# Travel Time Reliability Based Traffic Assignment Model for an Urban Road Network in New Delhi

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**ABSTRACT**: Driver's behaviour in traffic congestion is different from that in uncongested traffic condition. When traffic is uncongested motorists choose the path on basis of travel time. But in traffic congestion, motorists might choose the path based on travel time reliability due to uncertain from the system. The objective of the study is to introduce travel time reliability based traffic assignment techniques for road transport network. For this, Method of Successive Average (MSA) solution algorithm is considered for solving user equilibrium assignment and reliability based user equilibrium technique. The developed   Reliability User Equilibrium (RUE) model is applied to a small urban road network connecting origin (CRRI) destination (Ashram Chowk) on NH2 and an alternative path connecting the same origin and destination. Speed and travel time data is collected using Probe vehicle technique and Traffic volume data has been considered from the previous surveys. Preliminary data analysis has been done to find travel time, average speed, running speed and delay. These data were used to model the conventional travel time assignment model using MSA algorithm for traffic assignment. Link/ path travel time reliability modeled by considering Weibull probability distribution function. Results observed from   this study emphasises that RUE based assignment based model are efficient than the UE based model in route choice assignment under uncertain conditions. Further study is required to implement on medium size road network

**KEYWORDS**: Travel time reliability; reliabilty user equilibrium; method odf successive averages algorithm

## I.        INTRODUCTION

Reliable transportation system provides safe accessibility and efficient movement of people and goods. In road network, reliability is defined as the network which can guarantee an acceptable level of service for road traffic even if the function of some links are physically damaged or large amount of travel demand  is occasionally generated (Asakura and Kashiwadani,1991). In the available literatures regarding travel time reliability, most of engineering studies assumes reliability analysis as a physical event. Physical components might only be two states i.e. operation or failures (One or Zero variable denoting the states of components). This type of reliability analysis is identical to connectivity reliability in the studies of road network reliabilities. This type reliability analysis is suitable for abnormal situation such as earth quakes, landslides etc. In modelling real transport network, this assumption does not hold, due to events that may occur due to normal daily traffic conditions. The importance of travel time reliability and its necessity in daily traffic flow situations leads us to study about the various developments that took place in travel time reliability. These studies, useful to decide on the priorities of expanding the capacities of the road network will have to be determined on a rational basis so that the budget available can be scientifically allocated to various links of the road network.  In this respect the travel time reliability studies will be of great help. The need for such study has been realised and attempted in present study. Therefore there is a need to evolve the methodology and arrive at the results of travel time reliability for the networks in India.

Furthermore, the methodology of reliability based traffic assignment technique is also discussed and how this technique has been applied to a simple road network of an urban corridor in Delhi has been illustrated.

## II.      OBJECTIVE

The objective of this study is to study the necessity of travel time reliability analysis for urban road network and to develop a methodology for reliability based traffic assignment models.

## III.      METHODOLOGY

To find out the travel time reliability, speed and travel time related data is collected using Probe vehicle technique. Classified traffic volume count survey was conducted for 16 hours in the area.

## IV.      DATA COLLECTION, MODELLING AND ANALYSIS

Three routes are considered to illustrate the reliability based traffic assignment technique. For this an urban corridor on National Highway Number 2 of Delhi-Mathura road and two alternative path connecting the CRRI Signal and Ashram Intersection has been considered.  Preliminary data analysis has been done to estimate travel time, average speed, running speed and delay for each link. These data is used to model the conventional UE assignment model by considering MSA algorithm (SheffI.Y, 1985) for solving traffic assignment problem. The link performance functions are developed for each of the routes and Weibull probability distribution function has been considered to model the link travel time reliability. These models are used for RUE based traffic assignment. The schematic representation of the study area is shown in Figure 1 below.
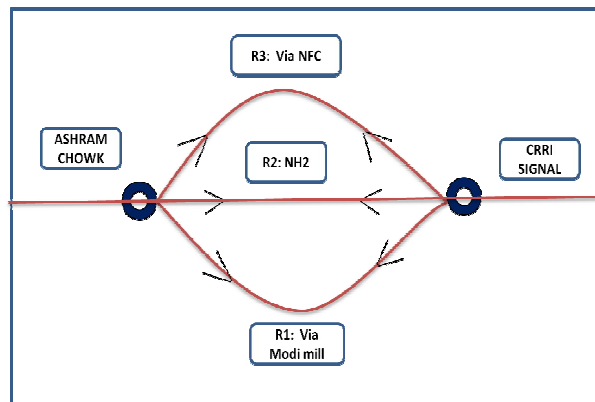


Figure 1- Schematic representation of the study area

## V.      RUE ALGORITHM

The standard Method of Successive Average (MSA) algorithm is modified for solving RUE based traffic assignment problem.  The algorithm, when applied to the solution of the Reliability based traffic assignment problem is summarized as follows:

*Step 0:* Initialization and generation of a set of link flows $(X_a^1)$.

*Step 1:* Update the link travel time $\{T_a^n\}$ using the derived link flows.

*Step 2:* Update the link travel time reliability $\{R_a^n\}$,  with the link flows.

*Step 3:* Direction finding and all-or-nothing assignment based on the current set of travel time reliability, $\{R_a^n\}$. This yields an auxiliary link flow pattern $\{Y_a^n\}$.

*Step 4:* Move and find the new flow pattern

*Step 5:* Check the convergence criterion.

In this study assumed that the link travel time follows Weibull distribution and estimated link travel time reliability. With this initial travel time reliability, all-or-nothing traffic assignment is done. It gives the set of link flows, using which the link travel time and its reliability is estimated. Auxiliary link flow pattern is generated with the current reliability. The new flow pattern is then found by setting $X_a^{n+1} = X_a^n + (1/n)(Y_a^n - X_a^n)$. Numbers of iterations were considered as a convergence criteria. This RUE algorithm implemented to simple urban road network. The results and discussion of reliability based traffic assignment is compared with traditional User Equilibrium assignment techniques (Sheffi,Y 1985) in the subsequent sections. To solve the entire procedure a set of programme was developed in MATLAB environment.

## VI.    CONCLUSION AND RECOMMENDATION

Results observed from this study emphasizes that RUE based assignment based model are efficient than the UE based model in route choice assignment under uncertain conditions. Further study is required to implement on medium size road network.

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