

OpenVMS Technical Journal

Including OpenVMS Oracle and Oracle Rdb database servers in a heterogeneous backup solution.

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Overview

Many companies enjoy the benefits of OpenVMS, such as its industry leading clustering capabilities and extremely high reliability, and continue to use it for mission critical applications. These applications are often based on Oracle DBMS, or Oracle Rdb. However, OpenVMS has often not been included in management suites. An example of such a limitation of OpenVMS in heterogeneous systems environments has been the lack of integrated backup and archival solutions, increasing Total Cost of Ownership for OpenVMS and, thus, reducing its perceived value. Until recently, no single solution has been available which could simultaneously meet the backup demands of file systems and databases for OpenVMS, Windows, UNIX and other Open system platforms

The LEGATO OpenVMS products enable OpenVMS systems, and their databases, to be backed up across a LAN, or SAN, or to locally attached storage while sharing resources with other operating systems and thus increasing Return On Investment, and reducing Total Cost of Ownership. Regular backup and archival activities are scheduled and initiated by a central NetWorker Server. Users of OpenVMS systems can schedule ad hoc backups or recoveries of individual files, directories or disks as necessary LEGATO has taken great care to ensure that its OpenVMS products support important features of OpenVMS including the unique capabilities of the ODS-2 and ODS-5 file systems, OpenVMS clusters, and OpenVMS shelving. DBA's can perform backups of Oracle and Rdb databases using the backup tools standard to these databases, RMAN and RMU, so that on-line backups can be performed, and with minimal changes to any existing scripts. These backups can be run manually, scheduled locally on the OpenVMS system, or centrally managed from the NetWorker server. This is all achieved by a product that looks and feels the same, regardless of platform, reducing learning time for System Managers, Operators, and users. This paper discusses the integration of OpenVMS systems in a NetWorker environment.

Limitations of Backup for OpenVMS

Thousands of customers around the globe depend on OpenVMS to run critical business and scientific applications. It often runs "bet your business" applications, where downtime is intolerable. However, despite the wide use of OpenVMS, it has been difficult to integrate OpenVMS with Enterprise backup solutions that include UNIX, Linux, Windows, and/or other system platforms. This issue is exacerbated by the wide use of relational databases on OpenVMS, as the tools provided by the database vendors have not been integrated into any heterogeneous backup solutions.

Solutions exist that allow UNIX and Windows clients to be backed up across a local area network (LAN) to a system running OpenVMS, or that allow OpenVMS systems to be backed up, over a LAN, to UNIX, Linux, or Windows systems. However, because of the rapid growth in data, solutions that rely entirely on LAN backup are proving inadequate.

Even with the evolution of Ethernet to 1Gb speeds, the amount of data stored on many UNIX and Windows systems has simply become too great for efficient LAN backup to an OpenVMS system or cluster. Similarly, older VAX systems are being consolidated into larger and larger Alpha Server systems that, due to the amount of data, now become poorly suited for network backup. Compound that with increasingly large databases, that can never be taken off-line, we have a result that many

Including OpenVMS Oracle and Oracle Rdb database servers in a heterogeneous backup solution
– Shaun Ellis

sites have been faced with the necessity of using one solution to backup OpenVMS and another for their Windows, UNIX or other systems, resulting in duplicate hardware and processes that increase management complexity and cost of ownership.

Overcoming Limitations of Backup for OpenVMS

With the availability of the NetWorker Client for OpenVMS and NetWorker Storage Node for OpenVMS, LEGATO Software was the first storage software vendor to completely integrate OpenVMS into a heterogeneous Enterprise backup and archival solution that allows sharing of resources. Now, with the addition of the NetWorker Module for Oracle on OpenVMS, LEGATO is the first vendor to bring fully integrated relational database backup to OpenVMS in a heterogeneous backup environment.

LEGATO NetWorker Support for OpenVMS

The NetWorker Client for OpenVMS software enables network backup of OpenVMS systems, and is appropriate for smaller OpenVMS systems. The NetWorker Storage Node for OpenVMS software allows OpenVMS systems to write data to direct-attached or SAN-attached backup devices *at least* as fast as OpenVMS Backup. The Storage Node also allows an OpenVMS system to provide backup services to network clients of any platform. In addition to traditional backup, it is often necessary, for regulatory reasons to Archive data for long periods. Both products, on Alpha and Itanium, support archival operations in addition to backup.

