Comparative Study: Open-Source Cloud Computing Performance for Small Business with ISO/IEC 25010:2011

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Abstrak

Abstrak. Transformasi Industri 4.0 telah mengubah seluruh strategi pengembangan bisnis yang dulunya tradisional menjadi digitalisasi dengan menggunakan berbagai jenis teknologi seperti cloud computing. Selain itu, perkembangan sistem informasi menuju era yang terus maju dalam ekosistem society 5.0 menciptakan mobilitas bisnis yang lincah menjadi pola bisnis yang disruptif yang harus diakhiri oleh perusahaan agar dapat bertahan. Untuk meningkatkan efisiensi proses operasional UKM, digitalisasi proses bisnis dan penerapan komputasi awan merupakan jalan keluar dari keterbelakangan teknologi. Pada penelitian ini penulis melakukan uji komparatif pada dua open source cloud computing yaitu OpenNebula dan OpenStack, dan diuji secara komparatif menggunakan stress testing dengan benchmark Apache dan standarisasi ISO/IEC 25010:2011 yang bertujuan untuk memenuhi kebutuhan bisnis UKM dan keunggulan kompetitif.

Kata Kunci : ***Cloud Computing*****, OpenNebula, OpenStack, SMEs, ISO 25010:2011**

Abstract

Abstract. Industry 4.0 transformation has changed all business development strategies that were once traditional to digitalization using various types of technology such as cloud computing. In addition, the development of information systems towards an era that continues to advance in the society 5.0 ecosystem creates agile business mobility into a disruptive business pattern that must be ended by companies to survive. To improve the efficiency of SMEs' operational processes, digitizing business processes and implementing cloud computing is a way out of technological backwardness. In this study, the authors conducted a comparative test on two open source cloud computing, namely OpenNebula and OpenStack, and tested comparatively using stress testing with the Apache benchmark and ISO/IEC 25010:2011 standardization which aims to meet the business needs of SMEs and competitive advantage.

Keywords: **Cloud Computing, OpenNebula, OpenStack, SMEs, ISO 25010:2011**

1. Introduction

Technological developments in the information system sector, both enterprise-scale companies to SMEs are continuing to develop with the times of the industrial revolution 4.0 [1]. Digitizing business processes and integrated systems such as the Internet of things, artificial intelligence, cloud computing to big data analytics, has become the objective of business developers to compete in the business environment of the era of disruption. The need for digital technology and the high percentage of SMEs contribution to the world economy, especially developing countries, which account for 80-90% of state revenue, force SMEs to increase their competitive advantage and with each other, thus not be eroded by larger companies [2]. As SMEs tend to be vulnerable to post-Covid economic problems, an agile, responsive, and efficient transformation is a mandatory change to replace traditional forms of business processes and management with automated computing systems. One of the functions that SMEs need most in digitization is cloud computing and database technology [3]. In terms of the advantages of cloud computing, SMEs do not need to provide a lot of infrastructure such as data centers, processing power, storage to desktop applications and so on, to cut IT operational costs in digital systems. With the support of multiple core processors, especially on servers, it can be used to run applications and services simultaneously using virtualization machines on server instances. In this study, a comparative analysis was conducted between two cloud computing, namely OpenNebula and

OpenStack to determine the type of cloud computing that is good and suitable for the development of SME systems [4].

2. Literature Review

A. Cloud Computing

OpenNebula is one of the PaaS cloud computing developed by OpenNebula System. OpenNebula is open source and commonly used for data center virtualization [8]. OpenNebula offers simplicity in providing a complete solution for creating and managing data center virtualization at the enterprise level. OpenNebula makes it easy to manage and deploy cloud computing as a cloud service, such as AWS and Google cloud. OpenNebula installation is relatively easy because open source with complete repository [9]. OpenNebula is also a DevOps utility that can speed up the development stage. Designed for diverse environments, components and interfaces are uniform with today's data center conditions.

