

PRODUCT OVERVIEW

M E R G E 3 8 6™

MERGE 386TM Product Overview

Merge 386—The Transparent Integration of DOS and UNIX[®]

Locus Computing Corporation has developed a system software product called **Merge 386**, a multitasking, multiuser operating system for the Intel 80386TM processor in which MS-DOSTM and UNIX are integrated into a unified, synergistic computing environment. This exciting new technology, pioneered by Locus for AT&T's 6300+ *Simul-Task*, provides the best of both worlds: the powerful multitasking facilities available in UNIX System V release 3 and the vast library of application software developed for MS-DOS and PC-DOSTM.

Merge 386 provides:

- A *virtual PC environment* in which all MS-DOS and PC-DOS application software runs “off-the-shelf,” without modification.
- Transparent execution of DOS and UNIX programs from either environment.
- Multiple DOS and UNIX processes running concurrently on the same processor in a fully paged, virtual memory environment.
- Support for DOS “ill-behaved” programs that directly access the BIOS or the actual PC hardware both on the system console and on remote terminals.
- Complete support for non-PC AT hardware configurations via an emulated DOS I/O subsystem.
- A high-performance BIOS modified to run in the virtual PC environment while maintaining complete compatibility with the IBM PC AT ROM BIOS.
- A fully integrated file system in which both DOS and UNIX have complete and transparent access to the entire file system. DOS applications even have access to files within a network environment via Remote File Sharing (RFS).
- Interprocess communication between DOS and UNIX programs by use of pipes and I/O redirection.
- The LX-WindowsTM subsystem providing high-resolution windowing into DOS and UNIX.
- Support of other 8086 operating systems
- Extensibility to allow the addition of custom virtual devices.

Merge 386 unleashes the full potential of your 80386-based computer by providing the ideal computing environment. MS-DOS and UNIX are combined to provide a single operating environment under which DOS and UNIX programs run concurrently and transparently. Applications written for either system can execute in the Merge 386 environment without modification or recompilation. In fact, data can be passed between DOS and UNIX programs, providing true cooperation between what were once two distinct and separate worlds.

Merge 386 Technical Overview

Merge 386 is a set of independently implemented operating systems and modules brought together into a single coherent user environment. From the user's point of view, Merge 386 appears as a single operating system on which he can execute the applications that suit his needs. Some of these applications may have been written for the MS-DOS operating system and others for the UNIX operating system. To the user, there need be no distinction between the two. Users can invoke MS-DOS commands from the UNIX interface or UNIX commands from the MS-DOS environment. Merge 386 is truly the transparent integration of MS-DOS and UNIX.

Under Merge 386, DOS can be invoked in the following ways:

- The user can start a separate DOS environment by simply starting DOS as a task from the UNIX shell prompt.
- A DOS command, such as Lotus 1-2-3®, can be invoked directly from the UNIX Bourne shell prompt.
- DOS programs can be exec'd from other UNIX programs such as **make** and **vi**.

At the heart of the Merge 386 system is the *Bridge*; a software driver that accurately and efficiently maps DOS system calls into their UNIX equivalents. This technology was developed and refined by Locus first with its PC-Interface™ product and later with Merge 286™ and AT&T's *Simul-Task*. It is through the Bridge that Merge 386 provides a fully integrated file system in which DOS and UNIX applications have complete access to all files, regardless of the environment in which the file was created. DOS can even access those UNIX files whose names don't fit into the DOS file name format by using a unique file name mapping scheme.

Merge 386 supports virtually all of the application programs written for MS-DOS and PC-DOS, even the "ill-behaved" programs which perform their I/O not by invoking system calls to DOS, but by going directly to the BIOS or PC hardware. To optimize the execution of these applications, a modified ROM BIOS, tuned to improve performance in the Merge 386 environment, has been provided to insure complete compatibility with the IBM PC AT BIOS. Because DOS hardware accesses are emulated in software, special drivers for any PC device can be installed to run in the shared DOS/UNIX environment.

The Locus Merge 386 Architecture

The Intel 80386 processor supports several modes of operation. UNIX is implemented in *protected* mode, the processors "native" 32-bit addressing mode which provides a paged, virtual memory environment. MS-DOS was developed to run on the 8086 which has no concept of memory management; DOS expects to reside at a particular place in memory and can actually directly access segment registers when referencing memory. The Intel 80386 supports what is called the *Virtual-86* mode in which complete and protected "8086 environments" are created for programs that were written to run on the 8086. When running in this mode, instructions and addressing are interpreted by the 80386 in the same way that they were interpreted on the earlier processor. To programs running in this environment, it appears that they have complete and exclusive control of the machine's resources.

