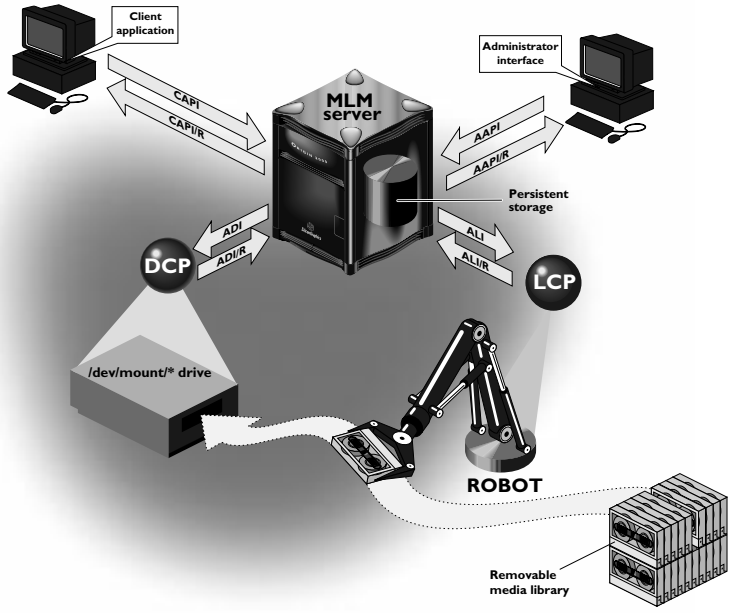
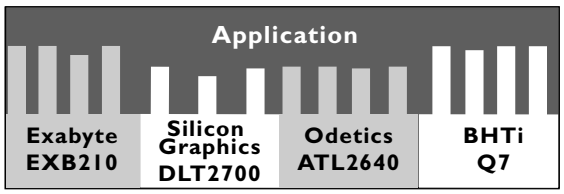
SiliconGraphics
Computer Systems

OpenVault



Removable Media Management Software

The traditional approach of dealing with robotic libraries is to write specialized applications that interface to particular libraries and drives. Generally, devices are monopolized by a single application. The Silicon Graphics® OpenVault solution overcomes the problems associated with this approach by separating the application from the tape management function.



Traditional approach to media management

OpenVault provides standard interfaces that raise the level of abstraction, enabling rapid deployment of removable media libraries, drives, systems, and client applications. A unit of removable media could be a tape reel, a tape cartridge, an optical disc, a removable magnetic disk, or a videotape.

OpenVault is a package of mediation software that helps other applications manage removable media. This facility can support a wide range of removable media libraries, as well as a variety of drives interfaced to these libraries. The modular design of OpenVault eases the task of adding support for new robotic libraries and drives.

OpenVault itself does not provide an end-user interface, nor does it generally become involved in I/O operations to media loaded in drives. User interfaces are provided by OpenVault client applications, which perform I/O to drives using standard system facilities after OpenVault has mounted and loaded media for the application.

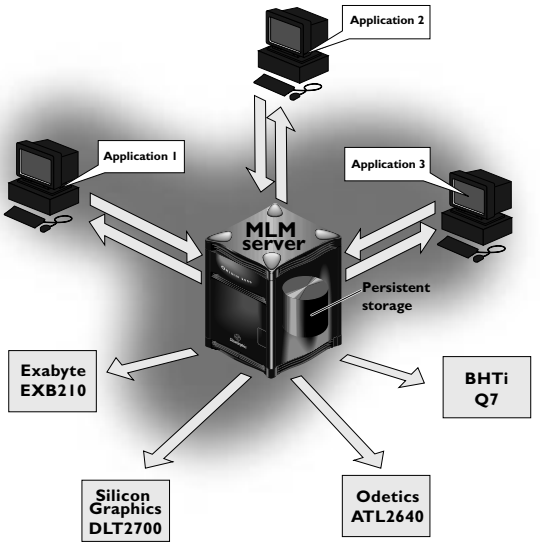
The following tertiary storage applications can all benefit from OpenVault:

- Tape access, such as tar or cpio
- Backup, to guard against data loss
- Archive, for long-term storage of unused data
- Hierarchical storage management, to automatically stage data to the most cost-effective medium
- CD-ROM jukeboxes or information libraries
- Broadcast libraries containing videotapes

OpenVault Architecture

OpenVault is organized as a set of cooperating processes. These consist of the following:

- One media library manager (MLM) server process mediates among the other components. The MLM is a multithreaded process that accepts client connections and fulfills access requests by forwarding them to the appropriate library and drive control programs. The MLM server maintains persistent storage that contains information about media in the system and descriptions of authorized applications, libraries, and drives
- Persistent storage (such as a database) tracks media and system components
- A library control program (LCP) is required for each removable media library controlled by the MLM server. An LCP deals with low-level details of a removable media library, its configuration, and its control procedures. The purpose of an LCP is to expose library configuration to the MLM server and to control a library as requested



OpenVault solution diagram

- A drive control program (DCP) is required for each drive controlled by the MLM server. Some removable media libraries contain multiple drives, in which case each drive has its own DCP. Drives need not be associated with a robotic library. A DCP manages the configuration of drives and performs the drive control tasks associated with mount and unmount requests. DCP exposes the drive configuration to the MLM server and controls drives as requested

Open Interface

OpenVault provides a standard set of interfaces for drives, libraries, and applications.

