An Overview of Superservers

Editor's Note
As local area networks (LANs) proliferate, the demands placed upon them by users increase. A new class of servers, called superservers, has emerged to meet these increased demands. This report explains the technology upon which superservers are based, profiles 12 vendors that offer machines which can be classified as superservers, and provides comparisons of 20 superservers offered by 9 of those vendors.

Report Highlights
Although LANs have grown from links between a few PCs to vast webs connecting hundreds of machines, none of the devices employed were originally designed to participate in such an interconnection scheme. PCs were conceived as standalone machines; minicomputers and mainframes as the peaks of a hierarchy without peer. As such, these machines have disadvantages making them less than suitable for use as servers in today's networks.

Until recently, these devices were the only tools available to perform the tasks of a server: central storage of data files and programs on disk; connection to shared peripherals; and now, as client/server computing becomes a reality, the more demanding job of performing application requests for client machines.

Several vendors have addressed the need for machines designed from the ground up as servers. These "superservers" speed processing of server requests using mainframe-like I/O bus architectures and multiple processors dedicated to I/O control.

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What Are Superservers?

Servers on local area networks (LANs) have four primary functions.

File Services: They serve to process application and data files which reside on the server but are used by individuals across the network.

Database Services: The database server application distributes a database application across a network so that the client provides a graphical user interface for the user while the compute-intensive tasks are being performed by the database network server. This arrangement is also commonly referred to as client/server computing.

Print Services: Printing can occur across networks. Control of the printing can occur at the server level.

Communications Services: The task of carrying applications and data over the local area network is also provided by the network server.

While network servers provide these tasks, very often these network servers are no more than personal computers, which have become the workhorses for server functions. As users put more applications and data on network servers, the load on them becomes constraining. These personal computers were not originally designed to process the volume of traffic that they are now being asked to handle. As the market pushes further in the direction of an increased load, the hardware manufacturers have responded with processors that are designed to rapidly and efficiently process file, application, and communications services.

The class of machine that has evolved is being called the *superserver*. Its primary distinction from other PC-type servers is its capability to speedily process large amounts of data to and from its hard disks and through its LAN adapters.

Superserver Functions

The superserver market has been broken down by three main server functions which categorize its market focus. They are:

- file servers
- communications servers
- applications servers

File servers generally offer mass storage and shared access to files and applications; network administration services (backup and archive); system administration (user authorization and file security); and peripheral services (printers, scanners, and faxes).

Communications servers support multiple network media (Ethernet, token-ring, FDDI, X.25, and other wide area networks); multiple protocols and operating systems (DECnet, LAN Manager, TCP/IP, AppleShare, NetWare); and electronic mail gateways.

Applications servers support horizontal applications (Database-DBMS/SQL); vertical applications (ECAD, MCAD, CASE, and Scientific); and X Windows applications.

Superservers can be either dedicated file servers, communications servers, or applications servers; or they can perform a mix of functions (i.e., a file server can also be a communications server). When some speak of superservers, they refer specifically to those servers which have been designed to facilitate network traffic—the communications server. Yet with the integration of tasks in some servers, it makes more sense to create this categorization in the manner discussed previously.

Superservers represent a convergence of the mainframe and minicomputer designs of yesterday and the desktop-based processing seen in microcomputers. Superservers look a lot like minicomputers or mainframes—they serve to process the transactions of a host of users, many of whom are now using diskless workstations (the terminal equivalent of yesterday). Processing occurs at the server level (the minicomputer or mainframe computer), and the results are viewed on the user's terminal. In fact, the only real differences between the mainframes and minicomputers of yesterday and today's superservers are size and processing capability. Superservers are smaller and can process more information more rapidly than many minicomputers and mainframes. They also can split the way in which processing is done (some on the client and some on the server).

The companies that have created superservers are the mainframe and minicomputer companies that recognize the trend that is occurring; the microcomputer companies that realize this trend is a natural extension of their product lines; and

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start-up companies that see the market as an opportunity to capitalize on what Forrester Research predicts will be a $12 billion market by 1994.

The key elements of distinction between companies in the superserver market are the following.

Processors: While most superservers use Intel's processors (80386 or 80486, either 25MHz or 33MHz), there are some machines that use Motorola processors. What has been shown repeatedly is that, while on the surface, it looks as if the processor type has a tremendous impact on processing speed, I/O bus structure and adapters have an even greater impact on speed. While RAM and cache size vary on these processors, RAM can inhibit network and application throughput if there is not enough available.

I/O Bus Structure/Architecture: Vendors in this market use the ISA (Industry Standard Architecture), EISA (Extended Industry Standard Architecture), or Micro Channel Architecture or a proprietary bus structure. The bus structure and the types of I/O adapters used have a great impact on network performance.

I/O Adapters: While most of the I/O that occurs is through some type of SCSI device, both the type and number of I/O adapters can have a dramatic effect on the performance of the network. Those companies that have developed either a proprietary bus or I/O adapter can often achieve much greater performance than those using industry-standard buses or adapters.

Operating System: Commonly, superservers support multiple operating system environments such as MS-DOS, OS/2, UNIX, SCO UNIX, SCO Xenix, or SunOS (UNIX). Different operating systems can have an effect on the network performance. The LAN running on top of the operating system can also impact on the network. Differences in 3Com, Banyan, IBM, and Novell LANs can impede or aid the network.

