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# ***TRANSIMS Training Course at TRACC***

*Transportation Research and Analysis Computing Center*

## ***Part 12***

### ***Reducing Computing Requirements by Subarea Microsimulation***

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## Contents

- Subarea Microsimulation Introduction
- Recap of the General Routing Concept
- Graphical Illustration
- Creating Suitable GIS Polygons
- Subarea Microsimulation and Routing

## *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

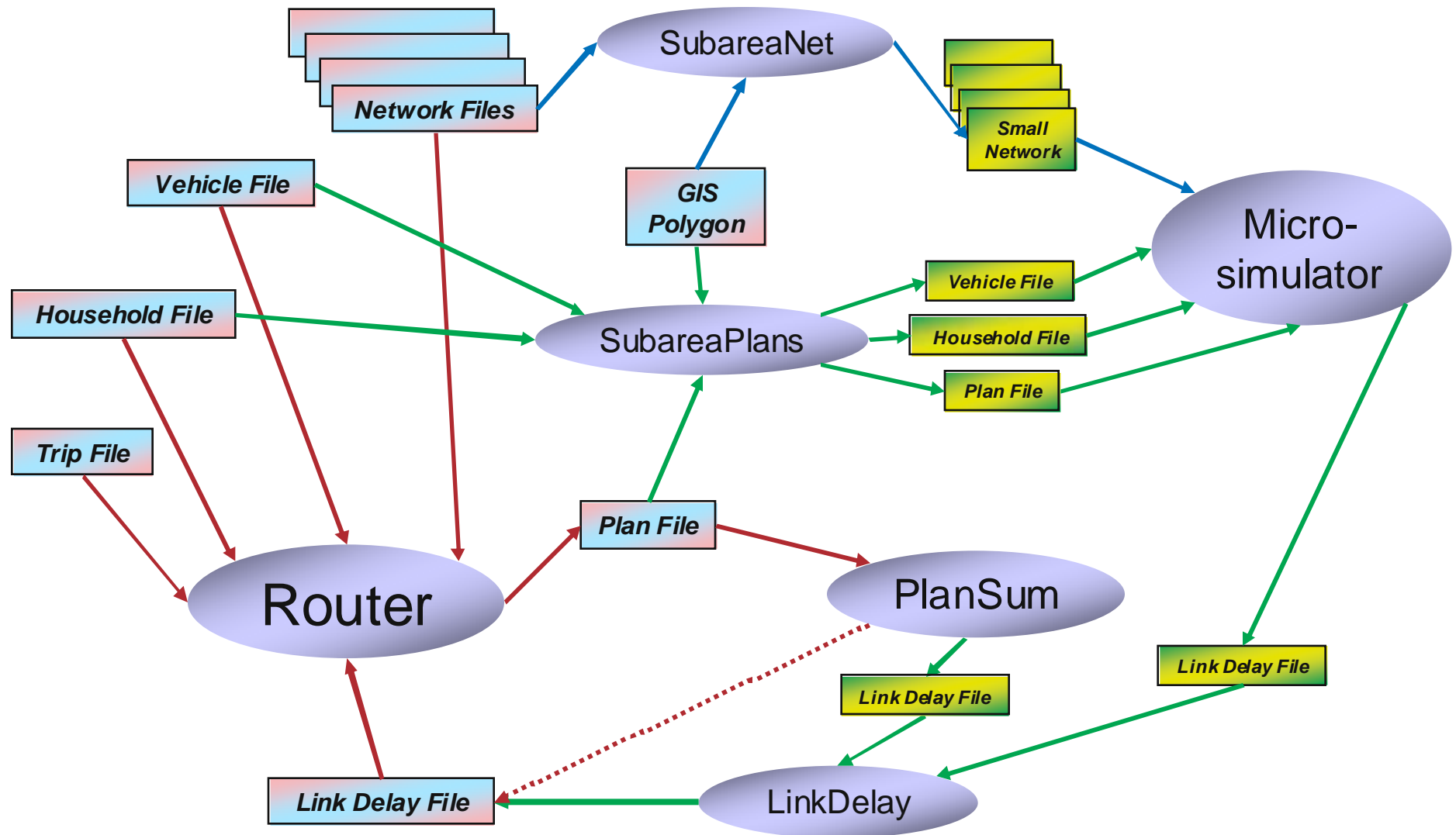
## *Recap of the General Microsimulation Concept*

