FSUTMS-Voyager Transit Model – *DRAFT* Application Framework

December 1st, 2006 Version

Abstract

This document's purpose is to describe how the elements of the proposed FSUTMS-Voyager Transit Model (FVTM) will be applied in PT and FSUTMS-Voyager. It is a companion document to the Theoretical Framework document. It will serve as a "working" document as the details and application are produced.

Overview

The FSUTMS-Voyager Transit Model will use PT and will minimize the use of non-scripted programs to the extent possible. The transit modeling system consists of modeling of transit demand and supply manifested in five areas: access to transit, the transit supply (network), path-building, mode choice, and assignment. Each one of these will be described in order executed in the model stream.

Some sections vary their approach depending on the size of the transit system and quality of observed data. A description of the different approach tiers is shown in the following table.

Description of Transit Model Approach Tiers

Tier	Maximum transit service in horizon year	Data availability	Examples
A	Local service only No park-and-rides	System-wide boardings & transfer rates	Polk County, SunTran
B	Local & express service Some park-and-rides	System-wide boardings & transfer rates	Votran, Spacecoast
C		Recent on-board survey; System-wide boardings & transfer rates	Jacksonville, Orlando, Tampa
D	Many different types of service Extensive park-and-ride system Potential major fixed-guideway system	Recent on-board survey for all modes; Detailed boarding & transfer rate information	Southeast Florida

In addition, some sections will have separate guidelines for general and New/Small Starts use because some techniques would likely be too burdensome for general long-range or highway planning efforts.

Access to Transit

There are four elements to correctly determine transit accessibility: zonal access, walk-access connectors, drive-access connectors, and non-centroid to non-centroid connectors.

a) Zonal Access

Zonal access is not necessary for Tier A and B areas due to their limited service and calibration/validation ability. For Tier C and D areas, it is recommended to maintain using Geographic Information Systems (GIS) to compute percent walks until the ability to generate zonal access proportions within the model stream is available. Percent walks will be simplified to "can/cannot" walk proportions. The portion of the zone within a ½ mile of bus lines and fixed-guideway stops is considered to have walk access to transit.

b) Walk Connectors

Walk connectors will be created using PT's GENERATE command. Two sets of connectors will need to be produced: walk-access/egress to transit stops and walk-access/egress to stations. It is probably easiest to use separate GENERATE commands.

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GENERATE Settings & Factors (Walk-Access/Egress Connectors)

Parameter	Description	Recommended Default Values			
		Tier A	Tier B	Tier C	Tier D
COST	Equation that determines the minimum cost path	DISTANCE (in miles)			
EXTRACTCOST	Equation that determines the skimmed value of the connector	Minutes = (DISTANCE / 2.5 mph) * 60.0			
FROMNODE (walk-access)	The list of origin and destination nodes that are eligible to be connected	All centroids			
TONODE (walk-access)		All non-centroids			
FROMNODE (walk-access to stations)	The list of origin and destination nodes that are eligible to be connected	All centroids			
TONODE (walk-access to stations)		All stations			
INCLUDELINK (walk-access/egress)	Links that can be traversed to develop the connectors	n/a			
EXCLUDELINK (walk-access/egress)	Links that cannot be traversed to develop the connectors	All freeways, ramps, transit-only links & high-speed roadways			
INCLUDELINK (walk-access/egress to stations)	Links that can be traversed to develop the connectors	n/a			
EXCLUDELINK (walk-access/egress to stations)	Links that cannot be traversed to develop the connectors	All freeways, ramps, transit-only links (except connector links) & high-speed roadways			
LIST	Lists each connector in the print file	True			
ONEWAY	Determines how the underlying highway links can be traversed. If true, connectors can only be created on one-way links in the coded direction. If false, connectors can be created on one-way links in both directions.	False			
DIRECTION	Specifies one of three ways the connector is generated: (1) FROMNODE(s) to TONODE(s) (2) TONODE(s) to FROMNODE(s) (3) Both (1) and (2)	3			
MAXCOST (walk-access/egress)	Maximum cost, as defined by COST, for a connector	1.1 miles for all modes			
MAXCOST (walk-access/egress to stations)	Maximum cost, as defined by COST, for a connector	3 miles for all modes			
MAXNTLEGS	The maximum number of connectors by mode for each FROMNODE	99 for all modes			
NTLEGMODE	Mode number for connector being generated	1			

The maximum walk time is set to 1.1 miles for walk-stop connectors, reflecting a one-mile maximum plus some extra to account for variance in network topology, and three miles for walk-station connectors. The maximum number of connectors per zone is set to 99 per transit mode. These artificially high values are designed so they do not constrain the path-building outputs and introduce user benefit abnormalities. Walk-station connectors will have their impedance modified by a program or script if their length exceeds ½ mile.

