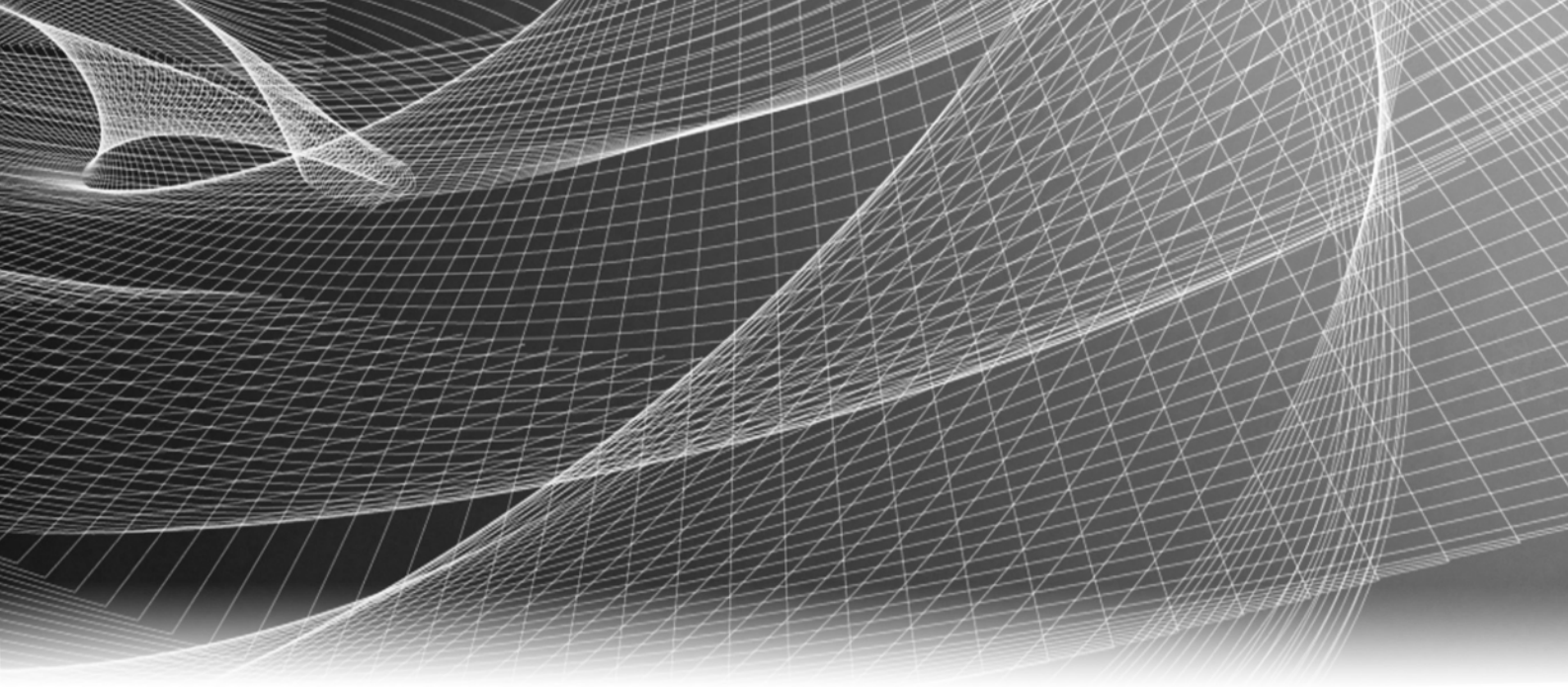

EMC® Avamar® 7.0

Product Security Guide

P/N 300-015-223
REV 03

EMC²

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TABLES

PREFACE

As part of an effort to improve its product lines, EMC periodically releases revisions of its software and hardware. Therefore, some functions described in this document might not be supported by all versions of the software or hardware currently in use. The product release notes provide the most up-to-date information on product features.

Contact your EMC Customer Support professional if a product does not function properly or does not function as described in this document.

Note: This document was accurate at publication time. Go to EMC Online Support (https://support.emc.com) to ensure that you are using the latest version of this document.

Purpose

This publication discusses various aspects of EMC Avamar product security.

Audience

This publication is primarily intended for EMC Field Engineers, contracted representatives, and business partners who are responsible for configuring, troubleshooting, and upgrading Avamar systems at customer sites, as well as system administrators or application integrators who are responsible for installing software, maintaining servers and clients on a network, and ensuring network security.

Revision history

The following table presents the revision history of this document.

Table 1 Revision history

Revision	Date	Description
03	September 16, 2013	Revised "Installation of level-2 security hardening features" on page 117 to correct minor errata.
02	August 31, 2013	Changed Appendix A, "Port and Network Requirements," to add port 7443 and port 61617 to the utility node's outgoing network port list.
01	July 10, 2013	Initial release of Avamar 7.0.

Related documentation

The following EMC publications provide additional information:

- *EMC Avamar Release Notes*
- *EMC Avamar Administration Guide*
- *EMC Avamar Operational Best Practices*

Conventions used in this document

EMC uses the following conventions for special notices:

NOTICE

NOTICE is used to address practices not related to personal injury.

Note: A note presents information that is important, but not hazard-related.

IMPORTANT

An important notice contains information essential to software or hardware operation.

Typographical conventions

EMC uses the following type style conventions in this document:

Bold	Use for names of interface elements, such as names of windows, dialog boxes, buttons, fields, tab names, key names, and menu paths (what the user specifically selects or clicks)
Italic	Use for full titles of publications referenced in text
`Monospace`	Use for: • System output, such as an error message or script • System code • Pathnames, file names, prompts, and syntax • Commands and options
`Monospace italic`	Use for variables.
`Monospace bold`	Use for user input.
[ ]	Square brackets enclose optional values
|	Vertical bar indicates alternate selections — the bar means “or”
{ }	Braces enclose content that the user must specify, such as x or y or z
...	Ellipses indicate nonessential information omitted from the example

Where to get help

The Avamar support page provides access to licensing information, product documentation, advisories, and downloads, as well as how-to and troubleshooting information. This information may enable you to resolve a product issue before you contact EMC Customer Support.

To access the Avamar support page:

1. Go to https://support.EMC.com/products.
2. Type a product name in the **Find a Product** box.
3. Select the product from the list that appears.
4. Click the arrow next to the **Find a Product** box.
5. (Optional) Add the product to the **My Products** list by clicking **Add to my products** in the top right corner of the **Support by Product** page.

Documentation

The Avamar product documentation provides a comprehensive set of feature overview, operational task, and technical reference information. Review the following documents in addition to product administration and user guides:

- Release notes provide an overview of new features and known limitations for a release.
- Technical notes provide technical details about specific product features, including step-by-step tasks, where necessary.
- White papers provide an in-depth technical perspective of a product or products as applied to critical business issues or requirements.

Knowledgebase

The EMC Knowledgebase contains applicable solutions that you can search for either by solution number (for example, esgxxxxxx) or by keyword.

To search the EMC Knowledgebase:

1. Click the **Search** link at the top of the page.
2. Type either the solution number or keywords in the search box.
3. (Optional) Limit the search to specific products by typing a product name in the **Scope by product** box and then selecting the product from the list that appears.
4. Select **Knowledgebase** from the **Scope by resource** list.
5. (Optional) Specify advanced options by clicking **Advanced options** and specifying values in the available fields.
6. Click the search button.

Online communities

Visit EMC Community Network (https://community.EMC.com) for peer contacts, conversations, and content on product support and solutions. Interactively engage online with customers, partners, and certified professionals for all EMC products.

Live chat

To engage EMC Customer Support by using live interactive chat, click Join Live Chat on the Service Center panel of the Avamar support page.

Service Requests

For in-depth help from EMC Customer Support, submit a service request by clicking Create Service Requests on the Service Center panel of the Avamar support page.

Note: To open a service request, you must have a valid support agreement. Contact your EMC sales representative for details about obtaining a valid support agreement or with questions about your account.

To review an open service request, click the Service Center link on the Service Center panel, and then click View and manage service requests.

Facilitating support

EMC recommends that you enable ConnectEMC and Email Home on all Avamar systems:

- ConnectEMC automatically generates service requests for high priority events.
- Email Home emails configuration, capacity, and general system information to EMC Customer Support.

Your comments

Your suggestions help us to continue to improve the accuracy, organization, and overall quality of the user publications. Send your opinions of this document to:

BSGDocumentation@emc.com

Please include the following information:

- Product name and version
- Document name, part number, and revision (for example, 01)
- Page numbers
- Other details that will help us address the documentation issue

CHAPTER 1
Introduction

The following topics introduce and describe Avamar security:

Overview

EMC® Avamar® is backup and recovery software with integrated data deduplication technology. This Product Security Guide provides an overview of the settings and security provisions that are available in Avamar to ensure secure operation of the product. Security settings are split into the following categories:

- "User Authentication and Authorization" on page 17 provides an overview of Avamar user accounts and the authentication and authorization mechanisms available for those accounts.
- "Client/Server Access and Authentication" on page 33 describes settings available to limit access by client components.
- "Data Security and Integrity" on page 81 describes settings available to ensure protection of the data that Avamar manages.
- "System Monitoring, Auditing, and Logging" on page 91 provides an overview of the features available to monitor events in the Avamar environment and to audit the operations performed. It also provides a list of log files that are available for each feature on each component in the system.
- "Server Security Hardening" on page 101 describes changes you can make to increase the security of the Avamar system.
- "Port and Network Requirements" on page 137 lists the ports and protocols that Avamar uses for client/server communication for all applicable firewalls.

Security patches

Each Avamar release is available with a set of up-to-date security patches.

Periodic security updates for multiple components

EMC periodically provides a security update for components of the Avamar system's host operating system. These periodic updates combine patches and updates released by the operating system's company (Red Hat or SuSE) since the previous Avamar periodic security update, and include relevant kernel-level and OS-level security patches and changes.

The periodic updates are cumulative. Install each periodic update issued for your Avamar system in order of release, starting with the first periodic update issued after the release of your Avamar system software.

EMC announces each periodic update through an EMC Security Advisory (ESA). The ESA provides details about the contents of the periodic update and installation instructions. Open the following location in a web browser to view these advisories and to register for email notifications:

https://support.emc.com/products/759_Avamar-Server

EMC provides the periodic updates as Avamar update packages that can normally be installed through Avamar Enterprise Manager.

Separately installed updates

If you separately install other security patches or security applications that are found to be incompatible with Avamar:

1. Remove the separately installed patches or applications.
2. Restore the Avamar system to its previous working configuration
3. File a support case with EMC support that includes a specific description of the separately installed patches or applications.

NOTICE

It is the responsibility of the customer to ensure that the Avamar system is configured to protect against unauthorized access. Back up all important files before you apply new security patches, applications, or updates.

Email home notification using ConnectEMC

When configured and enabled, the “email home” feature automatically emails configuration, capacity, and general system information to EMC Customer Support using ConnectEMC. Summary emails are sent once daily; critical alerts are sent in near-real time on an as needed basis.

The *EMC Avamar Administration Guide* provides details on how to enable the email home feature.

Remote access

If EMC Customer Support must connect to a customer system to perform analysis or maintenance, the customer can initiate a web conference using a web-based conferencing application such as WebEx.

Additionally, beginning with version 6.0, customers can install an EMC Secure Remote Support (ESRS) gateway to allow EMC Customer Support to access their systems without WebEx.

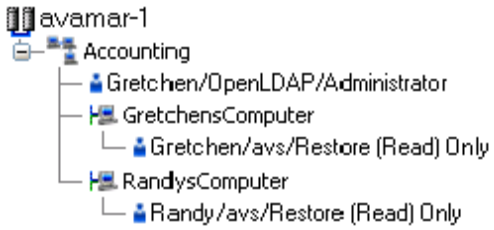
CHAPTER 2
User Authentication and Authorization

The following topics provide an overview of Avamar user accounts and the authentication and authorization mechanisms available for those accounts:

Domain and client users

In the Avamar system, user accounts can be added to Avamar domains or individual Avamar clients. The privileges of Avamar domain users extend to the Avamar domain to which they belong and any Avamar domains beneath it. Individual Avamar client users perform backups and restores of the Avamar client to which they belong and access backups in the system that belong to that Avamar client.

In Avamar, user accounts are not reusable objects; they are simply entries in a domain or client access list. When you add a new user account to the Avamar system, you actually add a new entry to the Avamar domain or Avamar client user access list. Consider the following example:



User “Gretchen” has been added to both the Accounting domain and her computer. However, the authentication system (OpenLDAP in the Accounting domain and avs on the computer) and role (Administrator in the Accounting domain and Restore [Read] Only on the computer) are different. These are in fact two completely separate user accounts that happen to have the same username.

Avamar user accounts comprise the following pieces of information:

- Username
- Authentication system
- Role

Username

The username for an Avamar domain user account or an Avamar client user account must be in the format that the selected authentication system accepts. For example, the internal Avamar authentication system uses case-sensitive usernames, whereas Windows Active Directory usernames are case-insensitive.

Note: Usernames cannot be longer than 31 characters.

Authentication system

An authentication system is a username/password system that is used to grant domain and client users access to the Avamar server. Avamar supports its own internal authentication system (“Avamar authentication” or “avs”), as well as directory service authentication. Directory service authentication uses an existing LDAP v.3 directory service or an existing Network Information Service (NIS) to provide authentication.

The *EMC Avamar Administration Guide* describes Avamar authentication and directory service authentication. Appendix B, "Enterprise Authentication" describes a deprecated authentication method, Enterprise authentication, for backwards compatibility with previous versions of Avamar.

Roles

Roles define various allowable operations for each user account. There are three basic categories of roles:

- Administrator roles
- Operator roles
- User roles

Administrator roles

Administrators are generally responsible for maintaining the system.

The role of administrator can only be assigned to Avamar user accounts at an Avamar domain level; this role cannot be assigned to Avamar user accounts at a client level. The role of administrator can be assigned to Avamar user accounts at the top-level (root) Avamar domain, or any domain beneath.

Root administrators

Administrators at the top-level (root) Avamar domain have full control of the system. They are sometimes referred to as "root administrators."

Domain administrators

Administrators at lower level Avamar domains (other than root) generally have access to most features, but typically can only view or operate on objects (backups, policy objects, and so forth) within that domain. Any activity that might allow an Avamar domain administrator to view data outside that domain is disallowed. Therefore, access to server features of a global nature (for example, suspending or resuming scheduled operations, changing run times for maintenance activities, and so forth) is disallowed.

Furthermore, Avamar domain administrators:

- Cannot add or edit other domain administrators
- Cannot change their assigned role
- Can change their password

Operator roles

Operator roles are generally implemented to allow limited access to certain areas of the Avamar system to perform backups and restores, or obtain status and run reports. These roles allow greater freedom in assigning backup, restore, and reporting tasks to persons other than administrators.

As with administrator roles, operator roles can only be assigned to Avamar user accounts at the Avamar domain level; these roles cannot be assigned to user accounts at the Avamar client level. Furthermore, to add the user account to subdomains, you must have administrator privileges on the parent domain or above.

There are four operator roles:

- Restore only operator
- Backup only operator
- Backup/restore operator
- Activity operator

Users who have been assigned an operator role do not have access to the entire Avamar Administrator application. Instead, following login, they are presented with a single window that provides easy access to the features that they are allowed to use.

Restore only operator

Restore only operators are generally only allowed to perform restores and to monitor those activities to determine when they complete and if they complete without errors.

As with roles assigned to other Avamar domain user accounts, restore only operators at the top-level (root) Avamar domain can perform restores for any client in the system; restore only operators at lower level domains (other than root) can only perform restores for clients within that domain.

To enforce these constraints, restore only operators do not have access to the full Avamar Administrator application. Instead, following login, restore only operators are presented with a window that provides easy access to the features that they are allowed to use.

Restore only operators can perform the following tasks within the allowable domain:

- Perform a restore
- Monitor activities

Backup only operator

Backup only operators are generally only allowed to perform backups and to monitor those activities to determine when they complete and if they complete without errors.

As with roles assigned to other Avamar domain user accounts, backup only operators at the top-level (root) Avamar domain can perform backups for any client or group in the system; backup only operators at lower level domains (other than root) can only perform backups for clients or groups within that domain.

To enforce these constraints, backup only operators do not have access to the full Avamar Administrator application. Instead, following login, backup only operators are presented with a window that provides easy access to the features that they are allowed to use.

Backup only operators can perform the following tasks within the allowable domain:

- Perform on-demand client backups
- Initiate on-demand group backups
- Monitor activities

Backup/restore operator

Backup/restore operators are generally only allowed to perform backups or restores, and to monitor those activities to determine when they complete and if they complete without errors.

As with roles assigned to other Avamar domain user accounts, backup/restore operators at the top-level (root) Avamar domain can perform backups and restores for any client or group in the system; backup/restore operators at lower level domains (other than root) can only perform backups and restores for clients or groups within that domain.

To enforce these constraints, backup/restore operators do not have access to the full Avamar Administrator application. Instead, following login, backup/restore operators are presented with a window that provides easy access to the features that they are allowed to use.

Backup/restore operators can perform the following tasks within the allowable domain:

- Perform on-demand client backups
- Initiate on-demand group backups
- Monitor activities
- Perform a restore

Activity operator

Activity operators are generally only allowed to monitor backup and restore activities and create certain reports.

Activity operators at the top-level (root) Avamar domain can view or create reports for backup and restore activities within the entire system (all domains and subdomains); activity operators at lower level domains (other than root) can only view or create reports for backup and restore activities within that domain.

To enforce these constraints, activity operators do not have access to the full Avamar Administrator application. Instead, following login, activity operators are presented with a window that provides easy access to the features that they are allowed to use.

Activity operators can perform the following tasks within the allowable domain:

- Monitor activities
- View the group status summary
- View the activity report
- View the replication report

User roles

User roles are always assigned to an Avamar user account for a specific Avamar client. As such, allowable operations are inherently constrained to that specific Avamar client.

Users assigned any of the Avamar user roles cannot log in to Avamar Administrator.

There are four user roles:

- Backup only user

  Users with this role can initiate backups directly from the client using the **avtar** command line.

- Restore (read) only user

  Users with this role can initiate restores directly from the client using the **avtar** command line or Avamar Web Services.

- Backup/Restore user

  Users with this role can initiate backups and restores directly from the client using the **avtar** command line or Avamar Web Services.

- Restore (read) only/ignore file permissions

  This role is similar to the Restore (Read) Only User role except that operating system file permissions are ignored during restores, thereby effectively allowing this user to restore any file stored for that Avamar client.

  This role is only available when you use internal authentication.

  Windows client user accounts should be assigned this role to ensure trouble-free restores, only if both of the following are true:

  - Users are authenticated using Avamar internal authentication.
  - The user will not access the Avamar client web UI.

Managing domain and client users

You can add a new user to an Avamar client or to an Avamar domain, edit user information, or delete a user by using the Account Management tab on the Administration window in Avamar Administrator. The *EMC Avamar Administration Guide* provides details.

Default user accounts

The Avamar system uses the following default user accounts and default passwords.

Table 2 Default user accounts

User account	Default password	Description
Avamar server Linux OS		
root	changeme	Linux OS root account on all Avamar nodes.
admin	changeme	Linux OS account for Avamar administrative user.
dpn	changeme	Linux OS account for Avamar maintenance user.
Avamar server software		
root	8RttoTriz	Avamar server software root user account.
Avamar Administrator		
MCUser	MCUser1	Default Avamar Administrator administrative user account.
backuponly	backuponly1	Account for internal use by the MCS.
restoreonly	restoreonly1	Account for internal use by the MCS.
backuprestore	backuprestore1	Account for internal use by the MCS.
replonly	9RttoTriz	Account for internal use by the MCS for replication.
MCS PostgreSQL database		
admin		No password, logged in on local node only.
viewuser	viewuser1	Administrator server database view account.
EMS PostgreSQL database		
admin		No password, logged in on local node only.
Proxy virtual machine Linux OS		
root	avam@r	Linux OS root account on all proxies deployed using the Avamar proxy appliance. This account is for internal use only.

Default passwords

EMC sets default passwords for the default user accounts when it builds the Avamar software. Default passwords are a security concern.

New install of Avamar server version 7.0 or later

Successful completion of a new install of Avamar server version 7.0 or later requires that you create passwords for the following essential Avamar and OS accounts:

- MCUser
- replonly
- root (Avamar server account)
- admin (Linux OS account)

- dpn (Linux OS account)
- root (Linux OS account)

Upgrade to Avamar server version 7.0 or later

Upgrading to Avamar server version 7.0 or later does not require any password changes. After the upgrade, EMC recommends that you change the password of any of the essential Avamar and OS accounts that uses a default password.

Avamar server version 6.x and earlier

In Avamar server versions 6.x and earlier, it is possible to install the software with default passwords for the essential Avamar and OS accounts. EMC recommends that you change those passwords.

Password encryption

Although Avamar passwords are typically entered as plain text, they are stored on each respective host file system in encrypted form.

All Avamar clients and utilities automatically detect whether a supplied password is plain text or encrypted. Either plain text or encrypted format will work.

The **avtar --encodepassword** command can be used to process a plain text password and output the correct encrypted string to stdout.

Encrypted passwords are host-specific. A password encrypted and stored on one host cannot be copied and used on another host.

Changing passwords for default user accounts

The **change-passwords** utility enables you to change passwords for the following default user accounts:

- The admin, dpn, and root operating system user accounts
- The root and MCUser Avamar server user accounts

The **change-passwords** utility also enables you to create new admin and dpnid OpenSSH keys.

IMPORTANT

After using this utility to change the password for the MCUser account, use dpnctl to restart the Avamar Desktop/Laptop service, dtlt, as described in the *EMC Avamar Administration Guide*. If the dtlt service is not restarted, Avamar client users will encounter session expired messages when they log in to the web UI.

To start the **change-passwords** utility:

1. Open a command shell and log in:
   - (Single-node) Log in to the server as dpn.
   - (Multi-node) Log in to the utility node as dpn.

2. Type:

   change-passwords

   The utility prompts you to change the operating system and Avamar server user accounts, as well as to create new admin and dpnid OpenSSH keys, if desired.

   You can choose to perform one or all of these tasks on all nodes including optional node types, or on utility node and storage nodes only.

   Keep in mind the following points about the utility:

   - If you are administering a multi-node server, you can choose whether to change the passwords on all nodes or only on selected nodes.
   - To change the password for either the MCUser or root Avamar server user accounts, you must specify the current password for the root account.
   - After changing the MCUser password using **change-passwords**, notify owners of hosts external to the Avamar server to update their Avamar Management Console Command Line Interface (MCCLI) configurations, as discussed in "Manually updating MCCLI passwords" on page 25.
   - If there were custom public keys in the authorized_keys2 files for the admin, dpn, or root operating system user accounts, then you may need to re-add the custom keys. The authorized_keys2 files are detailed in "SSH keys for operating system user accounts" on page 27.
   - Remember to resume all schedules by using Avamar Administrator.

Manually updating MCCLI passwords

The **change-passwords** utility changes the internal Avamar server MCUser password for the Avamar Management Console Command Line Interface (MCCLI). However, **change-passwords** will not update any MCCLI configuration files located externally to the utility node. Therefore, any external MCCLI configuration files will need to be manually updated.

IMPORTANT

Use of **change-passwords** to change the internal Avamar server MCUser password disables the MCCLI.

Edit the following files to manually update the MCUser password:

- ~admin/.avamardata/var/mc/cli_data/prefs/mcclimcs.xml
- ~dpn/.avamardata/var/mc/cli_data/prefs/mcclimcs.xml
- ~root/.avamardata/var/mc/cli_data/prefs/mcclimcs.xml

To edit the mcclimcs.xml files for admin, dpn, and root to use the new MCUser password:

1. 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.

2. Open ~admin/.avamardata/var/mc/cli_data/prefs/mcclimcs.xml in a UNIX text editor such as **vi** or **emacs**.
3. Locate the following entries:

```
<MCSConfig>
   <MCS
      mcsprofile="local"
      mcsaddr="AVAMARSERVER"
      mcsport="7778"
      mcsuserid="MCUser"
      mcspasswd="PASSWORD"
   />
   <!-- add more profiles if needed here and set default to select
default -->
</MCSConfig>
```

Note: This example has been simplified for clarity.

4. Change the mcspasswd=”PASSWORD” entry to the new password that you set with the **change-passwords** utility.
5. Save the changes.
6. Switch user to the dpn user account by typing:

```
su - dpn
```

7. When prompted for a password, type the dpn password and press **Enter**.
8. Load the dpn OpenSSH key by typing:

```
ssh-agent bash
ssh-add ~dpn/.ssh/dpnid
```

9. Open ~dpn/.avamardata/var/mc/cli_data/prefs/mcclimcs.xml in a UNIX text editor.
10. Repeat steps 3–5.
11. Switch back to the admin user account by typing:

```
exit
exit
```

12. Switch user to root by typing:

```
su -
```

13. When prompted for a password, type the root password and press **Enter**.
14. Open ~root/.avamardata/var/mc/cli_data/prefs/mcclimcs.xml in a UNIX text editor.

Note: The ~root/.avamardata/var/mc/cli_data/prefs/mcclimcs.xml file might not be present on all servers. If this is the case, skip steps 14–15.

15. Repeat steps 3–5.
16. Switch back to the admin user account by typing:

```
exit
```

Changing the root password on a proxy virtual machine

Change the Linux operating system's root password on a proxy virtual machine. This applies to all proxies deployed using the Avamar proxy appliance.

