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# Cognitive Cross-Layer, Energy Efficient MAC Protocol in Mobile Wireless Sensor Networks

**Mohammed Nazeer, Garimella Rama Murthy**

***Abstract:** In the region of mobile wireless sensor network, getting least energy consumption is a very important research problem. A number of energy proficient protocols have been implemented for static wsn, generally built on a layered design approach, i.e. they are motivated on designing ideal strategies for "single" layer by considering the sensor nodes as static. In proposed paper, we consider a cross-layer design. A new MAC protocol termed MAC-SWITCH is proposed. In this new approach, the communication between MAC and routing layers are fully exploited to achieve energy efficiency for various paradigms of mobile wireless sensor networks. More surely, in the proposed MAC-SWITCH algorithm, routing and data information at the network layer is used by the MAC layer such that it can reduces number of contention for channel and perform protocol switching based upon type of data. The performance of the proposed MAC-SWITCH is evaluated by quantification and simulation. The quantification is done by using gauss lattice point theorem and simulation by using the NS-2 simulator. It has been evident that the proposed MAC-SWITCH outperforms the existing aloha and SMAC protocols in terms of energy efficiency, number of contention, packet transmission and network lifetime.*

***Keywords:** MAC, Energy Efficiency, Routing, Wireless Sensor Networks.*

## I. INTRODUCTION

A wireless sensor network consists of a number of sensors use to provide transmission of data to the sink/sensors. [1] The design of MAC protocol with minimum energy consumption is an important issue due to limited battery power constrained on the sensor node. The power drain may terminate the necessary tasks of the sensor networks. Recently a lot of focus is done on developing energy efficient MAC protocols in MWSN's [5]. They focus on optimizing MAC layer energy efficiency by using on or off model i.e. keeping transceiver off when it is not involved in communication. They will not consider type of data. In proposed algorithm we uses cross layer design approach between MAC and network layer. This tactic maximized energy efficiency, a new protocol named "MAC-SWITCH" is proposed. By doing so, we believe that contention to access channel has been significantly reduced, real time data get quick response from sink due to protocol switching.

The major intention of the proposed MAC-SWITCH is to reduce the number of sensor nodes contending for the channel.

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In the existing approach all the nodes that exist in between the source and destination will participate in transmission of data and have negative effect from energy point of view. Some of the existing approach uses selected node for transmission based upon the cross layer protocol. To decide which node is on the routing path, the proposed scheme utilizes [2] leveling and sectoring routing algorithm information through a cross-layer design approach. Another task of MAC protocol is used to check the type of data. The data has been classified into two types real time and non-real time. The real time data are used to report events such as FIRE, non-real time data are routine values. Based upon type of data MAC protocol has to perform protocol switching (i.e. if the data is real time it has to use SRMA, MAC stop all non-real time data and use the spectrum of the primary user in order to report the event to the Base station as soon as possible). Non real time data (i.e. if the data is non-real time it will use pure contention MAC within the levels or cluster for sending the data to the propagation node or cluster head. Further it will send the data to the Base station) the performance of the proposed MAC-SWITCH protocol is estimated by quantification and simulation. The simulation is done by using NS2 network simulator.

In this research paper we propose cross layer MAC Switch protocols for mobile WSNs. This paper is staged into VI Sections. In section II, Related work. In section III, Interesting mobile WSN paradigm in section IV, Another mobile WSN paradigm. Section V Simulation result &analysis. Finally section VI indicates our future work followed by the concluding remark.

## II. RELATED WORKS

[6] It can be deploy to real time MWSN like IoT. It is evaluated by using various performances metric such as energy efficiency, throughput and delay. It reduces delay, energy and increase through put. It provide cross layer between three layers (network, MAC and physical). In full-duplex bidirectional route transmission, a sender node broadcasts discovery message, RTS message, and CTS message in its maximum power max in order to reach its STR and capture channel for transmission. It can also avoid hidden terminal problem but the disadvantage of this mechanism is the number of nodes contenting the channel are more all the neighboring nodes of the source content the channel for the transmission of the packet. [7] Present a cross layered MWSN routing protocol for critical data transmission in vehicular network the proposed mechanism consider proactive neighbor management, congestion and mitigation at network layer link quality and packet velocity at MAC layer and power switching at physical layer.

