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Distributed Deployment Model For Congestion Control In Wireless Sensor Network

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Abstract

The influence of wireless sensor networks (WSN) are generally carried by the communication medium losses, application that are diversified, deployed heavily, with limited processing power and less capacity for storing the event data, and having change often in the topology. Limitations mentioned above for providing vital and exclusive design challenges for employing in controlling data packets transport in wireless sensor networks. Consideration of reliable transport protocol is a must for data delivery reliability, energy efficiency, and mitigating congestion. The latter is considered to be vital, crucial and critical for dependence on throughput and lifetime and healthiness of network. Earlier several protocols proposal in the literature, but lessening congestion in WSN still remains open and challenging.

Review and sorting out some protocols from the review of literature is provided here in the paper. Primarily, depend on the policy to control the protocols are divided into resource control and traffic control. Traffic control protocols are reactive or preventive with respect to traffic adjusting. The resource control protocols are classified into type of resource for adjusting further.

With increase of Wireless Sensor Network (WSN) technologies there is demand of optimal sensor node deployment for considering one of the most important factors that directly affect the network coverage. Many researches in WSNs could solve the issue of coverage in homogeneous and heterogeneous cases but suffered from drawbacks such as energy consumption, congestion and delay.

A very important area in wireless sensor networks (WSN) congestion control, where there is traffic that becomes more greater than the combined or with the individual capacity of the primary channels. Thought is much required for developing extreme techniques that are much more sophisticated for avoiding, detecting, resolving congestion. With having resources that are very much constrained in the nature of WSN these all should be measured while planning techniques in achieving the throughput which should be maximum attainable. A range of approaches were carried in the past which are including some various routing protocols which are aided with congestion detection, congestion notification and control mechanism, wherein some dedicated protocols exclusively for congestion control. Earlier schemes, for avoidance of congestion were executed by the sink node which used to cause a topology reset and and finally a bulk traffic drop. The consequences measured for the latter mentioned congestion control protocols addressing the here the avoidance of congestion, detection, and resolution were introduced at the node level. This paper explores mechanisms for controlling congestion in the WSNs and presents a comparative study. The congestion control schemes are sorted out as centralized with partial congestion control and distributed with dedicated congestion control.

In this paper, we propose a deployment model based on packet intersection priority transmission for achieving balance between the network performance and transmission in heterogeneous wireless sensor network (HEWSN).

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The proposed model is deployment streamline of HEWSN nodes making a balance between the coverage and financial cost.
Performance of the proposed model is analyzed in terms of energy estimation, minimizing delay and alleviating congestion. The simulation result shows the capability of the proposed distribution deployment model to achieve minimum coverage, no delay in arrival of data packet for a distributed deployment. Furthermore, a comparative study with LEACH protocol has also been conducted, and results confirm the superiority of the proposed model.
Keywords: *Congestion control, wireless sensor networks, traffic, resource control.*

Introduction:

Wireless sensor networks (WSN) is equipped with tiny nodes which propose embedded devices along with sensors or and actuators. Normally wireless transmitters that are short ranged are used and operated separately however they also cooperate to route the data, either point to point or hop-by-hop forwarded towards to a sink or base station. WSN has more than a few sensor nodes which are distributed in a geographical covering indoor or outdoor area which can be limited or unlimited which are to monitor physical event and or environmental event upon the occurrence [1]. With the appearance of IoT (Internet of Things), WSN turned out to be more attractive with integration features with the integration of objects via internet with real physical world [2]. IoT with an insight transmits gathered information in several forms to everything that are available in the network [3][4], with an arrangement of sensing the concepts that are related to model like M2M (Machine To Machine) and CPS (Cyber Physical Systems) [5], [6].

Support of CPS for lining between the physical environment and the virtual environment by putting together sensing, computing, actuating, communicating and interfacing with M2M systems where permitting WSN for decisions making by limiting human interference by weighting on to communicate between machines along with applications by making the actions to be appropriate [5], [6].

Process automation, telemedicine, intelligent transportation, home automation, factory monitoring, energy conservation, target tracking, habitat monitoring, environmental monitoring, etc [1], [7] are WSN. Monitoring of physical processes in the sensor networks can be derived by the traffic patterns. The interest lies in the applications of different sensory data and by creating different requirements in the terms of reliability and QoS (Quality of Service). Additionally, the applications depend on, the delivery of data towards the traffic which is in upstream referred as event-driven applications, continuous applications, mission critical applications, query-driven applications, hybrid applications. These applications are as following.

