TRANSIMS Training Course at TRACC
Transportation Research and Analysis Computing Center

Part 8

TRANSIMS Configuration and Framework

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TRANSIMS Configuration and Framework

- TRANSIMS is a set of command line tools for Windows, Linux, and other Unix operating systems

- The tools work on text and binary files in various formats
    - Typically tab-separated tabular data and similar
    - Intermediate files can be in a TRANSIMS-specific binary format
    - ArcGIS shape files are created as outputs by a number of GIS utilities
        - *ArcNet, ArcSnapshot, ArcDelay, ArcPlan, ArcDiff, ArcProblem,…*
    - ArcGIS shape files are also used as input for some tools
        - *SubareaNet, LinkSum, PlanSelect…*

- Each tool accepts a well-defined control file containing configuration data for a specific invocation of the tool
    - Pairs of control keys and values (see control file training session)

Distribution of TRANSIMS

- Windows
  - Downloadable ZIP file of recently released 32bit executables
  - Executables should be placed into a suitable directory and added to the system path
  - Optionally, the DOS path can be set to include this directory
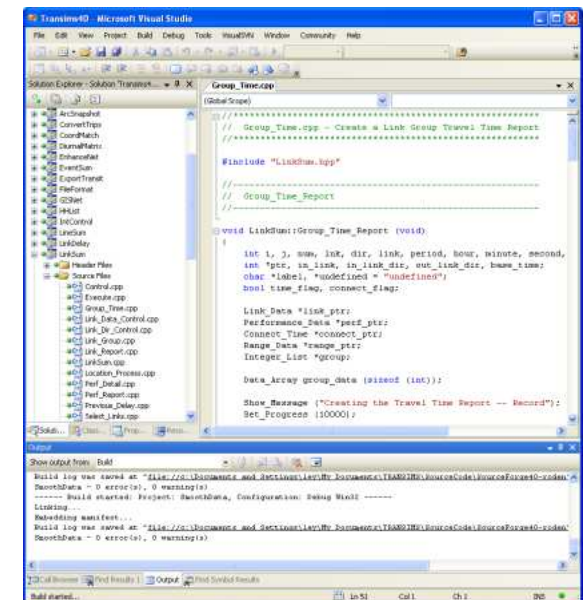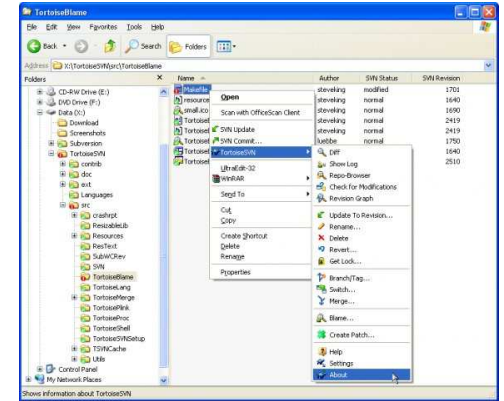
- Linux
  - Downloadable "TarBall" containing everything needed for compilation and installation
    - *Compatible with GCC-enabled Linux and Unix platforms*
    - *Can be repackaged into RPM packages using "rpmbuild"*
    - *Can be compiled under Linux using configure and make*

- Execution Framework
  - User-supplied shell scripts and batch files are typically used to invoke a sequence of TRANSIMS tools in a well-defined order
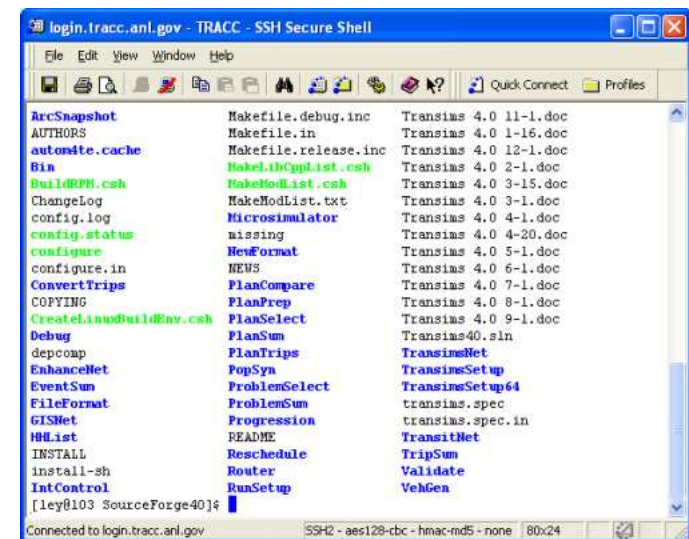
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Advanced Windows Installations with Source Code

- Install the **TortoiseSVN** interactive SVN client package
    - Can be found on and downloaded from SourceForge
- Install **Visual Studio 2005 Professional** (or Express – for free)
    - This may download up to 1GB of installation files from Microsoft
- Create a directory "Transims40" for the working directory to contain the latest source files on your hard drive in an appropriate location
- Right-click the directory and choose "TortoiseSVN Checkout"
- The URL of the repository is
    - https://transims.svn.sourceforge.net/svnroot/transims/version4/trunk/src/Transims40
- Click OK to download the latest source code
- Enter the directory and double-click on "Transim40.sln"
- Build the entire solution or individual executables

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Advanced Linux/Unix Installations with Source Code

