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Earth Sciences Directorate, Goddard Space Flight Center

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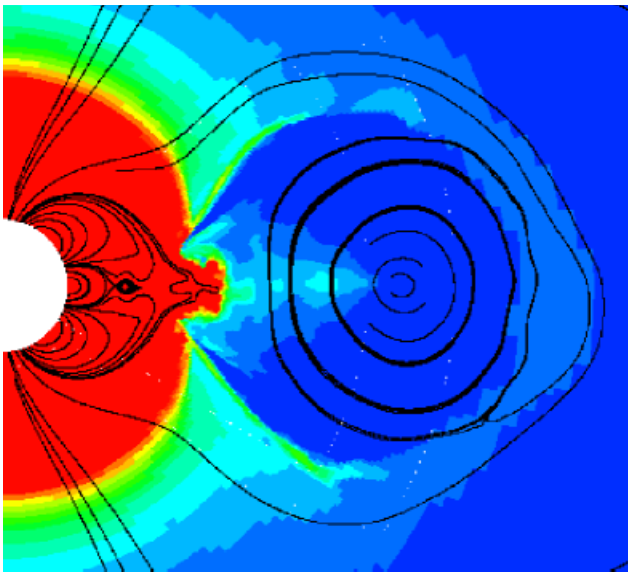

A coronal mass ejection escapes the Sun in a GSFC-NRL simulation run on the ESDCD's 128-processor Medusa cluster. Colors map mass density, ranging from blue (low) to red (high). Black lines represent magnetic field lines. Image credit: Peter MacNeice, Drexel University/GSFC

Computational Technologies Project

Beowulf Clusters Tackle Problems Worldwide

Geophysicist John Baumgardner has been simulating the Earth's interior for 20 years, but not until using the newest ESDCD computing cluster could he fully resolve structures like tectonic plates sinking into the mantle. "This is the first time that I have been able to capture this high degree of realism in global-scale calculations," said Baumgardner, of Los Alamos National Laboratory.

Baumgardner is harnessing Thunderhead, one of two large ESDCD clusters that extend the internationally successful "Beowulf" concept. Beowulf clusters can reduce costs by a factor of five over comparably performing commercial supercomputers by combining commodity hardware parts with the open source Linux operating system. In 1994, the ESDCD built the world's first Beowulf, a 16-processor system named Wiglaf, for $40K. Three years later, the ESDCD's 199-processor HIVE/Bulk Data Server cluster broke the 10 GigaFLOPS barrier for $372K.

"There has been an explosion of performance from 1997 until now," said John Dorband, Beowulf team leader and computer scientist of the ESDCD's Applied Information Sciences Branch (AISB). "The price stays similar, but performance goes through the roof." For $1.25M, the 512-processor Thunderhead attains 1.1 TeraFLOPS on the Linpack benchmark, which would place the machine at number 46 on the June 2003 TOP500 Supercomputer Sites list. A 2,300-processor Linux cluster claimed the number 3 spot, with 2 other Linux clusters in the top 10.

Hundreds of Beowulf installations now exist worldwide, and many serve as the main computing platforms for departments and even entire institutions. The ESDCD supplements its HP/Compaq AlphaServer SC45 and SGI Origin 3800 systems with Linux clusters to nurture focused applications and software development efforts that require large blocks of computing time.

Working with Dorband on the ESDCD Beowulf team are Udaya Ranawake of the University of Maryland, Baltimore County (UMBC), Josephine Palencia of Raytheon, and Glen Gardner of GST. Their busiest cluster is Medusa, named after the mythical creature with snakes for hair. The $300K system links 128 1.2-GHz AMD Athlon processors with a 2-Gb/sec Myrinet network. Its "snakes" are 17 office-based developer nodes—Linux workstations connected by Myrinet extensions—that put the high-performance cluster right on ESDCD scientists' desktops. "You can treat Medusa as your personal super-calculator," Dorband said.

