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PERFORMANCE ANALYSIS OF AF IN CONSIDERING LINK UTILISATION BY SIMULATION

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ABSTRACT

In this paper, we illustrate the performance analysis of Assured Forwarding (AF) in Differential Services (DS), in considering of bandwidth (BW) Utilisation or Link Utilisation (LU) and packets drop statistic on core router with MRED Queue. By simulation, we generate random traffic by source node, these sources are two types UDP and TCP by FTP, TELNET and CBR, and we test with small and large average file size for transferring, finally we analysis performance in considering LU and packet drop statistics at core router. In addition, we find out which averages file size for transferring more suitable for AF in terms of LU and drop packets statistic. And we try to find out that which policy is more suitable for UDP traffic like MM (Multimedia) traffic set by CBR traffic with more TCP flows. We 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 DiffServ, Assured Forwarding, TSW2CM, M-RED

INTRODUCTION

In present scenario, Internet has become necessary part of a human being life and communication network load with various diverse application 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 gives 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 parameter 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) [11] and Differentiated Services (DS) [12]. Integrated services, resource allocation for traffic is most important characteristic which arise scalability problem of Internet and which 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 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 different maximum four 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 priorities in three ways Low, Medium and High, in this way there are twelve different types maximum treatment can be achieved.

In paper [5], there are simulations studies of DS traffic in considering BW utilisation and show that allotted BW to AF not utilize as maximum. Also UDP traffic where there are no any 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. So in our simulation we study the UDP flows in simulation as CBR which available in ns2 [6] [7],we 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 file size for transfer. After simulation, we analyses LU and drop packets statistics of UDP and TCP, see what effect of policies in various condition is, 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 with RIO-D [9] (which is a version of M-RED [6] [8]).

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 below Fig-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).

