Distributed Systems – Programming Assignment - 1

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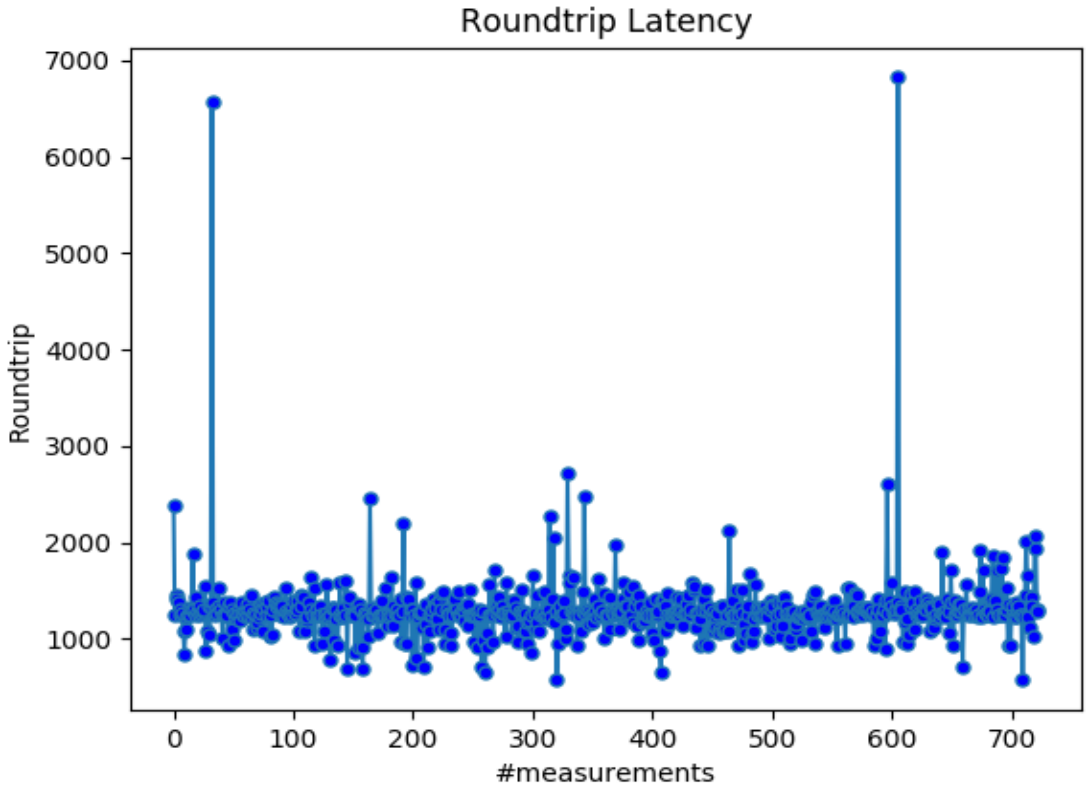
Question 1:

