TODV with Fault Tolerance for Quality of Service in Mobile Ad-hoc Networks

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Abstract:

A MANET consists of mobile nodes, with high mobility with multiple hosts and wireless communication devices. Since Mobile Ad-hoc Devices are typically used as ad-hoc manner and use to provide backbone to complete network, they have the nature that the mobile communication is not constant and due to absence of monitoring devices, Mobile Ad-hoc devices are more tends to fail, slowdown and link failures. Hence, it is important to defend them against link or node failures. Faults have more chances to occur when it comes to AODV protocol. Moreover when it comes to Time constraints for AODV protocol then fault tolerance can prove to be a difficult task. With new concept of RNC (Route Node Collection packet) to find better route selection, faulty conditions are also occurred along. In this Research, a Fault Tolerance mechanism has been proposed for TODV protocol base on optimal selection of nodes for routing process.

Keywords: *Time on Demand Distance Vector Protocol, Ad-hoc On Demand Distance Vector Protocol, Fault Tolerance Mechanism, Routing Protocols, Mobile Ad-hoc Network, Route Request, Route Reply*.

1. Introduction

Quality of Service (QoS) is a defined level of performance in a wireless network which is required by every type of network traffic. Quality of service is always required in many network situations, such as in sensitive infrastructure and sensitive military applications.

Effective mobile ad-hoc networks (MANETs) require Quality of Service capabilities that give fault tolerance and better recovery when some links failure occurred on an intermittent or permanent basis. [16]

Mobile Ad-hoc Network topologies can change often and unpredictably. Most protocols for multi-hop MANET routing maintain best effort routes.

In this experimentation, we have focused on the fault tolerance mechanism for timely based networks so that we can enhance the quality of service which in turns provides fault tolerance mechanism.

2. AODV & TODV

AODV is an on-demand routing protocol [3]. The AODV algorithm gives an easy way to get change in the link situation. [15] If link failure occurred than notifications are sent only to the affected nodes within range in the network. Generally after receiving this notification, it cancels almost all the routes through this affected node. [4]

Generally maintenance of AODV process is based on timely updates which suggest that entries into AODV process expired after timer expires. Further updated information is passed to the neighbors so that it can be updated about route breakage. Discovery of various routes from single source to various destinations is totally based on query and reply packets and intermediate nodes use logs to store the information of routes in route table.

The original AODV uses destination sequence numbers to identify the most recent path. The source node and intermediate nodes contain the next hop information for packet transmission.

The policy of an on demand protocol is that the source node floods the Route Request (RREQ) whenever it sends data through the network, since the source couldn't find any routes to forward the data. In the process of finding route there may be possibility of finding several routes to destination. According to original AODV the path is found by using destination sequence number. Whichever the route is having the highest destination sequence number compared to that of last stored, the path will be get selected for data transmission.

3. Problem Definition

A MANET is a multi-hop Ad-hoc wireless network where nodes can move arbitrary in the topology with variation of speed and trajectory. The MANET network has no infrastructure or dependency and can be implement quickly in any environment but due to limited computing power, low bandwidth, high mobility and absence of central coordinating entity, behavior of different routing protocols are difficult to calculate in different environments.

Reactive protocols seek efficient resource utilization when required. Some related work suggested time based on demand distance vector protocol which shows quite better results compared to simple on demand protocols. The protocol design presented here suits the MANETS dynamic topology perfectly in finding the best path or route for data communication. Since MANETS are

typically used as wireless backbones, they have the nature that the wireless communication is not constant. Hence, it is important to defend them against link or node failures.
The requirement for quality of service is increasing day by day as the more attacks, faults, congestion is occurring in Mobile ad-hoc infrastructure. Fault tolerance is most essential part for providing quality of service in Mobile ad-hoc devices. Moreover fault tolerance based on time constraints are need to be explored which demand refined and stable fault tolerance mechanism. The fault tolerance mechanism is done by improving quality of service by avoiding unwanted usage of energy and node failures in between wireless nodes. This research reflected the link failure and then provided solutions for it. This work focused on the Time based on demand distance vector protocol so that the faulty networks can be prevented. It particularly works on the detection of faulty nodes at the early state of the node connectivity. It find out the nodes which have low resources to sustain in whole process of routing and by removing these node we can filter out the week links from whole topology which in turns can enhance the quality and fault tolerance. Initially work has started with battery resources as the prime factor in deciding the propose work and latter we can find out other dependent factors. At initial state after finding faulty nodes (Nodes with very less battery resources), these nodes gone in sleep mode and will not participate in routing process. After shredding those nodes we have proceeded with other mechanisms based on time constraints. Quality of the network was the final target as quality is directly link to the amount of faults.
Parameters for fault tolerance are throughput, failure of nodes, delay, network load, overhead. These parameters have distinguish the normal working of the network and fault tolerance in network.