Medusa runs a variety of Earth and space sciences applications on demand. They include image segmentation for rapidly analyzing large volumes of satellite data, optical modeling for future NASA spacecraft, and solar physics simulations that investigate potentially harmful phenomena.

John Dorband pictured between the ESDCD's two large Linux clusters, Medusa (left) and Thunderhead.
Image credit: Richard Glassbrook, AMTI

Among the solar events being modeled are coronal mass ejections (CMEs), where the Sun propels several hundred million tons of matter at over a million miles an hour. CMEs can knock out satellites and power grids, so NASA and other agencies want to predict them. ESDCD and Naval Research Laboratory (NRL) collaborators are exploring how magnetic reconnection can trigger CMEs. In reconnection, stretched magnetic field lines snap apart and connect to other field lines at blindingly fast rates, freeing condensed matter at the Sun's surface. Using Medusa, the GSFC-NRL team has matched modeled reconnection patterns with recent observations of x-ray emissions and proven that their simulations produce a relatively fast CME.

"We are at the early stages of prediction, moving to push our simulations to higher and higher resolutions," said physicist Peter MacNeice of Drexel University. "Adaptive mesh refinement (AMR) allows us to do that most efficiently."

Simulations represent physical space on a grid (mesh) of squares or some other shape. AMR dynamically divides initially large squares into smaller and smaller squares where changes occur, thus putting higher resolution only where it is needed. The ESDCD's freely available PARAMESH AMR package works in conjunction with applications software. Medusa is the main development and testing platform for PARAMESH, which is designed to work on current supercomputer architectures. "If we can do well on a Beowulf, we will do well on pretty much any parallel system if it runs MPI," said PARAMESH co-developer Kevin Olson of UMBC.

Olson is also enthusiastic about Thunderhead because he "can access large numbers of processors immediately." "I want fast turnaround to debug and tune code," he said. Thunderhead was built by Professional Service Super Computers (PSSC) Labs and Northrop Grumman. They chose the same 2-Gb/sec Myrinet network as Medusa but took advantage of the faster 2.4-GHz Pentium 4 Xeon processors available in late 2002.

Thunderhead is the first ESDCD cluster to be managed more like a supercomputer center, compared to what MacNeice calls the "Wild West" environment on Medusa. The Beowulf team's new system software tools ease installation and usage monitoring. Most significantly, the system software allows multiple user scheduling for the first time. Baumgardner is pleased to be able to run his calculations on 128 processors for a week, enough hours to simulate a significant fraction of the entire history of rock deforming and moving inside the Earth.

NASA-funded Earth and space scientists can apply for Thunderhead access through the Computational Technologies Project's Guest Investigator program.

http://ct.gsfc.nasa.gov/gis.html
http://ct.gsfc.nasa.gov/gsfc-supercomputers.html
http://www.top500.org

SVS

New Pipeline Feeds Hurricane Media Storm

Images of deadly hurricanes crossing the Atlantic Ocean were among the first visualizations processed through the Scientific Visualization Studio's (SVS) new, quick-turnaround pipeline. The SVS developed this pipeline to speed the production of visualizations requiring timely delivery. The

new image processing system reduces production time from over 3 hours to less than 1 hour.

The SVS can now provide global and regional images and animations of breaking events, such as fires and hurricanes, to GSFC's Public Affairs Office for immediate distribution to NASA and the national news media. Data for these products are derived from Terra, the Sea-viewing Wide Field-of-view Sensor (SeaWiFS), the Tropical Rainfall Measuring Mission (TRMM), and the Geostationary Operational Environmental Satellite (GOES).

Pipeline visualizations of Fabian, a Category 3 hurricane, were featured during live media interviews with scientists Jeff Halverson of UMBC and Marshall Shepherd of GSFC's Mesoscale Atmospheric Processes Branch. The educational interviews were televised on September 10, 2003, by 25 stations across the country and in Canada. Related SVS visualizations were featured in the NASA Web site article "Recipe for a Hurricane," and the GSFC Web site Top Story "NASA Satellites Extract Ingredients in Hurricane Recipe to Improve Forecasts."