NetWorker on OpenVMS offers full support for critical OpenVMS features such as OpenVMS Cluster environments, co-existence with OpenVMS Shelving, and full support for the ODS-2 and ODS-5 file system including the ability to accommodate all file semantics, access controls, file types, file versions, and directory structures. In addition, both products make the full capabilities of NetWorker available on OpenVMS systems.

The Oracle module for NetWorker on OpenVMS uses the Oracle SBT V2.0 API. This means that LEGATO supports Oracle 8i, 9i, 10g, and Rdb 7.1.2.1.0 (or later) databases to be backed up, and can back them up on-line, enabling organisations to meet modern Service Level Agreements. The Module uses standard Oracle or Rdb backup scripts that do not need major modification to work. The scripts can be client, or NetWorker server initiated, with NetWorker accepting the stream of data being pushed by the database, and then writing it to the backup device.

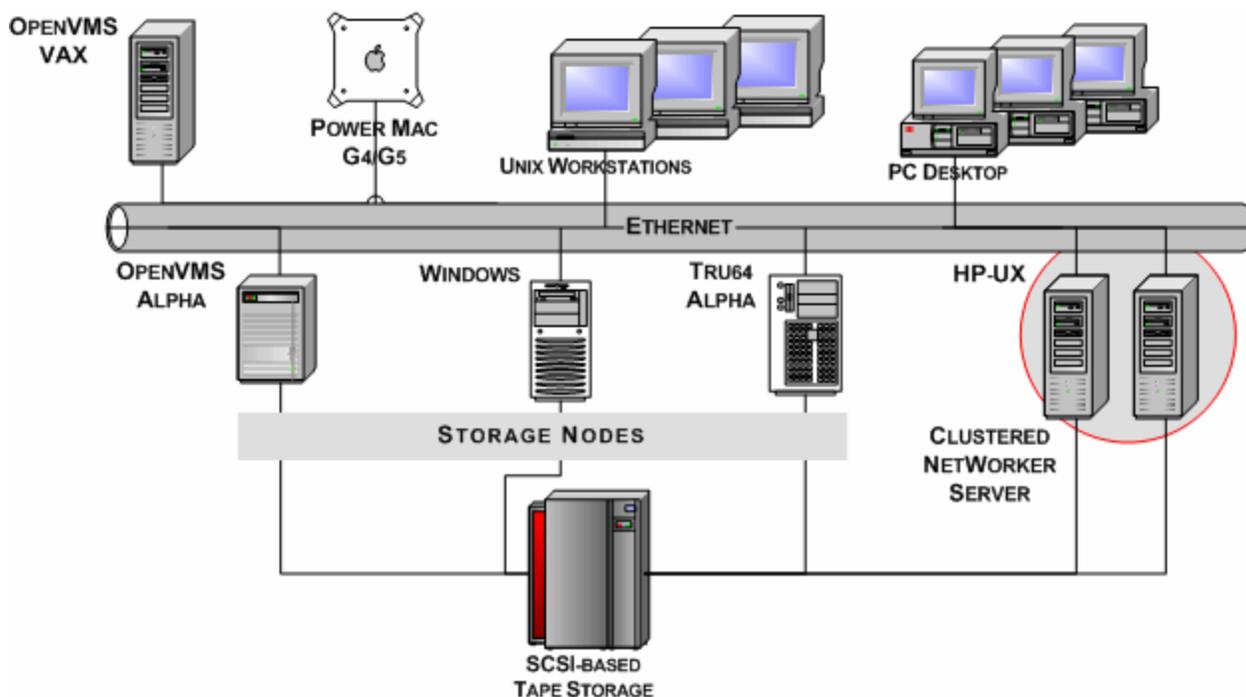


Figure 1: A Typical NetWorker Environment, with SCSI-Based Library Sharing

A typical NetWorker environment consists of a NetWorker Server, one or more Storage Nodes, and multiple LAN clients and associated tape libraries and/or standalone drives.¹ The NetWorker Server controls and directs all NetWorker operations, stores the Media Database, the configuration files, and also the Client File Indexes. Both the NetWorker Server and storage nodes can receive client backup data over LAN connections and write that data to an available tape, or disk. A storage node or server can also backup its own local data.