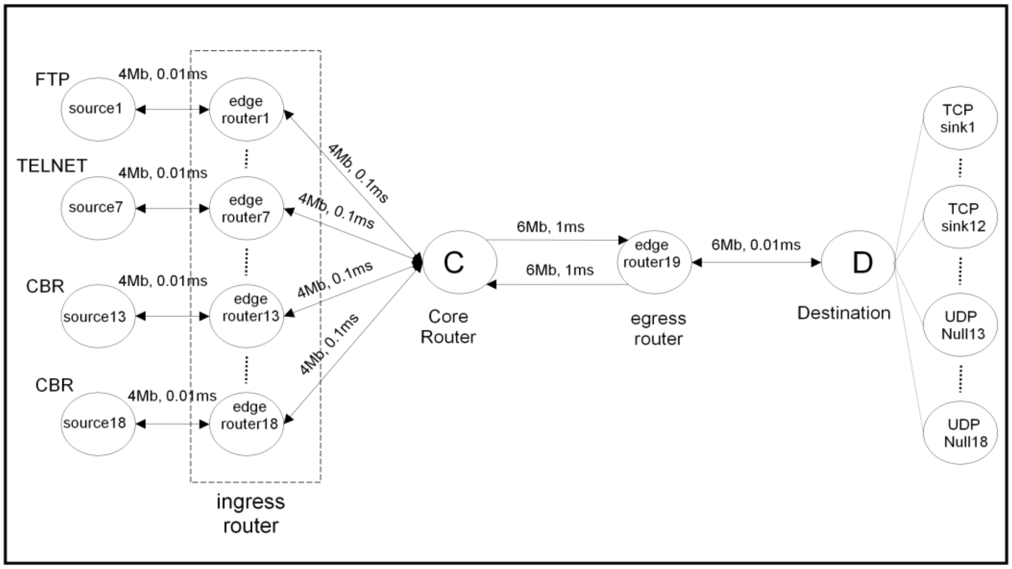

Fig. 1: Network for Policing

In this simulation two priority level are define by TSW2CM very easy by Per-Hope – Behavior (PHB) table. There need to set CIR (Committed Information Rate). If the connection's rate is below CIR, all packets are marked as high priority and then 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 M-RED as for high priority: min_{th}=20, max_{th}=40, max_p=0.02, TSW window length=0.02 second and set CIR=300Kb, for low priority: max_{th}=10, min_{th}=20, max_p=0.1, TSW window length=0.02 second and set CIR=10Kb. Another such type policy marker available in three priority level as called TSW3CM [10] for AF in DS. Incoming packets are enqued in M-RED (Multi RED) queues. Here we use RIO-D (RIO-Decoupled) version of M-RED, in this the probability of dropping an out-of-profile packet is based on the size of its virtual 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-Hope – Behavior (PHB) via code point, which is set for TSW2CM for high and low priority in single physical queue of RIO-D. 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 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, 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 try to 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. After 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 apply various average size of file transferring. As we already discussed that, our simulation is 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 first policy and third type simulation no giving priority to both type traffic i.e. simple and apply various average size of file for transferring with same CIR and see what's effect on LU and packets drop.

So, by simulation method, we try to test policy, can we maximize throughput or LU and low packets drop of such UDP (CBR) type traffic, because UDP traffic no have retransmission mechanism, so loss packets not retrieve and also find what should be average file size for transferring is better.

SIMULATION RESULT

After running our simulation, as experimental setup describe in previous section, obtain 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 bottleneck.

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	8	0	0	0	0	0
5-10	15	30	0	0	0	0	0
10-15	3	21	0	0	0	0	0
15-20	0	0	7	0	0	0	0
20-25	0	0	38	16	8	7	7
25-30	0	0	12	24	13	8	8
30-35	0	0	3	17	16	17	17
35-40	0	0	0	3	22	21	21
40-45	0	0	0	0	1	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	9	0	0	0	0	0
5-10	15	29	0	0	0	0	0
10-15	3	21	0	0	0	0	0
15-20	0	0	2	0	0	0	0
20-25	0	0	20	7	6	5	5
25-30	0	0	27	9	2	2	2
30-35	0	0	10	21	9	9	9
35-40	0	0	1	17	14	10	10
40-45	0	0	0	6	18	17	17
45-50	0	0	0	0	11	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	8	0	0	0	0	0
5-10	16	29	0	0	0	0	0
10-15	3	21	0	0	0	0	0
15-20	0	1	5	0	0	0	0
20-25	0	0	26	12	7	7	7
25-30	0	0	22	21	9	7	7
30-35	0	0	7	17	16	12	12
35-40	0	0	0	10	20	19	19
40-45	0	0	0	0	8	15	15
45-50	0	0	0	0	0	0	0

From Table-1, 2, 3 and Fig 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 not any effects. As the protection of vulnerable packets and average duration of session as a function of CIR. So there are CIR =300 kbps is good for this, so it set to high priority. But arrival rate of session does not depend on CIR it is random and setting low loss probability to queue, the throughput is also constant as a function of CIR.

