Enhancement Network Monitoring System Functionality by Implementing an Android-based Notification System to Monitor Virtual Servers on Cloud Computing Network

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A R T I C L E   I N F O

A B S T R A C T

Computer networks have evolved with the presence of cloud computing technology to accommodate the problem of inadequate computer devices and application services that are not integrated. USM (Universitas Semarang) which located in Indonesia is an educational institution that has implemented cloud computing technology using ROCCA (Roadmap for Cloud Computing Adoption) to accommodate the needs of internal application systems at this institution. The problem arises because the system administrator of the computer network is difficult to monitor the condition of the virtual server running because physically, the virtual server cannot be seen and touched. If there is a problem in one service, then the repair process takes a long time because there is not enough notification system to provide fast and detailed information about the condition of the virtual server running so that it will interfere with the quality of service from internal application system. The solution of these problems enhances the NMS (Network Monitoring System) functionality with notification system technology. Use PPDIOO method, this research will combine Pandora FMS and Telegram based on Android platform to implement a fast notification system in monitoring conditions virtual server resources which directly sent the message to the system administrator's smartphone. The expectation of this research is the quality of internal application service at USM (Universitas Semarang) can be properly maintained.

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1. Introduction

Computer networks in the modern era have evolved with the presence of cloud computing technology to accommodate the problem of inadequate computer devices and application services that are not integrated [1]. With cloud computing technology will save the cost of procurement of devices because only using 1 (one) computer device or by hiring from the cloud computing service provider, we can build many application services with multiple servers in virtual form.

USM (Universitas Semarang) which located in Indonesia is an educational institution that has implemented cloud computing technology using ROCCA strategy (Roadmap for Cloud Computing Adoption) to accommodate the needs of application systems at this institution [2]. Currently, cloud computing service USM (Universitas Semarang) has run 15 (fifteen) virtual servers to serve various internal institutional application systems and of course, the longer will be increased. The problem arises because the system administrator of the computer network is difficult to monitor the condition of the virtual server running because physically, 15 (fifteen) virtual server cannot be seen and touched. If there is a problem in one service, then the repair process takes a long time because there is not enough notification system to provide fast and detailed information about the condition of the virtual server running so that it will interfere with the quality of service from internal application system at USM (Universitas Semarang).

It takes an additional technology to help the system administrator of the computer network to manage the server devices and monitor the virtual server conditions both internally and externally. The Internal side such as counting the number of running processes, the number of storage quota remaining or displaying the workload graph from the server. While the external side is more to monitor the relationship server with outsiders such as online or offline status on computer networks. The solution of these problems and this needs is by building an NMS (Network Monitoring System) that provides detailed information about the condition of the virtual server and presents it in the form of images and graphics. The development of NMS (Network Monitoring System) itself runs well and quickly so this technology can be used as a tool for the system administrator of the computer network. From the various researchers that have been done, now cloud computing USM (Universitas Semarang) has built NMS (Network Monitoring System) application using Pandora FMS [3].

Because in Pandora FMS provides open API (Application Program Interface) facility for integration with other application system, then in this research will be enhance NMS (Network Monitoring System) functionality by building notification system through Android-based messenger application which also provide open API facility (Application Program Interface) so the notification about the condition of the virtual server can immediately connect quickly with the system administrator of the computer network's smartphone without having to turn on the PC (Personal Computer) to make remote access to Pandora FMS. It is hoped that this research will help the system administrator of the computer network in managing virtual server resources on cloud computing network so that the quality of internal application service in USM (Universitas Semarang) can be maintained well.

2. Discussion

Before this research is done, there are several results of discussion and research that need to be studied more deeply to add the necessary information. Some of these libraries include cloud computing, network monitoring system, and related works regarding monitoring of virtual server resources.

2.1. Cloud Computing

Cloud computing is a combination of the use of computing technology in a network with Internet-based development that has the function to run computer applications. Cloud computing is a technology abstraction of hidden infrastructure, so users can access via the Internet without knowing the infrastructure and technology contained [4].

Some of the benefits of cloud computing include scalability is the addition of cloud computing capacity without having to buy additional equipment such as hard drives because cloud computing service providers have provided facilities for additional capacity. While accessibility is another cloud computing benefit. Because Internet-based, then the technology users will be able to easily access the data and information needed. The main benefit of cloud computing is security. An anxiety about natural disasters that can damage data and anxiety due to the theft of data by others has been accommodated by cloud service providers, thus reducing the costs required to secure a data.

