# K-Connection Maintenance Algorithm for Balanced Routing In Mobile Ad Hoc Networks

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## *Abstract*

*In this paper we propose a connection balanced routing in mobile ad-hoc networks (MANETs) using backbone update messages. Virtual-Backbone (VB) construction is very familiar, to overcome broadcast storm problem in wireless networks. In real time, during the movement of nodes in MANET, more number of nodes added in a particular node (say a VB node), it leads poor quality of service in multi-hop wireless environment. To overcome this problem connection balanced is required; in terms of reduction of nodes attachment in a backbone node and attach these nodes with new VB, to maintain connectivity. Most load balancing routing (LBR) protocols are based on reactive routing and evaluate the routes by weight, which depends on the traffic load information collected by each intermediate nodes. The collection of data for load information from all the nodes creates more delay and processing time, leads to extra overhead and result in performance degradation. Existing research works deals with construction of virtual backbone only, no one give the solution for connection overhead problem. To overcome this we propose a localized algorithm to support reducing the number of connection and maintain these connections by nearby VB nodes or identify the new VB for maintain the k-connections.our results are witnessed by simulation.*

## *Key words*

*Connection Balanced Routing (CBR), Virtual Backbone (VB), Mobile Routing Protocols (MRP), Mobile Ad Hoc Networks (MANETs), Load Balanced Routing (LBR), Quality of Service Routing (QOS-R).*

## 1. Introduction:

In wireless communication, there are two access methods: infrastructure mode and ad-hoc mode. In ad-hoc mode there is no centralized device. All stations, or nodes, operate in a peer-to-peer mode, and they compete for the shared wireless channel. In this way, they are able to communicate with each other. Send the information from source to destination more numbers of routing protocols are proposed, namely pro-active protocols, re-active protocols, the hybrid protocols and these protocols based on flooding. To overcome this problem Virtual Backbones (VB) [1] [2] are proposed and only a few numbers of nodes perform the routing function. But assume the situations that, more number of nodes are adding with one backbone node during the movement. The backbones not able to support and maintain routing information between nodes, because all the nodes including the backbone node connected via one or two hop distance. Such type of VB construction in MANET [3] is concentrated by the researchers in simulations; practically this approach is not possible. Currently, multi-hop wireless routing protocols fail to provide good quality of service, especially in the presence of a large number of connections concentrating on some nodes. These effects result in poor packet delivery, long packet latency, high signal interference and high routing overhead. Most of the existing load balancing protocols adjust the routes [4] dynamically to balance the traffic load based on the knowledge of current load distribution, or [5] use multi-path routing to share the traffic equally to different nodes or path, which introduces much additional overhead.

Most load balancing routing protocols are evaluate the routes by weights, which depend on the traffic load information collected by each intermediate nodes. We call this kind of load balancing routing protocols as load aware based routing. Dynamic Load-Aware Routing (DLAR) [6], protocols is the example of this category. Dynamic Source Routing [7] inherently supports multi-path routing by allowing caching of multiple paths.Multi-paths routing between any source-destination pair of nodes has been studied thoroughly in the context of wired networks. The general understanding is that dividing the traffic flow among a number of paths (instead of using a single path) results in a better balancing of load throughout the network [8] [9].However, [10] showed unless using a very large number of paths the load distribution is almost the same as single path routing. Performance evaluation of our protocol with DSR [11] [12] for delay and AODV [13] [14] for throughput analysis, because both have the same property in terms routing decision. Unlike the entire above load balancing routing protocols, some of the routing protocol focus on balancing the load for the whole network without knowing the current load [15] information. Our proposed CBR-VB routing protocol also falls into this category. To discover a simple but efficient load balancing routing technique, we propose a algorithm to balance the connection without the knowledge of load information and no additional communication overhead.

The remainder of this paper is organized as follows. In Section 2, give the assumptions and network model. In Section.3 we give the new approach to CBR-VB. In section 4, we give the K-Connection Maintenance Procedure.Section.5 simulation results are analyzed. Finally, Section.6 concludes the paper.

