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Improved Adaptive Duty Cycle Control in Wireless Sensor Networks

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Abstract— On the Internet transport layer handles the congestion and reliability for individual packets. In Wireless Sensor Network application, congestion controlling techniques are required to control large quantity of traffic to neglect to loss of packets and consistence of end-to-end efficient packet delivery. In Wireless Sensor Network, researchers thus not agree the existence of a transport layer for WSN alike to the Internet. As resource constraint nature of sensor devices, researchers however allow that scale of internet for transport layer will surely be a substance of challenge. The implementation in microprocessor technology leads, high speed and large memories, high speed network, very efficient sensor network operating systems to develop many protocols under transport layer.

Keywords-*Delay, Random access network, Optimal MAC, Wireless Sensor Network, Transport layer.*

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I. INTRODUCTION

A group of nodes formed into a cooperative nature or network called as Wireless Sensor Network. In this, every node made up of processing capability (some more microcontrollers, CPUs or DSP chips), it may carry multiple types of memory (like program memory, data memory and flash memories), have a Radio Frequency transceiver (usually with a single-omni directional antenna), having a power source (e.g., batteries and solar cells), and accommodate various sensors and actuators. The nodes exchange a data wirelessly and often self-organize after being organized in an ad hoc fashion

Now a day's networks are of type bi-directional, which allows them to control the sensor's movements. The expansion of wireless sensor networks was confident by military appliance, many industries and end user applications like industrial process monitoring and control, machine health monitoring and so on.

A multi-hop random contact network is distributed in nature, which arranges no of applications on the sensor networks. To optimize the concert of network it, can apply maximization structure, but it will results algorithm into huge amount of delay. The network utility as a grouping of rate utility and energy cost functions and solve the two issues: 'optimal medium access control with link delay constraint' and 'optimal congestion and contention control with end-to-end delay constraint [1].

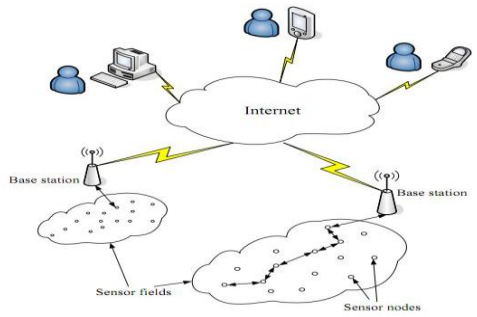

Figure 1: Accessing WSN through Internet

As shown in Figure 1, users can retrieve information of interest from a WSN by injecting queries and gathering results from the so-called base stations (or sink nodes), which behave as an interface between users and the network. In this way, WSNs can be considered as a distributed database. It is also envisioned that sensor networks will ultimately be connected to the Internet, through which global information sharing becomes feasible. [2]

II. IMPORTANCE OF DELAY

Wireless sensor networks have been used for many delay-sensitive purposes, e.g., emergency response and plant automation etc. In such kind of networks, delay measurement is significant for a number of reasons, e.g., real-time control of the networked system, and abnormal delay detection. For some applications, messages must arrive at a destination by a deadline.

There are different types of delay like processing delay, queuing delay, transmission delay, propagation delay, and arbitration delay. Delay can lead in wireless sensor network to reporting rate, packet size, node density, routing protocol, MAC protocol and topology. And hence there is need to study the problem of delay in WSNs and it is necessary to minimize the delay for packet processing.

III. DELAY OPTIMIZATION MECHANISM

Delay optimization needs to be lightweight and efficient. There are some mechanisms that can deal with this problem. By adjustment of Node density, by adjustment of reporting rate, by adjustment of Packet size, by using proper Routing protocol, by using MAC protocol, Different type of Topology

Reporting Rate: in network, the traffic load is not distributed evenly over the nodes. Like, the sensors which are one hop away from the sink transmit the entire network data

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traffic. This unevenness the data traffic load distribution can corrupt the network lifetime and functionality also. And by adjusting the reporting rate of node to the sink, we can decrease the non linearity in the traffic load. As if reporting rate is low, then it is assume that there may be chances of the congestion. [4]

Energy consumption also matters in wireless sensor network. Energy expenses are less for computation and sense the nodes. The cost of energy is for transferring 1 kbps distance of 100 meters is approx the same as that for the execution of 3 million instructions by using a general purpose computer. Thus, reducing the energy consumption due to communication is the input for the release of the energy constraint in WSNs.

Algorithm

a. IADCC scheme can reduces the average end-to-end delay by changing its duty cycle for avoiding congestion.
b. An IADCC scheme saves the energy consumption.
c. IADCC scheme also reduces the occurrence of changing the transmission rate and can decrease the control packet overhead by increasing the packet reception rate of the receiving node and decreasing the packet transmission rate of the sending node.

IV. EXPERIMENTAL

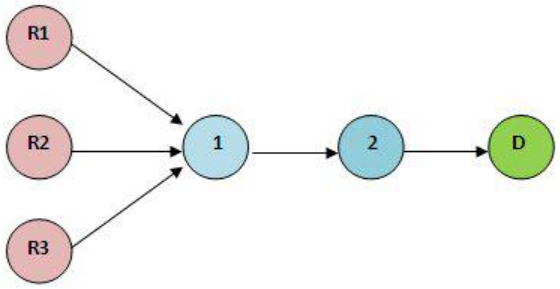

Figure 2: Scenario of topology for IADCC approach

The IADCC scheme, consider figure 4 scenario, each node having equal duty cycle. We are setting active cycle to 20 percent. Threshold for minimum and maximum for active period is set to 5 and 20 percent respectively. We are considering traffic generation or sending packets from route 1 (R1) at 300 seconds, route 2 (R2) at 600 seconds and route 3 (R3) at 900 seconds.

