

Modeling and Simulation of Vehicular Traffic Flow

4.2.2 Under dense network conditions with $\lambda = 2$

At $\lambda = 2$, the traffic flow in the four lanes exhibits an exponential distribution for both lane 1 and lane 2, indicating lower priority due to fewer vehicles in lane 2 compared to lane 1. In contrast, lane 3 and lane 4 demonstrate a partial normal distribution, as illustrated in Figures 4.2a and 4.2b. Notably, lane 4 holds the highest priority for packet reception, and lane 3 follows suit once lane 4 successfully receives the necessary reception. This observation sheds light on the correlation between traffic density and speed.

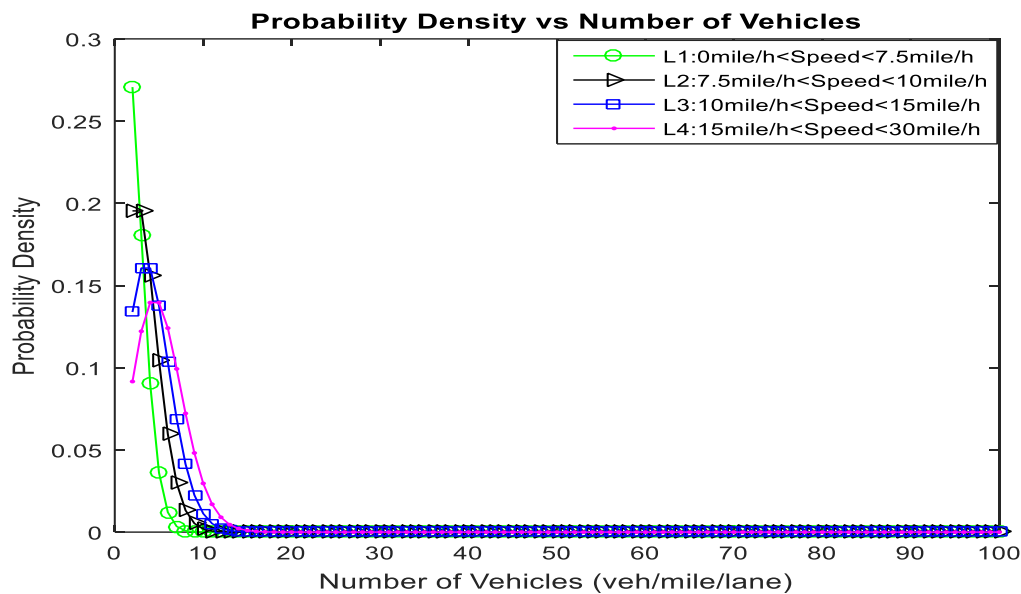
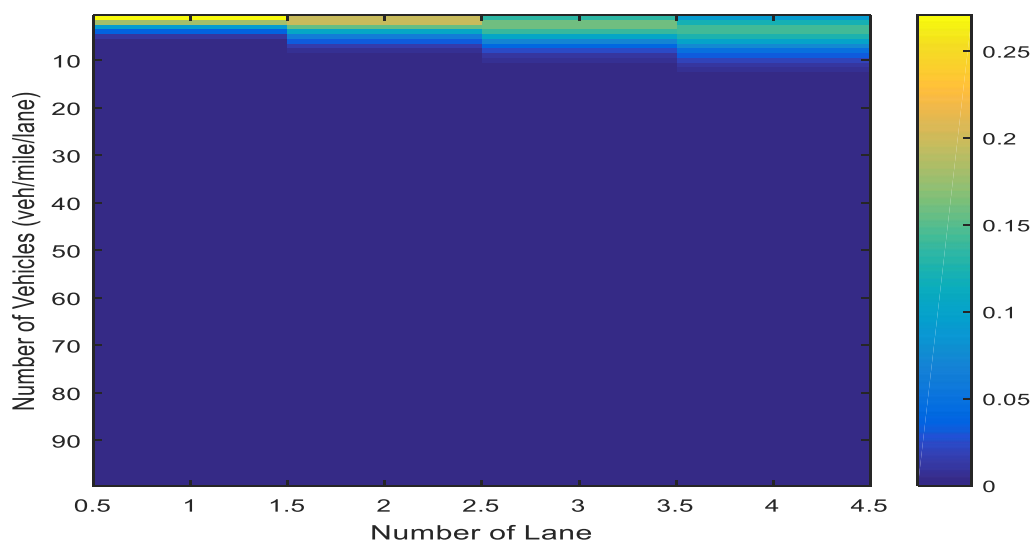


