A Review on Energy Efficient Data Aggregation Routing Algorithm in WSN

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Abstract*—Wireless sensor networks (WSNs) have significant potential in many application domains such as agriculture, health, environmental monitoring, battlefield surveillance, and wild fire detection. They, however cannot be used in large geographical areas due to the short communication range of sensors. In addition, sensor networks have been the lack of available network management and control tools, such as for determining the degree of data aggregation prior to transforming it into useful information. Designing different network management tools such for routing, localization, and data aggregation are, therefore, required in large scale WSNs. Only a few of the existing data aggregation methods have been developed for a large scale WSN. In this paper, review of some literature and techniques for data aggregation has been done in large scale WSN.

***Keywords*— WSN, Data Aggregation, Data Clustering**

I. INTRODUCTION

Wireless sensor networks (WSN) square measure spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their knowledge through the network to a main location. The more fashionable networks square measure bi-directional, also sanctionative management of sensing element activity[1]. The development of wireless sensor networks was driven by military applications like battleground surveillance; nowadays such networks square measure utilized in several industrial and client applications, such as process monitoring and management, machine health monitoring, and so on. With advancement in technology, sensor network composed of tiny and value effective sensing devices equipped with wireless radio transceiver for surroundings observance became possible. The key advantage of using these tiny devices to monitor the surroundings is that it doesn't need infrastructure like electrical mains for power offer and wired lines for web connections to gather knowledge, nor need human interaction whereas deploying[2]. These sensor nodes will monitor the surroundings by collection info from their surroundings, and work cooperatively to send the knowledge to a base station, or sink, for analysis.

Clustering in WSN: The method of grouping the sensing element rnodes in a very densely deployed large-scale sensing element network is understood as clump.

Data Aggregation: The intelligent manner to mix and compress {the knowledge|the info|the information} happiness to one cluster is understood as data aggregation in cluster based mostly surroundings.

Fizzy Fingerprint: To win the privacy goal, data owner generates a special sort of digests that we have a tendency to decision fuzzy fingerprints. Intuitively, the purpose of fuzzy finger prints is to cover actuality sensitive data in a very crowd. It denies the DLD (Data Leakage Detection) to access the actual price. In finger-printing, each shingle is treated as a polynomial q(x). Each constant of q(x), i.e., ci (0 < i < k), is one bit in the shingle. q(x) is mod by a selected irreducible polynomial p(x).

II. RELATED WORK

Scalable and Unified Management And management (SUMAC)is a giant scale Wireless detector Network (WSN) design that uses a medium vary mesh network as a bridge between geographically spread sensors clusters and net and provides users full knowledge possession and transmission of information among their own network. In SUMAC a high level setting (by users) that triggers a background process to set a default knowledge aggregation level and additionally to see rules and conditions to switch the default aggregation level is projected. For instance, default aggregation level can be set to average most sensors knowledge in an exceedingly single cluster. When AN event of interest happens detectors will mechanically slump the aggregation level to modify node to send raw sensor knowledge. SUMAC aggregation contains energy cost for path generation. Nodes share their energy consumptions, delay and buffer size with immediate neighbors[3]. This method is coupled with a visible interface to regulate the aggregation (static or dynamic) supported the assigned aggregation rules like hop count, resolution, sensors value, sensor tags, and/or GPS coordinate. In static aggregation, user selects nodes based on GPS coordinate, labelor ID and sets the selected node to combination or to forward their knowledge. Server statically sets the node aggregation level. In dynamic aggregation, aggregation level changes based on the events of interest occur. For example, if the current aggregation level is 2 ANd any node at level three detects an interest the aggregation level slides right down to four in order that knowledge at level three aren't mass. Users set the maximum/minimum threshold for sensed values such as temperature or lightweight. If the temperature exceeds a defined threshold, for example, the sensor nodes mechanically

