INFORMATION TECHNOLOGY SERVICE MANAGEMENT WITH CLOUD COMPUTING APPROACH TO IMPROVE ADMINISTRATION SYSTEM AND ONLINE LEARNING PERFORMANCE

Wilianto
Information Technology Study Program
Information Management and Computer College
Institute of Business Development Indonesia
Medan 20114, Indonesia
Email: wiliantogan@yahoo.com

Iskandar Fitri
Telecommunication Engineering
Faculty of Information and Communication Tech.
National University
Jakarta 12520, Indonesia
Email: tektel@yahoo.com

***Abstract*—This work discusses the development of information technology service management using cloud computing approach to improve the performance of administration system and online learning at STMIK IBBI Medan, Indonesia. The network topology is modeled and simulated for system administration and online learning. The same network topology is developed in cloud computing using Amazon AWS architecture. The model is designed and modeled using Riverbed Academic Edition Modeler to obtain values of the parameters: delay, load, CPU utilization, and throughput. The simulation results are the following. For network topology 1, without cloud computing, the average delay is 54 ms, load 110 000 bits/s, CPU utilization 1.1%, and throughput 440 bits/s. With cloud computing, the average delay is 45 ms, load 2 800 bits/s, CPU utilization 0.03%, and throughput 540 bits/s. For network topology 2, without cloud computing, the average delay is 39 ms, load 3 500 bits/s, CPU utilization 0.02%, and throughput database server 1 400 bits/s. With cloud computing, the average delay is 26 ms, load 5 400 bits/s, CPU utilization email server 0.0001%, FTP server 0.001%, HTTP server 0.0002%, throughput email server 85 bits/s, FTP server 100 bits/sec, and HTTP server 95 bits/s. Thus, the delay, the load, and the CPU utilization decrease; but, the throughput increases. Information technology service management with cloud computing approach has better performance.**

***Keywords*: Information technology service management; cloud computing; performance; Internet; Amazon AWS**

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I. INTRODUCTION

Cloud computing has a number of advantages in comparison to the traditional information technology (IT) infrastructure [1, 2]. It enables users or clients to rent and take benefits from the services with the infrastructure, platform, and software application management provided by the cloud computing vendors [3]. Cloud computing is a model enabled for ubiquitous (anywhere and anytime), cozy, on-demand network access to computing resources, which can be released and added quickly [4, 5]. The user does not need knowledge, expertise, or control over the cloud computing infrastructure [6]. Some major vendors are Salesforce.com, Amazon Web Services, Microsoft Azure, and Google Applications. The client can directly utilize the services without investing in expensive equipments and does not limited to the storage space. Cloud computing offers simplicity, flexibility, scalability, optimization, and efficiency of the IT infrastructure [7].

For the reasons, cloud computing has been widely utilized by businesses as well as education sector [8, 9], and it has become a major research field [10, 11]. For example, Ref. [12] has explored the use of cloud computing in education. The work asserted that cloud computing allowed us to regard online learning or e-learning as a form of services with huge data storage and high speed computing capability. Reference [13] showed that cloud computing has allowed health service administration to manage patient's data, disease, and patient treatments in the clinic at an affordable

cost. The system was a web-based system, which allowed access anytime, anywhere, and using any devices.

Information technology service management or relationship management is a study about client services in relation to an information technology infrastructure [14]. Information Technology Library (ITIL) provides the framework for the best practice in Information Technology Service Management (ITSM) [15]. Figure describes the ITIL framework. The framework consists of service strategy, service operation, service design, service transition and continuous process improvement.

Figure 2 shows the common description of a cloud computing services which consists of Infrastructure (IaaS), platform (PaaS), and Applications (SaaS). Figure 3 shows the service architecture of cloud computing. Figure 4 shows the non-exhaustive view of the main aspects forming cloud computing, which are types, models, locality, stakeholders, compare to, benefits, and features.

Cloud computing was initiated in 1960s by John McCarthy of MIT. By 2005, some big players (Amazon EC2 of Amazon.com, Google App Engine of Google, Blue Cloud Initiative of IBM) of cloud computing has emerged. Nowadays, PT Telkom Indonesia also offers SaaS and IaaS [6, 14].

