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Research paper

Buffer Management and Packet Loss Avoidance Using Random Early Passive Proactive Prediction Queue Management And Cluster Based Multipath Reliable Congestion Control Protocol

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Abstract

Mobile adhoc network is one of the wireless sensor networks which consist of collection of nodes that helps to transmit the information from source to destination. During the information transmission, it has faced several problems such as packet loss because of the buffer overflow and frequent link failure due to the mobility of the nodes present in the Manet. For overcoming these issues, in this paper introduces the routing and buffer management technology for reducing the packet loss as well as effectively transmit the information from source to destination. Initially the buffer has been managed in the Manet with the help of the random early detection passive proactive prediction queue management technique (REDPPPQM) which effectively manages the length of the packets also utilize the resources with effective manner, more over it reduces the packet loss and reduces the limitation present in the PAQMN. After buffering the packets, optimized route has been predicted with the help of the cluster based multipath reliable congestion control protocol which grouping the similar packets into gather and the optimized route has been detected that avoids the packet loss as well as saving the energy while transmitting the information in the Manet. At last the efficiency of the system is evaluated with the help of the experimental results and discussions in terms of the packet loss ratio, transmission efficiency, throughput and mobility.

Keywords:*Mobile adhoc network, buffer overflow, optimized route, random early detection passive proactive prediction queue management technique, cluster based multipath reliable congestion control protocol, packet loss ratio, transmission efficiency, throughput and mobility.*

1. Introduction

Mobile Adhoc Networks (MANET) placed an important role in the communication process because it consists of collection of autonomous nodes that does not support any static infrastructure while making the communication [1]. At the time of communication the nodes are interact with each other with the help of intermediate nodes that provides the way for the destination nodes with effective manner. In addition to this, the nodes present in the network minimize the time, cost, and infrastructure setup in several applications [2]. Even though the MANET provides the various unique features while transmitting the information from source to destination, the networks faces several difficulties such as limited resources such as CPU, memory, battery power etc. which reduces the information transmission range. In addition to this, the network increases the number of retransmission, packet loss, link failure; node failure and buffer overflow [3]. Further the mobile network uses the drop tail queue management process which discards the most of the packets because the queue may be full while making the transaction. The sender continuously transmits the information to the receiver which leads to create the queue overflow which causes huge number of packet drop [4]. This packet drop is happened based on the under-utilization of the queue which is called as the global synchronization. These mobile network problems are resolved with the help of the active queue management process which effectively minimizes the packet delay, queuing delay as well as improves the overall resource utilization process. The active queue management [5] process is worked along with the network interface controller (NIC) while the buffer gets fill or closed. In addition to this, queue management process enhances the entire network performance due to low memory utilization, energy; processing power also minimizes the packet loss while making the information transmissions which is done with the help of the explicit congestion notification (ECN) and Random Early Detection (RED) method. Even though the method provide the efficient way to utilize the resources it is difficult to manage the buffer space [6] while tuning the network packets which leads to created packet fail in the mobile ad hoc network. This packet fails also create the difficulties while routing the packet to the destination node. So, in this paper introduces the hybrid method called the random early detection passive proactive prediction queue management technique for managing the buffer size that reduces the packet loss. The reduced packet loss leads to transmit the packet to the destination node by successfully creating the route from source to destination. The optimized route has been developed by using the cluster based multipath reliable congestion control protocol that analyze the packets and similar packets are grouped together which reduces the packet loss with effective manner also minimize the energy. At last the efficiency of the system is evaluated with the help of the experimental results and discussions in terms of the packet loss ratio, transmission efficiency, throughput and mobility. The rest of the paper is organized as follows: Section 2 presents the recent related works done on queue management process in the wireless sensor network. The proposed method has been described in section 3. The experimental and its results have been discussed in section 4. Finally, the section 5 discusses the conclusion.

