# INTEGRATING MULTIMEDIA SERVICES OVER SOFTWARE DEFINED NETWORKING

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**Abstract -** *This paper proposes a methodology, which aims to improve the reliability of multimedia streaming while reducing the utilization of server resources. Software Defined Networking (SDN) posses a centralized SDN Controller enabled with OpenFlow protocol that monitors every node in the network. It optimizes video delivery using an algorithm (Scalable Video Coding) that sends layers of different bitrates via discrete paths. The optimal path is determined using LARAC algorithm. The OpenQoS can guarantee seamless video delivery with little or no video artifacts experienced by the end-users. HTML5 browser display embeds videos into the server. This allows everyone to access the media files irrespective of their platform, device, or browser. A powerful Amazon Web Server (AWS) and Adobe Media Server are deployed. Also guarantees the viewer with an alternative version of full functionality in case the less important segments are lost or discarded. It implements a resilient method for packet loss by utilizing independent paths. This transmits the multimedia files from one system to another connected over a distributed network.*

***Key Words***: ***Software Defined Networking (SDN), Quality of Service (QoS), OpenFlow, Open QoS, Scalable Video Coding (SVC), Lagrange Relaxation based Aggregate Cost (LARAC), Amazon Web Service (AWS), Streaming.***

## 1.INTRODUCTION

The networking elements have been turn into a significant element in almost all human activity. So, there is increase in the number of devices as well as amount of traffic in network is exponentially growing. The new inventions need to change the inflexibility of traditional network. The key technique of SDN is OpenFlow, which provides additional configuration options in the data plane. The principle of communication between data plane and control plane is allowed by the OpenFlow design and also permits the complete network to be controlled through Application Programming Interface (API).The networking foundation together with Open ONF is committed for promoting and adopting OpenFlow specification.

This realization of OpenFlow eliminate the drawbacks of severity of static protocols, open the possibility of fast Improvement and led research community to extend new paradigms. This paper presents an analysis of five policies such as route management, route discovery, traffic analysis, call admission and topology management.

The fast failure recovery mechanism is implemented in OpenFlow which will competent of recovering from connection failure using different path. The control plane in SDN not only performs forwarding of packets but also link alteration at a data level infringement the difficulty of layering. So this leads to remuneration in Optimizing network configuration and enhancing network performance. It also provides network programmability and capability to identify isolated virtual networks by means of control plane.

## 2. RELATED WORK

This section we discuss various proposed architectures, frameworks and routing algorithms based on SDN. These target various network aspects such as virtualization, scalability, Quality of service network management, programmability and service assurance.

Software Defined Networking (SDN) is a networking paradigm where the control and the data plane are decoupled and is logically centralized and programmable through interfaces.

QoS routing technique to optimize multimedia traffic dynamically based on the user needs is done by the implementation of LARAC algorithm.

An optimization framework for the OpenFlow controller using scalable video coding algorithm provides QoS support for scalable video streaming.

## 3. PROPOSED WORK

The key design goals for designing the proposed work are as follows:

- To create an **Open-flow enabled switches** (laptops) for streaming the multimedia file .
- To design an efficient routing algorithm to guarantee route management and route calculation and a method for optimizing video delivery over SDN based on open flow.

In this section the method for encoding videos dynamically from the server-side to stream them over a network is performed. We have used HTML5 for encoding videos in the server side and PHP script on the server-side can now handle the HTTP range requests normally and the progress controls no longer freezes. The video captured from webcam or any video file chosen are multi-casted over internet using HTTP. The video is fragmented using **Scalable Video Coding** algorithm that sends layers of different quality via discrete paths. Then, Setup a SDN network with four laptops which is connected through open-flow enabled switches. Optimal network connection is chosen to route fragments dynamically using LARAC algorithm.Stream the video over the HTTP response to the multiple devices by incorporating route management and route calculation.The fragments are then combined to form proper visual format and the clients are provided with end-to-end QoS added to the controller for better live streaming of multimedia.

## 4. ARCHITECTURE

In this section, we present the main components of integrating multimedia services over SDN and how they are inter-related with one another. The Figure comprises multimedia services, a SDN controller, SVC encoder and decoder, client and server.

