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A Survey on Software Defined Network: A New Era of Networking

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ABSTRACT:Today we depend on internet, internet is not only a source for resources but now it's a life for all human living on earth.Everything is connected and accessible from anywhere with the help of Internet. Despite working well and widespread adoption, tradition IP network is very hard to manage. Managing the Internet's core has become very complex and tedious and error prone. Tremendous growth in Internet users and large network traffic they generate and vender dependency of networkingdevices and all devices have diverse configuration protocols.SDN has the potential to simplify network configuration andreduce management complexity.In comparison with existing networks, SDN enables flexible, programmable and dynamic network. This paper presents a survey on the concepts of software defined network and its challenges.

KEYWORDS: SDN;Controller; Plane; API; Openflow; Switch; Datacenter; Interface;

I. INTRODUCTION

Software defined networking[1] is an approach to computer networking that allows networkadministrators to manage network services from a centralized software controller. That is done by the decoupling the system that control the network and decide the network's working called control plane from the forwarding devices, underlying system used to forward the traffic. There is tight coupling between control plane and data plane in tradition networking. Problem with the current networking is that software is tightly coupled with the hardware and interfaces are vender dependent. Vender write code and there are long delays in introducing new technology. SDN separates decision making power and control of all of the forwarding devices or application specific interface circuit (ASIC)[2].

We are moving from current networking which is hardware dependent to programmable networking.Explosion of mobile devices, Cloud Computing, Big Data, and network visualization trends deriving the network industries to re-examine and redesign the current network architectures.Following is the need for a new network architecture

1. *Changing traffic patterns:* Today network growing exponentially and demand of data increasing daily that increases traffic across the wide area network resulting to require huge amount of data dynamically from data centers.
2. *Rise of mobile devices:* Mobile devices such as tablets, smartphones, and notebooks increases exponentially and network not enough to accommodate requirement of these devices.
3. *The rise of cloud services:* The access demand of application services, infrastructure and other services introduces the need of scalability to handle traffic [3].
4. *Big Data:* Massive data shared parallelly between thousands of servers and that's needs maximum bandwidth and dedicated links between the servers [4].

Current networking has following problems [1].

1. *Inability to experiment new ideas:* Due to large number of installed hardware and protocol network is very complexand researcher are unable to innovate new ideas.

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2. *Scalability limitations:*
The huge rise of traffic demand might require changes in scale of the network architecture. The rise in the number of devices, however, highly increases complexity.
3. *Complexity and inconsistent policies:*
Development large number of protocols and devices make very complex to network.Network manager have to work with multiple interfaces and protocol to manage andtroubleshoot. This makes it very difficult to apply consistent policies.
4. *Vendor dependencies:*
All networking devices made by some vendors have different configuration. Dueto intellectual property right, no one can adopt the procedure and configuration ofother vendors. This heterogeneity makes very difficult communication. Networkmanager have to go all routers to configure and change configuration of routers.

Following fig. 1 show how a traditional networking devices where hardware is tightly coupled with software.