The proposed cross layered NCARP protocol contains the various components but Congestion Awareness protocol is not efficient as it is not avoiding the nodes that are unnecessarily participating in the contention of the channel.

[8]It performs cross layer between application, network, MAC and physical layer. The application layer provides location information used by MAC to assign transmission power it minimizes power to reduce energy consumption. In this model it broadcast to active neighbor only and minimize energy consumption in the network

[9] Its objective is to lower energy consumption by turning off radio module mostly. The scheduling is done by MAC layer by considering information of a node available by using AODV routing table. It performs cross layer between MAC and network layer and it assign node which can have multi access channel. The disadvantage of this mechanism is not considering mobility of the node and not avoiding the nodes which are unnecessarily contending for the channel.

[10] It modifies SMAC for calculating contention window. The value of the contention window lies between CWmin and CWmax. It supports real time data in an energy efficient manner. It reduces data loss and save battery power. It is more energy efficient. The disadvantage of this mechanism is not considering mobility of the node and not avoiding the nodes which are unnecessarily contending for the channel.

[11] It allows secondary user to access channel in a collision free manner. The SU will allowed to access channel based upon number of mini slots has been occupied by the SU. The SU with maximum number of mini slots will be granted with a channel.

## III. INTERESTING MOBILE WSN PARADIGMS

[4] In wireless sensor networks the following paradigms are possible based upon mobility

i. Mobile Base station and stationary sensors.
ii. Mobile sensors and stationary Base station.
iii. Both Base station and sensors are mobile.

### A. Energy Efficient Cross Layer MAC Protocol

There are three types of MAC protocols in mobile WSN (i.e. special case of structured MANETS) we propose “protocol switching” among the three types by cluster head based on the type of data. Further, in the case of, cognitive WSN, spectrum sensing is done by cluster heads (secondary users) and the cross layer protocol is utilized for efficiently accessing of channels.

The level and sector information is utilized by the cluster heads in choosing MAC protocol. MAC protocol falls into the following three categories.

I. Pure contention (Non real time data)
II. Contention with reservation (real time data)
III. Contention with scheduling

Nature of the routing protocol is taken into account in deciding MAC protocol

[12]Quantified energy saving by using routing protocols

We quantify number of unnecessary contention for the channel there by reducing the number of collisions

### B. Mobile Base Station Stationary Sensors

Mobile Base station and stationary sensors: over the sensor field, sensors are stationary and BS (base station) is mobile, Mobile BS is used for broadcasting the query and collects the sensed values. The mobile BS starts at various locations and move over the sensor field. Since BS is mobile placed in every sector, they perform broadcast and collect cost. Coordination between the mobile BS and cluster head is provided by using TDMA based MAC protocol to dump the data onto the mobile BS during their assigned slot.

### C. Specification of Cross Layer Protocol

Energy savings: Traditionally in the OSI layering model each layer does services to the layer above it for instance data link layer provides service to the network layer in the protocol stack, traditionally MAC and routing protocol are designed independently. But it was realized by researchers that cross layer protocol design is very useful i.e. MAC protocol design takes into account the routing protocol design and Vic versa

### D. Minimization of Channel Contentions: Equations, using Leveling and Sectoring

Collect cast: cross layer design: we realize that using leveling and sectoring algorithm for collect cast the cluster head prevent unnecessary propagation of packets from lower levels to the higher level i.e. the packet header (of packets received from physical layer) is checked to route packets from a certain level to the lower levels only and not higher levels.

### E. Analytical Modeling

The total channel used in propagation of packet from base station to all nodes can be calculated as $= X_T E_T + X_R E_R$Further, we can compute the total number of nodes for following cases:

Planned Deployment Broadcasting,

Consider a rectangular grid with the following cases.

Pure Contention or Aloha Contention:

In this condition no rules are applied for packet broadcast. The grid is deployed and the nodes are contending for channel using MAC layer. With no contention rules in place, all the nodes will be involved contending for channel using MAC layer.In case of grid with cluster heads, we are assuming that cluster heads are the only nodes, capable of contending for channel. All other nodes can't contend for channel, this assumption applies to all the cases.

