



Hitachi Universal Storage Platform V Hitachi Universal Storage Platform VM Hitachi Cache Residency Manager User's Guide

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Preface

This document describes and provides instructions for using the Cache Residency Manager feature of the Hitachi Universal Storage Platform V (USP V) and Hitachi Universal Storage Platform VM (USP VM) storage systems.

Please read this document carefully to understand how to use this product, and maintain a copy for reference purposes.

This preface includes the following information:

- [Intended Audience](#)
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Note: The Storage Navigator windows shown in this document were captured on a Windows[®] system with the Internet Explorer web browser. The Storage Navigator windows may display differently on other operating systems and browsers. Refer to the *Hitachi Storage Navigator User's Guide* for information on other supported operating systems and browsers.

Intended Audience

This document is intended for system administrators, Hitachi Data Systems representatives, and Authorized Service Providers who are involved in installing, configuring, and operating the Hitachi Universal Storage Platform V and/or Hitachi Universal Storage Platform VM storage systems.

This document assumes the following:

- The user has a background in data processing and understands RAID storage systems and their basic functions.
- The user is familiar with the Hitachi Universal Storage Platform V/VM storage system and has read the *Universal Storage Platform V/VM User and Reference Guide*.
- The user is familiar with the Storage Navigator software for the Universal Storage Platform V/VM and has read the *Storage Navigator User's Guide*.

Product Version

This document revision applies to USP V/VM microcode 60-08-0x and higher.

Document Revision Level

Revision	Date	Description
MK-96RD609-P	February 2007	Preliminary Release
MK-96RD609-00	April 2007	Initial Release, supersedes and replaces MK-96RD609-P
MK-96RD609-01	May 2007	Revision 1, supersedes and replaces MK-96RD609-00
MK-96RD609-02	August 2007	Revision 2, supersedes and replaces MK-96RD609-01
MK-96RD609-03	November 2007	Revision 3, supersedes and replaces MK-96RD609-02
MK-96RD609-04	May 2008	Revision 4, supersedes and replaces MK-96RD609-03
MK-96RD609-05	November 2008	Revision 5, supersedes and replaces MK-96RD609-04
MK-96RD609-06	July 2010	Revision 6, supersedes and replaces MK-96RD609-05
MK-96RD609-07	April 2011	Revision 7, supersedes and replaces MK-96RD609-06

Source Documents for this Revision

- MK-96RD609-09b

Changes in this Revision

- Added a note about prestaging operations (last bullet under **Notes** in [Using Prestaging for Immediate Data Access in Priority and Bind Modes](#)).

Document Organization

The following table provides an overview of the contents and organization of this document. Click the [chapter title](#) in the left column to go to that chapter. The first page of each chapter provides links to the sections in that chapter.

Chapter	Description
Overview of Cache Residency Manager	Provides an overview of Cache Residency Manager functions and operations.
About Cache Residency Manager Operations	Provides details on how Cache Residency Manager operates and the primary operational modes available for this product.
Preparing for Cache Residency Manager Operations	Describes the system and installation requirements for Cache Residency Manager. It also details how to calculate cache size and how to enable the software.
Using the Cache Residency Manager GUI	Describes the various elements of the Cache Residency Manager graphical user interface.
Performing Cache Residency Manager Operations	Describes how users place and release data into and out of Cache Residency Manager cache as well as other operations and use the functions of Cache Residency Manager.
Troubleshooting	Provides references to sources of troubleshooting information and contact information for the Hitachi Data Systems Support Center.
Appendix A: Device Types other than OPEN-V	Lists Cache Residency Manager information for volume types other than OPEN-V: OPEN-3, OPEN-8, OPEN-9, OPEN-E, and OPEN-L.

Referenced Documents

Hitachi Universal Storage Platform V/VM:

- *User and Reference Guide*, MK-96RD635
- *Hitachi Storage Navigator User's Guide*, MK-96RD621
- *Hitachi Virtual Partition Manager User's Guide*, MK-96RD629
- *Hitachi Virtual LVI/LUN and Volume Shredder User's Guide*, MK-96RD630
- *Hitachi ShadowImage User's Guide*, MK-96RD618
- *Hitachi ShadowImage for IBM® z/OS® User's Guide*, MK-96RD619





Document Conventions

The terms “Universal Storage Platform V” and “Universal Storage Platform VM” refer to all models of the Hitachi Universal Storage Platform V and VM storage systems, unless otherwise noted.

This document uses the following typographic conventions:

Convention	Description
Bold	Indicates text on a window, other than the window title, including menus, menu options, buttons, fields, and labels. Example: Click OK .
<i>Italic</i>	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: copy <i>source-file target-file</i> Note: Angled brackets (< >) are also used to indicate variables.
screen/code	Indicates text that is displayed on screen or entered by the user. Example: # pairdisplay -g ora d b
< > angled brackets	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: # pairdisplay -g <group> Note: Italic font is also used to indicate variables.
[] square brackets	Indicates optional values. Example: [a b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a b } indicates that you must choose either a or b.
vertical bar	Indicates that you have a choice between two or more options or arguments. Examples: [a b] indicates that you can choose a, b, or nothing. { a b } indicates that you must choose either a or b.
underline	Indicates the default value. Example: [<u>a</u> b]

This document uses the following icons to draw attention to information:

Icon	Meaning	Description
	Note	Calls attention to important and/or additional information.
	Tip	Provides helpful information, guidelines, or suggestions for performing tasks more effectively.
	Caution	Warns the user of adverse conditions and/or consequences (e.g., disruptive operations).
	WARNING	Warns the user of severe conditions and/or consequences (e.g., destructive operations).

Convention for Storage Capacity Values

Physical storage capacity values (e.g., disk drive capacity) are calculated based on the following values:

Physical capacity unit	Value
1 KB	1,000 (10^3) bytes
1 MB	1,000 KB or $1,000^2$ bytes
1 GB	1,000 MB or $1,000^3$ bytes
1 TB	1,000 GB or $1,000^4$ bytes
1 PB	1,000 TB or $1,000^5$ bytes
1 EB	1,000 PB or $1,000^6$ bytes

Logical storage capacity values (e.g., logical device capacity) are calculated based on the following values:

Logical capacity unit	Value
1 block	512 bytes
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or $1,024^2$ bytes
1 GB	1,024 MB or $1,024^3$ bytes
1 TB	1,024 GB or $1,024^4$ bytes
1 PB	1,024 TB or $1,024^5$ bytes
1 EB	1,024 PB or $1,024^6$ bytes

Getting Help

The Hitachi Data Systems customer support staff is available 24 hours a day, seven days a week. If you need technical support, log on to the Hitachi Data Systems Portal for contact information: <https://hdssupport.hds.com>

Comments

Please send us your comments on this document: doc.comments@hds.com. Include the document title, number, and revision, and refer to specific sections and paragraphs whenever possible.

Thank you! (All comments become the property of Hitachi Data Systems.)

Overview of Cache Residency Manager

The Cache Residency Manager feature of the Hitachi Universal Storage Platform V (USP V) and Hitachi Universal Storage Platform VM (USP V/VM) storage system allows you to store frequently accessed data in the storage system's cache memory. Cache Residency Manager increases the data access speed for the cache-resident data by enabling read and write I/Os to be performed at the higher front-end access speeds.

Cache Residency Manager operations are performed using the licensed USP V/VM Storage Navigator software. The Storage Navigator software communicates directly with the USP V/VM subsystems via a local-area network (LAN). The Storage Navigator software displays detailed Cache Residency Manager information and allows you to configure and perform Cache Residency Manager operations for the data stored on the USP V/VM. For more information on using Storage Navigator, see the *Hitachi Storage Navigator User's Guide*.

Cache Residency Manager can be used in conjunction with Virtual LVI/LUN to achieve better performance improvements than when either of these options is used individually. If you need to store an entire mainframe or open-system volume in Cache Residency Manager cache, you can use a small Virtual LVI/LUN volume to decrease the amount of cache required for the volume. For further information on Virtual LVI/LUN, see the *Hitachi Virtual LVI/LUN and Volume Shredder User's Guide*.

About Cache Residency Manager Operations

This chapter provides details on how Cache Residency Manager operates and the primary operational modes available for this product.

- [Prestaging Specific Data](#)
- [Cache Residency Manager Modes](#)
- [Using Prestaging for Immediate Data Access in Priority and Bind Modes](#)

Prestaging Specific Data

Cache Residency Manager supports “prestaging” data. This option places specific data in the Cache Residency Manager cache before it is accessed by the host. When prestaging is selected, the host is able to find the prestaged data in the Cache Residency Manager cache from the first access, thus enhancing its access performance.

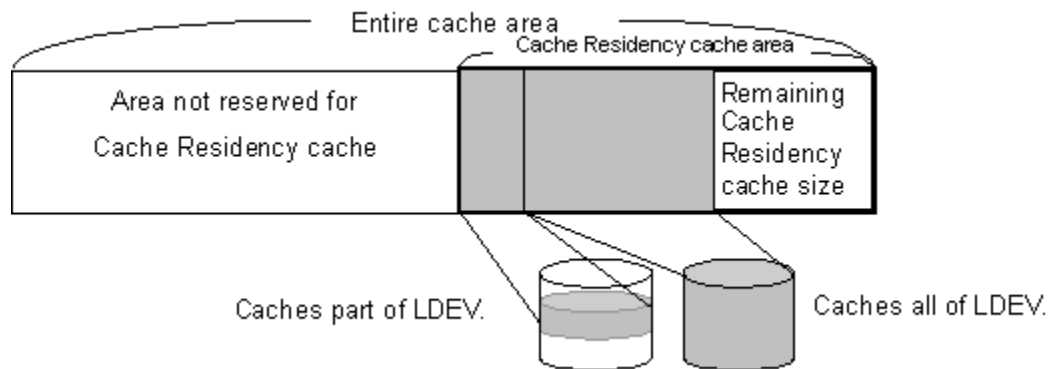


Figure 2-1 Cache Residency Manager Cache Area



Caution: Increase total storage system cache capacity when using Cache Residency Manager to avoid data access performance degradation for non-Cache-Residency data. Cache Residency Manager is only available on USP V/VM storage systems configured with at least 512 MB of cache. The Hitachi Data Systems representative configures the maximum allowable Cache Residency Manager area when the cache is installed.

Cache Residency Manager Modes

Cache Residency provides the following two operational modes for storing user data in cache memory:

- [Priority mode](#)
- [Bind mode](#)
- [Changing from Priority Mode to Bind Mode](#)

Priority Mode

In **Priority Mode** (normal mode), the total capacity of cache required is:

Standard cache + Cache Residency Manager cache + Additional cache

The main advantage of Cache Residency Manager priority mode is that read data is transferred at host data transfer speed. In priority mode the Cache Residency Manager extents are used to hold read data for specific extents on volumes. Write data is write duplexed in cache other than Cache Residency Manager, and the data is de-staged to the disk drive when disk utilization is low. The Cache Residency Manager software allows you to set the priority mode.

[Table 2-1](#) lists the standard cache capacity values for priority mode operations. For further information on the calculating procedures of required cache size for using Cache Residency Manager if the priority mode is set, see [Required Cache Size for Cache Residency](#).

Table 2-1 Standard Cache Capacity Required to Prevent the Access Performance from Degrading

Number of Areas Set in Priority Mode	Standard Cache Capacity
1 to 4096	2,048 MB × 2
4097 to 8192	4,096 MB × 2
8193 to 12288	6,144 MB × 2
12289 to 16384	8,192 MB × 2

Bind Mode

In **Bind Mode**, the total capacity of cache required is:

Standard cache + Cache Residency Manager cache

In bind mode the Cache Residency Manager extents are used to hold read and write data for specific extents on volumes. Any data written to the Cache Residency Manager bind area is not de-staged to the disk. To ensure data integrity, write data is duplexed in the Cache Residency Manager area, which consumes a significant amount of the Cache Residency Manager cache. The Cache Residency Manager software allows you to set the bind mode.

[Table 2-2](#) specifies the requirements for bind mode operations. For further information on calculating procedures for required cache size for using Cache Residency Manager if the bind mode is set, see [Required Cache Size for Cache Residency](#).

The primary advantage of bind mode is that all targeted read and write data is transferred at host data transfer speed. In addition, the accessibility of read data is the same as Cache Residency Manager priority mode; write operations do not have to wait for available cache segments; and there will be no backend contention caused by destaging data.

Table 2-2 Bind Mode Cache Requirements

System Type	RAID Level or Volume Type	Capacity Specifications	Cache Residency Cache Requirement
OPEN Systems	RAID 5 (3390) or RAID 6	Slot capacity: 264 KB Cache segment capacity: 16.5 KB Cache segments needed per slot: 48 (slot capacity / cache segment capacity)	3 times the space required for user data: 1 slot = 3 × 264 KB = 792 KB = 48 cache segments
	RAID 1, or external volumes	Slot capacity: 264 KB Cache segment capacity: 16.5 KB Cache segments needed per slot: 32 (slot capacity / cache segment capacity)	2 times the space required for user data: 1 slot = 2 × 264 KB = 528 KB = 32 cache segments
Mainframe (e.g., 3390-3, 3390-9)	RAID 5 mainframe or RAID 6	Slot capacity: 66 KB Cache segment capacity: 16.5 KB Cache segments needed per slot: 12 (slot capacity / cache segment capacity) Note: Even though a track for mainframe is 56 KB, because cache is divided into 16.5 KB segments, it requires 4 segments.	3 times the space required for user data: 1 slot = 3 × 66 KB = 198 KB = 12 cache segments
	RAID 1 mainframe, or external volumes	Slot capacity: 66 KB Cache segment capacity: 16.5 KB Cache segments needed per slot: 8 (slot capacity / cache segment capacity)	2 times the space required for user data: 1 slot = 2 × 66 KB = 132 KB = 8 cache segments

Cache Residency Manager bind data that has write attributes is normally not destaged. However, this data will be destaged in the following cases:

- During cache blockage that is caused by certain maintenance operations (e.g., cache upgrades) or that is caused by cache failure.
- If the storage system is powered off.
- If the volume is deleted from Cache Residency Manager bind mode.
- If a fixed or customized volume that is partly or wholly assigned to Cache Residency Manager is converted into free space by the Virtual LVI/LUN Volume-to-Space function.
- If a VDEV containing volumes that are assigned to Cache Residency Manager is initialized by the Virtual LVI/LUN Volume Initialization function.

