

# EECLA: Energy-Efficient Cross Layer Approach

Rakesh Kumar Saini\*

\*Department of Computer Application, DIT University, Dehradun, Uttarakhand, India.

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\*Corresponding author: Dr. Rakesh Kumar Saini, Department of Computer Application, DIT University, Dehradun, Uttarakhand, India. E-mail: rakeshcool2008@gmail.com

## Abstract

Energy efficiency of sensor nodes in wireless sensor network is most important issue because sensor nodes in wireless sensor network consist limited energy-efficiency. Thus our focus to improve the energy-efficiency of sensor nodes. Many researchers have proposed many techniques for improving energy-efficiency of sensor nodes like Clustering routing protocols, Cross layer modification technique and others routing protocols. Cross layer modification technique is best solution for improve energy-efficiency of sensor nodes in wireless sensor network. Cross layer modification technique can share resources between layers and it provides communication between layers. By using cross-layer approach data can be exchanged from one layer to any other layer. In this paper we propose an Energy-efficient cross layer approach (EECLA). EECLA will increase energy of sensor nodes in wireless sensor network.

**Key words:** Cross-layer approach; Wireless Sensor Network; Sensor network;

## Introduction

Wireless sensor network is collection of various sensor nodes that are used to monitor specific area. Sensor node is an electronic device that is made by four basic components that are - Power unit, Transceiver unit, Sensing unit, processing unit. Sensor nodes have limited energy and others resources. In the recent years, many research works have been presented for wireless sensor networks which are based on energy-efficiency of sensor nodes. Sensor nodes are small electronic devices that are used to monitor physical and environmental condition such as temperature, vibration, sound and so on. Due to limited energy-efficiency of sensor nodes, sensor nodes do not work properly in distributed environment so there is requirement of energy-efficient technique that should increase energy of sensor nodes in wireless sensor network. In Survey we find many techniques of improving energy-efficiency of sensor nodes these techniques are

### Clustering routing techniques

Many Clustering routing techniques have been proposed for energy-efficiency in WSN in the last few years. Clustering routing techniques are used for improve energy-efficiency of sensor nodes in wireless sensor network. These techniques are LEACH (Low-Energy Adaptive Clustering Hierarchy), LEACH-C (Low-Energy Adaptive Clustering Hierarchy-centralized), PEGASIS (Power Efficient Gathering in Sensor Information Systems), HEED

(Hybrid, Energy-Efficient, and Distributed), EEPSC (Energy-Efficient Protocol with Static Clustering).

### Routing Protocols

Many Routing protocols are used for improve energy-efficiency in wireless sensor network such as AODV (Ad hoc On-Demand Distance Vector), DSR (Dynamic Source Routing), Bellman Ford. These routing protocols are used for routing information between sensor nodes and base station.

### Cross-layer Modification Technique

Cross layer modification technique is one of the most popular techniques for improving energy-efficiency of sensor nodes in wireless sensor network. Cross-layer modification technique allows communication between layers non-adjacently. Cross-layer modification technique can share resources between layers.

In the above Energy-efficient techniques, Cross-layer modification technique is more energy-efficient as compare to clustering routing protocols and others routing protocols. Cross-layer modification technique is one of the solution of improve energy-efficiency of sensor nodes in wireless sensor network because Cross-layer modification techniques combine the recourses and create a network that is highly adaptive. In this paper we proposed Energy-Efficient Cross Layer Approach (EECLA). EECLA is more energy-efficient as compare to other Energy-efficient technique in wireless sensor network.

### Cross layer Modification

Cross-layer modification is an approach which provides interaction between layers one after another. In Cross layer design (Figure.1), any layer can communicate from any other layer. Physical layer directly communicate from Network layer Similarly Data Link layer communicate from Transport layer and Network layer can communicate from Application layer. In Traditional layer approach this facility was not available means we cannot communicate directly from any other layer. Cross layer modification provide facility in which we can share recourses between layers.

