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Evaluating the Effect of Network Scalability for Token BucketBased Congestion Control Protocol

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ABSTRACT: Wireless Sensor Network contains sensor nodes which are spread to sense the ecological surroundings, collect data and transfer it to a base station for processing. Energy conservation in the Wireless Sensor Networks (WSN) is an important task due to their inadequate battery power. The related works till now have already been done to resolve the issue keeping in mind the constraints of WSNs. From the survey, it has been revealed that the prevailing methods has used queuing model which might can restrict the performance of the congestion control algorithm. The behavior of the queue has been neglected for coverage fidelity, queuing thresholds, number of queues, blocking probabilities etc. The type of the traffic arrival process exhibits a bursty and correlated behavior, which totally degrade the network performance. To overcome these, this paper has been dedicated on improving the PASCCC further by utilizing token bucket algorithm rather than priority queues. This work has furthermore dedicated to the inter cluster data aggregation to improve the outcome further. The entire objective is to avoid congestion using the token bucket algorithm.

KEYWORDS:CONGESTION CONTROL, PASCCC, TOKEN BUCKET, WSNs

INTRODUCTION

A WSN contains a number of sinks and perhaps tens or thousands of sensor nodes spread within an area. The upstream traffic from sensor nodes to the sink is many-to-one multi-hop convergent. The upstream traffic could be categorized into four delivery models: event-based, continuous, query-based, and hybrid delivery. Because of the convergent nature of upstream traffic, congestion more probably appears in the upstream direction.

CONGESTION CONTROL

Two forms of congestion could occur in WSNs. The very first type is node-level congestion that's common in conventional networks. It's brought on by buffer overflow in the node and can lead to packet loss, and increased queuing delay. Packet loss consequently can result in retransmission and therefore consumes additional energy. For WSNs where wireless channels are shared by several nodes using CSMA like (Carrier Sense Multiple Access) protocols, collisions could occur when multiple active sensor nodes attempt to seize the channel at exactly the same time. This is often known as link-level congestion. Link-level congestion increases packet service time, and decreases both link utilization and overall throughput, and wastes energy at the sensor nodes. Both node level and link-level congestions have direct effect on energy efficiency and QoS.

There are two general approaches to manage congestion: network resource management and traffic control. The initial approach tries to improve network resource to mitigate congestion when it occurs. In wireless network, power control and multiple radio interfaces may be usedto improve bandwidth and weaken congestion. Traffic control implies to manage congestion through adjusting traffic rate at source nodes or intermediates nodes. This method is beneficial to truly save network resource and more feasible and efficient when exact adjustment of network resource becomes difficult. Most existing congestion control protocols belong to the type. Based on the control behavior, there are two general methods for traffic control in WSNs: end-to-end and hop-by-hop. The end-to-end control can impose exact rate adjustment at each source node and simplify the look at intermediate nodes; however, it results in slow response and relies highly on the round-trip time (RTT). In comparison, the hop-by-hop congestion control has faster response. However, it's usually difficult to regulate the packet forwarding rate at intermediate nodes due to the fact packet forwarding rate is determined by MAC protocol and could possibly be variable.

PASCCC: PRIORITY-BASED APPLICATION-SPECIFIC CONGESTION CONTROL CLUSTERING PROTOCOL

This section reveals description of distributed cluster-based routing protocol. To the most truly effective of knowledge, PASCCC is the initial protocol of its kind to take into consideration mobility, heterogeneity, and congestion detection and mitigation utilizing a cluster hierarchy. Many studies have addressed congestion detection and mitigation, but they're either generic or specifically connected to the transport layer. Following assumptions in regards to the PASCCC are made:-

1. Nodes are deployed randomly in the field with an alternative number of energy values.

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2. Nodes are designed for adjusting their transmission capacity to have the ability to reach an extremely distant CH within a specific round.
3. The positioning of a BS isn't fixed and it might be either within or away from sensor field.
4. Nodes are designed for moving over the field to cover vacant spaces utilizing the random waypoint mobility model with an interest rate V, where the worthiness of V ranges between Vmin and Vmax. Hence, complete coverage of the sensor field is guaranteed.

