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Reliable Data Collection Using Mobile Data Collector in Wireless Sensor Network

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Abstract*— in cluster based wireless sensor network common sensor nodes within the cluster sense the event periodically or continuous and transmit the data packets to the respective cluster head. Cluster heads will process the packets and transmit to the sink. As the cluster head act as intermediate node between common sensor nodes and sink so these nodes consumes more energy as compare to other nodes in network. So in this case these nodes are having more chances to dead early and due to that bottleneck problem occur in the network and this leads to affect the reliability of the network. With the help of proposed mobile data collector node (MDCN) model we can reduce the energy consumption of the nodes which are close to sink and also improve the reliability of the network*

Index Terms*— MDCN Architecture, reliability, Wireless sensor network (WSN), mobile data collector node (MDCN).*

I. INTRODUCTION

Wireless sensor network is collection of small microcontroller situated on sensors and communicates with each other through radio waves. In wireless sensor network data collection is very important task and it will carry out in reliable way. Basically in wireless sensor network sensor node will sense the event and disseminate this information to the sink in hop by hop fashion. Each intermediate node will process the data packet and forward the same to the next node. In cluster based WSN each node within cluster will forward the data packet to their cluster head then cluster head will forward it to the sink. Cluster head will one hop away from sink and act as intermediate node so it will consume more energy as compare to the node in the network and have more chances to dead early so at this position there are more chances of congestion and this leads to decreases the reliability of the network. One of the techniques to improve the reliability is to add redundant node in the network it will help to choose the alternative path in the network.

Another technique is to use the mobile data collector in WSN for data collection. Mobile data collector node is a mobile device which moves in the network for data collection, the main approach of this technique is to reduce the energy consumption of the nodes which are close to sink and increase the lifetime of the network. But this technique has some issues which is basically related with speed of the mobile data collector [2].

In this paper we consider the cluster based flat grid WSN network where common node in the cluster will communicate to their cluster head and there is mobile data collector node which will communicate with cluster head to collect the data packets and disseminate towards the sink in reliable way.

In this paper we use the MDCN architecture for wireless network with random cluster head selection approach within the cluster in addition we try to improve movement of mobile data collector node with shortest path selection technique for data collection within the network and enhance the reliability of the network.

Rest of this paper organized as follows. The work related to the mobile data collector node in wireless sensor network is review in section II and in section III we present the MDCN architecture with shortest path selection approach. In section IV we represent the performance analysis of MDCN model and finally we conclude with future work in section V.

II. RELATED WORK

A multihop wireless network which includes a plurality of wireless nodes, each having a packet relay function, and in which adjacent wireless node relay a packet to each other is known art. Through sequential relay of packets between wireless nodes, each wireless node can transmit a packet to a wireless node that is out of radio arrival range of the node.
Sensor networks deliver myriad types of traffic, from simple periodic reports to un-predictable bursts of messages triggered by external events that are being sensed. Even under a known, periodic traffic pattern and a simple network topology, congestion occurs in wireless sensor networks because radio channels vary in time and concurrent data transmissions over different radio links interact with each other, causing channel quality to depend not just on noise but also on traffic densities. Poor and time-varying channel quality, asymmetric communication channels, and hidden terminals all make even well-regulated traffic hard to deliver. In addition, under traffic load, multi-hop wireless sensor networks tend to severely penalize packets that traverse a larger number of radio hops, leading to large degrees of unfairness.
In order to overcome the problem in many of the one conventional technique that is hop-by-hop flow control, in which nodes signal local congestion to each other via backpressure, reducing packet loss rates and preventing the wasteful transmissions of packets that are only destined to be dropped at the downstream node.
In one of the other conventional technique that is a source rate limiting scheme alleviates the serious unfairness toward sources that have to traverse a larger number of wire-less hops.

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Another technique is a prioritized MAC layer that gives a backlogged node priority over non-backlogged nodes for access to the shared medium, thus avoiding buffer drops.

A mobile node for data collection is most attractive research area in wireless sensor network [4] based on the application it is basically divided in two group's offline and online. The main task of the offline is to collect the data from respective cluster head in short time.

There are different ways in which the common sensor data packets are transferred from the sensors to a sink. Usually, the data packets taken by the sensor nodes are relayed to a base station for processing using the ad-hoc multi-hop network formed by the sensor nodes [3]. While this is surely a feasible technique for data transfer, it creates a bottleneck in the network. Another approach is to use the data collector node to collect the data packets from the senor nodes and transfer o the base station.

