TRB Webinar:

Tools for Analysis of Capacity and Efficient Flow for Roundabout Design: PART I

May 6, 2015
1:00 PM – 3:00 PM ET

TRB
THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

NE ROUNDABOUTS
PTV GROUP
the mind of movement
KANSAS STATE UNIVERSITY

Today's Panelists and Moderator

- **Howard McCulloch**, *NE Roundabouts*
  round@roundabouts.cc

- **Karen Giese**, *PTV Group*
  karen.giese@ptvgroup.com

- **Eugene Russell**, *Kansas State University*
  geno@ksu.edu

Register for PART II and PART III

PART II – *RODEL and ARCADY*

June 11, 2015 (12:00 PM – 2:00 PM ET)

http://www.trb.org/ElectronicSessions/Blurbs/172492.aspx

PART III – *SYNCHRO, Sim Traffic, & TransModeler*

July 14, 2015 (2:00 PM – 4:00 PM ET)

http://www.trb.org/ElectronicSessions/Blurbs/172530.aspx

SIDRA INTERSECTION
Presentation

TRB Webinar - Tools for Analysis of Capacity and Efficient Flow for Roundabout Design
May 2015

Presenter:
Howard Mcculloch

Welcome!

SIDRA SOLUTIONS

PRESENTATION OBJECTIVES

As specified by TRB, presentation objectives are:

- Discuss the background and basis of SIDRA INTERSECTION
- Explain the critical inputs for SIDRA INTERSECTION
- Describe the step-by-step data input in SIDRA INTERSECTION
- Explain output facilities in SIDRA INTERSECTION
- Discuss analysis of output that will allow practitioners to evaluate roundabouts using SIDRA INTERSECTION
- Discuss specific strengths (specific use cases) for SIDRA INTERSECTION

SIDRA SOLUTIONS

Background of SIDRA INTERSECTION

- **SIDRA SOLUTIONS: company**
- **Software status**

SIDRA SOLUTIONS

SIDRA SOLUTIONS - COMPANY

Akcelik & Associates
(trading as SIDRA SOLUTIONS)

Established in 1999

The Software Development Team

Rahmi Akçelik, Mark Besley
Sabine Boukamp, Harry Cai
Ben Greene, Tony Phan
Umut Akçelik, Nilgün Şafak

International Quality Management System Certificate # QEC27492

SIDRA SOLUTIONS

SIDRA SOLUTIONS - AWARDS

MULTI-AWARD WINNING COMPANY

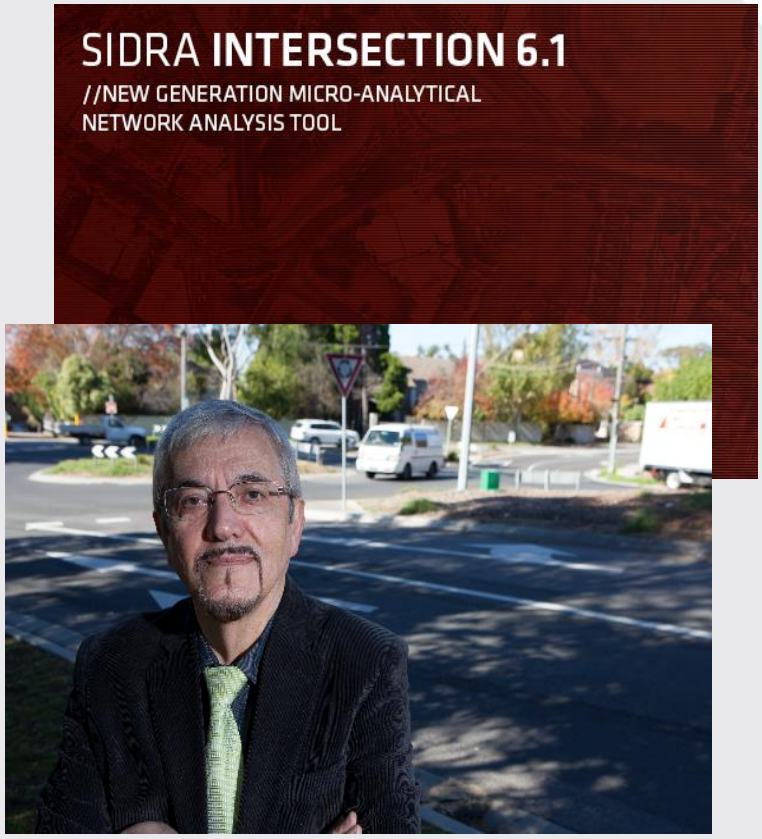
- 2014 Roads Australia Award for Technical Excellence to Dr R. Akçelik
- 2010 Telstra Victorian Small Business "Innovation" Award
- 2008 Contribution to the Transportation Profession Award of the ITE Australia & New Zealand Section to Dr R. Akçelik
- 1999 Clunies Ross National Science and Technology Award to Dr R. Akçelik
- 1986 ITE (USA) Transportation Energy Conservation Award in Memory of Frederick A. Wagner

SIDRA SOLUTIONS

SIDRA INTERSECTION Background

SIDRA INTERSECTION is an **analytical** tool to assist Transport Engineers model **intersections** and **networks**.

Dr Rahmi Akçelik is the author of SIDRA INTERSECTION. He leads the SIDRA SOLUTIONS software development. He is a leading scientist and software developer with over 300 technical publications in his area of expertise.



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SIDRA INTERSECTION Background
Research Base

STRONG RESEARCH BASE

Empirical and theoretical methods combined ...

- 20 years at Australian Road Research Board
- 15 years at Akcelik & Associates

Most documented software: sidrasolutions.com/Resources/Articles

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US Research Results in SIDRA INTERSECTION (as in Highway Capacity Manual)

Dr Akçelik has been a member of TRB Highway Capacity and Quality Service Committees and Subcommittees since 1980s.

This led to adopting US research results used in the Highway Capacity Manual for SIDRA INTERSECTION.

US Highway Capacity Manual (HCM): SIDRA INTERSECTION incorporates the HCM methodologies that are useful generally and it offers significant extensions to HCM methods.

Roundabout Capacity models in SIDRA INTERSECTION:

- **SIDRA Standard** (based on Australian research)
- **HCM 2010** (based on US research)
- **FHWA 2010** (based on UK research) – for comparison only

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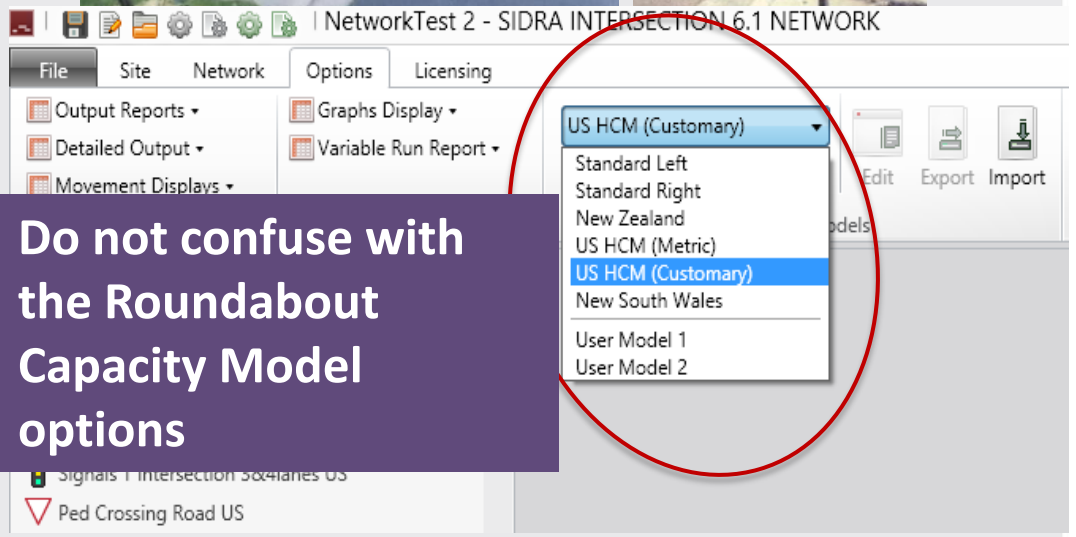
Local Conditions and Model Calibration

Different **driver behaviour**, **vehicle characteristic** and **traffic engineering practices** in different countries requires local calibration.

SIDRA INTERSECTION includes different **Models (Versions)** for different driving conditions.

US HCM (Customary) and **US HCM (Customary)** versions are calibrated according to HCM specifications.

User Models can be used for calibrating the **complete default system** for local conditions.



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SIDRA INTERSECTION Background

First released in 1984

Continuous development in response to user feedback

SIDRA INTERSECTION 6.0 | 6.1 | 7.0
(New NETWORK Model)

Version 6.0 released in April 2013 and improved significantly after release:

- Biggest changes in the 30-year history of the software

Version 6.1 released in February 2015

Version 7.0 expected to be released during late 2015

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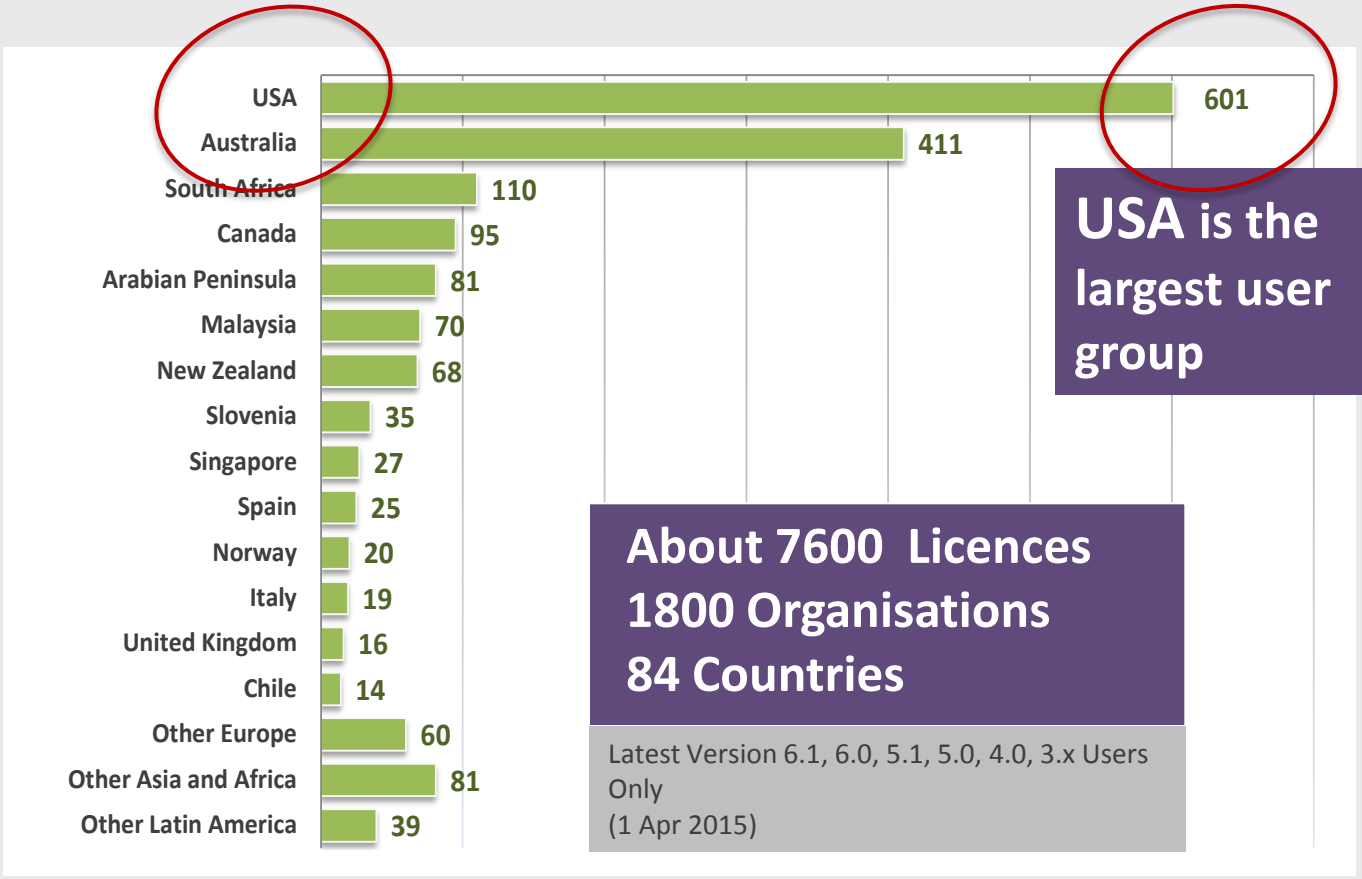
SIDRA INTERSECTION Users



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Documented real-life applications – Roundabout

Fitzsimons Lane - Porter St Roundabout, Melbourne, Australia

Using SIDRA, Vic Roads engineers redesigned a highly congested two-lane roundabout in Melbourne as a three-lane roundabout eliminating persistent congestion.

Paper available on:
sidrasolutions.com/Resources/Articles

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Documented real-life applications– Signals

Richmond Rd and Garfield Rd Intersection, Sydney, Australia

ARRB study for AUSTROADS (Project NS 1371 - Modelling and Analysis of Network Operations) compared micro-analytical (SIDRA INTERSECTION) and micro-simulation (VISSIM) modelling of this intersection including comparison against field measurements.

The study found that

> "Cycle average queue estimates were within one vehicle of field measurement".

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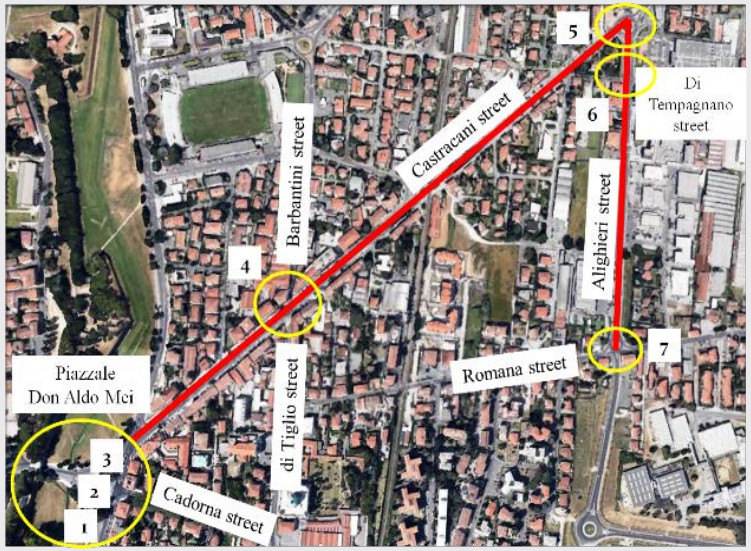
Documented real-life applications– Network

Road corridor in the historical city of Lucca, Tuscany, Italy

The University of Pisa researchers studied a **1.5 km road corridor with seven intersections** including signals, roundabouts and two-way stop controlled intersections.

SIDRA NETWORK model was used to



"This study has been possible thanks to SIDRA INTERSECTION (NETWORK version) that showed its **capability of modelling both single intersections and the road corridor**."

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Basis of SIDRA INTERSECTION

- What can SIDRA INTERSECTION do?
- Modelling principles
- Unique features

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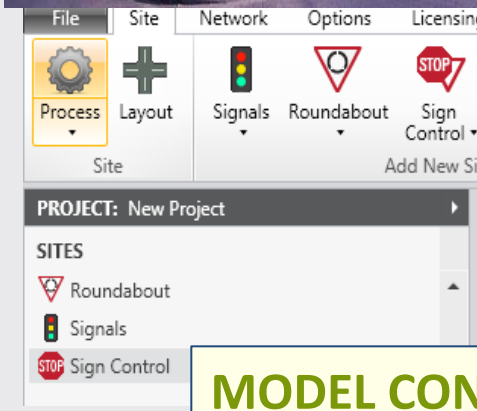
A traffic engineering tool for all intersection types – not just a roundabout software package !



MODEL CONSISTENCY in evaluating alternative intersection treatments

Micro-analytical method for evaluating alternative treatments for INTERSECTIONS AND NETWORKS in one package:

- Roundabouts
- Signals
- Sign Control
- Pedestrian Crossings

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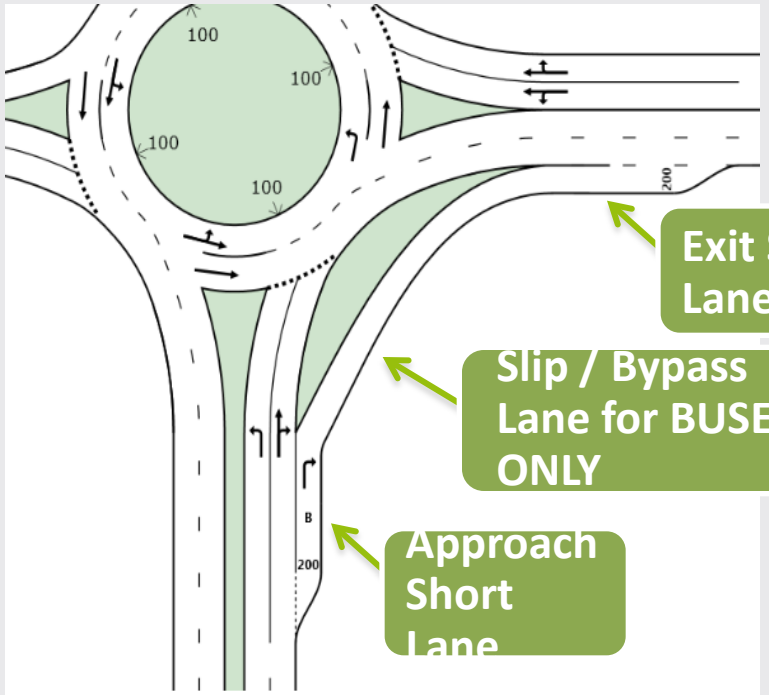
LANE-BASED MODEL

More realistic and reliable analysis compared with approach-based (UK) and lane group-based (US HCM) :

- General: Unequal lane flows, De facto exclusive lanes, Short lanes, Slip / Bypass lanes
- Roundabouts (Circulating lane use; Dominant and subdominant lanes)
- NETWORK Model (lane queues, lane blockage, signal platoon arrival and departure patterns)



Individual approach, exit and circulating lanes have different characteristics

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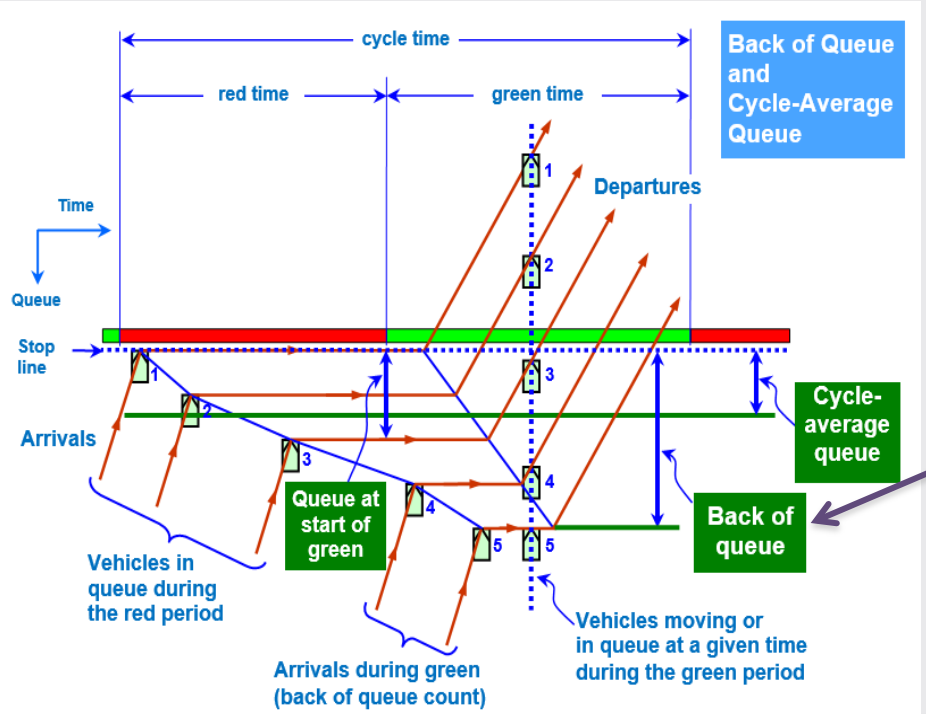
Importance of Back of Queue model

MODEL CONSISTENCY for different intersection types (definition of delay, back of queue, stops, etc).



Back of Queue Percentile and **Probability of Blockage** values are based on the **variability of back of queue** values in individual lanes

BACK OF QUEUE important for Short Lane and NETWORK Modelling

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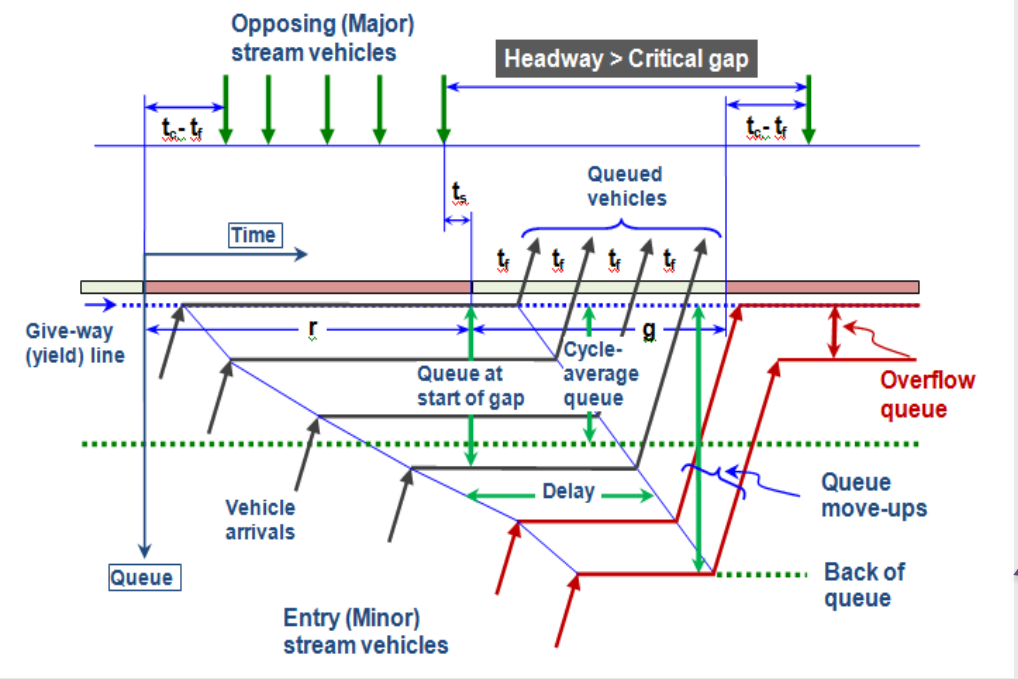
BACK OF QUEUE modelling by GAP ACCEPTANCE CYCLES

Unique method in SIDRA INTERSECTION to estimate **gap-acceptance cycles** helps to model **back of queue** and **stops** for Roundabouts and Sign control



Not in US Highway Capacity Manual or other methodologies

BACK OF QUEUE modelling by GAP ACCEPTANCE CYCLES

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Fundamental strength of SIDRA INTERSECTION

Fundamental strength of SIDRA INTERSECTION is in LANE-BASED CAPACITY ESTIMATION
(including lane flow calculations).

