

# A study on energy efficient Consistency schemes for Wireless Sensor Networks

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**Abstract**—The wireless sensor network is a distributed network which is also called actuator network. It has the availability of low cost and small sensor nodes that helps in every field and sectors for detecting the physical as well as environmental conditions i.e. pressure, temperature, also the effective method for communication, manipulation of data. The node size of wireless sensor network makes the route for the information with the help of routing protocols. Generally the node size of wireless sensor network is very small so this network consumes more energy. In this paper, various energy consuming techniques are discussed.

**Key Words**—Cooperative caching, Cache Data, Hybrid-Cache, Cache Path Nodes, LEACH, Cluster head, QoS, Flat net-works.

## I. INTRODUCTION

It is a distributed collection of sensor network. Internet of things is possible because of this network. There is no central access point among the nodes of the network. Generally this type of network is of narrow range. The word sensor means sense to monitoring the physical and environmental equipment. As the name wireless network, it works with the distributed system. It monitors the system via some parameters i.e. temperature, pressure. The deployment of the sensor nodes in these type of networks in an ad hoc fashion but once it is deployed the nodes will be able to autonomously organize themselves in a communication network. In the sensor nodes, batteries are used that means they are not for a long period of time. We know that in a wireless network multiple nodes are present and each sensor node has limited capacity of doing work but with a cluster of nodes is sufficient for the completion of mission figure 1 shows basic architecture of multiple sensor nodes [1].

This diagram shows the multiple sensor nodes at different places and there is one gateway which is used for the entering the data from one network to the other or to collect the data and route data back to the gateway [2]. During communication each node connects to one another to transfer the data from source to destination. The gateway acts like a base station. These sensor nodes are used to control information into the network or extract data from it. Sensor nodes have not enough power compare to sink. Internet is used to communicate with the help of gateway figure 2 shows gateway in WSN.

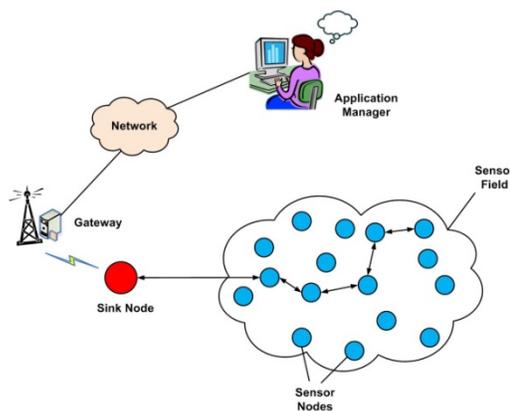


Fig. 1. Multiple Sensor Nodes Architecture

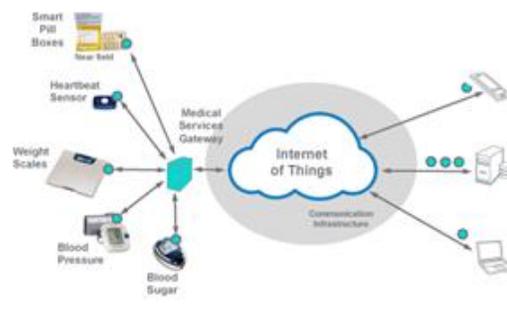


Fig. 2. Architecture Of A Clustered Wireless Sensor Network.

In this figure we can see how internet of things is possible with wireless sensor networks. This technology helps in every fields or sectors of the world.

- 1) **Sensor Node:** the sensor nodes are also called mote. As the name sensor, that has the power of senses the data. Generally it is used for sensing the environmental conditions like humidity, temperature etc. sensor nodes are the combination of processor, memory, transceiver etc. It has many functions like data processing, data storage, communication etc.
- 2) **Clusters:** A group of sensor nodes creates a cluster and it forms number of clusters and each cluster can hold

any number of nodes. It helps to make a communication part of the network.

- 3) Cluster Head: Each cluster has a cluster head which acts like a leader of that cluster. Data can be organized because of this cluster. It has many functions like data aggregation, communication between many clusters, manipulation of data etc. The results of cluster head and member nodes are always follow two tier hierarchy and also form higher tier and lower tier respectively.
- 4) Base Station: It is the outside part of all the clusters and all the data pass through the base station. Communication is possible between sensor nodes and end user by this station figure 3 shows the base station in WSN [3].

