Traffic Based Priority in Virtual Backbone Scheduling using Backbone node clustering and Multiple sink for QOS Routing

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Abstract **- Applications of Wireless Sensor Networks (WSN) is nowadays are widely used for military, fire detection and monitoring systems. Sensor Node is equipped with batteries as a sole energy. Therefore the energy efficiency is critical here in these sensor nodes. To achieve QoS, the data should be delivered efficiently even if there is an occurrence of interference or congestion in the network. Hence we should concern about QoS for efficient throughput and to increase the system lifetime as well the fairness improvement. This paper proposes a new algorithm, which delivers the efficient throughput to the destination using virtual backbone clustering and multiple sinks based on the traffic priority. The backbone node is constructed using CDS and scheduling of the backbone node is done using Duty cycle (DC) and STG, forming of backbone cluster helps to find efficient route and reduce the overhead of backbone nodes and thus minimizing the energy consumption and increase node lifetime. Clustering of backbone node also helps to deliver the data fast into high congested area. Thus eliminating the congestion in backbone nodes.**

Keywords: VBS, Priority, Route Selection and Sink

I INTRODUCTION

A Wireless Sensor Network (WSN) [1] monitors the physical and environmental conditions, these WSN consist of autonomous sensors which are spatially distributed and works cooperatively to monitor applications like temperature, sound, military and vibrations. Some applications have diverse data traffic which has different quality of service (QoS) requirements. The three different QoS requirements are 1) Energy Efficiency 2) Scheduling based on traffic priority and 3) Latency. Based on these requirements the data traffic can be split into:

- Regular traffic.
- Reliability sensitive traffic, in which the data are to be delivered without loss, but can have little delay.
- Delay sensitive traffic, in which data has to be delivered within deadline, but can tolerate minimum packet loss.
- Critical Traffic of high importance, which requires high reliability and short delay.

By the above classifications, the proposed system is designed to deliver the packets based on the priority. The creation of virtual backbone node is to minimize the energy consumption made by the node. Multiple backbone nodes may be created, which works alternatively to prolong network lifetime. In virtual backbone scheduling the traffic is sent using backbone sensor nodes, and the rest of the nodes go to sleep mode turning off their radios, thus minimizing the energy.

The data collected by backbone nodes are sent to a special node called as sink node, which is active all time, has higher energy and processing capabilities. Backbone nodes are the set of active nodes, creating single backbone node will not prolong the network lifetime, thus it is intuitive idea to create a set of disjoint backbone nodes. Connected Dominated Set (CDS) [2] algorithm is used to construct backbone node. Backbone nodes are constructed through sink node which is loop free. Here the use of multiple sink nodes helps in formation of backbone node clusters, which works efficiently in delivering more throughputs. The scheduling of backbone node is done through Duty cycle fashion which has become most integral part of WSN [3][4][5][6][7] Virtual Backbone Scheduling combines backbone node scheduling and Duty Cycle to work in a duty cycle fashion. Whenever some backbone node wants to forward some data packets (either data packets generated by the backbone node itself or received by some other backbone node) each backbone node checks the packet rate of the network which is defined as threshold value. If the data packet rate is

more than the threshold value, congestion occurs. Then backbone node will check whether the data packet has to be forwarded in unusual event or routine data. If it is unusual event the backbone node forward packets through shortest reliable route. Routine packets are forwarded through some other possible paths. If the threshold value is lower, then there is no congestion in network therefore all the packets are forwarded through some shared path. The major contributions in this paper are:

1. Construction of the backbone nodes, which minimizes node energy consumption, reduces the communication overhead, increases bandwidth efficiency and prolong the network lifetime.

2. Forming backbone node clusters and using of multiple sink node , to increase throughput

3. Constructing loop free backbone node using CDS through sink node.

4. Proposing Priority Based Traffic load in Virtual Backbone Scheduling, using Duty Cycle and STG. Proposed algorithm provides efficient way to overcome congestion in backbone node cluster.

