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Progress Report

ISSUES RELATED TO THE IMPLEMENTATION OF HOT LANES AS FEEDERS FOR TREN URBANO PLAZAS

by

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ABSTRACT

This paper is based on the Tren Urbano (TU) Plaza concept and the use of High Occupancy Toll (HOT) lanes to provide express service for most of the trip from the TU Plaza to the nearest TU station. The site selection process used to identify the potential Plazas is described. The proposed Río Hondo Plaza is used as a case study. The study area is introduced and a detailed description of the existing highway network is provided. Then, a dynamic traffic assignment-simulation model is presented as a suitable tool to examine the effect of different scenarios on the average trip time of a network with an HOV/HOT facility. An 'imaginary' network was designed to examine and understand some basic aspects of the model. The preliminary results of the study indicated that external based trips to the Metropolitan Area predominate, providing the potential market for 'classical' commuter traffic of the park and ride type. In addition, a critical aspect for the success of the Plaza is to offer high-speed preferential access to the TU station. Further research is planned to evaluate the issues related to the implementation of HOT lanes as feeders for TU Plazas. The use of DYNASMART traffic simulation-assignment model to study congestion, user behavior and pricing structure for the HOT lanes is on its way.

KEY WORDS

Tren Urbano Plaza, High Occupancy Vehicle (HOV) Lanes, High Occupancy Toll (HOT) Lanes, Dynamic Traffic Assignment.

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CHAPTER 1

INTRODUCTION

Tren Urbano (TU) will offer a new mode for rapid travel in the urban core. To the extent that TU encourages travelers to change from autos to transit, the rapid transit line will reduce roadway congestion, in addition to improving travel for its users.

The auto dominates the current transportation network in the San Juan Metropolitan Area (SJMA). Puerto Rico has one of the highest vehicular densities in the world with approximately 6 out of 10 people owning a car. The private auto is viewed as flexible, reliable and predictable, and is the instinctive mode choice for travelers who have the option of using a car. However, regional roads are extremely congested for many hours every day. According to the 1990 Census information, the SJMA generates 3.2 millions of trips per day. Projections for the year 2010 rise this figure by 45% to 4.6 millions of trips per day.

Phase one of TU will serve trips in one corridor in the urban core. In addition to trips with origins and destinations within walking distance of stations, 'público' and bus feeders will expand the service area considerably. This service will bring benefits to both users and non-users. However, many people, particularly those with trips that begin or end on the fringe of the SJMA, will not be able to make good use of its service. They will still need to travel by auto on the heavily congested roadway network. Transportation in the greater SJMA –for individuals, commercial vehicles and public transportation– could be improved by offering these travelers an alternative mode of travel. The number of people who need to travel to the SJMA during periods of congestion could be accommodated without traffic problems if they use transit modes including ridesharing. One method to encourage transit use and TU ridership is the provision of TU Plazas with special-use lanes. Special-use lanes are a method to reduce solo-auto travel and, thereby, traffic demand.

1.1 BACKGROUND

1.1.1 TREN URBANO PLAZA CONCEPT

According to the TU Transportation Planning Group, the TU Plaza concept is based on the development of a parking facility on the outer edges of the congested urban area, easily accessible from one or more major highways. Auto travelers would leave their autos at the facility, board an express bus or van, and ride comfortably and quickly to the nearest TU station. The Plaza would include a station for the buses or vans and would have concessions suited to transit uses, such as take-out cafes, dry cleaners, convenience stores, video stores, etc. Motorists would park their cars, purchase their coffee and newspapers at the concession, and board a comfortable bus. The bus would depart at short intervals for an express trip to the nearest TU station (5).

Obviously, the key to the success of the Plaza concept is speedy, comfortable service. Motorists are likely to use the service only if it offers an advantage over driving from home to the SJMA. To achieve this, the Plaza buses would leave at frequent, scheduled

intervals and provide express service, faster than a regular auto could make the same trip, by using special facilities such as reversible lanes and/or High Occupancy Vehicle (HOV/HOT) lanes for most of their trip to the TU station. Facilities would be provided for buses to bypass or move quickly through toll plazas. As a goal, bus shuttle time from the Plaza to the station should not exceed fifteen minutes.

