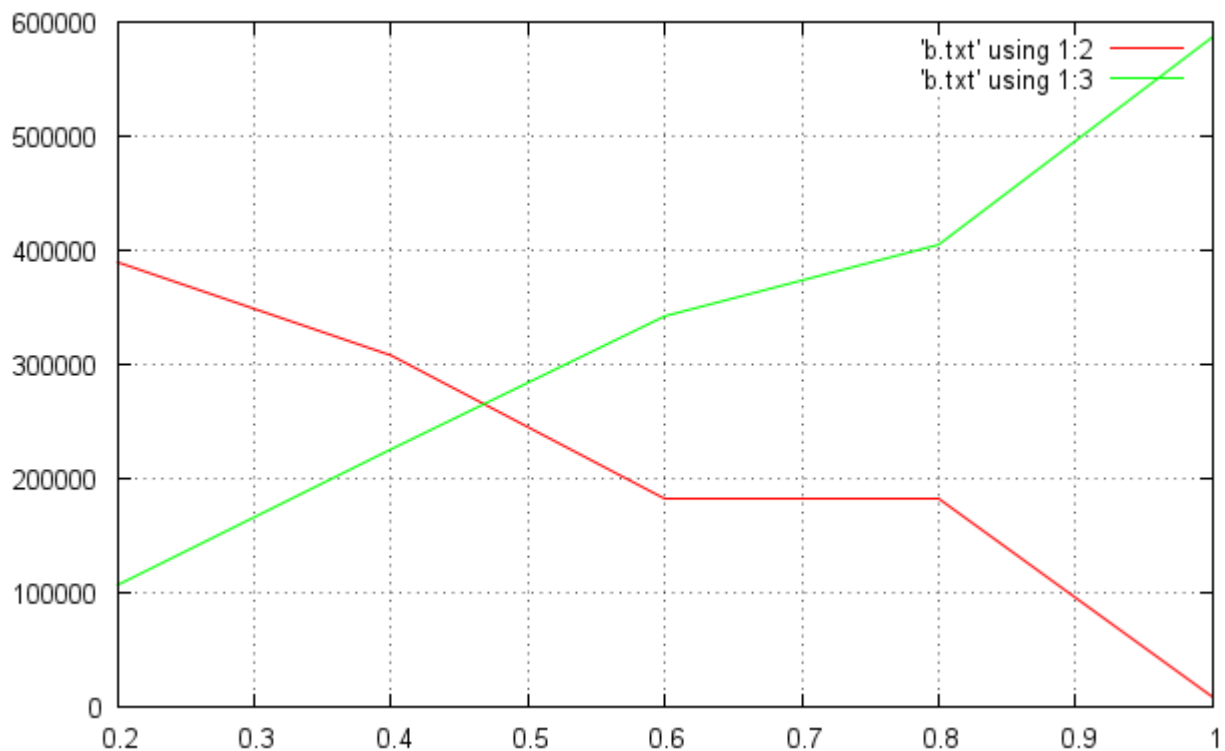


Task 1

(a)TCP/FTP

(b)

0.2	0.4	0.6	0.8	1
tcp: 389660	tcp: 308040	tcp: 183300	tcp: 183300	tcp: 9280
cbr: 107000	cbr: 226000	cbr: 342500	cbr: 405000	cbr: 586500
total: 496660	total: 534040	total: 525800	total: 588300	total: 595780
tcp ratio: 0.7846	tcp ratio: 0.5768	tcp ratio: 0.3486	tcp ratio: 0.3116	tcp ratio: 0.0156
cbr ratio: 0.2154	cbr ratio: 0.4232	cbr ratio: 0.6514	cbr ratio: 0.6884	cbr ratio: 0.9844



TCP uses more bandwidth at first, but UDP gradually uses more bandwidth as its sending rate increases and its traffic dominates the bottleneck at 1Mbps. The UDP traffic is favored because it has no flow control.

(c)

