Trust-Based Energy Efficient Protocol in MANETs.

J-COMPONENT PROJECT A2

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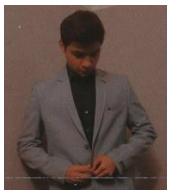

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REVIEW:2

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Abstract:

A mobile ad hoc network (MANET) is outlined as a network of mobile devices that can coordinate and communicate among themselves without any prior administration. Energy efficient lifetime maximizing methods based on channel awareness in MANETs result in better performance of the networks until the node's energy is capable of handling control messages.

For contention-based MAC protocols, they must handle the possible collisions while data transmission. Obviously, a collision occurs when two or more nodes transmit their data simultaneously and interfere with each other

Compared with schedule-based MAC protocols, contention-based MAC protocols consume more energy because they waste energy in collisions and idle listening.

Introduction

Medium Access Control (MAC) is an important technique that ensures the successful operation of WSN because it controls the radio's activity of sensor nodes, which consumes node's major energy.MAC protocols must be energy efficient in wireless sensor networks

A MAC protocol decides when competing nodes could access the shared medium and tries to ensure that no collisions occur while nodes' transmission.

Wireless channels are shared among the nodes results in signal interference which can be minimized by reducing the power level or the transmission range in network thus to increase a node's life the two major means are efficient battery management and transmission power management.

MAC protocols running on WSN must consume energy efficiently in order to achieve a longer network lifetime.

medium access is the major consumer of sensor energy and MAC protocols must be energy efficient to achieve longer network lifetime.

When running MAC Protocol on wireless sensor network much energy is wasted due to 1)idle listening 2)collisions3) overhearing4)protocol overhead and 5)traffic fluctuations

It is widely known that in wireless sensor networks (WSN), energy efficiency is of utmost importance. WSN needs to be energy efficient but also need to provide better performance, particularly latency. A common protocol design guideline has been to trade off some performance metrics such as throughput and delay for energy

In WSN most of the algorithms and protocol designs have been made energy efficient. A common design practice is to save energy at the expense of more relaxed QoS performance guarantees, such as low channel utilization, and longer delays and jitter.

In this paper the authors have proposed a novel energy efficient Medium Access Control (Residual Energy Efficient MAC) scheme for the wireless sensor network

The proposed scheme is good for applications where apart from energy efficiency there is need for collision avoidance

The energy consumption has been reduced because of the reduction in the number of the redundant data packets and control packets.

Literature Survey:

Summary-1
Enhancing the lifetime of Network in MANET by Using Sleep Mode MAC Protocol Design

Author:

D.Vemana Chary(1) , P.Padmanabham(2) , Bhima Prabhakara Rao(3) (1).Assistant Professor,VNR Vignana Jyothi Institute of Engineering and Technology,Bachupally,Hyderabad,Telangna,India. (2).Professor & Academic Director,BIET,Mangalpally,Hyderabad,Telangna,India. (3).Professor & Rector, University Campus,JNTU Kakinada,Andhra Pradesh,India.

Introduction:

The research paper discusses the ides about MAC protocol, particularly in the field of Energy Efficiency. We know that Mobile Ad-Hoc Networks are made up of interconnected set of nodes (devices like PDA and Mobiles). These nodes work on batteries for their functioning (transmitting and receiving messages). Conventional ways like Direct Communication and Cooperative Communication mechanisms for transmitting and receiving signals have proved to be ineffective when it comes to energy management and its conservation. Thus, authors tend to introduce a concept called Sleep Mode in-order to increase the lifetime of the device. This idea is a cluster of Direct and Cooperative Communication. In this algorithm there are 3 nodes N(S)[Sender], N(R)[Receiver] and N(H)[Helper]. When an N(S) node wants to send a message to N(R), it sends a RTS (Ready to Send) signal to N(H) which forwards it to the N(R) node. Once the N(R) node receives the RTS request and is ready to receive the message it forwards a CTS (Clear to Send) signal to the N(H) which forwards it to the N(S). When this occurs, the neighbouring nodes transmit a HTS (Helper Ready to Send) signal. So, now instead of sending the message to the receiver node via the helper node, the helper node is declared as ‘Asleep’, and the message is directly transmitted to N(R) from N(S). Thus, saving unnecessary middle nodes and complex data packet structure, which helps us to save the node’s life, to a great extent.

Findings:

The authors have compared the Sleep-Mode Method with other algorithms like DEL-CMAC and CoopMAC in Static Environment as-well-as in Mobile Environment. The results and graphs show that Sleep Mode shows a large amount of energy being conserved as compared to DCF. The result of Sleep -Mode is quite like DEL-CMAC protocol. Thus, it is an effective algorithm for saving the Energy Conservation.

My Review:

The authors have done an impressive job. They have successfully explored the sleep-mode protocol and have found good results. The experimentation and graphs are well presented.

Although it is a little difficult to understand some of their Time and Energy related formulas.

Overall, it is a nice paper and is very resourceful.

SUMMARY: 2
ENERGY EFFICIENT COOPERATIVE MAC PROTOCOL BASED ON POWER CONTROL IN MANETS

Authors:

Xiaoying Zhang, Algan Anpalagan, Lei Guo, Ahmed Shaharyar Khwaja

Introduction:

This research paper is based on power conservation based on Cooperative Protocol at MAC layer in MANETs. The author talks about how we can conserve the battery life of our devices for better and longer use. The authors introduce us to concepts of Time-Space backoff and Space Time-backoff algorithms. The authors have worked on their own protocol which they called as EECO-MAC protocol, in which they concentrate on 'transmission power' of Helper Nodes. We know that here are some nodes in a group of MANETs there are some nodes which are used more frequently because of their performance and position in the network, thus they are accompanied by heavy traffic and multiple collisions, which cause their batteries to drain at very high speed. It is necessary for us to select the right path for communication between nodes. Hence, it is important for us to work on battery life of nodes for better MANET connectivity.

The author introduces us with 2 algorithms to achieve so:

1). Space Time Backoff:

In this the nodes work on minimum transmission range and minimum CW (contention window) initially. Each time when the transmission fails the transmission power is increased to a higher level. When the transmission range reaches it highest point the CW size is doubled.

2). Time Space Backoff:

In this we start with minimum transmission range and minimum CW size initially. When the transmission fails, the CW size is doubled. When the CW size is at its highest the transmission rate will be updated to a higher level.

Thus, with the help of these 2 algorithms we can achieve good results for Energy Conservation.

Findings:

The authors have done quite an impressive job. They have compared these protocols with CoopMAC and DCF. And the result straight forward shows that the algorithms are quite useful for real time purposes. The order for their Energy Conservation is:

DCF < CoopMAC < Space-Time Backoff < Time-Space Backoff

Although we can see some extra delay in communication for these 2 algorithms.

My Review:

This was an extremely resourceful paper. All the things are well explained and there is no trouble understanding the concepts of the paper. It helped me to explore a new idea in my field. Thus, I found this paper up to the point and very interesting and useful.

SUMMARY-3

Energy-efficient MAC Protocol for IEEE 802.11-based Cognitive Radio Networks

Authors: Daewon Jung∗, Yonggang Kim†, and Hyuk Lim† ∗ The Affiliated Institute of Electronics and Telecommunications Research Institute (ETRI), Daejeon, Republic of Korea † Gwangju Institute of Science and Technology (GIST), Gwangju, Republic of Korea Email: hlim@gist.ac.kr

Introduction:

This paper discusses about a way to achieve energy efficiency for IEEE 802.11-based cognitive radio networks. As we know that 802.11 is Wi-Fi based protocol and is widely used in MANETs. We know that all the devices that are used for communication in MANETs are battery-based i.e., they need a power source to run, thus for longer lifetime of these networks we need our protocols to be more Energy-Efficient.

The authors have come up with an excellent idea for achieving so. They introduced an algorithm in which they tend to put all the nodes which are not participating in the communication to sleep when the others are communicating. The complete algorithm goes by the following steps:

1). The Primary Users try to establish communication. They can take the help of Secondary Users in-order to achieve so.

2). Once the connection is established the other nodes go into ‘Sleep State’.

3). The Sender has full access of the bandwidth for transmitting the complete frame.

4). The other nodes are in sleep till the next ‘Spectrum Sensing Period’.

5). Same process begins again in the new “Spectrum Sensing Period”.

Thus, the nodes which are not participating the communication are in ‘sleep mode’ which saves their Power.

Findings:

The author's found this algorithm quite efficient. It was clear that it showed very good performance as compared to DCF, which does not follow Energy Efficiency ideas. It showed 10%-38% improvement in final throughput. The algorithm showed its peak when there were just two devices directly communicating with each other. Thus, it is a good algorithm to achieve Energy Efficiency.

My Review:

I found the paper and idea good. I think the authors were successful in coming up with a good Energy-Conservation idea. Although I found the paper to be a little complicated in terms of

SUMMARY-4

ENERGY-EFFICIENT QUORUM-BASED MAC PROTOCOL FOR WIRELESS SENSOR NETWROKS

Authors:

L. Sherly Puspha Annabel and K. Murugan

Introduction:

The authors have introduced us to a completely new approach and understanding in the field of Energy-Efficiency for MANETs. Their idea is based on quorum which are nodes with non-empty intersection. They start by introducing a new concept that they refer to as BiQuorum- which is a superset of non-empty subsets of quorum, which has the intersecting property. Also, they have used the idea of Asynchronous Wake-Up Scheduling (An algorithm where no time synchronization occurs between nodes, the nodes wake up according to themselves). Finally, they introduce us with their algorithm which they refer to as Homogenous Quorum-Based Medium Access Control (HQMAC). They have taken the assumption that all the nodes are static, i.e. there is no change in topology. The HQMAC algorithm use BiQuorum which helps us to get minimum quorum ratio and thus achieve low power consumption and minimum Node Service. And the sleep and wake up time of the nodes are decided by the HQMAC algorithm by realizing the traffic load.

Findings:

The writers have compared their HQMAC protocol with QueenMAC protocol, and they have found the HQMAC surprisingly better than the QueenMAC protocol inspite of QueenMAC being a multi-channel based protocol. Also, there was less latency and high packet delivery ratio in the HQMAC protocol as compared to the other.

