San Diego was one of two locations selected in 2010 for the further development of work on the ICM concept

Real-time, simulation-based forecasting and the San Diego ICM project

The integrated corridor management project in San Diego is showing that real-time simulation has the potential to transform traffic management, explains Josep M Aymamí, senior project manager at TSS-Transport Simulation Systems

Fragmented traffic information from the different agencies responsible for highways, traffic signals, ramp meters or public transport systems makes it difficult to proactively manage congestion. Integrated corridor management (ICM) is a key US initiative for improving mobility, aiming to optimise traveller flow across the whole multimodal infrastructure by creating a single, standardised, centralised system.

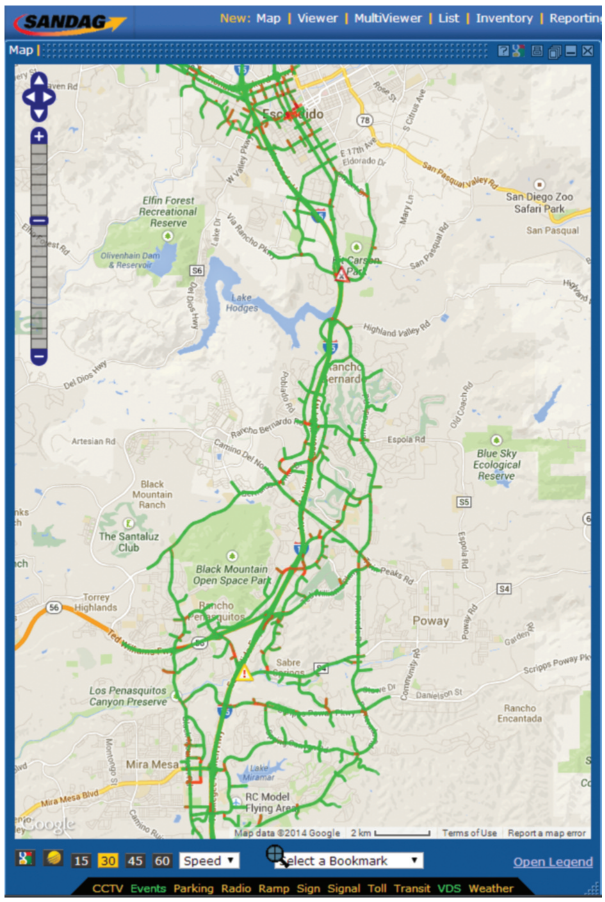
ICM is still in its infancy but preliminary test beds show that, when applied correctly, it can not only improve the flow of goods, services and people across a transportation network but also increase travel time reliability, thus reducing fuel consumption and emissions.

The US Department of Transportation (USDOT) launched its ICM Initiative in 2006 across eight sites, of which San Diego and Dallas were selected in 2010 for further development. Led by SANDAG (San Diego's regional planning agency) and its partners and with Delcan Corporation as systems integrator, the San Diego project combines 'smart' traffic management technologies and introduces concepts never used together before in the US: the project's pioneering Decision Support System (DSS), for example, uses strategies such as network traffic prediction, on-line microsimulation analysis and real-time response strategy assessment to give system managers comprehensive awareness of the current and predicted future performance of the entire corridor.

The project focuses on the 21-mile stretch of Interstate 15 (I-15) that runs from SR (state route) 52 in San Diego to SR-78 in Escondido, constituting the primary artery for the movement of commuters, goods, and services from northern San Diego County to downtown San Diego. It was already a model for the deployment of the latest and evolving technologies for data collection, demand management, and pricing strategies through its I-15 High Occupancy Vehicle (HOV) Express Lanes Project.

As of March 2014, the San Diego ICM system has been up and running for a full year. The project is now conducting successful ICM demonstration projects that show the benefits of ICM through improvements in corridor performance. In early 2014, SANDAG completed a successful 'Co-ordinated Test Plan' with all members of the I-15 integrated corridor management project team. In this test, all of the agency partners involved in the ICM project came together to witness the first ever 'fully automated' multi-modal corridor handling of a freeway incident in the US. The traffic management decision was successfully made entirely based on automatically triggered real-time simulations of the entire multi-modal transportation network.

The San Diego project has already won the prestigious ITS America award for Best New Innovative Practices and, following the success of the I-15 testing, FHWA (Federal Highways Administration) and USDOT are currently evaluating new sites and corridors for the next sponsored implementations of ICM across the United States.



