CHAPTER - 2

REVIEW OF LITERATURE

2.1 Introduction

Wireless networks are rapidly changing to provide connectivity to growing number of mobile devices. The requirement of the high data rate and enhanced capacity is definitely increased in order to meet the demands of new multimedia applications. Wireless Networks are expected to provide both reliable and high throughput services for end users. Such end to end performance is typically limited by interference either caused by neighboring overlapping transmissions or transmissions on successive links along a single path. Wireless communication technology focused on improving network capacity. However, with the rapid development of high-speed cellular and WLAN networks, and the widespread deployment of Smartphone, tremendous energy demands are predictable at both the network and mobile terminal ends to meet the exponentially-growing data traffic (e.g., multimedia and web access). Thus, much recent attention has focused on energy-efficient communication [5].

The issues of cooperative wireless communication are as follows:

- How to choose better relay nodes is a basic issue related to cooperative communication in these days. It helps to enhance the network gain.

- User is mobile in the wireless network and mobility factor is considered as a very significant factor. Dynamic relay selection methods are required for handling such cases.
To enhance the channel performance the relay nodes may be used for cooperation in transmission.

2.2 Relay Selection using MAC protocols

The wireless scenario used for cooperation, two kinds of case is used. In first case frames are forwarded using direct path and another approach in which data is forwarded using relay nodes which are volunteer nodes willingly ready to forward data on behalf of communicating nodes.

To enable this approach, the volunteer nodes must have an incentive to forward data and there must be a mechanism for selecting these nodes. The significant advantages achieved using this mechanism is

A cooperative MAC with integrated routing protocol was proposed for the general cooperative scheme. However, their solution required strict time synchronization and relied on a series of handshaking between the source and all potential relays.

Research is done on bi directional relay communication for relay selection. It can offer the opportunity to get the available diversity using single relay. Before starting data transmission the relay is going to opt for use. Average symbol error rate is the only a factor used for opting the relay node.

Cooperative relaying has received considerable attention lately due to the provably improved performance and their wide variety of applications. Relay selection has been an efficient cooperative technique in networks with multiple relays. The implementation of
relay selection is not very difficult because it not require changing physical layer techniques mostly.

2.3 Relay selection with enhanced cooperative MAC

Cooperation in network is becoming most useful technique now a day in wireless networks by reason of providing spatial diversity gain. This technique changes the traditional source to destination transmission mode and allows one or multiple relay nodes (RNs) to assist direct transmissions. Cooperation in wireless communications can significantly improve the link quality by exploiting the spatial diversity of multiple terminals. Cooperative techniques are promising candidates for emerging wireless networks.

Today’s scenario co-operative communication demand is going to increase significantly. Cooperation is used in physical layer for coding techniques and also use in mac layer to enhance the performance. Cooperative communication helps to reduce power consumption also. If we use more relays for cooperation the error can also be reduced.

2.4 Existing Works Done in MAC Protocol

S. Nam et al [6] analyzed and worked to reduce the time taken during the transmission and proposed a method for cooperative communication and relay selection. This method has presented two relay selection methods: Best Expectation method and Best-m method, and proposed simple, optimal algorithms to implement them. Furthermore, for channels with Rayleigh fading alone, it provided closed-form analytical approximations of the transmission times consumed by these methods. In fixed channel allocation, it analyzed
Channel allocation is flexible according to the link qualities. This method analyzed the
effects of fading on this relay selection methods and derives closed form approximations
which provide insight into these schemes.

Bin Cao et al [7] have proposed a relay selection algorithm ORS-MAC for a cooperative
MAC mechanism in an error-prone wireless network to exploit the potential benefits by
considering the MAC overhead incurred by retransmission. This proposed ORS-MAC
selected the most suitable node as a relay, thus alleviating the transmission failure
probability and enhancing the cooperation opportunity. The significant criteria are mac
over-head for relay selection in this work. Having failure in transmission, there is a
process of re-transmission of pkts. They have shown a work for relay selection using an
algorithm called optimal relay selection for co-operative communication. For calculating
a performance gains in co-operation a theoretical model is presented.

