Building Infrastructure Virtualization Or Cloud Computing With Vmware

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Abstract *– The utilization of infrastructure virtualization technology through the Private Cloud Computing model has emerged as a strategic solution for organizations seeking to enhance the efficiency of Information Technology resource management. This study focuses on the design and implementation of a virtual infrastructure based on Private Cloud Computing using VMware vSphere, with a case study conducted at PT. Nashta Global Utama. The research process began with the identification of problems and an analysis of the company's requirements for efficient, flexible, and secure IT management. Based on this analysis, a Private Cloud Computing architecture was designed, encompassing Server virtualization, computing resource optimization, data storage management, system security, as well as infrastructure monitoring and administration. The implementation involved the installation of physical Servers, resource optimization, the creation and configuration of virtual machines, infrastructure monitoring, and comprehensive testing to ensure system performance and reliability. The findings demonstrate that this technology enables multiple operating systems and applications to run concurrently on a single physical Server, thereby improving hardware utilization, reducing downtime, and strengthening service availability. Consequently, the proposed solution provides significant added value for enterprises in adapting to the dynamic demands of technology-driven business environments.*

Keywords: *Building, Infrastructure, Virtualization, Cloud Computing, Vmare*

1. INTRODUCTION

The rapid development of information technology demands organizations to have efficient, flexible, resilient, and easily manageable infrastructure innovations. Currently, PT. Nashta Global Utama is still using a physical server-based system (bare-metal) that causes various issues, such as suboptimal resource utilization because one application runs on one physical server (bare-metal), and the increasing number of applications leading to high hardware procurement costs. Slow capacity provisioning and service disruption due to the need for system shutdown. And the current infrastructure does not yet support balanced workloads (Distributed Resource Scheduler) and high service availability (High Availability), thereby increasing the risk of service disruptions that can hinder business operations..[1]

In the conventional model used by PT. Nashta Global Utama, each application runs on a single physical server. Therefore, when capacity increases, the company must add new devices. This process not only incurs service downtime but also increases investment and maintenance costs. Moreover, a failure in one server can cause downtime that affects service continuity. The limitations in scalability and the absence of a centralized monitoring system further worsen the effectiveness of infrastructure management.[2]

To address this issue, the implementation of Private Cloud-based infrastructure virtualization has become an urgent solution. This technology enables the consolidation of bare-metal physical servers into virtual machines, thereby optimizing resource utilization, reducing operational costs, increasing flexibility, evenly distributing the load across servers (Distributed Resource Scheduler), supporting continuous service availability (High Availability), and providing real-time visibility and monitoring of IT infrastructure. VMware vSphere, as a leading Private Cloud Computing virtualization platform, offers features such as Distributed Resource Scheduler, High Availability, vMotion, and centralized management and monitoring thru vCenter, which can minimize Downtime, enhance service resilience, and improve system security.[3]

By building a Private Cloud using VMware, PT. Nashta Global Utama can meet the needs of adaptive, secure, and cost-effective IT infrastructure. This implementation is expected to support business growth, improve operational efficiency, enhance flexibility, increase service resilience, and provide full visibility and control over managed data and systems.[4]

PT. Nashta Global Utama is one of the IT Consulting Companies that was newly established in 2017. Located at Jl. Pramuka Raya, Mampang, Pancoran Mas District, Depok City, West Java 16433. In its operations, PT. Nashta Global Utama requires a Virtual Machine, which is a service feature of VMware vSphere, Cloud Computing with a Private Cloud Model. This Virtual Machine will support laboratories, applications, and independently managed data, thereby enhancing the security of these applications and data. Therefore, PT. Nashta Global Utama must build an efficient infrastructure for the company. VMware vSphere Private Cloud enables the company to more easily meet these compliance requirements by providing full control over their data and infrastructure, as well as security features that comply with regulatory standards.[5]

To build a Cloud Computing system with a Private Cloud model, the researchers used the R&D research method, which stands for Research and Development. The Research and Development method means that it is conducted to test a problem by applying a certain theory so that the results obtained align with the analyzed problem and the theory used. The Research and Development research method consists of 6 stages: Analysis, Data Collection, Design, Implementation, Testing, and Production.[6]

