TECHNICAL *Summary*

INDOT Research

Technology Transfer and Project Implementation Information

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VALIDATION, CALIBRATION, AND EVALUATION OF ITS TECHNOLOGIES ON THE BORMAN CORRIDOR

Introduction

The spawning of the Internet and the communication revolution, coupled with highly economical computing commodity hardware costs, are motivating new paradigms for the real-time operation and control of large-scale traffic systems equipped with advanced information systems and sensor technologies. Non-availability of reliable on-line data and the prohibitive costs of high performance computers to process such data have previously been the primary barriers in these endeavors. Recently, falling computer hardware costs, the exponential growths in their performance capabilities, sophisticated sensor systems, and the ability to transmit data through the public domain quickly and reliably, have been synergistic in enabling the efficient deployment of real-time route guidance in large-scale traffic systems.

This study develops an Internet-based on-line architecture to exert control in large-scale traffic systems equipped with advanced sensor systems and information dissemination media. The aim is to develop an automated on-line system that disseminates messages to network users on the optimal paths and/or provides route guidance while satisfying accuracy and computational efficiency requirements. It explicitly accounts for the calibration and consistency-checking needs of the models being used within the architecture. The architecture incorporates fault tolerance methods for errors encountered at the architecture level and due to the malfunctioning of field sensors. Since cost is an important factor for large-scale deployment, an Internet-based remote control architecture is proposed to enable deployment and evaluation. The architecture is remote in that it can be used to deploy and evaluate alternative solution strategies in the offline/online modes from remote site locations (such as the Borman or Indianapolis traffic control centers). In addition, a remote architecture ensures that the associated models can be located at one central server and accessed from any INDOT site.

The study also proposes to use the Beowulf Cluster as an economical, flexible, and customizable computing paradigm to generate supercomputing capabilities for the real-time deployment of the proposed on-line control architecture. It serves as the enabling environment to execute and coordinate the activities of the various modules responsible for real-time network route guidance, data transmission, calibration and fault tolerance. In the context of large-scale traffic systems, a Beowulf Cluster can be configured in centralized as well as decentralized on-line control architectures with equal ease. Thereby, it enables individual traffic operators with smaller operational scope (such as local traffic agencies) to install mini Beowulf Clusters at their locations or allows several of them to operate remotely using a centrally located large-scale Cluster. For a large transportation agency, the use of a centrally located Cluster can significantly aid operational efficiency and cost reduction by obviating the need for hardware, software, space requirements, and maintenance at each individual location.

Findings

This research has the following findings that meet the research objectives.

1. An Internet-based remote traffic control architecture is economical and efficient, obviates redundancies in hardware and maintenance, and can be automated by incorporating fault tolerant systems.
2. The Beowulf Cluster computing paradigm serves as a viable alternative to expensive specialized supercomputing architectures to address the computational needs of real-time traffic operations and control.
3. Beowulf Clusters can be configured with equal ease for centralized and decentralized on-line control architectures. This enables small as well as large traffic agencies to implement a new generation of robust, but computationally burdensome, methodologies for traffic operations based on the application of advanced technologies.
4. The Fourier transform-based fault tolerant framework can detect data faults due to malfunctioning detectors and predict the likely actual data for the seamless operation of an on-line traffic control architecture. It can also detect incidents.

The off-line benchmarking tests to analyze data communication and parallel software codes suggest that the proposed Cluster computing architecture is highly efficient, and can enable real-time deployment of the associated traffic control strategies.

Implementation

The proposed on-line traffic control architecture can be implemented on the Borman Expressway or Indianapolis ATMS corridors for real-time route guidance operations after exploring various issues for enabling real-time communication links.

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