Cray/ REEL librarian (CRL) Administrator's Guide

SG–2127 2.0

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New Features

Cray/ REEL librarian (CRL) Administrator's Guide SG–2127 2.0

This rewrite of the *Cray/ REEL librarian (CRL) Administrator's Guide* supports the 2.0 release of CRL. New features specific to this manual include the following:

- Support for ER90 media type volumes allows you to catalog multiple volume serial numbers (VSNs) or partitions of a single ER90 cassette as individual volume records.
- Support for the UNICOS multilevel security (MLS) feature adds MLS labels and optional access control lists (ACLs) to file and volume records when MLS is configured.
- A new default volume set parameter specification, `DF.poolname`, has been added as the first source of default parameters.
- The maximum file ID length has been increased from 17 to 44 characters.
- The `phold=y` keyword has been added to the `rlvscratch`(1) command to release scratch volumes that are in the hold state.
- You may select whether to allow duplicate file names that are not differentiated by generation or version numbers by using the `RL_NODUPFIDS` parameter in `/etc/config/reel_env`.
- The `-y Z` option of the `tpmnt`(1) command has been added to bypass processing by CRL for volumes that do not exist in the CRL database.
- The `ftrack` keyword has been removed from the `rledit`(1) command.
- The `slocation` keyword has been removed from the `rlpsubmit`(1) command.
- The CRL administrator no longer is required to specify the `force=yes` keyword when using `rlvscratch`(1) on volume sets owned by other users.
- The *REEL librarian* reference has been removed from the output of the `rlr pvolumes` report.
- The `rlvunlock`(8) command has been added to release volume locks if a tape job aborts.

Record of Revision

The date of printing or software version number is indicated in the footer. Changes in rewrites are noted by revision bars along the margin of the page.

Version	***Description***
1.0	October 1992. Original printing to support Cray/REEL librarian (CRL) release 1.0.
2.0	January 1994. Rewrite to support Cray/REEL librarian (CRL) release 2.0.

Preface

This publication documents *Cray/ REEL librarian* (CRL) release 2.0 running on all Cray Research platforms, except CRAY-2 systems, using the 8.0 release or subsequent releases of the UNICOS operating system. CRL is a volume management system that controls a centrally stored library of tapes (or volumes) and validates requests for tape mounts by communicating with the UNICOS tape subsystem. This manual describes the concepts and commands you need to use CRL.

CRL is based directly on REEL librarian, a tape management system developed by Sceptre Corporation of Ann Arbor, Michigan. Only the catalog portion of REEL librarian has been ported to CRL. The functionality provided by the tape mount request system of REEL librarian was implemented in CRL through an interface to the existing UNICOS tape subsystem. The commands used in CRL begin with the letters `rl` or `RL` because of the desire to keep CRL as compatible as possible with REEL librarian.

Warning

The UNICOS 8.0 multilevel security (MLS) system is currently undergoing a security evaluation by the National Computer Security Center (NCSC) and is targeted to receive a B1 MDIA rating at or shortly after the 8.0 release of the UNICOS operating system.

MDIA is an acronym defined in the Trusted Network Interpretation (TNI). It is formed by combining the first letter of the following four security policies, which network components can support in order to obtain an evaluated rating:

M = Mandatory access control (MAC)
D = Discretionary access control (DAC)
I = Identification and authentication (I&A)
A = Audit

A network component can support any combination of these policies (for example, M, D, A, I, MD, MA, MI, DA, ...MDIA). The evaluated version of the UNICOS MLS system supports all four policies.

Because all security-relevant information must be specifically called out, especially as it pertains to the installation, configuration, administration, maintenance, and use of an evaluated system, it is necessary to define a term that describes the UNICOS MLS system being evaluated. Accordingly, the term *Trusted UNICOS 8.0* defines the specified configuration of all UNICOS structures and subsystems, as well as all other associated Cray product releases, that comprise the evaluated UNICOS MLS system.

The Trusted UNICOS 8.0 system is referred to as *Trusted UNICOS* in this manual. All the information relevant to Trusted UNICOS in this manual is identified to make this definition clear.

Until such time as the current evaluation is successfully completed, use of the term *Trusted UNICOS* in no way implicitly or explicitly implies, nor should the reader infer, that a B1 MDIA rating has been obtained from the NCSC for the UNICOS MLS system.

Any use by your site of a future update or revision to Trusted UNICOS implies the use of a site accreditation process to maintain an equivalent security level. Future enhancements of Trusted UNICOS will be documented in the corresponding release overview to aid the accreditation process.

Related publications

In addition to this document, administrators of CRL may want to consult the *UNICOS System Administration*, publication SG–2113, for information about configuring the UNICOS tape subsystem and starting and stopping the tape daemon.

Users of CRL may want to consult the *Cray/ REEL librarian (CRL) User's Guide*, publication SG–2126, for information on the concepts and operations needed to use CRL. In addition, the *UNICOS Tape Subsystem User's Guide*, publication SG–2051, contains information about using the UNICOS tape subsystem to mount, read, and write tapes. The user command man pages for the tape subsystem, published in the *UNICOS User Commands Reference Manual*, publication SR–2011, may also be helpful.

Warning

If your site is running a UNICOS multilevel security (MLS) or Trusted UNICOS system, there are additional administration requirements for establishing and maintaining a specific security level. To avoid invalidating your system's Trusted UNICOS evaluated rating, you must have read and understood the following information:

- *UNICOS Multilevel Security (MLS) Feature User's Guide*, publication SG–2111
- *UNICOS System Security Overview for Administrators*, publication SG–2141
- *UNICOS System Administration*, the MLS subsection, publication SG–2113

If your site is running a Trusted UNICOS system, you also must follow all procedures outlined in "Multilevel security (MLS) or Trusted UNICOS," page 44, in order to maintain the system's evaluated rating and to use CRL properly on a Trusted UNICOS system. Failure to do so may invalidate the evaluated rating. (See also "Multilevel security (MLS) or Trusted UNICOS" in the *Cray/ REEL librarian (CRL) User's Guide*, publication SG–2126, for a detailed description of the MLS feature and its support of CRL.)

Conventions

The following conventions are used throughout this manual:

Convention	Meaning
`Courier`	This font denotes literal items such as commands, files, routines, path names, signals, messages, and programming language structures.
italic	This typeface denotes variable entries and words or concepts being defined.
`bold Courier`	This font denotes literal items that the user enters in screen drawings of interactive sessions. Output is shown in nonbold Courier font.
[ ]	Brackets enclose optional portions of a command line.
...	Ellipses indicate that a preceding command-line parameter can be repeated.
$\boxed{\texttt{KEY}}$	Indicates a key on the keyboard.
`<KEY>`	Indicates a key on the keyboard for man pages.

The following machine naming conventions are used throughout this manual:

Term	Definition
CRAY Y-MP systems	All configurations of CRAY Y-MP systems supported by UNICOS 8.0, including the M90 series (M92, M94, M98); C90 series (C916, C92A, C94, C94A, and C98); E series (2E, 4E, 8E, and 8I); EL series (including CRAY Y-MP EL, CRAY EL92, and CRAY EL98).
CRAY X-MP systems	All configurations of CRAY X-MP systems supported by UNICOS 8.0. This includes CRAY X-MP, CRAY X-MP EA, and CRAY X-MP EMA systems.
CRAY-2 systems	All configurations of CRAY-2 systems supported by UNICOS 8.0.

Term	Definition
Cray MPP systems	All configurations of the CRAY T3D series, supported by UNICOS 8.0, including CRAY T3D MC, CRAY T3D MCA, and CRAY T3D SC.
All Cray Research systems	All configurations supported by UNICOS 8.0.

It is the objective of Cray Research to become compliant with IEEE Std 1003.1–1990 (POSIX.1) and IEEE Std 1003.2–1992 (POSIX.2). This manual reflects those ongoing efforts.

POSIX.2 uses utility to refer to executable programs that Cray Research documentation usually refers to as commands. Both terms appear in this document.

In this publication, Cray Research, CRI, and Cray refer to Cray Research, Inc. and/or its products.

Man page references

Throughout this document, reference is made to the online man pages available under UNICOS through the `man` command. A *man page* is a discussion of a particular element of the UNICOS operating system or a compatible product.

Each man page includes a general description of one or more commands, routines, or other topics and provides details of their usage (command syntax, routine parameters, system call arguments, and so on). If more than one topic appears on a page, the entry will appear in the printed manual alphabetized only under its major name. You can access a man page named `ls` online by typing `man ls`.

Section numbers appear in parentheses after man page names. Man pages are referenced in text by entry name and section number, as shown in the following example: The `-p` and `-s` options to the `dmput`(1) command require that the caller be super user.

The following lists the type of entry associated with each section number:

Section	Subject
1	User commands
1B	User commands ported from BSD
2	System calls
3	Library routines, macros, and opdefs
4	Devices (special files)
4P	Protocols
5	File formats
7	Miscellaneous topics
7D	DWB-related information
8	Administrator commands

A routine name followed by an empty set of parentheses designates a kernel routine; for example, `ddcntl`(). These routines do not have man pages associated with them.

All administrator command and file format man pages that are part of CRL are included in appendix A of this document. CRL user command man pages are published in the *Cray/ REEL librarian (CRL) User's Guide*, publication SG–2126.

Ordering publications

The *User Publications Catalog*, publication CP–0099, lists all Cray Research hardware and software manuals that are available to customers.

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- Use the postage-paid Reader's Comment Form at the back of this manual.

We value your comments and will respond to them promptly.

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PLEASE PROVIDE THE FOLLOWING INFORMATION ABOUT YOUR DOCUMENT:

1. Are there any special printing instructions?

2. Please identify the location of any files containing graphics for your document.

3. Briefly describe any customized Interleaf components.

   Added 2 or 3 new key components that did not exist.

4. Please describe any conventions unique to your document (e.g., special spellings or formats).

5. If you and your editor have negotiated any exceptions to the SIS style standard, please briefly describe them here.

6. Briefly describe any revisions that you cannot make now, due to time constraints, but plan to make for the next release.

7. Do you need ASCII files made and/or moved to the crayamid?

Introduction [1]

Cray/REEL librarian (CRL) is a volume management system that controls a centrally stored library of tapes (or volumes) and validates requests for tape mounts by communicating with the UNICOS tape subsystem.

This administrator's guide contains the following sections:

Section	Title and description
1	Introduction. Lists the features of CRL, describes the operation of the full-screen interface, and defines terms important to the understanding of CRL.
2	CRL Architecture. Describes the components of CRL conceptually and in terms of online storage, and discusses routine operation and maintenance tasks for CRL.
3	Installation Procedure. Lists the steps you must perform to load CRL from the release media, configure the installation parameters, and install it on your system.
4	Administering CRL. Describes the tasks for proper operational configuration, initiation, termination, and recovery of CRL.
A	CRL Man Pages. Contains a copy of all administrator command and file format man pages related to CRL.
B	CRL Messages. Lists the messages issued by CRL and their explanations.