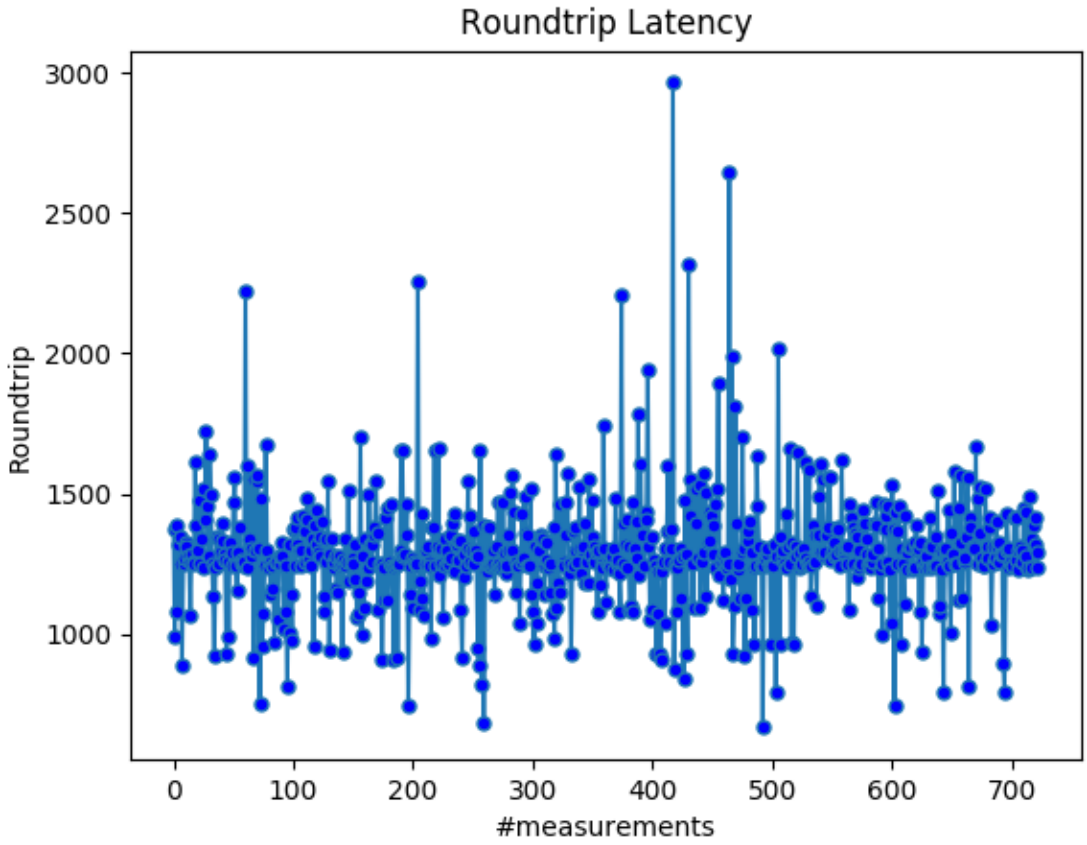
a) A and B are the same machine: -

Average Roundtrip Latencies: 1293.76

Standard Deviation: 358.66

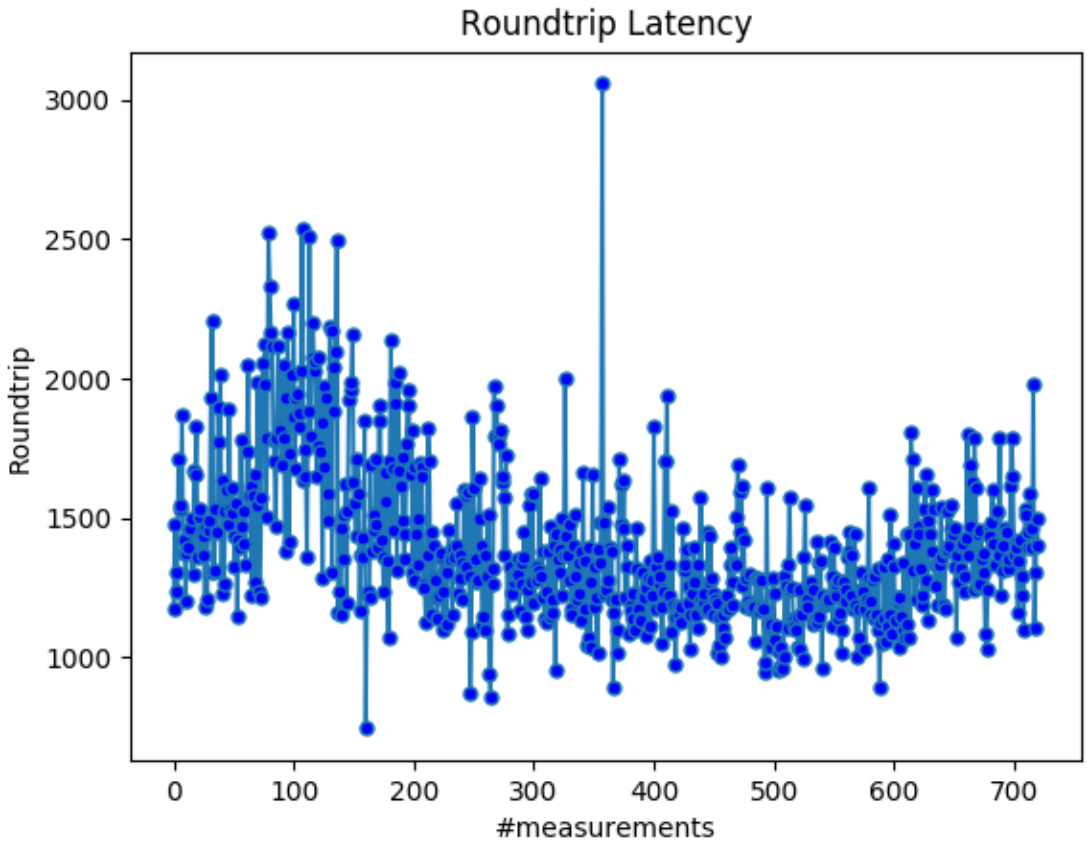


Average Roundtrip Latencies: 1292.44
Standard Deviation: 201.63

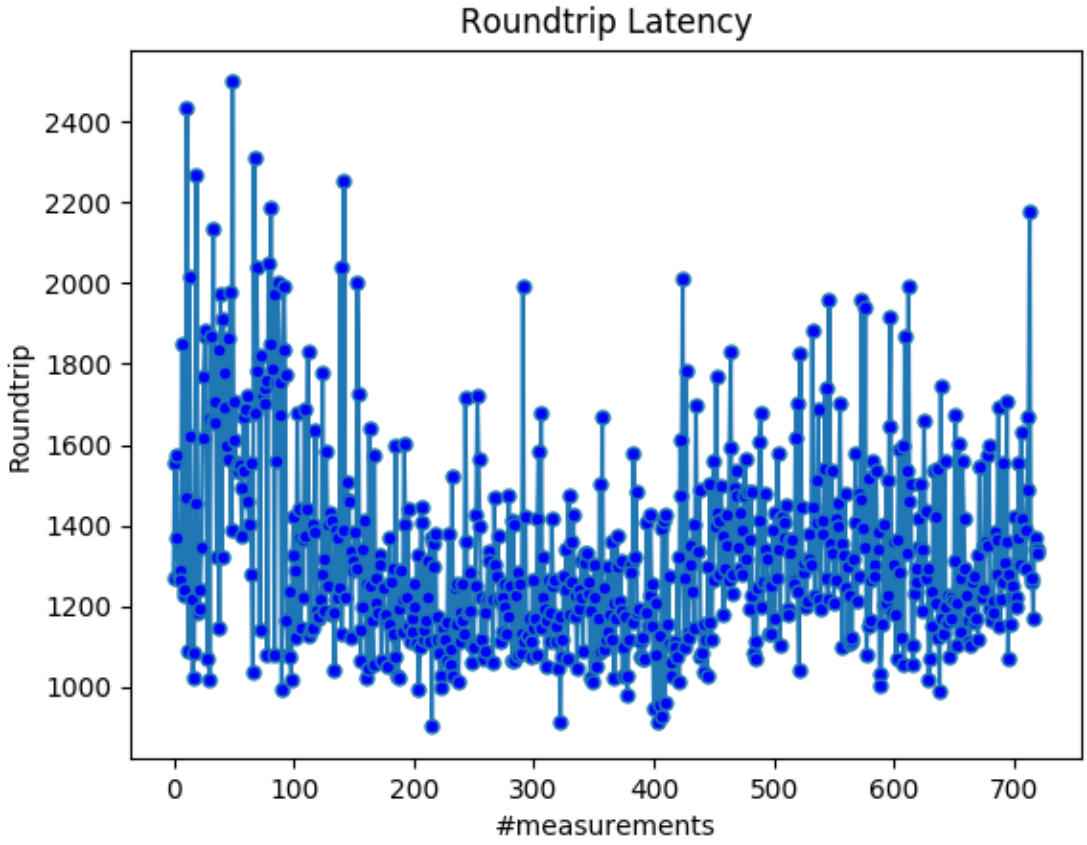


b) A and B are different machines with in the CS department, e.g. two different CSEL servers
Average Roundtrip Latencies: 1404.09
Standard Deviation: 285.74

elra-01.cs.colorado.edu
elra-02.cs.colorado.edu



Average Roundtrip Latencies: 1333.90
Standard Deviation: 247.406276



c) A and B are different machines across the CU-Boulder campus
Average Roundtrip Latencies: 5577.57484
Standard Deviation: 8335.68602

Local
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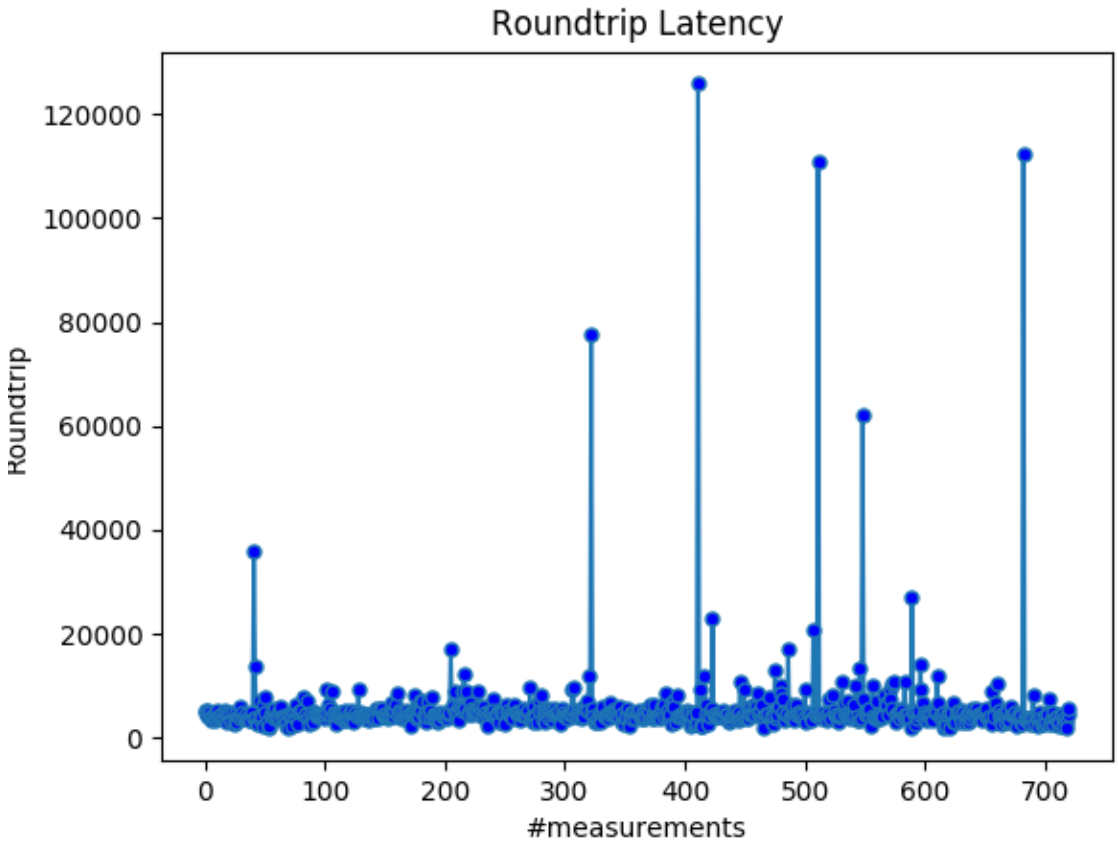
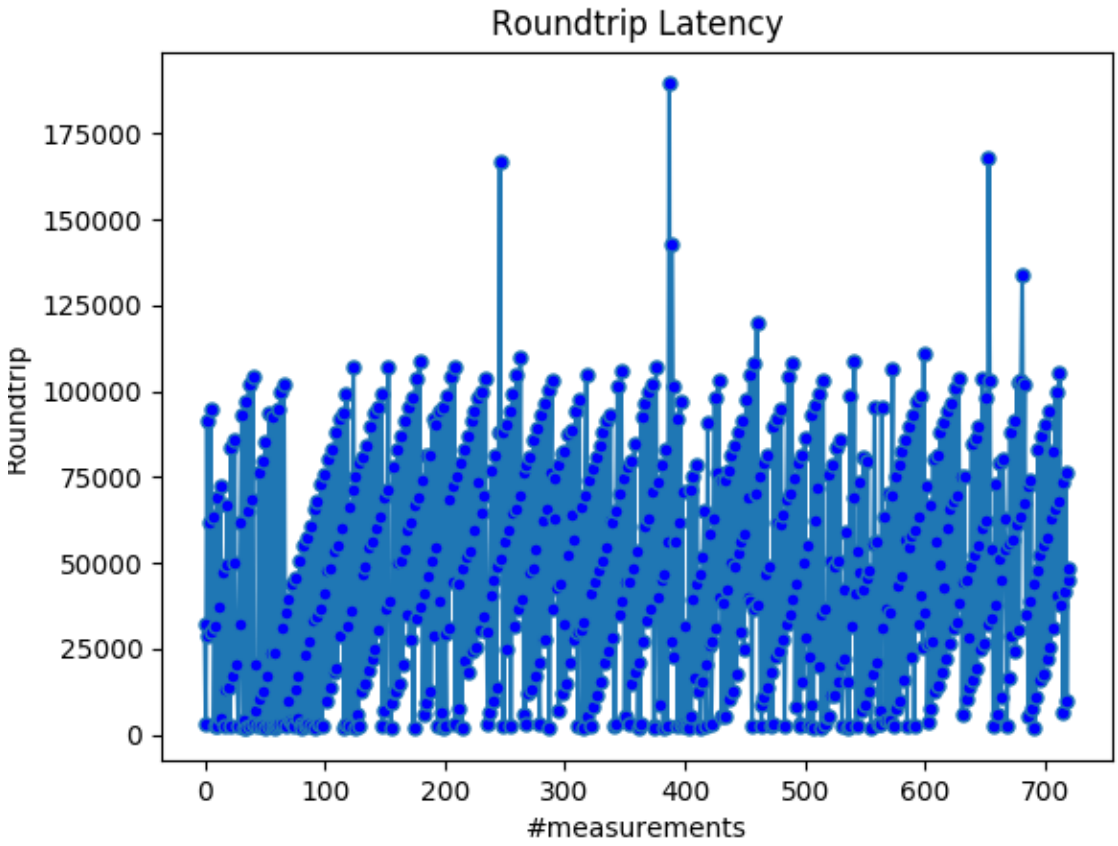


