Project 3

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1. *Introduction and Raw Data*

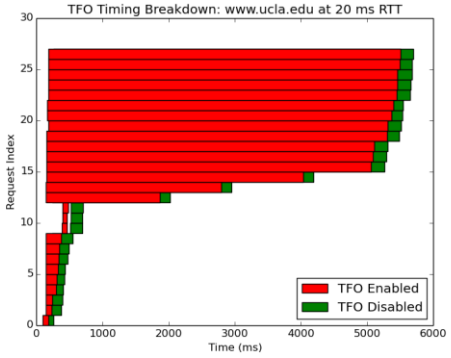
This project is aimed at examining how TCP Fast Open improves website transaction times. By replicating the TCP Fast Open paper [1], the experiments aim at observing website transfer times with and without TFO for different values of RTT. The websites used for the example data table below are en.wikipedia.org/wiki/TransmissionControlProtocol and www.amazon.com. The websites used for the rest of the experiment include www.gnu.org, www.ucla.edu and www.web.mit.edu.

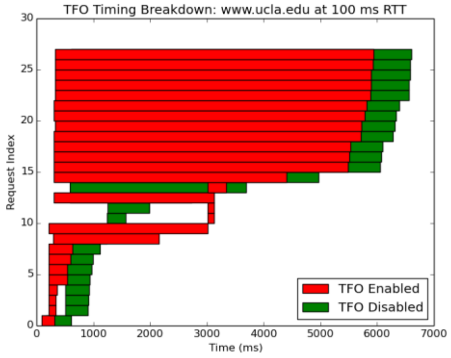
RTT(ms)	PLT: no TFO (s)	PLT: TFO (s)	Improv.
httpen.wikipedia.orgwikiTransmission_Control_Protocol			
200	6109.844	7885.424	29.06097111
100	3708.221	3144.12	15.21217317
20	2526.016	2117.081	16.1889315
httpwww.amazon.com			
200	4935.182	3920.891	20.55225116
100	2976.402	2044.766	31.30074499
20	1484.292	1296.352	12.66192905

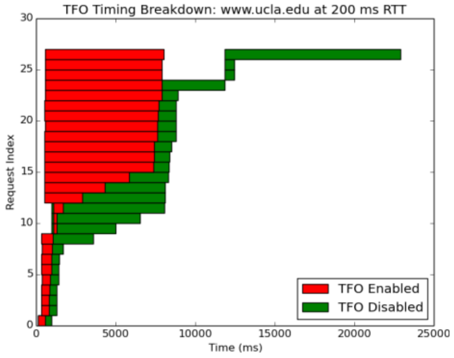
Analyzing the observations of the experiment, one can deduce that for each website as RTT increases, PLT will increase for all websites. Additionally it is evident that as RTT increases, PLT with TFO makes a larger difference in time than for small RTTs, where the difference in PLT with TFO and without is negligible for all websites.

2. *http://www.ucla.edu/*

UCLA is an educational institution website used by perspective and current students as well as instructors and professors from around the world. As seen in the table in Section 1, it is evident that the largest PLT improvement is when RTT is largest, and the least improvement is when RTT is smallest. For the 20ms RTT, with request above 12, it is evident that TFO Enabled is faster, but the speed difference appears negligible. As RTT increases, the difference in TFO Enabled/Disabled becomes more apparent. As seen in the graph for RTT of 200ms, All TFO Enabled requests are much faster than their TFO Disabled counterparts. More surprisingly, requests above 25 finish loading with TFO Enabled in a time faster than TFO Disabled requests start loading.