If there are no cluster heads

$$X_T = N - 1 \qquad (1)$$

$$X_R = N - 1 \qquad (2)$$

If there are cluster heads

$$X_T = N_C - 1 \qquad (3)$$

$$X_R = N - 1 \qquad (4)$$

Partially Controlled Contention or SMAC Contention:

In this condition, when a node receives a packet, it contending for channel for forwarding the packet probabilistic ally.

This situation is like getting a reward after tossing a coin. If head comes up, it will contend for channel for forwarding the packet otherwise the node will drop it. Hence there are upper and lower bounds, for total number of nodes involved in contending for channel for forwarding. Node count will be least, if there is a shortest path between source and the BS. Along with that all the nodes must forward the packet in that path. Hence the lower bound is the distance between the source and the BS. In worst case, all the nodes can transmit the packets. Hence, it defines the upper bound.

If there are no cluster heads

$$|D| \leq X_T \leq N - 1 \qquad (5)$$

$$|D| \leq X_R \leq N - 1 \qquad (6)$$

If there are cluster heads

$$|D| \leq X_T \leq N_C - 1 \qquad (7)$$

$$|D| \leq X_R \leq N - 1 \qquad (8)$$

Contention with leveling and sectoring:

In this case strict forwarding rule with level and sector ids have been imposed in leveled and sectored sensor grid field. Hence, the packets originating from a lower level must be dropped by a higher level node. Similarly, apart from the neighboring sectors, packets coming from distant sectors must be dropped by a receiving node.

If there are no cluster heads

$$X_T = \sum_{i \varepsilon S} N_i - 1 \qquad (9)$$

where S is the set of nodes in source sectoroid and below sectors, nodes in left sectoroid and below sectors, nodes in right sectoroid and below sectors

$$X_R = \sum_{i \varepsilon S} N_i - 1 \qquad (10)$$

where S is the set of nodes in source sectoroid and below sectors, nodes in left sectoroid and below sectors, nodes in right sectoroid and below sectors, nodes in left+1 sectoroid and below sectors, nodes in right+1 sectoroid and below sectors}

If there are cluster heads

$$X_T = \sum_{i \varepsilon S} N_i - 1 \qquad (11)$$

Where S is the set of Cluster heads in source sectoroid and below sectors, Cluster heads in left sectoroid and below sectors, Cluster heads in right sectoroid and below sectors

$$X_R = \sum_{i \varepsilon S} N_i - 1 \qquad (12)$$

Where S is the set of Nodes in source sectoroid and below sectors, Nodes in left sectoroid and below sectors, Nodes in right sectoroid and below sectors, Nodes in left+1 sectoroid and below sectors, Nodes in right+1 sectoroid and below sectors

Random deployment

We consider a sector in which there is a balanced binary tree of nodes.

Energy Savings in Transmission

$P_t$ = Energy spent in transmitting a packet.

When a query is broadcasted over sensor field, the numbers of packet transmitted are

Number of nodes at level 'j' = $2^j$

The number of nodes involved in contention for channel in rebroadcast= $E_t$

$$E_T = (1 + 2 + 2^2 + \dots + 2^i - 1) - (2^i - 1)P_t$$

Energy Savings for contention of channel in Reception

$p_t$ = Energy spent in reception a packet.

It should be noted that when nodes at level 'i' transmit the packet, number of nodes unnecessarily involved in reception of channel and thus wasting energy in reception are

The number of nodes involved in reception is $=E_T$

$$E_T = (1 + 2 + 2^2 + \dots + 2^i - 1) - (2^i - 1)P_r$$

We estimated $E_t$,$E_r$ with respect to nodes at level 'i'.

We thus combine the energy saved with respect to

I. Broadcasting query for data centric routing.
II. Collect Cost: sending data from nodes at level 'i' towards BS.

Now, we can estimate the total energy saved by avoiding unnecessary nodes contenting for channel with leveling and sectoring algorithm with respect to a single sector.

