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# Optimizing Transmission Power and Energy Efficient Routing Protocol in MANETs

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**Abstract**

Energy is the important criterion for a decentralized network. By the cooperative physical layer network coding scheme, the requirement of energy transmission can be reduced. This could be implemented using two routing algorithms namely CCSPR and COSPNCR. An algorithm is constructed for reducing power consumption and rate control. In contradiction of the conventional power aware algorithms, an efficient power aware routing (EPAR) method is proposed which distinguishes the capability of nodes by its residual battery power, and through the expected energy that spent in reliably data packets forwarding on a specific link. To evaluate this, the data routing is performed with high mobility in dynamic environment. By using this algorithm, less cost path can be chosen and data rate can also be controlled. Thus energy consumption can be decreased and hence lifetime of a node can be improved. This approach first identifies the path having high lifetime and through that path, the communication will take place. This work consumes a lesser amount of energy for the routing, thus makes power efficient routing. Hence the throughput is increased and the power consumption is reduced. The conventional shortest path routing method on regular line and the grid line networks attains the gain of energy savings up to 45–75% correspondingly. By using EPAR algorithm, the energy consumption rate is minimized, so the network life time and the performance are improved. The energy consumption rate can be decreased to 80% by using EPAR approach in Mobile Ad hoc Networks.

**Keywords** CPLNC · CCSPR · COSPNCR · EPAR · MANET · Energy saving

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## 1 Introduction

Mobile ad-hoc network (MANET) a self-configured and the infrastructure less network system of a mobile devices which was connected via wireless links i.e. through common air interface. Ad hoc is known as 'for this purpose'. The wireless communications has several nodes which are to be maintaining the better connectivity. As well as, the centric controllers are used to establish and maintain the communications among different terminals. Wireless local area network and the cellular networks are some of the examples for this system. By using the multi-hop transmissions, the power consumptions have to be reduced through avoiding the long ranger communications [1]. In the quasi-static Rayleigh fading channel method, the optimal power transaction assignment of the hybrid protocol was used to decrease the average transmission power in the system [2]. D-EPAR- Proposes to select energy efficient path whose distance is least from the destination [3]. Besides the transferring of messages to the recipients are known as broadcast system [4]. Therefore, all the nodes are arranged in the arbitrary function and each of those have the ability to move its own.

There was no static infrastructure needed in the system such as base station. In this system separate node would work as the router and then send those messages to the appropriate devices. While source and destination of each nodes were won't be in their range [4, 5]. Then the equivalent messages between them should be processed by depend on the in-between nodes. MANETs maintain some particular applications such as military communications, emergency search, information acquisitions in hostile environments, attack, virtual lecture rooms, conferences, at field terminals used for staff to allocation of files and rescue operations etc.

The battery power is required for the operation based on network that embarrassed by nodes. Energy management was an essential problem in such networks [6]. Battery power was the important source which can be used competently to keep away from the early dissolution of nodes which leads to the path breakup. The energy consumption problem reduced by saving the power via controlling the control messages that are asserted for synchronization purpose and the neighborhood relationship criteria in order to identify the path between source and destination. Meanwhile the again the transmission of packets that required energy for designing good protocols [7, 8] using few packet collisions and reduce power consumption. Single-hop and the multi-hop network are the networks that attained by MANET [9, 10]. When all nodes are in same range, it might communicate with another are known to be single-hope network. Besides, if all those nodes are relay to other nodes to transmit is known to be multi-hop network. Therefore, these two approaches were depending on [11]:

- The transmitter and receiver have a path loss in between them.
- Several operating modes are used for power consumption of radio transceiver.

Though, the multi-hop network is more efficient than the single-hop network centered on the theoretical artifact. As well as, the MANETs are mainly a battery driven system and it suffer the finite energy problem. All the nodes had an ability to move its own, while a node move out of range of the other node, the link between them would be broken. Therefore, the two reasons for breakage of link are given below:

- Energy exhaustion by node dying.
- According to the neighboring node, the particular node moves on different range.

