

Version 2.3 Travel Model: Developing the accessibility process

Presentation
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Meaning and use of accessibility

- Meaning: A measure of how easily *opportunities* may be reached:
 - What are opportunities?
 - Activities, goods, services, or destinations
- Use: One of several standard *performance measures* of a transportation system
 - One of many indicators that may be used to gauge how well transportation system investments are meeting goals and expectations

“Access” means different things to different transportation planners

1. Transportation modeler: the ability to reach places over the network 
2. Network coder: How cars/people reach the highway/transit network from zone centroids
3. Highway engineer: the connectivity of roadways to property, e.g., where curb-cuts allow access or a type of facility design (full/limited access)
4. Pedestrian planner: The degree to which sidewalks meet needs of the disabled (*accessible design*)

Who is interested in accessibility?

- Planners, home owners: Accessibility from homes to jobs
- Realtors: Accessibility from homes to schools, homes to Metrorail stations, homes to malls
- Developers, business owners: Accessibility from business establishments to target populations
- Employers: Accessibility from job sites to a targeted labor force



Accessibility and the CLRP Update

- The CLRP must be updated every 4 years, at minimum
 - The TPB's Plan is updated each year, typically
- Each CLRP update is analyzed to see how it *performs* with respect to the *TPB's Vision Goals*
- Performance measures include:
 - Metropolitan Growth
 - Travel Demand
 - Congestion
 - Mobile Source Emissions
 - **Job Accessibility**
 - Activity Clusters
 - Environmental Justice




A more focused definition of accessibility used by TPB staff

- The number of *opportunities* reached within a specified *time* threshold using a specified *mode*
 - Opportunities: typically jobs or households
 - Time: typically 45 minutes
 - Mode: typically highway or transit
- Extensions to the definition:
 - Percent of a target population that can reach “x” opportunities within “y” minutes

Hypothetical Accessibility Example: 5-Zone Study Area: Base Year

- A land use vector and a travel time matrix determines jobs accessible

Land Activity		AM Congested Highway Time Matrix (min)					Jobs Reached		
TAZ	Jobs	i/j	1	2	3	4	5		
1	10,000	1	5	25	20	46	50	17,000	TAZ 1 reaches jobs in TAZs 1-3 w/in 45 min
2	5,000	2	25	5	44	50	55	17,000	TAZ 2 reaches jobs in TAZs 1-3 w/in 45 min
3	2,000	3	30	20	10	40	50	17,500	TAZ 3 reaches jobs in TAZs 1-4 w/in 45 min
4	500	4	45	55	60	15	50	10,500	etc.
5	500	5	55	60	65	70	15	500	etc.
Total	18,000							62,500	

 indicates <= 45 minutes

Note: The theoretical maximum number of jobs accessible in this system would be:
 Total TAZs * Regional Jobs = 5 * 18,000 = 90,000 Jobs

Hypothetical Accessibility Example: 5-Zone Study Area: Base & Future Year

Base Year:										
Land Activity		AM Congested Highway Time Matrix (min)					Jobs Reached			
TAZ	Jobs	i/j	1	2	3	4	5			
1	10,000	1	5	25	20	46	50	17,000	TAZ 1 reaches jobs in TAZs 1-3 w/in 45 min	
2	5,000	2	25	5	44	50	55	17,000	TAZ 2 reaches jobs in TAZs 1-3 w/in 45 min	
3	2,000	3	30	20	10	40	50	17,500	TAZ 3 reaches jobs in TAZs 1-4 w/in 45 min	
4	500	4	45	55	60	15	50	10,500	etc.	
5	500	5	55	60	65	70	15	500	etc.	
Total	18,000							62,500		
Forecast Year:										
Land Activity		AM Congested Highway Time Matrix (min)					Jobs Reached		Change in Jobs Reached (Future - Base)	
TAZ	Jobs	i/j	1	2	3	4	5			
1	15,000	1	7	25	46	55	70	22,000	5,000	
2	7,000	2	30	12	47	63	58	22,000	5,000	
3	3,000	3	37	30	15	47	55	25,000	7,500	
4	1,500	4	50	60	67	20	50	1,500	-9,000	
5	700	5	60	65	70	75	46	0	-500	
Total	27,200							70,500	8,000	

indicates <= 45 minutes

“Winners”

