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Historical Survey on Software-Defined Networking

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Abstract **- Technology advancement in terms of networking is urging computer networks for high accessibility, bandwidth, ubiquitous and dynamic management. The information and communication technologies, therefore, demand new challenges to the future internet. The traditional networking approaches are non-error-prone and cumbersome, and they can't utilize the capability of the physical network infrastructure to its fullest.**

Keywords- **Software Networks, Routing and Switching, Open Flow, Software-Defined Networking.**

I. INTRODUCTION

Software defined networking is seen as the most appropriate solution for the future internet [1]. SDN is an emerging network infrastructure that decouples the control of networks from forwarding and has enabled direct programming of networks [2-4]. The network infrastructure is being touted to be the solution since it brings with it potential benefits which include:

- Improved performance
- Enhanced configuration
- Encouraged innovation

Encouraged innovation is one of its key benefits since it offers a convenient platform for experimenting new ideas and techniques in networking which encourages new designs. The programmability feature and the ability of the control plane to define isolated networks promote innovations and experimenting [5-6]. Improved network performance is facilitated by having a centralized and feedback control of information exchange between network layers. Configuration is enhanced by controlling and configuring networking devices automatically through a software and from a single point [7-10].
Software defined networking uses a reference model which consists of three layers, namely, control layer, infrastructure layer and the application layers which operate as illustrated below.

The layers communicate in a bottom-up manner. The infrastructure layer is responsible for collecting the network status which includes traffic statistics, network topology and network usages which are sent to the controller and stored in the local devices. At this layer, the switching devices are interconnected to form one network. At the infrastructure, layer packets are processed based on the rules provided by the controller. However, the SDN architecture requires modern or new hardware designs for the SDN switching devices.

The control layer acts as the bridge for the infrastructure and application layer through the upward interfacing and the downward interfacing. The downward interfacing specifies the functions for controllers to access switching devices functions. The downward interface interacting with the infrastructure layer creates the south-bound interface. The application layer with upward interfacing form the northbound interface. The northbound interface provides access points for networking devices in various forms such as the application programming interface API.

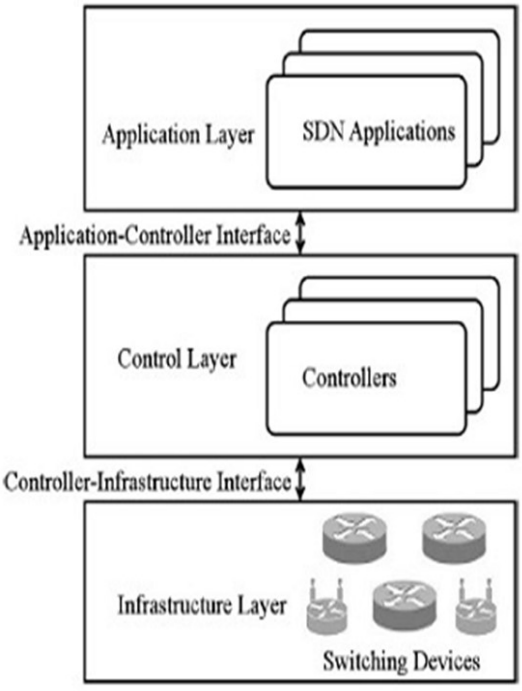

Fig. 1. SDN Main Layers.

The layer consists off our key components which are a rule update process, a high-level language, a network status synchronization process and a network collection process. The application layer usually supports user

requirements through SDN applications which are specially designed to support network users. Switching devices are accessed and controlled through the programmable platform which is provided by the control layer. The application layer operates switching devices which work at the infrastructure layer. Network virtualization, server load balancing, dynamic access control, seamless migration, and mobility are the operation done by the applications at the application layer. SDN applications are capable of implementing strategies which are used to manipulate the underlying physical networks with the help of the high-level language which is provided by the control layer [11].

II. OPENFLOW

Under the software defined networking architecture, a number of applications such as GENI has been developed to enable more control and configuration of networks. OpenFlow is a protocol under SDN whose objective is to enable simpler network environments where experiments can be undertaken without interfering with the production traffic in a given network. The experiments carried out are usually focused on creating controllable software network by focusing on how packets forwarding is to be controlled. Open Flow takes advantage of the features of modern switches and networks where there are flow tables which help in networking functions such as submitting, routing, statistical analysis of data streams and firewall protection. Open Flow protocol is evolving as time passes by and each release comes with new specifications and features. As a result Open Flow networks are being deployed for both production and research purposes [12].

There are many Open Flow projects today such as Mininet simulator and NOX controller which are often used for software defined networking related researches. Software defined networking is highly valued with Open Flow since the data plane is separated from the control plane alongside other networking capabilities.

However, despite the benefits such as enhanced configuration and improved performances, SDN still has got its challenges since the network infrastructure is still in infancy. A number of important issues are still not solved such as adoption and standardization. The Open Flow offers improved performance and configuration, but its driver is not yet deployed for the SDN controller development. The standard programming language and a north-bound API are not yet determined for SDN application development [13].

The challenges need further research so that various aspects concerning the architecture can be made clear as more and more vendors continue to design switching devices which integrate SDN features. Implementing SDN with the current approach of decoupling control plane from the data plane is very important even though it suggests a total removal of onboard routing protocols from switching devices. Ultimately the success of SDN will require developments and improvements in all the three layers.

III. CONCLUSION

SDN is a novel approach to computer networking that provides a centralized form of network management. It helped to increase the flexibility of data communication and provide a fault tolerance architecture; however, it requires more investigation regarding the issues occurring due to the centrality of the control plane. With the new improvement in the internet, we expect to see new challenges in SDN regarding the bottleneck and overload issues.

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