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MLBM-DVF: MODELING LOAD BALANCING AND MULTITENANCY-ORIENTED DATACENTER VIRTUALIZATION FRAMEWORK

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ABSTRACT

cloud computing is the most significant and popular technology in current research and computing world. This technology mainly responsible to provide computing platform for distributing number of resources like software and infrastructure with the help of virtualization. Thus, in cloud environment virtualization plays key role which responsible to handle logical operations; for e.g. storage and distributing computing resources, also provides a heterogeneous requirements from multi-tenants. The significant challenge in the background of cloud computing is the "Load Balancing", that influences on several problems like infrastructure cost, availability, and flexibility. In this research study, have explored a "Load Balancing" concept which considers such type of major issues and offers a better solution for this. The proposed methodology adopts benefits from the application of distributed virtual switch i.e. DVS. The proposed load-balancing framework design composed of two phases; 1) *"Virtual Server Placement*" and 2) "*Virtual Link Establishment*" phase. The primary constraints on the flow of network are the bandwidth demand of servers network interface. This methodology provides efficient Load Balancing exploiting of an elaborately designed virtual link establishment algorithm. The experimental analysis is carries out in MATLAB environment where the study evaluates discrete parameters such as Traffic, Bandwidth demand and Link count.

Keywords: *Data-Center, Multi Tenancy, Virtualization, Load-Balancing.*

I. INTRODUCTION

In the current period of computing world, the most popular and trending technology is the cloud computing. This computing environment contains group of virtual servers, network resources, data-centers, storage devices and load balancers etc. those are linked with one another [1]. Additionally, cloud computing is the most prominent mechanism in the area of distributed computing system and provides lots of advantages to both academic and commercial field in terms of storage, networking and information accessing. In distributed system, job-scheduling is the primary challenge to handle or balance the incoming network traffic in efficient manner [2,3,4]. According to case study, several load balancing algorithms have been introduced for example; 1) Round robin, 2) FCFS and 3) Throttled algorithm [5] which exploited for job scheduling to available VMs in distributed computing system. Additionally, these all scheduling algorithms works efficiently but there are few challenging problems viz. utilization of efficient resources, communication delay, bandwidth demand, traffic challenges and many more have not been proposed more accurately in the prior study so far.

Generally, load balancing algorithms are classified into two major categories; 1) Static load balancing algorithms and dynamic load balancing algorithms [6]. Static algorithms are efficient for homogenous environment whereas, dynamic algorithm performs significant role in homogeneous as well as heterogeneous computing environments. Additionally, these algorithms are highly suitable for any distributed system [2,7]. However, virtualization performs significant role in cloud computing which can handles the server load and increases the energy efficiency of virtual servers. Furthermore, if network load in the cloud is lower then, other servers could be on inactive (i.e. power off) mode to preserve the some amount of energy [8]. Thus, load balancer is require in both distributed and cloud environment.

Hence, in the current study, we introduce a model of "Load Balancing and Multi-tenancy oriented Data-Center Virtualization Framework" (i.e. MLBM-DVF) for the scenarios based on the integrated approach of one to one and hybrid algorithms. The designed algorithm contains two major phases; 1) Virtual-Server placement phase and

2) Virtual -Link Establishment phase. In this implementation process, load balancer perform significant role to assign a coming user request to the particular virtual server.

The key features of proposed MLBM-DVF framework as follows;

The proposed MLBM-DVF offers an efficient usage of network resources, also minimizes the infrastructure cost

α. By this approach, can freely allocate virtual servers according to the requirements.
β. Improves the traffic-locality (i.e. Inter-edge (¨inter) traffic and Intra-edge (¨intra) traffic), thus virtual resources can be utilized more efficiently.

The remaining part of the current research is organized as; II-section carries out with related work, III -section discusses about research methodology which includes framework design and algorithm implementation, followed by comparative analysis in IV -section. In the last V-section highlights the contribution of the study in the form of conclusion.

II. RELATED WORK

In cloud computing virtualization is a significant mechanism to solve the complexity of several computing resources like power consumption and DC infrastructure cost. So as to overcome these problems Duan et al. [9] have introduced embedded virtual network architecture. The proposed model has unique features which provide efficient architecture with limited resources. Finally, the experimental analysis carried out by evaluation of the theoretical results.