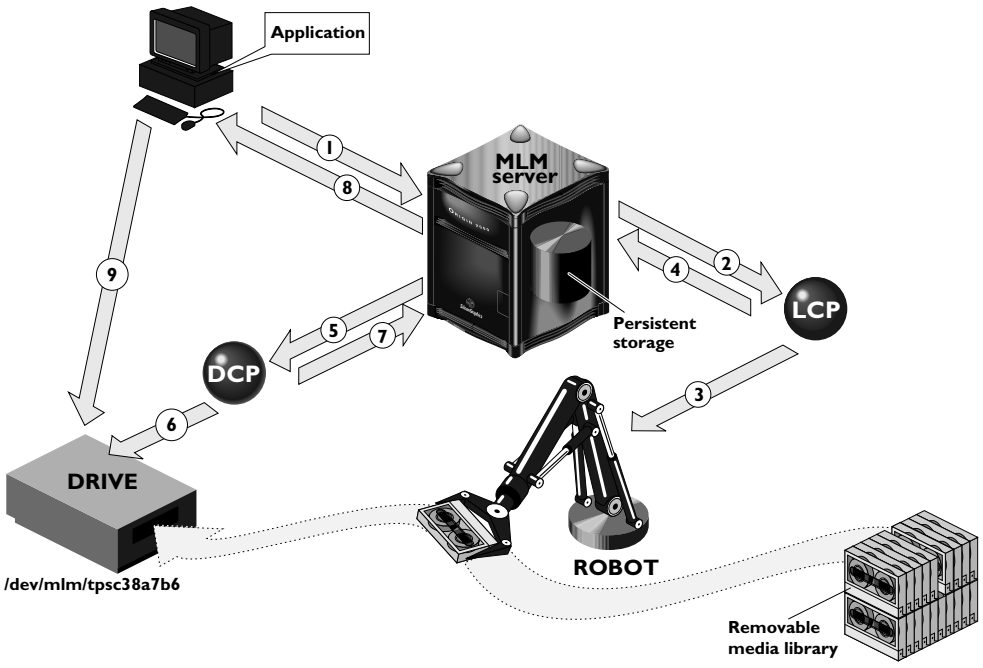
CAPI (client application programming interface) is the language client applications use to communicate with the MLM server. CAPI commands and responses are ASCII strings. Any number of client applications can make requests to the MLM.

The command-response format is semi-asynchronous. After submitting each command, the application waits for the server to acknowledge receiving the command but it need not wait for results before sending the next command. CAPI communications libraries can also work synchronously if this makes implementation more convenient.

Access to the server is session-oriented. The application initiates a session with the hello command and ends with a good-bye command. Meanwhile, the application may send commands to the server to mount and unmount removable media or to change attributes of media.

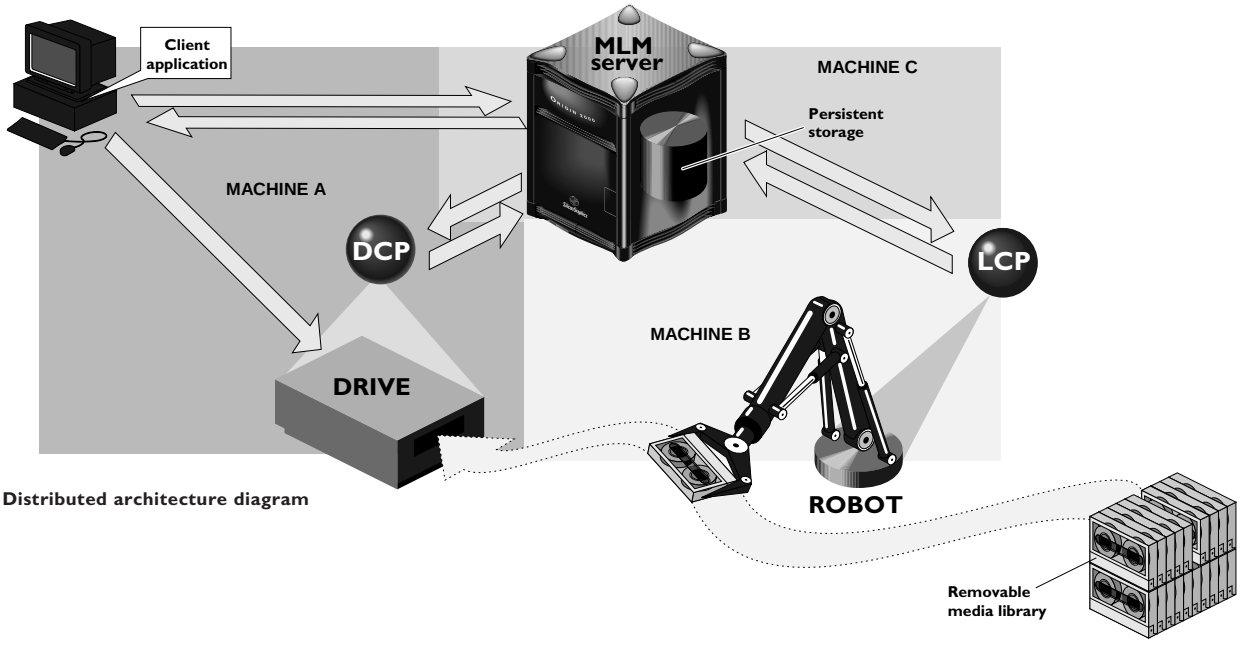
AAPI (administrative application programming interface) is the language administrative applications use to communicate with the MLM server. OpenVault comes with script-ready commands that can be used to administer OpenVault. The administrative API is less restrictive compared to the client API.

