Air-cooled CRAY T3E systems

Scalable power that works

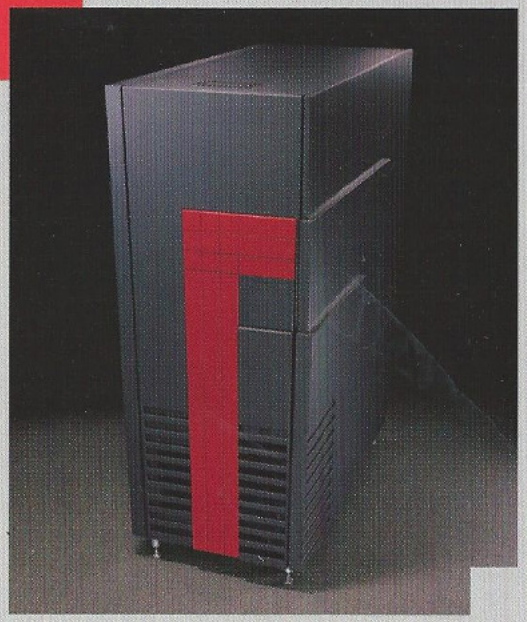
The CRAY T3E series of scalable parallel systems is the most powerful and flexible in the world. Across a wide range of air- and liquid-cooled configurations from 16 to 2048 processors with corresponding peak performance levels from 9.6 GFLOPS to 1.2 TFLOPS and prices from under $1 million, CRAY T3E systems deliver unmatched scalable performance and price/performance.

The power and flexibility of this new generation come from global system scalability—scalable performance based on the world's fastest microprocessor and the industry's best interprocessor communications, the world's first scalable operating system, and scalable I/O. In any configuration, every function and feature contributes to balanced scalable performance. Every price point offers tremendous room for growth with a corresponding payback in performance, throughput, and productivity.

CRAY T3E scalable parallel systems use the DECchip 21164 (DEC Alpha EV5) from Digital Equipment Corporation, capable of 600 MFLOPS peak performance. Each CRAY T3E processing element (PE) has its own local DRAM memory with a capacity of from 64 Mbytes to 2 Gbytes. A shared, high-performance, globally addressable memory subsystem makes these memories accessible to every PE in a CRAY T3E system.

To support the scalability of the CRAY T3E system, we created UNICOS/mk, a scalable version of our UNICOS operating system. UNICOS/mk is divided into "servers," which are distributed among the processors of a CRAY T3E system. Local servers process operating system requests specific to each user PE, while global servers provide systemwide operating system capabilities. The result is the world's first scalable operating system. This distribution of functions provides a global view of the computing environment—a single-system image—that allows administrators to manage a systemwide suite of resources as a single entity.

Breakthrough I/O technology sets new standards for I/O scalability, performance, capacity,



Performance
- ❑ 16 to 128 processing elements
- ❑ 9.6 to 76.8 GFLOPS peak performance
- ❑ Up to 256 Gbytes of globally addressable memory, with 2 Gbytes per PE memory option
- ❑ High-performance interconnect/3-D torus
- ❑ High-bandwidth, scalable I/O, up to 16 Gbytes/s

User productivity—complete, easy-to-use programming environment
- ❑ UNICOS/mk serverized, microkernel-based operating system
- ❑ Scalable, distributed functionality
- ❑ Standard, open UNIX operating environment
- ❑ Systemwide suite of resources managed as single entity
- ❑ CRAY CF90 programming environment
- ❑ CRAFT and HPF programming models
- ❑ CRAY C++ programming environment, including C
- ❑ Highly optimized Cray Message Passing Toolkit
  - • PVM
  - • MPI
- ❑ Optimized scientific libraries
- ❑ Cray TotalView Debugger
- ❑ Advanced performance analysis tools
- ❑ Visual program browser
- ❑ Automatic data conversion (CRAY, IBM, CDC)
- ❑ Message passing to support development of scalable heterogeneous applications

