E-Government Grid Services Topology Based On Province And Population In Indonesia

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***Abstract*— 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-based services for interoperability could be a solution for resource sharing and interoperability of e-Government systems. In previous study, we designed and simulated the topology of Indonesian e-Government Grid services based on function group from e-Government application solution map to connect the ministry/agency/department /institution. In this paper we analyse the result of e-Government services topology simulation based on the province and population in the country.**

Keywords— e-Government; Grid Services; e-Government Grid

I. INTRODUCTION

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.

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. It is a permanent commitment made by the government to improve the relationship between the private citizen and the public sector through enhanced, cost-effective, and efficient delivery of services, information and knowledge [1].

Chen, et al [1] proposed that one needs to consider some factors such as History and Culture, Technical Staff, Infrastructures, Citizens and Government officers for studying e-Government of a country. For Indonesian case, these factors are provided in Table I.

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.

TABLE I. FACTORS FOR STUDYING E-GOVERNMENT IN INDONESIA

Indonesia	
History and Culture	• Indonesia is a Republic with a presidential system, and a unitary state with power concentrated in the national government. • Since 1945, Indonesia has been struggling with democracy and after reformation in 1998, Indonesia has been experiencing a democratic movement generated in a new political conditions. • Although there are some problems of poverty, health and infrastucture, Worldbank reported as of July 2012, Indonesia's economy baseline outlook for growth is expected to be 6 percent in 2012 and increase to 6.4 percent in 2013 [2]
Technical Staff	• Indonesia has a large number of in-house staff but since there is no policy standard of e-Government implementation, the current staff unable to define specific requirements. • Some provinces in Indonesia have an ability to implement e-Government because of good financial and staff, but others still face some problems to implement it.
Infrastructure	• Since Indonesia has more than 17,000 islands and 33 provinces, in some areas with high population like Java island, there are superior current infrastructure and high internet access for employees and citizens, but in remote areas there are inferior current infrasturcture and low internet access for employees and citizens.
Citizens	• In a big city like Jakarta, Surabaya and others, there are high Internet access and citizens are trust in online services; many citizens know how to operate computers, but in a small town, there are low Internet access and citizens are reluctant to trust online services; few citizens know how to operate computers • Since Indonesia has a new experience of democracy after 1998 reformation, citizens more actively participate in governmental policy-making process
Government Officers	• Indonesia Government reported that in 2012 the number of Internet users in Indonesia significantly increased to 55 million, 25% of population in this country has access to computer and internet as well.

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.

Since Indonesia have not yet implemented Grid technology to conduct e-Government services, we propose the e-Government Grid services topology based on the province and population. A topology of our scenario is a schematic description of the arrangement of a network.

Our proposal will give a new perspective to develop e-Government in Indonesia to achieve a good governance and a clean government. As developing country, 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.

A. E-Government Implementation Strategy

The United States, as the largest developed country, has one of the most advanced e-Government Infrastructures in the world that focuses on increasing effectiveness and efficiency of government work and at the same time, reducing costs [1].

In 2012, US Government launches new Digital Government strategy, entitled "*Digital Government*: *Building a 21st Century Platform to Better Serve the American People*". The Digital Government Strategy sets out to accomplish three things [3]:

1) Enable the American people and an increasingly mobile workforce to access high-quality digital government information and services anywhere, anytime, on any device. For interoperability and openness, modernize our content publication model, and deliver better, device-agnostic digital services at a lower cost.

2) Ensure that as the government adjusts to this new digital world, we seize the opportunity to procure and manage devices, applications, and data in smart, secure and affordable ways. Build a sound governance structure for digital services, and do mobile "right" from the beginning.

3) Unlock the power of government data to spur innovation across our Nation and improve the quality of services for the American people. Enable the public, entrepreneurs, and our own government programs to better leverage the rich wealth of federal data to pour into applications and services by ensuring that data is open and machine-readable by default.

B. E-Government Development Stages

According to the United Nations E-Government Survey in 2012, Indonesia increased its world e-Government ranking from 109 in 2010 into 97 in 2012. It showed that Indonesia have made a tremendous effort to provide e-Government services to its people, despite the challenges faced by the country.