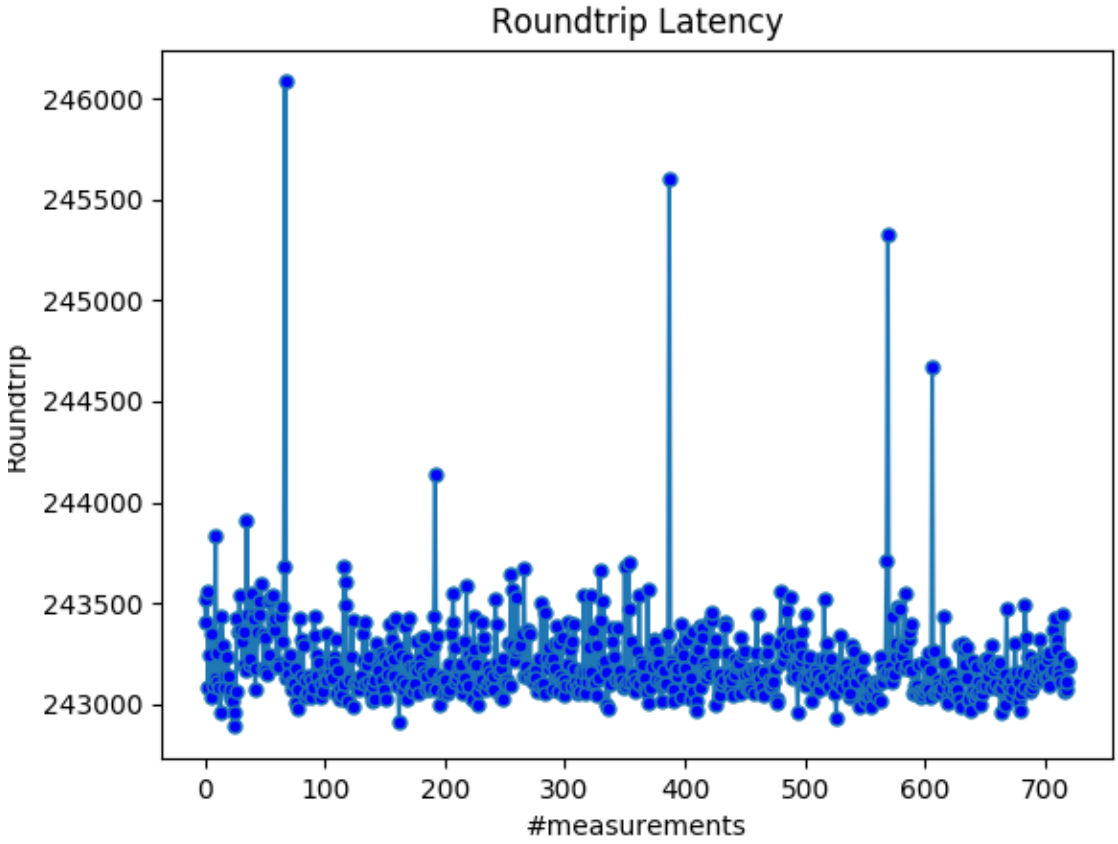
Average Roundtrip Latencies: 48410.6017
Standard Deviation: 34331.8773



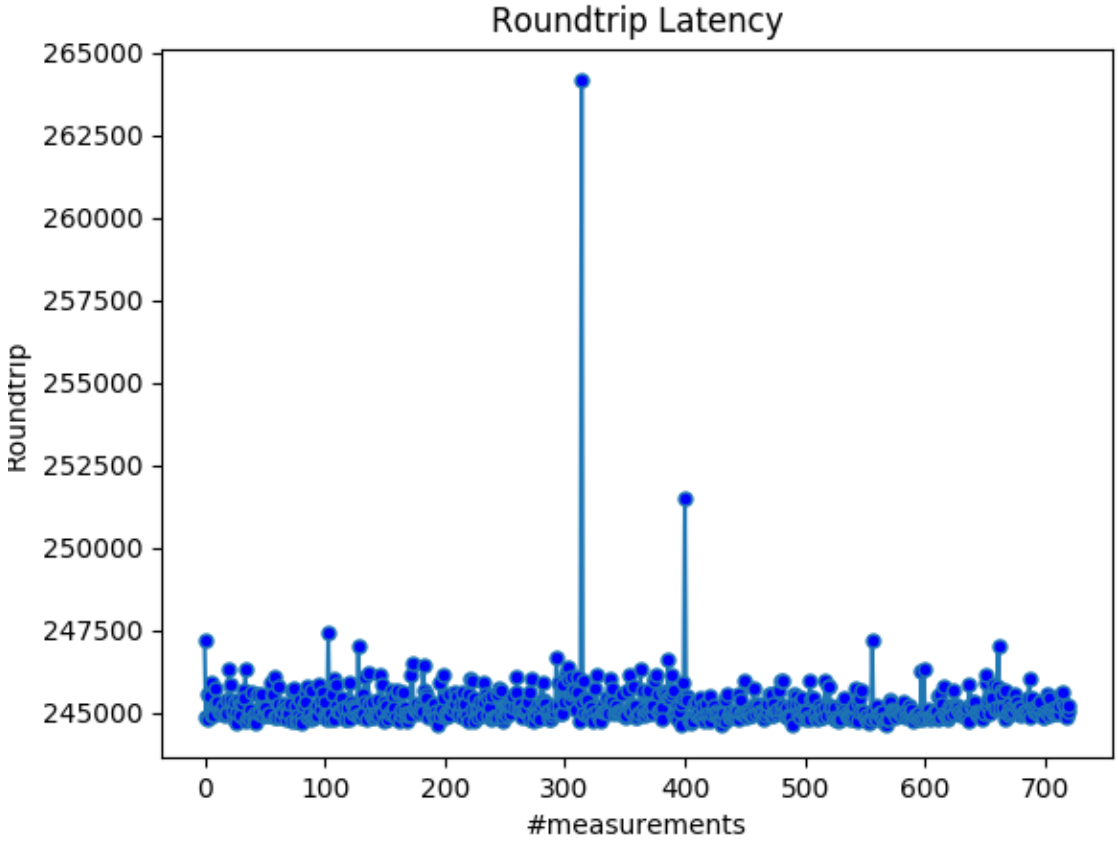
d) A and B are different machines, one in CU campus and the other at a different geographic location outside the CU campus, preferably on a different continent

Average Roundtrip Latencies: 243210.18
Standard Deviation: 226.725

CSEL – elra01.cs.colorado.edu
AWS EC2 instances ec2-13-126-31-10.ap-south-1.compute.amazonaws.com



