International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2020 IJSRCSEIT | Volume 6 | Issue 2 | ISSN : 2456-3307
DOI : https://doi.org/10.32628/CSEIT2062145

Optimize Network Infrastructure using Architecting and Protocols

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ABSTRACT

This paper focuses on designing and optimize network infrastructure using different techniques. Nowadays most people and organizations use the internet, so the main problem is how to connect reliable and efficient ways to manage clients. Using networking fundamentals and techniques to reduce traffic and optimize network infrastructure on the small organization. We provide an optimal solution for small and start-up organization so they can effort own devices instead of renting servers and routers.

Keywords : Routing Protocols, switching, QoS, reduce traffic, Load balancing, Design Architecture, CPU Utilization

I. INTRODUCTION

Nowadays the internet is mostly used and continuously growing every day. The Internet is very big and more interconnected networks are not easily connected with together. Sometimes maybe failure or any network down emergency small and medium-size business are cannot connect it. A huge number of devices is generating a large amount of data and that data is the exchange on the internet and interconnected networks. Improper utilization of bandwidth cannot use the effective efficiency of network infrastructure. Network optimization is improving on the network because of changes and growing up technology on infrastructure environment and that cannot easily change on network infrastructure. Sometimes any network problem like Packet loss, latency, jitter, and collision are created and it is a very serious issue for network infrastructure. Network optimization is a different technique to optimize network performance and efficiency. Ensuring the effective utilization of network architecture to reduce cost in the same environment, high connectivity on infrastructure, devices, and servers are easily connected and use effective ways to utilize resources. Network optimization is helpful for many ways like optimize bandwidth so extra bandwidth can be used for other resources and work faster data transfer and hence reducing the time. Optimizing network infrastructure provides better solutions for the IT Department and the client can easily access it. Using Virtualization and cloud computing on our infrastructure provides a greater range of handling databases, data management, centralized point to check the whole infrastructure from a logical and security point of view. Maintenance of the whole infrastructure is very easy if we use cloud platforms and virtualization technology. It provides better integration of business ideas with cloud infrastructure. Instead of using the old physical servers to use the cloud to increase productivity, no more single point to failure, using easy load balancing to reduce cost. Using both physical and cloud infrastructure audit will be easy because we can check the whole infrastructure in cloud-based on a report generated by the hosted company or ISP that give cloud services and servers. The client must handle only client base systems on organizations. It has many

benefits like easily recover data in event of an environmental disaster or network down emergency. In terms of network security is easy because cloud services cannot handle the whole security of organization cloud services company is creating and responsible for security. Only to creating inside of network policies and cloud administration policies that use for clients and admins. Using different routing protocols on different areas based on traffic to reduce it. Network Optimization also improves the application of performance like increasing bandwidth and fast data transfer on servers to clients. In terms of security to faster than the older system to check the authentication of users connect. Reduce collisions because of a faster transfer rate that cannot happen in to make collisions on the network. Creating automation scripting to make all devices configuration at the same time on network and changes easily. Design mostly 2-tier architecture instead of a 3-tier architecture that reduces latency, jitter, and other network modules. By checking devices on the environment that setup is correct or not that may affect network efficiency and use more bandwidth and resource utilization. Ethernet technology is globally used so good quality services are very important. Using different STP protocols on uses on the environment that may increase the efficiency of the network and reducing to chances of broadcast like that. Ether frame is very important because that creates a loop on a network and increasing resources utilization. So, our motto is to optimize the small and medium-size business network performance that easily and effectively connect and collaborate with other infrastructure networks.

II. METHODS AND MATERIAL

To best way to optimize network performance is to define new policy and change hardware based on device performance. The first step is to analyze the network architecture and know how to apply next-generation policy based on devices hardware and software. Sometimes old software is not more efficient compare to new versions and other software.

2. Optimize Design Architecture

Designing of the network depends on size and requirement upon infrastructure. Design mostly design two-tier architecture instead of three-tier architecture for small infrastructure because reduce cost and efficient performance. For small data Center infrastructure use spine and leaf architecture and campus use two-layer architecture.

2.1 Two-tier Architecture: [1,3]

In large scale infrastructure is used hierarchical model that used more than two layers of a level. But in small and medium infrastructure that cannot need more than two or three levels. So that the collapsed core architecture is provided to two-layer that consist of a collapsed core layer. The collapsed core layer is the backbone of the network. In the old scenario, the design looks like fig 2.1.