Cloud computing infrastructure has five criteria: on demand self-service, broadband access network, resource pooling, elastic (rapid elasticity) and measured service [4].

Efficiency is very important for huge network size. Without this consideration, the network performance or service quality will be inefficient and slow [21]. Packet collision, bottleneck, and Trojan virus attach [22] are all factors that may slow down the quality of services. The quality of services can be measured with the following indicators. Bandwidth is the maximum speed of the data transfer and is measured in bits/s. Throughput is the actual data transfer rate. Latency is the delay

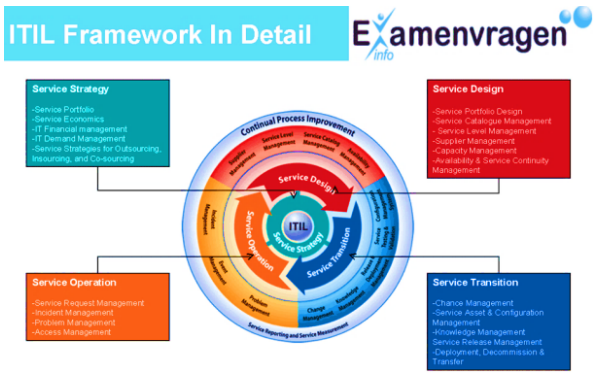

Fig. 1. The ITIL service cycle [16].

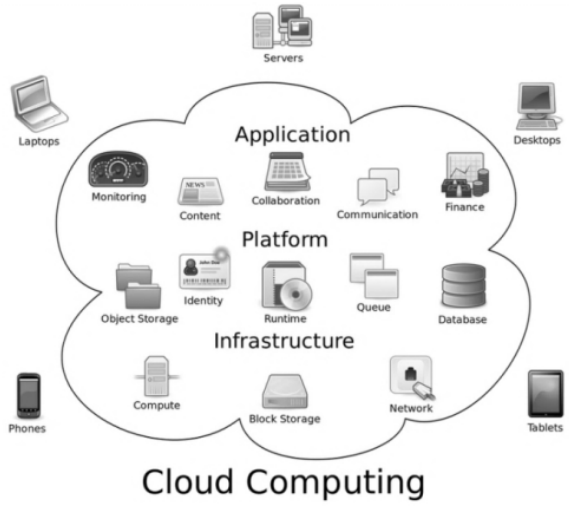

Fig. 2. Cloud computing common description [17].

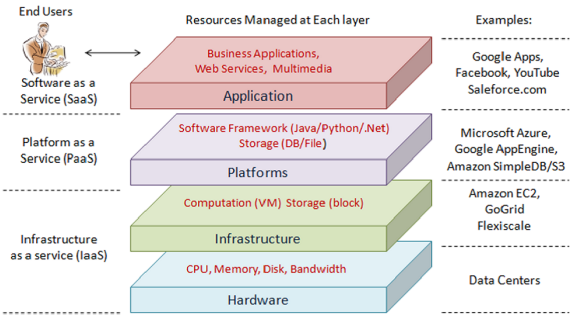

Fig. 3. Cloud computing service architecture [5, 18].

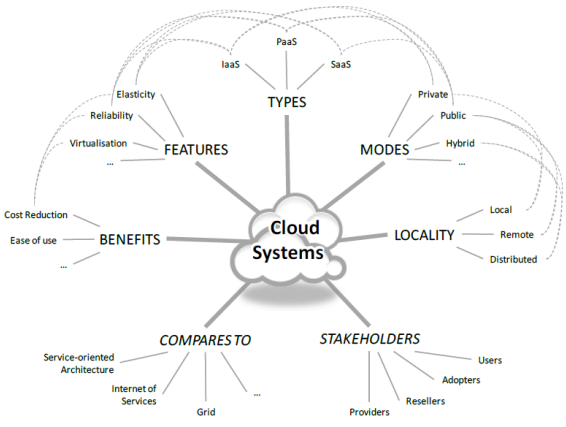

Fig. 4. Non-exhaustive view of main aspect forming cloud computing [19, 20].

between the sender and the recipient. Jitter measures the arrival time variation. And finally, bit error rate measures the number of corrupted bits in percentage of total transmitted data [23].

