# Comparison of the Q-Routing and Shortest Path Routing Algorithms.

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**Abstract- In this paper, we compare the self-adaptive Q-Routing and dual reinforcement Q-Routing algorithms with the conventional shortest path routing algorithm. The Q-Routing algorithm embeds a learning policy at every node to adapt itself to the changing network conditions, which leads to a synchronised routing information, in order to achieve a shortest delivery time. Unlike Q-Routing, the shortest path routing algorithm routes the packets based on the link with the least delay irrespective of the traffic pattern on the link. Here simulations are carried out under problematic conditions by taking into account the node and link failures. Results show that the adaptive (learning) approach performed better than the traditional non-adaptive approach under problematic conditions.**

**Keywords:** Routing algorithm, Q-Routing, dual reinforcement Q-Routing, shortest path routing.

## I. INTRODUCTION

In today's fast growing Internet, traffic conditions changes and failures occur at some parts of the network from time-to-time, in unpredictable manner. Therefore, there is a need for an algorithm to manage traffic flows and deliver packets from sources to the destination in a reasonable time.

The process of transmitting packets from its source node *s* to its destination node *d* in a network is called *routing*. Usually packets can make many hops at the intermediate nodes on its way to its destination. At each node a packet is received, stored and then routed to the next hop until it reaches its destination.

Routing algorithms are classified according to their adaptability to the changing traffic patterns in the network as dynamic (adaptive) and static (non-adaptive) algorithms [1]. In case of non-adaptive algorithms, the routing decision is based on local information; hence, routing problem is distributed over the network. On the other hand in non-adaptive algorithms there is a need for a global knowledge which makes it hrder to adapt to the changes in the network.

Shortest path routing algorithm [2] is one such widely deployed non-adaptive routing algorithm that routes a packet based on Dijkastra's well-known shortest path algorithm. In this approach, packets arriving at a node take the same shortest path to a particular destination on the network. The main drawback of this approach is that it does not take into consideration the changes in the network's traffic dynamically. For example, queuing results in congestion in the intermediate nodes that results in packets being delayed before reaching the destination. In such cases, it would be advantageous to forward packets to alternative routes that may not be the shortest path, but can eventually result in shorter delivery time.

The routing algorithms that are in use lacks intelligence, they need human assistance and interpretation in order to adapt themselves to the failures and changes. However, introducing intelligence not necessarily improves the performance of the algorithm but it improves the adaptability to the changes in the network.

In the recent years, agent based systems and reinforcement learning have been widely applied to routing problems. This is due to the fact that these methods do not need any supervision and they are distributed in nature. Swarm intelligence particularly ant based systems; Q-learning methods and hybrid agent based distance vector routing algorithms have shown promising and encouraging results.

Here, the focus is on the Q-learning, which is a form of reinforcement learning. Q-Routing [3] is an adaptive routing algorithm that routes packets based on the learnt routing information from its neighbours. Initially this algorithm builds a routing table based on the delivery times[1] (Q values) of the packets to every node in the network. These delivery times are updated every time a node forwards a packet for a particular destination, changes depending on the traffic at a given time to the destination. Based on this information, a node can choose an alternative route when the queues are congested in the intermediate nodes, thus resulting in faster delivery, unlike shortest path algorithm. In this type of learning pattern, routing information is synchronised on all nodes in the network. Bandwidth utilisation of this algorithm

[1]The delivery time for a packet is the time difference of the time the packet is introduced in the network and the time it reached its destination.