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Discretization Techniques to Determine the Cheapest Path

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Abstract— In the current network scenarios, finding the shortest path is important for functions like QOS Routing ,MPLS path selection ,ATM circuit Routing and Traffic Engineering which consists of some constraints i.e. path with less delay(or low cost).There is much research going on finding cheapest delay path especially in the context of voice or video calls and QOS routing .Most common solution for this problem is to discretize the delay in each link so that actual problem will be converted into easier problem which can be solvable in polynomial time. The proposed paper address two techniques to minimize the errors that were found during discretization, since the efficiency of the algorithms depend on the errors that were found. Because of the use of these techniques the algorithms will run with less time complexity.

Keywords— Quality of Service (QoS), Multi- Protocol Label Switching (MPLS), Asynchronous Transfer Mode (ATM)

I. INTRODUCTION

Implementing Quality of service is the challenging functionality in today's networking field, especially in distributed multimedia applications like video conferencing applications since it involves determining the cheapest path that satisfy the conditions like delay, cost, bandwidth[1]. There are various applications that use this constrained cheapest delay path algorithms. QOS routing algorithms[3] can be implemented on routers with two techniques are, one, online approach, second, extending the link state protocol like IS-IS.

Former is to implement the QOS algorithms as online algorithms but will run out the router if thousands of requests come at a time, so not desirable. Latter is to pre-calculate the cheapest delay-constrained path periodically to all destinations and cache the data .So there will be no burden to the router. This scheme is feasible to both constrained unicast and multicast networks. Feasible path is the path which satisfies the delay requirement [1]. Determining the cheapest path which satisfies the delay requirement is NP-Complete problem. A usual approach is to discretize the delay on the path.

Discretization makes the problem easier so that the simpler problem can run in polynomial time. But there is a scope for errors to introduce. The algorithm efficiency directly depends on the number of errors. So to reduce the error rate the sampling or rounding of values must be done exactly otherwise the running time of the algorithm goes to high[1]. The proposed paper deals with two approaches (Randomized discretization and path delay discretization) that reduce the discretization errors. [2] explains efficient routing based on the Qos(quality of service) requirements. Routing will be done even there is inaccurate information about the network state information. In the case of multicast routing one message has on demand for multiple users. In [3] is problem if a video is to be brought on demand by every user in the group with lowest cost then delay constrained shortest path technique gives solution to the problem. Our paper gives two techniques to discretize the errors in the link delay which will lead to fastest running time algorithms. This approach is well applied in Qos routing in voice traffic.

II. LITERATURE SURVEY

Shigang et al[2] proposed a multiple constraints path problem where a path can be restricted with delay and cost bounds on it. This problem is np-complete and it is solved with the help of some extended approaches. it gives time complexity of O(xEV) where 'x' is the adjustable value which increases the scope of finding the solution. Hassin described the selection of scaling factor and need to know about the lower, upper boundaries of an optimal solution of the pseudo-polynomial algorithm.

A.Goel et.al,[3] described the important elements of QOS Routing like determining different routes based on the constraints of QOS Routing and efficient use of resources across the network ,pros and cons of different routing algorithms. RochGuCrin et.al,[4] described about the effect of uncertainties in the process of selecting a path which is having the main aim as to satisfy the QOS requirements.

DannyRazet.al,[5]described discrete cost function for finding the exact and approximation solution for various kinds of problems and has a fully polynomial approximation scheme.

Ying Xiao, KrishnaiyanThulasiraman, GuoliangXue[6] described about the constrained shortest path selection base on the network programming and the G-LARAC algorithm is designed for computing constrained shortest path.

GuoliangXue proposed an algorithm for balancing the cost and delay in uni-cast and multicast tree routing networks i.e., is primal-dual algorithm [7].

III. PROPOSED SYSTEM

In this paper RTC which round-offs the errors along the path .If the no of nodes in the network is drastically increased then the error associated along the path also raised and which is also same for the RTF.The error couldn't be too large for achieving the approximation. So, by increasing the value of λ' the above algorithm must reduce the discretization error but increase in the time complexity.To avoid the above problem we introduce the new discretization technique i.e. Randomized discretization. In this technique without increasing the λ' value the performance of the algorithm is improved. Every connection link has +ve and –ve errors are balanced along the path that disparage error-rate.

