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An Impression of Software Defined Networks and OpenFlow for Beginners

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Abstract

Software defined networks (SDN), which is a new technology that is used for building new network and uphold the same. It divides the control from hardware parts and puts the control towards the software, which is referred to as Controller. Software defined network which is used for managing the traffic in the network and also to make priority to the packets which is forwarded in the network layer. We can define and regulate the switch for packet transfer. OpenFlow is the primary protocol used for communication and control of routing. The main advantage of SDN along with OpenFlow is that it can be used in dynamic networks.

Keywords: *Software Defined Networks, OpenFlow, Northbound API, Southbound API, ForCES.*

1. Introduction

Software defined networks (SDN), which was developed due to the work of UC Berkely and Stanford university in the year 2008 but got familiar in the year 2012, is an architecture where software programs play a major role in deploying and managing traffic in networks by using application program interfaces (APIs). An example of such interface is OpenFlow. The objective of SDN is to allow network engineers and administrators respond quickly to changing business requirements. The network administrator will shape the traffic in SDN without physically touching the switches and routers. SDN which has two main characteristics: the first feature which is that the SDN will separates the control plane and data plane. The second feature is that to SDN strengthen the control plane for controlling multiple data plane elements with a single software control program. Control plane which is used for express the way for handling the traffic in the network. Data plane which is used for ahead the traffic according to the assessment of the control plane. The intention of SDN is that to create a network which is flexible, simple to control, operate in dynamic and altering applications. With SDN the network administrator can adjust the traffic by specifying the rules for packets, example of such rules are: prioritizing for the packet, blocking certain packets. The brain of the SDN is known as controller, which is a device that helps in finding the best path in a network for each applications and it programs the forwarding actions of the switches. The device can be a virtual machine or a physical server. SDN programs can be used in many applications such as dynamic controller, load balancing in servers, energy efficient networking.SDN which is similar to early telephony networks that decoupled the control plane and network plane but with few added service.

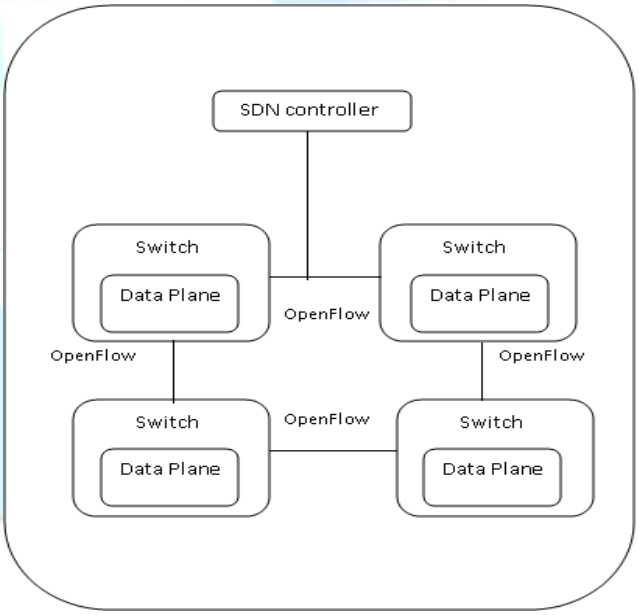

Fig. 1 SDN controller and Data Plane communication using OpenFlow

2. Need for SDN

Traditional networking operation which has tight coupling between control plane and data plane, so that network administrator wants to organize each component manually

for monitoring the network, routing and for controlling the traffic. Due to the modern server virtualization process most of the IT industries are switching from one server to another, this process needs each individual component to configure individually. Each network contains of thousands of component and this operation will slows the modernization approach. Traditional networking which has the few shortcomings such as it contains of heterogeneous switches, routers that works in distributed manner will lack in providing reliability. Traditional networks have increased the operational and deployment cost. Due to the increasing usage of internet, we are in need of new technology for effective utilization of network and its components .The ultimate solution to solve these problems is software defined networks (SDN). The other needs for SDN are users are changing to "Cloud" environment and they tend to use "Big data", these increases the utilization of bandwidth.