- 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

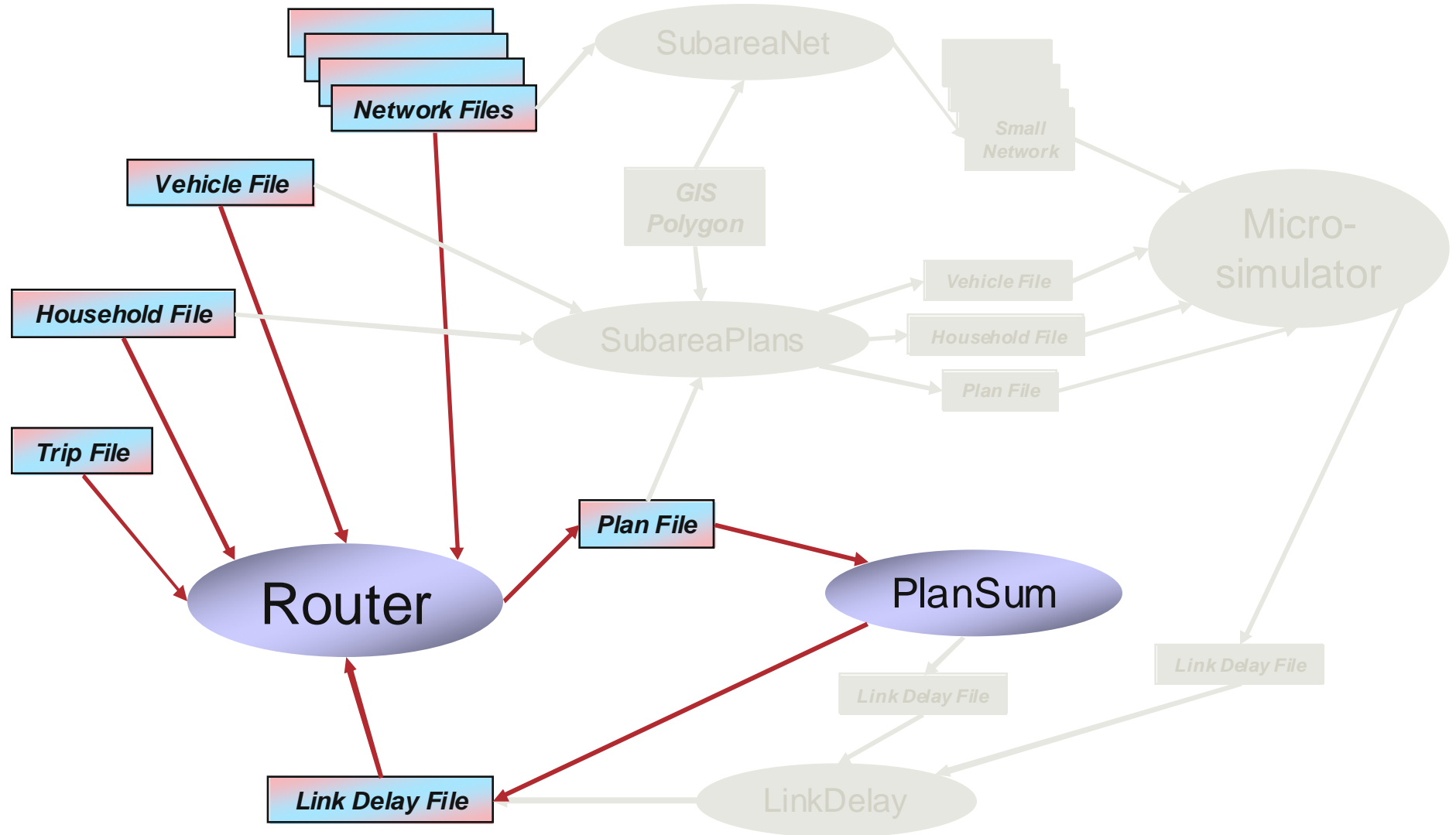
## ***Subarea Microsimulation Concept***

- 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)