stop aggregating the packets and additionally instruct neighbors to do therefore. In Directed Diffusion (DD), interest messages flow from the sink to the source mistreatment high-priced flooding (Interest propagation), then data messages flow from the supply to the sink at the start on multiple ways towards the sink (data propagation). As time progresses, the sink reinforces only a on knowledge quality) and variety of ways (depending thus the total variety of nodes in transmission is reduced. To alleviate expensive flooding for interest propagation in doctorate, clustering approaches area unit used, where interest messages area unit solely sent to cluster head (CH) and gateways. Chatterjea S. and Havinga P.propose Clustered Diffusion with Dynamic Data Aggregation (CLUDDA) that improves energy and network potency by integration cluster into Directed Diffusion (DD) and permitting nodes to collect and combination knowledge by as well as entire question definition with interest message[4]. The format of interest packet is significant in interest transformation, dynamic aggregation, and point formation. It also permits nodes to deal with unacquainted with queries. Interest packets contain not only the question however additionally the entire definition of the question. They allow nodes to interrupt down {a question|a question |a question} into its elementary parts and gather knowledge for these individual parts and method them mistreatment the query definitions, which in flip ends up in knowledge reduction. Ying Liang ANd Hongwei Gao propose an best cluster algorithmic rule based mostly on Target Recognition (OCABTR) that collects knowledge sporadically and thus, reduces transmission overload and energy consumptions of sensor nodes. When clusters area unit fashioned, sensors reside in different clusters would possibly represent the samegeo graphical space in terms of events to sense that will increase knowledge redundancy. It is also troublesome to combination similar knowledge in several clusters[5]. Hence, OCABTR uses genetic algorithm to partition nearby/adjacent nodes (to kind cluster) that sense similar events into a cluster that improves the rate of information aggregation. Data aggregation {based|based mostly|primarily based mostly} on dynamic routing (DABDR) is another cluster based aggregation routing protocol. DABDR creates tree structure where oldsters wait a bound time for kid knowledge. Data packets have a depth field that
ensures the direction of knowledge flowing from a sampling node to sink and a queue length field that produces knowledge packets flow to nodes with an extended knowledge aggregation queue in order that data packets area unit focused a lot of to create the aggregation a lot of energy economical. Tiny Aggregation Approach (TAG) is additionally a dynamic knowledge aggregation technique wherever, each epoch or time length is divided into timeslots. Different levels of tree area unit associated with completely different timeslots and nodes of every level will solely send knowledge in their specific timeslots. Hence, synchronization is achieved for sending and receiving knowledge that reduces energy consumptions. However, in this approach if ANode doesn't receive info} for {a kid|a toddler|a baby} at its specified timeslot the unused information of the entire sub-tree stock-still at that child can result an final inaccurate data[6]. Bidirectional knowledge Aggregation (BDA) adds a label to every question additionally to the fundamental regulation of TAG.

III. DATA AGGREGATION APPROCHES IN WSN

Data aggregation process is performed by specific routing protocol. Our aim is aggregating data to minimize the energy consumption. So sensor nodes should route packets based on the data packet content and choose the next hop in order to promote in network aggregation. Basically routing protocol is divided by the network structure, that's why routing protocols is based on the considered approaches[7].

Tree-Based Approach: The tree based approach is defining aggregation from constructing an aggregation tree. The form of tree is minimum spanning tree, sink node consider as a root and source node consider as a leaves. Information flowing of data start from leaves node up to root means sink(base station).Disadvantage of this approach, as we know like wireless sensor network are not free from failure .in case of data packet loss at any level of tree, the data will be lost not only for single level but for whole related sub tree as well. This approach is suitable for designing optimal aggregation techniques'.

