Design and Simulation of Throughput based QoS MANET Routing for K-color Multiple Packet Reception Devices

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Abstract:

Adhoc network is a self configuring mutually cooperated network of autonomous nodes.
We consider the case of a Mobile Ad-Hoc Network (MANET), with nodes that have multiple packet reception (MPR) capability.MPR is achieved by properly encoding the input signal into phases or segments to obtain better reception. such a segmentation of the incoming signal can be either a series of time-overlapping windows or a non time overlapping window, each to be processed by an algorithm that separates each transmitter signal. In this work we focus on the effect of varying the overlapping length. In this work we addressed the impact caused on the network throughput and on the relative computational complexity when the overlapping-length between consecutive analysis windows is varied, which has not been previously studied.
Further considering Network Throughput obtained through network coding in MPR as a QoS parameter for route discovery, we obtain the best path which is proved to provide better result in termns of throughput, Packet delivery ratio and control overhead.

Key words: Mobile Ad-Hoc Network(MANET), Multiple Packet Reception(MPR), Throughput, packet delivery ratio, control overhead.

1.Introduction

The wireless mobile ad hoc network (MANET) has shown to be a promising communication network to satisfy actual needs in terms of distributed functions and reliable performance [1]. In recent years there have been several proposals to improve the throughput in a MANET, which basically can be divided into two main categories. First, those which provide multiple packet reception (MPR) capability via a MAC layer protocol. Second, those which provide it via a signal processing (SP) algorithm operating at the PHY layer (additionally there are some hybrid proposals) [2]. We are interested in the proposals which make use of SP because of its flexibility. Some MPR-SP algorithms segment the received signal into time windows to be analyzed window-by-window (limiting the memory amount requirements and the amount of data to be processed) [3], [4]. Each window is processed using SP algorithms to resolve possible collisions of two or more data packets located in the same analysis window. In[4] the analysis windows are treated as non-overlapping time slots (it also assumes that the packet position within the window is known) and uses the known modulus algorithm(KMA) to separate one user from the others (with different modulation). Meanwhile in [3] the windows are allowed to overlap in time with no packet synchronization assumed, and modulation by polynomial phase sequences (PPS) is used to distinguish users. In [3] each node in a MANET uses a code selected at random from a finite-length codebook (shared by all the nodes in the network) to modulate the data packet to be transmitted. The PPS gives the packet a characteristic *color code* which is used to differentiate it from other transmitted packets. The analysis is limited only to the case when the overlapping length is equal to the data packet length1. This paper focuses on other values of the overlapping length. It is shown that an increase in the value of this parameter beyond the packet length can lead to an increase in the network throughput.

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position within the window is known) and uses the known modulus algorithm(KMA) to separate one user from the others (with different modulation). the windows are allowed to overlap in time with no packet synchronization assumed, and modulation by polynomial phase sequences is used to distinguish users[4].
The need for multiple access protocols arises not only in communications systems but also in many other systems such as a computer system, a storage facility or a server of any kind, where a resource is shared (and thus accessed) by a number of independent users[5].

From this paper, I have taken a new algorithm that provides multiple packet reception capability in wireless asynchronous *ad hoc* networks. We use a modulation induced cyclostationarity (MIC) approach similar to those used in, but in our case, the baseband data sequence is modulated by a polynomial phase sequence (PPS). This can be viewed as introducing a watermark in the desired signal or as a color code[6].

MPR can be achieved, provided some form of diversity is available [7], and can be obtained using antenna arrays (possible at both transmitter and receiver) that allow the system to exploit the spatial separation (space diversity) of the differentusers[7].

A special form of MPR is found in the capture phenomena (power diversity) that occurs when a strong user can be successfully received even when a collision occurs, provided the ratio between the combined powers of the interference and that of the strongest user is below a certain threshold . Spread spectrum code division multiple access(code diversity [CDMA]) is another form of diversity useful to resolve collisions and achieve multiple packet reception [6],[8].

1.1 MPR (Multiple Packet Reception)

MPR concept is fundamentally a recent trend in MANET. With the introduction of 4G and other Hybrid Network, MANET incorporates many different nodes from different networks. Therefore nodes are capable of handling different types of wireless signal with different channel capacity and bandwidth. The different signals either work with different physical wavelength or the same wavelength is divided over time or frequency sharing mode. In order to simplify our discussion, we assume that MPR is a capability by means of which a node can handle different signals with different antenna but only one at a time. We assume that our network is comprising of nodes where each node is a MPR node.

