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Enhancement of Stability in Manet Using Proposed Algorithm

N. Yadav[1*], V. Yadav[2]

[1]Computer Science and Engineering, GGV, Bilaspur, India
[2]Chemical Engineering, GGV, Bilaspur, India

[*]Corresponding Author: nishidv@gmail.com

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Abstract— As we know stability in ad hoc network is very much essential for soldiers during fight, So that they can send message and receive message fastly to reach their target. Mobile ad hoc network is a collection of mobile nodes. In this paper, we have simulated our proposed algorithm using MATLAB and we have analyzed our proposed algorithm using the standard performance measures such as convergence time and pause time and we have observed that the proposed algorithm is linearly scalable in terms of convergence time and convergence time is reduced as node density and pause time increases which leads to increase of stability in MANET.

Keywords—Convergence Time, Pause Time, MANET, AODV, Crash Fault,Value Fault

I. INTRODUCTION

Mobile Ad hoc networks (MANET) allow portable devices to establish communication among them independent of a central infrastructure [13][20]. Due to lack of centralized infrastructure and the frequent movement of mobile nodes, the MANETs are subjected to various kinds of faults including routing failures. The MANET is composed of N mobile nodes which can be faulty or fault-free. The purpose of distributed system-level diagnosis is to have each fault-free mobile node to determine the state of all mobile nodes in the system. Same as in [1][2][22] this paper also uses a hierarchical clustering approach proposed in[15]for evaluating convergence time of the proposed diagnosis algorithm in MANET using AODV routing protocol. The proposed diagnosis algorithm is linearly scalable under the assumption that the mobiles may be: (i) crash faulty due to out of range or physical damage and (ii) value faulty due to sending erroneous messages while operating in the field [1][2][22].The proposed fault diagnosis algorithm has been evaluated in this paper using parameter such as convergence time and varying pause time. Convergence time is the time between a fault detection and restoration of a new, valid path [23]. Another challenge in MANETs is to study the effect of pause time on the performance of the algorithms. Smaller pause time means that the nodes will stop for smaller times and as a result, the routes will never be stable. The significant degradation of convergence time is experienced by the proposed algorithms with an increase in the pause time. The routes are unstable at small pause times, as a result, messages, both on the average and in worst case scenarios, take more time to reach their destination. So, we can conclude that in this paper by using the same proposed algorithm a novel parameter convergence time is being evaluated.

II. RELATED WORK

In 1998, Hi-ADSD algorithm was introduced [15] in which it uses SNMP to implement fault diagnosis in LAN connected with Internet. In this, network management system consist of NMS (Network Management Station) also called monitor, that queries a set of agents and gets diagnosis information of them. The main disadvantage was that it was centralized system. Hi-ADSD is both adaptive in the sense that the system nodes can be diagnosed based on the test outcomes obtained so far. In 2004, the problem of distributed diagnosis was considered in the presence of dynamic failure and repair. Though the algorithm has been developed for dynamic fault environment [22], they assume a crash fault model without using clustering. This increases the diagnosis overhead for large class wireless networks such as MANET. To address the problem, the notion of bounded correctness [19] is defined. Algorithm Heartbeat Complete is presented and it is proven that this algorithm achieves bounded correctness in fully connected system such as bus network. In 2004, the scalable approach for fault tolerance [12][20] was introduced. They proposed a fault detection service (FDS) to implement in a distributed manner via inter-cluster heartbeat diffusion and to allow a failure report to be forwarded across cluster through the upper layer of the communication hierarchy. As a result they have exploited message loss to some extent. The drawback of their approach is poor clustering algorithm and large failure detection time. In 2007, a heartbeat based and variant of the gossip style failure detector for wireless ad hoc network was proposed which adapts the detection parameter to the current load of the network such that the failure detection time is a function of previous heartbeat messages[6][3]. However this approach lacks scalability and is not applicable to the large scale wireless ad hoc network. In 2007, the problem of fault diagnosis was considered and they have firstly analysed the disadvantage of the Comparison-Based Fault Diagnosis Algorithm (CBFD) such as the large system overhead due to the repetitive diagnosis and the flooding of diagnosis messages, and the fact that not all nodes can be diagnosed correctly with the presence of dynamic network topology [5][4].Then they have proposed a Cluster-Based Comparison Diagnosis algorithm for ad hoc networks and used concentrative control function of the cluster heads in hierarchical ad hoc network to optimize the diagnosis process and which decreases the system overhead and accomplishes correct diagnosis to all mobile hosts with either fixed or dynamic network topology. In 2008, the problem of self-diagnosis was considered in wireless and mobile ad hoc networks using the comparison approach [7][9]. They develop a new distributed self-diagnosis protocol, called DSDP for MANETS that identifies both hard (crash) and soft (value) faults in a finite amount of time[22]. Their algorithm also suffers from increase in diagnosis overhead for large MANET without using clustering. In 2008, a failure detection services for large scale ad hoc networks using efficient cluster based communication architecture was introduced [10]. The failure detection adopts the detection parameter to the current load of wireless ad hoc network. This approach uses a heartbeat based testing mechanism to detect failure in each cluster and take advantage of cluster based architecture to forward the failure report to other cluster and their respective members. Their approach is linearly scalable in terms of message complexity. In 2009, the problem of convergence time was considered and then she evaluated convergence time for the routing protocols Ad hoc On-Demand Distance Vector (AODV) and Destination Sequence Distance Vector (DSDV) and produced the comparative result of the two routing algorithm without clustering technique [11][8][18][16]. We show in this paper, the convergence time is reduced to a great extent in large MANETs by the use of clustering for diagnosis.

