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Research Article

Recent Triggers of Congestion, Transmission Failures and QoS Degradation in Packet Switched Networks

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Abstract: This study proposes active causes of network congestion, transmission failures and QoS degradation. Communication Networks associate traffic limits. The infinite set of traffic overwhelms the network capacity accompanied by packet loss. Capacity overflows and packet loss create diversified situation such as communication cut off in packet switched networks. Remote linkage of networks are growing hastily. The rapid growth of network architecture has resulted several novel factors that degrade QoS in remote conversation and seriously caused by communication failures. We made an effort to investigate the recent triggers of transmission failures, network errors, http errors, network stress and happening of congestion. The ultimate objective of this study is to find out most prominent sources that activates most critical situations in end-to-end communication. Usually, social networks are more error prone and bandwidth consumer sources. In this study, social, non-social and multimedia servers are examined to predict the share of errors related to http and network layer. We utilized network stress and load testing tool (WAPT6.0) to get practical results about several sort of remote servers in order to predict their effect upon QoS in network communication through particular experimentations.

Keywords: Congestion, flow control, network errors, QoS, transmission failures

INTRODUCTION

Network inter-links with several remote servers enriched with band-width greedy applications like grid computing, digital cinema, bulky set of medical imaging, airline reservation systems and online banking applications (Martini *et al*., 2009; Wang *et al*., 2005). Band-width survival and optimal utilization of bandwidth is still an open question. The Peer-to-Peer (P2P) traffic connections associate sufficient victim of service quality in packet switched networks. Recent trend of shifting ADSL and FTTH technology to P2P environment has invoked negative effects in web traffic linkage under dynamic ports that opens the challenging effort to cope up QoS issues in P2P scenario as evidenced by the author of study (Cho *et al*., 2006; Khosroshahy, 2011). This case usually associates with social networks that provide P2P linkage in delivering of HTTP streaming to offer good quality of service. In island 40% traffic follow P2P technology (Cho *et al*., 2006). Now days P2P traffic connections are causing critical situation of network congestion as agreed by the authors of several studies (Gurbani *et al*., 2009; Peterson and Cooper, 2009). In United States and Germany the utilization of P2P linkage for HTTP streaming is common with bulky hits (Erman *et al*., 2009; Maier *et al*., 2009). According to the authors of study (Pietrzyk *et al*., 2011) 18% user modifies their virtual IP address and splitting of multiple IP level sessions produce errors in network traffic under asynchronous transmission mode. Furthermore they claimed that 3% of IPs overlaps among several users and approximately any specific IP goes through 18 re-assignments. The distribution (Pietrzyk *et al*., 2011) of user's percentile against streaming and download category is depicted in Fig. 1. In World Wide Web, downloading and emailing activities are on peak (Pietrzyk *et al*., 2011) moreover, streaming and web page viewing activities are rated after them as represented in Fig. 2. Social networks and search engines are most widely used sources that provide downloading activities and Youtube is popular for video streaming.

It is shocking revolution that, Social media has overtaken the pornography sites and has become the number one activity on the web. Facebook is the 3rd largest virtual country of remote populations interlinked with internet as 60 million status updates happens on it daily. User averagely spends 23 min on Facebook upon each visit. According to US weekly report TIME magazine Facebook is on top to Google in usages. Every 1 of every 5 couples meet via Facebook and 1 in 5 divorces are also blamed on Facebook. In UK 50% mobile traffics are corresponds to Facebook and in

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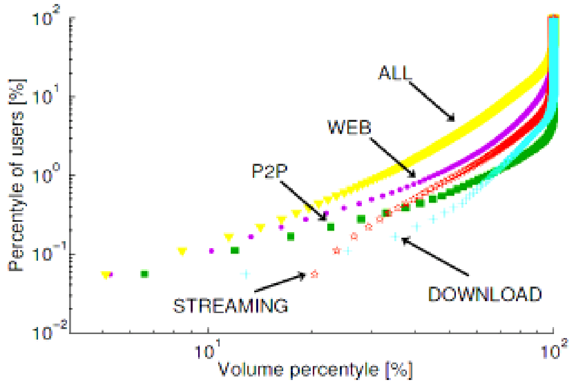

