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Research Paper

A study on load balancing techniques in SDN

Anish Ghosh [1] *, Mrs. T. Manoranjitham [1]

[1] Department of Computer Science & Engineering SRM Institute of Science and Engineering Kattankulathur, India
**Corresponding author E-mail:*

Abstract

Software defined networking(SDN) is a technique in networking which provides the administrators of the network with access to initialize, control, manage, and dynamically change how the network behaves through open interfaces and by the lower-level functioning abstraction. SDN simply addresses the basic knowledge that the architecture being static in traditional networks never provides assistance for the dynamic or scalable computing along along with the storage requirements of most of the modern computing. This is possible by the methods of decoupling or disassociation of the system that helps in making decisions about where the traffic is being delivered from the systems which then forwards this traffic to the required destination. Load balancing is the method in a computer network that is used to divide the amount of work between a collaboration of two or more computers in such a way that work can be completed in the same time limit. Hardware, software, or a combination of both can be used to implement load balancing. Moreover, computer server clustering is caused due to load balancing.This paper discusses the various kinds of load balancing algorithms which can help in better utilisation of resources and linear service delivery across multiple clients in an SDN environment.

Keywords: *SDN; Open flow; API; FTP; NLB*

1. Introduction

In systems administration terms, stack is normally alluded to the measure of information conveyed by the system. A heap balancer or server stack balancer, is an equipment or programming based gadget that productively disperses system or application movement over various servers. With a heap balancer, if a servers execution experiences inordinate activity or in the event that it quits reacting to demands, the heap adjusting abilities will naturally change the solicitations to an alternate server. Along these lines, stack balancers enhance the execution of systems and applications via consequently observing and overseeing application and system sessions. Not withstanding giving straightforward disseminated administration to various servers, stack balancers can help forestall disavowal of-benefit assaults, permit true blue clients continuous access to administrations, secure against single purpose of disappointment blackouts and counteract activity bottlenecks to frameworks.

2. Software defined networks

Then comes into action Software Defined Network (SDN) whose main motive is to program effectively the network with the software that is running on a centralized setup. Network switches and routers can make their own decisions. They can locally manage their advancing tables. Governance of traffic forwarding are directed by protocols of shared control- plane. Traditional networking protocols do not adapt to

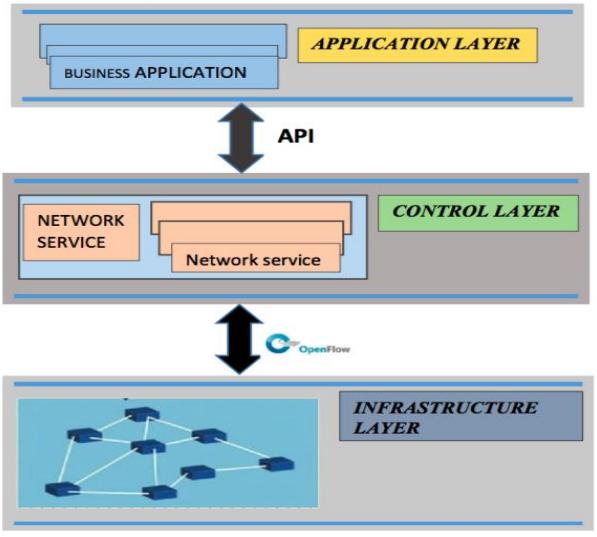

Fig. 1: Software Defined Network Architecture.

Situations dynamically. If they have to work together, network components in the forwarding domain, have to follow similar regulations as per common standards. The control plane is separated from the data plane. Now the control plane is present in the centralized controller that administers and governs where networks are connected with the hosts and what the topology of this network connecting to all of these hosts' together looks like. A central controller which is available everywhere allows network engineers to make use of efficient advancing methods controlled only by the software running on it.

Braun, W. and Menth, M., have explained in 2014 that how SDN has gained a lot of attention due to its ability to address lack in programmability in traditional net- working architectures which in

turn has also enabled easy and fast methods of network innovation. SDN provides a separation for the data plane from the control plane and on top that it facilitates software implementations of complex networking applications. The controlling of less specific and cheaper hardware by software applications by the use of standardized interfaces has become a reality. Moreover, the aim of dynamic addition new features to the network in the form of applications for networking while achieving more flexibility found the light of the day.The same concept is known from mobile phone operating systems as apps can be added to the system dynamically.