Biao Han et al [8] have presented a solution of node placement problem which is related
to cooperative communication for multi pair. Providing help to multiple pairs of source
and destination nodes limited no. of nodes are deployed in the network to maximize the
capacity of the system. After reviewing the effect of location on relay node, relay node
placement related problem is also analyzed. Problem related to attractive properties may
also be reviewed. Strategy related to geographic aware relay node placement is presented
to solve the relay node placement problem optimally in polynomial time. But it did not
consider the placement problem with fairness consideration.

Elzbieta Beres and Raviraj Adve [9] have provided a scheme which is basically for
selection of relay optimally. Using decode & forward scheme and time allocation in
subset selection the better node is going to be opted. DF with multi hop network, cooperative diversity using n node is also consider as a selection factor. Special code book is used for time allocation. With the help of inverse of the triangular rate matrix a numbering scheme for relay is developed. In all available networks size of network which should be highest in number used for finding optimal solution.

Helmut Adam et al. [10] have also worked for cooperative communication and after lot of practice they found that node selection is done when requirement is arise from destination side. The present state of the channel is considered the deciding factor to opt relay selection process. Simulation shows that consumption of energy is also reduced in large in number. Outage issue is not observed as a performance loss.

Yaming Luo et al. [11] have proposed a technique which uses EH systems for relay selection. How side information is use efficiently is the main focus of work. Problems occur for relay selection by casual or non casual SI, such cases are formulated in practical way. A relative throughput based relay selection technique is proposed.

Z. Zhou et al. [12] have demonstrated a method using selective single relay and power control especially for sensor network. To be a part of cooperative communication the desired relays calculate its data rate and getting the change for selection within a window of fixed length. By the mechanism of distributed fashion with minimum signaling overhead the selection of nodes is done.

Gong xiaowen et al. [13] have offered a cooperative communication using opportunistic approach for wlan on ad hoc mode, which give importance to categorization of desired trade off between the probing costs using co operative relaying and hence higher
throughput can be achieved by OCN. In OCN, it considered the problem of optimal stopping with two levels of incomplete information. Use of dedicated relays and also use of without dedicated relays both kinds of scenarios are considered. To handle both issues an optimal strategy is used. Then, it is observed that with dedicated relays scenario, the optimal strategy uses a threshold structure in which, it is favorable probing the devoted relay when the SNR of link between source and relay cross the given threshold. In the scenario which is without dedicated relays where more restrictive conditions are observed, the demanded strategy is also threshold based, in the sense that to probe the available relays are optimal when the SNR of the link between source to destination maintained between two thresholds.

Aggelos Bletsas et al. [14] have presented a simple opportunistic relaying with Decode-and-Forward (DaF) and Amplify-and-Forward (AaF) strategies under an aggregate power constraint. In particular, distributed relay-selection algorithms are considered that requires only local channel knowledge.

2.5 Classification of Relay Based MAC Protocols: Performance Indicator Based Approaches

Because of low cost and easiness in development WLAN is used worldwide for wireless communication. This standard describes multiple MAC protocol which is being provided to the nodes for sharing of the channel. The basic method avails for increment the capacity of wireless LAN in-order to provide higher rate for transmission over the physical layer. Multiple access rates are been standardize to expand the physical layer which results in providing higher rates of transmission. There are many features
supporting relay node selection mechanism. The IEEE standard 802.11 provides transmission from source to destination but likely with the unfavorable conditions results in poor throughput and low performance for WLAN network. Thus, to overcome these situations we used intermediate node known as relay node which help in complete transmission of packets from source to destination.

