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Enhanced AODV Routing Protocol Using Leader Election Algorithm

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***Abstract*—** Failure of communication link in mobile ADHOC network is major issue. For the failure of link the performance of network is degraded. Due to mobility of mobile node brake the communication link and path of routing is failed. For the repairing of routing node used various algorithm such as leader election, distributed and selection algorithm. The failure of link decease the performance of routing protocol in mobile ad-hoc network, for the improvement of quality of service in mobile ad-hoc network various authors proposed a different model and method for prediction of link. The prediction of link decreases the failure rate of mobile node during communication. The leader election algorithm plays a major role in link failure prediction algorithm the process of link failure prediction implied in form of distributed node distribution. Proposed a new link stability prediction method based on current link-related or user-related information in shadowed environments. The modified protocol acquired the process of thresholds priority Oder on the basic of neighbor's node. The selection of neighbor node deepens on the mode operation in three sections. According to order of state create cluster of priority of group. After creation of group calculate average threshold value and compare each group value with minimum threshold value and pass the control message for communication. Through this process mode of activation state of node is minimized the time of route establishment and maintenance. The selection of proper node in minimum time and other node in sleep mode the consumption of power is reduces. We modified SBRP protocol for selection of node during on demand request node according to sleep and activation mode of communication. Each node locally assigned priority value of node. For the evaluation of performance used network simulator NS-2.35. And simulate two protocol one is AODV-LE protocol, these protocol patch are available for the simulation purpose. And another protocol is AODV-LE-ME. AODV-LE-ME protocol is modified protocol of leader election protocol for the selection of mobile node during the communication.

Keywords- *Leader Election, ADHOC Networks, AODV-LE, AODV-LE-ME.*

I. Introduction

Wireless mobile ad hoc networks are self-organizing communication networks without any infrastructure. Peer nodes work collaboratively to transport packets through the network in a store and forward fashion since the limited transmission radius of nodes necessitates multi-hop communication. MANETs are appropriate in scenarios in which an infrastructure is either not feasible due to economic constraints or not available due to physical constraints such as natural disasters or battlefield deployments. Applications range from the communication-enabled soldier, disaster recovery and Voice over IP to mobile gaming. The mobility of nodes and radio propagation effects cause frequent changes in the topology of a MANET; link failures and link recoveries, which are in frequent events in wired networks, occur frequently in MANETs. Consequently, reliable high-bandwidth communication is a challenge that can only partially be addressed by existing methods for wired networks. One successful strategy to alleviate the impact of topology changes is to predict them such that corrective actions can be taken before the change occurs. Proactive routing protocols require nodes to exchange routing information periodically and compute routes continuously between any nodes in the network, regardless of using the routes or not. This means a lot of network resources such as energy and bandwidth may be wasted, which is not desirable in MANETs where the resources are constrained [1-3]. On the other hand, on-demand routing protocols don't exchange routing information periodically. Instead, they discover a route only when it is needed for the communication between two nodes [1, 6, 7]. Due to dynamic change of net- work on ad hoc networks, links between nodes are not permanent. In occasions, a node cannot send packets to the intended next hop node and as a result packets may be lost. Loss of packets may affect on route performance in different ways. Among these packet losses, loss of route reply brings much more problems, because source node needs to re-initiate route discovery procedure. The route formation should be performed rapidly, with minimal overhead. The routing protocol must also adapt to frequently changing network topologies caused by nodes mobility, as well as other network characteristics. Various routing schemes have been proposed for MANETs. The majority of these solutions are based on finding the shortest path in term of distance or delay. However, the shortest path may break up quickly after its establishment. Indeed, because of nodes mobility, some of links on the shortest path may fail as soon as the path is established. This failure causes connection interruption and data loss, if the rediscovering routes phase is not accomplished rapidly. However, rediscovering routes phase involves a substantial overhead. So, routing based on selecting the shortest path leads to degradation in the routing quality of service. This is why stable paths are worth to be exploited for routing packets, instead of shortest paths. The paths stability estimation can be done by predicting nodes future locations, which we call mobility prediction. Mobility prediction of a node is the estimation of their future locations. The definition of "location" depends on the kind of wireless network: In infrastructure networks, location means the access point to which the mobile terminal is connected. Many location prediction methods are proposed in literature: [13]. The main advantage of location prediction is to allocate, in advance, the convenient next access point before the mobile terminal leaves its current one, in order to reduce the interruption time in communication between terminal mobiles. In without infrastructure networks or MANETs, mobile's location means its geographic coordinates. Location prediction in Ad Hoc networks is a new topic. Its main advantage is to estimate link expiration time in order to improve routing performances.