It estimates

- Saturation Flow Rates for Signals
- Follow-up Headway and Critical Gap for Roundabouts and Sign Control

as a function of

- ROAD GEOMETRY
- TRAFFIC CONTROL and
- DEMAND VOLUMES

Does not rely on user guesses but can be calibrated by the user through input …

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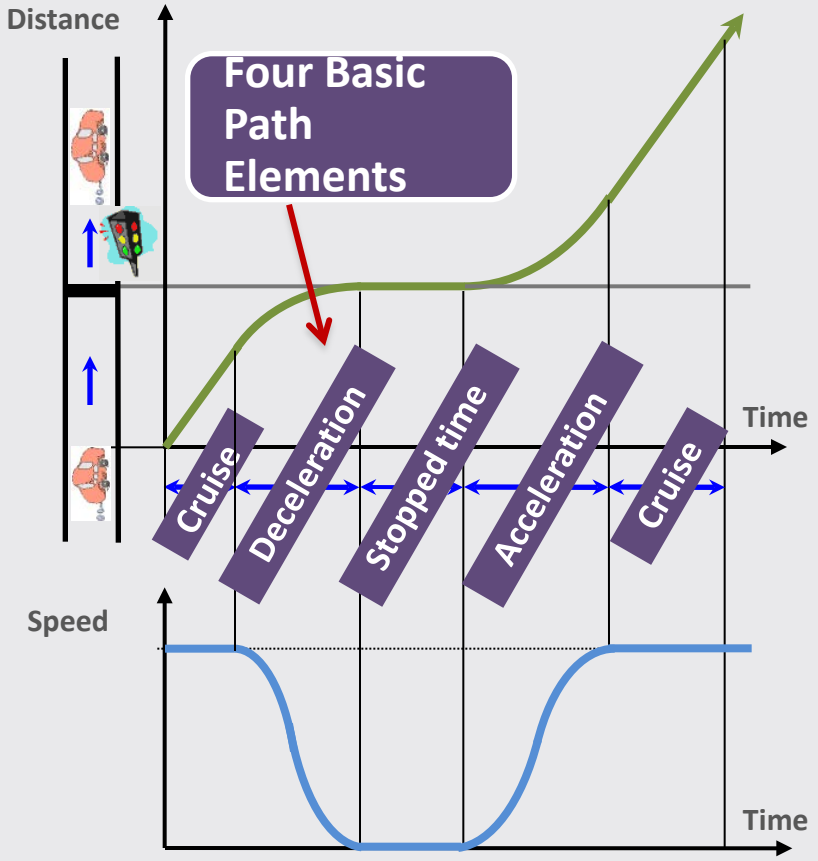
VEHICLE PATH model for stop-start traffic

Lane-based model used for the purpose of

- Emissions - CO_2, CO, HC, NO_x
- Fuel Consumption
- Operating COST
- Geometric Delay

Polynomial acceleration profile model used for light and heavy vehicles



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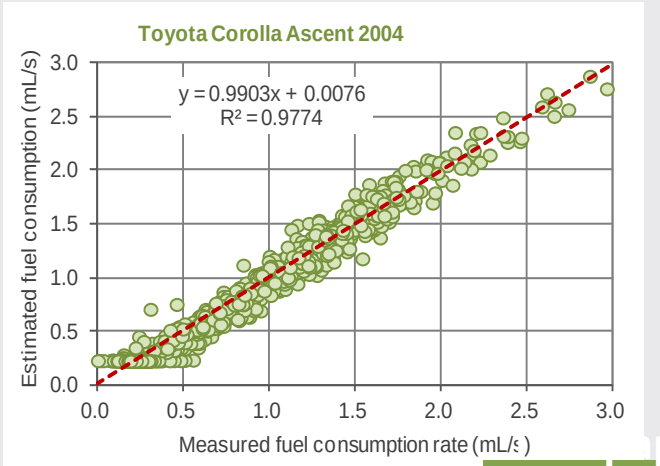
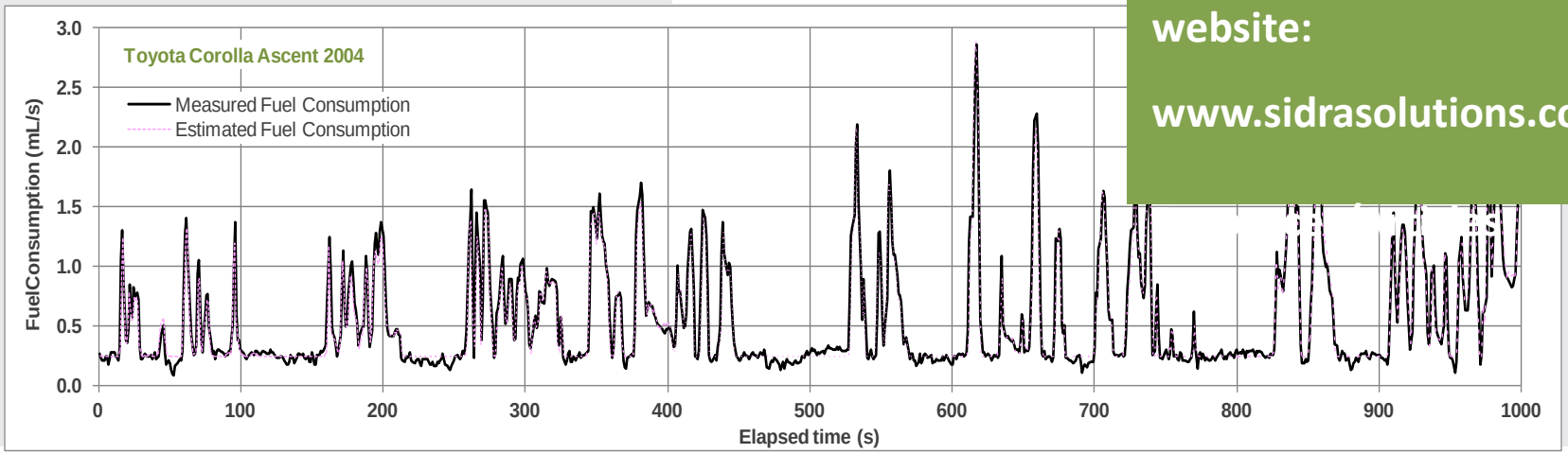
Fuel Consumption and Emission Models with updated parameters

- **Fuel and emission** model parameters updated for modern vehicles
- Model parameters are available for user input (**model calibration**)



Estimated vs measured instantaneous fuel consumption rates



website:

www.sidrasolutions.com/

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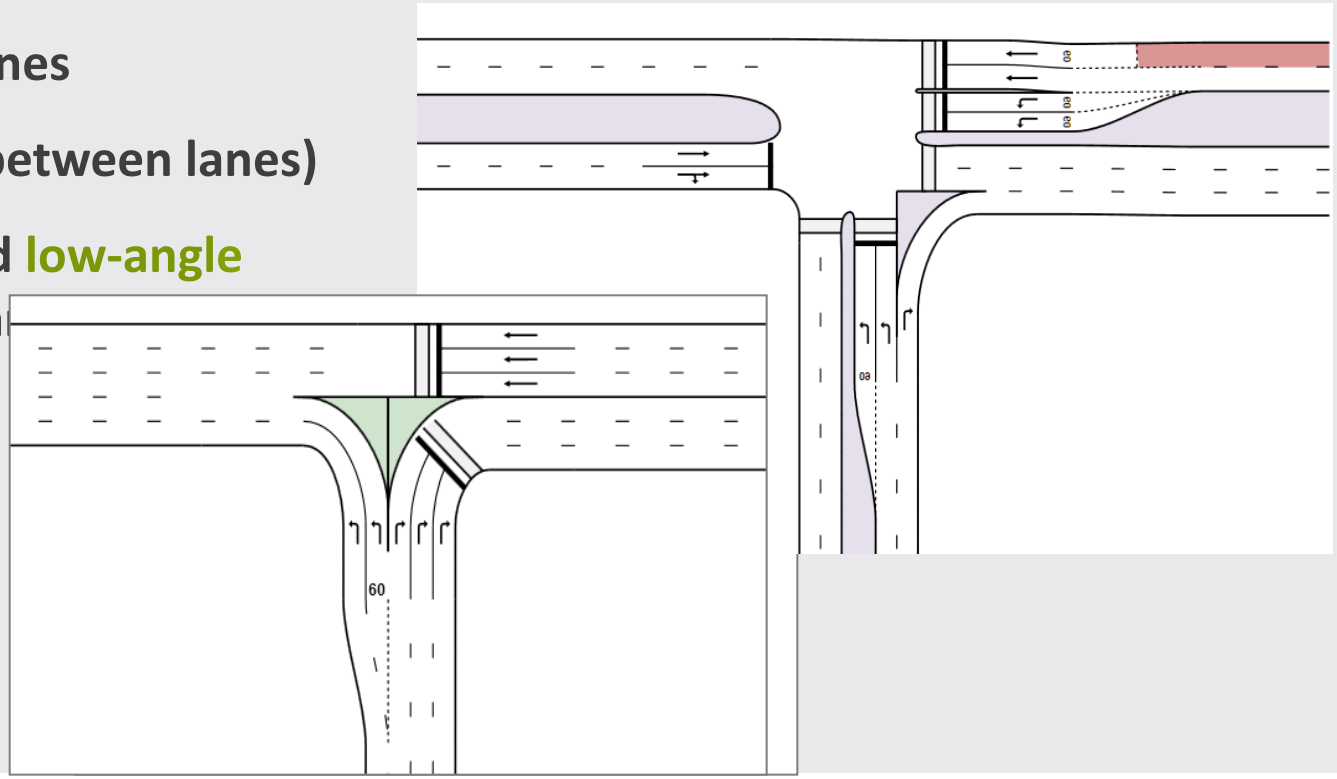
Flexible Intersection Geometry Specification

- **Two-Segment Lanes** (with lane segments that can be allocated to different Movement Classes)
- **Contra-flow** lanes
- **Strip islands** (between lanes)
- **High-angle** and **low-angle** slip (bypass) la



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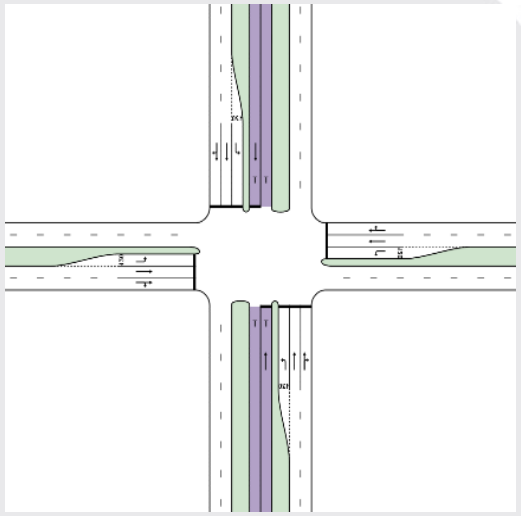
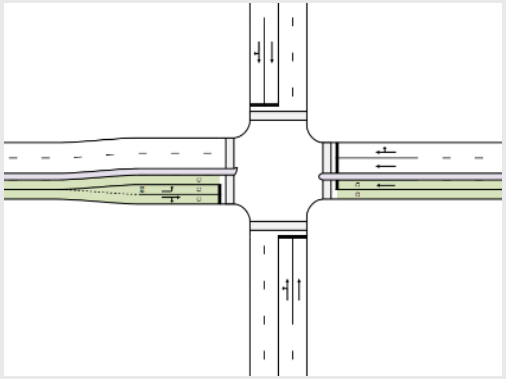
MOVEMENT CLASSES

- Light Vehicles
- Heavy Vehicles
- Buses
- Bicycles
- Large Trucks
- Trams / Light Rail
- Two User Classes for special treatment





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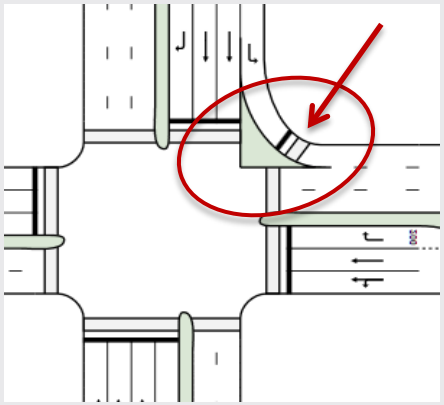
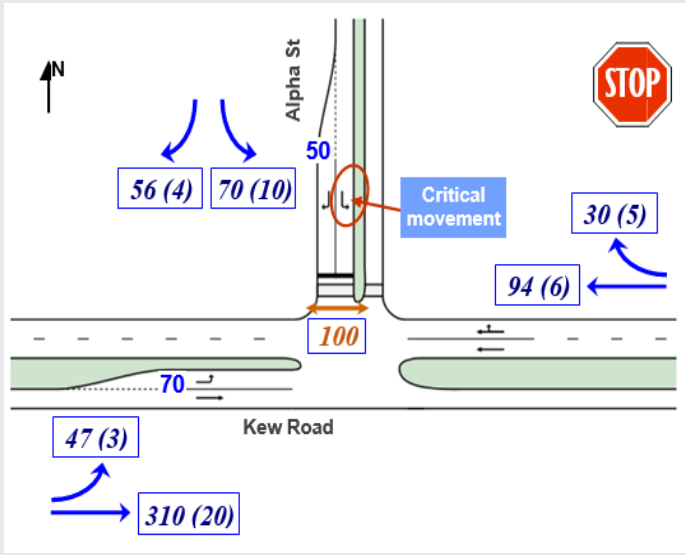
PEDESTRIANS | TWO-WAY SIGN CONTROL

PEDESTRIANS at Signalised intersections, Signalised Crossings, Roundabouts, Two-Way Sign Control



TWO-WAY SIGN CONTROL Capacity Model

Method to adjust **critical gap** and **follow-up headway** automatically for intersection geometry and control



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Roundabouts

- Geometry configurations and parameters
- Templates
- Roundabout Capacity Model
- Unbalanced flows and roundabout metering signals

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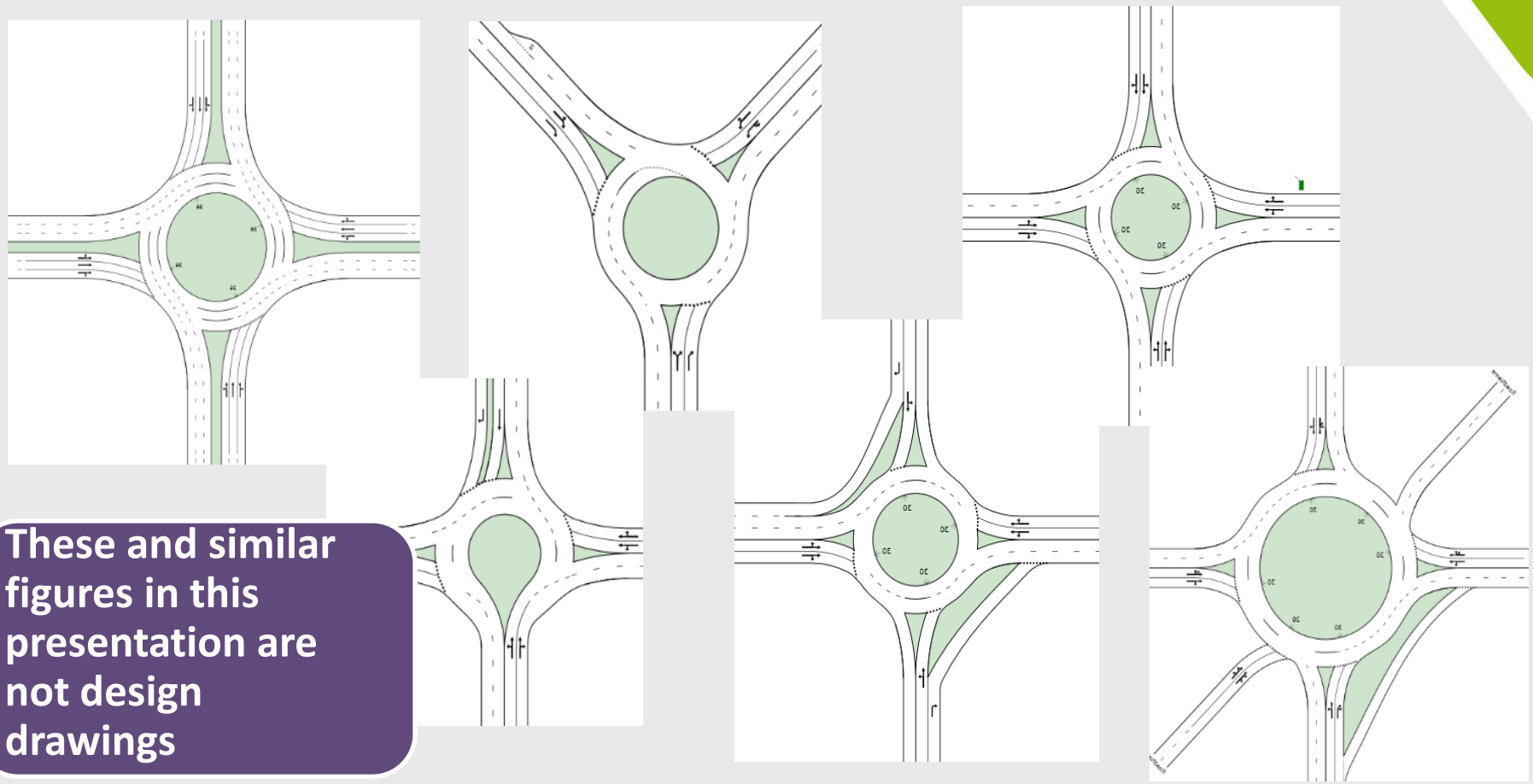
Roundabout Analysis – SIDRA INTERSECTION allows diverse GEOMETRY configurations



These and similar figures in this presentation are not design drawings

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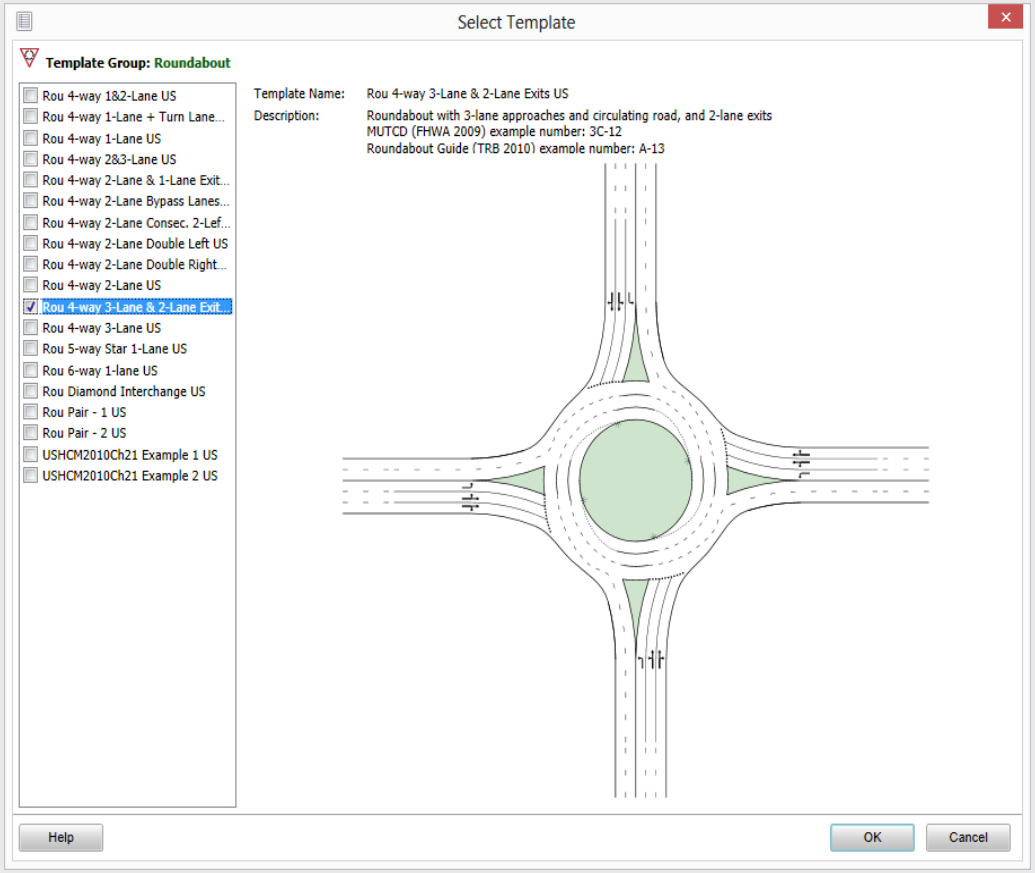
Roundabout Templates

SIDRA INTERSECTION provides a large number of templates for different 1-lane, 2-lane and 3-lane roundabout geometry configurations for easy set up including all MUTCD 2009 / TRB Roundabout Informational Guide design examples.



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Roundabout Capacity Model Options in SIDRA INTERSECTION

SIDRA INTERSECTION includes two main Roundabout Capacity Models

- SIDRA Standard (calibrated for US driving conditions)
- HCM 2010

Common fundamental features:

- Lane-based method
- Geometry and Driver Behavior (Gap Acceptance) effects combined
- Empirical and theoretical methods combined
- Non-linear form
- Back of queue estimation for queue spillback in short lane and network modelling

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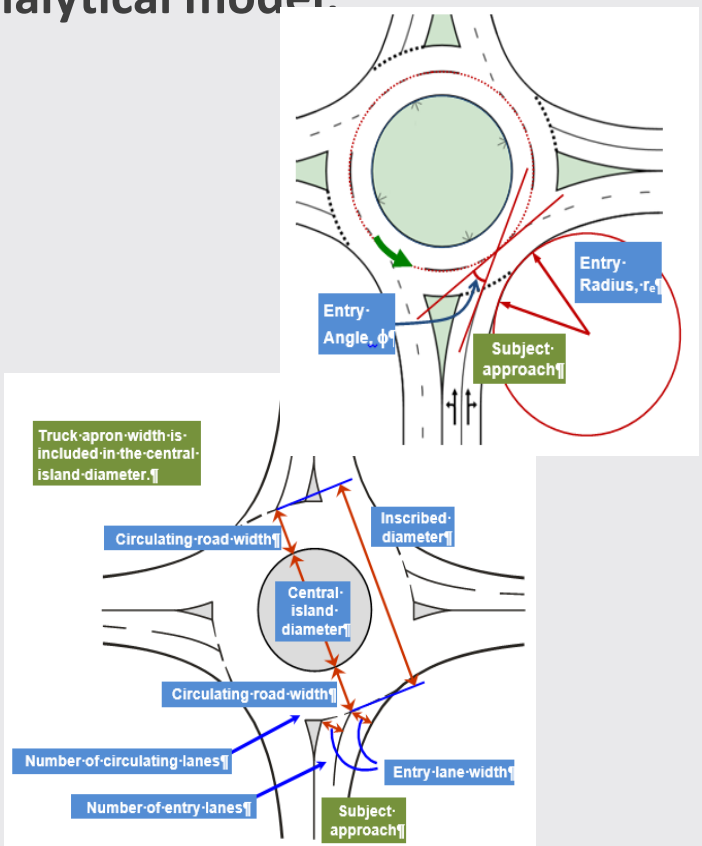
GEOMETRY parameters in the SIDRA Standard Roundabout Capacity Model

SIDRA Standard Capacity Model includes the largest number of roundabout GEOMETRY parameters for any analytical model:

- Number of entry lanes
- Average entry lane width
- Approach lane disciplines and configuration including bypass lanes (by Movement Class)
- Number of circulating (conflicting) lanes
- Central Island Diameter
- Circulating Road Width
- Inscribed Diameter
- Entry radius, Entry Angle
- Approach short lanes
- Number of exit lanes, Exit short lanes



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Observed at UK Roundabouts

Lane use at flared approaches (short lanes) depends on

These cannot be modelled using an APPROACH-BASED method

Driving on the left-hand side of the road

Lane underutilisation caused by a continuous lane without island on another approach

Unequal lane utilisation

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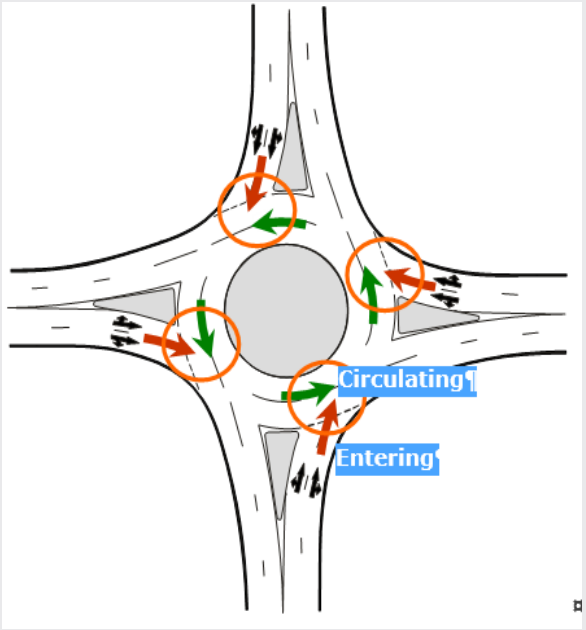
Capacity model with roundabout approach interactions

Roundabout is analysed as a closed system with interactions among roundabout entries

- Capacity constraint
- Bunched headway distribution model for the circulating flow
- Lane balance of circulating flow rates
- Unbalanced flow conditions