A. Round Randomly(RR)

Consider the link(x,y) divide the r'/λ' value for every link in the network .if the value $\notin$ Z,it is round to smaller (or)
larger integer value randomly then the mean error is zero.

$$d_p^T(x,y) = \left[\frac{d_p(x,y)}{r'}\lambda'\right] \quad with\ prob.p1 = \frac{d_p(x,y)}{r'}\lambda' - \left\lfloor\frac{d_p(x,y)}{r'}\lambda'\right\rfloor$$

$$= \left[\frac{d_p(x,y)}{r'}\lambda'\right] \quad with\ prob.p2 = p1 - 1$$

The discretization delay of path p is

$$d_p^T(P) = \sum_{(x,y)\epsilon p} d_p^T(x,y)$$

The discretization error of a link (x,y) is

$$\Delta^{r'}(x,y) = d_p(x,y) - d_p^T(x,y)\frac{r'}{\lambda'}$$

And the discretization error of a path P is

$$\Delta^{r}(P) = \sum_{(x,y)\,on\,p} \Delta^{r'}(x,y) = d_p(P) - d_p^T(P)\frac{r'}{\lambda'}$$

Now design the RDA(Randomized discretization algorithm) which is based on Dijkstra's algorithm[1] by using two additional parameters such as delay and cost. It uses the above statorgy for reducing the link delay.

B. Algorithm

1. Read the cost and delay from network into 2-dimensional array
   w$[v',i]$=stores the cost of cheapest path from x to v for all vεV,iε [0..λ']
   $s'[v',i]$ = store previous link of the path
2. Call the function RDA_Disjkstra with incrementing the λ' until the delay of path is smaller than the (1+e)$^{r'}$ for all v'.
3. The function RDA_Disjkstra finds the shortest path from the source node x to all the node with minimum discretization error of all the links.

Read _values(V,x, λ')

1. for each vertex v' ϵ V , each I ϵ [0.. λ'] do

2. w[v', i]=infinity, p[v',i] =NIL, $s'[v', i]$=infinity

3. w[x , 0] = 0, $s'[x,i] = 0$

DIS_RDA(u,v,i, λ')

4. $i' = i + d^r(u,v)$

5 error = $s'[u,i] + \Delta^{r'}(u,v)$

6 if error < 0 then

7 error = error + $\frac{r'}{\lambda'}$

8 $i' = i' - 1$

9 if $i' \leq \lambda$ and $w[v, i'] > w[u, i] + c(u, v) then$

10 w[v, i'] = w[u,i] + c(u,v)

11 p[v, i'] = u

12 $s'[v,i'] = \min\{s'[v,i'], error\}$

RDA_Dijkstra(G,s, λ')

13 read(V,s, λ')

14 for i=0 to λ' do

15 Q = V

16 while Q != Ø do

17 u = get_min(Q)

18 if w[u,i]=infinity then

19 break out of the while loop

20 for every adjacent node v of u do

21 DIS_ RDA(u,v,i, λ')

C. Path Delay Discretization

In the previous technique, discretization is done on individual links in which the error is accumulated on every link so the error rate is directly proportional to the path length i.e. the maximum error on the path is equal to the product of number of links and the discretization delay on each link. The term ($\frac{r'}{\lambda'}$) is the error which is the difference between the rounded delay and normal delay. The error on the path can be decreased in two ways.

It can be done by increasing the value of lambda but it eventually increases the execution time of the algorithm. The alternative is to minimize the discretization's count that is calculated on the path. So the value ($\frac{r'}{\lambda'}$) does not depend on the path length. The following is the algorithm for PDA which runs equally with RDA in worst case but it runs faster than RDA in average case.

Read _values(V,x, λ')

for each vertex $v' \in$ V , each I $\in$ [0.. λ'] do

w[v',i]=infinity, p[v',i] =NIL, z'[v',i]=infinity

w[x , 0] = 0, $z'[x,i] = 0$

DIS_PDA(u,v,i, λ')

$i' = \lfloor (z[u,i] + d^r(u,v)/r')\lambda' \rfloor$

if $i' \le \lambda'$ and $w[v,i'] > w[u,i] + c(u,v)$ $then$

w[v, i'] = $w[u,i] + c(u,v)$

p[v, i'] = u

z[v, i']= min{z[v, i'],z[u,i] + $d'(u,v)$}

PDA(G,s, λ')

read(V,s, λ')

for i=0 to λ' do

Q = V

while Q != Ø do

u = get_min(Q)

if w[u,i]=infinity then

break out of the while loop

for every adjacent node v of u do

DIS_ RDA(u,v,i, λ')

PDA(G,s)