To avoid the link breakage and node failure, energy efficient method has been proposed. Node gets die whenever the power of that particular node gets reduced, avoid that power consumption can be controlled in a proper manner. Efficient power aware routing (EPAR) is the approach reducing the power consumption and avoids the packet loss of a single node through selecting the high power path. The remaining section of the paper is given as follows: Sect. 2 explains the literature survey and Sect. 3 explains the two algorithms CCSPR and COSPNCR which are the basic concept of EPAR approach. Section 4 describes the contribution of the work and Sect. 5 explains the simulation results. Section 6 describes the conclusion and future work.

## 2 Literature Survey

In this section, we show how cooperative physical layer network coding (CPLNC) [12] can be in corporate into existing algorithm. According to another hop destination, the overhearing node are selected and placed near to it. Based on the time slots, the CPLNC adjust transmit and the receiving parameters. The CPLNC method was introduced for combining the continuous signals and synchronized transmitting nodes at the receiver side. The power saving routing (PSR) and the progressive power aware saving routing (PPAR) are used to modify the powers.

### 2.1 Power Saving Routing

The total energy per packet [13–15] which can be obtained by using single source shortest weighted path algorithm is reduced optimal power saving algorithm as the information of all nodes are known by a separate node. In order to reduce the transmission power, a node can be elected as a router between sender and receiver. Consider some parameters for all the cases which had been used in the PSR. Moreover, it determines the performance of algorithm based on the distance in between current and the destination nodes.

Therefore, the current node distance is given by;

$$d_{opt} = (2E/B(\alpha - 1))^{(1/\alpha)} \tag{1}$$

For another hop selection, the nodes are considered from near to the optimal location [16]. Besides, for the determination of such system, we introduced a PSR method which was very efficient and reliable one. In additional to, the proposed system has better energy efficiency and has three different states such as, average, worst, like best, to check the corresponding path of the nodes and performance of the network.

### 2.2 Progressive Power Aware Routing

Although, for designing the routing algorithm, the minimum power [14, 15, 17–19] has to be consider in between source–destination node based on power consumption criteria. As, it produce well known routing algorithm based on the outcome of simulation results. This scheme can be used for finding the neighbors, as direct transmission was better for non-localized proactive power-aware method and also for power consumption. The new work mainly concentrates on traffic and congestion characteristics based on selecting the routes in the network. However, high energy consumption might result in their failure as nodes are used for routing the packets from source–destination. The metrics used in this system for minimizing total consumption of energy per packet. The PPAR for the next hop destination that given as

$$(d^{\alpha} + 2E)/(\psi - X) \quad (2)$$

wherever d, ψ and χ represents as distances among the destination and the next hop, current node and subsequent hop, current node, and the destination, respectively.

The design objective of modifying DSR is to select energy efficient paths [20]. The main features of modified DSR are: (1) minimize energy consumed per packet (2) maximize network lifetime for network and (3) minimize maximum node cost. However, some intermediate nodes might act selfish and drop the packets for other nodes in order to save their own battery power. The proposed algorithm can find selfish nodes and deal with them by using a modified DSR protocol, which we call as an efficient DSR (EDSR).

## 3 Related Work

The wireless medium of the broadcast system supports the source node communicate the information to the destination section based on CPLNC method.

### 3.1 Co-operative Physical Layer Network Coding (CPLNC)

The system, mainly combining the continuous-time signal from the receiving node then it is transferring [21] to the transmitting one. Based on the amount of synchronized transmitting node, combines the continuous-time signals at the receiver node.

Figure 1 shows the wireless nodes model i.e. the three nodes are randomly located. The N1, N2 and N3 are the nodes in CPLNC. According to the CPLNC method, the nodes are transmitting based on N1 and N3–N2. As, it transmit the same symbol, in which minimum threshold of T is satisfied by N2.

The cooperative and the non-cooperative transmission of energy saving gain and it denoted by G,

$$G = \frac{\varepsilon ptp - \varepsilon cp \ln c}{\varepsilon ptp} \quad (3)$$

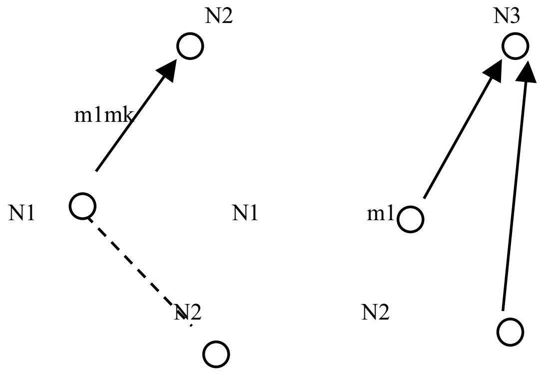



**Fig. 1** Wireless broadcast and three node network

Ɛptp = Point to point protocol energy consumption, Ɛcplnc = Energy consumption for physical layer network coding protocol.

