2016 1st International Electrical Engineering Congress (IEEC 2016)
May. 13-14, 2016 in IEP Centre, Karachi, Pakistan

Evolving Internet Traffic Trend in Pakistan

Muhammad Haris Rais[1] and Muhammad Asad Arfeen[2]

[1] Advanced Technical Services, Wateen Telecom, Pakistan (Haris.Rais@wateen.com)
[2] Department of Computer and Information Systems Engineering, NED University of Engineering and Technology Karachi Pakistan (arfeen@neduet.edu.pk)

Abstract: Historically, content download is the dominant portion of Internet traffic. The traffic used to be highly asymmetric with minimal uplink and heavy downlink utilization. With increase in peer-to-peer applications and social media, the asymmetry was noticeably reduced. In 2014, 3G and 4G licenses were auctioned in Pakistan. We have studied the traffic pattern of a cellular and non-cellular Telecom company in the last 18 months. As the penetration of broadband cellular services is increasing in Pakistan, the Internet traffic and asymmetry are also increasing. The increase in asymmetry is attributed to the video streaming options that were not feasible in 2G (GPRS/EDGE) technology. The peer-to-peer traffic is less dominant for cellular ISPs as compared to the non-cellular ISPs. The uplink to downlink ratio is different for cellular and non-cellular Internet Service Providers (ISPs). It depicts a change in usage profile for PC and mobile handsets users. The study of these real trends can help research in access layer technologies and also benefit the design and planning functions of the ISPs.

Keywords: LTE, GPRS,EDGE, Internet, ISP,P2MP,3G, 4G, Satellite, Latency, TCP, UDP, HTTP, HTTPS.

I. INTRODUCTION

Traditionally the Internet traffic was dominated by client server communication model. With centralized content and distributed clients at the edge of Internet, the traffic pattern was highly asymmetric with downlink (carrying content) overwhelmingly dominating the uplink utilization (carrying content requests only). With the advent of peer to peer applications, the trend saw a significant change in late 1990s and early 2000s. With the rapid advancement in Internet access technologies supporting high bandwidths, popularity of social media and reduced smart phone prices with high resolution cameras, the content has been commoditized and dispersed. In this study we have analyzed the Internet traffic trend in Pakistan after the launch of 3G/4G services. Similar exercises are conducted by international LTE operators like Verizon [1] and it uses this information for resource planning and to package its product offerings. We have evaluated the traffic pattern of segment of an anonymous Cellular Internet Service Provider in Pakistan. The values only depict the trend and do not reflect the total traffic of the operator. One of the aims is to evaluate the ratio between uplink and downlink bandwidth usage. We have also evaluated traffic trend in an anonymous non-cellular ISP and the major protocols contributing to the Internet traffic in Pakistan.

II. INTERNET TRAFFIC PATTERN FOR VARIOUS ACCESS TECHNOLOGIES

In this section we have discussed the Internet traffic pattern from the perspective of downlink to uplink ratio for various access layer (last mile) technologies in Pakistan. The traffic asymmetry is found to be different for different access technologies due to change in usage pattern associated with the technology in use.

A. Satellite Media - Low throughput and High Latency Media

For remote locations where other access technologies are not available, satellite is used to access Internet cloud. The first hop round trip delay of different satellite services vary in a range of 300 ms to 700 ms. This considerable delay impact the usage behavior and the uplink/downlink traffic trend. For consumer Internet services over satellite, the standard uplink to downlink ratio provisioned by most of the ISPs is 1:4

B. GPRS and EDGE – Pre-3G Cellular Traffic

From the year 2000 till 2014, various versions of GPRS and EDGE were launched by Pakistan Mobile operators. The services are still active. Surprisingly the traffic volume over GPRS/EDGE is still increasing till today as shown in Fig 1. This phenomenon is attributed to the increasing smartphone penetration in the country. As per PTA Annual Report 2015 [2], the smart phone penetration is increasing exponentially.

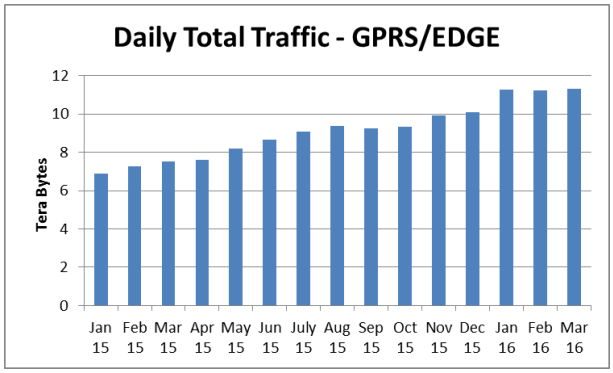

Fig. 1 Traffic Growth for GPRS/EDGE

The ratio between uplink and downlink for pre-3G cellular network is 19.5%. There is no noticeably

increasing or decreasing trend noted in this ratio as per the analysis of last 15 months data as shown in Fig 2.