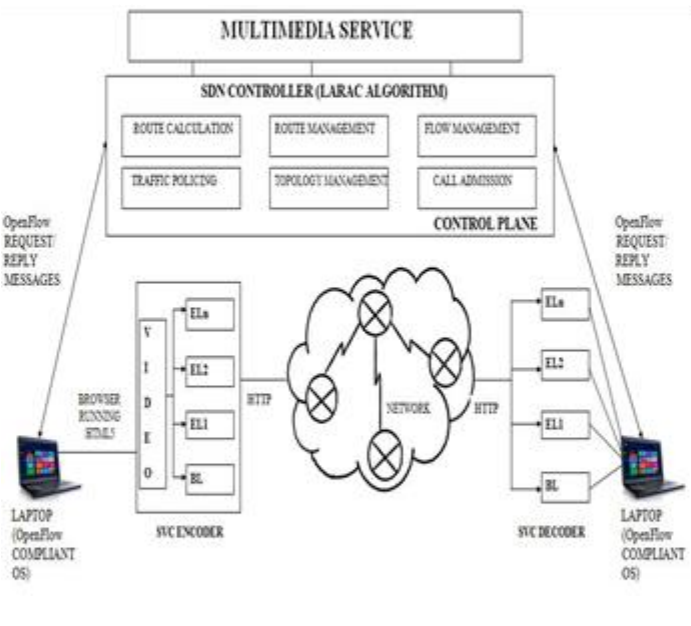


**Fig-1: Architecture diagram**

In the SDN controller the LARAC algorithm is implemented which manages six principles such as route management, route calculation, topology management, flow management, traffic policing and call admission. When the server receives request from client for video, the server will stream the video through a scalable video coding encoder which splits the input video sequence into complementary layers. The layered structure of scalable video content can be distinct as the combination of a base layer and several additional enhancement layers. The base layer corresponds to the lowest supported video performance, whereas the enhancement layers allow for the refinement of the base layer. When a receiver in a slow-bandwidth network would receive only the base layer, hence producing a video (15 frames per second, labeled as fps). On the converse, the second receiver in a network with higher bandwidth can process and combine both layers, which yields a full-frame- rate (30 fps) video and eventually a smoother video. The SDN controller which is based on OpenFlow that allows server to tell where to send the packets the LARAC is used for finding the congested and uncongested path to produce a optimal path.SDN controller uses the OpenFlow reply/request messages to communicate with the server.

## 5. STREAMING MULTIMEDIA

### 5.1 Network creation

In this module a sample network (torus network) is created in Mininet simulator. The torus network consists of switches at each corner. In this module, the controllers are decoupled which are residing along with data plane into a centralized SDN switch controller. Here 127.0.0.1(localhost) acts as the SDN controller. Every individual switches are then added to the controller and are globally managed by the controller. In this, the centralized controller can have access to all switches connected to it.

And, the switches are OpenFlow enabled. So, this whole network resembles to a Software defined network which results in reliable transmission of data packets. And then, the torus network is tested with multimedia streaming functions. Intent is added with the source and destination. The network shows the optimal path between the source and destination. The same can be implemented in real network conditions. In this module, ONOS has to be initialized. A cubical network with 4x4 switches is constructed. Using mininet 64 switches are interlinked forming a visual pattern. Hosts are pinged with the switches.

Command for creating a torus network in mininet:

**sudomn –topo=torus 4,4--controller remote**

### 5.2 LARAC ALGORITHM IMPLEMENTATION

The LARAC algorithm is a very proficient approximation algorithm that make out the integer relaxation of the CSP problem (RELAX-CSP) and is a geometric approach. The purpose of a minimum cost path a source node to a destination node of a network to the condition that the total delay of the path be less than or equal to a specified value. The shortest path is calculated based on link costs. The optimal path is obtained if delay constraint is met, or else algorithm provisions the path as the latest infeasible path. Then the shortest path is determined based on link delays. The SDN controller is a logical entity that monitors the OpenFlow enabled switches by sending OpenFlow FEATURE_REQUEST and FEATURE_REPLY messages. In this module, the feasible links are analyzed. The LARAC algorithm is used to find the path link where the shortest (minimum hops) is calculated. This path is concluded as the most efficient link for transfer of data packets between the switches. The flow table that contains all the possible links (paths) between the switches is maintained by a centralized controller. At the end of this module, an intent (Connection) between the hosts is created. The controller has a buffer that stores the link statistics. The controller determines the optimal path specified in the flow table. If the current path is congested, then it finds the next optimal path. The congested path is in which 75% (or more) of the bandwidth is already utilized. Using this LARAC algorithm, the optimal path is provided by the centralized controller to the switches where there is no congestion. In this optimal path there is no traffic and provides easy transmission of data packets to the switches.

### 5.3 SET UP TO STREAM A VIDEO

Web server creation is performed by registering in Amazon Web Service and log in into AWS to access Amazon services. For creating EC2 instance choose EC2 under compute service. When EC2 instance is launched from a chosen (Amazon Machine Image), instance will be booted with preferred OS. Configuring security groups are used to add IP addresses which forms a network to access the instance. The concept of a scalable video encoder is to split the single-stream video in a multi-stream flow, often referred to as layers. Scalable video coding (SVC) encoder encodes the input video sequence into complementary layers. So that receivers can choose and decode different number of layers each related to discrete video characteristics along with the processing constraints of both the network and the device. The layered structure of scalable video content can be distinct as the combination of a base layer and several additional enhancement layers. The base layer conforms to the lowest supported video performance, while the enhancement layers allow for the refinement of the base layer. When a receiver in a slow-bandwidth network would receive only the base layer, hence producing a video (15 frames per second, labeled as fps). On the converse, the second receiver in a network with higher bandwidth can combine both layers and progress, which returns a full-frame-rate (30 fps) video and finally a smoother video. The addition of enhancement layers enhances the resolution of the decoded video sample, so when the supplementary layers are made accessible to the receiver, the high resolution of the decoded video and user's quality of experience is achieved.