Not available in the HCM 2010 and other roundabout capacity models …

NOT as series of T intersections …



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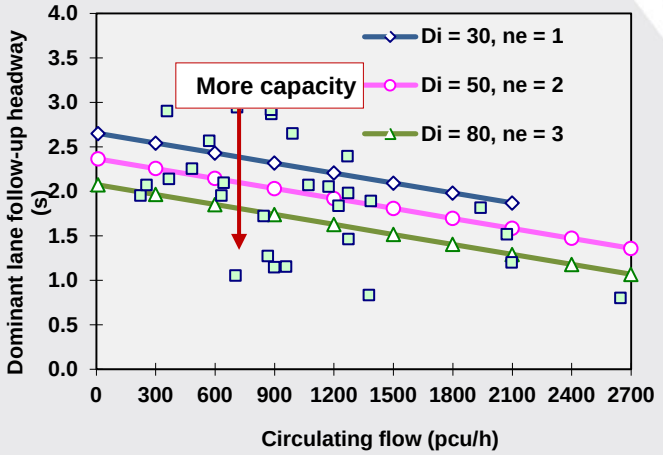
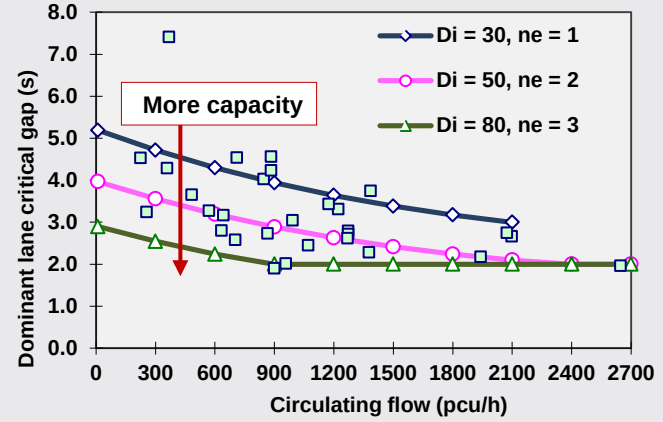
Other Advantages of SIDRA INTERSECTION Roundabout Capacity Model

- Follow-up headway and critical gap values:
  - sensitive to roundabout geometry
  - decrease with increased circulating flows
- Slip / Bypass lanes (give way and continuous)
- Upstream signal effects
- Metering signals
- Network model





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Metering Signals Analysis for UNBALANCED Flow Patterns

SIDRA INTERSECTION identifies congestion caused by UNBALANCED flow patterns at roundabouts

Roundabout Metering Signals

Driving on the left-hand side of the road

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Roundabout Metering Signals CASE STUDY:
Nepean Hwy – McDonald St, Melbourne, Australia, AM Peak

AKÇELIK, R. (2011). **Roundabout metering signals: capacity, performance and timing**. Paper presented at the 6th International Symposium on Highway Capacity and Quality of Service, Transportation Research Board, Stockholm, Sweden.

www.sidrasolutions.com/Resources/Articles

Driving on the left-hand side of the road

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SIDRA NETWORK MODEL

- Unique features
- Extra bunching for roundabouts and sign control
- Examples

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SIDRA NETWORK Model

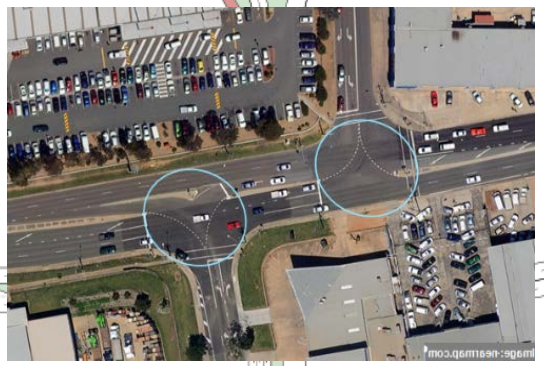
Unique lane-based NETWORK model

All intersection types
(signals, roundabouts, sign control)

Paired Intersections

Easy to CONFIGURE
SIDRA INTERSECTION Sites

Easy to compare a large number of scenarios quickly.



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Network Model in SIDRA INTERSECTION

Iterative method for lane blockage and capacity constraint

Importance of back of queue model and lane-based probability of blockage

Use of Special Movement Classes for closely-spaced intersections

Signal coordination model
(Lane-based second-by-second platoon model as a function of signal offsets)
This will not be discussed in this presentation

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Iterative method for lane blockage and capacity constraint

Backward spread of congestion (reduced upstream capacity)

Capacity constraint (reduced downstream arrival flows)

- The two basic elements of the model are highly interactive with opposing effects.
- SIDRA INTERSECTION uses a network-wide iterative process to find a solution that balances these opposing effects.
- Backward spread of congestion and capacity constraint are common to all intersection types.

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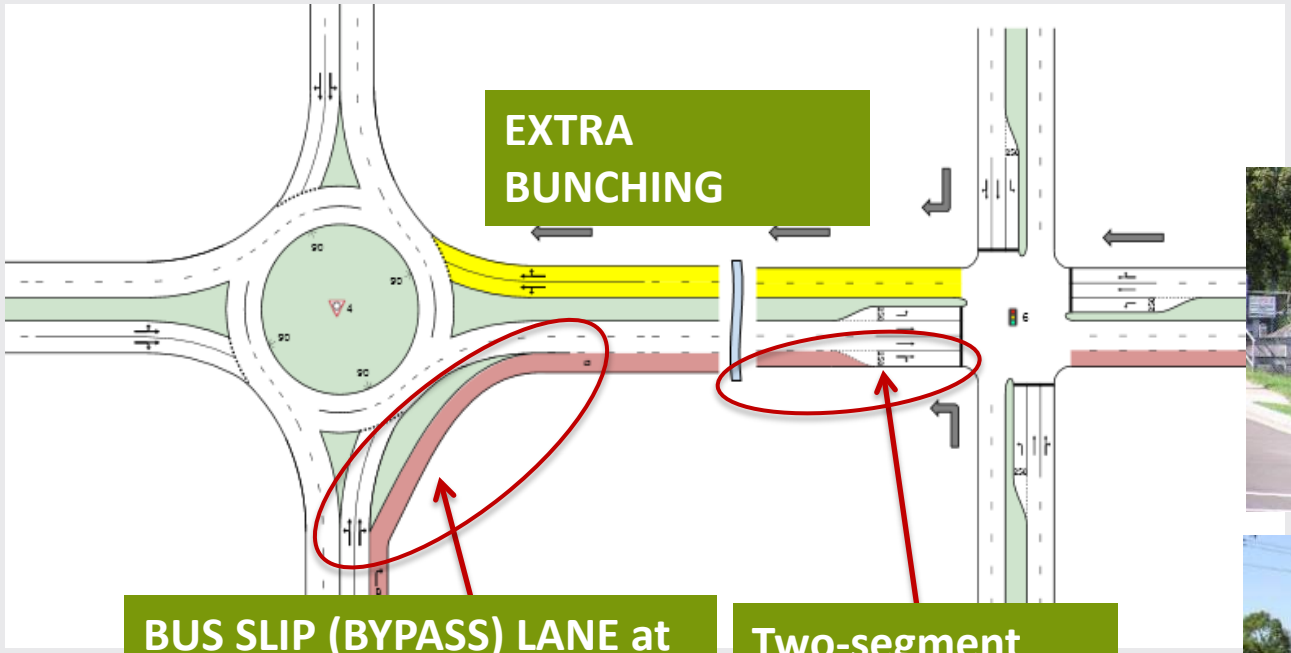
Network Example: Signals and Roundabout with Bus lane

SIDRA INTERSECTION Training Workshop Example



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Extra Bunching model for roundabouts and sign controlled intersections

Extra Bunching can be specified as **INPUT** according to the distance to upstream signals and the amount of platooning.

In **Network analysis**, use the **PROGRAM** option for the program to determine the Extra Bunching value.

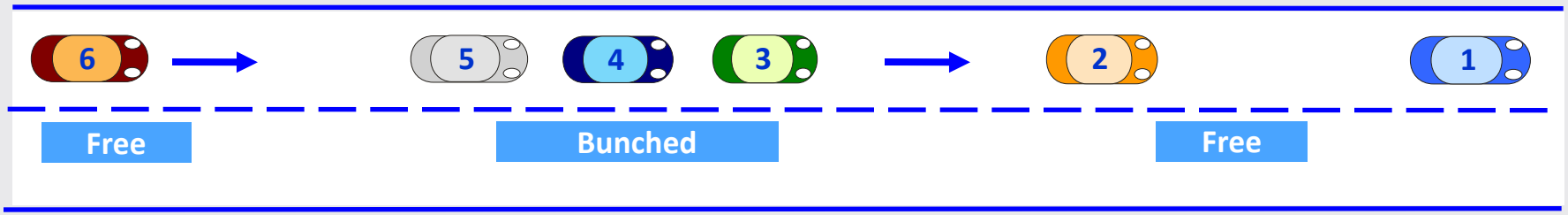
Individual vehicles

↓

Traffic flow

Bunched exponential distribution of headways (delay parameter)

Not in US Highway Capacity Manual or other analytical models …



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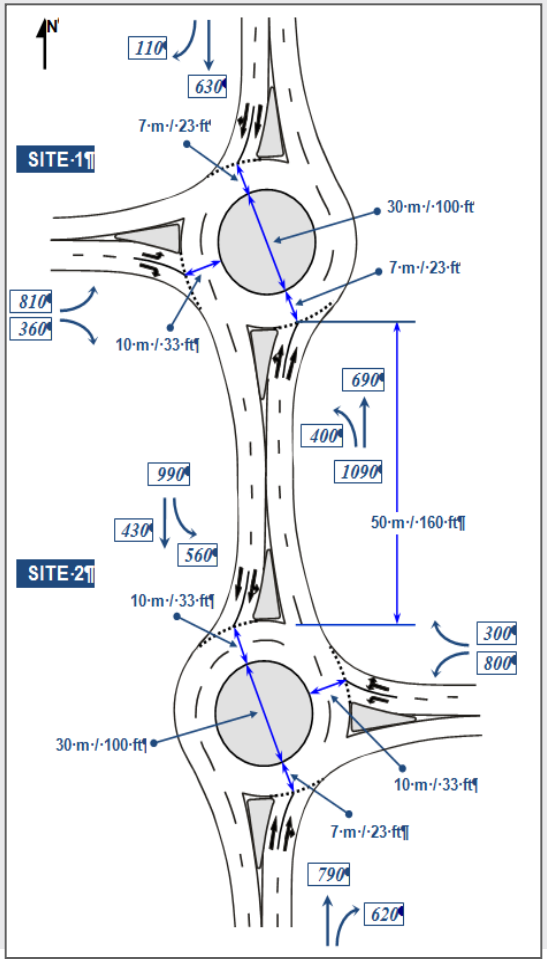
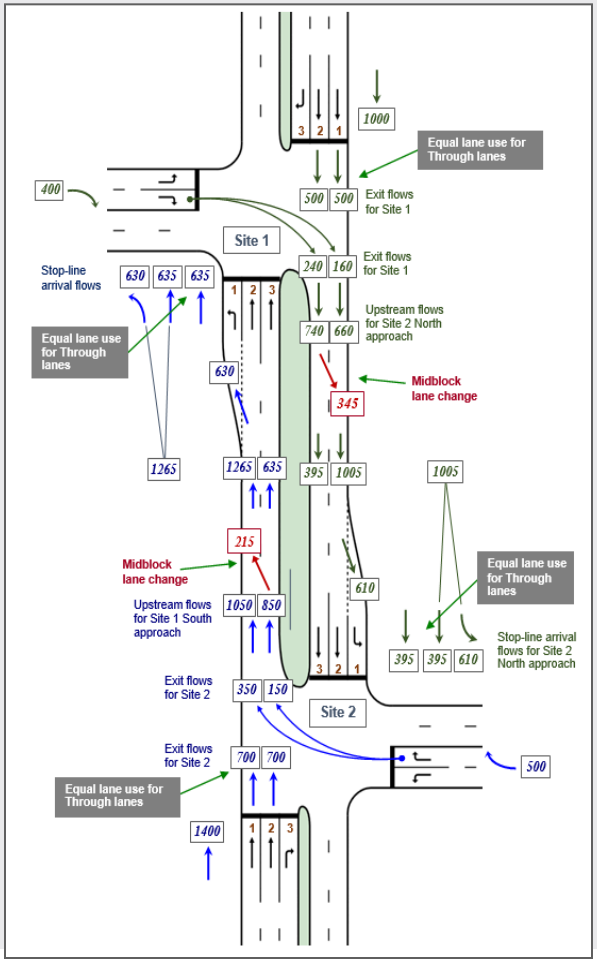
Midblock Lane Changes

Papers presented at the Canadian ITE 2013 Annual Meeting and the ARRB 2014 Conference:

Available on www.sidrasolutions.com/Resources/Articles





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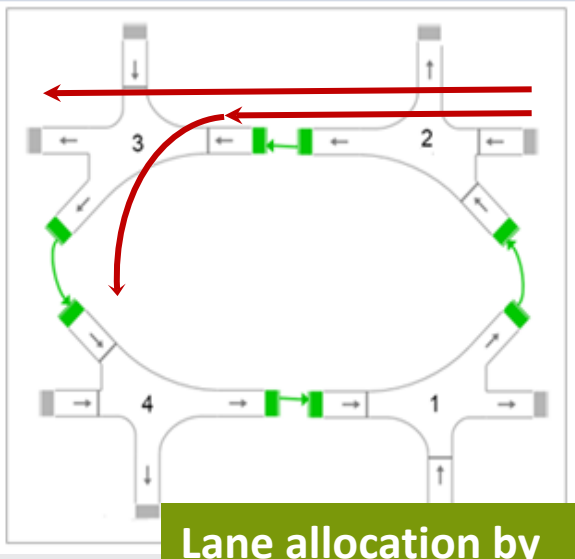
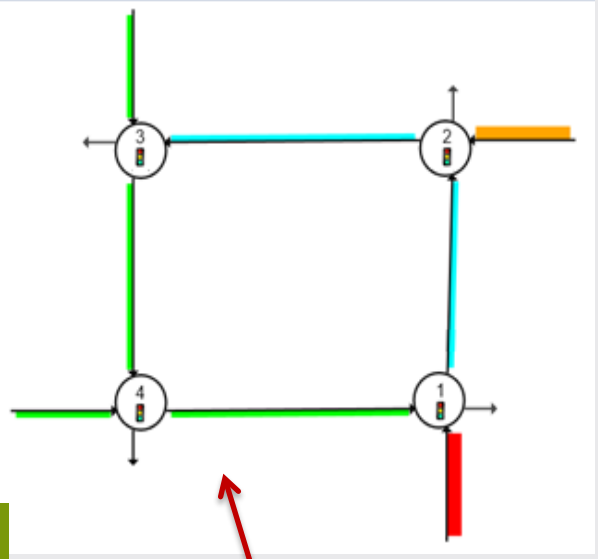
Network Example: Fully Signalised Roundabout





Templates will be available

Lane allocation by SPECIAL MOVEMENT CLASSES for turning movements

Network Displays

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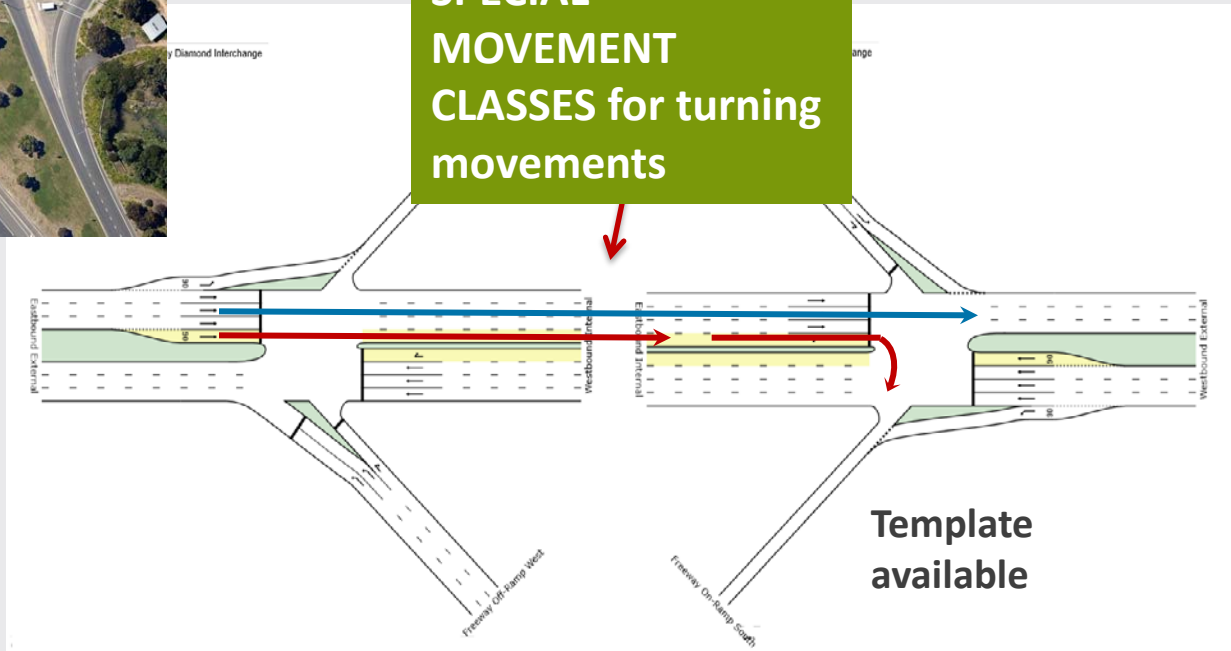
Network Example: Freeway Diamond Interchange

Doncaster Road - Eastern Freeway, Melbourne

Lane allocation by SPECIAL MOVEMENT CLASSES for turning movements



Template available

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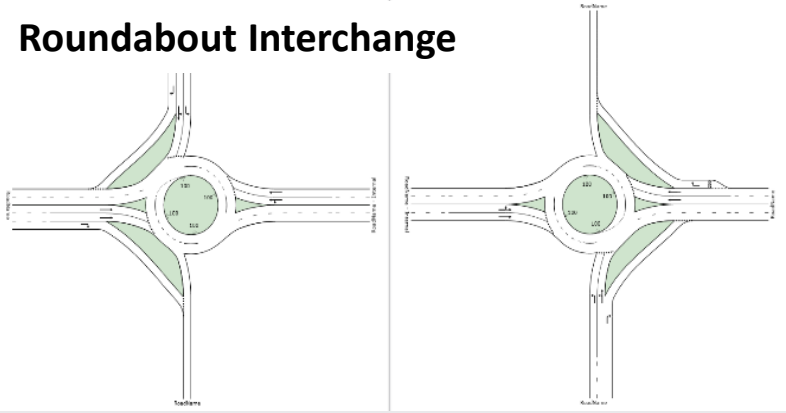
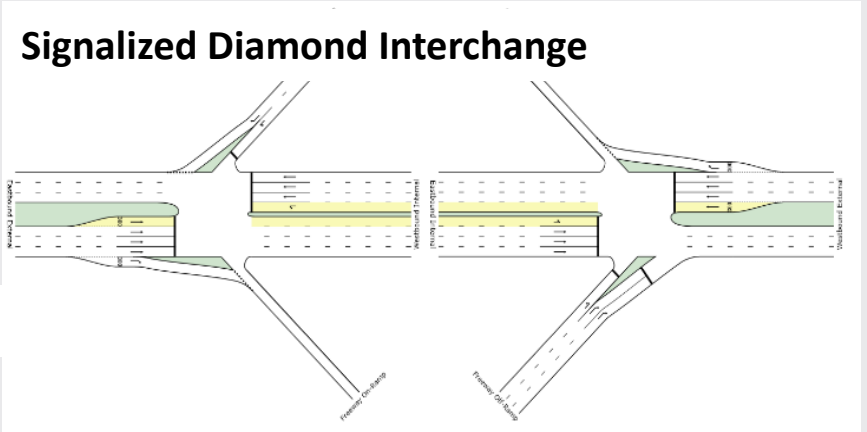
Network Example: Freeway Interchange Comparison

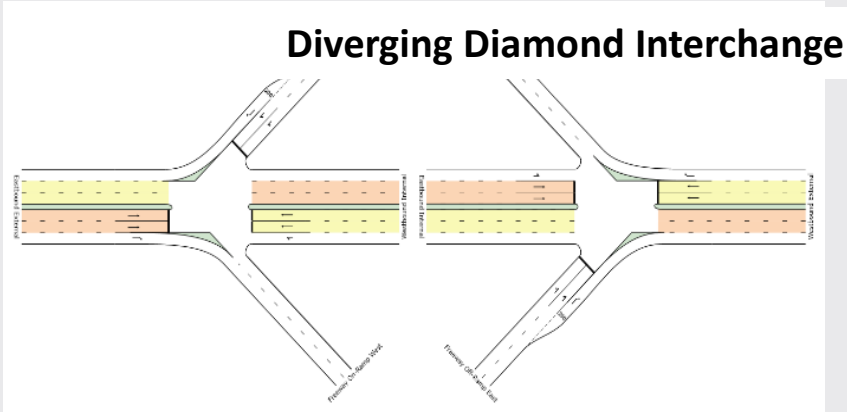
Roundabout Interchange



Signalized Diamond Interchange



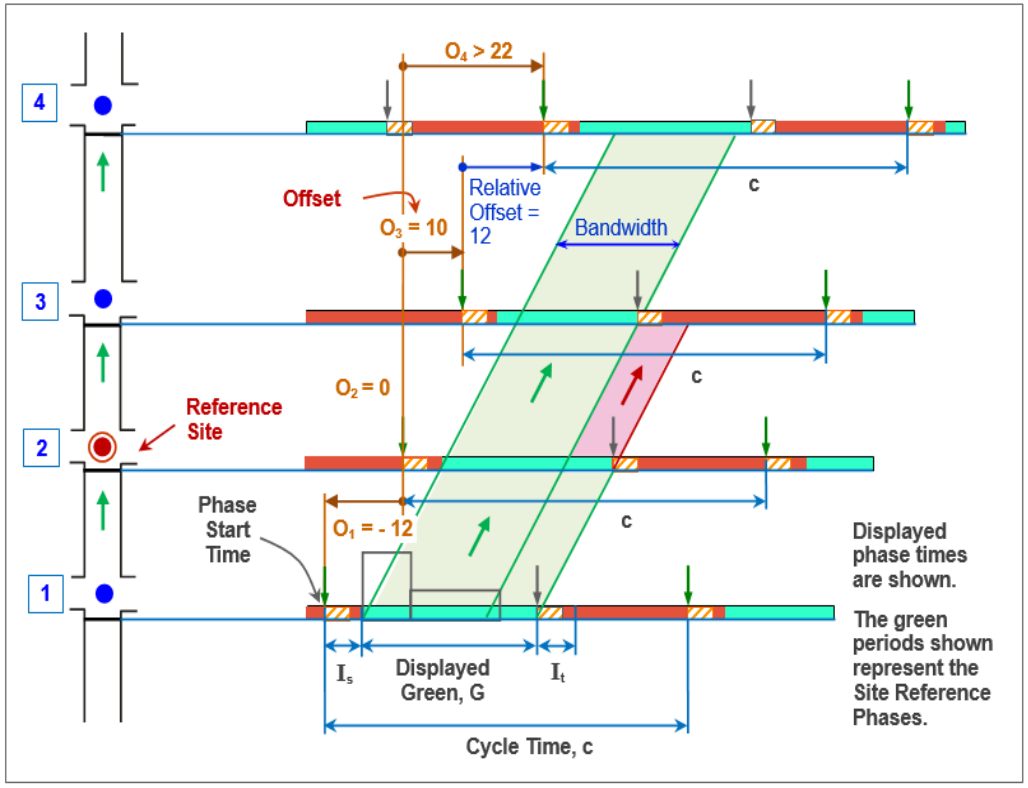
Diverging Diamond Interchange



SIDRA SOLUTIONS

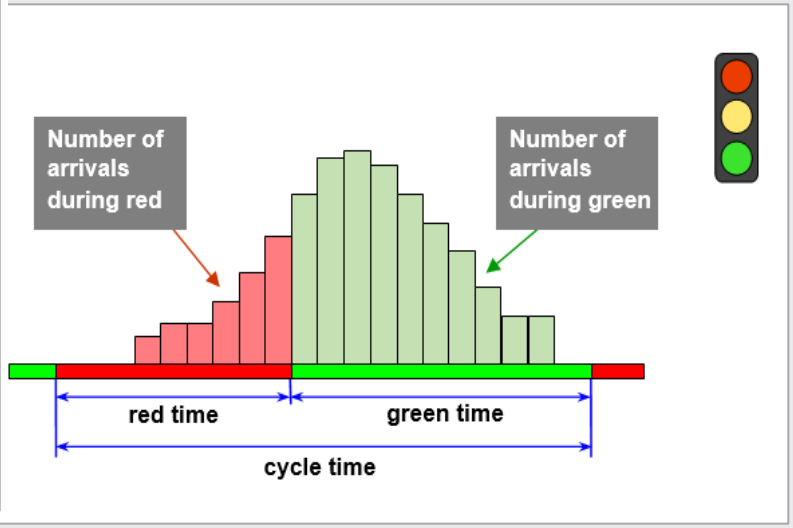
NETWORK TIMING and Platoon Patterns

Not covered in this presentation …



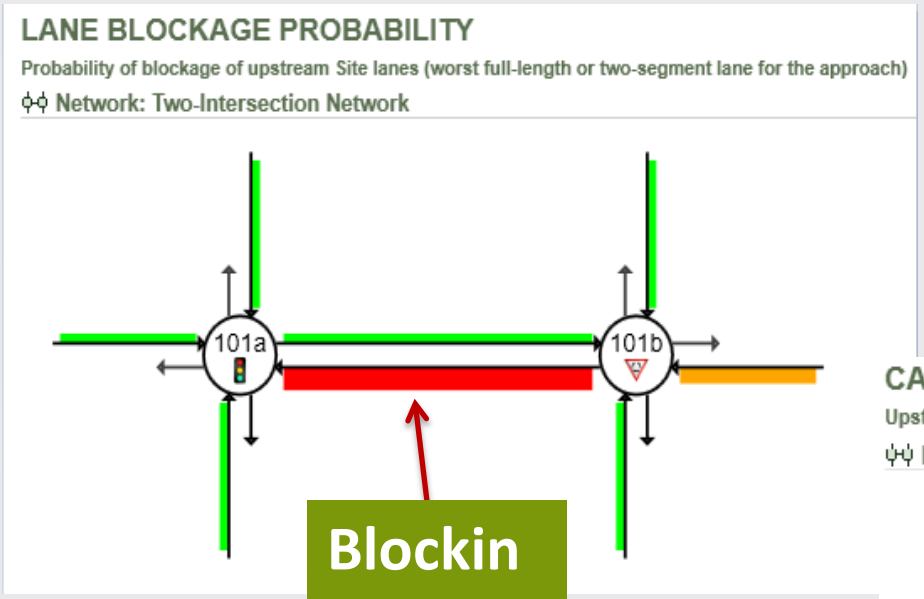
Lane-based (not link-based) second-by-second platoon patterns modelled to estimate

