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Cooperative Routing For Data Transmission in Wireless Sensor Networks with Multiple Flows

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Abstract

In this paper to meet the demands of wireless sensor networks (WNSs) and to design multiple sources to multiple destination model (MSMD) we consider cooperative routing algorithm by minimizing the collision which occurs due to contention between the nodes and to minimize the power consumption by proper power allocation. We develop an algorithm known as energy aware MCCR (EAMCCR) which efficiently reduces the collision probability as well as energy consumption during cooperative routing. It selects and combines the cooperative transmission path, route selection, and optimal power allocation efficiently using cooperative routing. Data aggregator is used to maximize the life time of network by gathering and aggregating the data in an energy efficient manner and reduces the medium access layer contention. Aggregate node is used to avoid repeated reception of similar data which causes delay and causes more power consumption during cooperative transmission. Credit and behavior analysis is done to detect and remove the unauthorized person known as hackers who are responsible for packet loss and packet delay. Result shows that the proposed algorithm EAMCCR can significantly reduce the packet collision and power consumption 75%.

Keywords: Cooperative routing, collision minimization, wireless sensor, data aggregator, aggregate node.

INRODUCTION

In general, a cooperative routing consists of two types of transmission, cooperative-transmission and direct-transmission links. In a fig 1 we are explaining about two different transmission links. The direct transmission is represented as (DT), where one node is for transmission and another node is receiving node. The cooperative transmission is represented as (CT), where there nodes are used as transmitter node, relay node and receiver node. In cooperative transmission with respect to the direct link we can use more than one relay nodes for relaying the signal to the receiver node. The definition of the traditional link, which includes only two nodes, should be revised. In order to improve and facilitate cooperative communication, researchers need to address the requirements for designing cooperative systems. These requirements include making decision about the cooperative transmission scheme, relay node selection, resource allocation, channel state information, and the cooperative routing metrics. In the entire paper, we define the source node as the initial transmitter node and the destination node as the final receiver node. To improve the robustness of wireless links cooperative diversity has been proposed as an effective technique[1]. Neighboring nodes is exploited by the cooperative routing to relay the packets from transmitting node to intended destinations. Multiple copies of packets are combined at the destination which leads to several advantages, such as better signal quality and higher capacity [2]. Cooperative communication[2] schemes in which cooperate with each nodes by promising significant gains in over all throughput and energy efficiency[6]-[8] other with ea node The main aim of the project is to achieve effective data transmission using Aggregator node thereby reducing the collision and energy loss.

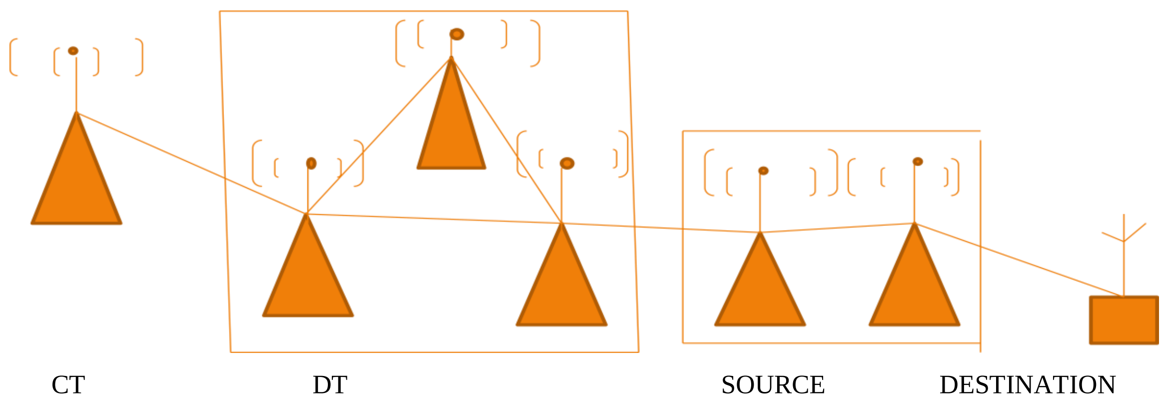

Figure 1. A sample cooperative route: constructing the route using cooperative Transmission (CT) and Direct Transmission (DT).

