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PERFORMANCE ANALYSIS OF AF IN CONSIDERING LINK UTILISATION BY SIMULATION WITH DROP-TAIL

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ABSTRACT
In this paper, we have illustrated the performance analysis of Assured Forwarding (AF) in Differential Services (DS), in consideration of bandwidth (BW) utilisation or Link Utilisation (LU) and packets drop statistic on core router with Drop-Tail Queue. As Drop-Tail queue is most common and simple FIFO queuing buffer algorithm. By simulation, we generate random traffic by source nodes. These sources are two types UDP and TCP by FTP, TELNET and CBR. We have used different average size of file for transferring. We have analysed performance in consideration LU and packet drop statistics at core router. In addition, we have established which average size of file for transferring is more suitable for AF with respect to LU and packets drop statistic. We have set high priority to UDP in first simulation for first policy then set it low priority in second simulation for second policy and in third simulation these are not set to priority to any type of traffic i.e. simple for third policy and policing is set by TSW2CM.

Keywords – **Differential Services, Assured Forwarding, TSW2CM, Drop-Tail**

INTRODUCTION
In presently, Internet has become necessary part of a human being life and communication network load with various diverse applications such as file transfer, email, web traffic, various MM traffic and interactive video games. These various Internet traffic have a variety of network service requirement, which causes new challenges to Internet network performance with network utilisation and giving assured or sufficient QoS (Quality of Service) to application. There are various policies, which affect the QoS at different layer of network architecture [2] such as at transport, network and data link layer. QoS of more effected by congestion in network which affect the QoS parameters such as throughput or LU, jitter, packets drop probabilities etc. Mostly QoS parameters effected at network layer where application treated in packets form and packets may drops or queued in buffer and treated according various characteristic of packets such as size, type, priority etc. So satisfies various demand of Internet not by easy with increase Internet capacity. There are requiring effective methods for managing the traffic and apply congestion control mechanisms.

In recent year, there are two different and complementary type traffic management framework has evolved from the IETF standard process: Integrated Services (IS) [8] and Differentiated Services (DS) [9]. Integrated services, resource allocation for traffic is most important characteristic which arise scalability problem of Internet and in contrast with the best effort nature of today's the Internet. And where DS approaches, individual flows are not identified and instead of the individual flows in each service class are aggregated together and then flows are treated on a per-class basis. The DS has three major components, policy, edge router and core router. Policy is specified by network administrator about the level of service a class of traffic should receive in the network. Edge router marks packets with a code point according to the policy specified and core router examines packets' code point marking and forwarding them accordingly. DS is classified in two types as Expedited Forwarding (EF) [3], which providing an almost airtight separation between premium and non-premium traffic. Second is Assured Forwarding (AF) [4] in which maximum four different classes are given different for forwarding and three dropping treatment in the same network resources. Every class define by four physical queue and each physical queue can be prioritised in three ways Low, Medium and High, in this way there are twelve different types maximum treatment can be achieved.

There are simulations studies of DS traffic in consideration BW utilisation and show that allotted BW to AF is not utilise as maximum [5]. Also UDP traffic where there are no congestion control mechanism exist and mostly bearer to MM traffic such as constant bit rate voice traffic, which is required to consisting flow in network. Thus in our simulation we have studied the UDP flows in simulation as CBR which available in ns2 [6] [7], we are giving it high priority for flowing in network then compare it with giving low priority to it and not giving any priority to both type of traffic with various random generating source traffic with some range of small and large average size of file for transfer. After simulation, we analyses LU and drop packets statistics of UDP and TCP, see what effect of policies in various condition, and find out how to we protect MM traffic such as CBR with UDP packets with TCP traffic in DS framework specially using AF with maximise LU and minimise packets drop. In our simulation, our criteria found using TSW2CM. As we have done already this experimental analysis with M-RED [11], so in this paper we have done with Drop-Tail queue.

This paper organised as section-I: introduction, section-II discuss network model for our simulation, section-III discuss the simulation result and analysis of results and section-IV discus the conclusion.