In data centers is collaborative form of computing and network tools for collecting, loading and storing, as well as exchanging of data information. Exchanging of large amount of data leads the growth of large traffic, due to this it unable to regulate the data packet in correct order, So to mitigate this problem Sehery and Clancy [10] have discussed a load balancing architecture which utilizes two methods that are randomize selection routing and dynamic load-balancing approach for maintaining flows to link. The simulation outcomes of designed architecture provide a higher bandwidth by comparing with static hashing approach.

A multi-rooted tree structure is used in data center networks (DCN) for achieving the efficient bandwidth delivery. But due to huge traffic across the network interrupts the efficient utilization of resources which cause fluctuation within network performance. In direction of resolving this issue the study of Guo et al. [11] has suggested real-time operational scheduling algorithm to operate the load balancing in the DCN. The result display that proposed algorithm acquires better running network in aspect of throughput and traffic load division.

In the study of Ballani et al.[12] has tried to stretching and provide better interface between cloud provider and cloud tenants and they designed a virtual framework to measure the trade-offs among performance ensures to multi-tenants and their expenditure and provider revenue. The outcomes of study comes show that the presented approach can able to reduce tenant costs with balancing the provider revenue.

In the study of Chowdhury et al. [13] has worked to resolve the issue of embedding in virtual network and consider this problem as mixed integer optimization. Author proposed two new algorithms that are Deterministic virtual network and Randomized virtual network by proposing the relation between mapping phase of link and node. The outcome of this study reveals that the proposed approach outperforms in respect of revenue, acceptance ratio and provisioning cost.

In cloud computing virtualization and sharing network resource plays very important role in reconfiguring the architecture of computing and networking but it faces some difficulty while embedding of multiple virtual networks based on share substrate. To deal with such type of issue Cheng et al. has utilized "*Random-Walk model*" to define the position of the network node. Based upon position of network node and introduced new algorithms

which finds and measures the shortest path among virtual nodes and plots the virtual links during that phase. The experimental result display that proposed approach obtains maximum revenue acceptance ratio.

The study of Benson et al. [15] has investigated the network load upon ten DC's which related with three type of different organizational area. Also analyzed the implications of the deployed data center applications and their transmission properties of data center network and its link.

In cloud computing embedding of multiple virtual networks is quite difficult task, in respect of finding proper solution Fischer et al. [16] has surveyed on various active approaches and techniques for virtual network embedding.

In the study of Botero et al. [17] has reported energy aware problem "Embedding Virtual Network" also introduced a MIP model which utilized to achieve energy-efficient embedding virtual network. The results shows that the proposed method gains energy in compare of traditional VNE methods.

The data center enables the efficient way for cloud computing services and provides basic infrastructure for computing and storage. But when some issues such as fault and failure, network maintenance occurs in data center networks then it can make several servers unavailable and datacenter networks also get congested due to this cloud services and internet services become nonresponsive. In order to obtain better solution Bodík et al. [18] has studied a complete analysis on large-scale applications and their communication network and constructed a optimize model which results a maximum fault tolerance along with bandwidth demand for core network.

In the study of Meng et al. [19] has reported about issues related with the flexibility and scalability of DCNs and consider this problem as optimization problem based on this offered a new algorithm which solution the Virtual Machine establishment/placement (VMP) problem. Later they studied the impact and conditions OF DCN traffic system and architecture on scalability profit achieved by network aware VMP. The outcomes of study showed that presented algorithmic approach provides higher performance over existing methods.

In [20], Fejjari et al. has concentrated on the problem related with reconfiguration of VN and designed a greedy algorithm to reduce level of overload in substrate links and cost of reconfiguration. The result of this study display that proposed algorithm performance is better than traditional method and is independent of other Embedding approaches and also reduces the reconfiguration cost and rejection rate about 80 to s85%.

In the study of Wood et al. [21] has discussed the beneficial aspects of Virtualization in data center by activating migration process of VM to discard the hotspot. Also they suggested a system called as sandpiper which automates to monitoring and detection hotspots and perform the needed migration task. The result of proposed system achieves optimal solution to eliminate the single hotspot within short period of time and it can be extent into large data center infrastructure.