### Related Work

Many researchers studied the necessity and possibility of taking advantages of cross layer design to improve the Energy-Efficiency of sensor nodes in Wireless sensor network. There is

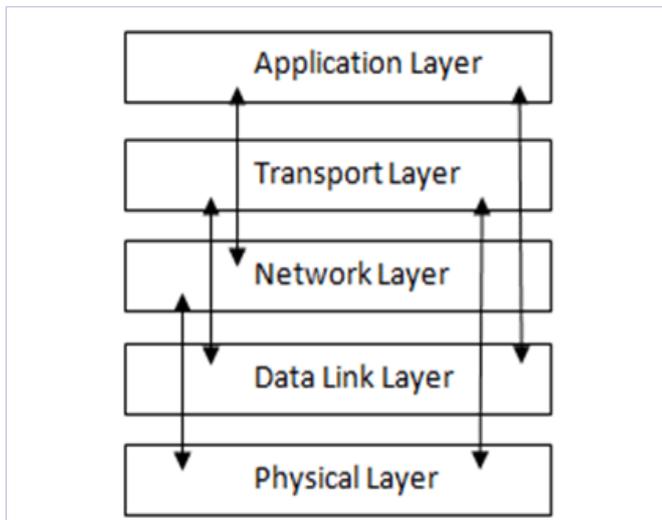


Figure 1: Cross Layer Design

a considerable amount of surveys that discuss WSN technologies in general [1-7]. Energy-Efficient Communication, Munish gupta et al. have proposed a Cross-layer modification technique which improve energy-efficiency of sensor nodes [8-18]. Proposed Cross-layer modification approach implement on lower three layers (PHYSICAL LAYER, MAC LAYER, and NETWORK LAYER) [9]. Have proposed an ARM (adaptive routing metric) which increases energy-efficiency of sensor nodes for various applications of wireless sensor network. Proposed approach performs better for average-end to end delay factor and control interference between sensor nodes in wireless sensor network [10]. Have proposed a Cross-layer approach which provide many solutions of energy improvement and compute sub optional solution for improvement energy-efficiency of sensor nodes in wireless sensor network [11]. Have proposed an Algorithm at layers which improve energy-efficiency and control throughput in wireless sensor network [12]. have proposed a cross-layer design approach which control routing of data between sensor nodes and base station. Proposed approach performs well in distributed environment and control network resources [13]. Has proposed a cross layer at the MAC Layer for improve energy-efficiency. Proposed approach is more energy-efficient as compare to other cross layer approach at MAC Layer [14]. have proposed a cross layer algorithm (CLA) which control power efficiency of sensor nodes in wireless sensor network. CLA Provides equal distribution of energy between sensor nodes and perform well for improving energy-efficiency of sensor nodes in wireless sensor network [15]. Have proposed a cross-layer approach which is based on MAC layer. Proposed cross-layer approach control data transmission between sensor nodes [16]. Have proposed a Lightweight congestion aware reliable Transport Protocol (LCART). LCART performs well for throughput, Average end to end delay [17]. Have proposed a cross-layer approach which improves the communication performance between sensor nodes and base station [18]. have proposed a cross-layer approach which saves energy-efficiency of sensor nodes in wireless sensor network.

### Proposed EECLA

In this paper, we proposed an Energy-efficient cross layer approach (EECLA). In proposed EECLA we are focusing on lower four layers, Transport layer, Network layer, MAC layer, Physical layer. Proposed Energy-Efficient Cross Layer Approach (EECLA) is more energy-efficient as compare to existing Cross layer approach. Proposed EECLA focus on Energy-Efficiency of sensor nodes in wireless sensor network. Proposed EECLA is shown in Figure 2. In Proposed EECLA we are using a Resources Sharing Controller (RSC) which shares the resources between layers. By using RSC each layer can exchange data from any other layers directly. Proposed EECLA works on Congestion control at Transport layer, Routing control at Network layer, Schedule control at MAC layer and Transmission control at Physical layer. (Figure 2)

