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# A Clustering Mechanism for Energy Efficient Routing Path

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**ABSTRACT**-For many applications in wireless sensor networks (WSNs), users want to continuously extract data from the networks for analysis. In wireless sensor networks, sensor nodes in the area of interest must report the cognitive process to the sink by sensing, and this report will satisfies the report frequency required by the sink. This approach proposes a link-aware clustering mechanism, called LCM, which determines energy efficient and establishes the routing path. Node status and causal connection of the nodes, considers a fiction clustering metric called the predicted transmission count (PTX). Itevaluates the attribute of nodes for clusterheads and gateways to construct clusters. Each clusterhead or gateway nodes depends on this primary clustering metric, helps to derive the priority of nodes which is having the greatest priority becomes the clusterhead or gateway. Simulation results show that this technique is significantly forms the higher degree of the clustering and considers the residual energy and link condition in the packet delivery ratio and energy consumption.

**KEYWORDS**— Wireless sensor network: node status, causal connection or link quality, predicted transmission count, clusters.

## I. INTRODUCTION

A Wireless sensor network (WSNs) consists of a set of sensor nodes which is not controlled by any outside sources. It will have little communication links, and then, collectively performs tasks without help from any central servers. Accurate data extraction is difficult in sensor networks.WSNs consist of large number of small autonomous wireless devices, called sensor nodes. Sensor nodes are battery powered devices [1]. The energyrequirement for sensor nodes while sensing, communication, and computation, leads to energy consumption, when transmitting data. Thus, it is a great consequence to design an energy efficient routing scheme for reporting sensory data to achieve a high delivery ratio and enhancement of network lifetime. However, sensor nodes are lacking spontaneity in energy supply and bandwidth [3]. The creation of new techniques will terminate energy inefficiencies that would reduce the lifetime of the network. Link aware clustering mechanism is used for energy efficient routing path for data transmission. Mainly, predicted transmission count is used for evaluating the qualification of nodes. It performs the node status and causal connection between the nodes. Primary link connection is established among the nodes using PTX.

## II. RELATED WORKS

In the tree-based routing protocol, the root node reduces through the channel for message reporting; thereby quickly deplete its battery power. The tree protocol generates more transmission delay [2].

The main issue of clustering is to select proper nodes to act as clusterheads and gateways which occur in active clustering [5]. Addition to active clustering, won and Gerla, have proposed a clustering technique, called passive clustering. In the passive clustering technique, every node in a cluster has an external cluster state, the clusterhead and gateway nodes for used for packet transmission. Passive clustering [8] can be described as on demand cluster formation protocol that does not use dedicated protocol-specific control packets or signals. The formation of cluster is dynamic and initiated by the first data message to be flooded. Which in turn reduces the duration of the initial set-up period, and the benefits of the reduction of the forwarding set can be felt by calculating the total energy consumed because the main function of the clusters is to optimize the exchange of flooded messages. The four states of PC, are as follows, (1)

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Initial, (2) Cluster head, (3) Gateway and (4) Ordinary. At the beginning, every sensor node is in the initial state until it receives a packet. If the sender's packet is not a clusterhead, the node which contains the particular packet switches to clusterhead-ready. This node will become a clusterhead if it successfully transmits a packet before receiving any packets from others. If the sensor node receives a packet from a clusterhead it changes state to ordinary. Any sensor node which has more than one clusterhead becomes gateway.In passive clustering, node status and link conditions are not identified. If cluster head exhausts its battery power, routing path may be destroyed. Sothat, it reduces packet delivery ratio. When PDR is reduced, network performance will be degraded. When there is poor link quality of the nodes, leads to retransmissions of packets and have unnecessary energy consumption.

## III. PROPOSED SYSTEM

1. Link Aware Clustering Mechanism

Based on passive clustering [8], proposes LCM considers node status and link condition, and proposes a fiction metric, called the predicted transmission count (PTX), the following determines the PTX,(1) Node status and (2) Link condition, which have the advanced results of PTX, the CH and GW are elected dynamically, and satisfies the expectation of the sink. PTX considers two important factors for selecting CH's and GW's for stable links to transmit higher data rates, the two factors used to transmit residual energy and link quality[channel condition] i.e., a node with high residual energy and stable link has high probability of becoming CH or GW node proposed method also uses ETX[expected transmission count] to measure the expected bi-directional transmission count each node in LCM periodically broadcast to obtain distance, forward delivery ration, reverse delivery ratio of neighbour thereby determines ETX. Thus the energy efficiency is increased, reduction in transmission delay and increase throughput to great extent compared to the existing works which maximizes the network lifetime.

