



# RTM 3.5

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Together all the way



# Changelog

- **EMME Version 4.5 Update**

- Python 3.7 syntax
- New `relocate\_tools` script includes new python package installations (pyyaml, pyarrow, xlrd, psutil, etc)

- **Updated land use**

- Horizon years 2017, 2035, 2050

- **Bug fixes**

- Fix blending factor for home-based university
- Fix reference for PnR bus travel times
- Fix reference to HbPb TNC person trips
- Update Pitt River bridge speed to 80 km/h



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# Changelog

- **Model feature updates**
  - New park and ride lots centroids (#101 to 220) to TAZ System
  - Trip production model with accessibility for HbShop, HbPb, HbSo
  - Add transit boarding penalty options
  - Add CAV penetration model
  - Consolidation of Analytics Tools



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# Changelog

- **Model feature updates con'd**
  - Update convergence criteria for auto assignment
  - Streamline the implementation of the mode choice model
    - [Advanced inputs](#) for mode choice module enabled
    - Removed intermediate demand matrices from emmebank
    - Implement segment naming convention for demand matrices
    - Add project specific summary demand export



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# Model feature updates

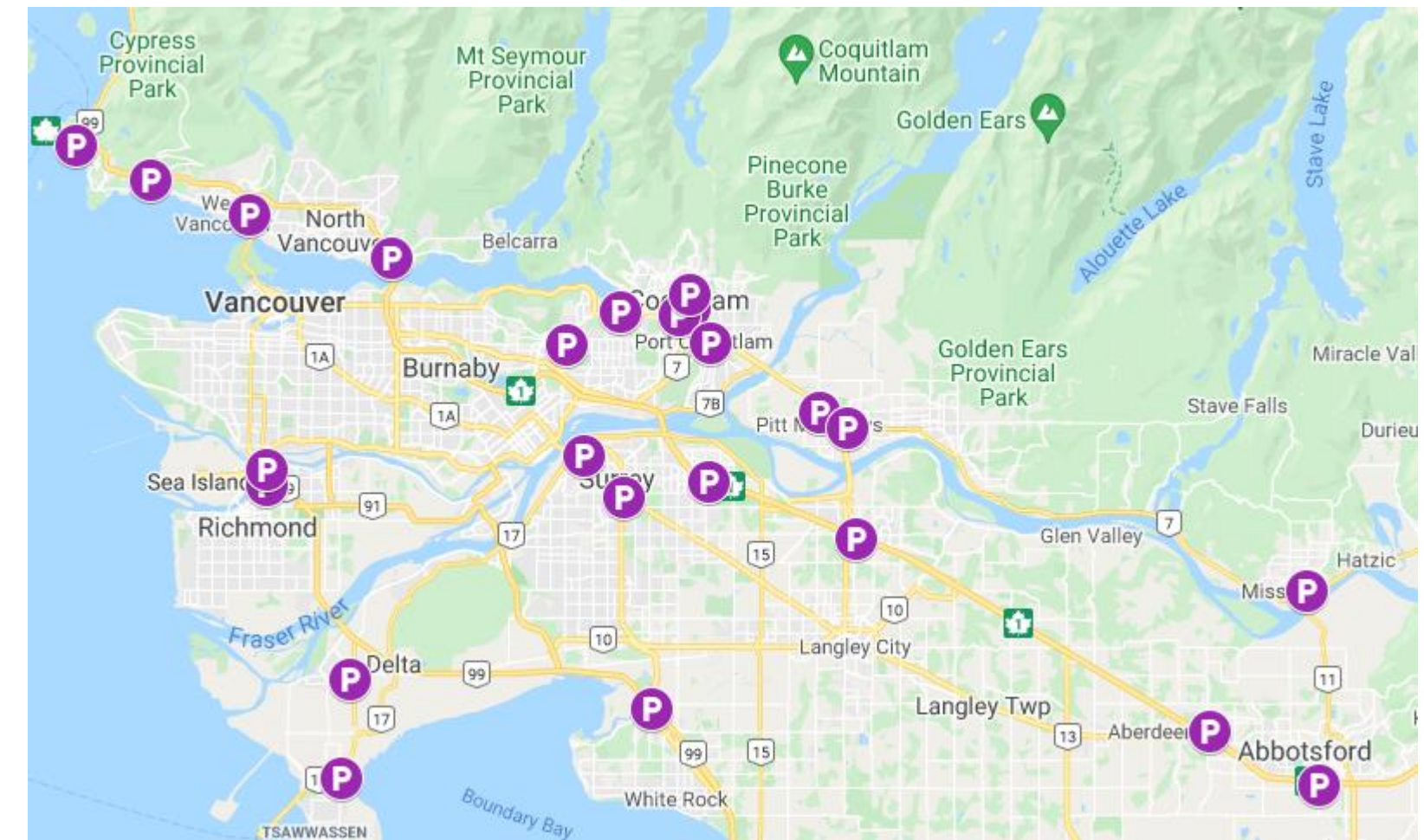


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# Park and Ride Lots

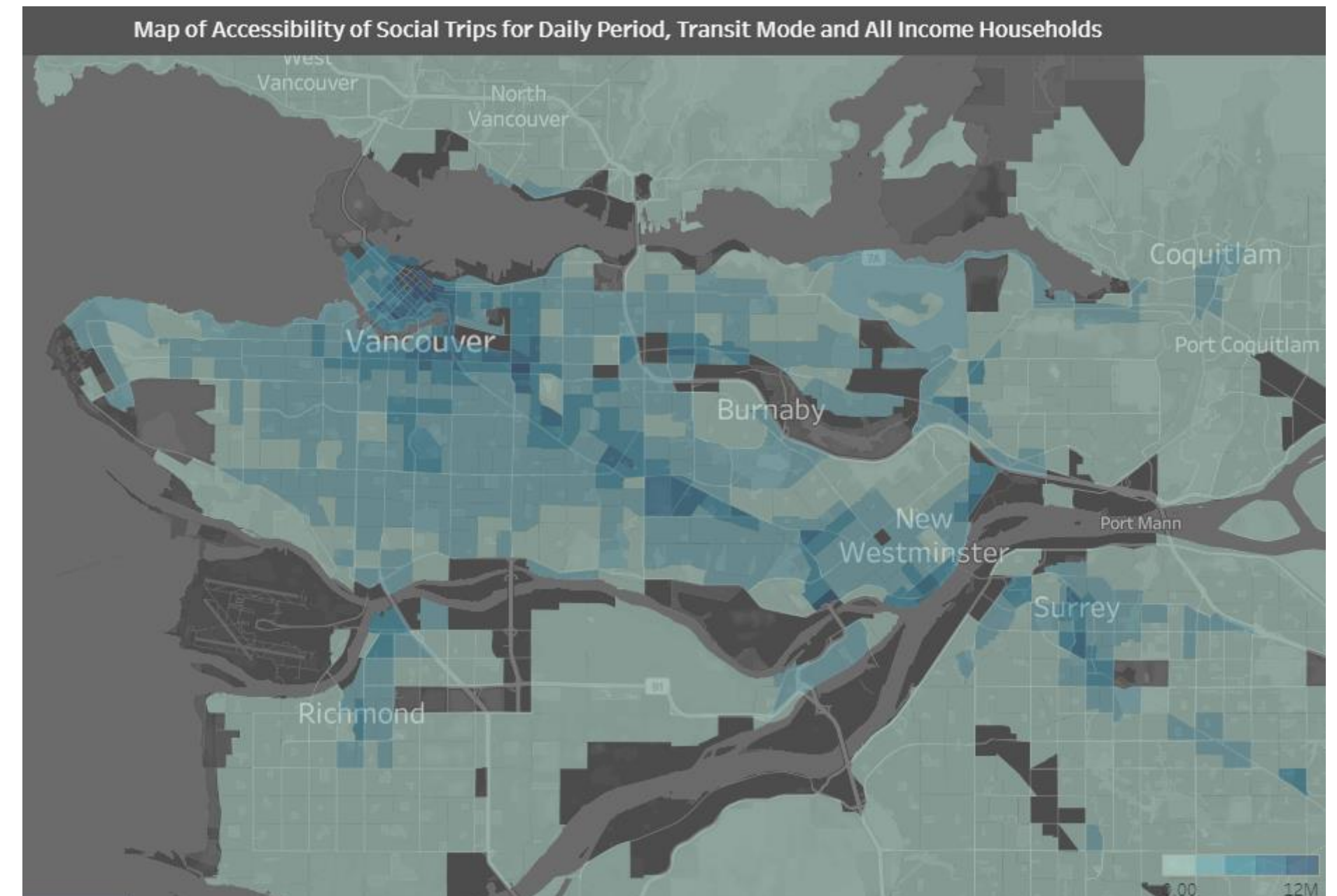
- Addition of PnR lots into TAZ system allows for analysis of PnR lot usage
- Addition of pnr\_usage summary table





# Trip Production Model Update

- Trip production model for some discretionary trip purposes is sensitive to accessibility changes
  - Home-based Shopping
  - Home-based Personal Business
  - Home-based Social
- Accessibility effects are differentiated by income segments (except for hbsocial)





# Transit Boarding Penalty

- Transit boarding was fixed to be 1 minute across the model with perception factor of 10
- Attributes on boarding penalty
  - transit line: **@brdline**
  - transit segment: **@brdpeneff**
  - @brdpeneff overrides @brdline if both are specified
- Specify boarding penalty variance across the region.





