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A Survey on Congestion Problem of MANET

Ms. Ritu Jain, Mrs.Bhawana Pillai

Computer Science and Engineering
Lakshmi Narain College of Technology & Science
Rajiv Gandhi Proudyogiki Vishwavidyalaya
Bhopal, India

***ABSTRACT*- Mobile Ad hoc network (MANET) is designed to overcome the natural limitation of these wired backbone networks and infrastructure-based wireless networks. MANET is based upon the nodes mobility model that uses dynamic topology which is the composition of many configurations, and each configuration has its existence probability. Transformation of Data in Ad-hoc environments exhibit less network performance because link breakage is most frequent due to nodes movement which is the main reason of route failures in MANET. There are many routing algorithms, but these have problem of congestion which decreases the overall performance of the network. In a self-organized network, nodes are autonomous; they may free ride and may not cooperate properly in network operations to save their resources. Such nodes are called selfish or misbehaving nodes and their behavior is termed selfishness or misbehavior. If such types of unreliable nodes are use for further communication they having a strong impact on transport layer protocols such as TCP, which are highly sensitive to packet losses. In this paper a survey of congestion control techniques of MANET has been present .Finally the future direction of making congestion adaptive routing protocol described**

KEY WORDS: Ad hoc Network, Congestion Prevention, Congestion control, Reliability, Routing Protocol.

1. INTRODUCTION

Mobile Ad hoc network (MANET) is designed to overcome the natural limitation of these wired backbone networks and infrastructure-based wireless networks. A mobile ad-hoc network is an independent group of mobile users which communicate over unstable wireless links in those situation where temporary network connectivity is required and in the areas where no prefixed infrastructure cannot be developed mobile ad-hoc network are very useful , such as disaster relief where existing infrastructure is damaged, or military applications where a tactical network is required Each device must forward traffic which is not related to its own use, and therefore these devices also work as a router. Every device can move freely in MANET, so topology of the network is not fixed and as compared to traditional network continuity of communication in MANET is weak. All network activity like delivery of the messages and searching the topology must be executed by the nodes themselves. Therefore routing functionality, for transferring information from source to a destination, will have to be integrating into the mobile nodes .Hence routing is one of the most important issue in MANET. To route the traffic properly each device continuously maintain the required routing information. The ad hoc wireless networks offer unique benefits and versatility for certain environments and some applications due to some special characteristics such as:

- A preexisting fixed infrastructure or any base stations are not required in MANET
- Such networks not operate under the limitations of a fixed topology.
- All nodes are allowed to be move, the composition of such networks is time varying. Addition of a new node and deletion of existing nodes require only the interaction of other nodes, no other agency is involved .

1.1 Routing Concept in MANET

All network activity like delivery of the messages and searching the topology must be executed by the nodes themselves. Therefore routing functionality, for transferring information from source to a destination, will have to be integrate into the mobile nodes .Hence routing is one of the most important issue in MANET. To route the traffic properly each device continuously maintain the required routing information. Since the hosts are mobile, the network topology may change rapidly over time. In ad-hoc network it is not possible to predict this topology. Hence to provide the communication within the network between these nodes, a routing protocol is used to discover routes between nodes. The purpose of such an ad-hoc network routing protocol is to determine the path between a pair of nodes so that messages may be delivered in an efficient manner and reach at correct destination within limited time. For this purpose there are various routing protocol have been designed. Because the node in MANET have limited range some node cannot be directly communicate each other hence the routing protocol which is implied on ad hoc network is based on multi sequence of one or multiple intermediate node. Mobile devices can exist in various forms there are great difference among these devices and this heterogeneity can affect communication performance and the design of communication protocol. An appropriate routing protocol for ad- hoc network must be satisfied following properties.

- To increase reliability routing protocol for MANET should be distributed.
- In mobile devices batteries are used for power so they may have very limited energy resource hence routing protocol should be power efficient.
- A routing protocol should also provide quality of services
- Privacy must be provided by the routing protocol because information sent in ad hoc route involves multiple nodes the relaying of packets has to be authenticated.

