Effective Distributed Data Center Performance for Logistics over Centralized Data Center by using Cloud Analyst

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Abstract
Logistics information system is the process of collecting information with material flow across the supply chain. The big challenges of logistics to using information system for information flow between the companies, their department, systems, logistics partner, suppliers and users are cost and latency. Cloud computing develops centralized and distributed data center to solve these issues with the help of different approaches. This paper focuses on centralized and distributed approaches for managing logistics information system over cloud. The proposed algorithm distributed service broker policy DSBP also shows the better performance in comparison to centralized data center for distributed data center.

Keywords:
Logistics Information System, Cloud Computing, Centralized approaches, Distributed approaches

1. Introduction

Logistics information system provides information flow between inventory, warehousing and transportation to provide high level of services for users. Logistics information system is record based system to analyze all the levels of logistics for validating the correct information at minimum time and cost. Information sharing is most important part of logistics. The major issues in logistics information system are providing accurate planning approaches and reducing cost. Information should be available and structured to all companies in their logistics information system so they can use information whenever they want at any location [1].

In 2012, Prajogo and Olhager analyzed the logistics integration by using information technologies in economic firm. of information technologies on economic company[2]. In 2013, Choy and Gunasekaran focused on logistics information system for decision making process for reducing human errors and cost to operate profitability efficiency[3]. In 2013, Farhangli presented the measurement of information technology, information sharing and information quality for exchanging information between the suppliers in successful partnership which has significant effect on the company performance[4]. In 2014, Qrunfleh and Tarafdar analyzed the performance of supply chain strategy and flexibility in the supplier revision relationships[5]. In 2015, Damian Daniluk and Bernhard Holtankamp defined the adoption of cloud in logistics mall for implementing the IT services and logistics processes[6]. Logistics information system establishes various links between the supplier, logistics partners and users to transfer information in supply chain by using public, private and hybrid cloud infrastructure. Cloud computing has various advantages such as advance development, reduced information transfer cost, less infrastructure, reduce latency and so on.

The logistics information system based on cloud has large capability of network, distribution, less cost and time. To support different process of supply chain, logistics information system adapts the cloud to ensure sufficient uses of the logistics resources. In the given example of company ABC figure.1, the flow of information is identified at each level of the system which shows the gaps in the information flow and bottlenecks, where there are needs of improving the system by using cloud computing to discuss the flow of information with stakeholders or suppliers or users to identify their issues in the logistics. There are following issues included:

- Lack of monitoring information status
- Inaccurate information
- Delays in delivery of information
- Geographical barriers

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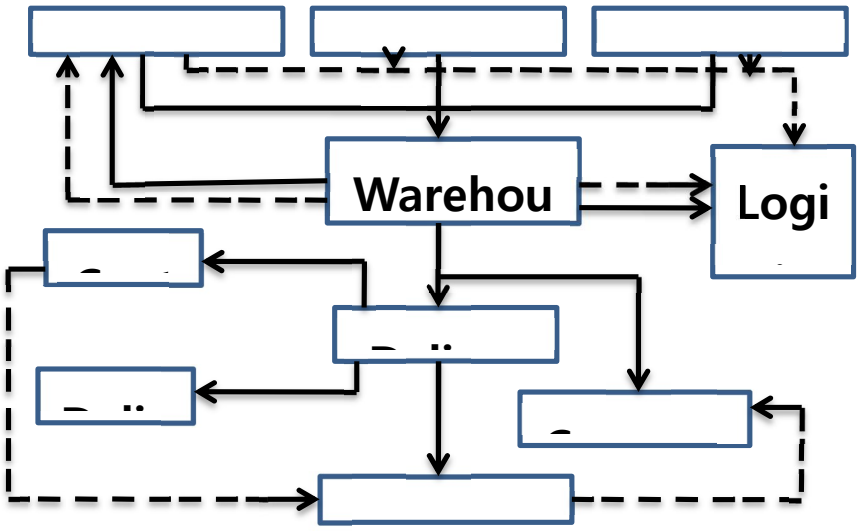

