INDEX

Motivation

❖ In a relatively short period of time, the Internet has had an amazing impact on almost every facet of our lives.

❖ With Internet, we are able access to new ideas, more information, unlimited possibilities, and a whole new world of communities.

❖ Internet has grown and evolved to influence how we interact, how we conduct business, how we learn, and how we proceed day to day. And as much as it has changed our lives, in the process, the Internet itself has changed too.

❖ The internet is a vital part of our lives. Just like your car, body, and robot underlings, your internet connection can be fine-tuned and made to work more efficiently. With just a little bit of effort, your surfing experience can be noticeably improved.

❖ Now a days Smartphones, watches, homes, and cars are increasingly requiring stable internet connections. Home appliances, door locks, security cameras, cars, wearables, dog collars, and so many other inert devices are beginning to connect to the web.

❖ In world continuously connected with Internet needs to be stable and reliable, it should be able to deliver data on time and in correct format.

Methodology

❖ To measure Stability of Internet, we used nodes-pairs from Planet Lab – A global research network. The Pairs we used are as Under

Sr No.	Pair Nodes
1-4	US - US
5	US - CZ
6	US - PL
7	US – GR
8-9	US - NZ
10-11	US – CA

❖ In measurement Project I had made scripts which ping & traceroute its pair node periodically. Each node will ping & traceroute to another node every 1 hour.

❖ In this project, I had created Bash Shell Scripts for various Functions. Usage and basic details of scripts are as under.

- Injector -> To inject Scripts on Nodes using SSH & SCP command.
- Process_check -> To Check Status of Process on the Node.
- Logger -> To Log on Nodes With its project specific Alice.
- data_reciver -> To Retrieve Ping & Traceroute data Files on Local Server.
- dir_deleter -> To Clean Nodes delete all scripts and data.
- demon_TA1_UN -> A Basic Example of Script Which I had ran on Node.

❖ In Addition Of all Bash Scripts I had used third-party python script, which I got from stack overflow.

❖ I had put demon and pingparser.py on Node and it generates dump of Ping & dump of traceroute to its Paired Node.

❖ Moreover, It generates CSV file containing basic data like hope counts, host destination, average and more.

❖ Every day running the scripts I checked status of my Process on every node & Retrieved data from Node.

Analysis

❖ I had collected data of over 10 days from 11 Different pair Nodes. Which I had sorted and Processed, after which there are some results. Pair nodes I had used are as Under.

Node-Pairs: -

Number	USA NODE	Pair Node	TYPE	Pair_Code
1	planetlab2.cs.uml.edu	planetlab3.cesnet.cz	Trance Atlantic	TA1
2	ricepl-1.cs.rice.edu	planetlab1.cs.aueb.gr	Trance Atlantic	TA2
3	planetlab-2.cmcl.cs.cmu.edu	planetlab4.mini.pw.edu.pl	Trance Atlantic	TA3
4	planetlab5.eecs.umich.edu	planetlab-n2.wand.net.nz	Trance Pacific	TP1
5	planetlab2.utdallas.edu	planetlab-n1.wand.net.nz	Trance Pacific	TP2
6	salt.planetlab.cs.umd.edu	planetlab1.unr.edu	US	UU1
7	planetlab2.cs.purdue.edu	planetlab1.cs.uml.edu	US	UU2
8	earth.cs.brown.edu	planetlab1.temple.edu	US	UU3
9	node2.planetlab.mathcs.emory.edu	planetlab4.cs.uoregon.edu	US	UU4
10	planetlab2.cs.ucla.edu	plonk.cs.uwaterloo.ca	US<---> CANADA	UC1
11	planetlab1.cs.purdue.edu	planetlab1.cs.ubc.ca	US<---> CANADA	UC2

Question 1:

NODE	Hopes	Sent Packets	Received Packets	Packet Loss	Min	Max	Average	Standard Deviation
planetlab3.cesnet.cz	12	20.00	19.98	0.09	115.83	119.13	116.34	0.97
planetlab2.cs.uml.edu	12	20.00	19.99	0.07	115.84	120.35	116.43	1.23
planetlab-n2.wand.net.nz	16	20.00	20.00	0.00	198.89	199.44	199.05	0.46
planetlab5.eecs.umich.edu	17	20.00	20.00	0.00	198.98	199.70	199.16	0.48
salt.planetlab.cs.umd.edu	15	20.00	20.00	0.00	60.86	61.87	61.20	0.36
planetlab1.unr.edu	16	20.00	20.00	0.00	60.82	62.10	61.17	0.42
planetlab1.cs.uml.edu	13	20.00	19.99	0.07	45.40	106.60	55.89	15.51
planetlab2.cs.purdue.edu	13	20.00	19.95	0.25	45.47	124.71	67.99	19.98
plonk.cs.uwaterloo.ca	21	20.00	20.00	0.00	79.13	80.08	79.45	0.42
planetlab2.cs.ucla.edu	22	20.00	20.00	0.00	79.14	80.02	79.46	0.41

❖ In Results I did not see any changes in path length over the different measurements.

