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QOS evaluation in SDN and Ethernet networks

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Abstract— Traditional network architectures, such as Ethernet, are not very satisfactory to its clients and users and do not meet their requirements. SDN (Software Defined Network) has completely changed the network architecture in terms of quality of service .In this respect, this article is a comparative study between the two architectures: SDN and Ethernet under Omnet4.6++, to determine the most appropriate technology.

Software-Defined Networking (SDN) is an idea which has recently reignited the interest of network researchers for programmable networks and shifted the attention of the networking community to this topic by promising to make the process of designing and managing networks more innovative and simplified compared to the well-established but inflexible current approach.

Index Terms— SDN, SDN Controller, SIP, QoS, OpenFlow protocol, Omnet 4.6++.

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1 Introduction

Software Defined Network (SDN) [1] is new concept architecture; it is a very positive change when dealing with QOS (Quality of Service) [2]. SDN is a recent architecture that has come to solve the complexity of those approaches by detaching control and data planes. Unlike the current computer networks, the SDN dissociates the plan control and the data plan. The purpose of the control plan is to decide how deal with traffic, that is to say, mainly to define the routing policies for data packets. The data plan deals only with the routing traffic, applying the decisions made by the control plan. So, the plan of control decides, and the data plan executes and implements.

The ONF was organized for the purpose of standardizing a protocol between the controllers and the network elements. This protocol is called OpenFlow [3].protocol and runs on the Southbound interface.

The SDN introduces a new entity, called the SDN controller, which Its role is to control the numerous equipment of the data plan (that is, the packet switches 1). Usually these packet switches are called virtual switches ("virtual switches"). Note that these virtual switches can perform routing operations (like routers and switches), filtering (like firewalls), address translation (like NAT). So, these virtual switches are versatile and should be the only one equipment found in networks (putting an end to the expansion of middleboxes). Finally, the decisions made by the SDN controller are communicated to the switches using a protocol such as OpenFlow

It is in fact a combination of network and software systems, in order to separate the signaling part (Control planes) of the transfer of data (Data planes), and making the control planes programmable. Therefore, we have more flexibility to manage the network behavior in general and the mobility in particular.

2 STATE OF THE ART

QOS and VoIP [4] in telecommunication network has always been the core requirements that meet users' expectations.

Users of these technologies have an extremely low tolerance for any form of voice or video delay service quality.

QOS is the ability to transmit a type of traffic in the right conditions, in terms of latency, end-to-end delays, jitter, packet lost rate, time of admission of calls, and so on.

The Quality of Service is very important for the proper use of voice over networks, and indirectly, for the priority processing of voice in the flow of data transmission.

This is to avoid the congestion of problems of the switch at the level of the data links as the resolution of the collisions. Ethernet increases the rate lost of the packets which poses the possibilities of saturation to the memory of the switch as well as the frames lost implies a recovery of losses by the transport layer which collapses the efficiency of the end-to-end quality of service with a transmission delay increase.

For all these reasons, SDN networks have been developed to improve the quality of service (Gigue, latency, end-to-end delays, and packet lost rate, and call intake time) at the level of the latter compared to Ethernet.

The objective of this work is to show "What is the amelioration of QOS under SDN report to Ethernet"?

3 SOFTWARE DEFINED NETWORK

The SDN controller is a program running on one or more nodes of the network. It will calculate the routes to be taken by incoming packets in the network and will then communicate them to all virtual switches. SDN has of course a central role for the good functioning of the network. Its decisions have a direct impact on users' perceived performance. It is therefore crucial that his decisions are taken at best.

The figure 1 shows the logical view of the SDN architecture consists of three layers:

The infrastructure layer: This is the physical part of the network that encompasses all the equipment.

The control layer*:* This one is the controller (CR) whose logical entities receive instructions or requirements of the SDN application layer and relay them to the network components.

The application layer: This layer consists of applications and programs that communicate the behaviors and resources with the SDN controller via APIs.