For further information on Virtual LVI/LUN, see the *Hitachi Virtual LVI/LUN and Volume Shredder User's Guide*.

Changing from Priority Mode to Bind Mode

Changing the mode without cache extension requires a Cache Residency Manager reconfiguration (i.e., release the data from cache, and then place the data back in cache with the desired mode).

Using Prestaging for Immediate Data Access in Priority and Bind Modes

You can use the prestaging function to make data available from the Cache Residency Manager cache the first time the host accesses the data. Both priority mode and bind mode permit prestaging.

Prestaging occurs under any of the following circumstances:

- When prestaging is performed from the SVP or from Storage Navigator.
- When the power is turned on.
- When cache maintenance is performed.



Notes:

- If you have accessed the Cache Residency Manager area for input and output before the prestaging operation is performed from the SVP or Storage Navigator, the host may not be able to find data in the cache at the first I/O access after Cache Residency Manager is configured.
 - In order to prevent the response time of host I/O being slow, the prestaging operation may be interrupted when the cache load is heavy.
 - If you specify the Cache Residency Manager setting on the volume during the quick formatting, do not use the prestaging function. If you want to use the prestaging function after the quick formatting processing completes, first you need to release the setting and then specify the Cache Residency Manager setting again, with the prestaging setting enabled this time. For information about the quick formatting, see the *Hitachi Virtual LVI/LUN and Volume Shredder User's Guide*.
 - When external volumes are set in the storage system, execute the **Disconnect Subsystem** command to the external storage system before turning off the power supply of the storage system. If you turn off the power supply of the storage system without executing the **Disconnect Subsystem** command to the external storage system and then turn on the power supply again, the prestaging processing is aborted. If the prestaging processing is aborted, perform the prestaging operation from SVP or Storage Navigator.
 - The prestaging processing is aborted if a volume is created, deleted, or restored during the prestaging operation. If the prestaging processing is aborted, perform the prestaging operation from Storage Navigator (or the SVP) after finishing the create, delete, or restore volume operation.
-

Preparing for Cache Residency Manager Operations

This chapter describes the system and installation requirements for Cache Residency Manager. It also details how to calculate cache size and how to enable the software.

- [Preparing USP V/VM and Storage Navigator Computers](#)
- [System Requirements](#)
- [Enabling the Cache Residency Manager Option](#)
- [Launching Cache Residency](#)
- [Required Cache Size for Cache Residency](#)
- [Cache Residency Manager Cache Extents](#)
- [Cache Residency Manager Restrictions](#)
- [Virtual Partition Manager Support Requirements](#)

Preparing USP V/VM and Storage Navigator Computers

Before launching Cache Residency, you must take several preliminary steps. These include the following:

- Install the USP V/VM storage system.
- Install the computer that you intend to use as Storage Navigator, and connect them to the USP V/VM internal LAN.
- Enable Cache Residency Manager on each storage system where you intend to use the product.

For detailed instructions, see the *User and Reference Guide* and the *Hitachi Storage Navigator User's Guide*.

System Requirements

Cache Residency Manager operations involve the USP V/VM storage system, the host servers that access the data stored in the USP V/VM, the fibre-channel connections between the USP V/VM and the host servers, and the licensed Cache Residency Manager software.

The Cache Residency Manager system requirements are:

- **Hitachi USP V/VM:** Cache Residency Manager supports all physical disk drive options and RAID-level configurations for the USP V/VM. The USP V/VM operates with the OPEN-V device type. For device types other than OPEN-V, see Appendix A.
- **Storage Navigator:** The Storage Navigator remote console software is required for USP V/VM Cache Residency Manager operations. The Cache Residency Manager remote console software is a component of the USP V/VM Hitachi Storage Navigator product. For instructions on installing the Storage Navigator computer and software, see the *Hitachi Storage Navigator User's Guide*.



Note: Administrator or Cache Residency Manager write access to the Storage Navigator software is required to perform Cache Residency Manager operations. Users without Administrator or Cache Residency Manager write access can only view Cache Residency Manager information.

Enabling the Cache Residency Manager Option

You must enable the Cache Residency Manager option on the USP V/VM using the USP V/VM Storage Navigator remote console software. Each USP V/VM requires its own separate set of license key codes.

For instructions on using the USP V/VM Storage Navigator software and enabling the option, see the *Hitachi Storage Navigator User's Guide*.



Note: When you use Storage Navigator on UNIX[®] workstations or in other non-Windows[®] environments, certain additional operating conventions must be followed. For details, see the *Hitachi Storage Navigator User's Guide*.

Disabling Cache Residency

For information on disabling the Cache Residency Manager option, see the *Hitachi Storage Navigator User's Guide*.

Launching Cache Residency

To use Cache Residency, the user must first log on to the primary SVP. For detailed instructions on the login process, see the *Hitachi Storage Navigator User's Guide*.

When you successfully log on to the primary SVP, the Storage Navigator main window opens (see [Figure 3-1](#)). Click **Go, Cache Residency Manager**, and then **Cache Residency Manager** on the menu bar of the Storage Navigator main window to open the Cache Residency window (see [Cache Residency Window](#)).



Note: When you open the Storage Navigator main window, you are in view mode. If you want to make changes to the Cache Residency Manager settings, you must select modify mode. For information and instructions on changing to modify mode, see the *Hitachi Storage Navigator User's Guide*.

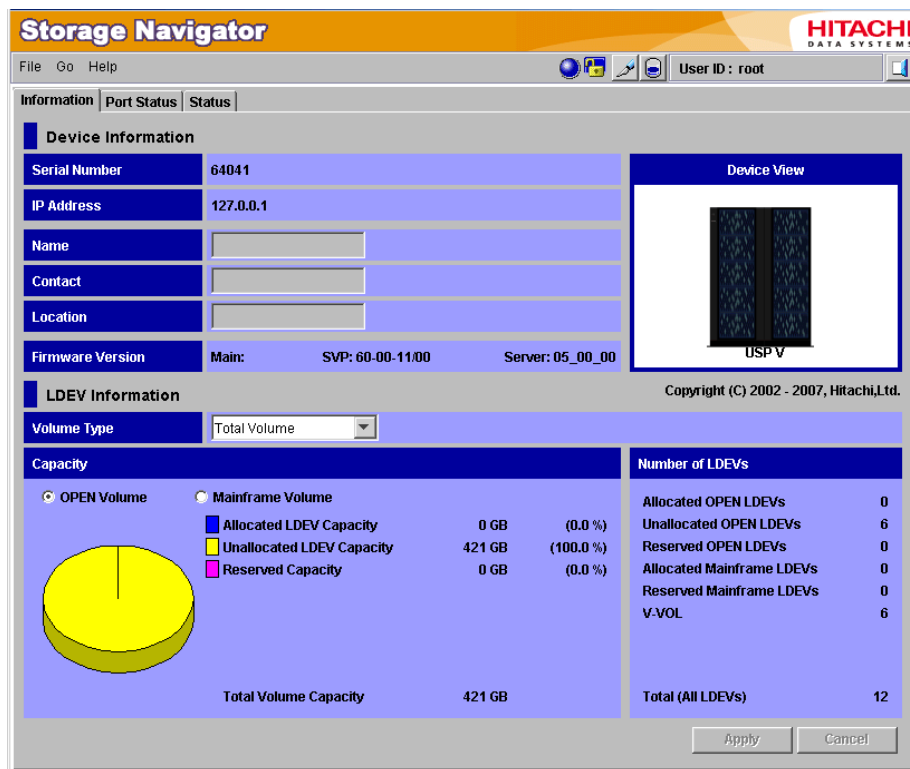


Figure 3-1 Storage Navigator Main Window, Information Tab

Required Cache Size for Cache Residency

The required cache size for Cache Residency Manager differs according to the operation modes, or the RAID levels. For example, if the bind mode is set, RAID-1 storage systems require twice the size of cache for the user data to use Cache Residency. However, RAID-5 or RAID-6 storage systems require three times the size of cache.



Note: If external volumes are used, twice the cache size for the user data is required to use Cache Residency Manager.

If the priority mode or the bind mode is set, the cache size is calculated assuming that one slot has the following values.

- For open-systems volumes:
 - For OPEN-V, one slot is 264 KB (512 LBAs).
 - For other than OPEN-V, one slot is 66 KB (128 LBAs).
- For mainframe (3390) volumes:
 - One slot is 66 KB (128 LBAs).

The calculating procedures for each operation mode and RAID level are described in the following sections.

Cache Requirements for Open-Systems

To calculate cache size for open-systems:

1. Calculate the converted values of the starting address and the ending address.

To calculate the converted values of starting address and the ending address for the all specified LDEVs:

a. For OPEN-V:

- Number of LBAs = LDEV size (KB) × 2
Convert the LDEV size to the number of LBAs.
- Number of slots = (↑Number of LBAs ÷ 512↑)
Round up the value that is calculated from the formula between two up-arrows (↑) after the decimal point.
- Converted value of starting address = 0
- Converted value of ending address = (Number of slots × 512) - 1

b. For emulation types other than OPEN-V:

- Number of LBAs = LDEV size (KB) × 2
Convert the LDEV size to the number of LBAs.
- Number of slots = (↑Number of LBAs ÷ 96↑)
Round up the value that is calculated from the formula between two up-arrows (↑) after the decimal point.
- Converted value of starting address = 0
- Converted value of ending address = (Number of slots × 96) - 1

To calculate the converted values of the starting address and the ending address if the volumes are specified:

c. For OPEN-V:

- Starting value = (↓Setting value of starting address (LBA) ÷ 512↓)
Round down the value that is calculated from the formula between two downward arrows (↓) after the decimal point.
"Setting value of starting address (LBA)" is the value which is input on the Cache Residency window.
- Ending value = (↓Setting value of ending address (LBA) ÷ 512↓)
Round down the value that is calculated from the formula between two downward arrows (↓) after the decimal point.
"Setting value of ending address (LBA)" is the value which is input on the Cache Residency window.
- Converted value of starting address = Starting value × 512
- Converted value of ending address = ((Ending value + 1) × 512) - 1

d. For emulation types other than OPEN-V:

- Starting value = (↓Setting value of starting address (LBA) ÷ 96↓)
Round down the value that is calculated from the formula between two downward arrows (↓) after the decimal point.
"Setting value of starting address (LBA)" is the value which is input on the Cache Residency window.
- Ending value = (↓Setting value of ending address (LBA) ÷ 96↓)
Round down the value that is calculated from the formula between two downward arrows (↓) after the decimal point.
"Setting value of ending address (LBA)" is the value which is input on the Cache Residency window.
- Converted value of starting address = Starting value × 96
- Converted value of ending address = ((Ending value + 1) × 96) - 1

2. Calculate the number of addresses between the starting address and the ending address calculated in procedure 1.
 - a. For OPEN-V:
 - Number of addresses
= Converted value of ending address - Converted value of starting address + 1
Calculate the number of LBAs that are used by the user data.
 - b. For emulation types other than OPEN-V:
 - Number of LBAs
= Converted value of ending address - Converted value of starting address + 1
Calculate the number of LBAs that are used by the user data.
 - Number of slots = Number of LBAs ÷ 96
Convert the number of LBAs to the number of slots.
 - Number of addresses = Number of slots × 128
Convert the number of slots with 128 LBA.
3. Calculate the required cache size according to the operation modes, or the RAID levels to use Cache Residency Manager.
 - a. Where the bind mode is set:
 - For RAID-1:
Required cache size = No. of addresses × (512 + 16) × 2 ÷ 1,024
The unit is KB.
 - For RAID type other than RAID-1:
Required cache size = No. of addresses × (512 + 16) × 3 ÷ 1,024
The unit is KB.
 - b. Where the priority mode is set:
Required cache size = Number of addresses × (512 + 16) ÷ 1,024
The unit is KB.



Note: If a RAID-5 or RAID-6 volume area is changed from priority mode to bind mode and no cache is added, then only 33% of the user data will fit in the area previously assigned for priority mode, and the remaining 67% is used to save read/write data.

If a RAID-1 volume area is changed from priority mode to bind mode and no cache is added, then only 50% of the user data will fit in the area previously assigned for priority mode, and the remaining 50% is used to save read/write data.

Changing the mode without cache extension requires a Cache Residency Manager reconfiguration.

Cache Requirements for Mainframe Systems

To calculate the cache size for the mainframe systems:

1. Calculate the converted values of the starting address and the ending address.
 - a. To calculate the converted values of starting address and the ending address for the all specified LDEVs:
 - Setting value of ending address (CC) = $(\downarrow((LDEV\ size \times 15) - 1) \div 15\downarrow)$
 - Round down the value that is calculated from the formula between two downward arrows (\downarrow) after the decimal point.
 - “Setting value of ending address (CC)” is the value which is input on the Cache Residency window.
 - Setting value of ending address (HH) = $((LDEV\ size \times 15) - 1) \text{ Mod } 15$
 - The remainder will be the setting value of ending address (HH).
 - “Setting value of ending address (HH)” is the value which is input on the Cache Residency window.
 - Converted value of starting address = 0
 - Converted value of ending address
= Setting value of ending address (CC) \times 15 + Setting value of ending address (HH)
“Setting value of ending address (CC)” and “Setting value of ending address (HH)” is the value which is input on the Cache Residency window.
 - b. To calculate the converted values of the starting address and the ending address if the volumes are specified:
 - Converted value of starting address
= Setting value of starting address (CC) \times 15 + Setting value of starting address (HH)
“Setting value of ending address (CC)” and “Setting value of ending address (HH)” is the value which is input on the Cache Residency window.
 - Converted value of ending address
= Setting value of ending address (CC) \times 15 + Setting value of ending address (HH)
“Setting value of ending address (CC)” and “Setting value of ending address (HH)” is the value which is input on the Cache Residency window.

2. Calculate the number of addresses between the starting address and the ending address calculated in procedure 1:
 - Number of addresses
 = Converted value of ending address - Converted value of starting address + 1
 Calculate the number of addresses of cache that are used by the user data.
3. Calculate the required cache size according to the operation modes, or the RAID levels to use Cache Residency.
 - a. Where the bind mode is set:
 - For RAID-1:
 Required cache size = $(\text{Number of addresses} \times ((128 \times (512 + 16)) \times 2)) \div 1,024$
 The unit is KB.
 - For RAID type other than RAID-1:
 Required cache size = $(\text{Number of addresses} \times (128 \times (512 + 16)) \times 3) \div 1,024$
 The unit is KB.
 - b. Where the priority mode is set:
 - Required cache size = $(\text{Number of addresses} \times (128 \times (512 + 16))) \div 1,024$
 The unit is KB.



