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Comparative Study of Different Routing Algorithms for Efficient Networking

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Abstract: ***In every network the main aim of designing protocols is to have more efficient and less energy consumption. Many different ideas have been developed and presented for the Dynamic Routing, out of which some are comparatively more efficient. In this project we are trying to implement three different shortest path routing algorithms like: Dijkstra's, Adaptive Routing & ACO (Ant Colony Optimization), by keeping some significant condition and analyze the properties of each in different topologies. Also, to present and report about the most efficient protocol for a desired network topology.***

Keywords: Clustering, Dijkstra's, Adaptive routing, Ant Colony algorithm, Blocking Probability, Simulation time.

1. Introduction

Over the past several years, the volume of Internet traffic has continued to grow rapidly. Bandwidth-intensive networking applications, such as video-on-demand, IP telephony, and file sharing using peer-to-peer network technology, consume a large amount of network capacity, putting much pressure on the network. This growth of Internet services and users has meant that arise the demand for quality of service (QoS) on the infrastructure of communications networks. This QoS is directly linked to factors such as low delay in transmission, high bandwidth available, high availability and low blocking probability. The Wavelength Division Multiplexing networks has achieved increasing acceptance as mean of transport for the promising traffic of the Internet and other sources that such need characteristics of quality, due mainly to their physical characteristics.

The growth of technology leads to increase in the usage of internet which leads to internet traffic so the optical networks are gaining higher prominence. The rest of the paper is organized as follows: Section II gives an insight on clustering. Section III details LEACH protocol. Section IV gives an overview on the proposed protocol .Section V gives the simulation results and analysis. Finally section VI VII gives concluding remarks and future works.

2. Objective

The main objective of the project is that we are going to reduce the amount of blocking probability in RWA by using certain methodologies in all optical networks.

The factors we are taking into consideration are:
- To find the topologies used in the network.
- Routers will keep on updating about their neighboring nodes.
- We use Dijkstra's, Adaptive shortest path algorithm and Ant colony algorithm.
- To find the shortest path in the network from source to destination.
- With the router's information shortest path in the network will be considered.
- Calculate the cost of the path in order to consider the shortest path.
- To choose best shortest path from source to destination, for specific type of network.
- Simulated results are taken for Dijkstra's, Adaptive shortest path and Ant colony algorithm.
- Reduction of blocking in the network is compared and verified.
- Reduction of delay time of the packet in the network is compared.
- At the end it will find and choose the best shortest path having less distortion depending on the topology.

3. Dijkstra's Shortest Path Algorithm

Dijkstra's algorithm is an algorithm for finding the shortest paths between nodes in a graph, which may represent, for example, road networks. It was conceived by computer scientist Edsger W. Dijkstra in 1956 and published three years later. Dijkstra's original algorithm does not use a min-priority queue and runs in time O(|V|2) (where|V| is the number of nodes). The idea of this algorithm is also given in Leyzorek et al. 1957. The implementation based on a min-priority queue implemented by a Fibonacci heap and running in O(|E|+|V|log |V|) (where |E| is the number of edges) is due to Fredman & Tarjan 1984.

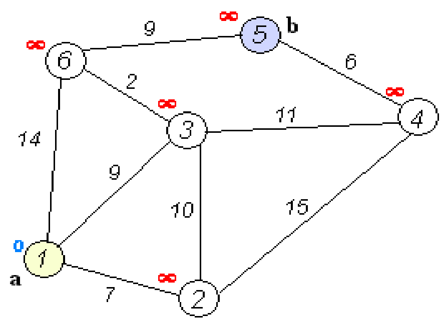


Figure 1: Dijkstra's Network Solution

A. Operation

Let the node at which we are starting be called the initial node. Let the distance of node Y be the distance from the initial node to Y. Dijkstra's algorithm will assign some initial distance values and will try to improve them step by step.

1) Assign to every node a tentative distance value: set it to zero for our initial node and to infinity for all other nodes.
2) Mark all nodes unvisited. Set the initial node as current. Create a set of the unvisited nodes called the unvisited set consisting of all the nodes.
3) For the current node, consider all of its unvisited neighbours and calculate their tentative distances. For example, if the current node A is marked with a distance of 6, and the edge connecting it with a neighbour B has length 2, then the distance to B (through A) will be 6 + 2 = 8.
4) When we are done considering all of the neighbours of the current node, mark the current node as visited and remove it from the unvisited set. A visited node will never be checked again.
5) If the destination node has been marked visited (when planning a route between two specific nodes) or if the smallest tentative distance among the nodes in the unvisited set is infinity (when planning a complete traversal; occurs when there is no connection between the initial node and remaining unvisited nodes), then stop. The algorithm has finished.
6) Select the unvisited node that is marked with the smallest tentative distance, and set it as the new "current node" then go back to step 3.