Figure 4.2a The effect of traffic flow when $\lambda = 2$



4.2.4 Under dense network conditions with $\lambda = 4$

With $\lambda = 4$, the traffic flow in the four lanes exhibits a complete normal distribution in lane 3 and lane 4, reflecting an increased number of vehicles, as depicted in Figures 4.4a and 4.4b. During this phase, Lane 3 and Lane 4 experience congestion, with Lane 4 having the highest vehicle count, necessitating the highest priority for reception rate before Lane 3. Lane 1, although still the least congested, sees an increased number of vehicles with the rise in λ . Notably, lane 1 exhibits higher mobility than lane 2, given that the number of vehicles in lane 2 surpasses that in lane 1, establishing lane 1 with the highest mobility rate.

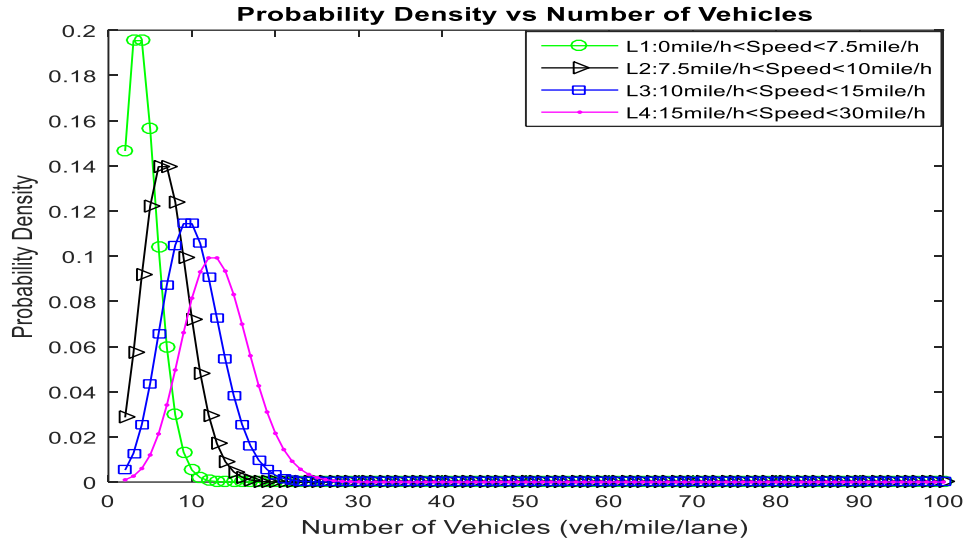


Figure 4.4a The effect of traffic flow when $\lambda = 4$

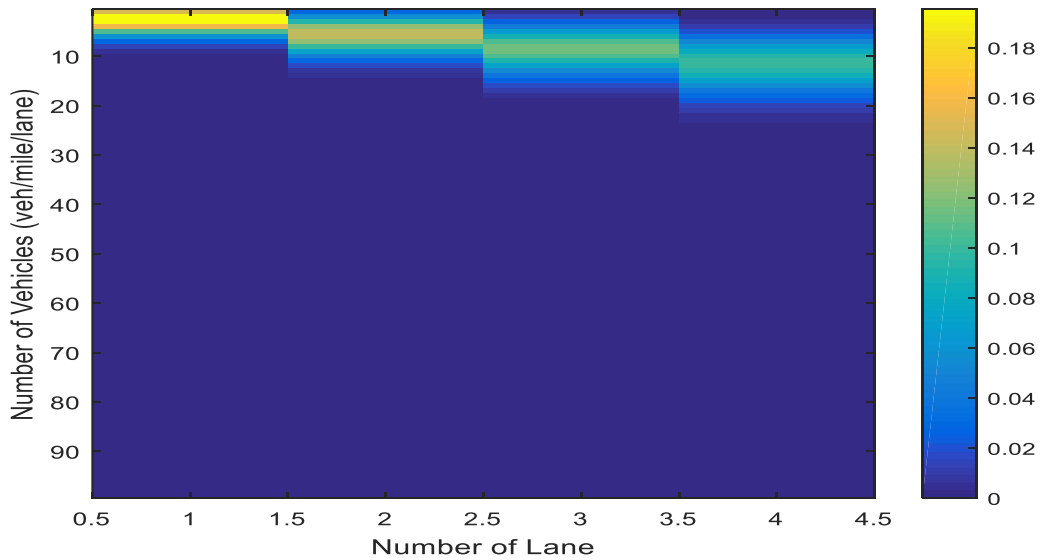


Figure 4.4b Vehicle trajectories in each lane

4.2.7 Under dense network conditions with $\lambda = 7$

In the scenario where λ equals 7, the traffic flow exhibits a complete normal distribution in lane 2, lane 3, and lane 4. Notably, lane 4 takes precedence in terms of packet reception, followed subsequently by lane 3. It is crucial to observe that as the value of λ increases, there is a notable and proportional increase in all four lanes. This observation indicates a direct correlation between traffic density and speed, as illustrated in Figures 4.7a and 4.7b.