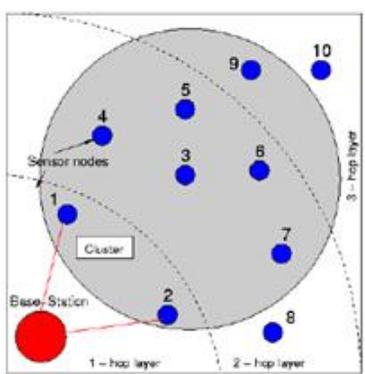


Fig. 3. Base Station

#### A. Important Characteristics of WSN:

- For manipulation of the data, it covers the wide area of network.
- Fault tolerance is high because number of sensor nodes close to each other.
- This network has high accuracy of sent data because the sensor nodes are close to each other so they combine their data for accuracy.
- These nodes are used not only for sensing the data but also forward that sensed data.

B. Localization of WSN : WSN has very efficient technique called localization technique. This technique is used with the routing protocol to provide the network services like topology control etc. The two important phases of the localization are:

- Ranging: with the help of this technique we can determine the distance of the sensor nodes. Example RSSI etc.
- Positioning: we can easily be determined the coordinates of the sensor nodes. Example: Minimum-Maximum Algorithm.

We can classify the Localization into three algorithms:

- centralized and distributed algorithms
- Range free and range based algorithms
- Anchor free and anchor based algorithms

#### C. Wireless Sensor Network Terminology

- Energy per packet: for sending the data from source to destination there is always consumption of energy.
- Reliability of nodes: during data transmission, energy nodes are directly proportional to the reliability.
- Lifetime of Network: Network is totally depend on the battery power.
- Dissipation of Energy: we can find the energy consumption at per node.
- Nodes Alive: After completing the process, how many nodes are alive.
- Distance: distance between source and destination.
- Packet Delivery Ratio: The ration of delivery of packets from source to destination should be high enough.
- Area of Sensor: It is the complete wide area or range which is covered by a particular sensor node.
- Time: the time till the first node dies.
- Idle Listening: the idle node is that node that takes part in the communication and also does not consume energy.

For communication between nodes of the wireless sensor network, it always follows a pattern which is as follows:

- Local: Local point is used for communication among the nodes.
- Point to point: The communication is always point to point that is the communication between sink node and cluster head.
- Convergence: It is the technique or mechanism of collecting the data which is sending or receiving between cluster head and base station.
- Aggregation: Multiple nodes send data and then aggregation of data occurs which is sent to the station or sink node.
- Divergence: Cluster head is always commanded by the sink node for sending the data.

#### D. Applications of Wireless Sensor Network:

- Medical Field: This technology is used for monitoring the pulse rate, temperature etc of the patients and then the patients report is sent to the concerned doctor.
- Fire: It monitors the places like forest for detecting the increased the temperature during fire. The sensor senses the temperature and give alarms.
- Military Applications: For surveillance the battlefield by the military and if any movement at the border areas, it send the message to the military persons.
- Agriculture: Crop is monitored by the sensor systems and help farmers to destroy the crops from the cattle.
- Building: All the elevators and sensor doors use this technology.

#### E. Various Challenges of WSN:

- Limited energy capacity: As we know that, battery powered are used by the sensors that's why they have limited capacity. Sometimes it creates a problem like in a war sensors can't be accessed and recharged. When the battery reaches a certain limit, the working of sensor automatically goes down that decreases its performance.
- Flat networks: In WSN, each node performs the same role. So there is no logical hierarchy. This network uses the flat addressing scheme and Routing Information Protocol is one of the examples of this network.
- Sensor locations: For management of the sensors, some-times designing of routing protocols become a challenge.
- Limited hardware resources: As we know, batteries are used in it, so it has limited energy and limited processing and also it has less storage capacities. So overall, it performs limited computational functionality.
- Scalability: Network size should be able to scale up via routing protocol. Also all the sensors have the same capacity but it should not be. And the communication should not be in a symmetric manner. All these functions reduce the scalability of wsn. So it should be taken care.
- Redundancy of data: With the help of data aggregation, redundancy in data decreases but it also decreases the QoS parameters that should not be.
- Data freshness: For WSN it is a very important issue. It is because an unwanted person can send an expired or old packet. If it happens then there would be wastage of network resources and decrease in network failure.