The connectors generated here will be reviewed by a FORTRAN program named REWALK for consistency with the percent walks. If there are no direct connectors (i.e., connector mimics the highway centroid connector), the walk percentage is set to zero. The walk percentage is set to zero (if

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not already) if no connectors were generated. Additionally, the portion of connector time that reflects the highway centroid connector may be modified if there is transit coverage of the zone. Once reviewed and modified if necessary, the connectors are passed directly to the path-builder.

c) Drive-Access Connectors

Drive-access connectors will be developed using a modified version of the AUTOCON program. The key input will be the highway network and a transit station data file created from the node layer. The drive-access connectors will have their length modified if they exceed their stated capture range. The connector cost will include driving time, terminal time, station parking cost and auto operating cost, all weighted to their transit run time equivalents. Other details will be forthcoming as this process is finalized.

d) Transfer Connectors

It is recommended to generate three sets of transfer connectors: (1) between rail and bus platforms, (2) between stations and nearby bus stops and (3) between all transit stops in CBDs. The first set addresses the new station micro-coding technique introduced in this approach. The second set mimics the existing SIDECON procedures. The third set replaces the coding of downtown sidewalks. Local areas should be encouraged to include area types, like major activity centers, if good sidewalks exist. A description of the parameters and their recommended values is shown below.

GENERATE Settings & Factors (Transfer Connectors)

Parameter	Description	Recommended Default Value			
		Tier A	Tier B	Tier C	Tier D
COST	Equation that determines the minimum cost path	DISTANCE (in miles)			
EXTRACTCOST	Equation that determines the skimmed value of the connector	Minutes = (DISTANCE / 2.5 mph) * 60.0			
FROMNODE (rail/bus platforms)	The list of origin and destination nodes that are eligible to be connected	All stations			
TONODE (rail/bus platforms)		All non-centroids			
FROMNODE (stations/bus stops)	The list of origin and destination nodes that are eligible to be connected	All stations			
TONODE (stations/bus stops)		All non-centroids			
FROMNODE (CBD transit stops)	The list of origin and destination nodes that are eligible to be connected	All CBD non-centroids			
TONODE (CBD transit stops)		All CBD non-centroids			
INCLUDELINK (rail/bus platforms)	Links that can be traversed to develop the connectors	Facility type 59			
EXCLUDELINK (rail/bus platforms)	Links that cannot be traversed to develop the connectors	n/a			
INCLUDELINK (stations/bus stops)	Links that can be traversed to develop the connectors	n/a			
EXCLUDELINK (stations/bus stops)	Links that cannot be traversed to develop the connectors	All freeways, ramps, transit-only links, high-speed roadways & facility type 59			
INCLUDELINK (CBD transit stops)	Links that can be traversed to develop the connectors	n/a			
EXCLUDELINK (CBD transit stops)	Links that cannot be traversed to develop the connectors	All freeways, ramps, transit-only links & high-speed roadways			
LIST	Lists each connector in the print file	True			
ONEWAY	Determines how the underlying highway links can be traversed. If true, connectors can only be created on one-way links in the coded direction. If false, connectors can be created on one-way links in both directions.	False			
DIRECTION	Specifies one of three ways the connector is generated: (1) FROMNODE(s) to TONODE(s) (2) TONODE(s) to FROMNODE(s) (3) Both (1) and (2)	3			

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MAXCOST (all)	Maximum cost, as defined by COST, for a connector	0.6 miles
MAXNTLEGS	The maximum number of connectors by mode for each FROMNODE	99 for all modes
NTLEGMODE	Mode number for connector being generated	11 (rail/bus & stations/bus) 12 (CBD transit stops)

Most of the settings are straightforward. The maximum distance is currently set to 0.6 miles, which reflects a ½ mile maximum plus some extra to account for variance in network topology. The maximum number of legs per zone has been set to minimize running time while maintaining connectivity between alternatives.

Transit System Coding

Coding the transit system in PT requires development or modification of at least five files: the System Data file, Fares file, Factors file, transit network and the highway network.

a) System Data File

The System Data File defines the modes, transit operators, vehicle types and wait-curves used in the transit system. Its filename is typically TSYSD_yya.PTS, where yya is the alternative-specific code.

i) Modes

PT releases the 30-mode limitation that existed in the FTTM, and it is proposed to take full advantage of the new 999-mode limit. Zonal access modes are reserved for modes 1-10 and intra-station connectors use modes 11-20. Transit modes should begin at mode 21. They are to be determined by relative transit speed rather than the "hard" modal definitions used in the FTTM. This will assist users to better calibrate transit speeds for different types of service (e.g., local, BRT, limited-stop, etc.) The proposed new modal definitions are listed below.