1 Present System

As discussed earlier in chapter 1, Multiple packet reception is ideally the capability of any node to receive packets with different encoding. Each node can tune it's receiver to receive packets upto K-Colors where each color signifies either an independent physical signal modulation depth or a network level packet encoding.

Such a network is new and conventional MANET algorithms can not handle MPR appropriately. The closest algorithm for handling multi color packets is color tree routing. But color tree routing only deals with allocating a different color to the route level and at any given instance of time a node can decode a packet of only a particular type of color. Hence such a algorithm works in transmitting packets of a particular color level rather than multiple color packets.

The other conventional algorithm like AODV assumes that all the nodes can handle all the colors at any given instance of time. Therefore the route obtained are shortest path. Further if the system is build over D color scheme and the nodes are K-Color receiver than in such a network K<D. Therefore AODV fails to produce best throughput.

3. Proposed System

First of all, we suppose there is a MANET with n nodes, which intend to communicate with
each other. Let us point out the main features of this model:

A1) Each node may transmit whenever it is necessary (i.e. the packet arrivals in any receiver will be asynchronous). Then it waits the duration of one analysis window before the transmission of the next data packet is allowed to occur, this increases the probability of a successful packet-decoding.

A2) The data packet length for all nodes in the network is constant and equal to J symbols; each symbol exhibits a duration of T seconds (i.e. the data packet time duration is JT).

A3) To separate one transmission from the others, each node in the network will use the same D-sized codebook of color codes. Once the node determines its need to transmit, it selects a color code at random from the codebook, and uses this to generate a sequence that modulates the data to be transmitted.

A4) In order to introduce another diversity level, the receiver uses a K-antenna array.

A5) The receiver also needs some algorithm to be able to decode the incoming signal and determine its data packets content; i.e., it must be capable of differentiate two packets with different color codes. Assuming *P* active nodes transmitting, the packet content arriving to a node will look like that shown in Fig. .

The way to approach A5 above, is to process the packets in a window by window fashion. This will allow the receiver to process only a small number of samples at a time, requiring only a small amount of memory in the receiver.

The analysis window length V is set to be N times the data packet length, i.e. V=NJ. If the window length is increased, the number of packets in the window will increase, and the possibility of having more than one packet with the same color code will also increase, which will lead to a decreased probability of successfully packet-decoding. The idea of mantaining a window by window analysis is motivated by the complexity required by the equalizer, due to the nature of the SP algorithms that are used to separate the D virtual channels from the received signal.

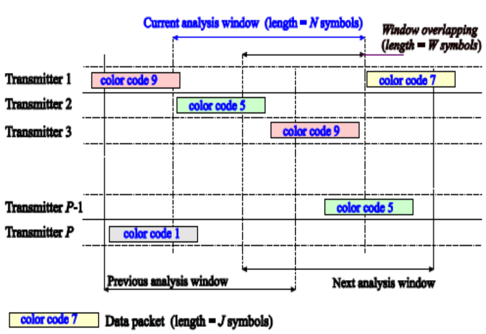

Fig: packet model with windows length and overlapping

4. Methodology

1. Declare an array of D colours(Unique number).
2. Declare a window W=5.
3. Transmitter can transmit a data of a particular color and can receive the data of another color. Reception of different colors can be over non overlapping or overlapping window.

4. 1st data from the queue is transmitted directly.
   Next data will be hold for next analysis window.
   Data will be encoded with random colours by every node.
   Receiver can receive K data with distinct colours.
5. If more than 1 data is received by a receiver with same colour then some of the repeated data Will be dropped.
6. Throughput is measured as total load (No. of. packets /sec*No. of. packets successfully decoded By receiver).
7. At each window calculate THROUGHPUT.
8. Find the route of maximum throughput nodes to show that overall throughput of the path is High.