Event-based: under this section, when network load is lighter it becomes active in reply to detected event. According to the application, the event data that is generated might be small, medium and large. For example, the battlefield observation, every sensor node keeps sensing its surrounding area continuously. On detection of an event for example an entry of tank, movement of human, at every event sensed sensor node sends the sample data collected to the base station outcome of which can lead to congestion [8].

Happening of any sort of event and the information generated leads to congestion, for application reliability it is important. Different combinations while measuring the density of traffic is derived from event-based applications while performing. There are few applications that generate a lightly occasional traffic which are received from small monitoring areas, while there are few others that generate huge frequent traffic across the sensing area [9].

Continuous sensing (Mission Critical): some applications which are critical those require continuous sensing and transmitting by acquiring real time data values, e.g., nuclear power plants monitoring, fire and gas monitoring. Due to excess load the network resists for continuous transmissions, to have an option with periodic sensing and transmission it should be with sufficient periodicity and by satisfying the requirement of the applications.

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Query-driven: applications which are mentioned in this category are the ones where the sensing nodes are triggered when there is an occurrence of the event which is detected and transmitted towards base station, for query-driven applications until and unless the sink raises the queries the sensor nodes do not reply.

Hybrid: applications of this group are common applications. The applications usually transmit the data in bulk which are generated in addition to the continuously sensed data. In case of structural health monitoring where each sensor measures vibration of the structure continuously at a certain rate. With sensors detecting a significant irregularity, generating and transmitting data at a higher rate [10], leads to congestion.

The occurrence of congestion is when the load of data traffic exceeds the capacity that is available at the node level for buffer overflow or link level for interference [11].

Data traffic to be delivered, with properly keeping pace, is delayed by reducing and time-varying channel quality, multi-hop forwarding requirement [12], making severely of the congestion problem. With fluctuating traffic load, a high scale of unfairness at remote sensor nodes is observed, along with the earlier problems.

Objective of the Study:

These conditions of congestion cause wastage of sensor nodes' energy [13], [14], and degrading the event detection reliability which leads to catastrophic [15].

Many papers that are dealing with the issues of transport layer that have been published earlier, referring to transport protocols [8]–[10], along with comparative studies [16], [17], design of cross-layer including transport layer [18], [19].

There is no standard transport layer protocol that exists for WSN regardless of many efforts that were conducted by the IETF [5], [20]–[22] for making known of different layers protocols where the situation of 6LoWPAN can be suitable for the environment of WSN.

Here some authors have presented their surveys for transport layer protocols and congestion control based protocols in [3], [11], [23]–[25], none of these surveys could provide a deep and complete classification, neither could cover protocols that come from major group.

Research Methodology:

This paper assesses several techniques which exist and are used for detection of, control of congestion. The remaining part of the paper follows Section II deals with literature review of congestion control example with discussion on the strategies. Section III comes up with the simulation and results. Section IV concludes the paper with some future scope.

Literature Review

It is important that the flow type directs the real congestion control keeping aside the application type. Several flow types which includes single packet, little packets, numerous packets, requiring a lighter control, marginal level control, rigid control, respectively. Numerous sensor nodes transmit information, data will flow and pass through intermediate nodes. Numerous sources increase the source of congestion but improve reliability. For example, the tree architectures, where the intermediate node has chances to undergo from congestion ultimately causing data packet loss, which depletes network performance, throughput and leading to energy deficiency.

The difficult raises while predicting the intersection points with respect to network dynamics where addition of sensor nodes, removal of sensors nodes, change in reporting rate, inconsistency in quality of radio channel over the time, here the transformation takes place from a non congested region of the network to the congested region of the network [12]. The junction will become a hotspot and happening of congestion referring to buffer overflow and contention referring to links interference. In view of the above mentioned grounds, a congestion control algorithm for data packet transmission and data delivery is much needed.

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Contention-based Congestion control: numerous sensor nodes present within the range of each other trying to transmit concurrently, at this instance losses happen due to the interference and causing packet loss. The throughput at all the sensor nodes in the area that is monitored is reduced [26]. The generation of data packet is small there is simultaneous transmission developing into independent of the rate of transfer. Depending on the exact time of generation of the data packet, explicit local synchronization between neighbors might reduce such type of loss [27], but the problem is elimination is not possible as the non-neighboring sensor nodes it can also be referred as hidden nodes can obstruct. The occurrence of contention might be possible between various flows in the area that is alike, and between unlike data packets of the similar flow, mainly for highly denser networks. Therefore, the capacity of nodes channel becomes time-variant.