But, the condition arising for the selection of relay node with which method, mechanism and criteria the relay node must be selected. Thus, in this paper we provide the description of protocols for relay node selection on following factors:

- Throughput and Delay
- MAC overheads and Retransmission
- Power aware and Efficiency
- Multiple Channel
- Time and Channel Constraint

2.5.1 Protocols on the basis of delay & throughput

Delay related and throughput related various protocols are explained here. It includes following protocols-

**CoopMAC protocol (2005):** Wireless LAN supports various rate of transmission, this makes station to experiences degraded quality of channel and to reduce bit error rate for each transmission it uses least rate of transmission. This method leads to throughput fairness anomaly among station with good quality and on contrary.
The MAC protocol is being proposed to improvises the anomaly been arisen. This protocol is being based upon efficient cooperative schemes. This principle supervises the station with low rate with the assistance of high rate station as helper and with this method low rate station also becomes capable to transmit in a high speed.

In this protocol, the source do not directly send the packet but transmit the data in two hop using intermediate station as helper. The basic advantage of this protocol makes faster transmission and thus overall time for transmission is being reduced. The helper station takes the data from source and then re-transmission takes place to the destination.

Thus every station maintains Coop Table for all helper. CoopMAC protocol follows five-way handshake and maintain Coop table. This protocol thus improvises the source station transmission suffering from poor quality of the channel and selects the helper station as relay and makes faster transmission to destination.

**CRS (2006):**

As the wireless protocol mediates between physical layer and the higher layer protocols and the IEEE standard 802.11 supports the feature on both sides. CRS [20] is acronym for Cooperative Relay Service. CRS is being used for WLAN supporting multiple channel rates. It provide that the station with higher rate relays the frames as alternative between the neighboring nodes having low channel rates and access point to enhances the energy efficiency and throughput. CRS cope with the delay as uses the following energy for data forwarding. It results in improvising the throughput without degrading the energy efficiency. CRS proves out to be significant as it enhances the performances for both stations have low and high channel rate. CRS with multiple rates selects the mobile
station in cooperative form from local network to avoid degradation in channel rate of transmission. It utilizes the energy efficiency which increases the performances. The usage of channel time in CRS and supporting mechanism provides help in forwarding of data packets.

To analyze this protocol we include following:

a) Time allocated for channel

b) Analysis of performance gain

c) Analysis of allocation of channel for forwarding.

CRS system model has three components which help in maintaining the channel energy and throughput:

• Algorithm for selection of proxy station

• Algorithm for scheduling of channel

• Multiple-forward hopping algorithm.

SOLOR (2014):

In the current scenario of IEEE standard 802.11 suffers from the problem known as rate anomaly which results in three major points for consideration such as:

a) Relay addition incremented consumption of power.

b) Variety of throughput and their preferences.

c) Dealing with legacy nodes.
To handle these 3 issues, we have SOLOR [15] viz. Self-Optimizing, Legacy-Compatible Opportunistic Relaying which enhance the network performance. It basically works on following criteria such as topology i.e. nodes associated in relaying and relay schedule i.e. time stamp between their access points. It considerably improvises the network throughput performances and reduces the power consumption even it contain legacy nodes i.e. devices present in current network. It attains its goal via selection of topology i.e. the path between access point and station also with the time duration being spent over relay activities.

But these two conditions overcome simply and provide best of throughput and reduced power consumption. It is also capable of compacting with the legacy nodes. This is also being achieved through the method of selecting the path reaching to the access point via relay stations which is known as topology of the network.

Thus, SOLOR consider the adaptable topology to ensure of receiving MCS rates helping in enhancing performance of the network with both parameters of throughput and power consumption.

2.5.2 MAC Overheads and Retransmission based protocol

This section contains the description of protocols which are based on MAC overheads and re-transmission:

rPCF (2004):
Discussing the IEEE 802.11 standard in terms of multiple transmission rates, then to maintain its performance we use rPCF i.e. relay enabled PCF. The PCF based MAC defined used to overcome the problems being arisen due to multi-rate capability.

The multi hop mechanism is used getting improved result of throughput as well as delay may also get decreased. Over all down fall in over head of network is also observed. The channel condition is playing significant role for

Depending on the channel condition the different data rate are provided by the IEEE 802.11. When relay is used the data is forwarded faster with respect to direct link. In such condition the direct link decrease the performance and relay link is helpful for increasing the quality and performance of the channel.

