CRAY J90™ Series SI-3X Upgrade/Migration Procedure

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Comments about this publication should be directed to:

CRAY RESEARCH, INC.
Service Publications and Training
890 Industrial Blvd.
Chippewa Falls, WI
54729

SI-3X Upgrade/Migration Procedure

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Overview

Device to Be Upgraded/Migrated

This document contains procedures on how to add an SI-3 external small computer system interface (SCSI) port to a CRAY J90 series system.

Description of Upgrade/Migration

Cray Research customers have the option of adding external peripherals to their CRAY J90 series systems by upgrading the number of SCSI port connections in their system. This procedure is written to aid CRI support personnel in the task of installing SI-3X upgrades or migrating the SI-3 controller from their CRAY EL series system to their CRAY J90 series system.

The instructions presented in this upgrade procedure provide the CRAY J90 series system users with added operational SI-3X capabilities. The software upgrade procedure creates two TEMPORARY scratch file systems when installing external SCSI disk devices and gives an example of configuring external SCSI tape devices. It is then the responsibility of the customer to configure these ports into his or her production configuration.

SI-3X Upgrade/Migration Prerequisites

The following list describes some special configuration considerations:

- It is recommended that the “Software Configuration Preparation for Disk Drives” section be completed prior to taking dedicated maintenance time on the system. This involves configuring any new disks into temporary scratch file systems that can be completed while the system is in multiuser mode prior to this upgrade.

  The customer may want to prepare a production version UNICOS configuration (`param` or `tapeconfig`) file prior to the upgrade in order to integrate any new SCSI peripherals into the existing CRAY J90 series system peripheral configuration. This `param` or `tapeconfig` file will then be available for the sections on integration and configuration in this upgrade.

- It is recommended that a full backup of existing file systems be completed before this upgrade is started.

- The combined maximum number of SI-3X and SI-3 controllers per IOS is three if no network controllers reside on the same IOS. Decrement the maximum by 1 for each network controller in that IOS.

  The maximum number of disk devices per SI-3X port is four (2 ports per SI-3X controller board). SCSI IDs 0-3 are available for the devices (the controller uses ID 7). The maximum tape controllers (`targets`) per SI-3X port is 7, with IDs 0-6. Note: A single tape controller may have multiple devices (`luns`).

- Procedures for integrating new disks with existing file systems are located in Section 5 of the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, Cray Research publication number SG-2416.

- Procedures for tape configuration are located in the *UNICOS Tape Subsystem Administrator's Guide*, publication SG-2307, and the *UNICOS Tape Subsystem User's Guide*, publication SG-2105.

- Product Availability Notice (PAN) # 86 defines support categories for the various tape technologies, defines differences between UNIX character special and advanced functionality, and provides general information about future tape product availability. Cray Research personnel can access this PAN on the World Wide Web via Mosaic at the following URL: `http://wwwcic.cray.com/OnLine/PRODUCT_INFO/PANS/PAN_86_Tape_Support.txt`. If you cannot access this PAN, contact Pat Hughes (`plh@cray.com`) at (612) 683-3029.

DD-U Disk Requirements

The DD-U generic SCSI disk must be a differential-type drive. The disk should be capable of being formatted at 4 Kbytes per sector and must support SCSI extended read and write commands. The Growth Error Table and Autoflawing DD-U driver software features are not supported. The `dflawr` and `dflaww` IOS commands are not supported. The `dd5stest` diagnostic supports the adapter onboard diagnostic testing, but does not support drive testing.

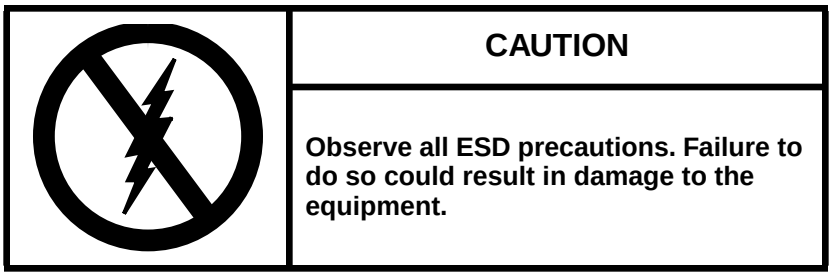
Training Requirements

Cray Research personnel who perform this upgrade must have completed training in CRAY J90 series hardware and system administration. If this is not possible, a hardware-trained person should have a system administrator available

during this upgrade. Prior experience in upgrading or installing the UNICOS operating system on a CRAY J90 series system or CRAY EL series system is advised.

ESD Precautions

Observe ESD precautions during the entire upgrade process. Wear an ESD smock and an ESD wrist strap. Do not wear jewelry when you work on a CRAY EL or CRAY J90 series cabinet.



ESD Smock

Wear a Cray Research-approved static-dissipative smock when servicing or handling an ESD-sensitive device. Completely button the smock and wear it as the outermost layer of clothing. You must have a portion of the smock's sleeves in direct contact with the skin of your arms. Skin contact is essential for a dissipative path-to-earth ground through your wrist strap. Tuck hair that exceeds shoulder length inside the back of the smock.

Wrist Strap

Wear a Cray Research-approved wrist strap when handling an ESD-sensitive device to eliminate possible ESD damage to equipment. Connect the wrist strap cord directly to earth ground.

Reference Publications

Refer to the following publications if you have questions when performing this upgrade.

- *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, Cray Research publication number SG-2416
- *UNICOS Tape Subsystem Administrator's Guide*, Cray Research publication number SG-2307

- *CRAY IOS-V Commands Reference Manual*, Cray Research publication number SR-2170
- *CRAY IOS-V Messages*, Cray Research publication number SQ-2172
- *CRAY J916 Service Manual Kit*, Cray Research publication number HMK-101-0
- *UNICOS Installation and Configuration Tool Reference Manual*, Cray Research publication number SR-3090
- Product Availability Notice (PAN) # 86. Cray Research personnel can access this PAN on the World Wide Web via Mosaic at the following URL: `http://wwwcic.cray.com/OnLine/PRODUCT_INFO/PANS/PAN_86_Tape_Support.txt`. If you cannot access this PAN, contact Pat Hughes (`plh@cray.com`) at (612) 683-3029.

Estimated Time to Install Upgrade/Migration

Table 1 divides the SI-3X upgrade/migration process into four separate procedures. Use this table to determine how much system time you should request to complete this upgrade. Ensure that you allow for time on the CRAY EL Series system to remove the SI-3 controller if you are doing a migration.

Table 1. Estimated Time to Install Upgrade

Install Task	Estimated Time to Install Upgrade
Hardware Install	1 hour
Hardware Verification Testing	1 hour
Software Configuration	1 hour
Software Verification Testing	1/2 hour

Parts Required

Table 2 lists the parts and part numbers that are included with an SI-3X upgrade. The part number for a SI-3X migration kit is 90393300.

NOTE: The SI-3 and the SI-3X are identical VME controller and cables.

Table 2. SI-3X Upgrade/Migration Kit Contents

CRI Part Number	Quantity Upgrade	Description
90360800	1	Module Assembly, SI-3 (DC-6S)
90317400	2	Cable Assembly, Intermediate SCSI-3
90272300	2	Cable Assembly, SCSI-3 Bulkhead
90289000	2	Cable Assembly, SCSI-3 to SCSI-1 AD †
90360701	4	Plate Assembly, 68 Pin
90205301	1	Adhesive, Threadlock
90202400	4	Screwlock Kit, Female
90030502	10	Cable Tie, Mounting Nylon 8 in.

† Used as a cable connector adapter

Tools Required

All tools required for this upgrade are included with the Customer Service toolkit.

Software Required

- Minimum IOS kernel revision - 1.3
- Minimum UNICOS Revision - 8.0.3.2J
- Special considerations: The UNICOS dump device (`/dev/dsk/dump`) cannot be configured on a DD-U device.