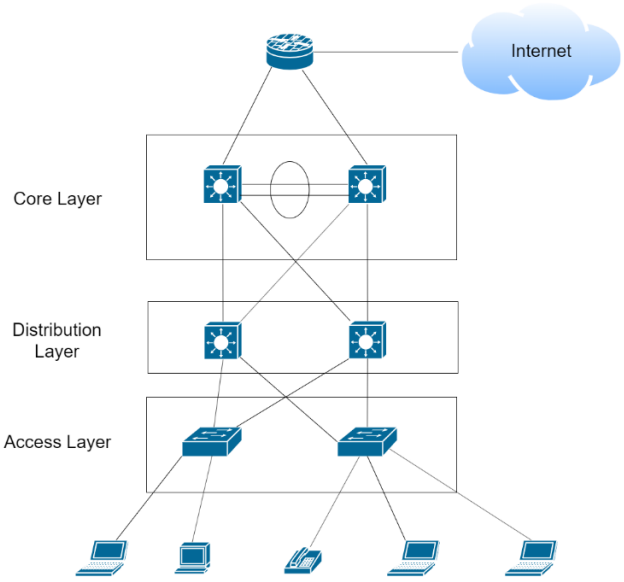


Fig 2.1

In this three-tier architecture core, distribution and access layer. The core layer is the backbone of the network that connects the campus network to the internet and major security provided on this layer.

Distribution is connecting the core layer to the access layer. An example of the core layer is on the main building and distribution layer switches and a router is a different building and that connects to the core layer. The access layer's major task is to connect endpoint devices to the core layer. Mostly access layer is layer 2 based decision.

But In small and medium-size organizations used collapsed architecture. In collapsed core architecture collapsed core layer and access layer. As shown in fig 2.2 the collapsed core layer is a combination of core and distribution. The collapse core layer is consisting of security like firewall, IPS, IDS, and router that connect to the internet. The access layer is connected collapsed core layer other than connecting to the distribution layer and the core. The collapsed core layer is performed major tasks like routing, switching, and connectivity provider to the infrastructure network. So, in this collapsed layer we optimize the network efficiently using different algorithms depending upon the requirement.

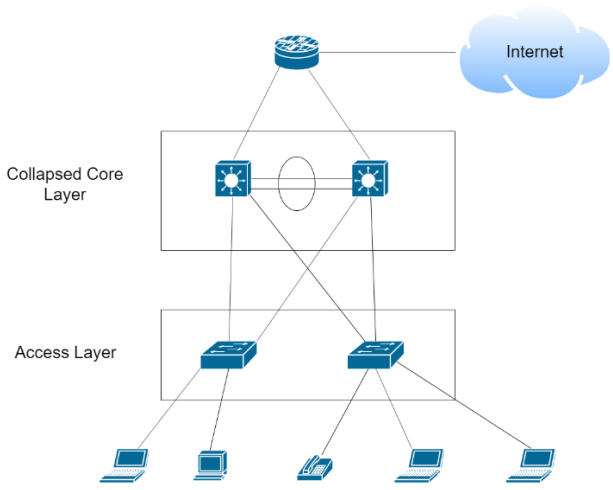


Fig 2.2

2.2 spine and leaf architecture: [1,3]

Most of the older servers and Data Center are used old architecture that not much efficient. In this architecture like two-tier architecture that reduces latency and high bandwidth between servers. The old architecture looks like that in this below picture.

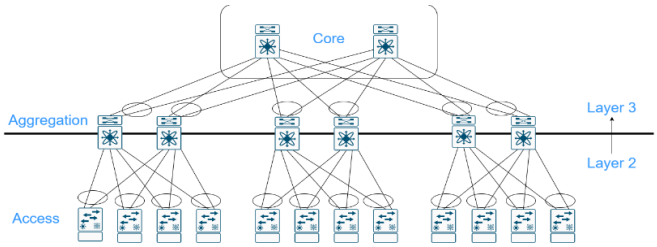


Fig 2.3

In this architecture, three-layer consist of core, aggregation, and access. In this topology core layer that uses for connecting internet and other clouds to the Data Center and this layer perform major routing decision. The aggregation layer is connected to their access layer and core layer via high-speed links. The access layer is connected to the virtual and physical servers together. In this topology layer, 3 to layer 2 is more time consuming for small infrastructure. But uses of spine and leaf architecture is reduce the layer and better performance for the data center.

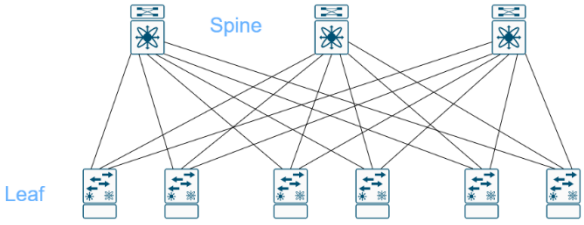


Fig 2.4

Figure 2.4 is the spine and leaf architecture model. In this topology Spine and leaf two-layer. The spine layer is a combination of core and aggregation layers. The spine layer is connected to the internet and perfume routing and switching tasks together. The leaf layer is like an access layer that connects the Data Center to the servers via full mesh and high-speed links. In this architecture is add new one more feature that vPC. vPC stands for the virtual port channel. In STP protocol forwarding port and blocking port cannot use parallelly. A blocked port is used for redundant paths for the network. But in vPC blocking port are used as an active-active uplink that provides full bandwidth from leaf to spine layer.