My Review:

I found the paper and algorithm to be a little complex and a little difficult to implement on the real-time basis. Also, the language and content used in the article is very complex. Overall, I found the paper and idea unique.

SUMMARY: 5

ENERGY EFFICIENT COOPERATIVE MAC PROTOCOL WITH POWER BACK-OFF IN MANETS

Authors:

Xiaoying Zhang, Algan Anpalagan, Lei Guo, Ahmed Shaharyar Khwaja

Introduction:

This is a revised research paper by the authors of co-related work for 'ENERGY EFFICIENT COOPERATIVE MAC PROTOCOL BASED ON POWER CONTROL IN MANETS'. The authors talk about how we can conserve the battery life of our devices for better and longer use. The authors introduce us to concepts of Time-Space backoff and Space Time-backoff algorithms. The authors have worked on their own protocol which they called as EECO-MAC protocol, in which they concentrate on 'transmission power' of Helper Nodes. We know that here are some nodes in a group of MANETs there are some nodes which are used more frequently because of their performance and position in the network, thus they are accompanied by heavy traffic and multiple collisions, which cause their batteries to drain at very high speed. The algorithm is thus divided into 2 parts: handshake procedure and best partnership selection algorithm. The control packets and other formalities are decided in the handshake part, whereas selecting the correct and optimum path is selected in the other part of the algorithm. It is necessary for us to select the right path for communication between nodes for better and faster communication. Hence, it is important for us to work on battery life of nodes for better MANET connectivity.

The author introduces us with 2 algorithms to achieve so:

1). Space Time Backoff:

In this the nodes work on minimum transmission range and minimum CW (contention window) initially. Each time when the transmission fails the transmission power is increased to a higher level. When the transmission range reaches it highest point the CW size is doubled.

2). Time Space Backoff:

In this we start with minimum transmission range and minimum CW size initially. When the transmission fails, the CW size is doubled. When the CW size is at its highest the transmission rate will be updated to a higher level.

Thus, with the help of these 2 algorithms we can achieve good results for Energy Conservation.

Findings:

The authors have done quite an impressive job. They have compared these protocols with CoopMAC and DCF. And the result straight forward shows that the algorithms are quite useful for real time purposes. The order for their Energy Conservation is:

For Nodes with initial high Energy (Nodes>15):

DCF < Space-Time Backoff < Time-Space Backoff < CoopMAC For Nodes with

initial low Energy (Nodes>10):

DCF < CoopMAC < Space-Time Backoff < Time-Space Backoff

Although we can see some extra delay in communication for these 2 algorithms.

My Review:

This is a nice revised edition of the previous paper the author's published. All the things are well explained and there is no trouble understanding the concepts of the paper. It helped me to explore a new idea in my field. Thus, I found this paper up to the point and very interesting and useful.

SUMMARY – 6

ENERGY EFFICIENT MANET PROTOCOL USING CROSS LAYER DESIGN FOR MILITARY APPLICATIONS

Authors:

Mamata Rath*,!, Binod Kumar Pattanayak* , and Bibudhendu Pati# * Department of Computer Science and Engineering, Siksha 'O' Anusandhan University, Odisha, India # Department of Computer Science and Engineering, C.V. Raman College of Engineering, Odisha, India ! E-mail: mamata.rath200@gmail.com

Introduction:

The authors of this paper have come up with a new concept which uses Cross Layer design for better and fast functioning of the nodes in MANETs. They have come up with an idea which is particularly beneficial for Military-related work. Their idea is mixture of various predetermined algorithms which are currently used for communication. They have worked on providing better load balancing for MANETs. They focus on selecting the intermediate nodes based on power and delay, i.e., a node with better power and less delay will be preferred for transmission in a MANET. Also, they have introduced a handshake mechanism which provides a cross-link layer between data link layer and network layer to make the routing related formalities faster. Thus, we are provided with better performance than other MANET algorithms.

Findings:

The authors have compared the algorithms with 2 other Cross-Based protocol namely PC-AODV and CLCP. And it is mentioned in the paper that the algorithm performs better than these two in terms of power consumption, network delay, network lifetime, throughput.

My Review:

This was a very complex paper, as Cross Layer Communication is a very new topic for an amateur like me. Although I found the paper quite resourceful. I would really like the authors to publish this idea again with deeper understanding.

Summary: 7

Coop Mac Power Conservation Protocol in MANETS

Authors:

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Introduction:

The authors have come up with an improved version of Cooperative MAC protocol. As we know the procedure in Cooperative MAC protocol involves sending and receiving of control packets which includes RTS, CTS, HTS, CCTS, NTS. The authors have come up with an upgraded idea in which they replace these Control Packets with simple Signals while transmission. They have come up 2 management frames Eager to Help (ETH) and
Interference Indicator (II). The ETH frame is responsible for selecting the most effective way finding the best relay or path for the transmission of the packet based on residual power and minimal transmittal power. The II frame is used to reassert the varying winning rally.

Thus, when the node has to select the next mode, it has to just send a small signal to the next node and in return, a ACK or NCK is received. Thus, in this manner the idea works, and the authors call the idea DEL-CMAC. Also, the authors have suggested to mix this idea with Sleep Mode mechanism to improve it.

Findings:

The author compares this idea with the old CMAC protocol. And the results that came out are quite straight forward and expected. The algorithm makes the process much faster and unnecessary management because of the Control packets are no longer needed. Thus, saving the overall battery-life of the MANET system.

My Review:

I found the paper straight forward. The topics and ideas are on the point and the language and algorithm is simple, effective, and easy to understand. I also think the paper misses some important calculations. Also, if the authors would have tried to compare this algorithm with other cross link algorithms it would have been better. Overall, it was a nice paper.

SUMMARY-8

DESIGNING OF COOPERATIVE MAC PROTOCOL FOR IMPROVING THE NETWORK LIFETIME OF MANETS

Authors:

Deepak T E M-Tech (Computer Network Engineering) Department of Computer Science Engineering Dayananda Sagar College of Engineering Bangalore, India Dr. Ramesh Babu D R Professor & Head Department of Computer Science Engineering Dayananda Sagar College of Engineering Bangalore, India

Introduction:

The authors have revisited the idea of Cooperative Communication. They have explored the idea of DEL-CMAC protocol. According to them the Cooperative Communicating can be a promising technique for increasing the lifetime of devices in a MANET. In Cooperative Communication data transmission occurs with formation of a relay that is because not all nodes are in the transmission range of each other. In DEL-CMAC protocol they have used the Residual Power and Transmission Power of a node for the selection appropriate helper nodes. Apart from two original frames used for RTS and CTS in CMAC, they introduce us with 2 more frames namely Eager to Help (ETH) and Interference Indicator (II). ETH is used for selecting the appropriate node based on spatial usage, transmission power, and residual energy. And II is used for reconfirming the interference range of the transmitting power of the wining relay. Thus, in this way the DEL-CMAC protocol works.

Findings:

The authors have compared the DEL-CMAC protocol with DCF (Distributed Coordination Function). And the results clearly show that the DEL-CMAC performs better in terms of network lifetime and throughput when the number of Nodes increases. Thus, DEL-CMAC gives better performance than DCF in terms of Energy Conservation.

My Review:

I think this paper is straight forward. There is no original idea by the authors, they have just rediscovered an existing protocol (DEL-CMAC). Although the language and information are very good and easy to understand. Overall, I found this paper good and resourceful.

Summary -9

MANETS through Energy efficient technique

Summary:

This paper discusses Energy efficient technique in manet's as in versatile ad hoc networks (MANET), battery life of hubs is one of the basic segments and arbitrary development of portable hubs inside a district of interest made the plan of MANET more unpredictable. The arrangement to have successive changes in the geography of versatile hubs notwithstanding saving the battery life for longer length is considerably more intricate.

In this research paper the authors have focused on pressure instruments incorporated with medium access layer (MAC) convention. .

In this Paper,They have presented an efficient energy usage model in MANET and have made an attempt to come out with one such approach based on image compression.

The frequent pattern mining based Huffman coding technique is explored for data compression as it is found to be one of the best text data compression technique in the recent day

The Proposed Method in this is

The SOURCE is the node here and before transmitting the data over the identified route, the node compresses the data and subsequently transmits the data based on the identified routing protocol.

Summary-10

Strong Security Scheme for Single Node and Colluding Nodes Byzantine Attacks in MANETS

Summary:

Mobile Ad Hoc networks are the wireless networks and are established spontaneously without any fixed infrastructure to connect the devices for communication and sharing resources.

MANETS are vulnerable to attackers and Byzantine attacks are the most harmful and hazardous one among the active attacks. Byzantine attacks are the major potential threats that shatter the proper functioning of the system

The authors presented a system in this paper which provides a mechanism for reliable and secured communication against all forms of Byzantine attack with strong authentication

The malicious nodes can execute attacks as single handed or by colluding with other attackers

Byzantine nodes exhibits many types of network attacks such as giving incorrect routing information, forwarding packets in the wrong non optimal route it also includes giving false information to neighbouring nodes

There are three ways to authenticate nodes at MAC layer. The nodes can be authenticated using shared secret key and public key infrastructure or can use certificate authority. Public and private key generation by the nodes and authentication of keys through certificates When nodes join the network, they have to broadcast their ID.

The proposed work identifies and blocks Byzantine attacks, a kind of crucial insider attack. This detection mechanism yields high performance by identifying the characteristic nodes and edges from the Kirchhoff's matrix and steps taken to avoid the malicious nodes in the path. Loyal nodes are identified by a collated code and are intimated during the communication channel establishment phase of the MAC layer and this authenticates the nodes as single sign on for entering into the security ring.

Summary-11

CHALLENGES ON ENERGY CONSUMPTION IN MANET-- A SURVEY

Summary:

In this paper the authors have specified about the challenges on energy consumption in MANET. There are 4 energy consumption modes. Transmission Mode, Reception Mode ,Idle Mode and Overhearing Mode. Energy consumed during idle mode is considered to be wasted energy which should be reduced or eliminated through energy-efficient schemes. Almost the same amount of energy is consumed during this mode.

