Case Study: Higher RTT between HEC-Lahore to HEC-Quetta

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A) Nodes Location/DNS(IP):

HEC-Lahore:	pingerlhr.pern.edu.pk (111.68.105.97)	HEC-PoP Node, Pakistan
HEC-Quetta:	pingerqta.pern.edu.pk (121.52.157.157)	HEC-PoP Node, Pakistan

B) Problem:

On October 09, 2012 during the routine monitoring of HEC-PoP nodes, I found that the RTT values between HEC-Lahore to HEC-Quetta are very high and all values are around 144ms. This anomaly was very unfortunate because all other PoP to PoP values between different cities were around 50ms.

C) Investigation:

Step 1: Daily Status*:* I checked the daily status of this link at:

http://www-wanmon.slac.stanford.edu/cgi-wrap/pingtable.pl?file=average_rtt&by=by-node&size=100&tick=daily&year=2012&month=10&from=PK.PERNLHRPOP.EDU.N1&to=PK.PINGERQTA.PERN.EDU.N2&ex=none&only=all&dataset=hep&percentage=any

and found the following values for the month of October 2012:

12Oct01	12Oct02	12Oct03	12Oct04	12Oct05	12Oct06	12Oct07	12Oct08	12Oct09
129.242	150.577	111.217	95.162	156.649	147.620	145.343	151.114	100.241

Step 2: Start Date: I checked the daily status for the month of September 2012 at:

http://www-wanmon.slac.stanford.edu/cgi-wrap/pingtable.pl?file=average_rtt&by=by-node&size=100&tick=daily&year=2012&month=09&from=PK.PERNLHRPOP.EDU.N1&to=PK.PINGERQTA.PERN.EDU.N2&ex=none&only=all&dataset=hep&percentage=any

and found that this problem is since September 15, 2012.

12Sep14	12Sep15	12Sep16	12Sep17	12Sep18	12Sep19	12Sep20
37.615	110.156	144.940	154.369	154.459	159.469	157.108

Step 3: Trace Route: Then I logged on to the HEC-Lahore Machine and execute the trace-route command for HEC-Quetta and found the following interesting results:

Traceroute From HEC-Lahore to 121.52.157.157 (HEC-Qta)		
Hop	**City/Country**	**RTT**
1 lhr-hec.gov.pk (111.68.105.97)	Lahore	0.650 ms
2 172.31.252.145 (172.31.252.145)	Private	0.591 ms
3 tw21-static61.tw1.com (117.20.21.61)	Transworld Lahore	6.892 ms
4 tw255-static101.tw1.com (110.93.255.101)	Transworld Pak	24.875 ms
5 tw255-static6.tw1.com (110.93.255.6)	Transworld Pak	35.380 ms
6 212.73.253.73 (212.73.253.73)	France	129.257 ms
7 ae-4-5.bar1.Marseille1.Level3.net (4.69.151.9)	USA	130.805 ms
8 ae-3-4.edge2.Marseille1.Level3.net (4.69.143.254)	USA	129.935 ms
9 213.242.115.6 (213.242.115.6)	UK	129.890 ms
10 static-10GE-KHI494-P01-KHI494-SWB.pie.net.pk (202.125.128.157)	Pak	133.642 ms
11 rwp44.pie.net.pk (221.120.251.42)	Islamabad	144.168 ms
12 rwp44.pie.net.pk (221.120.251.45)	Islamabad	143.565 ms
13 khi77.pie.net.pk (221.120.205.194)	Karachi	144.608 ms
14 sbkwu.edu.pk (121.52.157.157)	Quetta	144.561 ms

1. Up to 05 hops the route is fine and afterward at 6th hop the RTT goes from ~35 to ~129ms.
2. Then I checked all the IPs and their location from the following link "http://whatismyipaddress.com" and found that the packets are going outside Pakistan (this might be not the exact location of IPs but RTT value clearly shows the continent difference) as shown in the above table. So this is the reason for the higher RTT between these two nodes.
3. At 10th hop packets come back to Pakistan and then finally reached at destination in ~15ms difference.

Question: Why packets are going outside Pakistan which results in longer RTT. To see the status of other nodes near HEC-Quetta I got two more trace-routes:

i) HEC-Lahore to BUITMS-Quetta (Same Region)
ii) HEC-Lahore to HEC-Karachi (Nearby Region)

4. ***HEC-Lahore to BUITMS-Quetta:*** Trace-route shows the same status as above and the values are ~150ms, which shows that all the nodes in the Quetta region have the same problem.

