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Shortest Path Computation in Multicast Network with Multicast Capable and Incapable Delay Associated Nodes

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Abstract— Multicast transmission results in a bandwidth and cost efficient solution for transmission purpose .If we consider the real life scenario then the nodes considered can either be multicast capable nodes or multicast incapable nodes. In this paper, a method is proposed to increase the success rate of finding the minimum cost path within a given network with both multicast incapable and capable nodes. For this, a real life network is considered with 80 nodes complied within it. The nodes considered can either be multicast capable nodes or multicast capable nodes conforming with real life situations .It is shown that if we make use of algorithm proposed in the paper along with delay association and proper bandwidth consideration then success rate of finding the minimum cost path can be increased up to a significant value

Index Terms—Multicast capable nodes, multicast incapable nodes, minimum cost path

I. INTRODUCTION

THE exponential growth of media content delivery over the internet in recent time has consumed a significant amount of bandwidth: videos are now over one third of all consumer internet traffic and is expected to increase in future times. Because of all these reasons, service providers require more efficient techniques to transmit the data from transmitter to receiver in order to make proper use of bandwidth. Different kinds of techniques are used for this purpose ,like uni-cast technique ,broadcast and finally multicast. If we make use of unicast it results in unnecessary usage of bandwidth ,broadcast is not time efficient and is not reliable as well. Because in broadcast we need to transmit the consider data to every user in the network regardless of the fact that whether the user has asked for the data or not. Then finally comes the multicast technique. In multicast technique the service provider have privilege to send the packets to required users only which makes it a bandwidth efficient and time efficient technique. [1].

If we consider the real life scenario then some of the nodes within a network are multicast capable nodes and some are multicast incapable nodes. In the network considered I have considered the same scenario i.e. some of the nodes are multicast capable nodes and some are multicast incapable nodes[2]. While the proposed routing algorithm for multicast request can easily be applied to multicast overlay networks wherein all the nodes are multicast capable nodes, The same cannot be said for other types of network like RFC 4875,which further describes resource reservation protocol-traffic engineering (RSVO-TE) for the setup of point to multipoint label switched paths in MPLS and generalized MPLS, has not become standard yet, So it is unsafe to assume that multicast is always supported nodes in MPLS and GMPLS networks. In case of wavelength division multiplexing networks, however a node can be regarded as multicast capable if a switch with light splitting capability is deployed, this kind of switch is not broadly available in reality due to their expensive nature.[3]

Existence of multicast incapable nodes make it difficult to multicast within any given network. As a follow work, in this paper the author has proposed a new algorithm which can work for a network having multicast capable and multicast incapable nodes within it. In the proposed algorithm instead of considering a continuous path from source to destination ,different subgroups are created for all the intermediate nodes and then accordingly the minimum cost path is calculated regardless of the face whether the node is multicast capable or multicast incapable.[4]

II. PROPOSED ALGORITHM

This section describes the proposed algorithm , along with proper analysis of the epitome of the network considered. The objective of this algorithm is to find multicast tree for a given multicast network wherein some nodes are multicast capable nodes and multicast incapable nodes. It is assumed that any user can send the packets to as many users as needed when computing multicast trees for the request proposed.[7]

The following notations are used in the proposed algorithm:

- s: source
- d: destination
- v=Set of vertices
- V=All vertices within given network
- N=Total number of neighbours for a given source
- D=Distance between any two given nodes
- D_n = Minimum cost path
- Q=Queue
- S_{new} = New source
- D_{new} =New destination

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- D_g = Distance between source and neighbouring nodes

A. *Algorithm Description*

The algorithm proposed can be given as follows:

// initialization

1. dist[s]←0

// self distance to source node is assumed to be zero

2. repeat(s,d)
3. for all
4. {
5. v∈V–{s}
6. do
7. for (j=1 to N)
8. {
9. if (j is a neighbour of s and j ≠ s)
10. $D_j = d_{sj}$
11. If(j is not a neighbour of s)
12. D=∞
13. }
14. }

//Iterations

15. Mindistance (Q,dist)
16. for(j=1 to N)
17. {
18. if D_n < all D_g
19. dist= D_n
20. }
21. Return dist
22. S←0

// (S ,the set of the visited nodes is initially empty)