Wireless channels are shared among the nodes results in signal interference which can be minimized by reducing the power level or the transmission range in network thus to increase a node's life the two major means are efficient battery management and transmission power management

In this Research article the authors have commenced a literature survey, to promote energy consumption control for MANETs. This article studies current energy conservation techniques used at different levels and various approaches adopted for reducing power consumption.

To achieve better energy conservation performance metrics tradeoffs are advised since a single protocol cannot convey the total performance demands for MANET.

One of the protocols is PAMAS(Power Aware Multi-Access protocol with Signaling) It identifies the overhearing nodes and makes these nodes in hibernate state intelligently without causing any delays in the network and without affecting the throughput of the result. Actually it is the combination of 2 protocols namely Signaling channel protocol and MACA protocol. The control messages RTS/CTS (Request to send/Clear to send) mechanism of 802.11 and actual data packets travel over separate channels. This enables the nodes to determine when and how long they have to remain powered off.

Summary-12

OPTIMIZED ENERGY EFFICIENT ROUTING PROTOCOL FOR MANET

Summary:

Power reduction is rapidly becoming the key confront for implementing large Mobile AdHoc Networks (MANET). In MANET battery power is still the only source and the routing process consumes considerable power for the overheads. Therefore minimizing the energy consumed for the routing process plays an important role. In mobile networks, node mobility may cause frequent network topology changes,

which are rare in wired networks. There are several techniques such as power save method, power control method and minimum energy routing.

The decentralized environment of wireless ad-hoc networks makes them appropriate for a range of applications where central nodes can't be dependent on and may progress the scalability of wireless ad-hoc networks compared to wireless managed networks, though theoretical and practical limits to the overall capacity of such networks have been identified.

In This paper The authors have combined all these techniques in their respective layers and obtained an optimized routing process.

The proposed work which mainly consists of modification of protocols in each layer by which consecutive amount of energy is consumed when compared with the existing Span protocol and also the lifetime of the network is increased.

Summary-13

Enhancement of energy efficiency using a transition state mac protocol for MANET

Summary

A mobile ad hoc network (MANET) is outlined as a network of mobile devices that can coordinate and communicate among themselves without any prior administration. Energy efficient lifetime maximizing methods based on channel awareness in MANETs result in better performance of the networks until the node’s energy is capable of handling control messages.

To bridge the gap between network throughput and energy conservation under limited overhead, a Transition State supporting cooperative MAC broadcast protocol for both conserving node energy and to utilize available node in an effective manner prior to their energy drain is proposed in this paper

Directional MAC protocol which is a power control scheme needs the utilization of a separate channel for both transmission and reception of packet

The threshold of a node is defined based on its average energy consumption. The average energy consumption of a node is defined as the ratio between the summation of energy utilized throughout the transmission and the total number of transmissions the node has undergone

Through this article, a new routing protocol named TSMP for wireless ad hoc networks has been proposed, in which both energy conservation and utilizing the available node in an effective manner prior to their energy drain is achieved.

In this proposed technique, the first routing path to the destination is selected based on shortest distance and the rest of the nodes will move to the idle state. After each transmission, the nodes in transmission state will update their energy level (despite the destination) to their predecessor nodes

Summary-14

An Energy-Efficient MAC Protocol for Wireless Sensor Network

Summary:

It is widely known that in wireless sensor networks (WSN), energy efficiency is of utmost importance. WSN needs to be energy efficient but also need to provide better performance, particularly latency. A common protocol design guideline has been to trade off some performance metrics such as throughput and delay for energy

In WSN most of the algorithms and protocol designs have been made energy efficient. A common design practice is to save energy at the expense of more relaxed QoS performance guarantees, such as low channel utilization, and longer delays and jitter.

In this paper the authors have proposed a novel energy efficient Medium Access Control (Residual Energy Efficient MAC) scheme for the wireless sensor network

The proposed scheme is good for applications where apart from energy efficiency there is need for collision avoidance

The energy consumption has been reduced because of the reduction in the number of the redundant data packets and control packets.

Summary-15
Making MANET Energy Efficient

Authors:

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Introduction:

The paper introduces a scheme to improve existing on-demand routing protocols in ad-hoc network routing by introducing a power aware virtual node scheme. It is integrated with
Ad-hoc AODV(Ad-Hoc on Demand Vector) and (DSR) dynamic Source routing. The Energy Efficient Ad hoc Routing Protocol enables dynamic, self starting, multi hop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. It allows more stable route connections for mobile nodes. This is done by checking power status of each node in the topology which insures fast selection of routes with minimal efforts and faster recovery. The paper has compared the new routing protocol with the traditional protocols.

Findings:

The authors have compare the energy efficient AODV and DSR protocols with traditional protocols. The results of the graphs show that energy efficient AODV is better in terms of packet delivery, speed, better in TCP connections. The energy efficient DSR is better in speed and delivery of TCP connections.

But traditional DSR is better at packet delivery. Energy efficient AODV also shows more decay of packets for higher TCP connections.

My review:

I think that the authors have done a wonderful job in selection of a network route based on power status and activeness. The experimentation and graphs are well presented. Although some of the graphs show that traditional methods are better in terms of integrity but overall this new method is better in terms of performance. The paper has been presented wonderfully

Summary-16
A Novel Power Efficient MAC Protocol Design for MANETs

Authors:

Y.NEERAJA, Associate Professor, ECE dept , NARAYANA Engineering College GUDUR , Nellore ,DT. , A.P. India , neerajay30@gmail.com

Dr. V. Sumalatha, Professore ECE Dept. , JNTUA, Anantpur, DT. , A.P. India , sumaatp@yahoo.com

Introduction:

The paper introduces a novel power efficient MAC scheme for saving the energy and improving the lifetime of the network. The authors have proposed 3 new MAC protocols algorithms.
Algorithm 1: MAC operation
Algorithm 2: Proposed MAC protocol
Algorithm 3: Proposed ACO algorithm
The protocols consider the CSMA and CDMA with an evolutionary programming algorithm. Ant Colony Optimization has been implemented for efficient path selection based on the power consumption of the nodes.

Findings:

The authors have compared the throughputs of average energy consumption and lifetime of network of the coopMAC and the traditional DCF scheme. coopMAC shows better results with fewer number of nodes, but degradation occurs on increasing the number of nodes and cost of maintenance also increases.

My review:

I think the authors did very well job in presenting the papers, although the alogrithms very difficult to understand , but the graphs and other observations were well presented.

Summary-17
A COMPARATIVE ANALYSIS OF ENERGY EFFICIENT MAC PROTOCOL FOR WIRELESS SENSOR NETWORK

Authors:

Sweetu Faldu
Department of Computer Engineering, Atmiya Institute of Technology & Science Rajkot, Gujarat, India
Prof. Tosal M Bhalodia
Professor of Computer Engineering, Atmiya Institute of Technology & Science Rajkot, Gujarat,
India **Introduction:**

The authors proposed a CSMA based MAC protocols that provides efficient energy consumption , low latency , more accuracy and reduced network overhead. The paper well defined the protocols based on contention, contention free protocols and channelization , hybrid protocols. The new protocols tries to reduce energy consumption due to packet collisions , overhearing , over-emitting etc.

The paper compared the CSMA with various other protocols such as EERC-MAC , S-MAC , ASYM-MAC , DCD-MAC , RP-MAC , XT-MAC.

Findings:

Various advantages and disadvantages were provided by the new CSMA protocol when compared with other protocols. In overall it can be said that the CSMA is a better and more efficient and power saving protocol compared to other traditional MAC protocols.

My review:

The author presented the paper well. But It could have been made better with some pictorial presentations such as graph showing performance comparisons. Overall all terms were well explained and the information provided was to the point and accurate.

Summary-18
Performance evaluation of wireless sensor network MAC protocols with early sleep problem

Authors:

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Introduction:

The authors investigated the early sleep problem in the specific topologies of MANET's which result in undesirable extended latency in packets delivery. The paper evaluated the performance of traditional T-MAC protocol with 'early sleep' problem which arises due to asymmetric communication pattern on nodes-to-sink topology and also proposes a new protocol DETMAC in its place which can solve the problem by forwarding nodes towards the sink node to adaptively reschedule their sleep-wakeup timing.

The DETMAC solves the problem of consumption of energy by FRRS approach due to overload of DS and FRTS packets. They also suggested using 'full-buffer' approach to solve the problem.

Findings:

The DETMAC was proved to be better than T_MAC as:

DETMAC puts constraint on extension of active period so that the packets sent by the source node are limited compared to TMAC. This provides more time for relay nodes to forward packets.

TMAC wastes the active period of sink node whereas DETMAC lessens the active period which increases efficiency and lessens the energy consumption.

Both protocols were compared first using the 3 hops networks with one source , one sink and two relay nodes. The results showed that DETMAC had lower application level latency, average end-to-end latency and lower energy consumption compared to TMAC.

My review:

I think the paper was very well written , the related works were very well mentioned and their key aspects were also noted down. The paper also simulated the two protocols and presented the graphical comparisons. The problem was well explained along with the solution of the problem statement. The introduction to the topic was also well-written.

Summary-19

A Network Lifetime Extension-Aware Cooperative MAC Protocol for MANETs With Optimized Power Control

Authors:

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This work was supported by the Research University Individual (RUI) Grant under Grant 8014051.

Introduction:

The authors introduced a CMAC(cooperative medium access control) and
LEA-CMAC(lifetime-extension aware CMAC) for MANETs , LEA-CMAC mainly enhances the network performance through the cooperative transmission to achieve multi-objective target orientation. The authors provided some new algorithms to achieve the multi-objective target oriented CMAC protocol. The authors introduced a new
HRF(helper-ready-to-forward) frame along with the traditional CTS and RTS frames. The function of HRF is to select the best helper node in a distributed manner. The authors also did optimization based power distribution where they used the Shannon capacity theorem to allocate transmit power for the direct transmission and DF.

Algorithms proposed:

Optimized transmit Power using Asymmetric policy.