Question 2

a) Here In my results I saw outrages in different numbers. Some of them were short time. Some of them don't accept pings. Graph & Table data of same is as under.
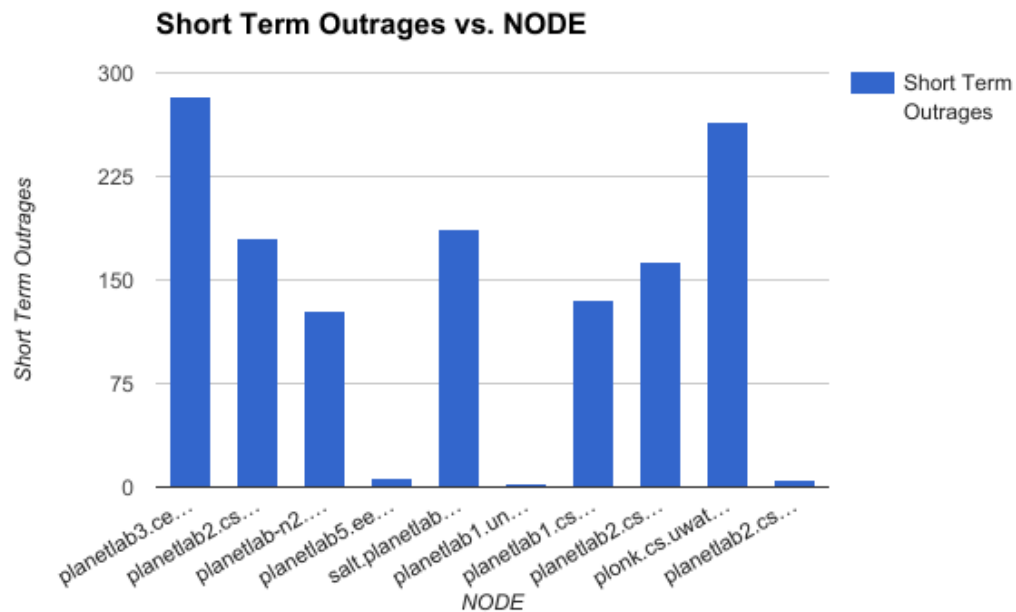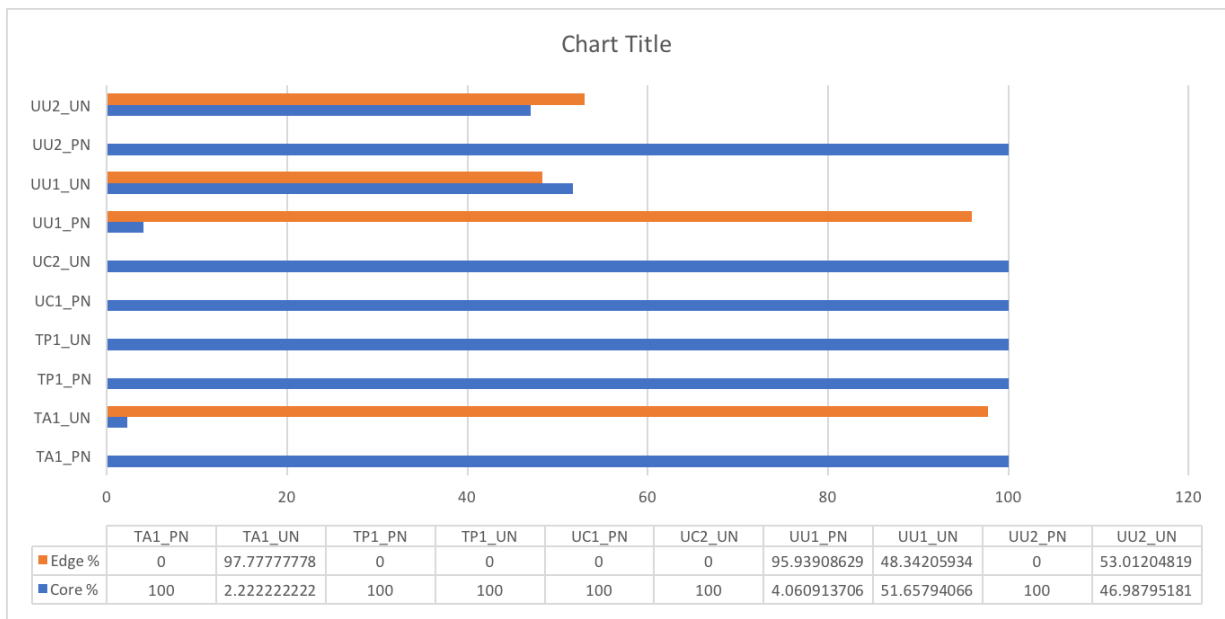
Graph:

Short Term Outrages vs. NODE

Table:

NODE	Short Term Outrages
planetlab3.cesnet.cz	283
planetlab2.cs.uml.edu	180
planetlab-n2.wand.net.nz	127
planetlab5.eecs.umich.edu	7
salt.planetlab.cs.umd.edu	187
planetlab1.unr.edu	2
planetlab1.cs.uml.edu	136
planetlab2.cs.purdue.edu	163
plonk.cs.uwaterloo.ca	264
planetlab2.cs.ucla.edu	5

b) From all of my results in one of my pair I found long time outrage, in which destination was not reachable in last days of my tests. The pair in which long time outrage occurred was pair of Trance Pacific.

| planetlab-n2.wand.net.nz | ⟶ | planetlab5.eecs.umich.edu |
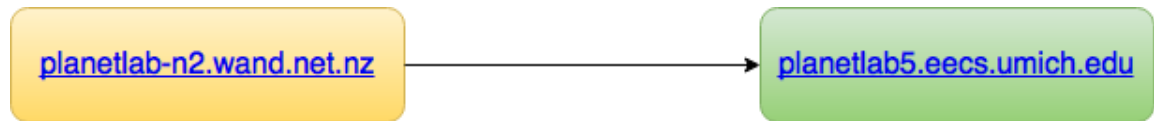
Question 3

❖ From Received Data, It is pretty tough to analyze what percentage are in the core vs. in the edge! Though using basic tricks and method we had tried to determine what percentage are in the core vs. in the edge.

❖ Chart in Percentage: -

Chart Title

	TA1_PN	TA1_UN	TP1_PN	TP1_UN	UC1_PN	UC2_UN	UU1_PN	UU1_UN	UU2_PN	UU2_UN
Edge %	0	97.77777778	0	0	0	0	95.93908629	48.34205934	0	53.01204819
Core %	100	2.222222222	100	100	100	100	4.060913706	51.65794066	100	46.98795181

❖ Data in Table Format

Outrages	TA1_PN	TA1_UN	TP1_PN	TP1_UN	TP3_PN	TP3_UN	UU1_PN	UU1_UN	UU2_PN	UU2_UN
Core	283	4	634	7	187	2	8	296	555	39
Edge	0	176	0	0	0	0	189	277	0	44
Total	283	180	634	7	187	2	197	573	555	83

Question 4

❖ No, in my results of measurements I had found significant difference in reliability. In below table, it is clear that In Links Between continental links vs inter-continental links Hope count, Packet Loss and Standard Deviation is not showing major difference. But On Other hand Just Round trip time which I found Higher for inter-continental links, which is due to data packets have to travel through undersea cables. (High RTT times may not importance in reliability but it may impact in Performance)

NODE	Hopes	Sent Packets	Received Packets	Packet Loss	Min	Max	Average	Standard Deviation
planetlab3.cesnet.cz	12	20.00	19.98	0.09	115.83	119.13	116.34	0.97
planetlab2.cs.uml.edu	12	20.00	19.99	0.07	115.84	120.35	116.43	1.23
planetlab-n2.wand.net.nz	16	20.00	20.00	0.00	198.89	199.44	199.05	0.46
planetlab5.eecs.umich.edu	17	20.00	20.00	0.00	198.98	199.70	199.16	0.48
salt.planetlab.cs.umd.edu	15	20.00	20.00	0.00	60.86	61.87	61.20	0.36
planetlab1.unr.edu	16	20.00	20.00	0.00	60.82	62.10	61.17	0.42
planetlab1.cs.uml.edu	13	20.00	19.99	0.07	45.40	106.60	55.89	15.51
planetlab2.cs.purdue.edu	13	20.00	19.95	0.25	45.47	124.71	67.99	19.98
plonk.cs.uwaterloo.ca	21	20.00	20.00	0.00	79.13	80.08	79.45	0.42
planetlab2.cs.ucla.edu	22	20.00	20.00	0.00	79.14	80.02	79.46	0.41