4. Adaptive Shortest Path Algorithm

We are going to find the improved performance of blocking probability in optical networks. In this algorithm first we find the number of shortest paths from the wavelengths available in that we choose the best path for transmission of data from source to destination, so that it will reduce the blocking probability in the network.

- Total number of data packets we have taken in terms of wavelength .
- We have taken 14 nodes in random topology.
- This algorithm is used to solve the RWA problem in optical networks.
- It will check the total data sent through the best path and received at the destination.
- Simulation is performed to show the results of reduced Blocking Probability

A. Algorithm

1) It will create the nodes and define their positions in the program.
2) Number of wavelengths available in the channel will be defined.
3) Define source and destination nodes in the chooses network.
4) If the source and destination nodes both are equal it will go back to the previous step to again define them. If they are not equal it moves to next step.
5) This algorithm will find and calculates all the available paths in the choose network.
6) It will take the help of Dijkstra's algorithm to find the shortest path in the network.
7) It will allot new wavelength for best defined path.
8) It will check for data transmission through that best path so that there should not be loss of data.
9) If the data transfer is succeeded it will count and calculate the total number of data transferred through that network.
10) If it is failed it will count for total number of data failed through that link and it will go back to allot new wavelength.
11) If the data transferred through the path is equal to data received in the destination it will check for round value=0.
12) After verification of round value is succeeded it will display the output or else it will go back again to define source and destination, by that the blocking probability will be reduced by using the best path.

5. Ant Colony Algorithm

Ants communicate to one another by laying down pheromones along their trails, so where ants go within and around their ant colony is a stigmergic system. In many ant species, ants walking from or to a food source, deposit on the ground a substance called pheromone. Other ants are able to smell this pheromone, and its presence influences the choice of their path, that is, they tend to follow strong pheromone concentrations. The pheromone deposited on the ground forms a pheromone trail, which allows the ants to find good sources of food that have been previously identified by other ants. Ant behaviour is shown in Fig. 2. Using random walks and pheromones within a ground containing one nest and one food source, the ants will leave the nest, find the food and come back to the nest. After some time, the way being used by the ants will converge to the shortest path.

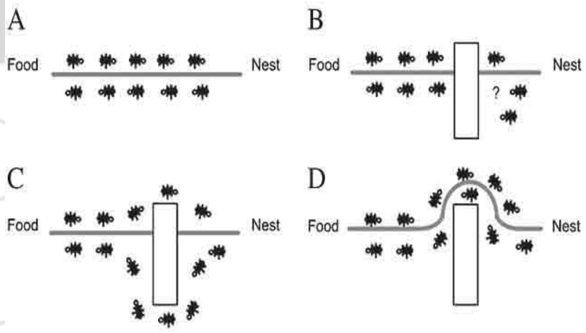


Figure 2: Ant Behaviour

A. Algorithm

At each stage, the ant chooses to move from one city to another according to some rules:

- It must visit each city exactly once;
- A distant city has less chance of being chosen (the visibility);
- The more intense the pheromone trail laid out on an edge between two cities, the greater the probability that that edge will be chosen;
- Having completed its journey, the ant deposits more pheromones on all edges it traversed, if the journey is short;
- After every iteration, trails of pheromones evaporate.

6. Simulation and Results

A. Hardware requirements

- Processor : Any processor above 128 MB
- Storage : Above 200 GB Hard Disk
- Ram : 1 GB