- Make sure the SVN client software is installed ("svn")
- Make sure the GNU C++ compiler is installed ("gcc")
- Make sure "autotools", "automake", and "libtool" are installed
- Enter an appropriate location on the file system
- Issue the command"
  - svn checkout https://transims.svn.sourceforge.net/svnroot/transims/version4/trunk/src/Transims40 Transims40
- Enter the Transims40 directory
- Execute the following sequence of commands
  - ./configure
  - make
- The executables can now be found in the "Bin" subdirectory of "Transism40"

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TRANSIMS Executable Options

- All of the TRANSIMS executables accept the following command line options
  - -H will display some help, including a **list of all control keys** available for the particular executable (very helpful in the absence of documentation for some of the tools).
  - -K will check all keys read from the control file and treat the ones that do not apply to the current tool as warnings, displaying a message on the screen and in the log file.
  - -B will operate the tool in BATCH mode, disallowing any interactive keyboard input. Progress messages are written line by line instead of backspacing and rewriting.
  - -Q will suppress much of the screen output and display only essential errors or exit conditions.
- Common return codes from the executables:
  - 0: SUCCESS
  - 1: ERROR
  - 2: WARNING

TRANSIMS Framework

- The user typically creates batch files or scripts to invoke the executables on a series of files, containing for example
    - C:\Transims40\Bin\TransimsNet –K –B TransimsNet.ctl
    - C:\Transims40\Bin\IntControl –K –B IntControl.ctl
    - C:\Transims40\Bin\ArcNet –K –B ArcNet.ctl

- Control files contain key and value pairs such as
    - NET_DIRECTORY   ../../network/production
    - NET_NODE_TABLE   FullArea_Node
    - NET_LINK_TABLE   FullArea_Link
    - NET_ACTIVITY_LOCATION_TABLE FullArea_Activity_Location
    - NET_PARKING_TABLE   FullArea_Parking

- Execution creates log files with the extension ".prn" in the same directory where the control files are located, containing detailed log information about the execution of the tool

TRANSIMS Tools
The Main Modules

- **PopSyn:**
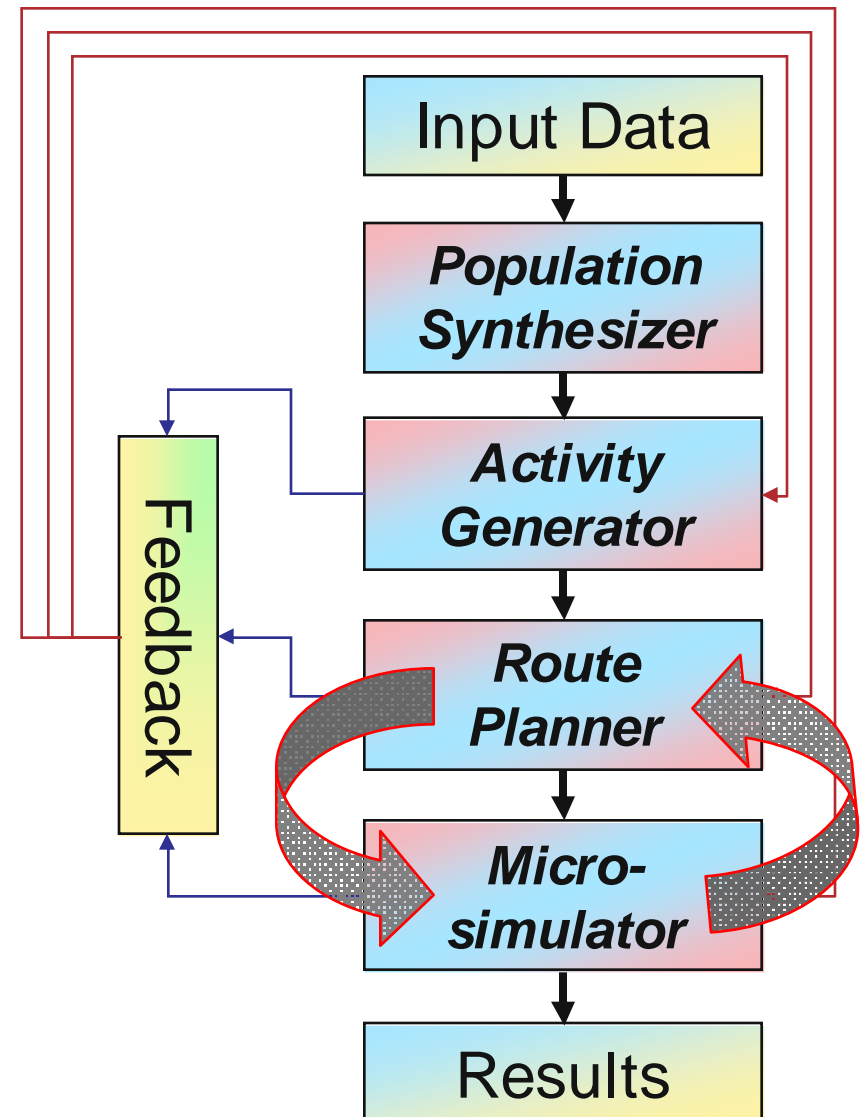 - Generate the synthetic population from Census data
- **ActGen:**
 - Generate the activities of the population from activity surveys
- **Router:**
  - Route the trips based on the activities on a time-aware road and transit network
- **Microsimulator:**
  - Execute the plans for each trip on the road network and develop feedback in form of a link delay file