4. Methodology

This research has focused on providing solution for said problem by providing quality of service and fault tolerance mechanism.

This research has focused on providing solution for said problem by preventing the faults from ad-hoc network to make it better in term of energy saving. This research Proposed a better solution for fault-tolerant by improving quality in selection of nodes which are best fitted for routing in between wireless nodes. Moreover research worked on Time on demand distance vector protocol for further experimentation.

Research has started with building a MANET network in OPNET simulator with FTP as application for measurement with AODV as routing protocol in first scenario as described in figure 1 below.

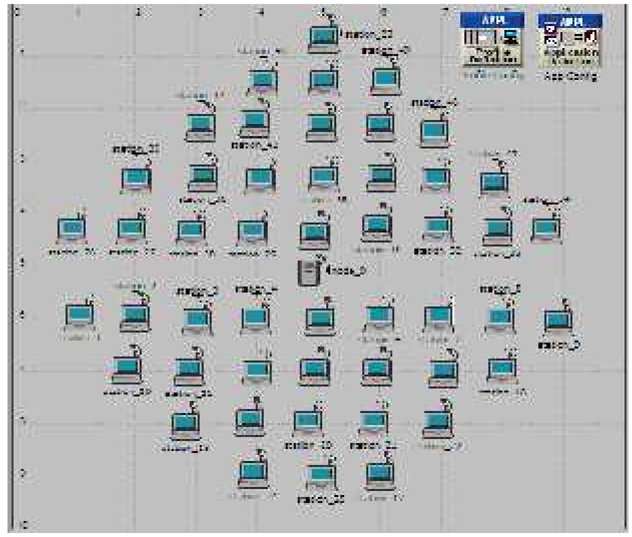

Figure 1: Overall simulation with AODV routing protocol

For providing fault tolerance in this research, basic node architecture has been modified which check the energy of the nodes and distribute the routing roles according to energy level. The node architecture of normal scenario (Figure 2) and node architecture changes (Figure 3) are given below.

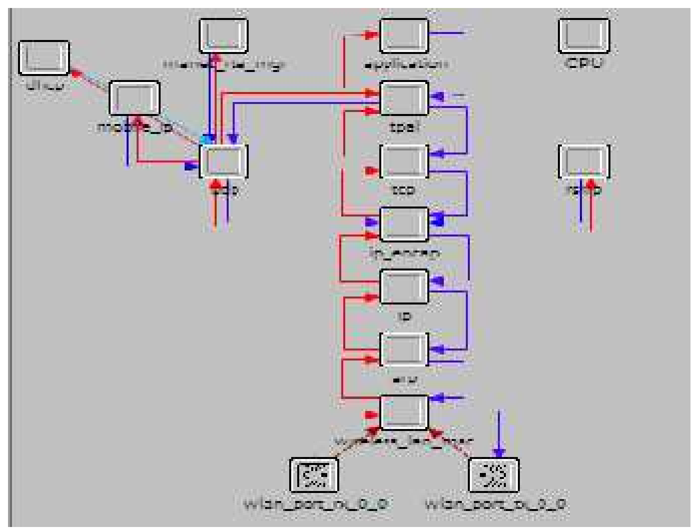

Figure 2: Node Architecture of normal process of TAODV

Below is the changes architecture of the AODV process for energy efficiency of mobile communication.

