IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 12, Issue 6, June. 2022, || Series -I || PP 22-33

An Energy efficient cluster based routing protocol (ECCRP) technique based on Weighted Clustering algorithm for different topologies in MANETs using Network Coding

Mirza Arif baig[1] Dr Najmuddin Aamer[2]
Research Scholar Sri Satya Sai University of Technology and Medical Sciences, Madhya Pradesh.
Professor and AI-ML Engg DEPT Theem College of Engg, Dist palghar, Maharashtra.
Received 01 June 2022; Accepted 15 June 2022

Abstract
Objectives
In mobile ad hoc networks, all nodes are energy constrained. In such situations, it is important to reduce energy consumption.
The purpose of this research is to minimize the energy consumption in cluster based routing protocol for different topologies and environments in MANETs using network coding and Consider other cluster based protocols(EEFUAV) and compare its performance with efficient cluster based routing protocol (ECCRP) by considering node mobility, traffic, and transmission range.
Network coding is an effective method to improve the performance of wireless networks .The energy efficient cluster based routing protocol (ECCRP) technique is planned to be designed to improve the performance of clustered based routing protocol (CBRP) in terms of energy consumption
Methods
- COPE protocol implements network coding concept to reduce number of transmissions by mixing the packets at intermediate nodes, hence to incorporate COPE into cluster based routing protocol to further reduce the energy consumption.
- To apply network coding at cluster heads to energy-efficient coding-aware cluster based routing protocol (EEFUAV) scheme to reduce number of transmissions.
- To modify the queue management procedure of COPE protocol to further improve coding opportunities.
- To use energy efficient scheme while selecting the cluster head. It helps to increase the life time of the network.
- To evaluate the performance of proposed energy efficient cluster

Based protocol using simulation. Simulation results show that the proposed EEFUAV algorithm reduces energy consumption and increases life time.
Finding
The proposed work investigates, for realistic results, we emphasize that, a complete MANETs is modeled and simulated. All possible data streams viz. image, audio, video and data are used in work are presented in the thesis. The investigative contributions of the work can be listed as:
A routing protocol, this will be multi-objective, energy efficient and secure for MANET applications have been developed.
An analytical and mathematical modeling is carried out along with simulations using NS2 tool.
To maximize network energy lifetime by avoiding nodes with little energy.
To achieve link stability.
To assure secure communication by integrating trust.
A security mechanism to reduce the effect of routing denial of service attack has been developed.
The system was simulated multiple number of times and average of the findings are reported.

Novelty
All nodes are energy constrained in MANET. In such a scenario, reducing energy consumption is necessary. The goal of this study is to minimize the energy utilization of various types and environments in MANETs using network coding in a CBRP. Consider other CBRP such as energy-efficient unmanned aerial vehicle fitness (EEFUAV) and compare its performance with the ECCRP and CBRP by taking into account node mobility, traffic and transmission range. Network coding is a way to enhance the efficiency of wireless

networks. Energy Requirements, of the EEFUAV approach is intended to be developed to improve the performance of the CBRP and Energy ECCRP.
Keyword- Energy efficient cluster-based routing protocol (ECCRP), Clustered-based routing protocol (CBRP), Energy-efficient fitness of unmanned aerial vehicles (EEFUAV), Mobile adhoc networks (MANET), Cluster head (CH), Weighted Clustering algorithm (WCA).

I. INTRODUCTION

1.1 Problem Statement

As MANETs lack infrastructure and are very dynamic in nature, routing becomes a key concern. Due to the limited battery capacity of mobile nodes, energy efficient routing has a substantial influence on MANETs. In complicated settings, such as battlefields and emergency relief scenarios, these batteries cannot be replaced or recharged. To that aim, nodes in ad hoc networks should be able to regulate their energy usage effectively in order to extend the network's lifetime. Each node's energy usage changes depending on its communication state: broadcasting, receiving, listening, or sleeping. Any node that loses power will have an impact on the overall network longevity. As a result, because energy efficiency is a vital and broad research subject, it should be taken into account.[1]

