The Analyst Model Performance Multi-tier for Increase of Efficiency Virtual Machine In Moodle Application

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ABSTRACT

The use of multi-tier schema has become general phenomena in moodle application on web base in nowadays. Usually is layer presentation on the first tier. On the second tier of the application layer and layer data on the third tier. This is modelling on this paper to looking application performance on web base who is using three-tier model and the impact of value amount in the server who is controlling of each on the tier for the performance. The example in the case who is used for this modelling is the application of Moodle for the college courses in XYZ University. The framework of modelling who is used is Simply which is the simulation framework activity base on the district is using phyton language programming. The simulation on simply can using to a certain interval timer or unlimited (the ideal until for the work all is serviced). The results of the simulation are showing the best obtained by using a single server on each of layer by optimizing the speed of process on the server.

Keywords: models of performance, application on based web, simpy

I. INTRODUCTION

On this time, the application in web base is almost can't to see in the single-tier who is only one in a server, it is good of physical server or virtual server or virtual machine(VM). The except is may be still on the development level. The meaning of, at the least of application and database who is used on the same as one server. This is can take effect to performance application on at all, the difficulting on controlling and identification of a problem, and make to the system is difficult of developed to make of needs who are increasing at the next time. The problems are solved by dividing of the system into some layer and commonly called as multilayer or multi-tier.

The application of moodle on web base quite popular is using for courses at long distance or commonly called as distance learning or e-learning. The setting default in file config.php on this application is looking of the database who is used and put in a local disk on Moodle data directory. Therefore is, can be concluded that in the default Moodle is designed to implemented on single – tier. The case of single – tier is this have deficiency which is unscalable.

The University of XYZ is the university which is using Moodle for an e-learning course [13][14]. The total of courses which is used e-learning course and the total of user who is increasing on The University of XYZ to impacting on the system of moodle most

to be changed is used multi-tier, cause is the needs of power increasing most to be determined who is better to escalate, which is from the side of web server, the side of the application process, or the side of the data process. The University of XYZ has been using technology VM to all web of services, including for Moodle application. If this service is using three-tier, it is the lot of VM will use. The question of very important is how to the scalability schema who is optimal from the side of price to increasing performance of Moodle application in the University of XYZ when changed is using three-tier architecture. The additional resources will always mean additional expenditure. With this is the model is expected to expenditure can be decreased in than increasing performance of a system.

This research is to apply models who are submitted from the previous researcher, which is Dayle Chettiar who is using the framework simply simulation who are written into phyton language[2]. Chettiar is using architecture model three-tier to the simulation of queue handling on cloud application to performance measurement. This research is focused on using a model to looking the optimal schema when an application of moodle single – tier is changed to three – tier. This research has some limited, which is used of data on browser hit only at one month taken from the log file, and used of sysbench tool to getting the rough thinking for a parameter of service rate each server in each layer, and use to an assumption of server price source of cloudkilat.com

II. METHODS AND MATERIAL

MODEL OF MULTI-TIER

A. Standard Concept

The architecture model a multi – tier, or commonly called is N – tier architecture, the involve of architecture development three – tier in one or several way[1], which is :

1. The replication of components in one of tier.
   The one of excellence client/server architecture is scalability, which is an ability to add components who are needs to handle of grown the transaction amount per second. The one solution is changing of the server who is concerned by the server have the power of process is higher. This is quite of troublesome where is most to downtime system because there is a transfer of application or data.

2. The increasing of specialization tier is longer anymore.
   On the one of an alternative to duplicating of application servers (where is the one of the server is contain the more one of application who is same with the server else) is by making to each of server have the specialization on the one of certain an application. The benefit from this an approach is each of server has costumed, both of software and hardware, to the execution of the one of certain an application.

3. The additional of portal service
   On two-tier the architecture or three-tire, one of the server is handling internet traffic at the next time, on duty double to be Firewall or Netfilter, and maybe to at once the data server. The concept of multi-tier is can used to web separate, application, and data with a purpose of increasing system whole capacity. Other design the strategies is separate to postal service from a web server and the application major. A portal of the service can be shaped as one of a certain application, which is :
   a. Firewall
   b. Load balancer
   c. Transaction processing monitor (TPM)
   The changed in scalability effort it is could be deep additional of logical tier or additional of component into logical tier.

The benefit of multi-tier than with single-tier as follows :

1. Multi-tier is used when needs already increase to system reliability, while of single-tier is used when the needs of a system are the power efficiency electricity.
2. Use of node on each tier is an increasing possibility to conflict solving and network resolve on the homogenous single-tier system.
3. The placement of node is possibility node user is high-power on tier higher by using the mechanism of life at needed so that to power efficiency.
4. The scalability is better, the price is cheaper, and the function is higher.

