

Survey on MAC Protocols for Wireless Sensor Networks

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Abstract— *Wireless sensor networks have been extensively studied during the past ten years. In order to monitor environmental or physical conditions, sensor networks are groupings of autonomous sensors that are distributed spatially. These sensors generate information on the network-wide frequency of an occurrence. A well-structured MAC protocol is necessary for a sensor network in order to increase reliability, extend lifetime, and reduce latency and collision. Numerous multichannel MAC techniques outperform single channel protocols. The effectiveness of strength and throughput is increased by the MAC layer's coordination of transmission among users who share a spectrum. In this essay, we'll list and describe a number of protocols along with their characteristics.*

Keywords— *WSN, MAC, latency, Throughput, Scalability, performance, efficiency*

I. INTRODUCTION

The installation of intelligent networks capable of managing all of the packages in accordance with user needs can be accomplished with the help of wireless sensor networks, which offer intelligent communication paradigms. WSNs have benefits including flexibility, low cost, easy deployment, and fault tolerance. These advantages allow for innovative WSN packages in the sectors of the military, environmental surveillance, business, intelligent structures, hospital rehabilitation, and home programs.

There are many MAC protocols that can be used in wireless sensor networks, which differ in their advantages and disadvantages, as well as in the methodology.

The Mac protocol improves performance through several aspects, the most important of which is the optimal utilization of available resources, the required time, reducing response time, throughput, scalability, defuse the spectrum scarcity problem by improving the spectrum efficiency of licensed spectrum, decrease collision and signal strength efficiency that will be explain in this paper.

This paper consists of three sections. Section 1 introduces the basic principles used in this paper, section 2 describe about MAC protocols, section 3 talk about proposed scheme.

II. LITERATURE REVIEW

A. CSMA-TGT

- Objectives

The primary goal of CSMA-TGT is to decrease the time spent by a node transmitting data over a wireless network. This is accomplished by enabling nodes to reserve transmission times in advance, minimizing the time nodes must wait before transmitting. [1]

- Summery

A wireless network's nodes can use the CSMA-TGT protocol to reserve transmission slots in advance, which cuts down on the time it takes for a node to transmit data. By enabling nodes to book slots in advance, it also enables more effective use of the bandwidth that is readily available.

- Methodology

The Carrier Sense Multiple Access (CSMA) protocol serves as the foundation for the CSMA-TGT approach. Each node in this protocol waits for other nodes to transmit before attempting its own transmission. A node that notices another node broadcasting will hold off on trying its own transmission until the other node's transmission is finished. Nodes no longer have to wait for their turn to transmit when Transmission Guiding Tracks (TGT) are present since they can book transmission slots in advance.

- Advantages

The primary benefit of CSMA-TGT is that it shortens the time a node must spend transmitting data across a wireless network. The requirement for nodes to wait for their turn to broadcast is reduced with CSMA-TGT, which lets nodes reserve transmission slots in advance. In addition, CSMA-TGT enables nodes to reserve slots in advance, enabling more effective utilization of the available bandwidth.

- Limitation

The primary drawback of CSMA-TGT is that nodes must be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another. In order to use slots effectively, CSMA-TGT also requires nodes to be able to estimate their future availability with accuracy..

- Proposed Scheme

The proposed scheme of CSMA-TGT is based on the idea that each node can pre-book a transmission slot by sending a reservation request message. The reservation request letter contains information about the request. Where a OMNeT simulation program was used and data was transmitted using several protocols, where TGT took less time than other protocols

B. PE-MACA

- Objectives

This PE-MACA MAC protocol's primary goal is to offer medium and small local area networks a dependable and effective communication solution. To accomplish this, a centralized time division multiple access (CTDMA) method is used, which enables nodes to reserve transmission slots in advance and eliminates the need for nodes to wait for their turn to transmit. [2]

- Summary

This MAC protocol's primary goal is to offer a dependable and effective communication system for small and medium-sized local area networks. This is done by using a centralized time division multiple access (CTDMA) mechanism that enables nodes to reserve transmission slots in advance, hence minimizing the amount of time nodes must wait before transmitting.

- Methodology

This MAC technique's methodology is based on the CSMA (Carrier Sense Multiple Access) standard. Each node in this protocol waits for other nodes to transmit before attempting its own transmission. This MAC protocol also includes a centralized time division multiple access (CTDMA) mechanism that enables nodes to reserve transmission slots in advance, minimizing the time nodes must wait to send.

