TRANSIMS Training Course at TRACC

Transportation Research and Analysis Computing Center

Part 2

Modeling of Street and Transit Networks in TRANSIMS

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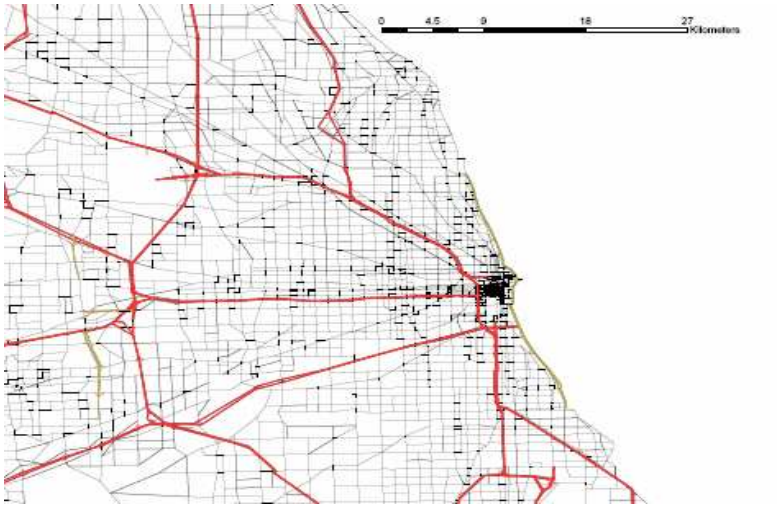
Last Updated: December 9, 2009

Unit **2**

Contents

Introduction

- The TRANSIMS Transportation Network provides detailed information for the Router and the Microsimulator about:
  - Streets
  - Lanes
  - Intersections
  - Connectivity
  - Signals
  - Parking
  - Transit Stops
  - Transit Routes
  - Land Use Activity Data

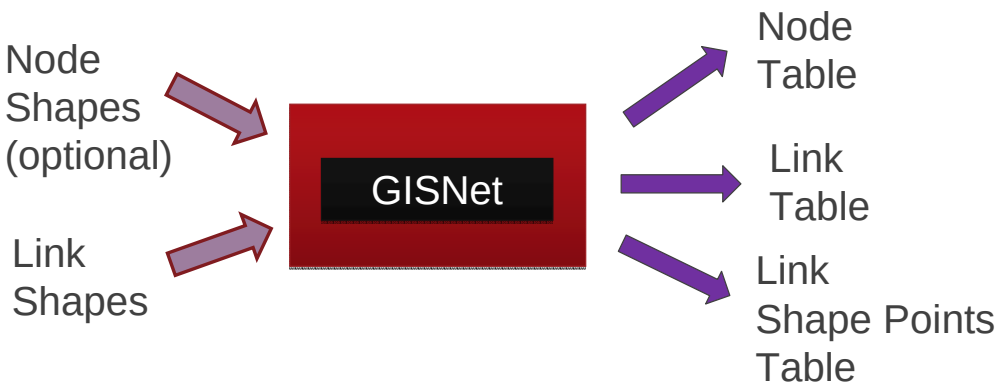


Data Availability

- Network tables are extensive and their preparation requires a large effort
- The basic nodes and links can often be imported from existing MPO models
  - Node and link conversion may require scripting for
    - Conversion between coordinate systems
    - Cross-referencing between different data sets
    - GIS processing to join or partition regional data sets
- Some information typically cannot be found at MPOs
  - Activity locations, parking locations
  - Network details such lane connectivity and traffic signals
- MPOs do typically have reasonable data for
  - Transit, road enhancement projects
  - Network enhancement plans and projections into future years

