Function Group Based of Indonesian e-Government Grid Services Topology

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Abstract

Information and Communication Technology (ICTs) is growing rapidly due to human needs for communication and fast access to information. This brought a new awareness around the world to create good governance and clean government. This is known as public management reform, called e-Government (e-Gov). Interoperability is a key issue in implementing an e-Government system. Grid-based services for interoperability (eGov Grid) could be a solution for resource sharing and interoperability of e-Gov systems. This paper report is the result of Indonesian government e-Gov policy study and simulation of initial eGov Grid Service Model in the country which aims to create good and clean governance.

Keywords*: E-Government, Grid Services, e-Government Grid*

1. Introduction

The use of Information and Communication Technologies (ICTs) has been pointed out as fundamental paths towards improving democracy and increasing people's participation in the decision-making process. It forces government to make new management patterns that related to issues of transparency, accountability, efficiency, effectiveness, service and other public policies in order to respon the community aspiration. There is ban initiative that the world should make renewal in the service and public management in order to make a new awareness throughout the world to create good governance (good governance and clean government) [1].

Good governance according to UNDP, is, among other things, participatory, transparent and accountable, effective and equitable. It promotes the rule of law. Good governance ensures that political, social and economic priorities are based on broad consensus in society and that the voices of the poorest and the most vulnerable are heard in decision-making over the allocation of development resources [2].

Public management reform is influenced by management progress of ICT, called e-Government (e-Gov) which is the use of information technology to perform activities of government services to the public.

1.1. Governance System in Indonesia

The Indonesian Central Government (called the Government) is the President and its supporting units which holds the power of the government as defined in the Constitution of the Republic of Indonesia Year 1945. To conduct governance, the Government uses the principle of Decentralization, see Fig 1. Task Assistance, and Deconcentration according to laws and regulations [3].

Government in conducting the government affairs has a relationship with the local governments. This relationship includes the authority relationships, finances, public services, resource utilization, and other resources.

1.2. E-Government in Indonesia

The initiative of e-Government in Indonesia was introduced through President Instruction No. 6/2001 dated 24 April 2001 on Telematika (Telecommunication, Media, and Information) which states that government apparatus should use the technology of Telematika to support good governance and to accelerate democracy process. Furthermore, e-Government should be publicized for different objectives to the governmental offices. Public administration is one of areas in which Internet can be used to provide access for citizens who constitute basic service and to simplify the relations between citizens and government [5].

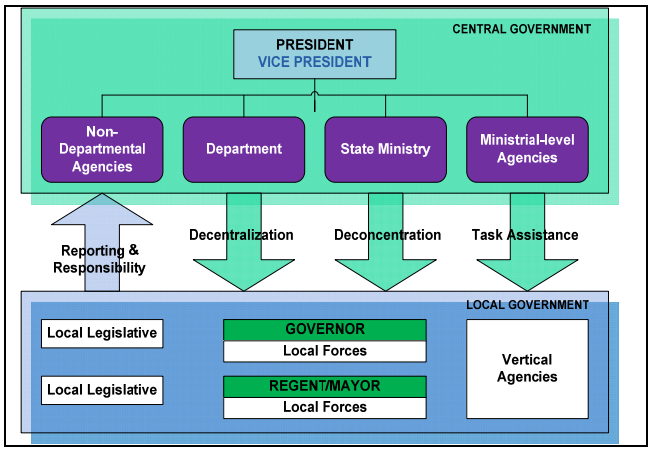

Fig. 1. Governance System in Indonesia [4]

It enhanced by Presidential Instruction No.3 Year 2003 about National Policy and Strategy of e-Government Development. It is an effort to build an electronic-based governance in order to improve the quality of public services effectively and efficiently. E-Government development means that management systems and work processes are reorganized within governmental agencies to optimize the utilization of information technology [6].

In Indonesia, e-Government is needed to support the government change towards a democratic governance practices and to support the application of authority balances between central and local government. Indonesian E-Government is also needed to facilitate communication between central and local governments, to gain openness and transformation towards information society era.

Changes are expected to build clean and transparent government which is capable to respond the changes effectively, to build a new dimension into organization, management system and process, and soon to apply the transformation process towards e-Government.

Considering that the scope of e-Government is not only for Local Government, but also for the Central Government which will lead to national interests. It is important to provide a standard guide of e-Government development to ensure that the system can fulfil the desired expectations and also to synergize one another (interoperability), among Central and Local Government agencies, as well as all the potential resources of the Republic of Indonesia.

