# IMPLEMENTATION AND ANALYSIS OF CHAIN BASED ROUTING IN COGNITIVE RADIO

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**ABSTRACT**

*Cognitive Radio is one of the most useful technologies in current era to enhance the network utilization. It is most useful to enhance the authentic usage of resources. Different MAC based protocols exist in cognitive radio for efficient performance. This paper studies different MAC protocols available in cognitive radio. Moreover, This paper study a chain based routing protocol and implement the same using the NS2. The analysis of the protocol with the energy consumption as parameter is done for network with different number of nodes.*

***Keywords:*** *Cognitive radio, Routing, Chain, Residual Energy*

## 1. INTRODUCTION

A CR is a vigilant remote(wireless) correspondence structure that considers its including condition and adjusts its internal parameters to achieve trustworthy and capable correspondence and perfect utilization of the preferences [1]. In the CWSNs, the hubs(nodes) modify their parameters including transmission and assembling as appeared by the radio condition. Cognitive points rely on 4 activities: (i) checking of range perceiving, (ii) examination and depiction of nature, (iii) streamlining of the best correspondence technique in light of different objectives, for instance, unwavering quality, security, power and insurance issues et cetera., and (iv) change and participation framework. The scholastic movement won't simply enable access to new range yet it will in like way give better spread traits affecting diminishing in charge use, frame life-time and unflinching quality in a WSN. The mental uttermost ranges of the systems will be set up for transmission to locate a free redirect in the unlicensed channel(band). A CWSN, thusly, will have the capacity to offer get to not solely to new range get-togethers disregarding the available band, yet notwithstanding the range band that has better inciting qualities. If a direct in a lower reiterate band is gotten to, it will thoroughly allow exchanges with higher transmission keep running in a CWSN, and subsequently less sensor hubs(nodes) will be required to outfit scope in a specific region with a higher framework life-time in context of lower essentialness use in the hubs. The analysis will be a more strong correspondence with diminished power utilize, expanded structure life-time and higher perseverance and updated QoS certification to applications [2].

Despite the way that there are a couple of central focuses and reasons for interest that can be ace by sending CWSNs [3], guaranteeing security tends to an immense test. Unless these burdens are comprehended to a suitable level, sending of CWSNs in certifiable applications may confront a good 'ol fashioned tangle. As

observed in [4],the CR nature of a structure shows a totally new show of risks and vulnerabilities that can't be possibly lightened.

Considering these attributes from an assailant's perspective, a CWSN will give inside and out more unmistakable capacity to an aggressor to dispatch strikes that are endeavored and certifiable and calamitous in nature and those which can be begun by essential shapeless vision controls [5].

## 2. TYPES OF MAC PROTOCOL

### 2.1 S-MAC

S-MAC stands for sensor-MAC. It uses Local synchronizations and occasional rest listen plans in view of these synchronizations frame the essential thought behind the S-MAC convention [6][7]. Neighboring hubs shape virtual groups to set up a typical rest plan. On the off chance that two neighboring hubs live in two distinctive virtual groups, they wake up at listen times of the two bunches. A disadvantage of S-MAC calculation is this plausibility of following two unique calendars, which brings about more vitality utilization through sit still tuning in and catching. Calendar trades are expert by periodical SYNC bundle communicates to prompt neighbors. The period for every hub to send a SYNC bundle is known as the synchronization time frame. Figure 1 speaks to an example sender-collector correspondence. Crash evasion is accomplished by a bearer sense, which is spoken to as CS in the figure. Moreover, RTS/CTS bundle trades are utilized for unicast type information packets.

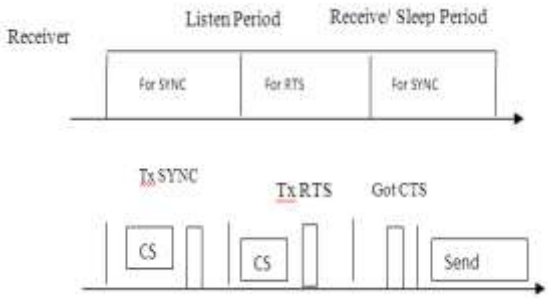


Figure 1: S-MAC Scenario[8]

With this system, one may accomplish vitality reserve funds by limiting correspondence overhead to the detriment of injustice in medium access. Occasional rest may bring about high inactivity particularly for multi-jump directing calculations, since every quick hub have their own rest plans. The inertness caused by intermittent resting is called rest delay in [6].

