Efficient Fault Tolerent Design For Multipath Routing Protocol In Manet

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Abstract: The rapid advancements in wireless technology make the communication in an easier and effective manner. Mobile ad hoc Network (MANET) is a popular wireless network, having collection of mobile nodes communicated through wireless links without using any predefined infrastructure. Routing Protocols serves as forwarding of data packets to have effective Data transfer among the nodes. The performance of ad hoc routing protocols will significantly degrade when there are faulty nodes in the network. The fault tolerant routing protocol addresses this problem by exploring the network redundancy through multipath routing. To overcome the problem of route failure due to route breakage we propose a new fault tolerant protocol design for multi path routing protocol to reduce the packet loss due to route breakage. In Fault-tolerant mechanism, the received signal strength and power level is determined for multiple disjoint routes to every active destination. We designed a local route for prevent the packet loss in the existing path. NS-2 is used for implementation and performance analysis which protocol achieves better throughput and packet delivery ratio with reduced delay, packet drop and energy.
[P. Arunkumar, S. Anbukaruppusamy. **Efficient Fault Tolerent Design For Multipath Routing Protocol In Manet.** *Rep Opinion* 2018;10(11):1-4]. ISSN 1553-9873 (print); ISSN 2375-7205 (online). http://www.sciencepub.net/report. 1. doi:10.7537/marsroj101118.01.

Key Words: MANET, Routing, fault, delay, packet, wireless network.

1. Introduction

A mobile ad hoc network (MANET) is a collection of dynamic, independent, wireless devices that groups a communications network. The eventual goal of designing a MANET network is to make available a self-protecting, “dynamic, self-forming, and self-healing network” for the dynamic and non-predictive topological network. According to the positions and transmission range, every node in MANET acts as a router and tends to move arbitrary and dynamically connected to form network. The topology of the ad hoc network is mainly interdependent on two factors; the transmission power of the nodes and the Mobile Node location, which are never fixed along the time period. Ad hoc networks excel from the traditional networks in many factors like; easy and swift installation and trouble-free reconfiguration, which transform them into circumstances, where deployment of a network infrastructure is too expensive or too susceptible. MANETs have applicability in several areas like in military applications where cadets relaying important data of situational awareness on the battleground, in corporate houses where employees or associates sharing.

2. Routing In Manet

The routing concept basically involves, two activities: firstly, determining optimal routing paths and secondly, transferring the information groups (called packets) through an internetwork. The later concept is called as packet switching which is straight forward, and the path determination could be very complex.

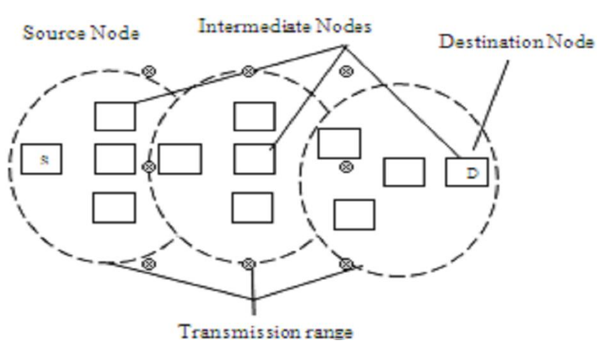

Fig.1 MANET Infrastructure

Routing protocols use several metrics to calculate the best path for routing the packets to its destination. These metrics are a standard measurement that could be number of hops, which is used by the routing algorithm to determine the optimal path for the packet to its destination. The process of path determination is that, routing algorithms initialize and maintain routing tables, which contain the total route information for the packet. This route information varies from one routing algorithm to another.

2.1 Routing Protocols In Manet

Routing protocols in MANET's can be done in many ways, but most of these are done depending on routing strategy and network structure. According to the routing strategy the routing protocols can be categorized as Table-driven and source initiated, while depending on the network structure these are classified as flat routing, hierarchical routing and geographic position assisted routing. The Table-driven and source initiated protocols come under the Flat routing.

