IJCSC International Journal of Computer Science & Communication Vol. 1, No. 1, January-June 2010, pp. 143-147

Analysing Latency and Link Utilization of Selfish Overlay Routing

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ABSTRACT

In internet routing,hosts are allowed to choose routes.This is called selfish routing.Since hosts are allowed to choose routes themselves inefficiences arise there.Such selfish overlay are not based on system wide criteria.In this paper nash equilibria is used to achieve optimized system wide criteria.Source routing(Selfishrouting),Optimal Routing,Compliant routing are compared using the Queuing models say M/M/1,M/D/1,P/D/1,P/M/1,BPR. Latency and link utilization of all the three routings are analyzed.In all the above the latency is reduced and the link utilization is increased.

Keywords: Selfish Routing, Nash Equilibria, Queuing Model

1. INTRODUCTION

The interaction between overlay routing and Traffic Engineering (TE) in a single Autonomous System was worked out here. A twoplayer non-cooperative non-zero sum game, where the overlay tries to minimize the delay of its traffic and the TE's objective is to minimize network cost is formulated.[1]

The price of anarchy (*i.e.*, the worstcase ratio between the average latency of a Nash equilibrium and that of the global optimal) depends on the "steepness"of the network latency functions. It is showed that the price of anarchy is unbounded for a general latency function such as M/M/1. In contrast to the theoretical studies, here the study is focused on a practical setting by using realistic network topologies and traffic demands.[2]

The inefficiency of selfish routing motivates researchers to design strategies to reduce the cost of uncooperation. For example, Korilis, Lazar, and Orda and Roughgarden study a network with a mixture of selfish traffic and "centrally controlled" traffic. Roughgarden shows that it is NPhard to compute the optimal strategy for "centrally controlled"traffic (*i.e.*, a Stackelberg strategy), and gives a simple algorithm to approximate the optimal strategy in a network of parallel links with total latency no more than a constant times that of the minimum latency[3][4]

The route controller can change network routing to optimize overall network performance. In other words, it can perform traffic engineering. An MPLS-based route controller can directly adjust the routing matrix R. An OSPF-based route controller can adjust the weights of the physical links to influence network routing [5], [6].

Link latency functions play an important role in determining the effectiveness of selfish routing. In this paper they use five representative latency functions: M/M/1, M/D/1 P/M/1, P/D/1, and BPR.They also implement piecewise-linear, increasing, convex functions to approximate any other latency functions. In all latency functions, a term for propagation delay is included. [7][8][9].

2. PRESENT WORK

After applying the Nash equilibrium there is optimized performance i.e the latency is reduced and the link utilization is increased. By calculating the BPR latency we found out that the latency achieved is higher comparatively and the link utilization achieved was lower comparatively. So while implementing the NASH-equilibrium game theoretic approach we find that the latency was reduced and link utilization was increased. This topographic model was used to compare three types of routing namely source routing, optimal routing and compliant routing. Source routing results in selfish routing, since the source of the traffic makes an independent decision about how the traffic should be routed. The selfish routing scheme studied in most previous theoretical work is source routing. Optimal routing refers to the latency optimal routing; it models a scenario where a single authority makes the routing decision for all the demands to minimize the average latency. When we consider the load scale factor on the x-axis and the average latency on the y-axis which is measured in micro-seconds, we find that the latency for the compliant routing is the highest. We consider 10 nodes while the transmission of packets gets slower after some time and at node 5 there is a packet drop. After few milliseconds the route is cleared by searching the correct route or by repairing the node using the traffic models. Using M/M/I we have results in which the optimal has the highest link utilization and the source routing has the least link utilization. Using M/D/I optimal has the highest link utilization and the source routing has the least link utilization. The latency for the P/D/1 queuing model was calculated. Here the arrival rate is given by lamda, the mean of packet length and the maximum queue length is also specified.

3. RESULTS AND DISCUSSIONS:

Here in this graph the cross line represents the optimal routing, plain line represents the source routing and line with boxes represents the compliant routing.

