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# IMPROVING QOS PARAMETERS IN WIRELESS SENSOR NETWORK

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**ABSTRACT**

Wireless sensor network is a collection of sensor nodes that are used for sensing the environment and transmitting the data to the base station. In WSN there are multiple Quality of Services which includes energy efficiency, throughput, delay, congestion control etc. that are used to increase the performance of network. The different routing protocols are used in network for finding the shortest path between source to destination. There are different routing protocols like AODV, DSDV, DSR .wireless sensor network is based on routing protocols and MAC protocols. In wireless sensor network source node send packet to the destination node. End-to-end delay, packet delivery ratio, packet loss ratio, throughput, energy consumption, congestion control etc. are the QoS parameters for wireless sensor network. Author Mohammad *et al.* Implement the IH-MAC protocol for achieving the energy and delay parameters in sensor networks. Authors implement IH-MAC using Link and Broadcast scheduling concept with parallel transmission. But in this paper we have designed and implemented RH-MAC protocol using CSMA and TDMA MAC Protocols. RH-MAC for achieving the Quality of Services (QoS) like PDR, PLR, Throughput, end-to-end delay, congestion control and reliability. For congestion control applying TDMA protocol to the nodes which are one hop away from the sink node. CSMA for the rest of the nodes. In second model we have to implement the Cluster based data dissemination.

**Keywords:** QoS, routing protocols, MAC protocols, data dissemination.

## 1. INTRODUCTION

Wireless Sensor Networks (WSNs) are widely used technology with number of applications such as home, military, environmental and health applications etc. It has helped in security management and in other fields benefiting humans across the globe. WSNs are the group of sensor nodes deployed in the environment. Sensor nodes monitor different physical conditions and communicate among each other using multihop wireless network. Every node in WSNs is a sensor nodes; these nodes have less memory space, dedicated processing capability and limited battery life. Sensor node senses the surrounding conditions where it has been deployed and communicates with neighboring nodes. The transmission of data is carried out from one hop to another hop until the data reaches to the destination [6]. Because of the limited battery life of the sensors routing in WSNs has became more difficult. Energy efficiency is a key component to extend the life of sensor nodes.

Considering the different conditions, lengthy routes and density of nodes in these networks, there is a need of suitable routing protocol. In the recent research it is found that the researchers are mainly focusing on clustering based routing protocol. The clustering is the collection of different clusters which individually contains set of common nodes [1] [2]. Each cluster is formation of cluster head and common nodes. The data from the common nodes is aggregated at cluster head and then transmitted to the destination. The TDMA technique is applied on the cluster head which intern avoids the collision of data packets and hence amount of energy is saved during transmission. Hierarchical routing protocols are used for the forming the clusters. These routing protocols are applied on different clusters to route through the inter cluster structure and intra cluster structure [3] [4].

In addition to the routing protocols, the MAC protocols are used to control sensor nodes in the wireless network and are mainly responsible for performance of the network. The MAC protocols are used to decrease the congestion in the network and delay, increase the network life-time and provide the flexible environment for data transmission. There are various MAC layer protocols which provide the mechanism for time slot allocation, carrier sensing, parallel data transmission, prediction mechanism to calculate best wake up time etc.

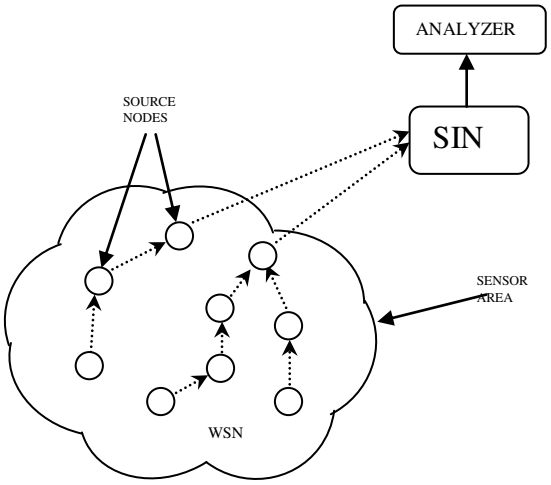



**Figure-1.** Basic diagram for wireless sensor networks.

The above Figure-1 represents basic architecture of wireless sensor networks. Sensors are deployed in environmental area. These sensor nodes collects the data from the environment and sends the data to the neighboring nodes. This nodes then forward this data to its nearest neighboring node until it is transmitted to the Sink.

Sink node is also called as Base station or Destination node. The data received at the Sink node is analyzed as per user's requirement.

