IMPROVING THROUGHPUT AND ENERGY EFFICIENCY BY PCTAR PROTOCOL IN WIRELESS SENSOR NETWORK

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***Abstract*— Wireless sensor network is an emerging technology consists of spatially distributed autonomous sensors to monitor physical or environmental conditions. The major constraints of these networks are limited to battery life and congestion. Most current routing protocols try to alleviate indiscriminate dropping of data. That type routing protocols not considering congestion and low priority data dropping, so it will degrade the throughput. Here proposing a prioritized congestion and traffic aware routing (PCTAR) protocol to ameliorate throughput by lessen congestion. PCTAR protocol dynamically discovers the routing zone by considering hybrid potential fields and data priority. The simulation result shows that the proposed method improves the overall throughput by 70 percent as compare to TADR. PCTAR protocol make worthier changes in the health care monitoring and military applications.**

***Index Terms*— Wireless sensor networks (WSN), congestion control, TADR and prioritization**

I. INTRODUCTION

A sensor network is an infrastructure comprised of sensing computing and communication elements that give an administrator the ability to instrument, observe, and react to events and phenomena in a specified environment. Wireless sensor networking promises a wide range of potential applications in both civilian and military areas. One of the great benefits of using wireless sensor network is that they can be used to replace the man power in military and health monitoring. To meet the requirements of the application a wireless sensor network design must have several unique features. The major constraints of these networks are limited to battery life and congestion.

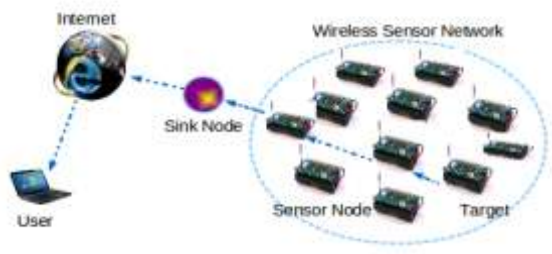

Figure 1: Wireless Sensor Network.

Undoubtedly the leading issue in sensor network is battery conservation and careful use of available energy. In wireless sensor networks the methods for energy conservation can be divided into two groups passive and active methods. Passive methods include using sophisticated energy sources to supplant the batteries and placement of sensors into energy efficient topologies. Active methods to conserve Energy include using specified operating systems.

Congestion control and reliable data delivery are the other paramount challenges in wireless sensor network. Network congestion occurs when a link or node is carrying so much data that its quality of service deteriorates. Typical effects include queuing delay, packet loss or the blocking of new connections. Packet loss is the discarding of packets in a network when a router or other network devices is overloaded and cannot accept additional packets at a given moment. Packets are the fundamental unit of information transport in all modern computer networks, and increasingly in other communication network as well.

All the protocols that are designed and implemented in wireless sensor network should provide some real-time support as they are applied in areas where data is sensed, processed and transmitted based on an event that leads to an immediate action. A- CAR[2], which is a differentiated routing protocol and uses data prioritization. Along with high priority (HP) packet, low priority (LP) packets also contain information. So the packet delivery of both the packets is to be achieved. TADR[1] is a distributed and scalable routing algorithm. Traffic aware dynamic routing can effectively alleviate congestion through by passing the hotspots, and met the fidelity requirements through improving the overall throughput. An extra rule is also introduced to prevent dropping of packets at the hot spots near the sink.

II. TADR

The congestion problem in Wireless Sensor Networks (WSNs) is quite different from that in traditional networks. Most current congestion control algorithms try to alleviate the congestion by reducing the rate at which the source nodes inject packets into the network. However, this traffic control scheme always decreases the throughput so as to violate fidelity level required by the applications.

In this paper, they present a solution that sufficiently exerts the idle or under loaded nodes to alleviate congestion and improve the overall throughput in WSNs. To achieve this goal, a traffic-aware dynamic routing (TADR)[1] algorithm is proposed to route packets around the congestion areas and scatter the excessive packets along multiple paths consisting of idle and under loaded nodes. Utilizing the concept of potential in classical physics, our TADR algorithm is designed through constructing a hybrid virtual potential field using depth and normalized queue length to force the packets to steer clear of obstacles created by congestion and eventually move toward the sink. TADR scheme has low overhead suitable for large-scale, dense sensor networks.

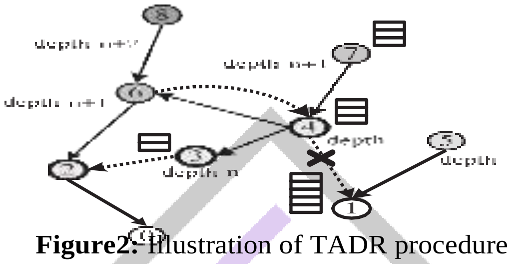

Figure2: Illustration of TADR procedure

2.1 MODULES

- Depth potential field formation.
- Queue length field formation.
- Superposition of potential field.

