

## Load Balancing In Software Defined Networking (SDN)

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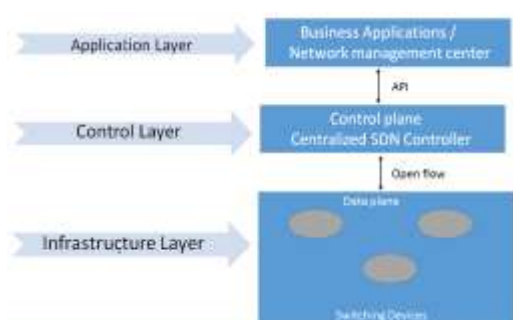
**Abstract:** In current era, the usage of internet and internet traffic has been increasing immensely. Network has to handle multiple clients with single server which is very difficult. Software define network (SDN) allows to improve the performance of network/server. It is the new developing network technology that able you to improve the network services. Software define network based load balancing is used to manage the huge traffic load which distribute the load among different servers. For this purpose different algorithms could be used. In this study we analyzed different algorithm which efficiently perform load balancing among available networks.

**Keywords:** Load Balancing, Software Defined Networking, Openflow, SDN based load balancing.

### 1. Introduction

In recent days internet is busy with huge traffic [1]. With the landing of new inventions generally in the ranges of mobile, social, and big datacenters, computer networks require high data transfer capacity, and effective management[2][3].

In 2008 analyst at Sanford University proposed a revolutionized idea known as software Defined Networking (SDN) in order to enhance the versatility, and ability of network [2]. SDN center thought is to isolate the control plane from forwarding plane, what's more control plane is programmable specifically [1]. This SDN invention proposing the idea of isolation and transmitting load balancing [4]. As appeared in the figure 1, the forwarding plane and the control plane are isolated. [6] For correspondence among control and forwarding plane open flow protocol is utilized [5].



**Fig. 1.** Software Defined Networking Architecture

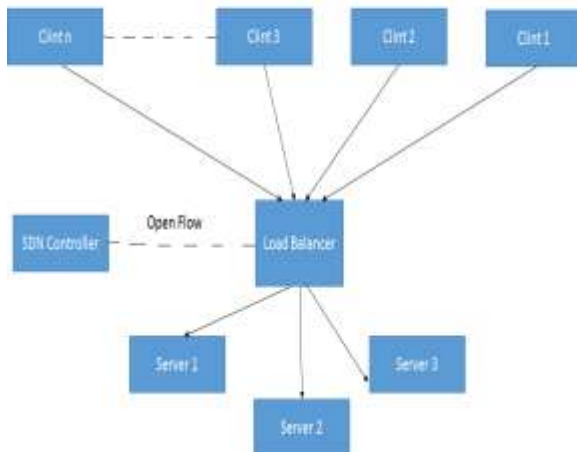
There are three main layers of SDN architecture such as 1) Application layer, 2) Infrastructure layer, and 3) Control layer [7]. With the some advantage of SDN advantages, there are some SDN research challenges as appear in the figure 2 [8]. Quality of Service (QoS), load balancing, security, and scalability are SDN research challenges [8] [9].



**Fig. 2.** SDN Research Challenges

To serves huge number of request per day different servers ought to be utilized as single asset and every request ought to be re-enacted as various servers. To disperse all request to multiple servers load balancing procedure is utilized. There are diverse load balancing technique to disseminate circulate the burden to various devices [1].

In SDN load balancing implied a productive and clever blockage mindful directing resolution. In the light of SDN condition it is a fundamental limitation to enhance the adaptability and accessibility of network which prompts accomplish greatest number of packets dealt with by the controller in insignificant time for any application. Figure 3 shows the architecture of SDN based load balancing.



**Fig. 3.** Architecture of load balancing

With the SDN controller the load balancing design comprises of open flow switch in which various servers are associated with it. SDN controller keeps p rundown of live servers that are associated with the open flow switch, and every server is appointed with static IP address. On an outstanding port 80 web facility is running on every server, virtual address covers by controller and to the virtual IP address all requests from the customers are sent. When the customers sends a request to the virtual IP, open flow switch utilized the data contained in bundle header and contrast it and flow passages in switch and if the customers bundle header data coordinates with flow section, at that point switch alter the goal virtual IP deliver to the address of one of the servers in view of load balancing procedure and forward the request to that server.