In another case we are interested to find the optimal path in sensor networks with a path-constrained mobile sink, which used in application such as ecological environment monitoring and health monitoring of large buildings [5].In this scenario, the mobile sink moves along a fixed path with constant speed to collect data periodically and returns to its start point before the deadline is missed and transfer this collected data packet to mobile node when it comes in its transmission range.

Another approach where we can use mobile sink for data collection in wireless sensor network [6] Mobile Sink Wireless Sensor Network (MSWSN) model, which uses a mobile sink to collect the data from the static nodes of the network. By using Gauss-Marko model we find the movement of the sink for data collection.

The delivery time will important factor when we consider mobile sink for data collection in cluster based wireless sensor network a simple and efficient data collection scheme, i.e., the *Partition-based NJN* (P-NJN) scheme [7]. Specifically, the P- NJN scheme starts by partitioning the sensing field into equal sized grids, and then by adopting certain existing clustering mechanisms.

III. MOBILE DATA COLLECTOR NODE MODEL

A. MDC Architecture

Mobile data collector node model is basically flat grid architecture. MDC model basically clusters based it is collection of five clusters and each cluster having common sensor nodes which sense the event generate the data packet and disseminate it to their cluster head. Within the clusters the cluster head will be elected by using election algorithm this algorithm will consider two parameter for each common sensor node within the cluster these are the node which having highest energy and the distance of that node from all other node within the cluster. Fig 1 shows the MDC architecture, lower layer shows clusters with common sensor node each cluster having cluster head above that the middle layer is mobile data collector layer which is used for data collection from cluster head and top layer is the sink layer.

B)Call DC method

Find DC method is basically used for finding mobile data collector node this method is used by cluster head. Cluster head will store the data packet within its buffer received from common sensor node within the cluster but cluster head buffer will have some limitations so when its buffer reaches to set threshold value it announce the message in the network this message contains the cluster id and its location parameter. When this message received by MDC it will find the location of respective cluster head, after that it will select the shortest path to visit and move towards the cluster head and collects the data packet from respective cluster head.

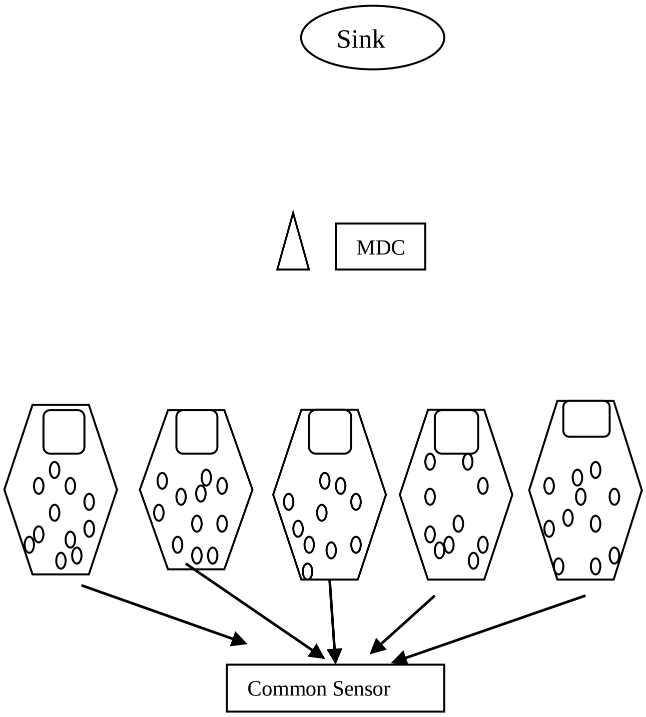

Fig 1 MDC Architecture

IV. PERFORMANCE EVALUATION

We verify our analysis results and evaluate the performance of proposed MDC based architecture. We consider 200 × 200 flat grid topology with 55 sensor nodes and one MDC node we analysis these result using NS2 simulator.

A. Experimental setup

Area of Sensor Field	**200 * 200**
Topology Used	**Flat grid**
Number of Sensor Nodes for Simulation	**50 Nodes**
Packet Length	**512 bytes**
IFQ Length	**200**
Transmission Range	**200 m**
Interference Range	**550 m**
MAC Layer Protocol	**802.11**
Routing Protocol	**AODV**
Frequency of Packet generation (1/Time Interval) Reporting Rate.	**Used different frequency rate for analysis**

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Source Nodes	**All Common Sensor node within clusters**
Cluster Head	**5**
DC	**1**
Sink Node	**0**

Table 1 Experimental setup

B) Quality of service parameters

We evaluate the QoS parameter for the proposed MDC model on following parameter.