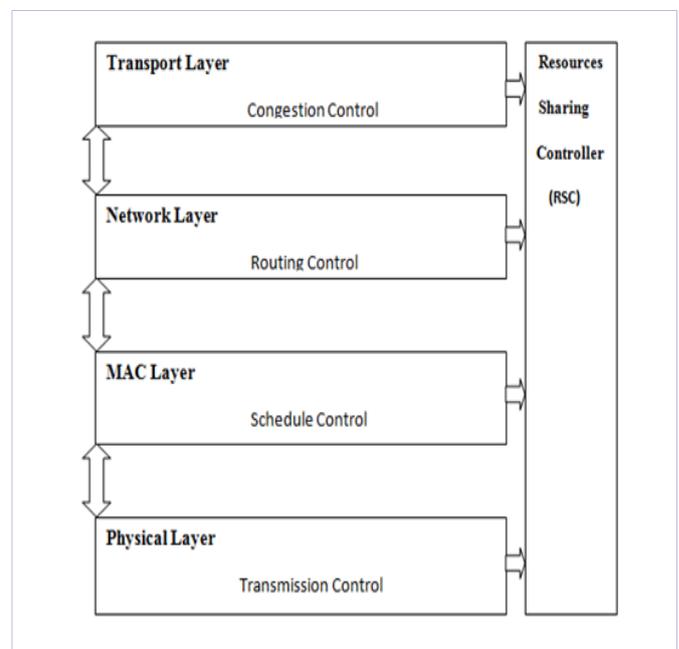


Figure 2: Energy-Efficient Cross Layer Approach

### Simulation of Proposed EECLA

We create a simulation environment for analysis performance of proposed EECLA. For this simulation we are using Qualnet 5.0.2 simulation tool. We are using some parameters in this simulation. Table 1 show the parameters. Figure 3 & 4 Shows Simulation environments in which some sensor nodes are cooperate pass their data to others sensor nodes.

Figure 5 Shows total packets sent from one network to another network by some source sensor nodes. Figure 6 Shows total packets received from one network to another network by some destination sensor nodes. There are we are using EECLA for improve energy-efficiency of sensor nodes. So there are sending nodes are equal to received sensor nodes. So we can say that there is no loss of packets sending from one network to another network. Figure 5 & 6

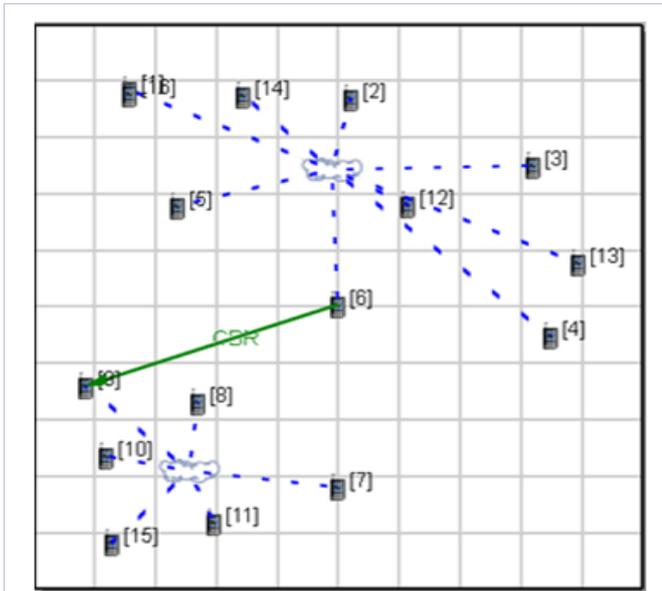


Figure 3: Simulation Environment

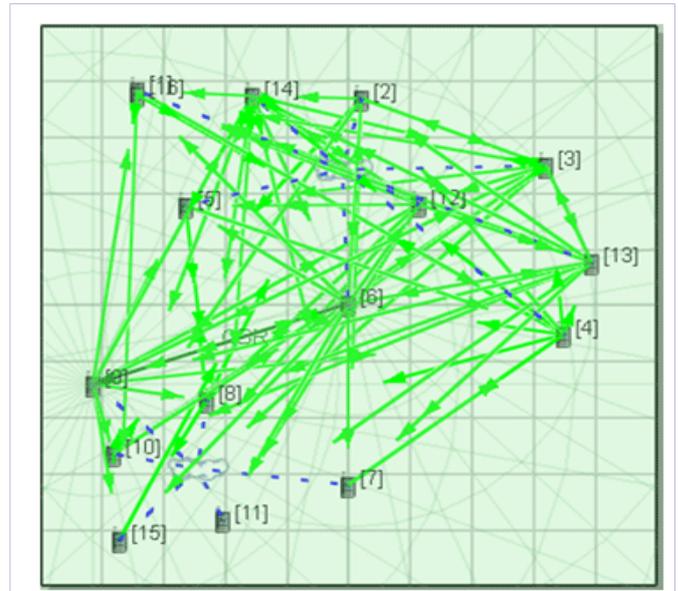


Figure 4: Running Simulation

Table 1: Simulation Parameters

Parameter	Value
Buffer Size	1024
Terrain Range	100m x 100m
No. of nodes	20
Frequencies	2.4GHz
Traffic Type	CBR
Channel Type	Wireless channel
Protocols	AODV

