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Analysis of Supply Chain Management in Cloud Computing

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Abstract*— Supply chain management typically involves supervising the transfer of products and goods, such as from a supplier, then to a manufacturer, a wholesaler, a retailer and finally to the consumer. Information technology (IT) refers to the use of computer-based programs to store and manipulate information. IT advances directly can correlate to supply chain management improvements, such as through the rise of effective virtual supply chains. Supply chain information collaboration system bases on cloud computing technology provide efficient supply chain information system based on cloud computing technologies like software as a service (SaaS), platform as service (PaaS) and infrastructure as service (IaaS). With the availability to anytime and anywhere cloud services provide sharing of resources of its services to supply chain. Because supply chain information sharing are demand driven by nature and increase or decrease globally so it should need scalable distributed system rather than centralize one. This paper adopts basic idea of cloud computing to provide an efficient and scalable solution for supply chain management using distributed datacenter of cloud computing.

***Index Terms*— Cloud Computing, Distributed Cloud, Distributed Datacenter, Supply Chain Management**

I. INTRODUCTION

In the modern world companies are investigating ways to optimize both cost and operational efficiency of each phase of their supply chain, such as planning and forecasting, sourcing and procurement, logistics and service and spare parts management. We may define Supply chain management (SCM) as the "design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand and measuring performance globally." Recent development in technologies enables the organization to avail information easily in their premises. These technologies are helpful to coordinates the activities to manage the supply chain. Supply chain management, then, is the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage. It represents a conscious effort by the supply chain firms to develop and run supply chains in the most effective & efficient ways possible. Supply chain activities cover everything from product development, sourcing, production, and logistics, as well as the information systems needed to coordinate these activities.

Cloud computing emerges as a useful technology that contributes to this optimization by providing infrastructure, platform and software solutions for the whole supply chain via internet. The utilization of cloud-based services in supply chain management leads to both financial and operational benefits. Lower cost in contrast to on-premises infrastructure cost, supply chain visibility, platform scalability and flexibility through supply chain partners' collaboration are some notable examples.

Cloud computing is a term, which involves virtualization, distributed computing, networking and web services. Cloud computing can be defined as "A Cloud is a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers"[5]. Cloud consists of several elements such as clients, data centre and distributed servers. It includes fault tolerance, high availability, scalability, flexibility, reduced overhead for users, reduced cost of ownership, on demand services etc.

Main advantage of cloud-based systems is their simplification. Cloud eliminates the compatibility problem using same platform access and provides easy connection to every part of supply chain. It enables supply chain information collaboration between partners in one supply chain system. Members of supply chain can enter and added in the collaborative environment of cloud using member id and password. After that all users have authorized to operate simple process and application in the same platform, which reduced response time of supply chain partners.

Another benefit is visibility which provides timely connectivity along multiple supply chain participants. Therefore, visibility is a key issue for SCM as it not only helps such companies to coordinate their operations and manage many different customers but also allows the customer network to have a transparent view of the entire system. Cloud-based systems are able to provide real time visibility of inventory and shipments and improve logistics tracking. By using cloud computing, companies can control their system capacity more accurately. In periods where demand is high, companies need enough capacity in order to be able to face this increasing demand. Consequently using common on-premises systems, they should own the necessary database for the whole year in order to respond to the excessive demand just for a short period. However, with the advent of cloud technology, companies where given the opportunity to adjust their capacity automatically according to their needs and scale their computing power depending on demand fluctuations.

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II. HISTORY AND FUTURE PROSPECTIVE OF SCM IN CLOUD COMPUTING

Thomas Schramm, Jonathan wright, Dirk Seng and Derk Jones divide the era of SCM in cloud computing in three parts [10].

Table 1: Implementation process of SCM on cloud platforms

2010-2011	2011-2013	2013-2015
Processes & providers characteristics & examples	**Processes & providers characteristics & examples**	**Processes & providers characteristics & examples**
In early pilots SCM using cloud needs innovation and continuous improvement. Testing attitude also needed. Support & administrative processes. These can easily be abstracted and isolated, and do not require complex integration. Examples: • Capability development/training delivery • Simple analytics	This era captures maturing phase, first providers disappears from the market and other invest to grow and improve service offering. Higher focus on core and rather complex processes. Examples: • Pricing optimization • Replenishment planning • Order processing • Transportation load building	Here consolidation phase starts and major player in each category of SCM defined. SCM accept well establish models for usage and payment of cloud based services. Also complex process covered in cloud e.g. requiring collaboration between many entities and tighter integration with other processes and perhaps involving physical capacity constraints. Examples: • Collaborative engineering • Warehousing and distribution of physical product • Reverse logistics/returns processing • Fleet management
User group interests	**User group interests**	**User group interests**
Companies with highest pressure for operational excellence and through competition, e.g. Products / Consumer Goods, High-Tech	Broader industry scope, companies with higher integration needs will start using cloud based services as part of their operating model	All industries applied cloud based processes

III. LIMITATION OF CENTRALIZE DATA CENTER FOR SUPPLY CHAIN IN CLOUD SYSTEM

In cloud computing storage and computing resources are managed centrally. In logistics management of SCM where no of distribution centers scattered over different regions. The centralized system keeps track on delivery information as well as services using a centralize data center. There is probability of network congestion and this problem depends because of load on datacenter. So various load balancing techniques are required. There will also chances to increment in latencies due higher demand of any particular service.