1. In IADCC, when congestion occurs at the time of transmission of packets, it will adjust the duty cycle at source and at the destination node also.

2. IADCC includes traffic control, congestion control and resource control, which is repeated during the congestion control period.

3. When congestion occurs, IADCC increases the packet reception rate of receiving node also increases the packet reception rate of a receiving node and decreases packet transmission rate of the sending nodes.

4. Therefore, IADCC can reduce the frequency of changing the transmission rate and the amount of control packets compared with the traffic control schemes.

RESULTS

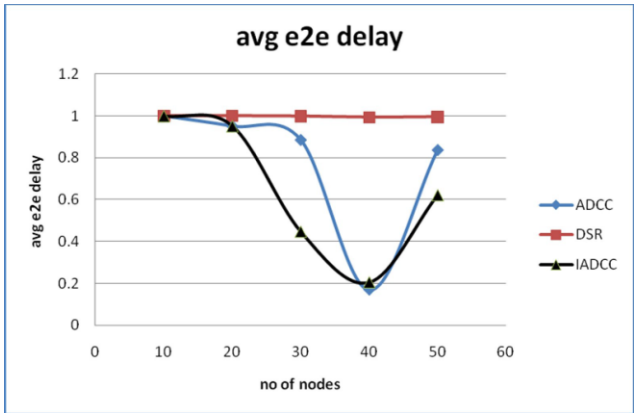

Figure 3: Average End to end delay function of node density for IADCCC, ADCC and DSR.

IADCCC out performs for average end to end delay as compare with DSR and ADCC.

As static routes are defined we get minimum delay for DSR. But as we can see better results for IADCC compare to DSR and ADCC. The DSR saturates throughout the scenario.

The scenario of 30-nodes shows that, the no of nodes increases (consider after 30 40 nodes), the average end to end delay get increased for ADCC and DSR because DSR every time add its own id header, so packet size is increases. When no. of nodes increases packet header size increases. And when packet size increases delay may get increases significantly. For IADCC it shows less end to end delay because it adjusting its duty cycle as congestion occurs in the route. **IADCC improves average end to end delay up to 12%.**

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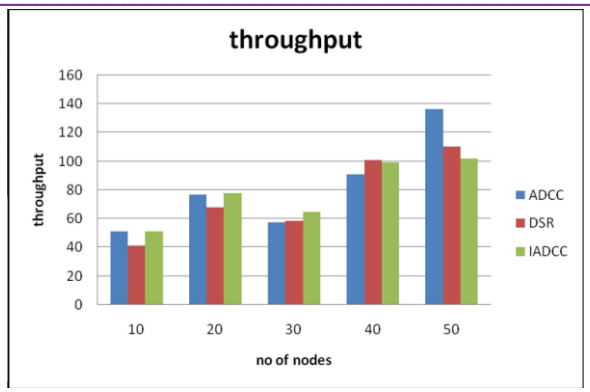

Figure 4: Throughput against node density

Throughput is the usual rate of successful packet delivery over a communication channel. Scenario 10, 20 and 30 nodes throughput is high for IADCC around **3 to 4 %** as compare to ADCC and DSR.

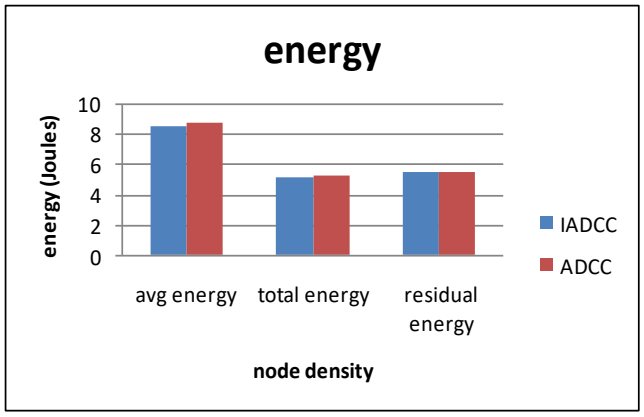

Figure 5: Energy graph for scenario of 6 nodes

Graph for average energy, total energy and residual energy for the scenario of 6 nodes. The average energy consumed for IADCC is less as compare to ADCC because the nodes are geos in to sleep mode as they are not transferring the packets, they becomes active when wants to tranfer a packets. So here average energy consumed for IADCC is slightly less as compare to ADCC.

Residual energy difference is more i.e. **upto 3%** IADCC saving energy for node communication because nature

CONCLUSION

In WSN, Delay is improved by adjusting duty cycle. In sensor network, there is need to check route for communication between nodes, its length, and many more parameter which may reduce the delay in network communication. DSR outperforms for SMAC. ADCC scheme can reduce the frequency of changing the transmission rate. Whereas IADCC scheme can reduce end to end delay and saves energy.

Proposed scheme gives minimized end to end delay i.e. 12%, average energy consumption minimized up to 3%, throughput increased up to 3 to 4 %. Hardware implementation will be the future work for IADCC scheme and we will try on dense network (up to 100 nodes) the same scheme.

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