Average Roundtrip Latencies: 245227.425
Standard Deviation: 845.90

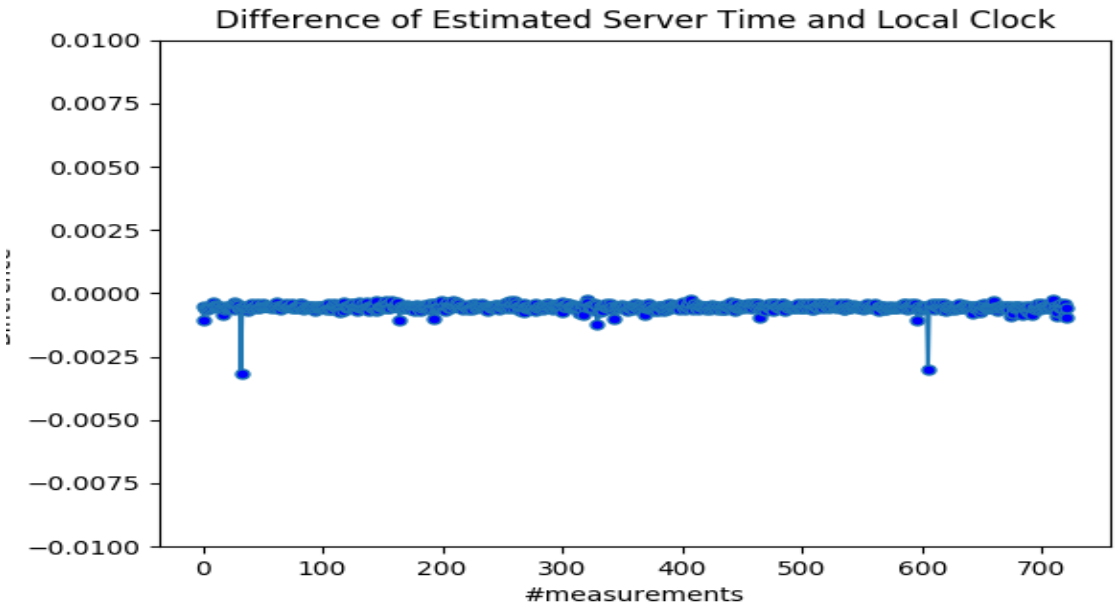


Analysis:
Here we have contrasted the latencies in each of the cases, we can clearly see that the average latencies of the four systems are in the following order:
Local < CSEL Server < Two Systems on campus < Systems communicating on two different continents
1293.76 < 1404.09 < 48410.601< 245227.42

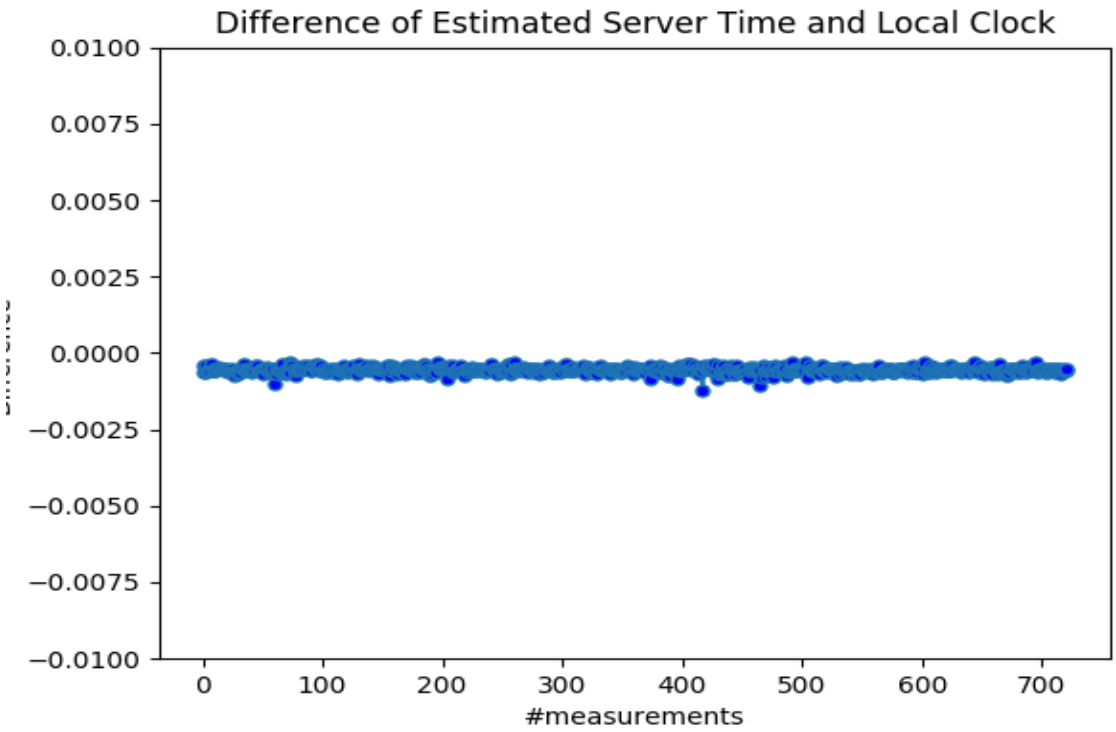
Why this variation in latencies?
As the communication is highly dependent on distance, processing time at servers, congestion on the networks (for e.g. different paths taken to travel, router congestion etc.). These could be some of the basic reasons for the variation on the networks. As in case 1 the data is inside the machine, case 2 the data is on an intra net, case 3, it's on the same network lastly, case 4 its on internet. Thus, we can see a variation in the values.