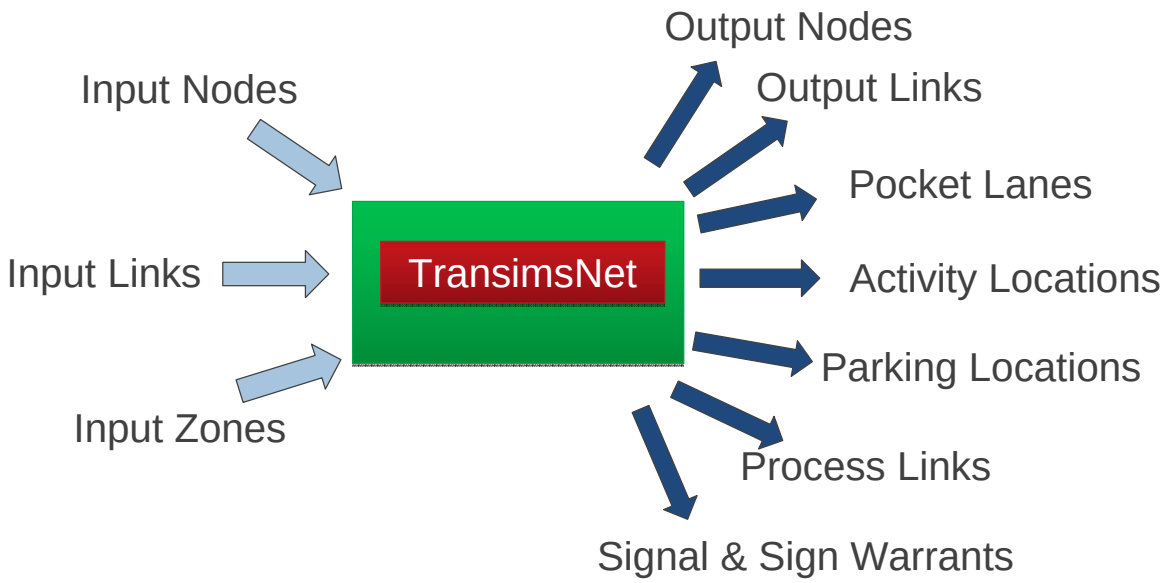
Data Availability – GISNet

- TRANSIMS provides a utility called GISNet for conversion of a network in ESRI shape format to TRANSIMS table format
  - Useful for incorporating modifications to the network through a GIS tool
  - Also makes it possible to greatly speed the transition from an existing MPO or Four Step model currently in shape format



TransimsNet Network Conversion

- TransimsNet converts typically available road network tables into a much more detailed network for use in TRANSIMS

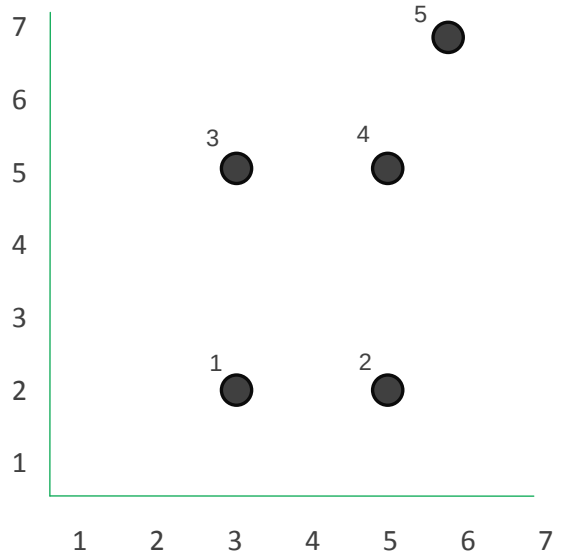


Input Node Table

- Network nodes are placed onto the roadway network where: roadways intersect, branch out, change number of permanent lanes, or end

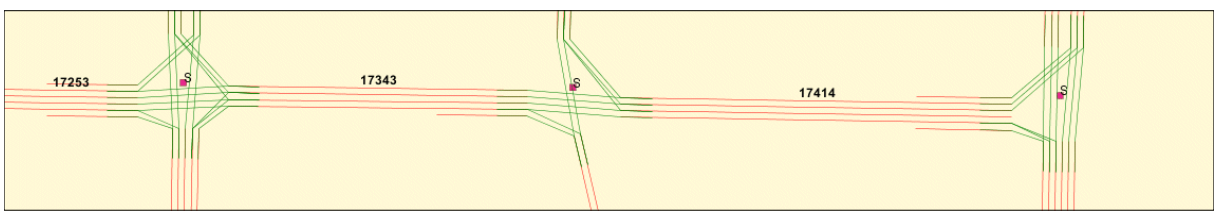
Node	X_Coord	Y_Coord
1	3	2
2	5	2
3	3	5
4	5	5
5	6	7