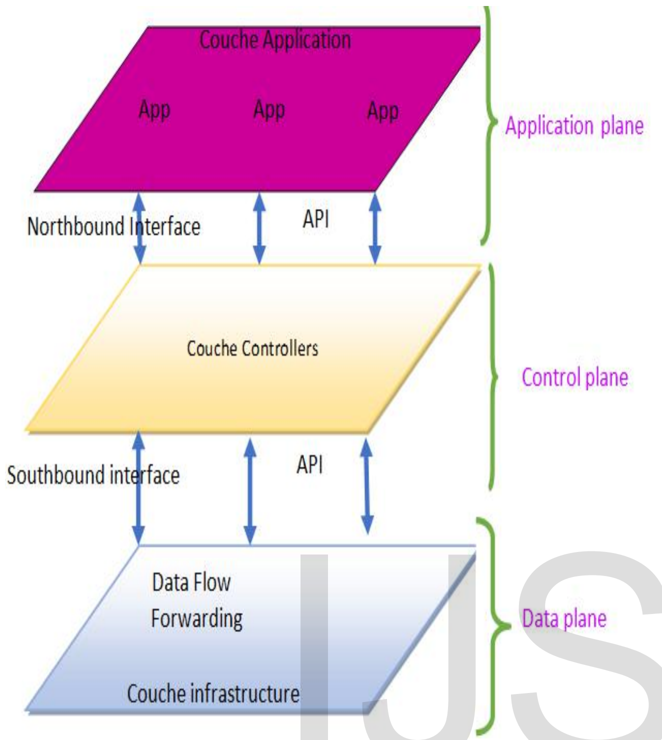

Fig.1. SDN Architecture and interfaces

The communication between the controller and the two physical layers is guaranteed by Open Flow (OF) protocol which is an open standard that allows researchers to run experimental protocols in networks they use.

3.1. Controller SDN

This is the brain of the SDN model. It collects information on all networks.

It provides a centralized view of the global network and sends commands to all network devices. It centralizes the intelligence of the network.

The controller architecture has evolved from the original single threaded design [5] to the more advanced multithreaded design [6] in recent years.

It contains the tools, technologies, and protocols needed to program the network infrastructure.

The SDN architecture is remarkably flexible. It can operate with different types of switches and at different protocol layers. SDN controllers and switches can be implemented for Ethernet switches (Layer 2), Internet routers (Layer 3), transport switching (Layer 4), or application layer switching and routing. SDN relies on the common functions found on networking devices, which essentially involve forwarding packets based on some form of flow definition.

Based on the study of available materials on twenty four SDN/Open Flow controllers, we have chosen the following seven open source controllers:

NOX [7] is a multi-threaded C++-based controller written on top of Boost library.

POX [8] is a single-threaded Python-based controller; it is widely used for fast prototyping of network applications in research.

Beacon [9] is a multi-threaded Java-based controller that relies on OSGi and spring frameworks.

Floodlight [10] is a multi-threaded Java-based controller that uses Netty framework.

MUL [11] is a multi-threaded C-based controller written on top of lib event and glib.

Maestro [12] is a multi-threaded Java-based controller.

Ryu [13] is Python-based controller that uses gevent wrapper of lib event.

3.2. Switch Open Flow

In SDN architecture, a switch performs the following functions:

The switch encapsulates and forwards the first packet of a flow to an SDN controller, enabling the controller to decide whether the flow should be added to the switch flow table.

It forwards incoming packets out the appropriate port based on the flow table. The flow table may include priority information dictated by the controller.

It can drop packets on a particular flow, temporarily or permanently, as dictated by the controller. Packet dropping can be used for security purposes, curbing Denial-of-Service (DoS) attacks or traffic mnagement requirements.

It is like any other layer 2 equipment. But with a table of flows performing a quick search and a packet forwarding. The difference is in inside the flow rules are embedded and updated in the switch flow table. A standard switch may have static rules inserted in the switch or may be a learning switch where it is the inserts rules into its flow table when it learns on which interface (Switch port).[14]

To carry out this work, it is based on Software that are characterized by flexibility under a Linux operating system.

The figures 2 and 3 show the topology used for SDN and the Ethernet.

4 Methods for the Simulation the SDN and Ethernet under Omnet 4.6++

In this work, the Session Initialization Protocol (SIP) is used, which is an application layer protocol. It is used for end-to-end signaling control to establish a communication session between the two networks for the exchange of data (or streams) over the Internet. This standard is presented with an exchange process between UAC (10.0.1) and UAS (10.0.0.4) as follows: The two topologies are used: Ethernet and SDN.

The simulation is done with the help of OMNET4.6++ and the simulated environment is as shown in the below screenshots.

