

EMC Solution for Bare-Metal Recovery: An Integration of EMC NetWorker with EMC HomeBase

Best Practices Planning

Abstract

This white paper describes the backup and recovery capabilities of an EMC[®] NetWorker[®] and HomeBase product integration. It describes the HomeBase feature set and how HomeBase Bare-Metal Recovery complements the NetWorker product suite. Basic procedures for backup and recovery are also provided.

December 2008

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Part Number H2952.2

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Executive summary

This white paper provides an overview of EMC's Bare-Metal Recovery (BMR) solution based on the integration of EMC® NetWorker® with the EMC HomeBase product suite. EMC's BMR solution provides seamless protection from catastrophic disasters for user data, application data, and the configuration state of the server. Though various disaster recovery solutions were available in the market, a requirement persisted for a BMR solution that was quick and simple to use. EMC's BMR solution addresses the need for just such a BMR product. This is a powerful addition to EMC's Backup, Recovery, and Archive (BURA) product offerings.

The NetWorker-HomeBase integration solution described in this white paper provides a very high degree of success in dissimilar hardware restores, high frequency of system configuration snapshots without significant network or CPU overload, and a very short window for both backup and recovery, providing high granularity of restores and automated server management. Apart from providing a BMR portfolio, this solution plays a very important part in different server migration strategies.

This solution leverages the information collected during the backup process to provide discovery, inventory, change, and compliance management of servers in the network, both local and remote.

Introduction

The objective of this white paper is to provide an overview of NetWorker-HomeBase integration release 1.0. This paper describes the environment setup required to implement the solution. It also provides an overview of the steps and processes executed during the recovery or migration of Windows servers.

The paper explains the reason a BMR solution is important in an enterprise, introduces EMC's BMR solution, and compares the concept used in the EMC solution to that of an image-based BMR. It then explains the steps required to protect the servers in the enterprise and the steps to re-create servers from a disaster.

This paper concludes with a list of the advantages of the EMC solution over traditional BMR solutions and explains how the solution is used for server migration as well.

Audience

This white paper provides an overall picture of EMC's BMR solution, its requirements, and setup details for guidance and proposal development. Its audience includes IT planners, storage architects, administrators, and EMC staff and partners.

Overview

Restoring servers after a disaster can be complex, especially when restoring the server to the exact configuration it had at the time of the destruction. The restoration of a server to dissimilar hardware can add to the complexity and is a time-consuming process. Installing the operating system on different hardware means that the drivers for the recovery hardware will be entirely or partially different from the hardware drivers in the failed server. This makes it difficult to recover the failed server to dissimilar hardware. To conduct a successful dissimilar hardware restore, there should be a repository of the different drivers, the Windows kernel, and the Windows subsystems. The restoration software should be capable of selecting the appropriate system files from this repository. If the appropriate files relating to the Hardware Abstraction Layer and the Windows kernel are not selected for restore, the system will fail to boot. Once the required files are selected, the system should be configured with various applications and settings available in the failed system.

EMC's BMR solution offers a flexible and reliable method for restoring a server from disaster. It provides easy steps for recovery of a server to similar or dissimilar hardware. EMC's BMR solution provides a logical extension to the NetWorker family by reliably backing up the complex system configurations

required for re-creating the server, such as the system state and application configurations, along with the traditional backup of user data. It provides the flexibility to recover the whole server, or only the selected configurations and also facilitates the recovery of applications. The same set of procedures used for recovery can also be used for migration.

BMR solutions

The basic process of system recovery involves reinstalling the operating system and the software applications and then, if possible, restoring the data and the settings. A simple data backup is a backup of the files, folders, and the folder hierarchy. Most backup applications do back up the whole server, the operating system, the applications, and the user data as well. The disadvantage of simple data backups is that a file system interface is required for backing up the files and folders. This prevents some files that are inaccessible from being backed up. Generally, these applications do not back up the configurations that are required to “re-establish” the previous state of the server and the applications after recovery. These backups do not guarantee the recovery of the whole system to its pre-failure state.

Bare-Metal Recovery is the process of bringing up a system after a catastrophic disaster, ensuring that the system recovers with the operating system, the applications, and the data as they were at the time of the failure. There are two techniques employed in restoring a server after a disaster to ensure recovery: image-based BMR and profile-based BMR.

