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MOTIVATION

In today's Internet, if there is too much load on the router to handle data then packet loss can occur in the route i.e packet loss can occur from source to destination. This behaviour of the connections between these source-destination pairs can happen due to the routing problem or routing reconfiguration of one or more intermediate routers in their path which causes this instability. So Internet path stability is important for sending data without packet loss from source to destination.

METHODOLOGY

Nodes

I've used the following nodes

Pair 1 US to Japan

planetlab01.cs.washington.edu

planetlab4.goto.info.waseda.ac.jp

Pair 3 US to New Zealand (Trans-Pacific Node)
planetlab2.cs.purdue.edu

planetlab2.aut.ac.nz

 This is the transpacific node

Pair 4 US to Spain (Trans-Atlantic Node)
planetlab2.cs.ucla.edu

planetlab2.tlm.unavarra.es

Pair 5 US to Canada
planetlab1.cs.uoregon.edu

plink.cs.uwaterloo.ca

Pair 6 US to Argentina
planetlab1.cs.uml.edu

planet-lab1.itba.edu.ar

Probing

Probing was performed by first running the script and periodically collecting the data every 2 days. After that analysis was done on each data file.

Data was retrieved by running scripts on each node

For example for pair 1 from US to Japan

scp ns167181@itsunix.albany.edu:/home1/s/n/ns167181/nisarg1a2b.sh /home/albany_ccn1

for pair 1 from Japan to US

scp ns167181@itsunix.albany.edu:/home1/s/n/ns167181/nisarg1b2a.sh /home/albany_ccn1

This script gives the data for every hour and saves the entire data for each ping and traceroute on each node in a text file.

This **data is collected** by running the command:

For example for pair 1 from US to Japan

scp /home/albany_ccn1/nisargping.txt ns167181@itsunix.albany.edu:/home1/s/n/ns167181

Data is processed by using AWK.This data collected for each pair is used to do analysis of data.

Hardware - Laptop

Software – FileZilla Client, Linux Terminal on Virtual Box, Putty, WinSCP, Putty

(1)

PAIR	MIN	MAX	AVERAGE	STANDARD DEVIATION
planetlab01.cs.washington.edu to planetlab4.goto.info.waseda.ac.jp	12	12	12	0
planetlab4.goto.info.waseda.ac.jp to planetlab01.cs.washington.edu	12	12	12	0
planetlab2.cs.purdue.edu to planetlab2.aut.ac.nz	16	16	16	0
planetlab2.aut.ac.nz to planetlab2.cs.purdue.edu	16	16	16	0
planetlab2.cs.ucla.edu to planetlab2.tlm.unavarra.es	17	19	17.37262	0.499935
planetlab2.tlm.unavarra.es to planetlab2.cs.ucla.edu	17	20	17.17	0.41835
planetlab1.cs.uoregon.edu to plink.cs.uwaterloo.ca	12	12	12	0
plink.cs.uwaterloo.ca to planetlab1.cs.uoregon.edu	15	17	15.0066	0.114897
planetlab1.cs.uml.edu to planet-lab1.itba.edu.ar	12	12	12	0
planet-lab1.itba.edu.ar to planetlab1.cs.uml.edu	19	20	19.00383	0.061898

Yes There is a change in the path length over the different measurements. This change can be due to packet loss or due to trans-oceanic link i.e due to geographical location.

Section 1

(2)

Pair	Temporary Outage	Long-term Outage
planetlab01.cs.washington.edu to planetlab4.goto.info.waseda.ac.jp	0	0
planetlab4.goto.info.waseda.ac.jp to planetlab01.cs.washington.edu	598	0
planetlab2.cs.purdue.edu to planetlab2.aut.ac.nz	311	0
planetlab2.aut.ac.nz to planetlab2.cs.purdue.edu	4	0
planetlab2.cs.ucla.edu to planetlab2.tlm.unavarra.es	101	11
planetlab2.tlm.unavarra.es to planetlab2.cs.ucla.edu	778	2
planetlab1.cs.uoregon.edu to plink.cs.uwaterloo.ca	1820	0
plink.cs.uwaterloo.ca to planetlab1.cs.uoregon.edu	486	0
planetlab1.cs.uml.edu to planet-lab1.itba.edu.ar	1180	5
planet-lab1.itba.edu.ar to planetlab1.cs.uml.edu	627	7

(a) Temporary outage occurs in nine pairs. This temporary outage can be caused by packet loss for tracerun from one node to another. It can also occur due to trans-oceanic link.

(b) There are long term outages in four pairs. This outage can occur if there is too much load on a router which can result in packet loss or if the destination IP address is not known.

