Effective Load Distribution Using Intuitionistic Fuzzy For Better Fault Tolerance in MANET

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Abstract In recent years exploration of wireless devices with small in size and platforms based on processing mobile have bring great attention towards the ad hoc networks. These Ad hoc networks are generally consists of temporary links connected among the nodes. MANET is such a dynamic network which compromises many good qualities to handle the wireless communication devices which are roaming randomly. MANET holds certain restriction on them because of the energy, battery consumption, load management, etc. Due to the nodes mobility nature and the characteristic of error prone nature the wireless medium pretense a lot of confronts, together with recurrent route change and packet losses, in the way of conferencing the necessities of QoS. Such disputes amplify packet delay, reduces throughput and lesser network failure. The MANET performance degradation gets worse as traffic load increase.

This work handles the problem of load imbalancing on MANET which is considered as one of the major issue by many researchers. This proposed work overcomes the problem of load balancing in MANET based on three different aspects. In the first phase a effective reliable on-demand routing protocol is proposed which adapts the compressing technique of sending the video frames in compressed format, and handles the link failure using route request, route reply and route error methods. This technique handles the failure of link by discovering them then rerouting the packets via next shortest path. The second phase adapts the behavior of ants to discover the route and the intuitionistic fuzzy estimation is used to find the direction for searching the optimal route and the fault occurred in the node or link is handled using the check point and fault manger.

Keywords — check point, fault manager, fuzzy estimation, intuitionistic, MANET, route error, route reply

I. INTRODUCTION

A temporary network with collection of mobile nodes which moves adversial without any control on central authority and not having any standard devices like traditional network is termed as Ad hoc Network [1]. In this Ad hoc environment due to the limited capability of transmission power each node needs help of their nearby nodes for sending their packets to the destination. These neighbor nodes act as intermediate nodes for forwarding packets. Thus in this type of network each node plays the role of host and the router. This is greatly adapted in real time networks where a fixed network environment cannot be able to deploy. Some of the real time applications are during discussions, sensor based networks, emergency situations and military services. These areas require different specification of routing protocols.

In general Ad hoc network holds dynamic topology due to the mobility nature of the nodes and this will influence the effects on characteristics of the network. These mobile nodes hold restriction on CPU, bandwidth of the path and memory consumption because these nodes are functioning using battery power. This will necessitate network utility that is source effectual. Additionally, the wireless media will also influence the activities of the net due to irregular link bandwidths ensuing from comparatively high fault rates.

These exclusive enviable features cause numerous novel issues in the aim of wireless Ad hoc networking protocols. Functions of networks such as routing, allocation of address, verification and permission must be intended to handle with a dynamic and unstable network topology. In order to set up routes among nodes, which are beyond than a single hop, especially configured routing protocols are unavailable.

II. PROBLEM DEFINITION

The major issue that affects the performance of Mobile Ad hoc Network (MANET) is the distribution of loads among the sensor nodes in a balanced way. The nodes in MANET holds limited power consumption and resources so when the large volume of data packets are passed to a node beyond its capability and it doesn't have any means to share the load to other nodes means then data transfer is too complex. The irregularity in usage of power consumption leads to

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disproportion of nodes. There are circumstances where some of the nodes possibly idle and few will be overloaded. A node which has more processing power completes its individual work speedily and is expected to have a smaller amount or no load at the majority of the time. So, in the incidence of under-loaded nodes keeps idle, the necessity for over-loaded nodes is unpleasant. There are many approaches on load balancing based routing techniques in the MANET environment. Next to load balancing most existing designs of ad hoc networks are based on the hypothesis of non-adversarial environments, i.e., each node in the network is supportive and well performed. Nevertheless, in adversarial environment, disobedient nodes forever survive, and may appreciably disgrace the routing recital. In such cases designing and developing routing protocols poses additional confront when one needs to propose routing schemes in the existence of adversarial environments in MANET. The necessity for fault tolerant routing protocols was recognized to deal with routing in adversarial environments, purposely in the existence of faulty nodes, by exploring network redundancies. Hence this work takes these two factors as major issues load balancing and fault tolerance in designing routing protocols in MANET and developed an enhanced mechanism.

