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A SURVEY ON RECENT CONGESTION CONTROL SCHEMES IN WIRELESS SENSOR NETWORK

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ABSTRACT - The transmission rate is one of the contributing factors to the performance of Wireless Sensor Networks (WSNs). A stopped up association causes reduced network response time, lining deferral and more packet setback.. There are a few approaches to staying away from congestion the board in wireless sensor networks. In any case, the significant test is to plan and implement a congestion overseeing technique with least energy usage and postponement. These review papers talk about the different techniques. In Wireless Sensor Networks (WSN), congestion is a significant test and it expands the heap in the sending channel. Accordingly congestion in WSN should be distinguished and controlled with an efficient approach.

Keywords: [WSN, Congestion control, Transmission Control Protocol.]

1. INTRODUCTION

A gathering of minuscule heterogeneous nodes alluded to as sensor nodes structure a wireless sensor organization. These nodes are sent over a large field with a computing gadget as a focal handling hub called a sink. Fundamentally, wireless sensor networks perform two primary activities - wireless sensing and data networking. Wireless sensor networks involve an immense assortment of scattered nodes over an expansive geographical field and have an expanded field of applications, some of them being in medical services, creature care monitoring and military reconnaissance, planned operations and transportation, soil wellbeing upkeep for agriculture, continuous security and home observation, foundation and so forth [1]. Whenever the Internet of Things (IoT) appears, WSNs are turning out to be more appealing with their combination in the genuine creating world by associating the different items through the web. In any case, there are likewise some worry issues relating to wireless sensor networks. The primary concern areas connected with wireless sensor networks are - assets, energy wastage, memory use, and computational power. The most well-known issue is energy utilization and battery use issues. One more significant issue in WSNs is the event of congestion in the networks.

There are several approaches to keeping away from congestion the executives in wireless sensor networks. Yet, the significant test is to plan and implement a congestion overseeing technique with least energy usage and deferral. These study papers talk about the different techniques. In Wireless Sensor Networks (WSN), congestion is a significant test and it builds the heap in the sending channel. Hence congestion in WSN should be recognized and controlled with an efficient approach.

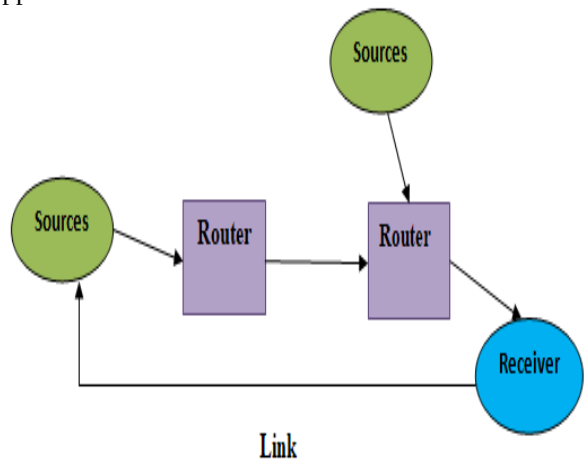

Figure 1. Congestion Control

The Internet has two control protocols that manage its way of behaving: the Transmission Control Protocol (TCP) for end-to-end network communication and the Internet Protocol (IP) for routing packets and for have to-entryway or door to-passage communication. A message sent by a source PC is parted into several packets that are communicated over (potentially) various paths in the organization, and the bundles are rejoined to recuperate the message at the beneficiary. An affirmation ("ack") message is sent back to the sender when a packet is gotten. The control instrument in TCP depends on rationing the quantity of packets in the know from the sender to the collector and back to the sender. The sending rate is expanded dramatically when there is no congestion, and it is dropped to a low level when there is congestion.

