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ANALYSIS OF IMPLEMENTATION AND PERFORMANCE EVALUATION OF VIRTUALIZATION-BASED SERVER INFRASTRUCTURE USING PROXMOX VE TO SUPPORT INFORMATION SERVICES AT NASPCI

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ABSTRACT — *This study aims to analyze infrastructure requirements, implement a virtualization-based standalone server using Proxmox VE, test infrastructure performance, and evaluate the implementation results using the PIECES framework. The National Air & Space Power Center of Indonesia (NASPCI) previously relied on commercial shared hosting to support its website-based information services. This arrangement limited administrative control, configuration flexibility, and resource management, while also creating a dependency on third-party service providers. The study employs the Network Development Life Cycle (NDLC) methodology, encompassing the stages of analysis, design, simulation/prototyping, implementation, monitoring, and management. The implemented infrastructure comprises Proxmox VE 8.4.19, an Ubuntu Server 20.04.6 LTS virtual machine, Nginx, PHP 7.4.3, MariaDB 10.3.39, CodeIgniter 3, GitHub, and Cloudflare Tunnel. Testing covered connectivity, web service access, CPU, RAM, storage, uptime, response time, and core website functionality. Results showed 0% packet loss for Proxmox VE and Ubuntu Server, an HTTP 200 status for both local and public HTTPS access, an average response time of 0.108 seconds, CPU usage of approximately 6.2%, available memory of around 1.5 GiB, and 30% root storage utilization. The PIECES evaluation demonstrated improvements in administrative control, resource flexibility, management efficiency, and the independence of information services. This research contributes by implementing a Proxmox VE standalone server to replace shared hosting, subjecting it to technical testing and comprehensive evaluation within the context of the non-profit organization NASPCI.*

Keywords: *Server Infrastructure, Virtualization, Proxmox VE, Cloudflare Tunnel, PIECES*

1. INTRODUCTION

Web-based information services require a server infrastructure capable of conti nuously providing applications, databases, networking, and storage. A well-managed infrastructure helps organizations maintain service availability and simplifies resource management. Virtualization is a widely adopted approach because it enables a single physical server to run isolated server environments with adjustable allocations of CPU, memory, storage, and network resources. NASPCI is an independent, non-profit, and non-partisan research and study organization. Prior to this research, the naspci.org website utilized Rumah web's shared hosting service, incurring annual costs of IDR 1,680,000 for hosting and IDR 200,000 for the domain. While this service supported the website, server configuration and resource management were constrained by the provider's facilities. Conversely, NASPCI possessed physical

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server hardware that could be utilized internally; thus, there was a need to migrate hosting functions to a self-managed server to enhance administrative control and management flexibility. Existing research on Proxmox VE has addressed topics such as server consolidation, Quality of Service, comparative operating system performan ce in virtualized environments, server infrastructure readiness, and high availa bility. Other studies have employed the Network Development Life Cycle (NDLC) for server deployment and the PIECES framework to evaluate information system performance and quality. A review of the literature reveals no prior study that specifically combines the implementation of Proxmox VE to replace shared hosting for a non-profit organization with technical infrastructure testing and a PIECES-based evaluation within the context of NASPCI. This gap serves as the basis for the present study. This research aims to analyze NASPCI's server infrastructure require ments, implement a virtualization-based self-managed server using Proxmox VE, test infrastructure performance under normal operating conditions, and evaluate its effectiveness compared to the previous shared hosting arrangement using the PIECES method. The study's findings are expected to provide a more autonomous and scalable infrastructure implementation model to support the organization's infor mation services.

2. METHODOLOGY

2.1. Research Design

This research is applied, implementative, and evaluative in nature, employing a case study approach focused on the NASPCI information service. Infrastructure develop ment utilized the Network Development Life Cycle (NDLC) framework, comprising analysis, design, simulation/prototyping, implementation, monitoring, and manage ment. The analysis phase identified the shared hosting conditions and NASPCI's requirements; the design phase establi shed the topology and resource allocation; the simulation/prototyping phase verified server environment compatibility; the imple mentation phase deployed Proxmox VE and website services; and the monitoring and management phases were used for testing, evaluation, and the formulation of management recommendations.

