Traffic Flow Parameters

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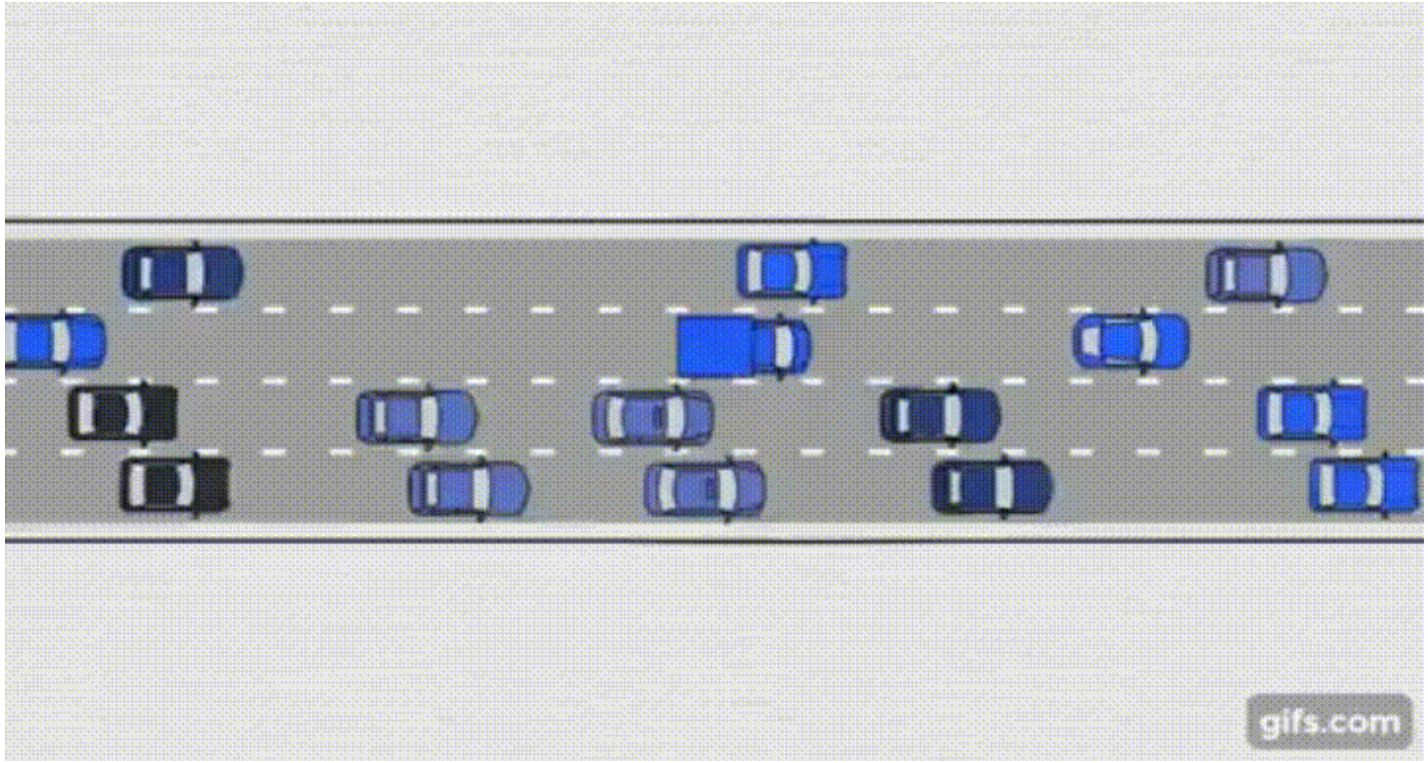
Introduction

What are Traffic Stream ?



What are Traffic parameters?

- The traffic stream includes a *combination of driver and vehicle behavior.*
- The driver or human behavior being non-uniform, traffic stream is also *non-uniform in nature.*
- It is influenced not only by the individual characteristics of both vehicle and human but also by the *way a group of such units interacts* with each other.
- Thus a flow of traffic through a street of defined characteristics will vary both by location and time corresponding to the changes in the human behavior.

Why Traffic parameters?

- Thus the traffic stream itself is having some parameters on which the characteristics can be predicted.

- The parameters can be mainly classified as :
  measurements of quantity, which includes density and flow of traffic and *measurements of quality* which includes speed.