(3)

Pair	Core Percentage	Edge Percentage
planetlab01.cs.washington.edu to planetlab4.goto.info.waseda.ac.jp	0%	0%
planetlab4.goto.info.waseda.ac.jp to planetlab01.cs.washington.edu	0%	100%
planetlab2.cs.purdue.edu to planetlab2.aut.ac.nz	100%	0%
planetlab2.aut.ac.nz to planetlab2.cs.purdue.edu	100%	0%
planetlab2.cs.ucla.edu to planetlab2.tlm.unavarra.es	0%	100%
planetlab2.tlm.unavarra.es to planetlab2.cs.ucla.edu	50%	50%
planetlab1.cs.uoregon.edu to plink.cs.uwaterloo.ca	60%	40%
plink.cs.uwaterloo.ca to planetlab1.cs.uoregon.edu	0%	100%
planetlab1.cs.uml.edu to planet-lab1.itba.edu.ar	50%	50%
planet-lab1.itba.edu.ar to planetlab1.cs.uml.edu	0%	100%

(4)

From US-CANADA

i.e. for nodes
planetlab1.cs.uoregon.edu to plink.cs.uwaterloo.ca
the average packet loss is 0%

From CANADA to US

i.e for nodes
plink.cs.uwaterloo.ca to planetlab1.cs.uoregon.edu
the average packet loss is 0%

From US to SPAIN (Trans-atlantic)

i.e. for nodes
planetlab2.cs.ucla.edu to planetlab2.tlm.unavarra.es
the average packet loss is 3%

From SPAIN to US (Trans-atlantic)

i.e. for nodes
planetlab2.tlm.unavarra.es to planetlab2.cs.ucla.edu
the average packet loss is 4%

From the above observations we can say that,

There is no packet loss for continental link US ←→ CANADA. So this link is reliable.

Whereas there is packet loss for intercontinental link US←→SPAIN. So this link is less reliable.

(5)

Pair	Fluttering	Where and how often
planetlab01.cs.washington.edu to planetlab4.goto.info.waseda.ac.jp	No	
planetlab4.goto.info.waseda.ac.jp to planetlab01.cs.washington.edu	No	
planetlab2.cs.purdue.edu to planetlab2.aut.ac.nz	No	
planetlab2.aut.ac.nz to planetlab2.cs.purdue.edu	No	
planetlab2.cs.ucla.edu to planetlab2.tlm.unavarra.es	No	
planetlab2.tlm.unavarra.es to planetlab2.cs.ucla.edu	Yes	From Spain to US. It occurs mostly for every tracerun
planetlab1.cs.uoregon.edu to plink.cs.uwaterloo.ca	No	
plink.cs.uwaterloo.ca to planetlab1.cs.uoregon.edu	Yes	From Canada to US. It occurs mostly for every tracerun
planetlab1.cs.uml.edu to planet-lab1.itba.edu.ar	Yes	From US to Argentina. It occurs mostly for every tracerun
planet-lab1.itba.edu.ar to planetlab1.cs.uml.edu	Yes	From Argentina to US. It occurs mostly for every tracerun

(6)

For pair US to Japan

planetlab01.cs.washington.edu

planetlab4.goto.info.waseda.ac.jp

There is no inconsistency between the forward (A→B) and reverse (B→A) path in pair-wise measurements.

For pair US to New Zealand

planetlab2.cs.purdue.edu

planetlab2.aut.ac.nz

There is a little inconsistency between the forward (A→B) and reverse (B→A) path in pair-wise measurements.

For pair US to Spain

planetlab2.cs.ucla.edu

planetlab2.tlm.unavarra.es

There is some inconsistency between the forward (A→B) and reverse (B→A) path in pair-wise measurements.

For pair US to Canada

planetlab1.cs.uoregon.edu

plink.cs.uwaterloo.ca

There is inconsistency between the forward (A→B) and reverse (B→A) path in pair-wise measurements.

For pair US to Argentina

planetlab1.cs.uml.edu

planet-lab1.itba.edu.ar

There is inconsistency between the forward (A→B) and reverse (B→A) path in pair-wise measurements.

