To Alleviate Congestion in TADR by using Combined Dominating Set Technique in Wireless Sensor Networks

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Abstract- In this paper TADR-Combined Dominating Set (TADR-CDS) based congestion control technique is proposed. The main aim of proposed work is to avoid congestion and to increase link stability. This technique is improved version of Traffic Aware Dynamic Routing (TADR) which improves throughput, time delay and energy by decreasing packet delivery ratio. Occurrence of congestion in the network degrade throughput, increase time delay and energy consumption in the network. To satisfy this objective and to maintain constant traffic rate, TADR-Combined Dominating Set (TADR-CDS) technique is proposed. Initial step towards achieving this goal is to make sets of nodes and these combined set of nodes transfer packets in a limited range as per the receiving rate of receiver node. In this way sender node dominates receiver node. This technique helps to degrade congestion by link stability between the nodes in the network. A comparison has been made between existing technique and the proposed technique i.e. TADR and TADR- CDS on the basis of delay, energy consumption, Packet Delivery Ratio (PDR) and the network lifetime.
Keywords- TADR-Combined Dominating Set Technique (TADR-CDS); Wireless Sensor Network; link stability; Traffic Aware Dynamic Routing (TADR).

I Introduction

Wireless sensor network is an emerging area which is used in various application. Wireless Sensor Network (WSN) is a combination of small nodes with sensing, computation and communication capability[3]. WSN can also be defined as a collection of small tiny devices which collect the information and transfer that data from one sensor node to another. Sometimes these sensor nodes get failed and packet may get dropped in the network due to which loss of packet in the network occurred. This failure of packet cause decrease in throughput and is retransmitted. Retransmission of data packet from sender node to receiver node causes energy consumption which in return leads to delay in data packet delivery at sender end[5-8]. There are many techniques to remove the congestion. Every algorithm or technique have common objective to less delay, less energy consumption and better network lifetime [9-12].

Wireless Sensor Network (WSN) contributed on a large extends in the sensor network. It contains number of sensor nodes (SN), which are small in size which are deployed in the remote area, such as the high mountain area, battle fields and the satellite in the outer space, where recharging of battery of WSN is not feasible. Thus, the main motive for WSNs is less energy consumption within the sensor nodes which may be constrained in terms of a small memory and a low computing capability. The use of WSN sometimes leads to problem of energy constraint which in terms leads to limited lifetime of sensor node. This limited lifetime of a sensor node lead to node failure, which can interrupt the entire system.

Sensor nodes are battery driven and hence operate with a limited energy resource. In large-dense sensor networks it is infeasible to replace batteries when a sensor is down. For instance, in wild and unreachable areas, such the Antarctica or the deepest zones of the Atlantic Ocean, sensors can be easily deployed in order to form a large-dense sensor network and sense seismic waves, temperature or other parameters as well. In these scenarios, the replacement of the battery of a sensor node would be highly expensive.

II Problem Formulation and Review of Literature

The problem of congestion [14] in wireless sensor network is quite different from that in traditional networks. The congestion control for WSNs should be simple to implement at an individual sensor node with minimal energy usage. Queue-based and rate-based are the most popular congestion control schemes to solve the congestion problem. The disadvantage of the queue-based schemes is that a backlog is inherently necessitated; on the other hand, the rate-based schemes can provide early feedback for congestion. Most of the congestion control algorithms try to alleviate the congestion by reducing the rate at which the source node injects packets in to the network.

Ekaterina Dashkova et al. [4] proposed a flexible generic web base protocol to improve congestion. Kim et al. [15], presents low-rate and short-range wireless radio communication on a device often hamper high reliability in wireless sensor networks. Bret Hull et al. [2] approach does not work in wireless network because radio transmition on different links interacts with and affect each other. The combination of these techniques, Fusion, can improve network efficiency by a factor of three under realistic workloads. Mohammad Z. Ahmad et al. [13], propose a distributed congestion avoidance algorithm which uses the ratio of the number of downstream and upstream sensor nodes along with available queue sizes of the downstream sensor nodes to detect incipient congestion. Monitoring queue sizes of downstream sensor nodes helps ensure effective load balancing and fairness in the avoidance algorithm. Through this technique the author provides a greater packet delivery ratio and higher network lifetime. Islam Hegazy et al. [16], use ns-2 network simulator to demonstrate the vulnerability of the MintRoute protocol to link quality attacks by a malicious node. Author propose “sequence number gap trick” as a lightweight means to test for and detect the presence of malicious attacker. The result of this research show the judicious use of the sequence number gap trick provides robust detection of malicious nodes, preserving the data delivery capabilities of the WSN.

