

# ITS Field Operational Test Summary

## Alternate Bus Routing System (ABR)

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### Introduction

The Alternate Bus Routing (ABR) System ITS Field Operational Test communicates real-time route diversion recommendations directly to New Jersey Transit buses traveling north-bound on the Garden State Parkway (GSP). The system uses Vehicle to Roadside Communication (VRC) technology (such as transponders) as the communications link. The ABR Project will demonstrate how bus routing management technologies and strategies can be united to achieve goals of an Intelligent Transportation System (ITS). The test utilizes the resources of government, private industry, and academia to implement and test the ABR system. The test evaluated the system performance confidence, system reliability, and the user acceptance.

Phase I field testing took place in November and December 1997. Phase II, originally scheduled to begin in January 1998, has been canceled. The final Evaluation Report for Phase I is due in March 1998.

### Project Description

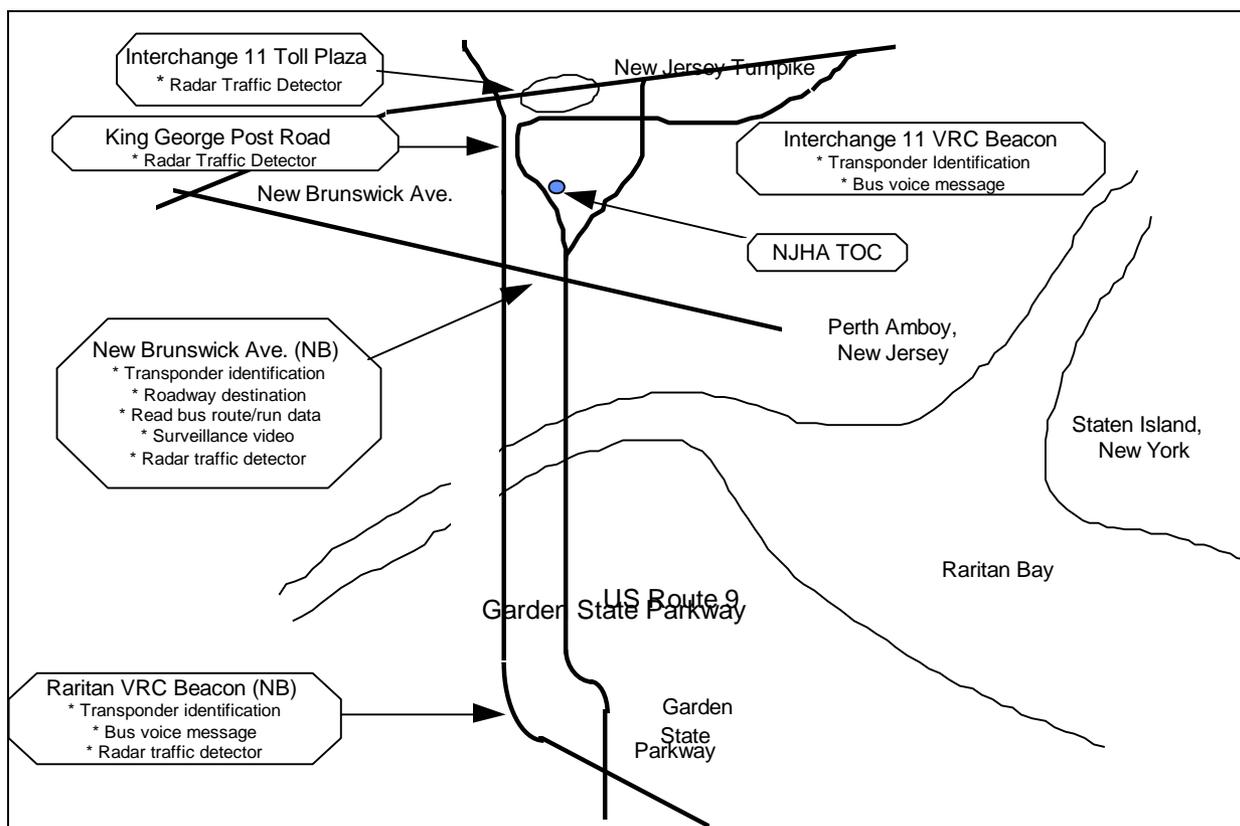
The ABR system test area covers the north-bound GSP from the Raritan Toll Plaza to the New Jersey Turnpike (NJT) exit. Buses and private carriers enter the GSP at several interchanges, exit onto the Turnpike, and proceed toward New York City on the Turnpike. Depending on traffic conditions on the GSP, traffic managers may recommend that buses exit and use US Route 9, which runs parallel to the GSP. Once the buses enter the NJT, either from the GSP or from Route 9, traffic managers may communicate further information to the buses regarding traffic conditions on the inner and outer roadways. Figure 1 shows the project location.

