Simulation of Traffic Management Mechanism in Mobile Ad hoc Network

Ms. Pritam Hatwar
Student of M. E. Electronics & Telecommunication

Prof. A. O. Vyas
Faculty of Electronics & Telecommunication
Department of Electronics & Telecommunication Engineering
G.H.Raisoni College of Engineering, Amravati, Maharashtra.

Abstract

Mobile devices and connectivity through mobile networks are growing at an increasing rate. Next generation mobile networks are not only used for cellular phone applications, but they are carrying different types of traffic like voice, video, and data. Call admission control(CAC) algorithm helps to regulate traffic which improves the performance by increasing the utilization of network capacity. Users of next generation networks expect a Quality of Service (QoS) depending on their application and service contracts.The proposed design will be applicable to any network generation and adhoc network by just changing the parameters according to the system need. The proposed design will define the CAC algorithm, which will balance therequest blocking and dropping in order to reduce the network congestion. Handoff request will be given higher precedence over a new request in the cell whenever there will be the inadequate bandwidth in the cell. QoS for Mobile Adhoc network will get improve by minimizing the probability of new request blocking and probability of handoff request dropping during rush hours in the network.Traffic management mechanism will be simulated and tested using MATLAB.

1.Introduction

The Mobile adhoc network (MANET) aims to provide integrated applications such as voice, data and real-time interactive multimedia such as email, video chat, video conferencing via inexpensive low-powered mobile computing devices over wireless infrastructures. To support various integrated applications with certain quality of service (QoS) requirement in the MANET, managing traffic is a major issue. The purpose of Quality of Service (QoS) term is to provide services to the end user with assurance in terms of delay in service, bandwidth allocation, voice quality, signal quality, etc. Due to the congestion during rush hours in the network there is a need of traffic management mechanism to avoid blocking.

The call admission control(CAC) is the traffic management mechanism which controls the admission of new request in the network. Here request means a signal which is carrying any type of data like voice, video, or multimedia data. Managing resources in the network is also the responsibility of CAC. Call admission control (CAC) is the practice or process of regulating traffic volume in voice communications, particularly in wireless mobile networks and in VoIP (voice over Internet Protocol, also known as Internet telephony). Call admission control can also be used to ensure, or maintain, a certain level of audio quality in voice communications networks, or a certain level of performance in Internet nodes and servers where VoIP traffic exists. Most CAC algorithms work by regulating the total utilized bandwidth, the total number of request, or the total number of packets or data bits passing a specific point per unit time. If a defined boundaryvalueis reached or exceeded, a new request may be prohibited from entering the network until at least one current request satisfied. Alternatively, a graceful degradation methodology can be implemented.

2. Literature Survey

In [1] CAC protocol depending on degrading the quality of existing calls, according to their degradation priority, by reducing the bandwidth allocated to them in order to accommodate new calls according to their admission priority. This protocol depends on borrowing bandwidth from connections that can afford some performance degradation in order to admit new users to the network. This strategy can be useful to increase the revenue of company. But due to degrading the required bandwidth, the quality of service is reduced.

3.Traffic Management Mechanism

Traffic management mechanism manage theentry of active users in the network by calladmission. It manages the operation of thenetwork in such a way that ensuresuninterrupted service provision, andaccommodates in an optimal way newconnection requests. AdmissionControl estimates whether a new usershould have access to the system withoutspoiling the basic requirements ofongoing users in the network. Admission control gives admission to the new user without degrading the performance of the existing users. Thus proficient and effectiveAdmission Control is crucial for the capacity and the performance of the network. Traffic management mechanism which implements admission control algorithm is called Interrupt Precedence mechanism.

In this mechanism, precedence is given to ongoing requests rather than accepting new requests in the cell.The Mechanism works as follows:

Firstly the threshold is defined depending on maximumnumber of users that a cell can accommodates. If the number of on-going requestsin a cell exceeds a threshold value and a newrequest arrives, then in that casenew request will be blocked; otherwise it will beadmitted.

The handoff request is rejected only when allchannels in the cell are busy in servingon-going requests.This technique has been analyzed in many papers, and analytical results for request blocking probabilities are obtained under the assumption that the average new request channel holding time and average handoff request channel holding time are equal so that one-dimensional Markov chain theory can be used. But when the average channel holding times for bothtype ofrequest are different, the approach will not work [18]. Thus, the one-dimensional Markov chain model for some new call bounding scheme, the assumption of equally distributed new and handoff requests are may not be appropriate; the multidimensional Markov chain may be needed to get expected simulation result.