The project covers a 21-mile stretch of the Interstate 15 (I-15) highway

Explaining the decision support system

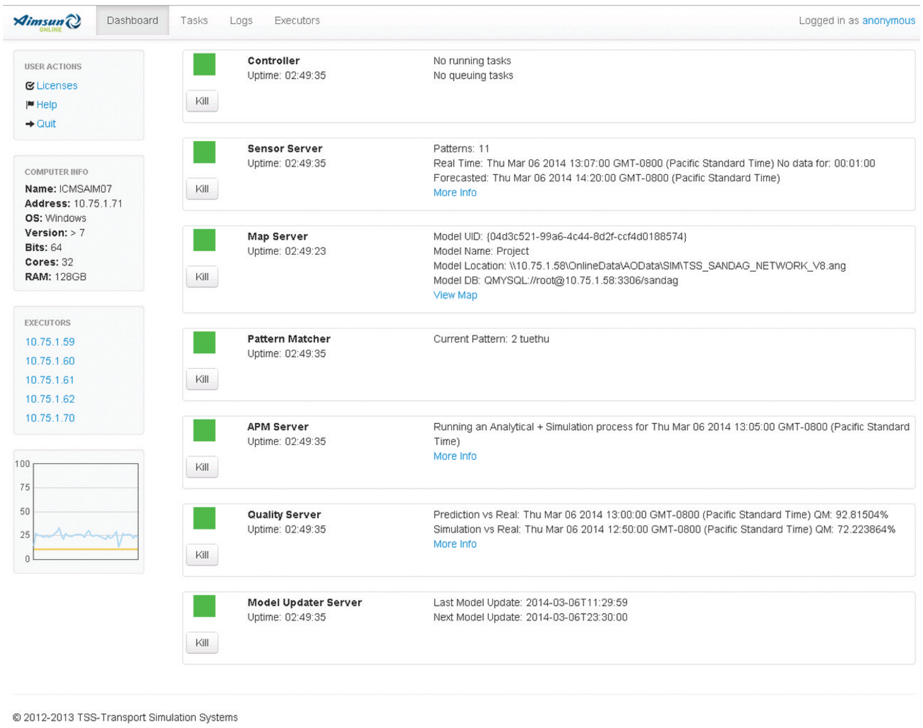
Core to the vision for an ICM solution for San Diego is the ability to forecast and simulate congestion and capacity imbalances in real time or near-real time, thus allowing system managers to anticipate problems before they arise. The DSS component of the ICM system will provide the technical platform that will allow different agencies to work together, collect, analyse and share data and implement response plans in real-time.

The multimodal DSS integrates two tools – the Delcan Intelligent NETworks ATMS, for field device monitoring and control, centre-to-centre data fusion, event management and response plan generation; and Aimsun Online, a tool from TSS-Transport Simulation Systems. Aimsun Online uses live data feeds and simulations to dynamically forecast traffic conditions based on the current state of the network, which helps system managers evaluate incident response and congestion management strategies.

The DSS allows managers to take preventative action using ICM strategies such as responsive traffic light synchronisation, co-ordinated ramp metering, alternative routing or bus priority on arterials. This ability to make traffic management decisions based on both current and predicted traffic conditions has so far been missing from ATMS solutions and will finally allow operators to be proactive instead of reactive. At the centre of the system is a data hub that uses Traffic Management Data Dictionary standards to collect, store and pass data between all of the various systems.

In order to understand how the DSS uses data it is important to understand how the DSS functions; it has three main operational components that differ from a typical ATMS: the Business Rules Engine (BRPMS); the Network Predictive Subsystem (NPS); and the Real Time Simulation Subsystem (RTSS).

The NPS takes an accurate reproduction of the current traffic status as the starting point and uses Aimsun Online analytics and microsimulation to forecast the next 60 minutes of network conditions. This information is produced every five minutes



The Aimsun Online dashboard is a key component in the system

and is fed into the BRPMS. The BRPMS uses the predictions and the user-defined congestion thresholds to identify locations of non-recurring congestion by comparing them against historical data; this may be due to changes in the demand or changes to the network capacity due to factors such as an incidents, weather or construction. Based on the configured system parameters, the BRPMS then selects a number of alternate routes. When selecting the route it checks that the devices (signals, ramp meters and signs) on those routes are available for use and that the routes have available additional capacity. When the routes and the devices have been selected, the BRPMS generates a number of plans to test various signal timing strategies and ramp metering strategies. This process can generate anywhere from one to 12 response plans. These plans are then sent to the RTSS, where Aimsun Online uses microsimulation to evaluate each response plan; this evaluation can take anywhere from three to ten minutes depending on the time of day, the impact of the event and the number of response plans. Once the evaluations are complete, each response plan is scored against the do-nothing scenario to provide a traveller-based, time-saving metric (not per vehicle). Once the best response plan has been selected, the system sends the requests to the agencies or directly to the device (depending on the configuration) to implement the proposed strategy. Once the congestion is no longer present in the NPS predictions, the BRPMS steps out of the response plan and returns devices to their normal operational mode for that time of day.

The engine at the core of the solution

The core engine of the RTSS and the NPS is Aimsun Online, which uses a microscopic Aimsun model. In order to generate the starting point for each simulation, be it an NPS or an RTSS simulation, Aimsun Online makes a number of data requests to the data hub to get the status files for each element within the network, including components such as toll prices, ramp meter status, weather conditions, parking status, current vehicle detection data (be speed occupancy and volume) or response plans information.

Once a simulation is complete, a full set of simulation results are uploaded into the data hub for use with the BRPMS and any external systems. These results provide the Measures of Effectiveness (MOEs) for the simulation nodes, links, routes, toll operations, ramp metering, and transit status. This provides a complete understanding of the system operations for the next 15, 30, 45, and 60 minutes. The Aimsun Online Dashboard is used to track the accuracy of the simulated and forecasted data versus the real system data.

As further corridors are developed using the I-15 ICM framework, one of the key advantages to using a set of data standards for this system is to provide a system that can be replicated in other regions, and also to provide a model and prediction data that can be used by external developers to develop apps and other features.

Currently an app is under development to call San Diego's 511 traffic, transit and commute information service, which provides users with both the current status of the corridor as well as the 15, 30, 45 and 60-minute predictions, incident information, and rerouting data provided by the DSS. ■