1.1.2 POTENTIAL TREN URBANO PLAZA LOCATIONS

The TU Plaza study team chose a number of potential sites that seemed to be suitable for the operation of a Plaza. The locations were along major transportation arteries with important traffic volumes, which served specific corridors. A total of 15 sites were originally identified.

The locations were subjected to a preliminary screening to choose the Plaza alternatives that were most attractive for the first round development. The criteria that were developed for this assessment included the following:

- Acquisition costs
- Compatible land uses
- Environmental impacts
- Expansion potential
- High traffic volume
- HOT/HOV potential
- Land availability
- Near expressway

These evaluation criteria were given weights for the nature of the conditions of the potential Plaza sites. A rating of "attractive" merited 3 points; "acceptable" merited 2 points and "poor" only 1 point. The resulting evaluation matrix is presented in Table 1.1, providing the sum of the total points for each site and the average scores.

The results of the screening established three Plaza sites as the most attractive. These were subjected to further development and analysis. Sites not selected for further development in the first round of TU Plaza program are not necessarily excluded from future development, as the TU system is expanded and improved. The potential sites selected are summarized Table 1.2.

This research concentrates on a TU Plaza site selected as one of the most attractive locations: Intersection of PR-5 and PR-199.

1.1.2.1 INTERSECTION OF PR-5 AND PR-199

The proposed site is located within the area reserved by PRHTA for the construction of the intersection of the 'Rio Hondo Connector' (PR-5) and PR-199 (Las Cumbres Avenue). There is a large parcel both north and south of PR-199. Exact siting depends upon the finalization of the plans for the intersection and the extension of PR-5 to the south. There appears to exist sufficient land for the

roadway and Plaza, however, this is subject to confirmation once the design issues have been resolved. At PRHTA instructions, the designer of the intersection will work with the TU Staff to accommodate the Plaza if possible.

1.1.2.2 TRANSPORTATION ACCESS

The proposed site is located proximate to the intersection of PR-5 and PR-199, major north-south and east-west connectors. The HOV lane provided in the PR-5 design will provide for speedy and efficient transfer of TU Plaza users to the Bayamón Centro TU Station.

1.1.3 BENEFITS OF PLAZA FACILITIES AND OPERATIONS

TU plazas could benefit both the SJMA as a whole and the Plaza users. Regional benefits would result from the reduction in highway congestion brought about by taking a number of autos off the roads outside the most congested parts of the urban area during peak travel times. Depending on the level of Plaza use, this could have noticeable benefits on some of the area's major highways.

The Plazas would also expand transit use and TU ridership to a new market. Suburban motorists currently do not use public transportation and do not think of transit as a desirable mode when planning their travel. These motorists could be introduced to transit through the Plazas, expanding the transit market and helping to create transit-oriented attitudes among area residents. This expansion of the transit market would result in immediate increases to TU ridership, and would lay the groundwork for riders on an expanded TU system in the future.

Plaza users would also benefit. They could shorten their travel time from home to the center of the city, due to the express facilities provided on the highways for Plaza buses. They could accomplish their trips in comfort and safety, and possibly complete some everyday tasks as part of the trip at the convenient retail facilities at the Plazas.

1.1.4 HOT LANES

High Occupancy Toll (HOT) lanes offer an opportunity to combine High Occupancy Vehicle (HOV) lanes and 'congestion pricing'. The concept of 'congestion pricing' is based on the idea of charging a fee equivalent to the marginal external congestion costs that the driver causes by using the roadway at the particular time. HOT facilities allow vehicles meeting a minimum occupancy requirement to use the roadway for free. Other vehicles containing less than the required occupancy may be permitted in the facility for a fee.

HOV facilities are often criticized for not being sufficiently used, a phenomenon known as "empty lane syndrome". HOT facilities have been considered the solution to rescue under-utilized HOV lanes. Allowing vehicles not meeting the occupancy requirement, such as Single Occupant Vehicles (SOVs), to use the facility grants these travelers the higher speeds and shorter travel times enjoyed by the HOVs while eliminating the "empty lane syndrome". The number of SOVs permitted on the roadway must be limited so that the

facility does not become congested. In order to be successful, the HOT facility must maintain travel time savings and reliability over the general-purpose lanes. To maintain these attributes, the HOT facility may increase the fees as the congestion on the facility increases. The fees charged provide revenue that could be used to improve transit or promote ridesharing programs.

