Regional Operations Forum
Managing a Corridor
What is a Corridor?

• “A broad geographical band that follows a general directional flow connecting major sources of trips that may contain a number of streets, highways and transit route alignments.”
  – From “Glossary of Regional Transportation Systems Management and Operations Terms” (TRB Circular)
Corridor Management

• Corridors offer opportunities to operate and optimize the entire system
  – As opposed to the individual networks.

• Transportation corridors often contain unused capacity
  – Parallel routes
  – Non-peak direction
  – Single-occupant vehicles
  – Underutilized transit services

• Managing the corridor can more fully utilize this capacity
  – Management approaches like ramp metering
  – Traveler information and outreach
Corridor Management and TSM&O

- TSM&O is the collection of activities (incident management teams) and supporting infrastructure (signs, signals, communications) used to ensure that the available supply of roadway capacity is used as efficiently, effectively, and safely as possible.
- Corridors are the molecular unit where TSM&O activities and infrastructure can be implemented.

*Corridor management is integral to TSM&O*
Examples of Corridor Management Components

- Integrated Corridor Management (ICM)
- Active Transportation & Demand Management (ATDM)
- Managed Lanes
- Freeway management
- Arterial management
- Bus Rapid transit
- Real-Time Traveler Information
- Traffic Incident Management

*We will cover the first two in this session*
Integrated Corridor Management (ICM)
What is ICM?

Through ICM, transportation facilities will realize improvements in efficient movement of travelers through institutional collaboration and proactive management of existing infrastructure.
USDOT ICM Initiative

- New institutional models
- New technology
- More dynamic operational strategies
- “Network” vs. Individual corridors
- Maximize corridor capacity
SANDAG I-15 ICM

- Primary artery for the movement of commuters, goods, and services from north San Diego County to downtown.
- I-15 Managed Lanes System
- Multi Institutional Cooperation/ Partnerships
- Multi-modal Transportation Improvement Strategies and Mode Shift – BRT, TSP
- 511, including transit information
I-15 ICM Decision Support
“Response Postures”

<table>
<thead>
<tr>
<th>Demand</th>
<th>Response Posture</th>
<th>Event Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>Light</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Incident closing freeway shoulder or one lane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Construction closing one lane of primary arterial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Breakdown of transit vehicle</td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderate</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Incident closing 1 freeway lane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Closure of Express Lanes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Construction on Pomerado reducing NB and SB to one lane each direction</td>
</tr>
<tr>
<td>Heavy</td>
<td>Aggressive</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Major incident at intersection of primary arterials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Closure of two or more lanes of the freeway</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Combination of low and medium incidents</td>
</tr>
</tbody>
</table>

**Response Posture**
- **Conservative**
  - Example – Provide slight increase to ramp metering rate
- **Moderate**
  - Example – Provide additional green-time to favor northbound traffic while still providing adequate cross-street timing
- **Aggressive**
  - Example – Display alternate route for freeway traffic on CSM, such as “INCIDENT AHEAD NB USE POMERADO”
I-15 ICM Response Plans

- 156 Alternate Routes
- 260 Local Arterial Intersections
- 18 Metered Interchanges
- 20 Dynamic Message Signs
- 5 BRT stations
- 20 miles HOT – reversible lanes
- 30 miles Traffic Responsive
- 511 (including app)

= 1.5 billion combinations!

Limited set of “point-in-time” Response Plans by:

- Using Asset Restrictions
- Using Availability Conditions
- Using Thresholds to select “next move” relationships

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Dallas  US-75 ICM

- Freeway with continuous frontage roads
- Managed HOV lanes
- Dallas North Tollway
- Arterials
- Bus Network, Light Rail
- Approx. 900 traffic signals
- Multiple TMCs
- Regional ATIS (511)
Dallas US-75 ICM Goals/Needs

• Improve reliability
• Improve incident management
• Robust detection strategy for freeways, frontage roads, arterials, light rail, park and ride lots and HOV lanes
• Decision Support System for operators to select appropriate combination of strategies
• Share incident, construction and special event information among agencies
• Dynamic management capabilities for signal timing on arterials and frontage roads
• Improve multimodal traveler information for the public
US 75 ICM Decision Support

An incident occurs on US 75 and is entered into SmartNET by agency staff.

SmartNET relays the incident information to DSS.

DSS evaluates the incident and commuting alternatives using expert rules.

DSS recommends solutions to multiple operating agencies.

ICM coordinator recommends DSS solution implementation.

Commuters receive information and make alternative travel choices.

DSS reevaluates solution based on roadway conditions and incident status.

- Examines current roadway conditions such as: incident location, light rail utilization, lanes blocked, available capacity of alternative routes.

- Forecasts 30-minute impact of implementing the recommendation to ensure value added.