Question 5

❖ Yes, most of my nodes did not show fluttering in its routes. But link between my nodes USA to Canada showed fluttering. Fluttering mostly occurred in link sending data from Canada to USA. My USA Node was located at LA, USA. Here is one sample our of traceroute which have fluttering in it. Here we can clearly see Fluttering in shown picture.

```
                                                                  Page 1/1
Saved: 26/04/17, 10:47:36 PM                          Printed for: Karan Sheth

 1  ========= { Round : 156, Date: 04-14-2017 (MM/DD/YYYY), Time: 08:17 (24Hr), Ho:
 2
 3  traceroute to planetlab2.cs.ucla.edu (131.179.150.72), 30 hops max, 60 byte pa
 4   1  * * *
 5   2  te2-7-dist-rt-phy.ns.uwaterloo.ca (172.16.3.5)  0.581 ms  0.819 ms  0.858
 6   3  xe1-0-0-u11-dist-sa-mc-trust.ns.uwaterloo.ca (172.31.0.149)  0.541 ms  0.5:
 7   4  te2-12-dist-rt-mc-global.ns.uwaterloo.ca (172.31.0.161)  1.226 ms  1.271 m
 8   5  te2-16-cn-rt-rac.ns.uwaterloo.ca (172.16.31.113)  0.975 ms  0.911 ms  0.94:
 9   6  gi0-0-0-ext-rt-rac.ns.uwaterloo.ca (172.16.31.105)  1.355 ms  1.431 ms  1.
10   7  216.191.167.37 (216.191.167.37)  2.647 ms  2.662 ms  2.456 ms
11   8  199.212.160.206 (199.212.160.206)  12.639 ms  12.472 ms  12.453 ms
12   9  ae5.gw2-chi.bb.allstream.net (216.191.65.82)  12.638 ms  12.422 ms  12.634
13  10  ae15.cr2.ord2.us.zip.zayo.com (64.125.24.149)  12.867 ms  12.723 ms  12.96
14  11  ae27.cs2.ord2.us.eth.zayo.com (64.125.30.244)  111.880 ms  110.680 ms  110
15  12  ae5.cs2.den5.us.eth.zayo.com (64.125.29.216)  73.870 ms  68.680 ms  68.618
16  13  ae4.cs2.lax112.us.eth.zayo.com (64.125.31.11)  88.593 ms  88.458 ms  88.44:
17  14  * * *
18  15  lax-agg6--zayo-la1.cenic.net (198.32.251.213)  58.441 ms  58.406 ms  58.41:
19  16  * * *
20  17  bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4)  58.377 ms bd11f1.ande
21      bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4)  59.143 ms
22  18  cr00f2.csb1--dr00f2.csb1.ucla.net (169.232.4.53)  58.425 ms  58.362 ms cr0
23  19  * * *
24  20  Planetlab2.CS.UCLA.EDU (131.179.150.72)  58.387 ms  58.406 ms  58.443 ms
25
26
```

Question 6

❖ No, in my collected data sets I did not see any inconsistencies in path in your pair-wise measurements. Here below table shows that for each Pair from A -> B & B ->A, hope count and packet loss is kind of same. By which I can say I did not see any inconsistencies in path in your pair-wise measurements.

Pair	NODE	Hopes	Packet Loss
Pair 1	planetlab3.cesnet.cz	12	0.09
	planetlab2.cs.uml.edu	12	0.07
Pair 2	planetlab-n2.wand.net.nz	16	0
	planetlab5.eecs.umich.edu	17	0
Pair 3	salt.planetlab.cs.umd.edu	15	0
	planetlab1.unr.edu	16	0
Pair 4	planetlab1.cs.uml.edu	13	0.07
	planetlab2.cs.purdue.edu	13	0.25
Pair 5	plonk.cs.uwaterloo.ca	21	0
	planetlab2.cs.ucla.edu	22	0

Question 7

❖ No, in my data collection I did not find any triangular routing. Though it is practically very tough task to do but in general there was no triangular routing in brief view of my data set.