Figure 1. An Example of Logistics Information System in ABC Company

For example, ABC Company has various manufacturers, connected to warehouse delivery centers and logistics distributors. The product is delivered to delivery centers to where retailers need them, it is necessary to have information, not only about the manufacturers, distributers, and demand of product and supply but also about the storage, cost of transfer, movements of goods, services of delivery centers, locations. The data centers are needed by the retailer to capture the information at each level and to use passed information to vendor and then vender have to pass information to make effective logistics operations.

2. Development of Logistics Information System

Logistics information system is more dynamic to handle the coordination and relation among the suppliers and users for sharing information and developing logistics strategies to solve the issues of any company. In 2007, Gunasekaran defined that the function of logistics supports the smooth flow of information about the products in supply chain by using information systems [7]. There are so many information system developments like material resource planning, enterprise recourse planning, supplier relationship management, customer relationship management to implement the performance of logistics [8]. In 2004, Hughes and Love defined Advanced information technology recently is supported to manufacturing and retail sectors for logistics providers like global positioning satellites for tracking the products information and process in whole supply chain as well as maintains the relationship between the supplier and users [9]. In 2008, Ketikidis defined the lack of information technology for information sharing due to the bottleneck, so logistics information has been adopted for accurating their operations [10]. In 2008, Liang also defined that logistics information system collects the information and analyze the decision within a company at different operation levels [11]. In 2006, Sarah A. shull gives an overview of emerging technologies to implement the operations of space logistics information system [12]. In 2008, Feng Liang proposed soft component technology for reconfiguring of logistics information system to improve the supply chain by using building blocks method [13]. In 2011, R.Oktarina focused on research of information system for logistics of disaster relief to support the distribution of information about the disaster relief goods, total reflected population, residents with disabilities, transportation, inventory status of tents, goods, medical equipments and sanitary items. Information about the location is traced by the route tracking system for railway track and road route for hospitals and response coordination [14].

3. Role of Cloud Computing in Logistics Information System

Cloud computing provides different services for logistics industries by using infrastructure, platform software as a service, which allow users to utilize these resources for information sharing, information execution and fast computation[15]. Cloud computing is advance

technology for managing and sharing information by using different types of data center environment which allows high quality of network, infrastructure, processes and quick responses to users' needs. Basically data centers are computer servers for the remote storage, processing and sharing of information at large scale. In this paper, we present requirement and effectiveness of centralized and distributed data center and analyze both based on different approaches and algorithms to minimize cost and latency between the manufacturers, suppliers, logistics partners and users. In centralized data center, the cloud provider is connected one or more data centers located into small geographical area because the distance between the end user and the data center can potentially be large. In central data center the central cloud administrator allocates the virtual machine of the data center using centralized policy. Then the data center providers do not need worry about resource utilization. The centralized data center reduces the work load of administrator to handle the data center. In centralized data center, the centralized approach can be executed by central manager and local manager of data center. The centralized approach can be executed by central manager and local manager of data center. There are many operations like creation, deletion, virtual machine migration which needs to contact the central manager where large amount of network traffic is increased [16]. The centralized system keeps track on delivery information as well as services using a centralize Datacenter. There is probability of network congestion and this problem depends because of load on Datacenter when various request form different regions occurs at the same time. So various load balancing techniques are also required. There are also chances to increment in latencies due higher demand of any particular service. Because supply chain is distributed in nature and each firm or organization wants to grow its supply and distribution, there should be need to scale IT services of supply chain at big level. Distributed Datacenter provide better bandwidth and traffic available for supply chain users in cloud.

