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A Study on Software Defined Networking

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ABSTRACT: The Internet, a collection of networks allows transmission of information from one place to another. Today's internet is growing fast; devices to the network for accessing and providing the services. The Traditional network makes it a difficult task to add and remove the network devices. The Static Nature of the conventional network makes it difficult to accomplish the dynamic computing and storage desires of big data centers and campuses. Software-Defined Networking is the new approach to networking. Software Defined Network model promises to simplify the network configuration and resource management. Software Defined Networking will replace the current network and fulfill the business needs via software rather than hardware. This paper introduces the concepts of Software Defined Network which will help to configure and manage the network needs.

KEYWORDS: Software Defined Network; OpenFlow; Open Network Foundation; Northbound Interface; Southbound Interface

I. INTRODUCTION

Software Defined Networking (SDN) gives assurance to dramatically reduce the complexity of network configuration and management as well as to make the introduction of innovation in the network operations possible. The challenges associated with the current traditional network like an explosion of the cloud, growth of big data centers , the mobility that make the network very complex and putting pressure on networks [1]. The Dispute of static nature of the traditional network and successfully handled through the new network is a Software Define network.

The main important of SDN to enable the big data application in the enterprise, which required redesigning and rethinking the way to design big data centers. The SDN play very important role in enabling big data applications and virtualization by simplifying the networks. Software-defined networking (SDN) is new concept towards networking in which controller is decoupled from hardware and given to a software application called a controller. In SDN network control plane is physically separate out from the forwarding plane, where a control plane controls several devices that will be part of data plan. The goal of SDN is to allow network engineers and administrators respond quickly to changing business requirements [2].

This paper addresses the fundamental concepts of SDN with architecture and challenges. The paper outlined as follows: Section II defines the architecture of SDN. Then, Section III presents the concepts related to SDN. Next, Section IV analyses the SDN challenges. Finally, Section V concludes with the discussion and conclusion.

II. SDN ARCHITECTURE

SDN architecture is dynamic, controllable, commercial, and adaptable; a designing model for the high bandwidth and dynamic nature of today's applications. This architecture [3] decouples the network control (network intelligence) and data plane (perform forwarding functions) which enables the network control to be directly programmable, and the underlying infrastructure layer abstracted from applications. The SDN architecture consists three layers, Application Layer (Application Plane), Control Layer(Control Plane) and Infrastructure Layer(Data Plane) shown in Fig.1 [4][5].
The applications (Security, Bandwidth Management, and Load Management) exist in the application layer and send their network requirements send to control plan through a Northbound Interface (NBI). SDN uses NBI to communicate with the applications and business logic present in the application layer to help network executives to programmatically manage traffic and deploy the services.

In SDN, control plan is detached from the data plane. This control plane is a centralized software-based controller that maintains the centralized view of the overall network and enables the network administrator to direct the underlying system about how to forward the traffic.

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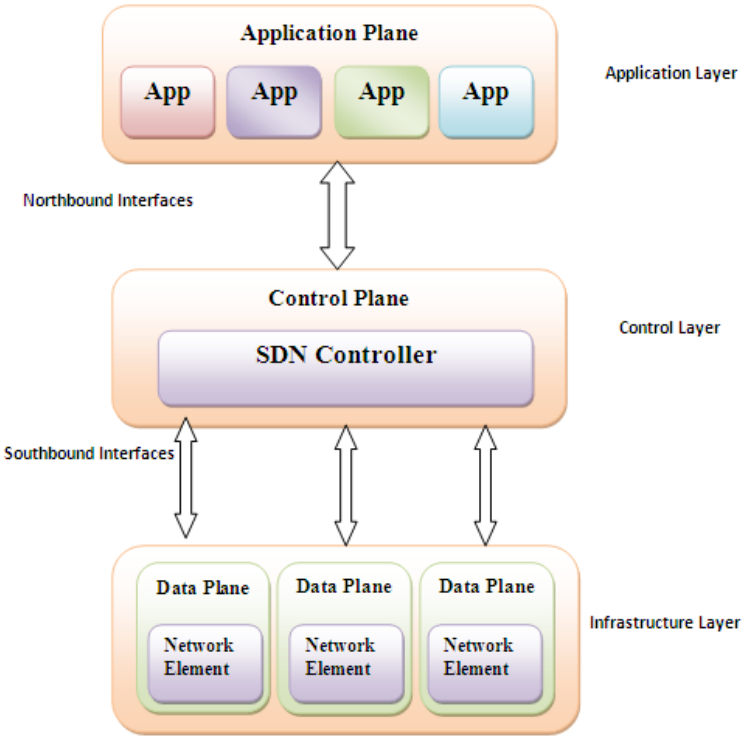

Fig. 1 Layer wise SDN Architecture

SDN Controller is the brain of the network that interacts with the data plane via a Southbound Interface (SBI), also called Control Data Plane Interface (i.e. OpenFlow). The SBI of SDN relays the information to the switches and routers deployed in a data plane. Data Plane (Forwarding Plane) consists of some network elements (e.g. Switches) responsible for forwarding the traffic as per the rules set by the controller. SDN architecture will provide a set of application programming interfaces that simplifies the implementation of network services like routing, multicasting, access control, etc. [2]. The SDN architecture allows a network administrator to implement highly scalable, adaptable, the manageable network that will fulfill the business dynamic needs.

III. CONCEPTS RELATED TO SDN

A. *OpenFlows:*

The openflow[6] is a protocol specially designed for SDN. It is an interface defined between control plan and data plan in SDN architecture. The hardware and software based OpenFlow interface deployed in a variety of networks. The standard enables networks having logically centralized control to configure and change the network behavior through a well-defined forwarding instruction set. Also, it enables researchers to run the experimental protocol in the campus network. Open standard OpenFlow implemented by vendors, OpenFlow, enabled switches now available in a market.