Conventions

The following conventions are used throughout this document:

Convention	Meaning
command	This fixed-space font denotes literal items such as commands, files, routines, path names, signals, messages, and programming language structures.
`manpage`(*x*)	Man page section identifiers appear in parentheses after man page names.
variable	Italic typeface denotes variable entries, words or concepts being defined.
`user input`	This bold fixed-space font denotes literal items that the user enters in interactive sessions. Output is shown in nonbold, fixed-space font.
<KEY>	This convention indicates a key on the keyboard.

Getting Started

1. Complete an inventory inspection of the SI-3X upgrade/migration.
2. Check off each step of this procedure after you complete it.

Create a Backup Copy of the UNICOS File System

It is recommended that you create a backup copy of the UNICOS file system before you proceed with the upgrade procedures. See the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, publication number SG-2416, for details on how to create a backup copy of the UNICOS file system.

Power Down the CRAY J90 Series System

1. Ensure that the customer has brought the system to single-user mode.
2. Using the right mouse button, click on any open working space. The `Workspace` menu will appear.
3. From the `Workspace Menu`, select the `J90 Console` menu item.

   NOTE: You must have superuser privileges to perform Step 4.

4. Log into the UNICOS operating system by entering `<CONTROL-a>` to get a UNICOS prompt and enter the root login and password.
5. Shut down the UNICOS operating system by entering the following commands at a UNICOS prompt:

```
# cd /
# /etc/shutdown 120  (takes 120 seconds to execute)
# /bin/sync
# /bin/sync
# /bin/sync
# /etc/ldsync  (if you are using ldcache)
```

6. Stop the `J90 Console` connection by entering the following commands:

```
# <CONTROL-a>  (toggles to the IOS)
sn9xxx-ios0> mc
sn9xxx-ios0> reset  (takes 30 – 45 seconds to execute)
BOOT[sn9xxx-ios0]> ~. <CONTROL-c>
```

7. Open the mainframe cabinet door.

8. Power off the system by pressing the CCU SYSTEM OFF button.

Hardware Upgrade Procedure

Open the CRAY J90 Series I/O Cabinet Rear Door

Remove the CRAY J90 Series I/O Cabinet Front Door

1. At the front of the I/O cabinet, push down on the latch and swing the door open.
2. There is a cable that prevents the door from swinging back. Remove the retaining screw that attaches the ground wire cable to the I/O cabinet.
3. Lift up and remove the I/O cabinet front door from its hinges.

If you are migrating an SI-3 controller board from a CRAY EL series system to a CRAY J90 series system, follow the procedure in the following subsection entitled "Remove the SI-3 Controller from the CRAY EL Series System."

Remove the SI-3 Controller from the CRAY EL Series System

1. Power down the IOS VME subsystem by depressing the VME INHIBIT/ENABLE button on the SCSI assembly.
2. Label the SI-3X ribbon cables and then remove them from each IOS board.
3. Loosen the retaining screws on the top and bottom of the board.
4. Grasp the board by the ejector handles located on the top and bottom of the board; push the top ejector handle up and the bottom ejector handle down at the same time and pull the board outward and away from the backplane.
5. Place the board on an ESD-protected surface.

NOTE: Do not leave any open slots in the CRAY EL series IOS if the system is still being used.

Install the SI-3 Controller

Install the new SI-3 controller board or the SI-3 controller that you have just removed from the CRAY EL series system, into the correct IOS (depending on customer configuration) using the next available slot in that IOS.

1. Pull out the VME tray.
   a. Remove the four screws that secure the VME tray to the cabinet.
   b. Pull out the VME tray as far as it will go.
   c. Loosen the 14 1/4-turn screws that hold the top cover to the VME tray.
   d. Remove the VME tray top cover and set it aside.
2. Unpack the new controller board (P/N 90360800) if you are performing an upgrade.
3. Place the controller on an ESD-protected surface.
4. Change any jumpers or switches necessary on the new SI-3 controller board. Refer to Figure 1.
5. Loosen the VME slot filler screws and lift out the VME slot filler.
6. Insert the new SI-3 controller board into the guide slots in the VME chassis and ensure that the board is completely seated. Secure the module-retaining screws.
7. Attach the male end of the SI-3X cables (P/N 90317400) to the front of the SI-3 controller. The port closest to the front of the VME is port 0, and the port closest to the back of the VME is port 1.

NOTE: Controller cables are labeled with the VME slot number (C1 through C20) and the port numbers (either 0 or 1); for example, C5 Port 0. These labels are located in the document holding tray just below the CPU card cage in the mainframe cabinet. Also add the appropriate label to the end of the intermediate VME cable (P/N 90317400) to indicate the VME bulkhead position to which it is attached.

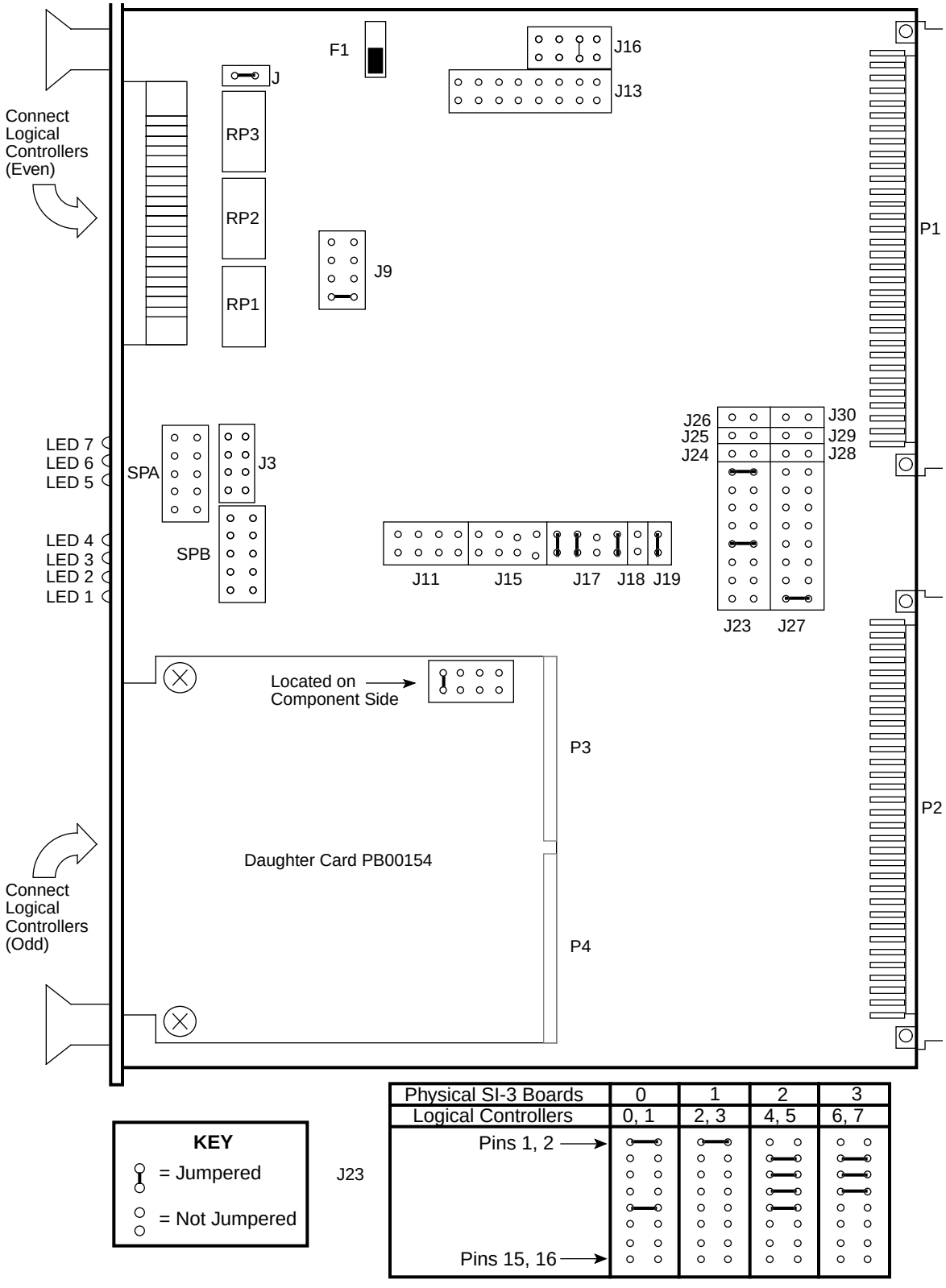


Figure 1. SI-3 Jumper Configurations

Make VME Bulkhead Plate Connections

NOTE: Try to use a location on the bulkhead that is in line with the newly installed controller card in the IOS to minimize the crossing of cables. Refer to Step 2.