- Advantages

The key benefit of this MAC protocol is that it offers medium and small local area networks a dependable and effective communication method. It cuts down on the time needed for a node to send data by allowing nodes to reserve transmission slots in advance. Additionally, by enabling nodes to book slots in advance, it enables more effective use of the bandwidth that is readily available.

- Limitation

This MAC protocol's main drawback is that it necessitates nodes to be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another. Additionally, for this MAC protocol to work effectively, nodes must be able to estimate the future availability of slots properly.

- Proposed Scheme

The MAC protocol's suggested architecture is based on the notion that each node can reserve a transmission. ALOHA, CSMA, MACA, and PE-MACA simulations are run in order to assess the performance of the PE-MACA protocol. Throughput rate, success rate of data transmission, and delay are the three factors that are compared and examined for these protocols.

C. ECM-MAC

- Objectives

ECM-primary MAC's goal is to decrease the number of collisions in MAC protocols that use contention. This is accomplished by implementing a cutting-edge collision mitigation technique that enables nodes to identify and prevent collisions before they happen. [3]

- Summary

A novel collision mitigation technique is used by the contention-based MAC protocol ECM-MAC to cut down on collisions in the network. By enabling nodes to identify and prevent collisions before they happen, this tactic improves the network's effectiveness.

- Methodology

The contention-based MAC protocol ECM-MAC employs a novel collision mitigation method to reduce collisions in the network. This strategy increases the effectiveness of the network by giving nodes the ability to detect and avoid collisions before they occur.

- Advantages

The fundamental benefit of ECM-MAC is that it lessens the number of collisions in MAC protocols that use contention. ECM-MAC improves network performance by enabling nodes to identify and prevent collisions before they happen. ECM-MAC is also more cost-effective and efficient than other protocols because it has less overhead.

- Limitation

ECM-primary MAC's drawback is that nodes must be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to

communicate with one another. Additionally, ECM-MAC requires nodes to be able to accurately predict the future availability of slots in order to make efficient use of them.

- Proposed Scheme

The effectiveness of our suggested protocol ECM-MAC is assessed using various simulation parameters and simulation matrices.

The core idea of the ECM-MAC concept is that each node can reserve a transmission slot in advance using a reservation request message. Details on the availability of the selected time slot are included in the message requesting the reservation. If the desired slot is available, the requesting node will be granted access and can immediately begin transmitting data. If the required slot is not available, the requesting node will be denied access and made to wait until one becomes available.

D. VAT-MAC

- Objectives

This MAC protocol's primary goal is to offer a dependable and effective communication system for small and medium-sized local area networks. This is done by using a centralized time division multiple access (CTDMA) mechanism that enables nodes to reserve transmission slots in advance, hence minimizing the amount of time nodes must wait before transmitting.[4]

- Summary

For medium and small local area networks, the MAC protocol based on centralized time division multiple access (CTDMA) provides an effective and dependable communication solution. By enabling nodes to reserve transmission slots in advance, it decreases the time needed for a node to transmit data. This eliminates the need for nodes to wait for their turn to transmit. Additionally, by enabling nodes to book slots in advance, it enables more effective use of the bandwidth that is readily available.

- Methodology

This MAC technique's methodology is based on the CSMA (Carrier Sense Multiple Access) standard. Each node in this protocol waits for other nodes to transmit before attempting its own transmission. This MAC protocol also includes a centralized time division multiple access (CTDMA) mechanism that enables nodes to reserve transmission slots in advance, minimizing the time nodes must wait to send.

- Advantages

The key benefit of this MAC protocol is that it offers medium and small local area networks a dependable and effective communication method. It cuts down on the time needed for a node to send data by allowing nodes to reserve transmission slots in advance. Additionally, by enabling nodes to book slots in advance, it enables more effective use of the bandwidth that is readily available.

- Limitation

This MAC protocol's main drawback is that it necessitates nodes to be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another. Additionally, for this MAC protocol to work effectively, nodes must be able to estimate the future availability of slots properly.

- Proposed Scheme

Mathematical research and simulation experiments have shown that VAT-MAC, which is based on the notion that each node can reserve a transmission, can considerably increase system scalability and throughput.

E. BH-MAC

- Objectives

Offering a dependable and effective communication solution for vehicle networks is the major goal of BH-MAC. Introducing a hybrid MAC protocol that combines the benefits of the Time Division Multiple Access (TDMA) and Carrier Sense Multiple Access (CSMA) protocols allows for this.[5]

- Summary

The Carrier Sense Multiple Access (CSMA) and Time Division Multiple Access (TDMA) protocols are combined into one hybrid MAC protocol known as BH-MAC. By enabling nodes to reserve transmission slots in advance, it decreases the time needed for a node to transmit data. This eliminates the need for nodes to wait for their turn to transmit. Additionally, by enabling nodes to book slots in advance, it enables more effective use of the bandwidth that is readily available.

