

# A survey of various data communication schemes in Wireless Sensor Networks

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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 we have do a review of some literature and techniques for data aggregation in large scale WSN.

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

## I. INTRODUCTION

With advance in technology, sensor networks composed of small and cost effective sensing devices equipped with wireless radio transceiver for environment monitoring have

become feasible. The key advantage of using these small devices to monitor the environment is that it does not require infrastructure such as electric mains for power supply and wired lines for Internet connections to collect data, nor need human interaction while deploying. These sensor nodes can monitor the environment by collecting information from their surroundings, and work cooperatively to send the data to a base station, or sink, for analysis.

**Clustering in WSN[6]:** The process of grouping the sensor nodes in a densely deployed large-scale sensor network is known as clustering. The intelligent way to combine and compress the data belonging to a single cluster is known as data aggregation in cluster based environment. There are some issues involved with the process of clustering in a wireless sensor network. First issue is, how many clusters should be formed that could optimize some performance parameter. Second could be how many nodes should be taken in to a single cluster. Third important issue is the selection procedure of cluster-head in a cluster. Another issue is that user can put some more powerful

nodes, in terms of energy, in the network which can act as a cluster-head and other simple node work as cluster-member only.

## II. DATA AGGREGATION

This is an address centric approach where each node sends data to a central node via the shortest possible route using a multihop wireless protocol. The sensor nodes simply send the data packets to a leader, which is the powerful node. The leader aggregates the data which can be queried. Each intermediate node has to send the data packets addressed to leader from the child nodes. So a large number of messages have to be transmitted for a query in the best case equal to the sum of external path lengths for each node.

**In-Network Aggregation:** In-network aggregation is the global process of gathering and routing information through a multi-hop network, processing data at intermediate nodes with

the objective of reducing resource consumption (in particular energy), thereby increasing network lifetime. There are two approaches for in-network aggregation: with size reduction and without size reduction. In-network aggregation with size reduction refers to the process of combining & compressing the data packets received by a node from its neighbors in order to reduce the packet length to be transmitted or forwarded towards sink. In-network aggregation without size reduction refers to the process merging data packets received from different neighbors in to a single data packet but without processing the value of data.

**Tree-Based Approach:** In the tree-based approach perform aggregation by constructing an aggregation tree, which could be a minimum spanning tree, rooted at sink and source nodes are considered as leaves. Each node has a parent node to forward its data. Flow of data starts from leaves nodes up to the sink and therein the aggregation done by parent nodes.

**Cluster-Based 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. Clusterheads do the role of aggregator which aggregate data received from

cluster members locally and then transmit the result to sink.

### III. RELATED WORK

Scalable and Unified Management And Control (SUMAC) is a large scale Wireless Sensor Network (WSN) architecture that uses a medium range mesh network as a bridge between geographically dispersed sensors clusters and Internet and provides users full data ownership and transmission of data within their own network. In SUMAC a high level setting (by users) that triggers a background process to set a default data aggregation level and also to determine rules and conditions to modify the default aggregation level is proposed. For instance, default aggregation level can be set to average most sensors data in a single cluster. When an event of interest occurs sensors can automatically slide down the aggregation level to enable node to send raw sensor data. SUMAC aggregation contains energy cost for path generation. Nodes share their energy consumptions, delay and buffer size with immediate neighbors. This method is coupled with a visual interface to control the aggregation (static or dynamic) based on the assigned aggregation rules such as hop count, resolution, sensors value, sensor tags, and/or GPS coordinate. In static aggregation, user selects nodes based on GPS coordinate, label or ID and sets the selected node to aggregate or to forward their data. 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 3 detects an event of interest the aggregation level slides down to 4 so that data at level 3 are not aggregated. Users set the maximum/minimum threshold for sensed values such as temperature or light. If the temperature exceeds a defined threshold, for example, the sensor nodes automatically stop aggregating the packets and also instruct neighbors to do so. In Directed Diffusion (DD) [3, 9], interest messages flow from the sink to the source using expensive flooding (Interest propagation), then data messages flow from the source to the sink initially along multiple paths towards the sink (data propagation). As time progresses, the sink reinforces only a number of paths (depending on data quality) and hence the total number of nodes in transmission is reduced. To alleviate expensive flooding for interest propagation in DD, clustering approaches are used, where interest messages are only 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 efficiency by integrating clustering into Directed Diffusion (DD) and allowing nodes to collect and aggregate data by including entire query definition with interest message. The format of interest packet is significant in interest transformation, dynamic aggregation, and point formation. It also