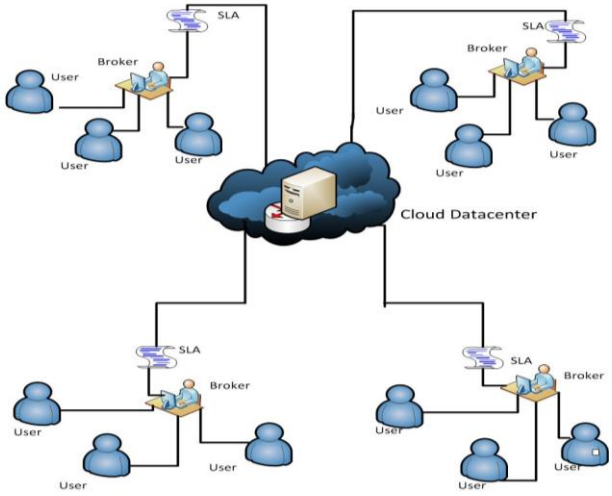

Fig 1: Architecture of Centralize Cloud Datacenter for SCM

IV. SIGNIFICANCE OF CLOUD IN SUPPLY CHAIN MANAGEMENT

In cloud computing, the applications of supply chain are innovative and generate a new field of research. Two or more parties linked by cloud services in cloud supply chain to provision of cloud services, related information and funds.

A. Forecasting and planning

Cloud-based platforms are going to help companies improve their service levels by collaborating the chain's partners (retailers, suppliers and distributors) that are playing a major role in demand forecasting. These clouds based platforms get the data from internet and perform basic operation like analytics and perform more accurate demand forecast for all supply chain partners. This will help to aware the chain partners to if there is volatile of real demand, they can handle it with easily.

B. Source and procurement

Sourcing includes acquisition, receipt and inspection of incoming materials as well as procurement process. Cloud based platform operate on database contains multiple data from different suppliers which provide efficient and different benefit for companies that handle thousands of them. On the other hand companies are able to select between supplier that which of them are able to provide appropriate martial as their specification and within time. Cloud based tools also enable companies and suppliers to mutually develop contracts and enhance contract management.

C. Inventory Management Using Wireless Devices

Inventory management enhanced by many organization using bar coding technologies and wireless services. RFID system integrates with the cloud based centralized data management sys-tem to deliver the global identification and tracking of any items or goods across the global supply chain management lifecycle [7].

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D. Collaborative Design and Product Development

Along with the development of information technology, internet network transmission technology is mature gradually, its security, stability, compatibility is constantly improved, and all application range is expanding continually, become a kind of the making universal of transmission [8]. Collaborative product development includes the use of product design and development techniques across multiple branches of same organization or between different organizations. All the developments process shared over secure network between different organizations. These processes include specific information, marketing firm, test result and design changes as well as customer feedback.

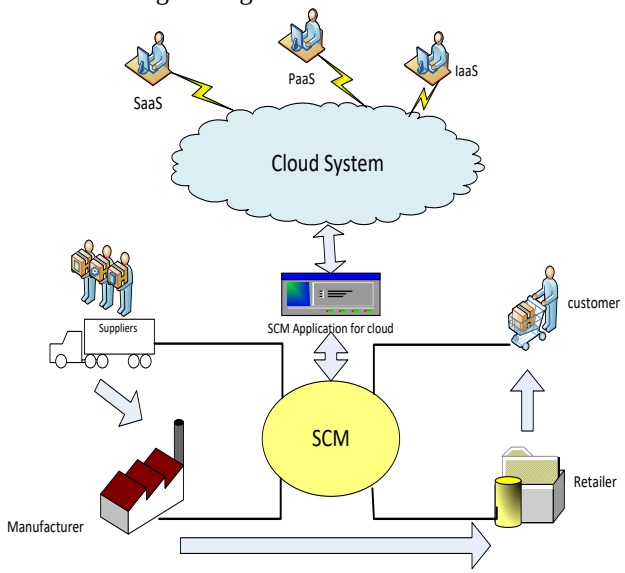

Fig 2: SCM architecture in Cloud Computing

E. Logistics management

Logistics involve process of material acquisition, warehousing and transportation process. Logistics information management system keep track on inventory information.by using logistic management under cloud gives fallowing benefits

1) On demand self-service

Consumers parallel request and use computing capabilities without any human interaction with their service provider. Here internet access allows users to consume computing capabilities by means of client's platforms like mobile phones, note books or PCs.