1.2 OBJECTIVES OF RESEARCH WORK

The objectives of proposed research work are:
We propose the performance analysis of energy efficient cluster based routing protocol (ECCRP) technique for different topologies and environments in MANETs. This technique is designed to improve the performance of CBRP in terms of energy consumption.
Also we compare the performance of this proposed protocol with other cluster based protocols in terms of node mobility, traffic, and transmission range.
To develop routing protocol, this will be multi-objective, energy efficient and secure for MANET applications.
The research will be carried out using analytical and mathematical modeling along with simulations.
To maximize network energy lifetime by avoiding nodes with little energy.
To achieve link stability.
To assure secure communication by integrating trust.
To develop a security mechanism to reduce the effect of routing denial of service attack.[1]

1.3 Contributions

The proposed work investigates, for realistic results, we emphasize that, a complete MANETs is modeled and simulated. All possible data streams viz. image, audio, video and data are used in work are presented in the thesis. The investigative contributions of the work can be listed as:
A routing protocol, this will be multi-objective, energy efficient and secure for MANET applications have been developed.
An analytical and mathematical modeling is carried out along with simulations using MATLAB tool.
To maximize network energy lifetime by avoiding nodes with little energy.
To achieve link stability.
To assure secure communication by integrating trust.
A security mechanism to reduce the effect of routing denial of service attack has been developed.
The system was simulated multiple number of times and average of the findings are reported.[1]
To reduce the energy consumption of routing protocols, I aim to apply network coding technology. My aim is to minimize CBRP energy consumption by checking various CBRP [6] protocol and ECCRP protocol network topology technologies.
The proposed research will focus on developing multi-objective energy efficient routing protocol with the following objectives,
1. To maximize network energy lifetime by avoiding nodes with little energy.
2. To achieve link stability.
3. To assure secure communication by integrating trust.
4. To develop a security mechanism to reduce the effect of routing denial of service attack.
The research will be carried out using analytical and mathematical modeling along with simulations. The research objective is to develop routing protocol, which will be multi-objective, energy efficient and secure for MANET applications.[1]

1.4 Wireless adhoc Networks

MANET or A wireless adhoc network (WANET) is a decentralized kind of remote framework. Since it does not depend upon a prior structure, this network is ad hoc. For instance, Using the entry points in controlled (infrastructure) wireless networks or routers in the wired networks as an option, every node take part in routing through sending information meant for additional nodes, thus the discovering of which the nodes forward information is done powerfully upon the base of connectivity of network as well as the algorithm of routing being used.

The nodes are permitted to move wherein wireless ad hoc mobile networks are the self-designing, dynamic systems. The wireless networks do not have the challenges of foundation configuration as well as management, empowering devices to make as well as connect networks that are "on the fly" – anyplace, any moment.[3]

MANETs (Mobile Ad hoc Networks):
MANET is a consistently self-sorting out, self-planning, and foundation less system of cell phones related without any wires. It is at times called as "on the fly" systems else "unconstrained systems".[4]
VANETs (Vehicular Ad hoc Networks):
Vehicular Ad hoc Networks are utilized to correspondence among the vehicles and also the equiproadside. InVANETs (Intelligent Vehicular Ad hoc Networks) are the sort of counterfeit consciousness which urges the vehicles to act in savvy conduct amid from vehicle to the vehicle crashes, mishaps. Radio wavesare utilized by Vehicles to communicate with each other, making correspondence arranges immediately on the fly where in the vehicles are continuing in the city.[5]
SPANs (Smart Phone Ad hoc Networks):
Smart Phone Ad hoc Networksuse current equipment (on a very basic level Bluetooth and Wi-Fi) also additionally programming (conventions) in modernly open cell phones to make shared systems without relying upon cell bearer systems, remote section focuses, or standard system foundation. Most as of late, iPhones of APPLE with variation iOS 7.0 and furthermore greater have been engaged with multi-peer specially appointed work organizing capacity, in iPhones, empowering countless telephones to influence promotion to hoc systems without relying upon cell correspondences. It had been guaranteed this; it is going to "change the entire world".[3]

Flying corps UAV Ad hoc organizes:

Unmanned Aerial Vehicle is a plane without pilot on load up. UAVs might be remotely dealt with (at a ground supervision stationwhich is driven by a pilot) or could take off alone reliant upon earlier modified flight outlines. National use of the UAV wires demonstrating the 3D scenes, parcel deliverance (ex: Amazon), et cetera.