Buffer-based Congestion control: every sensor node present uses a buffer that is available for the data packets that are waiting with some information to be transmitted. When there is buffer overflow in turn causing congestion and data packets loss. As it is because of reporting rate that is high that varies in time due to conditions raised for dynamic channel. The nature of WSNs are that they are many – to – one which is the main reason for causing congestion in additionally with the other reasons that are shared with general wireless sensor networks.

In this paper, the interdependency level of the congestion in wireless sensor networks is proposed that when using huge buffer sizes, there is a severe increase of network damaging the event reliability, because of limited capacity of the shared wireless sensor medium. Reducing the buffer size, improvement in event reliability up to some extent there is achievement. With the values of lesser buffer size, buffer which is excess leads to losing of many number of data packets ultimately resulting in the contention of lower channel and lesser end-to-end values of packet latency comparing to the values of higher buffer sizes. This result is reverse with respect to the conventional thought that when storage is limited it always leads to the degradation of the performance. This is beneficial for the real time applications. The study reveals maximum retransmission limit effect [28].

Sensible raise in the limit which is having a noteworthy difference with re-transmission values that are low, there is no positive impact when excess of re-transmission is there and no reliability of the overall network.

Congestion control is discussed in three steps starting with detection, after detection notification to the node that is directly concerned, for appropriate control to be taken. The following subsections that are mentioned below discuss the details.

Congestion Detection

In literature review, several congestion detection mechanisms were proposed, used and tested in the past [8]–[10], [12], [15]–[20]. Packet loss, packet service time, queue length, ratio of packet service time over packet inter-arrival time, delay are few identified. Quite a few cases, single parameter cannot indicate or decide congestion exactly.

Packet loss: Measurement can be done at sender side if ACKs - Acknowledgements are used; by this suggestion for reliability to be made certain with protocol [29]. Receiver end measurement can be done with sequence numbering. Moreover, CTS (Clear To Send) loss of data packet can be used as congestion indication [30].

While for instance when not overhearing the parent is forwarding from the upstream link, the child node at the link at downstream, it can be useful as packet loss indication [27]. With availability of time for repairing the losses provided reliability is ensured this can be used as an indication for congestion [31]. In some protocols the loss ratio is also used [32].

Queue length: each sensor node contains a buffer; the length can provide good indication for congestion. In [12], [33] - [36] a set threshold value is used for congestion and is indicated the moment buffer length exceeds the threshold value [32]. The difference is used which are in between the buffer that is remaining over the rate of traffic which is used as congestion notification [37], [38]. Excess rate can be signified by traffic rate, which

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clearly speaks out that difference between output rates, sum of source, forward rates. Buffer length is difference of input time and output time, similar to input rate and output rate [40], [39]. The buffer length and capacity of the sensor node are used collectively [37], [40].

With the appearance of number of non-empty queues Congestion level can be indicated [41]. With the occurrence of congestion, number is greater than 0. This number gradually increases with load of the network. If retransmissions are pertained at link layer, the contention of the link reflects through the length of the buffer[42].

Queue length and Channel load: When there is an increase in the collision of data packets, with more than a few failed MAC (Medium Access Control) retransmissions, the data packets are removed.

Therefore, when there is decrease in occupancy of the buffer due to these types of drops this may indicate the non presence of congestion this is only when the state of buffer is used for congestion detection.

Accurate congestion detection for hybrid approach is much required by using the queue length and the channel loading as an indication of congestion [8], [9], [43], [44], [45]. The busyness of the channel ratio or load of the channel is the ratio of the time interval when noticeable channel busyness either transmission is successful or there is collision with respect to the total time.

In this paper,"A Fairness-Aware Congestion Control Scheme in Wireless Sensor Networks," authors proposed that by using the ratio of the channel with busyness, channel load uniformly, although applied to division of nodes, and parallel to another set of nodes for queue length [8]. When a data packet it received and needs to forward the node activates channel monitoring.

Thus, there is no overhead available for measuring channel loading [9]. Here in this paper, "DST: delay sensitive transport in wireless sensor networks," author proposed use of delay at sensor node along with length of buffer for congestion indication. Mainly depending on the channel load and used rate [54].

Channel busyness ratio and throughput measurement:In this paper"A link adaptive transport protocol for multimedia streaming applications in multi hop wireless networks," authors proposed the usage of throughput in addition to channel busyness for taking into account in multi-hop environment the hidden nodes effects of problem. The throughput that is measuring the number of transmissions that is successful.

