SiliconGraphics
Computer Systems

Onyx at Lockheed

Distributed Interactive Simulation /Visual Simulation

Lockheed's MUSIC: Forty Seats in The Virtual World

Near the south end of San Francisco Bay, beside the runways of Moffett Field, a 40-seat multimedia theater is presenting the sights and sounds of a totally synthetic battlefield. On five six-by-eight-foot projection screens, tanks, planes, and helicopters move on and above authentic Middle Eastern terrain. The scene zeroes in behind a plane; its engine noise matches its speed. The operator shifts the point of view; suddenly we are in the cockpit. It shifts again and we watch it approach us, launch a missile, and veer away.

In this scenario, staged at Lockheed's Mission Utility Simulation Center (MUSIC), data about the identity, position and attitude of the hypothetical aircraft —its longitude, latitude, altitude, pitch, roll, and yaw —are fed from a simulator on a wide-area network to a four-processor Silicon Graphics Onyx™ RealityEngine²™ graphics supercomputer.

Onyx Application Brief Number 1, Volume One

Operator monitors the 3D view of an F-16 in flight

Lockheed's MUSIC presentation room

Onyx responds in real time with graphics of the plane and the terrain beneath it. A SpaceBall® provides six degrees of motion as the viewpoint roams. Five Electrohome ES-9000 projectors display the simulations for the audience.

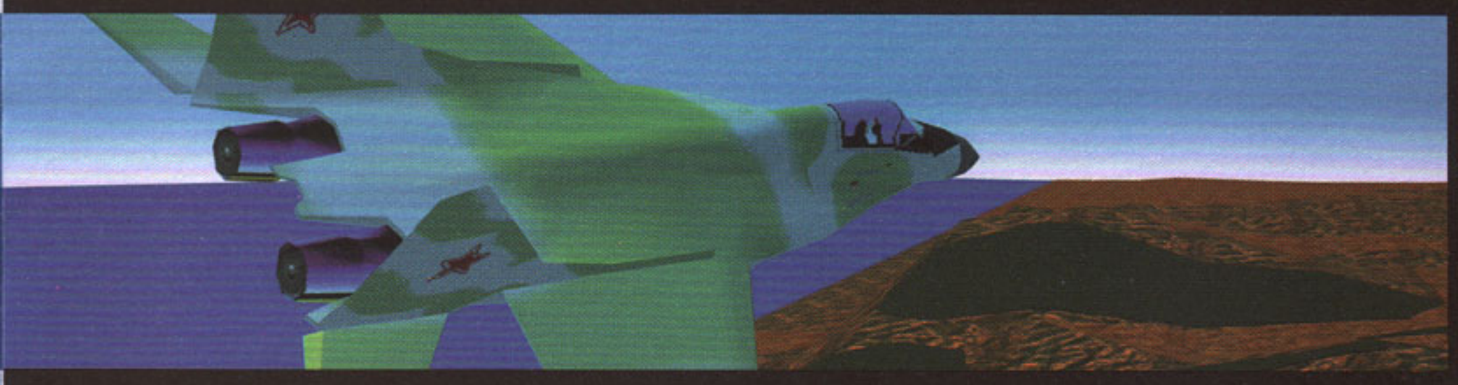
To perform this multi-element, real-time simulation, prodigious graphics capability is required. "We looked at various platforms for real-time graphics," says Geoff Phillips, Manager of Mission Simulations. "To run a system at 30Hz all the time, put in the terrain, and then the models, with freedom to roam, the Onyx was the only one. We ordered a rack-mounted Onyx system with one graphics pipeline and four Raster Managers."