The United Nations Department of Economic and Social Affairs [4] conducted an assessment of e-Government in large countries by evaluating the *information services* developed by the Government such as websites to provide information on public policy, governance, laws, regulations, relevant documentation and types of government services provided. It is expected that the websites have links to ministries, departments and other branches of government.

The next stage is to asses whether the *enhanced information service* is available which is expected that the government websites deliver enhanced one-way or simple two-way e-communication between government and citizen. Citizens can download forms for government services and applications. The sites also have audio and video capabilities and are multi-lingual, among others.

The next stage is to asses whether the *transactional services* engaged in two-way communication between government with their citizens, including requesting and receiving inputs on government policies, programmes, regulations, etc. In this stage, some form of electronic authentication of the citizen's identity is required to successfully complete the exchange. Government websites process financial and non-financial transactions.

And the last stage of e-Government in large countries is connected service where the government websites have changed the way governments communicate with their citizens from a government-centric to a citizen-centric approach.

C. E-Government 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 [5]. To conduct governance, the Government uses the principle of Desentralisation, Deconsentration and Task Assistance [6]. 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.

The initiative of e-Government in the country was introduced through President's Instruction No. 6/2001 dated 24 April 2001 on Telematika (Telecommunication, Media, and Information) which states that government officials 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 [7].

The initiative is then enhanced by Presidential Instruction No.3 Year 2003 on 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 [8].

Some factors to consider for developing e-Government in Indonesia were proposed in[8], they are:

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.

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.

As the developing country, Indonesia has some strategic plans to develop e-Government as follows [9]:

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.

Data and information integration is important among government agencies in Indonesia. 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 [10].

E-Government interoperability can be addressed using a cross-organizational workflow [11][12][13][14] and semantic web or semantic driven [15][16][17].

Yang, et al [18] 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. According to Yang, et al [18], service grid [19] is a kind of combination of grid computing [20] 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.

II. Design and Simulation of e-Government Grid Services in Indonesia

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 information 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 [21].

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 expended by each agency. This can lead to enormous waste and state financial harm for the whole country. Access, infrastructure and basic application is the key components to support the implementation of public services portal by information management and processing organization. We have proposed a function group based of Indonesian e-Government services topology as the result of the simulation using 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 that have functions to serve the public/citizens (G2C), business groups (G2B), inter-agencies (G2G) and services to employees (G2E). 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

application also influences the development of e-Government Grid Services independently and gradually [22].

In this paper, we simulate scenarios based on province and population in Indonesia. Our topology and scenarios follow that of Suhartanto, et al [23] with some modification for e-Government purpose. In our topology, we considered the government of Indonesia data consisting of 33 provinces, 370 regencies and 95 municipals [24] and also the number of population of each province based on results of 2010 population cencus by Indonesian Statistics Office [25]. Although the Minister of Internal Affairs of Indonesia said the moratorium or suspend the expansion area will be in place until the end of 2012 but in fact, at October 22, the parliament of Indonesia and the Government agreed for the addition of new province in Indonesia, that is North Kalimantan which is the division of the province of East Kalimantan. It will take 3-5 years for the preparation of new province infrastructures, so we used the number of province that has been in operation and have an administrative service to the citizens.

These are given details in the Table II.

To evaluate and analyze the performance of a Grid system topology, the experiment must be repeatable and controlled. It will be hard to conduct heterogeneous and dynamic Grid system. In addition developing environment for testing Grid systems is very limited, expensive and time consuming and it also should handle administration different policy 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. As our previous works, In the simulation, we also used GridSim of Buyya and Murshed [26].

We design the simulation that consists of three scenarios based on various 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 province grouped by island and region. Simulations are performed using three scenarios 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. We use FIFO (First In First Out) scheduling algorithm and SCFQ (Self-cCocked Fair Queuing) scheduling algorithm.

A. First Scenario

The first scenario divides the country into three region according to its time division, namely west Indonesia consisting of Sumatera and Java islands, central Indonesia consisting of Kalimantan, Sulawesi, Bali and Lombok Islands, and east Indonesia consisting of Maluku and Papua islands. The scenario involves three types of routers that are configured hierarchically which consist of leaf routers, edge routers and core routers. The leaf router is a router that is connected directly to hosts on the network.

