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Project3 Experiment

Design

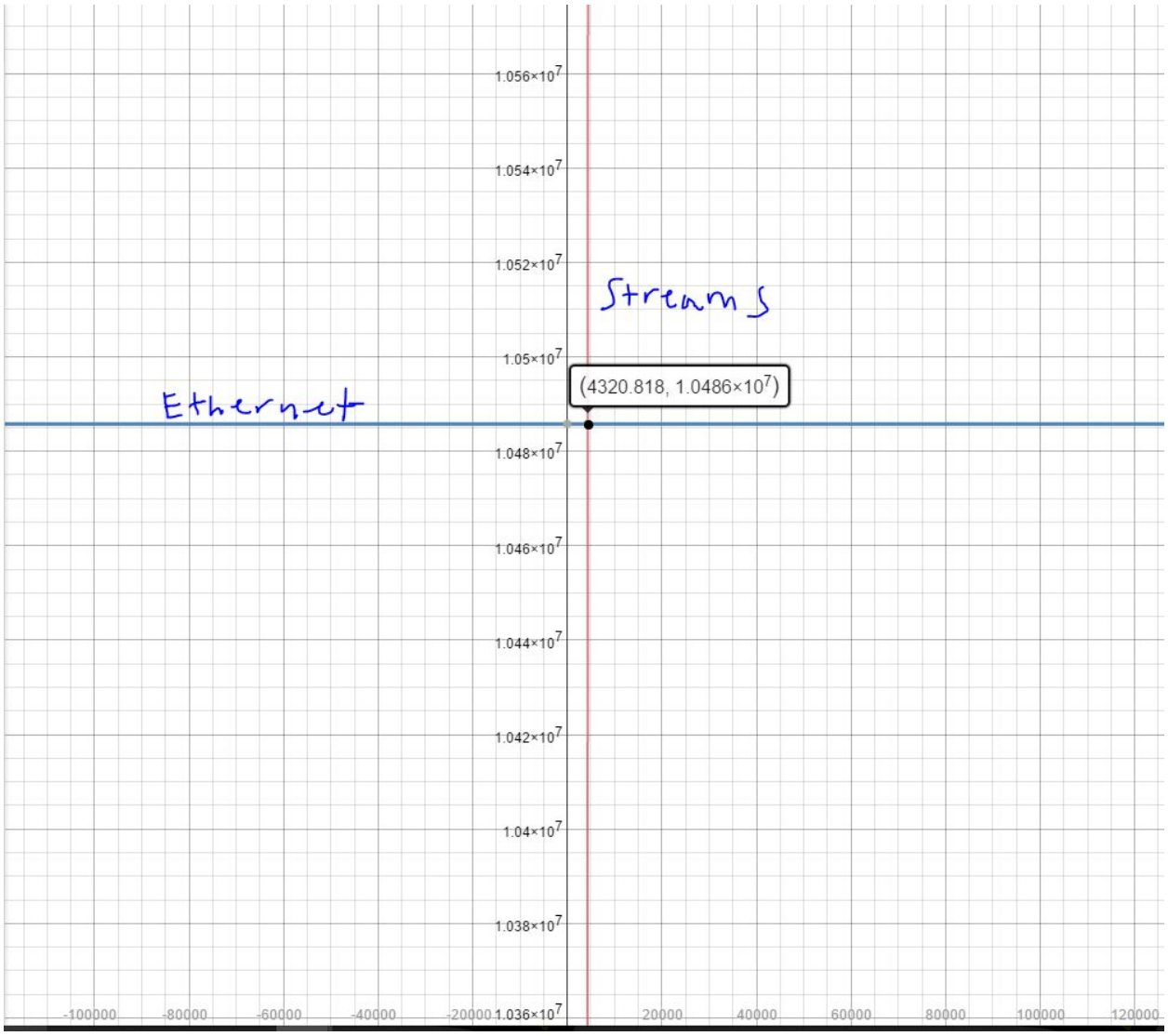
For this experiment, I made these assumptions about the Nutella movie being streamed:
The movie being streamed is "Walk" from the proj3 webpage
Walk is 10 frames long
Walk is approximately 30 characters per frame, and has a total of 379 characters.
One frame is being sent every 2 seconds.
For the LAN network, we will assume that the LAN is completely on Ethernet, and consists of only computers connected to a central router. No other traffic is allowed on this network, meaning that all the bandwidth on the network is available for nutella movie streaming. Also, the router is powerful enough to handle all the networks traffic without significant delays, meaning that streams will travel across the network as if all the computers are directly connected to one another. We will also assume that the ethernet connections in this network have a speed of 10 Mbps, as that is likely to be the bottleneck speed in most modern LANs. [1]
To do find the data rate for the Nutella stream, I loaded the server program onto one computer, and ran the client on the other. On the client machine I ran Wireshark and recorded all packets that transferred through during the runtime of the experiment. I also used a stopwatch to find the average time it took for the client to connect and run the entire movie. Using this time, and the total number of bytes reported transferred by wireshark, I was able to come up with a data rate for streaming a movie using my client. Using the information I gathered above about LAN networks, I was able to calculate the number of Nutella streams that could run on that network. Then, using information gathered from Netflix's website, I was able to estimate the amount of bandwidth Netflix creates per second, and use that to calculate the number of Netflix streams that could travel through my model LAN network at different quality levels.

