CRAY EL92 and CRAY EL94 Systems Overview

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Introduction

The EL92 and EL94 entry-level mainframes are cost-effective deskside systems designed to provide mainframe supercomputing compatibility within an office environment. Refer to Figure 1 for an illustration of the system.

These deskside supercomputers include the same UNICOS operating system, programming environments, compilers, and networking capabilities as larger Cray Research systems. The EL92's and EL94's provide a source-compatible application development platform for CRAY Y-MP, CRAY C90, and CRAY T3D computer systems. Because of their adherence to industry standards, the EL92's and EL94's can also operate compatibly with non-Cray Research systems in a heterogeneous computer network. The EL92's and EL94's use the same technology as the CRAY Y-MP EL and CRAY EL98 entry-level supercomputers and are available in several different hardware configurations. All EL92's and EL94's are air cooled and require either 100-to-120 Vac or 200-to-240 Vac power.

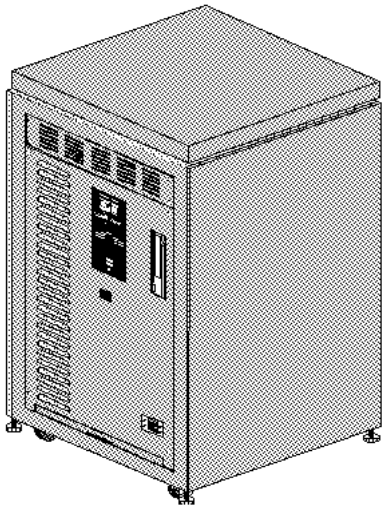

Figure 1. Mainframe Chassis

Hardware Configurations and Layout

EL92's and EL94's are available in four hardware configurations or models. The type of backplane determines the maximum number of processors and amount of main memory in the system. The two backplane options are 1 x 1 or 2 x 2, where the first number indicates the maximum number of CPU modules and the second number indicates the maximum number of memory modules. Refer to Table 1 and Table 2.

Table 1. EL92 Configurations

Model	Backplane	CPUs	Memory Size	DiskCapacity	HIPPI	Power
100	1 x 1	1	256 (32 Mwords)	6 Gbytes	N/A	100 – 120 Vac †
200	1 x 1	1	256 (32 Mwords)	21 Gbytes	1	200 – 240 Vac
300	2 x 2	1	512 (64 Mwords)	21 Gbytes	1	200 – 240 Vac
400	2 x 2	2	512 (64 Mwords)	21 Gbytes	2	200 – 240 Vac

† Model 100 can use either 100-to-120 Vac or 200-to-240 Vac.

Table 2. EL94 Configurations

Model	Type	CPUs	Memory Size	DiskCapacity	HIPPI	Power
150	1 x 1	2	256 (32 Mwords)	6 Gbytes	N/A	100 – 120 Vac †
250	1 x 1	2	256 (32 Mwords)	21 Gbytes	1	200 – 240 Vac
350	2 x 2	2	512 (64 Mwords)	21 Gbytes	1	200 – 240 Vac
450	2 x 2	4	512 (64 Mwords)	21 Gbytes	2	200 – 240 Vac

† Model 150 can use either 100-to-120 Vac or 200-to-240 Vac.

The EL92 model 100 and EL94 model 150, each with one CPU module and one memory module, have reduced disk capacity but are capable of using standard 110 Vac power; all the other models require 220 Vac. Models 200 and 250 have extended disk capacity, and customers can configure models 200 and 250 with a High Performance Parallel Interface (HIPPI). Models 300 and 350 have two memory modules and twice the memory capacity of models 200 and 250. Models 400 and 450 include an additional CPU module and another optional HIPPI channel.

All configurations include the following standard equipment:

- VMEbus input/output subsystem (IOS)
- IOS disk drive
- Tape drive
- Ethernet controller
- System console
- High-performance modem

The chassis houses the self-contained computer system, which consists of CPU and memory modules, an IOS with peripheral devices, and system power supplies. Figure 2 shows the front of the system with the front panel removed. The control panel, tape drive, system disk drives, and incoming AC power circuit breaker are located at the front of the chassis.

