Assignment 3

Queueing in the Linux Network Stack

Due: 22-10-2023

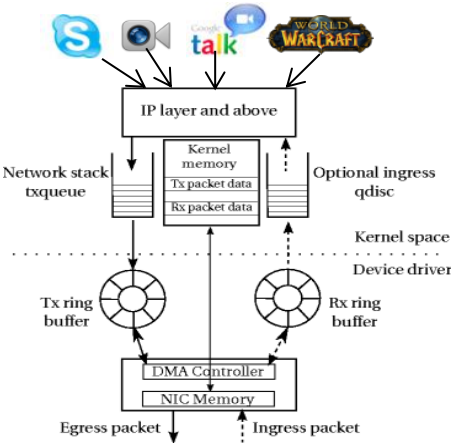
Basics

In this assignment, you'll understand the importance of packet queues in a networking system. Packet queue is a core component of any device that is connected to the Internet. It allows asynchronous modules to communicate, increase performance. However, it has somehow a side-effect, which is simply latency. This assignment aims to explain where IP packets are queued in the Linux network stack and how to control buffering for reduced latency!

This is an individual assignment and has to be done without the assistance of others.

Getting Started

You are encouraged to read some tutorials on Linux queueing system before working on this assignment (there is one survey paper on the course website that can be of a good starting point). Then, understand how queueing affects the delay. For example, queue size allocation is an important configuration parameter that determines network performance characteristics. Small queues lead to packet drops when buffers fill-up, degrading network performance. On the other hand, large queues can lead to excessive delays! As per the below figure, between the IP stack and the network interface controller (NIC) lies the driver queue. This queue is typically implemented as a first-in, first-out (FIFO)



Try to observe the effect of the buffering strategies over flow delay from the existing studies.

Consider a simple problem of a packet that needs to be transmitted over a single link. The delay experienced by that packet is a function of the data rate. Thus, there exists a trade-off between the transmission delay and the number of packets being buffered. In this context, the problem of interest is: given certain iPerf traffic, by which they must be delivered, how should transmission queue be allocated? Such that we minimize the amount of delay needed to meet the deadline constraints?

Assignment

In this assignment, you will need to analyze both TCP throughput and delay in wired and wireless networks using iPerf traffic while modifying the transmission queue size in a Linux. You should consider both wired and wireless interfaces. Basically, you will draw a conclusion on how should transmission queue size be allocated so as to minimize the amount of delay needed to meet certain deadlines? A TCP or UDP protocol of your choice can be used.

Deliverables

Students are expected to demonstrate the network behavior and performance metrics as follows:

1. Observe and plot TCP throughput over the wired and wireless channels while manipulating the queue size in Linux.
2. Observe and plot packet delay while manipulating the queue size in Linux.
3. Observe and plot the optimal queue size allocation that minimizes the delay. You may select a reasonable threshold value for the packets to arrive at the destination.

Handing In

All of your code should be in a single application directory. It should be reasonably documented (e.g., explain, at a high level, what each function does if it's not very simple). The directory must have a README that describes your algorithm and how it works. Prepare a 5-8 presentation on the output results and submit a tarball of this directory to the instructor.