B. Software requirement

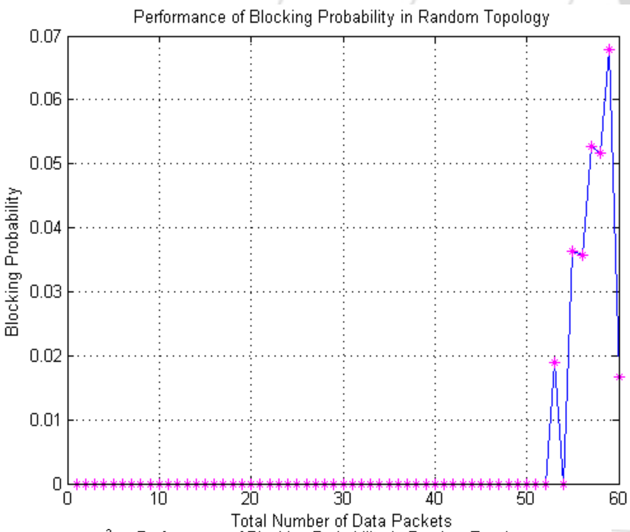
*MatLab

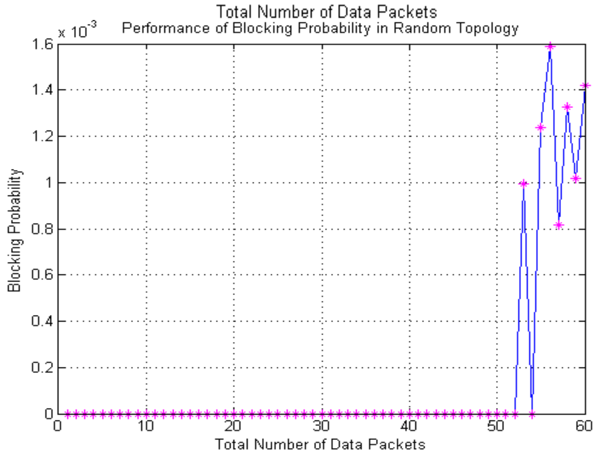
C. Assumptions

- The network we have taken is of random type.
- For that network we have taken the input to be in terms of multimedia data i.e., data packets. .
- We have used that random topology for All-optical networks.
- The number of available wavelengths which are going to get will be maximum at certain stages.
- Wavelength will be allotted for every transmission depending on the availability and requirement of the node.
- Each and every wavelength has different wavelengths in the network.

7. Random Network

Blocking Probability Analysis





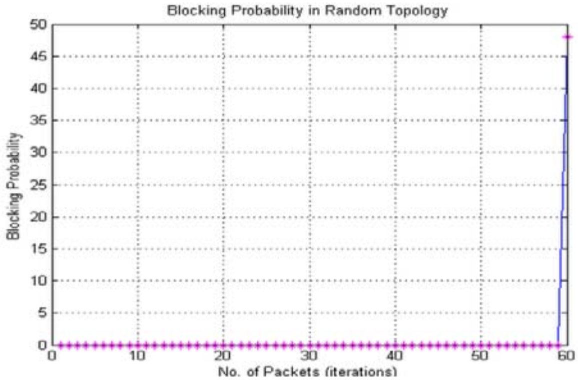
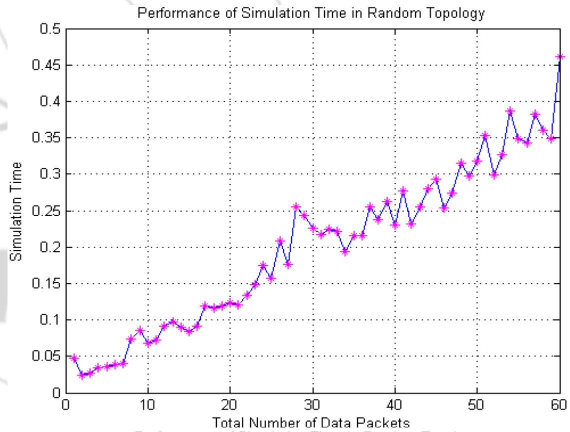
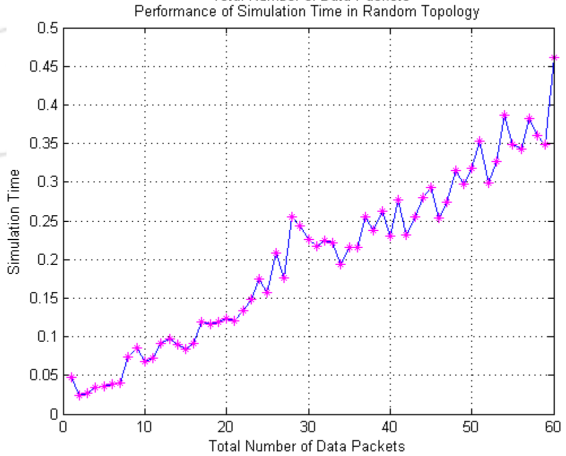


Figure 3: Performance of blocking probability in Random Topology for Dijkstra's, Adaptive Routing and ACO Respectively

According to the above graph there is no blocking till 50 for Adaptive routing and after that blocking probability increases slowly. The amount of blocking probability is high in Dijkstra's rather than Adaptive shortest path algorithm as the Dijkstra's find only the shortest path but Adaptive will choose the best shortest path so the blocking probability will be less.

