AMS Dallas Testbed and Data

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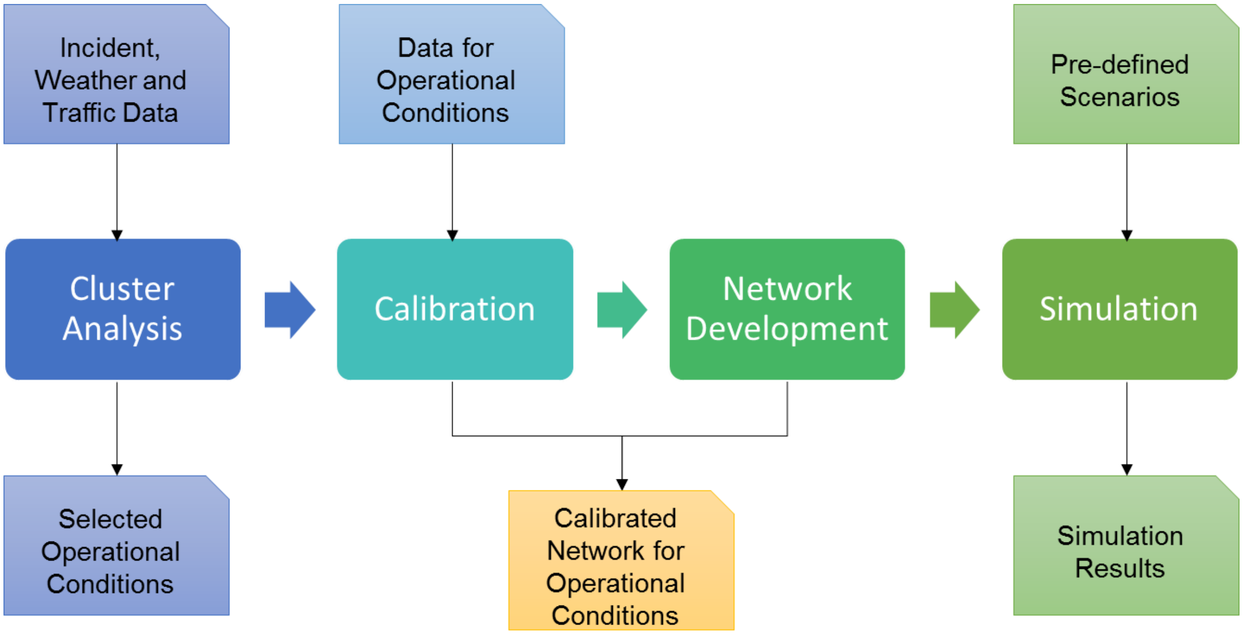
In order to explore a potential transformation in the transportation system's performance by the Active Transportation and Demand Management (ATDM) and the Dynamic Mobility Applications (DMA) programs in terms of mobility, safety, and environmental benefits, capable and reliable testbeds are proposed for Analysis, Modeling and Simulation. These testbeds provide valuable mechanisms to address this shared need by providing a laboratory to refine and integrate research concepts in virtual computer-based simulation environments prior to field deployments. Six AMS Testbeds were selected to form a diversified portfolio to achieve rigorous DMA bundle and ATDM strategy evaluation: San Mateo (US 101), Pasadena, Dallas, Phoenix, Chicago and San Diego Testbeds. In order to promote the use of the testbeds and data generated during the project within the research community, repositories of data and testbed files are shared on the USDOT's Research Data Exchange.

This repository consists of data sets pertaining to the AMS Dallas Testbed. The Dallas Testbed was developed for the US 75 Corridor in Dallas, Texas. The corridor is a major north-south radial corridor connecting downtown Dallas with many of the suburbs and cities north of Dallas. The corridor is a 20.1mile-long stretch of the US 75 freeway with continuous frontage roads and several parallel and crossing major regional arterial streets. The corridor includes a light-rail line (DART Red Line) and 10 park-and-ride lots. This Testbed was used to test several ATDM strategies considering a proactive network management approach that adopts simulation-based prediction capabilities. These strategies include Dynamic Shoulder Lane, Dynamic Signal Timing, Dynamic Routing, Ramp Metering and Dynamic Priced Parking. The Testbed is developed using the DIRECT software (Dynamic Intermodal Routing Environment for Control and Telematics), which was developed by researchers at Southern Methodist University (SMU).

