

1. Analysis of $N=4$:

- Varying buffer size:

1. The input given to program is: $N=4$, $T=2000$, $C=10000$. All sources have same average packet per unit time and they all start generating and stop generating packets at the same time. Each source input is shown in table 1.

Source	P_i	L_{\min}	L_{\max}	W_i	t_b	t_e
0	10	1000	1500	4	0.01	0.99
1	10	500	1200	2	0.01	0.99
2	10	750	1500	1	0.01	0.99
3	10	1000	1800	0.5	0.01	0.99

Table 1: $N=4$ source Parameters

2. For the input in table 1, buffer size B takes values from $[100, 1000, 10000, 100000]$. We get the results as shown in table 2 for various system level metrics.

Buffer Size	Mean Packet Delay	Mean Packet Drop Prob.	Server Utilization (%)
100	30.74	0.77	96.56
1000	145.23	0.78	92.99
10000	716.96	0.83	69.59
100000	717.70	0.88	47.54

Table 2: Metrics corresponding to different buffer size

The mean packet delay increases as the buffer size increases, since more packets are enqueued in the buffer and stay in there until they are transmitted.

The mean packet drop probability also increases with buffer size. But this is a consequence of the simulation implementation, where, when the simulation ends, the packet not sent out i.e. still in the buffer are considered to be dropped as well. Thus, as buffer size increases, drop probability increases.

- Varying link capacity:

1. Here, we maintain the buffer size to 100.

Link Capacity	Mean Packet Delay	Mean Packet Drop Prob.	Server Utilization (%)
10000	143.550	0.780	92.530
100000	29.300	0.120	38.200
1000000	0.005	0.060	0.041
10000000	0.025	0.061	0.004

Table 3: Metrics corresponding to different link capacities

2. We vary the link capacity for the above inputs 1 and C takes values from [10000, 100000, 1000000, 10000000]. The results obtained for various system level metrics are shown in 3. As the link capacity increases, each packet takes smaller amount of time to transmit i.e. the transmission completes faster. Thus, with increasing link capacity, the mean packet delay, mean packet drop probability and server utilization reduces. The source packet generation parameters also affect the server utilization. Since we have a less aggressive exponential distribution for IAT of each source, the server does not get enough packets to service.
3. We also vary the avg packet generation rate at each source, keeping the link capacity constant to C=10000000 and P_i taking values in [10, 20, 30, 40]. The results obtained are shown in table 4.

P_i	Mean Packet Delay	Mean Packet Drop Prob.	Server Utilization (%)
10	0.077	0.068	0.004
20	0.318	0.109	0.007
30	0.090	0.139	0.010
40	0.180	0.169	0.013

Table 4: Metrics corresponding to different packet generation rates, with constant link capacities

As P_i increases, we can observe that mean packet delay, mean drop probability and server utilization increases. Since, packets are generated at a higher rate, more packets are available in the buffer and for the server to service.

2. System Level metrics for N=8:

- The inputs are N=8, T=2000, C=10000000 B=1000. The per source metrics are given in table 5.
- The system level metrics for the input in table 5 are shown in table 6. It can be seen that the fraction of link BW allocated to each source is as per the weights assigned to them. However, it is also influenced by the P_i parameter.

3. System Level metrics for N=16:

Source	P_i	L_{\min}	L_{\max}	W_i	t_b	t_e
0	10	1000	1500	4	0.01	0.99
1	20	500	1200	2	0.01	0.99
2	23	750	1500	1	0.01	0.99
3	35	1000	1800	0.5	0.01	0.99
4	5	1000	1300	4	0.01	0.99
5	30	900	1100	2	0.01	0.99
6	30	750	2000	1	0.01	0.99
7	15	100	1800	0.5	0.01	0.99

Table 5: N=8 source Parameters

Conn ID	Bg	Bt	Bt/Bg	Fraction of link BW	Mean pkt delay	Pkt drop prob
0	23484564	17601688	0.7495	0.0653	0.0071	0.2508
1	31309310	23815440	0.7607	0.0884	0.0069	0.2398
2	46927281	35732788	0.7615	0.1326	0.0069	0.2378
3	85551581	65714911	0.7681	0.2439	3.7420	0.2318
4	11350157	8463964	0.7457	0.0314	0.0072	0.2539
5	53299762	41052341	0.7702	0.1523	0.0069	0.2297
6	73483441	56669415	0.7712	0.2103	0.0075	0.2288
7	26905192	20413090	0.7587	0.0758	0.0070	0.2431

Table 6: System level metrics for N=8