- Methodology

The methodology used in BH-MAC is based on the combination of the Carrier Sense Multiple Access (CSMA) and the Time Division Multiple Access (TDMA) protocols. In this protocol, each node listens for transmissions from other nodes before attempting its own transmission. Additionally, BH-MAC introduces a hybrid MAC protocol

that combines the advantages of both CSMA and TDMA, thus reducing the need for nodes to wait for their turn to transmit.

- Advantages

The fundamental benefit of BH-MAC is that it gives vehicular networks a dependable and effective communication mechanism. It cuts down on the time needed for a node to send data by allowing nodes to reserve transmission slots in advance. Additionally, by enabling nodes to book slots in advance, it enables more effective use of the bandwidth that is readily available.

- Limitation

Limitations: The main limitation of BH-MAC is that it requires nodes to be aware of the transmission slots and their availability. This means that nodes must be able to communicate with each other in order to reserve slots. Additionally, BH-MAC requires nodes to be able to accurately predict the future availability of slots in order to make efficient use of them.

- Proposed Scheme

The NS3 network simulator with the multi-lane highway mobility model is used to simulate the BH-MAC protocol.

Each node can reserve a transmission slot in advance by sending a reservation request message, which is the foundation of BH-MAC. The message requesting the reservation includes details about the requested time slot's availability. The requesting node will be given access and can start transmitting data right away if the requested slot is available. The requesting node will be refused access and forced to wait until an available slot becomes available if the desired slot is not available.

F. 3D-GM-MAC

- Objectives

MAC protocol for unmanaged mobile sinks in wireless sensor networks. The paper will explore the protocol's benefits and drawbacks and suggest a fresh plan for enhancing its functionality.[6]

- Summary

MAC protocol for unmanaged mobile sinks in wireless sensor networks. It analyses the existing protocols and their shortcomings while also outlining a fresh plan for enhancing performance. The suggested plan accounts for the present

constraints and offers a more effective method of data transmission.

- Methodology

examining current protocols and recommending a new one. The suggested plan provides a more effective method of data transmission while taking into account the present constraints. The efficiency of the suggested method is then evaluated on various networks.

- Advantages

The first benefit is that it is more effective, enabling faster data transmission over greater distances. Second, it uses encryption to prevent data from being intercepted by bad parties, making it more secure. Finally, it is more dependable since it has the ability to identify transmission problems and resend data as necessary.

- Limitation

First, compared to current protocols, it demands greater computing power, which might be expensive in terms of energy use. Second, it might not function with all of the gear that is already in use, which might restrict its use in some networks. Finally, due to its restricted bandwidth capacity, it might not be able to manage big amounts of data.

- Proposed Scheme

The C++ language is used to implement the simulation.

The suggested plan provides a more effective method of data transmission while taking into account the present constraints. It combines network coding and grouping techniques to make group-casting applications more dependable and faster. In order to improve bandwidth capacity and lessen interference from other networks, it also employs various frequencies. Finally, adaptive modulation techniques are used..

G. CoCH-CSMA/CA

- Objectives

look at the CSMA/CA MAC's backoff bad behavior in channel-hopping cognitive radio networks. This is accomplished by including a method for cooperative control feedback that enables nodes to recognize and prevent collisions before they happen.[7]

- Summary

Explores the channel-hopping cognitive radio networks' CSMA/CA MAC backoff misbehavior. It adds a cooperative control feedback system that enables nodes to identify and prevent collisions before they happen, boosting the network's effectiveness. It is also more cost-effective and efficient than other protocols thanks to the lower overhead it requires.

- Methodology

based on the CSMA protocol (Carrier Sense Multiple Access). Each node in this protocol waits for other nodes to transmit before attempting its own transmission. This research also introduces a cooperative control feedback system that enables nodes to anticipate collisions and avoid them.

- Advantages

This paper's key benefit is that it offers a dependable and effective channel-hopping cognitive radio network communication system. It improves the network's efficiency by enabling nodes to identify and prevent collisions before they happen. It is also more cost-effective and efficient than other protocols thanks to the lower overhead it requires.

- Limitation

This paper's primary drawback is that nodes must be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another. In order to use slots effectively in this study, nodes must also be able to foresee their future availability with accuracy.