Due to limited computational power and energy resources. In a cooperative transmission scheme, neighboring nodes are exploited as relay nodes, in which they cooperate with the transmitter–receiver pair to deliver multiple copies of a packet to the receiver node through independent fading channels. If the multiple source send to the one receiver means collision occurs. Cooperative routing algorithms is an routing algorithm which take into consideration the availability of cooperative transmission. Cooperative routing [2] was introduced by Khandani et al. and author researched about problem of selecting route using cooperative routing. Therefore with reduced complexity, heuristic routing algorithm is proposed by researchers. Existing cooperative routing MPCR in the literature can be divided into two categories: (i) routing algorithm which are implemented by first selecting the optimal route based on direct transmission in each link and when network congestion occurs between the node then uses cooperative transmission over the links of the selected route, and (ii) routing algorithm which assumes that the cooperative transmission is available on each link during route selection. It allocates the power to both transmitter and receiver. If the transmitting and receiving node is damaged it's difficult to replace it and more power is consumed during replacement of each node in multiple flows. First each link assumes that cooperative transmission is also available for each link and finds the route that minimizes the total transmission power. Using this exiting algorithm MPCR [12] cost of contention to each of its neighboring node is calculated either in the cooperative mode or using direct mode of transmission. By investigating the entire relay node in the transmitter node's neighborhood best relay node in the cooperative mode in the first phase is obtained. In the similar way corresponding minimum cost (transmission power) is selected to cooperative. In case of unavailability of relay node in the neighborhood will lead to direct transmission mode to transmit the data. Fig.2 shows the route chosen by the MPCR algorithm in a grid regular network. Equal power for both transmitter and relay nodes are assumed by MPCR and uses an approximation method to calculate the transmission power therefore, it is considered as a sub-optimal cooperative routing. Second, Bellman-Ford algorithm is used to find shortest path algorithm that select minimum cost route

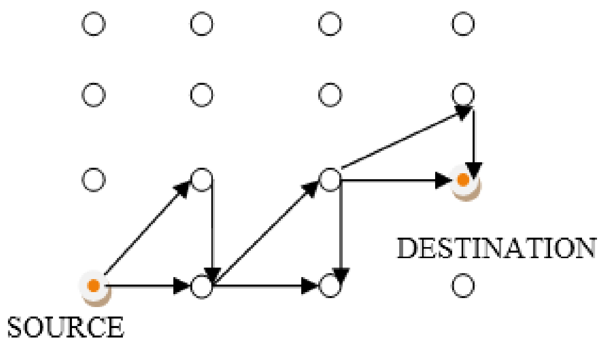

Figure 2. Route chosen by MPCR in a regular grid network

When multiple flow occurs interaction among the node occurs which may leads to hidden and exposed problem, which causes packet loss and packet collision. Therefore the algorithm approaches the non-cooperative protocol when network congestion emerges.

However, packet collision minimization, using cooperative routing, has not been addressed by the existing scheme, in energy constraint networks, such as wireless sensor networks (WSNs), not only power consumption but packet collision also can causes serious problems. For instance, for target detection in security or military applications of WSNs, packet collision can lead to missing of target or to long delay which leads to packet loss and which may have several consequences. Moreover, as it will be shown in the results, that cooperative routing protocols, which aims to minimize the transmitted power, doesn't mean that it necessarily lead to collision probability minimization. In energy constraint networks, such as Wireless Sensor Networks (WSNs), packet collision can cause serious problems. Which leads to delay to detect the target or missing of target in various securities based military application. For example, target detection in security or military applications of WSNs, packet collision can lead to missing the target or to long delays, which may lead to several consequences and effects. So MCCR [1] algorithm is used to reduce the collision in wireless sensor network. Packet collision is the main challenge of cooperative routing with multiple flows using cooperative routing an algorithm is proposed in [11] mathematical models and also minimizes collision probability. A transmitter node, *s*, will cause a collision to another node, *n*, if *s* is sending while *n* is simultaneously receiving (from another node, *m*), provided that the interference from *s* at *n* is high enough to cause a collision. Therefore, the collision minimization is formulated as the probability that the entire route causes collision to the network.