TransimsNet



Network Tables - Input Links

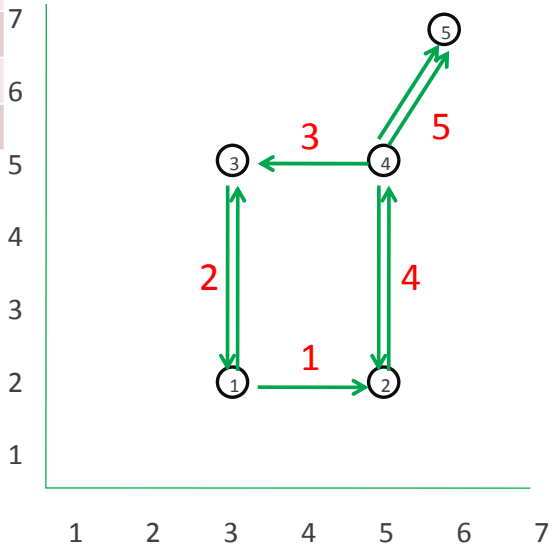
- Links are placed on the network to represent node interconnections
  - Links represent roadways, walkways, rail lines, etc.
  - Links always connect two nodes
  - Each node can be connected to several links
  - Links can be multi-modal, e.g. light rail on city streets
- Minimum Properties that must be specified for input
  - Anode and Bnode of Link
  - Number of Lanes from A to B and from B to A
  - Estimated FreeSpeed from A to B and from B to A
  - Functional class of the road (Highway, Major, Minor, Ramp, etc…)
  - What types of vehicles can use the road



Input Link Table

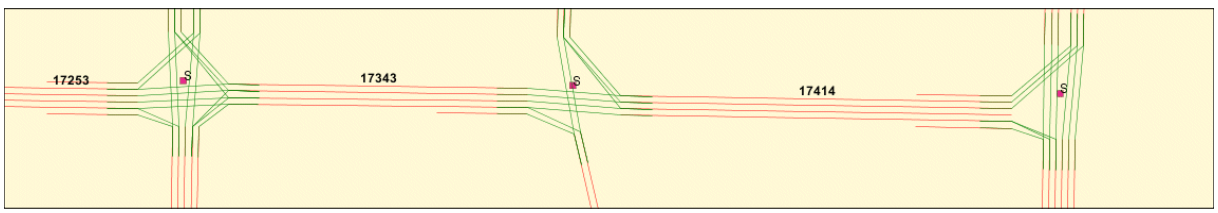
Link	Anode	Bnode	Lanes_AB	Lanes_BA
1	1	2	1	0
2	1	3	1	1
3	3	4	0	1
4	2	4	1	1
5	4	5	2	0

TransimsNet



Network Tables - Output Links

- Properties added by TransimsNet (unless specified on input)
  - A unique link ID
  - Length of the link (calculated via nodes and shape points)
  - Setback from the intersection in the A and B directions
  - Bearing (in degrees) of the link from A to B and B to A
  - Number of pocket lanes on the left and right in both directions
  - Speed Limits
  - Capacity estimations for both the AB and BA directions

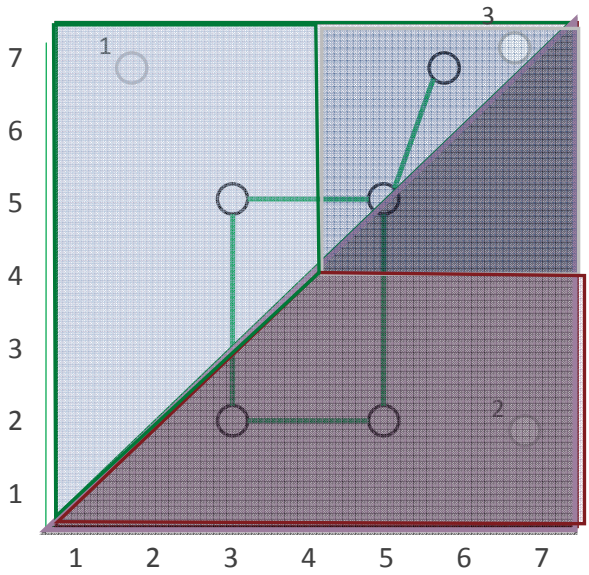


Input Zones

- Specifies the centroid location and area type for a traffic analysis zone
  - Any other network element is considered to be in the jurisdiction of the zone centroid which is the shortest distance away and is of the area type specified for that zone

