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Development of Bot for Microservices Server's Monitoring Using Life Cycle Approach to Network Design Method

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Abstract:
This study was conducted on an emergency response system that has been implemented in Demak, Kendal and Batang districts, namely Tanggapin. This system provides services in the form of reporting and actions, as well as information about the health sector, from the availability of hospital rooms to the availability of blood at PMI. Tanggapin uses a mobile-based and web-based platform, where the web is used as a medium for operators to input data and validate incoming reports. Due to complex system services with various supporting features, it requires a microservices architecture to operate independently and in a distributed manner. Because of this dynamic system, realtime monitoring support for server performance is needed via Telegram Bot. The monitoring system was built using the PPDIOO Lifecycle Approach to Network Design and Implementation method because it is simple and the flow of a process that never breaks so it is easier and more flexible to implement. The format used to exchange data uses the JSON (Javascript Object Notation) format. This study shows that the monitoring system can run well because every test carried out gives the expected results, namely the admin can receive a warning message via the Telegram Bot

Keywords: Microservices, Server Monitoring, Bot

I. INTRODUCTION

Computing needs will continue to grow along with the development of services provided by an institution through information technology. In the field of computer networks, more efficient techniques have been emerging in its development so that it can provide services on a wide scale. Computer networks allow for centralized computing processes and distributed computing. Nowadays, the computing needs in service provision are increasing. This has an impact on the increasing volume of data traffic simultaneously, the demand for mobile services and demands for increasing flexibility. Increasing services through computer networks must be balanced with the increase in computing resources, so as not to trigger an overload of work on servers and their supporting devices [1].

Recently, the microservices paradigm that uses *container* technology, namely packages to run applications without the need for virtual machines, is becoming increasingly popular. Microservices are an architecture based largely on separate autonomous services which can be developed, deployed and operated independently of one another [2]. Microservices have several challenges regarding team organization, development practices, and the infrastructure used [3]. In this regard, there are two important challenges that require support for management and monitoring of microservices system servers. The independent nature of the microservices-based system, as well as a highly dynamic distributed system, urgently needs the support of monitoring services and management of these services [4]. The first challenge concerns the relationship between software architecture and software teams. If the relationship between the software architecture and the software team is appropriate, it will be seen in the microservices system architecture. In the microservices system architecture, software teams can operate independently of each other. The second is the distributed nature and details of microservices. Microservices-based systems can consist of a large number of independently developed and deployed services, which interact while they are running. Due to this independent nature, the interaction between the service and the overall system architecture becomes clear as it is running.

6	Nilton Mendes Souza, Diogenes Dias, Lucas Bueno Ruas de Oliveira, Cristiane Aparecida Lana et al. "Exploring together software architecture and software testing: A systematic mapping", 2016 35th International Conference of the Chilean Computer Science Society (SCCC), 2016 Publication	<1%

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This research is applied to an emergency response system that provides services in the form of reporting and action, namely Tanggapin[1]. Tanggapin is a mobile-based application as well as web-based so that it can be accessed according to the needs and conditions of the user. Due to the complex system services with various supporting features, a microservices architecture is implemented so that they can operate independently and in a distributed manner. Because of this dynamic system, support for monitoring and service management is crucial. According to Cinque et al [5], Monitoring activities are essential activities in any software system. With the increasing use of microservices architectures, it will complicate the monitoring process and create challenges due to the log data source used for the monitoring process. By using a different machine from the microservices server computer as a log storage medium, it can make it easier for the team to manage and monitor the microservices system server more flexibly.

A number of studies on the use of bots to monitor servers have been conducted, as well as studies on the use of Telegram Bot as a monitoring tool and various applications has been widely carried out. Telegram Bot is used to integrate complaint of services available on university websites. With this application, a student does not need to visit the university website, just fill in a complaint via Telegram [6]. Telegram Bot is also used to guide non-expert users in monitoring the feasibility of radio frequency links, namely BotRf. BotRf is applied on smartphones and personal computers for bandwidth-limited environments [7]. On the other hand, Telegram Bot is also used to facilitate information dissemination on campus. Having the ability to handle multiple requests simultaneously, this bot can provide information according to user requests [8]. Meanwhile, Botanicum is a Telegram Bot application for classifying trees based on leaf images. This bot can classify approximately twenty different tree species in Russia. Interaction user with bots is carried out using simple conversation and brief instructions on how to take photos. The resulting classification accuracy reached 97.8% [9]. In this study, Telegram Bot is used as a notification sender to the user's telegram application when a microservices system is experiencing problems. The bot also provides easy access to time and place as a medium that is connected to the mobile microservices system via a smartphone device. The purpose of using the Telegram Bot in this study is as a medium in order to provide easy access and notification from the microservice system. The use of Telegram Bot service requires its own device to run smoothly. For this reason, the server is used as a place for installing Telegram Bot to make it more efficient. Because the server is a separate device from the microservices system, the use of Telegram Bot will not burden the processes, memory and services of other devices..

