The Successful Deployment of Mesh Routers for Trans-Continental JSAF Simulations, Urban Resolve

Thomas D. Gottschalk
CACR, Caltech
Pasadena, California
tdg@cacr.caltech.edu

Robert Lucas, Gene Wagenbreth & John Tran
Information Sciences Inst. /Univ of So Calif
Marina del Rey, California
{rflucas, genew, jtran}@isi.edu

William Helfinstine
Lockheed Martin Info
Burlington, Mass
bill.helfinstine@lmco.co

ABSTRACT

This paper reports the successful deployment of a robust scalable interest-managed router architecture that has supported a series of trans-continental JSAF simulations, such as Urban Resolve. Previous architectures had served well over the years, but were conceptually limited both in scalability and in robustness, or fault-tolerance. The scalable router architecture had its inception in high performance parallel computing research and its initial application in a truly scalable architecture for inter-node communications on parallel supercomputers and linux clusters. Its design provided both needed scalability and desirable robustness on the single platform meshes of several large parallel computers made up of hundreds of compute nodes. The scalable router was designed to integrate smoothly with other Urban Resolve software by reusing Run Time Infrastructures (RTI-s) components. In an effort to minimize communication latency, maximize use of available network bandwidth, and increase robustness of trans-continental (Virginia to Hawai'i) operations, Joint Forces Command's J9 directed that its wide-area router's offer the same characteristics of scalable and robust operations. That let to the wide-area deployment of the scalable routers. This paper sets forth the experience of that evolution, the non-disruptive incorporation of the new routers, the scalability of the interest-managed routing, and the performance of the new network. The assiduous factorization of the program, in order to optimize and temper the code, bore fruit during the implementation process and that factorization activity is explicated and analyzed. Further, the authors look to their experiences in high performance computing to lay out future capabilities and directions for additional development. The area of primary interest and importance is fault tolerance. A specific proposal for the design and fielding of a system impervious to the loss of individual router processes is presented.

ABOUT THE AUTHORS

Thomas D. Gottschalk is a Member of the Professional Staff, a Senior Research Scientist at the Center for Advanced Computing Research (CACR), and Lecturer in Physics all at the California Institute of Technology. He has worked at CACR for nearly a decade advancing the use of massive parallel computers for simulation. His instructional duties include Statistics and Experimental Design for Caltech Physics Graduate students. Dr. Gottschalk has been active in parallel programming for nearly two decades, with efforts spanning integrated circuit design, intelligent agent simulations, theater missile defense, and physics modeling. He consults for a number of other organizations, including his work on space based systems for the Aerospace Corporation. He received a B.S. in Physics from Michigan State University and a Ph.D. in Theoretical Physics from the University of Wisconsin.

Robert F. Lucas, Gene Wagenbreth and John J. Tran are all members of the JESPP team at the Information Sciences Institute of the University of Southern California. They have been active in high performance computing research for a more than a decade. Dr. Lucas received BS, MS and PhD degrees from Stanford University. Gene Wagenbreth has a BS in Mathematics and Computer Science from the University of Illinois. John Tran has BS and MS degrees in Computer Science and Engineering from the University of Notre Dame.

William Helfinstine is a senior research engineer in the Lockheed Martin Information Systems division. He has a long history of developing applications for the simulation community in the Department of Defense. He received a MS degree in Computer Science from the Massachusetts Institute of Technology.