NETWORK MODEL FOR SIMULATION

The network setup for our simulation as shown in Figure-1, total 12 TCP sources (6 FTP and 6 TELNET traffic) and 6 UDP (CBR traffic) and each source having 160 flows are connected to core router via edge (ingress router) and use policy model Time Sliding Window with 2 Colour Marking (TSW2CM Policer).

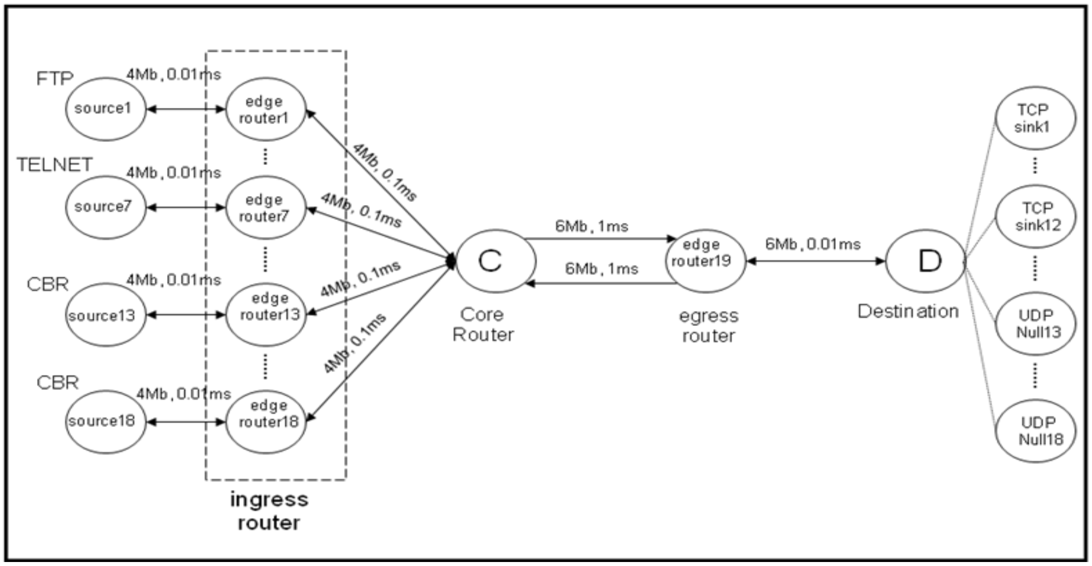

Figure 1: Network Topology for Policing Simulations

In this simulation two priority level are define by TSW2CM and it becomes by Per-Hop–Behaviour (PHB) table. This needs to set CIR (Committed Information Rate). If the connection's rate is below CIR, all packets are marked as high priority and if exceeds to CIR, packets are marked probabilistically such that at the average, the rate of packets marked with high priority correspond to CIR. In our simulation, with various file size transferring, set to first UDP as high priority and then compare it to with giving low priority. High and Low priority is set by CIR in TSW2CM and PHB table by corresponding code point of virtual queue of Drop-Tail queue as for high priority: max queue size=20, TSW window length=0.02 second and set CIR=300Kb, for low priority: max queue size=10, TSW window length=0.02 second and set CIR=10Kb. Incoming packets are enqueued in Drop-Tail queue.

The core router connected to egress edge router, which is connected to the destination as TCP Sinks and UDP Null. The core router would forward the traffic based on the respective Per-Hop–Behaviour (PHB) via code point, which is set for TSW2CM for high and low priority in single physical queue of Drop-Tail. In network setup model, source to ingress edge router, ingress to core router and egress to destination having 4 Mbps and link propagation delay is 0.01ms, egress to destination having 6 Mbps and link propagation delay is 0.01ms, core to egress link having 6 Mbps BW and 1.0 ms link propagation delay.

As we have earlier discussed, DS module in ns2 [1] [6] [7], AF can support four classes of traffic and each class has three dropping precedence, but here we use only one physical queue for TSW2CM with two drop precedence. In our first type, simulation for policy we set policy as high priority to (CBR) UDP traffic, in which we consider it as same constant bit rate traffic like voice – traffic and we capture result with various average size of file and see what effect on throughput or LU, and drop packets in network setup at core router.