2. Related Works

In this section discusses about the queue management process involved in the various researchers work. Arash Dana et al., [7] analyzing the queue management algorithms such as random early detection (RED) and drop trail method. These queue management methods effectively analyze the each information for maintaining the quality of the information. The efficiency of the algorithm is examined in terms of bandwidth, drop rate, delay variation, queue size, queue delay, and so on. Among the research analyze, the RED method successfully transmit the information from source to destination by utilizing minimum bandwidth also effective utilization of CPU resource. Hu YanZhang Guangzhao et al.,[8] introducing the SCHOKe active queue management algorithm for solving the bandwidth allocation, buffer congested in the router. The author developed algorithm uses the FIFO queue while transmitting the information from source to destination. In addition to this, the buffer has been stabilized with the help of hit that successfully manages the flow ID in the FIFO queue. Then the efficiency of the system is evaluated in the TCP/IP network with relevant performance scheme. Essam Natsheh et al.,[9] developing the fuzzy active queue management algorithm that uses the drop tail policy for avoiding the congestion also minimize the packet latency. During the information transmission process, the network uses the particular fuzzy logic which examines the packet size as well as buffer space. In addition to this, the author uses the mathematical model for managing the incoming starting time as well as packet dropping rate. This process is repeated continuously until to transmit the information from source to destination without making any packet loss. At last the efficiency of the system is evaluated in terms of using the network performance. Kinjal Vaghela et al.,[10] developing the random early detection method for avoiding the network congestion problem. The method analyzes the packet drop ratio while transmitting the information in the network. Based on the packet ratio, the network congestion notification has been enabled with the help of the explicit congestion notification process. This process reduces the packet loss as well as network failure with effective manner. According to the above discussions, the buffer space has been managed in the wireless sensor network using the random early detection passive proactive prediction queue management technique which is explained as follows.

3. Random Early Detection Passive Proactive Prediction Queue Management Technique

In this section discusses about the random early detection passive proactive prediction queue management process while transmitting the information from source to destination because the existing methods leads to create the packet drop also congestion due to the continuous packet transmission. so, the combined passive, active and proactive queue management process [11] reduces the packet drop as well as avoid the congestion in the mobile adhoc networks. Initially the source node transmit the packet in the network, at the time of transmission, passive queue management process is applied to the network that successfully maintains the status of the queue and with their interface. The interface process holds the packet status as well as schedule the packet with drop tail principle [12]. The method maintains the buffer size and length of the packet while transmitting the information. According to the packet size, the incoming packets are transmitted by the router for reaching the destination. In addition to the passive queue management process, the active management process such as random early detection method has been applied for avoiding the further packet loss. The random early detection method analyzes the incoming packets and computes the average length of the queue [13]. The queue size has been continuously monitored for reducing the packets in between the transaction. The computed queue length is compared with the minimum and maximum threshold value. The threshold value is estimated with the help of the probability values. The probability value is reached the maximum value 1 then, it has been dropped before transmission. The length of the buffer is analyzed by using the prediction queue management process [14] which examines queue length in every second with relevant sampling interval (SI). The queue may contain the larger time intervals which are referred as the prediction interval (PI) that means it contains several sampling intervals. Based on the intervals, the queue length has been computed which helps to transmit the information without making any packet drops. According to the queue length the dropping rate has been determined by using the probability values which is mentioned in above. Along with the probability value, the congestion of the packet is eliminated with the help of the proactive queue management process. The proactive process analyze [15] the state of the TCP of connection for initiating the congestion notification. In addition to the network state, the network bandwidth has been estimated according to the computed probability value and time which is estimated as follows,

$$\boldsymbol{Bandwidth} = \frac{\boldsymbol{MSS*c}}{\boldsymbol{RTT*\sqrt{p}}} \tag{1}$$

In the above eqn (1), MSS is denoted as the maximum queue segmented size, RTT is the time which means round trip time, c is the delayed packet which is varied according to the situation, and p is the packet loss probability value. The estimated bandwidth value is used to analyze the steady state of the packet. The probability value is estimated as follows which is calculated depending on the packet arrival situation.

$$\boldsymbol{p_i} = \left(\frac{\boldsymbol{N*MSS_i*C}}{\boldsymbol{L*RTT_i}}\right)^{\boldsymbol{2}} \tag{2}$$

According to the above eqn (2), the computed probability may be crossed 1 which leads to create the congestion while making the packet transaction due to the consistency. So, the probability computation process is changed as follows,

$$\boldsymbol{p_i} = \boldsymbol{min}\left[\left(\frac{\boldsymbol{N*MSS_i*C}}{\boldsymbol{L*RTT_i}}\right)^{\boldsymbol{2}}\right] \tag{3}$$

The computed $\boldsymbol{p_i}$ value is helps to notify the congestion process also the smaller time value increases the throughput of the entire process also eliminates the packet drop with effective manner. Then the transmitted packets are grouped using the cluster based multipath reliable congestion control protocol for providing the efficient route to reach the destination with successful manner.