The Dallas Testbed follows the general AMS Project Work Plan provided in the following diagram:



The datasets for AMS Dallas Testbed are organized into four directories:

1. Cluster Analysis Data - Cluster analysis was used to determine the representative days based on real world data such as incidents, weather, and traffic data. The clusters represent top operational conditions that exist in the region. The data used for cluster analysis in the Dallas testbed include the following: 1) Incidents; 2) Precipitation; 3) Speed; 4) Volume; 5) Routes; and 6) Travel Time. These data are used to identify the operational conditions that will be examined under implementation of Active Transportation and Demand Management (ATDM) strategies across the testbed. Based on the Cluster Analysis, the Testbed team calibrated the network to four Operational Conditions (OC) described as below:
    a. OC 1: Medium-High Demand + High Severity Incident + Dry Conditions
    b. OC 2: High Demand + Medium Severity Incident + Dry Conditions
    c. OC 3: Medium-High Demand + Minor Severity Incident + Dry Conditions
    d. OC 4: High Demand + Minor Incident + Dry Conditions
2. Calibration Data - For the Dallas Testbed, field data for the representative days was used for the simulation model calibration and validation. The simulation model is calibrated to several targeted thresholds to replicate real world field conditions. The calibration target variables used are as follows: 1) Speed; 2) Traffic Volume; and 3) Travel Times. These data are used to validate the simulation model's ability to replicate field traffic performance.
3. Testbed Files - Files provided in this repository consists of input files for the DIRECT Traffic Simulation. DIRECT or Dynamic Intermodal Routing Environment for Control and Telematics, simulation-based dynamic traffic assignment model for urban intermodal transportation network that is developed by researchers at the Transportation Research Laboratory at Southern Methodist University (TRL@SMU). DIRECT is capable of evaluating the demand-supply interactions in largescale urban intermodal transportation networks for operation planning applications. It is capable of evaluating the effectiveness of a wide range of traffic management strategies including, for example, intermodal traveler information systems, managed lane operation, value pricing, and emergency/evacuation planning. (Users are encouraged to refer to DIRECT manual for details on the software).
4. Simulation Results - This data environment consists of the simulation outputs that were generated using the AMS Dallas Testbed simulations. The files are in Microsoft Excel format and

are categorized according to the scenarios that were run for the testbed to answer ATDM Research Questions of various categories – (1) Active Management and Latency, (2) Prediction Accuracy, (3) Prediction Coverage, (4) Prediction Horizon and (5) Strategy Combinations.

Each of the directories have its own metadata documentation for reference. Users are encouraged to understand the scope of the testbeds from the following USDOT publications:

1. FHWA-JPO-16-373, ATDM-DMA AMS Testbed Project: Analysis Plan for Dallas Testbed.
2. FHWA-JPO-16-376, ATDM-DMA AMS Testbed Project: AMS Evaluation Plan.
3. FHWA-JPO-16-380, ATDM-DMA AMS Testbed Project: Calibration Report for Dallas Testbed.

Dallas Testbed was used to evaluate six ATDM strategies, namely, Dynamic Shoulder Lanes, Adaptive Ramp Metering, Predictive Traveler Information, Dynamic Routing, Dynamically Priced Parking and Dynamic Signal Timing. Predictive Traveler Information is used as a conjunction with Dynamic Routing and Dynamic Signal Timing.

The description and logic of how these strategies were implemented in the testbed are provided in the following table.