Service from cloud computing to date is divided into 3 (three) types as in Figure 1 below.
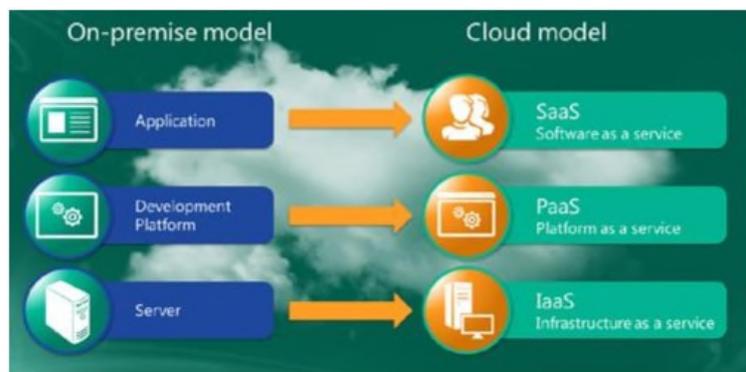
Figure 1 Cloud Computing Concepts [5]

2.1.1 IaaS (Infrastructure as a Service)

IaaS is a service that provides IT infrastructure such as CPU, RAM, storage, bandwidth, and other configurations. These components are used to build a virtual computer that can install the operating system and applications as needed. IaaS save money to build a computer physically and can be done configuration changes as needed. Examples of IaaS service providers are Amazon EC2 and TelkomCloud.

2.1.2 PaaS (Platform as a Service)

PaaS is a service that provides platforms such as operating systems, databases, web servers, and application frameworks. Companies that provide these services are responsible for maintaining this platform. The advantage of PaaS is that users can focus on applications built without thinking of the maintenance of the platform being used. Examples of PaaS service providers are Amazon Web Service and Windows Azure.

2.1.3 SaaS (Software as a Service)

SaaS is a cloud computing service that provides applications so users can directly use the application directly. The service provider is responsible for the infrastructure, platform, and applications that users use. The advantage of this service is that users do not need to purchase licenses to use the application, so users only need a client and internet device to access this service or a user pays a subscription rate to be able to access the service. Examples of these services are email, social media, messenger, Office 365, and Adobe Creative Cloud.

2.2. NMS (Network Monitoring System)

NMS is a tool or application to perform monitoring on the elements in a computer network. The function of the NMS is to monitor the quality of the SLA (Service Level Agreement) of the computer resources currently in use and running. The results of the monitoring are usually used as material in decision-making by the management, on the other hand, is used by the system administrator network to analyze whether there are discrepancies in the operation of computer networks.

Network Monitoring System (NMS) is the use of a system that constantly monitors the computer network or component that is problematic or fails and notifies the information to network system administrator through an application, email, SMS, messenger or other alarm. This is part of the functionality involved in network management. In addition, the development of Network Monitoring System (NMS) is an attack detection system or infiltration of computer networks that are often called Intrusion Detection System (IDS) which perform monitoring of computer networks for threats from outside the network and provide reports on network connections with problems [6].

In general, the Network Monitoring System (NMS) uses the Simple Network Monitoring Protocol (SNMP) protocol designed to provide network device management and network device configuration capabilities remotely [7]

2.3. Related Works

Several previous types of research that have been conducted on performance monitoring, as well as server, cloud computing resources, and notification system, are listed in Table 1 as follows.

Table 1 Previous Researches

Research Title	Tools Used	Research Result
An Efficient Network Monitoring and Management System [8]	Request Tracker and Nagios	Server monitoring and email notification information
A Survey of Network Monitoring and Administration using Email and Android Phone [9]	-	Survey monitoring server and notification information via email and SMS
Observing the Clouds: A Survey and Taxonomy of Cloud Monitoring [10]	Ganglia, Astrolabe, Nagios, Collectd, Riemann, sFlow and host sFlow, Logtash, MonALISA, visPerf, GEMS, Reconnoiter	Survey about monitoring tools and standardization for monitoring tools of server resources and cloud computing
Implementation of Monitoring System for Cloud Computing [11]	XenServer	Web-based cloud computing monitoring tools
The Impact of Virtualization in Cloud Computing [12]	Amazon's Web Services, Microsoft Azure, Google App-Engine	The impact of optimizing cloud computing with virtual servers

This research will build an API channel that is used to connect Pandora FMS with Android-based messenger application on system administrator of the computer network of USM (Universitas Semarang)'s smartphone, so that information about problems that happened on the virtual server can be quickly known with the notification generated both applications. Android-based messenger application that can meet the needs of this research is Telegram.