Production capabilities
- ❑ Dynamic scheduling of batch and interactive processes
- ❑ Large job processing
- ❑ Efficient parallel processing
- ❑ Full connectivity to UNIX (TCP/IP) and proprietary networks
- ❑ Security features (MLS, Kerberos, RIPSO, CIPSO)
- ❑ Extensive accounting and resource management facilities
- ❑ Network Queuing Environment
- ❑ Automated hierarchical storage manager
  - • Data Migration Facility (DMF)
- ❑ Tape volume management system
- ❑ Online tape support
- ❑ STK support
- ❑ Disk striping

and configurability. The CRAY T3E system performs I/O through multiple ports onto one or more scalable GigaRing channels. Each dual-ring I/O channel, with data in the two rings traveling in opposite directions, delivers high I/O data bandwidth and enhances reliability. Air-cooled CRAY T3E systems may be configured with an I/O channel for every eight PEs. All I/O channels are accessible and controllable from all PEs. On the CRAY T3E system, each GigaRing channel has a maximum data payload bandwidth of 1 Gbyte/s and provides high-speed access to peripherals, networks, and other Cray Research systems.

Air-cooled CRAY T3E scalable parallel systems are designed to provide scalable performance and price/performance at a low cost of ownership. They are available in sizes from 16 to 128 processors with peak performance levels up to 76.8 GFLOPS. These systems are ideal for industrial production and for budget-conscious organizations and departments with technical applications in scientific and engineering R&D.

Air-cooled CRAY T3E systems use standard 50/60 Hz power and do not require a computer room environment or special power or cooling arrangements. They are easy to install, operate, and maintain, and they are fully compatible with larger, liquid-cooled CRAY T3E systems. CRAY T3E air-cooled systems are easily upgraded, in increments of four PEs.

As an option, CRAY T3E systems may be coupled closely to the parallel vector architecture of industry-leading CRAY T90 or CRAY J90 systems in a scalable heterogeneous system. This capability provides maximum flexibility to meet the needs of individual user workloads. Customers can choose from a wide variety of system solutions with different mixes of parallel vector and scalable parallel computational capabilities—an offering unique to Cray Research.

Air-cooled CRAY T3E system specifications

CRAY T3E system	
Peak performance	9.6 - 76.8 GFLOPS
Architecture	Multiple instruction multiple data (MIMD) with hardware support for single instruction multiple data (SIMD) processing
Processing Elements (PEs)	
Microprocessor	DECchip 21164 64-bit super-scalar RISC Four-way instruction issue with two floating-point operations per clock 32-bit and 64-bit IEEE floating-point arithmetic
Local memory per PE	64, 128, 256, or 512 Mbytes or 1 Gbyte or 2 Gbytes
Data error protection	SECDED
Clock speed	300 MHz
Peak performance per PE	600 MFLOPS
Peak memory bandwidth	1.2 Gbytes/s
Packaging	4 PEs per module
PEs per system	16 (single cabinet) and 32 to 128 (multi-cabinet) in increments of 4 PEs Additional support PEs are provided for operating system use and to provide resiliency
Memory	
Technology	16-Mbit or 64-Mbit DRAM
Architecture	Shared, physically distributed, globally addressable
Total system memory	0.64 - 256 Gbytes
Interconnect network	
Topology	3-D torus
Data payload bisection bandwidth (128 PEs)	32 Gbytes/s
I/O	1 I/O channel available for every 8 PEs
Peak I/O bandwidth	1 Gbyte/s per channel
Physical characteristics	
Cabinet footprint area	AC16: 10.6 ft^2 (1 m^2); AC128: 63.6 ft^2 (6 m^2)

Air-cooled CRAY T3E system configurations

Model[1]	Cabinets	User PEs	Base Memory[2] (Gbytes)	Peak Performance (GFLOPS)	Maximum I/O Channels	I/O Bandwidth
Single cabinet						
AC16	1	16	2.0	9.6	2	2 Gbytes/s
Multi-cabinet						
AC32	2	32	4	19.2	4	4 Gbytes/s
AC64	3	64	8	38.4	8	8 Gbytes/s
AC80	4	80	10	48	10	10 Gbytes/s
AC128	6	128	16	76.8	16	16 Gbytes/s

1. Table shows the most popular sizes of AC models only.
2. Base model configuration includes 128 Mbytes of memory per PE. Optional memory sizes of 64, 256, or 512 Mbytes or 1 or 2 Gbytes per PE available.

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