Evaluation of Scheduling Algorithms for Multimedia Applications over Dual-Stack Network

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Abstract—This research has been dealing with a topic of dual-stack networks of issues providing Quality of Service (QoS) in (IPv4/IPv6) dual-stack environment and analysis of various applications such as FTP, voice and video of QoS in these networks. The future IP networks are relied upon to utilize IPv6 instead of IPv4, in light of the fact that IPv6 has been intended to fulfill the future system QoS necessities and IPv6 arrange offers huge points of interest over the current IPv4 organize. It will require a certain investment to change from IPv4 to IPv6. So that IPv4 and IPv6 will exist together amid the change period. In this examination, we embrace the Dual-Stack Transition Mechanism (DSTM) to think about system execution with scheduling algorithms applied QoS methods on (IPv4/IPv6) dual-stack traffic has been executed testbed created specifically for this study, with a view to validate the methods and evaluate the router's overall execution. This paper is considered three queuing systems which are First In First Out (FIFO), Weighted Fair Queuing (WFQ) and Priority Queuing (PQ) as a comparative study to investigate their effects on real-time applications in (IPv4/IPv6) dual-stack networks support. Meet the simulation environment OPNET Modeler where the simulation results are collected and analyzed.

The networks that have been styled consist of various pieces as a switch, device node, routers and servers. The performance metrics considered in this paperwork is jitter, end-to-end delay, traffic sent and received etc.

Index Terms—QoS; Dual-Stack; WFQ; FIFO; IPv4; IPv6

I. INTRODUCTION

The Internet is developing with the goal that it's splitting in the joints, since new once IP hubs are developing as well. Today there are computer games, smart TV, autos and indeed, even the smart hand watch require their own IP address. These permits accessing to IPv4 delivers to be their address space comprises around four billion locations. The IPv6 tends to consist of 128 bits contrasted
with 32 bits that the IPv4 tends to comprise. IPv4 is 30-years of age convention and the necessities for security have expanded throughout the years. This has been settled by introducing different increments to the convention. An IPv6 has taken them increments and made them a standard in the convention so that the security has expanded with its new convention [1], [2], [3], [4]. This has been resolved by installing various additions to the protocol. IPv6 has taken them additions and made them a standard in the protocol so that the security has increased with its new protocol [5]. The implementation of IPv6 in a network requires both knowledge and equipment to complete the new protocol. It will be required that both protocols be run parallel during a period when it will be a transition period until IPv6 is fully functioning [5].

There are some ways of doing things for the employment of these two Internet rules of conduct to be applied together [6]. In terms of networking, the idea of QoS refers to the capability to provide various services to network traffic with various classes. In this range, different mechanisms algorithms (FIFO, PQ, and WFQ) that are standard scheduling algorithms that action on routers, are tested to see their effects for QoS in the (IPv4/IPv6) dual-stack networks. This test works utilizing OPNET to system executions investigate. This work provides a comparison study in (IPv4/IPv6) dual-stack networks concerning their execution QoS.

The main contribution of this research is to furnish evaluation scheduling algorithms for multimedia applications over DSTM. Many types of research have been conducted to analyze the performance of QoS using IPv4 and IPv6 networks constraints. However, there is limited research which tries to understand the behavior of QoS in DSTM network.

The paper is organized as follows: In the next section, the of dual-stack transition mechanism. Section III, we summarizes the quality of serves in IP protocol. Section IV, explains the OPNET modeler and network topology. In section V, we obtained test results are given and performance comparison. Finally, the conclusion of our work is drawn in the last section.

II. DUAL STACK TRANSITION MECHANISM

Dual-Stack refers to the ability to use both IPv4 and IPv6 at the same time, within a network. A prerequisite for the use of both protocols at the same time is that the nodes in the network (servers, computers, routers, etc.) support both protocols. A node with dual-stack can be configured to use IPv4, IPv6, or both simultaneously. In the reality there are a few places that have some old switches don't ready to deal with the IPv6 convention. It might be the most coherent and simple is the arrangement dual-stack, which is characterized in RFC 4213. Double Stack implies that a switch or on the other hand hub has both the IPv4
and IPv6 stack empowered [3], [4], [7], [8]. This hub gets both the IPs address are doled out and after that offer the same connect yet without to meddling with each other [6], [9], [11]. Relegated to all switches in an association dual-stack, IPv6 will completely be upheld without meddling with the task of IPv4 [11]. The structure of double stack appears in Figure 1 [12].