The approach of Isabel, a hurricane initially reaching rare Category 5 wind speeds above 155 mph, triggered a second flurry of media events featuring SVS hurricane images on September 16, 2003. Another series of live interviews showed near-real-time images derived from Aqua and GOES data of Isabel's cold-water trails. As Isabel crossed the Atlantic, it sucked heat out of the ocean, leaving the cold-water trails in its wake. The media also presented the SVS 'cat scan' of a hurricane's internal rain structure using data derived from instruments on the GOES and TRMM satellites.

To produce an image through the pipeline, the SVS first obtains processed data and geographic positioning information in GeoTIFF, a common geographic image data format. Near-real-time data are obtained from portals such as the University of Maryland's Moderate Resolution Imaging Spectroradiometer (MODIS) Rapid Response System or the TRMM Rapid Response Pipeline. An Interactive Data Language (IDL) script is then run to automatically create a scene in Maya, the SVS's primary 3D software. The final product is created using Pixar's Renderman, rendering software that integrates well with the visualization tools used in the SVS.

Multiple data sets from instruments onboard NASA's fleet of Earth observing satellites help scientists to better understand the formation of hurricanes through their lifecycles as well as aid in prediction with increased warning time and more efficient

MODIS on NASA's Terra satellite captured this image of Hurricane Isabel just east of the Bahamas on September 15, 2003, at 11:30 e.s.t. Though the storm had begun to weaken, it still packed winds of 138 mph with gusts up to 167 mph. Image credit: SVS/MODIS Land Rapid Response Team at GSFC

coastal evacuations. Major hurricanes with winds over 110 mph can wreak havoc on homes and buildings and cause abnormal tides up to 12 feet high.

http://www.gsfc.nasa.gov/topstory/2003/0905fabian.html
http://www.nasa.gov/vision/earth/environment/HURRICANE_RECIPE.html
http://www.gsfc.nasa.gov/topstory/2003/0916isabel.html
http://www.gsfc.nasa.gov/goddardnews/20030919/index.html
http://svs.gsfc.nasa.gov/stories/isabel_20030916/index.html

NCCS Highlights

nccs.nasa.gov

The NASA Center for Computational Sciences (NCCS) has received an Agency-level domain for ease of Internet accessibility. Its new Web site address, http://nccs.nasa.gov, required the endorsement of the GSFC and NASA Chief Information Officers. This URL is recognition that the supercomputing facility is an Agency resource. The NCCS provides the NASA-funded science community with powerful computing and mass storage resources. Management and operations information as well as the NCCS's highly skilled computational science support staff can be accessed through this site. The NCCS is managed by GSFC's Science Computing Branch.

http://nccs.nasa.gov

GMAO GEOS Operations Now at NCCS

After months of planning and an intense data migration effort, the Global Modeling and Assimilation Office (GMAO) Goddard Earth Observing System (GEOS) primary operations began running at the NCCS on September 3, 2003. Late last summer, Ghassem Asrar, the NASA Associate Administrator for the Earth Science Enterprise, directed the former Data Assimilation Office to expedite their planned move of computing and storage from the NASA Advanced Supercomputing (NAS) Division at NASA's Ames Research Center to the NCCS. The NCCS engineered a computing and storage environment similar to the NAS environment to minimize the migration risk and to accomplish the migration according to the accelerated schedule.

