DEMYSTIFYING AVAMAR
KEY CONCEPTS AND FEATURES

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Executive Summary

Data deduplication is a method for eliminating redundant data from storage, especially from backups. It works by saving a single copy of identical data, replacing any further instances with pointers back to that one copy.

![Data Deduplication Diagram](image)

Figure 1: Data Deduplication

When it comes to data deduplication, one size does not fit all. That's why it is important to consider a solution's approach from the following three levels before making a decision:

1. Where does data deduplication occur? Does it occur at the source (a server, for example) or at the target that stores the data (a virtual tape library, for example)? A source-based approach results in less data being sent across the wire for backup, potentially shortening backup windows.

2. When does deduplication happen? In target-based implementations, data can either be backed up first, then deduplicated (post-process), or Deduplication can be executed during the backup process (inline). Each method has pros and cons: Post-process Deduplication may result in a faster backup, but inline can be replicated immediately after a backup concludes.

3. How does it happen? Object-level differencing reduces data by storing only the changes that occur, while hash-based chunking products locate global redundancies that occur among all files in a backup. Some technologies even difference at the file level, a technique with so many drawbacks there's little point in considering it here.

With EMC Avamar®, we get the advantage of source-based deduplication as well as target-based deduplication (with Data Domain® integration). It is an ideal solution for Enterprise backups as well as remote office backups (considering its great dedupe capabilities).
Abstract
Data Protection is major challenge for all organizations. Data is growing exponentially and robust backup technologies are required to meet Recovery Time Objective (RTO)/Recovery Point Objective (RPO) associated with Backup and Recovery of customer data.

Moving from tape to disk is not a recommended solution as most companies experience some type of pain associated with tape; i.e. inability to restore in an acceptable time frame; physical nature of tape; snapped tape; unreadable tape; slow Serial Access devices; and so on.

With drastic data growth, adding disk is not a good solution considering the cost associated with it. Thanks to deduplication, a major revolution is taking place in the data protection arena. Gartner views this technology as transformational because it radically decreases the economics of disk-based backup and recovery.

There are a number of deduplication vendors and it is always good to look at deduplication ratios when comparing different products which are available. Deduplication should save you much more space than compression.

So, what options exist to help your IT department with this challenge?

Of the many products in market, a key player is EMC Avamar® which has transformed the backup technology over the last few years. Taking advantage of data deduplication, this software/hardware tapeless backup and recovery solution deduplicates the data at the source client on a global level. Avamar offers:

- Global data deduplication
- Systematic fault tolerance
- Highly reliable, inexpensive disk storage
- Standard IP network technologies
- Scalable server architecture
- Flexible deployment
- Centralized management
- Desktop/Laptop support
- VMware protection
- Efficient monitoring and reporting
- Tape Out / Import
• Fastest recovery
• Homebase backup & recovery
• Remote Office backup
• Less network bandwidth consumption

This article intends to brief challenges faced by organizations backing up and recovering data along with Avamar key concepts and features, including Avamar integration with Data Domain and NetWorker®, VMware advantages, NDMP enhancements, Home Base integration, remote office data protection, and so on.

Those who read this article will gain a comfort level about key concepts and instrumental features of Avamar and will be able to use them efficiently to solve their data protection challenges.
Section I: Avamar Overview

Avamar System

Avamar is a software/hardware backup and recovery solution that uses patented global data deduplication technology to identify redundant sub-file data segments at the source, reducing daily backup data by up to 500x before it is transferred across the network and stored to disk. This enables companies to perform daily full backups even across congested networks and limited WAN links.

Avamar supports a wide-variety of client operating systems and applications, including: Windows, Linux, UNIX, NDMP, Microsoft SQL, Microsoft Exchange, SharePoint, Sybase, IBM Lotus Domino, DB2, SAP, and Oracle.

Avamar global data deduplication ensures that only unique data is backed up across the backup network. Using RAID (redundant array of independent disks) & RAIN (redundant array of independent nodes) it also provides systematic fault tolerance in case of disk or node failure. Since only unique data is transferred from clients to Avamar server, dedicated backup networks are not required. Storage nodes can be added to an Avamar multi-node server to accommodate increased backup requirements. Having Avamar Virtual Edition and Avamar Data Store provides flexible deployment options and centralized management of Avamar servers via the Internet. Table 1 shows the different Node types and their respective hardware configuration.

<table>
<thead>
<tr>
<th>Nodes</th>
<th>Disk</th>
<th>RAM</th>
<th>CPU</th>
<th>Ethernet</th>
<th>Chassis</th>
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<td>4</td>
<td>R510</td>
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<td>R710</td>
</tr>
<tr>
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<td>3x RAID 1 pairs</td>
<td></td>
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</tr>
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<td></td>
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</tr>
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<td>R710</td>
</tr>
</tbody>
</table>
Avamar Terminologies and System Components

Avamar server / Grid

The Avamar server is a group of one or more Nodes on a local, high-speed network. It stores client backups and provides essential processes and services required for client access and remote system administration. Avamar Administrator Server (mcs) and Avamar Data Server (gsan) run on the Avamar server.
The three Avamar server editions provide the flexibility to meet different customer requirements.

- **Software Only**
  The server software is installed on customer-supplied Avamar-qualified hardware platforms. Currently, Dell, HP, and IBM hardware platforms are supported.

- **Hardware Appliance (Avamar Data Store)**
  Consists of Avamar server software installed onsite on pre-configured and pre-tested Avamar-certified hardware.

- **Virtual Appliance (Avamar Virtual Edition)**
  Avamar server will be installed on VMware ESX server Virtual Machine. It will be single node non-RAIN server up to maximum capacity of 2TB.

**Avamar client**
A System is one or more Avamar servers and the network servers or desktop clients that back up data to those servers. Avamar Client software runs on each computer or network server being backed up. Avamar provides client software for various computing platforms.

**Avamar Administrator**
Avamar Administrator is a user management console software application that is used to remotely administer an Avamar system from a supported Windows or client computer.

**Global Storage Area Network**
The Global Storage Area Network (GSAN) is a component of the Avamar server. It is sometimes referred to as the data server or the storage server.

**Node**
A Node is a self-contained, rack-mountable network-addressable computer consisting of both processing power and hard drive storage. Nodes run Avamar server software on the Linux operating system.

**Utility node**
Utility node is dedicated to providing internal Avamar server processes and services, including the administrator server, cron jobs, Domain Name Server (DNS), external authentication, Network Time Protocol (NTP), and web access.
**Data storage node**

Data storage nodes include the Avamar Data Server software and are dedicated to providing backup storage.

**NDMP accelerator node**

The NDMP accelerator is a specialized node that, when used as part of an Avamar system, provides a complete backup and recovery solution for NAS devices via the Network Data Management Protocol (NDMP).

**Media access node**

The Avamar extended retention feature, included in version 6.1 of the core Avamar software product, is hosted on a dedicated media access node which is used for Avamar tape import and export operations and has a different part number than ADS. Gen4 7.8TB node has usable capacity of 6.5 TB of deduplicated storage. A single media access node supports up to five Servers.

**Transport node**

Transport nodes are Avamar Virtual Edition servers that have been modified specifically for use in the Avamar Data Transport system. They are the targets of replication from Avamar servers, and are used as backup and restore targets by the tape backup server. Transport nodes are sized at 1TB or 2TB nodes.

**Control node**

The control node is a 64-bit Linux host where the Avamar Data Transport application and the Avamar Data Transport Framework run. The Avamar Data Transport user interface is accessed from a web server that is installed on this host. In addition, the database of all transported files is often located on the control node. There is only one control node in an Avamar Data Transport system.

**Tape backup server / Archive server**

Avamar Data Transport supports the EMC NetWorker or Symantec NetBackup tape backup products. Both products have a server component that drives the tape archiving process.
Import server
Import server is the Avamar server that is installed on the Media Access node. Backups are imported from tape to this server.

