Mitigation of packets drop ratio using stochastic modeling in MANET

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Abstract

The growth in wireless adhoc network has inspired academicians, researchers and scientist's community to make MANET more reliable and promising network. Considering the aspect, we have developed a queueing model for manet which mitigate the packet drop and enhance QoS of the network. As packet dropping is one of the major security issue in Mobile Ad hoc Network. Therefore, this paper we mitigate the blocking packet dropping probability which resulted good performance of the MANET.

Keywords: Mobile Ad hoc Network (MANET), Quality of Service (QoS), Packet Drop Probability (PDP), Protocols.

1. Introduction

Wireless ad hoc network is one of the category of wireless networks which operates without the support of any fixed infrastructure. In this network nodes not only acts as hosts but also as routers which forwards data packets. Due to its self-organizing behavior ad hoc networks are mainly used in military applications, emergency operations and disaster recoveries. There are following crucial characteristics of this network mentioned below

1 Addressing scheme

The addressing scheme adopted by such network is quite important. A varying network topology requires a ubiquitous addressing scheme, which supposed to avoid the duplicate addresses in MANET. Mobile IP is presently being prevalent in cellular networks where a base station is responsible to handle the entire node's addressing [1].

2 Network size

Applications like data sharing in virtual classrooms, meetings, conference halls, etc. are very important features of this kind of networks. Though, the delay involved in the underlying network puts a strict upper bound on the size of the network.

3 Security

Security always remains a prime concern of MNs' deployment situation like battlefield, emergency rescue operation. The three basic goals of security are confidentiality, integrity and authenticity. These are very tedious to achieve because every node in the network is movable and participates equally in the network [2].

Again, as far as security is concern, it has been a paramount concern in case of MANET due to its intrinsic vulnerabilities. These vulnerabilities are found in the structure of MANET which is very difficult to get eliminated [3-5]. The attacks with malicious motives have been devised to use these vulnerabilities and to cripple MANET operations. The research in this area will continue be extremely active and imaginative to

enable faster, richer, less costly and more flexible communications. Wireless networks are taking the dominant position due to coverage of location difficult to wire, to satisfy the requirement of mobility and ad hoc networking.

2. Background of research

We have reviewed various queueing model in the literature and investigated how the how the queueing models are used for measuring various parameters [6,7].

A MANET is a set of independent self-governing nodes that converse over wireless links with one another by making a multi hop network, forming connectivity among them in a non-fixed infrastructure way. Due to its easiness and popularity, tactical communication as well as pursuit of interest in this sort of networks continues to cultivate. In this kind of network every node is able to serve the purpose of a source (transmitting data) and a destination system or also the router. The mobile nodes are highly movable in nature and generally leave the domain of the other nodes without any restrictions in the network. That's why, fostering connectivity among nodes is very tedious to achieve.

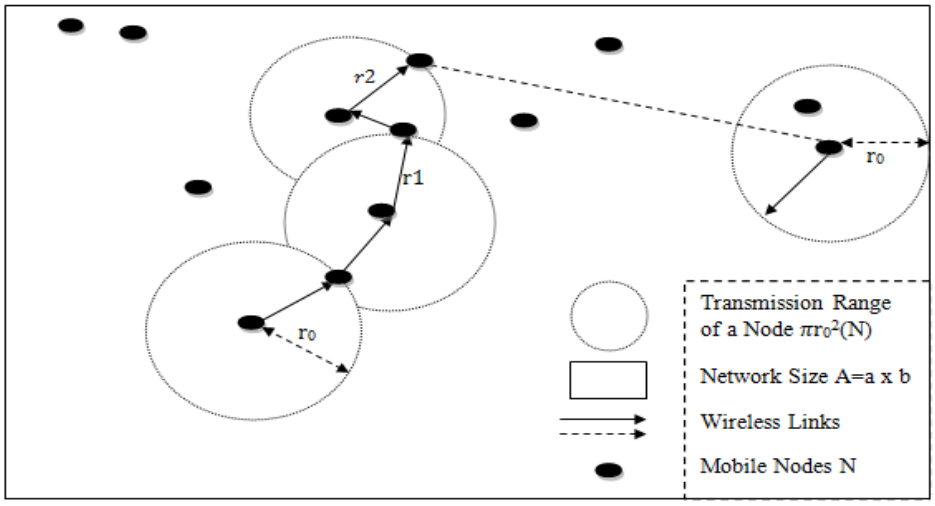

Figure 1: A Typical Mobile Ad hoc Network

Generally, Performance analysis in MANET is estimated by two ways either analytical modelling or by simulation. Simulation refers to a method for implementing a model over time and is usually considered expensive with respect of process as well as computational time. However, analytical modelling means to develop a mathematical model of a system behavior that represents performance in ideal condition. Essential characteristic and much of system behaviors can be abstracted by developing a mathematical model. Therefore, this is very attention-grabbing factor for the researcher to construct a queueing theory based analytical model Our key objective in the paper is to determine the queueing delay and the response time when data is transmitted between the nodes in MANET.

