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Motivation

With constant evolution of the Internet, many of its even well-established properties continue to change. Using traceroutes between large number of source-destination pairs with the Internet Control Message Protocol (ICMP), we study the stability and diversity of Internet paths as well as the amount of change in Round Trip Time (RTT) associated with a path change between a source-destination pair. Our results indicate that Internet routes are significantly less stable than previously reported.

Methodology

Following nodes were used

Node name	IP address
planetlab2.aut.ac.nz	156.62.231.244
planetlab-js1.cert.org.cn	218.94.106.112
pl1.eng.monash.edu.au	130.194.252.8
pl2.eng.monash.edu.au	130.194.252.9
planetlab2.inf.ethz.ch	192.33.90.67
planetlab1.unr.edu	134.197.113.3
planetlab01.cs.washington.edu	192.33.90.67
planetlab2.utdallas.edu	129.110.125.52
planetlab1.cs.ubc.ca	142.103.2.1
planetlab4.mini.pw.edu.pl	194.29.178.14

Probing was performed daily for one hour. Data was retrieved manually by using Ping and Traceroute command from A → B and B → A .

Software used was – PuTTY , Ms Excel ,MS word,Winscp.

Hardware used – ITSunix ,Personal Laptop

SL no.	Pair(A)	Pair(B)
1	planetlab2.aut.ac.nz	planetlab-js1.cert.org.cn
2	planetlab4.mini.pw.edu.pl	planetlab1.cs.ubc.ca
3	planetlab2.utdallas.edu	pl1.eng.monash.edu.au
4	pl2.eng.monash.edu.au	planetlab01.cs.washington.edu
5	planetlab2.inf.ethz.ch	planetlab1.unr.edu

Probing was performed once in a day for one Hour. Data was retrieved by using set of commands already included a file which contains all the commands used in the shell terminal. Following commands were used :-

```
chmod +x hemanshu.sh
```

```
/usr/bin/nohup ./hemanshu.sh
```

```
cat traceroute1.txt | gawk '(/134.68.5.54/) {print $1}'>> sk1.txt {for analysis file of traceroute file to calculate average, min, max, standard dev.}
```

```
cat traceroute1.txt | gawk '{print $1}'>>fluttering1.txt {calculating fluttering}
```

```
cat traceroute1.txt | gawk '(/* * */) {print $1}'>> out1.txt {for calculating temporary outages}
```

```
cat lastline1.txt | gawk '(/* * */) {print $1}'>> permanent1.txt{calculating Permanent outages}
```

```
cat ping1.txt | (awk -F/ '/^rtt/ { print $5 }') >> rtt11.txt{calculating Roundtrip time}
```

Analysis

Question 1:

Please refer to **Quest 1.xlsx** . There was some amount of change in path length due to traffic congestion or maybe in the travel route some node would have been either broken or not working. Hence, to overcome that the path would have been changed making delays.

Question 2:

a) Total Outages – 240

Yes, there were 220 temporary outages. Temporary outages is calculated considering traceroute data in mind. While calculating we usually carefully monitor that '*' or '**' is there. Which clearly distinguish it Ans provides user with an idea of some temporary outages in the middle of the path while that was travelling from one node to another. Mostly down for Maintenance and upgrading of software site.

b) Permanent outage were 20 means '* * * ' were there in the data received. This is because during that time somewhere in the way of traveling of data from one node to other node there could have been failure to transmit data on time. cat traceroute1.txt | gawk '(/* * */) {print \$1}'>> out1.txt {for calculating Permanent outages} .

Question 3:

Total outages = Temporary + permanent (edges)

Edges outages = $20/240 * 100 = 8.333333$

Temporary outages = $100 - 8.33 = 91.6666$

Question 4:

Yes, there is a significant difference's in the reliability of continental links vs inter-continental links crossing the Atlantic or the Pacific Ocean. Packet loss was calculated for each ping command and was compiled in **Question4.xlsx** file. The average packet loss was calculated in the mentioned file.

Question 5:

No Route Fluttering was observed, all of the nodes from $A \rightarrow B$ and $B \rightarrow A$ were having there designated path .No such abrupt path changing was noticed .

Question 6:

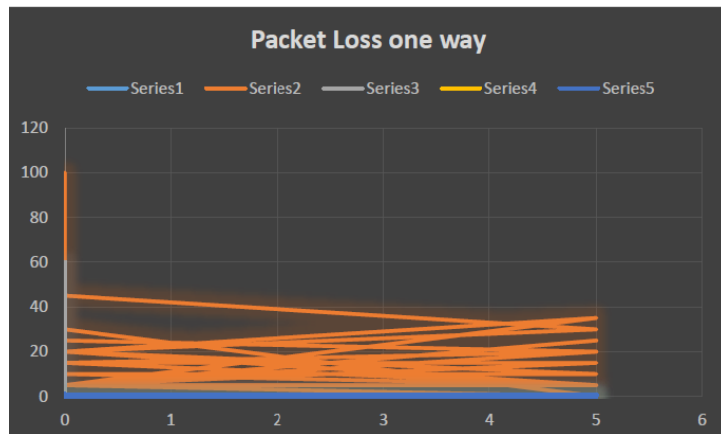
Yes, Inconsistencies in data was observed from $A \rightarrow B$ and $B \rightarrow A$, refer **Question 6.xlsx** . During Pair wise measurement it was noticed that the number of hops varied a lot depending on date , day time and moreover geographical distance .Whereas certain times it came exactly same from $A \rightarrow B$ and from $B \rightarrow A$.

Question 7:

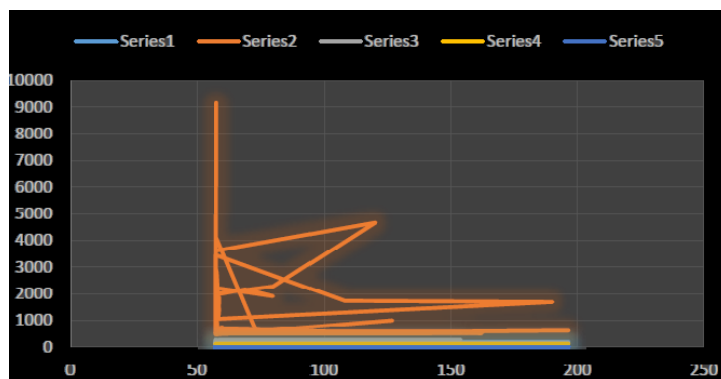
Yes, Triangular routing was observed in Pair C:

Node 1- pl1.eng.monash.edu.au i.e. Monash University (Australia) and Node 2 - planetlab2.utdallas.edu i.e University of Texas Dallas (USA).Apart from it Path from US to New Zealand going through Australia was also observed .

Question 8:



Latency



Ques 9: Long term outages decreased, and short-term outages increased.

Conclusion

Based on the sample of measurements, I think that Internet routing stability has increased in comparison with findings in [Paxon96]. Moreover the Path followed was constant most of the time with permanent outages lesser then Temporary ones.