1. Push the VME tray in and secure it with a single screw.
2. Push out the PE tray above the VME to gain better access.
3. Remove the two appropriate bulkhead plates that are each attached to the bulkhead by two screws.
4. Install the new plates (P/N 90360701) and secure them with the two screws removed from the blank plates.

NOTE: Ensure that the plate's gasket is positioned away from the metal mesh of the adjacent plate.

5. Attach the other end of the intermediate SI-3X cable to the VME bulkhead using two standoff screws (P/N 90202400) for each cable.

NOTE: Ensure that the standoff screws are seated into the bulkhead plate before you tighten them. As viewed from the back, port 0 is connected to the left of the port 1 connector. Orient the connector so that D points to the right. Use a small amount of thread adhesive on the threads of each standoff screw.

6. Tighten the standoff screws lightly with a nut driver and ensure proper seating.

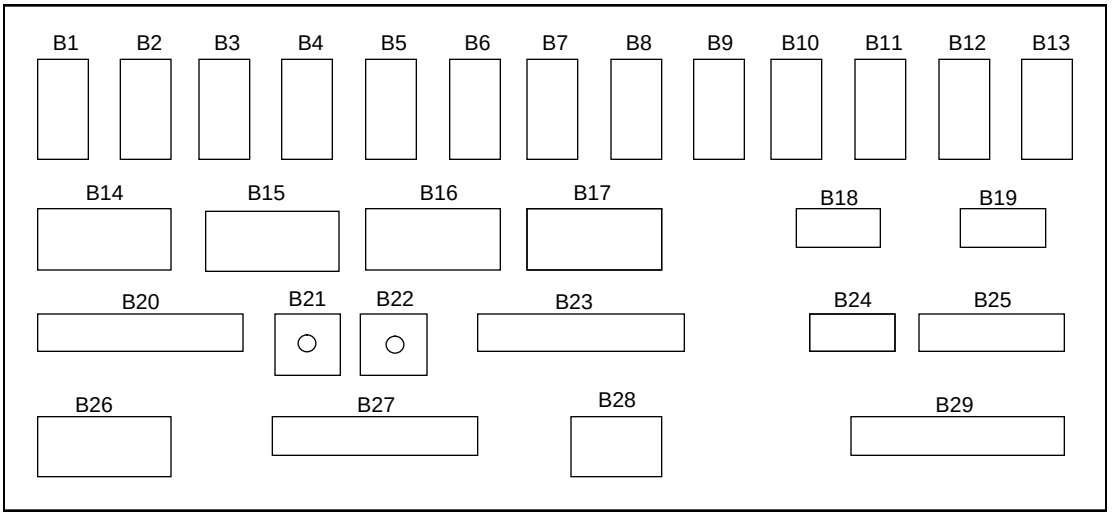


Figure 2. VME Bulkhead (Back View)

Install I/O Bulkhead Plate

1. Remove the two appropriate I/O bulkhead plates (slots A1 through A11) that are each attached to the bulkhead by two screws. Refer to Figure 3. It is recommended that you use the two open slots that are farthest to the right.

2. Install the new plates (P/N 90360701) and secure them with the two screws removed from the blank plates.

NOTE: Ensure that the plate's gasket is positioned away from the metal mesh of the adjacent plate.

3. Label the new cables (P/N 90272300) "A" (I/O bulkhead) and "B" (VME bulkhead).

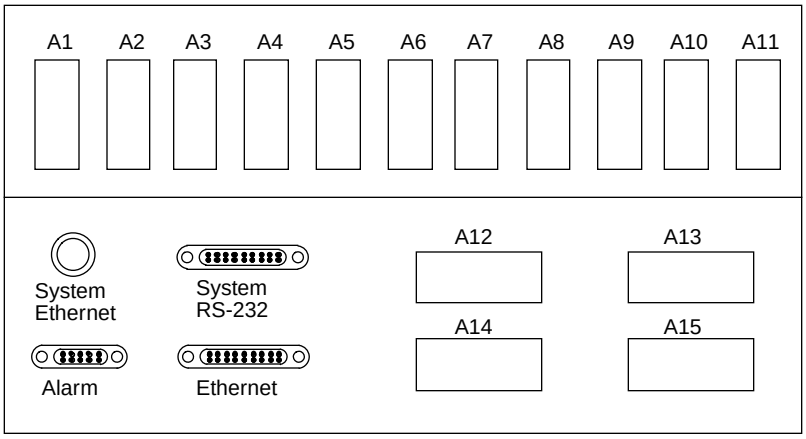


Figure 3. I/O Bulkhead

Disconnect all Cables from VME Bulkhead

1. Disconnect all cables from the VME bulkhead that are routed through one or both of the two flexible cable ways.

   NOTE: Whether one or both of the flexible cable ways are disconnected depends on the number of cables being routed and where the cables will be attached on the VME bulkhead.

2. Disconnect the flexible cable ways by removing the two screws that secure them to the VME tray. Refer to Figure 4. You may also snap the top crossbar out.

3. Lay the cable ways flat.

4. Loosen the two 1/4-turn screws at the front of the I/O cabinet just below the VME tray.
5. Remove the single screw from the front of the VME.
6. Extend the VME tray completely.
7. Remove the cable tray cover by sliding the cover out through the front of the I/O cabinet and set it aside.