RESULTS:
PART 1: Nutella data rate
The entire process (locating the server through multicast, connecting, playing the movie, disconnecting) took approximately 20.55 seconds. Through Wireshark, the entire process reported a transfer of 6234 bytes. As a total of 6234 bytes were transferred in total, and it took 20.55 seconds to complete the process, there was an approximate data rate of 303.35 bytes per second **(6234/20.55=303.35) or 2426.8 bits per second**.

PART 2:
LAN Bandwidth = 10 megabits = 10485760 bits

To find out how many Nutella streams could be run on my sample LAN network, I divided the total available bandwidth on the network, 10 megabits, or 10485760 bits, by the data rate I found from my movie transfer above.
10485760/2426.8= 4320.81 = 4320
4320 movie streams could be transferred across the network at once.
A chart comparing an increasing number of streams to the capacity of the LAN supports this data, showing that the amount of data being transferred crosses over the LANS limit right at 4320 streams:

Ethernet Bandwidth vs. Nutella Streams



PART 3: Netflix Streams on LAN
According to netflix's website, people use .3 GB per hour on low quality, .7 GB per hour on medium, and 3 GB per hour on HD. [2]

This means that people use (322122547.2/60)/60= 89478.485 bytes per second on low.
This means that people use (751619276.8/60)/60= 208783.132 bytes per second on medium.
This means that people use (3221225472/60)/60= 894784.85 bytes per second on HD.

