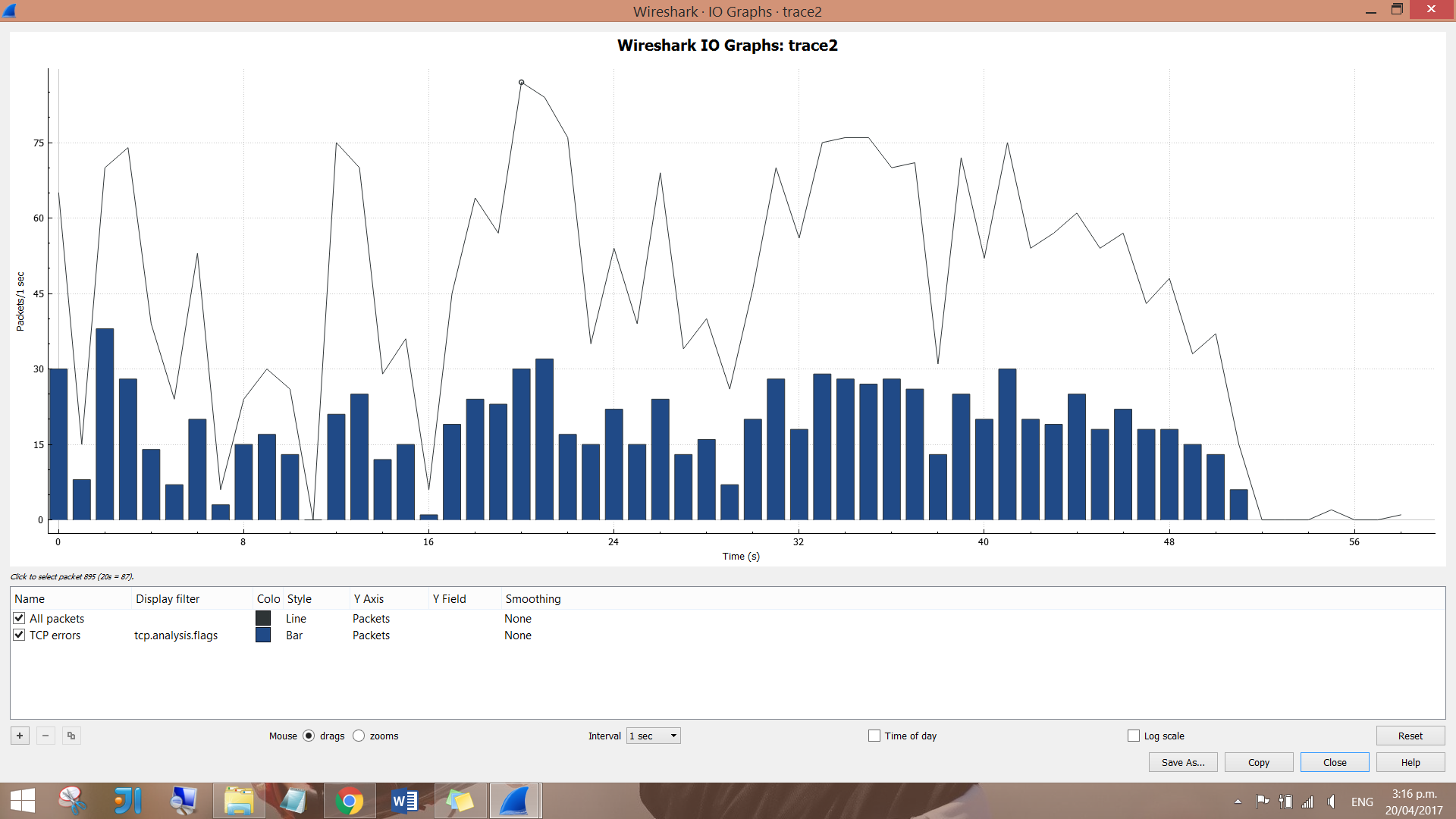
SOFTENG 364 Assignment 1

840454023, elee353

Task 1

Task 2

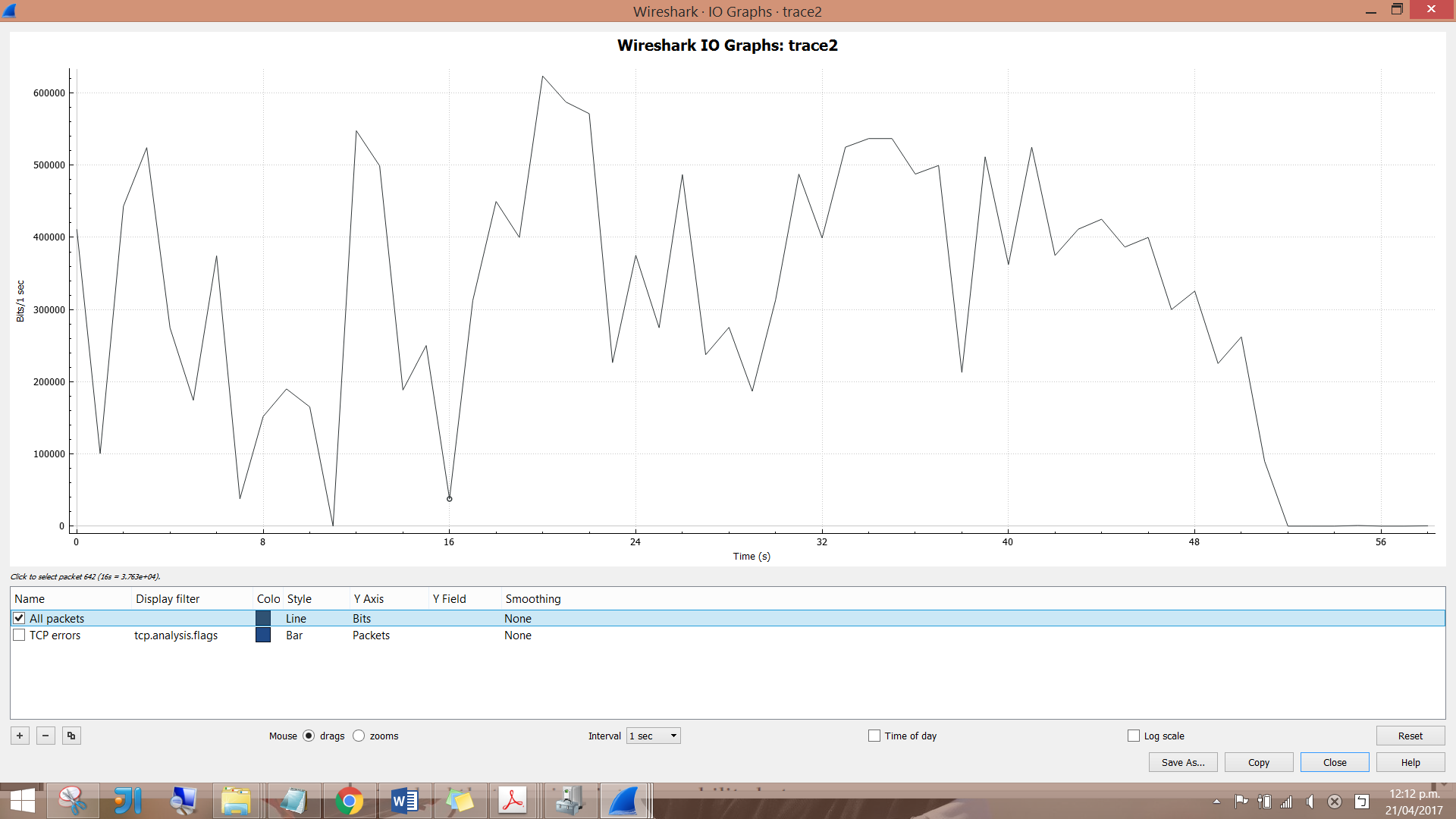
Q1.