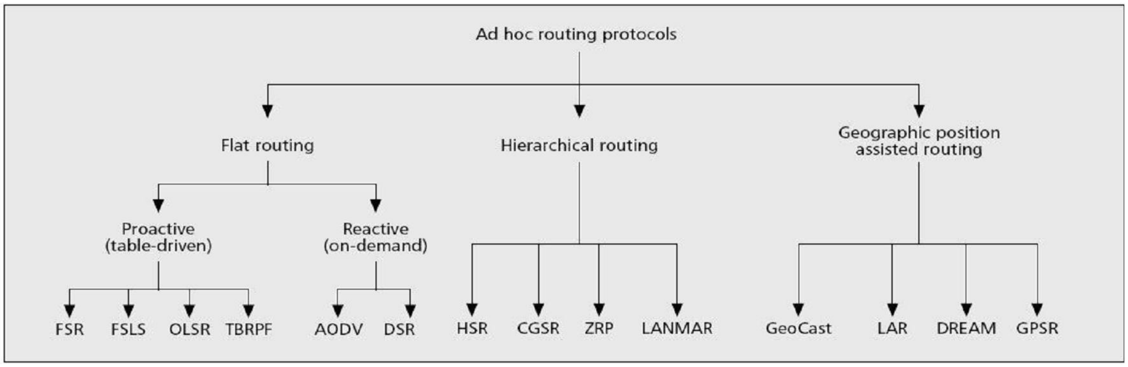

Fig.2 Classification of Routing Protocols in Mobile Ad-hoc Networks

3. Fault Tolerant Routing

To design efficient and fault-tolerant routing protocol is more crucial in MANETs. The main objective in the design of a fault-tolerant routing protocol is that if a route breaks due to node and/or link failures, there is always at least one more route available for a source destination pair. The main challenge that a fault-tolerant routing protocol should address is coping with node and/or link failures without incurring high overhead. The performance of ad hoc routing protocols will significantly degrade because of faulty nodes in the network or route failures. The main cause of route failures is node mobility. Another factor that can lead to router failures is the link failures due to the contention on the wireless channel. A route includes a sequence of links. Even if only one link in the sequence fails, the route no longer works. That is route stability is heavily affected by link stability. Whenever a route fails, consequent route maintenance is trigged and thus the network throughput degrades. Node failure due to power shortage is significant cause of route failure. In MANET, users communicate by relaying in multihop. A multihop route breaks because of the movement of relative nodes, burst error in Wireless channels or hidden terminal collisions. The route failure leads to unnecessary route maintenance, route error diffusion and upper layer multihop retransmission. This process significantly increases routing overhead and prolonged end-to-end delay. The fault tolerant routing protocol addresses these problems by exploring the network Redundancy through multipath routing. Guaranteed Packet delivery in the presence of faulty nodes will be provided by fault tolerant routing algorithm.

3.1 Classification Of Fault Tolerant Routing Protocols

3.1.1Proactive: This method provide protection before the fault occurs by suitably selecting optimum paths with least possibility of faults by caching important data by using erasure codes or redundant data.

3.1.2Reactive: They provide protection after the fault occurs by Using Retransmission techniques Using Effective Route maintenance techniques Using Alternate path techniques Multipath routing protocols can be used for fault tolerance in which proactive or reactive Techniques can be used. Multipath routing protocol provides fault tolerance with redundant information routed to destination via alternative paths. Thus probability is reduced saying communication is disrupted in case of link failure. The source coding can be employed in order to reduce the traffic overhead caused by more redundancy, also maintaining the same degree of reliability.

4. Fault Tolerant Multipath Routing

The AOMDV builds multiple paths using RREQs. However, the multiple paths have been built according to the time when the RREQ arrived. It does not consider the energy in the paths. Here the protocol not only considers residual energy in paths selection but also the energy balance in data transmission to maximize the lifetime of networks.

Battery power $$Eb = \sum_{i=1}^{n} Bi$$

E_{av} the average energy of the nodes

$$E_{av} = \frac{\sum_{i=1}^{n} E_r}{n}$$

Where E_r the residual energy of node I and n is is the number of nodes along the path. Now the energy level of node E_{el} given as $E_{el} = \frac{E_r}{E_{av}}$

E_b and E_{av} to indicate the value of battery power and the average energy along a path.

5. Route Discovery Process

Source node checks the routing table for any available paths when it needs a route to a destination. The source performs route discovery with network – wide flood of RREQ when path is invalid. when a node receives RREQ, it verifies whether it is the destination node and whether it has available routes to the destination node initially. Otherwise the entire process will proceed as conventional AOMDY protocol. If the current node is the destination, it will store the first received RREQ in the buffer and simultaneously starts the timer. The node will also receive other copies of RREQ at the same period. Each copy is under testing to know whether it provides a new disjoint path (node – disjoint and link –disjoint). This is processed by examining the first hop field in the RREQ copy. If RREQ provides a new disjoint path, it is stored in buffer, else dropped. If timer expires, the node drops all copies of the RREQs. If the battery power is minimum, the destination node replies with k-copies of RREQ. To control the number of RREPs for preventing RREP storming, parameter k is used.

