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A PATH FOR HORIZING YOUR INNOVATIVE WORK

PATH COMPUTATION BASED ON QoS PARAMETERS

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Abstract: - When dealing with the reliability of a network, it is important to maintain the network components physically connected. When all the components are connected but then also the end user is not getting the service, means that there is performance degradation. Such performance failure of a network occurs due to the imbalance of Quality of Service parameters such as delay, jitters, bandwidth, throughput, etc. It is important to detect such failure and find the counter measures. In a network, all the services should offer Quality of Service guaranties that are resilient to failure too. The Quality of Service connection requires that the existing routing mechanism should compute a path that satisfies QoS constraints. Path computation algorithm based on Quality of Service parameters (QoS) is a routing algorithm which deals with Quality of Service requirements of the end user who is using the service. The main aim of Quality of Service routing algorithm is to provide a flawless service to the end user. Generally emphasis is given only on the link components for finding the QoS satisfying path. We have proposed a QoS constraint routing algorithm which is a type of Multi-constrained routing algorithm where multiple node as well as link parameters are taken into consideration and compared our algorithm with the existing algorithms.

Keywords: Quality of Service, QoS parameters, Multi-Constrained Path, Multi-Constrained Optimal Path.

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INTRODUCTION

Monitoring and diagnosis of network conditions is a central problem in networking. As such, it has received a lot of attention in the Internet community in general and in the context of wired networks in particular. Therefore, how to construct an Internet performance monitor system with reliable performance measurement technique is so important for both ISPs and end users.

A Service Level Agreement (SLA) is a contract between a network provider and a customer that defines all aspects of the service that is to be provided. An SLA generally covers availability, performance and customer service. While the telephone operating companies are able to provide very tight performance assurances for circuit switched digital data services, packet switched networks are much less conducive to predictable behavior.

For QoS routing, it is important to have all information about network resource. This information can be gained by path establishment protocol or existing routing protocol. The protocol such as Open Shortest Path First provides the link state information like delay, bandwidth, etc. The type-of-service field of the protocol contains such information. In the past decade, active measurement techniques have been proposed that send sequences of probe packets from a source to receiver, and infer link-level metrics of interest from the received packets.

It is important to give equal importance to both nodes as well as link QoS parameters when dealing with QoS routing. Therefore, our algorithm has focused on both parameters. In this paper we have compared our algorithm with the existing routing algorithms and the result is shown.

The paper is divided into following manner. In section II, we have described the gist of the survey conducted during our research. Section III describes QoS routing technique along with existing algorithm which we took for comparison. In section IV, we have described our proposed Multi-Constrained Routing Algorithm (MCRA). The system architecture is described in section V. Section VI describes the mathematical model of our system. The final section VII gives the result of experimentation along with conclusion.

I. LITERATURE SURVEY

There are two types of Multi-Constraint Optimal Path problem - RSP and MCP. If K is the number of constraint then for K=1, the MCOP problem is called as Restricted Shortest Path, whereas for K ≥ 2, the MCOP problem is called as Multi Constrained Path. Both of these problems are NP-Complete and can be solved by pseudo-polynomial-time algorithms. However, these algorithms are computationally very expensive and therefore to deal with this problem, heuristics and approximation algorithms are introduced.

Mainly the previous study for QoS routing was surrounded by only single constraint or QoS in context of bandwidth and delay parameters alone. Many researchers worked on either one or two QoS constraints. But equal importance should be given to all QoS constraints and therefore multi-constrained term was introduced. An effective heuristic algorithm was introduced by Korkmaz and Krunz [8], for any number of constraints irrespective of their nature and dependencies. But the drawback for this scheme was that, as the heuristic approach was used the performance of algorithm was not always improved. Later Sobrinho [5] introduced the concept of hop-by-hop routing. The forwarding decisions were made independently by each node itself based on the destination address of incoming packet so that path computation takes place locally at the node. But hop-by-hop routing has limitations for QoS support. It does not operate correctly for every type of QoS path.

