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Traffic Flow Management Based on Theory of Queuing Models

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ABSTRACT

Today the population increased drastically which leads to formation of congestion by arising the different problems which show negative effect on the environment also produces major problems which were related with traffic management system and by observing the increased population. It was seen that the traffic management system is unexpected to scale to the projected increased in traffic over the next some decades by enhancing the co-ordination between controllers and the users of management system of traffic department could decreased the effect of observing traffic flow problems. In the current paper we summarized different models on the Basis of Queuing theory that has been proposed for collaboration of traffic flow management on the Basis of Queuing theory we can analyzed different issues of traffic Management System. The different the models presented in the paper on the Basis of Queuing theory developed a new approach towards the uninterrupted traffic flow system.

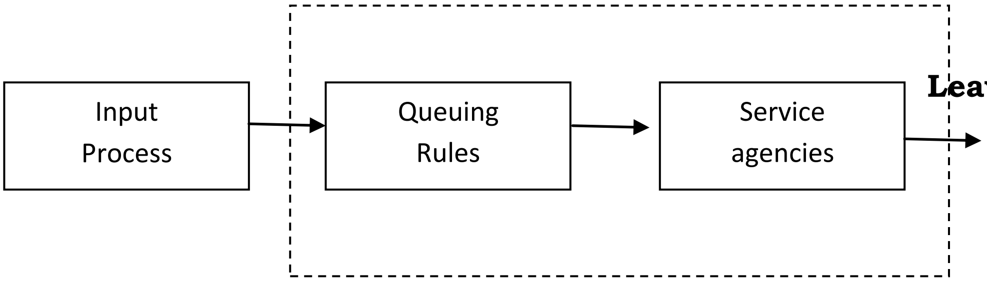
Keywords:*Traffic flow, Queuing Model, Collaboration, Uninterrupted.*

INTRODUCTION:

Queuing theory is one of the mathematical theory based on queuing system in daily life people will encounter all sorts of queuing problems including standing at bus stop, going to market, going to ticket office to buy the tickets and soon. In there problems the different people forms a queuing systems or a service system respectively. The former can be regarded as service agencies and the latter can be regarded as customers.The queue can be tangible queue may also be intangible queue for example several passengers make telephone call to order train ticket at the same time if passengers is on the phone can only wait for the other passenger this form of queue is invisible the people or some objects can be the queue such as semi finished products for processing in the production line machine waiting for maintenance and the information waiting for computing centre to process etc.

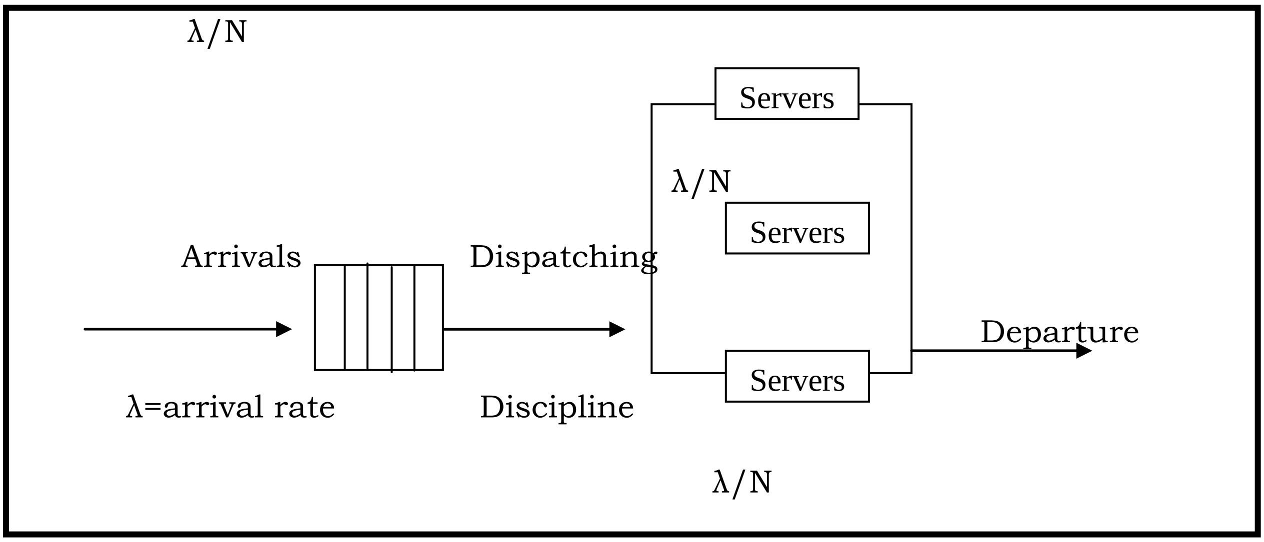
Queuing theory consist of three parts. Input process, queuing rules and service agencies.