II. METHOD

This study uses PPDIOO *Lifecycle Approach to Network Design and Implementation* method [10]. This method is widely used in the development and management of a computer network. PPDIO is implemented in six phases as an uninterrupted process flow. In this method phase, there is no beginning and end of the development of a computer network which is described in six phases as follows::

(1) Prepare: involves the current requirements, computer network development strategies and technology planning that are most suitable and support for the current architecture.

(2) Plan: involves the process of identifying network requirements based on user needs, objectives, facilities and other planning aspects. This phase also involves the characteristics of the existing network, and conducts a gap analysis whether the existing infrastructure can operationally support the development of the proposed system. Planning is also useful so that the network development process is aligned with the scope and parameters of resource requirements.

(3) Design: involves the design and specification aspects of the network as a comprehensive detailed design in order to meet the current engineering aspects. It also improves ithe availability, scalability, performance and reliability of network services to be provided. Design specifications that have been carefully compiled use as the basis for implementing computer network development.

(4) Implement: a computer network is built, or the addition of new components is integrated with the existing network infrastructure based on design specifications and objectives. The main principle is to maintain the stability of the existing network without creating new vulnerabilities.

[1] http://landing.tanggap.in/

(5) Operate: operational is considered as the final test of the conformity of network development with the design. This phase involves maintaining the network through day-to-day operations. Deviation detection, then corrections and performance monitoring are carried out in order to provide data for the optimization phase.
(6) Optimize: involves proactive and responsive network management. Proactive and responsive management is used to identify and resolve previous problems that affect the organization and the needs of users. Proactive and responsive error detection and correction is required for optimal network performance. In network development with the PPDIOO method, the optimization phase can require network re-planning if performance does not meet the goals and expectations.

The PPDIOO method requires that all stages be carried out in a structured and sequential manner, as illustrated in Figure 1.

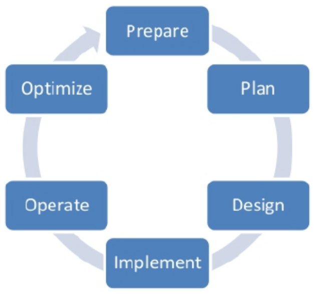


Figure 1: PPDIOO development method

To implement this method, this research requires hardware and software support as follows::
(1) Hardware
   a. Server Intel® Xeon® E5-2650 v2 @ 2.6 GHz, DDR4 16 GB.
   b. Local network devices and internet. Network devices with high speed are very important to maintain the quality and stability of communication between server.
   c. Smartphones are used as the installation device for the messenger application which is used to receive notification messages sent via the Telegram Bot.
(2) Software
   a. Ubuntu Operating System 18.04 LTS is used as the operating system installed on all servers.
   b. Docker is used as the main tool installed on all computer server.
   c. Prometheus is software that functions to collect metrics from targets which running on docker and server.
   d. Nodeexporter are Prometheus client libraries that are installed on Docker, and also installed on each computer server.
   e. Alertmanager can handle alert messages sent from Prometheus, and routed to recipients.
   f. Telegram Messenger is a messenger application installed on the user's smartphone, which is used as a device for receiving warning messages.

III. IMPLEMENTATION

Tanggapin is an integrated emergency response system that has been implementing in three districts in Central Java, namely Kabupaten Batang, Kabupaten Kendal and Kabupaten Demak. Regarding this study which is conducted on Tanggapin using the method explained above, the implementation of the method is explained as follows:

(1) The preparation and planning phase identify the requirements that apply to Tanggapin. Preparation and planning are also carried out to provide a computer network development strategy and to propose the most suitable technology for the current architecture.

(2) Design phase; at this phase, it involves the design aspects and network specifications as a comprehensive design in order to meet the engineering aspects Tanggapin. The system uses a computer server that functions as a monitoring server as well as a place to install Docker and Telegram Bot running in Docker. This design process is focused on analyzing hardware requirements, analyzing software and operating system