- The traffic stream parameters can be *macroscopic* which characterizes the traffic as a whole or microscopic which studies the behavior of individual vehicle in the stream with respect to each other.

Macroscopic characteristics

- Speed , density and flow

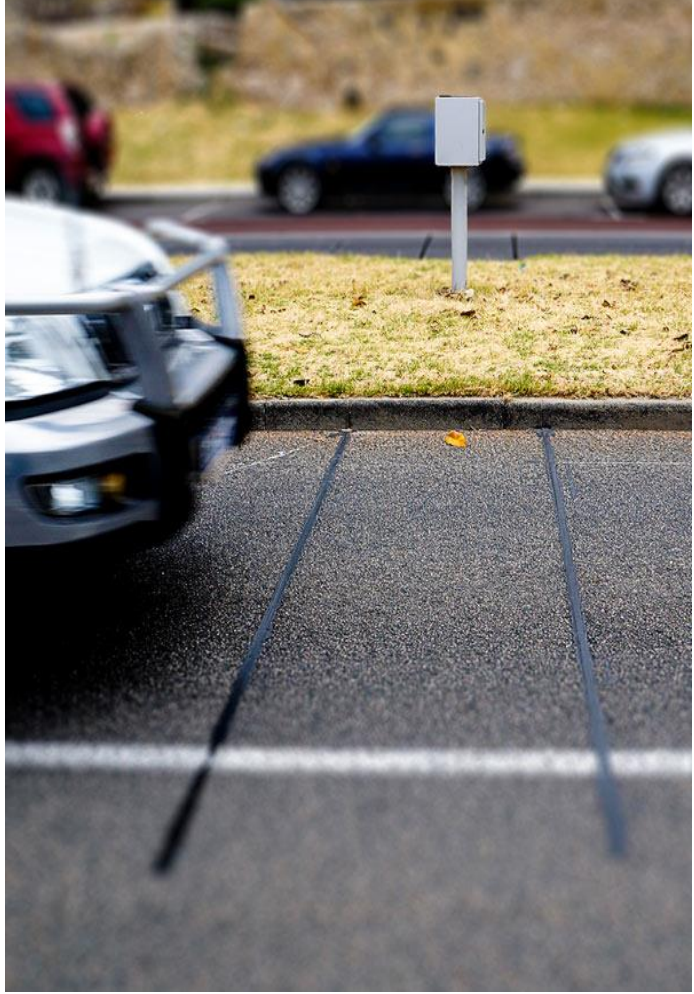
Microscopic characteristics

- Measure of Separations

Speed

Speed is considered as a quality measurement of travel as the drivers and passengers will be concerned more about the speed of the journey. It is defined as the rate of motion in distance per unit of time

$$v = \frac{d}{t}$$



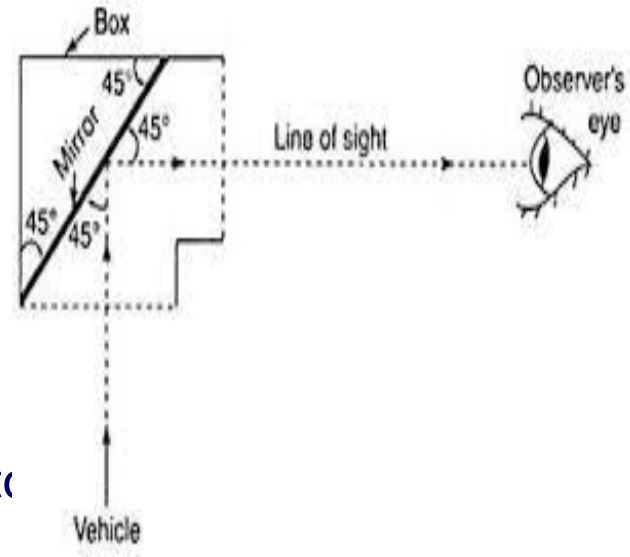
Source: https://www.strongtowns.org/journal/2016/5/9/ask-r-moses-how-do-traffic-counts-work

Speed

Speed of different vehicles will vary with respect to time and space. To represent these variation, several types of speed can be defined. Important among them are

- spot speed
- running speed
- journey speed
- time mean speed
- space mean speed

