TRANSIMS Training Course at TRACC

Transportation Research and Analysis Computing Center

Part 12

Reducing Computing Requirements by Subarea Microsimulation

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Unit **12**

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Contents

Subarea Microsimulation Introduction

- Microsimulation requires significant computing resources
- Subarea microsimulation provides a methodology to limit simulation to a smaller area within the large regional transportation network
- This is possible because other tools (beyond the microsimulator) are available to estimate link delays based on BPR+ traffic assignment functions (PlanSum)
- To analyze a specific small area in a large regional model, the exact interactions between vehicles in remote areas is insignificant
- Microsimulation should be performed in an area significantly larger than the study area to include approximated medium range effects
- The mechanism has been implemented without changing the microsimulator functionality
  - Tools exist to cut a smaller simulation network from the regional network
  - Plans are also extracted and modified to fit the microsimulation area
  - Resulting link delays are merged back into the regional link delays
  - Individual plans can be stitched together using PlanPrep

Recap of the General Routing Concept

- Main inputs for the router are
  - Activities from the activity generator
    - or Trips from tools such as ConvertTrips
  - Link delays from the microsimulator
    - or link delays from tools such as PlanSum
- After the first iteration, each trip is routed independently from any other trip (households are being rerouted as a group to allow for ride sharing)
- Link delays are basically a matrix, providing delays as a function of time over the day for each individual link
- The version 4 microsimulator also provides queues for left and right turns for each link to enhance fidelity
- After the first iteration, only subsets of trips are being routed based on households (to allow for ride sharing)
- After the router is done, tools such as PlanSum can calculate link delays based on BPR+ traffic assignment functions
  - PlanSum is therefore comparable to a very fast running but imprecise microsimulator

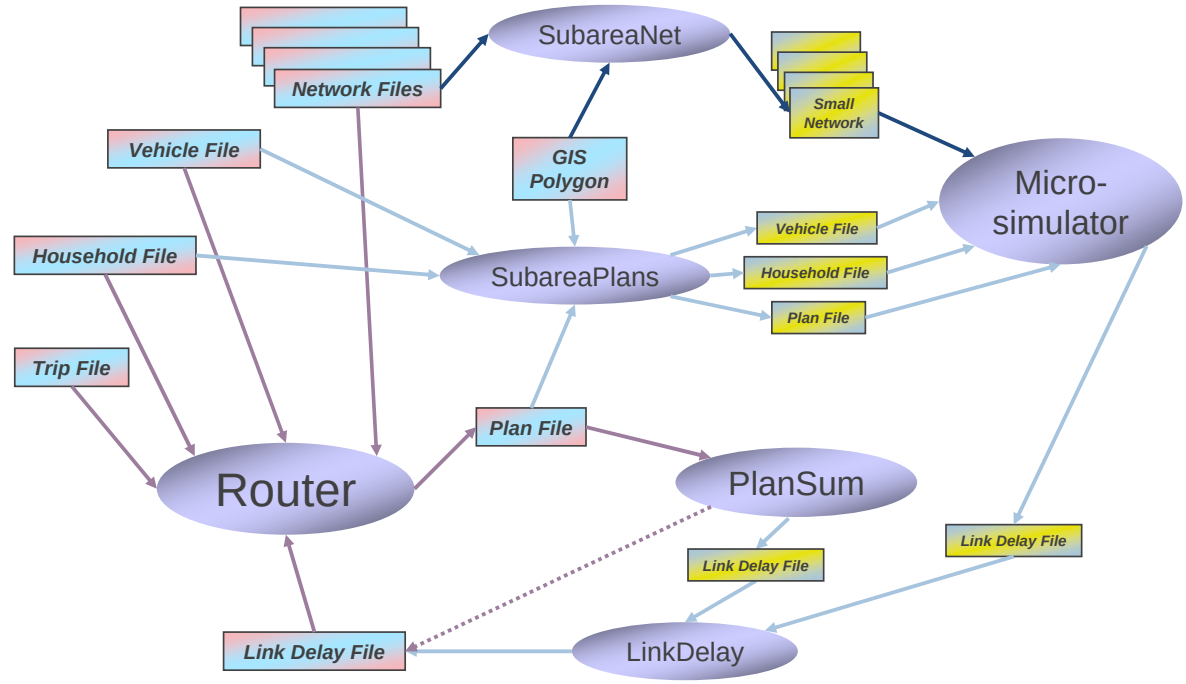
Recap of the General Microsimulation Concept