First, the algorithm calculates a cost function to each cooperative link based on the collision probability caused by cooperative link. Then, the algorithm applies the shortest path Bellman–Ford algorithm to find the path that causes minimum collision probability. A minimum-collision cooperative route is achieved by combining cooperative transmission, power allocation, and route selection. The algorithm selects the route that avoids nodes surrounded by neighbors, which have high probability of reception and are more susceptible to packet collision. Hence, it is desirable and must to minimize the collision probability as well as power consumption. In WSNs Many authors have discussed about this routing and many papers are related to this concept for example. They have already proposed a cooperative communication protocol, which achieves higher bandwidth efficiency while guaranteeing the same diversity order as that of the conventional cooperative scheme. For the symmetric scenario, we derive an approximate expression of the bandwidth efficiency and obtain an upper bound on the symbol error rate (SER) [3] performance. We show that full diversity is guaranteed and that a significant increase of the bandwidth efficiency is achieved. Moreover, we present the tradeoff between the achievable bandwidth efficiency and the corresponding SER. Finally, the obtained analytical results are verified through computer simulations. Similarly another paper they consider a cooperative wireless network where the source broadcasts data to relays, some or all of which cooperatively beam form to forward the data to the destination. The network is subject to an overall outage constraint. We generalize the standard approaches for cooperative communications in two respects: (i) we explicitly model and factor in the cost of acquiring channel state information (CSI)[5]-[6], and (ii) we consider more general, yet simple, selection rules for the relays and compute the optimal one among them. These rules include as special cases several relay selection criteria proposed in the literature. We present analytical results for the homogeneous case, where the links have identical mean channel gains. For this case, we show that the optimal transmission scheme is simple and can be computed efficiently. Numerical results show that while the cost of training and feedback of CSI is significant, relay cooperation is still beneficial.

Network coding scheme known as CPLNC [9] which was used to analyze the effectiveness of the scheme in reducing energy consumption. Through this analyze with sufficiently long packets, the algorithm achieves energy saving up 60% but using less number of hops. As per we have discussed no one has considered and addressed about both packet collision and power consumption using cooperative transmission. So we propose an algorithm known as Energy Aware minimum collision cooperative routing (EAMCCR) by combining cooperative transmission, route selection, and optimal power allocation efficiently to reduce the collision and power consumption in cooperative transmission. The cooperation concept in wireless communication network has a great effect in addressing the performance limitation due to scarcity of network resources [7]. It mainly concentrate to improve the channel reliability, throughput and achieve seamless services provision.

Aggregate node is used to avoid reception of similar data through which transmission power used by the node will be reduced. If any node battery is drained it will be replaced by the emergency node (EN). Before the battery is fully drained it is detected and replaced by the emergency node (EN). Credit and behavior analysis is used to detect and remove the node which is accessed by the unauthorized person like hacker.

SYSTEM ANALYSIS

In general, due to more robust link cooperative routing can improve the performance and reduce power consumption. However, relay node causes extra packet collision which causes extra packet transmission in the cooperative routing. Therefore, especially in terms of packet collision if we see the gain probability of a cooperative routing algorithm with multiple flows is different from the one with single flow. In the cooperative routing there are only few papers which consider about collision in multiple flows. In that previously viewed paper contention graph approach is used to avoid the collision, where a set of transmitting nodes coordinates their transmissions to a set of receiving nodes. This method will cause more power consumption because it allocates the power to each and every node so if collision occurs in any node will cause heavy packet loss. The exiting minimum power cooperative routing (MPCR)[1] algorithm is only used to reduce the power consumption but by reducing the power we cannot reduce the collision and contention occurring in the nodes in multiple flows and this algorithm approaches the non-cooperative protocol when net work congestion emerges it means it chooses direct transmission path in which collision will occurs more packet loss and power consumption lead to missing of target in various applications. Moreover, in the congestion problem is solved in the MAC layer but by reducing this congestion power we can't reduce the packet collision.

