



# BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

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Acting Director, MPO Staff

The Boston Region MPO,  
the federally designated  
entity responsible for  
transportation decision-  
making for the 101 cities  
and towns in the MPO  
region, is composed of:

MassDOT Office of Planning and  
Programming  
City of Boston  
City of Newton  
City of Somerville  
Town of Bedford  
Town of Braintree  
Town of Framingham  
Town of Hopkinton  
Metropolitan Area Planning Council  
Massachusetts Bay Transportation  
Authority Advisory Board  
Massachusetts Bay Transportation  
Authority  
MassDOT Highway Division  
Massachusetts Port Authority  
Regional Transportation Advisory  
Council (nonvoting)  
Federal Highway Administration  
(nonvoting)  
Federal Transit Administration  
(nonvoting)

## MEMORANDUM

**DATE** February 3, 2011  
**TO** Transportation Planning and Programming Committee  
of the Boston Region Metropolitan Planning Organization  
**FROM** Karl H. Quackenbush, CTPS Acting Director  
**RE** Work Program for: MBTA CharlieCard Trip-Paths Pilot Study

### ACTION REQUIRED

Review and approval

### PROPOSED MOTION

That the Transportation Planning and Programming Committee of the Boston Region Metropolitan Planning Organization vote to approve the work program for the MBTA CharlieCard Trip-Paths Pilot Study in the form of the draft dated February 3, 2011.

### PROJECT IDENTIFICATION

#### Unified Planning Work Program Classification

Technical Support/Operations Analysis Projects

#### CTPS Project Number

14321

#### Client

Boston Region Metropolitan Planning Organization

#### CTPS Project Supervisors

*Principal:* Elizabeth M. Moore

*Manager:* Thomas J. Humphrey

#### Funding

MassDOT §5303 Contract #TBD

## **IMPACT ON MPO WORK**

This is MPO work and will be carried out in conformance with the priorities established by the MPO.

## **BACKGROUND**

The MBTA's Automated Fare Collection (AFC) system records the number of passengers entering each rapid transit prepayment station through the electronic faregates, but does not directly provide any information as to the locations at which these passengers will exit the rapid transit system. Historically, to obtain station-to-station ridership totals, it has been necessary to rely on passenger surveys. Such surveys are too costly to conduct on a regular basis, and must extrapolate findings from small percentages of all riders.

Station-to-station ridership totals are needed to comply with the National Transit Database (NTD) requirement of reporting average passenger trip length by mode each year. They are also used in calibrating the CTPS regional model which provides forecasts of ridership on potential new transit services, and in monitoring compliance of average vehicle loads with MBTA service standards.

The 2008-2009 MBTA systemwide survey results indicate that 90 percent of the riders who enter the rapid transit system on a given day make two or more one-way rapid transit trips over the course of the day. Each of the trips that begins at a prepayment station (as opposed to a Green Line surface stop) will be recorded as an entry at that station. Each farecard used to enter the system has a unique serial number that is recorded, along with a time and date stamp, every time it is used to open a faregate. Consequently, the AFC system can show all of the faregates where a given farecard has been used over a given span of hours.

To protect passenger confidentiality, when the data are used in this manner, the MBTA substitutes randomly assigned numbers for the actual numbers. CTPS will not have access to any databases that identify individual farecard users. Many farecards are in use only briefly, so a different set of random numbers will be required for each set of records to be examined together.

It is reasonable to hypothesize that a passenger making more than one one-way trip on the rapid transit system on a given day will start each trip at either the same station where the exit from the previous trip occurred or at another station in the same general area. If this hypothesis is correct, the station-to-station travel of any farecard appearing more than once in a report for a single day could be depicted by treating each entry point as the exit point from the previous trip, and treating the initial entry point as the exit point from the final trip.

## **OBJECTIVE**

The purpose of this study is to test whether reasonably accurate station-to-station rapid transit ridership tables can be created by using AFC records of entry locations of farecards used two

or more times on a given day. The MBTA and CTPS have not previously attempted to create such tables. If the proposed method is successful, it could reduce the need to conduct special passenger counts and surveys to determine origin-destination patterns, resulting in substantial cost savings. Although not included in this Work Program, the method could be further adapted to calculate transfer volumes between the rapid transit system and the MBTA bus network.

Because there are no complete actual records of station-to-station travel, the accuracy of the proposed method will be judged by its consistency with origin-destination tables derived from other sources, including the 2008-2009 passenger survey and past boarding and alighting counts conducted by CTPS, and with trips reported as part of three travel surveys conducted by TransitWorks from 2005 to 2009. Passengers can exit as well as enter stations through AFC fare-gates, but farecards are not used in exiting. The AFC reports include the times when each fare-gate has opened for exiting passengers, but do not show how many passengers exited while the gate was open. Non-AFC exit gates are not equipped with any counting devices.

## **WORK DESCRIPTION**

### **Task 1 Collect AFC Data**

CTPS will work with the MBTA to obtain AFC transaction data for every station faregate, surface Green Line farebox, and other farecard reader, organized by station and route for seven sequential days in the fall 2010 rating. These will be the most recent data available during the anticipated schedule for this work program. Fall ridership is usually representative, as it is not impacted significantly either by vacations or by extreme weather conditions. The serial number for each transaction will have been replaced with a random code that ensures that different transactions with the same serial number also receive the same random code.