![Fig. 1. Dual-Stack system](image)

### III. QUALITY OF SERVES IN IP PROTOCOL

Quality of Service (QoS) is comprehended in the region of PC systems thorough asset designation control systems with the goal that the system can give that administration at a specific ensured level. QoS is, along these lines, the essential capacity of the system to distribute for the reason adherence to characterized transmission parameters with various needs for singular information applications streams or clients. Guaranteeing the subjective attributes of correspondence over united the system is especially essential for administrations, for example, VoIP, video conferencing, web based diversions, high volume information exchanges, and so forth., specifically considering the reality that some transmission portions may not be accessible in a few sections limit [13].

There are but not a lot of scheduling sets of computer instructions to manage router behaviors and important ones are summarized below:

A. **First-in First-out (FIFO)**

The FIFO is regarded as the simplest queuing technique that depends on the concept of the first packet arrived at the router buffer is the first one that transmitted where all arrival packets waited in the buffer until they are processed by the router. The likelihood of dropping information is expanded when the
normal approaching rate surpassed the preparing rate so drives the cradle to be topped off and afterward the new approaching parcel is disposed of. [1], [14], [15].

b. Priority Queuing (PQ)

It is obvious from the name Priority Queuing that this methodology manages bundles relying upon its classes, along these lines; the parcels are assigned to be in independent need classes and each having its own line. PQ consists of a set of queues ranked from the Highest to lowest according to priority. This means that the first packet that being processed should be within the highest priority queue then followed by the lowest priority [1], [13], [14].

c. Weighted Fair Queuing (WFQ)

The technique manages bundles by apportioning them in various classes and afterward put every parcel in various lines as indicated by their need. WFQ endeavors to give a computerized reasonable data transmission designation for all movement on the system and after that forward this activity stream by using a mix of source and goal locations and port number [1], [14], [15]. A queue for each flow is assigned and the amount of bandwidth required by these flows is determined by WFQ, so this process can prevent the effect of other traffic on the same network. The principle preferred standpoint of utilizing WFQ is that it guarantees the accessibility of data transfer capacity for other application with low need like FTP.

IV. OPNET MODELER AND NETWORK TOPOLOGY

To create a test network software was used OPNET Modeler version 14.5. OPNET Modeler is a discrete network simulator used for the design and analysis of communication networks. The program contains a large library and can be used to simulate QoS and DSTM [16]. OPNET consists of multiple layers and basic are Project Editor, Node Editor, and Process Editor [17]. In this work, the network model for simulation represents an abstract view of an enterprise campus having two LANs network, the first LAN has 3 devices node and switch that support IPv4 only connected to (Dual-Stack Router B) through bidirectional 10Base_T links and the second LAN has 3 devices node and switch that support IPv6 only connected to (Dual-Stack Router B) through bidirectional 10Base_T links. Both LAN uses the same applications are the same as shown in Figure 2. On the other hand, the servers, routers and switch work in dual-stack support IPv4 and IPv6 connected (Dual-Stack Router B) through bidirectional 10Base_T links. Between routers (Dual-Stack Router A) and (Dual-
Stack Router B), uses PPP DS1 link. The QoS Attribute, Application and Profile definitions, which are utilized to configure the network, are adjusted to support the dual-stack network design. The network configuration is copied to obtain three scenarios to examination three different queuing algorithms in dual-stack networks. The QoS configuration is acclimatized to display each of the queuing precision simulated. The configured networks are artificial for a 15-minute period utilizes three applications which are FTP (heavy load), video conference (high resolution) and voice (PCM quality speech).

![Fig. 2. Network configuration](image)

v. RESULTS AND PERFORMANCE COMPARISON

A. FTP Application

Figure 3 and 4 showed the average traffic sent and received in FTP application. We observe that for three scenarios, the traffic received differently from the traffic sent because there are two protocols used in a network at the same time, causing dropped packets. However, we observe that WFQ appears to have higher traffic owing to utilized different mechanisms for different preference and split the bandwidth. As an outcome, WFQ is eligible to transfer higher traffic than other algorithms for FTP application. PQ appears to have less traffic due to gives higher precedence to the multimedia application through the FTP application. On the other hand, FIFO appears between PQ and WFQ traffic because FIFO offer whole received data in one queue and transmit them pending the availability of the bandwidth [14].
Fig. 3. Traffic sent for FTP            Fig. 4. Traffic received for FTP

