Pasadena Testbed
Preliminary Analysis Plan

Project Status Meeting

Washington D.C.
March 24th, 2014

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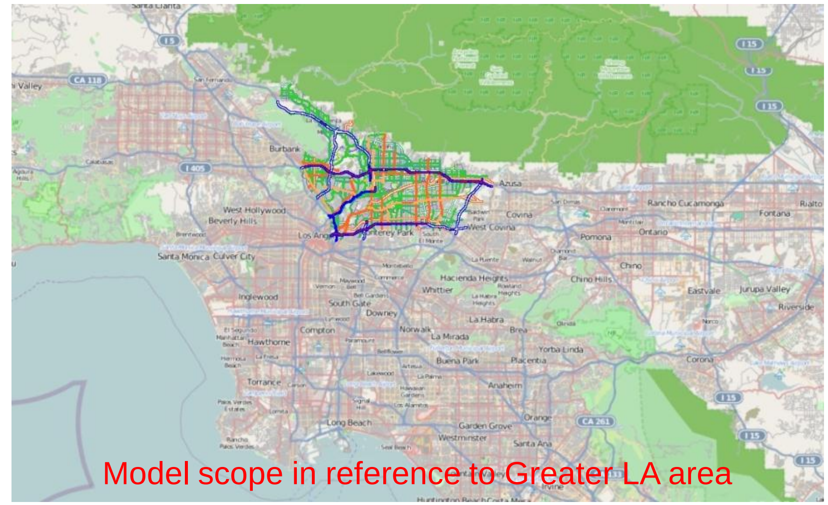
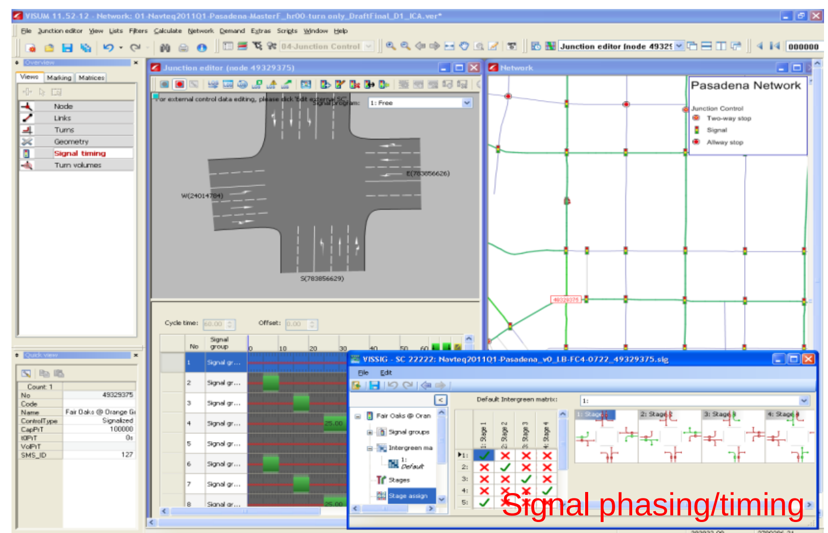
Pasadena Model Environment

- **Multi-resolution model development process**
- **Geographical scope: Pasadena and surrounding area**
- **Network**
  - NAVTEQ 2011Q1 navigation
  - NAVTEQ Traffic Patterns link speed profiles by day of week
  - Detailed lane topology
  - Junction geometry/control
  - Ready for Vissim export



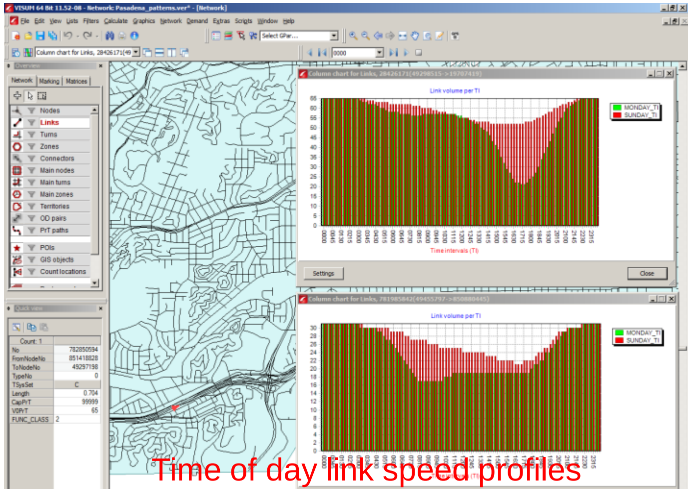
Model scope in reference to Greater LA area

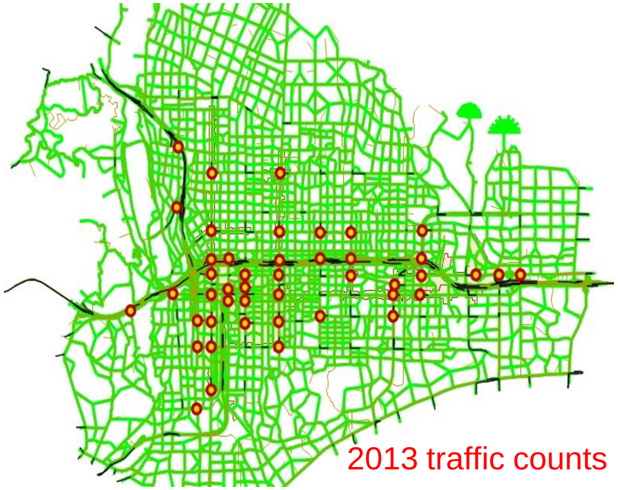


Signal phasing/timing

Pasadena Model Environment

- **Visum Dynamic User Equilibrium (DUE) assignment module**
  - Multi-class assignment
  - Analytical DTA model on link flows
- **Spatial and temporal scope**
  - Weekday AM 3 hours (6-9)
  - Weekday PM 4 hours (3-7)
- **"Cross-walk" to travel demand model (TransCAD)**
  - Zoning/connectors
  - SOV/HOV by segments, e.g. HBW/HBO/NHB, etc. (12 segments)
- **Up to date calibration data**
  - 2013 traffic counts
  - Corridor travel times





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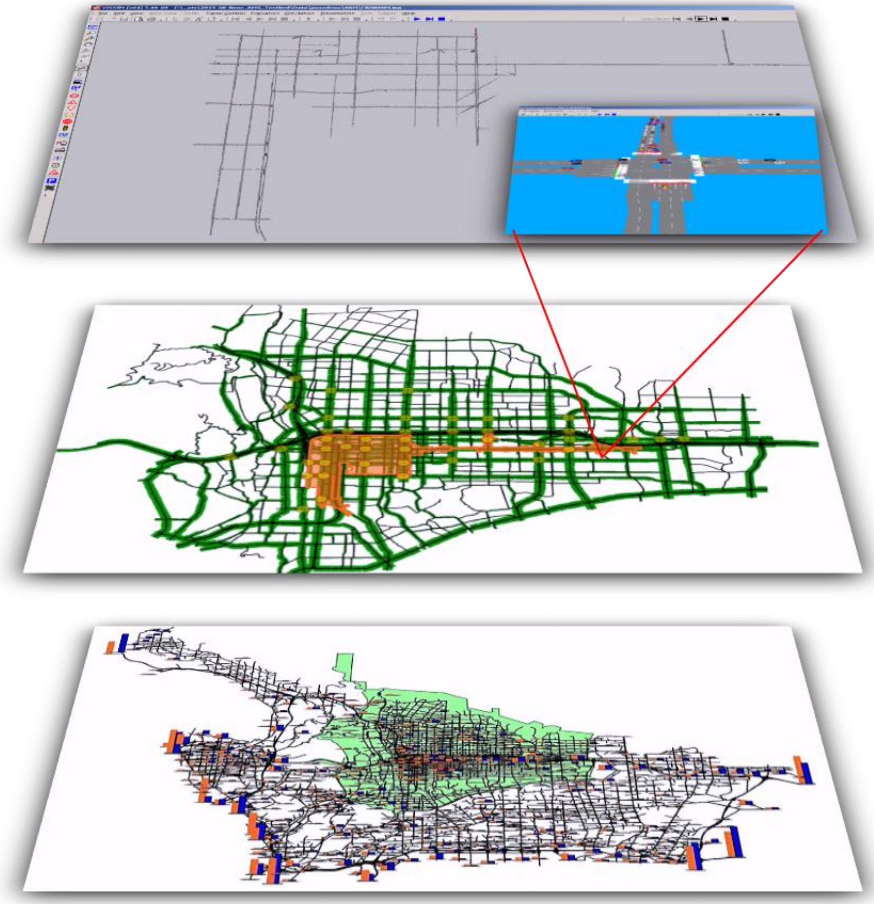
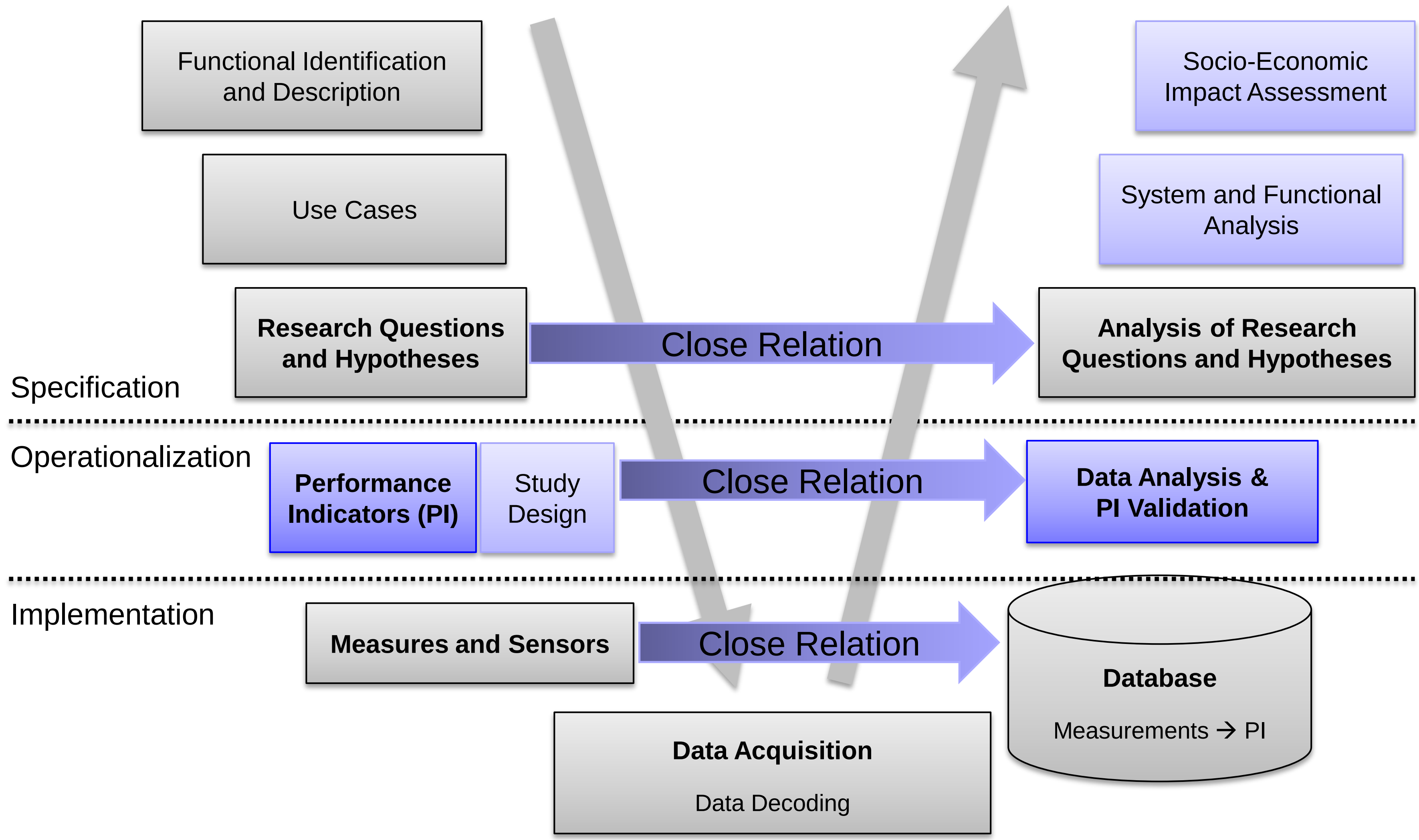
Pasadena Model Architecture

- **Vissim for <u>any</u> sub-area of city model**
  - Arterial traffic
  - SCATSim adaptive control (existing)
  - Light rail
  - Bus transit
  - Freeways (incl. ramp meters)
- **City of Pasadena 3-step model**
  - Trip generation and distribution
  - DTA
  - Control + geometry details
  - GTFS transit data
- **Regional travel model**
  - 24/7 demand data (from cell phone data)



Analysis Goals and Objectives



Research Questions – Synergies and Conflicts

- Are ATDM strategies more beneficial when implemented in isolation or in combination (e.g., combinations of ATM, ADM, or APM strategies)?
  - The Pasadena testbed will allow for the simulation analysis of any combination of ATDM strategies.
- Which ATDM strategy or combinations of strategies yield the most benefits for specific operational conditions?
  - The Pasadena testbed will allow for testing of specific ATDM combinations under any of the four assumed operational conditions.
- What ATDM strategies or combinations of strategies conflict with each other?
  - Through the evaluation of different ATDM strategy combinations, any potential conflicts of strategies with each other will be identified.

Research Questions – Prediction Accuracy

- Which ATDM strategy or combination of strategies will benefit the most through increased prediction accuracy and under what operational conditions?
  - Analyzing specific ATDM combinations under any of the four assumed operational conditions with different levels of prediction accuracy will help answer this research question.
- Are all forms of prediction equally valuable, i.e., which attributes of prediction quality are critical (e.g., length of prediction horizon, prediction accuracy, prediction speed, and geographic area covered by prediction) for each ATDM strategy?
  - The Pasadena testbed will allow for testing each specific ATDM strategy under various forms of prediction performance.

Research Questions – Active Management or Latency

- Are the investments made to enable more active control cost-effective?
  - The Pasadena testbed will provide performance measures that will allow for answering this research question.
- Which ATDM strategy or combinations of strategies will be most benefited through reduced latency and under what operational conditions?
  - Analyzing specific ATDM combinations under any of the four assumed operational conditions with different levels of latency will help answer this research question.

Research Questions – Op. Cond., Modes, Facility Types

- Which ATDM strategy or combinations of strategies will be most beneficial for certain modes and under what operational conditions?
  - The Pasadena testbed will provide performance measures by traveler type that will allow for answering this research question.
- Which ATDM strategy or combinations of strategies will be most beneficial for certain facility types (freeway, transit, arterial) and under what operational conditions?
  - The Pasadena testbed will provide performance measures by traveler type that will allow for answering this research question.
- Which ATDM strategy or combinations of strategies will have the most benefits for individual facilities versus system-wide deployment versus region-wide deployment and under what operational conditions?
  - This research question will be difficult to answer as most ATDM strategies will have to be "virtually deployed" on a subset of all possible locations. For example, adaptive signal control will be modeled at the corridor in downtown Pasadena where it is currently deployed in the field, but an expansion of that system may not be possible.

Research Questions – Prediction, Latency, and Coverage

- What is the tradeoff between improved prediction accuracy and reduced latency with existing communications for maximum benefits?
  - The Pasadena testbed will allow for testing scenarios that will provide answers to this research question.
- What is the tradeoff between prediction accuracy and geographic coverage of ATDM deployment for maximum benefits?
  - The Pasadena testbed will allow for testing scenarios that will provide answers to this research question.
- What is the tradeoff between reduced latency (with existing communications) and geographic coverage for maximum benefits?
  - The Pasadena testbed will allow for testing scenarios that will provide answers to this research question.
- What will be the impact of increased prediction accuracy, more active management, and improved robust behavioral predictions on mobility, safety, and environmental benefits?
  - With the exception of safety benefits, the Pasadena testbed will allow for testing scenarios that will provide answers to this research question.
- What is the tradeoff between coverage costs and benefits?
  - The Pasadena testbed will provide performance measures that will allow for answering this research question.

Research Questions – CV Technology and Prediction

- Are there forms of prediction that can only be effective when coupled with new forms of data, such as connected vehicle data?
  - The Pasadena testbed would allow for testing the effectiveness of different forms of prediction methods if they are supplied to the modeling team. The current assumption is that the testbed will only include one prediction method. However, this method can be configured for various levels of accuracy, coverage, quality, etc.

Research Questions – ST and LT Behaviors

- Which ATDM strategy or combinations of strategies will have the most impact in influencing short-term behaviors versus long term behaviors and under what operational conditions?
  - The Pasadena testbed will NOT provide performance measures that will allow for answering this research question.
- Which ATDM strategy or combinations of strategies will yield most benefits through changes in short-term behaviors versus long-term behaviors and under what operational conditions?
  - The Pasadena testbed will NOT provide performance measures that will allow for answering this research question.

Analysis Hypotheses

- ATDM strategies are most effective if deployed in combinations and not in isolation.
- ATDM strategies yield benefits under all operational conditions.
- There are no ATDM strategies that conflict with each other.
- All ATDM strategies relying on prediction benefit from increased prediction accuracy under all operational conditions.
- ATDM strategies benefit the most from increased prediction accuracy and geographic coverage.
- The investments to enable more active control are very cost-effective.
- ATDM strategies affecting facility and lane choice and operation benefit the most from reduced latency; however, this applies to all operational conditions.

Analysis Hypotheses

- ATDM strategies are most effective for the modes and facilities they are designed for; i.e., ATM and APM for traffic and ADM for transit. However, secondary cross-benefits between the modes and their respective ATDM strategies can be measured as well.