Mode Definitions

Mode	Description	Recommended Mode Number
Walk access/egress	Centroid to transit stop connector	1
Auto access	Centroid to park-and-ride station	2
Other access connectors	As needed (project & region-specific)	3-10
Intra-station connectors	Connects highway network to fixed-guideway stations or off-network bus terminals	11
Transfer connectors	Connects transit stops for transferring ("sidewalks")	12
Other Non-Centroid Connectors	As needed	13-20
Transit modes (by operator)	Local & express bus	21
	Bus rapid transit/premium bus	22
	Circulator (e.g., Metromover, streetcar, trolley)	23
	Heavy rail (e.g. Metrorail)	24
	Commuter rail (e.g., Tri-Rail)	25
	Other mode	26
	Project mode (for planning purposes)	27
Transit modes (operator #2)	Same as 21-27	31-37
Transit modes (other operators)	Same as 21-27 in groups of seven	41-47, 51-57, etc.

Each mode is defined in the System Data file by providing its number as well as the short (less than 12 characters) and long names used in reporting.

ii) Operators

Operators are used by PT to define boarding and transfer fares. Each operator is defined by providing its number and descriptive names; there are no recommended values for operators. It should be noted that a transit operator may be represented in PT via several operators to reflect its different fare structures for various modes. The fare structures are mapped to the operators in the Factors file.

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iii) Vehicle Types

The user has the ability to define the vehicle types and their characteristics. Just like modes and operators, each vehicle type is assigned a number and descriptive names. There are no recommended values for vehicle types.

iv) Wait-curves

Wait curves provide a means to alter the amount of time riders wait for transit service. In Tranplan, the wait time was hard-coded to ½ the value of the combined service frequency. Recent experience indicates that this relationship is not always sound, especially when service frequencies are one vph or less. The possibility of altering the existing "half-headway" guideline for bus or light rail service will be explored at a later time.

A unique wait curve for heavy rail systems is included to reflect a more realistic wait time for larger fixed-guideway systems. This was incorporated in the SERPM6 model. The maximum wait time is 15 minutes for these systems.

The current recommendation is to have two wait curves: one for the initial boarding and transfer wait time and another for heavy rail systems. The wait time will be capped at 30 minutes for bus and light rail services to avoid excessive waiting times for less frequent services. The settings for these curves are listed below.

Wait-curve Settings

Parameter	Description	Recommended Values	
		Initial & Transfer Wait	**Heavy Rail Systems**
NUMBER	Curve number	1	2
LONGNAME	40-character description	"InitialXferWait"	"HeavyRailWait"
NAME	10-character description	"InitXferW"	"HRailW"
CURVE	Curve breakpoints (service headway-wait time)	0-0, 4-2, 60-30, 180-30	0-0, 15-7.5, 30-11.25, 60-15, 180-15

b) Fares File

PT's fare capabilities are more flexible and extensive than previously available. At a minimum, the initial boarding fare and transfer fares need to be coded for each operator. It is not important that the fare system number correspond to the operator number. That mapping is set in the Factors file.

Three fare systems are likely to be used in virtually all models in Florida: free, flat-fare, and zone-based fare. The first fare system is for services that are offered for free. Flat-fare systems charge flat boarding and transfer fares. Transfer fares may vary by the previous fare system, though. Zone-based fare systems base the fare on the number of fare zones encountered during a trip. Tri-Rail in southeast Florida uses such a system. When using zone-based systems, it is important to remember to code FAREZONE on the node of each station in the highway network. The recommend values for all fare systems are shown below.

Fare System Settings

Parameter	Description	Recommended Value
NUMBER	Fare system number	None
LONGNAME	40-character description	None
NAME	10-character description	None
STRUCTURE	Type of fare system	"FREE" (free) "FLAT" (flat-fare) "ACCUMULATE" (zone-based)
SAME	Determines how the fare is produced for consecutive legs using the same fare system	n/a (free) "CUMULATIVE" (flat-fare & zone-based)
IBOARDFARE	Initial boarding fare (in dollars)	n/a (free) None (flat-fare & zone-based)

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FAREFROMFS	Transfer fares when transferring from other fare systems	n/a (free) None (flat-fare & zone-based)

c) Factors File

The Factors file defines the parameters for path-building. Please refer to the path-building section of this document for a description of most of the recommended settings for this file,.

d) Transit Network

It is planned to take advantage of as many of PT's network coding features as possible. For instance, it is recommended that the transit network will be stored in a single file and represent all time periods. Each line will be coded with at least two headways (PT can accommodate up to five), one for the AM peak period, and another for the off-peak period. If a line does not conduct service in any time period, the headway should be coded as zero for that time period. Buses should be coded as accurately as possible, which should be easier with the visual coding features available in FSUTMS-Voyager. Two-way coding should be reserved for only those lines whose routing does not vary in either direction. The list of transit line fields and their recommended values is shown below.