There is no fixed infrastructure such as base stations for mobile switching. Nodes within each other's radio range communicate directly via wireless links while those which are far apart rely on other nodes to relay messages. Node mobility causes frequent changes in topology. The wireless nature of communication and lack of any security infrastructure raises several security problems. The following flowchart depicts the working of any general ad-hoc network [12].

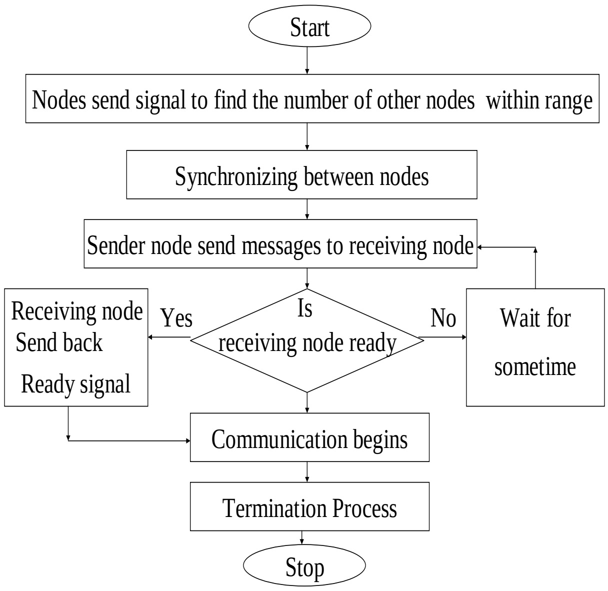


Figure 1: Working of a general Ad-Hoc Network.

II. AODV ROUTING PROTOCOL

Ad hoc On-Demand Distance Vector, AODV, is a distance vector routing protocol that is reactive. The reactive property of the routing protocol implies that it only requests a route when it needs one and does not require that the mobile nodes maintain routes to destinations that are not communicating [5, 6]. AODV guarantees loop-free routes by using sequence numbers that indicate how new, or fresh, a route is. [2][3]. The AODV protocol is one of the on-demand routing protocols for ad-hoc networks which are currently developed by the IETF Mobile Ad-hoc Networks (MANET) working group. it follows the distance vector approach instead of source routing. In AODV, every node keeps a local routing table that contains the information to which of it neighbors it has to forward a data packet so that it reaches eventually the desired destination. In general, it is desirable to use routes which have minimal length according to hop-count as a distance metric [8, 9]. However, AODV provides the functionality like DSR, namely to transport data packets from one node to another by finding routes and taking advantage of multiple hop communication. AODV is based on UDP as an unordered transport protocol to deliver packets within the ad-hoc network. Moreover, it requires that every node can be addressed by a network wide unique IP address and sends packets correctly by placing its IP address into the sender field of the IP packets. This means also that AODV is expected to run in a friendly network, where security is a minor concern. It should be mentioned that there are some attempts to extend AODV to prevent malicious nodes from attacking the integrity of the network by using digital signatures to secure routing control packets [6]. AODV requires each node to maintain a routing table containing one route entry for each destination that the node is communicating with. Each route entry keeps track of certain fields. Some of these fields are:

a. **Destination IP Address**: IP address of the destination for which a route is supplied.

b. **Destination Sequence Number**: Destination sequence number associated to the route.

c. **Next Hop**: Either the destination itself or an intermediate node designated to forward packets to the destination.

d. **Hop Count**: The number of hops from the Originator IP Address to the Destination IP Address.

e. **Lifetime**: The time in milliseconds for which nodes receiving the RREP consider the route to be valid.

f. **Routing Flags**: The state of the route; up (valid), down (not valid) or in repair.