Question 8
latency as a CDF

❖ **USA To Czech Republic**
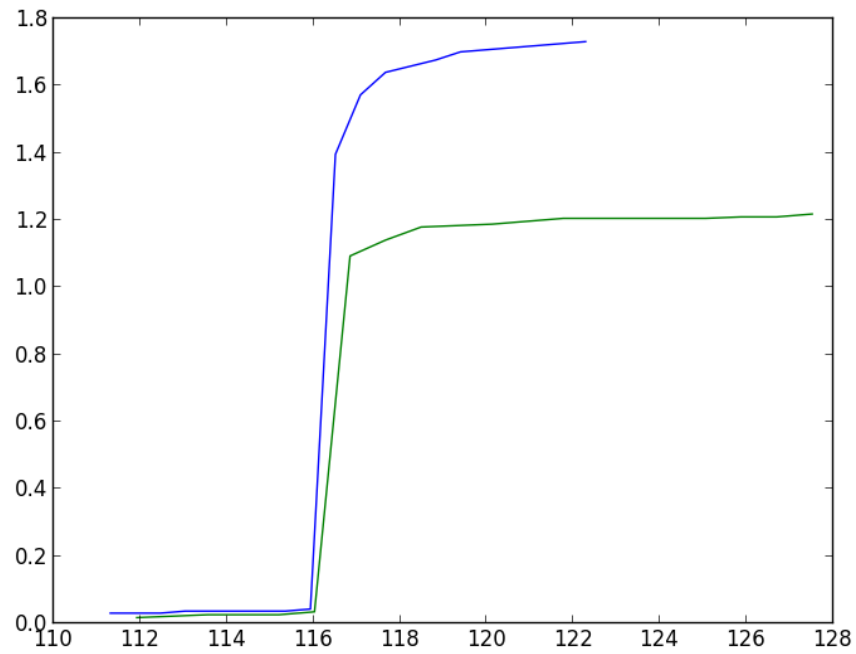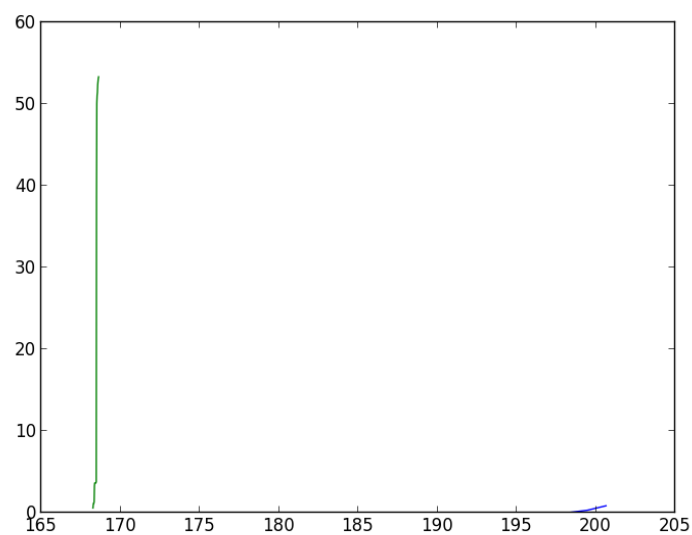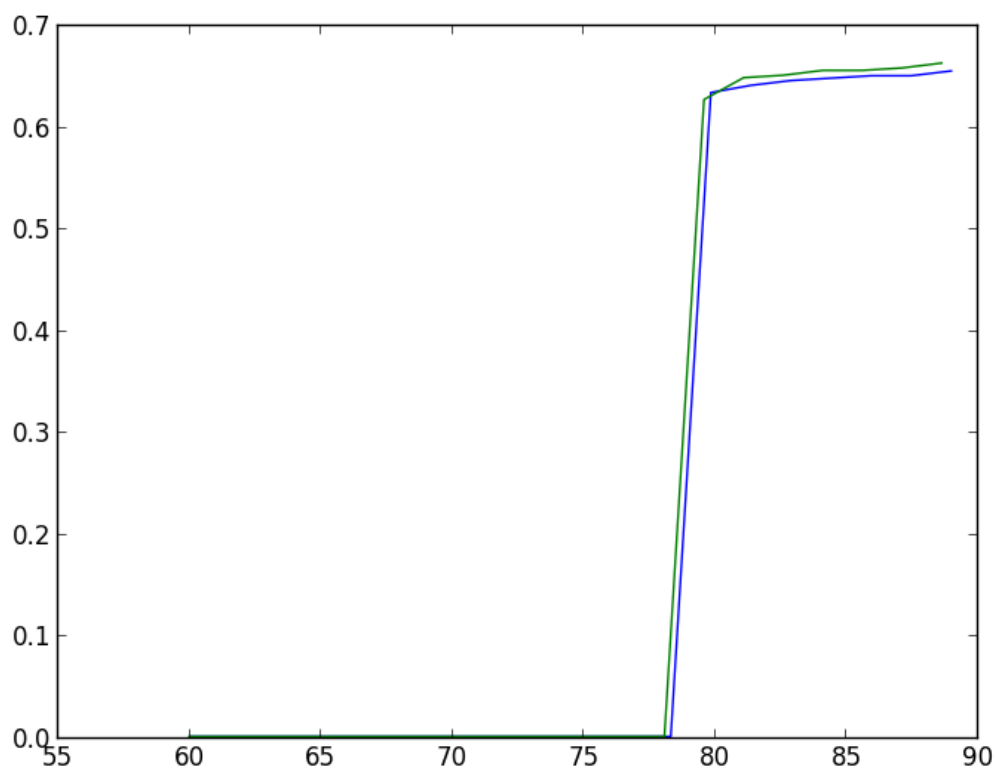