Question 2:
a) A and B are the same machine

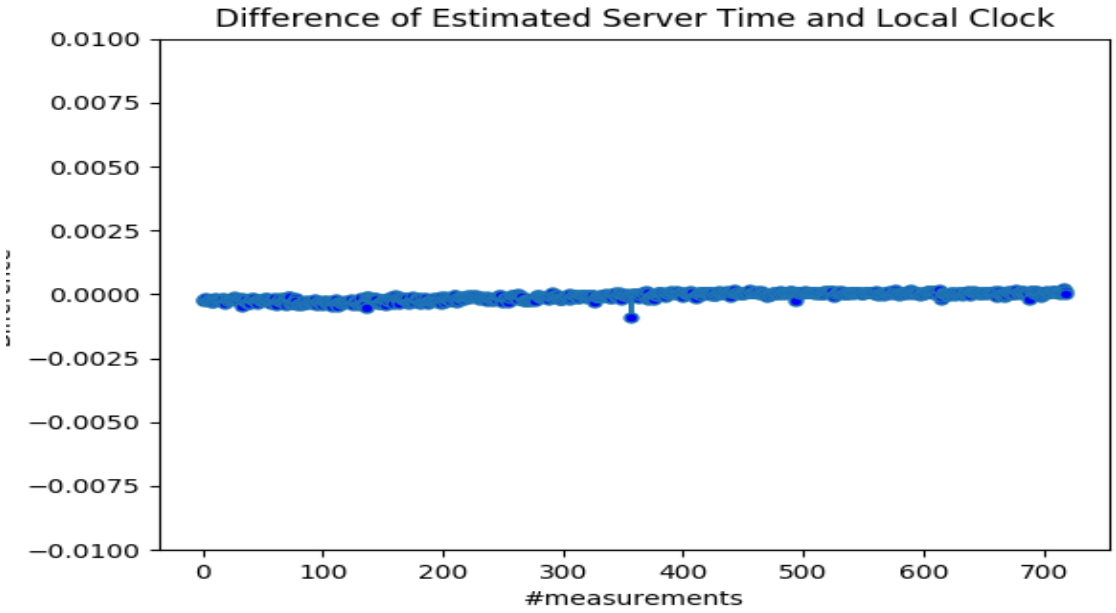
Minimum Latency: 560.04 μ seconds



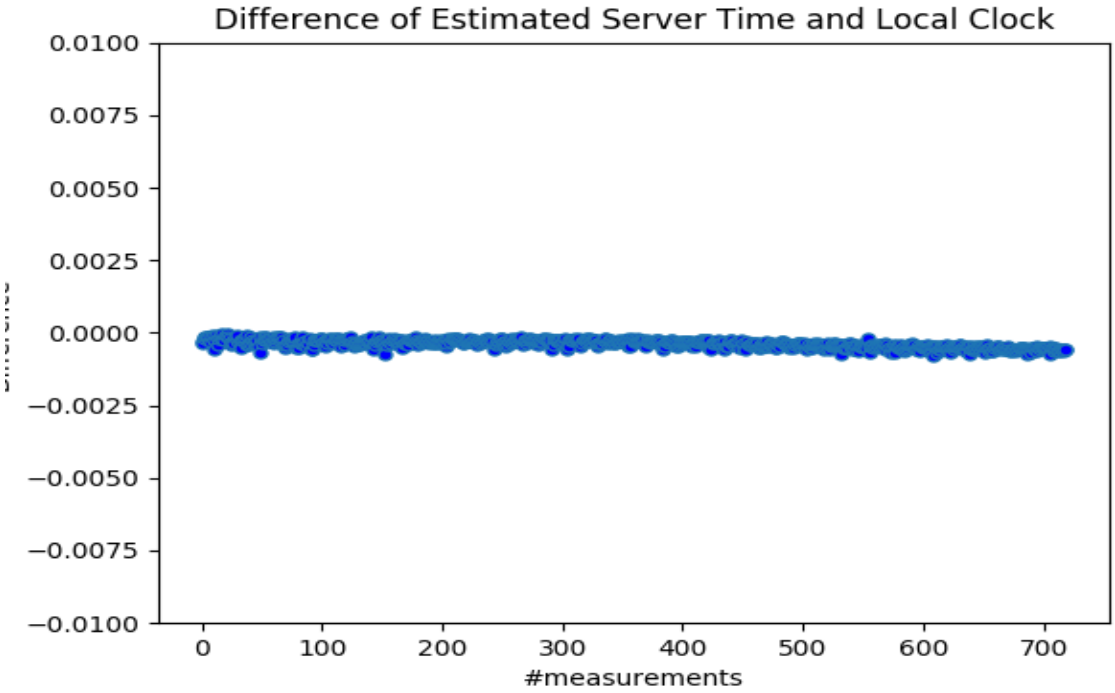
Minimum Latency: 657.08 μ seconds



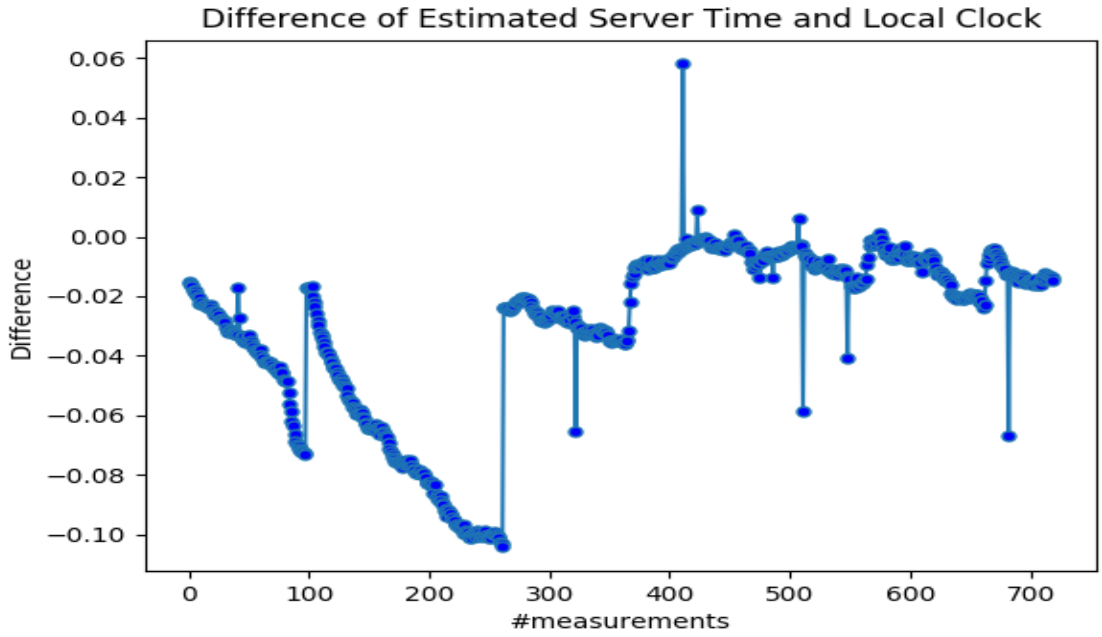
b) A and B are different machines with in the CS department, e.g. two different CSEL servers
elra-01.cs.colorado.edu
elra-02.cs.colorado.edu
Minimum Latency: 691.89 μ seconds



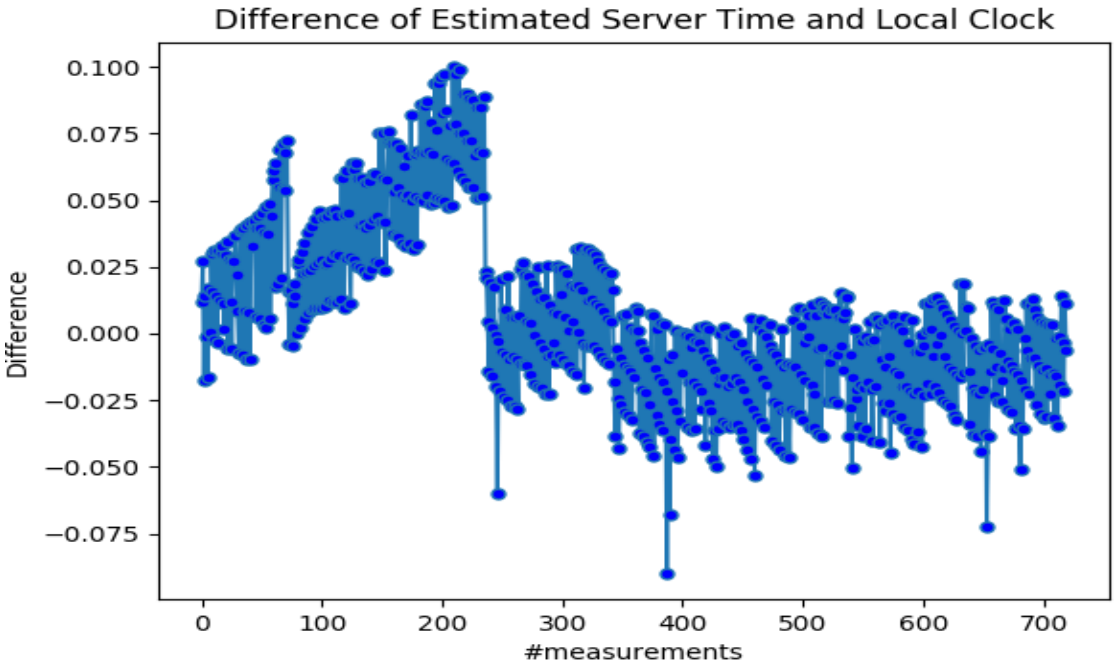
Minimum Latency: 797.98 µ seconds



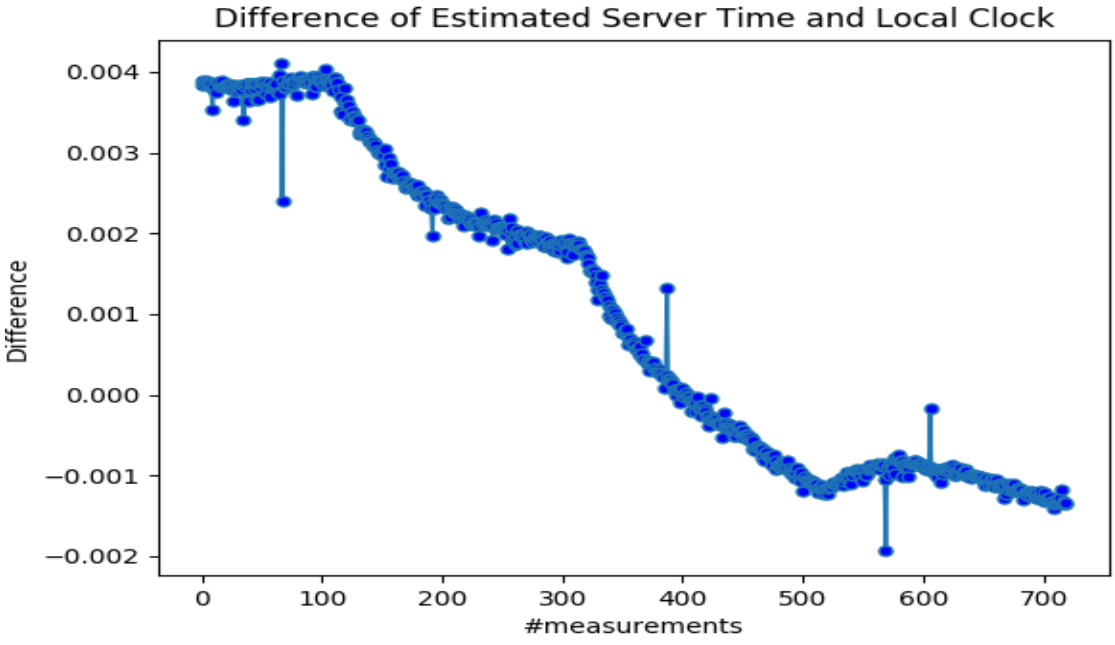
c) A and B are different machines across the CU-Boulder campus
Local
elra-01.cs.colorado.edu
Minimum Latency: 1729.01 µ seconds