In a SAN environment, systems with a large amount of online data storage—such as database servers, file servers, and application servers—may be configured as storage nodes, allowing them to backup their data directly to SAN-attached backup hardware. SAN configurations can dramatically improve utilization of tape resources.

On the NetWorker Server, the Media Database contains information such as which savesets are stored on which tapes, and when those savesets will expire. It also manages where those tapes currently reside, and when they are available to be recycled, or over-written. The Client File Index (CFI) contains information about each file that was backed up in each saveset. A browse period can be set separately on each saveset so that individual file data can be retired whilst preserving the knowledge of the saveset. Without this capability, the CFI could become a backup issue in its own right, as it would continue to grow as long as data is kept.

The NetWorker server also performs bootstrap backups of itself so that, in the event of a catastrophic failure, the NetWorker server can be completely restored with no loss of data.

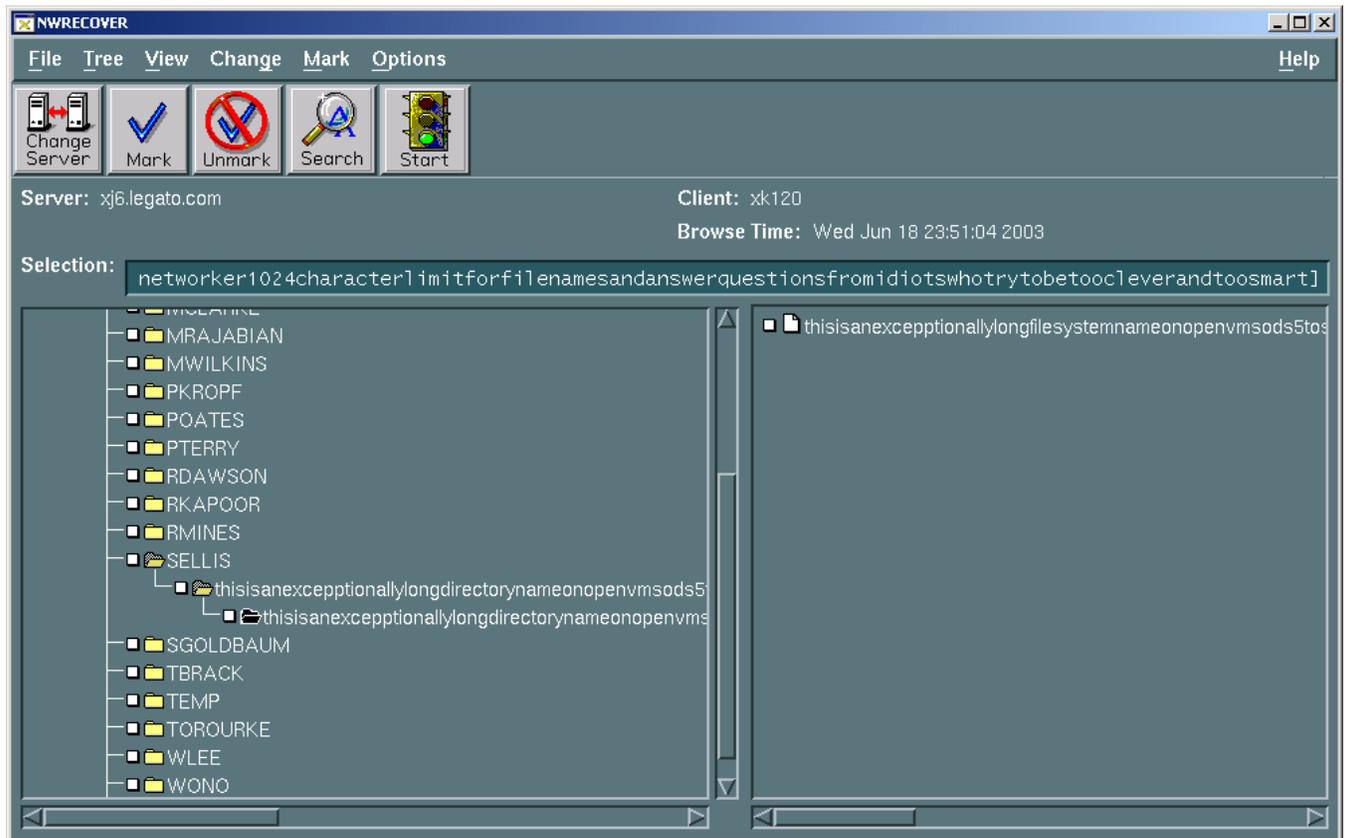
NetWorker Client for OpenVMS

A NetWorker OpenVMS client normally operates under the control of a NetWorker Server in accordance with guidelines and schedules established by an administrator. An administrator can