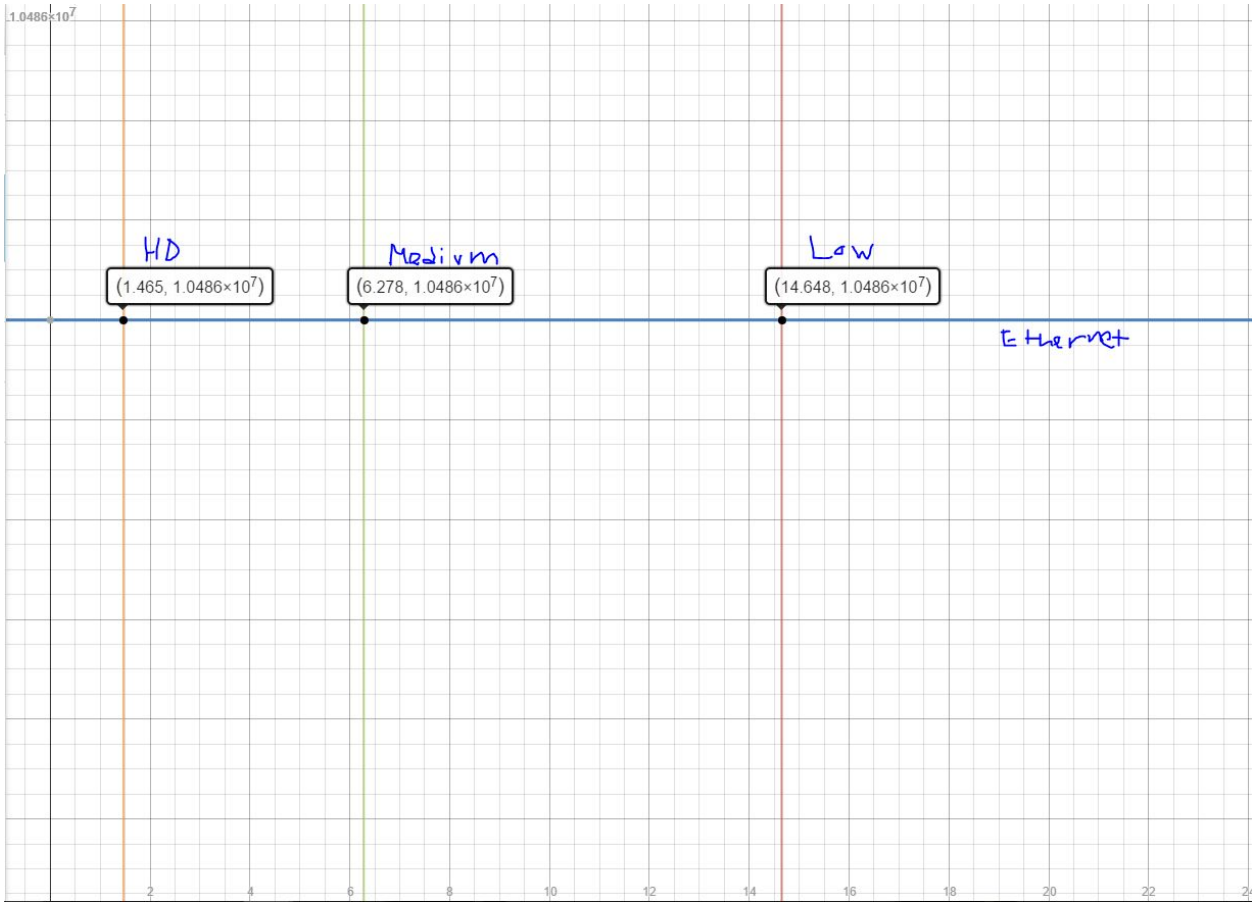
10 megabits = 10485760 bits
89478.485 bytes = 715827.88 bits
208783.132 bytes = 1670265.056 bits
894784.85 bytes = 7158278.8 bits

Using this information, I was able to calculate the number of Netflix streams that could go through the LAN example used above:
Low: 10485760/715827.88 = 14.64 = 14 streams
Medium: 10485760/1670265.056 = 6.27 = 6 streams
HD: 10485760/7158278.8 = 1.46 = 1 stream

From this data, the 10 Mbps network could handle 14 low quality Netflix streams, 6 medium quality network streams, or 1 HD stream at a time.

This data is supported by a graph comparing the ethernet bandwidth to an increasing number of hosts on each level of Netflix's service:

Ethernet Bandwidth vs Netflix Streams



Final conclusions:
With a bandwidth of 10 Mbps, an Ethernet network was able to support 4320 nutella streams (either from one nutella client using multicast or 4320 servers streaming to 4320 clients) at 2426.8 bits per second. This same network was able to handle 14 Netflix streams at low quality, 6 Netflix streams at Medium quality, and 1 HD Netflix stream. This seems logical to me, as a Nutella stream is simply the transfer of a small number of text characters over the network at only a single frame every few seconds. On the other hand, a Netflix stream, especially one at HD quality, is an extremely complicated and large collection of data that needs to be streamed at a very high rate in order for the video to play properly. Naturally, the Netflix streams would be many times more resource intensive than Nutella streams.

[1] http://www.lantronix.com/resources/networking-tutorials/fast-ethernet-tutorial/ “Fast Ethernet Tutorial”
[2] https://help.netflix.com/en/node/87 “How can I control how much data Netflix uses?”