1.2 Congestion Problem in MANET

MANET enables the transformation of information among the multiple disconnected network or more popularly mobile users. In MANET each mobile device works as a router and help each other for successfully delivering the data. MANET suffers from high transmission error rate due to the high transmission contention and congestion. The intermediate nodes are responsible for forwarding the data packets, if not able to deliver all the packets with the same arrival rate make a queue for storing some packets for short period of time so they can wait for their transmission. Problem of congestion is occurred in all type of network but to deal with this problem in wired networks is not so difficult as compare to the ad-hoc network because in wired network there congestion control techniques are implemented at

the transport layer where its functions are designed separately from the functions of other layers [11]. Such congestion control techniques do not apply directly to ad hoc networks, due to limited resources like limited wireless bandwidth, power constraints, where detected route can be fail due to node mobility and limited buffer size. Congestion control is a major issue in MANET as there is no central access point or controller. Congestion is a problem that occurs on shared networks, when multiple users want to access the same resources (bandwidth, buffers, and queues) and demand of this resource become greater than the capacity of network. This situation is called congestion. The traffic entering in the network is called offered load. Initially when the offered load increases the network throughputs also increases linearly but after some time load reaches the network capacity (the knee point), and if load continuously increase then throughput not increase in place of these response times start to get larger because coming packets at nodes are drop most of the time. In mobile ad hoc networks there are several factors that may cause of packet drop:

- Packet can be lost due to transmission errors, as wireless media is use for the transmission chances of interference is more in the channel [8]. This type of packet loss cannot be eliminated or reduced by improving the routing protocols.
- MANET suffer from multiple packet loss when node change their position during communication..When node move it may become unapproachable for a long time in such case multiple packet meant for it get lost.
- Packet arrival rate exceeds the outgoing link capacity due to limited resource like limited battery power, slow processor of intermediate node etc.
- If a packet not forward then it put on the queue but if the waiting time on the queue exceeds the limit then packet can be dropped by the node.

There is a close connection among type of network traffic, network congestion and buffering in network routers. In real time network environment each link capacity is finite and aggregate demand of the resources may exceed as compared to the available capacity. In such situation link becomes overloaded and when this happens it becomes congested. This congestion may be persistent (permanent) or transient (temporary). In case of transient congestion packet arrived abruptly in burst. In transient case solution to congestion is possible by providing a considerable buffer space in router for allowing packets for out-bound link to spend short period before being forwarded to next link. Two popular approaches used to deal with the congestion problem are:

1.2.1 Congestion Prevention

It is the mechanism to deal with the network from congestion which comes to play before network faces congestion. For this purpose nodes have to monitor their status and they negotiate with the neighbor node in the network so that no more traffic than the desired quantity, the node can handle, will be allowed to come into the network therefore no congestion will occur. Congestion affects the performance of network. So some necessary congestion control method is required to prevent the network from the congestion. Prevention from congestion in MANETs is much complicated as compared to wired networks due to its specific characteristics. The following are some of the main QoS provisioning and maintenance problems in MANETs.

A. Detection of Fixed Route is not possible in MANET

To prevent the network from the congestion it is better to choose a reliable path. For this purpose route will be analyzed so that an ideal error free fully coverage path with high transmission delivery ratio can be choose. It requires knowledge of the nodes which will be remain available all the time, but due to dynamic environment of MANET selection of such node is not possible.

B. Reservation of Bandwidth is not possible in MANET

Bandwidth reservation is one way to prevent the network from congestion, in which nodes reserve bandwidth for future communication through negotiation between the neighbor's nodes which come within two to three hops. It requires signaling, and exchanges of message between them as the channel is shared between the nodes. In MANET environment a node can moves from the reservation area of the node at any time even communication is going on. So reservation of bandwidth means extra overhead for signaling and releasing messages. Hence bandwidth reservation is not possible in MANET.

C. Absence of Service Level Agreement (SLA)

In MANET each participating node works as a host and as a router. Any node is not responsible for performing some specific task. Since all the nodes in the network cooperate to provide services, there is no clear definition of a Service Level Agreement (SLA). Whereas in, an infrastructure network the services to the users in the network are provisioned by one or more service providers. Hence estimation of the node behavior is not possible which is required for prevention from the congestion.