Features of CRL 1.1

The following features make CRL an important part of any hierarchical storage management plan that includes tapes:

- Online tape catalog that allows large numbers of volumes to be tracked and managed, listing their media types, data formats, and many other characteristics.
- Catalog transaction journaling to ensure catalog integrity and facilitate disaster recovery.
- Support for multiple tape storage sites. CRL can track a volume at any site defined in its configuration file.
- User access by file name. Users do not have to supply volume names, volume IDs, or volume serial numbers to access a file.
- Interface to UNICOS tape subsystem through Remote Procedure Call (RPC) protocol. This allows tape mount, read, and write requests to be issued through CRL to the UNICOS tape subsystem.
- Volume and file access control through owner, group, and world permissions as well as optional passwords. This method of control provides both volume- and file-level security. Additionally, if the UNICOS multilevel security (MLS) or Trusted UNICOS feature is enabled, it labels volume and file records with mandatory level and compartment parameters and optional access control lists; access to them is controlled according to the MLS policy in effect at the site.
- Full-screen and command-line interfaces for users, administrators, and operators. Allowing a choice of interface makes CRL easy to learn without interfering with the efficiency of experienced users.
- Support for ER90 volumes. This allows multiple volume serial numbers (VSNs) on a single piece of record storage equipment.

Full-screen interface
1.2

The `rl` and `rlconfig` commands (see `rl`(1)) invoke the CRL full-screen interface to the catalog. In this interface, you will encounter the five types of input described in the following list:

Input type	Description
Menu	A list of numbered items is presented. Enter the number of your choice in the field following the `SELECTION:` prompt above the menu. A new screen appears after a valid selection and `RETURN` are entered.
List window	A subwindow with a descriptive heading is displayed, followed by a list of entries. (Common headings include `MASTER LIST`, `User list`, and `Group list`.)

The commands available in a list window are as follows:

- `a` Adds an entry. When this option is selected, a new screen for adding a new entry is displayed.
- `d` Deletes an entry. When this option is selected, the entry pointed to by the cursor is deleted, and the list is redisplayed.
- `e` Edits an entry. When this option is selected, a new screen for editing the entry pointed to by the cursor is displayed.
- `j` Moves down to the next entry in the list.
- `k` Moves up to the previous entry in the list.
- `q` Exits the window and returns to the calling menu.

Input type	Description
Field entry	Text input is required. Enter your reply in the field next to the prompt. The prompt will be of the following form: *field_name* : Press `RETURN` to indicate that the field has been filled. The field value changes when `RETURN` is pressed.
Option list	A choice from a limited set of options is required. The options are displayed in a line, and one of the choices is highlighted by reverse video or by an asterisk next to it. You can move the highlighting (and thus change your selection) by using the space bar. When the desired option is highlighted, press `RETURN` to indicate that the selection has been made. The highlighting moves to the new choice when `RETURN` is pressed.
Command prompt	The cursor is to the right of a greater-than (>) character, indicating that a command is required. Respond by typing one of the single-letter commands described under the List window input type.

The keys listed in Table 1 have special meanings in the full-screen interface operation.

Table 1. Special full-screen interface keys

Function	Key	Description
Escape	`CONTROL-e`	Causes the current activity to be abandoned and cancels any current data entry. No changes are made.
Help	`CONTROL-b`	Presents help information on the screen in a subwindow. Enter `RETURN` to return to the calling window.

Table 1. Special full-screen interface keys
(continued)

Function	Key	Description
Form	`CONTROL-f`	Enters and processes the current menu or form. This is equivalent to keying a carriage return in the last field on the menu or form, and it allows you to update some of the fields in the form without having to step through fields that are not being changed.
Redraw	`CONTROL-r`	Redraws the current screen.
Clear field	`CONTROL-o`	Clears the contents of the current field.
Back field	`CONTROL-u`	Moves back one field.

The `rlconfig` command (see `rl(1)`) invokes the full-screen administrative interface. This interface allows you to configure the CRL elements shown in Figure 1.

```
+--------------------------------------------| CONFIGURATION MENU |--------+
|                                                                           |
|                                                                           |
|               SELECTION:                                                  |
|                                                                           |
|                                                                           |
|               0   Exit                                                    |
|               1   Operators                                               |
|               2   Storage Sites                                           |
|               3   Media Type Aliases                                      |
|               4   Miscellaneous                                           |
|                                                                           |
|                                                                           |
|                                                                           |
|                                                                           |
|                                                                           |
|       CNTL-E to Abort        CNTL-F to Commit        CNTL-B for Help      |
+---------------------------------------------------------------------------+
```

Figure 1. Configuration menu

Make your selection by entering the number of the desired action. The actions performed by these selections are described in "The `rlconfig` program," page 47.

CRL terminology 1.3

CRL manages libraries of mountable media types. The various types are completely definable by the site. They may consist of various tape media (including 9-track tape, cartridge tape, and ER90 tape) or other recording media (including optical disks, disk packs, and diskettes). For the remainder of this manual, the term *volume* refers to any media type that is being managed by CRL and is accessible by the tape subsystem.

CRL maintains the *library*, which consists of all volumes and files that are accessible through CRL by the tape subsystem. The library is managed through the CRL *catalog*, an online database in which CRL tracks volume and file attributes and ownership. All access to the volumes is cleared through catalog security. Volumes enter and exit the library by way of user or administrator submission and retrieval procedures.

Users write and read data on physical volumes by creating and accessing volume sets. A *volume set* is a logical volume that can consist of one or more physical volumes. When a user writes data to the volume set, transitions from the end of one volume to the beginning of the next are handled transparently. When a volume set is read, volume transitions are similarly transparent.

CRL is designed to address the functional needs of two groups: system administrators and end users. Each group has interfaces and programs developed to support its activities. This manual contains information needed by system administrators and includes man pages for each CRL administrator command and file format.

CRL is network software.† It provides a common volume management service to multiple CRL systems on a network. Any CRL node in the network can request volume information from the CRL server for use in managing its own set of mountable media devices.

† Implementation is deferred for sites running CRL in a heterogeneous network environment with non-Cray/ REEL librarian clients or servers.

CRL Architecture [2]

This section describes the architecture of CRL. The following topics are discussed:

- Online storage requirements
- Catalog physical structure
- CRL software structure
- Operating CRL

Figure 2 shows an overview of the architecture of CRL.

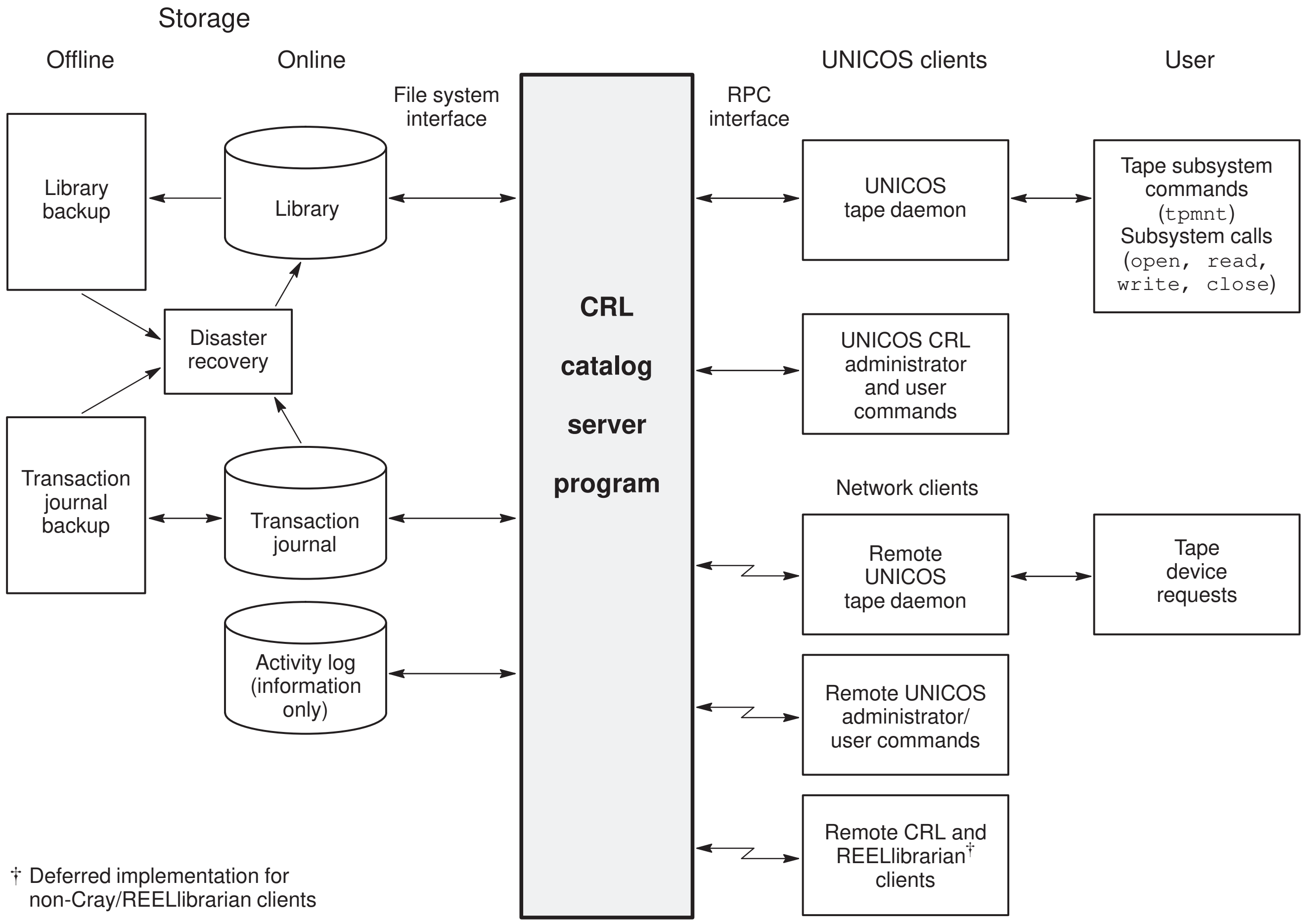

Figure 2. CRL architecture

Online storage requirements
2.1

CRL comprises both programs and data files. The CRL data directory path is defined by the `RLLIBDIR` parameter in the CRL configuration file (see "Configuring installation parameters," page 33.)

The CRL data directory should reside in its own file system. This file system should be initialized such that it is large enough to accommodate the largest number of files and volumes that will require cataloging. The directory containing the catalog is named `REEL/Librarian/Tdb` and is located in the CRL data directory specified by the `RLLIBDIR` configuration parameter.

To determine the approximate size of the CRL catalog, calculate the number of bytes for the volume database at 1.4 Kbytes per volume, and calculate the number of bytes for the file database at .8 Kbytes per file. All volumes must be cataloged, but you can suppress the cataloging of files by setting the file tracking option off for selected volume sets. (This can be done when a volume set is created with the `rlvcreate`(1) or the `rlvsubmit`(1) command, or by editing the volume set with the `rlvedit`(1) command).

