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Computer Network Assignment 1

1.1: Application Layer, Transport Layer, Routing Layer, Link Layer, and Physical Layer
1.2: Application Layer is responsible for hosting applications such as web browsers and social networking applications which uses socket API to transfer data. Transport Layer is responsible for reliable end-to-end delivery “between sender and deliver”. Routing Layer is responsible for data transfer between one host and another. Link Layers is responsible for local aspects of delivering data between “a variety of local networks” and end hosts. Physical Layer is responsible for “physically encoding bits as voltage”.

1.3: Application Layer is implemented on “web browser within end host”, since that is only place in which the intended URL is known. Transport Layer is implemented in OS kernel, since TCP and UDP protocols are useful for many web applications. Routing Layer is implemented in end hosts, routers, and gateways, since it encode source and destination address, and routers and gateways need to transfer data “from one network to another”. Link Layer is implemented in “hardware and firmware of Network Interface Card, and switch/AP”, since the above places need to participate in the process of delivering data between local networks and end hosts. Physical Layer is in both NIC and switch/AP since “both ends of cables” work together to deliver data.

1.4: Application Layer: HTTP protocol. Transport Layer: TCP protocol. Routing Layer: Internet Protocol. Link Layer: Address Resolution Protocol (Fairhurst). Physical Layer: Ethernet.

2.1: Low propagation delay and low capacity. The distance between laptop and wireless headphone is short, and capacity of Bluetooth is around dozen MB/s.
2.2: High propagation delay and high capacity. The distance between NY and London is long. Wired connection has high throughput since Ethernet link has high capacity.
2.3: High propagation delay and low capacity. The distance is obviously long and WiFi link has lower capacity in general.

2.4: Low propagation delay and high capacity. The distance is short if it's within a single building. Since it's high-speed network, we would expect high capacity to meet the business need of a large company.

3: IP address after typing ifconfig en0 on Mac: 10.2.204.21. It's a private IP address.
Laptop public IP address: 58.35.143.131 Cellphone public IP address: 58.35.143.131.
They are the same since the home WiFi has a single public IP address that several private IP addresses can map to in order to communicate with the Internet.
Cellphone IP address (with cellular plan): 112.64.68.15. It is different from the previous one (connected to WiFi), since my cellphone is no longer connected to the same private network as my laptop does.

4.3 Measuring Throughput

1: Initial throughput: 13.4KB/s range: [12.2, 46.2] KB/s

We are seeing this range as packets are delivered in different routes in the network. Sometimes we receive less packets per second due to many possibly different reasons such as packets get lost.

2: Initial throughput: 3.2MB/s range: [3.2, 60.2] MB/s (connected to access machine)

3: Wired connection has higher throughput since Ethernet link has higher capacity.

4: Initial throughput: 5.9KB/s range: [5.9, 21.6] KB/s We see smaller throughput since we have lower capacity and thus less packets received per second.