B. *Open Network Foundation(ONF):*

ONF [7] is a user driven organization devoted to the promotion and adoption of SDN, founded by Google, Microsoft, Yahoo, etc. The members of ONF [8] define an architectural framework and standards for the deployment of both SDN hardware and software. ONF is emerging open standards such as the OpenFlow Standard and the OpenFlow Configuration and Management Protocol Standard. It is the first, and only vendor-neutral standard communications interface defined between the controls and forwarding layers of SDN architecture.

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C. *Traditional and SDN Structure:*

- Traditional Networking: Traditional Networking Network consists of devices connected to each other for data transmission. In traditional Network architecture, the data path and the decision-making a process of switching or routing are collected on the same device. In traditional networks, a switch consists of both the control plan and data plan as show in Fig.2. Traditional switches perform both the functionalities of deciding where to send traffic through control plan and forwarding the traffic through a data plan. It is represented in Fig. 2

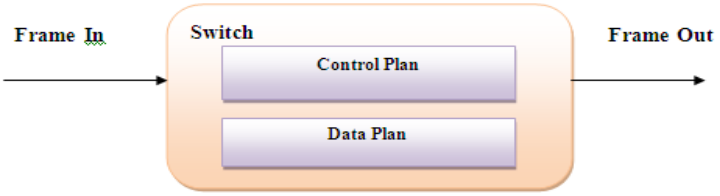

Fig. 2 Traditional Network Switch

- Software Defined Network: SDN abstracts the lower layer functionality by separating control plan and data plan. In SDN control plan functions are placed on SDN controller and SDN controller is nothing but server run SDN software. SDN switches (Physical or virtual) have a data plan which forwards the traffic (frames) as per the rules set by the SDN controller. SDN controller communicates to a data plan through OpenFlow protocol. The OpenFlow protocol conveys data forwarding instruction to a data plan. It is shown in Fig. 3.

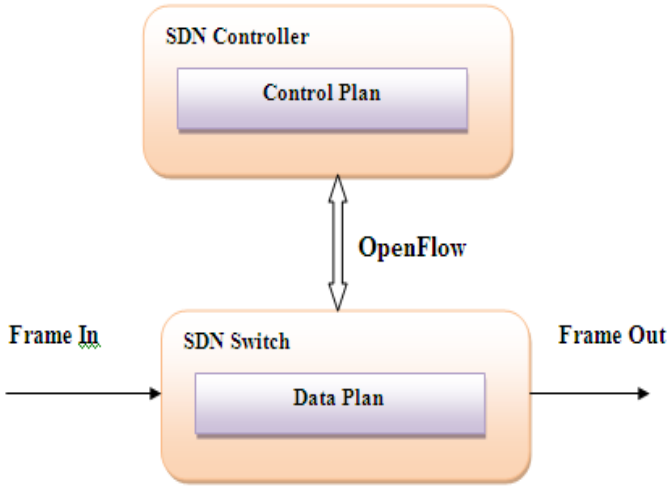

Fig. 3 Software Defined Network Switch

IV. SDN CHALLENGES

. SDN originally employed in data centers. It has helped companies adjust the network structure and requirements as per needs. Centralized Control of open flow architecture allows the network administrator to program the network behavior. When we try to implement SDN network we require to focus challenges of SDN [9][1].

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A. *Controller Scalability :*
SDN controller is the brain of a network. SDN network implementation requires defining a number of controllers needed for network and their location. The Network may require a single controller or hierarchy of controller in control plan. Voellmy et al. [10] concluded that "when the network scales up in the number of switches and the number of end hosts, the SDN controller can become a key bottleneck." The latency increases during transmission of information between multiple nodes and the single controller. The number of switches flows and bandwidth increaser's number of requests will be pending to the controller, which may not able to process. The SDN controller [NOX] studies said that it can handle 30 k requests [11]. For SDN network, a main challenge is a number of controller want and their localization.

B. *Convergence and Management :*
SDN OpeFlow [6] architecture was originally developed for enterprise campuses networks that help researchers to experiment their protocols. In other way, SDN designed for the small network like the private network. However, to try and extend this architecture to large networks requires attend some issues, for example, the problem of Interdomain Routing (Routing between two networks).

C. *Security :*
Security is a main concern in networking to detect and prevent anomalies. Networks mostly consist of host based and network based security mechanism which helps to network to detect intrusion be a part of their network or outside network. Current security solutions are difficult to manage, expensive, complex, inflexible. Programmable SDN requires intelligent security models because SDN systems handle by the network administrator who is configured the network as per requirements through software. Security needs to be developed in architecture to protect the controller securely.

D. *Controller Flexibility :*
OpenFlow [1] proposed centralized controller is venerable to the network. SDN allow network administrator effectively program a network with software running on a central controller. A malfunction of the controller can negatively compromise a flexibility of the whole network. SDN network needs to focus on to define the way to handle the controller failure. Currently emerging SDN technique focus on separate the control plan from the data plan and provide programmable interfaces to fulfill the business needs.

V. CONCLUSION AND FUTURE WORK

SDN has emerged as a means to improve programmability within the network to support the dynamic nature of future network functions by separating network control and forwarding functions. SDN has been employed in data centers and also assisted companies to adjust network configuration and structure. SDN promises to convert today's traditional static network into flexible, scalable, programmable based network with intelligence which dynamically configure network resources.

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