The transferred file set to Pareto distribution with shape parameter 1.25 with many average sizes of file for transferring as 5Kb, 10Kb, 50Kb, 100Kb, 200Kb, 400Kb, and 1Mb. In this simulation, we generate random traffic in simulation model and create congestion at core router to see effect on LU and packets drop of UDP and TCP at core router and link core to egress edge router. In our simulation, total simulation time set to 30 second. The simulation having done with global-trace file, for core to egress edge link calculate throughput or check LU at core router and calculate packets drop for throughput with using various average size of file for transferring. Our simulation is in three ways. In first way giving priority high to UDP type traffic as CBR i.e. for first policy and compare it second type simulation giving it to low priority i.e. for second policy and third type simulation no giving priority to both type traffic i.e. simple and using various average size of file for transferring with same CIR and see what is the effect on LU and packets drop. In this way, by simulation method, we have established the policy to maximize throughput or LU and low packets drop of such UDP (CBR) type traffic, because UDP traffic have no retransmission mechanism of dropped packets, so loss packets not retrieve. Also we have established better average size of file for transferring.

SIMULATION RESULT

After running our simulation, as experimental setup describe in previous section, we have obtained trace result in global-trace file from ns2 simulation. With global-trace file, calculate LU and packets drop statistics at core to egress edge link.

Table 1: High priority to CBR traffic

Class-Interval LU (%)	**Average size of transferred file**						
	5 KB	**10 KB**	**50 KB**	**100 KB**	**200 KB**	**400 KB**	**1 MB**
0-5	41	10	0	0	0	0	0
5-10	15	26	0	0	0	0	0
10-15	3	22	0	0	0	0	0
15-20	0	1	12	1	2	1	1
20-25	0	0	35	15	7	7	7
25-30	0	0	11	29	10	12	12
30-35	0	0	2	13	21	14	14
35-40	0	0	0	2	18	19	19
40-45	0	0	0	0	2	7	7
45-50	0	0	0	0	0	0	0

Table 2: Low priority to CBR traffic

Class-Interval LU (%)	**Average size of transferred file**						
	5 KB	**10 KB**	**50 KB**	**100 KB**	**200 KB**	**400 KB**	**1 MB**
0-5	41	10	0	0	0	0	0
5-10	15	28	0	0	0	0	0
10-15	3	19	0	0	0	0	0
15-20	0	2	5	0	0	0	0
20-25	0	0	21	9	7	7	7
25-30	0	0	24	9	2	1	1
30-35	0	0	10	22	10	9	9
35-40	0	0	0	17	16	10	10
40-45	0	0	0	3	18	16	16
45-50	0	0	0	0	7	17	17

Table 3: Simple (Not given priority to both UDP and TCP traffic)

Class-Interval LU (%)	**Average size of transferred file**						
	5 KB	**10 KB**	**50 KB**	**100 KB**	**200 KB**	**400 KB**	**1 MB**
0-5	40	7	0	0	0	0	0
5-10	17	30	0	0	0	0	0
10-15	2	21	0	0	0	0	0
15-20	0	1	9	1	2	2	2
20-25	0	0	34	14	6	6	6
25-30	0	0	13	24	13	8	8
30-35	0	0	4	18	14	16	16
35-40	0	0	0	3	20	17	17
40-45	0	0	0	0	5	11	11
45-50	0	0	0	0	0	0	0

From Table-1, 2, 3 and Figure 2 to 8, show that for very small average file size LU is very small and it is near about 5 to 10 % LU. For average file 50-100 KB it is increase 20 to 30 % LU but for very large average file such as 400 KB or 1MB give same result and there are no any effect because the average size of transfer file the 400KB exceeds more than CIR as in this simulation it is 300 KB for high priority code then maximum packets marked as high drop at ingress edge router and dropped, hence throughput or LU and packets drop are constant at core router for further larger file. Increasing CIR slightly improves LU and it is not more than its bottleneck link because there are no effects.