Distributed datacenter may be connected or disconnected to each other. After the getting this type of problem distributed data center is developed in which the first central manager decides which data center will serve this request and sends it to local manager to decide where it is going to deploy. After that the local manager chooses which physical machine in a data center will be executed that virtual machine. Other hand distributed data center has lack of making new policies to maintain the performance and decrease the maximum latency for selection of data center [16]. A customer requests can be serviced from nearest location to them in Cloud provide on demand services by which a supply chain user use services when required. The firm or organization which is using supply chain has different branches in different geographical regions like Asia, Europe and North America. If the supply chain of any firm's logistics (information sharing or delivery most widely used in logistics) is distributed globally then it requires a distinct infrastructure of cloud for each of its branches. Information sharing must be reliable and secure between different supply chain users so there is need of its own private cloud system. In private cloud information sharing has done reliable and secure way. So besides using a centralized Cloud Datacenter, supply chain firm should use distributed Datacenter under private cloud circumstances. Using distributed Datacenter under private cloud has fallowing benefits over centralized one.

4. Load Balancing

If the number of suppliers, logistics partners and users increase on cloud, the existing resources automatically decreases, this creates overloading and problem of delay between these people and cloud service providers. Load balancing is the process of distributing load among the various resources in cloud based architecture so that each resource does task equally at any point of time [17]. Load balancing algorithm helps to reduce the bandwidth usage which result in decreasing the cost of machine [18]. Load balancing algorithms in used for implementing in centralized and distributed data center. There are several load balancing algorithms are used for these data centers like round robin, active monitoring and throttled load balancing etc. The impact of these algorithms depends on architecture of data centers over the cloud. The existing data centers have these algorithms, but still the efficiency is presented to find the best suited algorithm for load balancing. We are implementing three algorithms for load balancing round robin, active monitoring and throttled load balancing in cloud environment. This paper describes three load balancing algorithms which are round robin algorithm, active monitoring algorithm and throttled load balancing algorithm.

1. Round Robin Algorithm: Round robin works in the round manner where each node is allotted with a time slice (in which nodes have to perform their task) and has to wait for turn. The time is divided and interval is allotted to each node. The complexity of round robin algorithm is less in comparison to other algorithms [19].
2. Active Monitoring Algorithm: This algorithm handles all the information related to each virtual machine and the number of requests currently allotted on which virtual machine. When a request is allocated, it searches which virtual machine is least loaded to allocate the request [20].

3. Throttled load balancing Algorithm: In this algorithm, virtual machine is used for assigning a specific job. The job manager has list of all virtual machines and also uses this indexed list. If there is no any virtual machine to accept any job then job manager will wait for the request of client ang takes job in a queue for fast processing [21].

5. Proposed DSBP Algorithm

Distributed service broker policy (DSBP) is based on proximity based service broker algorithm for comparing the performance of centralized and distributed data center. Proximity based service broker is simplest where the region selection is based on the earliest/ highest region in the proximity list and any Datacenter of the selected region is then selected randomly for the user requests to be processed.

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 have predefined in Datacenter. In DSBP scheduling is done in a such way that if more than one datacenters 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.

6. Cloud Analyst

Cloud Analyst is derived from Cloud Sim and extends its capabilities for simulating experimentations. Cloud Analyst provides modeler form to perform simulation experiments according to various parameters in quick and easy manner. Cloud Analyst also examines the large scale of internet application over cloud [22]. Cloud Analyst conducts a simulation experiments based on series of parameters verification in systematic and easy manner. There are some main important components discussed below [23]:

- **Region:** there are six regions corresponds to six continents in the world.
- **User Base:** It is a group of users and generates traffic that represents the users in simulation.
- **Internet:** It is used to implement routing behavior
- **Data Center Controller (DCC**): It is used to control data center activities.
- **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.
- **Service Broker:** it is used to decide which data center should be selected to provide the services to requests from the user base.
- **VM Load Balancer:** It is used for load balancing policy by data centers when the serving allocation is requested.