Queueing systems with server vacations and break down are studied in [8,9]. The work can be referred for extensive and deep surveys on queueing systems with vacation. In [10], the authors studied an M/G/1 queue with second optional service and server breakdown and examined the M/G/1 queue with constant repeated attempts and server vacations in which the server operates under a general exhaustive service vacation policy. With the growth of potential use of MANETs, a lot of research is being focused on providing QoS provision in many ways in order to deliver better results. This section gives a summarized overview of various research work undertaken previously in the field of providing QoS aware capabilities in Mobile Ad-hoc Networks.

Rest of the paper is organised as follows. Section 2 briefly introduces the model description. Section 3 presents the evaluation of proposed mathematical model to calculate queueing delay and response time. Section 4 presents the results. Finally section 5 gives conclusion of this contribution.

3. **Blocking probability at a node**

Blocking probability is the chance that a packet will be denied service due to the unavailability of space in the node's queue. A blocking probability of 0.01 means 1% of packets will be denied service. It should be as low as possible. It is represented at a time when the queue is full. Since each node has a single queue of the finite buffer size K. Therefore, the nodes have the capacity to conserve maximum K packets that are served in FCFS discipline. This probability of rejection P_K of an incoming packet that sees the queue full at any node in MANET is given by [11,12],

$$P_K = P_0 \frac{\rho^K}{c!c^{K-c}} \quad (12)$$

If the total number of packets is no more than number of number of nodes the packets are served without waiting in queue. Simulation model for MMCKK model is drawn in figure 2.

Therefore,

$$P_K = \frac{\rho^K}{c!c^{K-c}} \left[\frac{1}{\sum_{n=0}^{c} \left(\frac{K}{n}\right)\rho^n + \sum_{n=c+1}^{k} \frac{!K}{!K-n\ !C\ C^{n-c}}\ \rho^n} \right] \quad (13)$$

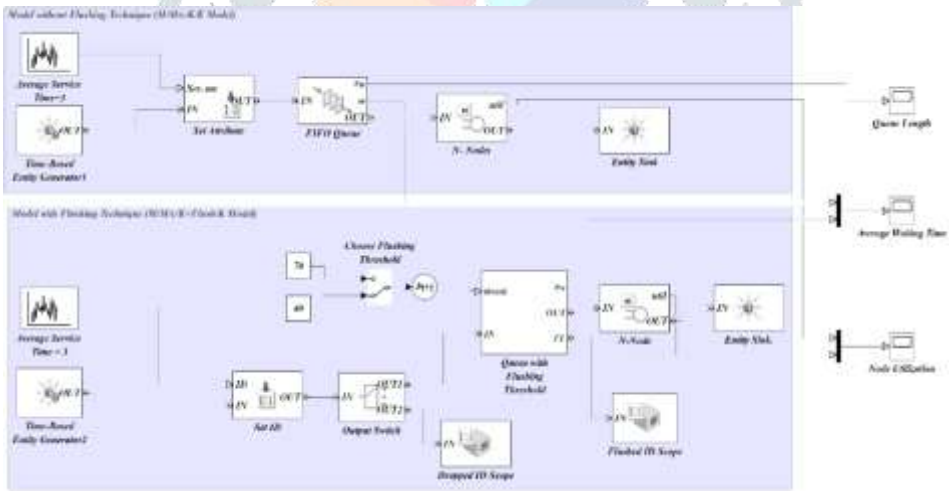

Figure 2: Simulation Model for MMCKK

The parameters taken for the implementation of this model is shown in Table 1 where network is made for 50 nodes with simulation time 200 seconds. Table 1 gives the network parameters values used in the analysis and simulations.

Table 1: Simulation Parameters

Parameter	Value
Arrival Rate distribution	Poisson
Service Rate distribution	Exponentially Distributed
Simulation Time	200 sec
Queue Capacity	150 packets

Traffic Generator	CBR
Threshold Upper	90
Threshold Lower	40
Packet Size	512 byte
Number of Nodes	50

1. Simulation Results and Observation

The performance of proposed M/M/c/K/K queueing model is evaluated using MATLAB [13,14]. Analytical results are shown by simulations which shows better outcomes. In figure 3, buffer capacity is compared between traditional and proposed M/M/c/K/K queueing model.