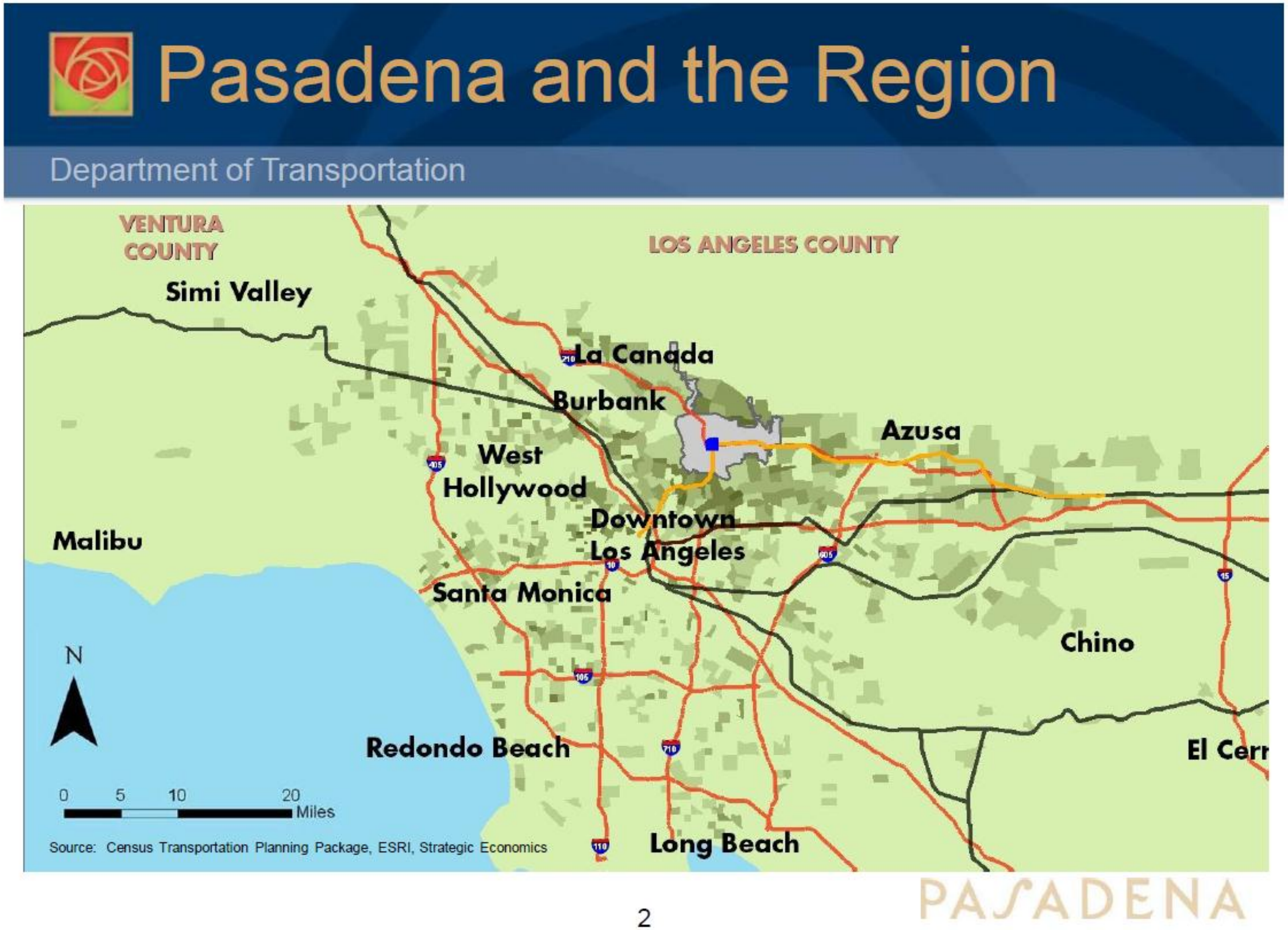
- The ideal situation is to achieve perfect prediction accuracy without any latency for the entire region. However, as this is not possible, there are minimum requirements for accuracy, latency and geographic coverage that need to be fulfilled in order not to render ATDM strategies ineffective.

- Mobility and environmental benefits will increase with increased prediction accuracy, more active management, and improved robust behavioral predictions

- Increased coverage increases ATDM benefits, but also cost. There is a level of coverage that will provide the highest value by maximizing the benefit/cost ratio.

ANALYSIS SCENARIOS

Baseline Description



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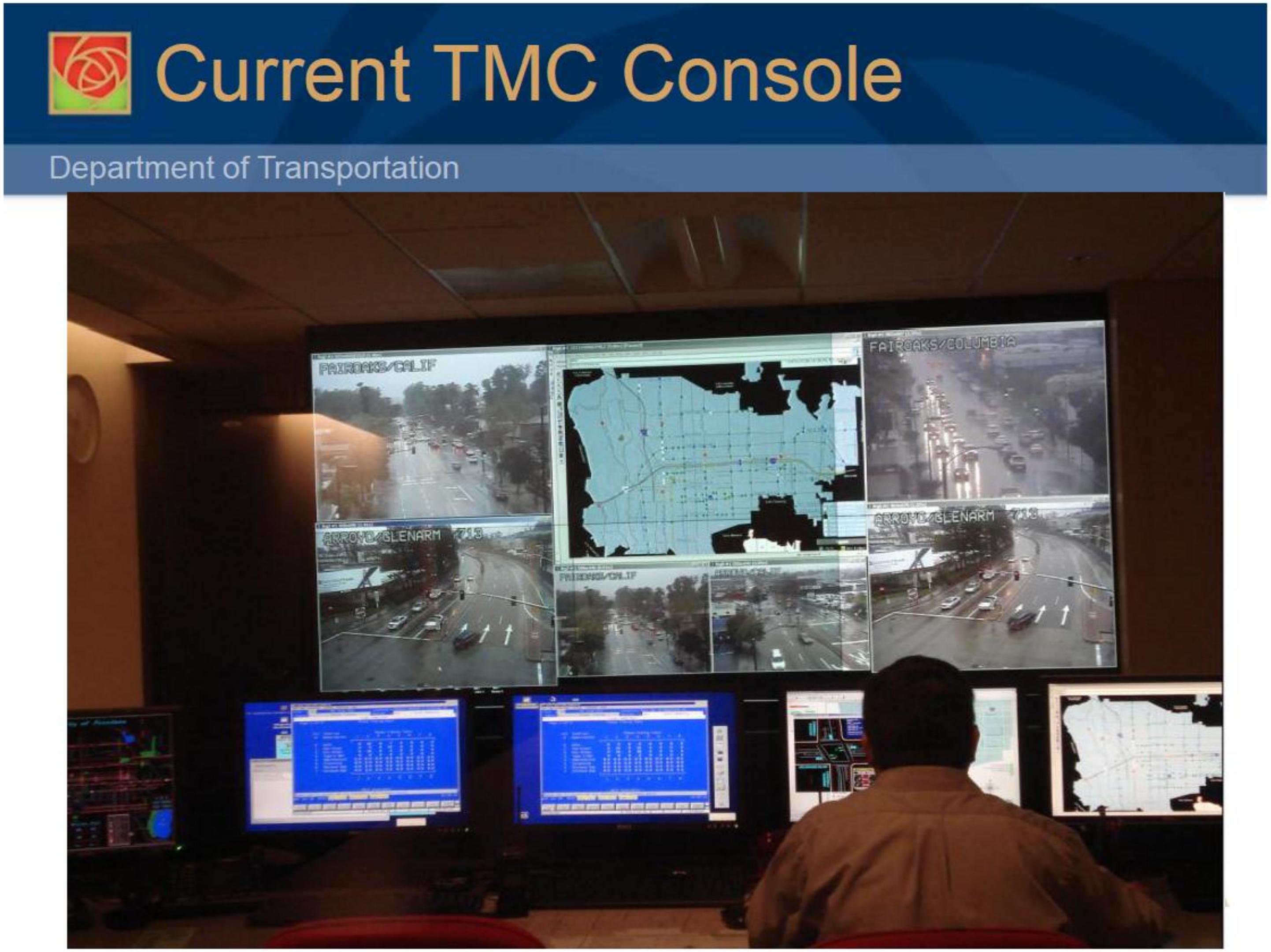
Baseline Description



Baseline Description

Current ITS Deployment

Department of Transportation

- Over 25 miles of fiber
- 4 Central Traffic Control Systems (all on the IEN)
- 31 CCTV Cameras
- 5 Fixed CMS (6 legacy CMS no longer operational)
- SMART Signal Pilot
- Transit Vehicle Arrival Information System
- Bluetooth Pilot
- SCATS Adaptive System on Fair Oaks Ave
- Video Detection (65 intersections)
- System Detection (80 intersections)

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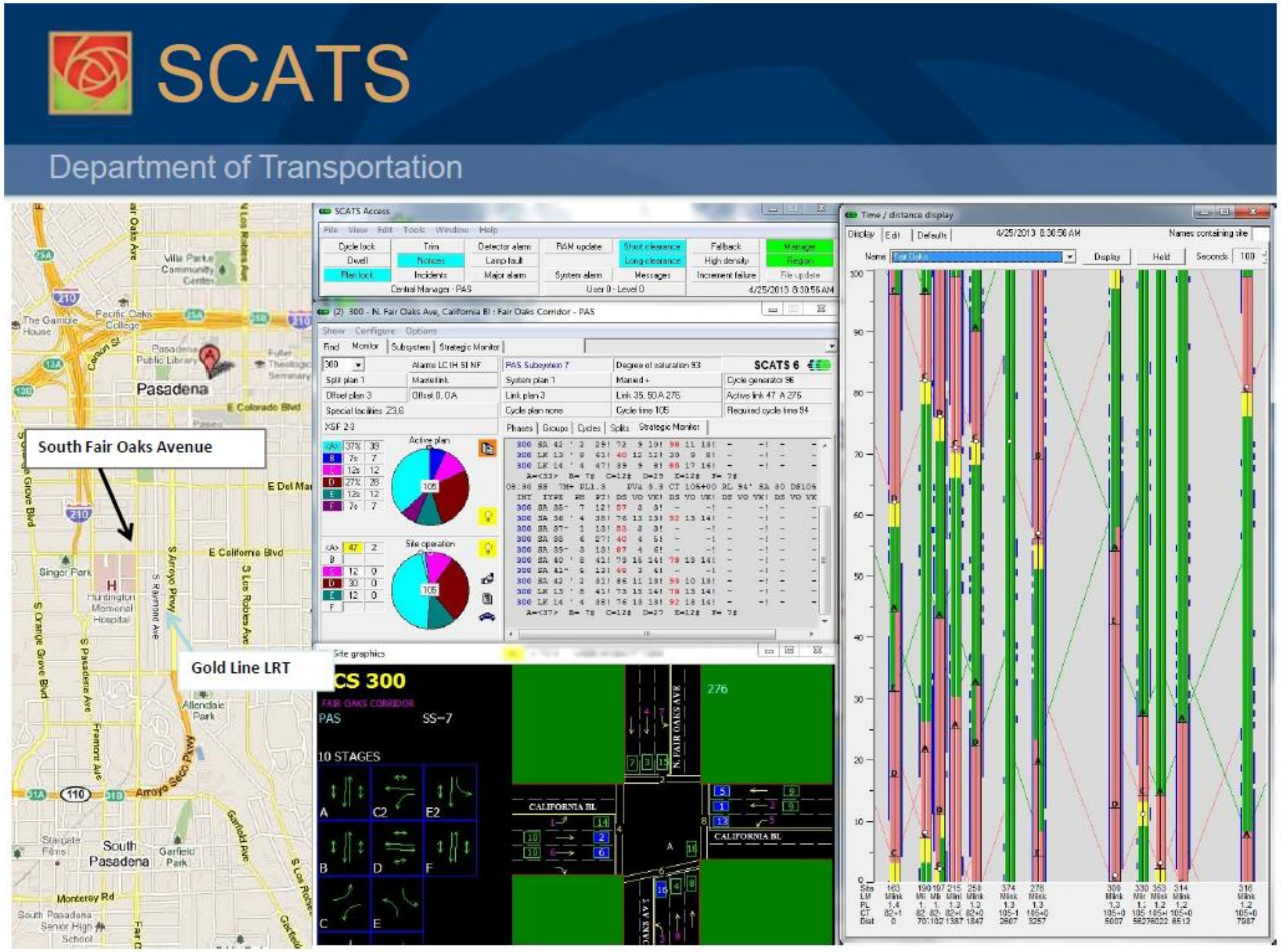
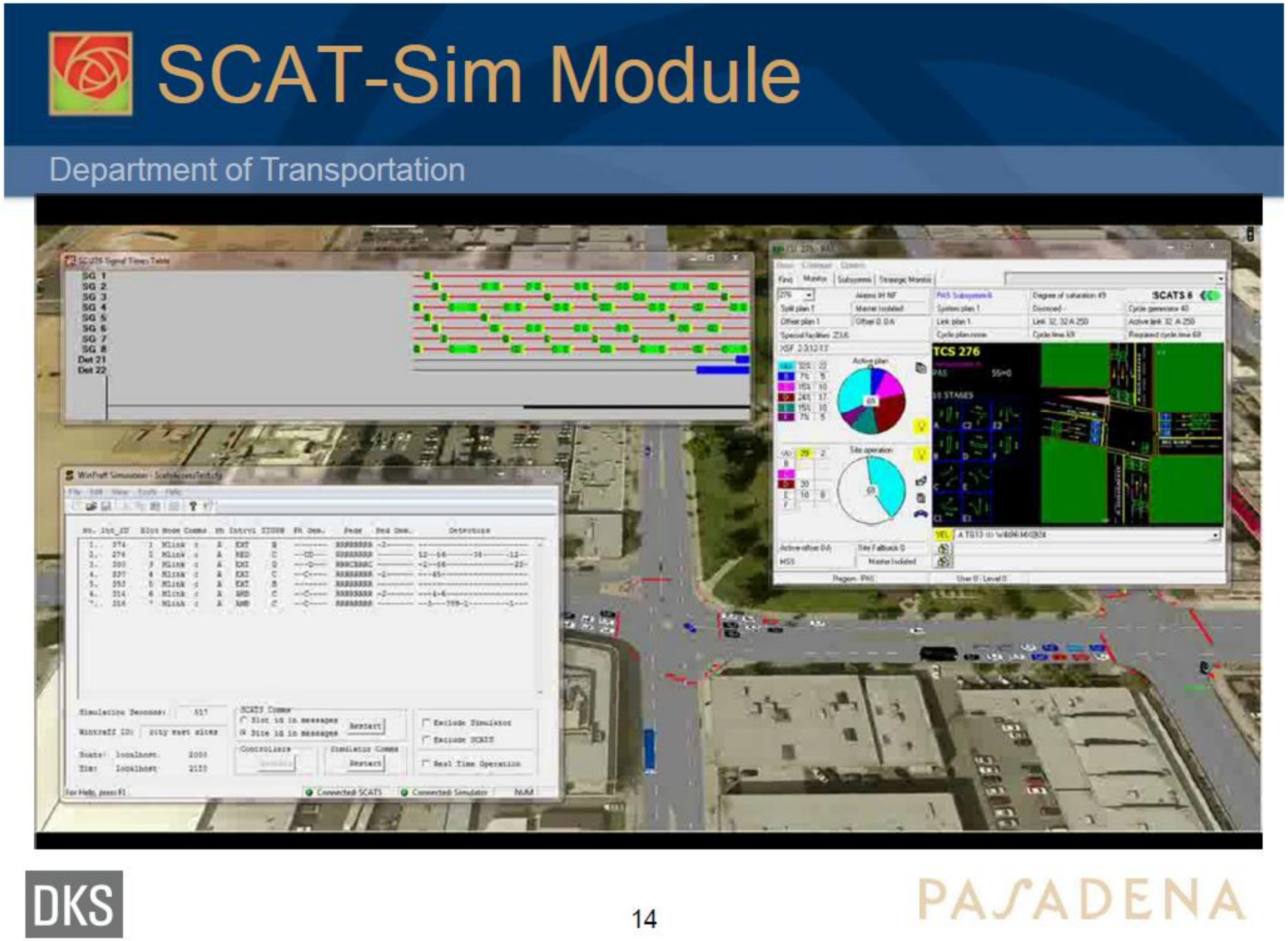
Baseline Description



Baseline Description



Baseline Description

Ongoing Projects

Department of Transportation

- Transit Arrival Information System
  - > Displays at stops, IVR, Web-based
  - > Real-time bus position
  - > On-time performance data by stop
- Parking Guidance System
  - > Real-time off-street parking availability
  - > Integrate with wayfinding signage
  - > Provide dynamic guidance
- Emergency Vehicle Preemption