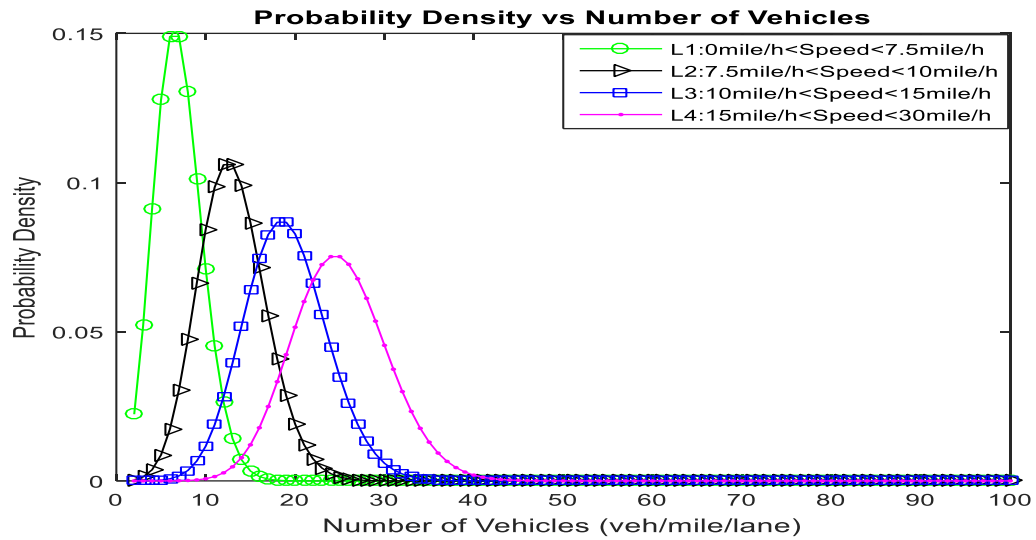


Figure 4.7a The effect of traffic flow when $\lambda = 7$

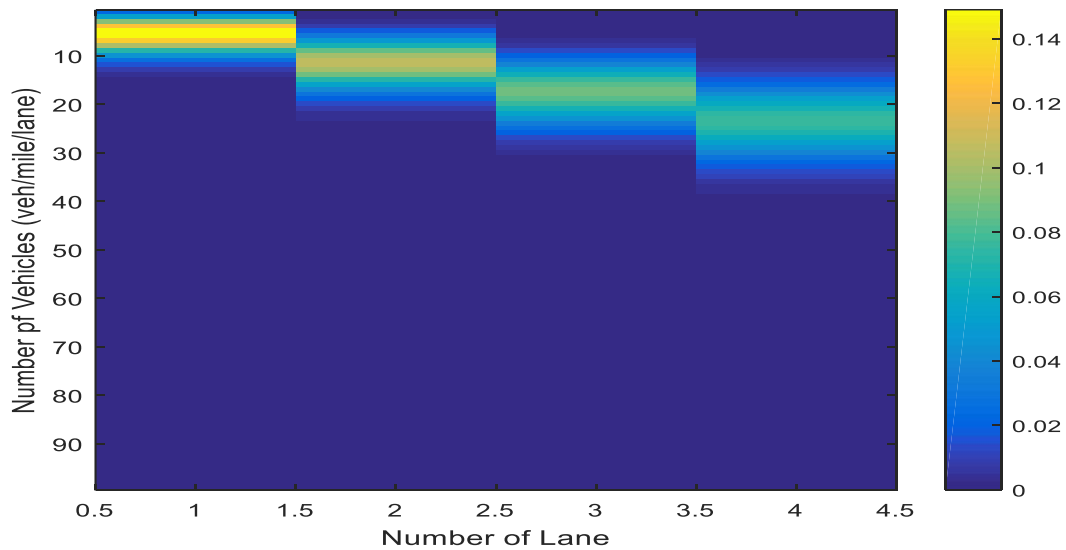


Figure 4.7b Vehicle trajectories in each lane

4.3 Congestion Control Models in Four-Lane Networks

In this study, Four-Lane Mobility in VANETs was employed to investigate congestion control within a network experiencing increased traffic density, akin to the scenario depicted in Figure 2.5. The impact of varying values of λ , ranging from 1 to 10, is illustrated in Figures 4.11 and 4.12. Additionally, the congestion control model's combined effects resemble a Phase transition (refer to Figure 2.5). These transitions are exemplified in the congestion control models, showcasing the effects of the λ parameter in Figures 4.11, 4.12, and 4.13 as detailed below.