III. PROBLEM STATEMENT

Link failure prediction is a new area of researcher area in mobile ad-hoc network. The failure of link decease the performance of routing protocol in mobile ad-hoc network, for the improvement of quality of service in mobile ad-hoc network various authors proposed a different model and method for prediction of link. The prediction of link decreases the failure rate of mobile node during communication. The leader election algorithm plays a major role in link failure prediction algorithm the process of link failure prediction implied in form of distributed node distribution. Proposed a new link stability prediction method based on current link-related or user-related information in shadowed environments. A more realistic user mobility model and a realistic propagation model are taken into consideration. According to the numerical and simulation results, it is found that the proposed method can accurately predict the link stability for different environment and mobility conditions. The prediction results can be regarded as a measure of the link stability, and can be applied to the applications, such as link performance prediction, system performance analysis, service quality prediction and route search. Furthermore, the impact of different mobility information on the accuracy of link stability prediction is also evaluated to assess the importance of the knowledge of mobility information.

IV. EXISTING SYSTEM

The problem of leader election has been widely studied in the context of wired distributed systems and recently there has been some work in the context of wireless networks. There have been several clustering and hierarchy construction schemes that can be adapted to do leader election [16]. But all of these algorithms assume static networks and are not applicable when topology changes can occur frequently during the election process, as might happen in ad hoc mobile networks. Leader election algorithms for mobile ad hoc networks have been proposed in [20, 22]. We are interested in an extreme-finding algorithm because for many applications it is desirable to elect a leader with some system-related characteristics. The algorithms in [4] are not extreme-finding and neither of these algorithms has been extended to do extreme-finding. Extreme-finding leader election algorithms for mobile ad hoc networks have been proposed in [7]. However their protocols are not well suited to the applications as they require nodes to meet and exchange information in order to elect a leader. There has been considerable work on leader election and spanning tree construction in the domain of self stabilizing systems that is important to our work. Informally, self-stabilizing systems are those systems that can recover from any arbitrary global state and reach a desired global state within finite time. Furthermore, this desired global state is stable, i.e., once it is reached, execution of a program action in the stable state will leave the system in the same stable state. A good survey on self-stabilization can be found in [27]. We believe that much of the work from the self-stabilization literature can be leveraged to solve problems in ad hoc networks. Self-stabilizing leader election algorithms have been proposed in [12, 13]. However, these algorithms assume a shared-memory model and are hence not applicable to the message-passing systems that we are interested in. In [21], however, the authors prove that for message-passing systems, problems like leader election and spanning tree construction do not admit solutions that are both terminating and self-stabilizing. An algorithm is said to be terminating if it reaches a fix point state i.e., a state in which all program actions are disabled. As we will see, our leader election algorithm achieves a slightly "weaker" form of stabilization. As failures are not always arbitrary, it is sometimes useful to consider recovery from a restricted set of states, instead of any arbitrary state as required by stricter definition of Self-stabilization. This restricted set of states is a set of states that arise from link failures, node crashes, network partitioning and merging. We show that our leader election algorithm recovers from these states to a stable state. We also show that it is terminating and that, upon termination, our algorithm ensures that all nodes have reached an agreement on who their leader is. Several leader election algorithms have been proposed for static networks that assume frequent process crashes and link failures that are closely related to our work. The authors in [28] propose several extreme-finding leader election algorithms for broadcast networks and which can tolerate arbitrary process failures. Every message in these algorithms is assumed to be reliably broadcast to all other nodes in the network. In their algorithms, every node that participates in election broadcasts its own identifier to all other nodes. A node upon receiving an identifier smaller than itself, in turn broadcasts its own identifier to all other nodes. If a node does not receive any other identifier for a time interval, it assumes itself to be the leader. Their algorithm is indeed applicable in a wireless ad hoc network. However, as every message has to be reliably broadcast to every other node, their algorithms can be expected to place an enormous strain on bandwidth in a wireless environment. In [26], a self-stabilizing leader election algorithm for a completely connected message-passing system has been proposed. In their model, process crashes are assumed to be permanent and no additions take place to the set of processes participating in the election after the election is initiated.

V. PROPOSED SYSTEM

The algorithm proposed a system model describe as MANET comprising n independent mobile nodes in the form of undirected graph G = (V, E), where set of vertices V correspond to the set of nodes and edges E between any two vertices represent that corresponding nodes are within transmission radii of each other. In addition, we have the following primary assumptions:

- Node Identity (ID): The nodes have unique IDs. It is used to identify participants during the election process and to break the tie between nodes during election.
- Communication Link: Communication links are bidirectional, reliable not necessarily FIFO.
- Neighbor Information: Each node holds its neighbors information only. No node has information about whole network.
- Node Communication: Nodes communicate by passing messages over the wireless link. The neighbor nodes can directly communicate with each other.
- Constrained Node Mobility: High node mobility may result in arbitrary topology changes including network partitioning and merging. Hence, we allow limited node mobility during election.
- Message Delivery: A message delivery is guaranteed only when the sender and the receiver remain connected for the entire duration of message transfer.
- Election Message (EM) and Coordinator Message (CM) Transmission: Both messages are assumed to have priority over application messages.
- Node Weight (NW): Each node has a priority associated with it to become coordinator. The priority of a node may be based on its id, battery power, computing power, etc.
- Unit cost of Acknowledgement Message (AM): We consider that application messages are flowing regularly in the network, so piggybacking of AM with application message has unit cost.
- No two isolated MANETs: For successful execution of MELFA, we assume that there is only one MANET.

- The following are secondary assumptions about MELFA:
- Existence of Routing Protocol: We assume that an underlying routing protocol exists to deliver messages between two nodes.
- No Fixed Initiator: Our algorithm does no assume the existence of some special node, called initiator.
- Node Buffer: Every node has sufficiently large buffer to store the EM and any further application messages until consumed.

VI. AODV IMPLEMENTATION FILES [14]

Header files:

- aodv.h
- aodv_packet.h
- aodv_rqueue.h
- aodv_rtable.h
- aodv_logs.h

Source code files:

- aodv.cc
- aodv_rqueue.cc
- aodv_rtable.cc
- aodv_logs.cc

Tcl file:

- LE-AODV.tcl
- MG-LE-AODV.tcl

VII. SIMULATION RESULT ANALYSIS

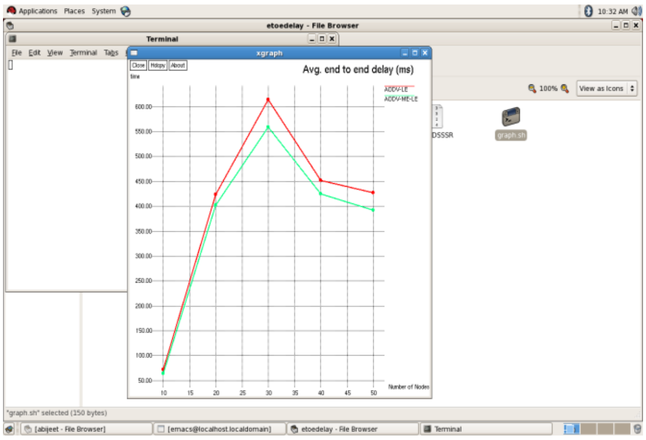
1. *SCENARIO*

- Scenario consists of 25 mobile nodes, 2 abnormal nodes.
- The topology is a flat grid area with 1000 m length and 1000 m width. A rectangular area was chosen in order to force the use of longer routes between nodes than would occur in a square area with equal node density.
- The two abnormal nodes are placed on each side of the area; their x, y coordinates in meters is (150,250) and (600,350).
- Simulation is run for 100 seconds of simulated time. Ten of the 25 mobile nodes are constant bit rate traffic sources. They are distributed randomly within the mobile ad hoc network.
- The time when the ten traffic sources start sending data packets is chosen uniformly distributed within the first ten seconds of the simulation. After this time the sources continue sending data until one second before the end of the simulation. The destination of each of the sources is one of the two hosts, chosen randomly.

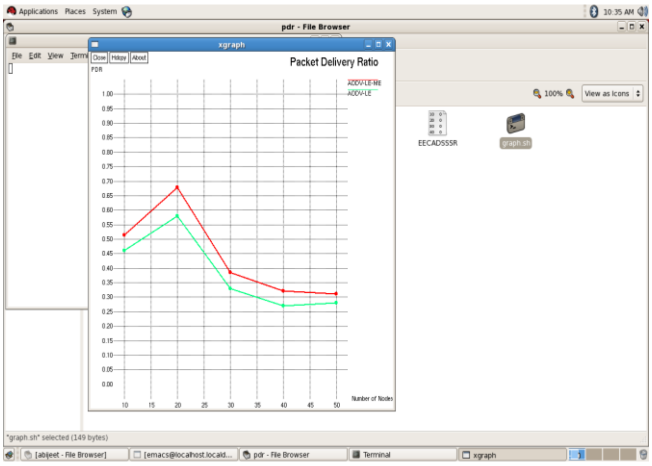
Method for simulation in NS-2 with help of OTCL & TCL simulation script file, now evaluation of performance of AODV-LE and AODV-LE-ME modified schemes, system used standard parameter of adhoc network.