The highest packets-per-second value seen was 87 packets per second.

It occurred in the 20th second.

Q2.

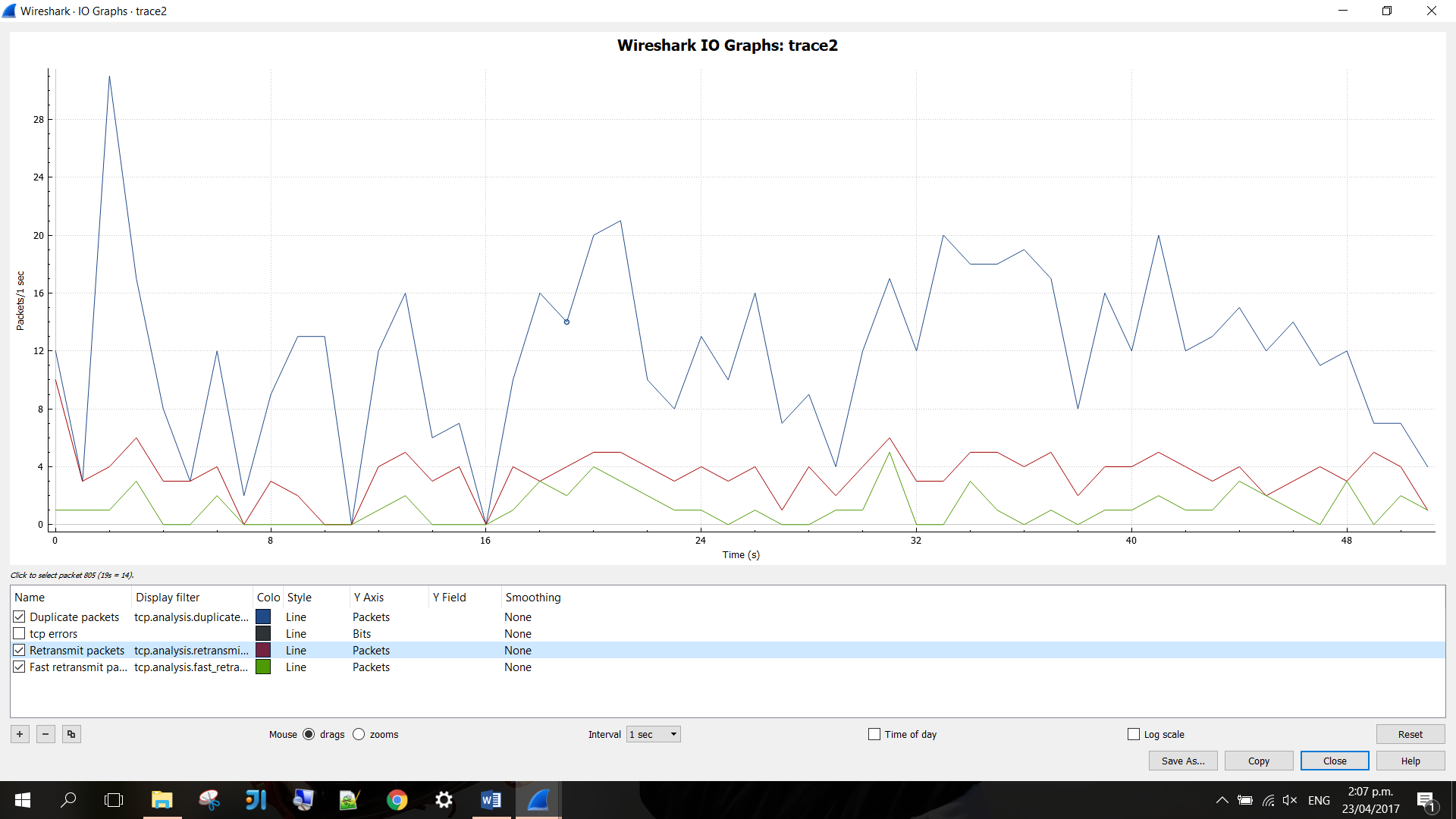


The highest bits-per-second value is 623500 bits per second.

It occurred in the 20th second.

