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Enhancing Quality of Service (QoS) For Ipv6 Video Streaming

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Abstract: Recently, multimedia traffic has massively increased due to the advances in the networking and communication. This type of traffic depends on the network performance and quality. So network quality of service has become a critical field of development and enhancements. Multimedia traffic is sensitive to different parameters like throughput, delay and packet loss. The new addressing approach IPv6 has been deployed widely. In this study, a new approach for delivering quality of service for video streaming based on IPv6 network infrastructure. Twenty bit flow label field of IPv6 header has been used to guarantee the main three video requirements, throughput, delay and packet loss. The value of minimum accepted values of these parameters has been assigned to the flow label. These parameters will be guaranteed through all the path from source to destination. This approach is expected to enhance the quality of service for video streaming applications over IPv6 networks.

Key words: Multimedia traffic, guaranteed, IPv6 networks, parameters, bit flow

INTRODUCTION

Video is one of the critical media which is used nowadays in the field of entertainment and communication. This media has been used for many decades. The internet growth and popularity in the mid of 90's represent a powerful motivation for video streaming using network which support best effort. Transferring Video over network that only support best effort delivery is affected by a number of different factors. These factor includes varying bandwidth, delay and packet losses. It also affected with many additional issues such as how to have a fair sharing of the network resources between different flows and how the one-to-many connection is efficient. Different video communication and streaming applications are exist and functional, these systems have various properties and condition for operating. Different approaches support Quality of Service (QoS) forms using different methods. Other approaches only provide support for best effort. The design of the system is affected by the properties of a video streaming application (Apostolopoulos *et al*., 2012).

Streaming video techniques has different advantages but it also has drawbacks. The Bandwidth issue is considered one of the biggest obstacles. Many users may not have enough bandwidth to watch streaming video with a good quality. The main advantage of streaming video techniques is that it is a time saving techniques. Clients can watch videos with a delay in seconds, after they download it. Streaming application allows big size media files which require big bandwidth and contains multimedia content to be buffed and played upon its receive, it doesn't require a complete download of the entire file to user hard drive before it can be watch or played (Sabla and Dieu, 2015). The process of capture video encode it and send it to a streaming server to stream it all over the network is show in Fig. 1.

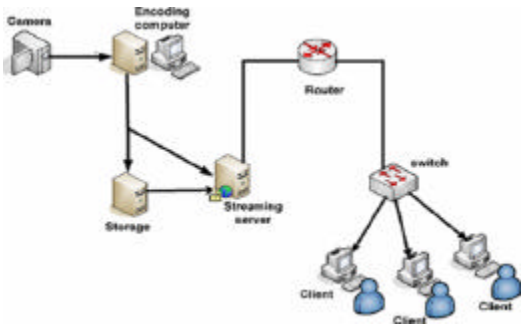

Fig. 1: Videos streaming network component

Quality of service: A vast area of information technology research for delivering data over the past years has been the support of QoS for different network infrastructure. QoS is a fuzzy concept when we describe term, QoS is the concepts of providing some type of priority for delivery service or performance guarantees when transfer specific data over the network. These guarantees can be on

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bandwidth, maximum delay and number of packet loss. Network QoS support can make video communication more flexible and reliable, it also can provides a number of features including prioritizing a video which is sensitive to specific amount of delay in relative to other types of data traffic (Williams, 2005). Various metrics are proposed to evaluate the quality of services provided for network traffic with QoS support. These evaluation metrics are defined as IP performance metrics (Silvia, 2003), these metrics can have parameters such as amount of data transmitted per second (throughput), bandwidth, delay, delay variation (jitter), packet loss rate and cost. For QoS levels, three levels of service are used in networks, these levels are: best effort, In this level the network is providing its possible best efforts to deliver the required packet to its target, there is no guarantee for packet delivery. This is the service level used by applications and ftp and http. In integrated Services network provides delivery method that provides a level of guarantee for the service, the guaranteed parameters is based on negotiating between connections end points. In differentiated services , a set of collaboration mechanisms is proposed to provide a certain applications or protocols a certain priorities for specific parameters to provide quality of service over other network traffic (Parra *et al*., 2011).

Problem statement: Video streaming applications suffers from different number of basic problems and obstacles (Liu *et al*., 2008). In this project we try to enhance the video streaming mechanism especially for IPv6 Internet environment. This environment is a critical, widespread and real infrastructure that illustrate the real problems that video streaming can face.