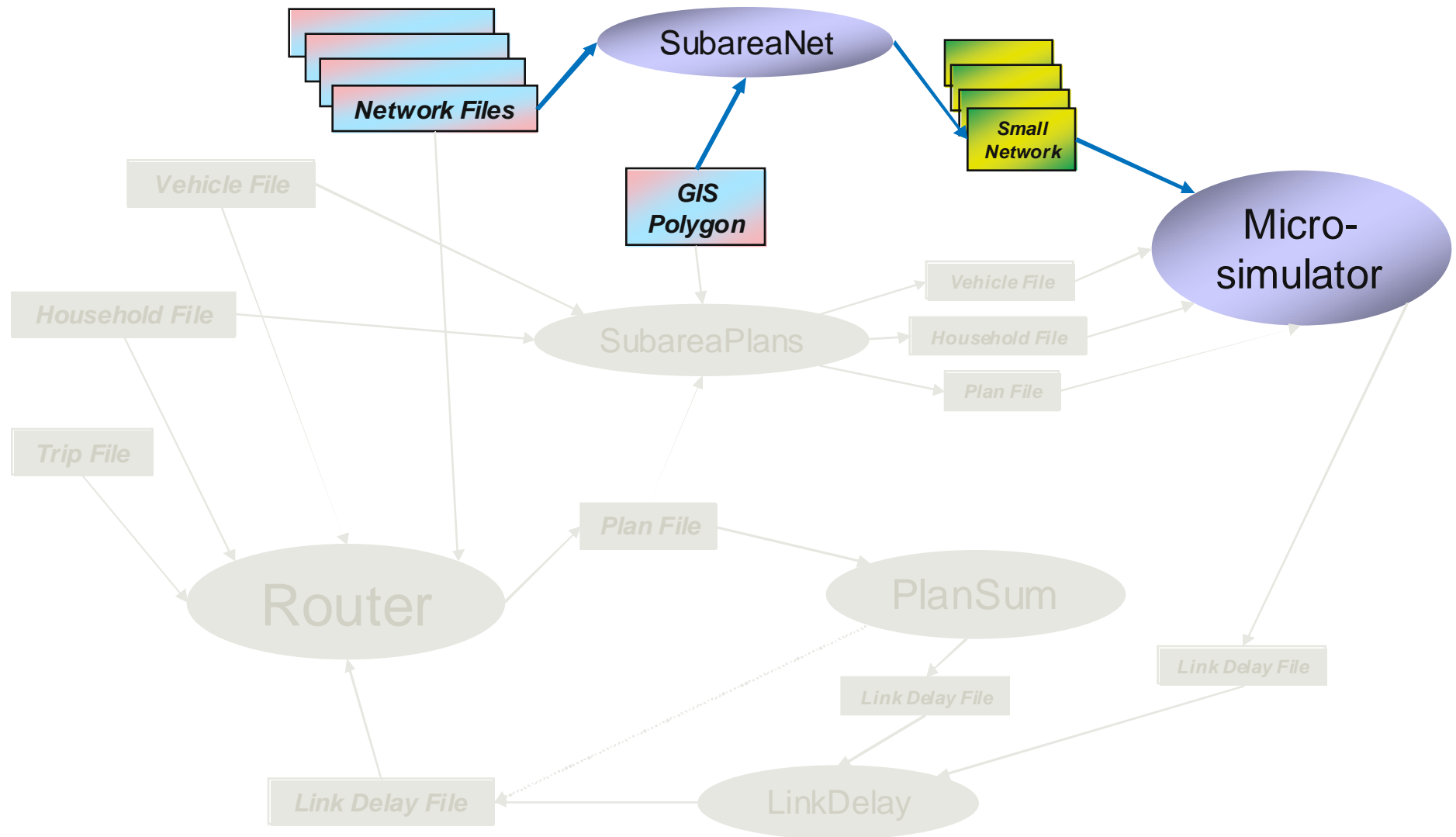


## Regional Router Iterations Only (Equilibration)

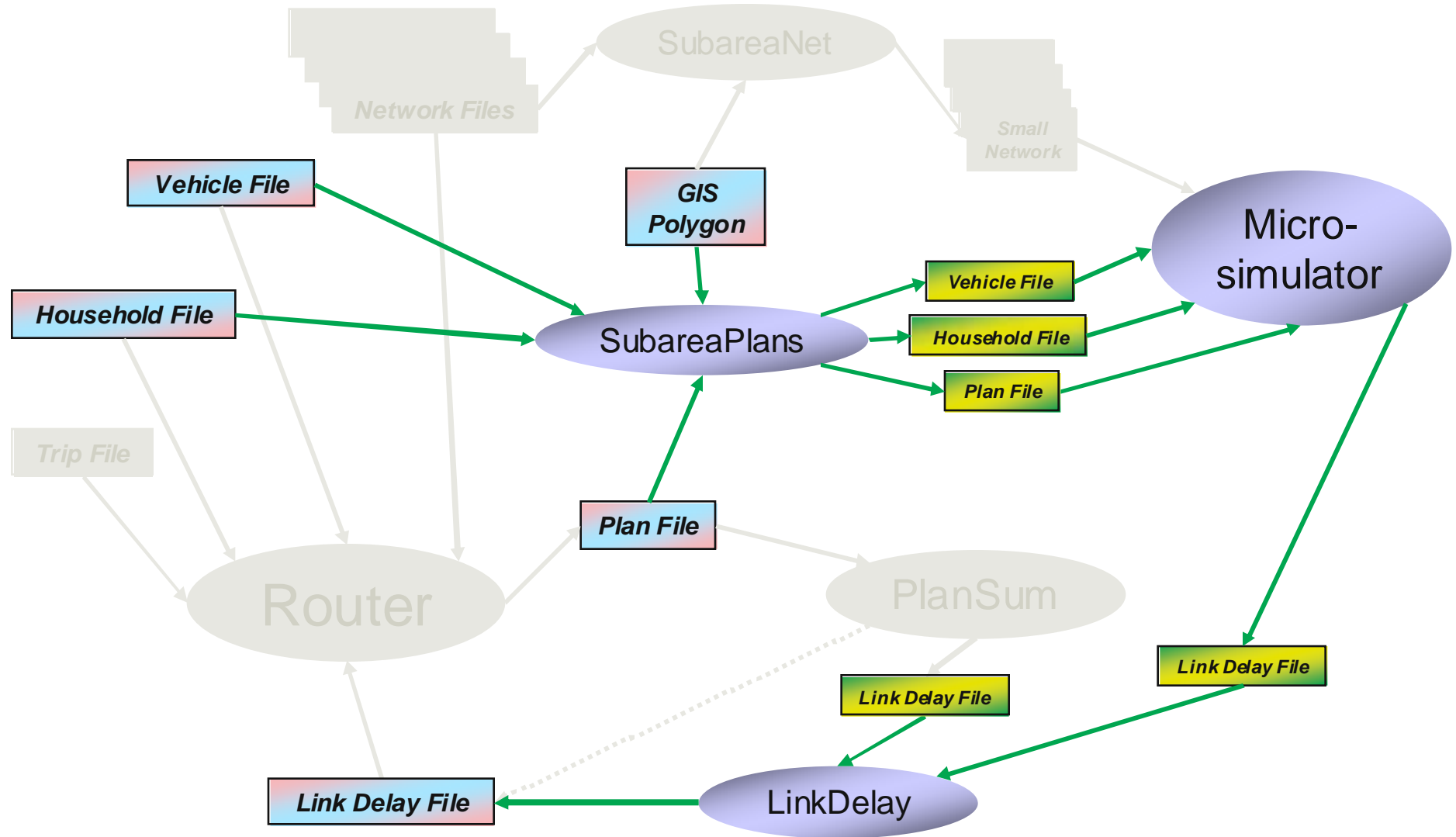




