Assistance with Development and Application of the TPB Travel Demand Model

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FY 2014 Task Orders

- T.O. 10 – Meetings and General Support
- T.O. 11 – Cube-Based Walkshed Process
- T.O. 12 – HOT/HOV Highway Assignment
- T.O. 13 – Mode Choice and Transit Modeling
  - 13.1 – Network Preparation and Path Building
  - 13.2 – Mode Choice Calibration

Percent of Zone that can Walk to Transit

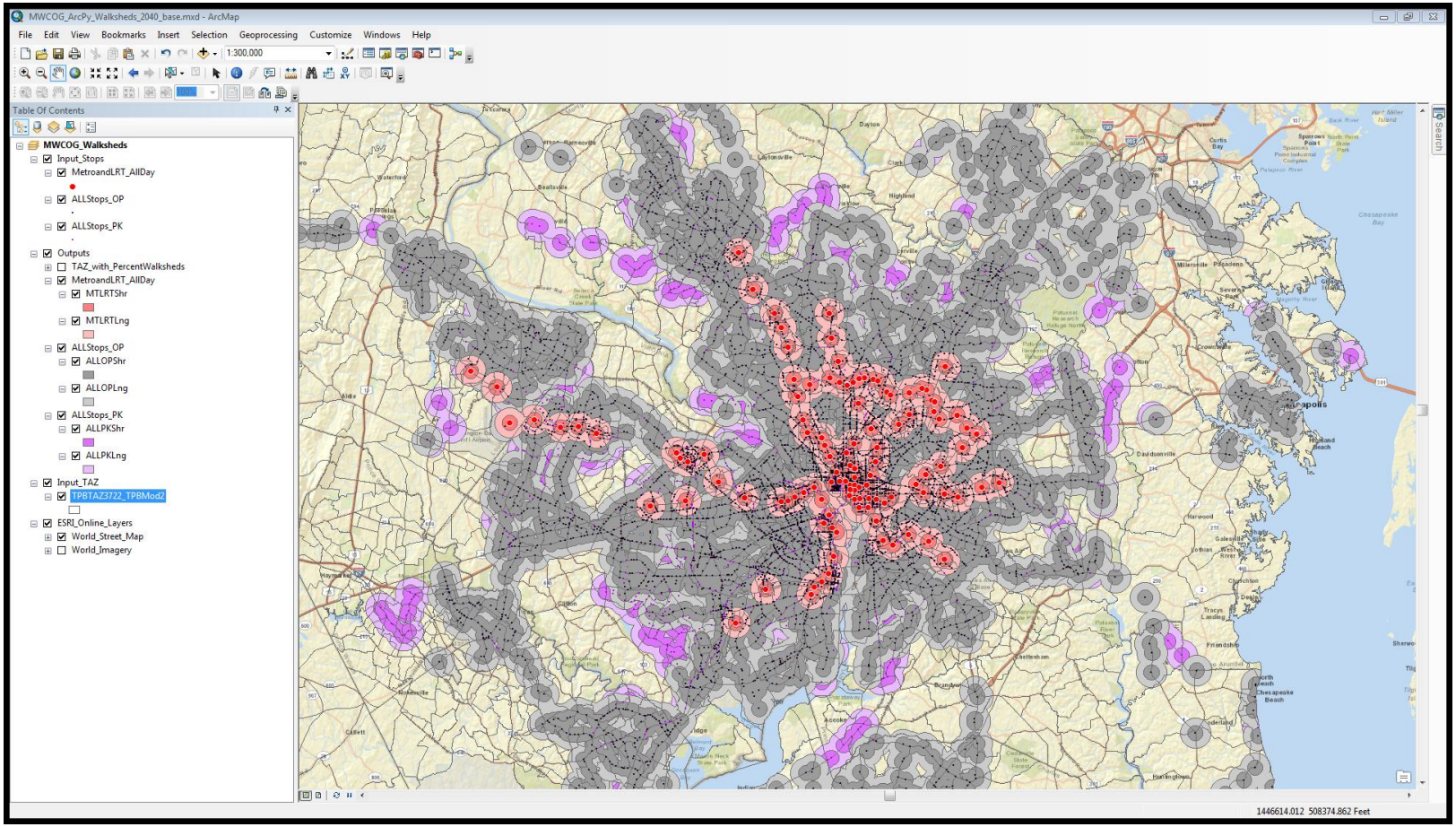
- Current Process
  - Manually prepare data
    - TRNBUILD line files → transit stop shapefiles (PK and OP)
      Metrorail+LRT shapefile
  - Manually run ArcGIS
    - Run ArcGIS (VBA or ModelBuilder) procedure
  - Manually replace model input(s)
    - 'AreaWalk.txt'
- Concerns
  - Requires ArcGIS software (extra expense)
  - Outside the modeling process (application consistency)
  - Staff turnover (maintenance / support)