Transit line fields

Parameter	Type	Description	Recommended Values
LONGNAME	Character	40-character description	None
NAME	Character	10-character description	None
ONEWAY	Boolean	If true, line travels in coded direction; If false, line travels in both directions	None
HEADWAY[1]	Numeric	Time between consecutive vehicles (1=peak period; 2=offpeak period)	Minutes (0 if not offered in period)
HEADWAY[2]	Numeric		
MODE	Numeric	Transit mode (defined in System Data file)	None
OPERATOR	Numeric	Operator (defined in System Data file	None
N	Numeric String	String of nodes traversed	Positive if vehicle stops for boarding, Negative if vehicle does not stop
TIME	Numeric	Sets the actual node-to-node travel time	None
CIRCULAR	Boolean	If true, the line is circular (i.e., it operates in a loop or circle) If false, the line is not circular	None

The existing transit speed curves will likely undergo major revisions. Those curves were designed to correlate transit speeds to 24-hour average speeds, something that is disappearing with the advent of time-of-day models. Recent data collected in Jacksonville and Tampa indicates that transit speeds are much faster than the original curves indicate. Additionally, PT is not restricted in the format of the transit speed curves. It is not inconceivable that the new relationships will be both a function of the auto speed and dwelling time.

e) Highway Network

PT highly integrates the transit network and the highway network, so some transit-related highway coding guidelines are necessary so that generalized scripting procedures can be developed.

The FTA has strongly encouraged the use of micro-coding fixed-guideway stations in recent months. The purpose is to reflect all the known attributes of travel in the network rather than relegating them to the utility bias constants. The bus platform is a node on the highway network (see graphic below). The rail platform is connected to the bus platform by a transfer link, coded with facility type 59, which requires one minute of travel time. Only the fixed-guideway system is able to access the rail platform. This system should be used for all fixed-guideway modes for general use modeling.