Image-based recovery

Image-based Bare-Metal restore differs from simple data backups in that it does not require the presence of the OS and the file system on the target machine. It takes a sector-by-sector snapshot of the hard disk and stores it as an *image*. This includes all the details present in the hard drive, master boot record, partition tables, file system, operating system, registry, drivers, software applications, and user-related data. The image-based BMR solution copies the old image into the new recovery server. However, if the target system has a different hardware configuration from the original, it may not boot due to mismatched drivers. Hence, the benefit of image-based recovery cannot be leveraged easily, as it requires a highly skilled engineer to sort out the discrepancies. For these reasons, the image-based recovery would often be unsuccessful in a scenario of dissimilar hardware restore, server migration, and application migration.

Profile-based recovery

Profile-based recovery was designed to overcome this disadvantage of image-based recovery. The process of taking a snapshot of the server’s configuration (both system and application configurations) is known as *profiling*. Profile-based recovery is different from image-based recovery in that it does the backup of system and application-related *configurations* as compared to the capture of the sectors of the hard drive. The profile data includes hardware configurations, operating system levels, system tuning, network configurations, security configurations, registry settings, different application configurations, and storage layouts. Profile-based backups do the complex job of backing up the operating system configurations as well as the application configurations, while backup software takes the responsibility of restoring the data.

Thus, profiles allow restoring the configuration of the failed system to a new server regardless of the changes in the underlying hardware. The nature of the process means that the configuration data captured can be thought of as platform-independent, permitting recovery or migration of full server functionality onto dissimilar hardware. This allows the user to move the server configurations to similar or dissimilar hardware.

Profile-based BMR starts with the appropriate operating system with drivers already installed and intelligently restores the profiled information. Profile-based recovery provides the user with a common procedure to recover the server on most major platforms and can be performed by minimally qualified personnel.

Image-based BMR is unable to handle the changes in the hardware if the server is recovered to different hardware. Image-based BMR also requires a considerable storage infrastructure to retain the images. As companies capture most of the information in their backup products, the profile-based BMR helps leverage existing backup infrastructure and investments.

Highlights of profile-based BMR over image-based BMR

The following are the salient highlights of the profile-based BMR when compared to the image-based BMR:

- Leverages the existing backup investments and the backup infrastructure.
- Provides a uniform recovery solution for all platforms including the recovery of different applications such as Active Directory, Exchange, and SQL. The same set of procedures provided by the profile-based BMR can be replicated when a server needs to be migrated.
- Provides a high degree of success in dissimilar hardware restore.
- Provides a high frequency of snapshots of the system state. None of the imaging solutions can match this frequency.
- Enables full or partial configuration restores. Users have the flexibility to select only those settings that are required or choose a subset of the hardware settings to restore.

EMC's BMR solution

EMC's Bare-Metal solution introduces a unique combination of NetWorker's data backup capability and the ability of the HomeBase product suite to capture and restore the configuration state (also known as the system state) of a server.

NetWorker

The EMC NetWorker family is the fastest and most flexible backup and recovery solution in the industry. NetWorker protects the critical enterprise applications at record speed. Its intuitive user interface and policy-based backup engine help automate and simplify the entire backup and recovery process. Powerful snapshot management provides instant data protection and rapid recovery by giving the user complete control of third-party snapshot tools. NetWorker is also the leader in backup-to-disk solutions that further accelerate recovery of the data.

HomeBase

The HomeBase product suite is a sophisticated tool set that utilizes profiling to gather information necessary for recovery in the event of a disaster or migration to new or different hardware. HomeBase software is designed to overcome the issues inherent in image-based server and application migration and recovery technology. Using profile-based technology, HomeBase products simplify server management for IT infrastructures through highly automated server recovery, regardless of operating system type. The HomeBase product suite comprises the HomeBase agent, HomeBase server, and HomeBase proxy server.

- The HomeBase agent is responsible for generating the profiles in each system.
- The HomeBase server collects all the profiles generated by the HomeBase agents, performs differential factoring for recovery and change notification, and acts as the central console for the environment with remote control of recovery and/or migration events.
- The HomeBase proxy server forwards the profiles generated by the HomeBase agents from behind a firewall to another HomeBase server.
- In addition to these profiles called base profiles, the HomeBase agents also collect profiles of some applications available in the system, called extended profiles.