1. Packet delivery ratio (PDR)
2. End –to- End delay
3. Packet generated
4. Packet received
5. Energy

A) Packet Deliver Ratio (PDR)

The fig 2 shows the result for Packet Delivery Ratio, here Packet size is fix 128 byte and Different Reporting rate 50, 100, 150,200 Pkt/sec and the Mobile Data Collector Node (MDCN = 01) above graph shows that when we transmit 50 Pkt/sec at that time PDR reaches up to 60 % and for 200 Pkt/sec it reaches to 85 % because as we increase RR more packet are generated and it also improve the PDR of the Network.

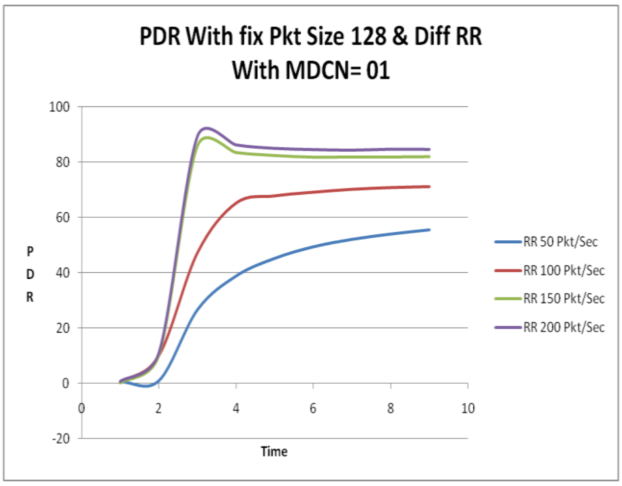

Fig 2 Packet delivery ratio (PDR)

B) End-to-End Delay

Fig 3 shows the result for End-to-End Delay, here Packet size is fix 128 byte and Different Reporting rate 50, 100, 150,200 Pkt/sec and the Mobile Data Collector Node (MDCN = 01) above graph shows that when we transmit 50 Pkt/sec at that time E2E Delay is high (10 MS) and when we transmit 200 pkt/sec it is low (2MS), this is because at the starting for a particular packet to find its routing path in its routing table need more time but after that when routing path is fix one then delay is minimizes and it almost reaches to zero. From above graph it is observe that as we increases the RR accordingly delay required less.

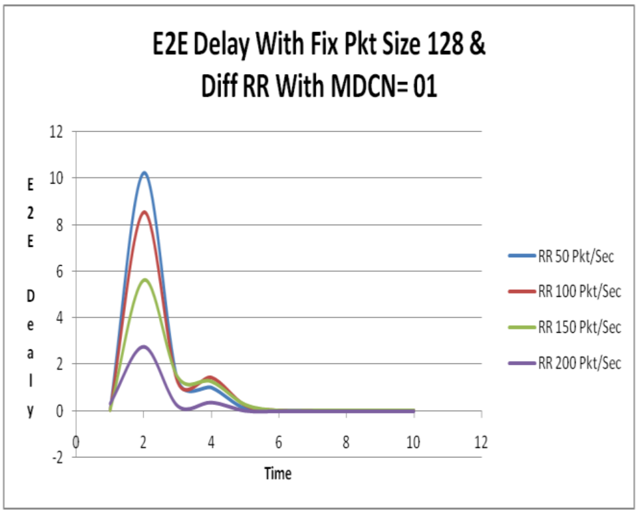

Fig 3 End-to-End delay

C) Packet generated

Fig 4 shows the result for Packet generated with fix Packet size 128 byte and different reporting rate the above graph show that as we increases the RR the number of packet generated is also increases.

