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Energy Efficient Cluster Based Routing Protocol for Mobile Ad-hoc Network

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Abstract

Mobile ad hoc network is a most popular technology due to this ad hoc nature for research and development. Due to ad hoc nature of network nodes are randomly mobile and their topology is frequently changing thus each node co-operate with other to communicate [1]. The dynamically developing topology is responsible for different kinds of performance and security issues in network. Additionally in this conditions the significant amount of resources are also consumed such as battery power, memory and processing capability [3,5]. Therefore, the resource consumption and performance is a critical issue in this network. In this paper the resource consumption issues of MANET is investigated and for optimizing the resources more specifically energy a clustering based routing protocol is proposed. The paper also includes a detailed survey on the different energy preservation technique.

Keywords

MANET, WCA, EPAR, WSN.

INTRODUCTION

Wireless communication is a different kind of network as compared to the wired communication. In wired communication the devices are having sufficient power supply and infrastructure according to the requirements. But wireless networks are developed using the independent units of nodes which are connected with wireless links. Therefore wireless communication is not required a fixed infrastructure thus allow mobility and scalability for adopting new nodes in networks. Due to mobility support the wireless devices are developed with limited computational abilities and power supply. These are the key resources for the ad hoc networks and expensive to keep the nodes live.

The MANET is a kind of network where the infrastructure is absent. All nodes in network are free to move in any direction randomly. Additionally supports the router to select the routes to manage the changing topologies. Routers are help in creating topology, finding path between source and destination and maintain the network path during path break conditions as route repairing.

Current wireless network are based on wire backbone and using fixed infrastructure with predefined geographical boundary. To set up this type of network in emergency is not possible and it will take time. Therefore, to support the critical situations the network with rapid deployment capability is need to be develop. The MANET is one of such kind of network which is rapidly deployable in critical situations. It is mobile multi-hop radio networks; provide solution for emergency operation like disaster recovery, battle field communication and so on.

Such situations we required mobile base station and communication must be supported between any two nodes. So the Multi-cluster architecture for wireless system is required because it can set-up with the changing network configuration. Formation of cluster is done by cluster-heads and. The set of cluster-heads is known as a dominant set. The resource is provided by cluster-head. In this architecture all node are mobile frequent cluster-head changes adversely and decrease performance of system, routing and resource allocation that rely on it. Choosing cluster-heads optimally is an NP-hard problem. A good clustering scheme should preserve the structure, performance and resources for improving the life time of network.

Rationale

In this presented work the performance improvement of mobile ad hoc network in terms of energy consumption is proposed. Thus a number of research articles are investigated but most of them are inefficient in terms of throughput or routing overhead. On the other hand the clustering algorithms are capable to improve the routing and network performance. Thus in this work the clustering algorithm for performance improvement is selected. Most of the performance losses in MANET is occurred due to frequent path break, reestablishment of paths, exchange of routing information, and similar others. Therefore a clustering algorithm can help to preserve the unwanted performance issues in network.

Therefore a number of clustering algorithms are explored and it is found the WCA (weighted clustering algorithm) is able to improve the network performance. That is parametric approaches which involve the different network parameters to keep preserve the performance of network. Additionally guarantees to find the efficient cluster heads by which the network service distribution becomes more efficient and reliable. This algorithm measures the node's quality and according to the evaluation nodes the cluster heads are selected for data transmission. In this algorithm the nodes are categorized

in two main roles first the cluster head by which the entire nodes are communicating with other nodes. Secondly the client nodes which consume the services distributed through the cluster heads are termed as client nodes. This section provides the understanding of the proposed work and the overall objectives and design strategy is discussed in detail in further sections.

Connectivity based Clustering

In connectivity based clustering approaches the key focus is made on the connectivity to the cluster-heads. The most popular approaches of the connectivity based clustering is given in this section.