Network Communications: Direct hooks into and out of the LAN and the I/O processor are achieved through network communications. The most popular vehicles to use are Ethernet and token-ring,

which offer network performance that is either 1M or 10M bps (Ethernet) or 4M or 16M bps (token-ring).

Network Administration: To facilitate the use of the network, many superserver companies have designed special network management tools to audit, control, and monitor activities either locally or remotely.

Vendor/Product Line Profiles

Companies that are active in the market are shown here by their origins.

Mainframe/Minicomputer Vendors
- AT&T
- Digital Equipment
- Hewlett-Packard
- IBM
- NCR

Microcomputer Vendors
- Compaq Computer
- Dell Computer

Start-Up Companies
- Apricot Computers
- Auspex
- NetFRAME Systems
- Parallan Computer
- Tricord Systems

In the following paragraphs, we present profiles of the preceding 12 superserver vendors and their superserver product lines.

Apricot Computers

Apricot has three superservers on the market: the Apricot FT 386-25, FT 486, and FT 486-25. The Apricot FT 386-25 uses an Intel 80386DX processor with a clock speed of 25MHz and cache of 32K bytes. It performs at 12 MIPS. The system has an optional 25MHz Intel 80387 DX processor.

The Apricot FT 486 employs an Intel 80486 processor. The processor has a clock speed of 25MHz and 128 Hypercache which is 128-bit-wide

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cache. It performs at 20 MIPS. The Apricot FT
486-25 employs symmetrical dual processing archi-
tecture and uses an Apricot DSPA 486 with an op-
tional second 25MHz Intel 486 processor. Its
performance is 35+ MIPS total system rating.

The Apricot superservers have a standard
VGA display with ports for a mouse and keyboard.
The Advanced System Controller (ASC) monitors
the status of main processors, the standard built-in
UPS, mains and battery supplies, and system ther-
mal sensors and controls access to internals.

The SCSI drive system allows for up to six
SCSI devices—five full-height bays and one half-
height bay. A variety of hard disks and SCSI
backup devices can be placed on the system. The
serial port controller has up to 32 channels per card
with a maximum of 64 channels.

The security system is controlled by a security
processor and an access control device (which is
accessed with an Apricot infrared security card).
The security management software allows for a
maximum of 25 user IDs and has such security fea-
tures as timed logon, audit trail, password history,
screen blanking, and block-level encryption (with a
proprietary algorithm).

Apricot supports a host of operating systems
such as MS-DOS, SCO and Internative UNIX
V/386 3.2, SCO Xenix 2.3, OS/2, NetWare 2.1,
NetWare 386, Pick, DOS, and C-DOS.

AT&T

AT&T offers two systems that can be classified as
superservers—the StarServer S System and the
StarServer E Symmetric Multiprocessor System.
StarServer S is based on the Intel i486 processor
and the EISA bus architecture; it is backward com-
patible with the ISA bus structure. It provides 26.5
MIPS performance and supports three operating
systems: AT&T UNIX System V (Releases 3.2.3
and 4.0), DOS 4.01, and OS/2 1.2 Standard Edi-
tion. It is configured with 8M bytes of memory as a
server and is expandable to 64M bytes of memory.
There are 10 EISA I/O expansion slots.

The StarServer E is expandable from a single
CPU (26.5 MIPS) to a four-CPU Symmetric Multi-
processor System (106 MIPS). It has a fully sym-
metric shared-memory version of the AT&T UNIX
System V operating system. StarServer E includes
12 EISA I/O expansion slots and is configured with
8M bytes of memory, expandable to 512M bytes.

Auspex

Auspex, founded in 1987, has been financed
mainly through its $20.6 million infusion of ven-
ture capital. The management team includes the
founders of Quantum, Adaptec, and Bridge Com-
munications. It views its target market as the net-
work and file access segment of the superserver
market.

The company has two different types of
UNIX servers: the NS3000 and NS5000 series.
Both servers are available with either Motorola or
SPARC-based processors. The NS3000 has a net-
work performance of 570 NFS I/O operations per
second (IOPS), while the NS5000 performs at
1,090 NFS IOPS. The user can get two to four
Ethernet ports on the NS3000 server or two to
eight ports on the NS5000. The IP routing ranges
from 3,000 packets per second (NS3000) to 6,000
packets per second on the NS5000.

Cache memory on both systems ranges from
16M to 96M bytes of primary I/O cache memory.
The disk drives are "hot pluggable," supporting
on-line installation and removal of disks. The
VME backplane supports either an 8-slot (NS3000)
or 14-slot (NS5000) VME backplane. Both systems
are completely compatible with UNIX (SunOS),
ONC/NFS, SNMP, TCP/IP, Ethernet, and VME.

Some of the features specific to both of these
systems include REX, a Remote EXecutive ser-
vice, a remote copy program (RCP), a remote login
program (RLOGIN), electronic mail (SMTP and
UUCP), and a TCP/IP terminal emulation (Tel-
net).

Compaq Computer

Compaq is an example of a microcomputer com-
pany that entered the superserver market as a natu-
ral outgrowth of its own microcomputer business.
Compaq's superserver product line is called the
Systempro. There are fundamentally two different
lines of the Systempro: the 33MHz Intel 80486-
based models and the Intel 80386-based models.
Compaq offers a total of six models (three in each
processor type) with the primary difference be-
tween these models being the size of fixed disk
(240M/420M and 840M bytes).