II PROBLEM DEFINITION

The problem in Wireless Sensor Network is that sensor nodes are deployed in open environment, thus the battery is the major console for all the sensor nodes. The radio of the node consumes more energy. To gain throughput on different traffic priority the scheduling of the traffic should be done accordingly based on priority. If the scheduling is not done accordingly to priority based, there may be a chance of the network getting congested. If the network is congested the QOS parameters are affected. To overcome these issues of QOS, we propose traffic based priority scheduling in virtual backbone nodes, which minimizes energy consumption of node and through backbone node clustering and using multiple sink nodes helps to increase throughput.

III RELATED WORK

Network Model: Let us consider a V as a set of n wireless devices which is widely distributed in a compact and convex region. Hence the region Ω is a unit-area square or a unit-area disk. Each node position is known by some low power receivers like GPS When single-hop broadcasting is done, each node i can get the location information of all nodes within its transmission radius. The Transmission radius ‘r’ is set to all nodes uniformly. Whereas when considered about multi hop network modeled by a graph which is known as communication graph which is denoted as G (V, r), where two nodes connected in G (V, r) if it is in Euclidean distance.

Li Qun Zhuang et al proposed issues related to data management in WSN, which provided various issues on node deployment and dynamics of sensor network and gave an efficient result to solve those issues [1]. D.Baghyalakshmi proposed an hierarchical routing model in WSN in which the sensor network divided into various zones or cluster, here the data forwarding takes place from the first level cluster head to second level cluster head and finally reaches to sink or destination [2]. To increase throughput and to save energy of sensor node Feng Wang [3] proposed an min and max data aggregation approaches on clusters. Here cluster head collects the data from sensor device applies aggregation technique based on average max and min, thus minimizing transmission. Xiaoxia Ren [4] proposed issues related to QoS in WSN about data sensing and reporting. Thus Xiaoxia Ren proposed three approaches namely continuous, event driven and query based. In first approach the sensor node will send data packets to sink node continuously after a fixed period of time. In second Approach data is sent to sink only when there is an event detected. Finally in third approach, data is sent to sink node only if sink node queries any request to sensor node. Priority based congestion control protocol is proposed by R.Malar [7] in which data computation takes place to optimize congestion control in WSN. The packet inter-arrival time and packet service time is measured as a congestion degree. Feng Wang et al [8]. proposed a better approach for data collection in WSN. It is based on clustering and aggregating approach. In this cluster head collects data from sensor nodes and perform aggregating of data based on average, max and min approach. This approach minimizes data to be transmitted and hence result in saving energy. Xiaoxia Ren et al [9]. Also provided QoS issues in wireless sensor network. Data sensing and reporting in WSNs is dependent on the application and the time criticality of the data reporting. R. Then Malar [10] proposed congestion control protocol based on priority approach. This protocol is known as priority based congestion control protocol (PCCP). PCCP employs packet-based computation to optimize congestion control for a WSN. It measures the congestion degree as the ratio of packet inter-arrival time and packet service time.

IV PROPOSED MODEL

In this section we describe about the backbone cluster scheduling to find the efficient throughput based on traffic priority in back bone cluster. The complete modules have been discussed below.

1. Backbone Cluster Construction and Multiple Sink

Backbone nodes are constructed using Connected Dominated Sets (CDS). Cluster based architecture is used to construct the cluster. Each cluster has a Cluster Head (CH) and Cluster Members (CM), Cluster Head dominate the Cluster member within the cluster. Clustering of nodes can deliver efficient routing. CH can be randomly formed. When CH is formed, it broadcasts its decision to other nodes. Each node responds to CH with its high signal strength. Selection of CH is repeated periodically to balance energy consumption. Sink node is placed in each cluster, sink can be place anywhere in the environment. Communication between the backbone node and sink is done using multihop. Different routes are constructed though sink nodes using Directed Acyclic Graphs (DAG).