Framework of PASCCC

In PASCCC, the nodes are designed for moving over the field if necessary to have the ability to cover vacant regions. Mobility ensures complete coverage and connectivity at all times. Hence, it's not as likely that generated events are going unreported. In PASCCC, 10% of the nodes are advanced. These nodes have higher energy in contrast to normal nodes, thereby developing a heterogeneous quantity of nodes in the network. PASCCC is definitely an application-specific protocol. PASCCC acts as a reactive protocol for temperature monitoring and as a proactive protocol for humidity. In reactive routing protocols, the nodes react immediately to sudden and drastic changes in the values of sensed events, and they're suitable for time-critical applications. In proactive routing protocols, the nodes start their transmitters, sense ecologically friendly surroundings, and report captured data occasionally to the BS. These protocols are suitable for applications that need periodic data transmission.

LITERATURE SURVEY

Larsen, Carl et al. [1] presented a routing-aware predictive congestion control yet decentralized scheme for WSN that uses a mix of a hop by hop congestion control mechanism to steadfastly keep up desired degree of buffer occupancy, and a powerful routing scheme that works in concert with the congestion control mechanism to forward the packets through less congested nodes. The proposed adaptive approach restricts the incoming traffic thus preventing buffer overflow while maintaining the rate via an adaptive back-off interval selection scheme. Additionally, the perfect routing scheme diverts traffic from congested nodes through alternative paths to be able to balance the strain in the network, alleviating congestion. This load balancing of the routes may even out the congestion level throughout the network thus increasing throughput and reducing end to finish delay. Closed-loop stability of the proposed hop-by-hop congestion control is demonstrated using the Lyapunov-based approach. Simulation results reveal that the proposed scheme results in reduced end-to-end delays. Zawodniok, Maciej, and Sarangapani Jagannathan [2] presented a novel decentralized, predictive congestion control
(DPCC)or wireless sensor networks (WSN). The DPCC includes an adaptive flow and adaptive back-off interval selection schemes that work in concert with energy efficient, distributed power control (DPC). The DPCC detects the onset of congestion using queue utilization and the embedded channel estimator algorithm in DPC that predicts the channel quality. Then, an adaptive flow control scheme selects suitable rate that will been forced by the newly proposed adaptive back off interval selection scheme. An optional adaptive scheduling scheme updates weights related to each packet to guarantee the weighted fairness during congestion. Closed-loop stability of the proposed hop-by-hop congestion control is demonstrated utilizing the Lyapunov-based approach. Simulation results reveal that the DPCC reduces congestion and improves performance over congestion detection and avoidance (CODA) [3] and IEEE 802.11 protocols. Enigo, V., and V. Ramachandran et al. [3] designed a congestion control mechanism at the origin which reacts on the basis of the amount of the node weights at each node. In this scheme, each node passes its calculated weight upstream. Each node adds its current weight to so it received from the downstream node, and passes these details toward the upstream node. At the conclusion,the origin will have the amount of all weight information from the corresponding downstream nodes and utilize it for controlling rates. Each sensor node transmits the information with the adjusted rate. The sink node receives enough time series for each sensor node. After collecting enough data, the sink node works on the clustering algorithm to partition sensor nodes based on the sending rates and similarity of data obtained. Then it sends out the cluster information to all sensor nodes and requires the sensor nodes within exactly the same cluster to work alternatively to truly save energy. The nodes inside a cluster adaptively enter into energy saving mode based on a random schedule. By simulation results, they indicated that their protocol achieves congestion control alongside energy saving. Huang, Zhipeng et al. [4] proposed the usage of an Extended Kalman Filter (EKF) to filter the impact of bandwidth variations from the operation of wireless congestion control protocols. Their EKF-based Bandwidth Estimation (EBE) scheme can predict link capacity by monitoring the persistent queue size of a wireless link thereby eliminating the requirement for direct measuring of the real-time bandwidth. They implemented EBE in NS-2 and integrate it with XCP and VCP protocols. Through extensive simulation studies, they demonstrated significant performance improvements

