Performance Analysis using Call Threshold CAC Scheme for MANET in Wireless MAN

Uttam D. Kolekar, Shrikant Bodhe and Deepak C. Karia

Abstract: **Mobile Ad Hoc network (MANET) is a collection of wireless nodes that can dynamically be set up anywhere and any time without using any pre-existing networking infrastructure. Call Admission Control (CAC) is a key element in the provision of guaranteed quality of service (QoS) in MANET. In this paper, call threshold CAC scheme is developed for MANET Wireless MAN (WiMax). Analytical results for some performance metrics such as New request blocking probability and handoff request blocking probability are obtained under some specific assumptions. Simulation is carried out for low traffic-low mobility, high traffic-low mobility, low traffic-high mobility, and high traffic-high mobility. Simulation results are obtained using MATLAB 7.0.**

Index Terms: **New request blocking probability, Call Admission Control, handoff request blocking probability, MANET, resource allocation.**

I. Introduction

WiMax (World-wide Interoperability for Microwave Access), standardized to IEEE 802.16, is a Wireless Broadband Access standard. It defines air interface specifications for Wireless Metropolitan Area Networks (MANs). This broadband access is set up using WiMax base stations (BS), just like the cellular base stations, servicing a radius of several kilometers. The end user connects to the base station, which then routes the signals via standard Ethernet cable either directly to a single computer, or to an 802.11 hot spot or a wired Ethernet LAN.

It was envisioned initially to supply the missing link for the 'last mile' connection in wireless MANs, supplying High-Bandwidth Internet Connectivity to markets that are un-served by wire line broadband services, such as cable or DSL. Such an application of 802.16 is called 'fixed access'. The user terminal is essentially immobile.

BS thus reducing service cost. 802.16a can be implemented for fixed access. Its NLOS advantage can be better appreciated with a Wi-Fi hotspot. Consider a Subscriber Set (SS) currently docked and connected to its local Wi-Fi hotspot now needs to roam in the area, which is close to hotspot, but not in its range. The SS with 802.16a capabilities can talk to its WiMax BS, which then routes the data to the local hotspot thereby increasing the range of hotspot. The feature works for mobility but at pedestrian speeds. This is 'portability with simple mobility' access. It also involves support to nomadic users who need to access network from different places but are stationary during connection. The next level of functionality results when extending the attributes of WiMax to 'fully mobile' access. Full mobility is standardized to 802.16e that provides broadband access at vehicular speeds of 120 Km/Hr or even more. So a subscriber set is now mobile (MSS) traversing across networks during connection. Thus, a notebook embedded with 802.16e capabilities could connect via Ethernet or 802.11 when docked and stay connected with 802.16 when roaming in city [1][2].

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II.CALL THRESHOLD CAC SCHEME FOR MANET IN WIRELESS MAN (WIMAX)

The wireless MAN that uses Base Stations (BSs) for communication is used to analyze the performance of multihop ad hoc network. When mobile terminal isn't able to communicate with any BSs, it uses other terminals as reference nodes (RNs). The handoff criteria are based on absolute and relative signal strengths. The relation between CAC criteria and performance criteria are investigated when both the mobile terminal and the reference nodes are moving.

There are two circumstances are used in wireless MANs 1) when base stations is not needed, but reference nodes (RNs) are used which is fixed or mobile; and 2) when base stations are used to connect conventional wired MANs [4].

The multihop-based wireless MAN has a strong advantage in that each terminal can move freely. The movement of mobile terminals, however, has to be tracked in order to ensure that multihop communication is carried out without disconnection. Several attempts have been made to develop CAC algorithms to get better QoS [5]. In the case of large-scale networks, such as networks using both wire and wireless in many cities, it is difficult for conventional algorithms to continue communication when mobile terminals are moved from one place to other place. This requires the development of algorithms that includes CAC functions for wireless MANs [3].