TRANSIMS Tools
Conversion of Road Networks

Subarea Microsimulation

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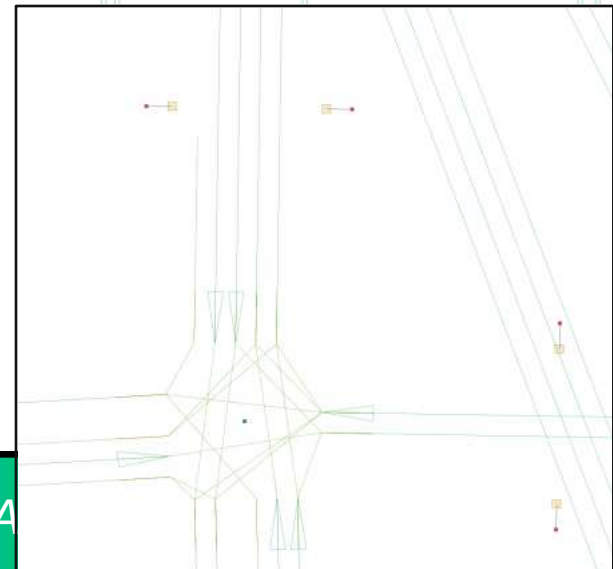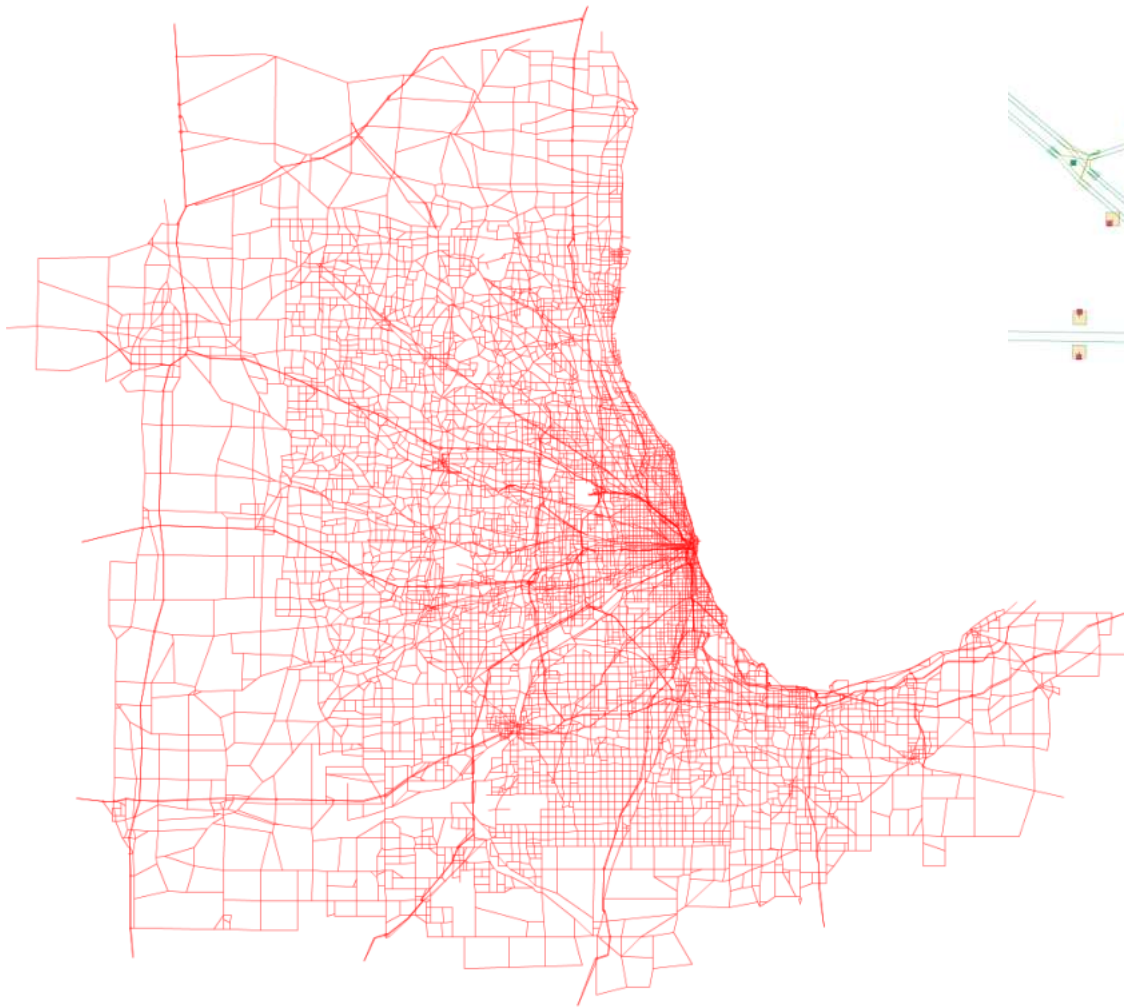
TRANSIMS Tools - Conversion of Road Networks

- **TransimsNet:**
  - Creates a refined network with most TRANSIMS network features such as parking lots, activity locations, connectivity records, signal and sign warrants, etc from
    - *A node table to provide the geographic location of nodes*
    - *A link table in Anode/Bnode format providing link data such as the number of lanes, speed limits, capacities, type, etc.*
    - *A zone centroid table to allocate activity locations to traffic analysis zones*
    - *An optional shape point file for improved visual accuracy*
- **IntControl:**
  - Creates traffic signs and detailed traffic signal data automatically from the warrants created by TransimsNet
    - *Creates all the signal phases and timings empirically*
- **EnhanceNet:**
  - Add bearing fields and type fields to link and connectivity tables