2. LITERATURE SURVEY

1. I. Shree, M. Karthiga and C. Mariyammal (2017) et.al proposed improving congestion control in WSN by multipath routing with priority based scheduling. A Wireless Sensor Network is a variety of hubs coordinated into a helpful organization. Wireless Sensor Networks (WSNs) are exposed to hub disappointments in view of energy imperatives; likewise hubs can be added to or eliminated from the organization upon application requests, prompting unpredictable geography changes. Bursty traffic coming about because of the recognized occasions will just objective congestion inside the networks, particularly in high rate applications. Congestion could happen at a sensor which causes energy squander, throughput, reliability and parcel misfortune. The bundles are booked by the planning unit and in light of the need number the information parcel is sent from the source to the objective. The protocol forestalls bundle bunching and gives smoothness to the traffic. Through observing and controlling the planning rate, stream control and congestion control are made due. Through NS2 simulation, we assess and concentrate on the presentation of the congestion control protocol and contrast it and different protocols. Simulation results show that the protocol accomplishes less bundle drops, throughput, below deferral and reliability than different protocols.

Merits
Another instrument is utilized to control Congestion and accomplishes sensibly fair transmission capacity allotment in asset compelled WSNs.

Demerits
Affirmation Control calculation which will guarantee Congestion control if there should be an occurrence of bursty traffic is absurd.

2. M. J. A. Jude and V. C. Diniesh (2017) et.al proposed DACC: Dynamic agile congestion control scheme for effective multiple traffic wireless sensor networks. Ongoing years have seen a dazzling ascent in the organization of wireless sensor bits for different applications because of their adaptability in detecting constant monitoring for large scope remote applications. The many-to-one information transmission presents network congestion/cushion flood at the sensor passages that injures the by and large WSN's presentation progressively monitoring. In this paper, another obligation cycle based congestion mindful calculation known as Dynamic Agile Congestion Control (DACC) is intended to defeat the limitations of FIFO based sensor bits at the doors. The DACC utilizes two sub-calculations one at the entryway that shrewdly faculties congestion during its underlying stage and one more at the sensor hub that progressively adjusts the obligation cycle in view of the packet stamping field. The DACC component utilizes MAC header outline G_flag to congestion notice and S_flag to focus on the packets without additional control packets. The hardware implementation in the sense sensor test bed demonstrates the DACC prevalence in sharpness level improvement, basic and non-basic distinguishing proof; obligation cycle based sending rate variety and limited packet misfortune.

Merits
Congestion control calculation utilizes assorted QoS to deal with various packet types at the sensor passages and direct the flooding of intermittent information by progressively changing the obligation cycle.

Demerits
The DACC system is redone to address the difficulties of the portable sensor hub and sensor cloud environment.

3. S. J., G. Y., S. A. S., C. K., A. R. and G. Raja (2018) et.al proposed Leaky Bucket based congestion control in Wireless Sensor Networks. In Wireless Sensor Networks (WSN), congestion represents a significant danger to wasteful correspondence between the hubs, prompting deferral of packets, spilling over in the support, unfortunate energy proficiency and limiting the throughput. To moderate congestion in such networks and defeated this significant issue, three stages are being taken, viz. congestion identification, congestion warning and congestion control. Traffic light and asset control are the two sorts of ways to deal with reduce congestion in wireless sensor networks. Congestion control based dynamic routing can likewise be applied to tackle the worry connected with WSN. By utilizing simulation instruments, which can possibly offer significant help for wireless networks, we can carry out the control of congestion by applying broken bucket based congestion control components for improved results in wireless sensor networks and contrast the results got and a portion of the current implementations. This approach will eliminate the underutilization of support in a hub where the information traffic is exceptionally low. Then again, it will likewise guarantee that there is no congestion occurring because of more modest support capacity.

Merits
The leaky bucket is a component utilized in packet-exchanged PC and media communications networks.

Demerits
If the transmission of information isn't taken care of appropriately, it results in congestion very much like in any kind of organization.

4. R. M. Kittali, S. K. Mahabaleshwar and A. V. Sutagundar (2016) et.al proposed Congestion controlled adaptive routing in wireless sensor network. Control of congestion on account of wireless sensor networks (WSNs) is an exceptionally significant area of premium, where an expansion in data transmission by sensor hubs results in a proportionately more modest increment or even a decrease in throughput. Along these lines, more modern techniques are expected to combat network

congestion. Different compelled assets of the WSN are to be considered while devising such systems. Various methodologies for congestion identification and aversion have been presented in the beyond couple of years. The conventional flooding and meddling calculation can cause a deficiency of data. To tackle a portion of the issues, this paper presents an original methodology for congestion control in view of dynamic routing. In the proposed work, at whatever point the packet crossing encounters congestion, an alternate path is figured to reroute the packets on the new path. The proposed work has three stages to be specific congestion identification, alternate path computation and yet again routing the packets on another path. As the hour of administration assumes a vital part in WSN, the utilization is made of this to ascertain the congestion time. The exhibition boundaries broke down are course finding, congestion limit and congestion ratio.