### F. Data Centric Channel Contention: Energy Efficient Collect Cost Channel

$$E_T = (1 + 2 + 2^2 + \dots + 2^i - 1) - (2^i - 1)P_t (13)$$

$$E_T^G = \sum_{i=2}^{|M|} (2^i - 1)p_t \qquad (14)$$

$$E_T^G = \sum_{i=2}^{|M|} 2^i - (m - 1)p_t \qquad (15)$$

$$= [(2^{M+1} - 2) - (M - 1)]p_t \qquad (16)$$

$$= [(2^{M+1}) - (M - 1)]p_t \qquad (17)$$

$$E_T^G = \sum_{i=2}^{|M|} (2^{i-1} - 1)p_t \qquad (18)$$

$$= \sum_{i=3}^{|M|} (2^{i-1} - (m - 2))p_t \qquad (19)$$

$$= [(2^m - 4) - (m - 2)]p_t \qquad (20)$$

$$= [2^m - m - 2)]p_t \qquad (21)$$

$\{E_t$,$E_r\}$ are estimated with respect to energy savings in a sector. When these quantities are multiplied by number of sector we get the effective energy saving.


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### *A. Planned Deployment Energy Saving in Collect Cost Channel*

In grid based sensor field the sensor nodes are placed at lattice point with a unit distance apart from each other vertically and horizontally. By taking certain radius value the given grid is classified into a level. By changing the radius value sequentially we are classifying the various sensor nodes (placed at lattice point) into different levels.

To determine the no of lattice point in the level we will use gauss lattice point theorem [3]. It determines the no. of lattice points inside and on the boundary of the circle of radius r by using following expression

$$N_{(r)} = 1 + 4[r] + 4\sum_{i=1}^{[r]}\left[\sqrt{r^2 - i^2}\right] \quad (22)$$

The number of sensor nodes in a specific level is calculated using

$$N_{Level_i} = N_{r_i} - N_{r_{i-1}} \quad (23)$$

Further the grid is divided into sectors with fixed angle. A sector along with a specific level is known as sectoroid. If there are S equally partitioned sectors, then total number of sensor nodes in a sector can be calculated using

$$N_{Sector} = 1 + \left[\frac{N_{(r)}}{S} - 1\right] \quad (24)$$

Now total number of sensor nodes in a sectoroid can be calculated as

$$N_{sectoriod} = N_{Sector_i} - N_{Sector_{i-1}} \quad (25)$$

The nodes should contend for channel to transmit the packet from the higher level to the lower level i.e. from sensor node to the BS. If any node situated at lower level is contend for channel to transmitting the packet to higher level, and then it is wasting energy.

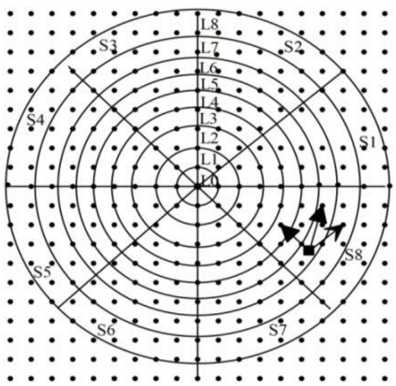


**Fig1: Leveling and Sectoring**

Let us consider a grid as shown in Fig1: Leveling and sectoring. At every point in the grid (consider as a lattice point) a sensor is placed. The entire grid has been divided into levels such as L1,L2, ..., L8 and further divided into sector as S1,S2,… ,S8.

### *B. Random deployment energy saving in Collect Cost Channel*

If we consider an arbitrary graph, a spanning tree can be extracted which is minimally a binary tree. Hence, we consider the case of balanced binary tree, nested tree and Q-ary tree for mathematically estimating the wastage of energy in contend for channels in transmission/reception. The consideration of simplest network topology would help in computation of energy wastage in absence of Leveling and Sectoring Protocol. The same can be applied to the real time WSNs.

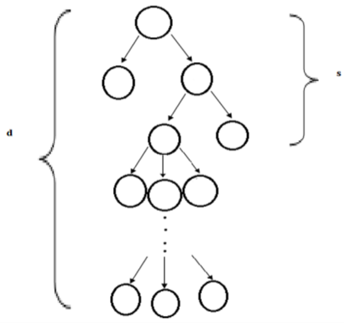

**Fig 2: Random Deployment of WSN**

The WSN is in the form of a Balanced Binary tree of depth d. The root node of the tree is the Base Station (BST). A node at depth ‘i’ broadcasts information which is being automatically received by the ‘i+1’Th depth and is transmitted further, since leveling and sectoring protocol is not used. As the nodes are arranged in the form of a binary tree nodes are involved in broadcasting. However, the transmission/reception to ‘i+1’th depth cannot be stopped. The nodes placed at further depths (depth greater than ‘i+1’) are involuntarily involved in transmission/reception (the transmission/reception to such nodes can be stopped through leveling and sectoring).