Some factors to consider for developing Indonesia E-Government [6]:

1. Consistently approach to the citizens, businesses, employees and local government in conducting a business transaction with the central government.
2. Development a shared strategic vision at all levels to build e-Government, including the technical architectures.
3. The design of standards-based approach to implement e-Government
4. Cooperation and collaboration among all parties to make e-Government policy.

The benefit gained from e-Government is not only providing online service but it is wider than that, because public sector performance also contributes to social economic progress of a country. In the globalization era the implementation of e-Government is very crucial because it has modernized public government worldwide and also the relationship between governments or countries. In conformity with aims to be achieved soon or later Indonesia is required to be able to implement e-Government. At this present e-Government is a necessity within the scope of constructing better public service.

There have been various types and specifications of technology that was implemented by each government agency. Determination to apply a particular technology on e-Government implementation will impact on the investment that has been expent by each agency. This can lead to enormous waste and state financial harm for the whole country. Access, infrastructure and basic applications is the key components to support the implementation of public services portal by information management and processing organization.

Based on strategic plan of the State Ministry of Communication and Information, there are some strategic plans to develop e-Government as follows [7]:

1. To develop a good service system with reasonable cost. The focus are to extend and improve the quality of information and communication network, to build the information portals and integrated public services, to build the electronic document management system, standardization and information security system;
2. To develop management system of central and local government. The focus are to improve the quality of services needed by the community, to manage the changes, to enforce the leadership and to improve the product of the regulation.
3. To optimize the use of information technology. The focus are on building the interoperability, standardization and procedure of electronic document management system, information security, basic application (e-billing, e-reporting) and to develop inter government network.
4. To improve the participation of private sector and information technology industry. The focus are to use the expertise of the private sector, to encourage participation of private sector and small industries.
5. To develop manpower capacity in the central and local government. The objectives are to develop ICT culture in government institutions, to optimize the use of ICT training facilities, to extend the use of ICT for distant

learning, and to put ICT as input for school curriculum and to improve the quality of teaching.

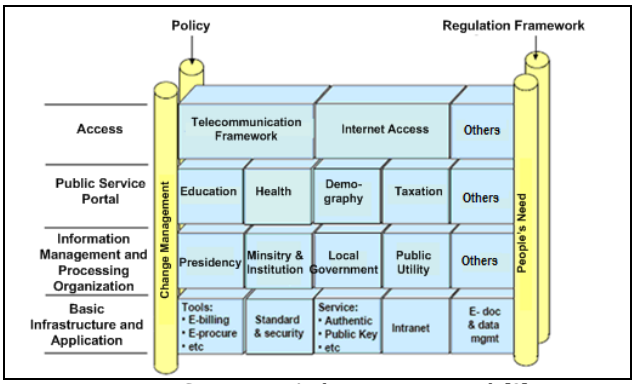

Fig 2. e-Government Architecture Framework [8]

1.3. E-Government Interoperability

Data and information integration is important among government agencies. It needs to formulate methods and technology of collaboration. The requirements of a broader and comprehensive data interaction among government agencies, especially in the use of data and information together should be encouraged.

Interoperability concepts and strategies are crutial agenda of the national e-Government development to achieve integrated, safe and efficient utilization of data and information.

Interoperability is defined as system ability to share and integrate information and work processes using a set of standards. One of solutions to the interoperability problem is using Grid technology. Open grid services aim for the integration of services across distributed and heterogeneous virtual organizations with disparate resources and relationships [9].

Indonesia government does not have a specific policy which deals with this interoperability yet. And there are not many research and applications in other country that discusses e-Government Grid in details. It happens because the development of e-Government Grid in some countries have not run as expected.

There are two types of approaches addressing e-Government interoperability, first based on cross-organizational workflow [10][11][12][13] and semantic web or semantic driven [14][15][16].

Service grid [17], a kind of combination of grid computing [18] and SOA technology, open up a new way for cross-organizational resources integrating and collaboration in e-Government. Service grid technologies can be used to build the platform resource sharing in e-Government system, and also bring new feature of better reusability, flexibility and scalability. Yang, et al, [19] proposed a service-grid-based framework for Shanghai e-Government interoperability, named eGov Grid, which targets at facilitating among "horizontal" organizations and interoperability among "vertical" e-Government subsystems. Hereinafter, "horizontal" means cross-organizational application, and "vertical" means information system within one organization.

Nugroho & Suhartanto [20] proposed Indonesian Education Grid Topology using Gridsim toolkit that discusses the design and simulation of an e-learning computer network topology, based on Grid computing technology, for Indonesian schools called the Indonesian Education Grid (IndoEdu-Grid). This work encouraged us to design and simulate the topology of Indonesian e-Government Grid services using GridSim toolkit.