2.1.1 DEPTH POTENTIAL FIELD FORMATION

To provide basic routing function TADR defines the depth potential field $V_d(v)$ to make each packet flow towards the sink. Depth (v) is quite similar to shortest distance since they both represent distance from the destination.

Depth potential field $V_d(v)$ = depth(V), where depth(V) is the depth of node v.

Depth field force from node v to neighbor w ε nbr(v)

$$F_d(V,W) = \frac{V_d(V) - V_d(W)}{C_{V,W}}$$

The depth difference between node v and neighbor node can only be one of -1, 0, 1.

The depth field force should also be one of 0, 1/Cvw, -1/Cvw

2.1.2 QUEUE LENGTH FIELD FORMATION

Queue length potential field at node v is V_q (v) = Q(v), Q(v) denotes normalized queue length potential field at node v.

$$Q(v) = \frac{P_n}{N}$$

Where P_n the number of packets in the queue and N is is the Buffer size at node v

2.1.3 SUPERPOSITION OF POTENTIAL FIELD.

The main attribute of TADR algorithm is Queue length field which make the routing algorithm traffic aware. The Queue length field performs the routing decisions as a combination of both depth and Queue length potential fields. Using linear combination method for simplicity and tractability.

Combine the potential fields by Vm(v) = (1-α)Vd(v) + αVq(v). Here Vm(v) is the potential field of the combined field at node v.

Combined force from node v to neighbor w ε nbr(v).\

$$F_m(V,W) = \frac{V_m(V) - V_m(W)}{C_{V,W}}$$

Depth potential field encourages data flow directly to the sink and Queue length potential field endows traffic aware solutions.

III. PROPOSED SYSTEM

The recent progressions in the field of sensing, computing and communication have made a lot of research efforts. The major challenges considering in the research activities are congestion control, improving throughput, energy efficiency, security, data rate and link failure.

This paper proposes a prioritized congestion and traffic aware routing (PCTAR) protocol. PCTAR PROTOCOL dynamically discovers the routing zone by considering hybrid potential fields and data priority.

PCTAR

Prioritized congestion aware routing scheme is designed based on the concept of prioritized congestion aware routing and hybrid potential field. The steps involved in this PCTAR design are

- High priority network formation
- Design of potential fields
- Routing zone discovery
- Differential routing

For calculating shortest path instead of quadrant or other method we are considering hybrid potential fields. Hybrid potential field is the combination of depth potential field and queue length field. In this the high priority packets are sending through this routing zone created according to the potential fields High priority and low priority packet delivery is assured because of traffic aware routing.

Routing zone creation and routing in PCTAR:-

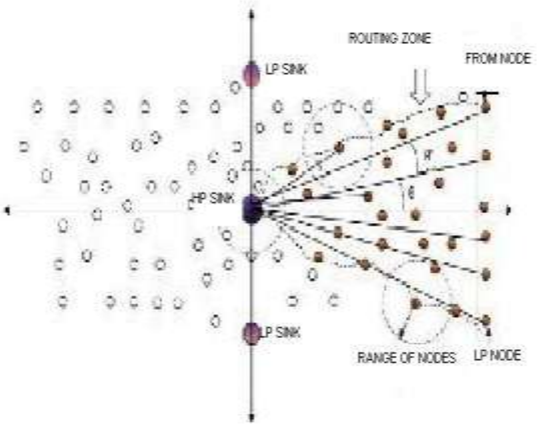

Figure 2: Routing zone creation

Steps for the algorithm/protocol

1. Select from node and to node.

2. Find out the shortest path between from node and to node.

3. Hybrid potential field is using to calculate shortest path.

4. Select the nodes which are from node and to node to create routing zone.

5. Calculating the depth and consider the queue length from node and sink.

6. Create routing zone by selecting nodes which are in the path from node and to node , in routing zone.

7. Calculate the shortest path between from node and HP sink.

8. Repeat the step 6

9. Calculate the path between to node and sink.

10. Repeat step 6.

11. Repeat step 10 & 11 by taking HP sink and all the nodes in the path of to node and from node.

4. SIMULATION RESULT

Implementation is done using NS-2. Here there are some important sequence that to be implemented with the simulator. The experimental set up contains 100 nodes. These 100 nodes are arranged randomly in positions. Since this is the wireless environment, the nodes are given the random motion. In the implementation, the throughput, packet delivery ratio (PDR), packet delay and node energy efficiency are measured.

4.1 Throughput Comparison

The number of packets that are transmitted in the network is shown in the following graph. Throughput is measured after the PCAR and TADR has been rectified. It is shown that the throughput after the prioritized congestion and traffic aware routing has been overcome is high. There is 34.5%.

