International Journal on Future Revolution in Computer Science & Communication Engineering
Volume: 4 Issue: 4
ISSN: 2454-4248
191 – 194

Congestion Control By Using Adaptive Data Rate Technique with High Bandwidth in Wireless Sensor Networks

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***Abstract* —** Wireless sensor network one of the most favourite topic for researcher to explore. Wireless sensor networks is very useful so more number of sensor nodes are deploying and large number of data being sensed and collected. To meet the expectations of demands networks should be in safe and good state. Problems in wireless sensor networks are congestion and wastage of energy. So it's necessary to control the congestion and minimize the energy consumption. Congestion causes heavy data loss and unnecessary retransmission of data. Congestion causes by many reasons. There are some techniques and algorithms which can control the congestion at some degree. Here we have suggested technique which can do a Congestion Control with High bandwidth in networks. Amount of congestion in network can be decided by maximum and minimum threshold values that can assign in initial phase of algorithm.

***Keywords- wireless** sensor networks ; congestion control technique ; high bandwidth*

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I. INTRODUCTION

WSNs comprises of thousands of tiny, inexpensive devices that are capable of sensing, computation, and communication. A wide range of potential applications include industry, science, civil infrastructure, transportation and security[4]. Most important use of Wireless sensors networks are sensing and monitoring of environment. There are hundreds or thousands of nodes which each node consists of its own sensor, data processing circuits, and communicating components such as transmitter and receiver. There are various types of sensors in a very small size, such as radar, thermal, visual and infrared, which can sense the environmental conditions[6]. WSNs requires power source and it will be provided by battery. WSNs can be configured dynamically and can be deployed at any place without having pre-define network architecture. This capability of WSNs make it more useful and reliable at mission critical project. Nodes can be battery operated and have transceiver to send data to nearest base stations. Sensor Nodes communicates with each other in order to transmit data to base station as WSNs do not have predefine network architecture. Sensor Nodes send and receive data in order to communicate. . To transmit data from the signal sensor nodes requires energy which is considered as drawback because some sensor nodes are deployed at remote locations which do not have renewable energy source as most of them are battery operated. Another problem that arise in WSNs is the congestion. Due to lack of energy resources the sensor nodes should be optimized in every parameter like processing, communication etc. Different types of solution were suggested to minimize power consumption for communication. During the packet transmission energy will be consumed and problem like congestion will occur during transmission which will add up in power loss. In order to Avoid power loss due to congestion and to make WSNs more reliable, the traffic should be monitored and maintain to avoid loss of the data. Transmission ratio should be maintain to keep the network in safe state. In this Paper, We proposed solution to avoid power loss that was caused by congestion and to control congestion in the system. In this we will provide method to improve packet delivery. Proposed system helps us to achieve high efficiency and high utilization ratio of the system.

II. LITERATURE SURVEY

A. Congestion Control Scheme Based On Fuzzy Logic in Wireless Body Area Networks [1]

One of the major issues in healthcare related wireless body area network is to control congestion. Reason for congestion in such application are unpredictable traffic load, many to one communication and limitation of bandwidth. Congestion degrades the overall network performance such as packet losses, increasing end to end delay and wasting energy consumption due to large number of retransmissions. Congestion in health care applications causes a delay in transmitting important signals , it may lead to death of a patient. To solve this problem and increase quality of service , it is necessary to develop a solution for congestion estimation and control. In this paper author propose a new congestion detection and control protocol for remote monitoring of patients health status using WBANs. In case of congestion, proposed approach is able to detect congestion by considering local information i.e. node rate and buffer capacity. In congestion system find difference between important signals and normal signals and assign priority to important signals. So it increased quality of service.

In this paper author proposes a new approach for healthcare WBAN applications. The approach find congestion using Type 2 fuzzy logic system and then adjust the incoming data rates accordingly. we assessed performance of the proposed approach by simulation studies. This result confirmed that proposed approach shows a significant performance in network throughput , utilization ratio , delay

 ISSN: 2454-4248
191 – 194

and energy efficiency. Author also demonstrated that the proposed approach is able to desired level of throughput.