## 2. Related Work

Kaur.K et al., 2016 [1] SDN is offer the adaptability by separating the forwarding plane and control plane. For correspondence between these planes open flow is the most common protocol. The forwarding plane is the virtual switch or silicon device. For changing over these

simple imbecilic device in to switches, security devices and load balancer control plane is required. In this article [1] they looked at different python based controllers such as POX, RYU and Pyretic controllers and checked the execution of the application made in them. Tested the execution on python based Mininet Emulator which can be utilized to make any size custom topology by composing few lines of python code. They utilized the python based controllers since python is ease to learn language and its controllers are easy to understand as compared with java based controller for example, Floodlight and Open daylight are exceptionally hard to use.

Xia et al., 2015 [7] Stated that SDN is situated to give more effective setup, better execution, and higher adaptability to oblige imaginative network outlines. One of the SDN application is load balancing that is a generally utilized method to accomplish better resource utilization. A typical practice of load balancing in data center is sending front-end load balancers to guide every customer's demand to a specific server copy to build throughput, diminish reaction time, and maintain a strategic distance from over-burdening of network.

In this article Bredel et al., 2014 [10] they utilized open flow for load balancing of web traffic across multiple web servers. By using TCP which is the end host load balancing is done of data between various servers and also blockage control. They compared their proposed algorithm with Hash- Based approach, Random approach, Round robin approach, Flow based approach, application aware path selection. In experimental work they exchange data from one server to another.

Li et al., 2014 [11] Stated that in conventional networks as the entirety status of the network is hard to acquire. So, it is difficult to understand the load balancing internationally in conventional networks. In this article [11] to solve this issue authors propose a way load balancing arrangement in view of Software Defined Networking (SDN) such as the Fuzzy Synthetic Evaluation Mechanism (FSEM). In which where the flow dealing with rules are introduced by the central SDN controller, then the network traffic is designated to the paths worked by Open Flow switches. In this article

[11] they use POX controller to execute the solutions, and directed complete tests in the Mininet to assess the viability, unwavering quality and productivity of proposed technique.

In this article Belyaev & Gaivoronski, 2014 [12] they concentrate on conventional networks security related issues due to SDN networks. In this article [12] they propose a solution in a SDN networks for proficient traffic distribution between every single rout. Analyses demonstrate that our solutions builds survival time of defended framework during DDoS attacks, accordingly it is viable as DDoS moderation network in SDN systems, however it can likewise be utilized as a general load balancing framework.

Ghaffarinejad & Syrotiuk, 2014 [13] Stated that today into the generation of network at Arizona State University (ASU) business load balancers are frequently being used. For load distribution load balancer confront one of the main issue such as static plan. To solve this issue, our point is to build up a SDN-based way to deal with load balancing to better adapt to the network variety. To empower advancement in and development of computer networks, Software Defined Networking (SDN) is developed. The round robin arrangement utilizes a circular queue to choose where to send a demand. In [13] authors have aim to produce such solution that may be less costly, more adaptive, then the business load balancers.

In this article Prete et al., 2014 [14] contextualizes the existing issue in current computer networks, and presents the SDN arrange as one of the primary recommendations for the reasonability of the internet of the future. The aim of this article [14] is to show a review of the issues included in the improvement of Software Defined networking by showing their qualities and fundamental components for the improvement around there, with accentuation on the network controller that has the key part in any SDN activity, once the software that defines the network is created in light of the advertised highlights. The Openflow, which is the primary interface related with the SDN worldview was displayed and portrayed.

In this article Li Pan, 2013 [15] they show open flow based load balancer in data center networks to accomplish elite and low latency. In

the load balancer they actualize a dynamic routing algorithm to circulate the traffic of up and coming networks flows and make every alternative way get equivalent measure of traffic load. It progressively apply to large scale networks and schedule data flows. They use the Beacon open flow controller and Mininet emulator for execution.