T.O. 11 – Cube-Based Walkshed Process

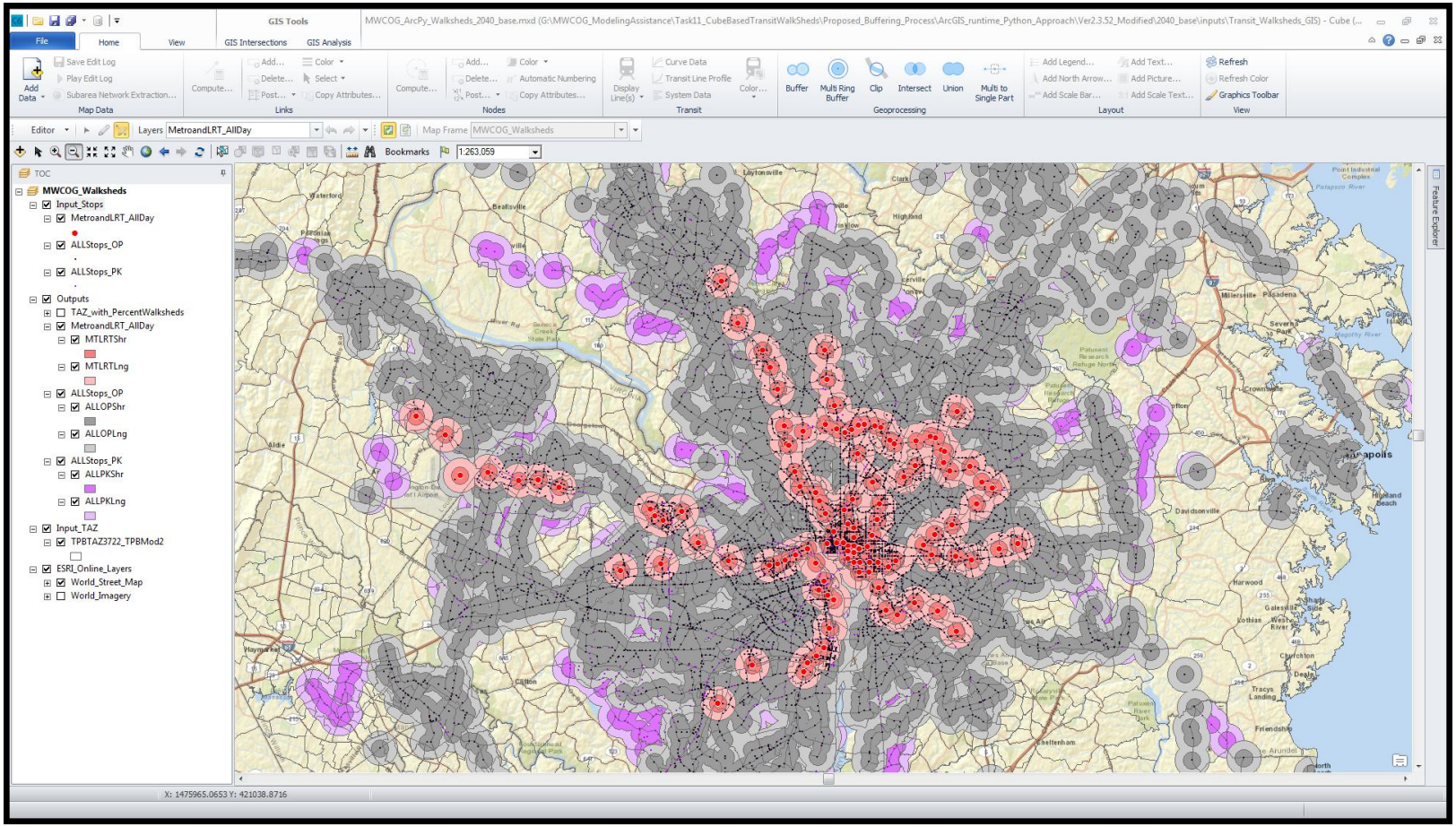
- Proposed ArcPy* based process
  - Integrates with TPB model procedures
    - Tested on Cube 6.1.0 SP1 with ArcGIS runtime and full ArcGIS
  - Automated data preparation (Cube script)
    - TRNBUILD line files → transit stop shapefiles (PK and OP)
      Metrorail+LRT shapefile
  - Automated walkshed process (Python script)
    - Uses ArcPy and ArcGIS runtime
  - Includes display / visualization options

* Part of ArcGIS runtime (Version 10 or greater) installed by Cube

ArcMap Display Options (in ArcGIS)



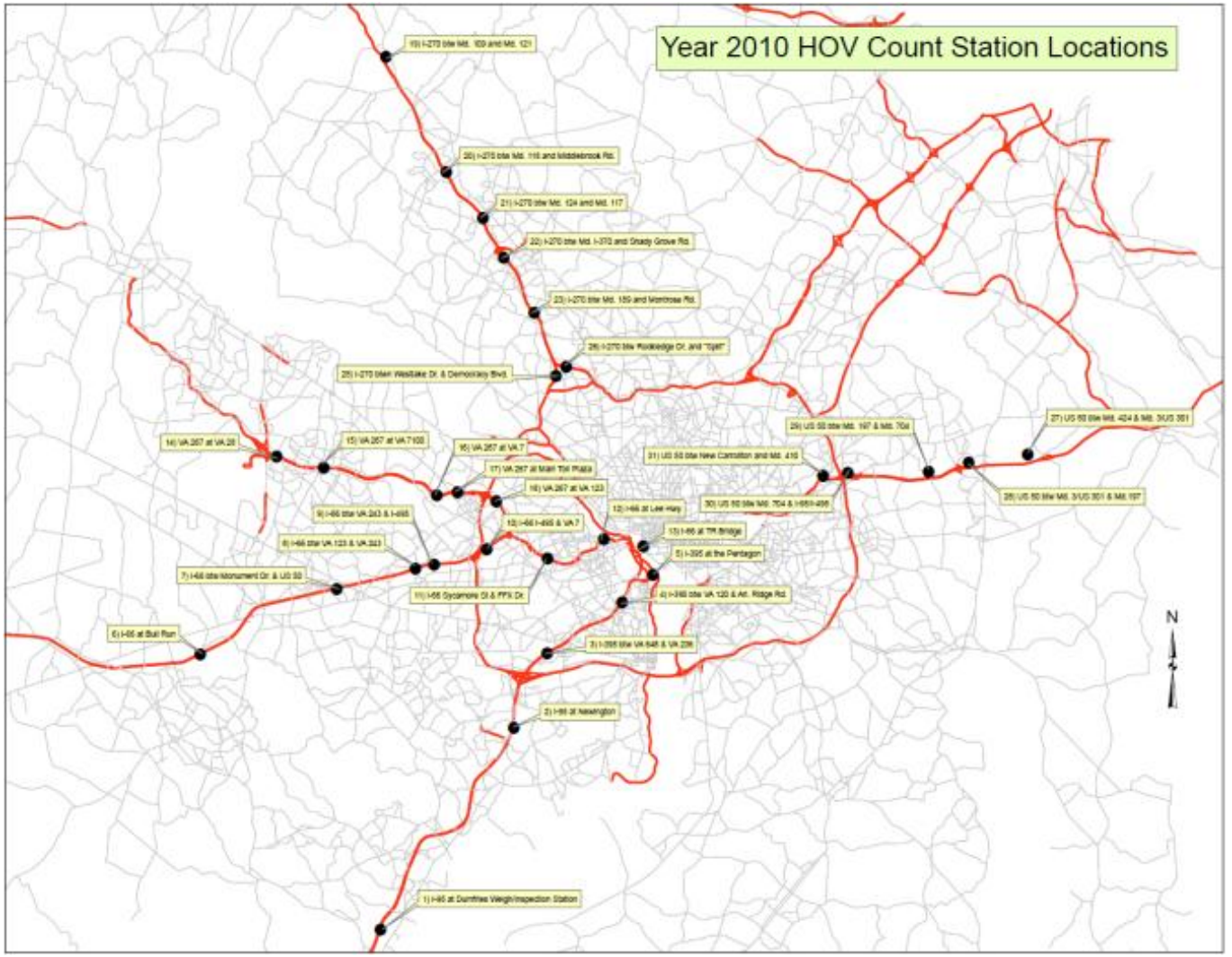
ArcMap Display Options (in Cube)