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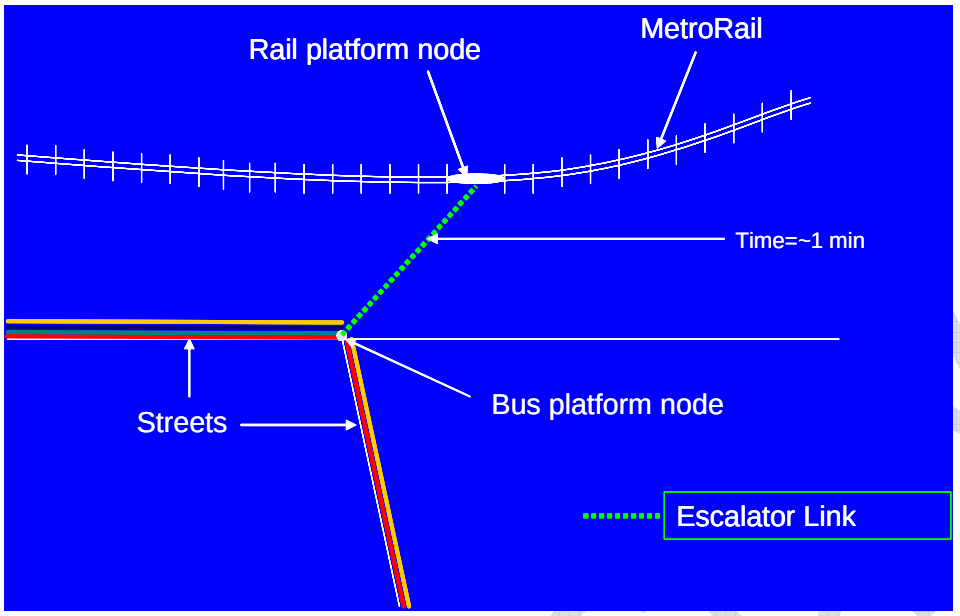
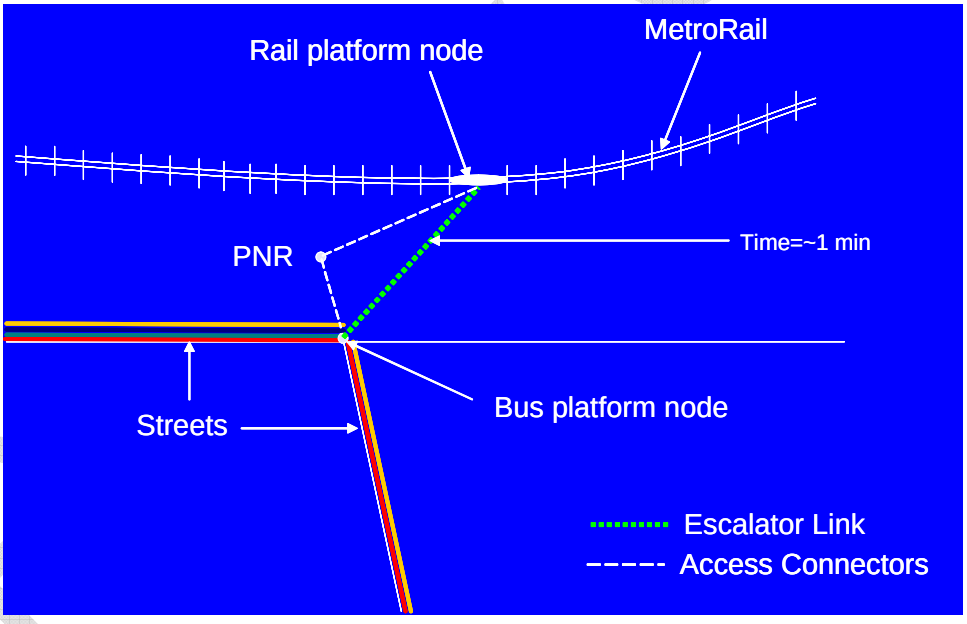
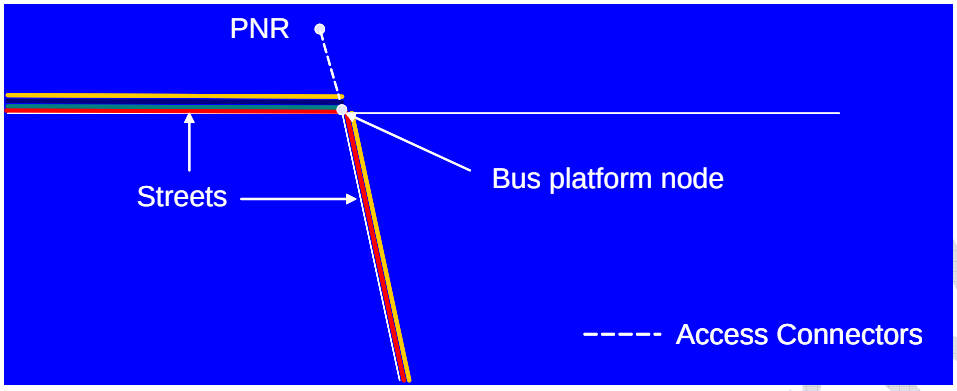


More detailed coding is needed for New/Small Starts planning. The park-ride needs to be coded explicitly with connectors to both the bus and rail platforms. This will require modifications to the auto access procedures described earlier.



Park-rides with bus-only service will likely want to be micro-coded as well for New/Small Starts studies. The PNR should be coded as a unique centroid. This allows for more accurate centroid-to-PNR drive times and, since the highway trip table includes these trips, provides good volume data for traffic impact analyses.



Transit-only links for bus and fixed-guideway transit should be coded directly into the highway network. These links are coded with facility type 69. Seven new fields in the highway network are proposed for these links for easier scripting during the transit speed computations. A set of three (distance, time and speed) are specifically for bus transit or other forms of transit subject to mixed-flow conditions. Another set of four fields are designed for fixed-guideway transit, with a mode field is added to the distance, time and speed fields. The bus-related fields do not have a mode since it is assumed that the speeds will apply to all transit operating within auto traffic. In all cases, time or speed should be coded, not both.