Simulation Time Comparison





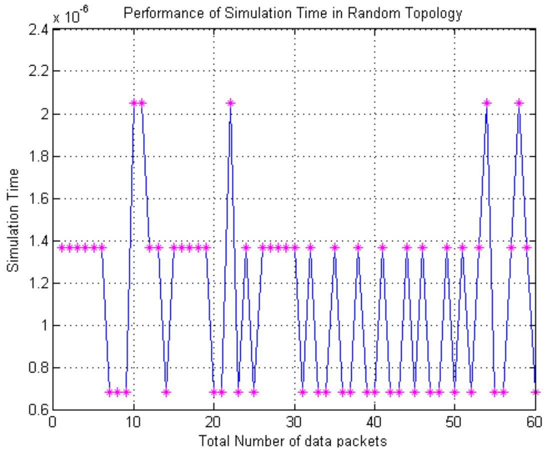


Figure 4: Simulation time of Dijkstra's, Adaptive Routing and ACO Respectively in Random Network

8. Tree Topology

1. Blocking Probability Comparison

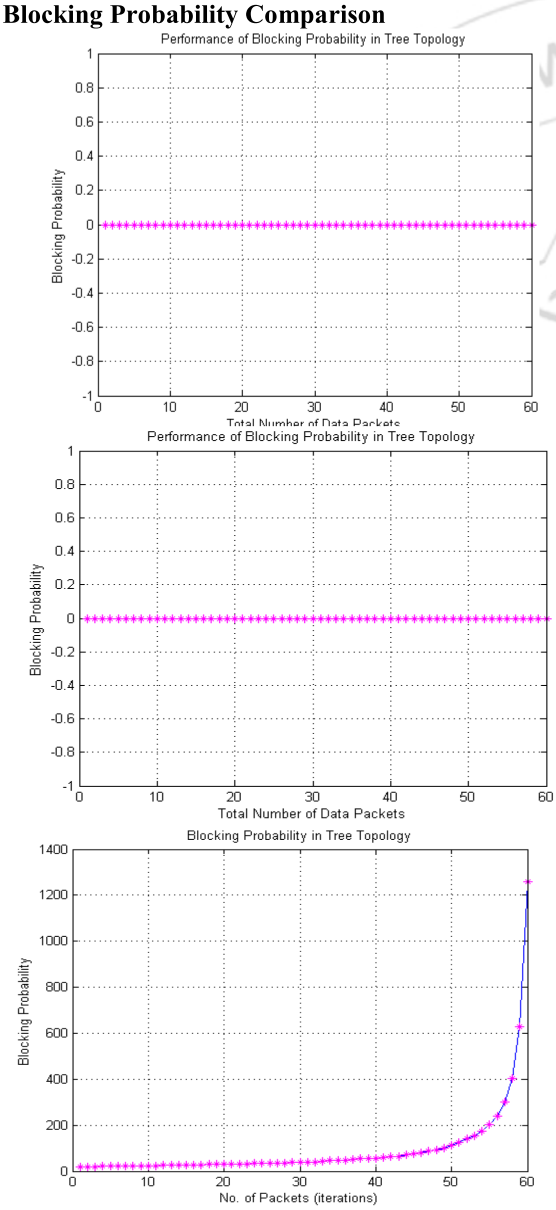


Figure 5: Performance of blocking probability in Tree Topology for Dijkstra's, Adaptive Routing and ACO Respectively

As we can see even if the number of packets increased there will be no blocking probability in both of the Dijkstra's and Adaptive shortest path algorithms. But when we observe the variations in the ACO, it shows that the ACO is not efficient for the network like tree. Tre network is a semi-constant network, where the path is always defined and there is no different path for communication. Dijkstra's is said to be the most efficient routing algorithm for the Tree Network.