(7)

US to Japan

planetlab01.cs.washington.edu
to
planetlab4.goto.info.waseda.ac.jp

There is no triangular routing

Japan to USA

planetlab4.goto.info.waseda.ac.jp
to
planetlab01.cs.washington.edu

There is no triangular routing

US to NZ

planetlab2.cs.purdue.edu
to
planetlab2.aut.ac.nz

There is triangular routing as the path for traceroute is from US to Australia to New Zealand

NZ to US

planetlab2.aut.ac.nz
to
planetlab2.cs.purdue.edu

There is triangular routing as the path for traceroute is from New Zealand to Australia to US

US to Spain

planetlab2.cs.ucla.edu
to
planetlab2.tlm.unavarra.es

There is no triangular routing

Spain to US

planetlab2.tlm.unavarra.es
to
planetlab2.cs.ucla.edu

There is no triangular routing

US to Canada

planetlab1.cs.uoregon.edu
to
plink.cs.uwaterloo.ca

There is no triangular routing

Canada to US

plink.cs.uwaterloo.ca
to
planetlab1.cs.uoregon.edu

There is no triangular routing

US to Argentina

planetlab1.cs.uml.edu
to
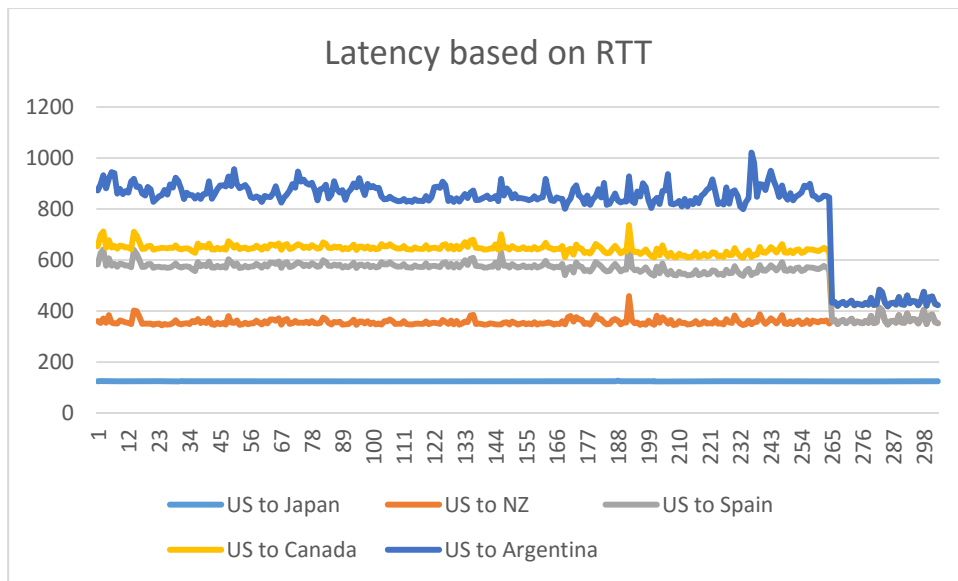planet-lab1.itba.edu.ar

There is no triangular routing

Argentina to US
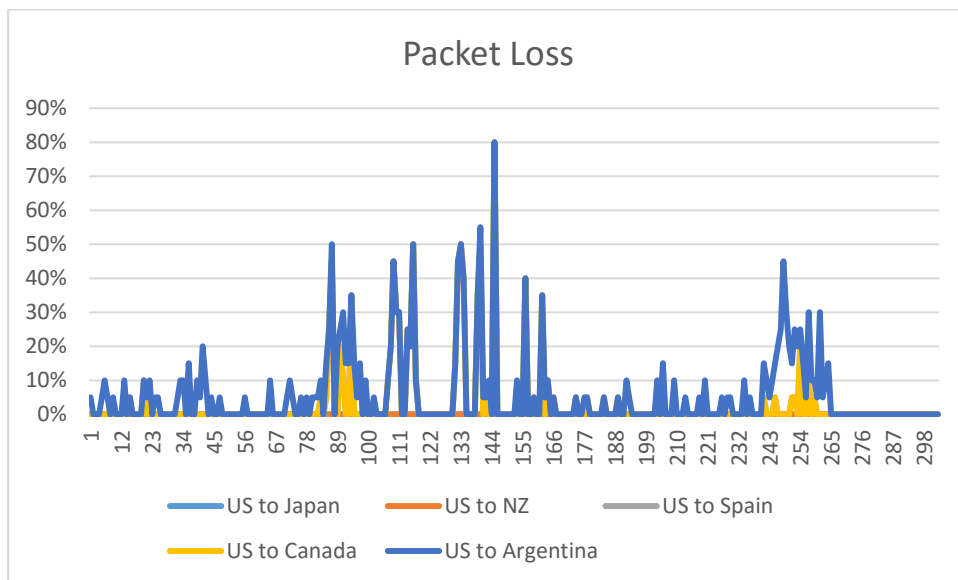

planet-lab1.itba.edu.ar
to
planetlab1.cs.uml.edu

There is no triangular routing

(8)

Latency graph

Latency based on RTT

Packet loss

Packet Loss

(9) Internet routing instability has increased in comparison with the findings in [Paxon96].