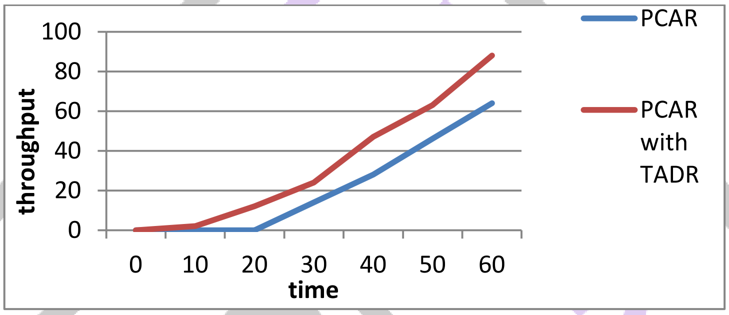

Figure 3: Graph representing throughput versus time.

4.2 Packet Delivery Ratio Comparison

Packet Delivery Ratio is defined as the ratio of the number of packets that are sent by the source node to the number of packets that are received by the destination. Packet delivery ratio is measured for the packets that are transmitted before applying PCAR and TADR and also after applying PCTAR protocol in the network. It has been noted that the packet delivery ratio is high

in the case when PCTAR applied in the network. By this, the packet loss reduced by 4.28%.The following graph depicts the comparison of the two cases.

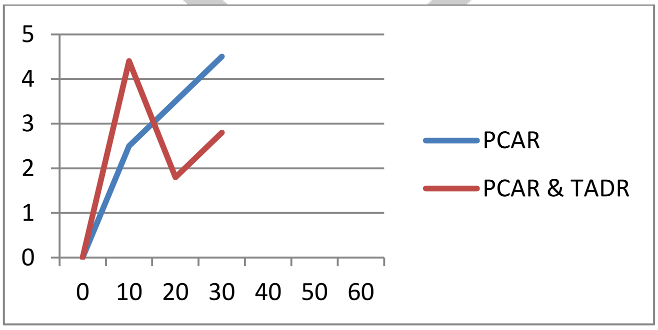

Figure 4: Graph representing packet delivery ratio versus time.

4.3 Packet Delay Comparison

The sum of store-and-forward delay that a packet experiences in each router gives the transfer or queuing delay of that packet across the network. Packet transfer delay is influenced by the level of network congestion and the number of routers along the way of transmission. It is shown that the packet delay after PCTAR implementation has been reduced.

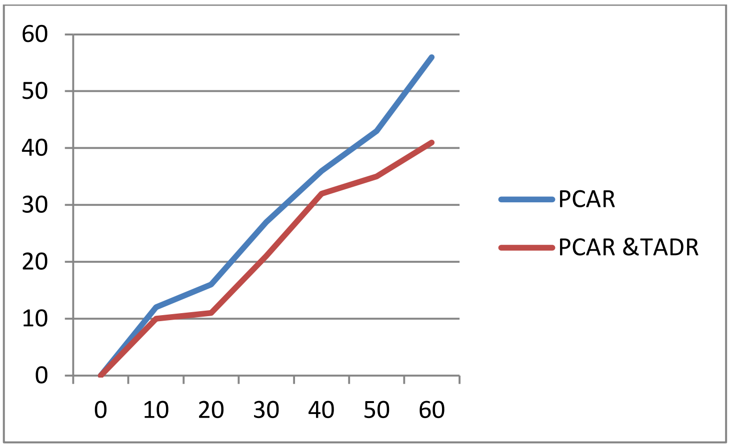

Figure 5: Graph representing packet delay versus time.

4.4 Energy Efficiency Comparison

Energy efficiency is inversely proportional to the energy consumption. Energy consumption is measured before implementing PCTAR and after implementing PCTAR. First we measure for PCAR and after combining it with TADR. The energy efficiency is high in the case when PCTAR applied in the network. By this the energy efficiency is improved by 20%.

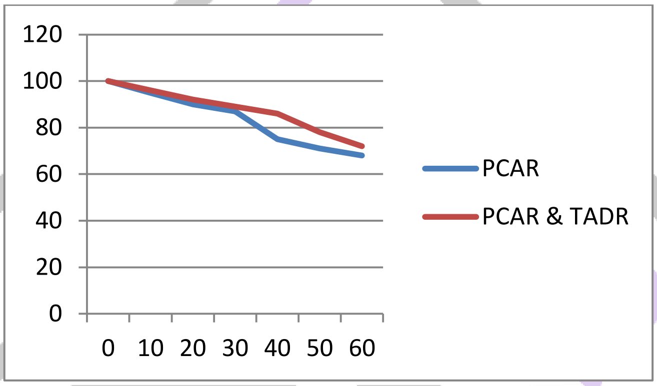

Figure 6: Graph representing energy efficiency versus time.

5. CONCLUSION

In wireless sensor network congestion control is quite different from other networks. Only the efficient traffic control can alleviate congestion, but it may affect the fidelity requirements of the application. The proposed method prioritized congestion and traffic aware routing (PCTAR) protocol to ameliorate throughput by lessen congestion. PCTAR protocol dynamically discovers the routing zone by considering hybrid potential fields and data priority. By this we got high throughput and energy efficiency.

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