This paper covers the detailed analysis of various existing routing protocols. These routing protocols work on the basis of different routing algorithms that satisfy the QoS constraints. This analysis include [I] Reducing Energy Consumption of battery-powered sensor nodes; [II] Improving wireless links considering noise, power consumption and channel conditions; [III] Proposing routing algorithms which suggests path reliability to improve performance; and [IV] Reducing congestion in the network.

## 2. LITERATURE SURVEY

In wireless Sensor Network routing Protocols are used for the communication between source to destination with shortest path. The cluster head present with Adaptive Clustering Habit $(ACH)^2$ scheme is used in WSN. This scheme increases the network Lifetime, stability and throughput of WSN. The $(ACH)^2$ handles the cluster head election and selection in such a way that there will be uniform load on CHs. Implementing $(ACH)^2$ scheme helps to calculate the node density and initial energy of nodes in different environment. $(ACH)^2$ is used to minimize the communication distance and also avoids the retransmission hence the energy efficiency is increased [1]. The author Pei Huang *et al*. proposed the Receiver-Centric (RC-MAC) MAC Protocol. The RC-MAC Protocol increases throughput, fairness and energy efficiency. Distributed channel assignment and receiver-centric medium access scheduling are used to increase the throughput. The receiver-centric scheduling is used in data gathering tree structure in WSN [2]. The Author proposed the joint Optimization Model for cluster-based topology in WSN. This model provides the protection for cluster heads. The performance increases with network lifetime and throughput [3].

The routing algorithm with Energy Delay Index for Trade-off (EDIT) is introduced which mainly focuses on two parameters with cluster formation i.e. Delay and Energy. It selects the cluster head and next hops to minimize the energy and delay for particular application. There are two different techniques like Euclidean distance and Hop Count are used to derive the distance between nodes and the sink [4]. In this paper the author Amir Ehsani Zonouz *et al*. proposed the Reliability-Oriented Single-Path routing Protocols. In complex environment to maintain reliability for communication is very difficult. The reliability of energy harvesting sensor nodes (EHSNs) and battery-powered sensor nodes (BPSNs) is structured. The wireless link failure models are present for each type of sensor nodes. Based on node and link reliability model, performance of different routing protocols is calculated in terms of average end-to-end path reliability [5]. The author Chilukuri Shanti *et al*. proposed Delay Guaranteed Routing and MAC Protocol (DGRAM) which is designed based on TDMA MAC protocol to provides delay guarantee and energy efficiency. The DGRAM is used for assigning the time slot for communication in network [6]. The paper [7] presents the cognitive network with Scalable Dynamic Routing Protocol for wireless sensor network. This protocol dynamically changes the path in transmission and adopts the changes in the network. The objective of this protocol is to increase the network performance and increase the scalability in the network. The proposed protocol works on parameters like throughput, packet delay and energy consumption.

The author Ieryung Park *et al.* proposed the MAC protocol for Achieving Low Latency and Energy Efficiency in hierarchical M2M networks with cluster nodes. In the M2M network efficient data transmission is done through the cluster head. This MAC also shows simulation results and achieves smaller average latency and minimized energy consumption per node. It compares with the SMAC and DMAC Protocols for sensor networks [8]. In wireless sensor network group of sensor nodes are present that are used to record and monitor environmental conditions and collect data to the central location. The main aim of author is to compare the energy efficiency based routing protocol for mobile and static wireless sensor network which makes the efficient clustering with location management and reduces the delay and energy consumption of re-clustering. It also allocates different slots for nodes and increases the network lifetime [9]. The author proposed the Fair Efficient Location-based Gossiping protocol. The energy efficiency is very important factor in wireless sensor network. The every node in WSN provides battery power for data communication. The communication is balanced between two nodes which increase the node life time. The author studied about how to increases energy efficiency and network lifetime in network [10].

