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Arbitration-based Reliable Distributed Mutual Exclusion for Mobile Ad-hoc Networks

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ABSTRACT: Wireless networks are gaining popularity to its peak today, as the user wants wireless connectivity irrespective of their geographic position. Wireless network is a network set up by using radio signal frequency to communicate among computers and other network devices. Wireless networks have emerged as a subsidiary of wired networks. Wireless Networks term is refers to a kind of networking that do not requires cables to connect with devices during communication. The transmission is take place with the help of radio waves at physical level [4]. Devices in a wireless network are set up to either communicate indirectly through a central place — an access point — or directly, one to the other. The first is called "Infrastructure Mode" and the other is called "Ad Hoc" mode (it's also called peer-to-peer). A permission-based distributed mutual exclusion algorithm is proposed. The algorithm is based on the concept of clustering. One by one clusters are created till the last node becomes a part of any cluster. Each cluster has one cluster head. Total number of nodes in a cluster is fixed. Each node in the network can send its request message only to its cluster head which further forward this request if it doesn't have CS, to those cluster leaders that are present in its *Info_set.* Each cluster leader maintains request list of whole system. Each request message generated has unique time stamp based on lamport's logical clock. The algorithm is assumed to execute in a system consisting of *M* clusters and *N* nodes, each cluster containing one cluster leader. Nodes are labeled as *0, 1……N-1,* and cluster leaders are labeled as *0, 1……..M-1.* We assume that there is a unique time stamp which is generated with every request message by node *i.*

Keywords: Distributed Mutual exclusion (DME), MANETs,

I. INTRODUCTION

A network can be defined as the combination of different devices e.g. computers to establish a communication with each other. In a network there is a successful movement of information from one system to another in the network. We can also define it as a grouping of different connecting devices in a particular manner. When number of computer systems are connected to distribute the information over different devices they composite the network. In networking there is a sharing of the sources over a network. These shareable resources can be hardware based or software based. The netwok is organized in different measures of traffic, size and structure of the network with the help of networking protocols.

A network can be of two types: Wired network and wireless network. A network in which we employ wires to maintain a link across different devices are called wired networks and in which we use radio signals are called wireless networks [5]. In wireless networks there is no need of any kind of connecting wires for communication instead of which we use radio waves for communication purpose. It is also known as Wi-Fi or WLAN. The information can be shared easily with such networks through radio frequency. 802.11 is the IEEE standard for the same. The two modes of Wireless Operating are:1. Infrastructure Mode 2.Adhoc Mode or Infrastructure less Mode. Adhoc modes are meant to be used in emergency conditions. So these set a different standard for wireless communication. This mode is for mobile nodes. There is no fixed infrastructure is required in ad hoc network like base stations. Nodes within each other radio range communicate wireless links directly [12].

There different types of Adhoc network available. These are as following: 1. MANET 2. Wireless Sensor Networks (WSN) 3. Wireless Mesh Networks (WMN). MANET stands for Mobile Ad hoc Network. Token Based Algorithm in MANET:

1. The group mutual exclusion (GME) problem is a generalization of the mutual exclusion problem. **Group mutual exclusion**: only processes in the same group can enter a critical section (CS) simultaneously. In other words, no two processes in different groups enter a CS at a time.
2. Critical section is a part of program that accesses shared resources.
3. In **token based mutual exclusion algorithms**, a unique token is shared among the hosts and if a host possesses the token than it is allowed to enter the critical section.
In **Permission based mutual exclusion algorithms**, the node that wants to enter in critical section (CS) must first obtain permission from rest of the nodes by exchanging messages.
In **quorum based mutual exclusion algorithms**, each node obtains permission from a subset of nodes referred as quorum for executing critical section. Any two quorums contain a common host.
4. **Distributed Mutual Exclusion (DME) algorithms must satisfy following properties:**
-Safety: No two processes, requesting for a different group can be in their critical sections concurrently.
-Freedom from deadlocks: Two or more hosts should not continuously wait for messages that will never arrive.
-Freedom from starvation: A host must not wait endlessly to execute the critical section while other hosts are frequently executing the critical section.
-Fairness: The requests for entering critical section are executed in order of their arrival in the system.
4. Look-ahead technique is used. All nodes including arbitrator will use this technique.
Designing look-ahead mutual exclusion involves two issues:
First is identifying sites which are concurrently competing for CS.
Second is enforcing mutual exclusion among these sites.

