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Implementation model architecture software defined network using raspberry Pi: a review paper

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Abstract

Software defined network (SDN) made with basic concepts that are different from traditional networks in controlling the network, the separation between the control layer and forwarding layer on different devices allows the administrator to adjust the control plan for all devices centralized in one action, while in traditional network, the control and forwarding layers are located in the infrastructure making network administrator must manage devices one by one. Research using single board computers on network technology provides an opportunity to implement SDN architecture. Raspberry Pi has sufficient ability. QoS results meet the ITU-T G.1010 reference which indicates that Raspberry Pi can be used on designed networks.

Keywords*: network management, raspberryPi, SDN*

1. Introduction

The development of network technology that continues to grow with the increase of Internet-of-Thing devices and applications. In traditional networks that are capable of supporting vendor-specific policies and do not offer flexibility for dynamic network environments [1]. With the lack of traditional networks, this shows frustration to meet the demands of rapid development because all components in the chain are integrated to form complex structures that are difficult to manage easily. Software Defined Network is considered as a technology that is able to efficiently manage all network infrastructure and transform the complex into a simple and manageable network architecture. In data conventional network paths (forwarding fields) and controls (control fields) in one-on-one devices in certain network software networks that separate packet data lines (forwarding fields) and controls (control fields) [2].

Arguments related to the needs of Software Defined Network, one of which is cost as a driving factor for switching from traditional networks [3-5] does not rule out internet of thing devices can reduce costs for building network SDNs and network topology controls so complex and can reduce the costs needed to build a network, Raspberry Pi is included in the category of single board computers with the ability to run desktop applications that have specifications that are able to implement the Network Design Software Architecture that is modeled, which later functions as a controller is a server capable of managing network topology. This controller is then connected to the switch and has an internet network originating from the router. In this study, a network was built to help administrators to easily manage the network for a centralized control unit on the controller using a raspberry pi. In addition, the results of its application to resource use and quality of service (QoS) were also measured.

2. General Architecture

Software-defined networking (SDN) is an emerging networking paradigm that gives hope to change the limitations of current network infrastructures [6]. Software Defined Network (SDN) is a network architecture that appears where the control field is separated from the forwarding field and can be programmed directly. Transfer controllers, which were previously tied to each network device, become accessible to the network infrastructure that allows

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computing devices to be summarized as network applications and services [7, 8], with the separator functions Datapath Plane and Control Plane required protocols useful for interconnection one another [9]. This is illustrated in Figure 1. SDN is futuristic architecture that is powerful, easy to manage, less expensive and flexible [10]. At present, there are several protocols being developed. Some OpenFlow protocols were developed by Stanford University and later in the following period were managed directly by the Open Network Foundation (ONF). ONF is a nonprofit consortium dedicated to development, standardization, and commercialization of SDN [11-12].

In Figure 2 shows architecture of Software Defined Network (SDN), any layer can work independently and communicate through the network interface to provide the function of layered different physical devices. Aspects of this architecture allow a network administrator to address some of the challenges in the world of computer networks [13-14]. In Figure 2 shows there are 3 layers on software architecture defined network (SDN) [15].

- Infrastructure Layer consisting of the elements of the network and the hardware that runs the functions switching and packet forwarding.
- Control Layer provides functionality controls that monitoring the behavior of the network forwarding via open interfaces.
- Application Layer serve to provide an interface in the creation of application programs which will then manage and optimize network are good and flexible

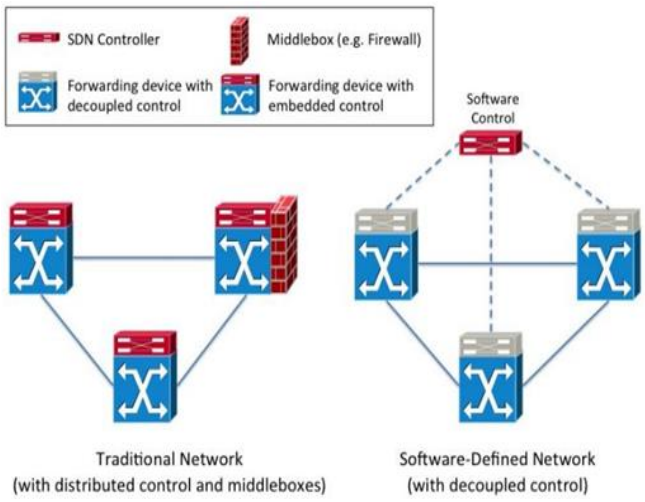

Figure 1. Difference SDN with traditional network [12]