In this article Shang et al., 2013 [16] proposed algorithm SBLB load balancing strategy enhance the reaction time of web servers then random and round robin algorithms. Contrasted and random it accomplish a more proficient load balancing and discerning arrangement of resources. The authors [16] presented that in order to minimize the expense of the deployment and conservation, SDN based IPS is used for scheduling the flow reasonably. It is quite ease to accomplish the coordination of IPSs through the unified security within the whole network, so that the security of them system can be moved forward.

In this article Namal et al., 2013 [17] authors have taken the concept of take advantage of innovated load balancing strategies used by flow confirmation control with software defined networking. In this article (Namal et al., 2013) authors compare their load balancing algorithm utilized by flow confirmation control with a systematic model to guarantee the rightness and productivity. In SDN based load balancing architecture controllers recover the load status through the Load Balancing (LB) application part.

Long et al., 2013 [18] Stated that with the quick development of system applications, how to balance workloads is a key issue in data center network. In order to decide their ways through a network, Open Flow protocol gives every client the automatic control for particular flows which is an aggressive contender for taking care of the issue. . To balance the load powerfully during the transmission, this article present LABERIO, a novel way exchanging algorithm. This kind of beat other load balancing algorithm like round robin and LOBUS by minimizing up to 13% transmission time.

Koerner odej, 2012 [19] Stated that load balancers have significant effect on the execution and the accessibility of the network because it has an unequivocal part in each enterprise network as

they serve regularly as a passage point. Their proposed load balancers approach coordinates the network and the load balancing usefulness and minimize the support exertion. For the primary evaluation [19] executed a round robin load balancing algorithms as a module for the open flow controller NOX. This module is actualized in C++ and adjusts the NOX stage.

Khiyaita et al., 2012 [20] They discussed that cloud computing will quickly changes the land scape of information technology. Be that as it may in spite of the critical benefits offered by cloud computing, the present innovations are insufficient develop. In this article [20] they studied the state-of-the-art of load balancing in cloud computing network, and build up the sate-of-the-art load balancing in cloud computing network.

Wang Richard, 2011 [21] concluded that online services rely on upon Load Balancing to completely use the multiple servers. Wang Richard, 2011 [21] stated that their Load Balancing architecture prevents problems before they happens maps pieces of sources IP addresses to multiple servers. So Load Balancer with insignificant involvement by the controller sent client requests straightforwardly. Wang Richard, 2011 [21] presented partitioning algorithm decided a negligible set of wild card rules to introduce, although transitioning algorithm changes these rules to adjust the new Load Balancing weights.

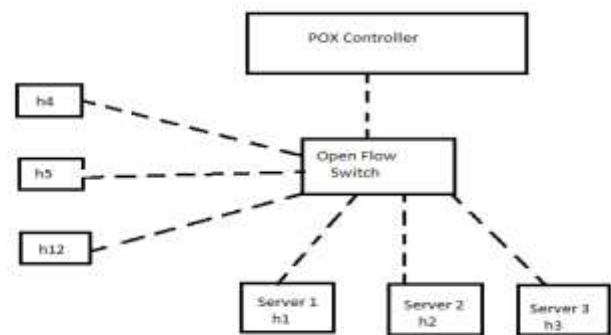
### 3. Methodology

In this exploration we will find SDN based load balancing algorithms through analyzing different SDN based load balancing strategies. The gathering of methodologies of research is made from various diverse algorithms. After gathering information about all algorithms we will be able to find the most appropriate and efficient algorithm that balance the load effectively.

#### 3.1 Round Robin Algorithm

This is the default load balancing strategy. Round Robin mode passes each new association demand to the following server in line, in the long run disseminating associations uniformly over the variety of machines being load balanced. [22] Figure 4 shows topology that comprises of 1 Open- Flow switch, 12 host what's more, 1 Pox

controller. Web server was executed on host 1, 2, and 3. For testing host host4 to host12 were utilized. Testing was performed on open load tool. [6] [22]. It use open flow switch alongside POX controller and three Server machines associated with the open flow. In their strategy there contains two sorts of IP addresses such as benefit IP in which customer send the request, and server IP that is the address given to the load balancer. Then according to the Round Robin procedure the Load Balancer will divert the demand to the server and measure the Transactions every seconds and normal reaction time. [22].