5 Understanding Protocol using Wireshark

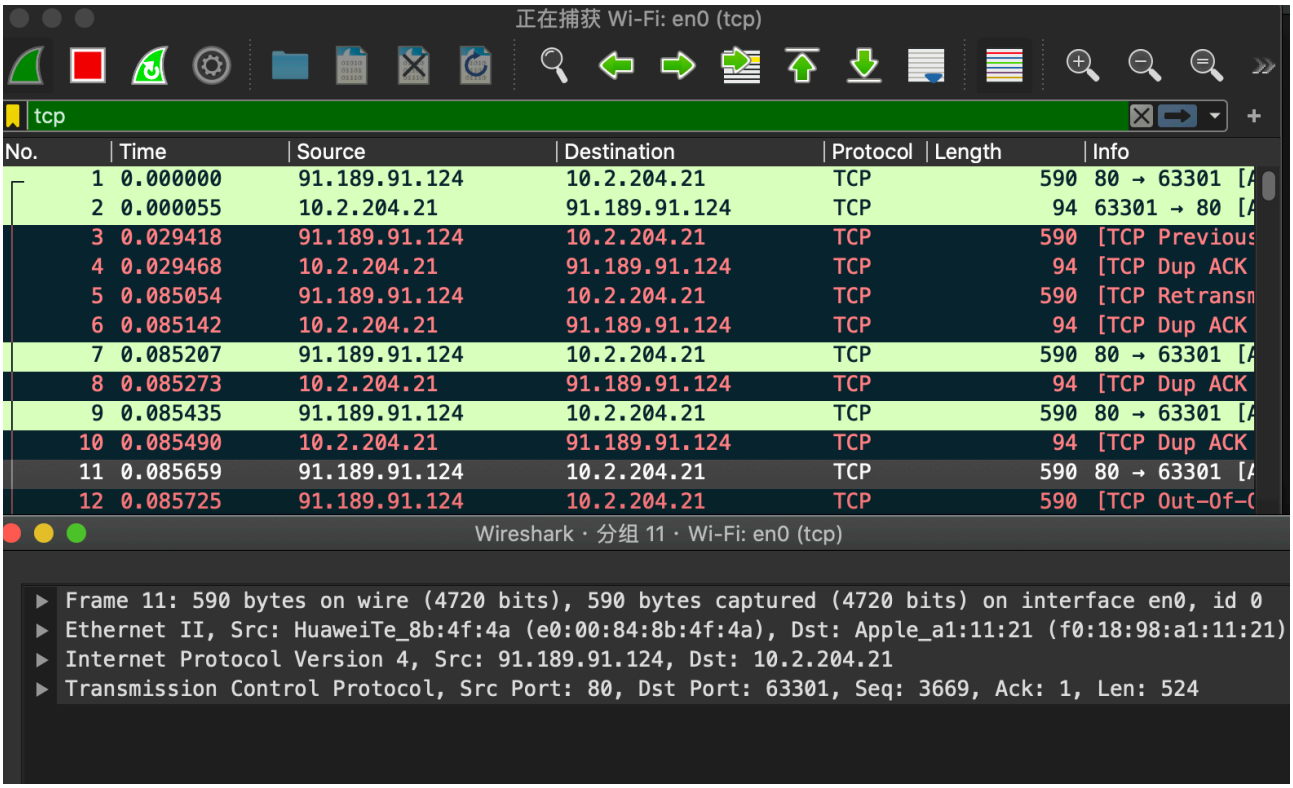
1: 590 bytes

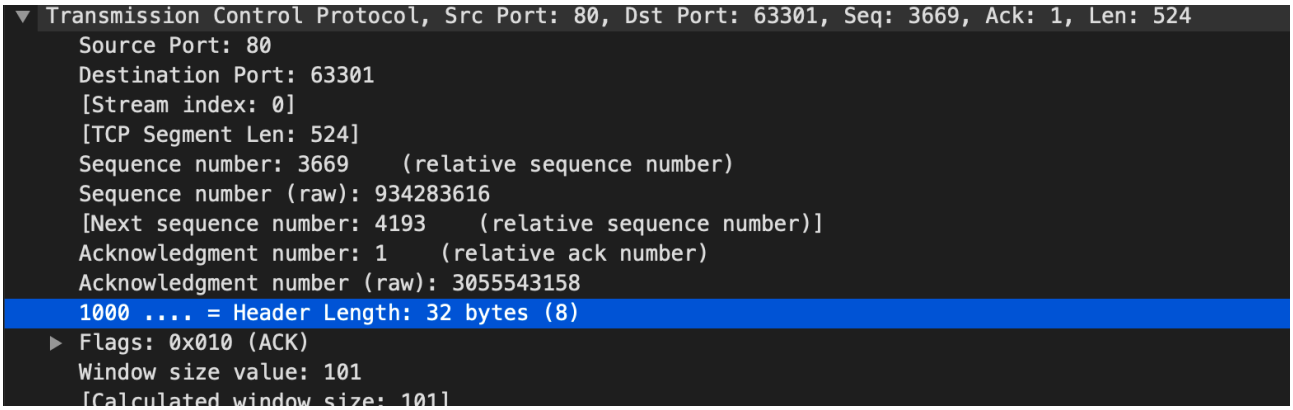
2: Internet Protocol: 20 bytes = 160 bits