The current study was initiated by the problem faced by a college in Medan, Indonesia, so called STMIK IBBI. Initially, the college manages their needs of the information technology infrastructures by themselves. This approach leads to a high cost for maintenance and software licenses, physical space, and produces low service levels. The all aspects of the network performance are not satisfactory: longer delay, large network load, great CPU utilization, and small network throughput. This work intends to evaluate to which extent the improvement of the network performance can be made by implementing cloud computing [24].

The scopes of this work is limited by the following. The network will be simulated using the software of Riverbed Modeler Academic Edition 17.5. The network data are obtained by using the software of Wireshark version 1.12.7. The analyzed cloud computing is assumed to be configured according to Amazon Web Services.

II. METHODS

The research steps are shown in Fig. 5. The network performance before and after implementing cloud computing will be simulated using Riverbed Modeler Academic Edition [25]. For each model, the network performance will be measured. The required data are obtained from Wireshark software and also collected via interview and review of the existing network documentation.

III. RESULTS AND DISCUSSION

The two topologies of the evaluated networks are shown in Figs. 6 (Network 1) and 7 (Network 2). Network 2 is a large network, which details are described in Figs. 8–11.

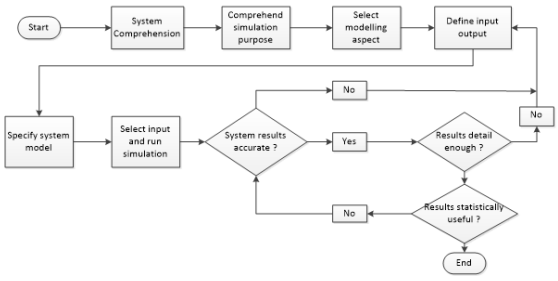

Fig. 5. The research procedure.

The topology of Network 1 with cloud computing integration is shown in Fig. 12. The size of the cloud computing IaaS selected from Amazon EC2 (Elastic Compute Cloud) is T2 instances with burstable performance instance, which provides a baseline level of CPU performance with the ability to rise above the

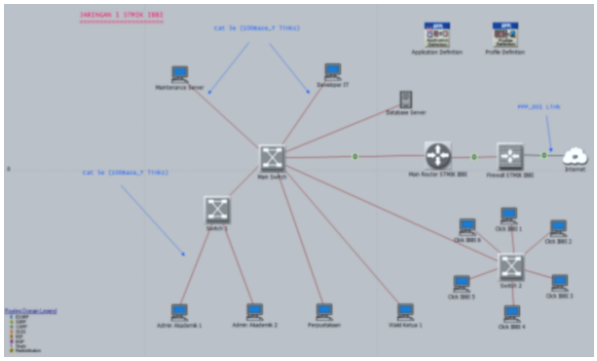

Fig. 6. The topology of the network 1.

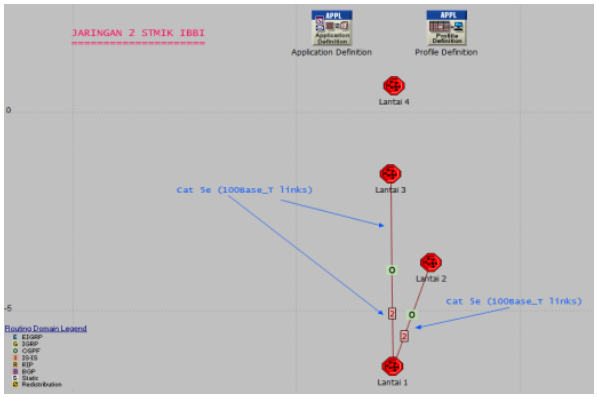

Fig. 7. The topology of the network 2.