Cluster based multipath reliable congestion control protocol

The source node transmitted packets are routed with the help of the Cluster based multipath reliable congestion control protocol [16]. The protocol also maintains the quality of the service by calculating the packet reliability values which is obtained by the neighboring node value. Based on the information, the first route reliability [17] value is estimated which is compared with the required reliability values. The reliability value is calculated as follows,

$$\boldsymbol{R_{path}(i, Dst) = R_{link(i,j)} * R_{path(j,dstt)}} \quad (4)$$

Based on the above process, the path reliability value is estimated in addition to this, link reliability value is calculated as follows,

$$\boldsymbol{R_{link(i,j)} = (1-\alpha)R_{link(i,j)} + \alpha.X_i} \quad (5)$$

After estimating the reliability value of both path and link, the route [18] has been created based on the network fluctuations. For avoiding the network or node failure, the node ID is crated based on the reliability values and probability values. This process is repeated and the minimum number of hops is generated and similar nodes are formed as cluster, with the help of the clusters, packets are transmitted via the path. In addition to this, the multiple paths have been generated to the destination node. Along with this process the node enter into the energy saving mode for save the network lifetime [19] with effective manner. Then the energy strength of the node is computed as follows,

$$\boldsymbol{E_s(AD) = min_{i\in AD}(E_i)} \quad (6)$$

Where, $\boldsymbol{E_s(AD)}$is accumulator energy strength. So, the node has been selected using the energy of the node as well as the link of the node which is estimated as follows,

$$\boldsymbol{C_{uv} = min\{RE_u - E_{tx}, RE_v - E_{rx}\}} \quad (7)$$

In the eqn (7), $\boldsymbol{E_{tx}}$ ***is represented as the***

node transmission cost

$\boldsymbol{E_{rx}}$ ***is the reception cost for node***,
$\boldsymbol{RE_u}$ ***and*** $\boldsymbol{RE_v}$ ***is residual energy***

of the node .

According to the above process the link between the nodes is estimated depending on the energy level, and reliability path values with effective manner also it saves the energy successfully. This process is repeated continuously for estimating the optimal route from source to destination with minimum congestion [20] , packet loss when compared to the other methods. Then the detail step by step procedures is discussed as follows,

Algorithm

Step 1: Initialize the nodes and transmitted nodes in network.
Step 2: Manage the queue status for eliminating the congestion issue
Step 3: Analyzing the incoming packet size and allocate the route for reach the destination.
Step 4: Further packet loss is eliminated by applying random early detection method which computes the average length of the queue.
Step 5: Compare the computed queue length with threshold value which may be maximum or minimum.
Step 6: Threshold value is determined according to the probability value of the network which assign the value as 1 when network reaches the maximum queue size.
Step 7: The queue size is managed continuously in sampling interval (SI) as well as prediction interval (PI)
Step 8: Depending on the queue length, congestion of the packet is examined by using the proactive queue management process.
Step 9: Along with this network bandwidth is computed as follows,

$$\boldsymbol{Bandwidth = \frac{MSS * c}{RTT * \sqrt{p}}}$$

Step 10: In addition to this, probability value is calculated depending on the packet arrival situation as follows,

$$\boldsymbol{p_i = \left(\frac{N * MSS_i * C}{L * RTT_i}\right)^2}$$

Step 11: Further probability value is computed depending on the packet consistency

$$\boldsymbol{p_i = min\left[\left(\frac{N * MSS_i * C}{L * RTT_i}\right)^2\right]}$$

Step 12: Based on the values, transmitted packets are collected and grouped together for making the effective transaction.
Step 13: Then the packet transmission process is done by using Cluster based multipath reliable congestion control protocol
Step 14: During the transmission, quality of the transmission is determined by examining the reliability value which is done as follows,

$$\boldsymbol{R_{path}(i, Dst) = R_{link(i,j)} * R_{path(j,dstt)}}$$

Step 15: After estimating the path reliability, link reliability is computed as follows,

$$\boldsymbol{R_{link(i,j)} = (1-\alpha)R_{link(i,j)} + \alpha.X_i}$$

Step 16: These computed path and link reliability reduces the node failure, network failure and so on.
Step 17: Before making the transaction, the node strength is computed based on the energy which is determined as follows,
$\boldsymbol{E_s(AD) = min_{i\in AD}(E_i)}$
Step 18: Then the node has been selected depending on the transaction metrics,
$\boldsymbol{C_{uv} = min\{RE_u - E_{tx}, RE_v - E_{rx}\}}$
Step 19: based on the above selection, data has been transmitted successfully from source to destination without making the congestion issues.