#### ***Product of Task 1***

AFC transaction data for each station and route for seven sequential days.

### **Task 2 Process Data**

In this task, CTPS will process separately the AFC data for each of the seven days for which records have been provided. From the records for each day, CTPS will use database queries to produce, for each rapid transit station, a table showing the number of farecard serial numbers also recorded at each other individual station or surface Green Line farebox or portable farecard reader. (Surface Green Line farebox records show the route on which a farecard was used, but not the specific boarding location.) Each record of the use of a farecard includes the time at which it was used. These times will be used to determine the chronological order of the use of cards with numbers appearing at more than one location.

Farecard numbers appearing only once will also be totaled for the location where they appear. A farecard appearing once could represent a passenger actually making only a single one-way trip on the sample day, a passenger using a different farecard for different trips on the same day, or a passenger making some trips with an unrecorded entry, such as showing a pass to a Green Line operator without tapping it on a farebox.

***Product of Task 2***

A set of tables showing for each station for each sample day, the number and percentage of the farecards used for entries at that station used subsequently at each other station.

**Task 3 Analyze Results**

In this Task, CTPS will compare the station-to-station results from the five weekday samples for consistency among them. The patterns found in these tables will also be compared with those in origin-destination tables derived from other sources, including the 2008-2009 passenger survey and past boarding and alighting counts conducted by CTPS, and with trips reported as part of three travel surveys conducted by TransitWorks from 2005 to 2009. For purposes of comparison, spreadsheet models previously developed by CTPS to generate origin-destination tables from boarding and alighting counts will be updated to incorporate the most recent available count data. CTPS has not conducted boarding and alighting counts or passenger surveys on the rapid transit system on weekends, but if the method of generating origin-destination tables from AFC data produces acceptable results from weekday data, it should also produce acceptable results from Saturday or Sunday data.

***Product of Task 3***

A summary of findings as to similarities and differences between the results of the AFC-based station-to-station ridership tables and tables produced by other methods.

**Task 4 Document Recommendations**

Based on the results of the preceding tasks, CTPS will make recommendations as to whether the AFC-based station-to station ridership estimation method is suitable for further application as is, is potentially suitable for further application with some refinements, or does not appear to be worth pursuing further at this time. If the method does prove suitable for further application, the frequency at which new sets of tables should be generated will be included in the recommendations. All of the recommendations will be presented in a technical memorandum.

**ESTIMATED SCHEDULE**

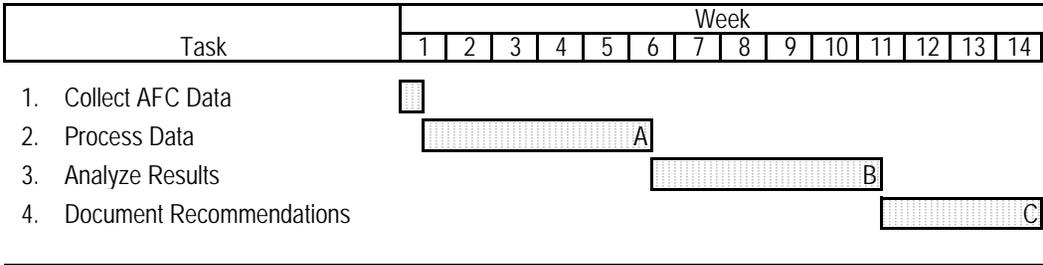
It is estimated that this project will be completed fourteen weeks after the notice to proceed is received. The proposed schedule, by task, is shown in Exhibit 1.

**ESTIMATED COST**

The total cost of this project is estimated to be \$39,930. This includes the cost of 14.1 person-weeks of staff time, and overhead at the rate of 90.69 percent. A detailed breakdown of estimated costs is presented in Exhibit 2.

KHQ/TJH/tjh

Exhibit 1  
 ESTIMATED SCHEDULE  
 MBTA CharlieCard Trip-Paths Pilot Study



- Products/Milestones
- A: Tables of fare-card matches by station
  - B: Summary of comparisons of origin-destination tables produced by different methods
  - C: Technical memorandum with final recommendations

Exhibit 2  
 ESTIMATED COST  
 MBTA CharlieCard Trip-Paths Pilot Study

<b>Direct Salary and Overhead</b>	<b>\$39,930</b>
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Task	Person-Weeks					Direct Salary	Overhead (@ 90.69%)	Total Cost
	M-1	P-5	P-4	P-3	Total			
1. Collect AFC Data	0.0	0.0	0.4	0.0	0.4	\$488	\$443	\$930
2. Process Data	0.0	4.0	1.0	0.0	5.0	\$7,601	\$6,893	\$14,494
3. Analyze Results	1.1	2.6	1.1	0.0	4.8	\$7,290	\$6,612	\$13,902
4. Document Recommendations	1.3	1.0	1.0	0.6	3.9	\$5,561	\$5,043	\$10,604
Total	2.4	7.6	3.5	0.6	14.1	\$20,940	\$18,991	\$39,930

<b>Other Direct Costs</b>	<b>\$0</b>
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None \$0

<b>TOTAL COST</b>	<b>\$39,930</b>
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*Funding*  
 MassDOT §5303 Contract #TBD