3. Research Methods

The development of computer network is a continuous activity so that the planning stage is the most important thing. The PPDIOO model (Prepare, Plan, Design, Implement, Operate, and Optimize) [13] assessed the appropriate method for initiating the development of computer networks.

The stages are starting from the "Prepare" stage that determines the strategy and business model of the cloud computing network by accessing the Proxmox dashboard of control panel cloud computing and observing the monitoring process that has been running so that it can determine the design in the next stage. The result of this stage contained in Figure 2.
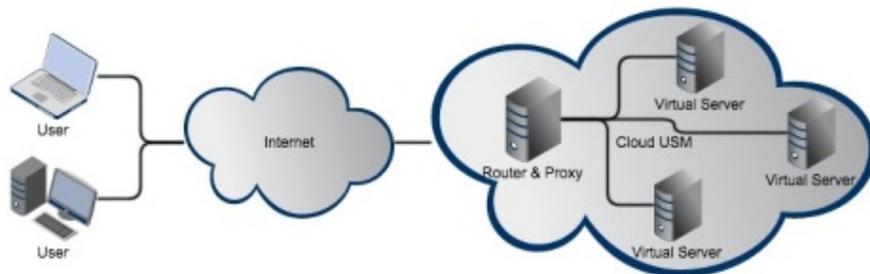
Figure 2 The Topology of Cloud Computing Network in USM (Universitas Semarang) [14]

The next step is "Plan". At this stage, the researcher analyzes the problem, planning for the enhancement cloud computing network of USM (Universitas Semarang), and conducts literature study as the comparison of research, chooses Telegram to support the functionality of Pandora FMS NMS (Network Monitoring System) is the result in this stage. "Design" stage is the stage where researchers consult with experts, then create a network design to perform virtual server monitoring that will be implemented on the cloud computing network USM (Universitas Semarang). Researchers also design an integrated system between Pandora FMS and Telegram as a system notification that will be sent a message about virtual server condition to the system administrator of the computer network's smartphone. This design is contained in Figure 3.
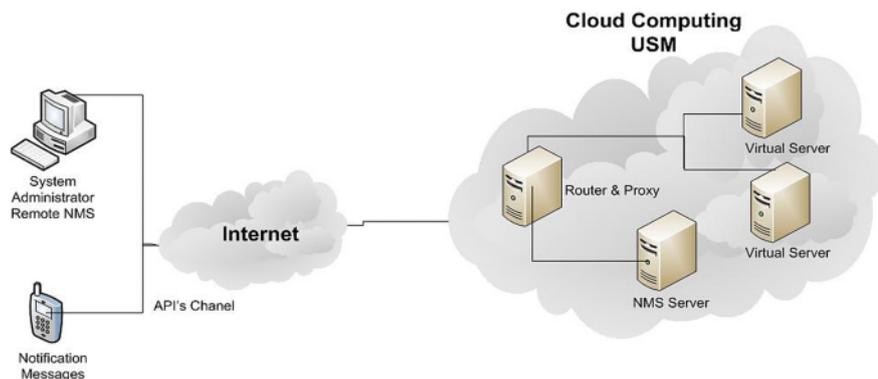
Figure 3 Designing NMS (Network Monitoring System) on Cloud Computing USM (Universitas Semarang) [15]