B. The queue bettwen-tier

The application web base in multi-tier absolutely is stream data packages as request and response from one to certain tier. Some processes fast in the queue this is influence some fast response system total to demand from the client, for example, a web browser. The meaning is, if the queue is not can handle as well, then the user who is accessing of web application it is waiting a long time to getting want it, or even web browser is showing time-out page. The application web very well is just to show a web page to the browser screen in faster. As in comparison, the survey declares that a user is leaving a mobile website when the page is not shown at 3 seconds[4].

The system or queue model network is a model where is the system who is the analyst in representation as a queueing network. The queueing network is a set of service centre who are represented on the node. Set of this service centre is representation system resources. Which will come to this service centre is a user, a work, or a transaction. The evaluation analyst is involved with using software to complete an equation group are generated by the queueing network and paremeters [5].

Two type of system queue network[2], which is :

1. The network system is an open network, which is the network system who is can have a job who is enter and exit.
2. The network system is a closed network, which is the queueing network who have an amount of job is permanent.

In the case of this research, a job which is conducted on Moodle is a job with varies total.

C. Virtual Machine and Cloud

Although is not default definition from cloud computing (or the abbreviated is cloud), the basic concept and the goal is quite clear, which is cloud computing is using virtualization technology and web technology modern to provide a resource from some service TI each[6]. This service is most to available in reliable and scalable so that the customer is lot using as well as explicit when on certain demand or when needed. This concept is not mentioned whether the virtualization is using spread system or single server and whether is using to the server with higher performance or not. Of course, this is very different from the term grid computing who is always using a spread system. Usually, cloud computing is using spread infrastructure, but it is centralized management and each node is usually autonomous.

From the other side, the technology of virtualization is to make a free system from limitation and increasing of system flexibility [7]. When a system or subsystem, example processor, memory, or tools I/O, virtualized, interface and resources who is seen from his interface are mapped on an interface of a real system who is implementation. Consequences are a real system who is transformed so that truly seen as a (or a group) virtual system who is different. The real system this is often known as the host of his virtual system as the guest. The benefit of the real used

virtual system on a system administrator has reduced downtime on process maintenance server.

In this world, this is already a lot of providing cloud services with price relatively quite expensive better than investigation of server on-premise, example the services who is given by Alibaba Cloud (www.alibabacloud.net). Indonesian also not left behind. A lot of cloud services who is used in Indonesian, example Cloud KitKat (www.cloudkitkat.net). As a rough thinking, price of rent a virtual machine at Alibaba Cloud with specification 1 virtual CPU, 1 GB ram, 2 GB swap, 40 GB storage, and 2 TB transfer on price USD 10 per month.

D. Simpy

Simpy Framework is a simulation framework of discrete incident on process-based which written using the programming language phyton. The last version is 3.0.10 and can to download in website Phyton. The processes in simpy can to write using the generator function Phyton. Some example of scenario on the performance analyst using Simpy which is :

1. Total of cars which it came to the car wash. It is to look for is how to many car wash station which optimal to a certain workload.
2. Total of the customer has been coming to cashier fast-food restaurant, to determining how too many optimal cashiers whom must to provided.
3. Total of the student has been coming to book load section in the library.

On this research, the environment process() function can use to start the process. "Instance Process" in Simpy is used for an interaction between a process and another process or the models. Example of process interaction which is :

a. Waiting for another process is done to execution.
b. interrupting another process and while waiting for another incident.

III. THE METODE USED

A. The model Three-Tier

The model used in this research is the three-tier model who put forward by Chettiar [2]. Each tier is handled by 2 VM. This is we call as the model (2,2,2), the meaning of this model is one of the tiers is handled by 2 VM, two of tier by 2 VM and three of tier by also 2 VM. Picture 2 shows the intended model. This is including into network model open queue. Web server 1 (WS1), on virtual machine 1 (VM1), application 1 (APP1) on VM2, database 1 (DB1) on VM3, WS2 on VM4, APP2 on VM5, and DB2 on VM6. Each of VM is modelled as an M/M/1 queue. The Assumption which used is :

1. All work which into system will definitely come out.
2. All work into system have time of exponential services and time between arrivals exponential also.
3. All of operational VM.
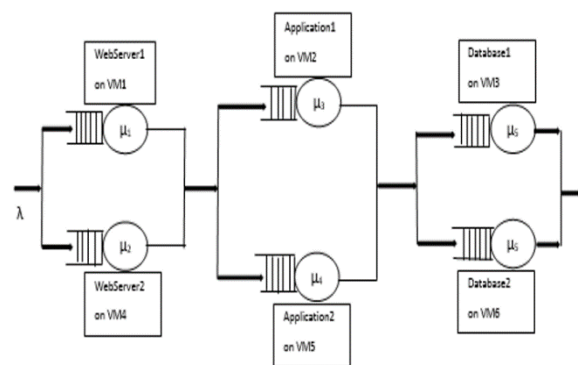
Picture 1. The model queue network used

B. Walking Conditions

The University of XYZ on this time is used model (1,1,1), It is the meaning each tier 1, 2, and 3 handles by 1 VM so that total is 3 VM on the whole system.