7. Experimental Simulation

The experimental simulation is performed by using Cloud Analyst simulation software. In cloud Analyst, user base (group of users) configuration and VM memory, Image size and Bandwidth are defined in main configuration tab. The centralized and distributed data center configuration consist the number of hosts, processor speed, memory, storage and bandwidth. The VM policy is defined in data center configuration tab. So now we can see the parameters of centralized and decentralized data center in the below table:

Table.1: Parameters configuration in centralized and distributed data center

Parameters	Data Center	
	Centralized	Distributed
Data Center ID	DC1 (only one data center)	DC1 to DC5 (total 5 data center)
User Base	10	10
Memory	2048 MB	2048 MB
Storage	10000 Images	10000 Images
Bandwidth	1000 bps	1000 bps
Virtual Machines	5	5

These parameters are configured according to the load balancing algorithms. The below graph shows the average of response time for comparison of centralized and distributed data center by using proposed DSBP algorithm.

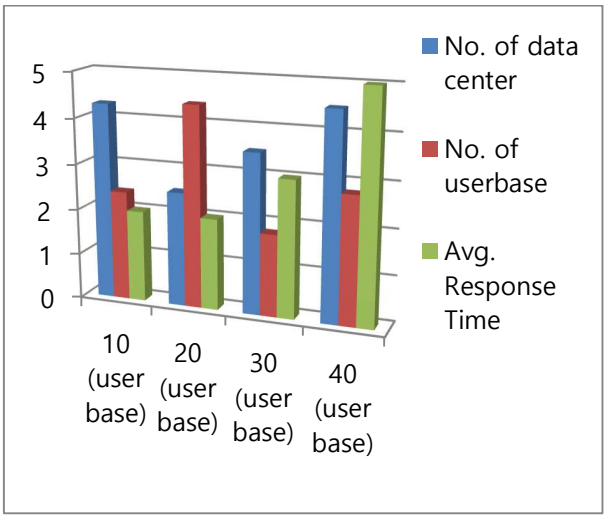

Figure.2: Performance of Centralized Data Center

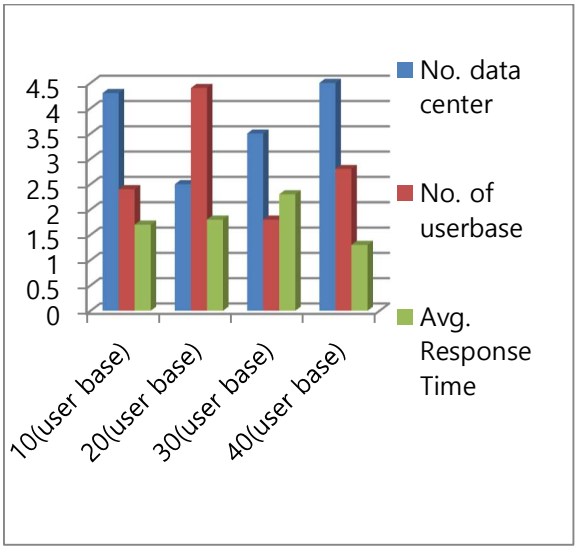

Figure.3: Performance of Distributed Data Center

The graph performance of figure.2 and figure.3 for response time shows that distributed data center gives better response time in comparison to centralized data center. In the below table we can see the better cost performance of distributed data center in comparison to centralized data center.

Table.2: Cost Performance of centralized and distributed data center

Data Center	Region	Total Virtual Machine Cost ($)	Total Data Transfer Cost ($)	Total Cost ($)
Centralized	R0 (Only one)	58.8 $	196 $	206 $
Distributed	R0 to R5 (Total 6)	48.2 $	120 $	80 $

8. Conclusion

The centralized and distributed data centers allow users to share information in logistics information system by using cloud services and resources. By using cloud based centralized and distributed data center policies, logistics information system can be effectively designed, used and managed in any company at minimum time and minimum cost. From the above performance of response time and cost, we can analyze that cloud analyst have facilities to provide different graphs performance and results for improving response time and cost at different parameters in cloud environment.

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