2. RELATED RESEARCH

Virtualization technology has been extensively researched and implemented previously, thus contributing to the support of this study. One of them is the research by (Handhoko, F. David 2020) titled "Design and Implementation with Virtualization Technology Using VMware vSphere (Case Study: FTI UKSW)." This research discusses the important role of information and communication technology in educational institutions and aims to design virtualization using Server Virtualization Technology in the Faculty of Information Technology and build a Server infrastructure that optimizes resource usage, facilitates maintenance, and saves costs on purchasing physical Server computers.[7]

The research conducted by (Khasanah & Kuryanti, 2019) titled "Server Virtualization Design Using VMware vSphere" highlights the strategic role of information and communication technology in supporting the operations of financial institutions with a large number of customers and employes. In this study, the application of virtualization technology and Private Cloud is discussed as a solution to improve system efficiency. The main objective of using server virtualization is to reduce hardware procurement costs and improve system performance. This technology enables the creation of a virtual environment where various applications or server services can run simultaneously on a single physical device, as if each were running on separate servers.[8]

The research conducted by (Dammara A, Adam I, Pranata M., 2023) titled "Analysis of Server Virtualization Performance Comparison Using Proxmox and VMware ESXi (Case Study: Server Virtualization for Moodle Usage) focuses on the utilization of Virtualization Technology, particularly the efficiency of physical devices for e-learning platforms such as Moodle. Moodle itself is a web-based online learning system that allows learning activities to be conducted online thru a browser. In its implementation, the choice of hypervisor greatly affects system performance. Proxmox VE and VMware ESXi are two examples of hypervisors that are frequently used. Based on the research results, Proxmox shows superiority in CPU load management and memory speed, while VMware ESXi excels in Moodle performance according to benchmark results. Therefore, understanding the characteristics and performance of each hypervisor is crucial to determine the most suitable virtualization solution for the needs of the e-learning system.*[9]*

Penelitian oleh (Gede Putu. dkk, 2015) Yang berjudul "Implementasi *Private Cloud Computing* Sebagai Layanan *Infrastructure As A Service* (*IAAS*) Menggunakan *OpenStack*" Penelitian ini berfokus pada Pemanfaatan Model Komputasi yaitu *Cloud Computing* dengan model layanan *Infrastructure As A Service* (*IAAS*) dengan menggunakan model komputasi Cloud Computing tersebut terbukti dapat meningkatkan efisiensi biaya karena tidak perlu membeli perangkat fisik seperti *Server*, *Storage*, dan *perangkat keras Network*. Serta menghemat biaya Listrik dan juga fleksibilitas tinggi karena akses sumber daya dari mana saja melalui *internet* serta mendukung kerja jarak jauh dan kolaborasi tim secara *real-time*. *Web Server* dengan *OpenStack* pun berhasil berjalan dengan Optimal pada Infrastruktur *Cloud Computing.[10]*

Research by (Gede Putu et al., 2015) titled "Implementation of Private Cloud Computing as an Infrastructure As A Service (IAAS) Using OpenStack" focuses on the utilization of the Cloud Computing model with the Infrastructure As A Service (IAAS) service model. This Cloud Computing model has been proven to increase cost efficiency because there is no need to purchase physical devices such as Servers, Storage, and Network hardware. It also saves electricity costs and provides high flexibility due to resource access from anywhere via the internet, supporting remote work and real-time team collaboration. The Web Server with OpenStack also successfully runs optimally on the Cloud Computing Infrastructure.[11]

Based on various previous studies, it can be concluded that the use of baremetal servers without virtualization technology has a major drawback in cost and resource inefficiency, where a single physical device can only run one service, leading to wasteful spending on hardware procurement, space, and electricity consumption. Additionally, traditional physical servers have a high risk of downtime due to the absence of High Availability and automatic Failover features, are difficult to maintain quickly, and are less flexible in handling user traffic spikes compared to VMware-based or Cloud Computing infrastructure, which is more adaptive and optimal.[12]