Q3.

Apply filters: tcp.analysis.duplicate\_ack, tcp.analysis.fast\_retransmission, and tcp.analysis.retransmission.



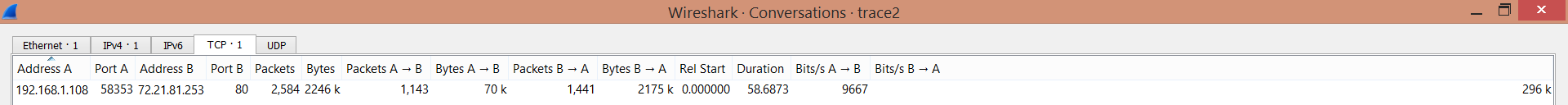
Q4.

Duplicate ACKs are sent when the receiver sees a gap in the packets it receives. The gap can be caused by a lost segment or just a reordering of segments.

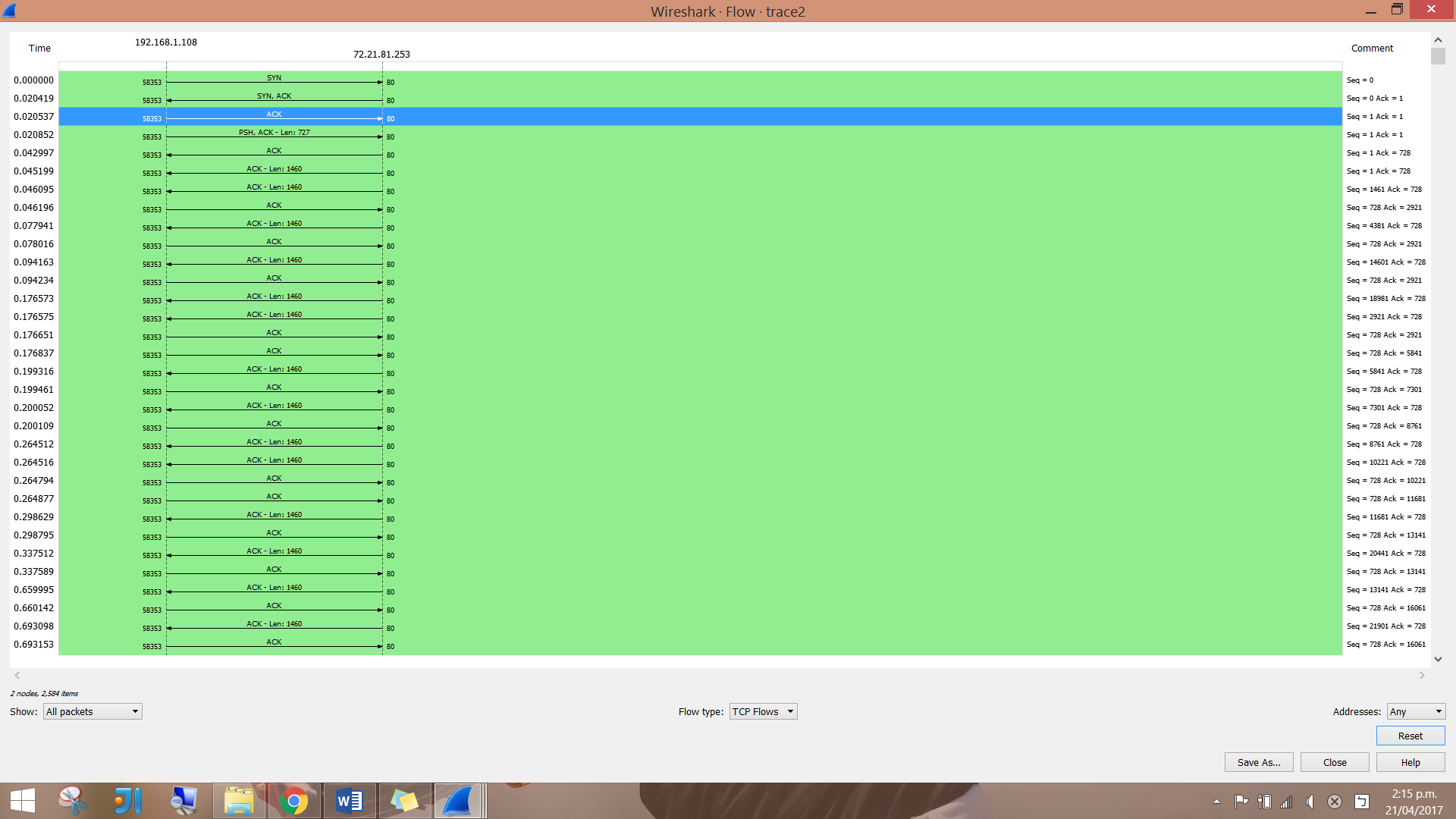
The sender will wait for a small number of duplicate ACKs to be received. If there is only one or two duplicate ACKs received before the reordered segment is processed, there is just a reordering of the segments and a new ACK will be generated.

If three or more duplicate ACKs are received in a row, it is a strong indication that a segment has been lost.

Q5.



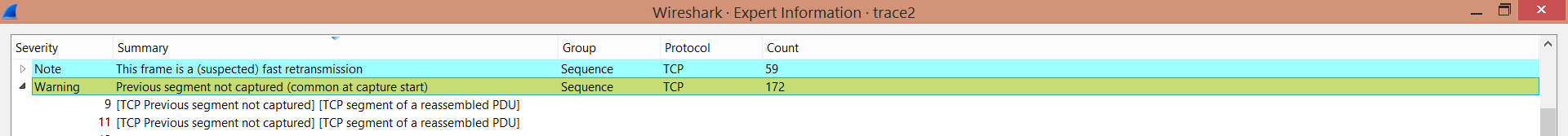


There are 2584 TCP conversations.

Q6.