Spot Speed



- *instantaneous speed of a vehicle* at a specified location
- used to design the geometry of road like horizontal and vertical curves, super elevation etc
- Location and size of signs, design of signals, safe speed, and speed zone determination, require the spot speed data
- Spot speed can be measured using an enoscope, pressure contact tubes or direct timing procedure or radar speedometer or by time-lapse photographic methods

Running Speed

- the average speed maintained over a particular course while the vehicle is moving is called running speed.
- It is found by dividing the length of the course by the time duration the vehicle was in motion
- this speed *doesn't consider the time during which the vehicle is brought to a stop*, or has to wait till it has a clear road ahead.
- the running speed will always be more than or equal to the journey speed

Journey Speed

- distance between the two points divided by the total time taken for the vehicle to complete the journey including any stopped time.
- if the journey speed is less than running speed, it indicates that the journey follows a stop-go condition with enforced acceleration and deceleration.
- The spot speed here *may vary from zero to some maximum* in excess of the running speed.
- A uniformity between journey and running speeds denotes comfortable travel conditions.

Time mean speed and space mean speed

- Time mean speed is defined *as the average speed of all the vehicles passing a point on a highway over some specified time period.*
- Space mean speed is defined as the *average speed of all the vehicles occupying a given section of a highway over some specified time period.*
- Both mean speeds will always be different from each other except in the unlikely event that all vehicles are traveling at the same speed.
- ***Time mean speed is a point measurement while space mean speed is a measure relating to length of highway or lane***

Flow

Flow..

- the number of vehicles that pass a point on a highway or a given lane or direction of a highway during a specific time interval.
- The measurement is carried out by counting the number of vehicles, passing a particular point in one lane in a defined period
- expressed in **vehicles/hour**
- Flow is expressed in planning and design field taking a day as the measurement of time
- *The flow with which the traffic moves shows the ability of the network to facilitate fast through-fare and allows travellers to reach their destination more quickly*

Types of volume measurement

1. **Average Annual Daily Traffic(AADT)** : The average 24-hour traffic volume at a given location over a full 365-day year, i.e. the total number of vehicles passing the site in a year divided by 365.

2. **Average Annual Weekday Traffic(AAWT)** : The average 24-hour traffic volume occurring on weekdays over a full year. It is computed by dividing the total weekday traffic volume for the year by 260.

Types of volume measurement

3. Average Daily Traffic(ADT) : An average 24-hour traffic volume at a given location for some period of time less than a year. It may be measured for six months, a season, a month, a week, or as little as two days. An ADT is a valid number only for the period over which it was measured.

4. **Average Weekday Traffic(AWT)** : An average 24-hour traffic volume occurring on weekdays for some period of time less than one year, such as for a month or a season.

Table 5.1: Illustration of Daily Volume Parameters

1. Month	2. No. of Weekdays in Month (days)	3. Total Days in Month (days)	4. Total Monthly Volume (vehs)	5. Total Weekday Volume (vehs)	6. AWT 5/2 (veh/day)	7. ADT 4/3 (veh/day)
Jan	22	31	425,000	208,000	9,455	13,710
Feb	20	28	410,000	220,000	11,000	14,643
Mar	22	31	385,000	185,000	8,409	12,419
Apr	22	30	400,000	200,000	9,091	13,333
May	21	31	450,000	215,000	10,238	14,516
Jun	22	30	500,000	230,000	10,455	16,667
Jul	23	31	580,000	260,000	11,304	18,710
Aug	21	31	570,000	260,000	12,381	18,387
Sep	22	30	490,000	205,000	9,318	16,333
Oct	22	31	420,000	190,000	8,636	13,548
Nov	21	30	415,000	200,000	9,524	13,833
Dec	22	31	400,000	210,000	9,545	12,903
Total	**260**	**365**	**5,445,000**	**2,583,000**	—	—

AADT = 5,445,000/365 = 14,918 veh/day

AAWT = 2,583,000/260 = 9,935 veh/day

Table 5.3: Illustration of Volumes and Rates of Flow

Time Interval	Volume for Time Interval (vehs)	Rate of Flow for Time Interval (vehs/h)
5:00–5:15 PM	1,000	1,000/0.25 = 4,000
5:15–5:30 PM	1,100	1,100/0.25 = 4,400
5:30–5:45 PM	1,200	1,200/0.25 = 4,800
5:45–6:00 PM	900	900/0.25 = 3,600
5:00–6:00 PM	Σ = 4,200	

