ARC's Experience Using its CT-RAMP Activity-Based Model

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Why an Activity-Based Model @ARC?

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Purpose:

- Enhance Theoretical Integrity of Regional Travel Demand Modeling System

Goals:

- Provide Greater Sensitivities to: Demographic Shifts (Aging of the Population, etc…) & Roadway Pricing Policies
- Improve Visualization of Model Results
- Better Representation of Trip Chaining & Intra-Household Interactions

ARC Strategic Plan for ABM Development

Work Methodically & Incrementally

Maintain a Dual-Track for Model Development & Implementation
- Improve Trip-Based Model (TBM)
- Develop ABM

Ensure On-Going Quality Assurance & Quality Control of ABM Results

Acknowledgements

Over the Years, the Following Firms & Individuals Have Assisted ARC in Developing its ABM:

- Parsons Brinckerhoff
- Atkins
- John Bowman
- Mark Bradley

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Historical Perspective: Why Did it Take ARC so Long?

- ***2001***: System Design for 13-County Model Domain
- ***2002***: Preparatory Work & Analysis of SMARTRAQ Household Travel Survey Data
- ***2003***: Debut of Population Synthesizer (birth of "PopSyn") with Emphasis on 1990 Backcasting
- ***Early 2004***: TMIP Model Peer Review Recommended Early Deployment of Population Synthesizer
- ***Late 2004***: EPA Designated 20 Whole Counties & 2 Partial Counties Within Metro Atlanta as Non-Attainment under PM 2.5 (Fine Particulate Matter)
- Result of this Non-Attainment Designation:
  - ARC Initiated Effort to Expand ***4-Step Trip-Based*** Model from 13 to 20 Counties in order to Meet Federal Requirements for Performing Conformity Analysis

Historical Perspective: Why Did it Take ARC so Long?

- **2005**: Expansion & Calibration/Validation of 4-step Trip-Based Model
  - ABM Model Development Slowed Down
  - ABM Model Development Efforts Dispersed
  - ABM Model Development Progress Impacted
- ***2006***: Expanded 13-County Population Synthesizer to 20-County Model Architecture
  - 13-County PopSyn Presented at May 2006 TRB Austin Conference
  - JAVA-based PopSyn
- **2007**: Long-Term Choice Models Implemented:
  - Workplace Destination/Location Choice Model
  - School Destination/Location Choice Model
  - Automobile Ownership Model

Historical Perspective: Why Did it Take ARC so Long?

2008: Core (Short-Term) Choice Models:

- Coordinated Daily Activity Patterns for all Households
- Joint travel / activity, including generation and participation sub-models
- Tour destination choice for all travel purposes
- Tour mode choice for all travel purposes
- Tour time-of-day choice for all travel purposes
- Stop frequency for all tour types
- Stop-location for all tour types
- Trip departure choice for all tour types, trip purposes, and trip placement in tour chain
- Parking choice for auto trips to CBD
- All implemented using the UEC (Utility Expression Calculator) for logit model specs, from spreadsheets to JAVA
- ABM Uses Cube Voyager / TP+ Graphical User Interface

Historical Perspective: Why Did it Take ARC so Long?

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2009-2010:

- Zonal & Network Data, Assignment & Skimming for Highway & Transit
- Model Shell Application for PopSyn, Core Models & Auxiliary Models (Trucks, Externals)
- Structural Calibration Targets Sources: Household Survey, Traffic Counts, CTPP, Transit Ridership
- Validation & Comparisons to Existing 4-step Model
- Software & Custom Hardware with Distributed Cluster Processing
- ABM VIZ for Results Visualization

2011-2012:

- Thorough QA/QC, Cloud Computing & Internal Use of ABM for Model Evaluation & Sensitivity Testing

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What's on Tap for ARC in 2013 and Beyond?
Transition from TBM to ABM

- "Just When You Think You're Done, It's Time to Do It All Over Again"
  - Fold in TBM's Recent Improvements into ABM (see next slide for more details)
  - Revisit ARC's CT-RAMP ABM Estimation
  - Integrate ARC's Recently Completed Household Travel Survey
  - Recalibrate / Revalidate
  - Integration with PECAS land use model
  - Integration with DTA & Microsimulation?

4-Step Trip-Based Aggregate Model: Recent Improvements

- Utilize Conflated Networks
- Consolidate Facility Types
- Update Speed/Capacity Tables
- Revise VDF Curves
- Revise Time-Of-Day Factors
- Revise Heavy-Duty External Trucks
- Incorporate Mode Choice Refinements
- Revise Highway Assignment Closure
- Convert emissions post-processor to utilize MOVES output