The main objective of cooperative routing in all proposed schemes is to minimize the energy consumption. Hence, it is desirable to minimize the collision probability in WSNs. In this paper, we aim to design a cooperative routing scheme for minimizing the collision probability subject to an end-to-end outage probability constraint. As compared to exiting system less power is consumed by proposed system. Even though it follows the shortest path algorithm it consumes more power because it first identifies cooperative path for data transmission if it is not available it chooses direct transmission path which leads to lot of power consumption, packet delay and also leads to packet collision. We cannot always monitor each and every node while data transmission process. Therefore we discovered our proposed algorithm known as EAMCCR (Energy aware multiple collision cooperative routing) which reduces both collision and power consumption with multiple flows. It use credit and behavior algorithm which checks the behavior of each node while transmission. And on the bases of analysis gives credit to each node. Through analyzing using proposed algorithm we can obtain energy gains up to 37% to 75%.

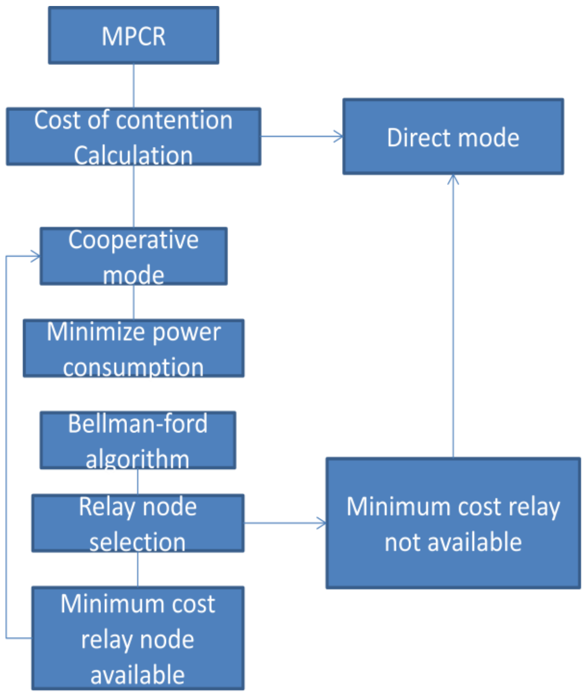

Figure 3. Exiting Flow diagram

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PROPOSED WORK

In this section, we propose collision and energy aware routing algorithm, which minimizes the probability that causes collision to other nodes in the network. The algorithm uses cooperative transmission, route selection, and optimal power allocation jointly to reduce the collision probability and power consumption, while the probability is kept below targeted value. As discussed before, we propose an cooperative routing algorithm: Energy aware minimum collision cooperative routing (EAMCCR) algorithm, which requires a route that causes minimum collision probability in the network. EAMCCR is implemented using following steps

1) Step 1: Each node in the network chooses the cooperative mode of transmission.
2) Step 2: EAMCCR algorithm is used to find the shortest path by avoiding collision and that route is selected for transmission.
3) Step 3: The optimal power is allocated to the selected route and node which reduces the transmission power.

The main challenge of cooperative routing with multiple sources and multiple destination nodes (i.e., multiple flows) is the packet collision. The algorithm proposed models which minimizes collision probability using cooperative routing. A transmitter node, will cause a collision to another node, if one node is sending while another node is simultaneously receiving from another node, provided that the interference from that node is high enough to cause a collision. Therefore, the collision minimization is formulated as the probability that the entire route causes collision to the network which is given by is the collision probability caused by the source node and relay node of hop in the route. First, the algorithm calculates a cost function to each cooperative link based on the collision probability caused by cooperative link. Then, the algorithm applies the shortest path Credit and behavior algorithm to find the unauthorized person like hacker that causes packet loss. By using this analysis we can minimum collision probability and minimum power consumption. A minimum-collision cooperative route is achieved by combining cooperative transmission, power allocation, and route selection. The algorithm selects the route that avoids nodes surrounded by neighbors, which have high probability of reception and are more susceptible to packet collision.