23. Q←V

// (Q,in beginning the Q contains all the vertices)

24 while

25. Q≠0

// (while the considered queue is not empty)

26. Do u ← mindistance (Q,dist)

// (select the element with minimum distance)

27. Repeat
28. {
29. path=path ∪ n

//(where D_n is minimum cost path)

30. }

31 . For (k=1 to M)

// M=No. of remaining nodes

32. {

33. D_k = min(D_k , $D_k + C_{jk}$)

34. }(until all nodes included in the path, M=0)

35. put

36. $s_{new} = d_{new-1}$

37 .repeat(s_{new}, d_{new-1})

//till all the destinations are covered

38. end

An example of how the proposed algorithm works can be given as:

Lets say we have a single source and a number of destinations to where we need to send the packets. The destinations considered in between can as well act as the source for any new destination and if any of the node is multicast incapable then that will be dealt accordingly .consider the network given below:

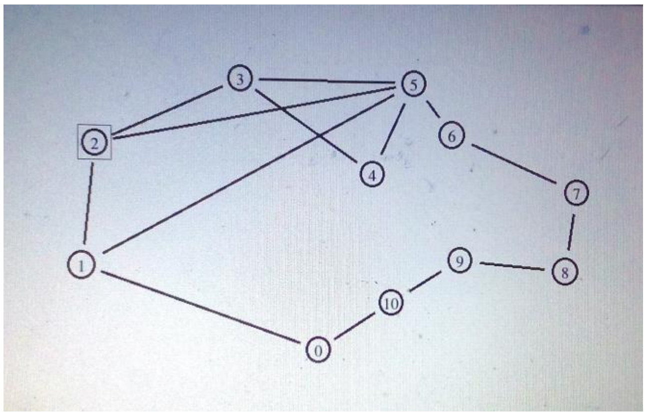

Fig.1

Lets say we have the node 2 as source and (5,7,10) as destinations. now we need to send the packet from 2 to 5. Following paths can be considered for the same purpose:

- 2→3→5
- 2→3→4→5
- 2→5
- 2→1→5
- 2→1→0→10→9→8→7→6→5

Now, if we analyze the trees found above then it is clear that third path has minimum hope counts. So, this path will be added to the shortest path tree. After that we will consider the next destination while taking 5 as the source now and then will calculate the minimum cost path in similar fashion. Same process is repeated again and again till we get the required minimum cost path within the given network.

Now, for analysis purpose I have considered following networks:

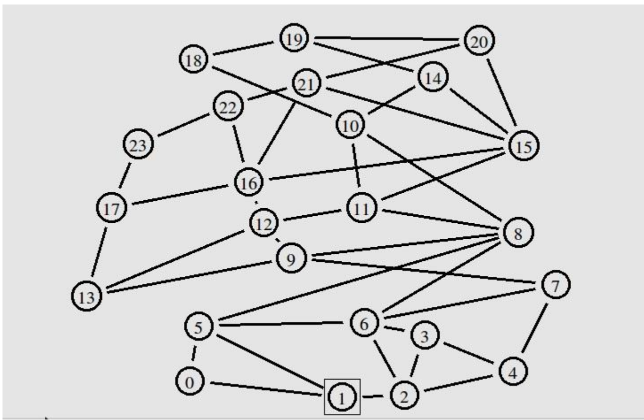

Fig. 2 Network 1

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Given network 1 is the first network that was considered in order to calculate the success rate. In the network considered above 21 nodes are taken within which some nodes are multicast incapable nodes while others are multicast capable nodes .consideration of multicast incapable nodes helps to deal with real life situation because all the nodes or the router in real life situation are not multicast capable.

