

# *Tech Brief*

## Development of a Simulation Model of an ITS Corridor

FHWA-NJ-2003-018

June 2003

### BACKGROUND

- Traffic congestion has been a serious problem for the last few decades and has given rise to increased travel times, vehicle-operating costs and stress levels for drivers. Travel delay has also affected the cost of conducting business, both regarding logistics and higher wages paid to employees in compensation for long commutes.
- Traffic congestion has also plagued the society and the government with high indirect costs of air pollution and noise, as well as direct costs due to capital expenses.
- The South Jersey highway priority corridor is chosen as the evaluation network in this project. From historical observations, it is well known that South Jersey highways have already reached high traffic congestion levels, especially during the morning peak hours due to the demand originating from Camden County destined to Philadelphia business district.

### HERE'S THE PROBLEM

- Over the years, the congestion problem has been addressed by using various approaches, such as capacity expansion, higher fuel and vehicle registration taxes, congestion pricing, expansion of mass transit, car-pooling, and improved traffic management and operations.
- Unfortunately, none of these approaches could manage to fully overcome the congestion problem. Especially capital intensive solutions, such as capacity expansion by building new roads, and politically controversial measures, such as higher fuel taxes and congestion pricing, proved to be relatively inefficient in addressing both long term and short term congestion problems effectively.

## AND, HERE'S THE SOLUTION

- Intelligent Transportation Systems (ITS) aim to reduce the travel time of vehicles by controlling the existing transportation infrastructure using state-of-the-art technologies. One of the current emphasis areas in ITS is improved coordination of existing infrastructure, and future improvements to improve the safety and reliability of surface transportation systems. Many ITS technologies, such as smart card technology, global positioning system (GPS) on cargo trucks, weigh-in-motion stations, E-Z pass technology, traffic sensors, and wireless communication are aimed at increasing the efficiency of the transportation services.

## BUT HOW CAN IT BE DONE?

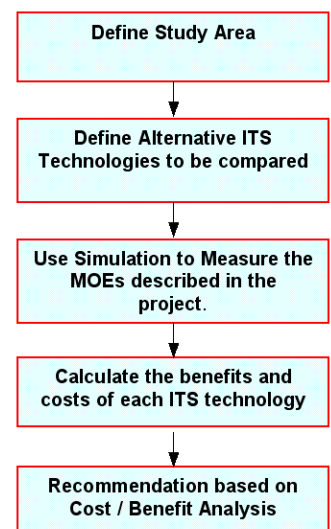
- The question is how to choose the ITS technologies best suited for the study priority corridor in New Jersey. The answer lies in the development of a high fidelity simulation laboratory environment for testing the success of ITS technologies in this high priority corridor.
- The impact of ITS technologies has to be evaluated using time-dependent demands and traffic flows. Microscopic traffic simulation is the only way to capture dynamic nature of traffic flow and demand within a certain time interval. This project thus develops a detailed simulation model of the South Jersey ITS priority corridor to test and assess the impacts of different ITS technologies on traffic flow and demand before they are deployed. This simulation model is a laboratory that can be used now and in the future to assess the impacts of any prospective ITS technology quickly and inexpensively.



## THESE ARE OBJECTIVES...

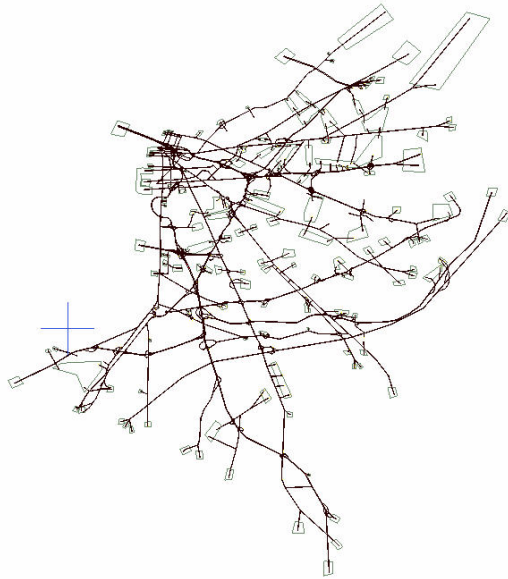
The main objectives of this project are:

- To develop and calibrate / validate a high fidelity simulation model of the selected ITS corridor in New Jersey. This simulation model is developed using PARAMICS simulation tool. It is very important to obtain the appropriate data that will be used to calibrate the simulation model. Without accurate calibration of the developed simulation model of the selected priority corridor, the second objective of this project cannot be accomplished successfully.
- To evaluate the effectiveness of existing and planned ITS technologies in the selected ITS priority corridor. This objective is accomplished by using the calibrated simulation model. An important aspect is selecting ITS technologies to be evaluated, as well as determining the “Measures of Effectiveness (MOE)” to be employed by the evaluation process.



