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Congestion Control in Wireless Sensor Networks: Existing Applicable Techniques for Weather Sensor Networks

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Abstract: **Wireless sensor network play a vital role in various fields like Intelligence, Military, Weather forecasting networks, automated systems etc.. The sensor nodes acquire the real time data and transmit the data, when large numbers of sensor nodes are active at a time and transmitting the data to the sink node then these situation lead to the congestion. Congestion may occur due to buffer overflow, low processing rate at output queue. Congestion leads to decrease network performance in terms of throughput, capacity, error rate, packet loss rate etc. It requires affective congestion control protocol for sensor networks. Most reliable protocols like TCP are working with better throughput in connection oriented networks, but for the wireless sensor networks, we have to design new protocols to handle congestion .There are many congestion control algorithms are proposed to handle congestion. This paper review on existing Congestion control algorithms which are specifically applicable for weather sensor networks.**

***Keywords*---Wireless Sensor Network, Congestion detection and control , weather forecast.**

1. INTRODUCTION

Wireless sensor network consists of spatially distributed autonomous sensors nodes to monitor environmental condition such as temperature, atmospheric pressure, humidity, motion of wind, wind direction, visibility etc. Congestion causes packet loss, which in turn reduces throughput and energy efficiency. Therefore congestion in WSN's needs to be controlled for high energy-efficiency, to prolong system lifetime, improve fairness, and improve quality of service (QoS) in terms of packet loss due to buffer overflow along with the packet delay.

In this paper section 2.1describes the various conditions by occurrence of that conditions congestion may take place, section 2.2 will describe the various congestion detection algorithms and section 2.3 will describe various congestion control techniques and finally section 3 describe the comparison of all the existing techniques.

2. RELATED WORK

Basically all the proposed techniques based on hop-by-hop congestion control ,end-to-end congestion control and path based congestion control. In the following section we describe the sources of congestion in WSN , the various congestion detection techniques and various congestion control techniques which can be applicable in weather forecast networks.

2.1. SOURCE OF CONGESTION

In WSN each sensor node comprises sensing, processing, transmission, mobilizer, position finding system, and power units. The nodes collect the data and transmit it toward the sink node. Studies shows that under the light load the data traffic is light, when an event has been detected like increase in temperature and decrease in atmospheric pressure dramatically before cyclonic condition and just opposite condition in anticyclonic condition , such condition lead to congestion in WSN.

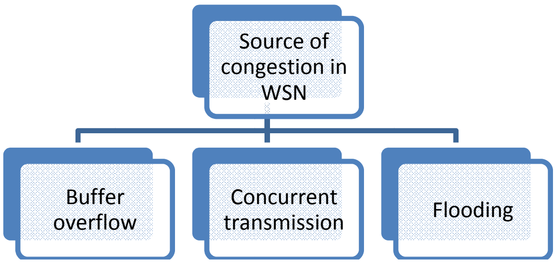

Fig1: Various source of congestion.

2.2. CONGESTION DETECTION

An accurate and efficient congestion detection algorithm plays a vital role in congestion handling . There are various congestion detection techniques which has low cost in terms of energy and computation complexity, those techniques are discussed below:

a) Congestion Detection in CODA[1]: Congestion Detection and Avoidance uses a combination of the present and past channel loading conditions, and the current buffer occupancy, to infer accurate detection of congestion at each receiver with low cost. Sensor networks must know the state of the channel, since the transmission medium is shared and may be congested with traffic between other devices in the neighbourhood.

b) Closed-loop, multi-source regulation [1]:In closed loop regulation operates over a slower time scale and is capable of asserting congestion control over multiple sources from a single sink in the event of persistent congestion. When the source event rate is less than some fraction of the maximum theoretical throughput of the channel, the source regulates itself. When this value is exceeded, however, a source is more likely to contribute to congestion and therefore closed-loop congestion control is triggered. The source only enters sink regulation if this threshold is exceeded. At this point a source requires constant, slow time-scale feedback (e.g., ACK) from the sink to maintain its rate. The reception of ACKs at sources serves as a self-clocking mechanism allowing sources to maintain their current event rates. In contrast, failure to receive ACKs forces a source to reduce its own rate

c) Hop-by-hop backpressure [2]: In this technique a node broadcasts backpressure messages toward the source as long as it detects congestion. Backpressure signals are propagated upstream toward the source. In the case of impulse data events in dense networks like weather forecasting WSN, it is very likely that backpressure will propagate directly to the sources. Nodes that receive backpressure signals can limit their sending rates or drop packets based on the local congestion policy i.e. in our case matching the current value with recently sent value . When an upstream node (toward the source) receives a backpressure message it decides whether or not to further propagate the backpressure upstream, based on its own local network conditions.