5. Algorithm

Actor Source

Actor Destination

participant Intermediate1

participant Intermediate2

Source -> Intermediate1: RREQ(Color)

Intermediate1->Intermediate1: Calculate Throughput

Intermediate1 -> Intermediate2 : RREQ (Color,TP1)

Intermediate1 -> Destination : RREQ(TP1)

Intermediate2 -> Intermediate2 : Calc Throughput

Intermediate2 -> Destination : RREQ(Color,TP2)

Intermediate2->Destination : RREQ(Color,TP1+TP2)

if TP HIGH of a RREQ

Destination ->> Source: RREP

else failed

Destination ->> Destination: Drop RREQ

end

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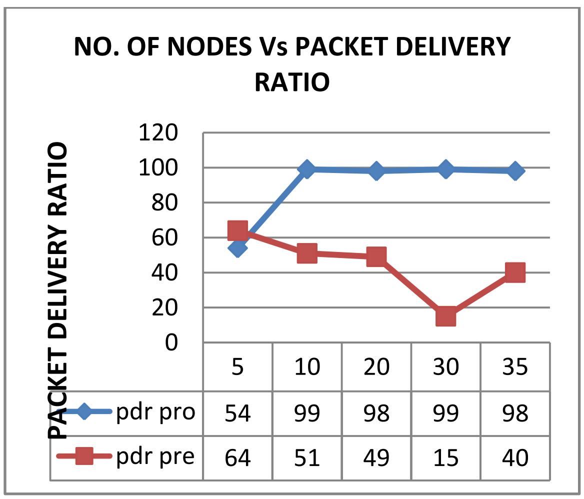
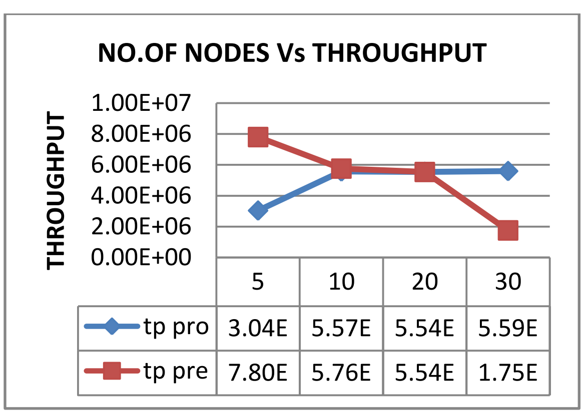
Destination --> Intermediate2: RREP

6. RESULTS AND DISCUSSION

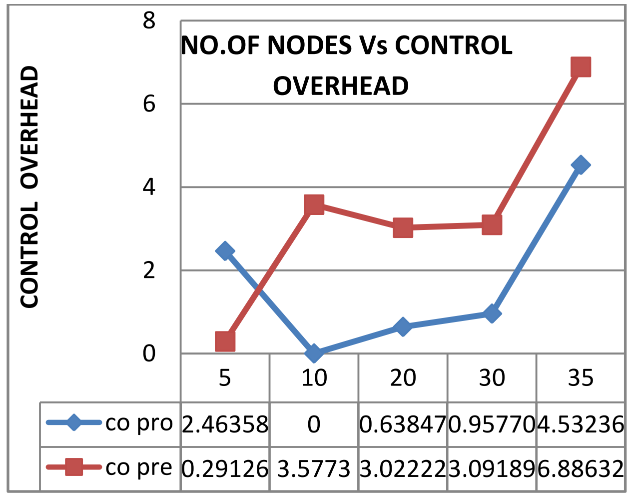
The simulation carried out for k-color multiple packet reception based on QOS MANET with the routing layer along with the present system by varying nodes ranging from 10 to 50 nodes for a period of 1000 sec in express mode and fixing the pause time for 122sec. we assume the throughput(Mbps), Packet Delivery Ratio(%), Control Overhead and latency in (sec) . Now we shall compare each and every simulation parameters for both the present and proposed system, this can be achieved by plotting the graphs for each parameters.



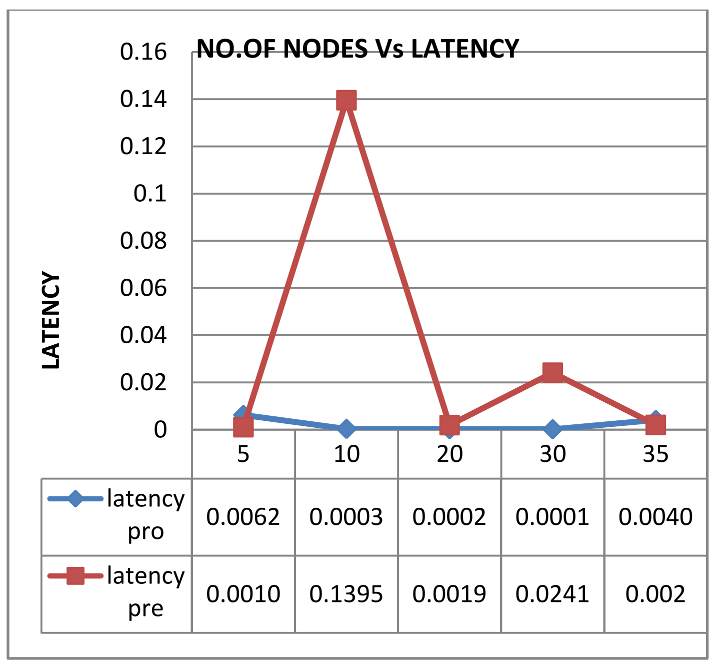
From the graph it is clear that the proposed system has a steady packet delivery ratio when it is compared with the present system throughout the node density ranging from 5 nodes to 35 nodes. This is because of the fact that the source selects the path which has high throughput with a color code.