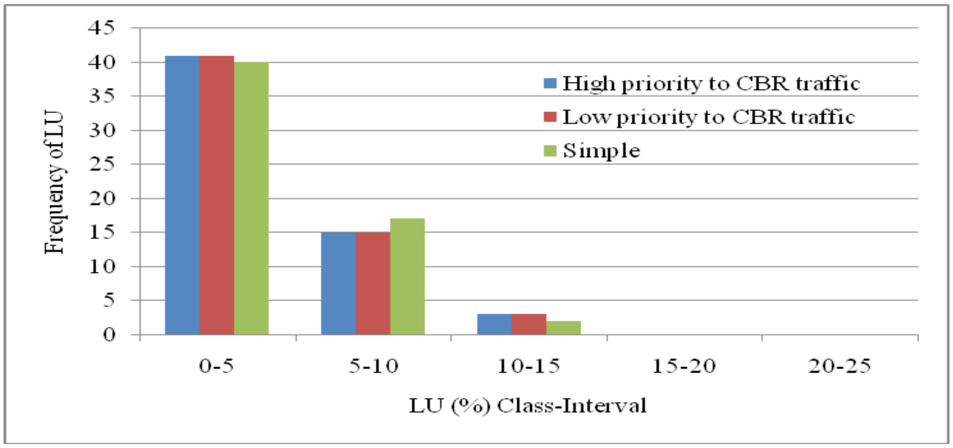

Figure 2: Comparison of LU with average size of transferred file of 5 KB

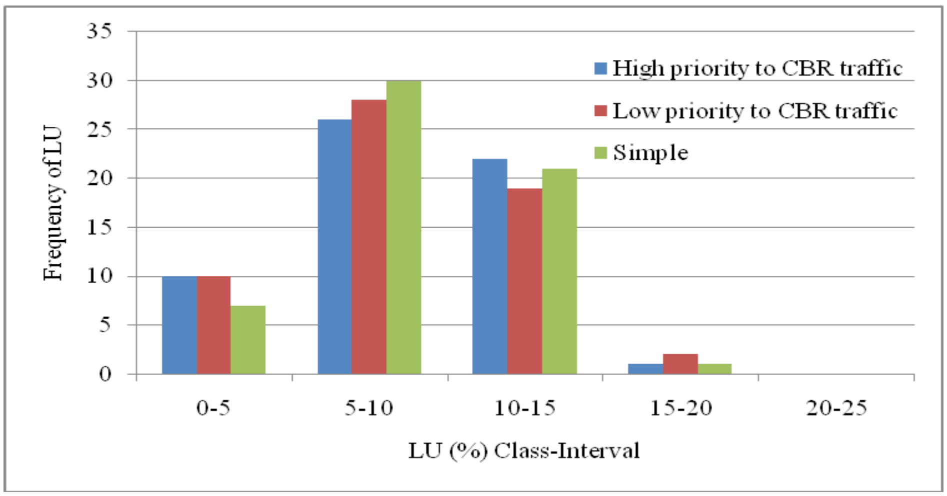

Figure 3: Comparison of LU with average size of transferred file of 10 KB

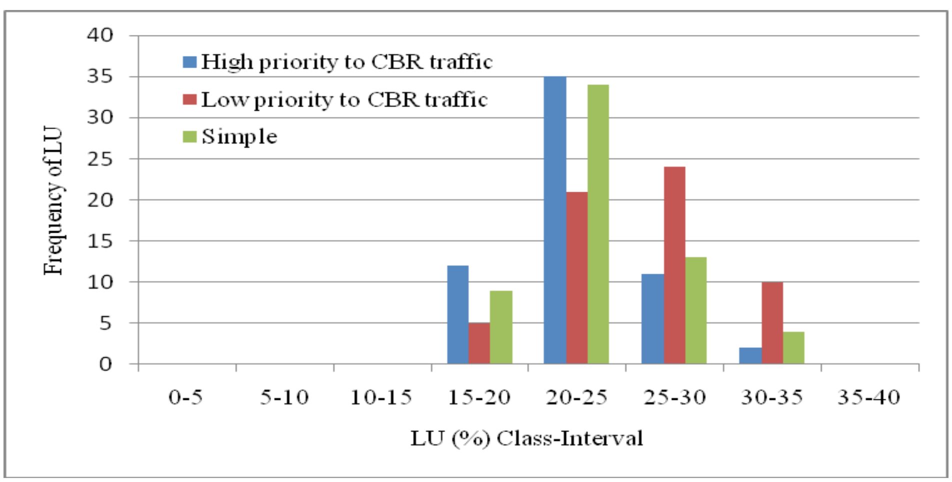

Figure 4: Comparison of LU with average size of transferred file of 50 KB

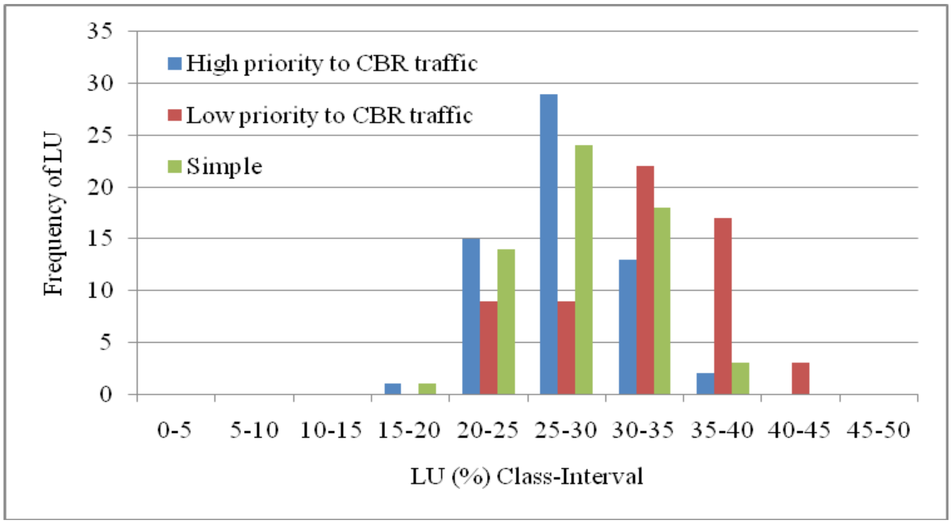

Figure 5: Comparison of LU with average size of transferred file of 100 KB

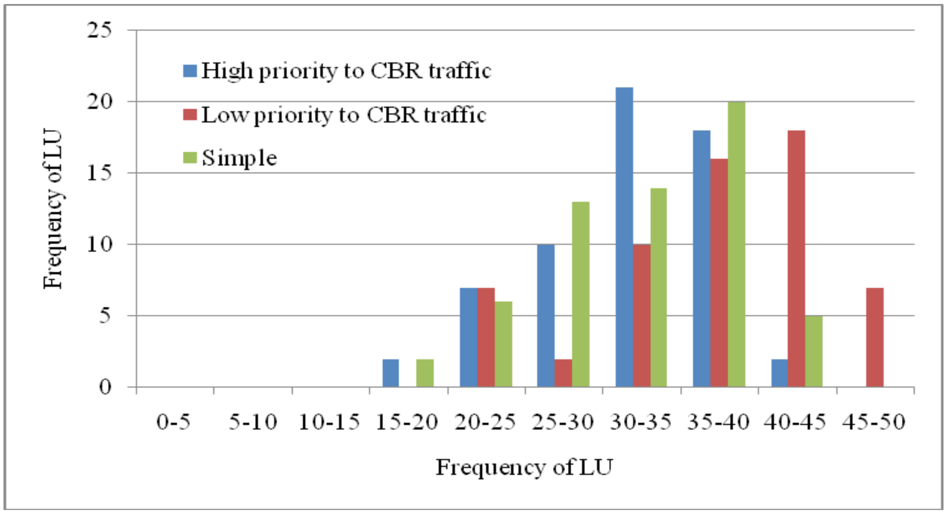

Figure 6: Comparison of LU with average size of transferred file of 200 KB