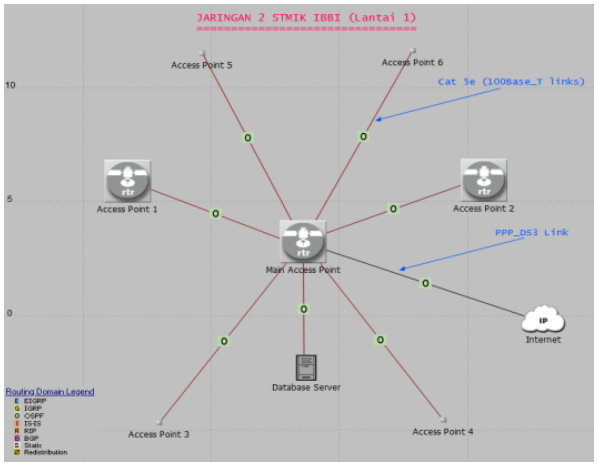

Fig. 8. The topology of the network 2: The detail on Floor 1.

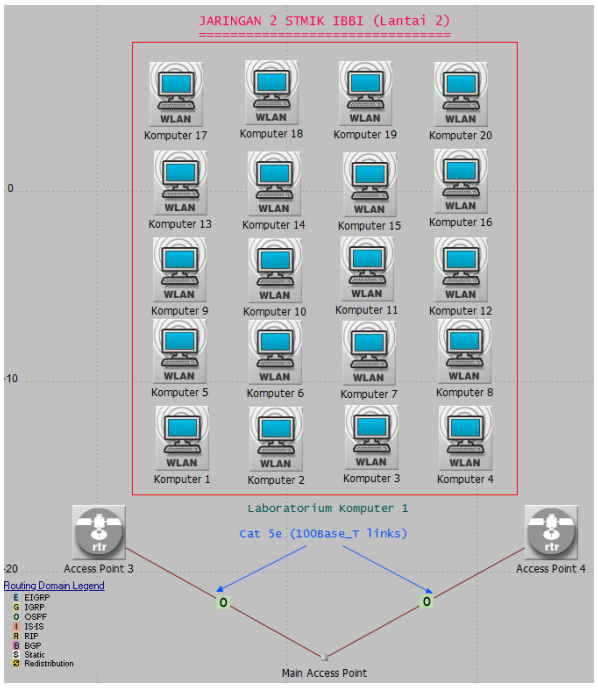

Fig. 9. The topology of the network 2: The detail on Floor 2.

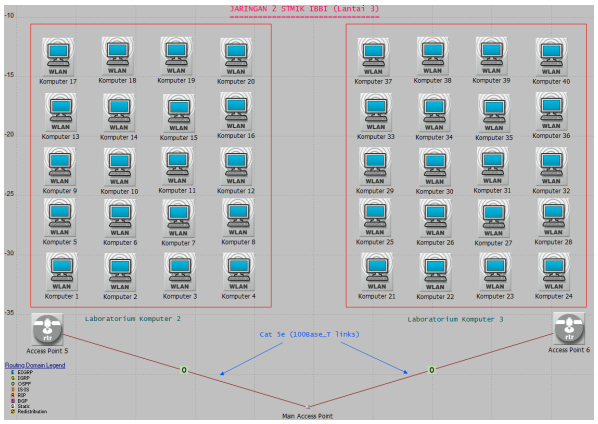

Fig. 10. The topology of the network 2: The detail on Floor 3.

Fig. 11. The topology of the network 2: The detail on Floor 4.

baseline and is managed by the CPU Credits. The T2 instance is a good choice for workloads that do not frequently use CPU fully or consistently (e.g., web servers, developer environment, and small database). The features of T2 instances are provided in Table I.

In the following, we compare the performance of Network 1 with and without using cloud computing. The first comparison is about the network delay (see Fig. 14). On the average, the network delay is 54 ms without cloud computing and 45 ms with cloud computing. Thus, the use of cloud computing improves the network delay performance by nearly 17%.