At the destination node the minimum power was applied to satisfy the SNR ratio which was inversely proportional to the power gain of the channel. It was offered two different routing algorithms based on CPLNC.

### 3.2 Cooperative Cost Shortest Path Routing Algorithm (CCSPR)

This method is applied to calculate the shortest path among source–destination node [22] in the network. The minimum of two link costs is known to be cooperative link cost. To control the transmission radius, each node adjusted the transmitted power dynamically. There should be needed a perfect phase synchronization method to reduce the delay when the multiple nodes are sending information to the single receiver. The structure of transmission of wireless medium is worn to transmit the information from source–destination (Table 1).

In the CPLNC transmission, the overall cost in direct transmission is from‘s’ to ‘i’ monitored by‘s’ to ‘i’ via ‘j’. Then the overall cost in the indirect transmission was from‘s’ to ‘i’ via ‘j’, which monitored by‘s’ to ‘i’ using ‘j’. The CPLNC linkage cost is compared with direct and the minimum transmission cost of the selected criteria in s-link transmission. Where‘s’ is node select and ‘i’ a direct transmission.

### 3.3 Cooperative Over Shortest Path Non-cooperative Routing Algorithm (COSPNR)

In between the source–destination a shortest path is transmitted based on the CPLNC method. Moreover, the CPLNC used less power than other transmission system, when the shortest route transmits the information in between two nodes (Table 2).

Along the routing protocol with all those sequential nodes are considering for the next transmission. The process should be continued till the final destination was grasped. The optimal non-cooperative shortest path route used the CPLNC method. The link-cost

**Table 1** Cooperative cost shortest path routing

| | |
|---|---|
| Step 1 | Each separate node‘s’ estimate the cost of direct transmission link for each neighbors of the node ‘i’,$i \in N(s)$, where N(s) is the neighborhood set of ‘s’ |
| Step 2 | For each neighbor has $i \in N(s)$, choose the nodes ‘j’ such that $j \in N(s)$, $j \neq i$ and $d_{si} > d_{sj}$ |
| Step 3 | The cost of link for the s-I link is a selection of as $LC_{si}$ |
| Step 4 | Then calculate the shortest path from source–destination by means of cost that implemented in it |

**Table 2** Cooperative over shortest path non-cooperative routing

| | |
|---|---|
| Step 1 | Calculate the shortest path route from source–destination by means of distributed shortest path algorithm |
| Step 2 | Then it send to the third node, when the CPLNC method consume a lesser amount of power than the direct transmission, after that the remaining information are transmitted based on direct transmission |
| Step 3 | The process should be continued till the final destination was grasped |

function has straight transmission energy and the residual energy of a transmitting node by implementing energy-aware algorithm in the system. The maximum is independent to the proportions of the network. It performs better from smaller networks.

### 3.4 Joint Power and Rate Control

The transmitting power could be increased to minimize the data rate of the secondary channel as same as that of primary channel quality. The transmitted power might be reduced to minimize the consumption of energy as same as that of secondary quality constraint [6]. The proposed system obtained two factors which are to transmit power and transmitting energy in residual power used to defining the optimal routing method. The power and the rate control value might be determined by on the chosen strategy.

- Power control of Rate efficient
- Energy efficient power control

Therefore, the foremost objective of this system is to reduce the secondary capacity. The new strategy RE-PC used to transmit maximum power that guarantees primary link quality. The impartial of proposed method was to maximizing the energy efficient of the secondary link. The new organization mainly utilize the small transmit power even though still make certain quality of the secondary link.

Power Aware Routing (PAR) is a new power-aware routing protocol that extends the lifetime of nodes in MANET [23]. The protocol selects the route which has the highest power at nodes and will take the lowest power to transmit the packet. While comparing with other power aware routing protocol, the EPAR not only deals with a reaming energy of nodes but also it will take care of power required to travels the packet from the sender to receiver. The EPAR convention utilizes min–max development for selecting the route that has the ample of packet capacity at the limited residual packet carrying capacity.