Mostly, the entire QoS routing algorithm uses unidirectional search to find the path that satisfy all constraints. The search starts from the source node and communicate in a network until a certain condition is satisfied and feasible path is obtained or no feasible path found. In such condition the maximum routing process time is consumed in finding the path between source and destination that satisfies all constraints and the quality of returned path. To reduce the searching time, a bidirectional multi constrained routing algorithm is introduced. The Bidirectional Multi-Constrained Algorithm [1] solves the three major perspectives - find k-shortest paths using bidirectional search, find the halt condition for bidirectional search without hampering the effectiveness of algorithm and gives a novel effective multi constrained routing algorithm.

II. QoS ROUTING

QoS routing has as main aim the selection of paths that satisfy the requirement of input traffic in the network. The QoS requirements can be specified in terms of certain constraints e.g. desired bandwidth, delay, number of hops, variation in delay experienced by receiver side (jitter), packet loss that can be tolerated, cost of links etc.

The QoS constraints can be represented in the form of metrics. Metric for a complete path with respect to each constrained parameter is determined by the composition rules of metrics. The basic rules are given below-

A. Additive Metric

The value of that constraint for a path is the addition of all links constituting path. For Example - delay, jitter, hop count, cost.

B. Non-Additive Metric

This is again classified into two types such as follows-

a. Multiplicative Metric

The value of the constraint of path is the multiplication of all its links or edges. For Example - reliability, probability.

b. Concave Metric

Here, either we take minimum value or maximum value of the link among all the links in the path. For Example - bandwidth.

The path that obeys the desired constraints is called as Feasible Path. And the path having either minimum or maximum value for a constraint is referred as Optimal Path.

For additive parameters we have used the Bidirectional extended Bellman-Ford (BEB) algorithm, which is given as follows where, a graph G is used to denote a network having s as sources node, t as destination node and c as cost of additive parameters (delay, weight, queue length) for finding feasible paths.

Algorithm Name : BEB(G,s,t,c)

```
IF ( EB(G,s,t,c,LeastCost) = SUCCESS )
   return SUCCESS
ELSE
   IF ( LeastCost ≥ f(c) )
    return No Feasible Path Exists
   ELSE
     Compute New Cost Function f(x)
```

```
      IF ( EB(G,s,t,c,LeastCost)=SUCCESS )
        return SUCCESS
      ELSE
        IF( LeastCost ≥ f(c) )
          return No Feasible Path Exists
       ENDIF
    ENDIF
  ENDIF
ELSE
      return FAIL
ENDIF
```

For non-additive parameters (bandwidth) we have used a simple Dijkstra Algorithm where the parameters are compared with the threshold values. If it satisfies the threshold values then minimum cost path is calculated using Dijkstra Algorithm based on link weights.

III. MULTI-CONSTRAINED ROUTING ALGORITHM (MCRA)

Our proposed algorithm uses both the additive as well as non-additive parameters for finding the feasible as well as optimal path. The proposed Multi-Constrained routing algorithm (MCRA) is given below:

Algorithm Name: Multi-Constrained Routing Algorithm (MCRA)

For (each node $x \in V(G)$)

{

$cost_i[x] \leftarrow \infty$, $i \in \{1,2,...,k\}$

$\pi_i[x] \leftarrow NIL, \forall i \in \{1,2,...,k\}$

}

```
cost1[s] ← 0;

π1[s]  ← NIL;

For ( i= 1 upto k)

{

     u ← EXTRACTMIN(Qi) ;

     If (costi[u] == INFINITY)

     {

          BREAK;

     }

}

For (each node v such that (u,v) ϵ E(G))

{

     c ← costi[u] + cost(u,v) ;

     If( c < costk[v] )

     {

          Determine the lowest index x (1 ≤ x ≤ k) such that

          c < costx[v];

          DECREASEKEY(Qx,<c,v>) ;

          πx[v] ← u ;

     }

}
```

IV. SYSTEM ARCHITECTURE

The system architecture is described in Figure 1.