Zone	X_Coord	Y_Coord
1	1	7
2	7	2
3	7	7

TransimsNet



Additional Input Tables

- Shape Point Table
  - Applies to the link table
  - Provides shapes to the links to better follow road segments
  - Contains x and y coordinates of shape points for each applicable link
- Keep Nodes Table
  - TransimsNet tries to remove unnecessary nodes by placing them into the newly generated shape point table
  - Nodes listed in this table are preserved even if no links connect to them (can be necessary for transit routes and similar)

The TransimsNet Miscellaneous Identifiers

- Area Types
  - Area types describe areas with similar characteristics, such as rules for placing signs, signals, pocket lanes, and other road features
- External Zones
  - External zones are different from regular traffic analysis zones, providing a mechanism to feed external traffic onto the network.
  - External zones must be specified as the last zones (the zones with the highest identifiers) in the input zone table
  - Node identifiers with x and y values identical to the zone centroids must be placed in the node table

The TransimsNet Parameters

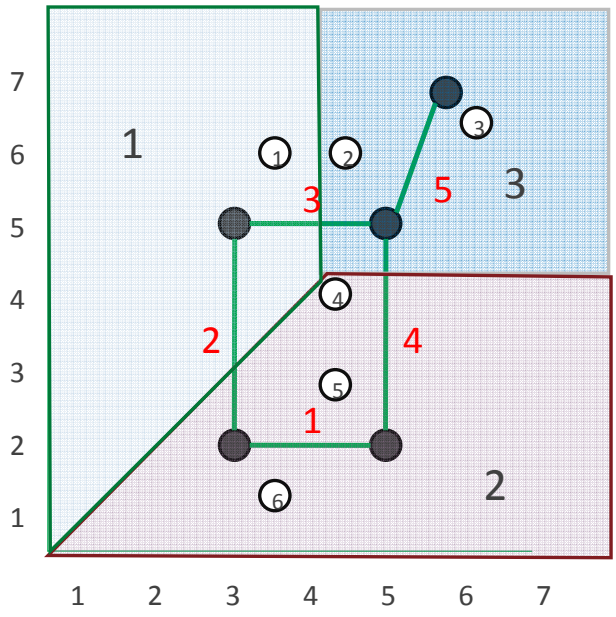
- TransimsNet takes a number of parameters to generate an extensive set of properly correlated network tables for use in the router, microsimulator, and other related tools. These are some of the more important ones.
- A matrix of facility type versus area type (and vice-versa) describing
  - Pocket lane lengths for the given facility and area type
  - Criteria for signal and sign placement for the given area type and facility type
- Activity Locations
  - Maximum number of activity locations per link
  - Minimum distance between activity locations
- Link and Connectivity Properties
  - Minimum link length
  - Maximum length to x/y ratio
  - Maximum connection angle

Activity Locations

- Activity Locations represent potential beginning and ending points of each trip and represent real world places of interest (homes, workplaces, schools, hospitals, etc.)