The Merge 386 software architecture is based on a standard AT&T System V.3 UNIX port for the Intel 80386 microprocessor. This UNIX system has been enhanced to support the existence of processes that run in Virtual-86 mode. This support consists of code "hooks" that manipulate internal data structures that instruct the processor to change modes under program control, or when interrupts or instruction traps occur.

Merge 386 Virtual Machine Monitor

When a process is executing in Virtual-86 mode, certain instructions are considered "privileged" and cause a trap when they occur. This trap causes control to be passed to a Virtual Machine Monitor (VMM), a module that interprets and emulates all of the privileged instructions that can be executed by a Virtual-86 task. Examples are instructions that let the program enable, disable, or check the state of interrupts, and I/O instructions.

Certain addressing modes also cause a trap into the VMM and must be correctly emulated as well. By properly emulating all these instructions and modes, Merge 386 can run 8086 programs in an environment that appears to them to be an actual 8086.

Merge 386 Virtual I/O Devices

One part of the VMM is the I/O Monitor. This module is responsible for decoding I/O instructions and determining what device the 8086 program is attempting to access. The I/O monitor builds a data structure containing this information and passes it to a module that knows how to emulate that particular device. This module, called a Virtual Port Interface (VPI), emulates all aspects of a set of I/O ports. Each VPI is responsible for the emulation of some type of device in the system. For example, there is an "interrupt controller" VPI, a "COM" VPI, and a "video" VPI. The interface between the I/O Monitor and the VPI modules is well defined and documented, so that additional VPI modules can be written easily and added to the system. This provides a high degree of flexibility in configuring virtual machines into the system. For instance, a serial COM port commonly found on an IBM PC can be emulated in a VPI and

supported on a multi-port serial board or, perhaps, a virtual circuit over a network. Merge 386 defines an interface between the VPI and underlying UNIX device drivers so that a virtual device can be emulated using a completely different physical implementation.

Direct Device Assignment

When a physical device on the 80386 system exactly corresponds to the device that the Virtual-86 program wants to access, Merge 386 can directly assign the device to the Virtual-86 process, and disable the protection trapping for that device. In this case Merge 386 avoids trapping the I/O instruction and achieves even higher performance. This is mostly useful for COM ports and floppy disk access.

Merge 386 Integrated File System

Under Merge 386, the file system is a standard, unmodified UNIX file system. MS-DOS has access to the entire UNIX file system via the Bridge, which intercepts MS-DOS system calls at the INT 21H level thus providing transparency at a very high level. When a DOS application issues a system call to perform file I/O, such as opening a file, the Bridge intercepts the request and conditionally passes it to a module called the Server which runs in 80386 protected mode. The Server issues a system call to the UNIX kernel to open the requested file and passes a file descriptor back to the DOS application via the Bridge. All I/O requests for this file descriptor are now handled by Bridge-Server transactions. In this manner, DOS "sees" the UNIX file system as a DOS file system. The Bridge and the Server are responsible for translating all DOS file I/O system calls, and for translating the results back into DOS conventions. Because the Server effectively runs as the user, UNIX file access permissions are enforced, which provides a high degree of data security. Additionally, Merge 386 provides support for those DOS applications that make use of record locking facilities found in later versions of DOS.

Merge 386 Virtual Screen Handler

Merge 386 offers a choice of user interfaces when using the system console. Locus has developed a graphics-based windowing system called LX-Windows, based on MIT's X-Windows. Using LX-Windows, the user can have multiple concurrent windows into both DOS and UNIX. Alternatively, the user may choose to have multiple terminal "sessions" in which each terminal session occupies the full display screen. Using a "hot key," the user can switch between the various sessions, all of which continue to execute even when not being viewed. The Virtual Screen Handler manages all aspects of the actual terminal input and output while the application continues to write to a screen buffer in virtual memory. All keyboard and mouse input is directed to the currently viewed application.

Multiple DOS/UNIX terminal sessions are also supported on serial terminals,

pushing DOS beyond the “system console only” limitation and making Merge 386 a true multiuser DOS computing environment.

Implementation Challenges

The difficulties and challenges of integrating two completely different operating systems are numerous. To be successful, the integrator must have a thorough understanding of both environments.

Some of the issues encountered in the development of Merge 386 follow:

- There are differences in the way DOS and UNIX allow files to be named. Merge 386 provides a unique name mapping scheme to allow DOS to access UNIX files with incompatible names.
- DOS applications can open an arbitrary number of files without closing any of them. Merge 386 provides transparent virtual file descriptor caching to provide compatibility within the UNIX environment.
- Some DOS applications make use of various undocumented side-effects of DOS system calls. Our experiences in providing DOS and UNIX integration over the past few years have revealed many of these “features” which can only be found by extensive DOS applications use and testing. As these cases were discovered, they were emulated in Merge 386 file service routines, thus allowing those programs to run transparently.
- Performance considerations are vital to the development of an effective solution. Merge 386 employs numerous techniques to minimize the overhead incurred in supporting multiple virtual environments. This includes installing the VMM and VPI modules as drivers in the UNIX kernel to allow fast access between virtual devices and the underlying physical devices. No task switching is performed when privileged instructions are trapped thus minimizing system overhead. In addition, process-scheduling algorithms have been modified to handle DOS programs that poll while waiting for user input.

