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Path Management Using HVO Approach and Signal Bit

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ABSTRACT: Paths between all source destination pairs in a communication network should be chosen such that an overall good utilization of network resources is ensured, and hence high throughput, low loss and low latency achieved. This paper describes about Path optimization and congestion control in ATM networks. It mainly covers highlights the proposed path management approach with its advantages. . For Path optimization a new algorithm called HV/HVO is used and for bad path avoidance a single bit called SIGNAL bit is used to avoid bad paths and to control congestion. The performance results of the proposed path management approach are presented. The simulation results showed that the algorithm find the optimal path from a specific source to destination

KEYWORDS: High throughput, low loss, low latency, Path Optimization ,congestion Control, HVO, SIGNAL bit,ATM.

I. Introduction

One of the important issues in ATM networks is Path management Paths between all source dstination pairs in a communication network should be chosen such that an overall good utilization of network resources is ensured, and hence high throughput, low loss and low latency achieved. At the same time the set of paths chosen must enable utilization of the available spare capacity in the network in such a manner that a failure results in a minimum disturbance of the directly affected traffic flows as well as other traffic flows in the network.

A. Previous work on Path Optimization

Murat Eren et al. [MuCe2K] presented a parallel annealed genetic algorithm (PAGA) for VP optimization. The algorithm stops when no more improvement statistically can be achieved or an upper limit value of the fitness value (a satisfactory solution for the user) is reached.

B. Previous works on congestion avoidance in ATM networks

Congestion in a network is a state in which performance degrades due to the saturation of network resources such as communication links, processor cycles, and memory buffers. Network congestion has been well recognized as a resource-sharing problem.

Hiroyuki Ohsaki et al. [HMY+96] proposed a Proportional Rate Control Algorithm (PRCA) with two major modifications: (1) the polarity of the feedback information is positive, and (2) the need for interval timers is eliminated. An improved version of PRCA called EPRCA (Enhanced Proportional Rate Control Algorithm). The two major enhancements of EPRCA — intelligent marking and explicit rate setting. A more impartial sharing of the available bandwidth can be achieved by using this intelligent marking mechanism in conjunction with the explicit rate setting mechanism.

II. Drawbacks of Existing Approaches

The cost of the control of the network, of which routing is a prominent component, has been increasing more rapidly than any other. Current measurements are not reliable enough in deriving effective routing decisions for an ATM network. In fact, it has been reported that in ATM networks current traffic measures could have little correlation to traffic patterns even in the near future. This is because of the highly dynamic nature of not only the traffic but also of

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the underlying architecture of the network itself. All of the routing updates are triggered by a change in any of the nodes' view of the network. The changes of view by a node, causes routing updates to be performed based on updates received by the other nodes. One of the concerns with distributed routing is the lack of consistency.

III. PROPOSED PATH MANAGEMENT TECHNIQUE

In this paper a novel Path management technique is proposed, it involves two phase process namely Path optimization and bad path avoidance. For Path optimization a new algorithm called HV/HVO is used and for bad path avoidance a single bit called SIGNAL bit is used to avoid bad paths and to control congestion.

A. Path optimization using HV/HVO algorithm

In this thesis a new optimization algorithm is proposed call the **Human's View optimization algorithm (HV or HVO Algorithm).**

Human's View optimization algorithm (HVO) is a probabilistic technique for solving computational problems which can be reduced to finding good paths through graphs. The algorithm uses two data objects in the MIB one is History Path table and SPM matrix.

Idea: Human beings are intelligent, because they are having view and sense capabilities (through their eyes and brain). So, humans can find out easily the shortest path between source and destination by observing the graph designed from network. So, based on the behaviour of the humans, we can apply this idea into virtual path optimization.

The original idea comes from observing the view of humans, in which humans are intelligent in finding shortest path for going to their destinations.

1. They first find the source and destinations to travel
2. Then they will find the ways to reach destination
3. After that they calculate the times and distances to reach destinations
4. At last they select the shortest way to reach destination
5. Then they start the journey to the destination.