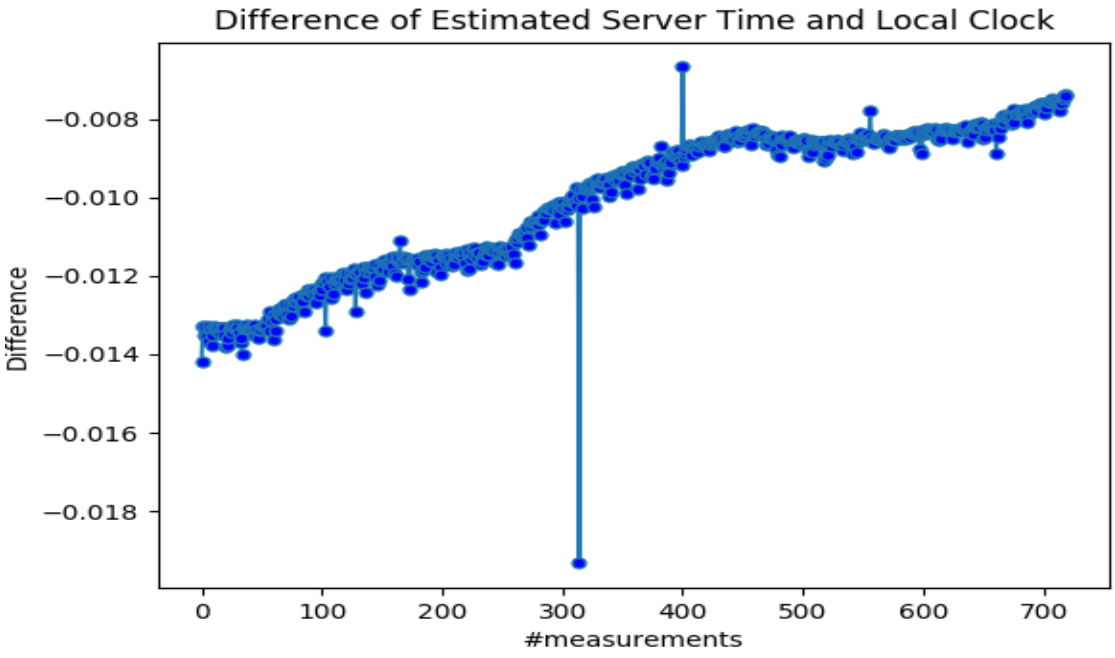
Minimum Latency: 1742.83 µ seconds



d) A and B are different machines, one in CU campus and the other at a different geographic location outside the CU campus, preferably on a different continent
CSEL – elra01.cs.colorado.edu
AWS EC2 instances ec2-13-126-31-10.ap-south-1.compute.amazonaws.com
Minimum Latency: 244684.93 μ seconds

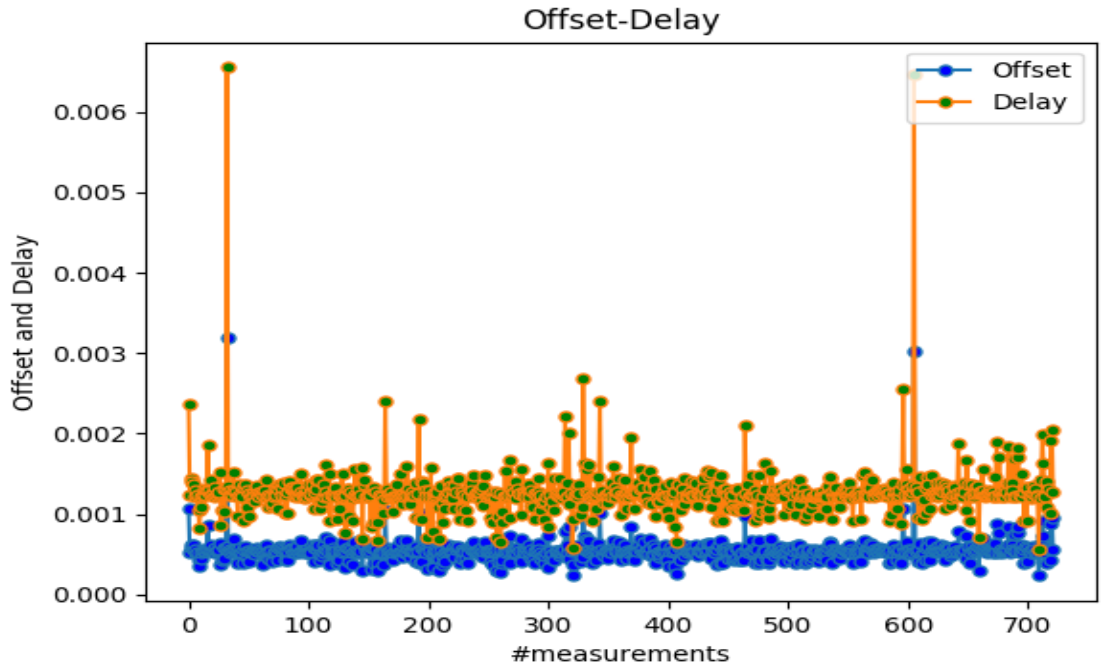


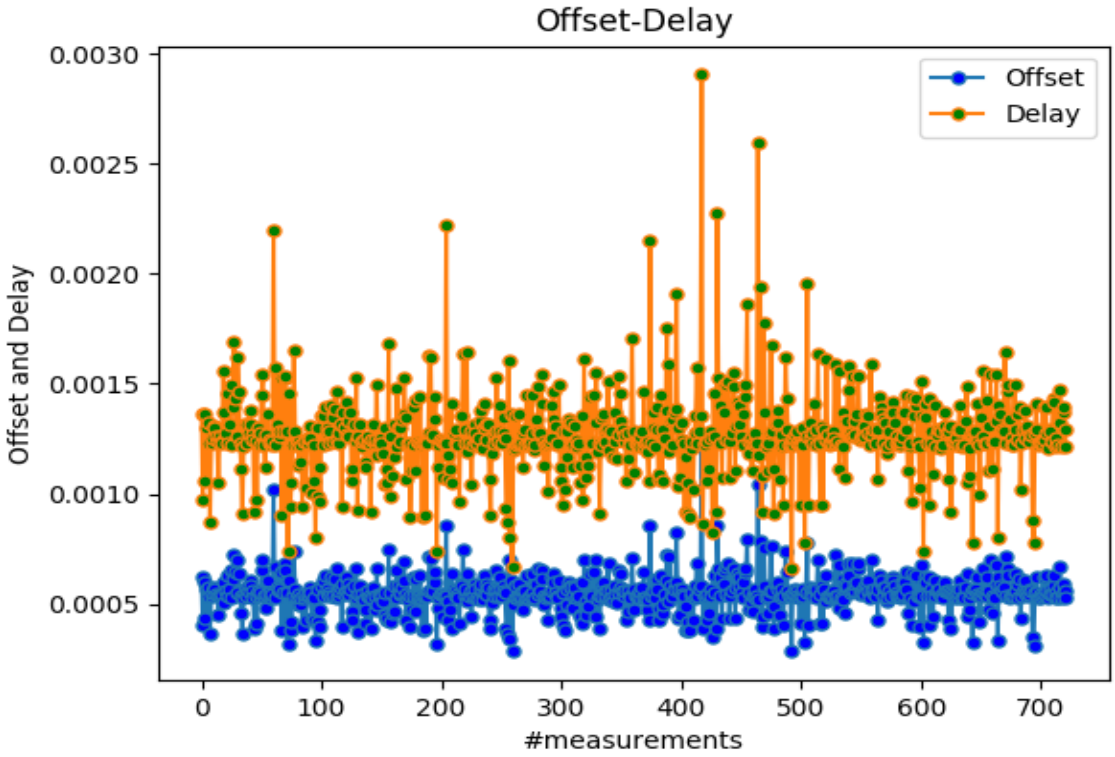
Minimum Latency: 242969.98 µ seconds



Based on our finding, to estimate a Tmin we should have the message reached most early at T1 and should leave late at T2. Thus, this means, T1 close to T0 and T2 close to T3. We can get the best estimate by considering the least delay, in this case we get the closest values of T1 – T0 and T2 – T3. Finding the minimum delay for each case we can calculate the error bounds by:
Error bounds: (T3-T1) / 2 + delay / 2