T.O. 12 – HOT/HOV Highway Assignment

- Implement the recommendations from T.O. 8
  - Additional HOV count data and calibration before integrating an HOV choice model into mode choice and highway assignment
  - Incorporate toll-setting and toll-choice into the standard highway assignment process
- Update HOV choice model
  - Use HOV counts provided by TPB
    - SOV <> HOV2 <> HOV3
- Update and test HOT lane model
  - Integrate toll choice into standard modeling process
    - Use Value of Time by six vehicle classes provided by TPB

HOV Count Locations



T.O. 13 –Transit Modeling

- Public Transport (PT) network design
  - TRNBUILD → PT transit routes
  - Non-Transit Leg generation (access/egress/transfers)
- Design report submitted for review (12/26/13)
- MWCOG comments incorporated (1/7/14)
- Updated on 1/10/2014

PT Conversion Task

- Purpose/Objective
  - Migrate from TRNBUILD to Public Transport (PT) for transit networks, path building and assignment
    - Cube software maintenance: TRNBUILD→PT
    - Offers a number of advantages and challenges
- Task Activities

TRNBUILD→PT Requirements

- PT uses an alternating sequence of transit and non-transit legs to define a transit path
  - Non-transit legs represent transfers between transit lines and access to and egress from transit lines
- TRNBUILD uses transit-only links, roadway links and transit routes to build transit paths
  - Paths may include a sequence of "non-transit" links
- PT requires…
  - Transit-only links integrated into a master network
  - Each non-transit path defined as one non-transit leg

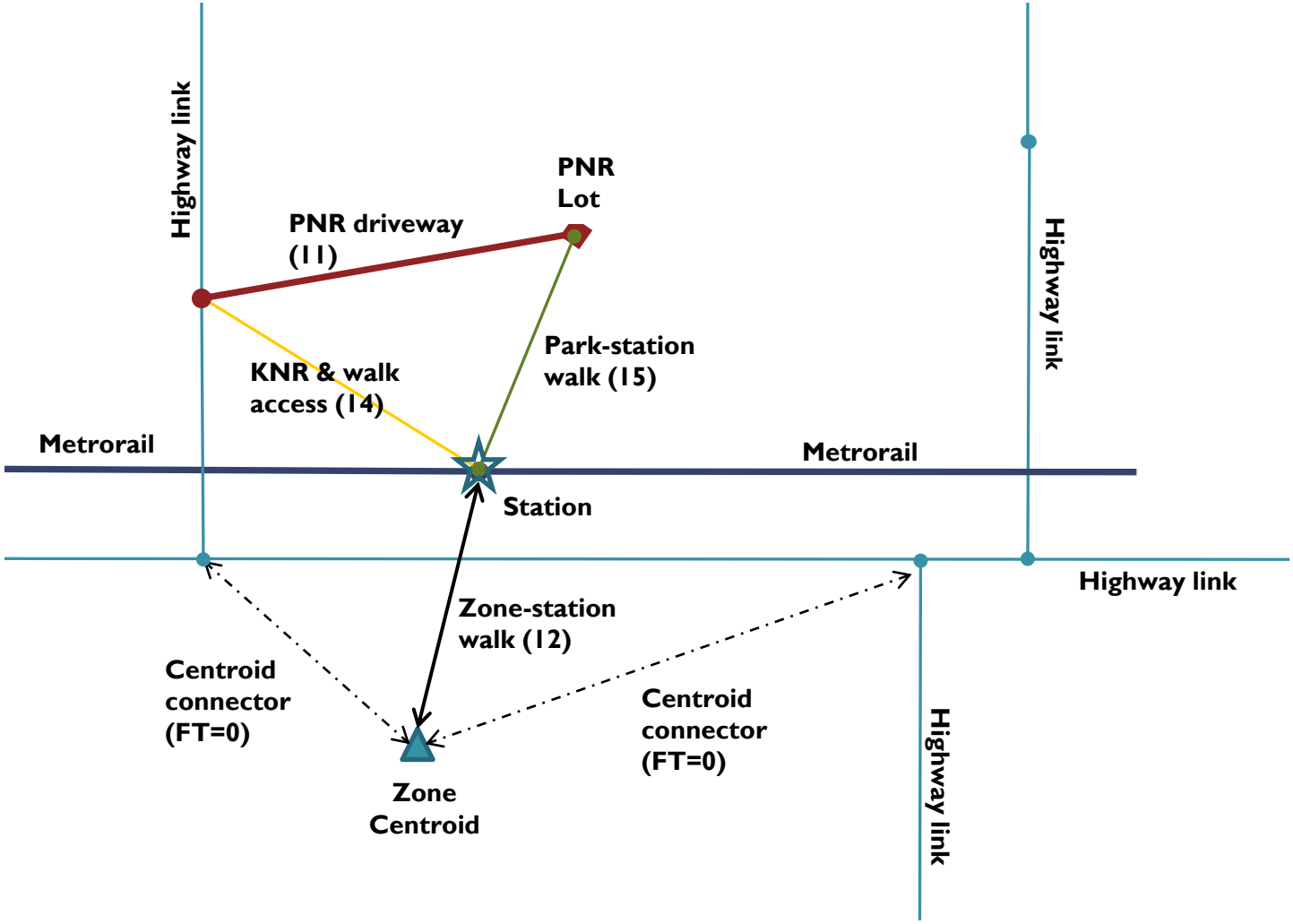
PT Network Preparation

- Developed rules and procedures for integrating transit-only links/nodes into a master network
  - Metrorail, commuter rail, light rail, access links, etc.
    - AECOM developed scripts to integrate the transit-only and access links into the highway network
    - MWCOG converted transit routes and coded access links
- Designed connection links/modes to enable PT to generate walk/drive/transfer non-transit legs
  - Distinguish between walk access/egress, park-n-ride, kiss-n-ride, and transfers between transit modes
    - Bus→bus, bus→Metrorail, light rail→Metrorail, etc.

