



EDUCATION

DANISH TECHNICAL UNIVERSITY

Sun helps university educate new generations of engineers

HIGHLIGHTS

Danish Technical University is the leading center of engineering education and research in Denmark, and one of Northern Europe's largest technical universities.

Industry/Market

Education

Products/Services

- Sun™ Enterprise™ 6500 server
- Sun Enterprise 4500 servers
- Sun Enterprise 250 servers
- Sun Enterprise 220R servers
- Sun Ray™ 1 and Sun Ray 150 appliances provide access to mathematical applications, Web browsers, office productivity tools, and other applications.

Key Results

- Greatly simplified administration and very low maintenance costs
- Improved performance
- A solution based on open standards that provides interoperability with other systems at the university
- Students benefit from access to reliable, scalable, high-performance servers

Danish Technical University (DTU) is the leading center of engineering education and research in Denmark, and is one of Northern Europe's largest technical universities. DTU offers studies in many engineering disciplines, including chemistry, electronics, mathematics, mechanics, computer science and informatics.

Historically, DTU is known for H.C. Ørsted's studies of electromagnetism and Niels Bohr's pioneering work in nuclear physics. DTU continues this tradition of technical excellence, educating new generations of engineers and researchers. Today, approximately 6,000 students are enrolled in bachelor's and master's degree programs, with an additional 625 students working towards their Ph.D's. The university employs a teaching and research staff of approximately 1,250 and has another 650 employees on its technical and administrative staff.

DTU is committed to providing a first-rate technical education for its students. Leaders at DTU believe that the basic purpose of a research university is to obtain and pass on knowledge. They recognize that technology is an essential component of a superior engineering education, and part of their mission statement outlines their commitment to help ensure that staff and students have access to state-of-the art equipment.

Aging Computer Lab Needs Upgrade

The aging computer lab in the DTU mathematics department was far from state-of-the-art, containing a mix of seven year old HP workstations, servers, and X-terminals with only 66 seats for students. Approximately half of these units were located in auditoriums and used as part of class instruction. The remaining

systems were used by students for class exercises and lab work. Students used standard UNIX®-based applications like Mathematica and MathLab for mathematical analysis, statistics, and other related course work. The mixed X-terminal solution had served DTU's math lab well, but the equipment was old and slow. In addition, technical staff at DTU needed up-to-date software development tools, particularly for Java™ technology. It was time to replace the aging equipment with a new solution.

DTU wanted to continue to provide access to the same applications, while expanding the number of available seats. High performance for running demanding mathematical applications was important, as was high availability that would allow students to complete their assignments on time.

Administrators had low cost and simplified administration as primary requirements of the new solution. They aimed to replace their complicated mix of multiple servers, workstation, and X-terminals with a simpler configuration that required less attention from system administrators. Support for open standards was an additional prerequisite for DTU. Their new solution had to integrate easily into their





Aerial view of Danish Technical University

existing network and interoperate with other servers and workstations currently in use.

A Search for Best Technology, Open Standards, and Low Cost

Henrik Madsen, Professor of Statistics at DTU, played a key role in researching and selecting

the new infrastructure for the mathematics department's computer lab. He describes their decision making process, "First, we simply called in several computer companies and looked at what they could offer and which technology they had."

They quickly ruled out a fat-client PC or workstation solution because of the anticipated overwhelming support costs. According to Madsen, "We have only two or three people to service all of our users. We could not go to a workstation or PC because that would clearly increase our administration cost dramatically. We couldn't afford such a solution."

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Professor of Statistics
Danish Technical
University

Sun Seen as the Leader in Technology

As a prestigious center of engineering education and research, it is imperative to DTU that they provide students with access to leading technology. And DTU viewed Sun as a leader in technology, a company with a vision for the future. DTU was already familiar with Sun's high-performance servers. They appreciated the servers' high levels of reliability, as well as performance and scalability. In addition, they liked the support for Java technology and other software development tools available on the Sun platform. And they were particularly impressed with Sun's new desktop platform — the Sun Ray™ appliance — with its innovative architecture, Hot Desk technology, and use of smart cards.

Sun's ongoing commitment to open standards was also significant to DTU's choice of ven-

dors. Madsen explains, "One of the main reasons for buying from Sun is that we feel that they are among the companies which really represent open standards." He continues, "We want to buy the best computer equipment and the best software solutions. We want to be able to mix it. And we are able to do that with Sun today."