Avamar Data Transport
Avamar Data Transport is a system of virtual machines that run in a VMware ESX Server environment in conjunction with tape backup software to transport deduplicated Avamar data to tape.

Avamar Extended Retention
The Avamar extended retention feature is a solution that exports backup data from an Avamar server to a tape library (physical or virtual) for long-term retention purposes. This backup data can be imported (or restored) from tape as needed.

Agents
Avamar agents are platform-specific software processes that run on the client and communicate with the Management Console Server (MCS) and any plug-ins installed on that client. There are two basic types of Avamar plug-ins:

- Filesystem plug-ins are used to browse, back up, and restore files or directories on a specific client file system
- Application plug-ins support backup and restore of databases or other special applications

Enterprise Manager
The Avamar Enterprise Manager provides centralized access to the Avamar Administrator for each Avamar system in an enterprise, as well as dashboard, reporting, and search capabilities.

Client Manager
Client Manager is a graphical interface used to activate, manage, and analyze backup clients. It is especially useful when dealing with an environment with a large number of clients to back up and manage.
**AvInstaller program**
The AvInstaller program is included in the Avamar software bundle. For new installations of Avamar v6.x, AvInstaller software and the Avamar Installation Manager User interface are installed on the single node Avamar server.

**EMC repository**
EMC repository contains server, client installation packages, and manifest files. The EMC repository currently spans two locations: ftp://ftp.avamar.com and EMC Subscribenet. High urgency packages such as hot fixes and OS patches are available from ftp://ftp.avamar.com. Low urgency packages are available from EMC Subscribenet.

**Local repository**
Local repository is the /data01/avamar/repo/packages directory on the Avamar single node server. The directory contains the most current manifest file from the EMC repository, installation packages, and workflow packages. The Avamar Downloader Service pushes packages from the EMC repository to the local repository. If a customer site does not allow Internet access, packages can be manually copied into the local repository.

**Manifest file**
An XML file listing all packages currently available for download from the EMC repository. When the EMC Subscribenet team adds a package to the EMC repository, it then adds an entry to the manifest file that describes the package and vice versa.

**Avamar Installation Manager**
Avamar Installation Manager is a web interface that manages installation packages. A successful Avamar v6.1 server software installation or upgrade embeds the Avamar Installation Manager Functionality in the Avamar Enterprise Manager. This feature is called System Maintenance.

**Avamar Downloader Service**
A Windows-based file distribution system that delivers software installation packages to target Avamar systems. The Avamar Downloader Service automatically downloads the manifest file from the EMC repository once a day and determines if new download packages are available.
Node resource database
An XML file named probe.xml stores the types and IP addresses of Avamar server nodes. It also stores the types and IP addresses of optional nodes such as media access node.

Stripe
A Stripe is a unit of disk drive space managed by Avamar.

Object
An Object is a single instance of deduplicated data. Objects are stored and managed within stripes on the Avamar server.

Domains
Domains are distinct zones within Avamar that are used to organize and manage backup clients. They are used to manage administration access to groups of clients.

Groups
Groups are used to create automated backups for a set of clients. Avamar backup runs according to group specifications.

Export policy
Defines the schedule on which a group of client backups will be exported to tape by Avamar extended retention. The export policy defines the group of clients that share a common schedule and retention periods for backup metadata and file-level metadata.

Datasets
Datasets define the persistent backup selections for the file systems, directories, or files to be included in a backup.

Schedules
The Schedule for a group determines when and how often a backup will automatically be run.

Retention Policies
Retention Policies specify how long each backup from the group will be kept.
Backup window
The backup window is when the majority of backups are performed. Backups should be scheduled to run during this time.

Blackout window
During the blackout window, backups cannot be performed. This window of time is reserved for maintenance activities such as garbage collection and checkpoint creation. By default, the blackout window runs from 8 am to 11 am.

Maintenance window
The maintenance window is reserved for other maintenance activities, primarily the HFS check. Backups may be initiated, but both backup time and maintenance activities will be impacted. By default, the maintenance window runs from 11am to 8 pm.

Avamar Functions
Data Deduplication
Data deduplication is a key feature of the Avamar system. Data deduplication ensures that each unique sub-file, variable length object is stored only once across sites and servers. This feature significantly reduces network traffic and provides greatly enhanced storage efficiency on the server.

Backup
An Avamar backup is defined as a point-in-time copy of client data that can be restored as individual files, selected directories, or entire file systems. Avamar provides two backup types: scheduled and on-demand.

- Scheduled backups are run automatically according to specifications that can be customized by the administrator using the Avamar Administrator interface.

- On-demand backups can be initiated from the Avamar Administrator interface and the Management Console command line interface (MCCLI). On-demand backups can also be run from a client.

Restore
Restore is an operation that retrieves one or more file systems, directories, or files from an existing backup and writes it to a designated location on clients.
Encryption
Encryption provides enhanced security during client/server data transfers and on the Avamar server. An Avamar server can be configured to encrypt all backup data stored on the server “at rest”.

Avamar can also encrypt data sent between client and server “in-flight”. Two types of in-flight encryption are available—medium and high. While it can also be disabled entirely, “at rest” encryption can be enabled when Avamar servers installed.

Replication
Replication is the process of transferring data from source to a destination Avamar server to support future disaster recovery of the source server. Avamar uses sophisticated data deduplication technology which eliminates data duplication and sends only unique data to the destination Avamar server. Avamar offers two types of replications.

- Normal replication
  Replication automatically creates a REPLICATE domain on destination server during first replication which is a mirrored representation of the entire source server client tree. During this normal replication, user data from source Avamar is replicated to destination Avamar server.
- Full root-to-root replication
  This replication creates a complete logical copy of an entire source server on the destination server. This data is not copied to REPLICATE domain on destination server; it is added directly to root domain as if the source clients had registered with the destination server.

Checkpoint
A checkpoint is a read-only snapshot of the Avamar server taken to enable server rollbacks. Checkpoints are created using hard-links to all the stripes.

Hash File System check
A hash file system (HFS) check is an operation that validates the integrity of a checkpoint. Once a checkpoint has passed a HFS check, it can be considered reliable enough to be used for a system rollback. Checkpoints are taken twice daily and validated once daily during the maintenance window.
Garbage collection
Garbage collection is the process of deleting unused chunks from backups that have expired. Garbage collection requires a quiet system in order to run. While garbage collection is running, the system is placed in a read-only condition. Garbage collection is run once a day during the blackout window.

Section II: Avamar Data Protection Enhancements
Microsoft Exchange Integration
Microsoft Exchange Server is the server side of a client–server, collaborative application product developed by Microsoft. Exchange’s major features—electronic mail, calendaring, contacts, and tasks—work with Microsoft Outlook on PC and Mac.

A Database Availability Group (DAG) is a set of up to 16 Microsoft Exchange Server 2010 Mailbox servers that provides automatic, database-level recovery. DAGs use continuous replication and a subset of Windows failover clustering technologies to provide high availability and site resilience.

A Recovery Database (RDB) is used for recovering Exchange 2010 mailbox database data and specific email items. RDB has to recover data from a backup without disturbing user access to the current data.

Microsoft Exchange 2010 Backup Implementation
Below are the steps for Exchange 2010 VSS Backup Configuration
1. Install .NET4.0 and MAPI (Microsoft Messaging API) / CDO (Collaboration Data Objects) on all DAG nodes.

2. Install Avamar file system and Exchange VSS plug-in on all DAG nodes. Optionally, you can install GLR feature which needs a reboot.

   Note: Please make sure to mount the active mailbox databases to alternate node prior installing and rebooting the Avamar file system, Exchange VSS, and GLR.

3. Run AvamarBackupUser Configuration tool on one of the Exchange servers and create an AvamarBackupUser account.
4. Change Avamar Services on all DAG nodes to run under AvamarBackupUser account and restart Backup Agent service.