1.4. Grid Computing Concept

The concept of Grid is taken from a distributed computer that is a concept of connecting supercomputer to metacomputer. The word Grid comes from the Electricity Grid which is an electronic device plugged into the grid that will acquire the same resources regardless where that source took place. Grid computing is a new information technology architecture that produces low-cost enterprise information systems and more able to adapt to business dynamics.

Grid middleware is used to bring a various number of resources of grid computing. Middleware is set of software that manage resources so that accessible to clients without having to know the configuration. There are several other levels to configure grid computing architecture such as local resource manager, core middleware, application development and deployment environment.

1.5. E-Government Grid Architecture

The traditional pattern "information center" adopts centralized data storage, which cannot easily adapt to an open e-Government environment due to non real-time update and high costs for management and maintenance of centralized data. Web services provide a loosely-coupled mechanism to encapsulate resources with standardized interfaces, which enables users to plug-in/out resources dynamically. Users only need to use Web services, do not need to concern, manage, and maintain resources behind a Web services. The previous architecture of e-Government applications is illustrated in Fig. 3 [19].

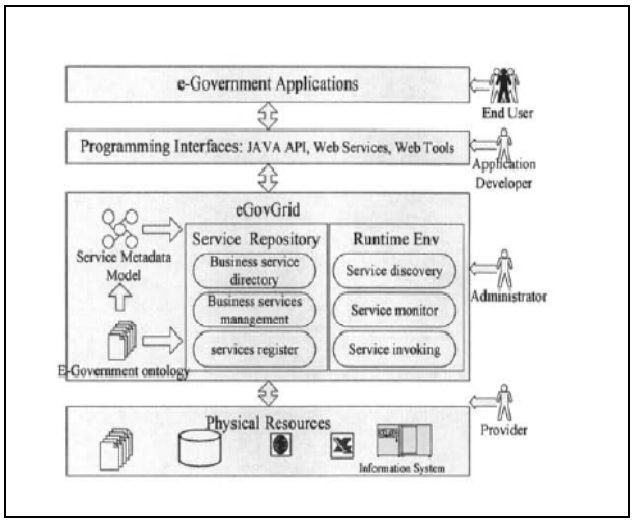

Fig. 3. Architecture of eGovGrid [19]

1.6. E-Government Grid System

The e-Government grid system is to cooperate with legacy systems of government's departments. The system supports the grid community through grid middleware based on multi-agent systems. Grid Manager manages the grid community that consists of legacy systems. Figure 4 shown the overview of an example of e-Government grid system [21].

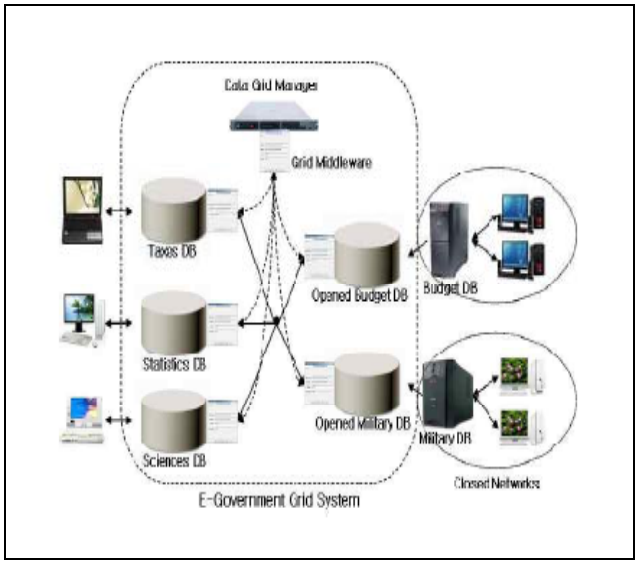

Fig. 4. *E-Government Grid* [21]

2. Design and simulation of e-Government Grid Services in Indonesia

The e-Government Grid Service Model in Indonesia is an adjustments based on the framework of existing e-Government and also the form of government in the country. Grid has proven resolve the problem of resources sharing on information that placed separately and dynamic including the sharing of data structures, databases, computational resources, storage resources, and other informations using open-standard protocols. The use of open-source to meet the requirement of the e-Government that have already designed a set of middleware to support the E-government applications is necessary and it can reduce the cost of the government and fully utilize the IT resources existing in the government.

The power of Indonesian government is concentrated in the central government with regional autonomy. The division of tasks and responsibilities between the Central Government and Local Government conducted by the Act [see Fig. 1 above].