## II. REVIEW OF LITERATURE

In [2] Kiran Maraiya et.al presented the summary of the wireless sensor networks. This transcript describes many characteristics of wsn like dense sensor node deployment, node mobility, battery power sensor nodes etc. it also describes that the battery or low power is the limitation of wsn. Also multi-hop routing may cause more nodes deplete their energy while routing as compared to single hop routing

Basilis Mamalis et.al [4], has described the clustering techniques and challenges of wsn. It also describes various including Probabilistic Clustering Approaches and Non-Probabilistic Clustering Approaches. It also mentioned the election of the cluster heads. Each cluster head has a unique identifier. Due to the larger size of the sensor node and time complexity of the network is very high. the extension in multi-hop communication patterns is unavoidable which increases the routing path.

Sung Hwi Kim et.al (2012) [3] has explained the issues of whole problem which is faced by the data dissemination protocol in Wireless Sensor Network. They described that whenever sensor nodes are failed due to energy consumption

or any physical destruction then holes are generated. Hole masking algorithm is proposed in this paper to deal with various holes in WSN and to reduce the energy consumption and to increase the lifetime of wireless sensor network by avoiding complicated computation and selecting the dynamic node in the grid cell. Hole masking algorithm explains that in each grid, residual energy i.e. node with larger energy level is selected as the head node. In Wireless Sensor Network, this head node is responsible for dissemination of data. Whenever any event takes place, the data is sent to head node for generation of data report and then that data report is forwarded to the sink. The queries of the sink are also handled and managed by the head node. So the energy of the head node is consumed at high rate. When this node dies or fails, the nearest node with largest residual energy is selected as the new head node.

In [5] H.Dubois-Ferries et.al, the method which is proposed in this paper based on Voronoi clusters which is used for handling the sink nodes. This Voronoi algorithm delegates a sink for each cluster to achieve data acquisition from sensors in cluster. Closest sink data is preserved by the node. When a message comes from a sink, the recipient checks whether the current estimate of closest sink distance is greater than the distance traversed by the packet. If so, the node updates its closest sink and parent entries and resends the message. A node also re-forwards the message if the distance traversed is equal to closest distance and the message came from the closest sink.

Kiran Maraiya et.al [6] has described many algorithms based on clustering technique and that is used for data aggregation. This paper has energy efficient algorithm with the help of clustering head section and these sections are not chosen constantly. The method which is described in this paper has one cons i.e. for transferring the data from the base station, node will have to choose first. But it consumes less energy.

Mortaza Fahimi et.al [7] described a LEACH protocol which is energy efficient clustering algorithm for the wireless sensor network. Low energy adaptive clustering hierarchy (LEACH) is a type of Time Division Multiple Access MAC protocol. The working of this protocol is to consume the low energy with the help of conserving protocol. Actually it maintains the clusters to improve the life time and also creates small clusters. Most of the nodes moves to the cluster head and these cluster head manipulate the data and move the data to the sink or base station. The nodes which are not move to the cluster head, communicate with the CH in a TDMA scenario. Generally the MAC protocol is used to decrease the consumption of energy.

## III. COOPERATIVE CACHING

Caching is the technique to enhance the performance of data access and cooperative caching facilities us with the capability of cached data sharing when we are having multiple numbers of nodes. Due to the lack of resource and high mobility wireless devices it is difficult to use but in [8] author presented the successful implementation of the cooperative caching [9] in wireless ad hoc network. They provides two methods for caching the data is named as Cache Data and one

is used to caching the path of the data and result of analysis of these two methods leads to the development of the hybrid method named as Hybrid Cache which having all the advantages of both the method and leads to better performance result.

In [10] author proposed a scheme based on the cooperative caching named as ZCS (Zone Cooperation at Sensors) focusing towards the wireless sensor network. In the proposed methodology the nodes forms a zone for Cache Corporation and perform sharing of the data from their cached zone figure 4 shows ZCS working.

