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A Comprehensive Survey of Promising Applications Based on Software Defined Network

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Abstract: **Today's networks are quite static, dedicated to single services and slow to change. With the increasing demands of users the traditional network is lacking the ability to fulfill the requirements. These users are business and application. Software Defined Networking(SDN) is the answer to these problems. SDN network allow dynamic handling of numbers allowing multiple users to share one common infrastructure for both carriers and services providers . SDN will give a new direction to the networking world. In this paper the description of limitations of traditional network is given, which led formation of SDN paradigm. The objective of this paper is to look at the research opportunities and challenges for SDN. This paper give a review of what is SDN, its need, architecture, implementation and more important the applications of SDN.**

Keywords: Software defined networking(SDN), data plane, control plane, OpenFlow protocol, SDN models, SND principles, SDN Applications.

1.INTRODUCTION

Internet usage has increased rapidly in past few years. Which has led to increase of network devices, s/w and h/w requirements and complexity in the networking environment. Numerous issues are faced by the traditional network to handle the increasing demands of the users. The network environment consist of number of equipment's such as routers, switches, server load balancers, firewalls, network address translators, intrusion detection systems and many more. The network administrator have to individually configure the devices through configuration devices. It become a big problem when the network in large. The major drawbacks faced by tradition network are increased complexity, unable to manage traffic, vendor dependency, inability to cope with different domains, inability to scale. This led researchers to think on a model that can overcome all the problems of current network. The model named as "Software Defined Network" is the solution to all the problems related to the traditional network. The basic idea of Software defined Network(SDN) is to move the intelligence out and make it logically centralized. SDN approach separate the control plane from the data plane.

Rest of the organization of paper is as follow: section 2 discuss the need of SDN. Section 3, 4 gives brief introduction of models and the detail structure of SDN paradigm. Section 5 and 6 for basic principles and features. Section 7,8,9 Continue with applications. And at last Section 10 concludes the paper.

3. MODEL OF SDN

There are number of models proposed for SDN. So to select which model to choose is a critical decision to take. Basically three models are proposed : Evolutionary model , OpenFlow Model and Network Virtualization model. A brief introduction of these models is given as:

3.1Network Virtualization Model: [1]Network virtualization works on the ides of eliminating restrictions of LAN partitioning. This LAN partitioning is located in the Virtual Standards of Ethernet. In the network architecture it is used to solve the issues of multicasting and scalibility. One of the major

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profit of Network Virtualization model is improvemet in the multi-tenant clouds without affecting the existing network. Complexity and overheard are the two drawbacks of this Network Virtualization Model.

3.1**Evolutionary Model:** [1]Improve the usage of Software within the network is the feature of Evolutionary model. This model increase the usage of software control in the network topology limit. Compatibility is the major issue of this Model.
issue arises.

3.3 OpenFlow Model: model on which he SDN work is the OpenFlow model. This paper deals with theOpenFlow model. The openflow Model for SDN may be distributed or centralized.

3.3.1Centralized SDN Model: In this model, a single controller manage and supervise the whole network. The centralized controller gives the global view of underlying network. Although it gives single point management and strong control but it face some limitations. The biggest limitation is that controller has to update the OpenFlow switch frequently than traditional network. The second limitation of centralized model is the cost of control plane scalability. Third limitation of this model is the overhead as every new packet has to be forwarded to the control plane before it follow some route.

3.3.1**Distributed SDN Model:** Limitation of centralized SDN Model is covered in Distributed SDN Model which is single point failure. The researchers classified this model into three classes. Improving the performance of specific controllers is focused in the first class. The second class gives about the distributed controllers. And the last class focus on the multi layered distributed controllers.

This model also faces some challenges. The first is it requires reliable network-wide view in all controllers. Secondly this approach cannot provide global view of underlying network.

3.3.3 Hybrid SDN control architecture: It is the combination of both the centralized and distributed Model mixing the features of both. The limitations of both the centralized and distributed network a reduced in this model.

