

Analysis, Modeling and Simulation Testbeds for Road Weather Connected Vehicle Applications

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AMS Testbed Project - Overview

AMS Testbeds are **virtual computer-based** environments, in a laboratory setting, to create models/tools that can capture impacts of Dynamic Mobility Application (DMA) and Active Transportation and Demand Management (ATDM) programs.

The Testbeds are:

- Made as close to real-world as possible by modeling an actual metropolitan region's transportation system and transportation demand (e.g., persons, vehicles, transit)
- Not directly connected to DOT operational systems or personnel (e.g., traffic management systems, TMC operators, etc.)
- Developed by building off existing and previous AMS capabilities and modeling efforts

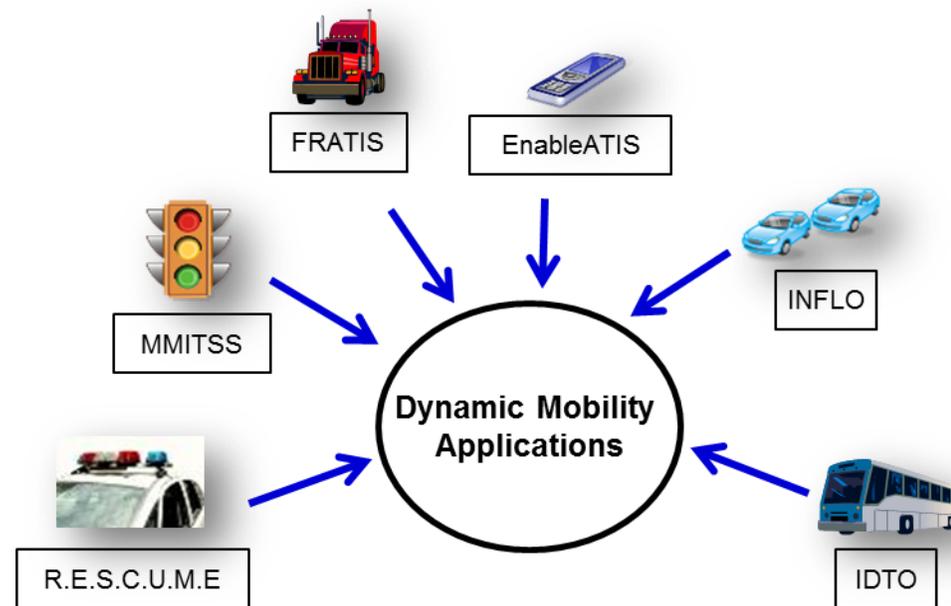
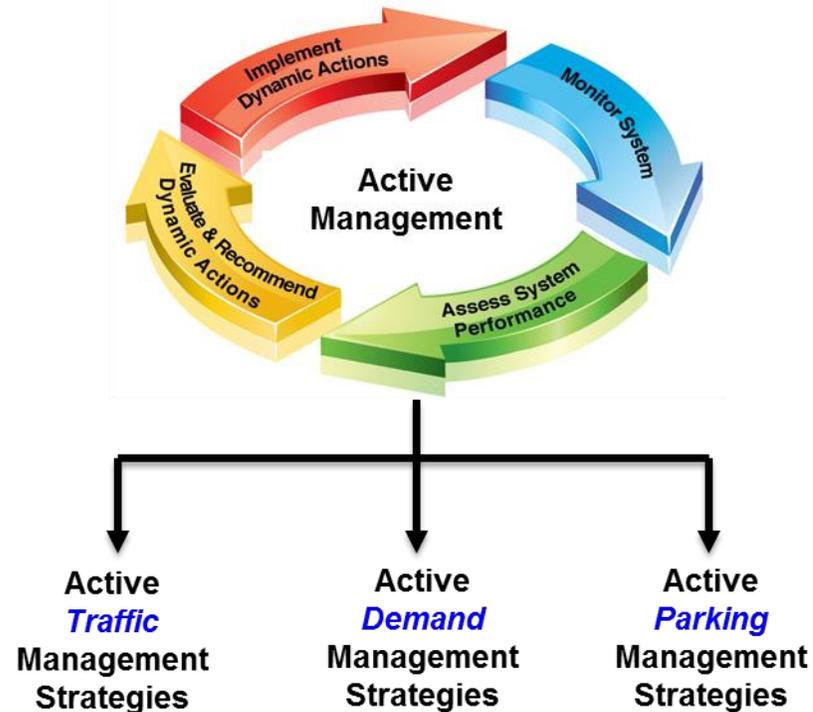
The AMS Testbed project will:

- Evaluate the system-wide impacts of individual and logical combinations of DMA bundles/ATDM strategies, and identify conflicts and synergies in order to maximize benefits

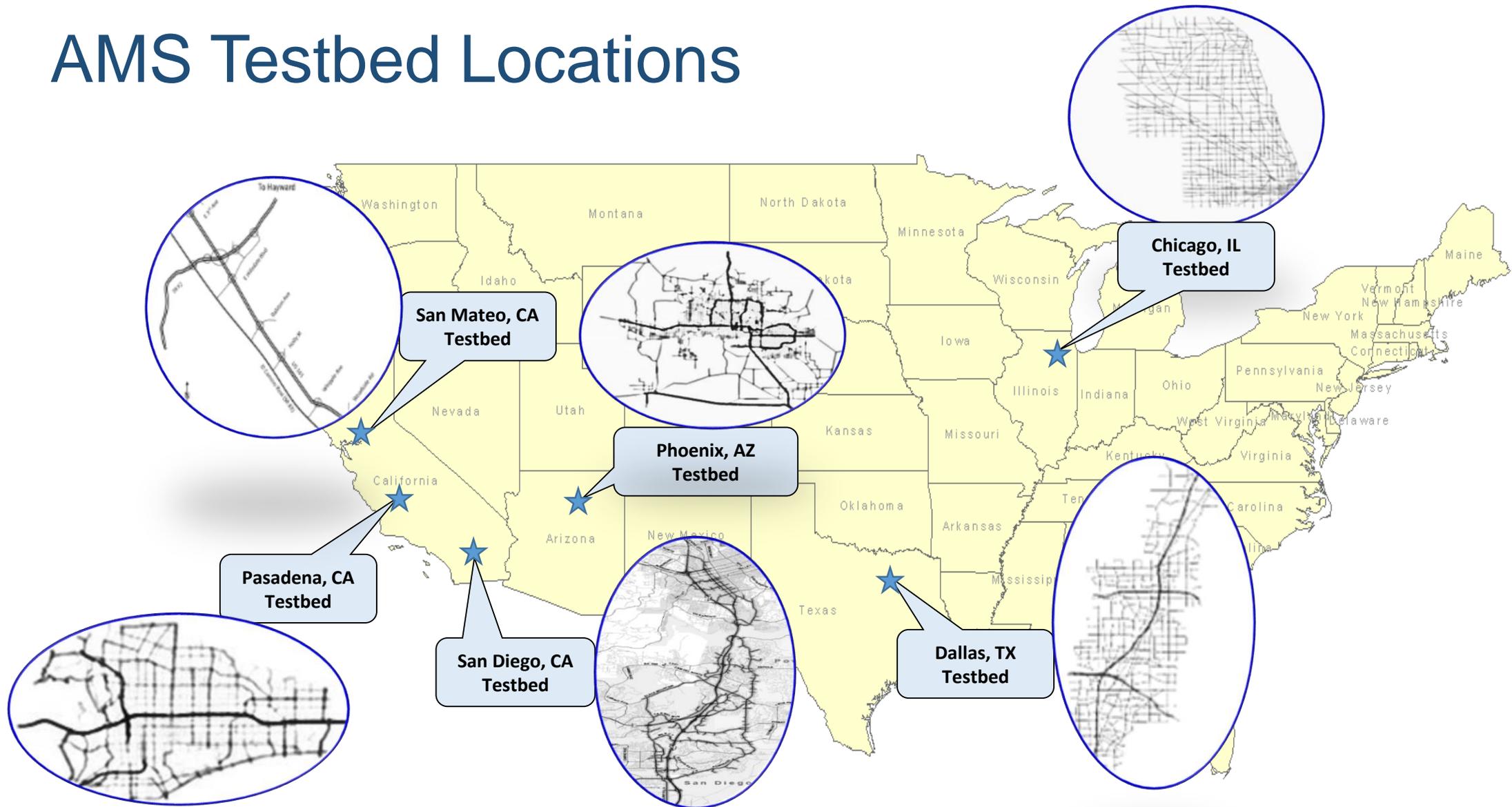


ATDM and DMA Programs

- USDOT has two programs to achieve transformative mobility, safety, and environmental benefits through enhanced, performance-driven operational practices in surface transportation systems management.



AMS Testbed Locations



Modeling Weather in AMS Testbeds

- Most of our testbeds consider weather conditions in both calibrations and operations.
- **Pasadena** and **San Diego** are modeling only dry weather.
- **Chicago** is our weather-specific testbed with Rain and Snow conditions.