In this scheme, the admission of new requests from mobile node is limited into the MANETs. The scheme works as follows: *if the number of new* requests from mobile node *in a service area exceeds a threshold when a new* request from mobile node *arrives, the new* requests from mobile node *will be blocked; otherwise it will be admitted. The handoff* request from mobile node is *rejected only when all channels are used up*. The idea behind this scheme is that it is better to continue on going requests from mobile node rather than to accept new customers in the future, because customers are more sensitive to requests from mobile node dropping than to requests from mobile node blocking.

A. Network Model

Figure 1 illustrates the network architecture of WMAN. This network consists of two BSs and pair of reference nodes (RNs), which act as Terminal Repeaters separated by distance D. A mobile node terminal *mt* moves from RN1 to RN2 in straight line with constant velocity. Each TR performs relay between the mobile terminal *mt* and the BS in the range capable of communication. Although the BSs don't move, the TR's between them move in straight line randomly.

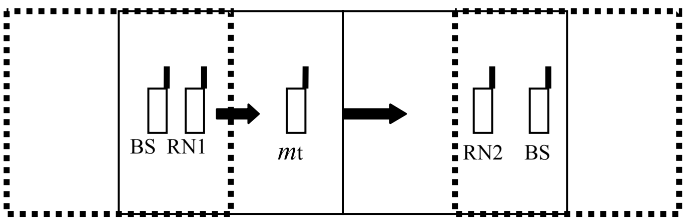

Fig. 1. Network Architecture for MANET in WMAN

B. Simulation Model and Analysis

Simulation is based on MANETs, which consist of 25 RNs. Each RN has a radio range of radius 2000m. The service area of one RN is 4000m x 4000m. At any time each mobile can communicate with all nodes within its transmission range.

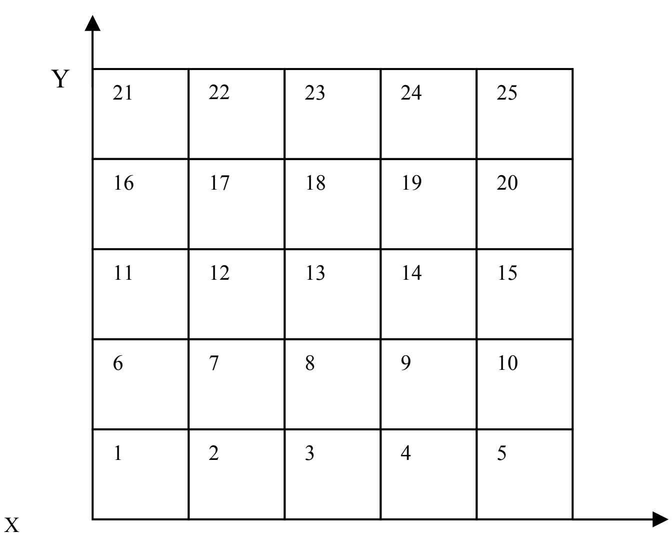

Fig. 2. Simulated Model for MANET in WMAN

It is assumed that the top RNs service area (RNs 21,22,23,24 and 25) and the bottoms RNs service area (RNs 1,2,3,4 and 5) are connected. That is if a user comes out of 21 from top, he will come in to RN1. Analogously, it is assumed that the left RN (RNs 1, 6, 11, 16 and 21) and right RNs (RNs 5,10,15,20 and 25) are connected too.

Assume that RN is at the center of service area. This service area is referred as cell. The handoff threshold can be set at any distance between cell-center to receive-threshold. The area between handoff-threshold and receive-threshold is called handoff area (shaded area of figure 3). The handoff threshold is set to – 45.