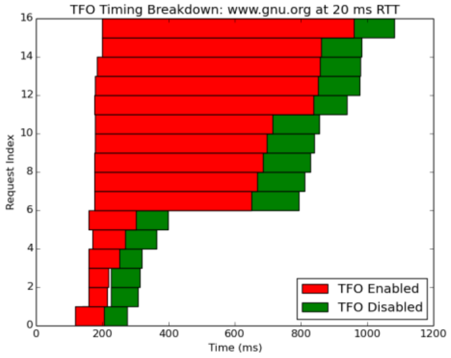


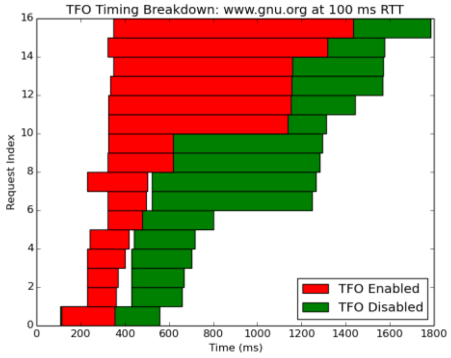


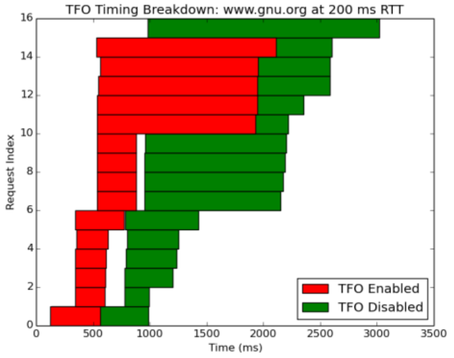
Consequently, it is evident that as the RTT time increases, the difference between Enabled and Disabled TFO increases as well. This is prominently displayed in the 200ms RTT graph as the TFO Enabled load time is faster than before the TFO Disabled website even begins loading. The UCLA website is content and navigation heavy, which is evident in the fact that it takes a long time for both TFO Disabled and Enabled to take a long time to load. However, we do see an improvement in load times even for such content heavy websites.

3. *http://www.gnu.org/*

The GNU website is mostly text with some images. For all RTT variances, the TFO Enabled performed better than TFO Disabled. However, it is noticeable that the different as RTT increases is marginal, at best. The gains from TFO Enabled appear to increase at first and then level off as RTT increases.

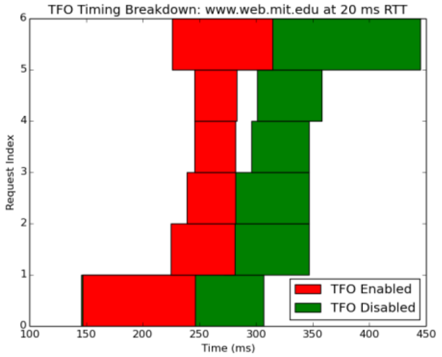


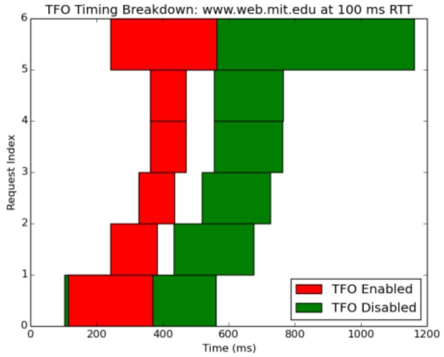


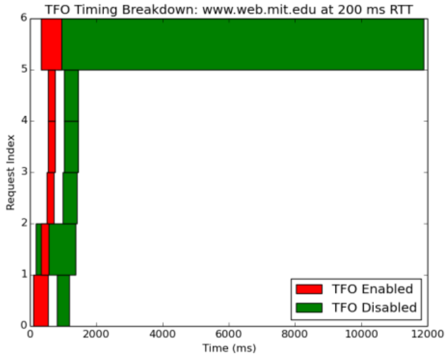


4. *http://www.web.mit.edu/*

The MIT website has some rich context, graphics and images on the front page. As such, it is evident more so that as RTT increases, the benefit of TFO increases much greater. Since the purpose of TFO is to remove RTT per TCP connection as well as reduce flow completion time, it is evident that the website with minimal content but some complex graphics benefits most from TFO Enabled. As seen in the graphs below, with RTT of 200ms, the content loading with TFO Enabled looks almost instant compared to TFO Disabled.







5. *Summary of Findings*

   From the graphs in the previous sections, it is evident that TFO cookies generally help speed up website loading in most cases. Depending on the content being loaded, TFO can show significant gains with increased RTT time. However, even with simple website content, the TFO Enabled still shows and improvement over TFO Disabled.

6. *Best or Worst TCP Fast Open*

   The Best TFO example is the http://www.web.mit.edu/ website as observed in the RTT 200ms graph. On the other hand, the worst TFO is arguably, the https://www.gnu.org/ site. This website appears to not gain significant performance increase with increased RTT values.

References

[1] jfbcs244. (2014, May 21). CS244 '13: TCP Fast Open. Retrieved from https://reproducingnetworkresearch.wordpress.com/2013/03/13/tcp-fastopen/