UAVs had additionally been utilized by US Air Force for information aggregation also in addition conditions recognizing, without taking a chance with the pilot in a remote adversarial environment. Through remote ad hoc system advancement implanted into the UAVs, different UAVs can talk among every different and also work like a gathering, supportively to finish an operation and occupation. In the event that if a UAV is demolished by a foe, its information could be immediately offloaded remotely to the other close- by UAVs. The UAV specially appointed message mastermind is moreover now and again known as UAV incite sky sort out.[1]

Navy ad hoc networks:

Naval force delivers for the most part use satellite connections as well as other naval radios to speak with ground station backside on land or with each other. On the other hand, such interactions are constrained by delays as well as restricted range. WANETs permit networks of ship area to be produced over the sea, empowering higher speed remote correspondences between ships, overhauling their sharing of imaging and in addition media data, as well as improved co-ordination in battleground operations. Some protection organizations (for example, Schwartz and Rockwell Collins plus Rohde) have made things that update deliver to-send and additionally transport to the shore cooperations.[2]

Wireless sensor networks:

Sensors are the significant gadgets that accumulate data identified with an unequivocal attribute, for example temperature, wetness, pressure, and so on. Sensors are progressively associated through remote to permit huge scale gathering the information of sensor. Along a vast specimen of the information of sensor, processing analytics could be utilized to do best of these information. The accessibility of sensor remote systems depend upon the thoughts driving WANETs, as sensors would now have the ability to send with no perpetual radio towers, and also they would now have the capacity to shape organizes over the fly. "Splendid

Dust" is one amongst the primary ventures performed at U C Berkeley, wherein small radios could be utilized to cross savvy tidy.[1]

Ad hoc network

WANETs permit instruments, sensors, recordings, as well as additional gadgets to be conveyed and organized remotely for hospital patient observing and clinic, specialist as well as medical caretakers' ready notice, as well as assembling recognition of such information rapidly at combination focuses, with the goal to save the lives.

Challenges:

Different books and what's more works have uncovered the convenient and moreover look into challenges going up against remote exceptionally named frameworks or the MANETs. The furthermore challenges (cons) and central focuses could be instantly compressed underneath:

Pros:

Exceeding operating systems

No any exorbitant framework ought to be introduced Usage of unlicensed repeat extend

Speedy course of data around sender

No any single motivation behind disappointment.

Cons

Every system components might be versatile ⇒ incredibly one of a kind topology System capacities ought to have abnormal state of versatility

No any focal substances ⇒ task in totally scattered way.

WANETs can work over various sorts of radios. They could be UHF (300 to 3000 MHz),SHF (3 to 30 GHz) and EHF (30 to 300 GHz) . Wi-Fi specially appointed utilizes the illegal ISM 2.4 GHz of radios. They could similarly be utilized on 5.8 GHz of radios

WEIGHTED CLUSTERING ALGORITHM

The weighted bunching calculation (WCA) can powerfully adjust with the steadily changing geography of specially appointed organizations. The weighted grouping calculation (WCA) adequately joins every one of the above framework boundaries with specific gauging factors picked by the framework needs. For instance, power control is vital in CDMA organizations, consequently the heaviness of the relating boundary can be made bigger. The adaptability of changing the weight factors assists us with applying our calculation to different organizations. The yield of clusterhead political race methodology is a bunch of hubs called the prevailing set. As per our documentation, the quantity of hubs that a clusterhead can deal with in a perfect world is δ. This is to guarantee that clusterheads are not over-stacked and the effectiveness of the framework is kept up with at the normal level. The clusterhead political race technique is summoned at the hour of framework initiation and furthermore when the current prevailing set can't cover every one of the hubs. Each conjuring of the political race calculation doesn't really imply that all the clusterheads in the past predominant set are supplanted with the new ones. If a hub isolates itself from its current clusterhead and appends to another clusterhead then the involved clusterheads update their part list as opposed to conjuring the political decision calculation. A fundamental adaptation of this calculation showed up in [8].

