Computer Networks (COL 334)

Assignment 2

3 b

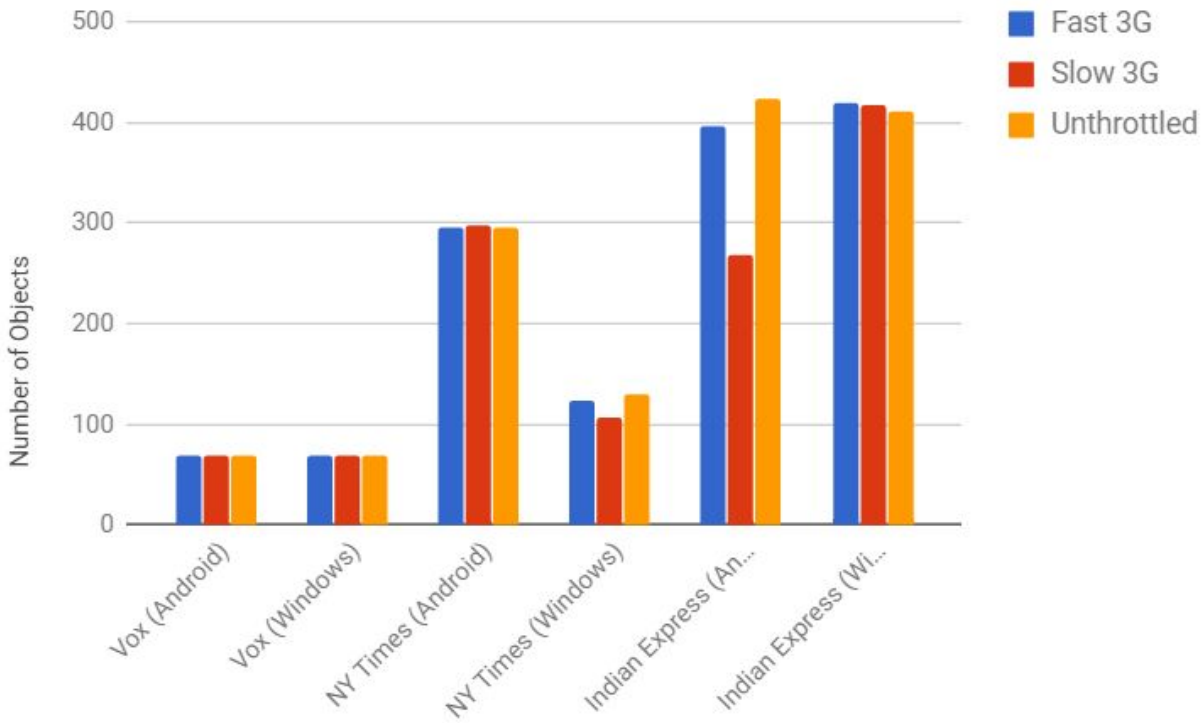
(ii) We can see in har file that for first dns query some time is required while for subsequent queries it will be -1. We ran script on www.iitd.ac.in and found out that all the objects are hosted under one domain ie iitd.ac.in so there are only 2 TCP connections that are showing positive value for dns time which means one of them is resolved for first time and when subsequent is resolved then it is done from cache so it returns -1. The reason for other dns query time to be positive is that cache for previous dns query must have been expired so it generates a new query and hence corresponding time.

(iii)

5.) Yes, maximum goodput in some cases is much higher than average goodput as network traffic keeps on changing and so is latency hence change in bandwidth. This conclusion is based on the observation that there are some objects of larger size that has recieving time less. There is another possibility, since there are multiple domains in a TCP connection so maybe one server has less congestion than others.

7.) No, download capacity is not well utilized as max achieved goodput is much higher than average achieved goodput. This happens because of waiting time, as browsers don't use pipelining so there will be waiting time for every get request.