B. *Reliable Transport Protocol based on Loss Recovery and Fairness for Wireless Body Area Networks [2]*

The transportation protocols for wireless body area networks must have to provide reliability and quality of service for the full network. This can be done through the reduction of packet loss ratio and low energy consumption of nodes. IEEE 802.15.6 standard provide support for quality of service , but it does not give any suggestions about transport protocols for wireless body area networks. In this paper author proposes a new transport protocol for wireless body area networks based on energy efficiency and emergency aware Medium Access Control protocol and IEEE 802.15.6 standard.

In this paper proposed transport protocol for wireless body area networks is based on IEEE 802.15.6 standard and MAC protocol implementation. The nodes and hub in WBAN find the lost packets and retransmit to them during slot reallocation phase. The measures the ratio between the amount of lost packets and the amount of received packets. The MAC protocol along with the proposed transport protocol (LR&F) outperformed the MAC protocol and the IEEE 802.15.6 standard in the percentage of the packet loss with or without emergency traffic, while maintaining a similar energy consumption as both protocols. When the Energy Waste Index is measured as the ratio between the percentage of the packet loss and the average of consumed energy. It shows that the proposed system has a better effectiveness of energy compare than the other protocols with or without emergency traffic. The latency of normal and emergency traffic compared in the presence of one emergency event. Emergency traffic's latency was a little higher than the other two protocols but it has a more reliability with degradation in packet loss.

C. *Intra and Inter Cluster Congestion Control Technique for Mobile Wireless Sensor Networks[3]*

Congestion level increases during routing in mobile wireless sensor networks. So it is required to automatically modify the data rate accordingly. In this paper author proposes a system for congestion control in MWSN by designing an intra and inter cluster congestion control technique. In this technique cluster head observe the congestion within the cluster each time based on certain parameters. Parameters are traffic intensity information , buffer occupancy and number of contenders. If the value of congestion is more than threshold value then it modifies the traffic rate based on the offered load and the number of contenders. In inter cluster technique the forwarder node selects the best cluster head based on the load. By the results it is clear that proposed technique minimize the congestion and the packet drop ratio.

This technique increased 38% in packet delivery ratio and decreased 31% in packet drop ratio when we compare it to the existing congestion control for multi class traffic scheme.

D. *Congestion Controlled Adaptive Routing in Wireless Sensor Network[4]*

In wireless sensor network to control the congestion is a very important aspect. In wireless sensor networks when data transmission increases it increase the congestion in network accordingly and it reduces the throughput of the system or network . So various techniques required to control the congestion . Various resources of WSN taken into account while implementing congestion control technique. In this paper author proposes a novel approach to control the congestion in wireless sensor networks by dynamic routing. In proposed system when packet experiences the congestion , system computes alternate path for it and re route packets to new path. In this there are three phases 1) Congestion Detection 2)Alternate Path Computation 3) Re-routing the packets on new path . Congestion in system or in traversal path can be detected by free space available in the buffer. With the help of residual energy , available bandwidth , hop distance we can calculate the alternate path. The important parameters considered for this approach are route discovery time , congestion ratio , delay etc.

E. *An Adaptive Rate Based Congestion Control with Weighted Fairness for Large Round Trip Time Wireless Access Networks[5]*

The time varying capacity in wireless network makes the queue management more complicated compare than the wired networks. Any bit error in the acknowledgement packet treated as the loss of packet which interpreted as the congestion . It reduce the window size which results resource wasting. In addition delay in wireless networks causes instability. In this paper authors design an adaptive robust rate based queue management which is based on gradient projection internal model control. It is used for achieve maximum utilization , to avoid congestion contemporary with weighted fairness and to achieve a robustness against packet error rate and fading phenomena. ARRQM tolerate the large RTT effects. Gradient method helps to achieve weighted fairness and gradient projection protocol helps to achieve maximum utilization. Proposed system robust against any uncertainty of parameters and external disturbance such as PER and capacity variations.