MOTIVATION

With the development in the computing environment, the applications and services of the MANETs have also increased. MANETs are susceptible due to an assortment of physical characteristics of environments and devices itself. This proposed work put forth the design and development of protocols focusing on load balancing with fault tolerance in MANET.

Overcoming Imbalance of Load in MANET

Once the Source node has selected a set of paths to the destination it can begin sending data to the destination along the paths. The load balancing and traffic allocation strategy used deals with how the data is distributed among the paths. The problem is how the packets to be distributed to each path. This work aims in design and development of effective reliable on-demand routing protocol towards video streaming for mobile ad hoc networks.

Lack of failure recovery mechanism in MANET

One of the benefits of multipath is that when a node fails to deliver a packet, the protocol could performance packet salvaging for fault tolerance. With packet salvaging, intermediate nodes maintain multiple routes to the destination and a RERR message propagates only until an intermediate node cannot forward the packet along an alternate path. This leads to overhead in designing an efficient fault tolerance mechanism to decrease the route discoveries in MANET.

OBJECTIVE:

The objective of this work is to develop an efficient and intellectual routing protocol in MANET to overcome the imbalance of load along with failure recovery. This is achieved more precisely by the proposed work

1. It aims in design and development of effective reliable on-demand routing protocol towards video streaming for mobile ad hoc networks. An adaptive video description coding is used. Packet loss, packet loss probability for determining the frame corruption probability is estimated along with state probability distribution.
2. Ant colony optimization based fault tolerance and load balancing using Intuitionistic Fuzzy Estimation is proposed to handle both fault tolerance and load balancing based on Intuitionistic Fuzzy Estimation. In this work the best part of the intuitionistic based starting strategy is utilized to choose the potential path in MANET along with failure recovery using check points.

III. SCOPE OF THE WORK

Development of Compressed video frames and traversing in multipath for managing link failure in MANET with load balancing using shortest path discovery and overcoming the packet loss to increase the throughput of video packet delivery form the source to the destination.

Implementation of algorithms for efficient fault tolerance using the intuitionistic fuzzy ant colony algorithm for finding the optimal shortest path by setting the check point manager and fault manager to refer during the link failure or node failure. Then either the route is redirected to next nearest path or not is decided with the help of the ant colony algorithm which reduced the control overhead.

IV. PROPOSED METHODOLOGY

This work encompasses of two different phases and their aim is to develop efficient techniques on load balancing in MANET. In the first phase transfer of voluminous packets over network is controlled using the implementation of video compression technique. In case of video chatting the load of such video packets is considerably reduced using an adaptive video description coding is used for efficient video streaming in MANET. The second phase handles the problem of fault tolerance in path chosen for traversal of packets. During data transmission if any of the link failure occurs then using the check point manager and fault tolerance the data can be passed in alternative shortest path without loss of any packets. It is attained by proposing the bio-inspirational based IFEACO algorithm which performs load balancing with effective fault tolerance. The potential of traditional ACO is increased by introducing Intuitionistic

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Fuzzy Estimation as a starting strategy instead of scheduling packets randomly to the ants. The fault tolerance is overcome by checking point index manager.

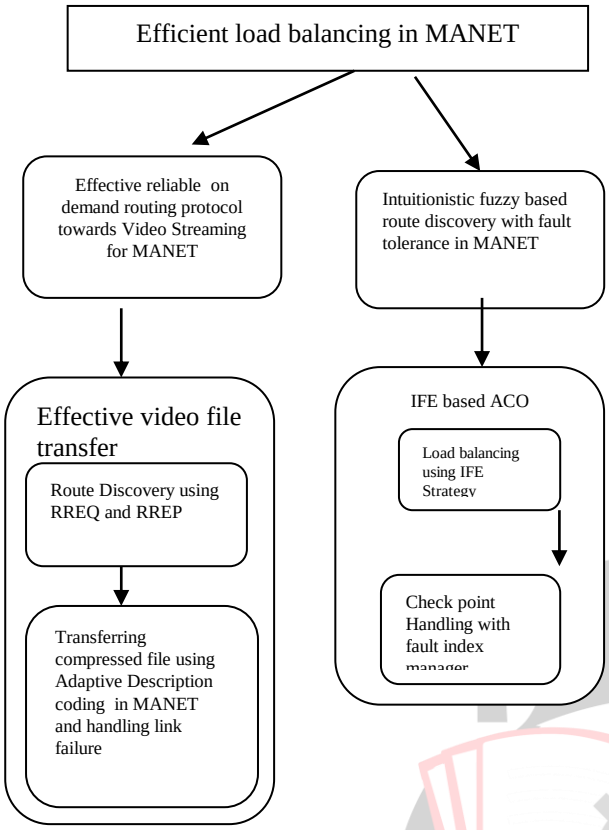

Figure 1:Overall Framework of this Work

Phase 1: Effective Reliable On-Demand Routing Protocol Towards Video Streaming For Mobile Ad Hoc Networks

