U.S. Department of Transportation
Research and Innovative Technology Administration

Office of Research, Development, and Technology
Research Bulletin

Technology Transfer Grant:
The Transportation Research and Analysis Computing Center (TRACC)

Modeling, Simulation and High Performance Computing Resources for the US Department of Transportation at Argonne National Laboratory

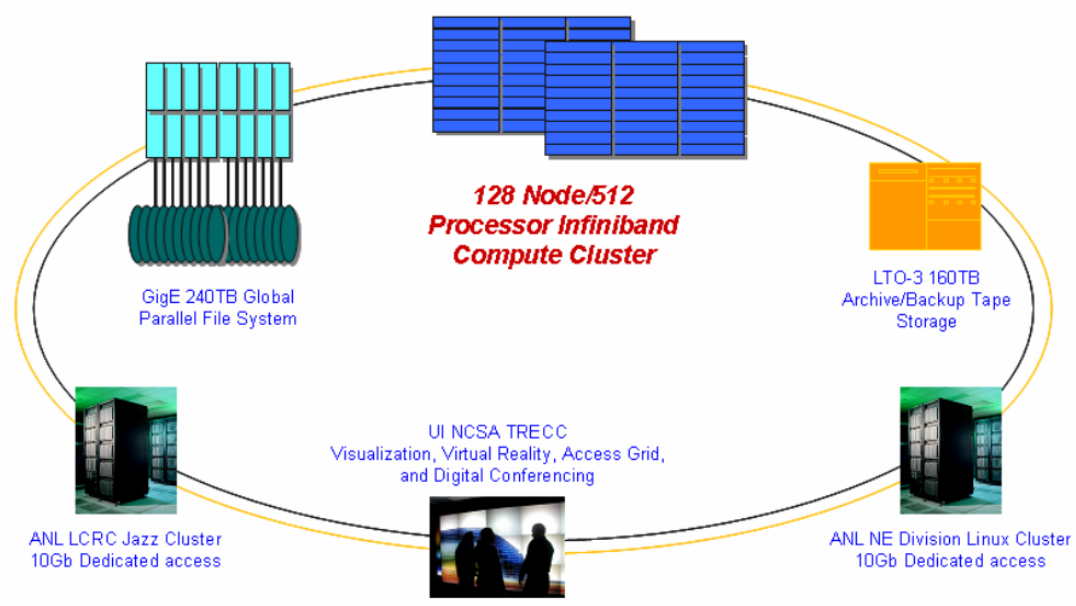
BACKGROUND:

Many applications of computer modeling and simulation of interest to the USDOT community currently require or will require access to advanced computing and visualization technologies. Examples include assessment of transportation system design and performance with micro-simulation based transportation network analysis codes, evaluation of evacuation planning with transportation system simulation models, computational fluid dynamics and computational structural analysis for infrastructure analysis such as bridge hydraulics and aerodynamics response, automobile crashworthiness and passenger and pedestrian safety evaluation, roadside hardware design and optimization, and structural response and crashworthiness of heavy duty vehicles, passenger and freight trains and aircraft.

The need for high-fidelity computational results requires the use of large-scale and detailed models of the systems and underlying phenomena in question. Effective use of these models relies on the availability of parallel and massively parallel computers to provide visual and computational capability in a timely fashion.

OBJECTIVES:

The objective of the program is to establish a Transportation Research and Analysis Computing Center (TRACC), a high performance computing and engineering analysis research facility, featuring a state-of-the-art massively parallel computer system, advanced scientific visualization capability, high speed network connectivity and modern engineering analysis software, established at Argonne National Laboratory's site at the DuPage National Technology Park. This project will provide advanced computing environment



for use by the USDOT community, providing specific applications support in key areas of applied research and development. The advanced computing facility is being linked to USDOT research and development facilities, state departments of transportation and university transportation research centers. Argonne partners include the University of Illinois' National Center for Supercomputing Applications (NCSA), the NCSA Technology, Research, Education and Commercialization Center (TRECC) and Northern Illinois University.

PRODUCTS/APPLICATIONS:

The primary function of the TRACC facility is to provide large-scale parallel computing capability for research and demonstration projects. Although TRACC is a general purpose advanced computing facility available for use by the USDOT community for a broad spectrum of applications, specific applications and technologies have been identified to have highest priority for research and development and user support. These initial applications include (1) traffic modeling and simulation and emergency transportation planning; (2) computational fluid dynamics for hydraulic and aerodynamic research for bridges and other critical highway structures; (3) multi-dimensional data visualization; and (4) computational structural mechanics and methods for analysis and optimum design of safety structures and analysis of transportation related infrastructure. TRACC's application area in traffic modeling and simulation and emergency transportation planning is focused on the use of the USDOT micro-simulation software - TRANSIMS. The initial demonstration project is focused on the Chicago metropolitan area for both transportation system and evacuation planning. The computational fluid dynamics (CFD) area, utilizing state-of-the-art commercial CFD software such as Fluent and STAR-CD, is initially focused on modeling of bridge hydraulics, with specific interest in bridge scouring and bridge stability after flooding events. The third area of computational structural mechanics, using the LS-DYNA structural analysis code, is focused on fluid-structure interactions for bridge stability analysis and advanced methods for crashworthiness evaluations. The final area of multi-dimensional data visualization is initially focused on using the advanced methods and visualization facilities of the National Center for Supercomputing Applications for visualization of TRANSIMS traffic modeling calculations.

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