Function application on Indonesian e-Government framework is divided into three sub-groups according to service types of e-Government based on user orientation as follows:

1. E-Government application systems group in which orientation function is to serve the needs and interests of the public (G2C: Government To Citizen)
2. E-Government application systems group in which orientation function is to serve the needs and interests of the business (G2B: Government To Business)
3. E-Government application systems group in which orientation function is to serve the internal needs of governmental agencies, or the needs among government with other government agencies (G2G: Government To Government)
4. E-Government application systems group in which orientation function is to serve employees of governmental agencies (G2E: Government To Employee)

Grid in the initial model of Indonesian e-Government Grid services is placed on service layer that enables resource sharing and interoperability among group functions where there are services repositories that serve as a virtual resource pool and runtime environment for discovery and invoking services [22].

The physical resources layer is decomposed into two layers, they are basic application and function application. The latter is divided into public, business and government oriented services. Given this separation, the process of

resources sharing among government agencies can be more specific depending on the services to be provided.

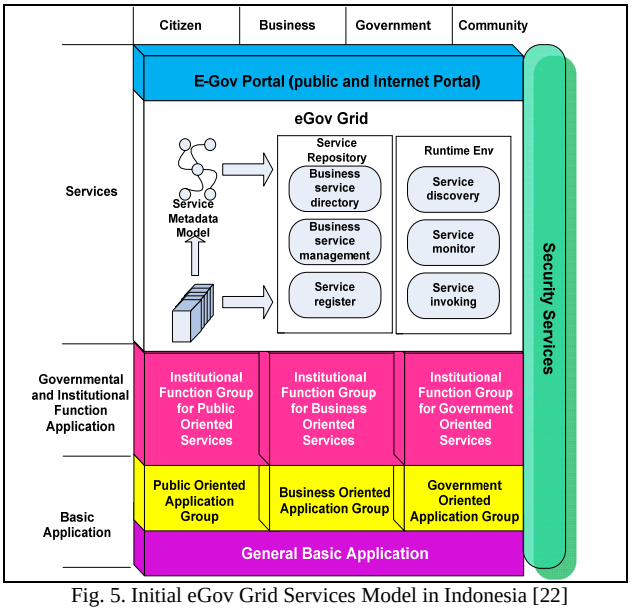

Fig. 5. Initial eGov Grid Services Model in Indonesia [22]

To evaluate and analyze the performance of a Grid system, the experiment must be repeatable and controlled. It will be hard to conduct considering the characteristics of Grid system that is heterogeneous and dynamic. Besides, the developing environment of testing system (testbed) for Grid systems is very limited, expensive and time consuming and should handle administration policy that different on each resource. Thus, it needs a simulation to study the behavior of Grid system and implement some complex scenarios to see the behavior of the system. Simulations can be performed on a single computer so that the cost, time of development and other barriers can be overcome.

GridSim toolkit (or GridSim) is developed with Java and is used to build discrete-event simulations of Grid systems. GridSim is an open-source application and licensed under GPL license, thus it encloses its source codes in its distribution package. GridSim's rationale is that creating a testbed infrastructure for Grid system is expensive and time-consuming, even an existing testbed infrastructure is also limited in size to a few resources and domains, and testing scheduling algorithms for scalability and adaptability, and evaluating scheduler performance for various applications and resource scenarios is harder and impossible to trace. This is because the Grid resources have a different administrative domain with different policies, users, and priorities. GridSim is built to overcome these problems, so that users can simulate a variety of scheduling algorithms and resource allocation scenarios and make thousands or even millions of resources with thousands of users. There are salient features of GridSim from supports the modeling of heterogeneous type resources to simulation of both static and dynamic schedulers, details is in [23].

The modular architecture of GridSim platform and components shown in the figure below:

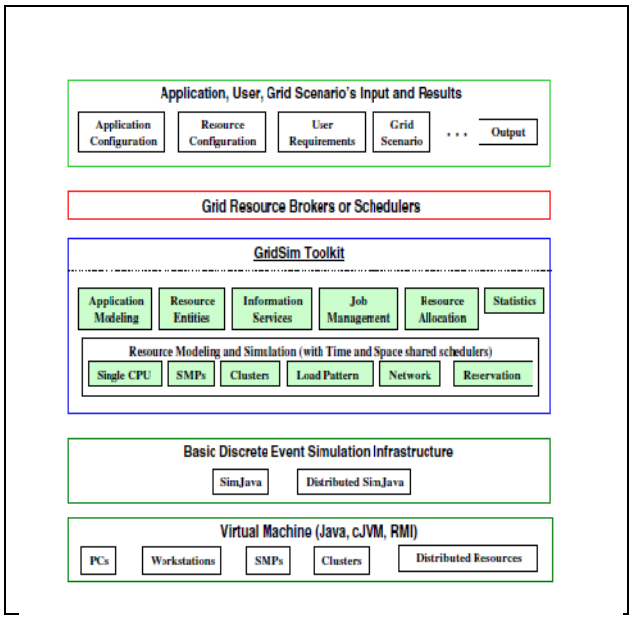

Fig. 6. Modular architecture of GridSim Platform and Component [23]