- **Percent Arriving During Green**
- **Platoon Ratio**



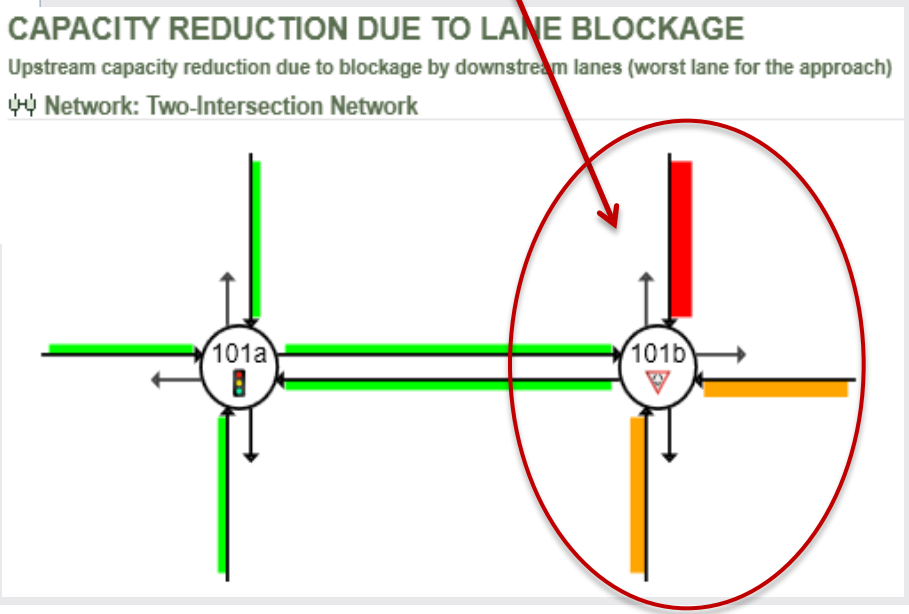
SIDRA SOLUTIONS

Importance of Back of Queue Model and Lane-Based Probability of Blockage in OUTPUT



Blockin
g

Blocked
(capacity
reduction)



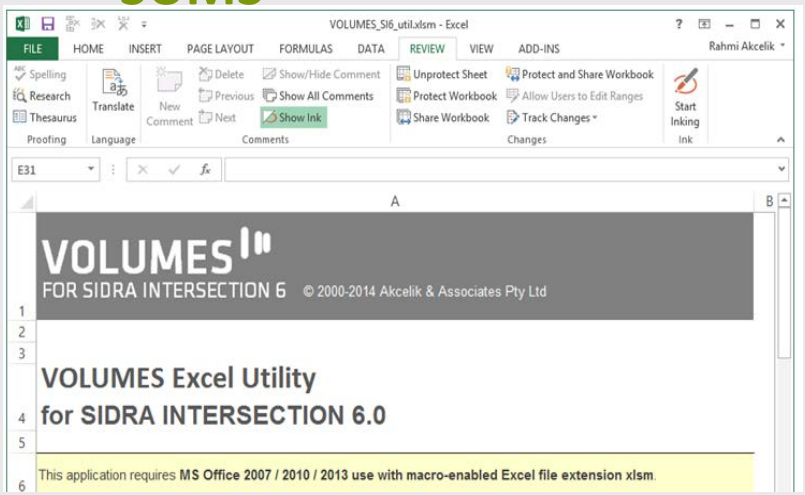
Back of Queue Percentile and Probability of Blockage values are based on back of queue estimates for individual lanes

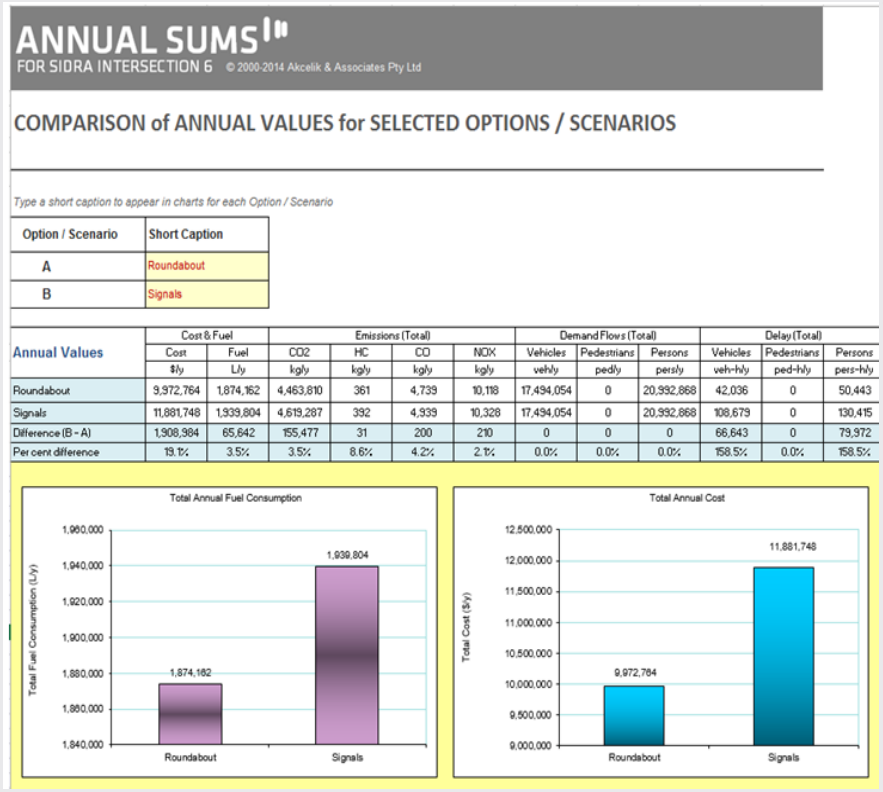
SIDRA SOLUTIONS

SIDRA INTERSECTION API & UTILITIES

EXCEL applications using API:

- VOLUMES
- ANNUAL SUMS
- NETWORK ANNUAL SUMS

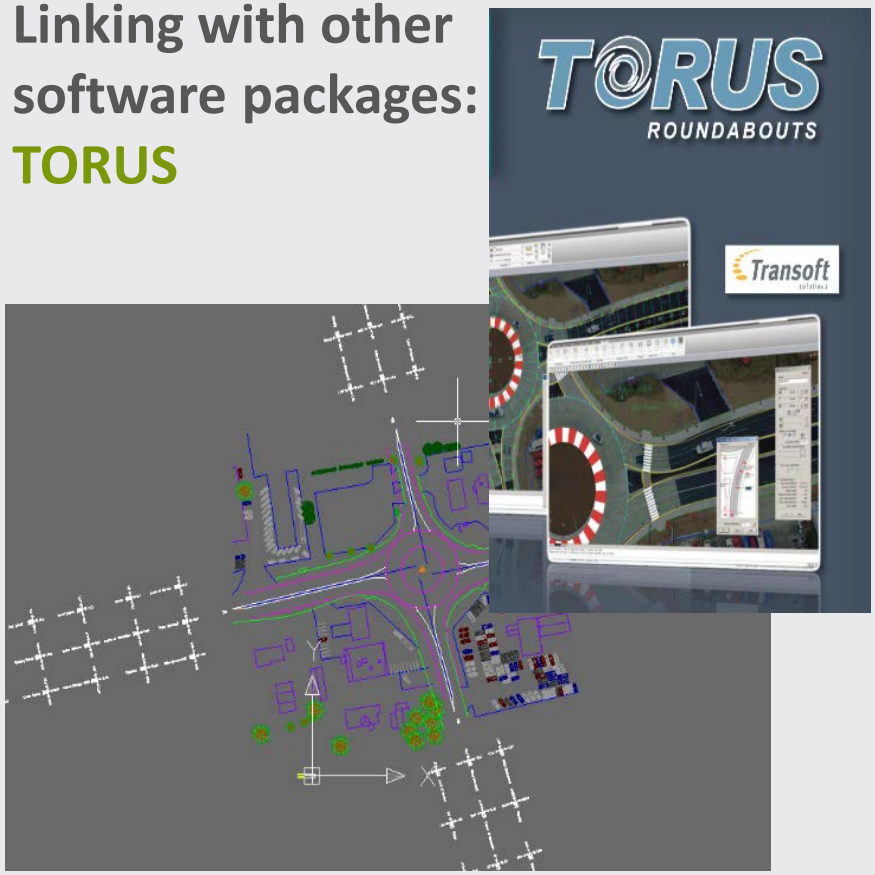




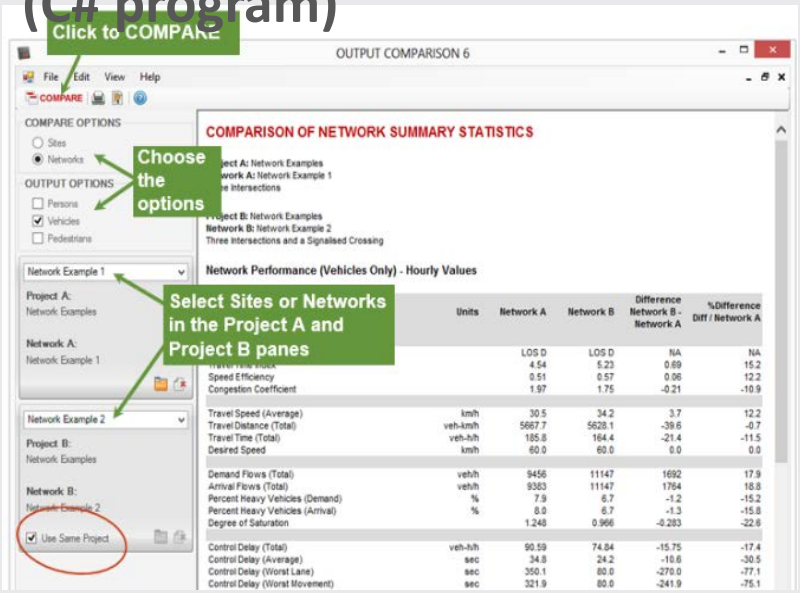
SIDRA SOLUTIONS

SIDRA INTERSECTION API & UTILITIES

Linking with other software packages: TORUS



API sample program: OUTPUT COMPARISON (C# program)



SIDRA SOLUTIONS

END OF PRESENTATION

Prepared by Rahmi Akçelik
www.sidrasolutions.com

SIDRA SOLUTIONS

TRB Webinar Series
06 May 2015

ROUNDABOUT ANALYSIS AND DESIGN WITH PTV VISSIM

Karen Giese, P.E.
PTV Group

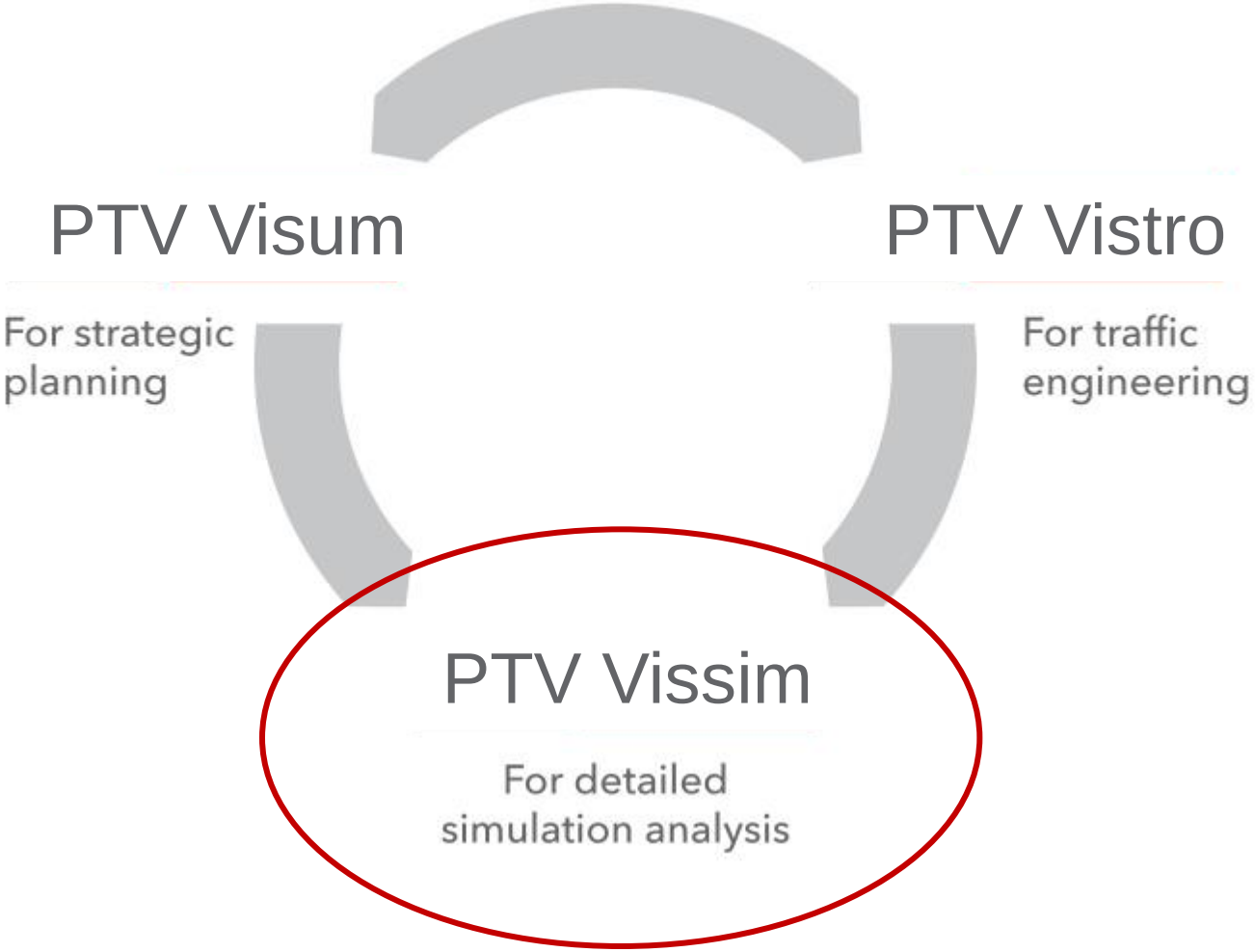
AGENDA

- Overview of PTV VISSIM
  - What is PTV Vissim?
  - PTV Vissim Background
  - Technical Overview of Vissim
- PTV Vision and Roundabouts
  - PTV Vision® in the Roundabout Design Workflow
  - VISSIM Roundabout Modeling Basics
    - Key Features for Roundabouts
    - Basic Roundabout Modeling Steps
    - Output
- Vissim Roundabout Modeling Calibration
- Vissim Roundabout Modeling Questions and Discussion

OVERVIEW OF PTV VISSIM

Karen Giese, P.E.
PTV Group

WHAT IS THE VISION TRAFFIC SUITE?



WHAT IS VISSIM?

Microscopic transit/traffic simulation consisting of

- Traffic flow model which moves and tracks each vehicle
- Signal control model

User-friendly graphical interface (GUI)

- Graphical network editor for data input of road network, transit lines, routes, volumes, detectors, signals, etc.
- Definition of user-specific vehicle types (passenger cars, HOV-cars, trucks, buses, articulated buses, trams, LRT-vehicles, bicyclists, pedestrians etc.)
- Definition of user specific driving behavior to override default values

Decision support system

- On-line visualization of traffic operation in 2D and 3D
- Measures of effectiveness like delay, queue length, travel times, mean speed, emissions etc

VISSIM BACKGROUND

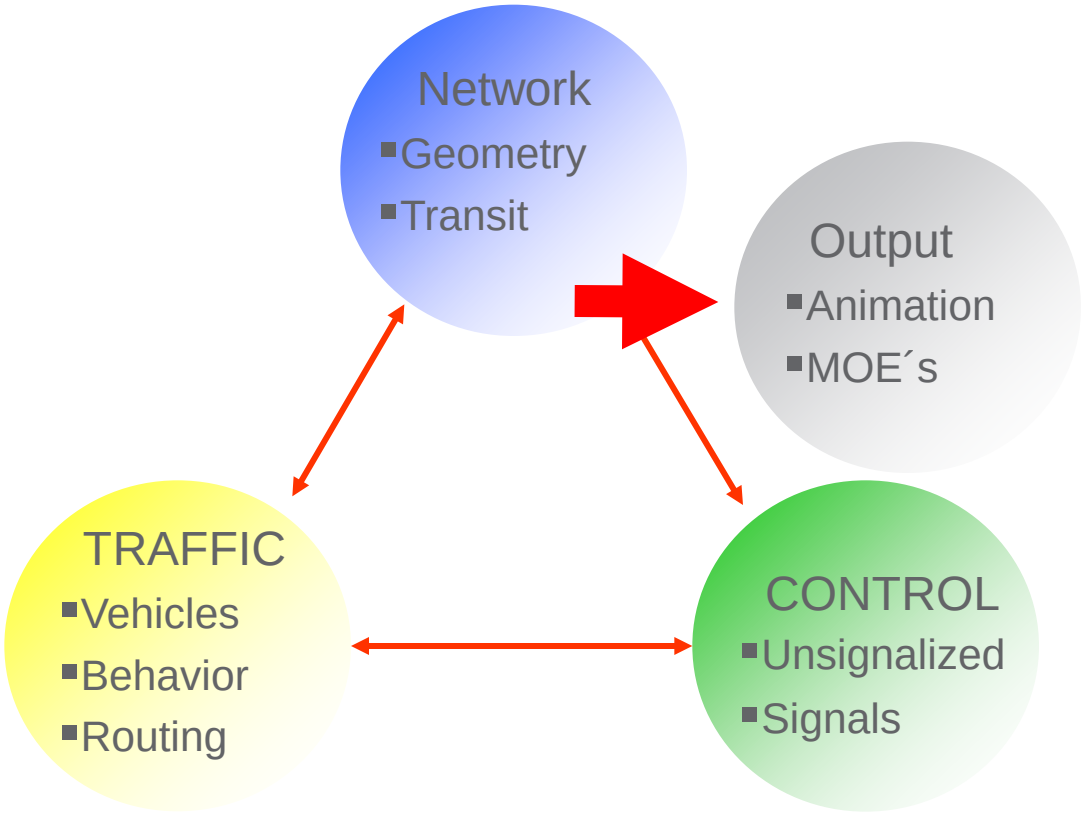
History

- Development started during early 1970's at the University of Karlsruhe, Germany
- First commercial release of VISSIM in 1993 for Siemens traffic control
- First international application in 1995
  (Eugene, Oregon)
- Currently embedded within software suite:
  Demand Forecasting → Simulation

CORE BUILDING BLOCKS OF VISSIM

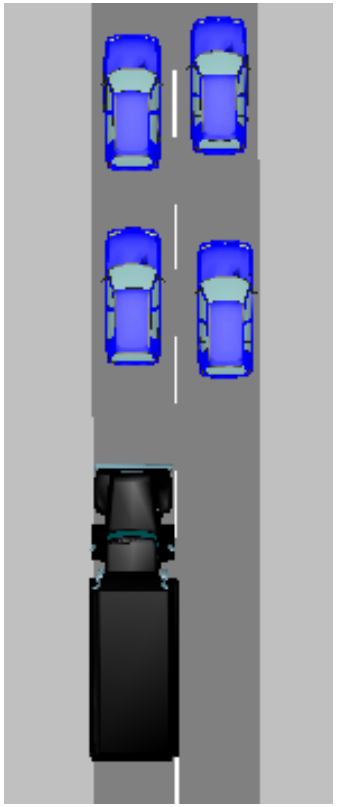
Four core building blocks in VISSIM

- **Network** representing the physical infrastructure for roadway and tracks
- **Traffic** representing the vehicular movements on the network
- **Control** representing how traffic behaves in case of conflicting movements
- **Output** generating results from simulation runs

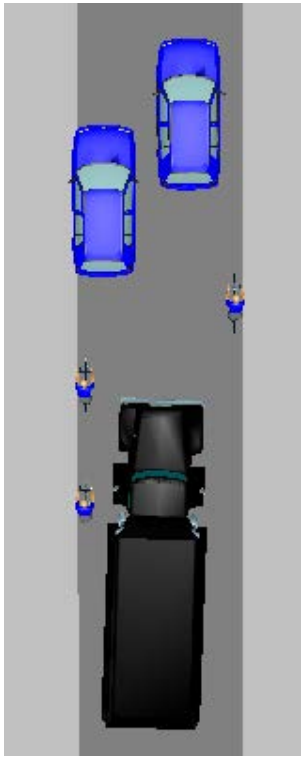


VISSIM MODEL BASICS

lane oriented



space oriented



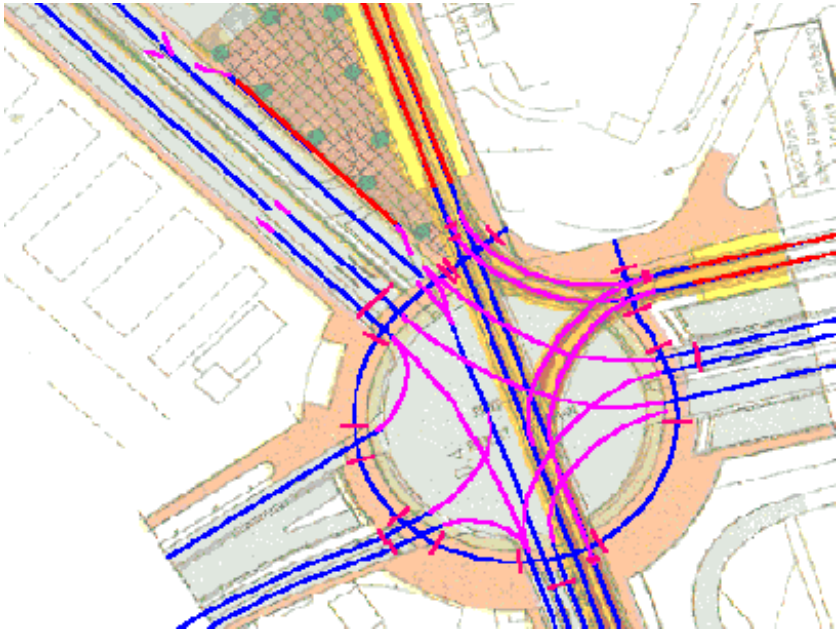
VISSIM GEOMETRY DETAILS

Network Topology

- Not link-node model but link-link model
- Flexible geometry
- Traffic modeled within intersections

3D

- Networks
- Vehicles
- Objects



GEOMETRY DETAILS

All Functional Classifications

ITS Infrastructure

- Variable speed limits, Route guidance, etc.