5. Register all the Clients on DAG.

6. Run the Avamar Cluster configuration tool from one of the Exchange servers for installing and configuring the Avamar Exchange DAG clients and provide static IP address and var directory for Exchange DAG client.

7. Run an on-demand full or incremental backup from Avamar Administrator Backup & Restore GUI by selecting the DAG client and Windows Exchange VSS plug-in. Backups can be automated like any other file system backup by selecting the DAG name as backup client. Other backup options such as active or passive replica writers, server preferred order list, and circular logging can also be chosen.

   Note: Exchange Server 2010 supports only Microsoft Volume Shadow Copy Service (VSS)-based backup and Extensive Storage Engine (ESE) streaming backup has been discontinued from Exchange Server 2010.

Microsoft SharePoint Integration
Microsoft SharePoint is a Web application platform developed by Microsoft. The common solutions using SharePoint are collaboration, content management, enterprise search, and web portals.

A SharePoint server is an individual server that runs the operating system and application software required to perform roles or to provide services for the SharePoint farm.

A SharePoint farm is a set of servers comprised of databases, applications, and web services that together provide a SharePoint solution.

A Web-Front-End (WFE) server provides services directly to end users and handles all web traffic from end users.

Microsoft SQL server of the content and settings in a SharePoint server are stored in Microsoft SQL relational databases.

Microsoft SharePoint 2010 Backup Implementation
Microsoft SharePoint Server 2010 provides two backup systems: farm and granular.

Components in the farm that can be selected for backup include the farm, web applications, and
shared and non-shared services and service applications. With the granular backup system, a user can back up a site collection or export a site or list.

Avamar provides two different plug-in for SharePoint

- Windows SharePoint Plug-in - One web front end server must be selected as owner of the backup and all other backend / SQL servers must be installed in secondary mode.

- Windows SharePoint Granular Recovery (GLR) Plug-in - Used for granular level recovery.

Microsoft SharePoint Backup Configuration Steps in Avamar

1. Install Avamar Windows file system client. For GLR configuration, set the Backup Agent service to run on SharePoint administrator credentials.

2. Install Avamar SharePoint VSS plug-in and select install GLR feature on hard disk for GLR configuration. On any one of the web front end servers, choose front-end plug-in. Other web front end servers do not have plug-ins; every other server in the farm is installed as back-end plug-in.

3. Activate all clients with Avamar.

4. From the Avamar Backup & restore GUI, select the server that has the front end plug-in installed and choose the Windows SharePoint VSS plug-in. Select Farm, right click, and select Backup up now to back up the SharePoint Farm.

Microsoft SQL Integration

Microsoft SQL Server is a relational database management system developed by Microsoft. As a database, it is a software product whose primary function is to store and retrieve data as requested by other software applications. Avamar supports full, differential, and incremental backup (only for transaction log backups). For SQL, it supports multi streaming up to six.

Microsoft SQL Backup Implementation for Windows servers

1. Install the Avamar for Windows client and SQL plug-in for SQL clients (SQL plug-in needs Microsoft .NET 4 installed) and register with Avamar Server.
2. From the Avamar Backup & restore GUI, select the SQL server and choose the Windows SQL plug-in. Select the database then right click and select Backup up now to back up the database.

3. When you select More Options, you can choose the backup type, force full backup (runs full backup if no previous full backup is available), use Data Domain® system (if any Data Domain is configured), and so on.

**NDMP Integration**

Network Data Management Protocol (NDMP) is an open protocol used to control data backup and recovery communications between primary and secondary storage in a heterogeneous network environment.

![Figure 3: Avamar environment with NAS backup using Accelerator node](image)

**NDMP Backup Implementation steps for NetApp**

Avamar uses NDMP Accelerator node to backup NDMP storage devices. Accelerator handles the data deduplication and NDMP processing and forwards the data to Avamar Server.

Steps for Configuring Backups for NetApp

1. Install Avamar server, accelerator, and filer on the network and ensure all three have connectivity each other.
2. Log in to filer and run `options ndmpd.access host=HOSTNAME` to provide access to the accelerator and run `options ndmpd.enable` to enable NDMP services on the filer where HOSTNAME is accelerator hostname.

3. Download the Avamar client for Linux and accelerator from Avamar Server and install them on the accelerator as root.

4. Log in as root on accelerator. Run `avsetupndmp` and follow the instructions to complete configuring the accelerator. Be sure to enter the NDMP user account when prompted, which has sufficient privileges to run the NDMP jobs.

5. Run the `avregister` on accelerator to register it to the Avamar Server.

6. In Avamar Administrator, click the Backup & Restore launcher button. The Backup and Restore window appears.

7. In the client's tree, select a storage device client then select for Backup tab.

8. Expand the accelerator node in the tree in the left pane of the Select for Backup tab.

9. Select the checkbox next to the volumes to back up.

10. Select Actions > Backup Now to back up selected volumes.

**Oracle Integration**

An Oracle server consists of an Oracle instance and an Oracle database. The Oracle instance is software executed on the server as part of the Oracle server that stays resident in memory. The database consists of files that are located on any number of physical storage devices. These files are timestamp-related to each other; losing one file results in a corrupt database. A database server is the key to solving the problems of information management.

**Oracle Implementation with Avamar**

The Avamar Plug-in for Oracle works with Oracle and Oracle Recovery Manager (RMAN) to back up an Oracle database, a tablespace, or datafiles to an Avamar server. Backup and recovery operations are initiated from RMAN.
Steps to configure RMAN backups for Linux servers:

1. **Install Avamar Client for Linux and Oracle plug-in on the Oracle server.**
2. **To back up Oracle RAC databases,** run the `rac_config` script on all cluster nodes, register only one node with Avamar Server, and select shared location for var directory.
3. **Create backupuser on an Oracle database** and provide sysdba privilege. Avamar server uses this account to perform backup and restores.
4. **Performing hot backups database,** you must be in ARCHIVELOG mode. To do so, run “alter database archivelog;” after connecting to the database.
5. **In Avamar administrator,** open the Backup & Restore window and select the Oracle server.
6. **Select the database to back up,** right click and select Backup up now to back up the databases selected.

**NetWorker Integration**

EMC NetWorker® is an Enterprise backup and recovery software that centralizes, automates, and accelerates data backup and recovery in an IT environment.

**NetWorker Integration with Avamar**

1. **Install NetWorker Linux Client software** on Avamar utility node and start NetWorker daemons.
2. **Stop the MCS,** edit the `/usr/local/avamar/var/mc/server_data/prefs/mcserver.xml` file, and set the `allow_duplicate_client_names` attribute to true.
3. **Restart MCS and log in to Avamar Administrator to create a domain called NetWorker.**
4. **Go to the NetWorker Administration Devices window,** right-click Deduplication Nodes, and select New. In the Identity area, enter the name of the Avamar server. In the Access area, enter the user name and password for the Avamar server.
5. **A NetWorker advanced file type device (AFTD)** is required for storing deduplication metadata. To create an AFTD device; from the NetWorker Administration Devices window, right-click Devices and, from the pop-up menu, select New. In the Name area, enter the path for the device. Then, select `adv_file` for Media type.
6. **Label the deduplication AFTD in the deduplication pool and mount the device.**
7. **Create a dedicated group for deduplication clients and tie the deduplication pool to the group.**
8. Go to the NetWorker Administration Configuration window, right-click Clients and click New. Provide the server name then select the Deduplication group and Avamar deduplication node to be used for backups. Make sure to check the Avamar deduplication backup checkbox.

9. Now you can run the Avamar deduplication backup just as you would run traditional NetWorker backups.

**Data Domain Integration**

EMC Data Domain is a target-based deduplication system that uses inline deduplication whereas Avamar uses variable segment deduplication for data deduplication. A Data Domain system manages data of greater than 5TB more effectively than Avamar server, especially for large, active databases.