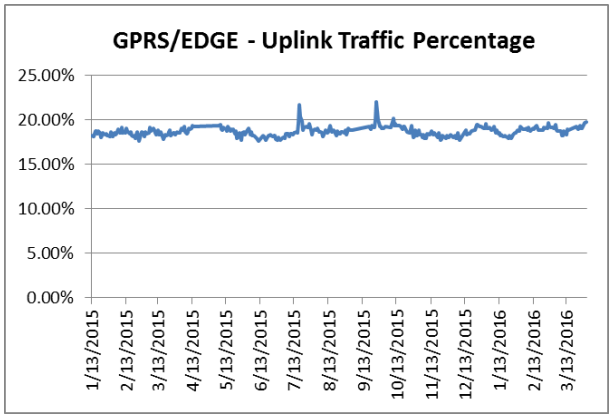

Fig. 2 Uplink traffic trend for GPRS/EDGE

C. 3G & 4G Cellular Traffic

After the auction of 3G and 4G licenses in Apr 2014, the mobile service providers have launched broadband cellular services in Pakistan. Partial network rollout was already completed and service was launched soon after auction. The 3G/4G footprint of mobile operators is increasing every day. For this study, we have taken starting point as Jan 2015 and studied the Internet traffic trend for 3G/4G in the last 15 months for one of the Cellular network segment.

A very high growth is observed in the Internet traffic in the last 15 months. The total Internet traffic over high speed Internet (excluding pre-3G share) has increased 14 times since Jan 2015 as depicted in the Fig. 3.

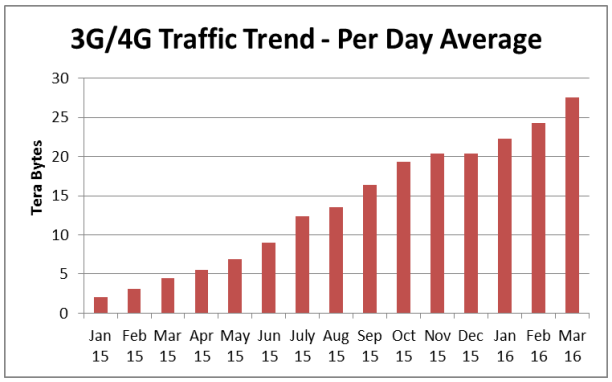

Fig. 3 Trend for 3G/4G Traffic of Cellular ISP

The uplink to downlink ratio is surprisingly reducing with the passage of time. The most dominant traffic for LTE networks is known to be streaming traffic [3]. At around 13.5% in Jan 2015, the uplink percentage of total traffic is reduced to 11.5% in Mar 2016 (see Fig 4).

This reduction is a critical indicator of usage pattern difference between high speed mobile Internet user and a low speed mobile Internet user. Mobile operators are launching services for mobile TV and content streaming. These services are contributing to the increased asymmetry of data utilization that was non-observant in the low speed mobile Internet statistics.

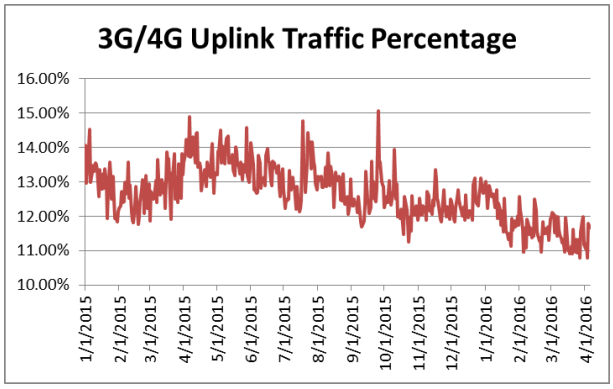

Fig 4 Uplink traffic trend for 3G/4G Network

D. P2MP versus Video Streaming

In this era of social media, the content is commoditized and dispersed. Every individual user is capable to upload content that will be downloaded by a group of users and has a potential to be relayed to any number of users. This traffic pattern is different from legacy client server model and peer-to-peer model. We call it as point to multipoint or (P2MP) traffic. The ratio of uplink to downlink traffic for P2MP traffic type lies in between client-server and peer-to-peer model.

