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Web based on-demand Transportation Modeling

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ABSTRACT

Designing and building better transportation networks have become vitally important as our cities get more populated, interdependent and complex. Desktop software systems for transportation modeling do an excellent job of travel demand forecasting but they have the inherent drawback of limiting collaboration between modeling experts and stakeholders involved in the planning process. Also producing timely results is a limitation due to high turnover times as well as variability in the work required for modeling. Speedy model results which help decision making by planners will greatly enhance the value of travel demand forecasting as a fundamental planning tool for developing cities. Extending the present systems to include a scalable and 'on demand' resource system will soon become a basic requirement for transportation modeling.

Our solution is a cloud-based, hosted, scalable travel demand forecasting platform that is accessible on the internet. The first part involves extracting model data from the desktop system, uploading it to a website and having the ability for users to modify/extend the model. The second part is to provide the infrastructure to schedule and run a large number of scenarios simultaneously. This is ideally hosted on a cloud computing platform where we can scale and auto instantiate any number of servers with each having the ability to run unique scenarios in parallel. Security is built into the web interface and this provides the relevant information based on each user groups' need as well as the interaction required to promote collaboration.

1 INTRODUCTION

Desktop travel demand forecasting systems are highly limiting to modelers and has the drawbacks listed below:

- Access to the model is limited to single users and is highly localized.
- It is cumbersome for multiple modelers to work on development of the same model.
- Modelers need to coordinate and share limited resources with each other. How do I complete 30 scenario runs with three servers and provide results in a timely manner? How can I start the next scenario as soon as the previous one ends so there is optimal usage of the application server?
- Users have to deal with extraneous tasks like maintenance of the servers and generation of reports for transportation planners instead of concentrating on the core task of modeling and forecasting.

Transportation planners also find the system limiting as it is very difficult to get timely information for decision making and makes it very time consuming for them to get involved in the modeling process as they do not have direct access to results.

These are inherent limitations in any desktop software system and the trend has been to move to networked and web enabled systems. However moving travel models is not easy due to the complex analytic and computation intensive nature of the models which use large datasets. Recent advances in internet technologies and cloud computing provide an excellent opportunity to defy the status quo and extend travel demand forecasting from a modeler's desktop to a global platform.

Cloud computing comes into focus only when you think about what information technology always needs: a way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software. Cloud computing encompasses any subscription-based or pay-per-use service that, in real time over the Internet, extends information technologies existing capabilities.(Eric Knorr & Galen Gruman InfoWorld 2008). This is a paradigm shift from capital investments for building information networks to an 'on demand' system where you consume resources on a pay-as-you-use model.

Software as a service (SaaS) is a major part of cloud computing and is the process by which any user can access an application using an internet browser. On the client side there is minimal upfront investment and on the provider side there is only one application to maintain.(Eric Knorr & Galen Gruman InfoWorld 2008).

The cloud also embraces 'Utility computing' where computing resources are shared and provided with a pay-as-you-use model. So if a scenario needs to be run, then a server is 'rented' and paid only for the actual time the server is used.

All these technologies come together to provide a web interface which hosts the transportation model and provides the SaaS interface to manipulate and create scenarios. This application is hosted in a highly secure network which is located on a cloud platform provided by commercial software vendors. The network has the inherent 'on demand' ability to add a number of servers at any moment and provides modelers the capability to provide fast and efficient results without requiring any knowledge of how the system functions.

Most organizations will be able to get faster results while reducing their costs by cutting down on software and hardware investments. For example, if a user needs to run 30 scenarios which take 24 hours each, then the study can take 30 days using a single server. The other option will be to have an upfront investment in 30 sets of software licenses and high performance servers. We haven't even talked about maintenance costs at this point. Alternately, we can leverage the cloud to spawn 30 servers on demand, run each scenario simultaneously and complete the study in just a single day for a fraction of the cost!

2 ARCHITECTURE

The major components of this global transportation system are listed below:

Model Data Extractor: This is a tool which will extract model data from the desktop and package it for uploading into a web system.

Web Interface: Provides the client the interface to upload transport models and share access to their model users. Users can create custom scenarios, upload inputs and schedule 'model' runs. A full fledged portal web site on a cloud server provides the required functionality for managing the data as well as user access. Main components of the web site include a data manager to upload and download data, system to map data to specific scenarios in the model and a report generation module which non modelers can use to produce custom reports. Collaborating and sharing ideas within the transport modeling community is facilitated by a user forum module.

Backend Application server: This server has the required transportation modeling software to run the scheduled scenario. Also we need to have the ability to customize this server for specific client requirements.

Run Controller: This application constantly polls web services to find if any runs have been scheduled. If so, it leverages scripts to instantiate an 'on demand' application servers. Now the application server pulls the assigned work /data, completes the run and posts the results back for the user. The run controller will then shut down the application server.

The present user interface system has a web server, file server and a database server, each hosted on separate servers. A static IP address is assigned to the web server so we can easily map it to a specific domain name. Several web servers can be added to this group and requests can be distributed between the servers. The system is completely extensible and we can scale up to a web farm with several load balanced web servers supported by a back end clustered database setup.

Security is a major part of the global system and there are several web techniques which will be followed to ensure that access is provided only on an 'as required' basis. Care will be taken to ensure safety from SQL injection, cross site scripting, denial of service and cached data. Also login

credentials will be stored using cryptography and network passwords will be routinely changed to avoid decryption by force.

This system also results in complete abstraction of the application server build and maintenance to a central cloud network where the hosting provider will provide centralized experts for maintaining the system. Administrative access is controlled by providing VPN tunnels to the cloud network.

3 CONCLUSION

Up to now, modern city planners have relied upon transportation modeling software that required local modeling experts as well as expensive high performance hardware/software to meet this need. This "expert-based" approach has been an adequate but expensive and time-consuming approach. Advancements in cloud computing are challenging this traditional approach as the better option for timely and cost effective travel demand forecasting to aid transportation planning decisions. We are using new technology to leverage this advantage and revolutionize the industry. The benefits of the new global platform are as follows:

- Ability to get timely information for decision making. We can run a large number of 'on demand' servers simultaneously and speed up the process of getting results.
- Collaborate and interchange knowledge in a global forum.
- Cost saving due to paying only for server usage instead of upfront investment and maintenance cost of hardware.
- Cost saving due to sharing licenses across web farms.
- Modelers can access their models through the internet and can easily share tasks with each other. Servers are always available and monitoring/scheduling runs is now automatic.
- Transport planners will now be able to see results in real time and have control over the process of generating reports and immediately collaborating with modelers to request additional scenario runs.
- The 'world becomes flat' with any modeling consultant or expert from around the world having the ability to run your models, share results and ideas.

4 BIBLIOGRAPHY

4.1 ERIC KNORR & GALEN GRUMAN, INFOWORLD APRIL 2008