Service Broker Policy Algorithm for Logistics over Cloud

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Abstract: Logistics information system focuses on flow of information with storage and services of goods supply from the origin point to consumption point of organization. Logistics information system makes this flow more efficient with the help of cloud. Cloud computing manages the logistics information system centrally. The centralized data center keeps the track of information distribution which creates network congestion and overloading on data center when various requests of users from different regions occur at same time. So, the data center needs to be maintained effectively for better performance. This paper presents the distributed service broker policy to implement centralized data center and proposes distributed data center for logistics information system over cloud. This paper also presents the result of distributed service broker policy algorithm to reduce network congestion, higher latency and cost due to large number of demand of particular service in distributed data center for logistics.

Keywords: Logistics Information System, Distributed Service Broker policy algorithm, Cloud Computing

I. INTRODUCTION

A big organization mostly provides global logistics services distributed over the different geographical locations in the world. Cloud computing provides centralized data center policy for sharing the resources among the logistics partners and users. For example, a supplier sets up a vendor portal by using private cloud and this portal allows other user to access information through their login id and password in secure manner. The logistics users and cloud providers have main issue is that how the logistics information system can be best utilized by using cloud computing. Logistics information system is a interconnected process which is involved in provision of product, distribution of product and service packages required by end users in supply chain. Every organization is investigating how the cost and time can be reduced in each phase of logistics in collaboration of logistics partners and users. Distribution of information for suppliers and users is very important issue in logistics management. In order to manage logistics effectively, the use of cloud computing is increasingly become extremely important. Information is distributed at right location; right time within minimum cost is satisfactory level of all the suppliers and users in logistics management. A data center is a large cluster of computers containing thousand servers by any organization. The data center provides a variety of service, hosting distributed file system, storage, transmission of large amount of data. Cloud service providers facilitate different services using large scaling with cost effectiveness and time efficient in cloud environment [1]. Cloud computing is advanced technology which contributes in cost and time optimization by providing software, platform, infrastructure as a services for logistics via internet. There are so many centralized architectures and policies for utilizing logistics in better form. In this paper, we propose a distributed architecture and distributed service broker policy algorithm for reducing the increment of cost and latency for logistics information system over cloud. Logistics information system is a process of planning and organizing of resources related to logistics information collection, storage, execution and distribution [2]. So, the coordination of suppliers, logistics partners and users for distributing information should be implemented for improving the logistics utilization in supply chain.

II. LITERATURE REVIEW

Cloud computing is an advanced technology to optimize logistics information system by using its infrastructure, platform and software solutions through the internet. Cloud computing is gifted to give cloud based service for developing financial and operational services in logistics management. Cloud computing infrastructure as a service provides cost effective service to the users who can save their cost by using services of cloud service providers or third party on the rental basis. There are various proposed approaches and architecture in a queue to implement the logistics for better utilization of logistics information system over cloud. Xiaona Ren et.al. (2011) proposed a prediction based algorithm which is called exponential smoothing forecast based on weighted least connection to