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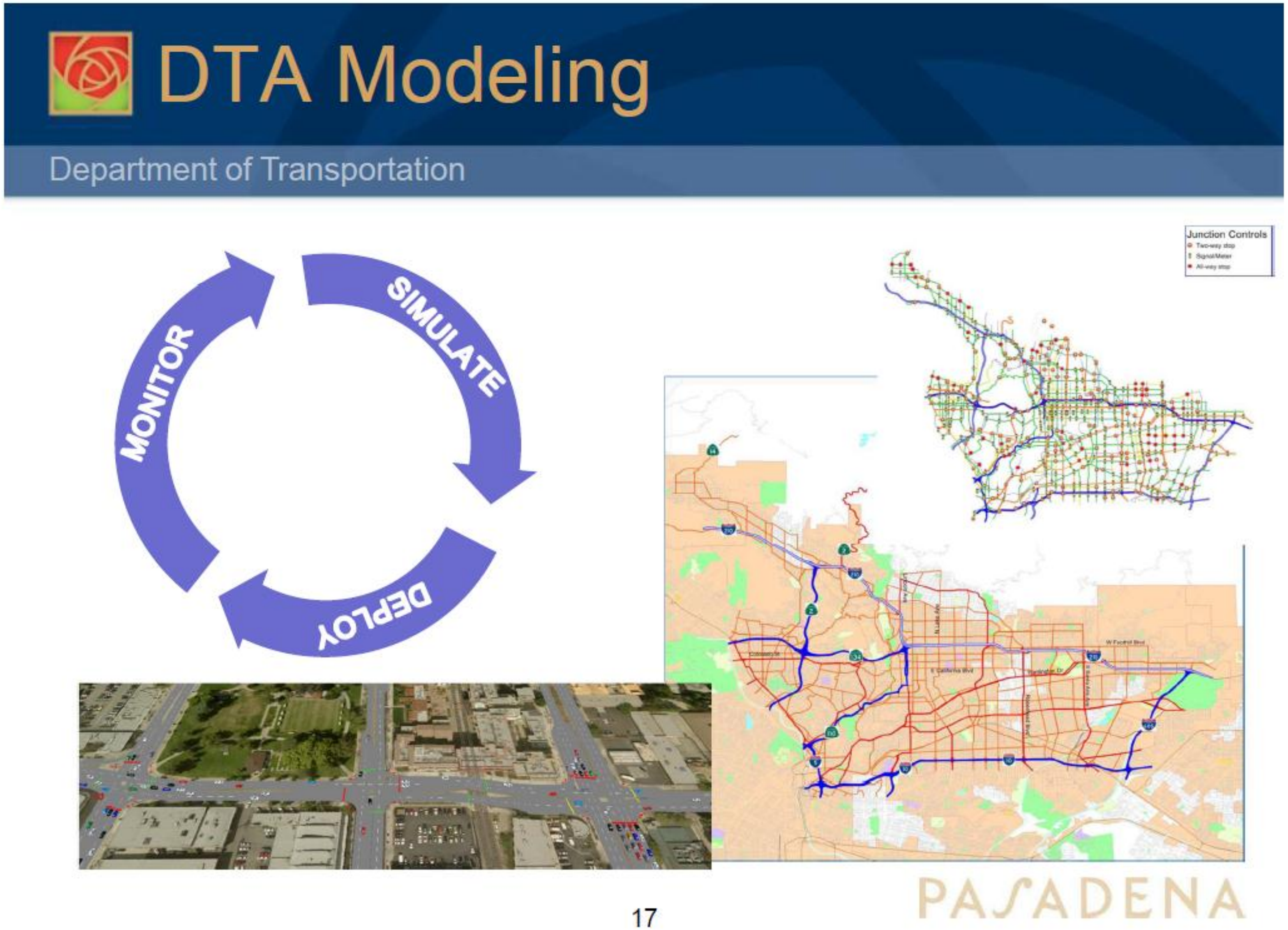
Baseline Description



Type of Travelers

- Transit riders
- Rideshare participants
- HOV passengers
- Passenger car drivers

Vehicle Modes

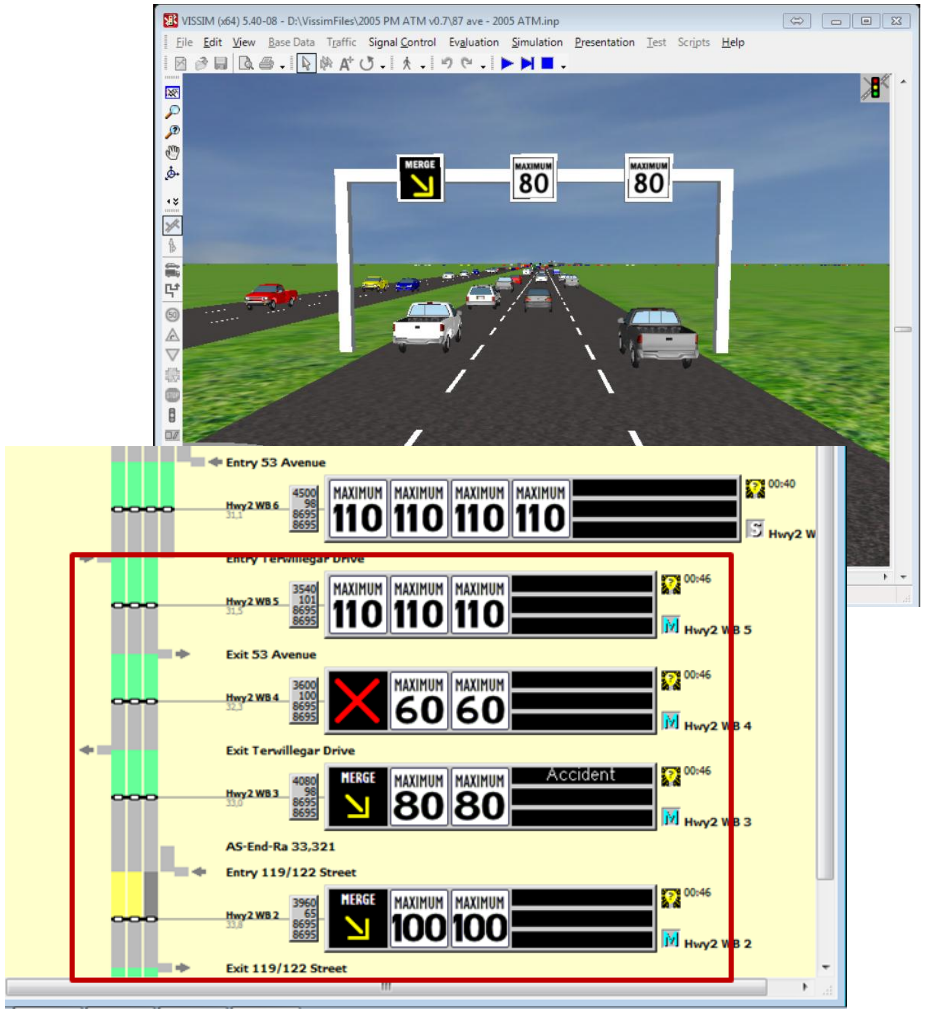
	Macroscopic	Mesoscopic	Microscopic
Light rail	✓		✓
Bus transit	✓		✓
Rideshare	✓		
HOV	✓	✓	✓
SOV	✓	✓	✓

Active Traffic Management: Dynamic Shoulder Lanes

- Algorithms and models used
  - Shoulder lane utilization based on predicted traffic conditions
- Input data required
  - Analysis scenario
  - Predicted traffic conditions
- Tools used to model strategy
  - Vissim
  - GeoDyn2-Control
- Development effort and risk
  - Minor

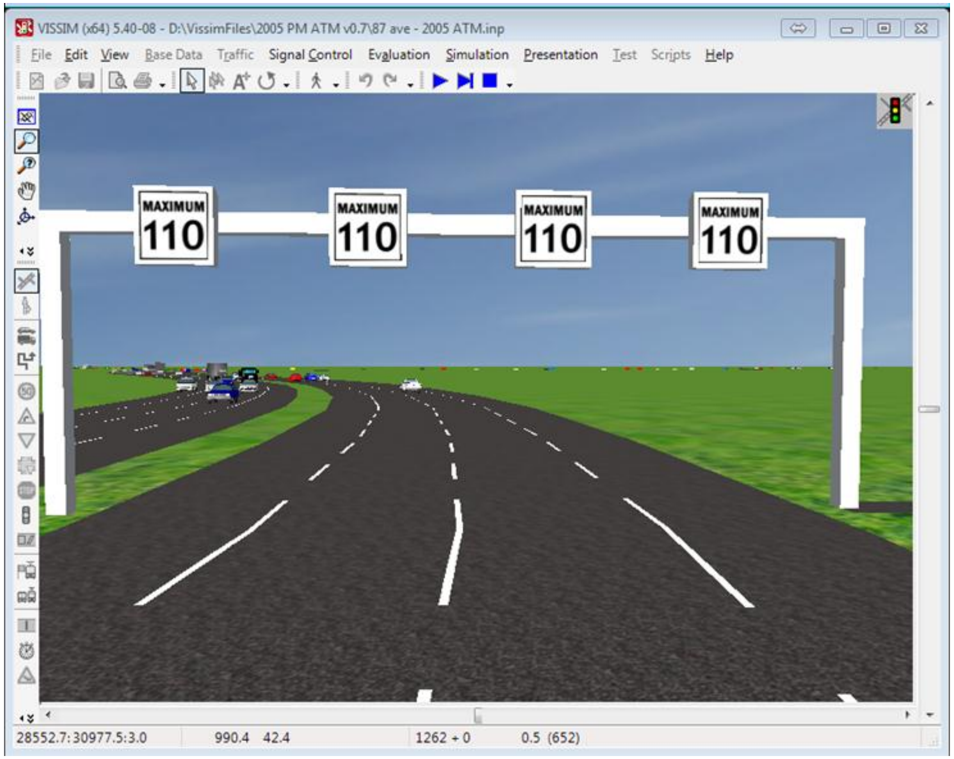
Active Traffic Management: Dynamic Lane Use Control

- Algorithms and models used
  - Lane utilization based on predicted traffic conditions
- Input data required
  - Analysis scenario
  - Predicted traffic conditions
- Tools used to model strategy
  - Vissim
  - GeoDyn2-Control
- Development effort and risk
  - Minor



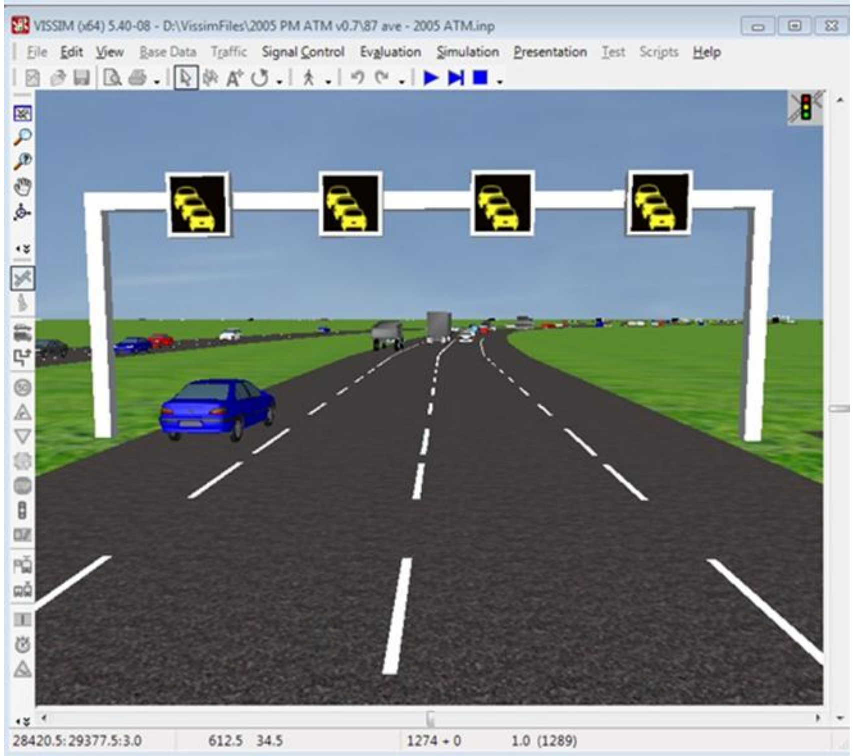
Active Traffic Management: Dynamic Speed Limits

- Algorithms and models used
  - Speed limits based on traffic conditions
- Input data required
  - Analysis scenario
- Tools used to model strategy
  - Vissim
  - GeoDyn2-Control
- Development effort and risk
  - Minor



Active Traffic Management: Queue Warning

- Algorithms and models used
  - Queue warning based on traffic conditions
  - Effect on microsimulation model unclear
- Input data required
  - Analysis scenario
- Tools used to model strategy
  - Vissim
  - GeoDyn2-Control
- Development effort and risk
  - Minor



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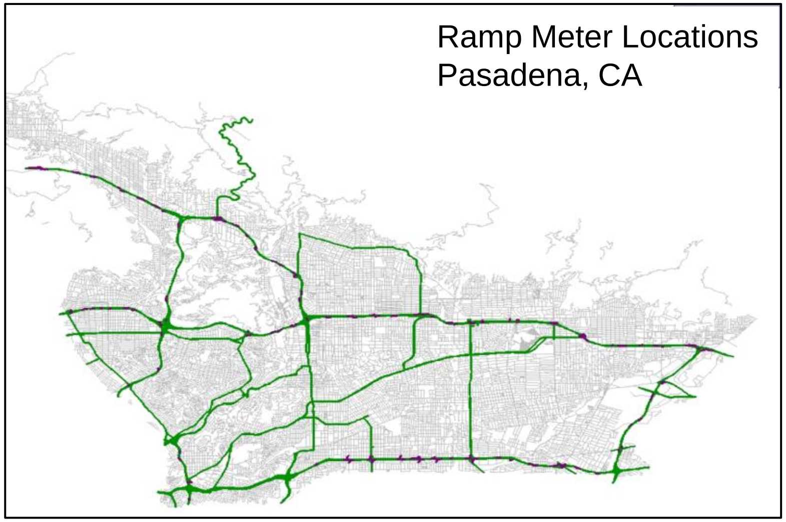
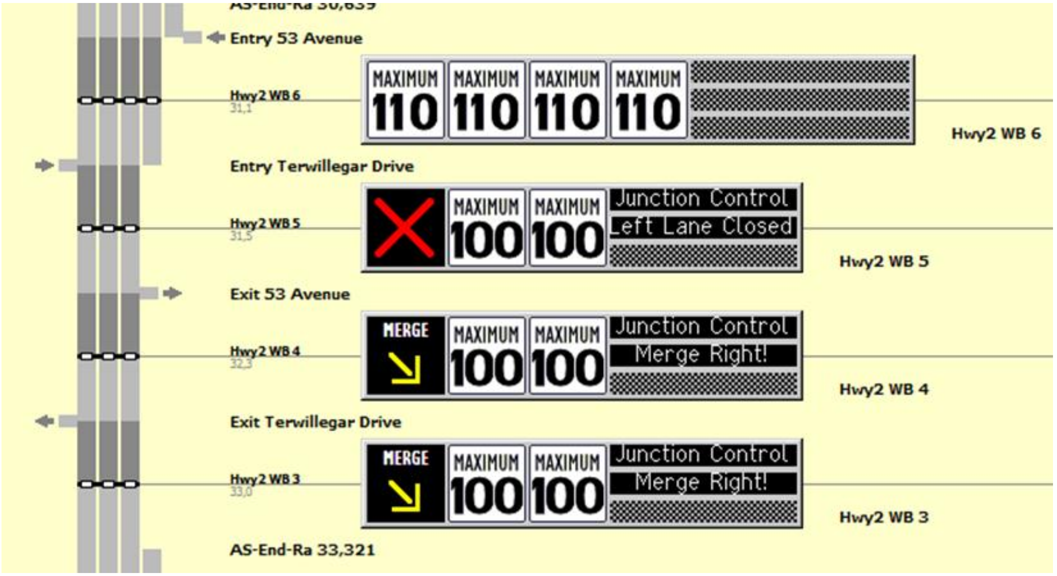
Active Traffic Management: Adaptive Ramp Metering

- Algorithms and models used
  - ALINEA
  - Ramp metering rates based on predicted traffic conditions
- Input data required
  - Analysis scenario
- Tools used to model strategy
  - Vissim
  - GeoDyn2-Control
- Development effort and risk
  - Minor, if using ALINEA, otherwise Medium



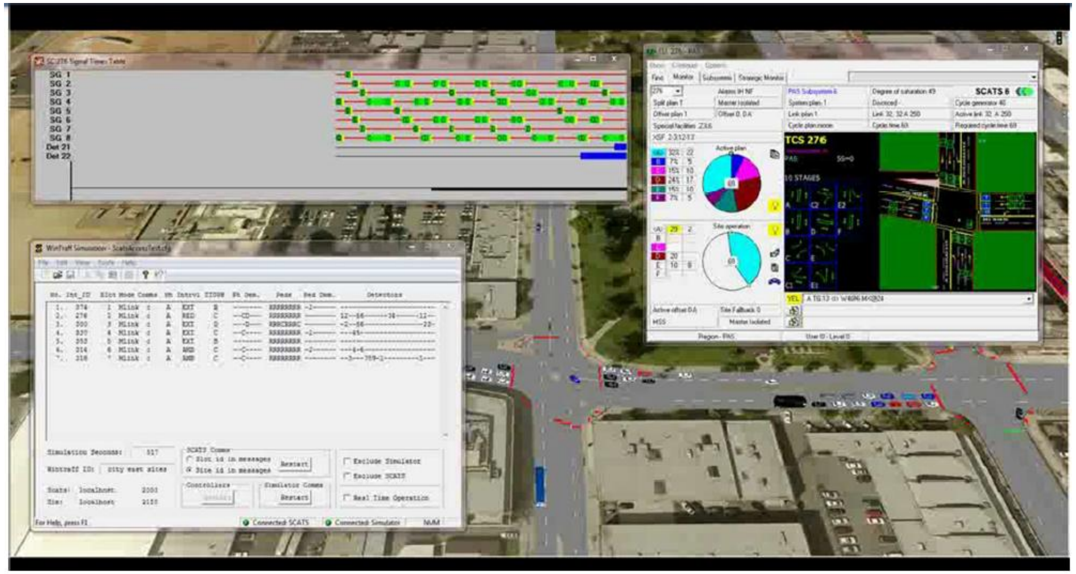
Active Traffic Management: Dynamic Junction/ Merge Control

- Algorithms and models used
  - Freeway junction lane allocation based on predicted traffic conditions
- Input data required
  - Analysis scenario
- Tools used to model strategy
  - Vissim
  - GeoDyn2-Control
- Development effort and risk
  - Minor



Active Traffic Management: Adaptive Signal Control

- Algorithms and models used
  - SCATS
- Input data required
  - Analysis scenario
- Tools used to model strategy
  - Vissim
  - SCATSim
- Development effort and risk
  - Minor



