Metadata's Role in a Scientific Archive

pp. 27-34

Judi Thomson, Dan Adams, Paula Cowley, and Kevin Walker

Computational and laboratory experiments generate masses of data that must be stored reliably, with minimal effort on each researcher's part, and must be retrievable for decades. The storage environment must also work seamlessly across scientific disciplines and capture all of a file system's features in a semantically-based catalog that provides Boolean, keyword, and tree-based data access.

The authors describe a metadata-based archive for scientific data that provides flexible archive storage for very large data sets. The system uses metadata to organize and manage the data without imposing predefined metadata formats on scientists.

Energy Management for Commercial Servers

pp. 39-48

Charles Lefurgy, Karthick Rajamani, Freeman Rawson, Wes Felter, Michael Kistler, and Tom W. Keller

Servers—high-end, multiprocessor systems running commercial workloads—have typically included extensive cooling systems and resided in custom-built rooms for high-power delivery. Recently, as transistor density and demand for computing resources have rapidly increased, even these high-end systems face energy-use constraints.

Commercial-server energy management now focuses on conserving power in the memory and microprocessor subsystems. Because their workloads are typically structured as multiple application programs, system-wide approaches are more applicable to multiprocessor environments in commercial servers than techniques that primarily apply to single-application environments, such as those based on compiler optimizations.

Dynamically Tuning Processor Resources with Adaptive Processing

pp. 49-58

David H. Albonesi, Rajeev Balasubramonian, Steven G. Dropsho, Sandhya Dwarkadas, Eby G. Friedman, Michael C. Huang, Volkan Kursun, Grigorios Magklis, Michael L. Scott, Greg Semeraro, Pradip Bose, Alper Buyuktosunoglu, Peter W. Cook, and Stanley E. Schuster

The *adaptive processing* approach improves microprocessor energy efficiency by dynamically tuning major resources during execution to better match varying application needs. This tuning usually involves reducing a resource's size when its full capabilities are not needed, then restoring the disabled portions when they are needed again.

Adaptive processors require few additional transistors. Further, because adaptation occurs only in response to infrequent trigger events, the decision logic can be placed into a low-leakage state until such events occur.

Reducing Disk Power Consumption in Servers with DRPM

pp. 59-66

Sudhanva Gurumurthi, Anand Sivasubramaniam, Mahmut Kandemir, and Hubertus Franke

Although effective techniques exist for tackling disk power for laptops and workstations, applying them in a server environment presents a considerable challenge, especially under stringent performance requirements.

The *dynamic rotations per minute* technique dynamically modulates the hard-disk rotation speed so that the disk can service requests at different RPMs, providing large savings in power consumption with little perturbation in delivered performance.

Leakage Current: Moore's Law Meets Static Power

pp. 68-75

Nam Sung Kim, Todd Austin, David Blaauw, Trevor Mudge, Krisztián Flautner, Jie S. Hu, Mary Jane Irwin, Mahmut Kandemir, and Vijaykrishnan Narayanan

Off-state leakage is *static power*, current that leaks through transistors even when they are turned off. The other source of power dissipation in today's microprocessors, *dynamic power*, arises from the repeated capacitance charge and discharge on the output of the hundreds of millions of gates in today's chips.

Until recently, only dynamic power has been a significant source of power consumption, and Moore's law helped control it. However, power consumption has now become a primary microprocessor design constraint—one that researchers in both industry and academia will struggle to overcome in the next few years.

Battery Modeling for Energy-Aware System Design

pp. 77-87

Ravishankar Rao, Sarma Vrudhula, Daler N. Rakhmatov

Advances in battery technology have not kept pace with rapidly growing energy demands. Most laptops, handheld PCs, and cell phones use batteries that take anywhere from 1.5 to 4 hours to fully charge but can run on this charge for only a few hours.

The battery has thus become a key control parameter in the energy management of portables. To meet the stringent power budget of these devices, researchers have explored various architectural, hardware, software, and system-level optimizations to minimize the energy consumed per useful computation. Research in battery-aware optimization is now moving from stand-alone devices to networks of wireless devices—specifically, ad hoc and distributed sensor networks.