- Agency implements the recommended solution.

THE BENEFITS

- Improved travel time reliability for commuters
- Enhanced decision making support for operating agencies
- Achieves a 20:1 return ($278.8 million) on the project’s cost over 10 years
- Less pollution from idling vehicles in congested traffic
USDOT ICM Status Update

• Testing and evaluating the DSS in both regions
• Independent evaluation
• Early lessons:
  – Agreements are the most challenging part of ICM
  – Determining mode shift is difficult, working through how to evaluate effectiveness
  – Combinations of strategies also are challenging to evaluate
Phoenix Area ICM

- Initiated ICM planning during original Pioneer Site applications (not selected)
- Incremental implementation with available regional funds
- MAG 2012 ITS Strategic Plan identified ICM as a regional priority; funding support for local projects that advance ICM goals
- Combining arterial signal timing improvements and ICM
- Integrating ICM into a larger corridor master planning effort
AZ Loop 101 ICM

- Arizona DOT, Scottsdale, Maricopa County
- Event-driven ICM – freeway closures
- Positives:
  - Dense arterial ITS
  - Experienced TMC staff
  - Provide arterial alt route
  - REACT to support arterial traffic diversions
- Focus on process improvements
- No new infrastructure
Regional Archived Data Server (Phoenix)
Engaging Stakeholders in ICM

• Identifying the right partners
• Lead/co-lead
  – Freeway management and operations – TOC, freeway service patrol, freeway incident response
  – Arterial management and operations – TOC, signal operations
  – Transit
  – Incident response and management – freeway and arterial incident response/law enforcement
  – MPO – planning
  – Others to be determined on a regional level based on operational need

• Leadership commitment – key to sustaining partnerships
Strategies for Engagement

- ITS Strategic Plans or Updates
- Traffic Incident Management Coalitions
- Standing Committee Meetings (Operations, ITS)
- Large-scale freeway or arterial improvement projects
- TIP funding cycles
- LRTP updates
- Follow up initiatives from RCTOs and other Ops Plans

*Plant seeds, build interest, introduce ICM as a collaborative, regional effort*
Defining YOUR ICM Program

- What is it that you (the region) wants ICM to address?
- What are the key gaps?
  - Institutional
  - Technical
  - Operational
- What is your foundation? (established or soon-to-be-implemented system)
- What is your timeframe for achieving objectives?
  - Or timeframe for being able to implement
- Each ICM will be unique, use the ConOps process
ICM Performance Measures

- National evaluation is looking at the following MOEs:
  - Vehicle and person throughput
  - Travel times and travel time index
  - Standard deviation of travel time
  - 80th, 90th, and 95th percentile travel times
  - Buffer and Planning Indices
  - Traveler Response
  - Safety benefits

- Your ICM Objectives
  - Traveler information
  - TIM
  - Data sharing
  - Institutional participation
## Demonstration Site Measures

<table>
<thead>
<tr>
<th>San Diego</th>
<th>Dallas</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Travel Time</td>
<td>• Travel Time Reliability</td>
</tr>
<tr>
<td>• Delay</td>
<td>• Increase Corridor Throughput</td>
</tr>
<tr>
<td>• Throughput</td>
<td>• Improve Incident Management</td>
</tr>
<tr>
<td>• Reliability and Variance of Travel Time</td>
<td>• Enable Intermodal Travel Decisions</td>
</tr>
<tr>
<td>• Safety</td>
<td></td>
</tr>
<tr>
<td>• Emissions and Fuel Consumption</td>
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</tbody>
</table>

San Diego Dallas
Interagency Agreements

- Essential for ICM and multi-agency operations strategies
- New operations models, potential for joint operations
- Data sharing and system connectivity
- Often, the most complex part of an ICM program and strategy
- Examples – I-80, SANDAG, AZ
  - Operating and operating authority
  - Data sharing parameters
  - Cost sharing
  - Decision making
Staffing and Training

• Staff capacity building
  – Current staff vs. supplementing staff
  – Leveraging available regional technical staff resources

• Staff training needs for ICM and next-generation operations
  – New systems and new operational approaches
  – Multi-agency training strategies essential
Discussion

• What are some key gaps participants see in developing an ICM strategy for your area?

• What are some ways to overcome these?
Active Transportation & Demand Management (ATDM)
What is Active Management?

