

# TRANSIMS Training Course at TRACC

Transportation Research and Analysis Computing Center

## Part 10

### Trip Table Conversion

**Dr.-Ing. Hubert Ley**

Transportation Research and Analysis  
Computing Center

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# Unit 10



TRACC - TRANSIMS Training Course

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## Introduction

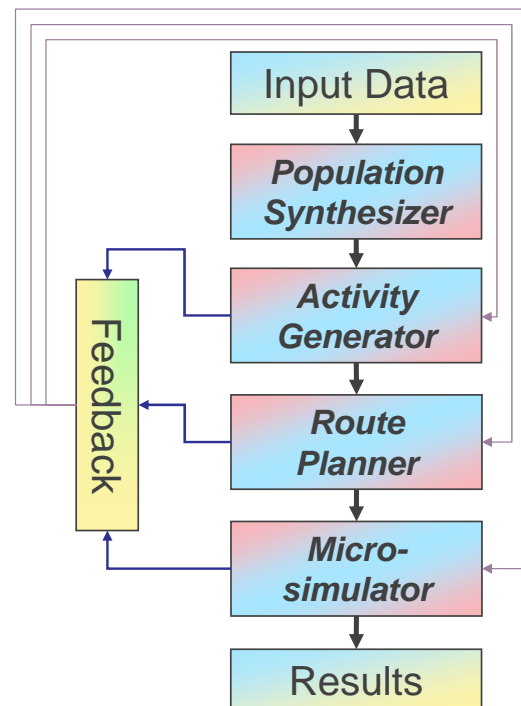
- TRANSIMS has been designed as an activity-based simulation tools based on census population data and activity surveys for the area being modeled
  - TRANSIMS depends heavily on the availability and quality of survey data
  - Surveys are expensive to obtain and need frequent updates
  - The complexity of modeling increases significantly by building a synthetic population and creating suitable activity patterns for the entire population
- Therefore, TRANSIMS can also be operated based on available trips and trip distribution data available from metropolitan planning organizations
  - Trip data is the basis for typical MPO planning purposes
  - Starting with existing data makes it much easier to create a metropolitan TRANSIMS model from scratch
  - Populations and activities can be added in the future based on the need for modeling specific scenarios
  - Trip data is typically based on traffic analysis zones with centroids being connected to the road network to load traffic demand appropriately



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## The Complete TRANSIMS Model

- Input Data for Modules
  - Transportation Network
    - Streets, Intersections, Signals
    - Transit Routes and Schedules
    - Land Use Data, Zoning Information
  - Transit Lines and Schedules
  - *Census Data for Population\**
  - *Household Activity Surveys\**
  - Itinerant Travelers and Trips
  - Vehicle Characteristics and Prototypes



\* Trip-based models do not need this data

Generalized TRANSIMS Flow Chart



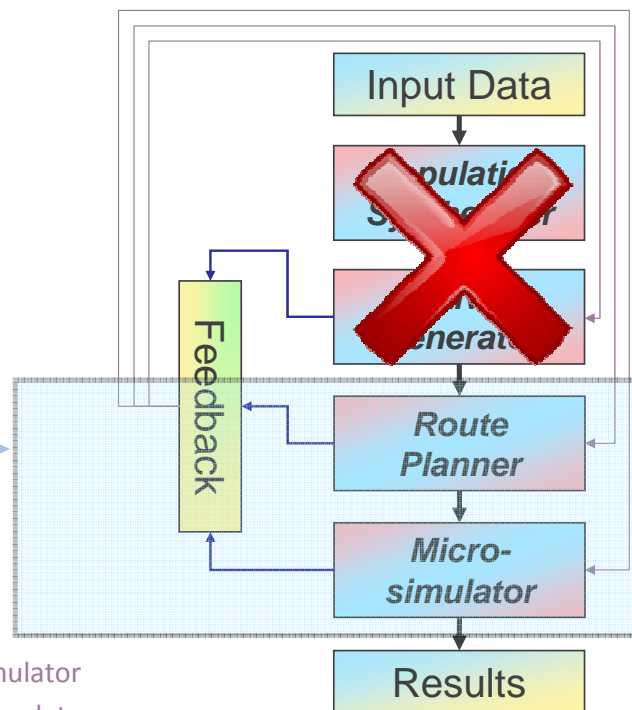
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## Simplified Trip-Based TRANSIMS Models