¹ Note that only an OpenVMS 64-bit system can act as a client, storage node and backup and restore databases, A VAX can act as a client only. The NetWorker server is not available on OpenVMS at this time.

schedule backup and archival operations using an administrative graphical interface. Users on a client system can initiate backup and recover actions as necessary, using a separate graphical interface or through a command line interface (CLI). For instance, if an important file needs to be recovered from backup, that action can be initiated from the client without administrator intervention, providing the user has privilege to access those files. Likewise, files that are important to the user can be backed up manually without waiting for regularly scheduled backups to occur. The ability to do this is a privilege provided, by default, by the NetWorker Administrator. However, this privilege can be removed giving the NetWorker administrator complete control over when backups occur.

Figure 2 NetWorker for OpenVMS Restore Interface Showing Very Long File Names from an ODS-5 Volume



The NetWorker Client for OpenVMS also includes customisations that allow the software to backup files with all the important options associated with the OpenVMS BACKUP command, such as the ability to backup open files, recording the backup date, various options for handling file aliases, etc. (See the later section entitled *NetWorker Equivalents to OpenVMS backup Functions* for more information.)

To improve backup speed, the NetWorker Client for OpenVMS is multi-threaded to enable several backup operations to occur in parallel. Optionally, client side compression can be used to reduce LAN traffic.

The file system support is essentially the same as the native OpenVMS BACKUP utility. Data can be backed up and restored to and from ODS2, and ODS-5 volumes, and even between the file systems, where the file system rules allow.

Including OpenVMS Oracle and Oracle Rdb database servers in a heterogeneous backup solution – Shaun Ellis

The NetWorker Client for OpenVMS also includes the ability to perform a point in time restore. You do not have to worry about which tapes need to be restored in which order. Provide NetWorker with the date & time that you wish to restore the system to, and NetWorker will take care of it all for you.

NetWorker Storage Node for OpenVMS

The NetWorker Storage Node for OpenVMS software allows an OpenVMS system to take on all the functions of a NetWorker storage node including receiving data from network clients and backing up local information direct to a storage device. Because of the storage capacity of many Alpha Servers running OpenVMS, backing up data locally, or to a SAN attached device is often the best solution.