The structure and architecture of model is given in below.

4. **Structure of SDN**

Basic idea of SDN paradigm is to separate the control plane and data plane. The data plane forward the packets. Data plane simply follows the order given by the control plane. The control plane is programmable. As discussed above the programmable property of control plane in SDN is an innovation, which make the network architecture more attractive. By separating the control plane, environment form interactive application is provided. In short ,we can say
„Control Plane is Operating System of network" . The work of controller is to perform security checking, naming, routing and cause of action. The controller describe the flow of data on data plane. The flow of any information should get first permission from the controller, after it can flow in the network. The basic structure of Software Defined Network is given below:

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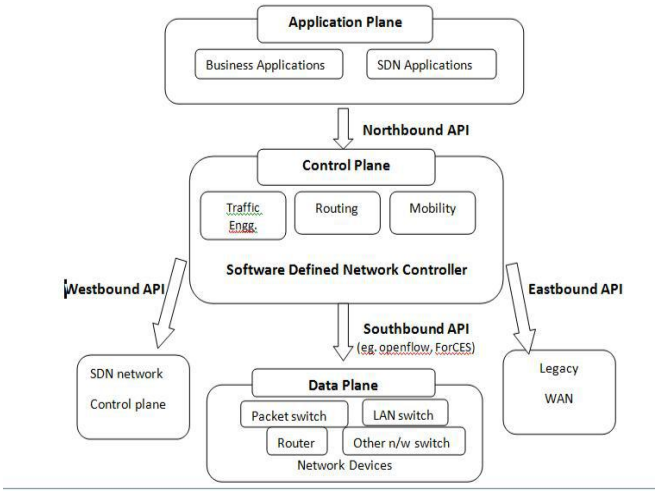

Figure1: Architecture of Software Defined Network

Software Defined Network consist o four key interfaces. These interfaces are illustrated in figure1.

Southbound-API: Southbound-API is the interfcae between control-plane and data-plane. Different protocols are available to create communication link between the Control-plane and Data-plane. Some examples of Southbound-API protocols are Open flow, For CES, I2RS. OpenFlow is the standard protocol. In this letter I am going to give detail of OpenFlow protocol.

Northbound-API: This Northbound-API is used to create communication with the external applications running at the top of network.. This API act as an interface between the applications and the SDN-Controller. No API for northbound is universally standardized. The information to be exchanged depends upon the application and the network. So, no standard API is required.

Westbound-API: To create a linking path between SDN planes of various network westbound-API is used. Information related to routing decision is exchanged between various networks via Westbound-API. The standard protocol used in this interface is BGP.

Eastbound-API: The interface between the control planes and the non-SDN domains is done through eastbound-API. Since this interface communicate with a non-SDN domain, so translationwithin the legacy network and the SDN is required. Which conclude that both the domains needs to be compatible with each other. For example, the routing protocols of non-SDN domain should be implemented on SDN-domain. And this is only possible when SDN-domain can use those protocols.

The main aim of software defined network is to ease the network administrator to respond to the requirements that are changing quickly in the network. The admin can change or shape the traffic by centrally controlling thewhole network instead of manually working on the network. The most popular approach to remotely control the routing tables is an open standard known as OpenFlow. OpenFlow protocol was defined by Open Networking Foundation (ONF). OpenFlow protocol uses Linux platform and is written in C language. Simple packet-handling rules of OpenFlow are: 1)Pattern: match packet header bits. 2)Actions: drop, forward, modify, send to controller. 3)Priority: disambiguate overlapping patterns. 4)Counters: #bytes and #packets.

Modern switches and routers have different Qos, firewalls, Nat etc. Hence, flow table of every vendor is

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different from other. So, some common set of functions are required that can operate on all the different flow tables. These common set of functions are provided by an open protocol OpenFlow. The OpenFlow data path consist of a Flow Table and acts related to every entry of flow[2].