Density

- Density is defined as the *number of vehicles occupying a given length* of highway or lane and is generally expressed as vehicles per km

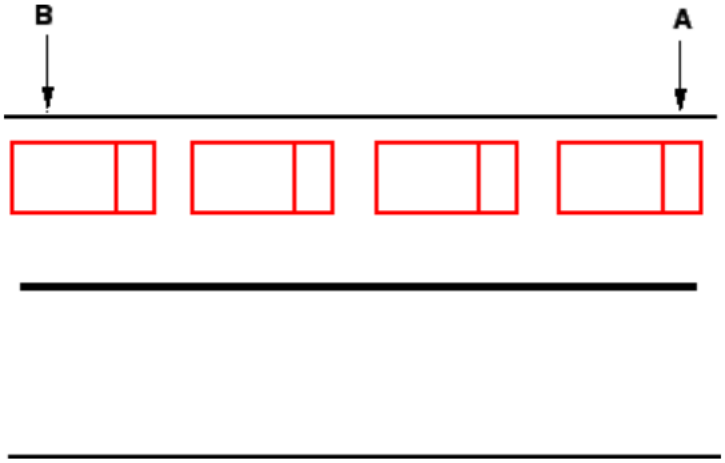
- Density is also equally important as flow but from a different angle as it is the measure most directly related to traffic demand.

- Again it *measures the proximity of vehicles in the stream* which in turn affects the freedom to maneuver and comfortable driving.

Density

If nx number of vehicles are occupying x distance of a road way then density is given as

$$k = \frac{n_x}{x}$$



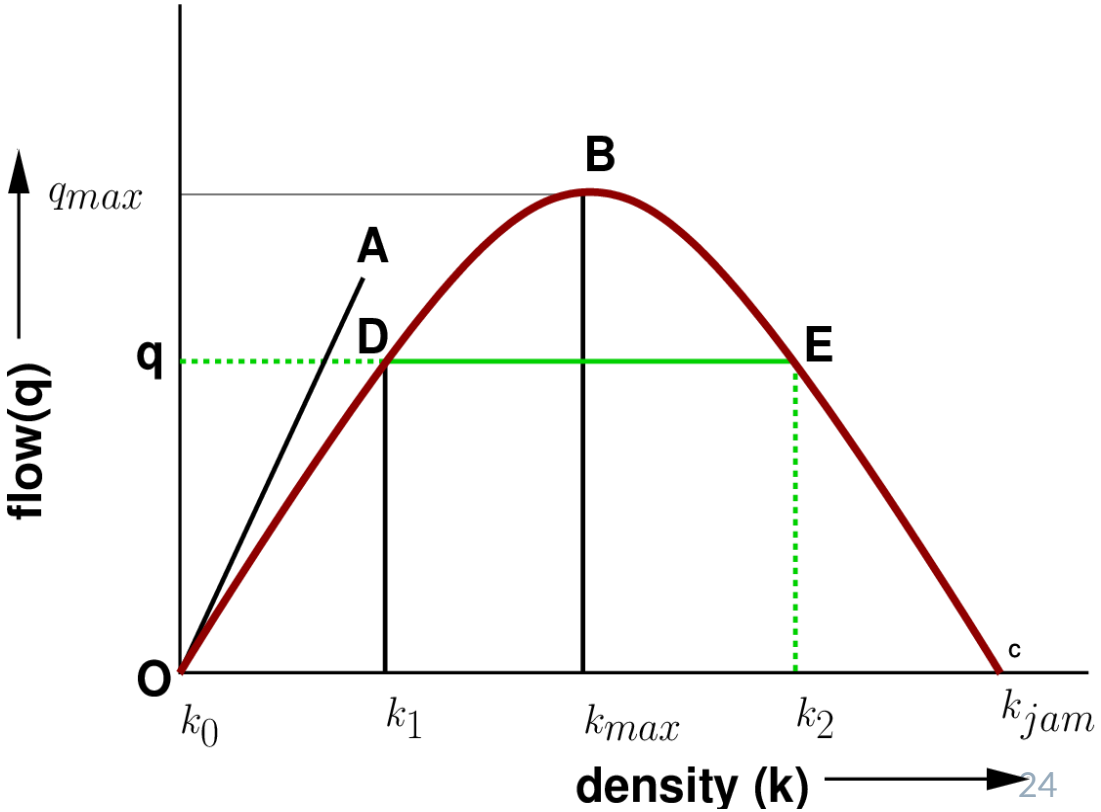
Relation between Flow, Density and speed