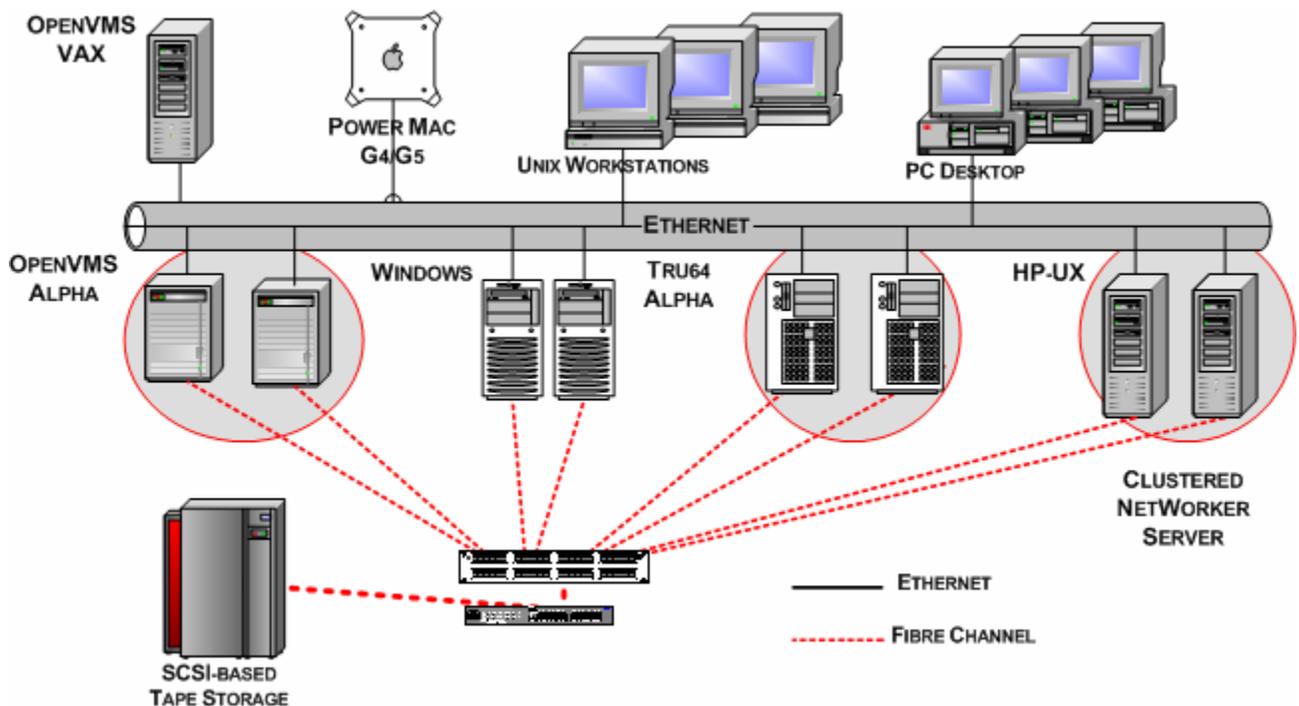


Figure 3: Sharing tape resources on a SAN with DDS. Tape devices within a shared library are not allocated to an individual server. The NetWorker Server and each Storage Node can utilise any available tape device.

An OpenVMS storage node has the backup, archival, and restore capabilities of an OpenVMS client as discussed in the previous section, plus the ability to direct data to direct-attached or SAN-attached storage devices. All OpenVMS SCSI and FC tape devices are supported using standard OpenVMS naming conventions, as well as OpenVMS File Systems for Disk-to-Disk backup.

An OpenVMS storage node has all the capabilities of any NetWorker V6 storage node including Dynamic Drive Sharing (DDS) (when used with a NetWorker Server running version 6.1 or later), staging, and cloning. DDS allows individual tape drives, within a tape library, connected to a fibre channel SAN to be dynamically shared between multiple storage nodes of differing operating systems and a NetWorker Server. A system initiating a backup is allocated a drive only for the time

it takes for its backup activity to complete. Upon completion, the tape is unloaded, and the drive is made available for use by other hosts.

The use of SAN-based backup storage allows storage to be centralised for better protection and much more efficiently managed. For instance, a single large capacity tape library can take the place of many smaller direct-attached libraries, substantially decreasing complexity and associated management costs, while increasing the level of protection for critical data.