A) MODULES

1. Topology Formation

Initially all the sensors set and they need to update their local information to its neighbour, so send a broadcast packet to its neighbour by this way it updates its information in the routing table, this Neighborhood Discovery, Base station or Sink initiates the Broadcasting.

2. CH and GW selection using Passive Clustering technique

In this module, once all the sensor nodes are set and broadcasting is done, these nodes are going to partition the network and elect Clusterhead and Gateway using Passive Clustering Technique.

3. Modified LINK-AWARE CLUSTERING MECHANISM using PTX

In this module, the modified Link Aware clustering Mechanism using Predicted Transmission Count are used, where the CH and GW's are elected by Node status i.e., comparing the residual energy left for each and every nodes and choosing one with highest energy, Node quality i.e., checking the link or channel condition how stable the link will be while sending the packets and the node ID, is the channel ID, thus select a stable path from source to destination before routing, thus in this module, the source as input and set a stable path between the source and sink for efficient packet transmission. Thus the energy ratio is increased; transmission delay is decreased and has maximum packet delivery. Further modify the proposed LCM to reduce the no. of hops it takes while cluster formation. By implementing shortest path algorithm in this concept, for reducing the number of Cluster-Head and Gateway formations, thus making the performance of the protocol is more efficient for data gathering compared to the existing clustering technique.

2. Performance Analysis

In this module, plot the packet delivery ratio, residual energy left, packet drop and throughput graph for the simulation.

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B) CLUSTER FORMATION

Clustering is a process that divides that network in to interconnected substructures called clusters. The cluster formation, shown in Fig1. Each cluster has a cluster head (CH) as coordinator within the substructure. Cluster formation is based on contact probability of each node in cluster based routing.

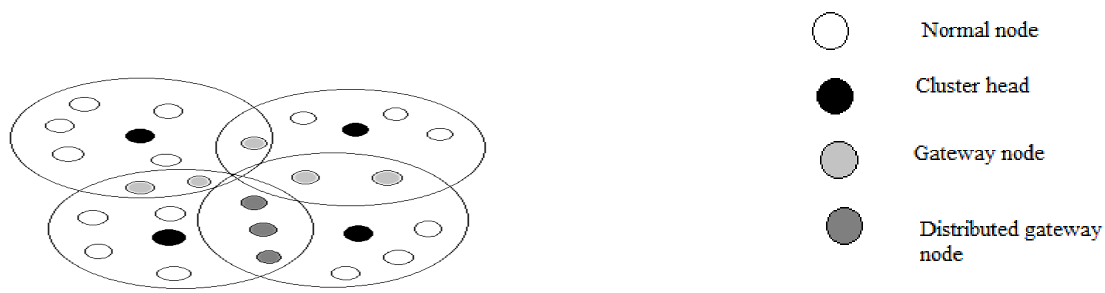


Fig 1. Cluster formations

The optimized flooding scheme makes use of broadcasting the information only within the cluster.

C) OPERATION OF LINK AWARE CLUSTERING MECHANISM

1) Predicted Transmission Count

Random selection is an effortless strategy to determine CH and GW nodes, because of its disregard of node status and link condition. Moreover, using only a single parameter cannot expose the influence of other factors on routing performance. The operation of LCM considers node status (residual energy) and link condition, and proposes a metric, called the predicted transmission count (PTX), to evaluate the suitability of CH or GW candidates. The PTX have the capability of a candidate for never ceasing transmission to a specific neighboring node. This study considers the transmit power, node status, and causal connection for routing paths to derive the PTX of CH or GW candidate. The highest priority of the nodes becomes CH or GW nodes.