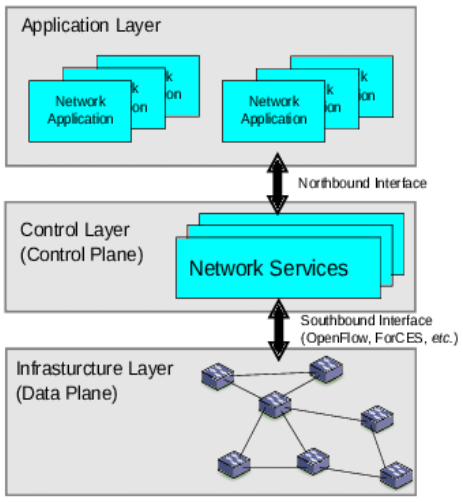

Figure 2. Layer on SDN [14]

2.1. Single Board Computer

Single board computer (SBC) is a complete computer designed at microprocessor with circuit boards, memory, input/output (I/O) and other features which are commonly used on computers with appropriate industry standards and interfaces to support the development of technology. SBC was used for the development of a system or for the purpose of learning. This computer is very wide usage [16]. Raspberry Pi provides full online support and very routine repair bugs that exist on the device. with the specification and support for the development of the Internet of Thing SBC often used for research and development of learning [16] with affordability and pretty hefty specs to run desktop applications.

2.2. OpenFlow

OpenFlow is a control interface that allows programming the switch on the data plan [8]. OpenFlow is the primary protocol in a network SDN because administrators can directly control the traffic packets on a forward plan or data plan via interface OpenFlow. OpenFlow defines the infrastructure of flow-based forwarding and Application Programmatic interface (API) standard that allows the controller to direct the function of the switches through a secure channel

(the secure channel) [17]. Although SDN and OpenFlow started as academic experiments [18], they gained significant traction in the industry over the past few years. In Figure 3 shows that OpenFlow switch can be divided into three parts [13]:

- Flow table in Figure 3 that indicates that the switch should process the flow in it. List of flow was made based on actions which intersect directly with each flow [19].
- The Secure channel is required to connect a switch with the controller. Through this channel, OpenFlow provides communication between the switch and controller through a protocol called protocol OpenFlow.
- OpenFlow Protocol. This Protocol provides a standard and open communication between the controllers and switches. OpenFlow protocol determines to interface where flow will be applied from the flow table of OpenFlow Switch.

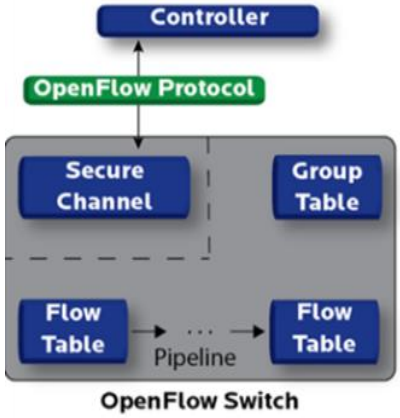

Figure 3. OpenFlow switch components [19]

OpenFlow switch on there is a table that contains three parts: the rule, action, and statistics [13]. The rule reads the header-the header of each layer such as mac address, IP address, port number, protocol and the other to determine the package that will go to the switch. The action is the action that will be performed if there is a package that goes into the switch and according to the rule, in the form of the command to forward the packet to the destination or drop packets and more. In Figure 4 shows the flow table in OpenFlow Switch contains statistics from each of the flow in the form of the number of packages and the number of bytes [20].