handle the long connectivity applications. This algorithm calculates the load on the server from different parameters like, CPU utilization, memory, number of connections and size of disk occupation [3]. Li Yi Peng (2011) focused on the impact of cloud computing on information sharing in supply chain. This paper has analytical study of real time information sharing based on cloud computing by using simulation model to calculate the expected advantage of cloud for complex supply chain [4]. Joerg Leukel and Stefan Kirn (2011) proposed a service oriented approach adopted by cloud computing to provide interconnected operations in supply chain [5]. Maik Linder et. al (2011) introduced a new idea of cloud supply chain to analyze different types of information requires in each process of supply chain [6]. Sunderaswarn, Squicciarini and Lin (2012) provided a brokerage based approach for cloud service selection. They proposed a novel brokerage based architecture in the Cloud, where the Cloud brokers is responsible for the service selection and design [7]. Thomas Schramm et.al (2012) analyzed the concept of cloud computing in supply chain. This paper identified six questions for decision makers to adopt new technology which gives significant impact on supply chain [8]. Jyotsana Ojha (2012) also presented centralized cloud environment which manages all storage and computing resources centrally and this centrally environment creates network congestion [9]. Choy and Ganasekaran (2013) presented a brief literature review on logistics information system for decision making process to reduce the human errors and high cost of operational efficiency [10]. Deepak Kapgate (2014) presented a static service broker policy algorithm which improved increment of over loading on the data center and increment of data center transfer cost and response time [11]. Damian Daniluk and Bernhard Holtankamp (2015) defined the adoption of cloud in logistics mall for implementing the IT services and logistics processes [12]. D. Chitra Devi and V. Rhymend Uthariaraj (2016) introduced scheduling and load balancing algorithm to help in reducing the number of resource probe executions and load in the virtual machines [13]. Logistics information system uses centralized and distributed environment for communication, information distribution among the logistics partners and users. As though many centralized and distributed environment improvement in logistics information system has taken place over a period of time reflects lack of advancement of centralized policy which lower cost and latency to maintain and distribute information in different regions of country.

III. CENTRALIZED AND DISTRIBUTED DATA CENTER FOR LOGISTICS

With the facility of anytime and anywhere cloud computing services provide resource sharing of its services in logistics management. Logistics information sharing is demand driven globally so it should be perfect centralized when a local data center handles the job request its local supply chain system. Cloud computing manages storage and resources centrally over the different regions. The centralized data center manages track on delivery information by using centralized policy approach. There so many data center selection and load balancing technique to reduce the data transfer cost and latency for logistics information system over cloud.. Distributed data center (DDC) provides a distributed set of machines that are running at different locations, connected to a single network. Distributed datacenter uses distributed computing, storage and network resources from multiple locations into a single resource pool. By using flexibility, scheduling, scalability and automation techniques, this resource pool can provide users with service and access on demand making a better utilization of resources [14]. The infrastructure of global logistics information serves hundreds of thousands of customers in more than hundred countries. The logistics companies are expanding to help their customer achieve lower latency and higher speed and low latency network. There are two main issues for choosing cloud computing environment in centralized and distributed policy for logistics information system:

- **Cost:** Due to overloading of user's requests, the transfer cost of virtual machine will be increased.
- **Time efficiency:** Multiple users give requests globally which creates time delay between the request and response. So, there is possibility of incrimination of latency.