Avamar clients use Data Domain Boost API (Application Programming Interface) to access and store data to a data domain system. This API is installed automatically when Avamar client is installed on the client computers. Avamar plug-ins that support backup and restore to and from Data Domain include: IBM DB2, Microsoft Exchange VSS, Hyper-V VSS, SharePoint VSS and SQL Server, Oracle, SAP with Oracle, Sybase, and VMware image backup and restore.

![Figure 4: Avamar environment with Data Domain DD Boost backup](image)
Data Domain Implementation steps with Avamar

1. Log in to Data Domain CLI (Command Line Interface) as administrative user and enable DD boost by typing `ddboost enable`

2. Create a DD boost user account and set it as DD boost user by typing

   `user add user priv admin`

   `ddboost set user-name user`

   where user is username for the account

3. Disable and Enable the DD Boost for the changes to take effect by typing

   `ddboost disable`

   `ddboost enable`

4. Enable SNMP if not already enabled from Data Domain Enterprise Manager → System Settings → SNMP

5. Log in to Avamar server GUI with administrative privileges and go to Avamar Administrator → Server → Server management tab → Actions → Add Data Domain Systems, then supply the fully qualified domain name of the Data Domain system and the DD Boost user name and password. On the SNMP tab, supply the SNMP Community String used to grant Avamar read and write access to the Data Domain system, then click OK.

6. In Avamar administrator, open the Backup & Restore window and select the server that has one of the Data Domain supported plug-ins installed (for example, Microsoft SQL) then select the plug-in and right click Back Up Now → More Options. On the Backup Command Line Options dialog box, select Data Domain system that has been added to the Avamar server, then click OK to run on-demand backups to the selected Data Domain system. For a scheduled backup, this is done from the Options tab in a Dataset specification.

   *Note: DD Boost is a licensable feature in Data Domain and DD Boost becomes the preferred method of connectivity for any clients that are enabled for DD Boost while DD Boost is also enabled on the Data Domain.*
**DB2 Integration**

IBM DB2 is a relational model database server developed by IBM. There are three main products in the DB2 family: DB2 for LUW (Linux, Unix, and Windows), DB2 for z/OS (mainframe), and DB2 for iSeries (formerly OS/400).

**DB2 Integration with Avamar**

The Avamar Plug-in for DB2 supports backups and restores of DB2 single instance configurations and DB2 configurations that implement DB2 Database Partitioning Feature (DPF). Each DB2 server requires the installation of the Avamar Plug-in for DB2 and an Avamar file system client. You can back up and restore DB2 databases using Avamar Administrator.

**Configuration steps for DB2 backups on AIX servers**

1. Log in to the DB2 server host as root and download AIX and DB2 installation package.

2. Install and register AIX client package to Avamar server. Once done, we need to install and configure DB2 as given below:

   a) Install Avamar Plug-in for DB2

      geninstall -d AvamarDB2-aix5-ppc64-VERSION.bff all

   b) Configure the Avamar Plug-in for DB2 software by typing:

      /usr/local/avamar/bin/avdb2setup

   c) Enter the Username for DB2 instance owner when prompted for the same.

   d) Provide Home directory for DB2 instance owner.

3. To perform first online backup of DB2 database:

   a) Enable archive logging:

      • For DB2 version 9.1 and earlier, type:

         db2 update db cfg for DATABASE-NAME using LOGRETAIN ON

         where DATABASE-NAME is the name of the database to back up.

      • For DB2 version 9.5 and later, type:

         update db cfg for DATABASE-NAME using LOGARCHMETH1 LOGRETAIN

         where DATABASE-NAME is the name of the database to back up.

   b) Perform an offline backup of the DB2 database. The database is now in a state that supports future online backups. We must also select the Create an Online backup option for the dataset or for an on-demand backup.
c) Now we are all set to take On-Demand Backups from client or scheduled backups which can be done by creating Dataset for DB2 backups.

**Sybase Integration**

The Avamar Plug-in for Sybase plug-in is software that works with the Avamar server and client software to provide deduplication backup and recovery for Sybase Adaptive Server Enterprise (ASE) data. A Sybase ASE server is the only type of Sybase database server that the Sybase plug-in supports.

The Sybase plug-in is deployed in an Avamar client/server system in a network environment.

The Sybase server host is Avamar clients that access the Avamar server for backup and restore services.

**Configuration steps for Sybase backups with Avamar on Linux**

1. Download, install, and register client package as root to Avamar server as given below:

   e) Type the following command depending on your Hardware:

   ```
rpm -hi AvamarSybase-linux-type-x86-version.rpm
   ```

   f) Create a symbolic link named `libsybase_avamar.so` in the Sybase ASE library directory, `$SYBASE/$SYBASE_ASE/lib`, that points to the Avamar Plug-in for Sybase library file, `libsybase_avamar.so`, in the Avamar installation_dir/lib directory.

   g) Edit the `avsybase` script file, and add the Sybase OCS (Open Client Server) library path to the `LD_LIBRARY_PATH` path in the script.

   h) Register the Sybase plug-in by running `/usr/local/avamar/bin/avregister`

2. In Avamar Administrator, click the Backup & Restore launch button and select the Sybase server that needs to be backed up.

3. Select the Sybase plug-in type and complete the settings in the Browse Command Line Options dialog box:

   - In the Sybase installation directory field, type the full pathname of the Sybase installation directory for the server to be backed up, represented by `$SYBASE` on Linux.

   *Note: type the actual text of the full pathname. For example, `/sybase instead of `$SYBASE`.  

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• In the Sybase server name field, type the Sybase server name, not the hostname. For example, type SERVER_ABC.
• In the OCS library directory field, type the full pathname of the Sybase OCS library directory, represented by $SYBASE/$SYBASE_OCS/lib on Linux or UNIX.
  Note: Type the actual text of the full pathname. For example, type /sybase/OCS-15_0/lib instead of $SYBASE/$SYBASE_OCS/lib.
• In the Sybase username and password field, type the Sybase username and password, then click OK.

4. Select Backup tab which displays a folder with the Sybase server name and perform one of the following on the Select for Backup tab:
   • To back up all the databases on the server or the logs of all the databases, select the checkbox next to the Sybase server name.
   • To back up specific databases or the logs of specific databases:
     a. Double-click the Sybase server name.
        All the databases of the Sybase server appear in the right pane.
     b. Select the checkboxes next to the databases that you want to include in the backup.

5. Select Actions → Backup Now and then give values for Retention and encryption as per standard configuration in Backup Environment. Click More Options and configure below parameters:
   a) Backup Command Line Options dialog box appears. Complete the settings in the Backup Command Line Options.
   b) To view the advanced options with red labels, select Show Advanced Options.
   c) Complete the settings in the Sybase Information group box:
      – In the Sybase installation directory field, type the full pathname of the Sybase installation directory for the server to be backed up, represented by $SYBASE on Linux or UNIX
      – In the OCS library directory field, type the full pathname of the Sybase OCS library directory, represented by $SYBASE/$SYBASE_OCS/lib on Linux or UNIX
d) In the Sybase username field, type the Sybase username. In the Sybase user password field, type the Sybase user password.

e) If required, select Enable debugging messages and select Store backup on Data Domain system to store the backup data on a Data Domain system.

f) Select the backup type as: Full backup, Incremental backup, Incremental backup with -no_truncate option, then Log truncation with truncate_only option followed by full backup; Log truncation with no_log option followed by full backup and next, complete the General settings for Number of Streams, Backup data verification -No verification, Full verification, Header verification and, if required, Protected backup password field. Type the password that the Sybase server uses with the Sybase dump and Pre and Postprocessing Options.

6. Click OK to close the Backup Command Line Options and Click OK to close the On Demand Backup Options dialog box and start the backup. Backups can be scheduled to run by creating Dataset for Sybase backups.

