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Fault Tolerance in the Mobile Ad hoc Network using Link Monitoring

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***Abstract* - The Mobile Ad-Hoc Network (MANET) is a wireless network for the communication. The MANET does not any centralized management system to monitor the network. The MANET uses a dynamic topology that is a run-time selection of a route for the communication. As communication goes on the strength of signal decreases, so the communication depends upon the availability of communication link. In the case of the link is not available for communication, the communication may fails or delay. To procure the link information to avoid the link breaks and survives the network. The fault tolerance using link monitoring is the main factor to achieve the survivability of the network.**

Index Terms - Fault Tolerance, MANET, Survivability.

I. INTRODUCTION

An ad hoc network is an autonomous network; the mobile nodes are acts as a router, can able to take their decision. The mobile nodes are moves with very high speed in any direction [7]. The survivability of the network is very hard to maintain. The dynamic topology is an important challenge in the MANET.

An ad-hoc network can change its form depending on the application. MANET is self-configuring and infrastructure less network in which node communicates efficiently without the utilization of wired links. In MANE, there are many challenges to security, mobility, survivability, etc. [6]. The major problem is survivability of the network; it is very hard to maintain. The MANET runs with limited energy resources, because of the limited power of nodes are unable to survive in the network. The survivability of node in the network majorly affects the performance of the network.

The mobile ad hoc network, the underlying routing protocols are on demand routing, so it large energy consumption. Because of energy consumption nodes are not participating in the communication. The insufficient energy node breaks the link between source and destination.

This paper mainly focused on link monitoring to maintain the survivability of the network. The link monitoring is very less overhead work to determine the link. The link monitoring is to avoid link break so as to prevent the discontinuity in the communication.

The paper is organized as follows. In section II, discuss the related work. Section III describes proposed mechanism about the link monitoring, Section IV describes mathematical proofing of the concept and Section V describes the conclusion.

II. RELATED WORK

R. Senthil Kumar et al. [1] introduced a mechanism of minimizing the route rediscovery process in MANET. In this mechanism proposed a novel method to Minimizing the Route Rediscovery Process based Protocol (MRRP) by scheming the RREQ packet to select the most stable route and reduce the link break. The proposed protocol has two schemes, Received Signal Strength(RSS) based on minimizing the route rediscover process and the optimization of flooding process, based on Time-to-Live (TTL) value, reducing route rediscovery process solution to accomplish the link failure.

Abolfazl Akbari et al. [2] introduced A New AODV Routing Protocol in Mobile Ad hoc Networks. In this mechanism mainly focused on the link break factors link energy, strength of signal, density etc. The main mechanism is avoiding the link break. The avoiding link break mechanism has more overhead to restart the routing from source and resend the same packet form source to the destination. The overhead required to resend the packet from the source node is more. Whenever reestablishment of the new path has more time, it increases delay in packet delivery to the destination. This paper talks about density of nodes, energy of nodes, and strength of signals. These factors are very important in case of fault tolerance of the network.

Patil V. P. [3] proposed the mechanism efficient AODV routing protocol for MANET with enhanced packet delivery ratio and minimized end to end delay. In this paper, discuses about link break due to mobility between nodes such as node failure and power off. This paper enhances network performance of AODV protocol when many link breaks due to the failure of node and power off.

The mobile ad ho network is used on-demand routing protocol such as AODV, DSR, etc. The literature survey focused about link break to many causes like power off, mobility, density, environmental hazards, etc.

III. PROPOSED WORK

In MANETs, to maintain network connectivity, network survivability is an essential aspect of reliable communication by providing outstanding services. Maintaining connectivity is a challenge in the self-organizing nature of the network topology and the dynamic behavior of nodes such as the frequent occurrence of the link and node failures due to mobility, radio channel effect interference, and battery limitation [4]. Network survivability in MANETs is most likely affected by either dynamic topology of the networks, Node, and link Fault or Security Attacks.

There is a need to develop a survivable resource-constrained wireless network. The essential key factor of any survivable network should be able to deliver essential services even in occurrences of failures, attacks, interruption.

A. Methodology

The proposed work, by considering the network scenario having five nodes out of them one is source (S) node and one is destination node (D). Others are intermediate nodes acts as routers. Figure 1 shows the network scenario for show link failure because power off, mobility, etc.