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of both protocols as caused by using EBE. Li, Xiaolong, and HomayounYousefi'zadeh [5] discussed that VCP is suffering from a comparatively low speed of convergence and exhibits biased fairness in moderate bandwidth high delay networks because ofutilizing an insufficient level ofcongestion feedback. Their previous work Double-Packet Congestion-control Protocol (DPCP) addressed this issue by increasing the quantity of the feedback distributed over two ECN bits in the IP header of a set of packets. However, DPCP faces deployment obstacles in encrypted wireless networks because of the fact |so it depends on partial information in the TCP header and the TCP header information is lost when crossing encryption boundaries. Furthermore, wireless networks are characterized by both error- and congestion-caused loss. Their previous work has revealed that the efficiency of DPCP, and for instance any congestion control protocol, over wireless networks might be reduced as caused by not to be able to differentiate between two kinds of loss. In this paper, they proposed an alternative congestion control protocol to that they referred as Distributed Congestion-control Protocol for Encrypted Wireless (DCP-EW) networks. DCP-EW is effective at efficiently operating in encrypted wireless networks while preserving most of the advantages of DPCP for wired networks. It will so by passively using the IP Identification field of a packet header rather than the TCP header along with a heuristic algorithm to differentiate between different sourced elements of loss. They implemented DCP-EW in NS-2 and the Linux Kernel. They demonstrated the performance improvements of DCP-EW in comparison to DPCP and VCP through simulation and experimental studies .Li, Mingwei, and Yuanwei Jing [6] proposed innovative model and congestion control algorithm for wireless sensor networks centered on feedback control, which is known as Feedback Congestion Control (FBCC). The algorithm has been created by exploiting linear discrete time control theory. A feedback control scheme is established between children node and father node. The FBCC detects the onset of congestion using queue length. Then, an energetic flow control scheme selects suitable incoming traffic that will be enforced by the newly proposed active scheme. Closed-loop stability of the proposed hop-by-hop congestion control is demonstrated using the Lyapunov-based approach. The scheme makes congestion control in WSN rise to theoretical height. Simulation results reveal that the FBCC reduces congestion and improves performance over Congestion Detection and Avoidance (CODA). The outcomes of simulations validate FBCC can avoid and alleviate congestion, and has reasonable ramifications of reliability, low energy consumption and high throughout.

Chakraborty, Arpita et al. [7] proposed a new congestion control algorithm in that the faulty nodes are identified and blocked from data communication using the idea of trust. The trust metric of all of the nodes in the WMSN is derived using a two-stage Fuzzy inferencing scheme. The traffic flow from source to sink is optimized by implementing the Link State Routing Protocol.The congestion of the sensor nodes is controlled by regulating the rate of traffic flow on the foundation of the priority of the traffic. Finally they compared their protocol with other existing congestion control protocols to exhibit the merit of the work. Lee, Joahyoung, and Byungtae Jang [8] proposed a new congestion control method centered on a generalization algorithm. The proposed method selects data forwarding nodes that distribute the congested traffic over other sensor nodes and is availableto aid data traffic between all sensor nodes fairly. This prevents biased energy consumption by some sensor nodes, and the sum total duration of the sensor nodes is prolonged by almost the quantity of saved battery energy. Farzaneh, Nazbanoo et al. [9] proposed a Dynamic ResourceControl Protocol (DRCP)
to control congestion in wireless sensor networks.DRCP utilizes multiple resources to control congestion.DRCP alleviates congestion by controlling transmission power. Simulation results show the performance of the proposed protocol that improves system throughput, and decreases packet dropping, while saving energy. Jan, Mian Ahmad et al. [10] proposed a priority-based application-specific congestion control clustering (PASCCC) protocol, which integrates the mobility and heterogeneity of the nodes to detect congestion in a network. PASCCC decreases the job cycle of every node by maintaining threshold levels for various applications. The transmitter of an indicator node is triggered once the reading of a particular captured event exceeds a particular threshold level. Time-critical packets are prioritized during congestion to be able to maintain their timeliness requirements. CHs ensure coverage fidelity by prioritizing the packets of distant nodes over those of nearby nodes. A novel queue scheduling mechanism is proposed for CHs to attain coverage fidelity, which ensures that the additional resources consumed by distant nodes are utilized effectively. The effectiveness of PASCCC was evaluated on comparisons with existing clustering protocols. The experimental results demonstrated that PASCCC achieved better performance. Kafi, Mohamed Amine et al. [11] handled congestion and interference control in wireless sensor networks (WSN), that will be required for improving the throughput and saving the scarce energy in networks where nodes have different capacities and traffic patterns.

