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Efficient Routing and Fair Bandwidth Allocation in Mobile Ad Hoc Networks

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***Abstract* - All MANETS exhibit versatile behavior in its topology because of node mobility factor. In theory TCP happens to be a transport-layer protocol designed to provide a reliable end-to-end delivery of data over unreliable networks. But in reality TCP encounters some challenges in multi hop ad hoc networks especially route failures and so congestion. To address this problem previously contention detection using congestion window adaptation (CWA–CD) procedures is designed and implemented to handle route failures. Although its performance is not up to the mark because of the complexity encountered in detecting the contention variations from the round trip time delays. So for a robust and better network performance we propose to use candidate list generation algorithm for packet forwarding with congestion control by contention control (4C) method. The algorithm involves constant updates of location specifics for every small intervals of time and steps to sort out the forwarding list that aids communication. As a result nearest nodes or routers participates in data transmission and this improve network performance and controls the congestion. A practical implementation of the proposed system validates the claim in terms of efficiency and fairness**

1. INTRODUCTION

1.1 MANET

MANETs are a kind of Wireless ad hoc network that often refers to a function of IEEE 802.11 [1] unguided networks and they have a routable networking environment. MANETs do not require any external effort in order to control its infrastructure. They consist of end to end, self-making, self-recoverable network. In contrast to a mesh topological network. MANETs can configure themselves and change their locations on the fly. A WANET (wireless ad hoc network) is a decentralized kind of wireless network. The network is ad hoc because it does not depend on its pre existing infrastructure, such as wired networks routers or access points in managed (infrastructure) wireless networks. Instead, each node participates in routing by forwarding data segments for other nodes, so the determination of which node forwards the data is done dynamically on the basis of connectivity of the network devices

1.2 Contention and Congestion

In data communication networks contention and congestion are the two major key points which degrades the network performance .Contention refers to the property that two or more nodes want to access the channel simultaneously in the network. Congestion refers to the property that when network filled with too many packets and this causes due to the contention in the network. Congestion occurs due to the contention; Contention RTT and Congestion RTT [2] are the two parts of round trip times. Congestion window adaptation through detection of contention is used to resolve the problems in mobile ad hoc networks contentions

In data communication network links are influenced by the node's resources and behavioural properties like reliability, as well as link properties which are length-of-link and signal loss, interference and noise. Since links can be connected or disconnected dynamically, a working network must be able to understand changes with this dynamic restructuring, preferably in a way that is timely, efficient, reliable, robust, and scalable. The network must allow any two nodes to communicate by relaying the information via other nodes. Mobile ad hoc network mainly deals with routing problem because this is the major factor which impact on whole network performance and throughput loss can found due to multichip networks [6]

We say that a network contention based due to the method it uses to access and control the communication network media. There are two contention based networks one is typical contention based networks and another one is modern contention based networks. In earlier or older contention based networks, every network device called net device was free to access the network information any time it needs to send the data. But this gives rise to the packet collisions over the network media when more than one network device transmits the data packets at a time. Thus in modern contention based networks an efficient technique is used to avoid collisions

1.3 Efficiency and Fairness

In mobile ad hoc network efficiency and fairness are the two major factors which generally users want to achieve. Efficiency refer to the property that the network channel capacity should be used at most i.e. maximum throughput to be achieved Where as fairness refers to the property that all the links must be assigned bandwidth properly called fair share of bandwidth allocation is required.

2. EXISTING SYSTEM

In existing system bandwidth delay product is calculated with congestion window adaptation and contention detection technique. In data communications bandwidth delay product [3] refers to the product of data links capacity which is calculated interms of bits per second and its round trip delay time which is in seconds. Here contention is detected by dividing or explaining the round trip time in two ways one is contention RTT and another one is congestion RTT. We all know that congestion occurs due to the problem obtained by contention between the network nodes. Network performance is gradually decreased due to the overhead of capturing the contention RTT values [3]. Using congestion window adaptation requires dynamic adjustment i.e. contention variation for one round trip time RTT. And it also encounters some problems like data integrity problems i.e. confidential or secure data will be accessed In MANET every node is a base station and itself a router. It does not require external control to the node to work dynamically, but due to this there is some problem identified which data integrity problem i.e. the data segments of one node is made available to the other node without proper connection. This causes unfair allocation of bandwidth to the links to transmit the data to the nodes. Similarly an explicit rate based flow control (EXACT) [4] is used in existing system to show the data transmission rates in the network and it selects the alternative paths dynamically when route interruptions occurred. In which data is migrated from one node to another node with predetermined route. If one route gets failed dynamically the other router is established and as usual data transmission will be done. Packet loss can be happened either by route failures or slow receiver. This information is known to the user only after one round trip time [4](TRR).