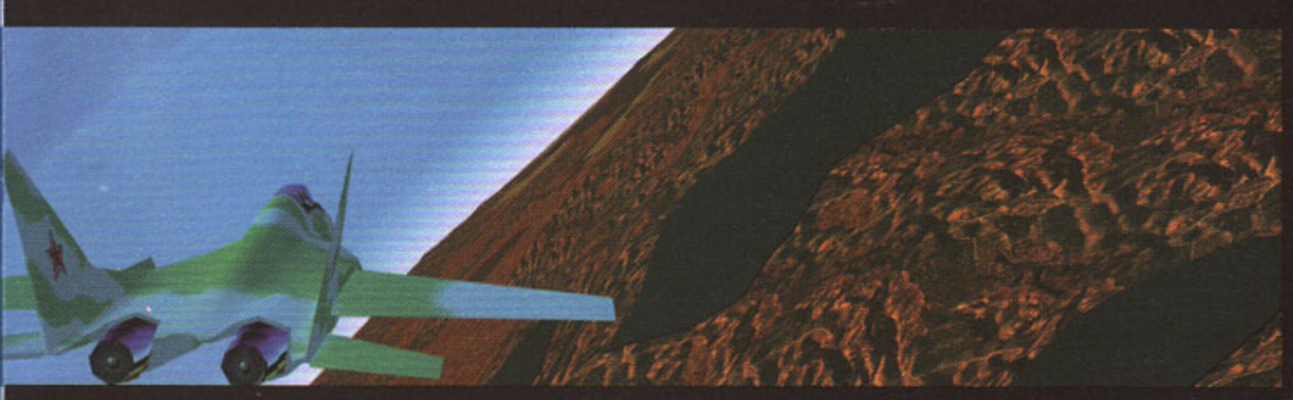
The philosophy behind MUSIC is that the people who buy complex products may not comprehend the physics that make them successful. They do understand performance, however, and Lockheed decided that real-time simulation was the best way to depict performance. Many simulations already existed throughout Lockheed Missiles and Space Company.

"As Lockheed builds programs," says Phillips, " we spend a lot of time building high-fidelity simulators. These simulators explain the physics of the product, how it works, but they don't really show people how the product performs and why it is cost-effective." MUSIC fills this gap by modifying the simulations and putting them in a real-world context.

Onyx, with IRIS Performer™ development software as its run-time application, fits into a MUSIC infrastructure that includes three main elements: the display generation system (Onyx RealityEngine^2 and a LAN), a wide-area network that links simulations stored on other computer systems, and the projection system. All subsystems interact under the IEEE Distributed Interactive Simulation (DIS) standard. "Every simulation out there runs asynchronously and autonomously," says Phillips, "and puts out messages to tell the world what it's doing. In the case of an airplane, the messages are probably sent 10 to 15 times a second to the RealityEngine^2. They say something like 'Hello, I'm an F-16, and here's my latitude, longitude, altitude, pitch, roll, and yaw.'"