# Connected Autonomous Vehicles (CAVs)

- Implemented through household auto ownership model
- May specify roadway capacity improvement due to CAVs
- Default is CAV off with
  - $hh\_cav\_penetration = 0$
- Caution: the future of CAVs is uncertain!



# Consolidation of Analytics Tools

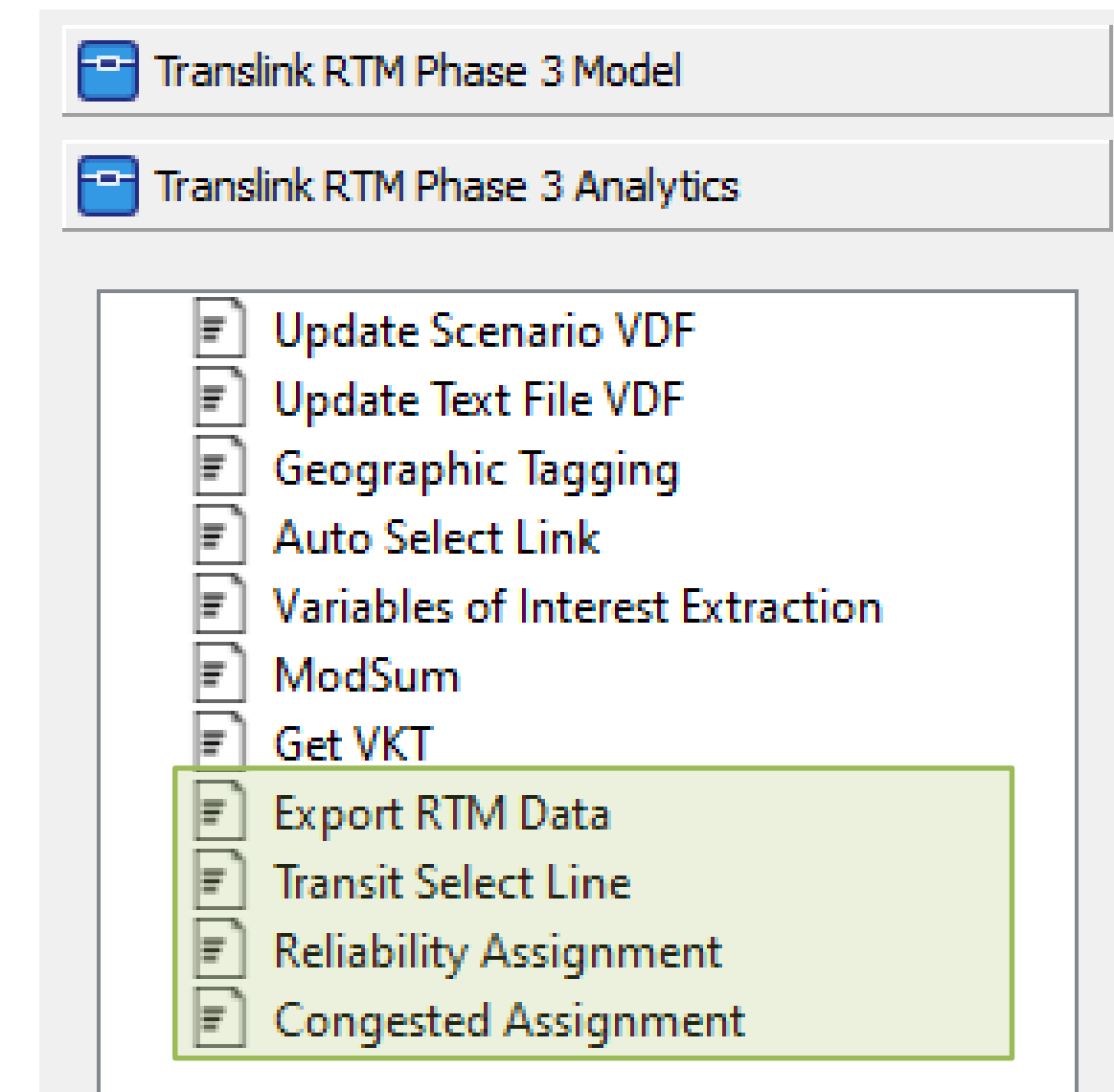
- Transit Select Link Tool
- RTM Matrix Export Tool
- Congested Assignment
  - Auto assignment with LOS-D (85% capacity) volume
- Reliability Assignment
  - Estimated using Google Maps API congestion data
  - Applied on RTM results to estimate reliability