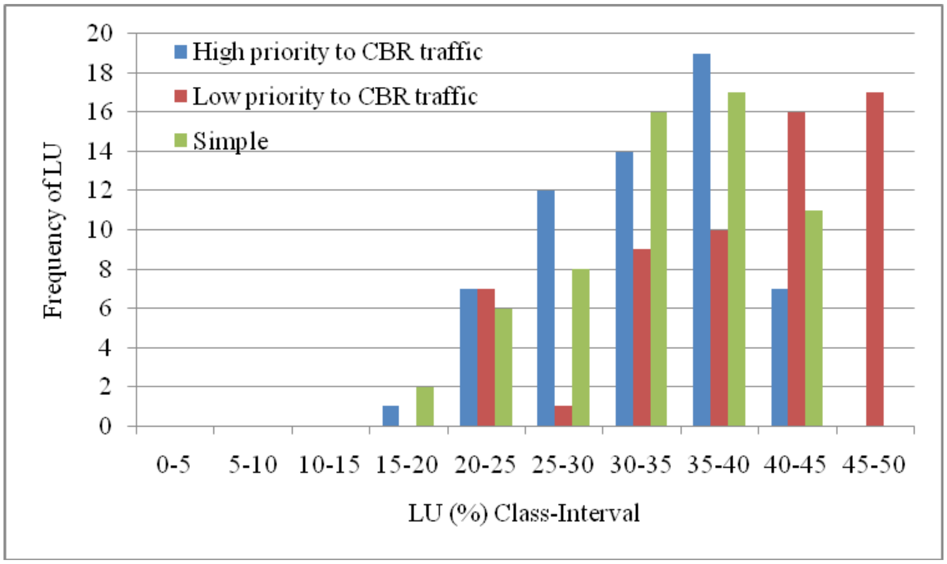

Figure 7: Comparison of LU with average size of transferred file of 400 KB

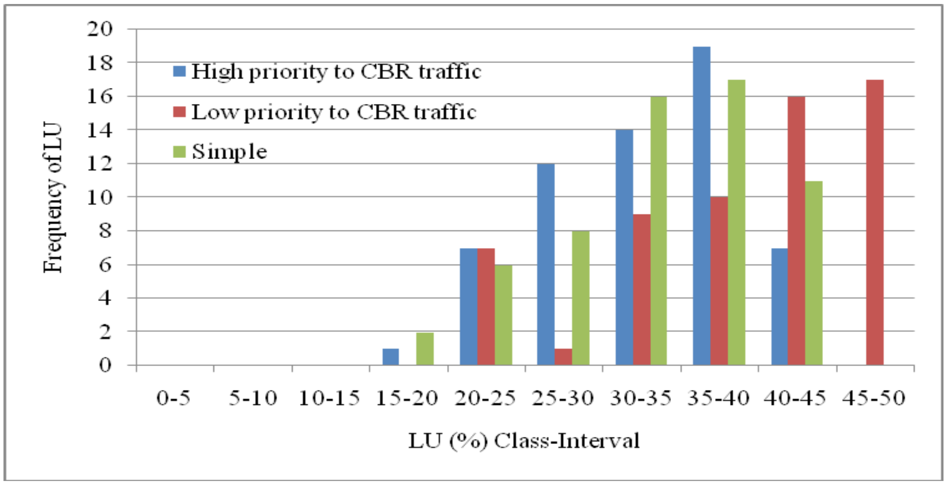

Figure 8: Comparison of LU with average size of transferred file of 1MB

In this simulation, LU calculates at each 0.5 second and total simulation time 30 second. So it gives 60 different times LU, due to random traffic generation we have approached real scenario. Therefore there are needed to calculate efficient way average LU for diverse LU at discrete time event. Here calculate average by Mode [10]. For calculation of Mode, there are required to calculate Mean and Median, and then calculate Mode by equation (1).

$$\text{Mode} = 3\ \text{Median} - 2\ \text{Mean} \tag{1}$$

Table 4: Average (Mode) LU at core to egress edge router

Average size of transferred file	**Link Utilisation (%)**		
	High priority to CBR traffic	**Low priority to CBR traffic**	**Simple**
5 KB	2.2333	2.2333	2.5031
10 KB	8.8771	8.2430	8.5381
50 KB	22.2142	26.0000	22.2647
100 KB	27.2413	33.8484	28.0416
200 KB	34.1904	40.8125	34.8095
400 KB	35.0476	44.8125	35.9583
1 MB	35.0476	44.8125	35.9583

