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Dynamic load balancing in Data Center – SDN Solution

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Abstract— In today's fast paced world, Network applications and their infrastructure are becoming more complex day by day. In data centers, Software defined network-based traffic management techniques control paths of incoming flows. In this paper, we propose an SDN-based dynamic load management algorithm for optimizing link utilization in Data Center Networks while considering the traffic priority. The algorithm finds the shortest paths from each host to others and calculates every link's cost based on the usability. When there is a congestion it replaces the old path with the alternative best route that has the minimum link cost and having lower traffic flow. Performance of the algorithm is evaluated by measuring throughput, delay and packets loss in a DCN. It shows improved performance in load balancing over time as the algorithm keeps on running.

Keywords—Software Defined Networking, Dynamic load balancing algorithm, Data Center Networks

I. INTRODUCTION

Most online services and social networking sites require high availability of internet connectivity, that is possible only when server is available. So, they often require multiple servers and employ hardware load balancers to interact with clients and servers. But managing of hardware load balancer is too costly. Therefore, SDN solution comes into the picture which is highly cost efficient and provides flexible applications that meet the requirement of service provider and consumer. Data Center network experiences unbalanced data traffic, like some paths are congested and some are free. The SDN solution utilizes the unused path and balanced the load accordingly in the network. SDN based Data Center network improves the performance by improving throughput, delay and packet loss. This results into optimization of link utilization in Data Center networks.

II. PROPOSED METHOD

A dynamic load balancing algorithm that performs load balancing in a Data Center network topology by calculating minimum transmission costs of the links at a given time. It performs multi-path capability, so Dijkstra's algorithm is considered to find multiple paths of same length. The traffic flows are based on their priority. The path with least cost and load is selected and traffic flow is forwarded on that route, among the selected paths. The new flows rules are then pushed to Open Virtual switches (OVSs) to update switch forwarding tables. The performance of this algorithm in fat-tree data center network is evaluated by throughput, delay and packet loss.

III. ALGORITHM

Below is the algorithm used to get maximize link utilization in the available path:

Input: T (Traffic Matrix), DCN Topology, Link Capacity
Output: Minimizing maximum link utilization path allocation of flows in T
1: all possible flow f in T do
2: List flow f in ascending order according to priority
3: List all possible paths from f(source) to f(destination)
4: list(p) = Apply the Dijkstra's algorithm to find multiple paths of minimum length
5: For all path p in list(p) do
6: List maximum link utilization [p] = maximum link utilization of p
7: End For
8: p(selected) = list(p) [index of minimum in list maximum link utilization]
9: Assign f to p(selected)
10: For all links l in p(selected)do
11: Update flow switch table
12: End For
13: End For

As we know, control plane and data plane are separated in SDN environment. As a simulation process, Floodlight OpenFlow controller is used as control plane and Mininet topology generator in data plane. The Wireshark and iPerf are the network analyzer tools used for analysis of the network with and without SDN environment.