The NCCS reconfigured a 512-processor SGI Origin 3800 into two separate systems with 384 processors and 128 processors, and the NCCS acquired an additional 128-processor system to support the computing needs of the GMAO. The bulk of the GMAO development and production workload was successfully migrated to the NCCS by early summer. With the help of SGI and NAS staff, the NCCS moved 170 Terabytes (TB) of GMAO data from the NAS facility to the NCCS for testing that began in July. Primary and backup copies of the data needed to stay at NAS while operations continued there, so the entire volume of data needed to be duplicated for shipment to the NCCS. Following the completion of the data migration and a period of parallel operations, the migration of GMAO operational processing was completed without interruption to the GMAO's scheduled workload. To facilitate the migration, GMAO data were maintained in SGI Data Management Facility (DMF), as it had been at NAS. The DMF data will be migrated to SAM-QFS in 2004 (see NCCS Highlights, "NCCS Migrates to SAM-QFS").

http://nccs.nasa.gov

NCCS Migrates to SAM-QFS

The NCCS has begun the migration from the Sun E10000 system running Legato UniTree software to the new Sun Fire 15000 server with Sun StorEdge Performance Suite and Utilization Suite (SAM-QFS). On September 16, 2003, all UniTree data were made accessible only through SAM-QFS. Initially, UniTree data are being transparently migrated to SAM-QFS on demand as users retrieve files.

This migration is the result of a competitive procurement to provide a long-term solution to the rapidly growing volume of data stored at the NCCS and to provide a high-reliability system. The bundled hardware-software solution from Sun was a cost-effective means to address the data volume that doubles

The Sun Fire 15000 is at the heart of the new NCCS SAM-QFS mass storage system. Image credit: Sun Microsystems

every 15-24 months. The Sun Fire 15000 provides roughly three times the performance of the legacy E10000. The E10000 was a single point of failure, but the new system has fault-isolation and hardware redundancy, configured with Veritas Cluster Server software to allow access to data during system maintenance, hardware outages, and future upgrades/expansions.

Before the switch, the NCCS invested significant effort into the development and testing of the new system, which was installed during the summer. This effort was required to minimize any impacts on the NCCS user community and to ensure that no data would be lost. A successful pilot-user test of the new SAM-QFS system was conducted by a team led by Ellen Salmon of the NCCS with support from the NCCS User Services and systems staff. For the test, over 7.1 TB of data were transferred to the new system to identify and resolve file usage problems before production conversion. Testing was completed on September 11, 2003. User Services developed tools to aid the migration for users and to provide functionality that differed between the old and new systems.

In Phase 2 of a 3-phase data migration plan, the NCCS began converting 320 TB of data from UniTree to SAM-QFS. While still handling the regular NCCS user workload, the NCCS expects to transparently move up to 5 TB of data per day using four dedicated Gigabit Ethernet (GE) connections between SAM-QFS and UniTree for a point-to-point data transfer. After a period of evaluating and tuning the performance of the UniTree-to-SAM migration, the NCCS started a background migration of the remaining UniTree data into SAM-QFS format. Upon completion of the on-demand and background migration, all requests to access the data will go directly to SAM-QFS, and the UniTree system will be shut down with the old hardware returned to Sun.

Phase 3 involves migrating the GMAO data to SAM-QFS from DMF, beginning in 2004 (see previous article).

CSC is providing system integration, AMTI is providing user support for the switchover, and Sun is performing the actual data conversion.

New Data Management System

As part of the continuing effort to deal with the huge volume of Earth Science data, the NCCS is working with integrator CSC and subcontractor Halcyon Systems, Inc. to prepare a Data Management System (DMS). The DMS consists of the Storage Resource Broker (SRB) combined with an Oracle database that holds the Metadata Catalog (MCAT).

The system is planned for initial use by the GMAO, as the largest user of NCCS mass storage resources. The system and its peripherals will help manage the massive GMAO data collection within the NCCS, and could eventually be used to improve NCCS management of all of its mass storage data. Currently, the GMAO has 190 TB of the total primary holdings of 290 TB for over 9 million SAM-QFS/UniTree files plus an additional 15 million files in DMF. The NCCS has an expected growth rate of 1 TB per day. The DMS will help users manage this volume of files by information about the file, not just file names. Once the NCCS and the GMAO gain experience with DMS and evaluate its reliability, cost, and availability, its functionality and tools will be offered to other NCCS users to manage their data holdings.