III. RESEARCH METHODOLOGY

In this section, have discusses about proposed methodology i.e. ***"Modeling of Load-Balancing and Multi-tenancy oriented Data-Center Virtualization Framework"*** (MLBM-DVF). The solution of Data-Center Virtualization (DCV) usually categorized as i) static approach and ii) dynamic approach. In first approach, the assigned networking resources are fixed where as second approach provides a reconfigurable resources, which is obtained from the cloud. The algorithm implementation process carried out in two phases, i.e. virtual server placement and link establishment phase. The study hereby presents detailed algorithm implementation procedure and illustration of both two phases.

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A. Virtual Server (VS) Placement

In this phase, system allocates the number of virtual-servers (VSs) as per the user's request. Throughout the process, the system tracks the instructions of increasing the level of traffic zone [22]. It means, the servers in the virtual private cloud are situated in topological order which allocate nearer to each other, so as to detain large scale network traffic on hierarchical low-level switches, e.g. if two virtual servers (VSs) are linked to single edge-switch, then node to node request flow from one to another utilizes the switching power of that edge-switch. Conversely, if set of VSs are connected with distinct switches, then similar request-flow between the VSs has to exploit additional network connections between the 2-layers and external switching power from core-switch. Hence, it is compulsory to allocate the VSs in similar fashion, in order that some available Edge-Switches are occupied for the allocation of VSs. Therefore, from this method system can attain higher efficiency by forwarding packet from source node to destination node or vice versa. Though system unable to move from one physical server to another, so that proposed system have the facility to allocate virtual servers. The next phase is responsible for the link establishment between the switches and servers. During this process, the consecutiveness is handled and virtual server migrations are reduced.

B. Establishment of Virtual Link (VL)

After the VS placement process, system is responsible to establish a network link between the severs; where system selects appropriate core -switches (Ci) and establishes the link between two layers (i.e. core and aggregation layer) and setups the route for ¨inter traffic. Same as in the previous phase (i.e. VS placement phase), here we are adopting a dynamic approach.

Particularly, there is no physical connection or hardware switches are allocated into virtual private cloud. In its place, for each ¨ inter traffic, system found a rout and placed the switches as per the algorithm implementation which is describes as follows.

In this phase, we adopted a dynamic strategy, because the propsed framework MLBM-DVF provides both global view and globally manage the network resources in the DC network. This mechanism is adopted by referring of fat-tree architecture

[23]. Therefore, from this mechanism system achieves a global optimization. However, in this model (MLBM-DVF), ¨inter traffic is measured in terms of three parameters; such as 1) initial edge-switch, 2) number of target edge-switches and 3) band width demand. Here, main thing is that, system mainly focuses on first or last edge-switches in place of VSs, since interaction between the virtual servers linked with similar edge-switch which do not generates the ¨inter traffic flow.

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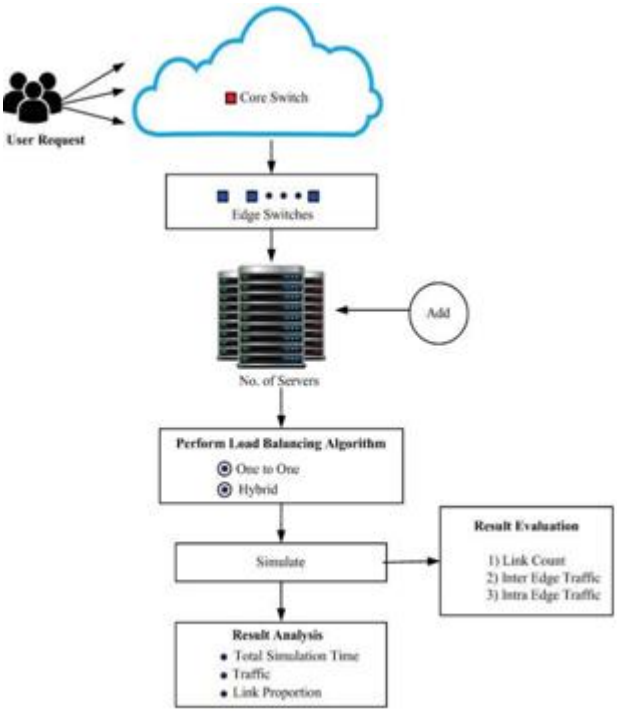

