8.1 DESCRIPTION OF TRANSPORT NETWORK

Route assignment, route choice, or traffic assignment concerns the selection of routes (alternative called paths) between origins and destinations in transportation networks. It is the fourth step in the conventional transportation forecasting model, following trip generation, trip distribution, and mode choice. The zonal interchange analysis of trip distribution provides origin-destination trip tables. Mode choice analysis tells which travellers will use which mode. To determine facility needs, costs and benefits, the number of travellers on each route and link of the network should be known (a route is simply a chain of links between an origin and destination), and therefore to undertake traffic (or trip) assignment. Suppose there is a network of highways and transit systems and a proposed addition. We first want to know the present pattern of traffic delay and then what would happen if the addition were made.

Each number of trips from a particular origin to a particular destination must be assigned to the alternative routes connecting the pair of nodes. While the path flows are of particular interest from the traveller’s point of view, the network designer is usually more interested in the corresponding link flows to detect bottlenecks.

8.1.1 Objectives of Traffic Assignment

During the classic traffic assignment stage a set of rules or principles is used to load a fixed trip matrix onto the network and thus produce a set of links flows. This is not, however, the only relevant output from the assignment stage; this has several objectives which are useful to consider in detail. Not all of them receive the same emphasis in all situations nor can be achieved with the same level of accuracy. The primary and secondary objectives of traffic assignment are:

1. Primary:
   - To obtain good aggregate network measures, e.g. total motorway flows, total revenue by bus service;
   - To estimate zone-to-zone travel costs (times) for a given level of demand;
   - To obtain reasonable link flows and to identify heavily congested links.
2. Secondary:
   - To estimate the routes used between each O-D pair;
   - To analyse which O-D pairs use a particular link or route;
   - To obtain turning movements for the design of future junctions.

In general terms we shall attain the primary objectives more accurately than the secondary ones. Even within objectives we are likely to be more accurate with those earlier in the list. This is essentially because our models are more likely to estimate correctly aggregate than disaggregate values.

It is a critical step in the sequential procedure, which determines link and OD travel times, thereby influencing OD choice and mode choice through a “feedback” mechanism, or through the solution of a route choice model integrated with a model of variable OD flows (demand). A schematic diagram for traffic assignment is given in Figure 8.1.

![Schematic Diagram for Depicting Traffic Assignment](image)

**Figure 8.1: Schematic Diagram for Depicting Traffic Assignment**

### 8.1.2 Inputs and Outputs in Assigning a Network

To carry out a traffic assignment, the following data are required:

1. The number of trips that will be made from one zone to another (this information was determined from trip distribution phase).
2. Available highway or transit routes between zones.
3. How long it will take to travel on each route.
4. A decision rule (or algorithm) that explains how motorists or transit users select a route.
5. External trips that were not considered in the previous trip generation and distribution steps.
All assignment techniques are based on route selection. The choice of route is based on several criteria such as travel time, length of travel, cost of travel, comfort, convenience and safety.

The highway network is described by a system of links and nodes (Figure 8.2).
**Link**: A link is a section of a highway network between two intersections.
**Node**: A node is either the centroid of a zone or the two or more intersections.

![Figure 8.2 Alternate Routes for Traffic Assignment](image)

The number of available paths between any pair of zones depends on the mode of travel. In the case of private transportation modes a driver has good deal of freedom to select a possible path between different sets of path variations. Private and public travel demand mainly depends upon travel time and travel cost. These aspects insist the vehicular traffic to select a particular path between any pairs of zones.

Traffic assignment is the stage of transportation network problem wherein the trip interchanges are allocated to the network. Assigning of a network gives the following outputs:

1. To estimate inter-zonal demand by mode.
2. To determine trip-maker’s choice of paths between all zones along the network.
3. To predict resulting flows on the individual links of the entire network of the considered mode.

Trip assignment processes involves earlier estimated demand and network description (links and nodes) as inputs and individual flows w.r.t individual links as outputs. The estimates of link utilization can be used to assess the likely level of service and to anticipate potential capacity problems.

### 8.1.3 Assumptions in Trip Assignments
- A time period of substantial length, compared with the duration of trips, in which the level of congestion in the network is relatively constant (either high or low); for
example, a period of one or two hours. Such models are static, in contrast to dynamic models.

- An input trip table giving the flow per hour from each origin zone to each destination zone.
- A road network description consisting of nodes, links and link travel a time-flow function, which increases indefinitely as flow increases without limit.
- In practice, the travel time pattern for each link is typically defined on its own flow, ignoring the flows of opposing or conflicting links. However the links nominal capacity may reflect the effect of intersecting links. The link capacity is not a strict upper limit on flow.
- Drivers have perfect information about travel times (deterministic), or perfect information plus a perception error (limited stochastic case), models with truly stochastic times are much more difficult, and not considered.

8.1.4 Applications of Trip Assignment

Some of the applications of traffic assignment analysis to the network are:

1. To determine the deficiencies in the existing transport system by assigning the future trips to the existing transport system.
2. To evaluate the effects of limited improvements and additions to the existing transport system by assigning estimated future trips to the improved networks.
3. To develop construction priorities by assigning estimated future trips for the intermediate years to the transport system proposed for those years.
4. To test alternative transportation system proposals by systematic and readily repeatable procedures.
5. To provide design hour volumes on highway and turning movements at junctions.

Thus the assignment processes is applicable for both transport planners and highway facility design engineers. The main need of traffic assignment processes is to evaluate:

- How the proposed transport system will work presently, and to the latter date.
- For the geometric design of highways and intersections.

Developments in computer technology made it possible to facilitate traffic assignment techniques computations so laborious. A computer network assignment procedure requires:

- A way of coding the modal network for computer processing.
- An understanding of the factors affecting the trip-maker’s path preferences.
- A computer algorithm that is capable of producing the trip-maker’s preferred paths.

For computer analysis, the network is coded, key punched and stored in the computer memory. The computer is then made to select the minimum path between the zones and assign predicted trips to these paths. Traffic volumes are thus accumulated for each section of the network.