The SRB is widely used data management software written by the San Diego Supercomputer Center (SDSC). Many supercomputing facilities are using SDSC's SRB to improve management of large data systems such as the Two Micron All Sky Survey, the Stanford Synchrotron Radiation Laboratory, and the Scripps Institution of Oceanography Digital Libraries. The SRB provides middleware that isolates the end user from the disparate and distributed hardware and software systems used to store data. Through client applications, GMAO researchers can seamlessly access and manage their data on the NCCS's high-end computers without ever having to know or understand the underlying network or hierarchical storage management system.

The SRB's user interface has the look and feel of a usual Unix file system. While user files have standard information such as creation dates and last access dates, they can also contain data management information, such as data expiration dates. This helps users to better manage aging data while freeing up valuable NCCS hardware resources. Furthermore, the SRB enables users to search for criteria about their data or metadata, increasing researchers' abilities to publish raw data and facilitating collaboration. Types of metadata that users can enter into the MCAT include information about platforms used to generate data sets (such as operating systems and compilers) or the data set itself (such as grid size and time of simulation).

The DMS glues together the SRB with other common NASA applications, such as Open Source Project for a Network Data Access Protocol (OPeNDAP) (formerly known as Distributed Oceanographic Data System (DODS)) for data to be shared in a collaborative environment and Grid Analysis and Display System (GrADS), an interactive desktop tool for easy access, manipulation, and visualization of Earth science data.

After successful beta testing, the DMS software was made available in mid-September to select GMAO users for user testing on the NCCS's SGI and HP platforms. DMS servers are available for both the SGI DMF and the Sun SAM-QFS file system.

Once the GMAO accepts the DMS based on extensive user tests to start in December 2003, the NCCS plans to non-intrusively move the approximately 250 TB of DMF-managed GMAO data under the control of the DMS in about 3 months.

http://www.npaci.edu/DICE/SRB
http://grads.iges.org/grads
http://www.unidata.ucar.edu/packages/dods

Automated Metrics Help Users

The NCCS has produced a new Web interface that automatically displays over 50 system usage metrics for the NCCS's four SGI high-end computers. The metrics are displayed in the form of easy-to-read charts, providing a wealth of system utilization information to enable the NCCS user community to more fully exploit NCCS resources. The system automatically refreshes the data every 10 minutes, ensuring that users are always viewing the most current systems information.

NCCS users can determine what turn-around time they can expect for their jobs, and GMAO management can determine at any time which NCCS machines are most available to absorb their production workload by viewing metrics showing over- and under-tasked systems. Users can also easily view such data as user, kernel (system), idle, and wait times. System administrators use this same information to implement procedures to increase system performance and efficient processing of user requests and jobs. NCCS managers may base maintenance, upgrade, and repair decisions on the utility data.

A portion of a system usage metrics chart showing weekly combined history of an SGI Origin 3800 at the NCCS. Dark green indicates utilization time. The red line indicates user time, and the blue line indicates idle time. Image credit: NCCS User Services*

Richard Dill of the University of Maryland at College Park (UMCP) produced the new interface under the 2003 Visiting Student Enrichment Program. He received guidance from Thomas Clune of the NCCS and Michael Witkowski of AMTI. The system was enhanced and prepared for final release by Michael Gurski of AMTI.

http://nccstag.gsfc.nasa.gov
(Access allowed from any NASA IP address or by authorized users only.)

**NCCS User Services provides the NCCS user community with a wide variety of services including Help Desk support. The Help Desk is manned Monday through Friday from 8 a.m. to 8 p.m. e.s.t., except for Federal holidays and GSFC closures. NCCS User Services may be contacted via telephone at 301-286-9120 or email at tag@nccs.gsfc.nasa.gov.*

How to Access NCCS Resources

To gain access to NCCS computing resources, follow the instructions at

http://nccs.nasa.gov/resources/main.html

Outreach

Visiting Student Enrichment Program

The 2003 Visiting Student Enrichment Program (VSEP) provided computer-related work experiences to students from universities, colleges, and high schools throughout the U.S. VSEP is managed by Marilyn Mack of the ESDCD's Science Communications Technology Branch (SCTB).