## 4 Proposed Method

Most of the existing paper based on the routing method in the wireless network system that deals with finding problems and maintaining the routers in the destination during changing topology and mobility of the network.

### 4.1 Power Aware Routing (PAR)

The minimum power route between the source and destination can be constructed by designing a routing algorithm PAR in the system. For improving the efficiency and the aware routing protocol, the super node method was used. It can be used to find neighbors for which direct transmission is the best choice in terms of power consumption. The super node method is a relay selection method, i.e. transferring the packets through that relay node only. In Fig. 2 darken nodes are forward nodes. The remaining nodes does not forward the packets, simply listen the received messages [24, 25].

Moreover, it mainly applied to observe the neighbors, in which better power consumption and the aware routing protocol provide best transmission choices.

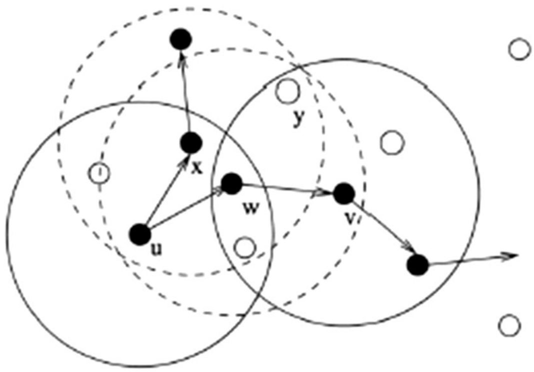



**Fig. 2** Forward node set in a MANET

### 4.2 Power Aware Routing Protocol

Batteries are applied to power the nodes in the wireless communication systems. For the period of system transmission, the SNR use less power in receiver side and it mainly depend on the distance among source–destination. When a transmitter can be energetically adjust the power transmission by continuously or based on power levels. Figure 3 describes the classification of power aware routing protocols. By adjusting the transmitter power the system became more efficient. Thus the subsequent signal is much efficient and strong for further process to reach corresponding destination [26, 27].

The power in the transmitter transmit continuously or based on discrete power levels by means of the active transformer adjust the power transmission. By adjusting the transmitter power the system became more efficient. Thus, its signal became strong to reach the corresponding destination.

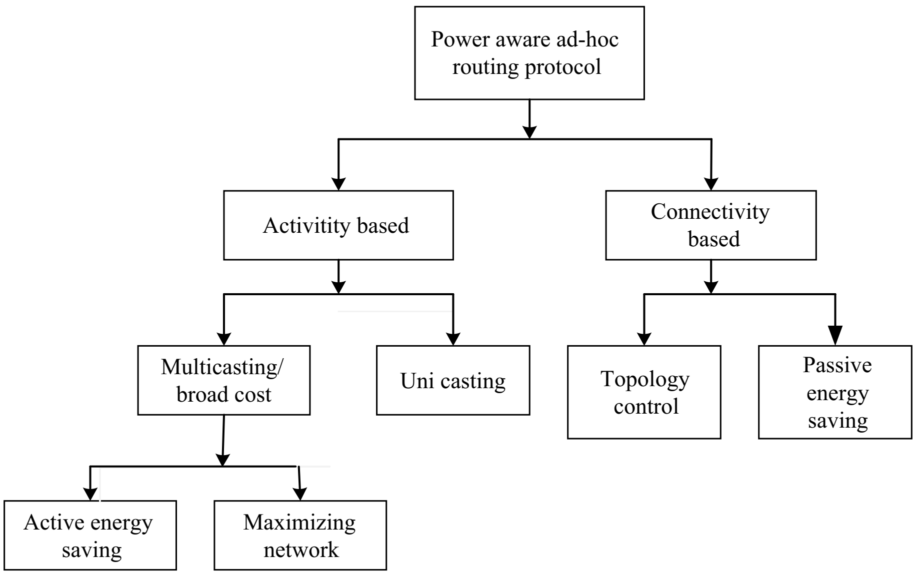



**Fig. 3** Power aware ad-hoc routing protocol

### 4.3 Efficient Power Aware Routing (EPAR)

EPAR is an efficient power aware routing protocol to get larger life time of a node. The EPAR system is mainly used to observe the node capability through its energy of data packet and residual power of a specific link. EPAR approach can be used in any type of wireless topology. MANET can also use the same approach. By sending control packets, a group will be formed in a particular time based upon location of the node, and select the best path which one is consuming minimum energy.