F. *A Fuzzy Technique to Control Congestion in WSN[6]*

In wireless sensor networks congestion is most important issue. This is because of the relatively high node density and source to sink communication pattern. Congestion causes a packet loss , wastage of energy (more energy consumption) and delay. So to increase network lifetime , enhance fairness and increase quality of service author develop a new system for congestion estimation and control. To control congestion author proposed a type 2 fuzzy logic based algorithm to detect and control congestion level in wireless sensor networks. The proposed system consist two main different parts . One part is used to estimate the congestion level in deployed nodes and Second part is used to

 ISSN: 2454-4248
191 – 194

find out the best transmission rate for deployed nodes. Then we apply the best transmission rate to immediate nodes. The performance of the proposed system is very efficient and improved compare than the PCCP which is non fuzzy algorithm. Proposed algorithm uses local information to control and detect congestion which is packet loss rate and delay.

III. PROPOSED WORK

Here we proposed modified congestion prediction and detection control algorithm. In this algorithm we detect and predict the congestion in the system. To find the congestion and to control the congestion in the system we use utilization ratio. When congestion occurs in network our proposed algorithm changes the rate of packet transmission and set new data rate to minimize the effect of congestion in network and to avoid congestion. In our proposed system we define a two threshold value, th_{max} and th_{min}. If utilization ratio is maximum then maximum threshold value th_{max} then there is no congestion in network so we are not applying any congestion control algorithm. If utilization ratio is between th_{max} and th_{min} then there is possibility of the occurrence of congestion so we are decreasing the data rate by some specific value. It is decreasing continuously until congestion in network is remove or solve. Now if utilization ratio is minimum then th_{min} then congestion occurred in network so we will calculate new data rate for transmitting packets. We define threshold value at the initialization phase of the system. At the initial level we are assuming that network is in good or safe state so there is no need to apply algorithm. With the help of this technique we can achieve better utilization ration then existing system. In our system we use high bandwidth to transfer packets . Instead of using many-to-one communication channel, we use one-to-many communication or broadcast network. It helps us to achieve high efficiency.

A. Basic Architecture

Here we can present the basic architecture of the proposed system.

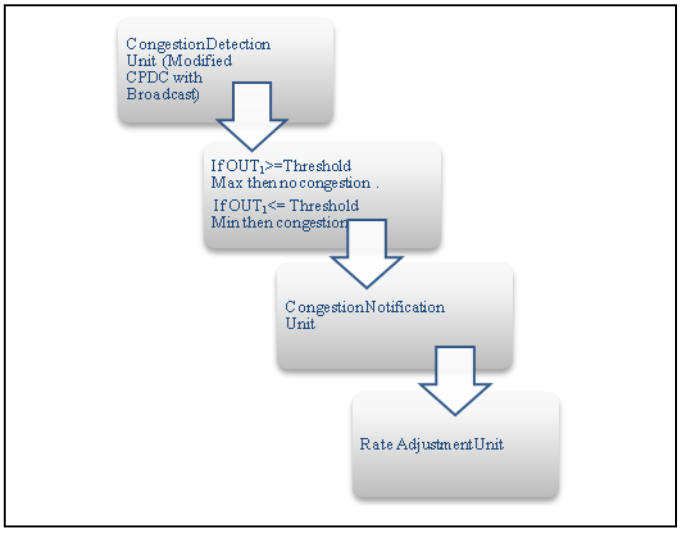

Fig 1. Basic Architecture of the system

B. Proposed Algorithm

- Symbols used in algorithms

TABLE 1 SYMBOLIC REPRESENTATION

Sr. No.	Symbolic Representation	
	Symbols	***Meaning***
1	UR	Utilization Ratio
2	th_{max}	Maximum Threshold
3	th_{min}	Minimum Threshold
4	DR	Data Rate
5	A	Decrement Rate
6	BDR	Best Data Rate
7	PDR	Packet Delivery Ratio
8	NPDR	New Packet Delivery Ratio

- Algorithms :