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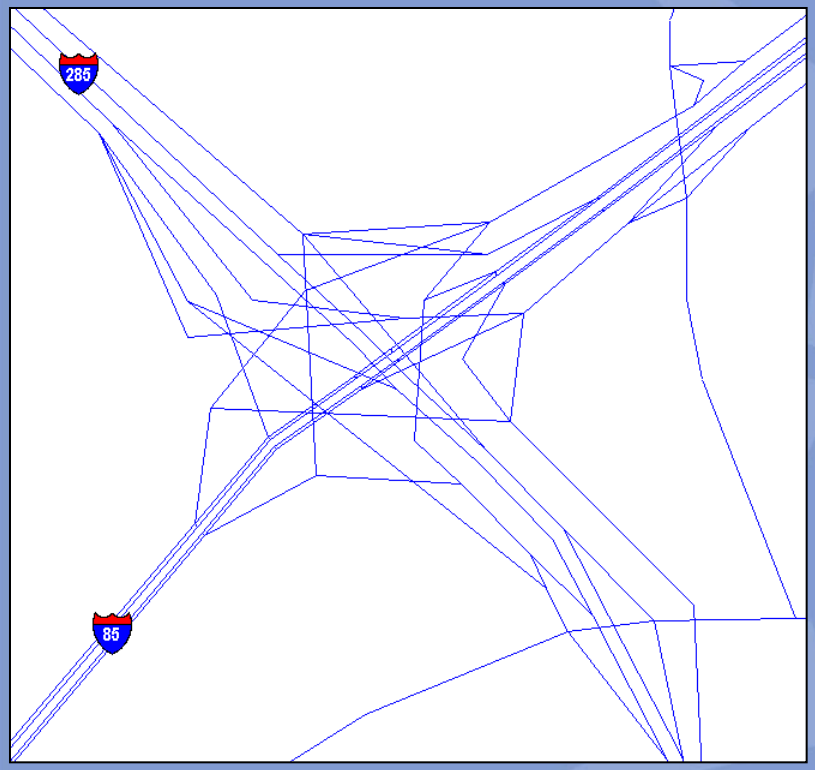
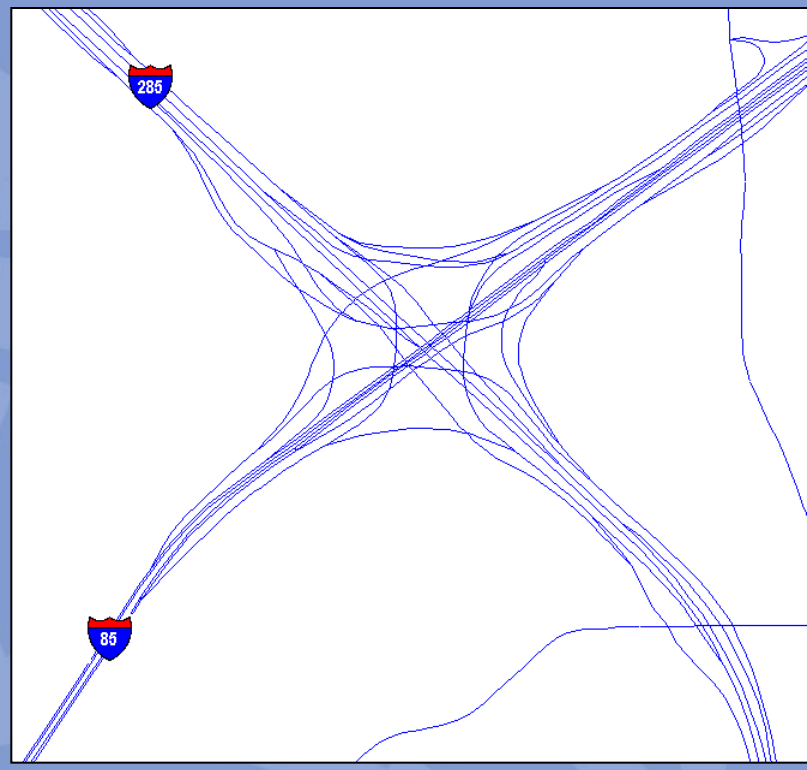
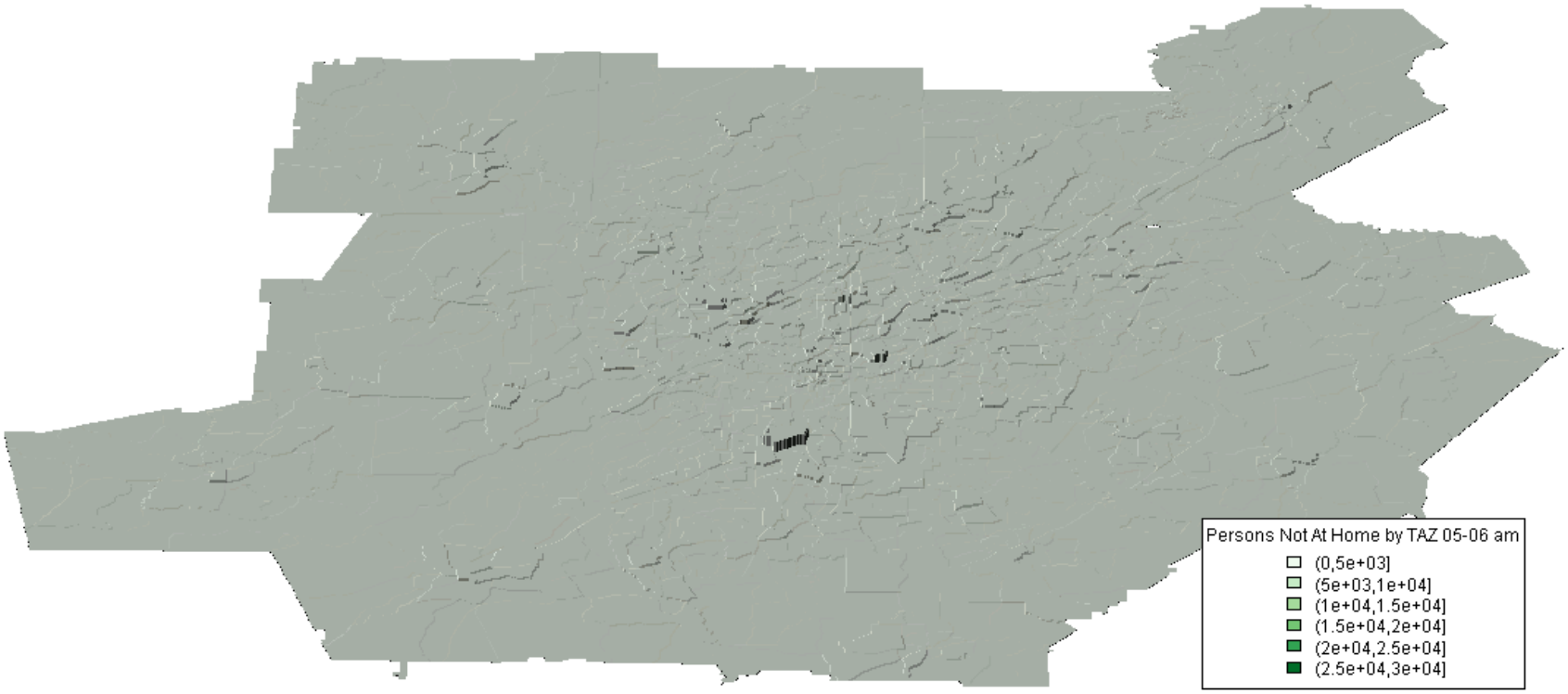
Conflated Networks

- True Shape Display
- Based on modified NAVTEQ data
- Modify network with highway shape file