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A scheme called *IACC* (*Interference-Aware Congestion Control*) is proposed. It allows maximizing link capacity utilization for every node by controlling congestion and interference. This really is achieved through fair maximum rate control of interfering nodes in inter and intra paths of hot spots. The proposed protocol has been evaluated by simulation, where the outcomes rival the potency of scheme when it comes to energy saving and throughput. Particularly, the outcomes demonstrate the protocol scalability and considerable reduced amount of packet loss that enable as high packet delivery ratio as 80% for big networks. Aghdam, ShahinMahdizadeh et al. [12] proposed a new content-aware cross layer WMSN Congestion Control Protocol (WCCP) by thinking about the characteristics of multimedia content. WCCP employs a Source Congestion Avoidance Protocol (SCAP) in the origin nodes, and a Receiver Congestion Control Protocol (RCCP) in the intermediate nodes. SCAP uses Number of Picture (GOP) size prediction to detect congestion in the network, and avoids congestion by adjusting the sending rate of source nodes and distribution of the departing packets from the origin nodes. Additionally, RCCP monitors the queue period of the intermediate nodes to detect congestion in both monitoring and event-driven traffics. Moreover, to enhance the received quality in base stations, WCCP keeps the I-frames and ignores other less important frame kinds of compressed video, in the congestion situations. The proposed WCCP protocol is evaluated through simulations centered onvarious performance metrics such as for instance packet loss rate, frame loss rate, Peak Signal-to-Noise Ratio (PSNR), end-to-end delay, throughput, and energy consumption. The outcomes reveal that WCCP significantly improves the network performance and the caliber of received video in the sink nodes, and outperforms the present state-of-the-art congestion control protocols. Sergiou, Charalambos et al. [13] presented a light congestion control and avoidance scheme, called Dynamic Alternative Path Selection Scheme (DAlPaS). DAlPaSis just aquite simple but effective scheme that controls congestion although it keeps overhead to the minimum. The operation of the scheme is on the basis of thecontrol of resources rather than controlling the sending rate at the source. The performance of DAlPaS has been evaluated against comparable schemes with promising results.

PROPOSED METHODOLOGY

Subsequent are the various steps with brief detail:-

Step 1: Start:–First of all, process is initialized.

Step2:Deploy WSNs: - After initializing, the Wireless sensor networks are deployed.

Step3:Apply token bucket algorithm to given nodes:- Then the token bucket algorithm is applied to the given nodes.

Step4: Apply T(n) to evaluate CHs if node has token:- After applying the token bucket filter algorithm, T(n) is applied to it for the evaluation of cluster heads if and only if node has token.

Step5:Associate member nodes with CHs:-Then the member nodes associated with the cluster head are evaluated in Step 5.

Step6:Applyinter cluster data aggregation to find path between CHs and base Station:-After that inter cluster data aggregation is applied to find path between cluster heads and the base stations.

Step7: Transmit data:-Then their occurs the transmission of the data.

Step8: Evaluate Energy dissipation:- After transmission of the data, dissipation of the energy is evaluated.

Step9:To find node dead:-Then it is found that whether the node is dead or not. If the node is dead, then goto step 10, otherwise goto step 3.

Step10: Count dead:-If the nodes are dead in step 9, then the dead nodes are counted.

Step11:To find dead equal to n:-In this step, it is found that whether the nodes are equal to n or not. If they are equal, then goto step 12, otherwise goto step 3.

Step12:Network lifetime:-Here the network lifetime is evaluated.

Step13:End

RESULTS AND DISCUSSIONS

FIRST NODE DEAD: - Table 1shows the first node dead evaluation of the existing and the proposed protocols. In the table, it is clearly shown that the proposed technique performs better as compared to the existing technique.