Note: If a RAID-5 or RAID-6 volume area is changed from priority mode to bind mode and no cache is added, then only 33% of the user data will fit in the area previously assigned for priority mode, and the remaining 67% is used to save read/write data.

If a RAID-1 volume area is changed from priority mode to bind mode and no cache is added, then only 50% of the user data will fit in the area previously assigned for priority mode, and the remaining 50% is used to save read/write data.

Changing the mode without cache extension requires a Cache Residency Manager reconfiguration.

Cache Residency Manager Cache Extents

The Cache Residency cache areas (called cache extents) have the following parameters:

- The cache extents are dynamic and can be added and deleted at any time.
- The USP V/VM supports a maximum of 1,024 addressable cache extents per LDEV and per storage system.
- For mainframe volumes, each Cache Residency Manager cache area must be defined on contiguous tracks, with a minimum size of one cache slot (or track) and a maximum size of one LVI. This is equivalent to 66KB.
- For OPEN-V volumes, Cache Residency Manager cache extents must be defined in logical blocks using logical block addresses (LBAs), with a minimum size of 512 LBAs (equivalent to 264 KB). (For other than OPEN-V, see Appendix A.) However, in most cases users will assign an entire open-system volume for Cache Residency. If the remaining cache memory is less than 256 MB, Cache Residency Manager is not available.
- The user has the option of prestaging the data to the resident cache area. If prestaging is not used, the data will be loaded into the Cache Residency Manager extents when the first “miss” occurs. If prestaging is used, performance may be affected for a short time while the data is read into Cache Residency Manager cache.



Caution: Prestaging of Cache Residency Manager data should not be performed during peak activity.

- All write I/Os to Cache Residency Manager data are duplex writes, guaranteeing full data integrity. The Cache Residency Manager data remains fixed in cache until the user manually deletes it. Deletion of Cache Residency Manager extents will destage any write data to the affected volumes.
- It is possible to expand the amount of Cache Residency Manager cache without canceling the existing Cache Residency Manager settings. Please call the Hitachi Data Systems Support Center for assistance.

Table 3-1 Cache Residency Manager Specifications

Item	Specifications	
	Open Systems	Mainframe
Emulation type	OPEN-V OPEN-3, 8, 9, E, L	3390-3, 3A, 3B, 3C, 3R, 9, 9A, 9B, 9C, L, LA, LB, LC, M, MA, MB, MC 3380-3, 3A, 3B, 3C, F, K, KA, KB, KC Note: The use of 3380 device emulation is restricted to Fujitsu environments.
Supported volumes	LUN Expansion (LUSE) volume Virtual LUN (VLL) volume	Virtual LVI (VLL) volume
Unit of cache area allocation	For OPEN-V, at least 512 LBAs: Equivalent to 264 KB For other than OPEN-V, at least 96 LBAs: Equivalent to 66 KB	At least one cache slot (or track): Equivalent to 66 KB. Up to 1 LDEV.
Number of cache areas	Per storage system: 16,384 Per LDEV: 4,096	

Cache Residency Manager Restrictions

The following are restrictions on the use of the Cache Residency function:



WARNING: Do not perform the ShadowImage™ quick restore operation or the Volume Migration operation on a Cache Residency Manager volume. Also, do not specify the Cache Residency setting on the volume on which the ShadowImage quick restore or Volume Migration operation is performed.

These operations swap the internal locations of the source and target volumes, which causes a loss of data integrity. For additional information, see the *Hitachi ShadowImage User's Guide* and/or contact the Hitachi Data Systems Support Center. See [Calling the Hitachi Data Systems Support Center](#).

- Do not attempt to allocate Cache Residency Manager cache beyond the allocated capacity.
- Do not apply Cache Residency Manager settings to volumes reserved for Volume Migration.
- Do not attempt to allocate Cache Residency Manager cache redundantly over the cache area that is already allocated to an LDEV.
- The Cache Residency Manager bind mode is not available to external volumes whose Cache mode is set to Disable (which is the mode that disables the use of the cache when there is an I/O request from the host).
- Do not apply or refer to Cache Residency Manager settings to volumes from the host and Storage Navigator PC at the same time, though you can apply the settings from the host if you use Cache Manager.
- If you specify the Cache Residency Manager setting on the volume during the quick formatting, do not use the prestaging function. If you want to use the prestaging function after the quick formatting processing completes, first you need to release the setting and then specify the Cache Residency Manager setting again, with the prestaging setting enabled this time. For information about the quick formatting, see the *Hitachi Virtual LVI/LUN and Volume Shredder User's Guide*.
- If you use Cache Residency Manager to set the bind mode, while the mode setting of the battery back-up system is de-staging, you run a risk that should the electric power be shut off, battery power may also run out before the de-staging processing is completed. To avoid this risk, do not set the bind mode if the mode setting of the battery back-up system is de-staging. Contact your system manager for information about the current mode setting of the battery back-up system.
- You cannot allocate Pool-VOLs and V-VOLs for Cache Residency Manager. For further information about Pool-VOLs and V-VOLs, see the *Copy-on-Write Snapshot User's Guide* and the *Dynamic Provisioning User's Guide*.

- You cannot allocate the journal volumes for Cache Residency Manager. For additional information about the journal volumes, see the *Universal Replicator User's Guide* or the *Universal Replicator for z/OS User's Guide*.
- You cannot allocate the remote command device for Cache Residency Manager. For further information about the remote command device, see the *Universal Volume Manager User's Guide*.

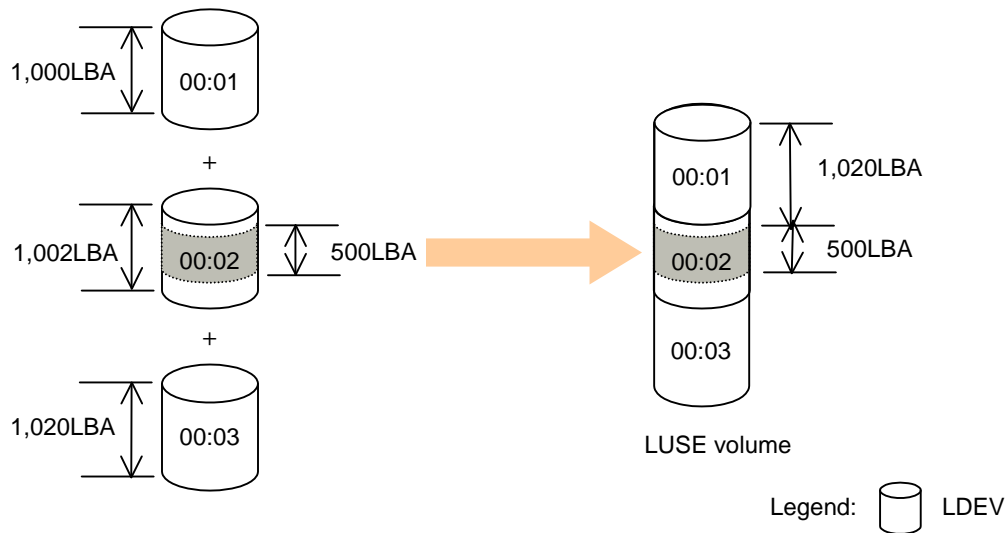


Figure 3-2 Example of LBA Value Setting When Using LUSE

If you want to set Cache Residency Manager for a LUSE volume, you must set Cache Residency Manager for an LDEV that is a component of the LUSE volume. To determine the LDEV for which you want to set Cache Residency, you must know the exact number of LBAs in each LDEV that is a component of the LUSE volume.



Note: The number of LBAs displayed on the Cache Residency window is different from the actual number of LDEVs, and does not match the number of LBAs recognized by the host.

To identify the exact number of LBAs in a LDEV, you must first display the Basic Information Display window and search for the parity group to which the LDEV belongs according to the LDKC, control unit (CU), and LDEV numbers.

Next, you must display the VLL window and find the exact number of LBAs in the LDEV. For further information about the Basic Information Display window, see the *Storage Navigator User's Guide*. For further information about VLL, see the *Virtual LVI/LUN and Volume Shredder User's Guide*.

As illustrated in Figure 3-2, the LUSE volume is composed of three LDEVs, i.e. 00:01 (1,000 LBAs), 00:02 (1,002 LBAs), and 00:03 (1,020 LBAs). If you see from the host and want to set Cache Residency Manager to 500 LBAs starting from No. 1,020 LBA, you may set the Cache Residency Manager to 500 LBAs starting from No. 20 LBA of the 2nd LDEV because the first LDEV size is 1,000 LBAs.

The following Virtual LVI/LUN (VLL) operations automatically reset Cache Residency Manager cache:

- When a fixed or customized volume that is partly or wholly assigned to Cache Residency Manager is converted into free space by the VLL Volume to Space function.
- When a VDEV containing volumes that are assigned to Cache Residency Manager is initialized by the VLL Volume Initialization function.

For further information on Virtual LVI/LUN, see the *Virtual LVI/LUN and Volume Shredder User's Guide* (MK-96RD630).



Caution: You may want to increase total storage system cache capacity when using Cache Residency Manager to avoid data access performance degradation for non-Cache Residency Manager data. Cache Residency Manager is only available on USP V/VM storage systems configured with at least 512 MB of cache. The Hitachi Data Systems representative configures the maximum allowable Cache Residency Manager area when the cache is installed.



Note: OPEN-V logical blocks are in 128-byte increments. Cache Residency Manager recognizes open-system logical blocks in 512-block increments. For example, if you enter starting LBA as 1 and an ending LBA as less than 512, Cache Residency Manager automatically changes the beginning LBA to 00 and the ending LBA to 511.

Virtual Partition Manager Support Requirements

The volume used for the Cache Residency Manager function varies based on user type.

If you are logged in to Storage Navigator as a storage administrator, you can apply the Cache Residency Manager function to all volumes. If you are logged in to Storage Navigator as a storage partition administrator, you can apply this function to the volumes in the cache logical partition (CLPR) that you administer. In this case, you cannot perform the prestaging function.



Note: You can use the Cache Residency Manager function only if the volume and the cache are allocated into the same CLPR.

Using the Cache Residency Manager GUI

This chapter describes the various elements of the Cache Residency Manager graphical user interface:

- [Cache Residency Window](#)
- [Multi Set Dialog Box](#)
- [Multi Release Dialog Box](#)

This chapter describes only the Cache Residency window and associated dialog boxes. For general information on Storage Navigator features, see the *Storage Navigator User's Guide*.

Cache Residency Window

The Cache Residency window provides the Cache Residency Manager information for the connected USP V/VM storage system and provides access to all Cache Residency Manager operations. [Figure 4-1](#) shows the Cache Residency window when an open-systems LDEV is selected. [Figure 4-2](#) shows the Cache Residency window when a mainframe LDEV is selected.

To open the Cache Residency window, on the menu bar of the Storage Navigator main window click **Go**, then **Cache Residency Manager**, then **Cache Residency**.

The Cache Residency window consists of the following components:

- CLPR list
- Prestaging checkbox
- CU:LDEV tree
- LDEV information table
- Cache information area
- Operations box
- Apply and Cancel buttons

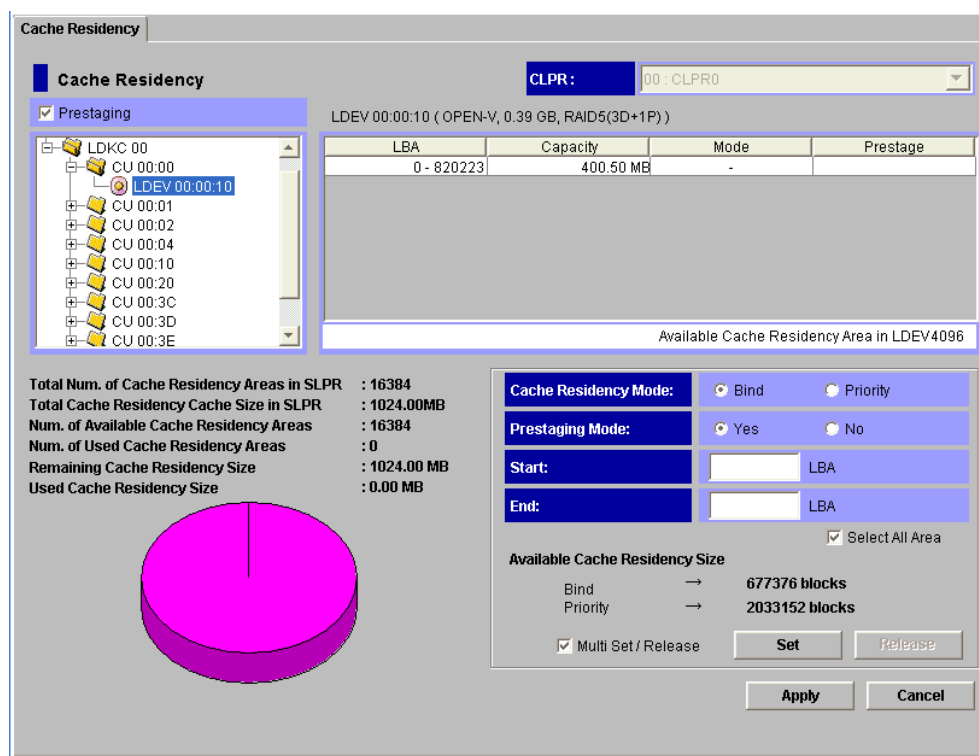


Figure 4-1 Cache Residency Window (Open-Systems LDEV Selected)