**PCF (2005):**

In heterogeneous system, the wlan is significantly enhanced the performance of the system. The ieee standard802.11 offered 2 mac scheme such as

- Distributed co ordinated function
- Point co ordinated function

The PCF [16] is based on polling i.e. selection of nodes function through majority supports. PCF is being designed over the DCF mechanism and hence provides contention free MAC, and thus because of this feature in PCF, it resulted in providing higher throughput and committed services. It makes the real time application more fruitful. PCF can be implemented our non-real time services. The performance of PCF is being
enhances through various efficient and robust polling mechanism. PCF also robust in efficient power management and hence increase the efficiency of whole working system.

DCF (2005):

WLAN provides multiple rates capability in a physical layer and hence this capability degrades performance of the network. Thus, we require the MAC layer supports method to overcome this anomaly. This protocol was being proposed and created for improvising the performance of contention oriented channel used for access. The DCF uses broadly two methods for transmission of data viz.:

a) Basic Access, also known as Default access mechanism.

b) Optional Request to send/ Clear to send.

This protocol works on the principle of handshaking. The basic access mechanism follows 2 way hand shake method. In this method the data is being sent from source and ack is being sent to source.

There is another method, 4 way hand shake. In this approach the request for sending the data is sent by the source. After the acceptance is sent by receiver as a cts pkt the data is transferred by source. After that process of sending the data is started and if receiver successfully received the data inform to sender about data received.

CoopMAC (2007)

The MAC protocol is being proposed to improvises the anomaly been arisen. This protocol is being based upon efficient cooperative schemes. This principle supervises the
station with low rate with the assistance of high rate station as helper and with this method low rate station also becomes capable to transmit in a high speed.

CoopMAC [17] protocol supports potential helper which is acting as an intermediate station from source to destination proving higher rate as compared to direct transmission. In this protocol, the source do not directly send the packet but transmit the data in two hop using intermediate station as helper. The basic advantage of this protocol makes faster transmission and thus overall time for transmission is being reduced. The helper station takes the data from source and then re-transmission takes place to the destination.

Thus every station maintains Coop Table for all helper. CoopMAC protocol follows five-way handshake and maintain Coop table. This protocol thus improvises the source station transmission suffering from poor quality of the channel and selects the helper station as relay and makes faster transmission to destination.

2.5.3 Power-aware protocols:

This section explains such protocols based on the power efficiency and utilizes the energy for enhancing the network performance. Such protocols are as follows:

**CRS (2006):**

As the wireless protocol lies between physical layer and the higher layer protocols and the standard of IEEE 802.11 supports the feature on both sides. CRS [18] is acronym for Cooperative Relay Service. CRS is being used for WLAN supporting multiple channel rates. It provide that the station with higher rate relays the frames as alternative between the neighboring nodes having low channel rates and access point to enhances the energy
efficiency and throughput. CRS cope with the delay as uses the following energy for data forwarding. It results in improvising the throughput without degrading the energy efficiency. CRS proves out to be significant as it enhances the performances for both stations have low and high channel rate. CRS with multiple rates selects the mobile station in cooperative form from local network to avoid degradation in channel rate of transmission. It utilizes the energy efficiency which increases the performances. The usage of channel time in CRS and supporting mechanism provides help in forwarding of data packets.

To analyze this protocol we include following:

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c) Analysis of allocation of channel for forwarding.

CRS system model has three components which help in maintaining the channel energy and throughput:

- Algorithm for selection of proxy station
- Algorithm for scheduling of channel
- Multiple-forward hopping algorithm.

**ECTP (2007)**

Efficient use of available energy is one of the significant aims of the wlan. To solve this problem a robust protocol is suggested called energy efficient cut through. The
implementation of this protocol is suggested for efficient use of energy in wlan environment. It is a combinational concept of MAC and next hop address without any information about host protocol and provides a relay node in the pair of communication ends adopts a higher data rate on the basis of path loss and channel’s condition.

This protocol is the enhancement of MAC protocol which has new means to message exchange techniques communication with relay node. The basic idea for this protocol is that it follows four-way handshake for communication and then relay won’t be competitive to channel again. This would save the bandwidth because again competing for channel waste bandwidth for channel which is already being reserved.