Compaq calls its architecture for the supers-
erver the Flexible Advanced Systems Architecture
with Multiprocessing Support (Flex/MP). Flex/MP
allows concurrent processing and I/O activity, de-
livering a high level of 32-bit system performance

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while maintaining compatibility with industry-standard hardware and software.

The bus structure is based on EISA, a standard Compaq helped establish. In concert with the Token-Ring Controller, it provides support for Ethernet, Arcnet, and FDDI networking through third party vendors. The Systempro uses an innovative fixed disk drive array technology which creates a faster response time to requests from multiple users. It can manage requests up to four times faster than nonarrayed drive systems.

The tower chassis of the unit provides 11 expansion slots and can accommodate 11 mass storage devices. Features such as drive mirroring, controller duplexing, and data guarding provide enhanced data protection. The Systempro models are positioned as client/server servers that perform a combination of file, applications, and communications services.

Dell Computer

Dell has combined quality products with mail order convenience to claim a top spot in the IBM PC clone market. Like Compaq, Dell sees superservers as a logical extension of its existing product line. The company offers two superserver models—the 25MHz 425TE and the 33MHz 433TE. Both machines are based on the Intel i486 processor.

Both models include 4M bytes of memory, expandable to 64M bytes on the memory board; eight expansion slots accommodating either ISA or EISA adapters; and 11 half-height storage bays for UNIX multiuser systems, workgroup servers, or power workstations.

Digital Equipment

The DEC 433MP is Digital's answer to superservers. While it can function as a network server, Digital also touts it as a multiuser timesharing system, applications/file server, or multiuser workstation for software development.

The system runs SCO UNIX System V/386. It can support more than 100 users. The system supports from one to six CPUs. It supports various networking capabilities including TCP/IP, NFS, DECnet, and PC LAN networking. It can simultaneously run SCO UNIX System V, Xenix, and MS-DOS applications.

The DEC 433MP supports both the ISA and EISA bus structures. It supports from one to six

Intel 80486 processor boards which allow for network expansion. The system has four embedded, high-speed serial I/O ports and a high-performance SCSI port.

Memory may be expanded from 8M to 64M bytes in 4M-byte increments. Its internal storage can expand to 1.2G bytes by using six 209M-byte disks. By using external storage devices, storage can be expanded to 8G bytes. Storage includes a 320M/525M-byte QIC tape drive, a 3.5-inch diskette drive, a 5.25-inch diskette drive, and a CD-ROM.

Hewlett-Packard

Hewlett-Packard's entry in the superserver market is the HP 9000 Series 800 family of business servers. The machines are based on HP's Precision Architecture RISC (PA-RISC), VLSI technology, and the UNIX operating system (HP-UX).

The HP 9000 Series 800 consists of the following models: 822S, 832S, 842S, and 852S, which are the entry-level and midrange members of the family; and the 850S, 855S, 860S, 865S, 870S/100, and 870S/200, which are the high-end members of the family.

The entry-level and midrange models feature performance ranging from 11 MIPS to 52 MIPS, memory ranging from 8M bytes to 256M bytes, and internal disk storage ranging from 335M bytes to 2.68G bytes. The processors reside on a single board; the processor module contains VLSI chips including the CPU, control units for the cache, System Interface Unit (SIU), and Floating-Point Co-Processor (FPC).

The high-end models feature performance ranging from 14 MIPS to 100 MIPS, memory ranging from 48M bytes to 768M bytes, and disk storage ranging from 42.88G bytes to 85.76G bytes. They contain the same single-chip CPU design as the low-end and midrange models.

IBM

IBM sees the convergence of both its microcomputer and minicomputer lines in its line of superservers—the IBM Personal System/2 Model 95 XP 486. While it carries a name similar to many of its personal computers, IBM has clearly distinguished this system as a server. It comes standard with an Intel 80486 processor running at 25MHz. The processor chip is upgradable to a 33MHz chip. The standard memory configuration

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is 8M bytes of main memory, expandable to 32M bytes. The standard 400M-byte SCSI fixed disk has a seek time of 11.5 milliseconds. The PS/2 Model 95 XP 486's data storage is expandable to 2G bytes. The system is equipped with eight 32-bit Micro Channel expansion slots (one is used for the SCSI adapter, and one is used for its XGA Display Adapter). There are seven internal storage device bays which support either a 3.5-inch half-height drive or a 5.25-inch full-height drive.

IBM has placed an enhanced performance XGA display adapter on the PS/2 Model 95 XP 486 that provides a 1,024 by 768 video display resolution. There is one DMA serial port and one DMA parallel port for use with external communications. The system supports a host of other communications through adapter cards which can be added to the system. It supports communications with Ethernet and token-ring networks as well as terminal emulation on an IBM 3270-type device or an IBM midrange 36/38 processor.

In addition to this network support, the PS/2 Model 95 XP 486 can communicate with many of the Rolm data communications modules to interface with this telephone equipment. Storage on the system is augmented by tape backup (ranging from 80M bytes to 2.3G bytes) and a CD-ROM device. A host of printers are supported by the system, including the IBM PagePrinter, LaserPrinter, Quietwriter, and IBM color plotters.