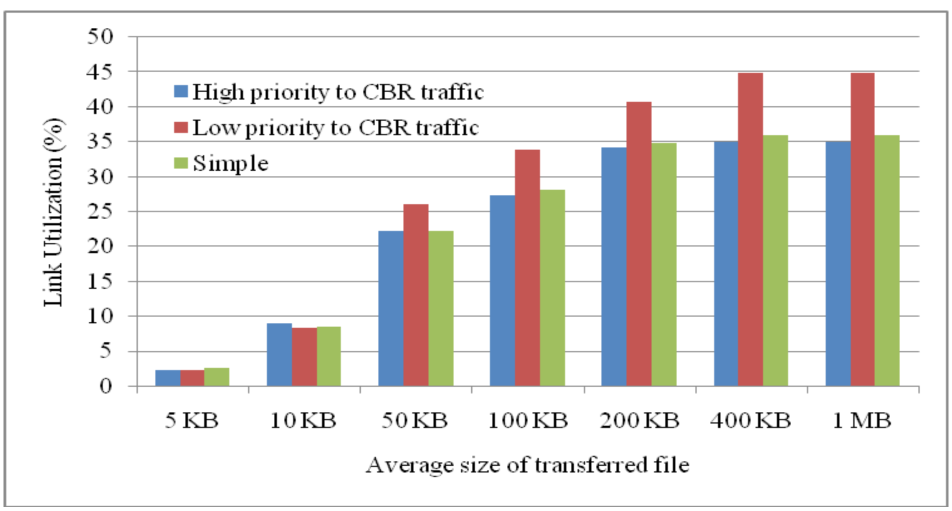

Figure 9: Average (Mode) LU at core to egress edge router

Now below, we show the packets drop statistics at core to egress edge link. Calculated result show in Table-5 and 6. In Table – 6, for showing graph, we take ratio of total drop to total receive packets due to large amount of packets count. In total receiving packets, we not consider *ack* (acknowledgement) packets because it is acknowledgement of receiving packets and small size in comparison to TCP or UDP packets.

Table 5: UDP packets drop statistics with various average transferred file at core router

	Average size of transferred file						
	5 KB	**10 KB**	**50 KB**	**100 KB**	**200 KB**	**400 KB**	**1 MB**
High priority to CBR traffic	33	315	10655	19943	28358	30759	30759
Low priority to CBR traffic	66	595	14574	24781	33728	36740	36740
Simple	65	518	11412	20585	28713	31531	31531

Table 6: Packets statistics with ratio of total drop to total receive (drop/receive) packets at core router

	Average size of transferred file						
	5 KB	**10 KB**	**50 KB**	**100 KB**	**200 KB**	**400 KB**	**1 MB**
High priority to CBR traffic	0.0097	0.0475	0.8502	1.211	1.5454	1.6358	1.6358
Low priority to CBR traffic	0.0116	0.0635	1.0662	1.5596	1.9512	2.0784	2.0784
Simple	0.0108	0.0617	0.8932	1.2718	1.5855	1.6989	1.6989

