The performance parameters for the simulations are:

i. **Average packet delay:** is the average delay a packet experiences while being routed from source to destination.
ii. **Average throughput per packet:** is the average number of packets being forwarded by a node for the duration of the simulation.

During the simulations, FIFO Queues is used in the input and output buffers. A random link failure is introduced artificially in every 5 seconds in order to test the behaviour of the algorithm in problematic conditions. On detection of a failure SPR recomputed all its routes, whereas Q-Routing and DRQR chose an alternative route apart from the failed one. The failed link is restored after 4 seconds, while the shortest path algorithm recomputed its routes. However, Q-Routing and DRQR fail to restore the original learning policy for that link and recomputed it once the link is recovered.

VI. RESULTS AND DISCUSSIONS

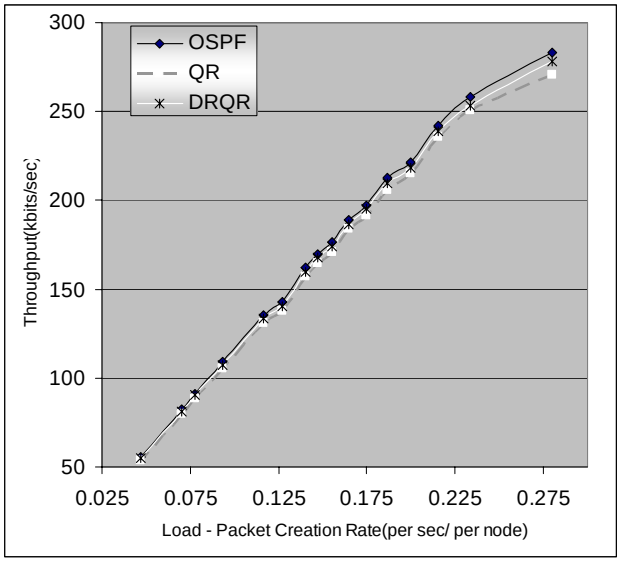

Figure4: Average packet delay versus system load (packet creation rate).

From fig. 4, it can be seen that as the system load increases average packet delay increases for all algorithms. Therefore, for Q-Routing algorithm, the delivery times are lower compared to the SPR and DRQR algorithms as it was expected. For example, when packet creation rate is around 0.3s Q-Routing algorithm delivers packets ~0.2s faster than others. This is because, at low loads the SPR algorithm ignores the bottlenecks and the failures in the network and floods the packets to the same shortest paths. However, Q-Routing and DRQR algorithms learn routing policy faster and routes packets over alternative routes to avoid congestion. However this deviation in the delivery time value remains low.

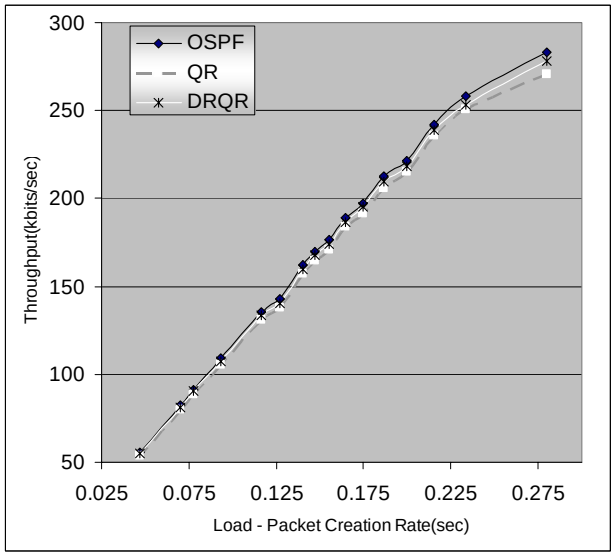

Figure5: Throughput versus system load (packet creation rate).

For the DRQR algorithm, the delivery time at high loads was reasonably high compared to Q-Routing, which can be accounted for the packet overhead, which makes the packet to carry the learning update along with the data. However, fig. 5 shows that in SPR throughput is higher compared to other two, as utilisation of the network is lower on Q-Routing and DRQR because of the learning messages.

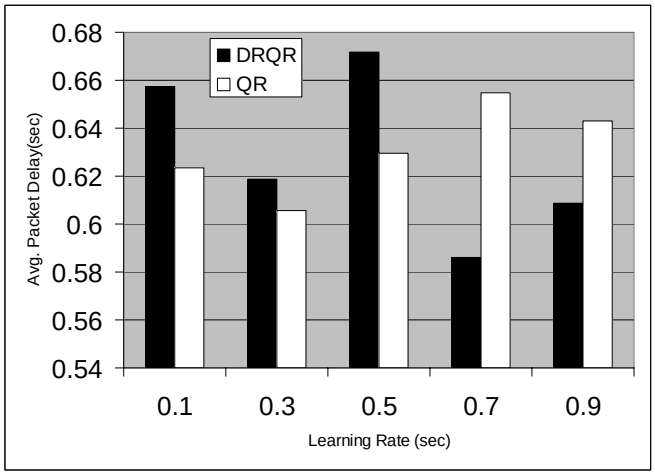

Figure6: Average packet delay vs. learning rate.