1. Open a command shell and log in as root.
2. Type:

   passwd

   The following appears in the command shell:

   ```
   Current Password:
   ```

3. Type the current proxy operating system root password and press **Enter**.

   The following appears in the command shell:

   ```
   New Password:
   ```

4. Type the new proxy operating system root password and press **Enter**.

   The following appears in the command shell:

   ```
   Confirm New Password:
   ```

5. Type the same password entered in step 4 and press **Enter**.

SSH keys for operating system user accounts

Access to the admin, dpn and root operating system user accounts is available through SSH login. SSH uses public and private encrypted keys to authenticate users logging in to those accounts. SSH login access can be obtained by supplying operating system account passwords or using either of two pre-authorized private keys, as described in the following table.

Table 3 SSH keys for operating system user accounts

Private key file name	Matching public key file name	Default passphrase	Authorizes access to	Location
admin_key	admin_key.pub	P3t3rPan	Operating system admin account	~admin/.ssh/
dpnid	dpn_key.pub		Operating system admin and root accounts	~admin/.ssh ~dpn/.ssh/

On an Avamar server, use the **change-passwords** utility, discussed in "Changing passwords for default user accounts" on page 24, to coordinate changes to private keys and corresponding authorizations across all nodes.

admin user account

The admin user account SSH v2 key configuration is controlled by the following files and directories in the home directory for admin.

Table 4 SSH key files for the admin user account

File/directory	Description
~admin/.ssh/	Private SSH directory. This directory must be fully protected and owned as follows: drwx------ 2 admin admin
~admin/.ssh/config	SSH configuration file. This file must contain the following entry: StrictHostKeyChecking=no This file must be fully protected and owned as follows: -r-------- 1 admin admin
~admin/.ssh/admin_key	Private RSA OpenSSH key file. This file must be fully protected and owned as follows: -r-------- 1 admin admin The admin user account SSH private and public keys must be named admin_key and admin_key.pub, respectively.
~admin/.ssh/admin_key.pub	Public RSA OpenSSH key file. This file is public and does not need to be protected. -r--r--r-- 1 admin admin
~admin/.ssh/dpnid	Private DSA OpenSSH key file. This file must be fully protected and owned as follows: -r-------- 1 admin admin
~admin/.ssh/id_rsa	Symbolic link to ~admin/.ssh/admin_key.
~admin/.ssh/authorized_keys2	Contains a list of public keys for users allowed to log in to the admin user account. This file must be fully protected and owned as follows: -r-------- 1 admin admin This file must contain public key entries for the admin and dpn user accounts: • The admin public key entry is an RSA key, prefixed with “ssh-rsa” and appended with the comment “dpn_admin_key.” • The dpn public key entry is a DSA key, prefixed with “ssh-dss” and appended with the comment “dpn@dpn41s.”

Any files not listed in the previous table can be ignored.

Use of the admin key requires a passphrase. The only method to change or remove a passphrase is to generate a new private/public key pair and modify the appropriate authorized_keys2 files accordingly. To ensure proper operation of the Avamar server, the admin user must authorize SSH access by way of the dpnid private key. This is accomplished by including the matching public key (dpn_key.pub) in the authorized_keys2 file for the admin user. The dpnid private key must not require a passphrase.

dpn user account

The dpn user account SSH v2 key configuration is controlled by the following files and directories.

Table 5 dpn user account SSH keys

File/directory	Description
~dpn/.ssh/	Private SSH directory. This directory must be fully protected and owned as follows: drwx------ 2 dpn admin - or - drwx------ 2 dpn dpn
~dpn/.ssh/config	SSH configuration file. This file must contain the following entry: StrictHostKeyChecking=no This file must be fully protected and owned as follows: -r-------- 1 dpn admin - or - -r-------- 1 dpn dpn
~dpn/.ssh/dpnid	Private DSA OpenSSH key file. This file must be fully protected and owned as follows: -r-------- 1 dpn admin - or - -r-------- 1 dpn dpn The dpn user account SSH private and public keys must be named dpnid and dpn_key.pub, respectively.
~dpn/.ssh/dpn_key.pub	Public DSA OpenSSH key file. This file is public and does not need to be protected. -r--r--r-- 1 dpn admin - or - -r--r--r-- 1 dpn dpn
~dpn/.ssh/id_rsa	Symbolic link to ~dpn/.ssh/dpnid.
~dpn/.ssh/authorized_keys2	Contains a list of public keys for users allowed to log in to the admin user account. This file must be fully protected and owned as follows: -r-------- 1 dpn admin - or - -r-------- 1 dpn dpn This file is deliberately left empty to ensure that no one can log in as user dpn using SSH keys.

Any other files can be ignored.

The only way to log in as user dpn is to know the operating system dpn password. To ensure proper operation of the Avamar server, the public key for dpn must be in both the .ssh/authorized_keys2 file for both root and admin.

root user account

The root user account SSH v2 key configuration is controlled by the following files and directories.

Table 6 root user account SSH keys

File/directory	Description
.ssh/	Private SSH directory. This directory must be fully protected and owned as follows: drwx------ 2 root root
.ssh/config	SSH configuration file. This file must contain the following entry: StrictHostKeyChecking=no This file must be fully protected and owned as follows: -r-------- 1 root root
.ssh/authorized_keys2	Contains a list of public keys for users allowed to log in to the root user account. This file must be fully protected and owned as follows: -r-------- 1 root root This file must contain a public key entry for the dpn user accounts. As currently shipped, the dpn public key entry is a DSA key, prefixed with "ssh-dss" and appended with the comment "dpn@dpn41s."

Any files not listed in the previous table can be ignored.

To log in as the root user requires the password for the root account or use of the pre-authorized dpnid private key. To ensure proper operation of the Avamar server, the root user must authorize SSH access by way of the dpnid private key. This is accomplished by including the matching public key (dpn_key.pub) in the authorized_keys2 file for the root user. The dpnid private key must not require a passphrase.

Password best practices

This section provides recommendations for password best practices.

Best practices for creating passwords

This section provides best information about creating passwords.

Personal Identifiable Information

Do not use Personal Identifiable Information (PII) in your password such as:

- Your name
- Your user name
- Your birthday
- Names of pets
- Names of your children
- The name of your alma mater
- Keywords associated with your hobbies

Using words from the dictionary

Do not use any word that can be found in the dictionary as your full password.

Using strong passwords

Always use strong passwords when creating passwords. Strong passwords include:

- At least eight characters
- Special characters such as a percent sign or ampersand
- Non-alphabetic characters
- Upper and lower case characters

Use different passwords for user accounts

Always use a different password for each user account.

Changing your password

Recommendations for changing your password:

- Change your most critical passwords on a regular basis.
- Change your passwords at least every 6 months.
- Avoid using variations of a previous password.
- Immediately change your password if you expect another person has access to your account, or knows your password.
- Always change your password as soon as you receive an account.

Password protection best practices:

You should always create a password that you can remember without needing to store it. However, if the password must be stored, follow these recommendations:

- Use a password vault application to protect and help manage your passwords.
- If passwords must be written down on a piece of paper, store the paper in a secure place and destroy it when it is no longer needed.
- Do not put your username and password on a post-it note under your keyboard.
- Do not write down your username and password in the same place.
- Use caution regarding where passwords are saved on computers. Some dialog boxes, such as those for remote access and other telephone connections, present an option to save or remember a password. Selecting this option poses a potential security threat.
- Never share your passwords with anyone and do not give your password to anyone over the phone.

CHAPTER 3
Client/Server Access and Authentication

The following topics provide details about access and authentication between Avamar clients and Avamar servers:

Network access control

The following topics provide details on network access control in an Avamar environment:

Subnet and gateway assignments

Avamar client machines must be able to connect to every node in the Avamar environment directly, and each node in the environment must be able to connect to the client machines.

Assign a default gateway to the router in the Avamar environment.

DNS requirements

The Avamar environment requires a Domain Name System (DNS) server.

If you have a single-node Avamar server, then assign a forward mapping and optionally a reverse mapping to the server.

If you have a multi-node Avamar server, then assign a forward mapping and optionally a reverse mapping to the utility node.

An example of a forward mapping entry is as follows in a Berkeley Internet Name Domain (BIND) environment:

```
avamar-1     A          10.0.5.5
```

A corresponding optional reverse mapping for a zone serving the 5.0.10.in-addr.arpa subnet in a BIND environment is as follows:

```
5      PTR        avamar-1.example.com.
```

Remote access control

Protect all nodes and the switch in the Avamar server against unauthorized access. To access Avamar server from a remote location, use a Virtual Private Network (VPN) system.

SNMP access configuration

Avamar supports system monitoring and event notification through the Simple Network Management Protocol (SNMP), as discussed in "Event notification mechanisms" on page 93.

Client/server authentication

Avamar clients and Avamar servers use Transport Layer Security (TLS) certificates and Public Key Infrastructure (PKI) for authentication and optional encryption of data in transit.

Avamar supports the X.509 v3 standard for formatting digital certificates. To sign the certificates, you can:

- Use a commercial certification authority (CA), such as Verisign.
- Generate a root certificate and set up a private CA.
- Self-sign (not recommended in production environments and not discussed in detail in this guide).

Note: Installing Avamar server automatically generates a public/private key pair and a self-signed certificate in the /data01/home/admin directory on each Avamar server storage node and in the /usr/local/avamar/etc directory on the utility node. Use these only for installation and testing. EMC does not recommend the use of self-signed certificates in production environments.

You can configure the Avamar environment for one-way or two-way authentication between Avamar clients and the Avamar server:

- With one-way authentication, the Avamar client requests authentication from the Avamar server, and the server sends a certificate to the client. The client then validates the certificate. This is also called server-to-client authentication in this guide.
- With two-way authentication, the client requests authentication from the Avamar server, and the Avamar server also requests authentication from the client. Set up client-to-server authentication with server-to-client authentication to provide a stronger level of security.

One-way authentication typically provides sufficient security. To provide additional security, set up two-way authentication.

Both configurations provide encryption of network data. “Encrypting data” on page 82 describes encryption.

The following topics provide details about client/server authentication:

- “Certificate acceptance workflow” on page 36
- “One-way authentication” on page 36
- “Two-way authentication” on page 50
- “Verify client/server authentication” on page 61

Certificate acceptance workflow

Avamar uses the following workflow when determining whether to accept a computer's certificate. Avamar uses this workflow when a client validates a server's certificate, and when a server validates a client's certificate.

1. Obtain the computer's fully qualified domain name (FQDN).

   When connected to a computer through the computer's IP address, use reverse-DNS to determine the computer's FQDN.

2. Compare the computer's FQDN to the value specified in the Common Name (CN) field of the certificate.

   - When the FQDN matches the value specified in the CN field, accept that the certificate validates the computer.
   - When the FQDN does not match, continue the workflow.

3. If the certificate has a wildcard character (*) in the hostname portion of the value specified in the CN field, perform a simple wildcard match of the computer's FQDN to the CN value.

   - When the wildcard match is successful, accept that the certificate validates the computer.
   - When the match is unsuccessful, continue the workflow.

   For example, the value "r*.example.com" in the CN field of the certificate would match a FQDN such as: "real.example.com", "right.example.com", or "reality.example.com"; but would not match "alright.example.com".

4. Compare the IP address of the computer to each IP address listed in the Subject Alternative Name (SAN) field of the certificate.

   - When the IP address of the computer matches an IP address in the SAN field, accept that the certificate validates the computer.
   - When the match is unsuccessful, reject the certificate and terminate the connection.

One-way authentication

With one-way authentication, the Avamar client requests authentication from the Avamar server, and the server sends the appropriate certificate to the client. The client then validates the certificate, using the certificate acceptance workflow.

Obtain the certificates required by one-way authentication through one of the following alternative methods:

- "Requesting signed certificates using a Certificate Signing Request" on page 37

  This method does not normally result in a certificate that contains multiple IP addresses in the SAN field. To obtain certificates that include the SAN field, use one of the other methods.

- "Requesting signed certificates using an enrollment form" on page 39
- "Signed certificates from a private CA" on page 40

After obtaining signed certificates, complete the following tasks:

- "Installing certificates in Avamar" on page 47
- "Configuring Avamar to use server authentication" on page 48
- "Configure clients to accept the server certificates" on page 48
- "Enforcing encrypted client/server communications" on page 50

Requesting signed certificates using a Certificate Signing Request

A Certificate Signing Request (CSR) contains the basic information that a commercial CA uses to issue a certificate. Create separate CSRs for the utility node and for each storage node. Alternatively, create a single CSR that references several nodes through the CN field.

1. Download and install OpenSSL on the system that will generate the CSRs.

   OpenSSL is available for Linux, Windows, OpenBSD, and other operating systems. For maximum security, use the OpenBSD operating system as the host for the OpenSSL key and certificate utilities.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single line (no line feeds or returns allowed).

2. Using an account with write permission for the current working directory, type the following command:

   openssl req -new -newkey rsa:3072 -keyform PEM -keyout *avamar-1key.pem* **-nodes -outform PEM -out** *avamar-1req.pem*

   where:

   - *avamar-1* is the Avamar server name.
   - *avamar-1key.pem* is the file name for the key.
   - *avamar-1req.pem* is the file name for the CSR.

   The OpenSSL web site at www.openssl.org provides information about the **openssl req** command.

   The following information appears in the command shell:

   ```
   Loading 'screen' into random state - done
   Generating a 3072 bit RSA private key
   .++++++
   ...++++++
   writing new private key to 'avamar-1key.pem'
   -----
   ```

3. At each prompt, type the information described in the following table. Press **Enter** after each entry.

   For optional fields, you can provide an empty value by typing a period (.) and pressing **Enter**.

The information that you specify is incorporated into the CSR.

Table 7 Server certificate information

Field	Description
Country Name	The two-letter ISO abbreviation for the country. For example: `US` The list of abbreviations is available on the ISO web site at www.iso.org.
State or Province Name	In countries where it is applicable, the state or province where the organization is located. For example: `California` This entry cannot be abbreviated.
Locality Name	City where the organization is located. For example: `Los Angeles`
Organization Name	The exact legal name of the company. For example: `Example, Inc.` This entry cannot be abbreviated.
Organizational Unit Name	Optional entry for additional organization information, such as a department name.

Common Name (CN)	FQDN of server, or wild card FQDN for several servers. The wild card character (*) must only appear once, and only in the hostname portion of the FQDN value.
	Example for single server:
	`node-1.example.com`
	Example wild card FQDN for several servers:
	`node-*.example.com`

Email Address	Primary email address for this server. For example: `avamar-1-admin@example.com`
Challenge password	A password that must be provided before the certificate can be revoked by the CA. The password is only required if your certificate is compromised. This is an optional field. To skip this field, enter a period character.
Company name	Name for your company. The exact legal name is not required. This is an optional field. To skip this field, enter a period character.

OpenSSL creates the CSR and key in the current working directory.

The output from avamar-1req.pem is similar to the following:

```
-----BEGIN CERTIFICATE REQUEST-----
ABCDEF...
...XYZ=
-----END CERTIFICATE REQUEST-----
```

The output from avamar-1key.pem is similar to the following:

```
-----BEGIN RSA PRIVATE KEY-----
ABCDEF...
...XYZ=
-----END RSA PRIVATE KEY-----
```

4. Repeat these steps for another Avamar server node, or group of nodes sharing the CN field.
5. Submit the resulting CSRs to a commercial CA for signing.

Requesting signed certificates using an enrollment form

Many commercial CAs provide signed certificates that include x509 v3 extensions, such as the Subject Alternative Name (SAN) field. When several IP addresses are included in the SAN field of a certificate, Avamar can use that certificate to authenticate:

- A multi-homed server, by using any one of its IP addresses.
- Several servers that share the certificate, by parsing the list of IP addresses.

The certificate request procedures used by commercial CAs vary. For Avamar server authentication, the certificate you receive must meet the format requirements shown in the following table.

Table 8 Requirements for commercial SAN certificate for servers

Attribute	Requirement
Key format	RSA
Key size	3072 bits
Output format	PEM
Private key format (keyout)	PEM
Private key format (nodes)	Not encrypted
File Name extension	.pem
Common Name (CN)	FQDN of server, or wild card FQDN for several servers. The wild card character (*) must only appear once, and only in the hostname portion of the FQDN value.
Subject Alternative Name (SAN)	List of several IP addresses for a multi-homed server, or a list of IP addresses for several servers sharing the certificate. A CIDR notation value can be used to refer to a range of IP addresses.

Signed certificates from a private CA

A private CA can be used to sign certificates. A private CA is set up within your organization.

This section uses OpenSSL to set up a private CA. This is one of several methods for setting up a private CA.

To set up a private CA and sign certificates, complete the following tasks:

- "Generating a private CA root certificate and key" on page 40.
- "Creating a custom OpenSSL configuration file" on page 42
- "Creating a CSR for Avamar nodes" on page 43
- "Using the private CA to sign certificates" on page 45.

Generating a private CA root certificate and key

Generate a root certificate and key by using OpenSSL.

When creating and signing certificates, EMC recommends that you:

- Properly secure the private key associated with the root certificate.
- Use an air-gapped network in a high-risk environment for signing operations and creating keys, CSRs, and other security-related artifacts. (An air-gapped network is completely physically, electrically, and electromagnetically isolated.)
- Use a hardware Random-number Generator (RNG) to efficiently and quickly generate random numbers with adequate characteristics for cryptographic use.
- For maximum security, use the OpenBSD operating system as the host for the OpenSSL key and certificate utilities.

To generate a root certificate and key:

1. Download and install OpenSSL and a Perl interpreter on the private CA computer.

   OpenSSL and Perl interpreters are available for Linux, Microsoft Windows, OpenBSD, and other operating systems.

2. Log in to the private CA computer as root.
3. Change the working directory to the location where you want to store the private CA root certificate and key.

   For example, /etc/ssl/private.

Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single line (no line feeds or returns allowed).

4. Type:

```
openssl req -new -x509 -newkey rsa:3072 -keyform PEM
 -keyout privateCAkey.pem -extensions v3_ca -outform PEM
 -out privateCAcert.pem -days 3654
```

   where:

   - *privateCAkey.pem* is the file name of the private CA key
   - *privateCAcert.pem* is the file name of the private CA certificate
   - *3654* is the number of days the certificate is valid, here it is 3,654 days

   Additional details on the **openssl req** command can be found on the OpenSSL web site at www.openssl.org.

   The following prompt appears:

```
Enter PEM pass phrase
```

5. Enter a passphrase for the key.

   The passphrase should be memorable. It cannot be retrieved.

   The following prompt appears:

```
Verifying - Enter PEM pass phrase
```

6. Re-enter the passphrase for the key.
7. At each prompt, type the information described in the following table. Press **Enter** after each entry.

   For optional fields, you can provide an empty value by typing a period (.) and pressing **Enter**.

Table 9 Root certificate with openssl req information (page 1 of 2)

Field	Description
Country Name	The two-letter ISO abbreviation for the country. For example: `US` The list of abbreviations is available on the ISO web site at www.iso.org.
State or Province Name	In countries where it is applicable, the state or province where the organization is located. For example: `California` This entry cannot be abbreviated.
Locality Name	City where the organization is located. For example: `Los Angeles`

Table 9 Root certificate with openssl req information (page 2 of 2)

Field	Description
Organization Name	The exact legal name of the company. For example: `Example, Inc.` This entry cannot be abbreviated.
Organizational Unit Name	Optional entry for additional organization information, such as a department name.
Common Name (CN)	The display name for the root certificate. For example: `example.com Certificate Authority`
Email Address	Contact email address for all CA-related issues. For example: `CA-admin@example.com`

OpenSSL creates the private CA certificate and key in the current working directory.

8. Create back up copies of privateCAcert.pem and privateCAkey.pem.

Creating a custom OpenSSL configuration file

Modify openssl.cnf to meet your organization's requirements:

1. Log in to the private CA computer as root.
2. Open /etc/ssl/openssl.cnf in a plain text editor.
3. For server and server-as-client certificates, add the following at the end of openssl.cnf:

```
[ server_ext ]
basicConstraints = CA:false
keyUsage = critical, digitalSignature, keyEncipherment
nsCertType = server,client
extendedKeyUsage = serverAuth, clientAuth
nsComment = "OpenSSL-generated server certificate"
subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid:always, issuer:always
subjectAltName = @alt_names
[alt_names]
IP.0 = NNN.NNN.NNN.NNN
# add ip for multihomed server or NAT
#IP.1 = MMM.MMM.MMM.MMM
DNS.0 = avamar00.example.com
#add hostnames for multihomed server or NAT
#DNS.1 = natavds.example.com
```

where:

- *NNN.NNN.NNN.NNN* represents an IP address for the server.
- *avamar00.example.com* represents the FQDN of the server. An asterisk wildcard character can be used in the hostname portion of the FQDN to represent the hostnames of several computers.

4. (Optional) Add additional IP keys and IP addresses to the [alt_names] section, using the following methods:

   - Uncomment the IP.1 key and replace *MMM.MMM.MMM.MMM* with an IP address. Use this format to add additional keys and IP addresses as required.

     For example:

     ```
     [alt_names]
     IP.0 = 192.168.100.21
     IP.1 = 192.168.100.22
     IP.2 = 192.168.99.16
     ```

   - For any key, IP.0 through IP.*n*, use a CIDR notation value to refer to a range of IP addresses.

     For example:

     ```
     [alt_names]
     IP.0 = 192.168.100.21
     IP.1 = 192.168.100.22
     IP.2 = 192.168.99.16
     IP.3 = 192.168.101.0/29
     ```

5. (Optional) Uncomment the DNS.1 key to add an additional FQDN entry, or wildcard FQDN entry, to the [alt_names] section.

   Use this format to add additional keys and FQDN entries as required.

   For example:

   ```
   [alt_names]
   ...
   DNS.0 = avamar0*.example0.com
   DNS.1 = avamar0*.example1.com
   DNS.2 = test.example.com
   DNS.3 = node*.home.com
   ```

   where the ellipsis represents IP keys not relevant to the example.

6. Save and close the file.

Creating a CSR for Avamar nodes

A Certificate Signing Request (CSR) contains the basic information included in the certificate. Create a CSR for the utility node, and a CSR for each storage node. Alternatively, create a single CSR that references several nodes through the CN field, the SAN field, or both fields.

1. Log in to the private CA computer as root.
2. Change the working directory to the location where you want to store the CSRs.

   For example, /etc/ssl/private.

Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single line (no line feeds or returns allowed).

3. Type the following, on a single command line:

   openssl req -new -newkey rsa:3072 -keyform PEM -keyout *avamar-1key.pem* **-nodes -outform PEM -out** *avamar-1req.pem*

   where:

   - *avamar-1* is the Avamar server name
   - *avamar-1key.pem* is the file name for the key
   - *avamar-1req.pem* is the file name for the CSR

   The following information appears in the command shell:

   ```
   Loading 'screen' into random state - done
   Generating a 3072 bit RSA private key
   .++++++
   ...++++++
   writing new private key to 'avamar-1key.pem'
   -----
   ```

4. At each prompt, type the information described in the following table. Press **Enter** after each entry.

   For optional fields, you can provide an empty value by typing a period (.) and pressing **Enter**.

   The information that you specify is incorporated into the CSR.

Table 10 Server certificate information (page 1 of 2)

Field	Description
Country Name	The two-letter ISO abbreviation for the country. For example: `US` The list of abbreviations is available on the ISO web site at **www.iso.org**.
State or Province Name	In countries where it is applicable, the state or province where the organization is located. For example: `California` This entry cannot be abbreviated.
Locality Name	City where the organization is located. For example: `Los Angeles`
Organization Name	The exact legal name of the company. For example: `Example, Inc.` This entry cannot be abbreviated.
Organizational Unit Name	Optional entry for additional organization information, such as a department name.

Table 10 Server certificate information (page 2 of 2)

Field	Description

Common Name (CN)	FQDN of server, or wild card FQDN for several servers. The wild card character (*) must only appear once, and only in the hostname portion of the FQDN value.
	Example for single server:
	`node-1.example.com`
	Example wild card FQDN for several servers:
	`node-*.example.com`

Email Address	Primary email address for this server. For example: `avamar-1-admin@example.com`
Challenge password	A password that must be provided before the certificate can be revoked by the CA. The password is only required if your certificate is compromised. This is an optional field. To skip this field enter a period character.
Company name	Name for your company. The exact legal name is not required. This is an optional field. To skip this field enter a period character.

OpenSSL creates the CSR and key in the current working directory.

The output from avamar-1req.pem is similar to the following:

```
-----BEGIN CERTIFICATE REQUEST-----
ABCDEF...
...XYZ=
-----END CERTIFICATE REQUEST-----
```

The output from avamar-1key.pem is similar to the following:

```
-----BEGIN RSA PRIVATE KEY-----
ABCDEF...
...XYZ=
-----END RSA PRIVATE KEY-----
```

5. Repeat these steps to create a CSR for another Avamar server node, or group of nodes.

Using the private CA to sign certificates

Create private CA-signed X.509 certificates for servers.

Before starting this task generate a root certificate and key, create a custom OpenSSL configuration file, and create a CSR for each Avamar node.

The procedure assumes the following:

- The CA certificate is in privateCAcert.pem.
- The key for the CA certificate is in privateCAkey.pem.
- The privateCA.srl serial number seed file does not already exist.
- The default openssl.cnf file that is provided with OpenSSL is modified to include information specific to your organization.