The energy used in each packet from source–destination had EPAR system. Therefore been minimized to keep the energy based on EPAR, the key functionalities of EPAR are,

- Minimize the variance of energies in all the nodes
- Prolong the lifetime of the network.

To optimize the performance of energy efficiency or the power of the related evaluation metrics based on the EPAR routing decisions. The EPAR algorithm is applied to choose the path established on the energy consumption in the battery lifetime prediction. Figure 4 shows the network model for EPAR approach and shows the lifetime of every node.

The AEFD selected by PAR, as the path had a minimum life time of network 1000 s. The RREQ has a destination address with the source node and the unique ID number. The nodes that are receiving the packets check, if the node knew its route to the corresponding

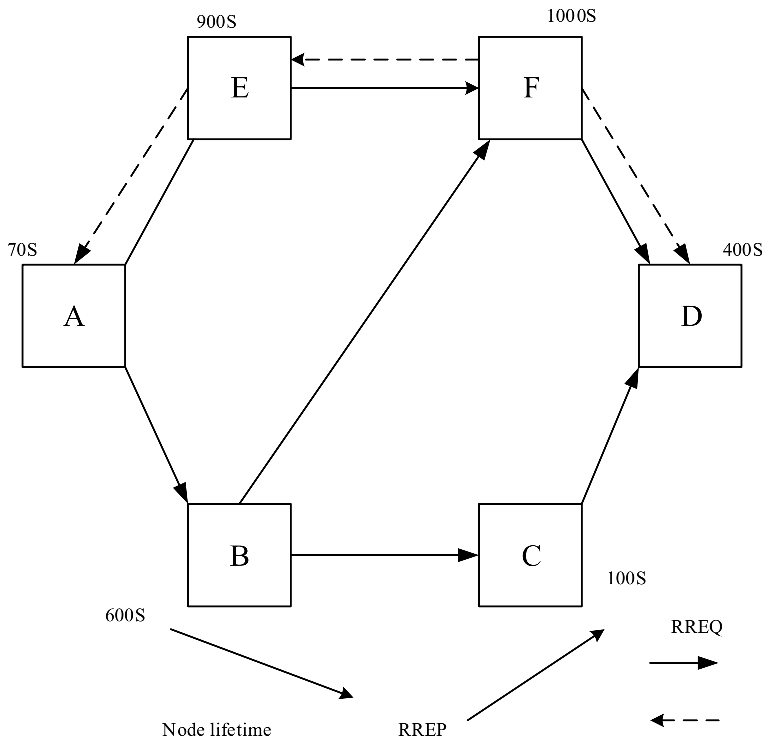



**Fig. 4** EPAR process in node lifetime

destination. The RREP has a node generating criteria, it consist of route record for the correct destination. When, the node was an in-between node, then the node use the cache method to generate the route depend on route record. Therefore, this procedure rises the lifetime of wireless MANET system.

### 4.4 Power Control of RTS/CTS Constant Rate

First consider power control in RTS/CTS-based systems with a fixed transmission rate. Note that the nodes in the RTS range may be unnecessarily blocked. However, this approach catches some basic properties of interference in wireless networks. Loosely speaking, the RTS range can serve as a measurement of how much interference the sender introduces to its neighbors when transmitting the RTS/data packet. The CTS range will be the measurement of 'interference' introduced by the receiver that blocks future transmissions around it.

The protocol minimizes the overall 'interference' so that the spatial utilization can be increased. The simple RTS/CTS framework that is given here resembles the IEEE 802.11 protocol. In the IEEE 802.11 MAC protocol, the RTS/CTS exchange reserves a fixed area for transmission, irrespective of the distance between transmitter and receiver. This results in poor spatial utilization. Furthermore, the fixed CTS range cannot prevent collisions. In optimal power control scheme, each link strives to minimize its transmission floor in order to maximize the spatial utilization of the network.

