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Electing a Cluster Head for Efficient Data Transmission in Wireless Networks

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Abstract: A cluster denotes a group of independent servers interconnected through a dedicated network to work as one centralized data processing resource. Clustering is a popular strategy for implementing parallel processing applications. Clusters are capable of performing multiple complex instructions and it also improves systems availability to users. Computer cluster is a simple two node system which just connects two personal computers. A cluster is a logical unit of file storage on a hard disk in case of personal computer storage technology and it is managed by the computers operating system Replication means that a copy of something is produced in real time that is, copying objects from one node in a cluster to one or more other nodes in the cluster. If a change is made to an object in one node in a particular cluster then this change is replicated to other nodes in the same cluster.

I. INTRODUCTION

A mobile ad hoc network is a self configuring wireless multi hop collection of mobile hosts that are connected in an arbitrary manner without the support of a fixed networking structure. An ad-hoc routing protocol must be distributed as each node should be involved in route discovery making the routing information and link costs more reliable. The energy consumption can be reduced by allowing only some nodes to communicate with the base station. These nodes called cluster-heads that collect the data sent by each node in that cluster compressing it and then transmitting the aggregated data to the base station. Several disadvantages are there for selecting the cluster-head using only the local information in the nodes. Since each node probabilistically decides whether or not to become the cluster -head, there might be cases when two cluster-heads are selected in close area of each other increasing the overall energy depleted in the network. The nodes send data to the respective cluster -heads, which in turn compresses the aggregated data and transmits it to the base station. The base stations are many times more powerful than the mobile nodes, having sufficient memory, power and storage.

In the steady state phase the cluster-heads collect the aggregated data and performs signal processing functions to compress the data into a single signal. This composite signal is then sent to the base station. All the nodes are compared on the basis of chances and the node with the maximum chance is then elected as the cluster-head. Each node in the cluster associates itself to the cluster-head and starts transmitting data. A clustered network structure is established to ensure that transmit power used by all nodes within the cluster converges to the same level. Each cluster has one cluster head which acts as a local control centre to coordinate the data transmissions. A cluster head is a sensor node that transmits an aggregated data to the distant base station. Non-cluster heads are sensor nodes that transmit the collected or sensed data to their cluster head. The cluster heads are responsible to coordinate the data transmissions in their cluster.

II. CLUSTER HEAD ELECTION

Clustering consist of two main phases. One is cluster head selection and other one is cluster formation. Cluster head act as a controller of cluster and its main function is to collect the information from nodes inside the cluster. A cluster head is a distinguished node in a cluster that performs data aggregation and monitors that inter – as well as intra-cluster transmission of data in the network. In cluster formation phase the nodes joins the cluster head that falls in the transmission range of cluster head. The nodes inside the cluster are called cluster members. These nodes transmit the sensed data to Cluster Head. The cluster head must be awake to receive all the data from the nodes in the cluster. The members of the dominating set (DS) are considered for cluster head election. The first level is the Energy Filtration. The next level s is based on Node Connectivity. The third level is based on considering the node ids. Initially when the nodes are deployed they are provided a unique identity (ID), which is basically a numeral. Lowest identity or LID is simple algorithm that selects a node with its ID lowest among the remaining nodes in the given set or cluster. Therefore, the node with LID becomes the cluster head. LID alone in the third level is considered only for the first round of cluster head selection. Age is another criteria that is regarded as the load balancing parameter for selecting head nodes

from the second round onwards in wireless sensor networks.

Once the cluster head receives all the data, it performs data aggregation to enhance the common signal and reduce the uncorrelated noise among the signals. After aggregate and compress the received data from all the nodes CH transmit the data to BS. Each node generate random number between 0 and 1 and if this number is less than the probability threshold then the node will be elected as a cluster head for current round. The node that lies in the transmission range of both the cluster heads is called Gateway node.

III. CLUSTER HEAD PROPERTIES

A. *Cluster Size*

It is better that cluster should be small sized because it minimizes transmission distance and load of cluster head.

B. *Cluster Count*

Large number of clusters leads to small size cluster distribution that is better in term of energy consumption.

C. *Cluster Density*

Cluster density is defined as proportion of the number of cluster member in the cluster and cluster area.

D. *Stability*

The network topology will be adaptive if clusters members are not fixed.

E. *Message Count*

Large number of message transmission lead to large amount of energy consumption in the election of cluster head.

F. *Intra-Cluster Communication*

Cluster members communicate to each other within a same cluster by Intra-cluster mechanism.

G. *Inter-Cluster Communication*

When cluster heads of different clusters are communicate to each other then it is called Inter-cluster mechanism.

IV. DYNAMIC CLUSTER HEAD NODE ELECTION PROCESS

Each sensor node has different energy level in its cluster at any given time. The energy level of the node depends on some factors such as sleep/wake up schedule, and amount of data transmitted and received. The sensor nodes are actively involved in detecting events and transmitting the information regarding the events. Each sensor node determines its residual energy based upon consumed energy so far used in detecting events and transmitting its information. This residual energy value determines whether the node should be considered as Cluster Head Node candidate or not. The Non cluster head node detects Cluster Head Node in its neighbor on the basis of multiple operations of Wireless Sensor Networks using multiple rounds. The base station broadcasts a short preamble message to each node of the Wireless Sensor Network. Each node computes its distance from the base station based on the signal strength. The node that gets a short preamble message becomes a candidate Cluster Head Node. Each node waits until it gets an alert from another node of the cluster to compare its radio range and residual energy. If no message is received by another node that is supposed to be candidate node, then this node is elected as Cluster Head Node. The cluster-head can be used as a repository for the knowledge of the cluster and as a coordinator of the cluster operations. The energy efficiency of selected cluster head guarantees the number of cluster head and made the initial energy of the node to a variable to signify common node and advance node.