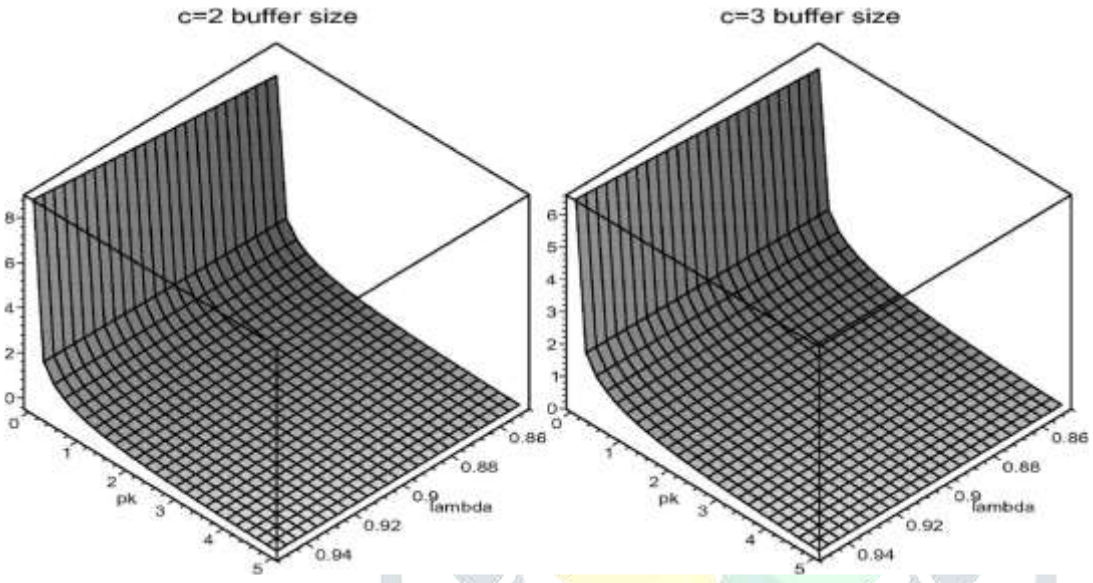

Figure 3: Closed form expression for M/M/C/K where C=3 and C=4

In figure 4, capabilities of the three routing protocol are studied with an objective to evaluate more reliable performance of DSR, AODV and DSDV protocols in the same simulation environment (25 to 200 mobile nodes). Simulations results are collected from a total of 60 scenarios of the three protocols. Performance metrics are calculated from trace file, with the help of this model. The simulation results are shown in the form of line graphs. Graphs show comparison between the three protocols by varying different numbers of sources.

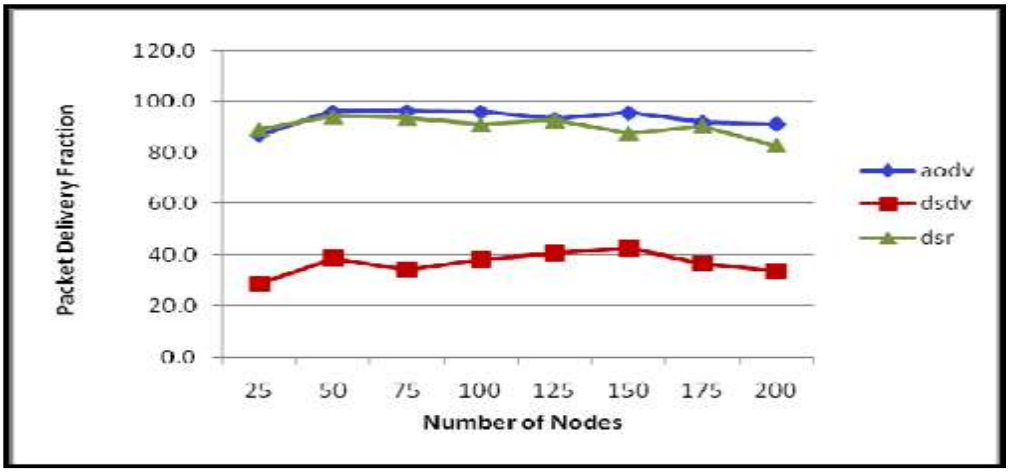

Figure 4: Packet drop fraction Vs. Number of Node

4. Conclusion

We have estimated an approximation to the blocking probability of *M/M/c/K* model for adhoc network. The closed form expression for the blocking probability of the M/M/c/K model is quite optimal buffer formula in comparison with simulation and well-known established results. Mobility feature may be captured during detection of packet drop in MANET.

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