Packet service time: In this paper"Congestion control and fairness for many-to-one routing in sensor networks,"the authors proposed that the period between arrival of packet at the MAC layer and transmission that is successful is nothing but the opposite of packet service rate. It cover ups the data packet waiting, collision decision, and data packet transmission time at the MAC layer [10].

There is a change in value with regard to the length of the queue and load of the channel, just one more measure of the above mentioned. Here one hop node delay is represented [46]. The is calculation for end-to-end delay is done in a similar way [47]. There might be wrong usage of service time for the traffic that is incoming when it is less than or equal to rather than it is outgoing through the channel that is overloaded [48].

Packet service time and queue length: In this paper"Congestion control and fairness for many – to – one routing in sensor networks,"the authors proposed that the service time is used for continuously adjusting the rate at which the data packets are sent by the children nodes [10].

Scheduler which is in between the network and MAC layer the data packets are provided from network queues to the MAC layer mentioned as the ratio of packet service time over packet inter-arrival time and can also be referred as scheduling time. The scheduling time that measures the number of data packets which are scheduled as per time unit.This ratio is indicated at both node level and link level congestion [15].

Ratio of rates in the place of times is used authors have named it as packet service ratio [49], [50], [51]. In this paper"Congestion control and fairness in wireless sensor networks,"the author proposed the difference between service rates and scheduling rates which is used in its place of the ratio [52]. In this paper"SenTCP: A Hop-by-

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Hop Congestion Control Protocol for Wireless Sensor Networks,"the author proposed that additionally the model ratio, here the length of the buffer is also used for detecting congestion [53].

Delay: The measurement of time that is necessary since the generation of data packet, at the sender side, until it successfully gets received at the next hop receiver [46], [54], or at end point receiver [47] the final destination. In this paper,"ATP: A Reliable Transport Protocol for Ad Hoc Networks,"the authors proposed that calculation is a fraction of the delay [30] which can also be said as queuing delay. By using delay there might be possibility in misleading for measuring congestion. By taking into account delay can be caused by the latency where the usage of duty-cycling at the MAC layer [56].

Congestion Notification

With detection in congestion, the information should be circulated allowing them to take appropriate decision. The information could be small may be a single bit possibly as congestion notification bit [12], [33], [27], [29] as new data rate information [47], there are some other values that are helping on the new rate calculation [10], [15], [53], [57] or at actual congestion level [53], [59], [61], [38].

The information about congestion can be transmitted using data packets header which is implicit notification [10], [12], [15], [33], [43], [59]–[61] otherwise separately as control messages which is explicit notification [8], [9], [34], [36], [44], [47].

Congestion Control

In few applications, there will be no improvement in the throughput while using the similar congestion control scheme at all sensor nodes.

For event-based applications where limited messages per event are transmitted, congestion control by traffic regulation is not applicable at the sources. In such type of cases phase shifting might be appropriate and useful [27]. An intermediate node has to be used for regulating the rate to forward the data packets from the event recorded to the sink station when a blockage is there, this occurrence should be at intermediate nodes. When there is reporting of multiple events (e.g. firebreak, battlefield), congestion control is extended towards rate control at the source nodes. Two important features of congestion are control and fairness [62]. By ensuring all data sources are having equal access to the network bandwidth by calculating its capability is fairness.

Events that are having different priorities need to be reported at different rates which are monitoring and control applications in WSN. It is purely subjected to the fairness of magnitude not with the fairness of equality.

There is one scheme known as token bucket scheme this scheme is a scheme where each sensor node transmits data packets provided it is having a token [12], [62]. Usage of rate partitioning is exactly for equal and magnitude division [8], [10], [24], [34], [53], [27] as well as scheduling is also related to the rate partitioning [63], [64], [42], [32], [49]. Usage of varied metrics could be for defining priority, depending on need of application, e.g., event, node, region, or time [65].

The definition of priority is at the node level and mainly on the vitality of the data [15], [59], [47]. In addition, the data packets that are being getting routed at the intermediate nodes are also being prioritized over the source packets. The definition of the priority is purely at the event level [49], [61], [37], [50], [51], [65]. Same sensor node provides, more than a few sensed events with different priorities. In this paper,"RAP:A Real-Time Communication Architecture for Large-Scale Wireless Sensor Networks," authors proposed for query based and event based applications, by prioritizing the packets from origination where they get generated from remote sensor nodes from the sink stations over the sources mentioned that are closed, using packet Velocity Monotonic Scheduling (VMS) [66]. Deciding the order for forwarding the data packets it should be in according with

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distance and end-to-end deadline. The ratio is the distance to the destination over the deadline value is the priority. Queues that are prioritized are used by RAP at each sensor node.