Lane Management

- Toll plazas, HOT, HOV Lanes, etc.

Freeway Modeling

- Merging, weaving areas, incident Modeling, etc.

Arterial Modeling

- U-turns, **Roundabouts**, Stop-controlled intersections, 2-way left turn lanes, etc.

Others

- Bike lanes, crosswalks, multi-use paths etc.

MODES

Vehicle Types:

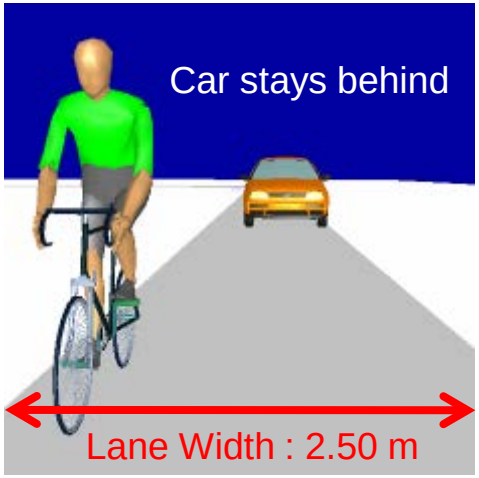
- User definable Vehicle Types (Unlimited)
- Autos, Trucks, Buses
- SOV, HOV
- LRT, BRT, Trams
- Bicyclists, Pedestrians

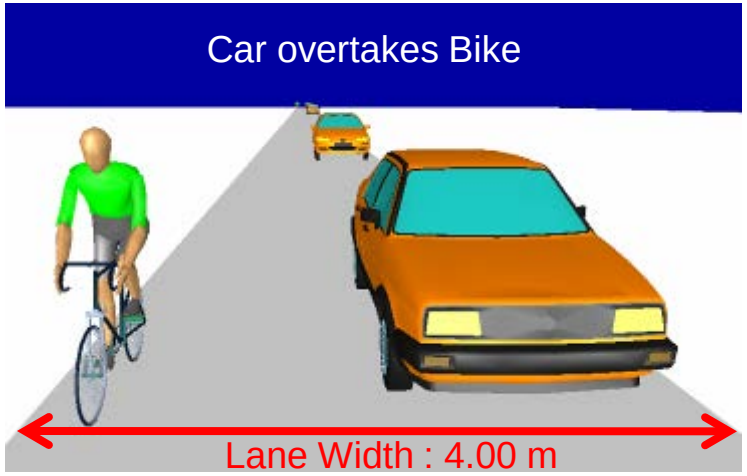
Technical Specifications:

- Dimensions
- Acceleration / Deceleration
- Articulation Points
- Power
- Dynamic route guidance equipment

MODES - BICYCLISTS

- Bike Trails
- Mixed use for Car and Bike
- Continuous lateral movement within its lane
- Overtaking within same lane depending on vehicle type, speed and required safety envelope

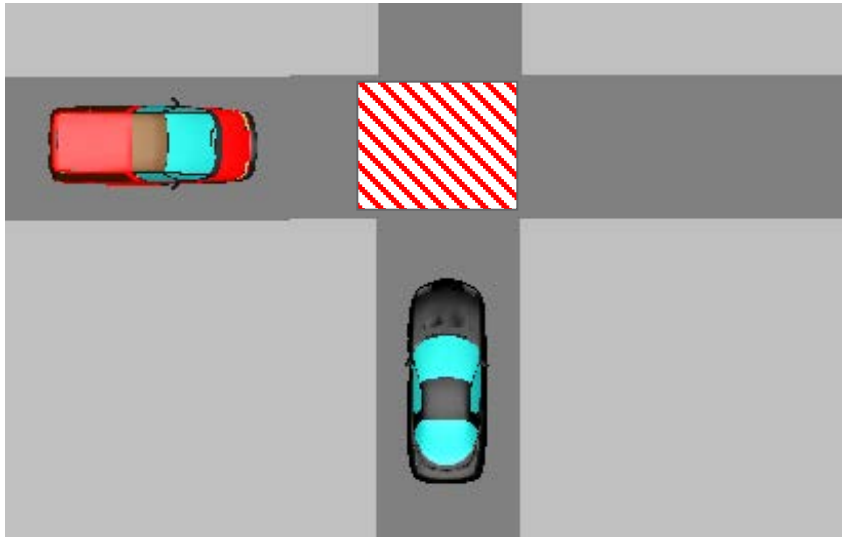




VEHICLE/VEHICLE INTERACTION

Car following

(model based on Wiedemann)



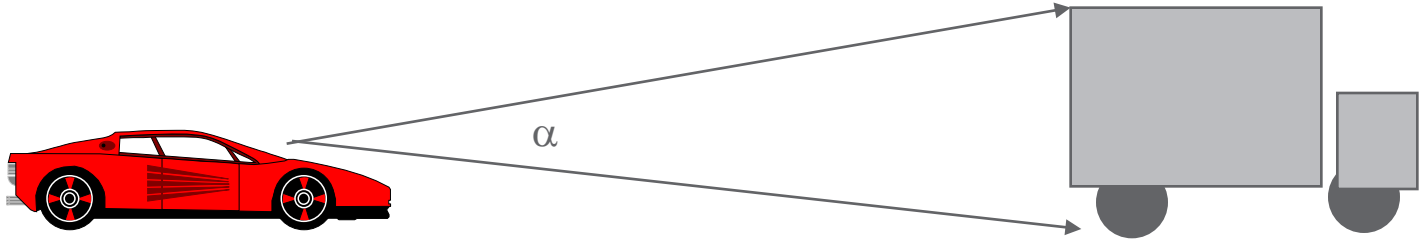
Conflict areas: priority rules

VEHICLE-TO-VEHICLE INTERACTION

Psycho-Physical – Car Following Model

Psychological:
- Desired speeds
- Desired safety distances

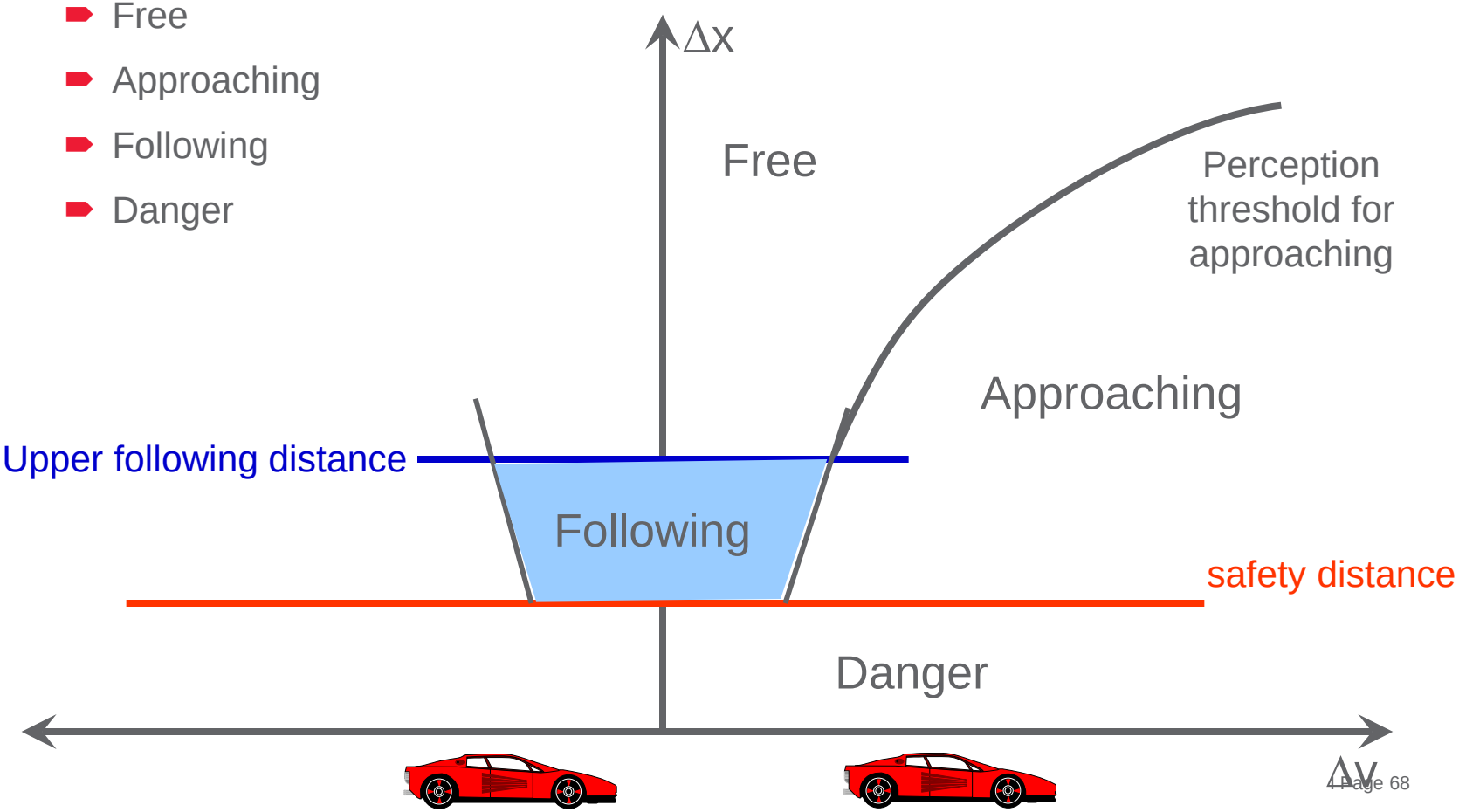
Physical:
- Perception limits
- Imperfect vehicle/throttle control



VEHICLE-TO-VEHICLE INTERACTION

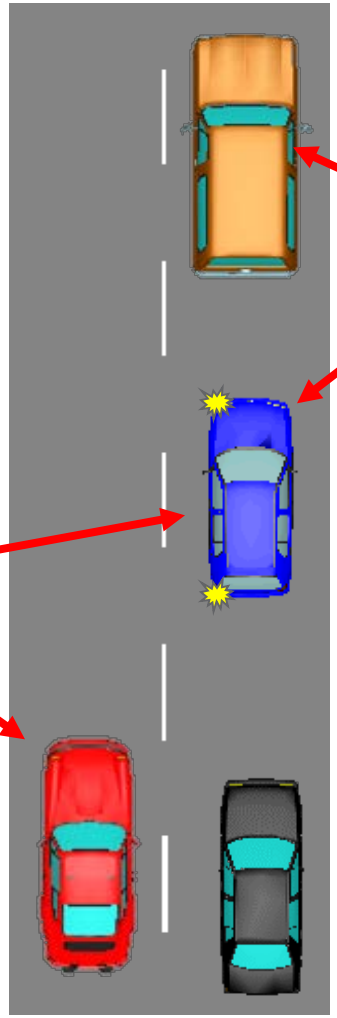
Psycho-Physical – Car Following Model

- Free
- Approaching
- Following
- Danger



VEHICLE-TO-VEHICLE INTERACTION

Lane Change Behavior



Maneuver planning:
driver accelerates
during lane changing

Cooperation:
each with every car,
but only once per
merging area

INTERACTION OF VEHICLES WITH ROADWAY INFRASTRUCTURE

Signal control:

- Fixed time
- Actuated control (VAP, NEMA/170/2070, Econolite ASC/3)
- Interface with external signal control possible (Hardware-In-The-Loop)

Rules of the Road:

- Stop signs
- Yield signs
- Speed reductions

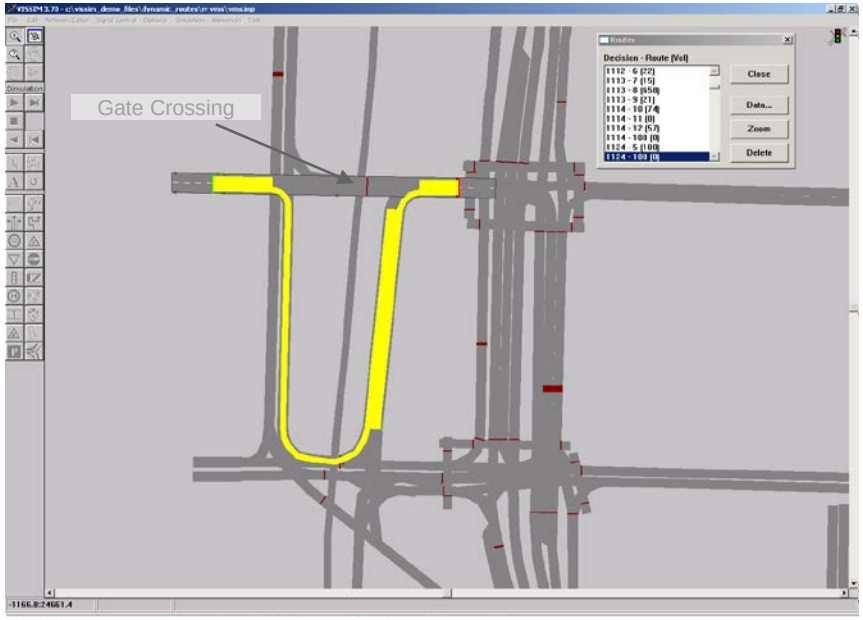
Link and vehicle type dependent driver behavior parameters

- Unlimited

VEHICLE ROUTING

Static O-D Route

- Turning Movements
- Time Period / Vehicle Class
- Relative flow of all Routes



Dynamic Routes

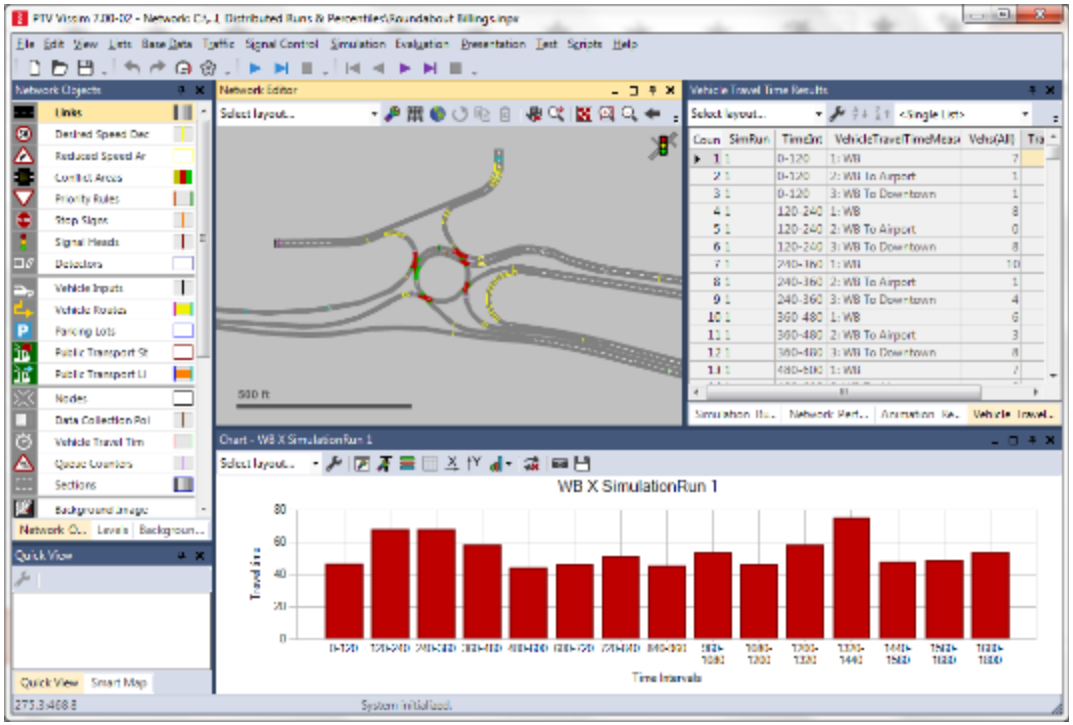
- Dynamically changing Relative flow based on Traffic condition

Dynamic Traffic Assignment

- TAZ’s and O-D table
- Automatic route search and choice based on minimum cost
- Multiple iterations

SIMULATION OUTPUT DATA

- Maximum solution: Complete protocol of all events
- User-defined parameters
- User-defined filters
- Aggregated MOEs for link segments, nodes/junctions and network
- Output to text file, data base and accessible via COM interface
- Graphical display in 2D (individual vehicles and aggregated results) and 3D



VISSIM PERFORMANCE MEASURES

System

- Network Delay, Network Travel Time, VMT

Intersection

- Delay - stopped, control, or person
- Queue lengths
- Number of stops

Link

- Density, Volume, Speed

Transit

- Travel time, Standard Dev., Pass. Wait Time

Signal control

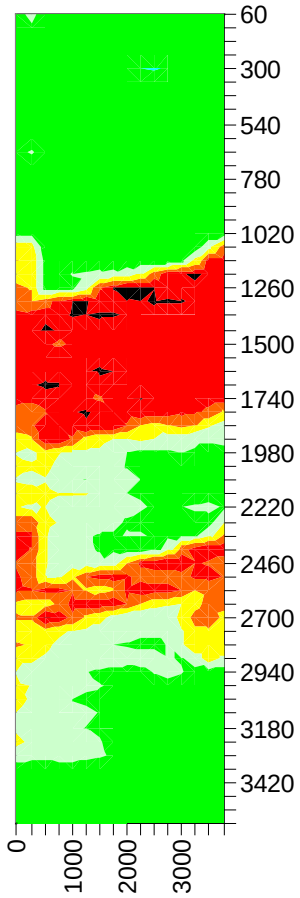
- Average Cycle Length, Average Green Time