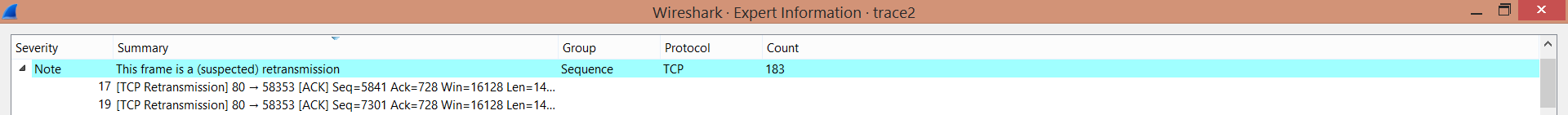
"Tcp previous segment not captured" means Wireshark did not see a packet that should have been in the trace.

This is caused by either the packet really wasn't seen on the wire due to a packet loss, or Wireshark did not record the packet fast and timely even though it **had been** on the wire.

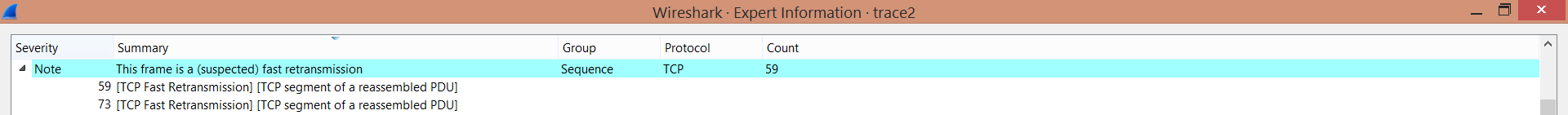


There is 172 times “previous segment not captured” has been detected.

Q7.



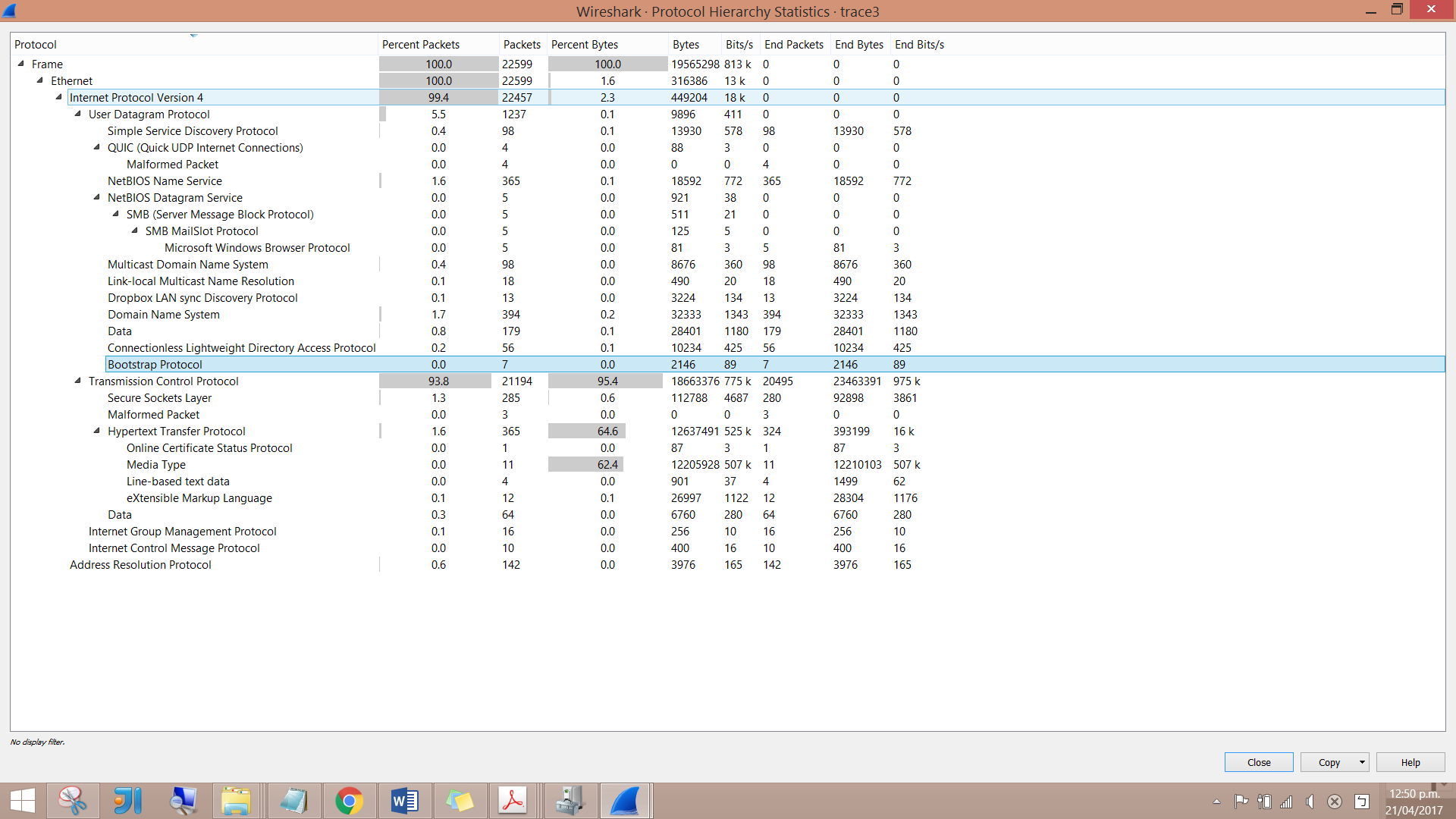
There are 183 retransmissions.



There are 59 fast transmissions.

Task 3

Q1.