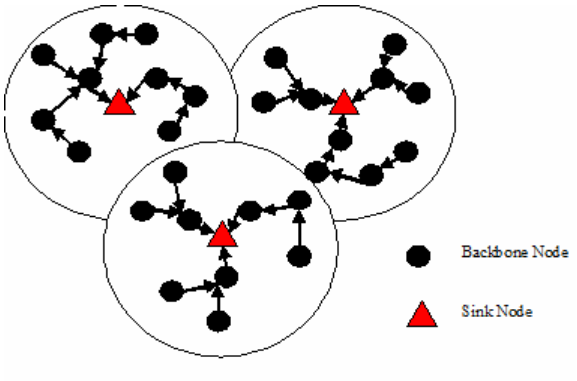

Figure 1: Backbone Cluster and Multiple Sink Nodes

2. Duty Cycle

Duty Cycle is one of the best solutions for scheduling backbone nodes in the network, backbone sensor nodes are duty cycled and has same working cycle. T is defined as continuous cycles which are measured in terms of round, where $T \geq 1$, T is a tunable parameter. Very First at the beginning of each round, a backbone is selected from cluster to work in duty cycle.

3. Schedule Transition Graph (STG)

STG is shown in the figure 2, it is a centralize approximation algorithm. The time scale is shown in horizontal which is counted in rounds. The possible states of the nodes are vertically listed in each round. The number of backbone is equal to the number of possible states in each round. There is an one to one mapping between state and backbone. Energy is used in 1 round which represents the time laps during each round when consumes energy. Transition of node is not allowed when there is state depletion in node. Backbone Scheduling, which dynamically turns off the radio of the sensor nodes to save energy.

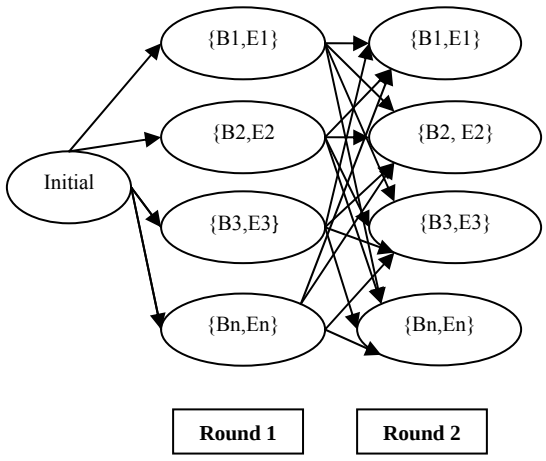

Figure 2: Scheduling of Backbone Node

Where B is a set of backbone nodes each backbone nodes work with rounds. Connectivity of all is a network connected sub-graph and all other nodes are 1-hop away from node.

4. Priority Based Traffic Load Reduction.

PBTR algorithm is proposed for backbone nodes cluster which can overcome congestion in wireless backbone node cluster. It also provides priority on location as well on data. The aim of this algorithm is to delivery data along the congested areas of backbone clusters.

First the backbone nodes created; through multiple sink nodes the CDS of backbone nodes are formed. Then we divide the backbone network into various backbone clusters, each backbone cluster has a cluster head which receive data from backbone nodes and transmit to other backbone cluster head. In this approach we divide into two phases. First, if a backbone node wants to forward some data to other backbone node, it checks for the congestion on the

network. If any congestion found in the network, the sender checks for the type of data to be sent, if it is critical data, the data will be sent through dedicated path. If it is normal data then it is given higher priority. In second phase priority is given to the location, it is necessary to deliver data to some cluster regions prior to other cluster regions. So here we provide location priority. If a backbone cluster has higher priority than other backbone cluster, then it will receive data in advance to other regions.

Proposed Algorithm

Step 1: Backbone nodes n backbone clusters are formed.

Step 2: Start the backbone node to generate data

Step 3: Priority decision:

- If data is critical, data is sent through dedicated path to critical task and go to step 5
- If data is Routine data, 1st priority is given and go to step 4
- If data is Information Message, 2nd priority is given and go to step 4

Step 4: Route selection function is used to select routes

Step 5: Highest priority data is transferred before the lowest priority

Step 6: Checking clusters based on geographical

- If geographical clustering is done go to step 7
- If no geographical clustering, find the highest priority regions of backbone go to step 7

Step 7: Send data through dedicated and shared path

Step 8: END

5. Localized Routing

Localized routing protocol allows multi-hop wireless transitions among nodes in a geometric area. Greedy routing is a widely used localized routing protocol. In Greedy routing protocol it finds the best shortest path among the nodes using local information. In this routing technique the forwarding node sends the forwarding information to the nearest destination.