II. LITERATURE REVIEW

Kayhan Erciyes and Orhan Dagdeviren, " A Distributed Mutual Exclusion Algorithm For Mobile Adhoc Networks", 2009
In this paper they proposed [1] a distributed mutual exclusion algorithm for mobile ad hoc networks. This algorithm requires a ring of cluster coordinators as the underlying topology. The topology is built by first providing clusters of mobile nodes in the first step and then forming a backbone consisting of the cluster heads in a ring as the second step. The modified version of the Ricart-Agrawala Algorithm on top of this topology provides analytically and experimentally an order of decrease in message complexity with respect to the original algorithm. We analyze the algorithm, provide performance results of the implementation, discuss the fault tolerance and the other algorithmic extensions, and show that this architecture can be used for other middleware functions in mobile networks.
Pratvina Talele *et.al,* "A Token based Distributed Group Mutual Exclusion Algorithm with Quorums for MANET", 2013
In this paper they explained [2] about the group mutual exclusion problem extends the traditional mutual exclusion problem by associating a type with each critical section. In this problem, processes requesting critical sections of the same type can execute their critical sections concurrently. However, processes requesting critical sections of different types must execute their critical sections in a mutually exclusive manner. A distributed algorithm is used for the group mutual exclusion problem in asynchronous message passing distributed systems for MANET. This algorithm is based on tokens, and a process that obtains a token can enter a critical section. To reduce message complexity, it uses a coterie as a communication structure, when a process sends a request messages. Informally, a coterie is a set of quorums, each of which is a subset of the process set, and any two quorums share at least one process. Performance of the proposed algorithm is presented. In particular, the proposed algorithm can achieve high concurrency, which is a performance measure for the number of processes that can be in a critical section simultaneously.
Abhilasha Gupta *et.al,* "A Permission-based Clustering Mutual Exclusion Algorithm for Mobile Ad-Hoc Networks", 2013
In this paper they explained [3] about the research that has been done on resource allocation in Adhoc networks. The Classical approaches of mutual exclusion and its variants need to be modified to suit the dynamic topology, low bandwidth and low processing capabilities of mobile adhoc network. The distributed mutual exclusion in MANETs is comparatively less explored area of research. In this paper, they proposed a new approach for mutual exclusion in MANETs which is based on clustering and the concept of weight throwing.

The algorithm uses cluster based hierarchal approach which also helps in reducing the message complexity of the algorithm. In this paper, they described a permission based clustering mutual exclusion algorithm in mobile adhoc networks. To reduce the number of messages exchanged, the "Clustering concept" is used. This algorithm is independent from logical topology so as to reduce the cost of maintaining logical topology.

Ravindra .E, Vinaya Datt V Kohir and V. D Mytri , "A Local Route Repair Algorithm Based On Link Failure Prediction In Mobile Adhoc Network", 2011

In this paper [4], they mentioned about the A mobile Ad Hoc network is a collection of wireless mobile terminals that are able to dynamically form a temporary network without any aid from fixed infrastructure or Centralized administration. In Large scale Ad Hoc networks the terminal mobility may cause radio links to be broken frequently. With reactive protocol such as AODV, This leads to increase in end-to-end delay, packet dropping rate and can reduce the packet delivery rate. In view of such disadvantages, we propose a new Algorithm which introduces a mechanism of link failure prediction and accordingly perform a rapid local route repair. Simulation results shows that a new algorithm reduces end-to-end delay and packet dropping rate and increases packet delivery rate. AODV takes too much time to rebuild the route after a link break along the active route is broken. This time is too long for some application, such as the real time services of voice and video. The route rebuild time can be reduced if to reduce the recommended HELLO interval.