“Losers”

Land activity increases over time

Mobility decreases over time

Hypothetical Accessibility Example: Observations

- Regional jobs are growing over time (by ~50%)
- Highway mobility is decreasing
 - Less travel time cells that are ≤ 45 minutes in future
- *Jobs reached* within 45 minutes are growing- but by a slower rate than overall *jobs* (~13% vs. ~50%)
- The example points out the “teeter-totter” challenge to planners: balancing development with the transportation system



Accessibility: distinguishing points

- Regional accessibility reflects two complex variables:
 - Land Use: Intensity, pattern, & J/H balance
 - Transport System: capacity, connectivity, congestion
- The two variables are not independent- one does not exist without the other



- It's best used as a relative measure

Accessibility: distinguishing points

- Accessibility is subject to the “cliff affect.” A small change in travel time for some TAZs may yield *drastic* changes in accessibility...

It's subject to volatility

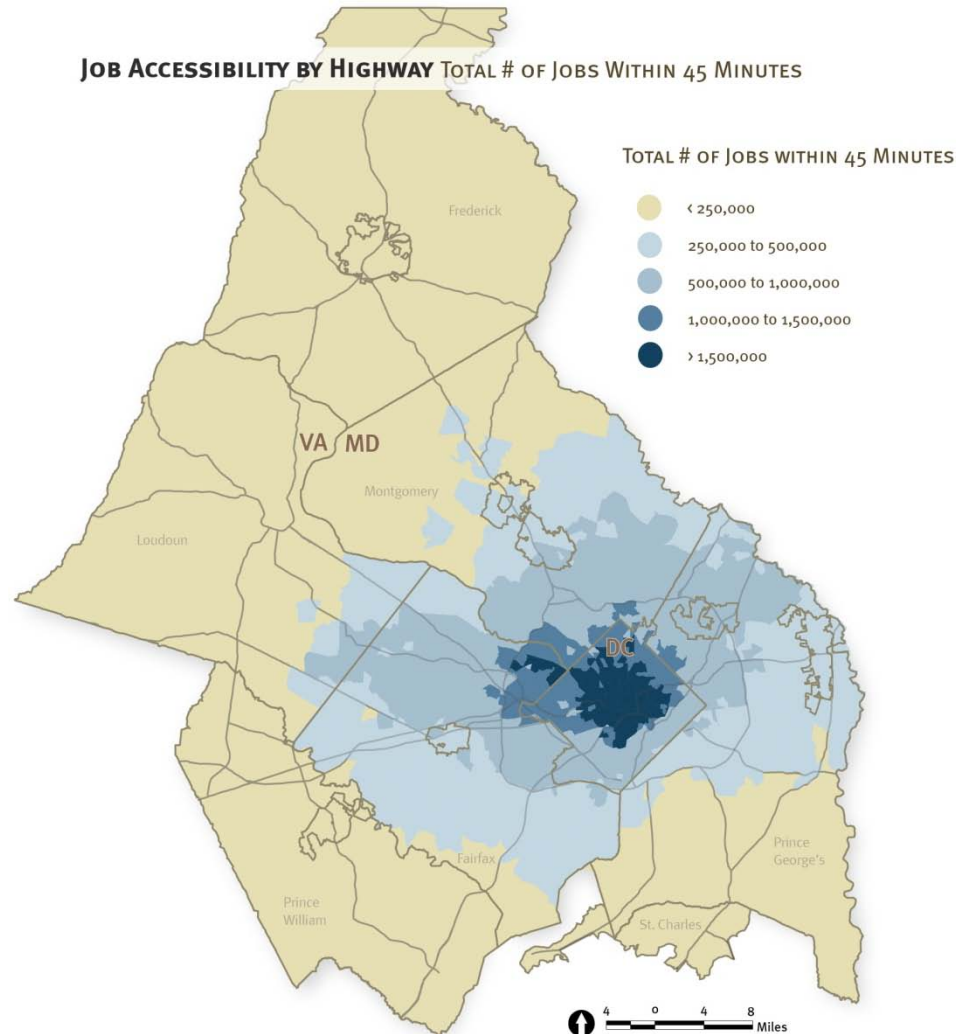


- As both land use and congestion are associated with *spatial* patterns, accessibility is best portrayed as a *map*, rather than as a number or a graph
 - Absolute accessibility contours
 - Relative accessibility contours (the change in access)