NETWORK CODING

Network coding reduce delays and construct a more robust network .NC is a technique in which transmitted data is decoded and encoded to enhance network throughput. With the advent of Cognitive Radio Networks (CRNs), network coding is shifting away from traditional wireless networks and toward CRNs.[8]

II. METHODOLOGY

Energy-Efficient Coding-Aware Routing Protocol

Simulation model

To make the most of the nodes' energy resources, we suggest an energy-efficient coding-aware routing protocol. This approach use wireless network coding to minimise the energy required for packet transmission and reception at a node. We use network coding in the CBRP protocol to take advantage of clustering and decrease broadcasting cost. The simulation model is depicted in Fig.3.1. The suggested system requires as input parameters nodes, node mobility, node beginning energy, and packets to be transmitted. It generates output in terms of simulation duration, number of packets sent to destination, and node energy left after the simulation.

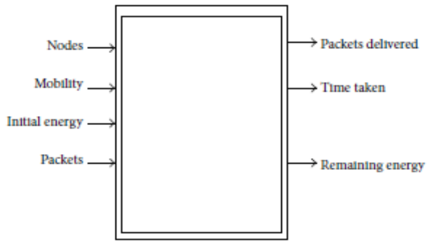


Fig 1: The simulation model

ENERGY EFFICIENT COPE ARCHITECTURE

This strategy enhances the number of coding options available at cluster heads. A node in a COPE-based network maintains a FIFO queue as well as two virtual queues for each neighbour. COPE's present queuing system restricts the coding chances that give coded packets better priority. They aid in the quicker depletion of the queue at the bottleneck node. At each node in the present COPE system, just one queue is maintained. Cope first dequeues the output queue's head packet and then checks the head packets of virtual queues one by one to locate the right packet to encode.[1]

ENERGY EFFICIENT CLUSTERING SCHEME

High energy nodes are regarded as cluster heads. One method for conserving energy in a cluster-based ad hoc network is for all member nodes except the gateway node to enter sleep mode while idle. Only CHs and gateway nodes are active for any communication in this technique; in other words, the network's backbone is always active for any communication. If a node is idle for t1 seconds, send a packet to CH to put it to sleep. If this node receives an ACK from the CH, it enters a t2-second sleep state. Every node has an internal clock that resets when it is placed to sleep. The node automatically wakes up after t2 seconds. Because cluster heads and gateway nodes are active throughout the network, our approach has a low latency time. In our module, we define idle timer, which displays the time that a node was idle, and sleep timer, which displays the time that a node was sleeping. We implemented the technique in the routing layer and only considered member nodes, excluding gateway and cluster head nodes.[2]

NETWORK CODING AT CLUSTER HEAD (CH).