Consider a transmitter–receiver pair (i, j), the maximal interference that the receiver j can tolerate (power margin at node j) is

$$p_{m\arg in(j)} = \frac{p_t^{(i)}G}{d_{ij\beta}^{\alpha}} - p_n \tag{4}$$

If a node k is transmitting at the maximal power $P_{\max}$ and has a distance of $d_{ij}$ to the receiver and if

$$p_r^k(j) = \frac{P_{\max G}}{dkj^{\alpha}} \geq \frac{p_t^{(i)}G}{d_{ij}^{\alpha}\beta} > P_{m\arg in}(j) \tag{5}$$

Then node k will interfere with the reception of node j. From Eq. (5)

$$d_{kj}\left(\frac{p_{\max d_{ij\beta}^{\alpha}}}{p_t^{(i)}}\right)^{\frac{1}{\alpha}} \leq \left(\frac{p_{\max d_{ij\beta}^{\alpha}}}{p_t^{(i)}}\right)^{\frac{1}{\alpha}} \tag{6}$$

Define $d_{\text{int}}^{j} = \left(\frac{p_{\max d_{ij\beta}^{\alpha}}}{p_t^{(i)}}\right)^{\frac{1}{\alpha}}$, which is the distance threshold within which a node transmitting at $P_{\max}$ can interfere with node j's reception from node i. The transmission range of CTS should be at least $d_{\text{int}}$ (j) which gives the lower bound of the reserved transmission floor. To ensure that all nodes within $d_{\text{int}}$ (j) can decode the CTS message, the received power of the CTS at a distance $d_{\text{int}}$ (j) must satisfy to make neighbors hear the CTS message, where $P_{\text{recv}}$ is the receiver sensitivity. So, the receiver transmitter power must be,

$$\frac{p_t^{(i)}G}{P_{\text{int}}^{\alpha}(j)} \geq p_{recv} \tag{7}$$

$$p_{t^{(j)}} \geq \frac{p_{recv} p_{\max d i j^{\alpha}}}{p_t^{(i)} G} \beta \tag{8}$$

To comply with the maximal transmission power, the possible link length of $d_{ij}$ should be smaller than the $d_{max}$. Otherwise, the CTS message will not be able to inform all possible interfering neighbors.

From Eq. (8) one can see that the transmission power of CTS $P_t^{(j)}$ is inversely proportional to the transmission power of data and RTS $P_t^{(i)}$. So, there is a trade-off between transmission power of RTS and CTS. The maximal transmission range is given by

$$d_{\max} = \left( \frac{G p_{\max}}{p_{recv}} \right)^{\frac{1}{\alpha}} \tag{9}$$

Combining Eqs. (7) and (8) one can get

$$p_t^{(j)} p_t^{(i)} \geq \left( \frac{d_{ij}}{d_{\max}} \right)^{\alpha} p_{\max}^2 \beta \tag{10}$$

The transmission range of CTS and RTS, defined as $d_c \left( \frac{p_t^{(j)} G}{P_{recv}} \right)^{\frac{1}{\alpha}}$ and $d_r = \left( \frac{p_t^{(i)} G}{P_{recv}} \right)^{\frac{1}{\alpha}}$, will satisfy $d_c d_r = \left( p_t^{(j)} p_t^{(i)} \right)^{\frac{1}{\alpha}} \left( \frac{G^2}{P_{recv}^2} \right)^{\frac{1}{\alpha}}$

$$\geq \frac{d_{ij}}{d_{\max}} \geq \frac{d_{ij}}{d_{\max}} \left( \frac{p_{\max G^{2\beta}}^2}{P_{recv}^2} \right)^{\frac{1}{\alpha}} \tag{11}$$

$$= \beta^{\frac{1}{\alpha}} d_{\max} d_{ij}$$

Let the area of the transmission floor be $A_{ij}(d_c, d_r)$ This area must be larger than the RTS or the CTS region. Thus one has

$$A_{ij}(d_c, d_r) \geq \max \left\{ \prod d_c^{*2}, \prod d_r^{*2} \right\} \tag{12}$$

The selection of $d_c$ and $d_r$ is subject to the following constraints

$$\geq \beta^{\frac{1}{\alpha}} d_{\max} d_{ij}$$

$$d_c \geq d_{ij}, d_r \geq d_{ij} \tag{13}$$

When $\beta^{\frac{1}{\alpha}} d_{\max} d_{ij} >^{dij}$, it is easy to see that $\max\left\{ d_c, d_r \right\} \geq \beta^{\frac{1}{\alpha}} d_{\max} d_{ij}$, and one gets

$$Min\left\{ A_{ij}(d_c, d_r) \right\} \geq \beta^{\frac{1}{\alpha}} d_{\max} d_{ij} \tag{14}$$