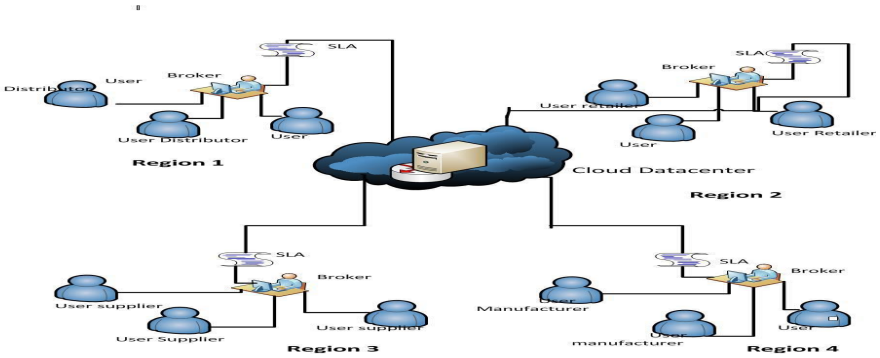

Fig.1: Centralized data center for LIS over Cloud

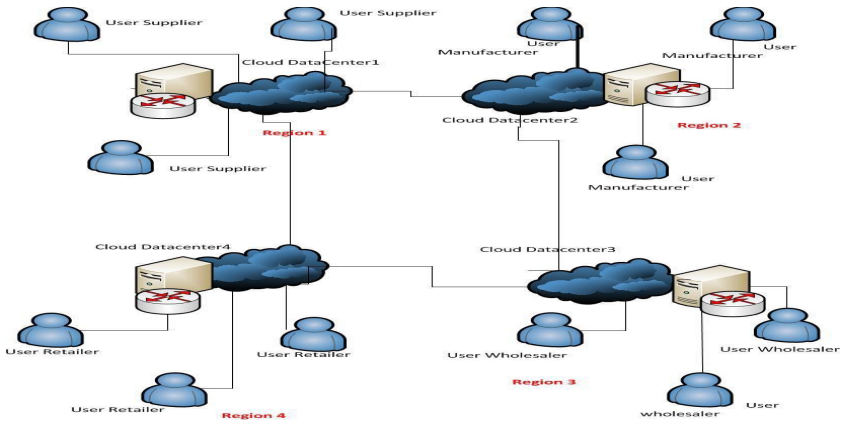

Fig.2: Distributed Data Center for LIS over Cloud

IV. CLOUD SIM AND CLOUD ANALYST

Cloud Sim is an event driven simulator built upon GridSim. It uses Java programming language. It is a modeling framework or simulation tool on cloud computing infrastructure [15]. It is an advance platform for using model of large data centers, unlimited of virtual machines, service brokers, scheduling and allocation policies of large scaling cloud platform. Cloud Sim is used for virtual machine (VM) management with three operations; host overloads detection, VM selection techniques and VM placement techniques [16]. Cloud Analyst is based on Cloud Sim for evaluating performance and cost of large geographical distributed cloud system which have heavy load of users on different parameters. It has also graphical user interface (GUI) and hardware parameters like storage, main memory, bandwidth, distance etc. for giving simulation results included cost, response time, data center processing time and overloading on data center in table and chart forms [17]. Cloud Analyst conducts a simulation experiments based on series of parameters verification in systematic and easy manner. The user request routing is very important task in cloud computing. The user request routing is a simulation tools in cloud analyst [18].

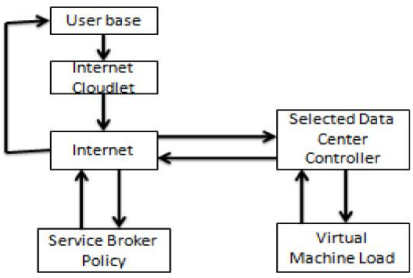

Fig.3: User Request Routing in Cloud Analyst

- **User Base:** It is a group of users and generates traffic that represents the users in simulation. It generates an internet cloudlet with application Id for each application and also includes name of the user base.
- **Internet Cloudlet:** It is used to specify a set of user requests and it also contains the application ID, name of the user base, size of request and input and output files.
- **Internet:** It is used to implement routing behavior
- **Selected Data Center Controller (DCC):** It is used to control data center activities.

- **Service Broker Policy:** it is used to decide which data center should be selected to provide the services to requests from the user base.
- **Virtual Machine Load Balancer:** It is used for load balancing policy by data centers when the serving allocation is requested.

V. PROBLEM FORMULATION

The main purpose of this paper is to enhance and implement the collaboration of logistics partners and users for information sharing with operating effectiveness. Cloud computing provides advance effectiveness of operating information by using infrastructure as a service. In logistics information system, the transmission of information is a big problem among the different logistics partner and users by using cloud service provider. Every suppliers, logistics partners and users want to share information in real time manner. Cloud computing has highly efficient service for transferring the data and also provide information sharing in real time by using different cloud services. Only the problem is that how users access the services and applications floated around the cloud. Applications are moved from one physical location to another in geographical region in distributed data center. So, there are issues raised like, scalability, accuracy, latency, loading and cost of virtualization in distributed data center. Cloud computing gain higher user satisfaction and increase resource utilization for logistics information system. There are various techniques used for the centralized and distributed data center with their added limitations and benefits respectively. In centralized data center the location of data center to the requests is based on proximity based routing, which randomly selects data center into multiple data center in the same region so there will be possibility of different selection each time. This type of result can be difficult to interpret for the researchers and developers and the cost of transferring data will be increased in such a random selection of data center.