Based on the above algorithm queue has been managed successfully and the efficiency [21] of the queue management process is explained as follows.

4. Simulation Results

This section analyzing the efficiency of the proposed random early detection passive proactive prediction queue management technique (REDPPPQM) approach. The system has to implement in the NS2 simulation tool which utilize the real bed hospital scenario. The efficiency of the queue management and routing protocol is compared with the existing approaches like Drop Tails (DT) [20] and prediction based queue management scheme (PAQMAN) [21].

Table 1:. Simulation Parameters

Parameters	Values
Simulation Area	250 m2
Number of nodes	250 nodes
MAC	IEEE 802.15.4
Packet size	40 bytes
Transmission rate	250kbps
Frequencies band	420MHz,868MHz, 2.4GHz
Channel mode	Log shadowing wireless model
Evaluation Parameters	Delay, Energy Utilization factor, packet delivery ratio
Simulation time	400sec

Based on the simulation parameters, the effectiveness of the proposed random early detection passive proactive prediction queue management technique (REDPPPQM) system is evaluated in terms of the packet loss ratio, energy utilization factor and packet delivery ratio which is explained as follows.

4.1 Performance Metrics

Packet Loss Ratio

The metric loss ratio is the metric is helps to calculate the number of packets fails to reach the destination with respect to the sending packets.

Energy Utilization Factor

Energy Utilization Factor (EUF) is analyzing the energy consumption of the node while transmitting the information which is estimated as follows,

$$\boldsymbol{EUF = EU/TE \times 100} \quad (8)$$

Packet Delivery Ratio

Packet Delivery Ratio (PDR) is the ratio between the number of packets transmitted successfully to the destination node and the number of packets originated from the sensor node.

$$\boldsymbol{PDR = \frac{No\ of\ packets\ transmitted\ successfully}{No\ of\ packets\ generated} \times 100} \quad (9)$$

4.2 Discussions

Based on the performance metrics, the obtained results are discussed as follows, The table 2 explained that the packet loss ratio of the network at the time of transmitting the information. Thus then proposed random early detection passive proactive prediction queue management technique (REDPPPQM) method consumes minimum packet loss ratio when compared to the other existing methods Drop Tails (DT) and prediction based queue management scheme (PAQMAN). Then the obtained packet loss ratio of different number of nodes is shown in the table 2.

Table 2: Packet loss ratio of 50 nodes

Arrival rate (Mbps)	Packet Loss Ratio		
	DT	PAQMAN	REDPPQM
10	0.06	0.05	0.02
25	0.23	0.24	0.09
35	0.36	0.29	0.17
45	0.41	0.33	0.14
54	0.56	0.45	0.27

According to the above table 2, the REDPPQM method consumes minimum packet loss ratio for 50 nodes (arrival rate 10 has 0.02,25 has 0.09, 35 has 0.17, 45 has 0.14 and 54 has 0.27) when compared to the different methods such as DT (arrival rate 10 has 0.06,25 has 0.23, 35 has 0.36, 45 has 0.41 and 54 has 0.56) and PAQMAN (arrival rate 10 has 0.05,25 has 0.24, 35 has 0.29, 45 has 0.33 and 54 has 0.45). More over the REDPPQM method consumes minimum packet loss while increasing the number of packets upto 250and the obtained packet loss ratio is shown in the table 3 and table 4.

Table 3: Packet loss ratio of 250 nodes

Arrival rate (Mbps)	Packet Loss Ratio		
	DT	PAQMAN	REDPPQM
10	0.11	0.09	0.05
25	0.34	0.30	0.18
35	0.48	0.35	0.22
45	0.59	0.46	0.28
54	0.64	0.51	0.33

According to the above table 3, the REDPPQM method consumes minimum packet loss ratio for 150 nodes (arrival rate 10 has 0.04,25 has 0.11, 35 has 0.18, 45 has 0.21 and 54 has 0.28) when compared to the different methods such as DT (arrival rate 10 has 0.09,25 has 0.31, 35 has 0.42, 45 has 0.54 and 54 has 0.61) and PAQMAN (arrival rate 10 has 0.08,25 has 0.28, 35 has 0.32, 45 has 0.38 and 54 has 0.46). The packet loss ratio rate is further examined by 250 and the obtained value is shown in the table 4.