- Flow is given by multiplying the density of the traffic (k) and the speed at which the traffic is travelling (v)

$$q=k*v$$

Relation between Flow, Density and speed

The relation between the density and the corresponding flow on a given stretch of road is referred to as one of the *fundamental diagram of traffic flow.* Some characteristics of an ideal flow-density relationship is listed below:

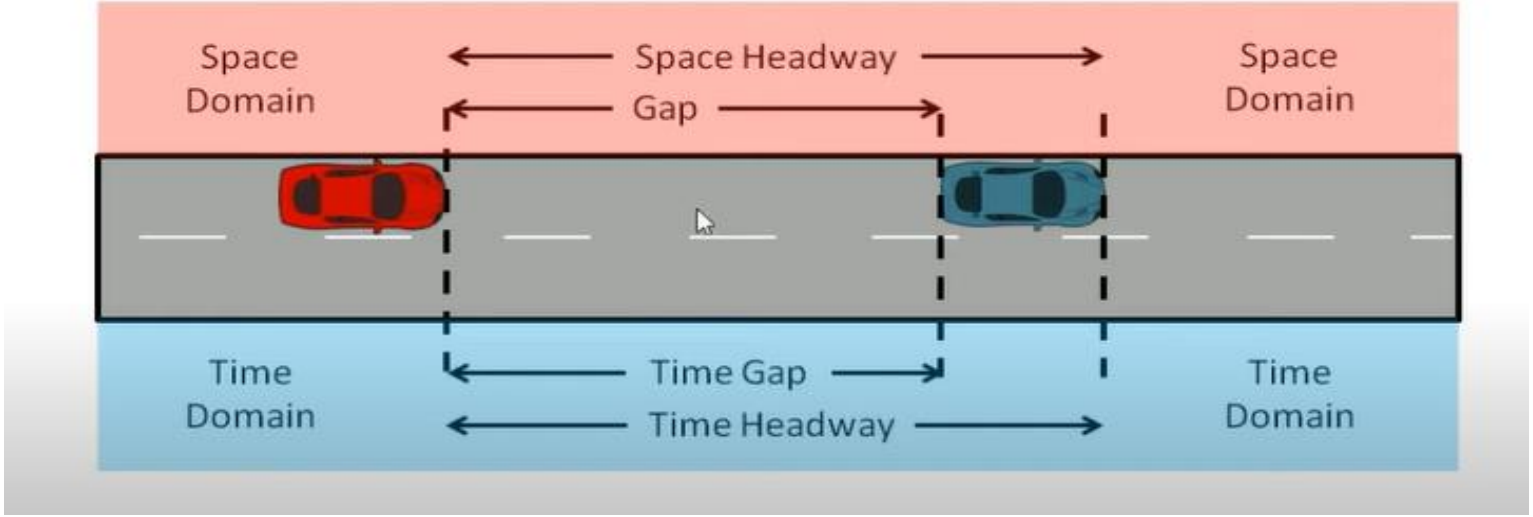


Relation between Flow, Density and speed

- When the density is zero, flow will also be zero,since there is no vehicles on the road.
- When the number of vehicles gradually increases the density as well as flow increases.
- When more and more vehicles are added, it reaches a situation where vehicles can’t move. This is referred to as the jam density or the maximum density. At jam density, flow will be zero because the vehicles are not moving.
- There will be some density between zero density and jam density, when the flow is maximum.

Microscopic Parameters

Headway and Gap



Time Headway

- Time headway is defined as *the time difference between any two successive vehicles when they cross a given point*. Practically, it involves the measurement of time between the passage of one rear bumper and the next past a given point. If all headways are added

$$\sum_{1}^{n_t} h_i = t$$

But the flow is defined as the number of vehicles n_t measured in time interval t, that is,

$$q = \frac{n_t}{t} = \frac{n_t}{\sum_1^{n_t} h_i} = \frac{1}{h_{av}}$$

Time Headway

- The average time headway is the inverse of flow and is sometimes Simply referred to as headway.