Because the channel condition of wireless links varies with time, the link quality which is dependable on the channel condition. Previously, researches used expected transmission count (ETX). The proposed LCM also uses the ETX to measure the expected bi-directional transmission count of a link. Let $ETX_{ij}$be the ETX of link $e_{i\,j}$, and therefore Eq. (1) can be defined as,

$ETX_{ij}$=—— (1)

Where, $p^{f}_{ij}$and $p^{r}_{ij}$denote the forward and reverse deliveryratios from node $s_i$to node $s_j$, respectively. The forwarddelivery ratio is used to measure the probability ofa data packet is received. The reversedelivery ratio is the probability which has the acknowledgment(ACK) packet is received. Each nodein the LCM broadcasts a message to obtain thedistance (Euclidean distance) to determine its priority, forward delivery ratio and reverse delivery ratio are considered with ETX, periodically. When node $s_i$, receives report messages form $s_j$, it canuse Eq. (2) to derive the PTX,

$q_{ij}$ ————(2)

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2) Priority calculation

The proposed LCM evaluates the suitability of CH or GW candidates to determine proper participants to forward data packets. A CH candidate (CH_R node) or a GW candidate (GW_R node), $s_i$, performs the following steps to determine its priority.

Step 1: Calculate the PTX of each neighboring in a cluster formation.

Step 2: Divide $S_i^{nbr}$ into two subsets, $S_{sat}(i)$ and $\overline{S}_{sat}(i)$,where the PTXs of all elements in $S_{sat}(i)$ are greater than orequal to $N_{req}$, and the PTXs of all elements in $\overline{S}_{sat}(i)$aresmaller than $N_{req}$.

Step 3: If $S_{sat}(i) \neq \emptyset$, set ρi as the PTX of the node, which has the minimum PTX in $S_{sat}(i)$; otherwise, set ρi as the PTX of the node, which has the maximum PTX in $\overline{S}_{sat}(i)$.

According to the PTX, higher quality of the nodes can be selected. The LCM determines the candidates satisfying the report quality by putting them into $S_{sat}(i)$. If $S_{sat}(i) \neq \emptyset$, the LCM considers the minimum PTX of all PTXs as the priority of $s_i$. This is because the link corresponding to the minimum PTX can be a requisite report quality.

If there is no links are able to make the expectations of the report quality (i.e., $S_{sat}(i) = \emptyset$), this studyselects the causal connection that can support many message reports as possible. Thus, the LCM considers the maximum PTX of all PTXs in $S_{sat}(i)$ as the priority of $s_i$. To ensure that the high priority node becomes the CH or GW node, the LCM uses a random back off approach to defer the transmission of data packets. Let be the waiting period $T_i^w$ of candidate node $s_i$. Then, $T_i^w$can be obtained as,

$$T_i^w = t_{slot}. \quad - \qquad (3)$$

Where $t_{slot}$is the time slot unit and (x) rounds the value ofx to the nearest integer less than or equal to x.

3) Cluster state transition

Fig 2, shows the cluster state transition diagram for theproposed LCM.Upon receiving messages; a node usesit to determine whether it must change its currentstate. For the lack of space, this work uses the IN nodeas an example to explain the state transition of LCM.

When an IN nodereceives messages from either a CH node or a GW node, itchanges its cluster identifier as that of the sender, because they arebelongs to the same cluster. If the sender is a CH node, the IN node then transits its state to GW_R. Otherwise, the IN nodes transits to CH_R if the sender is a GW node. There is a distributed gateway nodes in LCM. D_GW nodes receive messages from the GW_R nodes and sends back to the initial nodes when the cluster is formed. Meanwhile, the initial node enters the contention procedure to calculate its priority and determine its ultimate state. If the node becomes a CH or GW node, it then forwards the received message.

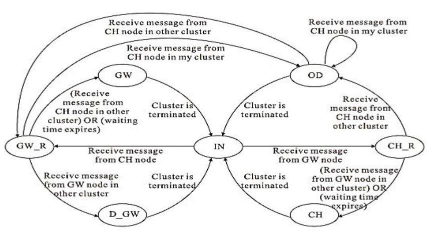


Fig 2 State transition for cluster

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## IV.SIMULATION SCENARIO

NS 2 (Network Simulator) is used in this work for simulation and evaluation of the LCM performance.The metrics used for the performance of evaluation are:

1. Packet delivery ratio:It is defined to be the percentage of the ratio of number of packets received to the number packets sent. Greater value of packet delivery ratio gives the better performance of the protocol.

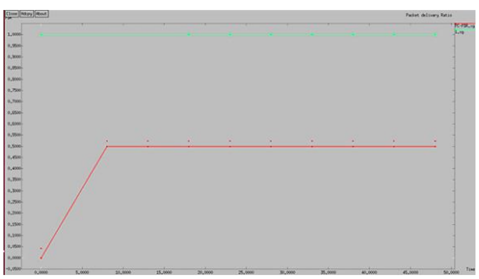
PDR= (Number of packets received/Number of packets sent)*100%

2. Throughput:A throughput is defined as the ratio of number of packets received to the time seconds.

Throughput=Number of packets received/Time (sec)

3. Residual energy: Itmeasures the mean value of the residual energy of all alive sensor nodes when simulation terminates.

