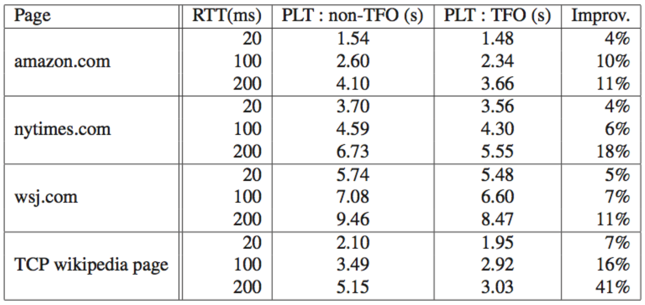
# Proposal: TCP Fast Open

Max Meyers
Roan Kattouw

TCP Fast Open proposes a seemingly obvious modification to the handshake mechanism of TCP: that is, including some data in the handshake itself, reducing the time of web page loads by one RTT. For short flows, this can be a serious savings. In their paper, Radhakrishnan et al show that the download of a sample Wikipedia page, with an emulated RTT of 200ms can be reduced by 41% by including data in the opening packet. We propose to attempt to reproduce the findings from the paper in a research environment:



| Page | RTT(ms) | PLT : non-TFO (s) | PLT : TFO (s) | Improv. |
|---|---|---|---|---|
| amazon.com | 20 | 1.54 | 1.48 | 4% |
| | 100 | 2.60 | 2.34 | 10% |
| | 200 | 4.10 | 3.66 | 11% |
| nytimes.com | 20 | 3.70 | 3.56 | 4% |
| | 100 | 4.59 | 4.30 | 6% |
| | 200 | 6.73 | 5.55 | 18% |
| wsj.com | 20 | 5.74 | 5.48 | 5% |
| | 100 | 7.08 | 6.60 | 7% |
| | 200 | 9.46 | 8.47 | 11% |
| TCP wikipedia page | 20 | 2.10 | 1.95 | 7% |
| | 100 | 3.49 | 2.92 | 16% |
| | 200 | 5.15 | 3.03 | 41% |

Given that client-side support for TFO has already been built into version 3.6 of the Linux kernel, we are already at an advantage to be able to test it, however it only works if the server also supports TFO. As such, we could do a number of things to reproduce these results.

1. Attempt to find existing web servers that support TFO with varying RTT's, and measure the results directly without any emulation.
2. Run web servers at various EC2 locations, enabling TFO on these servers (supported in Linux 3.7) and then testing from a stationary location.
3. Replicate the test environment of the original paper, using Google's web page replay tool on top of a dummynet emulation (or perhaps Mininet).

Clearly, the third option would produce results closest to the original paper, but it might be interesting to see if these numbers are reflected in the real world using real servers. The paper includes numbers from an emulation, but how do we know these work in the real world? Of course, using our own servers is somewhat an emulation itself, since a simple HTTP server with traffic going to one host is not necessarily representative of high traffic website like Amazon or NYTimes. It might, however, give a clearer view of the TFO performance improvements, without the many complicating factors of real world traffic.

In order to test TFO, we would have to compile version 3.7 of the Linux kernel (EC2 instances run on 3.2 by default, and TFO server support is new in 3.7), and write client and server programs in C (because we have to use different system calls and pass special flags to them for TFO).