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CLOUD-BASED GAME SERVER INFRASTRUCTURE AT PT. GAMES KARYA NUSANTARA (MAJAMOJO)

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ABSTRACT

In the era of the game publishing industry, MAJAMOJO collaborates with game developers in developing game server infrastructure in Indonesia, by realizing the adoption of cloud computing using the Roadmap for Cloud Computing Adaption (ROCCA) method. Cloud computing implementation by following 5 stages of modification of the ROCCA adoption model, namely the analysis, design, adoption, migration, and management stages. By using Amazon Web Service (AWS) Cloud Service (CSP) services. Cloud computing adoption is carried out by developing game server infrastructure as connectivity between the client and the game server. The analysis is carried out by collecting data and interviews from speakers, in the design of the cloud computing technology to be used, the selection of the technology is based on the results of the analysis stage, then the adoption process prepares the cloud infrastructure to be built, based on software selection and setting up servers with recommended specifications, then migration is the core of the cloud computing adoption process, Where the process transfers the system from the physical server to the virtual server, new management will be executed if the adoption and migration process has been completed with the Game Server and Game Client connectivity indicators running normally. With the application of cloud computing based on the characteristics of the cloud itself, it is flexible, scalable, and safe to access over the internet.

Introduction

In the increasing gaming industry and rapidly developing technology era, Telkomsel through PT. Telkomsel Digital Ecosystem and GoTo through PT. Anak Bangsa application created a Joint Venture (JV) company, namely PT. Games Karya Nusantara or Majamojo in 2022. Developing industrial business for the Southeast Asian market, focusing on game publishing development, by opening strategic partnership opportunities with third parties or game developers (Varghese & Buyya, 2018).

In the game industry, Majamojo will be a company that will publish various games in Indonesia and work with several game developers. To become a game publisher, information technology infrastructure is needed that can support the needs of game server infrastructure to run the company's business and operations. Where in the development of infrastructure requires some hardware and also a location for the data center of the infrastructure, therefore an effective and efficient solution is needed to accelerate business development using cloud-computing services (Simmon, 2018).

Cloud computing is motivated by the needs of the industrial world and computerization for the joint use of scattered computing resources but can be used as needed (on-demand). This course includes developments in hardware and software, libraries, and internet developments with the emergence of 4G and 5G internet technology which signify the progress of internet speed in the world in supporting the birth of cloud computing as a computing technology and service and computing resources (Shugrue, 2017).

Cloud computing is one of the technologies that change businesses and organizations. With the more mature cloud-computing technology, currently, many cloud-computing provider companies both local companies and world-class companies are competing to offer services such as Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS) services (Singh, Jeong, & Park, 2016).

The process of cloud computing adoption will be better if it is done systematically, therefore an adoption model is needed to analyze and provide the steps of the cloud computing implementation process (Gopal & Kaushik, 2017). Identifying the requirements definition is an important task because the requirements definition will determine how the cloud itself looks and how an institution can systematically accept it.

(Mengistu, Alahmadi, Albuali, Alsenani, & Che, 2017) conducted research related to the Implementation and Analysis of Mobile Cloud Gaming Online Using Open-Source Cloud Gaming Server Gaminganywhere On Android Devices that mobile cloud gaming is the development of infrastructure as a cloud computing service model. With the cloud gaming server service using open-source Gaming anywhere, mobile phone devices with Android operating systems that work as clients can access servers that run a game via a wireless network online (Kalaiprasath, Elankavi, & Udayakumar, 2017). The server captures audio frames and video frames are then encoded and sent to the client. To get the performance of the cloud gaming system implemented, tests were carried out with three parameters, namely resources, Quality of Service, and Quality of Experience. The result of client resource requirements only uses 6.2% CPU usage, 20.6 RAM for the Neverball game, and 3.6% CPU usage, 11.9 RAM for the Deadpool game. The client's FPS value is 29.1 for Neverbal and 14.5 for Deadpool. The total system delay is quite satisfactory, which is 0.19 seconds for Neverball on the local network and 0.35 seconds on the online network. While 0.3 seconds for Deadpool with local networks and 0.19 seconds for online networks.

Research (Cao, Li, Luo, Hao, & Jiang, 2018) related to Research on the Construction of Smart University Campus Based on Big Data and Cloud Computing, conducting the overall architectural design of a smart campus, and describing a big data platform, where the construction of a smart campus will bring major changes to education and teaching methods. Transformation of teaching models and methods, with the support of big data technology, through cloud computing, Internet of Things, and mobile internet technology, in-depth analysis and interpretation of data in colleges and universities. Research with the development of big data, and emerging technologies will

eventually be integrated into campus life, bringing services in a smart and oriented manner to lecturers and students of colleges and universities.