It is seen that $A_{ij}(d_c, d_r)$ is actually minimized when we have $d_c^* = d_r^* = \sqrt{\left( \beta^{\frac{1}{\alpha}} d_{\max} d_{ij} \right)}$

This hints at an optimal way of setting the transmission power, given the link distance. The upper bound of the area of the reserved transmission floor is

**Table 3** Simulation parameters

| | |
|---|---|
| Number of nodes | 100 |
| Mobility | 0–10 m/s |
| Routing protocol | CSPR, COSP-NCR, EPAR |
| Traffic | CBR |
| Simulation time | 10 min |

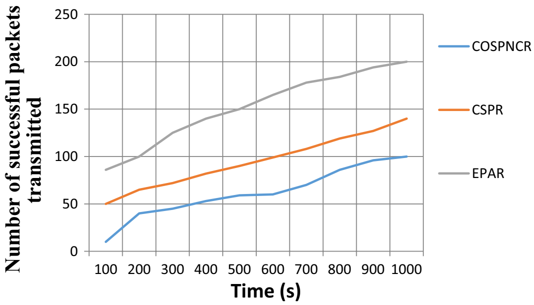



**Fig. 5** Throughput

$$MinA_{ij}(d_c, d_r) \leq \prod d_c^{*2} + \prod d_r^{*2} = 2^{\prod \beta^{\frac{1}{\alpha}} d\max_{d_{ij}}} \tag{15}$$

Thus together with lower bound it can be seen that

$$\prod \beta^{\frac{1}{\alpha}} d_{\max} d_{ij} \leq Min\{A_{ij}(d_c, d_r\} \leq 2^{\prod \beta^{\frac{1}{\alpha}} d\max_{d_{ij}}} \tag{16}$$

Thus, the area of the reserved floor is $\Theta\left(\beta^{\frac{1}{\alpha}} d_{\max} d_{ij}\right)$ when using the optimal power control scheme.

## 5 Simulation Result and Discussion

The simulations of new system are conducted using NS-2 software. 100 nodes are considered for simulation purpose. It is an efficient tool for network analysis, in which it yields mobility as it move in the uniform speed from 0 to 10 m/s. Table 3 shows the simulation parameters.

The power that consumed by the EPAR reduce significantly according to the amount of nodes. Moreover, the proposed method is contrasted with the existing work and also with the research work. Therefore, based on x-graph it compares the existing and proposed method via new method.

### 5.1 Throughput

The throughput is an effective parameter in this work. The throughput was well-defined as number of data packet received on the data transmission or the successful transmission of data within a significant time period. Figure 5 shows the throughput of the three algorithms, EPAR gives better throughput.

The quality of any network was represented as average successful rate of the data packet that is distributed in between the source and the destination node. As well as, it represented as bits/bytes in per second. Therefore, the throughput of the system is an important factor for a network parameter.

### 5.2 Average Delay

The delay is an important parameter in the network. It is defined as the time taken from the packets to transverse in between the source and the destination nodes. Therefore, the foremost source of delay was, propagation delay, processing delay, destination delay, source processing delay etc. EPAR produces less delay as shown in Fig. 6.

Average delay can be measured based on one way potential which was observed among transmitting and receiving event on each node. Figure 6 shows the delay will be less in EPAR approach.

### 5.3 Packet Delivery Ratio

The packet delivery ratio was well-defined as the numbers of data packet are transmitted based on the source and the destination node. It was mainly applied to analyze the loss rate of a packet in the data transmission of the network. Besides, it estimates the loss rate, efficiency and the correctness of the routing protocol.

The Fig. 7 shows the division of information packets that are effectively delivered during simulation period.