The Authors are working on the parameters like energy consumption, network traffic monitoring and delay etc. for improving network performance using Routing and MAC protocols. The VELCT technique is implemented for achieving the parameters like delay, throughput, energy Consumption and lifetime of the network. VELCT uses the tree based data collection technique to improve the network lifetime [11]. Mobile Based Ring Routing Protocol (MBRRP) is used by the author to minimize the packet delay ratio (PDR) and energy consumption. MBRRP is suitable for time sensitive applications [12].The Author Tunca, *et al*. proposed IH-MAC protocol which combines effect of CSMA and TDMA protocols. Different Scheduling algorithms like link and broadcast scheduling are used to improve the network efficiency. Packet delay is reduced to achieve the energy efficiency using parallel transmission [13]. The Author uses cross layered network model for MWSN (Mobile WSN). This technique is able to increase the energy consumption, packet delivery ratio and throughput. It also reduces end-to-end delay of the network [14]. The author proposed the Mobile Sink Based Adaptive Immune Energy-Efficient Clustering Protocol (MSIEEP) which increases the lifetime and constancy of the wireless sensor network. MSIEEP is more reliable and energy efficient than the low-energy adaptive clustering hierarchy (LEACH). The high energy nodes are used to select the

cluster head (CH). MSIEEP uses mobile sink to deliver packet to destination so as to increase the protocol efficiency [15]. The author Yanjun Yao *et al.* developed the Energy-efficient Delay Aware Lifetime-Balancing (EDAL) Data Collection Protocol to solve the open vehicle routing problem. EDAL protocol achieves the increased network lifetime, minimized packet delay and also connects all the nodes in the network with minimum path cost [16]. The author Jenq-Shiou Leu *et al.* developed the Regional Energy Aware Clustering method using Isolated Nodes (REAC- IN) which is used to solve the problem of random selection of nodes that creates isolated nodes in the WSN. This method increases the lifetime and the stability SYNOPSIS of the network and also helps to improve the cluster head selection among the energy nodes [17]. The author A Liu *et al*. used efficient data gathering scheme for increasing network reliability. The optimization approach is used for single-source linear network. This approach increases the network lifetime, reduces the energy consumption without affecting the network reliability [18]. The author Anu Arya *et al.* comparatively studied the AODV, DSDV and DSR routing protocols. The authors concluded that the DSR is better for throughput, AODV is better in PDR and End to End delivery ratio [19]. The author Kamal Kr. Gola *et al*. implemented the high speed data collection technique. With the help of this technique, the energy consumption is reduced and the network lifetime is increased. This technique ensures the secure data transmission in the network [20]. The author compared the routing protocols like AODV, DSDV, DSR and AOMDV with 802.11 and 802.15.4 protocols. Authors observed that the DSDV protocol is the better solution for 802.11 and 802.15.4 protocols [21]. The author Kriti Thakur *et al.* implemented energy efficient network using multi sink scenario. The Wi-Max communicates with the sink nodes which are passing data in the network. The network lifetime is increased [22]. The author implemented the solution for network congestion by detecting and minimizing the congestion for the distributed nodes in the wireless sensor network. The author implemented multipath rate organization technique which is used with priority support having distributed load on the nodes [23]. The author proposed energy consumption aware model in WSN. It works on listen/sleep mechanism for the sensor nodes so as to increase the energy efficiency in the Wireless sensor network [24]. Different energy efficient MAC protocols like S-MAC, B-MAC, D-MAC, C-MAC, W-MAC etc. were described with their advantages and disadvantages. These Scheduled Based and Contention Based protocols were described to increase the network lifetime and reduce the network overhead [25]. The author G.M Shafiullah implemented the EBMA and EA-TDMA protocols for Railway Monitoring Applications. The E-BMA protocol achieves increased energy efficiency for medium and low traffic condition. These two protocols are used to achieve the increased energy efficiency in the wireless sensor network [26]. MAC protocol design for Wireless Body Area Network (WBAN) is introduced to increase the efficiency and reliability of the WSN. The WBAN is used in health sector. The latency, energy consumption and packet loss ratio can be decreased by the WBAN [27]. To recover the data from the sensor network having multiple hops, the Compressed Sensing Based Protocol is used. This protocol is basically used to achieve the low reconstruction error and reduced delay overhead [28]. The author Tijs Van Dam proposed T-MAC protocol in order to achieve the energy efficiency. It works on listen/sleep method which SYNOPSIS solves the problem of idle listening. In T-MAC protocol each nodes communicate with its neighboring nodes by sending Request-to-Send (RTS), Clear-to-Send (CTS) and Acknowledgement (ACK) type of request messages [29]. The author Injong Rhee *et al*. proposed Z-MAC protocols, which combines the advantages of CSMA and TDMA protocols at different contention levels. Z-MAC also avoids the time synchronization failure and random topological changes. It achieves maximum channel utilization [30].

All these protocols and techniques were designed so as to achieve the energy efficiency, delay and overhead, high channel utilization and more. Each technique used was only satisfying two to three QoS qualities and was unable to achieve the maximum throughput from the sensor nodes.