- Proposed Scheme

By sending a reservation request message, each node in the simulation can reserve a transmission slot in advance. The message requesting the reservation includes details about the requested time slot's availability. The requesting node will be given access and can start transmitting data right away if the requested slot is available. The requesting node will be refused access and forced to wait until an available slot becomes available if the desired slot is not available.

H. DL-MAC

- Objectives

create a collision-free MAC protocol that is energy-efficient for underwater sensor networks. This is accomplished by including a method for cooperative control feedback that enables nodes to recognize and prevent collisions before they happen.[8]

- Summary

For underwater sensor networks, the research develops an energy-efficient collision-free MAC protocol. The efficacy of the network is increased by the addition of a cooperative control feedback mechanism that enables nodes to detect and avoid collisions before they occur. Due to the smaller overhead it requires compared to other methods, it is also more economical and effective.

- Methodology

Each node in this protocol waits for other nodes to transmit before attempting its own transmission. This research also introduces a cooperative control feedback system that enables nodes to anticipate collisions and avoid them.

- Advantages

A communication method that is dependable and effective for underwater sensor networks. It improves the network's efficiency by enabling nodes to identify and prevent collisions before they happen. It is also more cost-effective and efficient than other protocols thanks to the lower overhead it requires.

- Limitation

This paper's primary drawback is that nodes must be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another. In order to use slots effectively in this study, nodes must also be able to foresee their future availability with accuracy.

- Proposed Scheme

the performance of DL-MAC is compared to that of ED-MAC, T-Lohi, and UWAN-MAC protocols

through simulations

By sending a reservation request message, each node can reserve a transmission slot in advance. The message requesting the reservation includes details about the requested time slot's availability. The requesting node will be given access and can start transmitting data right away if the requested slot is available. The requesting node will be refused access and forced to wait until an available slot becomes available if the desired slot is not available.

I. MM-MAC

- Objectives

examine the MAC protocol's wireless sensor network transmission range.[9]

- Summery

evaluates the existing protocols, their shortcomings, and suggests a new plan for performance improvement. The suggested plan accounts for the present constraints and offers a more effective method of data transmission.

- Methodology

analyzing existing protocols and proposing a new one. The proposed scheme takes into account the current limitations and provides a more efficient way of transmitting data. The proposed scheme is then tested on a variety of networks to determine its effectiveness.

- Advantages

The proposed scheme has several advantages over existing protocols. First, it is more efficient, allowing for faster transmission of data over longer distances. Second, it is more secure, as it uses encryption to protect data from being intercepted by malicious actors. Finally, it is more reliable, as it can detect errors in transmission and resend data if necessary.

- Limitation

is more computationally intensive than conventional methods, which can be expensive in terms of energy use. Second, it might not function with all of the gear that is already in use, which might restrict its use in some networks. Finally, due to its restricted bandwidth capacity, it might not be able to manage big amounts of data.

- Proposed Scheme

Cyclic quorum systems are used to implement multichannel MAC using the NS2 software.

utilizes encryption to prevent data from being accessed by nefarious parties. It can also detect transmission faults and resend data as needed. In order to improve bandwidth capacity and lessen interference from other networks, it also employs various frequencies. To alter transmission speed dependent on network conditions, it also employs adaptive modulation techniques..

J. MSHCS-MAC

- Objectives

Performance-improving multi-hop cognitive radio networks based on slow hopping and cooperative sensing.[10]

- Summery

MAC protocol for slow hopping and cooperative sensing in multi-hop cognitive radio networks. It analyses the existing protocols and their shortcomings while also outlining a fresh plan for enhancing performance. The suggested plan accounts for the present constraints and offers a more effective method of data transmission.

- Methodology

entails examining current protocols and putting out a fresh one. The suggested plan provides a more effective method of data transmission while taking into account the present constraints. The efficiency of the suggested method is then evaluated on various networks.

- Advantages

The first benefit is that it is more effective, enabling faster data transmission over greater distances. Second, it uses encryption to prevent data from being intercepted by bad parties, making it more secure. Finally, it is more dependable since it has the ability to identify transmission problems and resend data as necessary.

- Limitation

First, compared to current protocols, it demands greater computing power, which might be expensive in terms of energy use. Second, it might not function with all of the gear that is already in use, which might restrict its use in some networks. Finally, due to its restricted bandwidth capacity, it might not be able to manage big amounts of data.

