# A Failure Recovery of Map using SFDA for an Energy Efficient Data Transmission in Mobile Synchronized Wireless Sensor Network

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**ABSTRACT**

Wireless sensor network has been recognized as a key technology in military applications. Wireless Sensor Network (WSN) are contiguous disseminated autonomous sensors to invigilate physical or environmental conditions and to cooperatively pass their data through the network main location. Mobile Access Points (MAPs) move over the network to gather information directly from individual sensors. It uses LEACH protocol to reduce the energy consumption while establishing and maintaining clusters, but it creates overhead. To solve the above problem the existing system, uses Distance Vector Multicast Routing Protocol (DVMRP), it requires that a router inform its neighbours of topology changes periodically. The distance vector specify to the fact that the protocol manages vectors of distances to other nodes in the network. The vector distance algorithm used to investigate the optimal topology design that reduces the average number of hops from the sensor to MA, and provide the scrutinize of throughput under both single-path and multi-path routing cases. But this method does not consider the failure of MAP. But there is a possibility that if the MAP fails, then the entire system may collapse. If the MAP does not work properly some data send by the cluster heads may lossed, which results inconsistency. To overcome this problem, the proposed method uses Simple Fault Detection Approach (SFDA) based on response timeout has been used to identify failures. This approach contains two phases, they are Design phase and Fault Response phase. The Failed MAP can either be recharged or reloaded by the Base Station (BS) which improves the consistency and the system performance and also recovered the MAP failure. Using this methodology, it can ensure reliability, efficiency, and ad-hoc enabled flexibility.

**KEY WORDS:** Distance Vector Multicast Routing Protocol (DVMRP), Low Energy Adaptive Clustering Hierarchy (LEACH), Mobile Access Points (APs), Simple Fault Detection Approach (SFDA).

## 1. INTRODUCTION

A wireless sensor network is a collection of specialized network within a interaction framework for monitoring and reporting conditions at diversified locations. Potential purpose of sensor network includes video surveillance, air traffic control, monitoring weather condition, traffic monitoring etc. Wireless sensor nodes use access points to connect users with other users inside the network and also can serve as the point of correlation between the WLAN and a fixed wired network. Each access point can able to serve multiple users within a defined network area as people move behind the range from single access point to other automatically. A tiny WLAN usually needs a single access point and increases its number of dependence among the network users and the physical size of the network. While using mobile access point, the data transmission depends on the physical speed of the access point which impacts the efficiency parameters throughput and delay.

In the existing system, it uses LEACH protocol which is a TDMA based MAC protocol a clustering and a basic routing protocol in the wireless sensor networks. It is mainly used to reduce the energy consumption needed to improve the lifetime of the wireless sensor network. The issue of this approach is the overhead associated with sink location acquisition. In order to overcome this problem, Distance Vector Multicast Routing Protocol (DVMRP) is used. DVMRP is based on the RIP protocol. The router creates a routing table with its multicast group which has the ability to provide corresponding distances between the nodes. DVMRP uses a reverse path flooding technique, which sends a copy of a received packet via each interface except the one at which the packet has arrived. DVMRP channels multicast transmission within unicast packets that are grouped into multicast data when they reach their destination.

**Single-path Vs Multi-path:**

**Single-path**: In a single-path routing method, only a single path remains between any two networks in the internetwork. While this reduces the routing table columns and the packet flowing paths, single-path networks are unable to work when a failure occurs in the system.

**Multi-path**: In the multi-path routing method, multiple paths were exists between networks in the internetwork. The multipath network is fault tolerant while using the dynamic routing. It can be more complex to configure.

Wireless Access Point (WAP) is an equipment that allows wi-fi device to connect with a wired network. In a proposed method it uses Mobile Access Points (MAs), which denotes the same meaning as access point but it can able to move along with the network. Using MAs it can achieve high monitoring capability. The major features of a mobile access points are: Access wherever, cost and convenience, privacy and achieves security.

**Related Works:** Noufal (2015), discussed the issues arisen in the wireless sensor networks. Routing in the wireless sensor network is limited because of the capabilities of a sensor node. The first algorithm was Location-Based Protocols in which sensor node is recognized by the location address of the specific nodes. It guarantees every sensor node to send its data independently. The next algorithm was Hierarchical Protocols in which nodes are clustered and the transmission done through the cluster heads. It reduces the energy consumed by each sensor nodes.