Space Headway

- It is defined as the *distance between corresponding points of two successive vehicles at any given time*. It involves the measurement from a photograph, the distance from rear bumper of lead vehicle to rear bumper of following vehicle at a point of time. If all space headways are added

$$\sum_{1}^{n_x} s_i = x$$

But the density (k) is the number of vehicles n_x at a distance of x, that is

$$k = \frac{n_x}{x} = \frac{n_x}{\sum_1^{n_x} s_i} = \frac{1}{s_{av}}$$

Space Headway

- The average distance headway is the inverse of density and is sometimes called as spacing.

Time Space Diagram

Time -Space Diagram

- Time space diagram is a convenient tool in understanding the movement of vehicles.

- It shows the *trajectory of vehicles* in the form of a two dimensional plot.

- Time space diagram can be plotted for a single vehicle as well as multiple vehicles

Time -Space Diagram

- The time-space diagram is a graph that describes the *relationship between the location of vehicles in a traffic stream and the time as the vehicles progress along the highway*
- Typically, time is drawn on the horizontal axis and distance from a reference point on the vertical axis.
- The trajectories of individual vehicles in motion are portrayed in this diagram by sloping lines, and stationary vehicles are represented by horizontal lines.
- The slope of the line represents the speed of the vehicle.
- Curved portions of the trajectories represent vehicles undergoing speed changes such as deceleration.