MI-24 "Hind" flying over the battlefield



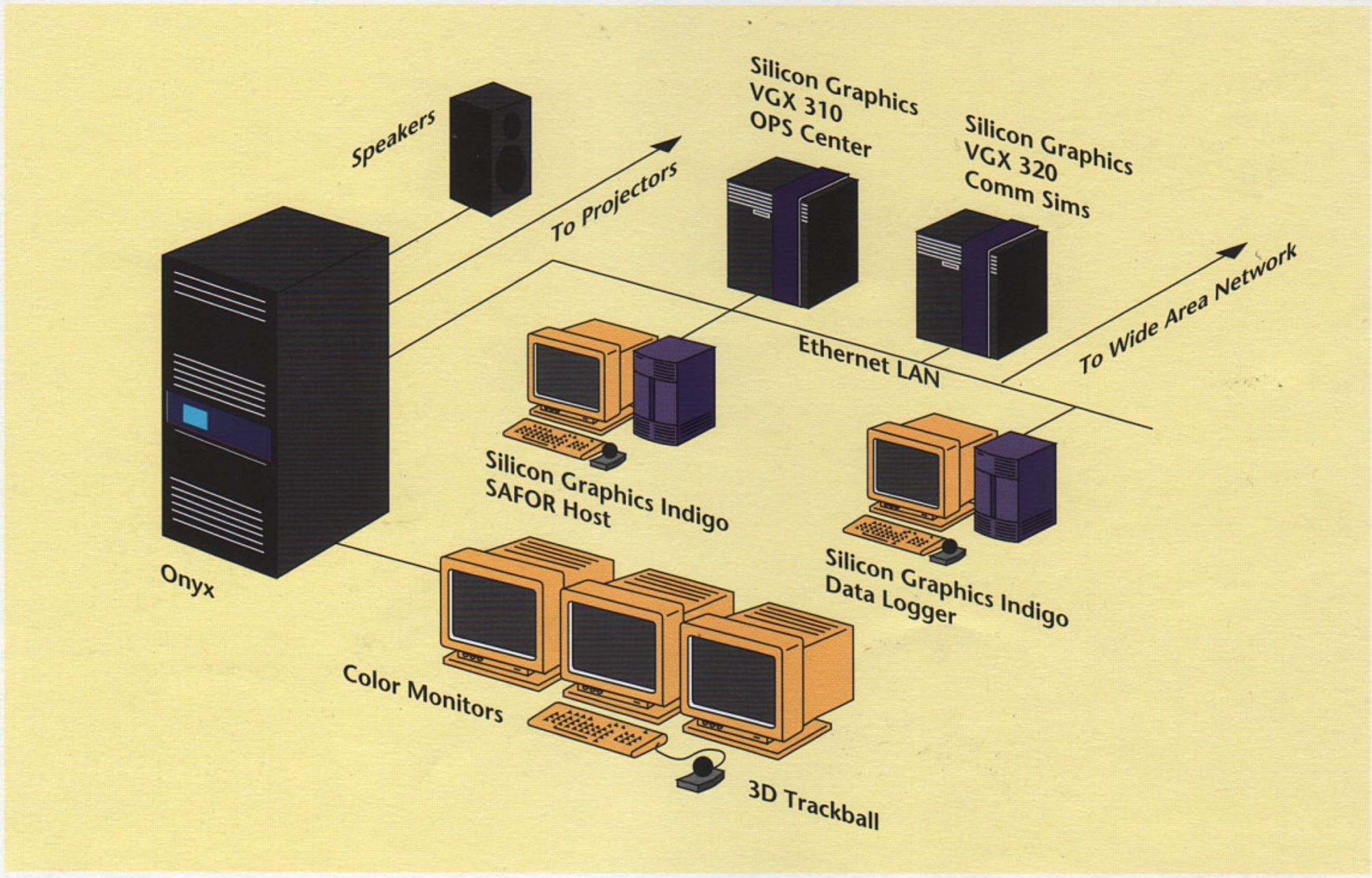


MIG-29 "Fulcrum" in flight

"We have polygonalized real-world terrain in our database. Onyx puts the plane at the right location and orients it correctly for pitch, roll, and yaw. It also calls up the sound table for that aircraft flying at that speed. Onyx delivers all the graphics and audio. It's pretty extreme."

The system stores all the data that is generated to create a specific simulation. That allows Phillips' people to run the simulation forward or backward at up to 10 times real-time speed. In replaying a simulation, the user can select a totally different point of view. A Paradigm AudioWorks™ package connected to the RealityEngine^2 drives a digital sound system (preamp, power amp, four speakers, and a subwoofer) that delivers sound appropriate to the visual model's speed and position. The Center also operates a Silicon Graphics VGX 310™, a VGX 320™, and two Indigo™ workstations.

"Onyx delivers all the graphics and audio. It's pretty extreme."



System configuration

MUSIC has immense graphics resources. The team can draw on some 150 MultiGen® models of operational systems to stage its panoramic simulations. Virtually everything in the U.S. war chest is available —helicopters, tanks, ships, satellites. Since almost all of these simulations predated MUSIC's establishment in March, 1993, most had to be modified or rewritten for the new environment.

Defense Mapping Agency (DMA) data describing virtually every locale in the world is available within the company. MUSIC's MultiGen converter reads the three-dimensional DMA map data into a graphics database of the terrain and its features. MUSIC can display the 2D maps and correlate them to its 3D database. If a plane is visible in the 2D display but not in the 3D version, it means that the plane is behind the user in virtual space. The user can return to the 2D world, click on the plane, and the display will go to the plane's location in the 3D world.

The use of all this hardware, software, and expertise is not restricted to MUSIC's original application. "We started in military applications," says Phillips, "but once you set up this infrastructure, you could just as easily insert terrain from San Francisco and do a disaster relief simulation, as an example. You can then measure how long it would take to clear a road, or how quickly hospital beds fill up. We have talked with a major automobile manufacturer about doing real-world simulations of vehicle performance. We can place their car model in the real terrain of any city and visually simulate all aspects of its performance."

For more information please call
U.S. 1(800) 800-7441
Europe (41) 22-798.75.25
North Pacific (81) 3-5420.71.10

Corporate Office
2011 N. Shoreline Boulevard
Mountain View, CA 94043
(415) 960-1980

SiliconGraphics
Computer Systems

Images courtesy of Lockheed.

APP-BRIEF LOCK (01/94)