However, the views of HOT facilities have not all been positive. A common opinion is that the HOT lanes are 'selective' and have been called "Lexus Lanes". The reasoning is that only the rich will use the facility though everyone is, in fact, offered the option to use the lanes. Pricing the additional capacity of HOV lanes allows for more efficient use of the roadway. The public may have pre-conceived ideas that only the rich will use the lanes, but as experience with HOT facilities becomes more widespread, the person who is late will realize the benefits of having the lanes.

1.1.5 PREVIOUS RESEARCH: FEASIBILITY STUDY OF HOT LANES AS FEEDERS FOR TREN URBANO – TOA BAJA PLAZA

This research provides a description of HOT lanes currently operating in California and Texas. Also, some public opinion survey results are discussed. The conclusions arising from this feasibility study can be summarized as follows:

The case study HOT lanes have been successful in achieving a higher lane efficiency than the freeway main lanes.

The TU Plazas need HOV/HOT facilities in order to offer a convenient, efficient, safe and rapid transfer from areas along the periphery of the SJMA to the stations.

According to the survey, HOV/HOT lanes would be reasonably well accepted in the SJMA.

1.2 PURPOSE OF THIS STUDY

The goal of this research is to examine the effect of different scenarios on the average trip time of a network with an HOV/HOT facility connecting the TU Plaza with the nearest TU station. These scenarios include but are not limited to the following:

- Lane utilization and access point restrictions
- Vehicle eligibility
- Demand levels
- Price
- User behavior

It is important to develop a trustable relationship with assignment-simulation models to study the effects of congestion on transit issues. With this study, TU will be able to obtain a better understanding of the relationship between pricing structure on HOT lanes and the use of this special facility for their 'público' and bus feeders. Another goal is to determine the advantages and disadvantages of using HOT lanes as feeders for TU, and therefore determine under what circumstances it is convenient to use them.

CHAPTER 2

RÍO HONDO CONNECTOR (PR-5)

The "Río Hondo Connector" is one of the major projects in the general alignment of TU. This connector follows the right-of-way once acquired for a north-south freeway proposed since 1965 but under design by PRHTA as 4-lane arterial with 2 additional HOV lanes for "públicos" and buses. The alignment is as follows: from PR-199 in Bayamón south to PR-174 and PR-2 at the intersection with PR-5. It includes an interchange at the intersection such that PR-2 elevates on structure over PR-174/PR-5, providing for signalized intersection underneath. The connector would facilitate both "público" and bus access to Bayamón center while also improving north-south and east-west traffic flow in the area.

The PR-5 extension is due to run along the alignment of the Río Hondo River – hence its name, the 'Río Hondo Connector'. Preliminary analysis suggests that some form of toll collection facility (booths or a plaza) could be positioned on PR-5 between its intersections with PR-174 (to the north) and Los Millones Street (to the south).

2.1 THE STUDY AREA

The study area roughly resembles a triangle to the south of central Bayamón bordered by PR-167 to the west, PR-174 to the east, and PR-199 to the south. This area is very heavily populated with a dense network of local roads – most of them residential. The following paragraphs present a description of each of the existing strategic links in the study area.

2.1.1 PR-167

Besides feeding traffic local to the study area into Bayamón and beyond (e.g. into central San Juan), it draws traffic from Naranjito, Comerío and other parts of a large hinterland to the southwest of the SJMA.

From the south, PR-167 approaches the study area through the urbanization of Bella Vista as a short section of three-lane highway with a central lane tidal-flow facility. To the north of the PR-830 intersection, the road widens to become two lanes in each direction, with some parallel collector/distributor support. All intersections are at-grade, with the busier ones having signal control. It retains this configuration for the remainder of its route into central Bayamón. From its intersection with 'Avenida Las Cumbres' (PR-199) to PR-2, the distance is approximately three miles. For these three miles, the area on either side of the road is continuously built-up however parking and servicing is, in the main, confined to collector/distributor roads thus reducing friction on PR-167 itself.

2.1.2 PR-174

From Aguas Buenas to the south of the SJMA, PR-174 winds its way north with one lane in either direction for much of its route towards the study area. The pavement surface is of variable quality and, in places, the carriageway width is particularly narrow. In common with PR-167, the southern-most sections of PR-174 traverse undulating countryside with frequent and sudden changes to the vertical alignment.

