

# **Arterial Performance Measurement Using Transit Buses as Probe Vehicles**

Prospectus for Master's Thesis

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## **Title of Thesis**

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## **Introduction**

With increasing data availability due to intelligent transportation systems (ITS) deployments, methods for assessing and reporting traffic characteristics and conditions have begun to shift. While previous Level of Service (LOS) methods were developed for use with limited data, we now have the power to develop new performance measures based on direct measurement. Important measures like average speed, travel time, and intersection delay can be used for direct performance monitoring of the transportation system in real time and in retrospect. On freeways, such performance measures are often estimated directly using data from inductive loop detectors (e.g., speed, occupancy, vehicle counts). For arterials with numerous signalized intersections, performance measures are more challenging due to more complicated traffic control and many origins and destinations. However, within signalized networks, travel time, speed, and other key performance measures can be generated both directly and indirectly using sources such as automatic vehicle location (AVL) data.

The objective of this research is to develop methods for assessing traffic conditions on an arterial network using transit buses as probe vehicles. The study location is a 3-mile corridor on Powell Blvd. in Portland, Oregon. This arterial runs from downtown Portland at SW First Ave., across the Willamette River on the Ross Island Bridge to the southeast Portland and ends at SE 39th Ave. The study corridor serves a high volume of traffic with Average Daily Traffic (ADT) of approximately 50,000 vehicles (Oregon Department of Transportation, 2001), traveling west during the A.M. peak and east during the P.M. peak.

Two sources of ITS data will be used to assess the arterial performance measures. The Metropolitan Transportation District of Oregon's (TriMet) Bus Dispatch System (BDS) data which includes an AVL component and a Global Positioning System (GPS) instrumented passenger vehicle traveling with normal (non-transit) traffic on the same arterial on the same days and times will be used to establish the relationships between the bus travel time and speed according to various traffic conditions.

## **Background**

Throughout the last decade, traffic engineers, planners, researchers, and transportation agencies have expended much effort trying to understand how a freeway system operates. Several key performance measures have been generated, numerous reports published and numerous freeway miles investigated. Even though such performance measures have been successful in describing freeway performance, we still lack solid methods for the

analysis of arterials. This is because arterials have complicated traffic behavior and many more variables than are associated with freeways.

For arterial performance measures, of all possible alternatives, traffic conditions are often evaluated by conducting travel time and delay studies (Oppenlander, 1976). Other arterial performance measures such as average speed can also be derived from travel time data. However, the studies of travel time and delay are time consuming and expensive. Test vehicles and two or more persons need to be dispatched in order to capture traffic movements and collect travel time data. With the increasing implementation of ITS, the probe vehicle technique plays an important role as an application designed primarily for collecting data in real time. Other than travel time data collection, the BDS system's primary application is for managing transit operations in real time. Since the bus probes are already in the traffic stream, they can be used for the collection of travel time data as a "passive" test vehicle (for specific purpose of collection travel time data, test vehicle is referred to as "active" test vehicle) (U.S. Department of Transportation, 1998).

The Metropolitan Transportation District of Oregon (TriMet) provides transit service in the three-county Portland Metropolitan area. During weekday, more than 500 TriMet's buses run along almost every major arterial of Portland during the peak period (Williams, 2000). Each of these buses is equipped with the Bus Dispatch System (BDS) which includes an AVL component. The BDS provides a rich data source of accurate time and location determined by a differential Global Positioning System (GPS). This data source represents a highly valuable probe's data as a source of information on traffic movement for the City of Portland. In order to benefit from this priceless resource, recently, City of Portland, Oregon Department of Transportation (ODOT) and TriMet have initiated the project called "ODOT/TriMet Transit Buses as Traffic Probes." TriMet is to report travel speeds over key corridors that are of interest to City of Portland and ODOT for these agencies to better monitor and manage the transportation system (Oregon Department of Transportation, 2003).

With the generosity of TriMet, ODOT, and City of Portland for supplying the data used herein, this study was started as a preliminary investigation submitted for the Master's Thesis fulfillment.

## **Objectives**

The objective of this study is to investigate the relationship between bus travel time and speed to the traffic condition using the comparison of the transit buses data and the ground truth data collected by a GPS instrumented passenger vehicle. It is a follow up study to the Timothy Williams's BDS Congestion Analysis Pilot Study (Williams, 2000). While Williams looked at the incident related congestion and preliminary travel time analysis on arterials, the current work will be a preliminary investigation on arterial performance that makes use of some performance measures and utilizes the test vehicle and BDS data for multiple days. Relationship would be established between the bus travel behaviors and the present traffic conditions. Also included will be an in depth

statistical analysis of the travel time data collection using the GPS equipped test vehicles and the arterial speed estimation using BDS data.

The analysis tool used in the study will be vehicle trajectories – graphs plotted with bus locations and test vehicle locations versus time, vehicle speed contour plots comparing the speed over time of buses and the test vehicle. Travel time and speed comparisons including some hypothetical/pseudo buses will also be investigated. Hypothetical buses are defined as the buses traveling non-stop and pseudo buses are the buses traveling at the maximum speed throughout the study corridor. The methodology of estimating traffic conditions using the BDS data will be addressed together with statistical analysis used during the study.

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