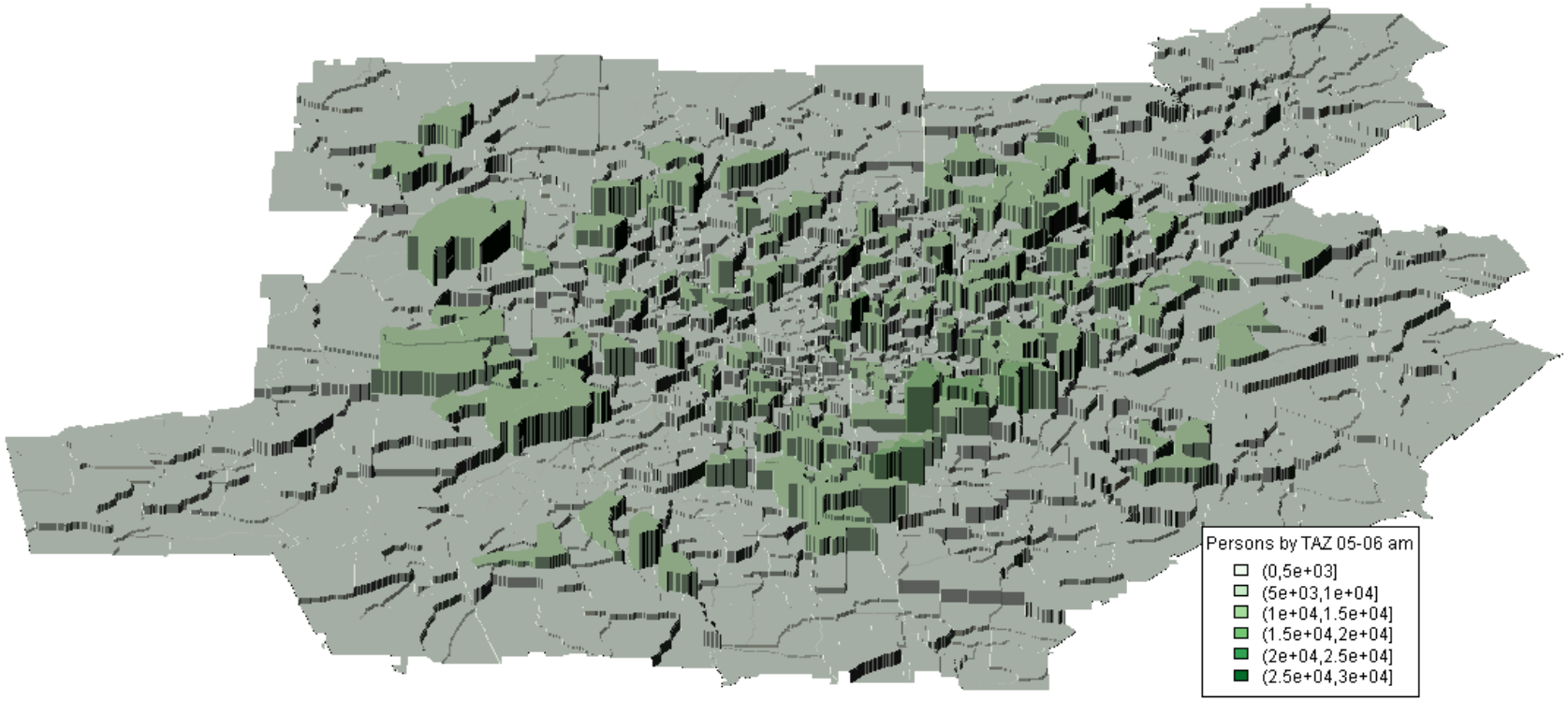




Persons Not At Home By TAZ and Hour

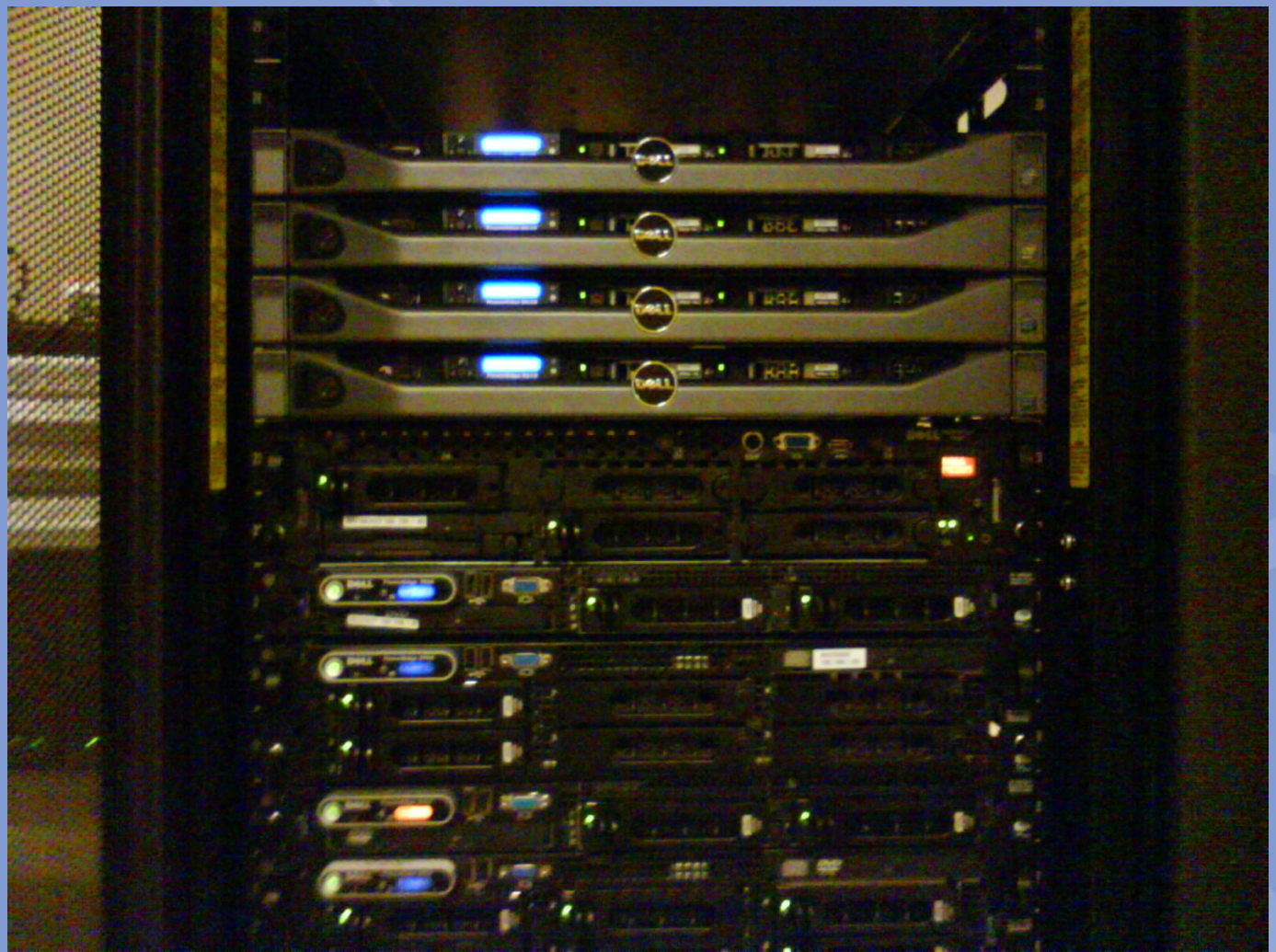


Persons By TAZ and Hour

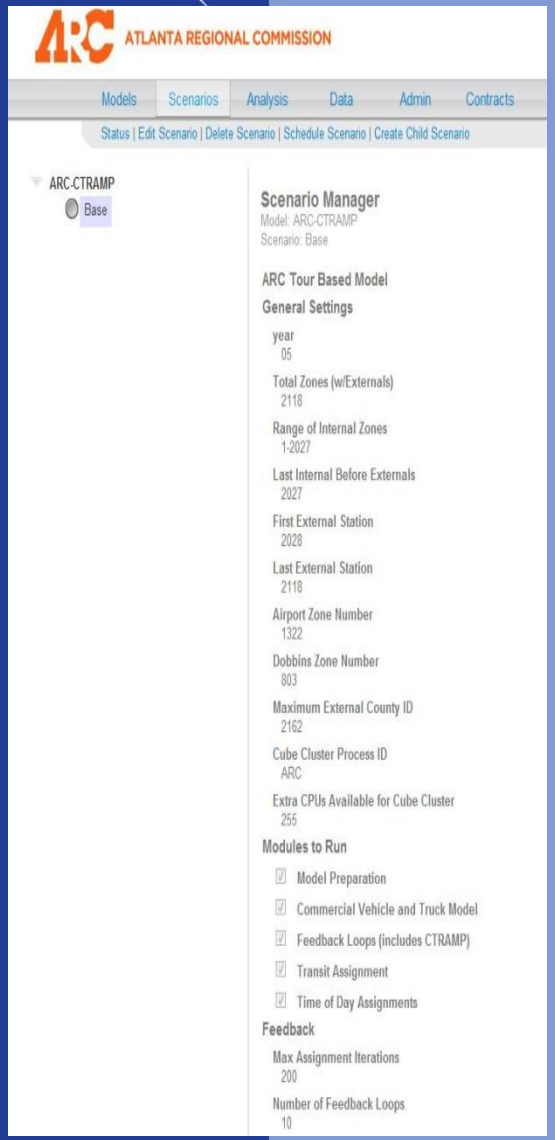