❖ **USA to New Zealand**
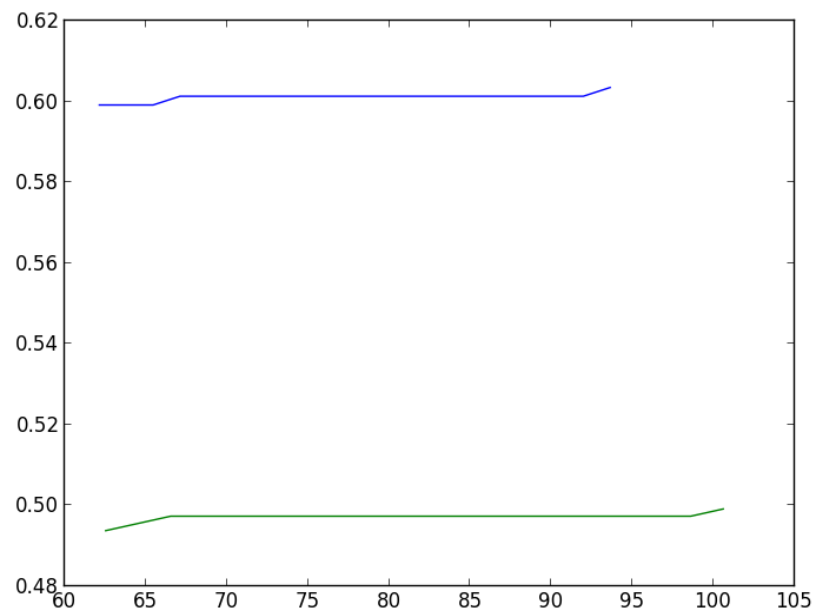
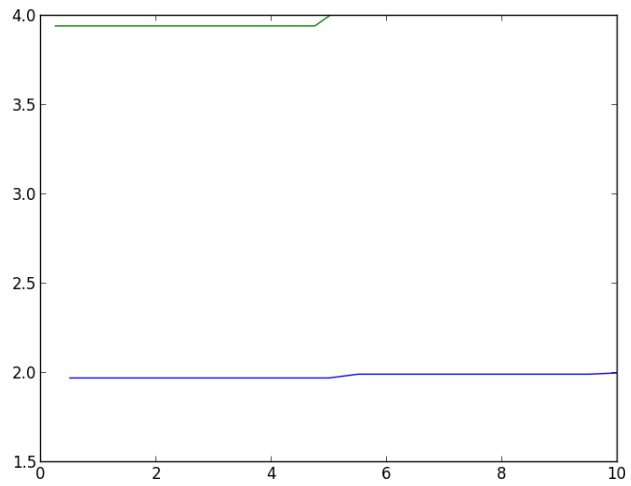❖ USA to USA
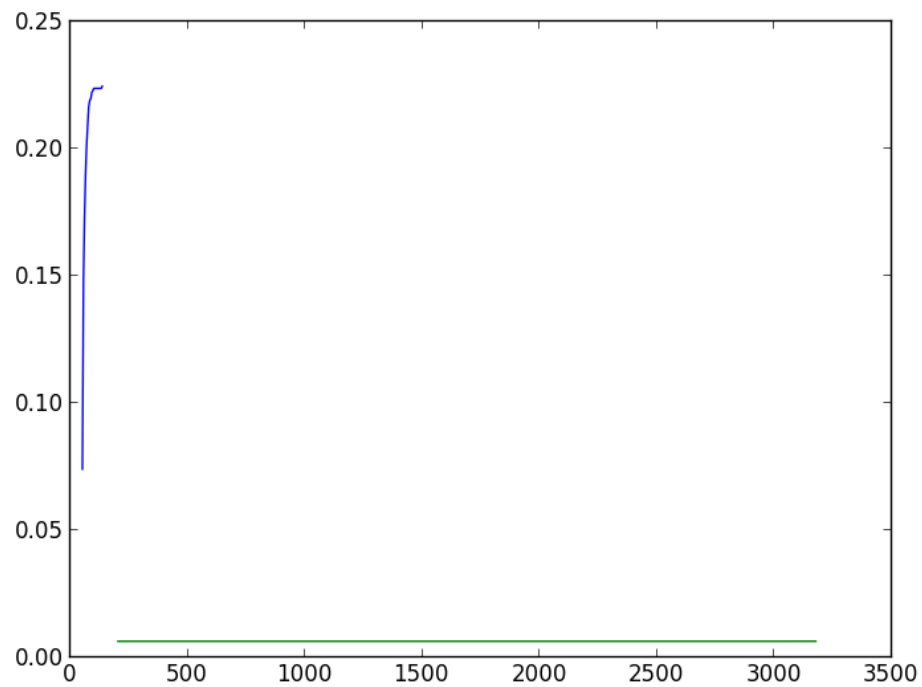