To sign a server and server-as-client certificate request and generate the signed certificate:

1. Log in to the private CA computer as root.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single command line (no line feeds or returns allowed).

2. Type the following command on a single line:

   ```
   openssl x509 -CA privateCAcert.pem -CAkey privateCAkey.pem
    -req -in avamar-1req.pem -extensions server_ext
    -extfile openssl.cnf -outform PEM -out avamar-1cert.pem
    -days 3654 -CAserial privateCA.srl -CAcreateserial
   ```

   where:

   - *privateCAcert.pem* is the full or relative path to the private CA certificate
   - *privateCAkey.pem* is the full or relative path to the private CA certificate key
   - *avamar-1req.pem* is the file name of the CSR
   - *openssl.cnf* is the full or relative path to the OpenSSL configuration file
   - *avamar-1cert.pem* is the file name of the resulting signed certificate
   - *3654* is the number of days the certificate is valid, here it is 3,654 days
   - *privateCA.srl* is a temporary serial number seed file

   The following information appears in the command shell:

   ```
   Loading 'screen' into random state - done
   Signature ok
   subject=/C=US/ST=California/L=Los Angeles/O=Example,
   Inc./OU=Dept55/CN=avamar-1.example.com/emailAddress=avamar-1-admin@
   example.com
   Getting CA Private Key
   Enter pass phrase for privateCAkey.pem:
   ```

3. Type the passphrase for the certificate key and press **Enter**.

   OpenSSL creates the signed certificate in the current working directory.

   The content of the signed certificate looks similar to the following output:

   ```
   -----BEGIN CERTIFICATE-----
   ABCDEF...
   ...XYZ=
   -----END CERTIFICATE-----
   ```

4. (Optional) Display the certificate content in text format by typing:

   ```
   openssl x509 -in avamar-1cert.pem -noout -text
   ```

Installing certificates in Avamar

Copy certificates to the Avamar system's nodes.

Before you begin, obtain certificates from a commercial CA or from your private CA.

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. Copy the certificate to the specified locations.
   - Single-node system
     - Copy to:

       `/data01/home/admin/cert.pem`

     - Copy to:

       `/usr/local/avamar/etc/cert.pem`
   - Multi-node system
     - On each storage node, copy the certificate generated for that node to:

       `/data01/home/admin/cert.pem`

     - On the utility node, copy the certificate generated for that node to:

       `/usr/local/avamar/etc/cert.pem`
3. Copy the key associated with the certificate to the specified locations.
   - Single-node system
     - Copy to:

       `/data01/home/admin/key.pem`

     - Copy to:

       `/usr/local/avamar/etc/key.pem`
   - Multi-node system
     - On each storage node, copy the key generated for that node to:

       `/data01/home/admin/key.pem`

     - On the utility node, copy the key generated for that node to:

       `/usr/local/avamar/etc/key.pem`
4. Stop and restart the Avamar server by typing the following commands:

   ```
   dpnctl stop gsan
   dpnctl start
   ```

Configuring Avamar to use server authentication

Configure the Management Console Server (mcs) to use server authentication.

Before you begin, obtain certificates from a commercial CA or from your private CA, and install the certificates on the Avamar system's nodes.

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. Open /usr/local/avamar/var/mc/server_data/prefs/mcserver.xml in a plain-text editor.
3. Locate the encrypt_server_authenticate preference and change it as follows:

   ```
   encrypt_server_authenticate=true
   ```

4. Save and close the file.
5. Restart the MCS by typing:

   ```
   dpnctl stop mcs
   dpnctl start mcs
   ```

6. Select either a **Medium** or **High** encryption level for future client communication:

   When you create and edit groups with Avamar Administrator, select **Medium** or **High** from the Encryption method list.

   The *EMC Avamar Administration Guide* describes how to override the group encryption method for a specific client, for a specific backup, and for a specific restore.
7. When you use the **avtar** command, include the **--encrypt=tls-sa** option and either the **--encrypt-strength=medium** option or the **--encrypt-strength=high** option.

Configure clients to accept the server certificates

Client computers validate server certificates based on a chain of trust between the certificate and a known valid certificate that exists on the client.

A server certificate issued by a commercial CA is normally accepted by a Windows client because a chain of trust exists between the server certificate and trusted certificates installed on the Windows client. When a public key certificate is not trusted by a Windows client, update the Windows client's trusted certificates store.

A chain of trust does not normally exist on a Linux client. To permit the client to validate the server certificate, import the server's public key certificate to the Linux client.

A chain of trust also does not normally exist when the server certificate is generated by a private CA. Import the server's public key certificate to both Linux and Windows clients.

Importing the CA root certificate to a UNIX-like client

Allow a UNIX-like client to authenticate an Avamar server's certificate by copying the root certificate of the CA that signed the Avamar server's certificate to the UNIX-like client.

Note: Determine the value of the client's SYSDIR environment variable. If that value is not /usr/local/avamar/etc, then replace /usr/local/avamar/etc with the value of SYSDIR in the following task.

1. Create the file chain.pem.
   - When the root certificate is several files that form a certificate chain, use cat with the redirect and append operators to combine the certificates by typing:

     ```
     cat chain-cert-1 > chain.pem
     cat chain-cert-2 >> chain.pem
     cat chain-cert-3 >> chain.pem
     ```

     where *chain-cert-1*, *chain-cert-2*, and *chain-cert-3* represent the path to each certificate in the certificate chain.

     The combined file must be named chain.pem.
   - When the root certificate is a single file, copy it to chain.pem.
2. Copy chain.pem to the UNIX-like client, in the following location:

   ```
   /usr/local/avamar/etc/chain.pem
   ```

Importing a private CA signed root certificate to a Windows client

Allow a Windows client to trust a private CA signed root certificate by importing the root certificate of the CA that signed the Avamar server's certificate into the Windows client's certificate store.

1. Copy the root certificate to the client machine.
2. In Internet Explorer on the Windows client, click **Tools** › **Internet Options**.

   The **Internet Options** dialog box appears.
3. On the **Content** tab, click **Certificates**.

   The **Certificates** dialog box appears.
4. On the **Trusted Root Certification Authorities** tab, click **Import**.

   The **Certificate Import Wizard** appears.
5. Click **Next**.

   The **File to Import** screen appears.
6. Click **Browse.**

   In the **Open** dialog box, in the list next to the **File name** field, select the correct extension type for the certificate, or choose **All Files**.
7. Find and select the certificate file.
8. Click **Open**.

9. On the File to Import screen, click **Next**.
10. On the **Certificate Store** screen, select **Place all certificates in the following store**, and click **Browse**.

    The **Select Certificate Store** dialog box appears.
11. Choose **Trusted Root Certification Authorities**, and click **OK**.
12. On the **Certificate Store** screen, click **Next**.
13. Click **Finish**.

Windows imports the private CA signed root certificate into client's Trusted Root Certification Authorities store.

Enforcing encrypted client/server communications

To configure the MCS to refuse unencrypted (plain-text) client messages, perform the following:

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. Open /usr/local/avamar/var/mc/server_data/prefs/mcserver.xml in a plain-text editor such as vi.
3. Locate the enforce_client_msg_encryption preference and change it as follows:

   ```
   enforce_client_msg_encryption=true
   ```
4. Save and close the file.
5. Restart the MCS by typing the following commands:

   ```
   dpnctl stop mcs
   dpnctl start mcs
   ```

Two-way authentication

With two-way authentication:

- The Avamar client requests authentication from the Avamar server, and the server sends the appropriate certificate to the client. The client then validates the certificate, using the certificate acceptance workflow.
- The Avamar server requests authentication from the Avamar client, and the client sends the appropriate certificate to the server. The server then validates the certificate, using the certificate acceptance workflow.

Before beginning these tasks, enable one-way authentication as described in "One-way authentication" on page 36.

Obtain the client certificates required for two-way authentication through one of the following alternative methods:

- "Requesting client certificates using a Certificate Signing Request" on page 51

  This method does not result in a certificate that contains multiple IP addresses in the SAN field. To obtain certificates that include the SAN field, use one of the other methods.

- "Requesting client certificates using an enrollment form" on page 53
- "Use a private CA to sign client certificates" on page 53

After obtaining signed certificates, complete the following tasks:

- "Configuring Avamar for client authentication" on page 58
- "Installing a client certificate on a Windows client" on page 59
- "Installing a client certificate on a UNIX-like client" on page 61

Requesting client certificates using a Certificate Signing Request

A Certificate Signing Request (CSR) contains the basic information that a commercial CA uses to issue a client certificate. Create a blanket CSR for all clients by using a wild card FQDN in the CN field. To enhance security, create separate CSRs for each client.

1. Using an account with write permission for the current working directory, type the following on a single command line:

   openssl req -new -newkey rsa:3072 -keyform PEM -keyout *avamarclientkey.pem* **-nodes -outform PEM -out** *avamarclientreq.pem*

   where:

   - *avamarclientkey.pem* is the file name for the key.
   - *avamarclientreq.pem* is the file name for the CSR.

   The following information appears in the command shell:

   ```
   Loading 'screen' into random state - done
   Generating a 3072 bit RSA private key
   .++++++
   ...++++++
   writing new private key to 'avamarclientkey.pem'
   -----
   ```

2. At each prompt, type the information described in the following table. Press **Enter** after each entry.

   For optional fields, you can provide an empty value by typing a period (.) and pressing **Enter**.

The information that you specify is incorporated into the CSR.

Table 11 Client certificate information

Field	Description
Country Name	The two-letter ISO abbreviation for the country. For example: `US` The list of abbreviations is available on the ISO web site at www.iso.org.
State or Province Name	In countries where it is applicable, the state or province where the organization is located. For example: `California` This entry cannot be abbreviated.
Locality Name	City where the organization is located. For example: `Los Angeles`
Organization Name	The exact legal name of the company. For example: `Example, Inc.` This entry cannot be abbreviated.
Organizational Unit Name	Optional entry for additional organization information, such as a department name.

Common Name (CN)	FQDN of client, or wild card FQDN for a group of clients. The wild card character (*) must only appear once, and only in the hostname portion of the FQDN value.
	Example for single client:
	`avamarclient-001.example.com`
	Example wild card FQDN for a group of clients:
	`avamarclient-*.example.com`

Email Address	Primary email address for the administrator of the client computers. For example: `admin@example.com`
Challenge password	A password that must be provided before the certificate can be revoked by the CA. The password is only required if your certificate is compromised. This is an optional field. To skip this field enter a period character.
Company name	Name for your company. The exact legal name is not required. This is an optional field. To skip this field enter a period character.

OpenSSL creates the CSR and key in the current working directory.

3. (Optional) When obtaining certificates for several groups of clients or for several clients, repeat these steps for each required certificate.
4. Submit the resulting CSRs to a commercial CA for signing.

Requesting client certificates using an enrollment form

Many commercial CAs provide signed certificates that include x509 v3 extensions, such as the Subject Alternative Name (SAN) field. When several IP addresses are included in the SAN field of a certificate Avamar can use that certificate to authenticate several clients that share the certificate, by parsing the list of IP addresses.

The certificate request procedures used by commercial CAs vary. For Avamar client authentication, the certificate you receive must meet the format requirements shown in the following table.

Table 12 Requirements for commercial SAN certificate for clients

Attribute	Requirement
Key format	RSA
Key size	3072 bits
Output format	PEM
Private key format (keyout)	PEM
Private key format (nodes)	Not encrypted
File Name extension	.pem
Common Name (CN)	FQDN of client, or wild card FQDN for a group of clients. The wild card character (*) must only appear once, and only in the hostname portion of the FQDN value.
Subject Alternative Name (SAN)	List of IP addresses for several clients sharing the certificate. A CIDR notation value can be used to refer to a range of IP addresses.

Use a private CA to sign client certificates

A private CA can be used to sign client certificates.

Before you begin, generate a private CA root certificate and key as described in "Generating a private CA root certificate and key" on page 40.

To use a private CA to sign client certificates, complete the following tasks:

- "Creating a custom OpenSSL configuration file for clients" on page 53
- "Creating a CSR for clients" on page 54
- "Signing client certificates by using a private CA" on page 56.

Creating a custom OpenSSL configuration file for clients

Modify openssl.cnf to meet your organization's requirements:

1. Log in to the private CA computer as root.
2. Open /etc/ssl/openssl.cnf in a plain text editor.

3. For client certificates, add the following at the end of openssl.cnf (after the server entry):

```
[ client_ext ]
basicConstraints = CA:false
keyUsage = critical, digitalSignature, keyEncipherment
nsCertType = client
extendedKeyUsage = clientAuth
nsComment = "OpenSSL-generated client certificate"
subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid:always, issuer:always
subjectAltName = @alt_names
[alt_names]
IP.0 = NNN.NNN.NNN.NNN
# add ip for multihomed server or NAT
#IP.1 = MMM.MMM.MMM.MMM
DNS.0 = client00.example.com
#add hostnames for multihomed server or NAT
#DNS.1 = natavds.example.com
```

   where:

   - *NNN.NNN.NNN.NNN* represents an IP address for the client.
   - *client00.example.com* represents the FQDN of the client. An asterisk wildcard character can be used in the hostname portion of the FQDN to represent the hostnames of several computers.

4. (Optional) Add additional IP addresses to the [alt_names] section, using the following methods:

   - Uncomment the IP.1 key and replacing *MMM.MMM.MMM.MMM* with an IP address. Use this format to add additional keys and IP addresses as required.
   - For any key, IP.0 through IP.n, use a CIDR notation value to refer to a range of IP addresses.

5. (Optional) Uncomment the DNS.1 key to add an additional FQDN entry, or wildcard FQDN entry, to the [alt_names] section.

   Use this format to add additional keys and FQDN entries as required.

6. Save and close the file.

Creating a CSR for clients

A Certificate Signing Request (CSR) contains the basic information included in the certificate. Create a single CSR that references a group of clients through the CN field, the SAN field, or both fields. Alternatively, create a separate CSR for each client.

1. Log in to the private CA computer as root.
2. Change the working directory to the location where you want to store the CSRs.

   For example, /etc/ssl/private.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single line (no line feeds or returns allowed).

3. Type the following command:

   openssl req -new -newkey rsa:3072 -keyform PEM -keyout *avamarclientkey.pem* **-nodes -outform PEM -out** *avamarclientreq.pem*

   where:

   - *avamarclientkey.pem* is the file name for the key.
   - *avamarclientreq.pem* is the file name for the CSR.

   The following information appears in the command shell:

   ```
   Loading 'screen' into random state - done
   Generating a 3072 bit RSA private key
   .++++++
   ...++++++
   writing new private key to 'avamarclientkey.pem'
   -----
   ```

4. At each prompt, type the information described in the following table. Press **Enter** after each entry.

   For optional fields, you can provide an empty value by typing a period (.) and pressing **Enter**.

   The information that you specify is incorporated into the CSR.

Table 13 Server certificate information (page 1 of 2)

Field	Description
Country Name	The two-letter ISO abbreviation for the country. For example: `US` The list of abbreviations is available on the ISO web site at www.iso.org.
State or Province Name	In countries where it is applicable, the state or province where the organization is located. For example: `California` This entry cannot be abbreviated.
Locality Name	City where the organization is located. For example: `Los Angeles`
Organization Name	The exact legal name of the company. For example: `Example, Inc.` This entry cannot be abbreviated.
Organizational Unit Name	Optional entry for additional organization information, such as a department name.

Common Name (CN)	FQDN of client, or wild card FQDN for a group of clients. The wild card character (*) must only appear once, and only in the hostname portion of the FQDN value.
	Example for single client:
	`avamarclient-001.example.com`
	Example wild card FQDN for a group of clients:
	`avamarclient-*.example.com`

Table 13 Server certificate information (page 2 of 2)

Field	Description
Email Address	Primary email address for the administrator of the client computers. For example: `admin@example.com`
Challenge password	A password that must be provided before the certificate can be revoked by the CA. The password is only required if your certificate is compromised. This is an optional field. To skip this field enter a period character.
Company name	Name for your company. The exact legal name is not required. This is an optional field. To skip this field enter a period character.

OpenSSL creates the CSR and key in the current working directory.

The output from avamarclientreq.pem is similar to the following:

```
-----BEGIN CERTIFICATE REQUEST-----
ABCDEF...
...XYZ=
-----END CERTIFICATE REQUEST-----
```

The output from avamarclientkey.pem is similar to the following:

```
-----BEGIN RSA PRIVATE KEY-----
ABCDEF...
...XYZ=
-----END RSA PRIVATE KEY-----
```

5. Repeat these steps to create additional a CSR for additional clients, or groups of clients.

Signing client certificates by using a private CA

Create private CA-signed X.509 certificates for clients.

Before starting this task, generate a private CA root certificate and key, create a custom OpenSSL configuration file for clients, and create a CSR for each client or group of clients.

The procedure assumes the following:

- The CA certificate is in privateCAcert.pem.
- The key for the CA certificate is in privateCAkey.pem.
- The privateCA.srl serial number seed file does not already exist.
- The default openssl.cnf file that is provided with OpenSSL is modified to include information specific to your organization.

To sign a client certificate request and generate the signed certificate:

1. Log in to the private CA computer as root.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single command line (no line feeds or returns allowed).

2. Type the following command:

   ```
   openssl x509 -CA privateCAcert.pem -CAkey privateCAkey.pem
    -req -in avamarclientreq.pem -extensions client_ext
    -extfile openssl.cnf -outform PEM -out avamarclientcert.pem
    -days 3654 -CAserial privateCA.srl -CAcreateserial
   ```

   where:

   - *privateCAcert.pem* is the full or relative path to the private CA certificate
   - *privateCAkey.pem* is the full or relative path to the private CA certificate key
   - *avamarclientreq.pem* is the file name of the CSR
   - *openssl.cnf* is the full or relative path to the OpenSSL configuration file
   - *avamarclientcert.pem* is the file name of the resulting signed certificate
   - *3654* is the number of days the certificate is valid, here it is 3,654 days
   - *privateCA.srl* is a temporary serial number seed file

   The following information appears in the command shell:

   ```
   Loading 'screen' into random state - done
   Signature ok
   subject=/C=US/ST=California/L=Los Angeles/O=Example,
   Inc./OU=Dept55/CN=client0.example.com/emailAddress=client0-admin@ex
   ample.com
   Getting CA Private Key
   Enter pass phrase for privateCAkey.pem:
   ```

3. Type the passphrase for the certificate key and press **Enter**.

   OpenSSL creates the signed certificate in the current working directory.

   The content of the signed certificate looks similar to the following output:

   ```
   -----BEGIN CERTIFICATE-----
   ABCDEF...
   ...XYZ=
   -----END CERTIFICATE-----
   ```

4. (Optional) Display the certificate content in text format by typing:

   ```
   openssl x509 -in avamarclientcert.pem -noout -text
   ```

Configuring Avamar for client authentication

Configure Avamar to authenticate client certificates.

Before you begin, obtain signed client certificates, and the signing authority's root certificate. The root certificate comes from either a commercial CA or your private CA.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Stop the Avamar server by typing:

   ```
   dpnctl stop gsan
   ```

3. Determine if the file chain.pem exists in the following locations:
   - Single-node system

     `/data01/home/admin/chain.pem`

     `/usr/local/avamar/etc/chain.pem`

   - Multi-node system
     – On each storage node:

       `/data01/home/admin/chain.pem`

     – On the utility node:

       `/usr/local/avamar/etc/chain.pem`

4. Based on whether the file exists, perform one of the following for each location:
   - When the file already exists, append the signing authority's root certificate:

     cat *path_to_root_cert* **>>** *path_to_chain.pem*

   - When the file does not exist, copy the signing authority's root certificate:

     cp *path_to_root_cert path_to_chain.pem*

   where:

   - *path_to_root_cert* is the full or relative path to the signing authority's root certificate.
   - *path_to_chain.pem* is the full or relative path to the specified location of chain.pem.

5. Restart the Avamar server by typing:

   ```
   dpnctl start
   ```

6. Enable client authentication by typing:

   ```
   avmaint config verifypeer=yes --avamaronly
   ```

Installing a client certificate on a Windows client

Install a client certificate on a Windows client to use when authenticating with an Avamar server.

Before you begin, configure the Avamar server to accept the client certificate.

Note: Space limitations in this guide cause the command in the following step to continue (wrap) to more than one line. Type the command on a single line (no line feeds or returns allowed).

To install a client authentication certificate on a Windows client:

1. Combine the key and signed client certificate into a PKCS #12 format file suitable for importing into a Microsoft Certificate Store by typing:

   ```
   openssl pkcs12 -in avamarclientcert.pem
    -inkey avamarclientkey.pem -export -out avamarclientcert.p12
    -name "Avamar Trusted Client"
   ```

   where:

   - *avamarclientcert.pem* is the file name of the signed certificate
   - *avamarclientkey.pem* is the file name of the key
   - *avamarclientcert.p12* is the file name of the resulting PKCS #12 file

   The following information appears in the command shell:

   ```
   Enter Export Password:
   ```

2. Enter a password for the PKCS #12 file.

   The prompt appears:

   ```
   Verifying - Enter Export Password:
   ```

3. Enter the same password.

   OpenSSL creates the PKCS #12 file in the current working directory.

4. Copy the PKCS #12 file to a temporary location on the Windows client computer.

5. Log in to the Windows client computer with an account that has local administrator privileges.

6. Open the Microsoft Management Console:
   a. Open the Windows **Start** menu and select **Run**.

      The Run dialog box appears.

   b. Type **mmc** and press **Enter**.

      The Microsoft Management Console appears.
7. From the **File** menu, select **Add/Remove Snap-in**.

   On Windows 7, the Add or Remove Snap-ins dialog box appears. On Windows XP and Windows Vista, the Add/Remove Snap-in dialog box appears.
8. (Windows XP and Windows Vista only) On the **Standalone** tab, click **Add**.

   (Windows Vista only) Perform the following additional steps:

   a. Select **Computer Account** and press **Enter** twice.

   b. Click **OK**.

   The Add Standalone Snap-in dialog box appears.
9. From the **Available snap-ins** list, select **Certificates**, and click **Add**.

   The Certificates snap-in dialog box appears.
10. Select **Computer account**, and click **Next**.

    The Select Computer dialog box appears.
11. Select **Local computer**, and click **Finish**.
12. (Windows XP and Windows Vista only) On the Add Standalone Snap-in dialog box, click **Close**.
13. On the Add or Remove Snap-ins dialog box, or the Add/Remove Snap-in dialog box, click **OK**.

    The Certificates (Local Computer) Management console is visible in the tree.
14. Open the Certificate Import Wizard:
    - (Windows 7 only):
      a. In the console tree, expand the following nodes: **Certificates (Local Computer)** › **Personal** › **Certificates**.

      b. Right-click the **Certificates** node and select **All tasks** › **Import**.
    - (Windows XP and Windows Vista only):
      a. In the console tree, expand the **Certificates (Local Computer)** node.

      b. Right-click the **Personal** node, and select **All Tasks** › **Import**.

    The Certificate Import Wizard appears.
15. Click **Next**, and then click **Browse**.
16. Navigate to the location of the PKCS #12 file and click **Open**.
17. Click **Next** and proceed through the remainder of the wizard.

Installing a client certificate on a UNIX-like client

Install a client certificate on a UNIX-like client to use when authenticating with an Avamar server.

Before you begin, configure the Avamar server to accept the client certificate.

Note: Determine the value of the client's SYSDIR environment variable. If that value is not /usr/local/avamar/etc, then replace /usr/local/avamar/etc with the value of SYSDIR in the following task.

To install a signed client certificate on a UNIX-like client:

1. Obtain a signed certificate and private key file for the client.
2. Copy the client's certificate to the following location:

   ```
   /usr/local/avamar/etc/cert.pem
   ```

   The file must be named cert.pem.
3. Copy the private key file for the client's certificate to the following location:

   ```
   /usr/local/avamar/etc/key.pem
   ```

   The file must be named key.pem.

Verify client/server authentication

To verify authentication, run a test backup with server authentication enabled. Use either **avtar** from the command line, or Avamar Administrator.

Verifying authentication with the avtar command

Use the avtar command to verify client/server authentication by running a backup and including the server authentication option:

```
--encrypt=tls-sa
```

The server authentication option requires authentication of the Avamar server based on the trusted certificates installed on the Avamar client.

Verifying authentication with Avamar Administrator

To verify client/server authentication with Avamar Administrator, run a backup and select medium or high from the Encryption method list. The Encryption method list appears on both the On Demand Backup Options dialog box and the Restore Options dialog box.

The *EMC Avamar Administration Guide* provides more information on how to run a backup with the Avamar Administrator.

Web browser authentication using Apache

Avamar Enterprise Manager, Avamar client web UI, and Avamar Web Restore use the Apache web server to provide a secure web browser-based user interface. Web browser connections for these applications use secure socket layer/transport layer security (SSL/TLS) to provide authentication and data security.

When a web browser accesses a secure web page from an unauthenticated web server, the SSL/TLS protocol causes it to display an authentication warning. An unauthenticated web server is one that does not authenticate itself using a trusted public key certificate.

The Apache web server provided with Avamar is installed with a self-signed certificate, not a trusted public key certificate. The self-signed certificate is sufficient to establish an encrypted channel between web browsers and the server, but it cannot be used for authentication.