**SOLOR (2014)**

In the current scenario of IEEE standard 802.11 suffers from the problem known as rate anomaly which results in three major points for consideration such as:

a) Relay addition incremented consumption of power.

b) Variety of throughput and their preferences.

c) Dealing with legacy nodes.

To handle these 3 issues, we have SOLOR [19] viz. Self- Optimizing, Legacy-Compatible Opportunistic Relaying which enhance the network performance. It basically works on following criteria such as topology i.e. nodes associated in relaying and relay schedule i.e. time stamp between their access points. It considerably improvises the network throughput performances and reduces the power consumption even it contain legacy nodes i.e. devices present in current network. It attains its goal via selection of
topology i.e. the path between access point and station also with the time duration being spent over relay activities.

But these two conditions overcome simply and provide best of throughput and reduced power consumption. It is also capable of compacting with the legacy nodes. This is also being achieved through the method of selecting the path reaching to the access point via relay stations which is known as topology of the network.

Thus, SOLOR consider the adaptable topology to ensure of receiving MCS rates helping in enhancing performance of the network with both parameters of throughput and power consumption.

2.5.4 Multi-Channel based protocol:

This section contains the description of the protocol based on multiple channel utilization:

Net COOP (2009):

Earlier design of the network for relay cooperation system results the better throughput. we use Net Coop protocol whose objective is to increment the life time of network with high throughput. This can be achieved by the cooperation of multiple relays. Net Coop algorithm checks and validates the relays which provide best possible cooperation so as to obtain network with high lifetime.

In this protocol, every station has table which records the data rate for the exchange of control message among various pairs of stations and the station which find that the transmission is not for them, then switch themselves to sleep mode. An algorithm for this
protocol is applying dual filter to choose the relay node as it selects the node on the basis of throughput improvising and also energy efficient constraints.

This protocol makes the source to choose the transmission mode will be least affected by the relaying and here it is found that the node which is low in energy then the source chooses alternative which results in lowering the loss of energy.

The principle of Net Coop forms by the cooperative format which forms between network throughput and lifetime. It uses flexible strategy for cooperation which supports network performance and enhances lifetime of the network without affecting the throughput.

2.5.5 Time and Channel based protocols:

This section contains the description of the protocol which is based on the time and channel constraints. It includes the following protocols:

**TOR (2007):**

Functioning over real time environment i.e. the streaming of audio-visual over the wireless is one of the significant technologies emerging in the multimedia types of transmission. The IEEE 802.11standard protocol is best suited for traffic handling but for streaming for audio-visual faces following challenges:

- Multi-path Fading
- Communication in gray zone
- Interference
• Time Constraint

• Predictive- Coded Property

To resolve the above described challenges, we present TOR [20] i.e. Time – aware Opportunistic Relay which operates on the MAC layer. This protocol over rules the path diversity to improvise quality of end – to – end service. Basically, relay node simultaneously forward packet to enhance reliability on end – to – end basis. To describe the transmission in time based manner, relay deadline is being calculated for each packet being transmitted.

This protocol results in the increment in packet delivery rate. It basically adopts time based transmission for video traffic at each node.

TOR uses the multiple path joints on nodes for over hear the traffic from other nodes, thus it provides higher gain and improves performance of the network. Relay candidate nodes over hear the transmission and relay makes the packet failed if its acknowledgement is missing.

TRCCL (2014):

IEEE Standard for WLAN supports various data rates which provides WLAN capacity increment but also results in anomaly problem. Thus, to emphasis over the problem we propose TRCCL protocol.

TRCCL [21] is an acronym for Transmission Rate and Channel Contention – Level protocol. This protocol chooses a relay node by keeping transmission rate as priority. It also selects the relay node by the transmission being occurred in the neighbor. Here, we
use the contention level of the channel for judging the transmission of its neighboring nodes.

TRCCL protocol uses the two-level relay selection property which include selection of node and then the exchanging of packets. It estimates the time of transmission by using its rate and select the node which has the least rate of transmission time as relay node. It also checks the contention level of channel which reduces the channel anomaly problem.

