# Ping

1. Min - 99ms, max - 103ms, variance - 4ms

```
C:\Users\uncle>ping -n 10 gatech.edu

Pinging gatech.edu [3.214.16.8] with 32 bytes of data:
Reply from 3.214.16.8: bytes=32 time=101ms TTL=234
Reply from 3.214.16.8: bytes=32 time=103ms TTL=234
Reply from 3.214.16.8: bytes=32 time=100ms TTL=234
Reply from 3.214.16.8: bytes=32 time=100ms TTL=234
Reply from 3.214.16.8: bytes=32 time=99ms TTL=234
Reply from 3.214.16.8: bytes=32 time=100ms TTL=234
Reply from 3.214.16.8: bytes=32 time=100ms TTL=234
Reply from 3.214.16.8: bytes=32 time=99ms TTL=234
Reply from 3.214.16.8: bytes=32 time=99ms TTL=234
Reply from 3.214.16.8: bytes=32 time=99ms TTL=234

Ping statistics for 3.214.16.8:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 99ms, Maximum = 103ms, Average = 100ms
```

2. Min - 249ms, max - 789ms, variance - 540ms

```
C:\Users\uncle>ping -n 10 hkust.edu.hk

Pinging hkust.edu.hk [143.89.12.134] with 32 bytes of data:
Reply from 143.89.12.134: bytes=32 time=250ms TTL=48
Reply from 143.89.12.134: bytes=32 time=250ms TTL=48
Reply from 143.89.12.134: bytes=32 time=249ms TTL=48
Reply from 143.89.12.134: bytes=32 time=264ms TTL=48
Reply from 143.89.12.134: bytes=32 time=386ms TTL=48
Reply from 143.89.12.134: bytes=32 time=422ms TTL=48
Reply from 143.89.12.134: bytes=32 time=789ms TTL=48
Reply from 143.89.12.134: bytes=32 time=586ms TTL=48
Reply from 143.89.12.134: bytes=32 time=506ms TTL=48
Reply from 143.89.12.134: bytes=32 time=325ms TTL=48

Ping statistics for 143.89.12.134:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 249ms, Maximum = 789ms, Average = 402ms

C:\Users\uncle>
```

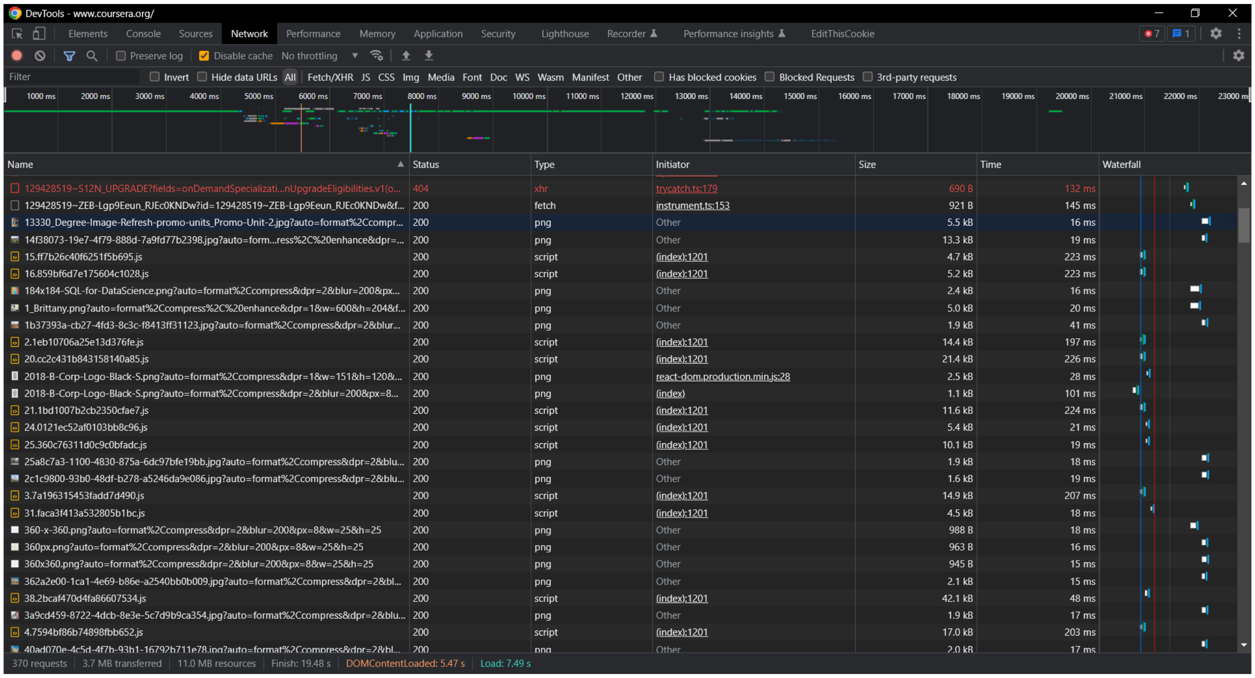
Dist. from Barcelona to Hong Kong: 10,058 km.
Min travel time: 10,058*1000m / (3e8 m/s) = 0.0335266667 seconds.
Ratio: 402ms/33.527 ms = 11.99