d) Queue Occupancy [3]: It is a simple way to detect congestion relies on monitoring a sensor's queue size. It infers the occurrence of congestion. If the fraction of space available in the output queue falls below a high water mark , the congestion bit of outgoing packets is set. Otherwise the congestion bit is cleared.
Cluster based congestion control[9] method which divide network into small subnet called cluster also uses queue occupancy based method to detect the congestion because this method is take less computational power then other methods

*e) Congestion notification bit [4]***:** In Event to Sink Reliable Transport [4], a sensor sets a congestion notification bit in the packet header if its buffer is full. The sink periodically computes a new reporting rate based on a reliability measurement, the received congestion notification bits and the previous reporting rate.

f) Congestion Control and Fairness [1]: It uses packet service time to deduce the available service rate and detects congestion. Each Sensor node uses rate adjustment based on its available service rate and number of child nodes. CCF provides simple fairness for all nodes with same throughput. But fairness can maintained while each node gets same priority

g) Intelligence detection [9]: In intelligent packet dropping algorithm, congestion in the network is detected by evaluating the occupancy of the buffer. When the buffer occupancy reaches the threshold, it infers the occurrence of congestion, to measure local congestion level at each intermediate node, the packet inter arrival time (Pa) and packet service time(Pb) at MAC layer is taken into consideration. Using Pa and Pb we can derive Congestion Degree (CD). By taking the value of CD into consideration we can detect the occurrence of congestion. **CD = *Pb*/*Pa*** If the value of CD is greater than 1 we can ensure that there is no congestion occurred, if the value results in lesser than 1 the congestion is been detected.

h) ESRT [10]: Event to sink reliable transport uses a congestion detection mechanism based on local buffer level monitoring in sensor nodes. In this model, the traffic generated during each reporting period is mainly depends on the reporting frequency rate and the number of source nodes . The reporting frequency rate does not change within one reporting period since it is controlled periodically by the sink at the end of each decision interval. If the sink receives packets whose congestion notification bit is marked, it infers that congestion is experienced in the last decision interval.

2.3. CONGESTION CONTROL

Congestion control algorithm prevent to the sensor network from hazards due to congestion .After detection of congestion , the congestion control algorithms are activated and perform their algorithmic based specific task. According to our study all the control method comes in to three type of control mechanism which are 1.End-to- End congestion control 2. Hope by hope congestion control3.Path based congestion control .All the proposed algorithms are basically based on the these three strategies ,in most of the cases hope-by-hope congestion control techniques is used .All most each method continuously monitor the situation of congestion whenever it is going to be happen then particular program is activated.

a) Locality Driven Congestion control in self organizing wireless sensor network [11]: This protocol proposed a technique for weather monitoring sensor networks, basically this paper suggest that the congestion control technique should be implementable and designed on the basic of application .This technique suggest an algorithm to compute an rate factor. The principle procedure is to examine the saturation of a link and the local congestion behavior.This parameters can be estimated based on the number of successfully received messages *N* during the last time interval *T.* The main advantage of the locality driven congestion control mechanism is the self-organization of all sensor nodes leading to an emergent behaviour of a complex system. Each node in the network autonomously runs the same algorithm based on local knowledge and no inter-node communication is necessary for congestion control.

b) Cluster based congestion control [8]: this method is basically implemented for densy deployed sensor networks wherein sensors are deployed to report periodic

Data In event-based sensor networks, reports are produced only upon the observation of specific events that satisfy certain prespecified conditions, a typical example might be the increase in the observed temperature beyond a present threshold. Environment monitoring and warning system can be best application of this algorithm .This paper present COMUT (Congestion control for Multi class Traffic). COMUT is based on the self-organization of the network into clusters each of which autonomously and proactively monitors congestion within its localized scope. The main benefit of sensor clustering is that a group of sensors can capture the behavioural interactions between flows.

c) Mitigating Congestion in Wireless Sensor Networks [3]: This congestion control scheme, uses Fusion technique which integrates three techniques: hop-by-hop flow control, rate limiting, and a prioritized MAC. Hop-by-hop flow control is designed to prevent nodes from transmitting if their packets are only destined to be dropped due to insufficient space in output queues at downstream nodes. Rate limiting meters traffic being admitted into the network to prevent unfairness toward sources far from a sink. A prioritized MAC ensures that congested nodes receive prioritized access to the channel, allowing output queues to drain. While these techniques do not explicitly rely on topology information, and this technique cannot able to solve the problem of hidden terminal which is generally comes in sensor network.