This proposed work combines Adaptive description coding (ADC) with multipath transport is an appealing approach because it provides error resilience as well as load balancing for video transmission over networks. To support ADC with path diversity, a multipath routing protocol is required to build multiple paths between the source and destination nodes through the ad-hoc network. A route discovery process is triggered when a source node needs a route to transmit packets to a destination node. A route request (RREQ) message is flooded to the entire network to find the routes. When the RREQ reaches the destination node, a route reply (RREP) message is sent back to the source node to build a new route. Route maintenance deals with the situation that a route becomes worse or even broken. When a route breaks, the node that detects the link failure sends a route error (RERR) message to the source node. Once the source node receives the RERR, either a new route is built from the route table or a route discovery is initiated to reconstruct a new route.

This phase presents how to use routing messages to estimate the packet losses in the network. Based on the routing mechanisms, a route error (RERR) message is initiated when the MAC layer fails all retransmission attempts to transmit a packet to the next hop destination. This RERR indicates that a link becomes unreliable and the packets transmitted through this link suffer a high packet loss rate. Before the source node receives the RERR, video packets sent from the source node are still transmitted through this error-prone link and are susceptible to losses. When the source receives the RERR, it either reconstructs the route from the route cache or initiates the route recovery process to find a new route. Packets scheduled to be transmitted in the broken route during the route recovery process are discarded and marked as lost.

Due to the random delay between link failure and RERR reception at the source, the preceding packet before RERR can be sent at a time before, right at, or after the link failure happens. We use three states to represent these three cases: GOOD means the packet is sent before the link failure, FAIL means the packet fails to transmit and triggers RERR, and BAD means the packet is sent after the link failure

Algorithm:

```
while have video context to send do
  Initiate reference list for current frame
    for all reference frames in current description do
      if the frame corruption probability of the reference is larger than a threshold then
      Remove the frame from the reference frame list
      end if
    end for
  if no frames are available in the reference list then
    Add available frames in the other description to the reference list
  end if
    Encode a packet of video using selected references and transmit it through one of the two paths
  if receive an RERR message that implies a link failure then
    Estimate the RERR delay and determine the packet loss probability for affected packets
    if a route is available in the route cache then
        Reconstruct a new route from the route cache
    else
        Initiate the route recovery process
    repeat
        Mark the packets scheduled to be sent through the broken route as lost
    until receive an RREP to build a new route
    end if
  Estimate the frame corruption probability based on the estimated packet loss probability
  end if
end while
```

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Phase 2: An optimized Intuitionistic fuzzy based route discovery with fault tolerance in Mobile Adhoc Networks

The proposed algorithm has introduced the novel approach on existing ant colony optimization in MANET resource allocation problem. The known ACO algorithms generate a solutions starting from a random node. But for some problems, especially subset problems, it is important from which node the search process starts. For example, if an ant starts from node that does not belong to the optimal solution, probability to construct it is zero. In this paper intuitionistic fuzzy based estimation strategy is adapted in which the start node of each ant depends on the goodness of the respective region. This work also considers the fault tolerance by introducing checking points on particular criteria to manage a reliable load balancing. The general Ant Colony Optimization approach for load balancing have been modified by using start point IFE based strategy along with the checkpoint and fault index of resources to meet the fault tolerance issue in order to improve the throughput and make the effective utilization of available resources in a computational MANET environment.

Initializing from the ACO with IFE based start node strategy selection where ants will move continuously through the nodes in the MANET in search of food laying down the pheromones and updating the pheromones tables. ACO Algorithm will initially declare the threshold levels of each node in the MANET and will check the timer of ants and the load on the node, if the load on the node is below the threshold value [17], the control will flow to the Checkpoint algorithm which includes the following components:

A) Checkpoint Manager:

It receives the scheduled packet from the scheduler implemented by the ACO, sets the checkpoint based on the failure rate of the resource on which it is scheduled and submits the packet with checkpoints to the resource. Then the checkpoint manager receives packet delivery failure message from the MANET resource and responds to that accordingly. Checkpoint manager implements checkpoint setter algorithm to set packet checkpoints.