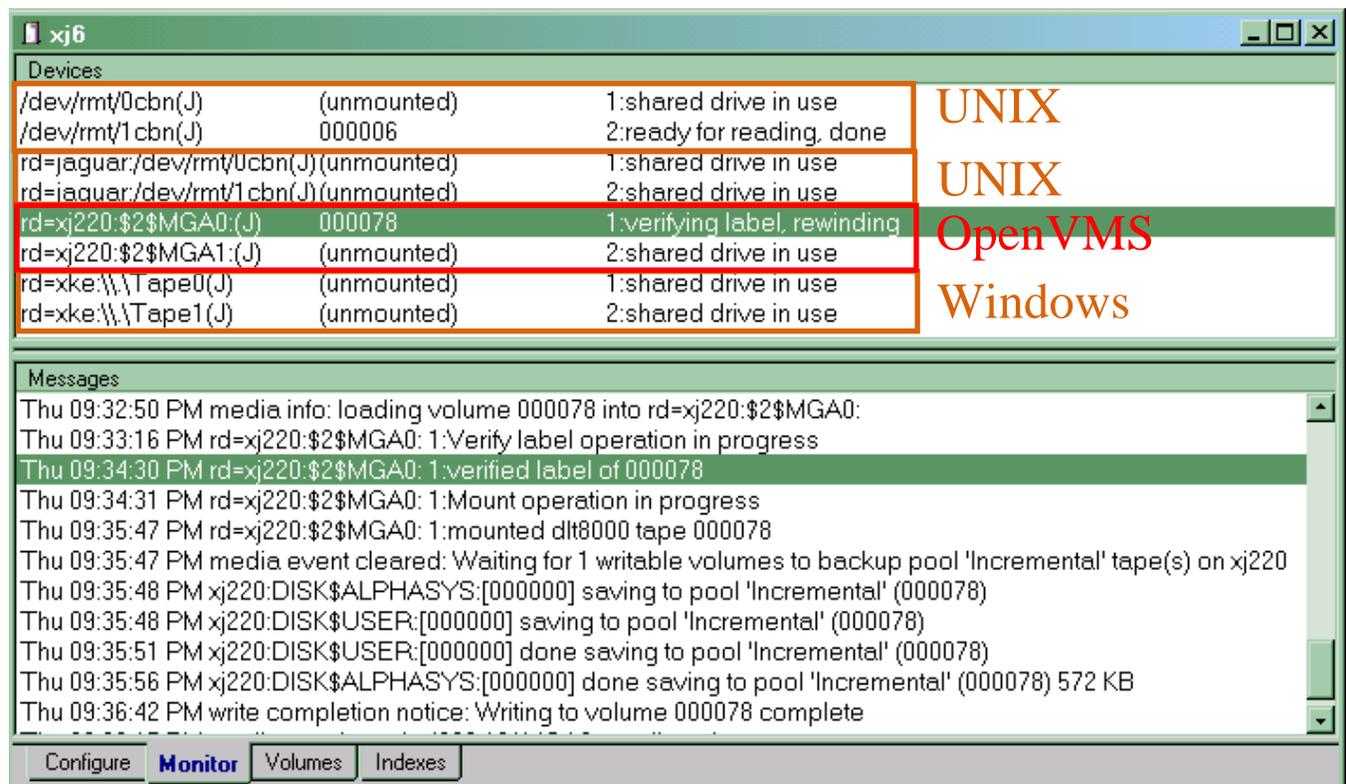


Figure 4: An actual backup of an OpenVMS system being performed to DLT8000 drives that are shared with UNIX and Windows systems.

Storage nodes also have the option of staging backup data to disk to dramatically increase backup speed. Data thus stored can be automatically transferred to tape at a later time. The recent availability of high capacity, low cost disk backup solutions also makes permanent or semi-permanent disk storage of backup data a possibility. The NetWorker DiskBackup option allows an unlimited number of NetWorker clients and storage nodes to be backed up directly to disk.

NetWorker storage nodes also have the ability to make duplicates, or *clones*, of complete tape volumes or individual backups. Clones are frequently sent to offsite storage, used to transfer data to another location or are simply retained to enhance the level of protection for important data.

Oracle Module for OpenVMS

Oracle 8i saw the introduction of RMAN (Recovery MANager), which brought to Oracle Database similar on-line backup functionality to Oracle Rdb's RMU (Rdb Management Utility). Both of these

Including OpenVMS Oracle and Oracle Rdb database servers in a heterogeneous backup solution
– Shaun Ellis

utilities support an API and, since Rdb 7.1.2.0.0 they both support the SBT (System Backup to Tape) API V2.0. LEGATO is the first heterogeneous vendor to support both Oracle Database and Oracle Rdb on OpenVMS using this API, via the optional NetWorker Module for Oracle. LEGATO already enjoys a close relationship with Oracle, with NetWorker single server being the exclusive backup application shipping with Oracle on every UNIX, Linux, and Windows distribution. The introduction of this optional module for NetWorker on OpenVMS extends the support of on-line backup of all Oracle databases that support the SBT V2.0 API. These databases are Oracle 8i, 9i, 10g, and Rdb 7.1.2.1.0 and later. LEGATO has worked closely with the Rdb development team to make sure that the Rdb implementation of the SBT API and NetWorker would work well together, expanding upon LEGATO's extensive experience with Oracle Databases.

Whilst it is possible to back up the files that make up a databases with the file system utilities, there can be no guarantee of recovery if the databases are actually on-line at the time. This means that databases must be closed so that reliable file system backups can be taken. For many companies, this is not acceptable. Both RMAN and RMU enable online backups of databases. The NetWorker Module for Oracle interfaces with the SBT API and provides a conduit for data to be written to backup devices by NetWorker, bringing all the advantages of NetWorker whilst maintaining a fully supported solution for Oracle Database and Oracle Rdb that is familiar to the DBA's. Indeed, the DBA's continue to use RMAN and RMU just as they do today.

