed Insights recommends keeping server response time under 200ms. (3) 200ms–1 second is acceptable. (4) Anything over 1 second is a problem [23]. CloudLinux-based web server is sufficient response time according to general rules of response time.

C. *Web Server Load Impact*

The last parameter is testing the load impact of the old web server, CentOS-based web server, and the new web server, CloudLinux-based web server of the Embassy of the Kingdom of Morocco using the LoadImpact K6 tool. This test is conducted to determine the benchmark value using virtual user (VU) visitors.

Load Impact has a simple user interface, but it also has powerful tools that allow users to gain insights into the performance and endurance of their websites and applications and identify issues and bottlenecks that slow and impede service delivery [24]. The sample results of the test shown in Figure 25.

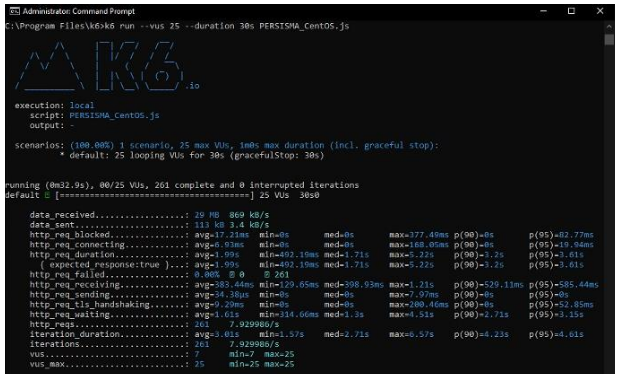

Fig. 25. Load Impact Sample Result

K6 is a cloud-based, open-source load testing service. One of the things that makes this tool appealing is the price of a variable-use model. It is, however, mainly developer-centric. Its load testing side is designed for high loads and can handle various modes, such as spikes, stress testing, and endurance runs [25].

Testing with each virtual user (ten virtual users, fifteen virtual users, and twenty-five virtual users) is carried out once a day in a month to find out how many total requests can be handled by the CentOS-based web server and CloudLinux-based web server, in that one month. The results of the total load impact request are illustrated in Figure 26.

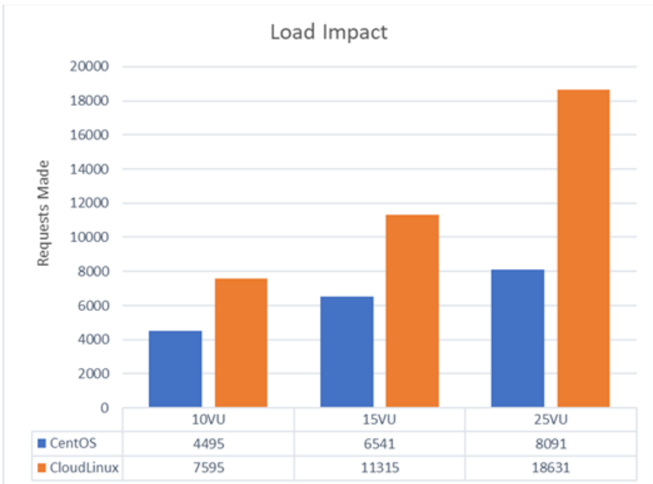

Fig. 26. Load Impact Chart (Higher is better)

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Testing used ten virtual users (10VU), CentOS-based web server can handle 4495 total requests, CloudLinux-based web server can handle 7595 total requests. Testing used fifteen virtual users (15VU), CentOS-based web server can handle total requests of 6541, CloudLinux-based web server can handle total requests of 11315. Testing used twenty-five virtual users (25VU), CentOS-based web server can handle 8091 total requests, CloudLinux-based web server can handle 18631 total requests. The greater the request value, the web server can handle many visitors simultaneously on a web server.

IV. CONCLUSION

The research that has been done can be concluded that CloudLinux-based web servers can run well without constraints. The uptime test results for the CloudLinux-based web server from December 2020 to March 2021 have an average of 99.971%, compared to the old web server, CentOS-based web server, from August to November 2020 which only has an average of 99.369%. An excellent average uptime, according to the Uptime Institute, is above 99.9%. The CloudLinux-based web server response time test results have an average of 684.75ms compared to the old web server, CentOS-based web server response time, which only has an average of 1110.75ms. An excellent average response time, according to the commonly used standards, is under 1 second. The latter results from load impact testing with ten virtual users (10VU), CloudLinux-based web server request has a value of 7595 compared with CentOS-based web server that only has a value of 4495. Load impact with fifteen virtual users (15VU), the CloudLinux-based web server has a value of 11315 requests compared to the CentOS-based web server, which only has a value of 6541. Load impact with twenty-five virtual users (25VU), CloudLinux-based web server has a value of 18631 requests compared to the CentOS-based web server, which only has 8091.

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