- Create a Road Network
- Create a Transit Network
- Obtain Transit Schedules



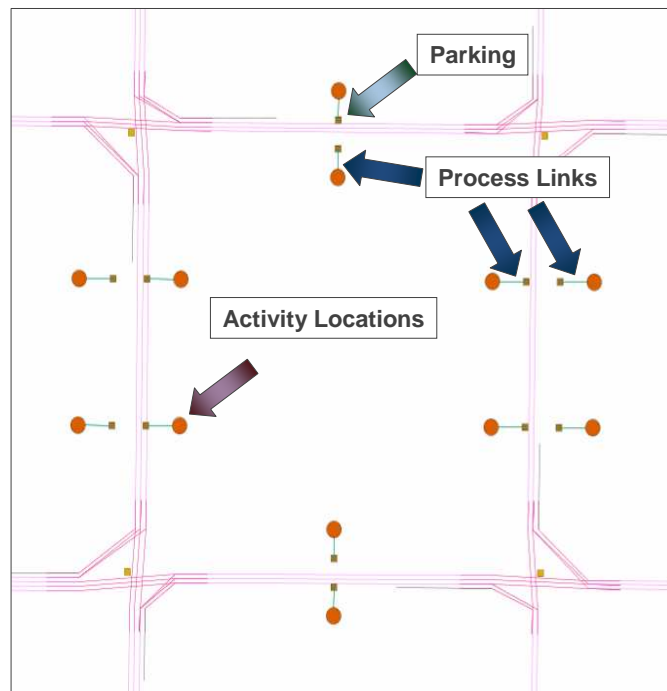
- Methodology #2
  - Obtain Trip Tables
  - Obtain Diurnal Distributions
  - Run Trip Converter
- Create Travel Plans from Trips using the Router
- Test the Travel Plans in the Microsimulator
- Iterate Between Router and Microsimulator



## The TRANSIMS Network and Trips

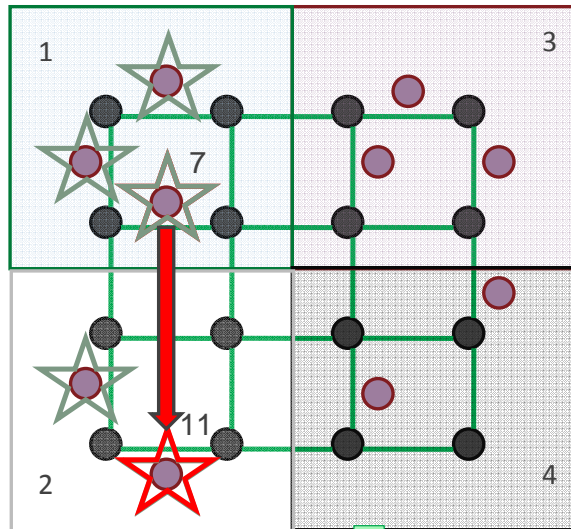
### Primary Challenges:

- How can trips be undertaken without having ever built an actual population?
- Where do trips start and end? How do traffic analysis zones and activity locations correlate?
- How is aggregate trip data extrapolated for use of a synthetic population?
- What format does trip data come in typically and how is it converted?



## ConvertTrips (Part 1)

Orig_Zone	Des_Zone	Trips
1	2	3
2	1	1
3	1	3
3	4	2
5	4	2
6	1	2



**ConvertTrips**

Trip #	Orig_Loc	Des_Loc	Approx_Travel_Time
1	7	11	5

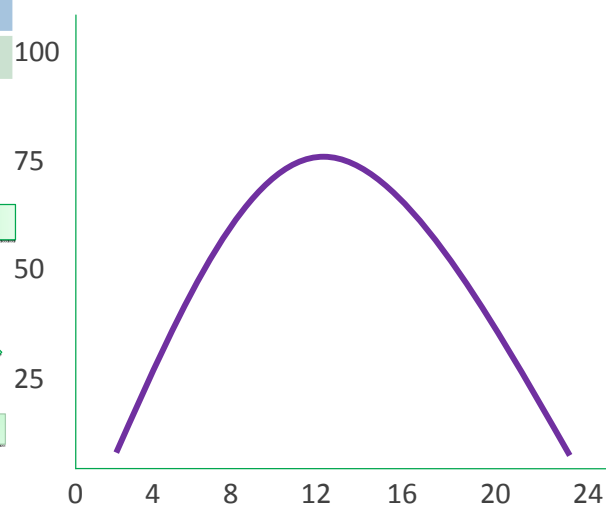


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## ConvertTrips (Part 2)