Service System



The queuing theory can be divided into single channel queuing System and Multichannel queuing system. In multichannel queuing system multi server models are applied which shows following

Multi server Mode



Assumptions in Queuing Models.

- Arrival Pattern
- Departure Characteristics
- Queue discipline

Arrival Pattern:

The Arrival Pattern contains two arrival patterns one of which is equal time interval and exponentially distributed time interval

Departure Characteristics:

It is the distribution of the amount of time. It takes a vehicle to depart on a particular service centre.

The number of service station or departure channels.

Queue discipline:

It contains FIFO which shows that the first vehicle to arrive is the first vehicle to depart and also it includes (LIFO) which shows that the last vehicle to arrive is the first to depart.

Purpose of traffic Queuing Models:

The main purpose of this model is to provide different ways which estimate important measure of highway performance including vehicle delay and traffic queue length

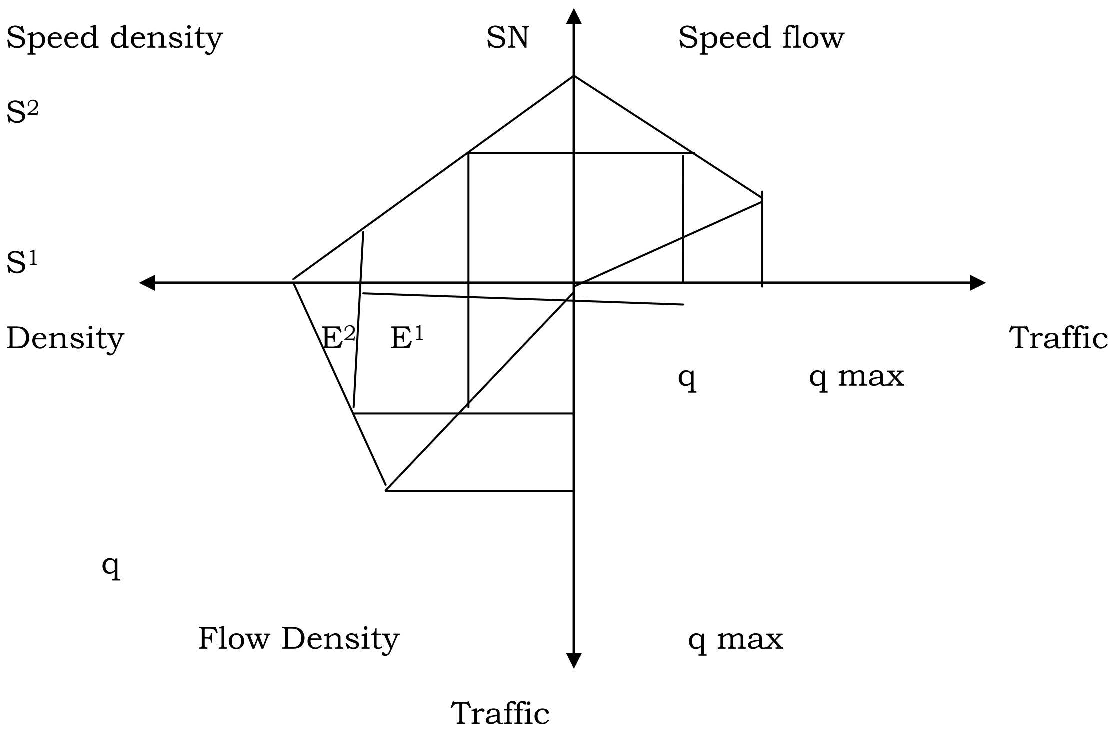
Queuing Approach to traffic Flow Management:

In this system the roads are subdivided into segment with length equal to minimal space needed by one vehicle on the road by defining C is the maximum average traffic density and the length is then equal to 1/C and matches the minimal space needed by are vehicle on that road. Each road segment is then considered as a service station in which vehicle arrived at certain rate and yet served at another rate.

It is often observed that the speed for certain time period tends to be reproduce whenever the same flow is observed based on this observation it seems responsible to stationary there should be relationship between flow, speed and density.

Speed flow density diagram

Effective Speed



Queuing Models:

It is defined by 3 alphanumeric Models

(1) The first value indicates the arrival rate assumption.

(2) .The second value gives the departure rate assumption.

(3) The third value indicates the number of departure channels.

The M/M/1 Model:

The time of inter arrival are exponentially distributed with expected inter arrival time which is equal to 1/ λ. The service time delineates the time needed for a vehicle to pass one road segment and is exponentially distributed with expected service time μ when the vehicle drives at normal speed SN the service time can be written as $1/(SN^0C)$ & μ equals to the product of nominal speed SN with the maximum traffic density C

by using formula for λ & μ we can obtained W as

$$W=\frac{1}{\mu-\lambda}=\frac{1}{SN*(C-E)} \quad \text{------ (1)}$$

by using expression for W the effective speed and relative speed are obtained.

$$S=\frac{SB\,(C-E)}{C}=SN*(1-\rho) \quad \frac{r-s1}{SN}=1-\rho \quad \text{------ (2)}$$

with ρ is the traffic intensity

$$\rho=\frac{\lambda}{\mu}=\frac{E}{C} \quad \text{--------------------(3)}$$

Substituting for E=(q/s) in (2) eq^n then the following expression are obtained.

$$\&(s.q)=S^1*C-S*C*SN+SN*q=O \text{ ------------(4)}$$

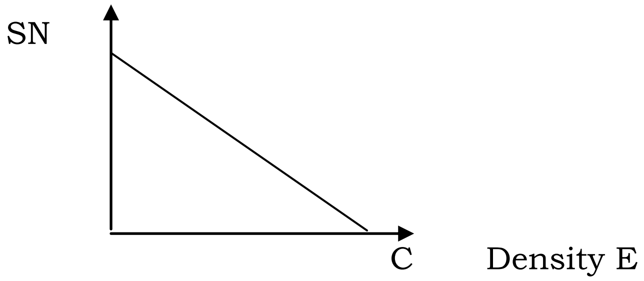
q max can be written as

$$q\ max\ \frac{SN*C}{4} \quad \text{------------------------(5)}$$

From the above eq^n it is concluded that there exist negative relationship between effective speed and traffic density E.

If the traffic density is law vehicle do not obstruct one another which leads to higher effective speed when more vehicle arrive on the road the effective speed S decreases

Effectove Speeds (KM/h)



The Speed Density dia for M/M/1 model

M/G/1 Model:

As in the M/M/1 model inter arrival time follows as exponential distribution with expected inter arrival time 1/ λ is the product of traffic density and normal speed the service time however is generally distributed with an expected service time of 1/ μ and standard deviation of 6 expected service rate it μ which equals to the product of normal speed SN with maximum traffic density C.