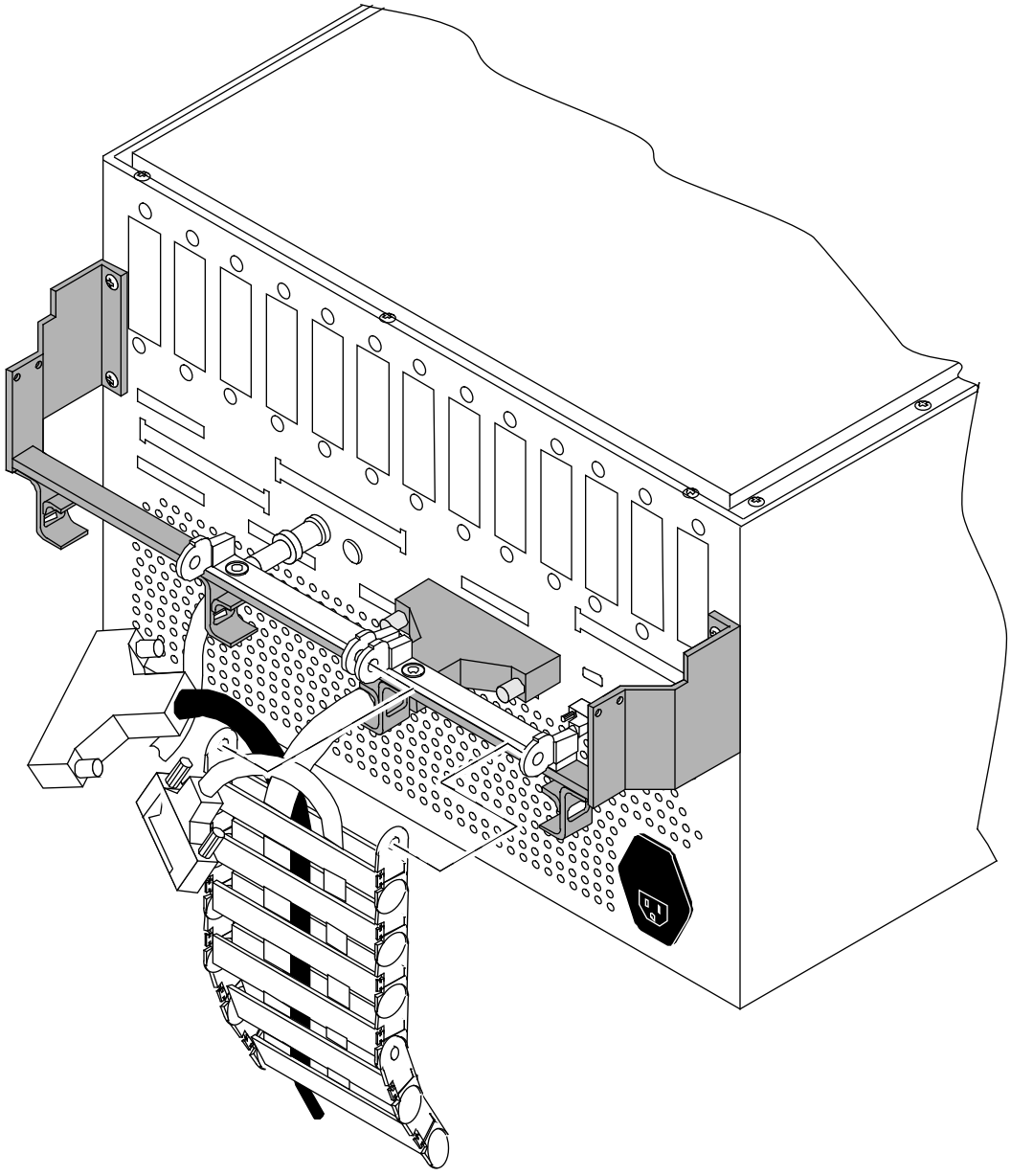


Figure 4. Flexible Cable Way

NOTE: If the SI-3X cables will be routed through only one of the two flexible cable ways, only the crossbars for that flexible cable way need to be opened. If the cables will be routed through both of the flexible cable ways, both crossbars will have to be opened

8. Pry open each crossbar of the cable way, using a standard 1/8-in. flat-bladed screwdriver and leave the inner side attached. Refer to Figure 5.

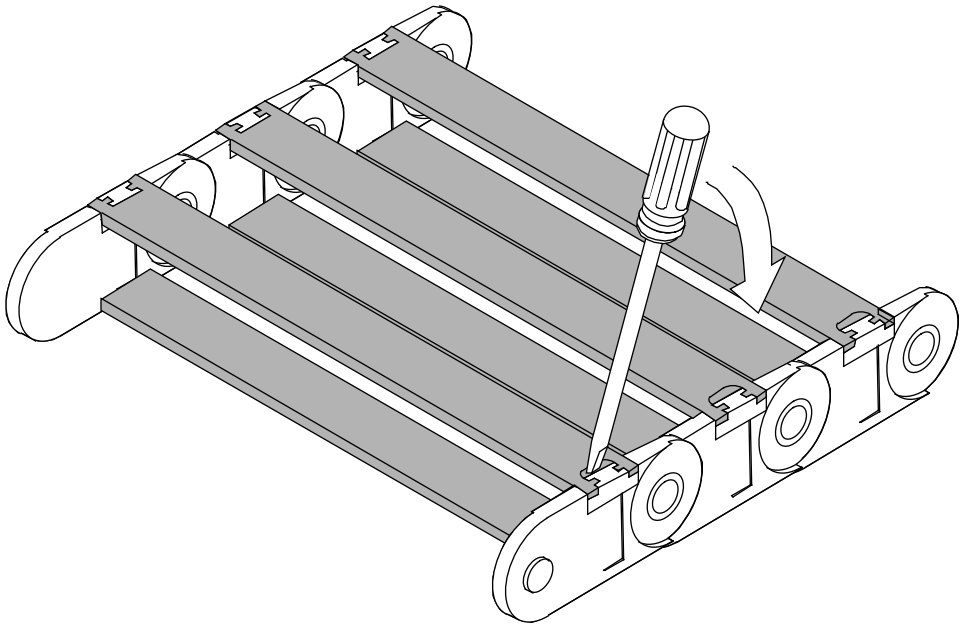


Figure 5. Flexible Cable Way Crossbars

Route Cables through Cable Tray and Flexible Cable Way

1. Route the SCSI cables down or up the right side of the I/O cabinet and secure them with tie wraps.
2. Place the SCSI cables in the flexible cable way and in the cable-routing tray. Ensure that the cables do not cross in the flexible cable way because this will make adjusting the cables more difficult.
3. Snap down all crossbars for the flexible cable way. (This is not easy!) Then, ensure that both ends of each crossbar are secure.
4. Slide the VME tray into the cabinet carefully and secure it with one screw.

CAUTION

Do not pinch the cables when you slide in the VME tray or the cable cover.

NOTE: Y1, power, and control cables are routed below the VME flexible cable-way attachment bar.

5. Reconnect the flexible cable way using the two screws originally removed from the flexible cable-way bar. Refer to Figure 4.
6. Reattach the Y1 cables to the VME bulkhead.
7. Reattach the rest of the cables to the VME bulkhead using cable and bulkhead labels. This includes connecting the new SI-3X cables (P/N 90272300) to the VME bulkhead.
8. Remove the single retaining screw and extend the VME tray out until the tray slides lock.
9. Adjust the cables inside the cable tray and flexible cable way if there is excess slack at the VME bulkhead.
10. Tighten all tie wraps.
11. Reinstall the cable tray cover by sliding it carefully in and over the cable tray from the front of the I/O cabinet.
12. Secure the cable tray cover at the front of the I/O cabinet with two 1/4-turn screws.
13. Install the VME cover.
14. Slide the VME tray in.
15. Install the four screws in the front of the VME tray.

Replace the CRAY J90 Series I/O Cabinet Front Door

1. Place the door on its hinge pins.
2. Reattach the front door’s cable wire to the I/O chassis.
3. Close the door.

Connect I/O Bulkhead Cables

1. Attach the SI-3X cable (P/N 90272300) to the I/O bulkhead using two standoff screws (P/N 90202400) for each cable.

NOTE: Ensure that the standoff screws are seated into the bulkhead plate before you tighten them. As viewed from the back, port 0 is connected to the left of the point 1 connector. Orient the connector so that D points to the right. Use a small amount of thread adhesive on the threads of each standoff screw.

2. Tighten the standoff screws lightly with a nut driver and ensure proper seating.

3. Attach the external device SCSI cables to the I/O bulkhead.

Close the CRAY J90 Series I/O Cabinet Rear Door

Power Up the CRAY J90 Series System

NOTE: If the `J90 Console` window is already up, proceed with Step 3

1. Using the right mouse button, click on any open working space. The `Workspace` menu will appear.

2. Select the `J90 Console` menu item.

3. Move the circuit breaker on the back of the I/O cabinet to the `ON` position first, and then move the circuit breaker on the mainframe cabinet to the `ON` position.

4. Press the `Alarm Acknowledge` button on the CCU.

5. Press the `CPU RESET` button on the CCU.

6. Press the `VME RESET` button on the CCU.

7. Verify that the SYSTEM READY light on the CCU illuminates.

8. Close the mainframe front door.

9. Watch the `J90 console` window to ensure that the system powers up correctly. If the `/diag/scripts/powerup` script exists on the IOS's file system, then this script will execute to test the IOBB. If no errors exist, the only output from this diagnostic is the message `Powerup IOBB test in progress`. You should see the `BOOT[sn9xxx-ios0]` prompt when power-up is complete.

Edit the IOS Configuration File

The IOS `/config` file (refer to Figure 6) lists the strategies, drivers, and IOP Ethernet addresses that are loaded into IOP memory when the IOSs are loaded.

Open an xterm window on the system console and use the `vi` command to update the `/opt/ios/9`*xxx*`/config` file. The IOS definition section of `config`, which corresponds to the IOS that is receiving the new disk or tape hardware, should contain the following appropriate entries:

NOTE: Strategies must precede drivers.