3. RESEARCH METHOD

Research methodology serves as a systematic framework designed to facilitate research in realizing and ensuring that research objectives can be achieved optimally. In conducting this research, the methodology applied includes information collection procedures and system development methods.

a. Data Collection Method

The information collection stage begins with a literature study, namely: Library Study. This study is conducted by exploring various literatures, such as scientific journals, textbooks, and official technical documentation related to virtualization technology. Additionally, related previous research is also reviewed to strengthen the theoretical foundation and serve as a comparative parameter during the system development phase. Observation, Observation was conducted by preparing and distributing surveys to relevant parties, such as System Administrators, Application Teams, and IT managers. This survey aims to obtain quantitative data regarding perceptions, needs, and preferences related to the implementation of Private Cloud. Interviews, the interview method was carried out with IT experts, System Administrators, and professionals with experience in implementing Private Cloud using VMware vSphere. These interviews aim to gain direct understanding of existing issues, challenges, strategies applied in the implementation process, and to determine the appropriate system requirements..[13]

b. System Development Method

This system development method is carried out using the Research and Development (R&D) method as the basis in the system development process. Research and Development (R&D) was chosen because of the systematic approach used in this research to design and develop technological solutions that meet the organization's needs. This method combines the scientific research process with system engineering stages to produce a product or system that can be tested and implemented in reality. The development process in the Research and Development (R&D) method is carried out thru several stages, namely:

1. Analysis Stage Identifying problems in the conventional system and formulating the needs for a new system that is more efficient, flexible, and secure.
2. Data Collection Stage Gathering technical information related to hardware, software, and network structure that will be used as the basis for system design.
3. Design Stage Developing the architecture design of the virtualization system, including network topology, device mapping, and logical configuration of VMware vSphere.
4. Implementation Stage Installing and configuring the virtualization system in the company's operational environment, as well as integrating infrastructure components.
5. Testing Stage Evaluating system performance thru functionality, integration, and performance testing to ensure the system operates according to specifications.
6. Production Stage (not fully implemented in this research) This is the final stage, which involves the comprehensive implementation of the system in the company's production environment. [14]

4. RESULT AND DISCUSSION

Before the implementation of virtualization infrastructure or Private Cloud Computing with VMware vSphere, PT. Nashta Global Utama relied on a Bare-metal Server-based system with the Red Hat Linux operating system. This server was used to run various applications and services that support the company's activities. Illustration of the Bare-metal Server concept can be seen in the image below.
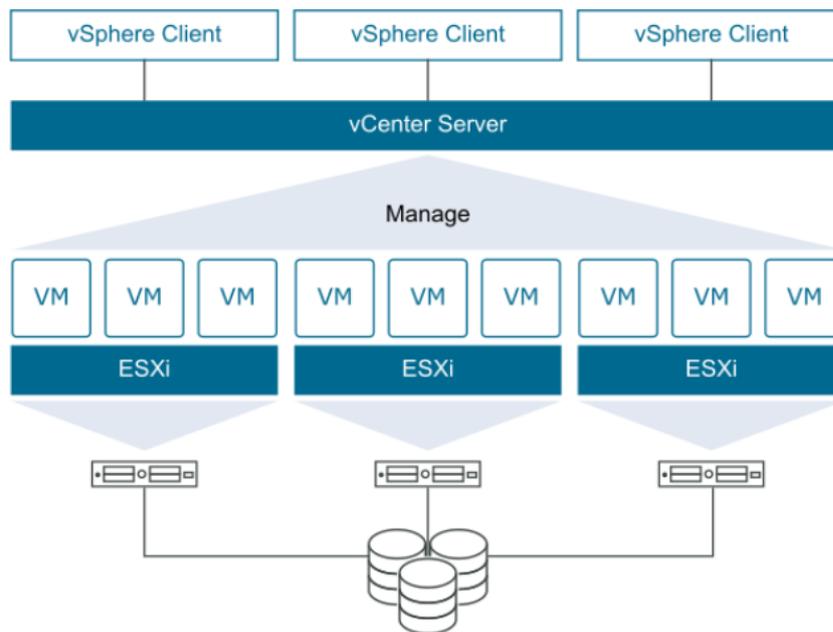
Figure 1 Conventional vs Virtualization