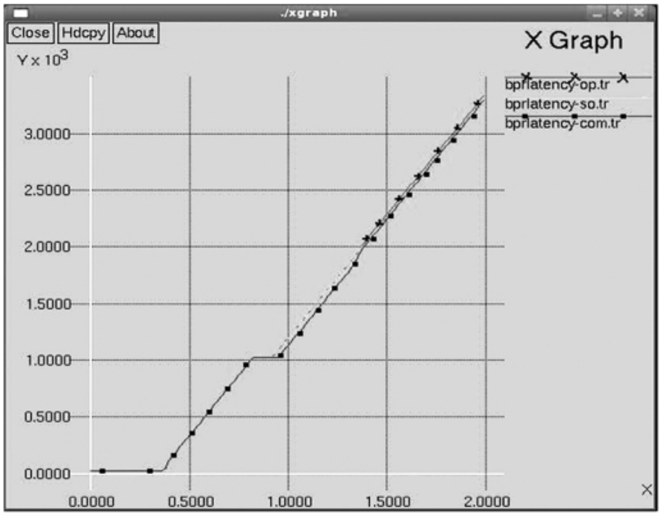

Fig1: Latency before Nash-equilibrium

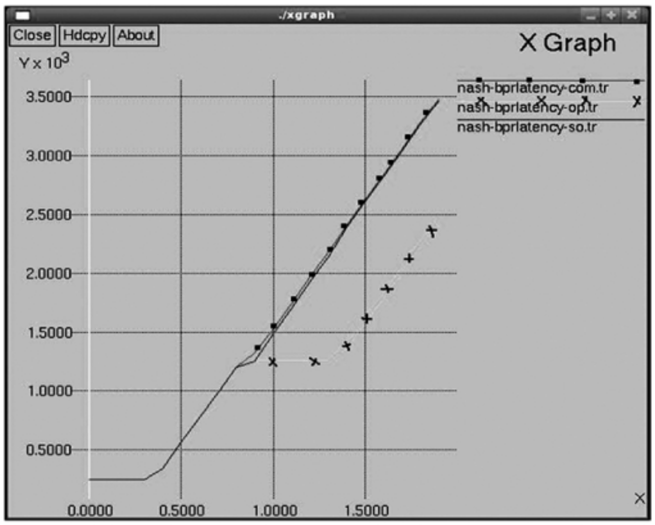

Fig 2: Latency after Applying Nash-equilibrium

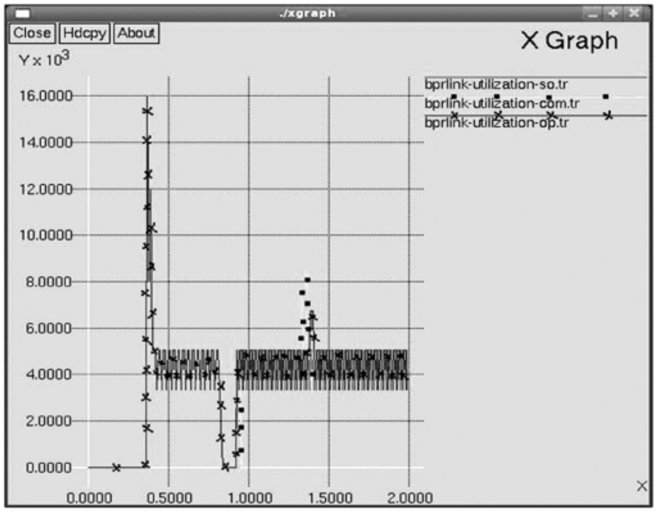

Fig3: Link Utilization before Nash

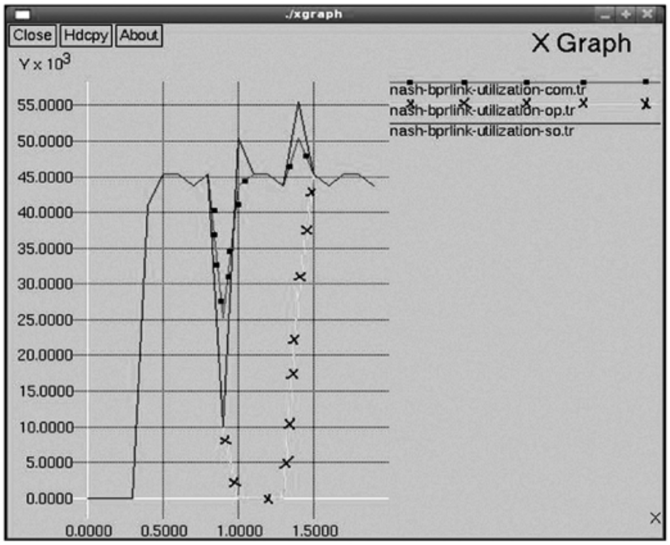

Fig 4: Link utilization after Nash-equilibrium

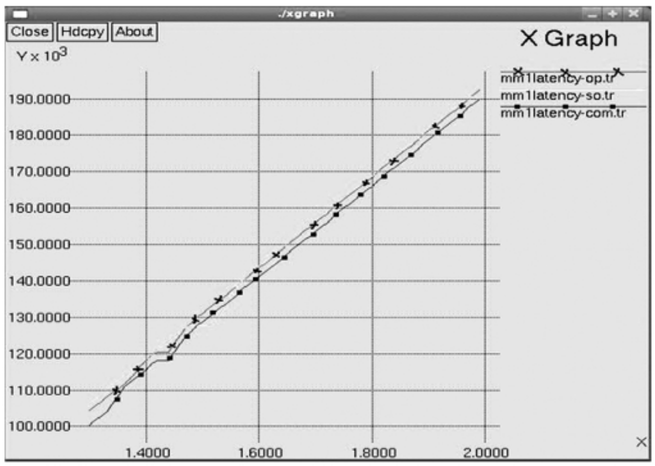

Fig 5: Latency before Applying Nash (M/M/I)

