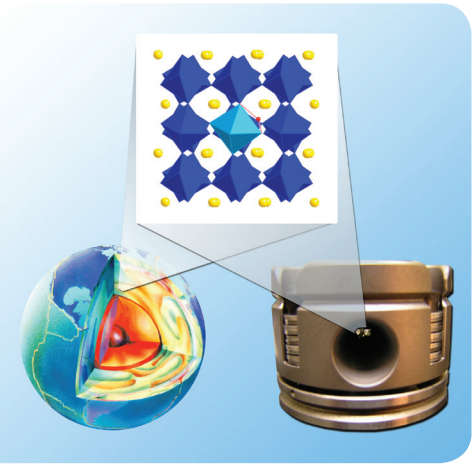
Determining water capacity of the Earth's mantle



above: Crystal structure of a perovskite-structured magnesium and iron silicate (with one hydrogen atom in red), which makes up about 80 percent of the deep mantle.

School children learn that nearly three-quarters of the Earth's surface is covered with water, in the form of oceans, ice, rivers and lakes. However, even our brightest scientists know little about the distribution of water beneath the planet's surface or even how much total water the planet contains.

"The Earth's solid, silicate mantle has the potential to host as much as ten times the water we see on the Earth's surface," said Wendy Panero, Ph.D., assistant professor of earth sciences at The Ohio State University. "Water dissolved in the silicate mantle has dramatic effects on the physical properties and behavior of the planet, such as influencing the long-term shifting and shaping of the surface and interior, decreasing melting temperatures and slowing the speed of earthquake waves."

Evidence suggests that the main mineral of the lower mantle is considerably drier than its shallower counterparts, implying that a water filter may exist 440-660 kilometers beneath the surface. Alternatively, water may exist in the lower mantle, but only in accessory minerals. This hypothesis has important implications on how we interpret present-day sea level rise and the origin and evolution of the planet.

To test her central hypotheses and answer related questions, Panero is leveraging the computational power of the IBM Glenn Cluster at the Ohio Supercomputer Center, paired with state-of-the-art, high-pressure experiments. She performs ab-initio calculations and molecular dynamics simulations to investigate deep-water storage and its effects deep within the Earth's interior. ■

Project lead: Wendy R. Panero, The Ohio State University
Research title: Computational mineral physics: Water storage and cycling in the Earth's interior
Funding source: National Science Foundation

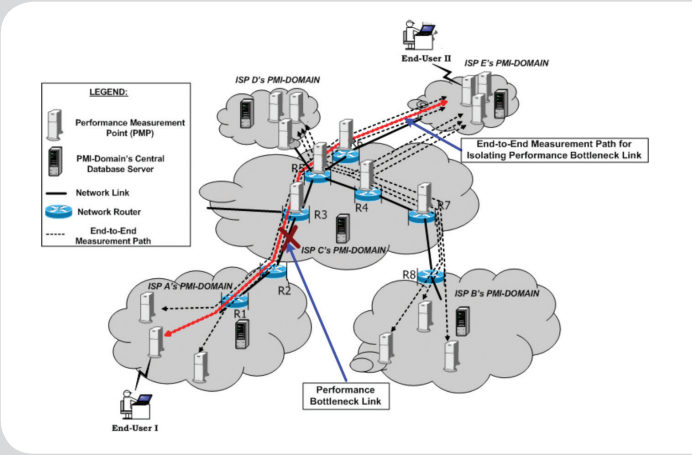
Monitoring advanced network health status

Prasad Calyam, Ph.D., a senior systems developer and engineer for the Ohio Supercomputer Center (OSC) and Ohio Academic Resources Network (OARnet), is devising methods to improve the performance of next-generation computer networks.

"The next generation of networks will be crucial for transmitting the huge amounts of research data generated for and processed by sophisticated applications, for projects such as the Large Hadron Collider, on high performance computers at universities, Department of Energy labs and businesses," said Calyam.

"In this project, we are developing novel research methods to measure and analyze network health status. The research findings are being incorporated to extend the 'ActiveMon' network health monitoring software that was created earlier at OSC/OARnet.

In another project, Calyam and Paul Schopis, director of networking for OARnet, are creating new techniques to measure data traffic on futuristic, global networks, especially for the National Science Foundation's Global Environment for Network Innovations (GENI) project. GENI will allow researchers throughout the country to build and experiment with completely new and different designs and capabilities that will provide the basis for the creation of a 21st century Internet.



above: Multi-Domain PMI System showing End-to-End Measurement Path

"This project will require the integration of software for centralized and distributed orchestration of active data traffic measurements into the on-going efforts of prototype implementation and deployment of the GENI facility," said Calyam. ■

Project lead: Prasad Calyam, Ohio Supercomputer Center/Ohio Academic Resources Network
Research title: Sampling approaches for multi-domain Internet performance measurement infrastructures to better serve network control and management
Funding source: Department of Energy
Research title: OnTimeMeasure: Centralized and distributed measurement orchestration software
Funding source: National Science Foundation, Raytheon BBN