III. System And Fault Model

The same system and fault model explained in [1][2][22] is presented here also for the evaluation of new parameters in the proposed algorithm. An arbitrary network topology is assumed to model MANET. The MANET is composed of N mobile nodes which can be faulty or fault-free. A synchronous system is assumed where the processing time and message delay is bounded. The set of fault free initiator mobile nodes in the system tests clusters of different sizes asynchronously. The system is grouped into number of clusters of size power of 2 as in the case of Hi-ADSD [15]. Generic parameters are assumed for executing the diagnosis tasks, send initiation time and propagation time of the messages in the MANET[1][2][22]. Once a node changes its state (fault free to faulty or faulty to fault free) it cannot further change its state in the same testing round. The work assumes a free space radio model for MANET where all the neighbouring nodes whether intended or not, receive a message once transmitted from a source node.

In this paper, we assume that the mobile nodes are subjected to two types of faults such as crash and value faults [17]. Crash faulty mobile nodes are unable to communicate with the rest of the system, due to physical damage, battery depletion or being out of range[1][2][22]. Value faulty nodes usually perform incorrect computation and communicate erroneous result or value while processing the data packet. A value faulty node may also corrupt the header of the message. We assume there are no link faults, a fully-of crash and value faulty nodes. Diagnosis Model:

The same diagnosis model explained in[1][2][22] is presented here also for the evaluation of new parameters in the proposed algorithm. The diagnosis model specifies the fault detection mechanisms in a MANET. The proposed algorithm assumes commonly used heartbeat based testing mechanism to detect faulty nodes in a cluster. A node x can test another node y if y is a neighbour of x. The algorithm assumes that the diagnosis process is initiated by a set of fault free nodes at the highest layer of clusters known as initiator nodes.

There are two types of messages exchanged during the diagnosis execution: (i) Fixed size heartbeat message and (ii) variable size diagnostic message. The heartbeat messages are further of two types: (a) initiation heartbeat message (init hb msg) and (b) response heartbeat message (res hb msg). The format of the heartbeat message sent by a node u consists of four Fields: (u, v, diagnostic value, message code) u and v are the sending and receiving nodes respectively [22]. Diagnostic value is the result of a diagnosis task executed in the node and is used to capture the value fault by comparison testing. Message code is a 2-bit Field identifies the type of message. The diagnostic messages exchanged during the execution of the algorithm are of two types such as (i) local diagnostic message (local diag msg) and (ii) global diagnostic message (global diag msg). Local diagnostic message is used by the initiator nodes and global diagnostic messages are used to achieve the global diagnostic view of the entire MANET.

The format of a diagnostic message sent by a node u contains (i, f (i), message code) where f (i) is the set of identifiers nodes currently diagnosed as faulty by node i, and message code is the code to identify the type of message[22]. To maintain the status of nodes about entire network each cluster head maintains a vector known as Status Table[i] which stores the status of each node i in the network. In fact, each initiator node is also a cluster head. Since the present work uses the clustering technique presented in the diagnosis algorithm Hi-ADSD, we have already illustrated the Hi-ADSD [1][2][22].

IV. PROPOSED ALGORITHM

Proposed algorithm is illustrated in Fig.1.The following notations used in the diagnosis algorithm are given in the Table-1:-

A. Description of Proposed Algorithm:

The proposed algorithm is given in Figure 1.In Step 1 of the algorithm, a cluster is created. In Step 2 assumes all the nodes are fault free at the initial stage of algorithm execution. In Step 3, diagnosis process is initiated by the initiator node by sending the request heartbeat message to the testee node [1][2][22]. An initiator node maintains a time out value after sending a heartbeat message to the tested node.In Step 4, the node which is being tested sends the response heartbeat message and observed diagnostic value and estimated diagnostic value are compared, if they are same then the node is free from value fault otherwise that node is value faulty node. In Step 5, if the initiator node does not receive any response heartbeat message within the time out value it assumes the tested node is crash faulty. In Step 6, the entire initiator node have tested every other node and collected local diagnostic messages.