(iv)

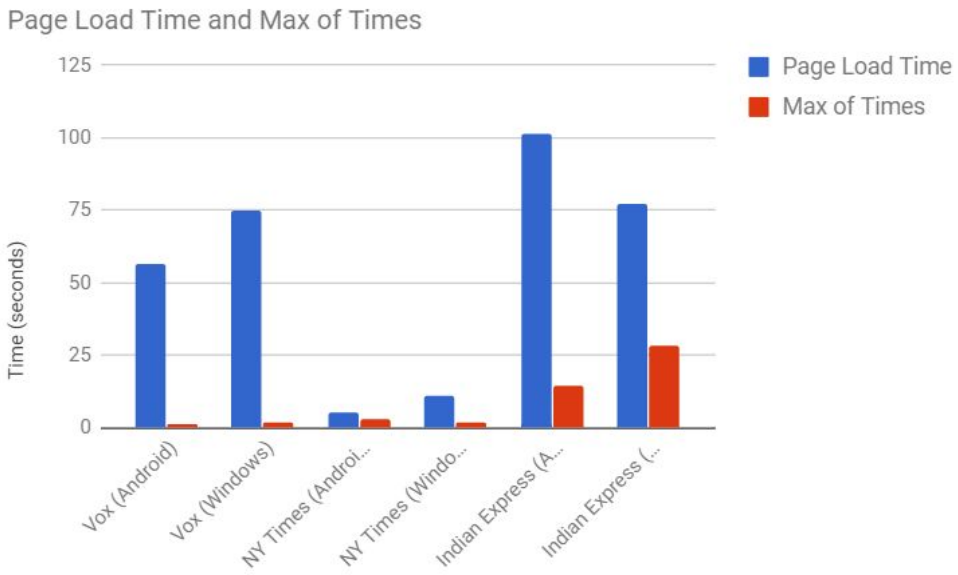


1.) Mobile browser downloads moreobjects as compared to Desktop browser except for Vox website because even for mobile version they are opening same website.

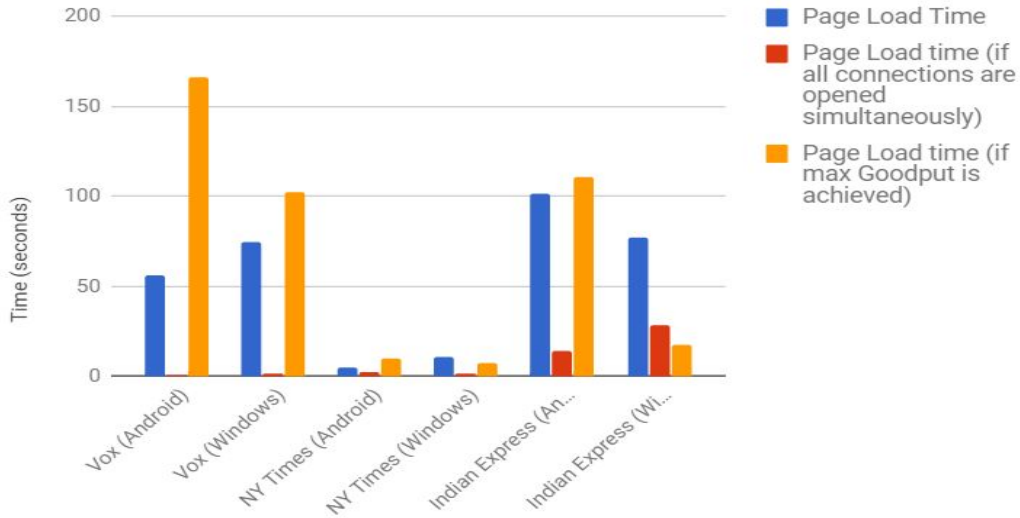
2.) Fast and Slow has same number of objects except for Indian Express.

3.) Yes, there is cap on number on TCP connection per domain and it depends on capacity of browser hence type of browser. It does not depend on type of connection.