D. Channel Reliability not be Guaranteed

Since the wireless bandwidth and capacity in MANETs are affected by interference, noise and multi-path fading, the channel is not reliable. Moreover, the available bandwidth at a node cannot be estimated exactly because it involves a large variations based on the mobility of the node and other wireless device transmitting in the vicinity etc.

E. *Routing Difficulty in MANET*

Routing is difficult in MANET because link breakage occur frequently. When any link of a path breaks, it need to find any other available link or replaced with a newly found path. This rerouting operation costs the scarce radio resource and battery power while rerouting also increase delay which also affect quality of service of applications and degrade the network performance. Hence routing operation has to deal with such type of challenge which is difficult to handle.

1.2.2 Congestion Control

To solve the problem of congestion another approach can be use in which an congestion control mechanism is performed after the network faces congestion. Congestion control mechanism usually perform to improve network overall performance. Based on the current load condition of the network, the congestion control is done through controlling the sending rate of data streams of each source which is helpful in the prevention from congestion in future and also leads to high utilization of the available bandwidth. The main objective of congestion control is to minimize the delay and buffer overflow caused by network congestion and hence enable the network to perform better. As congestion is directly related to the problem of dropping packet, it is required that some method have been applied on the network so that the drop of packet will become less. But to control on the amount of dropping rate is more difficult in MANET as compare to the wired network [8] due to some special characteristics of MANET] due to some special characteristics of MANET like:

A. Dynamic Topology

As in MANET there is no central point or base station, to control the whole network connection. Every device can move freely in MANET, so the topology of network is not fixed. Hence it cannot be predicted whether a node which participate during some transmission will cooperate in whole transmission or not. A node can move any time instance so a path detected by source node to transfer its data can be break at any time. If no path is found by the intermediate node to forward the data it will start to drop the packet after some time.

B. Multi Hop Routing Concept

Each node in MANET can receive and forward the data to the other nodes. But node forwarding capacity is limited to its transmission range; it means it can deliver the data packets to only that node which come under its transmission range. If any two nodes which not come under the transmission range of each other want to connect with each other multi hop routing concept in MANET. A route has been detected by a routing protocol then sender start to transfer the data to a node which comes under its transmission range this node called an intermediate node, each intermediate node further transmitted data to the other node and this process is repeated until data reach to the destination. It may be possible that some nodes have to deal with the heavy traffic as compare to other nodes in the network because they become the intermediate node in several route as they come under the transmission range of many node; hence arrival rate of packets at this particular node can be greater than its forwarding capacity so this node start to drop the packet.

C. Heterogeneous Environment

In MANET any device can participate if it is able to forward the data. These participating devices are of different type having different storage capacity and other resource. The transmission rate of each device may remain different. In MANET addition of new device is very easy if it come under the transmission range of other node it become the part of that network. So it may be possible that a new device come and start to transmit its own data on the route which is already detected by other node. All devices participating in communication are of different type and may become unavailable at any time, which makes the duration of communication not so long [6]. In such type of condition packets have been dropped by the predecessor node. Some time a specific node becomes the intermediate node between many nodes. A situation can arise at this node that many of its neighbor node forward the data to it the same time, so there will be excessive amount of packets arriving at these intermediate node. if the arrival rate of data on the nodes is greater from its transmission rate node will start to drop the packets.

D. More Density of Neighbor Node

The number of neighbor nodes of each node may also the cause of unreliability of a node in MANET, because if a node cannot deliver the data directly to the receiver node use intermediate node to forward the data packet, because any nodes which come under the transmission range of each other are called connected. In MANET for each node, more neighbor nodes mean more link connections between the nodes and their neighbors. it will become the reason of more arrival rate of packets at particular node hence more neighbor node of any intermediate node become the reason of coming heavy load as compare to the node reception capacity. In such type of condition node will start to drop the packet.

E. Presence of Packet Dropper Node

Reliability of the node will be decrease due to the presence of packet dropper node. In MANET participating devices have limited resource sometime routing protocol choose the path in which packet dropper node work as an intermediate node. A Packet Dropper node is selfish nodes which actually not forward the data packets to next node but in place of this it just drops the packet to save the resources [4]. Presence of packet dropper node is a severe problem in MANET and they are not only cause of large delay, but also become the reason of heavy traffic load on the network as the sender may get involved in sending packets again and again if no acknowledgement is received from the receiver.