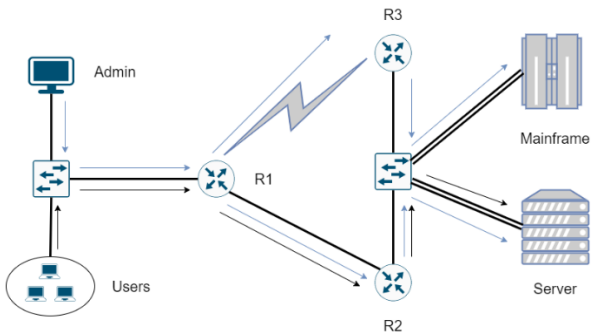
3. Network Optimize Techniques

3.1 Routing Protocols: [2,4]

The router is using router protocols to generate a routing table. This table is based on different parameters. There are different routing protocols like static and dynamic routing protocols. Static routing protocols is providing a path to path links like point-to-point links. Dynamic routing protocols are creating a routing table based on different parameters like metric and AD (Administrative distance). Metric is one type of value that count on the various thing like hop count, cost, bandwidth, latency, jitter, reliability. Mostly in the organization, the local network is dynamic routing because of the larger network have many routers and that router entry are added one by one is like impossible. A static route is mostly used on edge routes to use as the default gateway.

Static Route:

Static routing has manually added an entry on the router. Mostly static routing AD is by default 1 but sometimes use of backup route to use that AD is change based on the requirement. In static route used by using exit interface and net hop IP addresses. But sometimes issues occur on the network when exit interface instead of a next-hop address.



Users and admin routes are that different, so the high traffic of the network issue admin is handling the server without lagging and packet dropping. In this example, users are going to R1-R2-Server. But admin users are going to R1-(R2-R3)-Server & mainframe so any interrupt of network issue they can use easily to it.

Dynamic Routing:

Dynamic Routing creates a routing table based on neighbour membership information and other things. In the live environment mostly two protocols are used for inter-area communication OSPF, EIGRP. These protocols are different ways to calculate the metric and based on that it will create a routing table. The ad is the most important thing for the routing table. EIGRP AD value is 90 and OSPF AD value is 110 so the EIGRP is best for the communication. EIGRP is using Bandwidth, load, Reliability, delay this object to calculate the metric. OSPF is using only Bandwidth. Routing calculation:

EIGRP metric: $256 * \{K1*BW + [(K2*BW)/(256-load)] + (K3*delay)\} * \{K5/(reliability+K4)\}$

OSPF Cost: Reference bandwidth / Interface Bandwidth

In terms of EIGRP is better than OSPF because EIGRP is used more object for routing packet so that this decision is more reliable.

3.2 Route Summarization: [5]

Route Summarization is used when so much route is connected and high utilization of CPU. Using route summarization to reduce routing table so the router easily takes decision for a given request. Using RS CPU utilization is less compared to the whole summary of the route. Route summarization scenario only works when same class network on one side of router otherwise route cannot decide to which request are to send which side of the port.

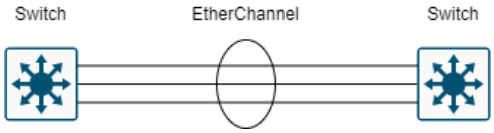
3.3 VLANs: [2,8]

VLAN is a logically separate broadcast domain into the sub broadcast domain. Using VLANs we distribute traffic for work and team. Reducing flooding only the same VLANs are to make flood messages. Using VLAN does not need extra network address space and

hardware. Mostly infrastructure is use VLANs for reducing traffic and increase efficiency.

3.4 Ether-Channel: [2,6]

EtherChannel is protocols that logically bundle server physical links into one logical link. It is port link aggregation technology. It connects switches, servers, and router using high-speed links and providing fault tolerance. It is scalable for small and larger deployment that needs more bandwidth and high-end connection. EtherChannel also provides load balancing and redundancy.



It's is capable of 8 links to bundle to them into one logical link. It's mostly used to connect two local sites, buildings and servers on the datacenter. EtherChannel has two protocols: LACP and PAGP.