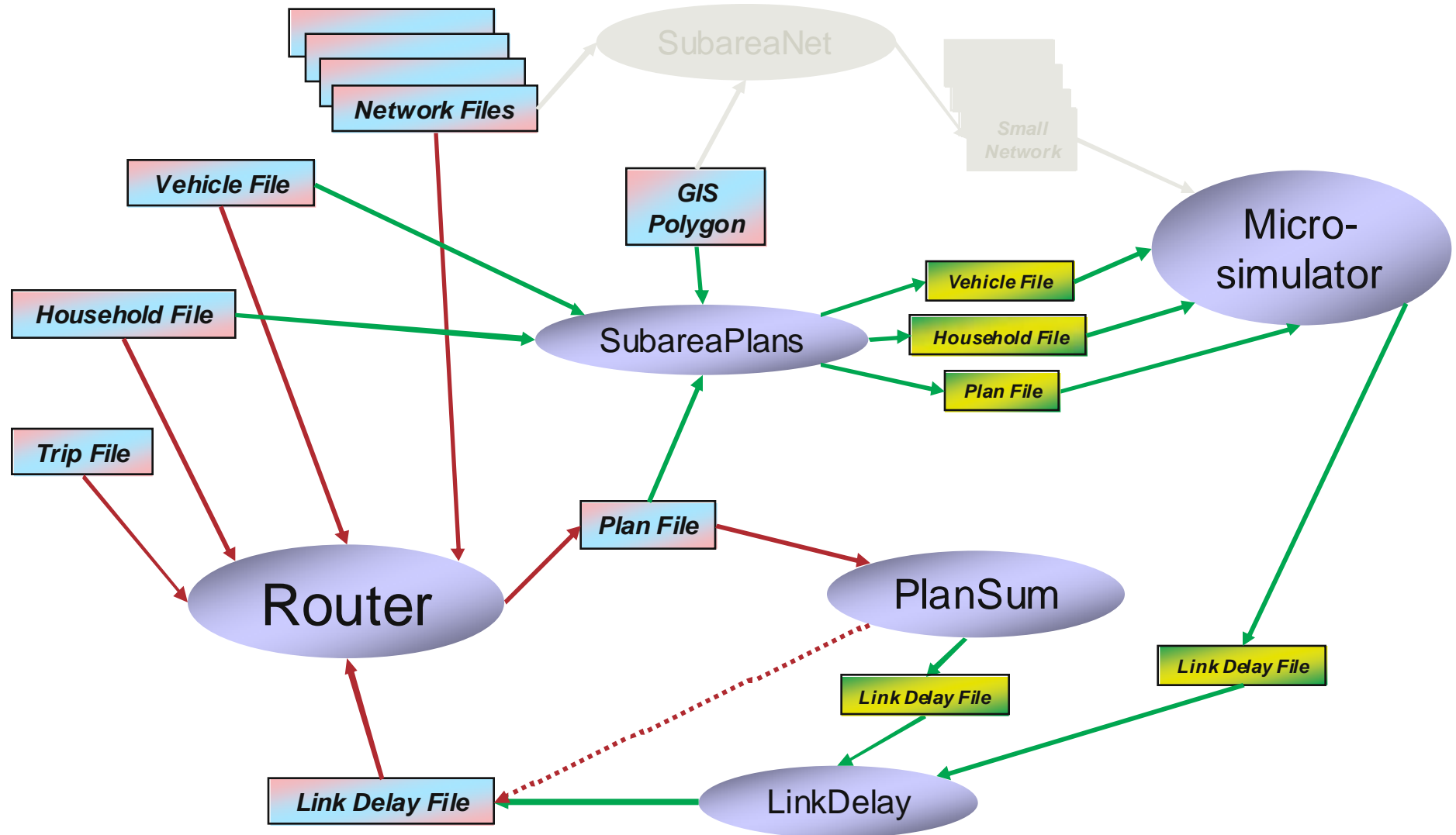
## Subarea Microsimulation Network (Generated Once)