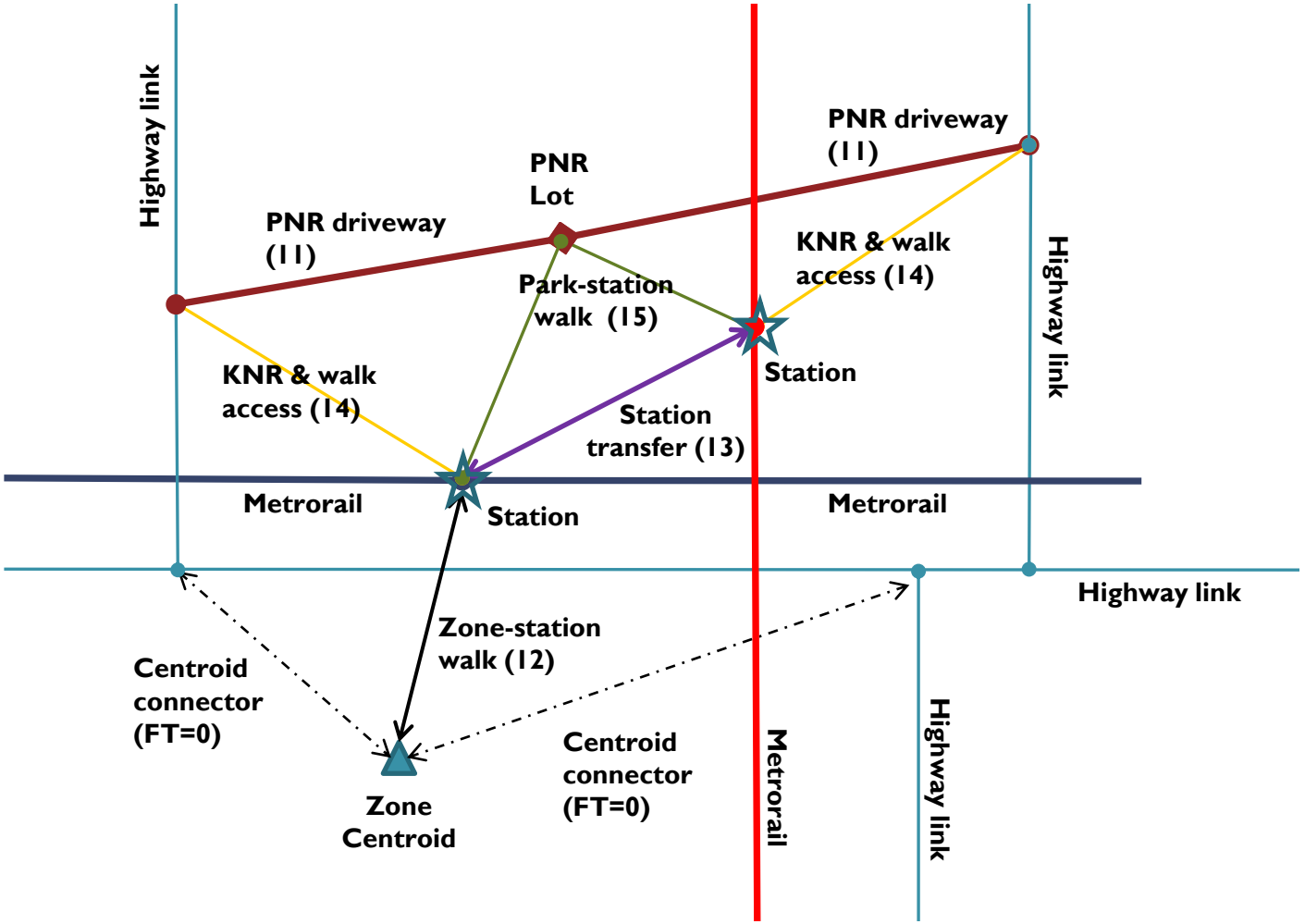
Non-Transit Modes: TRNBUILD vs. PT

Mode Code	TRNBUILD		PT	
	Non-Transit modes	Mode	Non-Transit modes	Mode
11	Non-transit drive access to transit (PNR or KNR): Each drive-access link represents the complete auto path from TAZ to PNR lot or the rail station	drive	PNR driveway (for drive access to PNR lot): Could be coded as a collector (FTYPE=4)	drive
12	Transfer between rail and non-rail transit (are not used for bus-to-bus transfers)	walk	Special walk-access links connecting zone centroids to transit stops where highway network does not have enough detail.	walk
13	Sidewalks	walk	Special walk links directly connecting transit stops of one mode or different modes together, "direct-walk transfer link," e.g., pedestrian tunnels.	walk
14	(Unused)		KNR driveway (for drive access to rail stations): Could be coded as a collector (FTYPE=4). Also allows walk access to station.	drive & walk
15	Transfer between PNR lot and transit stop node (rail station or bus stop)	walk	PNR walkway: Transfer between PNR lot and transit stop node (rail station or bus stop)	walk
16	Walk access to/egress from transit	walk	(Unused)	