Unlike many IBM systems, the PS/2 Model 95 XP 486 supports a host of operating systems including standard IBM DOS, Versions 3.3 and 4.0; OS/2 Standard and Extended Editions, Versions 1.2 and 1.3; the IBM 4680 Operating System; 3Com 3+Open LAN Manager Advanced System; Banyan VINES/486; Novell's Advanced NetWare 286, SFT NetWare 286, and NetWare 386; and SCO Xenix System V and SCO UNIX System V/386. IBM has also confirmed that this server supports most of the popular third-party products which run under MS-DOS.

NCR

The NCR S486/MC is this minicomputer vendor's superserver entry. It is built on NCR's own understanding of the client/server model and incorporates a 32-bit, 33MHz Intel 80486 processor which

is fully expandable to either a Micro Channel-based server or workstation. The system supports a range of operating systems: MS-DOS, OS/2, UNIX, and NetWare.

Six half-height and three full-height drive bays come with the system. All of the drives can be plugged into a "cableless" SCSI bus board. A single SCSI Host Adapter supports up to seven SCSI devices, which include a CD-ROM, optical disk drive, laser printer, and scanner.

When used as a workstation, the system can run at 27 MIPS and facilitate storage up to 4G bytes internally. The video interface is a super-VGA with 1M byte of RAM and seven MCA expansion slots. All of the S486/MC33's peripherals are based on an Intelligent SCSI RISC processor. The system can be expanded to 64M bytes of 80-nanosecond, 32-bit error detecting and correcting dual-ported memory (EDAC) through the parallel bus with four 16M-byte memory boards.

The S486/MC33 uses interleaved memory, which enhances memory as additional memory is added to the system. Its dual-ported memory improves the access time when multiprocessing by freeing the processor and enabling memory from one side to be used for the peripherals while the CPU uses memory from the other side.

NetFRAME Systems

NetFRAME Systems is an example of a company that was established solely to serve the superserver marketplace. Its product line includes four superservers—the NF100, NF200, NF300, and NF400. Many of the design elements permit interchangeability between systems, as well as upgradability.

The NetFRAME family has its own, unique, multiple independent bus structure that is shared throughout the product line. It uses the same memory architecture as well. The NF100 is referred to as NetFRAME's "entry-level with room to grow" model. It uses a 25MHz Intel 80386 processor. The standard configuration has 8M bytes of error correcting memory, 380M bytes of disk storage, support for remote console software, and NetFRAME's Server Activated Maintenance (SAM) program, which performs the basic server maintenance functions.

One I/O expansion board provides links to SCSI-II, RS-232, RS-422 (SDLC), and Ethernet or token-ring LANs. Maximum main memory is 32M

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bytes, and maximum internal disk storage is 3G bytes. The NF100 can attach to NetFRAME's external storage systems which enable the system to expand to an additional 16G bytes of storage. The system itself can accommodate three expansion processor boards.

The NF200, called "high performance in a compact unit," uses a 25MHz Intel 80486 processor. This server is viewed more as a data processing- or application-based server. The NF200 is equipped with 8M bytes of error-correcting memory, 380M bytes of disk storage, support for remote console software, and Net-FRAME's SAM program. It also has one I/O expansion board. An NF100 can be upgraded to an NF200.

The NF300 is capable of supporting up to five fully loaded Ethernet or token-ring LANs, unlike the NF100 or NF200, which can support only three. It uses a 25MHz Intel 80386 processor and comes with 8M bytes of error-correcting memory, a 380M-byte hard disk, and all other system and administration features found on the other Net-FRAME systems. The system can hold eight expansion processor boards. Disk storage is expandable to 6G bytes internally and 42.6G bytes externally; its maximum memory is 64M bytes. Redundant DC supply modules are an option that ensures further data integrity and system uptime.

The NF400 uses an Intel 80486 processor; its physical characteristics match the NF300, with 16M bytes of error-correcting memory. It can support up to eight fully loaded Ethernet or token-ring LANs.

Parallan Computer
Parallan manufactures a family of superservers intended to serve as platforms for transaction processing, SQL-based database management, and decision support. The servers use a hierarchical bus structure whose central feature is a 64-bit, 200M bps, parity-protected InterProcessor bus that supports the dual Intel 80486 processors. It also supports four banks of shared main memory, a Remote Maintenance processor, and dual-channel SCSI controllers. The server operates such that applications reside on one of the processors while the LAN Manager High Performance File System (32-bit HPFS) and network protocols reside on the other.

The Parallan servers are upwardly compatible and include the Parallan Server 290, Models 10, 20, 50, and 60. The Model 10 has five processors, including one 33MHz 80486 system processor, two RISC SCSI processors, the bit-sliced Intelligent Memory Mover, and the 80C186-based Remote Maintenance Processor (RMP). A 64-bit InterProcessor Bus, 8M bytes of Error Checking and Correcting (ECC) main memory, 676M bytes of hard disk storage, one dual-channel SCSI intelligent disk controller, a Micro Channel bus with eight slots, and Parallan's Maximum Availability and Support Subsystem (MASS) are all a part of the Model 10.

The Model 20 has one additional processor beyond the Model 10, a 33MHz Intel 80486 system processor. It differs from the Model 10 in that it contains 16M bytes of ECC main memory, 1.3G bytes of hard disk storage, a dual-channel SCSI controller, and a dual Micro Channel bus. The Model 50 has eight processors—two 33MHz Intel 80486 system processors, four SCSI processors, the Intelligent Memory Mover, and the 80C186-based RMP. It has the 64-bit IP-bus, 24M bytes of ECC main memory, 5.4G bytes of hard disk storage, two dual-channel SCSI controllers, dual Micro Channel buses with 12 slots, MASS, and one expansion enclosure. The Model 60 is identical to the Model 50 except that it has 32M bytes of main memory, 10.8G bytes of hard disk storage, and three expansion enclosures.