The data packets that are received from different prioritized senders might interfere on the same radio channel, prioritized MAC is applied by RAP for avoiding collisions between diverse senders. However, no rate control is presented by RAP. There is a requirement of localization, which comes at additional overhead. In this paper, “DST: delay sensitive transport in wireless sensor networks”, author proposes that it uses the deadline of remaining time as the priority packet [54]. In this paper, “Bandwidth Management in Wireless Sensor Networks,” author proposed that, data packet gets scheduling with higher priority with a decreasing value. and system rules are used for mapping the data type which is for a the rate of transmission and the traffic class where usage of priority and location is for scheduling the phenomena [67].

The end task of the sink is to detect the congestion this is end-to-end congestion control protocols [9], [29], [33], [57]. The congestion indication might be received by the sink and applies an exact rate adjustment for each source node to control [34], [54].

Research gaps:

Having long latency and one Round-Trip-Time (RTT) is much required to detect congestion in end-to-end control. The importance of transient condition and feedback latency during congestion, the notification received might be much later than the congestion phase. Here solution offered may be improper for WSN viewing transient congestion [10]. For immediately reaction to the congestion issue at the intermediate node hop-by-hop back-pressure protocols is appropriate [8]–[10], [12], [15], [43], [46], more control is required at these nodes.

Detection of congestion upon the strategy of the application is traffic control by using throttling technique at the sensor node rates, and resource controlling by utilizing the idle resources furthermore both are discussed below:

Traffic Control:

With Congestion Notification (CN) the regulation or change in rate for transmitting the data packets can be assured in diversified ways. Additive Increase Multiplicative Decrease (AIMD) is a scheme usually applied mainly when a single CN bit is used [9], [27], [42]. The packet transmitting is temporarily halted to permit the clearance of congested nodes from their queues [12], [29].

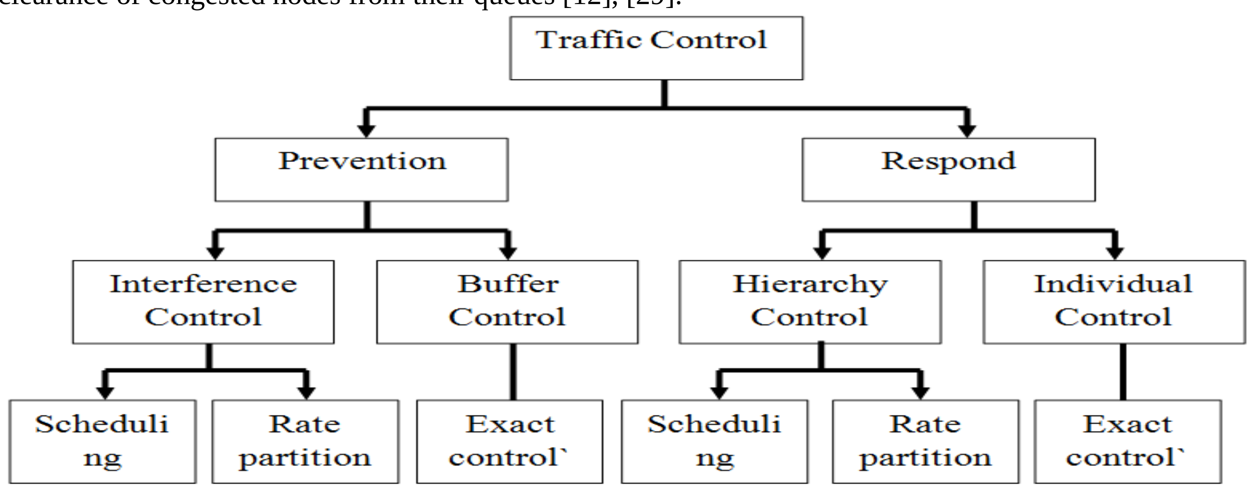

Fig. 01: Traffic control module

There is no representing of event reporting sensor nodes number, the factor for rate change in AIMD schemes is while calculating the increment/ decrement, leading to incorrect values [62]. If there is availability of detailed

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congestion information, there can be implementation of exact and accurate adjustment rate [8], [10], [15], [34]. Sink-based or in-network based solutions are used for adjusting the reporting rates. In some applications to stop propagating congestion packets are dropped [8], [68], though, congestion notification is not used, causing sources to misuse the resources by continuous submission of traffic and not achieving in reaching the final destination.

