

Review, Analysis of SDN and Difficulties in Adoption of SDN

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Abstract — *The legacy IP networks which are used for sharing information across the platforms (e.g., Computers, Mobile devices, and other Electronic devices) are difficult to control and configure because of not controlled from a centralized location in contrast SDN (Software-Defined Networking) is an agile and programmable network manner, through which networks are controllable from the central devices which are called SDN controllers. SDN three-layer structure subsists of the Infrastructure layer, Application layer, and Control layer. We focus in this paper on the adoption, integration, or implementation of SDN in enterprises and service providers. The adoption and integration of SDN are in the problem from starting; later on, work and development make it near to fully integrated and implemented in enterprises and services provides networking, But the hurdles problem persists in implementation, adoption, and integration of SDN. Those difficulties and problems are due to that SDN is yet too standardized and yet to provide software which full fill the needs of enterprises and service providers.*

Keywords—Software-Defined Network, Implementation, infrastructure layer, Control layer, Application Layer, OSI Model, NOX Controller

I. INTRODUCTION

In the modern era of computer networking the diverse devices, e.g., Mobile Devices, PCBs[1], Switches, Firewalls, and Computers communicate through the legacy TCP/IP[2] Network, is very difficult to control the data and its flow in the network with the management and to control of the network. The legacy TCP/IP network is now becoming insufficient for a large amount of data producing by the different devices mentioned above with some others like Sensors, Virtual Servers, and Big data servers because of the routing tables of routers and switches are shorting for the WAN[3] networks. The legacy IP network based on the Open System Interconnection (OSI) model. Which consists of 7 layers. In the OSI Model Data and control passed from one layer to another, the communication of data starts from the Application Layer from the Sender end, on the dominant of the OSI configuration and comes into the downward direction to the Physical Layer of the OSI model and then goes towards upward direction to the application layer to the top of the OSI configuration layer at the receiver end.

The 7 Layers of OSI

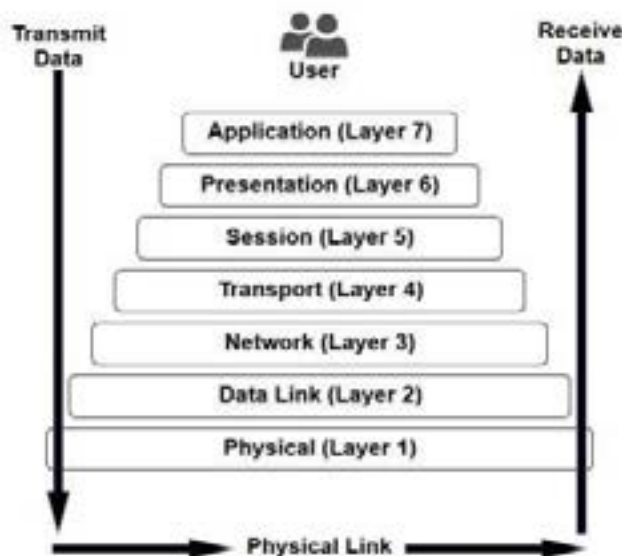


Figure 1: OSI Model Layer [4]

The traditional TCP/IP networks are complex and challenging to maintain because the devices such as Switches and Routers use in legacy TCP/IP networks are separately controlled by their own preinstalled configurable software. The data in legacy TCP/IP network flow in the network through the routing table, which is stored in routers. The decisions of flowing data from one end to the other end is made by the routers using the Routing-Table[5].

Software-Defined Networks:

In contrast to the legacy network, SDN is a materialize manner that is energetic, convenient, profitable, and versatile, fabricating it optimal intended for the high-bandwidth, influential quality of modernized applications. This manner decouples the network authority and progressing functions [6]. In other words, as the name defines that SDN, a network defined by the software, which means the whole network will be controlled and managed by the software application. Software-Defined Networking framework subsist of three layers are as follows:

A. Infrastructure Layer:

This layer subsists of routers, switches, and other network

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devices through which communication between the different

