COG STAFF INVESTIGATION OF CUBE PUBLIC TRANSPORT (PT) IN THE TPB VER. 2.3 TRAVEL MODEL

Proposed Fare Specifications

Feng Xie
TPB Transportation Engineer

Travel Forecasting Subcommittee
September 18, 2020

Introduction

- Fare modeling has been an integral component of the TPB travel modeling processes
  - Production-use Version 2.3 Model uses MFARE1.s and MFARE2.s processes to calculate TAZ-to-TAZ average fares in TRNBUILD
  - Developmental Version 2.5 Model adopts a dual calculation of fare:
    - Rather simplistic Public Transport (PT) specifications are used for path building
    - MFARE1.s and MFARE2.s processes are used to calculate fares for mode choice
- A recent staff investigation of PT in a developmental Ver. 2.3.85 Model with PT calls for more consistent and refined fare modeling relying only on PT fare specifications

Introduction

- During July-August, TPB staff conducted the following investigations:
  - Staff reviewed transit providers and their various fare structures in this region
  - Staff proposed a more realistic representation of those fare systems in PT
  - Staff implemented and tested the proposed PT fare specifications in the Ver. 2.3.85 Model, for year 2018
- On September 2, staff transmitted to RSG the modeling files and documentation associated with the above investigations
- COG and RSG agreed that this work could be used as a basis for fare modeling in the Gen3 Model

Outline

- The remainder of this presentation will cover:
  - Transit providers and their fare structures in this region
  - Proposed fare specifications
    - Fare systems
    - Discounts
  - Implementation
    - Model run
    - QC/QA checks
  - Concluding remarks and next steps

Transit Providers and Fare Structures

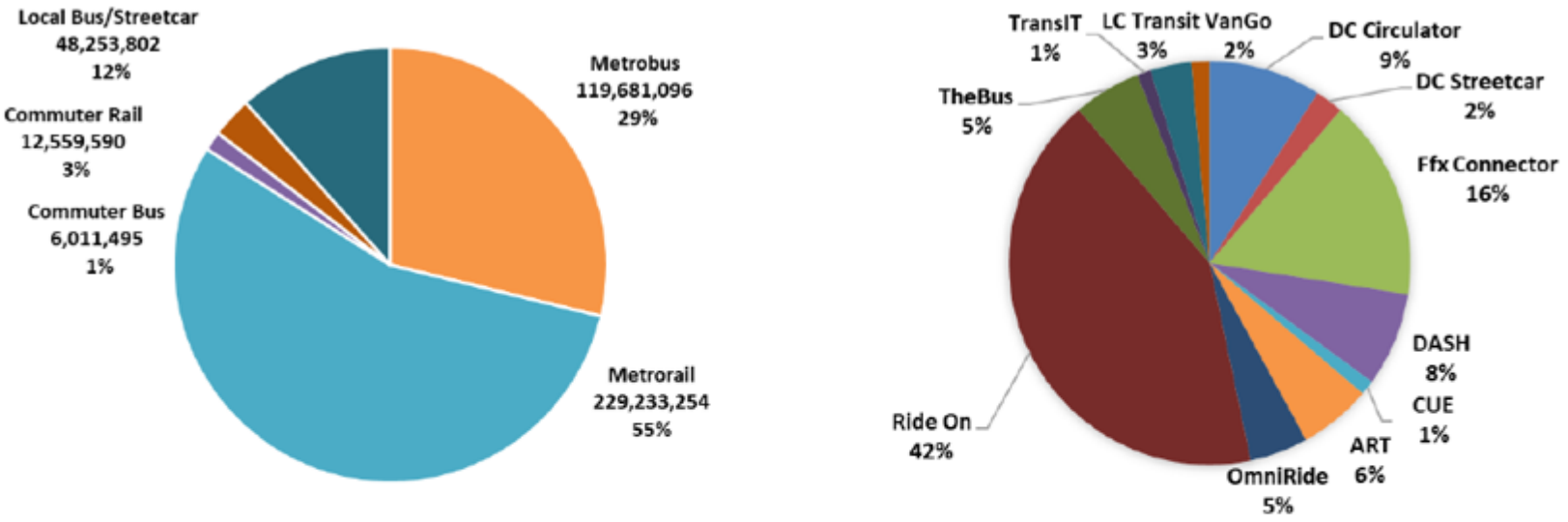
- WMATA publishes rail and bus fare structures in its tariffs:
  - Metrorail: Fares are calculated based on time of day, day of the week, as well as “composite miles” between origin and destination stations
  - Metrobus: Different flat fare rates are specified for local bus, express bus and airport shuttle services
- Regional commuter rail operators publish fare tables online:
  - MARC: MTA publishes station-to-station fare tables
  - VRE: VRE divides the region into fare zones and publishes fare-zone-to-fare-zone fares
- Multiple jurisdictions in the region provide local and express bus services
  - Many bus services in WMATA Compact Area (WCA), such as Ride On and Fairfax Connector, use the same fare structures as Metrobus
  - Other bus services, such as DC Circulator and MTA Commuter Bus, adopt different fare structures