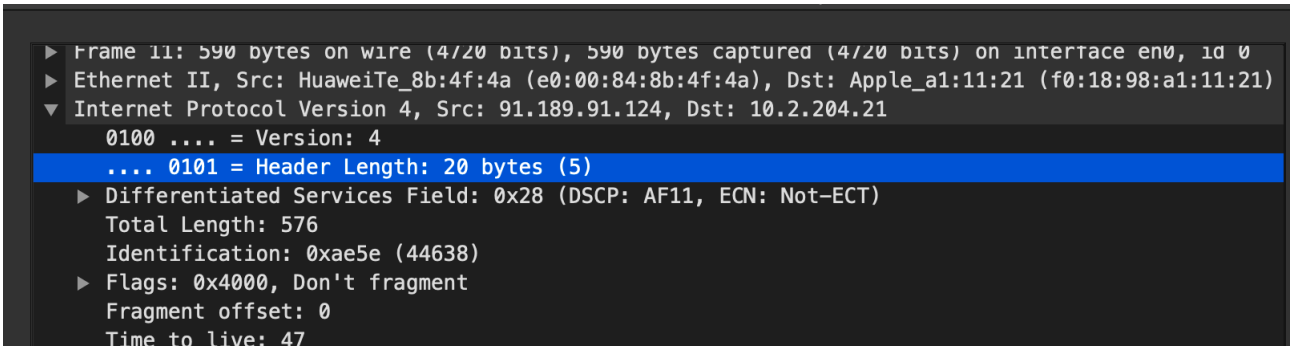
Transmission Control Protocol: 32 bytes = 256 bits

Ethernet: (590 - 524 - 32 - 20) = 14 bytes = 112 bits

3: (160 + 256 + 112) / (4720 - 160 - 256 - 11) = 12.595%







6.0.2 Measuring propagation delay (avg from 100 pings)

1: 0.101ms

2: 305.186ms

3: 0.467ms

4: 478.267ms

5: The first one is smallest since we ping our own computer, in which the distance is shortest. The difference in latencies between using a WiFi and wired connection is probably due to fact that wired connection is generally faster than wireless, by which they have different mediums and ways to deliver signals (Ribeiro). The latency with Australian server being the highest is due to that we are further away from the Australian, which results in higher propagation delay.

6.0.3 Measuring queueing delay (avg from 100 pings)

1: 308.339ms

2: 348.841ms

3: It comes from queueing delay, since we initiate cross traffic, by which packets spend time on the queue.