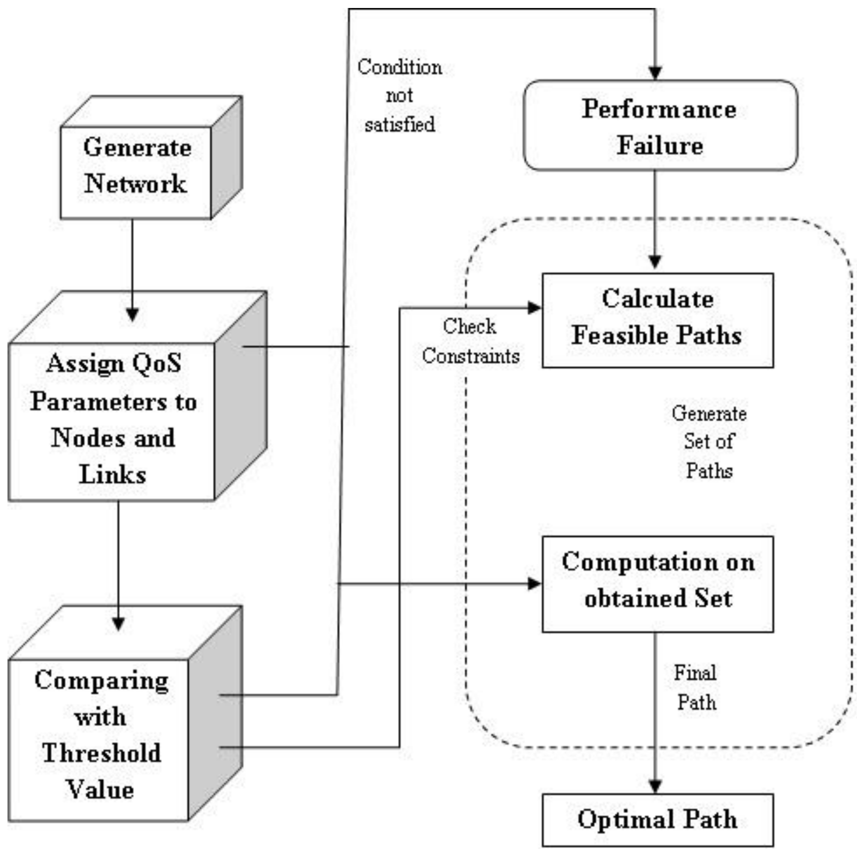

Figure 1. System Architecture

A wired network is generated in the first phase. All the links and nodes are given certain characteristics values. The values stored compared with the threshold which is selected on the basis of the application type. If certain path does not follow the constraint then it is considered as failure and passed to the next phase of feasible path computation to find alternative path. All the paths that satisfy the given constraint are obtained from source to destination. The set of paths obtained is forwarded to the next phase. Here the best suited path which follow all constraints is calculated which will be the final output.

Thus, the end user gets the service without even knowing the background details and our aim of failure resilient network service is achieved.

V. MATHEMATICAL MODEL

The mathematical model is in Figure 2, where I here is an input, A1 is algorithm for storing parameters, A2 is algorithm for comparing parameters with input, A3 is algorithm for performance failure detection, A4 is algorithm for finding feasible paths, A5 is algorithm to compute optimal path out of feasible paths and F is the final state.

Consider a network G (V, E, c) where V is set of vertices, E is set of edges and c is the cost as a connected graph. Furthermore, a source vertex s is given. Find for each v ϵ V a dipath from r to v (if such one exists).