To provide server authentication, and thereby prevent web browser warnings, complete the following tasks:

- "Create a private key" on page 63
- "Generating a certificate signing request" on page 65

The tools used in these tasks are part of the OpenSSL toolkit. OpenSSL is provided with Avamar.

Alternative authentication method

Authentication of the Tomcat server used by Avamar Enterprise Manager should normally be handled by Apache as described in this section. Then the Tomcat server is not required to provide server authentication and does not require a separate trusted public key certificate.

However, the Tomcat server listens on port 8543 and is configured to provide SSL/TLS authentication on that port. If your organization connects to Avamar Enterprise Manager directly on port 8543, you may want to install a trusted public key certificate for the Tomcat server.

"Tomcat server authentication" on page 69 describes how to replace the Tomcat server's default self-signed certificate with a trusted public key certificate.

Support for Subject Alternative Names

The Apache web server and the Tomcat servers support the X509 Version 3 (RFC 2459, section 4.2.1.7) extension for certificates that include the Subject Alternative Name (SAN) field. When several IP addresses are included in the SAN field of a certificate, Apache and Tomcat can use that certificate to provide authentication for:

- A multi-homed server, by using any one of its IP addresses.
- Several servers that share the certificate, by parsing the list of IP addresses.

Not all browser and OS combinations support Subject Alternative Names. Test a SAN certificate with the browser and OS combinations used by your company before installing such a certificate on a production system.

Create a private key

A private key can be generated with passphrase protection and without passphrase protection. It can also be generated using a random key generation algorithm. Use the method that is appropriate for the level of security required by your organization.

When a password protected private key is used, Apache prompts for the passphrase at startup. The configuration setting SSLPassPhraseDialog can be used to obtain the passphrase from a script. For more information, refer to Apache documentation available through the Apache web site at www.apache.org.

Creating a private key

To create a private key without a passphrase and without additional randomness:

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Create the private key by typing:

   openssl genrsa -out *server.key* **3072**

   where *server.key* is a name you provide for the private key.

   The private key is created in the current working directory.

Creating a private key with randomness

To create a private key using a random key generation algorithm:

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.

2. Create the private key by typing:

   openssl genrsa -rand *binary-files* **-out** *server.key* **3072**

   where *binary-files* is a colon-separated list of paths to two or more binary files and *server.key* is a name you provide for the private key.

   The private key is created in the current working directory.

Creating a passphrase protected private key

To create a passphrase protected private key:

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        su -

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Create the private key by typing:

   openssl genrsa -aes128 -out *server.key* **3072**

   where *server.key* is a name you provide for the private key.

   The following prompt appears:

   ```
   Enter pass phrase for server.key:
   ```

3. Type a passphrase and press **Enter**.

   The following prompt appears:

   ```
   Verifying - Enter pass phrase for server.key:
   ```

4. Retype the passphrase and press **Enter**.

   The private key is created in the current working directory.

Generating a certificate signing request

Apply for a public key certificate from a Commercial CA, by sending the CA a certificate signing request (CSR).

To generate a CSR:

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Generate the CSR by typing:

   openssl req -new -key *server.key* **-out** *server.csr*

   where:
   - *server.key* is a name you provide for the private key.
   - *server.csr* is a name you provide for the CSR.
3. (Passphrase protected private key only) Type the passphrase for the private key and press **Enter**.
4. Provide the Distinguished Name (DN) information as requested and press **Enter**.

   The tool prompts for DN information. At each prompt, type the information described in the following table, and press **Enter**.

   To leave an entry blank, type a period (.) and press **Enter.**

Table 14 Certificate signing request distinguished name information (page 1 of 2)

Field	Description
Country Name	The two-letter ISO abbreviation for the country. For example: `US` The list of abbreviations is available on the ISO web site at **www.iso.org**.
State or Province Name	In countries where it is applicable, the state or province where the organization is located. For example: `California` This entry cannot be abbreviated.

Table 14 Certificate signing request distinguished name information (page 2 of 2)

Field	Description
Locality Name	City where the organization is located. For example: `Los Angeles`
Organization Name	The exact legal name of the company. For example: `Example, Inc.` This entry cannot be abbreviated.
Organizational Unit Name	Optional entry for additional organization information, such as a department name.
Common Name	The fully qualified domain name of the Avamar server (single-node) or utility node (multi-node). For example: `avamar-1.example.com`
Email Address	Primary email address for this server. For example: `avamar-1-admin@example.com`

The following prompt appears:

```
Please enter the following 'extra' attributes
to be sent with your certificate request
A challenge password []:
```

5. Type a password or type **.** and press **Enter**.

   A password is optional. If provided, the certificate cannot be revoked without first entering the password. To skip this step type **.** and press **Enter**.

   The following prompt appears:

   ```
   An optional company name []:
   ```

6. Type an alternative form of the company name or type **.** and press **Enter**.

   The CSR is created in the current working directory.

Requesting a public key certificate

Request a public key certificate from a commercial CA. Include the CSR as part of the request.

After its criteria are met, the CA provides a public key certificate in the form of an electronic file, usually with the .crt file name extension.

The CA may also provide a certificate chain. A certificate chain is a series of certificates that link the public key certificate you receive to a trusted root CA certificate. Combine the certificate chain into a single file.

To combine the certificate chain into a single file:

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Use cat with the redirect and append operators to combine the certificates by typing:

   ```
   cat chain-cert-1 > cachain.crt
   cat chain-cert-2 >> cachain.crt
   cat chain-cert-3 >> cachain.crt
   cat chain-cert-4 >> cachain.crt
   cat chain-cert-5 >> cachain.crt
   ```

   where *chain-cert-1* through *chain-cert-5* represent the path to each certificate in the certificate chain and *cachain.crt* is a name you provide for the combined file.

Configuring Apache to use the key and certificates

Configure Apache to use the private key, public key certificate, and the certificate chain file. Then restart Apache.

To configure Apache to use the certificate, key, and certificate chain file:

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Change the working directory to the temporary location of the certificate, key, and certificate chain file.
3. Move the certificate, key, and certificate chain file to the default location.

Note: To use another location, see "Using custom locations for Apache SSL key, certificate, and chain file" on page 68.

- On Red Hat Enterprise Linux:

```
mv server.crt /etc/httpd/conf/ssl.crt/server.crt
mv server.key /etc/httpd/conf/ssl.key/server.key
mv cachain.crt /etc/httpd/conf/ssl.crt/ca.crt
```

- On SUSE Enterprise Linux Server:

```
mv server.crt /etc/apache2/ssl.crt/server.crt
mv server.key /etc/apache2/ssl.key/server.key
mv cachain.crt /etc/apache2/ssl.crt/ca.crt
```

4. Restart Apache by typing:

```
website restart
```

Using custom locations for Apache SSL key, certificate, and chain file

The Apache SSL configuration file is overwritten during Avamar system upgrades. This also overwrites custom paths for the certificate, key, and certificate chain file. To use custom paths restore the Apache SSL configuration file from the backup copy made during the upgrade.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

```
su -
```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

```
ssh-agent bash
ssh-add ~admin/.ssh/dpnid
```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Back up the latest version of the Apache SSL configuration file.
   - On SLES, type:

```
cd /etc/apache2/vhosts.d/
cp vhost-ssl.conf vhost-ssl.conf.orig
```

   - On RHEL, type:

```
cd /etc/httpd/conf.d/
cp ssl.conf ssl.conf.orig
```

Note: Space limitations in this guide cause the commands in the following step to continue (wrap) to more than one line. Type each command on a single line (no line feeds or returns allowed).

3. Change the working directory.
   - On SLES, type:

     cd /usr/local/avamar/var/avi/server_data/package_data/*UPGRADE_FROM_VERSION***/ConfigureApacheSsl/**
   - On RHEL, type:

     cd /usr/local/avamar/var/avi/server_data/package_data/*UPGRADE_FROM_VERSION***/ConfigureApacheSsl/**

     where *UPGRADE_FROM_VERSION* is the name of the directory created during the latest upgrade.
4. Extract the previous version backup copy by typing:

   tar -xzf node_0.s_*.*.*.tgz -C /
5. Restart Apache by typing:

   website restart

Tomcat server authentication

Two Avamar web-based services use Apache Tomcat servlet containers (Tomcat servers) to handle SSL/TLS sockets. By default these Avamar services share a self-signed certificate for the SSL/TLS sockets. A self-signed certificate is sufficient for encrypted data channels but does not provide adequate server authentication.

When a web browser accesses a secure web page that is served by an unauthenticated web server, the SSL/TLS protocol causes the browser to display an authentication warning. An unauthenticated web server is one that does not provide a trusted public key certificate for authentication.

The Avamar services that share a certificate for their Tomcat servers are:

- Avamar Enterprise Manager
- Avamar Web Restore

To provide authentication of the Tomcat server for these services, install a trusted public key certificate as described in "Install a trusted public key certificate" on page 71.

A trusted public key certificate is installed and stored with other certificates in the root keystore. This keystore is protected by a password, but the default password is commonly known and insecure. To protect the integrity of the keystore, change the password, as described in "Changing the root keystore password" on page 77.

SSL/TLS through Apache

Normally, the SSL/TLS sockets for Avamar Enterprise Manager and for Avamar Web Restore are handled by Apache HTTP Server (Apache). This occurs when a connection is made using web addresses of the form:

- Avamar Enterprise Manager

  `http://AVAMARSERVER/em`

- Avamar Web Restore

  `http://AVAMARSERVER`

where *AVAMARSERVER* is the resolvable hostname or IP address of the utility node or single-node server.

Apache redirects these connection requests to an SSL/TLS socket and handles that socket.

Server authentication is provided by installing a trusted public key certificate for Apache. Installing a trusted public key certificate for Apache is described in "Web browser authentication using Apache" on page 62.

SSL/TLS through Tomcat

The Tomcat servers for Avamar Enterprise Manager and for Avamar Web Restore can also be directly accessed using web addresses of the form:

- Avamar Enterprise Manager

  `https://AVAMARSERVER:8543/cas`

- Avamar Web Restore

  `https://AVAMARSERVER:8444/dtlt/home.html`

where *AVAMARSERVER* is the resolvable hostname or IP address of the utility node or single-node server.

When these addresses are used, SSL/TLS sockets are handled by a Tomcat server instead of Apache.

To provide server authentication when directly accessing the Tomcat servers, obtain and install a trusted public key certificate as described in "Install a trusted public key certificate" on page 71. Using a trusted public key certificate provides valid authentication of the Tomcat servers and prevents web browser warnings.

Note: These procedures are not required for Avamar Enterprise Manager or for Avamar Web Restore when accessed through Apache as described in "SSL/TLS through Apache" on page 70.

Install a trusted public key certificate

Install a trusted public key certificate to provide authentication of the Tomcat servers. This certificate is shared by the Tomcat servers.

The tasks involved in installing a trusted public key certificate are:

1. "Deleting the default key entry" on page 71
2. "Creating a new key entry" on page 72
3. "Generating a certificate signing request" on page 73
4. "Obtaining a public key certificate" on page 74
5. "Importing chained or root certificates" on page 74
6. "Importing the public key certificate" on page 76

Deleting the default key entry

You must delete the default `tomcat` key entry from the keystore before you can create a new key entry that contains your company's information.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Run the **keytool -delete** command by typing:

   ```
   $JAVA_HOME/bin/keytool -delete -alias tomcat
   ```

3. At the password prompt, type the keystore password and press **Enter**:

   ```
   Enter keystore password: PASSWORD
   ```

   where PASSWORD is the keystore password. The default is "changeit".

IMPORTANT

After the trusted public key certificate is installed, change the default keystore password, as described in "Changing the root keystore password" on page 77.

Creating a new key entry

After you delete the default `tomcat` key entry, create a new one that contains your company's information.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

     ```
     su -
     ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

     ```
     ssh-agent bash
     ssh-add ~admin/.ssh/dpnid
     ```

     b. When prompted, type the dpnid passphrase and press **Enter**.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single command line (no line feeds or returns allowed).

2. Run the keytool -genkeypair command by typing the following on a single command line:

   ```
   $JAVA_HOME/bin/keytool -genkeypair -keysize 1024 -alias tomcat
   -keyalg RSA
   ```

3. At the password prompt, type the keystore password and press **Enter**:

   ```
   Enter keystore password: PASSWORD
   ```

   where PASSWORD is the keystore password. The default is "changeit".

4. At each prompt, type the information described in the following table, and press **Enter** after each entry.

   Note: To accommodate individuals, the **keytool -genkeypair** command prompts for first and last name. However, in a corporate environment, this prompt should be answered with the fully qualified domain name (FQDN) of the Avamar utility node.

Table 15 Tomcat key fully qualified domain name information (page 1 of 2)

Field	Description
First and last name	Fully qualified domain name of the Avamar utility node.
Organizational unit	Organizational unit within the company that has authority over the host.
Organization	Name of the company.

Table 15 Tomcat key fully qualified domain name information (page 2 of 2)

Field	Description
City	City in which the host is located.
State	State in which the host is located.
Country	Country in which the host is located.

Generating a certificate signing request

To generate a certificate signing request (CSR) to send to a public certification authority (CA):

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single command line (no line feeds or returns allowed).

2. Create the CSR by typing the following command on a single command line:

   ```
   $JAVA_HOME/bin/keytool -certreq -keyalg RSA -alias tomcat -file
   tomcat.certrequest
   ```

3. At the password prompt, type the keystore password and press **Enter**:

   ```
   Enter keystore password: PASSWORD
   ```

   where PASSWORD is the keystore password. The default is “changeit”.

   A CSR named tomcat.certrequest is created in root’s home directory.

   The contents of tomcat.certrequest appear similar to the following excerpted example:

   ```
   -----BEGIN NEW CERTIFICATE REQUEST-----
   JIICpDCCAawCAQAwfzELMAkGA1UEBhMCVVMxETAPBgNVBAgTCENvbG9yYWRvMRMwEQY
   DVQQHEwpM
   ...
   3WRXIX2XDco8S0Lyf+Od5pASaRTc8SGWS6p8KSbqKrmdPVH5y0GonJp13va1iuY9vNN
   SQYM22+po
   rdVX0O/ULtuz9lJ2OA+9wAtYqN5Q8CEe18Vwlg==
   -----END NEW CERTIFICATE REQUEST-----
   ```

Obtaining a public key certificate

To apply for a public key certificate through a CA:

1. Contact a CA and apply for the public key certificate.

   The CA requests a copy of the CSR (tomcat.certrequest). The CA also requires the approval of the domain registrant listed for the Avamar utility node's domain. The domain registrant can be determined by using a domain lookup tool on the web.

   After you complete the CA application requirements, the CA provides a public key certificate that looks similar to the following excerpted example:

   ```
   -----BEGIN CERTIFICATE-----
   JIIEJDCCA42gAwIBAgIRAOiW1j5MGIPZ8zeLbNdSUPgwDQYJKoZIhvcNAQEFBQAw
   ...
   GorkhdbcBR5NVGq5UHB7sbKiDvbMuEf6Gwbier0mps7oEOMU8uh8v2rMTsXEuhtK
   csWTe/IxkOk=
   -----END CERTIFICATE-----
   ```

2. Open a command shell and log in using one of the following methods:

   - To log in to a single-node server:

     a. Log in to the server as admin.

     b. Switch user to root by typing:

     ```
     su -
     ```

   - To log in to a multi-node server:

     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

     ```
     ssh-agent bash
     ssh-add ~admin/.ssh/dpnid
     ```

     b. When prompted, type the dpnid passphrase and press **Enter**.

3. Save the public key certificate in root's home directory as tomcat.cert.

Importing chained or root certificates

You normally receive a chained or root certificate file along with the public key certificate.

Note: If you do not receive a chained or root certificate file with the public key certificate, skip this topic and proceed to "Importing the public key certificate" on page 76.

To import the chained or root certificate:

1. Open a command shell and log in using one of the following methods:

   - To log in to a single-node server:

     a. Log in to the server as admin.

     b. Switch user to root by typing:

     ```
     su -
     ```

- To log in to a multi-node server:

  a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

  ```
  ssh-agent bash
  ssh-add ~admin/.ssh/dpnid
  ```

  b. When prompted, type the dpnid passphrase and press **Enter**.

2. Open the chained or root certificate file in a text editor.

   The file contents are similar to the following excerpt of a chained certificate file, which contains two certificates:

   ```
   -----BEGIN CERTIFICATE-----
   MIIDdDCCAt2gAwIBAgIQJyzRkL6Balz4Y8X3iFwiFjANBgkqhkiG9w0BAQUFADCB
   ...
   69F7NxNQMf658Mkkx3Vv6+orEvHFqIw/Hx4uqmdBRpHy/cckaBcEqhJfew7IUFS+
   4KRrACEZFnBeaZQlTH8J7UqTThT7By2x
   -----END CERTIFICATE-----
   -----BEGIN CERTIFICATE-----
   MIIC5zCCAlACAQEwDQYJKoZIhvcNAQEFBQAwgbsxJDAiBgNVBAcTG1ZhbGlDZXJ0
   ...
   n0WuPIqpsHEzXcjFV9+vqDWzf4mH6eglkrh/hXqu1rweN1gqZ8mRzyqBPu3GOd/A
   PhmcGcwTTYJBtYze4D1gCCAPRX5ron+jjBXu
   -----END CERTIFICATE-----
   ```

3. Separate the chained or root certificate into individual certificate files using the BEGIN CERTIFICATE and END CERTIFICATE designations as the boundaries of each certificate. Save each with a distinguishing file name in root's home directory.

   For example, split the chained certificate shown in the previous step into two files, tomcat_chain1 and tomcat_chain2, and save each file in root's home directory.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single command line (no line feeds or returns allowed).

4. Import the certificate by typing the following command on a single command line:

   $JAVA_HOME/bin/keytool -importcert -trustcacerts -noprompt -file ~/*chained_certN* **-alias** *chained_certN*

   where *chained_certN* is a certificate file saved from the chained or root certificate that was received from the CA and *N* represents an integer identifier indicating that more than one certificate file was saved from the chained or root certificate.

5. At the password prompt, type the keystore password and press **Enter**:

   ```
   Enter keystore password: PASSWORD
   ```

   where PASSWORD is the keystore password. The default is "changeit".

   A message appears:

   ```
   Certificate was added to keystore
   ```

6. Repeat step 4 and step 5 for each individual certificate file derived from the chained or root certificate file.

Importing the public key certificate

To import the public key certificate that was saved as a result of the task "Obtaining a public key certificate" on page 74:

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single command line (no line feeds or returns allowed).

2. Import the certificate by typing the following command on a single command line:

   ```
   $JAVA_HOME/bin/keytool -importcert -trustcacerts -noprompt -file
   ~/tomcat.cert -alias tomcat
   ```

3. At the password prompt, type the keystore password and press **Enter**:

   ```
   Enter keystore password: PASSWORD
   ```

   where PASSWORD is the keystore password. The default is "changeit".

   A message appears:

   ```
   Certificate reply was installed in keystore
   ```

The trusted public key certificate is incorporated into the private key entry shared by the Tomcat servers of the Avamar services. It can be referenced using the "tomcat" alias.

Restarting services

Restart the services to make the public key certificate available for browser requests.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

- To log in to a multi-node server:
  a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

```
ssh-agent bash
ssh-add ~admin/.ssh/dpnid
```

  b. When prompted, type the dpnid passphrase and press **Enter**.

2. Restart the services by typing:

```
dpnctl stop ems
dpnctl start ems
dpnctl stop dtlt
dpnctl start dtlt
```

Changing the root keystore password

The default password of the root keystore is “changeit” and is commonly known. To secure the keystore and preserve the integrity of its keys, the keystore password should be changed.

The password for a Tomcat server’s private key entry must be identical to the keystore password. After changing the root keystore password, the password for the Tomcat server private key entry, created in “Install a trusted public key certificate” on page 71, should be changed to match the root keystore password.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

```
su -
```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

```
ssh-agent bash
ssh-add ~admin/.ssh/dpnid
```

     b. When prompted, type the dpnid passphrase and press **Enter**.

2. Change the root keystore password by typing the following command on a single command line:

```
$JAVA_HOME/bin/keytool -storepasswd
```

3. When prompted, type the old password and then the new password twice.
4. Change the Tomcat server private key entry’s password by typing the following command on a single command line:

```
$JAVA_HOME/bin/keytool -keypasswd -alias tomcat
```

IMPORTANT

The new key entry password must be identical to the keystore password.

5. When prompted, type the old password, and then twice type the new password.
6. Set the Tomcat server for Avamar Enterprise Manager to use the new password.
   a. Open /usr/local/avamar-tomcat/conf/server.xml in a plain-text editor.
   b. Find the Connector that contains the following attribute:

      ```
      port="8543"
      ```

   c. In that Connector, add the keystorePass attribute with the new password:

      ```
      keystorePass="newpassword"
      ```

      where *newpassword* is the same password used for the root keystore and the Tomcat server key entry.

      For example:

      ```
      <Connector ... port="8543" ... keystorePass="newpassword"/>
      ```

      where the ellipses represent other attributes in the Connector.

   d. Save and close the file.
7. Set the Tomcat server for Avamar Web Restore to use the new password.
   a. Open /usr/local/avamar-dtlt-tomcat/conf/server.xml in a plain-text editor.
   b. Find the Connector that contains the following attribute:

      ```
      port="8444"
      ```

   c. In that Connector, add the keystorePass attribute with the new password:

      ```
      keystorePass="newpassword"
      ```

      where *newpassword* is the same password used for the root keystore and the Tomcat server key entry.

   d. Save and close the file.
8. Restart the services by typing:

   ```
   dpnctl stop ems
   dpnctl start ems
   dpnctl stop dtlt
   dpnctl start dtlt
   ```

SSH authentication with Data Domain

If you store Avamar client backups on a Data Domain system, the Avamar Management Console Server (MCS) issues commands to a Data Domain system by using Secure Shell (SSH) commands. The commands retrieve information about the system, including serial number, disk capacity, CPU utilization, and so on.

The Data Domain system includes an SSH interface named DDSSH that allows commands to be issued remotely. DDSSH requires login credentials to establish a secure connection.

You can avoid the caching of a username and password for DDSSH by creating public/private keys on the Avamar server and exchanging the keys between the Data Domain system and the Avamar server for use by the MCS.

Providing authentication to Data Domain

To generate an SSH public/private key pair and send the public key to the Data Domain system:

1. Open a command shell and log in to the utility node of the Avamar server as admin.
2. Change to the .ssh directory by typing:

   cd ~/.ssh

3. Generate a public/private key pair by typing:

   ssh-keygen -b 3072 -t rsa -N "" -f *DDR_KEY*

   where *DDR_KEY* is the file name for the key. There is no passphrase for the key.

4. Log in to the Data Domain system by typing:

   ssh *AVAMAR_USER***@***DD_SYSTEM*

   where:

   - *AVAMAR_USER* is the name of the Avamar user on the Data Domain system.
   - *DD_SYSTEM* is the name of the Data Domain system.

5. Add the SSH public key to the SSH authorized keys file on the Data Domain system by typing:

   sysadmin@*DD_SYSTEM***# adminaccess add ssh-keys user** *AVAMAR_USER*

   where:

   - *DD_SYSTEM* is the name of the Data Domain system.
   - *AVAMAR_USER* is the name of the Avamar user on the Data Domain system.

6. Copy and paste the public key, which is the contents of the file ddr_key.pub, in /home/admin/.ssh:

   a. Open a second command shell and log in to the utility node of the Avamar server as admin.

   b. Change to the .ssh directory by typing:

      cd ~/.ssh

   c. Display the ddr_key.pub file by typing:

      cat ddr_key.pub

   d. Select and copy the contents of the file.

   e. Return to the first command shell window.

   f. Paste the contents of the file in /home/admin/.ssh.

7. Enter the key by pressing Ctrl+D.
8. Log in to the Avamar server as root.
9. Change directory to /usr/local/avamar/lib by typing:

   cd /usr/local/avamar/lib/

10. Copy the private key to /home/admin/.ssh/ddr_key, which is the path and name specified by ddr_ssh_key_path_name in the mcserver.xml file, by typing:

    cp /home/admin/.ssh/*DDR_KEY* **.**

    where *DDR_KEY* is the file name for the key.

11. Change the ownership of the key to the admin group by typing:

    chown root:admin *DDR_KEY*

    where *DDR_KEY* is the file name for the key.

12. Change the permissions for the key to 440 by typing:

    chmod 440 *DDR_KEY*

    where *DDR_KEY* is the file name for the key.

13. Modify the symmetric in-flight SSH traffic cipher to use a 128-bit key:

    ssh -c aes128-cbc *host_name***@***domain_name*

    where *host_name* is the hostname of the Data Domain system and *domain_name* is the domain name of the Data Domain system.

14. Test that you can log in to the Data Domain system without providing a password by typing:

    ssh -i *PATH/DDR_KEY AVAMAR_USER***@***DD_SYSTEM*

    where:

    - *PATH/DDR_KEY* is the path and file name of the key.
    - *AVAMAR_USER* is the name of the Avamar user on the Data Domain system.
    - *DD_SYSTEM* is the name of the Data Domain system.

CHAPTER 4
Data Security and Integrity

The following topics provide details on the options to provide security and ensure the integrity of data in the Avamar system:

Encrypting data

Avamar can encrypt all data sent between clients and the server "in flight." Each individual Avamar server can also be configured to encrypt data stored on the server "at rest."

