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ALLPATH: ALL PATH ROUTING ALGORITHM IN WIRED NETWORK

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Abstract *In computer network, to transfer the data from source to the destination there must be a known path which is calculated by the router on network layer by the process of routing. There are two types of routing Unipath and Multi path. In Wired network OSPF is used of unipath routing and extension of OSPF is used for multipath routing like edge disjoint or node disjoint but in wired network there is no algorithm which can calculate all the path in the network. To overcome this problem this paper proposed AllPath Algorithm which will find out all the paths in network*

Keywords: *Routing, Unipath, Multipath Routing, AllPath Routing*

Introduction

In Computer networks many computers are connected through wires or wireless to share the information or resources. The data is shared between the computers or devices in the form of packets. Earlier the devices were connected in point to point topology, so there is no need of routing. But now devices are connected in multipoint topology, so the packet needs the path from the source to the destination. When data transfer takes place, the data packet must know a path from source to the destination. The calculation of path in network is done by a router. The router is a device that place between at least two networks to get the path according to the current situation of the network. When a packet has many paths to reach their destination, the router selects best path according to the condition through which packet will flow. This selection process is termed as Routing. A router is always configured with some default route. A default route tells the router where to forward a packet if there is no route found for specific destination. To find out the paths router has to maintain a database that is known as routing table [1], [2].

On the basis of number of routes there are two types of routing:

Unipath routing: In unipath routing, there is only one path is selected to send the data from source to destination. The advantage of unipath routing is the selected path is best in specific conditions. The disadvantage of unipath routing is traffic congestion, less reliability. The best algorithm used to find unipath routing is OSPF. As its name implies Open shortest path first, it is a link state routing and it can be used without paying a single penny. This protocol implements Dijkstra's algorithm to find out the route. Dijkstra's algorithm finds out the shortest path which calculates the path which has lowest cost in the specific circumstances [3].

Multipath routing: The way to overcome this problem is to find out multiple paths. Traditionally multiple paths was used only as a backup path. If the primary path has any problem like link failure only then the alternate path was

used. No parallel utilization of path is performed. That was implemented only on the stationary traffic. Advantages of finding multiple path are increase in reliability, increase in fault tolerance. According to different algorithm different multiple paths are achieved but not all paths will get. There is probability the find paths are not effective in all condition. Multipath routing was first proposed by Maxemchuk to divide the load between source and destination in packet switching network. The method was shown to distribute load among several path that increase the overall utilization of network and decrease in delay, better performance and so on. After that the multipath routing is implemented on different network like ATM, B-ISDN etc. But through multipath routing some path are remained unknown. To use those path or increase the efficiency of routes all path routing can be used [4], [5].

Multipath Algorithm Based on Dijkstra's Algorithm:

The above protocol of multipath find the joint paths means they have common nodes or edges, that leads to overhead on the common edge or node if we use those path. There are two disjoint path finding algorithm are Suurballe's algorithm (for finding node-disjoint paths) Bhandari's algorithm (for finding edge-disjoint paths) [6].

i) Suurballe's Algorithm: This algorithm is used for finding node-disjoint paths. Node-disjoint paths means there is no common nodes between any two paths except source and destination [7].

Node-Disjoint Shortest Pair Algorithm:

1. Find a first shortest path.
2. Replace each edge of the shortest path with a unidirectional edge directed towards the source and with its metric made negative.
3. Split the intermediate nodes N of the shortest path into two nodes N′ and N″ with the following edges:
   - connect N′ with the (outgoing) unidirectional edge towards the source
   - connect N″ with the (incoming) unidirectional edge directed from the destination towards N
   - connect N′ and N″ with a unidirectional edge with metric = 0 directed from N″ towards N′
4. Split the edges between the intermediate nodes N of the shortest path and their neighbors into two unidirectional edges with corresponding metric:
   - connect N′ with the (incoming) unidirectional edge from the neighbor towards N
   - connect N″ with the (outgoing) unidirectional edge towards the neighbor
5. Find a second shortest path on this modified network topology.
6. Transform edges and split nodes back to original network topology.
7. Delete edges common to both found shortest paths and regroup remaining edges to shortest pair of node-disjoint paths.

ii) Bhandari's Algorithm: This algorithm is used to find out the edge disjoint path. In edge disjoint path there is no common edge between the calculated paths [7].