TABLE II. PROVINCE AND POPULATION IN INDONESIA

o	Province	Regency	Municipal	Population
1	Nanggroe Aceh Darussalam	18	5	4,494,410
2	Sumatera Utara	21	7	12,982,204
3	Sumatera Barat	12	7	4,846,909
4	Riau	9	2	5,538,367
5	Jambi	9	1	3,092,265
6	Sumatera Selatan	11	4	7,450,394
7	Bengkulu	8	1	1,715,518
8	Lampung	9	2	7,608,405
9	Kep. Bangka Belitung	6	1	1,223,296
10	Kepulauan Riau	4	2	1,679,163
11	DKI Jakarta	1	5	9,607,787
12	Jawa Barat	17	9	43,053,732
13	Jawa Tengah	29	6	32,382,657
14	Daista Yogyakarta	4	1	3,457,491
15	Jawa Timur	29	9	37,476,757
16	Banten	4	3	10,632,166
17	Bali	8	1	3,890,757
18	Nusa Tenggara Barat	7	2	4,500,212
19	Nusa Tenggara Timur	19	1	4,683,827
20	Kalimantan Barat	12	2	4,395,983
21	Kalimantan Tengah	13	1	2,212,089
22	Kalimantan Selatan	11	2	3,626,616
23	Kalimantan Timur	10	4	3,553,143
24	Sulawesi Utara	9	4	2,270,596
25	Sulawesi Tengah	9	1	2,635,009
26	Sulawesi Selatan	20	3	8,034,7

				76
27	Sulawesi Tenggara	10	2	2,232,586
28	Gorontalo	5	1	1,040,164
29	Sulawesi Barat	5	-	1,158,651
30	Maluku	7	2	1,533,087
31	Maluku Utara	6	2	1,038,087
32	Papua	20	1	2,833,381
33	Papua Barat	8	1	760,442

A host can be either a user's computer or resources on the Grid system and the function of the leaf router is to handle packets movements into or out of the host. The leaf routers are connected by an edge router that is situated in a central core router. A central core router is a router in the core network and serves the whole sub-network into a single large network. A baud rate for a link that connects a whole host with leaf router is set at 10 Mbps (megabits per second), while the baud rate for a link that connects the leaf router with edge router is set at 100 Mbps and the baud rate for the a link that connects all the edge router with central router is set at 1 Gbps (gigabit per second) because edge router have a function to forward packets in between networks. Core routers due to their role as internet backbone routers, support multiple telecommunication interfaces with high data throughput. A baud rate for link among core router is set at 500 Mbps.

Fig. 1 shows the network topology for the first scenario.

