Welcome to the 1st ICOIACT 2018

The emergence of Intelligent Systems Technology as a ubiquitous platform for innovations has laid the foundation for the rapid growth of the Information in the future innovation. The purpose of the 1st ICOIACT 2018 is to promote discussion and interaction among academics, researchers, and professionals in the field of information and technologies. In this conference, the author types that we got came from a student, academia, and government. We deeply thank the authors for their participation and high contribution in this conference.

The theme of The 1st ICOIACT 2018 "Opportunities and Challenges on Intelligent Systems Future Innovation"

The 1st ICOIACT 2018 (ICOIACT 2018) held on 6-7 March 2018 in Grand Zuri, Yogyakarta, Indonesia.

This conference provides an international forum for the presentation and showcase of recent advances on various aspects of ubiquitous technology. It will reflect the state-of-the-art of the methods, involving theory, algorithm, numerical simulation, error and uncertainty analysis and/or novel application of new processing techniques in engineering, science, and other disciplines related to ubiquitous computing. In this conference, several topics on the specific themes for intensive discussions are also planned according to the areas of interest.

We would like to extend our gratitude to the Technical Program Committee that has been reviewed the papers and conducted very interesting conference program as well as the invited and plenary speakers.

Finally, we would like to thank the steering committee members, the conference chairman, the organizing committee, the IEEE Student Branch of Universitas Amikom Yogyakarta, and the financial support from the conference sponsors that conducted the success of The 1st ICOIACT 2018.

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LINGO-Based Optimization Problem of Cloud Computing of Bandwidth Consumption in the Internet

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***Abstract*— Optimization problem is an important issue in the network Internet. With the dynamic approach in modeling networks, we can strengthen network performance and ensure that the cost will be minimized and profit of provider can be maximized. This research aims to study, analyze the scheme for cloud networking and formulate a plan of new models of dynamic networks and can work under a cloud of wireless networks. Mixed Integer Non Linear Programming (MINLP) is an integer linear programming model to optimize a particular purpose. In MINLP process, the objective function is determined beforehand. The optimal solution of MINLP lies in the majority of decision variables that can be an integer, Boolean or fractions. Model Cloud computing is one of the areas that is most discussed and promising in modern computer science. Cloud computing is a computing model in which resources such as processors, storage, network and software information that can be accessed by customers via the Internet. In the cloud computing implementation, we require a good traffic for performance and reliability of the system is maintained. QoS (Quality of Services) refers to the distribution of bandwidth. QoS is used as a measure of whether or not the characteristics of the network to meet the needs of different services that use the same infrastructure. Tests carried out on the quality of service parameters, namely, delay, packet loss, throughput and bandwidth. To formulate and solve optimization problems used LINGO software applications. The results show that by designing the optimization problem, the cost of consumption of the demand of the internet can be reduced; the maximum profit for the provider can be increased.**

Keywords—MINLP, cloud computing, QoS, LINGO, optimal solution.

I. Introduction

Users of internet services are almost equitable for all circles of society. Everyone uses the internet in this era of globalization, both from the low, the middle class, and the upper class. Internet users also do not know the age, from children, adults, to parents. Today the Internet has an important role for economics and education worldwide even for now health and business science is using the internet services. Internet can be said to be one of the warehouse of knowledge that has a myriad of information that can be accessed easily anytime and anywhere with the condition of having a connection that is connected to the internet. In general, it can be said that human jobs often rely on internet services. With the high interest of consumers in accessing the internet make the internet service provider (ISP) or internet service provider must provide services with the best quality (Quality of Service) that is useful to serve the user in achieving the best quality information. In addition to maintaining the quality of service and the optimal price for consumers of ISPs (Internet Service providers) should also consider the profit earned that will maximize profits for service providers (ISPs) [1]. Generally, QoS is divided into three entities namely, Bandwidth, End-to-End Delay and BER (bit error rate).