With increased social media activity, P2MP traffic is increasing continuously. However with the advent of high speed cellular Internet (3G/4G), video streaming from content hosting sites is also increasing. The content streaming has surpassed the effect of P2MP and dragged the uplink ratio downwards as mentioned in preceding section.

E. Non-Cellular Internet Service Provider

The dominant part of Internet traffic in mobile operator network is originated from mobile handsets. To evaluate the traffic trend of users using Internet from their personal computers, we have studied the traffic trend of a non-cellular ISP of Pakistan. We evaluated the statistics for the last 15 months. The uplink traffic trend is decreasing significantly as visible in Fig 5. The uplink to downlink ratio is 24% in Mar 2016 as compared to 34% in Jan 2015. However further research is required to confirm this decaying trend and investigate its reasons.

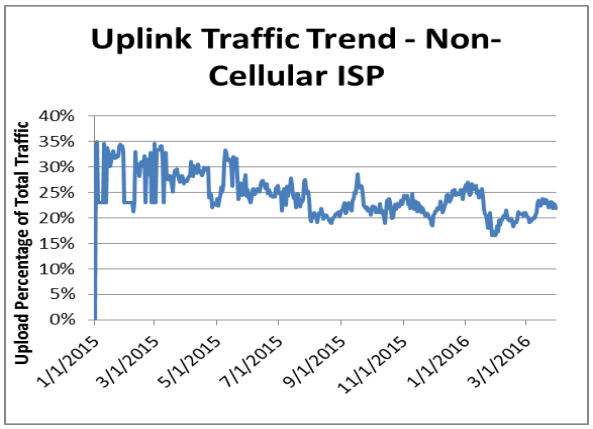

Fig 5 Uplink Traffic Trend – Non Cellular ISP

III. COMPOSITION OF INTERNET TRAFFIC IN PAKISTAN

In this section we will discuss the composition of Internet traffic in Pakistan as in March 2016. We have studied the Internet traffic captures. We studied the layer 3 and layer 4 headers of the captured traces. The traces belonged to 4 different times and days. We segregated the traffic into 6 basic types depending upon the IP protocol field and Source / Destination port numbers. Techniques are available for more granular analysis of protocols and applications [4][5] but it was not made part of the scope of this paper.

A. Packet Count Distribution

Around 2.6 million packets were observed in this study. 40 different well known protocols were identified in the traces. For the sake of ease and in view of the scope of this paper, we have bundled them into 6 types; HTTP, HTTPS, other TCP traffic, UDP traffic and traffic other than TCP or UDP.

The analysis shows that UDP tops the packet count with 66% of total packets belong to UDP protocol. Fig 6 shows the percentage of packet counts for these basic types. Next in line is TCP and within TCP, HTTPS leads the packet count. Roughly every fourth packet is of HTTPS (TCP/443). TCP and UDP combined constitute 99% of the total Internet packets.

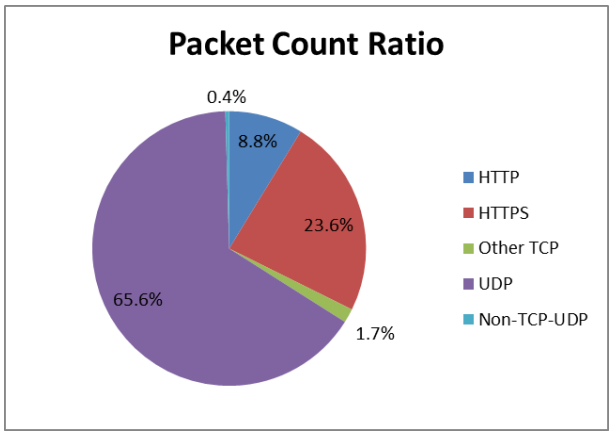

Fig.6 Packet Count Distribution of Internet Data

B. Traffic Volume – Byte Count Distribution

TCP tops the byte count in spite of reduced number of packets. The number of UDP packets is around 1.9 times that of all types of TCP packets. From the perspective of traffic volume (byte count), HTTPS (TCP/443) is the biggest contributor to Internet traffic with 42% traffic share. HTTP (TCP/80, 8080) makes 17% of the total Internet traffic in the studied samples as against 57% in 2009 [6] whereas UDP's share is 38%. The primary reason of reduction in port 80/8080 traffic is the shifting of major content hosting sites from unencrypted HTTP to secure HTTP (HTTPS). The detailed view can be seen in Fig 7.

