- At instant t6, the backoff counter of R2 expires and R2 attempts a cooperative transmission.
- At instant t7, R1 resumes the backoff counter and R2 resets a new backoff counter;
- At instant t8, the backoff counter of R2 expires and R2 attempts a cooperative transmission.
- At instant t9, station D is able to properly decode the original data packet and sends back an ACK packet, indicating the end of the cooperation phase.
- All the stations then know that the cooperation phase has ended.

4 Simulation of Protocol in NS-2

For experimentation network simulator is used. First network scenario is created. Then clustering is done for group formation of different nodes. Finally cooperative communication is implementation among nodes.

4.1 Network scenario

In our simulation, each node is set with a single omni-directional antenna, and two-ray ground reflection radio propagation model are applied. Default value used for each parameter in NS-2. The carrier sensing ranges and transmission range dependent on different factors such as the environment, the transmission power and the antenna. While evaluating simulation energy consumption due to radio’s energy consumption is focused. Table 4.1 gives the list of the parameters used while evaluation of simulation. To evaluate the performance of both proposed and existing grid topology scenarios is used. The performance of the scheme deliberates in terms of the packet delivery ratio and end-to-end delay that depends on the energy available in a network. On horizontal scale numbers of nodes are in use and on vertical scale transform according to performance metrics.

Table 1. List of the parameters used while designing of PRCSMA Protocol

Parameter	Value
Simulator	Ns-allionone-2.35
Simulation time	25sec
Channel type	Wireless Channel
Propagation Model	Propagation/Two Ray Ground
Medium	Phy/WirelessPhy
Standard	MAC/802.11
Logical Link layer	LL
Antenna	Omni Antenna
X dimension of the topography	1500
Y dimension of the topography	1500
Parameter	**Value**
Ad hoc Routing	AODV
Routing	DSR
Traffic	cbr