Attribute	Value	San Mateo	Pasadena	Dallas	Phoenix	Chicago	San Diego
Demand	Low	•			•	•	
	Medium	•	•	•	•	•	•
	High	•	•	•	•	•	•
Incident Severity	None	•				•	
	Low	•	•	•	•	(hypothetical case with incidents)	•
	Medium		•	•			•
	Major	•	•	•	•		•
Weather Conditions	Dry	•	•	•	•	•	•
	Light Rain	•				•	
	Moderate Rain			(hypothetical case of inclement weather)	•	•	
	Heavy Rain				•	•	
	Moderate Snow				•	•	
	Heavy Snow				•	•	



Chicago Testbed

- Following are the ATM, ADM, WRM and DMA strategies applications that will be evaluated through the Chicago Testbed

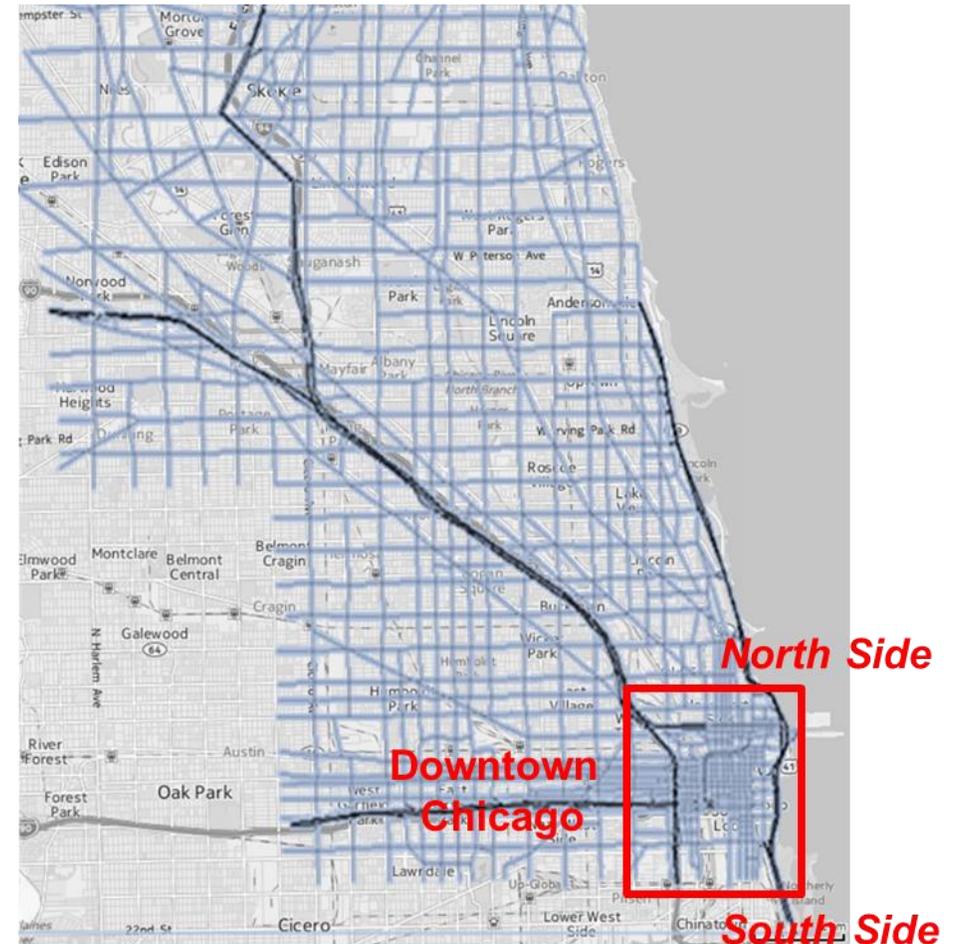
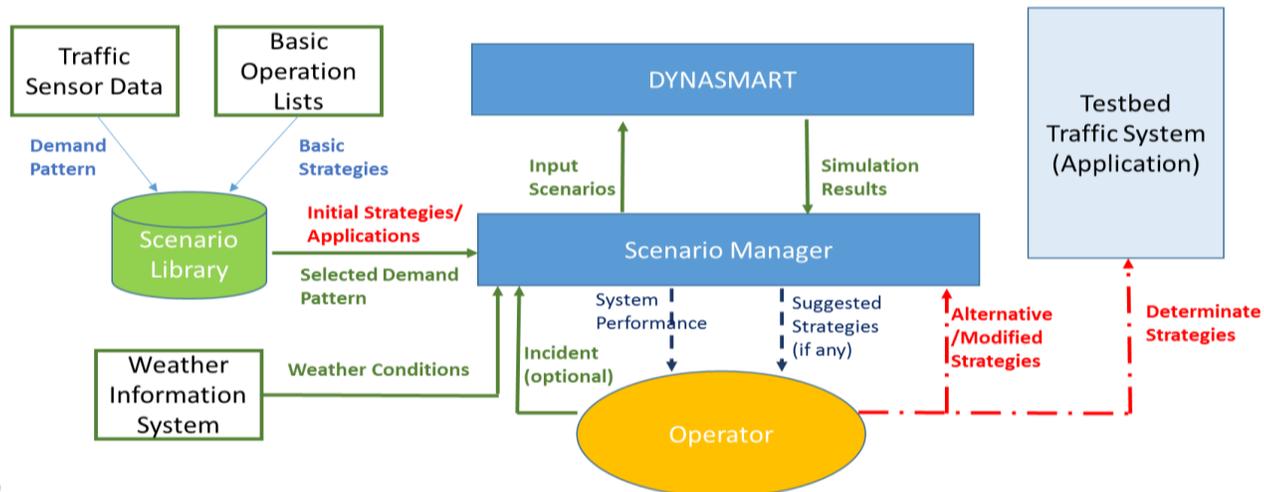
DMA/ATDM	Type/Bundle	Application
ATDM Strategies	Active Traffic Management (ATM) Strategies	Dynamic Shoulder Lanes
		Dynamic Lane Use Control
		Dynamic Speed Limits (Basic)
		Adaptive Traffic Signal Control
	Active Demand Management (ADM) Strategies	Predictive Traveler Information
		Dynamic Routing
	Weather-Related Management (WRM) Strategies	Snow Emergency Parking Management
		Traffic Signal Preemption for Winter Maintenance Vehicles
		Snowplow Routing
		Anti-icing and Deicing Operations
DMA Strategies	INFLO Bundle	Speed Harmonization (SPD-HARM) (Basic)