2. Simulation Time

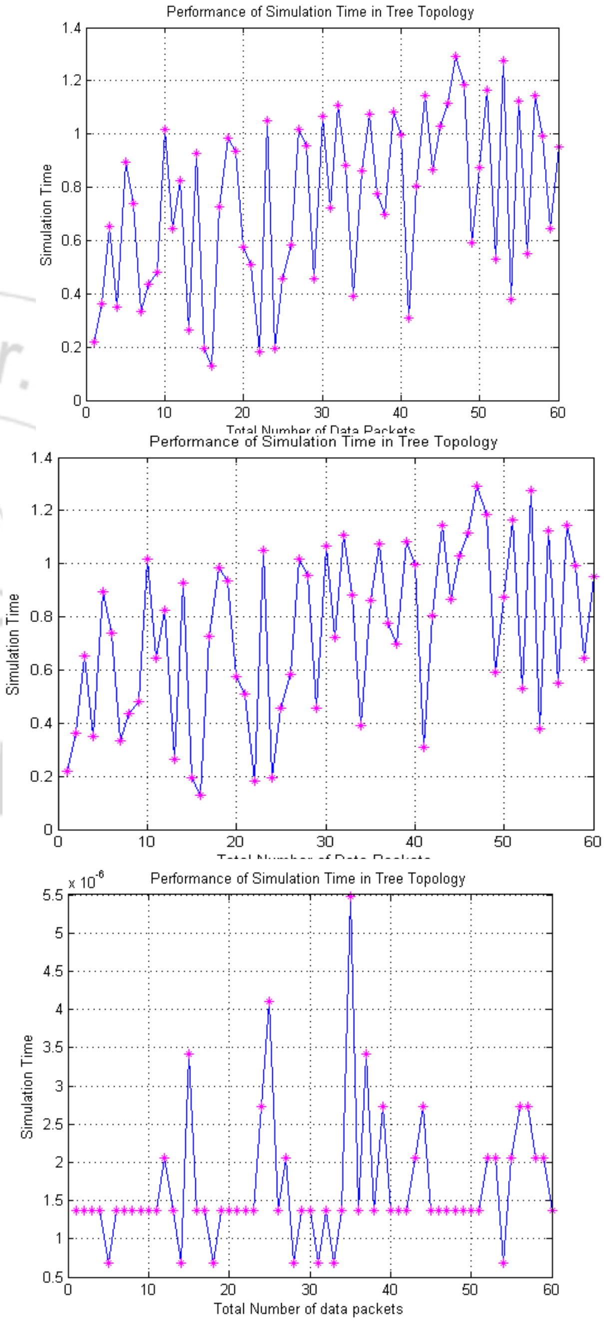


Figure 6: Simulation time of Dijkstra's, Adaptive Routing and ACO Respectively in Tree Network

It is similar to Random topology where it won't wait for free wavelengths to get allocated but it will jump to other node until it get free wavelength.

From the above graph we can see that the number of available wavelengths varies at certain stages or levels.

9. Conclusion

In our project we use the concept of three different routing algorithms: Dijkstra's Shortest Path Algorithm, Adaptive Routing and Ant Colony Optimization. This study shows its own disadvantages and advantages for different topologies. We know all these protocols play an important role in routing, but they do have some lapses with respect to that of the topology in which they are used.

For a random network, Dijkstra's algorithm seems to be less in its efficiency when compared to that of the other two. Even the Adaptive Shortest Path Algorithm is slightly inefficient when we have Ant Colony Algorithm. ACO finds the best shortest path and reduces the blocking probability in the network when compared to Dijkstra's algorithm and Adaptive Routing.

In the same scenario, if we observe the performance of these protocols in a tree topology, the result is totally different. Since, tree topology come us with a fixed line of communication and there is no need of rerouting, Dijkstra's algorithm seems to be more efficient. Dijkstra's algorithm is having lesser number of processing time and steps when compared to that of the other two algorithms, which makes that the best for the tree network.

Meanwhile, when we consider the ring topology, we observe a different result, Adaptive has less blocking probability but is not linear. But the response of the ACO is very linear and seems to be more consistent. Depending on the number of nodes in the network, we may have to choose between the Adaptive and ACO for a ring network. Dijkstra's algorithm has the large blocking probability, so it is totally kept out of the discussion.

We have made proper comparison of three protocols in three different networks, and has note of the best suitable protocol for all the specific networks.

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