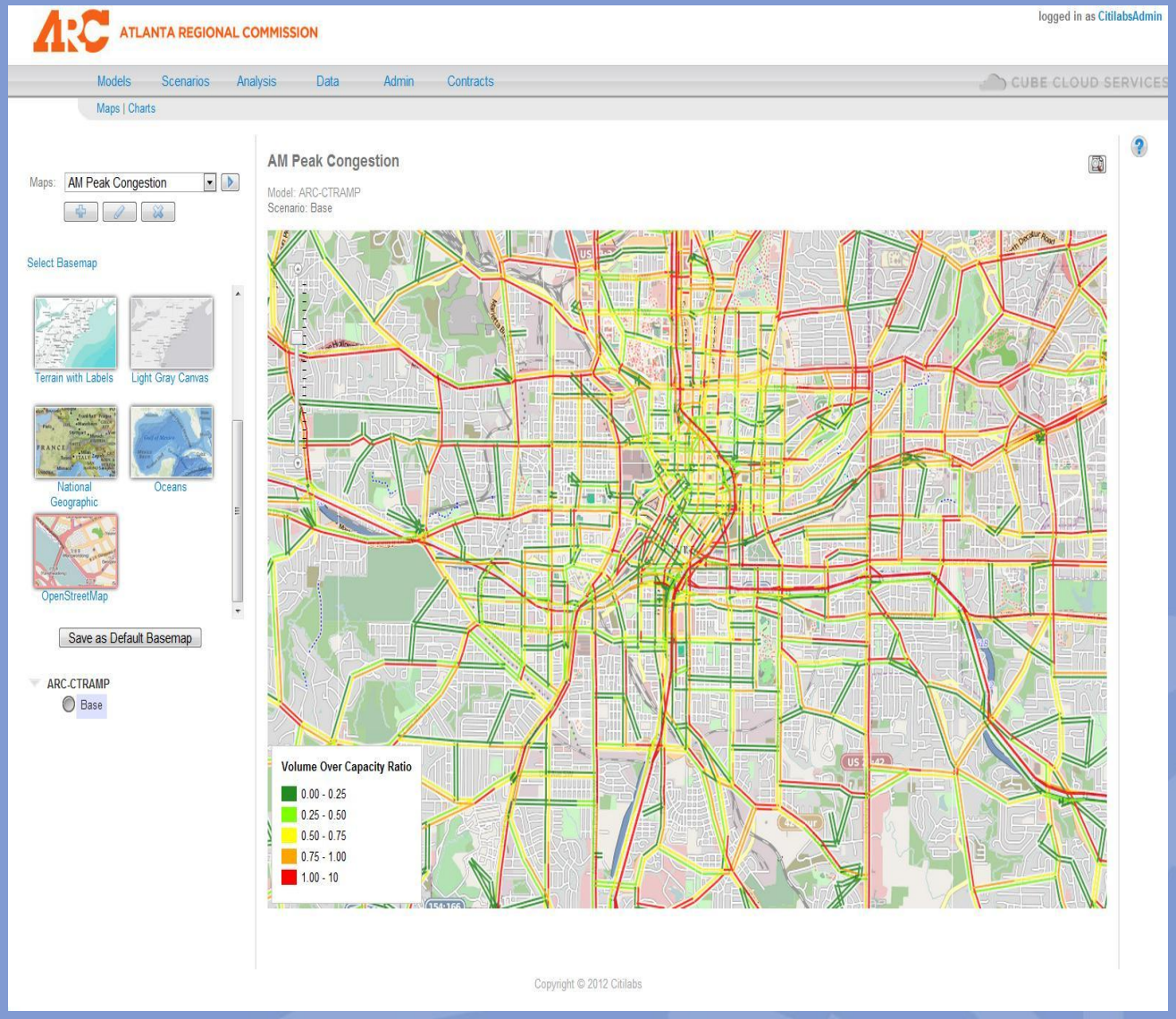
The ARC CT-RAMP Cluster

4 8-processor dual-core Dell servers with 32 GB RAM each



Cloud Computing: the ARC ABM is now "on the Cloud"