## Subarea Iteration Step

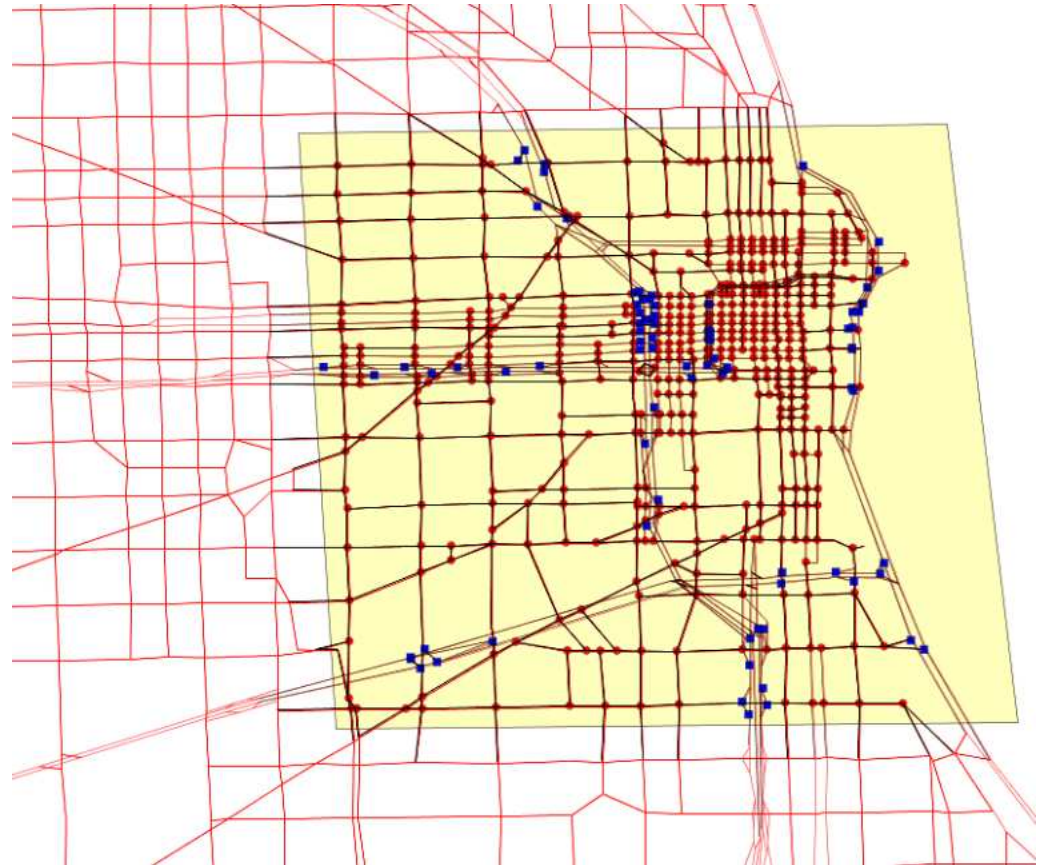


## Subarea and Regional Iterations (Complete Equilibration)



## 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



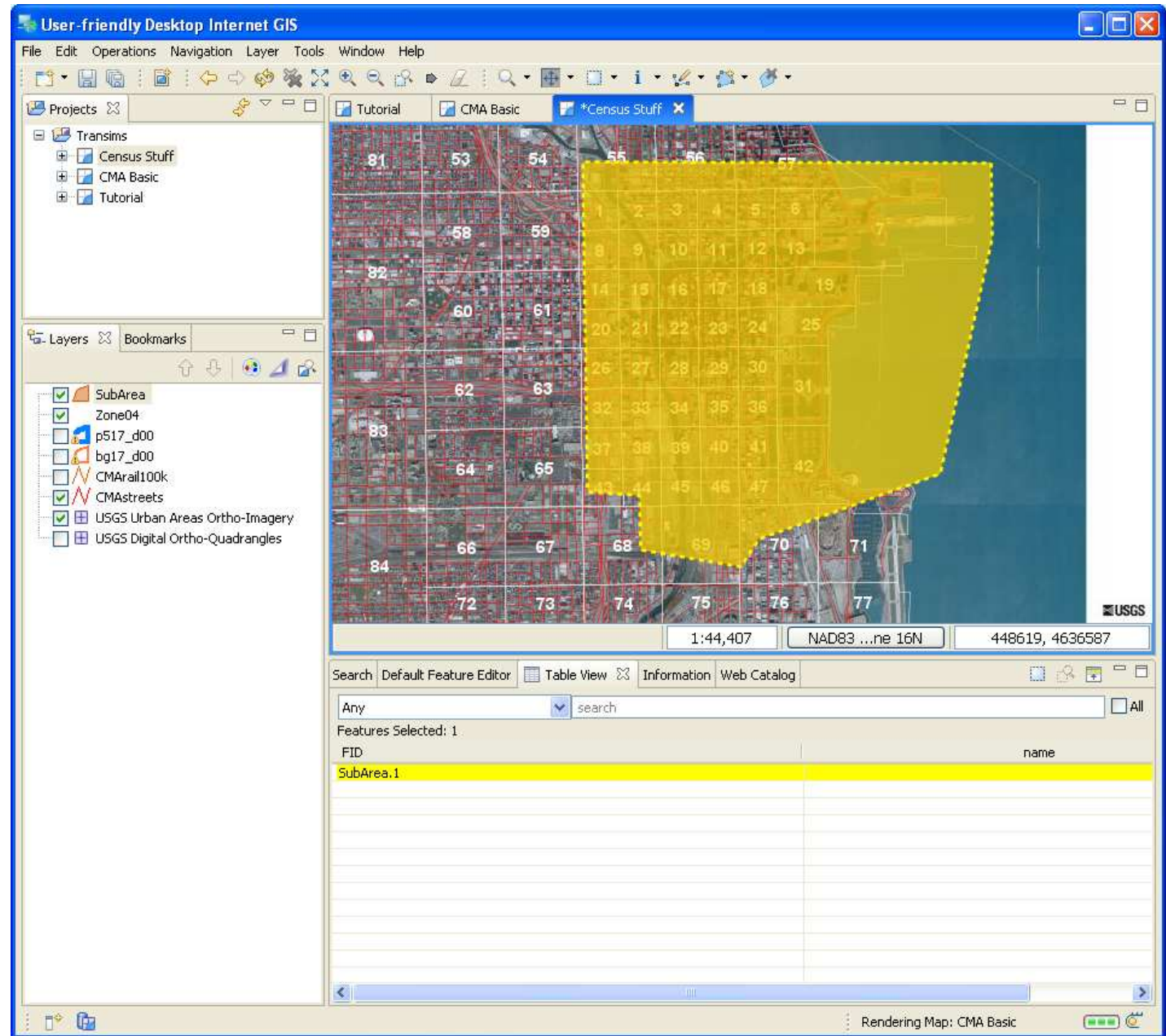
## Polygon Manipulation in uDig

- 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”