Lehsaini (2007), introduced the Cluster-Based Energy Efficient Scheme (CES) to enhance the lifetime of the network. The CES algorithm is used to elect the cluster-head to distribute the energy across the nodes in the network, which will improve the network lifetime. In this algorithm, sensor nodes with the greatest weight will be chosen as a cluster-head. The main protocol is LEACH which supports single hop algorithm for homogenous WSNs. In LEACH cluster-head role is rotated periodically among the sensors to equally distribute energy over the nodes in the network.

Baccelli (2006), discussed the maximum throughput for an opportunistic slotted ALOHA protocol. It uses to achieve throughput when the users gets increased. To find the throughput Signal-to-Interference-Ratio (SIR) threshold method is used. In the ALOHA protocol, nodes transmit its backlogged packets without a change in the message over the time. In ALOHA protocol, users can adjust their transmission.

Gokhan Mergen (2006), introduced Sensor Network with Mobile Access point (SENMA) in which sensor nodes are clustered and each cluster contains a Mobile Access Points (MAPs). SENMA offers energy efficient data transmission and multihop ad hoc architecture. Mobile APs significantly reduces the timing recovery and synchronization. Each APs work independently.

The system works with sensor nodes which are clustered and each cluster connected along with the mobile access points. The cluster also includes Cluster Head (CH), Center Cluster Head (CCH), Ring Cluster Head (RCH). The sensor nodes send its data to the base station using the above cluster heads. In this system it limits the average number of nodes from the sensor to mobile access points, which will increase throughput, reduce delay and using the energy efficiently.

## 2. METHODS & MATERIALS

**The Proposed Energy Efficient Data Transmission Scheme:** To overcome the problem arise in the existing system, the following method is proposed. In the existing system, it uses Sensor Network with Mobile Access Point (SENMA) in which mobile access point traverse the network to gather information directly from the individual sensors. But the transmission of data is affected by the physical speed of the MAs and also by its length. To rectify this problem, Mobile Synchronized Wireless Sensor Network has been proposed. This method uses Distance Vector Multicast Routing Protocol (DVMRP), which improve the throughput, reduce delay and enhance the energy of the system.

**Mobile Access Points (MAs):** In wireless sensor network (WSN), usually access point is a station where it can broadcasts and receives data from individual sensor. Access Points connects users to other users within the framework. Data transmission is done via the access points in the wireless sensor network.

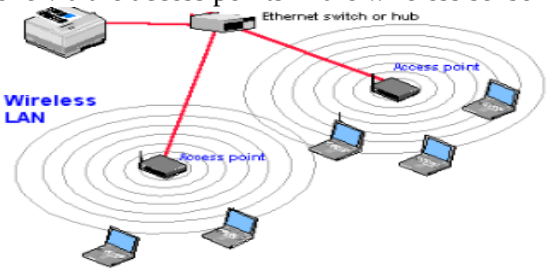


**Figure 1. Mobile Access Points**

Figure.1, shows the access points which give wireless network services to their surrounding users.

**General Description:** In the proposed method, the network is split into cells of radius d. Each cell includes single Mobile Access Points (MAs) attached to it. Each cluster is controlled by the cluster Head (CH), who is the handler for getting data from all its cluster members. Additionally, Center Cluster Head (CCH) which is deployed in the center of each cell, and K ring cluster head (RCH) are added on the ring of radius $R_t$. The CCH and RCH can initialize direct communication to the MA or with the nearby RCH which is closer with the MA. All the other nodes within a particular distance $R_0$ from CCH route its data to the MAP via CCH. Remaining nodes route its data to the MA by the nearby RCH. When the sensor node is within MAPs coverage area then direct communication will take place. After receiving all the data from the sensor nodes, the MA delivers the collected data to the Base Station (BS). This method commonly analyzes the throughput under both single path and multipath routing cases is used. In order to enhance the efficiency of the system Mobile Access Point Failure Mechanism can be used based on Simple Fault Detection Approach. This proposed system is autonomous based on the physical speed of the MA, which has a higher advantage than SENMA. This method defines the average number of nodes between the sensor and its nearest CH is reduced and also improve the efficiency of the system.

