HIGH SPEED NETWORK DESIGN

[EE_660]

Homework 1

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Abstract

To study the behavior of TCP and understand network requirements of video on demand services such as YouTube. The impact of network impairments such as packet error rate, burst error rate latency, bandwidth limitations are to be investigated suitable to be used as requirements for a new wireless network interface to be designed.

Introduction

Video on demand (display) (VOD) are systems which allow users to select and watch/listen to video or audio content when they choose to, rather than having to watch at a specific broadcast time. IP network based deployments of interactive video-on-demand (VoD) systems are today very limited in scope, but there is a strong belief among telecommunication companies that this market will expand exponentially in the next few years. Network parameters such as bandwidth, latency, packet errors play a huge role in delivering the right content to the users and hence we experiment these characteristics of a network to achieve suitable tradeoffs.

Methodology

1- Setup the experiment
2- Start a movie or TV show of your choice on YouTube or any other server
3- Monitor and record the bandwidth consumed by the traffic. Also record the video characteristics (encoding rate, type of video etc,) and user experience (picture quality etc.)
4- Change the packet error, latency and bandwidth parameters and record the experience

Experimental Setup

Tools Used-

1- Network Emulator
   Is a software-based emulator which can emulate the behavior of both wired and wireless networks using a reliable physical link, such as an Ethernet. A variety of network attributes are incorporated into the emulation model, including round-trip time across the network (latency), the amount of available bandwidth, queuing behavior, packet loss, reordering of packets, and error propagations. The tool also provides flexibility in filtering network packets based on IP addresses or protocols such as TCP, UDP, and ICMP.

