TTM 4150
Internet Network Architecture

Exercise 3: The simulation of IP Network with NS2

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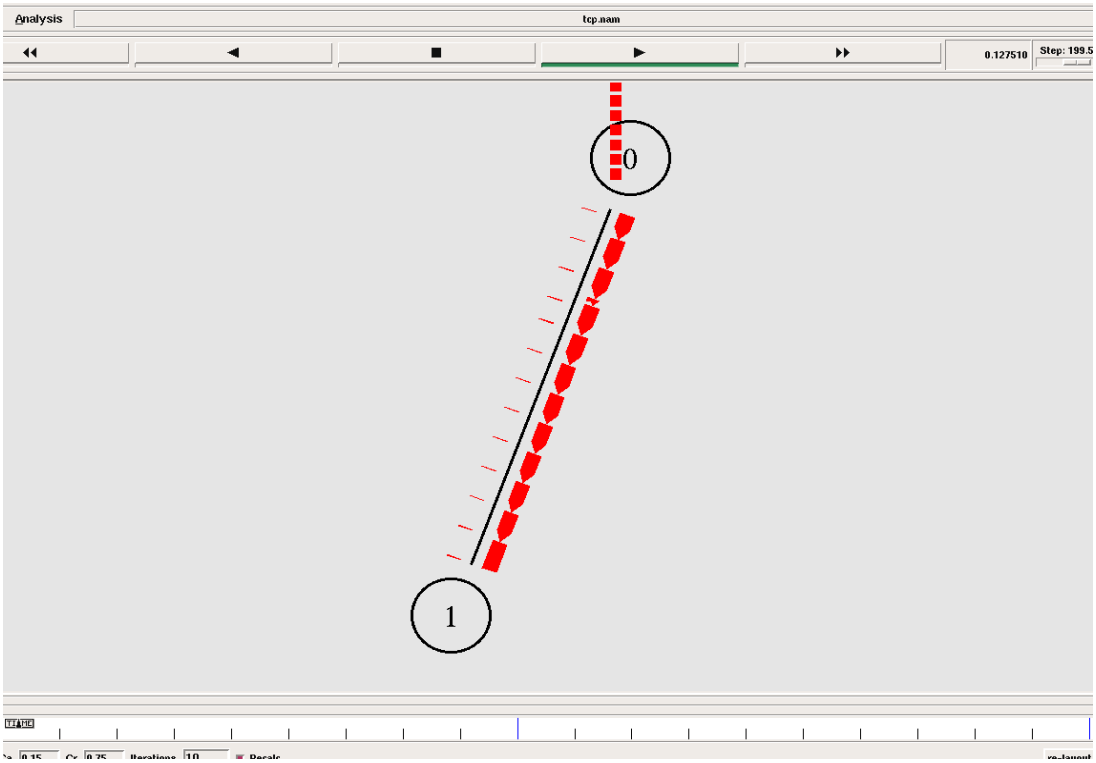
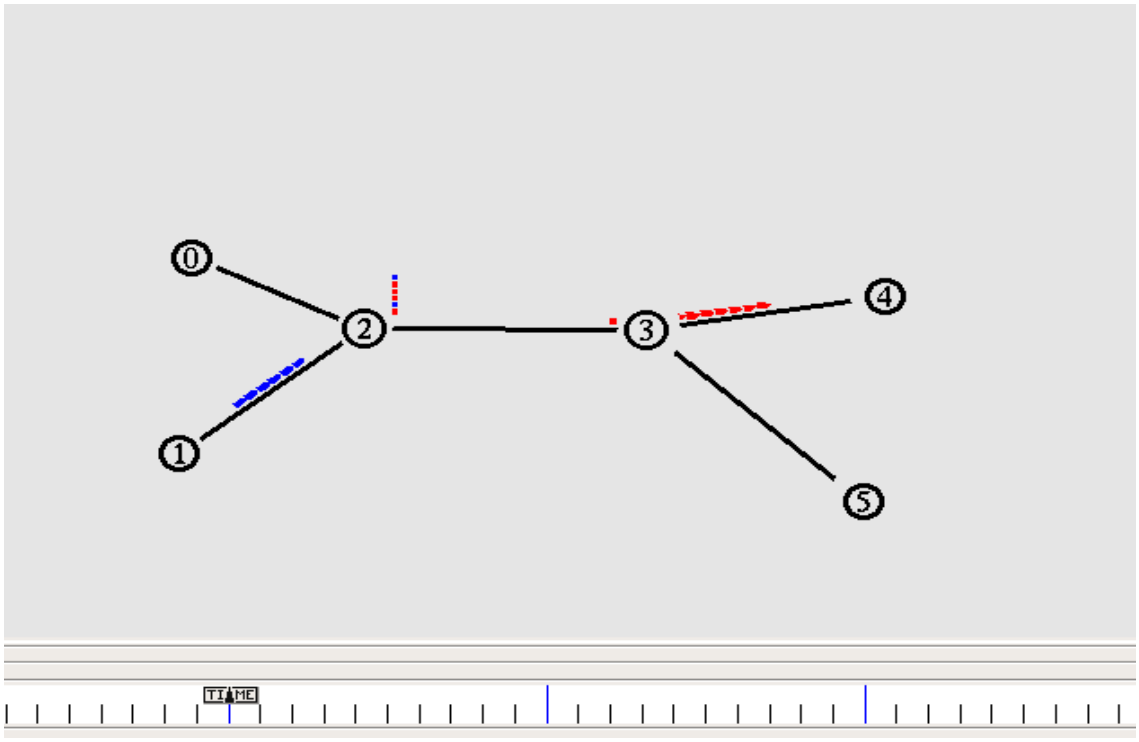
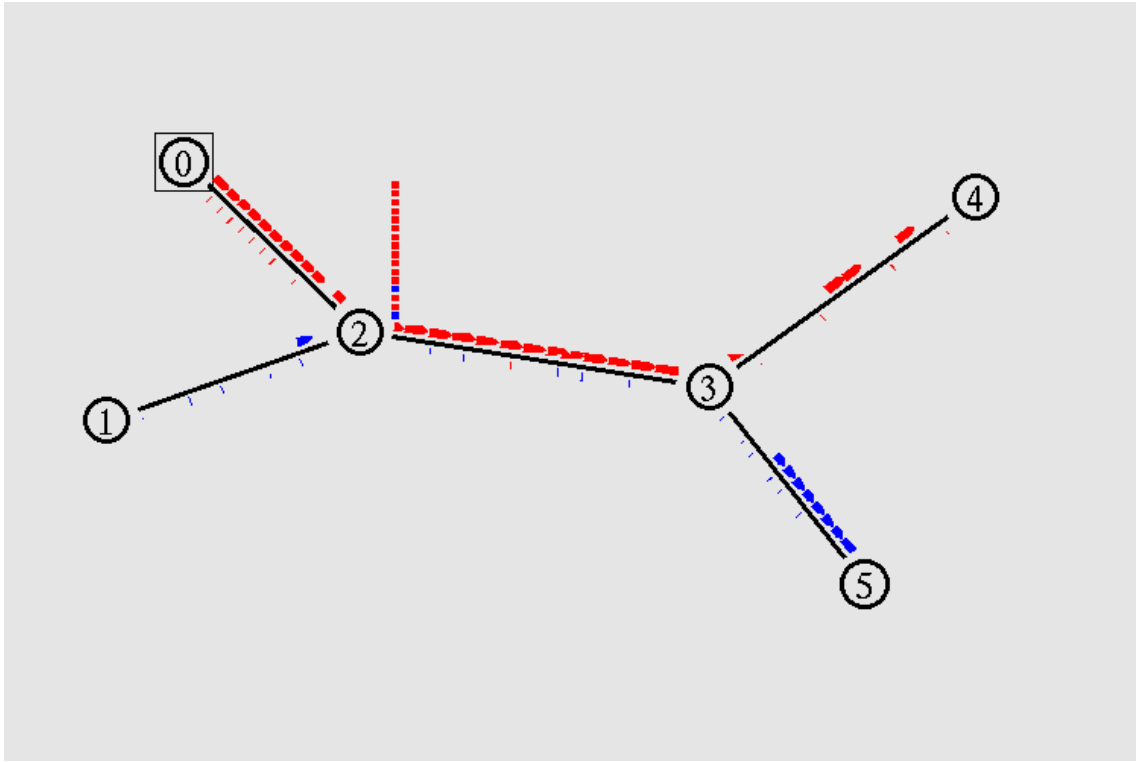
Task 1