VMware Integration
Avamar for VMware image backup and restore is built on the VMware vStorage API for Data Protection (VADP). Avamar for VMware image backup and restore is fully integrated with VMware vCenter Server to provide easy detection of virtual machine clients within the vCenter, and enable efficient centralized management of backup jobs.

Avamar utilizes Changed block tracking as well which is a VMware feature that tracks which specific file system blocks on a virtual machine have changed between backups. Using this feature provides valuable I/O reduction earlier in the backup process.

Backups and restores require the use of proxy virtual machine clients. Each proxy virtual Machine client provides all of the following capabilities:

*Backup of Microsoft Windows and Linux virtual machines (entire images or specific drives)
*Restore of Microsoft Windows and Linux virtual machines (entire images or specific drives)
*Restore of individual folders and files to Microsoft Windows and Linux virtual machines.

Proxies run Avamar software inside a Linux virtual machine, and are deployed using an Appliance template (.ova) file.
Steps for VMware Integration with Avamar (Windows)

Avamar for VMware image backup and restore supports protecting up to 5 vCenters from a Single Avamar server. Beginning with Avamar 6.0, support for multiple vCenters is enabled by default during new Avamar server software installations. However, if your Avamar Server was upgraded from the previous version, you might need to perform the following manual configuration to enable support for multiple vCenters.

To enable support for multiple vCenters

1. Open a command shell and log in using one of the following methods:
   * To log in to a single-node server, log in to the server as admin.
   * To log in to a multi-node server, log in to the utility node as admin.

2. Change directories by typing: cd /usr/local/avamar/var/mc/server_data/prefs

3. Edit com.avamar.mc.VMware.max_number_of_vcenters in mcserv.xml as shown below:

   ```xml
   <root type="system">
     <node name="com">
       <node name="avamar">
         <node name="mc">
           <node name="VMware">
             <entry key="max_number_of_vcenters" value="1" />
           </node>
         </node>
       </node>
     </node>
   </root>
   
   Note: Substantial portions of mcserv.xml have been omitted for clarity.
   ```

Figure 5: VMware backup environment using Avamar
4. Change the `max_number_of_vcenters` entry to an integer value between 2 and 5.
   
   *Note: This value must be equal to or greater than the maximum number of vCenters you will be using with this Avamar server. Currently, the absolute maximum number of vCenters that can be supported by a single MCS is 5.*

5. Save Changes and restart MCS by typing:
   
   ```
   dpnctl stop mcs
   dpnctl start mcs
   ```

6. Download and install vSphere client software.

7. Download and install Avamar Administrator software.

8. Configure vCenter-to-Avamar authentication.

9. Avamar VMware Image Backup will not work unless:
   
   * A valid authentication certificate is present on the Avamar Management Console Server.
   * Certificate authentication for all MCS-to-vCenter communications is turned off.
   
   *Note: You must perform this task for each vCenter you intend to protect.*

10. Open a command shell and log in
   
   * If logging into a single-node server, log in to the server as admin.
   * If logging into a multi-node server, log in to the utility node as admin.

11. Stop the MCS by typing:
   
   ```
   dpnctl stop mcs and switch to root su
   ```

12. Copy `rui.crt` from the vCenter machine to `/tmp` on the utility node or single-node server.

   The default certificate provided with vCenter is:
   
   * Windows 2008: `C:\ProgramData\VMware\VMware VirtualCenter\SSL\rui.crt`
   * Other Windows versions: `C:\Documents and Settings\All Users\Application Data\VMware\VMware VirtualCenter\SSL\rui.crt`
   * Linux: `/etc/VMware-vpx/ssl/rui.crt`

13. Create a temporary version of the MCS keystore by copying the live keystore to `/tmp` and typing: `cp /usr/local/avamar/lib/rmi_ssl_keystore /tmp/`

14. Add the default vCenter certificate to the temporary MCS keystore file by typing:
   
   ```
   cd /tmp
   $JAVA_HOME/bin/keytool –import –file rui.crt –alias ALIAS
   ```
-keystore rmi_ssl_keystore

Note: where ALIAS is a user-defined name for this certificate, which can often be the file name.

15. When prompted for a password, type the root password.

The following appears in the command shell:

Trust this certificate?

Press yes and enter

16. Back up the live MCS keystore by typing:

```
cd /usr/local/avamar/lib
cp rmi_ssl_keystore rmi_ssl_keystore.DATE
```

Note: where DATE is today’s date.

17. Copy the temporary MCS keystore to the live location by typing:

```
cp /tmp/rmi_ssl_keystore /usr/local/avamar/lib/
```

18. Exit the root subshell, and restart the MCS by typing:

```
exit
dpnctl start mcs
```

19. Create a dedicated vCenter user account. EMC strongly recommends that you set up a separate vCenter user account that is strictly dedicated for use with Avamar.

Note: You must perform this task for each vCenter you intend to protect.

20. Add vCenter client in Avamar Administrator by going to Actions > Account Management > New Client.


22. Once deployed, each proxy virtual machine client provides all of the following capabilities:

* Backup of Microsoft Windows and Linux virtual machines (entire images or specific drives)
* Restore of Microsoft Windows and Linux virtual machines (entire images or specific drives)
* Selective restore of individual folders and files to Microsoft Windows and Linux virtual machines
Proxies run Avamar software inside a Linux virtual machine, and are deployed using an appliance template (.ova) file. Proxy clients are allowed in any part of the Avamar Administrator account management tree except the vCenter server domain or sub domains.

23. Once the Proxy is configured, in Avamar Administrator, click the Backup & Restore launcher button. The Backup and Restore window appears. Click the Select for Backup tab and select a virtual machine client in the client’s tree.

24. In the Browse for File, Folders, or Directories pane, do one of the following:
   * Select the top (root) folder to back up the entire image.
   * Select one or more disks to only back up those specific virtual disks.

25. Click Backup Now to run the backup after reviewing your backup settings; i.e. Retention, encryption, and so forth.

**Hyper-V Integration**

Microsoft Hyper-V is a hypervisor-based server virtualization product for Microsoft Windows Server 2008 and Microsoft Windows Server 2008 R2 that enables you to create multiple virtual machines (VMs) on a single physical server to consolidate workloads.

With Hyper-V, the server is separated into individual partitions that are supported by the hypervisor. The parent partition performs all VM and hardware management. From the parent partition, you create a child partition for each VM (virtual machine). Possible configurations for Avamar Integration with Hyper-V: Hyper-V in a cluster, Granular Level Recovery, using Avamar with Data Domain as target storage device.

You can perform both application and crash consistent image-level backups with the Avamar Plug-in for Hyper-V VSS:

1. With an application consistent backup, the VM must be online and be VSS capable.
   Microsoft Integration Components (IC) must be installed. VSS runs in-guest and freezes the OS and all applications state.

2. With a crash consistent backup, the VM is offline or does not have the IC installed. In this case, the VM is paused before shadow copy creation and resumed after the shadow is created.
Possible backup workflows include:
Image-level VSS backup, Image-level saved state backup (or offline), Avamar federated architecture for Hyper-V failover clusters, Image-level backup in Hyper-V federated backups.

**Steps for Hyper-V Integration with Avamar on Windows servers**
In this section we will see how to configure Hyper-V backups on Windows Servers

1. Log in to the Windows server host as administrator and download the Avamar client software for Windows. Install the software and register it to the Avamar Grid.

2. Install the Avamar Plug-in for Hyper-V VSS. To install the Avamar Plug-in for Hyper-V VSS on a stand-alone Hyper-V Server, download AvamarHypervVSS-windows-x86_64-6.1.100.x.msi and install it on Hyper-V Management OS.

3. You can select to install Avamar Hyper-V VSS Plug-in GLR option while installing the above plug-in.

4. To perform image level backup, go to Avamar Administrator, click the Backup & Restore launcher button and select the Hyper-V client that needs to be backed up.