Protecting servers with the EMC's Bare-Metal solution

In order to claim that a machine is disaster-proof, it should be possible to bring the machine back to its original state.

The following sections describe how NetWorker and HomeBase can be configured to re-create a server from any disaster. This design allows for backup of the data and the configuration details separately. This enables selective recovery of only the data or only the configuration details. NetWorker backs up the data on the server while HomeBase backs up its configurations.

The first step is to select systems with sufficient configuration to act as a NetWorker server and a HomeBase server. The NetWorker server is configured to administer backups taken using NetWorker whereas the HomeBase server is installed to administer the HomeBase agents and do backups of the profiles generated by these agents. The HomeBase server is basically the repository for all the base profiles generated by the HomeBase agents and has a minimum requirement of a 3 GHz server with a minimum memory of 4 GB and a storage of 72 GB (approximately enough for daily base profiles to be stored from 100 servers). Following best practices, both NetWorker and HomeBase should be configured on different servers to avoid a single point of failure. Even though the base profile is copied onto the HomeBase server, it is also backed up using NetWorker to have a fallback option in case the HomeBase server fails. Additional HomeBase servers can always be set up and the profiles replicated automatically for additional redundancy. The HomeBase server provides profile administration, which enables dissimilar system restores, and report generation that provides compliance and change management.

Once the servers are configured, enterprise systems can now be protected from disaster by installing the HomeBase agent and the NetWorker client, configuring them, and then scheduling them for continuous profiling as well as backup.

The HomeBase agent generates two types of profiles: the base profile and the extended profile. The base profile contains the key operating system elements needed to recover or migrate a server. This base profile file is typically transported automatically off-server or off-site, where an enterprise's collection of such profiles are maintained. It is used to assist in the initial stages of the recovery or migration process. The base profile file can restore the system settings and configuration of the original server to the new system, including network interface settings, IP configuration, storage structures, routing tables, local settings, name service settings, paging space and IPC configuration, detailed kernel settings, and user/group settings. The extended profile contains the elements (like the Windows registry) from the original system, which after the bulk data restore, needs to be applied to the new target to "re-link" application binaries, freshly restored to the new target machine, with the Windows registry, and thus re-establish the application environment.

EMC's BMR solution enables scheduled backups of data, snapshots, and server configuration, providing robust disaster protection for the system. The base profiles are uploaded to the HomeBase server for administration, and should also be backed up using NetWorker along with the extended profile for additional protection. The HomeBase server contains a number of protocol services that support and accept the communication of the profiles from the agents. The most secure communication protocol between a HomeBase agent and a HomeBase server is the HomeBaseSSL protocol. Users can opt to use this point-to-point encrypted realtime data stream, which is recommended for agent-to-server communications.

Recovering servers using EMC's Bare-Metal solution

The recovery process is broken down into four basic steps. If followed, this results in a fully functional system equivalent to the failed server. The main steps of the recovery process are provisioning the server operating system, applying the base profile, restoring backup data, and applying the extended profile. Figure 1 illustrates the process of server recovery using the EMC's BMR solution.