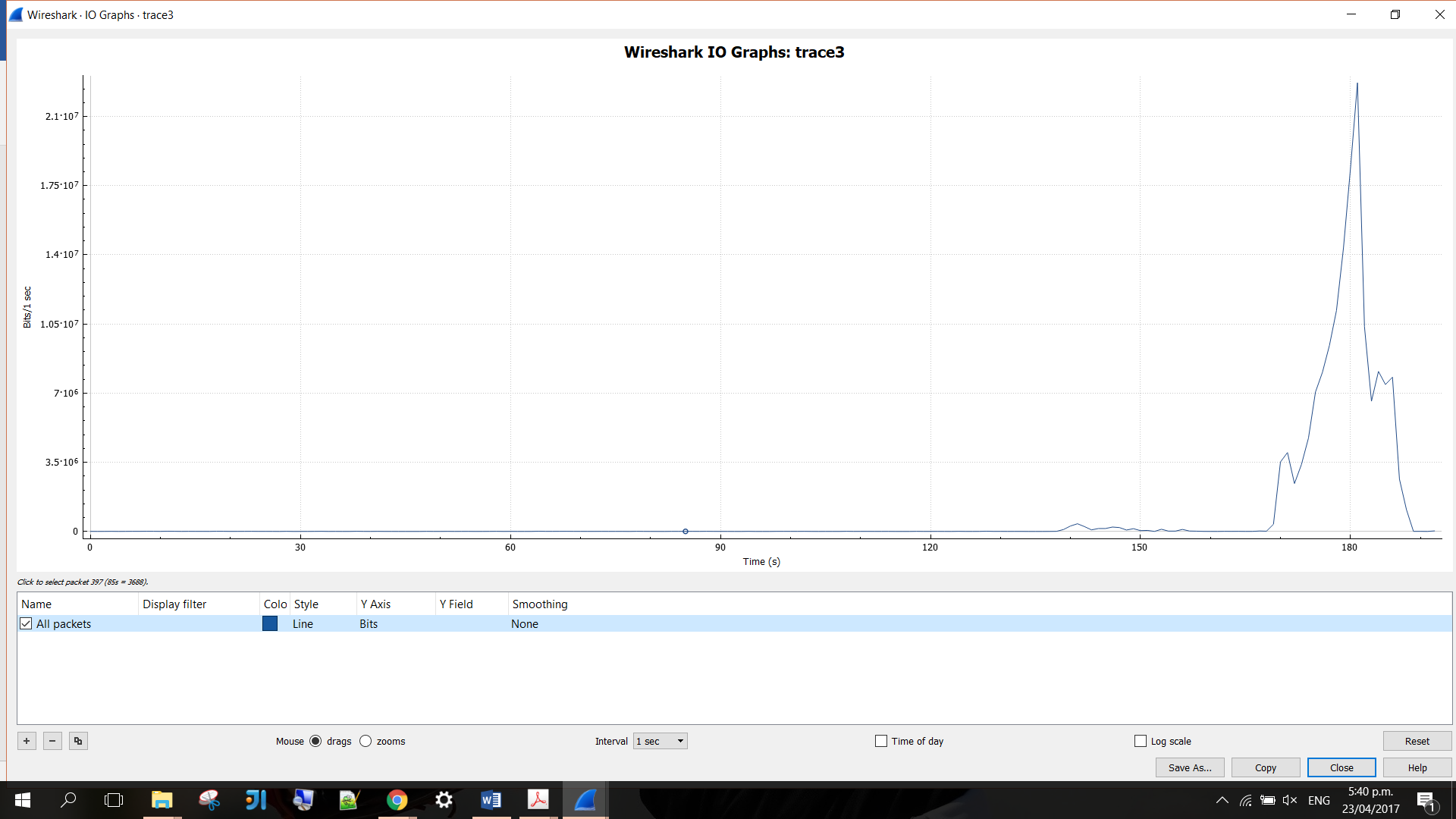
* ARP, NBNS, BROWSER, CLDAP, DB-LSP-DISC, DHCP, DNS, HTTP, OCSP, QUIC, SSDP, TCP, TLSv1, TLSv1.2, UDP
* 0 percent of the total was involved with DCHP messages.
* TCP is used the most here.

Q2.

Apply bootp, dns, tcp, and udp filters.



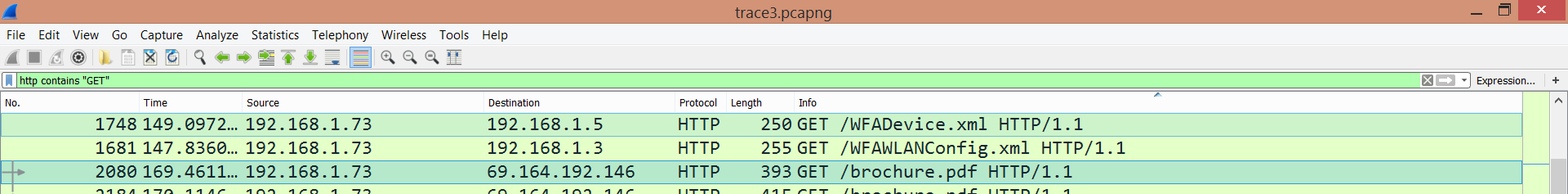
Q3.



The highest bits-per-second rate is 22700000 bits per second.

It occurred in the 181st second.

Q4.



Request IP: 192.168.1.73

Response IP: 69.164.192.146

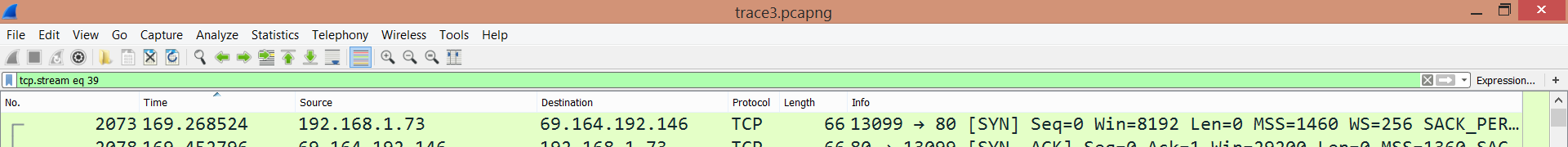
Q5.

* TCP conversation



Q6.