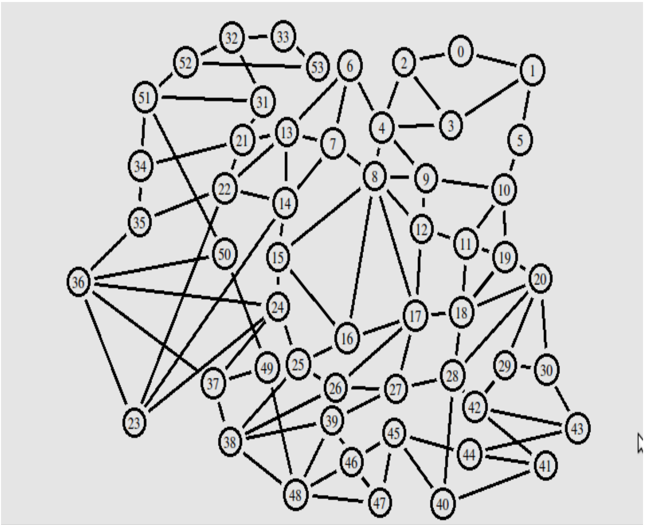

Fig.3 Network 2

Given network 2 is the second network that was considered in order to calculate the success rate.

In the network considered above 53 nodes are taken within which some nodes are multicast incapable nodes while others are multicast capable nodes .consideration of multicast incapable nodes helps to deal with real life situation because all the nodes or the router in real life situation are not multicast capable.

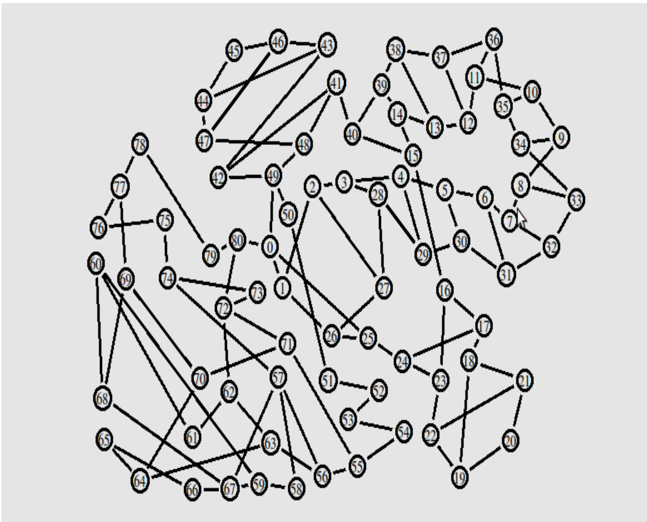

Fig. 4 Network 4

In network 3,I have considered 80 nodes within the network. Some of these nodes are multicast capable nodes while other one's are multicast incapable nodes. Consideration of both types of nodes within the network helps to make it more tangible to real life situations. Along with all these considerations I have introduced delay and appropriate bandwidth with each node in order to increase the success rate of finding minimum cost path from source to destination while numbers of destination for each source is continuously increased in order to study the phenomenon properly.

III. EXPERIMENTS AND SIMULATION RESULTS

First of all I have calculated the success rate and average number of trees found for network 1 without any introduction to delay and with already existing algorithms.

The graph obtained for success rate of the network above can be given as:

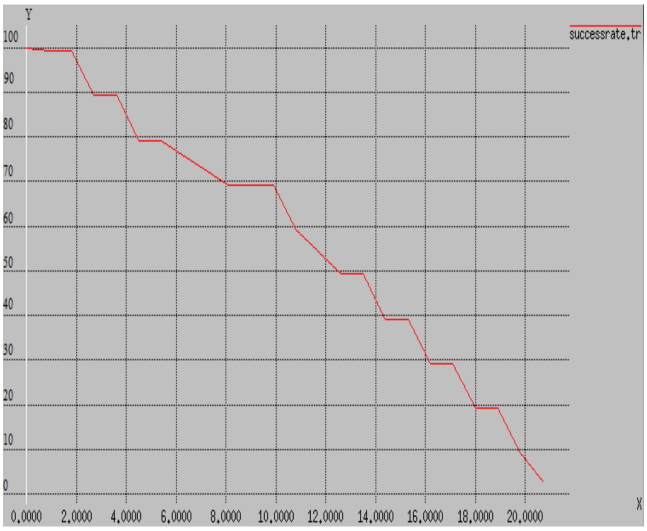

Fig.4 Success rate for network 1

Where

y-axis -> percentage success rate of finding minimum cost path.

x-axis-> No. of destinations for a particular source

From the graph above it can be concluded that success rate for finding the minimum cost path decreases with increase in number of destinations for any given source. This concept will get crystal clear with the help of data analysis of the graphic values in tabular form as given on the next page.