PT Network Representation

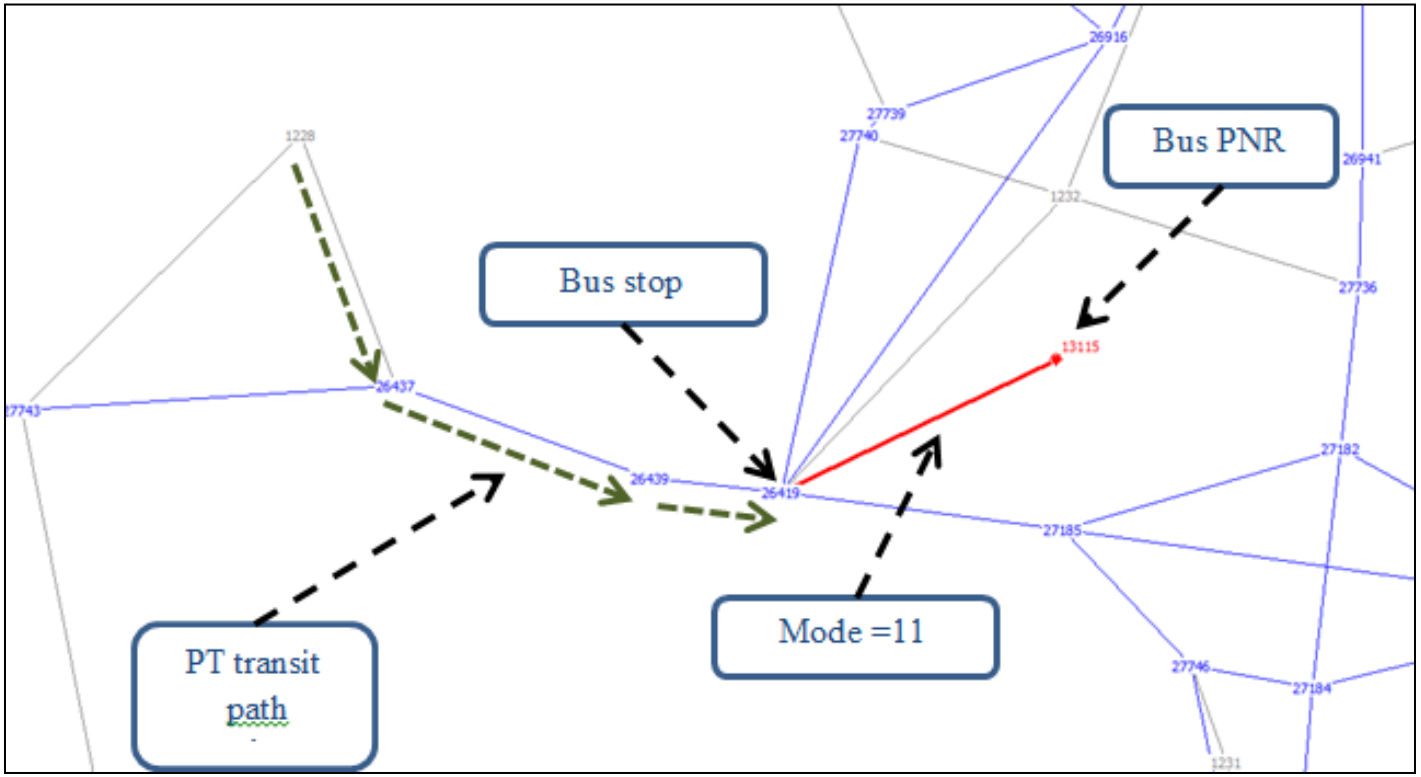


Station-to-Station Transfers



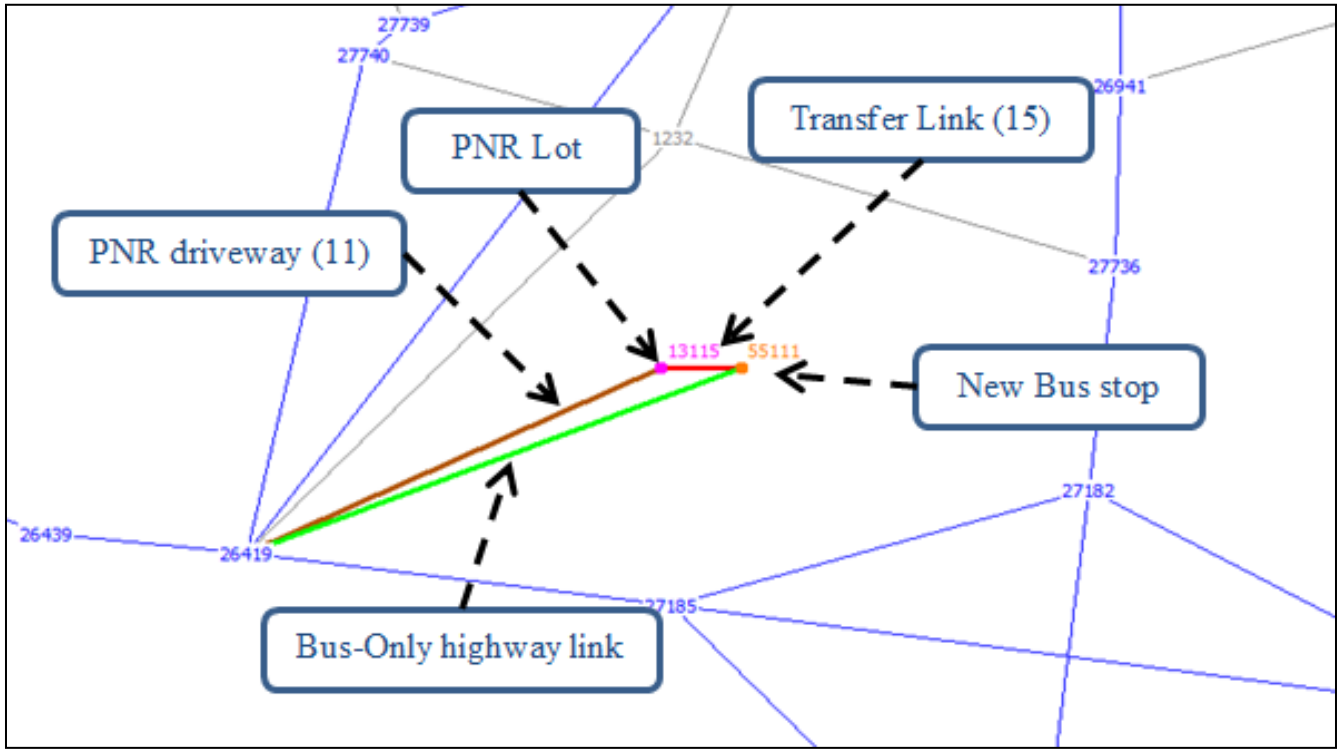
Bus Park-n-Ride Issue with PT

- Existing bus park-n-ride coding does not work with PT Generate



Bus Park-n-Ride Coding for PT

- Add bus-only link (not available to autos)
- Add new PRN stop to the bus routes



PT Generate Statements

- PT constructs non-transit legs using GENERATE
  - Includes NTLEGMODE, FROMNODE, TONODE, INCLUDELINK, EXCLUDELINK, etc.
    - From/to nodes used to distinguish zones from stops and bus stops from Metrorail and commuter rail stations
    - Include/exclude link used to control links used in path building
    - Each path "type" is assigned a unique non-transit leg mode
- Special access links were added to the master network to control PT non-transit leg generation
  - Connect Metrorail and commuter rails stations to highway nodes, park-n-ride lots, and nearby zones