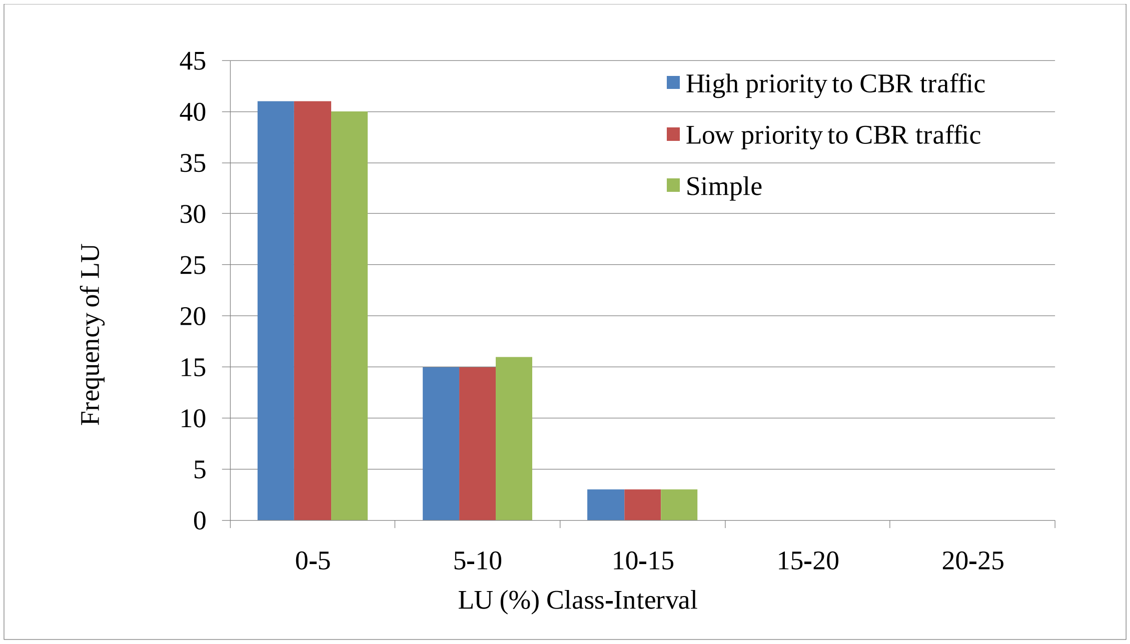

Fig. 2: Comparison of LU with average size of transferred file of 5 KB

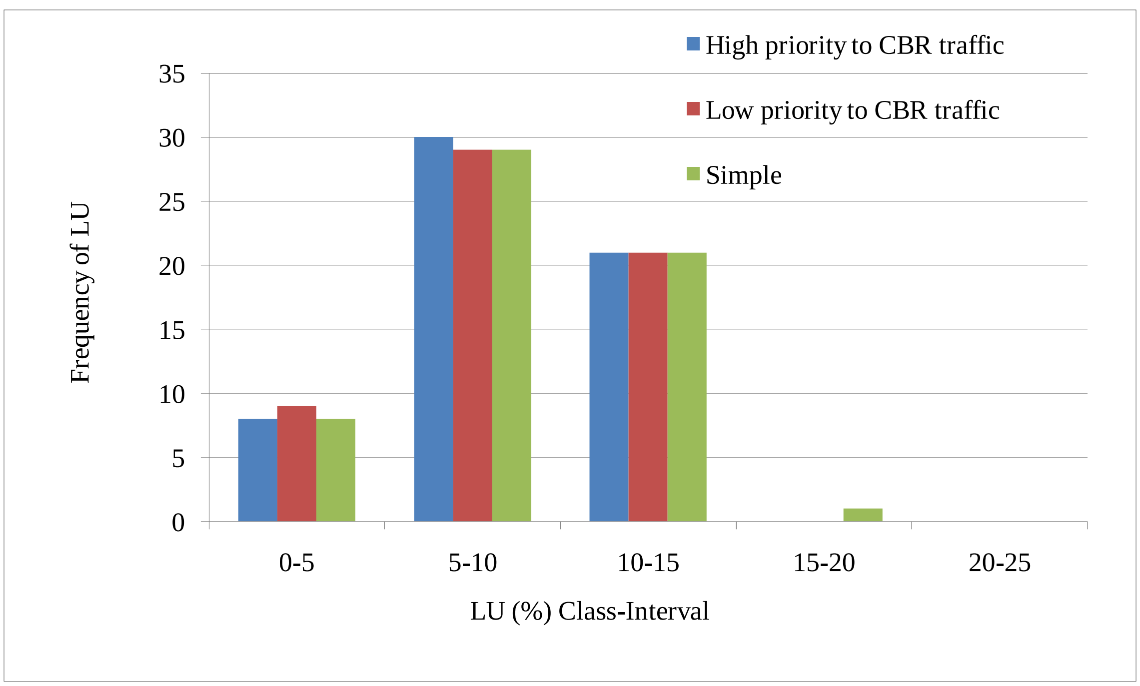

Fig. 3: Comparison of LU with average size of transferred file of 10 KB

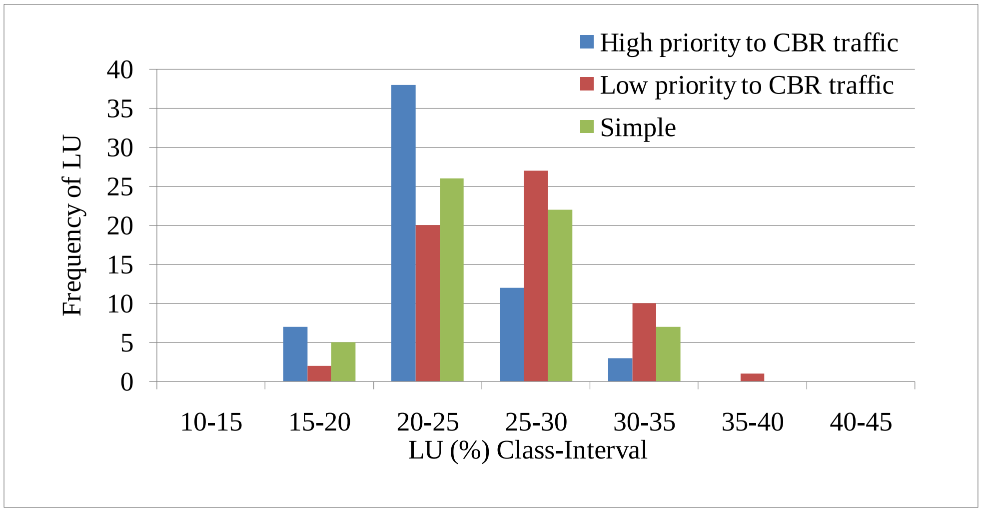

Fig. 4: Comparison of LU with average size of transferred file of 50 KB

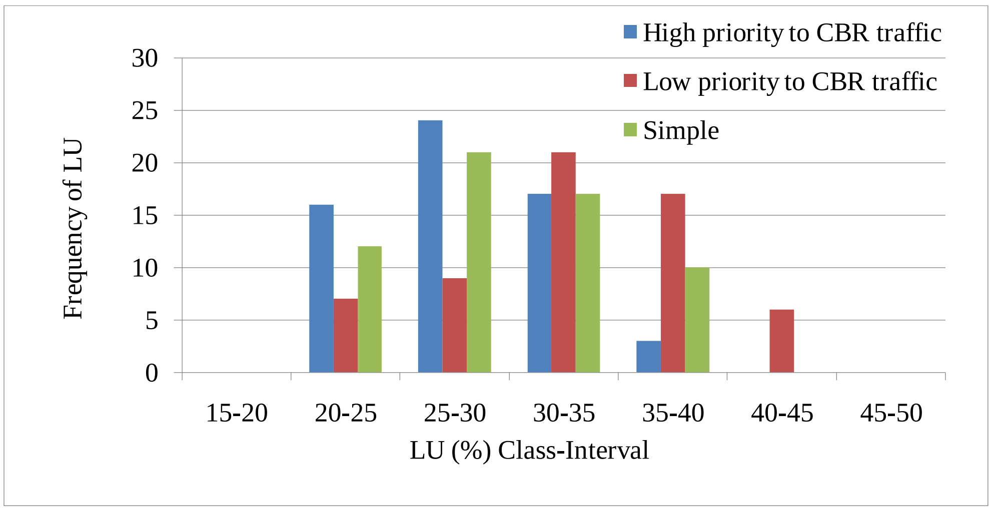

Fig. 5: Comparison of LU with average size of transferred file of 100 KB

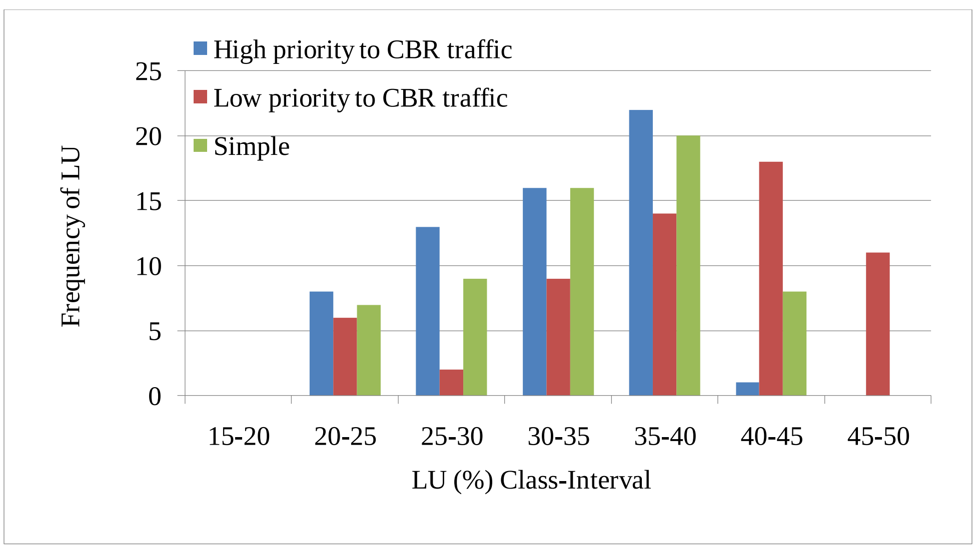