Moreover in MANET every node functions independently all the nodes tries to access the links bandwidth so the packets send by one station may also be available to other stations [5], because of this, network performance is degraded and fairness is not achieved. Figure 1 represents a MANET in which all the nodes having huge number of links to other nodes in the same network, the packets send by one node is made available to the other nodes and every node will access those packets. In EXACT This makes the network gets more congested and transmission rates become low, as a result we will degraded network efficiency in the form of throughput and improper allocation of bandwidth that is fairness is not achieved.

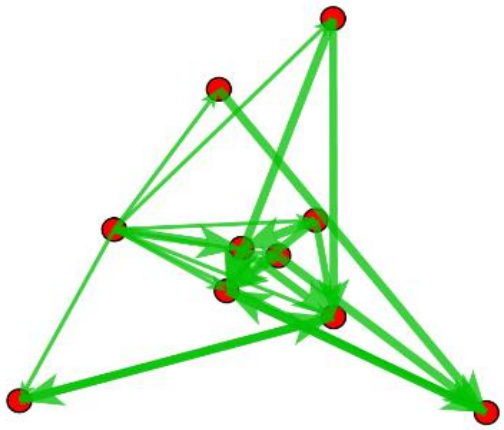

Figure 1: Illustration of MANET and Packet transmission

In figure 1 there are 10 nodes taken for sample and these nodes are being connected to other nodes in an unfair manner, due to this fairness is not achieved and efficiency of network in the form of throughput will be degraded. Assume every individual node acts as a sender or receiver

3. PROPOSED SYSTEM

Existing mechanisms [3][4]focused on link contentions and congestion control process. Even though, for calculating contention variation for every RTT is difficult because in the network we keep sending so many packets from source to destination. So this process becomes very complex in order to observe the contention variation for every time interval and bandwidth allocation is done unfairly. Link failures due to mobility are part of the main sources of link unreliability in mobile ad hoc networks (MANETs). Among the proposed solutions to improve throughput of a network in MANET we find a mechanism which focus on MANET routing environment that exhibits high data transmission rates, less latency and reduces network congestion and fairness. In this paper we propose to develop candidate list generation for packet forward algorithm along with congestion control by contention control (4C) method to handle route failures efficiently.

Algorithm

Algorithm : Candidate node selection for packet forwarding
ListN : Neighbor list
ListC: Candidate list, initialized as an empty list
Nr : Receiver node
Base : Distance between current node and Nr

```
If (find (ListN, Nr) then
        Next, hop← Nr
        Return
End if
For i←0 to length (ListN[i], Nr)
End for
ListN.sort ()
Next.hop←ListN [0]
For i,←1 to length(ListN) do
       If dist (ListN[i], Nr)>= base or length (ListN)=N
       Then
        Break
           Else if dist (ListN[i], ListN [0]<R/2 then
     ListC.add (ListN[i])
   End if
```

End for

In the algorithm ListN represents the neighbor list. And ListC represents the candidate list, the logic of algorithm verifies all the neighbors and selects candidate nodes through which data packets can be transferred to other nodes.

3.1 Congestion control by Contention control (4C) procedure

Congestion and contention together degrades the network performance certainly, one of the main reason for congestion is simultaneous attempts to access the single network channel. So if control the contention problem, then obviously we can also control the congestion problem in Mobile ad hoc network. By using congestion control by contention control procedure. Every packet in the network contains a special header in which source and destination address is stored. As per the algorithm for the entire network candidate node selection is done for packet forwarding. We all know that MANET migrates frequently from one place to another in all the way. Every nearest router checks the packet header and transfers that packet to nearest router in such a way that it reaches the target place or node.