Highway link fields for coding transit-only links

Parameter	Type	Description	Recommended Values
TBSDIST	Numeric	Distance for bus transit	DISTANCE (in miles)
TBSTIME	Numeric	Travel time for bus transit	Minutes
TBSSPEED	Numeric	Average speed for bus transit	Miles per hour (either TBSTIME or TBSSPEED is coded – not both)
TFGDIST	Numeric	Distance for fixed-guideway transit	DISTANCE (in miles)
TFGTIME	Numeric	Travel time for fixed-guideway transit	Minutes
TFGSPEED	Numeric	Average speed for fixed-guideway transit	Miles per hour (either TFGTIME or TFGSPEED is coded – not both)
TFGMODE	Numeric	Applicable fixed-guideway transit mode	None

Additional fields will be added to the highway links during transit speed calculations. As the speeds are determined – first checking for the transit-only link fields, then applying auto-transit speed equations if the transit-only times or speeds are zero – two fields will be added for each bus or mixed-flow transit mode and one field will be added for each fixed-guideway mode. These fields will be referenced in the PT path-building scripts. A description of the fields is listed below.

Highway link fields for transit speeds & travel times

Parameter	Type	Description	Recommended Values
MXXTIMEAM	Numeric	Peak travel time for mode XX (two-digit), which is a bus or transit mode operating in mixed-flow	Minutes
MXXTIMEMD	Numeric	Offpeak travel time for mode XX (two-digit), which is a bus or transit mode operating in mixed-flow	Minutes
MXXTIME	Numeric	Travel time for mode XX (two-digit), which is a fixed-guideway mode not subject to congestion	Minutes

The transit station file inputs should be coded directly on the nodes of the highway network and scripted into an ASCII file for use during the model run to ease the data maintenance burden on the user. In the FTTM, these fields were coded into the STATDATA.yya file. Information should be coded

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on both the rail platform (if applicable) and the bus platform/street node. The proposed node fields and their recommended values are listed below.

Highway node fields for coding transit stations

Parameter	Type	Description	Recommended Values
TSNAME	Character	Station name	n/a
TSTYPE	Numeric	Types of access available at station	0 – not used 1 – used
FAREZONE	Numeric	Fare zone (zone-based fares only)	Coded only on station nodes, not used if using free or flat-fare systems
TSRANGE	Numeric	Maximum roadway distance allowed for auto-access connector (miles)	2.0 – park- or kiss-and-ride 5.0 – fixed-guideway 10.0 – commuter rail or end of line fixed-guideway
TSPARKSPACE	Numeric	Number of parking spaces (park-and-ride stations only)	n/a
TSCOSTAM	Numeric	Parking cost in peak period	Cents
TSCOSTMD	Numeric	Parking cost in off-peak period	
TSPNRTERM	Numeric	Terminal time for park-and-ride trips	2.0
TSKNRTERM	Numeric	Terminal time for kiss-and-ride trips	0.5

Path-Building

The number of transit paths will depend on the types of service and access offered and the quantity and quality of available data. Tier A areas should produce walk- and drive-transit paths for each period. Tier B and C areas should produce four paths per period: walk-bus, walk-premium/project mode, drive-bus, drive-premium/project mode.

The Southeast Regional Planning Model (SERPM) should produce eight paths per period: walk-bus, walk-premium/project mode, walk-Metrorail, walk-Tri-Rail, drive-bus, drive-premium/project mode, drive-Metrorail and drive-Tri-Rail. Additional paths by auto ownership categories could be develop if sufficient data exists for calibration.

a) Summary of PT Best-Path Only

The PT best-path process was re-written in October 2006 to simplify the logic used in previous versions. While some very minor network simplification steps remain, it is essentially removed. The enumeration process follows vine-building logic, using uni-modal transit bundles if the FREQBYMODE setting is true, to build a single path. The evaluation phase processes that path for skimming and loading.

Boarding and transfer penalties apply in the enumeration phase. The only SERVICEMODEL option available at this time is FREQUENCY.

Several PT options are not available when the BESTPATHONLY option is turned on. ALPHA, CHOICECUT, LAMBDAW, LAMBDAA, REWAITMIN, REWAITMAX, and AONMAXFERS have no effect. Any SPREAD-related keyword, EXTRAXFERS1 and EXTRAXFERS2 do not apply when MUSTUSEMODE is not used.

b) Path-Building Settings

The proposed settings and factors for path-building are shown in the table below.

