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Software based Virtual Router Platform as a Super-peer in Software-Defined Network

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Abstract

SDN is a future-oriented network for efficient network management, which decouples the control plane and the data plane. A typical example is OpenFlow. OpenFlow is a standard protocol that operates between the controller and switches, which is a new method for controlling flows in a network. But, OpenFlow has a big challenge about some overheads between the controller and switches. In this paper, we discuss the challenge of OpenFlow based on the overheads between the controller and switches. We also show that software based virtual router platform that named XEBRA can address this challenge.

Keywords: Xen Hypervisor, OpenFlow, SDN, Super-Peers

1. Introduction

SDN(Software-Defined Network) is a new approach to designing, building and managing networks. The basic concept is that SDN separates the network's control as Control Plane and forwarding as Data Plane to make it easier to optimize each. A typical example is OpenFlow[1]. OpenFlow is a standard protocol that operates between the controller and switches, which is a new method for controlling flows in a network. OpenFlow defines a standard for sending flow rules to network devices so the control plane can add them to the forwarding table for the data plane. OpenFlow is one of the most suitable methods for implementing SDN, but there is still a challenge like reducing the centralized overheads. SDN controller performs all of control plane functions, including running the control plane protocols that connect with the outside world[2]. When the OpenFlow switch receives unknown packets in the flow table, the switch requests the policy for the packet from the controller via OpenFlow control message using TCP/IP Communication. If massive packets arrive because of the requirements of a Cloud service, the switch frequently contacts the controller to request the policies for each packet so there are major overheads for the controller and the network[3]. Our software based virtual router platform that named XEBRA(Xen hypervisor based Router Architecture)[4][5] can support these challenges as a new hybrid switch and controller with OpenFlow standard and IP routing, or even by using other protocols simultaneously. In this paper, we discuss the challenges of OpenFlow based on the overheads between the controller and switches. We also show that XEBRA can address these challenges.

2. XEBRA with SDN Architecture

The positions of the XEBRA platform in the SDN are represented as a switch or as a controller with a gateway. The XEBRA is open source so it can provide flexibility and portability. Figure 1 shows the XEBRA gateway with multiple controllers. We implemented a Floodlight[6] controller, which is a well-known OpenFlow

controller in the XEBRA platform. In addition, the XEBRA platform can support any type of controller. The XEBRA platform also has a virtual router to operate generic routing protocol.

The XEBRA platform can act as super-peers in a large-scale network, as shown in Figure 1. Centralized control is definitely a big advantage of SDN in terms of virtual network manageability. However, a distributed system has better performance than a centralized system. The reason why the IP protocol used by routers has been employed for the past 30 years on the global Internet and this routing process works on distributed nodes[3]. Therefore, it is necessary to reduce the overheads.

The super-peer architecture can counteract the deficiencies of centralized system. In Figure 1, the XEBRA platforms are super-peers, which represent SDNs. The SDN controllers that is shown at the top of the figure control these super-peers. The super-peers have a flow table for each SDN. When a controller orders a network policy from the super-peers, the super-peers have the policy and they execute their roles during flow switches. A super-peer manages its own switches. In this architecture, the switches send requests to the XEBRA platform as a super-peer to process unknown packets. This method can reduce the communication overheads. This effect will increase if the network becomes too large. The super-peer architecture is also beneficial for managing large-scale SDNs.

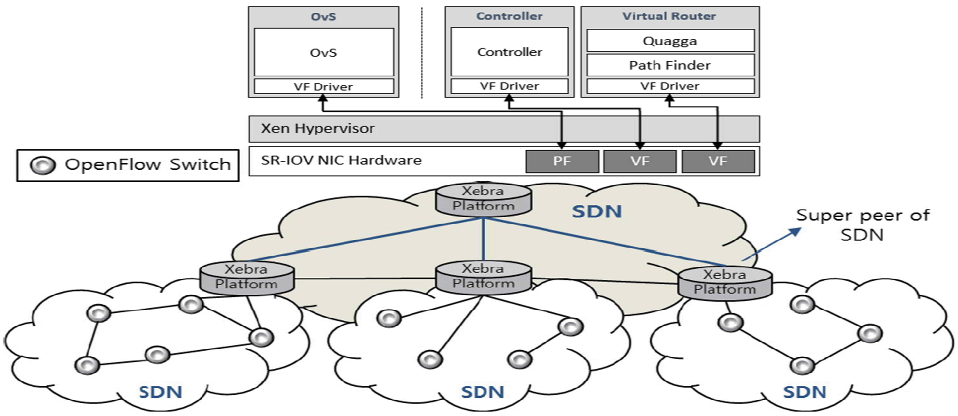

Figure 1. SDN implementation with XEBRA platform as super-peers

3. Conclusions

This paper presented XEBRA with the SDN Architecture for solving the well-known challenge of SDN such as overhead for processing new arrived packets in large-scale SDNs. To show that, we implemented well-known SDN switch and controller in XEBRA. We also introduced the XEBRA platform as a super-peer in large-scale SDNs and explained that the architecture is beneficial for managing large-scale SDNs.

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References

[1] McKeown, Nick, et al. "OpenFlow: enabling innovation in campus networks, "ACM SIGCOMM Computer Communication Review 38.2 (2008): 69-74.

[2] Openflow/sdn is not a silver bullet for network scalability, http://highscalability.com/blog/2012/6/4/openflowsdn-is-not-a-silverbullet-for-network-scalability.html, 2011. 79, 80

[3] J.H. Yoo. Et al. A technical trend and prospect of software defined network and openflow. *KNOM Review*, 15. 80, 84

[4] The Xen Project, http://www.xenproject.org

[5] Shin-Hyoung Lee, et al. “Network Virtualization Techniques for Future Internet” Telecommunications Review 21.3 (2010): 413-424.

[6] Floodlight, http://www.projectfloodlight.org/floodlight/