Figure 1 Proposed MLBM-DVF Framework

The proposed framework is implemented in numerical computing environment. The process is intially begins with performing user request to the cloud. In the first step; a number of users sends the request to the cloud which includes master user information (i.e. Uname, Uzone, Rtime, and Dsize). The system evaluates the request for each zone, then compare with either zone and update by adding traffic. Then system will localize the coordinates for cloud deployment. In the cloud environment, system consideres a single core swtich along with four edge switches. Here, core switches handles the ¨ inter traffic flow where as edge switches found a rout for VSs to be connected to the network & handles the ¨intra traffic also. After the establishment of core switch and edge swtiches, system will select or add number of virtual servers into the cloud according to the requirements. Then system computes the cloudlet request freqeuncy and generate the job. After the generating of job, system under go for the perfomance of load balancing algorithm. In this step, have considered two different traffic matrices; i.e. 1) one to one and 2) Hybrid. The efficiency of both matrices are computed with a variable parameter namely “Band width demaand” ranging between 1-16 units. In both process (one to one and hybrid) sysem generally evaluates the traffic per zone, traffic locality and link count. Finally, system will upadate the traffic as per the request and process moves to each zone by link updating.

Table 1 Algorithm Notations

Symbol	Description
Ureq	User request
Ci	Core switch
Ei	Edge switch
Vservers	Virtual servers

Cs	Cloud size
Sx and Sy	Servers coordinates
Sl	Sever slice

Algorithm for proposed MLBM-DVF Input:No of Ureq, Ci, Ei, and No of Vservers

Output: Δinter, Δintra, Stime, Lcount.

Start

1. Perorm Ureq operation
2. Init . Uname, Uzone, Rtime, and Dsize
3. Enter user information record
4. Add number of Ureq
5. Compute Ureq per zone
6. Update by adding traffic
7. Compute bar frequency as per Ureq vs traffic per zone.
8. Perform Virtual Server Placement

$$\text{Localize cloud} \leftarrow \left(\frac{A}{2}, dx.C_s - \frac{C_s}{2}\right)$$

9. Initialize Ci, Ei,
10. Compute localization of Ci and Ei
11. Add Vservers
12. Compute time series localization as

$$Xt \leftarrow \sum Sl_{xi} + S_x * sizeofserver$$
$$Yt \leftarrow \sum Sl_{yi} + S_y * sizeofserver$$

13. Visualize the server
14. Establishement of Virutal link
15. Perform Load blancing algorithm

a. One to one

b. Hybrid

16. Assing the value of bandwidth

17. Repeat the step (8↷13)

18. Compute traffic per zone, link count
19. Anlyze traffic proportition with respect to simulation time.

End

The core concept behind this algorithm is to minimize the level of future traffic locality after the allocation of VSs, therefore it increases the traffic locality matrices (i.e. ¨inter traffic and ¨intra traffic), so that virtual resources can be exploited more efficiently. In shortly can say that proposed algorithm reduces the network resource as well as time, and the framework is best suitable for user satisfactory experience data delivery & robust quality of service (QoS) support.

IV. RESULT ANALYSIS

To measure the overall effectiveness of proposed algorithm, MATLAB programming has been used to extend the Cloudsim simulation tool. The system handles the distinct events like e.g. incoming / outgoing request from cloud tenants, starting or ending of ¨inter traffic flows, etc. Here, system considers the private clouds which has two different traffic matrices i.e. 1) one-to-one and 2) hybrid, which simulates the multi tenancy. System runs the simulation under MATLAB environment.

In the virtual server placement process, virtual private cloud (VPC) is constructed to exploit successive server-slices.