Amandeep Singh Bhatia and Rupinder Kaur Cheema ,"Analysing and Implementing the Mobility over MANETS using Random Way Point Model" 2013.

In this paper [5], they mentioned about the wireless networks are increasing in popularity with current advances in technology, the architecture of such networks is not based on a centralized base station but on each node which acts as a router and forwards data packets to other nodes in the network. The technologies have driven into new era with the introduction of ad hoc networks and the concept behind the ad hoc networks is it works without the access points. It has features like adaptive, self organizing and decentralized in nature. Due to these specialized features, it has become a popular technology. So, there has been an inevitable need of a good routing protocol in order to establish the connection between the nodes since the mobile nodes can change their topology frequently. The movement of the mobile node is one of the important characteristics because it can affect the performance of the ad hoc network protocol. This paper has analyzed the mobility of the random waypoint model for different routing protocols in mobile ad-hoc network.

Roberto *et.al*, "A Distributed Mutual Exclusion Algorithm for Mobile Ad-Hoc Networks", 2001

In this paper they introduced about [6] distributed mutual exclusion algorithm based on token exchange and well suited for mobile ad-hoc networks is presented along with a simulation study. The algorithm is based onto a dynamic logical ring and combines the best from the two families of token based algorithms like Token asking and circulating token in order to get a number of messages exchanged per CS access (the main performance index for such algorithms) that tends to optimal values under heavy request load. It present a simulation study that (i) confirms this optimality and (ii) shows that, in a mobile ad-hoc network, an effective reduction in the number of hops per application message can be achieved by using a specific policy to build on-the-fly the logical ring.

III. RESEARCH OBJECTIVES

Following are the various objectives of this research work

1. To reduce the number of messages per critical section by using "look-ahead" technique.
2. To optimize the parameters that decides the performance of DME algorithms like synchronization delay, response time.
3. To prove the correctness of the algorithm in terms of safety, liveness and fairness.
4. To compare and analyze the performance of proposed approach with the existing ones.

IV. RESEARCH METHODOLOGY

The algorithm is assumed to execute in a system consisting of *M* clusters and *N* nodes, each cluster containing one cluster leader. Nodes are labeled as *0, 1……N-1,* and cluster leaders are labeled as *0, 1……..M-1*. We assume that there is a unique time stamp which is generated with every request message by node *i*. In addition, the proposed algorithm takes the following assumptions on the mobile nodes and clusters:

-All nodes have unique ids.
-No new cluster will be formed after initialization.
-A link level protocol ensures that each host is aware of the set of hosts with which it can currently communicate by providing indications of link formation and failures.
-Global clock is maintained on each node for synchronization.
-Clustering of nodes and election of cluster head is based on node unique id's.
-Size of cluster is fixed. Handshake protocol is used for reconfiguration of clusters.
-No node can move while the cluster formation is in progress.
-No two clusters overlap with each other.
-Status of nodes: *IN CS* (node is in critical section), *Wait RP* (cluster head waits for reply message from the node after it exits the CS), *IDLE* (node is in idle state).

V. CONCLUSION

A permission-based distributed mutual exclusion algorithm is proposed. The algorithm is based on the concept of clustering. One by one clusters are created till the last node becomes a part of any cluster. Each cluster has one cluster head. Total number of nodes in a cluster is fixed. Each node in the network can send its request message only to its cluster head which further forward this request if it doesn't have CS, to those cluster leaders that are present in its *Info_set.* Each cluster leader maintains request list of whole system. Each request message generated has unique time stamp based on lamport's logical clock.

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