Question 3:
a) A and B are the same machine





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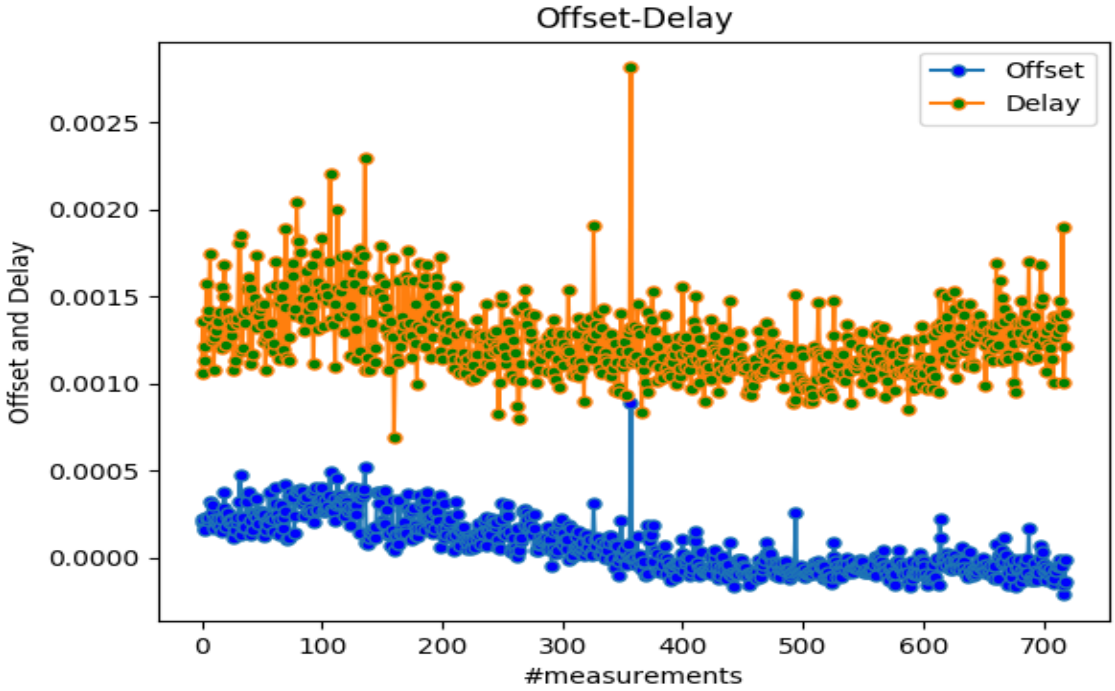
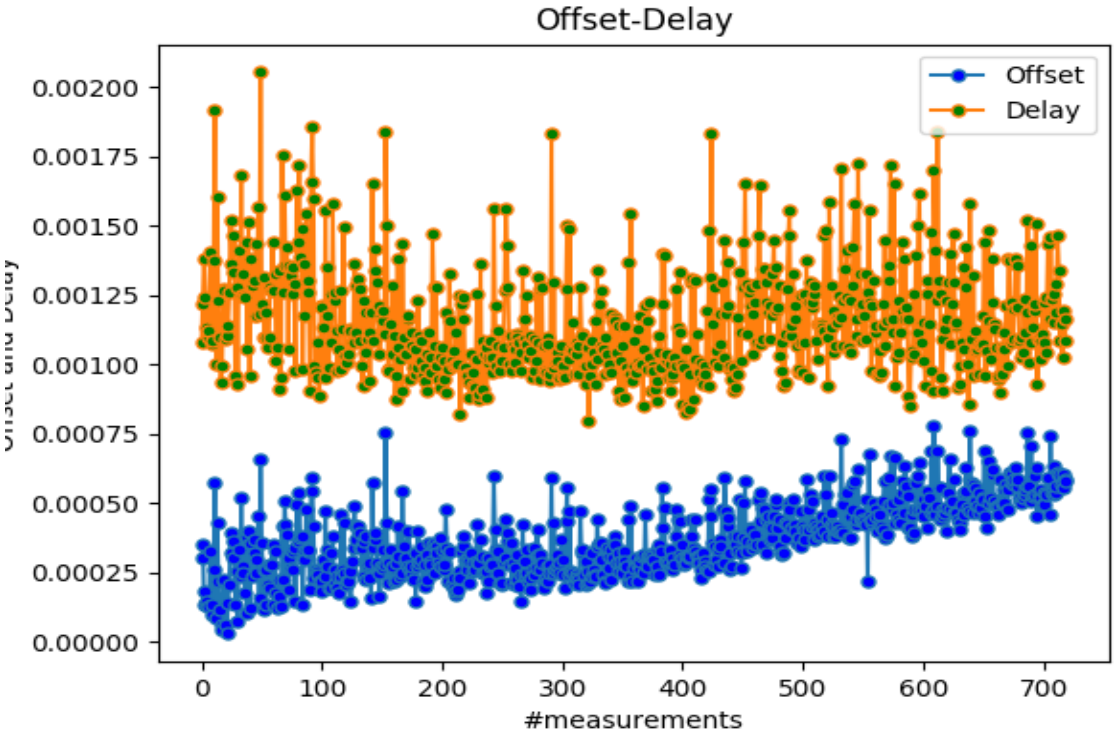
elra-02.cs.colorado.edu