Transit Providers and Fare Structures

- DC Streetcar, the only streetcar line currently in operation, is free to ride
- Fare information for future streetcar, BRT and light rail services are currently not available
- The fare structures are further complicated by various discount schemes:
  - Bus to rail, rail to bus, bus to bus transfer discounts
  - Discounts for special passenger types, such as seniors and students
  - Discounts for multi-ride tickets such as monthly pass and daily pass
  - Discounts for payment types, such as SmarTrip and Transit Link Card
  - Employer-based transit subsidies

Regional Transit Markets

- For regional fare modeling, it is important to understand the relative size of different transit services in the context of regional transit markets



Source: 2018 National Transit Database Stats;

Figure 1. Breakdown of 2018 Unlinked Passenger Transit Trips in Washington DC Metropolitan Area for Overall Transit System (Left) and for Local Bus/Streetcar System Only (Right)

Charts cited from Eric Randall, "2019 State Of Public Transportation Report", Presented at TPB Technical Committee Meeting, July 10, 2020.

Proposed Specifications: Fare Systems

- Staff proposed 10 fare systems to represent the various fare structures
- Following suggestion from RSG, single-ride cash fare rates were assembled for 2018, the base year chosen for the Gen3 Model

No	Description	PT Fare Structure	Fare Inputs
1	Metrorail	FAREMATRIX (FROMTO)	Station-to-station AM/OP fares calculated by MFARE1.s
2	VRE	FAREMATRIX (FROMTO)	Published 2018 fare-zone-to-fare-zone fares
3	MARC	FAREMATRIX (FROMTO)	Published 2018 station-to-station fares
4	WMATA Compact Area* Local	FLAT ($2.00)	WMATA Tariff #38, effective 2018
5	WMATA Compact Area* Express	FLAT ($4.25)	WMATA Tariff #38, effective 2018
6	DC Circulator	FLAT ($1.00)	DC Circulator website
7	Other Local Buses	FLAT ($1.25)	Estimated average
8	Other Express Buses	FLAT ($9.00)	Estimated average
9	Light Rail (Placeholder)	FLAT ($5.00) (Placeholder)	(Placeholder)
10	Streetcar and BRT	FREE**	DC Streetcar was free to ride in 2018

Notes: * WMATA Compact Area (WCA) buse services in this table include Metrobus (including Metroway), Ride-On, DASH, ART, Fairfax Connector, OmniRide, and PG the Bus.

** Although Metroway is coded as a BRT line, it should be included in Fare System #4, as its fare is consistent with Metrobus local service. Thus, the "Streetcar and BRT" fare system included only DC Streetcar in 2018, which was free to ride.

Proposed Specifications: Discounts

- TPB staff made the following simplifications on fare discounts:
  - staff did not consider discounts for special groups
  - Staff did not consider discounts associated with transit subsidy or transit pass, which will be considered in the transit pass ownership sub-model in Gen3
  - Staff modeled bus-to-Metrorail, Metrorail-to-bus and bus-to-bus transfer discounts with additional simplifications

	Transferring To					
Transferring From	Fare System #1 (Metrorail)	Fare System #4 (WCA Local Buses)	Fare System #5 (WCA Express Buses)	Fare System #6 (DC Circulator)	Fare System #7 (Other Local Buses)	Fare System #8 (Other Express Buses)
Fare System #1 (Metrorail)		$0.50	$0.50	$0.50	$0.50	$0.50
Fare System #4 (WCA Local Buses)	$0.50	$2.00	$2.00	$1.00		
Fare System #5 (WCA Express Buses)	$0.50	$2.00	$4.25	$1.00		
Fare System #6 (DC Circulator)	$0.50	$1.00	$1.00	$1.00		
Fare System #7 (Other Local Buses)	$0.50					
Fare System #8 (Other Express Buses)	$0.50					

Implementation

- TPB staff implemented the proposed fare specifications for 2018 in a developmental Ver. 2.3 Model, *i.e.*, Ver. 2.3.85 (PT|Calibr.) Model
- The implementation entailed creating or making modifications to the following modeling files:
  - VRE Fare Input File (New): *2018\Inputs\VRE_fares.dat*
  - MARC Fare Input File (New): *2018\Inputs\MARC_fares.dat*
  - Node Input File: *2018\Inputs\node.dbf*
  - PT Transit Line File: *2018\Inputs\Mode*am|op.lin*
  - PT System File: *2018\Inputs\TSYSD.PTS*
  - PT Fare File: *2018\Inputs\fare_am|op.dat*
  - PT Factor File: *2018\Inputs\am|op_trn.fac*
  - *Scripts\MFare1.s*
  - *Scripts\Transit_Skims_PT_MR|BM|AB|CR.s*