Since to get better traffic locality, i.e. minimize the ¨inter traffic load, thus minimize the work of VL establishment and infrastructure cost too. System represents the generated simulation outcomes of both ¨inter and ¨intra traffic-flow in the following figures.2 and figure.3

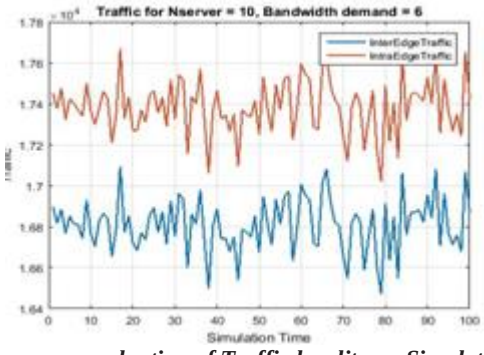

Figure 2 Performance evaluation of Traffic locality vs. Simulation time (100 sec)

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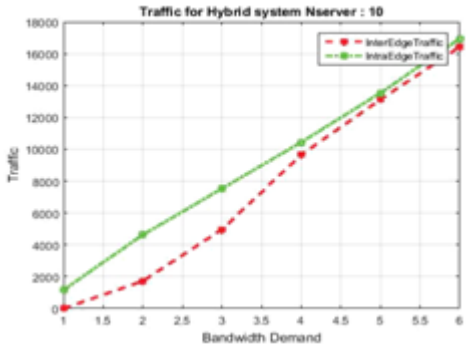

Figure 3 Performance evaluation of Traffic locality vs. Bandwidth Demand

The above figure.3 represents the impact of network environment of the traffic locality (i.e. ¨inter and ¨intra traffic). System notices that, in massive network environment, the proportion of ¨inter traffic load increases and the proportion of ¨intra traffic load decreases. Since, when the size of the virtual cloud is large, the server which belongs to one VPC can be place on another edge-switch. Whereas, figure.4 represents the impact of link counts among the virtual servers in VPC. Initially, system selects the one random server & sends that request to target node. Results shows that, flow of traffic will be depend on several parameters like bandwidth, Ureq..Etc but ¨inter traffic proportion is profitably limited as the outcome of the VS's allocation process.

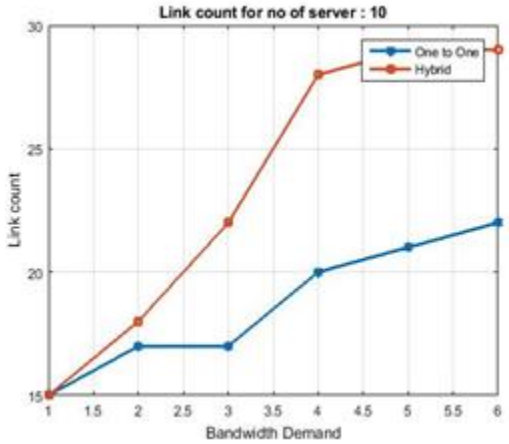

Figure 4 Performance evaluation of Link Count vs. Bandwidth Demand.

So as to evaluate to what percentage of network traffic is managed, system evaluates the link-count (Lcount) for distinct bandwidth demands (ùd). The above figure.4 represents the performance analysis of Lcount vs. ùd. Here, can note that if the Lcount gets high when the corresponding ùd will high. Explicitly, if it is a higher range of links has higher ùd upon them. Hence, traffic flow is equally disseminated in the virtual network. This analysis is experimented in different network scenarios. Therefore, can say that the traffic flow can be well balanced in this framework.

V. CONCLUSION

In this study, have proposed a "***Model of Load-Balancing and Multitenancy-oriented Data-Center Virtualization Framework"*** (MLBM-DVF). Proposed framework adopted a LB phenomenon to place co-operating virtual servers in a localized order. Also, the current research leverages the traffic symmetries and vigorous connectivity between VSs in the VL establishment process. This approach provides a "multi-tenancy oriented" VPC, providing great flexibility to the users.

The traffic matrices (¨inter and ¨intra) are supported in the VPC, permitting virtual server to interact with multiple destination servers in sequentially under the virtual networking model. The proposed MLBM-DVF model reaches a global LB and delivers predictable performance. Finally, the simulation outcome have been evaluated by measuring of link count, bandwidth demand, and simulation time which shows that proposed framework can efficiently handles the background jobs, and outperforms prior solutions.

Thus, in this study have mainly focused on load balancing scheme which can be applied into the cloud computing, but there are few other strategies which can be exploited to manage the request traffic in the CC environment. The overall performance of proposed MLBM-DVF model can be improved by distinct parameters.

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