Scenario I: Topology SDN is implemented with SDN Controller, 2 switch_OpenFlow and 6 nodes. (Figure 2)

Scenario II: Topology Ethernet is implemented with 1 router, 2 switchs and 6 nodes. (Figure 3)

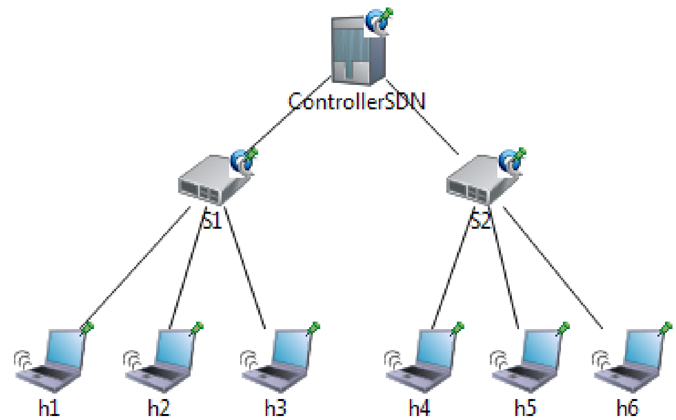

Fig.2. Topology SDN

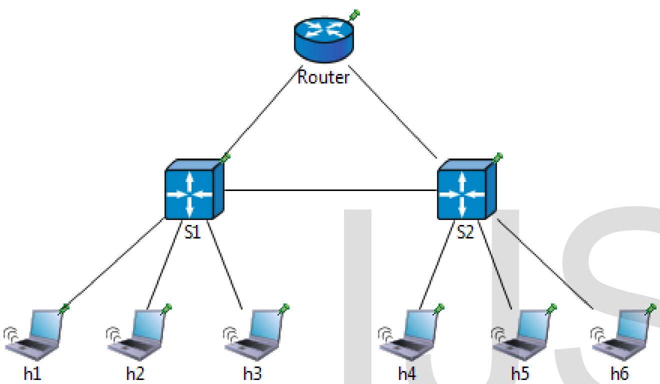

Fig.3. Topology Ethernet

5 Settling Time of Call

On the basis of the results found, it is observed that the time of call establishment under SDN (0, 009888 µs) is faster than Ethernet (0, 860855 µs), as illustrated in Figure .4.

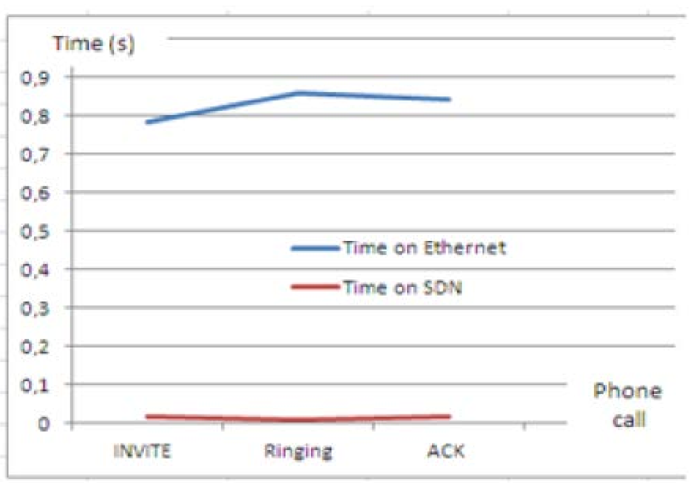

Fig.4. Settling time of call in SDN and Ethernet networks

In this case, the machine "10.0.0.4" wants to communicate with other one "10.0.0.1". It starts with a request for communication via the sending of an INVITE request. We note the code of the processing start with "180 RINGING", and OK which show us that the machine "10.0.0.4" accepts the establishment of a communication session. Finally, the machine "10.0.0.4" returns to its recipient an ACK message to confirm this establishment of the connection.

6 Results and Discussion of Simulation the SDN and Ethernet in Quality of Service Criteria (QoS)

In this part, we will see all the parameters of QOS (MOS, jitter, end-to-end delay, latency, lost packets) are done to show that the new SDN technology is better than Ethernet in terms of quality of service.

6.1 End to end delay under Etherent and SDN

Figure .5. shows the results of the end-to-end delay in the SDN scenario with the smaller value (2.5 ms) compared to the Ethernet scenario which has a higher delay of (20 ms), which explains why the SDN technology is beneficial compared to Ethernet.