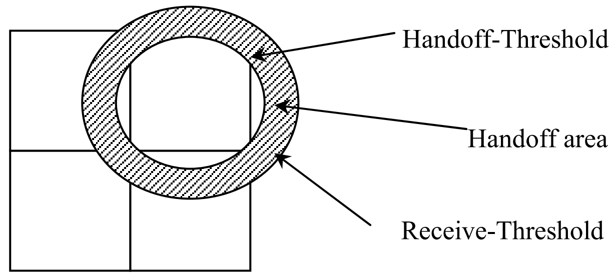

Fig. 3. Handoff Threshold and Receive Threshold.

The moving speed is uniformly distributed between 10 to 50 m/sec for low mobility and for High mobility it is 60 to 100 m/sec. The numbers of requests generated by mobile node are 10000. The signal strength is checked for the distance between 0.01 and 2*R. Where R is radius of radio range of RN.

C. Radio Propagation Model

Radio propagation is influenced by the path loss depending on the distance, shadowing, and multipath fading. The relationship between the transmitted power and received power can be expressed as

$$P(r) = 10^{\xi/10}.r^{-\alpha}.P_0$$

Where, P(r) is the received power; P_0 is the transmitted power, r is the distance from the reference to mobile node, ξ in decibels has a normal distribution with zero mean and standard deviation of σ (typical value of 8 dB). The 30 and 60 channels are used for simulation.
The user mobility pattern is described as follows:

When a new call request is generated, the moving direction of the mobile users is set by random variable, which is chosen from uniform distribution on the interval as shown table I

TABLE I
MOVING DIRECTIONS FOR MANET IN WLAN

Random Number (0-1)	Direction
0 - 0.25	Target service area of RN is North RN
0.25 – 0.5	Target service area of RN is East RN
0.5 –0.75	Target service area of RN is South RN
0.75 - 1	Target service area of RN is West cell

The user's location and RSS is monitored at every second. Following assumptions are made for simulation:

1. Each service area of RN has *C=60 and 120* channels.
2. Service area of RNs radius = *2000 m.*
3. Arrival of new requests from mobile node initiating in each service area of RN forms a Poisson process with rate λ .
4. Threshold for new call *K=125*
5. Each request from mobile node requires only one channel for service.
6. Arrival rate of new requests from mobile node and handoff requests from mobile node $\lambda = \lambda_h$=30.
7. μ_h = 1/400, and μ is varying from 1/600 to 1/200.
8. Traffic = 1 to 10.

Initially requests from mobile node is generated in the service area of RN, once a new requests from mobile node is admitted into the network, lifetime of this requests from mobile node is selected according to its distribution and then total number of new requests from mobile node is estimated. If new requests from mobile node are less than threshold, request from mobile node is accepted otherwise it is blocked. Once the requests from mobile node is accepted the parameters of requests from mobile node are updated and signal strength is checked, if signal strength is less than handoff threshold, at the same time if channel is available, handoff request is accepted otherwise it is blocked. Thus new blocking probability and handoff blocking probability is evaluated.

Simulation is carried out for Low traffic (10:10:50) Low mobility (0:25), High traffic (60:10:100) Low mobility (0:25), Low traffic (10:10:50) High mobility (25:50) and High traffic (60:10:100) High mobility (25:50) scenarios. Figure 5 shows the new call blocking probability of threshold scheme. The numbers of channels are increased from 60 to 120. It is observed that number that as numbers of channels is increased blocking probability is decreased.