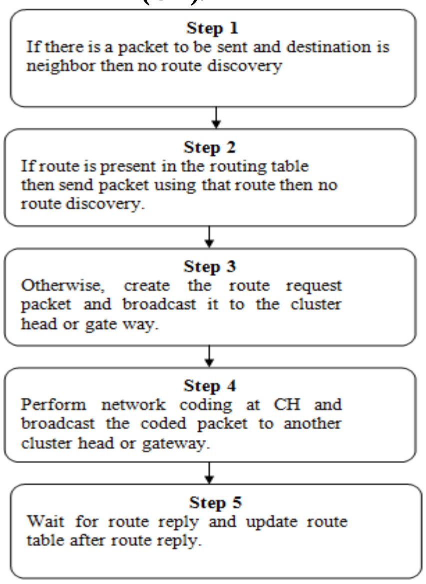


Fig 2 ***Algorithm at Node to Process Packet***

The cluster head is chosen utilising the above-mentioned process known as energy efficient clustering. It picks the node as cluster head by assessing its energy levels, which helps to extend the life of the cluster head as well as the network. To enhance coding chances, we deploy the above-mentioned energy-efficient COPE protocol at the cluster head. The cluster nodes will pass their packets to the cluster head, allowing us to have more packets at the CH, increasing coding options while decreasing the number of transmissions. To extend the life of the CH, we pick it depending on a threshold value on the node's energy levels. For example, we take node energy levels 50 and 70 out of 100 into account.

```
Coding Procedure
{
        Pick packet p at the head of the output queue
        Createtopology(n);
        UpdateNbrRecTable(P);
        U = tdpFwdnode(n);
         if u is not equal to Fwder(P) return;
         if allNbrRecv(P) return;
         if(Natives(p))
        {   if(Prob(p)>0.4 and DelayTolerance(p)>0.8)
            {   if size(p) > 100 bytes then
                {       which queue = 1
                }
                else
                {       which queue = 0
                }
            ObtainCodeSet(C)
            {// Pick packet p at the head of the output queue
                    C = p
                    for each remaining packet r in the queue
                    { for each neighbor v
                            {if (cannot decode(p ⊕ r)) then
                            { goto Continue
                            }
                    }
                    C = C ∪ r
                    p = p ⊕ r
                    Continue
            }
            return C
            }
            if (|C| > 1) then
             { sendCodedPkts(C);
            }
            else if (!Timeout(p)
            { Queue(p,t);
            }
            else { send Native(p);
            }
            } else
            {
                    for each r = decode(P)
                    { TDP_NC(P);
                    }
            }
            }
```

Algorithm 1: Packet encoding procedure

Packet Encoding and Packet Decoding

We employ the notion of the energy-efficient COPE protocol for packet encoding. If node u's neighbour reception table is correct, u transmits an XOR-ed packet p with packet probability 0.7 and delay tolerance 0.8. Neighbor V of u should be able to decode p using native packets that have been saved. The coding technique should ensure that all encoded packets' future hops can decode their corresponding native packets (see Algorithm 1).

Assume that source S must broadcast packets p 11, p 12, p 13, and p 14, and that Receiver R 11 extracts p 11 packet, Receiver R 12 extracts p 13 packet, Receiver R 13 extracts p 12 packet, and Receiver R 14 extracts p 14 packet. Receiver R 15 has all of the packets p 11, p 12, p 13, and p 14, but Receiver R 16 does not have any opportunity to decode the packet.

III. RESULTS AND DISCUSSION

This chapter contains pictures of the research work's findings. This chapter describes the simulation model's response to various inputs. The photographs are self-explanatory. The outcome changes depending on the input. The snapshot simplifies the user's understanding of the model's operating activities.

3.1 PERFORMANCE ANALYSIS OF ECCRP PROTOCOL

We utilise simulation to assess our suggested technique (Table 1). Our model is depicted in the images below. NS2 was used to run our studies. We take into account energy use while sending, receiving, idling, and sleeping. We conducted our simulation with various numbers of nodes. The proposed ECCRP protocol's performance is compared to that of the original CBRP protocol. NS2 is used to model CBRP and ECCRP.

Previous study

The actual model code developed in MATLAB 2014 and saved as m.file. The simulation settings are Field Dimensions - x and y maximum (in meters), Sink x and y Coordinates, and The number of nodes in the field. Types of Energy Model Transmit Amplifiers, Data Aggregation Energy, Heterogeneity Values the percentage of advanced nodes, the percentage of intermediate nodes, and the maximum number of rounds.

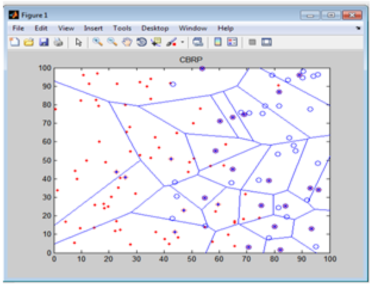


Figure 3: generating the initial nodes (CBRP)

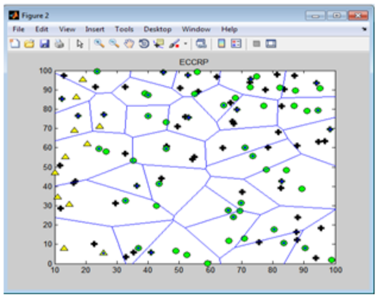


Figure 4: generating the initial nodes (ECCRP)