Table 1: Notation used in diagnosis algorithm

Symbols	**Description**
F	Number of faulty nodes
FF	Number of fault free nodes
init_hb_msg	Initiator heartbeat message
res_hb_msg	Response heartbeat message
Status_Table[node-id]	Status of all nodes in the network maintained at every node.
Dnode¡id	Diagnosis value of the node
Tout	Maximum time by the initiator nodes to diagnose faulty node.
Txcg	Time to exchange diagnosis information by all initiators.
Nc	Number of nodes in the cluster

Finally, In Step 7 prepares the global diagnostic message using diagnosis information throughout all the nodes to maintain a consistent view by every fault free node of the entire network.

```
Step 1: Create a cluster by computing the formula C(i,s) having N
        number of nodes.for all i = 0, 1, 2 …, N-1    s=1, 2 ..., logN
Step2: Let us assume that all the nodes in the network can initiate the
       diagnosis and they all are fault free at the time of initiation.
Step 3: Start Diagnosis:
            Repeat
            for s=1 to logN Do
            Send i_hb (i, j, Dj, init_hb_msg)
            Set_Timeout (T_out)
Step4: response r_hb (j, i, D'j ,res_hb_msg)
        if Dj = D'j, // then the testee node is fault free.
            Status_Table[i] =fault free
            ff = ff U [j]
            else
            // the node that replied an erroneous message are diagnosed
       as faulty
            f=N (initnode_id)-ff
            if (f=N (initnode_id)) Then
            //if its entire neighbor is faulty then the diagnosis is
       complete
            Terminate=True
            End if
Step5: Timeout:
       //the nodes that did not reply within time T_out are diagnosed as
       faulty.
            f=N (initnode_id)-ff
            if (f=N (initnode_id)) Then
      //if all its neighbors' are faulty then the diagnosis is complete
            Terminate=True
            End if
            Update the entry in the Status_table[i];
Step 6:Receive_local_diag_msg (i, fi )
     //when all initiator receives a local diagnostic message then,
            f=f U f_i;
            D= D U {i}
            D= N (init_node_id)-f
Step 7: Now, all initiator node will exchange local diagnostic message
      with each other and send it to every other nodes in the network.
```

Fig. 1: The Proposed Diagnosis Algorithm(Yadav,2010)(Yadav,2012)

B. Analysis of Proposed Algorithm:

In this section we analyze our proposed algorithm for computing its performance measures using new parameters such as convergence time and pause time.The claims and corresponding proofs are given as follows.

Claim : The convergence time of the proposed algorithm goes on decreasing using an AODV routing protocol with increase in number of nodes and pause time.

Proof: Using Hi-ADSD clustering technique, as the clusters are formed in the power of 2, and system itself is a cluster of N nodes, as we go on increasing the number of nodes in the cluster by power of 2 and the pause time, then the convergence time goes on decreasing with respect to the increase of pause time. Convergence time is the time elapsed between the detection of the fault and time needed to inform the source node that the particular destination node is faulty or fault free using new valid path. That is to found the status of the destination node by the source node using the AODV routing protocol, which reduces the number of broadcast by creating routes on demand basis. AODV allows nodes to respond to link breakage and changes in the network topology in the timely manner that is within T_{out}.

V. EXPERIMENTAL RESULTS

***Simulation Model*:** The MANET is modeled as a graph G (V, E) where V is the set of vertices correspond to mobile nodes and E is the set of edges of the graph corresponds to wireless links. A simulator is designed using MATLAB where we present experimental results of diagnosis on large network obtain through simulation. The experiments were conducted for the network of varying sizes of 8, 16, 32, 64,128 nodes. Tests were scheduled for each node at each 30± units of time, where ± is a random number between 0 and 3. During each test, the status of nodes are checked and if the node is fault free, diagnosis information regarding the cluster is copied to testing node. If the tested node is faulty, the testing nodes proceed testing as in the algorithm. Network is clustered using the algorithm described above. The parameters from diagnosis literature are assumed for executing the diagnosis tasks, send initiation time and propagation time of the messages in the MANET. In this paper our main focus was to evaluate the ratio of convergence time and pause time with the varying number of nodes, we have kept the maximum speed at 20 m/s and packet rate at 100 packets and all other parameters remained the same as in [1][2][21]. We have shown the results for 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 seconds of pause time, The same values of these parameters are used here also which we have used in[1][2][21].The parameters to evaluate the diagnosis algorithm are given in the following section-Simulation Parameters There are two different parameters which we have evaluated in this paper. These parameters are usually used to evaluate the proposed fault diagnosis algorithm.

A. Convergence Time: The time between a fault detection and restoration of a new, valid path, is referred to as convergence time.