The Maximum Availability and Support Subsystem (MASS) is Parallan's network administration tool. It also enables customer personnel or Parallan support to monitor, control, and tune a Parallan Server 290 remotely. Finally, it gives the system availability for fault-resilient operation.

Tricord Systems
Tricord Systems makes a family of superservers which has been specifically designed to give the client/server application processing power, flexibility, and implementation of popular PC industry operating systems. The PowerFrame Models 30 and 40 use Intel-based 80486 processors. The PowerFrames include Tricord's scalable Common Multiprocessor Architecture (CMA), which allows users to incrementally increase the power, performance, and capacity of their systems.

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The PowerFrame was introduced in mid-1990 and has been designed specifically for networks. The core technology consists of a high-performance memory design, one or two Intel 80486 processors, an EISA bus, a 132M bps Tricord PowerBus, and the Intel 800386-based Intelligent Input/Output Processor (IIOP). Tricord considers the PowerBus and IIOP, both developed by the company, to be the keys to network performance.

Operating systems supported by the PowerFrame are Novell's NetWare, Microsoft's OS/2 and LAN Manager, SCO UNIX, Interactive UNIX, and Banyan VINES. The PowerBus' bandwidth of 132M bps enables both rapid network performance as well as the use of multiple Intel 80486-based processors. It interconnects the 80486 processors, memory, and I/O devices, minimizing contention on the network.

The Intelligent I/O Processor is dedicated to the disk I/O task and enables multiprocessing to occur. It transfers data between memory and disk, which maximizes disk throughput. By performing in this manner, the main CPU can then concentrate on operating system and application tasks. A PowerFrame can support either one or two IIOPs. When it has two, it can support a total storage capacity of 42G bytes on 28 drives. PowerFrame uses an EISA I/O bus for LAN connections. It can transfer data at a maximum rate of 33M bps. This architecture also allows for use with ISA devices.

The Model 30 is a tower configuration optimized for use as a file, communications, or print server. The Model 40 provides greater expandability.

Vendors

Listed here, for your convenience, are the addresses and telephone numbers of the vendors whose superserver product lines are profiled in this report.

Apricot Computers PLC
111 Granton Drive, #401
Richmond Hill, ON, Canada L4B 1L5 (416) 492-2777

AT&T
295 N. Maple Avenue
Basking Ridge, NJ 07920 (908) 221-8694

Auspex
2952 Bunker Hill Lane
Santa Clara, CA 95054 (800) 735-3177

Compaq Computer Corp.
P.O. Box 692000
Houston, TX 77269 (713) 370-0670

Dell Computer Corp.
9505 Arboretum Boulevard
Austin, TX 78759 (512) 338-4400

Digital Equipment Corp.
146 Main Street
Maynard, MA 01754-2571 (508) 493-5111

Hewlett-Packard Co.
19091 Pruneridge Avenue
Cupertino, CA 95014 (800) 752-0900

International Business Machines Corp. (IBM)
Old Orchard Road
Armonk, NY 10504 (914) 764-1900
Contact your local IBM representative.

NCR Corp.
1700 S. Patterson Boulevard
Dayton, OH 45479 (513) 445-5000

NetFRAME Systems Inc.
1545 Barber Lane
Milpitas, CA 95035 (408) 944-0600

Parallan Computer, Inc.
201 Ravendale Drive
Mountain View, CA 94043 (415) 960-0288

Tricord Systems, Inc.
3750 Annapolis Lane
Plymouth, MN 55447 (612) 557-9005

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Table 1. Superserver Product Comparisons