Merits
The upstream traffic can be classified into four categories: event-based, continues, query based and hybrid.

Demerits
constant parameters like bandwidth, range of nodes etc. can be made dynamic for a more precise evaluation of the WSNs in some extreme cases

5. Nicolaou, N. Temene, C. Sergiou, C. Georgiou and V. Vassiliou (2019) et.al proposed Utilizing Mobile Nodes for Congestion Control in Wireless Sensor Networks. Congestion control and avoidance in Wireless Sensor Networks (WSNs) is a subject that has drawn in a ton of examination consideration somewhat recently. Other than traffic and asset control, the use of mobile hubs has additionally been proposed as a method for controlling congestion. Such efforts mostly focused on using mobile sinks for data assortment and congestion avoidance, as opposed to mobile hubs for congestion alleviation. In this work, we present a Mobile Congestion Control (MobileCC) algorithm with two varieties, to help existing congestion control algorithms in confronting congestion in WSNs. The primary variety utilizes mobile hubs that create locally-huge elective paths prompting the sink. The subsequent variety utilizes mobile hubs that create completely individual (disjoint) paths to the sink. a dynamic hub placement algorithm that takes care of the issue locally and a direct hub placement algorithm that creates another direct path to the sink, which comprises just of mobile hubs. Simulation results in an arbitrary geography show the way that the two varieties can lighten congestion.

Merits
Dynamic MobileCC only uses the lowest possible number of mobile nodes for each congestion event in the network and needs more time to create an alternative path.

Demerits
To extend our solution to consider longer periods of congestion and will include the notion of mobile node re-use and a thorough consideration of the energy cost of each algorithm in such periods.

6. M. Farsi, M. Badawy, M. Moustafa, H. Arafat Ali and Y. Abdulazeem (2019) et.al proposed A Congestion-Aware Clustering and Routing (CCR) Protocol for Mitigating Congestion in WSN. Wireless sensor networks (WSN) have been explored as a strong circulated sensing application to improve the effectiveness of embedded frameworks and wireless systems administration capacities. In spite of the fact that WSN has offered interesting chances to set the establishment for utilizing omnipresent and unavoidable computing, it experienced a few issues and difficulties, for example, regularly changing organization geography and congestion issues which influence network transfer speed utilization as well as execution. The principal objective of this study is to present a congestion-aware clustering and routing (CCR) protocol to lighten the congestion issue over the organization. The CCR protocol is proposed to diminish start to finish postpone time and draw out the organization lifetime by picking the appropriate essential bunch head (PCH) and the subsequent group head (SCH). Trial results show that the proposed CCR protocol works on the exhibition of the organization contrasted and the LEACH protocol, as it expands the organization lifetime, experiences no data overflow, and builds the quantity of packets sent in each round. The stability of the proposed protocol, as the organization area increments, is additionally demonstrated.

Merits
An assortment of applications can utilize this planned protocol.
WSN applications since groups are foreordained before organization, and it utilizes exceptional hardware and programming like the GPS to track down the geographical position of the nodes.

Demerits
Nodes in the CCR protocol will utilize GPS to decrease the energy utilized for knowing the distance among hubs, and effectively lay out arrangement, little arrangement stages and routing tables.
CCR protocol will send data just when it changed not all data.