Client/server "in-flight" encryption

To provide enhanced security during client/server data transfers, Avamar supports two levels of "in-flight" encryption: Medium and High. The exact encryption technology and bit strength used for any given client/server connection depends on a number of factors, including the client platform and Avamar server version. "Client/server encryption behavior" on page 83 provides details.

You specify the default encryption method to use for client/server data transfers (None, Medium, or High) when you create and edit groups. You also can override the group encryption method for a specific client on the Client Properties tab of the Edit Client dialog box, for a specific backup on the On Demand Backup Options dialog box, or for a specific restore on the Restore Options dialog box. The *EMC Avamar Administration Guide* provides details.

To enable encryption of data in transit, the Avamar server data nodes each require a unique public/private key pair and a signed X.509 certificate that is associated with the public key.

When the Avamar server is installed, a public/private key pair and a self-signed certificate are generated automatically in the /data01/home/admin directory on each Avamar server storage node and in the /usr/local/avamar/etc directory on the utility node. However, because self-signing is not recommended in production environments, you should generate and install a key and signed certificate from either a commercial or private CA. "Client/Server Access and Authentication" on page 33 provides instructions on how to do this, as well as how to configure both Windows and UNIX clients to validate the certificates from the Avamar server.

Note: You can also configure Avamar for two-way authentication, where the client requests authentication from the Avamar server, and then the Avamar server also requests authentication from the client. One-way, or server-to-client, authentication typically provides sufficient security. However, in some cases, two-way authentication is required or preferred.

The following steps detail the encryption and authentication process for client/server data transfers in a server-to-client authentication environment:

1. The Avamar client requests authentication from the Avamar server.
2. The server sends the appropriate certificate to the client. The certificate contains the public key.
3. The client verifies the server certificate and generates a random key, which is encrypted using the public key, and sends the encrypted message to the server.

4. The server decrypts the message by using its private key and reads the key generated by the client.
5. This random key is then used by both sides to negotiate on a set of temporary symmetric keys to perform the encryption. The set of temporary encryption keys is refreshed at a regular interval during the backup session.

IMPORTANT

If you store Avamar client backups on a Data Domain system, the connection between the Avamar client and the Data Domain system is not encrypted. The Data Domain Distributed Deduplication Bandwidth Optimized OST (DDBOOST) SDK, which Avamar uses to access the Data Domain system, does not support data encryption between the client and the Data Domain system.

Client/server encryption behavior

Client/server encryption functional behavior in any given circumstance is dependent on a number of factors, including the mcserver.xml encrypt_server_authenticate value, and the **avtar** encryption settings used during that activity.

The encrypt_server_authenticate value is set to true when you configure server-to-client authentication, as discussed in "Client/Server Access and Authentication" on page 33.

During backup and restore activities, you control client/server encryption by specifying an option flag pair: **--encrypt** and **--encrypt-strength**. The **--encrypt-strength** option takes one of three values: **None**, **Medium**, or **High**.

Increasing cipher strength used by Avamar servers

By default, the Management Console and Enterprise Manager servers support cipher strengths up to 128-bit. You can increase the cipher strength used by these servers to 256-bit for communications on the following ports:

- Ports 7778 and 7779 for the Management Console.
- Ports 8778 and 8779 for the Enterprise Manager.
- Port 9443 for the Management Console Web Services.

Increasing cipher strength for the Management Console

To increase the cipher strength used by the Management Console, do the following:

1. Set the rmi_cipher_strength parameter to high in the /usr/local/avamar/var/mc/server_data/prefs/mcserver.xml file:

   ```
   rmi_cipher_strength=high
   ```

2. Download and install the Java Cryptography Extension (JCE) Unlimited Strength Jurisdiction Policy Files 6:

   a. In a web browser, go to http://java.sun.com.

   b. Search for "Java Cryptography Extension."

   c. Download the file associated with Java Cryptography Extension (JCE) Unlimited Strength Jurisdiction Policy Files 6 (jce_policy-6.zip).

d. Unzip the jce_policy-6.zip file in a temporary folder and follow the instructions in the README.txt file to install.

3. Restart the Management Console Server by typing:

```
dpnctl stop mcs
dpnctl start
```

Increasing cipher strength for the Enterprise Manager

To increase the cipher strength used by the Enterprise Manager, do the following:

1. Set the rmi_cipher_strength parameter to high in the /usr/local/avamar/var/mc/server_data/prefs/emserver.xml file:

```
rmi_cipher_strength=high
```

2. Download and install the Java Cryptography Extension (JCE) Unlimited Strength Jurisdiction Policy Files 6:

   a. In a web browser, go to http://java.sun.com.

   b. Search for "Java Cryptography Extension."

   c. Download the file associated with Java Cryptography Extension (JCE) Unlimited Strength Jurisdiction Policy Files 6 (jce_policy-6.zip).

   d. Unzip the jce_policy-6.zip file in a temporary folder and follow the instructions in the README.txt file to install.

3. Restart the Enterprise Manager Server by typing:

```
dpnctl stop ems
dpnctl start ems
```

"At-rest" encryption

In addition to encrypting client/server data transfers, each server can be configured to encrypt data stored residing on it. This is called "at-rest" encryption.

When encryption is enabled, the server accepts a user-defined salt that is then used to generate an encryption key. The salt is stored on the Avamar server for subsequent encryption/decryption activities.

Key management is completely automatic:

- Old encryption keys are automatically stored in a secure manner so that data stripes encrypted with previous keys can always be decrypted and read.
- During server maintenance, crunched stripes will over time be converted to use the most current key.

Note that since any reads/writes from disk require encryption processing with this feature enabled, there is a performance impact to the Avamar server of approximately 33 percent.

Beginning with version 6.1, encryption is performed using AES 128 CFB. Older systems can continue to use 128-bit Blowfish until the salt is changed.

Data integrity

Checkpoints are system-wide backups taken for the express purpose of assisting with disaster recovery. Checkpoints are typically scheduled twice daily and validated once daily (during the maintenance window). You also can create and validate additional server checkpoints on an on-demand basis. The *EMC Avamar Administration Guide* provides details on creating, validating, and and deleting server checkpoints.

Checkpoint validation, which is also called an Avamar Hash Filesystem check (HFS check), is an internal operation that validates the integrity of a specific checkpoint. Once a checkpoint has passed an HFS check, it can be considered reliable enough to be used for a system rollback.

The actual process that performs HFS checks is **hfscheck**; it is similar to the UNIX **fsck** command.

You can schedule HFS checks by using Avamar Administrator. You also can manually initiate an HFS check by running **avmaint hfscheck** directly from a command shell.

An HFS check might take several hours depending on the amount of data on the Avamar server. For this reason, each validation operation can be individually configured to perform all checks (full validation) or perform a partial "rolling" check which fully validates all new and modified stripes, then partially checks a subset of unmodified stripes.

Initiating an HFS check requires significant amounts of system resources. To reduce contention with normal server operation, an HFS check can be throttled.

Additionally, during this time, the server is placed in read-only mode. Once the check has been initiated, normal server access is resumed. You can also optionally suspend command dispatches during this time, although this is not typically done.

If HFS check detects errors in one or more stripes, it automatically attempts to repair them.

Data erasure

When you manually delete a backup using Avamar Administrator or you automatically delete a backup when its retention policy expires and garbage collection runs, data is marked as deleted but is left on disk.

You can permanently and securely delete backups from an Avamar server in a manner that satisfies stringent security requirements by overwriting the data that is unique to a backup with random data. The following topics provide details on securely deleting backups from an Avamar server:

- "Requirements to securely delete backups" on page 86
- "How to securely delete backups" on page 87

Requirements to securely delete backups

Consider the following requirements for secure deletion of backups:

- You must be familiar with basic- to intermediate-level Avamar server terminology and command-line administration.
- Some steps to securely delete backups might require the use of third party tools such as the open-source srm or GNU shred utilities. The documentation for those utilities provides additional information regarding proper use, capabilities, and limitations of those utilities.
- Use of any non-certified storage hardware, including RAID controllers and disk storage arrays, might impact the effectiveness of the secure backup deletion. Consult the manufacturers of those devices for information about disabling or clearing write caches, or about any other features that impact data transfer to the storage media.
- The following conditions must be met in the Avamar environment:
  - All nodes must be in the ONLINE state, and no stripes should be in the OFFLINE state. This can be checked using the **status.dpn** command.
  - The most recent checkpoint must have been successfully validated.
  - Pending garbage collection operations can increase the time needed to complete the secure deletion process, or can cause extra data to be overwritten. Therefore, you should run garbage collection until all pending non-secure deletions have successfully completed. No errors should be reported by the garbage collection process.
  - The server should be idle:
    - There should be no backups in progress, nor should the server be running garbage collection or HFS checks.
    - The backup scheduler and maintenance windows scheduler should be stopped for the duration of the secure deletion process, so that no new backups or maintenance activities are initiated.
  - Avamar storage node ext3 file systems should not be configured to operate in data=journal mode. If this is the case, data might persist on the disk after the secure deletion process has completed.

How to securely delete backups

The **securedelete** program enables you to securely erase selected backups on the Avamar server.

This procedure can be used in conjunction with the existing procedures at a company to securely delete data from other parts of the operating system or hardware. Contact EMC Customer Support for any questions regarding the effect of company procedures on the Avamar server software.

1. 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, then load the admin OpenSSH key by typing:

     ```
     ssh-agent bash
     ssh-add ~admin/.ssh/admin_key
     ```

     When prompted, type the admin_key passphrase and press **Enter**.

     Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single command line (no line feeds or returns allowed).

2. Locate the backups to securely delete by typing the following command:

   ```
   securedelete getb --id=USER@AUTH --password=PASSWORD
    --account=DOMAIN/CLIENT
   ```

   where:
   - *USER* is the Avamar username.
   - *AUTH* is the authentication system used by that user (the default internal authentication domain is “avamar”).
   - *PASSWORD* is the password for the --id=*USER*@*AUTH* account.
   - *DOMAIN/CLIENT* is the full location of the client machine.
3. Locate the backup to delete in the list, and note the date in the created field.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single command line (no line feeds or returns allowed).

   IMPORTANT

   Do not interrupt the following securedelete delb command. If interrupted, all data will not be securely deleted.

4. Securely delete the backup by typing the following command:

   securedelete delb --account=*LOCATION* **--date=***DATE* **--id=***USER***@***AUTH* **--password=***PASSWORD*

   where:

   - *LOCATION* is the location of the backup, expressed as a file path relative to the current working directory. However, if the first character is a slash (/), the value is treated as an absolute file path.
   - *DATE* is the backup date noted in step 3.
   - *USER* is the Avamar username.
   - *AUTH* is the authentication system used by that user (the default internal authentication domain is "avamar").
   - *PASSWORD* is the password for the --id=*USER*@*AUTH* account.

   This operation typically takes several minutes to complete while the server securely overwrites data.

   If successful, the **securedelete delb** command returns the following response:

   ```
   1 Request succeeded
   ```

   If unsuccessful, the **securedelete delb** command returns the following response:

   ```
   0 ERROR! Exit code 0: Request failed.
   ```

5. If an error is encountered:
   - Search the knowledge base on EMC Online Support, for the specific error code.
   - If the required information is not found, engage EMC Customer Support using Live Chat, or create a Service Request as described in "Where to get help" on page 10.
6. Repeat step 2 – step 5 for all other backups that are to be securely deleted.
7. Check the server logs for any ERROR or WARN messages that might indicate a failure of the secure deletion operation by typing:

   mapall --noerror 'grep "ERROR\|WARN" /data01/cur/gsan.log*'

8. If any such messages are present:
   - Search the knowledge base on EMC Online Support, for the specific error code.
   - If the required information is not found, engage EMC Customer Support using Live Chat, or create a Service Request as described in "Where to get help" on page 10.

   If any stripes on the system have been repaired or rebuilt due to data corruption, then the bad versions remain on disk. Overwrite or securely delete these files by using an appropriate third-party tool.

9. Locate these stripes by typing:

   mapall --noerror 'ls /data??/cur/*.bad*'

   Information similar to the following appears in the command shell:

   ```
   /data06/cur/0000000300000016.0000000300000016.bad1240015157
   /data06/cur/0000000300000016.cdt.bad1240015157
   /data06/cur/0000000300000016.chd.bad1240015157
   /data06/cur/0000000300000016.wlg.bad1240015157
   ```

10. If backups were performed before the most recent checkpoint was taken, roll the server back to the most recent checkpoint, and repeat steps 2–9.

11. Repeat step 10 for all applicable checkpoints.

12. Repeat this entire procedure on all other Avamar servers to which this Avamar server replicates backups.

CHAPTER 5
System Monitoring, Auditing, and Logging

The following topics discuss the features available to monitor the Avamar environment and audit the operations performed. It also provides a list of log files that are available for each feature on each component in the system:

Client activity monitoring

You can monitor client backup, restore, and validation activity to verify backups are successfully completing and that no abnormal activity is occurring.

The Activity Monitor tab on the Activity window in Avamar Administrator provides details on client activity, including the type, status, start and end time, error code (if applicable), and other details for each client activity.

The *EMC Avamar Administration Guide* provides details on how to access the Activity Monitor tab and filter the activities that appear in the tab.

Server monitoring

There are several features available to assist you in monitoring the Avamar environment, including server status and system events.

Monitoring server status

You can monitor the status of the following items on the Avamar server:

- Overall Avamar server status
- Capacity usage
- Modules
- Nodes
- Partitions
- Checkpoints
- Garbage collection
- Maintenance activities

If you use a Data Domain system as storage for Avamar client backups, you also can monitor CPU, disk activity, and network activity for each node on the Data Domain system.

This status information is provided on the tabs in the Avamar Server window in Avamar Administrator. The *EMC Avamar Administration Guide* provides details on how to access the Avamar Server window and the information available on each tab.

Monitoring system events

All Avamar system activity and operational status is reported as various events to the MCS. Examples of various Avamar events include client registration and activation, successful and failed backups, hard disk status, and others.

Events are listed in the Event Management tab in the Administration window of Avamar Administrator. The *EMC Avamar Administration Guide* provides details on how to access the Event Management tab and filter the events that appear in the tab.

Event notification mechanisms

You can also configure Avamar to notify you when events occur. There are several features and functions available.

Pop-up alerts

Events can be configured on an event-by-event basis to generate a graphical pop-up alert each time one of those events occurs. One significant limitation of this feature is that Avamar Administrator software must be running in order for the pop-up alerts to be displayed.

Acknowledgement required list

Events can be configured on an event-by-event basis such that when events of this type occur, an entry is added to a list of events that requires interactive acknowledgement by the Avamar system administrator.

Email messages

Events can be configured on an event-by-event basis to send an email message to a designated list of recipients. Email notifications can be sent immediately or in batches at regularly scheduled times.

Syslog support

Events can be configured on an event-by-event basis to log information to local or remote syslog files based on filtering rules configured for the syslog daemon receiving the events. Third-party monitoring tools and utilities capable of examining log entries can access the syslog files and process them to integrate Avamar event information into larger site activity and status reports.

NOTICE

For maximum security, EMC recommends implementing remote syslog monitoring as described in the *EMC Avamar Administration Guide*.

SNMP support

Simple Network Management Protocol (SNMP) is a protocol for communicating monitoring and event notification information between an application, hardware device or software application, and any number of monitoring applications or devices. The Avamar SNMP implementation provides two distinct ways to access Avamar server events and activity completion status:

- SNMP requests provide a mechanism for SNMP management applications to “pull” information from a remote SNMP-enabled client (in this case, the Avamar server).
- SNMP traps provide a mechanism for the Avamar server to “push” information to SNMP management applications whenever designated Avamar events occur. Events can be configured on an event-by-event basis to output SNMP traps.

Avamar also can collect and display data for health monitoring, system alerts, and capacity reporting on a configured Data Domain system by using SNMP. The *EMC Avamar and EMC Data Domain System Integration Guide* provides details on how to configure SNMP for Avamar with Data Domain.

ConnectEMC support

Events can be configured on an event-by-event basis to send a notification message directly to EMC Customer Support using ConnectEMC.

The *EMC Avamar Administration Guide* provides details on how to configure each of these notification mechanisms.

Event notification profiles

Profiles are a notification management feature that are used to logically group certain event codes together and specify which notifications should be generated when these events occur. You can create custom profiles to organize system events and generate the desired notifications when any of those events occur. The *EMC Avamar Administration Guide* provides details on how to create and manage profiles.

Email home notification

When fully configured and enabled, the “email home” feature automatically emails the following information to EMC Customer Support twice daily:

- Status of the daily data integrity check
- Selected Avamar server warnings and information messages
- Any Avamar server errors
- Any RAID errors (single-node servers only)

By default, these email messages are sent at 6 a.m. and 3 p.m. each day (based on the local time on the Avamar server). The timing of these messages is controlled by the Notification Schedule.

The *EMC Avamar Administration Guide* provides details on how to enable and schedule the email home feature.

Auditing

The Avamar Audit Log provides details on the operations initiated by users in the Avamar system. The data in this log allows enterprises that deploy Avamar to enforce security policies, detect security breaches or deviation from policies, and hold appropriate users accountable for those actions. The audit log includes the following information for each operation:

- The date and time the action occurred
- The event code number associated with the action
- The ID and role of the user that initiated the action
- The product and component from which the action was initiated
- The severity of the action
- The domain in which the action occurred

The Audit Log is available in Avamar Administrator as a subtab of the Event Management tab in the Administration window. The *EMC Avamar Administration Guide* provides details on how to access the Audit Log and filter the events that appear in the log.

Gen4 and later Avamar Data Stores running the SUSE Linux Enterprise Server (SLES) operating system implement improved auditing features, such as Advanced Intrusion Detection Environment (AIDE) and the **auditd** service. "Many Level-1 security hardening features are part of the base SUSE Enterprise Linux Server (SLES) operating system on Gen4 and later Avamar Data Stores." on page 102 and "Auditing service (auditd)" on page 103 provide detailed information about those features.

Logs

Avamar software includes log files for server and client components, maintenance tasks, various utilities, and backup clients. These log files enable you to examine various aspects of the Avamar system.

The following sections includes log file information organized in tables for each Avamar component. For additional information on log files, refer to the Avamar guide for the specific component.

Single-node server

The following table lists single-node server log files.

Table 16 Single-node server log files (page 1 of 3)

Feature/function	Log file locations
Avamar Administrator server	/usr/local/avamar/var/mc/server_log/flush.log
	/usr/local/avamar/var/mc/server_log/restore.log
	/usr/local/avamar/var/mc/server_log/mcserver.log.#
	/usr/local/avamar/var/mc/server_log/mcserver.out
	/usr/local/avamar/var/mc/server_log/pgsql.log
	/usr/local/avamar/var/mc/server_data/postgres/data/pg_log/postgresql-DATE_TIME.log
	/usr/local/avamar/var/mc/server_data/mcs_data_dump.sql
Avamar Enterprise Manager (Tomcat)	/usr/local/avamar/var/em/webapp_log/admin.DATE.log
	/usr/local/avamar/var/em/webapp_log/catalina.DATE.log
	/usr/local/avamar/var/em/webapp_log/catalina.out
	/usr/local/avamar/var/em/webapp_log/host-manager.DATE.log
	/usr/local/avamar/var/em/webapp_log/localhost.DATE.log
	/usr/local/avamar/var/em/webapp_log/manager.DATE.log

Table 16 Single-node server log files (page 2 of 3)

Feature/function	Log file locations
Avamar Enterprise Manager (Server)	/usr/local/avamar/var/em/server_log/flush.log
	/usr/local/avamar/var/em/server_log/restore.log
	/usr/local/avamar/var/em/server_log/emserver.log.#
	/usr/local/avamar/var/em/server_log/emserver.out
	/usr/local/avamar/var/em/server_log/pgsql.log
	/usr/local/avamar/var/em/server_data/postgres/data/pg_log/postgresql-DATE_TIME.log
	/usr/local/avamar/var/em/server_data/ems_data_dump.sql
Maintenance tasks	/usr/local/avamar/var/cron/clean_emdb.log
	/usr/local/avamar/var/cron/dpn_crontab.log
	/usr/local/avamar/var/cron/cp.log
	/usr/local/avamar/var/cron/gc.log
	/usr/local/avamar/var/cron/hfscheck.log
	/usr/local/avamar/var/cron/ntpd_keepalive_cron.log
	/usr/local/avamar/var/cron/ntpd_keepalive_cron.log.#
	/usr/local/avamar/var/cron/suspend.log
avw_install utility	/usr/local/avamar/var/avw_cleanup.log
	/usr/local/avamar/var/avw_install.log
	/usr/local/avamar/var/avw-time.log
	/usr/local/avamar/var/log/dpnavwinstall-VERSION.log
axion_install utility	/usr/local/avamar/var/axion_install_DATE_TIME.log
Avamar File System (AvFS)	/usr/local/avamar/var/axionfs.log
change-passwords utility	/usr/local/avamar/var/change-passwords.log
ddrmaint utility	/usr/local/avamar/var/log/ddrmaint.log
dpnctl utility	/usr/local/avamar/var/log/dpnctl.log
dpnnetutil utility	/usr/local/avamar/var/log/dpnnetutil-version.log
	/usr/local/avamar/var/log/dpnnetutil.log*
	/usr/local/avamar/var/log/dpnnetutilbgaux.log
	/usr/local/avamar/var/log/dpnnetutilbgaux-stdout-stderr.log
permctl utility	/usr/local/avamar/var/log/permctl.log

Table 16 Single-node server log files (page 3 of 3)

Feature/function	Log file locations
resite utility	/usr/local/avamar/var/dpnresite-version.log
	/usr/local/avamar/var/mcspref.log
	/usr/local/avamar/var/nataddr.log
	/usr/local/avamar/var/smtphost.log
timedist utility	/usr/local/avamar/var/timedist.log
timesyncmon program	/usr/local/avamar/var/timesysncmon.log
Avamar Replicator	/usr/local/avamar/var/cron/replicate.log
Avamar license server	/usr/local/avamar/var/ascd-PORT.log
Storage server log	/data01/cur/err.log
	/data01/cur/gsan.log

Utility node

The following table lists utility node log files.

Table 17 Utility node log files (page 1 of 3)

Feature/function	Log file locations
Avamar Administrator server	/usr/local/avamar/var/mc/server_log/flush.log
	/usr/local/avamar/var/mc/server_log/restore.log
	/usr/local/avamar/var/mc/server_log/mcddrssh.log
	/usr/local/avamar/var/mc/server_log/mcddrsnmp.out
	/usr/local/avamar/var/mc/server_log/mcddrsnmp.log
	/usr/local/avamar/var/mc/server_log/mcserver.log.#
	/usr/local/avamar/var/mc/server_log/mcserver.out
	/usr/local/avamar/var/mc/server_log/pgsql.log
	/usr/local/avamar/var/mc/server_data/postgres/data/pg_log/postgresql-DATE_TIME.log
	/usr/local/avamar/var/mc/server_data/mcs_data_dump.sql
Avamar Enterprise Manager (Tomcat)	/usr/local/avamar/var/em/webapp_log/admin.DATE.log
	/usr/local/avamar/var/em/webapp_log/catalina.DATE.log
	/usr/local/avamar/var/em/webapp_log/catalina.out
	/usr/local/avamar/var/em/webapp_log/host-manager.DATE.log
	/usr/local/avamar/var/em/webapp_log/localhost.DATE.log
	/usr/local/avamar/var/em/webapp_log/manager.DATE.log

Table 17 Utility node log files (page 2 of 3)

Feature/function	Log file locations
Avamar Enterprise Manager (Server)	/usr/local/avamar/var/em/server_log/flush.log
	/usr/local/avamar/var/em/server_log/restore.log
	/usr/local/avamar/var/em/server_log/emserver.log.#
	/usr/local/avamar/var/em/server_log/emserver.out
	/usr/local/avamar/var/em/server_log/pgsql.log
	/usr/local/avamar/var/em/server_data/postgres/data/pg_log/postgresql-DATE_TIME.log
	/usr/local/avamar/var/em/server_data/ems_data_dump.sql
Maintenance tasks	/usr/local/avamar/var/cron/clean_emdb.log
	/usr/local/avamar/var/cron/dpn_crontab.log
	/usr/local/avamar/var/cron/cp.log
	/usr/local/avamar/var/cron/gc.log
	/usr/local/avamar/var/cron/hfscheck.log
	/usr/local/avamar/var/cron/ntpd_keepalive_cron.log
	/usr/local/avamar/var/cron/ntpd_keepalive_cron.log.#
	/usr/local/avamar/var/cron/suspend.log
avw_install utility	/usr/local/avamar/var/avw_cleanup.log
	/usr/local/avamar/var/avw_install.log
	/usr/local/avamar/var/avw-time.log
	/usr/local/avamar/var/log/dpnavwinstall-VERSION.log
axion_install utility	/usr/local/avamar/var/axion_install_DATE_TIME.log
Avamar File System (AvFS)	/usr/local/avamar/var/axionfs.log
change-passwords utility	/usr/local/avamar/var/change-passwords.log
ddrmaint utility	/usr/local/avamar/var/log/ddrmaint.log
dpnctl utility	/usr/local/avamar/var/log/dpnctl.log
dpnnetutil utility	/usr/local/avamar/var/log/dpnnetutil-version.log
	/usr/local/avamar/var/log/dpnnetutil.log*
	/usr/local/avamar/var/log/dpnnetutilbgaux.log
	/usr/local/avamar/var/log/dpnnetutilbgaux-stdout-stderr.log
permctl utility	/usr/local/avamar/var/log/permctl.log
timedist utility	/usr/local/avamar/var/timedist.log
timesyncmon program	/usr/local/avamar/var/timesysncmon.log

Table 17 Utility node log files (page 3 of 3)

Feature/function	Log file locations
Avamar Replicator	/usr/local/avamar/var/cron/replicate.log
Avamar license server	/usr/local/avamar/var/ascd-PORT.log
switch_monitoring utility	/usr/local/avamar/var/log/switch_monitoring.log

Storage node

The following table lists storage node log files.