The neighbor node verifies the special packet if it is not the target node just forward to the next node and vice versa. If the target node is found with the help of acknowledgment then it starts transferring the packets as long as the route is available. Due to mobility, if the target node goes far away then the link failure is occurred. Nodes in MANET continuously checks the status of their neighbors by sending hello packets for every interval of time and updates the routing table, the router always store the details according to the nearest router first . So it can easily allocate the next reliable route when link failure is identified, due to this continuous path will be maintained with less latency, it also controls the packet loss and maintains high data transmission rate which is Throughput.

When network having multiple hops [6] then only the problem occurred usually is congestion and due to this packet loss or throughput reduction is happened. So handing route failure in multipath network is a challenge really and causes poor performance [7] of network.

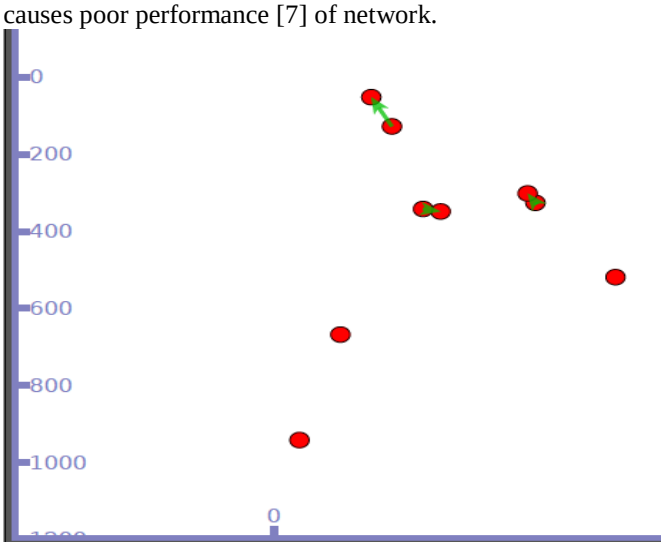

Figure-2: MANET having fair bandwidth allocation and data transmission between nearest routers.

Figure 2 specifies a MANET application in which only the nearest router will get participated in the data transmission. Since nodes in MANET always travels from one location to other location whenever two or more nodes come close then the available packets will be transmitted to the appropriate routers.

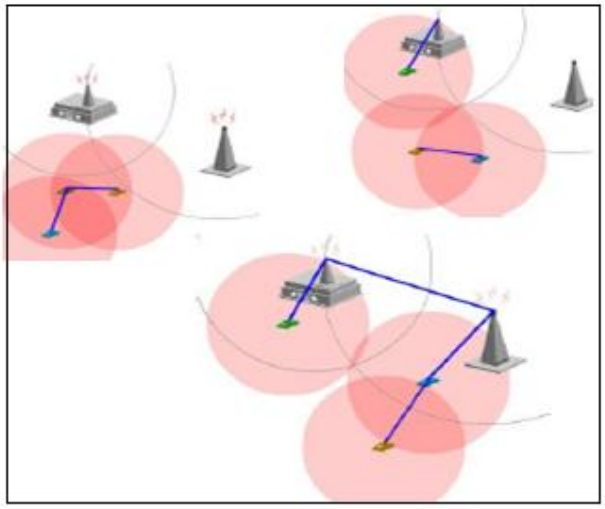

Figure-3: Proposed MANET application: Efficient routing with reduced network congestion

Figure 3 is another example of proposed process in which totally 3 groups of nodes have shown that means in each group nodes placed nearby distances so the data transmission is done only to the nodes which are very close to the sender and utilize the available bandwidth very fairly.

4. CONCLUSION

In this paper we prefer to explain all data transmitting operations in order to improve the efficiency and fairness of the mobile ad hoc network. We present a new method called congestion control by contention control (4C) method in which contention is controlled in such a way that nearby nodes will participate in data transmission and we are using candidate node selection for packet forwarding algorithm. This algorithm keeps track of updated routing table which consists of list of nodes selected for packet forwarding and checks the status of the node in the network. Data packets are transferred as every node consists of packet header which holds source and destination address. This process reduces the contention and congestion, improves the throughput without packet loss and maintains the fairness by allocating available bandwidth properly among several nodes.

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