This year, the program matched 18 students from a record 450 applications with mentors in 7 GSFC branches, including the ESDCD's 3 branches. Projects included the following:

Thomas Clune of the NCCS and Michael Witkowski of AMTI mentored Richard Dill, UMCP, who created a Web interface that displays near-real-time graphical reports of NCCS system usage. (See NCCS Highlights, "Automated Metrics Help Users").

Working with mentor Lee Foster of the SCTB, Derek Wagner, Oregon Institute of Technology, ported nuttcp, a highly useful network monitoring tool, to the Windows environment. William Fink of the SCTB originally developed nuttcp for Unix and Linux systems. Now the tool can be used on Windows machines worldwide.

Daniel Duffy and Edward Vanderlan of CSC mentored Carla Ball, Tulane University, who evaluated data transfer rates in the NCCS high-performance computing environment. This work was done in preparation for the migration of data to NCCS's new Sun SAM-QFS mass storage system.

Class of 2003, Visiting Student Enrichment Program. Image credit: Debora McCallum, GSFC

Clune and student Jennifer Bailey, Colorado School of Mines (CSM), developed an algorithm that allows more data points to be assimilated into a GMAO global atmospheric analysis model. Based on the work of CSM professor Junping Wang, the algorithm effectively increases the number of data points that can be assimilated into a weather forecast from 400,000 to more than 10 million observations in a day, using the same computational resources.

Jacqueline LeMoigne of the AISB mentored Matthew Wollenweber, Loyola College, who implemented a gradient image registration algorithm across a parallel computing environment. Distributing the computational load across several computers simultaneously decreased execution time and increased the potential image size that the algorithm could handle.

Nancy Maynard of the Earth Sciences Directorate mentored Amruta Sama, Hoggard High School, as she mapped the movement of carbon monoxide into

the Arctic using remotely sensed data from the Measurements of Pollutants in the Troposphere (MOPITT) instrument onboard NASA's Terra satellite.

Elizabeth Middleton of the Laboratory for Terrestrial Physics mentored Velinda Daleva, Lincoln University, as she assessed the effects of carbon and nitrogen in vegetation for studies on how natural ecosystems are altered by human-induced perturbations.

Phil Bording of CSC and Clune mentored Kimberly Sayles, University of Alabama, who wrote a finite element code to solve potential flow equation problems. The code can be applied to model the behavior of fluid flows, such as the movement of atmospheric currents over a mountain.

This year's cluster computing projects included input/output performance analysis and adapting code to a parallel computing environment. Other projects involved software validation for the James Webb Space Telescope, the use of ion engines for low-Earth orbit spacecraft, quantum chemistry calculations, and the simulation of water behavior using aCe, a programming language developed at the ESDCD.

Visit the VSEP Web site for a complete list of 2003 projects.
http://esdcd.gsfc.nasa.gov/VSEP/2003/VSEP2003list.html

Summer Fellowship

NASA Faculty Fellowship Program fellow Anthony Burrell, mentored by Patrick Gary, produced a white paper reviewing the interrelationship of the technologies deployed by the HECN Project with the general GSFC network infrastructure. The paper also provides advice on how to respond to future high-speed heterogeneous network demands.

Space Hope: Embraced by Baltimore

Space Hope provides free or relatively inexpensive IT training to the impoverished segments of Baltimore's urban population, who are underrepresented in the IT workplace. Space Hope helps alleviate the city's shortage of qualified, entry-level IT professionals while addressing the IT needs of the local economy. This pilot initiative, in year 3 of a 5-year grant, is currently funded primarily by NASA. Marilyn Mack of the SCTB is NASA lead for the project.

This year, Space Hope's first three A+ classes and its first Cisco class have already graduated. About 36 graduates have found jobs or other advancement, such as internships, through the program's 90 percent job placement rate.