TRANSIMS Tools - Conversion of Road Networks

Sample input tables for:

- Nodes
- Links
- Zones
- Shapes
  (not shown)

NODE	X_COORD	Y_COORD
1945	428121	4748132
1946	424938	4753691.5
1947	412534	4746420
...		
5001	327590.3	4581616.5
5002	327595.4	4581687.5

ZONE	X_COORD	Y_COORD	AREATYPE
1	446306.5	4638415	1
2	446724.4	4638426	1
3	447302.5	4638440	2
4	447672.9	4638431	2
5	448209.2	4638283	2

ANODE	BNODE	LENGTH	LANES_AB	LANES_BA	SPEED_AB	SPEED_BA	CAP_AB	CAP_BA	...
1945	19688	4409.60	3	3	24.58	24.58	2430.0	5400.0	...
1946	11223	1367.94	3	0	29.05	0.0	6000.0	0.0	...
1947	8666	6099.41	2	2	24.58	24.58	4000.0	4000.0	...

TYPE	USE	TOLL_AB	TOLL_BA	STREET
ZONECONN	AUTO/TRUCK/WALK	0.0	0.0	I-90
ZONECONN	AUTO/TRUCK	0.0	0.0	I-88
ZONECONN	AUTO/TRUCK/BUS	0.0	0.0	I-55

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TRANSIMS Tools – GIS Layer Output

- **ArcNet:**
    - Creates highly detailed GIS shape files for links, nodes, and most other network features for visualization in ArcGIS (see previous slide)
    - Many configuration options to show individual lanes, activity locations, parking lots, and much more
- **ArcPlan:**

    Show individual plans or groups of plans in form of lines on the road and transit network (after routing)
- **ArcProblem:**
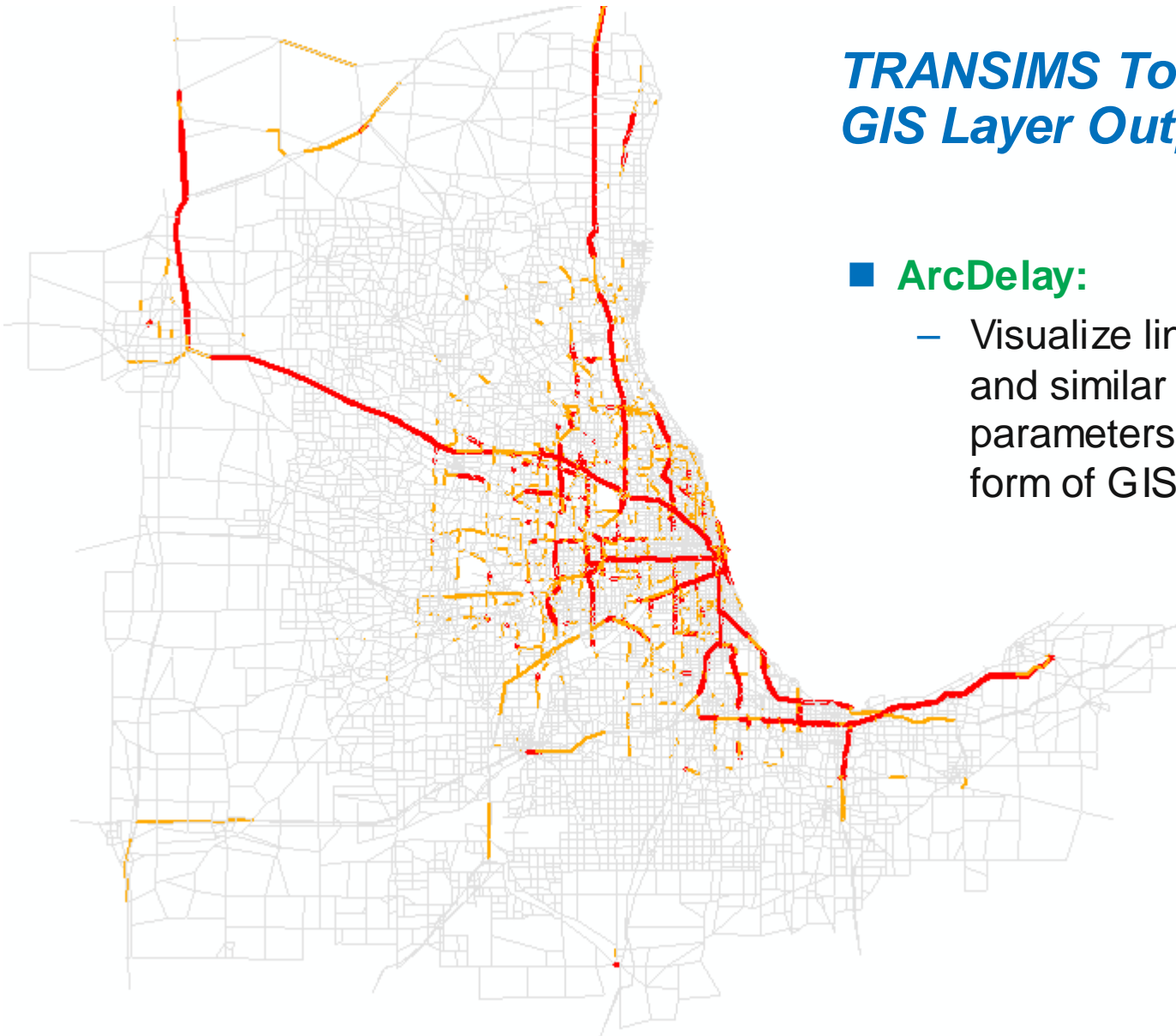   - Visualize the location of different problem types, such as:
        - *Zero Node Problem*
        - *Access Problem*
        - *Circuity Problem, etc.*
    - Works both for router and microsimulator