Figure 2 Proposed Topology

With the implementation of Cloud Computing infrastructure virtualization modeled as a Private Cloud using VMware vSphere, PT. Nashta Global Utama can overcome challenges related to scalability and efficiency in utilizing computing resources. This technology allows a single physical server to run various operating systems and applications simultaneously, eliminating the need to purchase new servers for each additional system or application. This provides advantages in the form of cost savings on investment and hardware maintenance.[15]

Based on the research results and the implementation of Cloud Computing infrastructure virtualization modeled as a Private Cloud with VMware vSphere at PT. Nashta Global Utama, the achieved results can be described as follows:

a. Increased Resource Efficiency Thru the application of virtualization technology, PT. Nashta Global Utama successfully reduced the costs of procuring physical servers. Previously, five production applications could only be run on five physical servers because each application required a separate operating system. After implementing the Private Cloud VMware vSphere infrastructure virtualization, with five physical servers, the company is now able to operate 103 virtual machines supporting various applications. This resulted in savings of up to 97.1% on the purchase of physical servers. Additionally, the utilization of computing resources became much more optimal. If previously the

utilization of physical servers was only around 8–15% of capacity, now the utilization rate has increased to 90% thanks to virtualization.
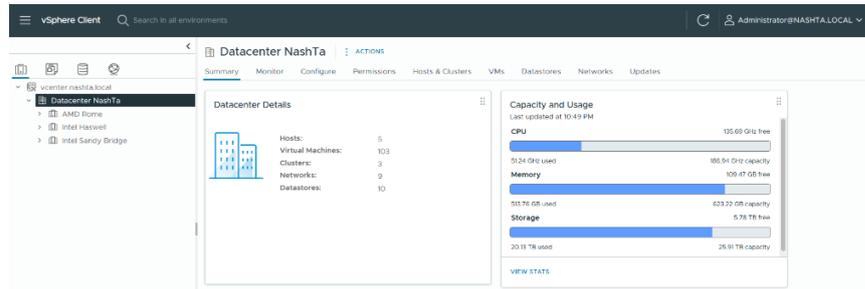

Figure 3 Implementation Results including Total Host Server, Cluster & Virtual Machines

b.Improvement of Infrastructure Flexibility and Scalability 1. The implementation of VMware vSphere Private Cloud infrastructure virtualization technology provides PT. Nashta Global Utama with the capability to adjust the company's IT infrastructure capacity. Horizontal and vertical scalability can be achieved quickly, allowing the IT team to respond to service requests efficiently without disrupting ongoing operations. The process of adding or reducing capacity is now faster and more efficient. Previously, capacity expansion that used to take up to a week for the procurement and configuration of physical servers can now be done in just a matter of minutes by adding new virtual machines.
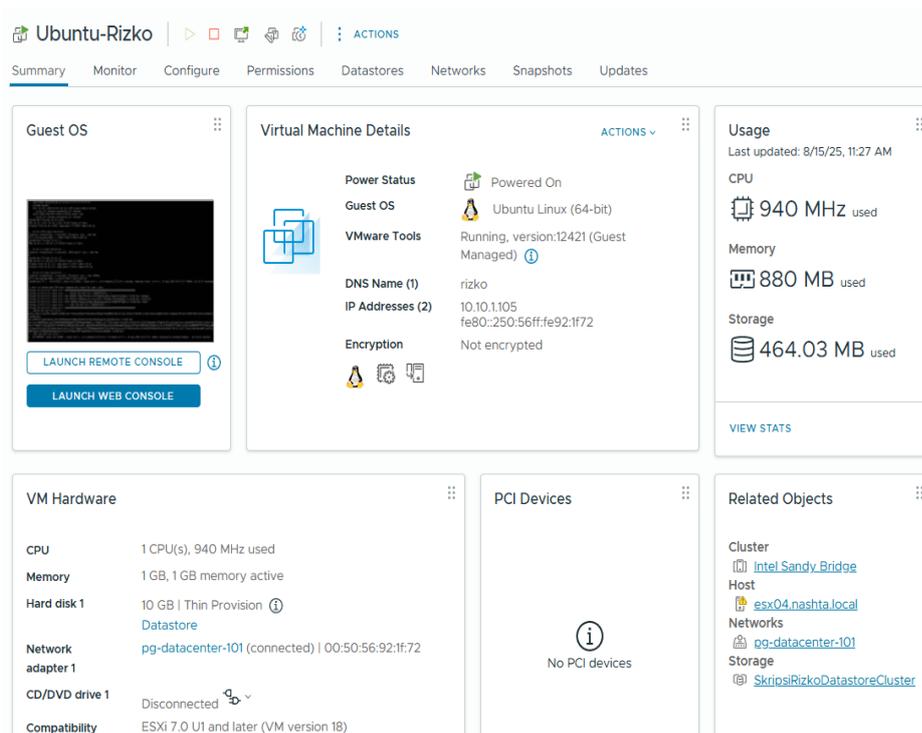
Figure 4 Virtual Machine Summary

