



Develop New York City Surface Transit Boarding and Alighting Ridership Daily Production Application Using Big Data

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1 Abstract

- NYCT has put into production a ridership application that determines surface transit boarding and alighting locations for each one of approximately 2.8 million daily passenger trips on board 218 bus routes, to support bus service scheduling and planning.
- The application combines data from an Automated Vehicle Location (AVL) system, Automated Fare Collection (AFC) system, and General Transit Feed Specification (GTFS).
- NYCT developed a highly optimized network generation tool (dynamic transfer link) to estimate bus boarding / alighting locations and link loads by solving for the shortest walking path on the sub-network.
- Results were validated and found to be consistent with manual ridechecks, limited O/D surveys, and others.
- Obtained accuracy was sufficient for NYCT surface transit schedule making and planning purposes.

2 Data Sources

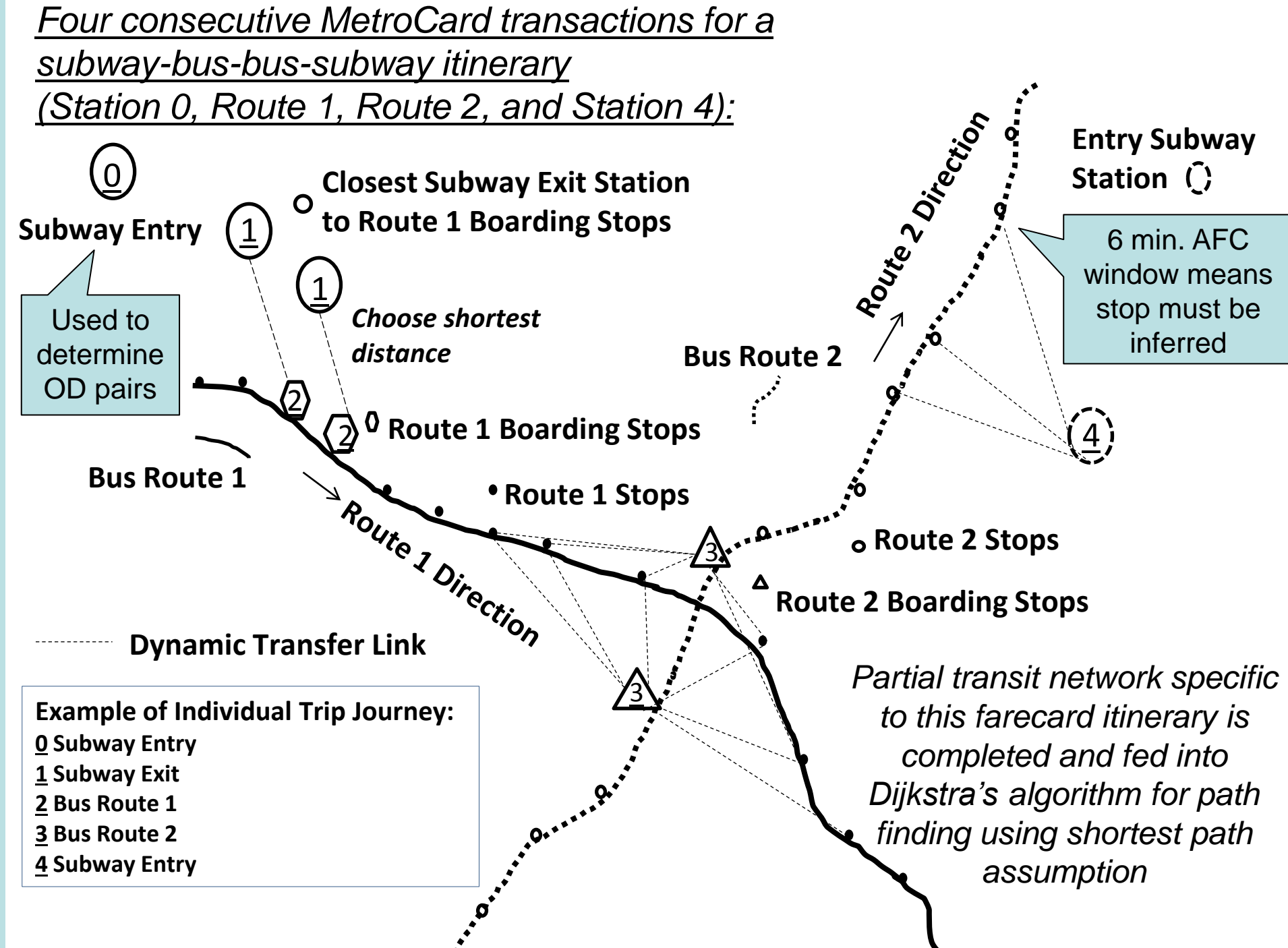
- AFC MetroCard Data**

Serial #	Date	Time	Bus #	Booth	POE(Bus Route)	
xxxxxx4324	20131031	73000	157	034 (5951)	2	147
xxxxxx4324	20131031	73000	156	034 010001	R177	1930
xxxxxx4324	20131031	140600	157	034 7778	2	120
xxxxxx4324	20131031	140650	156	034 000003	N017	1677
- MTA Bus Time Data (AVL)**

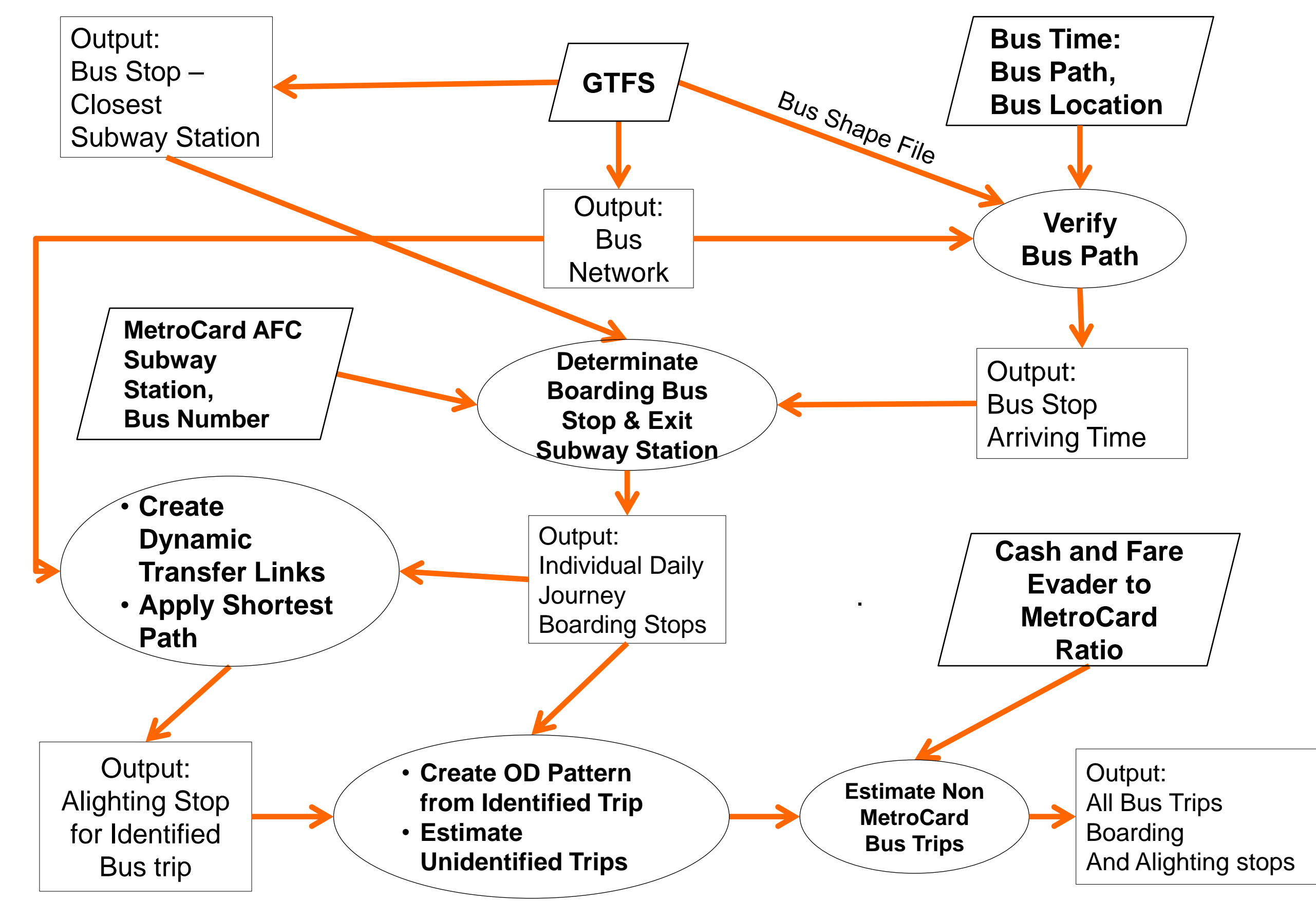
Bus #	Date Time	Latitude	Longitude
5951	"20131031 073044"	"MTA NYCT_BX19-25"	"BX19-25", 40.81997, -73.934915
7778	"20131031 140650"	"MTA NYCT_BX6"	"BX6-12", 40.836878, -73.9483
- GTFS Data (Bus Network)**