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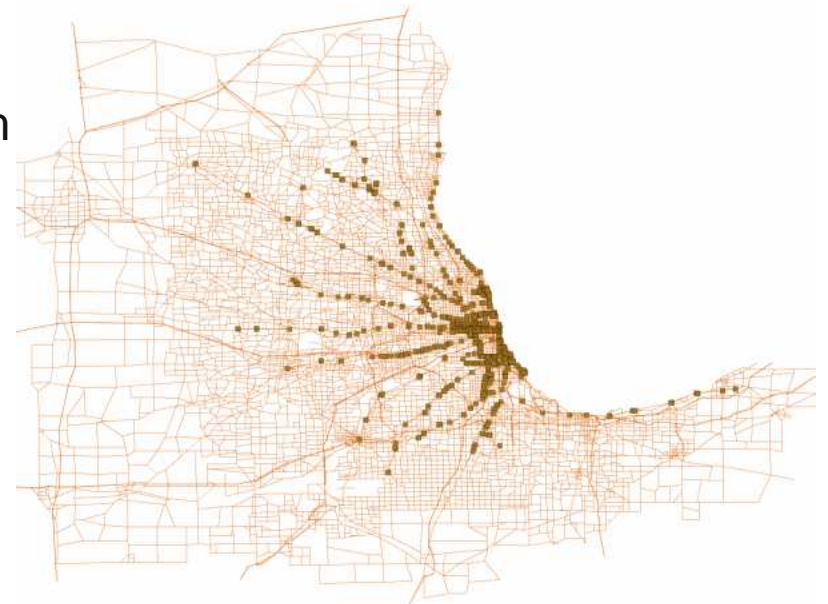
TRANSIMS Tools
GIS Layer Output

- **ArcDelay:**
  - Visualize link delays, volumes, and similar link-related parameters by time intervals in form of GIS layers

# TRANSIMS Tools – GIS Network Editing

- **GISNet:**
  - Reads ArcGIS node and link shape files and converts them into standard TRANSIMS network files
  - The node file is used to adjust the location of the nodes
  - The link file is used to introduce or edit shape points

Network Editing

- Move nodes
- Create shape points on links
- GISNet extracts geocoding into attributes

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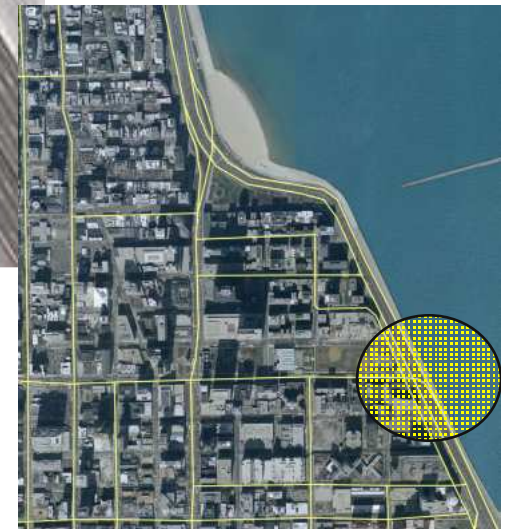
TRANSIMS Tools – Trip Conversion

- **ConvertTrips:**
  - Read trip tables and diurnal distributions and extrapolate to individual trips from activity location to activity location
  - Create artificial vehicles, households, and travelers
  - Assign vehicle types to trip table types
  - Estimate trip duration
  - Create a record for each trip in the trip table
  - Vehicular traffic as well as transit trips, park & ride, etc.

- **DiurnalMatrix:**
  - Specialized program to deal with thousands of diurnal distributions if they are known for each zone
  - The tools creates all necessary input files for ConvertTrips including TRANSIMS script files

TRANSIMS Tools - Partitioning

- **HHList:**
  - Extract a randomized list of households from a larger household list into a set of household lists to be used for partitioning
  - Each of these files contains approximately the same number of households
- **Partitioning starts with the Router:**
  - The router can use these household lists to work on a partial set of households. While reading the trip list, all records not belonging to the given household list are skipped so that the plan file contains only plans for the households in that list.
  - When partition-aware tools are invoked in partitioning mode, the number of the partition is passed on the command line as the last argument, e.g.
    - *Router –K –B Router.ctl* **0**
  - Partitioned data files have extensions ".tAA", ".tAB", etc.
  - Other tools that read and process plan files work simply on the subset defined by the partition number