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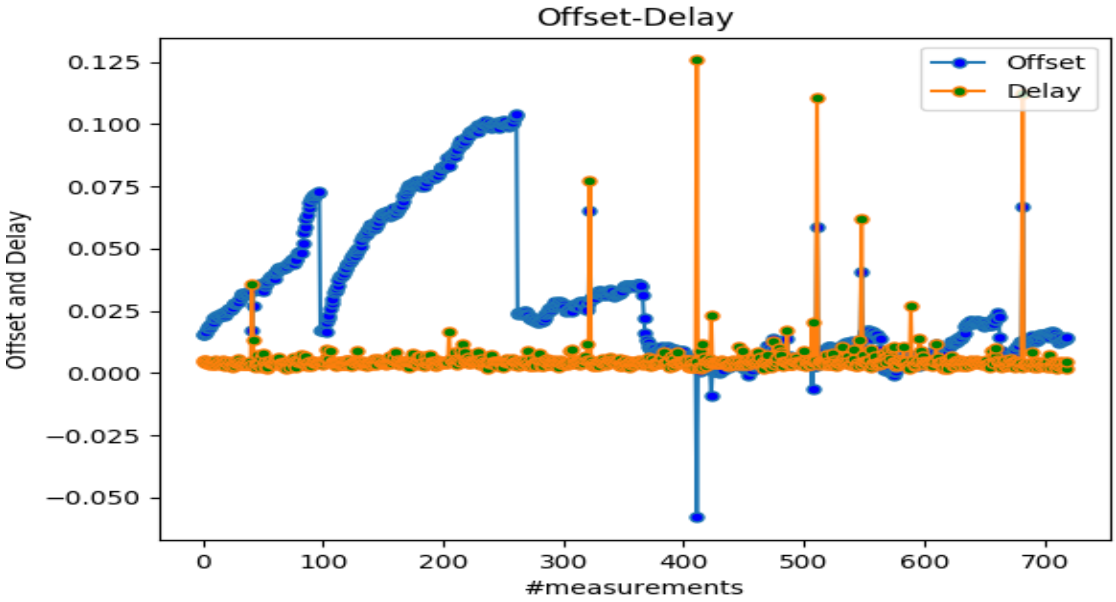
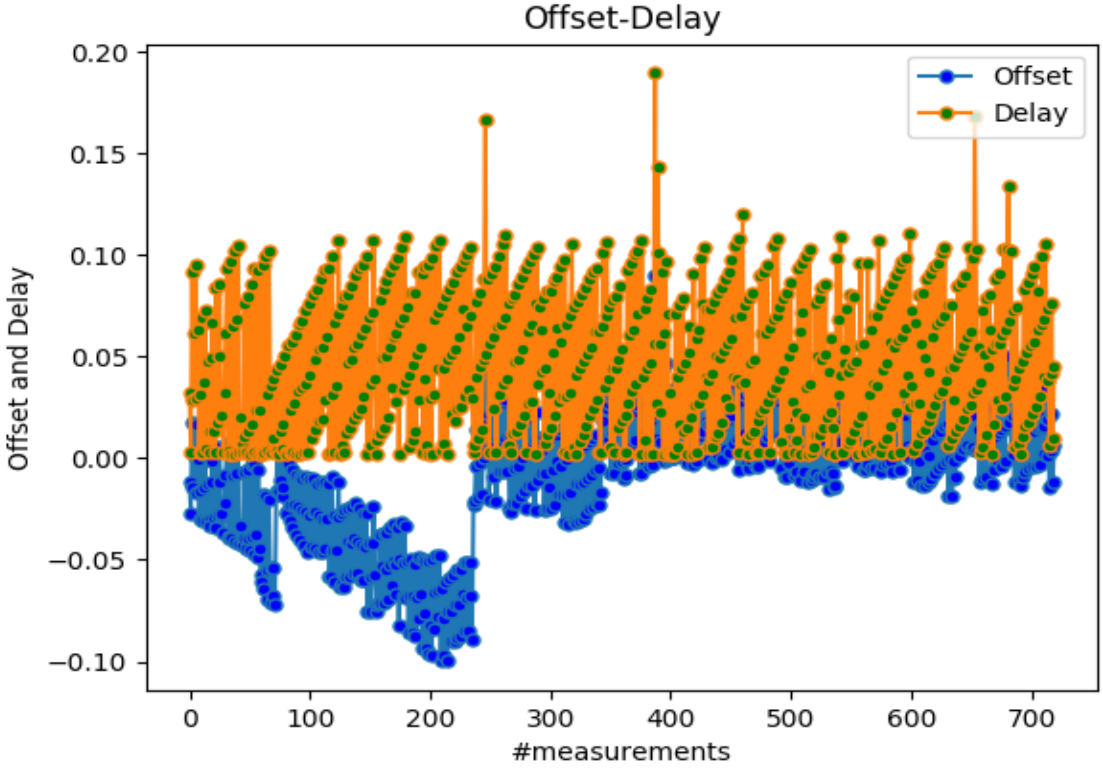
CSEL – elra=01.cs.colorado.edu
CSEL – elra-02.cs.colorado.edu





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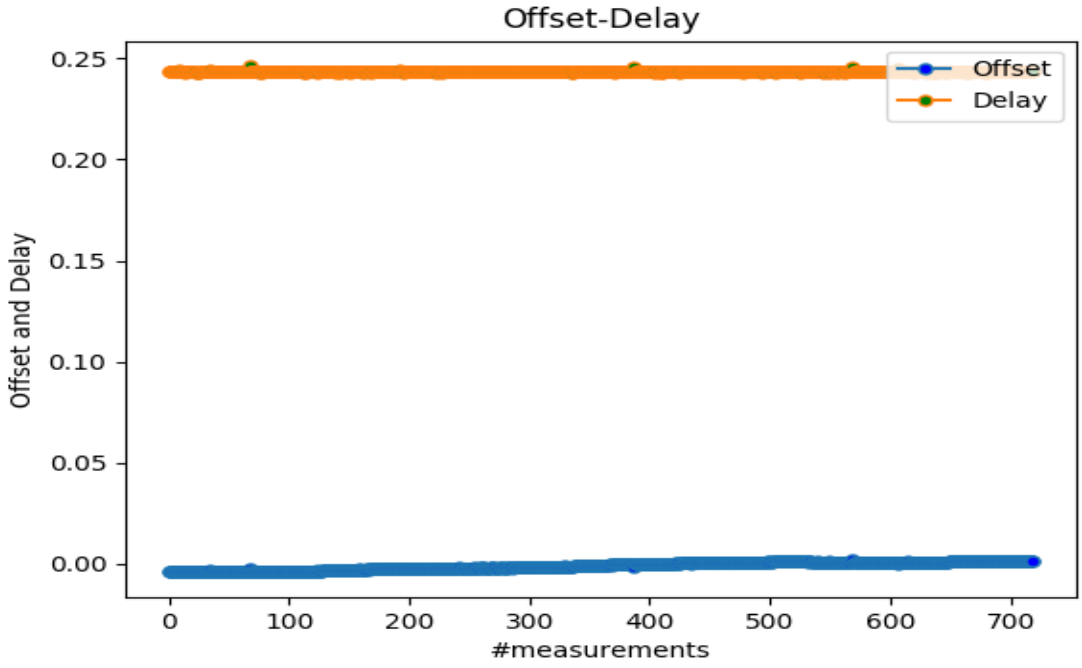

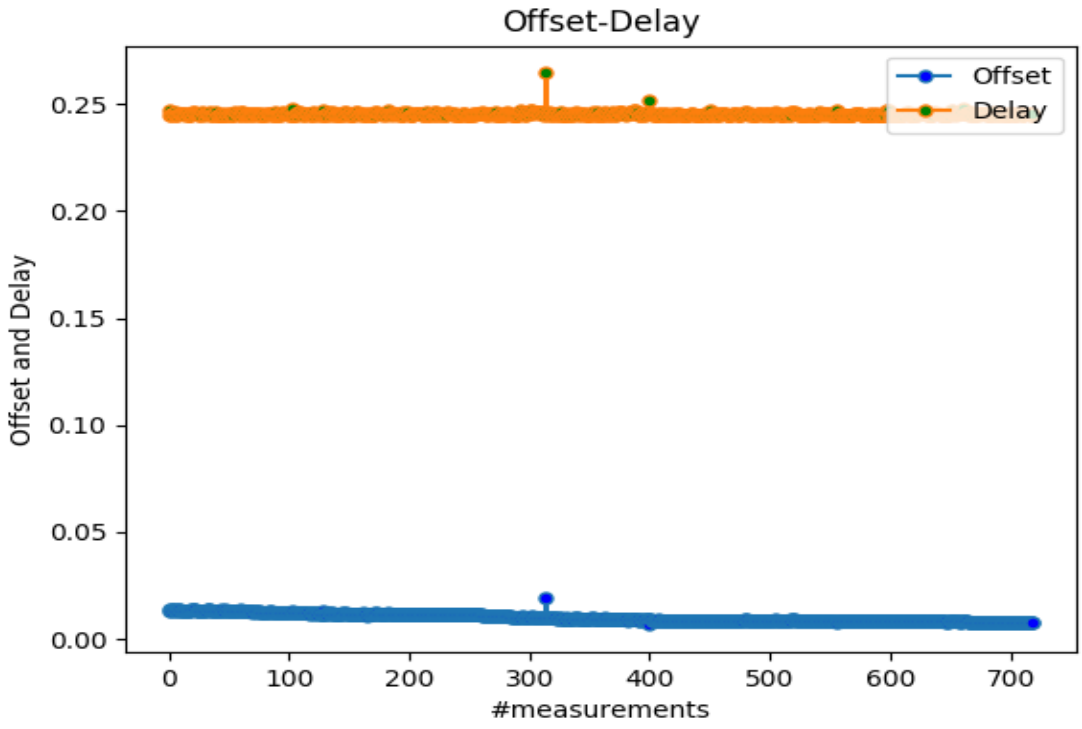

When compared to the values with question 1, the round-trip values here are not considered. Thus, the delay would be lesser than the roundtrip time. To explain this the following are the values in each case depicting the relation delay (di) < roundtrip delay:

Delay(di) < Propagation time
1. 1272.63 < 1293.76
2. 1271.75 < 1292.44
3. 1256.39 < 1404.09
4. 1156.35 < 1333.90
5. 5368.89 < 5577.57484
6. 48330.33 < 48410.6017
7. 243303.11 < 244227.425
8. 245407.72 < 245227.425

Here we have computed the delay as T3-T2 + T1-T0 whereas for the question1 we have considered T3 – T0.