VI. PROPOSED DSBP ALGORITHM

Distributed service broker policy algorithm is used for distributed data center where each region has its own data center and analysis how the response time will decrease when using data center selection based policy that user base request will executed on the nearest data center. So the nearest data center which has higher position in the proximity list response the request of user base. Proximity based service broker allows to the region selection based on the higher position in the proximity list and any data center of the selected region is then selected randomly for the user requests to be processed.

The steps of proposed DSBP algorithm:

1) Select the region
2) Calculate number of Data Center in selected region
3) If there is single Data Center then send the request to that specific Data Center
4) If there are multiple Data Center, select the nearest Data Center with minimum communication delay and maximum usable bandwidth between user base (client) and nearest data center in selected region
5) Find out the upcoming request in data center
6) Send the request to selected nearest data center
7) Analyze the result

The proposed DSBP algorithm is implemented by using Cloud Analyst simulation kit and analyzes the result graphically. The implemented algorithm is modified with respect to the centralized data center based service proximity algorithm. The pseudo code of the proposed DSBP algorithm is mentioned below:

```
1.  Get the Datacenter index of selected region
2.  regionaList ← regionalDatacenterIndex.get (region) // store regionlist of selected
3.  datacentre
4.  if regionaList is not NULL then
5.  listSize← size (regionalist)
6.  if listSize is 1 then
7.  dcName← regionalist.get(0)
8.  else
9.  for all pt in dcTotalCostList do
10. pt= p+ Bandwidthcost // p is cost of DC in VMcost list
```

```
11. if (dcTotalCostList.get (smallest) > dcToatalCostList.get (pt)) then smallest=pt;
12. end if
13. end for
14. dcName ←regionalist.get (smallest)
15. end if
16. end if
17. return dcname
```

DatacenterIndex is index of datacenter in a selected region. p is VMCOST in cost list and dcTotalCost = storage*storage cost + memory*memory cost + bandwidth*bandwidthcost. Storage, memory and available bandwidth are predefined in Datacenter. In DSBP scheduling is done in a such way that if more than one datacenters exists in the same region, the job request will be executed on datacenter which have lowest cost in terms of total cost, which is combined cost of virtual machine and data transfer cost.

VII. EXPERIMENTAL RESULT AND ANALYSIS

We configure the simulation by using centralized and distributed data center which receives user base request from selected regions. For getting efficient performance in terms of response time we test the centralized and distributed architecture for logistics with following parameters:

Table.1: User request configuration of data center DC1 for centralized data center

Data center ID	Region	Memory	Storage	Available Bandwidth	Number of processor	Processor speed
DC1	0	2048	1000000	1000	3	1000

In the above table DC1 is data center located in region which id is 0 and the physical hardware capabilities parameters are given.

Table.2: Cost configuration of data center DC1

VM cost	Memory cost	Storage cost	Bandwidth cost
0.01	0.05	0.01	0.01
Number of virtual machines (VMs) = 5	Memory =512	Images = 10000	Bandwidth = 1000

Table.2 represents the internal hardware cost of data center DC1. Each parameter have its own cost in terms of VM cost, memory cost, storage cost and bandwidth cost by using cloud service provider services.

Table.3: User request configuration of data center DC1 to DC6 for distributed data ceneter

Data center ID	Region	Memory	Storage	Available Bandwidth	Number of processor	Processor speed
DC1	0	2048	1000000	1000	3	1000
DC2	1	2048	1000000	1000	3	1000
DC3	2	2048	1000000	1000	3	1000
DC4	3	2048	1000000	1000	3	1000
DC5	4	2048	1000000	1000	3	1000
DC6	5	2048	1000000	1000	3	1000

In the above table DC1 is data center located in region which id is 0 and the physical hardware capabilities parameters are given.