## 2. Assumptions and Network Model:

We consider a wireless network consists of a set V of wireless nodes distributed in a unit disk graph. The maximum transmission range for a VB node is different from Non-VB nodes. These wireless nodes form a graph, in which there is an edge between two VB nodes if and only two nodes are connected with one hop (i.e., these two VB nodes can always receive the signal from each other directly). Hereafter, we always assume the network is a connected graph. We also assume that all VB nodes are able to provide efficient communication to N nodes. We assume that an individual node does not know the current load and each node may want to talk with one hop VB nodes. We then address how to design load balancing routing for Non-VB to VB communication scenario in a network in which every pair of nodes in the network has unit message to communicate.

## 3. Our Approach: Connection Balanced Routing (CBR-VB)

Similar to the classical greedy routing, our CBR-VB Routing protocol just forwards the packet to the neighbor. Notice that each node only needs to know its neighbors' positions (exactly one hop) to make the routing decision. The detailed routing algorithm is given in section 3.1 and the flow diagram given in Figure 1.the following steps are required to achieve the balanced routing in Virtual environments. Steps to be followed;

1. VB creation
2. Allow k-connection for each VB
3. VB reserves one VB for R-VB (reserved VB for alternate routing)
4. Indicate the New VB (one hop node-may be an R-VB)
5. Connection maintained and routing table updated by VB.

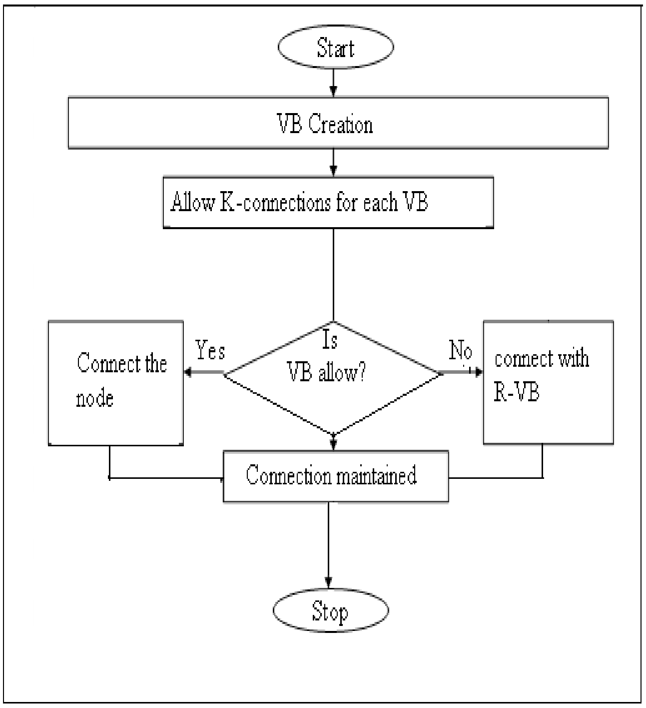


Figure.1 Connection Balancing in VB

### 3.1 CBR-VB Algorithm 1:

1: For each neighbor v, node u (VB) maintains one hop position of v in the unit disk graph.
Node u also send it location information to Non-VB (u).
2: while node u receives a packet with destination t do
3: if u and t ≤ Tr, where Tr is the transmission range and VB < K connections then
4: Forward the packet to t directly and return.
5: Map t to its routing table and update this information to one hop R-VB.
6: if, then
7: Forward packet to destination via destination VB.
8: else
9: Simply drop the connections.

The above algorithm states that following procedures are required to achieve connection balancing multipath networks.

1. Construct the backbone
2. Connect the VB nodes
3. Perform the routing via VB node
4. Allow only k-connections for each VB, as route failure occurs Reserved-VB provides the alternate route.(R-VB must be connected one hop from originating VB and having higher transmission power. The number connections (K) will be determined based on the number of nodes in the network. The entire process of Load balancing via virtual backbone is given by the following figure 1.

### 3.2 VB Constructions and Connections:

Let a directed graph G= (V, E) represent a network, where V contains all nodes in the network and E represent links between nodes. Construction of VB [12][13] has two stage as follows:1) construct dominating set S 2) connect all the VB nodes. For each iteration we find a

VB node u, which has high transmission range. The algorithm terminates V=0, because no edges in the graph.