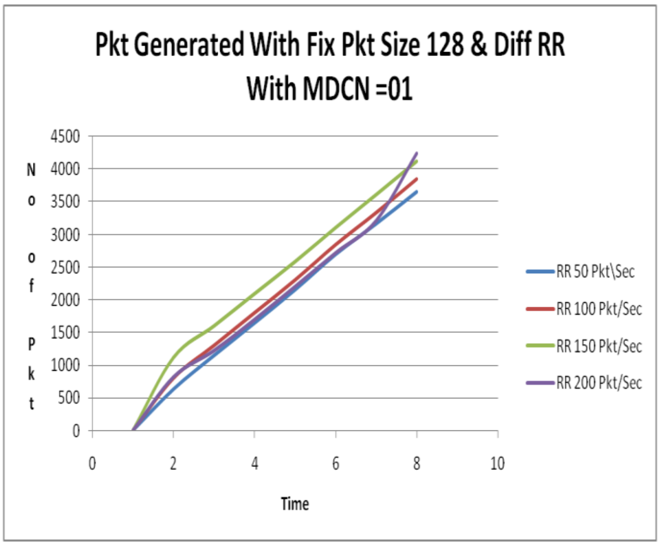

Fig 4 Packet generated

D) Packet received

Fig 5 shows the result for number of packet receive with fix packet size 128 byte and Different Reporting rate with MDCN =1. Here when RR is 200 pkt/sec the number of packet receive is 3500 and when RR is 50 number of packet receive is less i.e 2500. By observing the above graph it is clear that as we increase the RR number of receive packet is also more accordingly.

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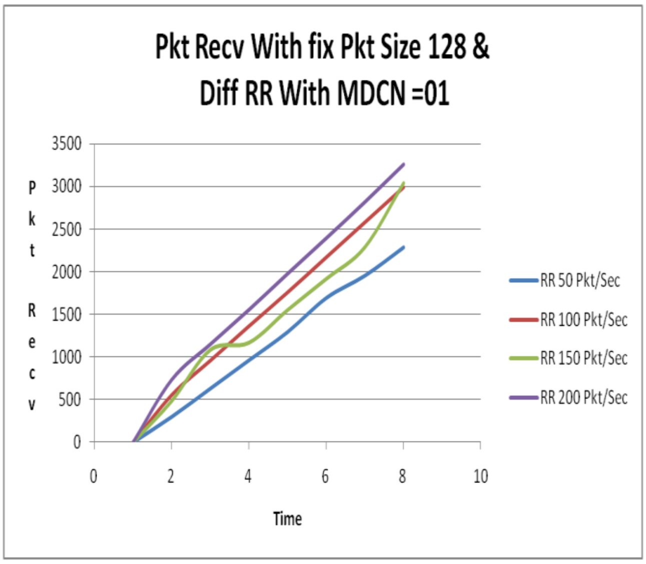

Fig 5 packet received

E) Energy

Fig 6 shows result for Energy consumed by cluster heads, MDCN & sink for different reporting rate. It is observe that for RR 200 every node consumes more energy as compare to other RR i.e 50,100,150 because as we increase the RR number of packet generate more so at RR 200 every cluster head & MDCN has to process 200 pkt/sec so that they need more energy.

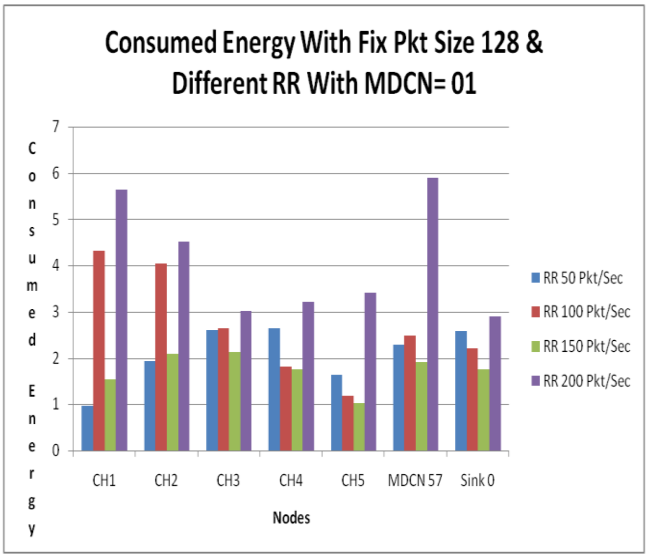

Fig 6 Energy consumed

V. CONCLUSION AND FUTURE WORK

In this paper we are concentrating on the area of wireless sensor network basically the nodes which are one hop away from sink consumes more energy as compare to other node in the network, so there are more chances that these node dead early and due to that congestion occur in the network and this leads effect on the reliability of network. But using our proposed MDC model we will reduce the energy consumption of the node which are one hop away from sink and improve the reliability of the network.

In future we try to increase the density of the mobile nodes according to the clusters in the network for data collection and try to improve reliability of wireless sensor network

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