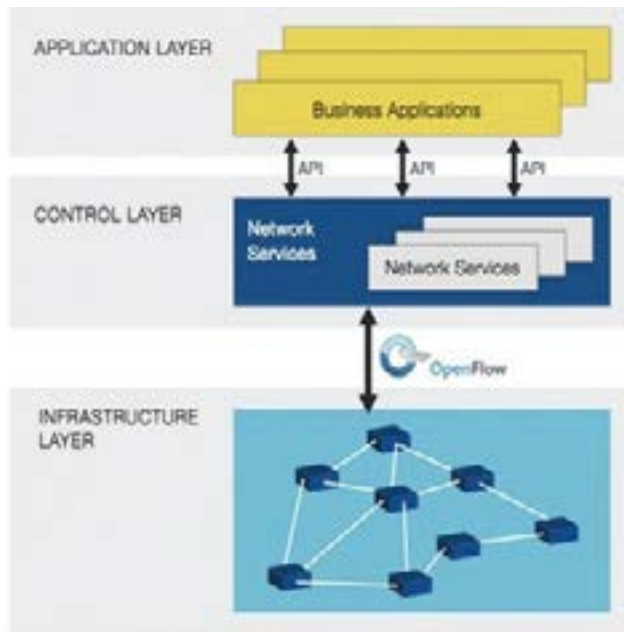


Figure 2: SDN Architecture [8]

devices are done. The main difference between these and legacy switches and network devices that these devices are controlled by software applications through the SDN controller.

B. Control Layer:

In the control Layer, the SDN controller plays the primary role where the SDN software application is installed on a controller, and the whole network Data flow and controlling the devices are done by the network administrator by the SDN software application.

C. Application Layer:

Application Layer consists of APIs (Application Programming Interface)[7]. These will be from any application interfaces like Business APIs, Games APIs, and so on.

SDN promises to improve network control, which enables enterprises and service providers to change the network to there day to day business requirements.

II. RELATED WORK

In the Introduction to SDN Akpovi Ominike and F. Y. Osisanwo, 2016, [9] discussed that legacy IP network is difficult to manage because it is vertically integrated into two planes, which are administered and Data Plane bundled together. The theory behind the SDN is to separate the assimilation of networking planes.

Shailendra Mishra and Mohammed Abdul Rahman AlShehri, Aug 2017, [10] discussed in conclusion by using the SDN

platform, the researcher develops much application acting as load stabilize, network virtualization charismatic access discipline in enterprises networks, etc. The crucial asset of an SDN capability is to gather all spectrum of the organization, as an ingredient of retainer virtualization, VM (Virtual machine) is progressively stimulated amid servers in a matter of seconds or minutes. Numerous SDN technologies are truly at the point of facilitating cloud computerization arrangements.

Analysts report that enterprises should change their focus from software-defined networking. In Gartner Report [11] SDN: Time to move on, it is discussed that the SDN is failing project so time to move on and not waste time on researching it. The report, though, says that SDN applies or imposed only in a small network of enterprises, which will later on integrating with the enterprise LAN network.

The David Geer Technology writer discussed in his article [12] the five difficulties which enterprises are facing to adopt SDN as main organization networks.

Kimmo Ahokas discussed in the paper [13] that the controlling of a lot of data traffic is now becoming more difficult in traditional legacy networks due to routing tables are becoming smaller for global routing, and hardware cost is also going expensive which affect the cost of networking and project and product. In that paper, he also wrote that the first OpenFlow compatible SDN controller was NOX, which was developed using the C++ platform, which offers application view and API for controlling the networks. In conclusion, he also discussed that SDN is a contemporary conception but still has gained a massive amount of attention in a short time due to uniqueness after the legacy networks. But still, SDN has many problems like controller repetition; failure demeanor and interoperability between devices from different vendors need to be marked as soon as a widespread endorsement on the Internet.

On the road to ensure and trustworthy SDN Diego Kreutz, Fernando M. V. Ramos, and Paulo Verissimo [14], they discussed that SDN is an emerging architecture, i.e., more flexible, manageable, cost-effective and adaptable with high bandwidth and compatible of today's application requirements. Due to SDN flexibility, it makes more qualify the network operators to use. SDN Architecture is directly programmable due to its decoupled from forwarding functions, abstracted to hide irrelevant details, centrally managed. SDN enables the solution of the complex network problems, but security and dependability are still an open issue. That research paper was based on the technique's building of a secure and dependable SDN network by design. In this way, the first step to describe the threats that may cause weakness to the SDN network. Then the sketch of secure & dependable SDN network and find out the issues that we may face. In this paper, the researcher has focused on security threats, finding the threats

and strong solution for eliminating those threats. Researchers have provided a new way for future researchers to work on SDN threats.