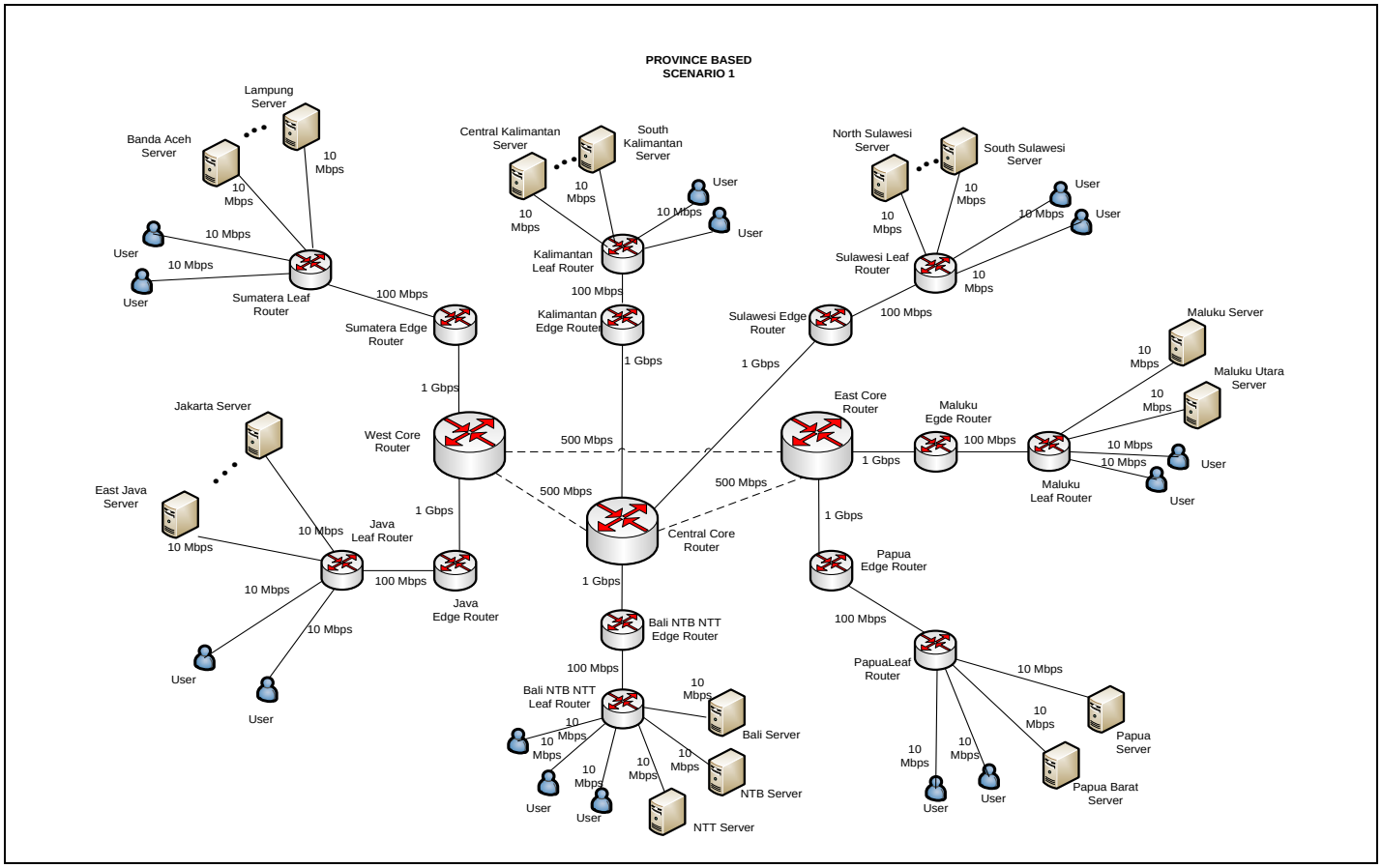

Fig. 1. First Scenario

B. Second Scenario

The second scenario is almost similar to the first scenario. The difference is that this scenario involve two types of routers, they are leaf routers and edge routers which configured hierarchically. The leaf routers are connecting the hosts to edge router and all the edge routers are connected by high-speed network between routers. A baud rate for a link that connects all hosts with leaf router is set at 10 Mbps. A leaf router is responsible to gather group information. While the baud rate for link that connects leaf router with edge router is set at 100 Mbps and the baud rate for link that connects edge router is set at 1 Gbps so that the edge router can forward packets in between networks faster.

Fig. 2 shows the network topology for the second scenario.

C. Third Scenario

The third scenario represents the whole province of the government structure. In this scenario, each province group by

island/archipelago that coordinated by leaf router. The leaf router will receive the first packets from each province and gathering information from group. All the leaf routers are connected by services with high-speed network among routers. Baud rate for link among leaf router is set at 100 Mbps.

Fig. 3 shows the network topology for the third scenario.