The simulation consists of three scenarios divided based on the configurations of the router and link connections. We use three different types of scenarios to see whether the effects of the formation or hierarchy of links and router configurations–which connect the ministry / agency / department / institution (M/A/D/I) that have functions to serve the public/citizens (G2C), business groups (G2B), inter-agencies (G2G) and services to employees (G2E). All of the M/A/D/I are connected with each other, so we can say that each M/A/D/I has a G2G function, but in this research, the G2G is more directed to the government service for other countries, because of all the M/A/D/I is considered to have connected one another. The division is conducted because there is a method of clustering in the Grid that has a significant impact on the performance of Grid systems.

Simulations are performed using three scenarios and divided based on the link connectivity and router configurations hierarchically to determine the effect of the configuration of the links and routers that are connected. The three scenarios will show the shortest processing time in the grid services. The scenarios show the function of each group of services perform by the government [see Fig. 5].

After studying the system of Indonesian government, the e-Government Grid services in Indonesia can be constructed as follows:

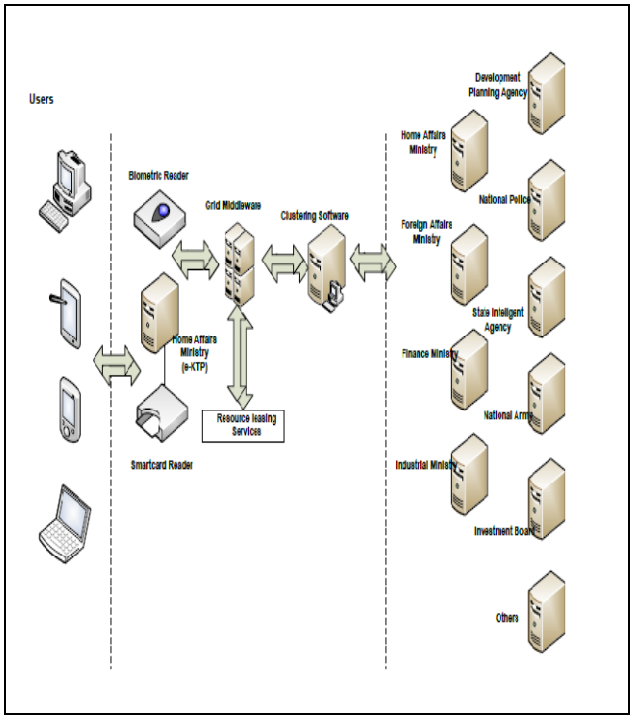

Fig. 7. E-Government Grid Services Model in Indonesia

2.1. First Scenario

The first scenario represents group function of e-Government in Indonesia. Each group perform a specific services according to the duties and functions as provided in laws and regulations.

This scenario is created by the division of the hierarchical model based on the services provided as described above, namely G2C, G2B, G2G and G2E. This scenario involves three types of routers that are configured hierarchically which consist of leaf routers, edge routers and core routers. Leaf router is a router that is connected directly to the host on the network. Host can be either a user's computer or resources on the Grid system where the function of leaf router to handle incoming packets into or out of the host. Leaf routers are connected by an edge router that is situated in a central core router. Central core router is a router in the core network and serves the whole sub-network into a single large network. Baud rate for link that connects a whole host with leaf router is set at 10 Mbps (megabits per second), while the baud rate for link that connects the leaf router with edge router is set at 100 Mbps and baud rate for the link that connects all the edge router with central router is set at 1 Gbps (gigabit per second). The following figure shows the network topology for the first scenario.