tcp: 9280

cbr flow 1: 478500

cbr flow 2: 108000

total: 595780

tcp ratio: 0.0156

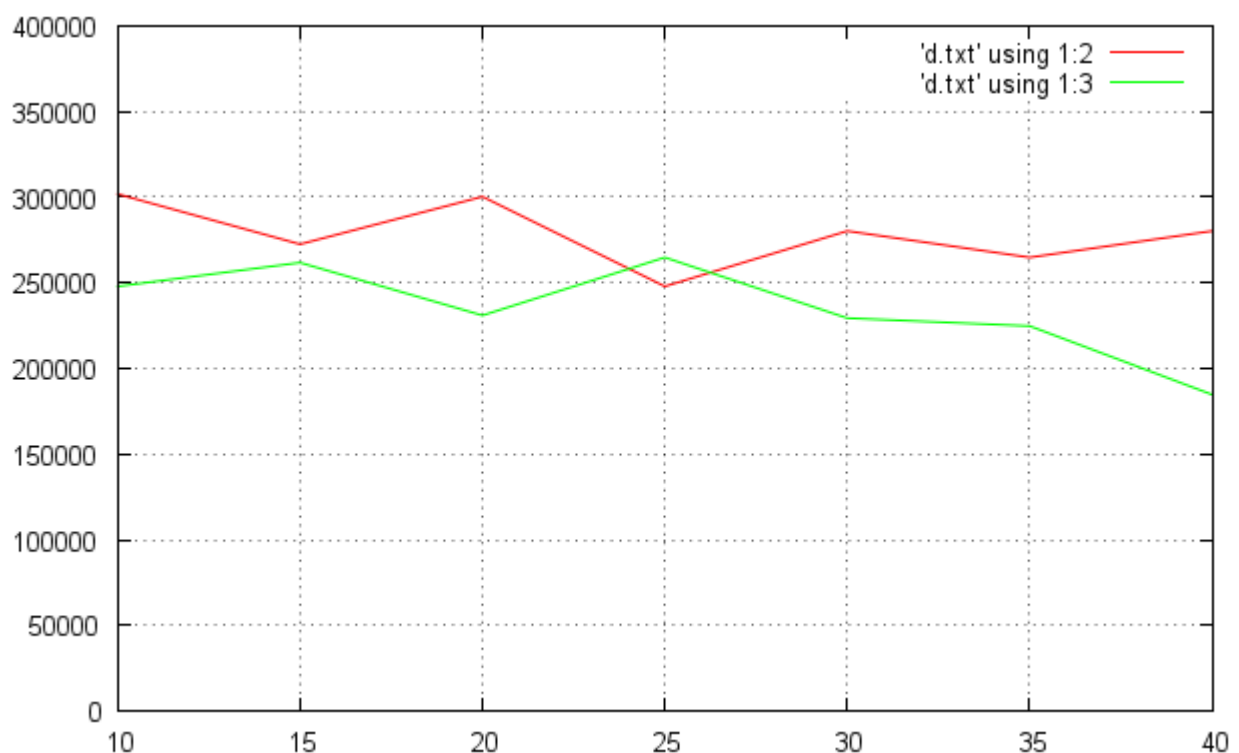
cbr flow 1 ratio: 0.8031

cbr flow 2 ratio: 0.1813

The UDP/CBR flow generated by node 2 is favored because it's sent at a higher rate.

(d)

10ms	15ms	20ms	25ms	30ms	35ms	40ms
tcp1: 301880	tcp1: 272620	tcp1: 300340	tcp1: 247980	tcp1: 280320	tcp1: 264920	tcp1: 280320
tcp2: 247980	tcp2: 261840	tcp2: 231040	tcp2: 264920	tcp2: 229500	tcp2: 224880	tcp2: 184840
total: 549860	total: 534460	total: 531380	total: 512900	total: 509820	total: 489800	total: 465160
tcp1 ratio: 0.5490	tcp1 ratio: 0.5101	tcp1 ratio: 0.5652	tcp1 ratio: 0.4835	tcp1 ratio: 0.5498	tcp1 ratio: 0.5409	tcp1 ratio: 0.6026
tcp2 ratio: 0.4510	tcp2 ratio: 0.4899	tcp2 ratio: 0.4348	tcp2 ratio: 0.5165	tcp2 ratio: 0.4502	tcp2 ratio: 0.4591	tcp2 ratio: 0.3974