Every node in this type maintains a table called as Relay Table. Relay table keep the records for the transmission being shared from source to destination. The protocol, TRCCL opt the nodes which have willingness to work as volunteer by using the criteria of transmission time and also channel contention level. For this the results can be obtained through relay table.

The transmission time of the packet can be defined as the time taken by a packet from source node to destination which includes total time with all relays used as an intermediates. While contention level is describe as the probability of the collision. Thus, it outperforms from the previous protocol for the time and channel category in terms of throughput and delay.

2.5.6 Advantages and Disadvantages of Described Protocols:

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Year</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCF</td>
<td>2003</td>
<td>It works over real time services and enhances performance.</td>
<td>It requires another nodes station active to help in relay</td>
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<td></td>
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<td>-----</td>
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<td>-----------------------------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td>DCF</td>
<td>2003</td>
<td>It overcomes the anomaly of multiplicity of rates.</td>
<td>Retransmission may be required sometime and that increase the MAC overhead.</td>
</tr>
<tr>
<td>rPCF</td>
<td>2004</td>
<td>It forbids the problem being occurred by multiple rates.</td>
<td>Large overheads degrade the attention.</td>
</tr>
<tr>
<td>CoopMac</td>
<td>2005</td>
<td>It provides faster transmission and reduces overall time of transmission.</td>
<td>It all provides things to analyze and perform statically not dynamically.</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRS</td>
<td>2006</td>
<td>It supports to attain high rate of transmission for low rate node.</td>
<td>It arises complexity in verify of the low rate node with multiplicity of condition.</td>
</tr>
<tr>
<td>ECTP</td>
<td>2007</td>
<td>It develops and mainly focuses over energy efficiency.</td>
<td>However, many times to energy efficient it compromises with performance.</td>
</tr>
<tr>
<td>TOR</td>
<td>2007</td>
<td>It works over time constraints and help in streaming over wireless channel.</td>
<td>Since being active it creates various nodes to collect multiple packets of same kind.</td>
</tr>
<tr>
<td>Protocol</td>
<td>Proposed Year</td>
<td>Principle/Working</td>
<td>Future Research</td>
</tr>
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<tr>
<td>NetCoop</td>
<td>2009</td>
<td>It develops the Performa to increase the life time of network with high throughput.</td>
<td>It requires time to select the node to help and how to help it.</td>
</tr>
<tr>
<td>TRCCL</td>
<td>2014</td>
<td>It helps in selecting node by contention level, hence maintains relay table.</td>
<td>Probability of collision is higher when the condition is not suitable.</td>
</tr>
<tr>
<td>SOLOR</td>
<td>2014</td>
<td>It is highly efficient over networks as it work over relay keeping area as topology.</td>
<td>It gives rise to measures of complexity and faults.</td>
</tr>
</tbody>
</table>