TransimsNet

Location	Link	Zone
1	3	1
2	3	3
3	5	3
4	4	2
5	4	2
6	1	2

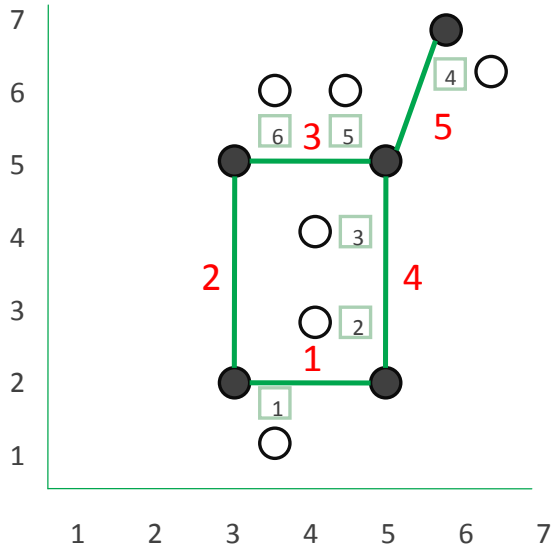


Parking Locations

- Transims parking lots generalize parking conditions for given links and are placed heuristically attached to existing activity locations

TransimsNet

Lot	Link
1	1
2	4
3	4
4	5
5	3
6	3

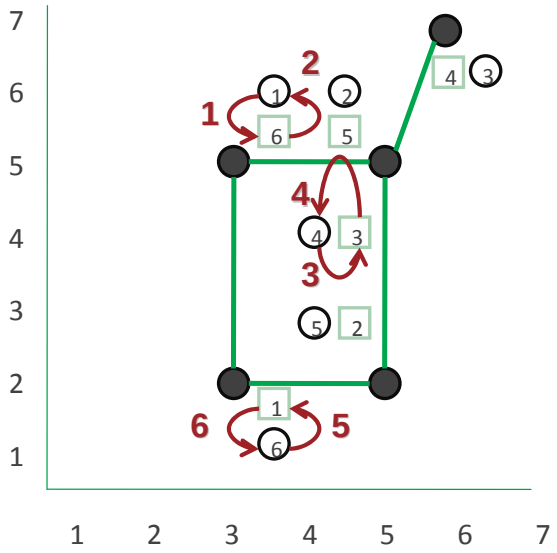


Process Links

- Process links can be thought of as unidirectional walk links that allow for traveler movement between: Parking locations, Activity locations, and Transit stops

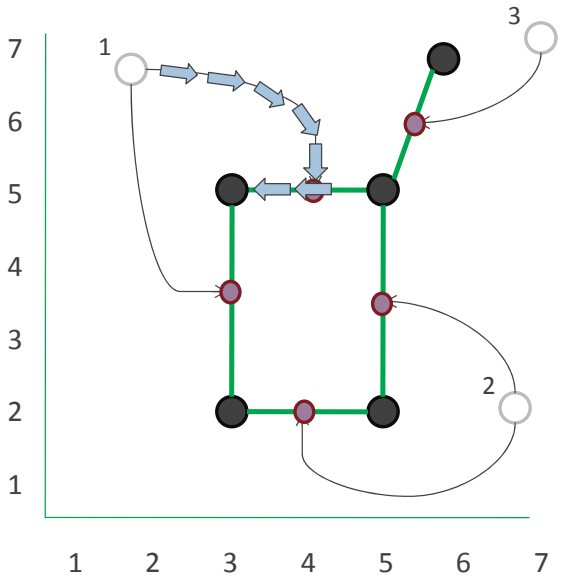
TransimsNet

Access	From_ID	From_Type	To_ID	To_Type
1	1	Activity	6	Parking
2	6	Parking	1	Activity
3	4	Activity	3	Parking
4	3	Parking	4	Activity
5	1	Activity	6	Parking
6	6	Parking	1	Activity



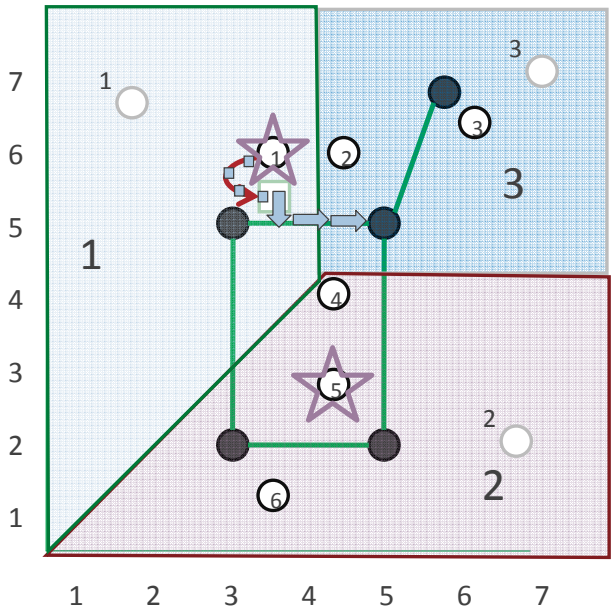
Contrasting TRANSIMS and 4 Step Model Centroids
4 Step approach