Existing Pasadena Vissim/SCATSim model

Active Traffic Management: Transit Signal Priority

- Algorithms and models used
  - TSP as embedded in D4 2070 signal controller firmware
- Input data required
  - Analysis scenario
- Tools used to model strategy
  - Vissim
  - D4 SIL (equivalent to Vissim's RBC controller)
- Development effort and risk
  - Minor

Active Traffic Management: Dynamic Lane Reversal

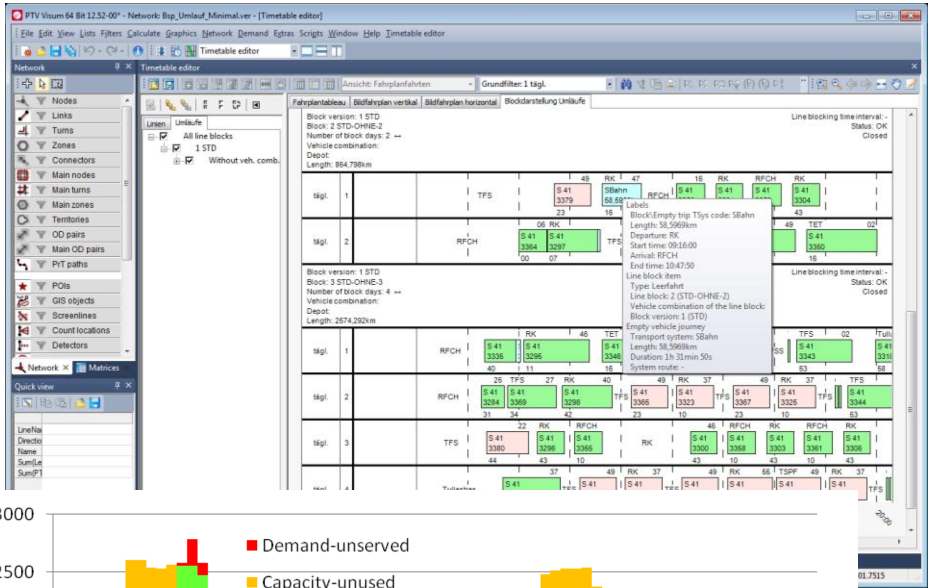
- Algorithms and models used
  - Dynamic lane reversal based on predicted traffic conditions
- Input data required
  - Analysis scenario
  - Predicted traffic conditions
- Tools used to model strategy
  - Vissim
  - GeoDyn2-Control
- Development effort and risk
  - Medium

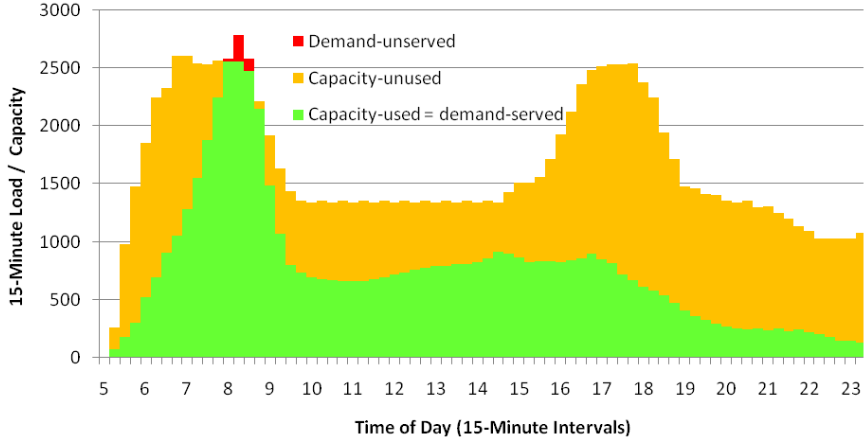
Active Demand Management: Dynamic Ridesharing

- Algorithms and models used
  - Aggregate tour based destination choice model
- Input data required
  - Demographic data/person types
  - Typical work/school locations
- Tools used to model strategy
  - Visum (tour based demand module)
- Development effort and risk
  - Medium

Active Demand Management: Dynamic Transit Capacity Assignment

- Algorithms and models used
  - Timetable based transit assignment
  - Line blocking, capacity indicators
- Input data required
  - Transit fleet (buses, rail cars etc.)
  - Transit schedules
  - Passenger demand
- Tools used to model strategy
  - Visum (line blocking module)
- Development effort and risk
  - Medium

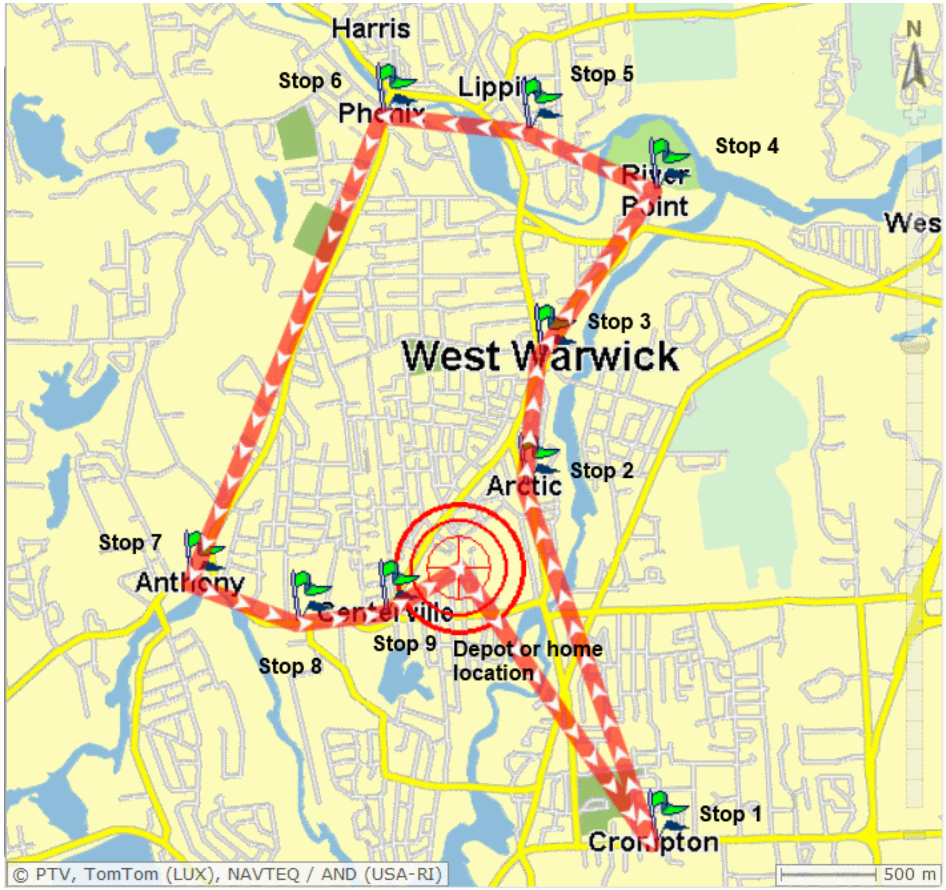




**Scherr. W, Fisher. I "Regional Application of 24-Hour Dynamic Transit Assignment", 12th TRB Transportation Planning Application Conference, Houston TX, May 2009

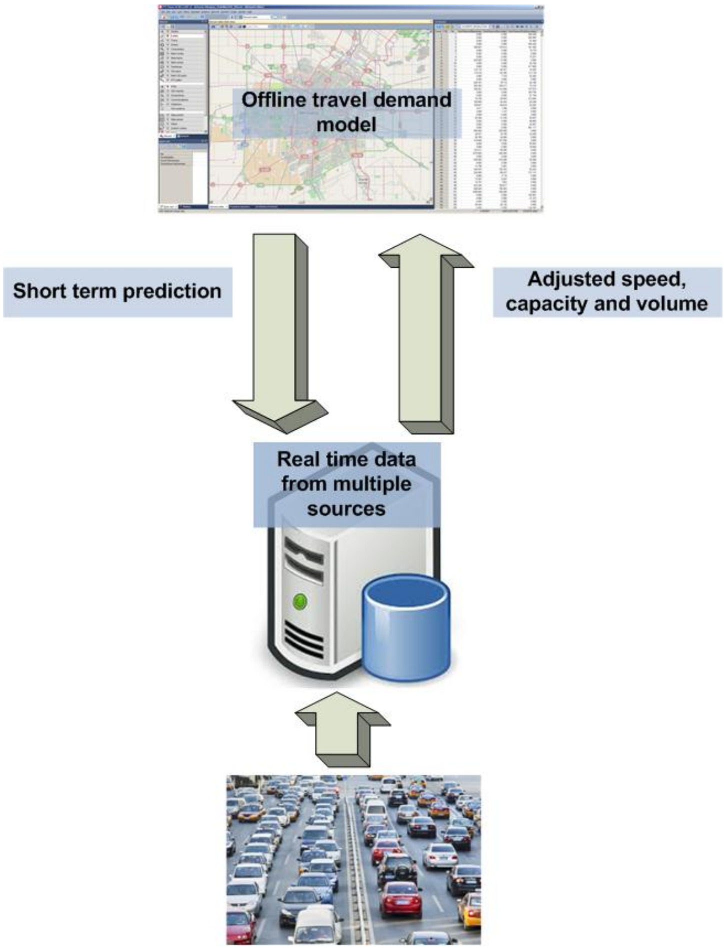
Active Demand Management: On-demand Transit

- Algorithms and models used
  - Traveling salesman problem (TSP)
  - Fast heuristic solution methods
- Input data required
  - Transit fleet
  - Depot location
  - Passenger demand
- Tools used to model strategy
  - Visum
  - PTV xTour
- Development effort and risk
  - Medium



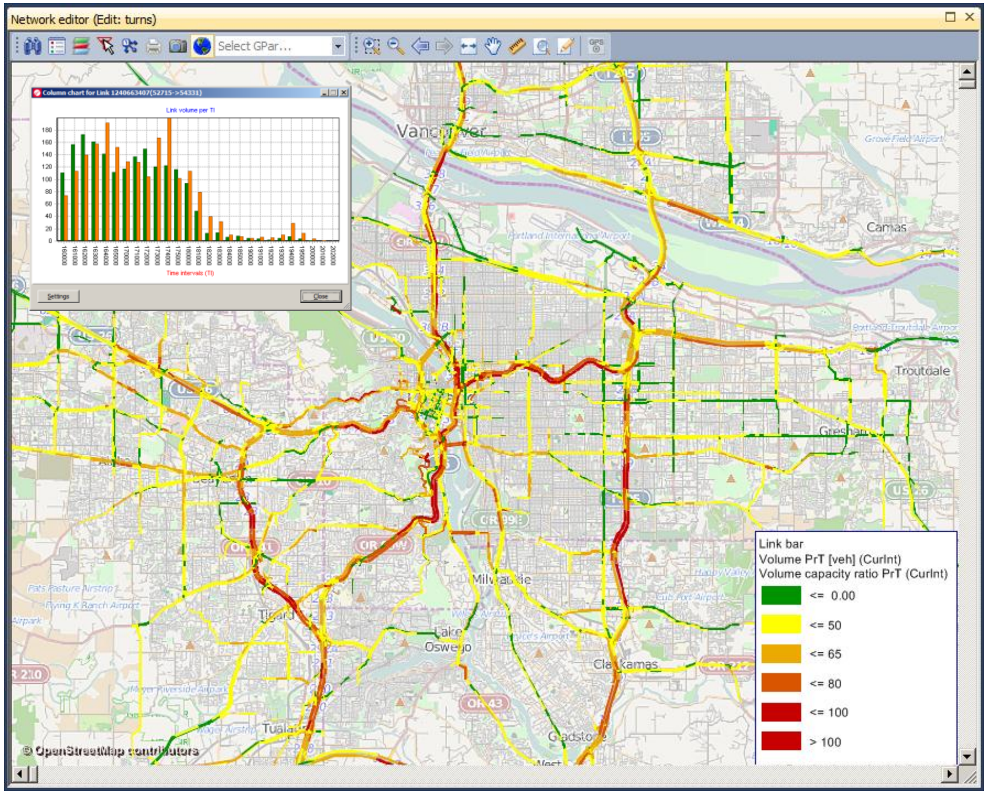
Active Demand Management: Predictive Traveler Information

- Algorithms and models used
  - Mode choice model
- Input data required
  - DTA model
  - Predicted traffic conditions
- Tools used to model strategy
  - Visum (incl. tour based demand module)
- Development effort and risk
  - Medium



Active Demand Management: Dynamic Pricing

- Algorithms and models used
  - Adaptation of Vickrey's departure time choice model
  - Mode choice model
- Input data required
  - Price elasticity (surveys)
  - Demographic data for market segmentation
- Tools used to model strategy
  - Visum (incl. tour based demand module)
- Development effort and risk
  - Medium/High



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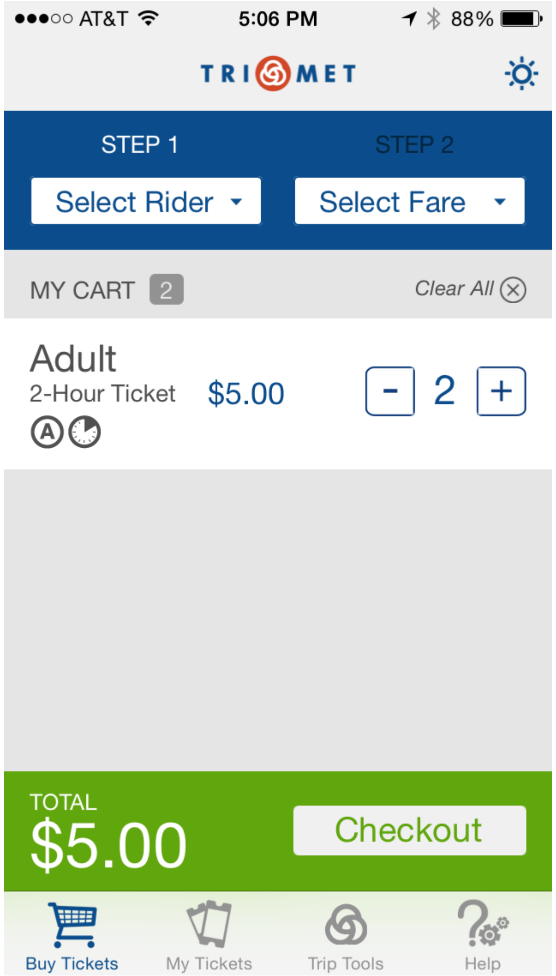
Active Demand Management: Dynamic Fare Reduction

- Algorithms and models used
  - Mode choice model
  - Rule based adjustments
- Input data required
  - Passenger demand
  - Price elasticity
- Tools used to model strategy
  - Visum (incl. tour based demand module)
- Development effort and risk
  - Minor



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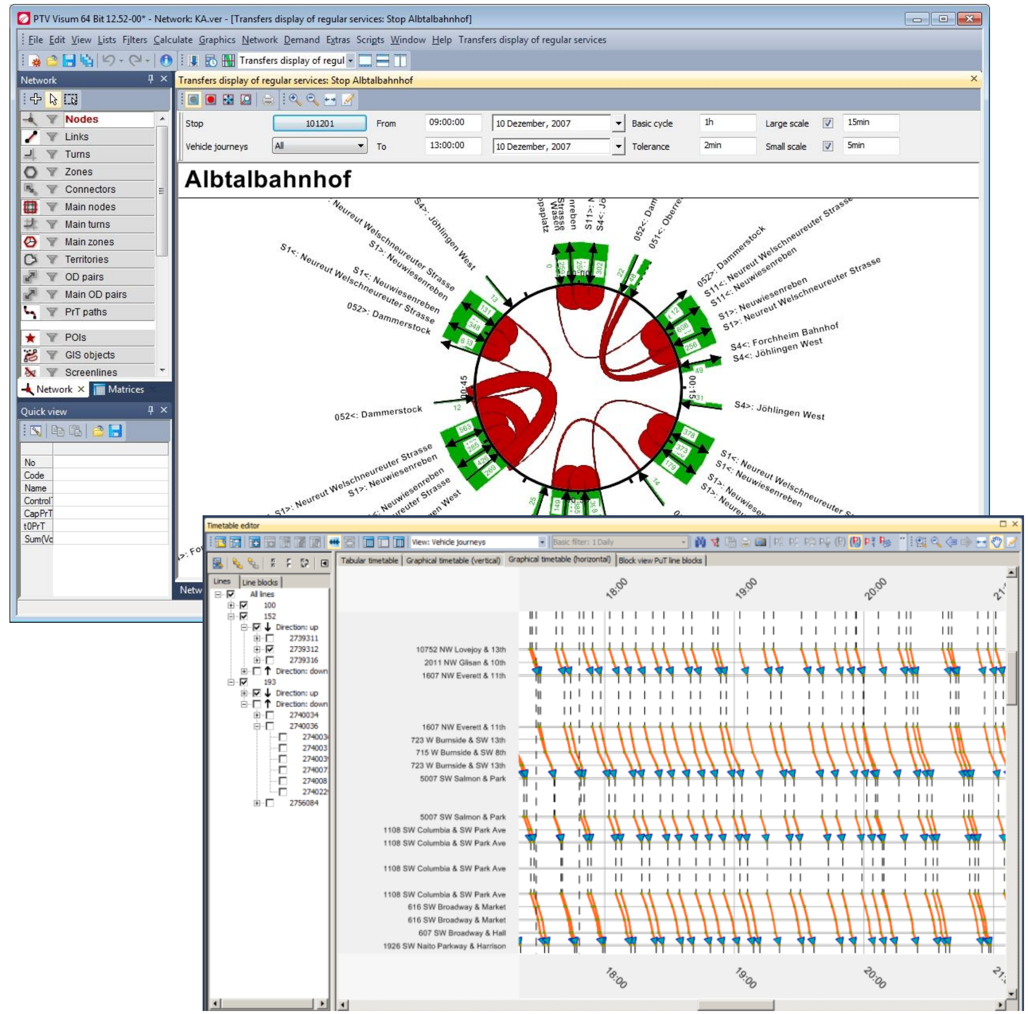
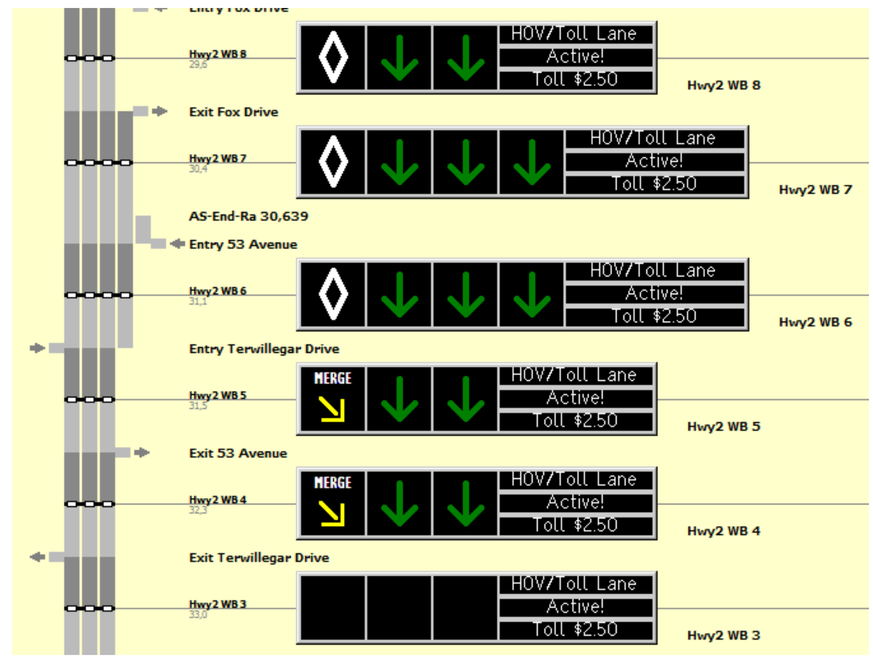
Active Demand Management: Transfer Connection Protection