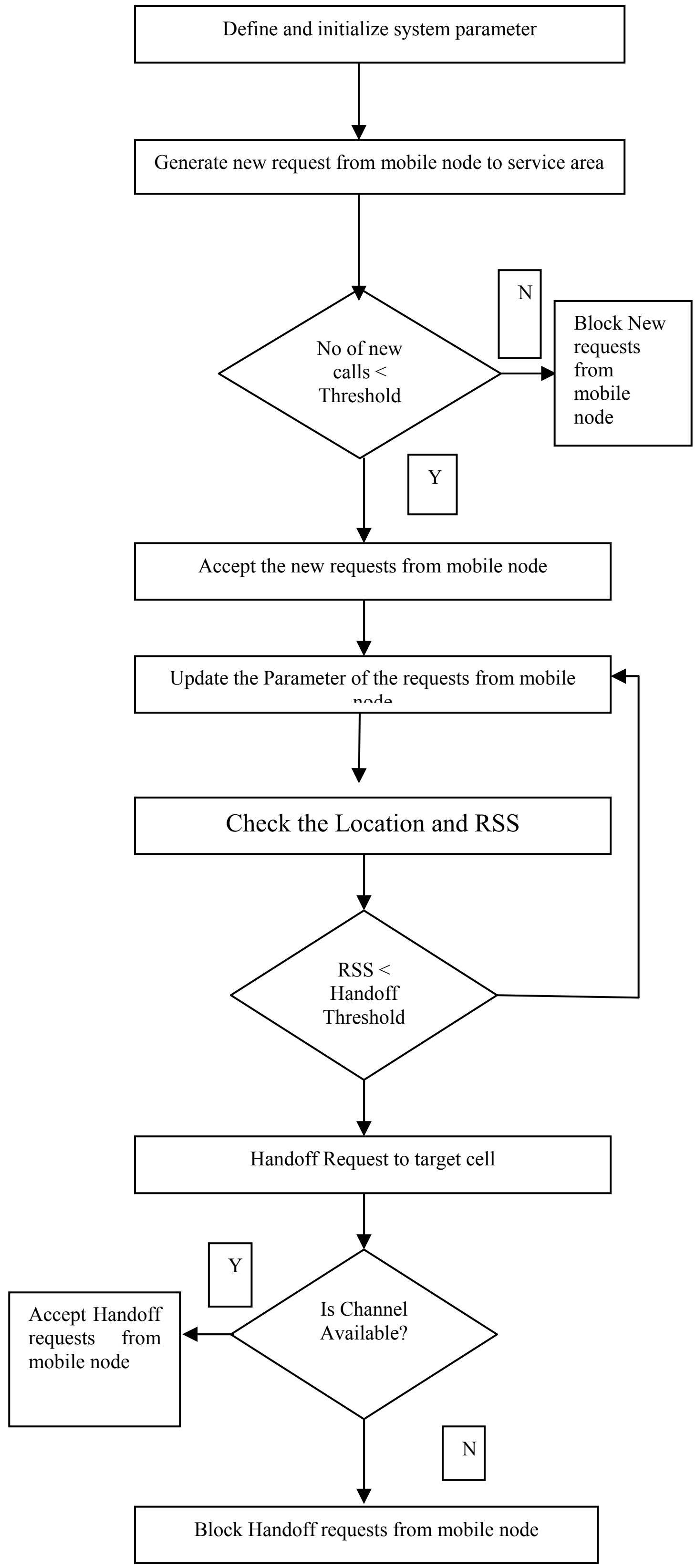

Fig. 4. Flow Chart for call Threshold Scheme for MANET in WMAN

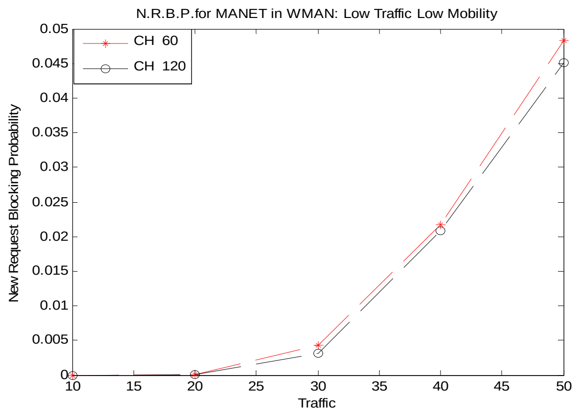

Fig 5. New Request Blocking Probability for Low Traffic-Low Mobility.