The architecture of SDN is depicted in Figure 1, which consists of three layers. The data plane is the lowest layer also known as, infrastructure layer. This layer consists of the forwarding network elements. The data plane is mainly responsible for data forwarding, along with the monitoring of all the information stored locally and gathering statistics. The layer above the data plane, is the control layer which is also known as the control plane. The forwarding plane is managed and programmed by the control plane. The in formation provided by the forwarding plane is used to define network operations and routing. It consists of one or more software controllers that can communicate with the forwarding network elements by the use of standardized interfaces, also known as southbound interfaces.

2.1. Advantages of SDN

A centralized and programmable network can be established in SDN such that it can dynamically provide in order to address as per the changing needs of the businesses. In addition to that, these are the other advantages:

i) Directly Programmable: The network is directly programmable as, from forwarding functions the control functions are seperated. This in turn enables the network so as to be configured by proprietary or open source automation tools, programmatically which include OpenStack, Puppet, and Chef.
ii) Centralized Management: Network related intelligence is centralized in the SDN controller software logically in such a way that it maintains a global network view, that appears for applications and policy engines in the form of a single, logical switch.
iii) Delivering Agility and Flexibility: SDN helps organizations in rapid deployment of new applications, services, and infrastructure so that they can meet with the changing business goals and objectives in a rapid manner.
iv) Enabling Innovation: SDN also allows organizations to customise new types of applications, services, and business models which can propose new revenue streams and more network value.

3. Traditional vs. software defined networks

Traditional networks are referred to as static kind of networks.These networks consist of a control plane, data plane and a management plane.

Software defined networks consist of a single layer of data plane with an open flow API which is interfaced with a controller which comprises of the control and management plane.An application layer exists above both of those.

Table 1 lists out some of the main differences in these networks.

Traditional Networking Software Defined Networking

These networks are static and are not flexible. These networks are dynamically programmable which means they can be programmed before deployment and while the network is running.

It has a distributed control plane. It has a centralised control plane.

These work using protocols. These use APIs to configure as per the needs.

Traditional networks are made up of hardware devices. Software defined networks are created using open softwares.

Table 1: Traditional vs SDN Networks

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Traditional networks are made up of hardware devices.	Software defined networks are created using open softwares.

4. Open flow

Open Flow (OF) is said to be one of the few first software defined networking standards. It was defined as a protocol for communication in SDN environments, which is used to enable the SDN controller in order to interact directly with network devices like routers and switches.Hence it can adapt better with the change in business requirements.

The most important part of a SDN network is the SDN controller which relays information to the applications and business logic above' (via northbound APIs) and routers/switches 'below' (via southbound APIs).

4.1. Benefits of open flow

Programmability It enables innovation and differentiation and accelerates new features along with introducing services.

Centralized Intelligence It simplifies provisioning while optimizing performance and provides management for granular policy.

Abstraction it helps in the decoupling of software and hardware, control plane & forwarding, with physical and logical configuration.

5. Load balancing

Load balancing is one of the biggest problems related to computer networking. This load can be in the form of memory, CPU capacity, network load or even delay load. In order to improvise the performance of the system along with resource utilisation, Load balancers are supposed to constantly share the work load of all the nodes in the distributed system. This can further aid in situations where either the nodes have more load or less load within the network by avoiding them.The process of making sure that the work load is evenly distributed in the pool of system nodes or processors in order to make sure that the running task can be completed without any disturbance is called load balancing.

The main goals of load balancing are:

i) Improving system performance
ii) Maintaining stability in the system
iii) Building a system which is tolerant to faults
iv) To be able to make modifications in the future

There are actually two types of load balancing algorithms:

1) Static Algorithm

In a static algorithm, equal division of traffic is done within the servers.Static algorithm is suitable for systems with low load variation.This algorithm needs to have prior information of the system resources in order to be able to make sure that decision of load shifting does not depend on current system state.

2) Dynamic Algorithm

In a dynamic algorithm, the lightest server in the whole system is looked for and accordingly preference is given for load balancing. As there is a need for real time communication with the network that can lead to increase in traffic in the system.And, current system state is used to make decisions for managing load.

6. Network load balancing

The availability and adaptability of net servers and its applications such as Web based, firewall, File Transfer Protocol (FTP), proxy, virtual private network, and other servers that are mission critical gets enhanced by network load balancing. Network Load Balancing also ensures that the traffic in the network is rerouted to all the remaining hosts in the network if any of the hosts within the cluster fail unexpectedly. A Network Load Balancing cluster can scale up to 32 servers.This helps in working on critical operations hassle free. Typical Network Load Balancing Configuration is shown in Figure 2.