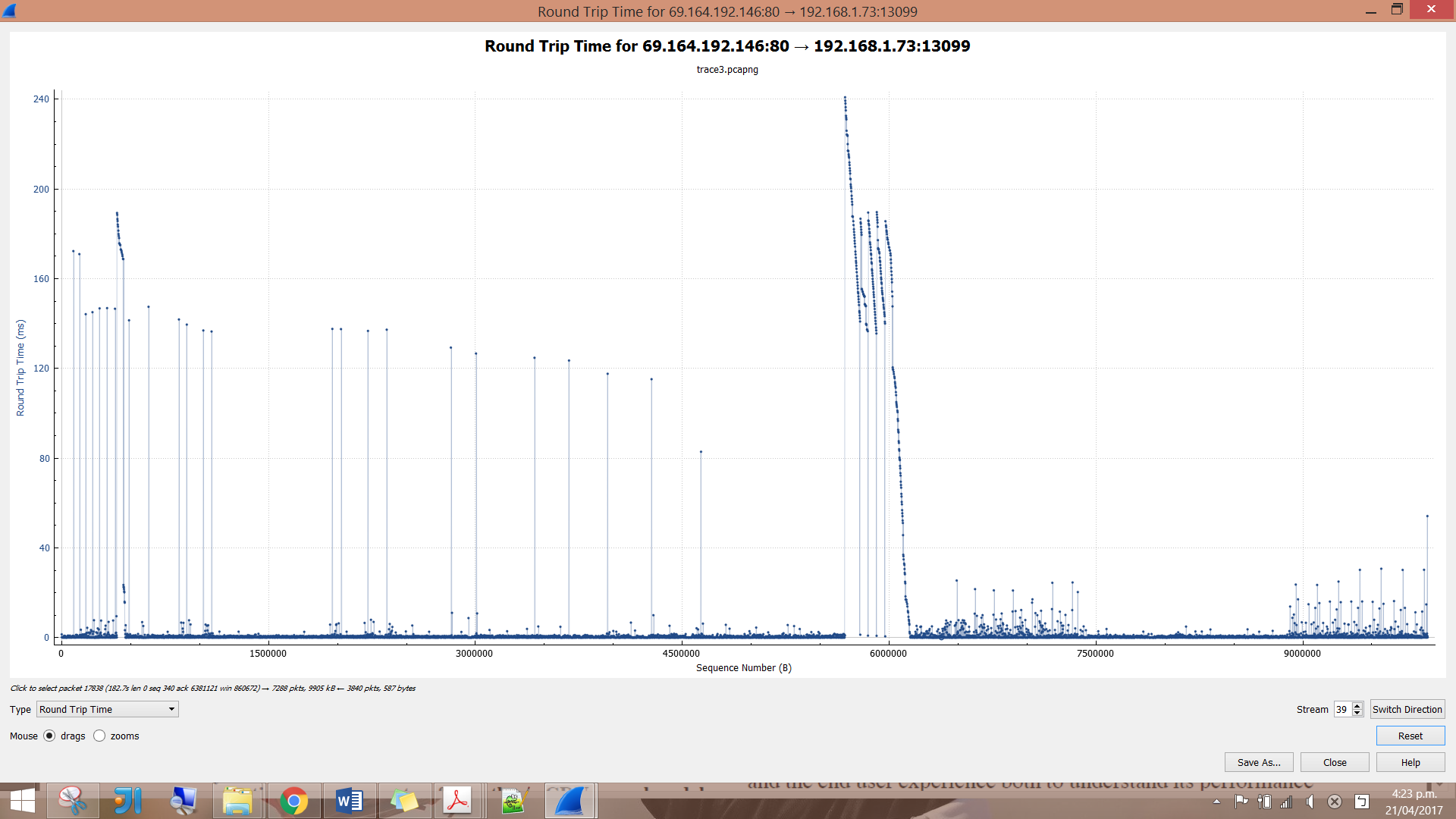


Download time = 192.372 – 169.269 = 23.103 seconds

Q7.

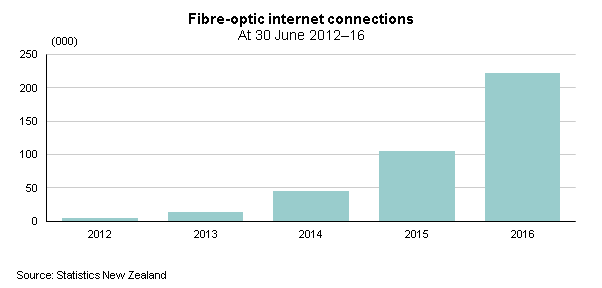
ToDo!!!

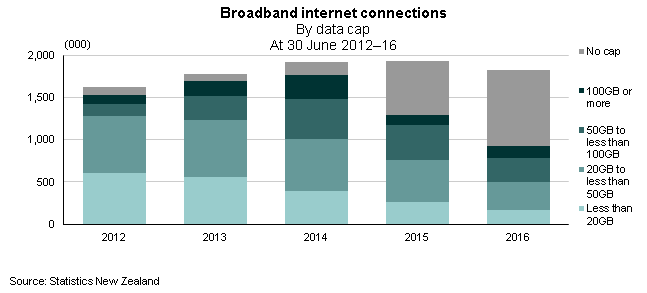
Q8.

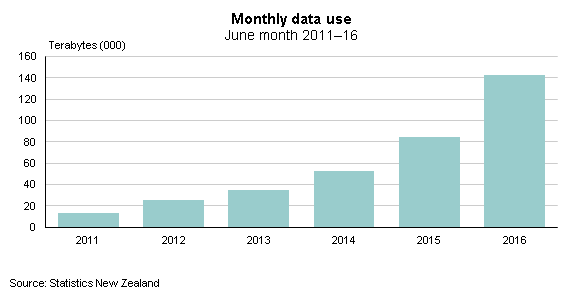


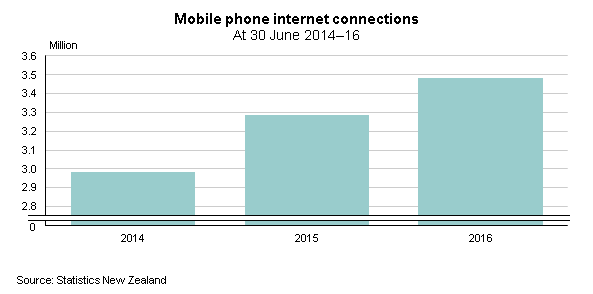
The longest RTT occurred in packet 17280, in the 182.268th second.

