

SSON Speech

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Through the course of my presentation I will be going through the following....

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Mobile Ad-Hoc Networks are wireless networks in which data reception and transmission is carried out through mobile terminals with routing functions called nodes.

Communication in these networks is carried out in a multi-hop fashion without any fixed infrastructure, such as base stations and relay stations. This makes them particularly useful in disaster environments, because in these environments the fixed infrastructure may have already been destroyed.

Since the nodes are free to move around in any direction, these networks are dynamically changing and their topology varies considerably with time.

Apart from mobility, battery life is also an important factor which may cause variation in these networks. This is because the nodes possess only a limited battery power. This means that if the transmission power is too high, then due to high energy consumption some nodes might go down which would have a severe effect on the whole network. And if the transmission power is too low then this could lead to messages not getting received at all.

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For large scale MANETs covering a large area the autonomous clustering scheme was proposed. In this scheme the network is divided into groups of connected nodes called clusters.

The clusters are disjoint with each other which means that each node belongs to exactly one cluster.

For this scheme the Hierarchical Routing Protocol was proposed which consists of intra-cluster routing and inter-cluster routing. In Intra-Cluster routing the source node and the destination node between which the communication is carried out belong to the same cluster whereas in inter-cluster routing the source node and the destination node between which the communication is carried out belong to different clusters.

There were several problems which were faced with this scheme: This scheme failed to adapt to the rapidly changing node density. The second problem was that the packet transmitting power of a node, which was closer to the receiving node, when it was higher than the packet transmitting power of the node which was sending packet, could cause radio interferences in transmission. Also, each cluster had the same transmission power regardless of their node density, which resulted in unnecessary energy consumption for clusters having high node density.

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Each cluster consists of a node which acts as the Cluster Head(CH) and the other nodes called as the member nodes and the border nodes.

Border Nodes are the nodes which are adjacent to the neighbouring clusters and act as Gateway for Inter-Cluster communication.

The Cluster Head is responsible for sending control packets periodically to maintain the cluster and the links through which these Control Packets pass through form a Cluster Head Based Tree(CHBT).

Two different kinds of packets are used to maintain Autonomous Clustering configuration called the MEmber Packet (MEP) and the Member Acknowledgement Packet(MAP). MEP are regularly broadcasted across the cluster by the CH to confirm the cluster members. Nodes which have already been assigned to a particular cluster and receive MEPs from a different cluster, start regarding themselves as Border Nodes (BNs), stop forwarding the MEPs further and start maintaining a list of the neighbouring clusters. MAPs are forwarded by each node to its parent node and are appended along with the node ID, hop count and state of the node. MAPs also contain information about the list of the cluster members and the list of the neighbouring clusters. All MAPs ultimately reach the Cluster Head which is situated at the root of the Cluster Head Based Tree.

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There is a need to keep similar cluster size.

A way of doing this is to fix an upper bound and a lower bound on the cluster size.

Generally, the size of the upper bound is kept 2.5 times the size of the lower bound.

Now, we can have three situations:

If Cluster Size is greater than the upper bound, then split the cluster

If Cluster Size is lesser than the lower bound, merge cluster with another cluster.

If Cluster Size lies in between the upper bound and the lower bound, then no action is necessary.

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One of the problems in the autonomous clustering scheme was that all the clusters regardless of their node density have the same transmission power. To overcome this problem another scheme called the Self-Organized Transmission Power Control Scheme was devised.

In this scheme the transmission power of the clusters is based on their node density.

This scheme worked perfectly for intra-cluster communication. But when inter-cluster communication is carried out, it results in one-way communication problem. This can be seen in the figure. In this figure clearly the node density of the cluster A is low and the node density of the cluster B is high. So, the transmission power of the cluster A will be high since for intra-cluster communication the radio transmission range needs to be broad. The transmission power of the cluster B would be lower since for intra-cluster communication the radio transmission range would be narrow. Therefore, when communication needs to be carried out from the cluster A to the cluster B then there would be no problem as data packets can be easily transmitted from BN of cluster A to the BN of cluster B. On the other hand, if a source node from the cluster B needs to communicate with a destination node in cluster A, then there would be a problem carrying out the inter-cluster communication as the data packet from the BN in cluster B might not be able to reach the BN of cluster A due to lower transmission power of the BN in cluster B when compared to that of cluster A.

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In the Self-Organized Transmission Power Control Scheme we need to keep transmission power based on Node Density. The node density of the entire cluster can be calculated by forming triangles using three nodes and then calculating the area of the triangles by using Heron's Formula. The distance between the nodes is determined using radio field strength.

There was a need to overcome the problem of One-Way Inter Cluster communication.

One possible way to do this is to increase the transmission power of the BNs in a cluster to those of the neighbouring clusters.

But by doing this there is a possibility of Radio Interferences within the same cluster.

A solution to this is to selectively increase Transmission Power of those BNs of a Cluster connected to the maximum BNs of Neighbouring Clusters. The authors of the paper designed an algorithm to do this.

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Talk about Proposed Scheme Algorithm

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Example of Proposed Scheme Algorithm

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The authors for checking the effectiveness of the new scheme when compared to the previous two schemes, that is, the autonomous clustering scheme and the self-organized transmission power control scheme conducted a simulation experiment. In this the evaluation metrics were....

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The authors used a mobility model in the simulation experiment. In this model the entire field is divided into grids and each grid represents the number of nodes and the velocity of the nodes.

The time interval was taken from $t=0$ to 3000 sec and it was assumed that the disaster occurs at around $t=1000$ sec. When the disaster occurs it was assumed that the nodes start moving towards the evacuation areas which are the two extreme grids. At around $t=1800$ sec, we can see that almost all the nodes have reached the evacuation areas.

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Show the results

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There are several ways to decrease energy consumption in MANETs:

1. Energy Efficient Routing: Avoid Nodes with Low Battery remaining
2. Scheduling Sleep Modes to avoid Battery Wastage
3. Energy Conservation by changing Network Topology
4. Methods like Aggregation for reducing Information to be delivered

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A possible improvement in the scheme could be to:

1. Combine Energy Efficient Routing with Proposed Scheme
2. Choose node with more battery remaining instead of randomly choosing among similar nodes at Step 5 of Proposed Scheme
3. May not cause decrease in Energy Consumption but may increase life of Network
4. Battery information included in MAPs sent to CH

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Demonstrate the idea

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To sum up I would like to say that:

1. Autonomous Clustering : No Energy Distribution based on Node Density
2. Self Organised Transmission Control Scheme: One-way Inter Cluster communication problem
3. Proposed Scheme: Energy Consumption Reduction without affecting Data Reachability
4. Further enhancement possible by combining Proposed Scheme with methods like Energy Efficient Routing
5. Reduced Energy Consumption methods foreseeable in future