Example of an “absolute” highway accessibility map

Map identifies which household locations are best suited to reach jobs at a specific point in time

Notice:
Accessibility is correlated with land prices

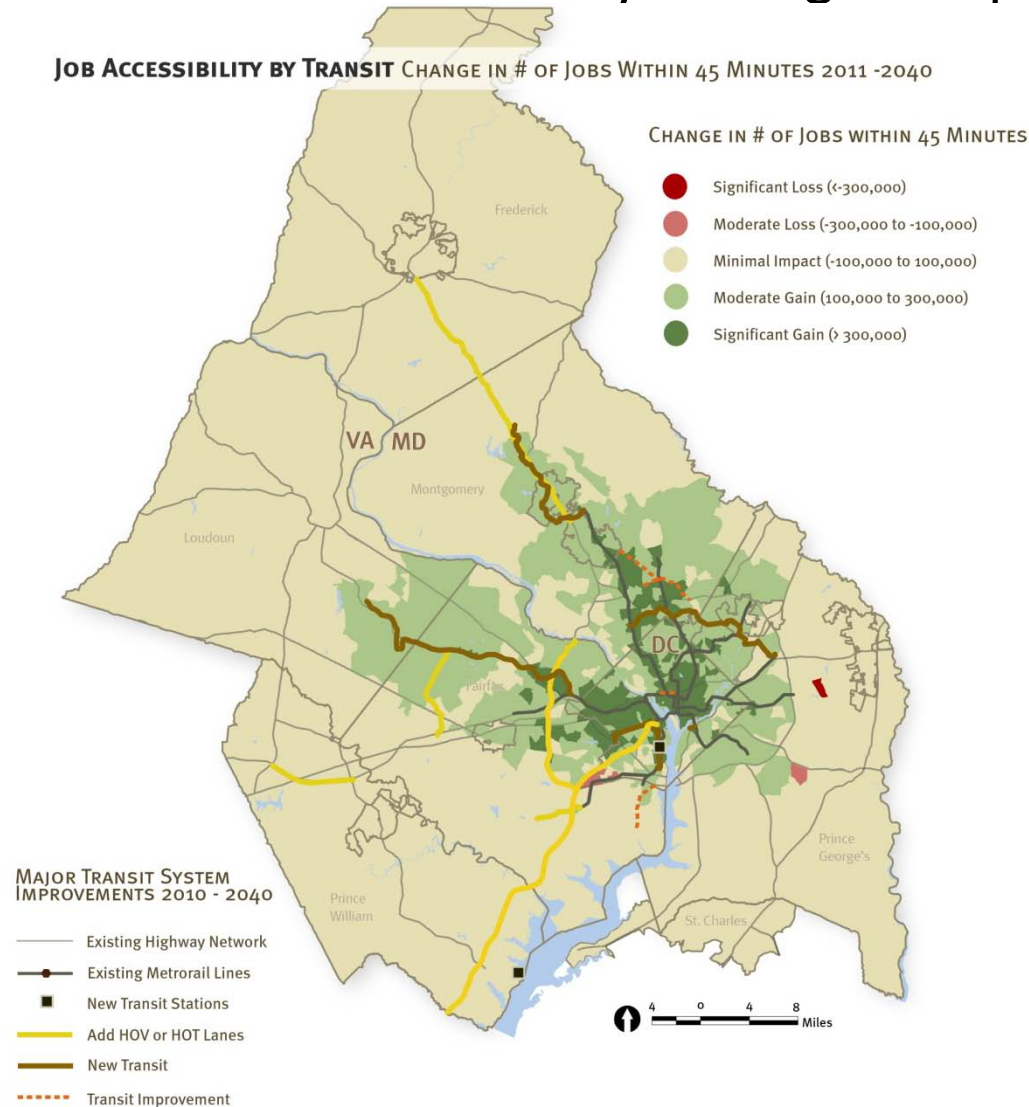


Example of a “relative” transit accessibility map

Also known as an accessibility “change” map

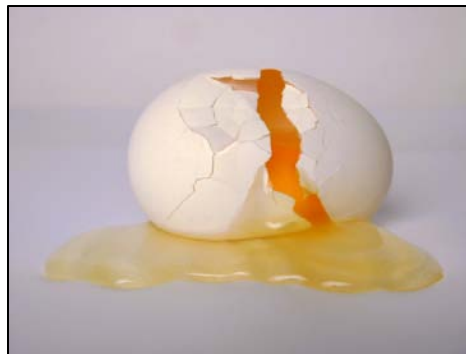
Map identifies where the “winners” of transit accessibility between two points in time

Notice: Accessibility gains are correlated with transit improvements



Added utility of accessibility analysis

- Accessibility plots often uncover quality control problems between two sets of networks relating to:
 - Integrity (e.g., disconnected TAZs)
 - Consistency (e.g., missing/miscoded transit lines)
 - etc.



The automated accessibility process

- Batch-file driven and Cube-Voyager based
 - Accessibility summaries are developed for two alternatives, so that
 - “Absolute” accessibility summaries are produced for *each* alternative
 - “Relative” accessibility summaries are produced showing the *change* in accessibility *between* alternatives
- Several types of accessibility measures are developed:
 - AM/Off-pk. Transit (Walk/Drive, Walk-Only, Drive only)
 - Job accessibility
 - HH accessibility
 - AM/Off-pk. Highway
 - Job accessibility
 - HH accessibility

Accessibility batch file example

```
:: ACCESS_MM.BAT - Batch file for absolute & relative accessibility
```

```
:: BASE Yr
set BASE_Nt_PATH=X:\modelRuns\fy12\Ver2.3.38_conf\2010_Conf\
