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A COMPRESSIVE SURVEY ON SDN

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Abstract: Today's network are quite static, dedicated to single services and slow to change. With the increasing demands of application users and business user the traditional network is lacking the ability to fulfil the requirements. Software Defined Networking (SDN) is the answer to these problems. SDN is a network in which numbers of services can be handled in a dynamic fashion allowing to consolidate multiple services on one common infrastructure for both services providers and carriers. 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. This paper review what is SDN, its need, architecture, implementation and challenges of SDN.

Keywords: Software Defined Networking (SDN), Open flow Switch, Open flow Protocol, SDN Models, Control Plane, Data Plane, SND Principles, SDN Applications.

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INTRODUCTION

From last few years the use of internet has increased rapidly. Which has led to increase of network devices, s/w and h/w requirements and complexity in the networking environment. The traditional network face a lot of problems to cope with 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 became 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. The control plane is logically centralized. The goal to logically centralize the control plane is to give the global view of whole network environment. This feature of globalization of network easy the network administrator to look at the network and take the decisions. (In short we can say Software Defined Network paradigm is an emerging technology in the field of networks which will give deal with the current problems being faced in the network world.

Rest of the organization of paper is as follow: section II discuss the need of SDN. Section III background. Section IV gives brief introduction of models and the detail structure of SDN paradigm, basic principles and features. In section V, Challenges and issues are outlined. In Section VI the present state of art in detailed. And at last Section VII concludes the paper.

NEED OF SDN

Today's network is expanding day by day to meet the needs of application users and the business users. It is becoming huge every day. The network support number of services varying from simple text messages to multi-media services. Several users opt number of services. This increase complexity and create traffic in the network. As a result, things gets messy and become hard to be managed. Time taken to provision network services to new applications, unlike other parts of IT , making changes to network is still a manual process. When an application is rolled out the administrator have to manually reconfigure device on network command line interface. Manual configuration adds hours and sometimes days to accomplish

this task. The dynamic changes to network cannot be done to accommodate new applications. Today's network is very complex. The visibility is limited to implement universal changes that expand from user to applications. The solution to all these problems is SDN.

Traditional Network: The traditional network is static in nature, slow to change and dedicated to single services. The current network have data plane and control plane both contained within simple physical system. The job of data plane is to handle packets in line based of information stored in tables. Execution of instruction in data plane originates in control plane. The control plane is sometimes referred to as the network node brain. Network uses control plane to communicate with other nodes in network. So, control plane handles the complexity. The control plane determine how individual packets should be handled and push this information down to fastest path in data plane. In traditional network the flow of data is managed and controlled by the networking devices i.e. routers and switches. The traditional network architecture is static in nature. Users don't have freedom to control the packets. The data plane has to carry the packets physically node to node following certain protocols, the control plane contains logic that the devices are using to forward the packets. After comes the management plane that act as the administrator.

The network administrator is management plane here. Now the administrator have to keep track of whole network. As discussed above more the complex network more difficult it will be for administrator to manage and control the network.

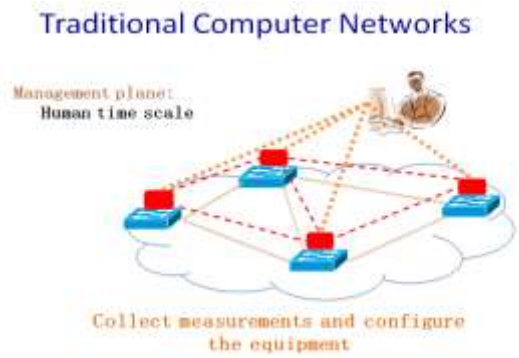

Figure 1: Traditional Network[13]

The answer to all the problems is the Software Defined Network. SDN takes a complicated network and separates the control plane from data plane. And gives a network that is simple.

Addition to, gives visibility to real time responses. We can bring in programmability to dynamically change how network response to business needs.

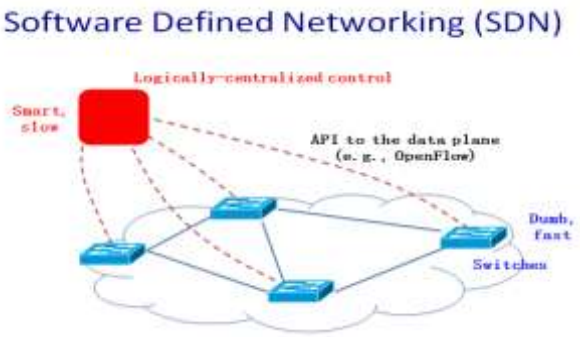

Figure 2: Software Defined Network [13]

In the figure 2 it is clear that the control plane is separate and is centralized. Now the network administrator need not to access every node individually. Instead, he has a global view of whole network and can easily maintain and configure the nodes.

MODEL OF SDN

There are number of models proposed for SDN. A brief introduction of these models is given as: Network Virtualization Model: [1]The most important goal of network virtualization is to get rid of restrictions on LAN partitioning that resides in Ethernet Virtual LAN standards and solve the issues like scalability & multicasting in the network architectures.