Routes

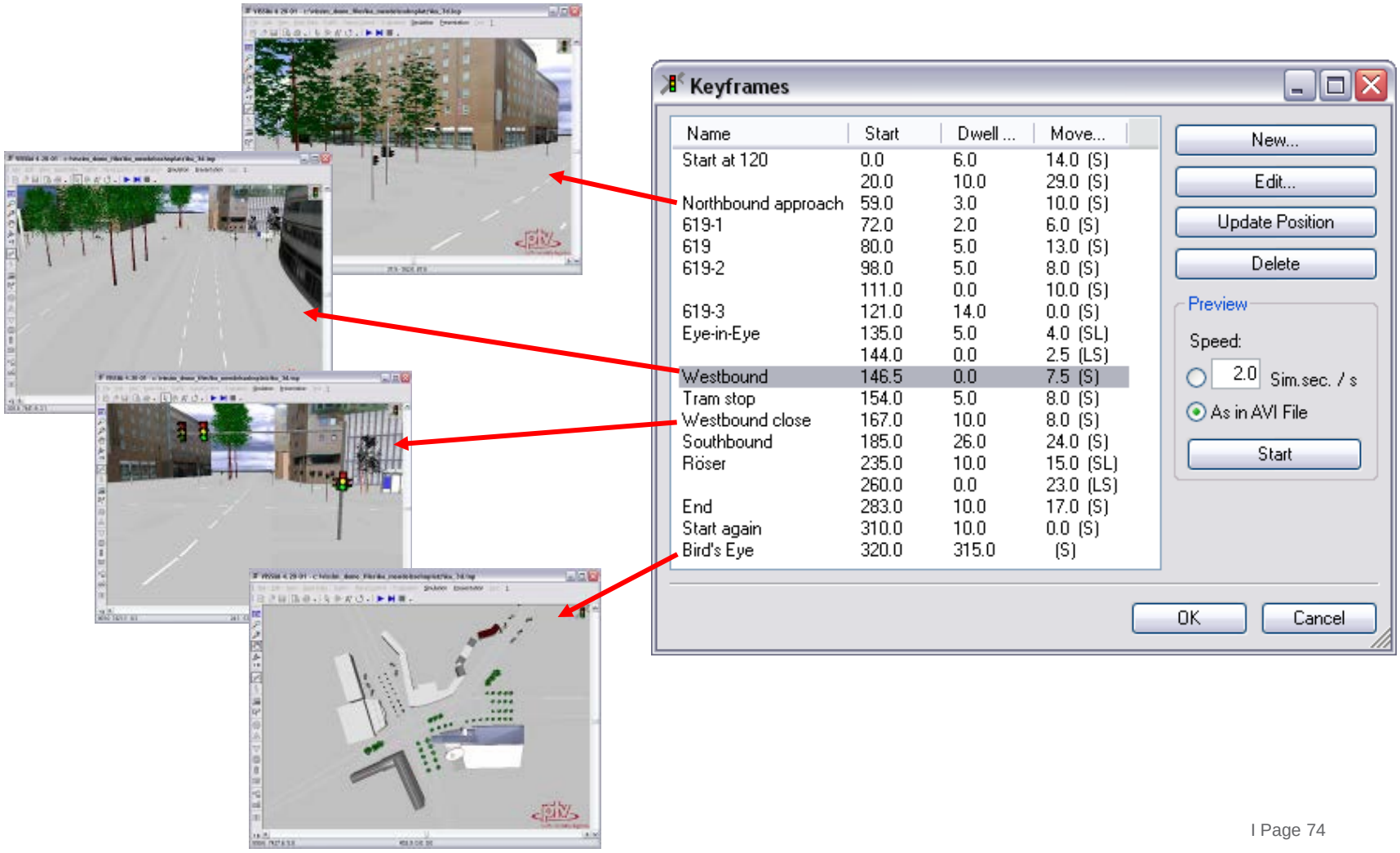
- Travel time, speed, delay

Point Data Collection

- # vehicles, speed



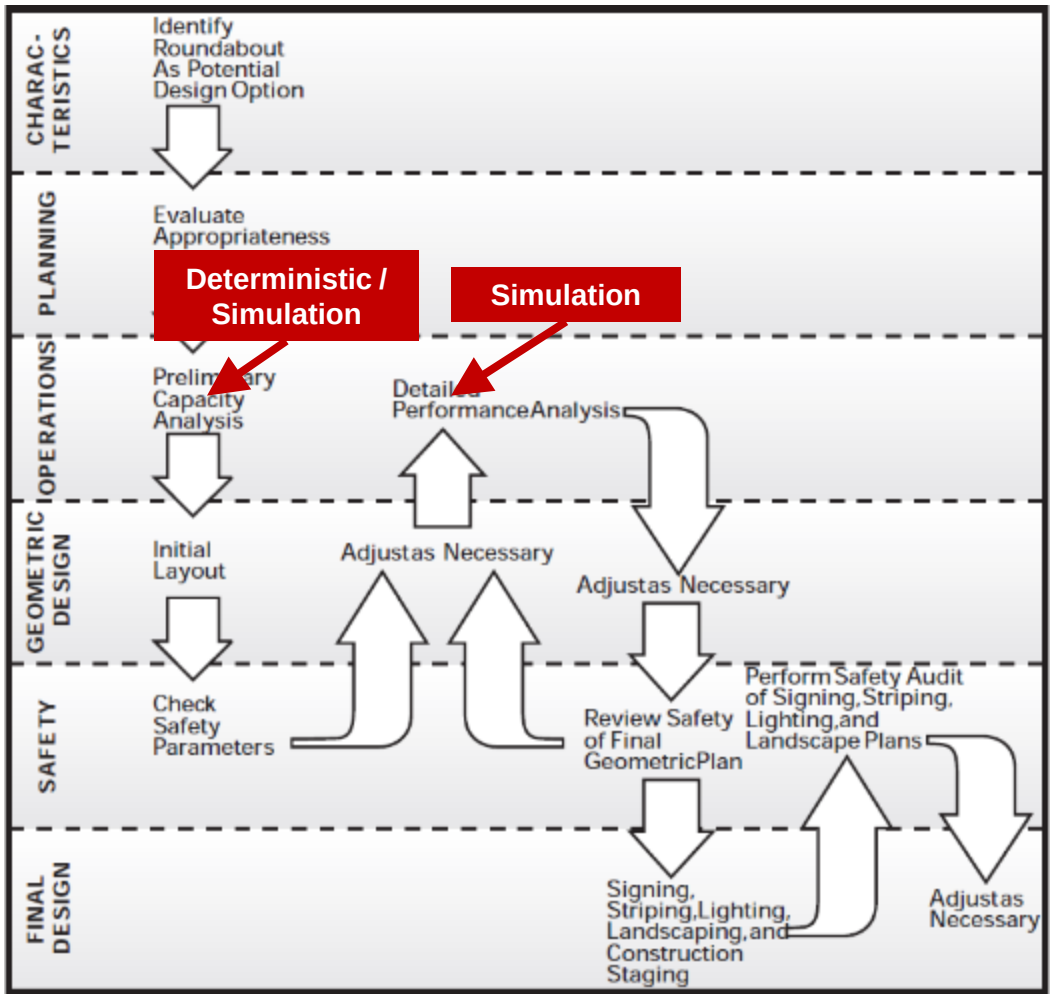
GRAPHICS: 3D MODE AVI/MOVIE PRODUCTION



PTV VISSIM AND ROUNDABOUTS

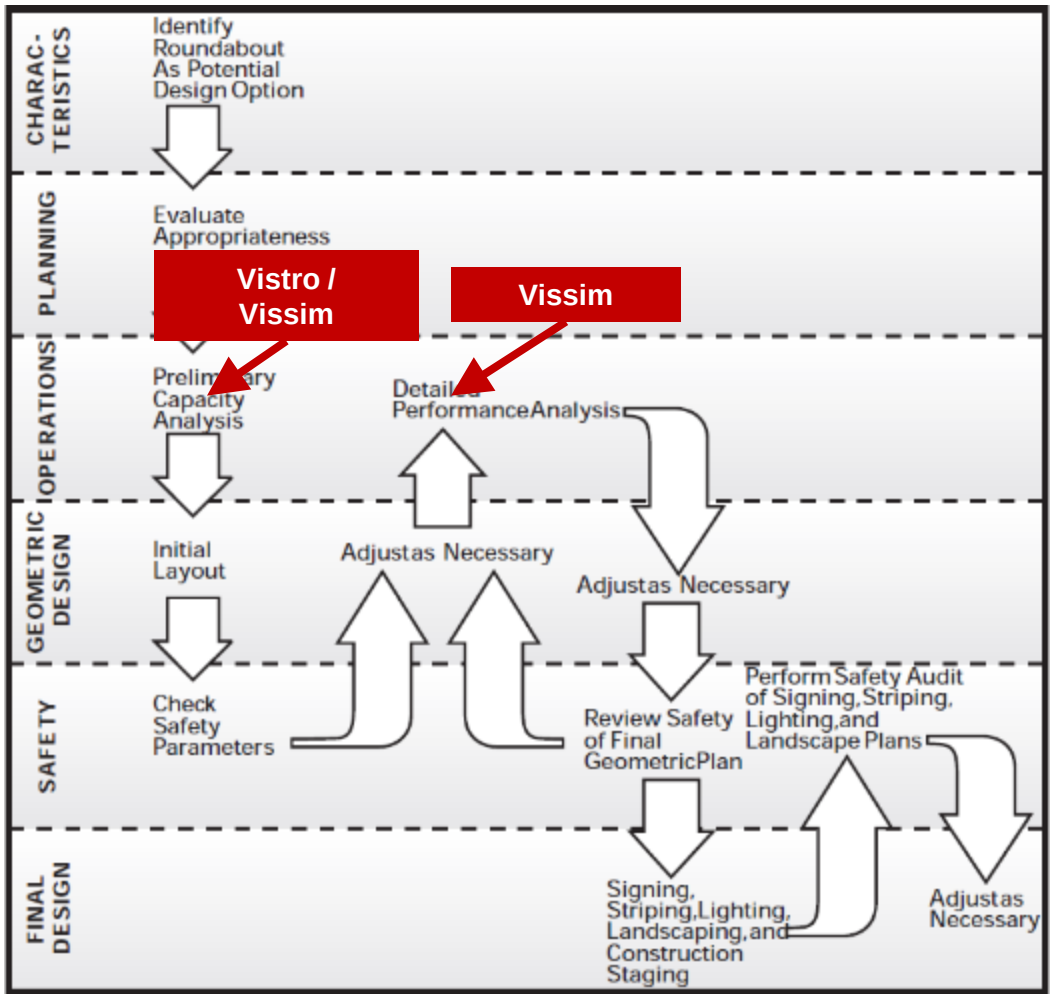
Karen Giese, P.E.
Vice President Product Management

PTV VISION® AND THE ROUNDABOUT DESIGN WORKFLOW



From “Roundabouts: An Informational Guide, FHWA, June 2000.

PTV VISION® AND THE ROUNDABOUT DESIGN WORKFLOW



From “Roundabouts: An Informational Guide, FHWA, June 2000.

VISION TRAFFIC SUITE
EXISTING ROUNDABOUT ANALYSIS TOOLS

Analytical / Deterministic Analysis

- PTV Visum Internal Methods
  - HCM 2010
  - TRL / Kimber Method

Simulation Analysis

- PTV Vissim

WHY SIMULATION

Evaluate Designs

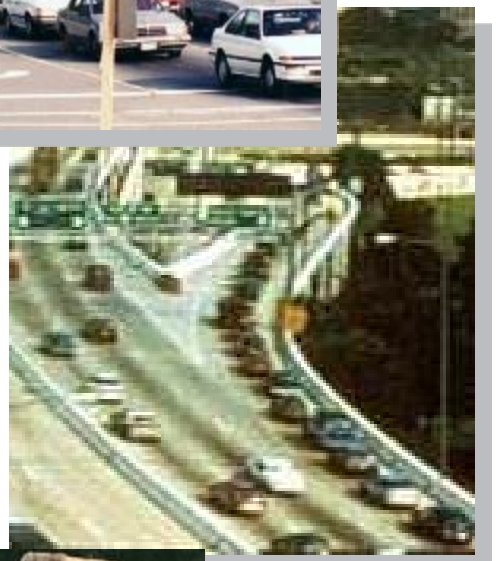
- Spillback Effects
- Storage Length Requirements

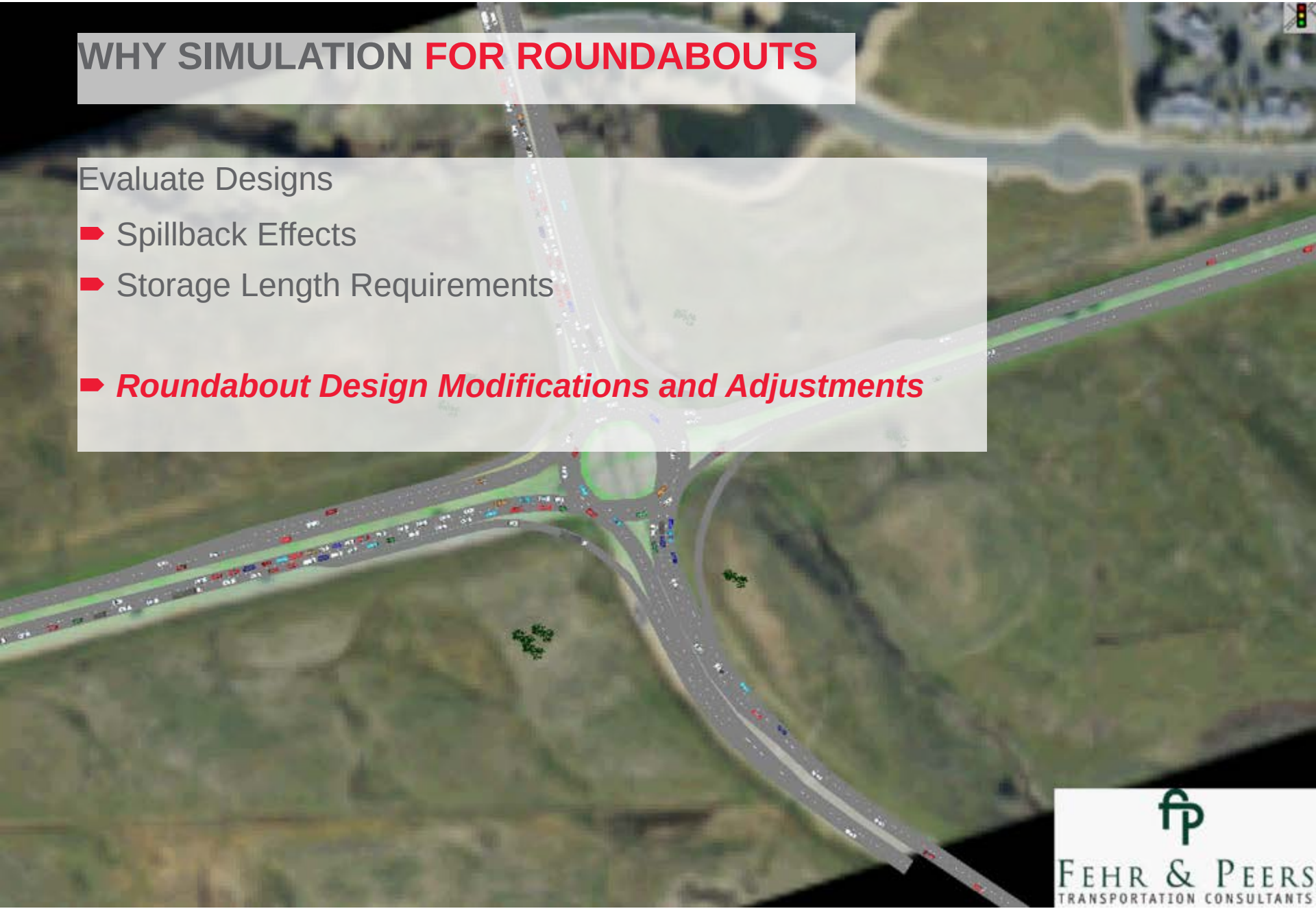
Understand System Integration / Transitions

- Freeway ↔ Arterial
- Transit ↔ Traffic ↔ Pedestrians ↔ Bicycles

Measure Dynamic Events

- Signal Priority or Pre-emption
- Ramp Metering
- ITS





WHY SIMULATION FOR ROUNDABOUTS

Evaluate Designs

- Spillback Effects
- Storage Length Requirements

- ***Roundabout Design Modifications and Adjustments***

FEHR & PEERS
TRANSPORTATION CONSULTANTS

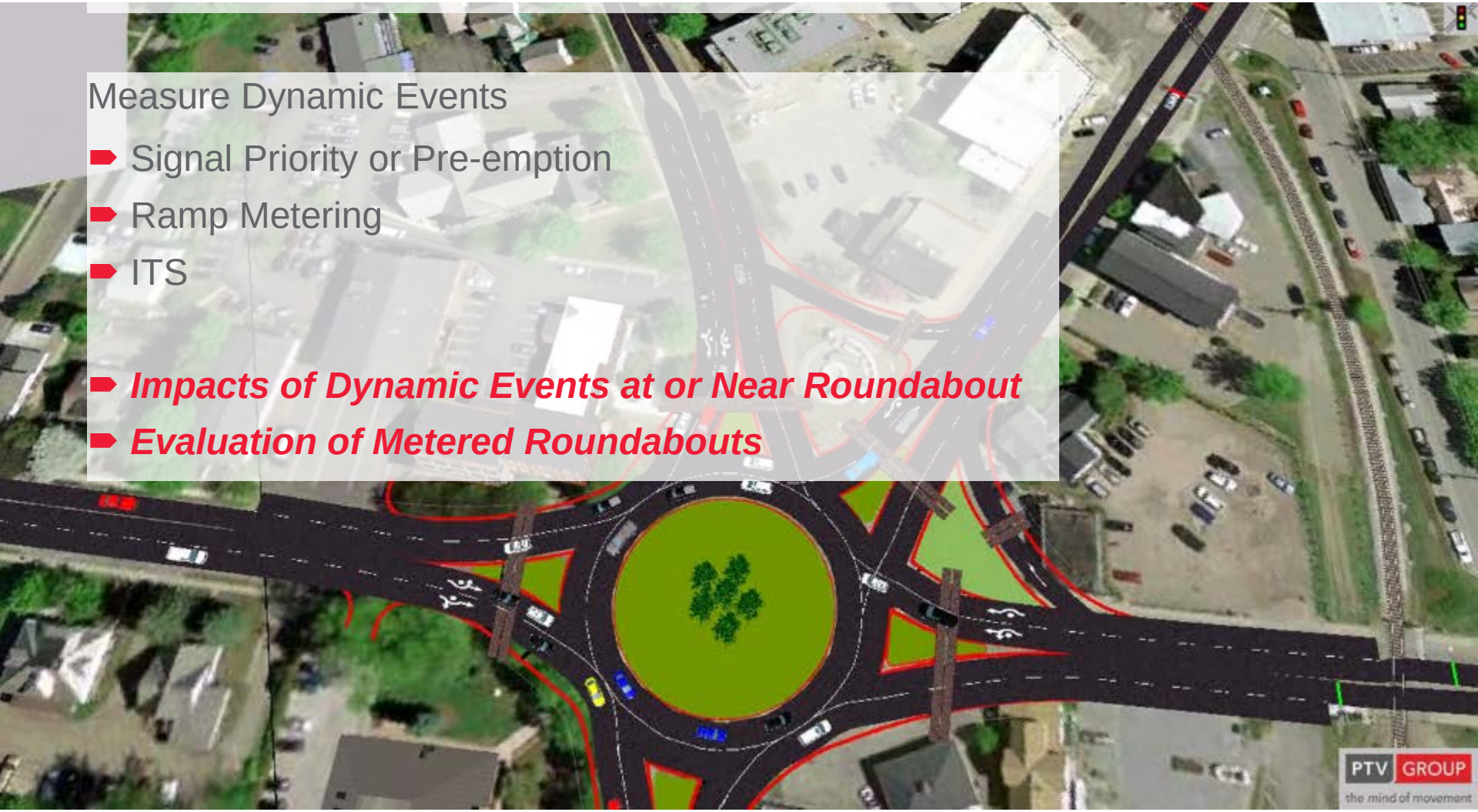
WHY SIMULATION FOR ROUNDABOUTS

Understand System Integration / Transitions

- Freeway ↔ Arterial
- Transit ↔ Traffic ↔ Pedestrians ↔ Bicycles

- ***Impacts of Roundabout on System Operations***
  - ***Interactions between Roundabouts and Adjacent Signals***
  - ***Operation of Non-Vehicle Modes In, Near, or Through Roundabout***

WHY SIMULATION FOR ROUNDABOUTS



Measure Dynamic Events

- Signal Priority or Pre-emption
- Ramp Metering
- ITS

- ***Impacts of Dynamic Events at or Near Roundabout***
- ***Evaluation of Metered Roundabouts***

KEY VISSIM FEATURES FOR ROUNDABOUT MODELING

Complete Support for Roundabout Design

- Link-Connector Geometry Structure
- Explicit Speed control
- Calibrated Yielding Behavior