Chicago Testbed Network

Chicago's DYNASMART model consists of:

- 4805 Links
 - 89 freeways, 47 highways
 - 308 ramps (61 of them are metered)
 - 4361 arterials
- 1578 Nodes, 545 signalized intersections



Chicago Testbed Operational Conditions

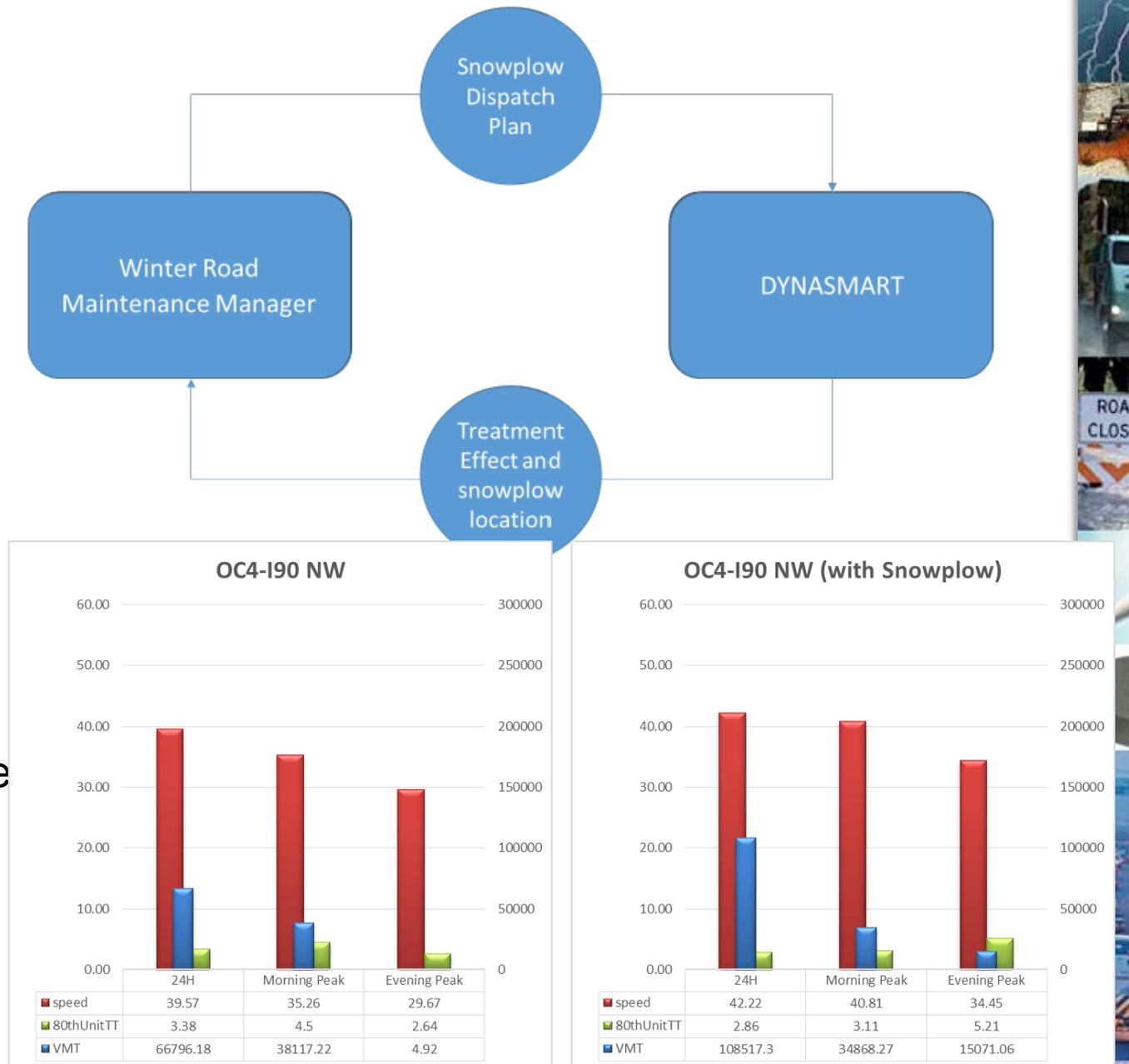
- Instead of using “typical day” models, Cluster Analysis was used to identify operational conditions.
- Five clusters have been identified to be used in Chicago Testbed that best represent the area along with one hypothetical operational condition.