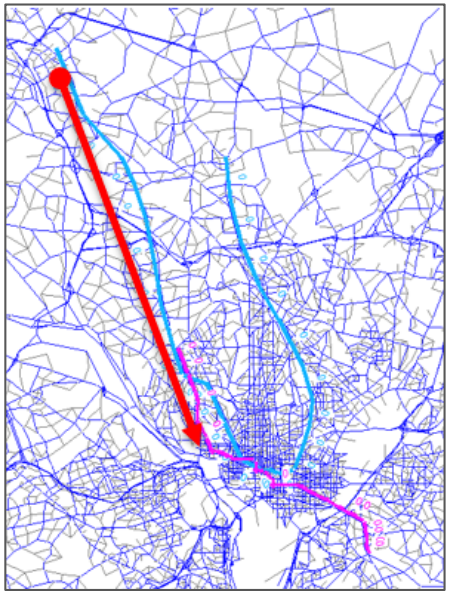
Testing

- Staff conducted a 2018 model run with proposed PT fare specifications
- Staff conducted QC/QA checks on PT fares based on model outputs
  - Fares derived from modeling outputs through path-tracing were compared to those manually calculated based on the fare structures and transfer discounts specified in model inputs
  - For 14 selected OD pairs, fare inputs and outputs were all consistent

8. Bus + Metrorail – with a transfer from Metrorail to Local Metrobus (Rockville, MD to Georgetown)
   - From Shady Grove (TAZ 521)
   - To Georgetown (TAZ 62)
   - PT path trace cost: $7.50
   - Input fare cost: $6.00 (Metrorail_Fare.mat, 1->14) + $2.00 (Local Metrobus) - $0.50 (transfer discount)) = $7.50
   - Output (Trace_AM_WK_BM_2018.PRN)

```
REval Route(s) from Origin 521 to Destination 62
521 -> 8001
8001 -> 8014 -> 20098 lines WMREDA
20098 -> 20573 -> 62 lines WM30NO WM30SO WM38BO WM33O
Cost= 112.02 Probability=1.0000

REval Route(s) from Origin 521 to Destination 62
N:    521 Mode  WaitA  TimeA Actual B/XPen Revcvd   Dist  Total  Lines(weight)
->   8001   20     -  10.81  10.81      -  27.03   0.54   0.54
->   8014    3  4.00  33.55  48.36   3.00  70.22  17.15  17.69  WMREDA(1.000)
-> 20098   32     -   2.41  50.77      -  76.24   0.12  17.81
-> 20573    1  2.78   7.32  60.87  15.00 105.52   1.26  19.07  WM30NO(0.111) WM30SO(0.111)
WM38BO(0.556) WM33O(0.222)
->    62   21     -   2.60  63.47      - 112.02   0.13  19.20
Mode  TimeA   Dist IWaitA XWaitA
   1  7.32   1.26   0.00   2.78
   3 33.55  17.15   4.00   0.00
  20 10.81   0.54
  21  2.60   0.13
  32  2.41   0.12
Fare=  7.50
```



Concluding Remarks and Next Steps

- Based on a review of the transit providers and their fare structures in this region, staff proposed and implemented 10 fare systems for this region in Cube Public Transport (PT)
- The PT fare specifications enable TPB staff to remove the dual calculation of fares and rely only on PT fare specifications throughout the Ver. 2.3 modeling process
- As part of the PT fare implementations, the node file and transit line files were updated offline using *ad hoc* scripts developed by TPB staff. If the proposed fare specifications are to be adopted in the TPB travel model, it would be ideal to make such updates in the network database
- Although the proposed specifications were implemented in the TPB Gen2/Version 2.3 Travel Model, it is expected that they will provide a basis for the fare modeling in the Gen3 Model

Acknowledgements

- I would like to express my sincere thanks to:
  - Jane, who reviewed transit providers and fare structures in this region
  - Jim and Meseret, who developed the 2018 network in PT format
  - Sanghyeon, who conducted the QC/QA checks on fare specifications
  - Mark and others, who provided review on the documentation of this work, and
  - Vipul Modi (Bentley Citilabs), who provided technical assistance with coding transfer discounts in PT

Feng Xie

Manager of Model Development, COG/TPB
(202) 962-3259
fxie@mwcog.org

mwcog.org/TPB

Metropolitan Washington Council of Governments
777 North Capitol Street NE, Suite 300
Washington, DC 20002