Internet video streaming is complicated since the Internet environment provides best effort service as the only way to deliver data. Which means that there is no guarantees on performance metrics which includes bandwidth, packet loss and jitter. These parameters are change dynamically. So, it is a critical objective of video streaming is to design a methods that is reliable and can be depend on it to deliver high quality video over the Internet where dynamic parameters exists (Apostolopoulos *et al*., 2002). These parameters are: Bandwidth, Delay jitter and Loss rate.

The first essential problem of videos streaming is the bandwidth. Existing bandwidth between two nodes in the environment of the Internet is generally has time varying value. If the sender transmits in a speed that is slower than the bandwidth of the available link then the receiver receive bad quality of the streaming video. On the other hand if the sender send in a faster speed than the available link bandwidth then link is getting congested and packets loss rate become higher. In this case a severe drop in video quality is happened (Wu *et al*., 2001). The goal to avoid the bandwidth problem is how to get a real estimate of link bandwidth and make the transmitted video bit rate match the estimated bandwidth and doesn't exceed it. Accurate estimating of link available bandwidth is additional issues which is need to be taken into considerations. Also it is needed to match the pre-encoded video to the estimated bandwidth of the channel and then transmit at a rate which is suitable to other synchronous flows in the Internet at the same time. This problem is need to be solved in the environment of the multicast. In this multicast environment a single sender sends a single copy of data. This copy is duplicated and delivered to multiple receivers and each receiver may have a variant bandwidth.

Jitter delay is the second problem that is a challenge for video streaming applications (Claypool and Tanner, 1999). This type of delay is the time between every two successive packets. Delay jitter is considered as a problem since the receiver perform the operation of receiving/decoding/displaying of the received packets at a constant rate. So any delayed packets caused from the jitter can results problems in the operation of the reconstruction of the streamed video. Including a playout buffer at the receiver can handle this problem but it add extra delay for the end to end delay. The third fundamental problem is the packets losses (Feamster and Balakrishnan, 2002). Which is represented by the number of different types of packets losses that may happen, based on the specific network environment. This can be clear with wired packet networks such as the Internet which has high rate of packet loss. Where wireless channels are typically has high rate of burst errors or bit errors. High packet Loss rate results on a very bad effect on the quality of the reconstructed video. To tolerate the effect of packet losses, a video streaming application is implemented with a kind of error control features.

Literature review: Ipv6 (Tai *et al*., 2011) is the successive version of Internet Protocol version 4 (IPv4). It has been considered as the successor to IPv4. The Internet Protocol version 6 (IPv6) was introduced to be the standard for the next-generation Internet Protocol from the three major candidate protocols that were participating. Theoretically, IPv6 uses a 128-bit address, allowing Addresses which is approximately 3.4× Addresses, this wide range can introduce more than 7.9× Times as much as IPv4. Two new field are added to the IPv6 protocol headed which can be used as features for implementing and enhancing QoS these two fields are Flow label field and traffic class field. Figure 2 show the fields of IPv6 header.

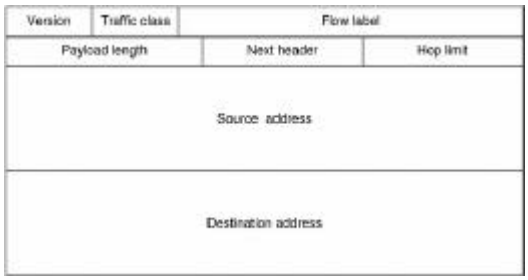

Fig. 2: IPv6 header fields

Flow classification in IPv4 header is based on the four fields: the source IP address field, the destination IP address field, transport layer protocol field and port number field. However, using encryption or when fragmentation happens some of these fields may be unavailable. To avoid these kinds of problems, the header of IPv6 provides a flow classification based on three fields: these field are flow label field, Source address field and destination address field, which has a predefine location in the IPv6 header. The flow label field (Tai *et al*., 2011) size is equal to 20 bits where the size of the traffic class field is 8 bits. This field is used by source hosts or intermediate router to specify the class of service and to provide priorities for IPv6 packets. Traffic class of IPv6 function is similar to the IPv4 Type of service field.

- It reduces and decrease the average processing load that router performs in for each packet to control the QoS, so this load reduction will reduces end-to-end delays of the packets
- The resources reservation using flow label field reduces the problems caused by dynamic route changes
- Using flow label field can facilitate the process of implementation of different mechanisms which can control the route flow or path based on QoS parameters and metrics

Related work: Different researches have been proposed to use flow label field to control quality of service over IPv6 for different purposes. The following table summarize the latest work where rersearchers illustrate the title of each study, the publication date, methodology, expected advantages and disadvantages (Table 1).