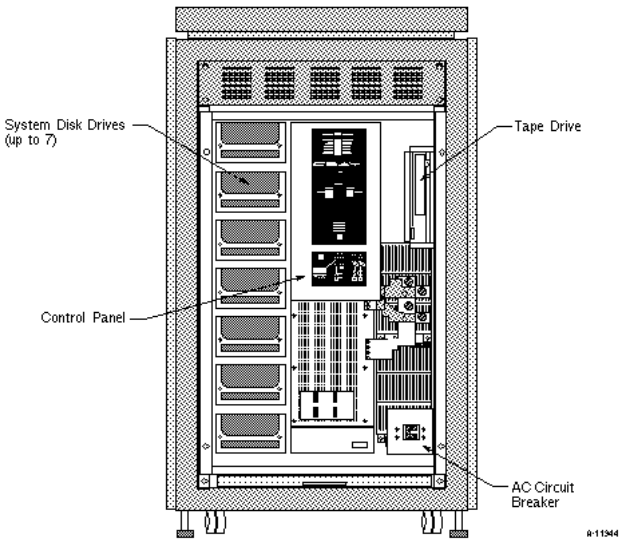

Figure 2. System Components (Front View)

Figure 3 shows the back of the system with the back panel removed. The I/O bulkhead, IOS, and IOS disk drive are located at the back of the chassis. The CPU modules, memory modules, and power supplies can also be accessed from the back.

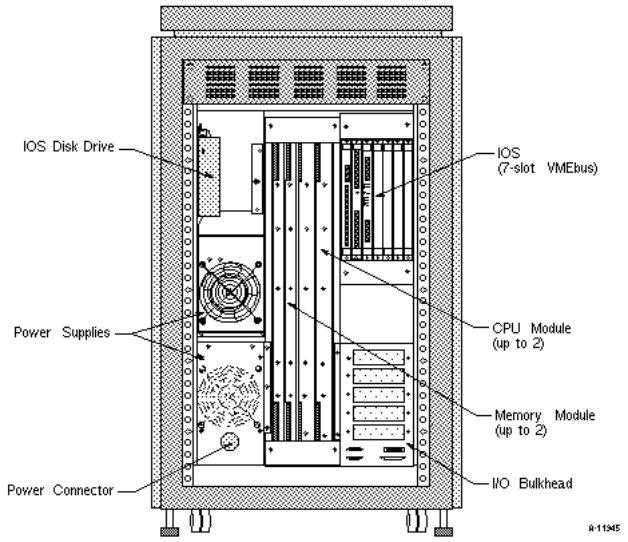

Figure 3. System Components (Back View)

A frame assembly contains the system chassis. The chassis is a 19-in. rack-mount assembly that contains the CPUs, memory, IOS, disk drives, and other supplementary items. For special applications, it is possible to install the EL92 or EL94 chassis in a standard 19-in. rack-mount cabinet. Refer to Figure 4.

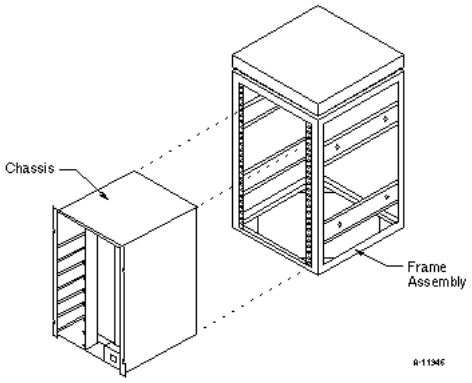

Figure 4. Frame Assembly

CPUs and Memory

The CPUs for the EL92 and EL94 systems use very large-scale integration (VLSI) technology. The VLSI chips used on the CPU are application-specific integrated circuits (ASICs). The ASICs are constructed using complementary metal oxide semiconductors (CMOS) and are contained in a 2 x 2 in. ceramic package. Figure 5 shows an EL92 CPU module.