Additional Features to Represent Real-World Applications

Extensive Measured Output

LINK-CONNECTOR GEOMETRY STRUCTURE

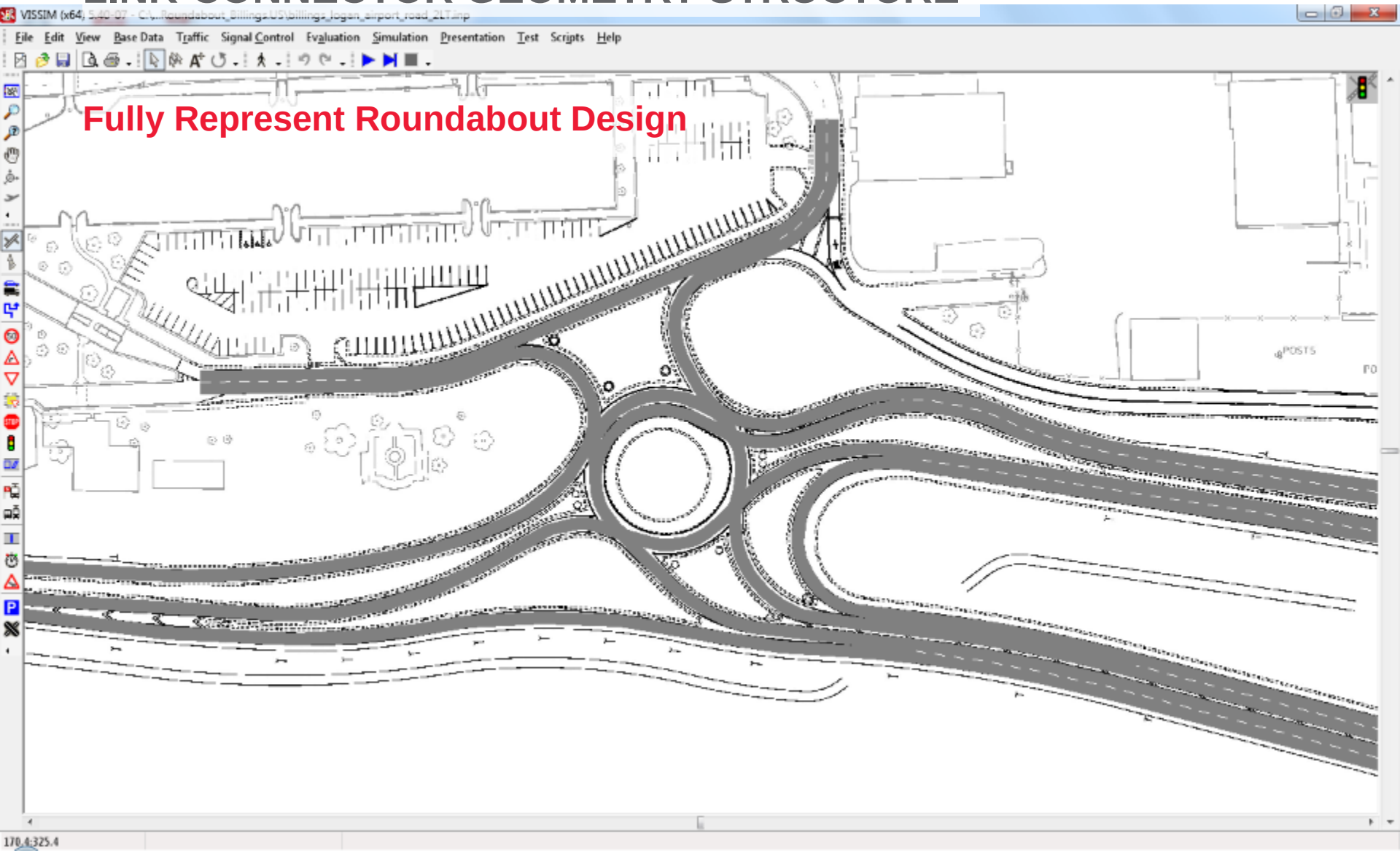
Fully Represent Roundabout Design

Model True Vehicle Trajectories

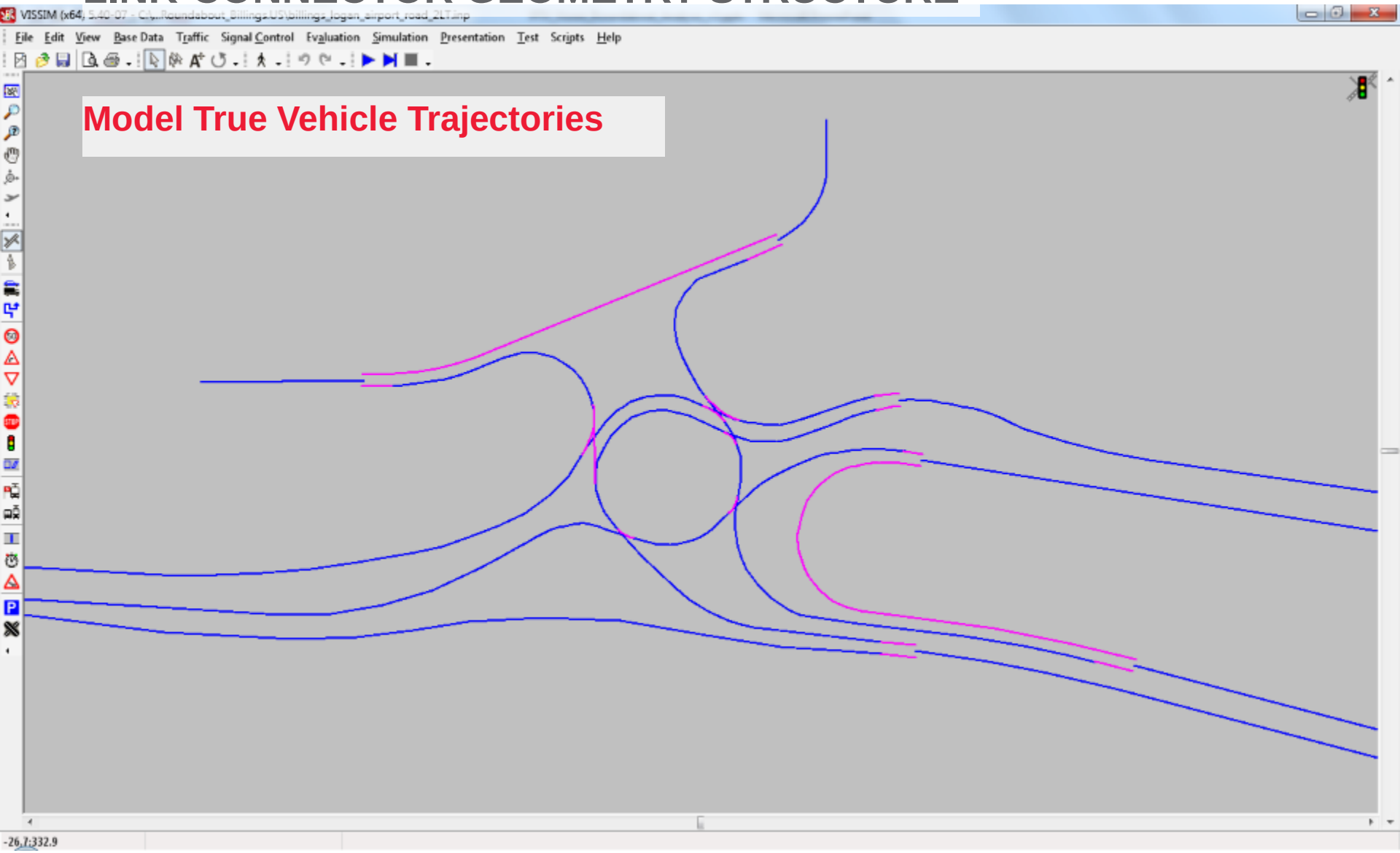
Model Traffic within Intersections

Represent Various Striping Options

LINK-CONNECTOR GEOMETRY STRUCTURE

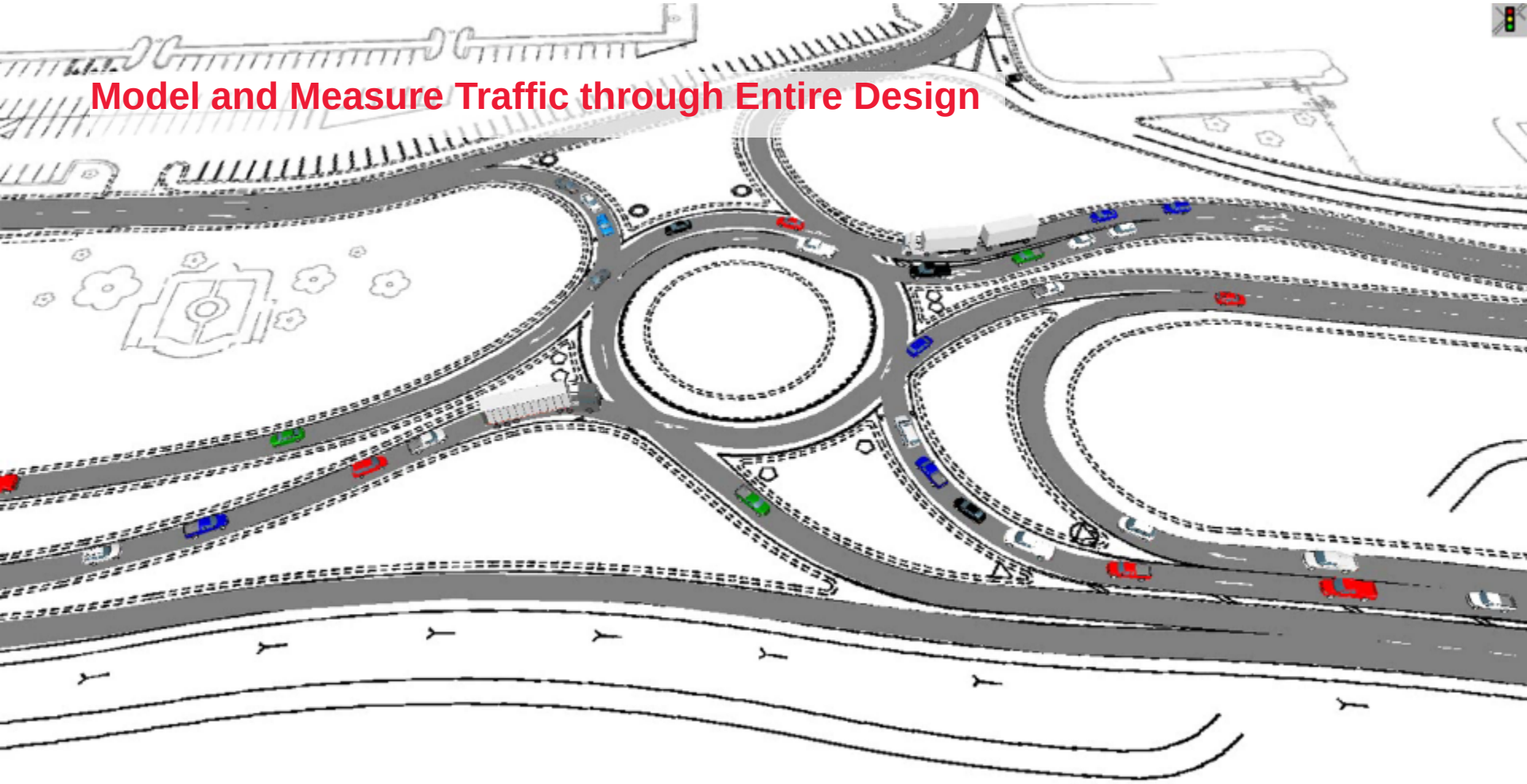


LINK-CONNECTOR GEOMETRY STRUCTURE



LINK-CONNECTOR GEOMETRY STRUCTURE

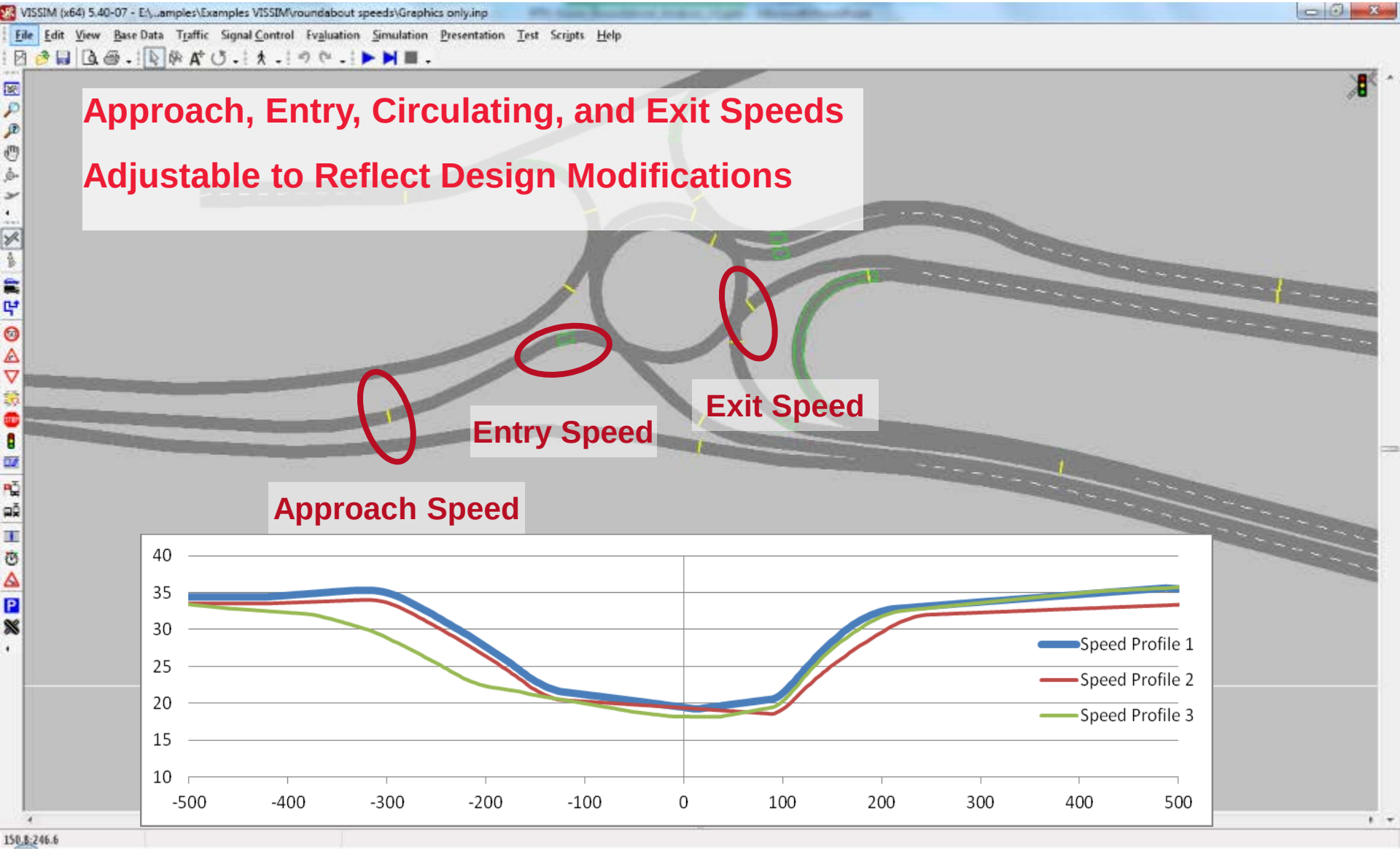
Model and Measure Traffic through Entire Design



LINK-CONNECTOR GEOMETRY STRUCTURE

Represent Various Simple & Complex Striping Options

EXPLICIT SPEED CONTROL



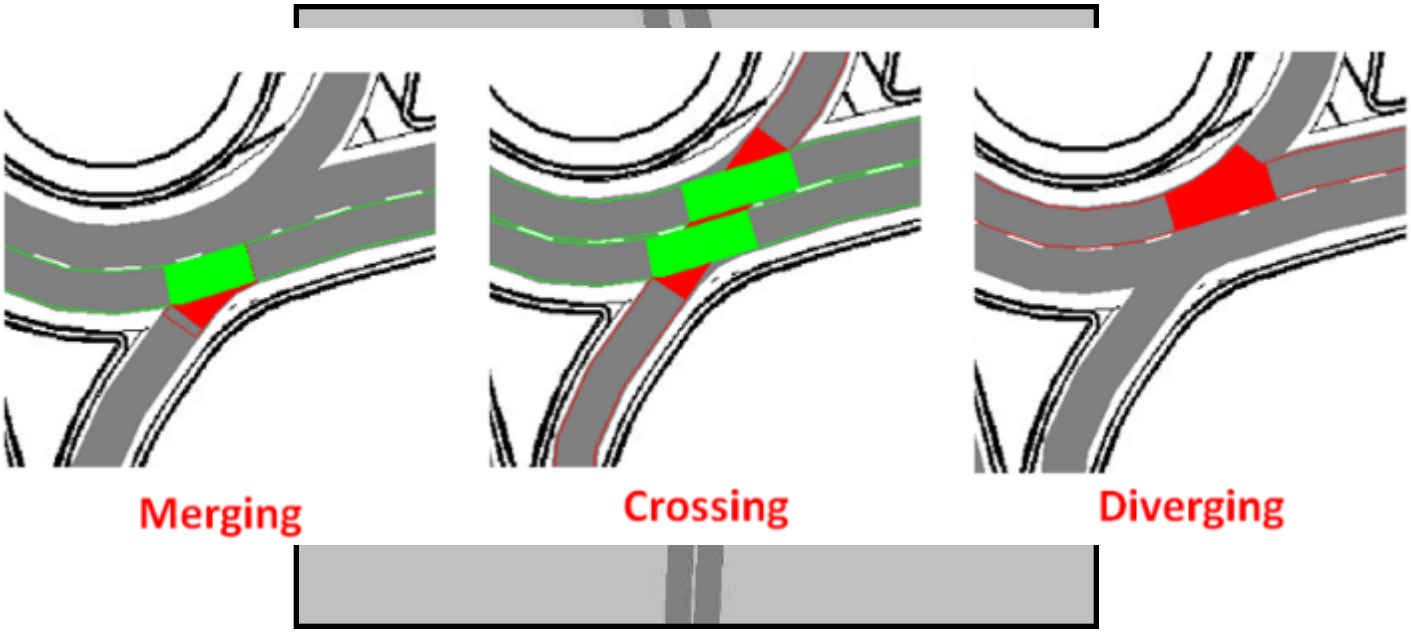
CALIBRATED YIELDING BEHAVIOR

Yield on Entry

Yield to Pedestrians

Other Yield Points

Various Gaps for Various Vehicles (Cars, Trucks, Bicycles, Pedestrians)



CALIBRATED YIELDING BEHAVIOR

Yield on Entry

Yield to Pedestrians

Other Yield Points

Various Gaps for Various Vehicles (Cars, Trucks, Bicycles, Pedestrians)

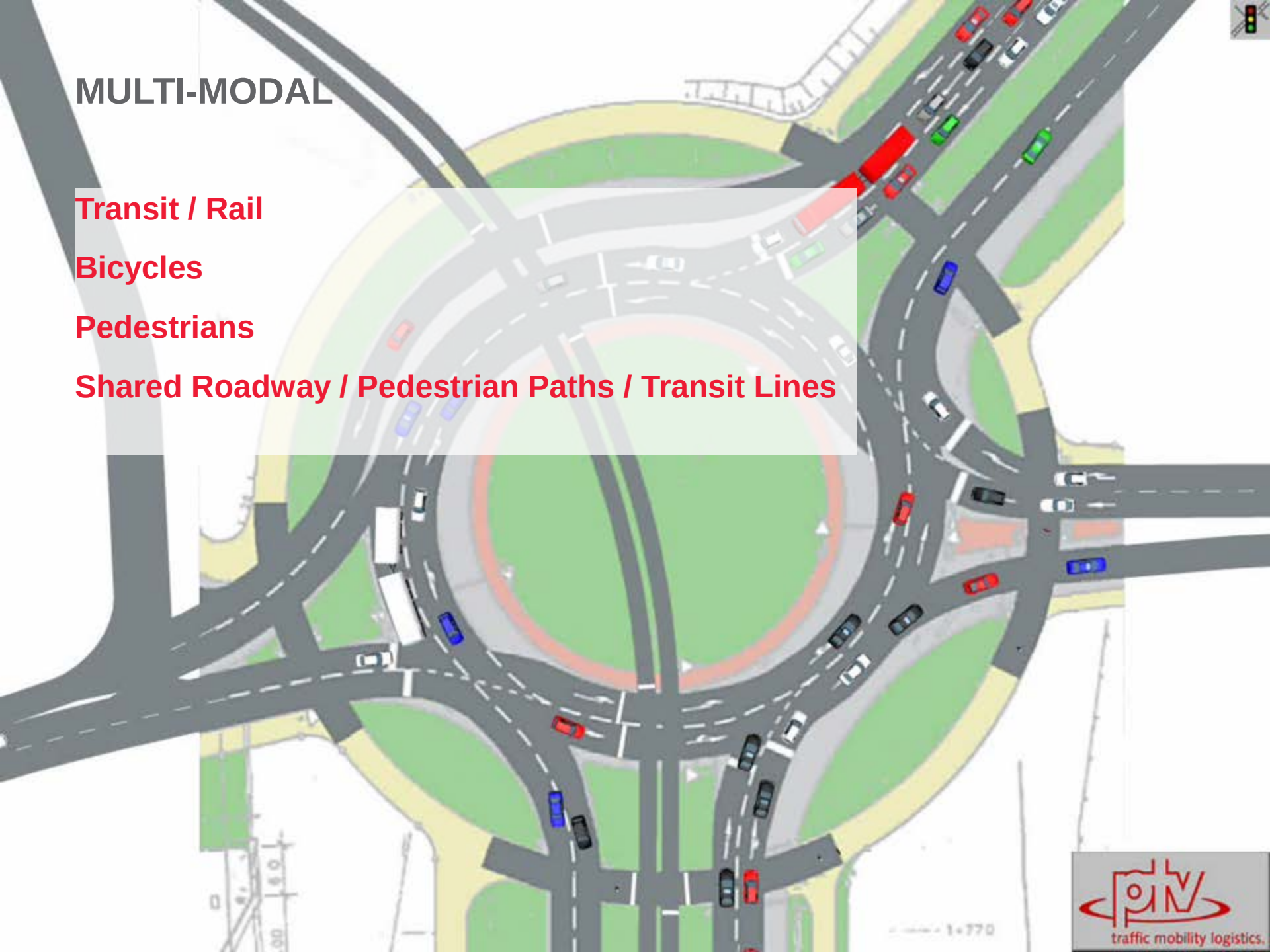
Video from SRF Consulting

KEY VISSIM FEATURES FOR ROUNDABOUT MODELING

Additional Features to Represent Real-World Applications

- Multi-Modal
- Advanced Vehicle Fleet
- Driver Behavior Control

MULTI-MODAL



Transit / Rail

Bicycles

Pedestrians

Shared Roadway / Pedestrian Paths / Transit Lines

DRIVER BEHAVIOR CONTROL

Lane Utilization

Lane Change Control

Truck Off-tracking

ADVANCED VEHICLE FLEET

AASHTO Design Vehicles

Large Vehicle Library

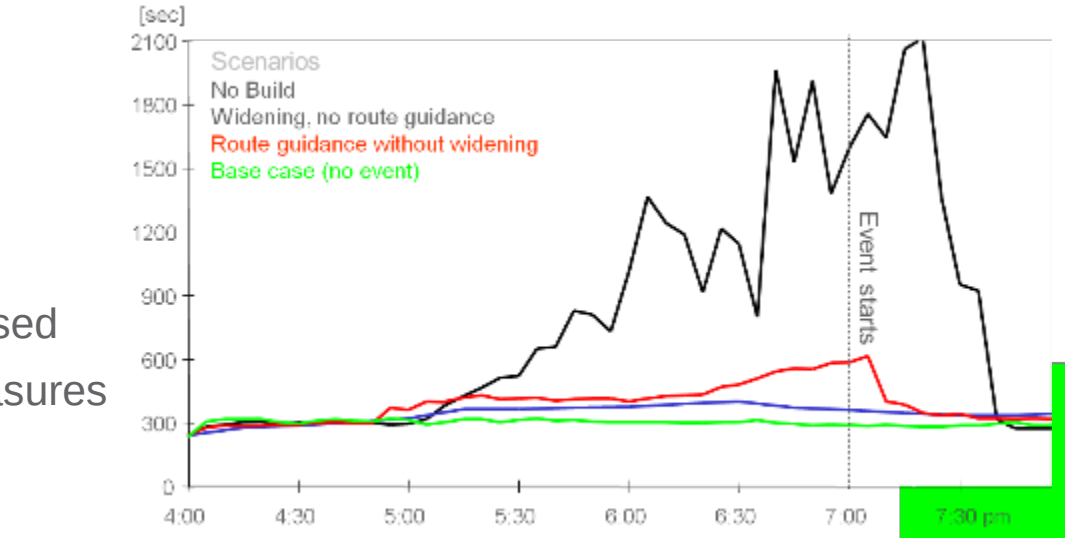
Bicycles and Pedestrians

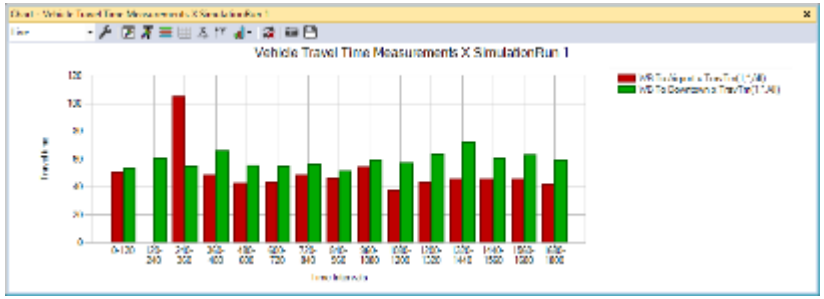
Custom Vehicles

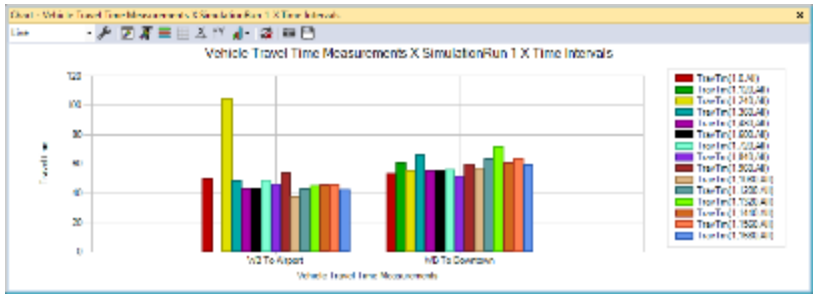
KEY VISSIM OUTPUT FOR ROUNDABOUT MODELING

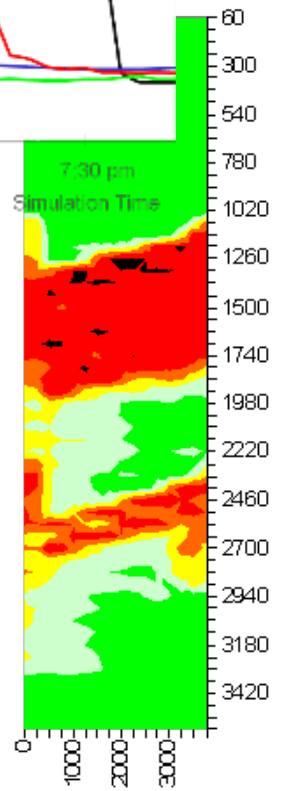
All Output Measured Directly

- Aggregated
  - Network
  - Intersection / Movement-Based
  - Vehicle and / or Person Measures
  - Vehicle Classes
  - User-Defined, User-Filtered
  - Multiple Runs
- Measures
  - Volumes
  - Queue Lengths
  - Approach Delay
  - Travel Times
  - Other Measures



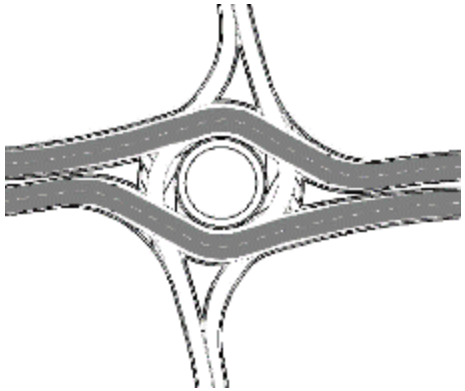






VISSIM ROUNDABOUT MODELING: BASIC STEPS

1. Build Geometry
   a. Links to Build Primary Movement Paths / Trajectories
   b. Links to Build All Other Movement Paths
   c. Connectors for All Links to Allow All Turn Movements



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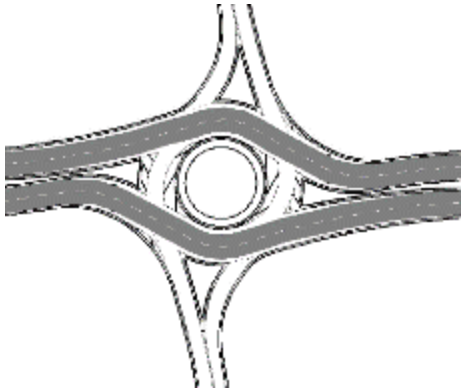

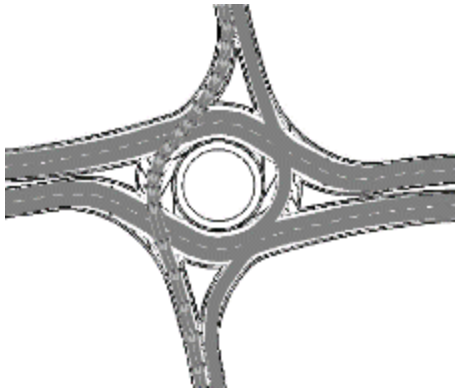

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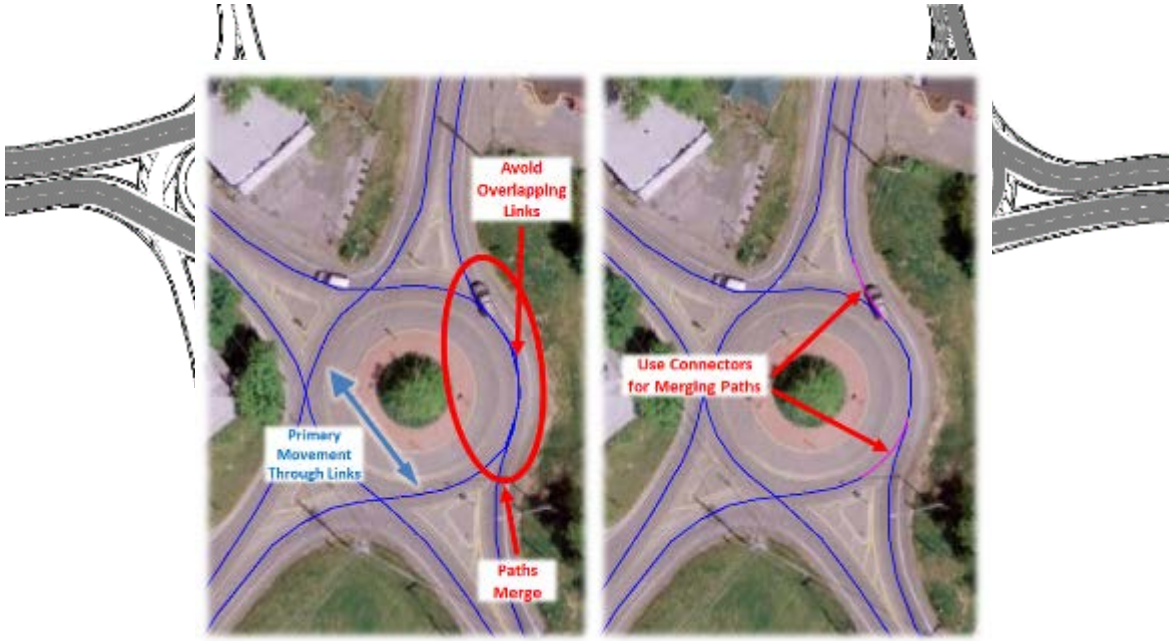
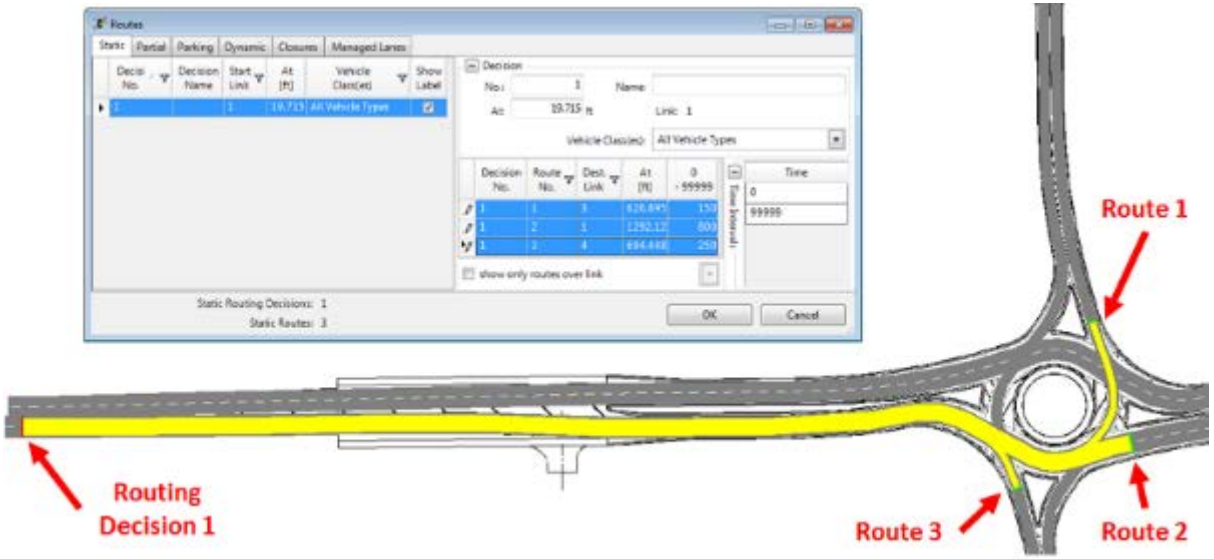