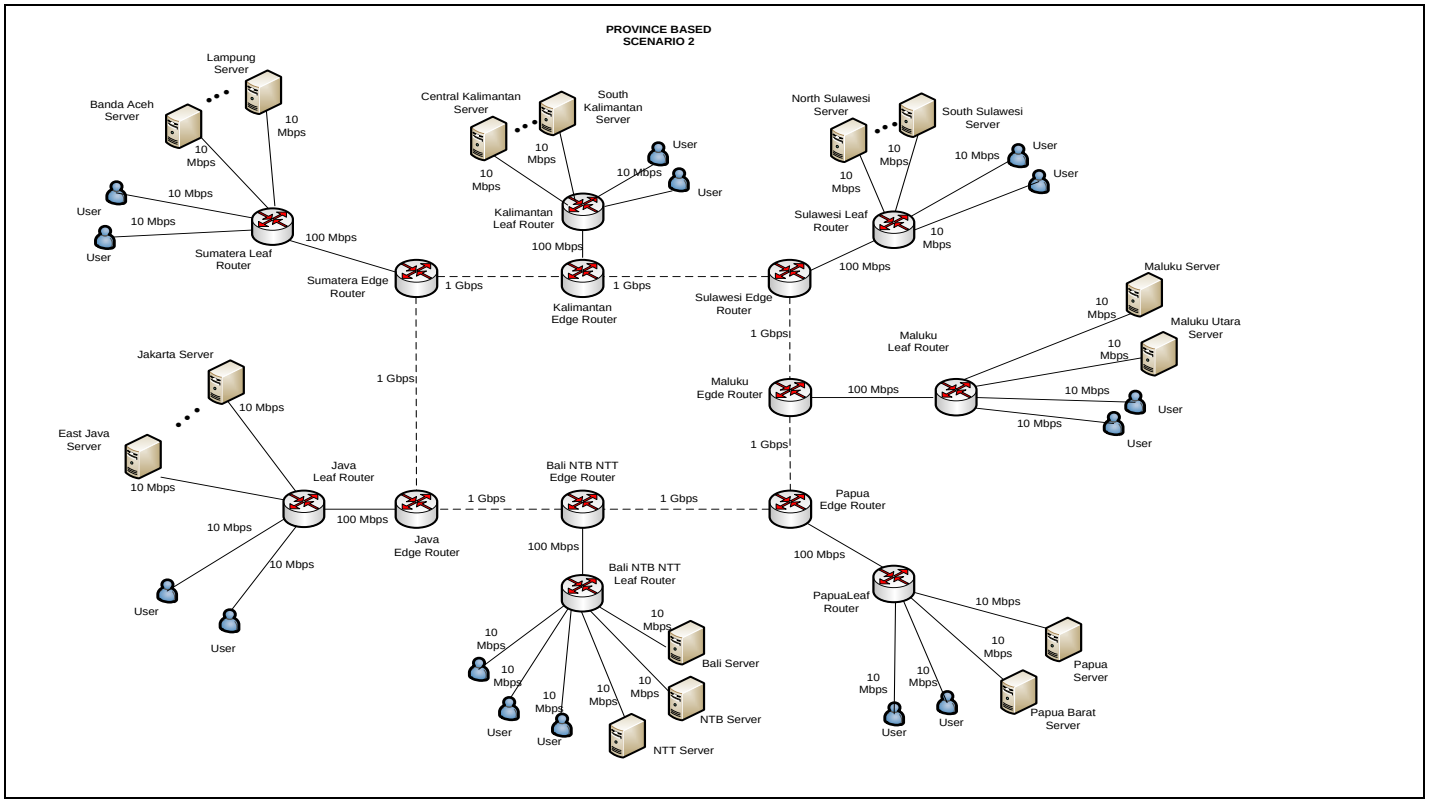

Fig. 2. Second Scenario

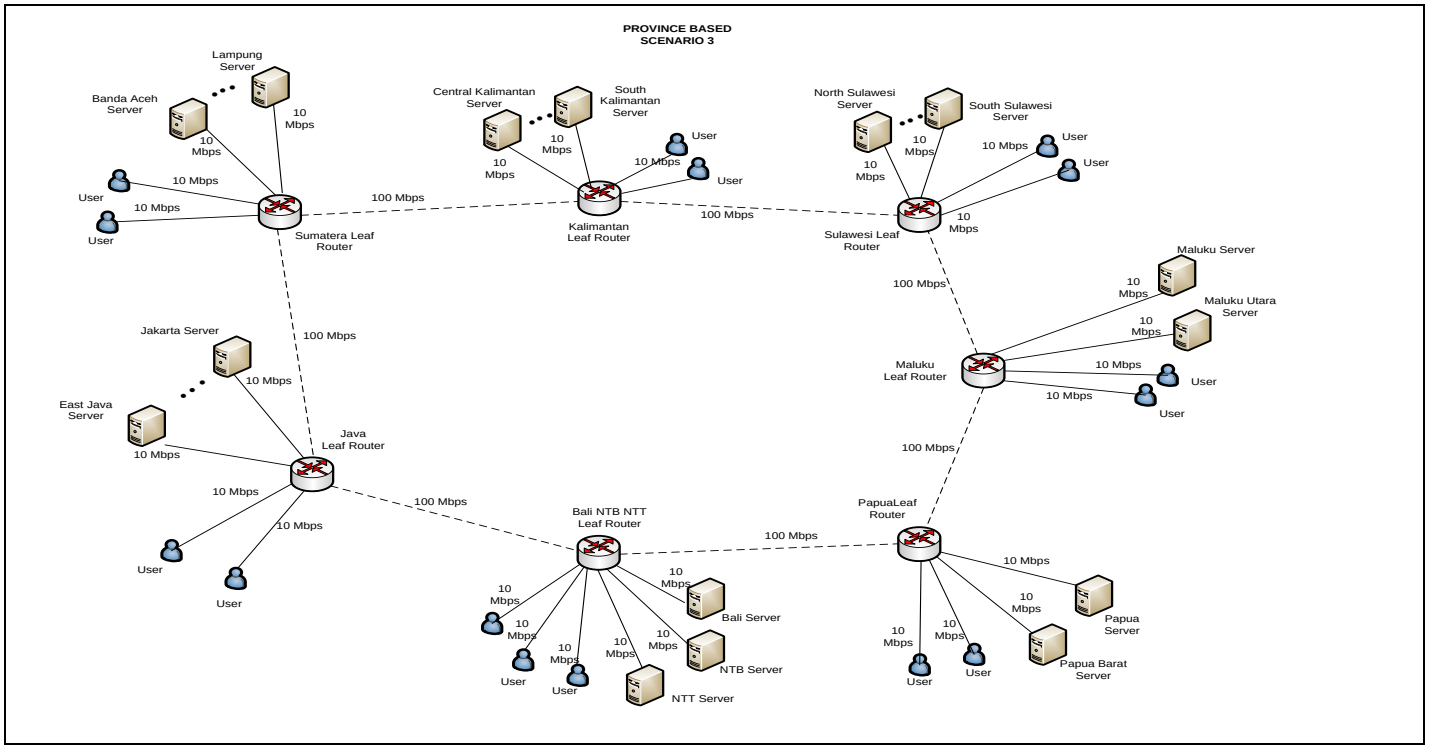

Fig. 3. Third Scenario

D. Result

We define three samples which based on three types of how the numbers of users are in each province where the total number of users in the country is set the same. In the first simulation, we assume that there is one user in each regency and municipal in each province and we label the sample as DS0. In the second simulation sample, DS1, we define the number of users in each province is proportional with the number of population in the province, however the total number of users in the country are the total number of users in DS0. Thus in each province the number of users is given as:

$$u = p/t \times nd0 \quad (1)$$

where:

u = number of user in each province

p = number of population in each province

t = total population in the country

nd0 = number of users of DS0