Time -Space Diagram

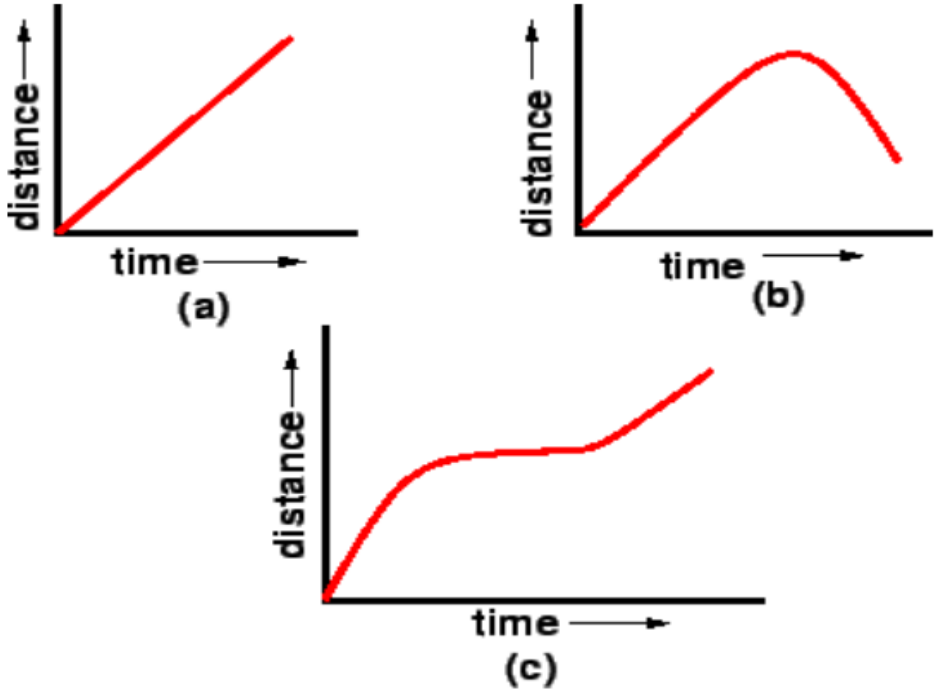


Figure 2: Time space diagram for a single vehicle

Time -Space Diagram

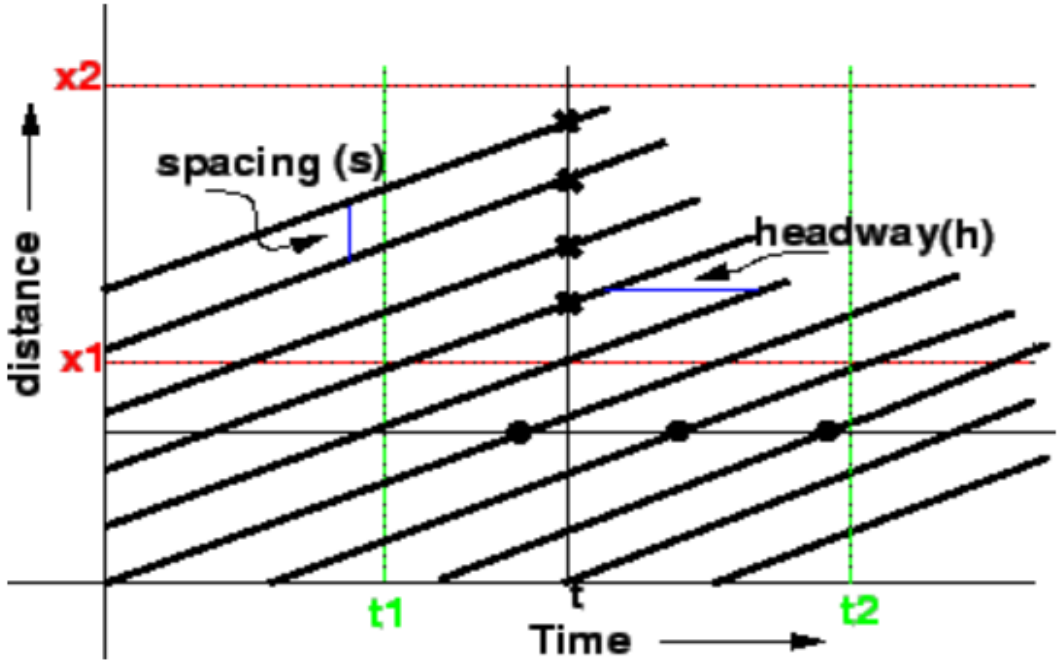
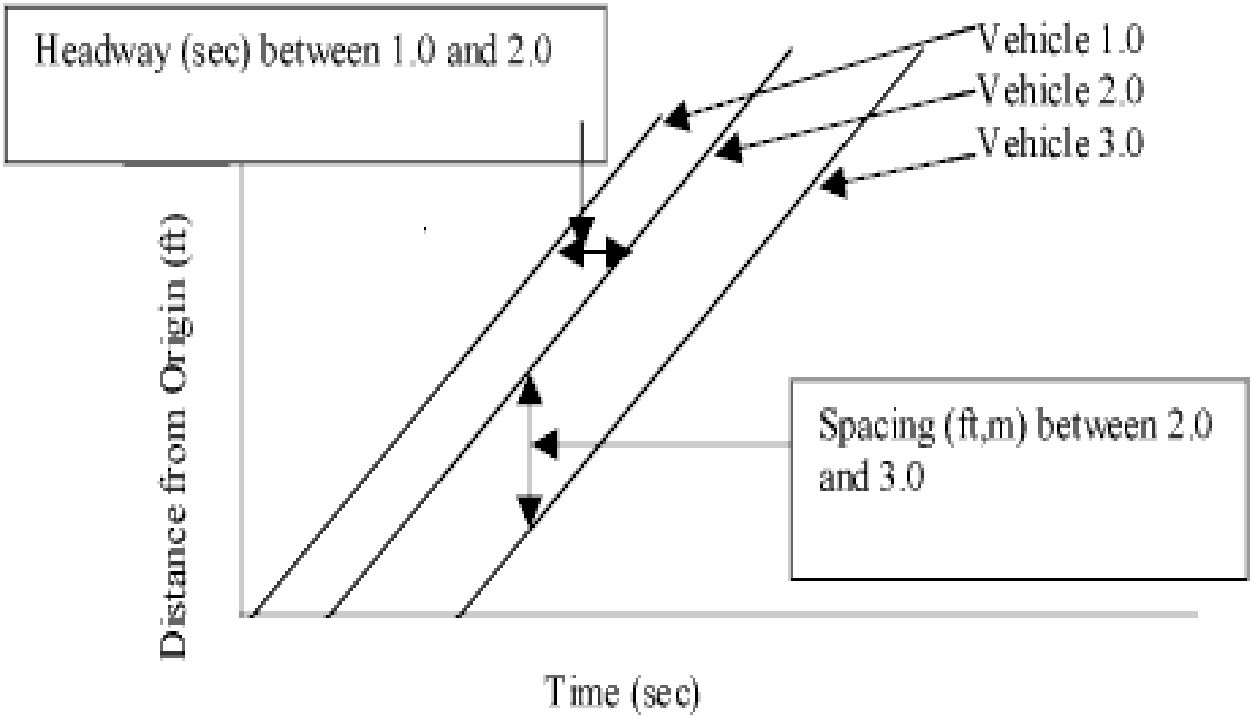


Figure 3: Time space diagram for many vehicles

Time -Space Diagram



Thanks!

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