MWCOG Non-Transit Legs in PT

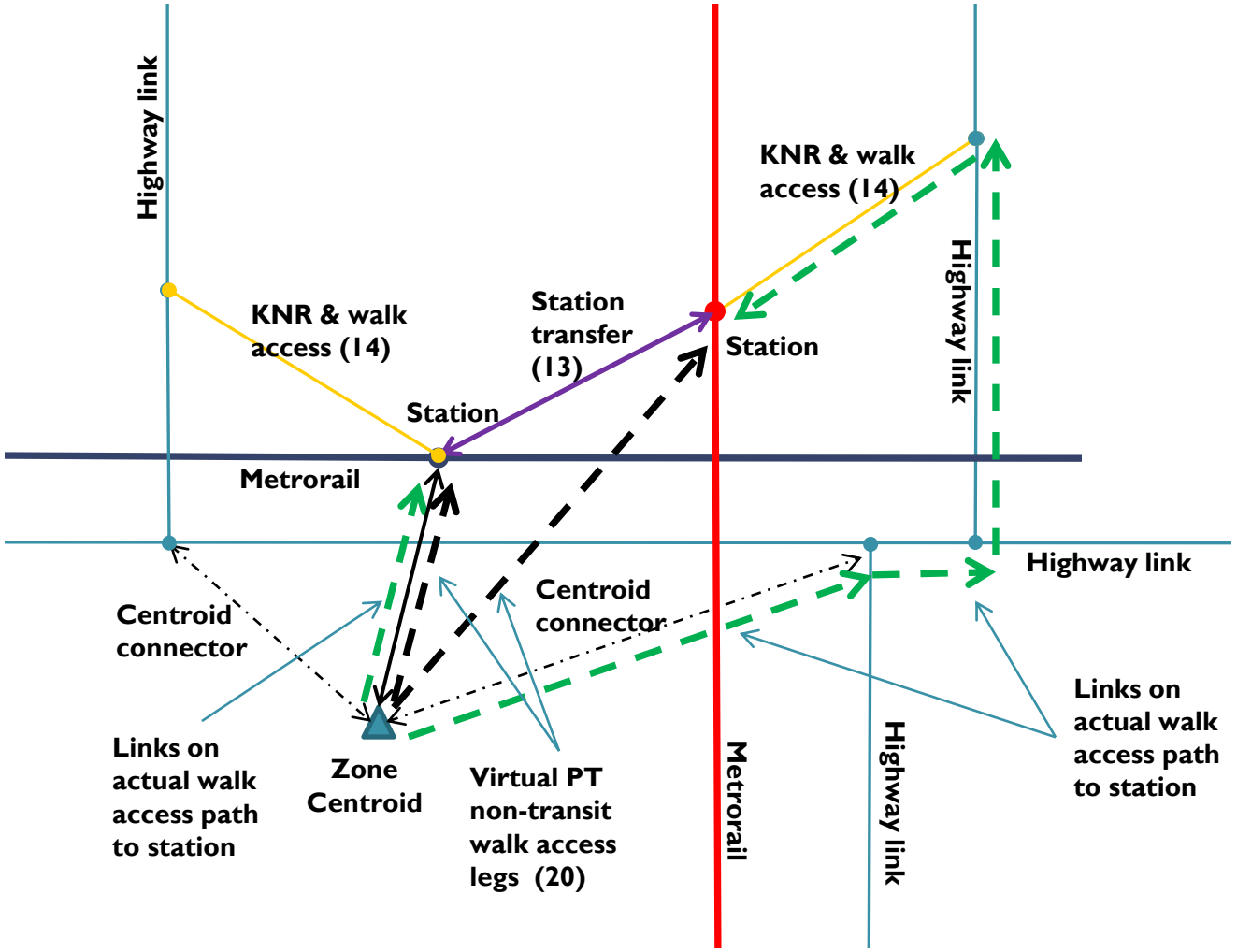
- Walk access/egress and transfer legs

From	To				
	Zone Centroid	Bus	Metro	Commuter Rail	LRT
Zone Centroid	-	20	20	20	20
Bus	20	22	23	24	25
Metro	20	23	33	34	35
Commuter Rail	20	24	34	44	45
LRT	20	25	25	24	55

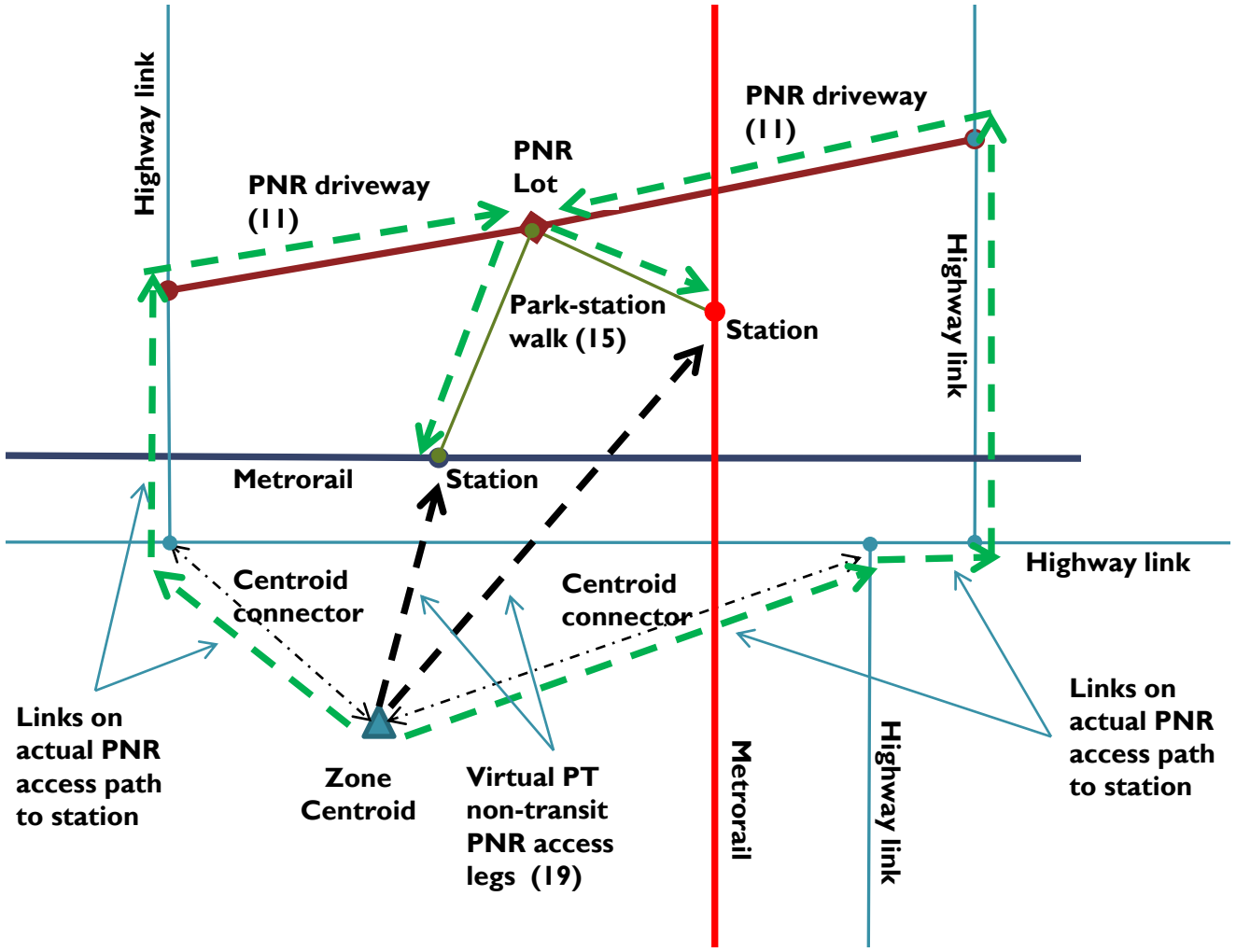
- Drive access legs

From	Mode	To			
		Bus	Metro	Commuter Rail	LRT
Zone Centroid	Drive (Kiss-and-Ride)	18	18	18	18
Zone Centroid	Drive (Park-and-Ride)	19	19	19	19