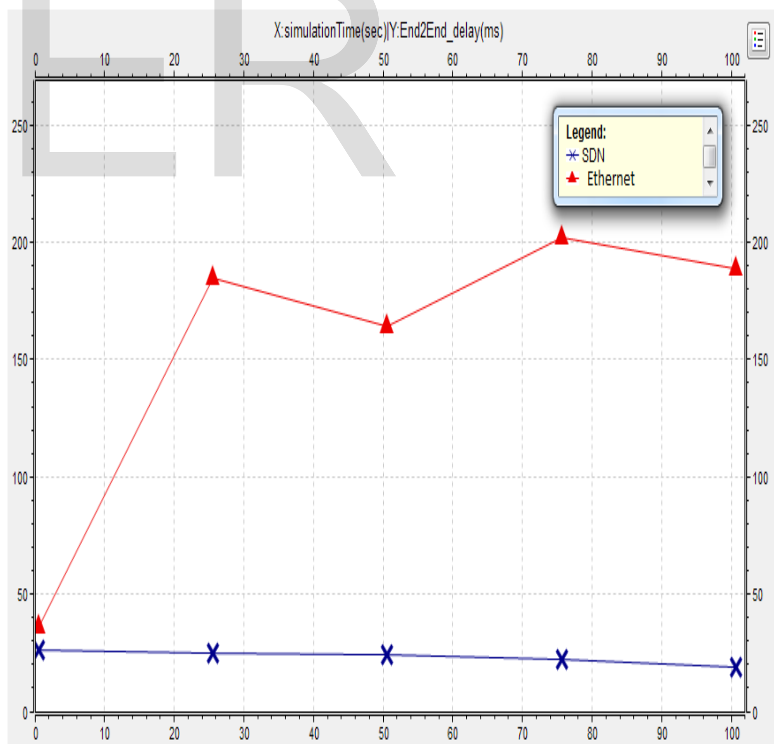

Fig.5.End to end delay in SDN and Ethernet networks

6.2 Jitter under Etherent and SDN

Figure .6 illustrates the jitter under the SDN scenario is less than the scenario based on Ethernet technology. This shows that SDN is better than Ethernet in terms of jitter.

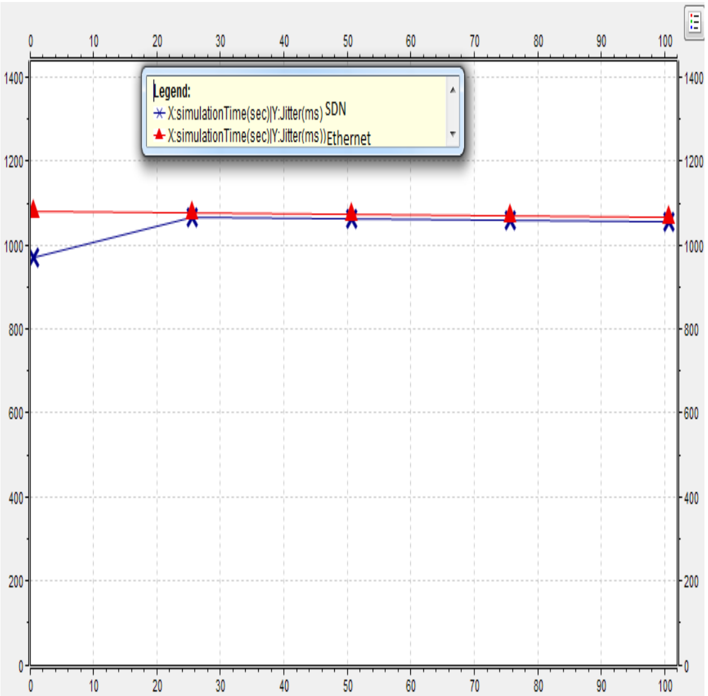

Fig.6. Jitter in SDN and Ethernet networks

6.3 Latency under Etherent and SDN

Figure 7 shows that the latency in an SDN network is lower by contrast, it is high under Ethernet technology.

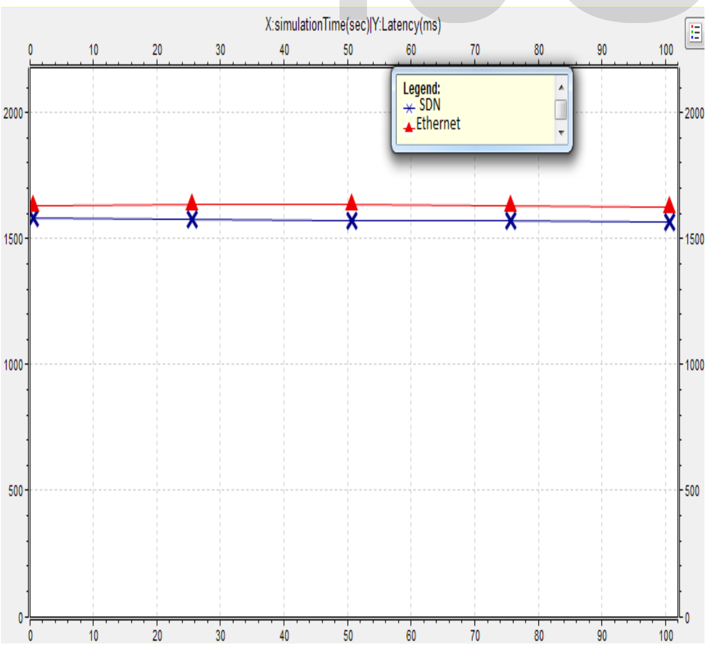

Fig.7. Latency in SDN and Ethernet networks

6.4 Lost Packets under Etherent and SDN

From the selected curves, in Figure 8. The number of lost packets under Ethernet is higher than the SDN. This shows that the impact of SDN is significant compared to Ethernet.

