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Survey on Wireless Sensor Networks, Architecture and Protocols for Data Aggregation

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Abstract:- Wireless sensor networks are formed by a collection of sensor nodes which are cooperate with each other and they send the data to the base station. Here, because of sensor nodes have limited power consumption we have to transmit the data within a limited time period. In WSN, nodes may be located far away from the base station, each node may be located far away from each other, and these nodes may have low power. To transmit the data to the base station, we have to write the efficient data optimization techniques which take low power. In this paper we are giving the various techniques of Data aggregation and understating of these techniques & Implementation.

Keywords: Cluster head, Data Aggregation, Fault Tolerance, Simulators, and Wireless Sensor Networks.

1. INTRODUCTION:

A sensor community is defined as being composed of a big variety of nodes with sensing, processing and conversation centers which might be densely deployed both within the phenomenon and very near it. Each of those nodes collects records and its purpose is to route this information returned to a sink. The network may have to possess self-organizing skills because the positions of individual nodes aren't predetermined. Cooperation amongst nodes is the dominant characteristic of this sort of network, in which companies of nodes cooperate to disseminate the data accrued in their region to the user as proven in. Recent advances in micro-electro-mechanical systems (MEMS) era, wireless communications, and digital electronics have made feasible to increase low-value, low-strength, multifunctional sensor nodes that are small in size and communicate freely in quick distances. These tiny sensor nodes, which encompass sensing, facts processing, and speaking components, leverage the idea of sensor networks primarily based on collaborative

effort of a huge range of nodes. Sensor networks represent a substantial development over traditional sensors, which might be deployed inside the following approaches. Sensors can be located some distance from the actual phenomenon, i.e., something known by experience notion. In this method, large sensors that use a few complicated techniques to distinguish the targets from environmental noise are required. Several sensors that perform most effective sensing may be deployed. The positions of the sensors and communications topology are carefully engineered. They transmit time collection of the sensed phenomenon to the principal nodes wherein computations are executed and records are fused. The function of sensor nodes want not be engineered or pre-determined. This permits random deployment in inaccessible terrains or catastrophe relief operations. On the opposite hand, this additionally means that sensor community protocols and algorithms have to own self-organizing skills.

As it file periodic are sundry sensor nodes sprinkled haphazard and the facts fulfilled of unique sensor nodes receives nonetheless in the sink. Then over net the person can view the data quiet per man or woman internet. Another exquisite promote of sensor organizations is the responsive decision of sensor nodes. Sensor nodes are coordinate an on-board slaughterer. Instead of dispatching bareness information to the nodes initiating the uniting, sensor nodes use their processing capabilities to section ally execute plain computations and skip on handiest the wished and little by little handled facts. A sensor node is made up of four basic components a sensing unit, a processing unit, a transceiver unit and a power unit. location finding system, a power generator and a mobilizer. It has two more subunits called sensors and analog to digital converters (ADCs). The analog signals produced by the sensors based on the observed phenomenon are converted to digital signals by the ADC, and then fed into the processing unit. The processing unit, which is generally associated with a small storage unit, manages the procedures. A transceiver unit connect the node to the network. The Entire architecture Called as a node. Next, come to the power unit, Power units have less power. And also other sub units, which are application based units. These networks formed by different types of sensors like seismic, low sampling rate magnetic, thermal, visual, infrared, acoustic, and radar, which will monitor ambdient conditions that include the temperature,

humidity, vehicular movement, lighting condition, pressure, soil makeup, noise level, the presence or absence of certain kinds of objects, ssand size of an object. Sensor nodes can be used for continuous sensing, event detection, even ID, location sending, and local control of actuators. The concept of micro sending and wireless connection of these nodes promises many new application areas. We categorize the application into military, environment, health, home and other commercial areas.

Military, Environment, Health, Home, Other commercial areas.

II. DESIGN ISSUES:

Before design a WSN, we have to consider the various factors which causes the failure of Sensor Networks. Before design WSN, we have to consider the various factors which causes the failure of Sensor Networks. The Sensor networks may fail may be due to the lack of Power Failure, Physical damage or environmental Interference, more number of sensors, cost of sensor nodes, including the subnets, hardware Units, Network Topology, Environment, Power Consumption, Communication and Processing.