**Fig. 4.** Round Robin topology [22]

Round robin evaluation results are matched with random strategy. As appeared in the figure 5, 6 round robin algorithm is better in transaction time and response time. [22]



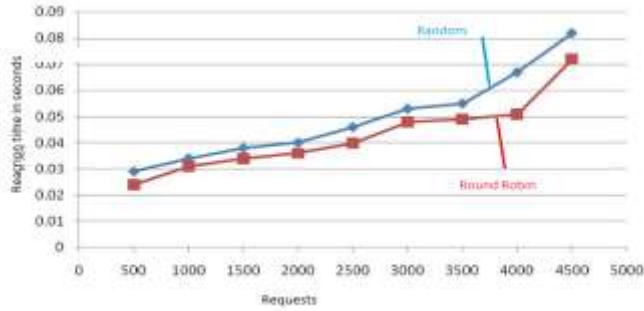


Fig. 5. Round Robin Response Time [22]

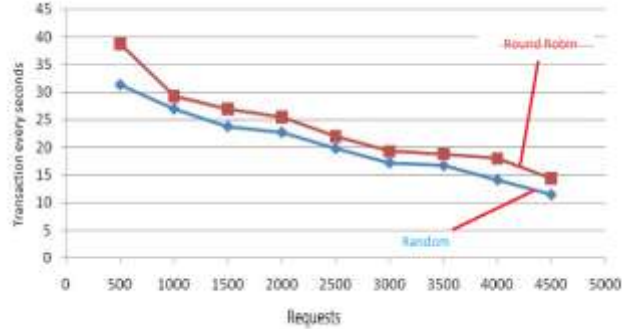


Fig. 6. Round Robin Transaction Time [22]

### 3.2 Weighted Round Robin Algorithm

This algorithm is utilized when we need one server to get a significantly bring down number of associations than a similarly proficient server, and then weight is allotted according to the capacity of the server. For example, if 1 server ability is 5 times more than server 2 at that point we can allocated a weight of 5 to server 1, and weight of 1 to server 2 [3]. Figure 7 shows topology that comprises of 1 open flow pox controller, 1 switch, 6 users, and 3 webservers, in which 60% of load is dispatch to server1, 30% to server 2, 10% to server 3[3].

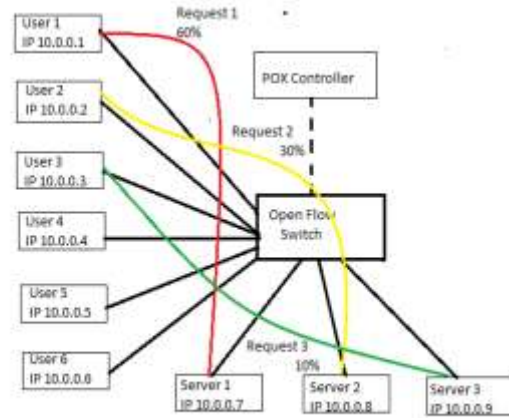


Fig. 7. Weighted Round Robin Topology [3]

There are two parts of address just like round robin strategy, and open flow switch works like a load balancers [3] Weighted Round robin evaluation results are matched with round robin strategy. As appeared in the figure 8, 9weighted round robin algorithm is better in transaction time and response time. [3]

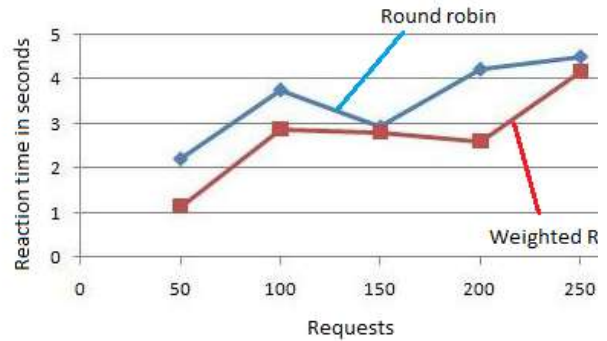


Fig. 8. Weighted Round Robin Response Time [3]