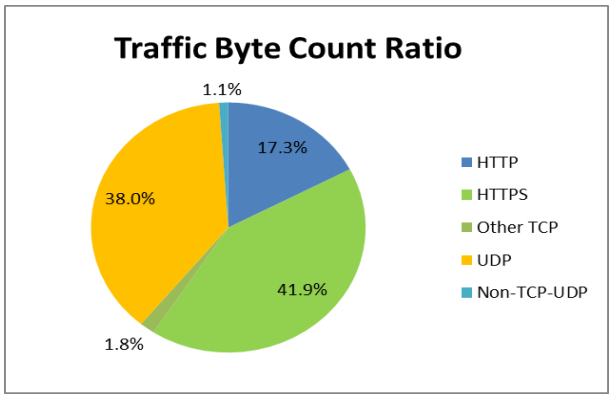

Fig. 7 Traffic Volume Distribution of Internet Data

C. Average Packet Size for Different Protocols

In network design, the traffic volume, packet count and average packet size are important parameters to be considered. As per the traffic samples, the average packet size of any packet traversing through Internet is 328 bytes. The average packet size for TCP traffic is 588 bytes which is 3 times bigger than average UDP packet size of 190. The Fig 8 shows the average packet size for the basic protocol types selected in this study.

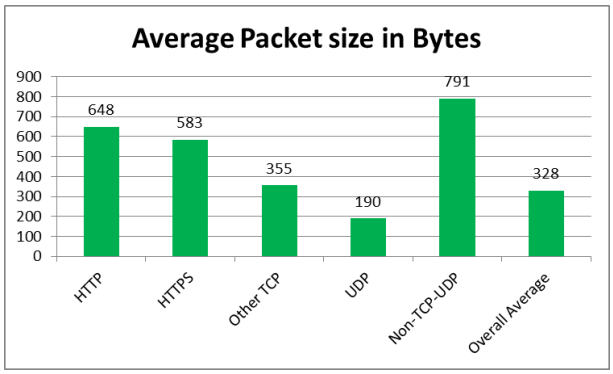

Fig.8 Average packet size for major protocols

IV. CONCLUSION

Internet traffic is rapidly growing in Pakistan. The highest rate is seen for 3G/4G network services with 14 times growth in last 15 months. The asymmetric distribution for uplink and downlink traffic for Internet has increased in the last 2 years. The trend depends upon the usage profile that varies with end point capability. The uplink to downlink traffic asymmetry is highest for 3G/4G networks due to increased trend of multimedia streaming. For low throughput cellular networks where the video streaming is not feasible, the uplink percentage is found to be nearly constant over the last 2 years and the ratio is higher than 3G/4G network users. For non-cellular ISPs, the trend is similar to high speed cellular networks, but the uplink share is relatively higher.

In overall Internet traffic, HTTPS has the maximum share (byte count) followed by HTTP and UDP (all protocols). The maximum number of packets traversing through non-cellular ISPs belongs to UDP but the average packet size is much smaller than TCP. In future study, more granular analysis may be carried out to

specify the applications and sub-applications having significant contribution in Pakistan's Internet traffic composition.

The understanding of traffic trends will help the Internet Service Providers in resource planning and product packaging. If the similar trend is observed globally, it can also serve researchers in optimizing new standards for Access layer technologies.

REFERENCES

[1] Verizon Telecom Business Report;"*4G LTE Technical Benefits Overview Report*", Retrieved from https://business.verizonwireless.com/content/dam/b2b/resources/LTE_Benefits_Overview_TDM.pdf, 2011

[2] Pakistan Telecom Authority , *Annual Report 2015*

[3] Nokia Networks white paper, "What is going on in Mobile Broadband Networks?" *Nokia Networks, 2014*

[4] Shane Alcock and Richard Nelson, "Measuring the Impact of the Copyright Amendment Act on New Zealand Residential DSL Users", *In Proceedings of the 2012 ACM conference on Internet measurement conference - IMC '12 (p. 551). Association for Computing Machinery*

[5] Thomas Karagiannis, Andre Broido, Nevil Brownlee, kc claffy, Michalis Faloutsos, "Is P2P dying or just hiding?", *Proceedings of the 9th IEEE Global Internet Symposium and Next Generation Networks(GlobeCom), November, Dallas, TX, (2004)*

[6] Gregor Maier, Anja Feldmann, Vern Paxson and Mark Allman, "On Dominant Characteristics of Residential Broadband Internet Traffic", *IMC '09 Proceedings of the 9th ACM SIGCOMM conference on Internet measurement conference*