Product	Apricot FT 386-25	Apricot FT 486	Apricot FT 486-25	Auspex NS3000
System Processor	Intel 80386DX	Intel 80486DX	Intel 80486DX	Motorola (NS3000M); SPARC (NS3000S)
Clock Speed (MHz)	25	25	25	Unavailable
Cache Size (bytes)	32K	128K	128K	16M
Main Memory (bytes)	4M/8M/12M/16M	4M/8M/12M/16M	4M/8M/12M/16M	8M (Motorola); 20M (SPARC)
System Architecture	Apricot	Apricot	Apricot: symmetrical dual processing	Auspex
Expansion Bus Architecture	MCA	MCA	MCA	Unavailable
Diskette Drives	5.25 inch, 1.2M bytes	5.25 inch, 1.2M bytes	5.25 inch, 1.2M bytes	None
Fixed Disk Space (bytes)	350M/650M/1050M	350M/650M/1050M	350M/650M/1050M	1G; up to 10G
Tape Drives (bytes)	150M/525M	150M/525M	150M/525M	150M; 1.3G/2.3G streaming cartridge
Expansion	Opt. 25MHz Intel 387DC	Opt. 25MHz Intel 387DC	Opt. 25MHz Intel 387DC	Up to 2 Ethernet processors
Standard Interfaces	1 serial port/1 parallel port; mouse/keyboard ports; 6 SCSI devices	1 serial port/1 parallel port; mouse/keyboard ports; 6 SCSI devices	1 serial port/1 parallel port; mouse/keyboard ports; 6 SCSI devices	5 concurrent SCSI channels; up to 4 tape drives
Operating System Support	SCO UNIX; Interactive UNIX V/386 3.2; SCO Xenix 2.3; OS/2; NetWare 2.1; NetWare 386; Pick; DOC; C-DOS	SCO UNIX; Interactive UNIX V/386 3.2; SCO Xenix 2.3; OS/2; NetWare 2.1; NetWare 386; Pick; DOC; C-DOS	SCO UNIX; Interactive UNIX V/386 3.2; SCO Xenix 2.3; OS/2; NetWare 2.1; NetWare 386; Pick; DOC; C-DOS	SunOS, Version 4; Sun ONC services; Network File System (NFS); Sun NIS Services; VME; UNIX (SunOS)
Communications	Ethernet LAN card; token-ring LAN card	Ethernet LAN card; token-ring LAN card	Ethernet LAN card; token-ring LAN card	TCP/IP; Ethernet/IEEE 802.3; SNMP
Data Transfer Rates	12 MIPS	20 MIPs	35+ MIPs	Unavailable
Features	Designed as network server or UNIX host; Apricot HyperCache system; security management software; built-in UPS; block-level encryption; timed logon, audit trail, password history	Designed as network server or UNIX host; Apricot HyperCache system; security management software; built-in UPS; block-level encryption; timed logon, audit trail, password history; advanced system controller	Designed as network server or UNIX host; Apricot HyperCache system; security management software; built-in UPS; block-level encryption; timed logon, audit trail, password history	570 NFS IOPS; SPARC or Motorola processor; 2-4 Ethernet ports; 3,000 packets per second IP routing; 16M-96M bytes ECC primary I/O cache memory; 1G-10G bytes disk storage; hot-pluggable disk drives; 8-slot 55M bps enhanced VME backplane

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Table 1. Superserver Product Comparisons (Continued)

Product	Auspex NS5000	Compaq Systempro 386	Compaq Systempro 486	Digital DEC 433MP
System Processor	Motorola (NS5000M); SPARC (NS5000S)	Intel 80386	Intel 80486	Intel 80486
Clock Speed (MHz)	Unavailable	33	33	33
Cache Size (bytes)	16M	64K	512K	256K
Main Memory (bytes)	8M (Motorola); 20M (SPARC)	32M (std.); 256M (max.)	32M (std.); 256M (max.)	8M (std.); 64M (max.)
System Architecture	Auspex	Flexible Advanced Systems Architecture	Flexible Advanced Systems Architecture	DEC
Expansion Bus Architecture	Unavailable	EISA	EISA	ISA/EISA upgradable
Diskette Drives	None	3.5 inch, 1.44M bytes; 5.25 inch, 1.2M/360K bytes	3.5 inch, 1.44M bytes; 5.25 inch, 1.2M/360K bytes	3.5 inch, 1.44 M bytes; 5.25 inch, 1.2M bytes
Fixed Disk Space (bytes)	1G; up to 20G	120M/210M/300M/ 320M/650M	120M/210M/300M/ 320M/650M	1.2G (max.); 6M-209M-byte hard disks
Tape Drives (bytes)	150M/1.3G/2.3G streaming cartridge	150M/250M/320M/525M cartridge	150M/250M/320M/525M cartridge	320M/525M QIC
Expansion	Up to 4 Ethernet processors; 20M-68M-byte CPU memory (SPARC)	386 System Processor; 2M/8M/32M-byte memory module	486 System Processor; 2M/8M/32M-byte memory module	1-6 CPUs; opt. CD-ROM
Standard Interfaces	10 concurrent SCSI channels; up to 8 tape drives	11 full-size expansion slots (7 EISA); 4 32-bit processor slots	11 full-size expansion slots (7 EISA); 4 32-bit processor slots	7 ISA/EISA slots; 2 serial ports/1 parallel port
Operating System Support	SunOS, Version 4; Sun ONC servers; Network File System (NFS); VME; UNIX (SunOS)	NetWare 386; NetWare 2.1; SCO UNIX System V; SCO Xenix 386; LAN Manager; VINES 4.0; 3+Open	NetWare 386; NetWare 2.1; SCO UNIX System V; SCO Xenix 386; LAN Manager; VINES 4.0; 3+Open	SCO UNIX System V; DECnet; MS-DOS; X-Windows system host; SCO Xenix
Communications	TCP/IP; Ethernet/IEEE 802.3; SNMP	Token-Ring Controller; Arcnet; FDDI; Ethernet	Token-Ring Controller; Arcnet; FDDI; Ethernet	Ethernet; DECnet; TCP/IP; NFS
Data Transfer Rates	Unavailable	Unavailable	Unavailable	Unavailable
Features	1,090 NFS IOPS; SPARC or Motorola processor; 2-8 Ethernet ports; 6,000 packets per second IP routing; 16M-96M bytes ECC primary I/O cache memory; 1G-20G bytes disk storage; hot-pluggable disk drives; 14-slot 55M bps enhanced VME backplane	Data striping; simultaneous request servicing; parallel data transfers; optimized request management; 32-bit bus master operation; data guarding; drive mirroring; controller duplexing; drive replacement alert system; auto reliability monitoring; automatic data recovery	Data striping; simultaneous request servicing; parallel data transfers; optimized request management; 32-bit bus master operation; data guarding; drive mirroring; controller duplexing; drive replacement alert system; auto reliability monitoring; automatic data recovery	Flexible system architecture; 1-6 CPU expansion; memory expandable to 64M bytes; disk expansion to 9.2G bytes using 18 devices; augments VAX and RISC products