Trip #	Orig_Loc	Des_Loc	Approx_Travel_Time
1	7	11	5

**ConvertTrips**



Trip #	Orig_Loc	Des_Loc	Start_Time	Approx_End
1	7	11	8:03	8:08



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## Typical Trip Data

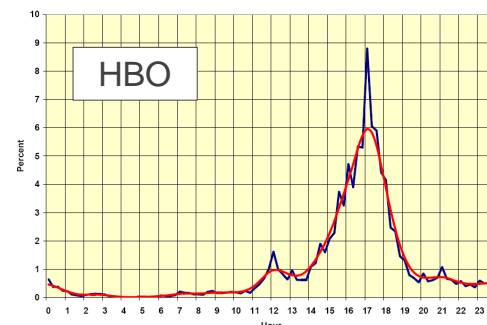
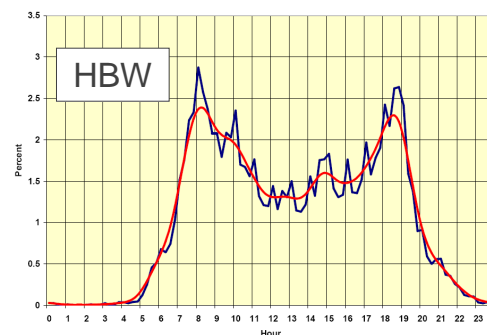
- Typical trip data comes in form of tables describing how many trips are being taken from any traffic analysis zone to any other traffic analysis zone for a given time interval (typically a day, see sample data on the right)
- Trip data is typically aggregated for the whole day
- Zones are at a relatively low resolution compared to TRANSIMS street networks
- For Chicago, there are 1950 traffic analysis zones
- Trip tables are often available for specific subsets such as
  - HBW
  - HBO
  - Transit ...

From	To	# of Trips
1	1	18
1	2	232
1	3	365
2	1	240
2	2	23
2	3	278



## Diurnal Distributions

- Diurnal distributions describe the total number of trips as a function of daytime
- Diurnal distributions vary widely from area to area and from trip purpose to trip purpose
- They represent another form of aggregate data and can be used in combination with the corresponding trip tables to reconstruct detailed trips from aggregate data
- Smoothing can be used to make diurnal distributions more suitable for trip conversion (the SmoothData tool)





## Typical Trip Data and the ConvertTrips Tool

- Transims provides a tool ConvertTrips to create approximated specific trips for an entire synthetic population based on available trip tables
  - Without a synthetic population based on Census data, ConvertTrips creates an artificial person and vehicle for each specific trip to place it onto the network
  - Without basing the trips on the activities of a specific person, otherwise related trips appear to be undertaken by different individuals
- Trips start and end points are extrapolated from aggregate zoning locations to specific TRANSIMS activity locations
  - A real work tour is being represented by some individual leaving at some time in the morning from somewhere close by and returning as a different individual at some time in the afternoon to yet another location close by
- Diurnal distributions must match the corresponding trip table to lead to defensible results



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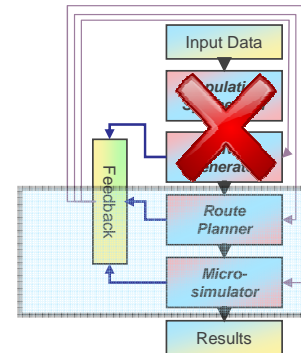
## Resolution of Zoning Data versus Road Network



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## Using Trip Tables in TRANSIMS

- ConvertTrips generates large trip tables with one record for each specific trip undertaken in the simulation area
- The records specify details such as
  - Start and estimated end time for each trip
  - The exact activity locations for both start and destination
  - The mode of travel
- It also creates one new synthetic person and one new vehicle for each trip
- These records can be used by the TRANSIMS router to create exact travel plans for subsequent use in the Microsimulator
- The extrapolation of aggregated trip and diurnal distribution data leads to large trip files, e.g. 1.4GB for 25,500,000 daily automobile trips in the Chicago Metropolitan Area



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## Combining Multiple Data Sets