Link	Trip_id, Stop_id Sequence	Node	Stop_id, Stop_name, Lat, Long
050600 BX19-25, 100640, 1		100640	"S. BL/EPHAM RD", 40.856, -73.880
050600 BX19-25, 100640, 2		100641	"S. BL/E 187 ST", 40.853, -73.881
050600 BX19-25, 100641, 3		100642	"S. BL/E 183 ST", 40.850, -73.882
050600 BX19-25, 100642, 4			

3 Dynamic Transfer Link Illustration



4 Methodology Flow Chart



5 NYCT Surface Transit Application

Passenger Maximum Transfer Length (Walk, Bike, etc.)

Connections with Regional Transit Operators

Operator	Required Special Processing
SIR	22 stations (AFC at St. George and Tompkinsville only); Entrance and Exit Fare Collection
Staten Island Ferry	Free shuttle between South Ferry, Manhattan & St. George, Staten Island; Residents make daily intermodal trips of subway-ferry-bus or bus-ferry-SIR.
PATH	Rail transit between New York and New Jersey, and six stations in Manhattan; MetroCard can be used to pay PATH fares.
nice	Serves Nassau County, to the east of Queens; MetroCard is fare media and service coordinated with NYCT routes; Over 8,000 transfers made between NICE and NYCT/MTA per month.
Westchester County	Westchester County bus (north of Bx); Over 7,000 monthly transfers to/from NYCT/MTA buses.

Non-AFC Passenger Adjustment Factor by County

6 Results and Validation

Ridecheck Link-Load Comparisons on Bx19

Correlation to Manual Ridecheck Data (Bx19)

Ons
 $y = 1.0542x$
 $R^2 = 0.9586$

Offs
 $y = 1.0515x$
 $R^2 = 0.949$

APC-AFC Link-Load Comparison on B7

Average Length-of-Haul Comparison for Local Bus

Model-Survey Comparison in Co-op City

Origin	Destination	AFC-AVL Model	Market Survey
Co-op City	Co-op City	8%	12%
Co-op City	Bronx (outside Co-op City)	55%	59%
Co-op City	Manhattan	27%	20%
Co-op City	Brooklyn	3%	3%
Co-op City	Queens	5%	4%
Co-op City	Elsewhere	2%	2%

7 Conclusion

- Once limited to academic research, a daily production application has been implemented with high quality of results for surface transit passenger boarding and alighting estimation.
- Critical passenger information like origin-destination matrix and travel patterns needed for surface planning and scheduling, traditionally obtained through labor-intensive, time and budget constrained survey, can now be acquired through applications taking advantage of big transit data.
- The heart of this innovation, the "dynamic transfer link" network generation method in shortest path, proved to be effective and feasible in solving large scale and highly complex realistic transit networks.