The fundamental concept of taking a dynamic approach to a performance based process.
Moving Towards Active Management

Transportation Agency Operators: Moving from Static to Proactive Management

- Static Management
  - Time of day
  - Set-it and forget it
  - Will work when there is limited variability

- Responsive Management
  - Respond to current conditions
  - Account for traffic impacts due to conditions
  - Reduce time of degraded operation

- Proactive Management
  - Respond to predicted changes in supply & demand
  - Ability to delay or eliminate breakdowns

- High complexity, high reward
- Emerging
- Low risk
- Proven

Actively Managing Operations

SHRP2
STRATEGIC HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
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Goal of ATDM Concept

- Attain the capability to dynamically monitor, control, and influence travel, traffic, and facility demand of the entire transportation system and over a traveler's entire trip chain.
ATDM approaches provide travelers with choices throughout the trip chain leading to network performance optimization and increased efficiency.

Key Takeaway: Active management occurs before, during, and at the end of the trip chain.
What does ATDM include?

Active Demand Management (ADM): A suite of strategies intended to reduce or redistribute travel demand to alternate modes or routes. Incentivizes drivers by providing rewards for travelling during off-peak hours with less traffic congestion.

Active Traffic Management (ATM): A suite of strategies that actively manage traffic on a facility.

Active Parking Management (APM): A suite of strategies designed to affect the demand on parking capacity.

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Examples of ATDM Implementation Strategies

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<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>ADM</td>
<td>Comparative multi-modal travel times, dynamic ride-sharing, pricing, and incentive approaches.</td>
</tr>
<tr>
<td>ATM</td>
<td>Variable speed limits, dynamic shoulder use, queue warning, lane control.</td>
</tr>
<tr>
<td>APM</td>
<td>Parking pricing, real-time parking availability and reservation systems.</td>
</tr>
</tbody>
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## Moving Towards Active Demand Management

### En-Route Traveler Information
- Scheduled Work and Closures (press releases)
- Incident information
- + Travel times
- + Comparative travel times and cost information (transit, rideshare, etc.)
- + Predictive information

### Example

<table>
<thead>
<tr>
<th>Route</th>
<th>Travel Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIA 5 TO 90</td>
<td>24 MIN</td>
</tr>
<tr>
<td>VIA 405</td>
<td>19 MIN</td>
</tr>
</tbody>
</table>

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**SHRP2**

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Moving Towards Active Traffic Management

**Variable Speed Limits**
- Manual operation based on identification of conditions
- Automated operation based on pre-defined thresholds
- Automated operations based on predicted travel conditions

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The ACTIVE and INTEGRATED Continuum

- Active, But Not Integrated
- Early in Active and/or Integrated Operations
- Integrated, But Not Active
- DESIRED END STATE: Active and Integrated
Relationship between ATDM and ICM

- ICM is the joint management of a transportation corridor as a complete system
  - Load balancing
- Corridor operates at optimal performance, given the available capacity of each network
  - ATDM needed to realize ICM vision
Active Management in a Corridor

<table>
<thead>
<tr>
<th>Agency Type</th>
<th>Mode/Facilities</th>
<th>Individually optimized through ATDM approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit Agencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeway Agencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arterial Agencies</td>
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ICM: Corridor Level Optimization and Operations

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Active Demand Management (ADM) Example: Mobile Applications

Innovative Mobile Traffic Apps:

- **Goal**: manage demand by influencing driver choice over a longer period of time.
- **How**: Encourage behavior change through incentives (e.g., bigger rewards during off-peak travel).
- **What**: Real-time trip predictions, route mapping, voice navigation and pre-trip alerts.

Source: http://www.metropia.com/commuters
Other ADM Deployments
Include:

<table>
<thead>
<tr>
<th>Project</th>
<th>Location(s)</th>
<th>ADM Strategy(ies)</th>
<th>Active Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-10 Katy Expressway</td>
<td>Houston, TX</td>
<td>Dynamic pricing</td>
<td>Dynamic pricing of HOT lanes and incentives for transit and HOV usage</td>
</tr>
<tr>
<td>I-35W HOT Lanes</td>
<td>Minneapolis, MN</td>
<td>Dynamic pricing</td>
<td>Dynamic pricing of HOT lanes and incentives for transit and HOV usage</td>
</tr>
<tr>
<td>Congestion and Parking Relief Incentives (CAPRI)</td>
<td>Palo Alto, CA</td>
<td>Dynamic Parking Pricing</td>
<td>Award credits for avoiding peak parking hours. Credits used for random cash drawings of $2.00 – $50.00. Transponders used to detect when cars park.</td>
</tr>
<tr>
<td>Messaging Infrastructure for Travel Time Estimates to a Network of Signs (MITTENS)</td>
<td>San Francisco, CA</td>
<td>Predictive Traveler Information</td>
<td>Real-time highway and scheduled transit travel time displayed to induce in-route mode shift.</td>
</tr>
<tr>
<td>Predict-a-Trip</td>
<td>San Francisco, CA</td>
<td>Predictive Traveler Information</td>
<td>Predictive travel times using historical data to inform pre-trip travel decisions</td>
</tr>
<tr>
<td>I-55 Bus-on-Shoulder Demonstration</td>
<td>Chicago, IL</td>
<td>Hard shoulder running, temporary shoulder use</td>
<td>Roadway sensors, dynamic message signs</td>
</tr>
</tbody>
</table>