Table B2-3: Travel Time Reliability model coefficients and summary statistics

Term	Coef.	Std. error	Statistic	p-value	Sig.
Intercept	-3.374	0.037	-91.355	2.00E-16	***
Log Travel Time Index	3.119	0.055	57.026	2.00E-16	***
Peak Period = True	0.178	0.022	8.194	2.86E-16	***
Log Distance (km)	0.837	0.009	89.881	2.00E-16	***
Bridge Crossing = True	0.162	0.010	15.775	2.36E-55	***
l(Log TTI: Peak)	0.438	0.068	6.404	1.59E-10	***

Sig. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
Residual standard error: 0.3996 on 9458 degrees of freedom  
Multiple R-squared: 0.6709; Adjusted R-squared: 0.6707  
F-statistic: 3856 on 5 and 9458 DF, p-value: < 2.2e-16

[From TransLink MPIC Report, page 240](#)





# Convergence criteria for auto assignment

- Previous convergence criteria is fixed to  $10^{-4}$  (base)
- New 4-cycle criteria default:
  - 0.01, 0.0005,  $10^{-4}$ ,  $10^{-4}$
- Reduce run time with least impact on convergence
- MAE and RMSE against base option is less than noise

The screenshot shows the 'Run RTM3' application window. It contains several input fields and buttons for configuring the model. The 'Global model iterations' field is set to 4. The 'Demographics File' and 'Geographics File' fields have 'Browse...' buttons. The 'Maximum iterations for the trip distribution sub-model' is set to 60. The 'Maximum relative error for the trip distribution sub-model' is set to 0.0001. The 'Maximum iterations for the auto assignment sub-model' is set to 300. The 'Maximum relative gap for the auto assignment sub-model' field is highlighted with a red box and contains the text '0.01,0.0005,0.0001'. Below this field, there is a small map showing a network of roads and a legend with a scale of 25. The map is labeled with 'Made with Esri. Map tiles © MapTiler © OpenStreetMap contributors'.

Run RTM3

Global model iterations:  
4  
Use 4 iterations in normal operation

Demographics File:  
Browse...  
File must be csv file.

Geographics File:  
Browse...  
File must be csv file.

Maximum iterations for the trip distribution sub-model:  
60  
The matrix balancing procedure should reach a convergence level of at least  $10^{-4}$  relative error in the final global iteration in order for the model to be considered converged. If this is not the case run again with more iterations.

Maximum relative error for the trip distribution sub-model:  
0.0001

Maximum iterations for the auto assignment sub-model:  
300  
The auto assignment should reach a convergence level of at least  $10^{-3}$  best relative gap or  $10^{-5}$  relative gap in the final global iteration in order for the model to be considered converged. If this is not the case run again with more iterations.

