MDBR algorithm for Routing as well as Load balancing with link failures on grid topology.

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Abstract – *Routing algorithm is very crucial in choosing, appropriate path to transfer the data packets from desired source to destination. Handling the congestion is one more challenge faced while routing the data packets. Even though there are ample number of routing protocols for choosing shortest paths and increase final throughput of existing network, in this paper we are going to discuss a protocol which not only transmits data using shortest paths but also balances the nodes on the routed path in order to face the congestion challenge, which named as Modified Depth breadth routing (MDBR) algorithms. Usually performance is measured as bits which are delivered in specific time I.e. throughput along with total data packets successfully transmitted to the destination. Here we considered performance measure as sum of costs between edges involved in routing. while data transmission if it suffers with congestion, Proposed mechanism traces areas with congestion on the network later it distributes the data from congested node with a check of incoming data flow and outgoing data flow of network traffic in form of packets and excess traffic is being diverted to other nodes which are participating in forming shorter paths and performance of proposed protocol is analyzed when there happens different failure of wires on network*

Keywords: congestion control; balancing of Load; load balancing concept; distribution of traffic ; failure of wires;

1.Introduction

Now in hyper speed network communications crucial role is played by routing algorithms in resolving ample number of issues. The performance of network is calculated as average transmission speed plus throughput of the system.

Usually network performance will be evaluated based on average transmission time combined with throughput of the system. The existing routing protocols are not capable of handling increased complexity on networks, where as scalability is concern with centralized algorithms, though static algorithms can handle problems of changed occurrences with Networks and Dynamic algorithms with distribution networks but they are facing stability problems. There is a scope of tremendous techniques are supposed to be implemented in data transmission throughout network with enforced optimization [1]. These techniques which includes data flow along congestion control in which nodes behave accordingly to hike or decrease the speed of the destination nodes which acknowledges packet are expected in the transmission [2, 9, 11].

The process of establishing communication path between sources to destination nodes is called as routing [5, 13, 14]. Computer scientists have carried out research on routing protocols for transmitting data which can handle the congestion in a network (a major issue) with optimized path techniques.

Main aim of load balancing is to spread the load equally on every node which is involved in computing with minimising the total time taken for executing the task as well as maximising the utilization. This is nothing but minimising the response time with improvement of rate of resource utilization. Load balancing can be done in two ways either static or dynamic.

Load balancing can be done either dynamically or statically [3, 4]. Static decision depends on current state of system which is a simple method with limited benefit due to lack of adapting time varying state where as dynamic approach relies on the state of system at the time of decision[3, 4, 9, 12]. Division of Load balancing protocols into number of clusters is based on the available information.

Particularly new computer model named Ant Colony Optimization (ACO) behavioral model[1, 14], can be used to solve minimization and other combinatory problems. Principles which control behavior of systems of nature is called load balancing [6, 11]. Number of distributed agents were evolved and interacted in a simulation model which is supposed to reach global goal. For problem solving the structure is distributed which emphasizes directly or indirectly among simple agents. For network applications involving tracing shortest routing paths, load balancing and so on, these multi agents can be used.

The proposed algorithm will handle congestion by balancing nodes with distribution of load to other nodes in existing paths.

3. PROPOSED CONCEPT

Proposed protocol is a combination mechanism with two concepts namely leaking bucket, Token bucket which named as (Modified Depth Breadth Routing algorithm) MDBRA which Ant colony optimization ACO implemented to handle congestion in network data communication.

Concept been adopted from LB is as follows when the bucket is full with water which leaked at constant speed here inflow rate exceeds outflow for minimizing the congestion. Same technique is implemented with ACO to balance the nodes of heavy traffic in the communication channel. Congestion occurs when the inflow capacity of node exceeds the outflow and this result in the down fall of the throughput because of the loss of the data packet during the transmission to desired destination.

Here one can balance data nodes with leaking bucket method with a condition at each node data inflowing should always less than or equal to data out flowing. Any node fails above mentioned condition then there exists congestion so excess data flow should change route to other nodes whose data inflow is less than data outflow.

