Multi-layered traffic model for Sydney's central business district

Transport for New South Wales (TfNSW) and Roads and Maritime Services (RMS) are developing an innovative, multi-layered traffic model of Sydney's central business district (CBD) to test the impacts of a wide range of projects, particularly the introduction of light rail through the city center. The model spans a large urban area, covering most of the possible rerouting impacts resulting from the light rail. While large-area models are nothing new, the mesoscopic model is one of the first of its size to provide operational modeling in such detail. It is even able to accurately mimic a SCATS traffic control system and offer close detail at intersections, which was previously only possible in small-area microscopic level models. It is the attainment of such breadth of scope combined with such depth of detail that makes the Sydney CBD model so innovative.

The rising use of data mining and predictive analytical techniques to improve decision-making processes means our lives are increasingly exposed to the results of these approaches.

The modeling platform will enable a multi-layered assessment of the transport operation of Sydney's CBD, including in its scope overall regional impacts not only for general traffic but also public transport. Multi-layered means the capability to model at the strategic planning level through to detailed operational assessment. The model is a joint project between GTA Consultants, TSS-Transport Simulation Systems (developer of the Aimsun traffic modeling software) and Azalient (developer of the Commuter nanosimulation software).

Although the Sydney model will enable the testing of transport policy decisions and infrastructure proposals of any size, the main project currently under consideration is the Sydney CBD Light Rail, which is part of Sydney's Light Rail Future project. The city already has 7km of light rail in place, but the new CBD and South East line is being built to reduce bus congestion in the CBD and provide higher-capacity public transport to hotspots currently served only by buses, such as Sydney Cricket Ground and the

University of NSW. In contrast to the existing Inner West line, the new route is mostly on-street and follows a similar path to routes used by the former tramway network.

The light rail expansion is set to run alongside a redesigned bus network that will see a reduction per hour of more than 220 buses entering the CBD in the morning peak. Work on the AU$1.6bn (US$1.4bn) project is scheduled to start in 2015 and will take six years to complete.

Approach path

TfNSW adopted a multi-level approach to account for regional traffic diversions resulting from changes in the capacity of the CBD's road network and hence plan for a realistic demand. Iterations with the strategic model were time consuming and of limited accuracy; in contrast, covering a wider area mesoscopically helps to provide

updated and time-dependent demand at boundaries, providing a higher order of accuracy. It can also take into account rerouting inside and outside the microscopic/nanoscopic area plus changes in the nanoscopic area that may affect demand at its boundaries.

The starting point for the modeling team was to import the road network from the existing strategic model, known as the Sydney Strategic Travel Model (STM), and information about bus routes and bus stops. As the STM road network covers the entire Newcastle, Sydney and Illawarra statistical divisions, the Aimsun macroscopic model replicated these model extents.

To model between the original macroscopic models and the new mesoscopic level, the team used Aimsun's Python scripting environment to build various tools to make the best
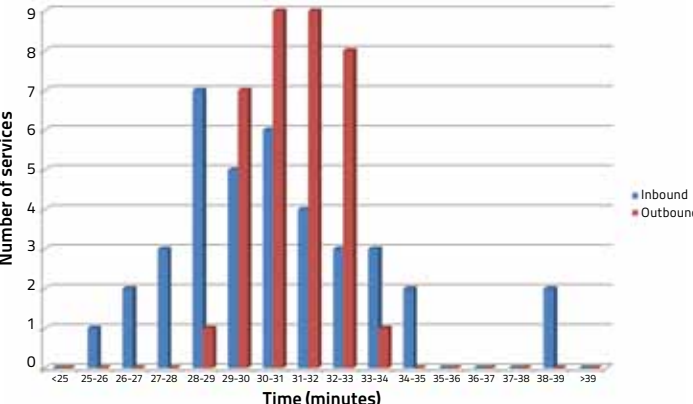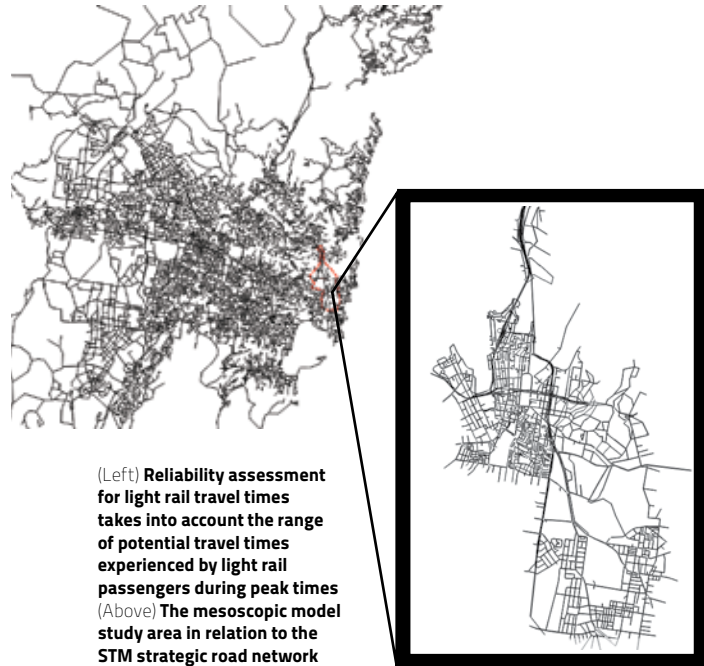
(Left) **SCATSIM with Aimsun for Sydney's CBD**