**Algorithm 2** Find a VB.
1. INPUT: A directed DG G= (V, E)
2. OUTPUT: A VB S
3. S-Set of nodes form VB
4. **While** V>1do
5.     Find non edge nodes in V
6.     Subtract the nodes with G
7.     Connect DS
8. **end while**
9. Return S

Initially VB is constructed using the above mentioned algorithm. In this way only half of the network involved in routing. During the node movement k-connections are permitted to connect VB nodes and VB check if more than k-connections, it indicate a new R-VB (Reserved VB). R-VB is one hop distance from the originating VB and has a high transmission power among one hop neighbors.

### 4. K-Connection Maintenance Procedure:

For maintain N connections the following procedure must be follow by VB node in the network.

**Algorithm 3** k=N connection maintenance.
**1: VB** periodically send the number of connection information to all the one hop nodes.
**2:** one hop nodes send their attachment to other VB details to originating VB.
**3: if** k=7 (3 rd case), VB reserved one R-VB for Upcoming connection request **then**
**4:** **if** k=N **then** (all VB nodes are connected)
**5:** share the connection between one hop R-VB (k=3or 5)
**6:** **else** (k>5, balance routing is not sufficient)
**7:** connect the node to best neighbor
**8:** **end if**
**9: end if**

The updating of connection balancing is done locally between the VB and other nodes. In this way all local computation supports connection balancing routing in the network.

## 5. Simulation Results:

For our simulation, we use the network simulator NS 2.30. Here we perform two set of simulation one is compare our result with [12] [13] conventional routing protocols like DSR and AODV. The DSR and VB have the same property in terms routing decision. In this dynamic topology employing the random waypoint (RWP) model, 90 nodes with an initial power of 40 and the transmitting range 150m are randomly positioned in a grid sized 900m*900m.The packet size is set to 256 bytes and the power consumed in transmitting and receiving a packet is set 0.4 and 0.2 respectively. The simulation runs for 250 seconds. The performance metrics which are used for evaluating the performance of each routing protocol based on throughput at which the first node in the network dies. Secondly we compare our load balancing algorithm with shortest-widest path algorithm [9]. It finds a set of paths with most available bandwidth (the widest paths), and then selects the shortest one among them. Here also we present two sets of simulation results in which we compare our balancing algorithm with balance index and connection blocking rate.

In the first set, we study performance of MANET in various speed levels and the result is displayed in Figure 2.In the second set, we show load balancing performance by comparing balance indices. In this case, Protocols are evaluated with ad hoc network topologies consisting of 90 wireless nodes, moving about in a rectangular space. The simulation time is 900 s for each run. Each run of the protocol is characterized by a pause time. At the start of the simulation, each node remains stationary for pause time seconds. Then, each node selects a destination from the rectangular space randomly, and starts moving towards the target with a speed uniformly distributed between 0 and a maximum speed of 20 m per second. In both cases, we generate more Non-VB connections in 1000x1000m$^2$ ns-2 simulators for a desired number of loads N and offered load (L). Comparison of connection blocking rate is given in Figure 3.

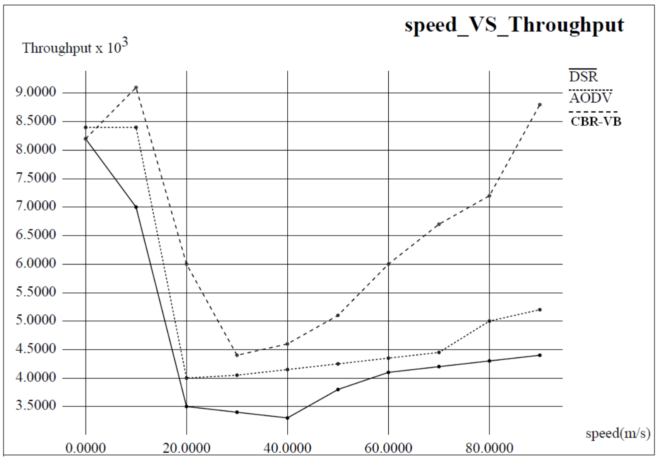


Figure.2 Throughput under various speeds

We use the same parameters used in shortest-widest path algorithm [9]. First, sizes of the N connections are chosen randomly, and the loads are placed at N random Non-VB nodes. The capacity of the Backbone node is set to the sum of connections divided by L.