- Algorithms and models used
  - Transit system manager decision support system
- Input data required
  - Transit fleet and schedule
  - Passenger demand
- Tools used to model strategy
  - Visum (transfer display tool)
- Development effort and risk
  - Minor



Active Demand Management: Dynamic HOV/ Managed Lanes

- Algorithms and models used
  - Dynamic HOV/Managed Lane operation based on predicted traffic conditions
  - Facility choice model
  - Heuristic pricing model
- Input data required
  - Predicted traffic conditions
  - Pricing elasticity
- Tools used to model strategy
  - Vissim
  - GeoDyn2-Control
- Development effort and risk
  - Medium



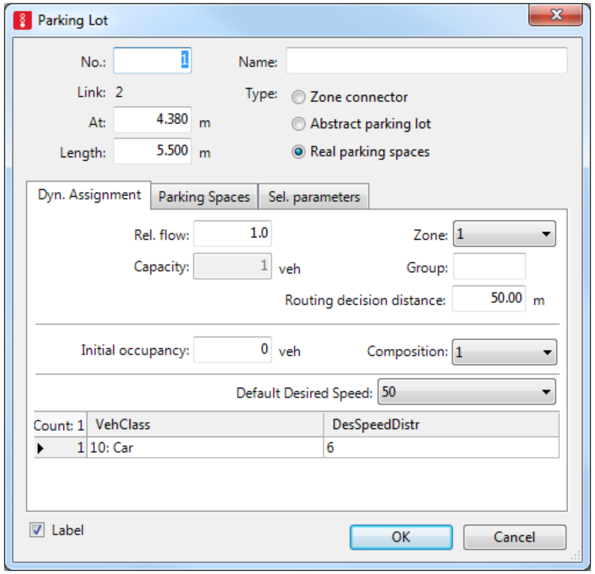
Active Demand Management: Dynamic Routing

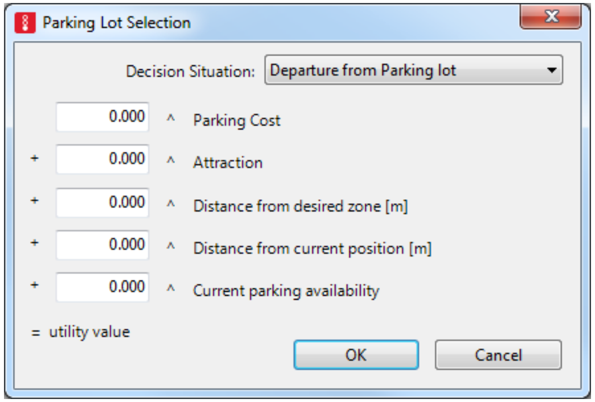
- Algorithms and models used
  - Dynamic Routing for select OD bundles based on predicted traffic conditions
  - Use of "dynamic routes" concept in Vissim

- Input data required
  - Predicted traffic conditions
- Tools used to model strategy
  - Vissim
  - GeoDyn2-Control
- Development effort and risk
  - Minor

Active Parking Management: Dynamically Priced Parking

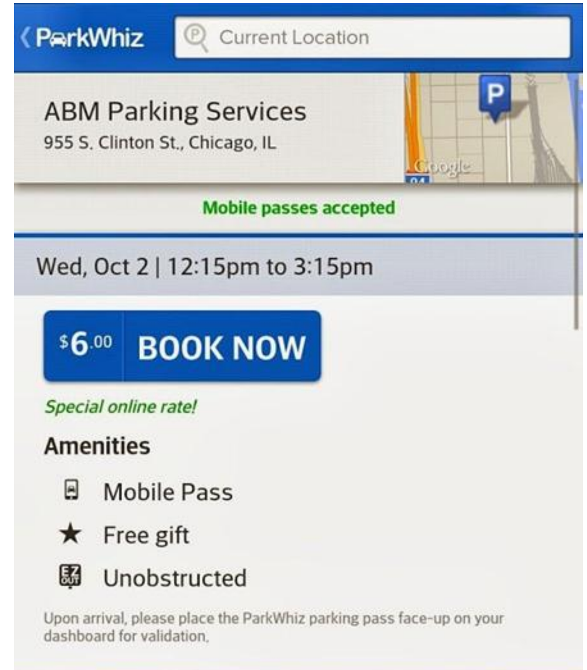
- Algorithms and models used
  - Mode and departure time choice
  - Simulation based parking choice model/shadow pricing
- Input data required
  - Pricing strategy
  - Pricing elasticity
  - Parking supply
- Tools used to model strategy
  - Visum (incl. tour based demand module)
  - Vissim
- Development effort and risk
  - Medium

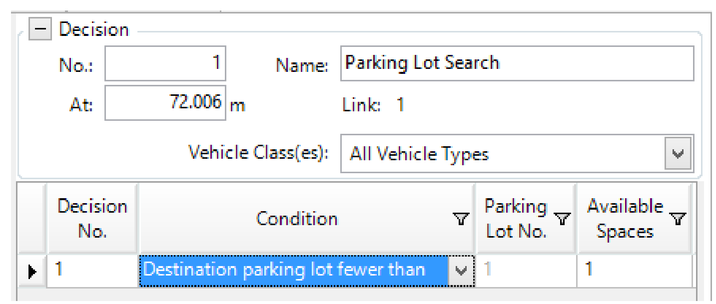




Active Parking Management: Dynamic Parking Reservation

- Algorithms and models used
  - Simulation based parking choice model with dynamic availability
- Input data required
  - Parking supply
- Tools used to model strategy
  - Vissim
- Development effort and risk
  - Minor





Active Parking Management: Dynamic Overflow Transit Parking

- Algorithms and models used
  - Bi-level parking lot allocation model modeled as optimal lot assignment and capacity reallocation
- Input data required
  - Available parking lots
  - Park and ride demand
- Tools used to model strategy
  - Visum (upper level model)
  - Python (overflow reallocation)
- Development effort and risk
  - Minor

Operational Conditions

- Operational conditions that can be modeled by the Pasadena testbed
  - Peak/Off-peak
    - Available cell phone sighting based demand profiles cover 24 hours and three different day types
  - Incident
    - Incidents are modeled by placing them in the microsimulation model with the ATM system manager and the traffic prediction system responding to them
  - Work Zone
    - Work zones are modeled by the ATM system manager and the microsimulation model and the traffic prediction system responding to them
  - Planned Special Event
    - Available cell phone sighting based demand profiles cover special events at the Rose Bowl
    - Response ATDM strategies are modeled by all tools

Analysis Scenarios

- Any combination of Operational Condition and ATDM Strategies is feasible!

Peak/Off-peak

Included Strategies

- Dynamic Shoulder Lanes
- Dynamic Lane Use
- Dynamic Speed Limits
- Queue Warning
- Adaptive Ramp Metering
- Dynamic Junction Control
- Adaptive Signal Control
- Transit Signal Priority
- Dynamic Parking Reservation
- On-demand Transit
- Predictive Traveler Information
- Dynamically Priced Parking

Excluded Strategies

- Dynamic Lane Reversal
- Dynamic Overflow Transit Parking
- Dynamic Ridesharing
- Dynamic Transit Capacity Assignment
- Dynamic Pricing
- Dynamic Fare Reduction
- Dynamic Transfer Protection
- Dynamic Overflow Transit Parking

Analysis Scenarios

Incident

Included Strategies

- Dynamic Shoulder Lanes
- Dynamic Lane Use
- Dynamic Speed Limits
- Queue Warning
- Adaptive Ramp Metering
- Dynamic Junction Control
- Adaptive Signal Control
- Dynamic Lane Reversal
- Dynamic Overflow Transit Parking
- Dynamic Ridesharing
- Dynamic Transit Capacity Assignment
- Dynamic Pricing
- Dynamic Fare Reduction
- Dynamic Transfer Protection
- Dynamic Overflow Transit Parking
- Predictive Traveler Information

Excluded Strategies

- Transit Signal Priority
- Dynamic Parking Reservation
- On-demand Transit
- Dynamically Priced Parking

Analysis Scenarios

Work Zone

Included Strategies	Excluded Strategies
Dynamic Shoulder Lanes	On-demand Transit
Dynamic Lane Use	Dynamically Priced Parking
Dynamic Speed Limits	Dynamic Parking Reservation
Queue Warning	Dynamic Transfer Protection
Adaptive Ramp Metering	Dynamic Transit Capacity Assignment
Dynamic Junction Control	
Adaptive Signal Control	
Transit Signal Priority	
Dynamic Lane Reversal	
Dynamic Overflow Transit Parking	
Dynamic Ridesharing	
Dynamic Pricing	
Dynamic Fare Reduction	
Dynamic Overflow Transit Parking	
Predictive Traveler Information	

Analysis Scenarios

Planned Special Event

Included Strategies

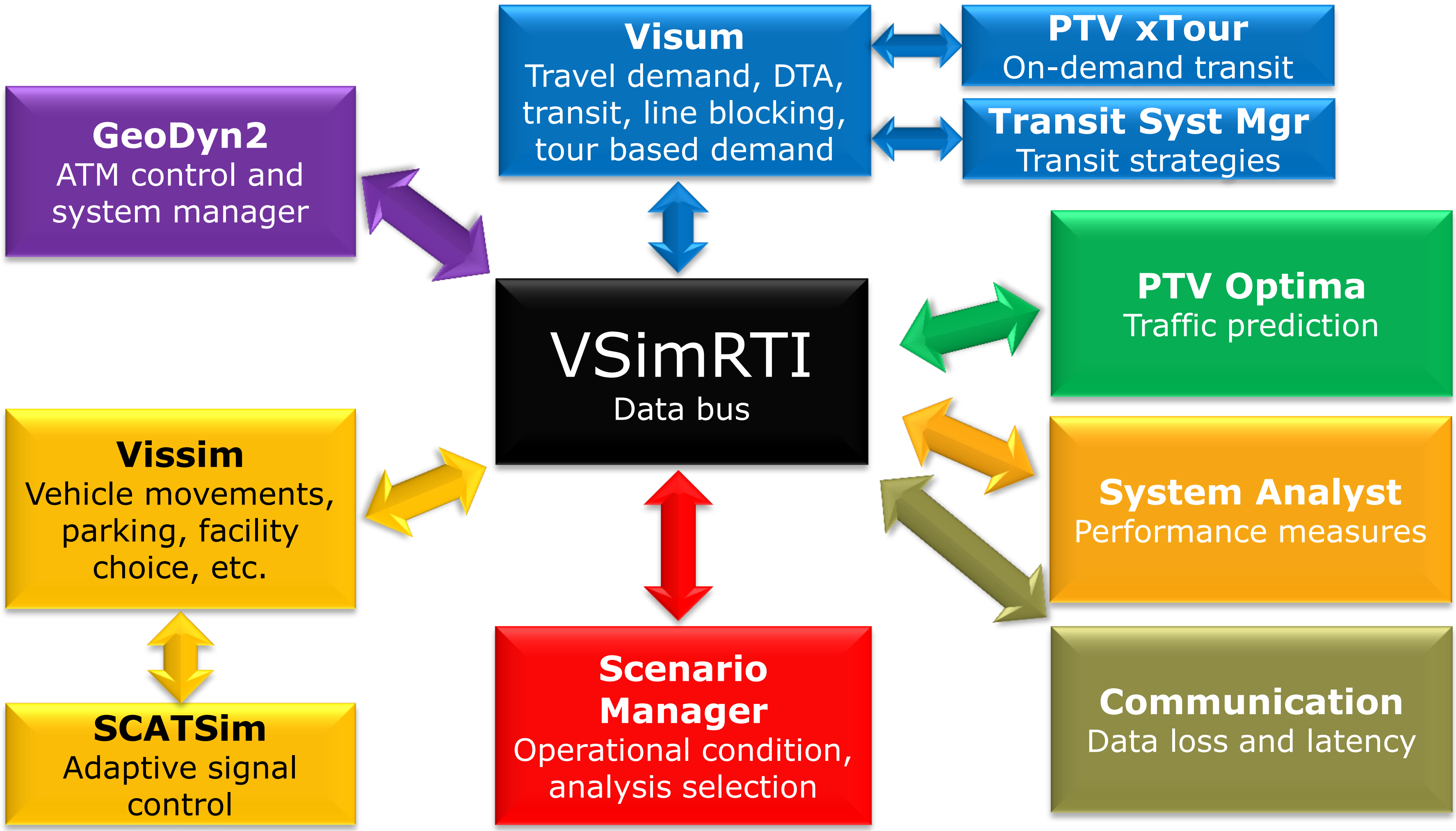
- Dynamic Shoulder Lanes
- Dynamic Lane Use
- Dynamic Speed Limits
- Queue Warning
- Adaptive Ramp Metering
- Dynamic Junction Control
- Adaptive Signal Control
- Dynamic Lane Reversal
- Dynamic Overflow Transit Parking
- Dynamic Ridesharing
- Dynamic Pricing
- Dynamic Fare Reduction
- Dynamic Overflow Transit Parking
- Predictive Traveler Information
- Dynamically Priced Parking
- Dynamic Parking Reservation
- Dynamic Transfer Protection
- Dynamic Transit Capacity Assignment

Excluded Strategies

- On-demand Transit
- Transit Signal Priority

ANALYSIS FRAMEWORK

Pasadena Testbed Description



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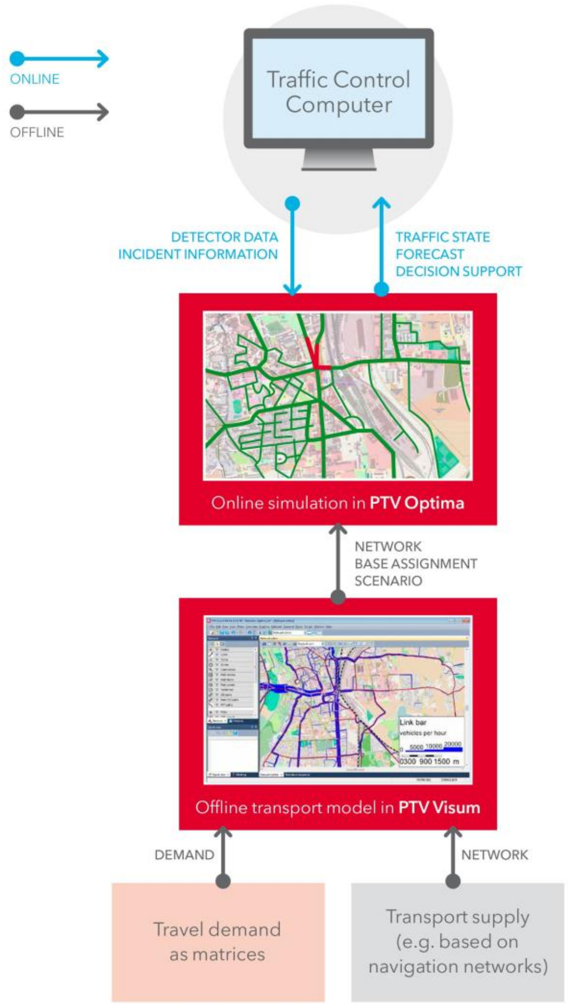
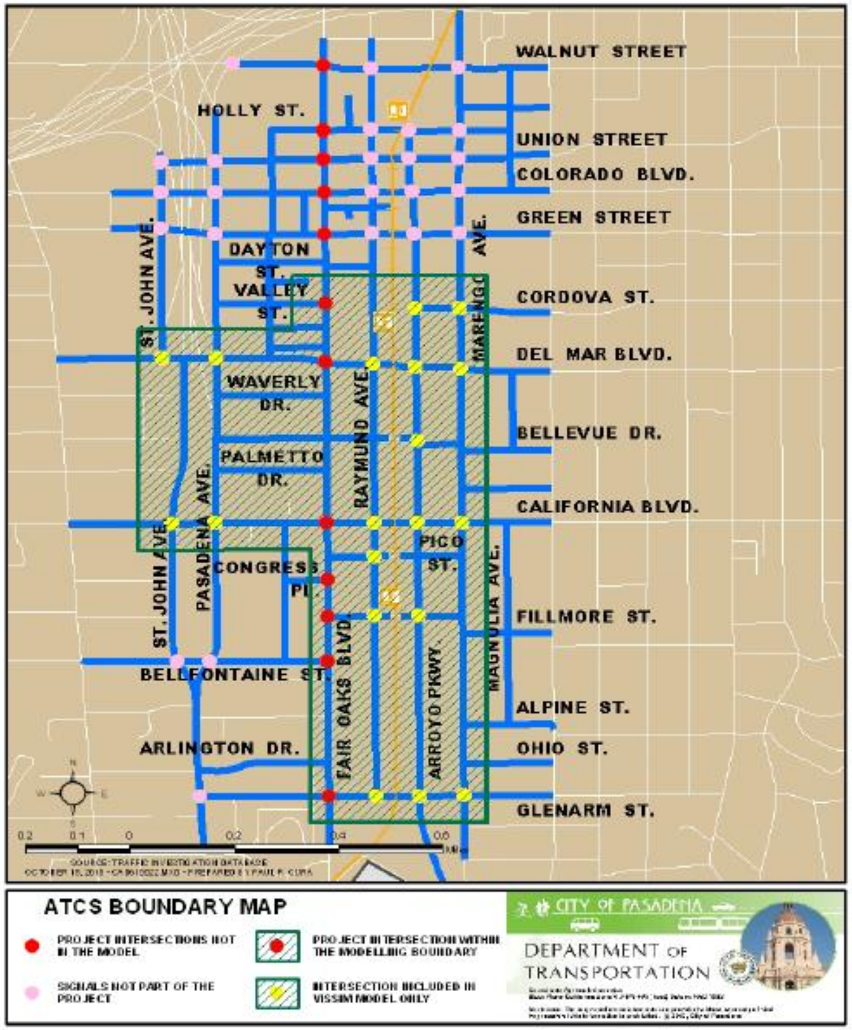
Traffic Prediction