set BASE_LU_PATH=X:\modelRuns\fy12\Ver2.3.38_conf\2010_Conf\
set BASEID=2010NT_2010NT
```

```
:: Alt Yr
set ALTR_Nt_PATH=X:\modelRuns\fy12\Ver2.3.38_conf\2040_final\
set ALTR_LU_PATH=X:\modelRuns\fy12\Ver2.3.38_conf\2040_final\
set ALTRID=2040NT_2040LU
```

```
:: -----
:: - Absolute Access TP+ Programs -
:: -----
```

```
:: AM/ Off-peak Walk & Drive Access Transit Accessibility File Generator
start /w Voyager.exe transit_access_MM.s /start -Pvoya -S
```

```
:: AM/ Off-peak Walk Access ONLY - Transit Accessibility File Generator
start /w Voyager.exe Wtransit_access_MM.s /start -Pvoya -S
```

```
:: AM/ Off-peak Drive Access Only - Transit Accessibility File Generator
start /w Voyager.exe Dtransit_access_MM.s /start -Pvoya -S
```

```
:: AM/ Off-peak Highway Accessibility File Generator
start /w Voyager.exe Highway_access_MM.s /start -Pvoya -S
```

```
:: -----
:: - Relative Accessibilty TP+ Program -
:: -----
```

```
start /w Voyager.exe ACT_DIFFERENT_MM.S /start -Pvoya -S
```

“Base” scenario paths to network, land use files

“Alt.” scenario paths to Network, land use files

Transit and highway accessibility routines for generating absolute accessibility summaries

Routine for generating accessibility difference summaries

How is transit travel time defined in the accessibility process?

- Based on actual (not perceived) time
- Based on the total (IVT and OVT) time
- The minimum “connected” travel time of any path:
 - All-Bus
 - Metrorail-Only
 - Metrorail-Bus combination
 - Commuter rail

How is highway travel time defined in the accessibility process?