Fig. 6: Comparison of LU with average size of transferred file of 200 KB

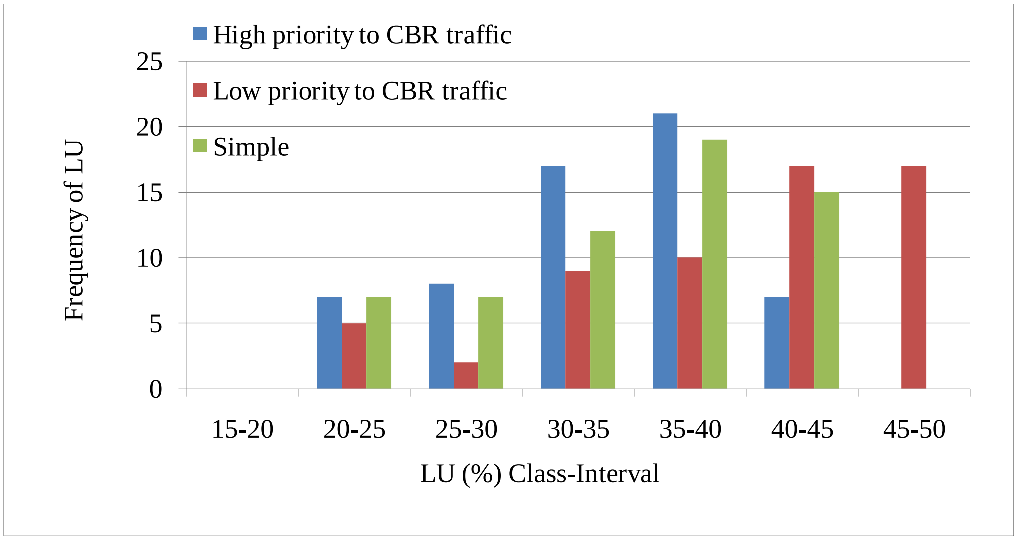

Fig. 7: Comparison of LU with average size of transferred file of 400 KB

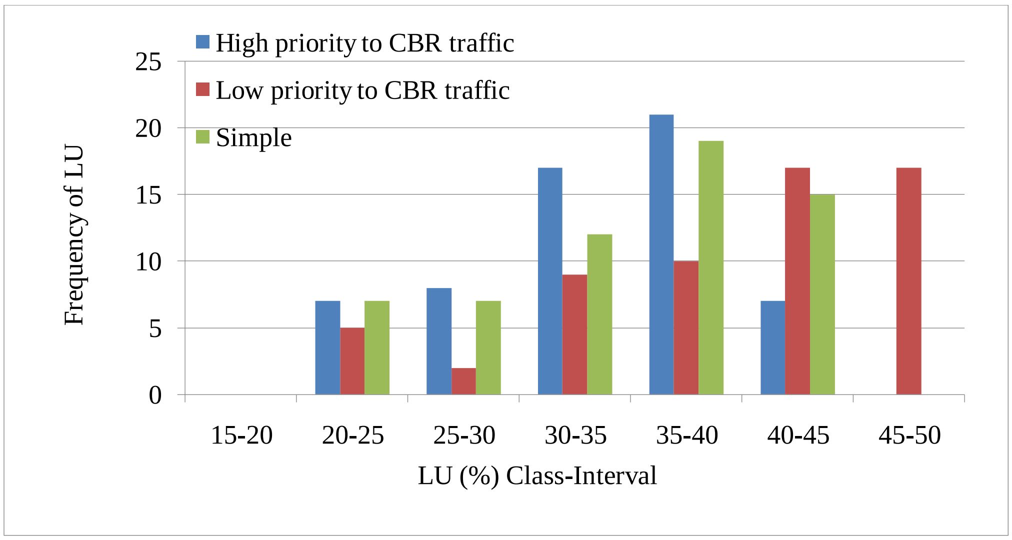

Fig. 8: Comparison of LU with average size of transferred file of 1MB

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 it try to approaches real scenario. So there are need to calculate efficient way average LU for diverse LU at discrete time event. Here calculate average by Mode [13]. For calculation of Mode, there are required to calculate Mean and Median, then calculate Mode by eq. 1.