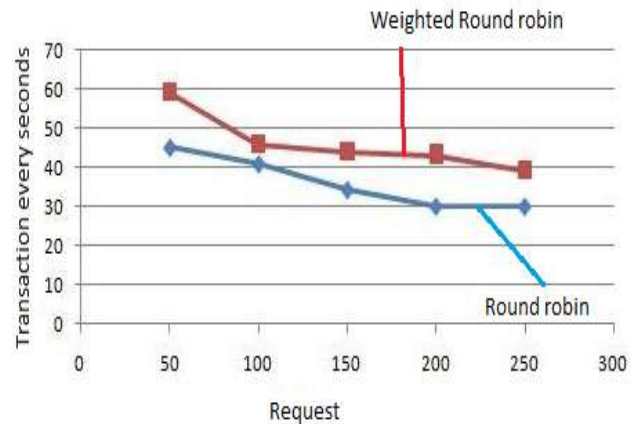
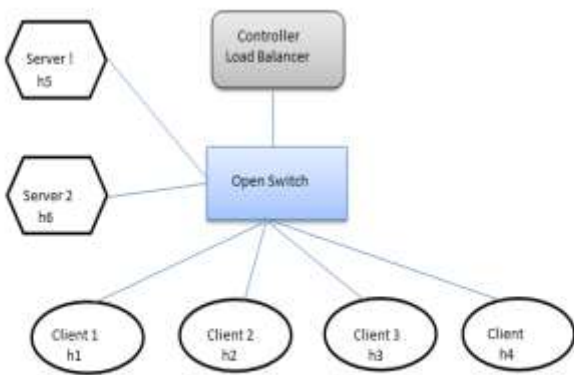


Fig. 9. Weighted Round Robin Transaction Time [3]

**3.3 Dynamic load balancing algorithm**

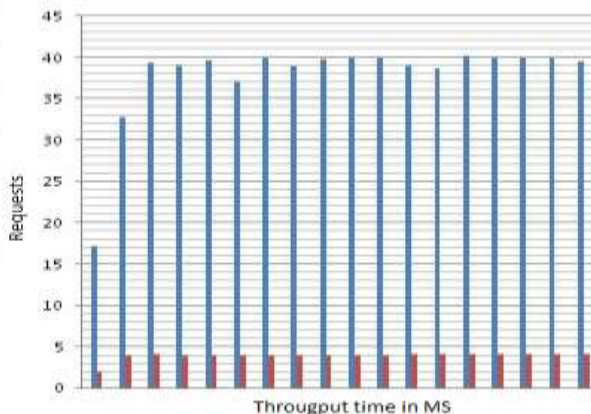
In dynamic load balancing the weights depend on constant checking of the servers and are thusly persistently evolving, and circulate associations in view of different parts of constant server execution examination, for example the present number of associations per hub or the speediest hub reaction time.[23]

Figure 10 shows the topology that consists of open flow POX/floodlight controller, 6 host in which 2 host are used for servers and 4 host are used for client nodes. [24]

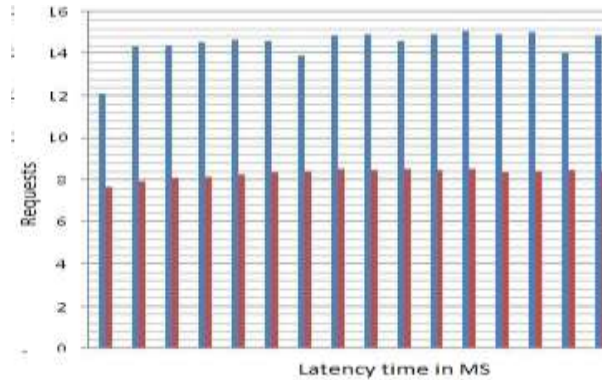


**Fig. 10.** Dynamic Load Balancing Topology [24]

Figure 11 shows the throughput mode, figure 12 shows latency mode of dynamic load balancer algorithm which display the quantity of extreme and base estimation flows per second .[24]