Findings:

The authors were able to extend the lifetime of network using distributed relay selection algorithm. Where the transmission gain and relay energy were also considered in selecting the best helper node. The proposed LEA-CMAC improved the overall network performance , has less energy consumption , and has better network throughput compared to traditional
CMAC.

My review:

The paper was very well written . Every term was explained in a clear and simple way so that anyone can understand it. Graphs were used to represent the data of simulation pictorially. Algorithms were thoroughly explained and the problem statement and solution were explained in detail

Summary-20

EESSMT: An Energy Efficient Hybrid Scheme for Securing Mobile Ad hoc Networks Using IoT

Introduction :

Mobile ad hoc networks are attaining popularity to its highest currently, as the users need wireless connectivity regardless of their geographical location. Threats of security attacks are growing on the Mobile Ad-hoc Networks (MANETs). MANETs must require a secure mode for communication and transmission which is rather challenging and vigorous issue. With the aim of providing secure transmission and communication, researcher worked explicitly on the security concerns in MANETs. Several secure protocols and security methods within the networks were projected but utmost of the security measures in their designs are not ruminated. Hence, a novel scheme is proposed in this paper for the secure and reliable data transmission in MANETs under black hole attack constructed on amended Ad hoc On-demand Multipath Distance Vector (AOMDV) protocol of our base scheme. This paper comprises AOMDV protocol for the multiple route discoveries along with K-Nearest Neighbor (KNN) for nearest neighbor node selection and use False keybuild Advanced Encryption Standard (FAES) encryption scheme for cryptography method. FAES algorithm is used with the aim of securing the IoT devices and data from the hardware and network attacks. Also, the interaction of the scheme with the IoT based concepts making our work even smarter to the users. The proposed scheme performance is stable with higher throughput while that of base scheme. The quality of the proposed scheme is measured in terms of energy consumption, EE-delay and throughput. The results of simulation
show that the Variance, EE-delay, energy consumption and throughput of proposed FAES-AOMDV protocol is lower than the original AOMDV protocol. FAES-AOMDV protocol ensures the secure transmission of data with least energy consumption in the presence of malicious nodes

Findings:

In this paper, an extended version of our base scheme is proposed to make the transmission of data be secure and reliable under malicious nodes by using a secure False-AES encryption scheme for cryptography. The selection of nearest neighbor nodes is done through K-nearest neighbor algorithm for selection of least cost nodes for data transmission. The results of simulation show that our proposed scheme offers a higher throughput along with lower EE-delay, energy consumption, which is considered to be good features for the emergency based applications of MANETs. Furthermore, the rate of success of proposed

scheme to guarantee and ensure the packet delivery to the destination is very high through multiple paths and in more secured manner.
This research work can be extended in future by implementing it with the large number of nodes. This approach is tested for AOMDV protocol; the scheme can also be tested for other routing protocols. We can also evaluate the proposed scheme for the real time applications of IoT and its communications.

My review:

I found the paper and idea good. I think the authors were successful in coming up with a

good Energy-Conservation idea. Although I found the paper to be a little complicated in terms of Language.

Overall, the paper and idea were very resourceful.

Summary 21

A Hybrid Genetic Fuzzy approach for power control cross layer MAC protocol in Wireless Network

Introduction :

The battery powered wireless hosts have limited energy. Hence, energy aware techniques with power saving mechanisms are resorted to conserve energy of nodes in wireless networks. Power based connectivity is an ad hoc implements power control mechanisms to enhance network life by improving throughput, locating cost effective routes and spatial reuse. This
study uses MAC protocol to implement coordination functions and power control mechanisms through Genetic Algorithm (GA).Upper network layers generated Fuzzy rules using two input variables like link quality and node neighborhood count; with optimal power consumption level as an output variable.Experiments with GA fuzzy rules are compared with DynamicSour ce Routing (DSR) routing and two hop power control methods. The results reveal that the two hop power control withGA fuzzy logic method lowers route discovery time, increase cache replies, minimizes simulation time and end to end delay in contrast to DSR routing and two hop routing protocols.

Findings:

Ad hoc networks are battery powered devices, energy conservation and power reduction are to be incorporated in therouting. Power consumption here is controlIed through controlling transmission power/choosing optimal transmission routes. Fuzzy Logic derives power control at every network node through input variables link quality based fuzzy rules and neighbourhood count. Experiments with Genetic fuzzy rules were compared to DSR routing and simple two hop power control procedures. Results showed that two hop power controls with GA fuzzy logic procedures reduced route discovery time, increased cache replies with limited simulation time and end to end delay as compared to DSR routing and two hop routing protocols.

My review:

I think the authors did very well job in presenting the papers, although the algorithms very difficult to understand, but the graphs and other observations were well presented **Summary 22**

Enhancement of energy efficiency using a transition state mac protocol for MANET

Introduction :

A mobile ad hoc network (MANET) is outlined as a network of mobile devices that can coordinate and communicate among themselves without any prior administration. Energy efficient lifetime maximizing methods based on channel awareness in MANETs result in better performance of the networks until the node's energy is capable of handling control messages. In the existing approach, the node's lifetime and consistency of packet flow are defaced due to unplanned energy conservation methods. This results in a tradeoffbetween network throughput and node energy, resulting in post network failure. The post net- work failure results in limited TTL of the nodes and retarded network throughput with higher control overhead. To bridge the gap between network throughput and energy conservation under limited over- head, a Transition State supporting cooperative MAC broadcast protocol for both conserving node energy and to utilize available node in an effective manner prior to their energy drain is proposed in this pa- per. TSMP reduces the total energy consumption to a maximum extent of 14–21% higher than DPCMP and 24–33% than SPCMP. And comparatively, the routing overhead falls almost 45–52% than SPCMP and 27–31% than DPCMP.\

Findings:

Through this article, a new routing protocol named TSMP for wireless ad hoc networks has been proposed, in which both energy conservation and utilizing the available node in an effective man- ner prior to their energy drain is achieved. In this proposed tech- nique, the first routing path to the destination is selected based on shortest distance and the rest of the nodes will move to the idle state. After each transmission, the nodes in transmission state will update their energy level (despite the destination) to their prede- cessor nodes. The predecessor nodes verify the broadcasted energy level with the threshold of each node. If the current energy level of the node is higher than the threshold, then relaying continues, else the node is replaced. Simulation results have revealed that the proposed protocol has a lower average delay with minimized over- head and less energy consumption. It is concluded that the given technique helps in the network performance improvement. In future the proposed TSMP will be implemented in field pro- grammable gate array (FPGA) based network systems.

My review:

The author presented the paper well. But It could have been made better with some pictorial presentations such as graph showing performance comparisons. Overall all terms were well explained and the information provided was to the point and accurate.

My review:

This was an extremely resourceful paper. All the things are well explained and there is no trouble understanding the concepts of the paper. It helped me to explore a new idea in my field. Thus, I found this paper up to the point and very interesting and useful.

Summary 23

An Optimal Energy Efficient Cross-layer routing in MANETs

Introduction :

In mobile ad hoc network (MANET), battery power is a significant resource for mobile devices. Hence conservation of energy and prolonging the network lifetime must be considered when designing routing protocols. But design of an energy-efficient routing protocol requires various factors of nodes from different layers, such as remaining energy, total traffic load and the number of channel contentions. Traditional layered approach has been found ineffective in handling power-related problems which can affect all the layers of the stack. To solve these issues, we propose a technique known as cross-layer routing protocol which utilize particle-swarm optimization (PSO) algorithm. The data success rate, node mobility and predicted remaining energy are measured from the network layer and PSO algorithm is applied to establish stable and energy efficient paths. After establishing the set of paths using PSO, the network contention is measured from the MAC layer and the contention window (CW) is adjusted dynamically based on the measured contention and predicted remaining energy. Simulation results prove that the proposed technique provides increased delivery ratio of packet with reduced consumption of energy and overhead when compared with existing techniques.

Findings:

An Energy Efficient Cross-layer Routing Protocol using PSO (EECRP-PSO) has been proposed. The data success rate, node mobility and predicted remaining energy are measured from the network layer and PSO algorithm is applied to establish stable and energy efficient paths. After establishing the set of paths using PSO, the contention window (CW) adjustment algorithm in MAC layer is proposed in order to reduce the energy consumption due to contentions. The proposed EECRP-PSO is simulated in NS2 and compared with EAMR-PSO protocol. Simulation result shows that the proposed protocol provides increased in ratio of packet delivery with reduced consumption of energy and overhead.

My review:

I think that the authors have done a wonderful job in selection of a network route based on power status and activeness. The experimentation and graphs are well presented. Although some of the graphs show that

traditional methods are better in terms of integrity but overall this new method is better in terms of performance. The paper has been presented wonderfully.

SURVEY TABLE:

Technology	Standard	Transmission Rate	Maximum Distance	Frequency Bands	Characteristics/Limitations
MANET (802.11)	CoopM-AC	>54-248Mbps	>50 m	2-60GHz	Good for medium range transmission of data.
	DEL-C MAC	>54-248Mbps	>50m	2-60GHz	Better Battery Life and Better performance for long distance transmission.
	DCF	54-248Mbps	50m	2-60GHz	Poor Performance when the number of nodes starts to increase.
Proposed:	Sleep Mode	<54-248Mbps	50m	2-60GHz	Very Good in terms of Battery-Life. Whereas, average when it comes to throughput, and transmission rate.
Proposed:	EECO-MAC Space Time Back-OFF	>54-248Mbps	>>50m	2-60GHz	Very Good in terms of Battery-Life, throughput, and transmission rate.
Proposed:	EECO-MAC Time Space Back-OFF	>54-248Mbps	>>50m	2-60Ghz	One the best proposed protocol, as it has a really good transmission rate as well as it has an excellent network lifetime.
Proposed:	IEEE 802.11 based Energy Saving Protocol	>54-248Mbps	>>50m	2-60GHz	About 10-38% more efficient thank DCF protocol. Although, a little complex to achieve synchronization in real time.