Variables	All	Cluster B-0	Cluster B-3	Cluster B-4	Cluster C-4	Cluster B-6	Cluster B-7 (hypothetical)
Cluster Description	AM Peak Demand	High	High	Medium	Low	Medium	Medium
	PM Peak Demand	High	High	High	Medium	High	High
	Incident	None	None	None	None	None	AM Peak
	Daily Weather	Clear /No Rain, No Snow	Moderate/ Heavy Rain Changing to Moderate Snow	Moderate Snow	Moderate Snow	Moderate and Heavy Snow	Moderate Snow



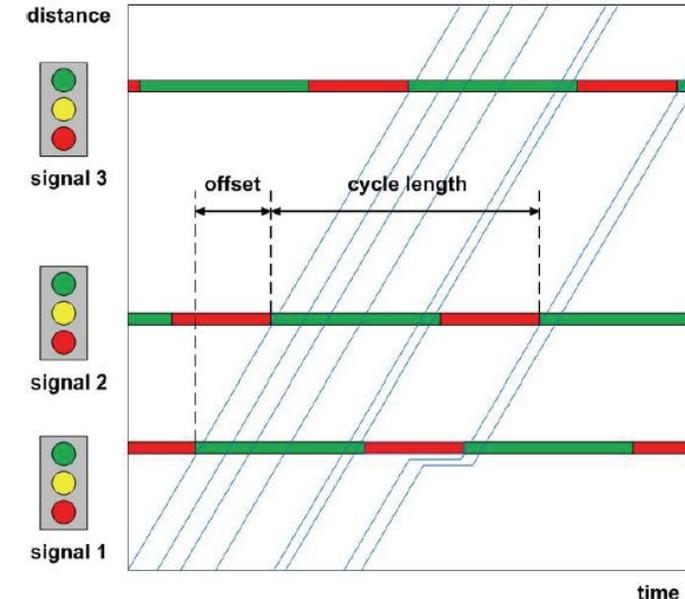
Snow Plow Routing

- Snow-plow depot location and sector design – based on existing characteristics from the city for each district.
- Vehicle routing – using multi-commodity flow model to minimize time and satisfy operational constraints.
- Vehicle scheduling with real-time information – dispatch plan, start-time and service types are developed based on link travel time information.