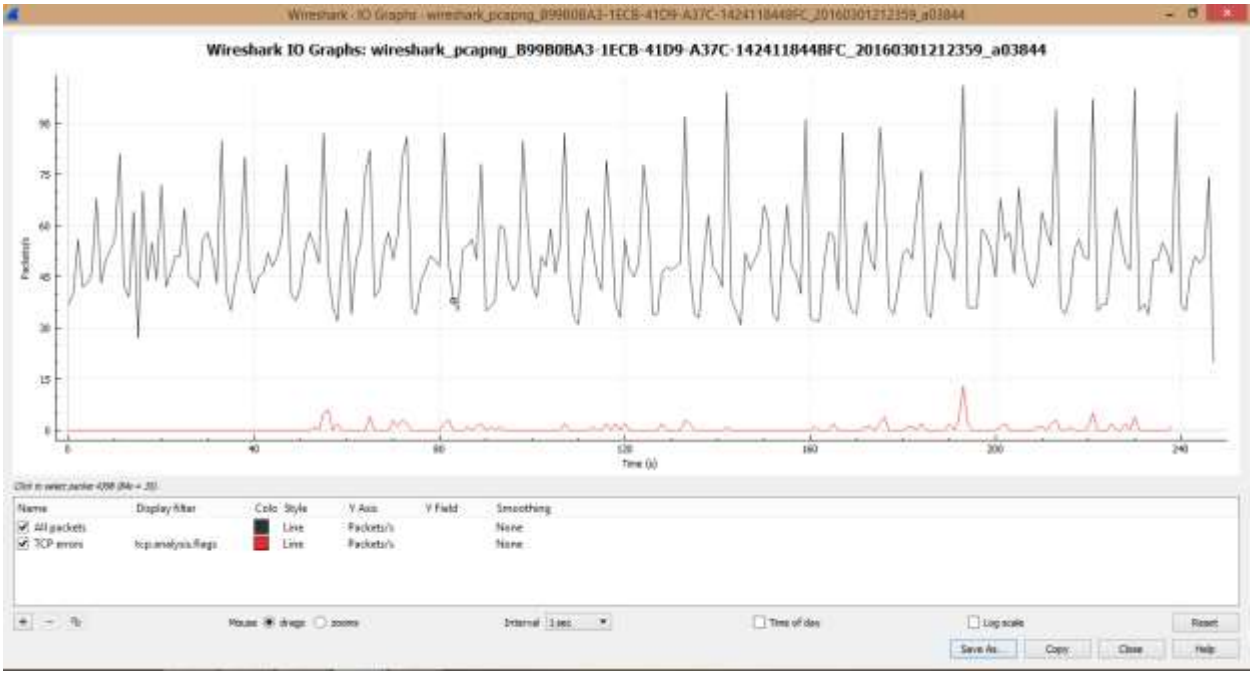
2- WireShark

   Wireshark is a network or protocol analyzer (also known as a network sniffer).It is used to analyze the structure of different network protocols and has the ability to demonstrate encapsulation. The analyzer operates on Unix, Linux and Microsoft Windows operating systems, and employs the GTK+ widget toolkit and pcap for packet capturing.

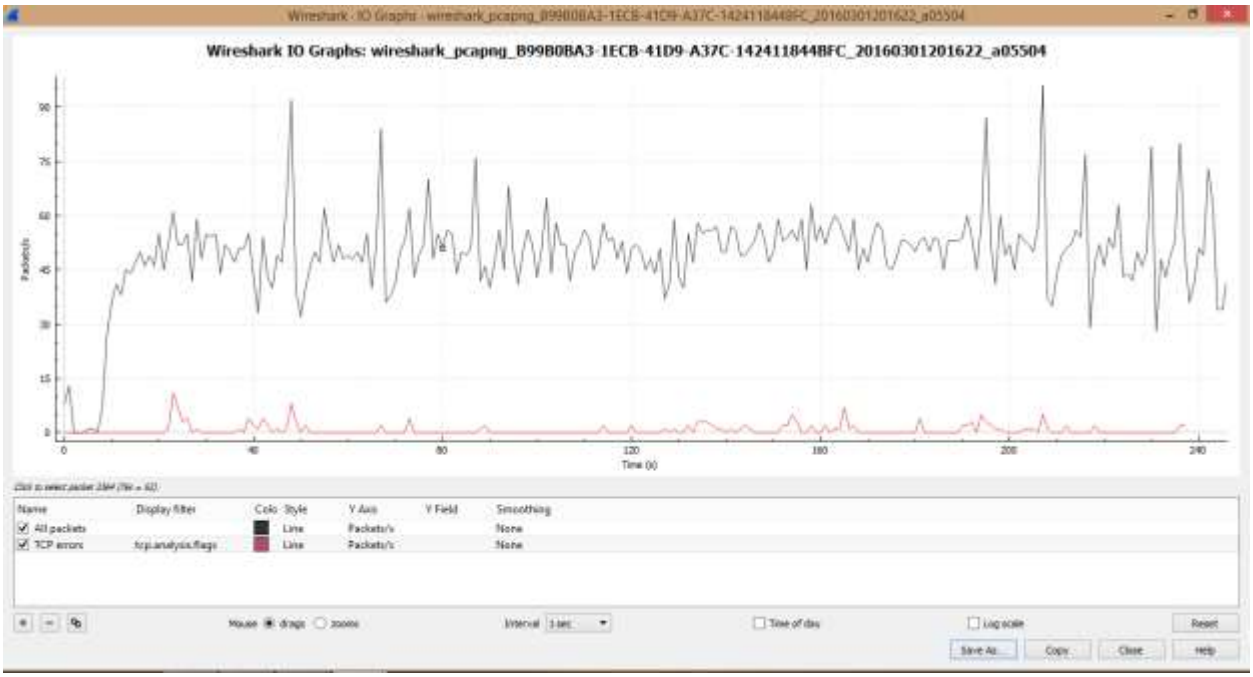
Observations

Experiment 1: To inject packet errors into the channel and observe bandwidth characteristics

