A Study of Congestion Control Mechanism Using Link Failure Detection in MANET

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Abstract- In MANET, routes may fail due to failure of links which may be caused by movement of nodes. In addition when mobility speed is high, link failures occur more causing delivery ratio to decrease. So the problem of packet losses and delays can be solved to a certain extent by detecting the link failures. From a long time Ant Colony algorithm is used in MANET because of its same structure and constraints with communication network.Still now Ant Colony optimization process is used only for route discovery and load balancing. In this article we find the different mechanisms for the link failure detection by using alternate route finding from the nearer of the faulty node resulting into improvement in throughput, and end to end delay parameters. And we compare the results with existing mechanisms so as to enhance the overall network performance.

Keywords-MANET,Routing,Congestion, Pheromone

I.   INTRODUCTION

Ad-hoc networking is a concept in computer communications, which means that users wanting to communicate with each other form a temporary network,without any form of centralized administration. Each node participating in the network acts as host and a router and must therefore be willing to forward packets for other nodes. The most important characteristics is the dynamic topology,which is a consequence of node mobility.Nodes can change position quite frequently leading to packet loss. The biggest challenge in MANETs is to find a path between communicating nodes, that is, the MANET routing problem. The considerations of the MANET environment and the nature of the mobile nodes create further complications which results in the need to develop special routing algorithms to meet these challenges. Swarm intelligence, a bio-inspired technique, which has proven to be very adaptable in other problem domains, has been applied to the MANET routing problem as it forms a good fit to the problem.

In this paper we studied different mechanism like Ant Colony Algorithm [1],Split multipath routing(SMR)protoco[2]lTCP with Explicit Link Failure Notification[4], TCP-BuS(TCP

with BUffering capability and Sequence information)[11],

TCP-F: A Feedback-Based Scheme [2]

The remaining part of the paper is organized as follows: In section II we provide the studied congestion control mechanism using link failure detection.In section III comparison between these algorithms is presented. In section IV we concluded the paper.

II.   ALGORITHMS

Many approaches exists for improving the parameters which affects the congestion using link failure detection Some of them are explained below:.

A.   Ant Colony Algorithm -Local link repairing of AODV

Ant Colony Algorithm has been used in Mobile Network since long because of isomorphism between them. ACO (Ant colony optimization) is used in the process of route discovery and load balancing only, but it will be used in case of link failure. Routing table at each will collect additional information of the next In case of link failure an alternate route for next to next node can be searched by applying ACO . Probably overhead parameter will also improve as control packets used in this case are only forward ants and backward ants. On the other hand control packets transmitted in pure AODV are RERR and R-RREQ (RREQ in case of route failure) will reduce.

Step 1: When a node enters in the network, it indicate its presence by the exchanging Hello message from other nodes in the network. Each active node periodically broadcasts a Hello message that all its neighbors receive. If a node fails to receive several Hello messages from a neighbor, a link break is detected. Hello messages is used to detect and monitor links to neighbors.

Step 2: When data transmission is required from a source to a particular destination, source node broadcasts a Route Request (RREQ) for that destination. Intermediate nodes creates a route to source, when a RREQ is received. If the receiving node has not received this RREQ before, is not the destination and does not have a current route to the destination, it rebroadcasts the RREQ.

Step 3: Route Reply (RREP) is generated If the receiving node is the destination or has a current route to the destination. RREP is unicast in a hop-by-hop fashion to the source. As the RREP propagates, each intermediate node creates a route to the destination. When the source receives the RREP, it records the route to the destination.

Step 4: Source begin sending data through the available valid route. If multiple RREPs are received by the source, the route with the shortest hop count is chosen. During the transmission Route table at each node is maintained by updating the timer associated with the route from source to destination.

Step 6 :*Neighbor detection*: All the neighbors of a particular node are exchanging hello message.Each node in the network is aware about its surrounding nodes.

Step 7 :*Routing table management :*In this case routing table will have one additional column. This column will have IP address of next to next node in the active link, which is modified by RREP packet. RREP has information about all nodes present in the link i.e. generated by destination.

Step 8 :*Ant-agent generation*: Two types artificial ant, forward ant (F-ANT) and backward ant (BANT), are utilizes to accomplish the route maintenance. F-ANT is in charge of establishing the pheromone routes from node 3 to its destination, at the same time, the pheromone routes from a destination to node 3 are created by B-ANT.

The formats of them are as follows:
F-ANT*<node address,Sequence ,number (Sn), Destination address,route records(dynamically increasing list ,including the intermediate nodes which F-ANT passed through and the corresponding arriving time),Hop count (Hc)>*
B-ANT*< node address,Destination address(the Source address of corresponding F-ANT),dynamical route records (its meaning same as in FANT),Sequence number (Sn)>*

Step 9 :*Transition probability*: The transition probability from node i to node j for the kth ant as

$$P_{ij}^{k}(t) = \frac{\tau_{ij}^{\alpha}(t)\ \eta_{ij}^{\beta}}{\sum_{k\in N(s^{p})}\tau_{ij}^{\alpha}(t)\ \eta_{ij}^{\beta}}$$

Where τ_{ij} and η_{ij} are respectively the pheromone value and the heuristic value associated with the component. Furthermore, α and β are positive real parameters whose values determine the relative importance of pheromone versus heuristic information.