Energy Consumption of Nodes

In this part, I investigate 30 sources among 60 nodes inside the designated region, with packet rates ranging from 5 to 60 packets/s. Each node travels at a speed of 0–20 m/s, and the simulation model was run 20 times. Each node is given 510 J, and the simulation is run for 1000 seconds. Figure 10 depicts the number of nodes with 0% residual energy as a function of simulation duration. When the simulation time is increased, the ECCCRP consumes less energy than the CBRP.

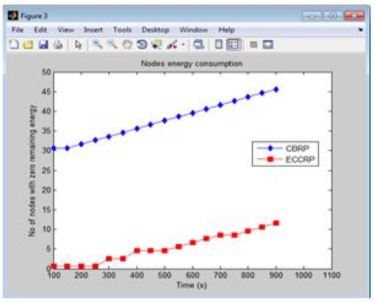


Figure 5: nodes energy consumption ECCRP

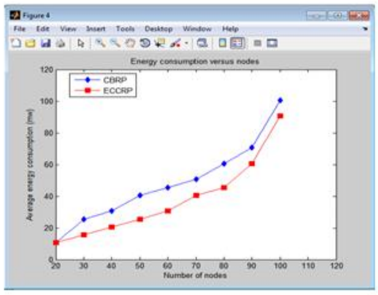


Figure 6: Energy consumption versus nodes for CBRP and

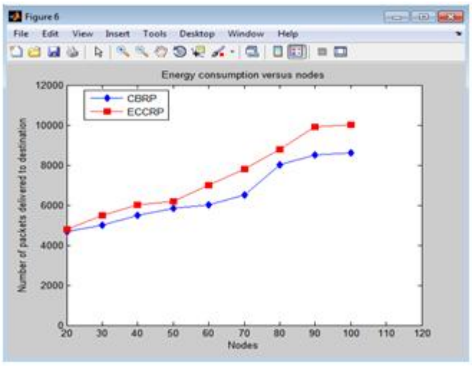
At 700 s, the suggested ECCRP algorithm has 6 nodes with 0% residual energy, but the CBRP has 41 nodes, as seen in Figure 10. In this case, the number of transmissions is proportional to the number of transmissions. We emulated the CBRP and ECCRP protocols here. Figure 11 depicts the average energy usage during route finding vs. the number of nodes in the network at various nodes. According to the results, as the number of nodes rises, so does energy consumption, and the performance of the ECCRP algorithm outperforms the CBRP method.

Energy Consumption.

The amount of energy utilised is proportional to the number of transmissions. We emulated the CBRP and ECCRP protocols here. Figure 6.6 depicts the average energy usage in route finding vs. the number of nodes in the network at various nodes. According to the results, as the number of nodes rises, so does energy consumption, and the performance of the ECCRP algorithm outperforms the CBRP method.

Energy Consumption versus Simulation Time.

The network's energy consumption vs simulation time is depicted in Fig.6.7. It is observed that as the simulation time grows, so does the energy consumption, and CBRP uses more energy. The ECCRP uses less energy in this case because we are conducting network coding at the CHs to limit the amount of transmissions. As a result, it takes less energy to transport the network's total packets.



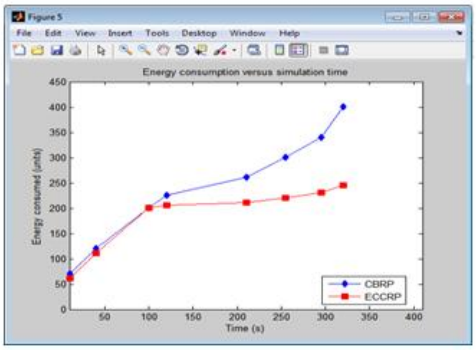


Figure 7: energy consumption Versus simulation time

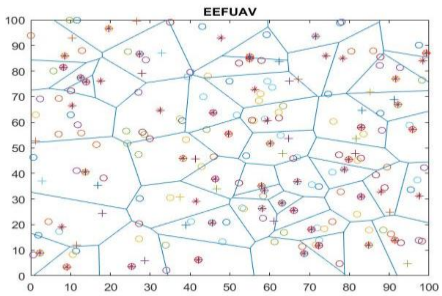
Figure 8: energy consumption versus nodes for CBRP and ECCRP

Data Packets Reached to Destination.