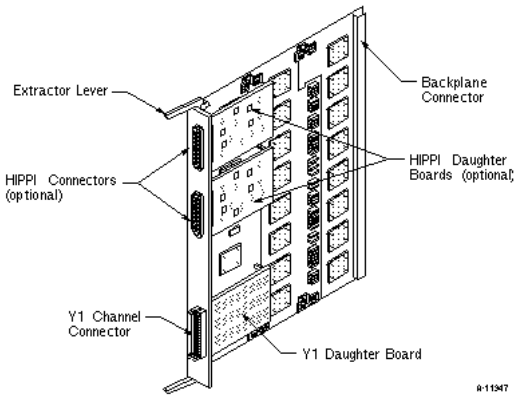

Figure 5. EL92 CPU Module

EL92 CPU Modules

The 2 x 2 backplane configuration can contain up to two CPU modules; the CPUs can work in conjunction by using shared registers or by using common memory. All CPUs run on a 30-nanosecond (ns) clock signal supplied by a separate clock module. Each CPU has a peak performance of 133 million floating-point operations per second (MFLOPS).

Unlike other CRAY EL series systems, which are designed with a backplane that supports four memory modules, the EL92 CPU is designed to function with a backplane that supports one or two memory modules. Therefore, the EL92 CPU is unique and cannot be used in other CRAY EL systems. Likewise, CPUs from other CRAY EL systems cannot be used in the EL92 chassis.

Except for HIPPI data transfers, all other data transfers to and from the CPU and peripheral devices are sent through the IOS. The CPU module connects to the IOS with an I/O cable set called the Y1 channel. A separate daughter board connects the Y1 channel to the CPU. In a 2-CPU system, only one CPU has the Y1 channel connected to the IOS. CPU modules equipped with the optional HIPPI channel have additional I/O daughter boards. Refer to Figure 6.

EL94 CPU Modules

CRAY EL94 systems (models 150, 250, 350, and 450) have an additional 16 ASICs mounted on an 8.2 x 20.5 in. secondary CPU that is attached to the primary CPU. The secondary CPU PC board shares scan, clock control, and memory access with the primary CPU module. The secondary CPU PC board connects to the primary CPU module with 9 connectors that provide 558 signal pins.

In addition to the secondary CPU PC board, EL94 CPUs also contain a removable memory arbitration bus (MAB) PC board. The MAB, which is mounted to connectors on the top of the CPU modules, provides a shared arbitration path between the CPUs. Signal pin restrictions on the backplane make it necessary to add the MAB to the mainframe.

CAUTION
On CRAY EL94 systems, you must remove the MAB before removing any of the CPUs from the card cage or you will damage the MAB, the CPU module, or both.

Memory Modules

As previously mentioned, the systems can be configured with one or two memory modules (refer to Figure 6). Each module has a capacity of 256 Mbytes or 32 Mwords (a Cray memory word is 8 bytes). The memory module has the same dimensions as the CPU module (16 x 22 in.). The module uses 4-Mbit dynamic random-access memory (DRAM) integrated circuits and several ASICs for data control and fanout.

Central memory is organized into banks and sections. Each module contains 16 banks; consequently, there are two banking schemes possible: 16 banks in a 1 x 1 configuration and 32 banks in a 2 x 2 configuration. Both configurations use four memory sections. The memory bandwidth is 106 Mwords/s and 212 Mwords/s for 1 x 1 and 2 x 2 configurations, respectively.

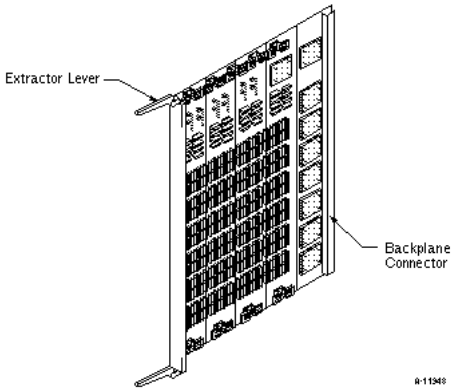

Figure 6. Memory Module

Input/Output Subsystem

The input/output subsystem (IOS) in the EL92 and EL94 consists of a 7-slot Versabus Modular Eurocard (VME) bus. The IOS provides the Cray Research operating system a means of communicating with peripheral devices. The IOS VMEbus supports standard 6U x 160mm VME boards. Refer to Figure 7.