And for the third simulation, DS3, we use same number of users at each province as:

$$u = nd0 / np \quad (2)$$

where:

u = number of user

nd0 = number of users of DS0

np = number of province

We round the number of users in each province in DS0, DS1 and DS2 to the nearest integer. Fig. 4 describes these samples:

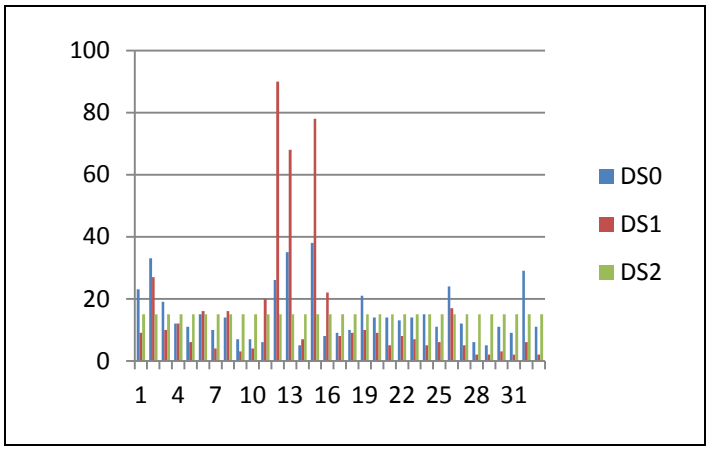

Fig. 4. Number of users in each province based on various sample type

In each simulation using the above three scenarios S1, S2, and S3, and two algorithms FIFO and SCFQ, we introduce three Gridlets which define jobs in GridSim sent by each user successively to a resource and the resource will give a sign which Gridlet is ready to be processed. The computing time in each province is defined to be the average of these three Gridlets response time, and the average computing time in the country is defined as the average computing time from all computing time in the provinces. The results are given in the Table III.