- ConvertTrips can operate on a large number of data sets
- Each data set can have its own diurnal distribution
- Weight can be applied for both choosing the destinations or origins of trips
- Diurnal distributions can be complex, and an internal scripting language can be used to assign specific diurnal distributions to each traffic analysis zone
- For Chicago, there are 10 data sets for HBW, HBO, NHB, Airport Travel, and several classes of trucks, plus 3 transit and 3 park and ride data tables
- All these can be converted in a single run of ConvertTrips
- An example control file is shown on the next slide to illustrate the control keys

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## Sample ConvertTrips Control File

```
#
# DEFAULT_FILE_FORMAT      TAB_DELIMITED
#
# TRANSIMS network files to be used as input for this run
#
# NET_DIRECTORY            ../../network/production
# NET_ACTIVITY_LOCATION_TABLE      FullArea_Activity_Location
# NET_PROCESS_LINK_TABLE      FullArea_Process_Link
#
# # New TRANSIMS files to be created by this run
#
# NEW_TRIP_FILE            ../../activity/Trip
# NEW_POPULATION_FILE      ../../household/Population
# NEW_HOUSEHOLD_FILE       ../../household/Household
# NEW_VEHICLE_FILE         ../../vehicle/Vehicle
#
# # General conversion parameters
#
# STARTING_HOUSEHOLD_ID    1
# STARTING_VEHICLE_ID      1
# TIME_OF_DAY_FORMAT       SECONDS
# RANDOM_NUMBER_SEED       12345
# VEHICLE_TYPE_FILE        ../../vehicle/VehicleType

#---- airport trips ----
# TRIP_TABLE_FILE_1        ../../CMAP/Trips/Version4/Input_Trips.airpoe
# TRIP_TIME_FILE_1         ../../trips/diurnal.airpoe
# TRIP_PURPOSE_CODE_1      1 # counter
# TRAVEL_MODE_CODE_1       2 # drive
# AVERAGE_TRAVEL_SPEED_1  15 # m/s
# VEHICLE_TYPE_1           1 # car
# ORIGIN_WEIGHT_FIELD_1    USER1
# DESTINATION_WEIGHT_FIELD_1  USER2

#---- external trips ----
# TRIP_TABLE_FILE_2        ../../CMAP/Trips/Version4/Input_Trips.autopoe
# TRIP_TIME_FILE_2         ../../trips/diurnal.autopoe
# TRIP_PURPOSE_CODE_2      2 # counter

#---- hbo trips ----
# TRIP_TABLE_FILE_7        ../../CMAP/Trips/Version4/Input_Trips.hbo
# TRIP_TIME_FILE_7         ../../trips/diurnal.hbo
# TRIP_PURPOSE_CODE_7      7 # counter
# TRAVEL_MODE_CODE_7       2 # drive
# AVERAGE_TRAVEL_SPEED_7  15 # m/s
# VEHICLE_TYPE_7           1 # car
# ORIGIN_WEIGHT_FIELD_7    USER1
# DESTINATION_WEIGHT_FIELD_7  USER2

#---- nhb trips ----
# TRIP_TABLE_FILE_8        ../../CMAP/Trips/Version4/Input_Trips.nhb
# TRIP_TIME_FILE_8         ../../trips/diurnal.nhb
# TRIP_PURPOSE_CODE_8      8 # counter
# TRAVEL_MODE_CODE_8       2 # drive
# AVERAGE_TRAVEL_SPEED_8  15 # m/s
# VEHICLE_TYPE_8           1 # car
# ORIGIN_WEIGHT_FIELD_8    USER1
# DESTINATION_WEIGHT_FIELD_8  USER2

#---- hbw trips ----
# TRIP_TABLE_FILE_10       ../../CMAP/Trips/Version4/Input_Trips.hbw
# TRIP_TIME_FILE_10        ../../trips/diurnal.hbw
# TRIP_PURPOSE_CODE_10     10 # counter
# TRAVEL_MODE_CODE_10      2 # drive
# AVERAGE_TRAVEL_SPEED_10  15 # m/s
# VEHICLE_TYPE_10          1 # car
# ORIGIN_WEIGHT_FIELD_10   USER1
# DESTINATION_WEIGHT_FIELD_10  USER2
```

See next viewgraphs ...