Acc to combining Little's th^m & Pollaczek Khintchin-e formula for L^5 and putting λ & μ we can obtained the following formula for the total time in the system W: $= \frac{1}{SN*C} + \frac{\rho^2 + SN^2 * E^2 * 6^2}{2*SN*E\,(1-\rho)}$

by using above expression for W effective and relative speed can be calculated in the analog way which was seen in M/M/1 model.

$$S: = \frac{2*SN*(C-E)}{2*C+E*(\beta^2-1)} = \frac{2*SN*(1-\rho)}{2*\rho*(\beta^2-1)}$$

$$r = \frac{2*(1-\rho)}{2+\rho*(\beta^2-1)}$$

by using above formula we can construct speed flow, speed density and flow density diagram for the M/G/1 model the exact shape of these curve depends on variation coefficient of the service time β

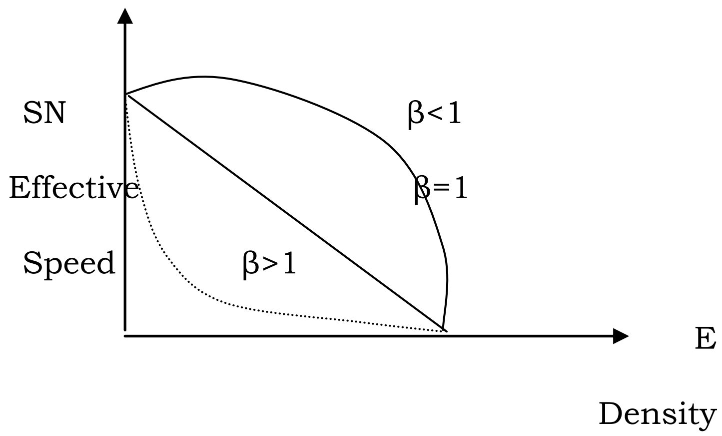
The speed density diagram for M/G/1 model, let E=(q/s)

$F(s_1q)=2*(*s^2+[q*(\beta^2-1)-2*C*SN]*S+2*q*SN=O$

Maximizing this eq^n for S we can calculate maximum traffic flow

$$q\ max = 2*SN*C*\left|\frac{\sqrt{\beta^2+1}-\sqrt{2}}{\beta-1}\right| \quad \beta>,O$$

$$q\ max = \frac{SN*C}{4} \quad \beta=1$$



G/G/1 Model:

With the G/G/1 model both arrival time and service time follows a general distribution with expected arrival time 1/λ and standard deviation *6* expected service time 1/μ and standard deviation of *6b* respectively consequently the shape of the speed flow density diagrams will depend not only on the variance of the service time but also on the variance of the inter arrival times.

Acc to combining Little's thM and the Kroener Lagen bach Betz formula for Land substituting for λ and μ we obtained the following formulas for the total time in the system W$\frac{-2^*(1-\rho)^*(1-ca^2)^2}{3^*\rho^*(ca^2+cs^2)}, c_q^2 < 1$

$$W=\frac{1}{SN^*C}+\frac{\rho^{2*}(ca^2+cs^2)}{2^*SN^*E^*(1-\rho)}*\rho$$

$$W=\frac{1}{SN^*C}+\frac{\rho^{2*}(ca^2+cs^2)}{2^*SN^*E^*(1-\rho)}*\rho \quad \frac{-(1-\rho)*(Ca^2-1)^2}{(1-\rho)*(Ca^2+C_S^2)}, Ca^2>1$$

With Ca^2 representing the square coefficient of variation of inter arrival times.

CONCLUSION:

Based on queuing theory we analytically constructed the speed flow density alagram using queuing model speed is determined based on different arrival and service processes. The current paper presented the traffic flow Queuing Model. The analytical tool used is queuing system. These analytic models allow for parameterised experiments, also in current research the crucial modelling parameters are deeply studied. The network of road and its traffic are explained by queuing system which approaches the result is speed and densities in every mode which allows for sensitivity analysis and evaluation of policy actions traffic management congestion control, traffic design and the environmental impact of road traffic.

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