

SYNOPSYS®

DataDirect Networks Storage System
Enables Next-generation Design for
Manufacturing on Synopsys Electronic
Design Automation Tools

www.datadirectnet.com

Challenge

Synopsys needed to improve the storage constraints for the performance of its EDA tools in sub-micron semiconductor manufacturing.

Application

High-performance storage system that enables the faultless performance of one of the industry's leading electronic design automation (EDA) software tools used in semiconductor manufacturing.

Solution

- Improved process time performance by over 150%
- Provided faultless streaming for error-free photomask creation, reducing expensive chip re-spins
- Scales for anticipated increase in CPU cycle demands resulting from increased complexity of EDA tools as process technologies continue to shrink

Synopsys is a world leader in delivering semiconductor design software, intellectual property, design for manufacturing (DFM) solutions and professional services that companies use to design systems-on-chips and electronic systems.

Semiconductor technology has adhered closely to Moore's Law, which postulates a doubling of transistors about every two years, for over four decades. Today's chips pack over a billion transistors into a single integrated circuit, which is manufactured using ever-shrinking process technologies – 65 nanometer features today, with 45nm technology emerging. This growing design complexity has necessitated increasingly sophisticated electronic design automation (EDA) tools. Chip vendors and semiconductor foundries are faced with challenges that threaten their very livelihood: ensuring that these highly complex, submicroscopic layouts are manufacturable and verifying that a device will work before millions of dollars are invested in photomask production and silicon wafer production.

“The engineers using the DataDirect Networks-based system are ecstatic with it, typically seeing a 10 times performance improvement for post layout tools compared to past solutions.”

— Glenn Newell
Senior Staff IT Architect, Synopsys

Synopsys leads the development of powerful DFM software tools that help overcome these challenges. And, when the costs of re-doing a chip during the final phases before production can exceed several million dollars in material costs and lengthened time-to-market, EDA tool vendors like Synopsys must be able to ensure that their tools perform flawlessly in the vital last steps before a design is transferred onto a wafer.

However, the advances in tool capabilities and process technologies have been significantly hampered by the lack of storage systems that can adequately support the massive file sizes and demanding throughput required as chips move from design to manufacturing. A reliable, high-performance storage system is critical in ensuring that a chip design is committed to silicon without expensive errors that can adversely affect chip functionality and reduce yields.

Synopsys operates one of the 500 most powerful high-performance computing (HPC) systems in the world, ranked #242 in 2006 by Top500.org. The massive system is used to verify the company's own licensed semiconductor designs and for quality assurance of their

EDA tools. Despite the mammoth processing power of Synopsys' cluster computer, key processes in the EDA cycle were hitting their limits due to bottlenecks in the storage architecture.

Glenn Newell, Senior Staff IT Architect at Synopsys, explained, “We were up against the wall with our existing NFS-based storage system, and weren't sure how we were going to solve the bottleneck problem for our existing tools, let alone how we were going to scale into the future. Clustered NFS doesn't help if you need to write a single large file at high rates and aren't talking about aggregate performance across the cluster.”

Shrinking Chips Need Smarter Tools

While the initial chip design process results in relatively small data sets, as a design is prepared for manufacturing, it must undergo a series of steps that push the limits for storage systems. Preparing the design file for the creation of photomasks is one of the most data-intensive steps in the process, involving resolution enhancement techniques such as optical proximity correction (OPC), which adds complex polygons to the mask data to compensate for distortions caused during mask-making. OPC is performed on an indexed file, with multiple parallel nodes simultaneously accessing the file and performing calculations on the data at any one time. This incredibly complex and intense mathematical computation inflates individual file sizes from 300GB to more than a terabyte.

Newell explained, “The post OPC processes were creating a huge I/O bottleneck. The best performance we were able to get from our first test configuration was 90MB per second. We knew we had to build a system that could deliver much faster performance to support the types of data I/O generated by OPC and Mask Data Prep. Using DataDirect's storage solution with a high-performance parallel file system knocked down the processing time by 153%. With 64 processors working, the test system was performing reads of more than 250MB per second with writes not far behind.”

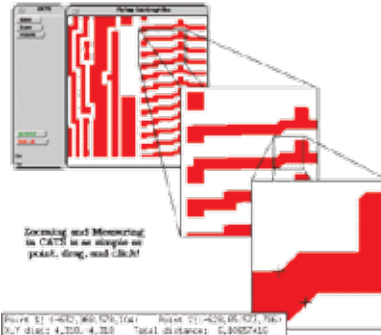
The final step after OPC and prior to mask production uses Synopsys CATS™, one of the most advanced data preparation software applications available for photomask manufacturing. CATS performs a highly I/O intensive distributed process called fracture that translates the chip design file into data that the mask write tool can understand.

www.datadirectnet.com



DataDirect Networks S2A (Silicon Storage Appliance) architecture enables modern data-intensive and streaming applications that rely on high-performance storage. DataDirect's S2A technology solves today's most challenging storage requirements by providing shared, high-speed access to a common pool of data, minimizing data center footprints and storage costs, reducing computational times, and capturing and serving multiple streams of high-bandwidth data.