III. DATA AGGREGATION:

Data is collected from the sensor in WSN and transmits to the base station for processing. Because of inefficiency of sensors, all sensors may not be transmitted to BS directly. It is good method to transmit the data to the neighborhood sensor by reducing the redundancy data and also the neighbor nodes also send the redundant data. Here, we have to consider one or more thing there will be huge data will be send to the base station from the Several Sensors.

Hence, We need various approaches for Intermediate nodes which reduce the number of Packets transmitted. This can be done by named aggregation. Data aggregation usually involves the fusion of from multiple sensors at intermediate nodes and transmission of the aggregated data to the base station (Sink). Example is given below.

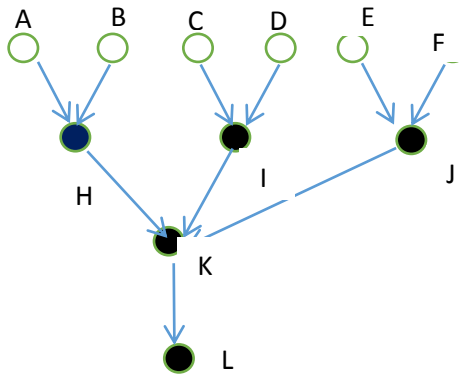


Figure 1. Aggregation of Data.

Data aggregation is shown in Figure 1. As its is shown data from nodes A and B gets aggregated at node H, Similarly data from nodes C and D at node I, E and F gets aggregated at node J and finally H, I, J resultant aggregates at L and the resultant is transmitted to the Sink.

IV. PERFORMANACE METRICS.

The performance of the network is then measured based on quantifiable parameters called performance metrics. They are network lifetime, data accuracy, latency, energy efficiency, bandwidth capacity and throughput, hop count, signal strength.

The functionality of the sensor network should be extended as long as possible. In an ideal data aggregation scheme, each sensor should have expended the same amount of energy in each data gathering round. A data aggregation scheme is energy efficient if it maximizes the functionality of the network. If we assume that all sensors are equally important, we should minimize the energy consumption of each sensor. This idea is captured by the network lifetime which quantifies the energy efficiency of the network. Other important matric is number of hop count in communication which determines the cost of the path and ultimately how much energy is consumed. Besides, this signal strength, if we have good signal strength then we have good communication and computations will be done in time.

V. data aggregation based networks

1.Flat networks

2. Hierarchical networks

Flat networks each sensor node have a equal battery power and have the same role in a network. Here data aggregation will be done in data centric routing manner which uses flooding approach . in the flooding sensors which have data matching the data packet and transmit response data packet back to the sink. All the communication and computation burden at the sink.

Hierarchical networks data aggregation data has to be done at special nodes, with the help of these special node we can reduce the number of number of data packet transmitted to the sink. So with this network improves the energy efficiency of the whole network.

Table 1 : Hierarchical Network Vs Flat Network.

Hierarchical	Flat Network
Data aggregation performed by cluster heads or leader node	Data aggregation is performed by different nodes along the multi hop path
Overhead involved	Data aggregation

in cluster or chain formation throughout the network	routes are formed only in regions that have data for transmission
Even if one cluster head fails, the network may still be operation	The failure of sink node may result in the breakdown of entire network
Lower latency in involved since sensor nodes perform short rang transmission to the cluster head	Higher latency is involved in the data transmission to the sink via multi hop path.
Routing structure is simple but not necessarily optimal.	Optimal routing can guaranteed with additional overhead
Node heterogeneity can exploited by assigning high energy nodes as cluster heads .	Does not utilize node heterogeneity for improving energy efficiency

In Table 1, we shown the difference between the Hierarchical Network versus Flat Networks and Table 2 we shown the Protocols for Hierarchical and Flat Networks.

