www.ijsrnsc.org

Available online at www.ijsrnsc.org

IJSRNSC

Volume-1, Issue-2, June- 2013
Review Paper

Int. J. Sci. Res. in Network Security and Communication
ISSN: 2321-3256

Review: Software Defined Networking and OpenFlow

Mandar B. Shinde[*1], Sunil G. Tamhankar[2]

[*1]*Department of Electronics Engineering, Walchand College of Engineering, Sangli*
[2]*Department of Electronics Engineering, Walchand College of Engineering, Sangli*

Received: 20 May 2013 | Revised: 25 May 2013 | Accepted: 18 June 2013 | Published: 30 June 2013

Abstract— This review paper explains Software Defined Networking (SDN), wherein control and forwarding planes are detached, shifting all the network intelligence to a server (SDN controller) to make a logically centralized network infrastructure. Open Flow protocol is the communication interface between control and forwarding plane. It allows researchers to experiment their abstractions in heterogeneous environment in a uniform way at line-rate and with high port-density; while on the other hand, manufacturers need not reveal the interior design and operations of their switches. Open Networking Foundation (ONF) community is encouraging different vendors to introduce OpenFlow in their products and elevate networking related innovations in world-wide college campuses.

Keywords- Software defined networking, OpenFlow, Virtualization.

I. INTRODUCTION

Rapid growth in mobile communication, server virtualization and cloud services has made present network infrastructure unfit to fulfill all their needs. Conventional networks are more suitable for client-server computing, but are inadequate when dynamic computing and today's storage needs are thought upon. The requirements of cloud computing and massive data centers have added to the complexity of the networks.

Many users seek to retrieve the corporate content and application connecting from any location, from any device and whenever they want, which makes traffic pattern change all the time. As a solution to this, people have started using public or private clouds which added extra traffic across the networks. Manipulation this huge amount of data needs thousands of servers, connected to each other, to be parallelized, which in turns add to the datacenter overheads to scale the network, maintaining the connectivity.

Increased complexity has made networks more static as IT is looking to avoid any interruption in services. With every new connection activated in network, it needs to reconfigure Access Control List (ACL) within whole network. At this level of complexity, it is very difficult to add or relocate any device in the network and this does not meet present server requirements, which are more or less dynamic in nature.

Another disadvantage of complex networks is- it is very laborious to append consistent set of policies, security and QoS, which leads to exposure of Enterprises to cyber-attacks and other unpleasant outcomes. [1]

II. SOFTWARE DEFINED NETWORKING

Traditional switches manage both fast packet forwarding (data or forwarding plane) and high-level routing (control plane) [2]. Software defined networking (SDN) separated control plane from data plane and made it programmable. The control plane now resides in a computer system, encouraging the researchers and network administrator to experiment with the network in a real time traffic environment. Thus, with SDN, static and inflexible networks transformed into programmable networks through flexibility, agility and virtualization.

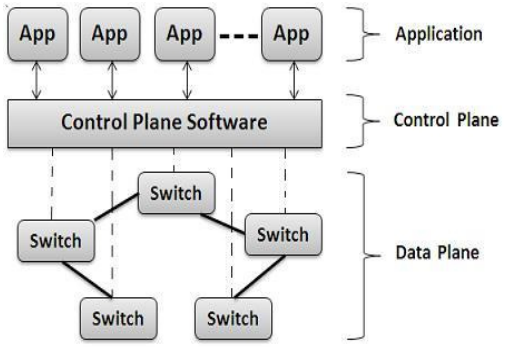


Figure 1. SDN Architecture.

Logical view of SDN architecture is shown in Fig. 1. Control plane is decoupled from data plane and transferred to a centralized software-based SDN controller. Every data-path element (like switch) is connected to this controller, thus entire network appears to be a single logical switch to the application layer. With SDN, Enterprises can manage the entire network from a single SDN controller, irrespective of different vendors of network elements. With this platform, network administrator can get a unified view of the entire network on their controller empowering better management, security and other capabilities. [1] [2]

Most importantly, network administrator can write their own code, deploy it in their hardware and make the network behave as they wish. Using centralized controller,

Corresponding Author: *Mandar B. Shinde*

one can alter network behavior in real time and deploy new services, policies and applications in short span of time. Also, with centralized nature of the network, SDN offers managers freedom to configure, administer, safeguard and optimize network resources through their own programs. They need not always depend on vendors to embed certain features into the hardware, they can write their own piece of code and deploy it anytime, bypassing vendors' closed software environments.