The multidimensional Markov chain theory could solve the problem when the average channel holding times are different for both streams. However, dimensionality gives birth to another problem. As observed in research of multidimensional Markov chain modeling, the state's dimension increases very rapidly. Hence it will be desirable to study some approximate solutions to evade solving a large set of balance equations. It is also a observation in the literature [18] that the peculiarity between channel holding times for new request and handoff request is not made. We can find the average channel holding time for cell traffic (the combined traffic of new request and handoff request), use this parameter to form the exponential distribution to approximate the channel holding-time distribution, and then apply the one-dimensional Markov chain model to find the call blocking probabilities.

Parameters defined in the system are as follows:

- C - No. of channels in the cell.
- t - Threshold for the Interrupt precedence mechanism.
- λ - The arrival rate of new request.
- λ_h - The arrival rate of handoff request.
- $1/\mu$ - Average channel holding time for new request.
- $1/\mu_h$ - Average channel holding time for handoff request.
- ρ - Traffic intensity of new request.
- ρ_h - Traffic intensity of Handoff request.

The two-dimensional Markov chain is used to model the system. Let (r_1, r_2) denote the state, where r_1 and r_2 denote the number of new requests and handoff requests in the cell, respectively. In transition diagram the state changes in two cases, first when a new request gets serviced then the state changes to a next state in vertical direction. Second, when a handoff call request gets serviced then the state changes to a next state in horizontal direction.Following are the transition sates:

$q(r_1,r_2: r_1 -1,r_2)= r_1\ \mu(0 <r_1 \leq t,\ 0 \leq r_1+ r_2 \leq C\ )$
$q(r_1,r_2: r_1 +1,r_2)= \lambda(s0 <r_1 \leq t,\ 0 \leq r_1+ r_2 \leq t\ )$
$q(r_1,r_2: r_1 ,r_2-1)= r_2\ \mu_h(0 <r_1 \leq t,\ 0 \leq r_1+ r_2 \leq C\ )$
$q(r_1,r_2: r_1,r_2+1)= \lambda_h(0 <r_1 \leq t,\ 0 \leq r_1+ r_2 \leq C\ )$

It is observed that in some states, such as those when $r_1+ r_2> t$, then the stream no longer have the symmetric nature.

To find the steady-state probability distribution $p(r_1,r_2)$,solving balance equation may be computationally difficult when the state dimension is large.
To solve this computational problem we use approximation in which we attempt to reduce the two-dimensional Markov chain model to the one-dimensional Markov chain model by normalizing the average service time for each flow so that the average service time becomes equal for both streams [20]. Then one-dimensional Markov chain model is used to find the request blocking probabilities.
By normalizing the average service time to unity, the arriving traffic for that stream will be scaled appropriately. This normalization process does not change the traffic intensity. Hopefully, the resulting blocking probability can be approximated[13].
The new request and handoff request arrival stream is Poisson with arrival rate ρ and ρ_h respectively, with their service rate equals unity. Let P^a_i denote the probability that there are i busy channels in steady state for the approximate model where variable i can take maximum value as C i.e. total no. of channels in cell. Then, the following stationary distribution for the approximate model is obtained:

$$P_i^a = \begin{cases} \dfrac{(\rho+\rho_h)^i}{i!} P_o & ,i \le t \\ \dfrac{(\rho+\rho_h)^t \rho_h^{i-t}}{i!} P_0 & ,t+1 \le i \le C \end{cases}$$

where,

$$P_0^a = \left[\sum_{i=0}^{t} \frac{(\rho+\rho_h)^i}{i!} + \sum_{i=t+1}^{C} \frac{(\rho+\rho_h)^t \rho_h^{i-t}}{i!} \right]^{-1}$$

From this stationary distribution, the blocking probabilities are obtained for new requests as follows

$$\text{New request blocking probability} = \frac{\text{No. of blocked requests}}{\text{Total no. of requests}}$$

$$p_{nb}^a = \frac{\sum_{i=t}^{C} \frac{(\rho+\rho_h)^t \rho_h^{i-t}}{i!}}{\sum_{i=0}^{t} \frac{(\rho+\rho_h)^i}{i!} + \sum_{i=t+1}^{C} \frac{(\rho+\rho_h)^t \rho_h^{i-t}}{i!}}$$

And handoff requests blocking probability is given by

$$p_{hb}^a = \frac{\frac{(\rho+\rho_h)^t \rho_h^{C-t}}{C!}}{\sum_{i=0}^{t} \frac{(\rho+\rho_h)^i}{i!} + \sum_{i=t+1}^{C} \frac{(\rho+\rho_h)^t \rho_h^{i-t}}{t!}}$$

These equations are used to approximate the request blocking probability of the new requests and handoff requests for the Interrupt Precedence mechanism.