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## Sample ConvertTrips Control File

```
#
# DEFAULT_FILE_FORMAT      TAB_DELIMITED
#
# TRANSIMS network files to be used as input for this run
#
# NET_DIRECTORY            ../../network/production
# NET_ACTIVITY_LOCATION_TABLE      FullArea_Activity_Location
# NET_PROCESS_LINK_TABLE      FullArea_Process_Link
#
# # New TRANSIMS files to be created by this run
#
# NEW_TRIP_FILE            ../../activity/Trip
# NEW_POPULATION_FILE      ../../household/Population
# NEW_HOUSEHOLD_FILE       ../../household/Household
# NEW_VEHICLE_FILE         ../../vehicle/Vehicle
```



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## Sample ConvertTrips Control File

```

■ #
■ # General conversion parameters
■ #
■ STARTING_HOUSEHOLD_ID          1
■ STARTING_VEHICLE_ID           1
■ TIME_OF_DAY_FORMAT             SECONDS
■ RANDOM_NUMBER_SEED            12345
■ VEHICLE_TYPE_FILE              ../../vehicle/VehicleType
■ #

```



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## Sample ConvertTrips Control File

```

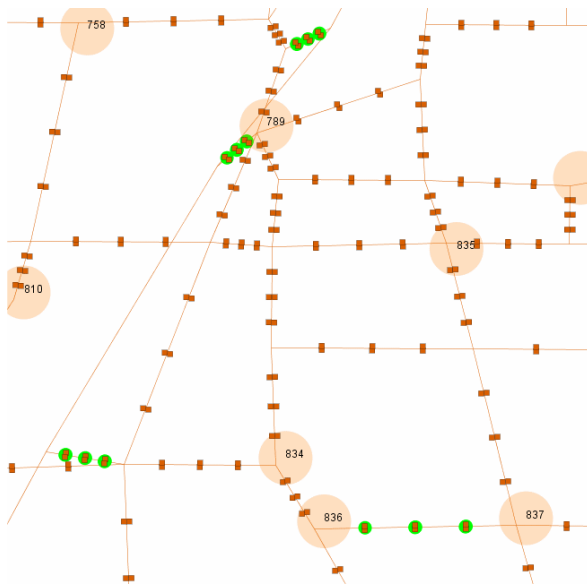
■ #---- airport trips ----
■ #
■ TRIP_TABLE_FILE_1              ../../CMAP/Trips/Version4/Input_Trips.airpoe
■ TRIP_TIME_FILE_1               ../../trips/diurnal.airpoe
■ TRIP_PURPOSE_CODE_1            1  #-- counter
■ TRAVEL_MODE_CODE_1             2  #-- drive
■ AVERAGE_TRAVEL_SPEED_1         15 #-- m/s
■ VEHICLE_TYPE_1                 1  #-- car
■ ORIGIN_WEIGHT_FIELD_1          USER1
■ DESTINATION_WEIGHT_FIELD_1     USER2
■ #
■ ...