### 5.4 OPENQoS FOR DELAY ANG JITTER REDUCTION

To optimize multimedia video delivery with little or no video artifacts by adding route management and calculation and traffic policing is done at earlier stages. The comparative study is performed to address the reduction in jitter, bandwidth and latency in SDN. The enhancement layer is requested by client based on the quality of video by performing SVC client implementation. If the client demands one base and two enhancement layers, then clients send an HTTP GET message to the corresponding ports of the server at the same time. Hence, the client throughput is maximized since it does not have to wait downloading packets of a video layer to request the next layer packets for a segment. In order to calculate throughput, a new method is formulated. Suppose the client request base and n enhancement layers. Let tdt represents the total time to download base and these n enhancement layers. The calculation of throughput and tdt for the requested segment is performed according to the formula given in (2) and (3), respectively. In the formulas, e i represents the i th enhancement layer, b represents base layer. x last t is the receiving time of the last packet of x th layer, t request is the sending time of the request and br x is the bit-rate of the x th layer. This mainly focused on calculation of delay and jitter reduction. The comparison of Software Defined Network and the traditional network based on calculation of delay and jitter. Optimize multimedia video delivery with little or no video artifacts by adding route management and calculation and traffic policing. The client decides to request one base and two enhancement layers and send an HTTP GET message to the corresponding ports of the server at the same time. Hence, the client throughput will be maximized while it need not have to wait for downloading packets of a video layer to request the next layer packets for a segment.

## 6. EXPERIMENTAL SETUP

To demonstrate the performance of our OpenFlow enabled network devices, we have constructed an experimental setup of a network as shown in Fig.6. Throughout the tests, we streamed a video file of size 450 KB having a resolution of 1024 × 768. We embedded the video using HTML5 browser view. The video is encoded at different bitrates using SVC Encoder at the browser end.

The Base Layer (BL) is streamed at 1800 kbps. The Enhancement Layer 1 (EL1) is

streamed at 900 kbps.

The Enhancement Layer 1 (EL2) is streamed at 150 kbps.These three streams are transmitted from the controller to the receiver ends.

### 6.1 NOVEL CONTROLLER DESIGN

We propose OpenQoS controller that enables six services for multimedia delivery. The services include Route Management, Route Calculation, Flow Management, Call Admission, Traffic Policing, Topology Management.
The SDN controller is a logically centralized entity. It monitors the link statistics of the network by sending FEATURE_REQUEST messages to individual nodes. The nodes in return send a FEATURE_REPLY message. These messages are forwarded using OpenFlow Protocol. The controller maintains two different flow tables to enhance video streaming. The two Flow Tables are,
Best Effort Flow Table and QoS Flow Table.
The Best Effort Flow Table maintains the paths that are shortest from the source. The shortest path is calculated by considering the number of hops (Hop Count) from the source to the intended destination. The Dijkstra's algorithm is used to calculate the minimum cost. This algorithm calculates the distance between the source and all possible destinations. It considers the source node cost as 'Zero' and all other possible node cost as 'Infinity'.
The QoS Flow Table determines the capacity of various links. It selects a path only if it can satisfy all the services assured by the QoS parameters. If the controller cannot satisfy the QoS parameters for a requester, then it rejects/block the call. The QoS paths have larger capacity but longer distance.

### 6.2 ADAPTIVE STREAMING OVER HTTP

The video file of size 450 KB is embedded into the Web Server (AWS). The multimedia file is to be bit-streamed adaptively at various bitrates. The streaming is done by using a SVC Encoder that separates the video content into multiple layers. Each layer corresponds to a video file of particular bit-rate. The Base Layer (BL) is the mandatory layer which is transferred first. The Enhancement Layers (EL) adds quality to the video.
The BL is streamed via the path having the highest capacity i,e 1800 kbps. This layer is transferred using the QoS Flow Table. The next enhancement layers are transmitted via paths having the next higher capacity i,e 900 kbps[17]. This layer is forwarded using Best Effort Flow Table.
An Amazon Web Server (AWS) and Adobe Media Server are hosted in the server end. The AWS server streams the video over HTTP to the client end.

## 7. CONCLUSION

Hence, in this paper we proposed a methodology to optimally stream video by restructuring SDN with enhanced services such as route management and route calculation etc. While comparing to the traditional network, we added functionalities to the software defined network by incorporating SVC and LARAC algorithm to minimize the delay and jitter in the network.

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