Once the design data has been fractured, it streams through the mask write tool, much like the process of burning a CD. The reliability and read/write performance of the storage array during this process is critical to avoid errors in mask creation that may result in having to recreate the mask, hugely expensive chip failures, or poor yields.



The Synopsys Optical Proximity Correction process in action.

"CATS relies on an uninterrupted data stream for the mask tool to make accurate masks. Any error or failure in the storage array can result in a mistake that translates into hundreds of thousands of dollars for a new mask, not to mention the lost time to market. The DataDirect storage system delivers hitless performance even if a drive or other failure occurs, reducing this risk." Newell continued, "Plus, the mask-making process is very bandwidth intensive because the file sizes and streaming rates are so large. It's critical to have non-stop, faultless streaming from the disk at very high rates, which the DataDirect solution provides."

DataDirect Networks' S2A Solution

The optimized storage configuration built by Newell and his team features a DataDirect Networks' S2A (Silicon Storage Appliance) solution with 16 terabytes of storage. The storage system interconnects to the compute cluster through an Infiniband-capable switch. Over 50 multi-core processors result in more than 200 cores simultaneously accessing the common storage pool.

"We went through a process of evaluating three different high-performance configurations before choosing DataDirect Networks," explained Newell, "DataDirect Networks' storage solution paired with the Lustre parallel file system has delivered fantastic performance. We've achieved 17 times the storage performance of our first test configuration, and six times the performance of our third setup."

Exhaustive performance tests of the new configuration revealed that less than 30% of the throughput available on the DataDirect S2A system was being used. However, Newell expects continued escalation of performance needs in the coming months, and has ordered an additional 16TB of storage to add to the

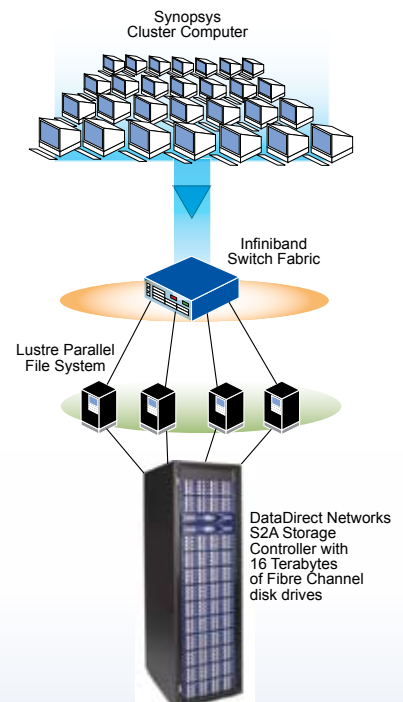
existing DataDirect S2A controller to leverage the remaining performance overhead.

The key factors in Newell's selection of DataDirect's solution were performance, scalability, reliability, and support. According to Newell, "We had some configurations that could meet our current performance requirements, but they couldn't scale to support the type of processing we are going to need in the not-too-distant future. The DataDirect S2A solution had the reliability so critical to us, it's architected to support the linear scaling we need for distributed processing applications like the CATS fracture process, and the DataDirect team was world class in terms of supporting this project."

Future EDA Requirements

As process technologies continue to shrink, the relative CPU cycles required for EDA tools is estimated to grow nearly exponentially in the next five years, continuing to put pressure on the company's storage requirements. Newell points out that as process nodes reduce from 65nm today to 45nm in 2009 he expects CPU cycle requirements to increase by a factor of 10. "But," he continues, "By 2012, that requirement looks like it may increase by a factor of 100. That's much, much faster than processing requirements have grown in the past."

He concludes, "It's not only a matter of having a storage system that can keep up with the performance requirements of our EDA tools, but our ability to scale to meet these increasing CPU requirements over the next decade will be critical to our business."



DataDirect Networks is the leading provider of scalable storage systems for performance and capacity drive applications. DataDirect's S2A (Silicon Storage Appliance) architecture enables modern applications such as video streaming, content delivery, modeling and simulation, backup and archiving, cluster and supercomputing, and real-time collaborative workflows that are driving the explosive demand for storage performance and capacity. DataDirect's S2A technology and solutions solve today's most challenging storage requirements, including providing shared, high-speed access to a common pool of data, minimizing data center footprints and storage costs for massive archives, reducing simulation computational times, and capturing and serving massive amounts of digital content.

Major corporations, supercomputing centers and rich media organizations, including AOL, Ascent Media, Autodesk, Boeing, CNN, Disney, Federal Reserve Board, FedEx, Ford, Hess, Kodak Gallery, Lawrence Livermore National Laboratories, NASA Ames, RIOT, Sandia National Laboratories, Sony, Technicolor, Time Warner, Thomson, Universal, and Veritas DGC, utilize DataDirect Networks high performance, high capacity solutions.

DataDirect
N E T W O R K S
Performance. Capacity. Innovation.

9351 Deering Avenue . Chatsworth . California 91311
phone +1.800.TERABYTE (837.2298) . fax +1.818.700.7601
sales@datadirectnet.com
www.datadirectnet.com