1.2.1 K-CONID

It is K-hope clustering algorithm it is the combination of two algorithms namely Lowest-ID and Highest-degree. Initially algorithm starts with a message sending process which is broadcasted to all nodes as a request for clustering. If using only a lower ID cluster heads are selected then more clusters are unnecessary generated. This results a set of cluster-heads and evaluation of nodes is becomes complex. So combining algorithm with highest degree can limit on the number of cluster heads. Therefore the node whose connectivity is higher among the neighbor is selected as cluster-head. K-CONID generalizes connectivity for node hope and node is selected whose id is lowest and degree of connectivity is same.

1.2.2 HCC

The HCC algorithm is also termed as 'Highest connectivity clustering algorithm'. In this technique every node broadcasts its id to the network neighbor; cluster-head is chosen the node having maximum number of neighbors that are direct in connection. Therefore the cluster-head are accessible from each node within the cluster. Cluster-head is directly linked with every node, so any two nodes can have maximum two hops away from each other.

Mobility based clustering

In mobility based clustering clusters are deployed in such a way by which the mobile nodes whose has low speed are gathered in same place and with the higher directional mobility gathered in different places. Therefore the mobility is a primary constrain of cluster head selection process. Thus to deploy a mobility based cluster a mobility metric is computed over a small periods of time by which difference between relative mobility of nodes are calculated. All the nodes send their mobility metrics to their neighbor. The node whose mobility is lowest is selected as a CH.

A) If two neighbor node whose state is not decided and having similar mobility then lowest id algorithm is used to select the cluster head.
B) If a node whose mobility is lower and move into another cluster then re-clustering is not performed.
C) If two cluster-heads are come into one another range then re-clustering is deferred for Cluster Contention Interval (CCI) and it permit contact between passing nodes.
D) If the node is cross transmission range of other nodes than Cluster Contention Interval timer has been expired and Re-clustering is performed.

1.4 Weighted clustering algorithm (WCA)

In this algorithm a weight metric is created, this matrix is used for cluster-head selection. In cluster-head election merged metric uses number of neighbor, distance with all neighbor, mobility of nodes and other parameters of networks.
The WCA (weighted clustering algorithm) is able to improve the network performance in terms of energy consumption and scalability of network. This algorithm measures the node quality and according to the evaluation the efficient nodes are selected for data transmission. In this algorithm the nodes are categorized in two main roles first the cluster head by which the entire nodes are communicating with other nodes. Secondly the client nodes which consume the services distributed through the cluster heads

LITURATURE SURVEY

The MANET is new generation wireless technology which offers a number of rapidly configurable utilities and applications. But due to the ad hoc nature of network some issues are remains to fix for performance and security. Due to frequently changing topology and path breaks makes this task more complicated as compared to other infrastructure based communication technologies. In order to support the mobility and ad hoc configurations of network it is required to develop the devices which individually deals with all the constrains of the network. Therefore devices are developed with the power and computational abilities. But the mobile devices having the resources in limited amount thus consumption and loss of these resources are considerable. Therefore the clustering approaches are developed for improving the connectivity, path losses, re-transmission losses and others. In this presented work the key focused is placed on improving the life of the network through WCA. that technique deals with the mobility, buffer length, energy and the degree of connectivity. This section provides the detailed investigation about the different approaches and efforts that are made in order to improve the performance of network and able to preserve the energy. Shivashankar et al [1] mainly focused on maximizing network lifetime of

network Therefore they introduces an EPAR protocol. That protocol is an enhancement of DSR protocol. After development the authors are experimented the protocol with different network environments and estimated the packet delivery ratio and network life time for performance analysis. Finally they showed that for medium and large ad-hoc networks using the DSR is inefficient and prepared EPAR and MTPR to obtain improve results. ***Xiang Jian Ji et al [2]*** discussed on energy efficiency of wireless sensor networks, additionally addressed the issues in network encoding, and routing associated issues. In order to overcome they introduces an Energy Efficient Routing algorithm (NC-ER). Finally the comparative study is made with multi-path routing protocol EECA. The comparison of both the technique is performed for cost to control information and average link-connection time. The simulation and results of the effort is provided are using NS2 simulator and experiments shows NC-ER provides better results as compared to EECA technique.