5. ***HEC-Lahore to HEC-Karachi:*** Whereas in the comparative trace-route from HEC-Lahore to HEC-Karachi the values are fine as shown in the table below:

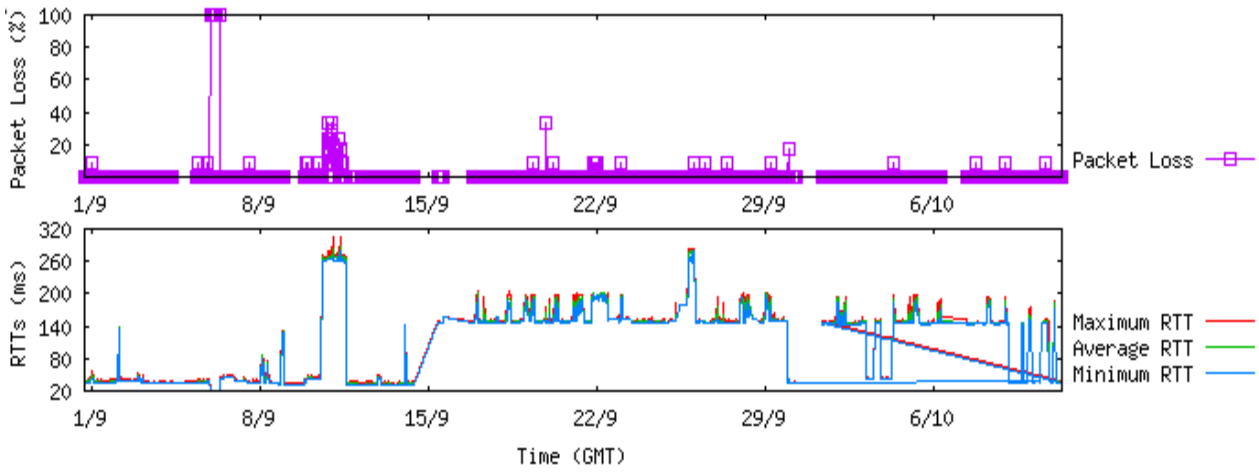
Traceroute from HEC-Lahore to 111.68.108.11 (Khi-PoP)	
Hop	**RTT**
1 lhr-hec.gov.pk (111.68.105.97)	0.548 ms
2 172.31.252.145 (172.31.252.145)	0.508 ms
3 tw21-static61.tw1.com (117.20.21.61)	6.805 ms
4 tw255-static101.tw1.com (110.93.255.101)	32.522 ms
5 tw255-static6.tw1.com (110.93.255.6)	36.273 ms
6 tw129-static238.tw1.com (119.63.129.238)	21.044 ms
7 172.31.253.2 (172.31.253.2)	25.341 ms
8 khi-hec.gov.pk (111.68.108.11)	22.969 ms

D) Conclusion:

Only the packets which are going towards Quetta region are facing problem resulting in higher RTTs whereas all other traffic from HEC-Lahore to other regions are fine. Therefore I reported this issue to Dr. Anjum Naveed and suggested that this issue need to be investigate at HEC-Islamabad level, that why Transworld Pakistan is routing the Quetta packets to outside Pakistan resulting in higher RTT. The possible problem is the wrong next hop IP address entry in the router at hop number 05 of Transworld Pakistan.

E) Problem Verification:

Dr. Les also verified this problem by taking the following graphs which clearly shows the problem on 15th September and onward, the RTT values are ~150ms.



F) E-mail to Concern Authority:

Dr. Anjum asked HEC concern person to resolve the issue at their end. He pointed out the strange behavior of the Transworld router. He said although the IP address 212.73.253.73 might not actually be located in France, the RTT value to this address is significantly high and its inclusion in the path from PoP Lahore to PoP Quetta needs to be investigated. He also said that it will be helpful if HEC can provide some insight into the issue so that we can figure out the exact problem.

G) HEC Investigation:

Mr. Jawad Raza (HEC) said in his reply that "***Issue has been resolved***. Previously traffic was following the path of our secondary service provider which was the reason of higher RTT value. We are still working with our secondary service provider i.e TW1 to resolve this issue. Meanwhile your traffic has been shifted to our primary link." Following is the trace-route of the link:

LHR-HEC-CPE-NE20E>tracert -a 111.68.105.97 121.52.157.157

traceroute to 121.52.157.157(121.52.157.157) 30 hops max,40 bytes packet

1	172.31.252.145	9ms	1ms	1ms
2	221.120.197.21	21ms	24ms	36ms
3	221.120.251.1	27ms	31ms	29ms
4	221.120.251.154	36ms	34ms	34ms
5	221.120.205.194	35ms	35ms	34ms
6	**121.52.157.157**	**34ms**	**35 ms**	**34ms**

H) Current Status:

Currently the link is working fine and the RTT values are around ~40ms. Below is the status of the link after resolving the issue:

12Oct09	12Oct10	12Oct11	12Oct12	12Oct13	12Oct14	12Oct15	12Oct16
100.241	70.940	74.324	37.163	41.243	42.282	40.454	41.949