- Model-based short-term (30 min) prediction of
  - Traffic volume
  - Traffic speed
- Input data required
  - Calibrated DTA model (available)
- Tools used to model strategy
  - PTV Optima
- Development effort and risk
  - Medium



Adaptive Signal Control

- SCATS currently deployed on downtown core parallel to LRT
- Existing SCATSim model integrated with Vissim
- SCATSim licensing arrangement to be determined
- Development effort and risk
  - Minor



Communication Model

- Low-fidelity model focused on ATDM requirements
- Representation of
  - Data loss
  - Latency
- Model options
  - Existing tool
  - Custom program

Communication
Data loss and latency

Scenario Manager

- Graphical user interface for run-time control
- Selection of
  - Operational condition
  - ATDM strategy bundle
  - Other parameters

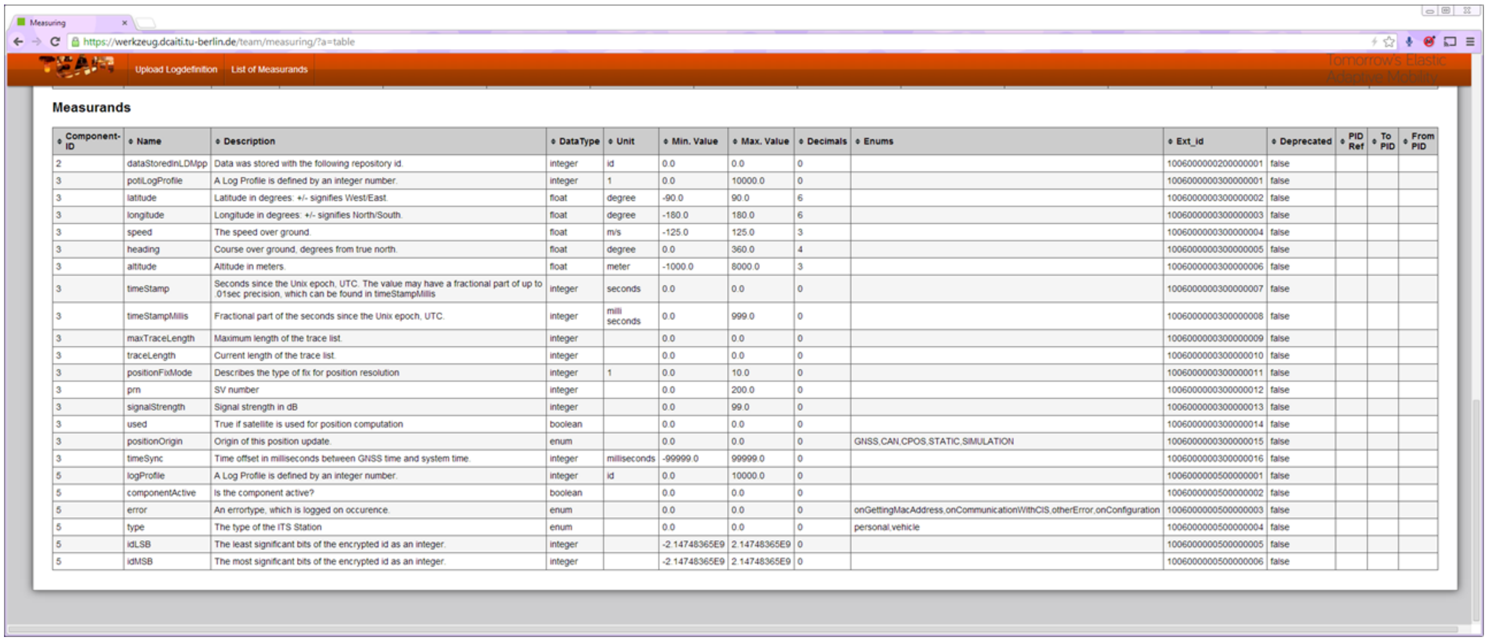
Scenario Manager
Operational condition, analysis selection

System Analyst

- Performance measure
  - Definition
  - Aggregation
  - Reporting

System Analyst
Performance measures

- Feature of VSimRTI


https://werkzeug.dcaiti.tu-berlin.de/team/measuring/?a=table

Upload Logdefinition | List of Measurands

Measurands

Component-ID	Name	Description	DataType	Unit	Min. Value	Max. Value	Decimals	Enums	Ext_id	Deprecated	PID Ref	To PID	From PID
2	dataStoredInLDMpp	Data was stored with the following repository id.	integer	id	0.0	0.0	0		1006000000200000001	false			
3	potiLogProfile	A Log Profile is defined by an integer number.	integer	1	0.0	10000.0	0		1006000000300000001	false			
3	latitude	Latitude in degrees: +/- signifies West/East.	float	degree	-90.0	90.0	6		1006000000300000002	false			
3	longitude	Longitude in degrees: +/- signifies North/South.	float	degree	-180.0	180.0	6		1006000000300000003	false			
3	speed	The speed over ground.	float	m/s	-125.0	125.0	3		1006000000300000004	false			
3	heading	Course over ground, degrees from true north.	float	degree	0.0	360.0	4		1006000000300000005	false			
3	altitude	Altitude in meters.	float	meter	-1000.0	8000.0	3		1006000000300000006	false			
3	timeStamp	Seconds since the Unix epoch, UTC. The value may have a fractional part of up to .01sec precision, which can be found in timeStampMillis	integer	seconds	0.0	0.0	0		1006000000300000007	false			
3	timeStampMillis	Fractional part of the seconds since the Unix epoch, UTC.	integer	milli seconds	0.0	999.0	0		1006000000300000008	false			
3	maxTraceLength	Maximum length of the trace list.	integer		0.0	0.0	0		1006000000300000009	false			
3	traceLength	Current length of the trace list.	integer		0.0	0.0	0		1006000000300000010	false			
3	positionFixMode	Describes the type of fix for position resolution	integer	1	0.0	10.0	0		1006000000300000011	false			
3	prn	SV number	integer		0.0	200.0	0		1006000000300000012	false			
3	signalStrength	Signal strength in dB	integer		0.0	99.0	0		1006000000300000013	false			
3	used	True if satellite is used for position computation	boolean		0.0	0.0	0		1006000000300000014	false			
3	positionOrigin	Origin of this position update.	enum		0.0	0.0	0	GNSS,CAN,CPOS,STATIC,SIMULATION	1006000000300000015	false			
3	timeSync	Time offset in milliseconds between GNSS time and system time.	integer	milliseconds	-99999.0	99999.0	0		1006000000300000016	false			
5	logProfile	A Log Profile is defined by an integer number.	integer	id	0.0	10000.0	0		1006000000500000001	false			
5	componentActive	Is the component active?	boolean		0.0	0.0	0		1006000000500000002	false			
5	error	An errortype, which is logged on occurence.	enum		0.0	0.0	0	onGettingMacAddress,onCommunicationWithCIS,otherError,onConfiguration	1006000000500000003	false			
5	type	The type of the ITS Station	enum		0.0	0.0	0	personal,vehicle	1006000000500000004	false			
5	idLSB	The least significant bits of the encrypted id as an integer.	integer		-2.14748365E9	2.14748365E9	0		1006000000500000005	false			
5	idMSB	The most significant bits of the encrypted id as an integer.	integer		-2.14748365E9	2.14748365E9	0		1006000000500000006	false			

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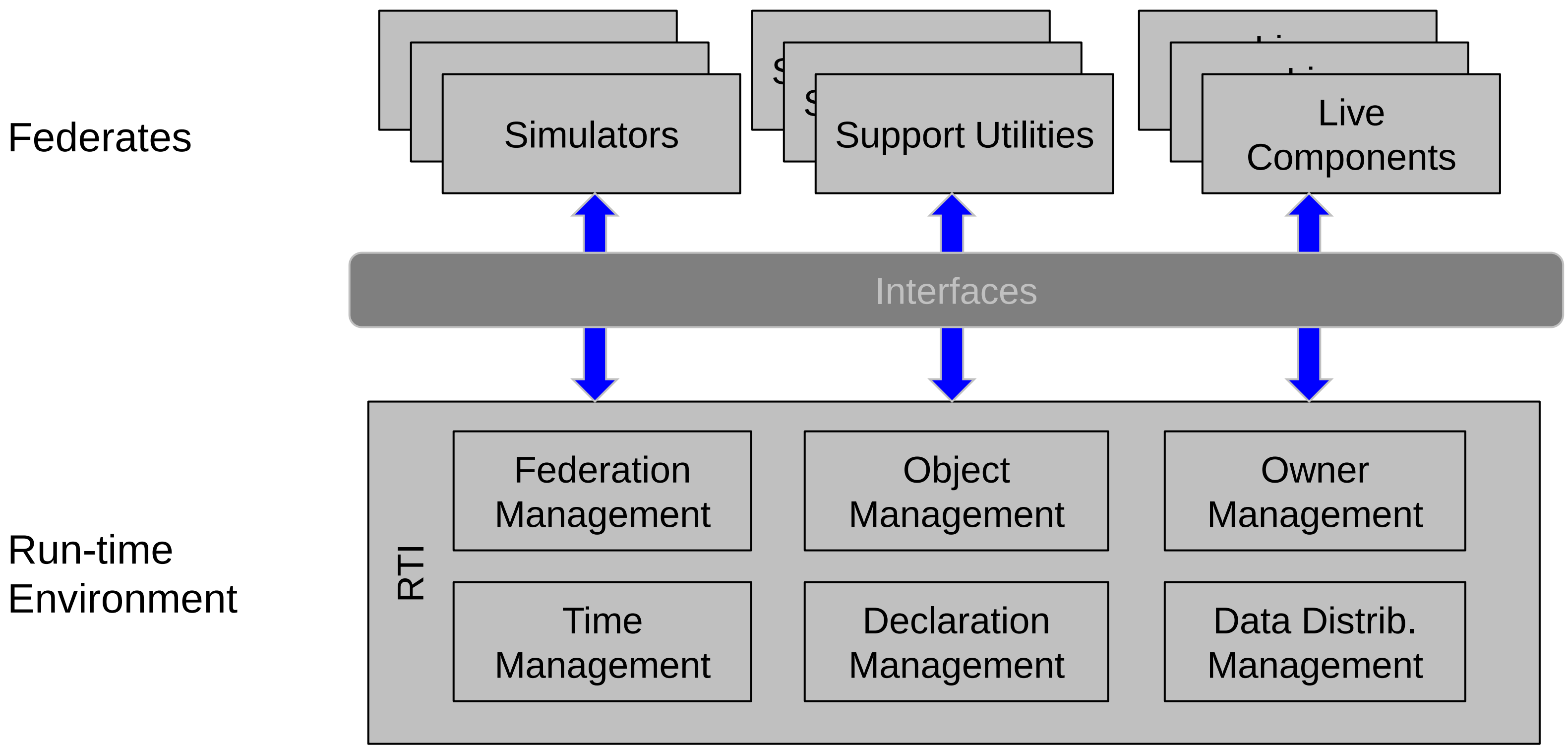
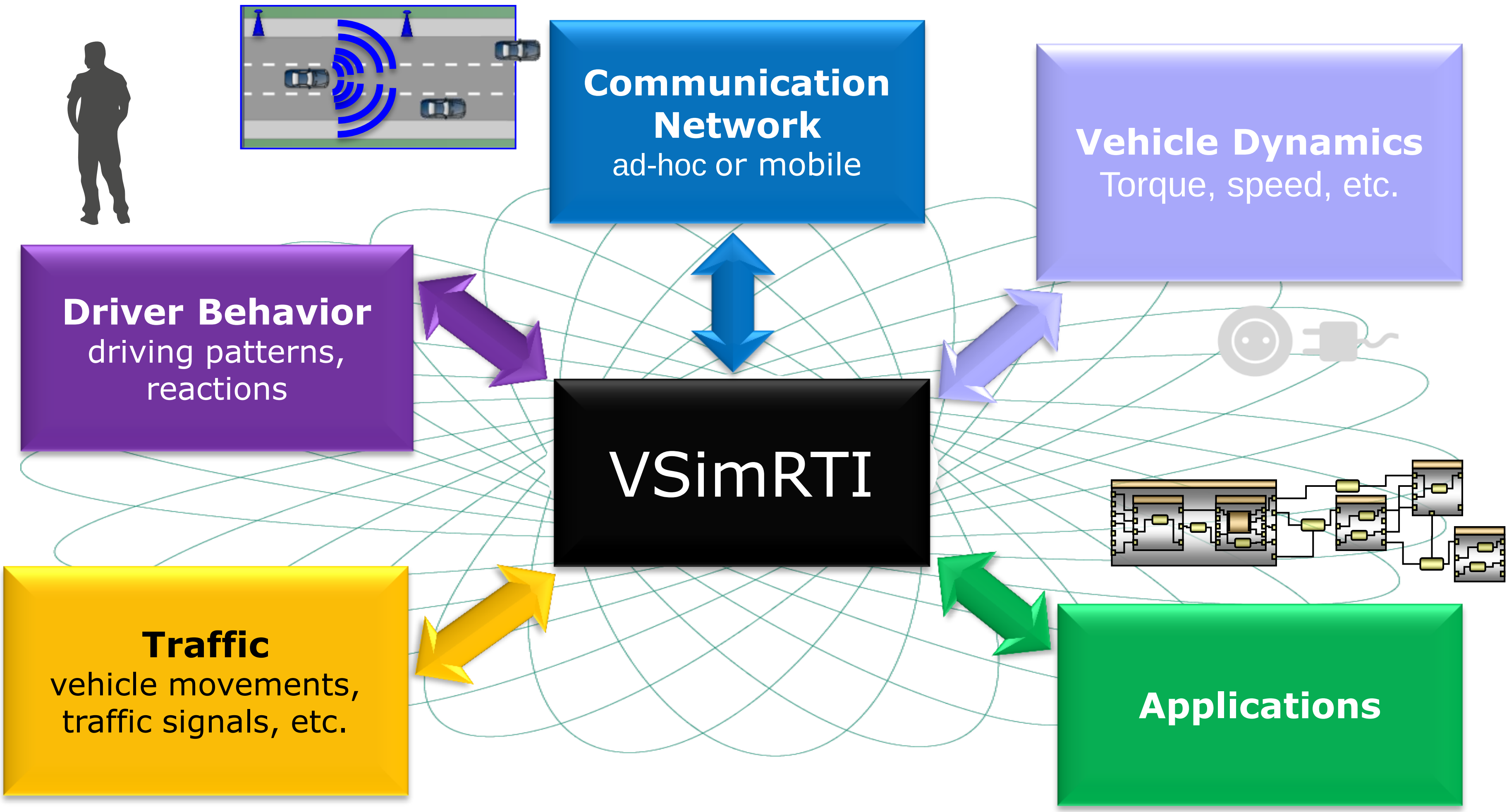
DATA BUS IMPLEMENTATION