In this paper we design a multiple source to multiple destination (MSMD) models [8]. When data is transmitted from multiple sources to destination sensor nodes are initialized simultaneously data transmission process starts and collision may occur due to contention between the nodes. To avoid the collision and power consumption we introduce an algorithm know as energy aware MCCR. First it combines the cooperative transmission, second optimal power allocation, third route selection.

Network Coding

Network coding is a process which allows the intermediate nodes to process the data or information that flows [11]-[12]. The intermediate node which we are using in our existing system allows only the different type of data. The node is called as aggregator node which is placed in between the network .Aggregator node is used to avoid repeated reception of similar data**.** So we can reduce the power consumed during the transmission of data.

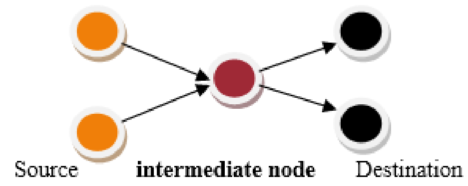


Figure 4. A sample network using intermediate node.

Maximization of network lifetime

In a wireless sensor network by minimizing the energy consumption per packet we cannot increase the lifetime of network [10]. In this paper we are increasing the lifetime as well as reducing the power consumption. Many routing are proposed to prolong the network lifetime. We here introduce a simple but effective approach by selecting the relay node to find the optimal power control and increased network lifetime among all the nodes during each transmission [4].

Credit and Behavior Algorithm

The analysis is used to detect and removed the node which is accessed by the unauthorized person like hacker. It checks the behavior of each node and on the bases of analysis it gives the credit to each node analyzed during data transmission process. After detecting and removing we continue with the data transmission process. After and before the replacement of the emergency node does not effect the data transmission .When the emerency node is replaced by the drained destination node the transmission process continues and the packet is delivered at correct time.

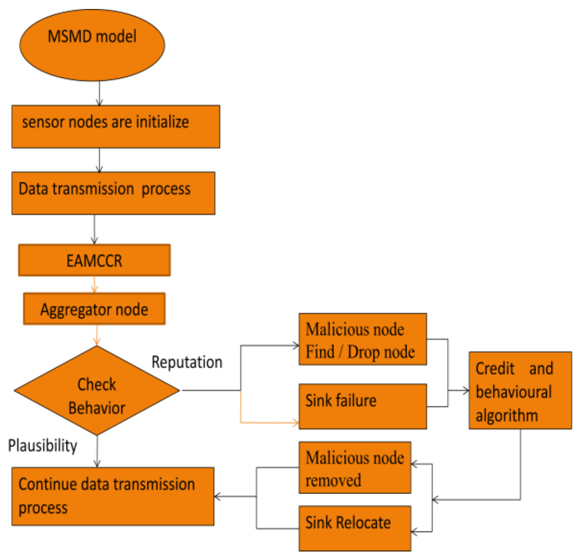


Figure 5. Proposed Flow diagram

RESULT

To analyze the performance of EAMCCR, we consider a random topology consisting of 10 to 35 sensor nodes (i.e., *N* varies from 10 to 35) and 3 or 4 flows (with randomly selected sources) within an area of 250 × 250.The simulation scenario is similar to the one which is used usually. We compare the proposed algorithm performance with respect to node throughput and packet delay.

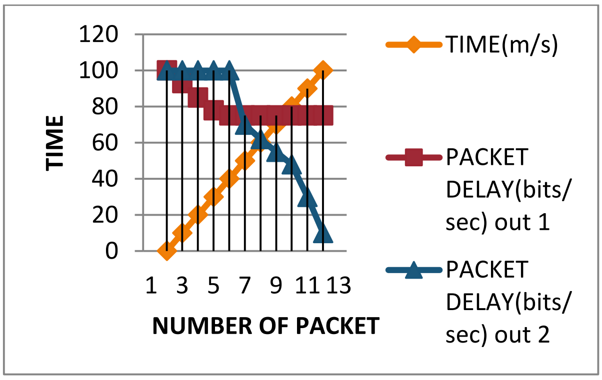


Figure 6(a) optimal power allocation in EAMCCR

ENERGY OPTIMIZATION AFTER AND BEFORE SINK RELOCATION			
S.NO	TIME(m/s)	PACKET DELAY(bits/sec) out 1	PACKET DELAY(bits/sec) out 2
1	0	100	100
2	10	93	100
3	20	85	100
4	30	78	100
5	40	75	100
6	50	75	70
7	60	75	62
8	70	75	55
9	80	75	48
10	90	75	30
11	100	75	10