3.5 Router Redundancy: [2,7]

Redundancy means one or more copies like that. In terms of the router, redundancy is provided hosts to automatic router assign based gateway and routing path. There are three mostly redundancy protocol: VRRP, HSRP, GLBP. Mostly, cisco vendors, clients use GLBP (gateway load balancing routing protocol). HSRP and VRRP are providing default gateway redundancy using the active and standby router. Unlike HRSP and VRRP, GLBP also provides load-balancing on the group and redundant routers.

3.6 Cisco Express Forwarding (CEF): [10]

Cisco Express Forwarding (CEF) is a packet-switching technique used within Cisco routers. The main purpose of CEF is to optimize the forwarding of packets and increase the packet switching speed. routing of packets in software with route processor is much slower than hardware forwarding.it does the layer 2(or above) switching packets in hardware.it gives fast access to the client by optimizing RIB(routing table).it built in two main components the forwarding information base(FIB) and adjacency table.

3.7 Minimize WAN Protocols: [1,12]

Minimizing WAN protocol will decrease processing delay, interface error and QoS mapping. There is some protocol we can use like, HDLC (High-level data link control) protocol, PPP (Point to point) protocol and frame relay.so here we use frame relay protocol. It is a layer 2 protocol and it is done with permanent virtual circuits.it performs error correction and improved disaster recovery.

4 Server-Client Optimization

4.1 Server Load Balancing: [1,10]

The primary vendors that have a server load balancing solution for the enterprise include f5 and cisco. CEF provides 2 methods for load balancing traffic over multiple links. they are Per packet -> As the name suggests, additional weights can also be assigned to an interface. This allows you to send more packets over one link then another. Useful for an unequal link. Per destination -> Also known as per session. Packets are load balanced based on the source and destination addresses.

4.2 TCP Windows Scaling: [9]

TCP window scaling Is defined to use an increase buffer size of TCP window size for performance optimization.it is increase the buffer size by exponentially until the receiver end sent ack of buffer size is full. increase TCP window size is increase network throughput for faster connectivity.

4.3 Increase Link Bandwidth: [1]

The most effective solution for increasing network capacity is increasing WAN link bandwidth. the most utilized link is the WAN circuit. so, here we use next-generation enterprise WAN (NEW) architecture

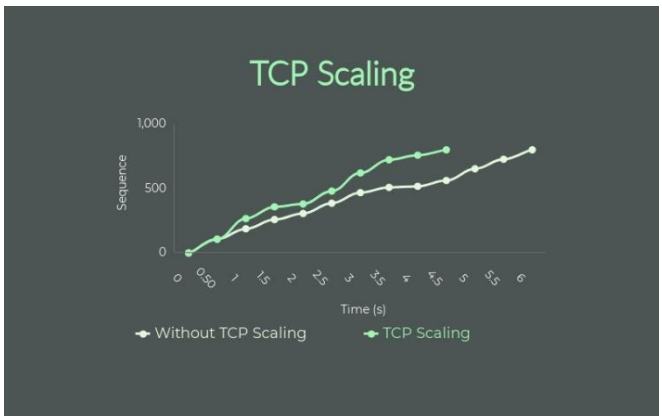
which includes WAN optimization, WAN virtualization, and network-as-a-service.

4.4 QoS (Quality of Services): [11]

The purpose of implementing quality of service (QoS) is to quantitatively measure the quality of service, several related aspects of the network service are often considered as packet loss, bit rate, throughput, transmission delay, availability, jitter, etc. Here, quality of service refers to traffic prioritization and resource reservation control mechanisms rather than the achieved service quality. Quality of service is the ability to provide different priority to different applications, users, or data flow, or to guarantee a certain level of performance to a data flow.

III. RESULT AND ANALYSIS

As an analysis of TCP Scaling in network environment to show that performance is better than without TCP Scaling. Using of TCP scaling faster and less delay to transfer packets. In below image to show that 800 packets to transfer rate between TCP and without TCP Scaling. At some point network collision occur so that time restart the process of TCP Scaling but after that is continuously growing packet of doubling rate.



IV. CONCLUSION

We concluded that the old organization's network infrastructure is not using the modern solution, so they have a problem with more traffic and network down situations. So, we provide solution that reduce traffic and reduce cost of monitoring and maintenance. Using this fundamentals technique to reduce CPU utilization on networking devices so it can accept more resources and compute it.

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Cite this article as :
Parth Suthar, Romit Kakadiya, Mitul Dhameliya, Dhruv Dangashiya, Rutvik Bhinasara, "Optimize Network Infrastructure using Architecting and Protocols", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 6 Issue 2, pp. 517-522, March-April 2020. Available at doi : https://doi.org/10.32628/CSEIT2062145
Journal URL : http://ijsrcseit.com/CSEIT2062145