5. **Basic Principles of SDN**

Working of software defined network relies on four principles. These are, control-plane and data-plane separation, controls with logical centralization, open interface and programmability. The categorized the Software defined Networking technology four of these principles are mandatory. Or we can say these principles are building blocks to the SDN paradigm.

Separation of control-plane and data-plane: The basic block of SDN is the separation of control place and the data plane. The control plane and data plane are developed separate. This gives benefit to the company having no necessary expert knowledge in both of the fields.[3] External setup of a software-based controller creates overhead on the hardware switches of vendors.
Logically Centralized Control: The controller of SDN is logically centralized. The term logically centralized mean that the when is have physical and virtual instance, it act like a single instance or component. The centralization gives the global view of network. This global view benefits the network administrator to manage the traffic in the network, making decision for routing the packets in the network and many more. Hence, gives much faster and large access to network than that of traditional network.

Programmability: programmability not only adds a feature to the control plane but also treats the network as a single programmable instance. Eliminating the problem of individually configuring the devices. The programmable data plane enables the data flow

independently and programmable manner. Even cross-layer operations can be easily programmed by SDN. Some vendors have to face problems to update the traditional network. So to overcome this problem the concept of Protocol Oblivious Forwarding (POF) is introduced in control plane. POF enables the programmability of the switches.

Open Interface: For SDN technology to be fully adaptive and flexible, it should have open interface. A closed interface limits the different approaches to be combined and hinders the innovation. The interface specially put an eye on the southbound-API of the SDN architecture.
The medium between data-plane and control-plane is this interface. Different protocols available for this interface to make link between the control-plane and data-plane. Some examples of Southbound-API protocols are Open flow, For CES, I2RS. OpenFlow is the standard protocol. In this letter I am going to give detail of OpenFlow protocol.

6. **Characteristics of Software Defined Network Technology:**

Scalability: The scalable feature of SDN describe the ability on network to increase or decrease according to the resources required. As the controller works on software it can easily synchronize and initialize the virtual and physical hosts. This property of controller plane act as variation in traffic.

Programmability: Being a primary principle of SDN , programmability also serves as a feature to SDN. The programmable data plane enables the data flow independently and programmable manner. Even

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cross-layer operations can be easily programmed by SDN.

Privacy: SDN also provide the transferor the facility to securely send information on network. As some of the confidential information need not to be sheared. So SDN implements privacy on required information.

Protocol Independency: This feature of SDN enables different types of protocols to match with SDN. Because of protocol independency feature SDN can easily cope with different network technologies and different layers of network. Also for the migration of traditional network to SDN network this feature is the key concept.

Feature to modify dynamically network: It is the ability to modify the parameters of network in a dynamic manner. This feature is helpful in area where there is only few need of operational changes. These changes are required per day where the need of virtual machine migration keep on changing minute or even seconds.

7. SDN for mobility and wireless network

It is predicted that by 2020 the connected mobile devices will be thousand times more than today which will connect customized and heterogeneous internet based applications and services. A technology named Software defined Wireless Networking (SDWN) provides mobility management, routing, radio resource management (RRM) and multi homing. The various challenges faced in SDWN are given in this section.

7.1 Multi homing management based on SDN

Multi Homing is a process of connecting end-host to multiple networks providing the user a facility to move anywhere in the wireless network. This can be done by providing SDN features between the edge network and the home network.

7.2 Mobility with SDN

IP mobility in traditional network is specified by Ipv4 that Internet Protocol Version 4 and Ipv6, Internet Protocol Version 4 . Very rare discussion is there regarding mobility based on SDN. SDWN, however, should support RRM, routing and mobility management. It should consist the feature of mobility management mechanism. Which in turn, from the application's perspective, used to maintain session continuity from the [15]. The major drawback in mobility management is handoff management as there is rapid movement of mobile nodes in virtualizes APs. Therefore, dynamic channel configuration should also be supported by SDWN.