We also analysis the optimal power allocation by comparing two outputs before and after the replacement of emergency node. In energy optimization by sink relocation energy of two outputs has been compared and graphed where time is plotted in x-axis and energy is plotted in y-axis in which first energy of output1 is decreased from (100.000 to 75.000) and initially time is increased from (0.000 to 3.500).When time is reached to 3.500 energy is maintained constant as 75.000. In output 2 time is initially increased from (0.000 to 3.500) and energy is decreased from (100.000 to 70.000) .Time is further increased and energy is continuously decreased

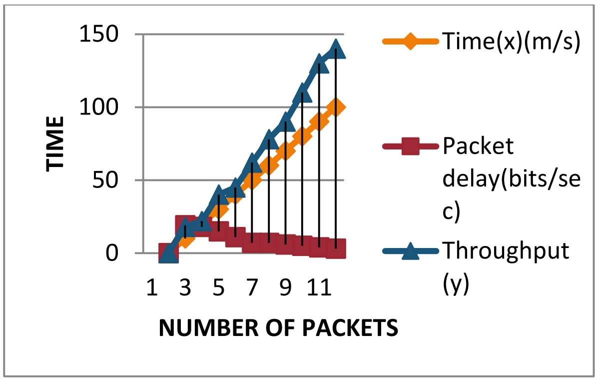
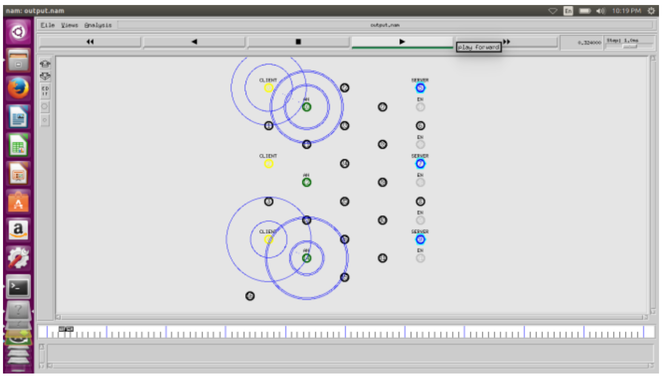


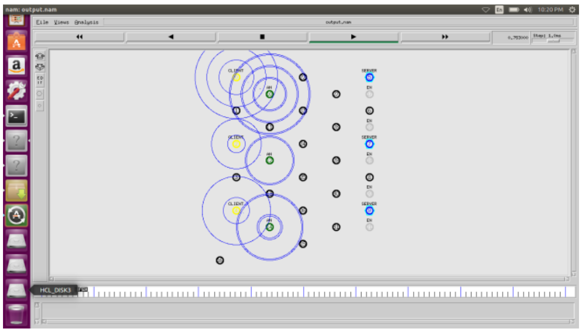
Figure 6 (B): Throughput Vs packet loss.

s.no	Time(x)(m/s)	Packet delay (bits/sec)	Throughput (y)
1	0	0	0
2	10	19	18
3	20	18	22
4	30	15	40
5	40	11	45
6	50	7	62
7	60	7	78
8	70	6	90
9	80	5	110
10	90	4	130
11	100	3	140

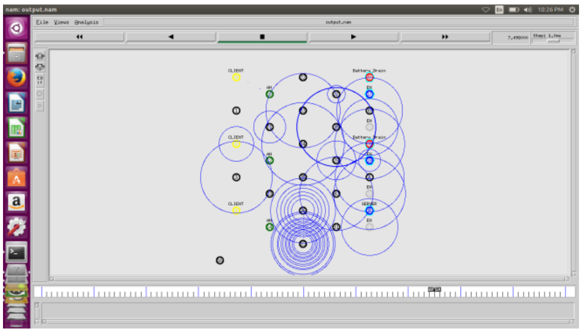
In output parameter of sink location throughput value is initially increased with time from (0.000 to 10.000) and packet delay is increased from (0.000 to 1.400).When throughput is increased with time and reached to 10.000 packet delay will continuously decreased. To reduce the packet delay we increase throughput valve up to allotted threshold valve.