Immediately south of a regional branch of the University of Puerto Rico (UPR), PR-174 widens to two lanes in either direction with a simple painted line marking the median. As before, all intersections are at-grade with the busier ones (such as those at PR-831 and PR-177) being signalized. At the intersection with PR-177, drivers wishing to stay on PR-174 are required to turn left followed by a sharp right. Thereafter, the carriageway width varies between one-and-a-half and two lanes in either direction, widening slightly on the immediate approach to PR-2.

2.1.3 PR-831 and PR-840

The other two roads entering the study area from the south are PR-831 and PR-840. Both are low-capacity, rural-type roads. PR-831 joins with PR-199 to feed into PR-174. To the west, PR-840 cuts across PR-199 to join with PR-167.

2.1.4 PR-199

PR-199 ('Avenida Las Cumbres') represents the base of the triangle described earlier. It is a key east-west link, which presently suffers from poor pavement quality, sudden grade changes and variable carriageway width.

2.1.5 OTHER STRATEGIC HIGHWAY LINKS IN THE STUDY AREA

To the west, PR-839 parallels PR-167. It has a single lane in either direction, passes through very densely built-up areas and remains highly congested for much of the day. Strategically, it represents a poor alternative to PR-167.

To the north, PR-2 runs east-west through the study area. This is the highest quality of road in the area with three lanes in either direction although, for sections, this falls to two with a central tidal-flow facility. The majority of its intersections, however, remain at grade.

PR-855 parallels PR-2 to the north, however, with only a narrow lane in each direction, it does not compete with PR-2. Instead, it serves local traffic movements.

PR-177 (Lomas Verdes) leaves the study area from PR-174, heading east for traffic bound for Guaynabo and southern San Juan.

2.1.6 HIGHWAY INVENTORY

Table 2.1 presents a highway inventory, summarizing the key characteristics of each of the roads considered above.

CHAPTER 3

INTRODUCTION TO DYNASMART

The objectives of this research require the application of a dynamic traffic assignment–simulation methodology. Dynamic traffic assignment (DTA) has two major advantages over static traffic assignment (STA) for evaluating traffic networks with HOV and HOT lanes. STA cannot adequately model congestion because the locations and extents of queues and their related delays cannot be identified. The drivers' responses to route guidance instructions cannot be depicted using STA. However, DTA allows for congestion modeling and route guidance. The time dimension is incorporated, thus allowing for the calculation of speeds and densities within a time interval. DTA formulations accommodate route changes over time in the modeling process.

DYNASMART, a traffic simulation-assignment model developed at the University of Texas at Austin is going to be used to analyze congestion, user behavior and pricing structure for the HOT lanes in order to study their feasibility as feeders for TU. DYNASMART combines the ability to simulate traffic flow and to represent dynamic route choice behavior. It integrates traffic flow models, network path processing, user behavior rules and information supply strategies.

3.1 TEST NETWORK

Figure 3.1 depicts the network used in the first set of numerical tests. It consists of 8 nodes and 10 links. The use of this 'imaginary' network for experimentation is intended primarily to examine and understand some basic aspects of DYNASMART.

3.2 INPUT DATA

DYNASMART requires a specific set of input files. These input files contain attributes associated with the network, control, user behavior, etc. The input data include:

A. Network Data

- number of zones
- number of nodes
- number of links
- length of the link
- number of lanes
- maximum speed
- saturation flow rate
- link identification
 - freeway link
 - freeway segment with detector
 - on ramp
 - off ramp
 - arterial
 - HOV/HOT lane

- B. Vehicle Generation Data
 - O-D Matrix
- C. Scenario Input Data
 - simulation times
 - user class definitions
 - vehicle type definitions
- D. Signal Control Data
 - node information
 - node number
 - control type
 - no control
 - yield sign
 - stop sign
 - pre-timed control
 - actuated signal control
 - number of phases
 - cycle length
 - timing for each phase
 - movements on each approach for each phase
- E. Ramp Control Data
 - number of ramps
 - detector ID number
- F. VMS Data
 - number of VMS
 - type of VMS
 - speed advisory
 - route advisory
 - congestion warning
- G. Movement Data
- H. Incident Data
 - total number of incidents
 - incident location
 - severity of incident (as a fraction of capacity reduction)
- I. Bus Data
 - number of buses
 - stop declarations
 - no stop
 - stop at the near block
 - stop at the mid-block
 - stop at the mid-block bus bay
- J. Pricing Data for HOV/HOT lanes
 - toll value on every link in the general-purpose network
 - toll value for the lower occupancy vehicles on the HOT lanes
 - toll value for the higher occupancy vehicles on the HOT lanes
 - dollar value of the time