- All routes have been predetermined by router runs in advance of microsimulation
- Plan files are sorted by time before microsimulation
- Microsimulation is based on the same TRANSIMS network as the router, but with additional refinements (number of lanes, traffic signals, etc.)
- Microsimulation starts with an empty network with all cars being parked in parking lots (including boundary parking lots for itinerant travelers)
- Microsimulation progresses forward in time trying to place travelers onto the network based on the plans from the router
- Interactions between travelers determine the speed at which traffic can pass through the links, resulting in updated link delays
  - These link delays are improved in Version 4 and contain separate queues for left and right turns in addition to the traditional link delays
- Problems resulting from network inconsistencies, unreasonable delays, etc. are being written into problem files to be addresses in subsequent iterations

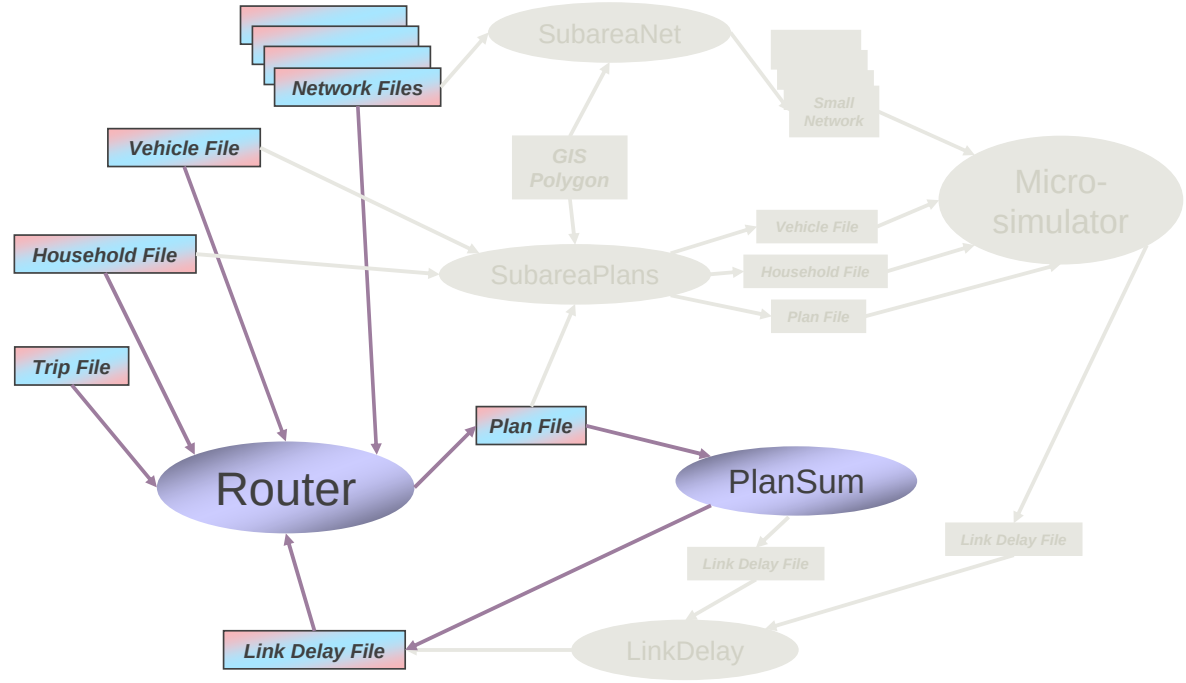
Subarea Microsimulation Concept

- Create a regional network, synthetic population, activities, etc.
- Run SubareaNet to create a copy of the TRANSIMS network enclosed by a GIS polygon file
  - This creates copies of all network tables such as nodes, links, signals, activity locations, parking, etc
  - This network is limited to the smaller area enclosed by the GIS polygon and boundary parking is placed on links that have been cut
- Run the router on the entire population to initialize plans
- Run PlanSum to determine the link delays based on BPR+ functions
- Run SubareaPlans to create new plan files from the plan files that the router created
  - Include only plans that go through links in the smaller area
  - Calculate the time at which travelers arrive on boundary parking lots according to the router's knowledge and cut the plans to contain only links and nodes within the subarea
- Run the microsimulator using the modified network and plans
- Use LinkDelay to merge regional router link delays with new link delays