7.3 Routing with SDN

Another key challenge is related to the routing of packets the network called Wireless Mesh Network (WMN). A WMN is a multihop wireless ad-hoc network. To form a wireless backbone, this stationary wireless mesh routers depend on traffic on behalf of other mesh routers or client stations.[16]. Its advantages is to provide fault tolerance in the situation when large number of nodes collapse, good efficiency for broadband connectivity and ease to configure wireless nodes. Dynamic routing algorithms

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are used to overcome the problems of WMN.

By enabling programmability of network SDN can solve these problems.

7.4 Mobile cloud using SDN

Mobile phone is fastest growing filed in the technology world. Mobile cloud computing provide a great backend on mobile device applications which give access to resources such as computing power and storage. SDN provides facilities to cloud services and its applications. It supervises the whole network conditions such as faults, retrieves network topology and support tunneling and provides network adjustment. It also facilitate mobile users the resource virtualization

Despite having advantages SDN for mobile cloud it has some limitations. Since mobile users are increasing rapidly, the overhead is increasing due to resources of devices that is extra latency and memory consumption and also limited computing capabilities.

Also there is frequent movement of mobile users between multiple networks, it become difficult to understand Mobile Personal Grid (MPG). The challenge for mobile clouds is transformation of physical access network to multiple virtual and isolated n/w and also management and maintenance of seamless connectivity.

7.5 SDN for Wireless Personal Area Network (WPAN)

Because of the reduced complexity of network, SDN can be implemented on numerous wireless networks. These can be Low-Rate Wireless Personal Area Network (LR-WPAN).

7.6 Cellular network based on SDN

The increasing demand and large patterns of mobile traffic has given rise to the demand of cellular network. The best solution for the increasing mobile users is to reduce cells which in turn will make the mobile client closer to the base station. A rapid response to the mobile terminals can be provided by SDN. SDN can avoid unwanted breaks in the services between various technologies. As supporting the increasing users can give rise to number of issues. In traditional cellular network there is a single straignt link between terminal devices and the base station. But in multihope network there are multiple links in-between the transmitter and receiver (also transmitter and receivers are multiple). This is multipath communication is called multihope cooperative network. Multihope cooperative network provides high density access to network by overcoming the limitations of existing technology which include mechanism for multiple acknowledgement and retransmission. This network also has some limitations as it work on half duplex mode so the spectrum usage is insufficient.
SDN overcome the limitations of multihope wireless network hence increase the capacity of cellular network. The routers of CellSDN could support various techniques like compression and decompression of header to reduce the overhead with packet payloads on low bandwidth links. Designing the network architecture is another challenge in CellSDN. Present CellSDN have a centralized control. This is issue when there is single point failure. So to overcome this limitation Distributed CellSDN is designed. On which distributed SDN model works efficiently.

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8. SDN for Cloud Based Networks

to create a communication channel between the IT application within the boundaries of computing infracture refers to Cloud based networking.
Many network functions requir performance which affect the factors as low security, inefficient mobile clouds, improper network virtualization etc. SDN is a complementary technology which provides virtualization and can cope with the challenges faced in cloud based network. The different opportunities on the Cloud based Networks are given as follow.

8.1 Information –centric networking based on SDN

Information-centric Networking (ICN) is getting special attention in cloud networks. In this user receive data content that is based on the naming of information rather than communication channels between the hosts. It also facilitate with in-network caching. However ICN faces numbers of challenges. Practically, there is interoperability in deployment of ICN mechanisms having various transmission techniques. Using SDN, ICN schemes can be implemented on the existing network without using ICN capable hardware [15].

However, for supporting ICN on SDN every packet require ICN information, so packet fragmentation increase overhead which decrease the performance of the network. The assigning of fixed labels is done by the SDN controller.

8.2 SDN supporting data centers and cloud

SDN provide promisimng solutions to implement the the capabilities required for data centers and cloud. These comprises of automating resources, creating new services on the existing network resources , network virtualization and many more.