(Alfarug Asri, Audia Rizqa, &; Mira Maisura, 2020) research on the Implementation and Analysis of Skyegrid Cloud Gaming On Android Devices, cloud computing is the transformation of information and communication technology from client or server-based computers. Cloud computing technology benefits users because there is no need to spend massive investments on software or applications as well as hardware maintenance. A cloud gaming application called Skyegrid, the research aims to implement a cloud-based mobile cloud game infrastructure using an open source server (Skyegrid) to find out Resources, Quality of Service, and Quality of Experience. Skyegrid is used to test several popular games, namely games called Rainbow Six Siege and Monster Hunter World. The result of this research is that Skyegrid's mobile cloud gaming system can implement a PC game that can be run on an Android smartphone and reduce CPU resource usage and RAM usage, and low costs by using Skyegrid cloud gaming compared to the use of a personal computer which requires greater costs.

In the game publishing business in Indonesia, MAJAMOJO requires a strategy for building game server infrastructure. This is the challenge faced by Majamojo, not just getting customers or game players. Especially how to maintain customers to remain part of MAJAMOJO which continues as a user and can increase competitiveness in the future. Therefore, researchers are interested in conducting research on the development of game server infrastructure by adopting cloud computing at PT. Games Karya Nusantara (MAJAMOJO).

The process of cloud computing adoption will be better if it is done systematically, therefore an adoption model is needed to analyze and provide the steps of the cloud computing implementation process. Identifying the requirements definition is an important task because the requirements definition will determine how the cloud itself looks and how an institution can systematically accept it.

The Roadmap for Cloud Computing Adoption (ROCCA) adoption model is a model that focuses on the stage of building cloud computing. This model is relatively complete and can be arranged according to the needs of the organization or company, by utilizing this model and carrying out stages according to the needs of organizations and companies, it can optimize the use of cloud computing because it is done by analyzing and making roadmaps as a map of the needs needed by the organization or company. Factors that are the focus of cloud computing adoption in organizations or companies include trust, security, legal and compliance, and organizational issues. 5 stages are needed namely the stages of analysis, planning, adoption, migration, and management of companies that will implement cloud computing.

Cloud computing is a model or paradigm that allows access to a shared computing resource, such as networks, servers, storage, applications, and other services easily from various places where access can be built or removed quickly and easily with interaction from the cloud service provider (Mell et al., n.d.). According to the Oxford Dictionary, cloud computing is a remote control process that uses an internet platform to access an

online server to perform work orders such as storing, managing, and processing data, rather than using a local server or personal computer.

Cloud computing consists of 5 important characteristics, 3 models for services, and 4 infrastructures in cloud computing, while according to Onno W. Purbo (2013), cloud computing is a computing model, where resources such as processor/computing power, storage, network, and software become abstract and provided as services on the network or internet using remote access patterns.

Cloud gaming or on-demand gaming is a relatively new way to play games on computers, TV box devices, and mobile devices. High-performance games will be installed and run on powerful cloud servers run by certain companies and then streamed to the player's screen in digital format or video games. The input data from the user is transmitted with the help of ordinary devices such as keyboards, mice, or gamepads as game controls. The data is processed and transmitted to the remote server. Then all in-game actions, including execution and rendering, are performed on a remote server, and the information is transmitted back to the user's device screen via the Internet (Cai et al., 2016).

In simple form, it is the process of running an interactive gaming application remotely in the cloud and issuing output in the form of video to the user's device via the internet. The user interacts with the application through a thin client, which is responsible for displaying video from the cloud rendering and also collecting commands from the user and sending them back to the cloud.

The research adopts the Roadmap for Cloud Computing Adoption (ROCCA) model, a model that focuses on the stages of building cloud computing. ROCCA is relatively complete and can be arranged according to the needs of the company. By utilizing this model and carrying out in stages that are to the needs of the company, it can optimize the use of cloud computing because it is done by analyzing and making roadmaps as needed by the company.

Table 1
ROCCA Adoption Challenges

Challenge	Stages
Trust	Analysis, Planning, Adoption, Migration
Security	Analysis, Planning, Migration
Legal compliance	Analysis, Planning
Organizational factors	Analysis, planning, adoption, migration.

In Table 1 are the challenges of ROCCA adoption related to identifying, evaluating, and planning an effective migration process, along with aspects that cover each aspect of ROCCA:

1. Reliability.

The focus on the reliability of the game server system after migration involves ensuring high availability, stable connections, and consistent performance on cloud servers.