Backups can be initiated by the server, or the client via a script or command line. With server initiated backups, the script is called by the server. Many of these scripts already exist today and take very little modification to work with NetWorker. For Rdb, one need only add the /LIBRARIAN qualifier in RMU backup and then define a single logical name to identify NetWorker as the custodian of the backup data. It is that simple.

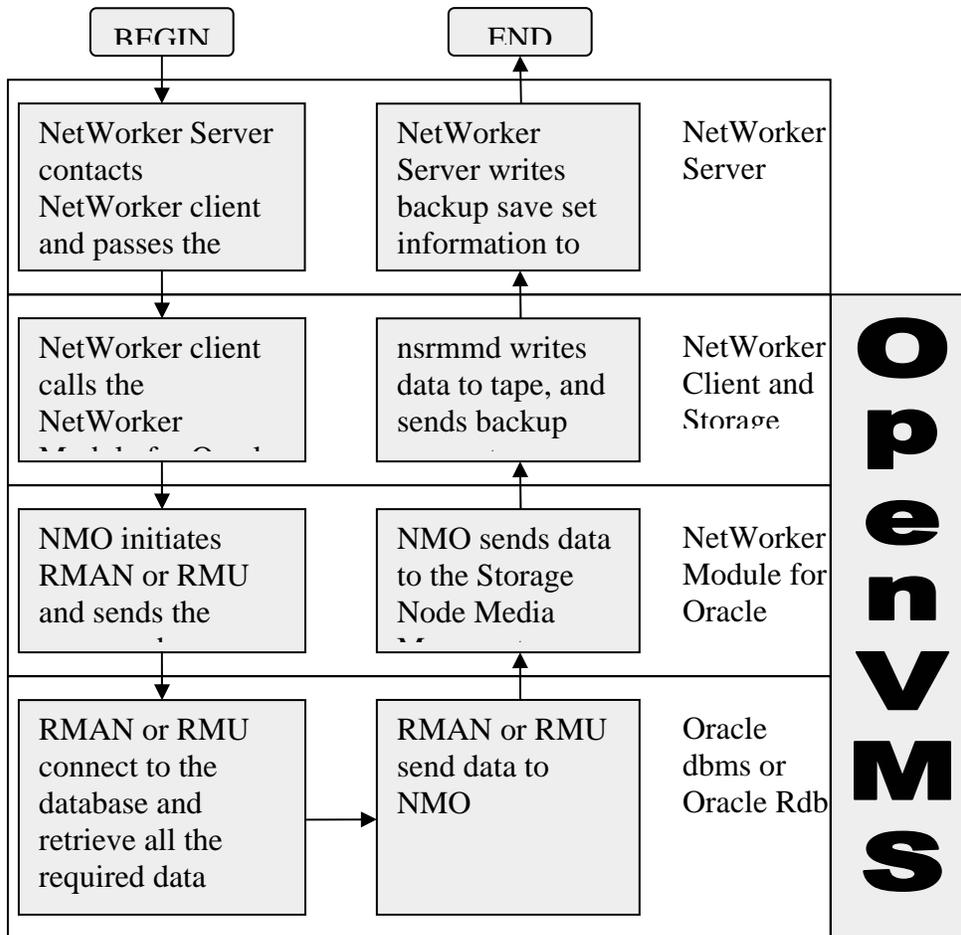


Figure 5: Flowchart of data flow and processes involved in a database backup.

Protecting an OpenVMS System Disk

The ability to quickly recover an OpenVMS system disk is critical should a disaster occur. NetWorker correctly handles OpenVMS file aliases and contiguous files, making sure that superfluous data is not backed up, and files are restored correctly.

Although NetWorker for OpenVMS does not, currently, have an equivalent to the OpenVMS standalone backup utility, there are a number of options for recovering an OpenVMS system disk in a NetWorker environment, such as:

- Create a small standby system disk (including NetWorker software) that can be booted in case of failure. NetWorker can then be used to recover backups to a replacement system disk.
- In environments with OpenVMS clusters, boot the failed system from the system disk of an operational system that has NetWorker installed. Use NetWorker to recover backups of the failed system disk to a replacement disk.

- Occasionally use OpenVMS backup to manually backup the system disk. This results in a system disk image that can be restored using standalone backup. Once this Image is restored, the disk can be brought up to date using NetWorker.