III. OpenFlow

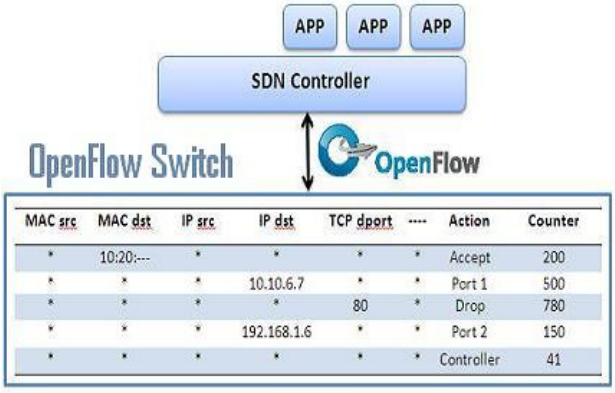
OpenFlow is the common interface between control plane and data plane of SDN architecture. It is a standard way using which a SDN controller can directly access and control forwarding plane residing in network boxes (like Network switches and routers). OpenFlow provides a means to add, modify or remove flow entries in flow table of network boxes (as shown in Fig. 2) and thus encourages network researchers to control the traffic over the portion of network. Although flow table structure varies from vendor to vendor, some functions such as QoS and traffic reporting are common to all; OpenFlow has standardized these common features. [3] [4]

A flow entry has three fields-

- A packet header, which decides how the packets are going to be routed.
- An action, which specifies what should be done with the packet flow.
- A counter, which denotes number of packets processed in each flow.

These flow entries contain actions associated with the packet flows; the fundamental ones are:

- Forward the packets to a specified port. This helps to route packets through the network.
- Drop a particular traffic. It is useful in security related applications where denial of service is required.



MAC src	MAC dst	IP src	IP dst	TCP dport	....	Action	Counter
*	10:20:---	*	*	*	*	Accept	200
*	*	*	10.10.6.7	*	*	Port 1	500
*	*	*	*	80	*	Drop	780
*	*	*	192.168.1.6	*	*	Port 2	150
*	*	*	*	*	*	Controller	41

Figure 2. Idealized OpenFlow Switch

- Encapsulate and forward the packets to the controller. This is normally related to very first packet of the flow, where it is necessary to define the rule for that particular flow.
- Forward the packets through switch's normal processing pipelining without taking any action. [3]

Since OpenFlow provides a standard platform to manipulate flow entries, an OpenFlow-based SDN architecture offers extremely detailed control, which makes the network capable to react to real-time changes at the application, user, and session levels.

IV. Benefits and Drawbacks

A. *Benefits*

- SDN has detached control plane load from the network devices allowing them to focus on forwarding and routing processes, enhancing traffic speed within networks.
- Using virtualized network management, OpenFlow helps to construct networks with less cost.
- Network administrator need not manage each switch individually, with SDN, they can control entire network at once, as if it is a single switch. [5]
- SDN motivates researchers to test their innovations in real time traffic scenario, which would have gone untried if there was no SDN technology.
- Administrators can keep their eyes on overall traffic which help them to easily deal with network intrusion detection.
- ONF's Urs Hoelzle said, OpenFlow also lets administrators prioritize different types of traffic and develop policies for how the network handles congestion and equipment problems. [6]
- OpenFlow fulfills the demands of cloud computing where smarter networks are required to co-ordinate number of network components together.

B. *Drawbacks*

- As SDN relies on centralized network management, it adds to administrators' worries regarding server (controller) security. If by any means server gets hacked, then whole network becomes more prone to be attacked.
- "OpenFlow will fit where you need less security," said Bill Seifert, chief technology officer of Avaya. [1]

V. Conclusion

OpenFlow switches support both software-based forwarding and conventional forwarding. It supports the enterprises to promote SDN technology continuously even in multi-vendor environment. The OpenFlow protocol is a key part in software-defined networks and presently is the only standardized SDN protocol which permits direct programming of the forwarding plane of network devices. SDN architecture, along with OpenFlow, allows researchers to program their own slice of network and govern it in their own way. In the near future, we may see utilization of SDN technology in datacenters, cloud systems and even in Internet to sustain tomorrow's heavy network loads.

References

[1] Open Networking Foundation, "Software-Defined Networking: The New Norm for Networks," *ONF White Paper, April 12, 2012.*

[2] Vaughan-Nichols S. J., "OpenFlow: The Next Generation of the Network?", *IEEE Computer Society, Vol. 44 (8), 13-15 (2011).*

[3] McKeown N., Anderson T., Balakrishnan H., Parulkar G., Peterson L., Rexford J., Shenker S., and Turner J., "OpenFlow: Enabling Innovation in Campus Networks," *ACM SIGCOMM Computer Communication Review , Vol. 38(2), 69–74 (2008).*

[4] (2012). Pitt D. Introduction to OpenFlow and Software-Defined Networking. [Online]. Available: https://www.youtube.com/watch? v=5-pLO4MZU3o

[5] Limoncelli T. A., "OpenFlow: A Radical New Idea in Networking", Communications of the ACM, Vol. 55(8), 42-47 (2012).

[6] (2012). Hoelzle U. Keynote speech at the Open Networking Summit. [Online]. Available: http://www.youtube.com/ watch?v=VLHJUfgxEO4.