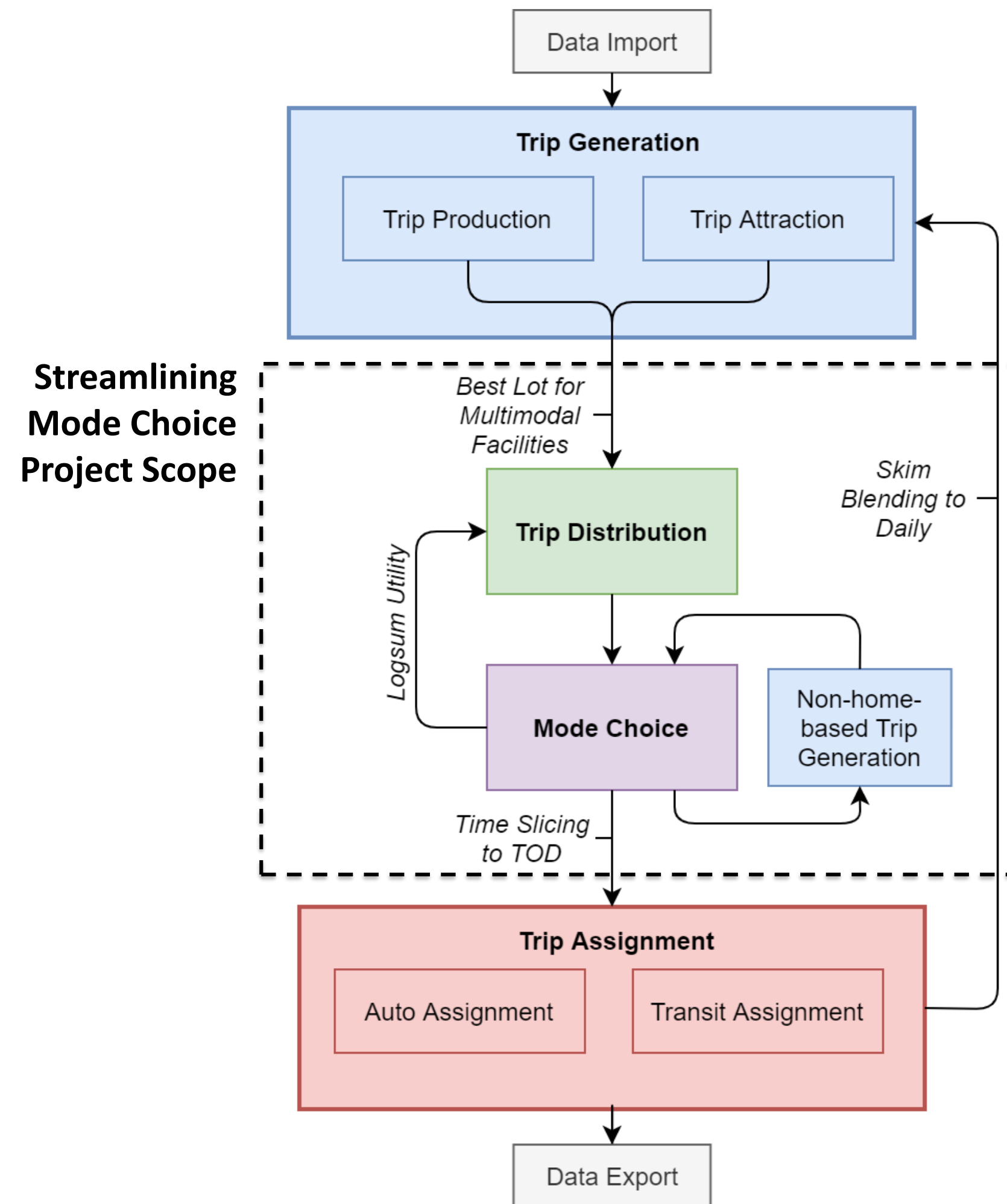
Maximum relative gap for the auto assignment sub-model:  
0.01,0.0005,0.0001  
Input allows for a list of relative gap by cycle separated by commas. For example '0.01,0.0005,0.0001' will perform first cycle with 0.01 rel gap, then second cycle with 0.0005 rel gap, and finally third or cycle thereafter with 0.0001 