

Reducing Run Times for Large Urban Models

The Metropolitan Council's experience with Cube Cluster

Background

Running travel demand forecasting models for large metropolitan areas, states, provinces, or nations requires a huge number of calculations and generates massive quantities of data. Often these models take many hours, or even days, to run. This was the case for the Metropolitan Council, the regional planning organization for the seven-county Minneapolis-St. Paul area, the most populated area in Minnesota. The Metropolitan Council's existing model routinely takes more than 36 hours to complete its calculations.

Citilabs develops travel demand modeling software used by large and small cities in more than 70 countries. To continue supporting its clients, Citilabs has developed a new extension to its Cube software suite—an extension that allows clients to use more than one computer to run their models. The new product, Cube Cluster, offers improved performance and flexibility. The Metropolitan Council tested Cube Cluster using three

ordinary desktop computers and reduced model run times by more than 65%.

The Metropolitan Council's tests

A user of Citilabs software for many years, the Metropolitan Council agreed to test Cube Cluster. Because of their experience with Citilabs software and their large and refined model developed for the Twin Cities area, the Metropolitan Council was an ideal candidate.

The Metropolitan Council implements their four-step trip-based model in Cube using Cube Voyager and custom Fortran programs. Ultimately, the model assigns high occupancy vehicle (HOV), non-HOV, and truck highway traffic to 24 discrete time periods. The model's network has more than 25,000 links and 1,632 traffic analysis zones.

The Metropolitan Council conducted the tests using the modeling team's existing computer hardware and software—the only "investment" required was the time spent reviewing documentation, setting up

How Cube Cluster works

Cube Cluster distributes run processes across multiple processors or multiple PCs. Cube Cluster uses two forms of distributed processing:

- Intra-step distributed processing — Splits the zone-based processing from a single step into zone groups, and processes each group separately.
- Multi-step distributed processing — Splits blocks of one or more modeling steps and distributes them to another computer to process.

With appropriate configuration, Cube Cluster enables you to run model processes simultaneously, optimizing use of your computer resources and reducing your overall run times.

Citilabs, Inc.
312 Clay Street, Suite 180
Oakland, California 94607, USA

World Wide Web
www.citilabs.com

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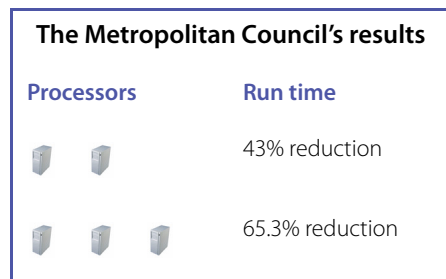
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the network and shared drive, modifying model scripts to enable Cube Cluster features, running tests, and analyzing performance. The Metropolitan Council tested the model by running Cube Cluster with both intrastep and multistep distributed processing.

On a single computer, the model's typical run time is about 36 hours, including full equilibrium feedback of traffic assignment results to trip generation, trip distribution, and mode choice. With a second computer, the Metropolitan Council reduced this run time by more than 40%. And by adding a third computer, the Metropolitan Council reduced run times to a little over 12 ½ hours.



As the Metropolitan Council testers learned to optimize the model steps and to allocate steps to each computer, run times improved. Testers concluded there is a brief learning curve when first applying Cube Cluster to a multistep model, given the need to gather information about variation in steps' run times and network performance.

Cube Cluster performance depends on model structure. The Metropolitan Council's model, like many models, is structured such that Cube Cluster could provide significant benefits. "We have taken a look at the Metropolitan Council's model and test results, and estimate that by continuing to add additional computers or processors, they would continue to see similar gains in performance," observes Matthew Martimo, Director of Traffic Engineering at Citilabs. "With eight processors working on the model, we estimate that model run times could be reduced by more than 80%, to approximately seven hours."

Conclusions

The Metropolitan Council had two goals for testing Cube Cluster:

- To run the current model overnight or even within an eight-hour day with reasonable levels of hardware and software investment
- To implement more advanced modeling techniques, which involve significantly more calculations, with reasonable run times

"We hoped that Cube Cluster could deliver significant performance improvements, allowing us to conduct more frequent and more detailed analyses," says Colby Brown, a Metropolitan Council modeler. Ultimately, he believes that performance gains will help his team fulfill both goals. "Ideally, we would like to refine our model to the fullest extent possible, while still reducing its total run time. This would make the model a more effective tool for policy makers evaluating which transit and highway alternatives best meet the transportation challenges facing our region."

More information

To learn more about the Metropolitan Council's transportation programs, please visit <http://www.metrocouncil.org>.

To learn more about Citilabs and Cube Cluster software, please visit <http://www.citilabs.com>.

About the Twin Cities and the Metropolitan Council

The Minneapolis-St. Paul metropolitan area is a thriving community of 2.7 million people. Consisting of Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington counties, the area includes all or part of 183 cities and townships. Major rivers in the area include the Mississippi, Minnesota, and St. Croix.

The Metropolitan Council is the regional planning organization for the seven-county Twin Cities area. It runs the regional bus and light rail system, collects and treats wastewater, manages regional water resources, plans regional parks, and administers funds that provide housing opportunities for low- and moderate-income individuals and families. The Council is appointed by and serves at the pleasure of the governor.

Cube Cluster is one of the many innovative and market-leading solutions developed by Citilabs—the leader in transportation planning software solutions.