For example, a site that needs to catalog an estimated 300,000 volumes containing 3.2 million individual files would calculate its storage as follows:

Volume database:
300,000 x 1.4 Kbytes = 420 Mbytes

File database:
3.2 million x .8 Kbytes = 2.56 Gbytes

The size of the CRL catalog is increased if the UNICOS multilevel security MLS or the Trusted UNICOS feature is enabled and users choose to assign access control lists (ACLs) to their volume sets and files. Each ACL consumes approximately 2.2 Kbytes.

In addition to the catalog files, *journal files* are maintained to record all CRL transactions that modify the catalog. This facilitates disaster recovery.

The journal directory is defined and identified to the CRL servers in the `REEL/Librarian/jdir` file in the directory, specified by the `RLLIBDIR` parameter. This directory must exist so that the CRL servers can be initialized. You can change the location of the journal file by using the Miscellaneous menu in the `rlconfig` command (see `rl`(1)).

It is strongly recommended that the journal directory be maintained on a file system separate from that of the catalog to limit the damage done and to facilitate the recovery process in the event of file system failure.

The amount of data maintained in the journal depends on the catalog activity and frequency of catalog backup. Because entire volume and file records are logged, the journal can grow large if there is heavy catalog activity. Backing up the catalog allows journal entries to be deleted (see "Backing up the catalog journal," page 52).

CRL allows catalog and journal directory default locations to be overridden, as described in "Configuring installation parameters," page 33.

Catalog physical structure
2.2

Figure 3 shows the way file and volume databases look conceptually.

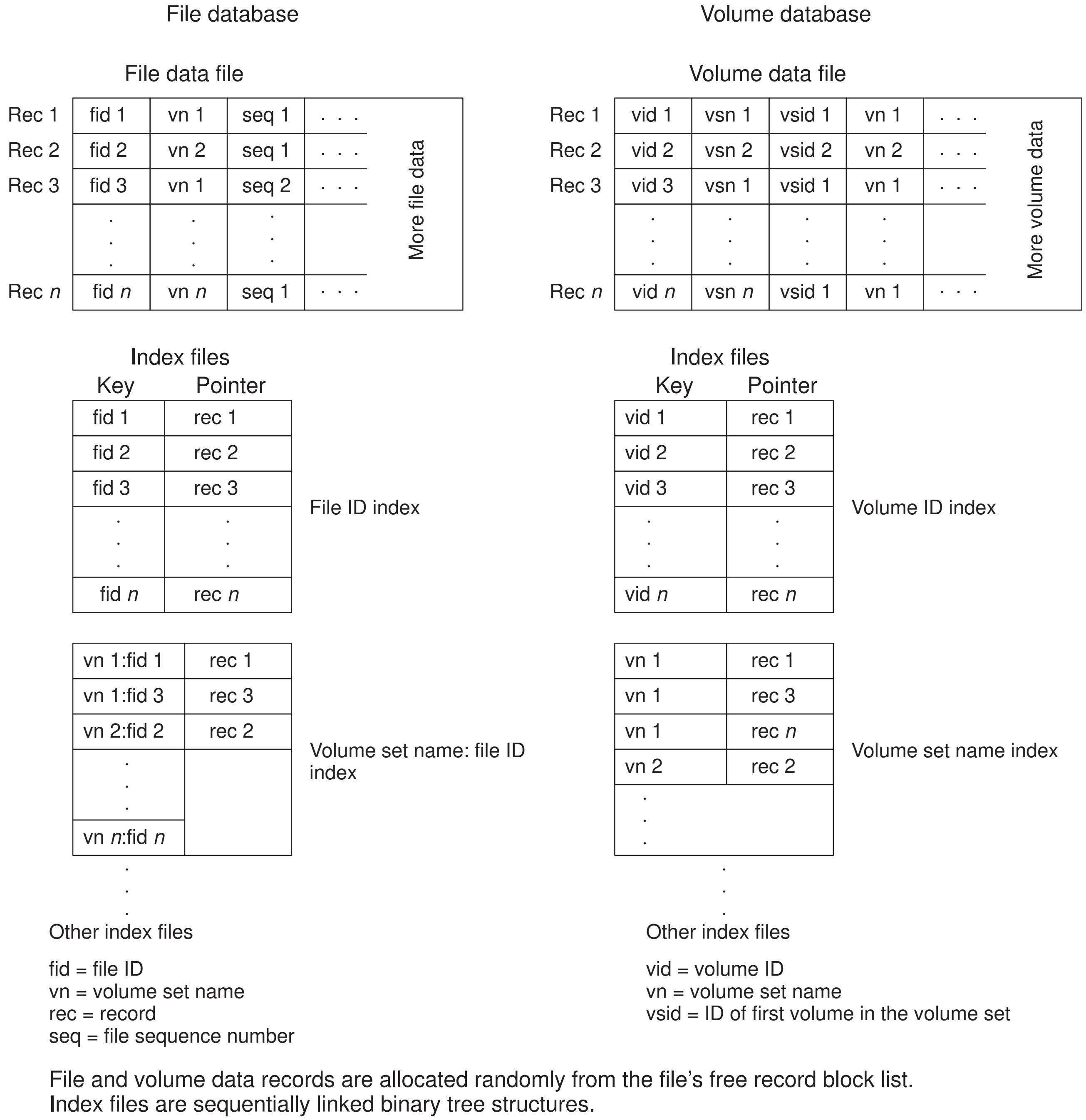

Figure 3. CRL databases, files, and indexes

The catalog resides in a file system that has a configurable location. The catalog is actually a collection of several B+tree databases, most notably the file database and the volume database. Each database consists of a data file, which contains a record for each object (file or volume) defined in CRL, and several index files that allow quick search times and minimal disk I/O when records are retrieved.

As an example of database operation, assume that a user has requested a tape file by using the `-f` option to `tpmnt`(1) and has not specified a volume identifier. CRL first searches the file ID index to get the location in the data file of the record that contains the information for the requested file. This information contains the name of the volume set to which the file belongs. CRL then searches the volume set index to get the location in the volume data file of the volume containing the file. It passes the appropriate information to the tape subsystem for the tape mount request.

The full catalog structure is more complicated than the example and the figure indicate, but the general concepts of B+tree database management apply throughout CRL.

CRL software structure
2.3

CRL software is composed of the following elements (illustrated in Figure 2, page 9):

- CRL catalog server program (CRL daemon)
- CRL client programs (CRL administrator and user commands)
- UNICOS tape daemon and tape subsystem interface that enables it to act as a CRL client

The CRL server registers its services with the system's remote procedure call (RPC) port mapper and waits for client programs to request those services. The clients, in turn, make their RPC service requests through the port mapper, using the appropriate program codes.

Caution

Because the CRL server is the only process that has access to the catalog, it must be running for any CRL functions to occur. If the CRL server is not operational and the tape subsystem has been configured with mandatory CRL processing, normal access to the tape subsystem through `tpmnt`(1) is not possible.

When the CRL server cannot be restarted, you must either restart the tape daemon (`tpdaemon`(8)) with CRL disabled or reconfigure a running (but quiet) tape daemon with the following command:

```
tpset -c off
```

Operating CRL
2.4

The following subsections discuss the operational aspects of volume management:

- Pool administration
- Media movement
- Library maintenance

Pool administration
2.4.1

Any user may own and manage any number of pools. In this mode of operation, the pool owner is responsible for seeing that the pool has the correct allocation authorization and sufficient scratch volumes to satisfy the expected allocation requests.

Although drafting scratch volumes from a pool is a convenient way to extend a volume set, scratch volumes may not be available in the named pool. If the tape daemon (`tpdaemon`(8)) tries to allocate a scratch volume and the allocation fails because there are no available volumes in the specified pool, it will format a volume serial number (VSN) mount request with the VSN equal to `?CRL??`. (You can change the VSN string by setting the `cray_reel_librarian_scratch_vsn` parameter in the `tpdaemon` configuration file, `/etc/config/tapeconfig`, described on the `tapeconfig`(5) man page.)

At this point, the operator can mount any scratch volume that is a member of a pool to which the volume set's owner has access permission. The volume will be allocated to the volume set. You should maintain a certain number of volumes for use in satisfying scratch requests received when the pool is empty.

If a site would rather not have users responsible for managing their own pools, the administrator must structure the scratch pools so that it is not only possible for users to access scratch volumes, but so that responding to scratch volume requests is convenient for the operators who must mount the volumes. The problem of maintaining one or two pools for use by the general population is that usually these pools should contain a large number of volumes, and the normal method of operation is for CRL (through `tpdaemon`) to notify the operator which volumes to mount. The operator may spend an excessive amount of time finding and pulling the requested tapes.

This problem can be solved by using the `cray_reel_librarian_operator_select_scratch` parameter in the `tpdaemon` configuration file, `/etc/config/tapeconfig`, described on the `tapeconfig`(5) man page. This parameter causes CRL to wait until the operator mounts a scratch volume before allocating it to the volume set (this is similar to the way empty pool requests are satisfied). For the access to succeed, the scratch volume supplied by the operator must be a member of a pool to which the user has access permission. The administrator can use the `rlr`(1) command to produce a list of appropriate scratch volumes. Those volumes can be moved to a convenient location for use in satisfying user scratch volume requests.

Media movement 2.4.2

For security reasons, you should keep copies of important volumes at a location other than the central library. CRL can track volume storage at any number of locations.

Users can request volume set movement from one location to another by using the `rlvmove`(1) command. A list of volumes waiting for movement is generated by using the `rlr admin=move maint` command. You can move the volumes and arrange transportation. You can also specify (using the `rlconfig` program) sites available as storage locations. Use the `rlmoved`(8) command to confirm the movement of volumes.

Additionally, a user may use rotation schedules to control the location and movement of volume sets. A *rotation* schedule is a list of one or more volume set residence steps. Each step is defined by a *location-type-count* combination that specifies where and for how long a volume set is to reside before being moved to the next step.

When a volume set is created and assigned a rotation schedule, it moves to the first *location* on the list, remaining there for the time designated by the *type-count*. After that period has elapsed, the administrator may then schedule the volume set to move to the second *location*. This process continues until it has resided at each step on the list, at which point the volume set retires.

The administrator must run the `rlrotate`(8) command in order for volume sets which are under rotation schedule control to be scheduled for movement from one step to another. It is recommended that `rlrotate` be run on a regular (daily) basis.

The `rlrotate` command searches the catalog for volume sets that are candidates for movement by virtue of a rotation step expiring. All such volume sets are marked as requiring movement, and these volume sets then appear on the output of the `rlr action=move maint` command.

2.4.3 Library maintenance

CRL tracks the number of times a volume is accessed. This facilitates the periodic cleaning and eventual removal of volumes from service. Using `rlr`(1), you generate a list of volumes that have a usage count exceeding the cleaning or removal limit.

When a volume is cleaned, you can confirm the cleaning (by using the `rlcleaned`(8) command) and the cleaning count is reset. When a volume is removed, its catalog entry is deleted. Volumes are scheduled for cleaning and removal only when they are in the scratch state.

Installation Procedure [3]

You must perform the following major steps to install CRL:

8. Load CRL software from the distribution media
9. Prepare the generation directory
10. Build CRL
11. Install CRL executable files
12. Configure CRL installation parameters
13. Install CRL operational files
14. Configure the UNICOS tape subsystem for use with CRL

The following subsections describe how to perform these steps.