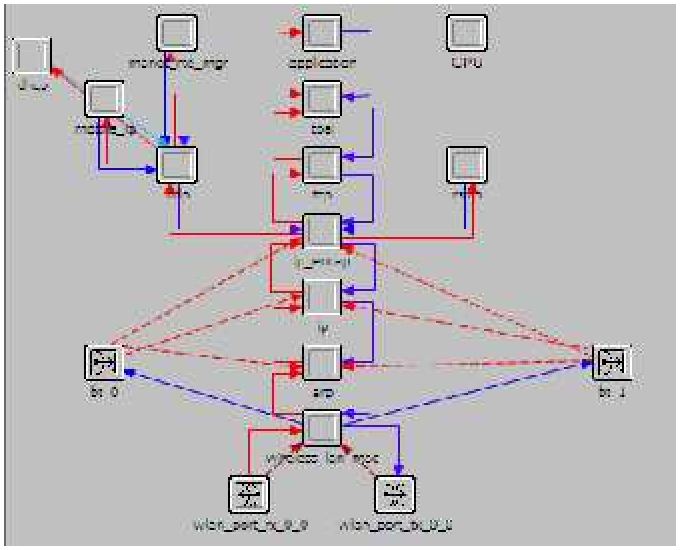

Figure 3: Node Architecture changes done for power efficiency

Scenarios have shown the improvement after implementation of optimized node architecture changes. Two modules have been added which collect the information from medium access layer and forward it to ARP layer and then after processing data fetch from ARP layer, send the data to higher layer where energy level of the nodes used to filtered and routing has been taken place.
Finally a scenario is used to test the faults in network by introducing four faulty links (fail nodes) as shown in figure 4 and performance has been fetched.

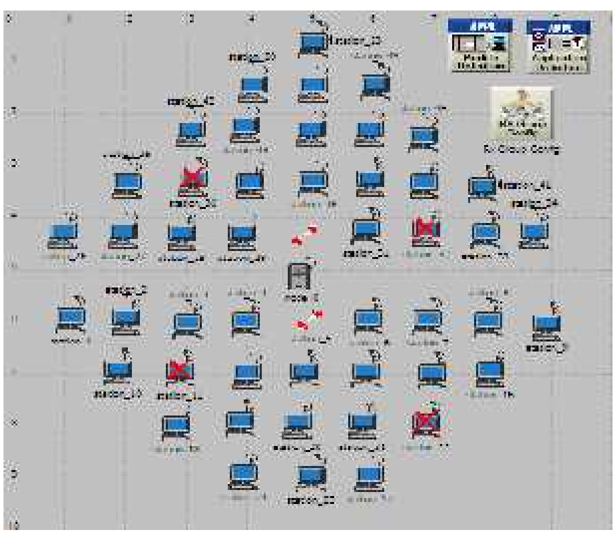

Figure 4: Network Topology with faulty nodes in clustered network

5. Experimentation

Basic parameters used for experimentation. Some of the experimentation done for checking the behavior of TAODV protocol is given below:

Parameters	Value
Simulator	OPNET
Simulation Time	900
No of nodes	50
Routing Protocol	AODV, TAODV
Traffic Model	CBR
Pause Time	100 sec
Speed	11 mps

Table 1: Parameters used for simulation

Results obtained for normal performance of AODV, Performance of TAODV, Performance of Clustered approach in TAODV and performance behavior of Faulty network in term of throughput, delay and Network load is discussed in the following sections.

Performance of AODV and TAODV with Throughput of four scenarios

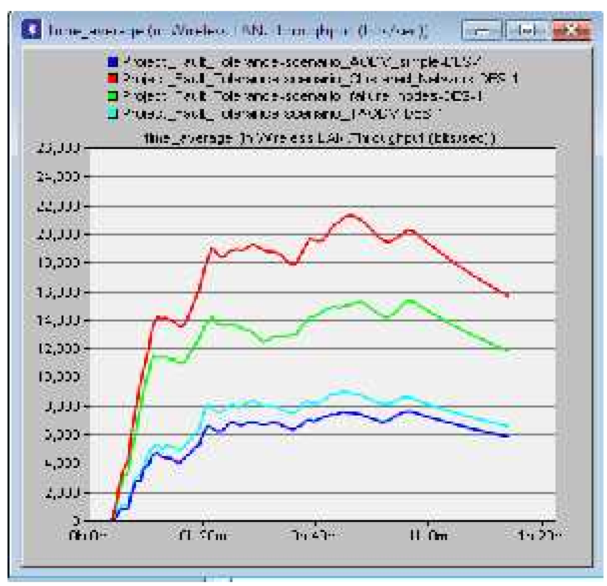

Figure 5: Throughput (bits/sec) comparison of all four scenarios

The performance of network is compared in above figure (Figure 5) and it show that the blue line of the throughput for normal AODV scenario. Sky blue line shows the performance increase in the throughput in case of TAODV scenario. Red line shows the throughput for the clustered network and orange one shows the performance measures of faulty network. It is clear from the graph that clustered network provides great results.