- Centroids are connected to the network through a series of internal zone connectors
- New nodes are often added to split the links at the point of contact with the internal connector
- These serve as the origins of trips and traffic is fed onto the network via the connector



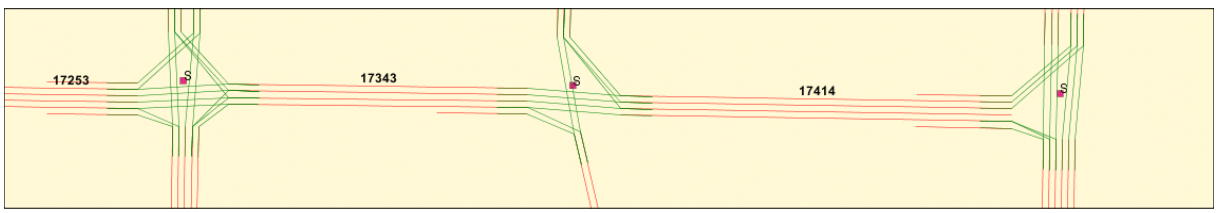
Contrasting TRANSIMS and 4 Step Model Centroids
TRANSIMS approach

- Zone Centroids are used to determine which activity locations fall into what zones
- A zone to zone trip is assigned to one activity location in each zone
- The activity location serves as the trip origin for the pedestrian
- The pedestrian travels along a process link to reach the parking lot, boarding a vehicle
- The vehicle from the parking lot attempts to load onto the network
- Upon loading, the traveler makes their way to their destination location and parking lot in the other zone



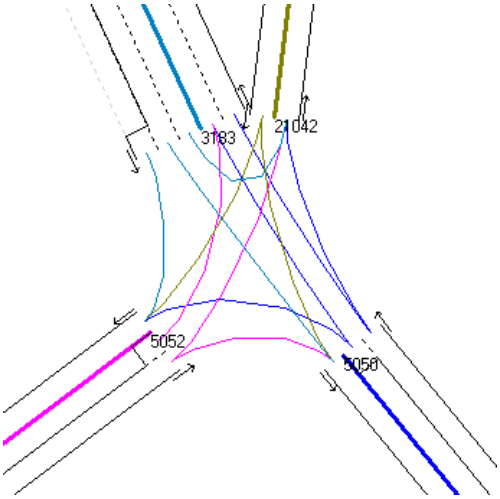
Network Tables - Pocket Lanes

- Pocket lanes are more finely described as
  - Turn, merge, and pullout lanes
  - Permanent lanes that are not present for the entire length of a link
- Properties of pocket lanes
  - Identifier of the node toward which the pocket lane leads
  - Identifier of the link on which the pocket lane lies
  - Starting position of pocket lane
  - Lane number of pocket lane
  - Types: T = turn pocket; P = pull-out pocket; M = merge pocket
  - Length of the pocket lane



Network Tables - Lane Connectivity

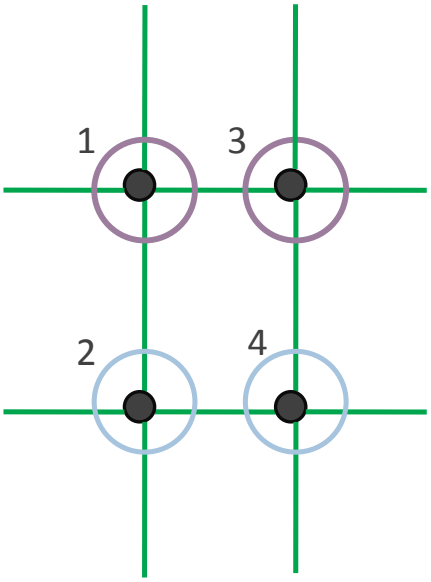
- Lane connectivity records specify all the movements allowed at a node
- Properties of lane connectivity records
  - The node identifier
  - The incoming link identifier
  - The outgoing link identifier
  - The lane number of the incoming lane
  - The lane number of the outgoing lane
- This information is essential for the router and the microsimulator and is not typically found in existing network data
- Tools exist to create automatic connections, but manual editing is important to ensure correct representation of intersections