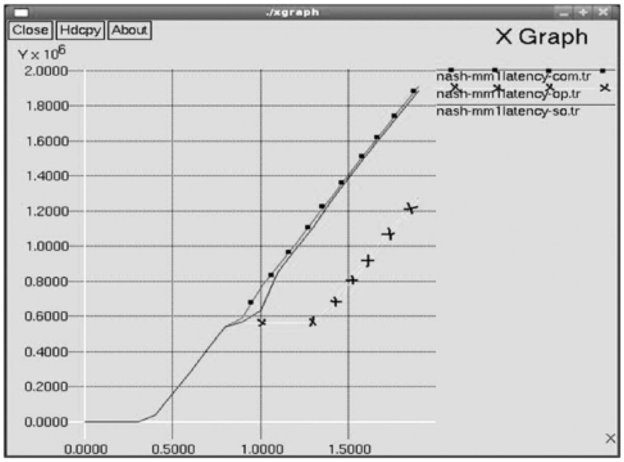

Fig 6: Latency after Nash-equilibrium

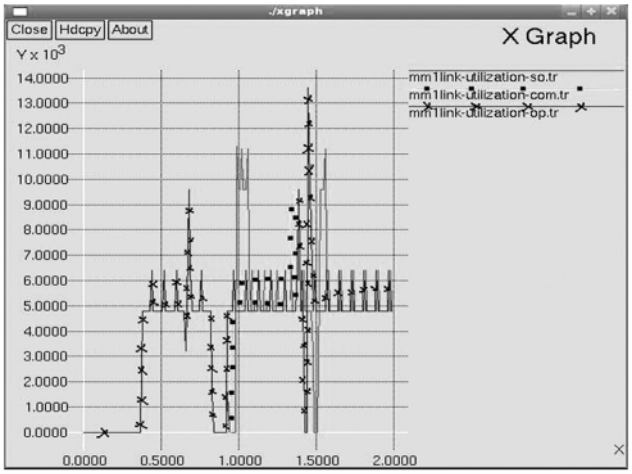

Fig 7: Link Utilization before Nash

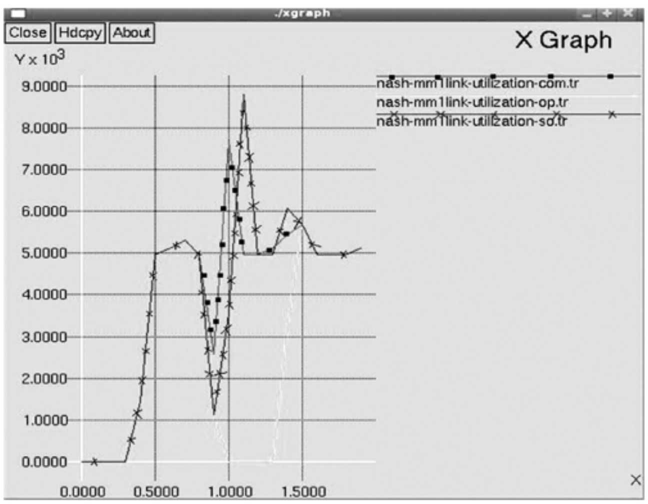

Fig 8: Link Utilization after Nash-equilibrium

M/D/I

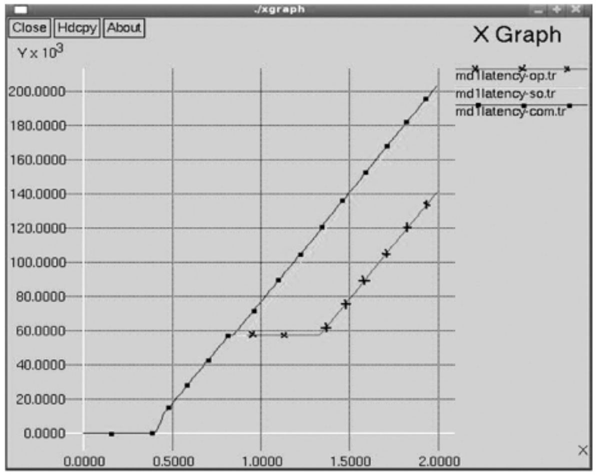

Fig 9: Latency before Nash-equilibrium

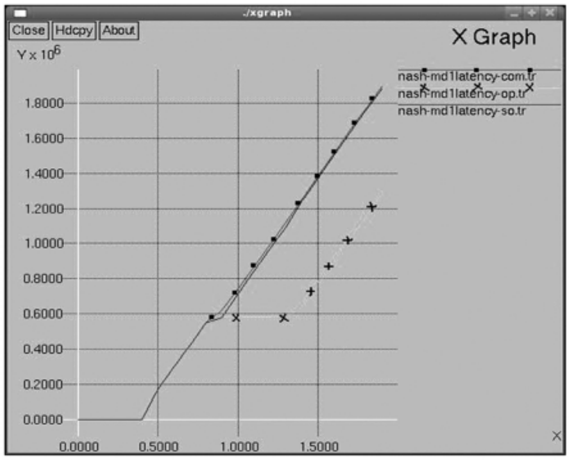

Fig 10(a): Latency after Nash-equilibrium

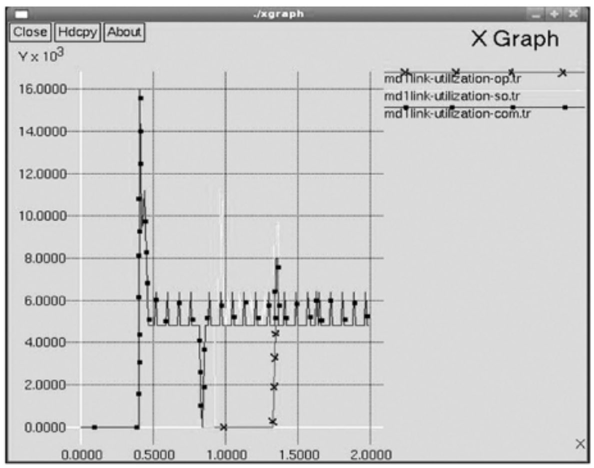

Fig 10(b): Link Utilization before Nash