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Table 1. Superserver Product Comparisons (Continued)

Product	IBM PS/2 Model 95 XP 486	NCR S486/MC33	NetFRAME NF100	NetFRAME NF200
System Processor	Intel 80486	Intel 80486	Intel 80386	Intel 80486
Clock Speed (MHz)	33	33	25	25
Cache Size (bytes)	256K	Unavailable	32K	32K
Main Memory (bytes)	8M (std.); 32M (max.)	4M/16M	8M (std.); 32M (max.)	8M (std.); 32M (max.)
System Architecture	IBM	Dual Bus/Interleaved Memory Architecture	NetFRAME	NetFRAME
Expansion Bus Architecture	MCA	MCA	NetFRAME	NetFRAME
Diskette Drives	3.5 inch, 1.44M bytes; 5.25 inch, 1.2M bytes	3.5 inch, 1.44 M bytes; 5.25 inch, 1.2M bytes	None	None
Fixed Disk Space (bytes)	400M; up to 2G internal storage	200M/320M/640M	380M (std.); 3G (max.)	380M (std.); 16G (max.)
Tape Drives (bytes)	80M-2.3G tape backup	200M/320M/525M tape backup	1.3G DAT or 2.2G cartridge	1.3G DAT or 2.2G cartridge
Expansion	33MHz system; 2 32-bit MCA expansion slots	Up to 64M bytes of 80-ns 32-bit memory (EDAC); up to 4G bytes internal	Intel 376 (386SX) processor; 8M/16M bytes main memory	Intel 376 (386SX) processor; 8M/16M bytes main memory
Standard Interfaces	6 32-bit MCA expansion slots; 1 DMA serial port/ 1 DMA parallel port; 7 internal storage bays	7 32-bit MCA expansion slots; 2 serial ports/1 parallel port	1 SCSI-II (5M bps); Intel 80376 processor; 1 Lo-calTalk port/1 serial port	1 SCSI-II (5M bps); Intel 80376 processor; 1 Lo-calTalk port/1 serial port
Operating System Support	OS/2 Extended Edition (OS/2 EE) 1.2/1.3; OS/2 Standard Edition (OS/2 SE) 1.2/1.3; DOS Version 3.3 and 4.0; AIX PS/2 1.2.1; IBM 4680 Operating System Version 2/3; 3+Open; VINES/486; Advanced NetWare 286/386; SCO Xenix/UNIX System V/386	MS-DOS; OS/2; UNIX; NetWare	NetWare 386; LAN Manager; UNIX	NetWare 386; LAN Manager; UNIX
Communications	Ethernet; Asynchronous; X.25; token-ring	Unavailable	RS-232; OSI; TCP/IP; Ethernet; SNA/SDLC; XNS; token-ring; Local-Talk (RS-422)	RS-232; OSI; TCP/IP; Ethernet; SNA/SDLC; XNS; token-ring; Local-Talk (RS-422)
Data Transfer Rates	Unavailable	7 MIPS	3M bps	3M bps
Features	Enhanced XGA display providing 1024 x 768 resolution; PS/2 SCSI 32-bit bus master; 400M-byte SCSI fixed disk with 11.5-ms seek time; 8 32-bit MCA expansion slots (1 for SCSI and 1 for XGA display adapter); security, audit, and control features	Super VGA video interface (800 x 600); high-performance SCSI II, implemented closely coupled I/O processor; configurable keylock and software password; auto switching international 385-watt power supply; Weitek 4167 Arithmetic Coprocessor	Parity checking on all data paths; error correcting memory; power module redundancy; automatic restart/retry; supports NetFRAME network management and administrative tools (SAM and RCON); remote administration from any 286/386 on network	Parity checking on all data paths; error correcting memory; power module redundancy; automatic restart/retry; supports NetFRAME network management and administrative tools (SAM and RCON); remote administration from any 286/386 on network

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Table 1. Superserver Product Comparisons (Continued)

