SDN: NETWORKING PARADIGM FOR THE FUTURE

Smitha Vinod[1], *X. Agnisekalarani*[2]

ABSTRACT

Operating system for a network, have you heard about it! It's been a reality since few years and yet to become popular. Network architecture has always been dependent on proprietary hardware devices, rather than programmable hardware components. This used to make the overall network management cost high and always forced users to be depended on the hardware making giants. There is a considerable change in this scenario after the implementation of programmable controllable network equipments into the networking sector. The program which controls the controller can be called in general terms an operating system for a network. After a few more research developments in the area of Software Defined Networks (SDN) and its load balancing and controller break down reasons these hardware equipments will be the most important inventions in the era of networking. This can make a new generation trend in Internet and mobile industry. SDN is expected to be the 5th Generation Technology change.

This paper aims at exploring the fundamentals of effective use of software defined networks and also provides a basis for understanding OpenFlow(OF) Platform.

Keywords— Software Defined Networking; SDN; OpenFlow; Controller; Network Operating system; Mininet; Putty;

I. INTRODUCTION

Society was always depended on proprietary hardware devices and this used to be the reason for the high overall network management cost. There will be a considerable change in this scenario after the successful implementation of the SDN technology because the trend will be changed into programmable hardware components instead of proprietary components after this implementation.

Here we present a system which demonstrates the various tools and techniques for experimenting SDN. Administrative control over existing proprietary hardware and OpenFlow hardware would be totally different. The freedom to control proprietary hardware would be very less comparing the other one. This programmable hardware allows enterprises to control the entire network through a single centralized controller which gives more power and freedom to update, and modify the code inside it. This change in technology will definitely bring in a huge change in the networking work style.

The major protocols of Internet were developed in the early seventies. The grand success of most of them made it remain as it is even after five decades. The capacity of

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networking is expected to grow day by day. Today everyone expects wireless, accurate, power saving, small equipments with high efficiency. Day by day the requirements are changing. The regular proprietary hardware's are not able to satisfy these changes in their software but programmable hardware's can overcome these changes easily.

Software Defined Networking currently functioning in the form of OpenFlow gives us an amazing opportunity to use an alternative computer network, enabling the design and deployment of a future Internet. This can also be a factor of change and reflection in the major commercial telecommunication sector. SDN redefines the functionalities and opportunities of network devices that are involved in the communication system. It also helps to make a link between the software that controls the hardware, and the network hardware which is not proprietary in nature and can be programmable. This programming possibility makes it flexible as well as predictable in reality. This scalable network in existence can help administrators to a large extent. The past few years of research shows that SDN is a booming technology with high expectations and research openings. Some of the major research challenges include controller failure issues, load balancing of controllers, fault tolerance issues, and network scalability.

Management plane: Human time scale

Control plane: Distributed algorithms

Data plane: Packet streaming

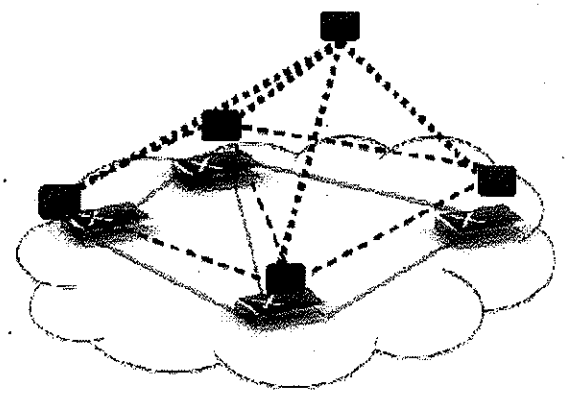

Figure 1: Traditional Computer Networks

In a small period of time SDN became the hot topic both in industry as well as academia. There are a few very important demands which are expected from SDN, those include performance perfection, scalability of the network, stable controller and availability.

II. Details of SDN

In SDN approach to networking, the control is decoupled from hardware and given to a software application called a controller. SDN is mainly used to make clarity in its elements. These elements are called the "control plane" and the "data plane". SDN is successfully able to manage and implement a system which makes decisions concerning how and where traffic is sent from the underlying system that forwards traffic to the selected destination. Here the first one is known as control layer and the second one is known as data layer. The inventors and vendors of these systems claim that this technology simplifies networking and enables new applications, such as network virtualization in which the control plane is separated from the data plane and implemented in a software application.

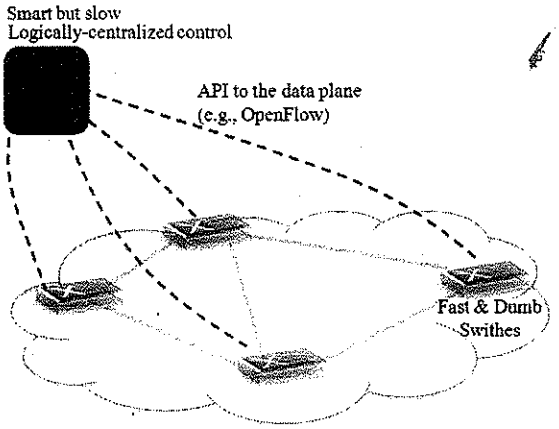

Figure 2: Software Defined Networks

This SDN architecture allows network administrators to have programmable central control of network traffic without requiring physical access to the network's hardware devices. SDN can be taken as the future technology for Internet.