- Based on SOV time
- Based on the total travel time
 - over-the-network and terminal time
- Includes both travel time and the toll-time equivalent if tolled segments are used for a given path

Example “absolute” accessibility output zonal file:

AM Hwy Accessibility to 2010 jobs

The diagram shows two boxes at the top. The left box is labeled 'TAZ' and has a blue arrow pointing to the 'Z' column of the table below. The right box is labeled 'Jobs within 5, 15, 25,... minutes' and has three blue arrows pointing to the columns labeled 'AMJB05', 'AMJB15', and 'AMJB25' in the table below.

Z	AMJB05	AMJB15	AMJB25	AMJB35	AMJB45	AMJB60	AMJB99
1.00	362323	1149904	1784082	2373925	2960722	3384981	3916121
2.00	243066	1137696	1776697	2354614	2948787	3377947	3921510
3.00	49450	1022164	1608615	2248675	2820353	3294847	3921510
4.00	39975	934254	1474290	2164262	2772387	3228654	3921510
5.00	268251	1153403	1763963	2295269	2913061	3430827	3921510
6.00	108717	1124883	1723434	2278871	2896817	3418104	3921510
7.00	414927	1153513	1778214	2349178	2958138	3393110	3921510
8.00	516036	1185403	1801157	2381678	2968617	3427172	3921510
9.00	480716	1157769	1779874	2318949	2942042	3428867	3921510
10.00	354989	1153483	1740157	2282988	2888325	3429823	3921510
11.00	348329	1129899	1742240	2262007	2868626	3423805	3921510
12.00	348619	1136499	1724103	2252802	2870326	3416933	3906443
13.00	422445	1175086	1751300	2291505	2899200	3442476	3921510
14.00	447496	1137521	1742280	2269830	2895954	3430614	3908725
15.00	373694	1149626	1756697	2264203	2902862	3444280	3921510

Example “relative” accessibility output zonal file

Change in AM Transit Accessibility to jobs within 45 min., from 2010 to 2040

z	BASEACC	ALTACC	CHGINACC
1	948399	1250928	302529
2	867438	1095894	228456
3	673276	824553	151277
4	480128	493969	13841
5	763851	960853	197002
6	0	0	0
7	921477	1179777	258300
8	987733	1344504	356771
9	942399	1264690	322291
10	968238	1282164	313926
11	1110039	1519446	409407
12	1250037	1705242	455205
13	1149573	1585141	435568
14	1279359	1804154	524795
15	1256325	1739756	483431

“Absolute” accessibility files created

Cube Voyager Script	Accessibility File Description	Base Scenario Output Files	Alternative Scenario Output Files
Highway_Access.S	AM Highway Acc to HH	<BASEID>_AM_HWY_ACCtoHH	<ALTID>_AM_HWY_ACCtoHH
	OP Highway Acc to HH	<BASEID>_OP_HWY_ACCtoHH	<ALTID>_OP_HWY_ACCtoHH
	AM Highway Acc to Jobs	<BASEID>_AM_HWY_ACCtoJB	<ALTID>_AM_HWY_ACCtoJB
	OP Highway Acc to Jobs	<BASEID>_OP_HWY_ACCtoJB	<ALTID>_OP_HWY_ACCtoJB
Wtransit_Access.S	AM Walk_Transit Acc to HH	<BASEID>_AM_WTR_ACCtoHH	<ALTID>_AM_WTR_ACCtoHH
	OP Walk_Transit Acc to HH	<BASEID>_OP_WTR_ACCtoHH	<ALTID>_OP_WTR_ACCtoHH
	AM Walk_Transit Acc to Jobs	<BASEID>_AM_WTR_ACCtoJB	<ALTID>_AM_WTR_ACCtoJB
	OP Walk_Transit Acc to Jobs	<BASEID>_OP_WTR_ACCtoJB	<ALTID>_OP_WTR_ACCtoJB
Dtransit_Access.S	AM Driv_Transit Acc to HH	<BASEID>_AM_DTR_ACCtoHH	<ALTID>_AM_DTR_ACCtoHH
	OP Driv_Transit Acc to HH	<BASEID>_OP_DTR_ACCtoHH	<ALTID>_OP_DTR_ACCtoHH
	AM Driv_Transit Acc to Jobs	<BASEID>_AM_DTR_ACCtoJB	<ALTID>_AM_DTR_ACCtoJB
	OP Driv_Transit Acc to Jobs	<BASEID>_OP_DTR_ACCtoJB	<ALTID>_OP_DTR_ACCtoJB
Transit_Access.S	AM Total_Transit Acc to HHs	<BASEID>_AM_TRN_ACCtoHH	<ALTID>_AM_TRN_ACCtoHH
	OP Total_Transit Acc to HHs	<BASEID>_OP_TRN_ACCtoHH	<ALTID>_OP_TRN_ACCtoHH
	AM Total_Transit Acc to Jobs	<BASEID>_AM_TRN_ACCtoJB	<ALTID>_AM_TRN_ACCtoJB
	OP Total_Transit Acc to Jobs	<BASEID>_OP_TRN_ACCtoJB	<ALTID>_OP_TRN_ACCtoJB