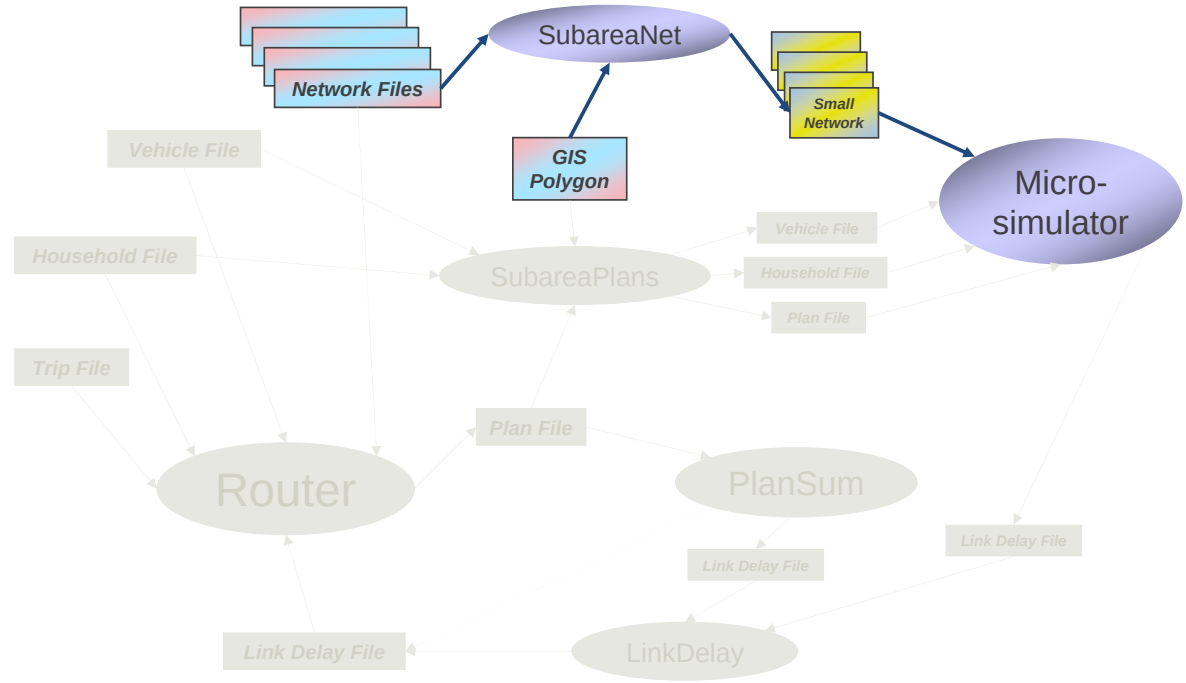
Subarea Microsimulation Concept (Complete)



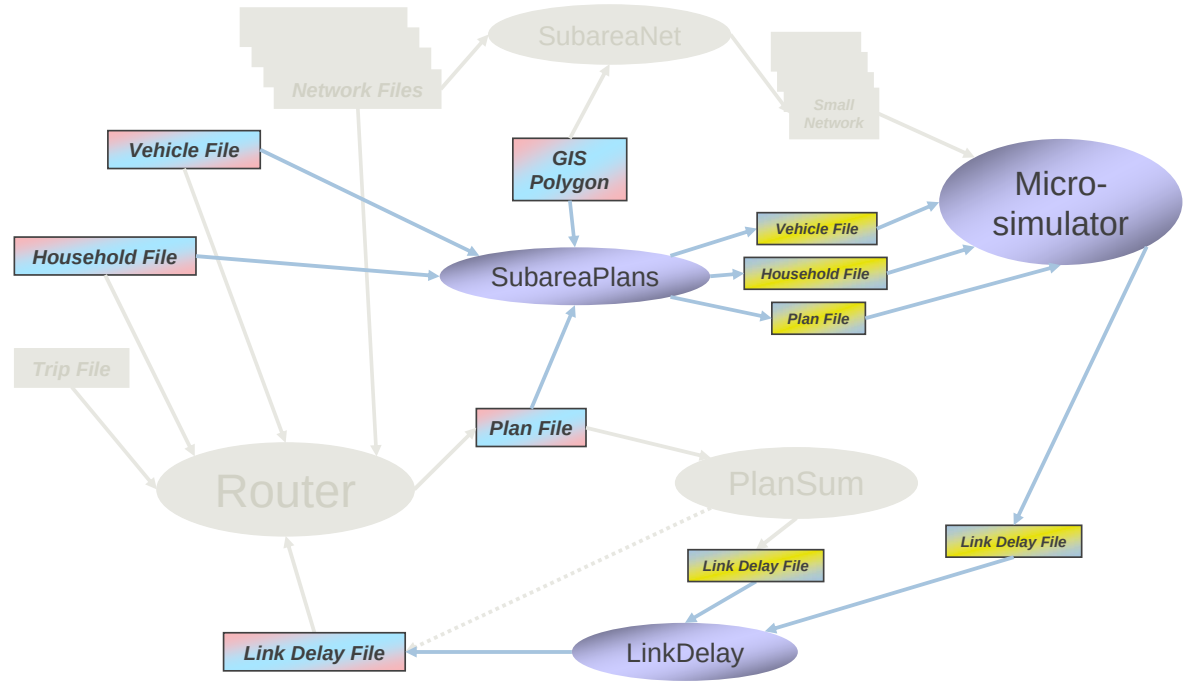
Regional Router Iterations Only (Equilibration)