```

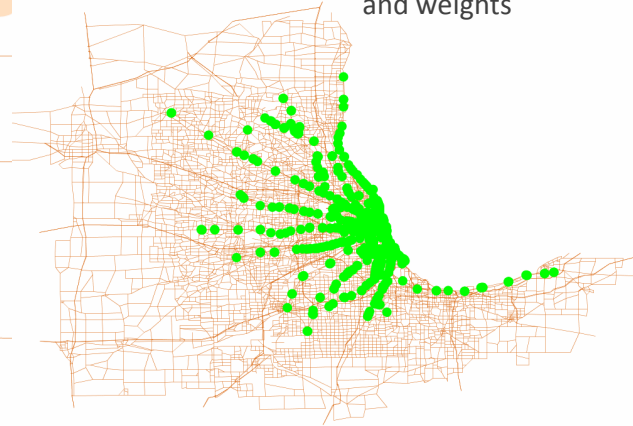


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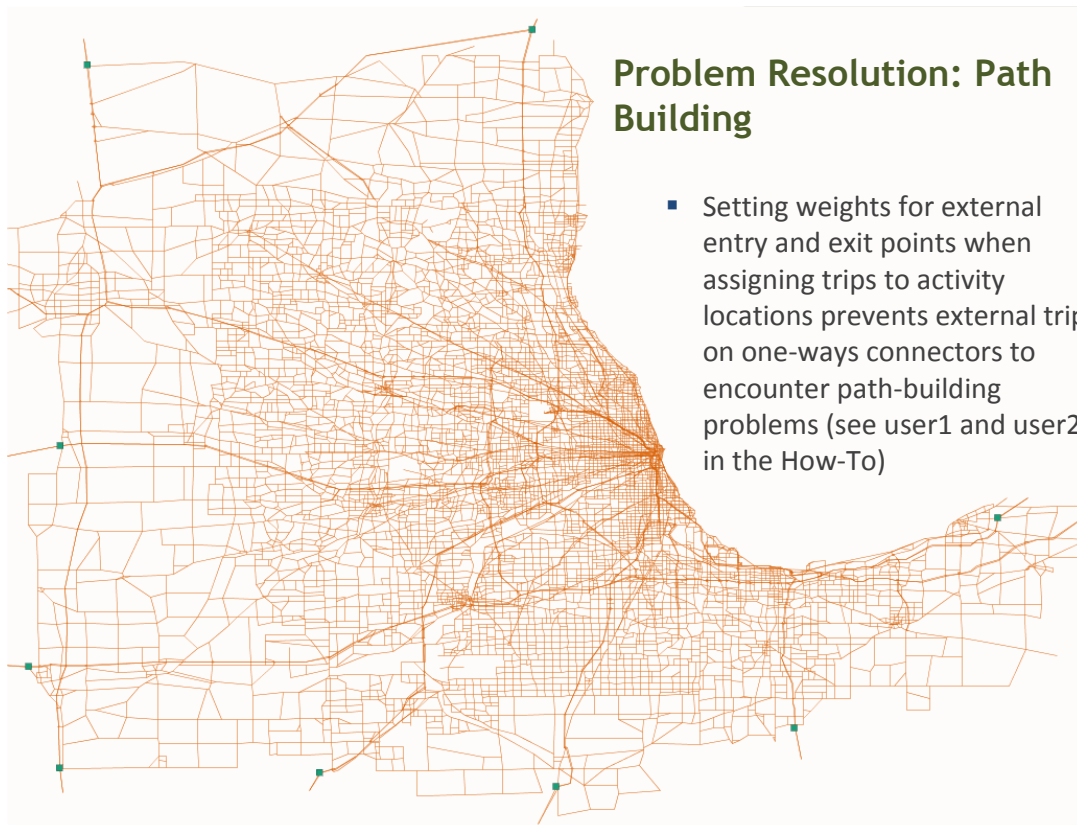
## Problem Resolution: Access Restrictions



- Example for a typical misconfiguration:
- Assignment of trips to activity locations may lead to truck being placed on roads that don't allow truck traffic
- Solution: LocationData tool and weights



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## Problem Resolution: Path Building

- Setting weights for external entry and exit points when assigning trips to activity locations prevents external trips on one-ways connectors to encounter path-building problems (see user1 and user2 in the How-To)



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## Additional Settings

- ConvertTrips is well-documented in a general tool description as well as in one of the How-Tos available from the TRANSIMS site

- A selected list of features:

- Zone equivalency: Zone groups represent large geographic areas or governmental entities (see sample on the right)
- Trip Purpose
- Travel Mode
- Return Trip Offset
- ConvertTrips can be run successively to append trips from multiple runs
- And much more ...

### Sample Zone Group File

```

1 0 Portland CBD - 1
1 1 1..16
2 0 West Suburbs - 2
2 1 79..307, 1248..1253
3 0 Southwest Suburbs - 3
3 1 308..403, 931..933
4 0 Southeast Suburbs - 4
4 1 404..557, 934..943, 1254..1258
5 0 East Portland - 5
5 1 561..563, 714..721, 731..738, 763..929, 949..961, 963..969
6 0 East Suburbs - 6
6 1 558..560, 564..713, 722..730, 739..762, 1259..1260
7 0 West Portland - 7
7 1 17..78, 930, 944..948, 962, 1247
8 0 Clark County - 8
8 1 970..1246

```



## Credits and Acknowledgements

- GIS visualization materials were mostly developed at Argonne based on the TRANSIMS tools developed by AECOM for USDOT
- Chicago road and transit network data used in some of the examples was provided by the Chicago Metropolitan Agency for Planning
- USDOT provided the funding for the development of these training materials
- USDOT provided the funding for the TRACC computing center and the resources necessary to perform these training session