5. Select the Windows Hyper-V VSS plug-in type and Browse for client machine.

6. Select Backup now and select Retention. Encryption settings are per your environment.

7. Go to more options and select if you want to enable multi-streaming. Define number of streams, if required.

8. For Group by, select the method by which Avamar groups data for multi-streaming:
   - Select Virtual machine to create one backup stream per virtual machine.
   - Select Volume to create one backup stream per clustered shared volume.
   Choose whether to exclude offline virtual machines by selecting or clearing the Virtual Machine Options checkbox.

9. In Advanced options, enable debugging if required and initiate a backup.

10. We are now set to take On-Demand Backups from client or scheduled backups which can be done by creating dataset for Hyper-V backups.

**Homebase Integration**
Sometimes it is faster to redeploy a system rather than to restore it. When it is necessary to perform restore, a nice feature to have is integrated bare metal recovery. A feature of Avamar that some people may not be aware of is the integration of Homebase into Avamar providing
single step recovery of Windows systems. Avamar client 5.0.105-169 includes the Homebase 6.4 agent.

The Backup System Profile option is used when EMC's Homebase product is integrated with Avamar for bare metal recovery. If you don't have Homebase, you do not need to enable this. If you do enable it when you back up a 2003 server, the job will complete with exceptions since the Homebase agent is not installed.

Avamar 5.0 comes with Homebase client pre-installed. When we check the option "Backup System Profile", it creates the file HBE_Profile.zip in the c:\program files\avs\var directory which can be used later for performing Bare Metal Recovery.

With Avamar 5.0 you can perform "Bare Metal Recovery" but it's not one touch recovery; it's manual recovery. You need to install OS on new hardware, patch it to same Service Pack Level, install Avamar Client and then perform recovery. Click the corresponding AvamarWindowsServerRecoveryOptionHBEwindowsx86_<version>.msi install package. Your browser will prompt you to either open the file “in-place” (on the server) or save it to your local computer. Either method will work. However, if you save the file to your local computer, you must open (double-click) that installation file to continue with this procedure.

To perform disaster recovery, you need to have already installed the Windows client and the Avamar Server Recovery Option beforehand and run successful backups with them. The Avamar Windows Server Recovery Option integrates EMC Homebase Embedded (HBE) technology with Avamar to provide:

- Full system backup and recovery, including system state
- Ability to recover to different hardware
- Ability to recover physical to virtual, virtual to physical


Lotus-Notes Integration

The Avamar Plug-in for Lotus Domino is software that backs up and restores Domino server data from the Avamar server. The Avamar Plug-in for Lotus Domino supports the Domino server in both stand-alone and clustered configurations. IBM Lotus Domino supports the use of DB2 databases as a data repository for Domino databases. This configuration, however, is not supported by the Avamar Plug-in for Lotus Domino.
Steps for Lotus Notes Integration with Avamar on Red Hat Enterprise Linux (RHEL)

1. Log in to the RHEL server host as root and download RHEL and Lotus notes installation package.

2. Install and register RHEL client package to Avamar server. Once done, install and configure Notes as given below:
   
   ```
   rpm -ivh AvamarLotus-linux-rhel4-x86-version.rpm
   ```
   
   where version is the version of the Avamar plug-in software

3. You can run an on-demand backup while the Domino server is running or stopped.
   
   *Note: Do not back up an online database during a database compaction. A hot backup of a database can fail during a database compaction.*

4. In Avamar Administrator, click the Backup & Restore launcher button and select the Dominos server that needs to be backed up.

5. Select the Domino Lotus plug-in type and Browse for Files, Folders, or Directories pane. Make sure to include notes.ini file as in the event of catastrophic data loss, the notes.ini file is required for a disaster recovery.

6. Select Backup Now and select desired retention and encryption methods. Now click more options to select Backup Label, Backup Type (Full, Incremental, or subset), Full path of the Domino server's notes.ini file (on AIX and Linux, the default directory is /local/notesdata/), Full path of the Domino directory, type the full path of the Domino directory, in the Domino user name field, type the Domino user name (this user name is the OS user, who has permissions to start and stop the Domino server on the IBM AIX and Linux operating systems), Select or clear Transaction Logs.

7. Click OK to close the on-demand Backup Options and backup is initiated. This enables taking on-demand Backups from client or scheduled backups which can be done by creating dataset for Notes backups.

SAP Integration

The Avamar Plug-in for SAP with Oracle (SAP plug-in) is software that works with the Avamar server and client software to provide deduplication backup and recovery for SAP Oracle data by using an Avamar server or Data Domain system as a backup storage device.
The SAP plug-in uses the BR*Tools backint interface to back up and restore the Oracle data.

**SAP with Oracle configuration steps for Linux with Avamar**

To install the SAP plug-in on a Linux system:

1. Log in to the SAP server host as root.

2. Download the rpm package from Avamar grid.

3. To install, type the following command on a single command line:
   ```
   rpm -hi AvamarSAP-linux-package_version.rpm
   ```
   where AvamarSAP-linux-package_version.rpm is the file name of the SAP plug-in installation package that was downloaded.

4. Edit `initDBSID.sap` which is located in `$ORACLE_HOME/dbs` and set `util_path=path`
   where path is the full path of the directory that contains the backint program.

5. Copy the backint program from the SAP plug-in installation directory to the directory that contains the SAP BR*Tools.

6. Create a symbolic link in the BR*Tools installation directory to the backint location in the Avamar directory.
   For example
   ```
   # ln -s /usr/local/avamar/bin/backint
   /usr/sap/SAPSID/SYS/exe/run/backint
   ```
   where SAPSID is the Oracle system ID of the database.

7. To use the SAP plug-in as a default program for backup, restore, and verification operations, set parameter `backup_dev_type = util_file` in initDBSID.sap

8. In Avamar Administrator, click the Backup & Restore launcher button.

9. In the clients tree in the left pane, select the SAP plug-in client to be backed up.

10. On the Select for Backup tab, select the SAP plug-in.

11. Complete the settings in the Browse Command Line Options dialog box the clock OK.

12. On the Select for Backup tab, select the checkboxes next to the items to be backed up.
13. In the Actions menu, select Backup Now and complete the settings in the On Demand Backup Options dialog box.

14. Click More Options and complete the settings in the Backup Command Line Options dialog box.

15. Click OK to close the Backup Command Line Options dialog box.

16. Click OK to close the On Demand Backup Options dialog box. The backups begins. Backups can also be scheduled by creating dataset and excluding database files and logs from file system backups dataset.

**Avamar Data Transport (ADT)**

Avamar Data Transport is a solution that transports backup data in deduplicated format from a production or disaster recovery Avamar server to tape. Since the data sent is already deduplicated, up to 75% reduction in tape costs for preserving daily backups can be achieved as compared to traditional solutions. It also offers compliance with regulatory and corporate data retention requirements.

**Avamar Data Transport Implementation**

An ADT (Avamar Data Transport) environment has three parts;

One Avamar server, the ADT server, and a tape backup server with an attached tape drive.

**Avamar Server**

One Avamar server, versions 4.1 and above is supported for ADT Implementation. This may be either a physical or virtual Avamar server.

**ADT server**

The ADT server itself consists of multiple virtual machines hosted on one or more ESX servers. Of these virtual machines, one is designated as a control node (Linux-based virtual machine that controls the operation of ADT hosts the ADT Framework and Application and PostgreSQL database that stores metadata of files that have been transported) and between one and ten virtual machines are transport nodes (specialized version of Avamar Virtual Edition (AVE) 5.0.3 with either 1 or 2 TB licensable capacities). Each transport node also contains Transport Node Services software for communication with other ADT components. Also, either a NetWorker or NetBackup client is installed on each transport node to enable data to be backed up from the node to tape.
Tape Backup Server
Data is transported to tape using the customer’s tape backup server. EMC NetWorker and Symantec NetBackup are currently supported as tape backup servers.