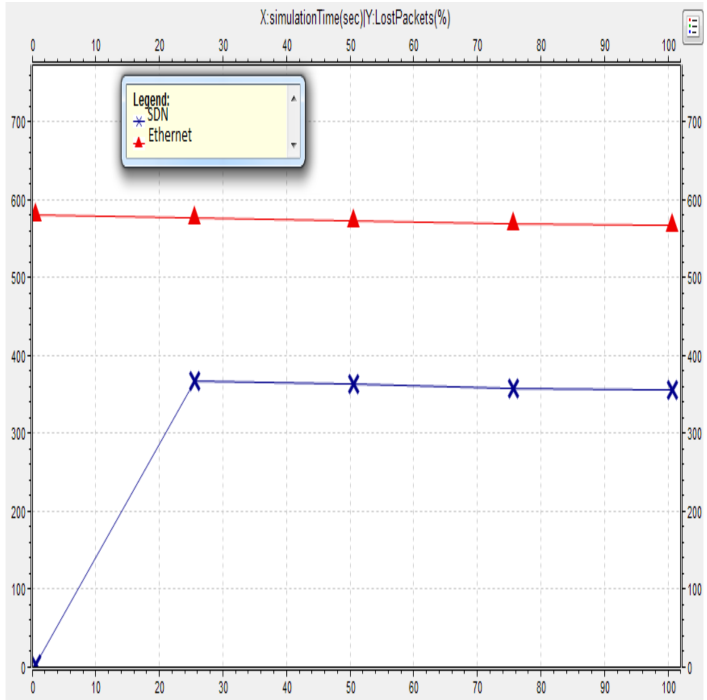

Fig.8. Lost packets in SDN and Ethernet networks

6.5 MOS under Etherent and SDN

The formula the MOS (Mean Opinion Score) used is :
MOS= 4 – ln (loss) - 0, 7*ln (size) [16]
Fig.9. shows that the MOIS offered by the SDN approach is 3, whereas the Ethernet 2 approach shows the quality of the voice transmission.

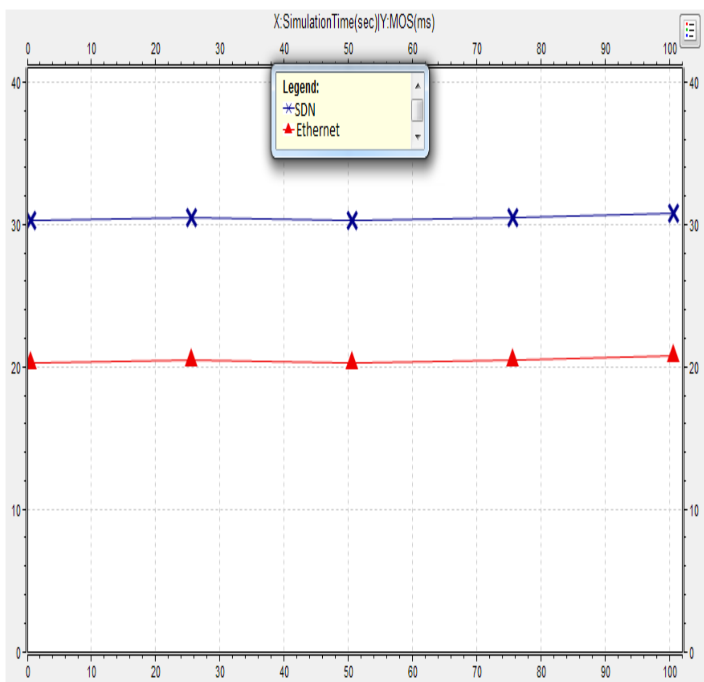

Fig.9. MOS in SDN and Ethernet networks

MOS	Quality of Voice Rating
5	Excellent
4	Good
3	Fair
2	Poor
1	Bad

Table.1. Relationship of MOS values to the Quality of Voice Rating.

From the results received, it is found that MOS under SDN which has the value of 4 is better than under Ethernet which has the value 3.

7 CONCLUSION

This article examines the performance under Ethernet and SDN in term of the QOS parameters (Endt to end delay, jitter, latency, packet lost, and MOS). As a result, it was absolutely noticed that the performance of QOS under SDN is more efficient compared to Ethernet.

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