We perform quantification model of the energy wastage occurs in the absence of Leveling and Sectoring protocol by considering the network in the form of binary tree, nested tree and Q-ary tree. Network topology plays a major part in the execution of network operations and the related power consumption. In order to realize the wastage, we first consider linear arrangement of nodes (being the simplest arrangement of nodes). In a linear arrangement, there are ‘n’ sensor nodes placed in a line, with the first node functioning as the Base Station. Assuming the k<sup>th</sup> node to be broadcasting, mathematically Fig. 3 show Linear Arrangement of Wireless Sensor Nodes Number of nodes unnecessarily involved in contending for channel for transmission, Wasted Transmission Energy. Formula

Number of nodes unnecessarily involved in transmission,

$$B_k = n - k - 1 \quad (26)$$

- Wasted Transmission Energy,

$$B_k = n - k - 1 \quad (27)$$

$$T_x = E_t + E_t(n - k - 1) \quad (28)$$

- Where, $E_t$ - Transmission energy

Therefore,

- For, Pure Flooding:
- Transmission

Number of nodes unnecessarily involved in transmission,


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$$B_{t_i} = \left[\sum_{j=i+2}^{[d]} 2^{j-i-1}\right] 2^i \qquad (29)$$

- Wasted Transmission Energy,

$$T_x = E_t + E_t[B_{t_i}] \qquad (30)$$

- For, Controlled Flooding:

In the case of controlled flooding each node contend for channel which receives a packet, broadcasts the packet with probability 'p' independent of other nodes.
Expected numbers of nodes unnecessarily involved in contend for channel for transmission,

$$B_{t_i} = \left[\sum_{j=i+2}^{[d]} 2p^{j-i-1}\right] 2^i \qquad (31)$$

Expected wasted Transmission Energy,

$$T_x = E_t + E_t[B_{t_i}] \qquad (32)$$

The wireless sensor network is in the form of a Q-ary tree of depth‘d’. The following expressions are generalizations of those derived for binary tree.

- Pure Flooding
- Transmission

Number of nodes unnecessarily involved in contending for channel for transmission,

$$B_{t_i} = \left[\sum_{j=i+2}^{[d]} q^{j-i-1}\right] q^i \qquad (33)$$

- Wasted Transmission Energy

$$T_x = E_t + E_t[B_{t_i}] \qquad (34)$$

- Controlled Flooding

In the case of controlled flooding, each node which receives a packet, contend for channel to broadcasts the packet with probability ‘p’ independent of other nodes.

- Transmission

Expected number of nodes unnecessarily involved in contending for channel for transmission,

$$B_{t_i} = \left[\sum_{j=i+2}^{[d]} qp^{j-i-1}\right] q^i \qquad (35)$$

Expected wasted Transmission Energy,

$$R_x = E_r + E_r[B_{r_i}] \qquad (36)$$

## IV. ANOTHER MOBILE WSN PARADIGM

Cross layer MAC protocol: mobile sensors, propagation nodes, stationary Base station. In this paradigm the sensor are mobile and base station is stationary. Some sensors are having smaller velocity and hence consider as relatively stationary and known as propagation nodes. These propagation nodes collect data from the mobile sensor nodes which are moving with higher velocity. The propagation nodes contend for the channel to transmit the data to static base station.

Examples: Mobile drones act as sensors over the agricultural field collecting sensed variables such as temperature, humidity, rainfall etc. there are static drones (acting as hover crafts) collecting data from mobile drones and send the data to the stationary Base station.
In a hierarchical hybrid mobile WSN arising in military application relative to commander of battalion the soldiers (i.e. sensors equipped with position (GPS) velocity and acceleration sensors are mobile. Thus such a wsn arises where BS is stationary and sensors are mobile. In this paradigm there are propagation nodes (e.g. commanders) which collect required sensed variables and transmit the data to stationary BS. We apply leveling and sectoring algorithm to static propagation nodes and static base station. The data available with the propagation nodes can be falls into two categories Based upon type of data MAC protocol can be tuned into the following category

i) Real time data
ii) Non real time data

The propagation node must make sure that real time data reaches Base station soon therefore it uses the more transmission power and primary user spectrum. The spectrum sensing is done by physical layer which provide channel availability to the MAC layer, this spectrum sensing can be done proactive or reactive manner. Only propagation node can uses licensed band spectrum. Non real time data can be sending to the base station without delay constraint using cluster head (employing leveling and sectoring algorithm) which contend for the channel in an intelligent manner. Non real time data uses pure contention protocol switching. non real time data reactive sensing only by the cluster heads with available data/packets. Non real time data does not require QOS constraints