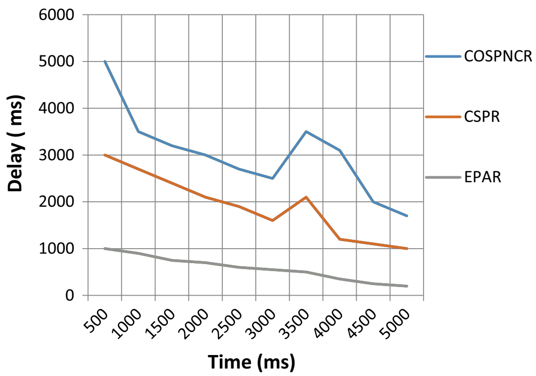



**Fig. 6** Average delay

**Fig. 7** Packet delivery ratio

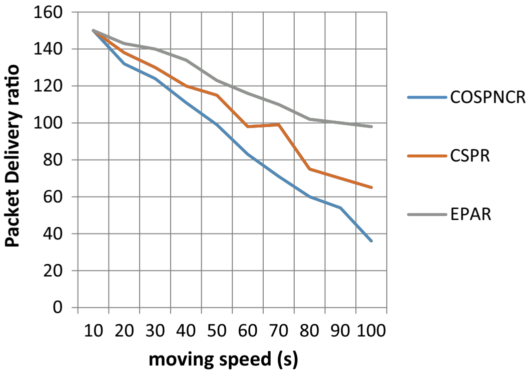



**Fig. 8** Percentage of energy cost

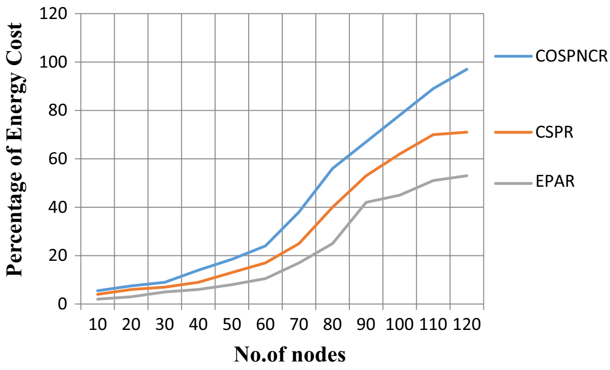
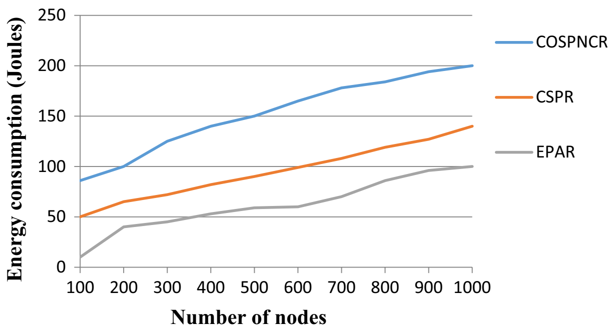



**Fig. 9** Energy consumption



### 5.4 Compare COSPNCR, CCSPR from EPAR

The EPAR method uses fewer amounts of hops that are compared to COSPNCR and the CCSPR. The proposed technique produce the consumption of energy reduced the COSPNCR and CCSPR in $24 \times 10^{-3}$. As a result, the proposed system achieves better energy efficient criteria with lesser number of nodes. Thus the energy saving is 50% and reduce the delay value is 15%. Henceforth the throughput is increases to 90.

Figure 8 and 9 shows the comparison of three algorithms CSPR, COSPNCR and EPAR in terms of energy cost and energy consumption versus number of nodes. Each link can be specified by energy cost, based upon the energy cost nodes will communicate, if the energy cost is less chooses that path for communication. EPAR algorithm uses less energy cost path and energy consumption through that path is less.

## 6 Conclusion

In this research work, it mainly contracts the problematic of maximal lifetime of wireless MANET network. The proposed CPLNC method combines the energy efficient transmission and the physical layer network coding method. The effectiveness of the new system was compared by means of the older method based on CCSPR, COSPNCR and Joint power and rate control techniques. The CCSPR system uses the CPLNC as the infrastructure of COSPNCR. It mainly transmits over non-cooperative shortest path route algorithm method. Moreover, the EPAR, COSPNCR, CCSPR a small network system which was used for comparable.

According to the results, the throughput of proposed system is better in all scenarios which have been investigated. Besides, based on the various graphs, it was successfully proven that the proposed energy efficient algorithm outperforms than traditional algorithm in an obvious way. Various security approaches can be implemented in an energy efficient network. Compare the results with the secured and non-secured energy efficient network.

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