Srigitha S. Nath et al [3] mainly deals with EACDSR protocol. That is a stato-dynamic clustering approach therefore in this technique asymmetric links, consistency and scalability issues are considered for network performance improvements. In these scheme nodes having high transmission range is selected as cluster-head. Due to higher radio range the EACDSR produces improved performance as expected.

Hassanali Nasehi et al [4] introduce a multipath routing protocol which is an improvement on AODV traditional routing protocol. The introduced protocol employed with directional antenna and the routing discovery is performed on the basis of regional distinct paths. Therefore this includes active neighbors of each path. This algorithm is compare with the similar routing techniques such as AOMD, AODVM, and IZM-DSR algorithm. But they found that routing overhead is higher than AOMDV and AODVM algorithm.

Shilpa Bade et al [5] suggested an energy aware routing protocol for reactive MANET configurations. They offered EADR algorithm which is an effective technique to use with energy consumption of nodes and minimizes energy consumption. They analyzed fifty node and compare EADR with DSR, DSDV, OLSR routing protocol.

PROBLEM DOMAIN

Mobile ad hoc network is a collection of mobile devices with wirelessly connected links, but the key issue is the limited resources availability. Once a device loosed their expensive resources the normal functioning of network are affected. Thus the following issues are addressed for solution development.

1. Low energy nodes are not functioning well and also not much reliable for communication
2. Greatly loaded nodes are affecting the performance by increasing the packet losses and the delay in network.
3. Frequent path breaks occurred by which the affect in network is also observed
4. Highly loaded nodes are also frequently losses their energy levels

PROPOSED WORK

Description

Mobile ad hoc network's routing is key of entire network configuration and data transmission. During the transmission of the network devices are first discover the path between source and destination and then using the appropriate routing path the transmission is performed. During the route discovery a number of packets are flooded and the in similar ratio the energy of nodes consumed. In addition of that the transmission power is higher when the node having large distance thus required to map the entire network information for preventing the frequent flooding of packets and secondly the clustered approach group the nodes by which the transmission power of nodes is reduced.

The proposed solution includes the energy efficient and promising route discovery. The algorithm can be described using some suitable steps, additionally the proposed algorithm can be summarized below and to understand the working of individual step.This section includes the proposed WCA algorithm which includes the fresh route information. The proposed routing algorithm is described in two different section first the primary calculation and secondly the cluster head selection.

In primary calculation we calculate the buffer for each node and mobility of the node and after calculating the weight of the node we compare the weight of the node . In secondary calculation cluster-head selection is done .The node having the maximum weight will be selected as cluster-head. All the communication of the node is done through cluster-head if node want to communicate with any node then this is done by master node. In MANET all the node are mobile so it is also the possibility that the head node can move out of the cluster so for this situation the process of cluster-head selection is continuously held and new cluster-head is selected.

5. Advantages

1. In this type of approach the node having the maximum energy is selected as a cluster head so we guarantee reliable communication.
2. The route having the maximum energy is elected so that frequent path break does not occurs.
3. Low energy node can affecting the performance so for reliable communication the node having energy will be the master.

4. Highly loaded node are not selected for transmission there for packet loss is reduced.

6. Expected outcome

After implementation of the desired concept of the energy efficient routing protocol the following outcomes are expected.

1. Rich literature collection of energy and load aware routing protocol design: during the investigation of the energy efficient routing techniques a number of research articles, research papers and tutorials are collected.

2. An implemented routing protocol for the energy optimization and performance enhancement: in this phase an enhanced technique for routing is prepared using the weighted clustering technique. The implementation of the proposed algorithm is performed using the NS2 simulator.

3. Performance study of the proposed routing protocol: after implementation of the proposed approach the performance of the system is evaluated in different parameter.

7. CONCLUSION

Mobile ad hoc network is a frequently utilized network due to their ad hoc configuration and easy deployment make it more adoptable for different applications. But the network devices developed for this network having limited computational and other resources. Therefore these resources are expensive in use. In this proposed work an energy efficient technique for improving the energy consumption in mobile ad hoc network is investigated and a new solution based on the energy efficient weighted clustering technique approach is designed for future implementation. The proposed technique promises to reduce the energy consumption in the ad hoc network by using the cluster addressing and the efficient cluster head selection.

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