Based on the latest research methods related to QoS over IPv6, there is no research topics propose a specific customization of flow label field to meet the requirements of video streaming. So if we can customize the 20 bit flow label field to provide different classes of QoS that support different video quality it will be a new contribution in the field of enhancing video streaming over IPv6 networks.

Research objectives: The research objectives are as follows:

- To enhance the video streaming quality by ensuring QoS over IPv6 networks
- To maintain minimum accepted of throughput , and maximum accepted delay and packet loss
- To maintain QoS of video streaming over layer 3 routers using Flow label of IPv6 header

Research scopes: The scope of this project is to enhance the quality of service using the flow label field of the IPv6 header. Different approach has been proposed to enhance the quality of service using flow label field. The video streaming quality of service has a special consideration related to the parameters that affected the quality of the video streaming. Optimizing the flow label 20 bit filed to support variant video quality classes based on different values of the affected parameters. These parameters include bandwidth, delay and packet loss.

MATERIALS AND METHODS

As we have explained the problems that faces videos streaming. We are planning to customize flow label field to take into consideration the triple constrains that affect videos streaming quality: Bandwidth, Delay jitter and Loss rate. The 20 bit flow label field can be divided among these three values to specify different level or classes of quality of service. Based on the requirement of video streaming quality at the application layer triple constrains values are set to provide the least acceptable parameters that guarantee the quality of video streaming.

By maintaining different acceptable values for different videos quality classes which can be attached to each IPv6 packet and maintained during packet route all over its path to the packet destination.

By this proposed method the quality of each class of video can be maintained with the supplied parameters of the triple constrains. It will suggests new specifications for flow label for more specific flow requirements.

We will study different class for video streaming quality based on videos resolution. We will optimized the 20 bit to properly fit the triple constrains to provide a wide range of service quality. The proposed method will work in network layer where ipv6 header will be added. IPv6 header flow label field will be set to guarantee minimum bandwidth and maximum delay and packet loss accepted. Finally ethernet header will be added to start transmitting.

Network simulator will be used to evaluate proposed method against recent proposed methods. Throughput, delay and packet loss will be considered to measure the

Table 1: Latest work related to research proposal

Study title	Researchers	Years	Methodology	Advantages	Disadvantages
Improving IPv6 Wireless Ad Hoc Networks QoS via Enhanced Flow Label with Stability Based Dynamic Source Routing Scheme (Tai *et al*., 2011)	Wai Yee Tai, Chong Eng Tan, Sei Ping Lau	2011	Proposed scheme utilized the Flow Label in Ipv6 packet header to reserve the resources in order to provide a better performance in the dynamic nature ad hoc network. It is designed for DSR routing protocol	Provides better control for QoS in the dynamic environment of Adhoc and DSR routing protocol.	The problem with this approach that is designed and implemented for adhoc networks and it works only with DSR routing protocols. This doesn't meet the requirements of different network scenarios and environments
Towards Utilizing Flow Label IPv6 in Implicit Source Routing for Dynamic Source Routing (DSR) in Wireless Ad Hoc Network	Yee *et al*.,	2012	They use the Flow Label of Ipv 6 packet header instead of the existing Flow ID in the Source Routing Protocol. They also use it to provide information for the intervening node in addition to providing Quality of service features to the ad hoc network which DSR works o	They provide a solution that combine between using flow label field for both flow identification and quality of service	it is specified for adhoc environment and the flow label field is not use for control Quality of service only but it also is used for other such as maintaining information for the intervening node
A secured flow label based QoS scheme for the evolved packet core in the evolved packet system (Luo *et al*., 2010)	Luo *et al*.,	2010	They utilized flow label in IP v6 to use it instead of barrier identification to overcome the limitation of latest QoS scheme. This approach also investigate the security problem of flow label and provide a novel method to enhance the secured application that use flow label	It provides an enhancement for the secured application of flow label. field.	This schema is mainly focus on the security concerns and this concerns utilize a specific space at the flow
Ipv6 end-to-end QoS provision for heterogeneous networks using flow label (Wang *et al*., 2010)	Wang *et al*.,	2010	Their approach keeps the ability of flow based QoS treatment and control.	It provide a better optimization for Flow label field to provide better control form QoS.	The provided QoS class mapping has consider only the packet loss and the delay parameter and doesn't give any specification related to needed bandwidth
Redefining Flow Label in IPv6 and MPLS Headers for End to End QoS in Virtual Networking for Thin Client (Aazam *et al*., 2013)	Aazam *et al*.,	2013	They investigate the specifications of the flow label and then they describe a novel design for providing QoS. They discussed it by dividing flow label for QoS and specifying bandwidth, delay, and packet loss in an open way	by this approach it would be easy for a flow to decide what to reserve and how much to reserve	This approach focus on MPLS networks and the mapping of Flow Field is designed to work in MPLS networks. Their approach doesn't standardized and defined that how these 20 bits flow label must be used efficiently to allow maximum possible