2. Optimization.

The purpose of optimization is to maximize the performance of game servers on cloud servers and analyze and optimize system configuration, databases, and caching to provide a smooth gaming experience to customers.

3. Cost

Evaluate the costs involved in migrating to the server cloud and long-term maintenance, to compare operational costs between on-premises servers and cloud servers, including hardware costs, licensing costs, and maintenance costs.

4. Compliance

Ensure that migrations comply with applicable security and privacy policies, including protecting user data, implementing necessary security measures, and complying with relevant regulations.

5. Agility

Consideration of the ability to make adjustments, scale, and elasticity in the management of game servers in the cloud. The advantage of cloud servers is their flexibility which allows them to organize resources tailored to needs.

The process of cloud computing adoption in ROCCA is divided into 5 phases as explained by Perdana (2017), namely the stages of analysis, planning, adoption, migration, and management.

1. Analysis Phase

This stage is an analysis of several possibilities that occur in building cloud computing. Take into account the internal needs of data needs for the company. Thus, accessibility that makes it easy for users needs to be considered. Compliance with regulations that have been issued by the government and adapted as needed. That way the organization's readiness for information technology needs to be measured using methods that have been prepared.

2. Planning Stages

This stage requires adequate data information because it requires measuring alignment with existing cloud computing. This use is to see how important and deep cloud computing will be built. The correlation with cost is crucial, with the need for hardware and software used. The safety factor is a factor that must be taken into account. At this stage security still uses the security system that has been provided by the service provider. Identification at this stage is to insert risks that will arise during implementation as a precaution.

3. Stages of Adoption

The next stage is the adoption of pre-planned needs, by actualizing the pre-planned infrastructure. Selection of software and applications by their designation. If needed, you can use a 3rd party to expedite the implementation. Pay attention to the Service Level Agreement (SLA), as needed. As well as clarifying user requirements in

the development of contracts. Identification at this stage is to measure what has been prepared in the previous stage. Prepare applications that are not yet in data integration in anticipation of migration needs.

4. Migration Stages

From the previous results, it can be seen that the results of the migration process can be carried out. The entire migration process should always be organized and supervised. In addition, it is necessary to provide support to the user. The implementation step of cloud computing is a series of migration activities carried out to support end-to-end migration (Taryana, Fadli, & Nurshiami, 2020). This process determines a comprehensive perspective, concurrently with business and technical issues. Involving stakeholders with different backgrounds, and supervision at this stage is necessary because this stage must ensure that the data is well integrated. In addition, it is necessary to provide support to the user. Support and control need to be done so that it can run according to plan beforehand. Risk identification is needed to be input for management (Ross, McEvilley, & Oren, 2016).

5. Management Stages

After the migration process, it is necessary to continue to supervise contracts and service providers in fulfilling SLAs using measuring instruments that have been determined in the previous stage. The role of management is very important, considering that up to this stage, it has gone through some heavy work. Management support helps streamline the distribution of information and necessary hardware and software needs (Bairizki, 2020). The implementation of documentation is very important because it can speed up repair work based on the needs needed. Software and hardware maintenance is an absolute must. Risk identification at this stage is knowing the risks that will arise to be discussed with top management. Cooperation with partners in reasonable cost estimates in dynamic load requirements needs to be considered and needs measurements tailored to application needs.

Research Methods

ROCCA adoption model in the development of cloud computing infrastructure for the realization of game server infrastructure. ROCCA is a general model that is often used in research related to cloud computing adoption, easily applied to several cloud computing, platforms, and any cloud infrastructure. However, ROCCA is more intended for the use of a public cloud model with Software as a Service (SaaS) services where users only choose one cloud computing service provider to implement.

The modification of the ROCCA adoption model still uses 5 (five) stages, namely Analysis, Design, Adoption, Migration, and Management. Changes in every detail of the stage (Dhib, Boussetta, Zangar, & Tabbane, 2016).

1. Analysis Phase

This stage begins with collecting data. The next step is to conduct interviews with parties responsible for IT infrastructure, such as the R&D department, IT department, programmers, and so on. Then observe the IT infrastructure that is already available

and record the devices and related applications that have been owned. Based on the results of the data collection, the analysis can be continued by planning a strategy for analysis results.

2. planning Stage

At this stage, the selection of cloud technology to be used is carried out, the selection of this technology refers to the results of the analysis stages carried out previously. The design costs are based on the selected cloud technology and the design of the adoption and migration process. This stage uses a pilot project model to determine the effectiveness of cloud computing implementation at PT. Games Karya Nusantara. This stage also determines what systems will experience the migration process to the latest infrastructure.