B. Pause Time: Pause time can be defined as time for which nodes waits on a destination before moving to other destination. Low pause time means node will wait for less time thus giving rise to high mobility scenario.

C. Pause Time vs. Convergence Time: Convergence time is measured as the interval between the detection of route failure and successful arrival of a packet at the destination over the newly computed route. This includes not only the routing convergence time, but also the time taken for the packet to traverse the network from the source to the destination over the newly discovered path. In other way, we can say, convergence time elapsed between the detection of the faulty node that is destination node by the source node. The reduction of convergence time with the increase of number of nodes and pause time is shown in Fig. 2, Fig. 3, and Fig. 4 which leads to increase of stability in MANET.

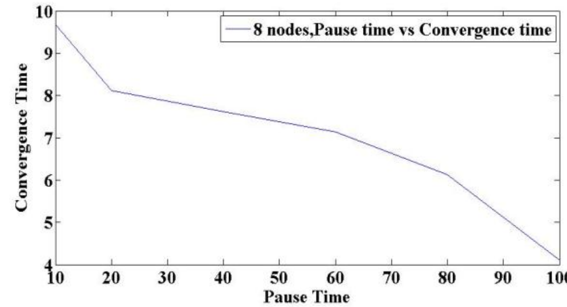

Fig.2: 8 Nodes, Pause time vs Convergence time

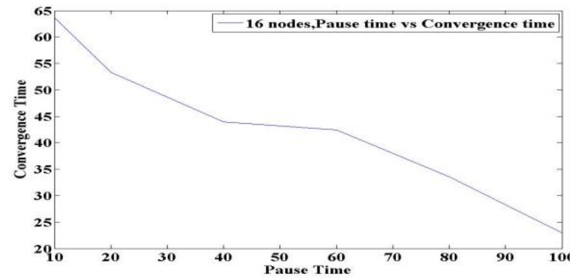

Fig.3: 16 Nodes, Pause time vs Convergence time

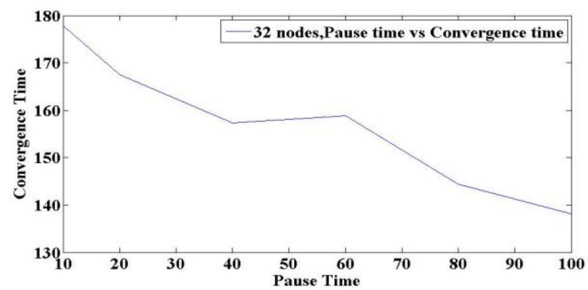

Fig. 4: 32 Nodes, Pause time vs Convergence time

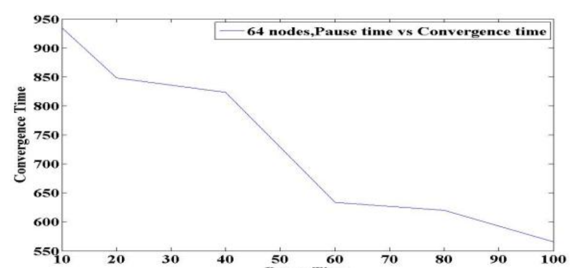

Fig.5: 64 Nodes, Pause time vs Convergence time

VI. CONCLUSION and Future Scope

In this paper, the proposed diagnosis algorithm has been simulated using MATLAB and has been evaluated analytically using the standard performance measures such as convergence time and pause time. The result shows that the proposed algorithm is linearly scalable to convergence time and convergence time is reduced as the node density and pause time increases which leads to increase of stability in the mobile ad-hoc network.

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Authors Profile

Mrs. Nishi Yadav pursed Bachelor of Engineering from Govrment Engineering College Bilaspur, Chhattisgarh in 2007 and Master of Technology from NIT Rourkela, Odisha in year 2010. She is currently working as Assistant Professor in Department of Computer Sciences, & Engineering, Central University Bilaspur, Chhattisgarh,India since 2010. She is a member of IEEE since 2016. She has published more than 10 research papers in reputed international journals including Thomson Reuters and conferences including IEEE and it's also available online. Her main research work focuses on Mobile Adhoc Network, Wirless Sensor Network, Network Security, Cloud Security and Privacy, Data Mining. She has 8 years of teaching experience.

Mr. Vishnu Yadav pursed Bachelor of Engineering from Guru Ghasidas Univesity Bilaspur, Chhattisgarh in 2008 and Master of Technology from NIT Rourkela, Odisha in year 2010. She is currently working as Assistant Professor in Department of Chemical Engineering, Central University Bilaspur, Chhattisgarh,India since 2013. She has published more than 8 research papers in reputed international journals including Thomson Reuters (SCI and Web Science) and conferences and it's also available online. His main research work focuses on Simulation and Modelling.