2.2. Research Locus and Object

The research was conducted at the National Air & Space Power Center of Indonesia (NASPCI). The objects of study included the previously used shared hosting infrastructure, NASPCI's physical servers, Proxmox VE (as the hypervisor), Ubuntu Server virtual machines (acting as production servers), and the naspci.org website service. Data were collected through observation, interviews, documen tation, and literature review.

2.3. Research Instrument

The implementation components consist of Proxmox VE 8.4.19, Ubuntu Server 20.04.6 LTS, Nginx, PHP 7.4.3, MariaDB 10.3.39, CodeIgniter 3, a private GitHub repository, the naspci.org domain, and Cloudflare Tunnel. Testing tools include the ping command for connectivity; curl for HTTP status and response time; nproc and free -h for CPU and RAM; df -h /for storage; uptime-p for operational duration; and desktop and mobile browsers for testing service functionality.

2.4. Analysis Techniques

Technical data were analyzed descriptively based on packet loss, HTTP status, CPU, RAM, and storage usage, uptime, response time, and the successful execution of the website's core functions. System evalua tion employed the PIECES frame work, covering Performance, Information, Econo my, Control, Efficiency, and Service. As technical logs from the previous shared hosting environment were unavailable following the migration, the technical comparison of the old system was conduc ted qualitatively based on obser vations, interviews, service documentation, and cost data whereas quantitative testing was performed on the dedicated server. The

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topology of the implemented server infra structure is shown in Figure 1.

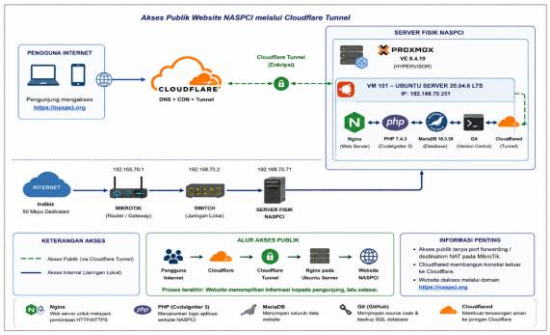


Figure 1. NASPCI Standalone Server Infrastructure Topology
Source: Research documentation (2026)

3. RESEARCH RESULTS AND DISCUSSION

3.1. Research Results

3.1.1.Server Infrastructure Implementation

The NASPCI physical server is configured using Proxmox VE 8.4.19 as the hyper visor. The production virtual machine (ID 101) runs Ubuntu Server 20.04.6 LTS and is allocated 1 vCPU, 2 GB of RAM, a 32 GB virtual disk, and the IP address 192.168. 70.251. This environment hosts Nginx, PHP 7.4.3, MariaDB 10.3.39, CodeIgniter 3, Git, and Cloudflare Tunnel. The use of Proxmox VE enables direct management of virtual machines and resources, aligning with virtualization practices from previous research. The website application is managed via a private GitHub repository, while public access is provided through the naspci.org domain, routed via Cloudflare Tunnel. This approach allows the public service to be accessed via HTTPS without directly opening inbound ports on the router. Nginx serves as the web server, CodeIgniter 3 handles application logic, and MariaDB provides the database. Nginx was selected due to its capability to function as both a reverse proxy and a web application server.

Parameter	Configuration
Hypervisor	Proxmox VE 8.4.19
VM	ID 101, Ubuntu Server 20.04.6 LTS
CPU	1 vCPU
RAM	2 GB
Virtual disk	32 GB
IP	192.168.70.251

Table 1. NASPCI Production Virtual Machine Configuration
Source: Research findings (2026)

3.1.2. Performance Test Results

Testing was conducted under normal operating conditions, covering connectivity, web service access, resource utilization, uptime, response time, and core website functionality. Proxmox VE and the Ubuntu Server virtual machine exhibited 0% packet loss during local network testing. Tests involving the local web server and public HTTPS access returned an HTTP 200 status. These results indicate that access paths and web services operated according to configuration during the testing period. CPU usage was recorded at approximately 6.2%, with the system idle 93.8% of the time. RAM usage was around 282 MiB with approximately1.5 GiB of available memory, while root storage usage stood at 5.6 GB out of 20 GB (approximately 30%). The virtual machine maintained an uptime of over three weeks without restarting during the observation period. Ten response time tests yielded a minimum of 0.103 seconds, a maximum of 0.118 seconds, and an average of 0.108 seconds, with all requests returning an HTTP 200 status.