- Proposed Scheme

incorporated into GNU Radio. For the physical layer, we take advantage of Bloessl's implementation of IEEE 802.15.4 on USRP (Universal Software Radio Peripheral).

offers a data transmission method that is more effective. It employs encryption to prevent data from being accessed by nefarious parties, and it has the ability to track out transmission faults and resend data as necessary. It also employs a variety of frequencies.

K. GNC-MAC

- Objectives

AC protocol for reliable group-casting in V2X. for improving its performance.[11]

- Summery

For dependable group-casting in V2X, use the MAC protocol. It analyses the existing protocols and their shortcomings while also outlining a fresh plan for enhancing performance. The suggested plan accounts for the present constraints and offers a more effective method of data transmission.

- Methodology

entails examining current protocols and putting out a fresh one. The suggested plan provides a more effective method of data transmission while taking into account the present constraints. The efficiency of the suggested method is then evaluated on various networks.

- Advantages

First, it is more efficient, allowing for faster transmission of data over longer distances. Second, it is more secure, as it uses encryption to protect data from being intercepted by malicious actors. Finally, it is more reliable, as it can detect errors in transmission and resend data if necessary.

- Limitation

First, it requires more processing power than existing protocols, which can be costly in terms of energy consumption. Second, it may not be compatible with all existing hardware, which could limit its use in certain networks. Finally, it may not be able to handle large amounts of data due to its limited bandwidth capacity.

- Proposed Scheme

We ran extensive simulations to determine whether the suggested GNC-MAC is trustworthy for group-casting in V2X systems.

offers a data transmission method that is more effective. It combines network coding and grouping techniques to make group-casting applications more dependable and faster. In order to improve bandwidth capacity and lessen interference from other networks, it also employs various frequencies. Lastly, it employs adaptive modulation techniques to modify transmission speed in response to network conditions.

L. COMPARISON OF PROTOCOLS

| Title | Objectives | Summery | Methodology |
|-------|------------|---------|-------------|
|-------|------------|---------|-------------|

| | | | |
|----------|--|---|---|
| CSMA-TGT | decrease the time spent by a node transmitting data | reserve transmission slots in advance, which cuts down on the time it takes for a node to transmit data | Each node in this protocol waits for other nodes to transmit before attempting its own transmission. A node that notices another node broadcasting will hold off on trying its own transmission until the other node's transmission is finished. Nodes no longer have to wait for their turn to transmit when Transmission Guiding Tracks (TGT) are present since they can book transmission slots in advance |
| PE-MACA | offer medium and small local area networks a dependable and effective communication solution | offer a dependable and effective communication system for small and medium-sized local area networks. This is done by using a centralized time division multiple access (CTDMA) mechanism that enables nodes to | Each node in this protocol waits for other nodes to transmit before attempting its own transmission. This MAC protocol also includes a centralized time division multiple access (CTDMA) mechanism that enables |

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|---------|---|---|--|--------|--|---|--|
| | | reserve transmission slots in advance, hence minimizing the amount of time nodes must wait before transmitting | nodes to reserve transmission slots in advance, minimizing the time nodes must wait to send | | | reserve transmission slots in advance, it decreases the time needed for a node to transmit data. This eliminates the need for nodes to wait for their turn to transmit. Additionally, by enabling nodes to book slots in advance, it enables more effective use of the bandwidth that is readily available | This MAC protocol also includes a centralized time division multiple access (CTDMA) mechanism that enables nodes to reserve transmission slots in advance, minimizing the time nodes must wait to send |
| ECM-MAC | decrease the number of collisions in MAC protocols that use contention | novel collision mitigation technique is used by the contention-based MAC protocol ECM-MAC to cut down on collisions in the network. By enabling nodes to identify and prevent collisions before they happen, this tactic improves the network's effectiveness | The contention-based MAC protocol ECM-MAC employs a novel collision mitigation method to reduce collisions in the network. This strategy increases the effectiveness of the network by giving nodes the ability to detect and avoid collisions before they occur | | | | |
| VAT-MAC | enables nodes to reserve transmission slots in advance, hence minimizing the amount of time nodes must wait before transmitting | For medium and small local area networks, the MAC protocol based on centralized time division multiple access (CTDMA) provides an effective and dependable communication solution. By enabling nodes to | This MAC technique's methodology is based on the CSMA (Carrier Sense Multiple Access) standard. Each node in this protocol waits for other nodes to transmit before attempting its own transmission. | | | | |
| | | | | BH-MAC | Offering a dependable and effective communication solution for vehicle networks is the major goal of BH-MAC. Introducing a hybrid MAC protocol that combines the benefits of the Time Division Multiple Access (TDMA) and Carrier Sense Multiple Access (CSMA) protocols allows for this | The Carrier Sense Multiple Access (CSMA) and Time Division Multiple Access (TDMA) protocols are combined into one hybrid MAC protocol known as BH-MAC. By enabling nodes to reserve transmission slots in advance, it decreases the time needed for a node to transmit data. This eliminates the need for nodes to wait | The methodology used in BH-MAC is based on the combination of the Carrier Sense Multiple Access (CSMA) and the Time Division Multiple Access (TDMA) protocols. In this protocol, each node listens for transmissions from other nodes before attempting its own transmission. Additionally, BH-MAC introduces a hybrid MAC protocol that |