4.2 Implementation of PRSCMA Protocol

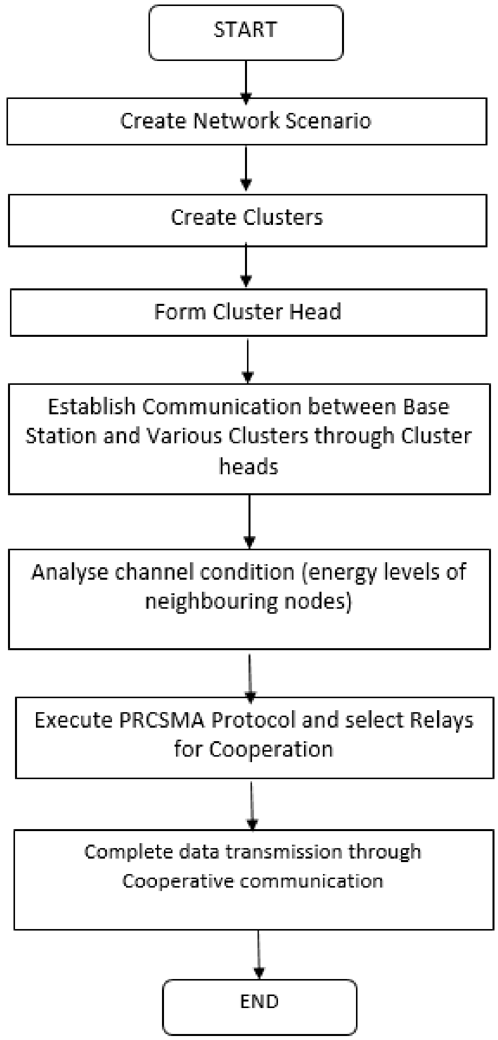

Figure 3: Flowchart of network scenario

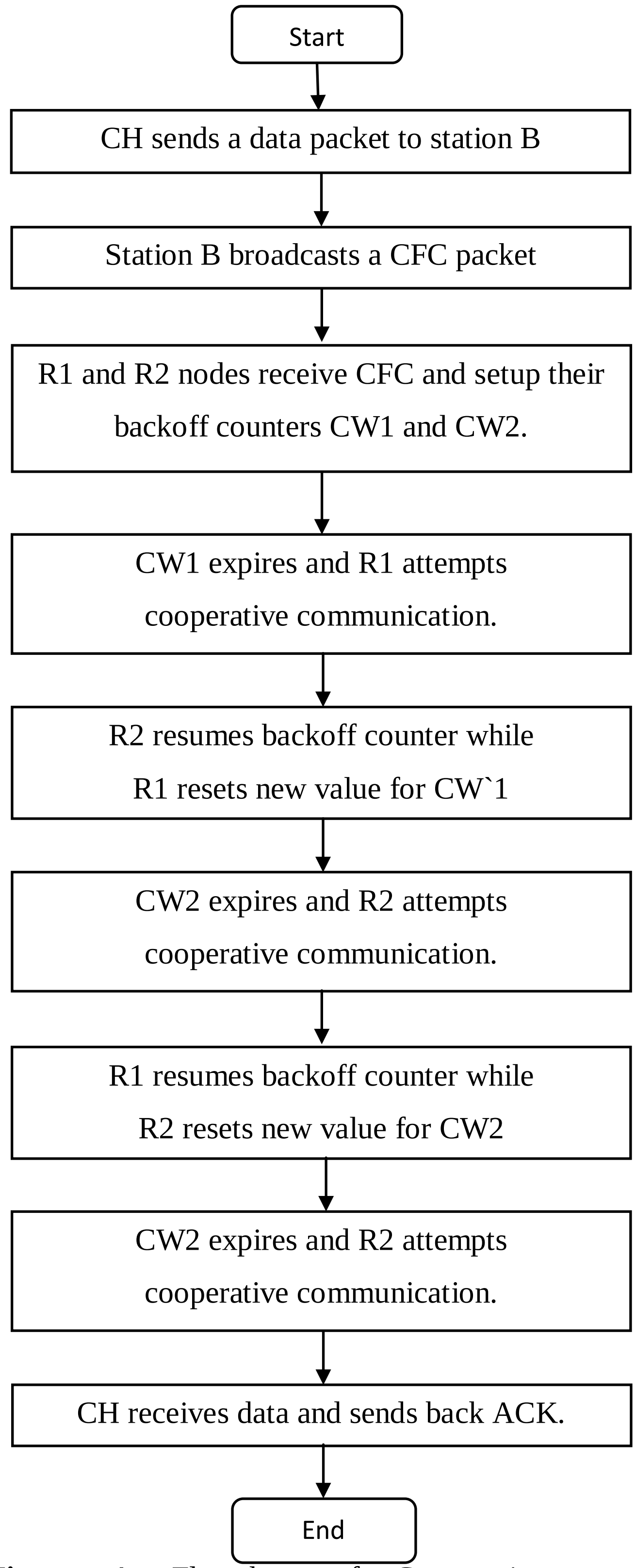

Figure 4: Flowchart of Cooperative communication using PRCSMA Protocol

Implementation of PRCSMA Cooperative Communication Protocol is as shown in Figure 3 and Figure 4 The implementation flowchart is divided into two parts via: Overall implementation of PRCSMA Cooperative Communication Protocol and Actual PRCSMA protocol working

4.3 Analysis Parameters for PRCSMA Protocol

Performance parameters such as Packet Drop Rate, Throughput, Packet Delivery Ratio, are used for analysis of the implemented PRCSMA Cooperative Communication Protocol.