## ROUTING PROTOCOLS

### A. Ad hoc on-demand distance vector routing (AODV)

The AODV protocol finds the route between source node and destination node only when there is information to be exchanged. At each node, next hop information is stored. This protocol finds the path on demand by broadcasting the request packet in the network. It requires more time for connection establishment. When a particular link fails, an error message is passed back to a transmitting node, and the process continues. The difference between AODV and other on demand routing protocols is that it uses a destination sequence number (DestSeqNum) to determine the exact path from source to destination.

### B. Destination sequenced distance vector routing (DSDV)

This type of protocol forms the list of destination nodes and their route information in the routing table. It contains the information of all possible paths reachable from the current node. For every entry the sequence number is assigned. If the link is present between nodes then even sequence numbers are used, else odd sequence numbers are used. In this protocol, the delay is less since all the possible paths to the destination are available to user. The sequence number is used to differentiate the routes and thus avoids the formation of loop, i.e. if the particular router receives the new information then it uses latest sequence number else route with the better matrix is used.

**C. Dynamic source routing (DSR)**

As the name suggests the DSR protocol is based on the source routing where all the routing information is stored at mobile nodes. Like AODV, this protocol also broadcast route request packets in the network. In this approach path is formed only if there is actual requirement of path formation. The DSR is designed to control the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table-update messages essential in the table driven approach. The routing overhead increases as the path length increases.

## 3. PERFORMANCE REVIEW TABLE FOR ROUTING PROTOCOLS

| Paper Reference No. | Techniques | Energy efficiency | Throughput | N/w life time | Fairness | Congestion | End to end delay | End to end path reliability | N/w Traffic | PDR | PLR | Increased reliability | Accuracy Low Latency |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1] | Adaptive Clustering Habit | √ | √ | √ | | | | | | | | | |
| [2] | RC-MAC Protocol | √ | √ | | √ | | | | | | | | |
| [3] | Joint Optimization Model | √ | √ | | | √ | | | | | | | |
| [4] | Energy Delay Trade Off (EDIT) | √ | | | | | √ | | | | | | |
| [5] | Dynamic Routing Method | | | | | | | √ | | | | √ | |
| [6] | Slot Time Assignment | | | | | | | √ | √ | √ | | | |
| [7] | Scalable Dynamic Routing Protocol | | √ | √ | | | √ | | | | | | |
| [8] | MAC Protocol | √ | | | | | | | √ | | | | √ |
| [9] | Energy Efficient Routing Protocol(EERP) | √ | | √ | | | | | | | | | |
| [10] | Fair Efficient Location-based Gossiping Protocol | | | √ | | | | | | √ | √ | | |
| [11] | Velocity Energy-Efficient and Link-aware Cluster-tree (VELCT) | √ | √ | | | | √ | | | | | | |
| [12] | Ring Routing Protocol | √ | | | | | √ | | | | | | |
| [13] | IH-MAC Protocol(broadcast scheduling-link scheduling) | √ | | | | | √ | | | | | | |
| [14] | Energy Efficient cross-Layer Network Operation Model | √ | √ | | | | √ | | | | | | |

| Paper Reference No. | Techniques | Energy efficiency | Throughput | N/w life time | Congestion | End to end delay | N/w Traffic | PLR | Increased reliability | Packet delay | Eliminate energy hole problem | stability period | Reconstruction error is minimized |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [15] | MSIEE Protocol | | | | | | | √ | | √ | √ | √ | |
| [16] | EDAL Protocol | | | | | | | | √ | √ | | | |
| [17] | Regional energy Aware Clustering method using isolated nodes (REAC-IN) | | | √ | | | | | √ | | | | |
| [18] | Efficient Data Gathering Scheme | √ | | √ | | | | | | | | | |
| [19] | Comparing the performance of DSR, DSDV and AODV. | | √ | | | √ | | | | | | | |
| [20] | High Speed data collection | √ | | √ | | | | | √ | | | | |
| [21] | Routing Protocols AODV, DSDV, DSR and AOMDV. | √ | √ | | | | | | | | | | |
| [22] | A Novel Approach Based On Clustering. | √ | | | | | √ | | | | | | |
| [23] | Multipath Rate Organization Technique. | | √ | | √ | | | | | | | | |
| [24] | Energy Aware Model | √ | | √ | | | | | | | | | |
| [25] | MAC Protocol. | √ | | | | | | | √ | | | | |
| [26] | EA-TDMA, B-MAC | √ | | | | | √ | | | | | | |
| [27] | CA-MAC. | √ | | | √ | | | | | | | | |
| [28] | Compressed Sensing Based Protocol: Conv. AODV, Conv. CDMA | | | | | | | | | | | | √ |
| [29] | T-MAC | √ | | | | | | | | | | | √ |
| [30] | Z-MAC | √ | | √ | | | | | | | | | |