Sun Ray Appliances Chosen As Next Generation Desktop Solution

After reviewing the current technology and available products, DTU determined that Sun Ray appliances were the best choice for their next generation desktop solution. In this innovative design by Sun, all processing occurs on one of the three central servers, with the Sun Ray appliances used only for input and output. Sun Ray appliances require zero administration — all configuration is performed on a centralized server, simplifying administration and eliminating the need to configure each desktop. Administrators gain increased security and greater control over the user environment, because storage and applications remain centralized. Users can easily and securely share desktops — nothing is stored locally on the individual appliances — so there is no danger of changing someone else's environment or corrupting another's files. Users also benefit from the inherent performance and reliability of powerful Sun servers, and they enjoy a more comfortable work environment with the Sun Ray appliances' fanless, noise-free enclosure and sharp, 24-bit color images. Madsen says, "The Sun Ray solution provides an optimal environment for work and study activities since it is compact, makes no noise, and emits very little heat. Many students have expressed that they absolutely prefer working in the Sun Ray appliance labs compared to the Linux/PC labs."

Sun Ray appliances also deliver Sun's innovative Hot Desk technology, which enables users to instantly access their own personal desktop and work-in-progress from anywhere in the workgroup. Smart cards, similar in size to a credit card, can be used to provide secure access to the system and enable easy mobility. Users can withdraw their smart card to stop mid-sentence in an application, and then continue where they left off by simply re-inserting the smart card into any unit in the same workgroup.

Sun Ray Appliances in Danish Technical University

320 Sun Ray 1 and Sun Ray 150 appliances are in use at DTU in computer labs, classrooms, and auditoriums. Two Sun Enterprise™ 250 servers and three Sun Enterprise 220R servers, each configured with two 400 MHz processors and 2 GB of memory, provide service for the desktop appliances. The Sun Ray servers are configured so if one server fails, the Sun Ray users on that server will be transferred to another server automatically. Switched 100 Mbit Ethernet is delivered to each desktop appliance while the servers utilize Gigabit Ethernet connections, providing a high quality of service.

A Sun Enterprise 6500 server, configured with 24 400 MHz processors and 24 GB of memory, and two Sun Enterprise 4500 servers, configured with 12 400 Mhz CPUs and 12 GB memory, are connected to the local area network and operate as compute servers for the Sun Ray appliances. The Sun Enterprise 6500 server also acts as a primary file server, with two Sun StorEdge™ D1000 disk arrays configured with sixteen 18 GB disks.

Auditoriums in the physics and mathematics departments are equipped with the all-in-one Sun Ray 150 model which has the Sun Ray appliance built into a 15" flat panel monitor with a projector port. The appliances are connected to video projector, allowing entire classes to follow along as instructors use advanced applications and software-based demonstrations to reinforce complex topics. Smart cards allow users to take their session with them between classes, laboratories, and auditoriums allowing secure access and increased mobility for students and faculty.

Users at DTU rely on the Sun Ray appliances for a wide variety of applications. Students and other users employ the appliances to access the World Wide Web, running Netscape browsers as well as chat sessions and Internet radio and television applications. For their course work, Forte™ C++ and mathematical applications like Mathematica and Matlab are

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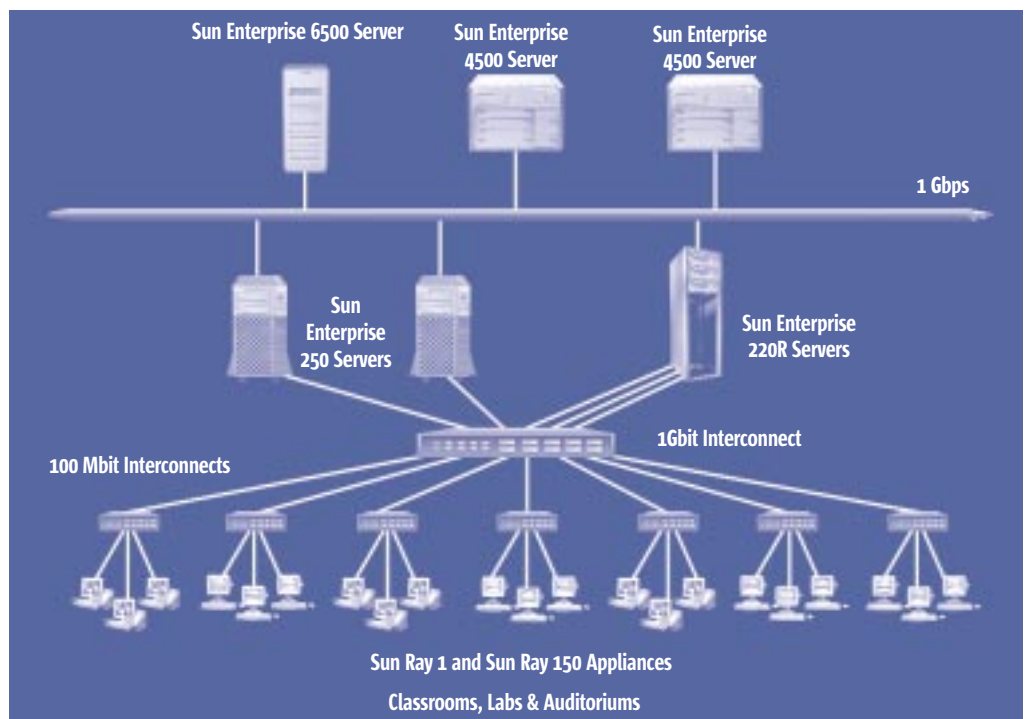
used. Office productivity tools — StarOffice™ software, data warehousing tools — SAS and SPlus, and assorted graphics applications are also accessed with the Sun Ray appliances.