The ABR system physical architecture consists of the following components:

- **Remote Traffic Microwave Sensors (RTMS)** that are located at four points along the corridor of the study area. These sensors detect volume, occupancy, and speed data on each lane and cover both the primary and alternate routes at New Brunswick Avenue, King George's Post Road, and NJT, Interchange 11. The detector located prior to Raritan Toll Plaza on the GSP collects data on the GSP, exclusively.
- The **VRC Transponders** are attached to each of the fifty buses being used in Phase I. Used as a secondary source of information, VRC transponders provide additional travel time information by enabling the automatic vehicle identification readers to identify buses by tag numbers, and track travel times and route selection decisions. To calculate travel times, the system software algorithm considers transponder and sensor information in a two to one weighting ratio. If the system detects no transponder data, it will use sensor data exclusively.
- The **Audio Annunciators** enable the communication of advisory messages to bus drivers from the New Jersey Highway Authority (NJHA) Traffic Operations Center (TOC) at Woodbridge, NJ. VRC transponders are located at the Raritan Toll Plaza, New Brunswick Avenue, and

NJT, Interchange 11. The ABR system evaluates traffic conditions north of the Raritan toll Plaza and gives bus drivers route guidance information near the Plaza. The system gives the route guidance message through an in-vehicle audio annunciator coupled to a VRC Transponder. Transponders north of the Toll Plaza may communicate additional information.

- A *surveillance camera* is located at the New Brunswick Avenue overpass. The camera is not directly linked to the decision making algorithm. However, it is helpful in monitoring the system through its full motion analog video transmission.



**Figure 1: Alternate Bus Routing Project Location**

The RTMS sensors sample flow, occupancy and speed data every 30 seconds for each lane and transmit this information to the TOC. At five minute intervals, the system calculates flow (vehicles/30 second), occupancy (percentage), and average speed (miles/hour) for each RTMS sensor. The algorithm then classifies the lane status as inactive, active, or failed. The ABR software stores the information by Route Number, Station, and Lane.

- After estimating travel time and delays for each route, the system algorithms may recommend a diversion at the Raritan Toll Plaza. The default route is the GSP. However, if delays on the GSP are excessive and the estimated travel time saving by using US Route 9 is significant, the ABR computer system will recommend diversion to the alternate route, US Route 9.

The evaluation of the results includes four tasks:

- Evaluation of Operation of Sensors and Spread Spectrum Radio Communications

- Evaluation of the Central Computer System
- Evaluation of In-Vehicle Operation
- Evaluation of the Performance of the Integrated System

## Results

The project's independent evaluator prepared an evaluation summary report for Phase I. The following paragraphs summarize the findings of the report.

The ***Radar Sensors*** provided the ABR bus routing algorithm with volume, occupancy, and speed data for each of the four locations of the study site. The evaluators compared the real traffic volume (collected by evaluator through video output) to the volume counts supplied by the system. This comparison showed that real volume was 11.13% larger than that recorded by the sensors.

The evaluation of the ***Operation of the Central Computer System*** tested the routing system accuracy. The main system performance function was to correctly estimate the bus trip times for both routes, and to determine the travel time differences between the two routes. The evaluators found that the differences in travel times averaged between two and three minutes. This travel time difference is not statistically significant.

The evaluation of the ***In-Vehicle Operation*** involved audio message testing performed by activating the transponders on the instrumented vehicles during test runs to verify that messages could be received at normal highway speeds. During preliminary testing of each system component by the system designer/implementer the messages sent from the operation's center were heard at the proper location-approaching Raritan toll Plaza. Further, the messages were heard clearly during both clear and rainy weather and the intensity of the volume and clarity of the message was acceptable.

The evaluation of the ***Performance of the Integrated System*** involved observing the system's output of diversion messages and assessing user reaction to the system. The evaluators could not make a definite determination of the system's usefulness because few diversion messages were issued during the testing period. Regarding user reaction, the evaluator conducted informal interviews with the bus operators and found:

- 60% were enthusiastic about the ABR project's potential to improve travel time
- 63% of the operators did not find the diversion message clear, while 46% thought the sound quality could be improved
- 67% of the drivers were optimistic that the ABR system would improve travel time,
- 47% of the drivers believed that the alternate route provides an advantage after the diversion instruction.
- 80% of the drivers thought the diversion message was accurate
- 60% of the bus drivers agreed that the ABR system saves travel time
- 25% of the drivers diverted to US Route 9, when the diversion message instructed the operators to stay on GSP

- 85% of the operators agreed that the equipment is functioning effectively and was placed conveniently within the bus.

**Test Partners**

Federal Highway Administration

Hughes

New Jersey Department of Transportation

New Jersey Highway Authority

New Jersey Transit

New Jersey Turnpike Authority

Rutgers University

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**References**

Rutgers University Departments of Civil and Industrial Engineering, Evaluation of the Alternate Bus Routing Project -- Phase I (Draft), December 1997