TRANSIMS Tools – Subarea Microsimulation

- **SubareaNet:**
  - This is a tool that uses a GIS shape file to cut out a part of the larger network and rewrite it as a new network with boundary parking on all links that were cut through.
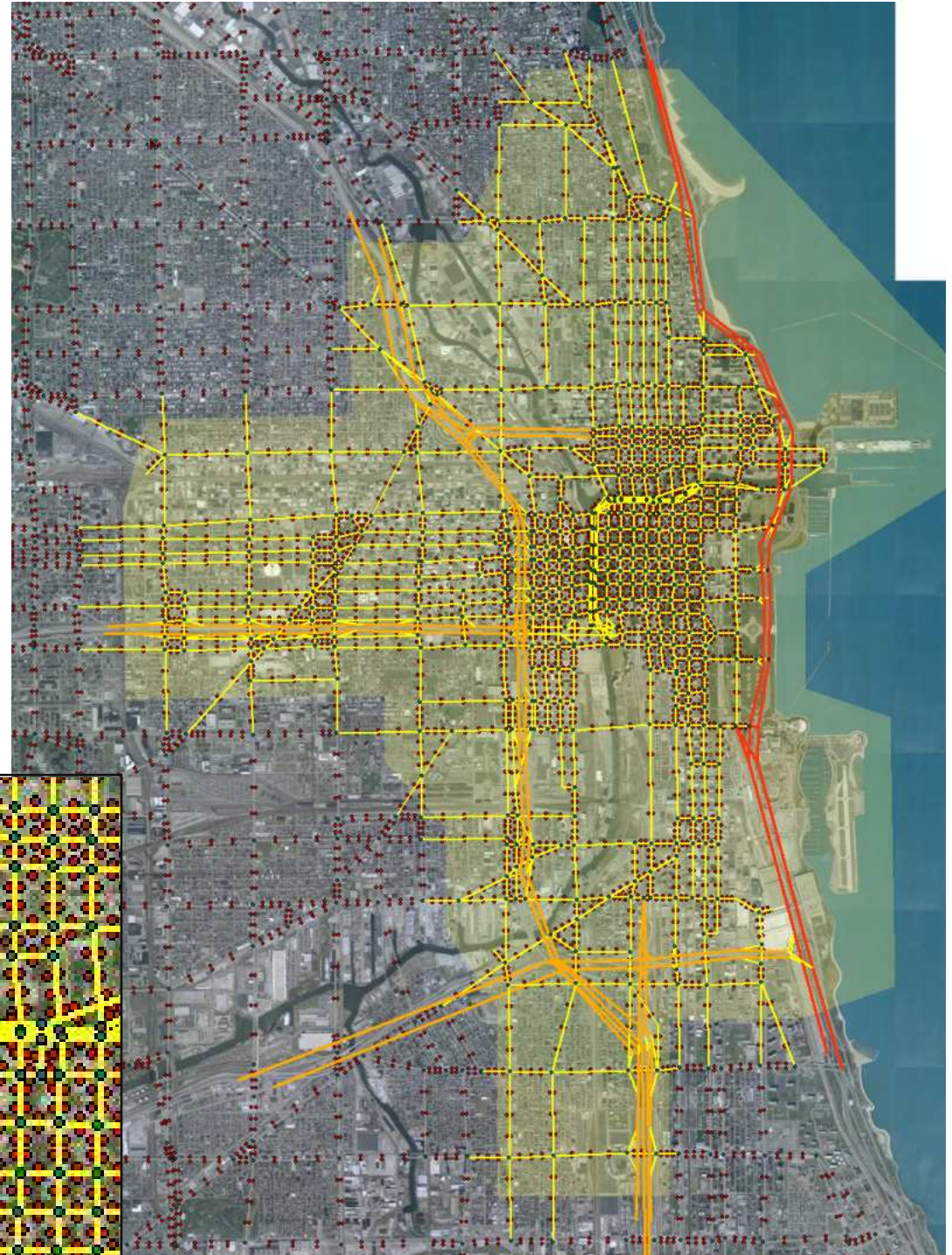
- **SubareaPlans:**
  - This is the corresponding tool that analyses the plans for each trip and determines whether they touch the subarea network at any time during the day
  - Trips that go through the subarea are extracted into a new plan file and are augmented with start and end parking locations corresponding to the router's time at which the trip enters and leaves the subarea network

- **LinkDelay:**
  - Merge link delays for the entire network and the subarea network after microsimulation

Subarea Microsimulation

- A typical subarea microsimulation zone is shown on the right
- The microsimulator treats this zone just like the entire network
- The result are link delays that must be merged with link delays determined by PlanSum using LinkDelay

TRANSIMS Tools – Feedback and Evaluation of Solutions

- **PlanSelect:**
    - Select households for rerouting based on criteria such as
        - *time of day, plan duration, V/C ratios*
        - *coordinates, vehicle types, subarea polygons, nodes*

- **ProblemSelect:**
    - Select households for rerouting based on criteria such as
        - *time of day, problem link, problem type*

- **PlanCompare:**
    - Generate convergence statistics and distribution charts by time of day
    - Compare plans files and select plans that have significantly different travel times

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TRANSIMS Tools – Other Utilities

- **LinkSum:**
  - Generate link data files of volumes, speeds, travel times, V/C ratios, travel time ratios, delay, average density, maximum density, average queue, maximum queue, and cycle failures summarized by time of day
  - Summarize data within a subarea polygon or for specified facility types
  - Summarize link data by zone or zone group found in the activity location file
  - Summarize activity location data fields by link direction
  - Report the links with the top 100 link volumes, lane volumes, period volumes, speed reductions, V/C ratios, travel time ratios, volume changes, or travel time changes
  - Report the link groups with total volumes greater than user specified values
  - Report the distribution of travel time, V/C ratio, travel time change, and volume change by lane kilometer and time period; and
  - Report various network performance statistics

