Multiple Corridor and ICM Management

Identifying the Need

Traffic congestion does not respect jurisdictional boundaries. To be managed effectively, traffic must be understood as a complex network at a large scale, including how special events, traffic management plans, incidents and response plans deployed along one corridor impact other nearby corridors. Data necessary to actively manage corridors and multiple corridors are not readily available, because existing standards for transportation data communications are either non-existent or insufficient. Moreover, a standardized integration layer to connect systems across multiple corridors and multiple jurisdictions does not exist. ICM efforts are commonly pursued as project-specific endeavors that continue to build isolated systems.

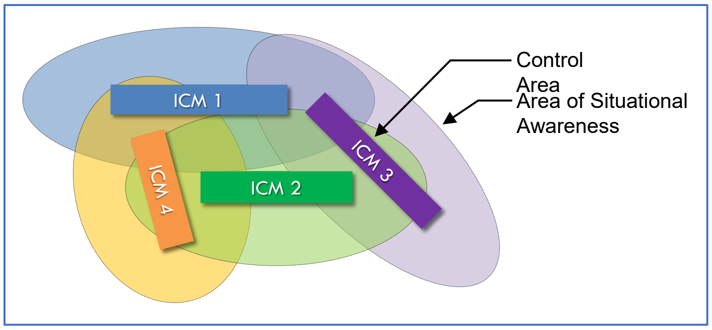

Figure 1: Schematic representation of ICM regions of control and ICM regions of situational awareness required for real-time control. Note that these regions may overlap, requiring coordination across multiple ICMs.

What is the Goal?

This project identified organizing principles for traffic management at large scales. In addition, it identified foundational elements of infrastructure and data exchange capabilities that are lacking in today's systems. We recommend priorities and incremental steps that can lead toward a safer, more efficiently operated and more connected multi-modal, multi-jurisdictional transportation network.

Project Description

This project formulated recommendations for large-scale traffic management enabling multiple corridor management efforts and/or ICMs to work together. In addition, it identified situations where conditions in one corridor influence management decisions in another corridor. To accomplish this, both traditional sensor data and probe data from "Big Data" vendors were analyzed to answer questions about aggregate traffic patterns on a multi-corridor scale.

Projected Benefits to California

The only opportunity available to manage a "typical incident" on an otherwise "typical day" is in simulation. This research built a foundation to recognize how and why a "real day" might differ from a "typical day", and to tailor decisionmaking related to a particular incident or type of incident in context. This research opens the door to the next generation of Transportation Systems Management and Operations (TSMO); one that is proactive instead of reactive.

Accomplishments

We used multiple case studies to investigate aspects of multi-corridor rerouting and found examples of "coupled freeways"—freeways that support each other's operations and that service similar origins and destinations. Using data from PeMS, INRIX, and Streetlight, we showed that large incidents on one freeway can cause changes and traffic congestion on the coupled freeways. Response plans that can reduce congestion near and around the incident may result in benefits on the coupled freeways.

Figure 2: Streetlight top routes analysis from SR-22 to SR-57 near Cal State during a freeway closure of SR-57. The predominant detour on SR-55 resulted in substantially increased congestion on SR-55 on that day.

Findings indicate that rerouting is highly impacted by the density of the freeway network and the distribution of trip lengths and that parallel freeways within about three miles, and with convenient access, are highly attractive as alternate routes. Results also indicate that as the distance increases and the ease of access is reduced, the attractiveness of a freeway as an alternate route falls off quickly; however, the distribution of trip lengths for a given link is also important. Incidents at critical network choke points that service a large proportion of long-distance trips can cause much larger rerouting effects. When approximately half of a freeway's capacity is blocked, the rerouting effects are clearly visible and affect a geospatial influence zone of 3-6 miles.

Several organizational strategies were also investigated to determine how to improve multiple corridor and ICM management. The recommended structure is a scalable structure that could implement multiple response plans to manage multiple incidents on the road network at the scale of a region. This kind of system would be applicable at a regional level whether or not each corridor in the region is pursuing an ICM. Most importantly, it also provides a framework to enable prioritization among ICM response requests across the region.

A scalable structure requires new and modern standards for data exchange, and communication of situational awareness, traffic data, and proposed response plans among jurisdictions. At a minimum, these standards need to be implemented at a scale commensurate with the size of the area/region to be managed. Data quality is likely highly variable across a region. Over time, as jurisdictions become "data-compliant" they will acquire capabilities that enable them to participate in cooperative management and response plan deployment.

Recommendations

A vision to achieve effective multi-jurisdictional collaboration for traffic management involves several key ingredients:

- Commitment
    - Acceptance that this is a long-term goal that will require years of consistent effort
    - Recognition that legacy, variety, and lack of standardization of infrastructure are serious barriers
- Standards
    - It is crucial to establish modern standards for the exchange of traffic management data
    - Standards must specify data semantics—the meaning of the data, not just its format
    - Vendors must be included in the standards generation and maintenance process
- Data
    - More complete, more representative, and more integrated data is needed for planning and real-time situational awareness
    - Further studies of emerging data sources are needed to improve the fidelity of traffic studies to determine the cost/benefits of large-scale traffic management strategies
- Incremental steps
    - When standards are in place, ATMS and local TMC systems can be updated or replaced to implement them, thus improving availability and usability of data for all
    - With consistent effort over time, the barriers to data exchange will be eliminated

Final Report

The final report is located at this link: https://escholarship.org/uc/item/7bm1r1k8

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