3. Modified Depth-breadth routing algorithm

DB routing algorithm is for searching shorter paths in the network but it won't carry the node balancing concept. With few added modifications to the original DB routing to enhance its behavior and performance which is named as Modified Depth Breadth routing algorithm [8, 9].

Modifications which were implemented in MDBR first to handle Congestion. This is done with load balancing concept which is implemented in two parts.

1. MDBR for direct representation: Every inner node is checked whether sum of its outflow or equal to or less than its own inflow of data, which is the output of our MDBR algorithm and actual data flow, stored in algorithm forms its input.

2. Every node of network which lies inside is identified to balanced flows:

All nodes which exist in selected path, checked as follows. If total input data flow exceeds total output data flow then a path is being identified from given node to the starting node and input flow is decreased to maximum possible extent along that path. This method is repeated for every node till all excess input data flow been removed.

4. VARIABLES AND PROPERTIES USED IN THE PROPOSED ALGORITHM.

Most critical part of algorithm is about movement of the ants. A random ant *A* at vertex m next vertex n is chosen based on three variables

1. A table list T_a containing all the visited vertices and visited edges in this run, if vertex *n* is in the table list, the possibility of choosing n is 0. So the ants are forced to create a valid tour.

2. The heuristic desirability η_{mn} – in the proposed System known as *visibility* – is defined as the inverse of the weight between *m* and *n*.

3. Virtual pheromone trail $\tau_{mn}(t)$ – also known as the learned desirability – is the pheromone trail on the edge connecting vertex *m* and *n* at time *t*.

sets up the following stochastic state transition rule. It constructs the probability distribution in the basic ACS algorithm. M_n^{TA} denotes the restricted neighbor hood of ant *A* on vertex m:

$$p_{mn}^{A}(t)=\begin{cases}\dfrac{[\tau_{mn}(t)]^{\alpha}.[\eta_{mn}]^{\beta}}{\sum_{l\varepsilon J_m^{TA}}[\tau_{ml}(t)]^{\alpha}.[\eta_{ml}]^{\beta}}, mfjnJ_m^{TA}\\ 0, otherwise\end{cases}$$

Which is the possibility for ant *A* at time *t* to go from vertex *m* to vertex *n*, where α and β are adjustable variables for the relative weight between visibility and pheromone trail.

Trail Deposition and Pheromone Trail Update:

The pheromone trail update property was implemented as Dorigo et al. used in AS is defined for every edge(*m*,*n*)

$$\tau_{mn}(t)\rightarrow(1-\rho).\tau_{mn}(t)+\Delta\tau_{mn}(t)$$

Where $\Delta\tau_{mn}(t)\equiv\sum_{A=1}^{m}\Delta\tau_{mn}(t)$

is the sum of pheromone deposited on the edge by all ant at iteration *t*. The pheromone deposited by each ant depends on the quality of the solution that the ant has constructed. Ant - where *Q* is a variable, which should have a value of same magnitude as the length of an optimal solution (although this can be disregarded) *k* deposits the following pheromone amount $\Delta\tau_{mn}^{A}(t)$ after a complete tour on each edge (*m*,n) that it has used in the solution:

$$\Delta\tau_{mn}(t)\equiv\{Q/L_A(t), if\ (m,n)\in T_{A(t)}$$
$$0, otherwise$$

$T_A(t)$ is the tour done by ant A at the iteration t and $L_A(t)$ is the length of this tour.

A.Load Balancing Concept In the proposed method

Main focus of DBR algorithm is on a searching technique implemented while routing in the network. Load balancing will clear the congestion problem which is crucial and current challenge of routing. By introducing the load balancing concept congestion problem is being handled. Optimal solution was found by deterministic model which adjusts the data flow at every node until the node is balanced precisely of input data flow and output data flow.

B.Ant colony optimization algorithm

In this algorithm a network with A of nodes associated in it where *x* is a generic source node and *y* destination node with existence of two categories of ants in the network named as Forward ant and Backward ant.

Forward ant which traverses from source node x to destination node y represented as FA x→y.