Loading CRL
3.1

This subsection describes how to load CRL software from the media and install it in the generation directory, `/usr/src/prod/crl`.

To install CRL, you must have `root` privileges. If you are running the UNICOS multilevel security (MLS) feature, you must also have `install`, `reclsfy`, `wrunlab`, and `suidgid` permissions.

If you do not have `install`, `reclsfy`, `wrunlab`, and `suidgid` permissions, contact your site security administrator to get them. To determine whether you have these permissions, execute the `spget` command (see `spset`(1)) as root on your current UNICOS system.

If the MLS feature is not enabled at your site, `spget` responds as follows:

```
cray# spget
spget: security is not enabled!
```

If the MLS feature is enabled at your site, `spget` responds with a list of permissions similar to those shown in the following example:

```
cray# spget

 permits equal 0130
                   reclsfy
                   wrunlab
                   suidgid
                   install
  .
  .
 <listing of other security levels>
```

The login ID under which the installation is done cannot have system resource limitations, such as disk quotas, memory limits, or CPU usage.

Selecting the media
3.1.1

You can load the CRL software from tape or by using electronically transferred `cpio` files.

To load from tape, see "Tape media." To load `cpio` files, see "`cpio` files," page 22.

Tape media
3.1.1.1

This subsection describes the procedure for selecting tape as the media from which the software will be loaded.

Position the menu prompt at the `Release media management` menu on the UNICOS Installation / Configuration Menu System main menu, as shown in the following screen, and press RETURN.

```
                 UNICOS Installation / Configuration Menu System

M-> Release media management ==>
    Configure system ==>
    Build/install system ==>
    Utilities ==>
    Preferences ==>
```

The `UNICOS Release Media Management` menu appears.

To specify the load device appropriate for the media on which the software was delivered, position the menu prompt at the `Define load device` menu item, as shown in the following screen, and press RETURN.

```
                         UNICOS Release Media Management

M-> Define load device ==>
            .
            .
            .
    Load asynchronous product ...
            .
```

The `Define Load Device` menu appears.

The supported values for media type are the following:

- `c150` (OWS-E 1/4-in. streaming tape)
- `c3480` (IBM 3480 cartridge tape)
- `9 track - 6250 b/i` (round tape)
- `9 track - 800 b/i` (round tape on expander)
- `CD-ROM` (optical disk)
- Blank (for loading from disk)

Position the menu prompt at the `Media type` selection item and select the value appropriate for your site. Your choice sets the `Physical load device` selection to an appropriate default value and affects the selections that appear on the rest of the `Define Load Device` menu.

The following two examples show load device definition menus similar to those that you might encounter.

Example 1:

The following is an example of loading from an IBM 3480 cartridge tape, using the UNICOS tape subsystem:

```
                         Define Load Device

    Customize load device parameters ==>
S-> Media type                                   c3480
    Physical load device                         Online Tape
    Remote or local?                             local
    Remote host name
    Package images directory name
    Optional package image name
    Verbose load (cpio -v option)                YES
    Reload only damaged/missing files            NO
    Continue load upon error                     NO
    Verify only, do not load package             NO
    Leave file characteristics untouched         NO
```

Set the `Media type` to `c3480` and set `Physical load device` to `Online Tape`. Ensure that `Remote or local?` is set to `local`. Mount the release tape on the selected drive at this time. Return to the `UNICOS Release Media Management` menu by pressing [E].

This completes the media selection step for tape media. Proceed to "Loading the release media," page 24, to continue the installation.

Example 2:

The following is an example of loading from the QIC-150 1/4-in. streaming tape device on the OWS-E operator workstation.

```
                          Define Load Device

    Customize load device parameters ==>
    Media type                                    c150
    Physical load device                          Tape Device
    Remote or local?                              remote
S-> Remote host name                              ows1653
    Package images directory name
    Optional package image name
    Verbose load (cpio -v option)                 YES
    Reload only damaged/missing files             NO
    Continue load upon error                      NO
    Verify only, do not load package              NO
    Leave file characteristics untouched          NO
```

Toggle the `Remote or local?` selection to `remote`, and set `Remote host name` to the name for your OWS-E operator workstation (`ows` is the default).

You may also have to select the `Customize load device parameters` menu to set the remote login ID. This menu appears as follows:

```
                    Customize Load Device Parameters

    Online 3480 (cartridge) device group          CART
    Online 3420 (round) tape device group         TAPE
    Online 3480 (cartridge) blocking (k-bytes)    32
    Nine track (round) tape blocking (k-bytes)    4
    Remote nine track tape device name            /dev/rmt0
    Remote cartridge (C150) blocking (k-bytes)    63
    Remote cartridge (C150) device name           /dev/rst0
    Remote shell program                          /usr/ucb/remsh
S-> Remote login ID                               djb
    Async product / revision directory base
    Package images file prefix                    TAPE.
```

The remote login ID specified must have a `.rhosts` file that authorizes logins from the Cray Research system. In the preceding example, the `.rhosts` file in the home directory of `djb` on `ows1653` must contain the following line:

```
sn1653 djb
```

Mount the release tape on the selected drive at this time.

Return to the UNICOS `Release Media Management` menu by pressing E.

This completes the media selection step for tape media. Proceed to "Loading the release media," page 24, to continue the installation.

`cpio` *files* 3.1.1.2

The following procedures are used when the software is delivered electronically in a `cpio` file or already exists on your system as a `cpio` file.

Position the menu prompt at the `Release media management` menu on the UNICOS Installation / Configuration Menu System main menu, as shown in the following screen, and press RETURN.

```
                 UNICOS Installation / Configuration Menu System

  M-> Release media management ==>
      Configure system ==>
      Build/install system ==>
      Utilities ==>
      Preferences ==>
```

The UNICOS `Release Media Management` menu appears.

Position the menu prompt at the `Define load device` menu, as shown in the following screen, and press RETURN.

```
                           UNICOS Release Media Management

M-> Define load device ==>
              .
              .
              .
    Load asynchronous product ...
              .
```

Position the menu prompt at the `Media type` selection and toggle it to blank. Toggle the `Physical load device` selection to `Disk`, and toggle the `Remote or local?` selection to `local`. Fill in the appropriate values for `Package images directory name` and `Optional package image name`.

The following example shows how the screen might appear after you have completed your selections:

```
                                 Define Load Device

    Customize load device parameters ==>
    Media type
    Physical load device                           Disk
    Remote or local?                               local
    Remote host name
    Package images directory name                  /tmp/djb
S-> Optional package image name                    async.cpio
    Verbose load (cpio -v option)                  YES
    Reload only damaged/missing files              NO
    Continue load upon error                       NO
    Verify only, do not load package               NO
    Leave file characteristics untouched           NO
```

This completes the media selection step for `cpio` files. Proceed to "Loading the release media" to continue the installation.

Loading the release media 3.1.2

To load CRL, return to the `UNICOS Release Media Management` menu by pressing [E]. Position the menu prompt next to the `Load asynchronous product` action, as shown in the following screen, and press [RETURN].

```
                        UNICOS Release Media Management

     Define load device ==>
               .
               .
               .
  A-> Load asynchronous product ...
               .
```

Depending on the selected method of loading, one of the following messages will appear on the screen.

- If you selected `Online Tape` as the method of loading, the following prompt appears on the console screen (where `CART` is specified in this example, the device you selected will appear):

```
Load Manager: Loading Async from Online Tape (Root - /)

Please mount ASYNC0 tape on an online CART device
and attend to the operator's console
```

Mount the release media on the appropriate device (if you have not done so already), and respond to the message at the operator's console by entering the following command:

`rep` *num* `ASYNC0`

num is the message number of the tape request.

- If your load media is the QIC-150 cartridge on the OWS-E operator workstation, the following prompt appears on the screen:

```
Load Manager: Loading Async from (Root - )

Mount ASYNC0 tape on the C-150 cartridge tape drive on remote host ows1653,
        then press return:
```

Insert the cartridge into the OWS drive and lock it in place with the slide switch (if you have not done so already) before pressing RETURN.

- If you selected `Expander` as the method of loading, the following prompt appears on the screen:

```
Load Manager: Loading Async from (Root - )

Mount ASYNC0 on the local expander tape drive,
        then press return:
```

Mount the release media on the expander tape drive (if you have not done so already) and respond to the tape mount request at the MIOP console by entering the following command:

```
RESUME @MT0
```

- If you are loading a `cpio` file from disk, the following prompt appears on the screen:

```
Load Manager: Loading Async from (Root - )
```

The release files are now read from the selected media into a temporary directory in `/tmp`.

Next, you will be asked whether another volume exists for this product.

```
Is there another volume to load for this asynchronous product ? (n/y)
```

Reply `n` to this question.

Preparing the generation directory
3.2

The generation directory can be created by loading a full CRL installation package or by loading a package prepared by the upgrade tool. Both packages are described in the following subsections.

The installation package
3.2.1

After the installation software is loaded, an installation script is invoked to move the software into the generation and configuration directories. The following is displayed when the script begins its execution:

```
You are about to install Cray/REELlibrarian (CRL) 2.0

This procedure will place the binary or source code, menu panels,
menu help files, configuration tool script files, and default
configuration files into the system.  When it has finished,
you may then configure the product using the CRL menus
in the UNICOS installation and configuration menu system.
Then build CRL through the "Build/install system" menus.

This product is being installed in the root file system / .

The target directories for the installation of this product
are as follows:

- The configuration files will be placed in /usr/src/skl/c1/etc/config
- The shell files will be placed in /etc/install
- The menu files will be placed in /etc/install
- The menu help files will be placed in /usr/lib/install/help
- The binary/source tree files will be placed in /usr/src/prod

Checking directory accessibility ...

The Installation process is now ready to start.

Do you wish to proceed with the installation [yes,no] ?
```

Reply $\boxed{y}$ to this question.

The script then asks whether you prefer to remove existing files automatically or to be prompted to remove them individually:

```
If this product has been installed previously, you may elect either
to remove automatically or replace all files from the previous
installation or to be queried on existing files encountered.

If you elect to save existing files, they will remain untouched and the
new file from this installation will be left in the binary/source tree.

Do you wish to remove files automatically [yes,no,quit] ?
```

For an initial installation, reply `y` to this question. For subsequent installations, respond according to your preference.

If existing files are not removed automatically, a message similar to the following will be displayed when existing files are encountered:

```
The following files exist in directory :
filename1
filename2
        .
        .
        .
The installation of this product should replace them.
Do you wish to save any of these files [yes,no,quit] ?
```

The *directory* and *filenames* given in the message reflect those of the existing files encountered. Respond according to your needs.

When the installation proceeds the following messages are displayed (along with file removal messages if appropriate):

```
Installing script files
        .
        .
        .
Installing menu files
        .
        .
        .
Installing menu help files
        .
        .
        .
Installing configuration files
        .
        .
        .
Installing binary/source tree
        .
        .
        .
Moving binary/source tree into /usr/src/prod/crl
        (A line with each file name will be output)
        .
        .
        .
The loading procedure is complete. You may now build, install, and
configure CRL using the UNICOS installation and configuration menu
system, or you may proceed with the process manually by following
the steps in the Cray/REELlibrarian (CRL)
Administration Guide, publication SG-2127.

Termination in process - /tmp/tmpdir contains
SCRIPT
copyright
crl
/tmp/tmpdir will be deleted during termination if it is being controlled
by 'install'.
Press RETURN to continue
```

tmpdir is the name of the temporary directory being used by the installation process. Press RETURN.

```
Done loading Async

Press RETURN to continue.
```

Press RETURN. Exit the menu system by pressing q and proceed to the next section.