7. L. Tang, Q. Guan and S. Jiang (2020) et.al proposed Congestion Control based on Geographic Routing Algorithm for Wireless Sensor Networks. Resource control is a branch of congestion control in wireless sensor networks (WSNs). The congestion-situated asset control plans in WSNs frequently re-course traffic burdens to stay away from blocked areas. The re-routing upward for congestion avoidance is especially large in large networks. Consequently, this sort of congestion control areas of strength for needs. In this paper,

congestion control in light of a geographic routing algorithm (CcbGr) for WSNs is proposed. It decides the congestion status of a hub utilizing edges of the line length and the changing pace of the line length. The simulation checks that CcbGr can lessen congestion, keep up with energy equilibrium, and bypass holes.

Merits
CcbGr can effectively address network congestion with high adaptability
the traffic light technique can be viewed as more effective when transient over-burden circumstances misogynist, while the asset control strategy is more effective in instances of determining high burden demands

Demerits
This method does not need to reduce the sending rate of the source node but transfers redundant traffic to the surrounding idle nodes. How to find the new fitful next hop is the difficulty in this method.

8. N. Aslam, K. Xia, A. Ali and S. Ullah, (2017) et.al proposed Adaptive TCP-ICCW Congestion Control Mechanism for QoS in Renewable Wireless Sensor Networks. The TCP/IP streams are inescapable in the quick communication between the sensor hubs over the web. Be that as it may, these sensor hubs are reliant upon different hotspots for provisioning energy and maintaining Quality of Service (QoS). The QoS ensures start to finish solid communication as it has numerous imperatives that should be controlled autonomously. In this article, we propose a technique to broaden the lifetime of these sensor hubs by presenting a clever mobile hub as a charger. Simultaneously, our technique presents an innovative component called the underlying steady congestion window (ICCW) to deal with the congestion of the bottleneck joins. The ICCW deals with the new sending rate for effective usage of the connection capacity by infusing two unique threshold values (SSTμ, SSTF) in the TCP system. The proposed situation is taking care of the energy empty out and congestion by the MCN and TCP-ICCW techniques individually to defeat the difficulties. The investigation of the proposed approach outflanks other analyzed strategies concerning QoS boundaries like reduction in data misfortune, upgrade in throughput and sending rate. The entire system results in congestion control and lifetime extension.

Merits
Only one request from the source node can use the link at a time while others must wait for their turn. Waiting requests maintain in a queue.

Demerits
The functionality of MCN will be upgraded as a sink node intended to enhance other QoS parameters and lifetime of the WSN.
The mobile charger cum sink node can recharge the nodes and accumulate their data concurrently.

9. A. A. Khan, S. Ghani and S. Siddiqui (2017) et.al proposed Design & implementation of distributed congestion control scheme for heterogeneous traffic in wireless sensor networks. As of late arising wireless sensor advancements incorporate various kinds of sensor hubs in an organization for data assortment. The heterogeneous Wireless Sensor Network (WSN) forces complex plan difficulties as hubs in such an organization frequently have various prerequisites concerning inertness and data transfer capacity. In this manner, the channel access for hubs should be figured out how to guarantee the separated quality of service for every need. This paper targets creating and assessing a distributed congestion control plot for CSMA to make it practical for prioritized heterogeneous traffic. For this reason, a model prior created for 802.15.4 has been improved and incorporated with the obligation cycled CSMA. Heterogeneous Traffic of three distinct needs has been utilized for assessing the performance of the proposed plot. a congestion control conspire for the WSN managing prioritized heterogeneous traffic. The plan has been incorporated with the CSMA implementation in a little OS environment. The throughput correlation uncovers that for heterogeneous traffic, the proposed conspire gives improved results when contrasted with the fundamental obligation cycled CSMA.

Merits
PHTCCP, traffic rate adjustment has been used as the major technique to reduce congestion for the prioritized diverse traffic.

Demerits
integrate the transmission strategies presented in this work with more advanced duty-cycle based MAC protocols are not possible

10. J. J. Justus and A. C. Sekar (2016) et.al proposed Congestion control in wireless sensor network using hybrid epidermic and DAIPaS approach. The wireless sensor network is a distributed framework for sensing and monitoring the integrated environment. For the most part, congestion in the WSN network happens because of the transmission of packets in the improper path from source to objective. Congestion in the organization creates extra burden on the organization. In Wireless Sensor Network (WSN) Congestion is one of the considered challenges which diminishes the asset and number of nodes sent in the organization. In WSN congestion should be limited through an effective way to deal with increment the performance of the organization. In the beyond couple of many years, various routing protocol has been created for the location and control of congestion in WSN. For congestion control in WSN, there is a need to locate and distinguish routing data about every hub in the organization for effective transmission path recognizable proof from the source hub to the objective hub. Data won't be communicated through that path in future. Through the proposed conspire it is normal that WSN

network throughput has been expanded with limited postponement and loss of packets in the WSN.