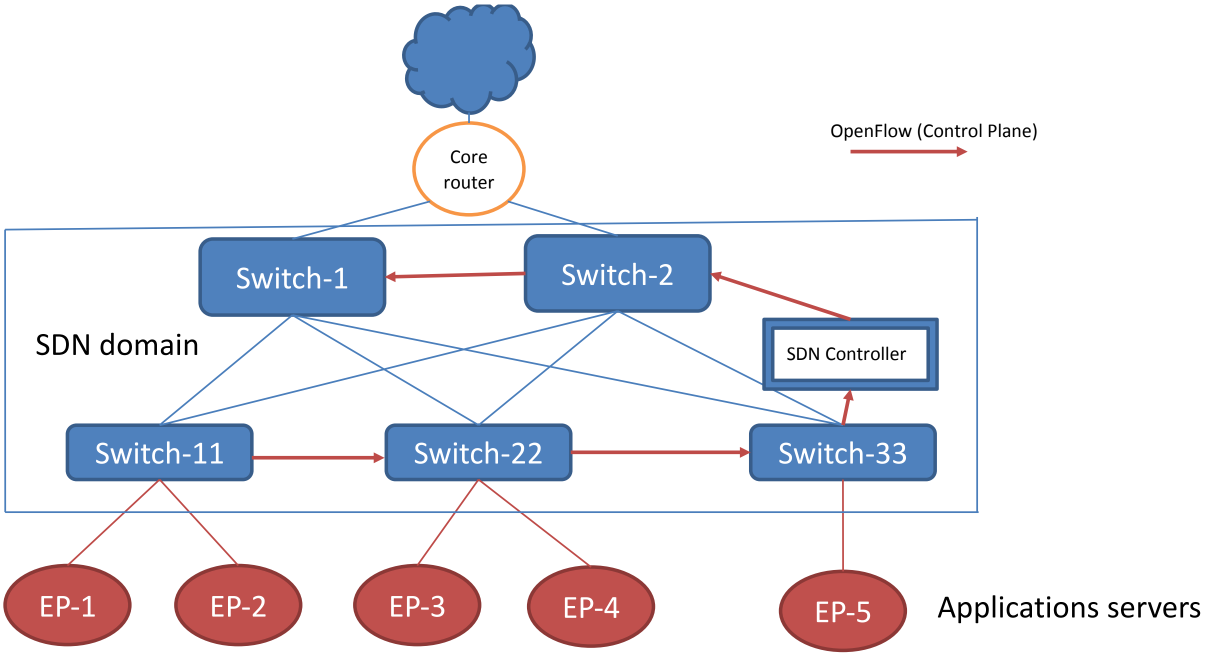

Figure-1 SDN enabled Data Center

Here, goal is to improve load balancing algorithm to improve the traffic management in the legacy data center environment using SDN approach. Initially, packet and normal transmission recorded before applying load balancing and when congestion occurs in the traffic, load balancing is applied, then throughput, delay and performance of packet is executed. When floodlight OpenFlow controller (control plane) is connected to Mininet (data plane) of 5 hosts and 6 switches and 9 links connected.

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The "Ping all" command executed at end hosts and REST API running tells the reachability of the hosts and corresponding MAC addresses, IP addresses, port mapping, link rates etc. Below is the host connectivity and respective switch diagram. Here, if we need to send traffic from host H1 to Host H3, there won't be a problem. But in that link if there are more traffic flowing, load will be more. And we need to do a load balancing in that particular link. Either we need to diversify the load via some other link or need to remove some link from the topology. So that throughput, Delay and performance should not impact the traffic.

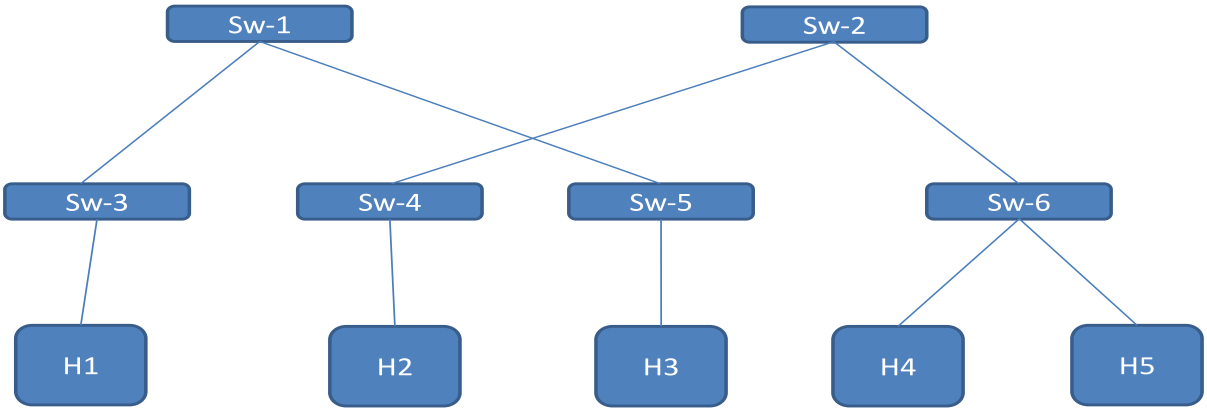

Figure-2 Switch host setup connectivity

In regular scenario, there is no requirement of load balancing. But whenever there is a congestion is necessity to apply the above algorithm in the code. After applying load balancing algorithm in the python code, it obtains all the path information, which it manages all the traffic etc. This will give the total cost link using Dijkstra's algorithm and when there is a more congestion in the traffic it will again re-calculate the path. Based on the new calculation (where congested path is not included), it will send the traffic with the minimum cost path.

There are some thresholds where load is defined to be in a good range. Below the threshold value of the load, there is no problem in traffic and load balancing is not required. If load is above the threshold value, traffic will be called as congested and there will be delay in the traffic, performance will be low, and throughput is less. During this time, load balancing in the traffic required.

IV. CONCLUSION

As we know, Data Center Networks are the backbone of the Internet services. Now-a-days, SDN simplifies and improves DCN management. Performance of data centers rely on proper resources utilization. Traditional load management employed in DCNs suffer as few links experience congestions while majority of the links are less utilized or idle. In Data Center Network SDN based solution offer better flow management. In this paper, we propose an SDN-based dynamic load management algorithm for maximum link utilization in Data Center Networks. When congestion occurs in the network, it replaces the old path of traffic flow with the alternate best route with minimum link cost that has shortest distance. It improves load balancing performance with reduced delay and increased bandwidth.

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