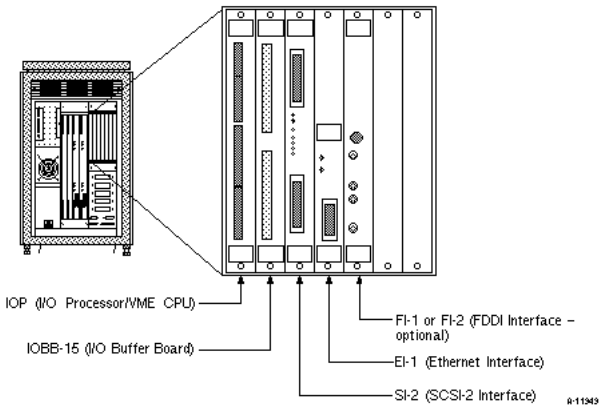

Figure 7. IOS VME Boards

The VMEbus CPU is called the input/output processor (IOP) and utilizes a 68030 microprocessor and 4 Mbytes of onboard memory. The IOP is the bus arbiter and processes all bus requests and interrupts. The IOP contains programmable read-only memory (PROM), nonvolatile random-access memory (NVRAM), and a small computer system interface (SCSI). The SCSI connects to the system maintenance tape drive and the IOS disk drive. These devices are described in the following subsection, Peripheral Devices." The system console and modem are also connected to the IOP through an RS-232 serial port.

The IOS also contains the input/output buffer board (IOBB-15). The IOBB-15 buffers data between the IOS and the Cray Research CPU. The Y1 channel connects the

IOBB-15 directly to a CPU module. The IOBB-15 is capable of a sustained data rate of 15 Mbytes/s.

The IOS is equipped with additional boards: the Ethernet interface (EI-1) and a SCSI-2 disk controller (SI-2). The EI-1 provides an interface between the IOS and an Ethernet network and conforms to the 10-Mbyte/s carrier sense multiple access/collision detection (CSMA/CD) standard.

The SI-2 provides the interface between the IOS and the system disk drives. The SI-2 has two channels; each channel supports synchronous SCSI transfers at 10 Mbytes/s. The SI-2 uses the SCSI-2 interface (SCSI fast and narrow I/O). Additional SI-2 controllers can be installed to control external SCSI devices.

Customers may also configure the IOS with a fiber distributed data interface (FDDI). The FDDI modules are designated FI-1 and FI-2. The FI-1 and/or FI-2 supports either single or dual media access control (MAC) in compliance with the FDDI standard.

Figure 8 shows the data paths associated with the IOS.

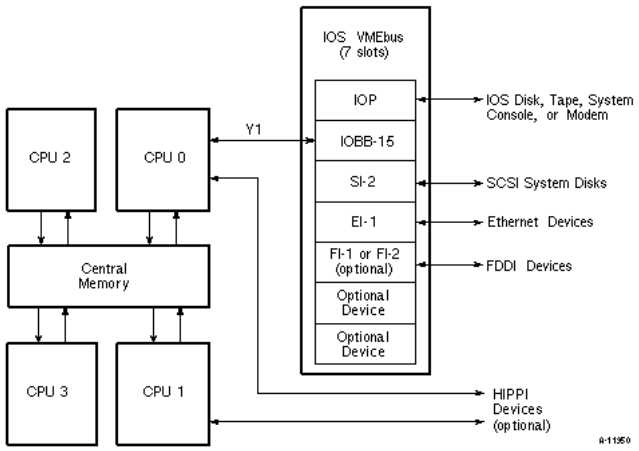

Figure 8. System Data Paths

Peripheral Devices

All systems include the following peripheral devices, as shown in Figure 9:

- IOS disk drive (HD-2)
- 1/4-in. streaming cartridge tape drive (DS-2) or digital audio tape (DAT) drive (DS-3)
- System disk drives (DD-5S)
- System console
- High-performance modem (V.32*bis*/V.42*bis*)

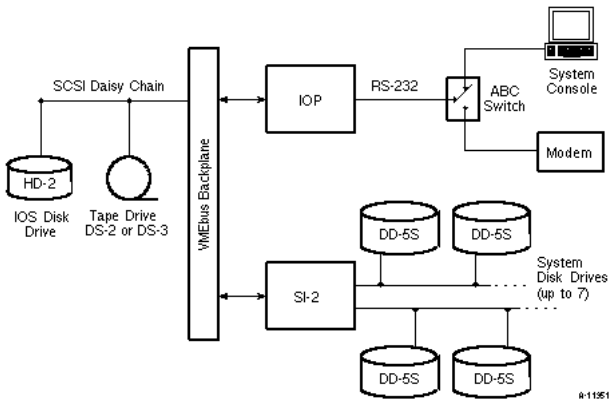

Figure 9. Peripheral Connections

IOS Hard Disk Drive (HD-2)

The IOS disk drive, designated HD-2, is a 204-Mbyte capacity SCSI unit. The HD-2 stores the IOS operating system, system diagnostics, and the UNICOS kernel and configuration file. The UNICOS kernel and configuration file is loaded from the IOS disk into central memory when the system is booted. The IOS disk drive is attached to the SCSI controller in the IOP through the VMEbus backplane J2/P2 connector and a SCSI daisy chain cable. These connections are shown in Figure 9.

Tape Drive (DS-2 or DS-3)

The tape drive is also connected to the IOP by the SCSI daisy chain cable. The tape drive is used for software installation, updates, and system backups.

EL94 models and EL92 models manufactured after first quarter 1994 use the DS-3 digital tape drive instead of the 1/4-in. streaming cartridge tape drive (DS-2). The DS-3 uses digital audio tape (DAT) technology that has been adapted for computer data storage. The DS-3 is connected to the VME CPU by the SCSI daisy chain cable.

System Disks (DD-5S)

The system disk drives are connected to the SI-2 SCSI differential controller. Refer again to Figure 10. The system drives are designated DD-5S; each drive can store approximately 3 Gbytes of data. The UNICOS operating system, application programs, and user data are all stored on the DD-5S disk drives. The drives are installed in one of two arrangements, based on the system power supply configuration. For 110-Vac systems, two DD-5S drives are installed for a total of 6 Gbytes of storage. For 220-Vac systems, seven DD-5S drives are installed for a total of 21 Gbytes of storage. Table 3 summarizes the data storage peripherals.

Table 3. Peripheral Devices

Device Type	Cray Research Name	Manufacturer and Model Number	Device Description	Storage Capacity	Transfer Rate
Tape Drives	DS-2	Archive Technology, Inc. Anaconda 2750	1/4-in. streaming cartridge tape drive	1.3 Gbytes	600.0 Kbytes/s
	DS-3 †	Hewlett-Packard Company C1533A DDS-2	Digital Audio Tape (DAT) drive	4.0 Gbytes on a 120-m tape	510.0 Kbytes/s
Disk Drives	HD-2	Seagate Technology, Inc. Swift ST1239N	3.5-in. SCSI interface IOS hard disk drive	204.0 Mbytes formatted	2.7 Mbytes/s
	DD-5S	Seagate Technology, Inc. Elite ST43401ND	5.25-in. SCSI-2 interface system disk drive	3.1 Gbytes formatted per drive	5.0 Mbytes/s
	DD-3 ‡	Hitachi Ltd. DK516-15	5.25-in. ESDI interface system disk drive	1.32 Gbytes formatted per drive	2.7 Mbytes/s

† CRAY EL92 and CRAY EL94 models manufactured after first quarter of 1994.

‡ CRAY EL92 beta units only.