3. Min - 293ms, max: 499ms, variance: 206ms

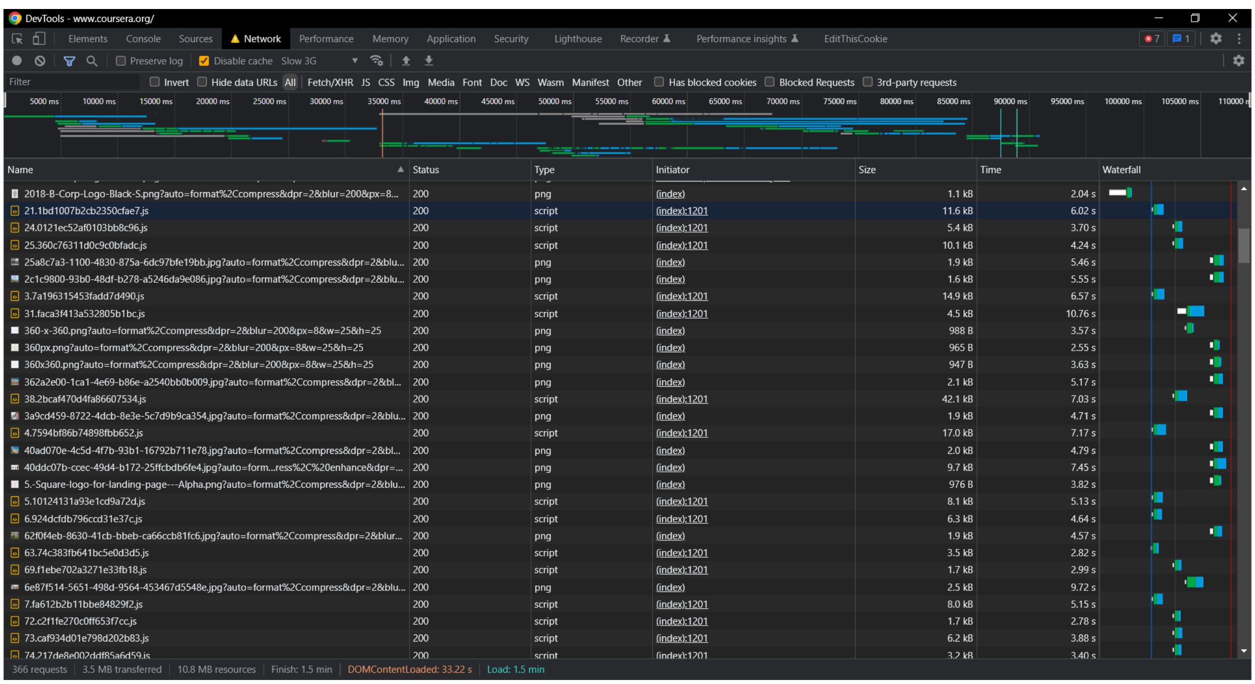
```
C:\Users\uncle>ping -n 10 gou.go.ug

Pinging gou.go.ug [154.72.194.117] with 32 bytes of data:
Request timed out.
Reply from 154.72.194.117: bytes=32 time=293ms TTL=43
Reply from 154.72.194.117: bytes=32 time=344ms TTL=43
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Reply from 154.72.194.117: bytes=32 time=499ms TTL=43
Request timed out.

Ping statistics for 154.72.194.117:
    Packets: Sent = 10, Received = 3, Lost = 7 (70% loss),
Approximate round trip times in milli-seconds:
    Minimum = 293ms, Maximum = 499ms, Average = 378ms
```

   Dist. from Barcelona to Kampala: 8603,700 km.
   Min travel time: 8603,700 *1000m / (3e8 m/s) = 0.028679 s.
   Ratio: 378ms/28.679 ms = 13.18
4. Barcelona → ATL: 256-234 = 22
   Barcelona → HK: 256-48 = 208
   Barcelona → KMP: 256-43 = 213
   Yes, higher hops means higher latency. This is because higher hops often correlate to higher distance, and there's some overhead latency between each hop.
5. I knew what ping was before this, but I did learn what TTL was and how it worked. It's interesting how TTL was used as a time counter before, but now it's simply decremented each hop. I also learned that the Ugandan website often times out when trying to access it from Barcelona on the eduroam network.