Traffic Aware Dynamic Routing (TADR) is the dynamic routing protocol in Wireless Sensor Networks which works for the avoidance of congestion in the sensor network. In TADR sensor nodes have dynamic positions and they transfer the data packets with the traffic awareness, so that congestion should not get occurred in the network. However, this traffic control scheme always decreases the throughput so as to violate fidelity level required by the application. TADR is proposed to route the packets around the congestion areas and scatter the excessive packets along multiple paths consisting of idle and under-loaded nodes. In Traffic Aware Dynamic Routing, congestion gets removed or traffic gets decrease by dynamic routing. In this technique multiple paths get observed by dynamic routing. TADR identifies other routes with multiple paths where sensor nodes are either overloaded or idle. TADR also faces some problem such as delay at the time of congestion and energy consumption

In TADR sender node forwards the packet to the neighbour node to transfer it (data packet) to the destination node. Every node is aware about their neighbour node. Sender node sends the request message to the neighbour node and in reply it get the status of the neighbour node about their distances but sender node is not aware that weather the neighbour node to whom the sender node is sending the data is idle or overloaded. While sending data to the neighbour node sender node just examines the shortest distance and transfer the packet. If that particular neighbour node is already loaded the packet may get lost in the network. Then packet get retransmitted, this cause energy consumption and delay.

III Existing Approach

Traffic Aware Routing Algorithm- Traffic Aware Dynamic Routing is a routing protocol to transfer the packets in the network. In Traffic Aware Dynamic Routing, congestion is removed or traffic gets decrease by dynamic routing. When traffic occurred in the network i.e. when more number of data packets get arrived then congestion arrised which cause loss of packet. TADR [1] identifies alternative routes with multiple paths; if one node is full then packet is retransmitted through second node which is either idle or less overloaded.

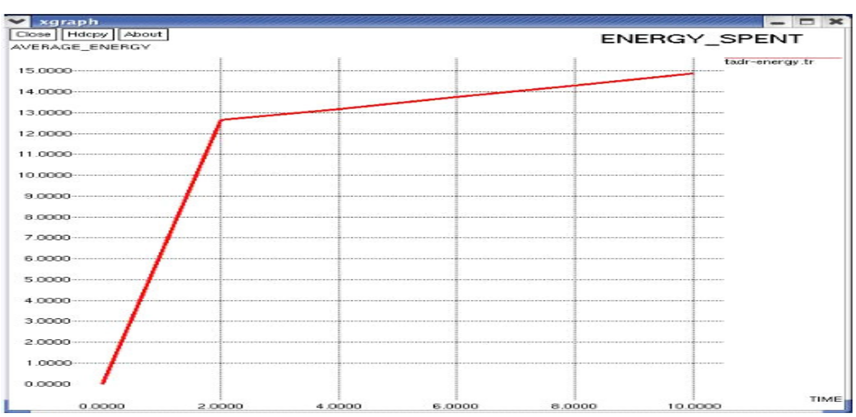

Fig 1:.Energy spent graph of TADR

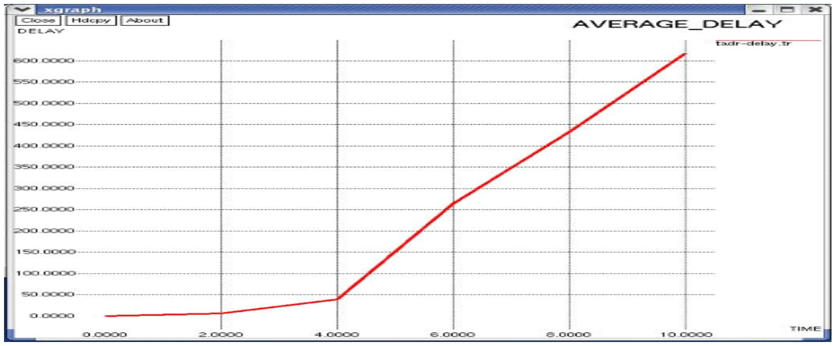

Fig 2: Average delay graph of TADR

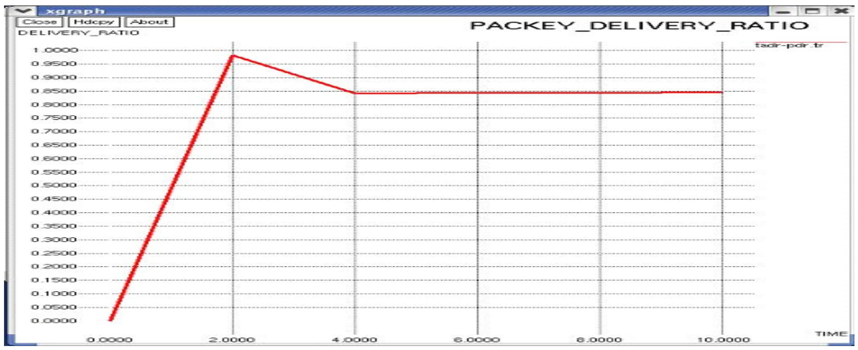

Fig 3:.Packet delivery ratio of TADR

In our implementation we get simulation results and above mentioned graphs we generated. The figures Fig 1, Fig 2, Fig 3 shows the graph line of energy spent, average delay and packet delivery ratio respectively of the TADR. These graphs generated for 50 nodes in the network and Time is taken on X-axis.