2.5.7 **Comparison of protocols:**

<table>
<thead>
<tr>
<th>Protocols</th>
<th>Proposed Year</th>
<th>Principle/Working</th>
<th>Future Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCF</td>
<td>2003</td>
<td>CSMA/CA is the basis of this protocol. Node selection is done on contention.</td>
<td>Low contention and low collision probability is the basis of channel selection.</td>
</tr>
<tr>
<td>PCF</td>
<td>2003</td>
<td>It selects the relay node on the basis of majority supports. It makes the selection of nodes and organized polling and result</td>
<td>Dynamic polling being organized to select node so as utilizes the same energy.</td>
</tr>
<tr>
<td>Protocol</td>
<td>Year(s)</td>
<td>Description</td>
<td>Advantages</td>
</tr>
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<tr>
<td>rPCF</td>
<td>2004</td>
<td>It selects the node for transmission for multiple rates which is being based on channel condition and uses multi – hops for data transmission.</td>
<td>rPCF can be used over the reduction of Control overheads of MAC.</td>
</tr>
<tr>
<td>COOPMAC</td>
<td>2005 and 2007</td>
<td>It supports low rate station being assisted by high rate station using intermediate station as helper node to transmit data from source to destination.</td>
<td>Dynamic performance over static condition of the Coop MAC protocol.</td>
</tr>
<tr>
<td>CRS</td>
<td>2006</td>
<td>The nodes offer the higher data rate is selected to consume the energy in a better way.</td>
<td>Dynamic relay selection is done from the nodes available during transmission.</td>
</tr>
<tr>
<td>ECTP</td>
<td>2007</td>
<td>For saving bandwidth relay nodes get selected by using combinational concept.</td>
<td>Energy is consumed in a better way by observing path loss condition.</td>
</tr>
<tr>
<td>TOR</td>
<td>2007</td>
<td>Relay selection is done by time factor.</td>
<td>Duplicate packets are prevented to deliver by selecting efficient relay</td>
</tr>
<tr>
<td>Network</td>
<td>Year</td>
<td>Methodology</td>
<td>Advantages</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
<td>-------------</td>
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</tr>
<tr>
<td>Netcoop</td>
<td>2009</td>
<td>It uses dual filter to select relay node based on throughput and energy constraint.</td>
<td>Auto updating of the relay table is used for minimizing the relay selection time.</td>
</tr>
<tr>
<td>Solar</td>
<td>2014</td>
<td>It selects the relay node on basis of topology being used and the path being selected for the transmission of data packets.</td>
<td>Selection prior relay through election algorithm and routing.</td>
</tr>
<tr>
<td>TRCCL</td>
<td>2014</td>
<td>It used two-level for the relay node selection i.e. time constraint and contention level of the channel. Every node in this type maintains a table called relay table which keep records for transmission from source to destination.</td>
<td>Checking of the node before selecting as relay to avoid multiple selection of the same node for transmission.</td>
</tr>
</tbody>
</table>
2.5.8 Related Work

(i) 2rcMAC (Two Relay Co-operative MAC)

In this cooperative MAC Protocol [22], node cooperation is used for enhancing the network performance. The cooperative communication is used for better performance of the network. Many times direct path is unable to satisfy the required data rate which causes the low throughput. To use other nodes which are able to serve better data rate may be used as volunteer and through these nodes better data rate can be achieved in the network. Nodes near to communicating nodes help to transmit the data as volunteer and can help to get better data rate. In this scheme 2 nodes used worked as volunteer for enhancing the network performance. If first node is unable to do its work complete then second node perform its task to complete the transmission. By using these 2 nodes the better performance can be achieved easily.

Fig 2.1: 2 relay Co-operative MAC
(ii) SRcoop:-

In this (SRcoop) [23] protocol, two relay nodes are selected for relay transmission. It introduced a new concept of smart relays nodes. Smart nodes are energy efficient nodes because it uses solar energy. The use of solar power is a good idea in current scenario because our traditional sources of energy are very costly and not environment friendly. Solar power system installation is costly in the beginning but for the long term, it is very economic. The protocol deploys limited number of smart relay nodes. Two kinds of nodes are used in this protocol, first one is ordinary and second one is smart node. Both types of nodes act as relay nodes. But first priority is given to smart nodes to play a role of relay nodes. If smart relays don’t satisfied the selection criteria then ordinary relay can be selected as relay nodes.

First of all channel reservation process is going to complete using rts and cts process. After that cooperative communication is going to be held and relays are needed to work as volunteer. So relays are opted for getting help in transmission. In first time slot, only smart nodes can be sent their response in relay response frame. After receiving the responses from the smart nodes, the receiver sends feedback for selection. If two best relays are not selected from smart nodes then ordinary nodes send their response in second time slot.

In this model, a modified relay response frame format is used. One additional slot is used which is reserved for smart relay. In 2rc mac, 8 slots are used but in this model total nine slots are used. In each slots, 8 mini slots are available and 8th mini slots of each slot is
reserved for feedback. First slot is reserved for smart nodes response and other 8 slots are used for ordinary nodes responses according to their data rates.

Fig 2.2: Relay Response Frame Format in SRcoop