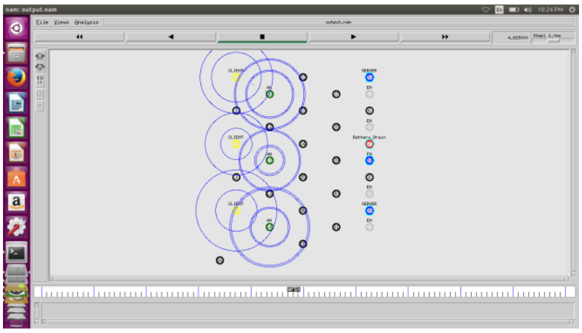
(a) Data is transmitted to the data aggregator node which receives all type of data and avoids transmission of similar type of data. This increases lifetime of network and reduces the power consumed during transmission.



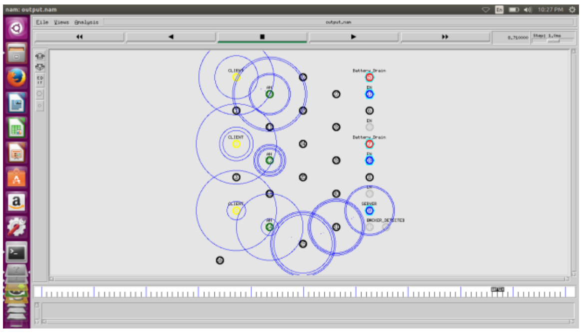
(b) Route is chosen by combining the cooperative transmission and monitoring of each node is done. Multiple source to multiple destination starts with the activation of transmission.



(c) Packet loss can occur due to hacker which is identified and removed from the network. This behavior is noticed by credit and behavior analysis due to which collision attack is reduced in the cooperative transmission path.



(d) If battery is drained it is indicated before it is fully drained by giving the signal hot spot detected. So the destination node is replaced by emergency node. The replaced battery is charged by solar panel. So there will be no packet loss due to battery drained node. This maintains the transmission processes to continue.



(e) Transmission process continues with less collision and power consumption.

Figure 7.(a),(b),(c),(d),(e) is the screenshot of simulation result.

To deal with the practical aspects of the presented framework, the technique can be implemented in an off-line manner during the initialization phase as a future work. We compare the collision probability caused by the EAMCCR algorithm and power efficiency with respect to the time before and after replacement of sink in a network having 3 and 4 flows, respectively. The analytical performance is obtained using the optimal power of source and relay nodes. Through analyzing both collision and power consumption is reduced up to 75%.

CONCLUSION AND FUTURE WORK

In this paper we have implemented energy aware MCCR (EAMCCR) using aggregator node which is used to detect collision as well reduces power consumption. We are using transport layer for data transmission in the Energy aware MCCR which efficiently reduces the collision probability as well as energy consumption during cooperative routing which is analyzed based on energy and time.

When Aggregator node is used to avoid the repeated reception of data is controlled so that energy of the destination is protected efficiently. By the selection of relay node we maximize the network lifetime. By this the working time of destination can be increased and this is used during emergency services. When battery is drained at the server node it is replaced by emergency node. Before the battery is fully drained it is detected and replaced by the emergency node (EN). Credit and behavior analysis is used to detect and remove the node which is accessed by the unauthorized person like hacker. By simulating 75% power consumption is reduced and less packet delay. By comparing the two outputs before and after the replacement of emergency node it reduces more packet loss and power consumption. Most of the cooperative routing algorithms have been evaluated through mathematically but we have derived theoretically and simulation aspect further implementation approaches in an off-line manner are identified as an area of future work.

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