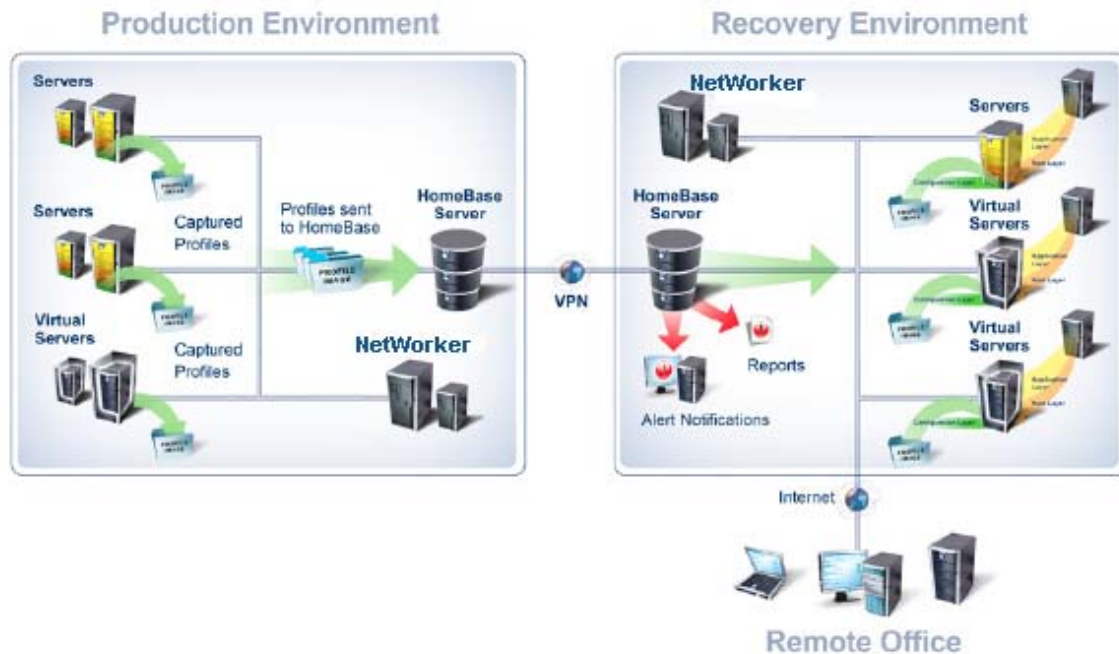


Figure 1. Server recovery using EMC's Bare-Metal Recovery

Provisioning of the server OS

During *provisioning*, the target server is set up for the same operating system and service pack level as the failed server. The HomeBase server generates a report of the original server's operating system and configuration data. Once the base operating system is installed, the same service packs on the original machine are installed. The target server should have the same system drive available as the original server. The HomeBase agent is installed on the provisioned server. In a Windows environment, the disks must be dynamic. This enables the HomeBase agent to accommodate varying sizes of recovered data, such that there is no need to partition the disk. This ensures the smooth recovery of the base profile.

Apply base profile

Once the target machine is identified, the base profile can be applied. The agent on the target server identifies itself to the HomeBase server by sending it the discovery or the recovery profile. The user selects the requisite base profile from the profile repository in the HomeBase server. Specific configurations can be restored from the base profile and multiple recoveries of the base profile can be applied to multiple servers. For example, if the re-creation of the network configurations of the failed system is not required, that configuration should not be selected in the restore. The restore selections are applied to the target. Once completed, the target server is rebooted. If a domain controller is being restored, the system must be rebooted in the Directory Services Restore Mode.

Restore backup data

After rebooting the target server, the user needs to install the NetWorker client and configure it to communicate with the NetWorker server containing the backup data. During the recovery process, HomeBase dynamically creates a list of certain files that should not be recovered by NetWorker. These files would not match the hardware configuration of the target server, and if recovered, would potentially corrupt the current configuration. HomeBase stores this list, named **exclude.legato**, in a folder called **Exclude** in its installation folder. This list typically includes files involved in the hardware interface (such as **ntoskrnl.exe**, **hal.dll**, **kernel32.dll**, **win32k.sys**, **winsrv.sys**, **ntkrnlpa.exe**), directories that contain the system registry (such as **system32\config**, **config**), the boot loader that is invoked after the system reads the master boot record, Active Directory data, NetWorker binaries, and HomeBase binaries.

To pass this exclude list to NetWorker, the user runs the **RecoverWithXclusion.bat** script on the target server. This script requires the NetWorker client name, NetWorker server name, and the location of any additional exclude file required to be deleted from the recovery list. The script then invokes NetWorker's recover binary and recovers all the files except those excluded.

Apply the extended profile

The restoration of the data using NetWorker will restore all the application binaries and the user data previously available in the original server. The next step is to apply the extended profile. The extended profile contains all the OS references to applications, hot-fixes, services, and so on that were present on the original server. Applying the contents of the extended profile effectively relinks the applications to the new platform. The extended profile will also restore the Active Directory database and the SYSVOL area from a Windows domain controller.

Reboot

Once the extended profile is successfully applied, the server is rebooted. At this point, the server will have the full functional capability of the original profiled server.