possible use of macroscopic-level information – e.g. to inform the dynamic model where information was unavailable, or feeding detailed dynamic model information back into the macroscopic-level model (such as updated signal timing information).

To assess the impacts of the proposed light rail and new bus network, the existing condition model was edited to reflect network and operational changes – network and intersection configuration changes as well as traffic signal updates (58 intersections). The model introduced dedicated light rail vehicles with specific vehicle characteristics, service frequencies, stop locations and dwell times.

To ensure accurate assessment not only of the impact of the final design but also the impact of closing lanes or streets for roadworks during the construction period, the team modeled different time periods (AM, daytime and PM). This was achieved in a single model along with current and future demand and supply scenarios for the light rail and bus services in addition to general vehicle traffic,

ⓘ | Need to know?

Sydney's CBD is set to reap the real-world gains of a novel approach to transport modeling

> A multi-layered approach is enabling the modeling team to assess regional impacts of traffic and public transport
> The Sydney CBD Light Rail project is set to greatly reduce bus congestion
> SCATSIM enables a transport simulator to be integrated with SCATS to improve the accuracy of the modeling

including operation of reversible lanes on the Harbour Bridge.

SCATSIM

The 'fixed time' model with manual signal optimization was sufficient for the model's intended use as a planning tool rather than an operational model. Although it is widely acceptable practice to use fixed timing in simulation models, it

is also acknowledged that the fixed time signal set-up presents a number of limitations in terms of representing the signal timings controlled by adaptive systems and the consequent improvements to capacity those systems provide. As a result of the evolving congestion over time, the need to establish the most efficient approach for optimizing signal timings at intersections was desirable for the next stage of analysis.

As a result, the Sydney CBD project has also involved pioneering work with SCATS (Sydney Coordinated Adaptive Traffic System), which is owned and marketed by RSM, and Aimsun's mesoscopic model. SCATS is a fully adaptive urban traffic control system that enables adaptive phase times, cycle times and offsets that respond to fluctuating traffic conditions and public transport demands and improves the efficiency of individual intersections or a series of intersections within the network.

So far SCATSIM has been used only at the microscopic level but in collaboration with RMS, the TSS team has developed the interface that can operate the SCATS traffic

signal system within the mesoscopic simulation environment to provide an appropriate level of precision to examine the CBD road network and its high level of congestion. This approach is closer to reality, where traffic signals adapt to changing demand in a more efficient manner.

Longterm benefits

Given the importance of the project to Sydney and the aim to address future transport needs, the SCATSIM model offers more precise estimation of the magnitude of traffic issues and supports the development of congestion management plans to address the forecast problems.

The model application to date has shown that Sydney has the traffic tool it needs – an accurate, practical, integrated model that is flexible enough to grow in line with the city's planning and operational requirements. ○

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(Left) **Reliability assessment for light rail travel times** takes into account the range of potential travel times experienced by light rail passengers during peak times
(Above) **The mesoscopic model study area in relation to the STM strategic road network**