ADT installation process includes 5 phases
1. Install control node
   * Import a Virtual Machine from adt-1.0.2.ovf file found on the ADT software ISO image.
   * Create two additional virtual drives:
     * For ESX 3.5, create two 250 GB drives
     * For ESX 4.0, create 1 TB and 500 GB drives
   * Configure basis networking using netconfig
   * Permit root login and set the time zone
   * Convert to a control node using script adt-emf.sh
   * Format the two extra drives
   * Check the network connectivity
   * Synchronize control node with NTP (Network Time Protocol)
   * Copy setup file from ADT software ISO image
   * Install framework with ADTFramework-linux-x64-setup.bin
* Similarly, copy setup file for database from ISO image and install PostgreSQL database
* During the installation setup password for Linux user and database user both called `postgres`.
* Create database tables for ADT using script `create_catalog.sh`
* Install public key using script `install_public_key.sh`
* Install the security logger by copying software from ISO image
* Connect to control node with web browser then create lockbox password and suser account info
* Log in as suser and click install for ADT Framework under Administration and Springboards
* Select ADT.zip file within ISO image
* Once the installation is complete the interface should be available

2. **Install ADT service on Avamar server**
* The Avamar, ADT, and tape servers should all be synchronized using the same NTP
* Check the network connectivity to ADT control node and tape servers
* Copy install file `TransportSystemService-linux-x54-setup.bin` from ISO and execute
* Specify the password for MCUser it has been changed from default

3. **Install transport nodes**
* Installing transport nodes is the same as installation of a regular AVE, except the OVF file is used
* Import Virtual Machine from `adt-1.0.2.ovf`
* Partition disks with `ave-part.sh`
* Configure networking with `netconfig` and `dpnnetutil`
* Perform Benchmark testing
* Installation is completed by editing `install.conf`, running `avqinstall` and updating the message of the day (MOTD)
* Update the client catalog to the highest level of any Avamar client in the environment
* Covert into transport node by running script `adt-ave.sh`
* License the transport node
* Install NetWorker or Netbackup client
* Repeat these steps for additional transport nodes

4. **Configure tape server groups (NetWorker) or Policies (Netbackup)**
* Check network connectivity to the Avamar server, control node, and each transport node
* If using NetWorker:
  * Create backup group and client for each transport node
* Select full option for backups and deselect Force incremental
* Set the Save set to /data01,/data02,/data03, etc.

* If using Netbackup:
  * Create a policy and client for each transport node
  * Set backup type to Full
  * Set backup selection to /data01,/data02,/data03, etc.

5. Install transport node services

* Network connectivity from each transport node to the Avamar server, control node, and tape server must be confirmed
* Copy the file `TransportNodeService-linux-x64-setup.bin` from ISO and execute
* When asked for a backup server, specify hostname of the tape server
* When asked for the Archive Catalog Host, specify hostname where the PostgreSQL database was installed
* The installation of the transport node services must be repeated on each transport node.

The installation of ADT can be verified quickly by logging into the ADT Framework and verifying that the Avamar server and that all transport nodes are visible.

Running On demand transport

- Open Avamar Data Transport GUI by typing control node name on web browser using https protocol
- Click on transport settings on quick launch springboard
- Since transports are performed by creating transport group, click on Avamar server from which you want to transport then click Add to create a transport group
- Once the transport group is created, select the group and click on Run immediately to run an on demand transport
- A transport group can be scheduled to run at a regular interval. This is configured under the Transport schedule tab. Retention can also be set for how long it should be kept on tape.

Note: Each transport node should be licensed and individual clients cannot be selected for transport with ADT 1.0. ADT 1.0 SP2 has been qualified with up to 10 transport nodes per control node.
**Avamar Extended Retention (AER)**

Avamar Extended Retention is a solution that exports backup data from an Avamar server to a tape library, either physical or virtual, for long term retention purposes. Although it is possible to store data on an Avamar server for long periods of time, the capacity can be limited and can become costly. Moving data to tape makes it easier to keep backups for multiple years. Backups can be restored from tape back to the client, if necessary.

![Figure 7: Avamar environment with Extended Retention feature](image)

The core software for Avamar Extended Retention is hosted on the Media Access node. During an export, backup data is rehydrated or reassembled from its deduplicated form, and streamed onto tape. Data is not staged on the Media Access node.

**Avamar Extended Retention implementation process steps**

1. Initial configuration of Media Access node
   * Media Access node is shipped with SUSE Linux Operation System already installed.
   * Boot up the node and use yast to configure basic networking.
   * Download both Avamar 6.1 SUSE avp file and Extended Retention software from Avamar ftp site.
   * Install the Avamar bootstrap software which provides the Avamar AVI Installer program.
   * Create the probe.xml file, update the node’s ssh keys, change the node type, and update the usersettings.cfg file.
* Install the internal instance of Avamar on the node and be sure to select the Enable Avamar external retention option.

2. **Extended Retention Installation on Media Access node**
   * Extract the Avamar Extended Retention tarball file which contains the AER cleanse script, AER Installer, the AER client software, and the security logger installer.
   * Run the AER cleanse script which reinitializes the Avamar server to a clean state.
   * Run the Extended Retention Installer which installs both the Extended Retention Application and the embedded NetWorker instance.
   * Install the Extended Retention client from the rpm file.
   * Run `avmultiregister.pl` script to register the client with the internal Avamar on the Media Access node itself and also with external Avamar server.

3. **Install Transport System Service on external Avamar server**
   * Log in to the external Avamar server.
   * Install the Transport System Service by running the executable.

4. **Install Security logger**
   * Install the Security Event Logger on the media access node.
   * License the internal Avamar instance on the media access node.

5. **System readiness test**
   * Log on to AER using address `https://media_access_node_ip:7443/imf.action` where `media_access_node_ip` is IP the address of the media access node.
   * Set lockbox password and suser password when prompted.

6. **Configure the tape library**
   * Open the Avamar Extended Retention workspace under the workspaces menu.
   * Click the Manage Export Media button, and then Configure to detect the tape library if not detected automatically during installation.
   * In the Manage Export Media window, click the Label Media button.
   * Select the volumes that will be used for storing exported backup data and label them.
   * Select one volume for use as a bootstrap tape.

7. **Creating and scheduling an export policy**
   * Log on to AER using address `https://media_access_node_ip:7443/imf.action` where `media_access_node_ip` is IP the address of the media access node.
   * Open the Avamar Extended Retention under workspaces.
* Click Configure Export Policies button in the Scheduled Exports springboard.
* Click Create New Export Policy on the Export Policy Management window which opens new dialog box.
* Leave the Active checkbox enabled. Next, set a retention value for the exports.
* Define the frequency of the export.
* Define which Avamar clients will have their backups exported to tape.
* Specify what types of backups from those clients are exported. You can select backups that have certain retention tags and backups generated by a certain plug-in.
* Now, export policy is created and exports are scheduled.

8. Running an On-Demand Exports
* From the Export Policy Management window, select a policy, and then click Perform On-Demand Export

9. Importing backups from tape
* Select Browse Exported Backups from the Import and Restore springboard
* On the Backup Browse/Import window, select the client that originally owned the desired data, and select the desired backup. Then, click Import from Tape.
* You will be asked if you want to reset the Avamar server before starting the import. If there have been a large number of previous imports from tape, then the internal Avamar server may be full. In this case, the internal Avamar server must be reset.
* The import process moves data from tape onto the Media Access node. When the import completes, the backup is made available to the internal Avamar instance on the Media Access

10. Restore imported data to client
* Register the Avamar client with the Media access node.
* Use Avamar Administrator to log into the Media Access node.
* Restore the desired files to the client using regular Avamar restore procedures.
* Finally, re-activate the client to the original server so that it can perform its regular backups.