V. ISSUES IN ELECTING A CLUSTER HEAD

A. *Limited Energy*

The limited energy in sensor nodes must be considered as proper clustering can reduce the overall energy usage in a network.

B. *Network Lifetime*

The energy limitation on nodes results in a limited network lifetime for nodes in a network.

C. Limited Abilities

The small physical size and small amount of stored energy in a sensor node limit many abilities of nodes in terms of processing and communication abilities.

D. Application Dependency

When designing a clustering algorithm, application robustness must be considered as a good clustering algorithm should be able to adapt to a variety of application requirements.

VI. CONCLUSION

Cluster head selection is major challenge to prolong energy efficiency and network's lifetime. The cluster head node is elected on the basis of residual energy of sensor nodes. The residual energy is calculated after performing the event monitoring process using the mathematical model. a secure election scheme that minimizes the effect of generation of compromised Cluster Heads. A new optimized clustering algorithm is used through cluster head selection focused on reducing energy consumption of local clusters and overall networks. Cluster Head can be enhanced by taking into consideration metrics related to QoS (Quality of service) and time constraints. The co-ordination selection is based on a node having energy information through which we can elect final cluster head which adapt low energy that makes the nodes live longer thus the complexity of the network and its energy consumption is much reduced. Clustering is the best solution for reducing flooding routing packets in mobile ad hoc network to adapt itself for its dynamic nature. Cluster-head can be selected by computing quality of nodes, which may mainly depends on the computation capability.

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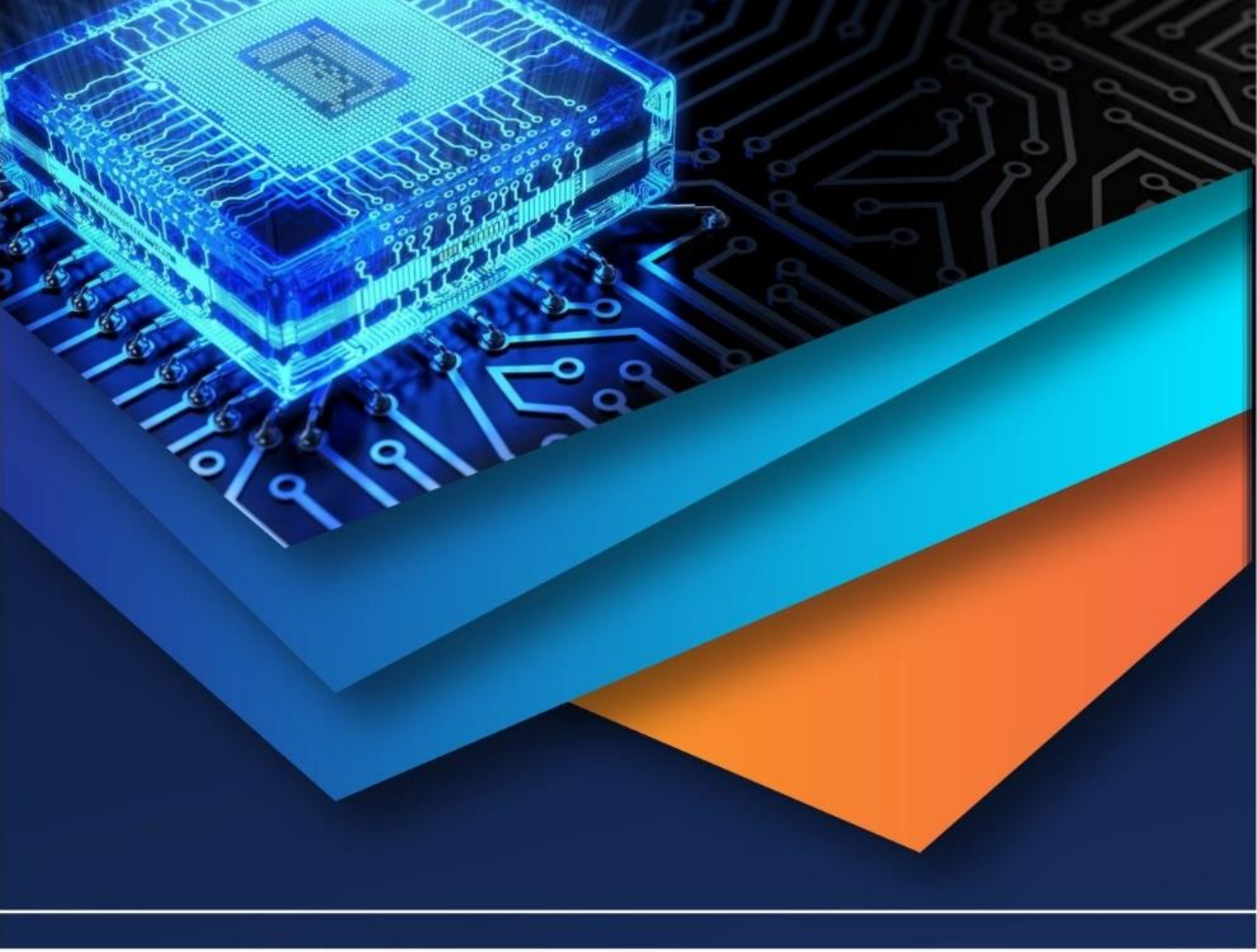

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