Table 18 Storage node log files

Feature/function	Log file locations
Storage server log	/data01/cur/err.log
	/data01/cur/gsan.log
dpnnetutil utility	/usr/local/avamar/var/log/dpnnetutilbgaux-stdout-stderr.log
	/usr/local/avamar/var/log/dpnnetutilbgaux.log
Maintenance tasks	/usr/local/avamar/var/ntpd_keepalive_cron.log*
timesyncmon program	/usr/local/avamar/var/timesyncmon.log*

Spare node

The following table lists spare node log files.

Table 19 Spare node log files

Feature/function	Log file locations
dpnnetutil utility	/usr/local/avamar/var/log/dpnnetutilbgaux-stdout-stderr.log
	/usr/local/avamar/var/log/dpnnetutilbgaux.log

Avamar NDMP Accelerator

The following table lists Avamar NDMP Accelerator log files.

Table 20 Avamar NDMP Accelerator log files

Feature/function	Log file locations
avndmp log	/usr/local/avamar/var/{FILER-NAME}/*.avndmp.log
dpnnetutil utility	/usr/local/avamar/var/log/dpnnetutilbgaux-stdout-stderr.log
	/usr/local/avamar/var/log/dpnnetutilbgaux.log

Access node

The following table lists access node log files.

Table 21 Access node log files

Feature/function	Log file locations
dpnnetutil utility	/usr/local/avamar/var/log/dpnnetutilbgaux-stdout-stderr.log
	/usr/local/avamar/var/log/dpnnetutilbgaux.log

Avamar Administrator client network host

The following table lists Avamar Administrator client network host log files.

Table 22 Avamar Administrator client network host log files

Feature/function	Operating system	Log file locations
Avamar Administrator management console	Windows 7	C:\Users\USERNAME\.avamardata\var\mc\gui_log
	Windows Vista Windows XP	C:\Documents and Settings\USERNAME\.avamardata\var\mc\gui_log
	Linux	$HOME/.avamardata/var/mc/gui_log/mcclient.log.0
Avamar Administrator management console command line interface	UNIX	$HOME/.avamardata/var/mc/gui_log/mccli.log.0

Backup client network host

The following table lists backup client network host log files.

Table 23 Backup client network host log files

Feature/function	Log file locations
Client **avagent** process (all clients)	C:\Program Files\avs\var\avagent.log
Client **avtar** process (all clients)	C:\Program Files\avs\var\{WORKORDER-ID}.alg
	C:\Program Files\avs\var\{WORKORDER-ID}.log
Avamar Client for Windows tray applet	C:\Program Files\avs\var\avscc.log
Avamar Plug-in for DB2	/usr/local/avamar/var/{WORKORDER-ID}.log
Avamar Exchange Client	/usr/local/avamar/var/{WORKORDER-ID}.log
Avamar NDMP Accelerator	/usr/local/avamar/var/{WORKORDER-ID}.log
Avamar Client for NetWare	/usr/local/avamar/var/{WORKORDER-ID}.log
Avamar Plug-in for Oracle	/usr/local/avamar/var/{WORKORDER-ID}.log
Avamar Plug-in for SQL Server	/usr/local/avamar/var/{WORKORDER-ID}.log

CHAPTER 6
Server Security Hardening

The following topics describe various server security hardening features, which are available for Avamar 6.0 and later servers running the SUSE Linux Enterprise Server (SLES) operating system:

Overview

STIG compliance

Beginning with version 6.0, Avamar servers running the SLES operating system offer a number of improved security features, which are primarily targeted for customers needing to comply with US Department of Defense (DoD) *Security Technical Implementation Guide (STIG) for Unix* requirements.

In addition, Appendix C, "IAO Information" provides STIG mandated information for Information Assurance Officers.

Server security hardening levels

The server security hardening features are grouped in increasingly more secure levels. Select a level of security appropriate for your organization, and make the changes in that level and any level beneath it. For example, level-3 security requires all changes described in level-1 and level-2 in addition to those described in level-3.

Level-1 security hardening

Many Level-1 security hardening features are part of the base SUSE Enterprise Linux Server (SLES) operating system on Gen4 and later Avamar Data Stores.

Level-1 features included in the base SUSE Enterprise Linux Server (SLES) operating system on Gen4 and later Avamar Data Stores:

- "Advanced Intrusion Detection Environment (AIDE)" on page 103
- "Auditing service (auditd)" on page 103
- "sudo implementation" on page 104
- "Command logging" on page 105

Additional level-1 security hardening tasks:

- "Locking down single-user mode on RHEL servers" on page 105
- "Disabling Samba" on page 106
- "Remove weak ciphers from Apache web server" on page 107
- "Force strong encryption for Java and Tomcat connections" on page 108
- "Removing suid bit from non-essential system binaries on RHEL" on page 111
- "Preventing unauthorized access to GRUB configuration" on page 112

Advanced Intrusion Detection Environment (AIDE)

The Advanced Intrusion Detection Environment (AIDE) is a SLES feature that is used to take a snapshot of an Avamar server configuration for purposes of establishing a reliable system baseline reference.

AIDE is a level-1 hardening feature that is implemented as part of the base SLES operating system on Gen4 and later Avamar Data Stores.

AIDE satisfies the STIG requirements in the following table.

Table 24 STIG requirements satisfied by AIDE

Requirement ID	Requirement title
GEN000140	Create and maintain system baseline
GEN000220	System baseline for system libraries and binaries checking
GEN002260	System baseline for device files checking
GEN002380	SUID files baseline
GEN002400	System baseline for SUID files checking
GEN002440	SGID files baseline
GEN002460	System baseline for SGID files checking

The system baseline snapshot is stored in /var/lib/aide/aide.db.

AIDE reports are run weekly as part of the /etc/cron/weekly cron job.

AIDE output is logged to /var/log/secure.

Auditing service (auditd)

The **auditd** service is a SLES feature that implements a CAPP-compliant (Controlled Access Protection Profiles) auditing feature, which continually monitors the server for any changes that could affect the server's ability to perform as intended. The **auditd** service writes log output in /var/log/audit/audit.log.

The **auditd** service is a level-1 hardening feature that is implemented as part of the base SLES operating system on Gen4 and later Avamar Data Stores.

The **auditd** service feature satisfies the STIG requirements in the following table.

Table 25 STIG requirements satisfied by the auditd service (page 1 of 2)

Requirement ID	Requirement title
GEN002660	Configure and implement auditing
GEN002680	Audit logs accessibility
GEN002700	Audit Logs Permissions
GEN002720	Audit Failed File and Program Access Attempts
GEN002740	Audit File and Program Deletion
GEN002760	Audit Administrative, Privileged, and Security Actions

Table 25 STIG requirements satisfied by the auditd service (page 2 of 2)

Requirement ID	Requirement title
GEN002800	Audit Login, Logout, and Session Initiation
GEN002820	Audit Discretionary Access Control Permission Modifications
GEN002860	Audit Logs Rotation

sudo implementation

The **sudo** command is an alternative to direct root login. On Gen4 and later Avamar Data Stores, the admin and dpn user accounts are automatically added to the sudoers file. This enables admin and dpn users to execute commands that would otherwise require operating system root permission.

Implementation of the **sudo** command for admin and dpn users is a level-1 hardening feature that is implemented as part of the base SLES operating system on Gen4 and later Avamar Data Stores.

Implementation of the **sudo** command for admin and dpn users satisfies the STIG requirements in the following table.

Table 26 STIG requirements satisfied by the implementation of sudo

Requirement ID	Requirement title
GEN000260	Shared Account Documentation
GEN000280	Shared Account Direct Logon
GEN001100	Encrypting Root Access
GEN001120	Encrypting Root Access

Prefixing commands with “sudo”

Instead of switching user to root with the **su** command, admin and dpn users can directly issue commands normally requiring root permissions by prefixing each command with **sudo**. For example, the following command installs MyPackage.rpm:

```
sudo rpm -ivh MyPackage.rpm
```

If prompted for a password, type the password and press **Enter**.

You might be periodically prompted to retype your admin or dpn password when prefixing other commands with **sudo**. This is normal.

Spawning a sudo Bash subshell

If you need to execute several commands normally requiring root permissions, you can also spawn a persistent **sudo** Bash subshell by typing **sudo bash**.

Commands normally requiring root permissions can now be typed directly with no additional modifications to the command line syntax. For example:

```
sudo bash
rpm -ivh MyPackage1.rpm
rpm -ivh MyPackage2.rpm
rpm -ivh MyPackage3.rpm
exit
```

Command logging

Gen4 and later Avamar Data Stores log all Bash shell commands issued by any user.

Bash command logging is a level-1 hardening feature that is implemented as part of the base SLES operating system on Gen4 and later Avamar Data Stores.

Bash command logging does not satisfy any particular STIG requirements. It is intended to be used as a generalized debugging and forensics tool.

Locking down single-user mode on RHEL servers

For RHEL servers, limit access in single-user mode to the root user. This task is not required on SLES servers.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Create a backup copy of /etc/inittab.
   - Single-node server:

     ```
     cp -p /etc/inittab /etc/inittab.backup
     ```

   - Multi-node server:

     ```
     mapall --all --user=root "cp /etc/inittab /etc/inittab.backup"
     ```

3. Open /etc/inittab in a plain text editor.

4. Add the following line in the sequence shown.

   Change:

   ```
   # System initialization.
   si::sysinit:/etc/rc.d/rc.sysinit
   ```

   To:

   ```
   # System initialization.
   si::sysinit:/etc/rc.d/rc.sysinit
   ss:S:respawn:/sbin/sulogin
   ```

5. Save and quit the file.
6. (Multi-node system only) Copy the changes made to /etc/inittab to all nodes.

   ```
   cd /etc
   mapall --all --user=root copy inittab
   mapall --all --user=root "cp /root/inittab /etc/inittab"
   mapall --all --user=root "rm -f /root/inittab"
   ```

Disabling Samba

For RHEL servers, and SLES servers with the optional Samba packages installed, disable Samba. This prevents the use of Samba commands to obtain valid local and domain usernames and to obtain the Avamar server's browse list. The browse list is a list of the computers nearest to the Avamar server.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press Enter.
2. Disable Samba.
   - Single-node system:

     ```
     service smb stop
     chkconfig smb off
     ```

   - Multi-node system:

     ```
     mapall --all --user=root "service smb stop"
     mapall --all --user=root "chkconfig smb off"
     ```

Samba is disabled and will not start when the Avamar system boots.

Remove weak ciphers from Apache web server

Modify the cipher suite used by the Apache web server to remove weak ciphers.

Removing weak ciphers on SLES computers

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        su -

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. In a plain-text editor, edit /etc/apache2/vhosts.d/vhost-ssl.conf.

   Note: Space limitations in this guide cause the entries in the next step to continue (wrap) to more than one line. Type the replacement entry on a single line (no line feeds or returns allowed).

3. Change the following line as shown here.

   Change:

   ```
   SSLCipherSuite
   HIGH:MEDIUM:!ADH:!EXPORT56:RC4+RSA:+SSLv2:+EXP:+eNULL:!MD5:!
   CAMELLIA
   ```

   To:

   ```
   SSLCipherSuite
   ALL:!aNULL:!ADH:!eNULL:!LOW:!EXP:RC4+RSA:+HIGH:+MEDIUM
   ```

4. Save and close the file.
5. Type the following commands to restart the Apache web server:

   /etc/init.d/apache2 stop
   /etc/init.d/apache2 start

Removing weak ciphers on RHEL computers

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        su -

- To log in to a multi-node server:
  a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

     ```
     ssh-agent bash
     ssh-add ~admin/.ssh/dpnid
     ```

  b. When prompted, type the dpnid passphrase and press **Enter**.

2. In a plain text editor, edit /etc/httpd/conf.d/ssl.conf.

   Note: Space limitations in this guide cause the entries in the next step to continue (wrap) to more than one line. Type the replacement entry on a single line (no line feeds or returns allowed).

3. Change the following line as shown here.

   Change:

   ```
   SSLCipherSuite HIGH:MEDIUM:!NULL:+SHA1:+MD5:+HIGH:+MEDIUM:!MD5:!ADH
   ```

   To:

   ```
   SSLCipherSuite
   ALL:!aNULL:!ADH:!eNULL:!LOW:!EXP:RC4+RSA:+HIGH:+MEDIUM
   ```

4. Save and close the file.
5. Type the following commands to restart the Apache web server:

   ```
   /etc/init.d/httpd stop
   /etc/init.d/httpd start
   ```

Force strong encryption for Java and Tomcat connections

Web browser connections made to Avamar's Java and Apache Tomcat servers normally accept the SSL 2.0 protocol. This permits web browsers that use SSL 2.0 to make an HTTPS connection. By default, Internet Explorer 8 (IE8) uses SSL 2.0 for HTTPS connections.

The SSL 2.0 protocol is flawed and is a security risk. Eliminate this risk by configuring Avamar's Java and Apache Tomcat servers to require all connections to use SSL 3.0 protocols and the TLS 1.0, 1.1, and 1.2 protocols.

After changes are made to prohibit SSL 2.0 connections, web browsers such as IE8 must be configured to use only SSL 3.0 protocols and the TLS 1.0, 1.1, and 1.2 protocols. This change can be accomplished by pushing out a new domain Group Policy or by manually changing the setting in each web browser.

NOTICE

Removing SSL_DHE_DSS_WITH_3DES_EDE_CBC_SHA encryption prevents strict compliance with the TLS protocol. However, removing this encryption is required in order to enforce a minimum encryption strength of 128 bits.

Forcing strong encryption for Java connections

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. Stop the Java component by typing:

   mcserver.sh --stop
3. Open /usr/local/avamar/var/mc/server_data/prefs/mcserver.xml in a plain text editor.

   Note: Space limitations in this guide cause the entries in the next step to continue (wrap) to more than one line. Type the replacement entry on a single line (no line feeds or returns allowed).
4. Change the value of the cipher_suite_128 key.

   Change:

   ```
   <entry key="cipher_suite_128"
   value="TLS_RSA_WITH_AES_128_CBC_SHA,TLS_DHE_RSA_WITH_AES_128_CBC_SH
   A,TLS_DHE_DSS_WITH_AES_128_CBC_SHA,SSL_RSA_WITH_3DES_EDE_CBC_SHA,SS
   L_DHE_RSA_WITH_3DES_EDE_CBC_SHA,SSL_DHE_DSS_WITH_3DES_EDE_CBC_SHA"
   />
   ```

   To:

   ```
   <entry key="cipher_suite_128"
   value="TLS_RSA_WITH_AES_128_CBC_SHA,TLS_DHE_RSA_WITH_AES_128_CBC_SH
   A,TLS_DHE_DSS_WITH_AES_128_CBC_SHA " />
   ```
5. Save and close the file.
6. Restart the Java component by typing:

   mcserver.sh --start

Forcing strong encryption for Apache Tomcat connections

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        su -
   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid

     b. When prompted, type the dpnid passphrase and press **Enter**.

2. Stop the emwebapp Tomcat components by typing:

   emwebapp.sh --stop

3. Open /usr/local/avamar-tomcat/conf/server.xml in a plain text editor.

   Note: Space limitations in this guide cause the entries in the next step to continue (wrap) to more than one line. Type the replacement entry on a single line (no line feeds or returns allowed).

4. Change value of the SSL connector as shown.

   Change:

   ```
   <Connector SSLEnabled="true" Server="Avamar"
   ciphers="SSL_RSA_WITH_RC4_128_MD5,SSL_RSA_WITH_RC4_128_SHA,TLS_RSA_
   WITH_AES_128_CBC_SHA,TLS_DHE_RSA_WITH_AES_128_CBC_SHA,TLS_DHE_DSS_W
   ITH_AES_128_CBC_SHA,SSL_RSA_WITH_3DES_EDE_CBC_SHA,SSL_DHE_RSA_WITH_
   3DES_EDE_CBC_SHA,SSL_DHE_DSS_WITH_3DES_EDE_CBC_SHA,TLS_KRB5_WITH_RC
   4_128_SHA,TLS_KRB5_WITH_RC4_128_MD5,TLS_KRB5_WITH_3DES_EDE_CBC_SHA,
   TLS_KRB5_WITH_3DES_EDE_CBC_MD5" clientAuth="false"
   maxKeepAliveRequests="1" maxThreads="150" port="8543"
   protocol="org.apache.coyote.http11.Http11NioProtocol"
   scheme="https" secure="true" sslProtocol="TLS"/>
   ```

   To:

   ```
   <Connector SSLEnabled="true" Server="Avamar" ciphers="
   TLS_RSA_WITH_AES_128_CBC_SHA,TLS_DHE_RSA_WITH_AES_128_CBC_SHA,TLS_D
   HE_DSS_WITH_AES_128_CBC_SHA" clientAuth="false"
   maxKeepAliveRequests="1" maxThreads="150" port="8543"
   protocol="org.apache.coyote.http11.Http11NioProtocol"
   scheme="https" secure="true" sslProtocol="TLS"/>
   ```

5. Save and close the file.

6. Restart the emwebapp Tomcat components by typing:

   emwebapp.sh --start

7. Return the active account to admin by typing:

   su admin

8. Stop the emserver Tomcat components by typing:

   emserver.sh --stop

9. Open /usr/local/avamar/var/em/server_data/prefs/emserver.xml in a plain text editor.

   Note: Space limitations in this guide cause the entries in the next step to continue (wrap) to more than one line. Type the replacement entry on a single line (no line feeds or returns allowed).

10. Change value of the cipher_suite_128 key as shown.

    Change:

    ```
    <entry key="cipher_suite_128"
    value="SSL_RSA_WITH_RC4_128_MD5,SSL_RSA_WITH_RC4_128_SHA,TLS_RSA_WI
    TH_AES_128_CBC_SHA,TLS_DHE_RSA_WITH_AES_128_CBC_SHA,TLS_DHE_DSS_WIT
    H_AES_128_CBC_SHA,SSL_RSA_WITH_3DES_EDE_CBC_SHA,SSL_DHE_RSA_WITH_3D
    ES_EDE_CBC_SHA,SSL_DHE_DSS_WITH_3DES_EDE_CBC_SHA,TLS_KRB5_WITH_RC4_
    128_SHA,TLS_KRB5_WITH_RC4_128_MD5,TLS_KRB5_WITH_3DES_EDE_CBC_SHA,TL
    S_KRB5_WITH_3DES_EDE_CBC_MD5" />
    ```

    To:

    ```
    <entry key="cipher_suite_128"
    value="TLS_RSA_WITH_AES_128_CBC_SHA,TLS_DHE_RSA_WITH_AES_128_CBC_SH
    A,TLS_DHE_DSS_WITH_AES_128_CBC_SHA " />
    ```

11. Save and close the file.
12. Restart the emserver Tomcat components by typing:

    emserver.sh --start

Configuring IE8 to use strong encryption

1. Start IE8.
2. On the menu bar, click **Tools** › **Internet Options**.
3. Select the **Advanced** tab.
4. Clear **Use SSL 2.0**.
5. Select **Use SSL 3.0**.
6. Select **Use TLS 1.0**.
7. Select **Use TLS 1.1**.
8. Select **Use TLS 1.2**.
9. Click **OK**.

Removing suid bit from non-essential system binaries on RHEL

Remove the suid bit from non-essential system binaries to prevent them from running with elevated permissions.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        su -

- To log in to a multi-node server:
  a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

     ```
     ssh-agent bash
     ssh-add ~admin/.ssh/dpnid
     ```

  b. When prompted, type the dpnid passphrase and press **Enter**.

2. Type the following commands:

   ```
   chmod u-s /sbin/pam_timestamp_check
   chmod u-s /opt/dell/srvadmin/oma/bin/omcliproxy
   chmod u-s /usr/lib64/squid/pam_auth
   ```

Preventing unauthorized access to GRUB configuration

Changes to the configuration file of GNU GRUB bootloader (GRUB) can change the startup configuration of the Avamar system. Install an encrypted password to prevent unauthorized changes to this file.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.

2. Start the encryption application.
   - On RHEL:

     ```
     /sbin/grub-md5-crypt
     ```

   - On SLES:

     ```
     /usr/sbin/grub-md5-crypt
     ```

3. When prompted, type the password for GRUB.

   The MD5 hash of the password appears.

4. Copy and save the MD5 hash.
5. In a plain text editor, edit /boot/grub/menu.1st.
6. Below the timeout line in the file, add:

   password --md5 PASSWORD-HASH

   where PASSWORD-HASH is the MD5 hash from step 3.

7. Save and close the file.

8. (Multi-node system only) Push the change to the storage nodes by typing the following commands.

```
cd /boot/grub
mapall --all --user=root copy menu.1st
mapall --all --user=root "cp /root/menu.1st /boot/grub/menu.1st"
mapall --all --user=root "rm -f /root/menu.1st"
```

Level-2 security hardening

Level-2 security hardening features can be installed on a feature-by-feature basis.

The level-2 features are:

- "Additional operating system hardening" on page 113
- "Additional password hardening" on page 114
- "Additional firewall hardening (avfirewall)" on page 116

All level-2 security hardening features can be installed on Avamar 6.0 and later servers running supported versions of SLES.

Additional password and firewall hardening can be installed on supported versions of Red Hat Enterprise Linux (RHEL).

"Installation of level-2 security hardening features" on page 117 provides details about installing, configuring, and uninstalling Level-2 security hardening features.

Additional operating system hardening

The additional **Operating System (OS)** hardening package provides the following capabilities for Avamar 6.0 and later servers running supported versions of SLES:

- Setting terminal timeout at 15 minutes
- Applying read-only permission to root home directory
- Removal of world read permissions on log files
- Removal of world read permissions on cron files
- Lockdown of some important /etc system configuration files
- Removal of world read permissions from admin, dpn, and gsan home directories
- Removal of unnecessary default accounts and groups
- Disabling of SSH v1 protocol
- Removal of unnecessary tomcat directories
- Changing system and user umask settings to 077
- Removing unowned files
- Enabling cron logging in syslog

The additional OS hardening package is a level-2 hardening feature that can be installed during Avamar server software installation, or manually after server software installation.

The additional OS hardening package satisfies the STIG requirements in the following table.

Table 27 STIG requirements satisfied by the additional OS hardening package

Requirement ID	Requirement title
GEN000460	Unsuccessful Login Attempts - Account Disabled
GEN000480	Unsuccessful Login Attempts - Fail Delay
GEN000500	Terminal Lockout
GEN000980	Root Console Access
GEN001000	Remote Consoles Defined
GEN001020	Direct Root Login
GEN001120	Encrypting Root Access
GEN001160	Unowned Files
GEN001240	System Files, Programs, and Directories Group Ownership
GEN001260	Log File Permissions
GEN001480	User Home Directory Permissions
GEN001500	Home Directory Permissions
GEN001260	Log File Permissions
GEN001560	Home Directories Files Permissions
GEN002420	User Filesystems Not Mounted With NoSUID
GEN002580	Permissive umask Documentation
GEN003160	Cron Logging
GEN003180	Cronlog Permissions

Additional password hardening

Avamar 6.0 and later servers running supported versions of SLES and RHEL operating systems can be configured to provide additional password hardening features such as:

- Aging — how long a password can be used before it must be changed
- Complexity — required number and type of characters in passwords
- Reuse — number of previously used passwords that can be recycled
- Lockout — denial of login after a specified number of unsuccessful login attempts
- Account lockout after 35 days without a login

NOTICE

Password hardening is not appropriate for all customers. Successful implementation of this feature requires structures and policies that enforce changes to all operating system user accounts every 60 days, and require users to log into those accounts at least once every 35 days. Failure to implement proper structures and policies before installing the password hardening feature might cause you to be locked out of your Avamar server.

Additional password hardening is a level-2 hardening feature that can be installed during Avamar server software installation, or manually after server software installation.

Additional password hardening satisfies the STIG requirements in the following table.

Table 28 STIG requirements satisfied by additional password hardening

Requirement ID	Requirement title
GEN000540	Password Change 24 Hours
GEN000560	Password Protect Enabled Accounts
GEN000580	Password Length
GEN000600	Password Character Mix
GEN000620	Password Character Mix
GEN000640	Password Character Mix
GEN000660	Password Contents
GEN000680	Password Contents
GEN000700	Password Change Every 60 Days
GEN000740	Password Change Every Year
GEN000760	Inactive Accounts are not locked
GEN000780	Easily Guessed Passwords
GEN000800	Password Reuse
GEN000820	Global Password Configuration Files
GEN000840	Root Account Access

Following successful installation and configuration, the following rules are enforced for all local Avamar server operating system user accounts and passwords:

- Account lockout
- Password aging
- Password complexity, length, and reuse

Account lockout

All local Avamar server operating system accounts must log in at least once every 35 days.

Furthermore, after three unsuccessful login attempts, that account will be administratively locked out.

NOTICE

The SLES operating system allows expired root passwords to be used for logins until a new password is set. This is done to prevent inadvertent root lockouts. This is a feature of the SLES operating system and cannot be overridden.