*d)Intelligent packet dropping algorithm[7]:*In IPD Congestion is controlled by assigning priority to the data packets. When the occupancy of the buffer increases, the data packets are dropped depending on priority assigned to the data packets i.e. Intelligent Packet Dropping. Depending on Buffer Occupancy, the level of congestion is analyzed and it is controlled. But dynamically assigning of priority to a data packet while travelling in the network is very difficult so this not a suitable for real time application.

e) ESRT[10]: In the scenarios where multiple concurrent events occur in the sensor field, i.e., if there are any common sensor nodes serving as a router for the flows generated by these multiple events. This information is detrimental to the selection of appropriate route. If there is no common wireless sensor node performing routing for these multiple events occurred simultaneously, then the flows generated by these multiple events are isolated, i.e., do not share any common path. In this technique congestion is avoided by choosing an unique path for each event, so that there will no redundant data in the network.

CONCLUSIONS

This paper consists of congestion control techniques which can be applicable in weather forecast network which uses sensor to collect data. During the study of techniques one thing is kept in to mind that techniques should be applicable to WFN .It will help to researcher to mitigate the challenges of congestion in WFN during hazardous period during natural disaster . All the studied techniques will gives their best performance if they will used according to the requirement i.e. application based because the need and challenges are different for different areas.

COMPARISON OF DIFFERENT CONGESTION CONTROL TECHNIQUES

Technique	Congestion Detection	Congestion Control	Action Initiator	Application specific Importance
Locality Driven Congestion control	Not available	BY assigning priority to each event	All data sensing node	Self organizing WSN i.e. Weather sensor network
Cluster based congestion control	Traffic Intensity Approximation Model	Rate limiting	Source node	Implemented for large area
Mitigating Congestion in Wireless Sensor Networks	Channel sampling	Hope-by –Hope flow control	Any node	Note Specified
Intelligent packet dropping algorithm	occupancy of the buffer CD=PA/PB	assigning priority to the data packets	Intemidiate node	In flooding environment where data packet having limited importance
Event to Sink Reliable Transport	By set ting Congestion notification bit in the ACK packet	By choosing the unique path each event	Sink node	Reliable event detection

Fig2. Comparison of various congestion control techniques

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REFERENCES

[1] C.-Y. Wan, S. B. Eisenman, and A. T. Campbell, "CODA: Congestion Detection and Avoidance in Sensor Networks," *in Proc. ACM SenSys*, Nov.2003.

[2] Partho P.Mishra, Hemant Kanakia, "A Hop-by-hop Rate based Congestion Control Scheme," *In Proc. ACM SIG COMM'*92: 112-123.

[3] B. Hull, K. Jamieson, and H. Balakrishnan, "Mitigating Congestion in Wireless Sensor Networks," *in Proc. ACM Sensys*, Nov. 2004.

[4] S. subramaniam, Y., Ozgur, A., Akyildiz, ESRT-Event-to-Sink Reliable Transport in Wireless Sensor Networks,In the Proceedings of ACM Mobihoc, pp. 177–189. ACM Press, New York (2003)

[5] C.T. Ee and R. Bajcsy, "Congestion Control and Fairness for Many-to-one Routing in Sensor Networks," *in Proc. ACM Sensys*, Nov. 2004.

[6] Chonggang Wang1, Kazem Sohraby1, Victor Lawrence2, Bo Li3, Yueming Hu Priority-based Congestion Control in Wireless Sensor Networks Proceedings of the IEEE

[7] Rekha Chakravarthi1, C.Gomathy2 ,"Intelligent Packet Dropping Algorithm for Congestion Control in Wireless Sensor Network" **,** Trendz in Information Sciences & Computing (TISC), 2010

[8] Kyriakos karenos, Vana kalogeraki srikanth V.. krishnamurthy ,"Cluster based Congestion Control for Sensor Networks" , ACM Transactions on Sensor Networks, Vol. V, No. N, November 2007.

[9] Bret Hull, Kyle Jamieson, Hari Balakrishnan,"Mitigating congestion control in WSN", ACM SenSys 2004, Baltimore, MD, November 2004.

[10] Ozgur B. Akan, *Member, IEEE,* and Ian F. Akyildiz, *Fellow, IEEE,"* ESRT: Event-to-Sink Reliable Transport in Wireless Sensor Networks", ACM Transaction on networking, vol. 13, no. 5, oct 2005.

[11] Falko Dressler ,"Locality Driven Congestion control in self organizing wireless sensor network", 3rd International Conference on Pervasive Computing