B) Checkpoint Server:

For each checkpoint the status of packet is returned to the checkpoint server. Checkpoint server save the packet status and return the packet status and last checkpoint whenever required i.e. during packet/resource failure.

C) Fault Index Manager:

Fault index manager updates the fault index of a MANET resource using fault index update algorithm depending upon the failure rate of the resource. The fault index of a MANET resource is incremented every time the resource does not complete the assigned packet within the deadline and also on resource failure. The fault index of a resource is decremented whenever the resource completes the assigned packet within the deadline.

Once the packet is completed update the pheromones on both the previous as well as on the current node. Again check if the node is under load, if yes then reassign the resources and reschedule the packet and if no then traverse to the node with maximum trailing pheromones ,update the pheromones on both nodes and repeat traversing until the node is overload, otherwise reassign the resources again.

Algorithm:

Begin
  Initilaize pheromone trails and parameters
  Generate population of m solutions
    For each individual ant calculate the fitness value
      For each ant determine its best position using intuitionistic fuzzy estimation
      Determine the best global ant
      Update the pheromone trail
      If failure occurs then
      Use the check point manager
      Rollback the last stage using the fault index manager
      Check if termination = true
end

V. EXPERIMENTAL RESULT

This section discusses about the simulation result conducted on the each of the two proposed phase of this work in detail

Experimental Result of Effective Reliable On-Demand Routing Protocol towards video streaming for MANET

From the Fig.2 it is shown that the throughput of RODRP is higher than AOMDV. Also the delivery ratio of RODRP is comparatively better than that of AOMDV and it is shown in Fig.3. In Fig.4 the packets drop of the proposed RODRP is reduced than AOMDV. Fig.5 represents the overhead of RODRP and AOMDV and it can be observed that the proposed protocol RODRP drops lesser number of packets than AOMDV routing protocol. From Fig.6 it can be observed that the jitter delay is reduced in RODRP than AOMDV. Overall, the proposed RODRP performs better well in all aspects than that of AOMDV.

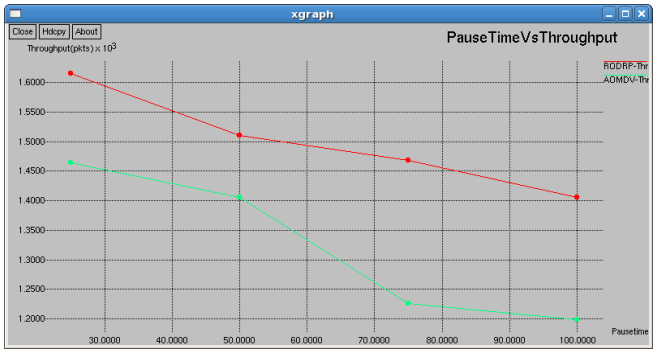

Fig.2 Pause time Vs Throughput

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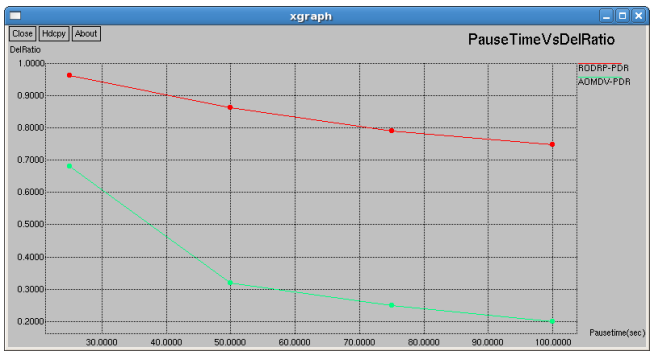