rel gap. Use more strict rel gap than default as needed.

(@wsvl + @whovl)-hasPce\*Pce->(@wsvl + @whovl)  
100 200 300 400 500  
Scale: 25  
Made with Esri. Map tiles © MapTiler © OpenStreetMap contributors



# Streamline mode choice model

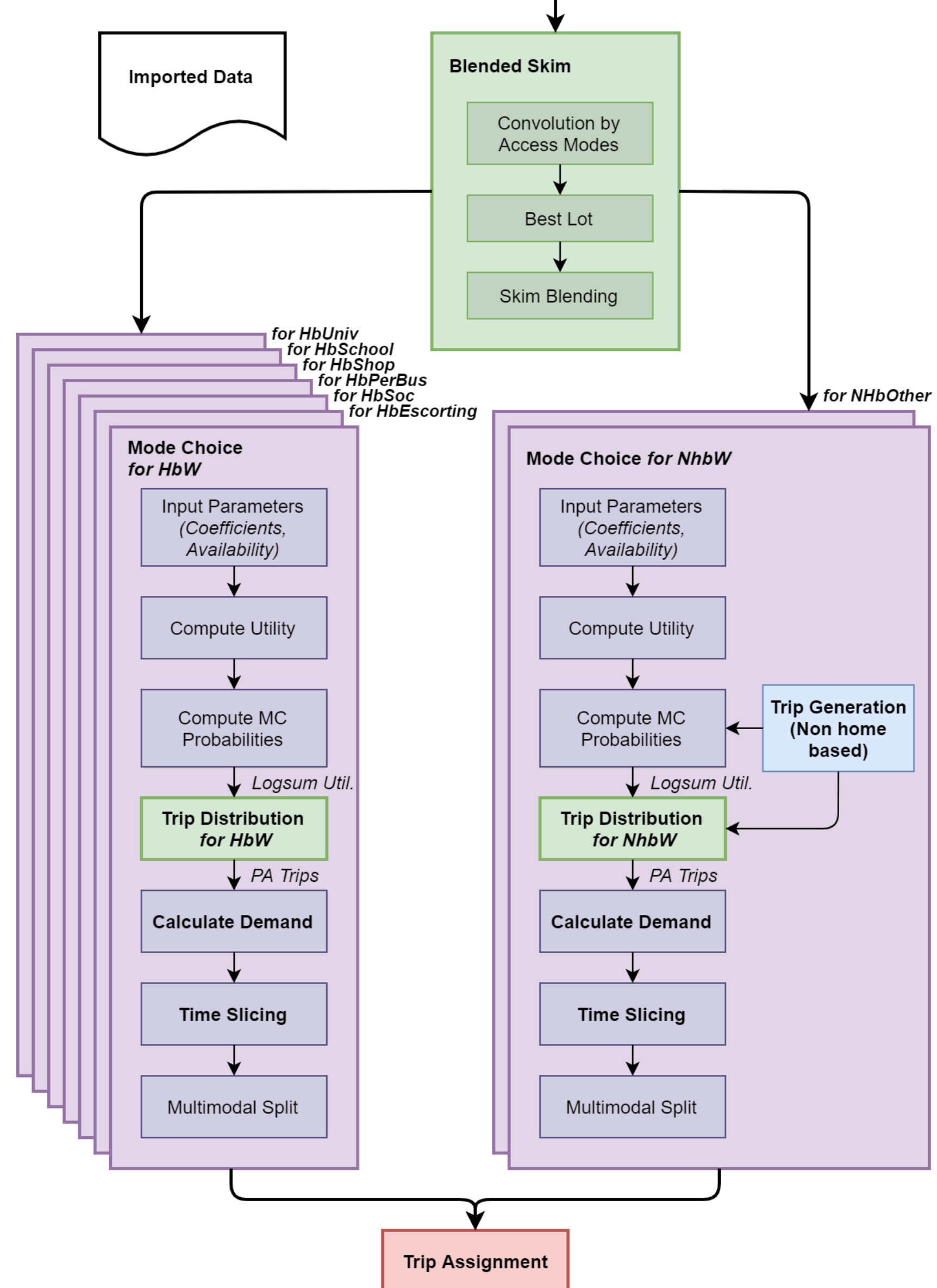
- Unified codebase
- Improve usability
- Adopt modularity
- Performance