**Fig. 11.** Dynamic Load Balancing Throughput Mode [32]

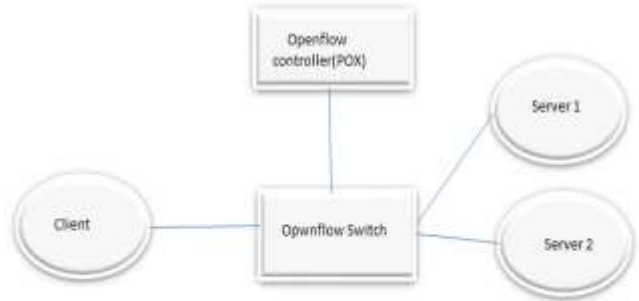


**Fig. 12.** Dynamic Load Balancing Latency [24]

**3.4 Flow statistic load balancing algorithm**

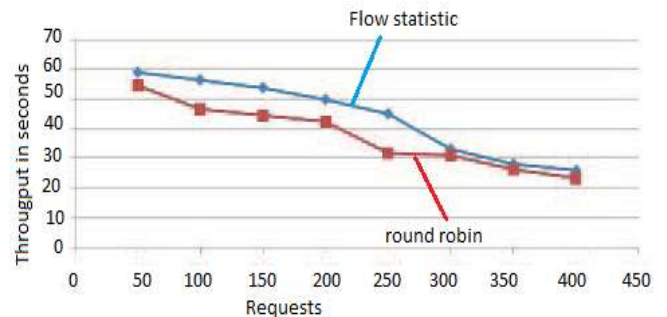
In flow statistic load balancing approach the web server specifically sends the answers to the user accordingly removing the unnecessary delay. [1]

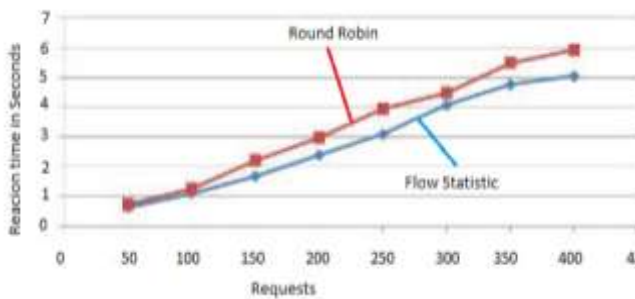
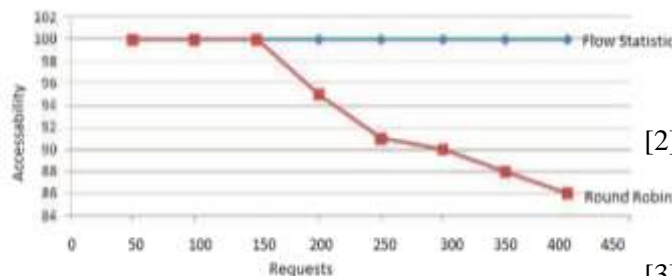
Figure 13 shows topology that consists of open flow POX controller, 2 servers with different IP addresses, and 1 client with different IP address. [1]



**Fig. 13.** Flow Statistic Topology [1]

Figure 14 shows average response time and figure 15 shows throughput of the flow statistic load balancing algorithm and accessibility is compared with round robin as appeared in figure 16 that shows flow statistic accessibility is better than round robin.[1]



**Fig. 14.** Flow Statistic Throughput [1]**Fig. 15.** Flow Statistic Response Time [1]**Fig. 16.** Flow Statistic Accessibility [1]

#### 4. Results

During our research we have observed and analyzed that all load balancing approaches are balance the load on various servers effectively but in all approaches there are some problems. In the light of these some problem we have concluded that weighted round robin load balancing approach is better than round robin, dynamic load balancing approach, but if we analyzing the performance of weighted round robin and flow statistic load balancing approach then we have detected that flow statistic load balancing approach is performing better then Weighted round robin approach, and the availability of the flow statistic approach is 100%.

#### 5. Conclusion

The present research was planned to find out the efficient load balancing algorithm in Software Defined Networking (SDN) technology. This paper primarily presents about the load balancing approaches in software defined networking (SDN), and their implementation in different controllers. Load balancing strategy is designed in the SDN controller which deals with the various type of load effectively. This paper presents the various load balancing strategies or algorithms, their implementation and

experimental evaluation was compared with the other load balancing approaches. Different load balancing parameters were utilized for comparing the performance of load balancing in software defined networking (SDN). Such parameters are response time, throughput, and availability. At the end this paper find out the best, efficient, and effective load balancing approach.

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