In eventual internet piece charismatic Traffic Slate and Crowding discipline over Data essence Based on Software Defined Networking [15] by Dong Sun, Kaixin Zhao, Yaming Fang, and Jie Cui, they discussed that the SDN and DCN are receiving attention in a wide range from both academia protocols among various data centers. In that paper, they concentrate on this concern and prospective brainy access of real-time deal with an energetic slate that could lead to full use of the network collateral. Big data[16] is one of the important topics in the world that the development industry is researching to increasing the rate of transmitting data in social networking websites to the data center. The Dynamic Scheduling and Congestion control transversely data centers planted on SDN is embellished on the design and exertion in that research paper.

In Report by Nick Feamster, Jennifer Rexford and Ellen Zegura on The Road to SDN: An academic records of Programmable Networks [17], they review the brief history of SDN after the evolution of Cloud computing a new concept emerged for the networks which will isolate the domination plane against the data plane. Domination plane is the management plane that handles the network influx and Data plane, leading the traffic bestowing to accords that the control plane compose as programmed. By untying the data plane from the influx plane, it will be accessible to succeed in the complex network, and it will give the user a better and secure network to use. It also clears the misconception of network virtualization and SDN, amortizing the cost of physical hardware as it will virtualize the network abstraction between the data plane and control plane do not provide these benefits directly as it will give cost reduction in Human resource.

III. PROBLEM STATEMENT

Legacy network rely on physical infrastructure due to which it has many limitations for example control plane is in your router or switch which tells the data where its destination or what will be the next hop in variation SDN abstracts the influx plane from the physical layer and due to which an administrator don't have to configure each device separately. The administrator just has to access the control plane and define policy, but the challenges we face in the implementation and adaptation of this concept are:

A. SDN Security and Monitoring:

In an interview with George Magklaras, senior systems engineer at the Biotechnology Center of Oslo explained how challenging is to monitor and secure SDN, He and his team conducted a test with OpenDayLight-established Software Defined Networking in habitat with HP and Cisco Hardware with pilot migration of 60 VLAN's control by adopting an

OpenStack separate cloud miniature Glitches emanate upon network control in contemplation of inbound and outbound IPS/IDS systems, he state IPS/IDS entirety by knock into a dispose of ports, as a substitute of precise port, to imitate the unified traffic of a VLAN or else network division as long as sniffing. Conventional switch software and hardware imitate certain traffic and distribute it into the IPS/IDS system. In comparison, SDN control a virtual machine monitor and public OS cycle to imitate the traffic. The analysis we execute on a diversity of IPS/IDS systems reveals that SDN drop roughly 25% to 30% of the aggression bearing actions. We associate so directed towards the SDN software stack attainment gradual to imitate traffic on ports and further descend Ethernet edges/circulation [18].

B. Proving Automation and Development Operation:

As SDN proposed to provide automation and dynamic provisioning but lack of skilled developers to make this dream into reality, the robustness of control plane to provide network automation and abstraction of hardware didn't become a reality due to lack of investment in this concept.

C. Lack of familiarity:

Due to well-known knowledge of existing legacy networks and not familiarity with SDN, Network engineers are still not trusting on SDN to integrate within enterprises and service provides businesses. SDN is still new to the IT personnel, and network administration wants to know how SDN works and how to deploy SDN in enterprises.

D. No standard Skillset availability of SDN:

There is no path of professional certification; likewise, CISCO to become a professional SDN administrator and no off the shelf product for the corporate consumer to get their hands-on experience on the product.

E. Selling Power to the Decision-maker:

Because of innovation and not familiarity and standardization, the SDN does not have the power to sell to the top management of enterprises.

There is no specified skill path to be a certified SDN engineer. Big Network giant companies don't want to adopt SDN as it will their proprietorship products, which are the main source of revenue for them. There is a lack of sponsorship in research on the concept. Enterprises hesitate in implementing an immature product.