PT Walk Access Legs to Metrorail

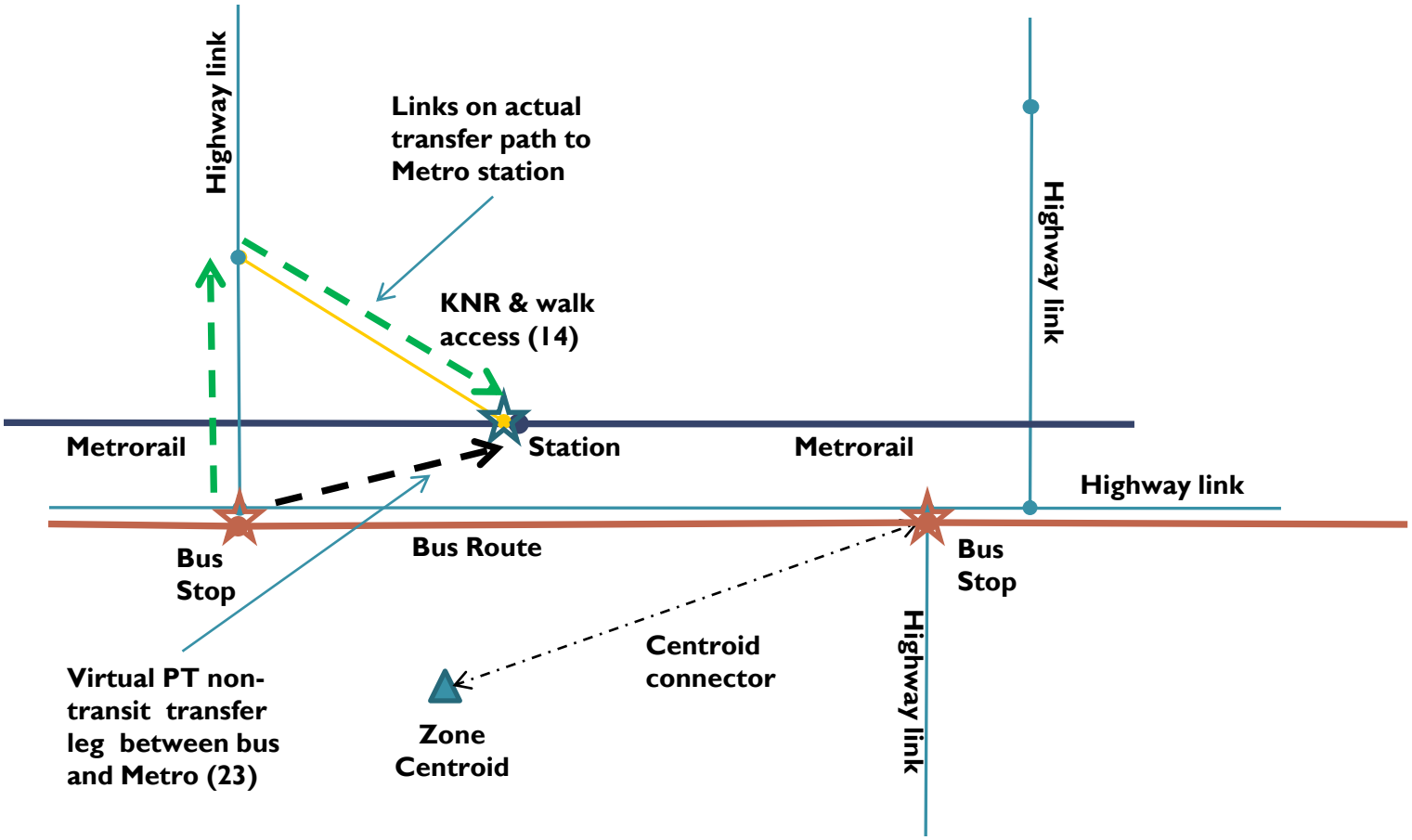


PT Drive Access Legs to Metrorail



Transfer Links between Different Modes

- Maximum cost controls number of transfer links

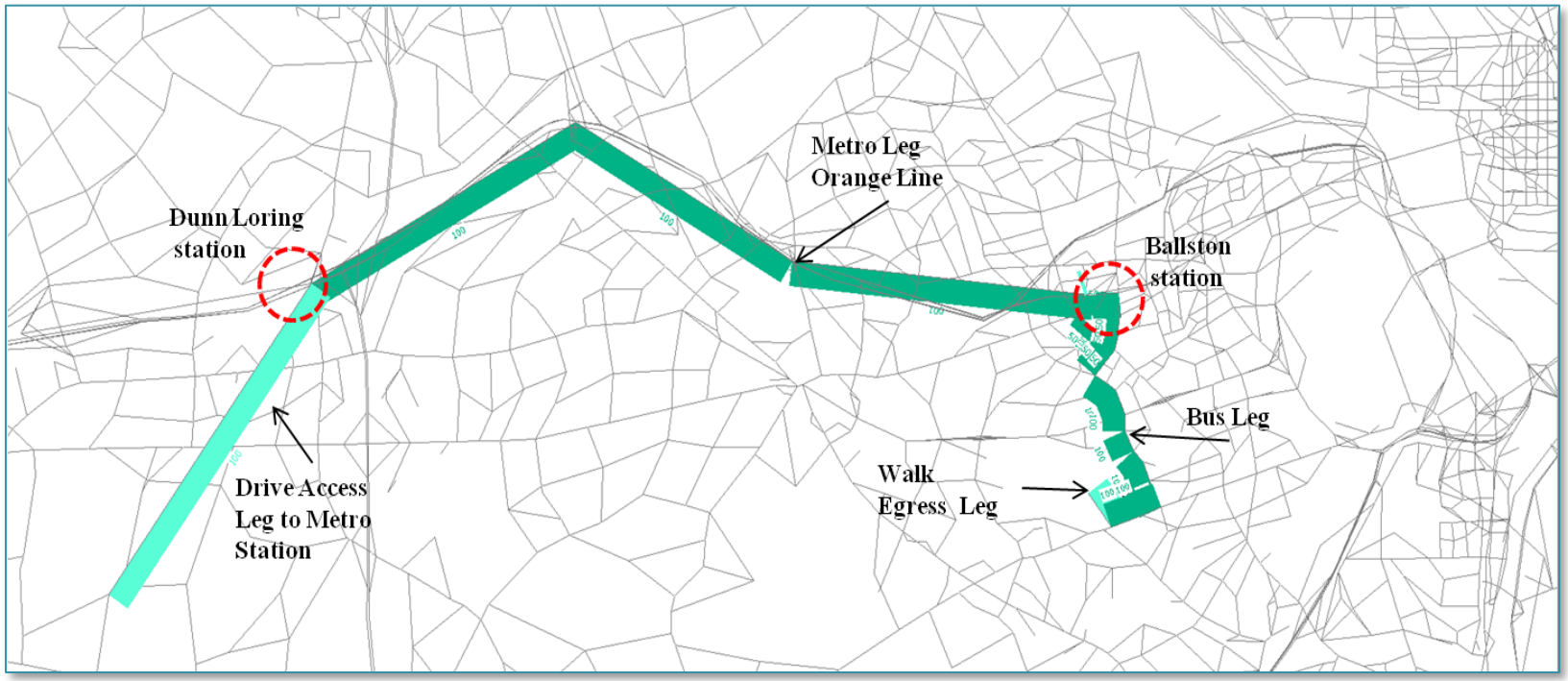


PT Path Building Task

- Purpose/Objective
  - Develop PT scripts to skim/load 22 transit path options
    - Two time periods (peak and off-peak), three access modes (walk, kiss-n-ride and park-n-ride), and four line-haul modes (bus-only, Metrorail-only, bus and Metrorail, and commuter rail)
- Task Activities
  - Validate integrated PT network prepared by MWCOG
    - Highway links, transit-only links, and special access links
  - Create transit paths using PT
  - Prepare required inputs for MWCOG fare calculation using PT

PT Path Building

- Path building scripts are relatively straight forward once non-transit legs are generated
  - On-screen path traces show NT legs as straight lines



Sample PT Walk to Transit Trace

REval Route(s) from Origin 1451 to Destination 1450

N:	1451	Mode	WaitA	TimeA	Actual	B/XPen	Percvd	Dist	Total	Lines(weight)
->	30479	20	-	3.80	3.80	-	5.70	0.19	0.19	
->	30028	6	7.50	0.24	11.54	5.30	18.74	0.07	0.26	ART53AW(1.000)
->	1450	20	-	5.20	16.74	-	26.54	0.26	0.52	

Sample PT PNR Trace

REval Route(s) from Origin 1340 to Destination 103

N:	1340	Mode	WaitA	TimeA	Actual	B/XPen	Percvd	Dist	Total	Lines(weight)
->	8043	19	-	18.02	18.02	-	18.02	7.95	7.95	
->	8016	3	3.00	17.19	38.21	5.30	43.51	7.11	15.06	WMGRNA-(1.000)
->	8016	-	-	0.00	38.21	-	43.51	0.00	15.06	
->	8008	3	1.00	16.53	55.74	6.90	67.94	6.18	21.24	WMREDA-(0.667) WMREDB-(0.333)
->	103	20	-	14.20	69.94	-	89.24	0.71	21.95	

Sample PT KNR Trace

REval Route(s) from Origin 1336 to Destination 216

N:	1336	Mode	WaitA	TimeA	Actual	B/XPen	Percvd	Dist	Total	Lines(weight)	
->	15007	18	-	10.29	10.29	-	10.29	4.82	4.82		
->	27951	1	7.50	2.12	19.91	5.30	25.21	0.72	5.54	WMC11I(1.000)	