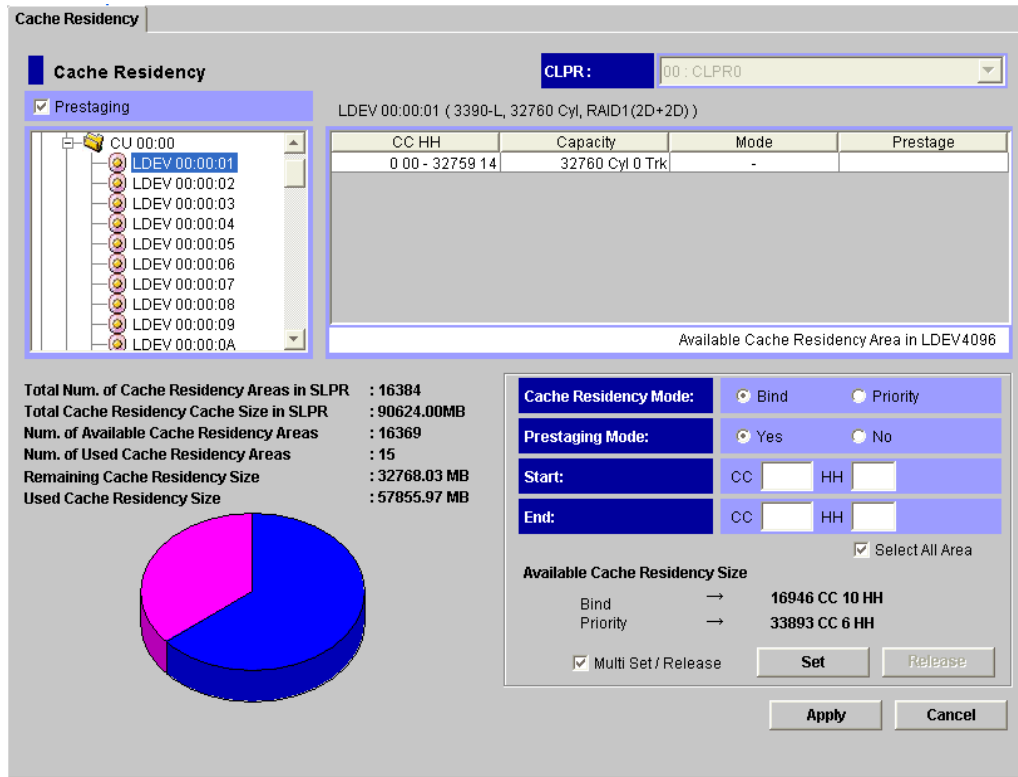


Figure 4-2 Cache Residency Window (Mainframe LDEV Selected)

CLPR List

Figure 4-3 shows the **CLPR** list, which is located in upper right corner of the Cache Residency window. The **CLPR** list allows you to select the cache logical partition (CLPR) containing the desired CUs and LDEVs. The Cache Residency window then shows the cache information for the selected CLPR and the CUs and volumes belonging to the selected CLPR.

If you administer more than one CLPR, use the **CLPR** list to select a CLPR by name and number. If you administer only one CLPR, the **CLPR** list shows only the CLPR that you have access to and does not allow you to select other CLPRs.

For information on cache logical partitions, see the *Virtual Partition Manager User's Guide*.

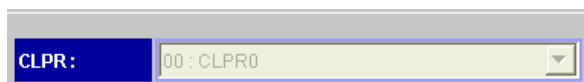


Figure 4-3 CLPR List on the Cache Residency Window

Prestaging Checkbox

[Figure 4-4](#) shows the **Prestaging** checkbox, which is located in the upper left corner of the Cache Residency window. The **Prestaging** checkbox allows you to enable and disable the prestaging function for Cache Residency Manager:

- If you select the **Prestaging** checkbox and click **Apply**, a Yes/No confirmation is displayed. To perform a Cache Residency Manager operation followed by a prestaging operation, click **Yes**. To perform only the Cache Residency Manager operation, click **No**.
- If you clear the **Prestaging** checkbox and click **Apply**, only a Cache Residency Manager operation is performed. If you select this checkbox later and click **Apply**, a Yes/No confirmation is displayed. If you click **Yes**, only the prestaging operation is performed.

The **Prestaging** checkbox is selected by default. The **Prestaging** checkbox is unavailable when the **Prestaging Mode** is set to **No** for each cache extent.

The **Prestaging** checkbox can be selected only when you are logged in to Storage Navigator as a storage administrator. If you are logged in as a storage partition administrator, it cannot be selected.



Figure 4-4 Prestaging Checkbox on the Cache Residency Window

CU:LDEV Tree

[Figure 4-5](#) shows the CU:LDEV tree, which is located in the upper left area of the Cache Residency window. The CU:LDEV tree lists the LDEVs that are available for Cache Residency Manager operations. The LDEVs are identified by LDKC number, CU number, and LDEV number (e.g., LDEV 00:01:48 is LDEV 48 in CU 01 in LDKC 00). An LDEV number ending with # (e.g., 00:00:01#) indicates that the LDEV is an external volume.

Only the volumes belonging to the selected CLPR are shown. Volumes that are reserved for Volume Migration™ and Compatible PAV alias volumes are not displayed, because these volumes are not available for Cache Residency Manager operations.

[Table 4-1](#) describes the icons in the CU:LDEV tree.

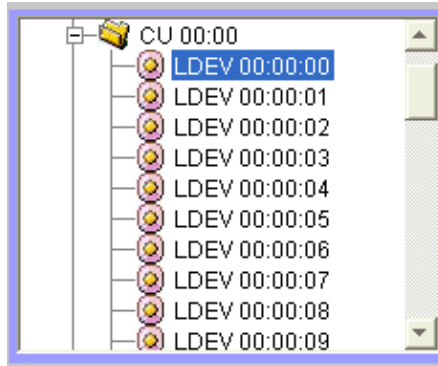


Figure 4-5 CU:LDEV Tree on the Cache Residency Window

Table 4-1 Icons in the CU:LDEV Tree

Icon	Description
	Indicates an open/expanded folder. An open LDKC folder displays the CUs that belong to that LDKC. An expanded CU folder displays the LDEVs that belong to that CU.
	Indicates an unopened/unexpanded LDKC or CU folder.
	Indicates that the LDEV is an internal volume for which Cache Residency Manager is not set or an external volume whose Cache mode is set to Enable .
	Indicates that the LDEV is an internal volume for which Cache Residency Manager is set or an external volume whose Cache mode is set to Enable .
	Indicates that the LDEV is an external volume where Cache Residency Manager is not set to Disable but Cache mode is set to Disable .
	Indicates that the LDEV is an external volume that has both Cache Residency Manager and Cache mode set to Disable .

LDEV Information Table

The LDEV information table, located in the upper right corner of the Cache Residency window, provides the detailed information and Cache Residency Manager settings for the LDEV selected in the CU:LDEV tree. [Figure 4-6](#) shows the LDEV information table when an open-systems LDEV is selected, and [Figure 4-7](#) shows the LDEV information table when a mainframe LDEV is selected. The LDEV information table also displays information for requested operations, which are shown in *blue italics* (see [Figure 4-8](#)).

LDEV 00:00:10 (OPEN-V, 0.39 GB, RAID5(3D+1P))			
LBA	Capacity	Mode	Prestage
0 - 820223	400.50 MB	-	
Available Cache Residency Area in LDEV4096			

Figure 4-6 LDEV Information Table (Open-Systems LDEV Selected)

LDEV 00:00:01 (3390-L, 32760 Cyl, RAID1(2D+2D))			
CC HH	Capacity	Mode	Prestage
0 00 - 32759 14	32760 Cyl 0 Trk	-	
Available Cache Residency Area in LDEV4096			

Figure 4-7 LDEV Information Table (Mainframe LDEV Selected)

LDEV 00:00:10 (OPEN-V, 0.39 GB, RAID5(3D+1P))			
LBA	Capacity	Mode	Prestage
0 - 511	0.25 MB	BIND	ON
512 - 820223	400.25 MB	-	
Available Cache Residency Area in LDEV4096			

Figure 4-8 LDEV Information Table Showing a Requested Operation

Item	Description
LDEV ID	Information for the LDEV selected in the CU:LDEV tree: <ul style="list-style-type: none"> ▪ LDKC:CU:LDEV ("#" after the LDEV number indicates an external volume) ▪ Emulation type ▪ Volume capacity in MB for open-systems LDEVs, in cylinders and tracks for mainframe LDEVs ▪ RAID level
Data Location	Data location on the LDEV by starting and ending addresses: LBAs for open-systems LDEVs, CC HH for mainframe LDEVs. When the data location is in blue italics, this indicates a requested operation.
Capacity	Capacity of the data stored in Cache Residency Manager cache: MB for open-systems LDEVs, cylinders and tracks for mainframe LDEVs. When the capacity is in blue italics, this indicates a requested operation.
Mode	Cache Residency Manager cache mode: <ul style="list-style-type: none"> ▪ PRIO indicates priority mode. ▪ BIND indicates bind mode. ▪ A dash (-) indicates that the area is not allocated for Cache Residency Manager cache. When the cache mode is in blue italics, this indicates a requested operation.
Prestage	Setting for the prestaging function: <ul style="list-style-type: none"> ▪ Blank indicates that the prestaging function is not set. ▪ ON indicates that the prestaging function is set. When the prestaging mode is in blue italics, this indicates a requested operation.
Available Cache Residency Area in LDEV	Available number of cache extents in the specified LDEV (maximum: 4,096).

Cache Information Area

Figure 4-9 shows the cache information area, which is located in the lower left area of the Cache Residency window. The cache information area provides information on the USP V/VM cache usage. The cache information area also indicates when prestaging operations and cache residency operations are in progress, as shown in Figure 4-10 and Figure 4-11.

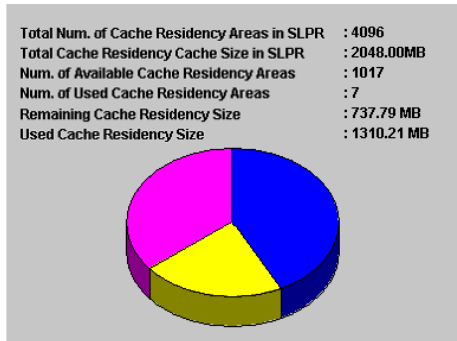


Figure 4-9 Cache Information Area

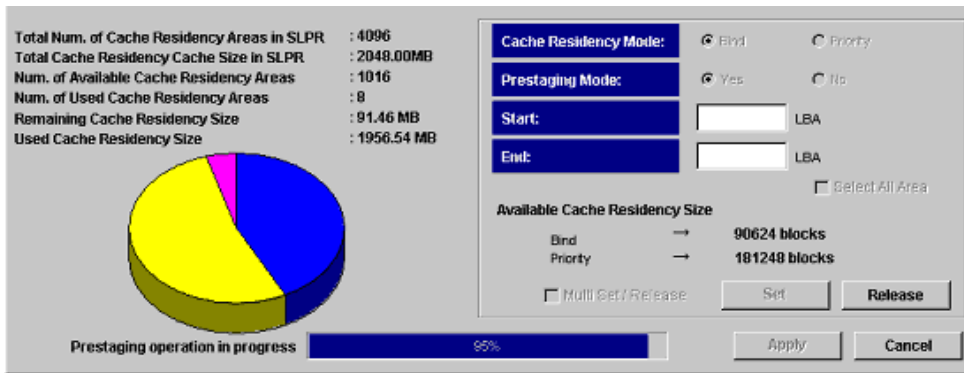


Figure 4-10 Prestaging Operation in Progress

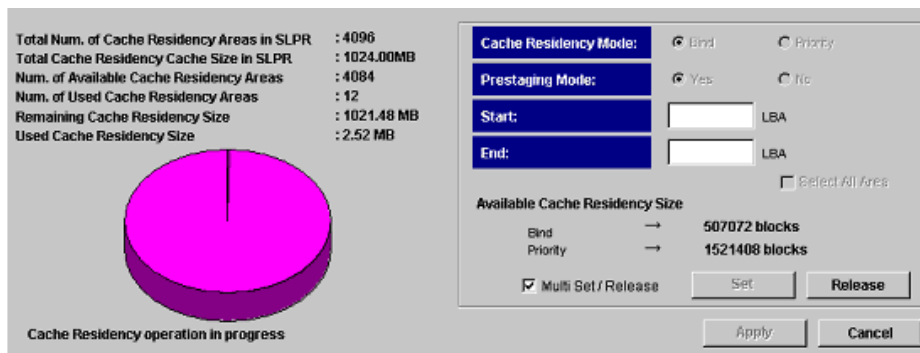


Figure 4-11 Cache Residency Manager Operation in Progress

Item	Description
Total Num. of Cache Residency Areas in SLPR	<p>If you are logged in to Storage Navigator as a storage administrator, Total Num. of Cache Residency Areas in SLPR displays the total number of Cache Residency Manager cache extents that can be set in the selected CU group (maximum: 16,384).</p> <p>If you are logged in to Storage Navigator as a storage partition administrator, Total Num. of Cache Residency Areas in SLPR displays the total number of Cache Residency Manager cache extents that can be set in the storage logical partition (SLPR) that you administer (maximum: 16,384).</p>
Total Cache Residency Cache Size in SLPR	<p>If you are logged in to Storage Navigator as a storage administrator, Total Cache Residency Cache Size in SLPR displays, the total capacity (in MB) of Cache Residency Manager cache extents in the selected CU group (maximum: 512 GB).</p> <p>If you are logged in to Storage Navigator as a storage partition administrator, Total Cache Residency Cache Size in SLPR displays the total capacity of Cache Residency Manager cache extents in the SLPR that you administer (maximum: 124 GB).</p>
Num. of Available Cache Residency Areas	Unused Cache Residency Manager cache area, calculated by subtracting the number of installed Cache Residency Manager cache extents in the CLPR from the maximum number of Cache Residency Manager cache extents (16,384).
Num. of Used Cache Residency Areas	Number of Cache Residency Manager cache extents that are used in the CLPR.
Remaining Cache Residency Size	Amount of Cache Residency Manager cache which is available for use in the CLPR (pink area on the pie chart).
Used Cache Residency Size	Capacity of Cache Residency Manager cache used in the CLPR (the total of the blue and yellow areas in the pie chart).
Pie chart	<p>Blue indicates cache that has been used.</p> <p>Yellow indicates the increase in the specified size of the cache.</p> <p>Pink indicates the remaining amount of available cache.</p>
Operation in progress	<p>Prestaging operation in progress (Figure 4-10) indicates the progress of the prestaging operation in percentage. The percentage shown in this progress bar does not affect the pie chart nor the values in the Operation box.</p> <p>Cache Residency Manager operation in progress (Figure 4-11) indicates the progress of the Cache Residency Manager operation in percentage. The percentage shown in this progress bar does not affect the pie chart nor the values in the Operation box.</p>

Operations Box

The operations box (see [Figure 4-12](#) and [Figure 4-13](#)), located on the lower right corner of the Cache Residency window, allows you to add data to and release data from Cache Residency Manager cache.

