Improve energy-efficiency of sensors using cross-layer design technique in WSNs

Rakesh Kumar Saini¹, Mayank Singh², Praveen Saini³

¹School of Computing, DIT University, Dehradun, Uttarakhand, India
²Consilio Intelligence Research Lab, Noida, India
³Moradabad Institute of Technology, Moradabad, UP, India

Abstract. Energy effectiveness is the chief limitation of Wireless Sensor Network because respectively device node in Wireless Sensor network has incomplete energy-efficiency and further limited resources. Cross layer design method allows straight announcement between procedure stack layers. Growth of cross-layer design method is greatest significant for enhancement excellence of facility corresponding energy-efficiency, scheme quantity and Normal end-to-end suspension of sensor nodes in WSNs. Therefore our emphasis is to expand the QoS of sensors nodes in WSNs. One of the methods to increase QoS is cross layer design technique in Wireless sensor network. QoS is compulsory on completely the coatings of wireless sensor network procedure heap nevertheless maximum effort emphasis individual on enhancing solitary coating in rapports of vitality ingesting for wireless sensor network. In this paper we recommend a CLD method which improves vitality depletion of the sensor nodes at the Network Layer, Data Link Layer and Physical Layers of the wireless protocol mountain since energy ingesting issues and others QoS issues happen in these three layers.

1. Introduction

In customary announcement nets, the Exposed Customary covered method has been effective in its capacity to be responsible for modularity, limpidity and adjustment in the cable route nets but strength be inappropriate in the WSNs domain. In the current centuries, many investigation mechanism have been presented for WSNs which are founded on the collaboration among numerous non-end-to-end coatings of the WSNs Mountain. CLD is a co-operation among numerous coatings that association the funds and generate a web that is extremely Adaptive. The CLD method can growing vitality effectiveness of sensor nodes in WSNs. Customary covered construction was very valuable and typically charity for announcement among dissimilar protocol layers. But presently there are sensor network smart from many experiments in undeveloped atmosphere. Customary covered construction is not appropriate for sensor network. Customary covered construction is appropriate individual for supported net. CLD method is appropriate for supported as well as sensor network. WSNs varies from
additional sensor networks in frequent funds. Initially, it covers of essentially unimportant remaining knots which complete classifying, handling, and then wireless transports. One of the core and primary difficulties moved by WSNs is that they are energy self-conscious, owed to the statistic that WSNs comprise of means knots which are cordless-functioned, consequently it is insufferable to reintroduce them, as they are projected to motivate in certain parts for centuries with no conservation. Hence, it is significant to invent conducts by which the vitality effectiveness of these sensor nodes can be augmented so that the general generation of the net is also upgraded. In this paper, we industrialized a CLD (Cross-layer design) method that can complete the impartial of create greatest use of the vitality effectiveness in WSNs.

The CLD technique is used in WSNs to improve vitality efficiency. Restrictions which can be improved by Cross layered enterprise method are quantity, net period, reserve restraint and Regular end to end adjournment. The customary layered approach permits communication among sheets contiguously but does not permit communication among sheets non-adjacently. Cross-layered design method permit interaction between layers non-adjacently thus nearby is prerequisite of a CLD method that determination increase QoS constraints like energy-efficiency, scheme quantity in WSNs.

2. Why cross layer design

The CLD is a co-operation among numerous sheets that association the incomes and generate a system that is extremely adaptive. As we all know that there are some restrictions of WSNs such as computational proficiencies are partial, storage capability is limited and energy or power is imperfect of instrument nodes in WSNs, effective use of vitality is one of the core strategy deliberations in WSNs. Cross layer design method is the greatest method for increase vitality adeptness in Wireless Sensor Networks. In Outmoded coated procedure creation one coating container interchange statistics and interconnect among respectively additional unique afterward additional. In customary covered method a procedure gather statistics that are approaching from higher layer and formerly onward data to higher layer likewise, a protocol gather data that are upcoming from inferior coating and then onward data to higher coating but there a procedure can interconnect and interchange data among coatings one afterward additional. Fig.1 Display the communication among head-to-head layers.

![Fig.1. Interaction between Adjacent Layers](image)

To overwhelm the disadvantages of customary covered protocol construction scheme in WSNs, we anticipated cross-layer design method. Cross-layer design technique permits not only procedure connections transversely the layers, nonetheless likewise the opportunities of integration and elimination of coatings, and the formation of new boundaries and objects for communications between the coatings (Ranjan et al., 2015). The customary covered method offers a stage for manipulative interoperable schemes, but it smarts from more transmission directly above. So, CLD is charity to minimalize this directly above by consuming statistics and info collective amongst dissimilar layers. Fig.2 Display the
interface between Non-adjacent layers. In Interface between Non-Adjacent layers any layer can collaborate with any other layer. In this paper we have arranged a cross layer configuration approach. Arranged cross-layer plan strategy will be beneficial energy effective as contrast with existing methodology.