B. Video Application

Figure 5 and 6 demonstrate the activity sent and got by the video application. The traffic sent is equivalent for both PQ and WFQ, while FIFO suffers from the amount of data sent. In any case, the WFQ has the most spectacular action and begins to drop bundles relatively about 117th second and reaches about 2,726 (bytes/sec) of data. While PQ has the minimum activity got and begins to drop bundles relatively about 117th second and reaches about 76 (bytes/sec) of data. While FIFO begins to drop bundles relatively about 117th second and reaches about 1,996 (bytes/sec) of data. WFQ execution is pre-eminent to the others for video conferencing [14].
Figure 7 illustrate obtained results between the average end-to-end delays in the video conferencing application. We watch that the average end-to-end delays of WFQ are bigger than 5.41sec which gives a higher delay execution as for the others. While PQ is bigger than 0.295sec which gives less delay compare with others. FIFO shows appear between WFQ and PQ [15]. It can be seen that the average end-to-end delay for FIFO are bigger than 2.26sec. By and large, PQ gives the best execution of video applications over a Dual-Stack network.

![Fig. 7. Average video conference packed end-to-end delay](image)

c. **Voice Application**

Figure 8 and 9 illustrates obtained results between the average traffic sent and traffic received by the voice application. For three scenarios, traffic sent is same. On the other hand, the received traffic change contingent upon the scheduling algorithms utilized. FIFO has the minimum traffic received reaches up to 19,028 (bytes/sec) of data. WFQ appears between PQ and FIFO and reaches up to 26,945 (bytes/sec) [15]. While PQ has the more traffic received reaches up to 28,175 (bytes/sec) of data. PQ gives the best performance on DSTM.
Figure 10 shows the average end-to-end delay in the voice application. The average end-to-end delays in the FIFO are larger than 2.21sec which gives a lower performance with respect to the others. While PQ and WFQ present at the same level 0.066sec which gives a better performance for the voice application.

Figure 11 shows the obtained results between the averages Jitter in the voice application. WFQ and PQ are Present at level zero and gives minimum Jitter
values. While FIFO creates a higher Jitter value [14], [15]. Hence, WFQ and PQ are better than FIFO for voice jitter application on DTSM.

![Average voice jitter](image1)

**Fig. 11. Average voice jitter**

**d. IP Traffic Dropped**

Figure 12 shows the obtained results between the packet loss (dropped packet). In general, more dropped packets for three queuing algorithms because there are two protocols used in a network at the same time, causing dropped packets. As a result, FIFO reaches up to 644 (packets/sec) and PQ reaches up to 1,228 (packets/sec) while WFQ reaches up to 1,223 (packets/sec). However, FIFO’s performance is better than other algorithms on DTSM.

![Average IP traffic dropped](image2)

**Fig. 12. Average IP traffic dropped**
Discussion

Table I illustrates obtained relative percentage increases in delay and Jitter of applications during 15-Minutes. Using the table, the performance of quality of serves over dual-stack networks can be compared easily.

| Application          | Parameter   | FIF O | PQ | WFQ |
|----------------------|-------------|------|----|-----|
| Video (High Quality) | End to End Delay (sec) | 2.26 | 0.295 | 5.41 |
| Voice (PCM Quality)  | End to End Delay (sec) | 2.21 | 0.066 | 0.066 |
|                      | Jitter (ms) | 2.69 | 0  | 0   |

For the video conferencing application, PQ gives the lowest end-to-end delay. Despite the WFQ has the highest end-to-end delay in this arrangement, it gives lower end-to-end delay than FIFO. The results in this test are in line with the results given in [14] that that use native IPv4/IPv6.

For the voice application, PQ and WFQ are given the lowest end-to-end delay and Jitter rate. Although FIFO has the highest end-to-end delay and Jitter rate in this configuration. The returns in this work are in line with the results given in [1], [14], [15], which use native IPv4/IPv6.

VI. CONCLUSIONS

In this paper focuses on the evaluation of QoS for using three applications video conference, FTP, and voice over the dual-stack network. The obtained outcomes examined by OPNET simulation. The outcome showed that the WFQ gives the best performance over a dual-stack network, compare with WFQ and PQ when mixed media movement exists all the while with different traffics on the system. While PQ gives less end-to-end delay for video and voice applications. In any case, activity got for video meeting application is not as much as the one given by WFQ. In any case, traffic received for video application is not as much as the one given by WFQ. FIFO has more terrible execution contrast and others for voice applications over a double stack arrange. Although it gives better performance compare with others queuing algorithms for IP traffic dropped. The tests in this study are in line with the tests that use native IPv4/IPv6. Therefore, there are not affected in performance scheduling algorithms when using networks supporting DSTM.
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