Fig. 1: Streaming vs. downloading ratio

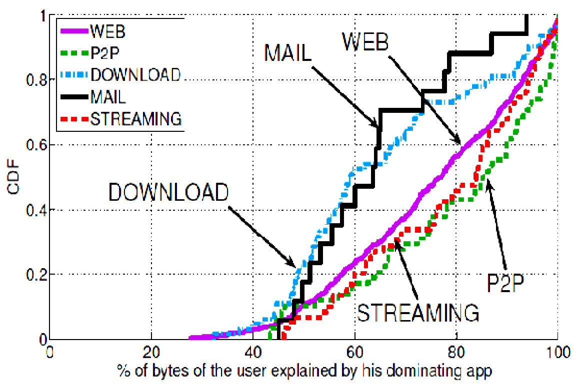

Fig. 2: User activities in World Wide Web

Table 1: Networks' availability and failure ratio

Metrics	Availability (%)	Failure (%)
Availability of networks devices (Gill *et al*., 2011)	60	40
Reliable and working link's ratio (Gill *et al*., 2011)	80	20
Single link failure (Markopoulou *et al*., 2008)	30	70
Link jumps (Plissonneau *et al*., 2008)	90% links have no jumps	10

alone USA the Facebook users are calculated more than to 127,000,000, in other words 41% of whole Americas. The 65 Million users access Facebook via smart phones now days. The usages of Youtube is almost 30% with 10% share of overall internet traffic and 20% share against HTTP traffic (Plissonneau *et al*., 2008). According to the opinion of the authors of study (Plissonneau *et al*., 2008), 40% users abort the Youtube video and 19% users perform at least single jump while viewing the videos. Youtube is the 4th most visited and 2nd largest search engines. Within 24 h 1.1 Billion videos are uploaded on it. According to rough estimate the sale business of social virtual gaming is expected about 6 billion US Dollars in 2013. Approximately 93% of the whole market is reliant on social media for business operations. For recruitment purposes, 80% companies catch employee through social Medias.

The peak utilization of social networks is creating overburden of internet traffic. According to the authors of study (Shoukat *et al*., 2011) the size of web has been increased up to 25 billion of web pages by the January 2011. Web is growing hastily on each going hour. Huge traffic is the greatest cause of capacity issues on network nodes and capacity overflows create peak load that triggers congested environments. The utilization of social networks is not only the cause of bulky web traffic but the architecture of network is also being complex due to their large number of inter linkage servers under various connecting strategies. It has been reported that web page response is severely degraded due to bulky web traffic and complexity of internet architecture by the authors of study (Shoukat and Iftikhar, 2011). While talking about the performance measurement of remote servers, the authors of study (Shoukat *et al*., 2012) claimed that failure of any remote server usually depends upon its health severity that can be measured through Mean Time to Repair (MTTR) and Mean Time between Failures (MTBF) rather to other metrics.

The swift admittance of any remote server relies on enviable factors like fair link utilization, queue length, network bandwidth, latency, jitter, response time, hits ratio and availability (Shoukat and Iftikhar, 2011; Ansari *et al*., 2012). Loaded and congested situations diversely affect these factors to cause communication delays and as soon as delay grows up to certain level, the unwanted situation occurred so called congestion (Shoukat and Iftikhar, 2011). Network router starts to loss network packets in congested situation due to the rise of allocated time sessions and this situation not only caused bandwidth loss or network blocking but it also creates the necessity of re-transmission to occupy network resources again (Shoukat and Iftikhar, 2011). According to the authors of study (Ansari *et al*., 2012) packet loss ratio is the master source that causes the happening of all other issues like poor bandwidth, end to end latency, unfair response, limited throughput and bulky sized packet queue in network communication. It means, packet loss ratio is the essential issue to escape congestion in network communication. The packet loss ratio is being more critical with expansion of network resources under social media. Where, there is bulky packet loss, the congestion will also be there. Therefore, QoS is essentially dependent on congestion and load of any network and social networks are more congestion prone entities.

Authors of the prior studies reported various opinions about networks availability and link failure ratios as summarized in Table 1. The share of single link failures is at top with 70% and the share of network devices in failure matters are 40% however, the share of different kinds of network links is about 20%.