## V. SIMULATION & RESULT ANALYSIS

The simulation is done by using NS-2 simulator to validate the performance of proposed MAC-SWITCH protocol with SMAC and aloha by using various performance metrics such as number of contention for channel per round, amount of energy and collusion.

SG = Size of Grid.
En = Energy.
Pk = Packet.
Co = Collusion.
RD = Round.
Nr = Number of rounds.
Pl = Planned.

**Table1: Comparison of Energy, Packets and Collusion**

| Pl | ALOHA | | | S-MAC | | | MAC-SWITCH | | |
|---|---|---|---|---|---|---|---|---|---|
| SG | En | Pk | Co | En | Pk | Co | En | Pk | Co |
| 5*5 | 1.25 | 25 | 54 | 0.9 | 18 | 42 | 0.65 | 13 | 12 |
| 6*6 | 1.8 | 36 | 93 | 1.25 | 25 | 78 | 0.9 | 18 | 27 |
| 7*7 | 2.45 | 49 | 158 | 1.5 | 30 | 126 | 1.15 | 23 | 34 |
| 8*8 | 3.2 | 64 | 245 | 2.1 | 42 | 197 | 1.5 | 30 | 63 |
| 9*9 | 4.05 | 81 | 354 | 2.7 | 54 | 254 | 1.9 | 38 | 86 |


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**Table 2: Simulation Parameters for both Planned and Random Deployment**

| Simulation Parameters | | |
|---|---|---|
| **Type** | **Parameters** | **Value** |
| Network lifetime | Simulation time | 1000 sec. |
| Base station | Co ordinates | X=0 Y=0 |
| Energy | Initial energy | 1 joule |
| No of Nodes | Node | 50 to 250 |
| Bandwidth | BW | 1 Mbps |

**Table3: Comparison of Energy, Packets and Collusion between Aloha, S-Mac and MAC-SWITCH.**

| RD | ALOHA | | | S-MAC | | | MAC-SWITCH | | |
|---|---|---|---|---|---|---|---|---|---|
| Nr | En | Pk | Co | En | Pk | Co | En | Pk | Co |
| 50 | 5 | 100 | 56 | 3 | 60 | 34 | 1.5 | 30 | 2 |
| 100 | 12.5 | 250 | 156 | 6 | 120 | 87 | 3.3 | 67 | 10 |
| 150 | 19.2 | 384 | 230 | 9.6 | 192 | 118 | 4.8 | 96 | 25 |
| 200 | 27.15 | 543 | 280 | 13.2 | 265 | 165 | 6.5 | 130 | 34 |
| 250 | 33.25 | 665 | 295 | 16.1 | 323 | 183 | 8.1 | 162 | 42 |
| 300 | 37.6 | 752 | 241 | 18.7 | 374 | 140 | 9.5 | 190 | 30 |
| 350 | 42.05 | 841 | 221 | 21.3 | 426 | 108 | 10.7 | 215 | 23 |

### A. Network Set-Up

In this test, the various number of nodes deployed (planned or random) as describe in table 1 and 3 the node are distributed over the dimension of (0, 0) to (100,100) with base station at the origin. The various simulation parameters are mentioned in table 2 Such as bandwidth 1 mbps packet size 25kb and it is run in rounds of 50 sec for 1000sec. Assume number of nodes in between 50 to 350 for all the rounds in random deployment and in planned deployment the number of nodes depend upon the size of grid. Assume energy required to transmit a single packet is 0.05 joule. It is concluded from the simulation results that the performance of the proposed MAC-SWITCH approach perform better than aloha and SMAC.