After the design stage is passed, then the process in the research continued to the "Implementation" stage by building a new one virtual server called PDP with Ubuntu operating system that is used to install Pandora NMS in the cloud computing network. The result of this stage is shown in Figure 4, which is the display of Ubuntu operating system that has been installed on the virtual server and Figure 5 is the dashboard of Pandora FMS.
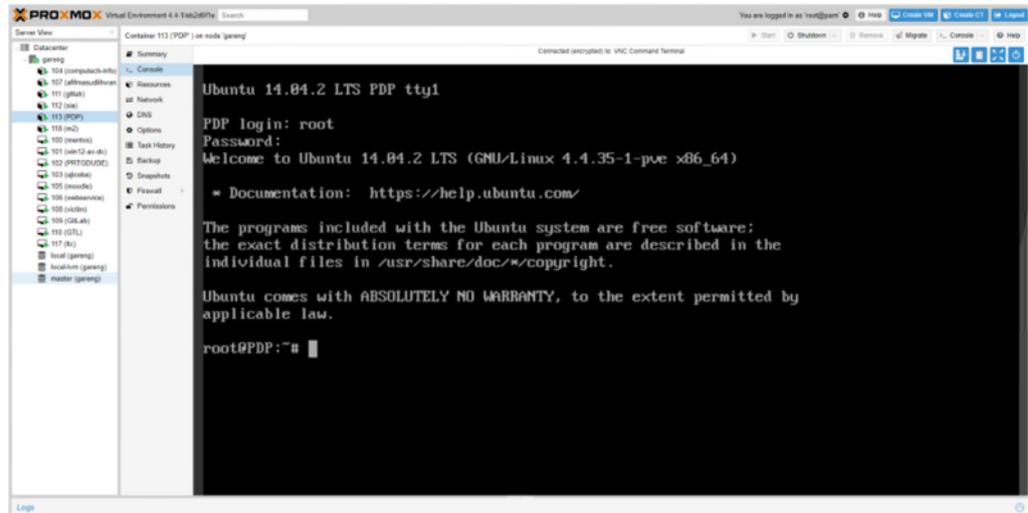
Figure 4 Virtual Server 113 PDP [3]

The next stage of "Operate" is done by using Pandora FMS to monitor the condition of the virtual server in cloud computing network. The result of this stage is shown in Figure 6.

Figure 6 describes that the hard disk, memory, CPU, task resources currently in use, the number of remote SSH performed, and the required processing time is the monitoring that can be analyzed inside a virtual server. In this case, there is 1 (one) red resource which means that the resource usage is close to the standard of resource usage. In this case, the red color is due to the almost full cache memory. So it can be analyzed using Pandora FMS that the memory usage to run the PDP virtual server is already reached 500 Mega Byte (MB) from the specified memory threshold of 600 Mega Byte (MB).
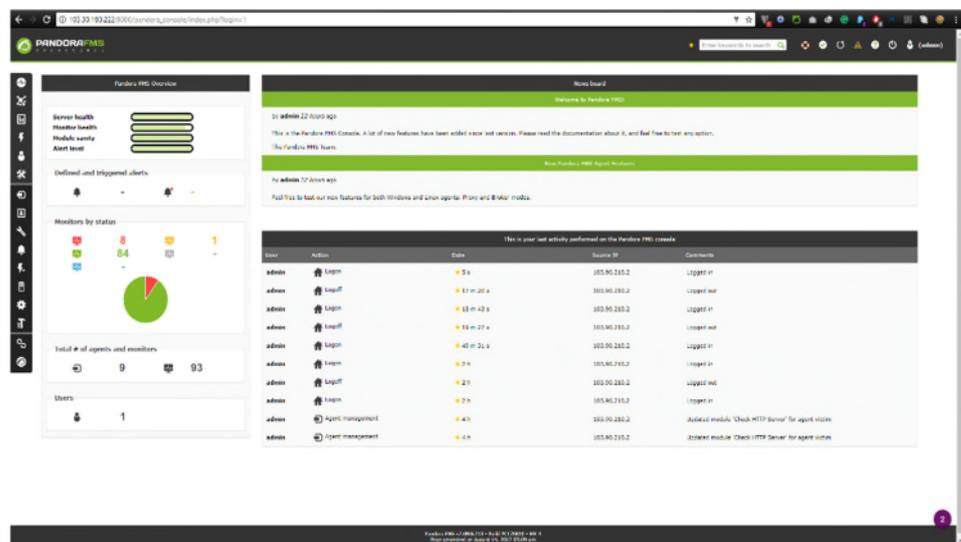
Figure 5 Pandora FMS Dashboard [3]