Edge-Disjoint Shortest Pair Algorithm:

1. Find a first shortest path.
2. Replace each edge of the shortest path with a unidirectional edge directed towards the source and with its metric made negative.
3. Find a second shortest path on this modified network topology need a **modified Dijkstra's Algorithm** that can handle loop-free directed negative edges.
4. Transform edges to original network topology (bidirectional and positive metric)
5. Delete edges common to both found shortest paths and regroup remaining edges to shortest pair of edge-disjoint paths.

Related Work

Refer to the reference algorithm founds out multiple paths between every source and destination pair that was not necessarily loops free every time. This routing algorithm was designed around a set of loop-free invariant conditions and uses inter-nodal synchronization that span no more than one hop. Using simulations, the performance of the routing algorithm, in terms of control message problem and concurrence times, was compared with other algorithms. The multiple next-hop choices that MPATH made available at each node could be used for traffic load-balancing and minimizing delays in the network. [8]

Multipath algorithm implemented the idea to transfer the packet to viable next hop that will not necessarily the part of the shortest distance. To maintain the next viable hop that used a data structure to maintain the next hop list. That algorithm was mainly use for the link failure. In case there is any link failure occurred that would give the alternate path. [9]

Node disjoint routing algorithm is used as the extension of OSPF algorithm. This algorithm uses the Dijkstra algorithm for finding the shortest path and stores it. The node containing in shortest path are removed with their link and then again Dijkstra algorithm is applied to get the alternate path. The problem with this algorithm is that mostly after two or three paths the network becomes disconnected. And the path chosen by this are not sure minimum cost path. To overcome this Suurbelle Algorithm is used. [7]

In computer networks, the data is transfer in the form of packets. To transfer a packet, there must be a known path. Traditionally single path routing algorithms were used. But that increases traffic load on that link and in case that path breaks down due to any reason then complete communication will stop. Multipath routing may be an alternate of this solution. There are so many multipath routing algorithms like edge disjoint or node disjoint. Through every multipath routing some specific paths are found out, so some path are still unused. So all path routing is used from which all path are find out, due to which efficiency of link increased and utilization of all links also grown up [11]

Problem Formulation

The most commonly used routing Protocol is OSPF, which implements the Dijkstra algorithm to find the shortest path. The advantage of OSPF is there is no hop limit and due to using of shortest path the use of resources are less as compared to another path, but the main problem with OSPF is single path routing that leads to increase in delay, traffic congestion and less reliability. To overcome this problem various multipath routing algorithms are considered like MOSPF, PIM, and CBR. But the problem with these protocols is they find the joint path due to which the joint area like node or edge gets overhead. To overcome this problem Suurballe's algorithm [7] and Bhandari algorithm [7] are taken. Suurballe's algorithm uses node disjoint algorithm, in which no common node between any two paths. And Bhandari's algorithm implements edge disjoint algorithm,in which there is no common edge between the calculated paths. But the problem with these algorithms is after finding some paths the graph becomes completely disconnected due to which no more paths can't be found out. In each case some paths are not finding out. Due to which there is no complete utilization of the network. In this paper, we explain All Path routing algorithm which finds out all the possible paths in the network that leads to complete utilization of the network.

Proposed Work

This paper presented All Path Routing algorithm which calculates the entire possible paths in the network. The advantage of all path routing algorithm is the identification of all possible paths in a network that may provide an option for existence of alternate paths as well as the availability of multiple paths for sharing of load. The all path routing used the traditional approach of node to node routing means that one node sends the data to its adjacent node only, now it will depend upon the current node what will be the next node. To implement all path routing algorithm routers must have global information about the topology.