IV. PROPOSED SOLUTIONS

During our research, we found out that SDN is a great concept, but the Research and development it required were not given due to which it faced a lot of problems to become a reality we focused on the problem in adoption of the concept faced by the Network industry. We proposed that making the Development of SDN tools should be made Open Source, so the problem of Research and development can be resolved.

The certification body must be created to the standardized skillset for SDN Engineers and Developers. Make SDN awareness program in Enterprises, so decision-maker is known to SDN concept.

It easy to sell hardware than a software/service an off the shelf product must be developed so that anyone purchase and test the product in their environment.

V. CONCLUSION

The traditional networks are becoming more and more complex as time goes on because of the “Big data” flow in networks. SDN provides agility and programmable network through the SDN controller. SDN is a breakthrough in the networking world but did not get much attention from enterprises. There are still adoption and other problems in SDN, so enterprises are not yet fully prepared to adopt SDN and use it as a mainstream network. So, we conclude as there is still a big research and development work needs to be done in the upcoming time.

VI. REFERENCES

- [1] Montrose, M. I. (1996). Printed circuit board design techniques for EMC compliance (Vol. 1, p. 996). Piscataway, NJ: IEEE Press.
- [2] Forouzan, B. A., & Fegan, S. C. (2006). TCP/IP protocol suite (Vol. 2). McGraw-Hill.
- [3] Balakrishnan, H., Stemm, M., Seshan, S., & Katz, R. H. (1997). Analyzing stability in wide-area network performance. *ACM SIGMETRICS Performance Evaluation Review*, 25(1), 2-12.
- [4] Briscoe, N. (2000). Understanding the OSI 7-layer model. *PC Network Advisor*, 120(2).
- [5] G.Huston, Analyzing the Internet BGP routing table, *Internet Protocol Journal* 4 (1) (2001).
- [6] McKeown, N. (2009). Software-defined networking. *INFOCOM keynote talk*, 17(2), 30-32.
- [7] Swales, A. G., Papadopoulos, A. D., & Tanzman, A. (2001). U.S. Patent No. 6,233,626. Washington, DC: U.S. Patent and Trademark Office.
- [8] Voellmy, A., & Wang, J. (2012). Scalable software-defined network controllers. *ACM SIGCOMM Computer Communication Review*, 42(4), 289-290.
- [9] *International Journal of Applied Information Systems (IJ AIS)* – ISSN: 2249-0868 Foundation of Computer Science FCS, New York, USA Volume 11 – No. 7, December 2016 – www.ijais.org 10 Introduction to Software Defined Networks (SDN)
- [10] *Indian Journal of Science and Technology*, Vol 10(29), DOI: 10.17485/ijst/2017/v10i29/112447, August 2017
- [11] Buzachis, A., Galletta, A., Celesti, A., & Villari, M. (2018, September). An innovative MapReduce-based approach of Dijkstra’s algorithm for SDN routing in hybrid cloud, edge, and IoT scenarios. In *European Conference on Service-Oriented and Cloud Computing* (pp. 185-198). Springer, Cham.
- [12] Geer, D. (2016). Five reasons IT pros are not ready for SDN investment.
- [13] Aalto University CSE-E4430 Methods and Tools for Network Systems Paper by Kimmo Ahokas of Aalto University School of Science.
- [14] HotSDN 13 Proceedings of the second ACM SIGCOMM workshop on hot topics in software defined networking Page 55-60, Hong Kong China – Aug 16 – 16 2013. ISBN: 978-1-4503-2178-5
- [15] Future Internet 2018, Article: Dynamic Traffic Scheduling and Congestion Control across Data Centers Based on SDN Published: 9 July 2018
- [16] Griffin, T. W., Mark, T. B., Ferrell, S., Janzen, T., Ibendahl, G., Bennett, J. D., ... & Shanoyan, A. (2016). Big data considerations for rural property professionals. *Journal of ASFMRA*, 167-180.
- [17] The Road to SDN: An Intellectual History of Programmable Networks Paper by Nick Feamster, Jennifer Rexford and Ellen Zegura from Georgia Tech Princeton University Georgia Tech, respectively.
- [18] Benzekki, K., El Fergougui, A., & Elbelrhiti Elalaoui, A. (2016). Software-defined networking (SDN): a survey. *Security and communication networks*, 9(18), 5803-5833.