Signal/Sign Warrants

- Warrant tables are intermediate tables that ultimately identify to IntControl where signals and signs should be placed. They exist because the user may wish to edit them to have more control over signal/sign placement.

TransimsNet



Signal Warrant
2
4

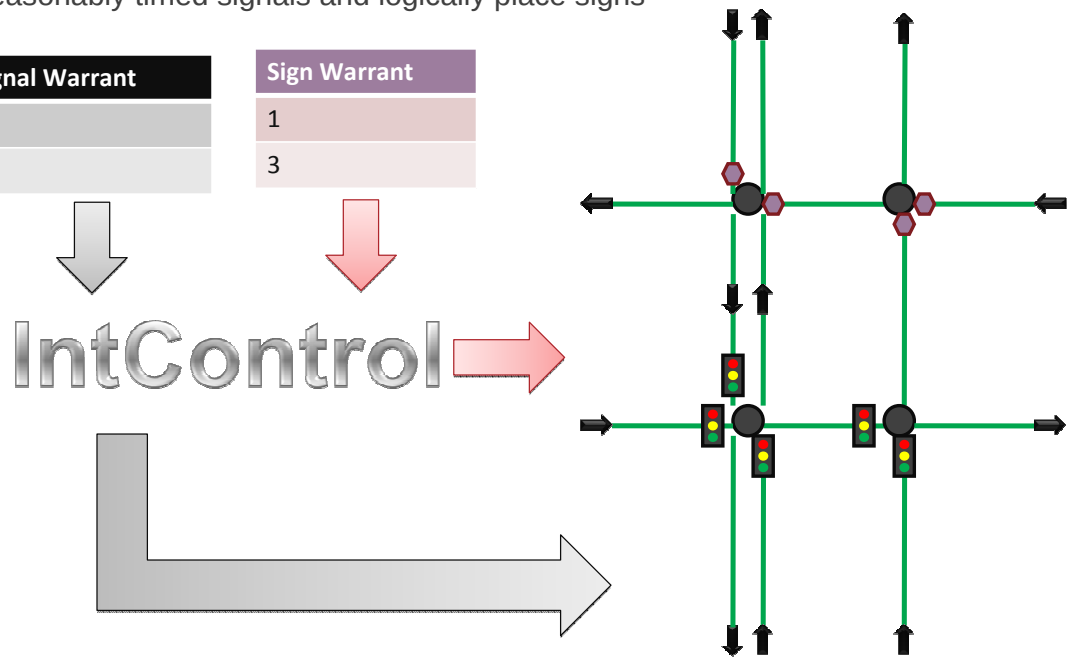
Sign Warrant
1
3

IntControl

- IntControl uses the warrant tables and network properties to calculate reasonably timed signals and logically place signs