System Console

The console for the EL92 or EL94 systems is a WY-60 terminal manufactured by Wyse Technology, Inc. The system console is used to boot and monitor the operating systems for both the IOS and UNICOS. The system console can also be used to run the system diagnostics. The console connects to the IOP by means of an RS-232 serial port and is configured to emulate a VT100 terminal.

Modem

A high-performance modem (V.32bis/V.42bis) shares the serial port used by the system console. A serial line ABC switch, as shown in Figure 10, is used to connect the modem to the serial line. The modem is used for remote support functions and is included as standard equipment for the system. The standard modem is a Microcom QX/4232bis modem. The Microcom QX/4232bis modem is capable of a maximum serial port speed of 38.4 Kbps. Customers may also equip the system with an optional Telebit NetBlazer network routing device. The NetBlazer router can provide additional security functions. Customers may omit the remote support hardware if an alternate service strategy is desired.

Power and Control

The EL92 and EL94 mainframes are compact air-cooled systems designed to use the power found in most office environments. Table 4 lists the environmental specifications for the system.

Table 4. Environmental Specifications

Characteristic	Specification
Height	41.50 in. (105 cm)
Width	23.50 in. (60 cm)
Depth	26.25 in. (67 cm)
Weight (maximum)	380 lbs (172 kg)
Heat Dissipation (maximum)	8.2 kBtu/hr (2.40 kW)
Operating Temperature	50 – 85 °F (10 – 35 °C)
Input Power (1 x 1)	110 V, 15 amp or 220 V, 15 amp
Input Power (2 x 2)	220 V, 15 amp
Power Dissipation (1 x 1)	1.4 kW
Power Dissipation (2 x 2)	2.4 kW

There are two basic power requirement configurations: 110 Vac and 220 Vac. Only EL92 model 100 can use either 110 or 220 Vac. All EL92s and EL94s have two power supplies: one supply is used to power the CPU and memory modules; the other supply powers the IOS, system disk drives, and all other supplementary items. The basic power distribution is shown in Figure 10.

The control panel, mounted at the front of the system, monitors environmental conditions. The control panel is equipped with light-emitting diode (LED) displays and an audible alarm. The panel display indicates power supply faults, temperature faults, and fan tray faults. The control panel is also equipped with system reset buttons, clock controls, and voltage margin controls.

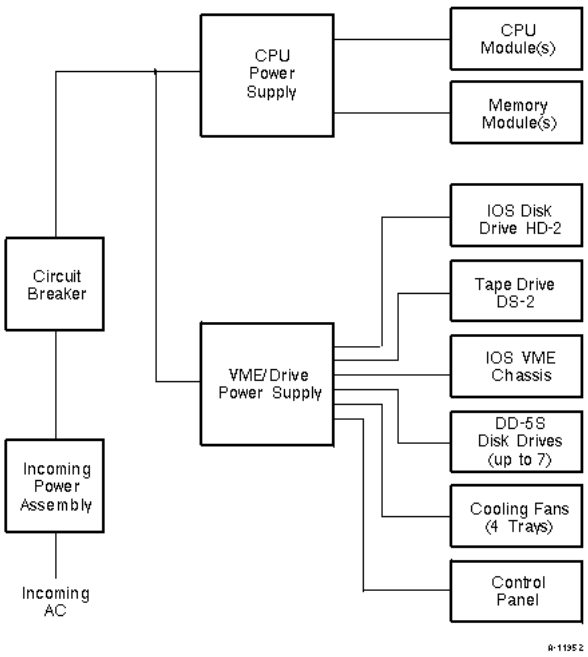

Figure 10. Power Distribution

The simplified cabling diagram is shown in Figure 11.