Locus Computing Corporation: The Obvious Choice

Merge 386 was designed and implemented by *one* company with vast expertise in both UNIX and DOS. In fact, Locus Computing Corporation is the *only* company with experience in integrating DOS and UNIX on a single processor. Our DOS/UNIX integration products boast a current installed base in excess of 100,000. Using this existing, proven technology, system manufacturers can reduce their “time-to-market” with a product that will be right the first time!

Merge 386 Questions and Answers

What is Merge 386?

Merge 386 is a software system that allows an Intel 80386-based microcomputer to run both UNIX and MS-DOS concurrently. Merge 386 users are free to use either UNIX or MS-DOS commands directly from the system prompt.

Will Merge 386 run on any Intel 80386 machine?

Yes. Since Merge 386 is implemented entirely in software, any 80386-based hardware configuration can be supported.

Even non-PC AT compatible hardware?

Yes. Since hardware access from the Virtual-86 environment is emulated in software, drivers can be developed to support custom hardware configurations.

Does Merge 386 do multitasking?

Merge 386 allows the user to run a number of DOS programs while a variety of UNIX programs are also running. The only limitation on the number of DOS programs that can run currently is the ability of the processor to support the load.

Does Merge 386 support multiple DOS users on the same processor?

Yes. The initial release of Merge 386 allows multiple users to run multiple DOS applications both from the system console and from ASCII terminals.

Do all MS-DOS and PC-DOS programs run under Merge 386?

Virtually all of the thousands of MS-DOS and PC-DOS programs run under Merge 386 without modification, from Lotus 1-2-3 to AutoCAD™ to Flight Simulator™.

What versions of MS-DOS and UNIX are compatible with Merge 386?

Merge 386 supports MS-DOS and PC-DOS Versions 3.1 and 3.2 and UNIX System V

Release 3.0.

Is it necessary to partition the hard disk between UNIX and MS-DOS?

No. The Merge 386 operating environment incorporates technology developed by Locus Computing Corporation for its PC-Interface package. PC-Interface provides by far the finest DOS/UNIX integrated file system and has been adopted by a number of OEMs—AT&T Information Systems, Celerity Computing, Motorola, Ridge Computers, Quadra-tron, Sun Microsystems, Texas Instruments, and UniSoft Corporation.

Does Merge 386 support the sharing of programs and data within a network environment?

Yes. Because Merge 386 supports a fully integrated file system whereby DOS can access any file accessible to UNIX, remote file access via the RFS (Remote File Sharing) feature of UNIX System V release 3 is extended to DOS users.

What about performance?

System performance is comparable to a conventional system running either UNIX or MS-DOS alone. DOS and UNIX programs load and execute with approximately the same speed as under conventional Intel 80386 systems. Users operating from an ASCII terminal may notice a decrease in performance due to the terminal line speed.

Will other operating systems besides MS-DOS run under Merge 386?

Any program or operating system designed to run on the 8086 will run under Merge. However, initially only MS-DOS programs will be able to directly access the UNIX file system.

Will Merge be supported in the standard UNIX System V Release 3 implementation which AT&T has contracted to Intel Corporation?

The agreement between Intel and Locus Computing Corporation states that Intel will provide the software and hardware necessary for Locus to complete the Merge effort on the Intel 80386 running UNIX System V Release 3.

What systems will be introduced with the Merge technology?

We anticipate that virtually all UNIX systems using the Intel 80386 processor will support MS-DOS/UNIX integration because of the increased value such a solution provides

to both the MS-DOS-based and the UNIX-based customers. On December 29, 1986, Convergent Technologies became the first system manufacturer to announce the availability of Merge 386 on their Intel 80386-based machines.

Why is Locus Computing Corporation the obvious choice for providing this revolutionary technology?

With the introduction of PC-Interface, AT&T's Simultask, and Merge 286, Locus has established itself as the leader in the DOS and UNIX integration market. Our vast experience in both UNIX and DOS uniquely qualifies us as the one company that can provide a complete, effective solution.

When will Merge on the Intel 80386 be available?

Initial versions of Merge 386 have already been delivered to several systems manufacturers. Fully tested multiuser, multitasking systems will be available Q1 1987.

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