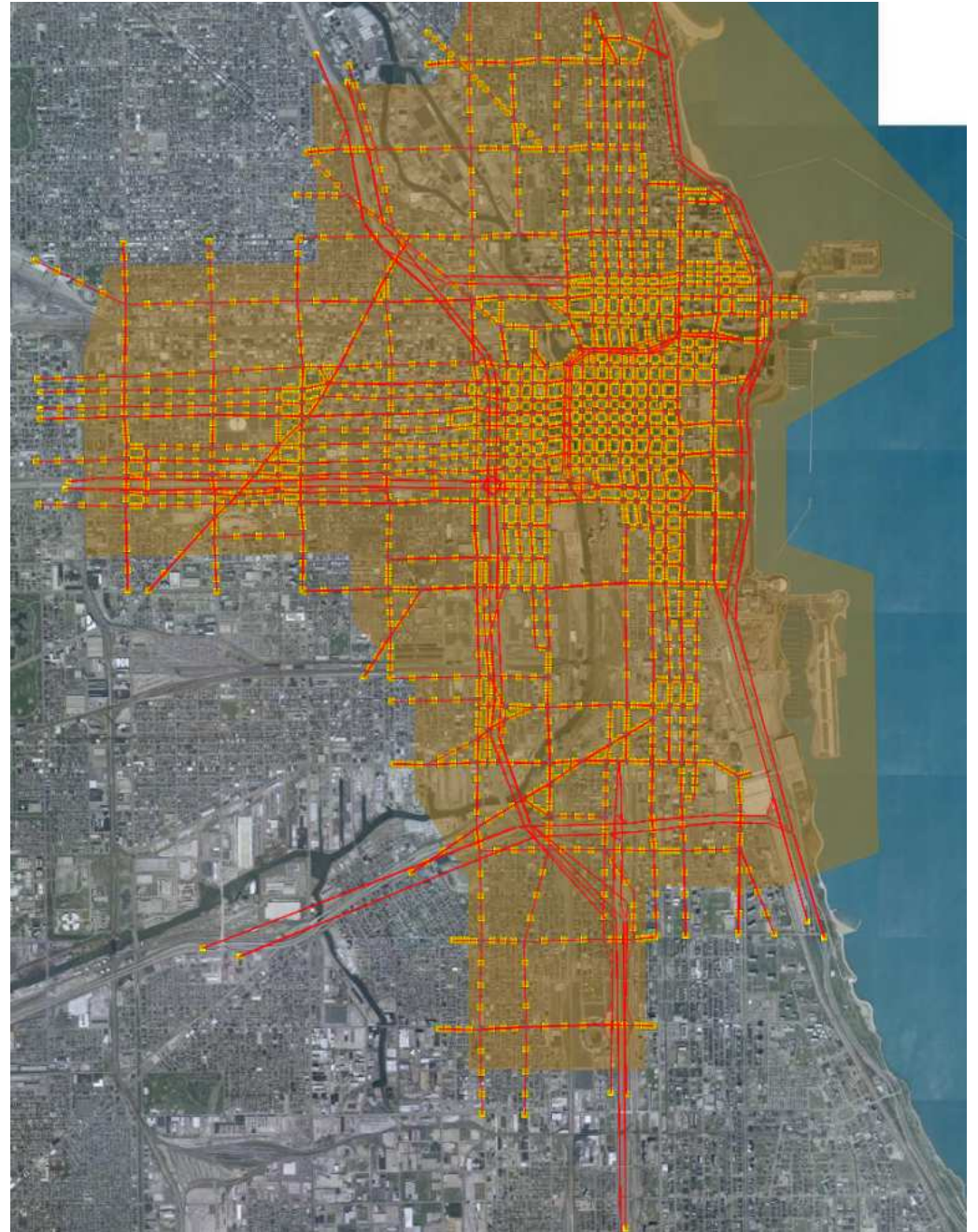
