Information Technology

Educational NASA Computational and Scientific Studies (enCOMPASS)

This project bridges the gap between computational objectives and needs of NASA's scientific research, missions, and projects, and academia's latest advances in applied mathematics and computer science.

Goddard Space Flight Center, Greenbelt, Maryland

Educational NASA Computational and Scientific Studies (enCOMPASS) is an educational project of NASA Goddard Space Flight Center aimed at bridging the gap between computational objectives and needs of NASA's scientific research, missions, and projects, and academia's latest advances in applied mathematics and computer science. enCOMPASS achieves this goal via bidirectional collaboration and communication between NASA and academia. Using developed NASA Computational Case Studies in university computer science/engineering and applied mathematics classes is a way of addressing NASA's goals of contributing to the Science, Technology, Education, and Math (STEM) National Objective. The enCOMPASS Web site at http://encompass.gsfc.nasa.gov provides additional information.

There are currently nine enCOMPASS case studies developed in areas of earth sciences, planetary sciences, and astrophysics. Some of these case studies have been published in AIP and IEEE's Computing in Science and Engineering magazines. A few university professors have used enCOMPASS case studies in their computational classes and contributed their findings to NASA scientists. In these case studies, after introducing the science area, the specific problem, and related NASA missions, students are first asked to solve a known problem using NASA data and past approaches used and often published in a scientific/research paper. Then, after learning about the NASA application and related computational tools and approaches for solving the proposed problem, students are given a harder problem as a challenge for them to research and develop solutions for.

This project provides a model for NASA scientists and engineers on one side, and university students, faculty, and researchers in computer science and applied mathematics on the other side, to learn from each other's areas of work, computational needs and solutions, and the latest advances in research and development. This innovation takes NASA science and engineering applications to computer science and applied mathematics university classes, and makes NASA objectives part of the university curricula. There is great potential for growth and return on investment of this program to the point where every major university in the U.S. would use at least one of these case studies in one of their computational courses, and where every NASA scientist and engineer facing a computational challenge (without having resources or expertise to solve it) would use enCOMPASS to formulate the problem as a case study, provide it to a university, and get back their solutions and ideas.

This work was done by Nargess Memarsadeghi of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16288-1

Coarse-Grain Bandwidth Estimation Scheme for Large-Scale Network

A new analytical approach, called the "leveling scheme," was developed to model the mechanism of the network data flow.

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A large-scale network that supports a large number of users can have an aggregate data rate of hundreds of Mbps at any time. High-fidelity simulation of a large-scale network might be too complicated and memory-intensive for typical commercial-off-the-shelf (COTS) tools. Unlike a large commercial wide-area-network (WAN) that shares diverse network resources among diverse users and has a complex topology that requires routing mechanism and flow control, the ground communication links of a space network operate under the assumption of a guaranteed dedicated bandwidth allocation between specific sparse endpoints in a star-like topology. This work solved the network design problem of estimating the bandwidths of a ground network architecture option that offer different service classes to meet the latency requirements of different user data types.

In this work, a top-down analysis and simulation approach was created to size the bandwidths of a store-and-forward network for a given network topology, a mission traffic scenario, and a set of data types with different latency requirements. These techniques were used to estimate the WAN bandwidths of the ground links for different architecture options of the proposed Integrated Space Communication and Navigation (SCaN) Network.

A new analytical approach, called the "leveling scheme," was developed to model the store-and-forward mechanism