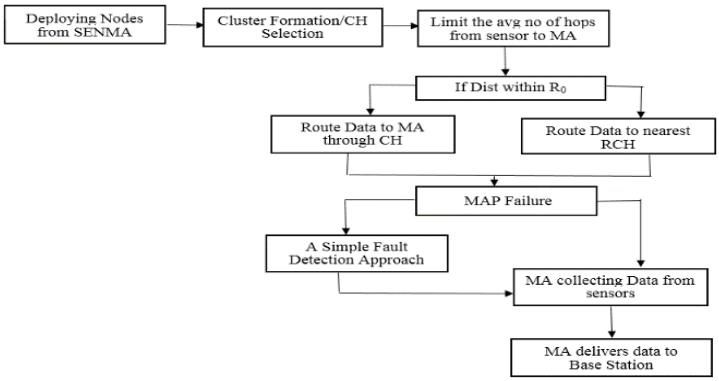


**Figure.2. System Architecture**

Figure.2, describes the system architecture of the proposed method. Deploying the nodes from SENMA means it delivers sensor nodes to the system. Then chosen the cluster head based on the Local Energy Estimation algorithm. Using this algorithm sensor nodes with the highest energy can be selected as the Cluster Head (CH). This algorithm is efficient to elect the CCH and RCH. If the sensor node within the distance $R_{0,}$ route the data to MA through CH. All the other nodes send its data to the nearest RCH. Then MAP collects data from all the other sensors. Then MA forward the data to the Base Station (BS). To overcome the problem due to the failure of Mobile Access Point, a Failure Recovery Mechanism has been introduced. A Simple Fault Detection Approach which has two phases used to handle the problem either by reloading the MAP or recharging the MAP. This Fault Approach is done by the Base Station (BS).

**Data Collection:** Data collected from individual sensors can be event based or periodic. Data transmits from the sensor node to CHs, between CHs, and from CCH/RCH to the MA are done on various channels to avoid intrusion between different communication links. Let the transmission range of every sensor node and CH be $r_c$ and $R_c$ respectively. CH have a huge storage capacity and longer communication range than SNs which is denoted as $R_c > r_c$. But the sensors which is not involved in inter-cluster method in order to minimize its energy consumption. To enhance the throughput and lower the delay, a number of nodes in routing should be minimized. MAP moves dynamically for data gathering only when the routing paths does not work.

**Distance Vector Multicast Routing Protocol (DVMRP):** It is an Internet-based routing protocol which provides an energetic mechanism for connection-less datagram delivery to a collection of hosts across an internetwork. DVMRP uses a distance vector disseminate routing algorithm which builds per-source-group multicast delivery. DVMRP routing decision based on the source address of the packet. This protocol follows the RIP protocol. It creates a routing table with the multicast group with an idea of the corresponding distances.

**Simple Fault Detection Approach (SFDA):** To handle the failure of Mobile Access Point (MAP), A Simple Fault Detection Approach depends on response timeout which guarantees to be more cost-effective way to identify failures has been used. This approach contains two phases. They are Design and Fault Response Phase. Design Phase deals with quantifying, placement and setting up of APs according to both on coverage area and performance criteria. And the Fault Response it consider the reconstruction of active APs in order to deal with APs fault in the service area.

Both these work are done by the Base Station (BS). The BS can reload or recharge the MAP to handle the situation. This method improves the efficiency and reliability of the system.

**System Modules:** The proposed system contains the below modules to achieve the target of the system.

**Deploying Nodes to from SENMA:** SENMA classify into two different types of nodes, they are Sensor nodes and Mobile Access Points. Sensor nodes are low power and low-cost nodes, but it limits processing and communication capability. But in contrast, mobile access points are provided with powerful processors and well-equipped transceivers.

**Cluster Formation:** The network is split into cells of radius d. Each cell contains single powerful Mobile Access Points(MA) with its. These clusters are controlled by the Cluster Head (CH). CH, RCH, CCH are elected depends on the sensor nodes.

**Center/Ring Cluster Head Selection:** Center/Ring Cluster Head is selected by Center Cluster Head Election Algorithm using Local Energy Estimation (CCHEA) that uses energy levels of neighboring sensor nodes as well as local energy level to restrict the decrease of the CH probability of the sensor nodes.

**Data Collection By Center/Ring Cluster Head:** Data collected from the sensors can be event based or periodic. Data transmits from SNs to CHs, between CHs, and from CCH/RCHs to the MA are done over different channels to avoid interference between various communication links. The transmission range of each sensor node and CH be $r_c$ and $R_c$, respectively. CHs have larger storage capacity and longer communication range than SNs, i.e.,$R_c > r_c$. Assume that shortest path routing between the CHs and the CCH/RCHs.

**Failure Recovery of MAP:** To handle the failure of MAP, a Simple Fault Detection Approach is used. Base Station plays a vital role in the failure recovery. If the Access Points been complained with the response timeout, then the

Base Station can either be recharge or reload the MAP depends on the suitation without lossing any data during the failure time, which improves the efficiency and reliability of the system.