performance of the proposed method against latest ones. The application layer requirements for video streaming quality will be translated to minimum acceptable parameters value that attached to each packet and interpreted by each router in the path from source to destination. Since IPv6 protocol works ate network layer we can try different type of videos streaming that works in transport and upper layer to compare their performance with QoS implemented by Flow Label in IPv6 header. To evaluate the performance of proposed method an efficient simulator need to be used .OPNET simulator is a tool which is used to simulate the performance and the behavior of any type of network. This simulator support working with OSI model, from layer 7 to the modification of the most basic physical parameters. The difference between this simulator and other simulators is its power and stability.

Video steaming is a very vital and critical service which is provided over the network. One of the critical measurement for such service is its quality. Maintaining a high quality of streaming without noticeable delay or packet loss is very important for making this service more reliable. By customizing flow label field of ipv6 packet header can maintain an acceptable quality of service that maintain videos streaming quality. Specifying the minimum acceptable bandwidth, delay and packet loss can guarantee specific quality of video. The flow label need to be interpreted as the following:

- Flow Label of with all 20 bit are zeros means packets not a part of any flow with QoS
- The flow label is identified by Flow Label, Source and Destination address
- Flow Label value must be maintained and delivered unchanged until it reach its destination
- Nodes that process packets through its path to destination must not do any mathematical or other properties of the flow label values which assigned by the source nodes

Bandwidth (M	Jitter (N bits)	Loss

Fig. 3: 20 bit flow label field optimization

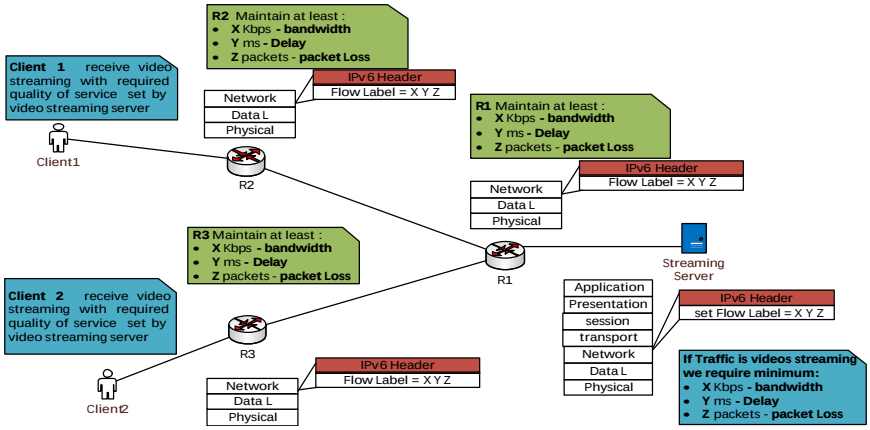

Fig. 4: Network data flow

Figure 3 shows the 20 bit flow label field optimization for providing parameters for triple video streaming constrains.

Figure 4 show the data flow through the network when a streaming server start sending video stream is specify the value of the flow label field based on the class required for the quality of videos that is being sent. When the packet received by a router it check the value of the flow label field and read the parameters of minimum bandwidth, delay and packet loss to guarantee the quality of the videos and send it with this requirements. Finally when a client receive this video it received it based on the requirement specified by the server with maintained quality of service for the videos.

OPNET simulator: OPNET stand for optimized network engineering tools. OPNET simulator is a tool which is used to simulate the performance and the behavior of any type of network. This simulator support working with OSI model from layer 7 to the modification of the most basic physical parameters. The difference between this simulator and other simulators is its power and stability.