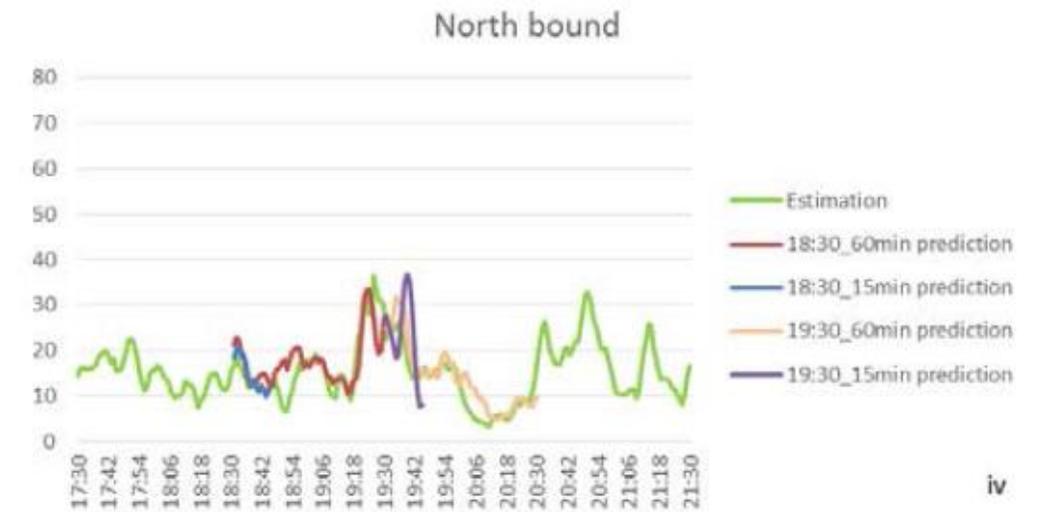
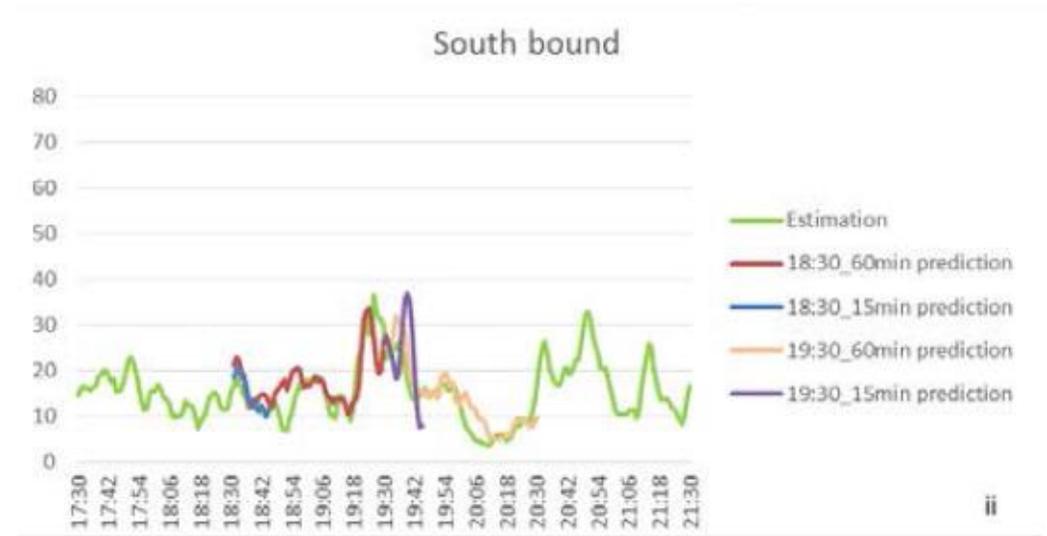
Adaptive Traffic Signal Control

- Implemented in “suitable” corridors – based on demand.
- Coordinated plans use common cycle time and specific offset-times between adjacent signals.
- Weather responsive plans are designed by altering offset times to match travel speeds in inclement weather.