The screenshot shows the 'Operations Box' for Open-Systems LDEV. It features a grey background with several sections. At the top, 'Cache Residency Mode:' has radio buttons for 'Bind' (selected) and 'Priority'. Below it, 'Prestaging Mode:' has radio buttons for 'Yes' (selected) and 'No'. The 'Start:' field is a text box containing '0' followed by 'LBA'. The 'End:' field is a text box containing '95' followed by 'LBA'. A 'Select All Area' checkbox is present and unchecked. The 'Available Cache Residency Size' section shows 'Bind' with an arrow pointing to '322272 blocks' and 'Priority' with an arrow pointing to '967008 blocks'. At the bottom, there is a 'Multi Set / Release' checkbox (unchecked), a 'Set' button, and a 'Release' button.

Figure 4-12 Operations Box (Open-Systems LDEV Selected)

The screenshot shows the 'Operations Box' for Mainframe LDEV. It features a grey background with several sections. At the top, 'Cache Residency Mode:' has radio buttons for 'Bind' (selected) and 'Priority'. Below it, 'Prestaging Mode:' has radio buttons for 'Yes' (selected) and 'No'. The 'Start:' field consists of two text boxes: 'CC' followed by an empty box, and 'HH' followed by an empty box. The 'End:' field also consists of two text boxes: 'CC' followed by an empty box, and 'HH' followed by an empty box. A 'Select All Area' checkbox is present and unchecked. The 'Available Cache Residency Size' section shows 'Bind' with an arrow pointing to '617 CC 2 HH' and 'Priority' with an arrow pointing to '1234 CC 5 HH'. At the bottom, there is a 'Multi Set / Release' checkbox (unchecked), a 'Set' button, and a 'Release' button.

Figure 4-13 Operations Box (Mainframe LDEV Selected)

Item	Description
Cache Residency Mode	<p>Selects the mode for the data to be added to Cache Residency Manager cache:</p> <ul style="list-style-type: none"> ▪ Bind sets bind mode. <p>Note: Bind mode is not available to external volumes whose Cache mode is Disable (which is the mode that disables the use of the cache when there is an I/O request from the host).</p> <ul style="list-style-type: none"> ▪ Priority sets priority mode. <p>Once you have requested a Cache Residency Manager operation, the mode buttons become disabled. If you want to change the mode for a requested operation, you must cancel the requested operation and request the operation again with the desired mode selected.</p>
Prestaging Mode	<p>Enables or disables the prestaging mode:</p> <ul style="list-style-type: none"> ▪ Yes enables prestaging mode for the requested operations. The prestaging operation will be performed if you select Yes and then click Apply. ▪ No disables prestaging mode for the requested operations. <p>The Prestaging Mode buttons are disabled when the Prestaging checkbox (above the CU:LDEV tree) is not checked.</p> <p>Once you have requested a Cache Residency Manager operation, the Prestaging Mode buttons become disabled. If you want to change the mode for a requested operation, you must cancel the requested operation and request the operation again with the desired mode selected.</p>
Start and End	<p>Enter the starting and ending addresses for the data to be placed in cache, specified in LBAs for open-systems LDEVs, and in CC HH numbers for mainframe LDEVs.</p> <p>For OPEN-V LUs, logical areas are defined in units of 512 blocks. If you enter 0 or 1 as the starting LBA and a value less than 511 as the ending LBA, Cache Residency Manager automatically changes the ending LBA value to 511.</p>
Select All Area	<p>Selects all data areas in the selected LDEV for Cache Residency Manager cache. This checkbox can only be selected if no data areas in the selected LDEV are assigned to Cache Residency Manager cache.</p> <p>If you check Select All Area, the starting and ending addresses (From and To) are cleared.</p>
Available Cache Residency Manager Size	<p>Cache size available for Cache Residency Manager data:</p> <ul style="list-style-type: none"> ▪ Bind displays the available size for bind mode. ▪ Priority displays the available size for priority mode.
Multi Set / Release	<p>Allows you to request Cache Residency Manager operations for more than one LDEV. If you check this box and click Set or Release, the Multi Set or Multi Release dialog box opens to allow you to set data into or release data from Cache Residency Manager cache for more than one LDEV.</p> <p>The Multi Set /Release checkbox does not allow you to select and cancel an individual Cache Residency Manager data area specified for an LDEV. You must perform a Release operation to cancel an individual data area.</p> <p>When the checkbox is enabled, the operation can be applied to the multiple LDEVs. On the other hand, when the checkbox is disabled, the operation is applied to only one LDEV.</p>
Set	<p>Adds the requested set operation (place data in Cache Residency Manager cache) to the LDEV information table. The Set button is enabled when you select a data area that is not in cache in the LDEV table.</p> <p>The Set button is disabled when Cache Residency Manager operations to release data from cache have been requested. To enable the Set button, either perform the requested release operations, or cancel the requested release operations.</p>
Release	<p>Adds the requested release operation (remove data from Cache Residency Manager cache) to the LDEV information table. The Release button is enabled when you select a data area that is in cache in the LDEV table.</p> <p>The Release button is disabled when Cache Residency Manager operations to set data into cache have been requested. To enable the Release button, either perform the requested set operations, or cancel the requested set operations.</p>

Apply and Cancel

The **Apply** and **Cancel** buttons (see [Figure 4-14](#)), located in the lower right corner of the Cache Residency window, allow you to start or cancel the requested operations, including prestaging operations and Cache Residency Manager operations.

- If prestaging is selected and you click **Apply**, a confirmation message appears to allow you to start the requested operations with or without prestaging. To continue with prestaging, click **Yes**. To continue without prestaging, click **No**.
- If you click **Cancel**, a confirmation message appears to allow you to cancel the requested operations. Click **OK** on the confirmation message to cancel the requested operations, or click **Cancel** to keep (but not start) the requested operations.

After you have started the requested operations, you can monitor the progress of the requested operations on the Cache Residency window (cache information area) to make sure that the operations complete successfully.

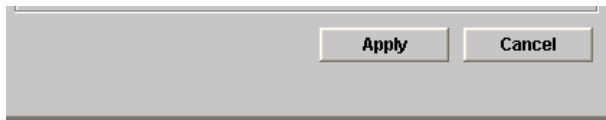


Figure 4-14 **Apply and Cancel Buttons**

Multi Set Dialog Box

The Multi Set dialog box (see [Figure 4-15](#)) enables you to select multiple LDEVs with data that you want to place into Cache Residency Manager cache. The items displayed on the Multi Set dialog box reflect the options selected on the Cache Residency window. Only volumes belonging to the selected CLPR are displayed in the Multi Set dialog box.

To open the Multi Set dialog box:

1. Select the desired options on the Cache Residency window:

To specify a range of data to place in Cache Residency Manager cache, enter the starting and ending addresses in the **Start** and **End** boxes.

To place all data areas of the selected LDEVs into Cache Residency Manager cache, enable the **Select All Area** option.

2. Enable the **Multi Set / Release** option.
3. Click **Set**, and then click **OK** on the confirmation message. The Multi Set dialog box opens with the selected options displayed.

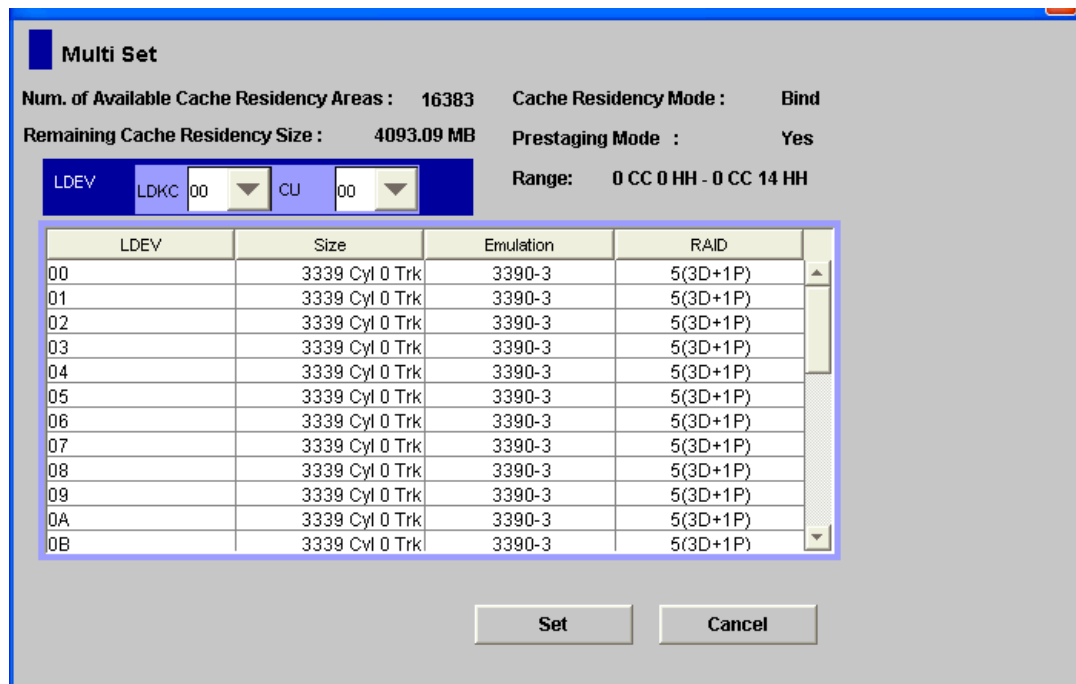


Figure 4-15 Multi Set Dialog Box

Item	Description
Num. of Available Cache Residency Areas	Number of Cache Residency Manager cache extents that can be created.

Item	Description
Remaining Cache Residency Size	Size of unused Cache Residency Manager caches.
Cache Residency Mode	Cache Residency Manager mode (priority or bind) specified by the Cache Residency Mode option on the Cache Residency window.
Prestaging Mode	Prestaging mode (yes or no) specified by the Prestaging Mode option on the Cache Residency window.
Range	Range of data to be placed into Cache Residency Manager cache. The data range is specified using the Start and End fields on the Cache Residency window. All is displayed if the Select All Area box was checked.
LDKC	Selects the LDKC that contains the desired CU and LDEVs.
CU	Selects the CU image that contains the desired LDEVs. Only CUs owned by the selected CLPR are displayed in the Multi Set dialog box.
LDEV table	<p>LDEVs in the selected CU image that are available for the Multi Set function. Note that only volumes owned by the CLPR selected from the CLPR: drop-down list in the Cache Residency window are displayed in the LDEV table.</p> <ul style="list-style-type: none"> ▪ LDEV displays the LDEV number. An LDEV number ending with # indicates that the LDEV is an external volume (e.g., 01#). ▪ Size indicates the size of the LDEV. ▪ Emulation displays the emulation type of the LDEV. ▪ RAID displays the RAID level of the LDEV. A dash (-) is displayed if the LDEV is an external volume.
Set	Saves the requested Set operations, and closes the dialog box.
Cancel	Closes the dialog box without saving the requested operations.

Multi Release Dialog Box

The Multi Release dialog box (see [Figure 4-16](#)) allows you to release Cache Residency Manager data from cache for more than one LDEV. To open the Multi Release dialog box, select an LDEV that has all data stored in Cache Residency cache, check the **Multi Set/Release** box, and then click **Release**.

The Multi Release function applies only to LDEVs that have all data stored in Cache Residency Manager cache. To release individual cache extents, you must select the cache extents in the LDEV information table and use the **Release** button to request the release data operations.

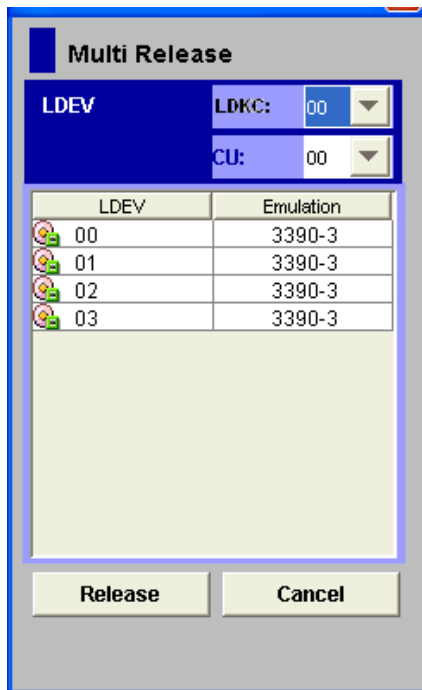


Figure 4-16 Multi Release Dialog Box

Item	Description
LDKC	Selects the LDKC that contains the desired CU and LDEVs.
CU	Selects the CU image that contains the desired LDEVs. Only CUs owned by the selected CLPR are displayed in the Multi Release dialog box.
LDEV table	LDEVs in the selected CU image that are available for the Multi Release function. Note that only volumes owned by the CLPR selected from the CLPR: drop-down list in the Cache Residency window are displayed in the LDEV table. <ul style="list-style-type: none"> ▪ LDEV displays the LDEV number. An LDEV number ending with # indicates that the LDEV is an external volume (e.g., 01#). ▪ Emulation displays the emulation type of the LDEV.
Release	Saves the requested Release operations, and closes the dialog box.
Cancel	Closes the dialog box without saving the requested operations.

Performing Cache Residency Manager Operations

This chapter describes and provides instructions for performing Cache Residency Manager operations:

- [Placing Specific Data into Cache Residency Manager Cache](#)
- [Placing LDEVs into Cache Residency Manager Cache](#)
- [Releasing Specific Data from Cache Residency Manager Cache](#)
- [Releasing LDEVs from Cache Residency Manager Cache](#)



Notes:

- For detailed information on the Cache Residency Manager windows, see [Using the Cache Residency Manager GUI](#).
- Administrator or Cache Residency Manager write access to Storage Navigator is required to perform Cache Residency Manager operations. Users without Administrator or Cache Residency Manager write access can only view Cache Residency Manager information.
- To set the Cache Residency Manager operations, write permission is necessary. If you log in with the user account that does not have write permission, you can view the Cache Residency Manager settings for the connected storage system but cannot set or change the options.



Caution: Do not set or release more than 64 LDEVs simultaneously. Performing Cache Residency Manager operations on many LDEVs during host I/O may cause the response time of host I/O to become slow.