The execution of traffic control can be in prevention or method of responding, which is based on interference or controlling buffer overflow. Interference can be avoided by avoiding collisions through scheduling the transmissions [32], [69], or by rate partitioning preventing in exceeding the interfering nodes capacity [40], [42], [70]. The schemes those are available by limiting the sending to avoid the buffer overflowing [71], [72].

Interference and buffer overflow can be alleviated by using reacting-based traffic control. The alleviation is based hierarchy rate control, or individual control, purely to adjust the rate of the concerned node. The hierarchy – based rate control that is properly organized is applied using a rate-based scheduling [63], [65] or using an weighted or equal rate partitioning, by not using any scheduling [8], [10], [12], [15], [27], [34], [37], [38], [59], [60], [47]. While applying traffic control individually, certainly the exact rate of control [31], [40], [57], or the common control [9], [29], [53], [68] is employed. The traffic control module is shown in the below Figure 01.

Resource Control:

The resource techniques could be when application's requirements cannot be met by using rate control methods, it could violate the requirement of application when reducing source traffic during any mission critical situation. By increasing the capacity, more resources made accessible in order to handle the high resulted traffic [44]. When congestion is occurred, alternative routes are used with routing methods by sending the data packets in and around the congested areas [35], [46]. When the offered traffic between congested regions and uncongested regions the routes available upon congestion load balancing has been utilized [44], [50] precautionary load balancing technique along with scheduling of an interference avoiding-based is used [44], [73].

Resource control can be claimed by using clustering and multiple radios [43]. The cluster-heads comprises of two radios; one is for exchanging packets with member nodes which are available at shorter distance, where another one is utilized for communicating with other cluster-heads available in the network and the sink node which are there at a longer distance. There are some protocols that are adjusted in transmitting power to send over longer distance [74]. Some other protocols promise resource control by adjusting duty cycling parameters, for having a stability between energy efficiency in case of low traffic and traffic fidelity [64]. Figure 2 represents resource control module.

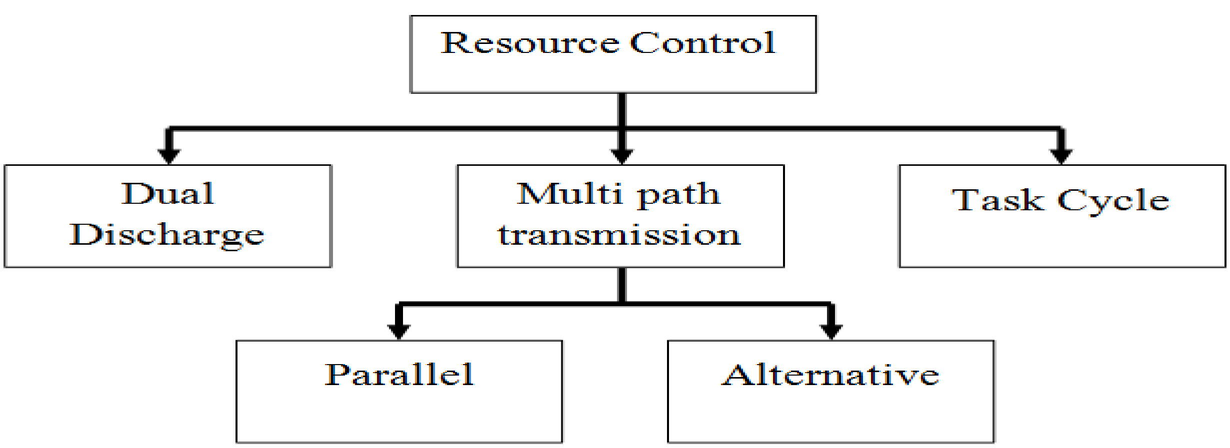

Fig. 2: Resource control module

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A comparative study has being carried where both traffic and resource control protocols for an event-based network are presented.

The parameters that are there for comparison are energy consumption, lifetime and healthiness of the network number of data packets that were dropped. Results disclose that the algorithms that are distributed in nature are promising a high network lifetime equally maintaining the stability of the data rate, along with standardization of data rate here the algorithms presented consume lesser power per node with minimal packet drops.

With dispersal of the available traffic which is through different paths by reduction of congestion, increasing the contention due to cross over of multiple routing paths toward the sinks. The merging of traffic along with the resources that are available which vitally is minimizing the congestion and contention and by improving energy efficiency and decreasing data packets drop.

Through the literature review, the performance of the protocols is highlighted using simulations, experimentation.The following section gives more details on these parameters.