Description: The input of the algorithm is a graph or adjacency matrix. Adjacency matrix is efficient in case of large network. From the adjacency matrix the adjacency list of every node is created. After the creation of tree takes place in which source is taken as root and the node which are adjacent to the root are taken as the child of the root. This process is in continued until child is not equal to the destination. If the child is not equal to the destination further the node which are in adjacent list are taken as the child of that child. The only limitation is that any node can't be its own child or grandchild or so. This limitation is only to remove the loop from the path. To do so we use a visited strategy. When a node from a adjacency list is visited that color is changed in the adjacency list. The color of unvisited node is taken as black and the color of visited node is taken as white. So if the color of node is white in that case that node will not be taken as the child again. After completion of the tree traverse the tree from the root to the destination child.

Flow Diagram

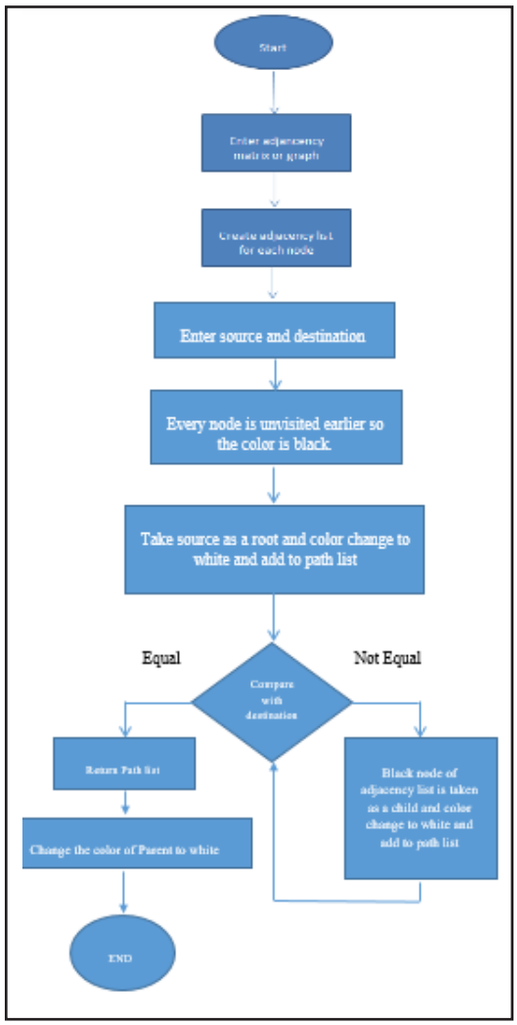

Fig. 1: Flow Diagram of all Path Routing Algorithm

Example:

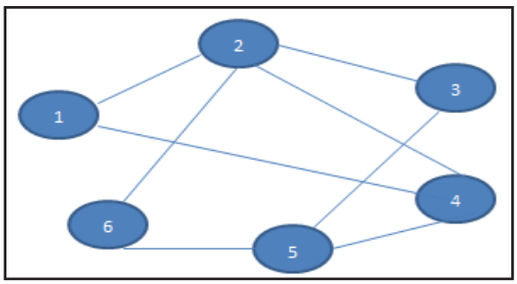

Fig. 2: Example Network

This is a network in which 1 is source and 4 is destination. To understand the complex graphs create the adjacency matrix of the graph. If there is link between any two nodes then the corresponding value in matrix is non zero.