To see how such energy savings effect network longevity when the ECCRP protocol is employed, each node was given a starting energy of 25 Joules. To guarantee that nodes ran out of energy, the simulations were performed for 5000 seconds. The number of data packets successfully delivered to the destinations is depicted in Fig.6.7. When compared to CBRP, it is obvious that the number of packets successfully delivered to the destination utilising the ECCRP protocol was higher.

3.2 PERFORMANCE ANALYSIS OF MODIFIED ECCRP PROTOCOL

The variety of topologies and situations the energy-ECCRP approach may be tested. Compare their performance to that of the EEFUAV when node mobility, traffic, and transmission range are taken into account by consider different cluster-based protocols**.**



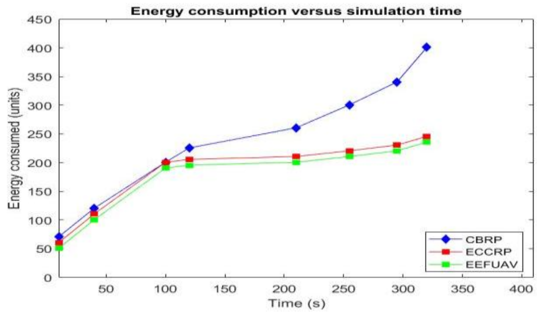
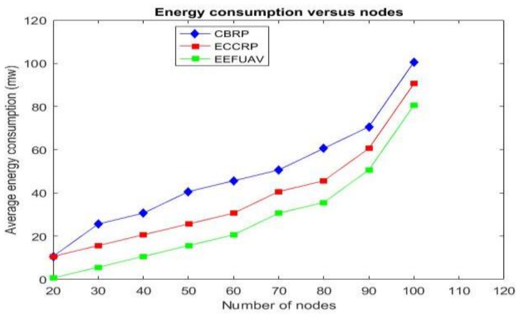


Fig 9: generating the initial nodes (EEFUAV) For CBRP and ECCRP and EEFUAV

Fig 10: energy consumption versus simulation time



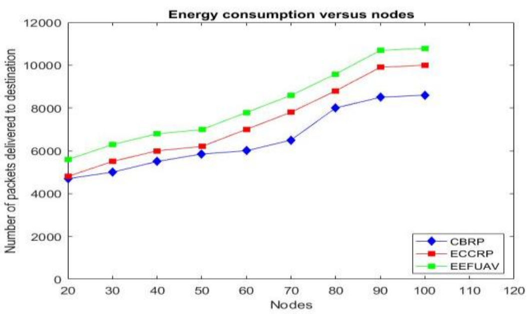


Fig 11: energy consumption versus nodes

Fig 12: energy consumption versus nodes

IV. CONCLUSION

In this study, we presented an EEFUAV approach to improve energy-ECCRP and CBRP's energy consumption performance. EEFUAV employs the Weighted Clustering method. To increases cluster life time by lowering energy usage the optimal CH is chosen. At CHs, to limit the number of transmissions, network coding is used and hence the amount of energy consumed. When coding at intermediate nodes we also implemented a flow-based queue structure to maximize coding chances.

In a variety of topologies this protocol has also been tested and settings to ensure its efficacy. By compared their performance by taking traffic, node mobility, and transmission range into account, we also looked at alternative cluster-based protocols.

Future Work

In future implemented and simulated of EEFUAV technique can be done in python programming and R language.

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Mirza Arif baig, et. al. "An Energy efficient cluster based routing protocol (ECCRP) technique based on Weighted Clustering algorithm for different topologies in MANETs using Network Coding." *IOSR Journal of Engineering (IOSRJEN)*, 12(06), 2022, pp. 22-33.