In [8], author proposed adaptive congestion control transmission of safety messages to deliver accident related message on timely manner without any delay. Here first create the vehicular network after that partition that network into equal width of segment. The vehicle which is near to the center of the segment will be selected as the local coordinator. This local coordinator assigns the time slot to each vehicle in that segment for beacons transmission. In the case of emergency message, time slot reservation carried out dynamically and time slot will be reserved for emergency message. So by using this mechanism emergency messages can be transmitted on timely manner without expense of beacons.

In [9], author proposed adaptive and reliable medium access control mechanism by combining carrier sense multiple access with time division multiple access to avoid collision effectively and use wireless resources efficiently. Here they introduce variable duration concept called "Chip" which have transmission period (TS) and reservation period. Transmission period is basically series of TDMA slots which is used by the nodes for their transmission while reservation period used by just newly incoming node to reserve a slot for transmission. When the local vehicle density is low then the duration of chip is short, for this case rest of the control channel duration can be used by the service channel to improve the throughput of the service channel. When the local vehicle density is high then the duration of the transmission period of control channel duration is high to make sure that every vehicle can transmit their safety packet successfully. In this case the duration of the control channel may be longer than service channel.

3. Proposed Solution

In the proposed technique, we will take the advantage of the MAC layer parameters which provides better performance and control in congestion of the broadcast domain in wireless network. First we understood the 802.11p standard and the congestion in the environment when multiple vehicles communicate with each other for warning and safety messages. All the nodes / vehicles transmit safety messages at regular configured interval at the configured data rate and the transmit power. Each node / vehicle sends and extra information like own mac address, transmit data rate, transmit power, own contention window (CW) value, node number appended in the data payload. For V2V communication, each node broadcast this information in the message so all the node receiving the frame would parse the node information and maintain the node table which includes information of all the nodes in its range. The MAC layer parameters slot-time, transmit power, broadcast data rate, CWmin value, packet interval etc. will be modified from its default values to enhance the broadcast congestion in the network.

4. Proposed Algorithm

This algorithm will be developed in Network Simulator–3 tool.

- Developed the program in this simulator which will contain wireless stations works in ad-hoc mode in 802.11p for V2V. Create X wireless stations in ad-hoc mode. This number of wireless stations for the test can be increased to any number.
- Place all the X wireless nodes with distance of 100 meters each.
- Generate safety messages/packets (broadcast) from the wireless devices. (1000 packets from each nodes with 500bytes of packet size).
- Monitor the received traffic (safety messages) generated by the wireless nodes on any single observer node in the network. Calculate the message drop rate due to congestion in the network as result-1.
- Every device would send the information regarding its own MAC parameters (i.e. slot time, tx power, broadcast data rate, CWmin value, packet interval etc.) of the node in safety message as a part of data payload. These information is used to making some decision making task to control congestion in the medium.
- Monitor the safety message generated by each node on every single node and configure itself with proper 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. slot time, transmit power, broadcast data rate, CWmin value, 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 as result-2.

The Congestion in result-2 would be observed lower from the result-1. This difference is the control over congestion by the proposed algorithm.

Dynamic Algorithm – 1 (TX Power)

If the neighbor node count reaches to its threshold value then the node would change its Transmit power (Tx)to lower value than the current one. (E.g. if the current transmit 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.

```
Gather the information and count of the neighboring node
If (neighbor node count > threshold) {
 Decrease the Transmit power;
}
else
 {
 Keep the Transmit power same;
```

5. Simulation Result

For simulation of the congestion control techniques, we have used Network Simulator as a programming tool, NS-3 version. We have implemented the scripts of network simulator to simulate our experimental scenario of wireless nodes and its visualizer for graphical representation & I have captured the RF congestion in the network.

Table 1: Simulation Parameters for Experimental Setup

Parameter	*Value/Description*
Number of Nodes in the Network	10 Nodes (can be varied)
Packet Size	500 bytes
Number of packets	100 packets
Message Interval	100 ms
Broadcast data rate	6 Mbps
Transmit Power	varied based on surrounding nodes

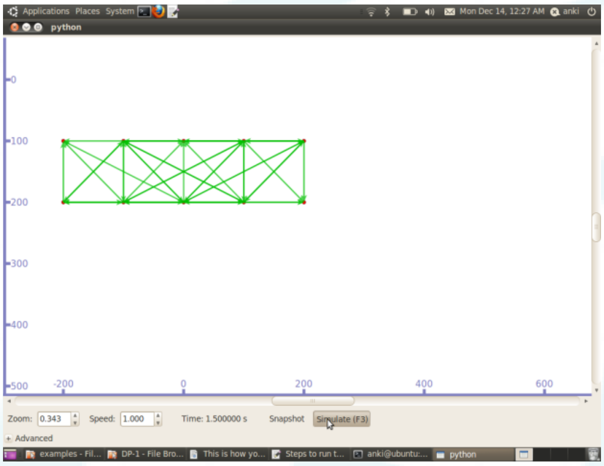

Figure 2: 10 Nodes transmitting with default scheme

As shown in figure 2, if the number of node is less(10) then node cannot interfere with other node and cannot create the congestion even if higher transmit power(default scheme). But if the number of node increases(40) then with higher transmit power more congestion in wireless environment as shown in figure 3.figure 4 shows the result of proposed scheme, in which for more number of node, the transmit power is less which reduce the congestion. Similarly we can adapt the contention window and packet interval value according to number of nodes.

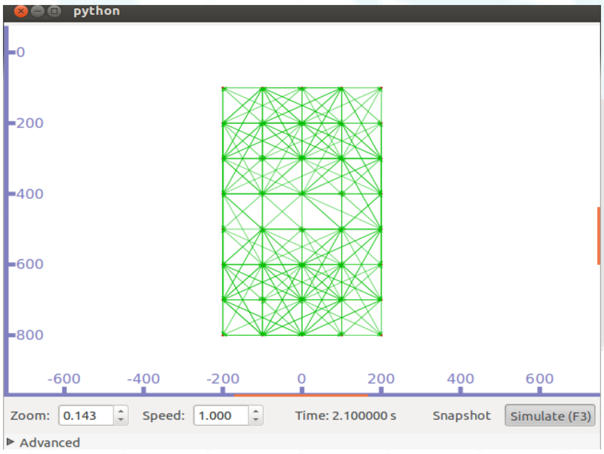

Figure 3: 40 Nodes transmitting with default scheme

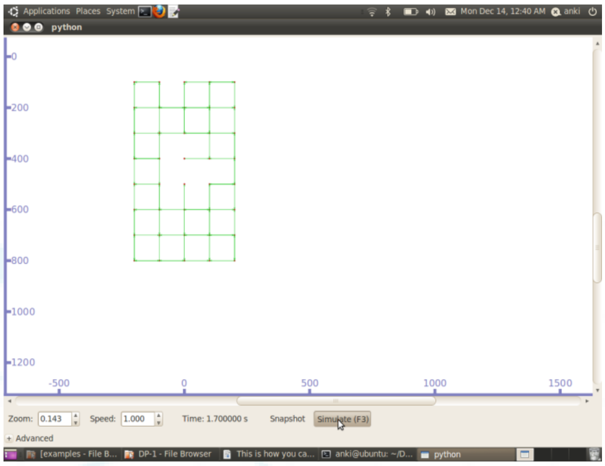

Figure 4: 40 Nodes transmitting with proposed scheme

6. Conclusion

By dynamically adaptation of transmission parameter like transmit power according to number of nodes we can reduce the congestion in vehicular Ad-hoc network. We can also adapt the parameter like packet interval, contention window according to vehicle density in future.

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