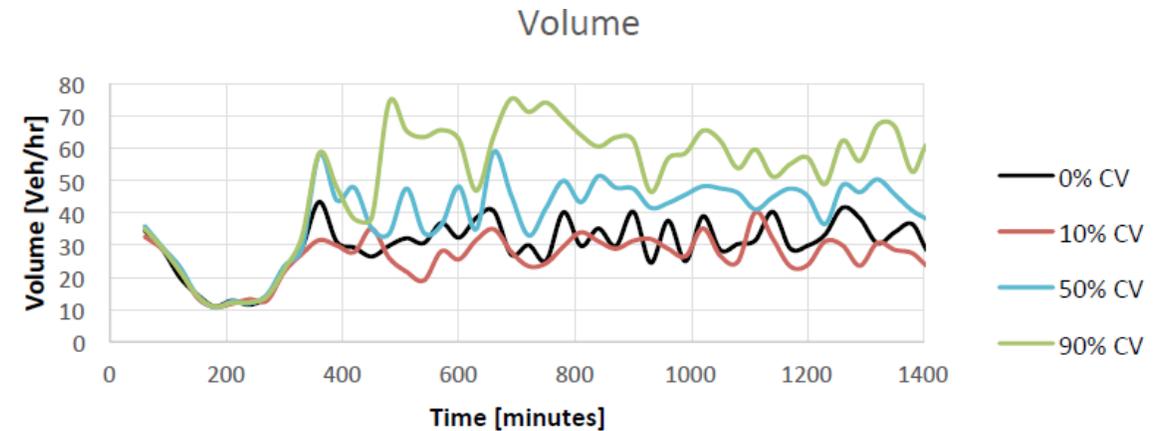
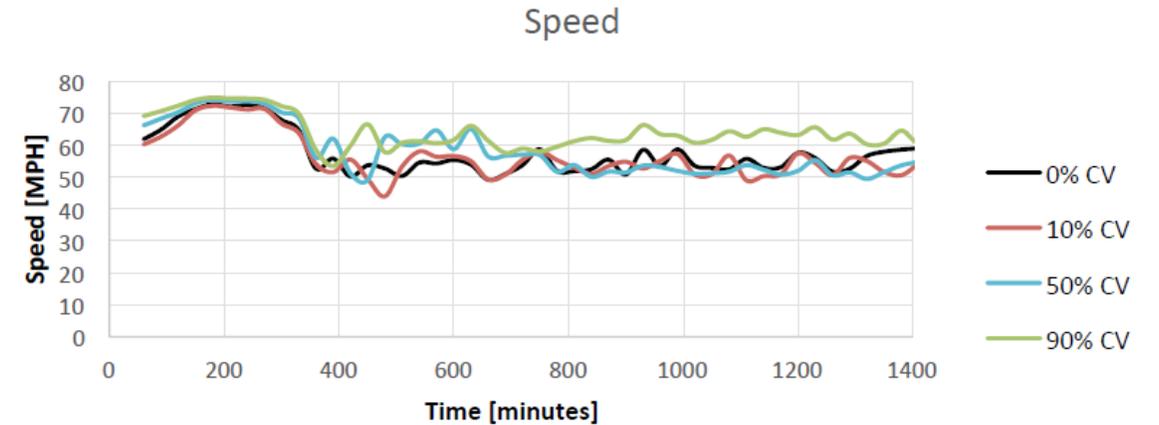
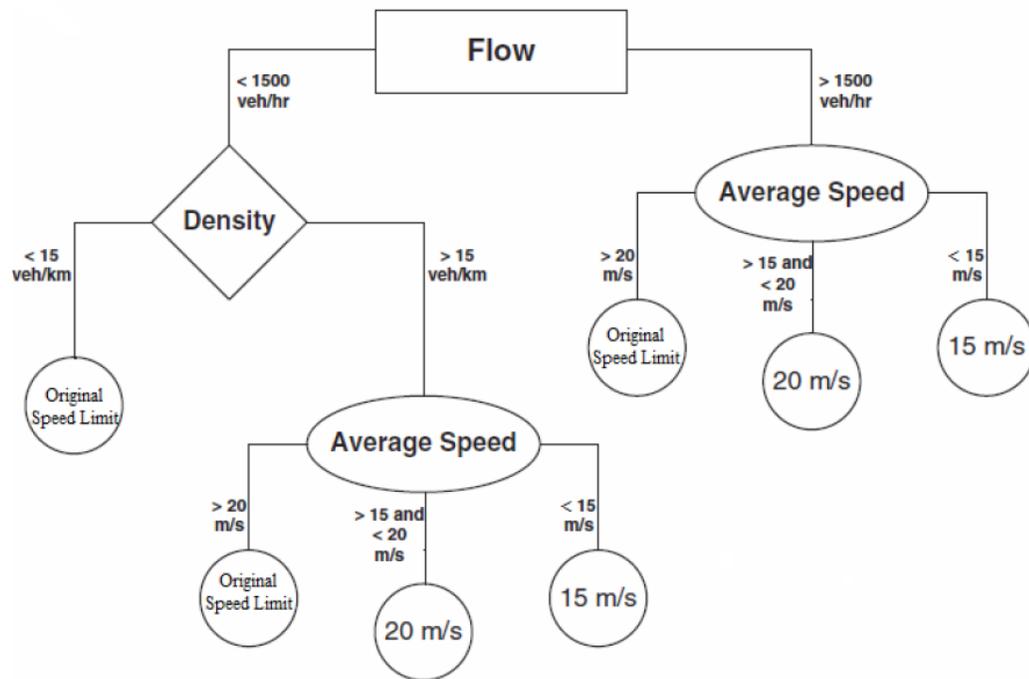
Prediction Horizon

- Conduct Prediction for a pre-defined horizon
- Generate Predicted Travel Times for all links for the predicted horizon
- Generate time-dependent shortest routes for all departure time intervals in the horizon.
- If a vehicle is equipped and the driver complies with the information, assign the vehicle to the new route.