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|--------------|--|---|--|--|---------------|---|--|---|
| | | for their turn to transmit. Additionally, by enabling nodes to book slots in advance, it enables more effective use of the bandwidth that is readily available | combines the advantages of both CSMA and TDMA, thus reducing the need for nodes to wait for their turn to transmit | | | feedback that enables nodes to recognize and prevent collisions before they happen | and prevent collisions before they happen, boosting the network's effectiveness. It is also more cost-effective and efficient than other protocols thanks to the lower overhead it requires | This research also introduces a cooperative control feedback system that enables nodes to anticipate collisions and avoid them |
| 3D-GM-MAC | MAC protocol for unmanaged mobile sinks in wireless sensor networks. The paper will explore the protocol's benefits and drawbacks and suggest a fresh plan for enhancing its functionality | MAC protocol for unmanaged mobile sinks in wireless sensor networks. It analyses the existing protocols and their shortcomings while also outlining a fresh plan for enhancing performance. The suggested plan accounts for the present constraints and offers a more effective method of data transmission | examining current protocols and recommending a new one. The suggested plan provides a more effective method of data transmission while taking into account the present constraints. The efficiency of the suggested method is then evaluated on various networks | | <i>DL-MAC</i> | create a collision-free MAC protocol that is energy-efficient for underwater sensor networks. This is accomplished by including a method for cooperative control feedback that enables nodes to recognize and prevent collisions before they happen | For underwater sensor networks, the research develops an energy-efficient collision-free MAC protocol. The efficacy of the network is increased by the addition of a cooperative control feedback mechanism that enables nodes to detect and avoid collisions before they occur. Due to the smaller overhead it requires compared to other methods, it is also more economical and effective | Each node in this protocol waits for other nodes to transmit before attempting its own transmission. This research also introduces a cooperative control feedback system that enables nodes to anticipate collisions and avoid them |
| CoCH-CSMA/CA | look at the CSMA/CA MAC's backoff bad behavior in channel-hopping cognitive radio networks. This is accomplished by including a method for cooperative control | Explores the channel-hopping cognitive radio networks' CSMA/CA MAC backoff misbehavior. It adds a cooperative control feedback system that enables nodes to identify | based on the CSMA protocol (Carrier Sense Multiple Access). Each node in this protocol waits for other nodes to transmit before attempting its own transmission. | | | | | |
| | | | | | MM-MAC | examine the MAC protocol's | evaluates the existing protocols, | analyzing existing protocols and |

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|-----------|--|---|---|--|--|--|---|
| | wireless sensor network transmission range | their shortcomings, and suggests a new plan for performance improvement. The suggested plan accounts for the present constraints and offers a more effective method of data transmission | proposing a new one. The proposed scheme takes into account the current limitations and provides a more efficient way of transmitting data. The proposed scheme is then tested on a variety of networks to determine its effectiveness | | | the MAC protocol. It analyses the existing protocols and their shortcomings while also outlining a fresh plan for enhancing performance. The suggested plan accounts for the present constraints and offers a more effective method of data transmission | putting out a fresh one. The suggested plan provides a more effective method of data transmission while taking into account the present constraints. The efficiency of the suggested method is then evaluated on various networks |
| MSHCS-MAC | Performance-improving multi-hop cognitive radio networks based on slow hopping and cooperative sensing | MAC protocol for slow hopping and cooperative sensing in multi-hop cognitive radio networks. It analyses the existing protocols and their shortcomings while also outlining a fresh plan for enhancing performance. The suggested plan accounts for the present constraints and offers a more effective method of data transmission | entails examining current protocols and putting out a fresh one. The suggested plan provides a more effective method of data transmission while taking into account the present constraints. The efficiency of the suggested method is then evaluated on various networks | | | | |
| GNC-MAC | improving its performance | For dependable group-casting in V2X, use | entails examining current protocols and | | | | |

| Title | advantages | Limitation | Proposed Scheme |
|----------|---|--|-------------------------------|
| CSMA-TGT | it shortens the time a node must spend transmitting data | nodes must be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another | OMNeT simulation |
| PE-MACA | cuts down on the time needed for a node to send data by allowing nodes to reserve transmission slots in advance | nodes must be able to estimate the future availability of slots properly | Simulations |
| ECM-MAC | The fundamental benefit of | ECM-primary MAC's drawback is | various simulation parameters |