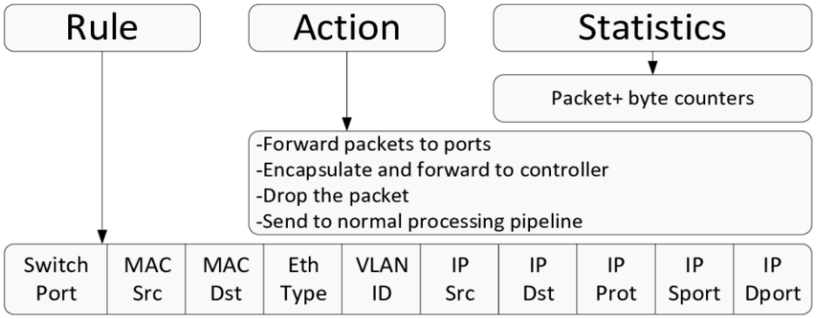

Figure 4. OpenFlow table [18, 21]

2.3. Open Shortest Path First (OSPF)

Open Shortest Path First (OSPF) is a routing protocol that is able to automatically manage and distribute the Information routing between networks following any change to the

network dynamically. OSPF is a fast converging routing protocol [22]. To route packages, OSPF calculates the shortest path tree for each route using a method based on Dijkstra's Algorithm [23]. To determine the shortest path, OSPF requires granting weight each link in the network. Weighted distributed link as link state [24]. The domain for the OSPF autonomous system located in one (us) [25].

3. Implementation

The resulting devices can function and generate the resulting exodus as expected. In Figure 5 shows the design of system implementation diagram block. At this stage, will be conducted a series of trials to test the results of the application on the device. Throughput: in this test will be tested speed (rate) data transfer, according to the reference standard QoS ITU-T G.1010 Performance: this will be tested on testing measurements of performance. Such as CPU Usage and the Memory used Resource controller and see if the system had worked in real-time.

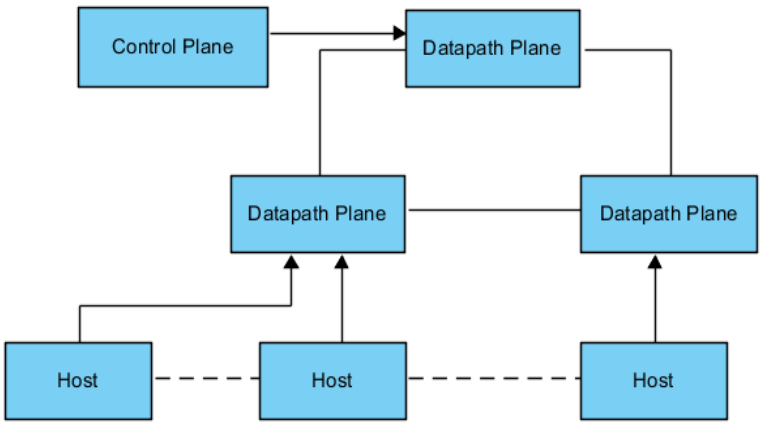

Figure 5. System implementation diagram block

4. Review Work

Table 1 illustrates the research paper that deals directly with propose solutions and enhancements. Various SDN architectures can be implemented by using OpenFLow standar with statisfied result with complies to many standar as ITU-G.1010, has been implemented using Mininet RouteFLow, OpenDayLight, with OSPF and Smart OSPF to meassure the effect of routing protocols on system perfomance with various QoS methods.

5. Comparison

Successful virtualization of networks on the implementation of OpenFlow network SDN, provide flexibility for all vendors who used to handle complex network on conventional networks, the development of quite a lot of features provided on its users. The papers compare OSPF protocol using the Mininet RouteFLow implementation of OpenFlow with conventional networks with result that OSPF in RouteFLow has shorter failover time than OSPF and RIPv2 in the conventional network also the throughput of RouteFlow decline along with the magnitude of the given background traffic, and decrease with an increasing number of switches.

OSPF using RouteFlow on the network SDN aims to detect network topology changes quickly in a large network, but in mixed network between SDN and conventional network Smart-OSPF is use in form of Hybrid-SDN (H-SDN). QoS can be achieved by prioritizing important broadband data traffic over the less important one. SDN QoS based routing in Raspberry Pi generates enormous control possibilities and enables automation, modification cost has an impact on the performance of views based on its value for QoS results and convergent times. Lower delay and jitter values archived in SDN with cost compared other topologies.