TABLE 1: FIRST NODE DEAD EVALUATION

NODES	EXISTING TECHNIQUE	PROPOSED TECHNIQUE
100	81	171
120	83	193
140	82	194
160	74	173
180	84	196
200	81	201
220	81	185
240	79	194
260	76	184
280	77	194
300	77	185

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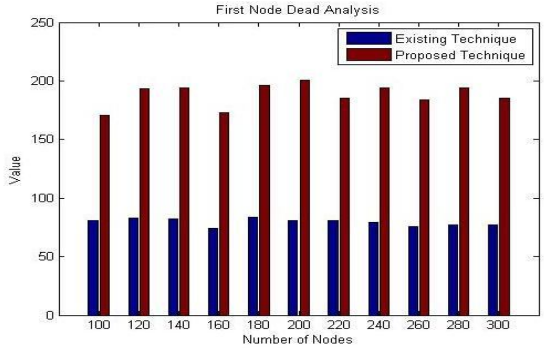

Fig 1:FIRST NODE DEAD ANALYSIS

Fig.1is showing the comparison of existing and theproposed with respect to total number of rounds in case of first dead node. X-axis is representing initial energy. Y-axis is representing the number of rounds. It has been clearly shown that the overall numbers of rounds in case of proposed technique are quite more than that of the existing technique. Thus proposed technique outperforms over the existing technique.

HALF NODE DEAD: -Table 2 shows the half node dead evaluation of the existing and the proposed protocols. In the table, it is clearly shown that the proposed technique performs better as compared to the existing technique.

TABLE 2: HALF NODE DEAD EVALUATION

NODES	EXISTING TECHNIQUE	PROPOSED TECHNIQUE
100	103	219
120	105	218
140	108	223
160	102	225
180	106	228
200	103	224
220	113	221
240	103	225
260	103	227
280	107	233
300	103	227

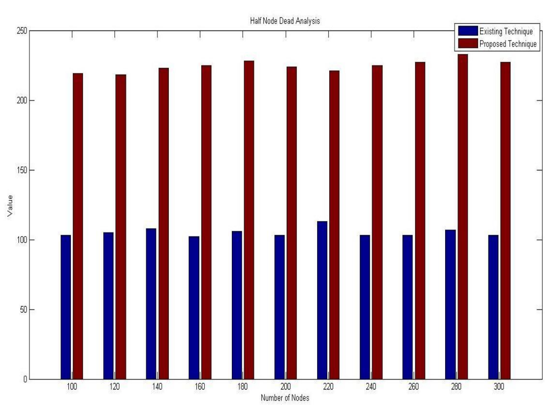

Fig 2:HALF NODE DEAD ANALYSIS

Fig. 2 is showing the comparison of existing and the proposed with respect to total number of rounds in case of half dead node. X-axis is representing initial energy. Y-axis is representing the number of rounds. It has been clearly shown that the overall numbers of rounds in case of proposed technique are quite more than that of the existing technique. Thus proposed technique outperforms over the existing technique.

ALL NODES DEAD: -Table 3 shows the all node dead evaluation of the existing and the proposed protocols. Table clearly showsthat the proposed technique performs better as compared to the existing technique.

TABLE 3: ALL NODE DEAD EVALUATION

NODES	EXISTING TECHNIQUE	PROPOSED TECHNIQUE
100	300	287
120	289	299
140	258	305
160	299	303
180	292	311
200	297	321
220	304	316
240	279	322
260	328	322
280	311	316
300	287	323

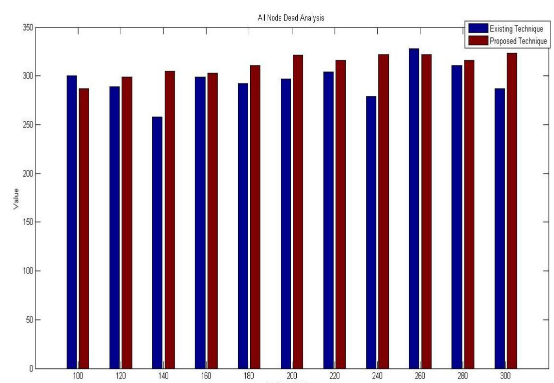

Fig 3: ALL NODE DEAD ANALYSIS

Fig.3 is showing the comparison of existing and the proposed with respect to total number of rounds in case of all dead node. It has been clearly shown that the overall number of rounds in case of proposed technique is quite more than that of the existing technique. Thus proposed technique outperforms over the existing technique.

CONCLUSION AND FUTURE SCOPE

In this paper, a priority based application specific congestion control clustering protocol has been improved after studying it. It is improved by using token bucket algorithm instead of priority queues. This work has also focused on inter cluster data aggregation to enhance the results further. The overall objective has been to prevent

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congestion by using the token bucket algorithm. Moreover a comparison has been made which proves the efficiency of the proposed algorithm.

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