Parameter	Results
Connectivity	Packet loss 0%
Web access	Local and public HTTP 200
CPU	Used ±6.2%; idle ±93.8%
RAM	282 MiB used; ±1.5 GiB available
Storage root	5.6 GB of 20 GB; ±30%
Uptime	More than 3 weeks
Response time	Min. 0.103 s; max. 0.118 s; average 0.108 s
Main function	Public, admin, and mobile websites successfully completed.

Table 2. Summary of Infrastructure Testing Results
Source: Research findings (2026)

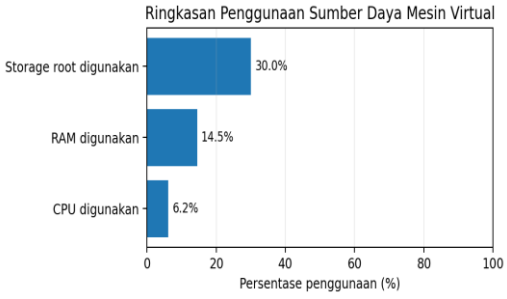


Figure 2. Virtual Machine Resource Usage Summary
Source: Research data processing results (2026)

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3.1.3. Infrastructure Performance Evaluation

Evaluation results indicate that the Prox mox VE-based server infrastructure can support the NASPCI information service under normal testing conditions. Local connectivity with no packet loss, an HTTP 200 status, and relatively consistent response times demonstrate that the service was accessible and responsive during testing. CPU, RAM, and storage availability further indicate that the virtual machine configuration retained sufficient resource headroom for the observed service load. An uptime of over three weeks demonstrates operational continuity during the observation period, though this cannot be considered a measure of long-term high availability. The study did not include load testing, concurrent multi-user testing, penetration testing, or failover testing. Consequently, performance results are limited to normal operating conditions and cannot be used to determine the server's maximum capacity.

3.2. Discussion

3.2.1.Pieces Evaluation

The PIECES evaluation compares the previous shared hosting setup with the standalone server across six aspects. Regarding Performance, the standalone server can be monitored directly via Proxmox VE and the operating system, allowing for the measurement of connec tivity, resources, uptime, and response time. Regarding Information, content such as profiles, news, activities, galleries, documents, and other information can still be displayed and managed through the administrator page. Regarding Economy, the shared hosting subscription fee of IDR 1,680,000 per year is eliminated since a physical server is already available; however, NASPCI still incurs costs for the domain, electricity, hardware maintenance, and management. Regarding Control, the management of Proxmox VE, virtual machines, Nginx, MariaDB, applications, and Cloudflare Tunnel can be handled internally, thereby enhancing adminis trative control. Regarding Efficiency, virtual machine resource allocation can be monitored and adjusted, while regarding Service, the website remains available via HTTPS and accessible through computers, mobile devices, and the administrator page. The PIECES framework is employed to provide structured evaluation, consistent with previous research.

Aspek	Evaluation Results
Performance	Server performance can be measured directly: 0% packet loss, HTTP 200, and an average response time of 0.108 seconds.
Information	NASPCI information remains available and can be managed via the administrator page.
Economy	Annual shared hosting costs are eliminated; costs for the domain, electricity, maintenance, and management remain.
Control	Control over hypervisors, VMs, web servers, databases, applications, and tunnels is enhanced..
Efficiency	Virtual machine resources can be monitored and adjusted according to needs.
Service	The public website, administrator interface, HTTPS, and mobile device access are functioning properly.