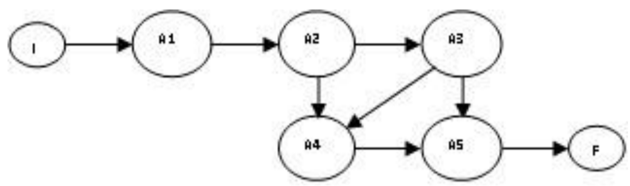

Figure 2. Mathematical Model

For s, n-1 paths have to leave s. For any other vertex, the number of paths entering the vertex must be exactly 1 larger than the number of paths leaving the vertex.

Let Ne denote the number of paths using each edge e ϵ E. The mathematical model for Shortest Path will be,

$$\min \ \Sigma_{e \in E} \ c_e N_e$$

s.t.

$$\Sigma_{v \in V} N_{v1} - \Sigma_{v \in V} N_{1v} = -(n-1)$$

$$\Sigma_{v \in V} N_{vu} - \Sigma_{v \in V} N_{uv} = 1 \qquad u \in (2,3,\ldots,n)$$

where,

$$N_e \in Ƶ+ \qquad e \in E$$

Consider an n-vector y = y[1] ,..., y[n]. If y satisfies that y[s] = 0 and for all (v,w) ϵ E : y[v] + c[v,w] ≥ y[w] then y is called a feasible path. If P is a path from s to v ϵ V, then if y is a feasible path, c(P) ϵ y[v]:

$$c(P) = \sum_{i=1}^{k} c_{ei} \geq \sum_{i=1}^{k} (y[v_i] - y[v_{i-1}]) = y[v_k] - y[v_0] = y[v]$$

VI. RESULT AND CONCLUSION

The sample network containing 14 nodes is used for experiment. We have compared our algorithm with the existing shortest path computation algorithms, i.e. Dijkstra and Bidirectional extended Bellman-Ford (BEB) algorithm. Algorithm 1 uses additive parameters (delay, queue length). Algorithm 2 uses non additive parameter (bandwidth). Algorithm 3, i.e. our MCRA algorithm uses both additive and non additive parameters. We have plotted a graph against all three algorithms as shown in Figure 3.

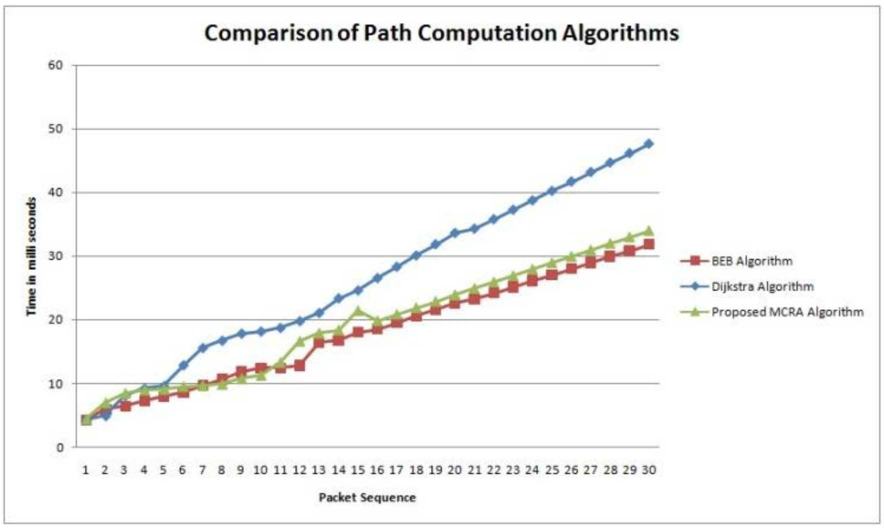

Figure 3. Comparison of different algorithm

From the graph we can conclude that our algorithm perform moderate compared to both with the advantage of using both node as well as link QoS parameters.

Majorly QoS path computation is done using single or two QoS parameters. Our MCRA algorithm uses both node and link QoS parameters for path computation and thus emphasis on Node and Link Characteristics strengthen path computation process (as shown in the comparison graph) to provide flawless service to end users.

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