F. Due To Absence of Physical Protection

In MANET it is not possible to protect a node form various types of threats as the node position is not fixed, a node can move in any direction in the network. The nodes can be attacked from any direction where fixed physical protection like firewall and gateways cannot be applied. It means for securing itself a node should be equipped to meet an attacker directly or indirectly. But due to absence of physical protection like in hard wired network there is a more chance for a node to become unreliable, and start to drop the packet

1.3 Major Performance Measures &Overview Of Congestion Control Schemes

The major performance metrics under consideration are:

A. Routing Load:

Routing load refer to the traffic which occur on the communication link due to transmission of route establishment (RREQ,RREP,RERR etc)packets . This routing packet contains some routing information send by a node. This packet uses some part of the available bandwidth of a communication protocol. This extra packet does not contribute to the content of message.

B.Normalized Routing Load:

It is the ratio of the number of routing messages propagated by every node in the network and the number of data packets successfully delivered to all destination nodes. The lower value off NRL means the better performance of the protocol.

C. Packet Delivery Ratio (PDR):

PDR is the ratio of the number of data packets successfully received by all destinations to the total number of data packets injected into the network from all sources in a specified amount of time. The PDR is a number between 0 and 1.it is generally represented in percentages.

If total no of packets transmitted=PTS

Total no of packets received=PTR

Then PDR(%)=(PTR/PTS)*100

D. *Throughput:*

The throughput metric is used to measures how well the network can constantly provide data to the sink. Throughput is the number of packet arriving at the receiver per unit time

.Let T is the unit time in which measure in milliseconds.

N is the number of packets which has been received in T

Then throughput=N/T milliseconds

2. CONGESTION CONTROL MECHANISMS

2.1 Dynamic congestion detection and avoidance

T. Senthilkumaran & V. Sankaranarayanan et-al[1] proposed a method for detecting congestion in advance and prevent the network from the congestion. Their work is based upon the calculation of approximate queue length in advance. For this purpose they calculate the average queue length at the node level. Network characteristics like congestion and route failure need to be detected and remedied with a reliable mechanism. To solve the congestion problem, a novel dynamic congestion estimation technique has proposed that could analyze the traffic fluctuation. By the assessment of average queue length, a node is able to find that there is some probability of congestion so it sends a warning message to its neighbors. When neighbors received the warning message they try to search some alternative congestion-free path to the destination. If some other path is available, then predecessor node starts further communication through alternative path. So this dynamic congestion estimation procedure tries to provide a reliable communication within the MANET by controlling upon the congestion in ad hoc networks. Proposed DCDR uses a non-congested path discovery mechanism to prevent network congestion, hence packet loss rate is decreased, and by which end-to-end delay is reduced so throughput is improved.

2.2 Detection and removal of packet dropper node

Reeta Bourasi & Prof Sandeep Sahu2 et-al [4] proposed a new technique to detect the packet dropper nodes in the network by using a reliability factor. In MANET each node has limited resources like limited battery power, a packet dropper node is that node in the network which may not cooperate properly in network operations as they not forward the coming data packets to the next node but instead of this they drop the data packet to save their resources. Such nodes are called selfish or misbehaving nodes and these nodes are also the reason of congestion. Dropping of data packet not only affects the network connectivity, but also can widely waste the network resources. To handle this situation a scheme based on MAC-layer acknowledgements is used to detect the packet dropper nodes. To eliminate such nodes from the network its reliability is evaluated during the packet transformation. In this work the field of reliability factor is increased on the basis of acknowledgement received from the receiver, and all senders making decision to send a packet through a node having higher reliability factor. By including the reliability factor field at packet header it is possible to identity the packet dropper nodes because such nodes not forward the packet to the next hop but instead of this they drop the data packets hence they not receive the acknowledgement from the next node and so its reliability factor field value never increased. Hence on the basis of nodes reliability factor a packet dropper node can be detected and also can be isolated from the network this is not only improving the performance but also increasing the throughput of the network.

