Sombrero version 0.003 – Sombrero Distributed SASOS Prototype

Extended Abstract

Sombrero is a research distributed single address space operating system (SASOS) being developed at Arizona State University. It runs native on Alpha 21164-based hardware enabling it to take full advantage of the properties of a single address space. The overall architecture is shown in figure 1. The Sombrero prototype is now 'operational' running simple test programs. Development, execution and debugging are being done on four systems configured like figure 2 by Alan Skousen, Don White, Rossen Tcherepov and Don Miller and also on a fifth set in the ASU Operating Systems laboratory for other students and researchers.

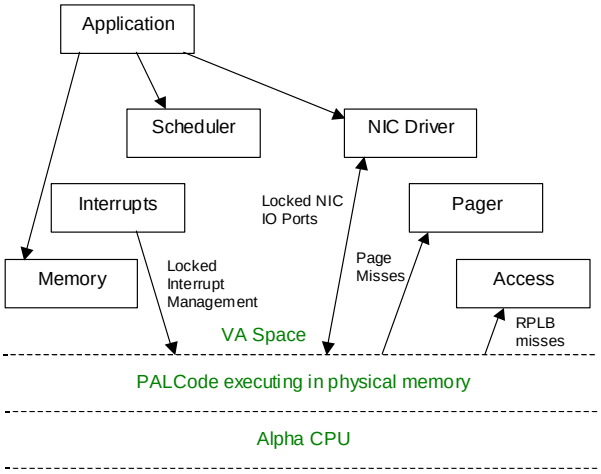

Figure 1: Sombrero Current Architecture

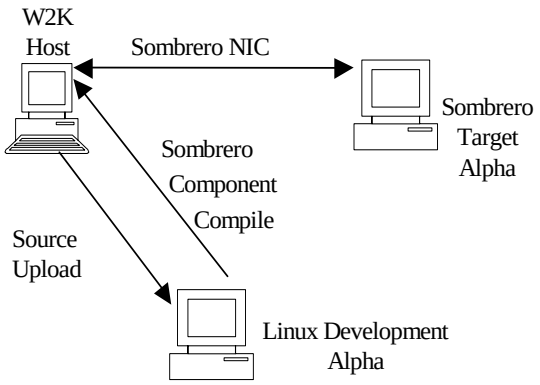

Figure 2: Current Sombrero Development Environment

Major goals of the Sombrero project are to reduce the cost of software development caused by the complexity of application and operating system software and secondly to improve performance. Sombrero, unlike Opal and Mungi does not run on top of a process-oriented operating system (Mach and L4 respectively). All modules including user applications and kernel services exist as instantiated program objects distributed among protection domains. There is no central kernel and no hardware protected kernel mode. Where needed, lock registers name protection domains that can access sensitive protected instructions and registers. Threads have associated 'carrier' protection domains that enable them to carry thread-relevant data from one general protection domain to another, facilitating passive servers and the efficiencies they provide. Sombrero, unlike the IBM iSeries, distributes the single address space across all Sombrero nodes on a network and does not have a large and complex Machine Interface between system and user space. Sombrero currently manages protection domain switching with an emulated protection look-aside buffer. Other features include, entry/return point and tail switch mechanisms to facilitate object linkage and protection domain traversal in the single address space. Additional features that take advantage of single address space properties are globally available user semaphores and locks, thread blocking on interrupts, hardware class objects, object based distributed consistency management, and network addressing based on virtual addresses.

The prototype Sombrero Systems (Figure 2) include a W2K host computer for editing, remote debugging and user interface, an Alpha based Red Hat Linux 7.1 development computer for compiling the Sombrero executable modules, the Boot Loader and PALCode and one or more target Alpha PCs that run Sombrero. Custom tools and services have been developed to run on the W2K host for communication, remote building and debugging, and the GCC compiler process has been augmented to modify intermediate output so that it is suitable for a single address space.

The key pieces we are currently developing include a virtual disk to provide persistence, distributing Sombrero to a second node, designing a java/html/xml-based I/O interface to Sombrero and using Sombrero's recently added hardware class objects to port Sombrero to a slightly different hardware base. When these crucial pieces are in place and debugged we plan to switch hardware bases to more current SASOS-friendly IA64 based systems.

Sombrero's single address space design is ideal for sharing in multi-computer environments and for protection in real-time and embedded environments. Sombrero provides increased system security because its VA-based protection mechanism is naturally resistant to program threats such as stack and buffer overflow. It also provides a platform for hands-on research into single address space operating systems for students and researchers at ASU.

Additional information on Sombrero can be found at http://www.eas.asu.edu/~sasos.