**Data Delivery to Base Station:** Data gathered from the center/ring cluster head is transmitted to Mobile Access Point. This data gathering can be event based or periodic. Then the access point delivers the data to base station.

## 3. RESULTS

This system describes the overall performance of the Mobile synchronized wireless sensor network through simulation values and comparison values. Here the system assumes that SNs and CHs are distributed in each and every cell, and TDMA/FDMA is used to scheduling. It considers the following parameters. The range of cluster heads is $R_c$=30 m and that of sensors is $r_c$=15 m, the assumed values for $R_0$ and $R_t$ are set based on the proposition I, the path loss exponent is β=2. And threshold value is γ=5 dB, and the bandwidth reuse measure is $N_{intf}$=2. Take the packet size is 16 bytes and rate of data is 5 Kbps, then the packet duration is 25.6 ms. In this simulation, the collision effect or interference among clusters uses the same channel or frequency band is take into account. The neighboring CHs with a distance lesser than $N_{intf}$ x $R_c$ from active CH is participating in the system performance.

**Time Vs Throughput:** The Time Vs Throughput graph describes the amount of throughput based on time. Throughput normally used to measure the quantity of data that can be transmitted at a time. Throughput shall be measure using the parameter kbps.

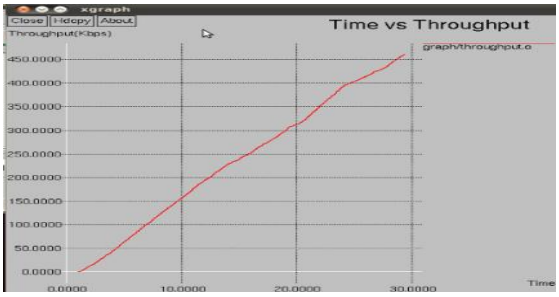


**Figure.3.Time Vs Throughput**

Figure.3, shows the graphical representation of Time Vs Throughput. Throughput can be analyzed in both single path and multipath routing cases.

**Time Vs Delay:** The Time Vs Delay graph describes the delay based on time. Delay normally measured as the total amount of time it gets delayed compared to the expected time of data delivery.

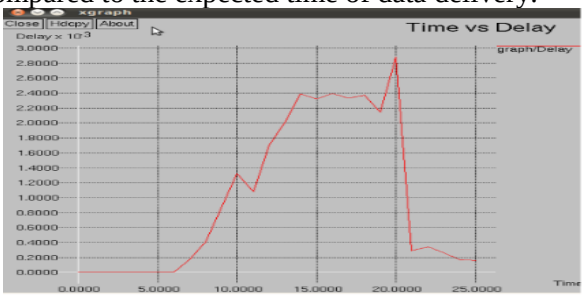


**Figure.4. Time Vs Delay**

Fig.4, shows the relation of Time Vs Delay. The delay is a factor which describes the latency in the data transmission.

**Time Vs Energy:** The Time Vs Energy which describes the energy of the system it can sustain to a certain level. Energy is measured as the quantity of energy that can used in data transmission and the ability to maintain the lifetime of the system. Energy is measured as joules.

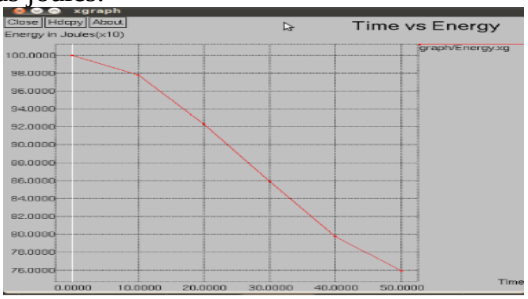


**Figure.5. Time Vs Energy**

Figure.5, shows the energy maintained by the proposed system based on time. Energy is simply the total lifetime of the network while using the resources continuously.

## 4. CONCLUSION

This proposed method achieves better performance, which enhances the throughput of the system, reduces delay, efficient usage of energy and very low packet loss. The Mobile Access Points (MAs) coordinate the sensor nodes and its data transmission, this proposed methodology achieves a highly resilient, reliable, and scalable system. This methodology reduces the average number of nodes from any sensor to the MA. Throughput analysis is done in both single-path and multi-path system. And the recovery of Mobile Access Point enhances the efficiency and the reliability of the system. The future work is related to the suggestion that it can expand the distance without degrade its performance, that expected to has the improved throughput and energy and also reduces the delay and packetloss.

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