TRANSIMS Tools – Other Utilities

- **ArcSnapshot:**
  - Create GIS shape files from selected records in the TRANSIMS microsimulator snapshot files

- **LinkDelay:**
  - Merge, average, and convert link delay files or smooth the link delays between time increments *(see also: subarea microsimulation)*

- **NewFormat:**
  - Converts Version 3 transit driver plans to a Version 4 transit driver file
  - Converts a Version 3 population file to a Version 4 household and population file
  - Converts a Version 3 activity file to a Version 4 activity file
  - Converts a Version 3 survey activity file to a Version 4 survey activity file

TRANSIMS Tools – Other Utilities

- **PlanPrep:**
  - Merge, sort, select, and combine plan files
  - Reintegrate subarea plans with regional plan files
  - Create and check plan partitions
  - Generate distribution reports of path and travel time changes

- **PlanSum:**
  - Summarize the link demands generated by the Router
  - Apply volume-delay equations to estimate link travel times
  - Produce link volume, link delay, and turning movement files by time of day
  - Produce zone or district trip tables and skim files by mode and time of day
  - Summarize transit ridership demand by transit route, run, and stop
  - Generate V/C ratio reports by link and link groups by time of day
  - Create diurnal distributions of the start, end, and mid-trip times of each plan

TRANSIMS Tools – Other Utilities

- **PlanTrips:**
  - Generate a trip file from a plan file
  - Use the time constraints from the original trip file and the trip duration from the plan file
  - To update the trip start and end times in the new trip file and optionally the new plan file
  - Generate a report documenting the plan time shifts in 5 minute increments

- **Validate:**
  - Compare link delay file to link and/or turning movement counts
  - Compare link volume and/or movement files to link and turning movement counts
  - Generate statistical reports for volume level, facility type, area types, link group (screenline), zone group (district), and turning movements
  - Output link volume data by time increment and time period ranges

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TRANSIMS Tools – Other Utilities

- **VehGen:**
  - Synthesize and locate vehicles based on the number of vehicles in each household

- To be continued …

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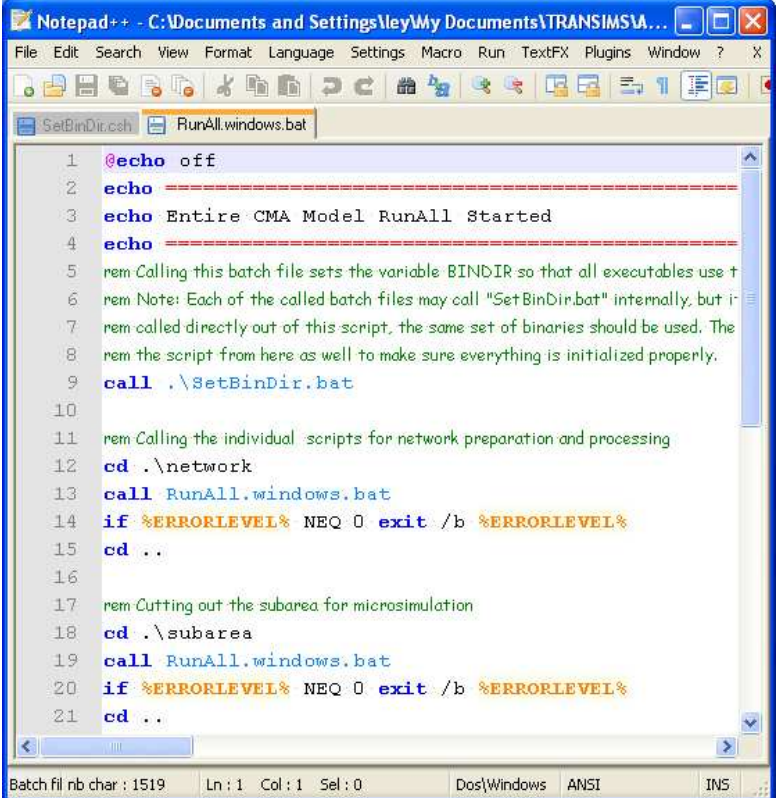
TRANSIMS Tools – Currently Undocumented Tools

- **AdjustPlans**
- **ArcDiff**
- **ArcRider**
- **CoordMatch**
- **EventSum**
- **ExportTransit**
- **FileFormat**
- **LineSum**
- **ListID**
- **LocationData**

- **NewFormat**
- **ProblemSum**
- **Progression**
- **Reschedule**
- **RunSetup**
- **SideFriction**
- **SmoothPlans**
- **TPPlusNet**
- **TPPlusRoute**
- **TripSum**

Scripting

- **Windows**
  - Tools work on input and output data files, e.g. network tables, plan files, and more
  - Windows batch files ".bat" are frequently used to chain TRANSIMS tools together
  - Batch files provide very limited scripting capability
  - Perl is being widely used for scripting by TRANSIMS users, e.g. at AECOM
  - The freely available CygWin environment allows full scripting under Windows using the normal Windows executables (important for performance reasons)
  - For editing, we recommend the freely available NotePad++ editor (also available from SourceForge, just like TortoiseSVN and TRANSIMS itself)