Table 3. Summary of PIECES Evaluation Source Research evaluation results (2026

3.2.2. Contribution and Comparison with Previous Research

The research results reinforce the finding that Proxmox VE can serve as a virtuali zation platform for managing servers and virtual machines. Unlike previous studies, this research goes beyond merely discussing hypervisor performance or virtualization readiness; it involves deplo ying a production server to host the NASPCI website and migrating service functions from shared hosting to an internal server. The Network Development Life Cycle (NDLC) methodology was appliedspanning from requirements analysis to monitoring and management consistent with standard network infrastructure development approaches. The study's primary contri bution lies in the integration of Proxmox VE, Ubuntu Server, Nginx, MariaDB, Codel gniter 3, GitHub, a domain, and Cloudflare Tunnel into a unified, self-managed infra structure, which was tested against tech nical parameters and evaluated using the PIECES framework. This approach provides empirical evidence of the imple mentation while illustrating the benefits and implica tions of self managed server administration for a non-profit organization. Consequently, the research yields not only a design but also demonstrates public-facing and administrative services actively running on the new infrastructure.

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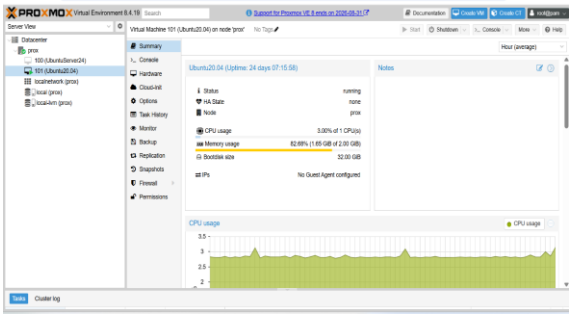


Figure 3. Status of the Ubuntu Server virtual machine on Proxmox VE. Source: Research documentation (2026)

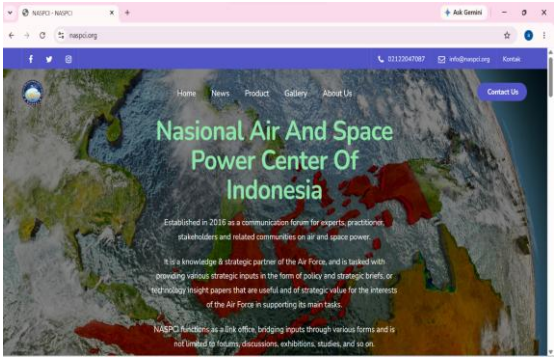


Figure 4. NASPCI website display on a standalone server. Source: Research documentation (2026)

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

- *The NASPCI infrastructure require ments were met by utilizing an in-house physical server running Proxmox VE and an Ubuntu Server virtual machine to host the production website.*

- *The infrastructure successfully integra ted Nginx, PHP, MariaDB, CodeIgniter 3, a private GitHub repository, the naspci. orgdomain, and Cloudflare Tun nel, enabling access to both public services and the administrator interface.*
- *Under normal testing conditions, connectivity showed 0% packet loss; web access returned HTTP 200 status codes with an average response time of 0.108 seconds; CPU usage was approximately 6.2%; available memory was around 1.5 GiB; root storage utiliza tion was about 30%;and uptime excee ded three weeks.*

- *A Pieces evaluation demonstrated improvements in administrative control, resource flexibility, manage ment efficiency, and service autono my compared to shared hosting, although costs for electricity, the domain, mainte nance, and manage ment still need to be taken into account.*

4.2. Recommendations

- *Cloudflare Tunnel needs to be configu red as a service to ensure it runs automatically whenever the server or virtual machine restarts.*

- *Backups for virtual machines, Proxmox VE snapshots, and Maria DB databases need to be scheduled and validated through recovery testing.*

- *Monitoring systems for CPU, RAM, storage, connectivity, uptime, and web site status need to be imple mented, complete with outage notifications.*

- *Future research should incorporate load testing, long-term monitoring, high avai lability, and specialized security testing to allow for a more comprehensive evaluation of service capacity and resilience.*

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