Strategies	Description
`/dev/disk`	Disk device strategy for all disk drives
`/dev/taped`	Strategy for tape daemon tape interfaces
`/dev/tape`	Strategy for all non-tape daemon tape interfaces*
Drivers	**Description**
`/dev/si2`	SCSI interface driver for SI-3 controller; required for any SCSI disk or tape attached to an SI-3 controller; must come before `/dev/sdisk` and `/dev/s2tape`
`/dev/sdisk`	SCSI disk device driver
`/dev/s2tape`	SCSI tape driver for SI-3 attached tape devices and for IOP attached maintenance tape device (DAT)
`*/dev/tape`, part of the `ddal` interface, is not supported at UNICOS 9.0. See page 38 for details on 9.0 functionality.	

These are permanent additions. These entries may already exist in the given IOS section if that IOS already contains hardware that uses one or more of these modules. These drivers can run both customer-supplied and Cray Research-supplied devices simultaneously in an IOS. Each of these entries should be listed only once in an IOS definition section of the `config` file, but they should be listed in every IOS definition section that relates to an IOS receiving these disks or tapes. Figure 6 shows a sample IOS `/config` file.

```
# IOS configuration file
# Define architecture (XMS|YMP-EL|EL-90|J90
ARCH=J90
#

sn9004-ios0: 10.1.0.96
# Strategy name
# --------------
/dev/console
/dev/disk
/dev/ethnet
/dev/taped
/dev/tape

# Device driver name
# -------------------
/dev/dc5i
/dev/si2
/dev/sdisk
/dev/s2tape
/dev/ether
```

Figure 6. IOS `/config` file

Verify That the Upgraded Hardware is Functional

After at least one SCSI disk and/or tape is installed on the new SI-3X, perform the following disk verification and tape verification procedures to verify that the upgraded hardware is functional.

Controller and Device Verification

1. Load the IOS kernel by entering the following command (this step takes 3 to 30 minutes, depending on the number of peripherals in the system). If there are no devices attached to the new SI-3X board(s), the load time will increase by approximately 1 minute per empty SI-3X board, because the software performs time-out processing to determine that no devices are attached to the SI-3X.

```
BOOT[sn9xxx-ios0]> load
```

2. Confirm that the new controllers and devices are correctly recognized in the output of the IOS `load` command. The following output is an example of partial `load` command output for two SI-3X boards. The first board has no devices on its first port (SCSIbus 0) and has one EXABYTE tape drive on the second port (SCSIbus 1). The second SI-3X has two customer-supplied SCSI disks on each of its two ports (SCSIbus 2 and SCSIbus 3):

```
VME SCSI SI-3/64D: SCSIbus 0 - detected
VME SCSI SI-3/64D: SCSIbus 1 - detected
VME SCSI SI-3/64D: SCSIbus 2 - detected
VME SCSI SI-3/64D: SCSIbus 3 - detected
SI-3 SCSIbus 2 Target 0 [s20], type = DD6S
SI-3 SCSIbus 2 Target 1 [s21], type = DD6S
SI-3 SCSIbus 3 Target 0 [s30], type = DD6S
SI-3 SCSIbus 3 Target 1 [s31], type = DD6S
SI-3 SCSIbus 1 target 3 lun 0 [rse130], type = EXB
```

   The disk information in the `[s`*xy*`]` notation is used in Step 1 and Step 2 on page 22. The *x* refers to the controller number within an IOS (0 and 1 in this example, corresponding to `eiop` 20 and `eiop` 21, respectively). The *y* refers to unit or device number (0 and 1 in this example).

   This device information is also available from the IOS `whatmic` command and the IOS `/adm/mic_code.log` file.

NOTE: Your customer-supplied disk devices may appear as disk type `DD6S` in the `load` and `whatmic` command output. You should still refer to these drives as `DD_U` in your software configuration (`param` file).

If all the new devices and controllers are not recognized, verify that the IOS configuration file was properly edited. If that file looks correct, verify that the hardware was properly installed by completing the following tasks:

- Examine all cable connections and terminators to make sure they are functional.
- Examine all terminator pins to ensure that they are straight.
- Verify that both the front and rear power enable switches are enabled on the new disk device.
- Verify that the LEDs on the SI-3X board are as follows: BDOK (board OK) LED is green; TPWR (termination power) LED is yellow.

Disk Verification

NOTE: No diagnostics are supported for external 3rd party disk devices. The IOS utility commands, `dformat` and `dstat`, are supported.

1. Optional step: You may want to reformat the disk drive(s) at this time, especially if the new drive(s) have never been used. Reformatting invalidates all data on the drive(s). See the `dformat`(8) man page for more details. Note that dformat does not maintain a Growth Error Table for DD_U devices. The following text is an example command line and
its output.

```
sn9xxx-ios> dformat s01 -l 2
s01 format completed. Block size: 4096, Block count:
782826
```

2. Use the `dstat` command to determine the block count and sector size. Make note of this information, which you will need in Step 5 on page 25.

```
sn9xxx-ios0> dstat s01
```

The following example shows the `dstat` command output for a DD_U drive. In this example, the block count for this device is 782825 (block count is the maximum value allowed for the `length xxx sectors` portion of the `pdd` statement in the `param` file). Note also that the sector size value must be 4096 in the `dstat` output.

```
sn9xxx-ios0> dstat s01
Driver Strategy Numbers:
     Number of driver calls made : 0
     Number of chained calls made : 0
     Times requests were suspended : 0

SCSI Adapter 0 [S0]: 3 drives found
     Drive   Total Reads    Total Writes    Outstanding
       0          0              0              0
     Drive   Total Reads    Total Writes    Outstanding
       1          0              0              0

     Drive   Total Reads    Total Writes    Outstanding
       2          0              0              0

SCSI Adapter 0, Drive 1, Serial Number : 46158
     Data Cylinders: 2737 Heads : 21
     Sectors/Track : 14 Sector Size : 4096
     Blocks available for data : 782825
     Device does support SCSI-2 tags
```

Tape Verification

Utilities and diagnostics are not supported for external third party tape devices.

The `mt`(8), `dd`(8), and `tar`(8) IOS commands can be specified at the IOS prompt to test the ability of the IOS software to access the newly installed tape drive(s). The following examples refer to the new drive as rss350, residing on IOS1.

You may want to try the following command both when there is and when there is not a tape mounted in the new drive. Ensure that the command's output correlates to the state of the tape in the drive.

```
sn9xxx-ios1> mt -f rss350 status

SCSI tape drive
Device status [Ready, Online]
sn9xxx-ios1>
```

To verify that the tape drive and the IOS software are functioning properly, you can execute simple tape movements such as rewinding or skipping forward over a couple of files by using the following commands:

```
sn9xxx-ios1> mt -f rss350 rewind
sn9xxx-ios1> mt -f rss350 fsf 2 (*skip 2 files in this example*)
```

NOTE: Do not preface tape commands (such as `dd`, `tar`, and `mt`) with `/dev/` when you execute them from the IOS prompt. See the appropriate IOS-V man page for details on tape commands.

Tape devices attached to SI-3X controllers are not accessible from the IOS `BOOT[sn9xxx-iosx]>` prompt.

Software Configuration Preparation for Disk Devices

NOTE: You can complete this section prior to taking dedicated maintenance time on the system. If you have already completed this section, continue with the "Disk Software Change Procedure" section on page 28.

NOTE: The UNICOS Installation / Configuration Menu System (ICMS) does not support DD_U devices.

Update and verify the UNICOS configuration file. Save a copy of the original version by entering the following commands:

```
sn9xxx-ios0> cd /sys
sn9xxx-ios0> cp param param.disk
```

The changes you will be making in the following "IOS Information for Disk Devices" section should be considered permanent. Portions of the "Disk Configuration" section will reflect the temporary scratch file systems created in this upgrade procedure.

NOTE: The customer must integrate these disks into the existing CRAY J90 series system disk configuration following completion of these upgrade procedures.