Task 4

* **In General**
* As at 30 June 2016, the number of fibre-optic connections has increased more than double the number of connections at the same time last year. Almost 50 percent of all broadband connections in New Zealand had no data cap. This is in response to a tremendous increase in demand for streaming or on-demand services such as TV or movie streaming, online radio or music streaming, online gaming, and content creation and sharing. Furthermore, this large increase in the number of uncapped broadband connections influences the increase in data usage. Each New Zeland residential connection used approximately 88 gigabytes on average, which equates to approximately 85 hours of streaming TV or movies per month.
* Additionally, The mobile phone internet connections in New Zealand had an average of 900 megabytes per connection. This is equivalent to around 24 hours of music streaming on a mobile phone, depending on the quality of streaming. (Statistics New Zealand, 2016)







* Video traffic is the major consumer of internet bandwidth, because multimedia files are generally large in nature. Videos are a sequence of images displayed at a constant rate, while digital images are arrays of pixels.
* There exist a very diverse range of video communication and streaming applications, which have very distinctive operating conditions or properties. Video communication system designs significantly depend on the characteristics of the communication channel, such as bandwidth, delay, and loss. Some video channels support Constant Bit Rate (CBR), such as ISDN or DTV. On the other hand, some channels support Variable Bit Rate (VBR), for example, DVD storage and communication over shared packet networks. (Apostolopoulos, J. G., Tan, W. T., & Wee, S. J., 2002)
* In a video streaming application, a client typically begins playout of the video while the file is being downloaded from the server. This means the client will be playing out the video from one location in the file while it is receiveing later parts of the file from the server. Streaming avoids having to download the entire file and potentially incurring a longer delay, before beginning playout.
* Several network protocols have been designed and standardised for communication between clients and streaming servers. The Internet protocol (IP) serves as the network-layer protocol for Internet video streaming. The transport protocol provides end-to-end network transport functions for streaming applications. Transport protocols include UDP, TCP, real-time transport protocol (RTP), and real-time control protocol (RTCP). UDP and TCP are lower-layer transport protocols, while RTP and RTCP are upper-layer transport protocols that implement on top of UDP/TCP. UDP and TCP protocols support such functions as multiplexing, error control, congestion control, and flow control.
* The application layer contains several protocols including HTTP and DASH. HTTP is used to exchange or transfer hypertext. DASH (Dynamic Adaptive Streaming over HTTP) is a technique that enables high quality streaming of media content over the Internet to be delivered from conventional HTTP web servers. It is an extension of the classic HTTP streaming.
* However, DASH-based streaming is very different from UDP-based streaming as it involves adaptation both by the application and by TCP. (Martin, J., Fu, Y., Wourms, N., & Shaw, T., 2013)
* The media content exists on the server in two parts: a Media Presentation Description (MPD) and segments. MPD essentially describes a manifest of the available content and their URL addresses, while the segments contain data segments of the actural multimedia bitstreams. (Sodagar, I., 2011)
* By parsing the MPD, the DASH client learns about the content details and starts fetching the segments using HTTP GET resuests. (Sodagar, I., 2011) In order to prevent rebuffering due to buffer starvation, a bit rate level less than the measured available bandwidth is usually chosen.
* Because of the benefits that HTTP-streaming based technology implies and due to the fact that DASH is a company-independent standard, YouTube and Netflix have implemented DASH as the preferred streaming technology rather than Flash Video streaming.
* The DASH standards focus primarily on the syntax required to describe content manifests and video segments. The standards do not identify speciﬁc encoding methods and protocol behaviors such as the frequency of client request.
* Forthermore, contend distribution networks (CDNs) replicate stored content and put the replicated content at the edges of the Internet. Given that a large portion of the traffic flowing throught the Internet is stored content such as multimedia, CDNs can significantly reduce the traffic loads on the ISPs and the related interfaces between ISPs.
* Some control is shifting to the consumer, as more people sign up for specialist digital subscription services, and consume content at a time that suits them. Nearly a quarter (24%) of New Zealanders subscribe to digital content such as Netflix and Spotify.  Compelling content continues to be king, and audiences will watch it using whatever the device, and this is true for advertising as well.

[http://www.nielsen.com/nz/en/insights/reports/2016/new-zealand-media-trends-2016.html]

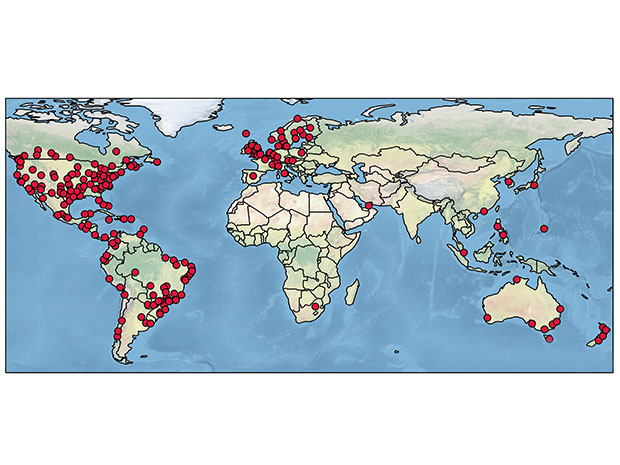
* **Netflix**
* **[unreeling netflix]**
* **There are approximately 4 Netflix ISP servers in new Zealand, while there are 4669 serves in 243 global locations.** [ Researchers Map Locations of 4,669 Servers in Netflix’s Content Delivery Network]
* 

Figure 1http://spectrum.ieee.org/tech-talk/telecom/internet/researchers-map-locations-of-4669-servers-in-netflixs-content-delivery-network

* Netflix is the leading subscription service provider for TV shows and online movies. It is the single largest source of Internet traffic in the US, consuming 29.7% of peak downstream traffic.
* In March 2016, Netflix claimed to deliver about 125 million total hours of viewing to customers per day.