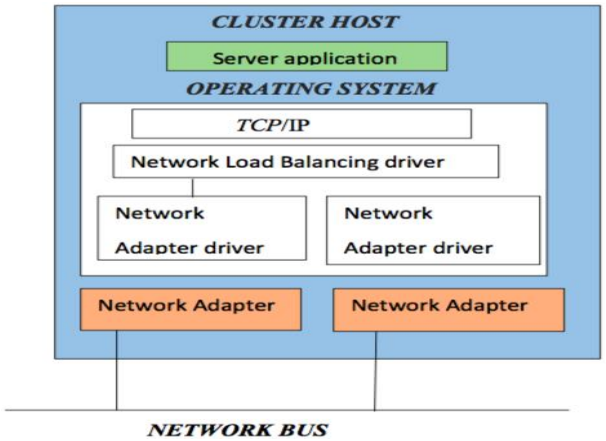

Fig. 2: Typical Configuration of NLB Host.

7. Works related to load balancing

There are a wide number of techniques and algorithms which are capable of being used to balance the load related to the access requests made by clients across various server pools.The technique that we opt for will be based on the application or the kind of service that is being used along with the network status and servers that remain during the request time.Normally the methods mentioned below are used as in a combination in order to find the server best suited to meet the new requests.

Now we list down some of the techniques used by Load balancers:

1) Round Robin

This method is used to provide tolerance against simple faults.A group of identical servers are assigned works in such a way that they are all capable of providing services which are same.Even though each server has its own unique IP address, they are all configured to make use of duplicate domain name.All Internet domain name associated IP addresses are listed down in the DNS server.On reception of the requests of the domain name of Internet along with the associated IP address ,all the addresses are sent back in a rotational manner sequentially.

Weighted Round RobinThis is just an extension of the Round Robin load balancing algorithm.In this type, every server of the network pool is assigned with a static numerical weight.Higher rated servers will receive more number of requests.

2) Least Connection

Round Robin as well as Weighted Round Robin, do not take into consideration the current state of server load as the requests are being distributed.Unlike them, the Least Connection method takes into consideration the current server load.The request is then sent to the server which had serviced the least number of sessions which were active at that time.Weighted Least ConnectionSimilar to the Weighted Round Robin method, every server is provided with a number.This is used by the load balancer while allocating the server requests.Now suppose the number of active connections are same on two servers, then higher weighted server would be provided a request that is new.

3) Agent Based Adaptive Load Balancing

In a pool of servers, an agent is assigned to every server which reports to the load balancer about its current load. This information in real time is made use of to decide which server should be placed to handle requests best. This is used in a combination with other techniques like Weighted Round Robin and Weighted Least Connection.

4) Chained Failover (Fixed Weighted)

This method requires an order of servers which is predetermined that need to be configured in the chain they are present in. The first server in the chain is sent all the requests. The next server in the chain is sent all requests if there is a chance of not accepting any more requests , then the third server and so on.

5) Weighted Response Time

In this method information from the servers regarding response time is constantly received in order to check whether the server is responding at its fastest in some specific period of time. The next request for server access is sent to that server. This is supposed to make sure that if any server is already dealing with a lot of load and already started to respond slowly, it wont receive any new requests. This lets the load to spread out evenly on the server pool available over time.

6) Source IP Hash

In this method an algorithm is used which takes into attention the source and destination IP addresses of the client and server which is then combined to generate a unique hash key. The key obtained is then used to allocate clients to any particular server. As the keys can always be regenerated, in case a session breaks, Source IP hash load balancing method can make sure that the requests from the client is directed to the same server which was used previously.It is useful as it ensures that client can connect back to a session after disconnection if the session is still active. A small example of this would be retaining items in a shopping cart just in between sessions.

7) Software Defined Networking (SDN) Adaptive

This method uses a combination of knowledge of the upper networking layers along with the information of the condition of the network at lower layers. To decide on how to allocate requests , the information regarding data from the network layers 4 and 7 is combined with data from the network layers 2 and 3. This then allows information regarding the server status, status of applications running in the network, network infrastructure health, and the congestion level in the network in order to play a part in decision making process for load balancing.

8. Conclusion

Software defined networking provides the network administrators to control, manage, and dynamically change how the network behaves.But the issue here is load Balancing. The ever increasing number of client requests to the server leads to an overloaded system which may be the cause for poor performance which further could lead to reduce in quality of service provided.Therefore the Software defined networks need an economical and effective load Balancing algorithm to provide continuous service without crashing or any depletion in the quality of service.This paper provides a brief analysis of some load balancing algorithms for services in a software defined network with the main concentration to balance the loads.The various load balancing algorithms are compared on the basis of different types of parameters.

The authors have identified a crowd based algorithm to meet the requirements of the user in order to provide continuation of service which is done by the distribution of workload in a balanced manner to get a hand of the maximum resource utilisation and reducing idle time.

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