Protocol Name	Flat Networks	Hierarchical Network
LEACH		✓
PEGASIS		✓
HIERARCHICAL PEGASIS		✓
SPIN	✓	
DIRECTED DIFFUSION	✓	
TEEN		✓
APTEEN		✓
ROUMER ROUTING	✓	
GRADIENT BASED ROUTING	✓	
ENERGY BASED ROUTING		✓
ENERGY AWARE ROUTING FOR CLUSTER BASED SENSOR ROUTING	✓	
CADR(CONSTRAINED ANISOTROPIC DIFFUSION ROUTING)	✓	
ACQIREE(ACTIVE QUERY FORWARDING IN SENSOR NETWORK)	✓	
ENERGY AWARE ROUTING	✓	

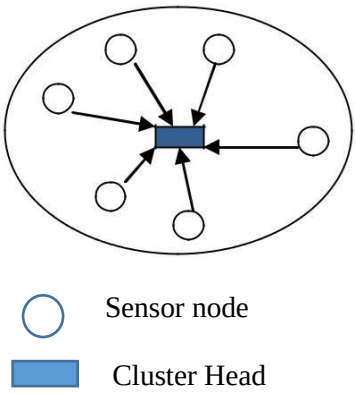
V. ARTICHETURES OF DATA AGGREGATION.

Based on various applications and requirements there are several existing architectures for data aggregation. They are Centralized, Decentralized, Cluster Based, Tree Based, Grid, Chain.

CENTRALIZED ARTICHETURE

Here, each sensor node sense a data and transmit to the one central node, called central processor fusion node. The disadvantage is that inflexible to sensor changes and the workload is concerned as a single point.

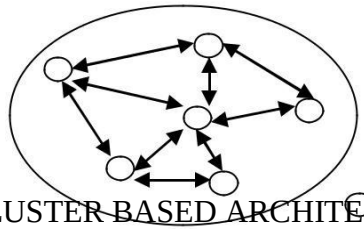
Figure 2. Centralized Architecture



DECENTRALIZED ARCHITECTURE

There is no signle centralized node that makes desciion of all the sensor nodes. Data fusion occurs locally at each node on the basis of local observations and the information obtained from the neighbouring nodes. The disadvenage is that very hard to make decisions.

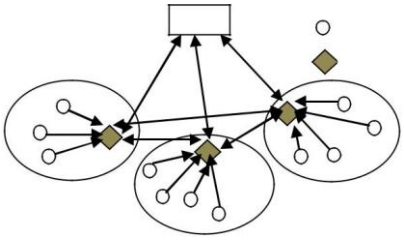
Figure 3. Decentralized Architecture



CLUSTER BASED ARCHITECTURE

Wireless sensor network is resource constraint that‘s why sensor cannot directly transmit data to the base station. In which all regular sensors can send data packet to a cluster head which aggregates data packet from all the regular sensors in its cluster and sends the concise digest to the base station. With the help of the scheme we save the energy of the sensors. In energy constrained sensor networks of large size, it is inefficient for sensors to transmit the data derectly to the sink, in such scenarios, sensors can transmit data to a local aggregator or cluster head which aggregates data from all the sensors or cluster head which aggregates data from all the sensors in its cluster and transmits the concise digest to the sink. There are some issues involved with the process of clustering in a wireless sensor network. First issue is how many clusterts should be formed that could optimize some performance parameter. Second could be how many nodes should be taken into a single cluster.

Figure 4: Cluster Based Architecture



TREE BASED ARCHITECTURE.

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 nodes to forward its data . Flow of data starts from leaves nodes up to the sink and there in the aggregation done by parent nodes. In which all nodes are organized in form of tree means hierarchical, with the help of intermediate node we can perform data aggregation process and data transmit leaf node root node. One for the main aspects of tree based networks is the construction of an energy efficient data aggregation tree.

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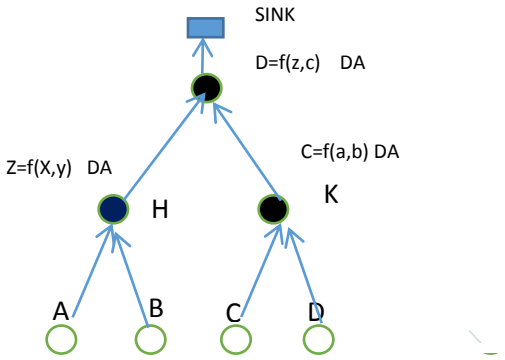


Figure 5: Tree Based Architecture.