“Relative” or “Change” in accessibility files created

Cube Voyager Script	Description	Zonal Accessibility Change Filename
Act_Different.S	Change in AM Peak Highway Acc. to HHs	<BASEID>_<ALTID>_CHG_AM_HWY_ACCtoHH
	Change in AM Peak Highway Acc. to Jobs	<BASEID>_<ALTID>_CHG_AM_HWY_ACCtoJB
	Change in AM Peak Total_Transit Acc. to HHs	<BASEID>_<ALTID>_CHG_AM_TRN_ACCtoHH
	Change in AM Peak Total_Transit Acc. to Jobs	<BASEID>_<ALTID>_CHG_AM_TRN_ACCtoJB
	Change in AM Peak Walk_Transit Acc. to HHs	<BASEID>_<ALTID>_CHG_AM_WTR_ACCtoHH
	Change in AM Peak Walk_Transit Acc. to Jobs	<BASEID>_<ALTID>_CHG_AM_WTR_ACCtoJB
	Change in AM Peak Driv_Transit Acc. to HHs	<BASEID>_<ALTID>_CHG_AM_DTR_ACCtoHH
	Change in AM Peak Driv_Transit Acc. to Jobs	<BASEID>_<ALTID>_CHG_AM_DTR_ACCtoJB
	Change in Off-Peak Highway Acc. to HHs	<BASEID>_<ALTID>_CHG_OP_HWY_ACCtoHH
	Change in Off-Peak Highway Acc. to Jobs	<BASEID>_<ALTID>_CHG_OP_HWY_ACCtoJB
	Change in Off-Peak Total_Transit Acc. to HHs	<BASEID>_<ALTID>_CHG_OP_TRN_ACCtoHH
	Change in Off-Peak Total_Transit Acc. to Jobs	<BASEID>_<ALTID>_CHG_OP_TRN_ACCtoJB
	Change in Off-Peak Walk_Transit Acc. to HHs	<BASEID>_<ALTID>_CHG_OP_WTR_ACCtoHH
	Change in Off-Peak Walk_Transit Acc. to Jobs	<BASEID>_<ALTID>_CHG_OP_WTR_ACCtoJB
	Change in Off-Peak Driv_Transit Acc. to HHs	<BASEID>_<ALTID>_CHG_OP_DTR_ACCtoHH
	Change in Off-Peak Driv_Transit Acc. to Jobs	<BASEID>_<ALTID>_CHG_OP_DTR_ACCtoJB

Access “change” is based on 45 minute threshold

Conclusions

- A process for developing accessibility files based on standard Version 2.3 travel model outputs files has been in progress
- Accessibility summaries will be included in our next evaluation of the adopted 2011 CLRP, along with several performance measure summaries
- The Version 2.3-based accessibility process remains in draft, pending staff review of draft results