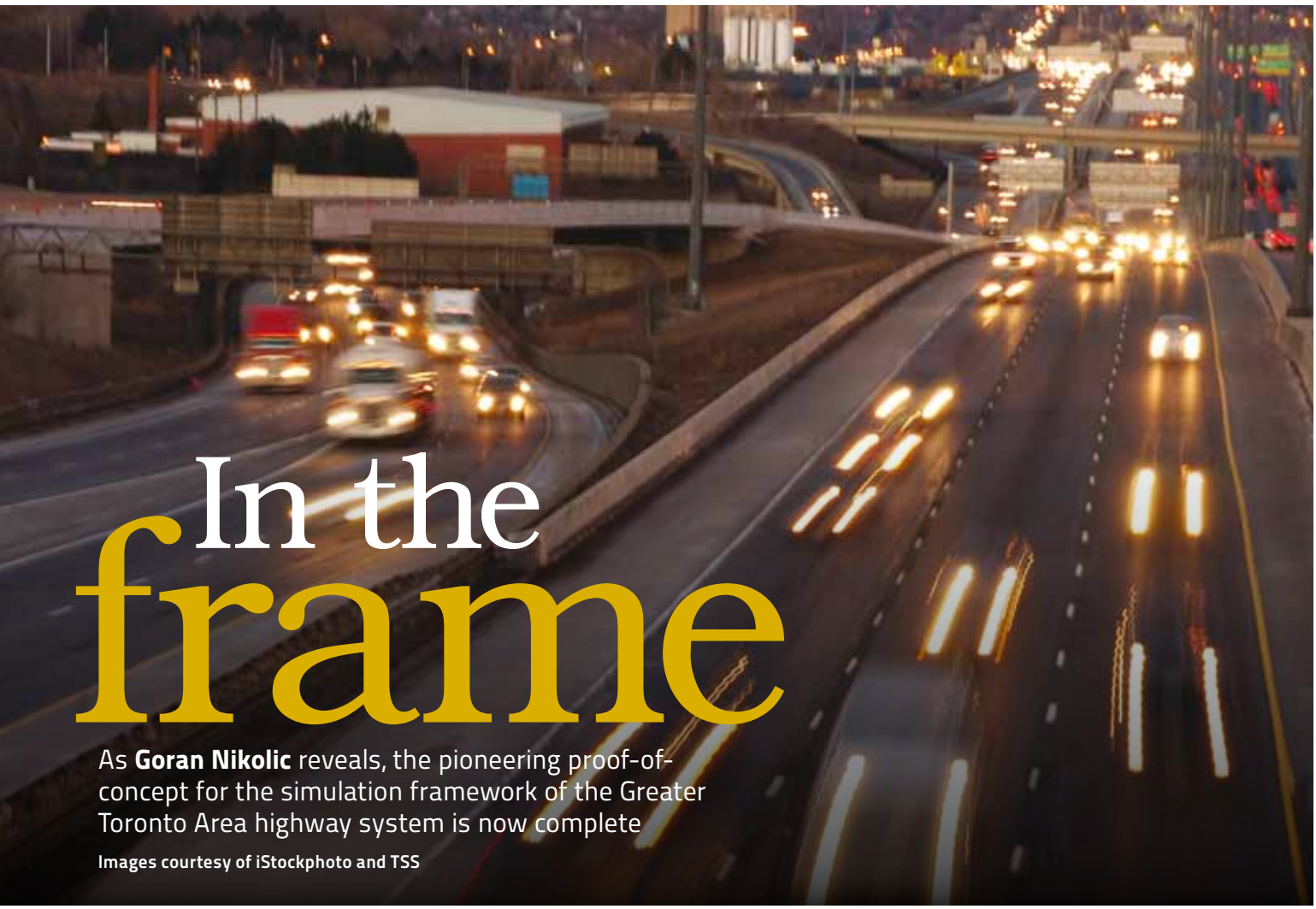

In the frame

As **Goran Nikolic** reveals, the pioneering proof-of-concept for the simulation framework of the Greater Toronto Area highway system is now complete

Images courtesy of iStockphoto and TSS

As with many large metropolitan areas throughout the world, the Greater Toronto Area (GTA) faces major challenges with traffic congestion. Many travelers experience long commutes and even relatively minor lane blocking incidents or adverse weather can create significant additional delays. The Ontario Ministry of Transportation's Central Region must carefully examine design alternatives, construction staging and incident/event management to optimize its complex highway system's safety and efficiency. As part of this work, MTO makes extensive use of traffic simulation modeling for highway planning and design, construction, operational reviews and traffic management strategies.