4.3.1 Packet loss

Packet loss occurs when one or more data packets sends travelling across an network fail to reach their destination. Packet loss is either caused by errors in data transmission, typically across wireless networks. Packet loss is measured as a percentage of packets lost with respect to packets sent.

$$Packet\ loss\ = \frac{\sum\left(\begin{matrix} Number\ \ of \\ Packet\ \ Send - Number\ \ of \\ Packet\ \ Receive \end{matrix}\right)}{\sum(Number\ \ of\ \ Packet\ \ Send\ )} \times 100 \quad (5.1)$$

4.3.2 Throughput

Throughput can be defined as the ratio of the total bytes in data packets received by sink nodes to time from first packets generated at a source to last packet received by sink nodes.(Eq.5.2) The greater value of throughput states superior performance of the protocol.

$$Throughput\ = \frac{\left(\begin{matrix} Total\ bytes\ in \\ data\ packets \\ received\ \ by \\ sink\ node \end{matrix}\right)}{\left(\begin{matrix} Time\ \ from \\ first\ packet\ \ generated \\ at\ source\ \ to \\ last\ packet\ \ received \\ by\ sink\ node \end{matrix}\right)}$$

4.3.3 Packet Delivery Ratio

The packet delivery ratio (PDR) given by equation 5.3 defined as a ratio of numbers of data packets reached to target over the network to number of packets generated. The greater amount value of packet delivery ratios states superior performance of the protocol.

$$PDR\ = \frac{\sum(Number\ \ of\ \ Packet\ \ Receive\ )}{\sum(Number\ \ of\ \ Packet\ \ Send\ )} \quad (5.3)$$

This Parameters are been evaluated and tested for different number of nodes and at different simulation time for knowing the performance of the proposed vs. existing system.

5. Experimentation

Experimentation is carried out in 5 parts via:

1. Cluster Formation and Cluster Head Selection.
2. Identification of weak CH using PDR.
3. Initiation of CFC.
4. Relay Selection based on PRCSMA.
5. Completion of Data transmission using relaying.

5.1 Cluster Formation and Cluster Head Selection.

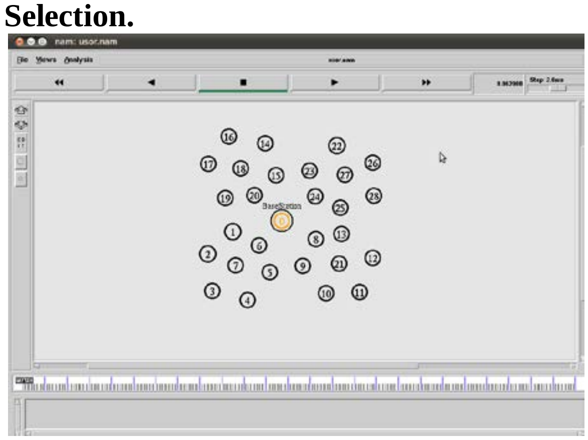

Figure 5: Simulation in NS2-Cluster Formation

shows cluster formation. Here four clusters are formed where each cluster consists of seven nodes

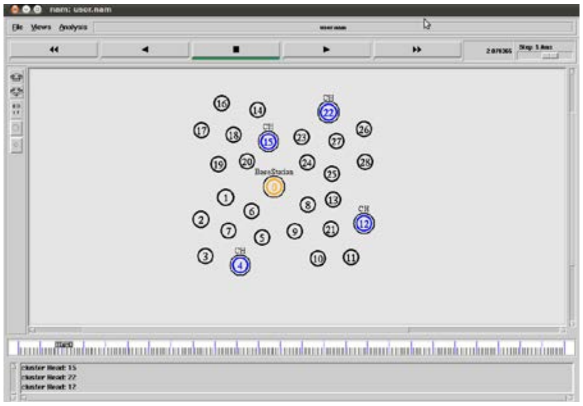

Figure 6: Simulation in NS2-Selection of Cluster Head

5.2 Procedure to select the Cluster Head (CH)

Input: Cluster set with nodes.
Output: CH selection node.
Step 1: select all nodes as initial population.
Step 2: Select evaluation set
Step 3: Apply crossover on similar power nodes.
Step 4: Apply mutation on each sensor node.
Step 5: Apply fitness on all nodes power
Step 6: select best node using rout let wheel selection.
Step 7: Check GA evaluations
Step 8: Select final max energy node as CH node.