Figure 6 shows the handoff request blocking probability of MANET. It is found that as numbers of channels are increased, the handoff blocking probability is decreased.

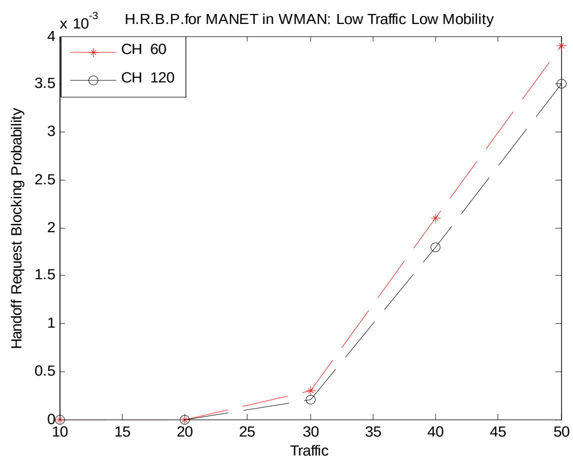

Fig. 6. Handoff Request Blocking Probability for Low Traffic Low Mobility

Figure 7 and 8 shows that new call blocking and handoff call blocking for high traffic Low mobility both are decreased as numbers of channels are increased.

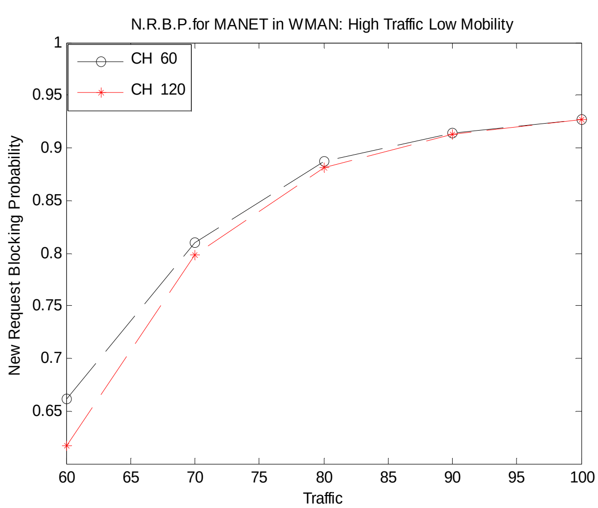

Fig. 7.New Request Blocking Probability for High Traffic Low Mobility

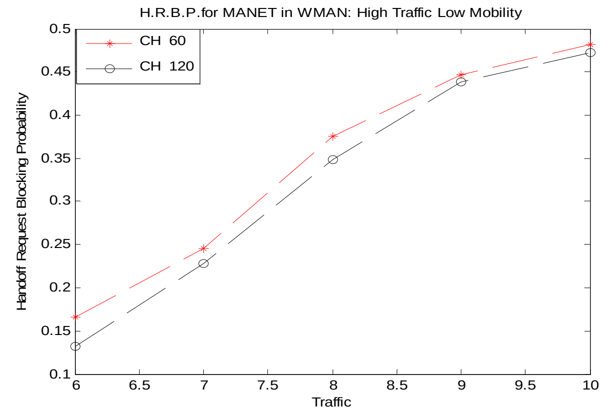

Fig. 8.Handoff Request Blocking Probability for High Traffic Low Mobility

Figure 9 and 10 shows that even by increasing number of channels, the system performance are improved as expected.