When we consider the node density ranging from 5 nodes to 35 nodes for understanding the throughput, the proposed system has a better throughput compared with the present system.

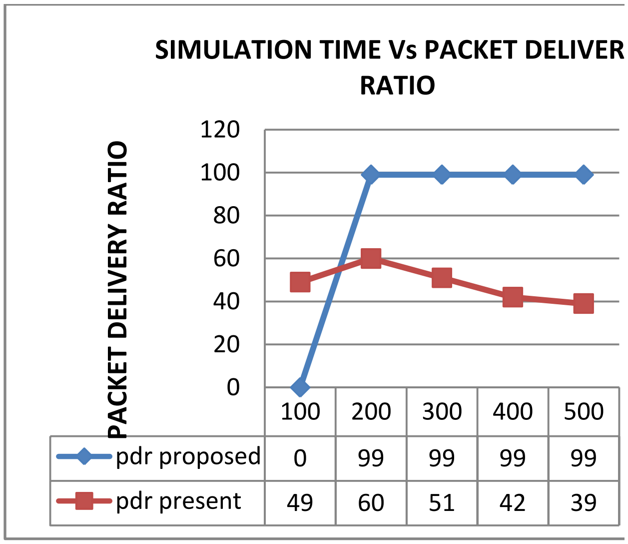


From the above graph we can say that the control overhead of the proposed technique is much lesser than the present technique.



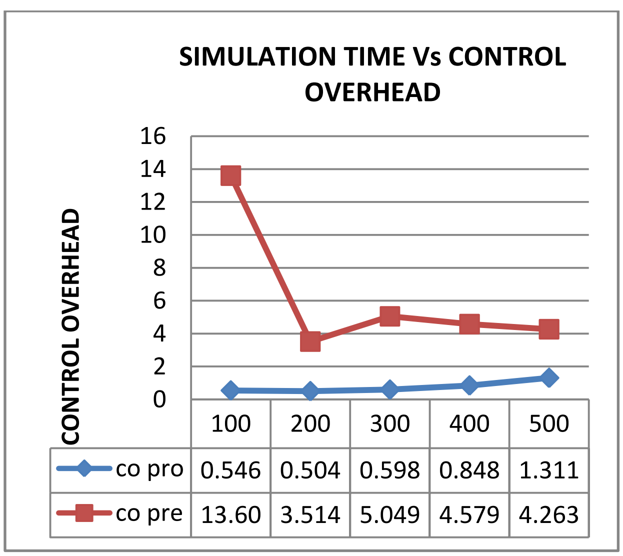
The above graphs shows that the proposed system out performs the present system in terms of latency. This behavior is more noticeable when the number of nodes increases.

The simulation is carried out for the proposed system along with the present system by varying simulation time ranging from 100 to 500, fixing nodes as 10 for a period of 1000 sec in express mode and fixing the pause time for 122 sec. We measure the throughput (Mbps), packet delivery ratio (%), control overhead and latency (sec). Now we shall compare each and every simulation parameter for both the present and proposed system, this can be achieved by plotting the graph for each parameter.



	100	200	300	400	500
pdr proposed	0	99	99	99	99
pdr present	49	60	51	42	39

When we consider the simulation time ranging from 100 sec to 500sec for understanding the packet delivery ratio, the proposed system has a better packet delivery ratio compared to present system.



	100	200	300	400	500
co pro	0.546	0.504	0.598	0.848	1.311
co pre	13.60	3.514	5.049	4.579	4.263

From the above graph we can say that the control overhead of the proposed technique is much lesser than the present technique.