3.3 DYNASMART MODEL STRUCTURE

The input data include time-dependent OD matrices and network data. At the core of the framework, and essential to its flexibility and efficiency, is an integrated network representation system that supports extremely efficient path processing routines, which provide essential information to both user behavior models as well as information supply strategies.

Given the network representation, link characteristics as well as control parameters, the simulation component will take a time-dependent loading pattern and process the movement of vehicles on links, as well as the transfers between links according to specified control parameters. These transfers require instructions that direct vehicles approaching the downstream node of a link to the desired outgoing link. The user behavior component is the source of these instructions, as it determines individual path decisions of users in the network. Alternatively, path decisions may be pre-assigned for some or all users according to a particular assignment scheme. DYNASMART overall structure is shown in Figure 3.2.

3.4 OUTPUT INFORMATION

For different analyses, three levels of output can be obtained from DYNASMART:

- A. Overall System Performance
 - average overall travel time
 - average travel (moving) time
 - average entry queue time
 - average stop time
 - average travel distance
 - congestion index
 - simulation summary report
- B. Selective Information
 - link
 - average speed
 - average density
 - average end queue
 - total number of vehicles passed by
 - vehicle
 - behavior attributes
 - travel time
 - travel distance
 - traveled path
- C. Detailed Information
 - vehicle trajectories
 - signal timing
 - path information
 - concentration profiles

CHAPTER 4

PRELIMINARY CONCLUSIONS AND FUTURE WORK

4.1 THE CONCLUSIONS ARISING FROM THE PRELIMINARY STUDY OF THE 'RÍO HONDO CONNECTOR' CAN BE SUMMARIZED AS FOLLOWS:

- The 'Río Hondo Connector' has been designed as a limited-access expressway to significantly enhance the highway capacity for movements from a large and developing catchment area to the south and southwest of Bayamón into central Bayamón and beyond to San Juan itself.
- Aside from the Connector, there are highway investments underway to improve the quality of the transport network on the study area. Of particular importance are the extensions of PR-5 to the South, improvements to PR-167 and the completion of the east-west link on PR-199, which involves upgrading PR-199 to three lanes in either direction. This improvement is critical to the attractiveness of the Connector as PR-199 effectively represents the access link to it from both PR-167 and PR-174.

4.2 THE CONCLUSIONS ARISING FROM THE PRELIMINARY STUDY OF THE 'TREN URBANO PLAZA CONCEPT' CAN BE SUMMARIZED AS FOLLOWS:

- For the proposed TU Plazas, the flow of commuters to and from the municipalities outside the SJMA represents an important market. The 1990 Census information provides a matrix of residence and employment by municipality for Puerto Rico. According to this information, 45,921 people resided in municipalities outside of the SJMA but were employed in the SJMA and 21,422 resided in San Juan but work outside of the region. The data are presented in Table 4.1, by directional flow and by transportation corridor. For the purpose of this research, the proposed Río Hondo TU Plaza serves the Central Corridor connecting south central areas to San Juan by means of using PR-167 and PR-174.
- As shown in Table 4.1, external based trips to the Metropolitan Region predominate, providing the potential market for "classical" commuter traffic of the park and ride type, in other words – home to TU Plazas by private automobile, bus or 'público', shuttle bus to the TU Station and via TU to destination, reversing the flow for the return home part of the trip.
- An aspect of critical importance for the success of the Plaza is the ability to offer the potential for high-speed preferential access to the TU station from the Plaza sites. This consideration had an important impact on the selection of viable sites.

4.3 FUTURE WORK

The following activities have been completed:

- Background research on TU Plaza concept, potential TU Plaza sites, and the benefits of Plaza facilities and operations
- Interview TU Transportation Planning Group
- Review of previous research about HOT lanes as feeders for Toa Baja Plaza
- Get related with DYNASMART, a traffic simulation-assignment model
- Preliminary analysis of findings

Basically, the future work includes additional analysis from the simulation model in order to study the effect of different variables on the average trip time of a network with an HOV/HOT facility connecting the Río Hondo TU Plaza with Bayamón Centro station, as described in Section 1.2. The results obtained from this analysis are going to be very useful to provide answers to the questions that remain to be addressed about HOT lanes and their effectiveness in the proposed corridors for the TU Plazas.

