

Multiple operating systems coexist on multiprocessor system

Virtual machine concepts implemented on the series 3000 MICRO-mainframe from Syte Information Technology permit several operating systems to coexist on the same central processor. Likewise, the system disguises its multiprocessor architecture so that it appears as a single processor to these operating systems. Finally, both operating systems and the application programs executing under them can access resources at other nodes of a local area network as if the resources (eg, physical devices or files) were physically attached.

Global environment manager

Devised to offer mainframe processing power in a desktop package, the systems are based on multiple tightly coupled microcomputers organized in a mainframe architecture. Each system can perform the floating point calculations necessary to computer aided engineering or can serve as a general purpose office machine.

At the heart of this sleight of hand is the global environment manager

(GEM). It takes the place of the basic input/output system, event scheduler, file manager, and user interface portions of the operating system so that virtual environments can be created for each executing operating system. The supervisor portion of GEM runs on each processor module (a maximum of four) to handle the low level functions (eg, print drivers, and record access) required of the operating systems running under it.

This supervisor runs in a separate address space (or mode) from the 16-Mbyte logical address space dedicated to each user execution environment. As many as 255 user-execution environments can exist on each processor node. Moreover, each operating system can use several such environments to handle multiple tasks or multiple users, or a user can perform simultaneous tasks on different environments using a single operating system.

In a sense, the supervisor address space is a global address space because it maps all resources available on the network as though it were

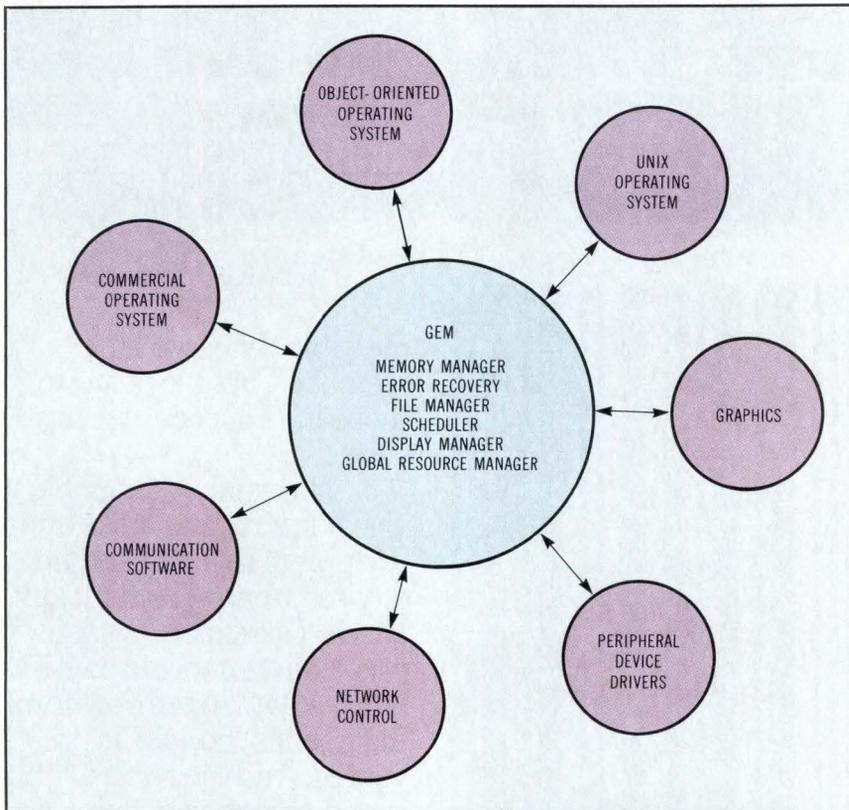
physically attached. GEM's object orientation makes this possible. Physical resources represented as uniquely identified objects include disk drives, graphics displays, and input devices. Objects also represent abstract resources such as directories, files, and executing programs.

Any primitive operations that occur within GEM use defined procedures (or methods) that operate on the data structures associated with these objects. These operations are grouped as classes so that they can operate only on a defined set of objects. For example, floating point operations (or methods) cannot operate on objects containing text files or binary object programs. GEM can be easily modified without adversely affecting the rest of the system since changes in methods affect only its associated objects.

Such encapsulation extends beyond low level functions contained within GEM. Operations such as database management are also divided into subsets based on the functions being performed and the types of data

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The global environment manager (GEM) implements the machine-dependent portions of any operating system (eg, device drivers and file system) executing on the Syte 3000. New operating systems can be added simply by porting over systems calls and message handlers.

required, both in hardware and software. This allows system functions to be physically distributed across the network because the data and procedures needed to manage the resource stay with that resource.

Messages hold one key to making this approach work. Instead of issuing a system call to operate on a resource, a message is sent to the object that represents the resource. The message includes the name of the function and the name of the target object. The sender only needs to know the object's name, not its class or location on the network.

Directories serve as the other key to making GEM work. They are organized into a network-wide hierarchy so that users can refer to a resource by its unique name without knowing its physical location. Directories also serve as the principal means of access control since they also contain such information as user identification, group (a collection of

users), node, and area (a collection of nodes).

Contrasting approach

With this object-oriented approach, the Syte system differs sharply from the time-honored method of implementing concurrently executed operating systems. One approach, favored by Convergent Technologies Inc (Santa Clara, Calif) with its MegaFrame system, calls for multiple operating systems to run their own dedicated processor and memory (see *Computer Design*, July 1983, p 99).

MegaFrame supports Unix on a 68000 microprocessor, while its own CTOS operating system executes in a separate address space on an 80186 processor. The Unix call handler was modified so that messages were routed to CTOS in response to resource requests. In a sense, Unix needed to be taught about inter-processor communications.

On the other hand, the Syte approach executes Unix on the same physical processor as GEM. Unix system calls are issued as if the operating system had full access to a single CPU and associated peripherals. GEM dynamically assigns multiple Syte processing units to execute programs and service requests, independent of the user execution environment (ie, operating system).

The other means of supporting multiple operating systems is to translate the system call of one operating system into the system calls of another. Apollo Computer (Chelmsford, Mass) implements its Aux version of Unix in this manner. Its own operating system, Aegis, takes requests issued from C-shell command interpreters (both the Bourne and Berkeley 4.2 versions) and converts them into the suitable Aegis calls. All compilers, application programs, and utilities exist under Aegis rather than Unix.

The Unix operating systems running under GEM implement the full Bell System V (or soon Berkeley 4.2) specifications with system calls handled in the same manner as if they were issued on a Digital Equipment Corp (Maynard, Mass) VAX-11/780. What GEM replaces is the machine dependent portions of the operating system, such as the device drivers, file manager, and user interface.

Each workstation in the series 3000 is equipped with a NS16000 microprocessor with memory management and floating point capabilities as the main processor, and an 80186 for high speed disk and network processing. Memory can be expanded from 1 to 15 Mbytes, with Ethernet used to access remote data bases through a demand paging technique. The single-unit price for a model 3000 with 1-Mbyte memory and 19-in. 1024 x 800-pixel monochrome display is \$21,900. **Syte Information Technology**, 11339 Sorrento Valley Rd, San Diego, CA 92121.