On the system console, use the `vi` command to update the `/opt/ios/9`*xxx*`/sys/param.disk` file with the new disk information. Ensure that you update all appropriate information in the following subsections.

IOS Information for Disk Devices

Note the IOP (cluster) where the SI-3X controller has been installed. Add the appropriate `eiop` value to the `cluster` definition statement for that IOP.

The `eiop` values for SI-3X disk controllers range between 20 and 25, inclusive. The first physical SI-3X disk controller board on an IOS will be assigned `eiop` values 20 and 21, correlating to the two SCSIbus ports on that SI-3X board. The second physical SI-3X disk controller board on that same IOS will be assigned `eiop` values of 22 and 23. The third physical SI-3X disk controller board will have `eiop` values of 24 and 25.

The following example cluster statement defines IOS 0 as having two SI-3X controller boards in it with disks (DD-5S, DD-6S, or customer-supplied DD-U) attached to these two boards:

```
cluster 0 {
muxiop; eiop 0; eiop 20; eiop 21; eiop 22; eiop 23;
}
```

These values are used regardless of the type of disk device being controlled by the SI-3 board. One physical SI-3 controller contains two ports, 0 and 1, each of which connects to an independent SCSIbus. Each port is treated by the software as a separate logical SI-3 controller. SI-3 controller boards that are not controlling disk devices should not have associated `eiop` values included in the cluster statement.

Disk Configuration

If you need more information on disk configuration syntax, refer to the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, publication number SG-2416.

Add the appropriate information to define the new physical device configuration.

1. Specify the `cluster` (IOS) and `eiop` (logical controller) numbers. These are the same values chosen in the preceding "IOS Information for Disk Devices" subsection.
2. Specify the `channel` using the Y1 channel value (in octal) that corresponds with the specified IOP cluster.
3. Specify the `type` parameter for DD-U drives to be `DD_U`.
4. The `unit` parameter will be 0, 1, 2, or 3, signifying the disk drive SCSI ID that is attached to that `eiop` (logical controller) number.
5. Specify the capacity (sectors) based on the output of the `dstat` or `dformat` command. Do not specify a size exceeding the number of blocks determined from the `dstat` command (1 block = 1 sector).

Disk Configuration - Physical Definition

NOTE: Your customer-supplied disk devices may appear as disk type `DD6S` in the `load` and `whatmic` command output. You should still refer to these drives as `DD_U` in the software configuration (`param` file).

You must use system-wide unique names and minor numbers for each physical device definition (`pdd`) statement for the new disks. Do not use existing names or `pdd` minor numbers. The name of the disk itself also must be unique throughout the entire UNICOS configuration file.

The following example shows possible physical device definition statements for one SI-3 controller with two drives attached to each of the SI-3's two ports. Each drive in this example has a capacity of 78100 4096-byte blocks.:

```
disk S30_100 {type DD_U; iopath{cluster 1;eiop 20;channel 040;} unit 0;
     pdd scratch_a0    {minor 26; sector 0; length 500000 sectors;}
     pdd scratch_b0    {minor 27; sector 500000; length 281000 sectors;}
}
disk S30_101 {type DD_U; ipath{cluster 1;eiop 20;channel 040;} unit 1;
     pdd scratch_a1    {minor 28; sector 0; length 781000 sectors;}
}
disk S30_110 {type DD_U; ipath{cluster 1;eiop 21;channel 040;} unit 0;
     pdd scratch_b2    {minor 32; sector 0; length 781000 sectors;}
}
disk S30_111 {type DD_U; ipath{cluster 1;eiop 21;channel 040;} unit 1;
     pdd scratch_b3    {minor 30; sector 0; length 781000 sectors;}
}
```

Disk Configuration - Logical Definition

Add the appropriate information to define the logical devices that relate to the new physical devices.

1. You must use system-wide unique names and minor numbers for each logical device definition (`ldd`) statement relating to the new disks. You cannot use existing names or `ldd` minor numbers.

2. The following definitions are possible logical device definitions for the temporary scratch file systems created in this upgrade procedure:

```
ldd scratcha {
     minor 20;
     pdd scratch_a0;
     pdd scratch_a1;
}
ldd scratchb {
     minor 21;
     pdd scratch_b0;
     pdd scratch_b2;
     pdd scratch_b3;
}
```

3. The values for `PDDMAX`, `PDDSLMAX`, and `LDDMAX` may require adjustment. Refer to the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, publication number SG-2416, for more information.

   `PDDMAX` represents the maximum number of physical disks allowed.

Physical disks are the `disk` entries in the `param` file. `PDDMAX` should be at least equal to the number of configured physical disk devices.

`PDDSLMAX` represents the maximum number of physical slices allowed. Physical slices are the `pdd` definitions in the `param` file. `PDDSLMAX` should be set to at least one more than the highest minor number used by a `pdd` statement in the `param` file. (`PDDSLMAX` is used to calculate the size of a kernel table, and the minor numbers are used to index into that table.) A value of at least 256 is recommended for `PDDSLMAX`. This is needed for the correct operation of the `pddconf`(8) command.

`LDDMAX` represents the maximum number of logical devices allowed. Logical devices are the `ldd` definitions in the `param` file (and the devices created in the directory `/dev/dsk`). `LDDMAX` should be set to at least one more than the highest minor number used by an `ldd` statement in the `param` file. (`LDDMAX` is used to calculate the size of a kernel table, and the minor numbers are used to index into that table.)

Validate your changes to the `param` file by performing the following steps:

4. UNICOS must now be in single-user or multiuser mode. If UNICOS has not been booted, boot to single-user mode now by entering the following command:

```
sn9xxx-ios0> /bin/boot
```

5. On UNICOS, copy the `param.disk` file from the SPARC console's file system to a UNICOS file, such as `/param_test`, as follows:

```
# exdf -i /sys/param.disk > /param_test
```

6. To validate the syntax of your `param` file changes, enter the following command:

```
# /etc/econfig /param_test
```

If the `econfig` command detects a problem with your configuration file, you must correct that problem **before** continuing with the next step. It also is worthwhile to manually review the changes made to the `param_test` file at this time to make sure you have not made any logical errors.

If changes are made to the `param_test` file while validating it under UNICOS, copy the changed version back to the system console before proceeding by entering the following command:

```
# exdf -ro /sys/param.disk < /param_test
```

7. Return to the IOS prompt (if not already there) and make a backup copy of the existing `param` file, and then replace it with the newly created version of the `param` file. Enter the following commands:

```
# <CONTROL-a> (toggles to the IOS console if in single-user mode)
sn9xxx-ios0>
sn9xxx-ios0> cd /sys
sn9xxx-ios0> cp param param.bak
sn9xxx-ios0> cp param.disk param
```

This is the end of the "Software Configuration Preparation for Disk Devices" section.

Disk Software Change Procedure

1. Boot UNICOS to single-user mode, with the new `param` file, by entering the following command:

```
sn9xxx-ios0> /bin/boot
```

2. On UNICOS, use the `exdf` command to copy the `param` file from the SPARC console's file system to a UNICOS file, such as `/param_test`:

```
# exdf -i /sys/param > /param_test
```

3. Create the device nodes for the new disk configuration by entering the following UNICOS commands:

```
# /bin/mv /dev/mkdev.sh /dev/mkdev.sh.bak
# /etc/econfig -d /param_test > /dev/mkdev.sh
# chmod 700 /dev/mkdev.sh
# cd /dev
# rm -f dsk/* pdd/* mdd/* sdd/* ldd/*
# /dev/mkdev.sh
```

4. Create the two new temporary scratch file systems by entering the following commands:

```
# /etc/mkfs -q /dev/dsk/scratcha
# /etc/mkfs -q /dev/dsk/scratchb
```

5. Verify the two new temporary scratch file systems by entering the following commands:

```
# /etc/fsck /dev/dsk/scratcha
# /etc/fsck /dev/dsk/scratchb
```

6. If you are running MLS, use the `/etc/labelit` command to label the file systems appropriately.

7. Ensure that you can mount the two new scratch file systems by entering the following commands:

```
# /bin/mkdir /scratcha ; chmod 755 /scratcha
# /etc/mount /dev/dsk/scratcha /scratcha

# /bin/mkdir /scratchb ; chmod 755 /scratchb
# /etc/mount /dev/dsk/scratchb /scratchb
```

8. To verify that the upgrade was successful, copy data to the scratch file systems by entering the following commands:

```
# cp /unicos /scratcha/uni1
# cp /unicos /scratcha/uni2
# cp /unicos /scratchb/uni3
# cp /unicos /scratchb/uni4
# cp /unicos /scratchb/uni5
```

   Verify that each file is the proper size; then remove these files.