5.1 Node Failure Conditions

When $PR = T\text{min}$

Node C is to fail shortly then Node D informs node B about status of node C B starts caching the data packets.

When $PR < T\text{min}$ Node C is completely failed then Node D informs node B about the status of node C Node B salvages all packets that are still in its data cache through the alternate path.

Where Tminis the minimum transmission power threshold value.

6. Algorithm Process

Source (S) has data to send but has no route to
Destination (D)
Transmit a RREQ containing source ID and sequence number
if (receiving node is not D)
check sequence number for RREQ and incoming link
if (duplicate packet and different incoming link)
forward the packet to the neighbor nodes
else
drop the packet
end if
else RREQ at destination
perform route selection
end if
D receives first RREQ packet
D sends back RREP along the source route in RREQ
D waits for a threshold time duration
At the end of the time interval, D selects the maximally disjoint route from the route already
Chosen and the one with the shortest latency
D sends another RREP to S along this new route
S can use any or both routes to send packets

7. Performance Metrics

7.1 Average End-to-End Delay

End-to-end-delay is averaged over all surviving data packets from the sources to the destinations.

7.2 Average Packet Delivery Ratio

It is the ratio of the number of packet received successfully and the total number of packets sent

7.3 Average Energy: It is energy consumption averaged over all the nodes.

7.4 Throughput: It is the number of packets received successfully.

7.5 Drop: It is the number of packets dropped.

8. Simulation Environment

Table1. Simulation parameters

No. of Nodes	**50**
Area Size	1500 x 300
Mac	802.11
Radio Range	250m
Simulation Time	100 sec
Traffic Source	CBR
Packet Size	512
Mobility Model	Random Way Point
Speed	5m/s
Pause time	0,10,20,30 and 40
Initial energy	5.1 J
Sending power	0.66
Receiving power	0.395
Idle Power	0.035

Simulation Results

9. Conclusion

The fault tolerant algorithm for multipath routing protocol (FTMR) MANET is designed to reduce the packet loss due to mobility induced link break using NS2 environment. The source chooses the optimal paths for transmitting the data according to the path Delivery Probability and delay probability computed at destination node. Fault occurs at any intermediate node during the transmission, it is detected by the downstream node and route recovery process is commenced.

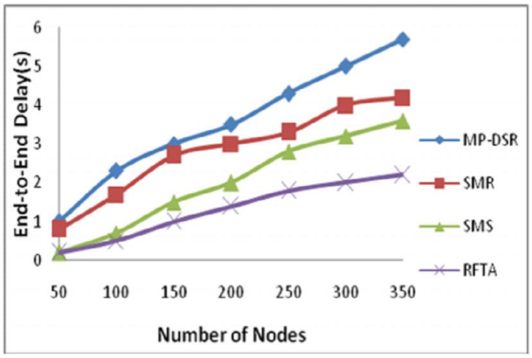

Figure 3 Throughput

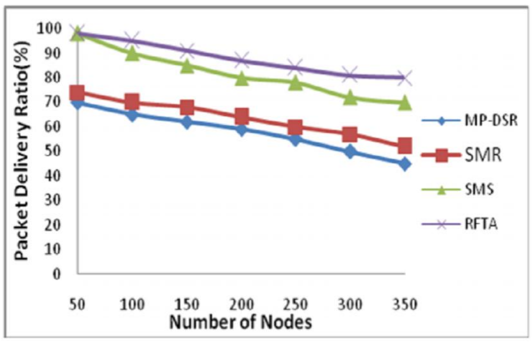

Figure 4. End to End delay

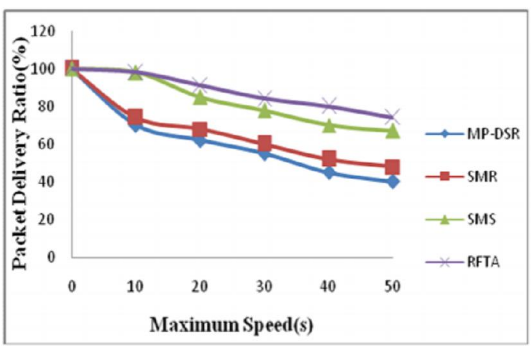

Figure 5. Maximum Speed

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11/18/2018