Product	NetFRAME NF300	NetFRAME NF400	Parallan Server 290 Model 10	Parallan Server 290 Model 20
System Processor	Intel 80386	Intel 80486	Intel 80486	Dual Intel 80486
Clock Speed (MHz)	25	25	33	33
Cache Size (bytes)	32K	32K	128K	128K x 2
Main Memory (bytes)	8M (std.); 64M (max.)	16M (std.); 64M (max.)	8M (std.); 128M (max.)	16M (std.); 128M (max.)
System Architecture	NetFRAME	NetFRAME	Parallan	Parallan
Expansion Bus Architecture	NetFRAME	NetFRAME	MCA	MCA
Diskette Drives	None	None	3.5 inch, 1.44M bytes	3.5 inch, 1.44M bytes
Fixed Disk Space (bytes)	380M (std.); 6G (max.)	380M (std.); 6G (max.)	676M x 2 (std.); 18.9G (max.)	676M x 2 (std.); 18.9G (max.)
Tape Drives (bytes)	1.3G DAT or 2.2G cartridge	1.3G DAT or 2.2G cartridge	1.2G DAT	1.2G DAT
Expansion	Intel 376 (386SX) processor; 8M/16M-byte main memory	Intel 376 (386SX) processor; 8M/16M-byte main memory	12 MCA slots (1 EVGA); 8M/32M-byte incremental memory	12 MCA slots (1 EVGA); 8M/32M-byte incremental memory
Standard Interfaces	1 SCSI-II (5M bps); Intel 80376 processor; 1 LocalTalk port/1 serial port	1 SCSI-II (5M bps); Intel 80376 processor; 1 LocalTalk port/1 serial port	8 MCA slots (1 EVGA); up to 4 SCSI buses and controllers	8 MCA slots (1 EVGA); up to 4 SCSI buses and controllers
Operating System Support	NetWare 386; LAN Manager; UNIX	NetWare 386; LAN Manager; UNIX	Parallan-enhanced OS/2 1.21; client workstation support for DOS, Windows, OS/2	Parallan-enhanced OS/2 1.21; client workstation support for DOS, Windows, OS/2
Communications	RS-232; OSI; TCP/IP; Ethernet; SNA/SDLC; XNS; token-ring; LocalTalk (RS-422)	RS-232; OSI; TCP/IP; Ethernet; SNA/SDLC; XNS; token-ring; LocalTalk (RS-422)	32-bit bus master; 16-bit Ethernet; token-ring; SNA/SAA	32-bit bus master; 16-bit Ethernet; token-ring; SNA/SAA
Data Transfer Rates	7M bps	8M bps	Up to 70 MIPS	Up to 70 MIPS
Features	Parity checking on all data paths; error correcting memory; power module redundancy; automatic restart/retry; supports NetFRAME network management and administrative tools (SAM and RCON)	Parity checking on all data paths; error correcting memory; power module redundancy; automatic restart/retry; supports NetFRAME network management and administrative tools (SAM and RCON)	Maximum availability and support subsystem; LAN Manager multiprocessing extensions; opt. LAN Manager 2.0	Maximum availability and support subsystem; LAN Manager multiprocessing extensions; opt. LAN Manager 2.0

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Table 1. Superserver Product Comparisons (Continued)

Product	Parallan Server 290 Model 50	Parallan Server 290 Model 60	Tricord PowerFrame 30	Tricord PowerFrame 40
System Processor	Dual Intel 80486	Dual Intel 80486	1-2 Intel 80386	1-2 Intel 80386
Clock Speed (MHz)	33	33	25/33	25/33
Cache Size (bytes)	128K x 2	128K x 2	256K	256K
Main Memory (bytes)	24M (std.); 128M (max.)	32M (std.); 128M (max.)	8M (std.); 128M (max.)	8M (std.); 128M (max.)
System Architecture	Parallan	Parallan	Tricord Multiprocessor	Tricord Multiprocessor
Expansion Bus Architecture	MCA	MCA	EISA	EISA
Diskette Drives	3.5 inch, 1.44M bytes	3.5 inch, 1.44M bytes	3.5 inch, 1.44M bytes	3.5 inch, 1.44M bytes
Fixed Disk Space (bytes)	676M x 8 (std.); over 30G (max.)	676M x 16 (std.); over 30G (max.)	385M	385M
Tape Drives (bytes)	1.2G DAT	1.2G DAT	2.3G helical scan SCSI	2.3G helical scan SCSI
Expansion	12 MCA slots (1 EVGA); 8M/32M-byte incremental memory	12 MCA slots (1 EVGA); 8M/32M-byte incremental memory	EISA bus upgradable to IIOP	8M-byte memory module
Standard Interfaces	8 MCA slots (1 EVGA); up to 4 SCSI buses and controllers	8 MCA slots (1 EVGA); up to 4 SCSI buses and controlelrs	EISA SCSI controller or IIOP; 5-slot PowerBus; 7 EISA slots; 1 parallel port/2 serial ports	EISA bus with IIOP; 5-slot PowerBus; 7 EISA slots; 1 parallel port/2 serial ports
Operating System Support	Parallan-enhanced OS/2 1.21; client workstation support for DOS, Windows, OS/2	Parallan-enhanced OS/2 1.21; client workstation support for DOS, Windows, OS/2	NetWare 386; OS/2; SCO UNIX; VINES; Interactive UNIX	NetWare 386; OS/2; SCO UNIX; VINES; Interactive UNIX
Communications	32-bit bus master; 16-bit Ethernet; token-ring; SNA/SAA	32-bit bus master; 16-bit Ethernet; token-ring; SNA/SAA	Ethernet; token-ring; TCP/IP	Ethernet; token-ring; TCP/IP
Data Transfer Rates	Up to 70 MIPS	Up to 70 MIPS	33M bps	33M bps
Features	Maximum availability and support subsystem; LAN Manager multiprocessing extensions; opt. LAN Manager 2.0	Maximum availability and support subsystem; LAN Manager multiprocessing extensions; opt. LAN Manager 2.0	Virtual memory; coherent cache with zero wait state design; Fast Page Mode main memory for burst-mode transfers; scalable architecture allowing for incremental increases in power, performance, and capacity; data integrity provided by PowerFrame IIOP; open architecture	Virtual memory; coherent cache with zero wait state design; Fast Page Mode main memory for burst-mode transfers; scalable architecture allowing for incremental increases in power, performance, and capacity; data integrity provided by PowerFrame IIOP; open architecture

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