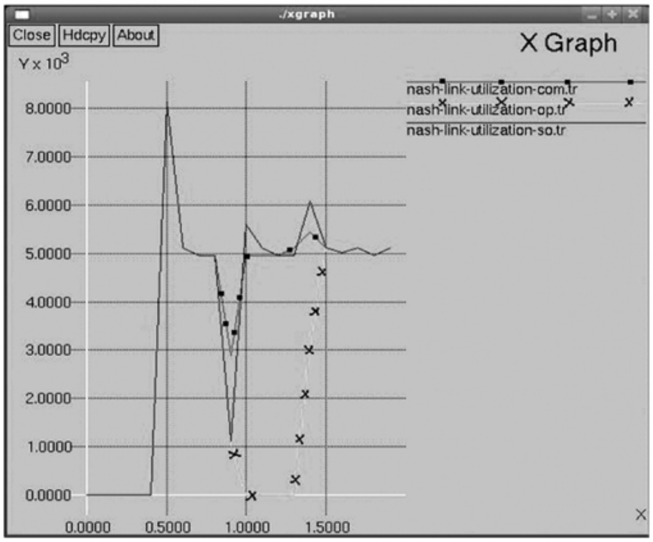

Fig 11: Link Utilization after Nash-equilibrium

P/M/I

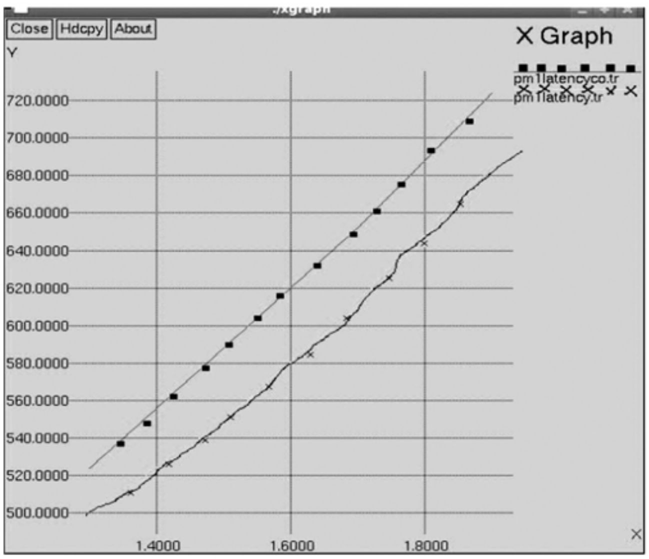

Fig 12: Latency before Nash-equilibrium

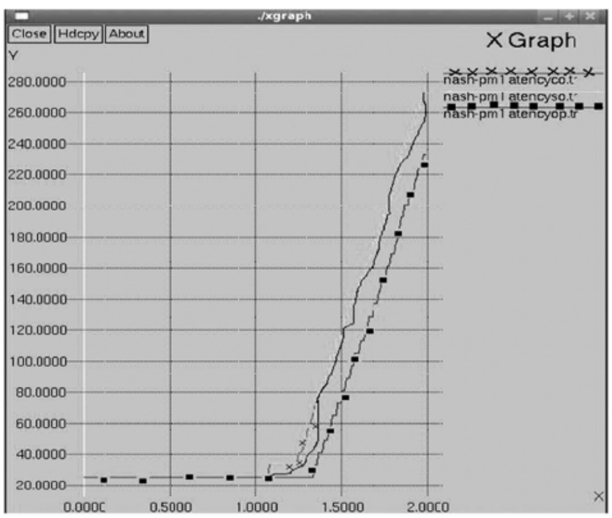

Fig 13: Latency after Nash-equilibrium

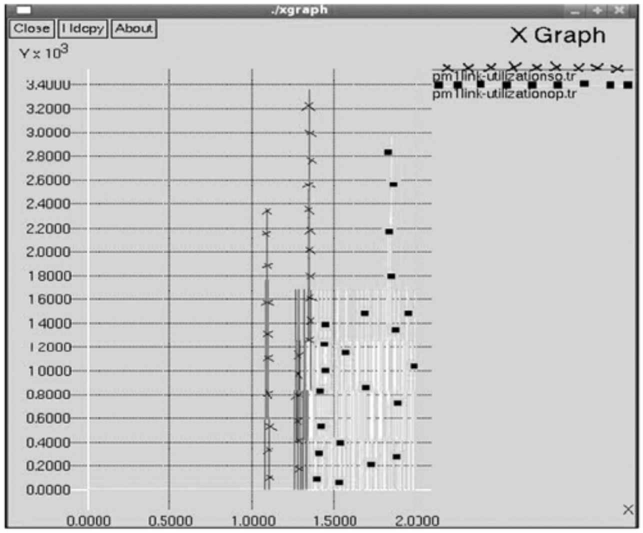

Fig 14: Link Utilization before Nash

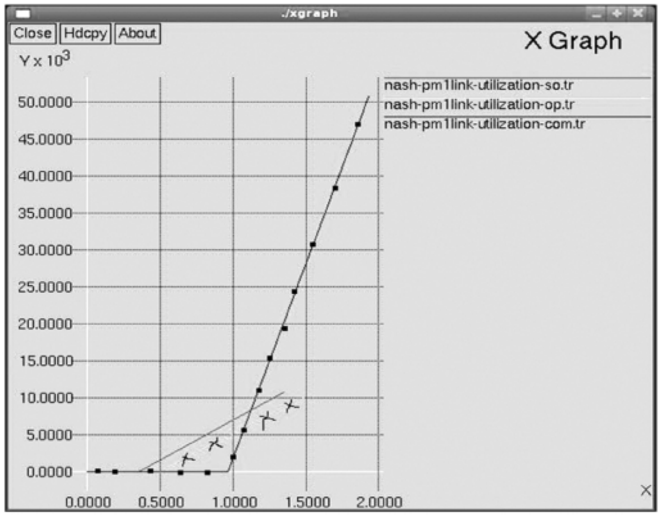

Fig 15: Link Utilization after Nash

P/D/I

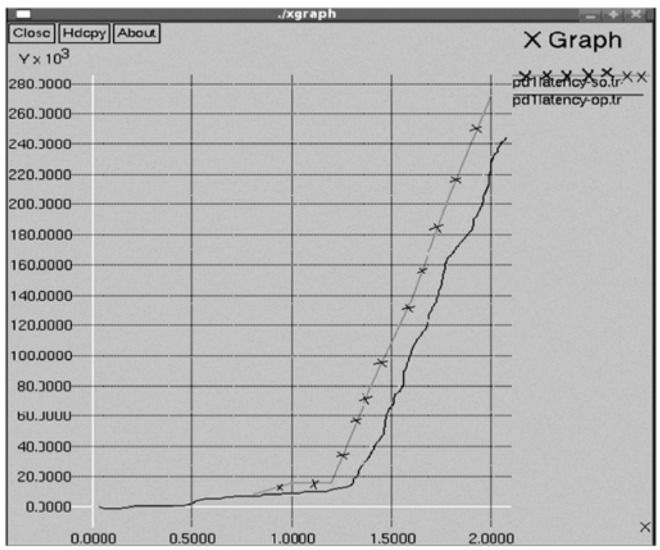

Fig 16: Latency before Nash-equilibrium