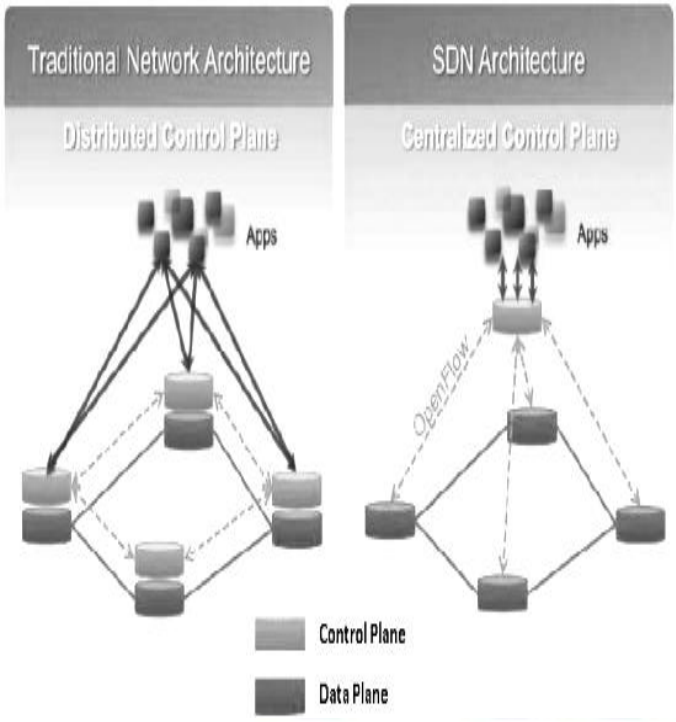

Fig. 2 Traditional vs. SDN network

3. Pro and cons of SDN

A network is just a computer with specialized hardware. It needs software to tell the hardware to do a task, so there is no specific name for providing software defined networks (SDN).

Few benefits of SDN are:

1. Automation of common tasks.
2. Low operational cost.
3. Flexibility.
4. Reduces operational time.
5. Infrastructure cost saving.
6. Easier to design, deploy and scale.

Some issues in SDN:
Security, integration with existing system and with centralized controller for real-time decision-making in software simply won't scale to meet the demands of growing networks.

4. Openflow protocol

Forwarding and Control Element Separation (ForCES) was created by the Internet Engineering Task Force (IETF). ForCES is used for contacting between controlling devices and other devices. We have virtualization technique for solving the traditional problem but when considering server virtualization, it is limited to 4000 VLANs in layer-2.Open networking foundation (ONF) which is a non-profitable organization which created OpenFlow. OpenFlow is an example of API. One of the advantages of OpenFlow protocol is that it contains of multiple feedbacks for increasing the accuracy of the network. Openflow is a layer2 technique. OpenFlow is a protocol used to program the table in different flow for routers and switches. The difference between ForCES and OpenFlow is that the architecture of the network is unchanged in ForCES but it is changed in OpenFlow. Currently OpenFlow1.3.0 is proposed which contains of few advantages such as controlling rate of the packets via flow basics and additionally cookies are added to each packet.

5. Openflow switches

The main elements of openflow are:
Flow table, Group table, Controller and OpenFlow.

4.1 Flow table

Flow table which is installed on switches, will act according to the entries in the table.

Match Fields	Counters	Instructions

Fig. 3 Components of Flow table.

Match fields:
Match fields are used for making matches against packets. These consist of the ingress port and packet headers, and optionally metadata specified by a previous table.
Counters:
To update for matching packets
Instructions:
To modify the action set or pipeline processing

4.2 Group table

Group table is responsible for packet forwarding.

Group Identifier	Group Type	Counters	Action Buckets

Fig. 4 Components of Group table.

Group identifier:
A 32 bit unsigned integer uniquely identifying the group
Group type:
To determine group semantics
Counters:
Updated when packets are processed by a group
Action buckets:
An ordered list of action buckets, where each action bucket contains a set of actions to execute and associated parameters.

4.3Controller

Controller obtains the use of openflow protocol for path setup via network and tracking of switches.

4.4 OpenFlow

Openflow carries the message between SDN controller and hardware components.

Controller manages the flow table's entries (add, delete, update) with the help of protocol. The characteristics that are used for identifying the path include number of hops, speed, etc. These devices will communicate with other devices directionally with the help of application program interfaces. There are two API directions in networks which include:

1. **Northbound APIs:**
   These APIs, allow the network components to communicate with higher level components. In SDN, this API is used for interfacing between the controller and to the services which are all requested to manage the network. Some of the applications include data management, routing, path identification and automation.

2. **Southbound APIs:**
   These APIs, allow the network components to communicate with lower level components. In SDN, the OpenFlow protocol is used as southbound APIs which uses commands for data forwarding, topology identification depending upon the order of northbound APIs.

4.5 Applications of OpenFlow

The application areas where these Openflow can be used are:

1. Network management.
2. Network virtualization.
3. Data center virtualization.
4. Wireless applications.
5. Wide area network applications.
6. Routing.
7. Network congestion control.

6. Conclusions

As the network's state is transforming from static to dynamic, we have to move towards a new network era for compensating the issues in the traditional network. SDN

will help the users for solving these issues and will become the new technology that going to change the routers and switches concept in the network security books. Even it is not easy and also it will take time for the adaptation of SDN by all. Mean while it also has to improve a lot in the security and integration. This new application has positive points to use such as reduced cost and time also. With SDN it is possible for an IT staff to handle servers and networks with a common approach to provide a network with improved scalability, and manageability.

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