Path-Building Factors & Settings

Group	Parameter	Description	Recommended Default Value
Global Settings	BESTPATHONLY	Enacts the single-path path-builder	T

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	FREQBYMODE	If true, PT will combine headways on same-mode services. If false, PT will combine headways across modes	T
	RECOSTMAX	Maximum weighted time for any path to be either considered the minimum cost path or enumerated	300.0
	MAXFERS	Upper limit on the number of transfers allowed	5
	SERVICEMODEL	Determines the type of service model to be used. Only FREQUENCY is available with BESTPATHONLY=T at this time.	FREQUENCY
Access/Egress Modes	DELMODE	List of transit modes that are removed from consideration for minimum cost path or route enumeration	Project/premium mode for bus paths; None for project/premium paths; Auto access modes for walk paths
	DELACCESSMODE (walk-access paths)	List of access modes that are removed from consideration for minimum cost path or route enumeration	2,3
	DELACCESSMODE (drive-access paths)		1
	DELEGRESSMODE (walk-access paths)	List of egress modes that are removed from consideration for minimum cost path or route enumeration	2,3
	DELEGRESSMODE (drive-access paths)		2,3
Fares & Wait Times	FARESYSTEM	Number of the fare model that will apply to operators	n/a
	IWAITCURVE	The curve number (defined in System Data File) to be used for the initial wait time at specified nodes	3 (rail stations only) 1 (all other non-centroid nodes)
	XWAITCURVE	The curve number (defined in System Data File) to be used for the transit wait time at specified nodes	3 (rail stations only) 1 (all other non-centroid nodes)
	WAITFACTOR	Node-specific wait time weighting factor	2.00 for all nodes
Run Factors	RUNFACTOR (walk-access modes)	Factor applied to the in-vehicle time of a particular mode, including access modes	2.00
	RUNFACTOR (drive-access modes)		1.50
	RUNFACTOR (all transit modes except commuter rail)		1.00
	RUNFACTOR (commuter rail only)		0.80
Boarding & Transfer Penalties	BRDPEN (all transit modes)	Penalty applied to boarding of a transit mode (in minutes)	2.00
	XFERCONST	Transit mode to transit mode transfer penalty constant	5.00 (all transit modes to all transit modes)

The transfer and maximum time settings are designed to eliminate extremely lengthy transit paths. The maximum weighted travel time is set to 300.0. Areas with survey data that can demonstrate paths routinely exceed these limits are allowed to modify the settings accordingly.

The lower RUNFACTOR value for commuter rail modes reflects the FTA's acceptance of lower in-vehicle time coefficient values for this mode. It is recognized that as compared to other forms of transit (bus/rapid transit) the in-vehicle time spent on a commuter rail is perceived as less onerous because of its attributes which allow users to utilize their time using the system in a more productive

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fashion. The most notable attribute is that generally all riders are guaranteed a seat, which allows users to engage in other activities during their trip.

In general, the favored mode should have a 1.00 RUNFACTOR while "lower" modes should have a 1.30 RUNFACTOR for any path. For bus paths, the RUNFACTOR for all available transit modes should be 1.00. For project/premium paths, the project and premium modes should have a RUNFACTOR of 1.00. All other modes, especially buses, should have a 1.30 RUNFACTOR.

c) Skim Settings

Transit skims are created in the evaluation phase. A skim matrix is created for each transit path. The recommended table definitions are listed below. The second and third tables will include drive-access time, auto occupancy cost, parking cost and terminal time.

Transit Skim Table Descriptions (for Tiers

Table #	Name	Keyword	Modes Included
1	Walk access time	TIMEA(0,1)	Walk-access, walk-egress, station access
2	Drive-access time to bus	TIMEA(0,2)	Weighted drive-access time plus weighted auto occupancy cost, parking cost & terminal time
3	Sidewalk/transfer time	TIMEA(0,11) + TIMEA(0,12)	Transfer time
4	Bus in-vehicle time	TIMEA	All local and express bus service
5	Premium bus in-vehicle time	"	Limited stop, BRT services
6	Circulator in-vehicle time	"	Circulators, streetcars, trolleys
7	Light/Heavy rail in-vehicle time	"	Light Rail, Heavy Rail
8	Commuter rail in-vehicle time	"	Commuter rail
9	Other mode	"	Typically mode introduced before project mode
10	Project mode in-vehicle time	"	New mode that is object of alternatives analysis
11	Boardings	BRDINGS(0,TMODES)	All transit modes
12	Initial wait time	IWAITA(0,TMODES)	"
13	Transfer wait time	XWAITA(0,TMODES)	"
14	Fare	FAREA(0,TMODES)	"
15	Total transit time	TIMEA(0,ALLMODES)	All modes

Mode Choice Model

The market segments will use the appropriate path built by the path-builder and represented by the weighted skim values. For Tier C and D areas, the proposed percent walk calculations simplify the access markets calculations in the utility equations. Instead of the seven short-/long-walk categories, there are now three: can walk (walk-walk), must drive (drive-walk), and no transit access.