2) Resource Pooling

In order to fulfill the consumers demand from multiple consumers, the cloud computing service providers pooled their resources. The provider dynamically assigns or reassigns physical or virtual resources to consumers. Consumers on the other hand have no knowledge about the resource location which is assigned to consumers.

3) Elasticity

In cloud computing it is the ability of providers to quickly add and release the resources as soon as possible to match changes in consumers demand. This should be done in efficient manner.

4) Scalability

Scalability means that a system "maintains its performance goals/SLAs even when its workload increases (up to a certain workload bound)." Whereas an elastic system dynamically adds or release more resources when service demand increase or decreases respectively. So elasticity adds dynamic component to scalability.

V. IMPACT OF CLOUD COMPUTING ON SCM

Cloud computing system uses lot of technology like standardization technology, virtualization technology, data management technology and platform management technology in supply chain information collaboration. Flexibility is great power of cloud computing system. It has the ability to increase or decrease computing power as required by users. This term is referred as scalability. Scalability ensures that computing services available to the users at any point in time. Scalability is highly concern issue in supply chain management system. Because supply chain is distributed in nature and each firm 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 for supply chain users in cloud.

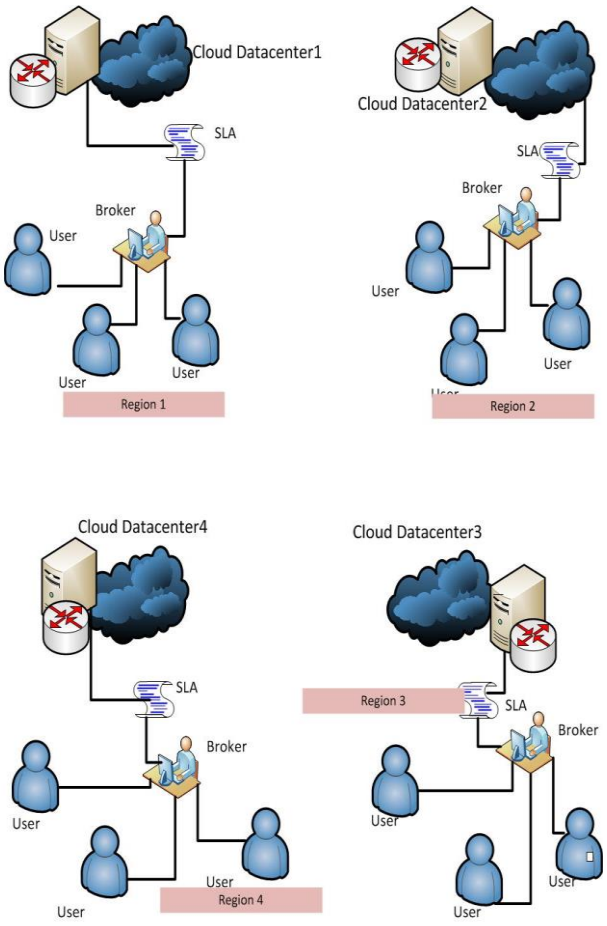

Fig 3: Distributed Cloud datacenter for SCM Users

Cloud provide on demand services by which a supply chain user use when required. The firm or company which is using supply chain has different branches in different geographical regions like Asia, Europe and North America.

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If the supply chain of any firm 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 data center, a company or firm should use distributed data center under private cloud circumstances. Using distributed data center under private cloud has fallowing benefits over centralized one.

A. Efficiency

Centralized system takes request from users globally which create more loads on servers. So there will be chance of increment in latency. This will create time delay between request and response. On the other hand local datacenter under distributed cloud environment gives more fast response to their users.

B. Scalability

A system would scalable if cloud gives least amount of latencies during information sharing and collaboration between two or more users.

C. Security

In private cloud the firm creates its security policy according to their own requirement**.** If it is distributed then policy has great effect due to their regional information sharing policy. A single supply chain company can use different security policy for different users in different regions.

VI. CONCLUSION

Supply chain firms are initially start using cloud computing for their services and using cloud services supply chain efficiently utilized. The various architecture of cloud is available and need to explore fully utilized and scalable cloud infrastructure. In this paper we presented how supply chain can adopt the basic idea of cloud computing for its IT services and also presented an architecture of distributed cloud datacenter instead of centralize cloud datacenter which gives more efficient and scalable infrastructure for supply chain users and partners which reside in different regions. Above architecture will best suit for where information tracing or sharing are highly used like forecasting and logistics management of supply chain. Therefore companies who are willing to improve their services of information collaboration and want to scale their services at large level can use distributed cloud datacenter.

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