assumes that each node have knowledge about its physical/ geographic position by GPS or by some other position determining services. In it each node also has the knowledge of source, destination and other neighboring nodes. As compared to topology based routing, position based routing uses the additional information of each participating node to applicable in VANET, that additional information is gathered through GPS. Position based routing provides hop-by-hop communication to vehicular networks. A position based routing protocol consists of many major components such as "*beaconing*", "*location service and servers*" and *"recovery and forwarding strategies"*

### 3. Greedy Perimeter Stateless Routing-GPSR.

Greedy Perimeter Stateless Routing (GPSR) [17] is one of the best examples of position based routing. GPSR uses closest neighbor‟s information of destination in order to forward packet. This method is also known as greedy forwarding. In GPSR each node has knowledge of its current physical position and also the neighboring nodes. The knowledge about node positions provides better routing and also provides knowledge about the destination. On the other hand neighboring nodes also assists to make forwarding decisions more correctly without the interference of topology information. All information about nodes position gathered through GPS devices. GPSR protocol normally devised in to two groups:

- Greedy forwarding: This is used to send data to the closest nodes to destination.
- Perimeter forwarding: This is used to such regions where there is no closer node to destination. In other words we can say it is used where greedy forwarding fail

### 4. Results and discussion

We discussed and analyzed the simulation results of our study. We selected throughput and packet drop performance metrics for the evaluation of routing protocols. To check the performance of routing protocols in VANET we designed two different networks and named them as highway and city. For the highway scenario we have selected AODV and GPSR and evaluate them in the presence of low and high node‟s speed on highways. While in city scenario we selected AODV, GPSR and A-STAR routing protocols to check their performance in the large city environment in the presence of radio obstacles.

The results of various routing protocols for both highway and city scenarios in VANET in terms of throughput and drop packets has shown in the tabulated form below.

| Routing protocol | Throughput (KB/sec) | Packet drop |
|---|---|---|
| **AODV** | 5043 | 16712 |
| **GPSR** | 12209 | 13877 |

***Table 1: Highway scenario results with node's speed 20 m/s***

| Routing protocol | Throughput (KB/sec) | Packet drop |
|---|---|---|
| **AODV** | 5043 | 16712 |
| **GPSR** | 12209 | 13877 |

***Table 2: Highway scenario Results with node's speed 30 m/s***

The following are the result that we is obtain from the tables

- The above results shows that GPSR out performs AODV in both scenarios of highway in terms of throughput. There was no significant effect in the throughput rate of GPSR with the increment in nodes speed. On the other hand AODV performance in terms of throughput affected by the nodes high speed.
- Above results shows that when nodes moved with 20 m/s there was slight difference in the performance of both protocols in terms of drop packets.

While drop packet rate of GPSR became lower with the increment in nodes speed. However, a little increment in drop packets of AODV with node"s high speed.

- So we realized that GPSR completely outperform AODV in terms of throughput and rapid movement of nodes does not affect its performance. From results we also realized that AODV performance suffers with nodes speed which reduced its throughput rate. Furthermore, increment in speed reduces the drop packet rate of GPSR.

| Routing protocol | Throughput (KB/sec) | Packet drop |
|---|---|---|
| **AODV** | 9921 | 7573 |
| **GPSR** | 13859 | 6495 |
| **A-STAR** | 190081 | 2457 |

***Table 3: City scenario Results***

As compared to highway scenarios the node's speed was very low in city scenario. That's why all three protocols perform well in this scenario.

- Table 3 results shows that A-STAR completely outperformed AODV and GPSR in terms of throughput and drop packets. While GPSR also had better throughput rate than AODV. We realized that throughput rate of A-STAR was higher than AODV and GPSR. However, slight difference in the performance of AODV and GPSR in terms of drop packet.

From above results we realized that A-STAR provides scalable results in city environments of VANET. We also realized that there was slight difference in performance of GPSR and AODV in terms of drop packets. However, GPSR provides higher throughput than AODV in the presence of radio obstacle.

## 5. Conclusion

The main goal of this thesis is to identify different issues in ad hoc routing protocols and to evaluate these routing protocols against each other in VANET. In this study we focused from traditional ad hoc routing protocols to recently proposed position based routing protocols. We have examined how different routing protocol suffers from the highly mobile nature of VANET.

From the conducted study, we suggest that position based routing protocols are more promising than traditional ad hoc routing protocols for VANET. Although position based routing is scalable for VANET but it is hard to suggest any single routing protocol that can deal with different scenarios of VANET. The selection of a single routing protocol is hard in VANET because the protocol performance depends on vehicle speed, driving environment etc that may vary from one environment of network to another.

## 6. Future work

In wireless network community VANET received attention of many researchers due to its unique nature. Although amount of research has been devoted to the various routing issues in VANET but still there are some areas that need more attention. Due to time constraint, we only focused on traditional ad hoc and position based routing protocols but still there are some areas in these routing protocols that need more attentions. These are the few future work that need to be improve.

- Secure routing is one of the challenging areas. Due to the unsecure and ad hoc nature of VANET, there is prone to several security attacks that may lead to devastating consequences. So security attacks should be investigated with respect to different attacks in VANET.
- Several other routing methods such as broadcast, geocast and cluster based routing methods can be consider for the evaluation of routing protocols in VANET.

- New algorithms should be proposed to provide reliable QoS for safety and comfort applications in VANET.

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