The third VM is the virtual machine in Proxmox version 4.4.1 which to his host. The specification technical on third VM is as follows :

1. Tier 1 (web server) : operation system is Linux Alpine, 2-core vCPU, vCPU, 2 GB RAM, 20 GB Storage. Web services which used is Nginx version 1.4.6.
2. Tier 2 (application) : operation system is Linux Debian, 2-core-vCPU, 4 GB RAM, 40 GB Storage. The applicaton which is running is Moodle version 3.3.1.
3. Tier 3 (database) : operation system is Linux Ubuntu, 1-core vCPU, 1 GB RAM, 40 GB Storage. The applicaton of RDBMS which is running is MariaDB version 10.2.1.

On the third VM is pure to running operating system and services with default configuration and not optimation yet. Used of tools **ab** and **sysbench** on Linux to measure the performance of each VM which giving results that are:

1. Tier 1 (web server) have service rate in average at 53 per seconds.
2. Tier 2 (application) have service rate in average at 41 per seconds.

Tier 3 (database) have service rate in average at 18 per seconds.

IV. RESULTS AND DISCUSSION

A. Simulation of Model

The first simulation is using mode (1s, 1s, 1s). The word "s" here states that VM is used standard specification (basic) like has been outlining on the previous chapter, that is specification with service rate at 53 per seconds on tier 1, at 41 per seconds on tier 2, and at 18 per seconds on tier 3. The simulation did to workload 29 worked at each of seconds. The second simulation is using model (1s, 1s, 2s). Tier 3 is

added to 2 VM because judging by each ability tier, just of tier 3 which have ability decreased workload. The third simulation is used model (1s, 1s, 1h). The word "h" here states that VM on tier 3 is using "high" where is ability 2 bigger than VM standard, that is at 36 per seconds. The fourth simulation is using model (2s, 2s,2s) where is on each tier using 2 VM at once.

The parameter is used by simulation as shown in Table 1. The parameter maxNumber is declared the total worked which into the system, that is 1000 worker. In this case, actually which is a worker is a web hit or HTTP request packet. The parameter endTime is declared at the maximum time in the simulation, that is at 2000 seconds of simulation. When at that the time is still work not finish yet than the simulation is stopped. The parameter of serviceRateL1, serviceRateL2, and serviceRateL3 is declared many of work in coming at one second.

Table 1. Parameter of Simulation

| Parameter	Nilai
maxNumber	1000
endTime	2000
serviceRateL1	53
serviceRateL2	41
serviceRateL3	18
ArrRate	29

Table 2 is showing data which take on to the fourth simulation. The simulation is giving at time limitation which is as request time, that is at the time which is expected of work can be finished. The simulation is using request time at 0.2 seconds, at 0.4 seconds, at 0.6 seconds, at 0.8 seconds, and at 1.0 second. The number in Table 2 is showing how to many works is finish before request time, in percentile. The columns avRT is declared average system response time which declares how to long average of one work is finishing by the system. As an example, for request time at 0.8 seconds on the model

(1s, 1s, 1s), the system can succeed 2,4 % to total work before at 0,8 seconds which avRT at 11,32 second. The visualization on this Table 2 graphically can to see in Picture 2.

Table 2. Data Results of Simulation

Model	0.0	0.2	0.4	0.6	0.8	1.0	avRT
(1s,1s,1s)	0,000	0,000	0,005	0,018	0,024	0,030	11,320
(1s,1s,2s)	0,000	0,251	0,594	0,813	0,927	0,977	0,350
(1s,1s,1h)	0,000	0,385	0,816	0,962	1,000	1,000	0,267
(2s,2s,2s)	0,000	0,368	0,675	0,817	0,925	0,982	0,350