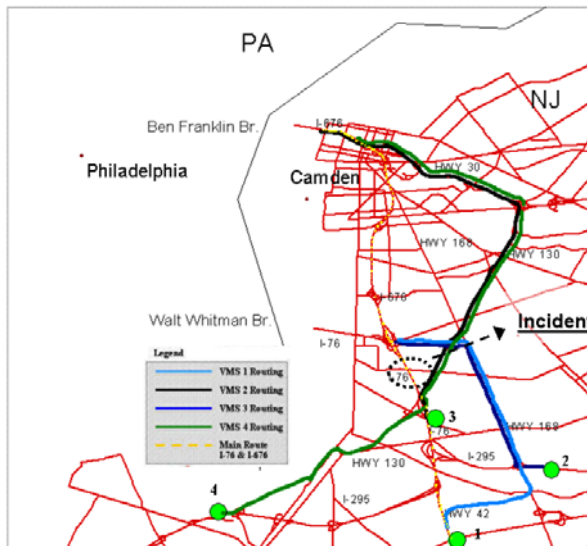
## HERE IS WHAT WE DID...

- As suggested by a recent study conducted for the NJDOT, the ITS applications that can be considered for this priority corridor are:
  - Vehicle routing via variable message signs
  - Advanced traffic management via ramp metering
  - Alternative scenarios including different combinations of these applications are tested with and without incidents and evaluated based on selected MOE's. The selected locations of the ITS application scenarios in this project are consistent with the recommendations of the NJDOT study that identified most promising locations for these technologies.
- The South Jersey highway network was developed in PARAMICS simulation software. The figure below shows the screen shot of this network. The generated network includes ~2000 nodes and ~4000 links. Link information such as number of lanes, highway type, speed limit, line width, etc. are entered using "NJDOT Straight Line Diagrams." Origin-Destination (O-D) demand matrix provided by Delaware Valley Region Planning Committee (DVRPC) is aggregated for the study network (137 zones).



the selected MOE's. PARAMICS Application Programming Interface is utilized for vehicle routing in simulation. The location of these 4 VMS and the alternative routes are shown in the figure below. The results show that a careful selection of VMS locations reduces congestion during an incident, short-term roadwork, and adverse weather conditions.

- After the simulation model is developed, calibrated, and finally validated, it is important to determine how the selected ITS technologies are evaluated. In this study, the effects of ITS technologies are quantified using various MOE. The measures that are considered in this study are total travel time in the network and O-D travel times.
- 4 possible VMS locations suggested by the aforementioned NJDOT study are evaluated for effectiveness of vehicle guidance in the case of an incident at a predefined location in the network. The evaluation is based on
- Ramp metering is one of the major ITS technologies that can be deployed in NJ to improve traffic conditions. Ramp metering is a direct and efficient way to control and upgrade freeway traffic flow by regulating the number of vehicles entering the freeway.



- 3 ramp metering strategies are tested as part of the ITS scenarios identified in this report. Namely, ALINEA, New Control and Mixed Control. Efficiency of these ramp-metering strategies is tested using PARAMICS simulation model of the SJ highway network.
- Finally cost benefit analysis of vehicle routing using VMS and ramp metering is also conducted. The positive results of the cost benefit analysis support the use of these ITS technologies for congestion reduction for the demand and network conditions used in this study.

**FOR MORE INFORMATION CONTACT:**

NJDOT PROJECT MANAGER:	Karl Brodtman
e-mail	@DOT.STATE.NJ.US
UNIVERSITY PRINCIPAL INVESTIGATOR:	Dr. Kaan Ozbay
UNIVERSITY:	Rutgers University -CAIT
PHONE NO.	(732) 445-2792
e-mail	kaan@rci.rutgers.edu