$\lambda' = \lambda'_0$

do

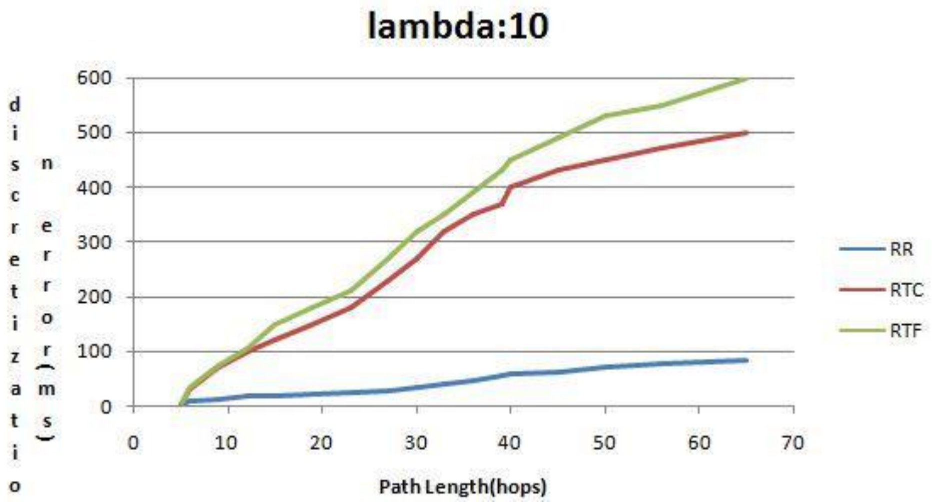
$\lambda' = 2\lambda'$

PDA_Dijkstra(G,s, λ')

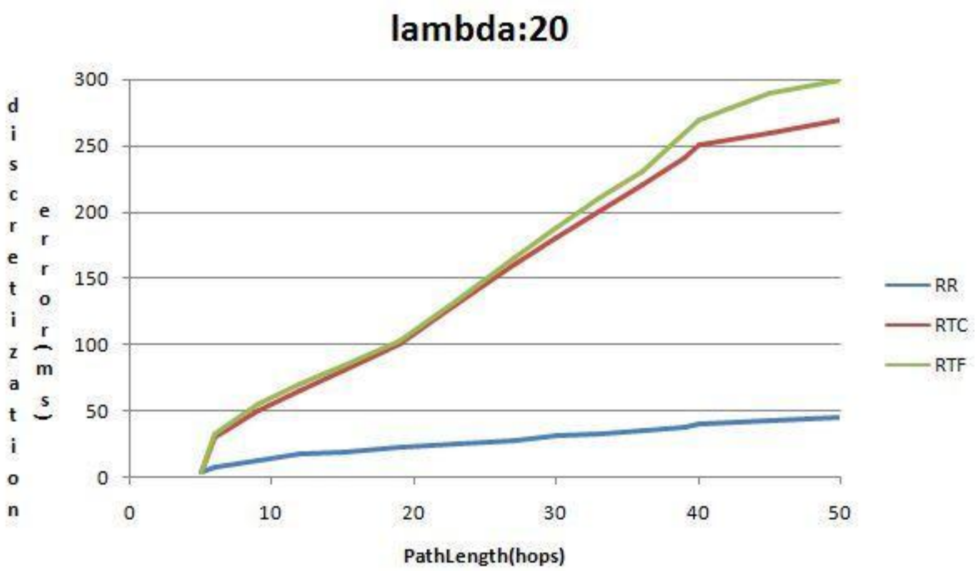
while $\exists v' \in V, d'(P^{v'}) > (1+\in)r'$

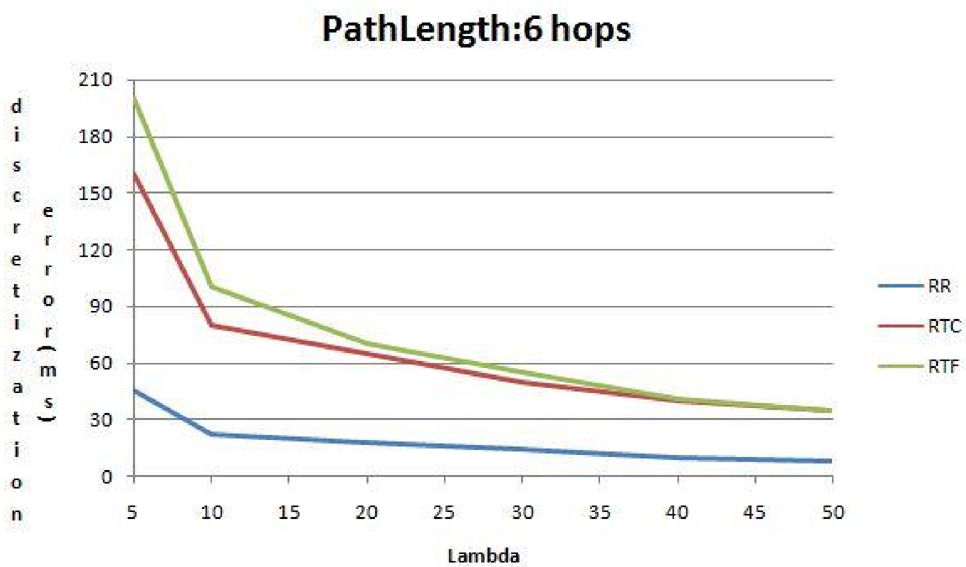
Where$(P^{v'})$ is the path with min{w[v',i]$\notin$ $[0..\lambda']$ }