Recovery of the EMC Bare-Metal solution in the enterprise

To configure the NetWorker server and the HomeBase server:

1. Set up the NetWorker server on an appropriate machine and configure the storage devices appropriately. Follow procedures in the *EMC NetWorker Release 7.4 Multiplatform Version Installation Guide*.
2. Configure the NetWorker server with the details of the systems to be protected. These systems are the NetWorker clients. Schedule backups on the NetWorker server for the NetWorker clients.
3. Set up the HomeBase server on an appropriate machine. Follow the instructions provided in the *EMC HomeBase Server Installation and Administration Guide*. Configure the HomeBase server for scheduled profiling of NetWorker clients.

To prepare the systems for disaster recovery:

1. Install a NetWorker client on the systems to be protected.
2. Install the HomeBase agent on all the NetWorker clients.
 - a. Follow the instructions for installation provided by the HomeBase Agent Installation wizard. Configure these client systems with the IP address of the HomeBase server.
 - b. The NetWorker client will back up the data while the HomeBase agent will back up the system configurations.
3. The HomeBase agent backs up the profile by performing the following:
 - a. Run the profiler from the command prompt of the client using the command
`hba profile -k`

This creates both the base profiles and extended profiles and uploads the base profiles to the HomeBase server.

4. Back up data using the NetWorker client.
 - a. Both the base and the extended profiles are backed up using the NetWorker client.
 - b. The entire system is also backed up.

To perform a Bare-Metal Recovery:

1. Provision the target system for recovery.
 - a. Install a new operating system on the target system. The target system should be of the same operating system and the service pack level of the original system. Generate a report of the profile stored on the HomeBase server to determine the needed operating system and service packs.
 - b. Install and configure HomeBase agent on the target systems.
 - c. Make the disks on the target system dynamic. Select **Computer Management > Disk Management**. Right-click the disks available and select **Convert to Dynamic Disk**. This facilitates the recovery of the different partitions available on the failed system.
 - d. Reboot the system once the disks are dynamic. This ensures the smooth recovery of the base profile.
2. Profile the target machine so that it can be identified by the HomeBase server. The HomeBase server uses this profile to identify the new machine and compares it with the profile to be recovered. NetWorker can be used to save these profiles as well.
3. Perform a recovery of the base profile by performing the following:
 - a. Log in to the HomeBase server.
 - b. Select the **Agents > Run Recovery** option.
 - c. Select **Create Batch**.
 - d. Map the source agents to the destinations agent.
 - e. Add the source agents and select the desired profile.
 - f. Define the configurations to restore.
 - g. Add the destination agents.
 - h. Map the source agents to the destination agents and click **Save**.
 - i. A list of created batches is displayed.
 - ii. Select the batch to recover.
 - iii. Click **Run Recovery**.

Note: The base profile can also be recovered from NetWorker and can be applied to the new machine using the command:

```
hba recover -t -k <path of the base profile>
```

4. Reboot the target system.
5. Log in to the target systems using the username and password provided by the HomeBase system (**Username: indigostone** and **Password: H0meBase**).
6. Install the NetWorker client on the destination system.
7. Restore the backed up data. This will recover the extended profile along with the data. The recovery using NetWorker starts by running **RecoveryWithXclusion.bat** at the command prompt.
 - a. The HomeBase server creates an exclude list when the base profile is recovered. This list contains the files to be excluded when the recovery of data is done. This prevents mismatched drivers and hardware-specific files from overwriting the existing files.
 - b. The script prompts for the NetWorker server name and the NetWorker client name. The location of the exclude file is also required. After this information is provided, the data is recovered automatically with the "Overwrite" option set in the NetWorker Recovery command. The files listed in the exclude list are excluded.
 - c. NetWorker prompts for a reboot after the restore. This is not required.
8. Recover the extended profile from the HomeBase agent command prompt:

```
hba recover -e <path of the extended profile>
```

9. Reboot the target machine.

To perform an Active Directory recovery:

1. Install the NetWorker client and the HomeBase agent in the source machine.
2. NetWorker is used to back up the source machine (the drives and the VSS components) and HomeBase is used to profile it using the command **hba profile -k**.
3. Provision the target system for recovery.
 - a. Install the same operating system with the same service pack level on a new system. The target machine should have Active Directory installed as well.
 - b. Install the Home Base agent on the target machine.
4. Profile the target machine using the **hba profile -k** command. This enables the HomeBase server to identify the machine and compare backup configurations. The profiles can also be saved using NetWorker.
5. Perform the recovery of the base profile with one of the following:
 - a. Recover the profile using NetWorker and then use the following recovery command:
`hba recover -t -k <path of the base profile>`
 - b. Follow steps 3a to 3g of the [normal recovery procedure](#).
6. Once the base profile recovery completes, reboot the machine. Start the machine in **Directory Services Mode** by pressing F8. The login is: **Username: indigostone** and **Password: H0meBase**.
7. Restore the backed up data. This will recover the extended profile along with the data. The recovery using NetWorker is executed with **RecoveryWithXclusion.bat** on the command prompt.
8. Once the data is recovered, reboot the machine. Start the machine again in **Directory Services Mode** by pressing F8. Log in as Administrator and provide the credentials for the same.
9. Recover the extended profile with the following command:
`hba recover -t -k -e <path of the extended profile>`
10. Once the recovery is successful, reboot the machine.

To perform an Exchange Server recovery:

1. Install the NetWorker Module for Microsoft Exchange Server and the HomeBase agent in the source machine.
2. NetWorker Module for Exchange is used to back up the Exchange data (Information store and Public folders) available in the source machine. The HomeBase agent creates the profiles to be sent to the HomeBase server. The profiles can also be saved using NetWorker.
3. Provision the target system for recovery.
 - a. Install the same operating system with the same service pack level on a new system. The target machine should have Active Directory installed as well.
 - b. Install the Home Base agent on the target machine.
 - c. Install Exchange Server on the target machine.
4. Profile the target machine using the **profiler -k** command. This enables the HomeBase server to identify the machine and compare backup configurations.
5. Perform the recovery of the base profile to a target machine with one of the following:
 - a. Recover the profile using NetWorker and then use the following recovery command:
`hba recover -t -k <path of the base profile>`
 - b. Follow steps 3a to 3g of the [normal recovery procedure](#).
6. Recover the extended profile with the following command:
`hba recover -t -k -e <path of the extended profile>`
7. The Exchange data is recovered using the NetWorker Module for Exchange Server and the NetWorker server.
8. Validate that Exchange services are started including IIS.
9. Validate that the domain name/hostname/Exchange Server and other network services are recovered.
10. Validate that all Exchange items are restored.

To perform a SQL Server recovery:

1. Install the NetWorker Module for Microsoft SQL Server and the HomeBase agent on the source machine. NetWorker Module for Microsoft SQL Server backs up the SQL Server data and HomeBase agent creates the profiles to be sent to the HomeBase server.
2. Provision the target system for recovery.
 - a. Install the same operating system with the same service pack level on a new system. The target machine should have Active Directory installed as well.
 - b. Install the Home Base agent on the target machine.
 - c. Install SQL Server on the target machine.
3. Profile the target machine using the **hba profile -k** command. This enables the HomeBase server to identify the machine and compare backup configurations.
4. Perform the recovery of the base profile to a target machine using one of the following:
 - a. Recover the profile using NetWorker and then use the following recovery command:
`hba recover -t -k <path of the base profile>`
 - b. Follow steps 3a to 3g of the [normal recovery procedure](#).
5. Reboot the target machine.
6. Use NetWorker to recover the SQL data.
7. Recover the extended profile with the following command:
`hba recover -t -k -e <path of the extended profile>`
8. Reboot the machine.
9. Validate SQL data and the target machine configuration.

Recommendations

- To prevent a mismatch between the configuration and the server data, profile the server just before the server's data backup. The pre- and post- commands of NetWorker should be used for the same. Set the NetWorker client attribute to use **savenpc** as the backup command. In the **savenpc** directive, specify the **hba profile -k** command so that the profiles are created just before the backup of the server is performed.
- The HomeBase servers should perform replication of the profiles to different HomeBase servers. A replication agreement should be established between the administrators of the HomeBase servers in different sites, before the replication of the profiles.
- The frequency of the profiling depends on the backup strategies set up by different organizations. It depends on the liveness and criticality of the server and its applications. Profiling is recommended if the server configuration changes regularly. For example, in a critical scenario of Online Transfer, the profiling should be done every day along with the data.
- If there are a large number of servers to be recovered, it is very easily achieved using the HomeBase server console.
- Normally, when the profiling is done, the base profiles would be uploaded to the HomeBase server. If for some reason, the base profiles cannot be uploaded, use NetWorker to back up the profiles. At the time of the recovery, the user can restore the base profile using NetWorker and upload the same to the HomeBase server. The profiles can be checked for compatibility using the HomeBase server before the actual recovery of the base profile.