Placing Specific Data into Cache Residency Manager Cache

Use this procedure when you want to place specific data from one or more LDEVs into Cache Residency Manager cache.



Note: Performing Cache Residency Manager operations on a large amount of data during host I/O may cause the host I/O response time to become slow. To avoid degradation of response time, set data from only one LDEV at a time.

To place specific data from one or more LDEVs into Cache Residency Manager cache:

1. Select the desired CLPR from the **CLPR:** drop-down list on the Cache Residency window.
2. In the CU:LDEV tree on the Cache Residency window (upper left), select the LDKC and the CU that contains the desired LDEV, and then select the desired LDEV.

The LDEV information table displays the information for the selected LDEV. A dash (-) in the **Mode** column indicates an area not already allocated to Cache Residency Manager cache.

3. Select an unallocated area in the LDEV information table as the area to place specific data from one or more LDEVs into Cache Residency Manager cache. The starting and ending addresses of the selected area are displayed in the **Start** and **End** fields.



Note: For OPEN-V LUs, Cache Residency Manager identifies a logical area in units of 512 blocks. (For other than OPEN-V, see [Logical Blocks](#) in Appendix A.) If you enter 0 or 1 as the starting LBA and a value less than 511 as the ending LBA, Cache Residency Manager automatically changes the ending block address to 511.

4. Select the desired options on the Cache Residency window. These options will be applied to all selected LDEVs:
 - a. Select the desired mode (**Bind** or **Priority**) in the **Cache Residency Manager Mode** box.
 - b. Select the desired **Prestaging Mode** setting (**Yes** or **No**).



Note: If you want to set the prestaging function, the **Prestaging** checkbox (upper left corner of Cache Residency window) must already be selected.

- c. Verify the starting and ending addresses of the area to be placed in Cache Residency Manager cache in the **Start** and **End** fields. Edit as needed. Make sure that the **Select All Area** box is NOT checked.



Caution: Make sure to select the correct options, since the options cannot be changed after data is added to cache. If you want to change between bind mode and priority mode, or enable/disable the prestaging function, you must release the cache extent that you want to change, and then place the data back into Cache Residency Manager cache with the desired settings.

5. If you do not want to apply the same options to any other LDEVs, make sure that the **Multi Set / Release** box is not checked, click **Set**, and then click **OK** on the confirmation dialog box. The requested Cache Residency Manager operation is displayed in blue in the LDEV information table.

If you want to apply the same options and data range to additional LDEVs:

- a. Select the **Multi Set / Release** box on the Cache Residency window, click **Set**, and then click **OK** to open the Multi Set dialog box. The Multi Set dialog box ([Figure 4-15](#)) displays the data range and options selected on the Cache Residency window.
 - b. On the Multi Set dialog box, select the desired LDKC and CU image, and select the desired LDEVs. The data range and options displayed on the dialog box will be applied to all selected LDEVs.
 - c. Click **Set** to return to the Cache Residency window. The requested Cache Residency Manager operations are displayed in blue in the LDEV information table.
6. Repeat steps (2)–(5) until all desired operations are listed.
-



Note: You cannot use the **Release** button until you apply (or cancel) your requested operations.

7. Verify the Prestaging setting:
 - To enable prestaging, select **Prestaging**.
 - To disable prestaging, clear **Prestaging**.
8. To start the operations, click **Apply**:
 - If Prestaging was selected, respond to the Yes/No confirmation that displays. To continue with prestaging, click **Yes**. To continue without it, click **No**.
 - To cancel the operation, click **Cancel** and click **OK** on the confirmation that displays.
9. Monitor the Cache Residency window to make sure that the operations complete successfully. The cache information area displays the progress of the requested operations.

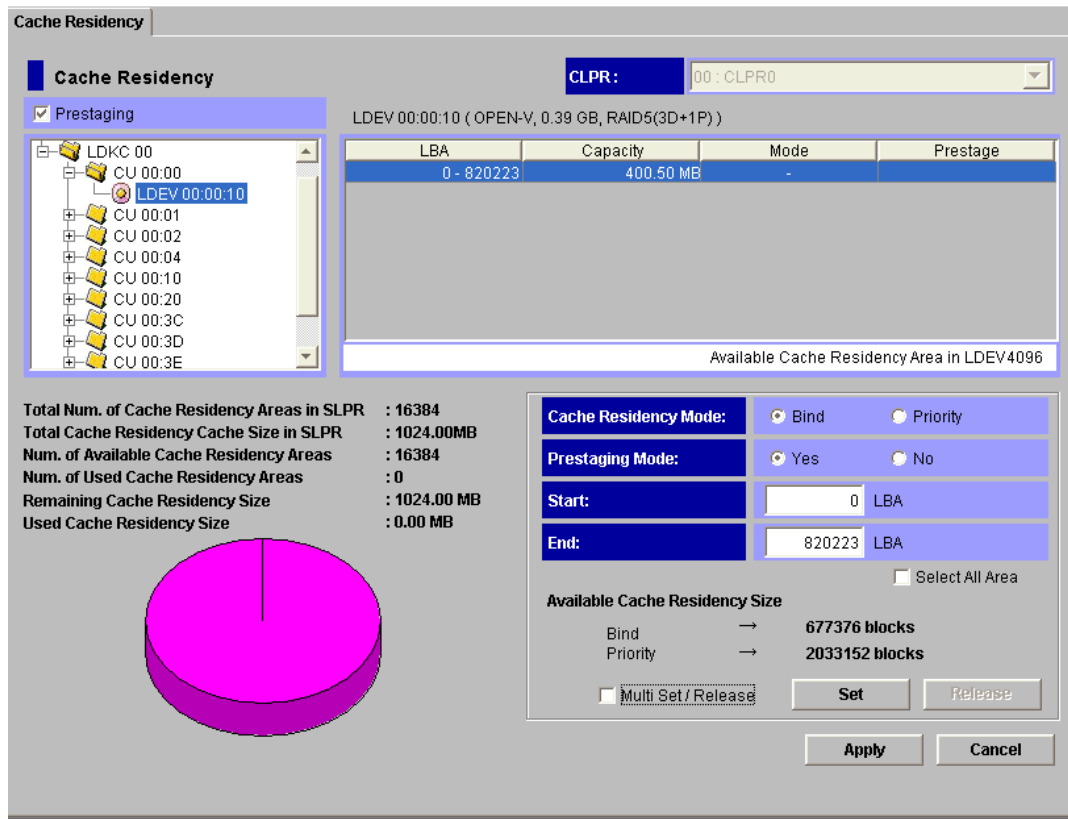


Figure 5-1 Selecting LDEV and Specifying Data Area and Options

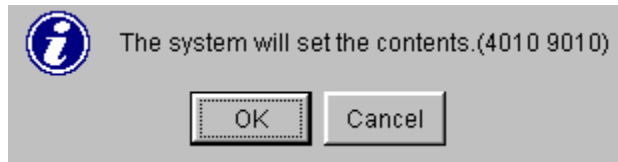


Figure 5-2 Confirmation Message for Placing Data into Cache

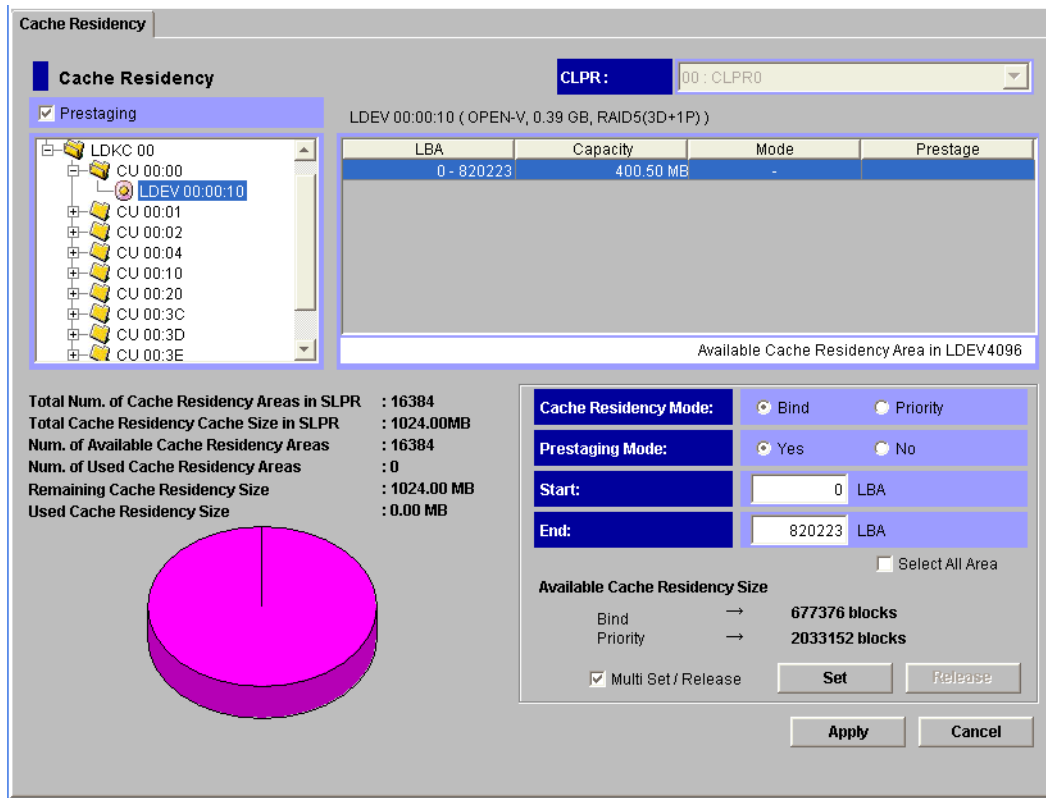


Figure 5-3 Specifying Same Data Area and Options for Multiple LDEVs

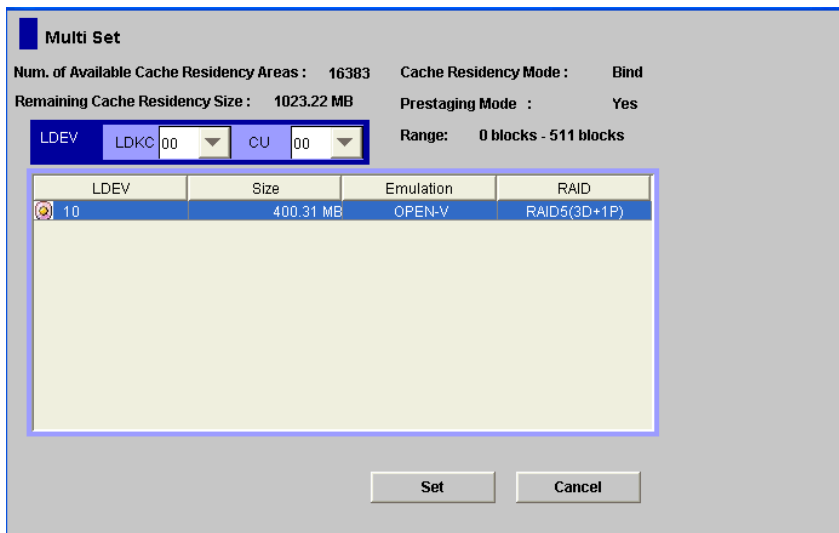


Figure 5-4 Selecting Additional LDEVs on Multi Set Dialog Box (Specific Data Range)

Cache Residency

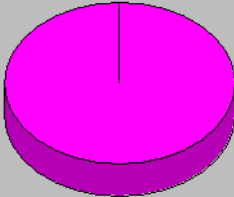
Cache Residency CLPR: 00 : CLPR0

Prestaging LDEV 00:00:10 (OPEN-V, 0.39 GB, RAID5(3D+1P))

LBA	Capacity	Mode	Prestage
0 - 511	0.25 MB	BIND	ON
512 - 820223	400.25 MB	-	-

Available Cache Residency Area in LDEV4095

Total Num. of Cache Residency Areas in SLPR : 16384
 Total Cache Residency Cache Size in SLPR : 1024.00MB
 Num. of Available Cache Residency Areas : 16383
 Num. of Used Cache Residency Areas : 1
 Remaining Cache Residency Size : 1023.22 MB
 Used Cache Residency Size : 0.78 MB



Cache Residency Mode: Bind Priority
Prestaging Mode: Yes No
Start: [] LBA
End: [] LBA
 Select All Area

Available Cache Residency Size
 Bind → 676864 blocks
 Priority → 2031616 blocks
 Multi Set/Release [Set] [Release]

[Apply] [Cancel]

Figure 5-5 Verifying Add Data Area Operation

Placing LDEVs into Cache Residency Manager Cache

Use this procedure when you want to place ALL data on one or more LDEVs into Cache Residency Manager cache.



Note: Performing Cache Residency Manager operations on many LDEVs during host I/O may cause the host I/O response time to become slow. To avoid degradation of response time, set only one LDEV at a time.

To place all data on one or more LDEVs into Cache Residency Manager cache:

1. Select the desired CLPR from the **CLPR:** drop-down list on the Cache Residency window.
2. In the CU:LDEV tree on the Cache Residency window (upper left), select the LDKC and the CU which contains the desired LDEV, and then select the desired LDEV.

The LDEV information table displays the information for the selected LDEV. A dash (-) in the **Mode** column indicates an area not already allocated to Cache Residency Manager cache.

3. Select the desired options on the Cache Residency window:
 - a. Select the desired mode (**Bind** or **Priority**) in the **Cache Residency Manager Mode** box.
 - b. Select the desired **Prestaging Mode** setting (**Yes** or **No**).

Note: If you want to set the prestaging function, the **Prestaging** checkbox (upper left corner of Cache Residency window) must already be selected.
 - c. Check the **Select All Area** box. Leave the **Start** and **End** fields blank.



Caution: Make sure to select the correct options, since the options cannot be changed after a cache extent is added. If you want to change between bind mode and priority mode, or enable/disable the prestaging function, you must release the cache extent that you want to change and then place the data back into Cache Residency Manager cache with the desired settings.

4. If you do not want to apply the same options to any other LDEVs, make sure that the **Multi Set / Release** box is not checked, click **Set**, and then click **OK** on the confirmation dialog box. The requested operation is displayed in blue in the LDEV information table.