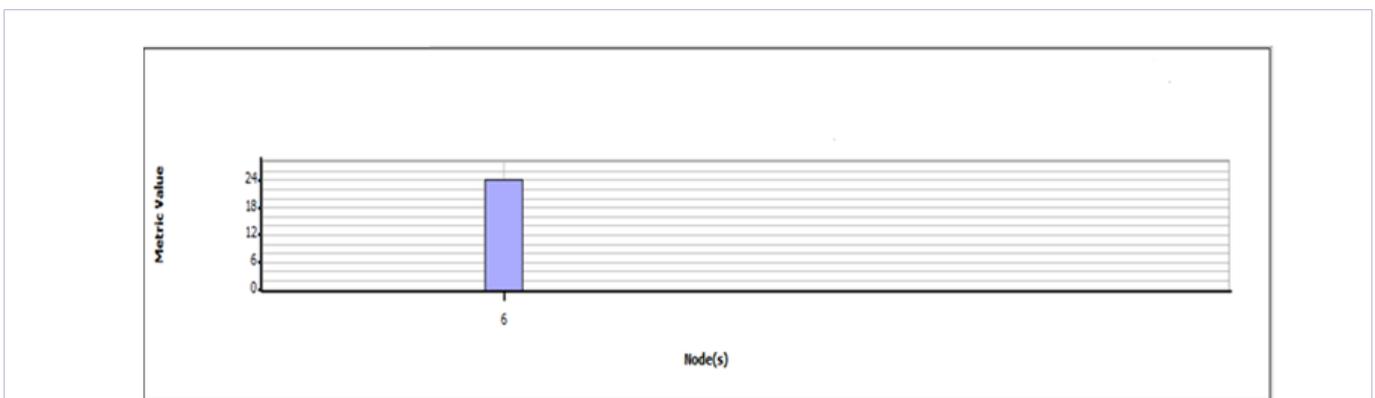


Figure 5: Total packets sent from one network to another network

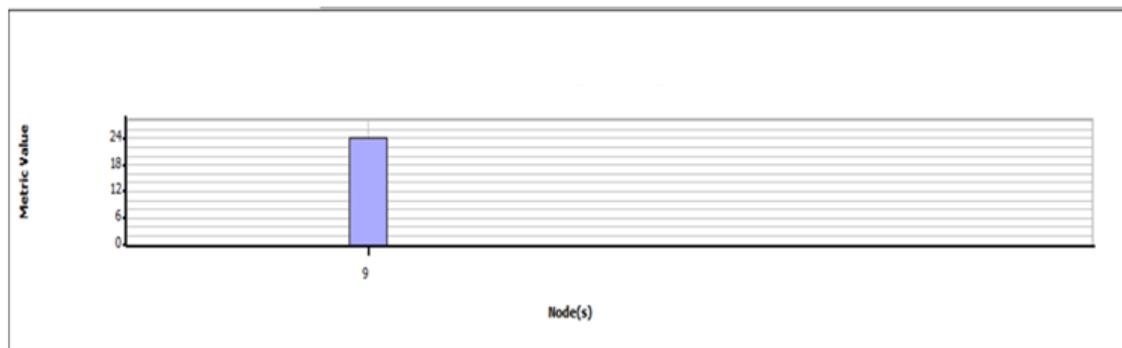


Figure 6: Total packets received from one network to another network

## Conclusions

In this paper, we have proposed an energy-efficient cross layer approach (EECLA) for improve energy-efficiency of sensor nodes in wireless sensor network. Proposed EECLA is using a Resources Sharing Controller (RSC) for sharing resources between Transport layer, Network layer, MAC layer and Physical layer. By using RSC every layer can exchange data from any other layer. We are focusing Congestion control at Transport layer, Routing control at Network layer, Schedule control at MAC Layer and Transmission control at Physical layer. In Proposed EECLA, Resources Sharing Controller (RSC) handles all activities between layers and make schedule for sensor nodes that are sending data to base station. Proposed EECLA will be more energy-efficient approach as compare to existing Cross layer approach.

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