M =

	1	2	3	4	5	6
1	0	1	0	1	0	0
2	1	0	1	1	0	1
3	0	1	0	0	1	0
4	1	1	0	0	1	0
5	0	0	1	1	0	1
6	0	1	0	0	1	0

Tree Formulation:

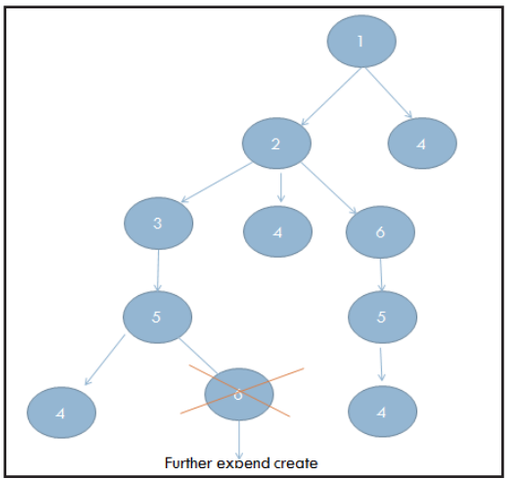

Figure 3 Formulated Tree

Figure 4.3 Shows the formulated tree from algorithm in which source is taken as a root and every node is expanding with their adjacent node as a child until the child node is not equal to destination. In this 6 is not expand because adjacent node of 6 are 2 and 5 in figure 3.2, which are parent of 6 in figure 3.3. if we expand 6 with child 2 and 5 this will create a loop.

The Possible path for that network:

$1 \rightarrow 4$

$1 \rightarrow 2 \rightarrow 4$

$1 \rightarrow 2 \rightarrow 3 \rightarrow 5 \rightarrow 4$

$1 \rightarrow 2 \rightarrow 6 \rightarrow 5 \rightarrow 4$

There is no possibility of more than above paths. The packet can choose any path from them according to their requirements.

RESULTS

All Path routing algorithm has been implemented on Matlab R2009a for identifying all the possible path in graph and total time of execution for various number of nodes.

Firstly, we use the network which is in as example in Figure 4.2.

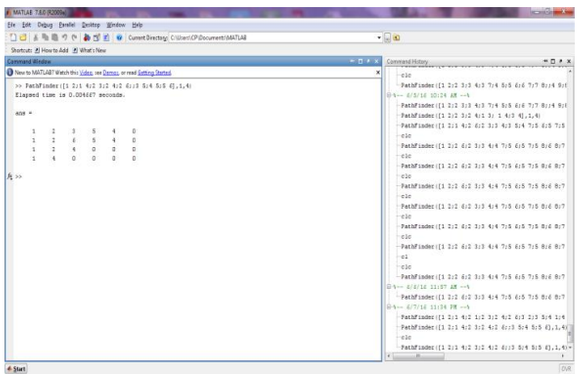

Fig. 4: Snapshot of Example Network

Output of example network is:

$1 \rightarrow 4$

$1 \rightarrow 2 \rightarrow 4$

$1 \rightarrow 2 \rightarrow 3 \rightarrow 5 \rightarrow 4$

$1 \rightarrow 2 \rightarrow 6 \rightarrow 5 \rightarrow 4$

Hence this output shows the proof of correctness of proposed algorithm.