Table.4: Cost configuration of data center DC1

VM cost	Memory cost	Storage cost	Bandwidth cost
0.01	0.05	0.01	0.01
Number of virtual machines (VMs) = 5	Memory =512	Images = 10000	Bandwidth = 1000

Table.4 represents the same service broker policy which is closed data center or proximity based service broker policy and same round robin load balancing across VM in single data center means cloudlet execution on VM in single host according to round robin manner. Now we obtain that the average time and average cost according to overall response time of user base request and response time of each user given by selected region. The requirement of efficient time in logistics is most important task because each part of logistics depends upon each other for sharing information among the logistics partners and users. In centralized data center, we can see that load is increasing due to various user bases across various regions and executed on a single data center DC1. Global logistics is distributed in nature where various logistics partners and users connected with other users at various locations or regions. In centralized data center there is possibility of high response time by using single data center among the logistics partners and users. It will be in sufficient for logistics because each parts of logistics should get response timely. In the below graph presentation we can analyze the performance of response times of different configuration of user bases in centralized and distributed data center.

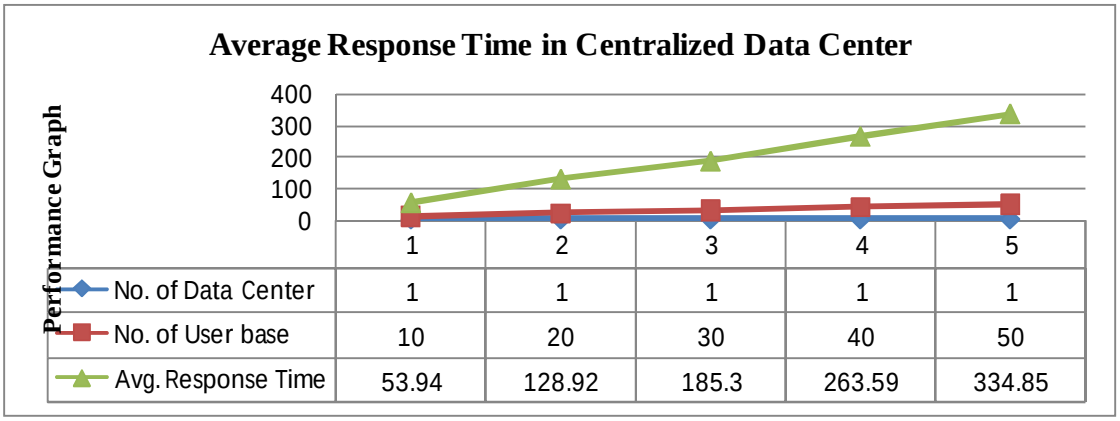

Fig.4: Performance graph in terms of response time of Centralized Data Center

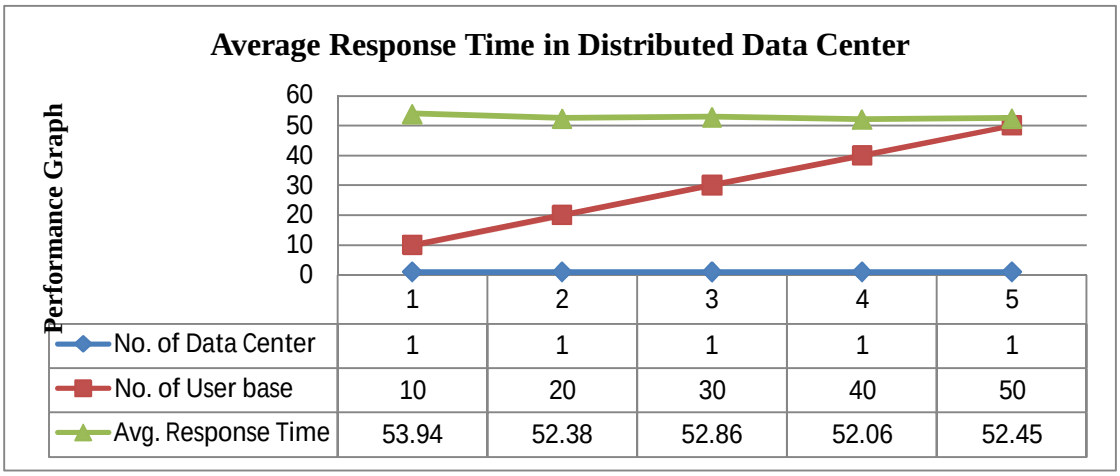

Fig.5: Performance graph in terms of response time of Centralized Data Center

According to the comparison of above two graphs we can analysis that when the number of user base request or job when increases, the response time of the request decreases rapidly. This decreasing response time comes due to heavy load of job request from various regions in centralized data center. Proposed distributed service broker policy in distributed data center allows that local data center takes request from its own region and don't face workload on its server because each local data center performs its action and gives the efficient response time. Here we also found that various response times from different region are also approximately same. Hence provide a scalable solution when the number of user request is increasing.