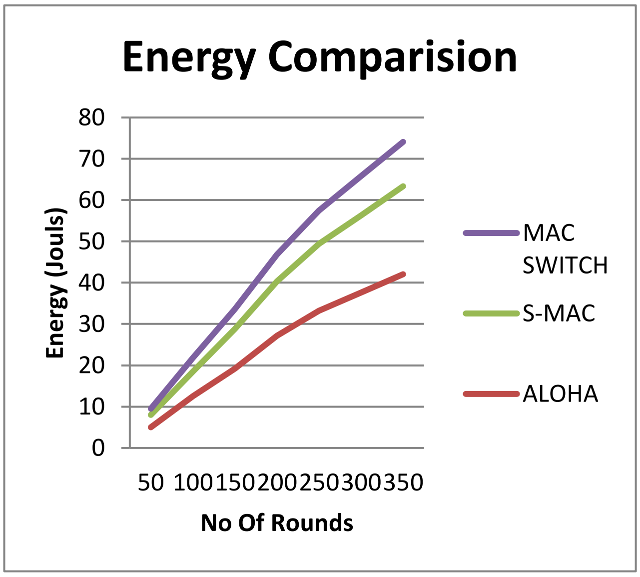


**Fig 3: Amount of Energy Consumption**

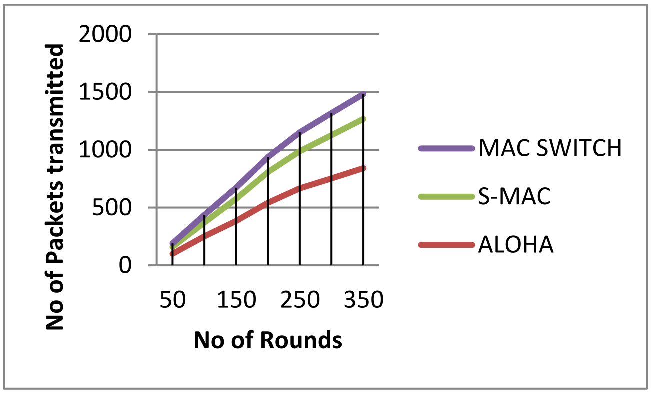


**Fig 4: Number of Packet Transmitted.**

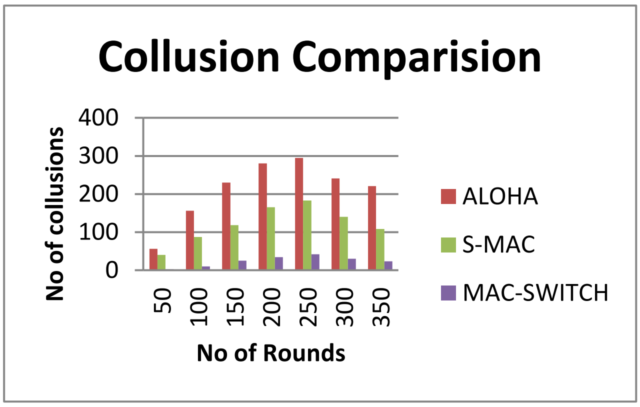


**Fig 5: Collusion Comparison**

### B. Simulation Results Discussion:

The graphical results obtained from the simulation of existing and proposed protocols are as shown in Figures 3, 4 and 5.Fig 3, 4 shows the amount of energy consumed and number of contention by aloha, S-MAC and MAC-SWITCH for each round in both planned and random deployment, and it can be observe that the amount of energy consumed by proposed algorithm is less with less number of contention when compare to the aloha and SMAC. Fig 5 shows the number of collusions occurs when the traditional MAC protocol is utilized. The lifetime of the network depends on the energy consumption and number of collusion. It is seen from Fig 3 and 4 that energy consumption and collusion in aloha and S-MAC more than the proposed model.

## VI. CONCLUSION

The S-MAC and aloha protocol work efficiently for static environment were base station and sensors both are static. In this paper we proposed MAC-SWITCH protocol based upon cross layer approach for various paradigms of MWSN and we evaluated its performance by quantification using gauss lattice point theorem and simulation by using NS2 simulator. This protocol can be utilized in various real time applications such as drone, health, security and agriculture etc. The simulation result proves that the proposed MAC-SWITCH protocol performs better than SMAC and aloha in terms of number of collusion, packet transmission, energy consumption and increasing network life time.



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