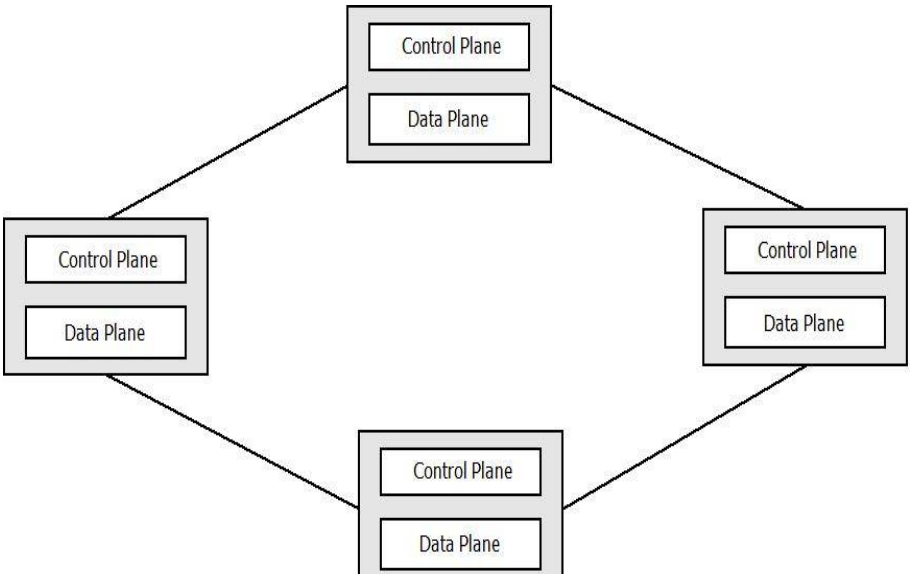

Fig. 1Traditional Network

II. BASIC SDN ARCHITECTURE

The main idea behind SDN is separation and centralization of control and use open flow control protocol between controller and forward devices.It divides control plane and data plane in two parts and moves the control out of network nodes. It converts the network switch into a simple forwarding device and control logic implemented in control plane which is a logically centralized controller. Following fig. 2 shows how all decision power of individual networking devices transferred to a centralized place called controller.

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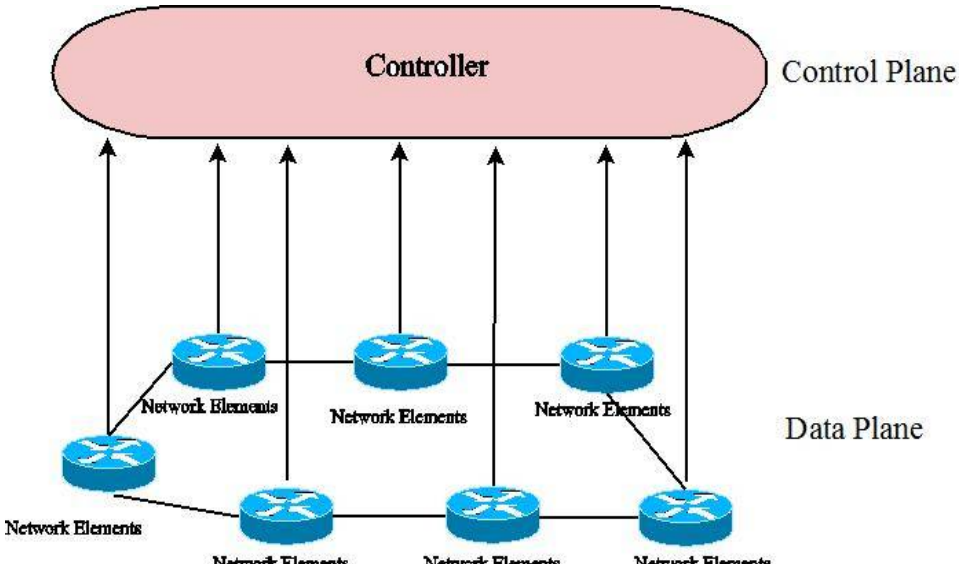

Fig. 2

Open Networking Foundation (ONF) introduces this SDN architecture [1][2]. SDN is described by partitioning architecture into three layers as shown in fig. 3. All layer has unique functionality and relationship with upper and lower layer. Bottom plane is networking devices (routers, switches etc) known as data plane or forwarding plane, middle plane is control place have controller (floodlight, pox, ryu etc) control the network and provides relevant information to upper plane that is application plane. Fig. 3 shows the layers of SDN architecture and terms associated with SDN architecture is described here.

