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Efficient Topology Discovery in Software Defined Networks: Revisited

Dana Hasan and Mohamed Othman*

Department of Communication Tech and Network, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor D.E, Malaysia

Abstract

Software Defined Networks (SDN) is a novel model for networking that is currently becoming an interesting area for research and industry organizations which makes networks more manageable and customizable. In this paper, we investigated OpenFlow Discovery Protocol v.2 (OFDP v2) and compare it with standard OFDP protocol. We also intend to study OFDP v2 behavior and how it works in term of packet retransmission between SDN controller and SDN switches. We mean to show how OFDP v2 works from different perspective. Our experiments show that using OFDPv.2B protocol requires at least one retransmission per each packet which the controller sends out. However, OFDPv.2 still shows better results when it is compared with standard OFDP protocol in term of reducing the number of Packet_OUT messages.

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Keywords: SDN; OpenFlow; SDN controller; Topology Discovery; Packet-Out messages; OFDP.

1. Introduction

Internet has become a life necessity due the indispensable facilitation it provides for mankind. In this network of networks, almost everything is connected to everything and can be accessed from anywhere. Regardless of all the simplification which it can provide, IP networks still need a lot of complexity to build, manage, and maintain. It takes a lot of efforts to configure the network based on pre-set outline and harder to maintain the network to face new changes, network errors, and load variations. In current IP networks, data plane and control plane are bounded together.

* Corresponding authors. Tel. +60389471707
E-mail address: danajaf@gmail.com; mothman@upm.edu.my

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Therefore, it is network management becomes a real challenge, especially large networks. The growth of network and information technology serve the needs for better service in term of quality, availability, and dependability, elasticity, and security [1]. These requirements drastically increased the complexity of networks and current network should be able to support heterogeneous applications, technologies, and multi-vendor equipment, causing the network management to become a challenge. Software Defined Networks (SDN) is the latest networking model with many potentials to further enhance the network abilities in term of simplification, efficiency, management and control. Furthermore, better enhance the innovation rate for the future of technology [2].

SDN becoming an interesting area for both researching and industrialization. They began to put more efforts and investments to better develop it. Through a unified plane, SDN can control the network with different vendor equipment and view an abstract view of the network resources. It provides a simplified and programmable network which can afford better network management and maintenance. Unlike traditional networks which forwarding devices search for the network path, making routing decisions, and running protocols. Also, they forward packets to their next destination. However, in SDN the data plane is separated from control plane. This means that the network has a logical centralized control unit and all the intelligence is removed from network equipment. Logical centralization doesn't mean that the control unit is physically centralized, which leads to single point failure [3,4].

Managing networks in SDN network requires the SDN controller to have fresh information about the condition of the network, especially topology. Therefore, its essential to have reliable mechanism to discover the network topology. The SDN controller should have information about every device in the networks and the connection channels which links them. To keep the service running a almost real-time vision about the topology of the network in an SDN network is mandatory, especially for the large networks. The current protocol which is operated by current controllers is OpenFlow Discovery Protocol which facilitate the topology discovery. However, this protocol lack efficiency issues [5]. It also has reliability issues when applied in large network with heavy traffic. To solve these problems, [2] introduced a novel solution to reduce the load on the network during discovery periods called OpenFlow Discovery Protocol v2 (OFDP v2). They provided two solutions to improve the efficiency of topology discovery in SDN Network called (OFDPv2A) and (OFDPv2B). However, they didn't investigate the protocol in term of retransmission of the discovery packets. In this paper, we have redone [2] work in topology discovery using OpenFlow Discovery Protocol v.2B (OFDP v.2B). We chose to use this particular protocol to put the load of the topology discovery solely on the network controller. We intended to find out about the flow of traffic when the SDN network undergo topology discovery procedure. The empirical analysis shows that our simulation reveals different results patterns when we take retransmitted OpenFlow packets into consideration.

2. OpenFlow

The Internet experienced the virtualization in general way, more specifically, SDN which makes networks customizable and programmable. SDN uses OpenFlow protocol to decouple data plane from control plane in the network and put all the intelligence in a single logical component called controller. The controller manages the network and decides where a traffic flow should go [6]. OpenFlow opens a portal between network applications and network forwarder in SDN environment which grants the controller necessary access to manage and configure the network switches. Other protocols like BGP, SNMP, PCEP, etc are utilized at forwarder's level [3]. Fig. 1 illustrates the structure of SDN networks and its components.

In order to maintain the service, SDN controller should keep updating the information about the network and its topology [2,3]. One of the critical tasks which the controller is responsible for is almost real-time sight of the network topology which is known as Topology Discovery. Compared to legacy protocols which depends on Link State (i.e. OSPF), Topology Discovery in SDN is more critical. All network controllers are using (OFDP) protocol to discovery network topology in an SDN network by using Link Layer Discovery Protocol (LLDP) frames in form of messages [7].