4. Flow Chart

The simulation model can be described using flow chart as shown in figure 1.
Initially new request will be generated in the cell, the new request would be granted for admission if the total number of ongoing requests value less than the threshold value and also if the channel would be available in that cell. Once the new request will be received in the system, distance and velocity of that session would be updated. And also the other parameters like Locations and signal strength of the accepted request would be checked for every moment and accordingly updated. If signal strength of the previously accepted signal will be less than handoff threshold value and channel will be existing in the target cell, then handoff this request from source cell to target cell, otherwise handoff request will be blocked. The traffic management mechanism will give precedence to the handoff request over new request whenever there will be inadequate bandwidth in the cell.
In this way the new request blocking probability and handoff request dropping probability will be minimized.

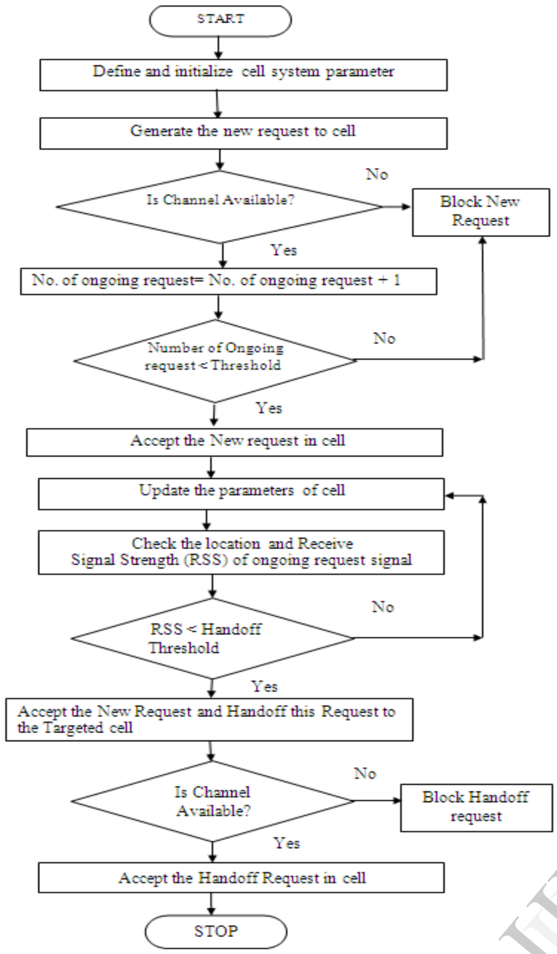

Figure1.Flow Chart for Traffic Management Mechanism

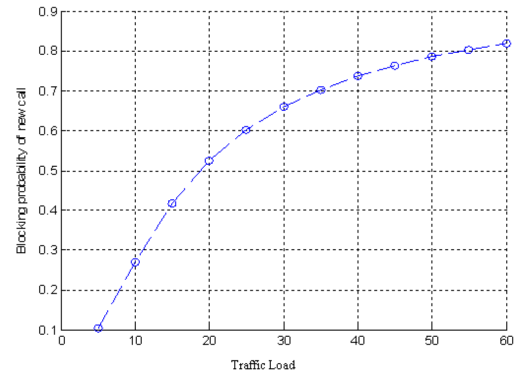

Figure 2. Graph of Blocking probability of new request against Traffic Load

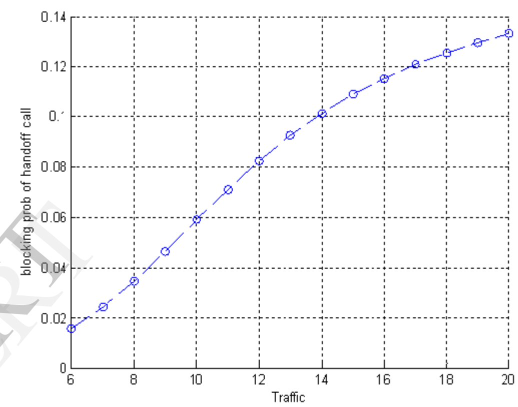

Figure 3. Graph of Blocking probability of Handoff Request against Traffic Load

5.Simulation Result

Following are the assumed values for the parameters.

- Channel Capacity C=30
- Cell Radius = 2000 meters
- New request traffic intensity ρ = 6 to 20
- Handoff traffic intensity ρ_h=10
- Threshold t=26
- Total Average Traffic ($\rho+\rho_h$) = 6 to 60
- Each requestrequires only one channel for giving service.

- Distance between two hop = 20 meter

Above figure 2 and figure 3shows that handoff request dropping probability isminimum as compared to the new requestblocking probability.

6. Conclusion

In this paper, we propose the Interrupt precedence traffic management mechanism which reduces the blocking during rush hours.

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