Password aging

All local Avamar server operating system accounts must have their passwords changed every 60 days. Once a password is changed, it cannot be changed again for at least 24 hours.

Password complexity, length, and reuse

All local Avamar server operating accounts are required to have passwords with the following characteristics:

- Password complexity requires that you use at least three of the following four character sets:
  - Two or more lowercase characters
  - Two or more uppercase characters
  - Two or more numeric characters
  - Two or more special (non-alphanumeric) characters
- Minimum length is determined by complexity:
  - If you use any three character sets, the password must be at least 14 characters.
  - If you use all four character sets, the password must be at least 11 characters.
- Passwords must contain at least three characters that are different from the last password.
- The previous 10 passwords cannot be reused.

Additional firewall hardening (avfirewall)

Avamar 6.0 and later servers running supported versions of SLES and RHEL operating systems can be configured to use Linux IPTABLES.

Additional firewall hardening is a level-2 hardening feature that can be installed during Avamar server software installation, or manually after server software installation.

Additional server firewall hardening satisfies the GEN006580 - Access Control Program STIG requirements.

This feature is implemented by way of the **avfirewall** service.

The output for **avfirewall** is logged to /var/log/firewall on SLES servers only. The /var/log/firewall file is not available on RHEL servers. However, firewall logging can be implemented using syslog on RHEL servers. The *EMC Avamar Administration Guide* provides details about implementing syslog.

Note: If you are backing up a Hyper-V or Microsoft SQL plug-in to a server running the **avfirewall** service and the encryption method for the backup is set to None, the backup will fail with errors indicating a problem connecting to the server. Set the encryption method to Medium or High.

Installation of level-2 security hardening features

Level-2 security hardening features can be installed during Avamar server software installation. The *Avamar SLES Installation Workflow Guide* provides information about installing and enabling security hardening features. This guide is available during installation when you click the help icon in Avamar Installation Manager.

If you did not install level-2 security hardening features during Avamar server software installation, you can manually install them as described in the following topics.

Manually installing level-2 hardening packages on SLES

To install level-2 hardening packages on SLES:

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin,
     b. Switch user to root by typing:

        ```
        su -
        ```

     c. Load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     d. When prompted, type the dpnid passphrase and press **Enter**.
2. Change directory to where the install packages reside by typing:

   ```
   cd /usr/local/avamar/src/SLES11_64/
   ```

3. If installing on a multi-node server, copy one or more level-2 hardening packages to all other server nodes by typing:

   ```
   mapall --all+ --user=root copy avhardening-VERSION.x86_64.rpm
   mapall --all+ --user=root copy avpasswd-VERSION.x86_64.rpm
   mapall --all+ --user=root copy avfwb-VERSION.x86_64.rpm
   ```

   where VERSION is the specific version you are installing.

If you are not installing a particular level-2 hardening feature, omit the command to copy that install package.

4. Install each hardening package by doing one of the following:

   - If installing on a single-node server, type:

     ```
     rpm -Uvh avhardening-VERSION.x86_64.rpm
     rpm -Uvh avpasswd-VERSION.x86_64.rpm
     rpm -Uvh avfwb-VERSION.x86_64.rpm
     ```

   - If installing on a multi-node server, type:

     ```
     mapall --all+ --user=root "rpm -Uvh
     avhardening-VERSION.x86_64.rpm"
     mapall --all+ --user=root "rpm -Uvh avpasswd-VERSION.x86_64.rpm"
     mapall --all+ --user=root "rpm -Uvh avfwb-VERSION.x86_64.rpm"
     ```

   where VERSION is the specific version you are installing.

   If you are not installing a particular level-2 hardening feature, omit the command to install that package.

5. If installing on a multi-node server, delete the packages you copied in step 3 by typing:

   ```
   mapall --user=root "rm -f avhardening*"
   mapall --user=root "rm -f avpasswd*"
   mapall --user=root "rm -f avfwb*"
   ```

   If you did not copy a particular install package in step 3, omit the command to delete that package.

Manually installing level-2 hardening packages on RHEL

To install level-2 password and firewall hardening packages on RHEL:

1. Open a command shell and log in using one of the following methods:

   - To log in to a single-node server:

     a. Log in to the server as admin.

     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:

     a. Log in to the utility node as admin,

     b. Switch user to root by typing:

        ```
        su -
        ```

     c. Load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     d. When prompted, type the dpnid passphrase and press **Enter**.

2. Change directory to where the install packages reside by typing:

   ```
   cd /usr/local/avamar/src/RHEL4_64/
   ```

3. If installing on a multi-node server, copy one or more level-2 hardening packages to all other server nodes by typing:

   ```
   mapall --all+ --user=root copy avpasswd-VERSION.x86_64.rpm
   mapall --all+ --user=root copy avfwb-VERSION.x86_64.rpm
   ```

   where VERSION is the specific version you are installing.

4. Install each hardening package by doing one of the following:

   - If installing on a single-node server, type:

     ```
     rpm -Uvh avpasswd-VERSION.x86_64.rpm
     rpm -Uvh avfwb-VERSION.x86_64.rpm
     ```

   - If installing on a multi-node server, type:

     ```
     mapall --all+ --user=root "rpm -Uvh avpasswd-VERSION.x86_64.rpm"
     mapall --all+ --user=root "rpm -Uvh avfwb-VERSION.x86_64.rpm"
     ```

   where VERSION is the specific version you are installing.

   If you are not installing a particular level-2 hardening feature, omit the command to install that package.

5. If installing on a multi-node server, delete the packages you copied in step 3 by typing:

   ```
   mapall --user=root "rm -f avpasswd*"
   mapall --user=root "rm -f avfwb*"
   ```

Additional firewall configuration to support replication

Installing the level-2 firewall hardening package will cause replication to fail until the following additional configuration is performed:

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. Open /usr/local/avamar/etc/repl_cron.cfg in a plain text editor.

3. Add the following entries:

   ```
   --dstavmgr=--encrypt=tls
   --dstavmaint=--encrypt=tls
   ```

4. Save your changes.

Additional firewall configuration to support Avamar Client Manager

Installing the level-2 firewall hardening package will block the ability of Avamar Client Manager to manage the clients associated with the firewall protected server. To permit management access for Avamar Client Manager, complete the following additional configuration:

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin,
     b. Switch user to root by typing:

        ```
        su -
        ```

     c. Load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     d. When prompted, type the dpnid passphrase and press **Enter**.
2. Open /etc/firewall.base in a plain text editor.
3. Add a line to /etc/firewall.base to define a range of IP addresses as M_SUBNET, by typing:

   M_SUBNET=*IP-address*

   where *IP-address* consists of the IP addresses that are allowed to access port 5555, and *IP-address* is formatted using one of the following methods:
   - A single IP address.

     For example: 192.25.113.29
   - A comma-separated list of IP addresses.

     For example: 192.25.113.29,192.25.113.50
   - A CIDR notation address range.

     For example: 192.25.113.0/24
4. Beneath the line defining the value of M_SUBNET, add the following if/then statement to allow the IP addresses defined by M_SUBNET to have access to port 5555.

   ```
   if [ $THISNODE == "$UTILITY" ]; then
   $IPT -A INPUT -p tcp -m multiport --dport 5555 -s $M_SUBNET -j ACCEPT
   fi
   ```

5. Save and close the file.

6. Restart the firewall by typing:

   ```
   service avfirewall stop
   service avfirewall start
   ```

7. (Multi-node system only) Log in to each storage node as root and complete step 2 through step 6 on that node.

Uninstalling level-2 hardening features

To manually uninstall a level-2 security hardening feature (operating system, password, or firewall):

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin,
     b. Switch user to root by typing:

        ```
        su -
        ```

     c. Load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     d. When prompted, type the dpnid passphrase and press **Enter**.
2. Uninstall each hardening package by doing one of the following:
   - If uninstalling a package on a single-node server, type:

     ```
     rpm -e PACKAGENAME
     ```

   - If uninstalling a package on a multi-node server, type:

     ```
     mapall --user=root --all+ "rpm -e PACKAGENAME"
     ```

     where PACKAGENAME is:
     – **avhardening*.rpm** for the operating system hardening package.
     – **avpasswd*.rpm** for the password hardening package.
     – **avfwb*.rpm** for the firewall hardening package.
3. Repeat step 2 to uninstall additional level-2 security hardening packages.

Level-3 security hardening

Level-3 security hardening features disable all web-based services and reduce other services to the minimum required to manage and use the Avamar system. Level-3 security hardening features can be applied to a running, fully functional Avamar system.

After level-3 security hardening, the following services are unavailable:

- Apache web server, including:
  - Web-based restore
  - Web-based document download
  - Web-based software download
- Enterprise Management Server (EMS) web server, including:
  - Avamar Enterprise Manager (EM)
  - Web access to the Avamar Management Console
  - Avamar Client Manager
- Avamar Desktop/Laptop web server, including:
  - Web-based backup and restore, and other Avamar Desktop/Laptop features
- Dell OpenManage web server
- SNMP
- RPC

NOTICE

Some of the Level-3 security hardening tasks block services and processes that are required during system upgrades. Before beginning a system upgrade, complete the tasks described in "Preparing for a system upgrade" on page 134.

Level-3 prerequisite

Before starting the level-3 security hardening tasks complete all level-1 and level-2 tasks.

Level-3 tasks

Complete each of the following tasks to implement level-3 security hardening:

- "Disabling Apache web server" on page 123
- "Disabling Avamar Enterprise Manager" on page 124
- "Disabling Dell OpenManage web server" on page 125
- "Disabling Avamar Desktop/Laptop" on page 126
- "Disabling SSLv2 and weak ciphers on all nodes" on page 126
- "Updating SSH" on page 129
- "Disabling snmpd" on page 130

- "Disabling RPC" on page 131
- "Preventing access to port 9443" on page 132
- "Changing file permissions" on page 133

Disabling Apache web server

Stopping and disabling the Apache web server prevents access to that service.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press Enter.
2. Type the following command to turn off the Apache web server:

   ```
   website stop
   ```

3. Type the following command to disable the Apache web server:

   ```
   chkconfig apache2 off
   ```

The Apache web server is disabled and will not automatically run when the computer is restarted.

Disabling Avamar Enterprise Manager

Stopping Avamar Enterprise Manager prevents access to that service. On a single-node system only, disabling Avamar Enterprise Manager prevents the service from starting when the computer is restarted.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Type the following command to stop Avamar Enterprise Manager:

   ```
   dpnctl stop ems
   ```

   Avamar Enterprise Manager stops. It will restart when the computer is restarted.

   Note: On a multi-node system, this step must be repeated each time that the computer is restarted.

3. (Single-node system only) Type the following command to disable Avamar Enterprise Manager:

   ```
   dpnctl disable ems
   ```

   Avamar Enterprise Manager is disabled and it does not restart when the computer is restarted.

Disabling Dell OpenManage web server

Disabling the web server for Dell OpenManage prevents web browser access to that service. The Dell OpenManage services remain available at the console.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

     ```
     su -
     ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

     ```
     ssh-agent bash
     ssh-add ~admin/.ssh/dpnid
     ```

     b. When prompted, type the dpnid passphrase and press Enter.
2. Type the following command to stop the Dell OpenManage web server:
   - Multi-node system:

     ```
     mapall --all+ --user=root "service dsm_om_connsvc stop"
     ```

   - Single-node system:

     ```
     service dsm_om_connsvc stop
     ```

3. Type the following command to disable the Dell OpenManage web server:
   - Multi-node system:

     ```
     mapall --all+ --user=root "chkconfig dsm_om_connsvc off"
     ```

   - Single-node system:

     ```
     chkconfig dsm_om_connsvc off
     ```

4. (Optional) Type the following command to verify the web server is not running:
   - Multi-node system:

     ```
     mapall --all+ --user=root "chkconfig dsm_om_connsvc --list"
     ```

   - Single-node system:

     ```
     chkconfig dsm_om_connsvc -list
     ```

Disabling Avamar Desktop/Laptop

Stopping Avamar Desktop/Laptop prevents access to that service. On a single-node system only, disabling Avamar Desktop/Laptop prevents the service from starting when the computer is restarted.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Type the following command to stop Avamar Desktop/Laptop:

   ```
   dpnctl stop dtlt
   ```

   Avamar Desktop/Laptop stops. It will restart when the computer is restarted.

   Note: On a multi-node system, this step must be repeated each time that the computer is restarted.

3. (Single-node system only) Type the following command to disable Avamar Desktop/Laptop:

   ```
   dpnctl disable dtlt
   ```

   Avamar Desktop/Laptop is disabled and it does not restart when the computer is restarted.

Disabling SSLv2 and weak ciphers on all nodes

Prevent GSAN from using SSL v.2 and weak ciphers in communication between nodes and clients. This task requires different steps depending on the Avamar system version.

To use NDMP with this security hardening feature, make the additional configuration changes described in "Configuring to use NDMP" on page 128.

To use replication with this security hardening feature, make the additional configuration changes described in"Configuring to support replication" on page 128.

NOTICE

This procedure enforces the use of strong ciphers and prevents clients that do not support strong ciphers from connecting with GSAN. For example, clients running any of the following OS versions do not support strong ciphers and are blocked by this procedure: Microsoft Windows NT, Microsoft Windows 2000, and Microsoft Windows 2003 (without strong cipher patches).

Avamar system versions 6.0 through 6.0.1

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. In a plain text editor, edit /usr/local/avamar/etc/stunnel/stunnel.conf.

   Change:

   ```
   foreground = no
   client = no
   cert = /usr/local/avamar/etc/stunnel/stunnel.pem
   pid = /usr/local/avamar/var/stunnel.pid
   [axionssl]
   accept = 29000
   connect = 27000
   ```

   To:

   ```
   foreground = no
   client = no
   cert = /usr/local/avamar/etc/stunnel/stunnel.pem
   pid = /usr/local/avamar/var/stunnel.pid
   options = NO_SSLv2
   ciphers = ALL:+HIGH:!LOW:!EXP
   [axionssl]
   accept = 29000
   connect = 27000
   ```

3. Stop and start stunnel:

   ```
   stunctl stop
   stunctl start
   ```

Avamar system versions 6.1 and later

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

     ```
     su -
     ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

     ```
     ssh-agent bash
     ssh-add ~admin/.ssh/dpnid
     ```

     b. When prompted, type the dpnid passphrase and press **Enter**.

   Note: Space limitations in this guide cause the command in the next step to continue (wrap) to more than one line. Type the command on a single line (no line feeds or returns allowed).

2. Type the following command:

   ```
   avmaint config --ava
   sslciphers='TLSv1+HIGH:!SSLv2:!aNULL:!eNULL:@STRENGTH'
   ```

3. Repeat these steps on each node.

Configuring to use NDMP

1. Open a command shell and log in to the accelerator as admin.
2. Switch user to root by typing:

   ```
   su -
   ```

3. Open /usr/local/avamar/var/avtar.cmd in a plain text editor.

   If the file does not exist, create it.

4. Add the following lines to the file:

   ```
   --encrypt=tls
   --encrypt-strength=high
   ```

5. Save and close the file.

Configuring to support replication

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. Open /usr/local/avamar/etc/repl_cron.cfg in a plain text editor.

3. Add the following lines to the file:

```
--avtar=--encrypt=tls
--avtar=--encrypt:1=tls
--dstavmgr=--encrypt=tls
--dstavmaint=--encrypt=tls
--encrypt-strength=high
```

4. Save and close the file.

Updating SSH

Update to the latest version of OpenSSH. Configure sshd to:

- Deny empty passwords
- Log at INFO level
- Use protocol 2

1. Contact your EMC Customer Support professional to obtain and install the latest Avamar platform security rollup package.

   The platform security rollup package installs the latest version of OpenSSH.

2. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

     ```
     su -
     ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

     ```
     ssh-agent bash
     ssh-add ~admin/.ssh/dpnid
     ```

     b. When prompted, type the dpnid passphrase and press **Enter**.

3. Open /etc/ssh/sshd_config in a plain text editor.
4. Add the following lines to the file:

```
PermitEmptyPasswords no
LogLevel INFO
Protocol 2
```

5. Save and close the file.
6. Restart sshd by typing:

```
service sshd restart
```

   Restarting sshd can cause current SSH sessions to terminate.

Disabling snmpd

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Type the following command to stop snmpd:

   ```
   service snmpd stop
   ```

3. Type the following command to disable snmpd:

   ```
   chckonfig snmpd off
   ```

   This prevents snmpd from starting when the computer is restarted.
4. In a plain-text editor, edit /etc/init.d/dataeng.

   Change:

   ```
   OS_SNMP_SVCNAME="snmpd"
   ```

   To:

   ```
   OS_SNMP_SVCNAME=""
   ```

5. Reboot the system by typing:

   ```
   reboot
   ```

6. (Optional) After the system is up, search /var/log/messages for the following warning:

   ```
   dataeng: warning:  not started.  must be started to manage this system
   using SNMP
   ```

   This warning means that snmpd is disabled.

Disabling RPC

Disable the remote procedure call (RPC) service on all nodes.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

     ```
     su -
     ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

     ```
     ssh-agent bash
     ssh-add ~admin/.ssh/dpnid
     ```

     b. When prompted, type the dpnid passphrase and press Enter.
2. Type the following to stop the RPC service:
   - On SLES computers:

     ```
     service rpcbind stop
     ```

   - On RHEL computers:

     ```
     service portmap stop
     ```

3. Type the following to disable the RPC service:
   - On SLES computers:

     ```
     chkconfig nfs off
     chkconfig rpcbind off
     ```

   - On RHEL computers:

     ```
     chkconfig portmap off
     ```

4. Repeat these steps on each node.

Preventing access to port 9443

Avamar Management Console Web Services normally use Port 9443 for Java Remote Method Invocation (RMI). Configure iptables to block port 9443.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. In a plain text editor, edit /etc/firewall.default to add the following lines:

   ```
   $IPT -A INPUT -p tcp -m tcp --dport 9443 -j DROP
   $IPT -A INPUT -p udp -m udp --dport 9443 -j DROP
   ```

3. Save and close the file.

Changing file permissions

Use chmod o-w to prevent users in the Others group from writing to specific folders and files.

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Type the following commands:

```
chmod o-w -R /etc/openldap
chmod o-w -R /root/
chmod o-w /data01/avamar/var
chmod o-w /data01/avamar/var/change-passwords.log
chmod o-w /data01/avamar/var/local
chmod o-w /data01/avamar/var/local/ziptemp
chmod o-w /data01/avamar/var/p_*dat
chmod o-w /opt/dell/srvadmin/iws/config/keystore.db.bak
chmod o-w /tmp/replicate
chmod o-w /usr/local/avamar/bin/benchmark
chmod o-w /.avamardata/var/mc/cli_data/prefs/mcclimcs.xml
chmod o-w /.avamardata/var/mc/cli_data/prefs/mccli_logging.properties
chmod o-w /.avamardata/var/mc/cli_data/prefs/prefs.tmp
chmod o-w /.avamardata/var/mc/cli_data/prefs/mccli.xml
chmod o-w /data01/home/admin/.avamardata/var/mc/cli_data/prefs/mccli.xml
chmod o-w /data01/home/admin/.avamardata/var/mc/cli_data/prefs/mcclimcs.xml
chmod o-w /data01/home/admin/.avamardata/var/mc/cli_data/prefs/mccli_logging.properties
chmod o-w /data01/home/admin/.avamardata/var/mc/cli_data/prefs/prefs.tmp
chmod o-w /data01/home/dpn/.avamardata/var/mc/cli_data/prefs/mccli.xml
chmod o-w /data01/home/dpn/.avamardata/var/mc/cli_data/prefs/mcclimcs.xml
chmod o-w /data01/home/dpn/.avamardata/var/mc/cli_data/prefs/mccli_logging.properties
chmod o-w /data01/home/dpn/.avamardata/var/mc/cli_data/prefs/prefs.tmp
chmod o-w /data01/avamar/var/mc/server_log/mcddrsnmp.out
```

Preparing for a system upgrade

To permit a successful system upgrade, some of the level-3 security hardening changes must be temporarily reversed. After the system upgrade is complete, reapply those changes.

Complete the following tasks before starting a system upgrade:

- "Enabling the Apache web server" on page 134
- "Enabling Avamar Enterprise Manager" on page 135

Enabling the Apache web server

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. Type the following command to enable the Apache web server:

   ```
   chkconfig --add apache2
   ```

3. Type the following command to start the Apache web server:

   ```
   website start
   ```

The Apache web server starts. After completion of the system upgrade, disable the Apache web server as described in "Disabling Apache web server" on page 123.

Enabling Avamar Enterprise Manager

1. Open a command shell and log in using one of the following methods:
   - To log in to a single-node server:
     a. Log in to the server as admin.
     b. Switch user to root by typing:

        ```
        su -
        ```

   - To log in to a multi-node server:
     a. Log in to the utility node as admin, then load the dpnid OpenSSH key by typing:

        ```
        ssh-agent bash
        ssh-add ~admin/.ssh/dpnid
        ```

     b. When prompted, type the dpnid passphrase and press **Enter**.
2. (Single-node system only) Type the following command to enable Avamar Enterprise Manager:

   ```
   dpnctl enable ems
   ```

3. Type the following command to start Avamar Enterprise Manager:

   ```
   dpnctl start ems
   ```

   Avamar Enterprise Manager starts. After completion of the system upgrade, disable Avamar Enterprise Manager as described in "Disabling Avamar Enterprise Manager" on page 124.

APPENDIX A
Port and Network Requirements

This appendix lists port and network requirements for the Avamar system, and provides additional information about using a Data Domain system to store Avamar backups.

Required ports

This section describes the listening ports that must be open on each of the following components of an Avamar deployment:

- Avamar utility node (or single node server)
- Avamar storage node
- Avamar client
- Avamar Downloader Service Windows host

A listening port is a network port on the specified Avamar component computer that has a service bound to it. The service handles the network packets that are sent to the computer at that port.

Each required port must be open to receive packets addressed to that port from the computer listed in the source column. Relevant routers, switches, and firewalls must allow the packets to reach the port. Functionality is reduced when a process listening on a required port cannot receive packets from a source computer.

As part of the hardening of an Avamar server, some of the required ports are intentionally closed. This results in an increase in security in exchange for a loss of some functionality.

To increase security without a loss of functionality, filter network traffic and allow only packets of the protocol listed in Protocol and from the computers listed in Source to reach the designated port.

Avamar utility node required ports

The following table describes the listening ports that must be open on an Avamar utility node or single-node server. For each row in Table 29, the listed port on the utility node or single-node server is the destination.

Table 29 Required ports on an Avamar utility node or single node server (page 1 of 3)

Port	Protocol	Service name	Source	Additional information
22	TCP	SSH	• Administrator computers • Other Avamar server nodes	Secure shell access.
69	TCP	TFTP	Internal switch	
80	TCP	HTTP	• Web browser clients • Reverse proxy web server • AvInstaller • Avamar Downloader Service host	Provides web browser access to Avamar services. A reverse proxy web server can be used to limit access to this port.
137	UDP	NETBIOS Name Service	Avamar proxy	Used for Avamar proxy communication.
138	UDP	NETBIOS Datagram Service	Avamar proxy	Used for Avamar proxy communication.

Table 29 Required ports on an Avamar utility node or single node server (page 2 of 3)

Port	Protocol	Service name	Source	Additional information
139	TCP	NETBIOS Session Service	Avamar proxy	Used for Avamar proxy communication.
161	TCP	SNMP	Data Domain system	This is the getter/setter port for SNMP objects from a Data Domain system. Required when storing Avamar client backups on a Data Domain system.
443	TCP	HTTP protocol over TLS/SSL	• Web browser clients • Reverse proxy web server • AvInstaller • Avamar Downloader Service host	Provides web browsers with HTTPS access to Avamar services. A reverse proxy web server can be used to limit access to this port.
700	TCP/UDP	Login Manager	• Web browser clients • Reverse proxy web server	
1080	TCP	3ware RAID management	Web browser clients	All nodes with legacy Axion-M or Axion-E hardware only. Only allow access from trusted administrator computers.
1234	TCP	Avamar installation utility HTTPS	Web browser clients	Only open this port for installation of the Avamar software. Only permit access from trusted administrator computers used during software installation. **Notice:** Close this port when installation of the Avamar software is complete. Avamar services do not listen on port 1234.
5555	TCP	PostgreSQL administrator server	• Utility node running Avamar Client Manager • PostgreSQL administrator client computers	Only open this port if you manage the Avamar server using Avamar Client Manager or if you must manage the PostgreSQL database from a remote computer. Limit access to trusted administrator computers.
7778	TCP	RMI	Avamar Administrator management console	Limit access to trusted administrator computers.
7779	TCP	RMI	Avamar Administrator management console	Limit access to trusted administrator computers.
7780	TCP	RMI	Avamar Administrator management console	Limit access to trusted administrator computers.
7781	TCP	RMI	Avamar Administrator management console	Limit access to trusted administrator computers.
8105	TCP	Tomcat	Avamar client computers	Used by Avamar Desktop/Laptop.
8109	TCP	Tomcat	Avamar client computers	Used by Avamar Desktop/Laptop.
8181	TCP	Tomcat	Avamar client computers	Connections from Avamar client computers and from AvInstaller hosts are redirected to this port.
8444	TCP	Tomcat	Web browser clients	Web browser connections from Avamar Desktop/Laptop client computers are redirected to this port.