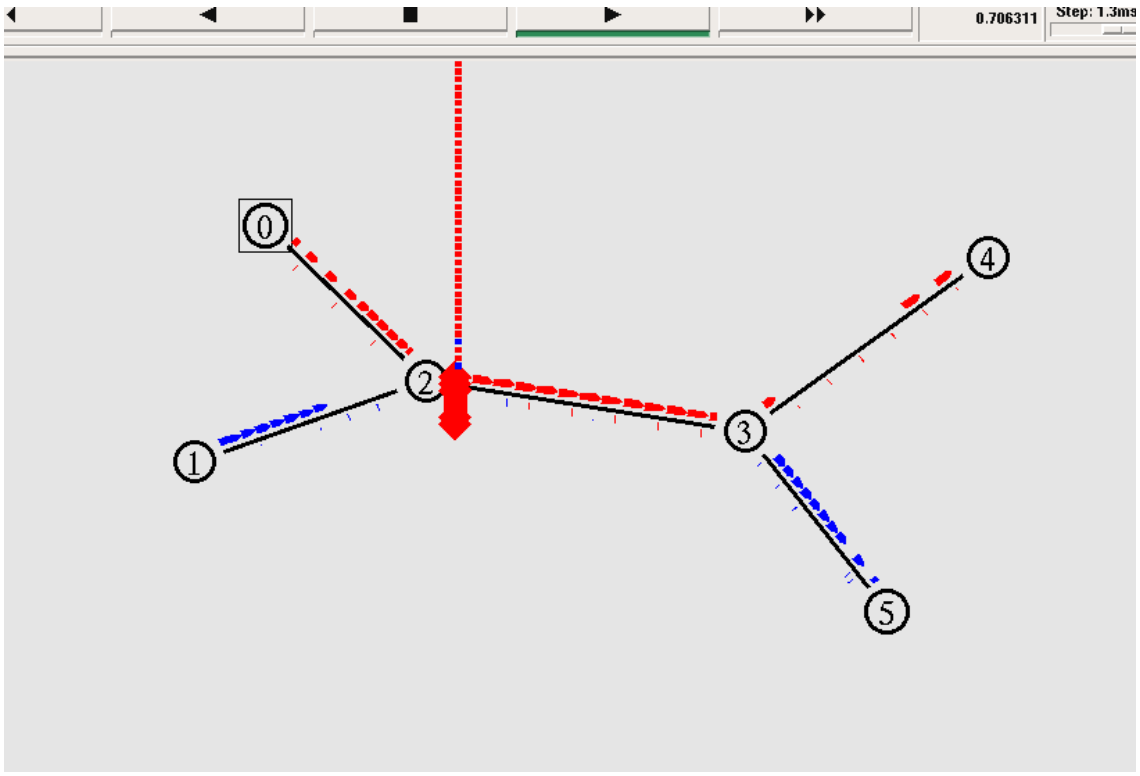


The traffic goes from 0 to 1 normally, and we can see the node 0 is buffering some of the packages because of the slow start control congestion mode.