allows nodes to deal with unfamiliar queries. Interest packets contain not only the query but also the entire definition of the query. They allow nodes to break down a query into its fundamental components and gather data for these individual components and process them using the query definitions, which in turn results in data reduction. Ying Liang and Hongwei Gao propose an Optimal Clustering Algorithm Based on Target Recognition (OCABTR) that collects data periodically and hence, reduces transmission overload and energy consumptions of sensor nodes. When clusters are formed, sensors reside in different clusters might represent the same geographical area in terms of events to sense that increases data redundancy. It is also difficult to aggregate similar data in different clusters. Hence, OCABTR uses genetic algorithm to partition nearby/adjacent nodes (to form cluster) that sense similar events into a cluster that improves the rate of data aggregation. Data aggregation based on dynamic routing (DABDR) is another cluster based aggregation routing protocol. DABDR creates tree structure where parents wait a certain time for child data. Data packets have a depth field that

ensures the direction of data flowing from a sampling node to sink and a queue length field that makes data packets flow to nodes with a long data aggregation queue so that data packets are concentrated more to make the aggregation more energy efficient. Tiny Aggregation Approach (TAG) is also a dynamic data aggregation method where, each epoch or time duration is divided into timeslots. Different levels of tree are associated with different timeslots and nodes of each level can

only send data in their specific timeslots. Hence, synchronization is achieved for sending and receiving data that reduces energy consumptions. However, in this approach if a node does not receive the data for a child at its specified timeslot the unused information of the whole sub-tree rooted at that child will result an ultimate inaccurate data. Bidirectional Data Aggregation (BDA) adds a label to each query in addition to the basic working principle of TAG.

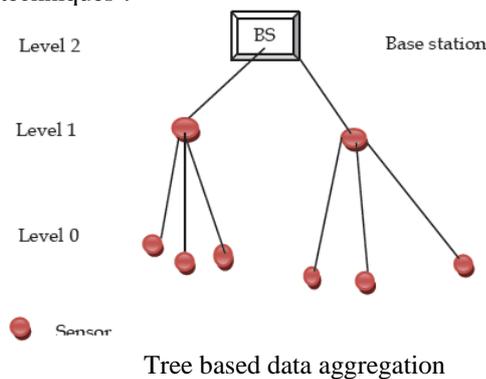
### IV. DATA AGGREGATION APPROACH IN WIRELESS SENSOR NETWORKS

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.

#### **Tree-Based Approach:**

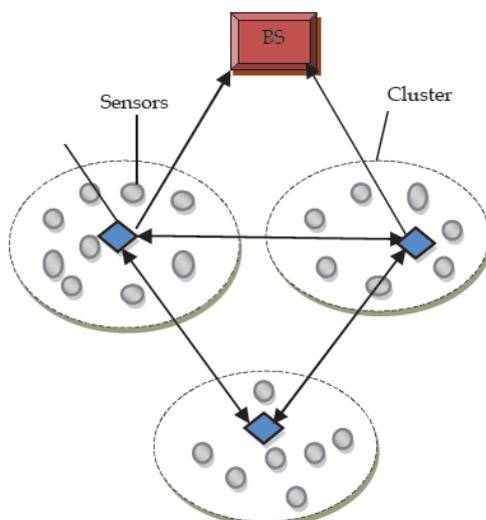
The tree based approach is defining aggregation from constructing an aggregation tree. The form of tree is

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’.



**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). 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.



**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. 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.

**V. CONCLUSION**

In this paper we present 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. In this paper we discuss the data aggregation are one of the important techniques for enhancing the life time of the network. And security issues is 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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