Simulation results and analysis

In this section, the performance of the proposed and other traditional methods LEACH, PRRP is assessed using MATLAB/Simulink respectively. During simulation, the control parameters of traditional algorithms over proposed are well examined to obtain good performance. With start of a congestion control protocol, evaluation must be in terms for improving its energy efficiency by utilizing the alive nodes and improving the energy efficiency in the presence of traffic that is overloaded by managing the traffic with available resources. In the literature review, measures to calculate the wireless sensor networks performance under the influence of congestion are numerous. The metrics that are used in common by the protocol that is proposed are: energy efficiency and data packet latency.

The proposed system includes two modules:

A) Central Base Station

B) Cluster Head

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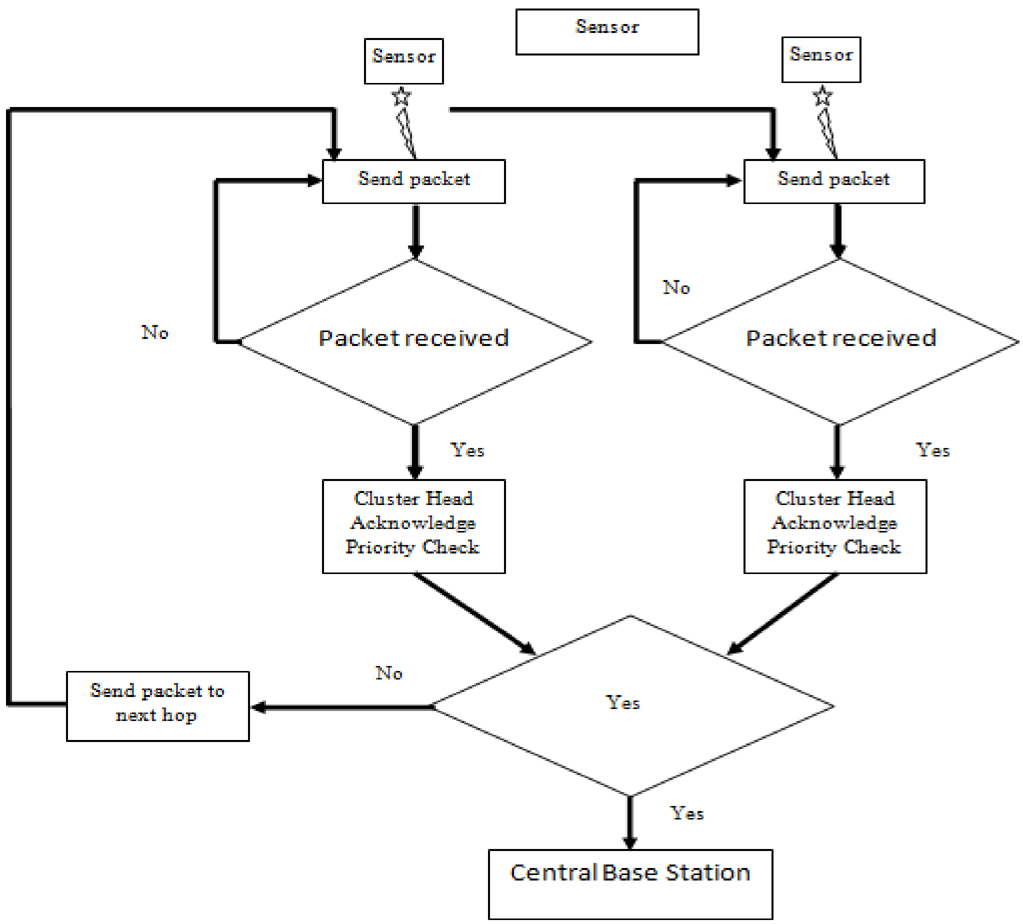

Fig. 3: Flowchart WSN

Central Base Station

Many sensor nodes are deployed in the sensing area the moment an event is detected each sensor node assist each other by transmitting the sensed data packets central base station. To meet the demands of the central base station the desired transmission rate is done for prioritized data packet. In a network, the sensor nodes sense the event and then generate periodic events to impulsive bursts of event messages. The central base station receives the prioritized data packets from cluster heads in the network for further course of action.

Cluster Head

The Cluster Head is responsible for collecting all sensed event data and in the cluster head it gets prioritized before transmitting the data packet to the central base station.