Figure 15 shows a comparison of the network load. On average, the network load is 110 000 bits/s without cloud computing and 2 800 bits/s with cloud computing. Thus, the network load decreases significantly by nearly 98%.

Figure 16 shows a comparison of the CPU utiliza-

Fig. 12. The design of Network 1 with cloud computing.

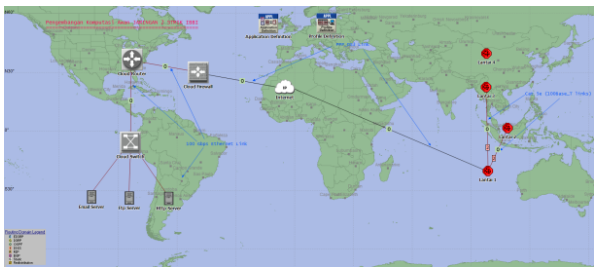

Fig. 13. The design of Network 2 with cloud computing.

TABLE I
IAAS TABLE OF CLOUD COMPUTING AMAZON EC2 [26].

Instance Type	t2.small
vCPU	1
CPU Credits (hour)	12
Memory (GB)	2
Storage (GB)	EBS only
Networking Performance	Low to moderate (Public)
Physical Processor	Intel Xeon family
Clock Speed (GHz)	Up to 3.3
Intel AVX/Turbo	Yes
Window Usage	$0.036 per hour

tion. On average, the CPU utilization is 1.1% without cloud computing and 0.03% with cloud computing.

Figure 17 shows a comparison of the throughput of Modem Router ↔ Main Switch. On average, the throughput is 440 bits/s without cloud computing and 540 bits/s with cloud computing. The use of cloud computing increases the throughput by 23%.

As for Network 2, the results of the following. On average, the delay is 39 ms without cloud computing and 26 ms with cloud computing, a factor of 33%; the network load is 5 400 bits/s without cloud computing and 3 500 bits/s with cloud computing, a factor of 54%; the CPU utilization is 0.02% without cloud computing

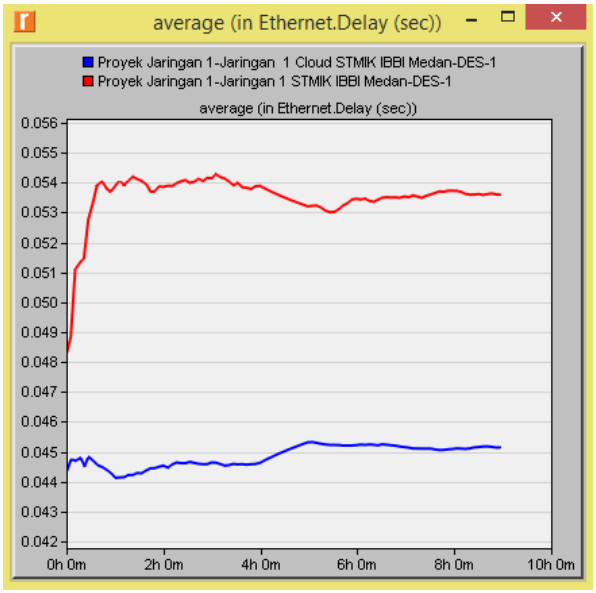

Fig. 14. The averaged delay time of the networks with and without using cloud computing.

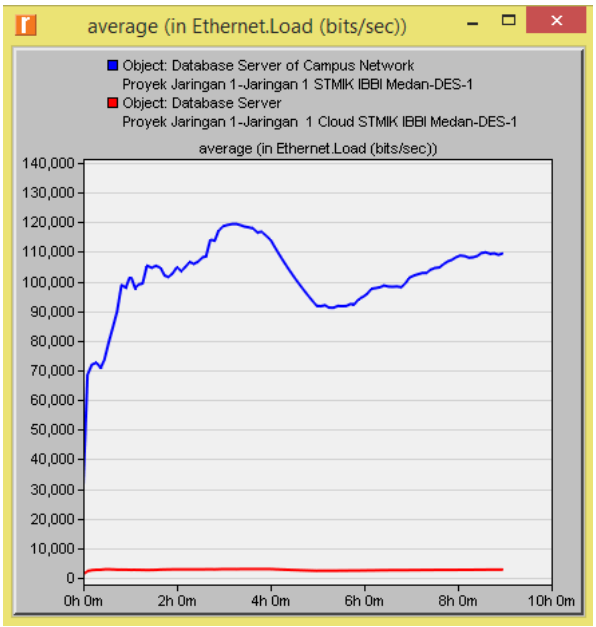

Fig. 15. The network load with and without using cloud computing.