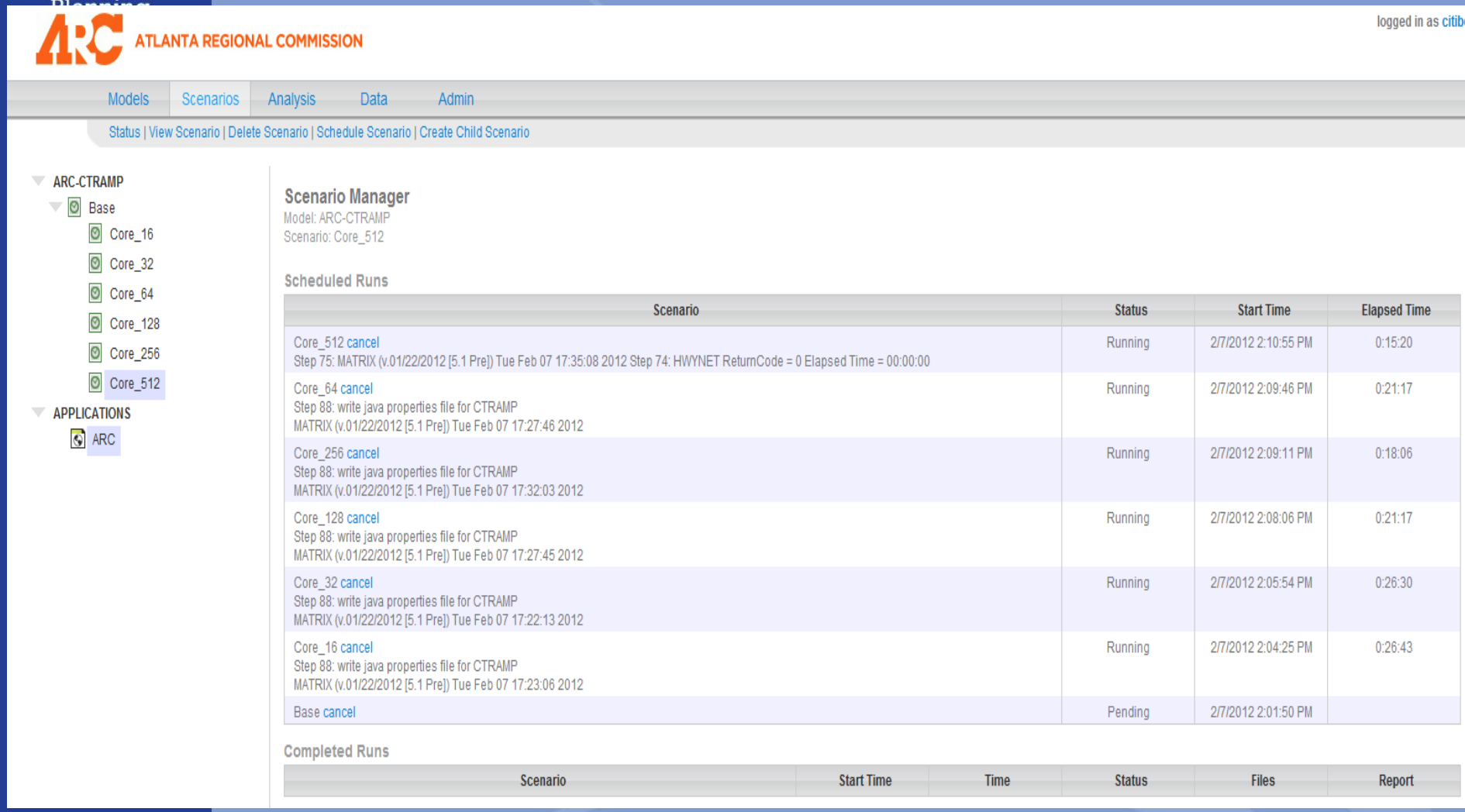




User interface – http://www.planthecity.com

Cube Cloud Services Setup

- Includes management of multiple scenarios & simultaneous runs



Cloud Run Times

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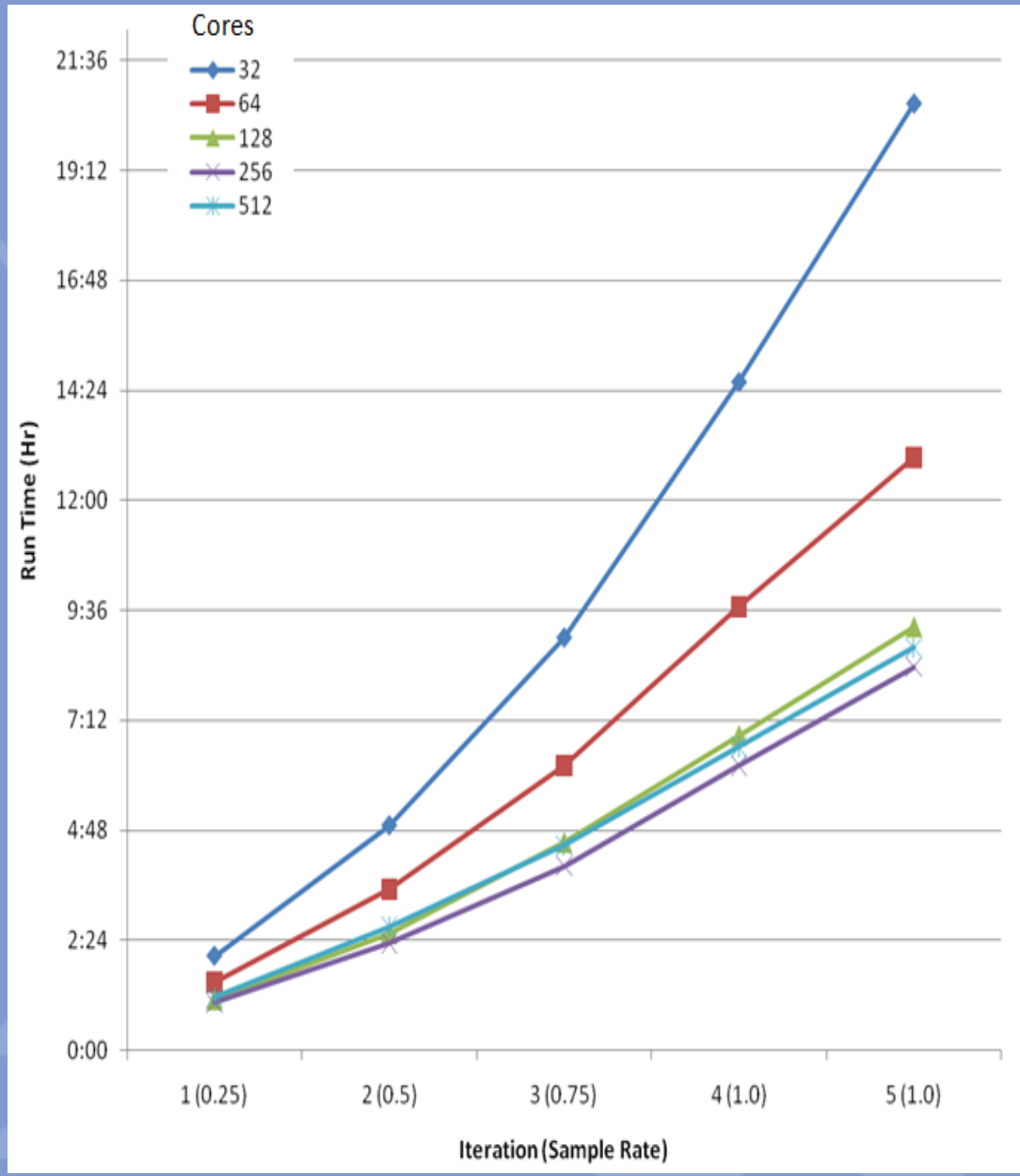
Diminishing returns observed around 128 cores (or 16 instances) with current setup

The household data manager is a likely bottleneck since it handles a significant amount of data I/O



Visualization in Modeling

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See:

http://www.youtube.com/ARCModeling

Social Networking Sites & Modeling

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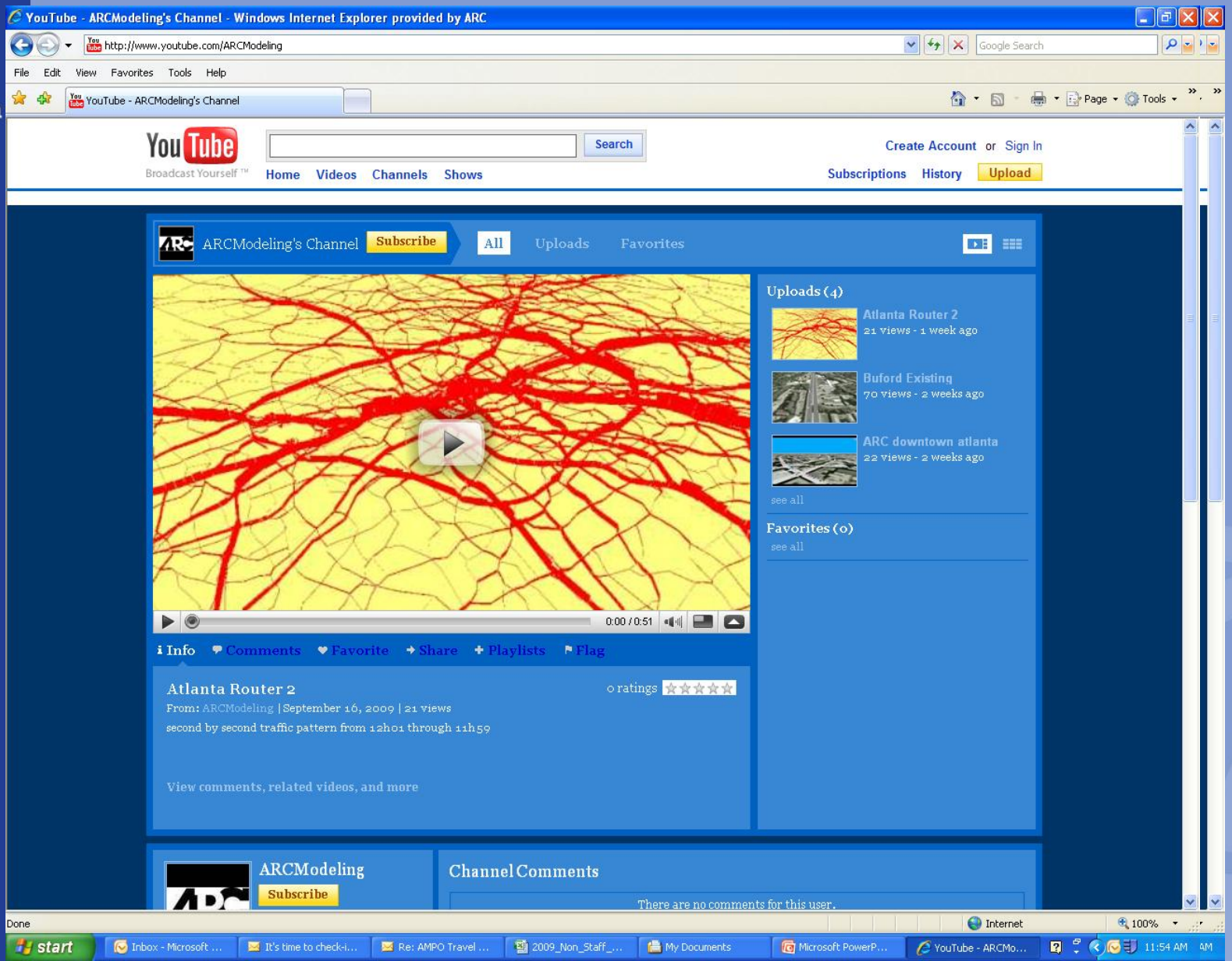
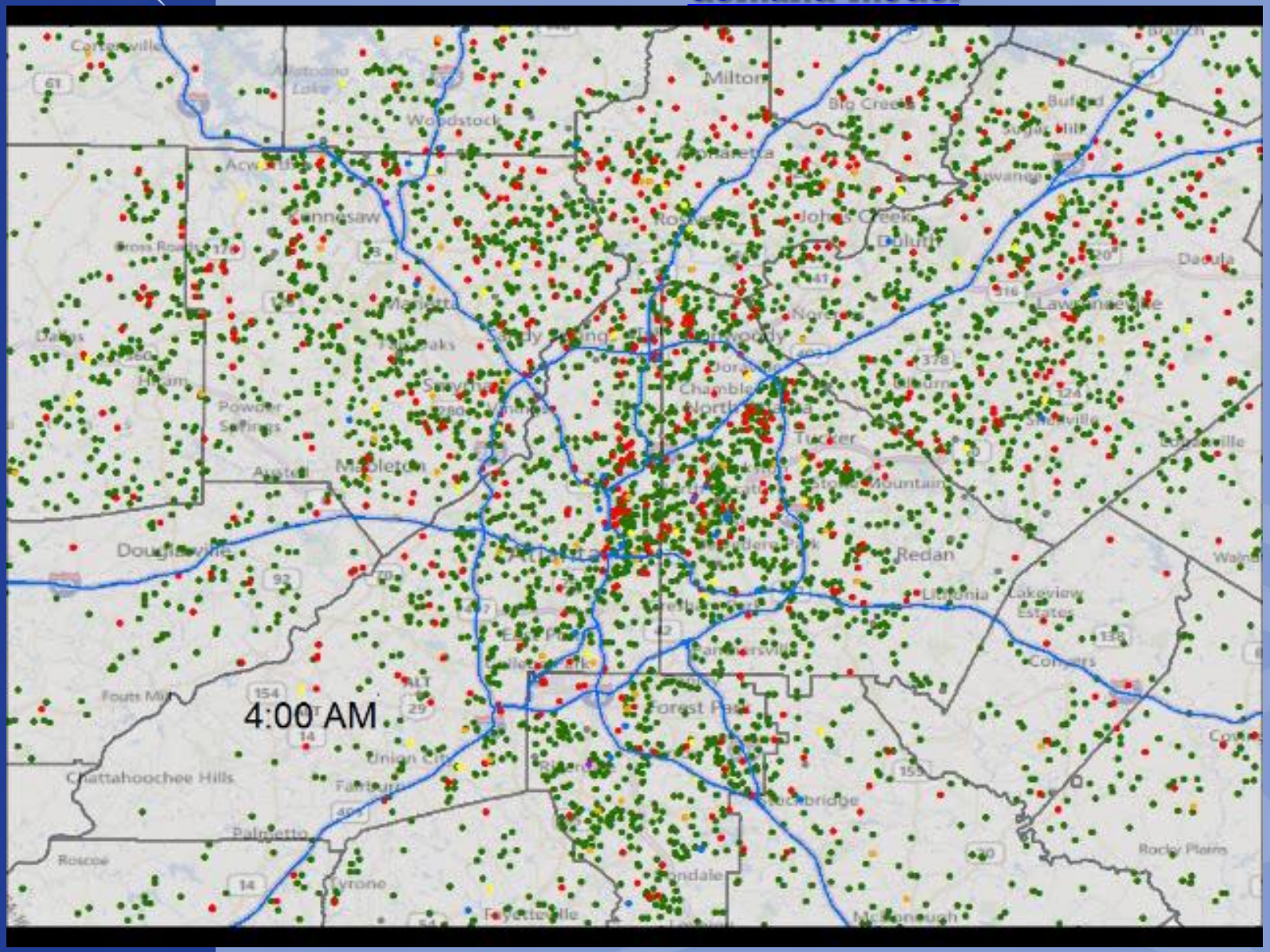