Based on [1-3], and advanced research [4-9] and [10, 11], the development of wireless networks primarily modeling the pricing of wired or wireless internet networks as well as network pricing involving utility functions have been discussed. The development of wireless networks can serve as an optimization problem that is the most important part of business life. The model of internet service pricing level focuses on different pricing and usage schemes that may involve QoS networks and multi-service networks. The service providers must be able to handle internet usage requests with the right pricing scheme. In this case, ISP uses Bundle Pricing strategy to minimize cost and maximize profit [12]. Utility functions relate to the level of satisfaction of consumers get on the consumption of information services that can maximize profits to achieve certain goals [13]

Bundle Pricing is a marketing strategy whereby two or more products are formed into one package [14]. Bundle pricing is considered to overcome the diversity of consumer types and the uncertainty of consumers to the information services offered [15]. The preliminary results discussed by [6] showed that the improved MINLP scheme in the bundle pricing strategy has proven to be better than a bundle pricing scheme that does not involve utility functions. After the results obtained from this study, some critical issues that arise today is cloud computing or known as cloud computing.

Cloud computing is a new breakthrough that is warmly discussed and promising in modern computer science. Cloud computing is a resource computing model such as processor, storage, network and software information accessible to customers over the Internet [16]. Some characteristics of cloud computing is broad network access that is the ability to access network services through standard mechanisms using platforms such as mobile phones and laptops. On-demand self-service that manages the service without human interaction with the service provider or used as needed. Rapid elasticity or elasticity resources i.e. the ability of services available can quickly and elastically raise and lower the capacity according to the needs of servers and users. Measured service is a system for monitoring and optimizing service resources that must be provided in a scalable and regular manner, as well as automatic control of the cloud system and optimal resources as it is done in the payment process such as storage, processing and bandwidth. Resource pooling i.e. pooling resources that come from providers and users.

Cloud computing itself is as an implementation of the concept of on-demand computing model and utility computing. On demand computing model is a model that allows service providers to provide resource computing available to users when required only in other terms. This service is available only when users need it, such as time and user-dependent storage [17]. The Utility Computing has the goal to maximize the efficiency of resource use and minimization of enterprise costs [17].

Cloud computing service providers (CSP) (i.e., Amazon EC2, Rackspace Cloud servers TM) provide infrastructure on demand and cost based on usage to provide flexibility to customers. So customers only need to pay for what they have used. CSP has infrastructure for service providers (SPs); this service is known as Infrastructure as a Service (IaaS). SPs build their services (for example, hosting applications, very time-giving content, on-demand labor, search engines, and so on.

The cloud service model itself which is shared by SAAS (software as a service) i.e. the capability afforded to consumers by running applications that can be accessed in mail except to private ownership such as memory or other terminology is the monitoring of communication finance content. Cloud platform service is the ability given to the consumer to spread the infrastructure made by consumers to the cloud or the acquisition of applications made based on the programming language / provider. In other word, consumers do not manage OS storage.

Cloud computing itself has advantages where data can be accessed anywhere and anytime while having access to the internet. Cloud computing itself can save the cost and space infrastructure of computer resources because it uses online storage system. Operations and management are also easier, simpler, and more easily monitored from one server. Because of the high internet bandwidth, users also make advantages for business people in the infrastructure. However, despite the advantages that cloud computing itself has a lack of access is slow if accessed many people at the same time, because this cloud is dependent on internet connection.

Cloud computing services is easy to apply. The user only need to enter or login to the programs that are available without installing or downloading the existing software. System work done by the cloud system so users can directly be used by the cloud services. Infrastructure of the cloud is like a data storage medium that is stored virtually through the Internet network. After that, the data continues to the application server, after the data received in the application server then the data will be processed.

With the advantages and ease of access offered by the cloud system it certainly has a positive impact for users of Internet services, where users of the service will be helped by the existence of this service, which certainly can be accessed when the user is located anywhere. This surplus will certainly attract the great attention of internet service users. With the increase of users will certainly also increase the use of internet bandwidth. Bandwidth is a quantity that shows the amount of data that can pass in a network connection. With the high consumption of bandwidth that will be used by the user, it can impact on the narrowing of the path that leads to congestion due to lack of bandwidth while the available channels are not able to accommodate the amount of bandwidth required. Therefore, it is necessary to have the right solution in data bandwidth usage system, which will be optimized which will have positive impact for server, user and business.

This study aims to study, analyze the schemes for cloud networks and formulate new dynamic model plans and can work under wireless network clouds. This study focuses on optimizing the use of bandwidth in which the model of the cloud will be completed using the optimization method. Cloud model itself will be simplified into the mathematical model first by determining the purpose function and function constraints.