MANET (802.11)	Queen-MAC	54-248Mbps	>50 m	2-60GHz	It is single quorum-based MAC protocol. It independently schedules the wake-up time for nodes.
Proposed:	HQMAC	>54-248Mbps	>>50m	2-60GHz	It is a biquorum-based MAC protocol. It independently schedules two adjacent quorum systems so that the overlapping of nodes becomes a smotth process. Thus, improves the performance and network life-time.
MANET	PC-AODV	54-248Mbps	250 m	2-60GHz	Good but higher delay and Energy Consumption.
CLCP	54-248Mbps	>50m	2-60GHz	Better throughput and lesser delay, still consumes a lot of power.	CLCP
Proposed:	PDO-AODV	>54-248Mbps	>250m	2-60GHz	Better Batter Life and Better performance in terms of transmission rate and throughput.

INTRODUCTION TO PAP PROTOCOL: (PROPOSED PROTOCOL)

- First, we will declare a Synchronized (General) Channel Sensing Time Period for our MANET.
- Each non-helper node which was incapable of gaining access to the channel, is expected to go to ’Sleep-Mode’ for the given Channel Sensing Time Period and enter ‘Wake-Up’ mode again in the next session.

- When the ‘Source Node’ Gain direct access to the ‘Receiver Node’ all other nodes go to ‘Sleep-Mode’, and the direct communication occurs like DCF.
- Residual Power and Lower Transmission Power of a node. The Source node is given the whole channel to transmit 1 complete frame.
- Again, for the next ‘Time Sensing Period’ the nodes will fight to get access to the channel.
- Suppose this time the source and receiver are not in the same transmission range. We will require to select intermediate Helper Nodes to transfer our data.
- This is done using the DEL—CMAC protocol i.e., the Helper Node is selected based on Higher Throughput.
- Again, all the non–helper nodes will go in ‘Sleep-Mode’. And the channel is given to the ‘Source Node’ for transmission of 1 complete frame.
- Again, the next Channel Sensing Cycle will come, and the process is repeated.

ASSUMPTIONS:

- The system of nodes are considered to be homogenous. And being spread in a particular region
- The nodes are moving with slow speed, or no speed at all.
- The system is defined to be ideal, i.e., there is no sudden faults or failures in the system.

ALGORITHM:

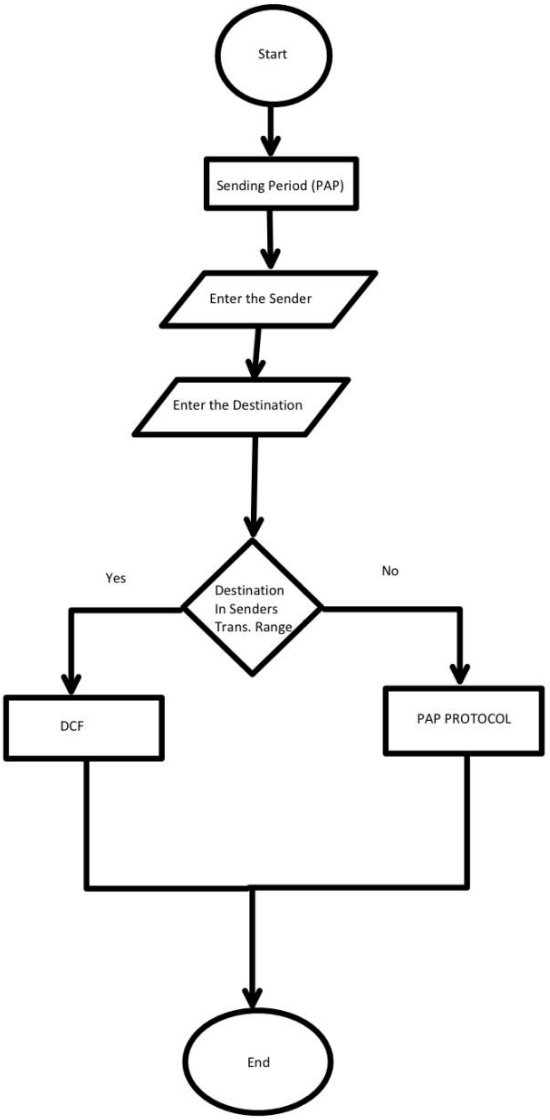
```
PAAP{
For(Particular Channel Sensing Period){
N Wake-Up Mode
S(access to the channel){
Switch(transmission range)
Case:1(Direct Transmission){
For(1 frame){
S D using (DCF)
NH  Sleep Mode
}
Case:2(Hoop Transmission){
For(1 frame){
S D via Helper Nodes decided using (DEL-CMAC)
NH Sleep Mode
}
}
}
}
```

}
DCF{

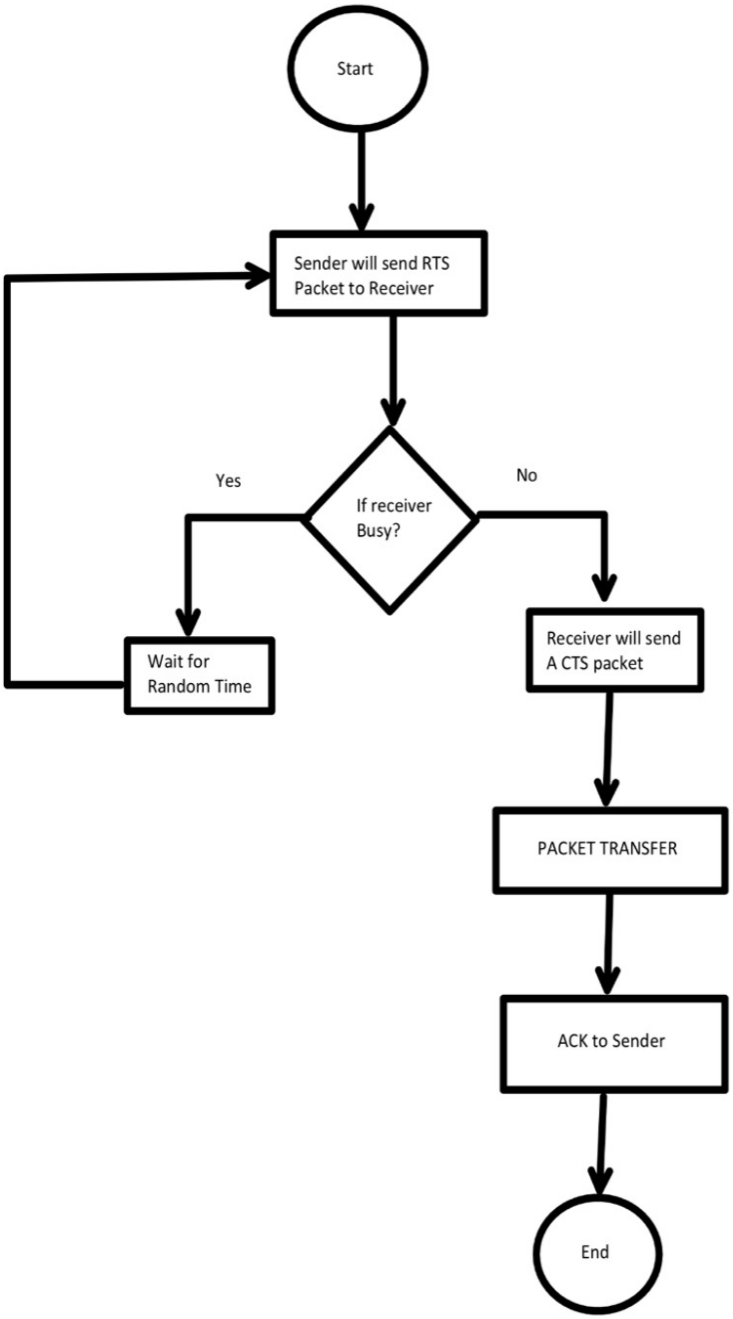
SD (RTS);
If(D is not busy?){
DS (CTS);
SD(Data Packet)
DS (ACK);
}
}
DEL-CMAC{
If(D in Transmission range of S){
DCF(SR)
}
Else{
For(D in transmission range){
SH(RTS) [Selection of H is done based on Higher Throughput]
}
HD(RTS)
If(D not busy? && D in now in range of S){
DS (CTS)
SD (Data Packets)

}
If(D not busy? && D in not in range){
DH (CTS)
HS (CTS)
SHD (Data Packets)
}
}
}
Where:
S: Source
D: Destination
N: All Nodes
NH: Non-Helper Nodes
H: Helper Nodes
R.E.: Residual energy
T.P.: Transmission Power

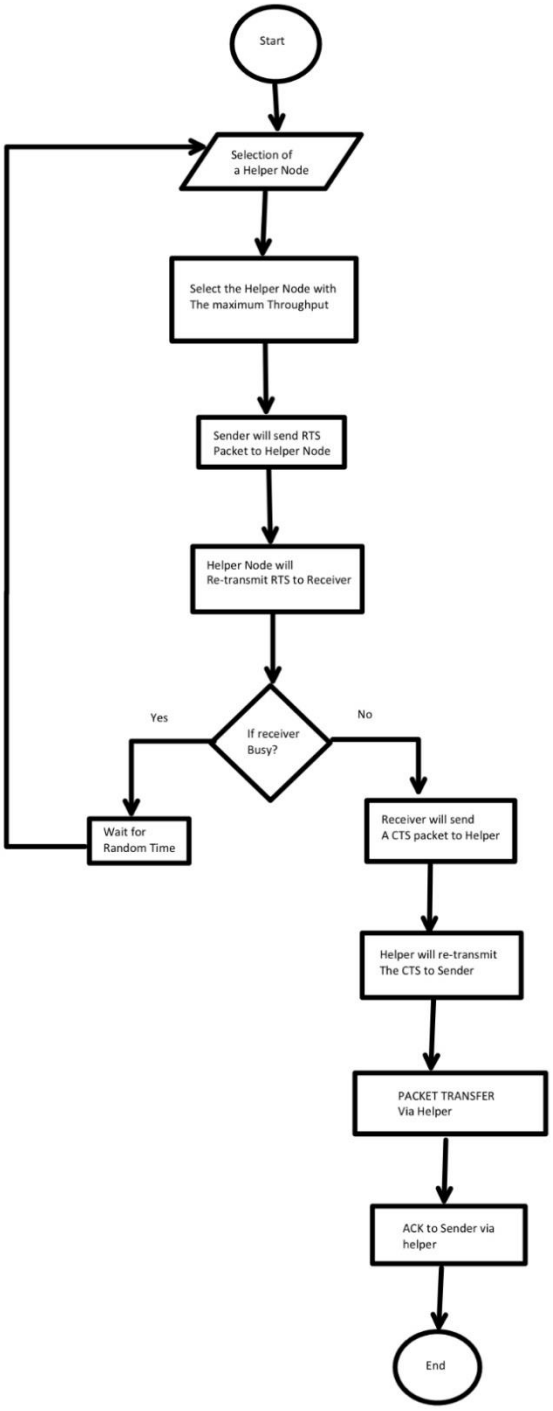
FLOWCHART:



Flow-Chart-1: When to use PAP Protocol



FLOW-CHART-2 DCF



FLO-CHART-3: PAP PROTOCOL

CODE:

PAP.java

```java
package com.company;

import org.w3c.dom.Node;

import java.io.FileWriter;
import java.io.IOException;
import java.io.PrintWriter;
import java.lang.reflect.Array;
import java.util.ArrayList;
import java.util.Collections;
import java.util.Comparator;
import java.util.Scanner;

class Nodes{
    int id;
    int type;
    int energy=100;
    String region;
    int throughput=0;
    void throughput0(){
        throughput+=1;
    }

    void throughput1(){
        if(throughput>0) {
            throughput -= 1;
        }
    }
    void energy_con(){
        energy-=1;
    }

    public int getId() {
        return id;
    }

    public void setId(int id) {
        this.id = id;
    }

    public int getType() {
        return type;
    }

    public void setType(int type) {
        this.type = type;
    }

    public int getEnergy() {
        return energy;
    }

    public void setEnergy(int energy) {
        this.energy = energy;
    }

    public String getRegion() {
        return region;
    }

    public void setRegion(String region) {
```

```
        this.region = region;
    }

    public int getThroughput() {
        return throughput;
    }

    public void setThroughput(int throughput) {
        this.throughput = throughput;
    }

}

class NodeThroughputComparator implements Comparator<Nodes> {
    public int compare(Nodes node1, Nodes node2) {
        return node1.getThroughput() - node2.getThroughput();
    }
}

class Mechanism{
    void dcf(Nodes sender, Nodes destination){
        System.out.println("RTS from "+sender.id+" to "+destination.id);
        System.out.println("CTS from "+destination.id+" to "+sender.id);
        System.out.println("Transfer Packet");
        System.out.println("Acknowledgment from " + destination.id + " to "
+ sender.id);
        sender.energy_con();
        destination.energy_con();
        sender.throughput0();
    }

    void paap(Nodes sender, Nodes destination,Nodes helper) {
        System.out.println("RTS from "+sender.id+" to "+helper.id);
        System.out.println("RTS from "+helper.id+" to "+destination.id);
        System.out.println("CTS from "+destination.id+" to "+helper.id);
        System.out.println("CTS from "+helper.id+" to "+sender.id);
        System.out.println("Transfer Packet");
        System.out.println("Acknowledgment from " + destination.id + " to "
+ helper.id);
        System.out.println("Acknowledgment from " + helper.id + " to " +
sender.id);
        sender.energy_con();
        destination.energy_con();
        helper.throughput0();
        sender.throughput0();
    }

}


public class Main {
    public static void main(String[] args) throws IOException {
        // write your code here
        Scanner sc = new Scanner(System.in);
        Nodes nodes[] = new Nodes[5];
        for (int i = 0; i < nodes.length; i++) {
            nodes[i] = new Nodes();
            System.out.println("Enter the Id of " + i);
            int id = sc.nextInt();
            nodes[i].setId(id);

            System.out.println("Enter the type of " + i);
            int type = sc.nextInt();
            nodes[i].setType(type);
```

```
            sc.nextLine();

            System.out.println("Enter the Region of " + i);
            String region = sc.nextLine();
            nodes[i].setRegion(region);

        }
        ArrayList<Integer> A = new ArrayList<Integer>();
        ArrayList<Integer> B = new ArrayList<Integer>();
        ArrayList<Integer> C = new ArrayList<Integer>();


        for (int i = 0; i < nodes.length; i++) {
            if (nodes[i].region.contains("A")) {
                A.add(nodes[i].id);
            }
        }
        for (int i = 0; i < nodes.length; i++) {
            if (nodes[i].region.contains("B")) {
                B.add(nodes[i].id);
            }
        }
        for (int i = 0; i < nodes.length; i++) {
            if (nodes[i].region.contains("C")) {
                C.add(nodes[i].id);
            }
        }

        System.out.println("Enter no. of times communication occurs");
        int times = sc.nextInt();

        FileWriter fw = new
FileWriter("C:\\Users\\abc\\IdeaProjects\\test1.txt",true);
        PrintWriter out = new PrintWriter(fw);
        for (int i = 0; i < times; i++) {
            out.print(i+" ");
        }
        out.println();
        for (int k = 0; k < times; k++) {
            System.out.println("Enter the Sender Node's ID");
            int s_id = sc.nextInt();
            System.out.println("Enter the Receiver Node's ID");
            int d_id = sc.nextInt();

            if ((A.contains(s_id) && A.contains(d_id)) || (B.contains(s_id)
&& B.contains(d_id)) || (C.contains(s_id) && C.contains(d_id))) {
                Mechanism m = new Mechanism();
                m.dcf(nodes[s_id], nodes[d_id]);

                int total_energy = 0;
                for(int j = 0; j < nodes.length; j++){
                    total_energy += nodes[j].getEnergy();
                }

                out.print(((nodes.length*100)-total_energy)+" ");
            }

            else if ((A.contains(s_id) && (A.contains(d_id) == false)) ||
(A.contains(s_id) == false && (A.contains(d_id))) || (B.contains(s_id) &&
(B.contains(d_id) == false)) || (B.contains(s_id) == false &&
(B.contains(d_id))) || (C.contains(s_id) && (C.contains(d_id) == false)) ||
(C.contains(s_id) == false && (C.contains(d_id)))) {

                ArrayList<Nodes> temp = new ArrayList<>();
                for (int i = 0; i < nodes.length; i++) {
```

```
                    if (nodes[s_id].region.length() >
nodes[d_id].region.length()) {
                        for (int j = 0; j < nodes[s_id].region.length();
j++) {
                            String letter =
Character.toString(nodes[s_id].region.charAt(j));
                            if (nodes[i].region.contains(letter) &&
nodes[i].region.contains(nodes[d_id].region) && nodes[i].type == 0) {
                                temp.add(nodes[i]);
                            }
                        }
                    } else {
                        for (int j = 0; j < nodes[d_id].region.length();
j++) {
                            String letter =
Character.toString(nodes[d_id].region.charAt(j));
                            if (nodes[i].region.contains(letter) &&
nodes[i].region.contains(nodes[s_id].region) && nodes[i].type == 0) {
                                temp.add(nodes[i]);
                            }
                        }
                    }
                }

                Collections.sort(temp, new NodeThroughputComparator());

                Mechanism mechanism = new Mechanism();
                mechanism.paap(nodes[s_id], nodes[d_id],
temp.get(temp.size() - 1));

                int total_energy = 0;
                for(int j = 0; j < nodes.length; j++){
                    total_energy += nodes[j].getEnergy();
                }

                out.print(((nodes.length*100)-total_energy)+" ");

            }

        }
        out.println();
        out.close();

        int total_energy = 0;
        for(int i = 0; i < nodes.length; i++){
            total_energy += nodes[i].getEnergy();
        }
        System.out.println("Total Energy consumed = " +
((nodes.length*100)-total_energy));

        FileWriter fw1 = new
FileWriter("C:\\Users\\abc\\IdeaProjects\\test.txt",true);
        PrintWriter out1 = new PrintWriter(fw1);

        out1.println(((nodes.length*100)-total_energy));

        out1.close();
    }
}
```