Task 2





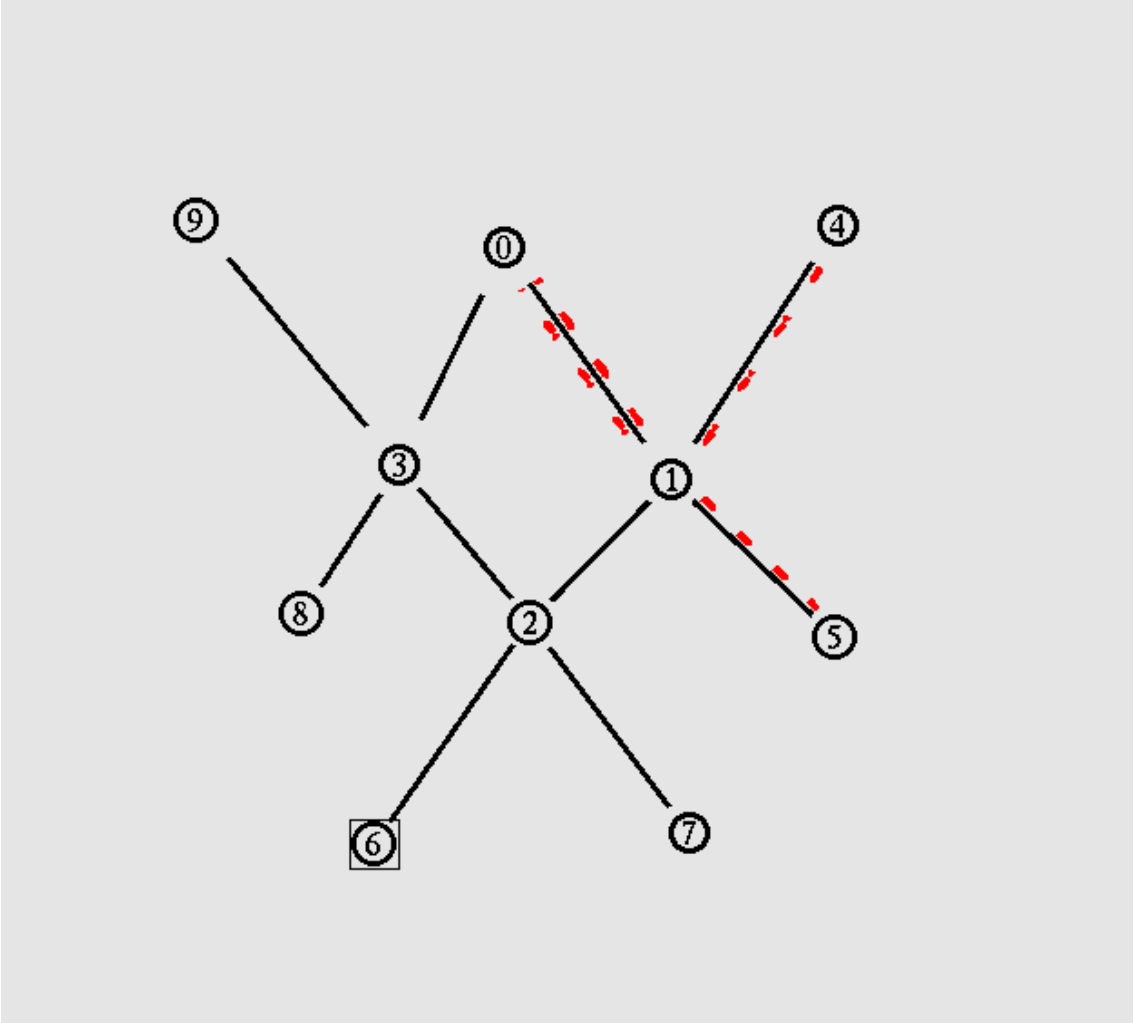


In this sequence of screenshots we can see:

- Nodes 0 and 1 are generating packages with a rate of 1460 B every 0.003 seconds
- Nodes 0 and 1 start sending packages with a slow start in order to control congestion, so they start sending packages with a slower rate than 1460B each 0.003 seconds. Node 1 starts after 0.3 seconds of the starting of the simulation (screenshot 2.1).
- Node 0 is generating more packages than it is sending because of the slow start at the beginning.
- When the rate from node 0 is bigger than 1460B every 0.003 seconds, then node 2 is receiving traffic from 0 and 1, its buffer starts to accumalate packages. (screenshot 2.2)