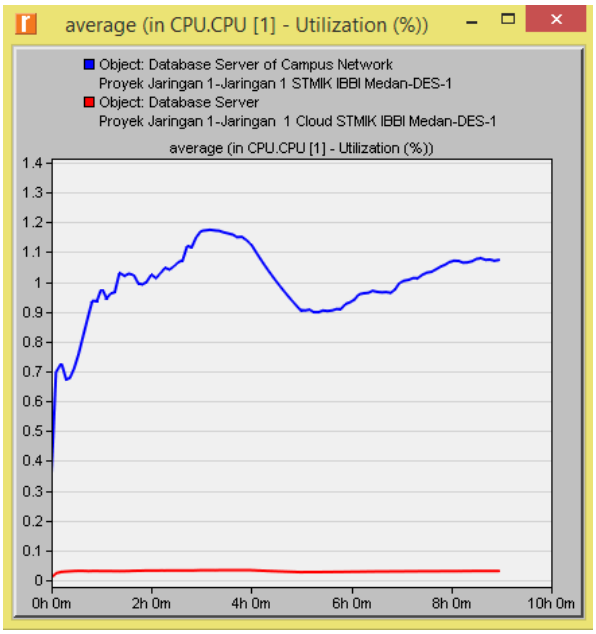

Fig. 16. The CPU utilization of the networks with and without using cloud computing.

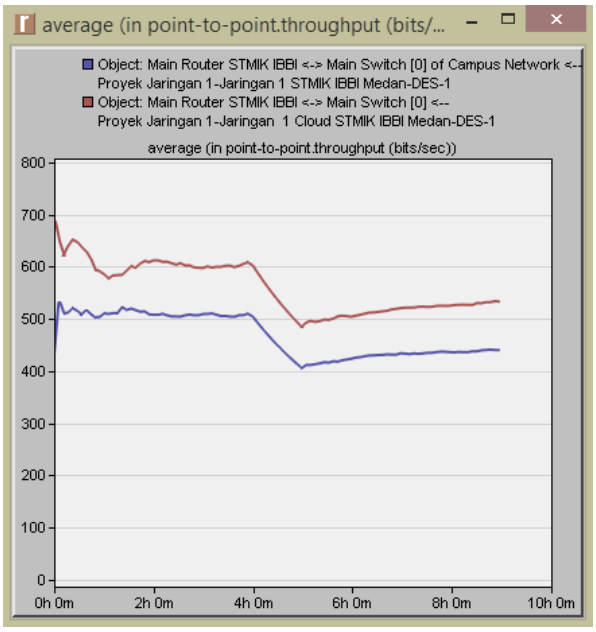

Fig. 17. The throughput of Main Router ↔ Main Switch of Network 1 and with cloud computing.

and 0.0002% with cloud computing; and finally, the throughput, without cloud computing, is 1 400 bits/s for database server. For the case with cloud computing, the throughput is 85 bits/s for email, 100 bits/s for FTP server, and 95 bits/s for HTTP server.

IV. CONCLUSIONS

This work has studied the network performance issue for the case with and without the use of cloud computing for the network infrastructure at the college of STMIK, IBBI, in Medan, Indonesia. The network traffic data are acquired by using Wireshark 64-bit version 1.12.7. The obtained data includes the data of database access, email, FTP, HTTP, and telnet service. These data are used on the simulated network with and without using cloud computing. The study focuses on the network performance improvement given by the use of cloud computing. In general, it was found that the use of cloud computing decreases the network delay, load, and CPU utilization, but increases the network throughput.

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