The upgrade package
3.2.2

After the upgrade software is loaded, an installation script is invoked which will prompt you for the name of the directory in which the base files are located as shown in the following screen:

```
What is the name of the directory (in /usr/src/prod/)
where the base files are located [crl]?
```

Press RETURN to accept the default name or enter the name of the directory that contains the base files for the product you are upgrading. You will then be prompted for the name of the directory that will receive generation files as shown in the following screen:

```
What is the name of the directory (in /usr/src/prod/)
that will receive the generation files [crl]?
```

If the directory that will receive the generation files does not exist, the installation script will create the directory. If the directory that will receive the specified generation files already exists, an opportunity to exit the script will be provided so that the former directory can be backed up. When a `KB y` (`yes`) is specified, the installation script will continue with the creation of the upgrade generation directory.

Building CRL

3.3

This subsection describes the steps you can use to build and install CRL independent of the UNICOS installation tool. Following these steps may result in a faster build by avoiding the overhead of the UNICOS installation tool.

If you are following these steps on a Trusted UNICOS system, however, you must enter the UNICOS installation tool first and escape to a shell process in order to set the proper privileges as follows:

```
cray# setucat secadm
cray# cd /etc/install
cray# ./install
cray# !
```

The CRL relocatable binaries reside in the `/usr/src/prod/crl` directory by default and have been installed there by the load process described in "Preparing the generation directory," page 26. The CRL generation data includes several subdirectories, most of which contain an Nmakefile for the directory. Because most of the Nmakefiles depend on being called by a higher level Nmakefile, the preferred method of building the CRL programs is to execute `nmake`(1) while in the `/usr/src/prod/crl` directory.

If the installation is a CRL server application, issue one of the following command sets to initiate the build:

```
If you are running the POSIX shell or Korn shell:
cray# cd /usr/src/prod/crl
cray# nmake >/tmp/crl_nmake.out 2>&1

If you are running the C shell:
cray# cd /usr/src/prod/crl
cray# nmake >&/tmp/crl_nmake.out
```

If the installation is a CRL client application, issue one of the following command sets to initiate the build:

If you are running the POSIX shell or Korn shell:
```
cray# cd /usr/src/prod/crl
cray# nmake TYPE=CLIENT >/tmp/crl_nmake.out 2>&1
```

If you are running the C shell:
```
cray# cd /usr/src/prod/crl
cray# nmake TYPE=CLIENT >&/tmp/crl_nmake.out
```

These commands save the messages output by `nmake` in a file called `/tmp/crl_nmake.out`; you can substitute any appropriate file name. When `nmake` has completed, check the output file for errors that occurred during the build. Any `'*** exit code 1'` messages should be investigated.

Installing CRL executable files
3.4

Running `nmake` as described in the previous subsection builds the CRL commands and libraries. To install the commands and the menus for the full-screen interface, execute the `nmake install` command while in the `/usr/src/prod/crl` directory.

The `nmake install` command builds and installs CRL. If the commands and libraries have been built previously, the build process is mostly a null operation because `nmake` only rebuilds targets that are out-of-date with dependencies.

If the installation is a CRL server application, issue one of the following command sets to install the executables:

If you are running the POSIX shell or Korn shell:
```
cray# cd /usr/src/prod/crl
cray# nmake install >/tmp/crl_nmake_install.out 2>&1
```

If you are running the C shell:
```
cray# cd /usr/src/prod/crl
cray# nmake install >&/tmp/crl_nmake_install.out
```

If the installation is a CRL client application, issue one of the following command sets to install the executables:

If you are running the POSIX shell or Korn shell:

```
cray# cd /usr/src/prod/crl
cray# nmake TYPE=CLIENT install >/tmp/crl_nmake_inst.out 2>&1
```

If you are running the C shell:

```
cray# cd /usr/src/prod/crl
cray# nmake TYPE=CLIENT install >&/tmp/crl_nmake_inst.out
```

These commands save the messages output by `nmake` in a file called `/tmp/crl_nmake_inst.out`; you can substitute any appropriate file name. When `nmake` has completed, check the output file for errors that occurred during the installation.

The administrator commands are installed in the `/etc` directory by default. The user commands are installed in the `/bin` directory . The menus are installed in the `rl_menus` directory, which is located in the `/etc` directory by default. (These default directories can be changed through the `RLBINDIR` configuration parameter described in "Configuring installation parameters.")

Configuring installation parameters
3.5

The CRL configuration file must exist before the CRL installation script (`crlinstall`) can be successfully executed. By default, the configuration file is named `/etc/config/reelenv`. You can change the name of this file by setting the `REELENV` parameter to a different path name.

If an attempt is made to execute `crlinstall` before the configuration file exists, `crlinstall` will create a default configuration file, and then exit to allow the installer to edit the file according to the following parameter definitions.

For the CRL commands to communicate properly with the CRL server , this configuration file must have read permission for all users.

The /etc/config/reelenv configuration file may be edited using the Configure System → Cray/REELlibrarian configuration menu of the UNICOS menu system, or it may be edited directly.

Issue the following commands to install the default configuration file for direct editing:

```
cray# cd /usr/src/prod/crl/etc/install/config
cray# cp reelenv /etc/config/reelenv
cray# chmod 644 /etc/config/reelenv
```

The following parameters must be defined in the configuration file in so that the appropriate database and operational files can be created. At a minimum, the RLLIBDIR, RL_MACH, and RLLOGDIR parameters probably will require modification.

Parameter	Description
REELENV	The name of the configuration file; /etc/config/reelenv by default.
RLLIBDIR	This parameter is only applicable to CRL server applications. It defines the directory of the CRL data files. This directory is checked to verify that it exists. See "Online storage requirements," page 10, for a description of the proper sizing of this file system.
RLBINDIR	The directory containing the CRL administrator commands. This directory is /etc by default.
RLPBASE	The RPC remote program number assignment that the CRL server and clients use for communications. The system administrator should verify that this value is not in conflict with existing RPC functions.

Parameter	Description
`RLLOGDIR`	The directory for the server and command log files. When this parameter is defined, each server or command initiation results in the creation of a log file named `RL.`*command* in this directory. Any existing files with similar names are deleted. If this parameter is defined, it is very important that the directory it names exists and that all users have write permission to it. If not, the CRL commands will fail when they attempt to create a log file in the directory.

Warning

It is very important if CRL is being installed in a UNICOS multilevel security (MLS) or Trusted UNICOS environment that this directory be created through the `mlmkdir`(8) command so that it is a multilevel directory. If this is not done, command execution that initiates processes with differing security labels will result in debug log file creation failures. This will not affect the functional execution of the commands, but it will generate an error message and the loss of the debug information that might have been generated.

Also note that, when accessing files in the `RLLOGDIR` directory in a secure environment, there may be similarly named files at different levels. CRL and security administrators must take care to access the correct debug log file when using `RLLOGDIR` to trace CRL activity.

Parameter	Description
	This directory exists mainly for debugging and it should not be necessary to define this parameter after the initial installation has been completed successfully. This parameter can be removed or added at any time prior to the initiation of the CRL server or to the initiation of any CRL command to disable or enable logging. The server log (`RLLOGDIR/RL.RL`) may become large, based on the amount of activity and the length of time between server restarts. Be careful to ensure sufficient space for file expansion.
`RL_MACH`	The network ID of the CRL server. This specifies the machine that registers all of the RPC services required by the CRL client processes (CRL commands and the tape subsystem). If this is a CRL server installation, this ID can be obtained as the output of the `hostname`(1) command on the installation machine. If this is a CRL client installation, this ID can be obtained as the output of the `hostname` command on the CRL server machine.
`RLVIDEQVSN`	Default VID to VSN. This allows a site to implicitly assign a VID equal to a volume's VSN unless specified otherwise. This aids sites in making a transition to CRL appear transparent to existing user jobs. Valid settings are `YES` and `NO`.
`RLRACKEQVSN`	Default rack location to VSN. This allows a site to implicitly assign a rack location to the VSN unless required otherwise. Valid settings are `YES` and `NO`.

Parameter	Description
RLVSNUPPER	Forces all VSNs to be converted to uppercase. Because neither ANSI nor IBM standard labels allow lowercase characters, and some tape silo managers generate errors if VSN fields in requests contain lowercase characters, some sites may benefit from converting all VSNs to uppercase. The conversion takes place for all command keyword values that specify a VSN.
RLMAXVSN	Maximum number of VSNs that may be submitted through the `rlpsubmit`(1) command, using the `vsn=first^last` notation. This limits the damage that can be done by an improperly formatted VSN specification.
RLNODUPFIDS	If this parameter is set to `YES`, no ambiguous file names will be created. All file records that are created will contain a generation number (starting with 1), and any file creation requests that do not specify `:G` will have `:G+1` added to the file ID specification, and any file creation requests that use `:Gnnnn` without `:V` will have `:V+1` added to the file ID specification.

The following values are the defaults that `crlinstall` uses to create a CRL configuration file named `/etc/config/reelenv` if the `REELENV` parameter either does not exist or does not point to a valid configuration file, and no file named `/etc/config/reelenv` already exists. Use these values as a guide for installing a correct configuration file.

```
REELENV       /etc/config/reelenv
RLLIBDIR      /usr/crl
RLBINDIR      /etc
RLPBASE       667777770
RLLOGDIR      /usr/spool/crl
RL_MACH       *****
RLVIDEQVSN    YES
```

```
RLRACKEQVSN    YES
RLVSNUPPER     YES
RLMAXVSN       200
RLNODUPFIDS    NO
```

Installing CRL operational files 3.6

When `nmake install` has completed, a POSIX shell script named `crlinstall` will exist in the `/usr/src/prod/crl/distdir` directory. This script copies or creates the necessary operational files and places them in their proper locations for CRL initiation. As shown in the following commands, change to `/usr/src/prod/crl/distdir` and execute `crlinstall` to complete the final CRL installation step.

On a Trusted UNICOS system, you must first enter the UNICOS installation tool and escape to a shell process in order to set the proper privileges as follows:

```
cray# setucat secadm
cray# cd /etc/install
cray# ./install
cray# !
```

On all systems, use the following commands to install CRL operational files:

```
cray# cd /usr/src/prod/crl/distdir
cray# ./crlinstall
```

If the installation is a CRL server application, `crlinstall` asks for the name of the target directory for the transaction journal files. The script tries to create the directory if it does not exist. See "Online storage requirements," page 10, for information on the size and location of the journal directory.

Configuring the tape subsystem
3.7

In order for the UNICOS tape subsystem to operate with CRL, it must be rebuilt after the CRL libraries have been built and installed. A check in the tape subsystem Nmakefile is used to satisfy the CRL subroutine references in the tape subsystem commands.