Mixed Programming Integer Non Linear (MINLP) is an integer linear programming model to optimize specific goals. In the MINLP process, the destination function is determined first. The optimal solution of MINLP lies in the majority decision variable that can be an integer, Boolean or fraction. In this paper, we present the cloud model over time by considering it as a multi-period time problem by using four case constraints that are differentiated into parameters and variables. The application of the mathematical optimization method used in solving the cloud-computing model requires data that will be applied to this model. The data used is numerical data. With the application of this method it is expected to obtain the optimal solution of the application of cloud model with mathematical optimization method. This application is expected to provide comparisons before and after using this method on previous cloud models to assist ISPs as internet service providers in setting price alternatives that can maximize profit and for users to set tariff optional options that meet user needs and budget in use and utilization of the internet. In this study it is required the help of LINGO software which will assist math calculations with good results.

II. Research Method

In this study, the understanding and calculation of the amount of bandwidth consumption will be completed using the optimization model in which the formula and research results will be simulated with LINGO software. Before applying this model on lingo software, this model will be simplified first so it can be processed well by LINGO software itself. This program serves to solve non-linear optimization problem to get optimal solution. This optimization model is formed based on parameters and variables that will be used to solve the optimization problem. The constraints used are four cases where variables and parameters are randomly assigned. How much data is used for this model of numerical data samples so that the results are later obtained in numerical form as well so as to make it easier to see the differences and draw conclusions. In this study, we discussed MINLP model. As for the reason why this research done is lack of research on Mixed Integer Non Linear Programing model. With the lack of research on this MINLP model makes researchers do research that apply it to the cloud model. With this research is expected to be more and more researchers who apply this MINLP model. The advantages of this research include research on the cloud model is still new and has not been much discussed. Other than that, this research can be useful and useful for internet service providers (ISPs) who can apply this method to benefit the business. This research also has advantages which the case raised from this study focuses on the consumption of bandwidth which bandwidth is the thing that is still a critical issue in the network world. With this research the optimization is conducted by using the data bandwidth.

III. Result and Discussions

In this study the optimization model used is based [18] are as follows :

$$\text{Min} \sum_{t\in T}\sum_{i\in I}\sum_{j\in J} C_{ij}y_{ij}(t) + \sum_{t\in T}\sum_{i\in I}\left(C^+y_i^+(t) + C^-y_i^-(t)\right) \quad (1)$$

Constraints:

$$\sum_{j\in J} y_{ij}(t) \le 1, \qquad \forall i \in I, \forall t \in T \quad (2)$$

$$\sum_{i\in I}\sum_{j\in J} V_{ij}.y_{ij}(t) \ge D(t), \qquad \forall i \in I, \forall t \in T \quad (3)$$

$$\sum_{j\in J} y_{ij}(t) - \sum_{j\in J} y_{ij}(t-1) - y_i^+(t) + y_i^-(t) = 0 \quad (4)$$

$$y_i^+(t) + y_i^-(t) \le 1, \qquad \forall i \in I, \forall t \in T \quad (5)$$

$$y_i^+(1) = \sum_{j\in J} y_{ij}(1), \forall i \in I, \qquad y_i^-(1) = 0, \forall i \in I \quad (6)$$

Of the constraints listed above are t and $t-1$, this states that there is a time difference that occurs when operating time before and after, so in this study the time difference is exemplified by

$$y_{ij} = \begin{cases} i+1, \; j+1, \; \text{for } t \\ i, j = 1, \; \text{for } t-1 \end{cases}$$

So with these conditions

$$y_i^+ = \begin{cases} i+1, \; \text{for } t \\ i = 1, \; \text{for } t-1 \end{cases}$$

and

$$y_i^- = \begin{cases} i+1, \; \text{for } t \\ i = 1, \; \text{for } t-1 \end{cases}$$

In this research we discussed 4 cases from the above model, each case will be distinguished based on the selection of parameters and variables on the function of certain constraints, the selection of variables and parameters is determined randomly. This research is divided into 4 cases because of the four cases it can get different results- different. From four cases, there are variables, variables, parameters and parameters. Of the four cases to be discussed above, we described as follows.

1. Case 1

   On the case 1, server i on frequency to-j per time (V_{ij}) is selected as parameter and request per time (D) selected as a variable in Eq.(3) in which the Table I and II presents the parameter and variables respectively. The parameters and variables are set to satisfy all the conditions required by the Model (1)-(3).