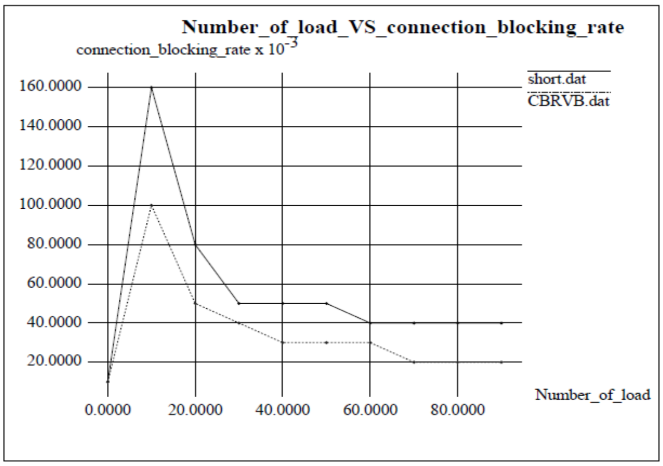


Figure.3 Comparison of connection blocking rate

The capacity of Non-VB node links is one third of the VB capacity. For L= 1, the total amount of connections equals to the total capacity of wireless links at the VB.This shortest-widest path algorithm achieves the lowest blocking rate; the connection-balancing algorithm adjusts connections dynamically, while the other algorithms select the connections and terminate. To illuminate this difference, we show CBR-VB performance. We define the balance index for evaluation of connection balance. It is the ratio between connections maintained by virtual backbone to alternate connections. Comparison of balance index of our algorithm with QoS based algorithm is shown in Figure 4.

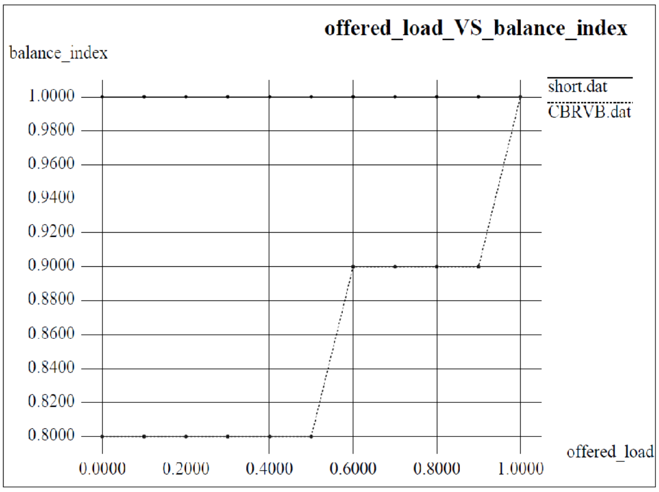


Figure.4 Comparison with load balancing performance

## 6. Conclusion:

In this paper, we focused on the problem of load maintenance and allocate new connections in ad hoc networks. The main features of these algorithms are as follows: (1) if the VB is overloaded by more than k-connections, it finds new VB for connection maintenance (2) when routes are broken, originating VB find the one hop R-VB, which will provide alternate route. Connection balancing routing is a very complex issue and full of challenges, e.g., even how to define the traffic connection in fast moving networks is still an open problem. Routing is one of the key topics in multi-hop wireless networks which determine the route or path taken by packets as they flow from a source to a destination. Various routing protocols have been proposed and studied in literature. Most of the existing virtual backbone routing protocols are based on greedy algorithms and no performance guaranteed in real time. We propose a localized algorithm for connection balancing in virtual backbone mobile ad hoc networks. We show that if the numbers of connections are increased in one VB, connection blocking rate not affect the QoS. Our connection-balancing routing algorithm lowers the bandwidth blocking rate to maximize network utilization. For future work, we would like to extend the algorithm to work with multi path wireless dense networks.

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