❖ USA to USA (Pair -2)
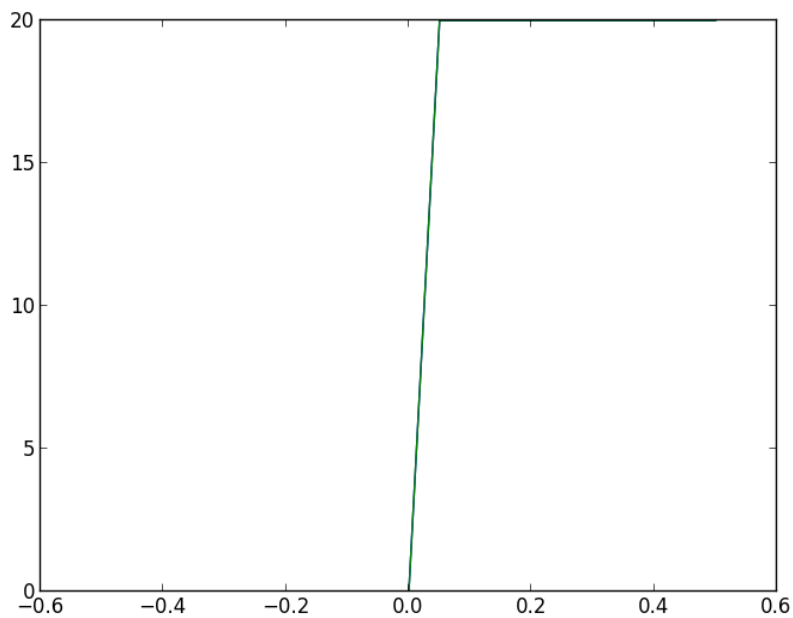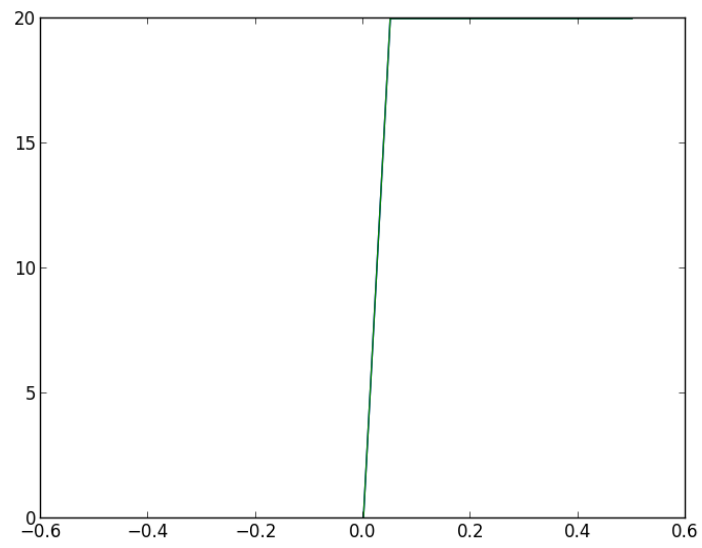
❖ USA to Canada