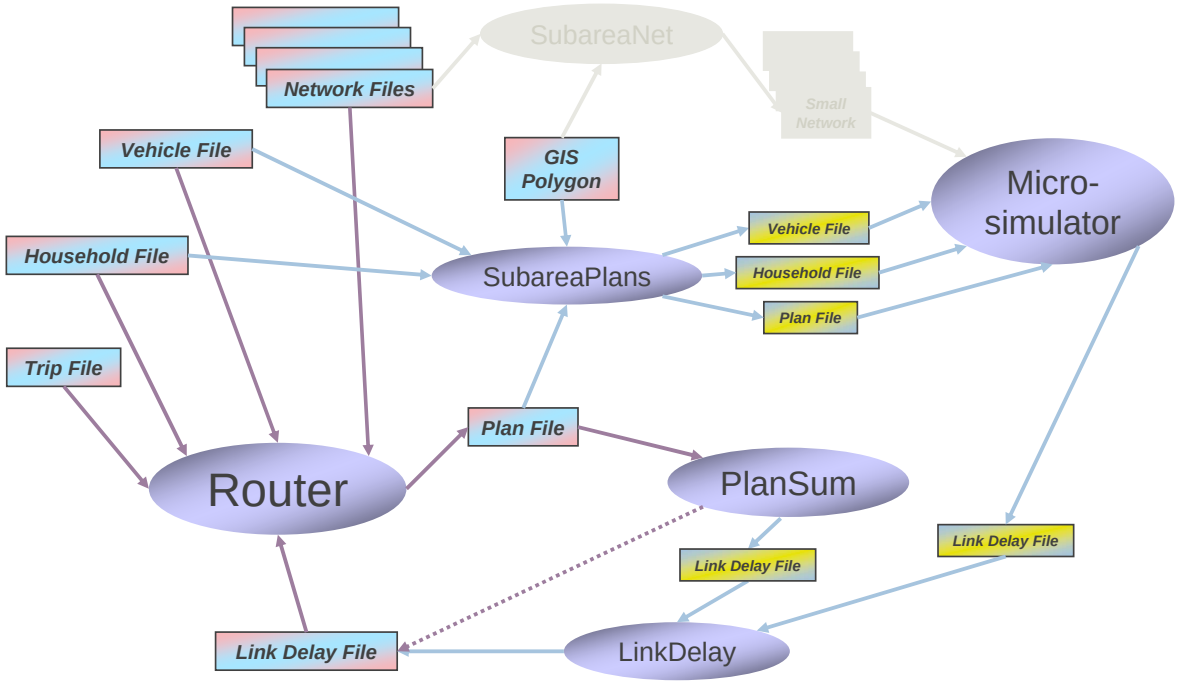
Subarea Microsimulation Network (Generated Once)



Subarea Iteration Step

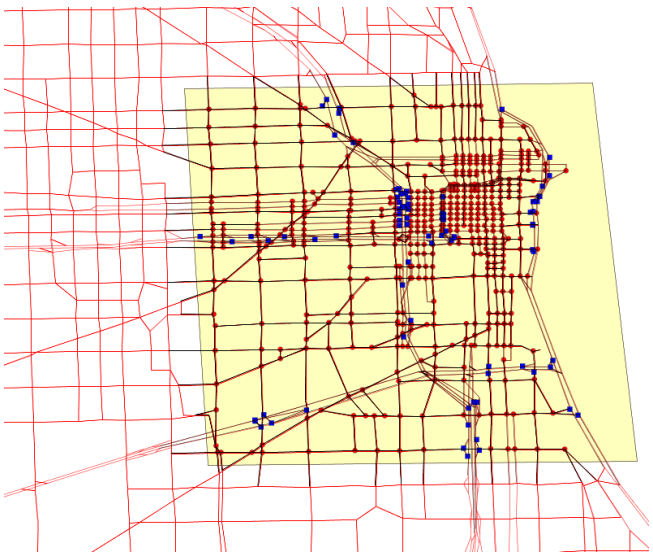


Subarea and Regional Iterations (Complete Equilibration)