The last stage of this method is "Optimize" which is the result of this research. This stage begins to create a channel that connects the system that monitors the resources of the virtual server that is NMS (Network Monitoring System) Pandora FMS and Android-based messenger service that is Telegram. After that, the process will be arranged; delivery of information will be accepted by the computer network's system administrator smartphone.
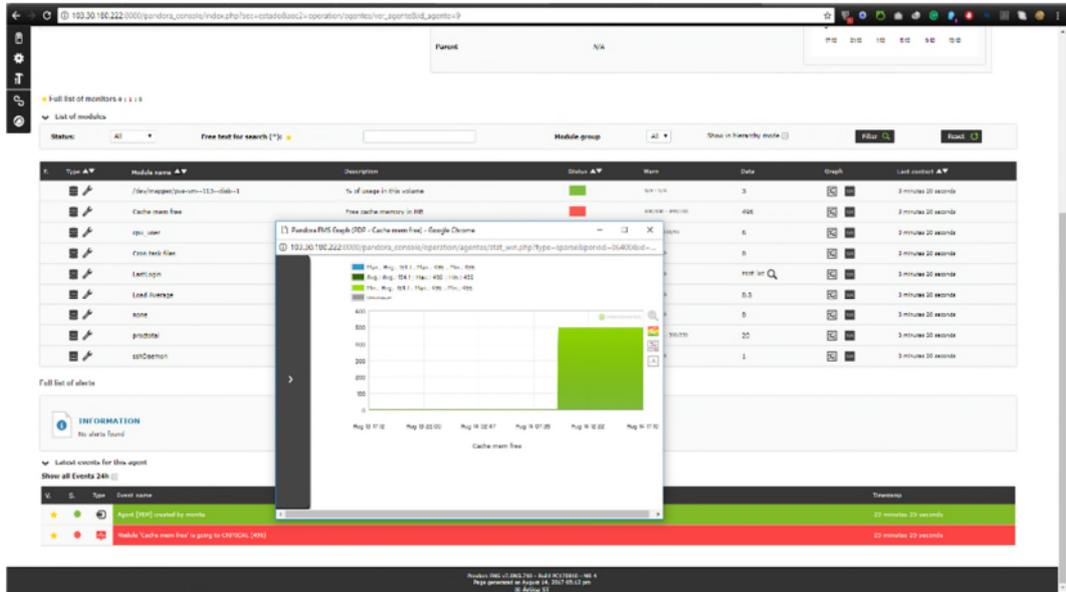
Figure 6 Graph Cache Memory [3]

4. Result

Creating a channel to build a notification system that connects Pandora FMS and Telegram can be done by creating a new channel on the application Telegram as in Figure 7.
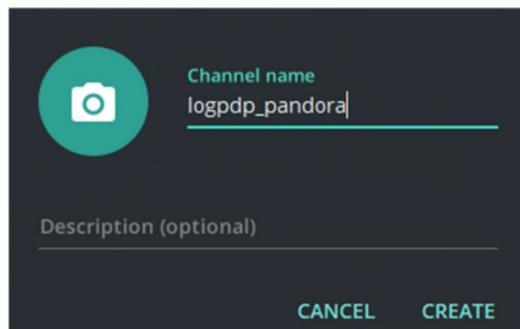
Figure 7 Creating Channel in Telegram

In the application, Pandora FMS needs to be set also to connect the channels that were built from Telegram before, as shown in Figure 8. In the form also made arrangements for any notification sent by Pandora FMS to Telegram.

Figure 8 Connecting Channel and Building Notification System

The result of the notification system that has been built is the sending of messages to Telegram account on system administrator of the computer network's smartphone about the problems that are going on inside the virtual server. These results are in Figure 9.

Figure 9 Message from Pandora FMS

5. Conclusion

The conclusion of this research is that NMS (Network Monitoring System) functionality can be enhanced when combined with the notification system to others communication device like the smartphone. Through Pandora FMS combined with Telegram is expected to further accelerate the handling of problems both physical servers and virtual servers on cloud computing network and further increase awareness of the problems that occur on the virtual server so that the quality of internal application services in USM (Universitas Semarang) will be maintained properly. The limitations of performance on this notification system are all resources in cloud computing such as hard drive, CPU state, memory state, and so forth cannot be monitored automatically but must be made manually one by one in Pandora FMS application.

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