$$\text{Mode} = 3\ \text{Median} - 2\ \text{Mean} \qquad \text{(eq.1)}$$

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	2.3336
10 KB	8.5466	8.5695	8.5783
50 KB	22.2456	26.4444	21.9301
100 KB	27.5833	34.0000	28.6904
200 KB	34.2708	42.4285	35.9583
400 KB	36.0686	44.6960	38.4912
1 MB	36.0686	44.6960	38.4912

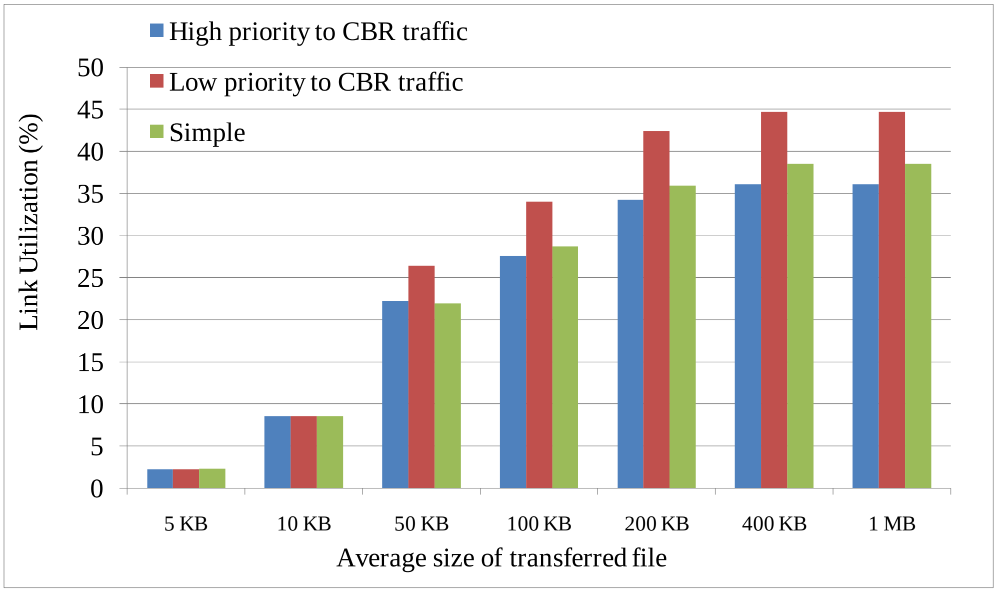

Fig. 9: Average (Mode) LU at core to egress edge router

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* packets because it is acknowledgement of receiving packets in small in size in compare 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	4	58	11003	8342	7620	7283	7283
Low priority to CBR traffic	7	334	15307	25968	34966	37669	37669
Simple	37	365	13053	22157	29945	32630	32630

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	0.0025	0.0137	0.8582	1.2346	1.5706	1.6810	1.6810
Low priority to CBR traffic	0.0015	0.0321	1.0949	1.6163	2.0184	2.1276	2.1276
Simple	0.0078	0.0496	0.9953	1.3822	1.6837	1.7831	1.7831

