Research Paper Engineering

Congestion Control in Vanet

Rinkal Shah — Department of Electronics and Communication Engineering, Venus International College of Technology, Gandhinagar

Shailee Patel — Asst. Professor, Department of Electronics and Communication Engineering, Venus International College of Technology, Gandhinagar

ABSTRACT

The wireless technology, used in versatile area, used in most of application like ISP, Consumer appliances, Mesh networking, vehicle communications etc. Technological involvement increasing number of wireless devices which also creates more congestion in the wireless environment and greatly effect on the throughput, increases high-error rate, long-latency and data loss in congested environment. The IEEE 802.11p includes communication between vehicles (V2V) and between vehicle and roadside infrastructure (V2I). All vehicles use same DSRC channel to broadcast Basic safety messages at some regular interval, which causes high congestion in wireless environment if more vehicles are in radius, which may leads to major vehicle accidents. The proposed dissertation includes enhancements in existing Medium access control (MAC) technology to reduce the congestion due to heavy broadcast traffic in the network. This dissertation also aims to study existing 802.11P Medium Access Control algorithm and to get knowledge of NS-3 tool and simulate the multiple wireless devices scenarios on this tool and do research on Existing MAC algorithm to modify some parameters like TX power, Data Rate, packet interval etc., to reduce congestion in medium, to decrease the high error rate and data loss and finding different techniques to enhance the medium access control behavior in environment like vehicular.

KEYWORDS Vanet, Data Rate, TX Power, Packet Interval, Medium Access Control

INTRODUCTION

A network state where a network node or link carries so much data that it may weaken network service quality, resulting in queuing delay, frame or data packet loss and slow response time & low throughput.

A vehicular ad hoc network (VANET) that allows the vehicles to communicate with other vehicles and with the roadside equipment. A VANET turns every participating vehicle into a wireless router or node, allowing vehicles approximately 100 to 300 meters of each other to connect and, in turn, create a network with a wide range. Objectives of VANET is Broadcast warning messages to neighboring vehicles in case of vehicle accidents, obstacle, bad weather conditions , and emergency braking on the road[1].

Safety message needs to be transmitted all the time for all near neighbors, to give information about the current status of vehicle and to let other vehicle aware about the status of near network, this critical information must be sent with high probability and reliability to avoid network problems [5]. Sending safety message without using a congestion control mechanism creates the broadcast storm problem.

PROPOSED ALGORITHM:

Developed the program in NS-3 simulator which will contain X wireless stations works in ad hoc mode in 802.11p for V2V. Generate safety messages (broadcast) from the wireless devices. Monitor the received traffic generated by the nodes on single observer node in the network. Calculate the message drop rate due to the network congestion. This is the default scheme how the vehicles communicate in the network.

Each node in the network receive safety message from all the other nodes in the network. As it's the broadcast message. Every device would send the information regarding its own MAC parameters (i.e. Data Rate, TX power, packet interval etc. [3]) of the node in safety message as a part of data payload. Developed mechanism to generate neighbor node table from these received broadcast messages with their MAC parameters' data and calculate count of the neighbor nodes. Monitor the safety message generated by each node on every single node and configure itself with better configurations based on the other nodes in the surroundings. Modify the MAC parameters on the each wireless node properly based on the other nodes around it (i.e. Data Rate, TX power, packet interval etc.) in the wave/Wi-Fi MAC layer of the NS-3 framework. Monitor the traffic again with the single observer node and calculate the message drop rate.

IMPLEMENTATION METHODOLOGY:

- **Dynamic Algorithm – 1 (Data Rate)**

All the nodes receives the information of neighboring nodes and it will maintain the count of neighboring nodes. If the neighbor node count reaches to its threshold value then the node would change its data rate to higher value than the current one. (If the current data rate is 6 Mbps then it would increase itself to 9Mbps). This will reduce the range and decrease its message TX duration. This way all the node forms the logical cell around itself and the node will not interfere all the other nodes in the network except the few once in its range / cell. This helps in increasing parallel transmission and reduce the collusion.

1. Gather the information and count of the neighboring node
2. If (neighbor node count > threshold) { Increase the data rate;}
3. else { Keep the data rate same; }

Below is result statistics for TX Data Rate method:

By increasing TX data rate we can reduce TX time of the frame over the medium, which leads to fast transmission and reduces the collision. This method reduces the collision by very less amount.