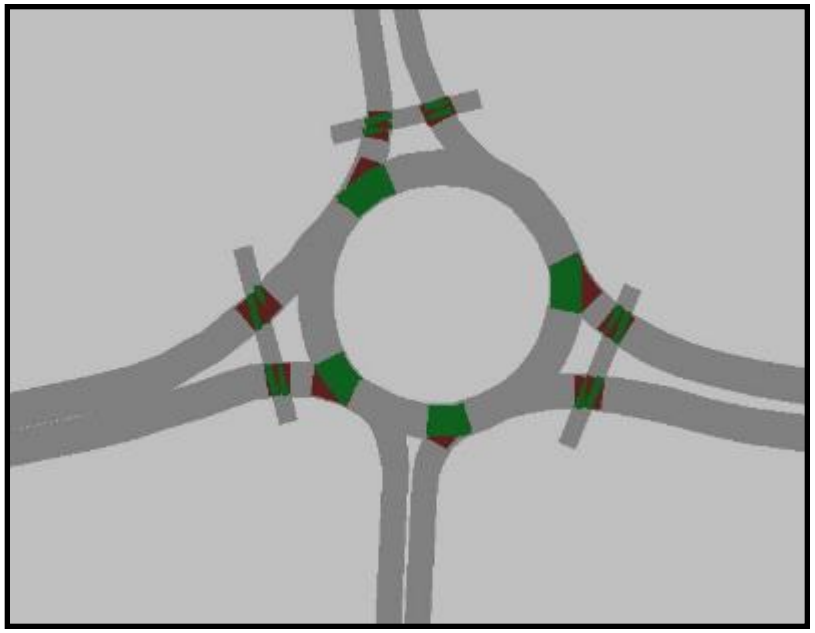
VISSIM ROUNDABOUT MODELING: BASIC STEPS

2. Code Roundabout Volumes
   a. Vehicle Inputs for Approach Volumes
   b. Static Routing Decisions for Turning Movements
3. Add Speed Control
   a. Desired Speed Decisions for Approach, Circulating, and Exit Speeds
   b. Reduced Speed Areas for Entry Speeds



VISSIM ROUNDABOUT MODELING: BASIC STEPS

4. Roundabout Yielding
    a. Conflict Areas at Entries
    b. Conflict Areas for Pedestrian Crossings
    c. Conflict Areas for Exit Conflicts, if Required
    d. Priority Rules for Added Control, when Needed



VISSIM ROUNDABOUT MODELING: OUTPUT

Measures of Effectiveness

- Volumes
  - Direct Impact on Capacity
- Entry Queue Lengths
- Approach Delay
- Travel Times
  - Critical when Comparing Various Control Devices
  - Measure between Two Points Outside Influence of Design
  - Lane Change Parameters

VISSIM ROUNDABOUT MODELING: OUTPUT

PTV Vissim Evaluation Tools

- Node Evaluation
  - Volumes
  - Delays
- Queue Counters
- Travel Time Sections

VISSIM ROUNDABOUT MODELING CALIBRATION

Karen Giese, P.E.
Vice President Product Management

VISSIM ROUNDABOUT MODELING: CALIBRATION

"Visual Calibration"

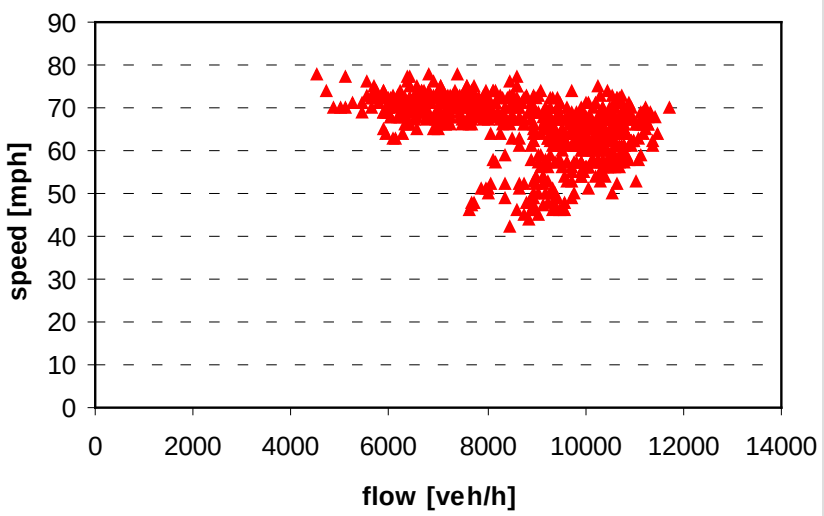
- Error Checking
- Engineering Judgment

Quantitative Calibration

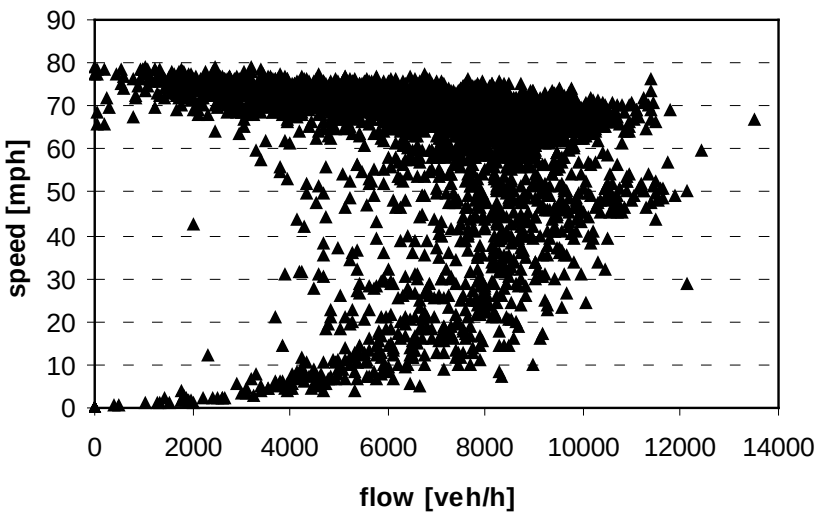
- FHWA Traffic Analysis Toolbox Volume III: Applying Microsimulation Models
- Calibration Data
  - Field Data of Existing Roundabout
  - Field Data of Existing Nearby Roundabout with Similar Characteristics
  - Guidance from HCM 2010
- Calibrate Each Approach

EVALUATIONS / OUTPUT DATA - CALIBRATION

Measurement
(aggregated over 5 lanes)



Simulation



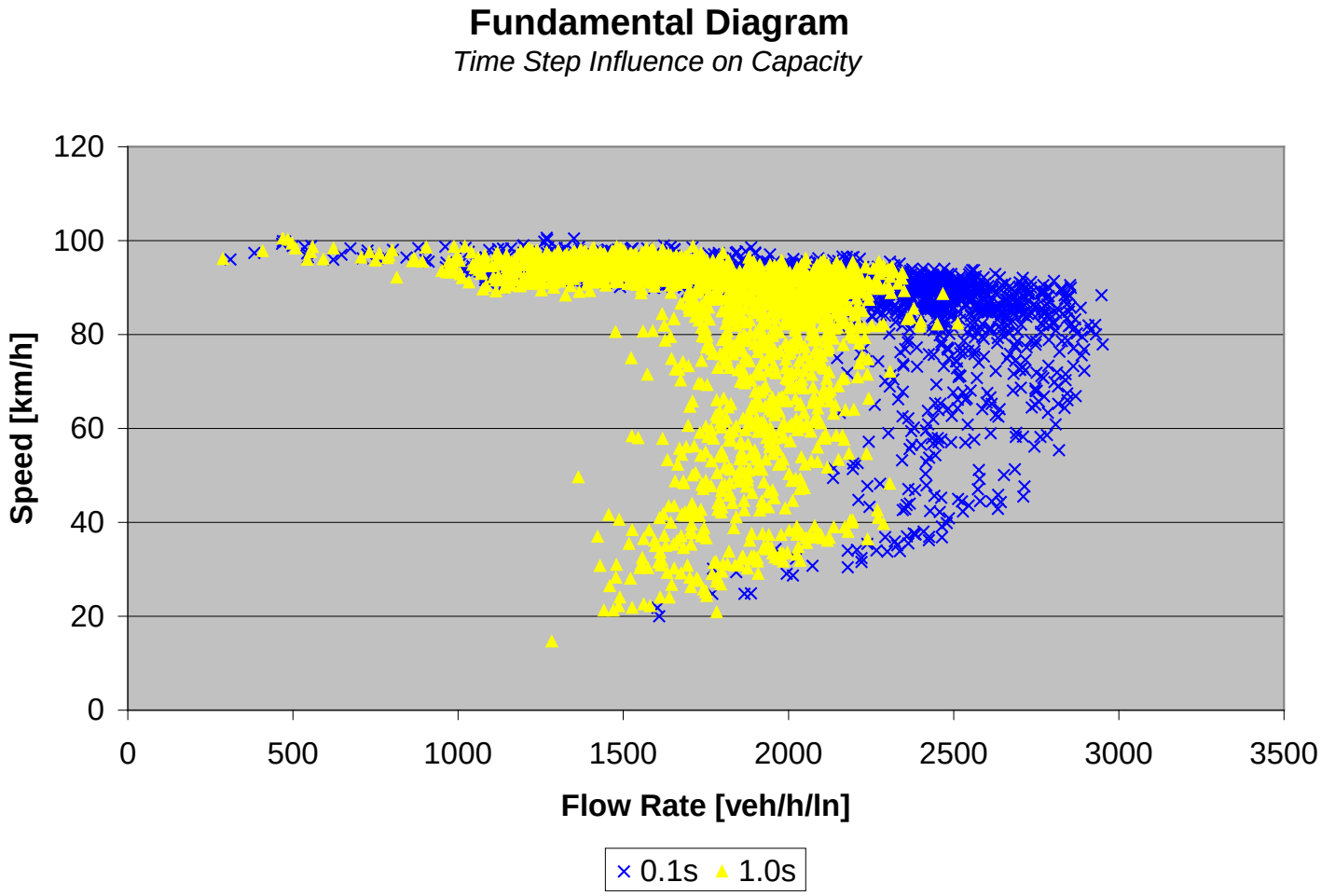
Simulation Parameters

- 0.2 second simulation resolution
- Perception thresholds set to tight platoons
- Reduced desired safety distance
- Tight desired speed distribution

Calibration Results

- 2400 vphpl average
- Stable to unstable flow replication
- Speed-flow relationships are similar

SIMULATION RESOLUTION



VISSIM ROUNDABOUT MODELING: CALIBRATION

Key PTV Vissim Calibration Adjustments

- Speed Distributions
  - Direct Impact on Capacity
- Yielding Behavior / Gap Acceptance Adjustments
- Driving Behavior Parameters
  - Car Following: No. of Observed Vehicles
  - Safety Distance Parameters
  - Lane Change Parameters

Calibration Measures

- Volume Throughput
- Speeds
- Capacity
- Saturation Flow Rate
- Queue Lengths (Qualitative)

CALIBRATION STEPS

Calibrate each approach

Input turning volumes for all approaches

For calibration approach, increase vehicle input to oversaturate the entry

Set up Data Collection Point at calibration approach entry and circulating lane

- Volumes
- Speeds

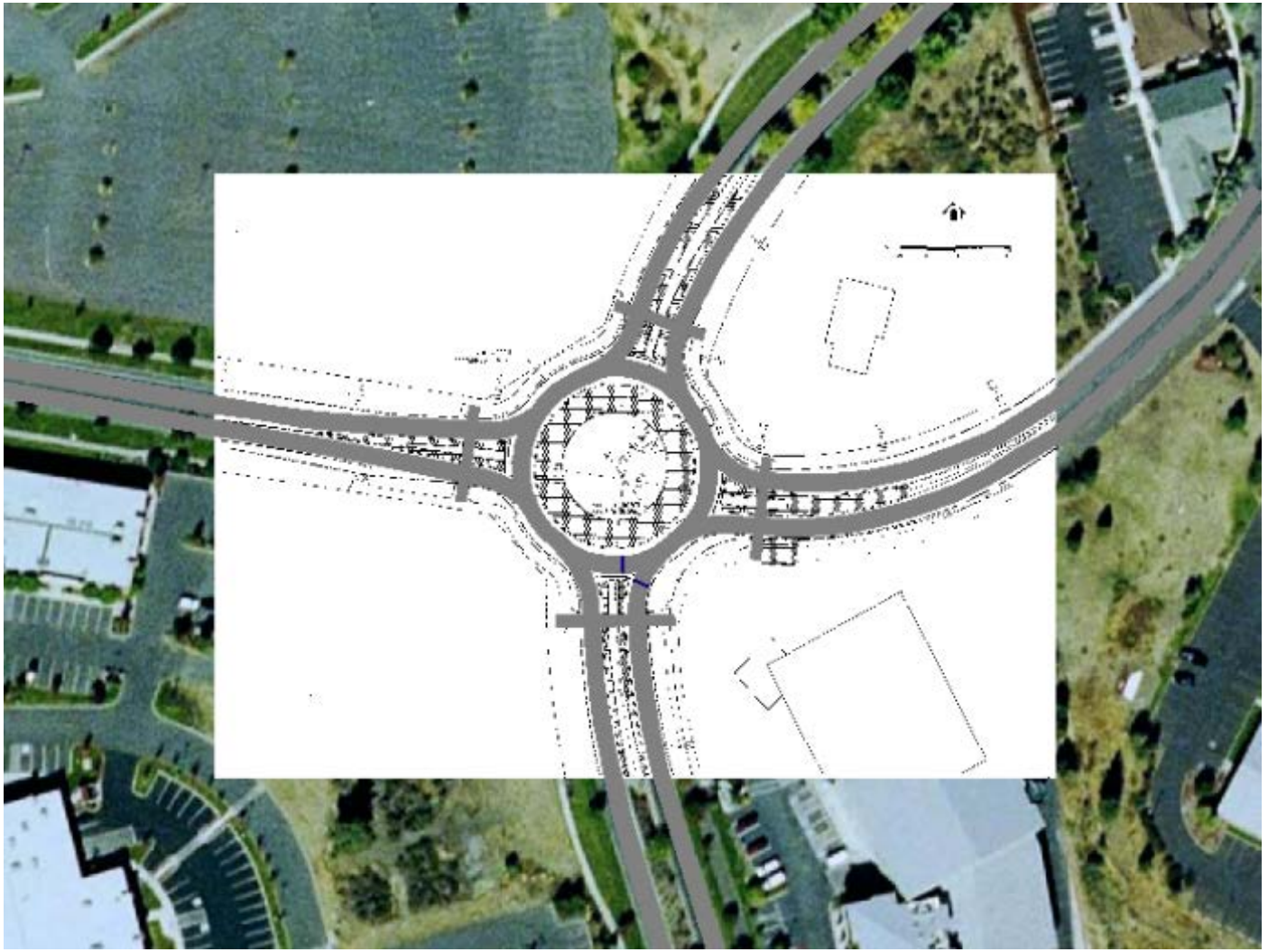
Simulate

Compare to calibration data source

- For given conflicting volume, is entry volume correct?
- Plot data collection output (Entry Volume vs. Conflicting Volume)

Adjust parameters as necessary and repeat test

CALIBRATION EXAMPLE



CALIBRATION EXAMPLE

Turning Movements

Eastbound			Westbound			Northbound			Southbound		
LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
255	190	30	25	90	60	30	275	270	20	230	105
20			20			20			20		

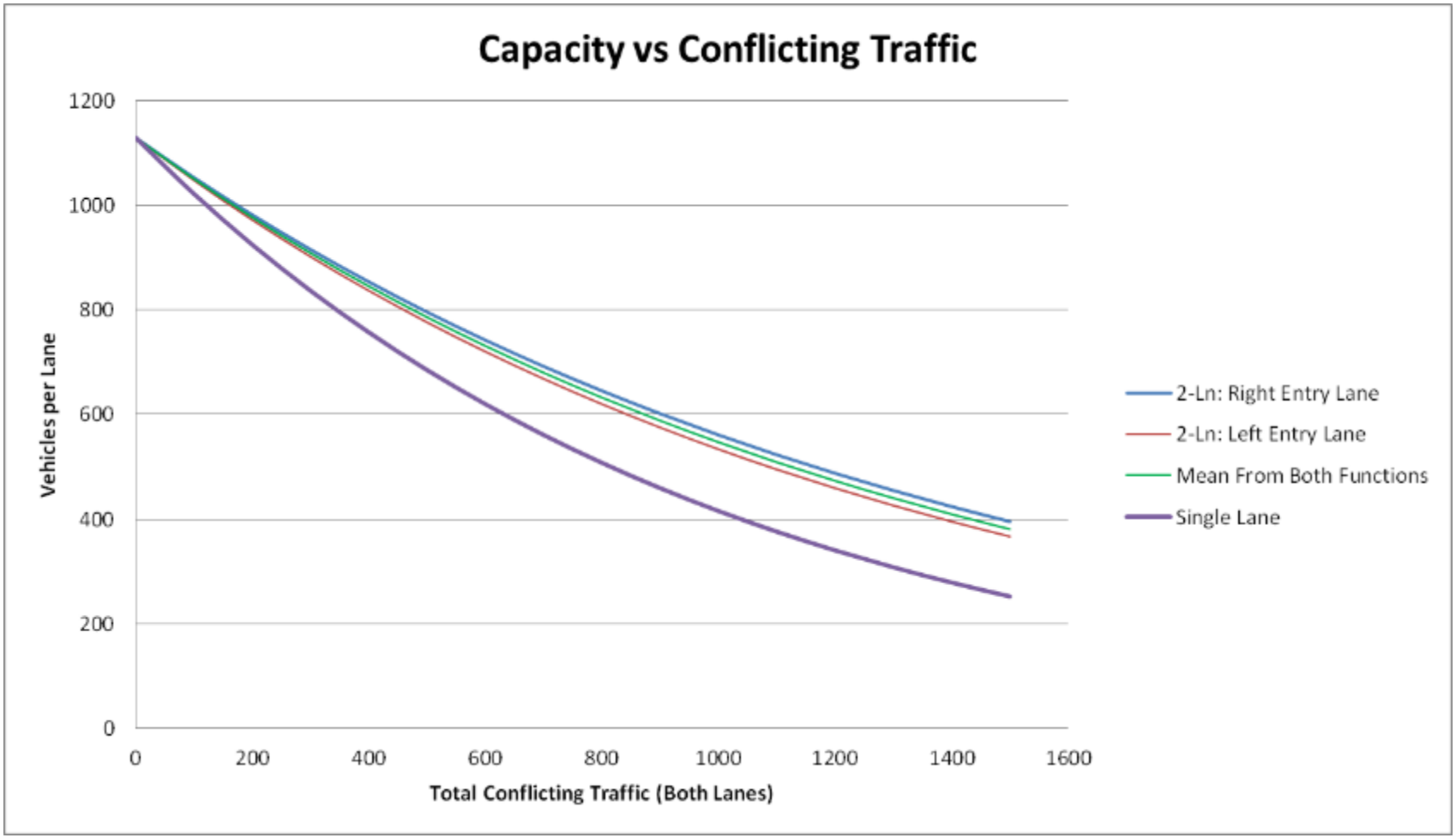
Geometry Characteristics

Characteristic	Value
Approach Speeds	30 – 35 mph
Entry Speeds	~ 12.5 – 15.5 mph
Circulating Speeds	~ 15.5 – 18.5 mph
Heavy Vehicle Percentage	2%

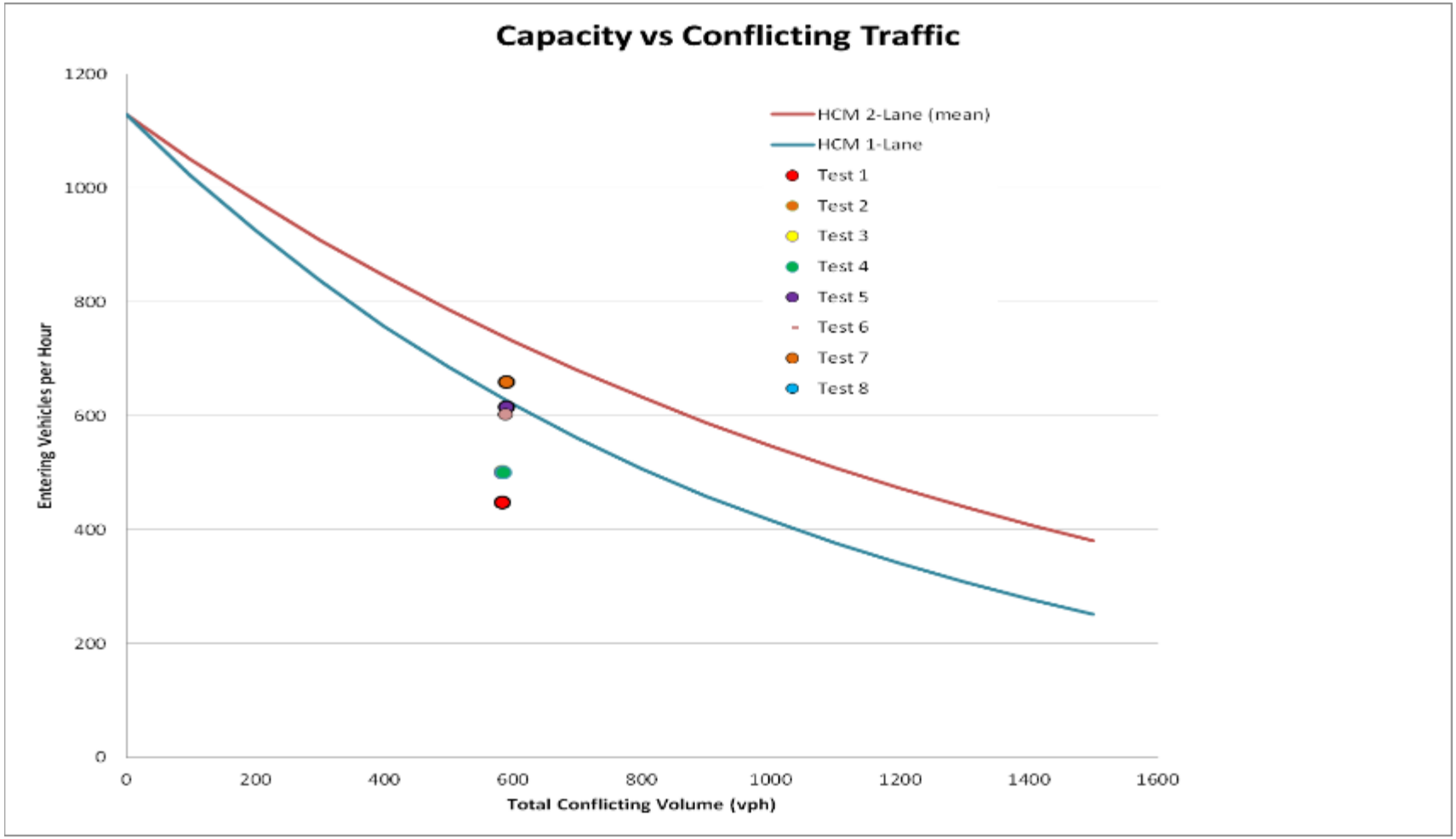
CALIBRATION EXAMPLE

	Circulating Speed		Approach Speed		Conflict Area Parameter Settings				
	Min	Max	Min	Max	Front gap	Rear gap	Safety factor	Anticipate route	Observe adj
Test1	14	17	12.4	15.5	0.5	0.5	1.5	0	0
Test 2	18.6	21.7	12.4	15.5	0.5	0.5	1.5	0	0
Test 3	18.6	21.7	12.4	15.5	0.5	0.5	1.5	1	0
Test 4	18.6	21.7	12.4	15.5	0.2	0.5	1.3	1	0

CALIBRATION EXAMPLE



CALIBRATION EXAMPLE



CALIBRATION NOTES

Data is difficult to find due to lack of oversaturated roundabouts in U.S.

Best Data Sources

- Existing roundabout
- Nearby roundabout with similar characteristics
- General roundabout with similar characteristics (database, clearing house)
- Guidance from HCM
- Other Software / Model Output is NOT Calibration Data

Queue data used for qualitative, not quantitative

TRB Webinar Series
06 May 2015

ROUNDABOUT ANALYSIS AND DESIGN WITH PTV VISSIM

Karen Giese, P.E.
PTV Group