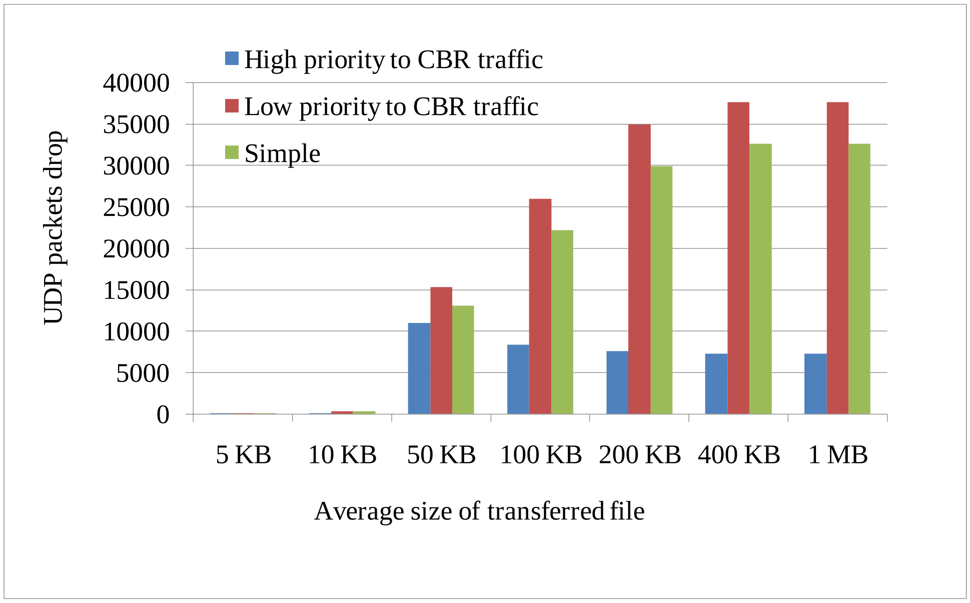

Fig. 10: UDP packets drop statistics with various average transferred file at core router

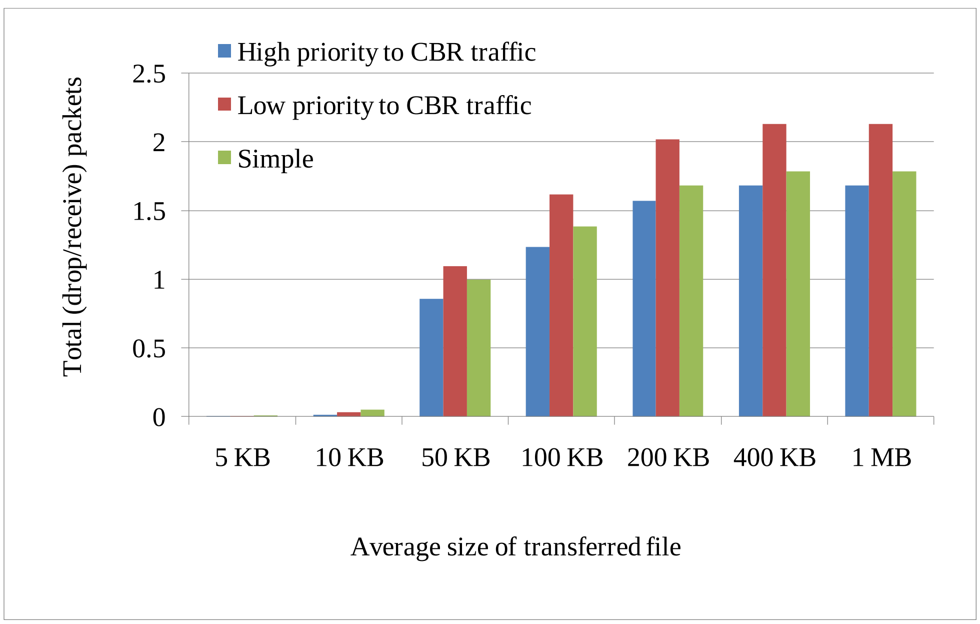

Fig. 11: packets statistics with ratio of total drop to total receive (drop/receive) packets at core router

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

CONCLUSION

By simulation we see that if giving UDP traffic (CBR) to high priority slightly decrease throughput in compare to both other policy and also minimize loss of packets in AF of DS network and improve QoS of UDP traffic and achieve better performance rather than simple way and where average size of transferred file should be 10 Kb to 100 Kb and not larger than its CIR else maximum packets are marked high drop probability and dropped.

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