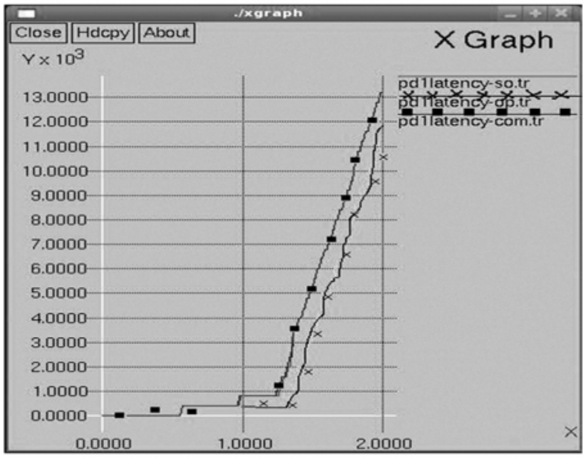

Fig 17: Latency after Nash-equilibrium

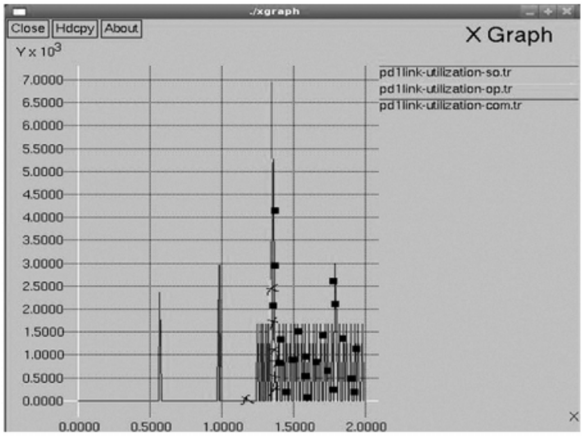

Fig 18: Link Utilization before Nash

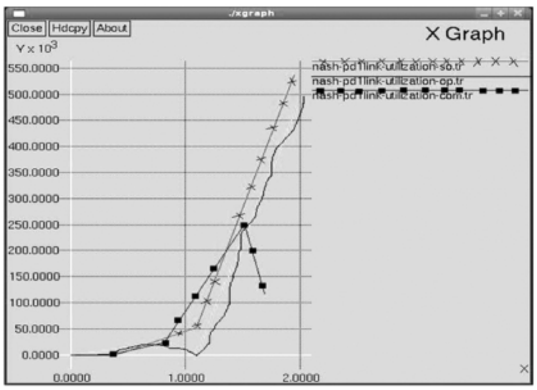

Fig 19: Link Utilization after Nash

4. CONCLUSION AND FUTURE WORK

Since hosts are allowed to choose routes themselves inefficiences arise there. Such selfish overlay are not based on system wide criteria. while implementing the NASH-equilibrium game theoretic approach we find that the latency was reduced and link utilization was increased.The latency and link utilization for the P/D/1,M/D/1,P/M/1,BPR for all the three routing schemes was calculated using x graphs with the TCL file. Eventhough the nash equilibria was used only the latency was decreased but not the link utilization. Increased link utilization may increase to congestion on certain links.So link utilization should be reduced in such a way that latency should also be optimized. The above said can be done as future work.

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