3 c

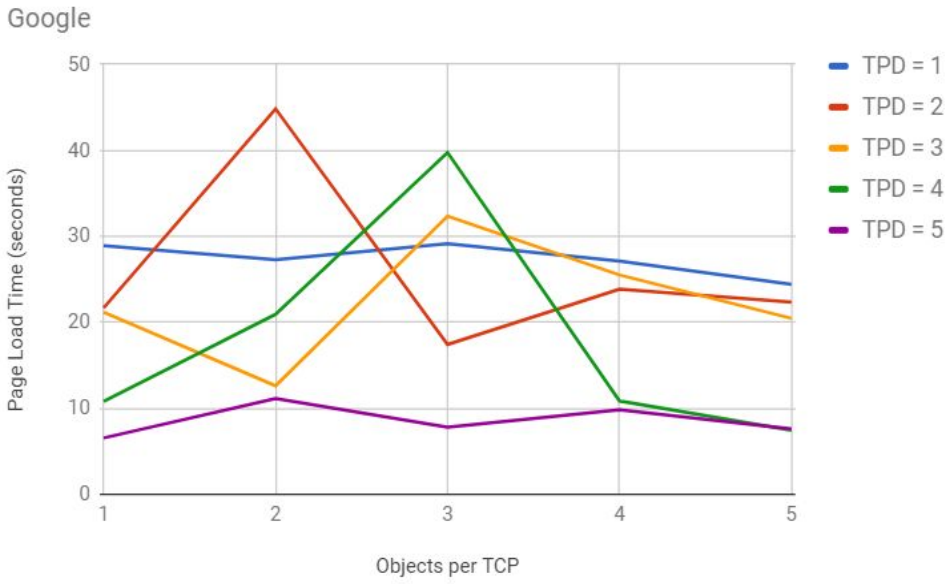


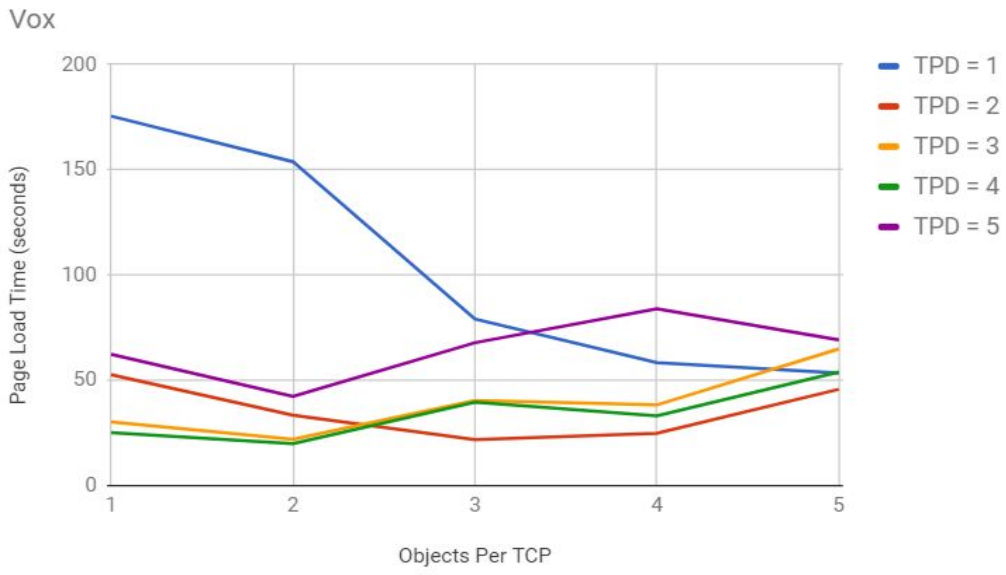
(ii) There is huge difference in both times as situation under which we calculated time is not real. It is not possible to open all connections simultaneously because of bottleneck bandwidth.



(iv) Red time will always be less than blue and yellow as we are downloading all objects simultaneously. But yellow time may vary as there may some domains that have more objects to download but they are being downloaded in single TCP connection while in blue they are divided in others as well.

4 c





For this part I have extracted data for **google** and **vox** (it took a lot of time for nytimes and indian express) . I'll be using following terminologies for observations:

Max TCP connections per domain = t
Max objects per TCP connection = o
p = t * o

Observations :

1) The time depends on the **p**. If the no. of objects > p then tcp connections have to be closed and opened again which is sequential. So if we have 23 objects to download, and t is 4 and o is 2 => p is 8, so 4 TCP connections have to opened and closed, 3 times. This is the reason why the maximum time occurs when t and o both are 1.

2) It naturally occurs that higher value of **t** will result in less amount of page load time. But as we increase the value of t above a certain value, the page load Time attains a minima and after a certain value starts increasing. This is because our **bottleneck bandwidth** has a certain limit, and increasing the no. of TCP connections would result in less bandwidth per TCP connection.

3) The limits of bottleneck bandwidth depends upon the network you are using. For this part I used IITD WiFi and at a time when there was too much traffic and due to which bottleneck bandwidth per user was too low. In comparison to other networks where a user has a guaranteed throughput, I can use fix values of t and p for a given bandwidth and variable t and p for bandwidth with varying traffic.

4) Max. objects per domain should not be a sufficient criteria for distribution of objects among different threads. **Objects with larger size** should be in different TCP connection.

5) Also, the page load time depends on distribution of objects in different domains and should both t and o should be some function of the distribution. For data of google, the no. of objects per domain are (1,1,1,1,2,2,3,7,9), for 9 objects per domain value of t should be high compared to 1 object per domain.