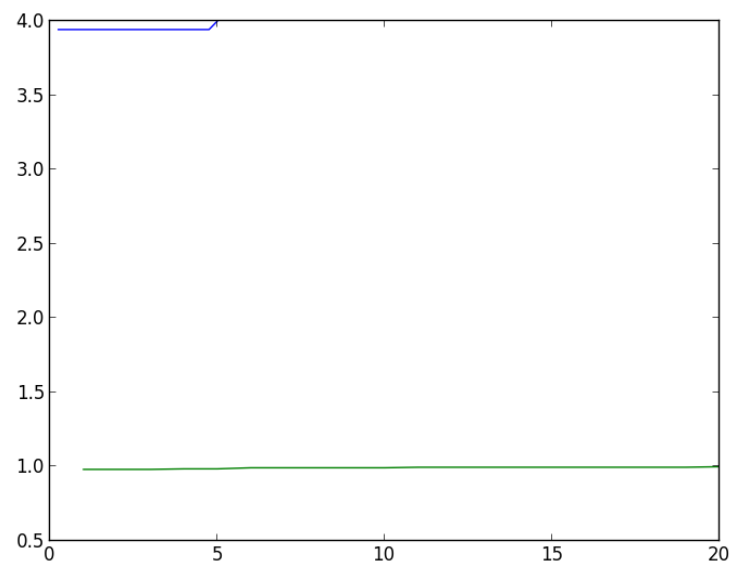## Packet Loss

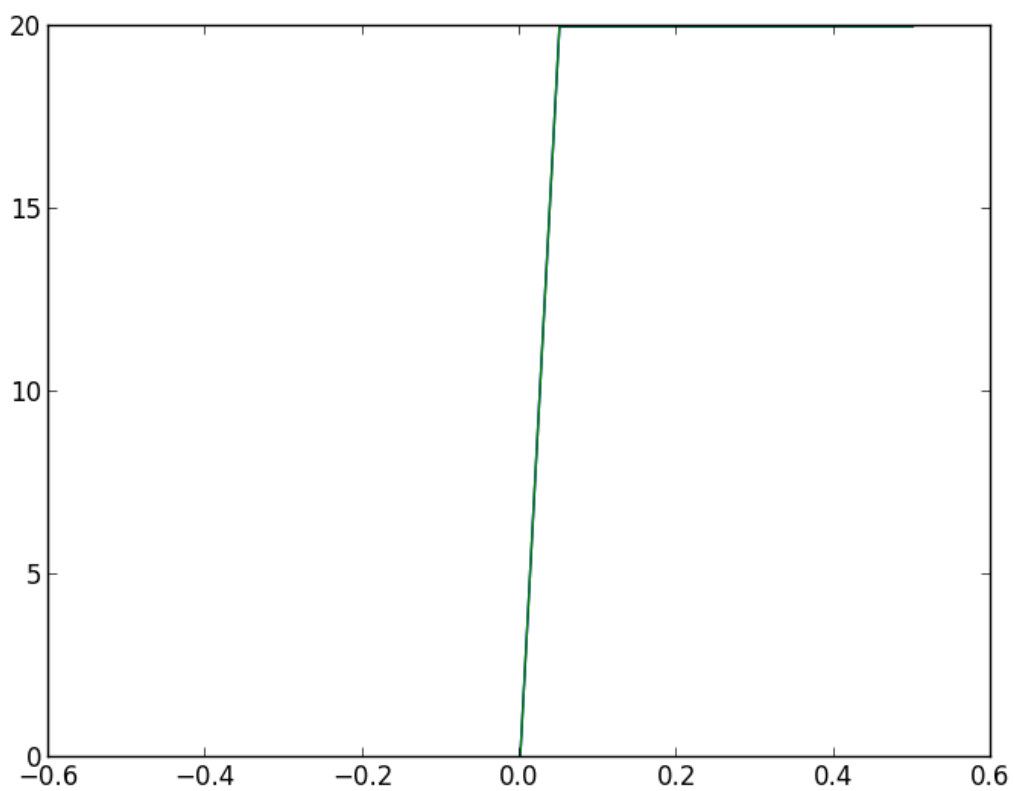❖ USA To Czech Republic

❖ USA to New Zealand

❖ USA to USA

❖ USA to USA (Pair -2)

❖ USA to Canada

Conclusion

Question 9

❖ After measuring internet in this project, I believe that in recent days Link between intercontinental & continental did not have vast difference in reliability.

❖ Also Now a days due to advance technics Reliability of Internet is increased in compare to 80' and 90'

❖ In compare to Paxon96's Measurements my data set is very tiny, though I believe from outcomes of my data collection Reliability of internet is increased over time.