![Fig.2. Interaction between Non-Adjacent Layers](image-url)

3. Problem statements

CLD method allows dissimilar layers of the wireless protocol stack to inter-communicate and interchange data between each other. Afterward teaching of remaining effort we discovery some difficulties in this part that are registered below:

1. Cross layer design is challenging to analysis and reshape since alteration in one layer should be result in other layer.
2. There is deficiency of calibration in design of cross-layer. The privation of calibration can indication to numerous difficulties. The privation of calibration can reduction complete net routine in WSNs.
3. The restrictions of a layer which purposes be appropriate in other layers need to be recognized.

4. Related work

A scarce CLD methods have been planned for WSNs [1]-[7]. The whole works study have deliberate in [8]-[18]. Munish gupta et al. [8] has industrialized a cross layer design method which improves dynamism ingesting of the instrument nodes at the Network, MAC and Physical layers of the protocol mountain as greatest of vitality overwhelming issues happen in these three layers, the optimization of liveliness ingesting consuming CLD is improved as the single layer method. Zeeshan Ali Khan et al. [9] planned an adaptive direction-finding metric which assistances in diminishing the vitality feasting as well as assembly the actual limits of the solicitation. Direction-finding metric achieve healthy below dissimilar request limit belongings as it earnings into explanation the result of overcrowding on a specific track by occasionally approximating the suspension standards. Hui Wang et al. [10] planned a Breakdown and Grouping (D & C) method to calculate suboptimal answer and also an iterative procedure is planned for the D & C approach. Planned iterative procedure can likewise deliver important development on the presentation of net time. Jain-Shing Liu et al. [12] have planned a CLD method that can flawlessly house direction-finding, development and watercourse regulator to concurrently happen the different purposes with the assistance of net usefulness enlargement. CLD is accomplished on accomplishing the combined disinterested by using the disseminated calculation. Yong Ding et al. [14] have designate the numerous strategic appearances of Wireless Sensor Networks, announcement association and cross layer algorithm (CLA) is providing which founded on control control. LA Delivers
real-time announcement devoid of cooperating the liveliness attentiveness of the current liveliness attentive direction-finding protocol. This allows even delivery of energy spending to sensor nodes. Qingxu Xiong et al. [15] have assembled the sensor ontology and the singular implication subject for MAC is distinct by assuming calculation geometry procedures. By merging request semantics, MAC Procedures can straight contract with request & regulator the data broadcast. Ian F.Akyildiz et al. [17] have planned the sensor ontology which substitutes the whole old-style layered decorum construction that has been used so distant in Wireless Sensor Networks. XLM meaningfully expands the announcement recital and overtakes the traditional layered protocol constructions in footings of both network presentation & application difficulty. This connection highlights on cumulative the corresponding of enquiry tracks for liveliness efficiency.

5. Performance analysis of aodv and bellman ford routing protocols in WSN

Subsequently positioning of big sensor nodes is actual problematic in actual so, we progress a simulation situation to confirm throughput and normal endways stay influence of direction-finding protocols like AODV and Bellman ford routing protocols, for this resolution we are consuming QualNet 5.0.2 replication demonstrating instrument. We are consuming around restrictions and their standards for simulation which are Summarize in Table 1.

5.1 Throughput

Throughput is parameter of QoS in WSNs. Throughput amount how many containers established by base position from sensor nodes.

5.2 Average End-to-End Delay

Normal endways interruption is the regular period in which packages direct since instrument node to the unsuitable place.

| Parameter         | Value                      |
|-------------------|----------------------------|
| Sensor nodes      | 1,2,3,5,7,10,11,16         |
| Destination node  | 17                         |
| Buffer Size       | 1024                       |
| Terrain Range     | 100m x 100m                |
| No. of nodes      | 16                         |
| Frequencies       | 2.4GHz                     |
| Traffic Type      | CBR                        |
| Channel Type      | Wireless channel           |
| Protocols         | AODV,BELLMAN FORD          |
The efficiency of AODV and Bellman Ford are confirmed in the experimentation, the sensor nodes in WSNs are disseminated accidentally in the 100m * 100m area.

![Simulation Environment](image1)

In this imitation atmosphere (Fig.3) sensor nodes 1, 7, 2,10,3,16,11,15 are co-operately permit their statistics to the destination node (Base Station) consecutively simulation is shown in Fig.4. In Successively reproduction sensor nodes are distribution packages to terminus node 17(Base Station).