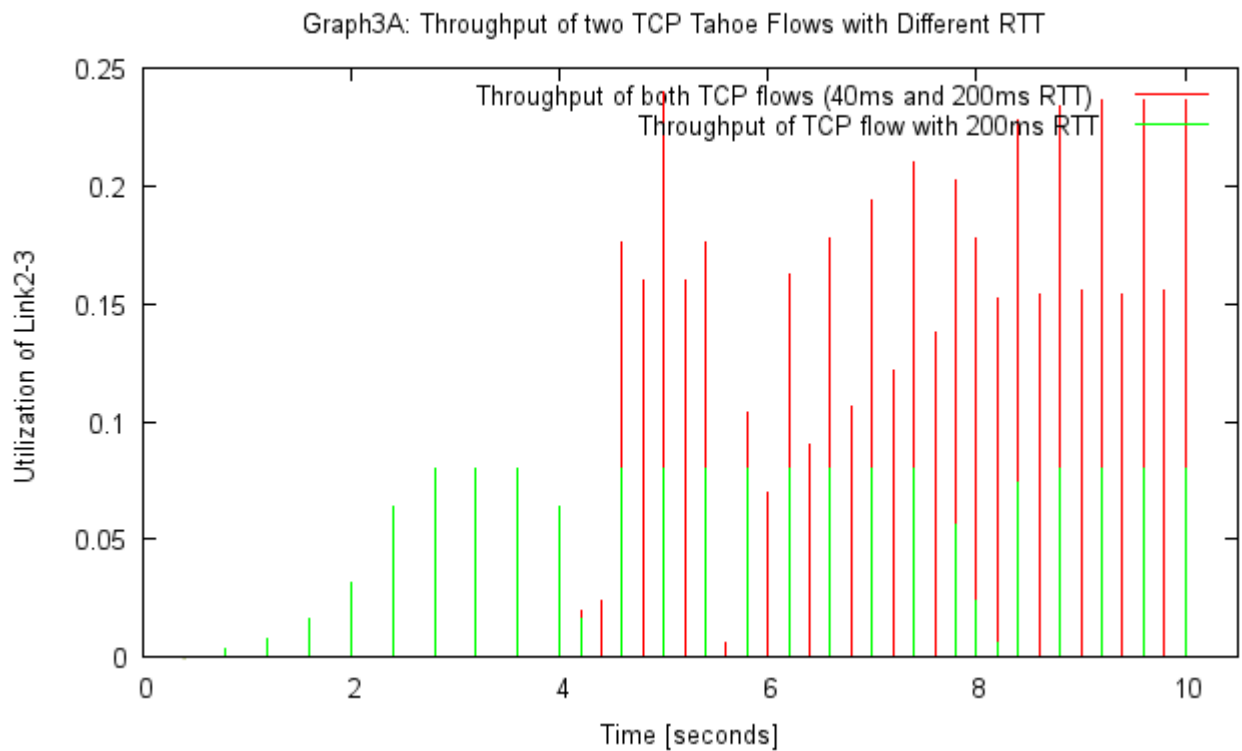


The two connections both get approximately half of the bandwidth because of the TCP flow control.

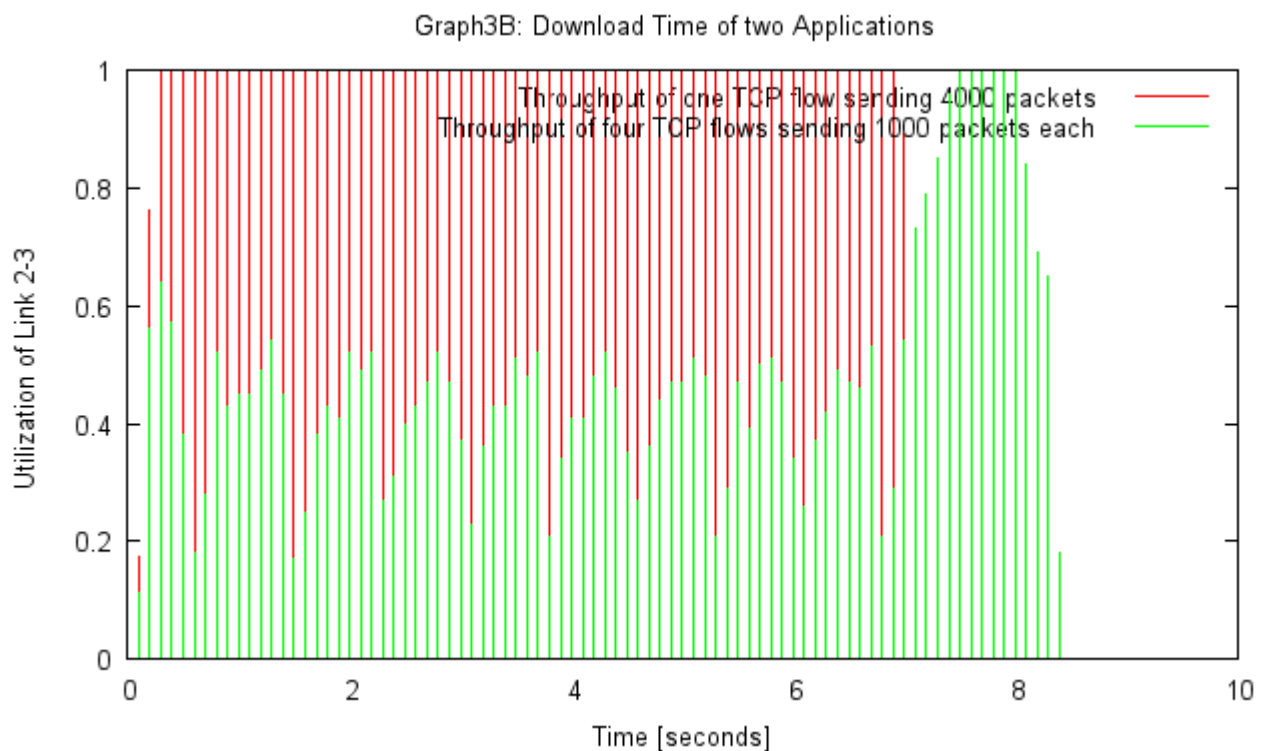
Task 2

(A)

1. Yes, some packets were dropped at node2 at about 5.5 sec.
2. $(0.15 + 0.25 - 0.08) / 0.08 = 4:1$ (bandwidth of the 40ms-RTT flow vs. that of the 200ms-RTT one)
3. Because packets in the 200ms RTT TCP flow are more likely to time out, which causes the flow control algorithm to decide to send at a lower rate.
4. By modifying the flow control algorithm to allow for a larger timeout.



(B)



1. The 4-connection application performs poorer than the single-connection one.
2. The 4-connection one takes about 40% of the bandwidth of Link 2-3.
3. It's not unfair.