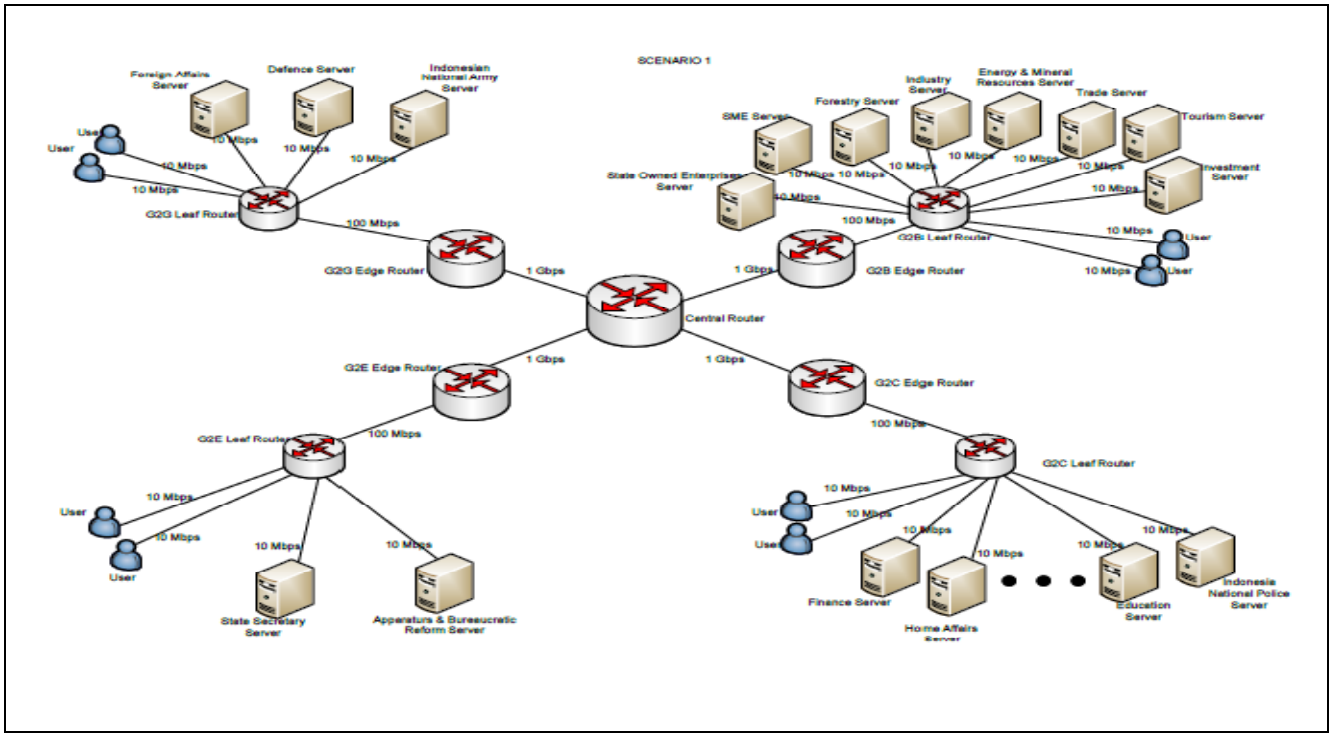

Fig. 8. First Scenario

2.2. Second Scenario

The second scenario is similar with the first scenario. The difference is this scenario only involves two types of routers that are leaf router and edge router which configured hierarchically according to the function groups as described above. Leaf router connecting the hosts to edge router that in the second scenario all the edge router connected by high-speed network between router. Baud rate for link that connects all hosts with leaf router is set at 10 Mbps. Baud rate for link that connects leaf router with edge router is set at 100 Mbps and baud rate for link that connects edge router is set at 1 Gbps.

Fig. 9 shows the network topology for the second scenario.

2.3. Third Scenario

The third scenario represents the whole M/A/D/I of Indonesia government structure. In this scenario each agencies connect direclty and involves the leaf router that connects all M/A/D/I by services with high-speed network among routers. Baud rate for link among leaf router is set at 100 Mbps.

Fig. 10 shows the network topology for the third scenario.