2.3 *Ensuring Reliability of terminal node*

Majid Ahmad & Durgesh Kumar Mishra et-al[9] define and formulate an efficient reliability calculation technique for large scale MANET. Terminal-pair reliability is defined as the probability of successful communication between any two (selected) terminals in a network, so consequently terminal reliability depends on the participating terminals and also the connecting link. The reliability calculation methods have an exponential growth factor for time complexity as number of nodes increase, thus making it computationally unfeasible to calculate reliability of large scale mobile networks . To calculate reliability of large scale mobile networks .This work proposes a reliability calculation scheme which is realistic for calculating reliability of large scale MANETs. The proposed approach calculates the reliability of Mobile ad hoc networks by identifying critical links within a network. The proposed scheme takes critical nodes as the calculation assumptions and thus this method should be able to limit reliability calculation complexity within practical reach.

2.*4 By Controlling On the Buffer Overflow Problem*

Robin Choudhary& Niraj Singhal et-al [10] presents a good method for controlling upon the problem of congestion. As compare to the wired networks where a fixed medium is used for the transmission of data only limited bandwidth is available in mobile ad hoc networks so there is more chance for the occurrence of error which further impose limits on the amount of data that can be sent. Hence it is required that this limited resources should be use as efficient as possible during the transmission with minimal loss. Mobile nodes have limited transmission capacity, multi-hop relay; nodes mobility puts some extra burden on TCP‟s congestion control mechanism so congestion control mechanism of traditional network cannot be used in ad hoc networks. In this paper for the purpose of congestion control focus is done to limit the delay and buffer overflow problem which become the reason of network congestion .By controlling upon the delay better performance of the network is obtained. As the large amount of packet loss is one of the main reason for high delay and low throughputs.. Existing solution for calculation of delay are based on the network Parameter such as RTT, RTO, Bandwidth and number of nodes are used for communication between sources to destination in MANET. These techniques are totally depending on the receiving acknowledgement and sending acknowledgement for each receiving packet. The most existing technique does not getting differentiate between the link of failure with other type of failure. In this paper it is determine whether link failure loss occurrence or not. The link failure and network partitioning which mainly created by a failure such as mobility and battery depletion has negative on MANET. To solve this problem a novel approach, which uses velocity change and change angle in spherical coordination system to classify and control the congestion before packet lose in MANET is proposed.

2.6 **By reducing the link connection if node have high density of neighbor nodes**

.Xibin Zhao,Zhiyang You,and Hai Wan et-al[15] presents a method for reliability analysis in MANET. They proposed that the node performance is also influenced through the number of neighbor nodes of that node. In their work effect of node mobility and reliability in a real MANET platform is proposed and analyzed. They proved that the wireless network has limited capacity, and the throughput of the wireless network granted to each user can be decrease to zero if the number of users increased. As the transmission capacity of the wireless network affect the throughput and it will affect the terminal reliability of MANET. Congestion means arrival of excessive amount of packets at a network which leads to many packet drops. A node can communicate with many nodes which are its neighbor nodes. As they come under the communication range of that node then there will always the chance that at the same time many neighbor nodes send their data packets to the same node, so there will be excessive amount of packets arriving at these nodes become the reason of packets drop. Hence congestion is related to the density of the node in some area, and it will influence the terminal reliability by reducing the intermediate node reliability. For each node, more neighbor nodes, mean more link connections between the nodes and their neighbors which may cause of unreliability of that node, so in this paper, to reduce the congestion problem, focus is upon identifying the relationship between the number of link connections and the node reliability.

2.5 ***By using Optimized Reliable Ad hoc On-demand Distance Vector (ORAODV) scheme***

Srinivas Sethi & Siba K. Udgata et-al [16] proposed an Optimized Reliable Ad hoc On-demand Distance Vector (ORAODV) scheme that offers quick action to handle dynamic link conditions, low processing and low network utilization in ad hoc network. The proposed protocol (ORAODV) is designed for optimal route discovery and reliability of packet delivery. A new concept of Blocking Expanding Ring Search (Blocking-ERS) is used in it to avoid network wide broadcasting. The Blocking-ERS does not start its route search procedure from the source node every time a rebroadcast is required. The rebroadcast can be initialized by any appropriate intermediate nodes on behalf of the source node which acts as a relay or an agent node. Retransmission of data packet in ORAODV provides satisfactory performance in term of packet delivery ratio (PDR), normalizing routing load (NRL) and delay for different network density in term of number of node, various mobility rates.

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