Space Hope's Honeywell lead Antonio Jones (left) and recent graduate Rodney Johnson share Space Hope success stories on radio station WOLB's "Empower Hour" September 9, 2003. Image credit: Marilyn Glass, Honeywell

The greater Baltimore community has embraced the program, forging cooperative agreements between community outreach programs and Space Hope. The project's success stories have been featured several times on local AM radio station WOLB's "Empower Hour," an ardent supporter of Space Hope.

ESDCD Updates

Awards: Computational Optics for Exo-planetary Imaging

Three proposals by Richard Lyon, an optical scientist with the ESDCD, won NASA awards totaling over $1.5M for 3 years. All three awards are for advanced optical methods and systems relating to coronagraphic detection of Jupiter- and Earth-like planets around nearby stars.

Two of the proposals are for NASA's Terrestrial Planet Finder (TPF) mission, which is scheduled for launch in 2015 as part of NASA's Origins Science Theme. Lyon will be the principal investigator (PI) for the first award, which is for advanced supercomputing modeling of optical systems for exo-planetary detection, imaging, and spectroscopy. For the second TPF award, Lyon will be co-investigator (Co-I) for an actual laboratory demonstration of one technique for exo-planetary imaging.

The third award is for 2003 NASA Research Opportunities in Space Science for advanced coronagraphic techniques for exo-planetary detection. As Co-I, Lyon will develop advanced simulations and a laboratory testbed at the Center for Astrophysics at Harvard University.
http://planetquest.jpl.nasa.gov/TPF/tpf_index.html

IS&T Chair

Jacqueline Le Moigne was named Chair of GSFC's Information Science and Technology (IS&T) Colloquium Committee. Committee members from the ESDCD include John Dorband and John Schnase. The colloquium brings leaders in the IS&T field to GSFC for presentations on cutting-edge IS&T topics. The series is hosted by GSFC's Office of the Assistant Director for Information Sciences and Chief Information Officer.

http://ISandTColloq.gsfc.nasa.gov

IT-PWG Formed

Four members of the ESDCD were selected to serve on GSFC's Information Technology (IT) Pathfinder Working Group (IT-PWG). GSFC Center Director Al Diaz has charged the newly formed committee to "assure that Goddard's IT Infrastructure (both hardware and software systems) is at the forefront of technology change in bringing support to future NASA/GSFC science information systems, where applicable and appropriate." IT-PWG is chaired by Milton Halem, Distinguished Information Scientist, Emeritus, of GSFC's Earth Sciences Directorate (ESD). The group includes 13 representatives from GSFC's Applied Engineering and Technology Directorate and the ESD. ESDCD members include Patrick Gary, Ellen Salmon, John Dorband, and Horace Mitchell.

High Performance Networking

In cooperation with GSFC's Storage Area Network (SAN) Pilot project, the ESDCD's High End Computer Network (HECN) Team is continuing to test protocols enabling SAN-over-IP (see ESDCD News, Spring 2003).

William Fink of the SCTB led the set-up of a SAN interconnection using Internet Fibre Channel Protocol (iFCP). An advantage of iFCP is that it can be used to facilitate migration from a Fibre Channel SAN to an IP SAN or a hybrid network.

Testing was based on two Nishan Systems IPS 3000 Series IP Storage Switches, each with a 1-GE interface, using GSFC's 2-GE link-aggregated Scientific and Engineering Network.

The SAN Pilot project measured up to 640-Mbps single-stream data transfers from reads and writes between two buildings at GSFC. Data transfers were between a Linux-based workstation attached to a SAN in one building and disk storage attached to a SAN in a separate building. The project confirmed this rate with an 18-hour test conducted on September 3, 2003.

The HECN team is coordinating further tests using Nishan iFCP-based gateways among widely distributed SANs between GSFC, UMCP, and SDSC. These tests will assess the affects of greater distances between SANs on data throughput performance.

For information or questions contact:
esdcdnews@webserv.gsfc.nasa.gov

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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