### 2.2 BERKELEY MAC (BMAC)

Another conflict based MAC convention is B-MAC which is broadly utilized as a part of WSNs. B-MAC resembles to Aloha with Preamble Sampling , BMAC obligation cycles the radio handset [9]. BMAC is likewise like CSMA convention with having a component of Low Power Consumption . Unsynchronized obligation cycling and long preludes are utilized as a part of BMAC to wake up recipients. BMAC increment

unwavering quality and channel appraisal by a channel instrument. The sensor hub can change any working factors in the convention, for example, back off esteems. This gives an adaptability interface. BMAC utilizes a versatile introduction testing plan which limit sit out of gear tuning in and decrease obligation cycle as appeared in figure 2. On the off chance that no bundle arrived timeout returns hub to rest. CCA and parcel bakeoffs are utilized by BMAC for channel assertion, interface layer affirmations for unwavering quality. There are no synchronization, RTS, CTS in BMAC [10].

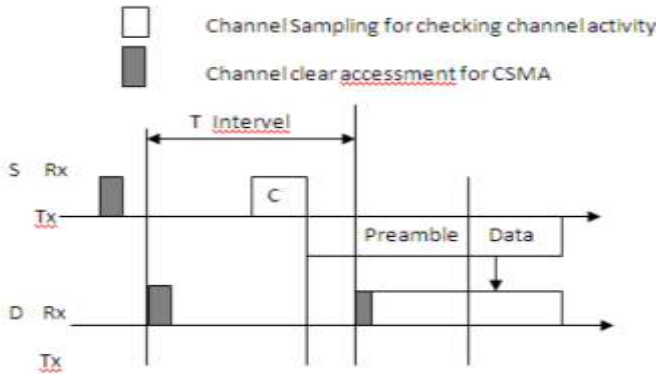


Figure 2: Preamble sampling in BMAC [10]

2.3 DMAC

Unite cast is the for the most part watched correspondence design inside sensor systems. These unidirectional ways from conceivable sources to the sink could be spoken to as information gathering trees. The foremost point of DMAC [11] is to accomplish low dormancy, yet to be vitality proficient. DMAC could be condensed as an enhanced Slotted Aloha calculation where openings are allocated to the arrangements of hubs in light of an information gathering tree as appeared in Figure 3. Consequently, amid get time of a hub, the greater part of its youngster hubs has transmit periods and fight for the medium. Low dormancy is accomplished by doling out ensuing openings to the hubs that are progressive in the information transmission way.

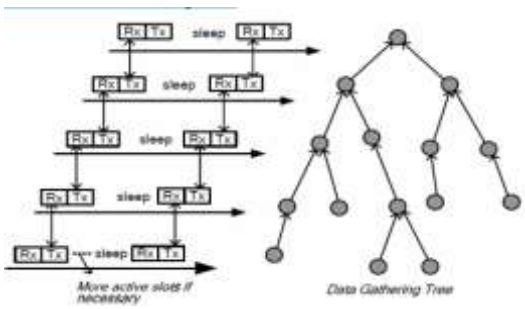


Figure 3: DMAC implementation

2.4 WISE MAC (WMAC)

The working of WiseMAC [12] when the sender begins the preface before the collector is relied upon to wake up instead of choosing an arbitrary time. For cautioning the getting hub the prelude goes before every datum parcel. The hubs which are available in the system test is having the medium with a typical period, yet their relative calendar counterbalances are autonomous. On the off chance that a hub finds the medium occupied after it awakens and tests the medium, it consistently tune in till it gets an information parcel or the medium goes to the sit out of gear state. The extent of the preface in WiseMAC is at first set to be equivalent to the testing time frame. Figure 4 indicates prelude minimization in WiseMAC. In the Process of learning and reviving their neighbor's the hubs rest plan amid each datum trade as a component of the Acknowledgment message. The hub keeps a table of the rest calendars of its neighbors and chooses claim plan in like manner.

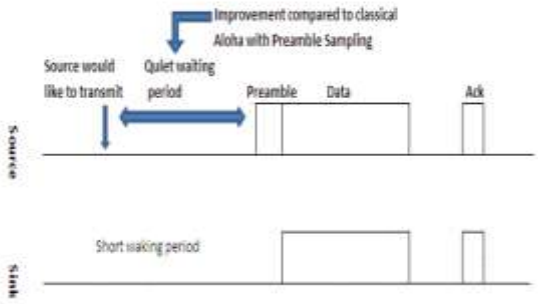


Figure 4: Wise MAC preamble minimization

The likelihood to diminish the impacts caused by that particular begin time of a wake-up introduction, an irregular wake-up prelude can be received. The wake-uppreamble length gets influences by the clock floats between the source and the goal.