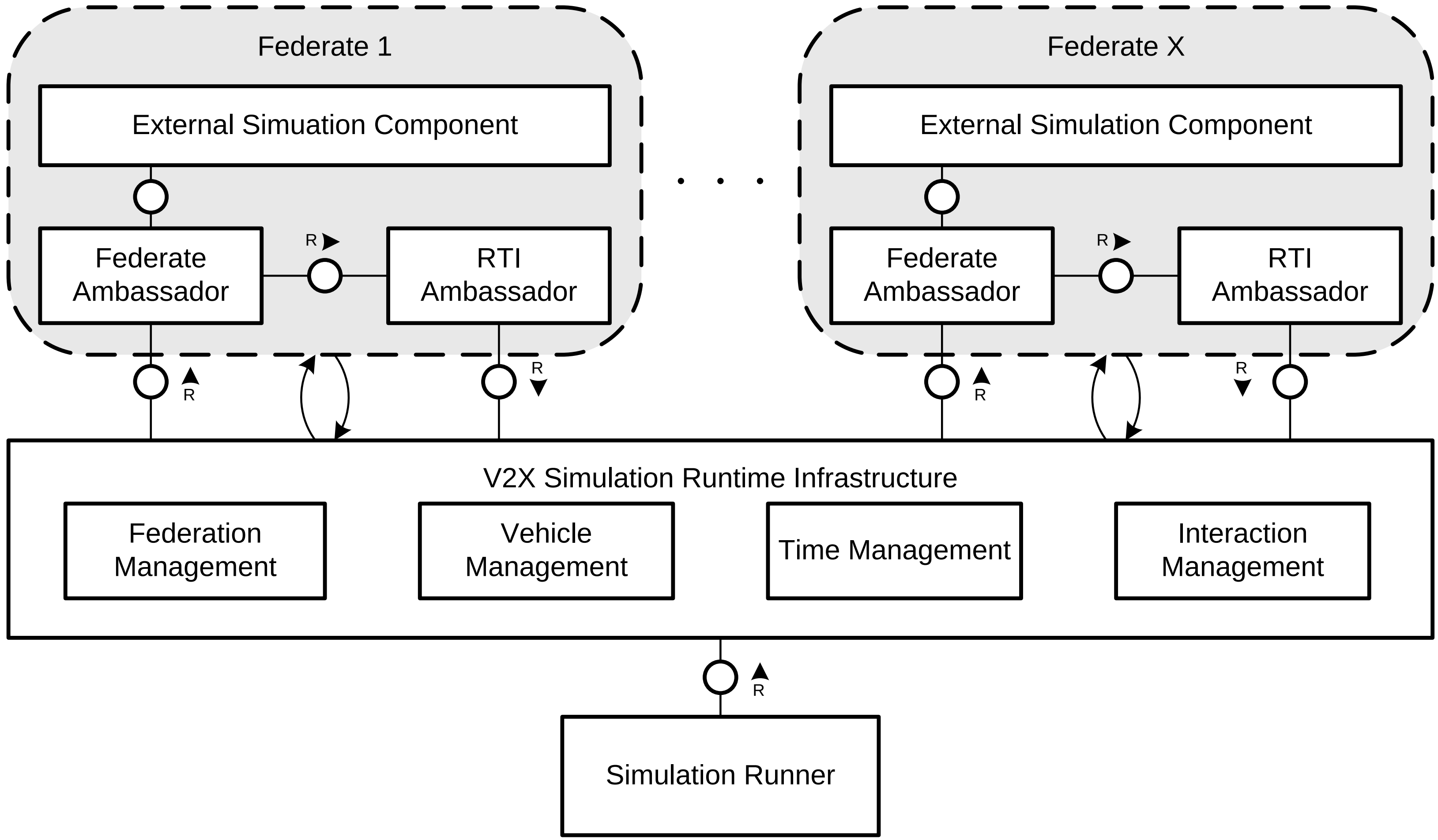
VSimRTI Based on IEEE High Level Architecture HLA



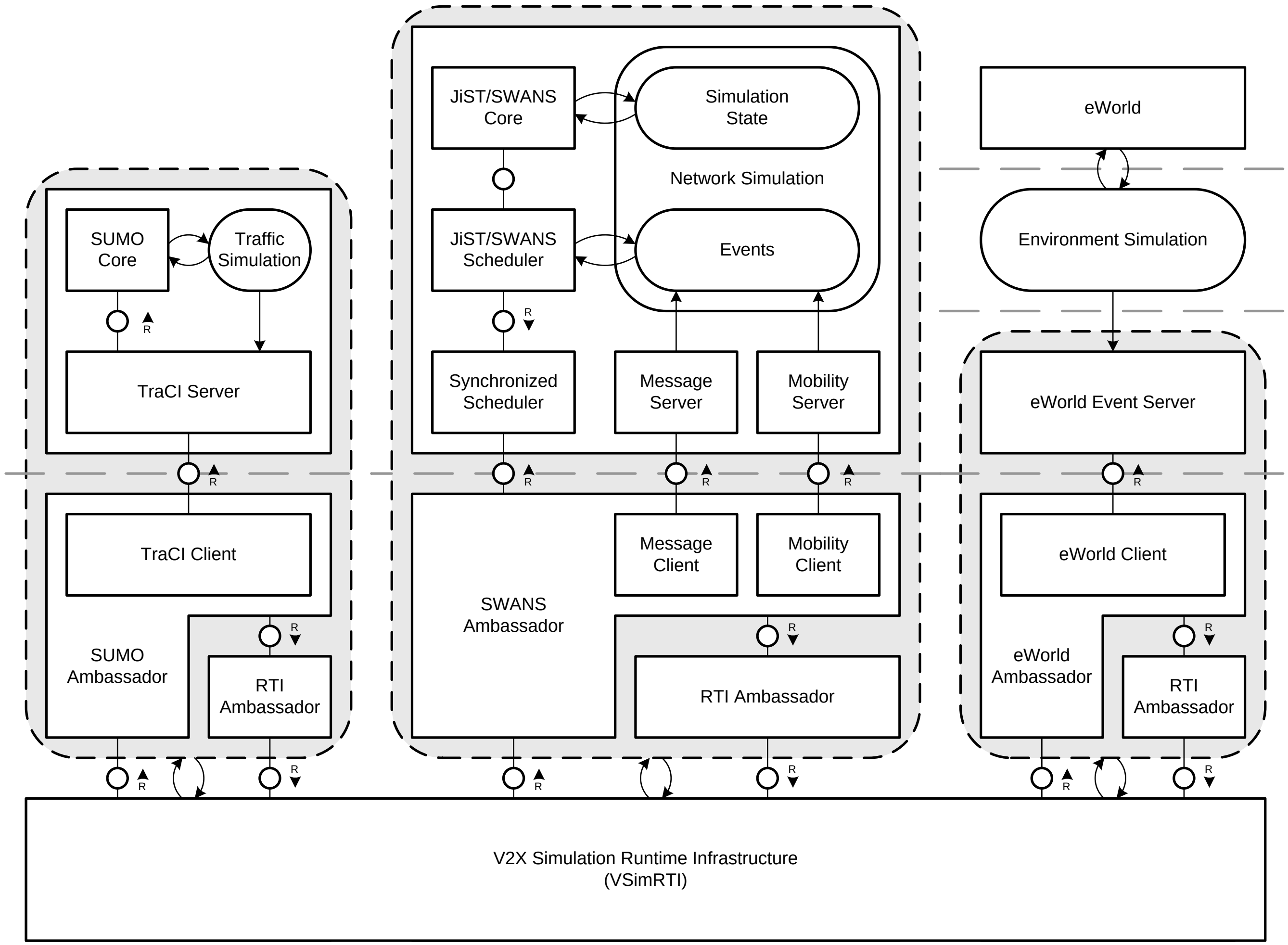
Off-the-Shelf Data Bus Software



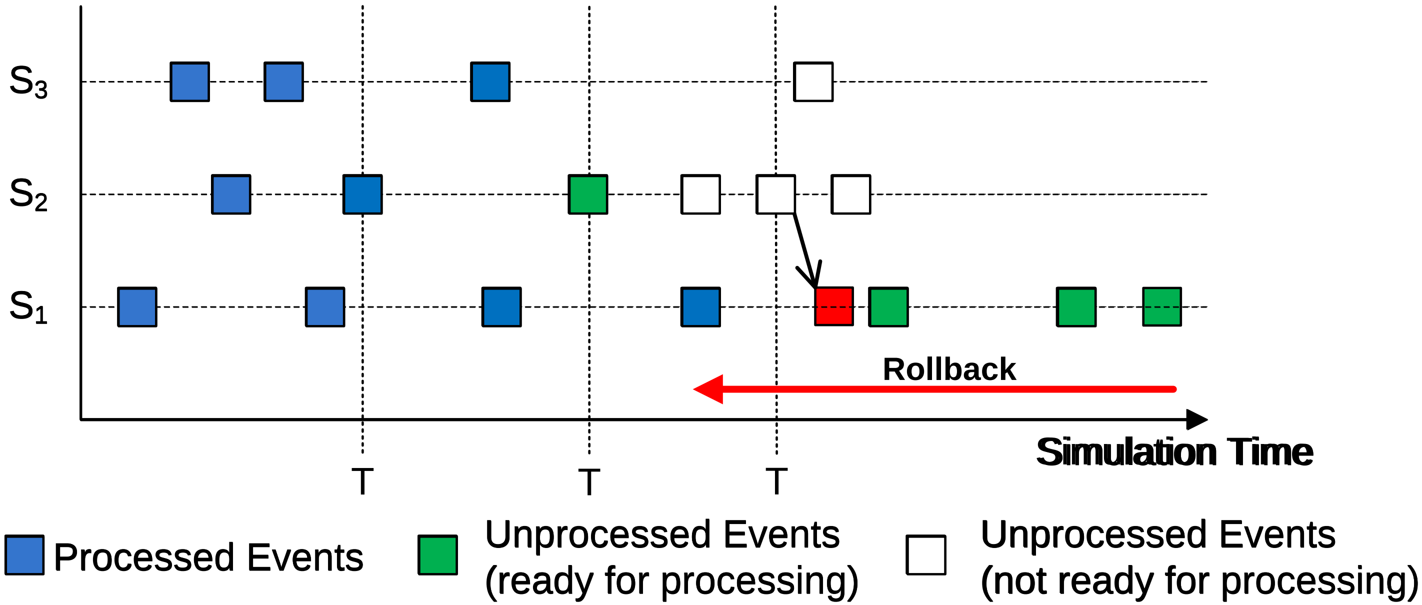
General Architecture of Data Bus (VSimRTI)



Example Traffic, Communication, and Application Simulator



Opportunistic Synchronization of Simulators



Processing of local events regardless of dependencies

Rollback if event is scheduled in the past

Time Warp: Save/Restore States, anti-messages

Result: overall simulation time significantly shorter than sequential simulation

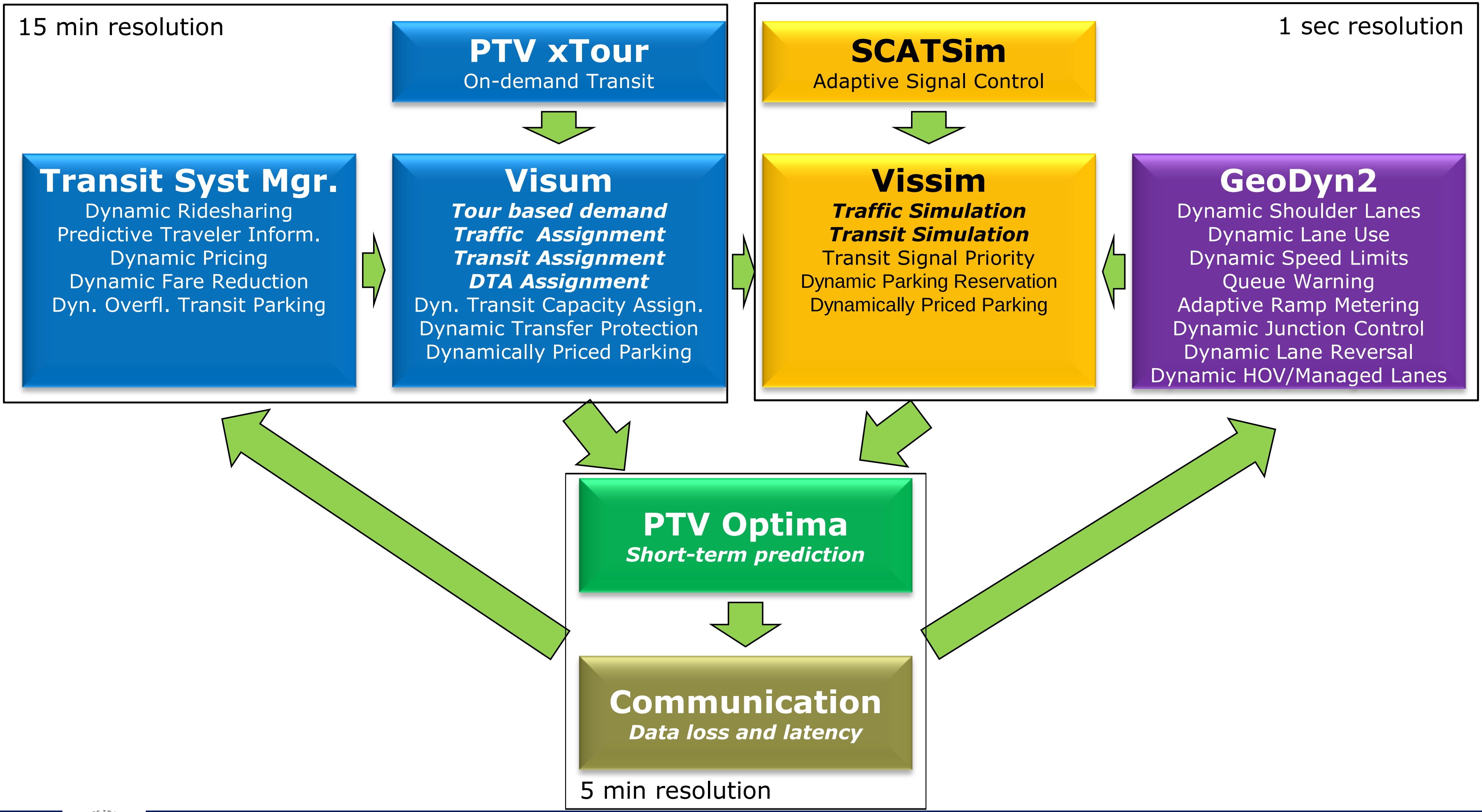
Tools Needed for Analysis

Tool	Modes	Performance Measures
Vissim	GP traffic, HOV, transit	Travel time, delay, throughput
Visum DTA	GP traffic, HOV	Volume, travel time, throughput
Visum	GP traffic, HOV, transit, ride-share	Trips, volume, travel time, throughput

Analysis Phases

Phase	ATDM Strategies	Tools
Trip planning – Departure time choice – Destination choice – Mode choice ▪ Transit ▪ Rideshare ▪ HOV ▪ SOV	Dynamic Ridesharing Dynamic Transit Capacity Assign. On-demand Transit Predictive Traveler Information Dynamic Pricing Dynamic Fare Reduction Dynamic Transfer Prot. Dynamic HOV/Managed Lanes Dynamically Priced Parking Dynamic Parking Reservation	**Visum** Travel demand, DTA, transit, line blocking, tour based demand
En-route – Route choice – Facility choice – Parking lot choice	Dynamic Shoulder Lanes Dynamic Lane Use Dynamic Speed Limits Queue Warning Adaptive Ramp Metering Dynamic Junction Control Adaptive Signal Control Transit Signal Priority Dynamic Lane Reversal Dynamic Parking Reservation Dynamic Overfl.Transit Parking	**Vissim** Vehicle movements, facility choice, parking, etc.