Table 1. The Objective of SDN Research Paper

No	Literature Review		
	Title of Paper	Author	Objective
1	*Analisis Performansi Perutingan Link State Menggunakan Algoritma Djikstra Pada Platform SDN* [7]	Abu Riza S et al.	Link state ISIS can be implemented on platform SDN. Throughtput value decline with the magnitude of the given background traffic, and nearly all experiments showed a decreaseing value of the packet lost with increasing number of switches.
2	On the Resilience of Software Defined Routing Platform	Pengcheng et al.	Emulator Mininet and switches are used to compare OpenFlow and traditional distribution protocol. OSPF generates in the RouteFlow reach the failover time shorter than the OSPF and RIPv2 in switches
3	Performance Evaluation of OpenDaylight SDN Controller	Zuhran et al.	This journal examines performance analysis of Floodlight and OpenDaylight. The results of the test using OpenDaylight Cbench shows that it has problems with the use of the memory resource. This testing found the failure in OpenDaylight with certain latecy percentage per switch.
4	QoS-based Routing over Software Defined Networks	Andrew Kucminski, et al.	The researcher made a trial using a Raspberry Pi computer on the original SDN network as a virtual SDN switch managed by a centralized controller. The results obtained are a great opportunity to exercise control and automation using the QoS-based routing approach for SDNs.
5	Software Defined Networking Architecture, Security and Energy Efficiency: A Survey[1]	Rawat Danda B, et al.	This survey discusses the architecture of the various threats to SDN as well as new threats arising due to the application form and SDN energy efficiency on security testing. Energy efficiency in the form of comparisons of energy consumption when not using network security as well as with the SDN without security applied.
6	*Analisis Performa Jaringan SDN Berdasarkan Penggunaan Cost Pada Protokol Ruting OSPF*[8]	Khoerul Anam, et al.	Discuss about the performance analysis against conventional networks and networks that use OSPF based SDN cost or without cost, with the conclusion that the application of the modification cost has an impact on the performance of views based on its value for QoS results and convergent times.
7	A Survey on Software-Defined Network (SDN) and OpenFlow: From Concept to Implementation[9]	Fei Hu, et al.	Successful virtualization of networks on the implementation of OpenFlow network SDN, provide flexibility for all vendors who used to handle complex network on conventional networks, the development of quite a lot of features provided on its users.
8	*Analisis Simulasi Penerapan Algoritma OSPF Menggunakan RouteFlow pada Jaringan Software Defined Network (SDN)* [12]	Ridha M et al.	Routing protocols OSPF was applied topology SDN by using his RouteFlow goal to ease in controlling network with centralized system. Time convergence and Quality of Service parameters is measured with the scenario of disconnections links, the addition of a number of switches and background traffic complies with the standard parameter refers to the ITU-T G. 1010
9	Implementation of Smart-OSPF in hybrid Software Defined Network [13]	Yasunori N et al.	Implemented Smart-OSPF scheme aimed at reducing traffic congestion ratio by distributing traffic in just the edge nodes, just like the function of the OSPF on normally. The concept of H-SDN is to apply a system with conventional systems SDN network together. In this paper, applied the distribution function of traffic in edge nodes in the S-OSPF using H-SDN.
10	*Prototipe infrastruktur software defined network dengan protokol openflow menggunakan ubuntu sebagai controller* [23]	Rikie Kartadie, et al.	On a simulation used mininet as builders network and on the prototype wearing router WR1043ND TP link and PC. For controllers that use IE OpenDaylight. Testing conducted with the first ICMP packet results between the two is not so far away, just like any ICMP packet routing testing obtained results do not differ greatly.

6. Conclusion

In this paper, we compare the various research papers on SDN architecture and the implementation of SDN. With a constantly evolving network technology, SDN will be used as a solution to manage future networks. In the future, we want to propose a software architecture model implementation in a single board computer device.

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