## 4. PROPOSED SYTEM

The energy consumption is more when the data is distributed over the network. For reducing this energy consumption and data dissemination clustering technique is used. Data dissemination is the process of distributing the information throughout the network. The information is collected by common nodes which are also called as source nodes. These common nodes transmit data to the sink node. The sink node is used for collection of the data or information. Sink node is responsible for managing and monitoring the information collected from other nodes. This process is carried out hop by hop from source nodes towards sink node. Thus a technique in which collecting a data and transmitting it to the sink is called as data dissemination.

There are different techniques for the data dissemination such as cluster based, infrastructure based, information based etc. The following figure shows the cluster based data dissemination.

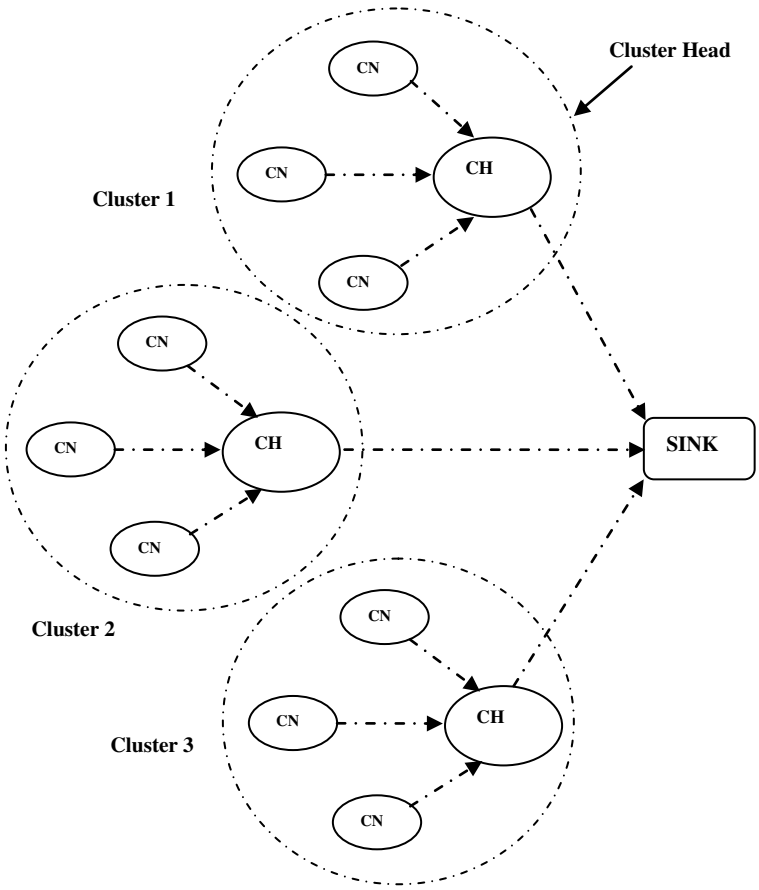



**Figure-2.** Architecture of cluster based data dissemination.

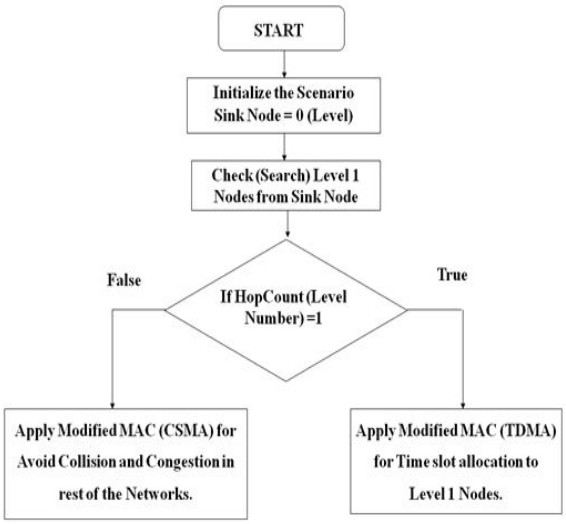
In clustering based approach group of sensor nodes is created which together forms a cluster. Every cluster contains one cluster head which is responsible for intra-cluster data collection. The information is collected by common nodes. These common nodes transmit data to the cluster head. The cluster head monitors the cluster and reports the collected data to the sink. There is the inter cluster communication between the cluster head and the sink node. The clusters are connected to the sink in a hierarchical structure.