9. Security Challenges in SDN

Security id one of the major challenges in SDN. According to research studies, increase in number of malware attacks and DdoS, phishing activities can greatly change the security of SDN infrastructure. Although, mobile ad-hoc networks need much more complicated security challenges because of having lack of infrastructure.

Few security challenges are encripted in SDN. As OpenFlow do not specify data integrity. Security in SDN will need sophisticated authentication mechanism and encryption to prevent hacking recovery from packet failure.

10. Conclusion

The studies have concluded that current network architecture is not capable of coping with the increasing demands of the internet services. The answer to all the problems of
Current network is SDN technology. There are number of benefits of SDN in network environment. SDN helps the network administrator to manage, control and make decisions of the network in a better manner. SDN is a technology through which costumer can create their network according to the business needs. And is also helpful for those need network change in their day to day life (e.g. social networking sites). SDN can easily cooperate with the technologies that are going to be hot topics and also an evolution in IT wthtorld.
In this paper we have studies the problem being faced in the traditional network , and technology called

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SDN that can cope with the increasing demands, its architecture and at last the wide range of applications based on SDN and the issue and challenges in faced in them.

11. REFERENCES

[1]Furqan Alam, Iyad Katib, Ahmed Saeed Alzahrani, "New Networking Era: Software Defined Networking" Volume 3, Issue 11, November 2013.

[1]K.Venkatraman, and Dr.V. Parthasarathy, "Managing and Configuring Network through Software Defined Networking (SDN)", International Journal of Computer Science and Mobile Computing Vol.2 Issue. 11, November-2013.

[3] Michael Jarschel, Thomas Zinner, Tobias Hoßfeld, Phuoc TranGia, and Wolfgang Kellerer, "Interfaces, Attributes, and Use Case:A Compass for SDN", 2014 IEEE.

[4]Jon Matias, Jokin Garay, Nerea Toledo, Juanjo Unzilla, and Eduardo Jacob, "Toward an SDN-Enabled NFV Architecture", IEEE Communications Magazine ,April 2015.

[3][5] Sławomir Kukliński, "Programmable Management Framework for Evolved SDN". IEEE Communications Magazine ,April 2017.
[4]
[6] Alexander Shalimov, Dmitry Zuikov, Daria Zimarina, VasilyPashkov, Ruslan Smeliansky, "Advanced Study of SDN/OpenFlow controllers", May 2018.

[7] Mohamed Aslan, and Ashraf Matrawy, "On the Impact of Network State Collection on the Performance of SDN Applications" , IEEE Communications Letters, 2017.

[8] Tamal Das, Marcel Caria and Admela Jukan, Marco Hoffmann, "Insights on SDN Migration Trajectory", IEEE ICC Next Generation Networking Symposium, 2015.

[10] Nick Feamster , Jennifer Rexford , Ellen Zegura , "The Road to SDN: An Intellectual History of Programmable Networks".IEEE ,April 2018.

[11] Akram Hakiri,Aniruddha Gokhale,Pascal Berthou,Douglas C.Schmidth, Thierry Gayraud. "Software-Defined Networking:Challenges and research opportunities for future Internet" IEEE Communications Magazine ,April 2015.

[12]Y.Zhang, J.Luo, H.H fnfu, "Wireless mesh networking:architecture, in: Protocols and Standards, Wireless networks and Mobile Communication", 2016.

[13] K.-H. Kim, S.-J, Lee, P. Congdom, On cloud-centric network architecture for multi-dimensional mobility,2012.

[14]L.Suresh,J.Schulz-Zander, R.Merz,A.Feldmann,T.Vazao,"towards programmable enterprise wlans with odin", 2017

Copyright © 2019Authors

ISSN: 0971-1260
Vol-22-Issue-16-August-2019

[15] R.Raghavendra, J. Lobo, K.-W.Lee, "Dynamic graphquery primitives for sdn-based cloudnetwork management",2012.

[16]P.Pan, T Nadeau, "Software-defined network(SDN) problem statement and use cases for data center applications"March 11,2012.

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