2. *PERFORMANCE PARAMETER*

- **Energy:** It gives energy consumption for number of mobile nodes in AODV-LE and AODV-LE-ME scenario of adhoc network. In Figure, it shows that energy of the mobile nodes in AODV-LE gives change in energy consumption with increasing of nodes with 10 to number of nodes and AODV-LE-ME gives with low energy consumption with respect to number of nodes.



- **Throughput:** It gives the fraction of the channel capacity used for useful transmission (Data packets correctly delivered to the destination) and is defined as the total number of packets received by the destination. It is in fact a measure of the effectiveness of a routing protocol [14][15][16]. In Figure, it shows that throughput of packet send and received during attacking mode in AODV-LE-ME is high as compare with AODV-LE scenario.



- **Average end-to-end delay:** This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times[7][8][9]. In Figure, it shows that average end to end delay during attacking mode during communication in AODV-LE is high increase up to 30 nodes then it decreases and same with AODV-LE-ME, but end to end delay time decreasing.

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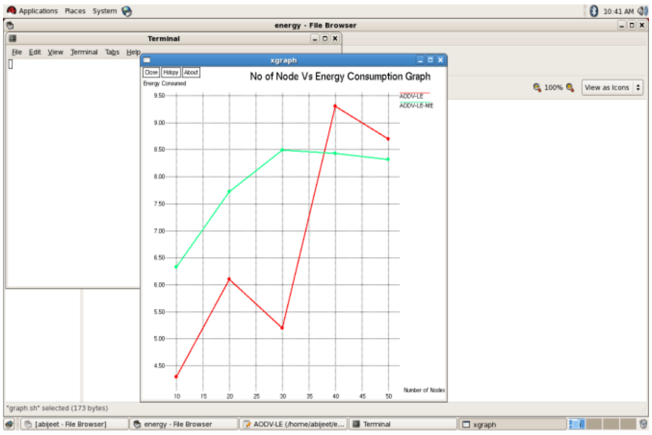
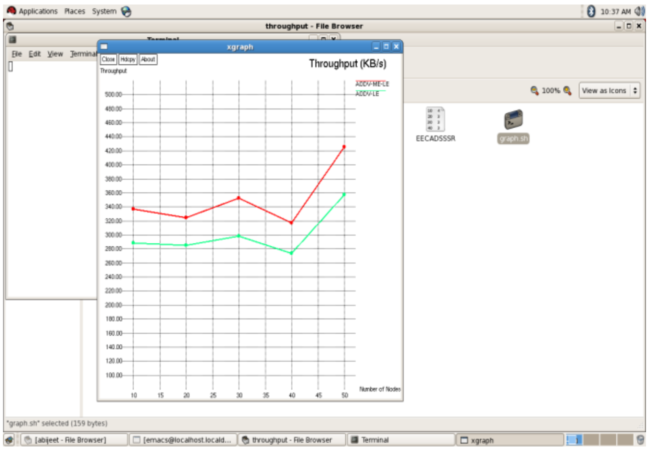


➢ **Packet delivery fraction:** The ratio of the data packets delivered to the destinations to those generated by the traffic sources [7][8][9]. In Figure, it shows that packet delivery ratio of simulated node in AODV-LE-ME of sleep node of power saving mode is more as compare with AODV-LE.



CONCLUSION

Hence system modified the AODV routing protocol for secured communication and energy efficient process instead of link failure and traffic congestion. Our proposed model reduces the link failure in dynamic topology during control messaging. It reduces failure of link increases the performance of network. For the co-ordination of node used election technique. The proposed algorithm divide node in two states sleeps mode and active mode. The processes of going node sleep to active mode calculate priority of all sleep nodes and compare with arithmetic mean of threshold. The value of sleep mode greater and equal to threshold thus acts as master node in group. In this fashion the utilization of power minimized on time of group communication. Our experimental result shows maximum life time network in comparison to AODV routing protocol. In future we also improved the key authentication mechanism in group communication.

Our proposed mechanism has overcome some of the limitations like it has the miss some group node request during group communication. It also introduces little bit computational overhead during route advertisement and path establishments. Modified AODV-LE and AODV-LE-ME with energy condition add with routing table and maintain the status of sleep and active node in real environment. During path discovery and path establishment it take much time in compression of normal SBP scheme so in this system minimized route calculation with optimization technique for path optimizer.

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