->	27951	-	-	0.00	19.91	-	25.21	0.00	5.54		
->	20042	9	5.00	40.23	65.14	6.90	77.34	14.28	19.82	MT05BI(0.667)	MT09AI(0.333)
->	8014	23	-	0.80	65.94	-	78.14	0.04	19.86		
->	8019	3	1.00	9.53	76.47	6.90	95.57	3.81	23.67	WMREDA(0.667)	WMREDB(0.333)
->	216	20	-	12.80	89.27	-	114.77	0.64	24.31		

MWCOG Fare Calculations and PT

- MWCOG uses first and last Metrorail and bus stations for fare calculation
- PT generates first and last boarding station using STOP2STOP keyword
  - ACCUMULATE = ADJACENTBYMODE

I	J	FromNode	ToNode	Mode	Accum	VOL
97	83	8007	8009	3	5	1.00
97	275	8021	8018	3	5	1.00
98	365	8021	8039	3	5	1.00
102	1511	8021	8052	3	5	1.00

Generate First/Last Boarding Station

Leg	Mode
1	1-2 on mode 1
2	3-4 on mode 1
3	5-6 on mode 2
4	7-8 on mode 1
5	9-10 on mode 1

Value of ACCUMULATE	Results of STOP2STOP
FIRSTLAST	1-10
ADJACENT	1-2, 3-4, 5-6, 7-8, 9-10
ALLONOFFS	1-2, 1-4, 1-6, 1-8, 1-10, 3-4, 3-6, 3-8, 3-10, 5-6, 5-8, 5-10, 7-8, 7-10, 9-10
FIRSLASTBYMODE	1-10 mode 1 5-6 mode 2
ADJACENTBYMODE	1-4 mode 1 5-6 mode 2 7-10 mode 1

Process Summary

- PT Conversion
  - Refine MWCOG highway network development process to:
    - Code special PNR drive access links for Metrorail, LRT, commuter rail stations and bus PNR lots
    - Code special walk access links between PNR lots and stations and between stations (e.g., tunnels)
    - Code special bus-only links and bus stops for bus PNR lots
    - Re-route bus routes through the bus PNR stop
    - Add direct walk connections between zones and stations in areas where the highway network is sparse

Next Steps

- T.O. 11 – Cube-Based Walkshed Process
  - Deliver documentation and updated software
- T.O. 12 – HOT/HOV Highway Assignment
  - HOV choice model refinement
  - HOT lane testing
- T.O. 13 – Mode-Choice and Transit Modeling
  - Compare PT and TRNBUILD transit paths
  - Adjust parameters and calibrate PT
  - Modify the TPB model batch process for PT
  - Use PT skims in ModeChoice calibration