Leveraging EMC's BMR solution

There are additional advantages obtained by using EMC's BMR solution. Since the HomeBase server acts as a repository of the profiles of different systems in the enterprise, it can administer the profiles, perform change notifications, and produce detailed, accurate server asset reports throughout the production environment. Useful alerts based on certain pre-set change criteria can then be generated. As the base profile is very small, it can be stored over long periods of time, enabling the enterprise to meet compliance

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requirements. The HomeBase product suite provides a number of useful reports. Also, many machines can be restored in parallel, dramatically reducing the aggregate recovery time. The strategies, as mentioned in the previous sections, employed for the Bare-Metal Recovery are easily replicated for performing regular server/application migration.

Server/application migration

Apart from the BMR capability, the highlight of the EMC's BMR solution is the capability of server migration and application migration to different machines. The migration process is equivalent in many ways to the BMR process. The systems are normally migrated when the hardware becomes outdated and needs to be replaced. The EMC's BMR solution provides migration capabilities for applications among and between physical and virtual environments. Application migration includes the migration of applications such as Active Directory, Exchange Server, and SQL Server. Figure 2 is an example of a scenario when Active Directory is migrated from an outdated server to a new server.

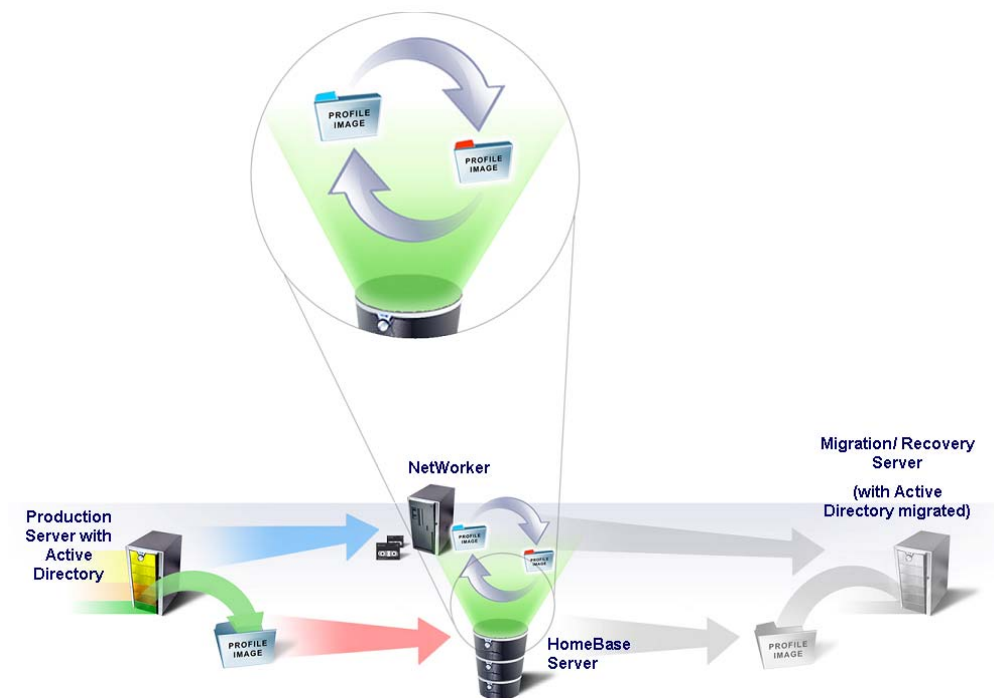


Figure 2. Migrating Active Directory to a new server

Conclusion

The BMR solution offered by EMC is a high-end solution with a process that provides very high reliability in server recovery and migration. This solution also provides several additional options to leverage the protected data such as asset management, report generation, and change notification.

References

- *EMC NetWorker Release 7.3 Multiplatform Version Administration Guide*
- *EMC HomeBase Agent for Microsoft Windows Recovery and Migration Guide*