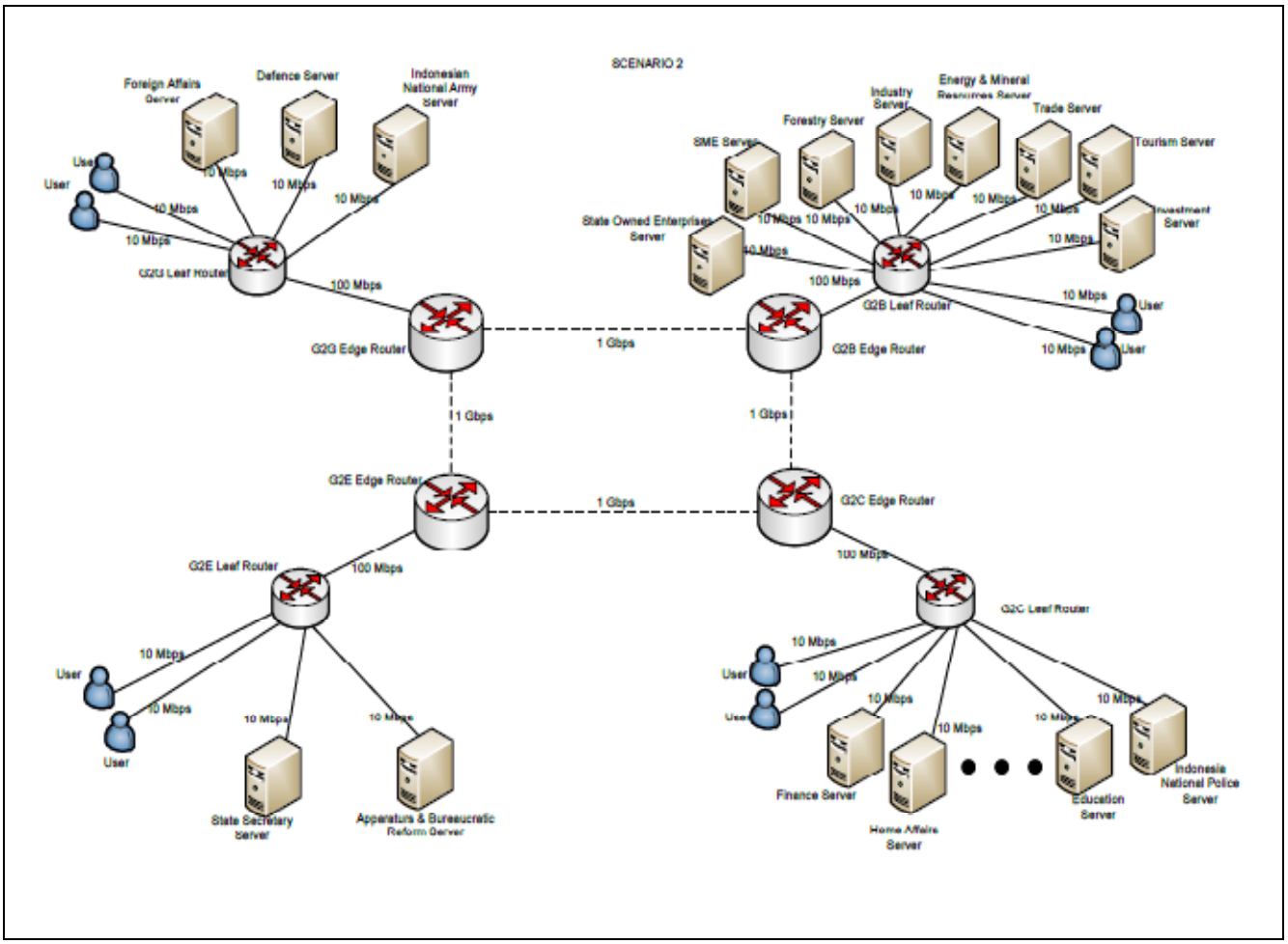

Fig. 9. Second Scenario

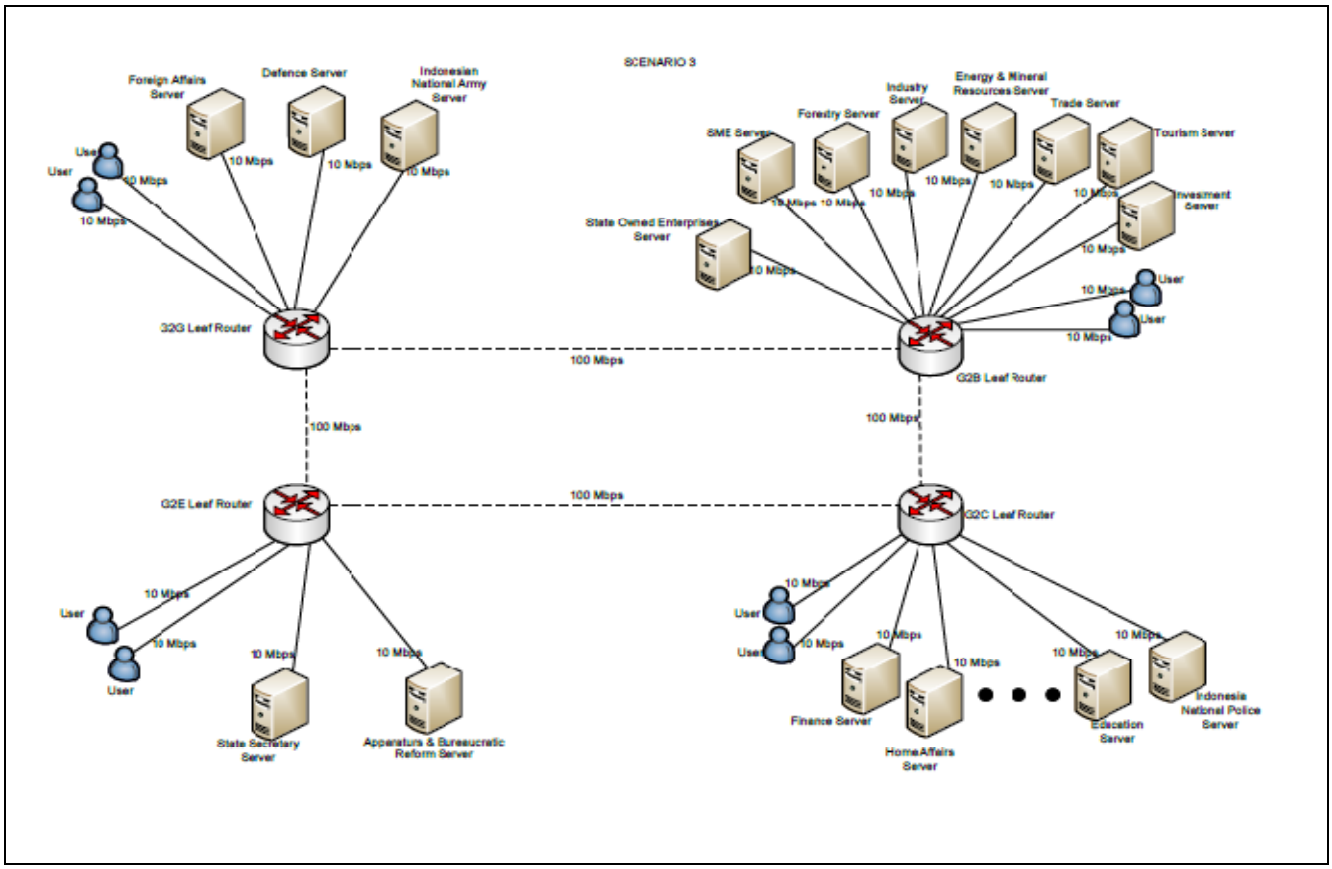

Fig. 10. Third Scenario

2.4. Result

The result data from simulation of the three scenarios are shown in the table below:

Table 1. Result of the simulation

Scenario	Procesing Time (FIFO algorithm)	Processing Time (SCFQ algorithm)
Scenario 1	120,21711	122,90021
Scenario 2	120,61980	123,30901
Scenario 3	120,07479	124,12805

The data above can be analyzed that in the development of e-Government Grid in Indonesia using FIFO (First In First Out) scheduling algorithm, then the most suitable is the topology that allows data packets having a low number of hops. In this simulation, network with the lowest number of hops seen in the third scenario. Topology in the first and second scenario make the processing time becomes longer because the data packets will have a larger number of hops.

If using SCFQ (Self-clocked Fair Queuing) scheduling algorithm, then the most suitable is the topology that makes the data packets with the same priority has small possibility to meet each other in a single router or link. In this simulation, topology that meet this condition is a topology on the first scenario.

Indonesia has a large number of ministry / agency / department / institution (M/A/D/I) and also has 33 provinces with 398 regencies, 93 municipalities and 6 adminstrative regencies/municipalities that are not autonomous region and that do not have a board of local representatives.

As a developing country which has just initiated an e-Government, Indonesia requires major infrastructure development hence a great amount of investment. The separation of basic application and function application make the interoperability processes easier because specific services are made in cluster. The division of the apllication also influences the development of e-Government Grid Services independently and gradually.

3. Conclusion