![Running Simulation](image2)

6. Simulation results

QualNet 5.0.2 simulator is used to tool the direction-finding protocols. The Performance of the AODV and Bellman Ford is evaluated. Table 1 inclines the limitations used in the reproduction. The vital presentation processes are throughput and Average end-to-end delay. Simulation result shown in fig. 5 and fig. 6. In fig.5 show result throughput. Throughput resources entire amount of packages recognized by the base station.
In Fig.5 revealed entire quantity of containers established by ignoble place. sensor nodes 1,2,3,5,7,10,11,15 are directing packages to base station, there are ignoble place well-known dissimilar-dissimilar packages since sensor nodes.

In Fig.6, Routing protocols shows low end to end delay.

7. Proposed cross layer modification technique

Proposed CLD technique permits communication amongst coatings. In this approach, respectively coating interconnect with other layers and each layer has information about others layers. We plan our cross-layer design technique as in Fig.7. Initially at Physical layer we compute RSSI (Received Signal Strength indicator) Assessment of Sensor nodes from Base Station and send these RSSI values to Network layer and use a Cross-layer routing algorithm, Cross-layer routing algorithm provide facility to all sensor nodes by using this routing algorithm sensors nodes find location of base station and communicate with base station. Besides at Network Layer we designed RSSI evaluation of sensor hubs and on the off chance that hub has more prominent RSSI worth, at that point decision this hub as information advancing knob from sensor hubs to base station, thirdly at MAC Layer we zeroed in on evading sway and snooping for this reason a Development framework is utilized here. Plan strategy assortments program of all sensor hubs that are looming from Network layer and convey botch free transmission. Improvement strategy is utilized for staggered detecting and network. It Create a timetable for all sensor hubs, each sensor hub send information when channel is free.
We are utilizing a cross-layer dissemination conspire which holder multiuser transmission in a particular declaration recurrence and bit properties in MAC Layer and Physical layer. Cross-layer pointing calculation at Network layer is appeared in Algorithm 1. Algorithm 1 articulations the reasons among sensor hubs and Base station. Advancement system at MAC Layer is uncovered in calculation 2. It designed the event if it is free, on the off chance that channel is free, at that point give a schedule opening to sensor and correspondence holder to Cross layer allotment cradle (CLAB). CLAB checkered recurrence, Channel and schedule opening of sensor hubs and in the event that channel is free, at that point dispatch bundles from CLAB to Physical Layer.

### Table 2: Notations used

| Notation | Description               |
|----------|---------------------------|
| $S_N$    | Sensor nodes              |
| $B_S$    | Base Stations             |
| $B_D$    | Buffer data               |
| $P_N$    | Packets                   |
| CLAB     | Cross layer allocation buffer |
| $T_s$    | Time Slot                 |
| $Ch$     | Channel                   |

#### Algorithm 1: Cross-Layer Routing Algorithm at Network Layer

1. $S_N$ wants to send packets to $B_S$
2. $S_N$ check its sensing feasibility from $B_S$
3. If $B_S$ is in sensing range then $S_N$ sends RQ msg for packets sending to $B_S$
4. If RQ msg received by $B_S$ then it sends back response message RM1 to $S_N$ for sending packets
5. $S_N$ Sends packets to $B_S$
6. If $B_S$ receive packets of $S_N$ then it sends response message RM2 to $S_N$ for confirmation of packets received successfully
7. If $B_S$ is not ready to receive data, $S_N$ waits for response message RM1
8. Repeat step 1 to 6

#### Algorithm 2: Scheduling Algorithm at MAC Layer

1. If buffer data $B_D = P_N$ Then
2. Check Channel $Ch$ whether it is free or not
3. If $Ch=0$ then set $Ch=P_N$
4. Set $P_N = T_s$
5. $P_N$ dispatch to CLAB buffer
8. Conclusion

Cross-layer plan technique assurance at recoup the energy proficiency of sensor hubs in remote sensor organizations. Proposed cross-layer plan realistic in this paper achieves the goal of refining essentialness skill by minimalizing course discovering costs. In this paper, we have arranged a unique cross layer plan technique for recoup energy-productivity and plan amount in remote sensor organization. Proposed cross layer plan strategy will upgrade dynamism utilization at Physical layer, Data interface layer and Network layers of the remote sensor network convention stack. Proposed CLD technique grant declaration among layers non-contiguously and each layer has data about other layer like Application layer has data about MAC Layer and MAC Layer has data about Network layer and Network layer has data about Physical and Data interface layer. In Planned CLD strategy, Development methodology assortment program to all sensor hubs that are drawing nearer from network layer and cross layer appropriation course of action license multiuser broadcast in a lone dispatch station. In forthcoming examination work, we will put on arranged CLD strategy in QualNet 5.0.2 Simulator exhibiting execute and affirm the extended CLD technique and afterward approve the result with the staying cross layer plan strategy. Proposed cross layer plan technique will be extra energy-productive strategy as associate to winning cross layer adjustment strategy.

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