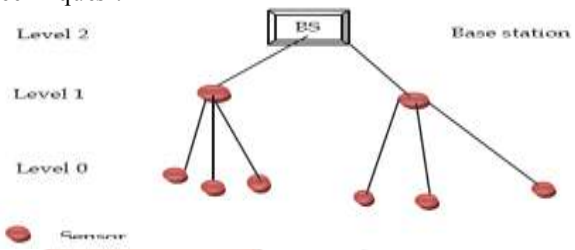

Fig 1: Tree based data aggregation

Cluster-Based Approach: In energy-constrained sensor networks of large size, it is inefficient for sensors to transmit the data directly to the sink In such scenarios, Cluster based approach is hierarchical approach. In cluster-based approach, whole network is divided in to several clusters. Each cluster has a cluster-head which is selected among cluster members. Cluster-heads do the role of aggregator which aggregate data received from cluster members locally and then transmit the result to base station (sink)[8]. Recently, several cluster-based network organization and data-aggregation protocols have been proposed for the wireless sensor network. Figure shows a cluster-based sensor network organization.

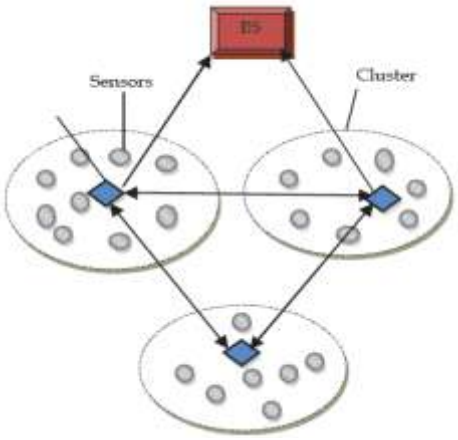

Fig 2: Cluster based data aggregation

Multi-path Approach: The drawback of tree based approach is the limited robustness of the system. To overcome this drawback, a new approach was proposed by many researchers .in which sending partially aggregated data to single parent node in aggregation tree, a node could send data over multiple paths. In which each and every node can send data packets to its possibly multiple neighbors[9]. Hence data packet flow from source node to the sink node along multiple path, lot of intermediate node between source node to sink node so aggregation done in every intermediate node. Using this approach we will make the system robust but some extra overhead.

Hybrid Approach: Hybrid approach followed between tree, cluster based and multipath scheme. In which the data aggregation structure can adjusted according to specific network situation and to some performance statistics.

IV. LITERATURE SURVEY

Gurbinder Singh Brar et al. [17] propose directional transmission-based energy aware routing protocol named PDORP. The proposed protocol PDORP has the characteristics of each power economical gathering device data system and DSR routing protocols. In addition, hybridization of genetic algorithmic rule and microorganism hunt improvement is applied to projected routing protocol to establish energy economical best methods. The performance analysis, comparison through a hybridization approach of the projected routing protocol, gives higher result comprising less bit error rate, less delay, less energy consumption, and better output, which leads to higher QoS and prolong the period of the network. Moreover, the computation model is adopted to evaluate and compare the performance of the each routing protocols exploitation soft computing techniques.

Jin Qi et al. [18] proposed a hybrid security and compressive sensing-based theme for multimedia system device information gathering is bestowed. It has light security mechanism and so decreases the complexness and energy consumption of system. The use of cryptographic techniques like secret writing and hashing mostly will increase the energy consumption of sensors, which aggravates the original crucial energy constraint downside of wireless device networks (WSNs). To reduce the burden of sensors, compression can be utilised. Since the traditional chaos-based schemes aren't directly applicable for WSNs, we gift a hybrid security answer. The hybrid security consists of 8-bit integer chaotic block secret writing and a chaos-based message authentication codes.

Muhammad Usman et al. [19] proposed a class-conscious D2D communication design wherever a centralized software-defined network (SDN) controller communicates with the cloud head to scale back the quantity of requested long-run evolution (LTE) communication links, thereby improving energy consumption. The concept of native and central controller permits our design to work just in case of infrastructure harm and hotspot traffic scenario. The architecture helps to maintain the communication between disaster victims and initial responders by putting in multi-hop routing path with the support of the SDN controller.