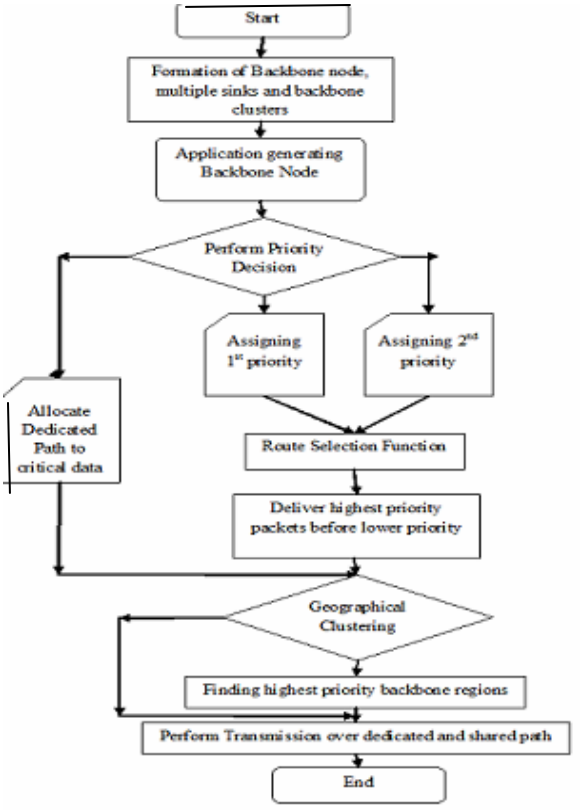

Figure 3: Flow Diagram

V EVALUATION METRICS

The simulation is carried on Network Simulator 2 (NS2) tool; experiment is carried on a simple virtual backbone network for normal packet deliver and compared with virtual backbone network with priority based approach.

Simulation is conducted on NS2 simulation tool of an area 1500m x 1500m, Number of nodes used is 49. Out of which 6 Nodes makes one cluster, and we construct backbone nodes and multiple sink node in each cluster. Type of traffic used is CBR. Below table show the parameters used.

SL No	Parameters	Values
1	Number of Nodes	49
2	Topology Dimension	1500x1500
3	Traffic Type	CBR
4	Radio Propagation Model	TwoRayGround
5	MAC Type	802.11

6	Packet Size	512
7	Antenna Type	Omni
8	Mobility Speed	250
9	Routing Protocol	AODV

Table 1: Parameters

As discussed above, the network is divided into 8 backbone cluster of 6 backbone nodes each. Each cluster has cluster head, which is randomly selected, Cluster Head is chosen periodically gives chance for other node to be Cluster Head in next time period. Cluster Head which receives data from sink node and sends data to other cluster head. Cluster head is labeled as Head, if a backbone node in one cluster wants to communicate with backbone node of other cluster. It has to communicate only through cluster head and multiple sinks. Below figure 4 shows the cluster of back bone nodes and with multiple sink nodes.

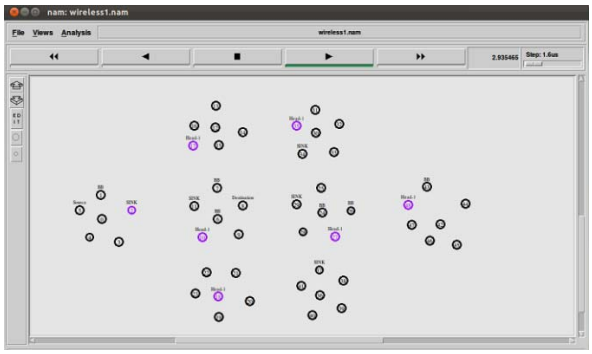

Figure 4: Clustering of nodes

As shown in the figure 5 below, data is transmitted to the back bone cluster, with high priority. Hence there is no packet loss.

