

# Assignment 1

**Objective:** The goal of this assignment is to perform experiments and analyze results to see the performance trade-offs between TCP and QUIC. As part of this assignment, you will perform experiments in terms of page load time (or file download time) of various file sizes and under various network bandwidths.

**Setup:** For this, first setup a client-server testbed and run tc/netem to emulate various network conditions. Get hold of two different physical machines (don't run them on virtual machines as the results can be very different, and you won't be able to capture the true behavior of TCP and QUIC). Use ethernet communication, not WiFi, as you won't be able to get 1000Mbps on a WiFi connection. Set up a client-server testbed using:

- a) Chromium standalone QUIC server for QUIC.
- b) Apache server for TCP.

*Run both the servers on the same machine.*

## Analysis:

1. Use **PLT**(Page Load Time) as a performance metric for comparing TCP and QUIC
2. Report CPU utilization while performing the experiments.
3. For each scenario, draw a heatmap graph of TCP QUIC comparison very similar to “*Taking a long look at QUIC*” paper

## Experiments:

Compare TCP and QUIC performance :

1. Across various object sizes [5KB, 500KB, 10Mb, 50MB] and across different network bandwidths [1Mbps, 10Mbps, 150Mbps, 1000Mbps]. Draw the heatmap and figure out configurations of object size/file size and network bandwidth where
  - a. QUIC outperforms TCP by a significant margin,
  - b. TCP outperforms QUIC by a significant margin and
  - c. They are mostly similar. [3 +3 +3]
2. Use the configurations obtained from the previous experiment and introduce losses, delays
  - a. With different packet loss percentages [0.1%, 7%, 10%]. Draw the heatmap. [3]
  - b. With 112 ms RTT and with 10 ms jitter, that causes packet reordering. Draw the heatmap [2]
3. Take 700MB object size and network bandwidth of 1000Mbps. Monitor the CPU utilization for TCP and QUIC. Plot a graph of CPU utilization and throughput with time. For this, you need to collect a packet trace along with a script/program to monitor CPU utilization continuously. [4]

**Bonus question:** Perform the 3rd experiment on a mobile phone and analyze the results. Connect to WiFi that can give you 200Mbps+ throughput; depending on the space left on the device, you decide to download a 100MB file. Figure out a way of getting CPU utilization on the device. [2]

Create a report of each experiment type and its result. Analyze the results and explain the reason behind your observations.