Table 4: Packet loss ratio of 250 nodes

Arrival rate (Mbps)	Packet Loss Ratio		
	DT	PAQMAN	REDPPQM
10	0.09	0.08	0.04
25	0.31	0.28	0.11
35	0.42	0.32	0.18
45	0.54	0.38	0.21
54	0.61	0.46	0.28

According to the above table 4, the REDPPQM method consumes minimum packet loss ratio for 250 nodes (arrival rate 10 has 0.04, 25 has 0.11, 35 has 0.18, 45 has 0.21 and 54 has 0.28) when compared to the different methods such as DT (arrival rate 10 has 0.08,25 has 0.28, 35 has 0.32, 45 has 0.38 and 54 has 0.46) and PAQMAN (arrival rate 10 has 0.09, 25 has 0.31, 35 has 0.42, 45 has 0.54 and 54 has 0.61). In addition to this, method successfully delivery the packets with high rate which is shown in the figure 1.

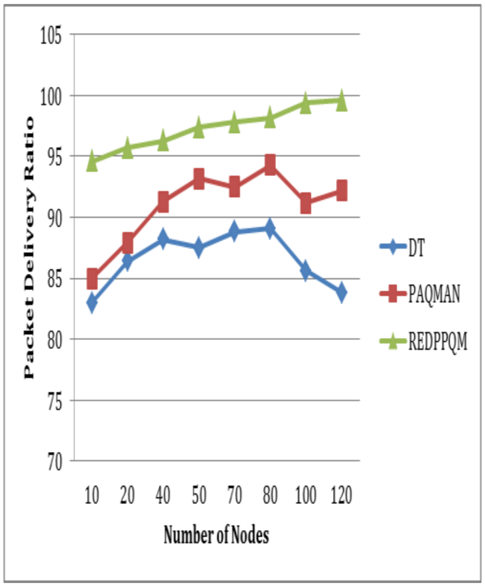

Figure 1: Packet Delivery Ratio

Then the above discussion clearly indicates that the proposed system ensures the high packet delivery ratio which means it successfully transmitting the information from source to destination. Thus the maximum packet delivery ratio has been obtained such as proposed method REDPPQM attains the 99.6%, while DT and PAQMAN attain the 84.2%, 93.2% respectively. Even though the routing protocol successfully transmits the information from source to destination, the energy utilization factor should be considered which is shown in the figure 2. According the graphical representation, the nodes are consumes minimum energy which helps to sustain the life time of the node while transmitting the information from source to destination with effective manner. Thus the proposed system efficiently transmits the patient information via the network with minimum packet loss ratio, minimum energy and cost when compared to other routing methods.

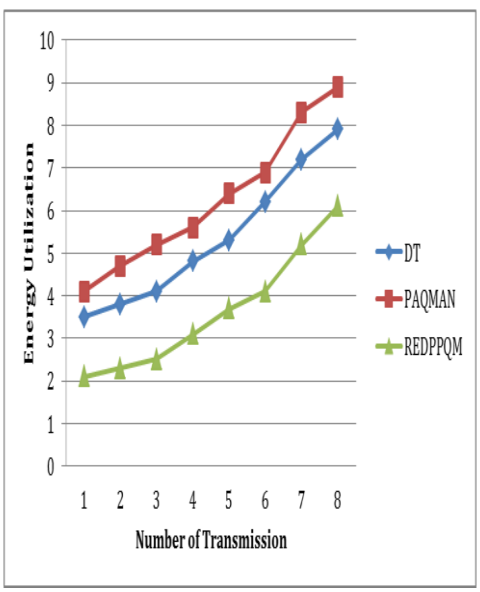

Figure 2: Energy Utilization Factor

Thus the above discussions clearly shows that random early detection passive proactive prediction queue management technique (REDPPPQM) method effectively manages the buffer size also transmit the information with minimum loss ratio for different number of nodes also consumes minimum energy and ensures the high packet delivery ratio successfully.

4. Conclusion

This paper discussing the random early detection passive proactive prediction queue management technique (REDPPPQM) and cluster based multipath reliable congestion control protocol effectively transmit the packets in the mobile ad hoc networks. At the time of transmission, network queue length has been estimated successfully, according to the size of the queue; the probability value of the size is estimated. Depending on the dropping probability values, packets are transmitted in the networks and the routing has been analyzed by using the described protocol. The protocol analyzes the path and link reliability values that are calculated using the neighboring node information. Along with the reliability values, energy of the node is estimated for minimizing the network life time with effective manner. The simulation has been performed with simulation environment containing 250 nodes and the efficiency of the REDPPPQM achieves better results than the DT and PAQMAN in terms of packet delivery ratio, packet loss ratio and energy utilization factor.

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