# RTM 3.4

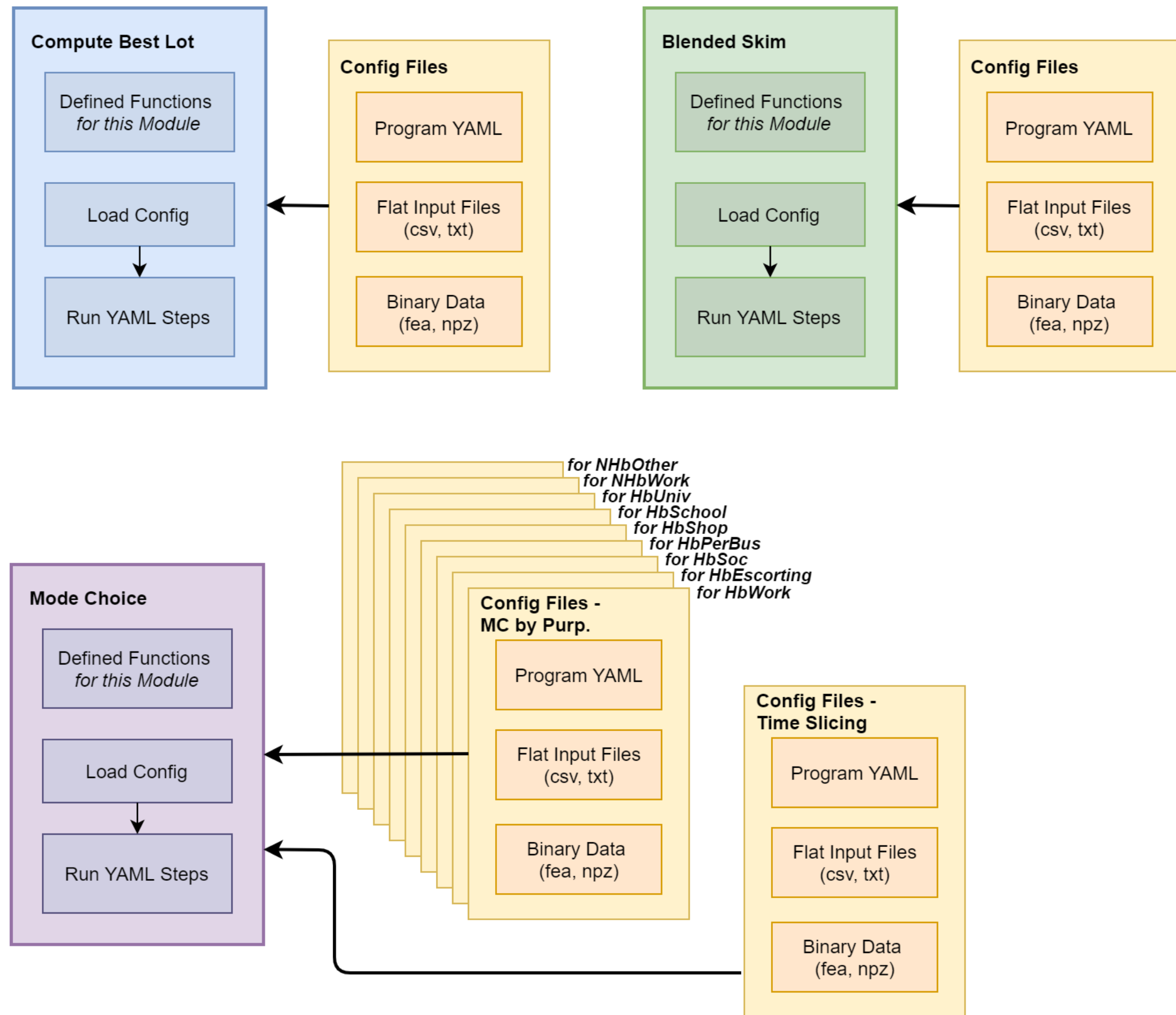
## Code Structure

- Steps and order of execution are explicitly written
- Reused code often duplicated with small variations
- Hard coded variables names
- Data access at any point



# RTM 3.5 Code Restructuring

- Components are modularized
- Modules are abstracted into a collection of functions
- Configuration files define the model being deployed
- Similar implementation can be created without needing separate code base
- Documentation: [Advanced Inputs - RTM \(translinkforecasting.github.io\)](https://translinkforecasting.github.io)