c.Improvement of Business Continuity (Distributed Resource Scheduler) and High Availability (HA) with Distributed Resource Scheduler (DRS) and High Availability (HA) features as well as VMotion from VMware vSphere, PT. Nashta Global Utama is able to minimize downtime due to hardware failures. For example, if one of the physical servers fails, the VMs running on it can automatically migrate to another server without disrupting the ongoing services.
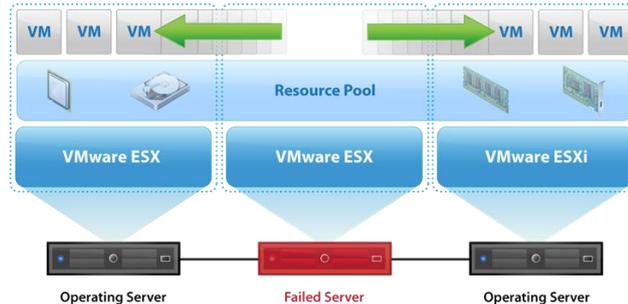
Figure 5 High Availability (Automation Migrate VMs)

Figure 6 Usage Host Server Before DRS Feature Activation

Figure 7 Activation of the Distributed Resource Scheduler Feature

Figure 8 Usage Host Server after activating the DRS feature

d.Security and Performance Monitoring System security is enhanced thru the implementation of network segmentation using VLAN port groups, centralized logging, role-based access control, and real-time system activity monitoring. Monitoring is conducted using VMware vCenter, which allows administrators to centrally monitor the performance, capacity, and status of each infrastructure component, as well as an automatic alarm

system that detects anomalies in the system, devices, network, virtual machines, and every infrastructure component.
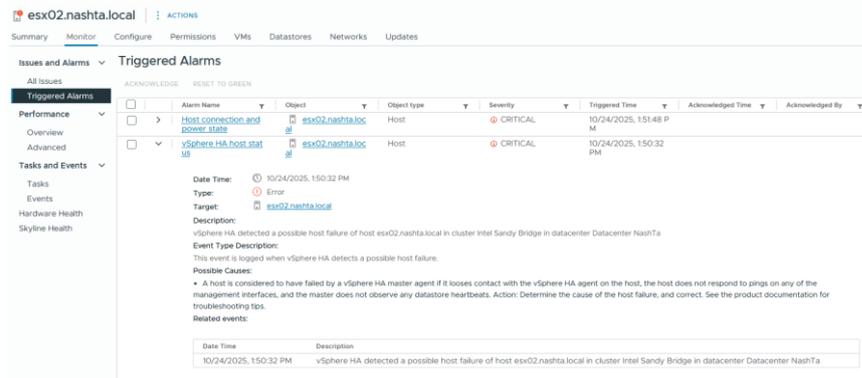