9. Unmount all file systems by entering the following command:

```
# /etc/umountem
```

10. The system can now be booted to multiuser mode or the customer may proceed to the “Disk Device Integration” section. Enter multiuser mode by entering the following command:

```
# /etc/init 2
```

Disk Device Integration

Now that it has been verified that the disk subsystem configuration has been successful, it is necessary for the customer to integrate these new disks with existing file systems. This requires further editing of the `param` file: the file that was previously edited in this upgrade to create the scratch file systems.

Refer to the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, publication number SG-2416, for details. The procedure pages in the File Systems section of that manual describe the necessary steps. The alterations are described both with and without the use of the UNICOS Installation / Configuration Menu System (ICMS); however, the ICMS cannot be used to configure DD-U type disks. The change procedures outlined in this upgrade document can be used to supplement SG-2416.

NOTE: Create backup copies of any file systems that will be changed in the UNICOS configuration file (`param`).

The changes made to the IOS configuration file and some changes made to the UNICOS configuration file (`param`) in the "Software Configuration Preparation for Disk Devices" section should be retained. These include the addition of `eiop` values to the IOS cluster definition and any changes to `PDDSLMAX`, `LDDMAX`, and `PDDMAX` in the UNICOS definition section.

Tape Configuration

The following procedure for configuring a 3480 compatible tape device is provided as an example. For other devices, see the manuals referenced here.

This example is for a device that was previously described in this document as `rss350` in the IOS load-time output. The device name in the `tapeconfig` file is arbitrary, but using the name assigned by the IOS `load` command may reduce confusion.

For definitions of support categories for the various tape technologies, to define the differences between UNIX character special and advanced funtionality, and to provide general information about future tape product availability, see Product Availability Notice (PAN) # 86. Cray Research personnel can access this PAN on the World Wide Web via Mosaic at the following URL: `http://wwwcic.cray.com/OnLine/PRODUCT_INFO/PANS/PAN_86_Tape_Support.txt`. If you cannot access this PAN, contact Pat Hughes (`plh@cray.com`) at (612) 683-3029.

If your system is running UNICOS release 8.0.4 or earlier, for information on tape configuration, see the Tape Subsystem section in the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, publication SG-2416.

If your system is running UNICOS release 9.0 or later, for information on tape configuration, see the *UNICOS Tape Subsystem Administrator's Guide*, publication SG-2307, and the *UNICOS Tape Subsystem User's Guide*, publication SG-2051.

Example: Configuring a Tape Daemon Device

NOTE: The following procedure does not use the Menu System (install) tool. If you use the Menu System for configuring your system, import the `tapeconfig` file after you complete this procedure. Otherwise, you may lose your tape configuration as a result of the

Menu System writing to the `tapeconfig` file.

1. Log in to your UNICOS system as root.
2. Create a `tapeconfig` file, if one does not already exist. When your CRAY J90 series system with UNICOS 8.0.4 is delivered, it will include a `/etc/config/text_tapeconfig` file.

```
# cd /etc/config
# vi tapeconfig    or   # vi text_tapeconfig
```

NOTE: A copy of the UNICOS 8.0.4B `/etc/config/text_tapeconfig` file follows. This file is an example of a basic `tapeconfig` file and does not have SI-3X defined within it. Refer to the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, publication number SG-2416, and the *UNICOS Tape Subsystem Administrator's Guide*, publication number SG-2307, for format and parameter definitions required for entry in the `tapeconfig` file.

```
#
# USMID @(#)ELS/bld/text_tapeconfig.default80.410/07/94 13:18:12
#
# copy for default package -> /etc/config/text_tapeconfig
#

LOADER
   name = Operator ,
   type = OPERATOR ,
   status = UP ,
   message_path_to_loader = MSGDAEMON ,
   message_class = NONE ,
   server = UNICOS ,
   scratch_volume_label_type = (NL,AL,SL) ,
   queue_time = 0 ,
   verify_non_label_vsn = YES ,
   message_route_masks = (UNICOS) ,
   mode = ATTENDED


DEVICE_GROUP
   name = DAT
IOP
   number = 0 ,
   cluster = 0
   {
        CHANNEL
             address = 022 ,
             status = UP
        BANK
             number = 0
             {



             CONTROL_UNIT
                       protocol = IOP ,
                       status = UP ,
                       path = ((022, 0))

             DEVICE
                       name = rpd03 ,
                       device_group_name = DAT ,
                       id = 030 ,
                       type = DAT ,
                       status = DOWN ,
                       loader = Operator
        }
   }
```

```
OPTIONS
   avr_at_startup = YES ,
   max_number_of_device_groups = 8 ,
   max_blocksize = 4194303 ,
   tape_daemon_trace_file_prefix = /usr/spool/tape/trace ,
   tape_daemon_trace_file_owner = 0 ,
   tape_daemon_trace_file_group_id = 9 ,
   tape_daemon_trace_file_mode = 0640 ,
   tape_daemon_trace_file_size = 409600 ,
   tape_daemon_trace_savefile_prefix = /usr/spool/tape/save/trace ,
   blp_ring_status = UNRESTRICTED ,
   system_code = CRI/UNICOS ,
   reselect_cart = NO ,
   device_group_name = DAT ,
   retention_period_days = 0 ,
   servicing_frontend_at_startup = NO ,
   secure_frontend = NO ,
   servicing_frontend_mandatory = NO ,
   mainframe_job_origin = C1 ,
   scratch_volume_action = FREE ,
   operator_message_type = USCP_TYPE_1 ,
   check_vsn = YES ,
   check_file_id = YES ,
   check_protection = NO ,
   check_expiration_date = YES ,
   tape_daemon_dump_mask = (MLT,LBL,DPW,SM,LDRREQ,CSI,ACC,EDT,FUNC)
```

3. For the 3480 compatible device, you must add the following information to the `/etc/config/tapeconfig` or `text_tapeconfig` file and then save it in a file named `/etc/config/tapeconfig`. The tape daemon uses the parameters in the `tapeconfig` file.

   a. For the DEVICE_GROUP definition section, add the following information:

```
DEVICE_GROUP
      name = DAT , (Note: this line is already in text_tapeconfig)
      avr = YES
DEVICE_GROUP
      name = CART ,
      avr = YES
```

   b. For the CHANNEL definition in the IOP section, add the following information:

```
CHANNEL
     address = 023 ,
     status = UP
```

c. For BANK, CONTROL_UNIT, and DEVICE definition in the IOP section, add the following information:

```
BANK
     number = 1
     {
          CONTROL_UNIT
               protocol = SI2 ,
               status = UP ,
               path = ((023, 3))
          DEVICE
               name = rss350 ,
               device_group_name = CART ,
               id = 050 ,
               type = 3480 ,
               status = DOWN ,
               loader = Operator

     }
```

NOTE: For details on the `tapeconfig` definitions, content, and parameter entries, see the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, Cray publication number SG-2416, and the *UNICOS Tape Subsystem Administrator's Guide*, publication number SG-2307. It is very important to understand what each of these entries represents. SG-2416 contains explanations and specifies how to determine the correct value for each entry.