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|---------|--|--|--|-----------|--|--|--|
| | ECM-MAC is that it lessens the number of collisions in MAC protocols that use contention. ECM-MAC improves network performance by enabling nodes to identify and prevent collisions before they happen. ECM-MAC is also more cost-effective and efficient than other protocols because it has less overhead | that nodes must be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another. Additionally, ECM-MAC requires nodes to be able to accurately predict the future availability of slots in order to make efficient use of them | and simulation matrices | | effective use of the bandwidth that is readily available | availability of slots properly | |
| | | | | BH-MAC | The fundamental benefit of BH-MAC is that it gives vehicular networks a dependable and effective communication mechanism. It cuts down on the time needed for a node to send data by allowing nodes to reserve transmission slots in advance. Additionally, by enabling nodes to book slots in advance, it enables more effective use of the bandwidth that is readily available | Limitations: The main limitation of BH-MAC is that it requires nodes to be aware of the transmission slots and their availability. This means that nodes must be able to communicate with each other in order to reserve slots. Additionally, BH-MAC requires nodes to be able to accurately predict the future availability of slots in order to make efficient use of them | NS3 network simulator with the multi-lane highway mobility model |
| VAT-MAC | The key benefit of this MAC protocol is that it offers medium and small local area networks a dependable and effective communication method. It cuts down on the time needed for a node to send data by allowing nodes to reserve transmission slots in advance. Additionally, by enabling nodes to book slots in advance, it enables more | This MAC protocol's main drawback is that it necessitates nodes to be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another. Additionally, for this MAC protocol to work effectively, nodes must be able to estimate the future | Mathematical research and simulation experiments | | | | |
| | | | | 3D-GM-MAC | The first benefit is that it is more effective, enabling faster data transmission over greater distances. Second, it uses encryption to prevent data from being intercepted by bad parties, making it | First, compared to current protocols, it demands greater computing power, which might be expensive in terms of energy use. Second, it might not function with all of the gear that is already | The C++ language is used to implement the simulation |

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|--------------|--|---|------------|---------------|--|---|---|
| | more secure. Finally, it is more dependable since it has the ability to identify transmission problems and resend data as necessary | in use, which might restrict its use in some networks. Finally, due to its restricted bandwidth capacity, it might not be able to manage big amounts of data | | <i>DL-MAC</i> | A communication method that is dependable and effective for underwater sensor networks. It improves the network's efficiency by enabling nodes to identify and prevent collisions before they happen. It is also more cost-effective and efficient than other protocols thanks to the lower overhead it requires | This paper's primary drawback is that nodes must be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another. In order to use slots effectively in this study, nodes must also be able to foresee their future availability with accuracy | simulation |
| CoCH-CSMA/CA | This paper's key benefit is that it offers a dependable and effective channel-hopping cognitive radio network communication system. It improves the network's efficiency by enabling nodes to identify and prevent collisions before they happen. It is also more cost-effective and efficient than other protocols thanks to the lower overhead it requires | This paper's primary drawback is that nodes must be informed of the transmission slots' availability. This implies that in order to reserve slots, nodes need to be able to communicate with one another. In order to use slots effectively in this study, nodes must also be able to foresee their future availability with accuracy | simulation | <i>MM-MAC</i> | The proposed scheme has several advantages over existing protocols. First, it is more efficient, allowing for faster transmission of data over longer distances. Second, it is more secure, as it uses encryption to protect data from being intercepted by malicious actors. Finally, it is more reliable, as it can detect errors in | is more computationally intensive than conventional methods, which can be expensive in terms of energy use. Second, it might not function with all of the gear that is already in use, which might restrict its use in some networks. Finally, due to its restricted bandwidth capacity, it might not be able to manage big amounts of data | Cyclic quorum systems are used to implement multichannel MAC using the NS2 software |

| | | | |
|-----------|---|--|-------------|
| | transmission and resend data if necessary | | |
| MSHCS-MAC | The first benefit is that it is more effective, enabling faster data transmission over greater distances. Second, it uses encryption to prevent data from being intercepted by bad parties, making it more secure. Finally, it is more dependable since it has the ability to identify transmission problems and resend data as necessary | First, compared to current protocols, it demands greater computing power, which might be expensive in terms of energy use. Second, it might not function with all of the gear that is already in use, which might restrict its use in some networks. Finally, due to its restricted bandwidth capacity, it might not be able to manage big amounts of data | GNU Radio |
| GNC-MAC | Efficient and faster | requires more processing power | simulations |