3. Adoption Stage

This stage is a preparatory stage where IT consulting institutions prepare cloud infrastructure to be built. Starting from choosing software and setting up a server with recommended hardware specifications. The next process is to install and create a game server. The route with the internet network for game clients and install firewalls.

4. Migration Phase

This stage can also be called the core of the cloud computing adoption process, which is moving applications from physical servers to virtual servers. Starting from creating a virtual server with default specifications and providing access to IT. Next, perform the game server and data migration process using the various migration methods available. If the system application undergoing migration does not have dependencies with other applications, it is recommended to use the logical backup method.

5. Management Stage

After the adoption and migration process has been completed with indicators that the application undergoing migration can run normally, this stage can only be done. Provide management authority to related parties, documentation, and handbooks to make it easier to overcome problems that will arise. Carried out at this stage is monitoring, support, and cost management of the use of cloud computing.

6. Proposed Method

Analysis of aspects of ROCCA (Reliability, Optimization, Cost, Compliance, Agility) and their application in-game server migration. Exposure to how each aspect of ROCCA contributes to the successful migration and its impact on the associated game server system.

Based on the results of analysis and planning, at the adoption stage, a cloud computing platform and infrastructure will be selected to be used by Majamojo for game servers.

The game server infrastructure migration phase will be carried out using AWS cloud services. Majamojo will migrate infrastructure in development first to identify possible risks that occur and mitigate these risks. Development is done for an initial process in migration before the public live server stage.

After the infrastructure development migration process is complete, management will then be carried out to supervise contracts with service providers in fulfilling SLAs and adjusting future service development, determining the management team for infrastructure development that has been carried out accompanied by documentation, monitoring and support facilities that support to maximize service functions both to internal and external parties in the university environment, in this Majamojo as a support for infrastructure development carried out.

Results and Discussion

Cloud Computing Infrastructure Testing

Infrastructure feasibility testing will be carried out to measure several things regarding cloud computing infrastructure that has been realized, as further level after the infrastructure migration process is complete, testing is carried out related to the following:

a. Performance

Measurement is done by ensuring the access performance of users who are operating on cloud computing does not interfere with connections from other users. On each device or device performance must remain equally good and the SLA of the service provider is appropriate.

b. Security Testing

Ensure only users who are given permission can access the cloud, check firewall settings, VPN, antivirus, and others.

c. Functional Testing

The data input process on the game server must validly show proper and appropriate connectivity, the system must be able to read the type of access of each user, and some available services must be integrated with the game server system and the system of the client itself.

d. Interoperability & Compatibility Testing

Checking the compatibility of client devices on cloud game servers, ensuring system verification can work on different platforms.

e. Network Testing

Checks include checking proper network connectivity, as well as checking data integrity when streaming data between the game server and client, as well as connectivity based on client latency.

f. Load & Stress Testing

Testing is carried out by checking services when several users access the server simultaneously (CCU), as well as checking for system changes in certain access loads.

The application of the Roadmap for Cloud Computing Adoption (ROCCA) adoption model in the implementation of cloud computing infrastructure development to support the realization of game servers, in practice it is necessary to make several adjustment modifications so that it can be implemented properly and according to needs.

In this implementation, several things must be faced, especially technological problems in Indonesia, including security problems and bandwidth limitations. Therefore, an appropriate strategy is needed for the adoption process of cloud computing technology. The 5 stages of the strategy include the stages of analysis, planning, adoption, migration, and management. The use of this strategy well is expected to be a key factor in the success of implementing cloud computing.

The adoption and migration of cloud computing is the most crucial stage because data and information need to be integrated with systems, then risk management to be developed. Risk identification is an additional method, it can reduce the risks arising in its implementation. After risk identification is obtained, the next stage is to manage risk.

Conclusion

The results of the tests that have been carried out can be concluded that the infrastructure with the cloud computing model adopted using the Roadmap for Cloud Computing Adoption (ROCCA) method is by the business at PT. Games Karya Nusantara in overcoming several problems regarding the latency of game clients to cloud game servers has resulted in good and smooth game server performance and traffic without any problems for users who are directly tested by Majamojo customers. The application of the Roadmap for the Cloud Computing Adoption model has also been used as a reference at PT. Games Karya Nusantara (Majamojo) in the process of flexibility migrates on-premises game servers to cloud game servers. In the adoption process using the ROCCA model, several applications of cloud computing technology are implemented. In the future, in terms of development related to the adoption of game server infrastructure in the cloud environment, it will be carried out gradually to continue performance testing with a larger user capacity, auto-scale testing on cloud game servers, and several applications of cloud technology that have been realized in writing a thesis that the author has implemented using the Roadmap for Cloud Computing Adoption (ROCCA) model.

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