## 3. CHAIN BASED ROUTING IN COGNITIVE RADIO

This protocol transmits the data by forming an energy efficient chain in the network. This chain is formed on the basis of location of the nodes. In the event that a few hubs show in various chains cease to exist then the courses break [13]. This has critical effect on the execution of the convention as far as information conveyance. As the name suggests, the chain have to be reformed in this stage. This task is performed by the base station by using the technique discussed above [14][15]. The above convention is adjusted by choosing the closest neighbor with most noteworthy vitality to enhance the execution. The investigation is done in the following segment.

## 4. RESULTS

The chain based cognitive radio is compared with traditional routing based cognitive radio protocol using various parameters that are explained below.

i. **Energy Consumed:** It is amount of energy consumed for transferring the data from source to destination. The mean of energy of energy consumed by each hub(node) is the average energy consumption in the network.

∑ Energy consumed by each hub(node)/number of hubs(nodes)

ii. **Residual Energy:** It is the difference of total energy and the energy consumed by the network.

∑ Energy of each hub(node) - ∑ energy consumed by each hub(node)

iii. **Network Life time:** It is the time until all hubs(nodes) within the network get dead. In other words , it is the operating time of the network.

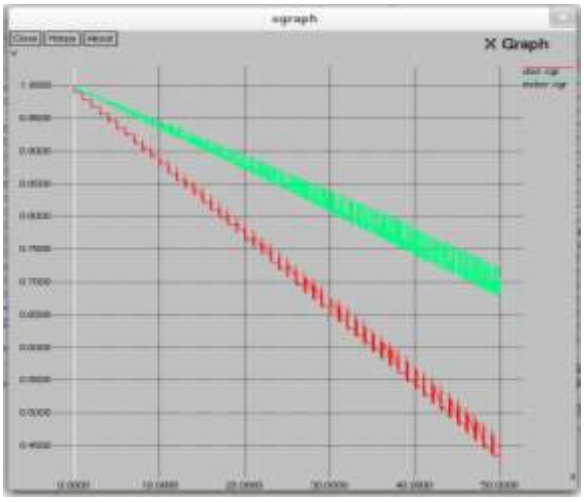


Figure 5: Residual Energy Comparison on 10 Hubs(nodes)

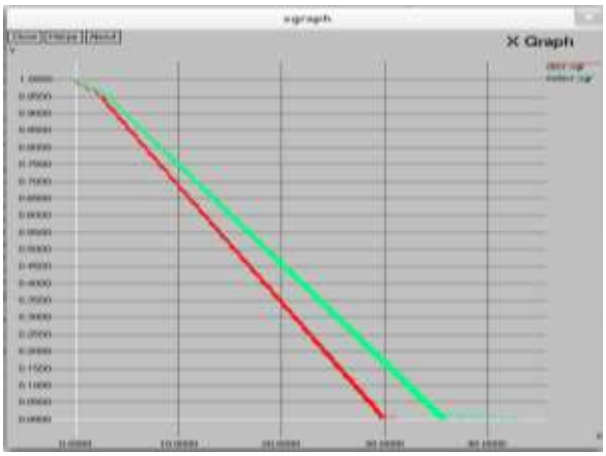


Figure 6: Residual Energy Comparison on 15 Hubs(nodes)

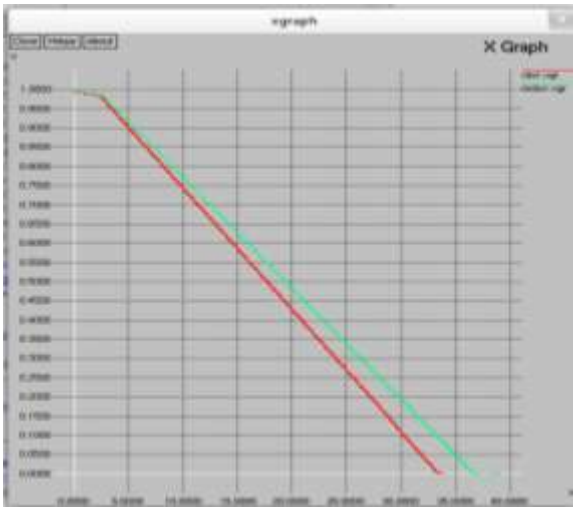


Figure 7: Residual Energy Comparison on 20 Hubs(nodes)

The above figures show that the residual energy is more at the same time instance in the chain based protocol as compared to the existing protocol.

## 5. CONCLUSION

The study and the analysis shows that the chain based routing consume less energy as compared to the existing protocol. Moreover the lifetime of the network is approx 10% greater than the existing protocol. It can be viewed from the figures shown above. Overall we can say that chain based cognitive radio protocol is energy efficient as compared to the existing protocol. In future the work can be extended by using meta-heuristic techniques.

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