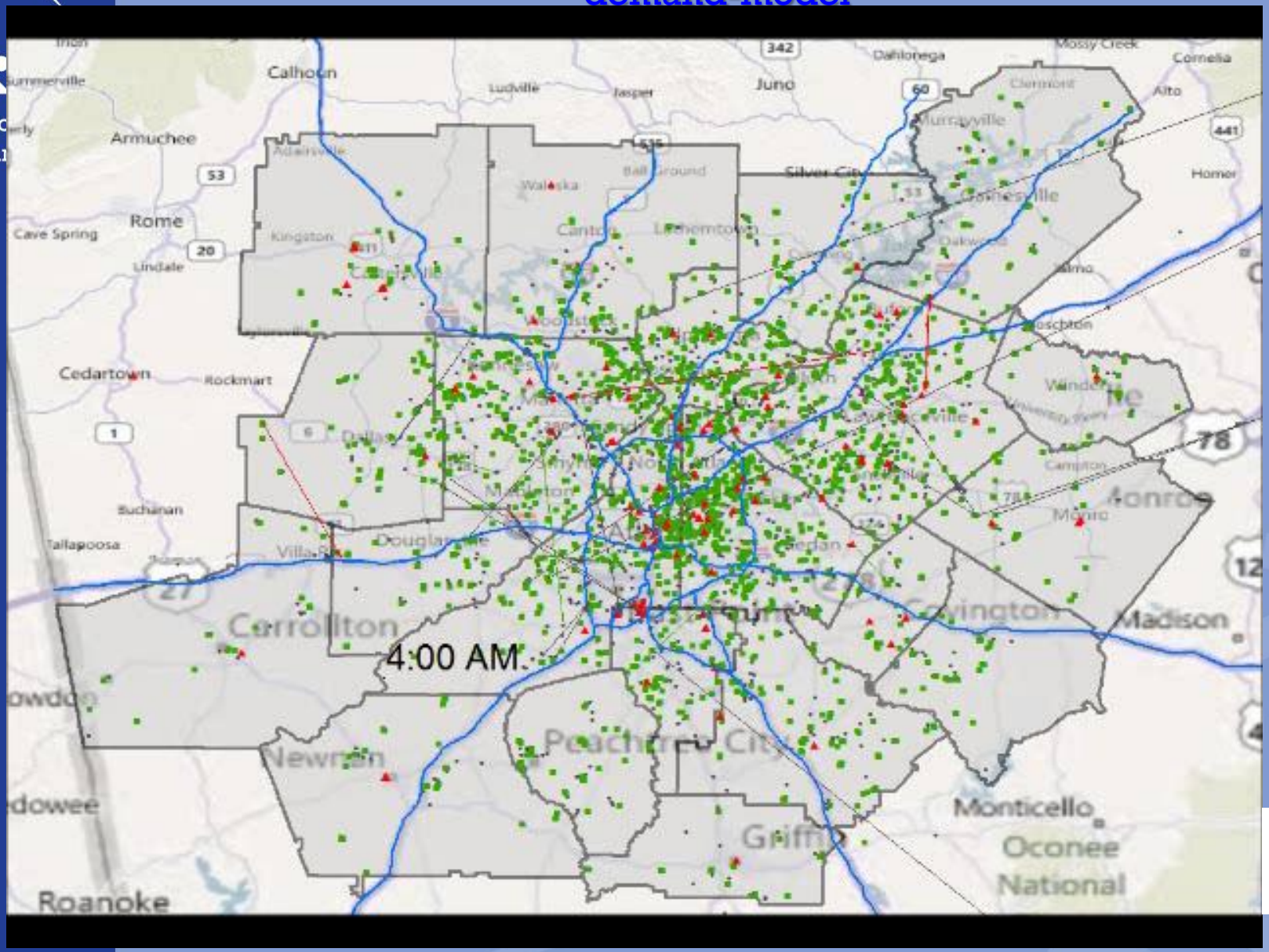
Household Travel Survey

Video featured on: www.atlantaregional.com/transportation/travel-demand-model



GPS: Putting it all together!

Video featured on: www.atlantaregional.com/transportation/travel-demand-model



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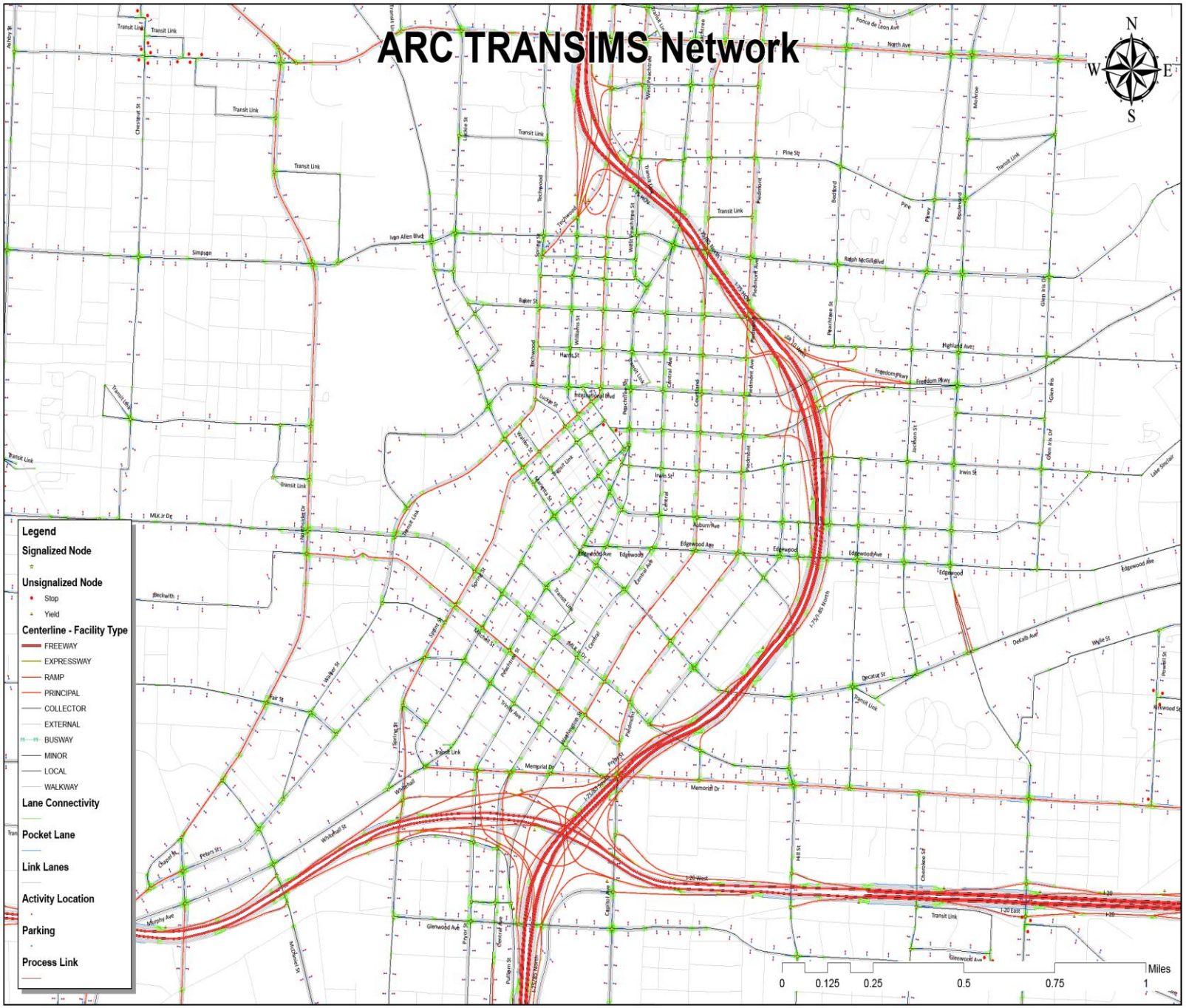
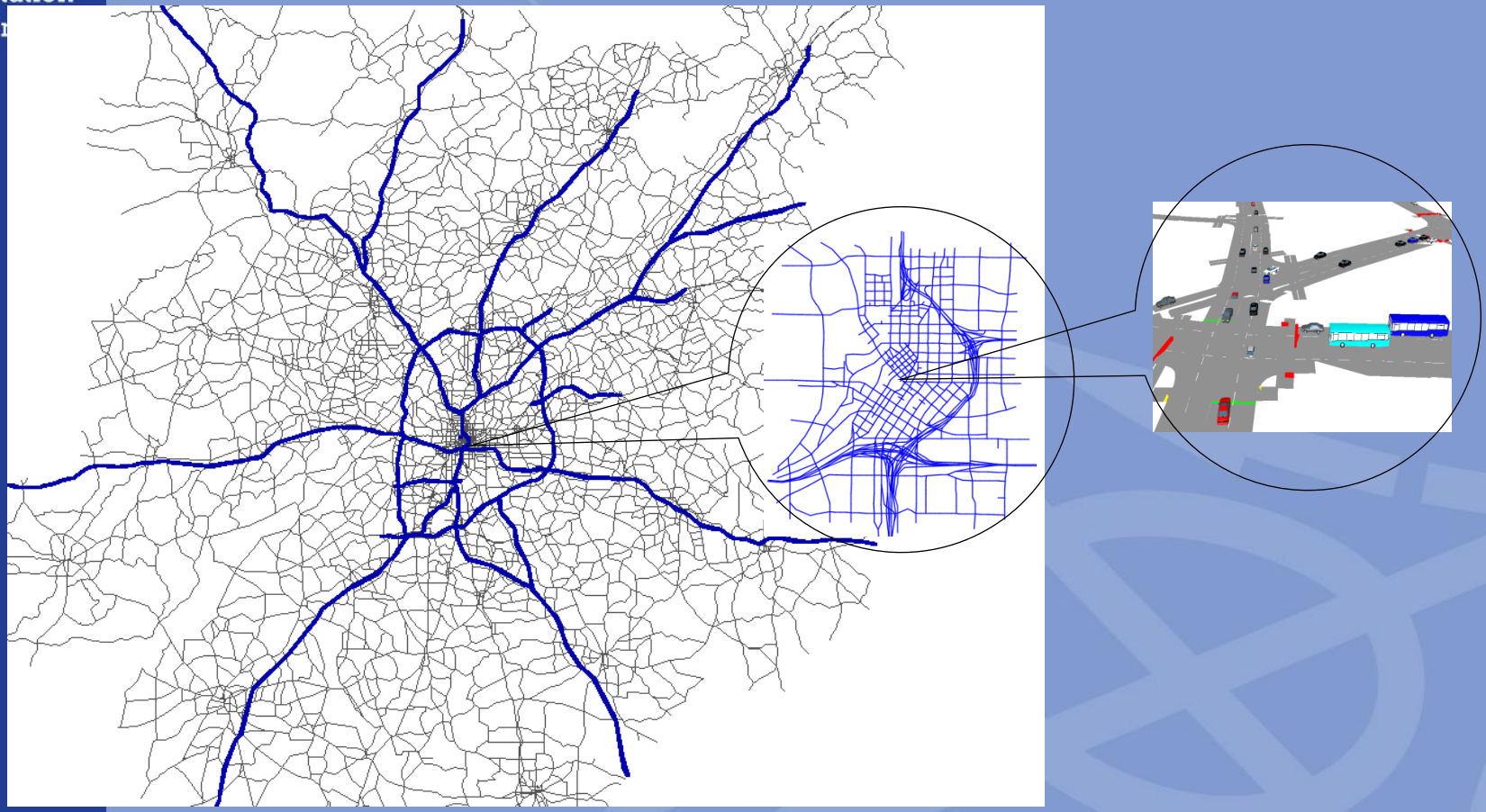
ARC TRANSIMS Network