Activity Model for Congestion Control

The proposed model in this paper where group of systems work together. The moment event is sensed the sensor node transmits the data to cluster head and goes to idle state after receiving the acknowledgement from cluster head the cluster head collets all the data and prioritizes the data and transmits to central base station for further course of action. These systems have a shared state, operate concurrently and can fail independently without affecting the whole system.

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This part of the work deals with the results of implementation of the algorithms that are proposed. The comparison of proposed with LEACH, PRRP protocols for analysis and the results display with significant improvement in the performance with reference to the energy consumed and no of alive nodes in the network. All the existing algorithms LEACH, and PRRP and proposed algorithm are implemented in MATLAB.

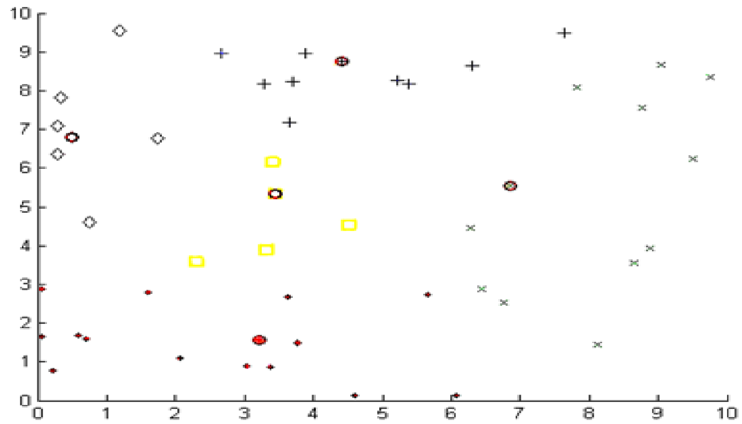

Fig. 4: Clustering output
Colored regions show different groups formed by clustering process. Red circles are the cluster Instruments.

Table 1:: Energy consumed

Number of Iterations	LEACH Basic	PRRP	Proposed
10	103870	17304	16603
20	132527	17654	13371
30	144839	35719	30902
40	150519	53145	45939
50	155161	67631	56977

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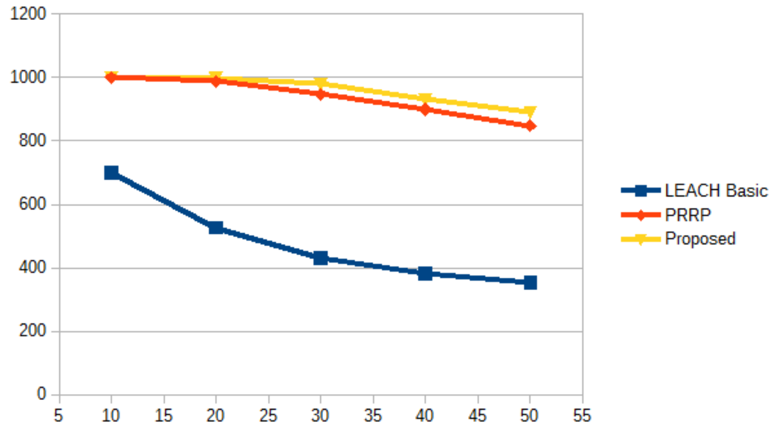

Fig. 5: Number of alive nodes with respect to iterations

Conclusion

WSNs get exposed towards harsh environmental conditions like contention over links interference and congestion over buffer overflows impacting in the performance of the overall system which is the basic nature of WSN. Transport protocols plays key role in the improvement of network reliability and throughput.

In this paper, the protocols were analysed in terms of correctness to detect, notify and control congestion.

Study on congestion control protocols shows the application and flow types which are described by the many-to-one nature of communications that influence and guide the control that is applied to the traffic. With types of application, different mechanisms to handle the congestion are used, traffic control by controlling the rate of sensor node or resource control by utilizing resources that are idle are used to meet up the application requirements.

In view of the type of flow, while applying similar type techniques for congestion control at all sensor nodes could be incorrect decision for improving throughput. With huge packet event-based applications, the rate control is extended to the sources. With periodic and continuous applications, reacting on the congestion it can lead to degradation of performance due to the raise frequency of packets sending. The strategy followed for controlling congestion is via transmission scheduling finally reducing the collisions and rate partitioning by preventing it beyond the interfering nodes capacity which seems to be hopeful solution offered. The main drawback of wireless sensor networks is that they are extremely energy constrained, the rates of transmitting data packets of the sources can only limit congestion but ultimately might result reduce the network lifetime and effecting throughput.

Future scope can be data packet to be transmitted in a single hop for even more energy efficiency minimizing data packet arrival.

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