B. Cloud Computing Characteristics

Figure 1. Cloud Computing Characteristics

Based to figure 1 above, there are 5 cloud computing characteristics that indicate a system is categorized as cloud computing according to NIST. The analysis of system characteristics made in this study can be seen as follows [7], [8]:

1. On-Demand self-services
   This means that users can order and manage services without human interaction with the service provider, for example by using a web portal and a management interface. Procurement and provision of services and associated resources occurs automatically at the provider.
2. Broad Network Access
   Broad network access is a service that is available that can be accessed widely with various platforms, especially those that can be adequately accessed via the internet, either using thin clients, thick clients, or other media such as smartphones. This cloud server is built on a web-based basis, where a system built on the web is a system that can be accessed widely and of course multi-platform.
3. Resource Pooling
   Cloud service providers, providing services through resources grouped in one or various data center locations consisting of several servers with a multi-tenant mechanism.
4. Rapid elasticity
   The advantage of cloud computing that is very important is the ability to elasticity. Elasticity means that the Cloud system can be downgraded or increased in function and size according to the needs of the user. This can increase the efficiency and effectiveness of resources in the cloud.
5. Measured service
   Measured Service means that the Cloud Computing system can automatically control and optimize existing resources by controlling the type of service being used.

C. OpenNebula

OpenNebula is one of the PaaS cloud computing developed by OpenNebula System. OpenNebula is open source and commonly used for data center virtualization [8]. OpenNebula offers simplicity in providing a complete

solution for creating and managing data center virtualization at the enterprise level. OpenNebula makes it easy to manage and deploy cloud computing as a cloud service, such as AWS and Google cloud. OpenNebula installation is relatively easy because open source with complete repository [9]. OpenNebula is also a DevOps utility that can speed up the development stage. Designed for diverse environments, components and interfaces are uniform with today's data center conditions.

D. Openstack

OpenStack is an opensource distributed software system that implements the cloud as a service (PaaS) platform, developed by RedHat Platform [5]. OpenStack makes cloud applications easy to use and scales over different cloud fabrics, implementing a suite of APIs and architectures that also make applications portable across the services they use [10]. OpenStack is a Google App Engine (GAE) compatible API and thus executes GAE applications on premises or via other cloud infrastructure, without modification. The core components of OpenStack are Keystone, Nova, Glance and Neutron. Keystone is a core component of OpenStack for identity authentication and authorization.

3. Methodology [10 pts/Bold]

For server implementation, OpenNebula and OpenStack were built as private servers, with the aim of virtualizing the IT platform according to the needs of the SME business. The system is stress tested to handle users around 100 users, which will be proven in the research discussion. Both the timing of the system request and the capacity will be compared using the Apache benchmarking configuration based on the ISO 25010: 2011 standard, especially on the system reliability characteristics. [11]

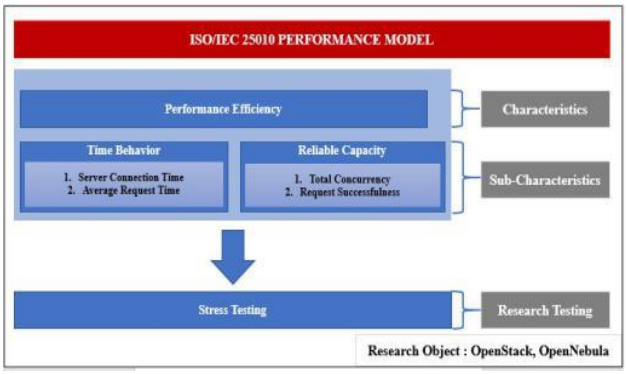

Figure 2. ISO 25010:2011 Performance Efficiency

Performance assessment divided into two sub-characters, which are time behaviour and capacity. The time behaviour represents the aspects that need to be considered as server speed connection and request time [12]. While in the capacity, represent the total request that is successfully done. For the scenarios and system requirement of the test that according to the number of requests and concurrency, based on the scope of the SME business need that can be seen from table 1 below:

Table 1. Testing Scenario

No	Business Scope	Concurrency (-c)	Number of Requests (-m/-n)
1	Small and Medium Enterprises (SMEs)	100	250
2			350
3			500

Table 2. Testing Scenario

No	Server Softwarwe	Port	Internet Speed
1	Apache 2.4.41 (OpenStack) Thin (OpenNebula)	80 (OpenStack) 9869 (Open Nebula)	9.2Mbps
2			
3			

Table 3. System Requirement

No	System Requirement		
	Specification	ON	OS
1	Hardisk	20 GB	20 GB
2	Memory	4 GB	6 GB or higher
3	Operating System	OpenNebula 5.12	OpenStack
4	NIC	2	2
5	Processor	1 (2core)	1 (2core)

4. Result And Discussion [10 pts/Bold]

1. Cloud Interface

Based to Figure 3, the main features of both cloud computing console and configuration like dashboard, and settings. The use of cloud-based IT infrastructure by utilizing adaptive virtualization machine can be used for various types of business needs such us servers, databases

and so on. In this research OpenNebula and OpenStack use Ubuntu 18.04 LTS as host operating system and used to install any type of software application that needed for the business.

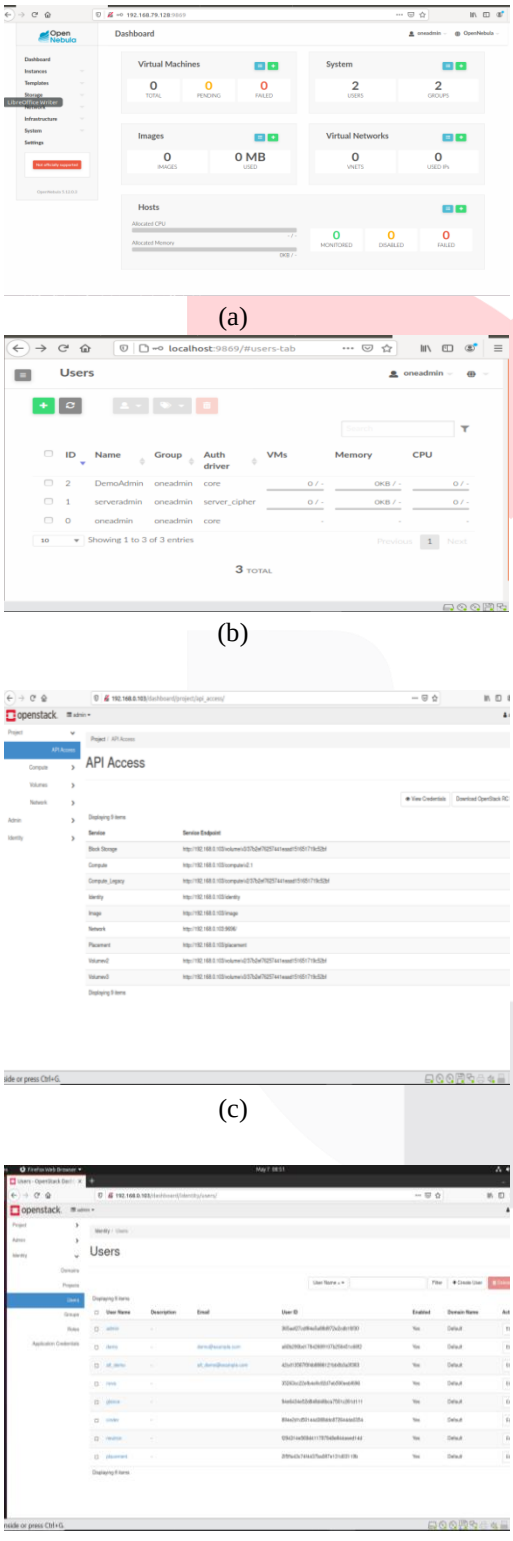

Figure 3. Interfaces in OpenNebula (a, b) & OpenStack (c, d)