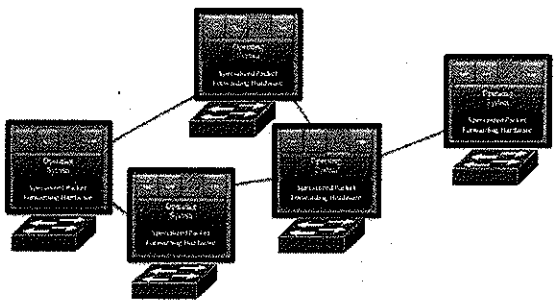

Figure 3: Traditional Networking system

The major drawback of this traditional system is that it cannot dynamically change according to network conditions. This makes an additional burden for the network administrators. There is no control plane abstraction for the entire network. This situation can be related to very old situation of us where there was no stable operating system for the computers. The controlling power and options were very limited. The entire hardware was supposed to replace for a simple additional function. There wasn't any provision for updating the software. But today all of us are blessed with enough options of operating system customization provisions. This is almost the same with SDN. This gives network administrators more managing capabilities which was earlier embedded inside a switch and was not reachable to ordinary people, is now made possible.

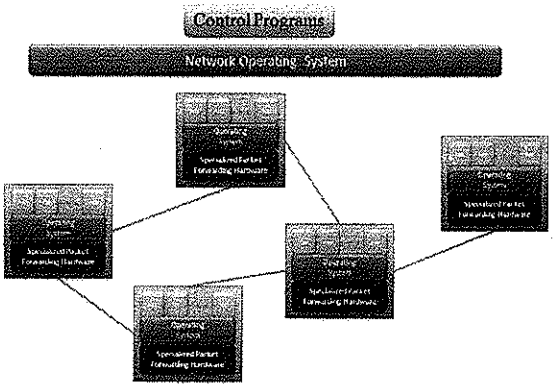

Figure 4: An operating system for network system

So there will be an operating system for the network. This will separate the control from the individual devices and make a data plane and a separate control plane. This will make the hardware just a basic equipment. So the main aim was to have a standardized software control interface that speaks directly to hardware and the whole network will behave like a big independent network model.

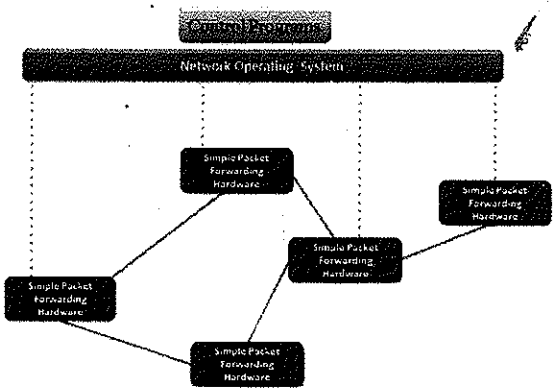

Figure 5: An operating system for network system

Network management [1] is a challenging problem of wide impact with many enterprises suffering from significant monetary losses that can be of millions per hour, due to network issues, as downtime cost. The SDN [2] approach is a new paradigm that enables the management of networks with low cost and complexity. It also allows a more flexible management of network infrastructures, whose resources may be operated by means of a well defined programming interface. SDN is reshaping the future of computer networks by decoupling control and data planes. The control plane is composed by an Operating System and applications that run on top of it. The forwarding plane contains the switches, routers, and other network equipment. Nowadays, inter-domain routing system shows some critical problems, mainly due to its fully distributed model. Recent research has showed that it would be beneficial to apply the SDN approach to address some of those problems. Several approaches have been recently proposed to implement the SDN concept.

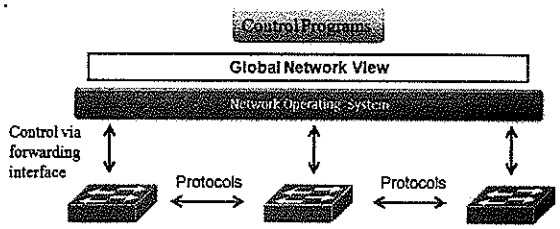

Figure 6: SDN an operating system for network system

There are some basic features which differentiates SDN from conventional networks like the separation of control from forwarding plane. There are many attracting features of this decoupling. Mainly data and control plane components can advance independently, as long as we define a standard API between the two.