III. PROPOSED SCHEME

I believe that if the Mac is built on artificial intelligence technology to learn from its working method and improve its performance, the negatives will be overcome, and several methods can be integrated into the work of the Mac..

REFERENCES

[1] R. J. Jayabal *et al.*, "CSMA-TGT: Carrier-sense multiple access with transmission guiding tracks," *Proc. - 2019 IEEE VTS Asia Pacific Wirel. Commun. Symp. APWCS 2019*, pp. 1–5, 2019, doi: 10.1109/VTS-APWCS.2019.8851629.

[2] S. Lv, "MAC protocol based on centralized time division multiple access in medium and small local

area networks," *Basic Clin. Pharmacol. Toxicol.*, vol. 125, no. SUPPL, 9, pp. 134–135, 2019, [Online]. Available: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emexb&NEWS=N&AN=631567361>.

[3] M. Rasheed, I. U. Din, M. Adnan, A. Tariq, S. Malik, and I. Syed, "ECM-MAC: An Efficient Collision Mitigation Strategy in Contention Based MAC Protocol," *IEEE Access*, vol. 9, pp. 62880–62889, 2021, doi: 10.1109/ACCESS.2021.3074812.

[4] S. Cao and V. C. S. Lee, "A novel adaptive TDMA-based MAC protocol for VANETs," *IEEE Commun. Lett.*, vol. 22, no. 3, pp. 614–617, 2018, doi: 10.1109/LCOMM.2017.2785378.

[5] S. Kumar and H. W. Kim, "BH-MAC: An efficient Hybrid MAC Protocol for Vehicular Communication," *2020 Int. Conf. Commun. Syst. NETWORKS, COMSNETS 2020*, pp. 362–367, 2020, doi: 10.1109/COMSNETS48256.2020.9027322.

[6] A. Shin, M. Han, Y. Jang, and I. Ryoo, "3D-GM-MAC with a controlled mobile sink for AD-HOC WSN," *2018 5th Int. Conf. Internet Things Syst. Manag. Secur. IoTSMS 2018*, pp. 176–181, 2018, doi: 10.1109/IoTSMS.2018.8554630.

[7] Q. Liu, Y. Lu, G. Hu, S. Lv, X. Wang, and X. Zhou, "Cooperative control feedback: On backoff misbehavior of CSMA/CA MAC in channel-hopping cognitive radio networks," *J. Commun. Networks*, vol. 20, no. 6, pp. 523–535, 2018, doi: 10.1109/JCN.2018.000085.

[8] F. A. Alfouzan, A. Shahrabi, S. M. Ghoreyschi, and T. Boutaleb, "An energy-conserving collision-free mac protocol for underwater sensor networks," *IEEE Access*, vol. 7, pp. 27155–27171, 2019, doi: 10.1109/ACCESS.2019.2901646.

[9] S. Radha, P. Nagabushanam, T. J. Reddy, and B. Sachin, "Transmission Distance in MAC protocol for Wireless Sensor Networks," *Proc. Int. Conf. Inven. Commun. Comput. Technol. ICICCT 2018*, no. Iccict, pp. 1813–1818, 2018, doi: 10.1109/ICICCT.2018.8473115.

[10] N. Pham, K. Kwon, and D. Kim, "MSHCS-MAC: A MAC protocol for Multi-hop cognitive radio networks based on Slow Hopping and Cooperative Sensing approach," *Proc. - IEEE Symp. Comput. Commun.*, vol. 2018-June, pp. 1–7, 2018, doi: 10.1109/ISCC.2018.8538496.

[11] Y. Li, H. Mosavat-Jahromi, L. Cai, and L. Lu, "GNC-MAC: Grouping and Network Coding-assisted MAC for Reliable Group-casting in V2X," *IEEE Veh. Technol. Conf.*, vol. 2020-Novem, 2020, doi: 10.1109/VTC2020-Fall49728.2020.9348600.