Here, humans get the routes information from the several sources. For example by asking already travelled person, using Google maps and etc. When applied to Networks, from the humans view, there are two ways to get the shortest path.

1. By using the history of previous packets journey to the Destination
2. By observing the network graph

Using the history : Like human beings, here also first we need to check for the packets previously sent to the destination. By getting this history we can choose the right path.

Algorithm: HV or HVO Algorithm

```
// HistoryPathtable is an array containing the historical paths for each node
//len indicates the total no of paths
//D indicates the destination
//P indicates the paths
// I is the index used to refer the paths
Step 1: Get all paths P from history
Step 2: Set len = no. of paths, destination: D
Step 3: While (P € D && i != len)
Step 4: HISTORY Path table[i]=p; i++;
Step 5: Sort paths
Step 6: Select shortest path
```

If no history exist from the selected source, then its adjacent nodes are identified and from these nodes an optimal distance node is selected and the HV or HVO algorithm is applied form this node.

Using Network Graph : Like humans, if there is no person previously visited the destination, and then they will go to the Google maps, then they will decide the way to reach destination.

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Here, also need to look at graph.

Algorithm

Step 1: Analyze the graph
Step 2: Apply any graph based optimization algorithm
Step 3: follow the path which is short
For example consider the network in the fig 4.6.

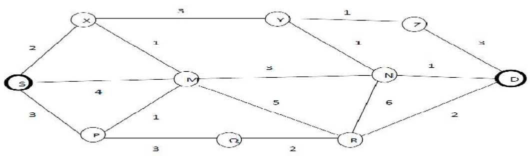

Fig.1: A Sample network

Suppose the history paths from the node S to D are represented as below in the History Path Table[S].

Table 1: History Paths from the node S to D

S.No.	Node	Path	Path cost
1.	S	S – X – Y – Z – D	9
2.	S	S – X – M – N – D	7
3.	S	S – M – N – D	8

From these previous history paths, it is evident that the second path is optimal, so it is selected. For example consider that there is no history path from node S to the destination D, then its adjacent nodes are identified and an optimal distance adjacent node is selected. The adjacent nodes of node S from figure are X, M, P and their distances are as follows:
S – X = 2, S – M = 4, S – P = 3
Since the distance from S – X is optimal, so the node X is selected and now the algorithm will check to find any history paths are available from X – D.
Suppose the history paths from the node X to D are shown in the History Path Table 2.

Table 2: History Paths from the node X to D

S.No.	Node	Path	Path cost
1.	X	X – Y – Z – D	7
2.	X	X – M – N – D	5

From the history path it is evident that the second path is optimal and hence it is selected. In case no history path is found for any intermediate nodes then Ant colony optimization algorithm is used. After selecting the path, this path should be checked for any failures.
The probability of reaching the nodes using HV/HVO algorithm can be represented using a stochastic matrix. The following 3 × 3 matrix defines a discrete time Markov process with three nodes:

$$\mathbf{P} = \begin{bmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ P_{31} & P_{32} & P_{33} \end{bmatrix}$$

Where P_{ij} is the probability of going from j->i. A stochastic matrix satisfies the following conditions

$$\forall_{i,j} P_{i,j} \geq 0$$

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$$\forall_j \sum_{i=1}^{M} P_{ij} = 1 .$$

Where M is the order of the matrix.
For example consider the network in figure 4.6 and take the node Q
Cost QP=3 and QR=2
To find probability: x/3,x/2(where x is probability)
Total probability=1 ➔ x/QP + x/QR =1
x/3 +x/2 =1
x=6/5
Therefore Probability value=2/5, 3/5 for P and R respectively. Similarly the following matrix shows the probabilities of all the nodes in the network.