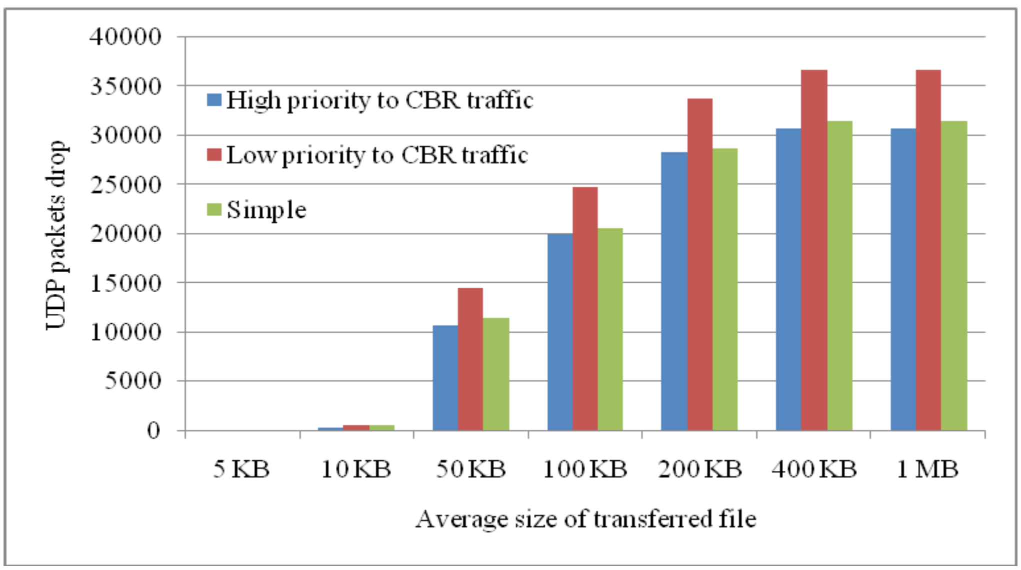

Figure 10: UDP packets drop statistics with various average transferred file at core router

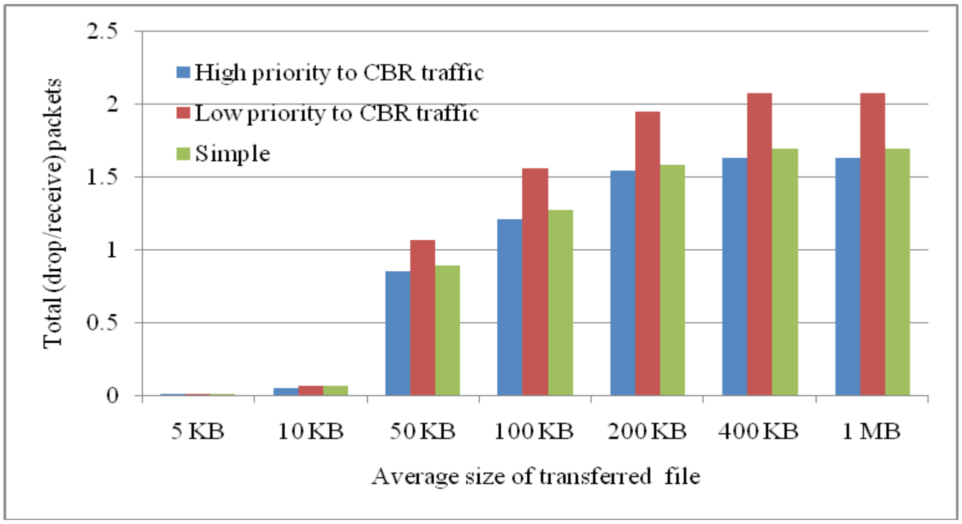

Figure 11: Packets statistics with ratio of total drop to total receive (drop/receive) packets at core router

From figures- 2 to 8, giving high priority to UDP traffic give slightly constant LU rather than other which is shown by class-interval frequency of LU in the graphs because constant bit transfer rate characteristic. But by table-4 and Figure-9, shows that average LU of first simulation is slightly high than simple policy simulation for small average size of file as for 10 kb and slightly less for large average size of file, but by Table-5 and Figure-10, we see that by first policy there are slightly low UDP packets dropped than simple policy and by Table-6 and Figure-11 show that it has also slightly less drop/receive packets ratio, i.e. it increase slightly more packets receiving or goodput than simple policy. And by second policy simulation where UDP packets is in low priority give high LU than other but there are very large packets drop, so it is not good because due to more packets drop degrade the QoS of applications because we have to compromised between utilisation and packets drop. Also see that for small average size of file give low LU but very less packets dropping because there is not more congestion with this policy. But with near about average file size of 50 KB give some better performance in receiving packets, less packets dropping and better LU. With large average size of file, it gives higher LU but it increasing high packets drop, so it is bad. Therefore, with near about 50 KB of average size of file is better.

CONCLUSION

By simulation we see that if we give UDP traffic (CBR) to high priority it slightly decreases throughput in compare to both other policy with respect to Drop-Tail queue. Thus first policy that give high priority to UDP traffic improve QoS of UDP traffic and achieve better performance rather than simple policy (or i.e. third policy) in AF of DS domain network. The average size of transferred file should be 10 Kb to 50 Kb and not larger than its CIR else maximum packets are marked high drop probability and dropped. Due to property of Drop-Tail queue of FIFO buffer, when networks in congestion then queue immediately full and it drops packets and degrades the quality of application.

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