TABLE I. Parameters for Each Improved Model for Case I

Symbol	Definition
C_{ij}	The bandwidth usage that works on the server i on frequency to-j per unit time
C^+	Server cost for on
C^-	Server cost for off
V_{ij}	Server i on frequency to-j per time
I	Number of servers
J	Number of frequencies

TABLE II. Variables for Each Improved Model for Case I

Symbol	Definition
y_{ij}	The binary decision variable if the server i work on frequency to j at time t
y_i^+	$\begin{cases} 1, \text{ if server } i \text{ on at time } t \\ 0, \text{ if there is no time change} \end{cases}$
y_i^-	$\begin{cases} 1, \text{ if server } i \text{ off at time } t \\ 0, \text{ if there is no time change} \end{cases}$
$D(t)$	Request per time

2. Case 2

   In case 2, server i on frequency to-j per time (V_{ij}) and request per time (D) are both parameters in Eq. (3) like stated in Table III and IV.

TABLE III. PARAMETERS FOR EACH IMPROVED MODEL FOR CASE II

Symbol	Definition
C_{ij}	The bandwidth usage that works on the server i on frequency to-j per unit time
C^+	Server cost for on
C^-	Server cost for off
V_{ij}	Server needs i on frequency to-j per time
I	Number of servers
J	Number of frequencies
$D(t)$	Request per time

TABLE IV. VARIABLES FOR EACH IMPROVED MODEL FOR CASE II

Symbol	Definition
y_{ij}	The binary decision variable if the server i work on frequency to j at time t
y_i^+	$\begin{cases}1, & \text{if server } i \text{ on at time } t\\ 0, & \text{if there is no time change}\end{cases}$
y_i^-	$\begin{cases}1, & \text{if server } i \text{ off at time } t\\ 0, & \text{if there is no time change}\end{cases}$

3. Case 3
   In case 3, server needs i on frequency to-j per time (V_{ij}) is chosen as variable and request per time (D) is parameter in Eq. (3) like stated in Table V and VI. The symbols are explained in definition part of each table.

TABLE V. PARAMETERS FOR EACH IMPROVED MODEL FOR CASE III

Symbol	Definition
C_{ij}	The bandwidth usage that works on the server i on frequency to-j per unit time
C^+	Server cost for on
C^-	Server cost for off
I	Number of servers
J	Number of frequencies
$D(t)$	Request per time

TABLE VI. VARIABLES FOR EACH IMPROVED MODEL FOR CASE III

Symbol	Definition
y_{ij}	The binary decision variable if the server i work on frequency to j at time t
y_i^+	$\begin{cases}1, & \text{if server } i \text{ on at time } t\\ 0, & \text{if there is no time change}\end{cases}$
y_i^-	$\begin{cases}1, & \text{if server } i \text{ off at time } t\\ 0, & \text{if there is no time change}\end{cases}$
V_{ij}	Server needs i on frequency to-j per time

4. Case 4
   In case 4, both server needs i on frequency to-j per time (V_{ij}) and request per time (D) are variables like stated in Eq. (3) that are presented in Table VII and VIII, respectively. The symbols are explained in definition part of each table.

TABLE VII. PARAMETERS FOR EACH IMPROVED MODEL FOR CASE IV

Symbol	Definition
C_{ij}	The bandwidth usage that works on the server i on frequency to-j per unit time
C^+	Server cost for on
C^-	Server cost for off
I	Number of servers
J	Number of frequencies

TABLE VIII. VARIABLES FOR EACH IMPROVED MODEL FOR CASE IV

Symbol	Definition
y_{ij}	The binary decision variable if the server i work on frequency to j at time t
y_i^+	$\begin{cases}1, & \text{if server } i \text{ on at time } t\\ 0, & \text{if there is no time change}\end{cases}$
y_i^-	$\begin{cases}1, & \text{if server } i \text{ off at time } t\\ 0, & \text{if there is no time change}\end{cases}$
V_{ij}	Server i on frequency to-j per time
$D(t)$	Request per time

To solve the models presented in Eq (1)-(3), we give the numerical example of the parameters and it is solved numerically by using LINGO 13.0. In Table IX, we give the numerical value of the parameters.