IV Proposed Approach

Traffic Aware Dynamic Routing (TADR) [17] depends on the philosophical concept of researchers that network congestion control does not mean minimising throughput. Congestion arises in the network due to excess of packets. To overcome the congestion problem a new technique name TADR Combined Dominating Set (TADR-CDS) is implemented. The main aim of TADR-CDS is to avoid the congestion by providing link stability to the nodes.

- Initially all nodes in the network are assigned node_ids.
- Sender node will forward data packet to receiver node throughput intermediate nodes (neighbour nodes). Nodes are based on the factors like threshold, delay, constant bit rate (cbr) and packet size.
- Source node sends request message (RREQ) to receiver node. Sender node starts transmitting data packet after receiving reply message (RREP) from receiver side.
- If sender node does not get reply message (RREP) from receiver node then it update and retransmit the request message (RREQ).
- Just by exchange of RREP and RREQ message sender node come to know about the neighbour nodes and sets of nodes get formed.
- If reply message (RREP) is received by sender node then data packet transmission will take place. If RREP message is not received by sender node then receiver node resends the RREP message and after getting acknowledgement data packet gets transmitted.

TADR-CDS technique helps in combating congestion. It provides link stability due to which our simulated results regarding parameters like delay, energy and pdr improves as compare to the Mint route and TADR.

V Result Analysis and Performance Evaluation

The performance of this technique gets analyzed against some parameters like throughput, time delay, packet delivery ratio (pdr) and energy. The simulation results of this technique are analyzed under NS2 simulator. The main aim of our paper is to maintain link stability by using Combined Dominating Set (CDS) in TADR. Both techniques are simulated under same parameters. Parameters are shown in the table to understand and to analyze the performance of the CDS technique

Table 1: Simulation Parameter

Name of Parameters	Parameters
Channel type	Wireless channel
Radio propagation model	Two Ray Ground
Antenna type	Omni Antenna
Link Layer Type	Link Layer
Interface Queue Type	Queue/Drop Tail/PriQueue
Max packet in ifq	200
Network interface type	Phy / WirelessPhy
MAC type	Mac/802_11
Number of mobile nodes	50
Routing protocol	TADR
Grid size	500 00

We analyze and evaluate the performance of our technique. We plot the graph of various parameters against simulation time using 50 nodes. Fig 4 shows TADR-CDS technique is having less energy consumption as compare to TADR. TADR consumes more energy because of packet retransmition.

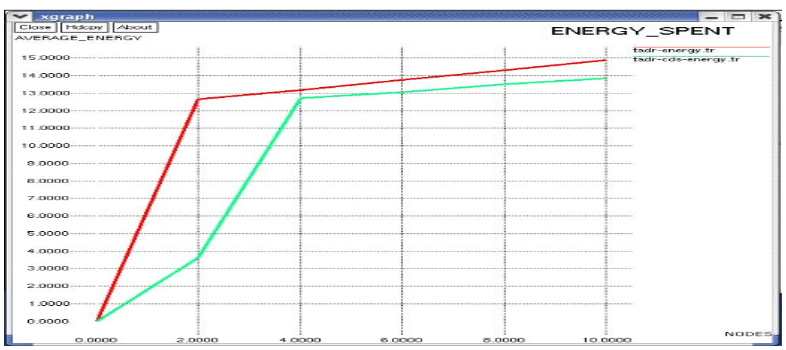

Fig 4: Energy Consumption

Delay can be defined as the time interval between the data packet delivery. If data packet cannot receive at the receiver end at a particular time of interval that retransmition of packet is held which cause delay in the network.