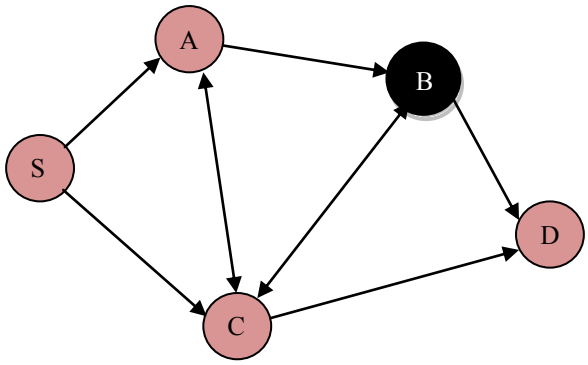

Fig 1: Network Scenario

In figure 1, source node S wants to communicate with destination node D. There is path available like S-A-B-D, S-A-C-D, S-A-B-C-D, etc. If the source node is select S-A-B-D path for the communication with the destination node as the shortest path. The source node S is communicating with the destination node via the S-A-B-D path. While communicating with the destination node, the node B fails to forward the packets to the destination node D because of one the reason from link failure like energy consumption, mobility, etc. In this case, the source node again rediscovers the path and sends the packet to the destination node via another available path. This mechanism required some more amount of time; it increases the end-to-end delay in packet delivery to the destination node D.

The proposed mechanism works in some different manner. The proposed basic idea is to monitor the link, in which it observe the power of node, time to live (TTL) of the node, mobility, etc. In the case of the energy level of the intermediate node, it is less than threshold energy level of a node then that node is not able to forward the packet to a neighbouring node. If it is found that the energy level is less than threshold energy level of the node, then start the rediscovering new path from previous node. This process consumes tiny amount of time as compared to starting rediscovering new path from source node and it avoids link failure. This mechanism helps to survive the network.

In the case of mobility of the node, it observes the strength of the signal. If the strength of signal got weak than the threshold value, then select another neighbouring node of the previous node. This mechanism avoids the link break and maintains survivability of the network.

In the case of TTL of the node, it observes the TTL value of the node. If TTL value finds less than the threshold value of TTL value, then select another neighbouring node of the previous node. This mechanism maintains the survivability of the network.

IV. Analytical Approach Towards the Link Monitoring

The primary task is avoiding the link break to survive the network. The detection of the danger of link can be easy with the help of binomial theory.

Node μ is threshold probability that packets are dropped because of network traffic, congestion, etc [5]. Then, Packets received at next node of source is n(1-μ), where n is total packet sent from source. Then, packets received at next node is n(1-μ)(1-μ) and so on,

Finally at destination,

$\bar{\mu} = n - n(1-\mu)^n$ .....[1]

Where, $\bar{\mu}$ is packet received at the destination. It is less than threshold value of total packet received at the destination, then start the monitoring the link. This will helps to avoid continuous monitoring of link. This mechanism is minimizing the overhead of link monitoring. In the proof of above equation 1, consider the small network as shown in figure 1.

The random values are considered for calculation at the S-A-B-D link.

Table I
Number of Packets Received at Particular Node

Nodes	S	A	B	D
Normal AODV node packets received	100	92	84	76
Packets receive with danger of lin node	100	92	0	0

Table 1 shows the number of packets received at a particular node. So "B" is a danger of link node. The values are calculated using equation 1. Assume 100 packets are forward from the source node S.

Let the threshold probability for packet drop rate to be 0.08 i.e. eight packets may be a drop in the normal state (without any danger of link).

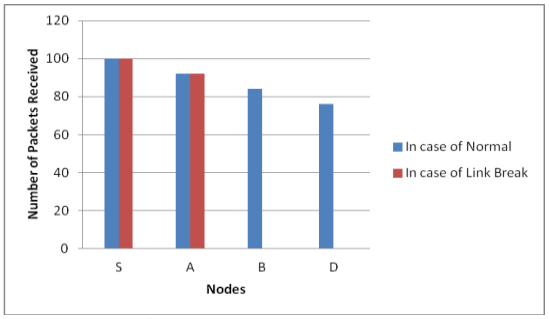

Fig. 2 Number of Packets Received Vs. Particular Nodes

Figure 2 shows the number of packets received Vs. an individual nodes (nodes "S" "A" "B" "D"). Figure 2 shows the performance of the network having the danger of link. The node shown in Figure 2 are the source node "S", black hole nodes "B" and the next hop node "D" from the S-A-B-D link out of the path to the destination. The packets are dropped at each node due to link break.

V. CONCLUSION

To maintain survivability of the network, the fault tolerance is a very important factor. To achieve the network survivability, the link break observation is playing vital role. The link monitoring is avoided link with less overhead. This paper concludes the less overhead method to achieve the survivability of the network. The link monitoring by considering all aspects is to achieve end –to-end packet delivery.

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