The MLM server talks to an LCP using the textual language Abstract Library Interface (ALI). An LCP translates between the ALI and the actual library control interface. The MLM server talks to a DCP using a textual language, the Abstract Drive Interface (ADI). A DCP translates between ADI and the actual drive control interface. The OpenVault developer's kit includes parsers and generators for these languages. Parsers and generators, as well as the communications layer, are delivered with a C language interface.



OpenVault architecture diagram

1. **Mount vol "Servers .001"**
2. **Mount cart "AB1234" in Drive 3**
3. **SCSI commands**
4. **Done**
5. **Verify vol and put online**
6. **SCSI commands**
7. **Ready**
8. **"Servers .001" ready on /dev/mlm/tpsc38a7b6**
9. **I/O to /dev/mlm/tpsc38a7b6**



Distributed architecture diagram

Distributed Architecture

OpenVault is designed so that different components can run on different machines. The only restriction is that the application and the DCP must run on the machine attached to the drive. Even this restriction is somewhat flexible, since the application may itself be distributed and SCSI cables can attach Machine A to drives physically housed in a library associated with Machine B.

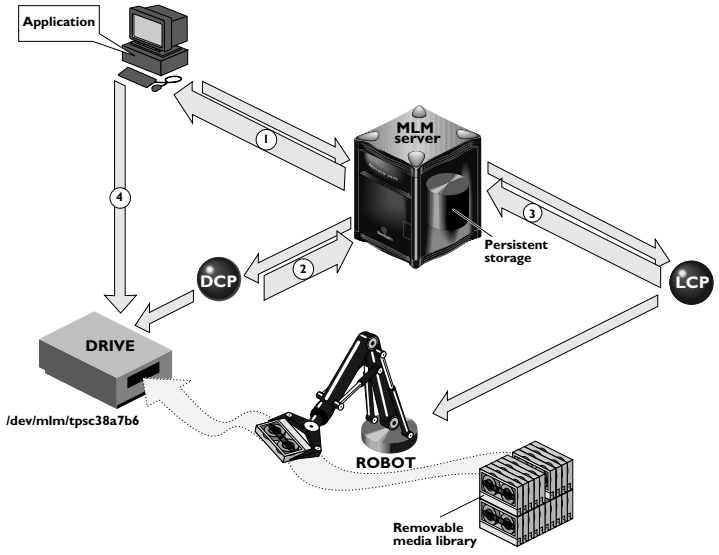
Since the interfaces are simple ASCII text strings using TCP connections, the components are portable to a wide variety of systems. Public key authentication is used whenever a new session is established to help protect against network attacks.

In addition, OpenVault demonstrates good behavior in the event of failures. The MLM server detects loss of connection to an LCP or a DCP and will try to reestablish the session. Additionally, the LCP and DCP will handle library or drive failures.

OpenVault Enables Rapid Deployment

OpenVault solves the problems of traditional media management by providing middleware that raises the level of abstraction, enabling rapid deployment of removable media libraries, drives, systems, and client applications.

- Manufacturers of robotic libraries and drives can develop a single OpenVault interface to support a multitude of system platforms
- Software vendors can integrate new robotic libraries and drives quickly, eliminating product support delays
- Computer system providers can offer a complete range of robotic libraries and storage applications when customers want them
- Users and administrators gain access to removable media libraries and application sharing becomes possible



OpenVault interface diagram

1. **Client Application Programming Interface (CAPI)**
2. **Abstract Drive Interface (ADI)**
3. **Abstract Library Interface (ALI)**
4. **Standard device I/O**

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