If you want to apply the same options to additional LDEVs:

- a. Select the **Multi Set / Release** box on the Cache Residency window, click **Set**, and then click **OK** to open the Multi Set dialog box. The Multi Set dialog box displays the data range and options selected on the Cache Residency window.

- b. On the Multi Set dialog box, select the desired CU image, and select the desired LDEVs. The options displayed on the dialog box will be applied to all selected LDEVs.
 - c. Click **Set** to return to the Cache Residency window. The requested Cache Residency Manager operations are displayed in blue in the LDEV information table.
5. Repeat steps (2)–(4) until all desired operations are listed.



Note: You cannot use the **Release** button until you apply (or cancel) your requested operations.

6. Verify the Prestaging setting:
 - To enable prestaging, select **Prestaging**.
 - To disable prestaging, clear **Prestaging**.
7. To start the operations, click **Apply**:
 - If Prestaging was selected, respond to the Yes/No confirmation. To continue with prestaging, select **Yes**. To continue without it, select **No**.
 - To cancel the operation, click **Cancel** and click **OK** on the confirmation.
8. Monitor the Cache Residency window to make sure that the operations complete successfully. The cache information area displays the progress of the requested operations.

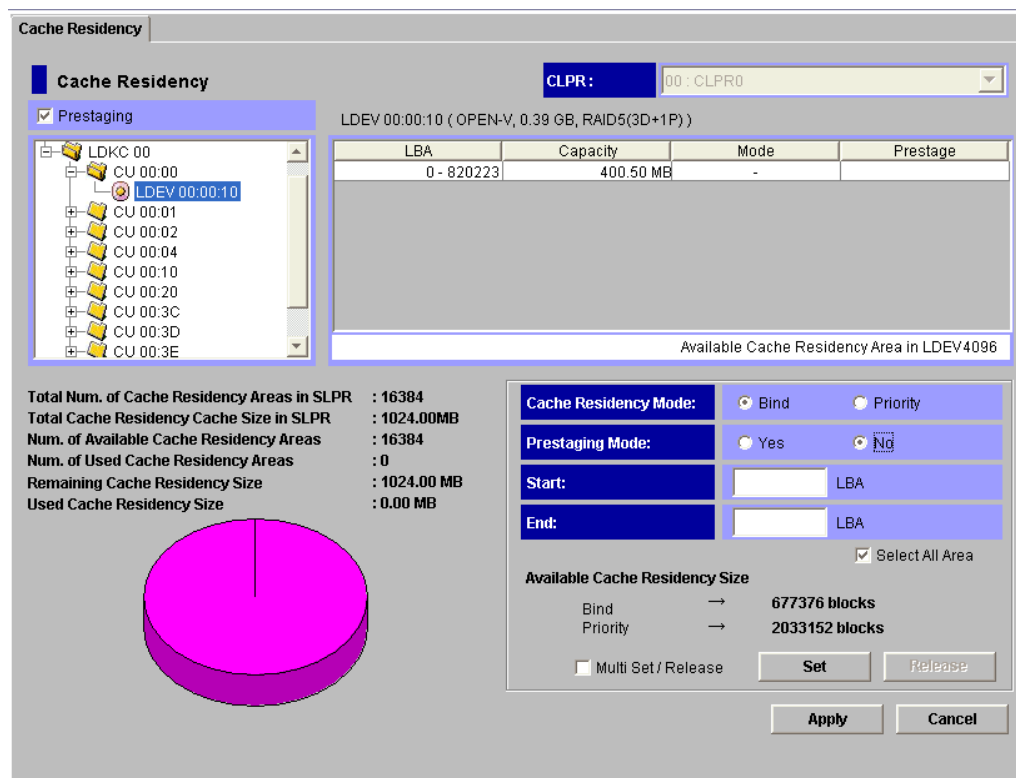


Figure 5-6 Selecting LDEV and Specifying Options

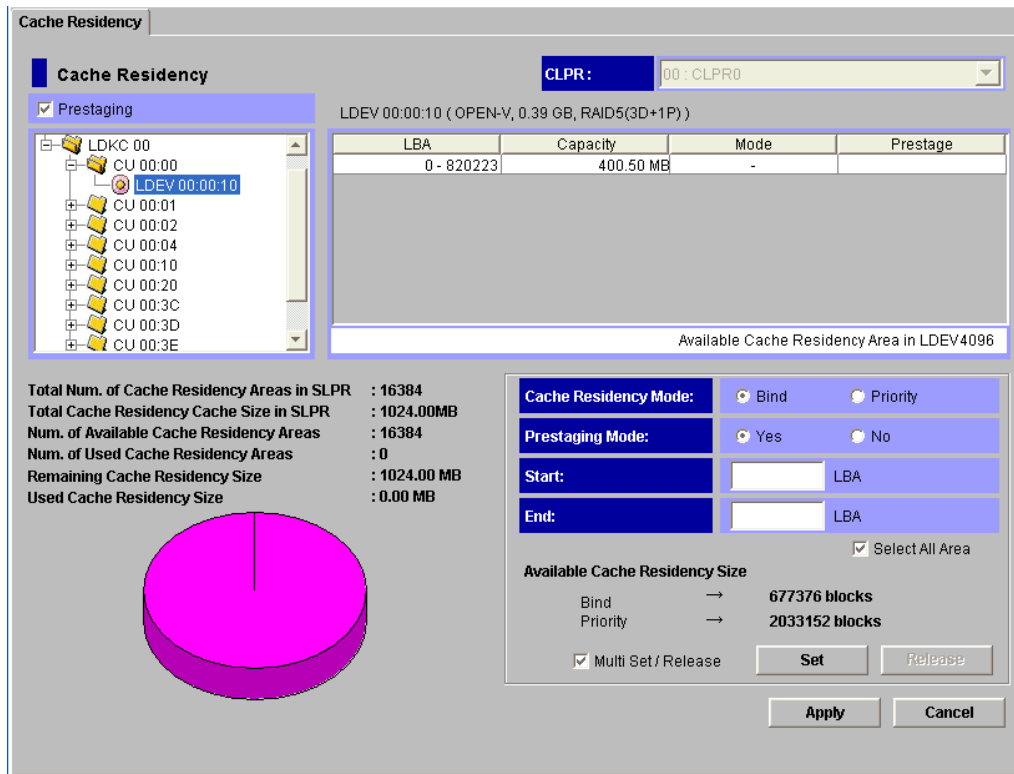


Figure 5-7 Selecting LDEVs to Place in Cache Residency Manager Cache

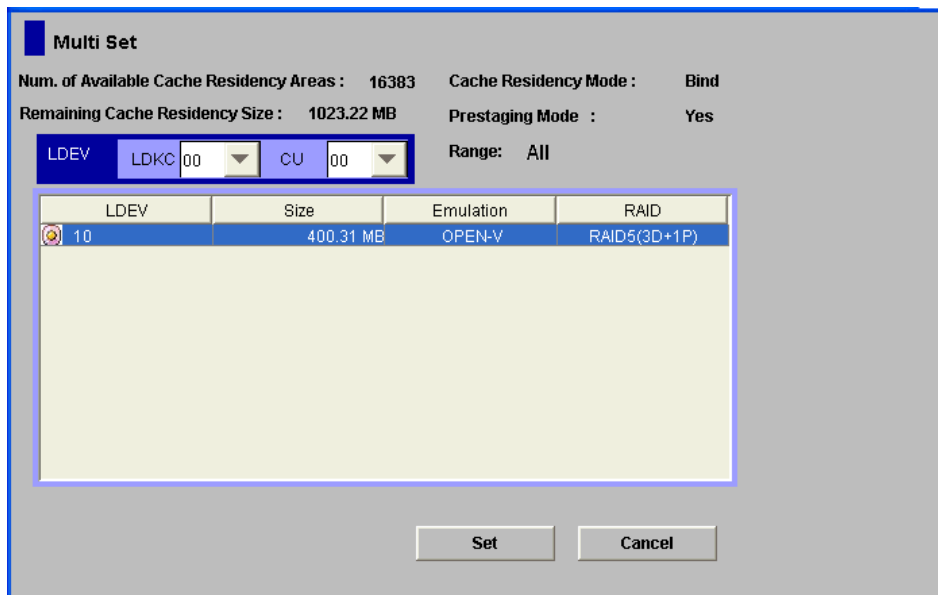


Figure 5-8 Selecting Additional LDEVs on Multi Set Dialog Box (All Data)

Cache Residency

Cache Residency CLPR: 00 : CLPR0

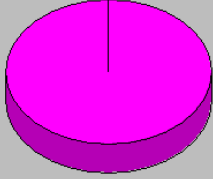
Prestaging

LDEV 00:00:10 (OPEN-V, 0.39 GB, RAID5(3D+1P))

LBA	Capacity	Mode	Prestage
0 - 820223	400.50 MB	<i>BIND</i>	<i>ON</i>

Available Cache Residency Area in LDEV4096

Total Num. of Cache Residency Areas in SLPR : 16384
 Total Cache Residency Cache Size in SLPR : 1024.00MB
 Num. of Available Cache Residency Areas : 16384
 Num. of Used Cache Residency Areas : 0
 Remaining Cache Residency Size : 1024.00 MB
 Used Cache Residency Size : 0.00 MB



Cache Residency Mode: Bind Priority
Prestaging Mode: Yes No
Start: LBA
End: LBA
 Select All Area

Available Cache Residency Size
 Bind → 677376 blocks
 Priority → 2033152 blocks
 Multi Set / Release

Figure 5-9 Verifying Add LDEV Operations

Releasing Specific Data from Cache Residency Manager Cache

Use this procedure when you want to release specific data areas on one or more LDEVs from Cache Residency Manager cache.



Note: Deleting data from cache during host I/O may cause the response time of host I/O to become slow. To avoid degradation of host response time, limit the amount of data you delete in one operation as follows:

If the host timeout period is set to 10 seconds or shorter, limit the total amount of data to:

- 1 GB or less for open systems
- 1,000 cylinders or less for mainframe

If the host timeout period is set to 11 seconds or longer, limit the total amount of data to:

- 3 GB or less for open systems
 - 3,000 cylinders or less for mainframe
-

To release specific data areas on one or more LDEVs from Cache Residency Manager cache:

1. Select the desired CLPR from the **CLPR:** drop-down list on the Cache Residency window.
2. In the CU:LDEV tree on the Cache Residency window (upper left), select the LDKC and the CU which contains the desired LDEV, and then select the desired LDEV.

The LDEV information table displays the information for the selected LDEV. The **Mode** column displays **Prio** or **Bind** for each data area that is allocated to Cache Residency Manager cache.

3. Select the data areas that you want to release from Cache Residency Manager cache (see [Figure 5-10](#)). This enables the **Release** button.
4. Click **Release**, and click **OK** on the confirmation message.

The requested operation is displayed in blue in the LDEV information table.

5. Repeat steps (2)–(4) for each LDEV for which you want to release specific data from Cache Residency Manager cache.
-



Note: You cannot use the **Set** button until you apply (or cancel) your requested operations.

6. Verify the Prestaging setting:
 - To enable prestaging, select **Prestaging**.
 - To disable prestaging, clear **Prestaging**.

7. To start the operations, click **Apply**:
 - If Prestaging was selected, respond to the Yes/No confirmation that displays. To continue with prestaging, select **Yes**. To continue without it, select **No**.
 - To cancel the operation, click **Cancel** and click **OK** on the confirmation that displays.
8. When the delete confirmation message appears (see [Figure 5-11](#)), click **OK** to begin the deletion, or click **Cancel** to cancel your request to delete data. Monitor the Cache Residency window to make sure that the operations complete successfully. The cache information area displays the progress of the requested operations.

When the data has been released, the verification window will appear (see [Figure 5-12](#)).

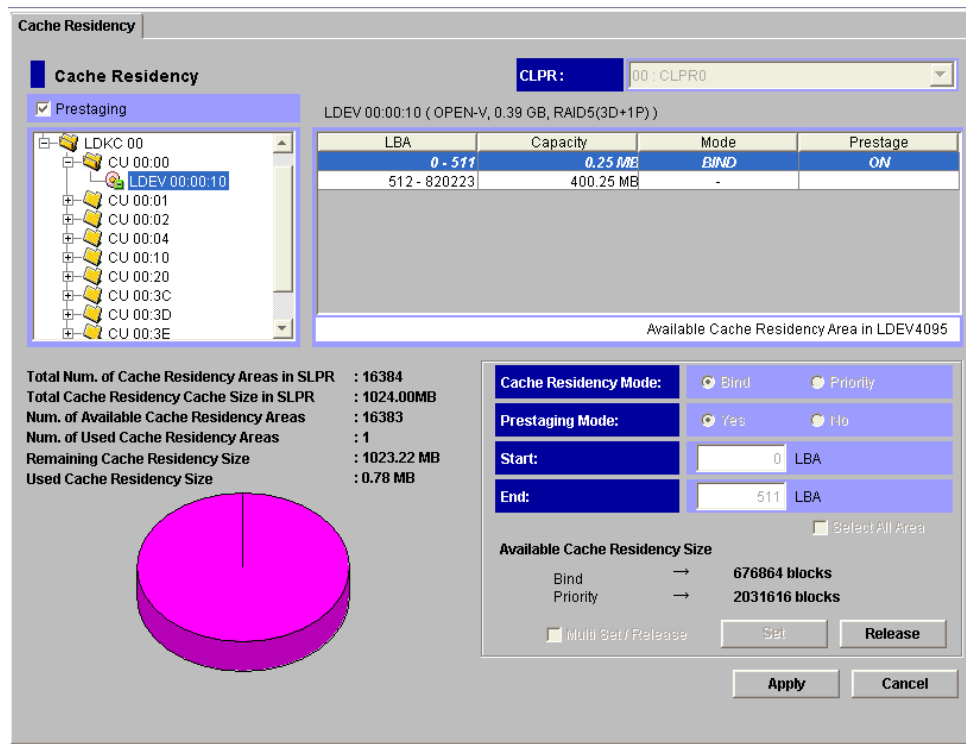


Figure 5-10 Selecting Data Area for Release

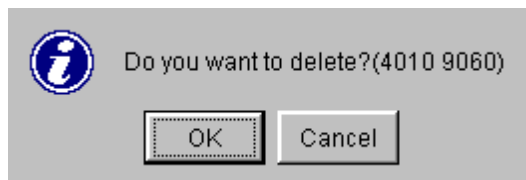


Figure 5-11 Confirmation Message for Deleting Data

Cache Residency

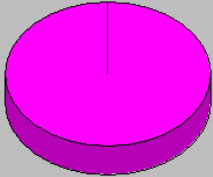
Cache Residency CLPR: 00 : CLPR0

Prestaging LDEV 00:00:10 (OPEN-V, 0.39 GB, RAID5(3D+1P))

LBA	Capacity	Mode	Prestage
0 - 820223	400.50 MB	-	

Available Cache Residency Area in LDEV4096

Total Num. of Cache Residency Areas in SLPR : 16384
 Total Cache Residency Cache Size in SLPR : 1024.00MB
 Num. of Available Cache Residency Areas : 16384
 Num. of Used Cache Residency Areas : 0
 Remaining Cache Residency Size : 1024.00 MB
 Used Cache Residency Size : 0.00 MB



Cache Residency Mode: Bind Priority
 Prestaging Mode: Yes No
 Start: [] LBA
 End: [] LBA
 Select All Area

Available Cache Residency Size
 Bind → 677376 blocks
 Priority → 2033152 blocks

Multi Set / Release [Set] [Release]
 [Apply] [Cancel]

Figure 5-12 Verifying Release Data Operations

Releasing LDEVs from Cache Residency Manager Cache

Use this procedure when you want to release ALL data on one or more LDEVs from Cache Residency Manager cache.