2. Time Behaviour Result

Research on stress testing based on-time behaviour sub-characteristics describes the performance level of virtual cloud computing servers made by OpenNebula (ON) and OpenStack (OS). As stress testing parameters, both cloud computing is suitable for assessing system time behavior and reliable capacity with ISO 25020:2011 and are grouped as follows in Table 3:

Table 3. Time Behavior Parameter

No	Indicator	Criteria
1	The average time (mean) to process input more than 4000 milliseconds (>4 second)	Very Slow
2	The average time (mean) to process input max 4000 milliseconds (4 second)	Slow
3	The average time (mean) to process input max 3000 milliseconds (3 second)	Fair
4	The average time (mean) to process input max 2000 milliseconds (2 second)	Good
5	The average time (mean) to process input max 1000 milliseconds (1 second)	Optimal

The following are the results of stress testing using the apache benchmark service with a concurrency of 100 and the number of requests in a row (250/350/500). More detailed results can be seen in the table below:

Table 4. Result of Stress Testing in Time Behaviour (in detail)

No	Concurrency/Number of Request	Time Type	Minimal Time (ON/OS)	Mean Time (ON/OS)	Maximum Time (ON/OS)	Criteria
1	100/250	Connect	2/5	24/25	51/55	Optimal
		Processing	44/10	150/38	233/69	
		Waiting	41/3	144/32	220/63	
		Total	67/36	174/63	270/87	
2	100/350	Connecting	2/2	11/24	22/51	Optimal
		Processing	92/44	176/150	276/233	
		Waiting	65/41	165/144	252/220	
		Total	98/67	186/174	297/270	
3	100/500	Connecting	1/2	11/57	101/264	Optimal
		Processing	32/40	313/109	637/631	
		Waiting	31/39	303/206	629/625	
		Total	46/48	324/266	645/677	

Based on the test results which can be seen from table 4 above, it can be concluded that both OpenNebula (ON) and OpenStack (OS) achieve the “Optimal” results in the assessment of time behavior sub-characteristics. When compared, Openstack has a slight advantage in the average

(mean time) speed of service for each processed request.

3. Reliable Capacity Result

In assessing reliable capacity, stress testing aims to review how much resistance the system has in operating the requests entered by the user. In this test, failed requests and requests per second are examined more deeply, and are classified according to the criteria in the table below:

Table 5. Reliable Capacity Parameter

No	**Indicator**	**Criteria**
1	Failed Request = 0	Optimal
2	Failed Request < 5%	Good
3	Failed Request 5-10%	Fair
4	Failed Request >10%	Poor

The following are the results of stress testing using the apache benchmark service with a concurrency of 100 and the number of requests in a row (250/350/500) for the reliable capacity subcharacteristics. More detailed results can be seen in the table below:

Table 6. Result of Stress Testing in Capacity (in detail)

No	**Criteria (-c/-m)**	**Failed Request**	
		ON	**OS**
1	100/250	0	0
2	100/350	0	0
3	100/500	0	0

In the reliable capacity assessment, the stress test with the number of requests respectively 250/350/500 in a row and concurrency of 100, resulting in no failed requests (failed requests = 0), indicating the system is running optimally. But, in the requests per second section, Openstack has advantages, especially in processing requests faster than OpenNebula. In addition, openstack also has relatively high stability compared to OpenNebula which experienced a significant decrease in speed when handling more requests.

5. CONCLUSION

The conclusion from the research results of comparative study on both cloud computing for SME business based on ISO 25010: 2011 standardization is:

1. Openstack has a higher request processing speed than OpenNebula, it can be seen from the reliable capacity test where OpenStack can process more requests per second with lower time connection.
2. Although the speed that Openstack is greater, the weakness of Openstack is that the system requirements consume more RAM than OpenNebula in Installation.
3. Further research or measurement tools are needed regarding more detailed factors such as using Jmeter to get better results.

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