The clustering approach works on basis of TDMA and CSMA MAC protocols. Cluster head working with TDMA MAC and other common nodes working with CSMA MAC protocol. Time slot is allocated to each cluster head using TDMA. Cluster head transmits data to the sink node within active period. Rest of the nodes are in sleep state. Data is collected by cluster heads as a CSMA and it transmit data to sink node as a TDMA MAC protocol. Data dissemination at cluster head is used to reduce energy consumption, delay, packet loss ratio (PLR), congestion control etc. at the sink node.

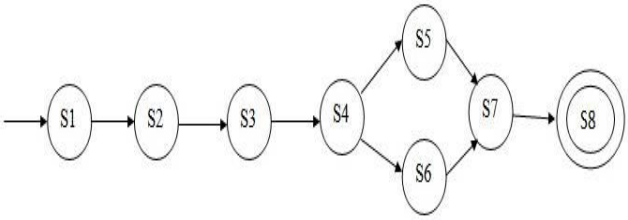
**ALGORITHM**

1. Start.
2. Initialize and assign sink node level = 0.
3. Search level (hop) 1 nodes from the sink node.
4. If (hop count = 1)
   then Apply modified TDMA for slot time allocation
   Slot Time (ST) = Total time/Number of sensor nodes (Level 1)
   Transmit data within allocated slot time ST as a TDMA.
   else
   Apply modified CSMA to the rest of the nodes.
   Collect data as a CSMA from rest of the network.
5. Collect data from level (hop) 1 nodes to the sink node.
6. Stop.

Flowchart




## STATE TRANSITION DIAGRAM




S1= Start State.

S2= Initialize the Scenario Sink Node = 0 (Level).

S3= Check (Search) Level 1 Nodes from Sink Node.

S4= If HopCount (Level Number) =1.

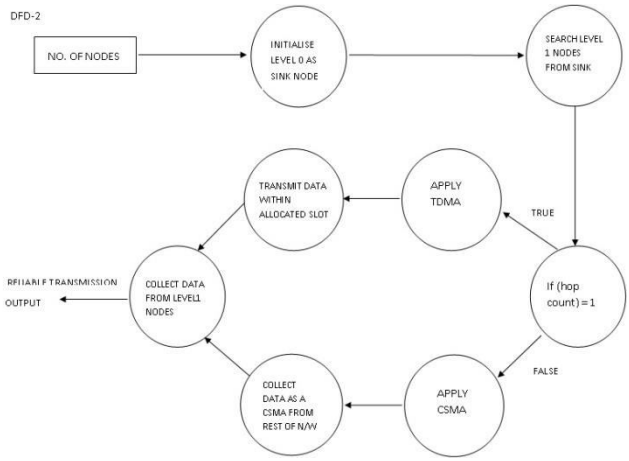
S5=Apply Modified MAC (TDMA) for Time slot allocation to Level 1 Nodes.

S6=Apply Modified MAC (CSMA) to Avoid Collision and Congestion in rest of the Networks.

S7= Collect data from sink node.

S8= Stop.

## DATA FLOW DIAGRAM




## CONCLUSION AND FUTURE WORK

In this paper we have studied different routing protocols and routing technique. These techniques are developed for achieving various QoS in WSN. Most of the authors concentrate on achieving Energy, Congestion Control and delay parameters. We proposed cluster based data dissemination approach which is useful for achieving maximum QoS using CSMA and TDMA. Finally we concluded that many routing protocols are designed to reduce energy consumption and End-to-End delay. In future we go one step ahead and design a new novel Hybrid MAC protocol using CSMA and TDMA which will help for achieving maximum QoS parameters.

Wireless sensor network is a set of distributed nodes randomly deployed in environmental area. Performance of the networks is measured using QoS of networks. Depending upon the congestion control performance of the network can be improved. Many researchers implement the different protocols, techniques and algorithms for performance improvement of network. In this paper we covered maximum techniques and protocols implemented by the many researchers. Techniques which achieve maximum QoS like delay, congestion control, throughput, energy efficiency in the network are proposed in this paper. The Given Table shows the techniques and protocols implemented by researchers. The QoS is achieved by the protocols and techniques. We come to the conclusion that this paper is very useful for new researchers for the innovation of new techniques and protocols in sensor network. Table contains advantages and list of the QoS achieved by authors. In future work we invent the hybrid protocol or technique which is very useful to achieve more parameters of sensor networks

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