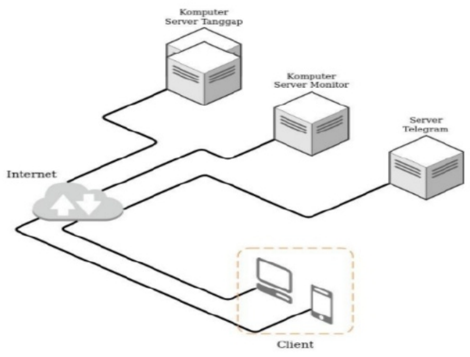
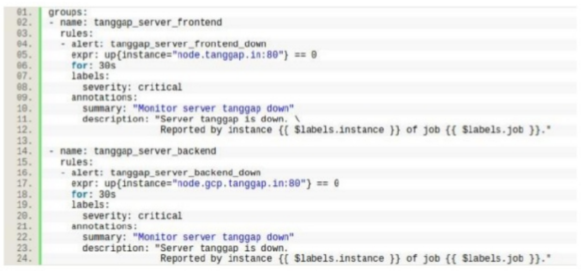


Figure 2: Star Network Topology used in this study

requirements, as well as network architecture and topology. The computer server that functions as a monitoring server is used to record all activity and data traffic on the Docker network and also to monitor the microservices system [11]. Meanwhile, the Telegram on computer server functions as an API service provider that will be used in the development. The client functions as a recipient of notification messages sent from the Telegram Bot. The network topology used in the monitoring system is depicted in Figure 2.

(3) Inplementation Phase
As explained above about the software requirements, the use of Docker, which is to help making the testing of the system easier. Because it can isolate all processes that are running on one computer server [12]. Hence, the test will run optimally. In sequential manner, the software installation on the server start from the installation



```
groups:
- name: tanggap_server_frontend
  rules:
  - alert: tanggap_server_frontend_down
    expr: up{instance="node.tanggap.in:80"} == 0
    for: 30s
    labels:
      severity: critical
    annotations:
      summary: "Monitor server tanggap down"
      description: "Server tanggap is down. \
                   Reported by instance {{ $labels.instance }} of job {{ $labels.job }}."

- name: tanggap_server_backend
  rules:
  - alert: tanggap_server_backend_down
    expr: up{instance="node.gcp.tanggap.in:80"} == 0
    for: 30s
    labels:
      severity: critical
    annotations:
      summary: "Monitor server tanggap down"
      description: "Server tanggap is down.
                   Reported by instance {{ $labels.instance }} of job {{ $labels.job }}."
```

Figure 3: Script Alert Rule Monitoring Server

of (a) the Ubuntu Server 18.04 LTS operating system, (b) the monitoring server configuration, in order to communicate with each other between the monitoring server and the microservices server, (c) Installing the Docker engine, (d) Docker compose installation, (e) installation and configuration of Traefik used to balance microservices server workloads, (f) Promotheus installation and configuration, (g) Alertmanager installation and configuration, (h) Nodeexporter installation and configuration, (i) Promotheus integration and Alertmanager, (j) Integration of Nodeexporter and Promotheus, (k) Integration of Traffic and Promotheus, (l) up-down monitoring of server computers, (m) up-down monitoring of microservice services, (n) grouping of computer server metrics data and (o) monitoring the server status.

In accordance with the design that has been provided, then testing of Nodeexporter is carried out so that it can collect metrics data from computer server, and then send it to Prometheus which will later be processed and executed by Prometheus. Next, test the warning rule configuration on the Alertmanager to find out if a service has a problem or is down. Testing on the Telegram Bot API is carried out, but with the condition that only certain Telegram accounts can receive notification messages via the Telegram messenger application. After simulating and getting the desired results, the system will be ready to be implemented.

(4) Operational Phase.

The operational phase is considered as the final test of the suitability of the network development to the design [13]. A script using the extension ".rules" is created to perform up/down monitoring of the computer. It is created using the command ~ *$ touch alert-server.rule*, and the file is used to determine alert conditions based on metrics data collected by Prometheus and using Prometheus expressions. Figure 3 is an example of alerting rules for up/down monitoring on a computer server. In general, the Server Microservices monitoring architecture with Telegram Bot was developed on Tanggapin is depicted in Figure 4.

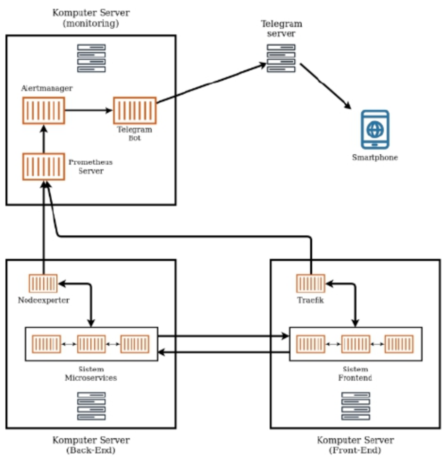


Figure 4 Architecture of monitoring sistem

In Figure 4 above, the computer server is used to run supporting software such as docker, and in Docker there are several supporting services and tools that are running. Computers server are connected to the internet as well as functioning as internet network providers, and also network management for Docker. On the Smartphone, the Telegram messenger application will be installed which is used to connect with the Telegram Bot installed on Docker.