OPNET simulator is very powerful when dealing with complex networks that has a big number of devices and massive traffic flows. It can be also used to simulate networks where a little change can have a critical impact. Prior to implementing any new change, it is possible to predict the behavior and to verify the configurations of the devices. OPNET has various tools that allow students to analyze their simulated networks and specify any future implementations they wish to do.

RESULTS AND DISCUSSION

Expected results and significance of study: To evaluate our proposed method we going to build a simulation network of videos streaming servers and receiving clients. The researchers plan to use an existing upper layer protocols and we will compare our proposed method with latest proposed methods in this field that use QoS architecture in IPv6 networks. The performance will be measure based on performance parameters including throughput, delay and packet loss which reflect the quality of the videos being streamed.

Different consideration need to be taken to guarantee a good performance for the process of video streaming as follows:

- Application which can work on transport layer or other upper layers need to have the ability and the tools to specify the exact value of the 20 bit flow label field that meets the class of QoS it want to use
- The network nodes that the traffic pass through must keep the value of the flow label field unchanged on the same value set by the source. Different types of router operating system set the value of flow label field to zeros or change its value
- The optimization of flow label field can result in a better quality of service classes that meet different quality of videos streaming
- Choosing the most suitable network simulator to meet the implementation requirement of proposed method for source node, destination node and routing nodes

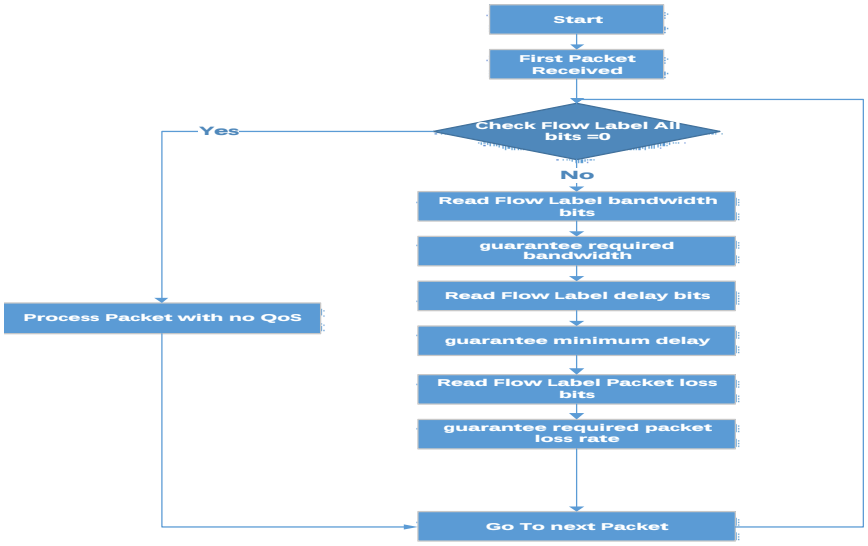

Fig. 5: Flow chart of the proposed method

Researchers expect that the proposed method will enhance the quality of video streaming over IPv6 using flow label field by supporting different quality of video streaming with different requirements.

Figure 5 show the flow chart of the proposed method when a new packet is received the router read the IPv6 header and fetch the 20 bit Flow Label field. It check the value of the 20 bit of all are zeros it router the packet without any QoS specification else it read the bandwidth bits of these 20 bits and guarantee this bandwidth as minimum bandwidth. Then it read the next delay bits and guarantee the minimum delay for sending this packet. Finally it reads the last bits for packet drop and specify the minimum allowed number of packet drops.

CONCLUSION

In this proposal, enhanced flow label utilization method has been proposed to enhance control of video streaming quality over IPv6. This method will optimize the 20 bit flow label field to meet the constrains of video streaming by specifying the minimum acceptable values of bandwidth, delay and packet loss for the corresponding quality of video.

This method is designed basically to deal with video streaming parameters to guarantee a specific range of quality so we expect that this method will enhance the quality of video streaming over ipv6.

Proposed method can face various limitations and problems, source node must provide means for the application and transport protocols to specify the flow label values to be used with their flows and also be able to select unused flow label values for flows. The second limitation is the ability of the network nodes that the traffic pass through to save the value of the flow label field unchanged on the same value set by the source. Different types of router operating system set the value of flow label field to zeros or change its value.

The optimization of flow label field can reflect in a better quality of service classes that meet different quality of videos streaming.

Further advances by use the traffic class field with the flow label field can result in better performance and provides a wider range for video streaming parameters.

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