Integrated Subarea Modeling



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Conclusions & Lessons Learned

- ABM Requires Detailed & Thorough QA/QC
- Design & Conceptualize your Household Travel Survey with an ABM Model System in Mind
- Maintain a Parallel Model Development Track with your 4-Step Trip Based Model
- Like Anything Else, ABM Requires *Lots* of:
  - Dedicated Staff Resources & On-Going Training
  - DATA (Surveys and/or "AirSage" O-D types)
  - Computer Resources (Servers or Cloud Computing?)
  - Consultants Assistance
  - Programming Expertise
  - GIS & a True Geo-Database for Project-Level Planning
  - $,$$$,$$$.$$

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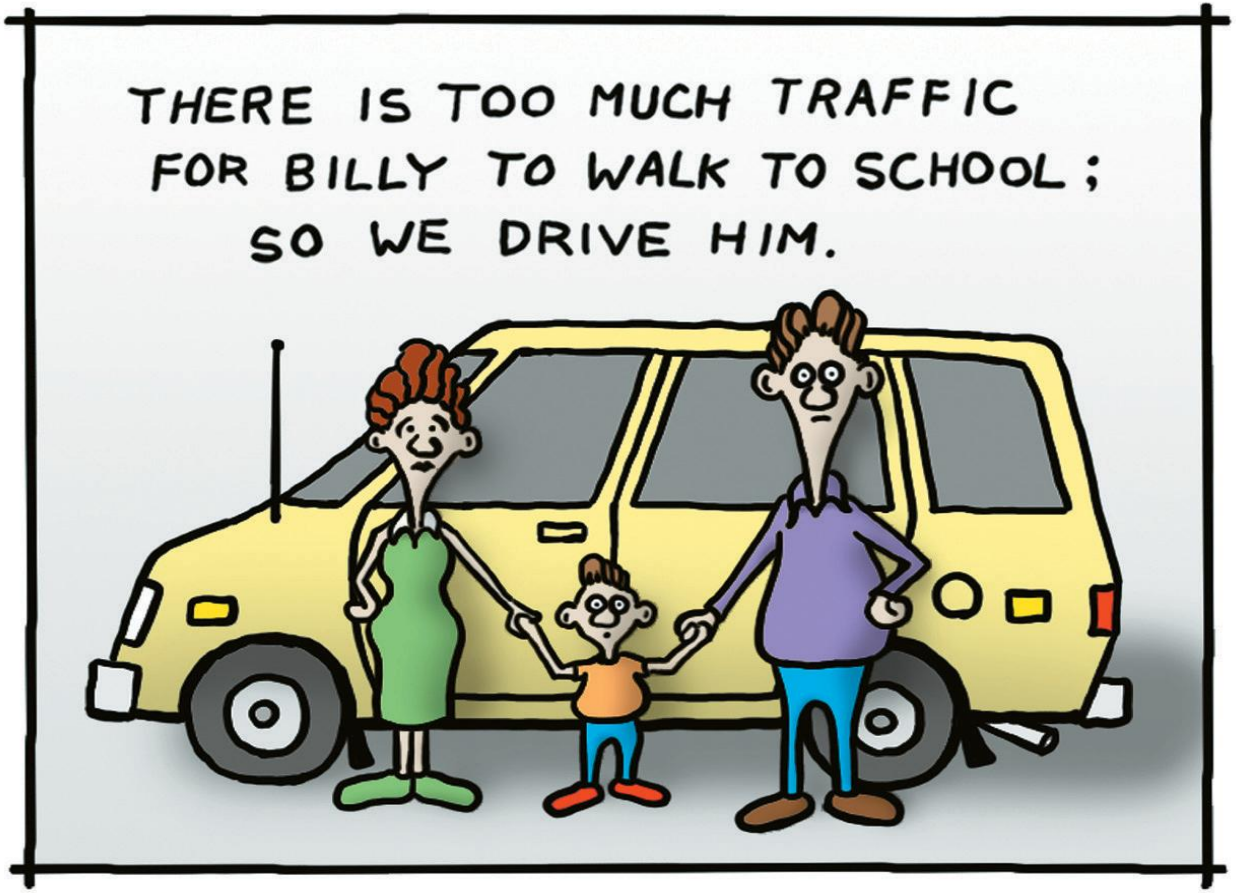
Atlanta's Most Crucial Step: Moving ARC's ABM into Practice & Official Production Mode

- Thus far ABMs are being Developed and Applied mostly in Regions where 4-step Models had been Abandoned or never Developed
- Rigorous Practical Testing and Cross-Comparisons of ABM & 4-Step Trip-Based Model (both in good shape!) is Finally Possible in Atlanta

Questions & Comments?



Traffic Inducing Traffic

For more info: www.atlantaregional.com/transportation/travel-demand-model