According to our opinion, the ratio of single link failure is larger because it mostly happened due to the network device failures. According to the authors of study (Boutremans *et al*., 2002) link's failures and router's blockages are the prominent reasons for the degradation of network's QoS. Persistent router utilized Random Early Detection scheme to avoid congestion, however Drop-Trail method is still utilized on large scale that considered as poor mechanism to avoid congestion (Khosroshahy, 2011).

In this study, we made an effort through practical experimentations against several social, non-social and multimedia platforms in order to predict, which source facilitates bulky set of http errors, network errors, failed sessions and failed hits that caused the situation of congestion and transmission failures on the web.

METHODS AND EXPERIMENTATIONS

Variety of remote servers running behind popular social networks are selected to acquire the values against selected metrics like, hits failure ratio, percentage of HTTP errors, percentage of network errors and average response times in seconds. This experimentation is conducted under web application testing tool (WAPT6.0) that initiates bench marking instance (s) under telnet port 23. We selected those backend remote servers of social networks that have bulky usages rather to other remote services. Similarly, we also selected a top ranked and highly accessed Google server to make its comparison with highly accessed social networks by using selected evaluation metrics (as discussed earlier). This experimentation has been performed in Computer Science Department, King Saud University on machine having 2.4 GHz Processor, 3 GB RAM, No firewalls and link speed 266 MB/Sec. Selected remote Servers were tested up to several weeks through random time spans. Most likely, we selected the different time spans like early in the morning, afternoon, evening and mid nights to run our experiments. The purpose behind the selection of these time interval is to get most accurate experimental readings because the usages of some servers found at peak in nights while the other founded in office time or evening. Each time the prominent and most distinctive values against the selected metrics have been recorded. Our main focus was to record the failed sessions, failed hits, Http Error, network errors and response time to verify the obstacles share of each servers over the remote communication. The experimental values that did not have enough variation are neglected in each case.

EXPERIMENTAL RESULTS

We tested the remote servers running behind selected social networks under Web Application Testing (WAPT) Tool designed by Microsoft Corporation. WAPT has been used extensively to benchmark the remote servers in prior studies (Shoukat and Iftikhar, 2011; Gupta and Sharma, 2010; Rajput *et al*., 2010). We tested the selected servers for several weeks and summarized the most prominent results (Table 2 to 5) taken from large number of experimental data sets.

The remote server with IP address: 69.63.189.74 was tested to acquire the ratio of HTTP errors, network errors, failed session, failed hits and average response delays up to several days in various times spans as summarized in Table 2. The maximum 60 failed sessions with 60 failed hits are recorded where the

Table 2: Failure summary of facebook server (69.63.189.74)

Date	Failed session/ successful session	Failed hits/ successful hits (%)	Http errors (%)	Network errors (%)	Avg. response time (sec)
22/07/2012 5:08:36 PM	10/238 = 4.20%	10/43121 = 0.023%	0	0.11	0.58
06/07/2012 6:21:49 PM	1/2480 = 0.04%	1/52375 = 0.001%	0.01	0	0.61
08/07/2012 12:53:02 AM	0/0 = 0.00%	2/11451 = 0.017%	0	0	0.71
09/07/2012 5:24:19 PM	37/197 = 18.78%	37/10094 = 0.366%	0	1.81	1.10
10/07/2012 10:18:22 PM	0/151 = 0.00%	0/13338 = 0.000%	0	0	0.99
11/07/2012 9:13:29 PM	1/213 = 0.46%	6/15812 = 0.037%	0.07	0	0.70
12/07/2012 4:00:06 PM	60/168 = 35.71%	60/10364 = 0.578%	0	3.56	1.02
14/07/2012 4:02:37 PM	3/425 = 0.70%	7/20792 = 0.033%	0.09	0	0.46
15/07/2012 9:37:11 PM	2/298 = 0.67%	6/16987 = 0.035%	0.13	0	0.87
17/07/2012 9:23:33 PM	10/647 = 1.55%	18/35578 = 0.042%	0	0.30	0.82
22/07/2012 4:55:16 PM	15/624 = 2.40%	23/29478 = 0.078%	0	0.39	0.74
Average	4.16%	0.110%	0.07	1.23	0.78

Table 3: Failure summary of google server (173.194.32.87)