COOPMAC.java

```java
package com.company;

import org.w3c.dom.Node;

import java.io.FileWriter;
import java.io.IOException;
import java.io.PrintWriter;
import java.lang.reflect.Array;
import java.util.ArrayList;
import java.util.Collections;
import java.util.Comparator;
import java.util.Scanner;

class Nodes{
    int id;
    int type;
    int energy=100;
    String region;
    int throughput=0;
    void throughput0(){
        throughput+=1;
    }

    void throughput1(){
        if(throughput>0) {
            throughput -= 1;
        }
    }
    void energy_con(){
        energy-=1;
    }

    public int getId() {
        return id;
    }

    public void setId(int id) {
        this.id = id;
    }

    public int getType() {
        return type;
    }

    public void setType(int type) {
        this.type = type;
    }

    public int getEnergy() {
        return energy;
    }
```

```
    public void setEnergy(int energy) {
        this.energy = energy;
    }

    public String getRegion() {
        return region;
    }

    public void setRegion(String region) {
        this.region = region;
    }

    public int getThroughput() {
        return throughput;
    }

    public void setThroughput(int throughput) {
        this.throughput = throughput;
    }

}

class Mechanism{
    void dcf(Nodes sender, Nodes destination){
        System.out.println("RTS from "+sender.id+" to "+destination.id);
        System.out.println("CTS from "+destination.id+" to "+sender.id);
        System.out.println("Transfer Packet");
        System.out.println("Acknowledgment from " + destination.id + " to " + sender.id);
        sender.energy_con();
        destination.energy_con();
        sender.throughput0();
    }

    void coopmac(Nodes sender, Nodes destination,Nodes helper) {
        System.out.println("RTS from "+sender.id+" to "+helper.id);
        System.out.println("RTS from "+helper.id+" to "+destination.id);
        System.out.println("CTS from "+destination.id+" to "+helper.id);
        System.out.println("CTS from "+helper.id+" to "+sender.id);
        System.out.println("Transfer Packet");
        System.out.println("Acknowledgment from " + destination.id + " to " + helper.id);
        System.out.println("Acknowledgment from " + helper.id + " to " + sender.id);
        sender.energy_con();
        destination.energy_con();
        helper.throughput0();
        sender.throughput0();
    }

}


public class Main {
    public static void main(String[] args) throws IOException {
        // write your code here
```

```
Scanner sc = new Scanner(System.in);
Nodes nodes[] = new Nodes[5];
for (int i = 0; i < nodes.length; i++) {
    nodes[i] = new Nodes();
    System.out.println("Enter the Id of " + i);
    int id = sc.nextInt();
    nodes[i].setId(id);

    System.out.println("Enter the type of " + i);
    int type = sc.nextInt();
    nodes[i].setType(type);

    sc.nextLine();

    System.out.println("Enter the Region of " + i);
    String region = sc.nextLine();
    nodes[i].setRegion(region);

}
ArrayList<Integer> A = new ArrayList<Integer>();
ArrayList<Integer> B = new ArrayList<Integer>();
ArrayList<Integer> C = new ArrayList<Integer>();


for (int i = 0; i < nodes.length; i++) {
    if (nodes[i].region.contains("A")) {
        A.add(nodes[i].id);
    }
}
for (int i = 0; i < nodes.length; i++) {
    if (nodes[i].region.contains("B")) {
        B.add(nodes[i].id);
    }
}
for (int i = 0; i < nodes.length; i++) {
    if (nodes[i].region.contains("C")) {
        C.add(nodes[i].id);
    }
}

System.out.println("Enter no. of times communication occurs");
int times = sc.nextInt();

FileWriter fw = new FileWriter("C:\\Users\\abc\\IdeaProjects\\test1.txt",true);
PrintWriter out = new PrintWriter(fw);
for (int i = 0; i < times; i++) {
    out.print(i+" ");
}
out.println();
for(int k = 0; k < times; k++){
    System.out.println("Enter the Sender Node's ID");
    int s_id = sc.nextInt();
    System.out.println("Enter the Receiver Node's ID");
```

```
            int d_id = sc.nextInt();


            if ((A.contains(s_id) && A.contains(d_id)) || (B.contains(s_id) && B.contains(d_id))
|| (C.contains(s_id) && C.contains(d_id))) {
                Mechanism m = new Mechanism();
                m.dcf(nodes[s_id], nodes[d_id]);

                int total_energy = 0;
                for(int j = 0; j < nodes.length; j++){
                    total_energy += nodes[j].getEnergy();
                }

                out.print(((nodes.length*100)-total_energy)+" ");
            }

            else if ((A.contains(s_id) && (A.contains(d_id) == false)) || (A.contains(s_id) ==
false && (A.contains(d_id))) || (B.contains(s_id) && (B.contains(d_id) == false)) ||
(B.contains(s_id) == false && (B.contains(d_id))) || (C.contains(s_id) && (C.contains(d_id)
== false)) || (C.contains(s_id) == false && (C.contains(d_id)))) {

                ArrayList<Nodes> temp = new ArrayList<>();
                for (int i = 0; i < nodes.length; i++) {
                    if (nodes[s_id].region.length() > nodes[d_id].region.length()) {
                        for (int j = 0; j < nodes[s_id].region.length(); j++) {
                            String letter = Character.toString(nodes[s_id].region.charAt(j));
                            if (nodes[i].region.contains(letter) &&
nodes[i].region.contains(nodes[d_id].region)) {
                                temp.add(nodes[i]);
                            }
                        }
                    } else {
                        for (int j = 0; j < nodes[d_id].region.length(); j++) {
                            String letter = Character.toString(nodes[d_id].region.charAt(j));
                            if (nodes[i].region.contains(letter) &&
nodes[i].region.contains(nodes[s_id].region)) {
                                temp.add(nodes[i]);
                            }
                        }
                    }
                }


                while(true){
                    int index = (int)(Math.random() * temp.size());
                    if(temp.get(index).type == 1){
                        System.out.println("Packet not send by " + temp.get(index).id);
                        temp.get(index).energy_con();
                    }
                    else {
                        Mechanism mechanism = new Mechanism();
                        mechanism.coopmac(nodes[s_id], nodes[d_id], temp.get(index));
                        break;
```

```
                }
            }
            int total_energy = 0;
            for(int j = 0; j < nodes.length; j++){
                total_energy += nodes[j].getEnergy();
            }

            out.print(((nodes.length*100)-total_energy)+" ");

        }

    }
    out.println();
    out.close();

    int total_energy = 0;
    for(int i = 0; i < nodes.length; i++){
        total_energy += nodes[i].getEnergy();
    }
    System.out.println("Total Energy consumed = " + ((nodes.length*100)-total_energy));

    FileWriter fw1 = new FileWriter("C:\\Users\\abc\\IdeaProjects\\test.txt",true);
    PrintWriter out1 = new PrintWriter(fw1);

    out1.println(((nodes.length*100)-total_energy));

    out1.close();
  }
}
```

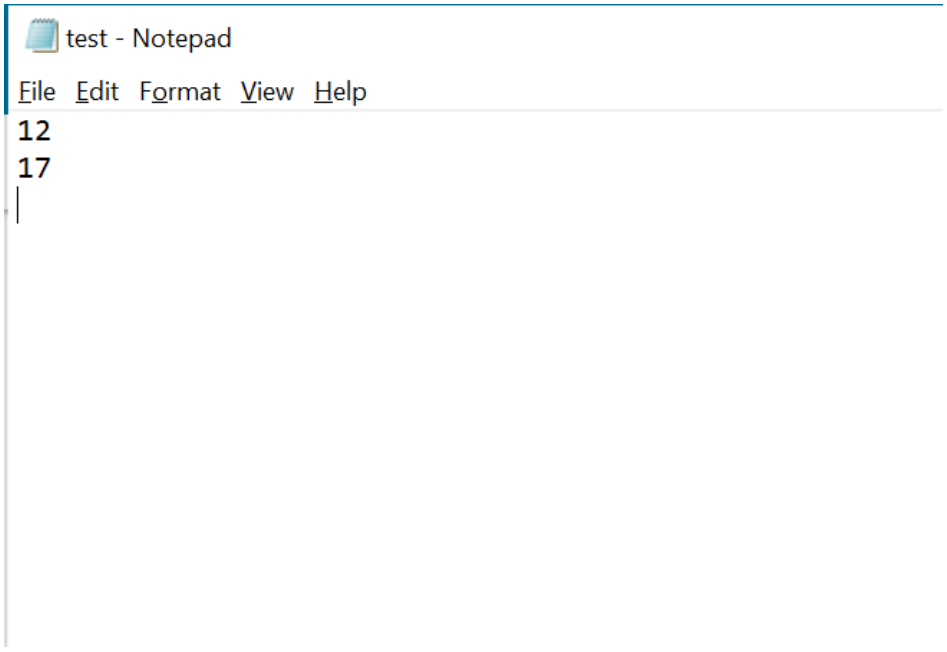
barplot.m:

```
A = load("test.txt");
names = {'PAAP';'COOPMAC'};
bar(A);
set(gca,'xticklabel',names);
xlabel('Protocols (X-AXIS)');
ylabel('Energy consumed (Y-AXIS)');
```

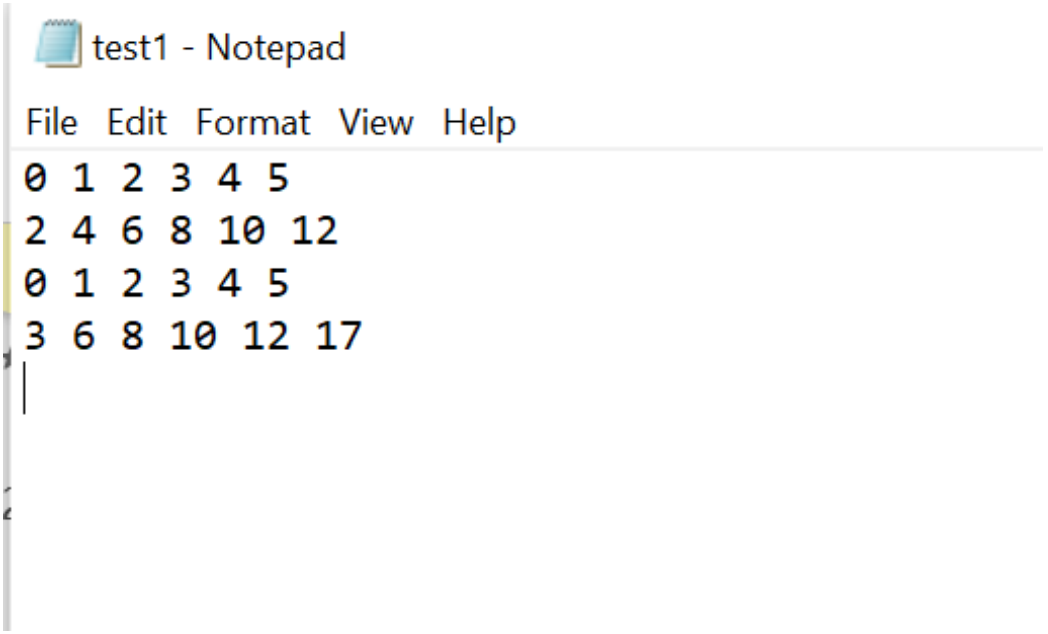
lineplot.m:

```
A = load("test1.txt");
plot(A(1,:),A(2,:))
hold on
plot(A(3,:),A(4,:))
hold off
xlabel('No. of communication');
ylabel('Energy consumed');
legend('PAAP','COOPMAC');
```