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TABLE 1.1: TU PLAZA ALTERNATIVE SITE SCREENING MATRIX AVERAGES

ID	Location	Acq. Costs	Land Use	Environ. Impacts	Expansion Potential	Traffic Volume	HOT/HOV	Land Available	Express way	Total	Avg.
1	PR-22/PR-165	9	9	8	9	9	9	9	9	71	24
2	PR-167/Levittown Blvd.	5	6	5	6	6	5	6	6	45	15
3	PR-22/PR-167	5	6	6	5	7	5	5	8	47	16
4	PR-29/PR-167	3	6	6	5	7	6	5	6	44	15
5	PR-5/Los Millones	3	6	6	6	7	7	5	7	47	16
6	PR-5/PR-199	8	9	8	9	9	9	9	9	70	23
7	Cataño Transit Center	5	9	7	3	6	3	3	3	39	13
8	PR-20/PR-199	7	6	6	5	6	5	6	7	48	16
9	PR-199/PR-1	3	5	6	4	6	6	4	6	40	13
10	PR-52/PR-199	3	6	6	3	9	4	5	8	44	15
11	Iturregui Transit Center	6	8	8	6	6	3	6	3	46	15
12	Carolina Transit Center	5	8	9	4	6	3	3	6	44	15
13	Trujillo Alto	7	6	6	7	6	6	7	5	50	17
14	Caguas Norte Near PR-52	9	9	8	9	9	8	9	9	70	23
15	Caguas Centro	3	6	6	3	6	6	3	6	39	13

TABLE 1.2: POTENTIAL PLAZA SITES

Plaza Location	Tren Urbano Station
Toa Baja: PR-22/PR-2/PR-165	Bayamón Centro
Río Hondo: PR-5/PR-199	Bayamón Centro
Caguas Norte Toll: PR-52/PR-30/PR-1	Centro Médico

Source: TU Transportation Planning Group

TABLE 2.1: STUDY AREA HIGHWAY INVENTORY

Road Number	Road Name	Functions	Number of Lanes	Carriageway Width	Pavement Condition	Competitor to the Río Hondo Connector?
PR-167	Avenida Comercio	Major north-south strategic link running through the study area to the west	2 in each direction	Medium	Fair – good	Yes, main competitor
PR-174		Important north-south strategic link running through the study area to the east	Varies between 1 and 2 in each direction	Varies from narrow to wide	Fair – good	Yes, important competitor
PR-831	Calle Minillas	Minor north-south link feeding into the bottom of the study area	Mainly 1 in each direction	Narrow – medium	Poor – fair	In part, in combination with PR-174
PR-840	Camino Aldea	Minor north-south link feeding into the bottom of the study area	Mainly 1 in each direction	Narrow – medium	Poor – fair	In part, in combination with PR-167
PR-199	Avenida Las Cumbres	Key east-west link running along southern end of the study area	Varies between 1 and 2 in each direction	Varies from narrow to wide	Poor – fair	No, but critical access road
PR-839	Calle Hiram Gonzáles	Local road, paralleling PR-167	1 in each direction	Narrow	Fair	Very weak competitor
PR-2		Major east-west link running along northern end of the study area	Divided-6 in the study area	Medium	Good	No
PR-855	Calle Santa Cruz	Local road, paralleling PR-2	1 in each direction	Narrow	Fair	No
PR-177	Lomas Verdes	Key east-west link for traffic for Guaynabo and south San Juan	Divided-4 in the study area	Medium	Fair – good	No