If the `/usr/lib/libcrl.a` library file exists, the tape subsystem Nmakefile tries to satisfy the CRL subroutine references from that file.

If the library file does not exist, a file that contains a stub for each reference will be used. This file is named `zcrlstubs.o` and is located in the tape subsystem build directory. This effectively disables the operation of CRL. Follow the normal tape subsystem build and installation procedures to rebuild the UNICOS tape subsystem at this point.

CRL exists in one of the following three states in relation to the tape subsystem:

- Disabled
- Enabled for discretionary use
- Enabled for mandatory use

If enabled for discretionary use, CRL calls are made only when the `-X` option is selected on the `tpmnt` command. This mode of operation is not suggested for normal use because the volumes that exist in the library may contain data that is not consistent with the information maintained in the catalog, and catalog integrity would be compromised.

If enabled for mandatory use, all `tpmnt` requests use CRL processing for access control and cataloging functions.

After the tape subsystem has been built and installed with the library references required for operation with CRL, it must be configured to activate that operation into one of the three states described above. Do this by using one of the following:

- The `/etc/config/tapeconfig` file for static configuration at `tpdaemon`(8) initiation
- The `tpset`(8) command for dynamic configuration while the `tpdaemon` is running but quiet (no tape requests pending)

When `/etc/config/tapeconfig` is used, a line beginning with `cray_reel_librarian` should exist with a `YES` or `NO` designator . When `YES` is selected, the feature is enabled for discretionary use unless another line exists beginning with `cray_reel_librarian_mandatory` and a `YES` designator. In that case, the feature is on for mandatory use. In either case, CRL cannot be configured on if front-end servicing is also configured on.

To use the `tpset` command, select the `-c` option with a state of `on` (for discretionary use), `mandatory` (for mandatory use), or `off`. The `tpset` command may also be used with no options to produce a report of the current CRL state.

In some instances of tape subsystem failure, an abnormal tape job termination may result in a volume set appearing as though it currently is being used by the `tpdaemon` when, actually, it is not. This "lock" condition will persist for the effected volume set until the `tpdaemon` is restarted or until the `tpset -c on` command is executed. Either action will clear all volume set locks. If `tpset -c on` is used, it must be invoked when there are no outstanding tape jobs or pending requests. It also is possible to clear the locks manually on individual volume and its associated volume set by using the `rlvunlock`(8) command.

Rebuilding spset, spget, and spclr
3.8

Once CRL has been installed on a UNICOS system with multi-level security enabled, the `spset`, `spget` (see `spset`(1)), and `spclr`(1) commands must be rebuilt and reinstalled.

On a Trusted UNICOS system, you must first enter the UNICOS installation tool and escape to a shell process in order to set the proper privileges as follows:

```
cray# setucat secadm
cray# cd /etc/install
cray# ./install
cray# !
```

On all systems with multi-level security enabled, use these commands to rebuild and reinstall `spset`, `spget`, and `spclr`:

```
cray# cd /usr/src/cmd/sp
cray# rm spset spget spclr
cray# nmake installsys
```

Setting privilege assignment list (PAL)
3.9

If the system on which CRL is being installed is a multi-level security (MLS) system and is using privilege assignment lists (PALs), you must set the PALs for CRL commands as follows:

```
cray# setucat secadm
cray# /etc/privcmd -b /etc/privdb/crl.db
```

This completes the installation of CRL. See "Administering CRL" for a discussion of the operational parameters you should configure before starting CRL.

Administering CRL [4]

The CRL administrative tasks include the following:

- Conforming to UNICOS multilevel security (MLS) or Trusted UNICOS requirements (if running on the system).
- Defining operational parameters through the `rlconfig` program
- Rebuilding the CRL database
- Starting CRL
- Stopping CRL
- Backing up the CRL database
- Recovering the CRL database
- Generating CRL reports

CRL administrative tasks can be performed by root users and users who have been defined as operators using the procedure described in "Operators," page 48. In this section, the term *administrator* refers to either a root user or a valid CRL operator. At sites running the MLS feature or Trusted UNICOS, the system must be operated by a qualified administrator; otherwise, the evaluated rating of the system will be invalidated.

CRL can exist as either a client or a server under UNICOS. The administrative tasks described in the following subsections apply to server applications. Client applications must rely on the configuration of the CRL server on which they depend. It is important that the CRL server be properly configured with device and site information that is pertinent to the client. Each of the following subsections should be analyzed for client requirements and the proper configuration steps taken on the server machine.

Multilevel security (MLS) or Trusted UNICOS

4.1

If your site is running the multilevel security (MLS) feature or Trusted UNICOS, there are additional administration requirements in order to avoid invalidating your system's evaluated rating. This subsection describes the changes made to the 2.0 release of Cray/REEL librarian (CRL) to add MLS to its functionality and also describes the administrator's role in assuring maintenance of an evaluated system.

The difference in operating the `tpdaemon` interface between CRL and UNICOS will be transparent to those users who do not use the MLS feature or who operate at a single MLS label. Users of MLS who operate at multiple MLS labels will find the changes to CRL familiar because the MLS interface is similar to the one used in the UNICOS file systems. (See "Multilevel security (MLS) or Trusted UNICOS" in the *Cray/ REEL librarian (CRL) User's Guide*, publication SG–2126, for a detailed description of the MLS feature and its support of CRL.)

If MLS is running, additional CRL administrative responsibilities involve assuring the correct labeling of CRL database files and assuring that the binaries and directories on which CRL depends are appropriately privileged.

Warning

Information in this subsection assumes that you have read and understood the following information:

- *UNICOS Multilevel Security (MLS) Feature User's Guide*, publication SG–2111
- *UNICOS System Security Overview for Administrators*, publication SG–2141
- *UNICOS System Administration*, the MLS subsection, publication SG–2113

If your site is running a Trusted UNICOS system, you must thoroughly understand the information and follow all procedures outlined in this section to maintain the evaluated rating of and to properly use CRL on a Trusted UNICOS system. Failure to do so may invalidate the evaluated rating.

The **`privcmd`** *command*
4.1.1

All of the salient files and directories can be properly labeled and privileged with their default values by running the `privcmd` command. `privcmd` should be run for the first time immediately after the `nmake install` step of the installation procedures is complete. (The `nmake install` command builds and installs CRL. See "Setting privilege assignment list (PAL)," page 41, and "Loading CRL," page 17, for a more detailed description.) This will set the privileges of the CRL binaries so that the database will be correctly labeled when it is created.

The CRL daemon will label the database with the proper level when it is created (or re-created during `RLrebuild`). If at any time there is a question about the correctness of the labels or privileges of any CRL binaries, directories, or files, `privcmd` can be executed to insure everything is appropriate. The following subsections describe the default labels and privilege assignment lists (PALs) that are set by `privcmd` and how those defaults may be modified for the specific needs at your site.

CRL executable privileges
4.1.2

The CRL administrative functions that are the responsibility and the privilege of the valid CRL administrators are somewhat more restricted in a CRL installation with MLS or Trusted UNICOS. In a non-MLS system, CRL administrators (who are defined by the `Operators` selection of the `rlconfig` program) have the ability to manipulate (create, modify, read, delete) any and all file and volume records. In a MLS or Trusted UNICOS system, these administrators will require additional privileges to manipulate file and volume records. In a Trusted UNICOS system, these privileges will be assigned by virtue of executing trusted binaries while possessing an active category as described in the appropriate man page. These privileges are required in order to force CRL administrators to comply to the general MLS or Trusted UNICOS rules of mandatory access control (MAC) and discretionary access control (DAC) policies.

If a site opts to run a UNICOS MLS system without the privilege mechanisms described in this subsection, the binaries described will grant all privileges that would be mediated, based on an active category, to users whose real `uid` is root. It is important to note that configuring CRL in this manner invalidates the system's evaluated rating. (Using anything other than the privilege mechanism for TFMgmt invalidates the rating.)

The `spset` *and* `spget` *commands* 4.1.3

The `spset` and `spget` commands (see `spset(1)`) have been enhanced to perform label reporting and modification as well as access control list (ACL) assignment for CRL files and volume sets in very much the same manner that they do for UNICOS disk files.

The `spclr` *command* 4.1.4

The `spclr(1)` command has been enhanced to remove an ACL for a CRL file or volume in much the same manner that it does for UNICOS disk files.

CRL database 4.1.5

The CRL database files are labeled with the system-high designation and so are accessible only to those processes which operate at the system-high level. The CRL daemon will operate at system-high, and the database will automatically be created with the system-high label `SECURE_MAC`. (These database files are defined by the `RLLIBDIR` parameter in the configuration file. See "Configuring installation parameters," page 33.)

CRL debug log directory 4.1.6

The CRL debug log directory, as defined by `RLLOGDIR` in `/etc/config/reelenv`, must be a multilevel directory if it exists. (Refer to "Configuring installation parameters," page 33, for more information on this directory's functionality). The `mlmkdir(8)` command should be used to create `RLLOGDIR` so that processes at differing levels are able to create files for writing. If this is not done, command executions that initiate processes with differing security labels will result in failures in the creation of the debug log file. This will not affect the functional execution of the commands, but it will generate an error message and will cause the loss of the debug information that might have been generated.

Note

When accessing files in `RLLOGDIR` in a secure environment, there may be similarly named files at different levels and so the CRL and security administrators must take care that they access the correct debug log file when using `RLLOGDIR` to trace CRL activity .

CRL transaction journal (TJ)
4.1.7

The CRL transaction journal (TJ) is a set of date-named files, one file for each date. Each database transaction that results in a new, modified, or deleted CRL volume or file record also results in an entry in the TJ file. (The journal directory is defined and identified to the CRL servers in the `REEL/Librarian/jdir` file in the directory specified by the `RLLIBDIR` parameter.) These files are created by the CRL daemon and, therefore, are labeled at system-high.

The `rlconfig` program
4.2

Set the CRL parameters that affect daily operation by using the `rlconfig` program, which is a full-screen, menu-based program that aids you in configuring CRL. It informs you what to do and how to ask for help. (See "Full-screen interface," page 5, for operational information.)

`rlconfig` must be executed by a user with root privilege. It should be run before the CRL server is initiated the first time to ensure that the operational parameters are defined correctly for the site. The default values for each parameter are listed below in parentheses. Start `rlconfig` by issuing the following command:

```
cray# /etc/rlconfig
```

There are four menu selections on the `Configuration Menu` available from the `rlconfig` command. These menu selections allow configuration of the following elements of CRL:

- Operators (default: `root`)
- Storage sites (default: `onsite`, `offsite`, `vault`)
- Media type aliases (default: `TAPE`)
- Miscellaneous operational parameters (default: `Yes` (volumes must be accepted))

These elements are described in the following subsections.

Operators
4.2.1

An *operator* is a user who is permitted to perform library service functions such as accepting and returning volumes, cleaning volumes, and moving volumes. Use the `Operators` menu selection of the `Configuration Menu` to list the IDs of all users who are defined as CRL operators.

(The term *operator* has its roots in the REEL librarian product from which CRL was ported. REEL librarian includes a tape mounting service. The term has been perpetuated in the CRL operational interface for reasons of compatibility, but this manual uses the term *administrator* to refer to persons performing CRL administrative tasks.)