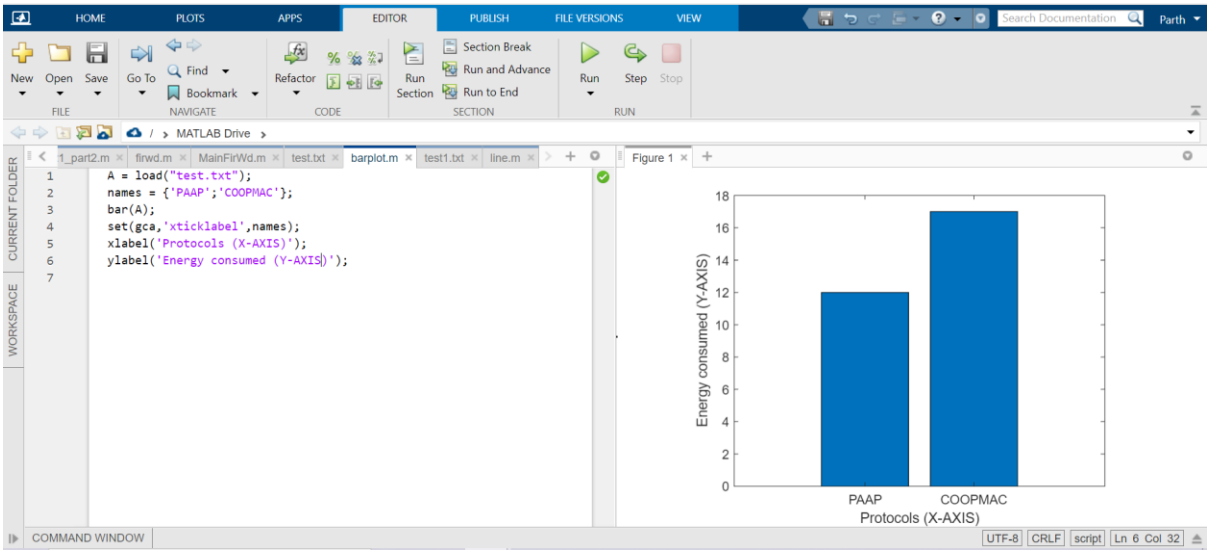
RESULTS/OUTPUT:



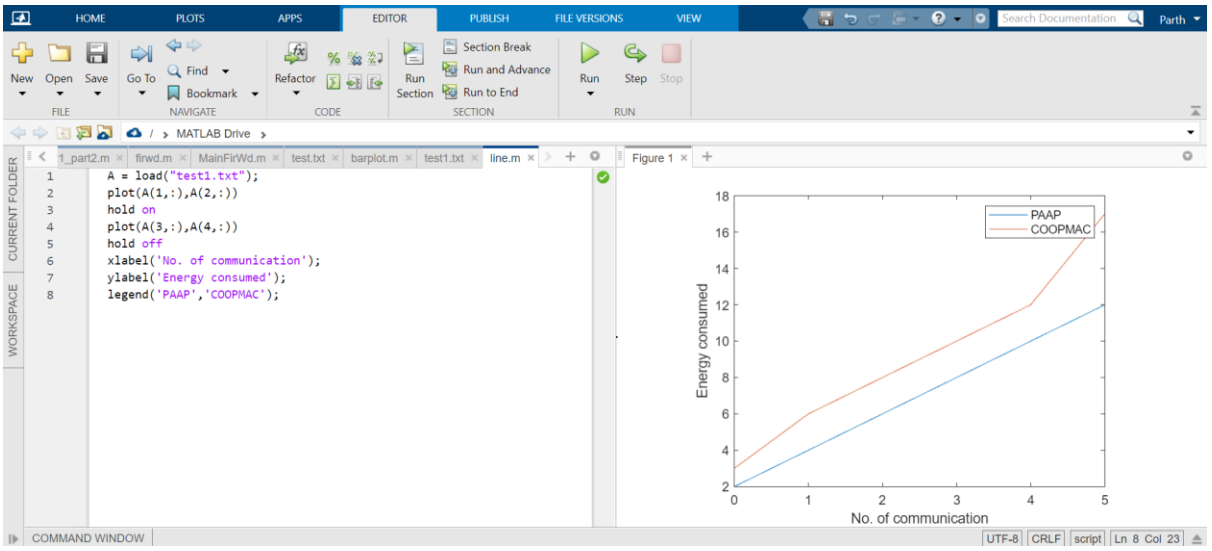
test.txt



test1.txt



Graph: Energy Consumed after a series Communication



Graph: Energy Consumed after every Communication

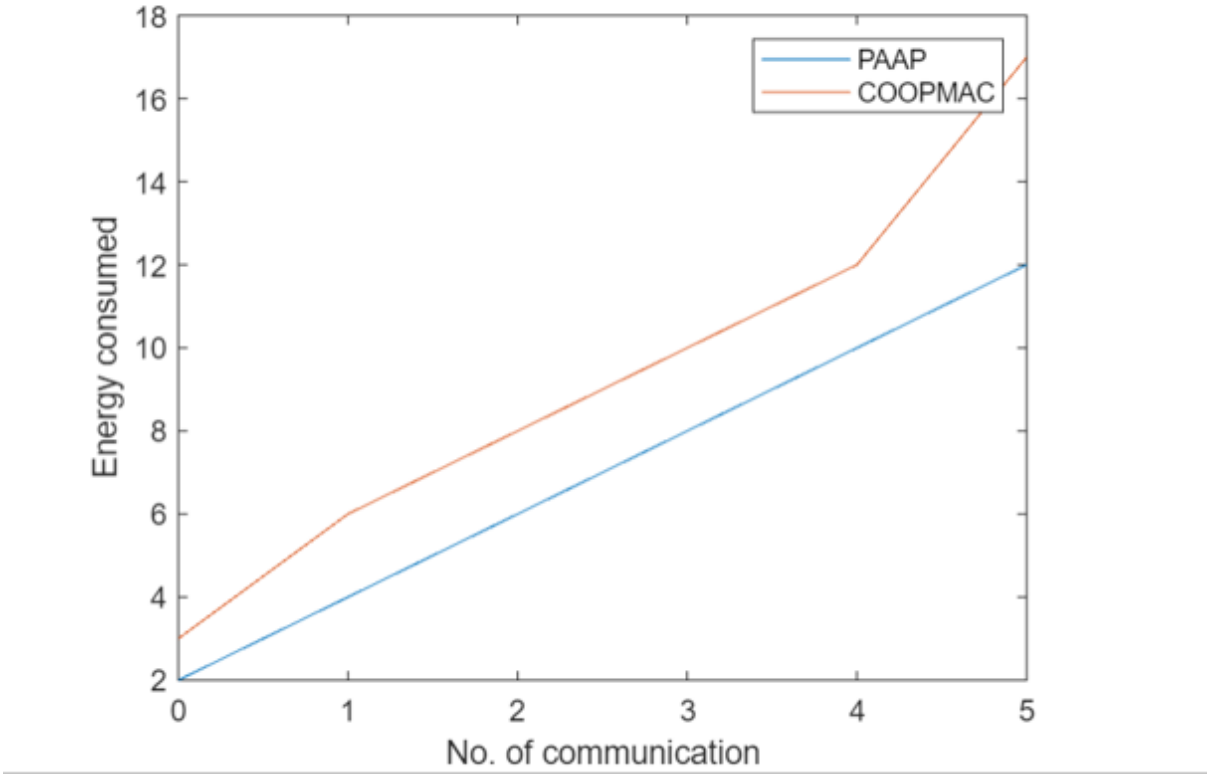


Chart 1: Energy Consumption after every Communication.

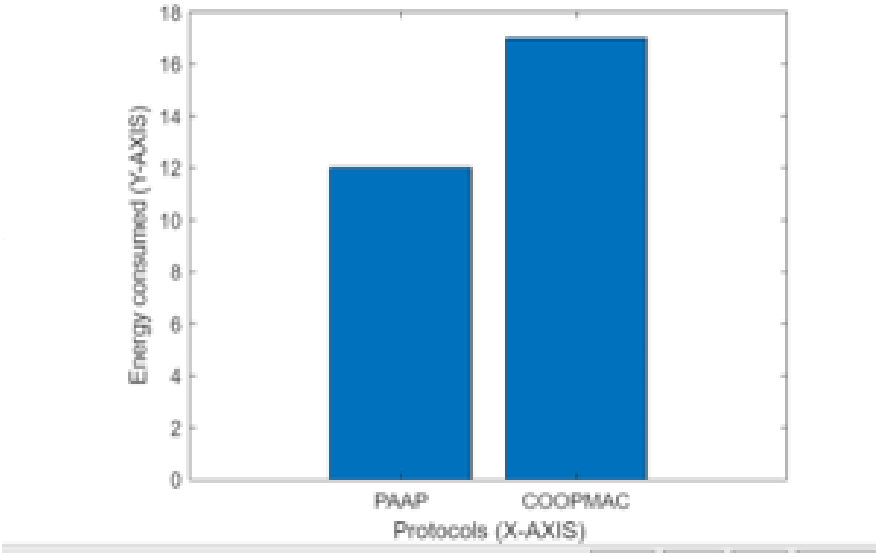


Chart 2: Total Energy Consumption at the End.

REVIEW/ANALYSIS:

- Energy-Efficiency
- Higher Throughput
- Lesser Delay

CONCLUSION:

In conclusion, PAP protocol has performed far better than CoopMac protocol in an ideal situation. The idea of taking throughput as a parameter for the selection of the helper node has given us a small margin for saving battery. Also, the performance increase with the increase in the number of nodes. As we take a close look at the algorithm it is clearly visible that PAP also helps to achieve lesser delay. The algorithm is also successful in providing us with better throughput than other protocols. Thus, we have successfully achieved Trust based on Energy Efficiency, Throughput, Delay through this protocol.

Along with the above benefits, there is some relaxation in QoS performance such as the transmission power of nodes can go down, there can be jitters and excessive loads on high performing nodes, which can lead to damage or faster discharge of them. Thus, there can be other consequences in this protocol. We tend to discover and explore more about this protocol to get even better and real-time results.

FUTURE WORK:

1). Applying PAP protocol in a real-time situation with better simulation.

2). Comparing PAP protocol with EECO-MAC and other DEL-CMAC protocols.

3). Adding other features like Residual Energy and Transmission Power in PAP protocol.

4). Achieve better simulation with more nodes and more regions of transmission.

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https://matlab.mathworks.com/

https://www.javatpoint.com/

Link for code video and other important documents:

https://drive.google.com/drive/folders/112VN7OynYOWlOBJbES854oygNI0BZkt_?usp=sharing

https://drive.google.com/file/d/11xwDSLIttAm5Mjjy5Xxm3pjXc43OQtBx/view?usp=sharing