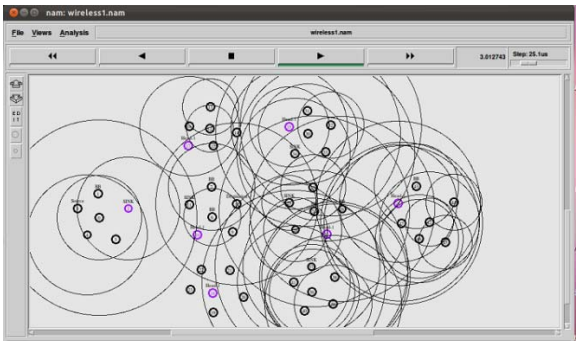

Figure 5: Data transmission with priority

As shown in the figure 6, data transmission of a back bone cluster without any priority may leads to congestion and packet dropping. In the proposed method Backbone cluster head checks the priority of receiving backbone clusters. Clusters with high priority receive data prior to other backbone clusters.

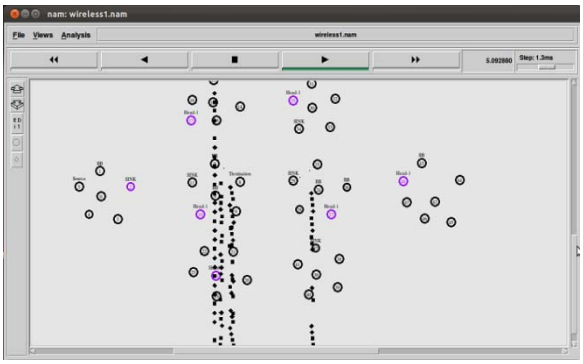

Figure 6: Packet loss without priority

RESULTS and ANALYSIS

I. Packet Delivery Rate

Below graph figure 7 shows the packet delivery rate of the back bone cluster, which delivers the packet efficiently with highest priority. The x axis shows the time used to deliver the packets with priority. Y axis indicates the priority values.

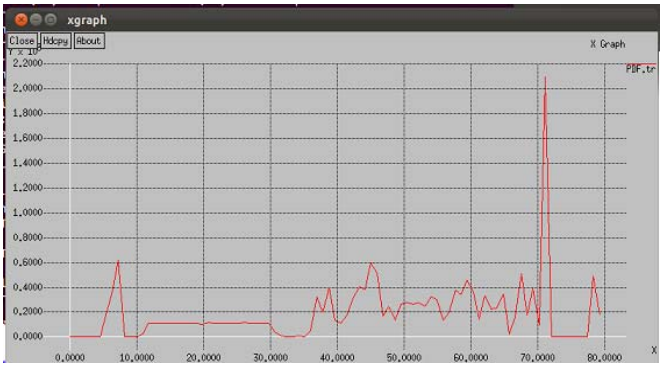

Figure 7: Packet Delivery Graph

II. Throughput

Graph figure 8 represents comparison of throughput for proposed algorithm and with simple wireless cluster sensor without any priority. The red line indicates the proposed system in delivering packets using PBTR approach, whereas the green line indicates the normal packet delivery without any priority. X axis indicates the time and Y axis indicates the throughput rate in kbps

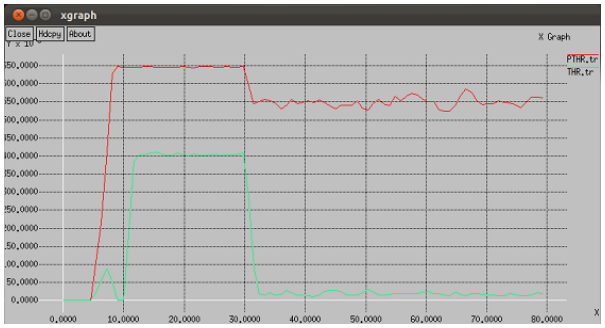

Figure 8: Throughput Graph

VI CONCLUSION

Priority based load reduction algorithm (PBTR) for back bone cluster network is proposed. The performance of the algorithm is carried out using NS2 2.35. The routing protocol used is AODV. The simulation results are compared with the simple cluster without any priority. Performance metrics are packet delivery rate and throughput. Drawback of existing system is the node overhead, it need to check for traffic level for every packet it sends, thus consuming more energy. Using back bone cluster and multiple sink nodes, PBTR can deliver packets efficiently in a high congested area and reduces the node overhead and node energy consumption. Thus improving the QoS using prioritized clustering approach.

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