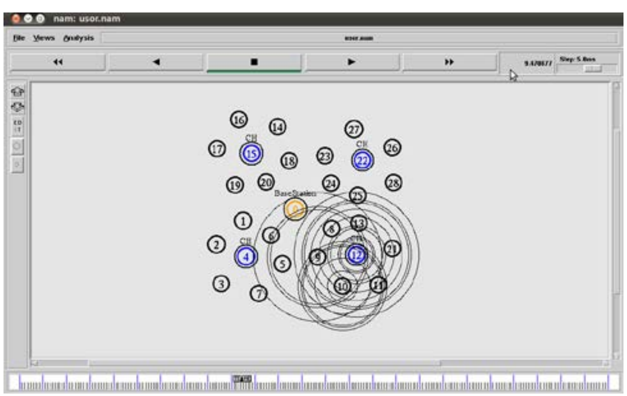

Figure 7: Simulation in NS2-Centralisation of Cluster Head

The selected Cluster Head is then forced to be positioned at the centre of the cluster, as shown in Fig. 5.4.

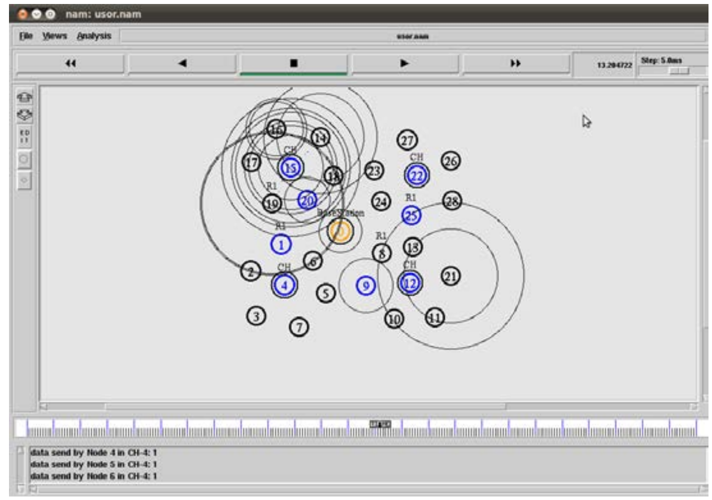

Figure 8: Simulation in NS2-Relay Selection based on PRCSMA.

5.3 Procedure for Construction of ACO for best node selection

Input: Initial source node *Sn*, Destination node *dn*, Group of neighbor nodes nd *[]*, each node *id*, each node energy*eng*.
Output: Source to destination path when data received success.
Step 1: User first select the sn and dn
Step 2: choose the packet or file f for data transmission.
Step 3: if (f! =null)
Step 4: read each byte b form fd when reach null
Step 5: send data, initialize cf1,cf2,pf1,pf2
Step 6: while (nd[i] when reach NULL)
    Cf1=nd[i].eng
    Pf1= nd[i].id
    Cf2=nsd[i+1].eng
    Pf2= nd[i+1].id
Step 7: if (cf1>cf2)
    Cf2=null
    Pf2=null
    Else
    Pf1=pf2
    Cf1=cf2;
    Pf2=null
    Cf2=null

Step 8: end while

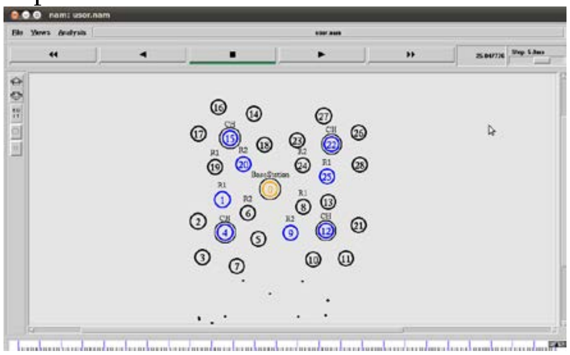

Figure 9: Completion of Data transmission using relaying.