The graphic at picture 2 is showing that with increasing of total or ability of VM in tier 3, the system can be finishing work is better than a model standard (1s, 1s, 1s). Almost in all of the work can be finish before, at 1 second, that is model (1s, 1s, 2s), model (1s, 1s, 1h) or model (2s, 2s, 2s). As a point of comparison, request time at 0.8 seconds is showing increasing is quite significant from 3% worked finish on the model (1s, 1s, 1s) to 97 % on the model (1s, 1s, 2s). Even become 100 % on model (1s,1s,1h). This is proving that must to do of escalation on a system in progress.
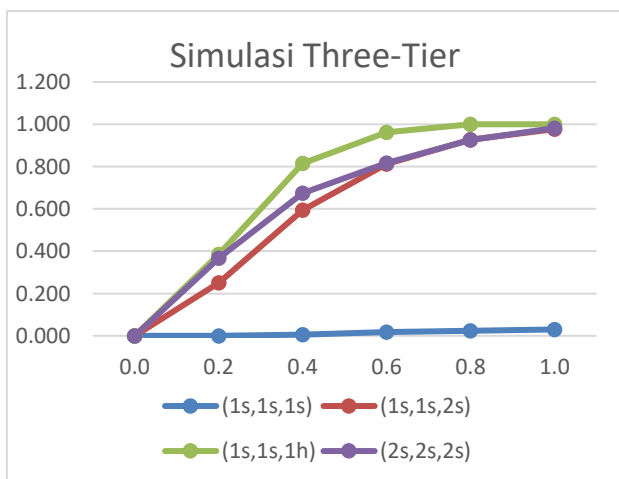
Picture 2. The simulation of three-tier model

From graphic at Picture 2 is can to seen that increased of performance already occurred by increasing VM total on tier 3, that is model (1s,1s,2s). This is quite reasonable because it this time tier 3 ability is already top to arrival rate. Increasing total VM on tier 1 and 2 is not change which significantly. This is showed by the model curve (2s,2s,2s). Such of, intercalation total VM on tier 1 and 2 is not needed, because in this case, the ability of VM on tier 1 and 2 is up to arrival rate.

B. Compared of Price

For determination of the best model to configuration efficient virtual machine from price side, then must to compared price VM for each model. From the previous discussion, model (2s,2s,2s) is not to take into account because the intercalation of performance is not significant. Therefore, just the model (1s,1s,2s) and (1s,1s,1h) which on an account and that too is just tier 3 because both of them have total VM as same as on tier 1 and 2.

Tier 2 is the data layer which is using MariaDB. On the website, MariaDB[9] and discussion in website LowEndTalk [10] recommend increasing RAM to increase of performance MariaDB. Therefore, can be to assumptions, by increasing of RAM total to twice, then service rate tier 3 increase to twice too. By price reference on website Alibaba Cloud [11], in counted price that is :

1. The increase of VM configuration from a model (1s,1s,1h) can model (1s,1s,2s), regardless of investment on tier 1 and 2 which not be counted, investation on tier 3 is twice USD 10 per month or same as USD 20 per month.
2. The increase of VM configuration from the model (1s,1s,1s) to mode (1s,1s,1h), regardless of investment on tier 1 and 2 which not be counted, investation on tier 3 is USD 19 per month.

In the data, this price is showing on the model (1s,1s,1h) is still better than the model (1s,1s,2s).

Other the consideration in choosing the best model is that graphic which is shown by performance increasing using model (1s,1s,1h) is still better than the model (1s,1s,2s), because is an overhead time which caused by load balancer is must to divide work to more than one server. The deficiency from the model (1s,1s,1s) is still of the single point of failure (SPOF) because on each tier is not redundant.

V. CONCLUSION

The conclusion which can on take from previous this discussion that is :

1. From the simulation is can do on four models take on the conclusion that the best of the model is more efficient price, in this case, is the model (1s,1s,1h). Therefore, The University of XYZ recommended increasing of performance VM just on tier 3, that is increase database server capacity, in this case, additional RAM and optimization on operation system and MariaDB configure.

2. Used of the model (2s,2s,2h) is possible but just to increase server redundant to avoid SPOF. This model is can to used in future then needs of process power increase too.

Things still can further be tested do a simulation again by the system which has been doing optimization. The four-point must attend, that is :

1. The optimization on operation system which is used. Example, take into consideration what servers are used and how data to read/write on disk. Then data is more often read than write, cache function can be activated or minimize parameter swappiness on the operating system.

2. The optimization on server web. As the vanguard of the system, cache function also can be activated on a web server is Nginx. Therefore compression function of data can also to

activated so that data faster transmission to a client.

3. The optimization on Moodle application. There are many ways it can to optimizing the Moodle application. Example moving the file is often read to storage faster.

4. The optimization on RDBMS MariaDB. According to Todorov [12], there are 15 changed on setting my.cnf is can be used to make MariaDB can service faster.

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