	S	X	Y	Z	M	N	P	Q	R	D
S	0	6/13	0	0	3/13	0	4/13	0	0	0
X	3/11	0	2/11	0	6/11	0	0	0	0	0
Y	0	1/7	0	3/7	0	3/7	0	0	0	0
Z	0	0	3/4	0	0	0	0	0	0	1/4
M	15/167	60/167	0	0	0	20/167	60/167	0	12	0
N	0	0	6/15	0	2/15	0	0	0	1/15	6/15
P	1/5	0	0	0	3/5	0	0	1/5	0	0
Q	0	0	0	0	0	0	2/5	0	3/5	0
R	0	0	0	0	6/41	5/41	15/41	0	0	15/41
D	0	0	0	2/11	0	6/11	0	0	3/11	0

B. Bad path avoidance using SIGNAL Bit

In this thesis a new technique is proposed for identifying and bypassing the bad paths. A SIGNAL Bit (SB) at every link, indicating its status. The SB can contain either a value 0 or 1. 0 indicates no congestion and 1 indicates congestion in the link. Since only 1 bit is required to store the SB it does not introduce much overhead.

For each incoming lines we have outgoing lines in the routing table from which one outgoing line is selected. Based on SB the ATM switch connects an incoming link to an outgoing link which is free from congestion. When the link capacity is equal to or little lower than the Bandwidth allocated the SB is set, which does not allow other nodes to use this link. There by avoiding congestions to happen in the network.

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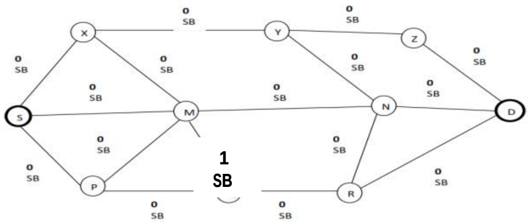

Fig.2: Network with a bad path

SPM is a n x 1 matrix, where n is the number of adjacent nodes for a particular node. Initially the entries of SPM matrix are all zeros (i.e. SB=0), when there is a failure the corresponding entry in SPM is made to 1(i.e. SB=1). The steps involved in this process are as listed below

1. Initially all SPM entries are zero indicating that there is no failure.

For example consider the network in fig 4.6

$$\text{SPM of Node S} = \begin{array}{c} X \\ M \\ P \end{array} \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

When a link fails in the network and a node identifies the failed link. EC Message is broadcasted and the corresponding SPM matrix values are updated. For example consider the network in fig 4.6 where a link fails as shown in Fig 4.7.

$$\text{SPM of node } \mathbf{M} = \begin{array}{c} N \\ O \end{array} \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

2. The entire nodes will bypass this link during transmission until it is restored from failure.
3. When a failed link is identified the recovery process is initiated.

This is a very simple procedure to avoid congestion and to protect the network from a failure. When a failure occurs all the neighboring nodes are intimated about the failure, so that they don't opt for the failed path during any further data transmission. This approach protects the network from performance degradation after a failure occurs.

IV. ADVANTAGES OF PROPOSED PATH MANAGEMENT

The cost of implementation of the algorithm is far less than the other algorithms, especially when there is a historical path from a specific source to destination. The Proposed system handles dynamic traffics with consistent routing. A single bit is used to avoid bad paths in the network, which is not costlier than the existing techniques.

V. RESULTS

The Proposed Path management technique performance is illustrated in the below figure. The simulation results showed that the algorithm find the optimal path from a specific source to destination. Table 4.3 shows the throughput values for different number of nodes by using the proposed path management. From the table is evident that the throughput does not decrease as the number of nodes is increasing. Fig 4.8 represents the same graphically as the number of nodes are increasing the graph takes a linear path.