Algorithm 1 : Congestion Prediction And Detection Control

Input : UR , th_{max} , th_{min} , A , DR

Begin :

1. Set DR for all Nodes
2. Set the Value of A
3. While (Transmit and received packets by nodes)do
4. For each node
5. UR : no of packets sent / no of packets received
6. If (UR >=th_{max})then
7. //do nothing
8. If(th_{min}<UR<th_{max})then
9. BDR = Get_New_Data_Rate(node_id, DR, A)
10. Set_New_Data_Rate(node_id, BDR, flow_id)
11. If (UR<=th_{min}) then
12. BDR = Congestion_Control (node_id, DR, flow_id)
13. Set_New_Data_Rate(node_id, BDR, flow_id)
14. End for
15. End While

Algorithm 2 : New Data Rate Estimation (To Decrement Data Rate)

Input : A , DR

Begin :

1. Initialize BDR
2. BDR = DR - A
3. Return BDR

Algorithm 3 : New Data Rate Estimation (Get New Data Rate)

Input : DR

Begin :

1. Initialize BDR NPDR
2. Calculate PDR
3. NPDR = PDR / (2-PDR)
4. BDR = DR * NPDR
5. Return BDR

 ISSN: 2454-4248
191 – 194

IV. RESULT

Here we created 6 nodes and take a range of each node 50m. Each node will forward the packet to its neighboring connected node within its range. This scenario applied for all system here its 6 nodes. We use 48 Mbps speed to transfer packets. For routing we use AODV routing protocol and we used Adhoc wifi mac protocol. Simulation result is displayed in below image.

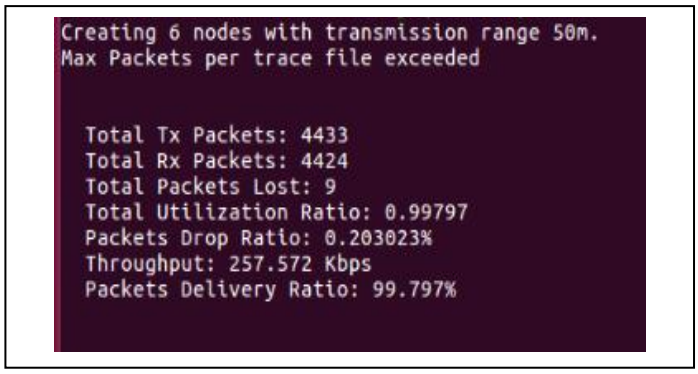

Fig 2. Simulation Result

We also generate the graph of sent packets sum Vs receive packet sum

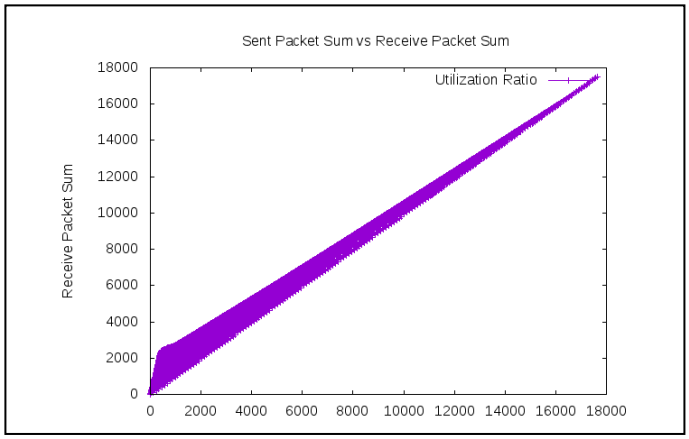

Fig 3 Sent Packet Sum Vs Receive Packet Sum Graph

The simulation result and graph shows that our proposed technique is more efficient than the other congestion techniques.

V. CONCLUSION

There are many techniques for congestion control. In our technique we use modified congestion and prediction control approach with broadcast network with high bandwidth. With this technique we achieve high efficiency and utilization ratio at higher speed. Our proposed system work efficiently and smoothly for high bandwidth in wireless sensor networks.

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