Evolutionary Model: [1] Evolutionary model objective is to maximize software control within the boundaries of network topologies. Open Flow Model: model on which he SDN work is the Open Flow model.

Structure of SDN

Basic idea of SDN paradigm is to separate the control plane and data plane. The data plane is the packet forwarding plane. 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:

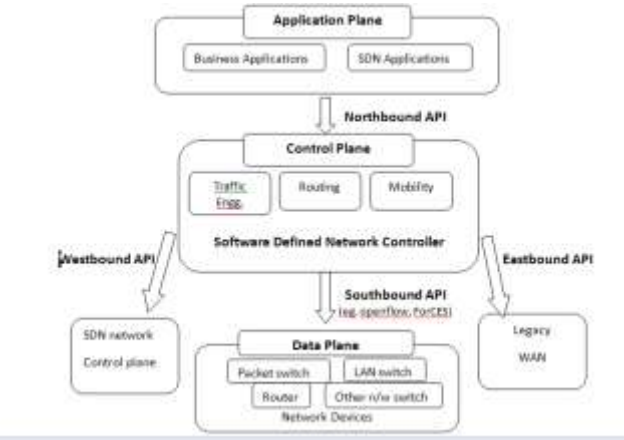

Figure1: Architecture of Software Defined Network

Software Defined Network consist of our key interfaces. These interfaces are illustrated in figure1.

Southbound-API: The interface between data-plane and the control-plane is the southbound-API. Different protocols available for this interface to make communication between the data and control plane. Some examples of Southbound-API protocols are Openflow, ForCES, I2RS. OpenFlow is the standard protocol. In this letter I am going to give detail of OpenFlow protocol.

Northbound-API: SDN exchange information with the applications running on the top of network via northbound-API. The northbound-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: The westbound-API act as a communication path between Software Defined Control planes of different network domains. This interface allows the exchange of information between the networks related to routing decisions. 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. The implementation of this interface depends on the technology used in the non-SDN domain[3]. Since this interface communicate with a non-SDN domain, so translation between the legacy network and 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.

Basic Principles of SDN

The software defined network work on the four basic principles. These are

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. [3]It put forward the externalization of control plane from a network device to an external control entitiy called "controller". This gives benefit to the company having no necessary expert knowledge in both of the fields.[3] The externalization of a software-based controller puts pressure on traditional hardware switch vendors, which are reduced to providing forwarding hardware only.[3] This has already introduced new and disruptive start-ups to the market that have sped up innovation in the network.

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.

That is the interface between the data-plane and the control-plane. Different protocols available for this interface to make communication between the data and control plane. Some examples of Southbound-API protocols are Openflow, ForCES, I2RS. OpenFlow is the standard protocol. In this letter I am going to give detail of OpenFlow protocol.

ISSUES AND CHALLENGES IN SDN

The challenges that the SDN faces in its evolution are classified as:

1. Separation of Control plane and data plane: Since control plane is separated so an appropriate protocols should be choosed from available protocols and appropriate forwarding elements.

2. Open Interface: Maintenance of open interface can be a challenging because different vendors might send proprietary information on Network via open interface. This might generate additional values if the things of same vendors are used which affect the performance and can may also lead to deadlock.

3. Logically Centralized Control: The understanding of logically centralization of controller challenging for network vitalization, scalability and depending on specific scenario.

4. Migration of current network to SDN: the migration of traditional network to the SDN technology is the biggest challenge in the development of SDN. Since many of the vendor devices may not be able to cope with the SDN devices. So a lot off work is to be done in this area.

5. Maintenance of SND Controller: Because SDN controller is centralized is maintance become more critical. If man controller fail whole network will collapse. As in traditional networks, if one networking device failed other device take control of the failed device to make smooth working of network environment.

Applications of SDN:

Support to Big-Data: Database perform thousands of queries at a time and are now real-time and distributed. Is has been suggested that volume of data will be increasing 10 times or even more in the coming years. The companies are moving to the concept of big data to manage their huge amount of data. The current network is not fitting to support these features of Big Data. Solution to this problem is the SDN.

Internet of Things: The Internet of Things (IoT) is the most emerging topic in the field of IT. IoT works on heterogeneous domains. These different domains can be easily implemented in the SDN paradigm.

Service Provider –SDN: SDN also have an application in cross domain service innovation by proposed architecture of Service Provider-SDN.

In wireless and Optical Networks: SDN is also gaining popularity in the optical and wireless network. SDN enables high bandwidth, error correction, efficient traffic management, flexibility, data security and efficient resource utilization. Critical issues like traffic management are easily handled by SDN network.

Network Virtualization: SDN has contributed to network virtualization, which provides isolation, abstraction and shearing of resources in the network environment.

CONCLUSION

The Current network architecture is unable to cope with the increasing demands of application and business users. This paper give a brief introduction about the limitations of traditional network. 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 world. For example Big-Data, IoT, NFV etc.

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