Fig 5 shows TADR-CDS technique has less delay than TADR. TADR is affected by delay because of congestion in the network, node failure and low link stability

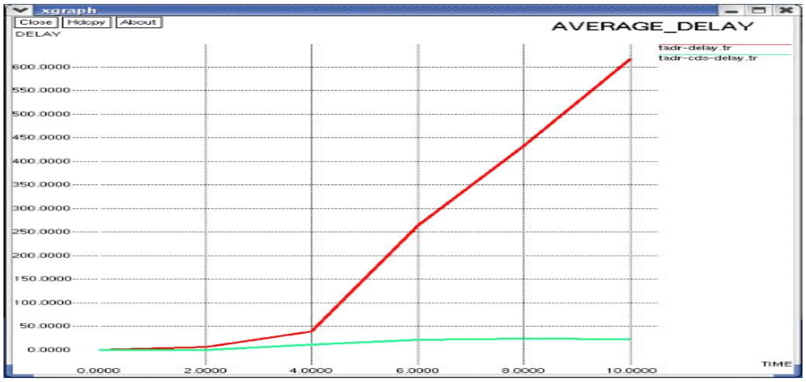

Fig 5: Average Delay

The ratio of all the received data packets at the destination over the number of data packets sent by the CBR sources is known as Packet delivery ratio. It is the ratio of the data packets delivered to the destinations to those generated by the sources.

Fig 6 shows the packet delivery ratio graph. In this graph TADR-CDS have good packet delivery ratio. At the end the value of TADR-CDS declines as compare to TADR. Overall this technique (TADR-CDS) shows better result in packet delivery ratio. If further simulation time is increased the graph line of TADR-CDS increases and shows better result that TADR-CDS.

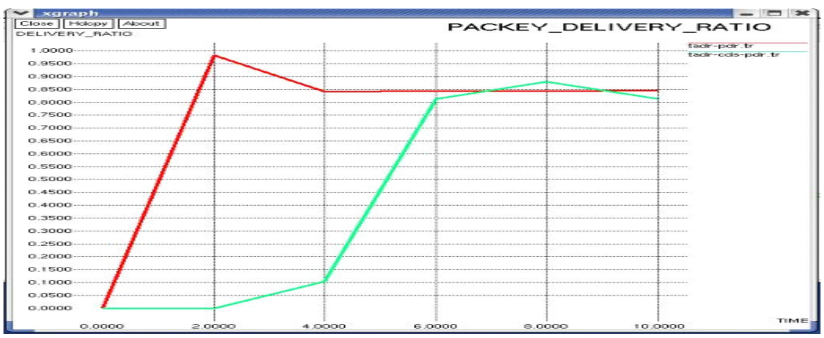

Fig 6: Packet Delivery Ratio

In Table 2, the comparison between TADR and TADR-CDS is carried out. The factors like delay, Energy consumed, Packet Delivery ratio, Congestion Occurrence etc. is evaluated in the research and comparison has been done on such parameters

Table 2: Comparision between TADR and TADR-CDS

Parameters	TADR	TADR-CDS
Definition	Dynamically route the traffic.	Set of nodes work in a combined form.
Protocol used	TADR	TADR
Throughput	Good result of throughput	Lowest value of throughput
Delay	Average value of delay	Very low
Energy consumed	Average energy consumption	Less energy consumption
Packet Delivery Ratio	Average pdr	Average pdr
Link stability	No	Yes

Tables 3 and Table 4 contain simulation results of TADR and TADR-CDS respectivaly. The simulations of these two technologies (TADR and TADR-CDS) are carried out at the interval of 2 seconds and values are noted down. On the basis of the values of energy consumed, delay and packet delivery ratio the tables are maintained to compare the simulation results of TADR and TADR-CDS.

TABLE 3: Table of simulation result of TADR

simulation time(s)	energy(J)	delay(ms)	packet delivery ratio
0	0	0	0
2	12.65	6.99	0.9817
4	13.19	38.97	0.8919
6	13.76	263.61	0.8925
8	14.32	432.25	0.8932
10	14.88	616.92	0.8445

TABLE 4: Table of simulation result of TADR-CDS

simulation time(s)	energy(j)	delay(ms)	packet delivery ratio
0	0	0	0
2	3.6258	0	0
4	12.7225	11.00	0.1046
6	13.0706	20.57	0.8i30
8	13.5116	23.02	0.8802
10	13.8549	22.43	0.8125

VI Conclusion

TADR protocol was found suitable in many scenarios, but had a drawback of congestion due to unstable link. The main objectives of this research are to decrease consumption of energy at the nodes and delay in data packet delivery; and to increase packet delivery ratio. So, to alleviate congestion in the network a new technique called TADR Combined Dominating Set (TADR-CDS) is used. In this technique link stability gets maintained which lead to better results in terms of less energy consumption and less delay. With the help of TADR-CDS technique simulation results show that delay and energy consumption decreases.

By performing simulation results parameters like energy consumption, delay and packet delivery ratio are improved. In future TADR Combined Dominating Set (TADR-CDS) technique can be used to improve other factors like throughput which cause congestion in the network. Throughput of TADR-CDS scheme can be used by the researchers in future for further researches. Survey of existing protocols can be extended for application and transport layer.

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