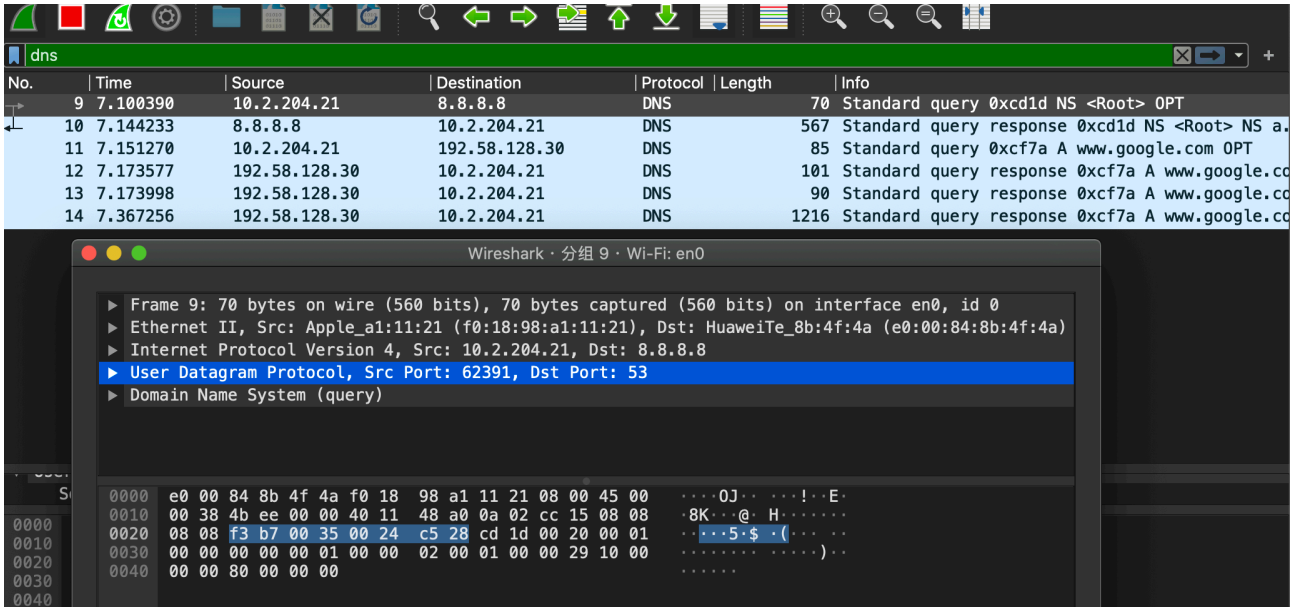
4: 304.227ms

5: limit = 500KB/s, with traffic: 238.262ms, without traffic: 320.046ms

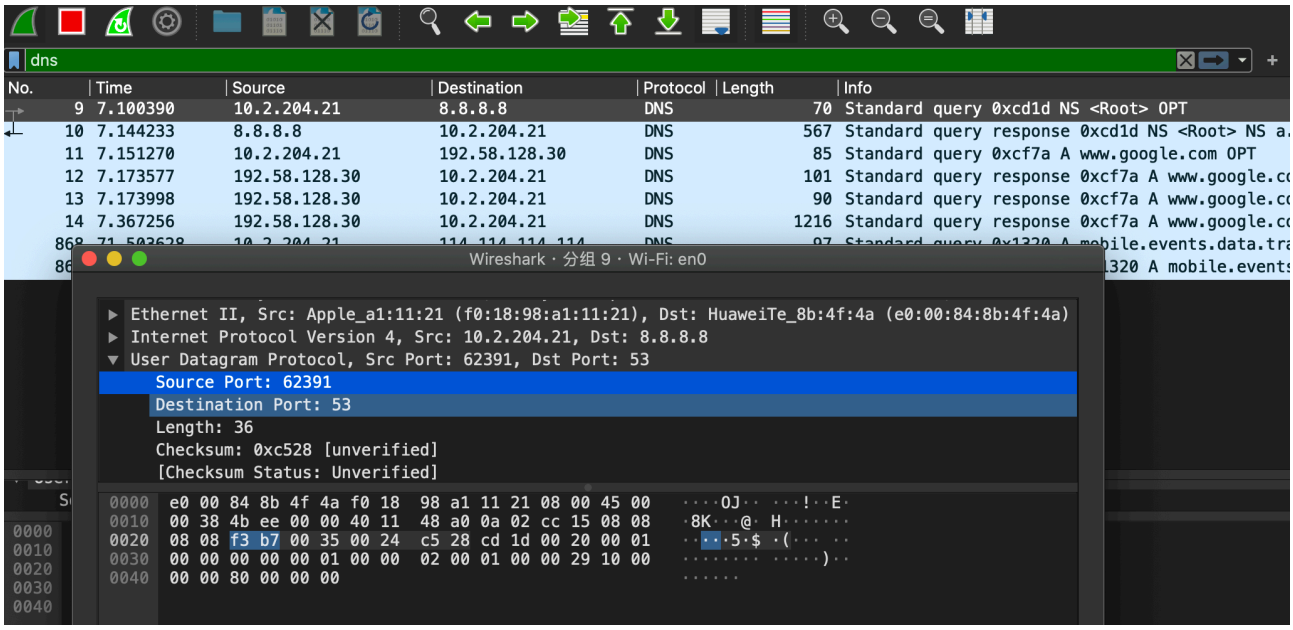
They are better than limit = 1MB/s experiment. Packets are delivered slower in the network since we have lower capacity, which results in less packets entering the queue and thus lower queueing delay.