Scripting

- Linux
  - Provides very powerful scripting and execution environments for codes such as TRANSIMS
  - All tools work on Windows, Linux, Mac OS, and may be compatible with other platforms as well
  - Typical Linux tools such as "head", "tail", "grep", "sed", and many others make it easier to work remotely with really large files
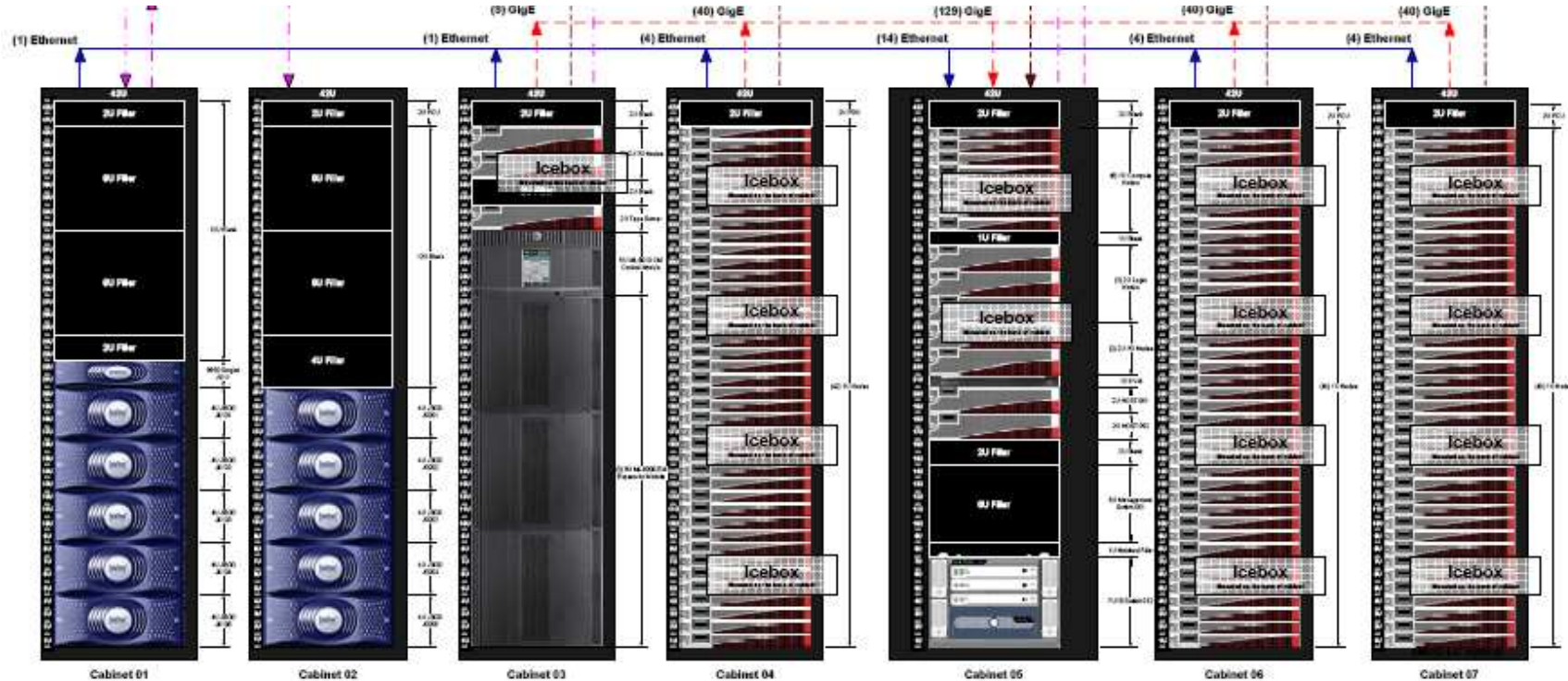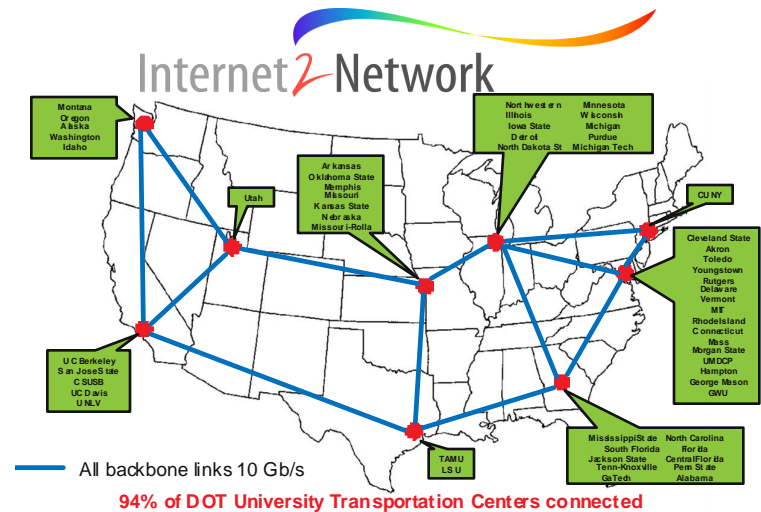
- The typical Linux tools are also available as regular Windows executables, making their use possible under Windows environments

TRACC HPC Cluster

- This cluster with 512 cores is being used to run TRANSIMS more effectively

- Requires the use of either partitioning (readily available) or of multi-threaded MPI versions of TRANSIMS (under development at TRACC)

All backbone links 10 Gb/s

94% of DOT University Transportation Centers connected

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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