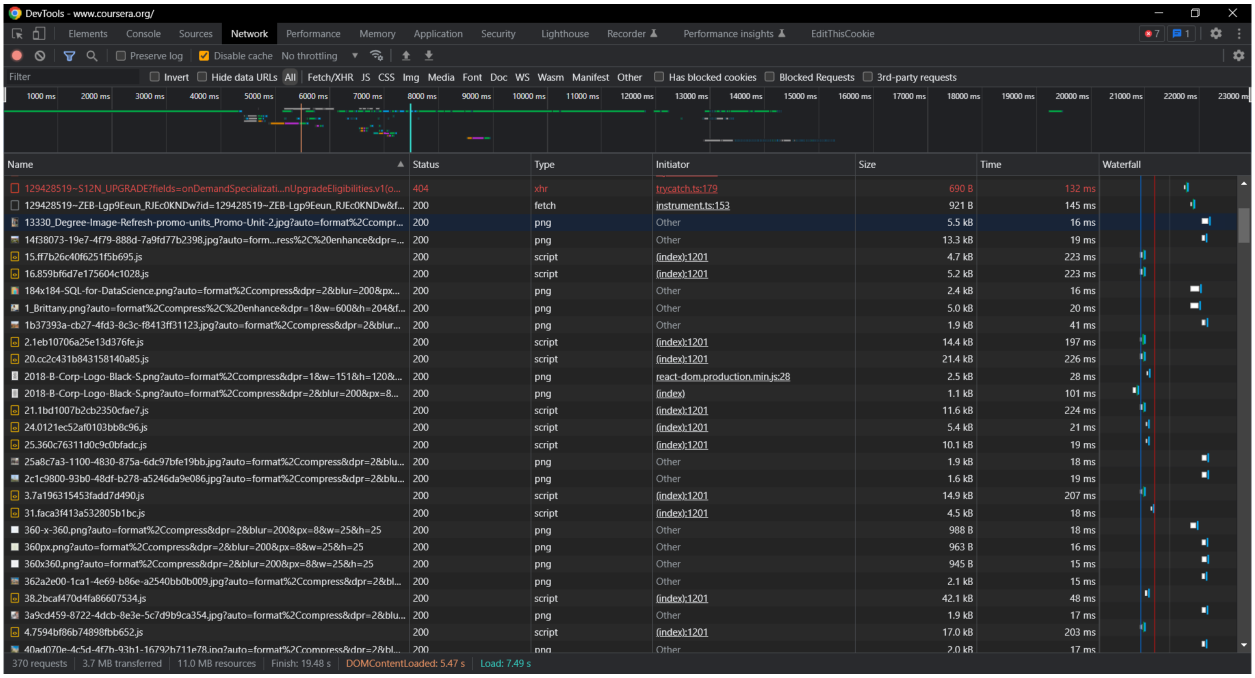
# Web Performance

1. 


3.7MB Transferred, 7.49s total time, bandwidth 493.992 kBps.

2. 


3.5MB Transferred, 90s total time, bandwidth 38.889 kBps.

3. 


3.6MB transferred, total time 10.22s, throughput 352.250 kBps

4. I learned that you can throttle your web performance, disable cache, and get highly detailed reports for the site's statistics and load times, all using the chrome devtools. I also learned how the different network speeds can influence a website's performance. I was surprised how drastic the magnitude between the different tiers of internet speeds were.

# Performance Delay

1. 1000b * 1Gb/1.342e8B = 7.4506e-6 Gb
   7.4506e-6 Gb / 1Gb/1s + 7.4506e-6 Gb / 100Gb/1s + 7.4506e-6 Gb / 20Gb/1s + 7.4506e-6 Gb / 1Gb/1s = 0.0000153502s = **0.0154ms**
2. 0.003ms + `5ms + 15ms + 0.0154ms = **20.183ms**
3. No. 0.003ms + `5ms + 15ms + 0.0154ms = **20.183ms**. This is because the order of the delays has no bearing on the sum total of all delays.
4. 15ms*99 + 7.4506e-6 Gb / 100Gb/1s + 5ms + 7.4506e-6 Gb / 20Gb/1s + 7.4506e-6 Gb / 1Gb/1s = **1490 ms**. The queue forms behind R1.
5. Queue still forms behind R1 because the bottleneck is between R1 and R2. Since the thing that contributes to latency behind the bottleneck is the bottleneck's latency, and no change was made to the bottleneck, the queue still forms behind R1.

# Layering

1. In order of occurrence: version, header length, type of service, total packet length, identification, IP flags, fragment offset, time to live, protocol, header checksum, source address, destination address, and IP option.
2. It’s all 20 bytes. The size of the data packet does not influence the header size. I would need to know the structure of the routers and the average size of each byte.

# Throughput

1. 1 Mbps
2. Still 1 Mbps
3. Still 1 Mbps