Table 29 Required ports on an Avamar utility node or single node server (page 3 of 3)

Port	Protocol	Service name	Source	Additional information
8505	TCP	Tomcat	Utility node or single-node server	Avamar Desktop/Laptop uses this port to send a shutdown command to its Apache Tomcat server. Limit access to the utility node or single-node server.
8543	TCP	Tomcat HTTPS	Web browser clients	Web browser clients use this port to create HTTPS conections to Avamar Enterprise Manager and Avamar Installation Manager. Limit access to trusted administrator computers.
8580	TCP	AvInstaller	Web browser clients	Used for conections from Avamar Downloader Service computer, and for access to AvInstaller from other web browser clients.
8778	TCP	RMI - Avamar Enterprise Manager	Utility node or single-node server	Any utility node that has Avamar Enterprise Manager installed. Limit access to to the utility node or single-node server.
8779	TCP	RMI - Avamar Enterprise Manager login_server	Utility node or single-node server	Any utility node with Avamar Enterprise Manager installed. Limit access to to the utility node or single-node server.
8780	TCP	RMI - Avamar Enterprise Manager service_context	Utility node or single-node server	Any utility node with Avamar Enterprise Manager installed. Limit access to to the utility node or single-node server.
8781	TCP	RMI - Avamar Enterprise Manager node_context	Utility node or single-node server	Any utility node with Avamar Enterprise Manager installed. Limit access to to the utility node or single-node server.
9443	TCP	RMI - Avamar Management Console web services	Web browser clients	
19000-19500	TCP/UDP	GSAN	Avamar server nodes	GSAN communication.
20000-20500	TCP/UDP	GSAN	Avamar server nodes	GSAN communication.
25000-25500	TCP/UDP	GSAN	Avamar server nodes	GSAN communication.
26000-26500	TCP/UDP	GSAN	Avamar server nodes	GSAN communication.
27000-27500	TCP	Avamar server	• Avamar client computers • Avamar server nodes • Avamar nodes acting as a replicator source	GSAN communication.
28001	TCP	Avamar server CLI	Avamar client computers	CLI commands from client computers.
29000	TCP	Avamar server SSL	Avamar client computers	GSAN communication.

Avamar storage node required ports

The following table describes the listening ports that must be open on an Avamar storage node. For each row in Table 30, the listed port on the storage node is the destination.

Table 30 Required ports on an Avamar storage node

Port	Protocol	Service name	Source	Additional information
22	TCP	SSH	• Administrator computers • Other Avamar server nodes	Secure shell access.
1080	TCP	3ware RAID management	Web browser clients	Nodes with legacy Axion-M or Axion-E hardware only. Only allow access from trusted administrator computers.
19000-19500	TCP/UDP	GSAN	Avamar server nodes	GSAN communication.
20000-20500	TCP/UDP	GSAN	Avamar server nodes	GSAN communication.
25000-25500	TCP/UDP	GSAN	Avamar server nodes	GSAN communication.
26000-26500	TCP/UDP	GSAN	Avamar server nodes	GSAN communication.
27000	TCP	Avamar server	• Avamar client computers • Avamar nodes acting as a replicator source	GSAN communication.
29000	TCP	Avamar server SSL	Avamar client computers	GSAN communication.

Avamar client required port

The following table describes the listening port that must be open on Avamar client computers. In Table 31, the listed port on Avamar client computers is the destination.

Table 31 Required port on Avamar client computers

Port	Protocol	Service name	Source	Additional information
28002	TCP	avagent	Avamar server	Provides management functionality from Avamar Administrator.

Avamar Downloader Service required port

The following table describes the listening port that must be open on the Avamar Downloader Service Windows host computer. In Table 32, the listed port on Avamar Downloader Service Windows host computers is the destination.

Table 32 Required port on an Avamar Downloader Service Windows host computer

Port	Protocol	Service name	Source	Additional information
8580	TCP	Avamar Downloader Service	Avamar server	Avamar server connects to this port to access the Avamar Downloader Service.

Optional ports

In addition to the required ports, it is recommended that other ports be open to provide added functionality.

Avamar utility node optional ports

The following table describes the optional, but recommended, listening ports for an Avamar utility node or single-node server. For each row in Table 33, the listed port on the utility node or single-node server is the destination.

Table 33 Optional ports for Avamar utility node or single node server

Port	Protocol	Service name	Source	Additional information
514	UDP	syslog	Utility node or single-node server	Avamar server connects to this port to communicate events to syslog.
5556	TCP	PostgreSQL	PostgreSQL client computer	Avamar server node running Avamar Enterprise Manager. Limit access to computers that require access to the Avamar Enterprise Manager database.
5557	TCP	PostgreSQL	Avamar Enterprise Manager host computer	Avamar server node with metadata search feature installed. Facilitates metadata search in Avamar Enterprise Manager.
8509	TCP	Tomcat	Utility node or single-node server	The Apache JServ Protocol (AJP) uses port 8509 to balance the work load for multiple instances of Tomcat.

Network requirements

To provide full-featured functionality, Avamar component computers must communicate with various network resources. Packets sent from an Avamar component computer must be permitted to reach the specified destination computer, at a specified port, and using the specified protocol.

Network routers, switches, firewalls, and destination computers must be configured to allow this communication.

Avamar utility node network requirements

The following table describes the network requirements for an Avamar utility node or single-node server. For each row in Table 34, the Avamar utility node or single-node server is the source and must have access to the listed port on the listed destination.

Table 34 Network requirements for Avamar utility node and single-node server (page 1 of 2)

Port	Protocol	Destination	Additional information
7	TCP	Data Domain system	Outgoing port is required to permit registration of a Data Domain system.
25	TCP	EMC Customer Support	Outgoing port is required to allow the ConnectEMC service to contact EMC Customer Support.
53	TCP/UDP	DNS	Required for name resolution and DNS zone transfers. TCP connection to DNS is required by VMware proxy nodes.

Table 34 Network requirements for Avamar utility node and single-node server (page 2 of 2)

Port	Protocol	Destination	Additional information
88		Key Distribution Center (KDC)	Required for access to Kerberos authentication system.
111	TCP/UDP	RPC port mapper service on Data Domain system	Only required when backups are stored on a Data Domain system. Access to RPC and NFS port mapper functionality on a Data Domain system.
123	TCP/UDP	NTP time servers	Provides clock synchronization from network time protocol servers.
163	TCP	SNMP service on Data Domain system	Only required when backups are stored on a Data Domain system.
389	TCP/UDP	LDAP	Provides access to directory services.
443	TCP	VMware vCenter proxy service	
464		Key Distribution Center (KDC)	Required for access to Kerberos Change/Set password.
902	TCP	VMware ESX server proxy service	
2049	TCP/UDP	NFS daemon on Data Domain system	Only required when backups are stored on a Data Domain system.
2052	TCP	NFS mountd process on Data Domain system	Only required when backups are stored on a Data Domain system.
7443	TCP	Media Access node that hosts Avamar Extended Retention	Only required when using the Avamar Extended Retention feature.
19000-19500	TCP/UDP	Avamar server nodes	GSAN communication.
20000-20500	TCP/UDP	Avamar server nodes	GSAN communication.
25000-25500	TCP/UDP	Avamar server nodes	GSAN communication.
26000-26500	TCP/UDP	Avamar server nodes	GSAN communication.
27000	TCP	Avamar server nodes	GSAN communication.
61617	TCP	Media Access node that hosts Avamar Extended Retention	Only required when using the Avamar Extended Retention feature.

Avamar storage node network requirements

The following table describes the network requirements for an Avamar storage node. For each row in Table 35, the Avamar storage node is the source and must have access to the listed port on the listed destination.

Table 35 Network requirements for an Avamar storage node

Port	Protocol	Destination	Additional information
53	TCP/UDP	DNS	Required for name resolution and DNS zone transfers. TCP connection to DNS is required by VMware proxy nodes.
123	TCP/UDP	NTP time servers	Provides clock synchronization from network time protocol servers.
19000-19500	TCP/UDP	Avamar server nodes	GSAN communication.
20000-20500	TCP/UDP	Avamar server nodes	GSAN communication.
25000-25500	TCP/UDP	Avamar server nodes	GSAN communication.
26000-26500	TCP/UDP	Avamar server nodes	GSAN communication.
27000	TCP	Avamar server nodes	GSAN communication.

Avamar client network requirements

The following table describes the network requirements for Avamar client computers. For each row in Table 36, the Avamar client computer is the source and must have access to the listed port on the listed destination.

Table 36 Network requirements for Avamar client computers (page 1 of 2)

Port	Protocol	Destination	Additional information
53	TCP/UDP	DNS	Required for name resolution and DNS zone transfers.
80	TCP	Avamar server HTTP service	Required to use the web browser UI of Avamar Desktop/Laptop and the web browser UI of Avamar Web Restore.
123	UDP	NTP time servers	Provides clock synchronization from network time protocol servers.
443	TCP	Avamar server HTTPS service	Required to use the web browser UI of Avamar Desktop/Laptop and the web browser UI of Avamar Web Restore.
3008	TCP	Active archive service on Data Domain system	Only required when backups are stored on a Data Domain system, and the active archive feature is enabled.
8105	TCP	Avamar server	Used by Avamar Desktop/Laptop.
8109	TCP	Avamar server	Used by Avamar Desktop/Laptop.
8181	TCP	Avamar server HTTP redirect port	Required to use the web browser UI of Avamar Desktop/Laptop and the web browser UI of Avamar Web Restore.
8444	TCP	Avamar server HTTPS redirect port	Required to use the web browser UI of Avamar Desktop/Laptop and the web browser UI of Avamar Web Restore.

Table 36 Network requirements for Avamar client computers (page 2 of 2)

Port	Protocol	Destination	Additional information
27000-27500	TCP	Avamar server	GSAN communication.
28001	TCP	Avamar server	CLI commands from client computers.
29000	TCP	Avamar server	GSAN communication.

Avamar Downloader Service network requirements

The following table describes the network requirements for an Avamar Downloader Service Windows host computer. For each row in Table 37, the Avamar Downloader Service Windows host computer is the source and must have access to the listed port on the listed destination.

Table 37 Network requirements for Avamar Downloader Service

Port	Protocol	Destination	Additional information
21	TCP	EMC FTP server	Provides the Avamar Downloader Service with FTP access to updates, security rollup packages, hotfixes, and patches provided by EMC.
53	TCP/UDP	DNS	Required for name resolution and DNS zone transfers.
80	TCP	Avamar server HTTP service	Provides HTTP access to the AvInstaller service.
123	UDP	NTP time servers	Provides clock synchronization from network time protocol servers.
443	TCP	Avamar server HTTPS service	Provides HTTPS access to the AvInstaller service.

Port and network requirements for Data Domain

The Avamar server listening ports that are required when Avamar backups are stored on a Data Domain system appear in "Required ports" on page 138.

The Avamar server network requirements when Avamar backups are stored on a Data Domain system appear in "Network requirements" on page 142.

In addition to the requirements in these section, implement the port and network requirements for the Data Domain system, as described in in "Port Requirements for Allowing Access to Data Domain System Through a Firewall", available from the Data Domain Support Portal at: https://my.datadomain.com.

APPENDIX B
Enterprise Authentication

For backwards compatibility, this appendix preserves information about the deprecated Enterprise authentication method. The functionality of this method is replaced, and improved upon, by the directory service authentication method. Information about the directory service authentication method is available in the *EMC Avamar Administration Guide*. This appendix provides the following sections:

Enterprise authentication

Enterprise (or external) authentication enables users to use the same user ID and password to log in to multiple systems. The Avamar external authentication feature is not a single user ID/password login, fully integrated into an external authentication system on which users are created and managed. Instead, the same user ID must be created on both Avamar and external systems while the password is set and managed externally.

Avamar Login Manager provides access to the external authentication databases through the standard Pluggable Authentication Module (PAM) library of the Linux operating system.

Login Manager runs on the utility node and is installed and started during Avamar server installation and upgrade. It uses the domains configuration file to identify the supported domains.

Supported components and systems

External authentication is only available for specific Avamar components and two external systems.

Avamar components

Avamar Administrator, Avamar Enterprise Manager, and Avamar Web Access support external authentication for user accounts.

External authentication is *not* available for Avamar server-level administration user accounts, including:

- root, admin, and dpn operating system user accounts
- Special Avamar system administrative users like MCUser and root

External systems

Avamar supports the following categories of external authentication systems.

Table 38 Supported external authentication systems

Category	Description
Lightweight Directory Access Protocol (LDAP)	Hierarchical directory structure X.500 standard system such as: • Microsoft Active Directory Service (MS ADS) • Novell NDS and eDirectory
Network Information Service (NIS) SUN Yellow Pages (YP)	Flat workgroup-based database structure of user IDs, passwords, and other system parameters comparable to Microsoft Windows NT such as: • Master NIS Server - Primary Domain Controller (PDC) • Slave NIS Servers - Backup Domain Controllers (BDC)

Configuring enterprise authentication

To configure Avamar external authentication:

1. Back up the current configuration files.
2. Configure the LDAP or NIS interface, as discussed in "Configuring the LDAP interface" on page 149 or "Configuring the NIS interface" on page 152.
3. Use Avamar Administrator to create the users who require login access to Avamar. The *EMC Avamar Administration Guide* provides detailed instructions.

   The username must match exactly the user ID on the LDAP or NIS server. Create external users in the proper LDAP or NIS server domain location (for example, the root "/" or other directory like "/clients/"). When creating users, the external domain appears in the Authentication System list.
4. Confirm the creation of the external users by logging in to Avamar Administrator or Avamar Enterprise Manager as the external user.

   Log in according to the following rules:

   a. User ID followed by `@DOMAIN`.

      Where DOMAIN is the LDAP or NIS server domain that you specified when you edited the /etc/avamar/domains.cfg file while configuring the LDAP or NIS interface.

      For example: SueV@example.com

   b. User password same as entered in the external LDAP or NIS system.

   c. Domain path where external users reside (for example, "/clients/").
5. Back up the configuration files again.

   Also, the best practice is to back up configuration files before installing software upgrades because the process might overwrite the configuration files with default values.

Configuring the LDAP interface

1. Collect the following server information and utilities.

Table 39 Information required to configure LDAP (page 1 of 2)

Category	Item
Information about external LDAP system	LDAP domain name
	IP address or fully qualified domain/hostname of the LDAP authentication server
	Distinguished name (DN) of the user for LDAP queries
	Password of DN used for LDAP queries
Information about the Avamar server	Linux operating system root user password
	Linux operating system admin user password
	Avamar system admin username and password

Table 39 Information required to configure LDAP (page 2 of 2)

Category	Item
Utilities for testing and troubleshooting	ldapbrowser
	GetMyDN (Windows utility from Softerra)
	ldapsearch (/usr/bin directory)

2. Open a command shell and log in:
   - If logging into a single-node server, log in to the server as root.
   - If logging into a multi-node server, log in to the utility node as root.
3. Open /etc/avamar/domains.cfg in a UNIX text editor, such as **vi** or **emacs**.
4. Add the following entry in the Customer Specific Domains section, and then save the file:

   ```
   DOMAIN=ID
   ```

   where:
   - DOMAIN (format: example.com) is a unique customer-specific LDAP domain used for addressing PAM.
   - ID is an integer larger than 1. IDs 0 and 1 are reserved for Avamar internal use.

   Note: Step 5 requires the creation of a symbolic link for this entry. Instead of DOMAIN=ID, an existing ldap=3 is available for use (by uncommenting the line). If ldap=3 is used, skip step 5 because the symbolic link already exists.

   The DOMAIN part of the entry (either ldap or a unique LDAP domain) appears in the Avamar Administrator Authentication System list. Entering a unique DOMAIN clarifies which LDAP domain is used for external authentication.
5. Create a unique lm_ldap file and symbolically link to it by typing:

   ```
   ln -sf /etc/pam.d/lm_ldap /etc/pam.d/lm_NUMBER
   ```

   where NUMBER is the LDAP domain ID in step 4.
6. Log in to the server as admin.
7. Load the admin OpenSSH key by typing:

   ```
   ssh-agent bash
   ssh-add ~admin/.ssh/admin_key
   ```
8. When prompted, type the admin user account passphrase and press **Enter**.
9. Confirm that the systemname and lmaddr are set up correctly by typing:

   ```
   avmaint config --avamaronly | grep systemname
   avmaint config --avamaronly | grep lmaddr
   ```

   These commands display the hostname and IP address of the utility node, respectively.

10. As root, create a symbolic link from ldap.conf to ldap.conf.winad by typing:

    ln -sf /etc/ldap.conf.winad /etc/ldap.conf

11. Set correct group ownership and file permissions for ldap.conf by typing:

    chown root:root /etc/ldap.conf
    chmod 0600 /etc/ldap.conf

12. Confirm the symbolic link by typing:

    ls -l /etc/ldap.conf

    The following information appears in the command shell:

    /etc/ldap.conf -> /etc/ldap.conf.winad

13. In a UNIX text editor, open /etc/ldap.conf.
14. Modify the following entries, and then save the file:

    `host HN-IPADD`

    where HN-IPADD is the fully qualified hostname or IP address of the LDAP server.

    `base dc=DOMAIN, dc=com`

    where DOMAIN is the first part of the LDAP domain name. For example: example.com would be displayed as dc=example, dc=com.

    `binddn cn=PROXYUSER, ou=PROXYUNIT, ou=PROXYORG, dc=DOMAIN, dc=com`

    where PROXYUSER, PROXYUNIT, PROXYORG, and DOMAIN comprise parts of the distinguished name of the user used to bind with the LDAP server. Components include:

    - cn - common name
    - ou - organizational or unit name
    - dc - domain

    For example: Distinguished name avamaruser.users.avamar.emc.com
    Components: cn=avamaruser, ou=users, ou=avamar, dc=emc, dc=com

    `bindpw PWD`

    where PWD is the password of the user used to bind with the LDAP server.

15. Restart Login Manager by typing:

    service lm restart

16. Confirm that configuration changes were accepted by typing:

    avmgr lstd

    All domains used in Avamar authentication are listed.

Note: Space limitations in this guide cause the commands in the next step to continue (wrap) to more than one line. Each command must be entered on a single command line (no line feeds or returns allowed).

17. Confirm that the LDAP server can be queried by typing the following command:

    ```
    ldapsearch -x -W -h HOSTNAME -b dc=DISTINGUISHED_NAME -D
     cn=VALID_USERNAME, cn=users,dc=DISTINGUISHED_NAME
    ```

    where:

    - HOSTNAME is the hostname or IP address of the LDAP server.
    - dc=DISTINGUISHED_NAME is the domain part of the distinguished name (the two "dc" components).
    - VALID_USERNAME is a valid user in the LDAP server domain.

    A success message or referral result should appear. A communication or authentication failure is a problem indication.

    For example:

    ```
    ldapsearch -x -W -h 10.0.100.21 -b dc=aelab01,dc=com -D
     cn=administrator,cn=users,dc=aelab01,dc=com
    ```

Configuring the NIS interface

1. Open a command shell and log in:
   - If logging into a single-node server, log in to the server as root.
   - If logging into a multi-node server, log in to the utility node as root.
2. Open /etc/avamar/domains.cfg in a UNIX text editor.
3. Add the following entry in the Customer Specific Domains section, and then save the file:

   ```
   DOMAIN=ID
   ```

   where:

   - DOMAIN (format: example.com) is a unique customer-specific NIS domain used for addressing PAM
   - ID is an integer larger than 1. IDs 0 and 1 are reserved for Avamar internal use.

   Note: Step 4 requires the creation of a symbolic link for this entry. Instead of DOMAIN=ID, an existing nis=2 is available for use (by uncommenting the line). If nis=2 is used, skip step 4 because the symbolic link already exists.

   The DOMAIN part of the entry (either nis or a unique NIS domain) appears in the Avamar Administrator Authentication System list. Typing a unique DOMAIN clarifies which NIS domain is used for external authentication.

4. Create a unique lm_nis file and symbolically link to it by typing:

   ln -sf /etc/pam.d/lm_nis /etc/pam.d/lm_NUMBER

   where NUMBER is the NIS domain ID in step 3.

5. Set correct group ownership and file permissions for the lm_nis file by typing:

   chown root:root /etc/pam.d/lm_NUMBER
   chmod 0600 /etc/pam.d/lm_NUMBER

   where NUMBER is the NIS domain ID in step 3.

6. Confirm the symbolic link by typing:

   ls -l /etc/pam.d/lm_NUMBER

   where lm_NUMBER is the file created in step 4.

   The following information appears in the command shell:

   ```
   /etc/pam.d/lm_NUMBER -> lm_nis
   ```

7. In a UNIX text editor, open lm_NUMBER (created in step 4).

8. Modify the following entries, and then save the file:

   auth required /lib/security/pam_nis.so domain=NISDOMAIN
   account required /lib/security/pam_nis.so domain=NISDOMAIN

   where NISDOMAIN is the NIS domain in step 3.

9. Log in to the server as admin.

10. Load the admin OpenSSH key by typing:

    ssh-agent bash
    ssh-add ~admin/.ssh/admin_key

11. When prompted, type the admin user account passphrase and press **Enter**.

12. Confirm the systemname and lmaddr are set up correctly by typing:

    avmaint config --avamaronly | grep systemname
    avmaint config --avamaronly | grep lmaddr

    These commands display the hostname and IP address of the utility node, respectively.

13. As root, restart Login Manager by typing:

    service lm restart

14. With keys loaded, confirm that configuration changes were accepted by typing:

    avmgr lstd

    All domains used in Avamar authentication are listed.

15. Open /etc/sysconfig/network in a UNIX text editor.

16. Add the following entry, and then save the file:

    ```
    NISDOMAIN=DOMAINNAME
    ```

    where DOMAINNAME is the NIS domain in step 3.

17. Open /etc/yp.conf in a UNIX text editor.
18. Add the following entry:

    ```
    domain NISDOMAIN server NISSERVERNAME_IP
    ```

    where:

    - NISDOMAIN is the NIS domain in step 3.
    - NISSERVERNAME_IP is the NIS server hostname or IP address.

    Examples:

    ```
    domain hq server 122.138.190.3
    domain hq server unit.example.com
    ```

19. Set **ypbind** to automatically start by typing:

    ```
    /sbin/chkconfig ypbind on
    ```

20. Confirm the previous settings by typing:

    ```
    /sbin/chkconfig --list ypbind
    ```

    The following information appears in the command shell:

    ```
    ypbind 0:off 1:off 2:off 3:on 4:on 5:on 6:off
    ```

    Numbers 3, 4, and 5 should be “on”. If not, type:

    ```
    /sbin/chkconfig --level NUMBERS ypbind on
    ```

    where NUMBERS is a comma-separated list of the numbers to set "on" (for example, /sbin/chkconfig --level 3,4 ypbind on).

21. Start the **ypbind** daemon by typing:

    ```
    service ypbind restart
    ```

    The following information appears in the command shell:

    ```
    Shutting down NIS services: [ OK or FAIL ]
    Binding to the NIS domain: [ OK ]
    Listening for NIS domain server:
    ```

    Note: Shutting down NIS services can fail if it has not started already. In that case, listening for the NIS domain server should fail because the default NIS domain has not yet been set up.

    A delay in the start() section is usually required between the **ypbind** and **ypwhich** (in next step) commands.

22. Confirm NIS configuration by typing:

    `ypwhich`

    This command displays the IP address or the fully qualified domain name of the NIS server.

    `ypcat -d NISDOMAIN passwd | grep USER-ID`

    where:

    - NISDOMAIN is the NIS domain in step 3.
    - USER-ID is the partial or whole name of a user registered in the external authentication system.

    These commands verify that data can be retrieved from the NIS domain server by returning user login data from the NIS server.

APPENDIX C
IAO Information

US Department of Defense (DoD) *Security Technical Implementation Guide (STIG) for Unix* mandates information that should be disclosed to an Information Assurance Officer (IAO). This appendix provides that information in the following sections:

SGID/SUID bit

Pursuant to the disclosure requirements of STIG compliance rule GEN002440, the following files have the SGID/SUID bit set:

```
/data01/connectemc/archive
/data01/connectemc/failed
/data01/connectemc/history
/data01/connectemc/logs
/data01/connectemc/output
/data01/connectemc/poll
/data01/connectemc/queue
/data01/connectemc/recycle
/lib64/dbus-1/dbus-daemon-launch-helper
/opt/dell/srvadmin/oma/bin/omcliproxy
/usr/bin/lockfile
/usr/bin/slocate
/usr/bin/ssh-agent
/usr/bin/vlock
/usr/bin/wall
/usr/bin/write
/usr/lib/PolicyKit/polkit-explicit-grant-helper
/usr/lib/PolicyKit/polkit-grant-helper
/usr/lib/PolicyKit/polkit-grant-helper-pam
/usr/lib/PolicyKit/polkit-read-auth-helper
/usr/lib/PolicyKit/polkit-revoke-helper
/usr/lib/PolicyKit/polkit-set-default-helper
/usr/lib/vte/gnome-pty-helper
/usr/sbin/lockdev
/usr/sbin/postdrop
/usr/sbin/postqueue
/usr/sbin/sendmail.sendmail
/usr/sbin/utempter
/usr/sbin/zypp-refresh-wrapper
```

System-level accounts

Pursuant to the disclosure requirements of STIG compliance rule GEN000360, the following accounts are system-level accounts and are not privileged user accounts:

```
at
mysql
admin
dnsmasq
messagebus
polkituser
suse-ncc
uuidd
wwwrun
stunnel
```

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