Merits
The protocol has been created as an adaptable and hearty method for large scope dispersal of data and dynamic organization.

Demerits
Congestion and collusion control has to be done by each node in a network
for an efficient data transmission over the network is not possible in current proposed method.

11. N. H. Bt Halim, N. B. Yaakob and A. Bin Awang Md Isa (2016) et.al proposed Congestion control mechanism for Internet-of-Things (IOT) paradigm. Wireless Sensor Network (WSN) is one of the Internet-of-Things (IoT) ideal models which give monitoring services to cataclysmic events, for example, volcanic eruptions and seismic tremors which can influence the existence of individuals. Accordingly, the Quality-of-Service (QoS) of the basic applications is a significant issue to guarantee its effectiveness and strength. Other than its without a doubt services and commitments in monitoring frameworks, WSN's restricted assets can seriously corrupt the QoS in IoT applications. Congestion in WSN will additionally decrease the normal QoS of the related applications. For this situation, effective utilization of scant assets is essential to guarantee consistent data transmission. The power utilization of a sensor hub can be decreased by diminishing the pace of packet retransmission which is brought about by congestion. In this paper, a specific packet disposing of strategy which is known as Packet Discarding based Node Clustering (PDNC) is presented. PDNC really do control the congestion in WSN by disposing of the packets in light of the size and TTL. PDNC gives a lower level of packet misfortune and lower end-to-end delay contrasted with the original technique.

Merits
Selective packet discarding is used to overcome the congestion problem.

Demerits
High numbers of common nodes cause the sink node facing the difficulty to handle all the traffic generated by the nodes.

12. Y. Zhuang (2019) et.al proposed Data Collection with Accuracy-Aware Congestion Control in Sensor Networks. Data assortment is a crucial and basic capacity of wireless sensor networks (WSNs) for the digital actual frameworks (CPS) to assess the condition of the actual world. Nonetheless, shaky organization conditions force critical challenges in ensuring the data precision that is fundamental for the solid assessment of actual states. Without productively settling congestion during data transmission in WSNs, packet misfortune because of congestion can altogether debase the data quality. Different congestion control plans have been proposed to address this issue. The majority of them depend on decreasing communicated data tests to eliminate the congestion, which, nonetheless, could prompt appallingly high assessment mistake. In this paper, we break down the effect of congestion control on data precision and propose a Congestion-Adaptive Data Collection conspire (CADC) to determine the congestion under the assurance of data exactness productively. CADC mitigates congestion by versatile lossy pressure while guaranteeing a given generally data assessment mistake bound in a distributed way. Also, CADC is extended by thinking about the dynamic organization geography and the application of total capacities in WSNs. Broad trial results show the prevalent performance of our plans in examination with past plans.

Merits
When the congestion happens, the network uses alternative transmission paths that are created by unused/redundant nodes in the network, even at the cost of more transmission hops to the destination.

Demerits
CADC is not extended with considering the dynamic network topology and the application of aggregate functions in WSNs.

13. N. Thrimoorthy, T. Anuradha and A. Kumar (2017) et.al proposed a virtual model to analyze congestion in a wireless sensor network (WSN). To divide data among a few gadgets we want an organization association. The gadgets can be any electronic gadget which deals with data move protocols, for example PC, PC, cell phone, wired/wireless sensors, switches and so on. This organization can be wired or wireless or a mix of both. In a wired association, these are fixed to one another while in a wireless organization the likelihood of changing the overall position between them is high. Gadgets in the wireless organization use cell or batteries to get energy rather than from a direct wellspring of power. For each adjustment of organization arrangement, it requirements to recalculate the path of packet move. In a thick area, for example area containing a bigger number of gadgets than the others, the congestion rate is high on the grounds that a similar course is chosen by additional gadgets. In the introduced paper we manage sensors as the organization gadget. An expansion in congestion prompts numerous results like choice postponement, loss of data as packets, expanded upward while retransmission of dropped packets, energy misfortune because of the expanded responsibility by sensors and decreased life range of sensors. Utilizing these techniques to control congestion assists with expanding throughput as well as the effectiveness and reliability of the framework.