Simulation Parameters:

Packet size = 500 bytes

Number of packets sent = 35 per node

Number of nodes = 10 (9 sender – 1 receiver)
Packet interval = 1 ms
Total packets transmitted: 315

TX Data rate	6 Mbps	9 Mbps	12 Mbps	24 Mbps	27 Mbps
Number of Packets Received	89	98	162	244	270

Table: Varying TX Data Rate Results

- **Dynamic Algorithm – 2 (TX Power)**

If the neighbor node count reaches to its threshold value then the node would change its TX power to lower value than the current one [2]. (E.g. if the current TX power is 23 dbm then it would decrease it to 20dbm). This will reduce the range and this node will not interfere the node which is at far distance. This way, the nodes which are far away from each other's range can transmit simultaneously.

1. Gather the information and count of the neighboring node
2. If (neighbor node count > threshold) { Decrease the TX power; }
3. else { Keep the TX power same; }

Below is result statistics for TX Power method:
As the number of nodes increases in the network it increases the collision possibility. To overcome this issue if we reduce the power of each node in the congested network as a result each node forms a small cell around it and due to low TX power the node will not interfere with the far distance node. So all the nodes which are far from each other's range can transmit simultaneously.

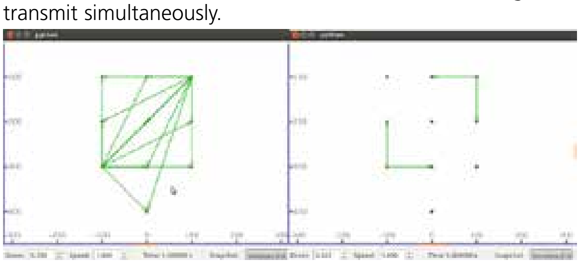

Figure: *Nodes transmitting with Maximum Power and Minimum Power*

- **Dynamic Algorithm – 3 (Packet Interval)**

If the x number of vehicles are there in the network, and they all transmit at the same packet interval which is 100ms then the channel busy time will lead up to 100% which would create congestion in the network. To reduce the congestion in this case, we can increase the packet interval to 200ms to reduce the channel busy time by half and reduce the collision.

1. Gather the information and count of the neighboring node
2. If (packet interval on neighbor nodes are same AND neighbor node count > threshold) { Increase the packet / message interval;}
3. else { Keep the packet / message interval same; }

Below is result statistics for packet interval method:
If the number of vehicles increase the threshold value in the network, and if they all transmit at the same packet interval which is 100ms then the channel busy time will lead up to 100% which creates congestion in the network [4]. To reduce the congestion in this case, we increase the packet interval to 200ms to reduce the channel busy time by half and reduce the collision.

When the node wants to transmit the packet it sense the medium, if it sense the channel as busy it will wait till the medium to be free. In this method we take the difference of the value between now - current time and the time when medium will become idle. This difference value we add as a small jitter to main packet interval. So when the node sends the next packet from application we add this jitter. Every node add this jitter to its packet interval. So next time when node try to access the medium the chance of free medium is high compare to last transmission.

Simulation Parameters:
Message interval: 100ms
Number of nodes = 100
Packet Size = 500 bytes
Number of packets = 100
Broadcast data rate = 6 Mbps
Collision percentage reduced by 4.85% from the default scheme.

COMPARISON BETWEEN DEFAULT SCHEME AND PROPOSED SCHEME:

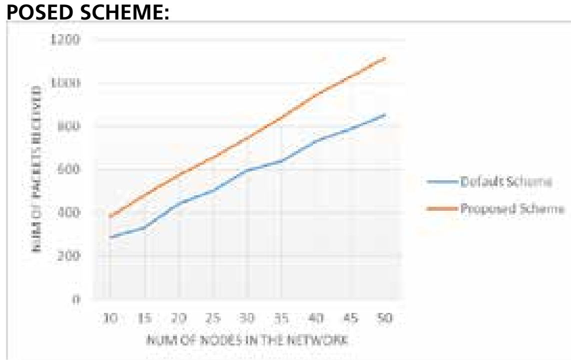

Figure: *Comparison Chart between Default Scheme and Proposed Scheme*

In the above graph, we have plotted the comparison between the default scheme verses the proposed scheme. We have plotted the graph as the number of packets received successfully verses the number of nodes available in the network. The packet received rate is higher in case of the proposed scheme because the MAC parameters on the each wireless node are configured properly based on the other nodes surrounding it (i.e. TX power, broadcast data rate, packet interval etc.) in the wave/Wi-Fi MAC layer.

CONCLUSIONS
The proposed technique that we have introduced in this thesis is by combining the advantage of the MAC layer parameters will help in reducing congestion in wireless medium.

This technique is very simple and provides better performance in the congested wireless network with broadcast packets which has shown the performance enhancements by simulation.

The packet received rate is higher in case of the proposed scheme because the MAC parameters on the each wireless node are configured properly based on the other nodes surrounding it (i.e. TX power, Data rate, packet interval etc.) in the wave/Wi-Fi MAC layer.

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