III. Network Setup

As a part of the research a virtual SDN network environment has been set up, which includes:

1. **Mininet simulator:** Mininet simulator helps to create a realistic virtual network, running real kernel, switch and application code, on a single virtual machine. Eg: In seconds it creates Controllers, Switches and Hosts with a single command: *sudo mn.*

Figure 7: Mininet creates a virtual network with *sudo mn*

2. Oracle VM VirtualBox: is a cross-platform virtualization application.

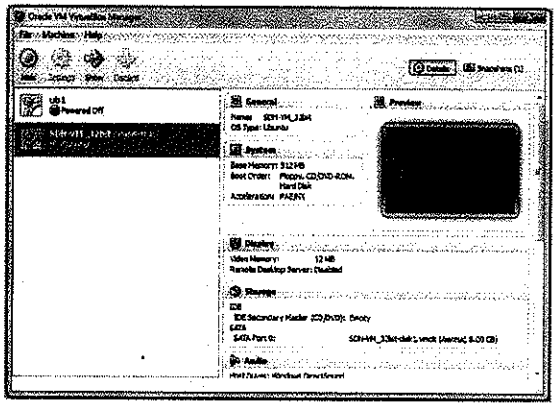

Figure 8: Oracle VM VirtualBox

3. Xming: It allows one to use Linux graphical applications remotely. Along with this one must also install PuTTY.

4. PuTTY: It is a free and open-source terminal emulator serial console and network file transfer application.

IV. Discussions

The interest towards software defined networks is rapidly growing and it has already been adopted in different hardware equipment manufacturing. This motivates us to contribute our sincere efforts towards the improvements in the area of study of SDN technology.

Decoupled data and control planes in SDN can have different topologies. Software-defined networking adds a level of flexibility that can accommodate network programming and management at scale. Traditional networks have previously failed in this area. Current attempts in this direction are very promising, even though many challenges remain for the future.

Here we have discussed techniques [6] for implementing open, logically centralized, network control, and OpenFlow like control over the forwarding plane of proprietary equipment. We show that the barrier to entry by organizations may be alleviated by offering options for transitioning from a network with proprietary setup, to an all SDN network with custom control applications without the need for a costly network wide upgrade of equipment. In addition, we discuss that technologies that have been in network equipment can be used to realize similar functionality to many of the new OpenFlow extensions proposed recently.

Worldwide [9] mobile network operators are spending billions to upgrade their own network to the latest standards for wireless communication of high-speed data for mobile phones. This is in contrast with the decline in average revenue per user and threatens (1) their profitability and (2) the fast adaptation of new standards. Investigating new mechanisms that can decrease the capital expenditures and operational expenditures of a mobile network is therefore essential. Enabling multiple mobile network operators on a common infrastructure is one such mechanism. Here users will get an insight on the relative cost savings that a mobile network operator can reach through Software Defined Networking (SDN) and network sharing.

The techno-economic analysis of some of the studies [9] indicates that SDN and virtualization helps to reduce the expenditure in many cases. As a consequence, mobile network infrastructure virtualization through the use of OpenFlow could be one of the problem solvers to tackle

the issue of rising costs and decreasing profitability. Still, we did not take into account the direct effect on operational expenditures and the indirect effect that network sharing can adversely affect the ability of the operators to differentiate themselves.

Network management is a challenging problem of wide impact with many enterprises suffering from significant monetary losses that can be of millions per hour, due to network issues, as downtime cost. The SDN approach is a new paradigm that enables the management of networks with low cost and complexity. It also allows a more flexible management of network infrastructures, whose resources may be operated by means of a well defined programming interface. SDN is reshaping the future of computer networks by decoupling control and data planes.

The SDN architecture consists of a control plane, a forwarding plane and a protocol that enables communication with both planes. The control plane is composed of an Operating System and applications that run on top of it. The forwarding plane contains the switches, routers, and other network equipment. Nowadays, inter-domain routing system shows some critical problems, mainly due to its fully distributed model. Recent research has showed that it would be beneficial to apply the SDN approach to address some of those problems. Several approaches have been recently proposed to implement the SDN concept.

This area of study includes various issues, challenges and opportunities and solutions to the various SDN related developments. On the various stages of development enough effort will be taken to propose a new improved method of implementation of SDN technique.

There are three characteristics of SDN distributed systems that are universally desirable:

Consistency, meaning that the system responds identically to a query no matter which node receives the request (or does not respond at all);

Availability, i.e., that the system always responds to a request (although the response may not be consistent or correct); and

Partition tolerance, namely that the system continues to function even when nodes or the communications network fail.

At the other extreme is OpenFlow, it stresses consistency. The controller acts as a global database, and specific OF mechanisms ensure that a packet entering the network is handled consistently by all switches. OpenFlow also attempts to provide high availability, with mechanisms for handling the first packet of a new flow, and popular test suites examining scalability and availability.

OpenFlow is one of the most prominent SDN components, having been supported by several device vendors.

V. Conclusion

The interest towards software defined networks solutions is rapidly growing and they have already been adopted in different hardware equipment manufacturing.

In future, the potential of SDN can be used in various sectors including networking, engineering, hardware designing, and education. Application performance enhancement, optimizing capital expenditure and operational expenditure, simplicity and operational agility makes SDN a winning solution for networking enterprise customers in the upcoming years.

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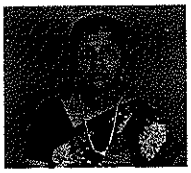

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