Fig 3. Pause time Vs Delivery Ratio

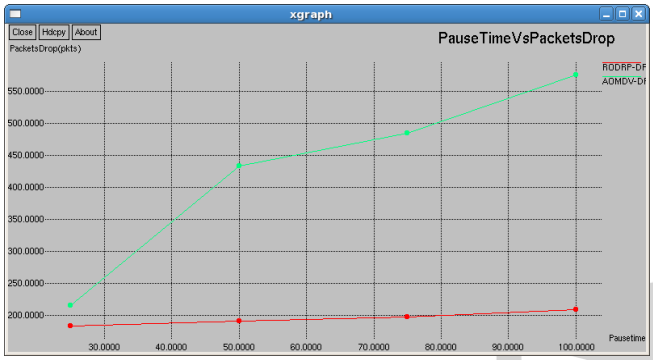

Fig.4 Pause time Vs Packets drop

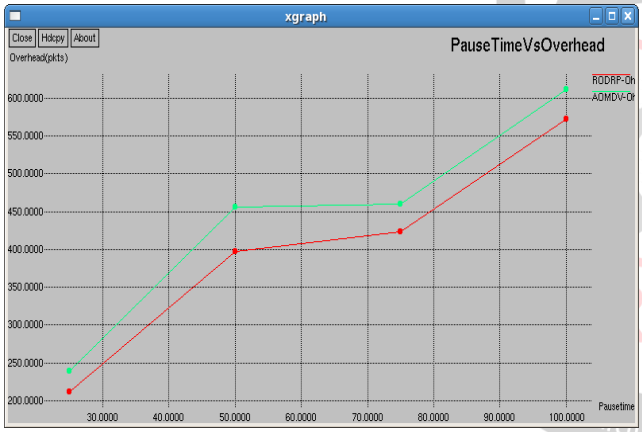

Fig.5 Pause time Vs Overhead

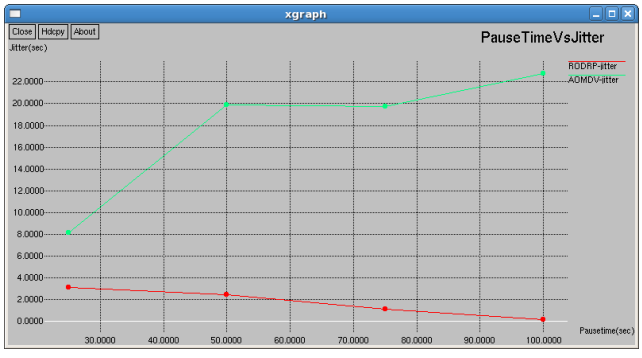

Fig.6 Pausetime Vs Jitter Delay

Experimental Results of Intuitionistic fuzzy based ant colony route discovery with fault tolerance in Mobile Adhoc Networks

The comparison of the proposed IFEACO method with ACO algorithm and three traditional packet scheduling algorithms: First-Come-First-Served (FCFS), Largest Job First (LJF) and Shortest-Job-First (SJF).

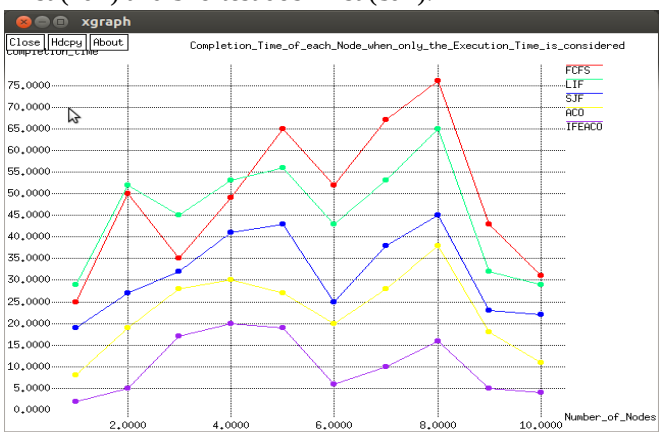

Fig 7a

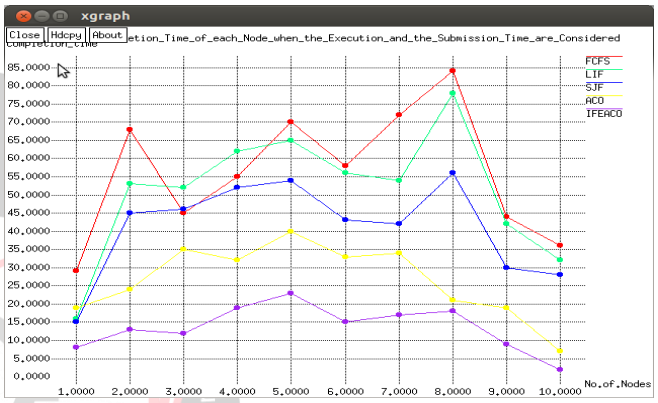

Fig 7(b)