(5) Optimation Phase.

The optimization phase is carried out after considering that the condition through the information obtained from monitoring that has been built both on the hardware and software side. Based on the operational phase that has been carried out, it is assessed whether the system is running well according to the design that has been made or not. Optimization is done after checking to ensure whether the system is running according to the configuratoin setting that have been set or not. Management and maintenance are carried out so that the network system runs according to quality standards and services.

IV. RESULT AND DISCUSSION

In this study, testing was carried out by using several types of problem conditions in one of the services of the microservices system.

4.1. Testing of monitoring system

Testing of monitoring system are carried out to find out whether the monitoring system is running as expected or not, hence testing is carried out for several times. From the tests that have been carried out repeatedly, it can be concluded that the warning message *down* on one of the service containers from the microservice system can be received via the Telegram Bot three times at different times. Table 1 below describes the monitoring system testing scenario.

Table 1: Testing schenario of monitoring system

No	Testing aspects	Ways of testing
I	Down of computer server	Shut down the computer server and turn it back on. Done in several tests.
II	CPU overload of the computer server	Simulate on the use of CPU on the computer server using *"stress-ng"* tools. It is carried out for several tests.
III	Memory overload of the computer server	Simulates memory usage on the computer server using the "memtester" tool. Done it in several tests.
IV	Microservices system down	Turn down one of the responsive microservices system services and turn it back on
V	CPU overload of Microservices system	Simulates CPU usage on one of the responsive microservices system services using the "stress-ng" tool. Done in several tests.
VI	Memory overload of Microservices System	Simulates memory usage on one of the responsive microservices system services using the "memtester" tool. Done in several tests.

Based on Table 1, server monitoring testing is carried out with six server conditions, where each condition is conducted using a different test method. In each test method, the test was conducted three times with the results shown in Figure 5. The results explained that the average time of notification appearance after six types of testing is 2,4 minutes.

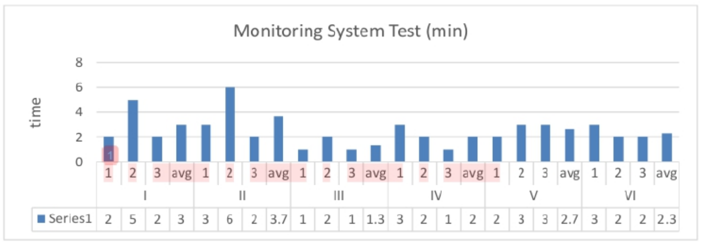


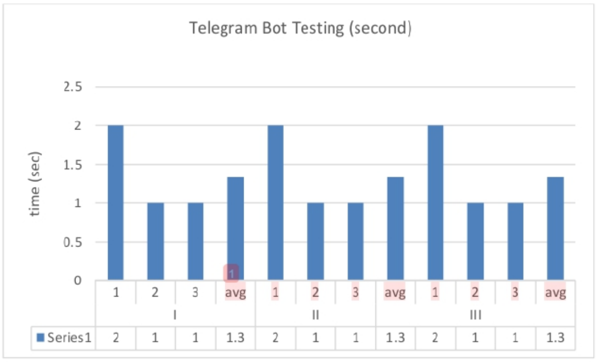
Figure 5 Testing of monitoring system

4.2 Telegram Bot testing

Bot is computer program that handle tasks in automated manner [14]. In order to provide a better bot performance, bot testing is crucial [15]. The test is carried out to find out whether the Telegram Bot responds to commands entered and runs as expected. The Telegram Bot test scenario is described in Table 2. 7

Table 2 Telegram Bot scenario testing

No	Testing
I	By entering the command "/*alerts*".
II	By entering the command "/*silences*".
III	By entering the command "/*status*".



	I				II				III			
	1	2	3	avg	1	2	3	avg	1	2	3	avg
■ Series1	2	1	1	1.3	2	1	1	1.3	2	1	1	1.3

Figure 6 Test of Telegram bot

V. Conclusion

This study produces a microservices server monitoring system with Telegram Bot. From the results of the tests that have been carried out, it can be concluded that the monitoring system can run well because every test carried out gives the expected results, namely the admin can receive a warning message via the Telegram Bot. The author concluded, that the messages are received in real time when the server computer / microservices system experienced a sudden downtime or overload, and warming. The appearance of automatic notification in the monitoring system is around 2.4 minutes after the incident. Meanwhile, by entering the test command / alerts, / silences and / the average on the Telegram Bot test, it response at the average of 1.33 seconds. With this monitoring system, when the server computer / microservices system is down or overloaded, the damage information can be conveyed to the admin in real time and it will be easier to get this information as well as be quick respond to repair when damage occurs.

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