Figure 9 Monitoring dashboard Alert & Security

Figure 10 Monitoring Performance Overview

e. Impact and Savings Analysis The implementation of Private Cloud infrastructure virtualization has a significant impact on operational cost efficiency and hardware investment. Consolidating physical servers into a virtual cluster reduces space requirements, electricity consumption, and cooling costs. Additionally, the much faster VM provisioning time boosts the productivity of the IT team.
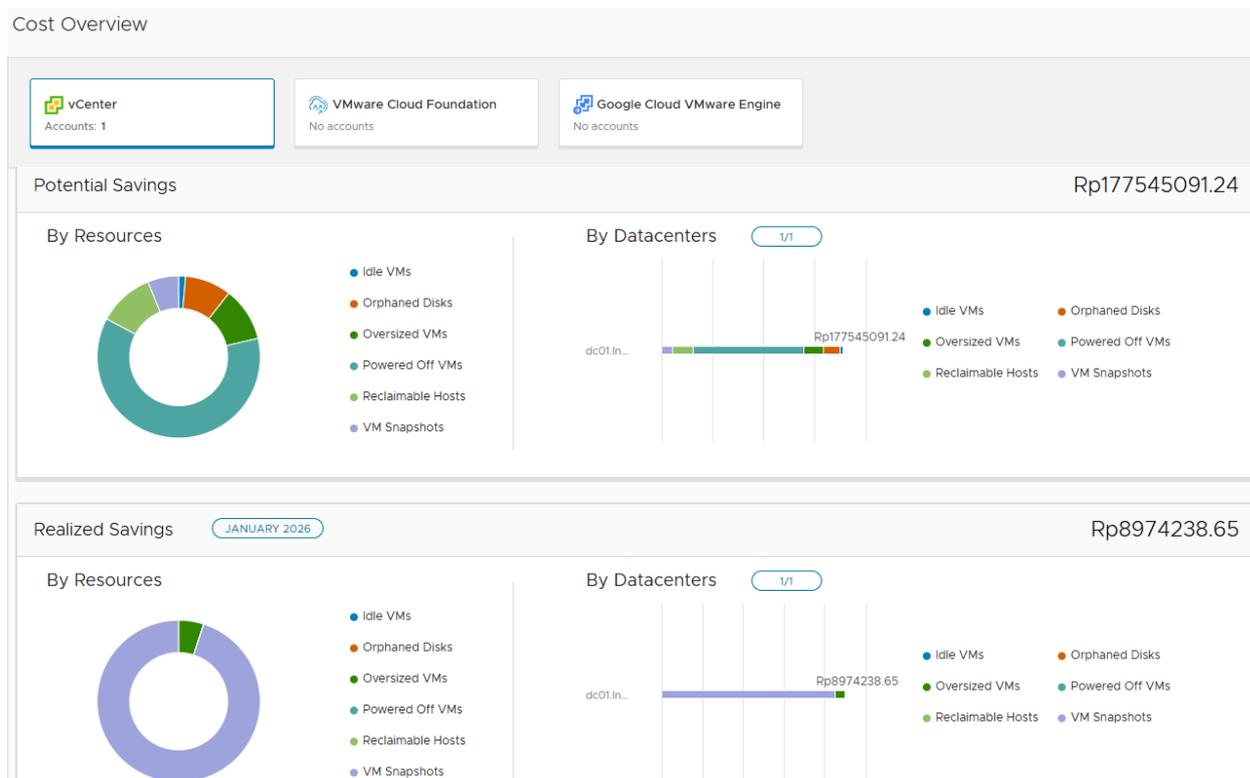
Figure 11 Cost & Savings Summary with and without VMware virtualization

5. CONCLUSION

With the presence of infrastructure virtualization technology using the Private Cloud model, PT. Nashta Global Utama achieves a drastic efficiency in resource utilization, consolidating physical servers into more numerous and optimal virtual machines capable of running various different applications without the need for additional physical servers. VMware vSphere helps PT. Nashta Global Utama to manage and provide comprehensive security for the system and infrastructure components using VMware vCenter Server. Additionally, with the VMware vSphere virtualization infrastructure technology that features high availability (High Availability) and VMotion support, PT. Nashta Global Utama can minimize service downtime or downtime due to hardware failures. If a physical server fails, the Virtual Machines running on it can automatically migrate to another server host without disrupting or stopping the ongoing operational services.

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