IV. PERFORMANCE ANALYSIS

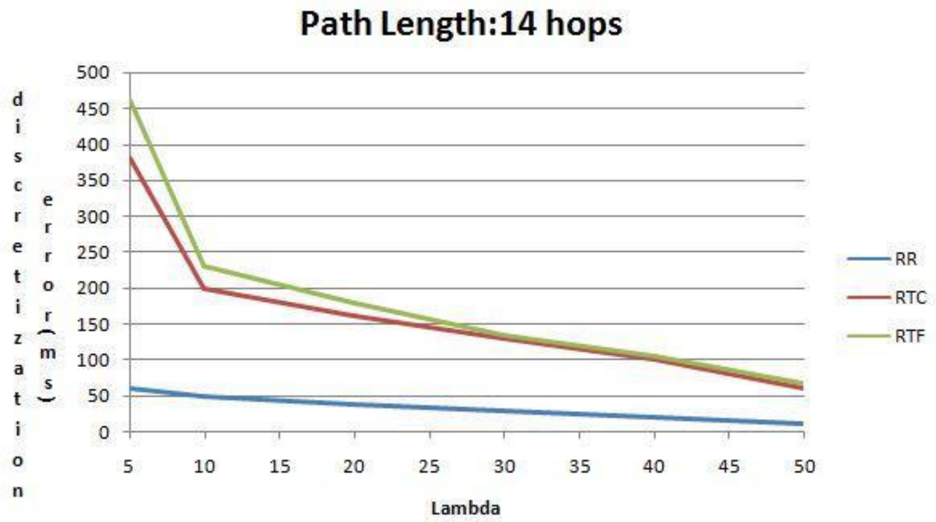


For lambda =10 the path length increases discretization error also varies for 3 discretization error RR gives less discretization error when compared to the RTF and RTC





As path length=6 is fixed the lambda value varies then discretization error also varies RR has less discretization error when compared to the RTC and RTF



V. CONCLUSIONS

The existing systems use the techniques called RTC, RTF to reduce the discretization errors. But to minimize these errors much more the value of lambda should be more. As the value of lambda increases, computation speed decreases. To overcome this, the proposed system discusses two approaches namely Randomized discretization and path delay discretization were discussed so that without reducing the value of lambda and to make the algorithm run faster i.e. to reduce the running time complexity.

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REFERENCES

[1] Shigang Chen, *Member*, Meongchul Song, and Sartaj Sahni,"Two Techniques for Fast Computation of Constrained Shortest Paths" *IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 16, NO. 1, FEBRUARY 2008.*

[2] S. Chen and K. Nahrstedt, "An overview of quality-of-service routing for the next generation high-speed networks: Problems and solutions,"*IEEE Network, Special Issue on Transmission and Distribution of Digital Video*, vol. 12, no. 6, pp. 64–79, Nov./Dec. 1998.

[3] A. Goel, K. G. Ramakrishnan, D. Kataria, and D. Logothetis, "Efficientcomputation of delay-sensitive routes for one source to all destinations,"in *Proc. IEEE INFOCOM*, 2001, pp. 854–858.

[4] Roch GuCrin,Ariel Orda, "QoS-based Routing in Networks with InaccurateInformation: Theory and Algorithms","*IEEE Conference Publication* 0-8186-7780-5/97.

[5] D. Raz and Y. Shavitt, "Optimal partition of QoS requirements with discrete cost functions," in *Proc. IEEE INFOCOM*, 2000, pp. 613–622.

[6] Y. Xiao, K. Thulasiraman, and G. Xue, "Approximation and heuristicalgorithms for delay constrained path selection under inaccurate stateinformation," in *Proc. 1st Int. Conf. Quality of Service in HeterogeneousWired/Wireless Networks (QShine)*, Oct. 2004, pp. 130–137.

[7] G. Xue, "Primal-dual algorithms for computing weight-constrainedshortest paths and weight-constrained minimum spanning trees," in*Proc. IEEE IPCCC'00*, Feb. 2000, pp. 271–277.

[8] H. C. Joksch, "The shortest route problem with constraints," *J. Math.Anal. Applicat.*, vol. 14, pp. 191–197, 1966.