The Figure 9 shows the completion of data transmission from CH to base station using cooperative nodes known as relays (R1 and R2) by PRCSMA cooperative communication protocol.

6. Results and Discussion of PRCSMA Protocol

6.1 Results

Results of the experimentation on designed PRCSMA protocol are discussed further. Here two approaches are used viz; Data transmission without Cooperative communication and Data transmission with cooperative communication

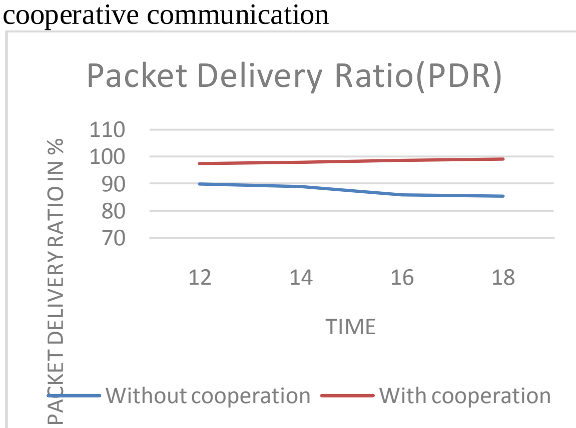

Figure 10 Plot of Packet Delivery Ratio w.r.t. various time slots

The Figure 10 shows packet delivery ratio of data transfer with cooperation remains in the range of 97% to 99%, whereas packet delivery ratio of data transfer without cooperation drops from 90% to 85% as the transmission time increases.

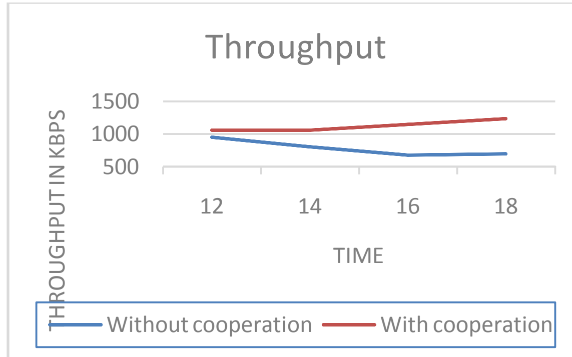

Figure 11: Plot of Throughput with respect to various time slots.

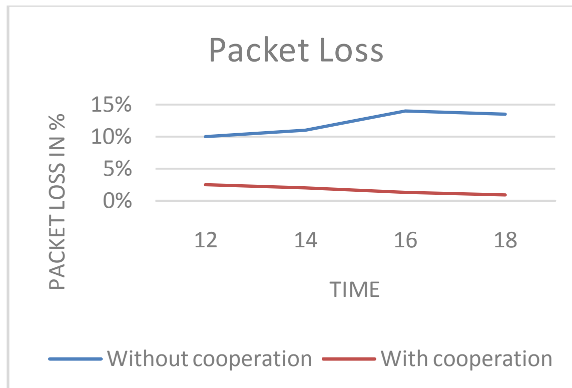

Figure 12 Plot of Packet loss with respect to various time slots.

As the time varies, the packet loss for with cooperation mode is decreased linearly and the packet loss in without cooperation mode is increased from 10% to approximately 15% with respect to time.

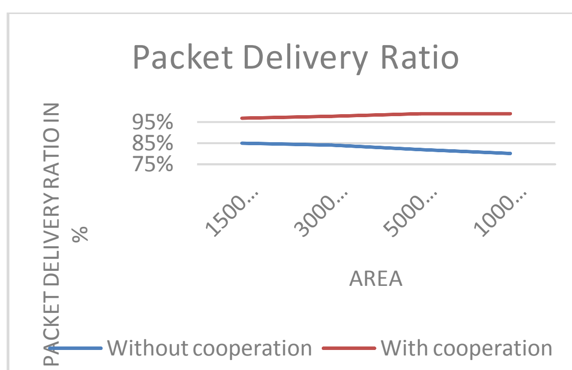

Figure 13: Plot of Packet Delivery Ratio with respect to different areas.