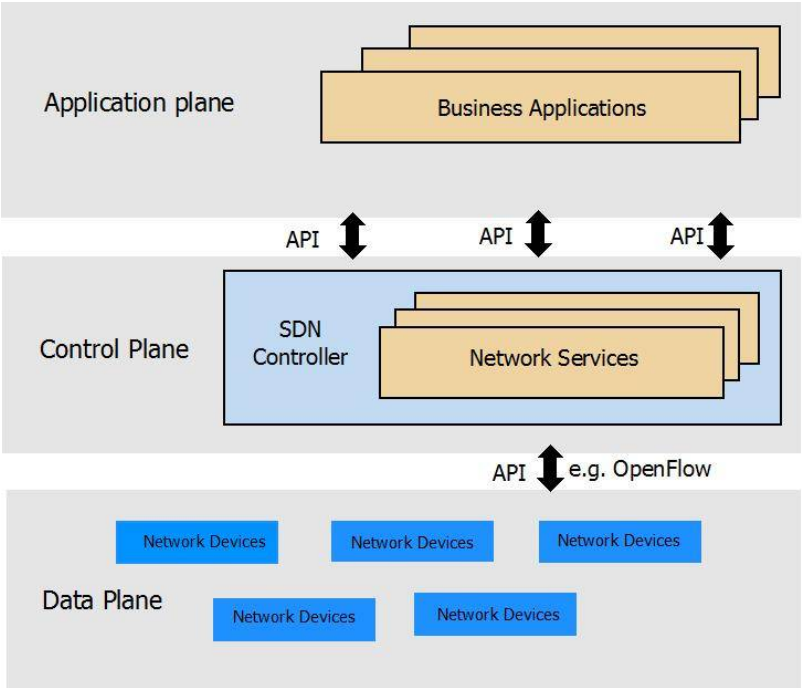

Fig. 3.SDN architecture [1]

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1. **Control Plane**
   SDN control plane is centralized control software running at server. Control plane enable application administrator to apply new policies and protocol to data planeand make decision about where traffic should flow. NOX, POX, Floodlight and OpenDaylight etc. are examples of SDN controller running on control plane.
2. **Data Plane**
   Data plane is comprising of forwarding devices carries network traffic. Forward packet to next hop according to control plane rule
3. **SDN Southbound Interfaces**
   SDN Southbound Interfaces is presented to lower layers that permit communicationbetween control plane and data plane. Network Configuration Protocol (NetConf)and OpenFlow are southbound API[1].
4. **SDN Northbound Interfaces (NBI)**
   SDN NBIs are interfaces between SDN Controllers and SDN Applications and normally give abstract network views. Northbound API must support a wide variety ofapplication, so one size will not fit all, Thats why there is no standard northboundinterface and protocol
5. **Application Plane**
   SDN Applications are programs that explicitly, specifically, and programmaticallycommunicate their network necessities and desired network behavior to the SDNController via NBIs
6. **EastWest protocols**
   In the case of a multi-controller-based architecture, the EastWest interface protocolmanages connections between the different controllers

III. OPENFLOW

It is a protocol works in SDN. OpenFlow[6] is SDN protocol that is used to centrally control network forwarding devices. This is first standard protocol for the communication between control plane and data plane.OpenFlow gives programming based access to the flow tables that educate routers and switches how to direct network traffic movement. The forwarding device in an OpenFlow scenario is an OpenFlow enabled switchthat contains more than one flow tables and an abstraction layer that communicates withthe controller. OpenFlow supported switches are 1.OpenFlow only 2. OpenFlow Hybrid.OpenFlow-enabledswitches support just OpenFlow operations, i.e., all packet is handled by the OpenFlowpipeline [7].Figure 4 shows OpenFlow architecture.OpenFlow protocol run over transmission control protocol and uses secure socket layer for security purpose.

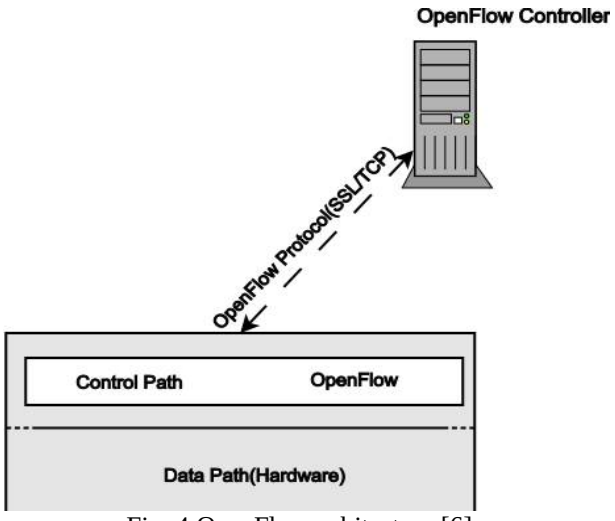

Fig. 4.OpenFlowarchitecture [6]