Analysis Process

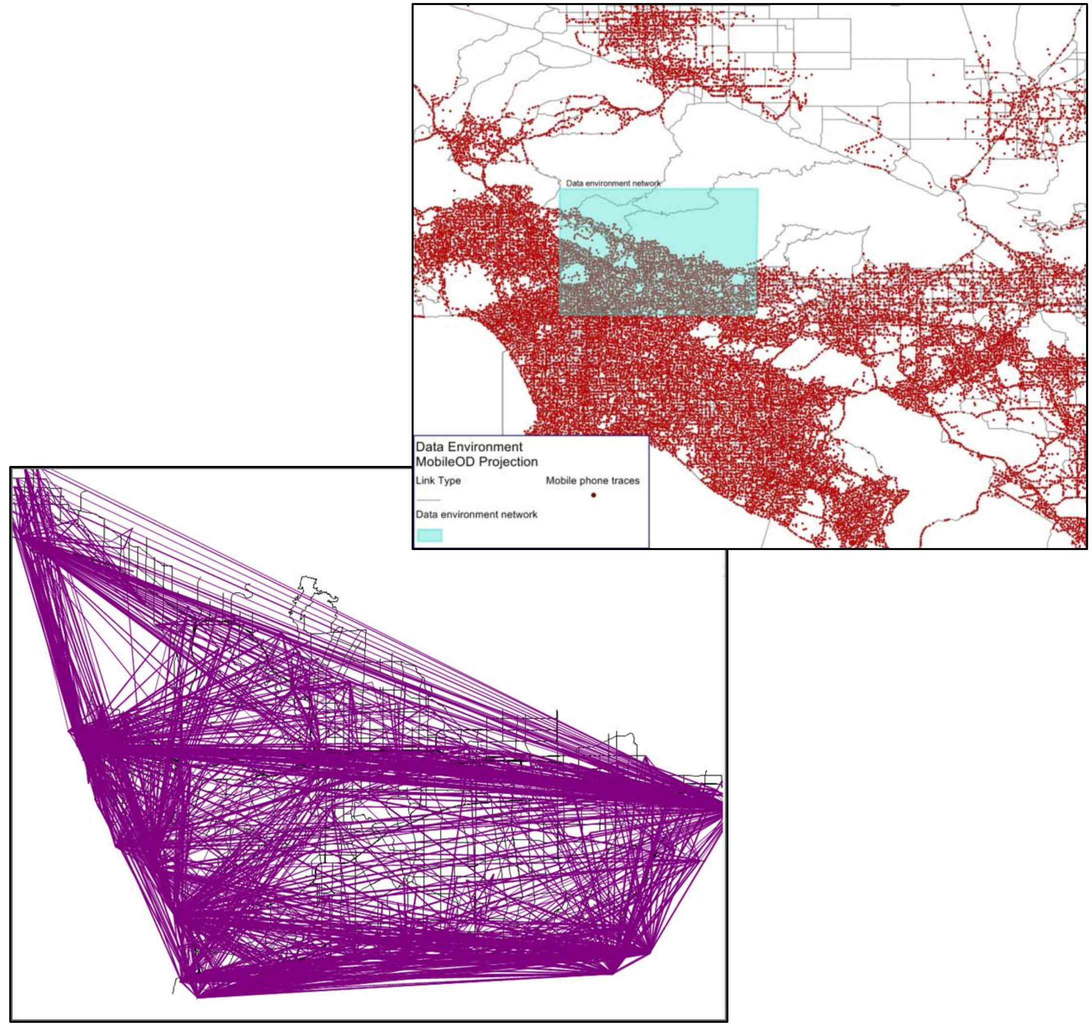


DATA NEEDS AND AVAILABILITY

Historical Data: Cell Phone Based Travel Demand

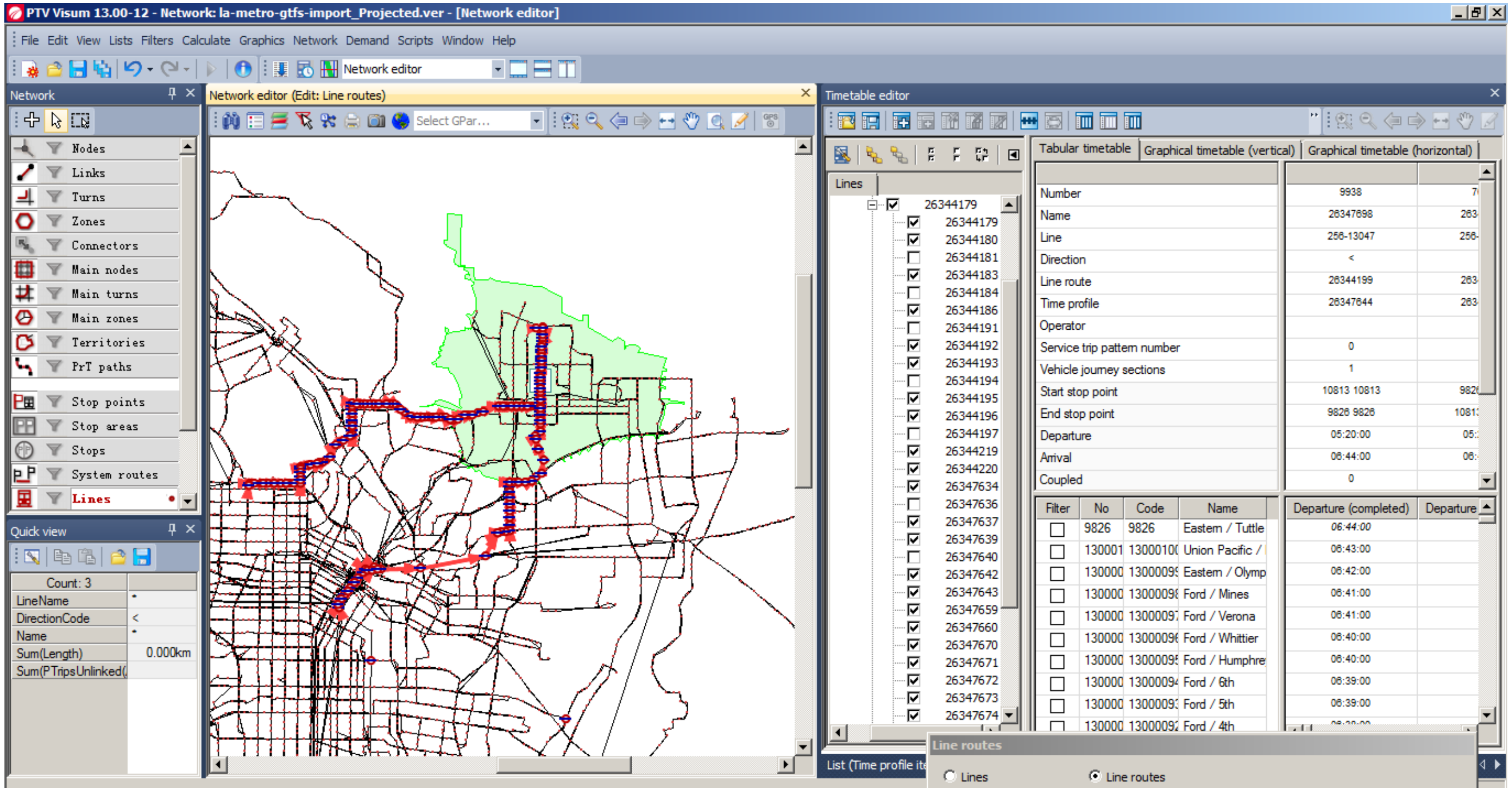
- Mobile phone sightings
  - Collection period: 12:00AM 09/01/2010 through 11:59PM 10/31/2010
  - Total number of sightings: 6.4 billion
  - Encrypted Sprint subscribers: 1.8 million

- Identified trips mapped to TAZs
  - 308,988 for weekdays
  - 102,571 for weekends
  - 158,617 for event days



Historical Data: Google Transit Feed

- Routes
- Stops
- Schedules



Historical Data: MTA Transit Data

- Transit trip table
- Transit station count data (on/off/transfer)
- Transit fleet
- Depot locations

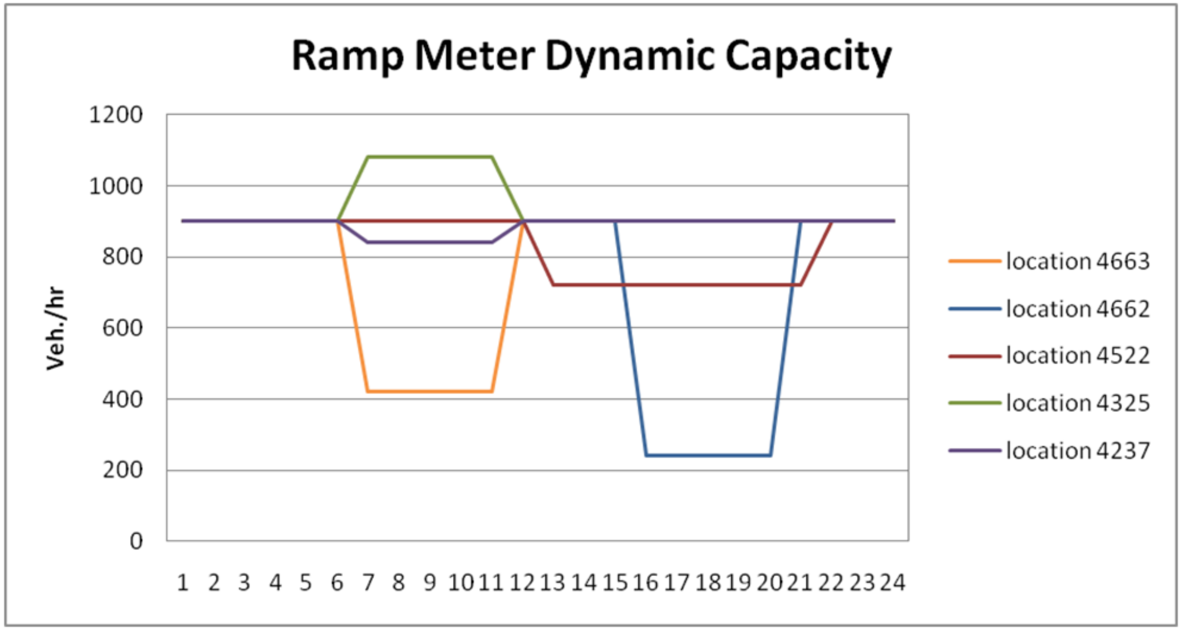
Historical Data: Travel Survey

- Travel survey data
  - Price elasticities
  - Demographic data

- Potential sources
  - SCAG travel survey 2001
  - Caltrans household survey 2010-2012
  - SCAG activity-based model development (on-going)

Historical Data: Caltrans Ramp Metering Rates

- Ramp metering rates by
  - Location
  - Time of day
  - Day of week



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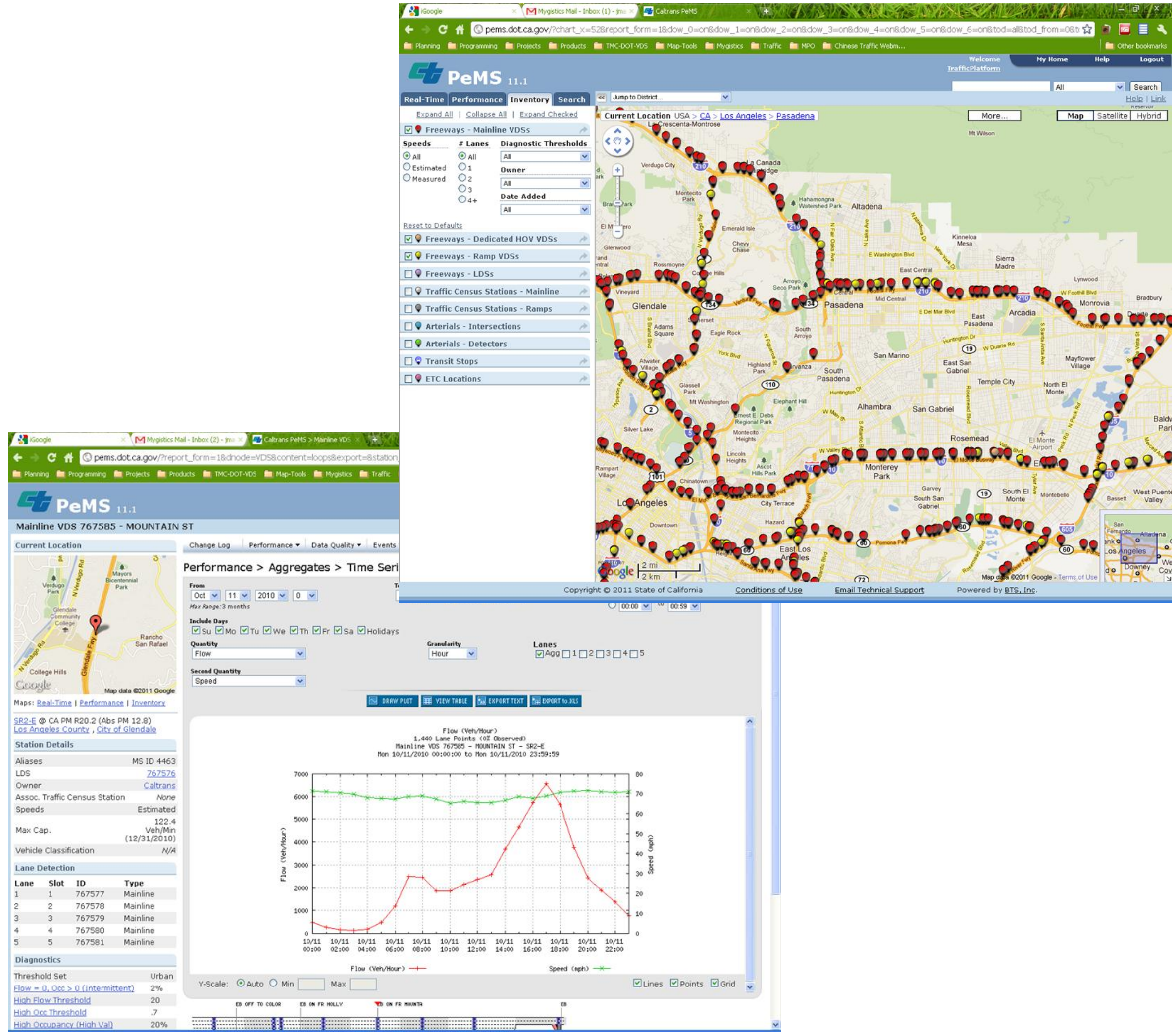
Real-time Data

- It is necessary to analyze not only historical data trends but also real-time data and the system's response to various events. The Testbed team needs to list all possible real-time data necessary for the analysis; some examples can be listed below:
  - Sensor detector vehicle count and speed data
  - Video surveillance data, including vehicle occupancy data
  - Signal plans and traffic control device data and real-time operations data (e.g., toll prices, HOV restrictions, turn restrictions, parking restrictions, shoulder lane operations)
  - Work zone data
  - Incident information.

Real-time Data: Caltrans PeMS

- PeMS detector stations
- Categories
  - Freeway mainline
  - On/off ramps
  - HOV lanes
  - Freeway to freeway connectors

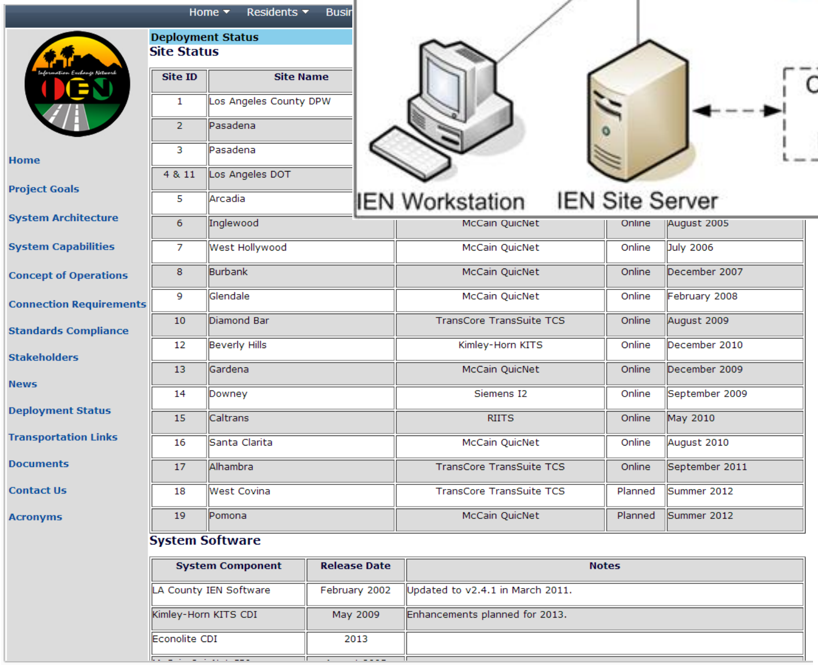


Real-time Data: Caltrans LCS

- Caltrans maintains a state wide lane closure system (LCS) data
  - Arranged by Districts
  - Updates every 10-11 minutes
  - Publically available, also authorized for this project

Real-time Data: LA County IEN

- LA County Information Exchange Network
  - Open architecture intersection data sharing
  - Monitoring and control
  - Signal timing and phasing
  - Publically available, need to apply for access for this project



Home Residents Busi

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Concept of Operations
Connection Requirements
Standards Compliance
Stakeholders
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Deployment Status
Transportation Links
Documents
Contact Us
Acronyms

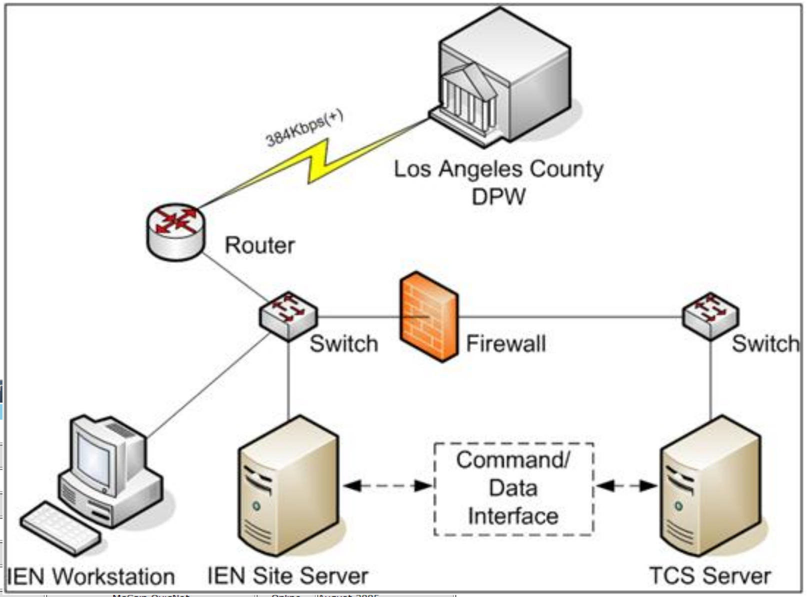
Deployment Status

Site Status

Site ID	Site Name			
1	Los Angeles County DPW			
2	Pasadena			
3	Pasadena			
4 & 11	Los Angeles DOT			
5	Arcadia			
6	Inglewood	McCain QuicNet	Online	August 2005
7	West Hollywood	McCain QuicNet	Online	July 2006
8	Burbank	McCain QuicNet	Online	December 2007
9	Glendale	McCain QuicNet	Online	February 2008
10	Diamond Bar	TransCore TransSuite TCS	Online	August 2009
12	Beverly Hills	Kimley-Horn KITS	Online	December 2010
13	Gardena	McCain QuicNet	Online	December 2009
14	Downey	Siemens I2	Online	September 2009
15	Caltrans	RIITS	Online	May 2010
16	Santa Clarita	McCain QuicNet	Online	August 2010
17	Alhambra	TransCore TransSuite TCS	Online	September 2011
18	West Covina	TransCore TransSuite TCS	Planned	Summer 2012
19	Pomona	McCain QuicNet	Planned	Summer 2012

System Software

System Component	Release Date	Notes
LA County IEN Software	February 2002	Updated to v2.4.1 in March 2011.
Kimley-Horn KITS CDI	May 2009	Enhancements planned for 2013.
Econolite CDI	2013	



MODEL CALIBRATION APPROACH

Model Calibration Parameters and Approach

- Models to be calibrated
  - Visum
  - Visum DTA
  - Vissim
- Operational scenarios calibrated for
  - Peak/Off-peak
  - Incident
  - Work Zone
  - Planned Special Event
- Calibration data sources
  - Caltrans PeMS

SYSTEM EVALUATION

System Performance Measures

- Proposed system performance measures include:
  - Vehicle Throughput
  - Vehicle/Person Delay
  - Travel Time reliability
  - Fuel consumption and emissions

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