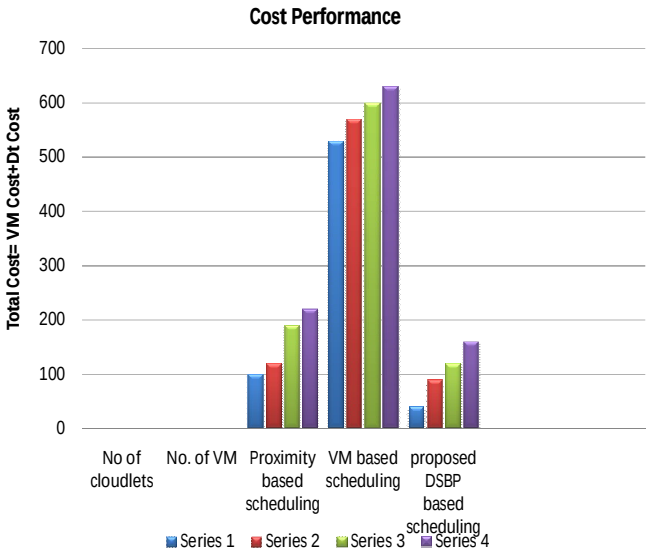

Fig.6: Cost performance graph using different data center selection scheduling algorithm

In above cost performance graph, figure.6 present that distributed service broker policy algorithm have least cost of data center in comparison to other service broker policy of centralized data center selection scheduling, where we take number of cloudlet on x axis while number of cost of data center on y axis. According to the graph performance of average response times and cost, the following results are included:

- The distributed data center will give fast response time and minimum cost than centralized one. So distributed data center scheme is highly suitable for logistics information system or information delivery in global logistics.
- In distributed data center scheme, if proposed DSBP algorithm will be selected, the output will be time efficient and cost effectiveness in selection of data center in terms of virtual machine cost and data transfer cost.
- The overall implementation of proposed DSBP algorithm will be better efficient for selection of data center in logistics information system by using cloud simulators.

VIII. CONCLUSION

Logistics is an initial stage for adopting cloud for its IT based services. Distributed data center architecture gives the efficient response time and effective cost service in comparison to centralized data center in the selected region. The result shows the distributed service broker policy algorithm uses proximity based routing policy and virtual machine based algorithms to improve the infrastructure of logistics information system over cloud. Cloud Sim and Cloud Analyst help to simulate the performance of response time and data transfer cost based on infrastructure as a service of cloud for logistics information system. In future, time and cost can be reduced by using some distributed routing algorithms on these cloud simulators to make researchers and developers to predict real time implementation of logistics information system over cloud.

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