Backward ant is being generated by a forward ant FA x→y in the destination node y and represented as BA x→y.

Upon updating routing tables of the visited nodes, backward ant traverses through *FA x*→y path as per the information gathered before by *FA x*→y to reach the source node s.

Every ant holds a stack *Sx*→y(A) of data in the system, where the *A* index refers to the *A* visited node, in a journey, where *Sx*→y(0)= *x*, *Sx*→y (*m*)= *y*, being *m* the jumps done by *FA x*→y for to reach destination *d*.

Let any network node designated as A will hold a routing table with A entries, one for each possible destination.

Let assume *n* be a entry of *A* routing table (possible destination).

Let assume set of neighboring nodes of node *k be Ak* .

Let *Pmn* be the probability with which an ant or data packet in *k*, jumps to a node *m*, *n €Nk*, when the destination is *m* (m≠*k*). Then, for each of the A entries in node *k* routing table, it will be *nA* values of *Pmn.*

$\sum_{i€ Nk}$ Pm,n=1,m=1..N (1)

5. Experimental Setup

In this proposed protocol MDBR algorithm simulated network is a domain of combined LB, TB with ACO algorithm was executed by representing physical network objects.

For simulation two types of topologies were planned namely 5X5 Basic properties were tested on 2X2 topology which is simple in representing, here the distribution and convergence of the path is being tested.

Using 5X5 and 10X10 topologies describing and investigation of the traffic will be convenient. Simplicity of regular topology and reduced complexity made easy to explain about the paths of network.

About the types of topologies:

2x2 grid which is also named as Double Bridge. This consists of four routers connected by four wires.

5X5 grids with 25 experiments were conducted on a 5X5 grid network, which consists of 25 routers connected in a grid with wires between adjacent routers. This topology is used to test MDBR ability to route in a 'larger' (but still simpler) network.

The reason behind choosing these grid topologies for simulation is, the positions of the routers are arbitrarily chosen and there exists many numbers of feasible paths.

Approach for for handling the congestion in the proposed protocol

In existing network, for every inner node the total outflow should be equal or less than input flow. This forms the output for the MDBR algorithm and actual flow will be the input.

At each inner node in the network, balanced flows should be identified. In the selected route, for each node the total inflow exceeds the total outflow then a path is being identified from the source node and the flow is adjusted by minimizing the flow to maximum extent. This process is continued several times for every node in the selected route till the excess flow is being removed.

The flows primarily satisfying at every internal node the sum of outflows is at most as greater as sum of its inflows will be the input for this protocol. The balanced flows of which holds condition (for each inner node, sum of out flow is equal to total inflow)

6. Experimental Analysis

Proposed algorithm is executed in fourteen different ways one without link failure and remaining with randomized link failures on 2X2 and 5X5 topologies. Bench mark algorithm Dijkstra algorithm stopped execution when it reached the failure link in the network where as MDBR algorithm continued execution without much effect on it with slightly increased hop count and average traversal time. MDBR algorithm was not much affected with the link failures, it continued with other links available (which not suffered with failures) on the network channel. Experimental results were depicted in the following table 1 with different types of link failures.

Experimental Results

TABLE I
RESULTS FROM THE EXPERIMENTS FOR 25 NODES OF 1000 PACKETS

Link Failure %	No. Of Hops	Average time for Packet in milliseconds
4	06	368.19
8	05	363.24
12	08	403.05
16	06	432.05
20	06	442.99
40	08	388.25

7. Conclusion

One can conclude from the above experiments conducted and with obtained results, the effect of link failure was not effect much on the MDBR algorithm expect with slight variation in the average speed and the number of hops and finally MDBR algorithm was able to transmit the packets from source to destination without any effect of link failures where as the Dikstrar's routing algorithm failed to execute even with single link failure in the grid network topology where as the MDBR algorithm was successfully executing even in case of link failures in the network. This is due to the mechanism implemented to balance the nodes with heavy traffic and diverting to other possible paths on the network channel. It controls the congestion and data packet loss is controlled to the maximum extent even in case of various link failures.

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