Performance of AODV and TAODV with Network Load of four scenarios

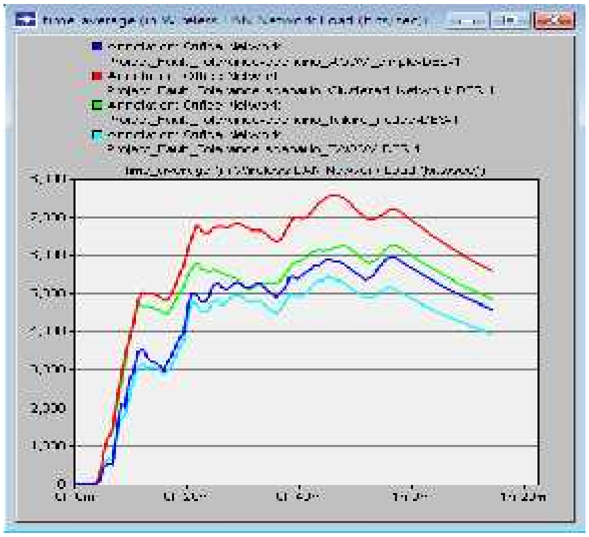

Figure 6: Network Load (bits/sec) comparison of all four scenarios

The performance of network is compared in above figure (Figure 6) and it show that network load of the proposed scheme is little high as compared to other scenarios. As proposed work is doing many processes and providing good communication so load can be on higher side as compared to other scenarios.

Performance of AODV and TAODV with Delay of four scenarios

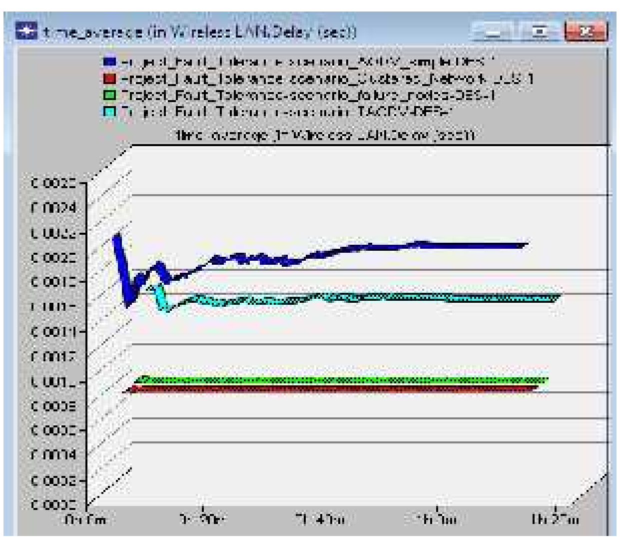

Figure 7: Delay (sec) comparison of all four scenarios

The performance of network with delay is compared in above figure (Figure 7) and it show that the blue line shows the delay of the normal network and sky blue line shows the decrease in the delay which is in better in case of TAODV as compared to normal network. Lowest line i.e red line shows the delay in case of proposed work and finally orange one shows the delay in case of node failure scenario.

6. Conclusion

In this work, the performance of the Ad-hoc on demand distance vector routing protocol and Time Ad-hoc on demand distance vector protocol have been summarized. The main focus was to show the performance of TAODV under normal environment, under Clustered environment and performance after faults occurrence in term of throughput (shown in figure 5), delay (shown in figure 7) and network load (shown in figure 7). In doing so, a TAODV scenario has been created and performance found to be better than normal AODV. This network further extended to create cluster heads and cluster formation according to the energy check level. Performance of network increases after clustering according to the proposed work as shown in graphs, TAODV gives more throughputs as compared to normal AODV and further clustered network of TAODV provides the improvements in term of throughput. Delay is case of TAODV is much less than the AODV. In node architecture changes (shown in figure 3) has been done according to the developed algorithm. After clustering and energy saving distribution, faulty behavior has been added to network with failure of four wireless nodes (shown in figure 4) and fault tolerance mechanism works fine to compensate the throughput loss by maintaining the level of performance for the faulty network also. Performance and fault tolerance property of network has been validated which shows improvement of the performance in case of proposed work scenario. This research provides great scope for mobile ad-hoc networks to behave similar to wireless nodes in case of sensor networks in which energy saving is the biggest concern. Moreover proposed work behave like a proactive routing process as it store information of some intermediate node which are learned early in route search process so it can be consider as a hybrid protocol scheme and can be used in both pro active and on demand network scenarios.

In nutshell, fault tolerance and quality has been improved with proposed algorithm by implementing clustering approach and energy checking process.

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