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IV. NETWORK OPERATING SYSTEMS/CONTROLLERS

The OpenFlow controller is responsible for governing all the rules and policies in the network it is also called network operating system. It generates rules in proactive or reactive manner and installs it into the Openflow switch. SDN contain large set of OpenFlow controller used according applications need and controller can be implemented in centralized and distributed manner. Following are some description about controller.

1. **Nox:**First OpenFlow controller NOX [7] was developed at Nicira Networks. NOX is written in C++ and provide well defined API for OpenFlow 1.0.
2. **POX:**POX [7] can be considered as a sibling of NOX OpenFlow controller providing python API.
3. **Beacon:** Beacon [8] is a Java-based open source controller developed in 2010. As a java based controller, it has better compatibility.
4. **Floodlight:** The Floodlight [9] Open SDN Controller is an enterprise-class, Apache licensed, Java-based OpenFlow Controller. It is supported and maintained by a community of Big Switch Networks developers.
5. **Ryu:** Ryu [10] is commonly referred as component-based open-source software defined by networking framework. It is implemented entirely in Python, and supported by NTTs labs.

SDN has some other efficient centralised and distributed OpenFlow controller not described here like Onix [11], OpenDayLight [12],SMaRtLight[13] etc.

V. KEY CHALLENGES OF SDN

SDN is new and developing innovation. Like each innovation has a few issues SDNis not the exception. In SDN, control plane is isolated from the information plane,so fundamental concern of this architecture is to give reliability, adaptability, security, and service management. This area concentrates on three particular questions emerging from the difficulties of SDN.

1. **Performance:** Average processing speed of network node in terms of latency and throughput is called performance. SDN is a flow-based strategy, so performance of SDN is flow rate processed by controller per unit time. Key factorthat affect the performance of SDN is flow setup time. If there is no entry inswitch table then packet wait till controller sends rule to switch [14].
2. **Scalability:** Accepting that the performance related prerequisites can be accomplished inside of the logically centralized programmable architecture, afurther issue that in SDN is scalability. The issue can be divided into network node and controller node scalability [15].
3. **Security:**Security is the main issue in SDN. SDN controller have all the decision power of network so if security of controller is compromised whole network will be compromised. So, it will be easy for a hacker or an intruder to hack the controller, and make changes in the network or steal or modify data from there.So SDN must give secure connection and encryption system between outside switches and the controller server outside of the switch [16].

Despite having some issues SDN provide an efficient network. Lots of research going on SDN issues and some of them solved and optimised at minimum level.Software Defined Networking changing the world. Basically, created for datacenter where unpredictable data is coming. Two best research in SDN based on data center communication are 1. B4: software defined WAN [17] is a project developed by researcher of Google and SWAN project(Software Defined WAN) [18].Following number of unique characteristics B4 have.Massive bandwidth requirement given by Microsoft researcher, deployed to modest number of site, Elastic traffic demand that seeks to maximize average bandwidth and Full control over edge server and network. SWAN used to boost the high utilization in inter datacenter network by controlling whole network with centralized controller.

VI. CONCLUSION AND FUTURE WORK

In this paper, we discussed both current hardware oriented network architecture and SDN, and examined some of the key issues challenges and future directions. SDN give an open space for researcher to further optimise the network. We have discussed architectural design and deployment of SDN controller. Separation of control plane from data plane

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simplifies the whole network. SDN is the solution for high demand of resources, unpredictable traffic patterns, rapid network reconfiguration, incorporating business rules. SDN is ideal for the customer where traffic patterns change rapidly like social networking site Facebook, twitter, yahoo etc. Large data center which have geographically spares resources or may be specific location have high demand of large data.

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BIOGRAPHY

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