Henrik Madsen
 Professor of Statistics
 Danish Technical University

Network Configuration Details

The private interconnect is implemented using one 12-port 3Com Gigaswitch switch and eleven 24-port stackable 10/100 Mbps switches (3Com SuperStack II Model 3300). The Sun Enterprise 250 and 220R servers connect to the 12-port switch using a Gigabit link. This switch then connects with the 3Com 3300s over a 1 Gigabit link. The Sun Ray appliances access the servers through the 3Com 3300 switches and a 100 Mbit line. Where there are more than 24 Sun Ray appliances in one location, two 3Com 3300 switches are used. The first switch is connected to a second switch at the rear of the switch, called the matrix port, which provides 1 Gbps of inter-switch communication bandwidth and 100 Mbps bandwidth to the desktop.

The Sun Enterprise servers are all connected to the local area network backbone. All other existing servers at DTU are also connected to the backbone, providing Sun Ray appliance users with full access to these servers as well.



High-speed Internet access is also available through the local area network, connecting Sun Ray appliance users to the World Wide Web.

Sun Ray Appliances Provide an Excellent Computer Lab Environment

Sun Ray appliances have successfully fulfilled the needs of DTU. According to Professor Madsen, the new Sun Ray appliances have delivered on their promise and he gives high marks to their very low maintenance costs and easy system administration, high performance, and uptime. DTU had sought an open solution, and they are pleased with the Sun Ray system, citing its flexibility and ability to interoperate well with other systems on the campus.

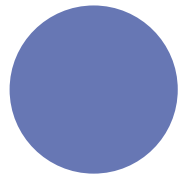
Administrators and teachers aren't the only ones happy with the new arrangements. Users now have better performance for their demanding applications, which run on the high-performance Sun Enterprise servers. Professor Madsen credits the Sun Ray architecture, which leverages the shared resources and the inherent reliability, availability, and scalability of Sun servers to deliver enterprise computing performance to the desktop. In addition to better performance, this architecture allows DTU to more effectively upgrade and scale the performance as needed, by adding more memory or faster CPUs on the centralized servers and having all users automatically benefit at each desktop appliance. Users gain access to powerful, scalable, and reliable servers while the university benefits with economics unmatched by general-purpose desktop platforms.

When asked what advice he could offer his colleagues at other universities, Professor Madsen responds with a strong recommendation for Sun Ray appliances, "I think they should take a look at a system where the administration is very low,

where researchers can spend their time on the research and not on computer maintenance, and where the investment can be protected." He continues, "I'm sure that the future belongs to a system like Sun Ray appliances."

Sun Ray appliances bring leading technology to the desktop at DTU. This highly innovative approach to desktop computing addresses DTU's pressing need for simplified administration and low-cost maintenance without compromising performance. Sun's Hot Desk technology simplifies desktop management by centralizing it at a single location where it can be more easily and economically managed. Because the appliances never require upgrades and they efficiently share expensive resources, the Sun Ray architecture keeps the total cost of ownership low.

DTU has a long history of technical excellence as the leading center of engineering education and research in Denmark. For over fifteen years, Sun has also maintained a history of innovation in computing and networking and technology. Together, DTU and Sun's creative solutions are preparing the next generation of engineering and research leaders.



HEADQUARTERS SUN MICROSYSTEMS, INC., 901 SAN ANTONIO ROAD, PALO ALTO, CA 94303-4900 USA
PHONE: 650 960-1300 FAX: 650 969-9131 INTERNET: www.sun.com



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SALES OFFICES

Africa (North, West and Central): +9714-3366333 • Argentina: +5411-4317-5600 • Australia: +61-2-9844-5000 • Austria: +43-1-60563-0 • Belgium: +32-2-704-8000 • Brazil: +55-11-5187-2100 • Canada: +905-477-6745 • Chile: +56-2-3724500 • Colombia: +571-629-2323
Commonwealth of Independent States: +7-502-935-8411 • Czech Republic: +420-2-3300-9311 • Denmark: +45 4556 5000 • Egypt: +202-570-9442 • Estonia: +372-6-308-900 • Finland: +358-9-525-561 • France: +33-01-30-67-50-00 • Germany: +49-89-46008-0 • Greece: +30-1-618-8111
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