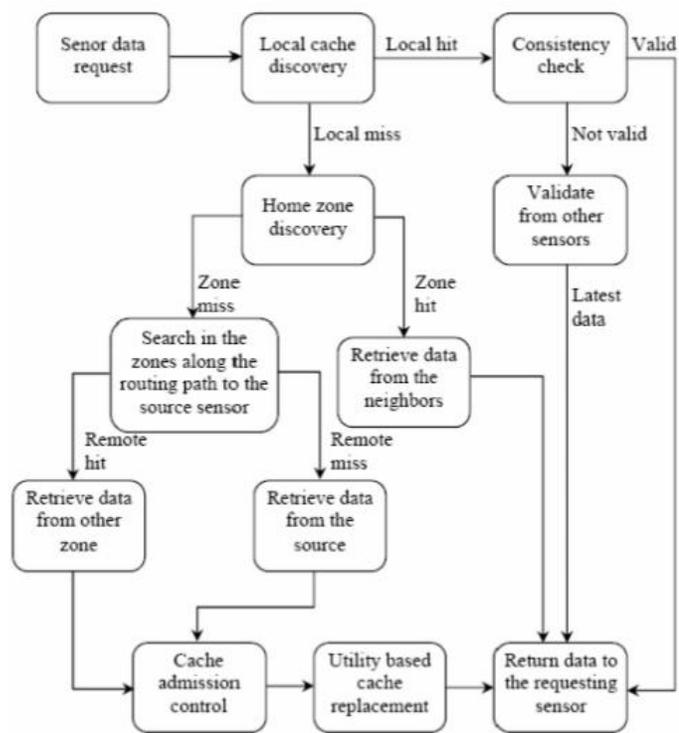


Fig. 4. ZCS cooperative caching

The supreme substantial characteristics pooled by the above-mentioned concerned of application are:

- **Lifetime:** Due to mobility we cannot use very heavy power backups in the mobile devices that why they are facing the problem of limited lifetime or energy. Physical replacement of battery again and again is not possible.
- **Scalability:** The wireless devices architecture is must be scalable in nature till any number of devices.
- **Wide range of densities:** The placements of wireless sensors are not consistent and they are keeping on changing on the basis of requirement according time and space dimension.
- **Data-centric networking:** The objective of the wireless sensor network is provide response to the request not number and our basic network is used for transferring bits from one place to another.

#### A. Cooperative Caching in WSN Through Clustering:

This proposed approach uses clustering based on the partition of network in non-overlapping clusters on the basis of physical juxtaposition of the network this proposed methodology called GCC (Global Cluster Corporation). Data caching supports the fast request and response of the data by provision of cache storage of data. This proposed works mitigates the overhead of the discovery process of cache and lead to better performance enhancement it divides whole wireless network in equal size clusters on the basis of distance in their geographical location as shown in figure 4 Combining the cache memory of individual wireless devices and put forward a sufficient size of cache space for better performance within each cluster and this mechanism automatically select a node to maintain the GCS information of the various participant nodes of network and named this node CSN (Cache State Node).

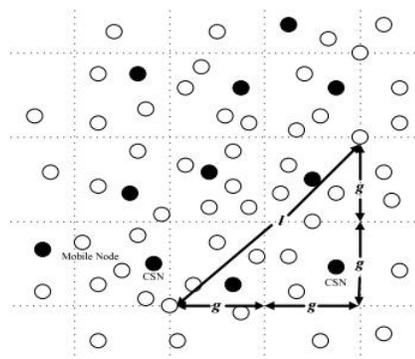


Fig. 5. Partitioning of WSN into clusters

#### IV. CONCLUSION

This paper provide you detailed review of the wireless sensor network (WSN) and mobile ad hoc network (MANET). This help you explore all the clustering protocol, energy efficiency, challenges and application of wireless sensor network in practical life. with the help of localization based clustering we can preserve the power of the wireless devices, which provide you better understanding of wireless network terminology and working. in this paper author also discussed about the cooperative caching in ad hoc network which leads to provide understating process of the sharing of cache space among multiple nodes of the wireless sensor network and how cache sharing enhance the performance of the network. This paper also helps in finding gaps in existing techniques of the wireless sensor network which provides you idea for the research work and motivate you towards various research finding in wireless sensor network

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