Merits
The sensors are built to use inbuilt cells which can be chargeable or not. The limitation with these devices is that, they should be in certain range limit.

Demerits
For each packet transfer the optimal path will be calculated, which depends upon the time to send the packet between them.

14. S. Chowdhury, A. Benslimane and C. Giri, (2021) et.al proposed Non cooperative Gaming for Energy-Efficient Congestion Control in 6LoWPAN. Wireless sensor networks (WSNs) give a huge commitment to the progression of the Internet of Things (IoT) as they can move a gigantic volume of data to the Internet with the assistance of low power and minimal expense self-working sensing gadgets. This paper manages the congestion issue which is one of the basic issues in 6LoWPAN (IPV6 over low power and lossy Wireless Personal Area Network) based network as it makes huge packet misfortune that leads corrupted throughput and additional energy utilization. We propose a congestion control instrument for 6LoWPAN by utilizing non-agreeable game hypothesis. The proposed strategy named Non-agreeable Gaming for Energy-effective Congestion Control (NGECC) decides the ideal data move pace of all the source nodes (leaf nodes) to stay away from congestion at the moderate nodes. NGECC thinks about both the channel occupation and the support overflow as the primary variables of the packet misfortune in the organization. For the simulation of the NGECC strategy, we use Contiki OS and Cooja test system, which works in view of the IEEE 802.15.4 norm and executes the 6LoWPAN protocol stack. The performance of NGECC has been assessed by contrasting it and the insightful results, the default RPL network working, and two other existing strategies. The simulation results show that the NGECC outflanks the current strategies as far as sending pace of data packets, packet conveyance ratio, throughput, weighted decency file, energy utilization, and delay.

Merits
To make the solution energy efficient, we consider an energy parameter in the payoff function of each leaf node.

Demerits
Intend to apply a dynamic priority function to determine the node's priority assuming that the nodes may send different types of application packets as per the user's demand.

15. H. S. Z. Kazmi, N. Javaid, M. Imran and F. Outay (2019) et.al proposed Congestion Control in Wireless Sensor Networks based on Support Vector Machine, Grey Wolf Optimization and Differential Evolution. The transmission rate is one of the contributing variables to the performance of Wireless Sensor Networks (WSNs). A clogged organization causes diminished network reaction time, lining deferral and more packet misfortune. To address this issue, we have proposed a transmission rate control technique. The ongoing hub in a WSN changes its transmission rate in light of the traffic loading information acquired from the downstream hub. Multi classification is utilized to control the congestion utilizing a Support Vector Machine (SVM). To get less miss classification errors, Differential Evolution (DE) and Gray Wolf Optimization (GWO) algorithms are utilized to tune the SVM boundaries. The near examination has shown that the proposed approaches DE-SVM and GWO-SVM are more capable than the other classification techniques regarding classification error.

Merits
Congestion at a node occurs if the arrivals of data packets at a particular node are greater than the number of outgoing data packets.

Demerits
And classify different type of faults to decrease sensor failures and handle network traffic appropriately and we aim to consider more dynamic and practical test scenarios in WSN

CONCLUSION
In this article, we synopsis the prerequisites for congestion control in WSNs. The vitally existing congestion control algorithms are summed up and examined. They can be arranged into four classifications: rate guideline and distribution; routing streamlining; data handling; need segregation. It is extremely important to keep away from the event of congestion in the organization to get the exact data with practically no packet misfortune and wastage of time in running congestion control algorithms. Protocols should be intended for congestion avoidance instead of controlling congestion after it works out. It's smarter to keep away from it and you make certain about it.

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