GIS Polygons

- The SubareaNet and SubareaPlans tools require a shape file with a single polygon to perform the network and plan cutting operations properly
- ArcGIS or uDig can be used to create and optimize such polygons
- In the example shown, a very simple polygon is being used
- The polygon needs to be carefully optimized to minimize the number of significant links it crosses

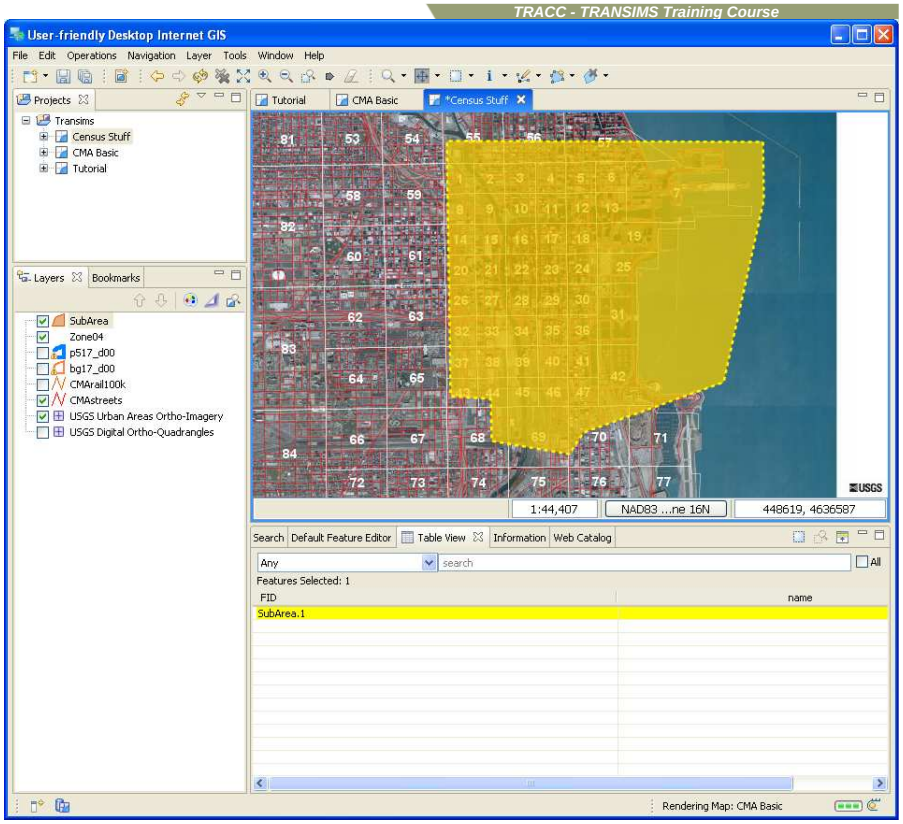


Polygon Manipulation in uDig

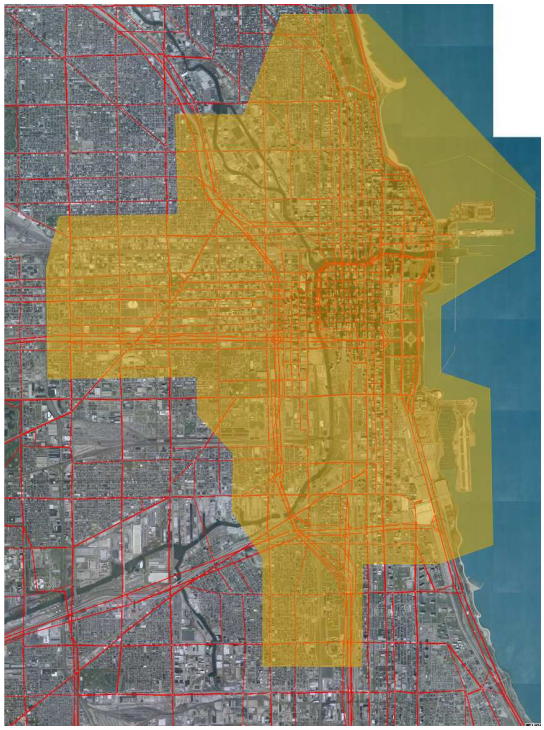
- Zoom in to an area slightly bigger than the polygon to be created
- Choose “Layer” and then “Create Layer” from the menu bar
  - Under “geometry”, change the type from “LineString” to “Polygon”
  - Change the coordinate system from “WGS84” (or some other possible default) to the appropriate UTM zone of the TRANSIMS model (TRANSIMS does not convert projections automatically):
    - NAD83 / UTM zone 16N (EPSG:26916) for Chicago
    - NAD83 / UTM zone 18N (EPSG:26918) for Alexandria
- From the tool bar, select the “Create Polygon Tool” (make sure that the newly created layer stays selected when using the polygon tool)
  - Click once for each shape point of the polygon, and double-click to finish polygon creation (create only one polygon)
- In the layer list, right-click on the newly created polygon layer and choose “Rename”, then choose a meaningful name (e.g. “SubArea”)