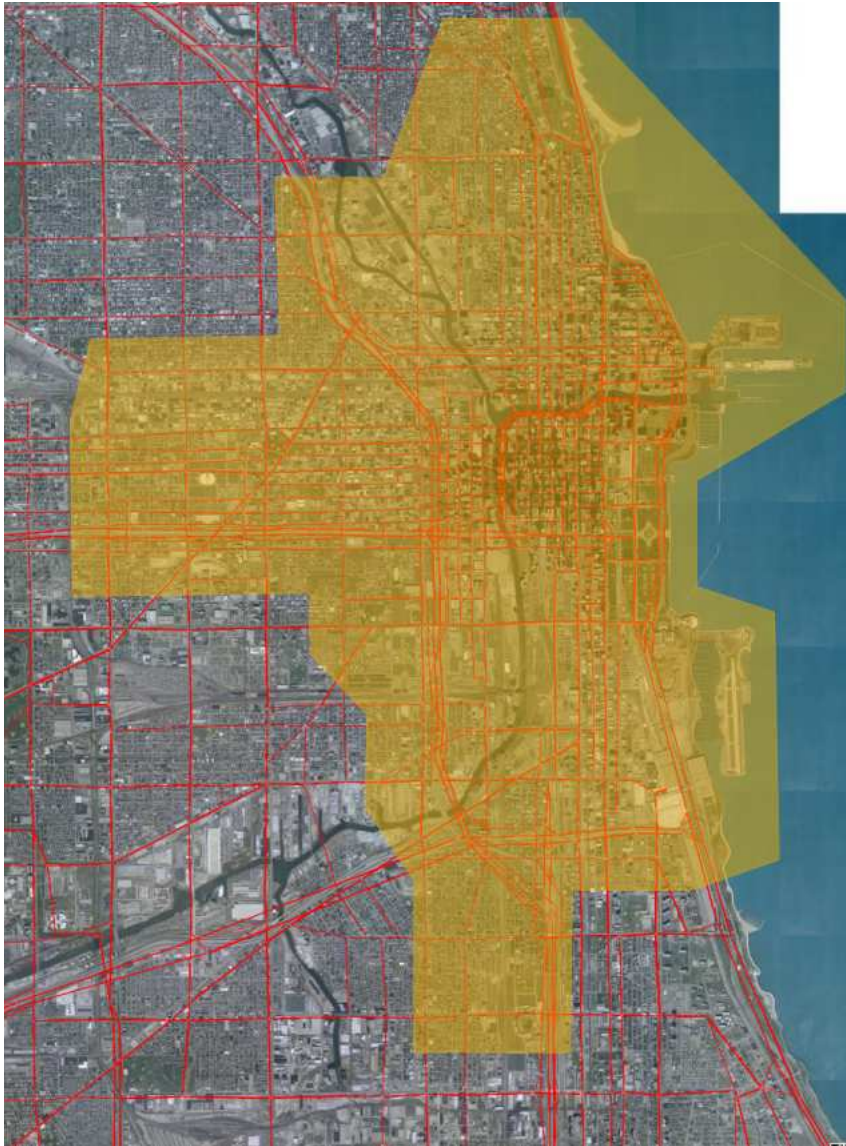
## Polygon Manipulation in uDig