Note: Deleting data from cache during host I/O may cause the response time of host I/O to become slow. To avoid degradation of host response time, limit the amount of data you delete in one operation as follows:

If the host timeout period is set to 10 seconds or shorter, limit the total amount of data to:

- 1 GB or less for open systems
- 1,000 cylinders or less for mainframe

If the host timeout period is set to 11 seconds or longer, limit the total amount of data to:

- 3 GB or less for open systems
 - 3,000 cylinders or less for mainframe
-

To release all data on one or more LDEVs from Cache Residency Manager cache:

1. Select the desired CLPR from the **CLPR:** drop-down list on the Cache Residency window.
2. In the CU:LDEV tree on the Cache Residency window (upper left), select the LDKC and the CU which contains the desired LDEV, and then select the desired LDEV.

The LDEV information table displays the information for the selected LDEV. The **Release** button is enabled if the selected LDEV has data that is stored in Cache Residency Manager cache (indicated by **Prio** or **Bind** in the **Mode** column).

3. If you do not want to release any other LDEVs from Cache Residency Manager cache, make sure that the **Multi Set / Release** box is not checked, click **Release**, and then click **OK** on the confirmation dialog box. The requested operation is displayed in blue in the LDEV information table.

If you want to release additional LDEVs from Cache Residency Manager cache:

- a. Check the **Multi Set / Release** box, click **Release**, and then click **OK** on the confirmation message to open the Multi Release dialog box.
- b. On the Multi Release dialog box, select the desired LDKC and CU image, and select the desired LDEVs to release from Cache Residency Manager cache.
- c. Click **Release** to return to the Cache Residency window. The requested Cache Residency Manager operations are displayed in blue in the LDEV information table.

4. Repeat steps (2) and (3) until all desired operations are listed.



Note: You cannot use the **Set** button until you apply (or cancel) your requested operations.

5. Verify the Prestaging setting:
 - To enable prestaging, select **Prestaging**.
 - To disable prestaging, clear **Prestaging**.
6. To start the operations, click **Apply**:
 - If Prestaging was selected, respond to the Yes/No confirmation that displays. To continue with prestaging, click **Yes**. To continue without it, click **No**.
 - To cancel the operation, click **Cancel** and click **OK** on the confirmation that displays.
7. Monitor the Cache Residency window to make sure that the operations complete successfully. The cache information area displays the progress of the requested operations.

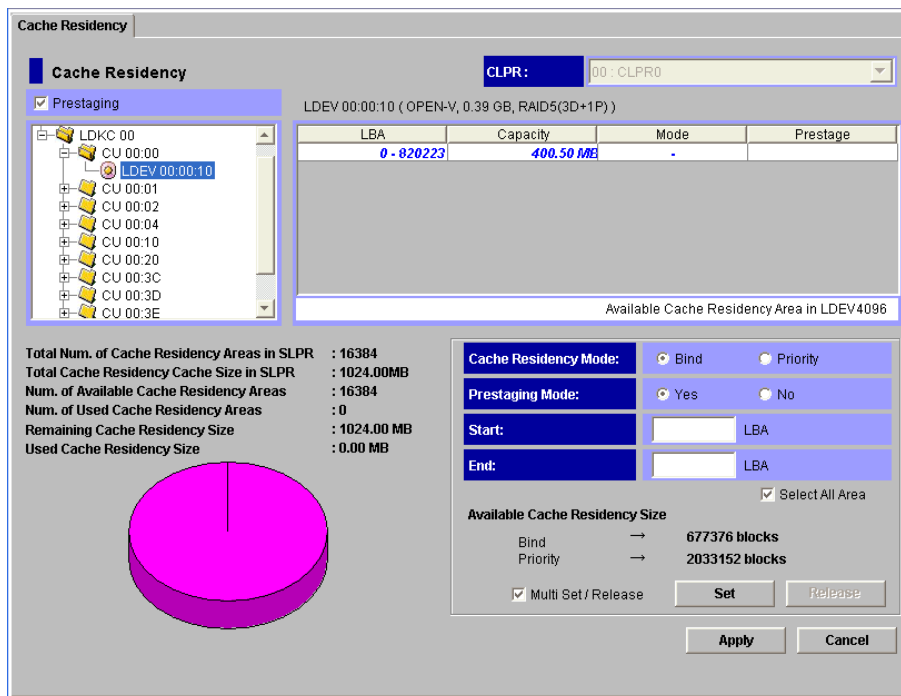


Figure 5-13 Clicking the Release Button after Selecting LDEVs from Cache Residency Manager Cache

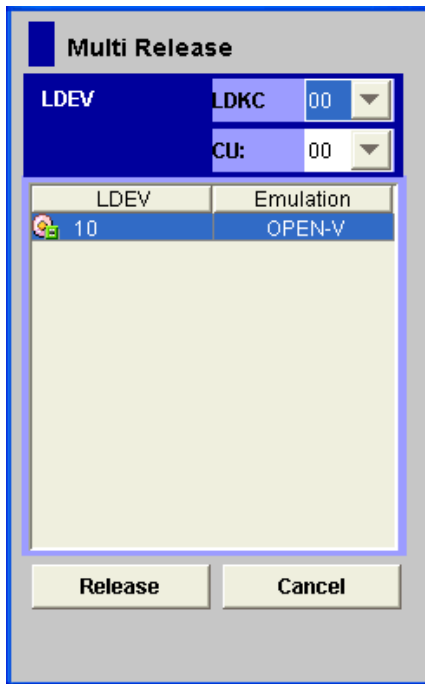


Figure 5-14 Selecting Multiple LDEVs on Multi Release Dialog Box

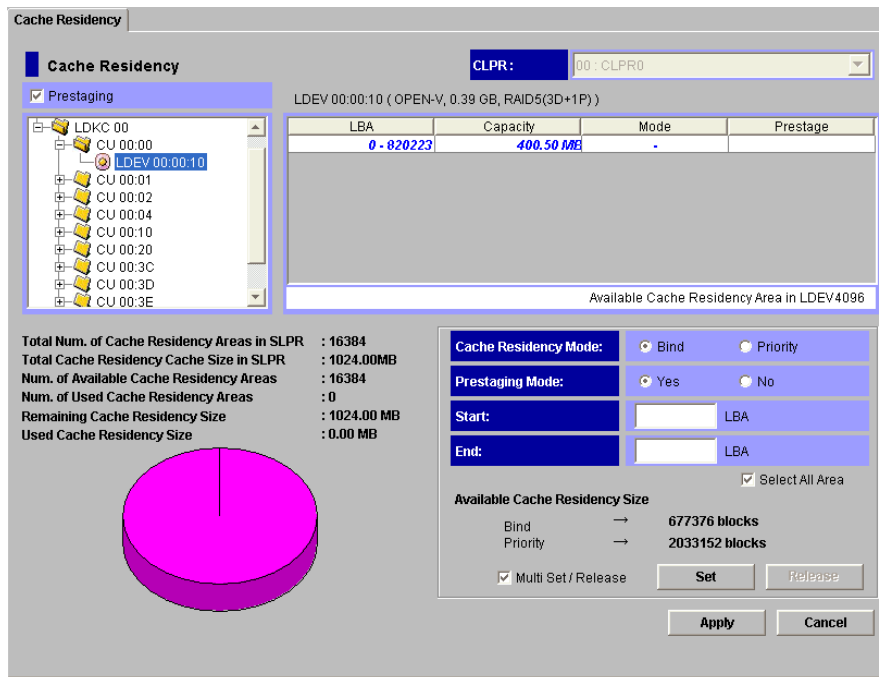


Figure 5-15 Verifying Operations after Releasing LDEV Data from Cache

Changing Modes after Cache Residency is Registered in Cache

If Cache Residency is registered in the cache, the following mode options appear gray and are unavailable for change:

- Cache Residency Mode (Bind, Priority)
- Prestaging Mode (Yes, No)

To change the mode options:

1. Release the cache extent.
2. Restore the data with the new settings.

Troubleshooting

This chapter provides references to sources of troubleshooting information and contact information for the Hitachi Data Systems Support Center.

- [Troubleshooting](#)
- [Calling the Hitachi Data Systems Support Center](#)

Troubleshooting

For troubleshooting information on the USP V/VM, see the *User and Reference Guide*.

For troubleshooting information on the Storage Navigator software, see the *Storage Navigator User's Guide*.

For information on Storage Navigator error codes, see the *Storage Navigator Messages*.

Calling the Hitachi Data Systems Support Center

If you need to call the Hitachi Data Systems Support Center, make sure to provide as much information about the problem as possible. As a minimum, be prepared to supply the following:

- The circumstances surrounding the error or failure
- The Storage Navigator configuration information saved by the **FD Dump Tool**
- The exact content of any messages displayed on the Storage Navigator
- The severity levels and reference codes of service information messages (SIMs) displayed on the **Status** tab of the Storage Navigator main window.
- You cannot use the **Release** button until you apply (or cancel) your requested operations.

The Hitachi Data Systems customer support staff is available 24 hours a day, seven days a week. If you need technical support, log on to the Hitachi Data Systems Portal for contact information: <https://hdssupport.hds.com>

Device Types Other Than OPEN-V

This appendix lists Cache Residency Manager information for open-system volumes other than OPEN-V: OPEN-3, OPEN-8, OPEN-9, OPEN-E, and OPEN-L. To ensure product compatibility with your device type, please contact your Hitachi Data Systems account team for the latest information.

- [Configuring Cache for Priority Mode](#)
- [Cache Residency Manager Cache Extents](#)
- [Logical Blocks](#)

Configuring Cache for Priority Mode

When configuring cache for device types other than OPEN-V, remember that the capacity per slot is 66 KB.

Cache Residency Manager Cache Extents

For open-systems volumes, Cache Residency Manager cache extents must be defined in logical blocks using logical block addresses (LBAs) with a minimum size of 96 LBAs (equivalent to 66 KB) for other than OPEN-V. However, in most cases users will assign an entire open-system volume for Cache Residency. If the remaining cache memory is less than 256 MB, Cache Residency Manager is not available. Table A.1 outlines Cache Residency Manager specifications.

Table A.1 Cache Residency Manager Specifications

Item	Specifications
Emulation Type	OPEN-3, 8, 9, E, L
Cache Area Allocation	At least 96 LBAs, equivalent to 66 KB
Supported Volumes	Normal volumes, LUSE volumes, and VLL volumes
Number of cache areas	4,096 per LDEV and per storage system

Logical Blocks

For device types other than OPEN-V, Cache Residency Manager recognizes open-system logical blocks in 96-block increments. For example, if you enter a starting logical block address (LBA) as 1 and an ending LBA as less than 96, Cache Residency Manager automatically changes the beginning LBA to 00 and the ending LBA to 95. Table A.2 shows the LBA blocks for open systems other than OPEN-V.

Table A.2 Logical Block Addresses for Device Types other than OPEN-V

Starting LBA	Ending LBA	Starting LBA	Ending LBA	Notes
0	95	192000	192095	
96	191	288000	288095	
192	287	384000	384095	
288	383	480000	480095	
384	479	576000	576095	
480	575	672000	672095	
576	671	768000	768095	
672	767	864000	864095	
768	863	960000	960095	
864	959	1920000	1920095	
960	1055	2880000	2880095	
1920	2015	3661824	3661919	
2880	2975	3840000	3840095	
3840	3935	4800000	4800095	
4800	4895	4806624	4806719	OPEN-3 maximum LBA
5760	5855	4806720	4806815	
6720	6815	5760000	5760095	
7680	7775	6720000	6720095	
8640	8735	7680000	7680095	
9600	9695	8640000	8640095	
19200	19295	9600000	9600095	
29900	28895	10560000	10560095	
38400	38495	11520000	11520095	
48000	48095	12480000	12480095	
57600	57695	13440000	13440095	
67200	67295	14350944	14351039	OPEN-8 maximum LBA
1904	71999	14422944	14423039	OPEN-9 maximum LBA
72000	72095	28452864	28452959	OPEN-E maximum LBA
76800	76895	71192064	71192159	OPEN-L maximum LBA
86400	86495			
96000	96095			



Acronyms and Abbreviations

CCHH	cylinder, cylinder, head, head
CLPR	cache logical partition
CRM	Cache Residency Manager
CU	control unit
FD	floppy disk
GB	gigabyte (see Convention for Storage Capacity Values)
KB	kilobyte (see Convention for Storage Capacity Values)
LBA	logical block address
LDEV	logical device
LDKC	logical disk controller
LU	logical unit
LUN	logical unit number
LUSE	LUN Expansion
LVI	logical volume image
MB	megabyte (see Convention for Storage Capacity Values)
no.	number
PB	petabyte (see Convention for Storage Capacity Values)
prio	priority mode
RAID	redundant array of independent disks
SIM	service information message
SLPR	storage logical partition
SVP	service processor
TB	terabyte (see Convention for Storage Capacity Values)
USP V	Hitachi Universal Storage Platform V
USP VM	Hitachi Universal Storage Platform VM
VDEV	virtual device
VLL	Virtual LVI/LUN

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