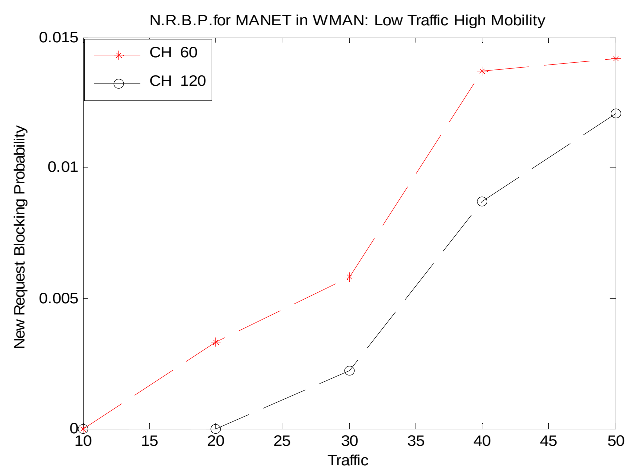

Fig. 9. New Request Blocking Probability for Low Traffic High Mobility

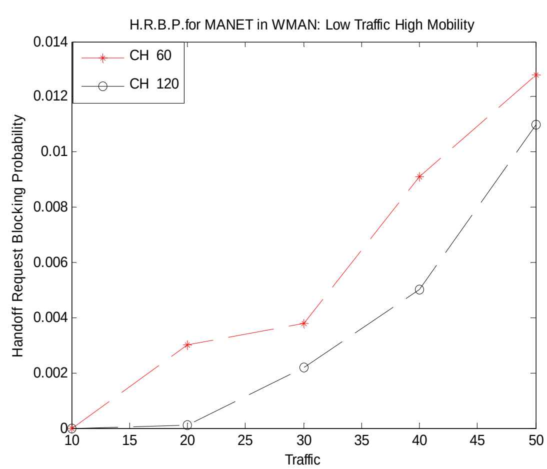

Fig. 10. Handoff Request Blocking Probability for Low Traffic High Mobility

Figure 11 and 12 shows that blocking probability and handoff probability is increased very high which is not practical.

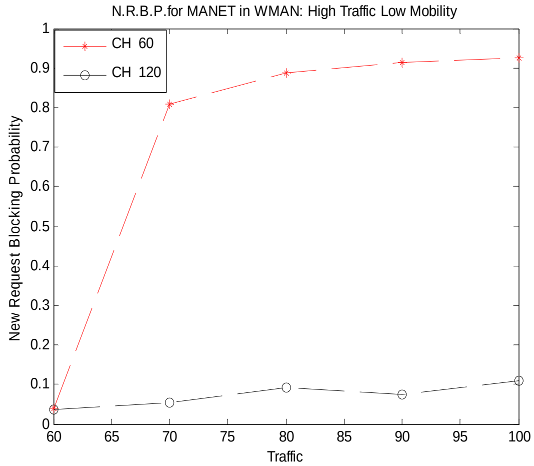

Fig. 11. New Request Blocking Probability for High Traffic High Mobility

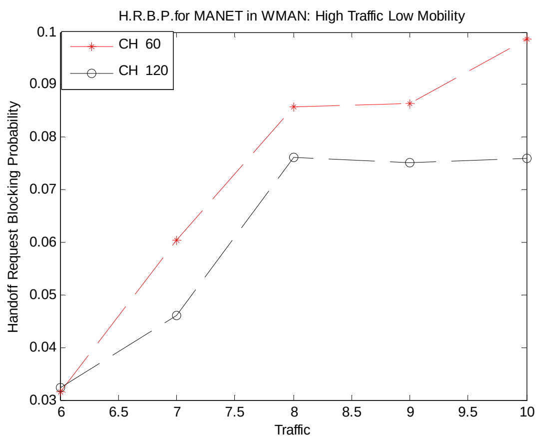

Fig. 12. Handoff Request Blocking Probability for High Traffic High Mobility

III. CONCLUSION

Call Threshold CAC scheme is analyzed and simulated for MANET in WMAN; from the result it is concluded that the call threshold scheme works best when the traffic is heavy. When a large number of requests from mobile node arrive in a service area of reference node, if too many new requests from mobile node accepted, the network may not be able to handle the resulting handoff traffic, which will lead to severe call dropping.

IV. REFERENCES

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V. BIOGRAPHIES

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