The Figure 13 shows packet delivery ratio without cooperation mode is decreased by 5% and for with cooperation mode it ranges between 95% to 100%

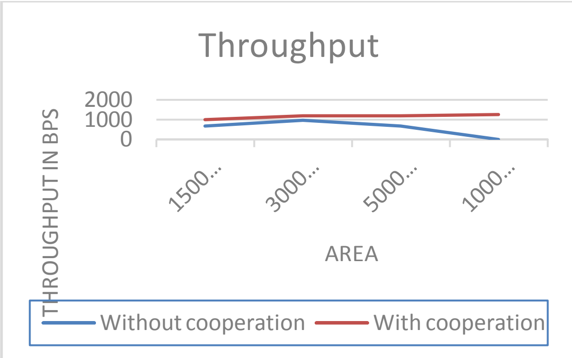

Figure 14 Plot of Throughput with respect to different areas.

The throughput of data transmission of without cooperation mode is seen to be reduced as area increased and it is reduced up to 700 Kbps and remained constant. The throughput of with cooperation mode increases with respect to time as well as area

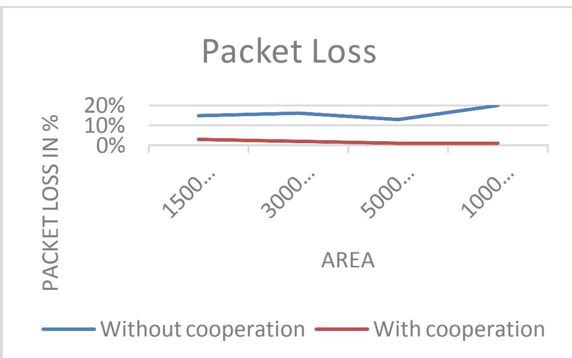

Figure 15 Plot of Packet Loss for different areas.

In Figure 15 it is seen that packet loss is lower in case of data transmission with cooperation mode as compared to that of without cooperation mode.

6.2 Observations

Following summary can be done based on the experiment conducted;

- Packet delivery ratio of data transfer with cooperation remains in the range of 97% to 99%, whereas packet delivery ratio of data transfer without cooperation drops from 90% to 85% as the transmission time
- It is seen that as the time varies, the packet loss for with cooperation mode is decreased linearly and the packet loss in without cooperation mode is increased from 10% to approximately 15% with respect to time.
- Packet delivery ratio without cooperation mode ranges between 80% to 85% and for with cooperation mode it ranges between 95% to 100%.
- The throughput of data transmission of without cooperation mode is seen to be reduced as area increased and it is reduced up to 700 Kbps and remained constant. The throughput of with cooperation mode increases with respect to time as well as area.
- It is seen that packet loss is lower in case of data transmission with cooperation mode as compared to that of without cooperation mode.

7. Conclusion

I have analyzed and carried out Persistent Relay Carrier Sensing Multiple Access cooperative communication protocol to discover benefits of cooperative communications in a distributed wireless network, we have studied two fundamental issues, namely when to cooperate and whom to cooperate with, from a PRCSMA protocol design perspective.

I have studied concept of cooperation communication with PRCSMA cooperative MAC protocol that can differentiate beneficial cooperation from unnecessary cooperation.

Effective relay selection is integrated to improve link utilization and thus increase network throughput, optimal grouping of helper relays for signalling overhead minimization is considered.

Simulation results demonstrate that the proposed approach with beneficial cooperation outperforms its non-cooperative counterpart in terms of throughput, Packet delivery ratio and Data Packet loss.

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