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Review

Software defined networks: A survey

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ABSTRACT

As a result of the development of internet and ICT (information-centric technology) advances including mobile, cloud, social networking, big data, multimedia and the tendency towards digital society, the management and configuration of them have become highly complex, challenging and time consuming. Also, access to high bandwidth, extendibility and dynamic management are of critical significance, especially when network devices are vertically integrated. Hence, a set of unique predefined line commands and operating systems or firmware should be used. SDN (software-defined networking) is a structure designed for simplifying and improving network management with high flexibility by splitting control plane and data plane. Thus, network programmability is enhanced which in turn leads to more innovation opportunities. Although SDN is regarded as a new research issue, it has attracted numerous researchers' attention from both industrial and academic institutes. In this paper, data plane, control plane and application plane as the three planes of SDN and the interfaces between them such as OpenFlow are investigated and the challenges and the latest technologies in relation to SDN are examined. The investigation and overview of SDN reported in this paper might be used by the interested future researchers to better understand and apply SDN in real-life applications.

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1. Introduction

As a result of the development of internet and ICT (information-centric technology) advances including mobile, cloud, social networking, big data, multimedia and the tendency towards digital society, the management and configuration of them have become highly complex, challenging and time consuming. Also, access to high bandwidth, extendibility and dynamic management are of critical significance, especially when network devices are vertically integrated. Hence, a set of unique predefined line commands and operating systems or firmware should be used. SDN (software-defined networking) is a structure designed for simplifying and improving network management with high flexibility by splitting control plane and data plane. Thus, network programmability is enhanced which in turn leads to more innovation opportunities. Although SDN is regarded as a new research issue, it has attracted numerous researchers' attention from both industrial and academic institutes. In this paper, data plane, control plane and application plane as the three planes of SDN and the interfaces between them such as OpenFlow are investigated and the challenges and the latest technologies in relation to SDN are examined. The investigation and overview of SDN reported in this paper might be used by the interested future researchers to better understand and apply SDN in real-life applications.

Internet structure and computer networks usually consist of different network devices such as router, switch and different types of middle-boxes which are vertically-integrated and designed by chips and ASIC (application-specific integrated circuits) with high throughput and a specific function. For managing and configuring such network devices, a set of specific and predefined line commands based on embedded operating system is used. Hence, it can be argued that managing a large number of network devices is a big challenge which is prone to many errors. Thus, traditional networks are hardware-centric which suffer from significant shortcomings regarding research and innovations, reliability, extensibility, flexibility and flexibility and manageability. Since internet and mobile networks develop and new technologies such as cloud, social networking and virtualization emerge, the need for networks with higher bandwidth, higher accessibility and dynamic management is becoming a critical issue.

For solving the problems and limitations of traditional networks, a structure, known as SDN, was proposed where network control is split from the forwarding mechanism and it can be programmed and controlled directly. SDN uses a controller which is logically centralized and has a global view towards the network and several simple packet forwarding devices (SDN switches) are controlled and configured through interfaces such as ForCES and Open-Flow. SDN switches are made up of one or more forwarding tables which are controlled by the centralized controller. In other words, they are controlled and programmed in the control plane. Using this mechanism, software developers can easily control network resources. Also, packets are handled by forwarding tables. That is, with respect to the policies accomplished by the centralized controller on forwarding tables, SDN switches can operate in the same way as router, switch, NAT, firewall, etc. Splitting control plane and data plane simplifies the management of modern networks and provides the opportunity for more innovations. As a result, researchers can test and investigate their own ideas and evaluate the results. Since SDN plays significant roles in modern internet structure and ICT technology, it has attracted researchers' attention.

SDN structure consists of three main parts. At the lowest level,