Transforming the interconnection between travelers, data and transportation planners: An open-source cloud computing platform for mobility optimization with heterogeneous data sources

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Current Research Activities Related to Cloud Computing

My team has developed a cloud-computing based multi-criteria data mining and routing system on the Microsoft Azure platform (available at www.uroute.org): Advanced Routing in the Cloud with Heterogeneous data sources (ARCH). This open-source multi-criteria routing engine has both web and smart phone interfaces (shown in Fig. 1), developed by the University of Utah team for the US Department of Transportation (DOT) SafeTrip 21 project, in collaboration with the University of California, Berkeley, California Partners for Advanced Transit and Highways (PATH) and NAVTEQ research teams. The University of Utah has also developed a fully functional, open-source dynamic traffic assignment model that uses the GNU General Public License (GPL), "DTALite", which can be downloaded from http://sourceforge.net/projects/dtalite/. Based on an agent-based traffic simulation-assignment framework, DTALite uses a computationally simple but theoretically rigorous traffic queuing model in its lightweight mesoscopic simulation engine. For example, DTALite can simulate 20 days of traffic evolution for the Portland Metropolitan Network (with about 1-2 million vehicles) in a little over 1 hour on a quad-core computer.

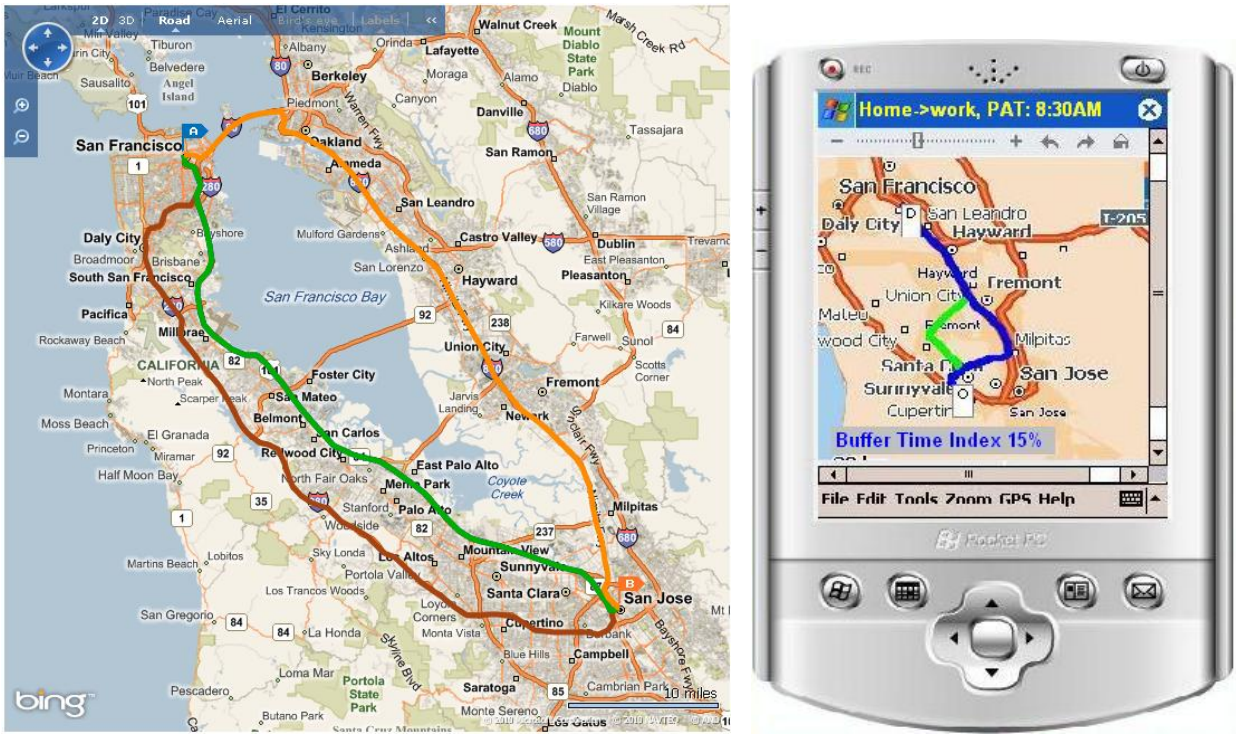

Figure 1. Open-source multi-criteria routing prototype on Bing Maps and Windows Mobile Phone Interfaces, with preferred arrival time (PAT) at 8:30AM in Bay Area, CA

Abstract of Future Research Problems

Project Title: An open-source cloud computing platform for mobility optimization with heterogeneous data sources

Cloud Computing (CC) represents a fundamentally new approach for real-time large-scale system modeling, ubiquitous communication, and diverse data synthesis. Personalized (but public agency coordinated) travel information represents an ideal CC application, but one which requires transformative advances both within the traditional domains of transportation planning, traffic analysis, network behavior, and demand forecasting but also within the emerging field of CC itself.

This research aims to integrate these socially critical fields to develop cloud computing based methods and tools, with a special focus on post-earthquake recovery planning and emergency response, a high-impact and challenging problem in the engineering computation domain. Three critical elements are needed to achieve the previously stated aim: (i) an open-source CC platform (ii) a new generation of traffic algorithms capable of exploiting the radically differing nature of emerging data interconnectivity and (iii) public agency and private traffic data provider coordination/buy-in.

The Microsoft CC environment provides element (i) which supports an open-source platform for Mobility Optimization via Network Assignment and Routing in the Cloud with Heterogeneous data sources (MONARCH). MONARCH must include innovative traffic optimization methodologies enabling a previously unrealizable transportation system built on tight interconnections between travelers, data and planners (thereby achieving element ii). With improved individualized information and network observability, traffic management/planning organizations (element iii) can increase the value of their contributions as they will achieve superior system representations, real-time response, and improved control measures (and further feed the integrated data environment with high-quality planner generated data sources). Finally, private traffic data providers can grow profitable services in data sharing, data mining, and delivering coordinated traffic information.

This research has the following broader impacts: Coordinated pre and post-earthquake recovery planning, reconstruction, and mitigation strategies for greatly reduce the economic losses caused by natural disasters; the close integration of earthquake engineering, transportation science, computer science approaches in modeling a highly interdependent and dynamic physical/human/cyber system and in improving its system resilience and efficiency. Additionally, open-source traffic simulation and visualization tools increase computational intelligence and power for modeling, sensing and controlling the complex transportation system recovery process.

Keywords: *Data-intensive* distributed *computing,* Real-time traffic management and control, Traffic network assignment and routing, Travel information provision, Post-earthquake recovery planning