Step 10 :Trail intensity:The trail intensity is updated according to the following formula

$$\tau_{ij}(t)\ = (1-\rho)\ \tau_{ij}(t) + \Delta\ \tau_{ij}(t)$$

B.   Split multipath routing(SMR)protocol

SMR is an on-demand protocol that builds maximally disjoint routes. These scheme uses two routes for each session; the shortest delay route and the one that is maximally disjoint with the shortest delay route. We attempt to build maximally disjoint routes to avoid having certain links from being congested, and to efficiently utilize the available network resources. Providing multiple paths is useful in ad hoc networks because when one of the route is disconnected, the source can simply use other available routes without performing the route recovery process.
    There are two approaches in SMR route maintenance.
1.Builds a new pair of routes when any existing route of the session is disconnected.
2. It performs rerouting only when both routes are broken. SMR had considerably fewer packet drops compared with DSR.
Split Multipath Routing (SMR) that establishes and utilizes multiple routes of maximally disjoint paths which helps minimizing route recovery process and control message overhead.

*C. **TCP with Explicit Link Failure Notification***

Explicit Link Failure Notification technique is similar to TCP-F. However in contrast to TCP-F, the evaluation of the proposal is based on a real interaction between TCP and the routing protocol This interaction aims to inform the TCP agent about route failures when they occur. It use an ELFN message, which is piggy-backed on the route failure message sent by the routing protocol to the sender. The ELFN message is like a "host unreachable" Internet Control Message Protocol (ICMP) message, which contains the sender receiver addresses and ports, as well as TCP packet's sequence number On receiving the ELFN message, the source responds by disabling its

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retransmission timers and enters a "standby" mode. During the standby period, the TCP sender probes the network to check if the route is restored. If the acknowledgment of the probe packet is received, TCP sender leaves the standby mode, resumes its retransmission timers, and continues the normal operations.Transmission Control Protocol (TCP) used in the wired networks performs satisfactory and the overall throughput of the ad hoc network is low. It has been determined that Explicit Link Failure Notification (ELFN) implemented, significantly increases the throughput size.
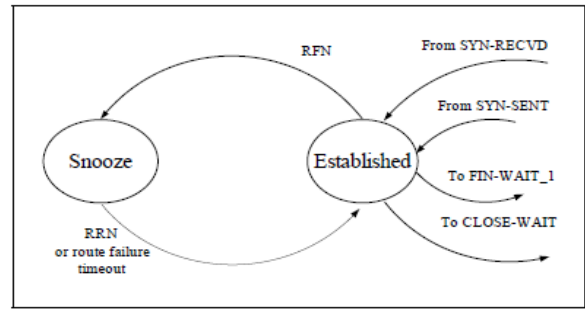
D.   **TCP-BuS:**

In TCP-Bus (TCP with BUffering capability and Sequence information), intermediate nodes buffer packets in case of a route failure instead of dropping them.The intention is to not having to retransmit all these packets. To avoid timeouts at the source when buffered packets are delivered after the route is reconstructed, the timeouts for these packets are extended.Selective retransmission requests by the destination node allow a fast recovery from lost buffered packets without the need
 to wait for these extended timeouts to expire. A scheme for avoiding unnecessary retransmission requests is proposed. In order to ensure the delivery of control messages like route failure notifications, a reliable delivery scheme is suggested for these messages. To detect a re-established route both explicit notifications and probe packets, i. e., both the TCP-F and the ELFN way of detecting the new route, are examined.

E.   **TCP-F: A Feedback-Based Scheme**

In TCP-Feedback scheme, the sender is forced to stop transmission without reducing window size upon route failure. As soon as the connection is reestablished, fast retransmission is enabled.TCP-F relies on the network layer at an intermediate node to detect the route failure due to the mobility of its downstream neighbor along the route. A sender can be in an active state or a snooze state. In the active state, transport layer is controlled by the normal TCP. As soon as an intermediate node detects a broken route, it explicitly sends a route failure notification (RFN) packet to the sender and records this event. Upon reception of the RFN, the sender goes into the snooze state, in which the sender completely stops sending further packets,and freezes all of its timers and the values of state variables such as RTO and congestion window size. Meanwhile, all upstream intermediate nodes that receive the RFN invalidate the particular route to avoid further packet losses. The sender remains in the snooze state until it is notified of the restoration of the route through a route reestablishment

Figure 4- State machine of TCP-F

III.   COMPARISON

In Ant Colony Algorithm,Overhead parameter will also improve as control packets used in this case are only forward ants and backward ants.Throughput and end to end delay parameters can be improved.In TCP-F Receipt of RFN at the source results in freezing of its state and reduces unnecessary SENDs as well as timeouts. Source can resume transmission earlier than in case of TCP which leads to increased throughput and reduction in the number of retransmissions. Avoids successfully undesired retransmissions from the source Improves the efficiency of source to receiver's delivery with the aid of buffer.

Split Multipath Routing (SMR) that establishes and utilizes multiple routes of maximally disjoint paths which helps minimizing route recovery process and control message overhead.A scheme for avoiding unnecessary retransmission requests is proposed. In order to ensure the delivery of control messages like route failure notifications, a reliable delivery scheme is suggested for these messages. To detect a re-established route both explicit notifications and probe packets, i. e., both the TCP-F and the ELFN way of detecting the new route, are examined.

IV.   CONCLUSION

In MANET, routes may fail due to failure of links that may be caused by movement of nodes. In addition when mobility speed is high, link failures occur more causing delivery ratio to decrease. So the problem of packet losses and delays can be solved to a certain extent by detecting the link failures.Packet delivery failures due to wireless link collisions may incur unnecessary route reestablishments from the source node. Thus this type of route reestablishment can be prevented if there exists a mechanism different mechanisms for the link failure detection by using alternate route finding from the nearer of the faulty node resulting into improvement in throughput, and end to end delay parameters.
    Thus performance of MANET will be significantly increased, along with TCP throughput.

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