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Assignment 6 - TCP Fast Open - Returned

Title	Assignment 6 - TCP Fast Open
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Grade	**8.0 (max 10.0)**

Instructions

Assignment 6 - TCP Fast Open

Goal

The goal of this assignment is to learn about a specific change to TCP that reduces transfer latency. In the past lesson you learned about persistent TCP connections which enable a web browser to reuse a connection for multiple data requests. However, many HTTP requests occur over new TCP connections for example because an image for a webpage is located on a separate content server or an ad is being loaded from a third party resource. This led researchers at Google to investigate reducing the setup costs for a TCP connection. They developed TCP Fast Open (TFO) which begins sending data during the TCP handshake thereby reducing the latency of a new connection by one RTT.

You will replicate the experiment from the original paper in Mininet to observe how TCP Fast Open improves round trip times for real websites. The test setup provided uses a modified Chrome binary to download web pages from Mininet hosts. The hosts act as web servers serving mirrored data from real websites. The tests run for different latencies with TCP Fast Open disabled and then enabled. TFO is a now merged in the Linux kernel so it is built into Ubuntu 13.04 which is installed on the virtual machine from assignment 1.

Directions

1. Update to the latest assignment code:

```
git commit -a -m "Saving work"
```

2. Install a VNC server, termcolor and an additional library:

```
sudo apt-get update
```

```
sudo apt-get install vnc4server
```

```
sudo apt-get install libnss3-dev
```

```
sudo easy_install termcolor
```

3. Read the original TCP Fast Open paper. You'll need to read this to answer the quiz questions.

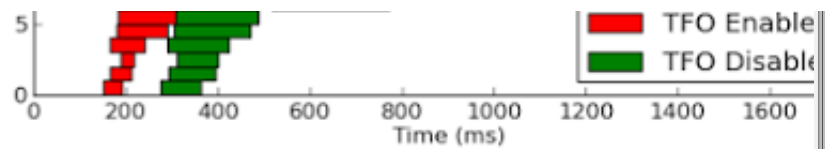4. Run the experiment to replicate the paper:

```
vnc4server
```

```
sudo ./run.sh
```

5. The experiment takes some time to complete. When its finished you should see results similar to the image below. Be sure to copy and paste this text into a text file named observations.txt for your final submission.

```
Page      RTT(ms) PLT: no TFO (s) PLT: TFO (s)     Improv
httpen.wikipedia.orgwikiTransmission_Control_Protocol
          200     7419.859         5817.565         21.594
          20      2570.471         2145.34          16.539
          100     4183.631         3400.245         18.725
httpwww.amazon.com
          200     6111.644         4184.72          31.528
          20      1684.071         1332.384         20.883
          100     4148.951         2191.288         47.184
```

You can also view graphs of the results in the `output-figures` folder.

TFO Timing Breakdown: www.amazon.com at 20 ms RT

6. Now, using your own set of websites, run the experiment. To do this, you'll need to create a `.pages` file with a list website URLS each on a single line similar to the `Paper.pages` file. For simplicity, call the file `myURLS.pages` . Then run the `fetch.py` script to download the web pages, modify the `run.sh` script to use your new `.pages` file, and re-run the experiment:

```
./fetch.py --name myURLS
```
```
--- Modify run.sh script on lines 21 and 29 (change --name
```
```
sudo ./run.sh
```

Note that the script has issues with Javascript heavy web pages and avoid using `https` sites as well. The Google and Udacity home pages work well as test sites. Also, if you shut down the virtual machine after step 4, be sure to restart VNC.

7. Submit the log data from step 5, the data replicating the paper's results, and your answers to the quiz questions in hw6.txt below to the T-Square.

Quiz Questions

1. It can be said that the web transfer latency is dominated by -

   - A - Round trip time (RTT)
   - B - Number of Round trips
   - C - Both a and b
   - D - None of the above

2. RTT of a web flow comprises of two components - transmission delay and propagation delay. Which of them can be reduced with an improvement in network bandwidth.

   - A - Transmission Delay
   - B - Propagation Delay
   - C - Both a and b
   - D - None of the above

3. Which of the following best describes the purpose of TCP fast Open (TFO)? -

   - A - Enables data to be exchanged safely during the initial TCP handshake

TCP handshake.

- B - Reduces the number of round trips required to transfer data by one.
- C - Is a mechanism to provide authentication at the transport layer using security cookie.
- D - Both a and b
- E - Both a and c

4. According to the authors, TCP handshake is a key performance bottleneck for modern web transfers.

- A - True
- B - False

5. Arrange the following events in the sequence that they occur - a. Server encrypts the client IP to generate cookie. b. Client sends a SYN packet to request a TCP connection under TFO along with data. c. Client sends a SYN packet to request both TCP connection and TFO cookie. d. Client caches the TFO cookie for this particular server's IP.

- A - bacd
- B - badc
- C - acdb
- D - cadb

6. Unlike expected, it is seen from the authors' experiment that TFO does not show any improvement for the nytimes webpage.

- A - True
- B - False

7. What does TFO use at its core to mitigate the denial of service attacks?