Signal Warrant
2
4

Sign Warrant
1
3



Network Tables - Traffic Signals

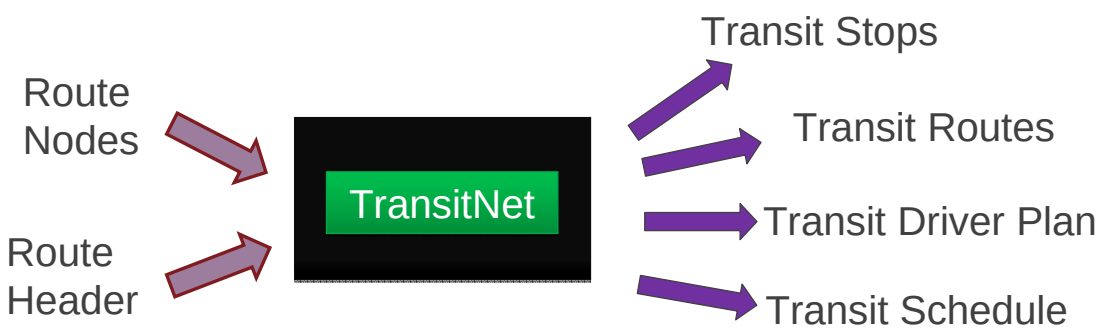
- Just like on a real street network, traffic signals are essential to support the effective flow of traffic in a simulated network
- Traffic signals are described with a set of tables
  - Signalized node table
  - Phasing plan table
  - Timing plan table
  - Detector table
  - Signal Coordinator table
- Traffic signals and traffic signal coordination require a significant amount of work to create a representative simulation
- Traffic signal data is hard to obtain
- Traffic signal timings and phases may change during the course of a day

Network Restrictions – Lane Use and Turn Prohibition

- TRANSIMS provides the option of manually constructing tables to represent restrictions in the network
- The lane use table controls whether certain types of traffic may use the given lane for a given part of the day. Fields include:
  - The corresponding link identifier and lane identifier (0 means all lanes)
  - The node toward which the lane leads
  - The vehicle type to which the restriction applies
  - The type of restriction: High occupancy lane, bicycle, auto, truck, bus, rail
  - The start and end time of the restriction
- The turn prohibition table defines where certain types of traffic may not turn for a given part of the day. Fields include:
  - The identifier of the node
  - The identifier of the incoming and outgoing link defining the turn movement
  - The vehicle type to which the prohibition applies
  - The type of restriction: High occupancy lane, bicycle, auto, truck, bus, rail
  - The start and end time for this prohibition

The TransitNet Utility

- Route Header File: Contains general route information
  - Route ID, name, and mode
  - Time periods during which the route runs
  - Start time within a period
  - Frequency of route
- Route Nodes File: Contains route paths
  - Route ID
  - List of nodes route traverses and length of stop (0 if no stop)

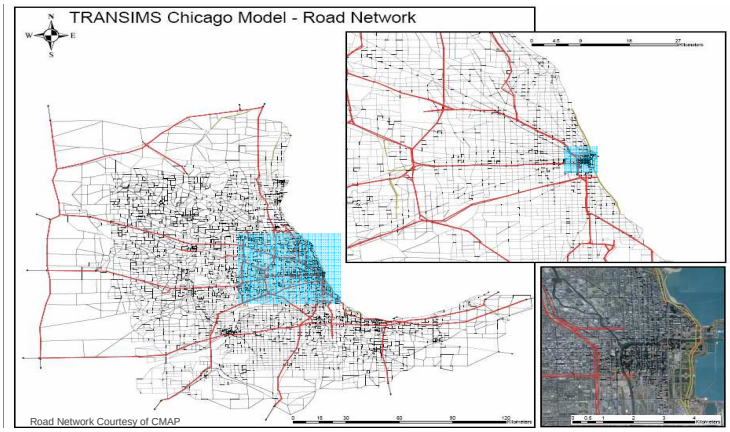


Network Tables - Transit Tables

- Transit Stops
  - Where passengers board and leave transit vehicles
  - Connected to the rest of the network via process links
- Transit Routes
  - Specifies the list of stops for a given route and other details on how the transit vehicle travels
- Transit driver plan
  - List of nodes in order of route
- Transit schedule and transit zone tables
  - Departure and arrival time tables from each stop
  - Costs of travel by zone, if specified

Example: Chicago Metropolitan Area

- The Chicago Metropolitan Agency for Planning maintains a road and transit networks in a database for regional planning
  - Can be used to project the network features into the future based on planned highway and transit projects
  - Can be extracted in many different formats, including tabular formats suitable for TRANSIMS processing
- Road Network Tables
  - Nodes
  - Links
  - Zones
- Result shown on the right has been derived with the ArcNet tool from the functional CMA TRANSIMS model



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
- Some figures have been developed for USDOT by Prof. Antoine Hobeika, Virginia Polytechnic Institute, Civil and Environmental Engineering
- The presentation is loosely based on materials provided by USDOT at a training course in November 2006