Throughput = No. of packets transmitted per unit time

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Table 3: Throughput of the network using proposed path management

No. of Nodes	Throughput (Mbps)
10	5
20	5.89
30	6.12
40	6.25
50	6.05
60	6.07
70	6.05
80	6.07

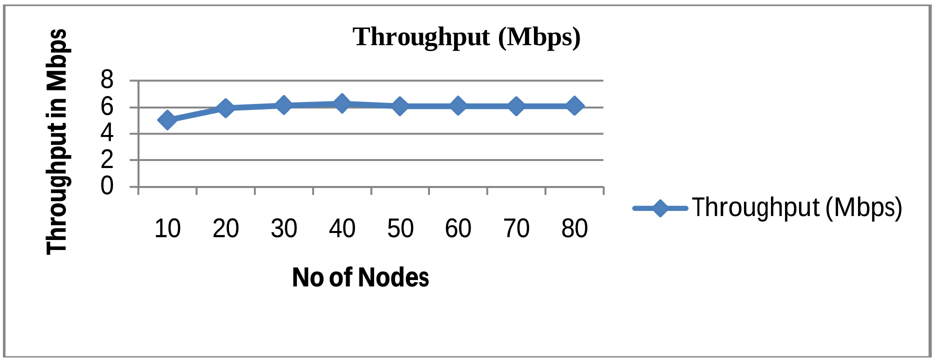

Fig.3: Performance evaluation of Proposed Path management by using Throughput parameter

Cell Loss Ratio (CLR): The percentage of cells that are lost in the network due to error or congestion and are not received by the destination. CLR= Lost cells/ Total Transmitted cells

Table 4.4 shows the cell loss rate with different number of nodes by using the proposed path management. From the table is evident as the number of nodes increase the CLR also increases but the incremental ratio is less and it is linear from 70 nodes. Fig 4.9 represents the same graphically as the number of nodes are increasing the graph takes a incremental path.

Table 4: Cell Loss rate of the network

Number of Nodes	CLR
10	1e-6
20	1e-5
30	1e-4
40	0.0001
50	0.001
60	0.01
70	0.1
80	0.1

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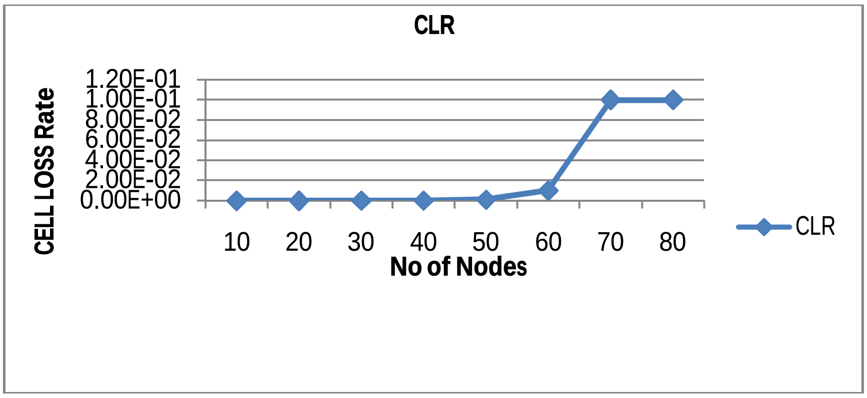

Fig.4: Performance evaluation of Proposed Path management by using CLR parameter

C. CONCLUSION

This Paper presented the existing Path Management techniques and their drawbacks. This paper first described the existing VP routing algorithms and VP path selection techniques finally it described a new path management techniques is used for finding optimal paths and to avoid bad paths. The paper ends with the results and summary of the proposed path management technique.The simulation results show that the proposed path management technique is able to find the optimal paths at a faster rate when there is historical paths and its performance is not poor even when there is no historical paths.

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BIOGRAPHY

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Dr. K.Sailaja is working as associate Professor in the Department of MCA, Chadalawada Ramanamma Engineering College, Tirupati. She did her Ph.D. in Computer Science in the area of Computer Networks. She is in teaching since 1999 and having 11 years of research experience. She completed her M.Phil in computer science in the area of WDM networks. She finished M.Tech in computer science and Engineering. She presented papers at National and Internal Conferences and published articles in national & international journals.