The research aim is modelling an e-Government Grid in Indonesia by performing a simulation using GridSim toolkit that is based on the Java programming language. Simulations carried out by testing three different types of topologies in terms of link and router configuration with FIFO and SCFQ algorithms. The result is the average time processing that is used to obtain the most effective topology for each scheduling algorithm.

From the simulation results can be concluded that the SCFQ scheduling algorithm tends to create packets lifetime in the router with heavy traffic becomes shorter. Packet lifetime is the time of packet in the queue or the time difference between time the packet is enter into the queue and time the packet is out of the queue. It is due to packet priority setting where high-priority packet will be prioritized so that the overall packet lifetime will be reduced.

In examining the details above and considering the existing condition, the practice of e-Government Grid Services in Indonesia is facing some challenges in particular encountered by government organizational. The application of e-Government Grid Services in the public officials needs to be supported by the policy and employees who understand technology well. Which is also needed are the officials who motivate to learn and be able to manage change. Information technology changes fast so that the willpower to learn has to be owned by every public institutional employee.

The policy to implement e-Government Grid Services needs a standardized legal foundation of implementation. In addition to the policy it is also necessary to determine further legal foundation for technical and manual of e-Government Grid services implementation.

In our next works, the model of e-Government Grid Services will be improved by considering some factors in existing practices which are done by some government units and government agencies. As the current work focused only on central e-Government service, in the future the services which cover the whole parts of the country will be considered.

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