Note: Internal Avamar instance on media access node must be licensed
Section III: Avamar Administration & Monitoring Enhancements

Email alerts
Avamar employs a number of methods to provide notifications when events occur including pop-up alerts, the acknowledgement required list, email messages, syslogfiles, and SNMP traps.

Email Home is offered as part of the server maintenance plan when fully configured and enabled it automatically emails the warnings and errors information to EMC to twice a day.

ConnectEMC is a standardized application that automatically transfers event data and product information—such as the serial number of active utility and data nodes—from customer sites to EMC Technical Support. Beginning with Avamar 5.0, ConnectEMC is enabled and configured during installation of the Avamar server.

External Authentication
Avamar can be configured to leverage an external repository such as Microsoft Active Directory in addition to its own internal authentication system such as Windows Active Directory, Network Information Server (NIS), and Open LDAP (Lightweight Directory Access Protocol). User names and roles must be added and assigned to Avamar server. Passwords for a particular user are maintained and authenticated by the external authentication system when configured to use external authentication.

Desktop Laptop (DTLT) Support
Desktop/Laptop provides an easy to use graphical user interface to be installed on a desktop or laptop in use by an end user. This allows the end user to perform on-demand backups and restores without help desk intervention. Desktop/Laptop is included as an option in the Avamar client installer. It is available for Windows XP, Windows Vista, and Mac. It is also supported on qualifying Linux computers. End users can initiate an on-demand backup through the Desktop/Laptop interface. This will back up data using the dataset and retention policies set by the Avamar administrator for the client. It uses LDAP or Active Directory Authentication to ensure that the user is authorized to access their data for restores.

Enterprise Manager
The Avamar Enterprise Manager provides centralized access to the Avamar Administrator for each Avamar system in an enterprise, as well as dashboard, reporting, and search capabilities. With Enterprise Manager, backup administrators can monitor and manage all Avamar servers in a distributed environment.
Client Manager
Client Manager is a graphical interface used to activate, manage, and analyze backup clients. It is especially useful when dealing with a large number of clients.

Integration with Data Protection Advisor
EMC Data Protection Advisor (DPA) is EMC’s powerful data protection management software that automates monitoring, analysis, alerting, and reporting across backup, replication, virtual environments.

DPA added to Avamar environment provides centralized monitoring across multiple Avamar grids and domains, and provides long-term trending to improve planning and provisioning. DPA also monitors capacity, CPU, memory, performance, and many other environmental and system characteristics. It also provides insight into bottlenecks and Avamar deduplication rates.

DPA chargeback reports provide the ability to perform a financial cost analysis for backups and restore that have taken place in an environment. The Deduplication Cost Savings report shows the cost savings of an Avamar installation for each machine being backed up.

Section IV: Avamar Virtual Addition
Avamar is a very good Remote Office backup solution but, on occasion it does not meet customer requirement for Remote Office Backups. It can certainly backup servers in Remote Office over WAN to the data centre. First full backup (i.e. initial seeding of data) to the data centre grid will take a lot of time but with source level and global deduplication in place, daily backups (Virtual Full) will complete in much less time over the WAN (Wide Area Network).

However, the biggest disadvantage with this approach is Restore Capability. If it’s needed to restore the entire remote office or a complete server residing at the Remote office, it might take days to weeks to complete the restore, in turn affecting the Recovery Point Objective (RPO).

To meet the RPO, it is often suggested to have a Grid (a single node in the case of a small remote office) installed locally which is then replicated to the data centre to meet the offsiteing requirements. This solution invokes extra cost of deployment and maintenance of the Grid at the remote office.

If you are facing this challenge, Avamar Virtual Edition (AVE) is the right choice for you. Instead of deploying a Grid locally at the remote office, consider AVE which is very useful for backing up small remote offices.
What is AVE?
Avamar Virtual Edition (AVE) allows the Avamar solution to be standardized on VMware infrastructure. It is ideal for small, remote offices or small data centres, by lowering the total cost of ownership through sharing the server and storage infrastructure and reducing the cost of hardware support and maintenance.

AVE Specifications
AVE is a single-node non-RAIN Avamar server running as a virtual machine on a VMware ESX Server. The licensed capacity sizes include: 0.5 TB, 1.0 TB, and 2.0 TB. Each of these capacity versions has a set of requirements for memory, I/O, and storage. The choice of AVE version to be deployed depends on the type of data in the environment to be backed up and the expected daily change rate.

AVE Installation
The VMware ESX Server is supplied by the customer. Installation of AVE on a virtual machine is performed by EMC-trained personnel. The AVE benchmark test must be run to ensure that server hardware and the virtual environment meet expected I/O performance benchmarks. Also, the benchmark test helps to determine the impact of AVE on other virtual machines running on the same physical server. AVE runs on Red Hat Enterprise Linux in contrast to the physical Avamar server.

Conclusion
Per Gartner’s report:
It is believed that by 2014, 80% of the market will choose advanced, disk-based appliances and backup software-only solutions over distributed VTLs. It now believes that one-third of organizations will change backup vendors due to frustration over cost, complexity, and/or capability, and will do so by 2016, not 2014.

It also now believes that by 2015, at least 25% of large enterprises will have given up on conventional backup/recovery software and will use snapshot and replication techniques instead. Additionally, by the end of 2016, at least 45% of large enterprises—up from 22% at year-end 2011—will have eliminated tape for operational recovery.
EMC Avamar meets all requirements of being a market leader in the backup and recovery domain in the coming years. This article has discussed many advanced features which can be applied to ease Data Protection issues.
Appendix

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www.storagewiki.com
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http://itknowledgeexchange.techtarget.com

Avamar documentation
EMC Avamar Administration student guide
EMC Avamar 6.1 Administration guide
Avamar Extended Retention Student guide
Avamar Data Transport Student guide
Biography

Arunkumar Velumani holds a Diploma and BTech in Computer Science, starting his career with Computer Sciences Corporation. He has worked on numerous products; EMC Symmetrix, VNX, Avamar, NetWorker, Data Domain, CX, CDL, and DPA, Symantec Netbackup and Enterprise Vault, Simpana CommVault, Dell Netvault, HP Data Protector, Falconstor VTL and SIR.

His industry certifications include:

- EMC Information Storage Associate
- EMC Backup and Recovery Associate
- EMC Storage Administrator – SAN Specialist
- EMC Storage Administrator Backup Recovery – Avamar Specialist
- EMC Storage Administrator Backup Recovery – NetWorker Specialist
- EMC Implementation Engineer - SAN Specialist
- EMC Implementation Engineer - Data Domain Specialist
- EMC Technology Architect – Backup Recovery Specialist
- Symantec Netbackup 7.0 for Unix Administration
- Data Protection Administrator for UNIX using Netbackup 6.5
- ITIL v3 Foundation Certified
- Oracle Solaris 10 System Administrator Certified Professional - Part I
- CommVault Certified System Administrator

Anay Pathak completed his Engineering (B.Tech) and started his career as System Engineer with Hewlett Packard. Later, he joined CSC in June 2008 and since then he has taken over multiple roles within CSC. Currently, he is working as Lead SME for Backup and Recovery Domain. His Skill set includes: EMC Avamar, EMC Data Domain, Symantec Netbackup, Simpana CommVault, EMC NetWorker, EMC DPA, and HP Data Protector and Falcon Store Appliances

His industry certifications include:

- EMC Information Storage Associate (EMC)
- EMC Backup and Recovery Associate
- ITIL V3 Service Management Foundation Certification (EXIN)
- Data Protection Administrator for Unix using Netbackup 6.5.(Symantec)
• Foundations of IBM Cloud Computing Architecture (IBM)
• IBM Certified Sales Specialist (Storage Sales V2) (IBM)
• **EMC Implementation Engineer - Data Domain Specialist**
• **EMC Storage Administrator Backup Recovery – Avamar Specialist**

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