7 Understanding DNS using Wireshark

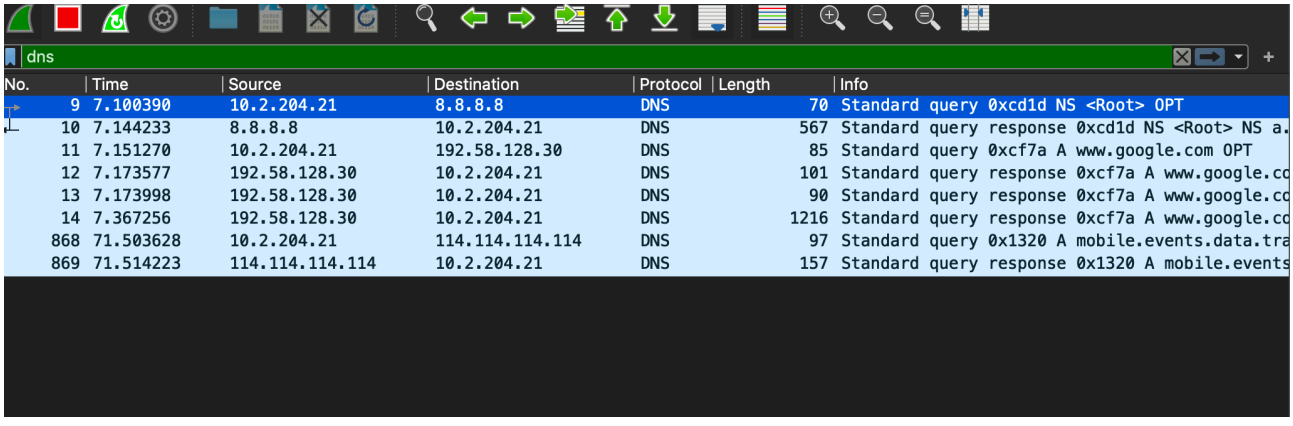
1: UDP



2: client side: 62391, server side: 53



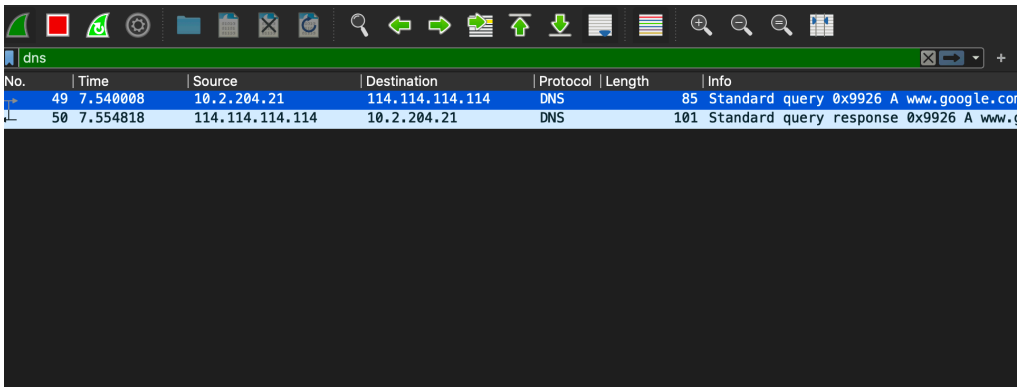
3: 3 distinct IP addresses



4: 8.8.8.8, 192.58.128.30, 114.114.114.114

5: 7.1 + 7.144 + 7.151 + 7.173 + 7.173 + 7.367 + 71.503 + 71.514 = 186.125ms

6: 7.54 + 7.55 = 15.09ms



7: 114.114.114.114

Works Cited

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