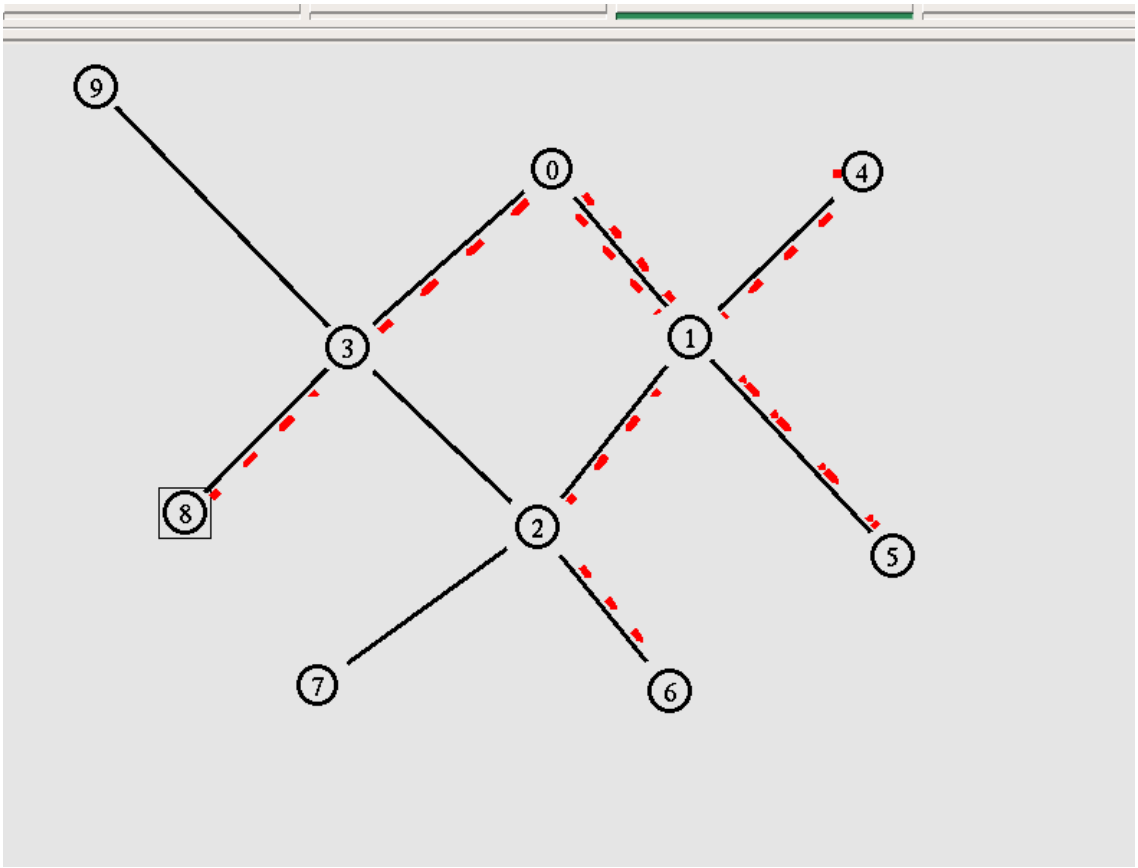
– When the buffer is overloaded, node 2 starts to drop packages.. (screenshot 2.3)

Task 3



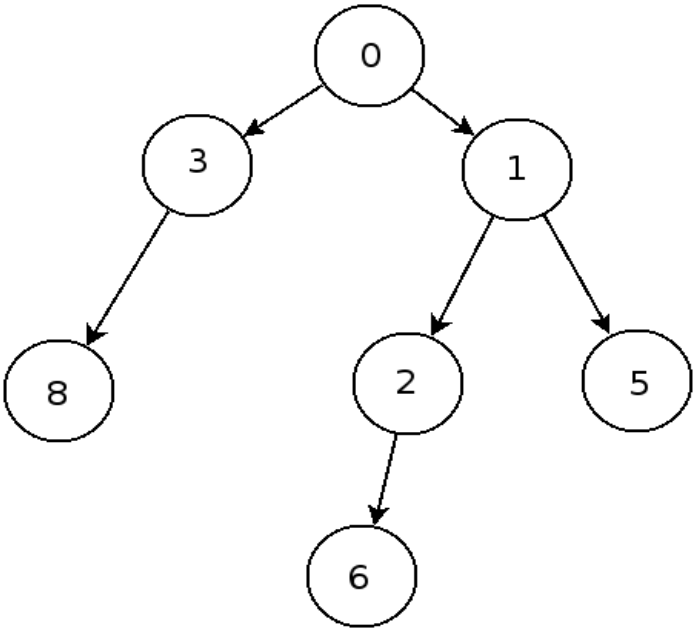
In multicast there is only one connection from the source, and we have to set up a rendez-vous node. The servers which are interested in receiving the traffic should join the multicast group (in this case is only node number 5).
Therefore in this case the traffic from 4 to 5 goes in this way: 4->1->0->1->5.