CHAIN BAASED ARCHITECTURE

In which each sensor sends data to the close neighbor. All sensors are structured into a linear chain for data aggregation. The nodes can form a chain by employing a greedy algorithm or the sink can decide the chain in a centralized manner. In the Greedy chain formation assumes that all sensors have inclusive knowledge of the network. The farthest node from the sink initiates chain formation and , at each step, the closest neighbor of a node is selected as its successor in the chain. In each data gathering round, a node receives data packet from one of its neighbors, aggregates the data with its own, and sends the aggregates data packet to its other neighbor along the chain,. Eventually , the leader node in the are si,ilar to cluster head sends the aggregated data to the base station.

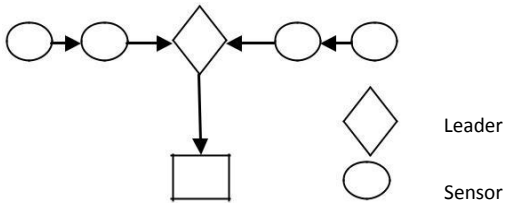


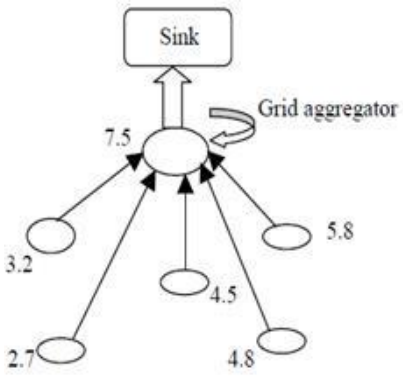
Figure6: Chain Based architecture.

GRID BASED ARCHITECTURE

In which a set of sensors is assigned as data aggregators in fixed regions of the sensor network. The sensors in a grid send the data packet directly to the aggregator of that grid. Hence, the sensors within a grid do not communicate with each other. In-network aggregation is similar to grid-based data aggregation with two major differences; each sensor noide within a grid can assume the role of aggregators node in terms of rounds untill the last node dies. This is similar to cluster based data aggregation in which the cluster heads are fixed.

In-network aggregation, the snesor with the most critical information aggregates the data packets and sends the fixed data send to the sink. Each sensor transmitt the signal of ite to neighbour. If the neighbour has higher singmal then sender stops transmitting the packets. After getting data packets from all neighbours, the node that has the maximum signal strength becomes data aggregator.

Figure 7: Grid Based Architecture.



VI PROTOCOLS BASED ON DIFFERENT ARCHITECTURES.

Protocol	Organization type	Objectives	Characteristics
LEACH	cluster	Network lifetime: number of nodes that are alive, latency	Randomized cluster head rotation, non-uniform energy drainage across different sensors.
HEED	cluster	Lifetime: number of rounds until the first node death	Assumption: Multiple power levels in sensors. Cluster heads are well distributed. Achieves better performance than LEACH
PEGASIS	chain	Lifetime: average energy expended by a node	Global knowledge of the network is required. Considerable energy savings compared to LEACH.
Hierarchical chain based protocols	chain	Energy× delay	Binary chain based scheme is eight times better than LEACH and the three level scheme is 5 times better than PEGASIS.
EADAT	tree	Lifetime: number of alive sensors at the end of simulation time	Sink initiated broadcasting approach. It is not clear how to choose the threshold power (P_{th}) for broadcasting help messages. No comparisons made with other existing aggregation algorithms.
PEDAP-PA	tree	Lifetime: time until the death of last node	Minimum spanning tree based approach. Achieves two times performance improvement compared to LEACH, PEGASIS.

VI. ADVANTAGES OF DATA AGGREGATION

We can enhance the robustness and accuracy of information which is obtained by the entire network, reduce the redundant information, reduces the network traffic Load and conserves energy of the sensors.

VII. CONCLUSION

In this paper given the introduction to sensor, wireless sensor networks, applications, Design issues, data aggregation approaches in WSN's , Data aggregation networks, architecture and advantages of Data aggregation.

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