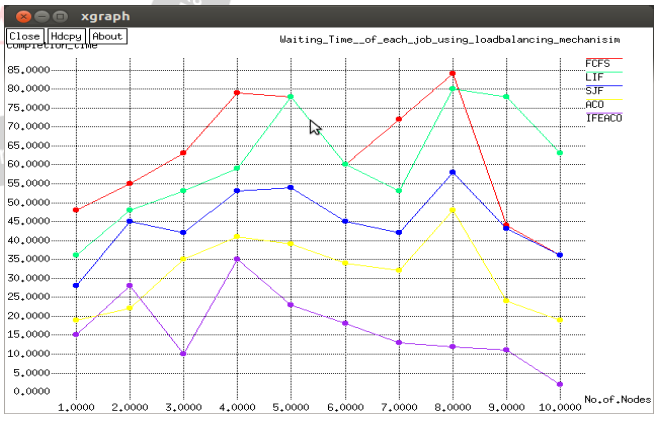

Fig 7(c)

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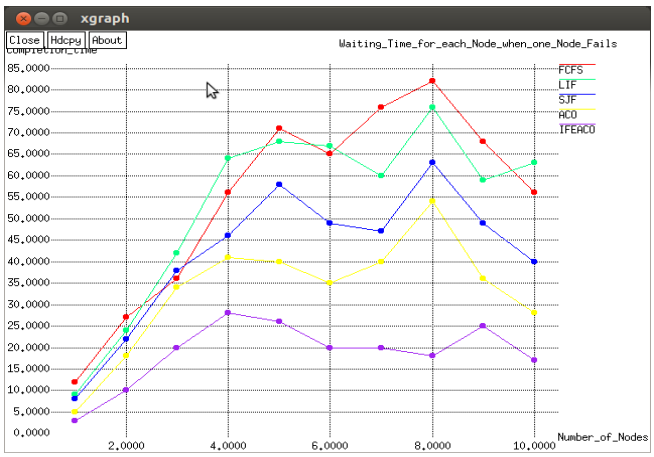

Fig 7(d)

Figure: 7 (a-d) Performance comparison of proposed work with other algorithms based on five different factors

The comparison result of the proposed work with other existing algorithms is shown in the figures. The figure: 7(a-d) shows the Completion Time of each Node when only the Execution Time is considered. In Figure it can be viewed that all the nodes have minimum completion time when using the IFEACO algorithm as compared to others. This completion time includes the execution time and the waiting time of all packets at their nodes.

The figure7(a) compares the Completion time of each Node when the Execution and the Submission Time for proposed method with others. Total waiting time of each packet contains the execution time of all previous packets plus the time from its submission to the time when it gets a processor. The results are shown in Figure and hence it can be concluded that the proposed IFEACO algorithms have similar completion times as compared to other algorithms when the submission time is considered.

The figure7(b) depicts the Waiting Time of each packet by using Load Balancing Mechanism and it is revealed that proposed algorithm continuously monitors each node, and, if any node becomes overloaded, the packets are migrated from one node to another

The figure 7(c) shows the comparison result of Waiting Time for each Node- when one Node Fails In order to support fault tolerance, packets on node 4 are distributed between different nodes taking care of the completion time as well as the load balancing using checkpoint-restart during runtime. The results are shown in Figure 7. It is depicted that that the proposed IFEACO algorithm outperforms all other algorithms despite the failure of nodes.

VI. CONCLUSION

This work focuses on effective load balancing with shortest route discovery in mobile Adhoc networks. The work executes in two different aspects to overcome the problem of load imbalance. Adaptation of effective on demand route discovery overcomes the problem of packet loss due to link failure during video frames on transmission. Next if the failure occurred in the path or nodes its previous state or data information is recovered using the check point manager and the fault index manager using the intuitionistic fuzzy ant colony optimization with well defined starting strategy for search the optimal route. Thus the work achieves its objective by development and design of these two phases.

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