- 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

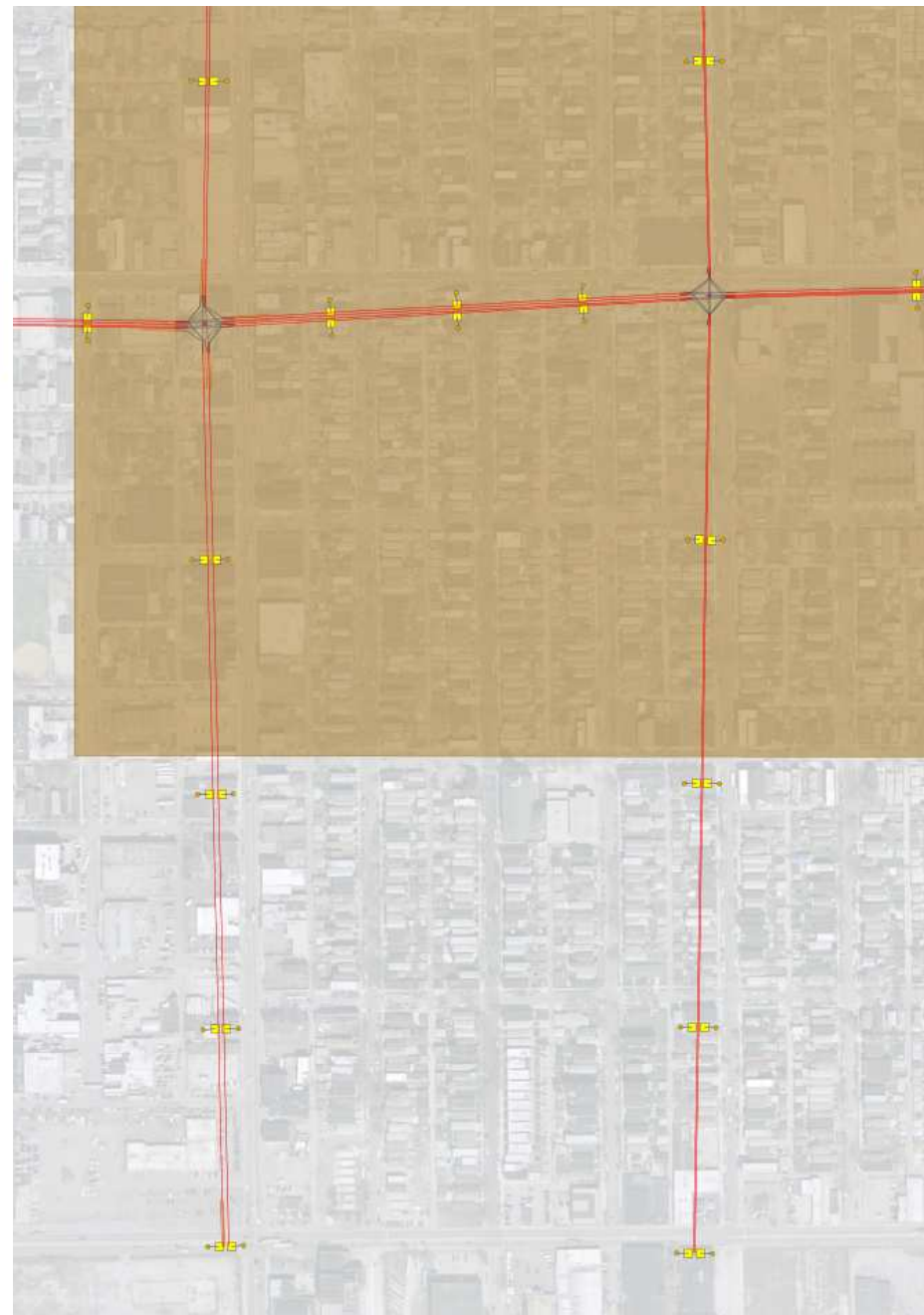




## *Reduced Subarea Network*



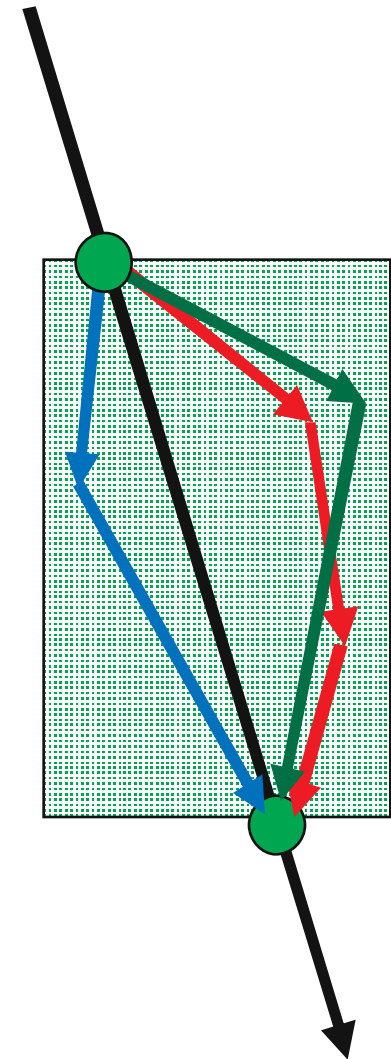






## Subarea Microsimulation and Routing

- 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
- 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