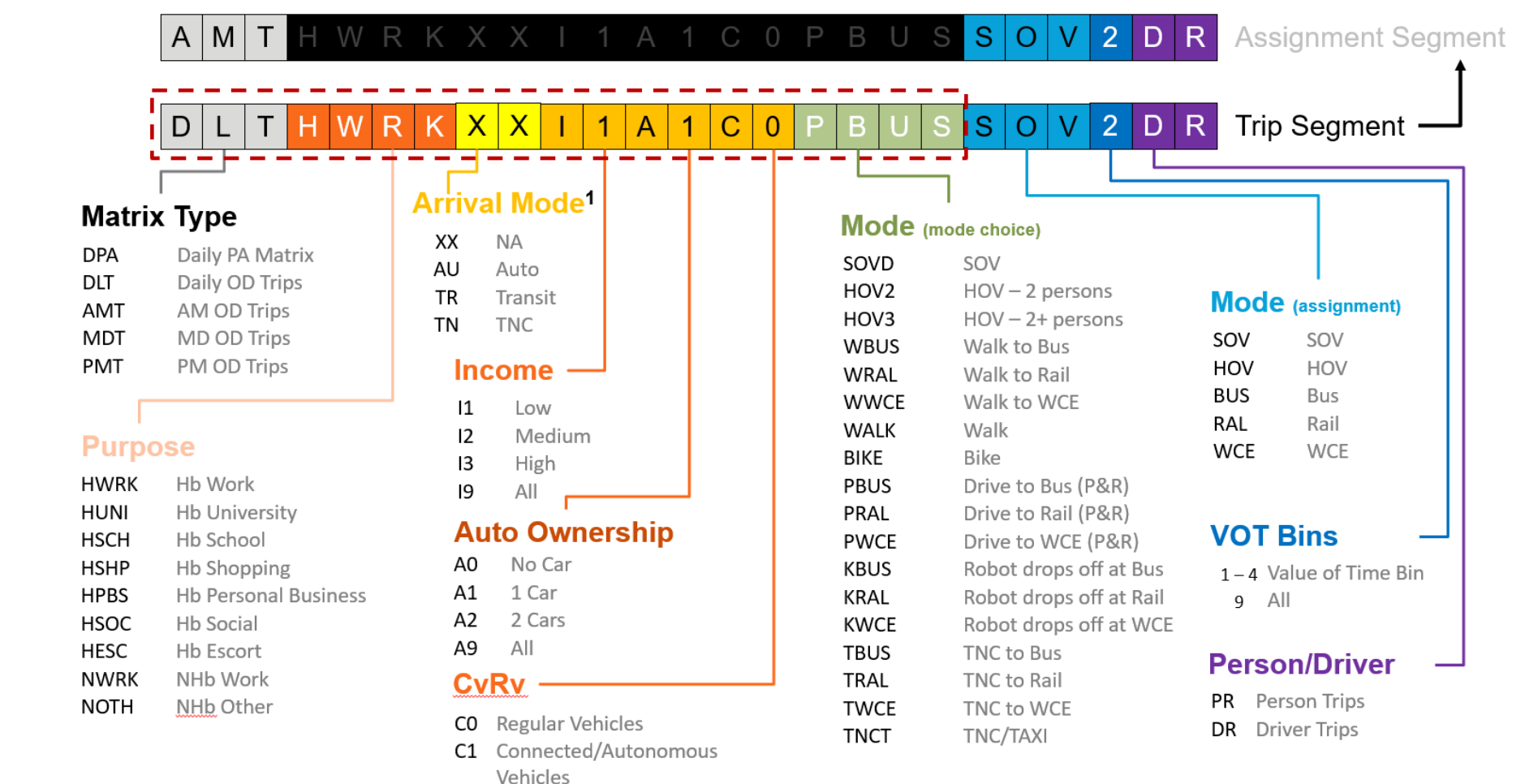
# Intermediate data cleanup

- Size of RTM 3.4 database
  - 18.4 GB (2050 BAU)
  - 1364 mf matrices
- Size of RTM 3.5 database
  - 10.6 GB (2050 BAU)
  - 593 mf matrices
  - Reduced logbook entries
  - Addition of lite log file
- Demand data **must** be summarized to be available post-run

```
log_21051415.txt X
D: > rtm_db > 0515_FinalRelease > 4cycle > db_run2050 > log_21051415.txt
1 2021-05-14 15:21:23 - Mem Used 10257 MB - Start of Model Run
2 2021-05-14 15:21:23 - Mem Used 10249 MB - git sha exported: add687c
3 2021-05-14 15:22:25 - Mem Used 9662 MB - Start of Cycle 1
4 2021-05-14 15:22:25 - Mem Used 9662 MB - Cycle 1: option by cycle custom scalar
5 2021-05-14 15:22:25 - Mem Used 9662 MB - Cycle 1: data prep and VAM
6 2021-05-14 15:24:53 - Mem Used 7827 MB - Cycle 1: trip generation
7 2021-05-14 15:24:59 - Mem Used 7784 MB - Cycle 1: mode choice procedure
8 2021-05-14 15:25:04 - Mem Used 9542 MB - Cycle 1: generalized time calculations
9 2021-05-14 15:25:10 - Mem Used 9260 MB - Cycle 1: compute best lot
10 2021-05-14 15:25:14 - Mem Used 8975 MB - yaml loaded: ComputeBestLot.yaml
11 2021-05-14 15:25:14 - Mem Used 8975 MB - Cycle 1: GetBestLots
12 2021-05-14 15:26:06 - Mem Used 7701 MB - Cycle 1: matrix extra variables
```

# Segment Naming Convention

- Reduced instances of hard coded variables and model parameters
- Adopted a structured and configurable naming convention
- Enabled more flexible demand data summary with file pattern ***DemandSummary\_\*.yaml***



# Summarize Demand

- Multiple yamls with **DemandSummary\_\*.yaml**
- **Data type:** *matrix* or *data\_table*
- **Export format**
  - *sql*: save to trip\_summaries.db
  - *csv*: comma separated text file
  - *fea*: Dataframe as feather
  - *emx*: emme matrices – matrix only
- **Group by**
  - segmentations to keep, i.e.: *[mat\_type, purpose, assign\_mode]*
- **Filter by:**
  - List of attribute values to include
- **Geography:**
  - *gy, TAZ, i* or *j* – *data\_table* only
- **Post eval:**
  - col or df operations – *data\_table* only

```
! DemandSummary_Default.yaml X
! DemandSummary_Default.yaml
8
9 STEPS:
10 - DemandSummary
11
12 DemandSummary:
13 # steps to export demand summaries, method of summary is always sum of trips
14 export_demand_steps:
15 # name of step will be used as table or file name
16 pnr_usage:
17 type: data_table
18 export_format: ['sql']
19 geography: 'TAZ'
20 group_by: [purpose, assign_mode]
21 filter_by:
22 mat_type: ['DPA']
23 pr_dr: ['PR']
24 purpose: ['HWRK']
25 assign_mode: ['SOV']
26 post_eval:
27 col_assign:
28 pnr_usage: "df['trips'] / 2"
29 df_assign:
30 - "df[['i','j','pnr_usage']]"
31 - "df.groupby(['i','j']).sum().round(3).reset_index(drop=False)"
32 - "df[(df['i'] > 99) & (df['i'] < 999)]"
```

```
! DemandSummary_RTS.yaml U
! DemandSummary_RTS.yaml
9 STEPS:
10 - DemandSummary
11
12 DemandSummary:
13 # steps to export demand summaries, method of summary is always sum of trips
14 export_demand_steps:
15 # name of step will be used as table or file name
16 RTS_Demand:
17 type: matrix
18 export_format: ['fea']
19 group_by: [mat_type, purpose, income, assign_mode, vot]
20 filter_by:
21 mat_type: ['DPA']
22 pr_dr: ['PR']
```