Task 4



In this case we can see that the traffic is being sent to nodes 8, 6 and 5.

Multicast Tree:



Calculate bandwith:

The bandwith for one link is:

1460 B/ 0.003 s = 486666 B/s

We are using 7 links, but one of them (0-1) is used twice, therefore the bandwith used for the multicast network is:

486666 B/s x 8 links = 3893328 B/s

The capacity of one link is 10 Mb/s, therefore the capacity for the multicast network is
10Mb/s x 10 links = 100 Mb/s = 100 MB/s = 104857600 B/s

Therefore the bandwith/capacity rate is:

3893328 / 104857600 = 0.037129669 (We are using a 3.71% of the network capacity for the multicast traffic).

Suggestion for improving the bandwith/capacity rate:

We could reduce the number of links setting node 1 as rendez-vous node. In this way the number of links would be 7, so the bandwith would be

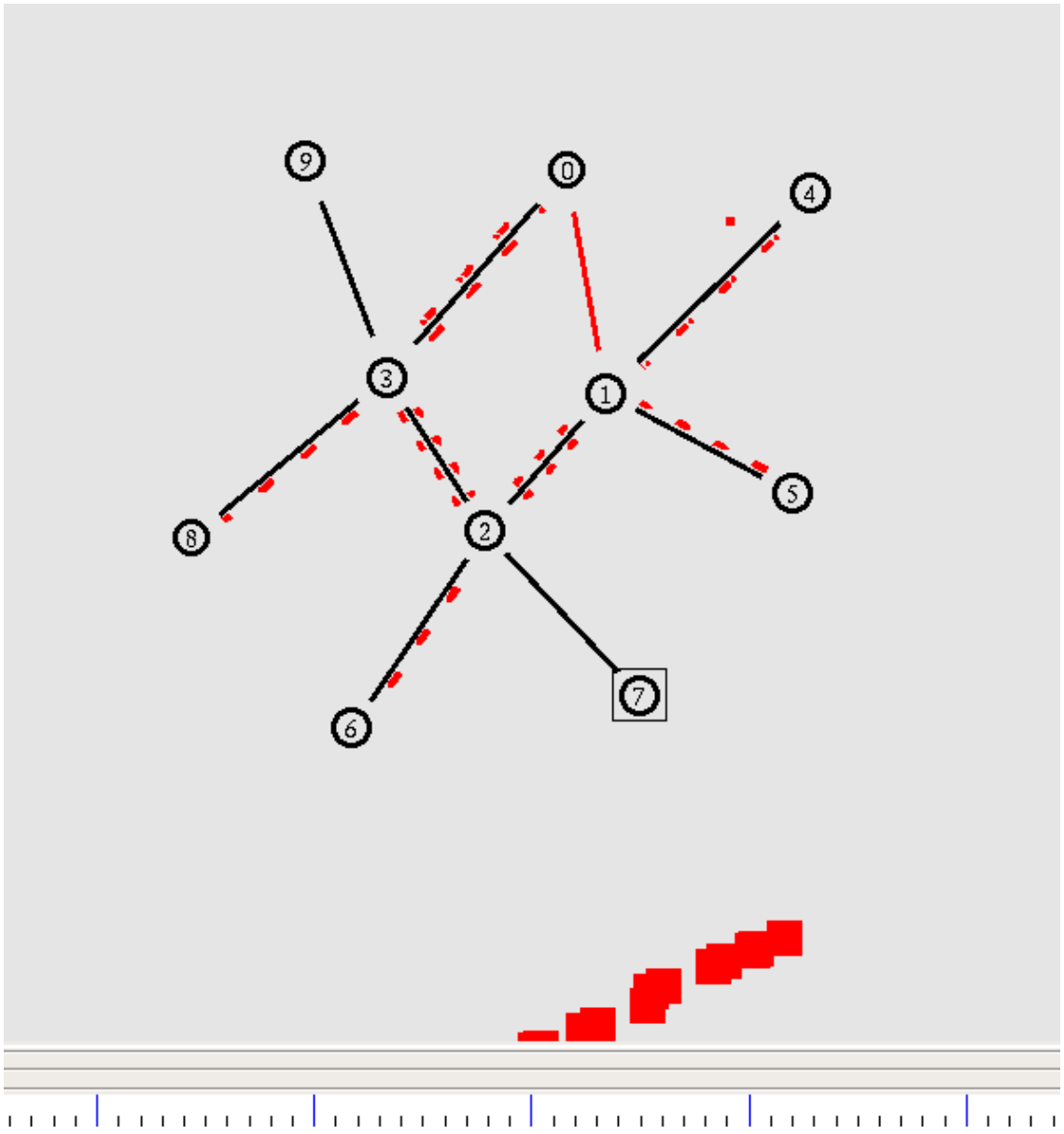
486666 B/s x 7 links = 3406662 B/s

and the badwith/capacity rate would be:

3406662 / 104857600 = 0.032488461 (We are using a 3.24 % of the network capacity for the multicast traffic).

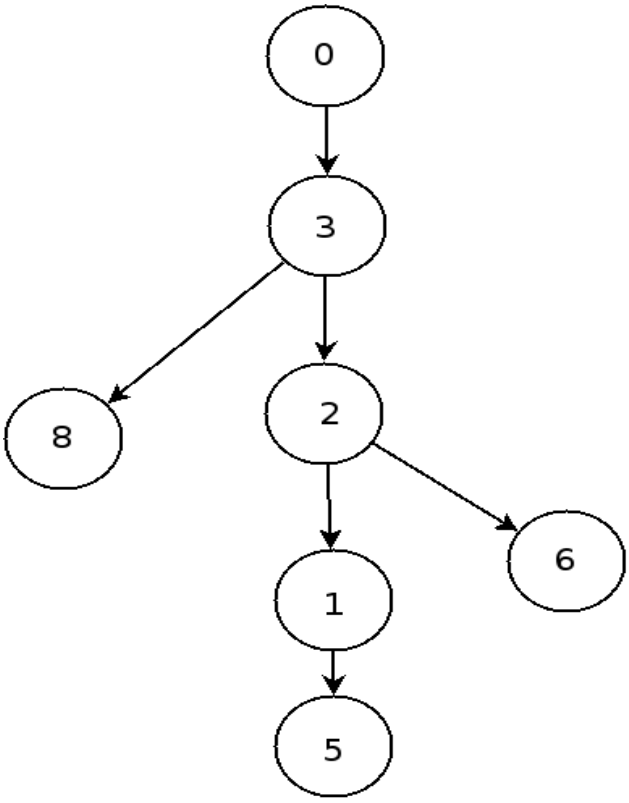
So the traffic would be reduced in 0.037129669 - 0.032488461 = 0.004641208 (a 0.46% less)

Task 5



Here we can see how the traffic is being sent to the sinks once the link is broken.

Multicast Tree:



Calculate bandwith:

The bandwith for one link is:

1460 B/ 0.003 s = 486666 B/s

We are using 10 links, but some of them (0-3,3-2,1-2) are used twice, therefore the bandwith used for the multicast network is:

486666 B/s x 10 links = 4866660 B/s

The capacity of one link is 10 Mb/s, therefore the capacity for the multicast network is
10Mb/s x 10 links = 100 Mb/s = 100 MB/s = 104857600 B/s

Therefore the bandwith/capacity rate is:

4866660 / 104857600 = 0.046412086 (We are using a 4.64% of the network capacity for the multicast

traffic).

Comparison with an unicast solution:

The unicast solution would use less links, but the source should keep more connections; so the bandwith support by the 4-1 nodes link would be overloaded because we would need 3 connections, and therefore 3 streams.
This is the advantage of the multicast solution: we have only one stream and the source server and its links are not going to be so overloaded.