ATM Example: Seattle, WA

Smarter Highways

- Variable speed limits, lane control, traveler information
- Reduce speeds approaching congestion, crashes, work zones
- Warn motorists of downstream queues
- Display which lanes are open, closed, and closed ahead
- Primary objective is safety improvement
ATM in Action in Seattle Area
ATM Example: Northern Virginia I-66

- Intended to improve safety and incident management.
- Includes new sign gantries, shoulder and lane control signs, speed displays, incident and queue detection, and increased traffic camera coverage.
Active Traffic Management Simulation

Scenario 5A: Add Lane To Drop Lane - Closed

Scenario 6A: Add Lane and Drop Lane - Closed
ATM Example: Minneapolis I-35W

- Intelligent Lane Control Signs (ILCS) located every \( \frac{1}{2} \) mile over every lane.
- Advisory variable speed displays
- Use of the ILCS is primarily for incident management and speed harmonization.
- Designates when the priced dynamic shoulder lane is open or closed along with additional signing.
Other ATM Deployments Include:

<table>
<thead>
<tr>
<th>Project</th>
<th>Location(s)</th>
<th>ADM Strategy(ies)</th>
<th>Active Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive ramp metering</td>
<td>Los Angeles, CA / Minneapolis, MN / Portland, OR / Houston, TX</td>
<td>Adaptive ramp metering</td>
<td>Roadway sensors, ramp meter signals, TMC algorithms, TMC control</td>
</tr>
<tr>
<td>Weather Responsive Speed Limits</td>
<td>Mobile County, AL / Flagstaff, AZ / Portland, ME / Truckee River, NV / Pittsburgh, PA / Knoxville, TN / Cheyenne, WY</td>
<td>Dynamic Speed Limits</td>
<td>Traffic management center (TMC) control, variable speed limit signs, atmospheric sensors, visibility sensors, pavement conditions sensors, dynamic message signs</td>
</tr>
<tr>
<td>I-70 West Rolling Speed Harmonization</td>
<td>Silverthorne, CO</td>
<td>Dynamic speed limits</td>
<td>Roadway sensors, ramp meters, law enforcement control</td>
</tr>
<tr>
<td>Variable Speed Limits on I-285</td>
<td>Atlanta, GA</td>
<td>Dynamic speed limits</td>
<td>Roadway sensors, dynamic message signs, dynamic speed limit signals, TMC algorithms and control</td>
</tr>
<tr>
<td>Midtown in Motion</td>
<td>Manhattan, NY</td>
<td>Adaptive Traffic Signal Control</td>
<td>Roadway sensors, dynamic message signs, TMC algorithms and control</td>
</tr>
</tbody>
</table>
ATDM Summary

• ATDM represents next evolutionary step in Transportation Systems Management & Operations (TSM&O).
• Based on real time and predicted information and dynamic actions.
• Performance driven.
• Demand management much more prominent than historically in Operations.
• Active Management concept is shared by ATDM and ICM.
Group Discussion

• What other examples of ATDM have you heard about?
• What technologies or activities does your agency have that you would consider ATDM?
• Where you have deployed any of these technologies or systems, what lessons have you learned?
Characteristics Indicating Potential ATM Deployment Success

- High prevalence of crashes
- Bottlenecks
- Adverse weather
- Variability in trip reliability
- Construction impacts
- Financial constraints
- Limitation in capacity expansion
- Supporting infrastructure
- Agency capability and maturity
Outreach and Education

• Promotion
  – Encourage use and acceptance

• Education
  – Internal and external stakeholders
  – Institutional training
  – Awareness raising

• Outreach
  – Outreach campaigns
  – Branding
  – Media support and cooperation
WSDOT Outreach Examples

• Smarter highways video on Youtube
  http://www.youtube.com/wsdot#p/u/12/cd0doR0Ga-l
• Smarter highways www.smarterhighways.com
• Posted links on Twitter, Facebook and WSDOT blog.
WSDOT Outreach Examples

• Developed short animations for educational PSAs.
• Handouts: folios, postcard sized handouts, visualization of signs and explanation of symbols
• Outreach to cities, counties, businesses, colleges
Managing a Corridor Considerations

- What are your initial considerations?
- How would you go about developing a plan for corridor management?
- Who would you involve?
- What technologies/systems/actions would you consider?
- What are the major gaps or challenges you see in implementing the plan?
- What would you do to give your plan the best chance of success, especially considering the gaps/challenges?