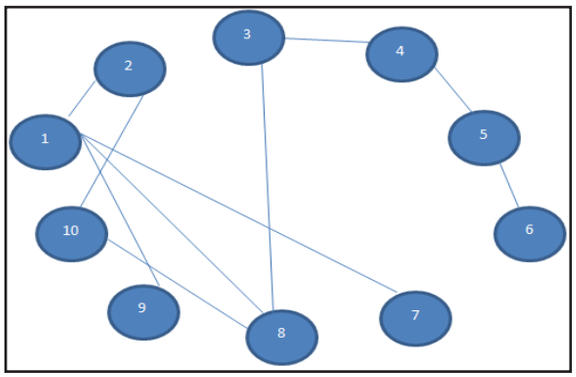

Fig. 5: Network of 10 Nodes with 10 Edges "Source: 1 **Destination: 10"**

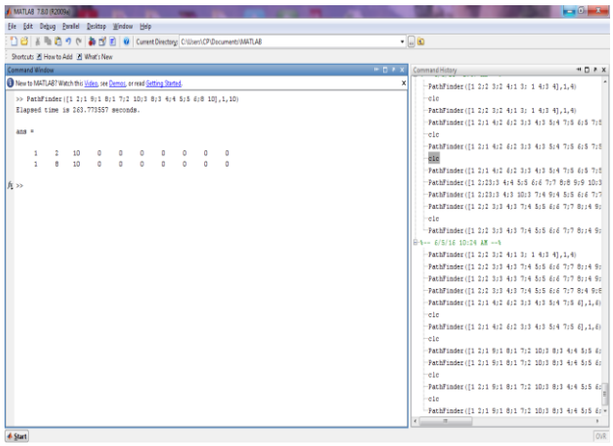

Fig. 6: Output for 10 Nodes and 10 Edges

Figure 5.2 shows the output when there is 10 node in graph having links (1 2;1 9;1 8;1 7;2 10;3 8;3 4;4 5;5 6;8 10) with Source 1 and destination 10.

Identified Paths:

1 2 10 0 0 0 0 0 0 0

1 8 10 0 0 0 0 0 0 0

From results we conclude as the number of nodes increases the execution time increases and there is no major effect of number of links on the execution time.

Conclusion

To transfer data packet from source to the destination the packet needs the path through which it will flow. The path is calculated by the router on network layer by the process of routing. If the topology is multipoint then there is no need of routing. But in case of point-to-point topology for sending the data routing is must. The most commonly used routing protocol is OSPF, which finds out shortest path but a single path that leads to more traffic congestion, less reliability. So many multipath routing algorithms are proposed, from which the node-disjoint algorithm is used commonly. In node-disjoint algorithm there are no common nodes between any two paths but through this algorithm all possible paths cannot be identified. This leads to less utilization of the network. So, in this paper, propose "An All Path Routing Algorithm" which finds out all the possible paths in the network. The main purpose of this algorithm is full utilization of all links in the network. The problem with this algorithm is the router must know complete topology already, if there is any change in link at the run time that will create problem. So, in future one can enhance this work by performing it on dynamic basis.

References

Forozen, B. A. (2007). *Data communication and Networking*. Tata mcgraw Hill.

Tanenbaum, A. S. (2007). *Computer Networks*. Pearson Education.

Comer, D. E. (1995). *Internet working with TCP/IP Principle, Protocol and Architecture*. Prentice Hall.

Tsai, J., & Moors, T. (2006). A review of multipath routing protocols: From wireless ad hoc to mesh networks. *Proceedings of ACoRN Early Career Researcher Workshop on Wireless Multihop Networking*, July 17-18.

Liu, W., Zhang, Y., & Lou, W. (2005). Performance Optimization using Multipath Routing in Mobile Ad Hoc and Wireless Sensor Networks. *Performance Optimization using Multipath Routing.*

(2015, April) memory/Disjoint_Path_Finding. [Online]. http://www.macfreek.nl

Siemens, A. G., Götz, F. J., & Bahr, M. (2012). Multipath link state routing. *IEEE 802.1 AVB TG Meeting.*

Garcia-Luna-Aceves, J. J., & Vutukury, S. (2000). Mpath: A loop-free multipath routing algorithm. *Elsevier Journal of Microprocessors and Microsystems.*

Narvaez, P., & Siu, K. Y. (1999). *Efficient algorithms for multi-path link state routing* ISCOM'99, Kaohsiung, Taiwan.

Fang, Y., & Huang, X. (2009). Performance study of node-disjoint multipath. *IEEE Transactions on Vehicular Technology*, 58(9), 1942-1950.

Shilpa. (2016). An efficient all path routing algoritm. *International Journal of Scientific and Engineering Research*, December, 7(12), 407-410.