If we analyze the result in tabular form then it can be given as:

Table 6: Tabular analysis for success rate of network 1

Number of Destinations	Success Rate
2	100
4	85
6	76
8	70
10	70
12	54
14	45
16	30
18	20
20	9

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The tabular analysis strengthens the concept discussed above. Correspondingly, the average number of trees found per request can be given by the graph below:

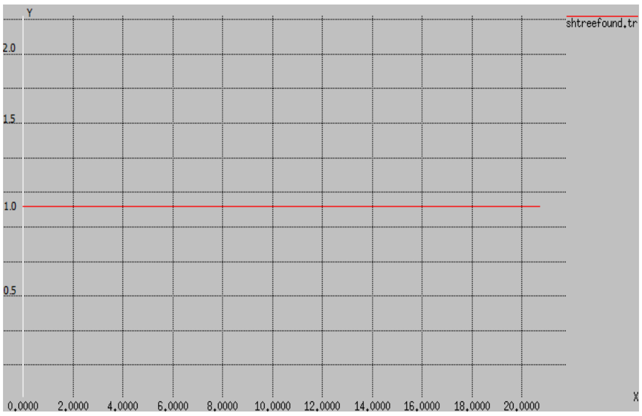

Fig.5. Average number of trees found per request for network 1

Similarly,if we simulate the data for network 2 considered above with existing algorithm without any introduction to delay or proper bandwidth in the tool used then the graph obtained can be given as given in figure 6.

In the graph obtained:

y-axis -> percentage success rate of finding minimum cost path.

x-axis-> No. of destinations for a particular source

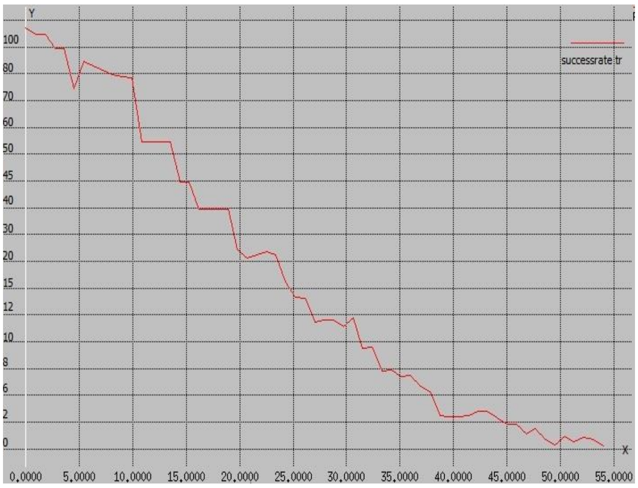

Fig.6. Success rate for graph 2

From the graph above it can be concluded that success rate for finding the minimum cost path decreases with increase in number of destinations for any given source. This concept will get crystal clear with the help of data analysis of the graphic values in tabular form as given below. The tabular analysis of graph above can be given as:

Table 7. Tabular analysis for success rate of network 2

Number of Destinations	Success Rate
5	81
10	76
15	45
20	22
25	14
30	12
35	7

40	4
45	2
50	2

The tabular analysis strengthens the concept of decrease in number of shortest path found with increase in number of destinations.

Correspondingly, the average number of trees found per request can be given by the graph below:

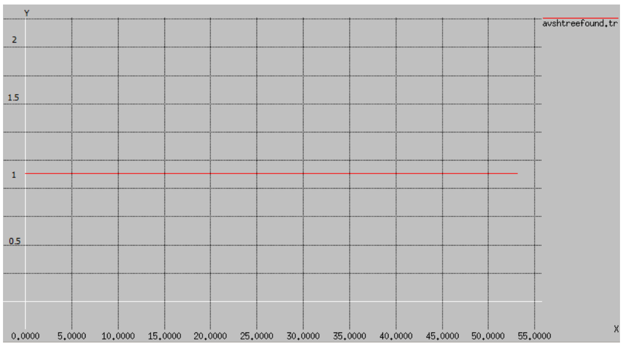

Fig.7. Average number of trees found per request for network 2

If we analyse the data for network 3 using the proposed algorithm then the graph obtained for success rate can be given as:

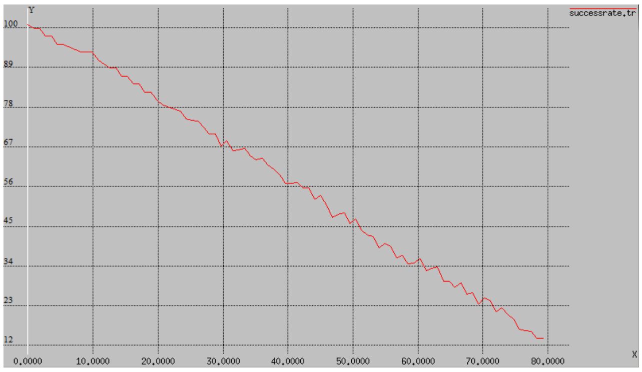

Fig. 8. Success rate for network 3 using proposed algorithm

Where:

y-axis -> percentage success rate of finding minimum cost path.

x-axis-> No. of destinations for a particular source

The tabular analysis of the graph can be given as

Table 7. Tabular analysis for success rate of network 2

No. of Destinations	Success rate
10	93
20	80
30	69
40	57
50	46
60	36
70	25
80	13

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The average number of trees found per multicast request for network 3 can be given as:

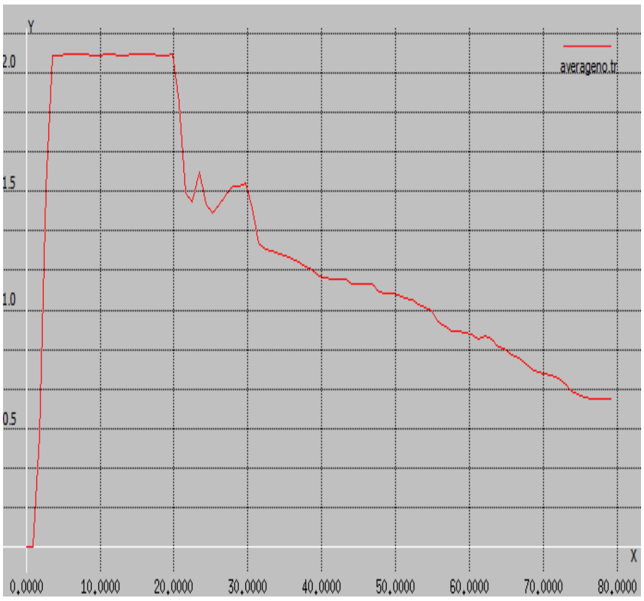

Fig.9. Average number of trees found per request for network 3

From the analysis done above it is pretty much clear that if we make use of the algorithm proposed the success rate of finding minimum cost path in a network with both multicast capable nodes and multicast incapable nodes can be increased significantly.

The tabular representation makes the improvement crystal clear which is basically because of delay association with each node along with proper bandwidth consideration within the algorithm proposed to calculate the shortest path.

Improvement using the proposed algorithm can be analyzed in tabular form as:

No.of destinations	Network 1 (Success rate)	Network 2 (Success rate)	Network 3 (Success rate)
10	70	76	93
20	8	20	80
30	-	12	69
40	-	4	57
50	-	2	46
60	-	-	36
70	-	-	25
80	-	-	13

IV. CONCLUSION

After analyzing every aspect of the thesis proposed it becomes pretty clear that if we make use of the proposed algorithm in any network having multicast capable and multicast incapable nodes in accordance with real life situations along with delay associated nodes and appropriate bandwidth then it becomes possible to increase the success rate up to a considerable value.

In my base paper ,the authors had proposed an algorithm to calculate success rate for finding the minimum cost path with increase in number of destinations while multicasting from a given source to various destinations neither having introduction to delay mechanism nor the proper bandwidth considerations. Different types of algorithms were proposed regarding the same mechanism used according to requirements of user. There were scopes of improvement basically and by making those improvements the proposed thesis tries to improve the success rate for finding the minimum cost path.

The result obtained can further be improved if we make use of application layer multicast instead of network layer multicast. Application layer multicast is not that much popular now a days but that is where the future lies.

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