The text in the new `/etc/config/tapeconfig` file follows:

```
#
# USMID @(#)ELS/bld/text_tapeconfig.default80.410/07/94 13:18:12
#
# copy for default package -> /etc/config/text_tapeconfig
#

LOADER
   name = Operator ,
   type = OPERATOR ,
   status = UP ,
   message_path_to_loader = MSGDAEMON ,
   message_class = NONE ,
   server = UNICOS ,
   scratch_volume_label_type = (NL,AL,SL) ,
   queue_time = 0 ,
   verify_non_label_vsn = YES ,
   message_route_masks = (UNICOS) ,
   mode = ATTENDED
DEVICE_GROUP
   name = DAT
   avr = YES
DEVICE_GROUP
   name = CART ,
   avr = YES
IOP
   number = 0 ,
   cluster = 0
   {
         CHANNEL
               address = 022 ,
               status = UP
         CHANNEL
               address = 023 ,
               status = UP
```

(`tapeconfig` file continued)

```
            BANK
                  number = 0
                  {
                        CONTROL_UNIT
                              protocol = IOP ,
                              status = UP ,
                              path = ((022, 0))
                        DEVICE
                              name = rpd03 ,
                              device_group_name = DAT ,
                              id = 030 ,
                              type = DAT ,
                              status = DOWN ,
                              loader = Operator
                  }
            BANK
                  number = 1
                  {
                        CONTROL_UNIT
                              protocol = SI2 ,
                              status = UP ,
                              path = ((023, 3))
                        DEVICE
                              name = rss350 ,
                              device_group_name = CART ,
                              id = 050 ,
                              type = 3480 ,
                              status = DOWN ,
                              loader = Operator
                  }
      }
   OPTIONS
      avr_at_startup = YES ,
      max_number_of_device_groups = 8 ,
      max_blocksize = 4194303 ,
      tape_daemon_trace_file_prefix = /usr/spool/tape/trace ,
      tape_daemon_trace_file_owner = 0 ,
      tape_daemon_trace_file_group_id = 9 ,
      tape_daemon_trace_file_mode = 0640 ,
```

(`tapeconfig` file continued)

```
  tape_daemon_trace_file_size = 409600 ,
     tape_daemon_trace_savefile_prefix = /usr/spool/tape/save/trace ,
     blp_ring_status = UNRESTRICTED ,
     system_code = CRI/UNICOS ,
     reselect_cart = NO ,
     device_group_name = DAT ,
     retention_period_days = 0 ,
     servicing_frontend_at_startup = NO ,
     secure_frontend = NO ,
     servicing_frontend_mandatory = NO ,
     mainframe_job_origin = C1 ,
     scratch_volume_action = FREE ,
     operator_message_type = USCP_TYPE_1 ,
     check_vsn = YES ,
     check_file_id = YES ,
     check_protection = NO ,
     check_expiration_date = YES ,
     tape_daemon_dump_mask = (MLT,LBL,DPW,SM,LDRREQ,CSI,ACC,EDT,FUNC)
```

4. Determine whether the tape daemon is running by entering the following commands:

```
# ps -ael | grep tpd
 1 S   0   558   1 26 20   36250   400   3055666 ?   0:01 tpdaemon
# tpstat
 userid jobid dgn a stat dvn   bx i rl ivsn evsn blks NQSid
              DAT - down rpd03 02 0
```

If it is running, enter the following commands to stop it:

```
# /etc/sdaemon -k tpdaemon
 Stopping daemon: tpdaemon.
# ps -ale | grep tpd
```

5. Start the tape daemon so that it will use your new configuration file by entering the following commands:

```
# sdaemon -s tpdaemon
 Starting daemon: tpdaemon.
# tpstat
userid   jobid dgn a stat dvn    bx i rl ivsn   evsn   blks NQSid
               DAT - down rpd03 02 0
               CART - down rss350 03 0
```

6. Configure up the rss350 tape device by entering the following commands:

```
# /etc/tpconfig rss350 up
# tpstat
 userid jobid dgn  a  stat dvn     bx i rl ivsn  evsn  blks  NQSid
              DAT -  down rpd03    02 0
               CART -  sdwn rss350   03 0
```

7. Copy a file to the rss350 device by entering the following commands (Load a blank cartridge tape with write protection off in the rss350 device.):

```
# rsv CART
# tpmnt -l sl -p scratch -v TEST1 -g CART
# dd if=/unicos of=scratch
# rls -a
```

8. Read a file from the rss350 device by entering the following commands:

```
# rsv CART
# tpmnt -l sl -p scratch -v TEST1 -g CART
# dd if=scratch of=/tmp/tapetest
# rls -a
```

9. Compare the original file to the file that was copied to and from the tape to ensure they are identical by entering the following command:

```
# cmp /unicos /tmp/tapetest
```

Configuring a Character Special File

This section describes the character special files that are used by the `ddal` or character special tape interface that is available only in UNICOS 8.0. These files reside in the /`dev` UNICOS directory. The new character special tape interface (tape-daemon-assisted), available in UNICOS 9.0, uses character special files that reside in the `/dev/tape` UNICOS directory. These special files are created automatically when the tape daemon is started. See the *UNICOS Tape Subsystem Administrator's Guide*, publication number SG-2307, for details on the `/dev/tape` tape character special files.

NOTE: See the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, publication number SG-2416, or the *UNICOS Tape Subsystem Administrator's Guide*, publication number SG-2307, for `mknod` parameter definitions. It is very important to understand what each parameter represents. SG-2416 contains explanations and specifies how to determine the correct value for each entry. It also includes examples of `mknod`

commands for other supported SCSI tape devices.

1. Create the character special file by entering the following commands:

```
# cd /dev
# ls -l r*
 crw-r--r--  1 root   root   43, 0 Jun 16 08:49 rmt00
 crw-r--r--  1 root   root   43, 5 Jun 20 09:23 rpd03
 crw-r--r--  1 root   root   43, 2 Jun 16 08:49 rpe02
 crw-r--r--  1 root   root   43, 0 Jun 16 08:49 rpq01
# /etc/mknod /dev/rss350 c 43 6 0 10 6 3 5 0 0 0
```

2. Verify that the rss350 device is now present and that it has the appropriate permissions by entering the following commands:

```
# file r*
 rmt00:   character special (43/0)  0 9 66 0 0 0 0 0
 rpd03:   character special (43/5)  0 8 68 0 3 0 0 0
 rpe02:   character special (43/2)  0 8 65 0 2 0 0 0
 rpq01:   character special (43/0)  0 8 64 0 1 0 0 0
 rss350:  character special (43/6)  0 10 6 3 5 0 0 0
# ls -l r*
 crw-r--r--  1 root   root   43, 0 Jun 16 08:49 rmt00
 crw-r--r--  1 root   root   43, 5 Jun 20 09:23 rpd03
 crw-r--r--  1 root   root   43, 2 Jun 16 08:49 rpe02
 crw-r--r--  1 root   root   43, 0 Jun 16 08:49 rpq01
 crw-------  1 root   root   43, 6 Aug 17 16:52 rss350
# chmod 644 /dev/rss350
```

3. Copy a file to the rss350 device by entering the following command (Load a blank cartridge tape with write protection off in the device.):

```
# dd if=/unicos of=/dev/rss350
```

4. Read a file from the rss350 device by entering the following command:

```
# dd if=/dev/rss350 of=/tmp/tapetest
```

5. Compare the original file to the file that was copied to and from the tape to ensure they are identical by entering the following command:

```
# cmp /unicos /tmp/tapetest
```

6. You also may want to create a nonrewind device file interface for this tape drive, such as `/dev/nrss350`. See the *UNICOS Basic Administration Guide for CRAY J90 and CRAY EL Series*, publication number SG-2416, or the *UNICOS Tape Subsystem Administrator's Guide*, publication number SG-2307, for details.

Removed Parts Disposition

Do not dispose of removed parts locally; return the removed parts to:

Cray Research, Inc.
1000 Halbleib Road
Chippewa Falls, WI 54729
Attention: Removed Equipment Management

IR Reporting

There is a separate incident report for upgrades. Refer to *CSH # ADM-COM-9307*. Please fill one out.