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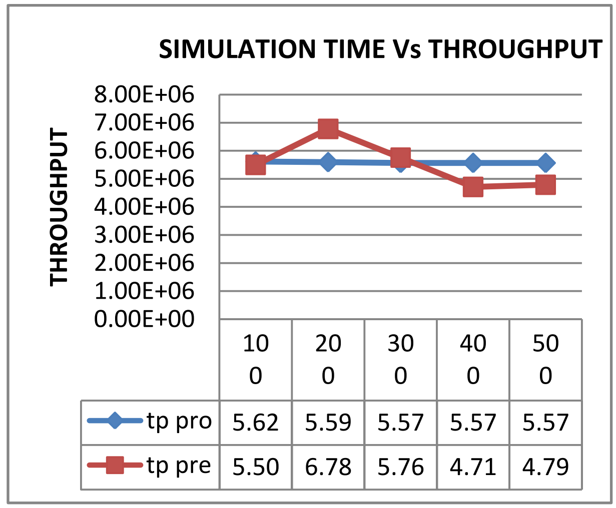
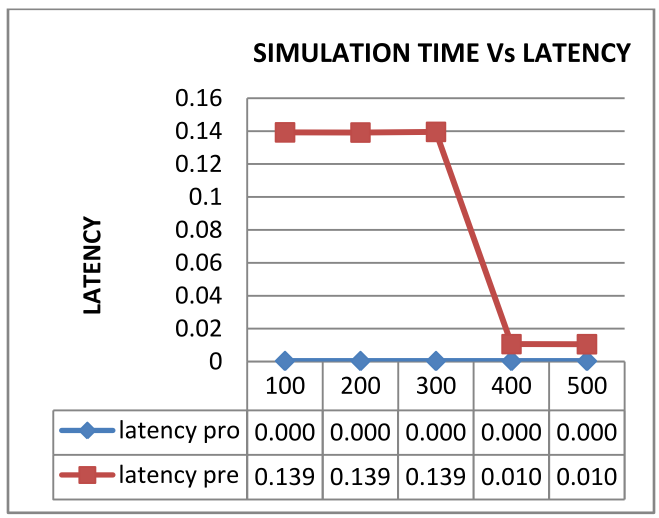


	100	200	300	400	500
tp pro	5.62	5.59	5.57	5.57	5.57
tp pre	5.50	6.78	5.76	4.71	4.79

When we consider the simulation time ranging from 100 sec to 500sec for understanding the throughput, the proposed system has a better throughput compared to present system.



	100	200	300	400	500
latency pro	0.000	0.000	0.000	0.000	0.000
latency pre	0.139	0.139	0.139	0.010	0.010

When we consider the simulation time ranging from 100 sec to 500sec for understanding the latency, the proposed system has a lesser latency compared to present system.

ANALYSIS AND DISCUSSION

The performance of the proposed system is better than the system that does not incorporate throughput information in the routing. This is due to the fact that the proposed system depends upon incorporating throughput of the node which is calculated over a period of time as successful packet decoding probability. As throughput is the measure of channel capacity, higher throughput signifies better resource availability in the nodes. Therefore this ultimately results in better throughput and longer lifetime of the routes.

This results in more longevity of the routes over period of time. Therefore number of control packets required for maintaining the routes is reduced. This results in better control overhead. Due to sustained transmission over a period of time, rerouting and retransmission issues are reduced. This results in better latency performance for the proposed system.

When number of nodes increases, more nodes are available for routing. But at the same time channel is shared between many a nodes. Hence congestion creeps into the network. But as the proposed system relies on resolving the congestion through analyzing the throughput, this performs better in terms of both packet delivery ration and latency in comparison to present system.

As the packet delivery ratio of the proposed system along with latency is better in proposed system, it results in better throughput.

Therefore we can say that the proposed system is better than the present system.

7. Conclusion and Future Work

Adhoc network has eveolved from a simple data communication network to hybrid network and various types of traffic with different rate from different wireless channels are handled by the nodes. Therefore there are many devices which can receive and process D wireless signal simultaneously. For example a laptop can be configured in a Bluetooth or a Wifi or a GPRS based Adhoc network.

In such a network, analyzing and identifying the t nodes that are best suited for the data transmission are difficult. Few algorithms have tried to provide solution for such problems through color encoding schemes.

But Such Solutions do not take into account of QoS aspect. In this work we have presented an innovative design for MPR MANET with color decoding scheme and taken throughput analysis in routing. Results show that the system performance is much better than AODV in high traffic or in congestion scenerio.

The system can be further updated with intelligent decision making by the nodes where by a node can switch between different color decoding based on the traffic demand.

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