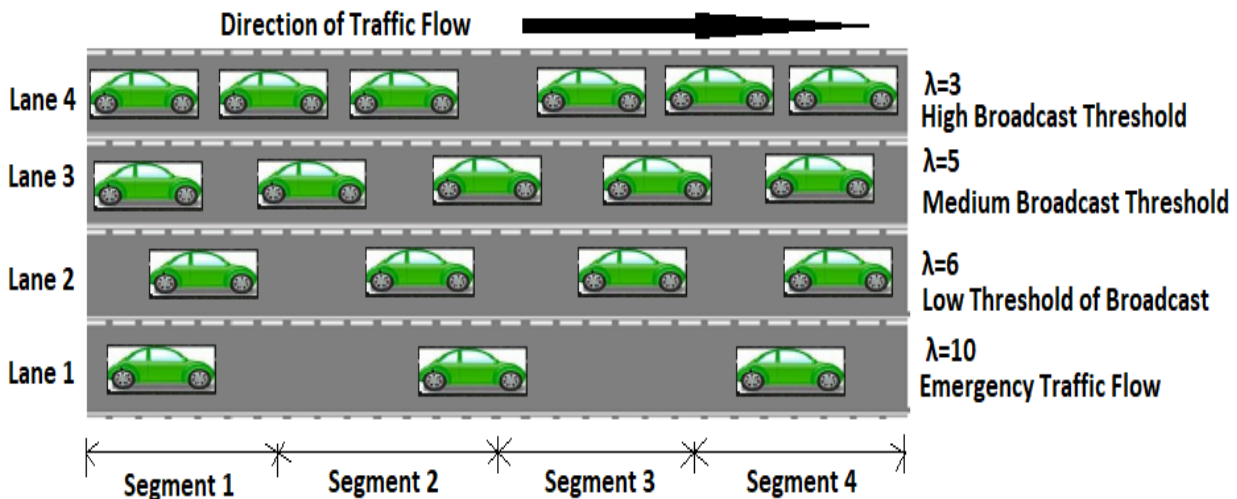


Figure 4.11 Four-Lane at the right side of the road showing the direction and movement of the vehicle

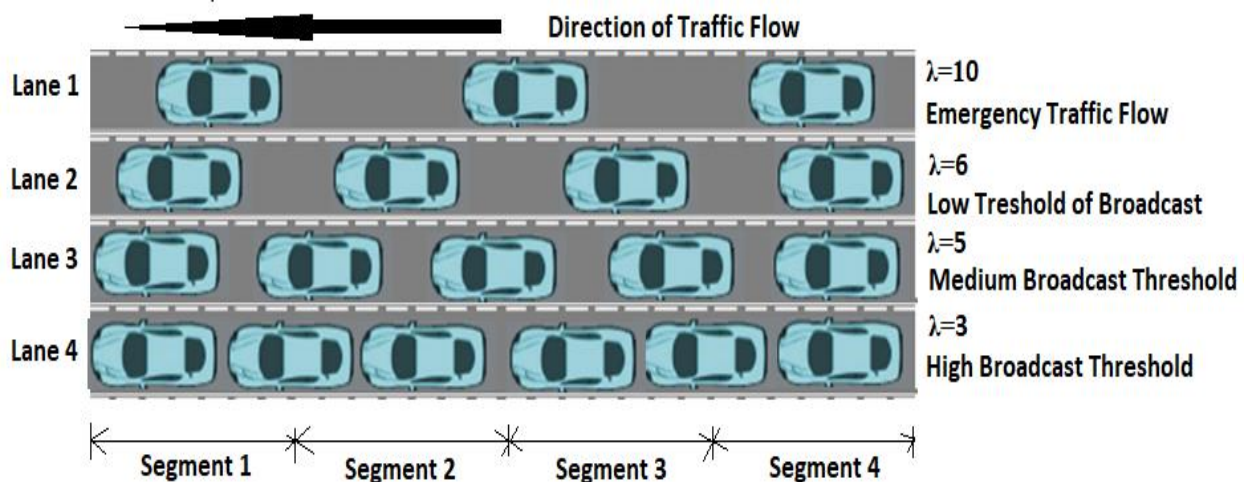


Figure 4.12 Four-Lane at the left side of the road showing the opposite direction and movement of vehicles