The recommended core mode choice coefficients and values are shown in the table below. The transit-related coefficients are based on FTA's examination of coefficients across the country. They have proven to be reliable in their estimates of user benefits since they have sound inter-relationships. Cities with existing multi-modal transit service (e.g., Palm Beach, Broward, and Miami-Dade Counties) will have an expanded variable set.

Mode Choice Coefficients & Values

Coefficient	Name	Units	Recommended Default Value		
			HBW	HBNW	NHB
Transit in-vehicle travel time for all modes except commuter rail; Auto in-vehicle travel time	IVTT	Minutes	-0.0250	-0.0125	-0.0250
In-vehicle travel time for commuter rail	IVTTCR	Minutes	-0.0200	-0.0100	-0.0200
All out-of-vehicle time: walk time, wait time, terminal time	OVT	Minutes	-0.0500	-0.0250	-0.0500
Transit fare; parking cost; auto operating cost	FARE	Cents	-0.0025	-0.0025	-0.0050
Drive-access to transit time (represented in IVTT minutes on access connector)	AAT	Minutes	-0.0375	-0.01875	-0.0375
Number of transfers in transit paths	XFER	Number	-0.1250	-0.0625	-0.1250
Value of time	--	$/hour	6.00	3.00	3.00
Transit access nesting coefficient	--	Utilities	0.5	0.5	0.5
Transit nesting coefficient	--	Utilities	0.3	0.3	0.3

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Auto nesting coefficient	--	Utilities	0.8	0.8	0.8
Shared ride nesting coefficient	--	Utilities	0.2	0.2	0.2

Drive-access time and station parking cost should not be computed with separate coefficients in the utility expression. These variables will be passed in in-vehicle time equivalent minutes via the travel time access leg so that they are properly evaluated by the path-builder. KNR paths should be evaluated using half of the auto operating costs to represent their "share" of operating the vehicle. The mode choice model should also remove the station parking cost from the drive-access cost.

Overall, these values are close to what has been used historically in Florida. The out-of-vehicle coefficients are slightly lower than in the FTTM. The new ratio of OVT to IVTT is proposed to be 2.0. The existing ratio used across the state is about 2.25. The nesting coefficient is identical, 0.5. The fare coefficient in the table is equivalent to a value of time of $6/hour for HBW and $3/hour for HBO and NHB purposes, compared to the $3.75/hour used today.

Small cities using a minimal number of paths should script their mode choice models in Voyager as the run time impact will likely be minimal. It is expected that medium- and larger-cities will choose to maintain their mode choice models in FORTRAN.

Transit Assignment

Transit assignment follows the same general methodology as path-building. An assignment module will be needed for every transit path created in path-building. PT assignments are decimalized, a key difference from the integer-based assignments in the FTTM.

Summarizing transit assignments is a key issue. FTTM used a utility (TADLOD) and a module (REPORT TRANSIT LOAD) to produce readable transit reports such as those in TASSIGN. A special program will be needed as PT does not create similarly-styled reports.

Calibration/Validation

Calibrating and validating the transit model will depend on: the amount of transit service, the availability of on-board survey data, and the possibility of conducting a study that will lead to an FTA forecast review. There will be two tiers of calibration/validation for general planning purposes and another tier for New/Small Starts analysis. For general use, the lower tier will assume non-existent survey data and apply to areas with modest transit service (Tiers A and B), and the upper tier will be oriented towards larger cities with a potential New/Small Starts project (Tiers C and D).

a) Tiers A and B

All transit agencies should be able to produce the following information necessary for this exercise: average weekday system wide boardings and average weekday number of transfers.

Follow these steps to calibrate the mode choice model. First, divide boardings by the transfer rate to produce regional linked transit trips. Portion the linked trips by purpose using default percentages (to be provided). Calibrate the mode choice model using these figures. Then assign the trip table and compare estimated and observed boardings. Estimated boardings should be within 20% of the observed.

b) Tiers C and D

This calibration tier is predicated on relying entirely on local data and performing a more detailed calibration/validation effort. System ridership figures should be gathered by route and operator. Essentially, the effort will carefully calibrate each market segment and access mode. Validation will

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consist of boarding by access modes and by geography. Estimated boardings should be within 20% of the observed.

New/Small Starts projects require a rigorous method of mode choice calibration to avoid adding to the bias constant burden. The following items should be reviewed for correctness/reasonableness: bus running times/speeds, the travel markets served by the express bus routes, express bus coding and stopping patterns (especially downtown), and path traces. Since FTA guidance changes frequently, it is recommended to coordinate calibration and validation efforts with the FTA.

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