MTO's Central Region Traffic Office has completed the proof-of-concept (POC) for its pioneering Simulation Framework (or SimFrame): a multipurpose, multilayer traffic simulation framework for the freeway and major arterial road network in the GTA. The MTO project team, which included engineering consultants Delcan Corporation and McCormick Rankin (MRC), developed a single master model that will not only consolidate local knowledge and best practices but also optimize modeling performance and efficiency. The intent of this new model is to become MTO Central Region's primary tool for future traffic analysis as part of planning and design, operational reviews and traffic management strategy decision-making.

Traffic management in Ontario is set to improve via the use of the SimFrame

With the POC completed, the goal is to expand the framework to encompass the entire highway system in the GTA and embark on large-scale, network-wide applications. This includes traffic planning and analysis of advanced traffic management strategies and a more comprehensive operational assessment of Central Region's options for managed lanes such as high-occupancy vehicle (HOV) or other priority facilities.

Preliminary work has focused on urban portions of Highways 400, 401, 404, and 407; part of Ontario's 400-Series highway system. The 400-Series is a complex network of 1,500kms of controlled-access highway in Southern Ontario that is expanding into Northern Ontario. Segments of the 400-Series include various innovative traffic technology and systems such as HOV lanes, advanced traffic management systems (ATMS), an electronically tolled highway and a collector-express roadway configuration in the Toronto area.

Highway 401 stands out in particular as the centerpiece of the 400-Series network and as one of the busiest highways in the world. Together with Quebec Autoroute 20, it forms the transportation backbone of the Quebec City – Windsor corridor, along which over half of Canada's population resides. At one location in Toronto, the average traffic level exceeds 420,000 vehicles per day.

The size and complexity of the highway network means that in terms of traffic modeling, the MTO team faced some very demanding situations. This was further complicated by needing to model heavy congestion and challenging physical features such as short sections between entry and exit ramps and transfer lanes between express and collector roadways.

Because of this combination of great size and dense detail, the MTO team was looking for an all-in-one approach that could integrate macroscopic, mesoscopic and microscopic layers of modeling. With its integrated three-tier approach, Aimsun was a good candidate for the modeling platform, and was evaluated as the best fit from among the nine proposals submitted as potential software platforms for the POC.

Aimsun has a single common network and database that supports all levels of modeling, and it has a good interface with MTO's existing Emme travel demand model. MTO already possesses a strong Emme model for Ontario's Greater Golden Horseshoe Area (GGHM). The SimFrame is able to fully utilize the GGHM output. so nothing is wasted. It was also necessary for the product to have proven consistency in modeling results from the micro and meso layers, plus powerful and efficient 'zooming in' to focus on sub-areas for detailed analysis.

(Top left) **Construction project on Highway 401** (Below) **Modeling traffic flow in Aimsun**

Testing times

In parallel with the POC effort and under the watchful eye of the MTO Traffic Office, Delcan and MRC have been putting the Aimsun platform through an extensive evaluation process since 2008. The testing is an ongoing process of assessment, calibration, validation, feedback and algorithmic enhancements, and has included everything from the importation of existing traffic demand models to regional-scale evacuation of over a million vehicles. The consultants have checked that the framework is able to simulate every aspect of the 400-Series network: reproducing queue lengths and shapes at ramps on multilane highways with peak flows; incorporating cost functions that allow faithful modeling of tollways and HOV lanes; and reproducing the process of traffic flow balancing between the express and collector lanes. In almost every case, feedback from these projects has led to important enhancements in the underlying software platform to tackle the complexity of Ontario's highway network.

In total, more than 12 real-life projects have been completed in this period as part of the testing process. These include the impact of a new LRT line, a BRT facility in York Region, and specialty applications such as developing evacuation travel time estimates for two nuclear power generation facilities.

> The size and complexity of the network means very demanding situations in terms of modeling

The SimFrame is the culmination of over 12 years of innovative modeling solutions from MTO. The MTO has made extensive use of microscopic simulation with more than 100 projects, including: evaluation of the impact of proposed highway or interchange improvements; provision of travel-time estimates for use in forecasting HOV use, the operation of HOV lanes and on-street transit; and the operation of toll facilities, roundabouts and ATMS.

Reduce, reuse and recycle

The theme of reusing and recycling past projects is central to the objectives of the SimFrame development. The SimFrame streamlines the simulation process as a centralized modeling framework and avoids a situation where the same road section appears in different models with potentially different results. Consolidation also brings the benefits of standardized calibration, which assists in achieving consistency across studies. In addition, the SimFrame will lower costs by moving away from single-use models to a model that can be re-used time and time again. Finally, starting from an existing base model means swifter results, as it's no longer necessary to build and calibrate a new model from scratch for each new project.

Wide-area projects that cannot be modeled efficiently at the microscopic level due to the large size of the study area, but that require more detail than that provided at the macroscopic level, can now be addressed using the mesoscopic level. Furthermore, with SimFrame, there is no need to maintain and update separate models with independent networks and databases.

• *Goran Nikolic is head of traffic planning at the MTO*