TABLE IX. NUMERICAL EXAMPLE

Parameter	Value
C_{11}	100
C_{12}	150
C_{13}	210
C_{21}	250
C_{22}	330
C_{23}	120
C_{31}	230
C_{32}	310
C_{33}	260
C_p	110
C_m	220
V_{11}	120
V_{12}	130
V_{13}	135
V_{21}	140
V_{22}	150
V_{23}	155
V_{31}	160
V_{32}	165
V_{33}	170
D	10

After we run it using LINGO, the solver status for each case is obtained like stated in Table X. For the decision variables, the solutions for each case are presented in Table XI.

TABLE X. SOLVER STATUS

Solver Status	Case			
	Case 1	Case 2	Case 3	Case 4
Model Class	*PILP*	*PILP*	*MINLP*	*MINLP*
State	*Global Optimal*	*Global Optimal*	*Local Optimal*	*Local Optimal*
Objective	0	930	$0{,}309966\times10^{-5}$	0
Infeasibility	0	0	$0{,}190163\times10^{-8}$	0
Iteration	0	0	17	4
Extended Solver Status				
Solver Type	*Branch and Bound*	*Branch and Bound*	*Branch and Bound*	*Branch and Bound*
Best Objective	0	930	$0{,}309966\times10^{-5}$	0
Steps	0	0	0	0
Update Interval	2	2	2	2
GMU (K)	30	31	30	29
ER (Sec)	0	0	0	0

TABLE XI. MODEL SOLUTION

Variable	Value			
	Case 1	Case 2	Case 3	Case 4
y_{11}	0	0	0	0
y_{12}	0	0	0.1901632×10^{-8}	0
y_{13}	0	0	0	0
y_{21}	0	0	0	0
y_{22}	0	0	0	0
y_{23}	0	1	0.1901632×10^{-8}	0
y_{31}	0	0	0	0
y_{32}	0	0	0	0
y_{33}	0	0	0	0
y_{1p}	0	0	0.1901632×10^{-8}	0
y_{2p}	0	1	0.1901632×10^{-8}	0
y_{3p}	0	0	0	0
y_{1m}	0	0	0	0
y_{2m}	0	0	0.1901632×10^{-8}	0
y_{3m}	0	1	0.1901632×10^{-8}	0
V_{11}	-	-	0.1346649×10^{8}	0
V_{12}	-	-	0.525864×10^{10}	0
V_{13}	-	-	1.234568	0
V_{21}	-	-	1.234568	0
V_{22}	-	-	1.234568	0
V_{23}	-	-	1.234568	0
V_{31}	-	-	1.234568	0
V_{32}	-	-	1.234568	0
V_{33}	-	-	1.234568	0
D	0	-	-	0

In Table I-VIII the definitions for each variable and parameters are shown and the differences for each case based on (3) by using the available possibility. The X-XI table shows the result of solving the model with 4 existing cases using LINGO program.

In case 1 optimization model is Pure Integer Linear Programming (PILP) with optimum result of 0. In case 1, it requires server i on frequency to-j per time (V_{ij}) as parameters and queries per time $(D(t))$ as variable.

In case 2 optimization model is Pure Integer Linear Programming (PILP) with optimum result of 930. In case 2, it requires server i on frequency to-j per time (V_{ij}) as parameters and queries per time $(D(t))$ is also as a parameter.

In case 3 optimization model is Mixed Integer Non Linear Programming (MINLP) with optimum result of 0.309966×10^{-5}. In case 3, it requires server i on frequency to-j per time (V_{ij}) as variable and queries per time $(D(t))$ is as parameter.

In case 4 optimization model is Mixed Integer Nonlinear Programming (MINLP) with optimum result of 0. In case 4, it requires server i on frequency to-j per time (V_{ij}) as variable and queries per time $(D(t))$ is also as variable.

As we can check for the defined parameter and variables, the models turn out to be different models due to requirement for whether the models are linear, nonlinear, and pure linear or mixed nonlinear.

IV. CONCLUSION

Based on the solution of the cloud model using LINGO software, the optimum result obtained from the model is that in case 3 the optimum result is 0.309966×10^{-5} unity of time. Of the four cases we also obtained a different type of model that is in the case of one type model which is obtained is in the case of 2 types of models obtained which is Pure Integer Linear Programing (PILP), and in the case of 2 types of models obtained which is Mixed Integer Non Linear Programing (MINLP).

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