Li Sun et al. [20] proposed a fountain-coding motor-assisted relaying theme to deal with challenge to ensure the secrecy of cooperative transmissions underneath eavesdropping attacks. Using projected approach all the supply packets area unit initial encoded with fountain codes (FCs) and then transmitted over the channels. Based on the essential characteristic of FC transmissions, a sufficient variety of coded packets have to be with success received to recover the initial information. Therefore, transmission secrecy is guaranteed if the legitimate receiver will accumulate the needed variety of FC packets before the auditor will. To satisfy this condition, a cooperative jamming methodology is utilised to worsen the received signal quality at the auditor. By applying the constellation rotation approach, the information-bearing signal and the electronic countermeasures signal area unit designed rigorously to cut back the negative result of the jamming procedure on the legitimate receiver.

Jun Wu et al. [21] proposed a hierarchical framework based mostly on probability discovery and usage management (UCON) technologies to boost the protection of WSNs whereas still taking the low-complexity and high security necessities of WSNs under consideration. The features of continuous call and dynamic attributes in UCON will address in progress attacks exploitation advanced persistent threat detection. In addition, technique used a dynamic adaptive probability discovery mechanism to find unknown attacks. To design and implement a system exploitation the mechanism represented higher than, a unified framework is proposed in that low-level attack detection with easy rules is performed in sensors, and high-level attack detection with complex rules is performed in sinks and at the base station.

Zhi Zhao et al. [22] investigated the green distributed nonlinear state estimation downside in wireless device networks (WSNs), which can be seamlessly integrated with the forthcoming 5G communication system. A distributed signal reconstruction algorithm is projected by using compressive sensing and agreement filter to solve thin signal reconstruction issue in WSNs with energy potency thought of. In particular, the pseudo-measurement (PM) technology is introduced into the cubature Kalman filter (CKF), and a

sparsity constraint is obligatory on the nonlinear estimation by CKF. In order to develop a distributed reconstruction algorithm to fuse the random linear measurements from the nodes in WSNs, the PM embedded CKF is typeulated into the data form, and then the derived information filter is combined with the agreement filter, while the square-root version is more developed to improve the performance and strengthen power saving capability.

Ahmed Al-Riyami et al. [23] proposed a novel theme, called Associate in Nursing adjustive early node compromise detection theme, to facilitate node compromise attack detection in a cluster-based WSN. The scheme is designed to attain a coffee false positive magnitude relation within the presence of assorted levels of message loss ratios. To achieve this feature, two ideas area unit used in the planning. The first is to use cluster-based collective higher cognitive process to find node compromises. The second is to dynamically adjust the rate of notification message transmissions in response to the message ratio within the sender's neighborhood. The performance of the scheme, in terms of false positive ratio, false negative ratio, and transmission overheads, is evaluated using simulation.

Haiping Huang et al. [24] proposed a novel Privacy-Preserving inner product Protocol (PPSPP) for wireless device networks. Based on PPSPP, then propose a Homomorphic-Encryption-based Euclidean Distance Protocol (HEEDP) while not third parties. This protocol can succeed secure distance computation between 2 device nodes. Correctness proofs of PPSPP and HEEDP are provided, followed by security validation and analysis. Performance evaluations via comparisons among similar protocols demonstrate that HEEDP is superior; it is best in terms of both communication and computation on a large vary of information varieties, especially in wireless device networks.