Storage sites
4.2.2

CRL provides for volume storage tracking at multiple sites. Use the `Storage Sites` menu selection of the `Configuration Menu` to define the valid site names for volume storage. User requests will reference these site names.

Media type aliases
4.2.3

A media type must be defined for each mnemonic that may be used as the argument to the `-g` option of the `tpmnt`(1) command. The `crlinstall` script defines one media type, `TAPE`, as the default for CRL operation. Sites can create additional media types through the `Media Type Alias` selection of the `Configuration Menu`.

Using this configuration option also adds an important feature called *aliasing* . Aliasing is defined in the following paragraphs.

A media type is typically a form of media (for example, reel or cartridge) and a recording density (for example, 1600 b/i). Volumes can often support more than one storage density. For example, a 9-track 6250-b/i tape can be used for 6250-b/i, 1600-b/i, or 800-b/i recording.

In pools, available volumes are designed as scratch volumes. A user can request a specific media type from the pool. If the pool does not have a volume of that media type, the user is notified. However, CRL provides an aliasing feature that allows it to substitute a volume with a different media type. This feature allows the administrator to name the media types that can be substituted for other media types. By entering the `e` (edit) keyword command for any of the media types in the master list, you can define aliases for that type.

Miscellaneous
4.2.4

Two configuration parameters are set through the `Miscellaneous` selection of the `Configuration Menu`. These parameters are the journal directory parameter and the volume acceptance parameter. (The implementation of a third parameter, hard error limit, is deferred.)

The journal directory parameter allows the administrator to change the directory in which the transaction journal files are kept. This definition is initially made when the `crlinstall` script is executed; it may be changed on this menu.

The volume acceptance parameter determines whether you must accept a volume before it is accessible by the tape subsystem. If `Volumes must be Accepted` is set to `YES`, an administrator must accept each volume that a user submits to the library before that volume is usable by the tape subsystem. Acceptance is performed by using the `rlaccept`(8) command.

Rebuilding the CRL database
4.2.5

If the site has not run CRL version 1.0 previously, this step is not required.

If the site has been running CRL 1.0, the CRL database needs to be converted to the CRL 2.0 format before initializing the CRL 2.0 server. This step **must** be complete before starting the CRL daemon or unpredictable results could occur.

It is important to note that converting the 1.0 version CRL database to the 2.0 version CRL database changes the structure of the CRL file and volume records. There are fields in the 2.0 database that do not exist in the 1.0 database, and as such, the database conversion is a one way conversion if the new 2.0 fields are used. That is, while it is possible to convert a 2.0 CRL database back to a 1.0 CRL database, it is not possible to include the new 2.0 file and volume record fields in the 1.0 database if they have been used in the 2.0 records.

The fields that are new in CRL 2.0 are the ER90 support parameters, the multilevel security labels and ACLs, and the extended 44-character file ID in the file record. Any of these fields that are in use in a 2.0 CRL database will not be propagated into the CRL 1.0 database if that conversion subsequently is executed.

If the CRL server is started and the CRL database is discovered to be other than the one the server is expecting, the following messages will appear and the server will abort:

```
Starting up Tape Database Fatal: volume database
version mismatch Fatal: server version = x,
actual = y Fatal: use RLrebuild to convert
database
```

If these messages appear, the administrator immediately should determine the cause of the problem and correct it either by setting the `RLLIBDIR` parameter in `/etc/config/reelenv` to point to a compatible database, or by running `RLrebuild`, which will convert any existing database to one which is compatible with the existing `RLrebuild` (and therefore with the CRL server) program.

If the `RLrebuild` program is asked to convert a newer version of the CRL database to an older version, messages will appear cautioning the administrator that a backwards conversion is taking place and that data loss is likely, as described above.

The messages that will appear are as follows:

```
Rebuilding Volumes (Files)...          -
Initializing Volume (File) Table

CAUTION: Existing volume (file) database is a
later version         than the CRL binaries.
        Loss of data fields is likely !!

Continue[y/n]:
```

The administrator is warned to proceed with caution if converting back from CRL 2.0 to CRL 1.0.

Before proceeding, back up the CRL database by the usual means to assure that a complete recovery is possible. After the backup has been accomplished and verified, the database conversion can be invoked with the following command:

```
RLrebuild
```

The system responds with the following:

```
Database Rebuild... Last consistent transaction
was at (date)
Continue[y/n]:
```

Respond by pressing RETURN. `RLrebuild` then rebuilds the entire CRL database:

```
Rebuilding Volumes...
     - Initializing Volume Table
        Adding (vid)
        Adding (vid)
          .
          .
          .

Rebuilding Files...
     - Initializing File Table
        Adding (fid) to (vname)
        Adding (fid) to (vname)
          .
          .
          .

Rebuilding Pools...
     - Initializing Pool Table
        Adding (poolname)
        Adding (poolname)
          .
          .
          .

Rebuilding Rotations...
     - Initializing Rotation Table
        Adding (rotation)
        Adding (rotation)
          .
          .
          .

Starting up Tape Database

     - restarting from abnormal shutdown...

     - last consistent transaction: Thu Jun 24 11:37:05 1993(1)
Database Rebuild Complete
```

Starting CRL
4.3

Start CRL by entering the `/etc/reel start` command when you are logged in as the root user. (The `/etc/reel start` command may be executed as part of the `/etc/rc` script.)

The first time you enter this command, CRL creates the catalog. Subsequent initiations verify the state of the catalog and perform whatever steps are necessary and available in context to ensure the integrity of the catalog. (See “Server failure and recovery” for information on troubleshooting the CRL server.)

Stopping CRL
4.4

Stop CRL by entering the `/etc/reel stop` command when you are logged in as the root user. (The `/etc/reel stop` command may be executed as part of the `/etc/shutdown` script.)

This command performs an orderly shutdown of the CRL server and log daemons, and it flags the catalog as having been closed in a manner that does not require validation on the next server startup.

Backing up the catalog journal
4.5

A journal of all catalog transactions is maintained by CRL. The journal is maintained in a directory whose location is configured by using the `Miscellaneous` selection of the `rlconfig` program in the UNICOS Installation / Configuration Menu System. The files are named for the transaction date (in the form *yy.mm.dd*), and they contain every catalog transaction that resulted in catalog modification on that date. In the event of catalog corruption, the CRL server automatically attempts to reconcile the catalog against the journal when the server is started.

The journal continues to grow indefinitely until you initiate catalog and journal backup procedures. These procedures consist of backing up the catalog and journal by whatever means you choose (`dump`(8), `cpio`(1), and so on), then executing the `RLbackup`(8) command to remove from the journal directory all files that were created prior to the previous day.

Server failure and recovery
4.6

The CRL server is normally terminated by the `/etc/reel stop` command. An unusual event may cause a system crash and cause the server to terminate abnormally. Often the crash does not affect the server startup because the server has the ability to reconcile automatically minor problems with interrupted transactions.

Server core file
4.6.1

If the CRL server encounters a condition that results in a core dump, the resulting core file will be created in `RLLOGDIR/core_rl` (if `RLLOGDIR` is defined and exists), or in `/usr/tmp` or `/usr/tmp/core_rl` directories.

Server error logging
4.6.2

CRL server errors are logged in either the network error log or the local server log. The network log resides in the `REEL/log` file in the CRL library directory defined by the `RLLIBDIR` configuration parameter. The local server log resides in the `RL.RL` file in the CRL log directory defined by the `RLLOGDIR` parameter. (If `RLLOGDIR` is undefined, the file resides in the CRL library directory `RLLIBDIR`.)

The network log contains errors that pertain to the network environment of CRL, and the local server log contains errors and requests encountered in the basic operation of the server's request handling and catalog processing.

The following subsection discusses the situations in which the CRL server cannot reconcile its start-up problems without your intervention.

Server start-up errors
4.6.3

Some start-up conditions cannot be repaired automatically. These situations are reported through error messages to the operator as the CRL server starts up and encounters insurmountable problems. The following are the errors that may be reported in these cases:

```
Fatal: get_(record type): seek error
```

Solution: Run the `RLrebuild` command as detailed in the next subsection.

`Fatal: get_(record type): read error`

Solution: Run the `RLrebuild` command as detailed in the next subsection.

`Fatal: get_(record type): time error`

Solution: Run the `RLrebuild` command as detailed in the next subsection.

`Record newer error`

Solution: This error indicates that the catalog shows a last modification time located far in the future relative to the current system time. The current system time may actually be set far in the past. If so, reset the system time and restart the server. If the system was running with a time far in the future, run the `RLrebuild` command as detailed in the next subsection.

`Record check error`

Solution: Run the `RLrebuild` command as detailed in the next subsection.

The **`RLrebuild`** *command*
4.6.4

The `RLrebuild`(8) command reconstructs the CRL catalog by examining the transaction journal and reconciling it against an older version of the catalog. Any discrepancies are resolved to reflect the information in the journal. The `RLrebuild` command completely rebuilds the catalog by creating a new version of it. In doing so, `RLrebuild` examines each catalog entry for correctness.

To reconstruct the catalog so that the server can run, perform the following steps:

1. Stop the CRL server by using the `/etc/reel stop` command.

2. Recover the catalog from a back-up version. The catalog consists of the `REEL/Librarian/Tdb` directory in the CRL library directory (defined by the `RLLIBDIR` parameter) and all subdirectories of `Tdb`.

3. Execute the `RLrebuild` command.
4. Back up the rebuilt catalog.
5. Restart the server.

Generating CRL reports
4.7

The `rlr`(1) command generates reports for CRL. Various report types can be requested through this command. Refer to the `rlr`(1) man page for a complete list of keyword specifications and reports.

CRL Man Pages [A]

This appendix contains the man pages for the administrator commands and files used by CRL.

The following subsections introduce and summarize the content of the man pages.

CRL administrator command summary
A.1

This appendix includes man pages for the following CRL administrator commands:

Command	Function
`RL`(8)	Starts the CRL server. The server can also be started by the `reel`(8) command, which initiates the `rlog` process.
`RLbackup`(8)	Disposes of database journal files that are no longer required because of a recent database backup. This command can be run immediately after a successful full backup of the CRL catalog directory and its subdirectories.
`RLrebuild`(8)	Rebuilds the database from a back-up copy and the journal. This should be necessary only when the CRL server announces unrecoverable errors when initiated.
`reel`(8)	Starts or stops the `RL` and `rlog` processes. This command is the preferred method of initializing the CRL server.
`rlaccept`(8)	Accepts a volume submitted to the catalog for use. A site may require this operation for all volumes after submission and before actual use.
`rlcleaned`(8)	Confirms volume cleaning. This command causes the cleaning count for the specified volumes to be reset.