- In the layer list, right-click on the newly created polygon layer and choose “Export”, then “Layer Export”, then choose file name “SubArea.shp”

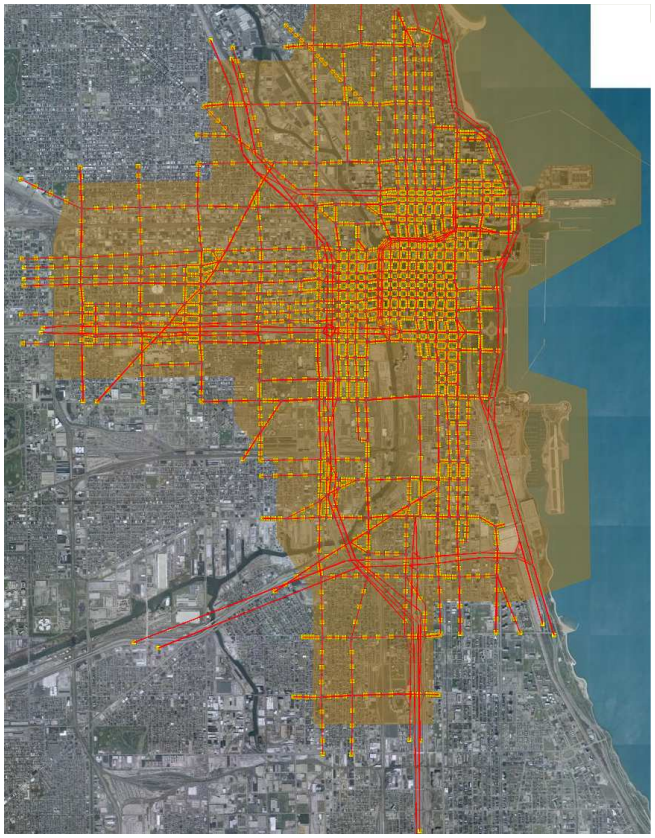
Polygon Manipulation in uDig

- Polygons can also be edited
  - Adding and removing shape points
  - Reshaping areas to optimize the subarea cuts
- Don’t create more than one polygon, don’t cut holes

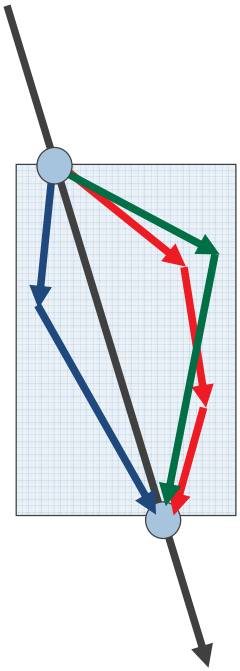


Reduced Subarea Network





Subarea Microsimulation and Routing



- Subarea microsimulation provides the means to simulate a smaller area in a regional model in much more detail
- The iteration framework is significantly more complex and requires additional knowledge on the use of TRANSIMS tools
- An iterative loop between router and microsimulator can be established for just the subarea, leading to satisfying equilibration (illustrated on the right)
  - The resulting plans are only part of the metropolitan routing plans
  - Individual subarea plans can be stitched into the longer plan that a traveler entering or leaving the subarea may have in the metropolitan data set
- An outer iteration of the router based on the refined link delays and refined plan segments from the subarea completes the 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
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- USDOT provided the funding for the TRACC computing center and the resources necessary to perform these training session