Date	Failed session/ successful session	Failed hits/ successful hits	Http errors (%)	Network errors (%)	Avg. response time (sec)
05/07/2012 11:06:20 PM	0/540	0/9430	0	0	0.25
06/07/2012 6:36:37 PM	0/563	0/9828	0	0	0.25
08/07/2012 1:14:16 AM	0/99	0/11614	0	0	0.64
09/07/2012 5:44:41 PM	0/252	0/10467	0	0	0.32
11/07/2012 9:47:06 PM	0/165	0/15476	0	0	0.54
12/07/2012 4:33:17 PM	0/167	0/13048	0	0	0.52
14/07/2012 4:59:59 PM	0/235	0/14991	0	0	0.48
15/07/2012 11:12:40 PM	0/305	0/16317	0	0	0.47
17/07/2012 10:36:01 PM	0/316	0/15986	0	0	0.41
Average	0.00%	0.00%	0.00	0.00	0.43

Table 4: Failure summary of youtube server (173.194.78.136)

Date	Failed session/ successful session	Failed hits/ successful hits	Http errors (%)	Network errors (%)	Avg. response time (sec)
05/07/2012 9:18:06 PM	0/581 = 0.00%	0/45601 = 0.000%	0	0	0.31
08/07/2012 1:35:26 AM	1/166 = 0.60%	0/38052 = 0.000%	0	0	0.44
10/07/2012 11:32:15 PM	47/319 = 14.73%	47/41597 = 0.110%	0	0.41	0.52
11/07/2012 10:31:12 PM	1/209 = 0.47%	2/29707 = 0.006%	0	0	0.49
Average	5.26%	0.058%	0.00	0.41	0.44

Table 5: Failure summary of faces server (66.154.123.236)

Date	Failed session/successful session	Failed hits/successful hits	Http errors (%)	Network errors (%)	Avg. response time (sec)
09/07/2012 6:12:26 PM	1/177 = 0.56%	1/20461 = 0.004%	0	0.01	0.50
10/07/2012 10:56:14 PM	1/266 = 0.37%	1/43237 = 0.002%	0.010	0	0.50
11/07/2012 9:30:05 PM	46/60 = 76.66%	60/21988 = 0.272%	0.060	0.88	0.73
12/07/2012 4:19:56 PM	10/130 = 7.69%	10/32422 = 0.030%	0.110	0.01	0.59
14/07/2012 4:16:26 PM	0/141 = 0.00%	0/28865 = 0.000%	0	0	0.43
15/07/2012 10:45:53 PM	0/193 = 0.00%	0/32437 = 0.000%	0	0	0.48
17/07/2012 10:21:08 PM	8/189 = 4.23%	8/18960 = 0.024%	0	0.12	0.67
22/07/2012 5:08:36 PM	10/238 = 4.20%	10/43121 = 0.023%	0	0.11	0.58
Average	15.61%	0.059%	0.120	0.22	0.56

maximum HTTP error percentage remained 0.13%. Moreover, the maximum percentage of network error remained 3.56% with 1.10 sec response delay. The effect of failed hits, failed session, HTTP and network's errors reflect the worst delays in response time of the remote server as discussed in Table 2. This shows that average response delay is directly proportional to network's errors.

The remote server with IP address: 173.194.32.87 was tested to acquire the ratio of HTTP errors, network errors, failed session, failed hits and average response delays up to several days in various times spans as summarized in Table 3. But in this case no failed hit, no failed session with none of http and network's error was reported. The effect of failed hits, failed session, HTTP and network's errors reflect "no" worst delays in response time of the remote server as discussed in Table 3. This shows that average response delay is inversely proportional to network's errors. This shows that average response delay is directly proportional to network's errors.

In case of remote server with IP address: 173.194.78.136, more average response delay were recorded only in case of failed hits, failed sessions and the presence of network's errors which again shows that networks errors and average response delays are directly proportional to each other as discussed in Table 4. Similarly, in case of remote server with IP address: 66.154.123.236, more response delays had been recorded in case of failed sessions, failed hits and the presence of some network' error s as reported in Table 5. This conclusion also reflects the direct relation of response latency with network errors.