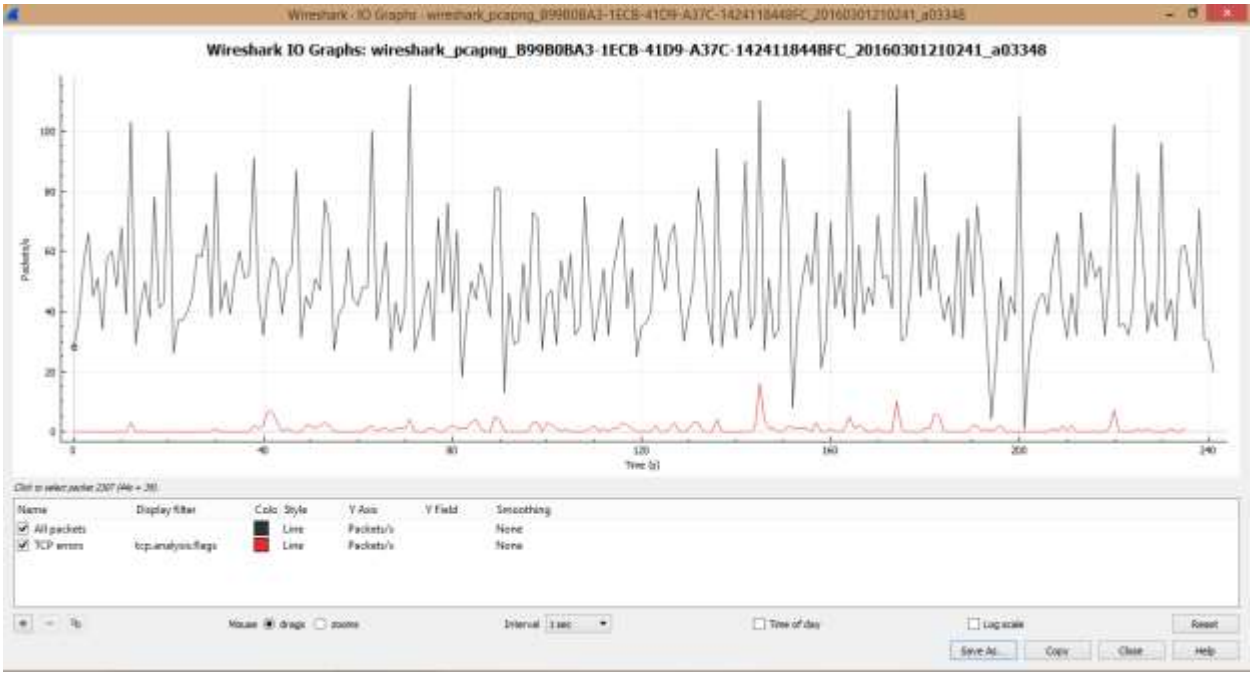
Case1- PER : 10E-5



Case2- PER : 10E-4

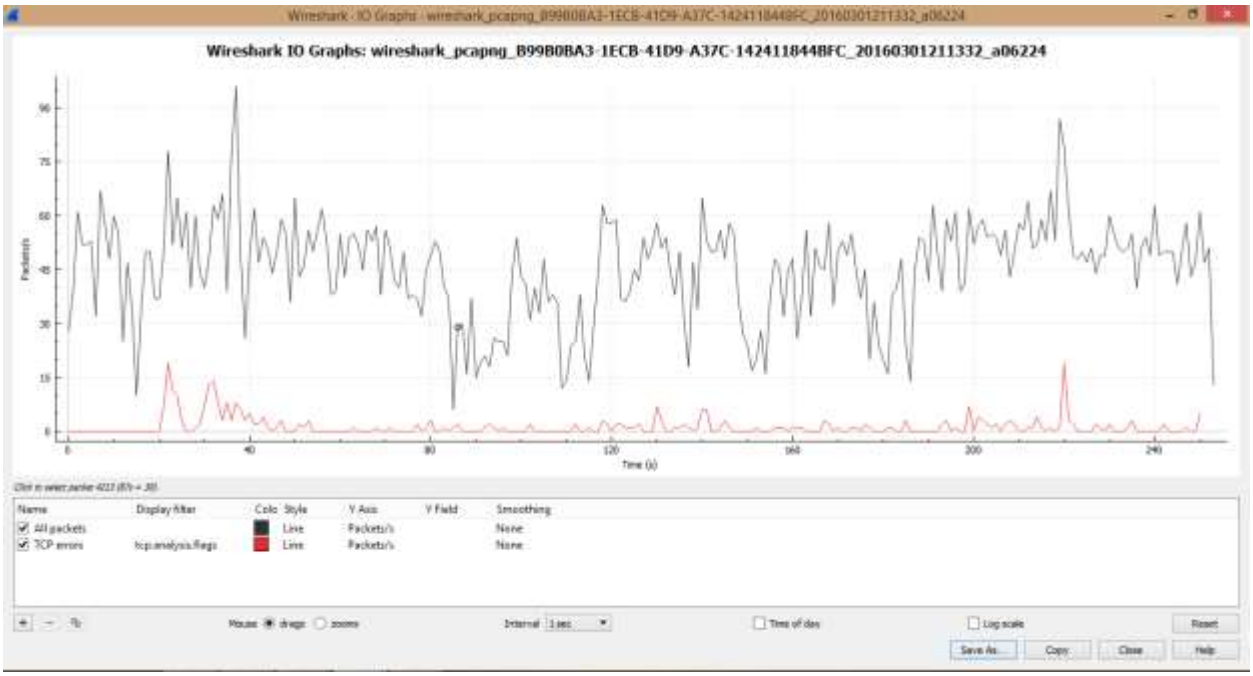


Case3- PER : 10E-3



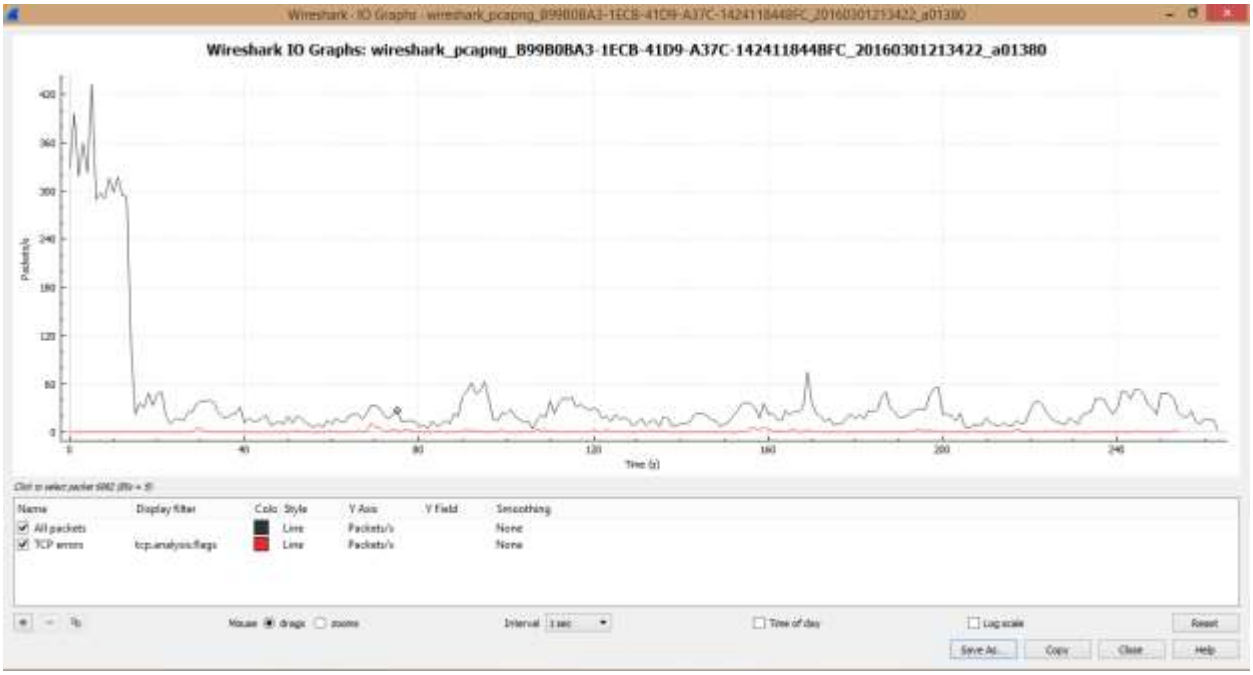
Case4- PER : 10E-2

Case5- PER : 10E-1



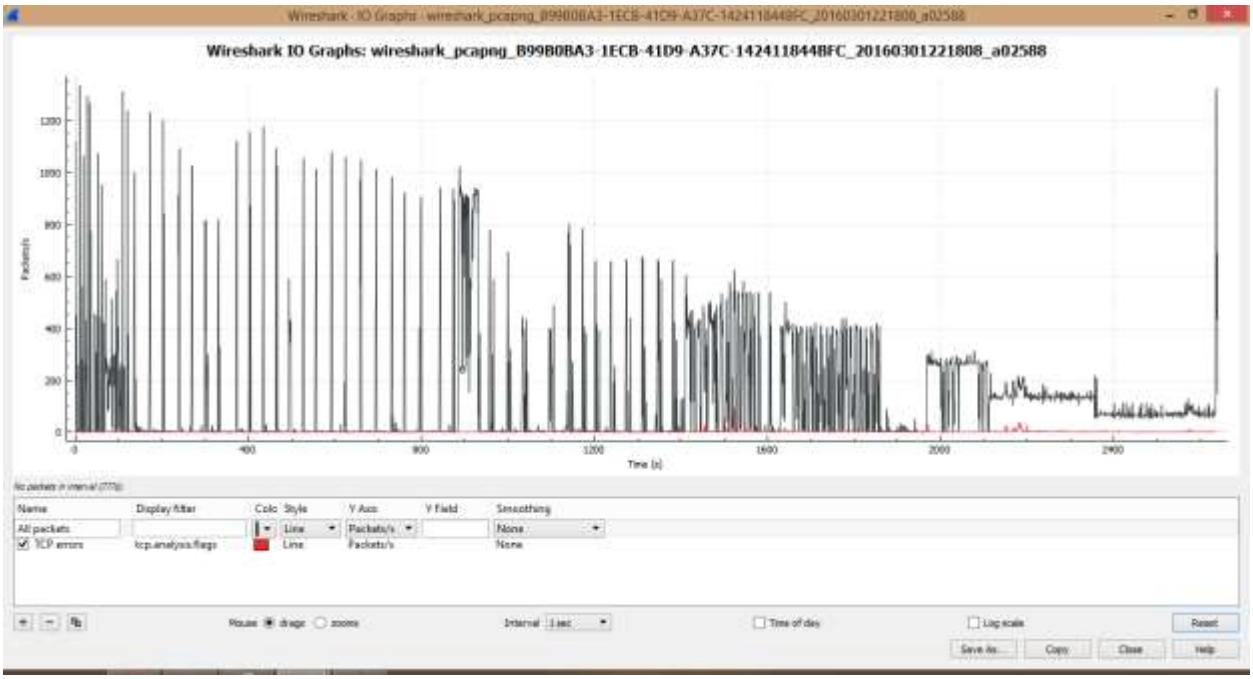
Introduction of packet errors causes significant damage to the video. The video slowly starts to fade and the quality diminishes to an extent where it is almost very unclear. Picture quality considerably degrades with introduction of more errors into the channel. This can be clearly observed by the video diminishing and pixelating.

Experiment 2: To inject packet delays into the channel and observe bandwidth characteristics



From the graph it can be clearly observed that bandwidth is inversely proportional to the delay. With increased number of packets waiting to be delivered, the video slowly starts to buffer. There is increased time in loading the video which wastes a lot of available bandwidth.

Experiment 3: To limit the bandwidth of the application to 10 Mbits/Sec < BW < 500 Kbits/sec with steps of 1 Mbit/sec decrementing the bandwidth every 4 minutes



The above graph is a representation of the bandwidth v/s time. By limiting the application bandwidth and gradually decreasing it, the video quality degrades to an extent where there is a significant difference between the high and low bandwidth scenarios.

Conclusion

It can be observed from the above graphs that delay, bandwidth and packet errors play a significant role in the network transmission. While a small change in the value doesn't make much of an impact, the video quality largely diminishes beyond a threshold and impacts the user perseverance.

It can be noted that audio quality does not vary as much since audio is less bandwidth hungry unlike the video applications. Thus, these network parameters play an important role in video streaming and there is always a tradeoff between the available resources and the network parameters.