Command	Function
`rlconfig`	Configures the CRL system through the full-screen interface. See "Full-screen interface," page 5, for information about the interface. This command is documented on the `rl`(1) man page.
`rlerased`(8)	Confirms volume erasure.
`rlmoved`(8)	Confirms volume movement to a new location and sets the location of the specified volumes to the new location.
`rlremoved`(8)	Confirms volume removal from the library and deletes the catalog entries of the specified volumes.
`rlreturn`(8)	Confirms the return of a volume from the library to its owner and deletes the specified volume's catalog entry.
`rlrotate`(8)	Executes the CRL volume set rotation schedules.
`rlvunlock`(8)	Removes any UNICOS tape subsystem locks that exist for a volume and all members of the volume set to which it belongs in the CRL library.

CRL file format summary
A.2

This appendix includes man pages for the following CRL file formats:

File	Function
`fmts`(5)	Defines the media formats supported by CRL.
`jdir`(5)	Identifies the directory containing the daily journal files in which CRL catalog transactions are recorded.
`loc`(5)	Defines the locations in which volumes controlled through CRL can reside.
`ops`(5)	Lists the user IDs of users who have been defined as CRL operators.

CRL Messages [B]

This appendix lists the error messages issued by Cray/REEL librarian (CRL).

`RL001: Reel system error`

An inconsistent catalog condition was encountered when processing a Cray/REEL librarian record. Contact the CRL administrator.

`RL002: Bad arguments`

The Cray/REEL librarian server encountered an argument list inconsistent with that which it expected. Contact the CRL administrator.

`RL003: Could deadlock`

The Cray/REEL librarian server received a request to use a particular user/key combination that could result in a deadlock access situation. Contact the CRL administrator.

`RL005: Undefined media type`

The Cray/REEL librarian server encountered a request with a media type that has not been defined through `rlconfig` (see `rl`(1)). Ensure that the command-line parameters are correct.

`RL014: Volume or volume set in use elsewhere`

The Cray/REEL librarian server encountered a request to lock a volume that is already locked for use elsewhere. Wait for the volume to become free.

`RL015: Unknown volume or volume set name`

The Cray/REEL librarian server encountered a request for a volume ID or volume set name that does not exist in the catalog. Ensure that the command-line parameters are correct.

`RL016: Volume permission denied`

The Cray/REEL librarian server encountered a request for access to a volume record from a user who does not have the necessary permission. Ensure that the command-line parameters are correct.

`RL017: Volume not in a mountable location`

A request was made to mount a volume that is currently in a location from which it is not mountable. Request a volume move.

`RL022: Pool permission denied`

The Cray/REEL librarian server encountered a request for access to a pool to which the user does not have access. Ensure that the command-line parameters are correct.

`RL023: No compatible volumes available`

The Cray/REEL librarian server encountered a request for a scratch volume from a pool that had no compatible volumes in the scratch state.

`RL024: No match`

The Cray/REEL librarian server was unable to satisfy a volume request based on the parameters it was given. Ensure that the command-line parameters are correct.

`RL025: Unknown pool`

The Cray/REEL librarian server encountered a request for a pool that is not defined. Ensure that the command-line parameters are correct.

`RL036: Service unavailable`

A Cray/REEL librarian service call failed. Contact the CRL administrator .

`RL038: Volume submission/retrieval error`

The Cray/REEL librarian server encountered a request for a volume submission or retrieval service that cannot be honored because the volume in question is not in the correct state. Contact the CRL administrator.

`RL039: Unrecognized user name`

The Cray/REEL librarian server encountered a request including a user name for which no valid entry was found in the system password file. Contact the CRL administrator.

`RL040: Unrecognized group`

The Cray/REEL librarian server encountered a request including a group name for which no valid entry was found in the system password file. Contact the CRL administrator.

`RL041: Command permission denied`

The Cray/REEL librarian server encountered a request for a service restricted to valid administrators from a user who is not so defined.

`RL042: Unknown location`

The Cray/REEL librarian server encountered a request including a reference to a location that is not defined. Ensure that the command-line parameters are correct.

`RL046: Incorrect password`

The Cray/REEL librarian server encountered a request including a required password that did not match the password of the record being accessed. Ensure that the command-line parameters are correct.

`RL047: Network communication error`

The Cray/REEL librarian server encountered an error in network communication traffic. Contact the CRL administrator.

`RL052: Record ID not unique`

The Cray/REEL librarian server encountered a request for a volume or file record that was specified in ambiguous terms. (For example, a volume might have been identified by a VSN that belongs to two separate volume IDs.) Ensure that the command-line parameters are correct.

`RL053: Volume set name already exists`

The Cray/REEL librarian server encountered a request to create a volume set having the same name as a volume set that already exists. Change the volume set name specification.

`RL072: See server error list`

The Cray/REEL librarian server encountered more than one error. The CRL server error log will contain the error messages. Contact the CRL administrator.

`RL075: Pool not empty`

The Cray/REEL librarian server encountered a request to delete a pool that is not empty.

`RL076: Receipt number and volume ID do not match`

The Cray/REEL librarian server encountered a request to return a volume with a receipt that did not match the one in the volume ID record. Ensure that the command-line parameters are correct.

`RL078: Unknown volume identifier`

The Cray/REEL librarian server encountered a request for a volume ID that does not exist. Ensure that the command-line parameters are correct.

`RL079: Volume identifier required`

The Cray/REEL librarian server encountered a request for a service for which a volume identifier must be specified. Add the volume identifier to the parameters on the command line.

`RL082: Pool already exists`

The Cray/REEL librarian server encountered a request to create a pool using a pool name that already exists. Change the pool name in the command parameter list.

`RL087: Cannot scratch a volume in a volume set`

The Cray/REEL librarian server encountered a request to scratch a volume that is a member of a volume set. Individual volumes in a set cannot be scratched. If necessary, scratch the entire volume set.

`RL088: Volume set not expired`

The Cray/REEL librarian server encountered a request to scratch a volume set that is not expired. Use the `force=yes` keyword if the volume set must be scratched.

`RL093: Bad volume name`

The Cray/REEL librarian server encountered a request including a volume set name that could not be parsed. Ensure that the command-line parameters are correct.

`RL095: Volume set already exists`

The Cray/REEL librarian server encountered a request from the full-screen interface to create a volume set; the name specified already exists. Specify a different volume set name.

`RL096: Bad file name`

The Cray/REEL librarian server encountered a request including a file name that could not be parsed. Ensure that the command-line parameters are correct.

`RL097: Ambiguous file name`

The Cray/REEL librarian server encountered a request including a file name that could not be uniquely resolved. Specify unambiguous file name qualifications (such as the volume set name) on the command parameter list.

`RL102: CRL server going down`

The Cray/REEL librarian server is shutting itself down. Contact the CRL administrator if this is not part of a normal Cray/ REEL librarian shutdown procedure.

`RL103: Duplicate volume ID`

The Cray/REEL librarian server encountered a request to create a volume; the volume ID specified already exists. Contact the CRL administrator.

`RL110: Unknown volume serial number`

The Cray/REEL librarian server encountered a request including a volume serial number that does not exist in the catalog. Ensure that the command-line parameters are correct.

`RL112: Unknown file`

The Cray/REEL librarian server encountered a request including a file ID that does not exist in the catalog. Ensure that the command-line parameters are correct.

`RL113: File not expired`

The Cray/REEL librarian server encountered a request to remove a file record that is not expired. Use `rlfedit`(1) to expire the file, if so desired, and retry the command.

`RL114: File permission denied`

The Cray/REEL librarian server encountered a request for access to a file for which the user does not have the necessary permission.

`RL127: Port mapper not responding`

The Cray/REEL librarian server encountered an error when attempting to communicate with the Remote Procedure Call port mapper. Contact the CRL administrator.

`RL128: RPC connection error`

The Cray/REEL librarian server encountered an error in its Remote Procedure Call connection. Contact the CRL administrator.

`RL129: RPC service appears to be hung`

The Cray/REEL librarian server encountered an error in its Remote Procedure Call connection. Contact the CRL administrator.

`RL130: Cannot remove a volume currently in a volume set`

The Cray/REEL librarian server encountered a request to remove a volume that is a member of a volume set. If necessary, the volume set may be scratched.

`RL134: Receipt number not found`

The Cray/REEL librarian server encountered a return request with a receipt number that was not found. Check the receipt number and retry the command.

`RL134: Attempt to modify privileged volume field`

The Cray/REEL librarian server encountered a request to modify a volume record field available only to administrators from a user who is not so defined. Contact the CRL administrator.

`RL200: Format mismatch on specific scratch request`

The Cray/REEL librarian server encountered a request for a specific scratch volume; the requested media type did not match the media type in the scratch volume record. Contact the CRL administrator.

`RL201: Location mismatch on specific scratch request`

The Cray/REEL librarian server encountered a request for a specific scratch volume; the requested location did not match the location in the scratch volume record. Contact the CRL administrator.

`RL202: Length mismatch on specific scratch request`

The Cray/REEL librarian server encountered a request for a specific scratch volume; the requested length did not match the length in the scratch volume record. Contact the CRL administrator.

`RL203: The VID specified in a scratch request is not in the scratch state`

The Cray/REEL librarian server encountered a request for a specific scratch volume; the volume was not in the scratch state at the time of the request.

`RL204: Volume set name cannot begin with '.'`

The Cray/REEL librarian server encountered a request to create a volume set with a name beginning with the dot character (`.`). Due to the `.vsid` notation, mnemonic volume set names cannot begin with a dot (`.`).

`RL205: Volume is not completely submitted`

The Cray/REEL librarian server encountered a request for a volume that has not been completely submitted. The volume is probably awaiting acceptance. Contact the CRL administrator.

`RL206: ER90 external id, partition not found`

The Cray/REEL librarian server has been asked to supply information for an ER90 volume with an external ID and partition number that do not exist.

`RL207: Client cannot connect to privileged port`

A Cray/REEL librarian client attempted to issue a request to the Cray/ REEL librarian server on a system that has the multilevel security (MLS) feature enabled and it failed to connect via a trusted port. Contact the security administrator to ensure that the Cray/REEL librarian commands are properly configured.

`RL208: Client request from unprivileged server port`

The Cray/REEL librarian server on a system that has the multilevel security (MLS) feature enabled received a request from a Cray/REEL librarian client that originated on an untrusted port. Contact the security administrator because this indicates a rogue version of a client; properly privileged clients should terminate if they fail to connect to a trusted port.

`RL209: Server cannot get client socket MLS data`

The Cray/REEL librarian server on a system that has the multilevel security (MLS) feature enabled received a request and was unable to determine the security label of the socket used for the connection. Contact the security administrator.

`RL211: Permission Denied`

The Cray/REEL librarian server on a system that has the multilevel security (MLS) feature enabled received a request that may have had a security policy violation. This is the general purpose response.

`RL212: No such ACL key found`

The Cray/REEL librarian server on a system that has the multilevel security (MLS) feature enabled received a request for an access control list (ACL) that it was unable to locate. Contact the security administrator.

`RL213: ACL format error`

The Cray/REEL librarian server on a system that has the multilevel security (MLS) feature enabled received a request for an access control list (ACL) that was retrieved and determined to be in a format other than a valid UNICOS ACL format. Contact the security administrator.

`RL214: Use rlvedit to change vmode`

The Cray/REEL librarian server on a system that has the multilevel security (MLS) feature enabled received a request to change the volume mode through the `rledit` command. Reissue the request using `rlvedit`(1).

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