NetWorker Equivalents to OpenVMS backup Functions

OpenVMS includes a backup utility as part of the Operating System. It has special features to deal with the specifics of the OpenVMS File System, some of the capabilities are used by default; others are enabled by NetWorker's equivalent to a qualifier, called a "directive".

The NetWorker Client for OpenVMS has the similar functionality to the OpenVMS backup utility, as well as SLS or ABS:

- **/Alias**. NetWorker automatically handles RMS File aliases correctly
- **/Incremental** and **/Image**. NetWorker performs Full, Incremental, or level backups. Level backups are not available to OpenVMS backup, but are available to users of HP's ABS. NetWorker does not have an exact equivalent to an Image backup. However, NetWorker can backup and restore an OpenVMS system disk.
- **/Modified/Since**. NetWorker can use a date/time, in OpenVMS format, to specify that files modified since a specific date should be backed up.
- **/Block Size**. By default, to maximise throughput, the NetWorker Storage Node selects the best block size for the backup device. On OpenVMS, NetWorker is limited by OpenVMS, so the maximum block size is 63K.
- **/Delete**. NetWorker provides an option to the archiving function that is equivalent to this capability.
- **/Exclude**. It is possible to exclude files with NetWorker. Depending on the interface used depends on how this function is performed.
- **/ignore=interlock**. By default, NetWorker on OpenVMS behaves the same as OpenVMS Backup as it will not backup open files. However, this can be enabled via a NetWorker for OpenVMS directive.
- **/Ignore=nobackup**. By default, NetWorker will ignore files marked nobackup, and backup the file headers only. There is a directive for the NetWorker client for OpenVMS to backup these files.
- **/list**. When a backup is performed, the list of files backed up are stored in the on-line indexes. A report can be run against the on-line indexes to find out what files were backed up. For a manual save, the files are also displayed on the input screen as they are backed up.
- **/record**. NetWorker client for OpenVMS provides a directive to have the record date stamped on files.
- **/select**. NetWorker can be directed to backup anything from the entire system, down to an individual file. It supports OpenVMS wildcards for easy election
- **/tape_expiration**. NetWorker implements much of the media management capabilities of SLS, or ABS. NetWorker can manage the on-line file indexes, and the retention policy for tapes. It does this as two separate definitions.
- **/unshelve**. NetWorker co-exists with HSM for OpenVMS. By default files will remain shelved, but it is possible to force them to be unshelved

Including OpenVMS Oracle and Oracle Rdb database servers in a heterogeneous backup solution
– Shaun Ellis

- **/verify.** By default NetWorker performs in the same way as OpenVMS backup and does not verify the data. However, data verification can be selected as a standard part of the product.

NetWorker equivalents to SLS/ABS/Tapesys

- **Jukebox management.** NetWorker knows exactly which cartridges are in which slot in a jukebox, and automatically mounts those cartridges into free drives. It also provides the ability to manage importing and exporting of cartridges.
- **Media and File Index Database.** NetWorker stores the Media and File Index information in XDR encoded databases on the NetWorker server. NetWorker has a very powerful command set to interrogate these databases, and to export them in varying formats. Because the data is stored in an open format, you can even migrate these databases to systems that run a different Operating System.
- **Disaster Recovery, and High Availability.** NetWorker automatically backs up these databases as part of its standard backup cycle, and provides utilities to restore NetWorker in a Disaster Recovery scenario. NetWorker also supports Highly Available NetWorker servers using most of the industry standard UNIX and Windows clustering solutions, including LEGATO's own Application Availability Manager.

Conclusion

OpenVMS continues to be the platform of choice for many important business applications. It is important to note that it increasingly co-exists with many other system platforms. Software solutions that facilitate the management and backup of OpenVMS systems in heterogeneous environments are essential to help control IT costs, decrease management complexity, and enable IT departments to meet Service Level Agreements. With the NetWorker Client for OpenVMS, NetWorker Storage Node for OpenVMS, and NetWorker Oracle Module for OpenVMS, LEGATO enables the integration of OpenVMS into a seamless enterprise backup solution so that IT departments can continue to take advantage of the unique capabilities of OpenVMS that has made it critical to so many businesses, without compromising the integrity of those systems.



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Including OpenVMS Oracle and Oracle Rdb database servers in a heterogeneous backup solution
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