V. PDORP ALGORITHM

PDORP is one of the heuristic optimization methodology and a set topic of swarm intelligence. PDORP is supported replicating the concept of however water drops mix to make rivers and rivers successively mix to hitch the ocean by choosing the shortest path based mostly on altitudes of the land through that they flow[17]. In PDORP, the source (drop generating) positions generate water drops and these water drops square measure interested to satisfy the destination or ocean. Similarly, in WSN data assortment method, the sensor nodes generate the knowledge and this knowledge is interested to achieve the bottom station. Each such sensing element network node has many parts: a radio transceiver with associate external associatetenna or association to an internal antenna, associate electronic circuit for interfacing with the sensors and an energy supply, a microcontroller, usually a battery or associate embedded sort of energy harvest. In river formation stage, the river is created between drop generating positions and ocean exploitation the repetitive method having the functions select−Forward−Position(), move−Drops(), erode−Path(), and add−Sediments()[17]. The iterative method is recurrent till either all drops follow the same path or satisfying the opposite ending conditions like restricted variety of iterations, limited execution time. There is similarity a between PDORP and data assortment processes in WSN. In PDORP, the source (drop generating) positions generate water drops and these water drops square measure interested to satisfy the destination or ocean. Hence, the sensor knowledge act like water drops, the source positions like sensing element nodes, and base station as Sea. In the proposal an approach is outlined for energy potency and reduction in knowledge born within the WSN network. In PDORP algorithm a set is outlined, in which if one node therein set is died out then the full set ought to be replaced[1]. A modification in the PDORP algorithm is created to attain the objectives of the analysis during which associate energy threshold set for every node. In case of the proposed approach with the low energy within the set of network the neighbour nodes of the set will cowl the realm of the died node. The proposed approach is outlined on the basis of hymenopteran Colony improvement exploitation that the rule become a lot of energy economical. In this way the information born attributable to the replacement of the set is also reduced therefore there's a discount within the energy dissipation[17.]

VI. LIMITATION OF PDORP

In WSN, multi-hop routing is an effective mechanism for knowledge assortment. In multi-hop routing, the selection of forward node for relaying knowledge plays a significant role. In the WSN the most important problem is to conserve energy and improve the network period. In this research the higher than outlined drawback are taken care of[17.

The problem of the way to transfer knowledge to the sink as quick as potential whereas maintaining energy potency is difficult. Although there have been varied studies regarding the way to choose associate optimized relay node to attain the minimum delay, to our knowledge, a theoretical study of end-to-end delay and energy efficiency has not until now been performed as a result of these goals square measure connected to a plurality of network parameters[17].

- One of the biggest disadvantages of enormous scale wireless sensor networks lies on the quality of supply involving selective replacement of sensors that have ran out of energy.
- More complex to tack than wired network.
- Gets distracted by various parts like Blue-tooth.
- It does not enable USA to try to to over are often finished a wired system

Using this approach the data dropped and other Quality parameters are also improved like, delay, load and throughput etc as defined in results and discussion.

VI. LIMITATION OF PDORP

In WSN, multi-hop routing is an effective mechanism for data collection. In multi-hop routing, the selection of forward node for relaying data plays a vital role. In the WSN the major problem is to conserve energy and improve the network lifetime. In this research the above defined problem will be taken care of[17.

The problem of how to transfer data to the sink as fast as possible while maintaining energy efficiency is challenging. Although there have been numerous studies concerning how

to select an optimized relay node to achieve the minimum delay, to our knowledge, a theoretical study of end-to-end delay and energy efficiency has not hitherto been performed because these goals are related to a plurality of network parameters[17].

- One of the biggest disadvantages of large scale wireless sensor networks lies on the complexity of logistics involving selective replacement of sensors that have ran out of energy.
- More complex to configure than wired network.
- Gets distracted by various elements like Blue-tooth.
- It does not allow us to do more than can be done with a wired system

I. CONCLUSION

This paper presents wireless sensor network is consist a large number of sensor node. And these nodes are resource constraint. That's why lifetime of the network is limited so the various approaches or protocol has been proposed for increasing the lifetime of the wireless sensor network. The paper discusses, the data aggregation is one of the important technique for enhancing the life time of the network and security issues like data integrity. With the help of integrity we reduce the compromised sensor source nodes or aggregator nodes from significantly altering the final aggregation value.

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