DISCUSSION AND ANALYSIS

Social networks are more traffic prone entities in remote linkages. The bulky traffic caused more number of hits with more number of session failures that further caused the happening of http and network's errors. The existence of network's errors badly affects the response of any remote server. Our experimentation shows that average latencies of any remote server are directly proportional to the ratio of network's errors. In our selected list of remote servers, two are social network's servers, one is multimedia server and the other one is a search engine. In all experimental cases, some degree of network errors was only reported in the presence of session and hit failures. Http errors only be founded in case of both social network servers. Moreover, the percentage of networks errors associated with social and multimedia servers are quite larger rather to non-social media as summarized in Table 6. Moreover, the response delays of social network servers are also larger to non-social and multimedia servers. Therefore, Social networks are the big sources of creating rush on remote network's routes. However, the prominent reason behind the network session and hit failures is overloaded situation of network. Overloading situation overwhelms the network capacity that results waiting state for network packets on several routers. As soon as this condition goes on peak the network starts losing packets that caused severe network stress or congestion. More often, one or more network routers are engaged in the transmission of several users whether the request is for social media or for the non-social media source. As described earlier the social networks deals with more number of traffics rather to non-social networks but the routers are same for both network users. Due to this reason the non-social network user has to bear the same penalty of network load, stress and congestion created by the social network users.

In the light of reviewed literature, we found that in overall remote networks related failures, 40% failures occurs due to network device failures and 70% failures happens due to single link failures. However, the share of distinct kinds of remote links is 20% and the failure happens due to link jumps are only 10%. But through

Table 6: Server comparison for errors and response delays

Remote servers IP	HTTP errors (%)	Network's errors (%)	Average response delay (sec)
Social network server: 69.63.189.74	0.07	1.23	0.78
Non-social network server: 173.194.32.87	0.00	0.00	0.43
Multi-media server: 173.194.78.136	0.00	0.41	0.44
Social network server: 66.154.123.236	0.12	0.22	0.56

our experimentation, we found that failed session and failed hits are the result of bulky user requests to access the social networks that caused HTTP and network's errors as discussed in Table 6. Efficient response is a prime metric to measure QoS in remote linkage. Social networks create more degree of network errors that diversely affect the response of remote server. Facebook has become the 3rd largest country of remote population. On Facebook (Social Media) every 100 requests create 1.23% share of network errors:

If User Requests (R) = 100
Then Network Errors (NE) = 1.23
Suppose ~~R~~ = 1 million, the Error counting Formula becomes:
~~NE~~ = {E/R} * ~~R~~
~~NE~~ = {1.23/100} * 1000000 = 12300 Network Errors

In each going second billions of users send trillions of remote requests to access the Facebook Server (s). With this same ratio 1 Trillion user requests are caused $123*10^8$ networks errors. Similarly, the Http errors also affect the response of network servers. This kind of errors and response delays produced by social media are greatest source of degrading the QoS of remote network's server. This degradation of QoS is not only effects the social media users but it also affects the other users who just aim to access any other remote network server. This happens due to the mutual utilization of network routers that offer services for both social and non-social clients at the same. In this case each network user has to bear the same penalty of network stress, load and congestion regardless of his/her connection to the social or non-social server. On the other hand non-social network's requests did not create bulky networks and Http errors as in case of accessing Google Server and multimedia server as reported in Table 6.

CONCLUSION

Errors on network layer are directly proportional to the round trip latencies of data packets. This case usually, associates with bandwidth greedy media such as social networks that contribute huge traffic rush on the web. Moreover, social networks produce more errors on http and network layer that caused diverse response of remote resources. As much as, network's errors, as will be the diverse response of remote server. Poor response triggers bulky latencies in fulfilling the requests of web users and causes more number of hits with bulky set of session failures. As soon as this situation goes a bit longer, the router starts dropping of packets and leads the network towards stress and congestion state. This case not only, affects the social network users but all other users using non-social network have to bear the penalty of diverse QoS. According to our estimation, any widely used social network can cause up to $123*10^2$ networks errors against 1 million user requests, where the daily user requests of same sort social media normally grows up to trillions per day. The end-to-end response delays of Social network servers are larger to non-social and even multimedia servers. All these factors severely degrade the QoS on the web. This research study enlightens the technical picture of QoS degradation and will be more supportive for the development of future network protocols in order to filter the network traffic on base of social or non-social network.

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