ATDM Strategy	Modeling Logic	
	Description	Logic

Dynamic Lane Shoulder	DIRECT represents highway links at the lane level. To model the dynamic lane shoulder strategy, a shoulder lane, with pre-defined characteristics, could be added to the link. This shoulder lane would be configured to serve the traffic as long as the strategy is active (e.g., peak period, incident, evacuation, etc).	if (shoulder lane strategy starts){ for (selected freeway links){ - Define a new Lane Object (speed limit, capacity, jam density)
		- Mark Lane as a shoulder lane
		- Add Lane to Link
		}
		}
		if (shoulder lane strategy terminates){ for (selected freeway links){ - Shift traffic from shoulder lane to adjacent lanes
		- Remove Lane from Link
		}
		}

Adaptive Ramp Metering	Ramp metering is modeled in DIRECT by adjusting the outflow rate for each ramp. The considered resolution is six seconds. When the ramp is open, the outflow rate is equal to the saturation flow rate. When the ramp is closed, the outflow rate is set to zero. The logic (e.g., ALINEA or any other logic) that determines the optimal timing is external to DIRECT. However, it can be developed as an additional task.	Assumption: the optimal inflow rate for each ramp is determined exogenously to the simulation model
		if (Adaptive Ramp Metering Scheme
		is activated){
		for (Ramps in this schemes){
		outflowRate = newOutflowRate
		
		} }

Predictive Traveler Information	DIRECT implements a simulationbased short-term traffic network state prediction module, which runs in a rolling horizon framework. The prediction module provides information on the time-dependent link travel times for a pre-defined future horizon (e.g., 30 minutes). These predicted travel times could be used to develop different predictive traveler information strategies. The impact of the provided information on the travelers' route-mode choice decisions could be captured in the simulation.	- Conduct Prediction for a predefined 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.
Dynamic Routing	DIRECT is capable of modeling dynamic routing based on the provided traveler information. Drivers with access to information are assumed to be able to compare their current routes with the new routes. If the difference in the travel time is greater than a pre-defined threshold, drivers are assumed to switch to the new route. The route diversion could be occurring at any junction along their routes including the DMS locations.	Assumptions: - Travelers are assumed to be assigned to their historical routes. - The percentage of travelers with access to pre-trip and en-route information is assumed given. Logic: - At each SP update interval, the shortest paths from all origin nodes to all destinations are generated. - For all travelers with access to information, if the travel time (cost) of the new path is better than the time of the current path by a predefined threshold, the traveler is assumed to switch to the new path.

Dynamically Priced Parking	Following the dynamic route assignment logic in DIRECT, travelers are assigned to routes that minimize a generalized cost measure. This measure is in the form of a weighted linear function which includes the total travel time and the total travel cost. The travel cost component includes the expected vehicle operation cost and any out-of-pocket cost elements (e.g., parking cost, tolls). The set of optimal routes are periodically updated to capture congestion dynamics in the network as well as changes in the parking cost associated with implementing a dynamic parking pricing scheme.	Assumption: the parking cost for each parking facility is determined exogenously to the simulation model for (all parking facilities){ if (a new parking cost is implemented){ - read the new cost value - modify the generalized travel cost for all private car and parkand-ride paths to include this cost } }
Dynamic Signal Control	The DIRECT model allows modifying the signal timing plan for all or a subset of the intersections in the network at any point of time during the simulation horizon. A signal control scheme is described in terms of its activation start and end times and the timing plan for all intersections considered in this scheme. Multiple schemes could be a priori defined for the simulation horizon. These schemes are implemented in the simulation based on their activation times. If a traffic management module is used to generate a control scheme at any point in time, this scheme can also be deployed in the network according to its activation time.	Assumption: Each control scheme is defined by its start and end times. All junctions in this scheme are defined in terms of their new timing plans. if (Control Scheme is activated){ for (Junctions in this scheme){ for (all signal phases at this junction){ GreenInterval = newGreen RedInterval = newRed Offset = newOffset } } }