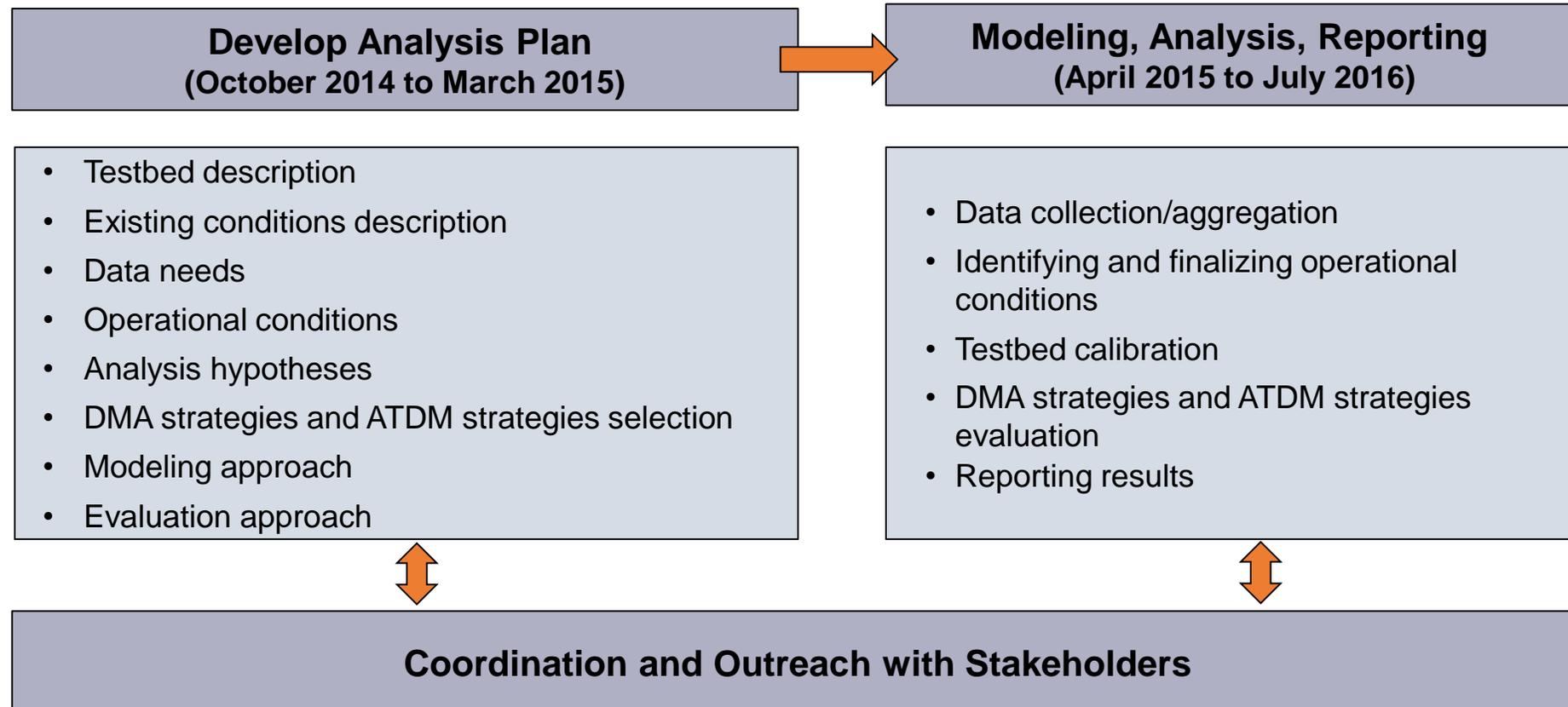


Speed Harmonization

- Basic Speed Harmonization was evaluated based on the following decision tree method.
- CV vehicles follow harmonized speed advisory.



Process for Chicago Testbed Evaluation



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