Source: Steer Davies Gleave

FIGURE 3.1: THE TEST NETWORK STRUCTURE

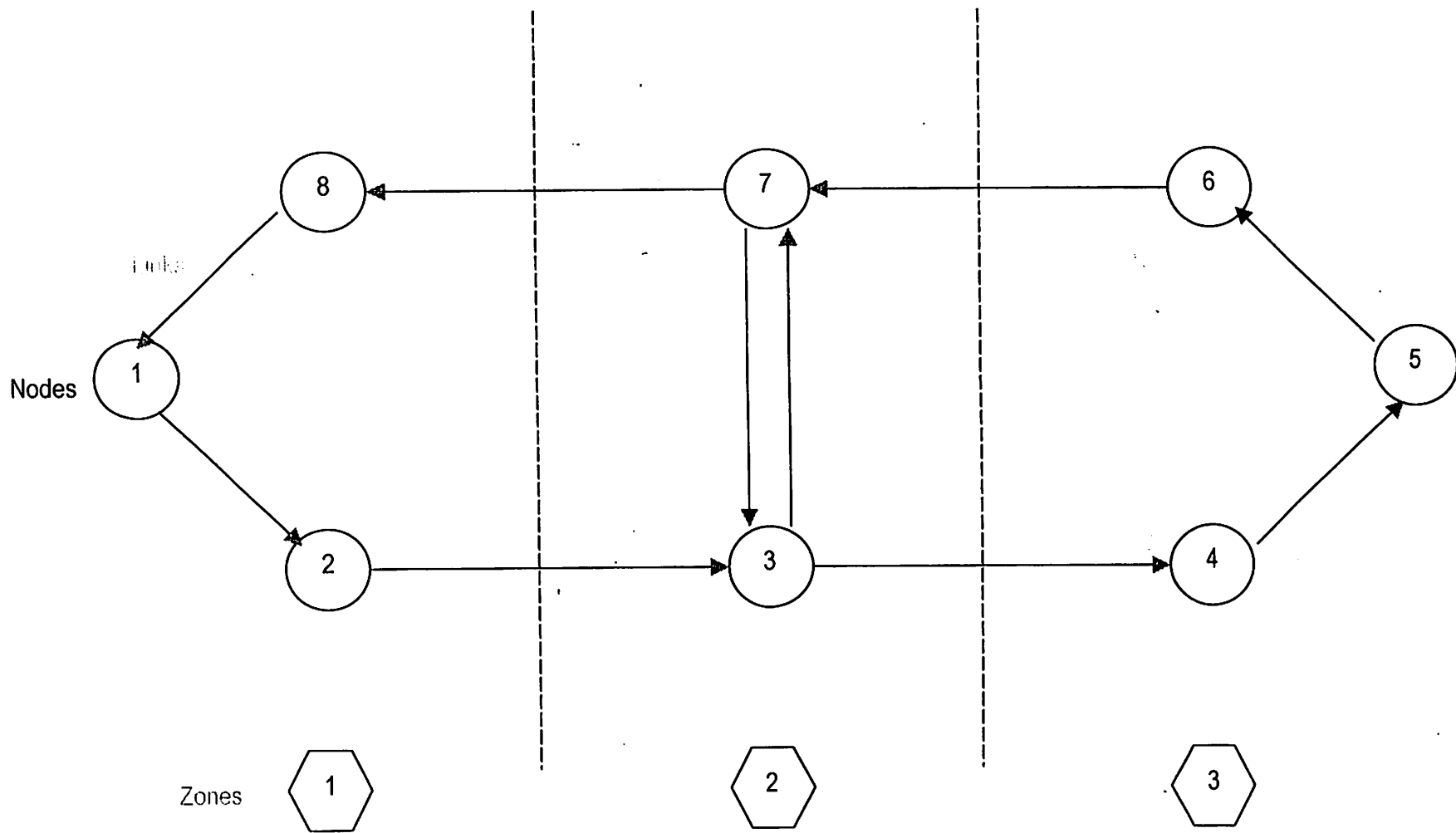


FIGURE 3.2: DYNASMART MODEL STRUCTURE

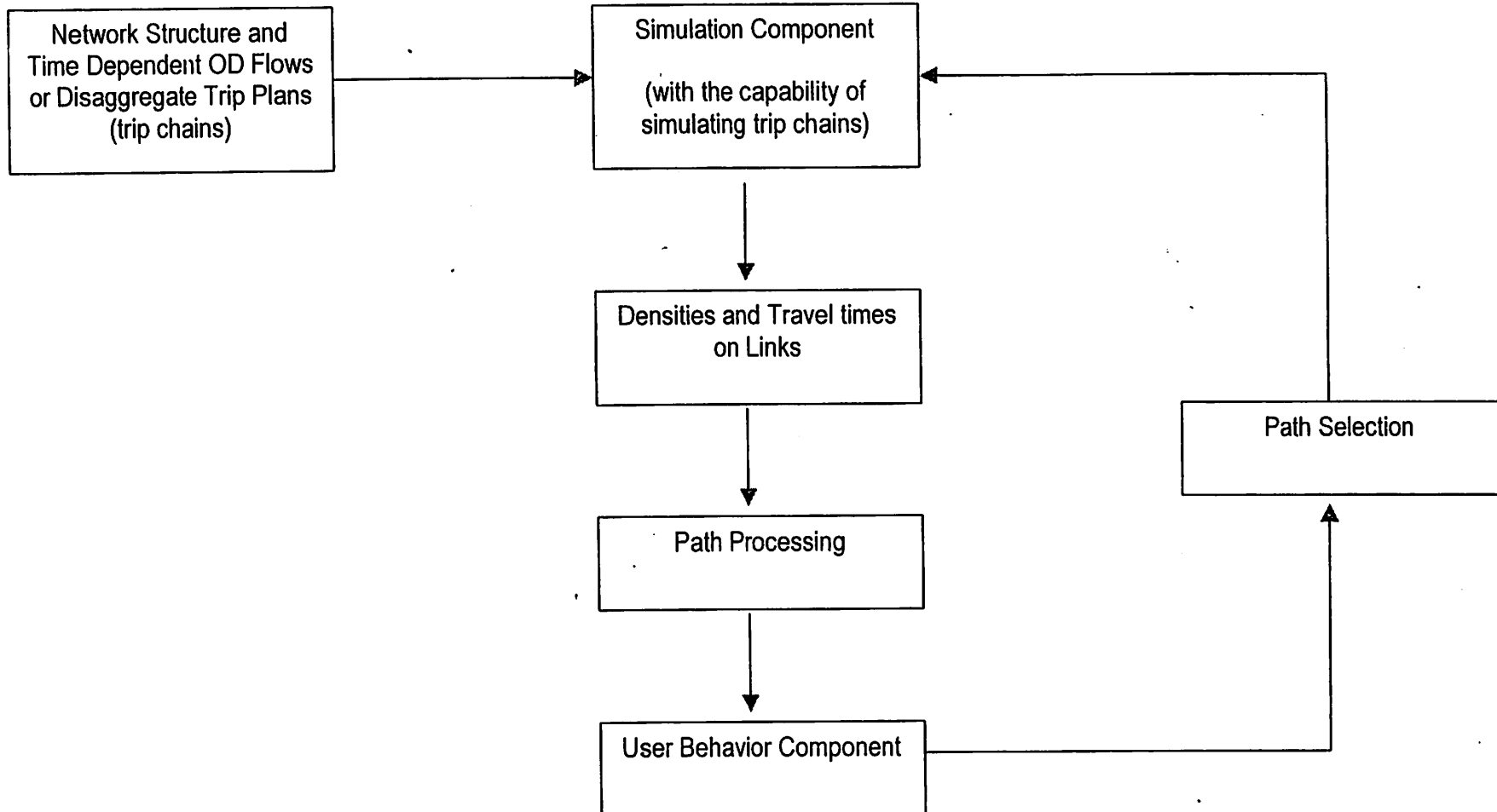


TABLE 4.1: INTERNAL – EXTERNAL HOME TO JOB TRIPS FOR SJMA IN 1990

Transport Corridor	Description	Residents External to SJMA & Employment in SJMA	Residents of SJMA & Employment External to SJMA
Northwest	Connects to the SJMA from the west by PR-2 and PR-22, and includes Vega Alta, Dorado, Vega Baja, Manatí, Arecibo, Barceloneta and cities to the west	10,963	6,634
Southern & Southeast	Connects from the SJMA to the Caguas area and the south by PR-1, PR-52 and PR-30, including Cayey, Ponce, Humacao and Guayama	23,825	11,062
Central	Links central areas to San Juan using PR-167, PR-199 and the extension of PR-5, including Aguas Buenas, Comerío, Naranjito, Barranquitas, Vega Alta and cities of the central area	7,374	1,155
Northeast	Links the SJMA to Fajardo and points to the East by PR-3, including Luquillo and Ceiba	3,759	2,571
Total		45,921	21,422