4. Packet drop:Packet loss occurs when one or more packets of data travelling across a computer network fail to reach their destination. Packet drop occurs due to channel congestion. Corrupted packets rejected in-transit. Network congestion occurs when a link or node is carrying so much data that its quality of service deteriorates. Typical effects include delay, packet loss or the blocking of new connections.



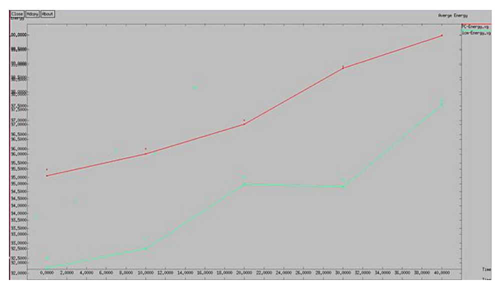


Fig 3.Performance comparison of PDRFig 4.Performance comparison of Energy

According to the Fig 3, In PC, when the ETX value of sensor node is high, number of retransmission of packets takes place. The energy consumption leads to packet retransmission. As a result, compared with the result of PC, the LCM achieves a higher residual energy. In Fig 4, the number of packets received is decreased in passive clustering. In LCM, maximum packets are delivered in time. In Fig 5, the number of nodes in the network increases, number of packets also increased.The probability of packet collision also increases in PC. When the threshold is more likely to cause nodes along the constructed routing path to quickly exhaust their energy because of the increased frequency. When the covered routing path is not continuous, and the clustering mechanism must reconstruct the cluster structure. This reconstruction of data packet may leads to additional energy utilization of sensor nodes, thereby reducing the packet delivery ratio. The LCM outperforms the PC, when number of nodes increases. It designs the PTX as the fiction clustering metric for CH and GW election and LCM achieves the desirable packet delivery ratio.

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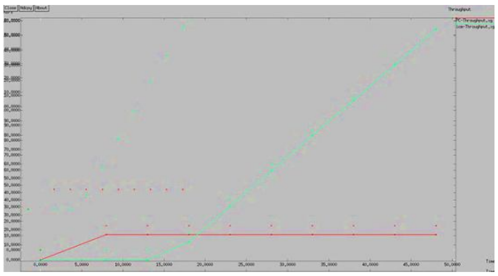

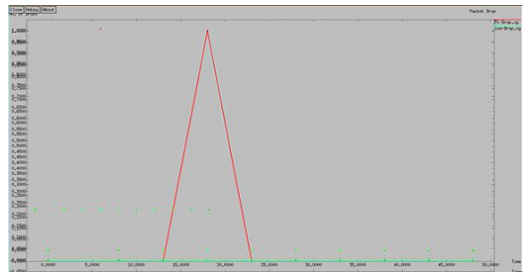

Fig 5.Performance comparison of ThroughputFig 6.Performance comparison of Packet drop.

In Fig 6, passive clustering has more packets descend in lower level than LCM.Network collision occurs when a link or node is carrying so much data, where that its quality of service becomes disintegrates, which includes the effects of queuing delay, packet drop or the blocking of new connections. The packet drop is highly reduced in LCM with the primary link of PTX.

## IV. CONCLUSION

This work has proposed a link-aware clustering mechanism, called LCM, to provide energy-efficient routing in wireless sensor networks. The LCM introduces the predicted transmission count (PTX) to construct cluster structures. The PTX delegates the level of report quality that nodes can support and is derived from the transmit power consumption, residual energy, and link quality. The PTX can be said as, fiction clustering metric to determine a priority for each CH or GW candidate. This is called as primary link. Based on the derived priority, the LCM can select the optimized nodes, having highest priority, becomes clusterheads or gateways. As a result, the LCM considers both node status (i.e., energy usage) and link condition (i.e., ETX value) for efficiently constructing a never ceasing and reliable routing path which guarantees the report quality. Simulation consequence confirms that the proposed LCM achieves a better energy consumption, packet drop, packet delivery ratio, and throughput. In future work which relates to secondary or multiple links among the nodes for enveloping higher energy, and more reliable link among the nodes to get efficient data transmission.

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