[**How Netflix Works With ISPs Around the Globe to Deliver a Great Viewing Experience**]

* Netflix uses cloud services such as Amazon AWS cloud, CDNs, and other public services.
* Video streaming of Netflix is served out of multiple CDNs, and UltraDNS, which is a public DNS service used as its authoritative servers. The encoded and DRM protected videos are sourced in Amazon and copied to CDNs. The average bandwidth of CDNs can vary significantly over time and over geographic locations.
* Netflix uses TCP to stream videos.
* Netflix’s content delivery strategy stores content at both IXPs and ISPs. In the United States, Netflix is primarily delivered through IXPs. Meanwhile, there are no Netflix servers at IXPs in Canada or Mexico. Customers in those countries are served exclusively by servers within ISPs, as well as possibly through IXPs along the U.S. borders. [ Researchers Map Locations of 4,669 Servers in Netflix’s Content Delivery Network]

Netflix’s centralized approach outside the U.S. is convenient because it has more control and scalability according to the local market.

* Netflix uses the DASH protocol for streaming. Each video is encoded at various quality levels, and is divided into small ‘chunks’. The client requests one video chunk at a time via HTTP. With each download, it measures the receiver’s bandwidth and runs a rate determination algorithmto determine the quality of the next chunk to request. DASH allows the player to freely switch between different quality levels at the chunk boundaries.
* Netflix video streaming is controlled by instructions in a manifest file that provides the DASH player metadata. The manifest files are client-specific and delivered via SSL connection. They also rank CDNs to indicate the preferred CDNs. In general, the Netflix client appears to stay with the same CDN as long as possible even if it has to degrade the quality level of the playback.
* Netflix statically assigns a CDN to users for extended period of time. Usually each user only concentrates on one CDN in most cases, while other CDNs appear to serve only as backups. These are used only if the current CDN server cannot support even the lowest video quality.
* Audio and video contents are downloaded in chuncks. Download sessions are more frequent at the beginning so as to build up the player buffer. Once the buffer is sufficiently filled, downloads become periodic.
* Netflix serves video in multiple formats and bitrates. When a Netflix client requests for the mmanifest file from Netflix, the client indicats the applicable formats of the content. A manifest file is then sent back by the Netflix server based on the client request.
* Based on the client capabilities, the server sends URLs for the video and audio chunks in the returned manifest files.
* Netflix clients do not try all possible available bitrates when trying to determine the optimal playback rate.
* the DASH client of Netflix contains three main functional areas: the HTTP access, the media engine that decodes and renders the video stream, and the control engine. [Characterizing Netflix Bandwidth Consumption]
* The latter component monitors the arriving video stream and determines the quality of stream to request. The client will maintain a playback buffer that serves to smooth variable content arrival rates to support the video playback. The client requests a new segment (tagged with the desired bitrate) once the playback buffer drops below a certain threshold. When the playback buffer is almost empty, the client is likely to go into a ‘buffering’ state where it requests segments at a high rate. [Characterizing Netflix Bandwidth Consumption]
* The session therefore operates in one of two states: buffering or steady state. While in a buffering state, the client requests data at a rate up to the available bandwidth over the path between the server and the client. If conditions permit, the session will attempt to ﬁnd a ‘steady state’ where it requests segments at a rate necessary to playback the content at a given encoded bitrate. [Characterizing Netflix Bandwidth Consumption]
* **The Netﬂix adaptation appears to default to TCP control during periods of heavy, sustained network congestion. However, the application algorithm is clearly intertwined with TCP control during periods of volatile network conditions.** [Characterizing Netflix Bandwidth Consumption]
* **YouTube**
* YouTube is one of the most popular services on the internet, being the most visited website in the world.[YOUTUBE’S dash]
* One hundred hours of video is uploaded to YouTube every minute.

[ <http://www.nzherald.co.nz/lifestyle/news/article.cfm?c_id=6&objectid=11236543>]

* YouTube’s content delivery strategy prefers to store content at IXPs.[ Researchers Map Locations of 4,669 Servers in Netflix’s Content Delivery Network]
* YouTube uses a Flash-based client which is embedded in the webpage. The commumication between the client and server is done over HTTP, and HTTP is over TCP. Consequently, YouTube does not have to cope with lost or reordered packets. However, a stalling of the video may be caused by transmission problems.
* HTTP is more firewall friendly as UDP can be more likely to be blocked by firewalls. Additionally, the client manages HTTP streaming without having to maintain a session state on the server.
* By using Dynamic Adaptive Streaming over HTTP (DASH), YouTube is able to switch the video quality based on the recent link capabilities. This enables YouTube’s player quality parameter. If it is set to ‘auto’, YouTube can adapt the bitrate of the video based on the client’s available bandwidth.[YOUTUBE’S dash]
* YouTube’s streaming strategy has two phases: a burst phase and a throttling phase. The burst phase is the initial phase where there exists a significant burst of data. After this initial burst, the receiveing download data rate of YouTube’s player is considerably reduced. In addition, the transmission rate during the throttle phase influences the amount of data sent by the YouTube server during the burst phase. .[YOUTUBE’S dash] This strategy reduces congestion in the network by eliminating the transmittion of unused data.
* DASH provides the advantages in bandwidth and cost saving for YouTube, especially when the majority of users do not watch more than the first 20% of a video.[YOUTUBE’S dash]
* One disadvantage of DASH is the amount of storage required to host all the videos in various bit rates and segment lengths on YouTube.
* **Lightbox**
* CDN, DASH
* Discuss how video streaming on the internet is achieved in general
* then discuss the approaches taken by the above three services
* the protocols involved
* facts pertaining to New Zealand
* Pictures
* reference all your sources, including any images taken from other sources
* 1200 words