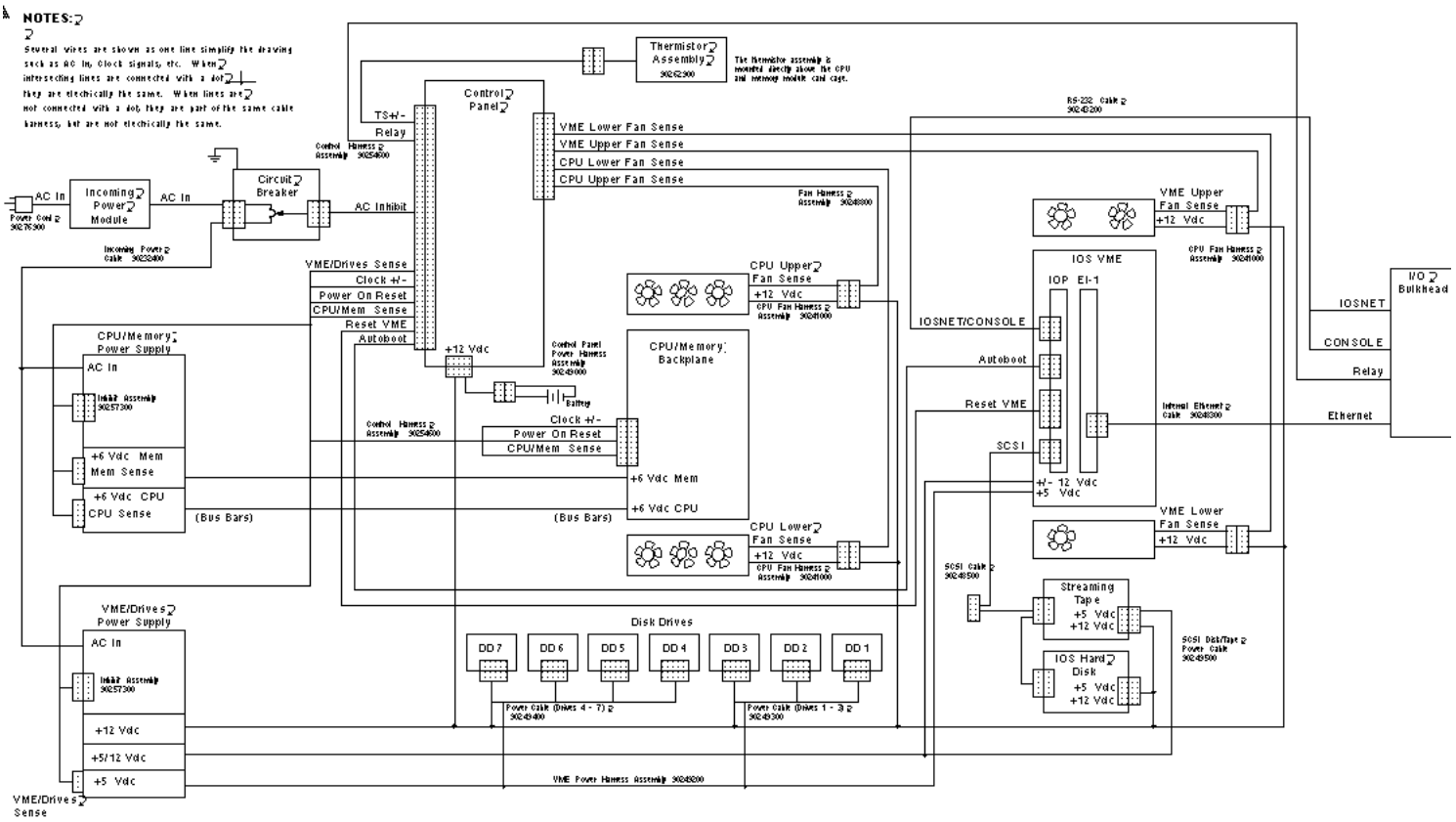

Figure 11. Simplified Cabling Diagram

Software Overview

EL92 and EL94 mainframes function with two distinct operating systems: the IOS operating system and the UNICOS operating system. The IOS operating system is a Cray Research proprietary real-time system that resides in the IOP local memory. Although several of the basic IOS commands use the same syntax and arguments of standard UNIX commands, the IOS operating system should not be confused with a UNIX operating system. The IOS kernel and supporting files are stored on the IOS disk drive.