Where S1FIFO indicates the first scenario using FIFO algorithm, S1SCFQ indicates the first scenario using SCFQ, the same meaning applies to S2FIFO, S2SCFQ, S3FIFO, and S3SCFQ. Fig. 5 shows in general that sample DS1 is the most efficient one compared with DS0 and DS2.

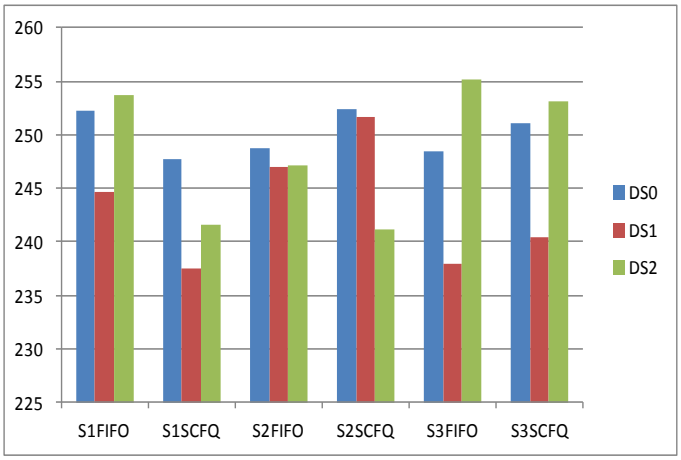

Fig. 5. Result comparison of DS0, DS1, DS2

The results above show that Scenario 1 using SCFQ algorithm in DS1 gives the best processing time and Scenario 3 using FIFO algorithm in DS2 gives the worst processing time.

Scenario 1 using SCFQ scheduling algorithm in DS1 tends to make packet lifetime in routers with crowded traffic becomes shorter. As we see that more than 70% of population in Indonesia is in Java Island which is use West Core Router. Packet lifetime shows the difference between the enqueuing and dequeuing time of packets. This is because there are packet priority settings where the packets with higher priority will be served first, so the overall packet lifetime will be reduced. SCFQ algorithm can provide differentiated services for data traffics by changing the weight associated with traffic classes. The higher the weight of a traffic class, the better treatment of the class. Treatment here means the wider bandwidth allocation (bandwidth) so that the execution time would be smaller.

Scenario 3 using FIFO algorithm in DS2 gives the worst processing time because packet lifetime is higher. In FIFO mechanism, all packets are enqueued at the end of a queue, and the first packet located in the beginning of the queue will be dequeued first. The packets are unordered and no differentiated service will be provided.

The data above can be analyzed that in the development of e-Government Grid services 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 of DS1 using the population comparison as the number of user in each province.

TABLE III. RESULT OF THE SIMULATION

Scenario / Simulation	S1FIFO	S1SCFQ	S2FIFO	S2SCFQ	S3FIFO	S3SCFQ
DS0	252.23357	247.72993	248.76200	252.34099	248.45325	251.00456
DS1	244.60348	**237.48944**	246.93003	251.68368	237.95047	240.34692
DS2	253.70659	241.51920	247.14717	241.07650	**255.08733**	253.06667

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 of DS1 using the population comparison as the number of user in each province.

And we can see that DS1 give the best performance. So we can say that the most suitable for Grid topology in Indonesia is using the number of population comparison as the number of user in each province.

III. CONCLUSION

The research aim at 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 and three types of number of users based on the province, population and same number of users in each province. 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.

The proposed Grid arhitecture in this paper will be used as inputs for providing e-Government services and its implementation on a Cloud platform for the best performance. Comparing Grid services to Cloud services, we can see that Grid is about performance and Cloud is about scalability. In our next work, we will model the country e-Government Grid services based on Cloud Computing to test the scalability of the Grid system driven by economical scale considering some factors in existing practices done by the government.

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